Martin Slough Enhancement Project
2021 Monitoring Report

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INTRODUCTION

This report summarizes the 2021 monitoring efforts for the Martin Slough Enhancement Project. This report was prepared by the Natural Resources Services division of the Redwood Community Action Agency (RCAA) in partnership with Michael Love & Associates (MLA) in fulfillment of permit and agency requirements, and in accordance with the 2021 Martin Slough Monitoring Plan.

Background

Martin Slough is part of the Elk River watershed, which is part of the larger Humboldt Bay ecosystem. Martin Slough has been identified by the California Department of Fish and Wildlife as playing a key role in the life cycle of coho salmon (*Oncorhynchus kisutch*), providing ideal rearing habitat for juvenile coho; it also provides critical habitat for the endangered tidewater goby (*Eucyclogobius newberryi*). In 2006 the Elk River watershed, including Martin Slough, was listed under the Clean Water Act as impaired for sediment and siltation, citing impaired water quality, impaired spawning habitat, and increased depth of flooding due to sediment. The Martin Slough project site is diked-former-tideland that has been degraded by past management practices, including draining the former tidal wetland by excavating straight-line channels, removing the riparian vegetation, and installing dikes and tide gates at the confluence of Martin Slough and Swain Slough. The exclusion of the tide resulted in losing the sediment transport benefits and natural fluvial geomorphic process that maintained the tidal wetlands and the channel capacity. In response to these stressors, the Martin Slough Enhancement Project was developed with the goal of enhancing fish habitat for endangered coho salmon and reducing the extent and duration of flooding.

The project area encompasses two properties – 40 acres of pasture owned by the Northcoast Regional Land Trust (NRLT) and 120 acres upstream of the NRLT property owned by the City of Eureka and operated as the Eureka Municipal Golf Course. The project was initiated in 2001 when RCAA and partners began preparing a feasibility study, which was completed in 2006. Between 2007 and 2014, RCAA contracted with Michael Love & Associates (MLA) and GHD, Inc., to develop designs for a new tide gate at the confluence of Martin Slough and Swain Slough, along with enhancements to the slough channel, new tidal marshes, and off-channel brackish and freshwater ponds. The tide gate replacement was completed in 2014, and enhancement work on the NRLT property was completed in 2019. Enhancement on the Golf Course began in 2019, and is estimated to be completed in 2021 (see Table 1).

Project Purpose

The purpose of the Martin Slough Enhancement Project is to improve aquatic and riparian habitat and reduce flooding of pasture and golf course greens throughout the project area. Specific goals of the project include the following:

1. Improve fish access from Swain Slough into Martin Slough,
2. Reduce flood impacts to current land use,
3. Improve sediment transport,
4. Increase the amount of riparian corridor and riparian canopy,
5. Improve water quality (increased circulation, decrease nutrient inputs, decrease sedimentation),

6. Increase the extent of the estuarine ecotone in Martin Slough, providing a gradual transition from brackish water to freshwater habitats, and
7. Enhance and create low-velocity off-channel/backwater habitats.

Project Phasing

The Martin Slough Enhancement Project was developed to be implemented in five phases. Table 1 outlines each phase, along with the completion status. Monitoring begins for each phase once construction has been completed, and continues for five years post-construction, depending on availability of funding.

Table 1. Project Phasing

	Action	Status
Phase 1	Replace 3 outdated tides gates on Martin Slough at the confluence with Swain Slough with two 6'x6' side hinged gates, one 6'x6' top hinged gate, and a 2'x2' auxiliary gate – fitted with muted tide regulators that allow for a muted tide into Martin Slough	Completed 2014
Phase 2	Enlarge Martin Slough channel throughout NRLT property, build Marsh plains A and B and Pond C, realign SE tributary and construct a freshwater pond, replace two culvert crossings and install an agriculture bridge	Completed 2018
Phase 3	Enlarge Martin Slough channel on the lower Eureka golf course up to the east tributary, enhance Pond D, remove undersize culvert, and install new access bridge	Completed 2019
Phase 4	Enlarge Martin Slough channel up to the North Fork confluence, enhance Pond E and construct Pond F, and replace bridges	Completed 2020
Phase 5	Enlarge remainder of the upper Martin Slough channel and the north fork, construct Pond G, install temporary salinity barrier	Completed 2021

MONITORING OVERVIEW

Purpose

The essential purpose of monitoring activities is to raise a warning flag if the project's enhancement components or the current course of management actions are not working so that corrective actions and adaptive management may be applied while cost-effective and time sensitive solutions are still available. Conversely, good monitoring can also demonstrate that the current design and management approaches are working and provide evidence for the continuation of current management. In addition, implementation of the Monitoring Plan will demonstrate ongoing permit compliance and, it is anticipated, a trajectory of incremental project success as the project meets various annual performance criteria described in the Plan, which cumulatively lead to attaining final success criteria. Finally, the results of thorough project evaluation through

implementation of this Plan will help this project to provide information about sound design or flaws, effective or ineffective management techniques to other projects, land managers, restoration designers, and practitioners conducting similar estuarine restoration efforts in and around Humboldt Bay.

Parameters

Five general post-construction parameters (topography, hydrology, water quality, vegetation, and fisheries) are outlined in the Martin Slough Monitoring Plan. These parameters are directly linked to individual long-term objectives established for the project and will provide a multi-parameter basis for evaluating the final success of the project. These five parameters were selected to ensure that overlapping structural and functional components assessing both physical and biological characteristics of the site will be measured to evaluate project success.

This report covers post-construction monitoring for Phases 2 through 5, and addresses all five parameters: fisheries, topography, hydrology, water quality, and vegetation. Post-construction monitoring was conducted according to the 2021 Martin Slough Monitoring Plan and to all project permits.

Performance and Success Criteria

Performance criteria are annual qualitative and quantitative benchmarks against which project progress will be tracked. The final success criteria will be used to determine if the project has substantially met its individual and overall objectives within the five (5) year monitoring period. Attainment of the final success criteria will indicate that the project is trending toward meeting the long-term habitat goals with little chance of failure. While overall monitoring will continue for a five-year period, if final success criteria are reached for a particular parameter in less than five years, monitoring of that parameter may be discontinued or reduced in scope and frequency.

There are separate annual performance and final success criteria for each parameter and a correlating monitoring method and schedule. Specific performance and final success criteria are listed for each parameter in Table 2.

Table 2. Topographic, hydrologic, water quality, fisheries and vegetation monitoring parameters, schedule, performance and success criteria.

Parameters	Type of Monitoring	Frequency	Schedule	Performance Criteria	Success Criteria	Remedial Actions
Topographic	Repeat surveys longitudinal channel profiles of mainstem Martin Slough and cross section of slough channels, marshplains, and ponds	Collected in Years 1, 3 and 5	Once during the year	- No high points in mainstem thalweg profile that restrict drainage of ebb tides - Less than 10 percent net change in cross sectional area below design MHHW of 5.5 feet (NAVD88) at all cross sections	- No high points in mainstem thalweg profile that restrict drainage of ebb tides - Less than 20 percent net change in cross sectional areas below design MHHW of 5.5 feet (NAVD88) at all cross sections within project after 5 years.	- Evaluate causes of excess aggradation or scour (i..e. tidal prism) and address root causes. - Identify cause of high points. Actions may include channel excavation or changes to tidal prism.
Hydrologic	Data logger used for continuous recording of water levels in Swain Slough and Martin Slough	Download approx. every six weeks	Continuous through period where MTR is being adjusted, or if funding is available, through the end of Year 5 after last phase completed	Muted high tides sufficient during growing season to inundate constructed marshplains		Adjust 6'x6' MTR gate and Auxiliary MTR gate to increase time gate is open
				Tide gate duration open $\geq$ 35% (not including aux. door), assumes muted tide is only through auxiliary MTR gate	Tide gate duration open $\geq$ 50% (not including aux. door)	
				Summer MLLW in Martin Slough > 2.0 ft (NAVD88)		Identify potential high points or channel aggradation. Actions may include channel excavation or changes to tidal prism.

Parameters	Type of Monitoring	Frequency	Schedule	Performance Criteria	Success Criteria	Remedial Actions
Water Quality	Surface and bottom salinity and temp. meters placed at the 3 Martin Slough water level monitoring stations. Spot meas. Of DO, salinity and temp. during downloads. Additional spot meas. w/fisheries monitoring.	Continuous, download approx. every six weeks	Year round through Year 5 following final phase of implementation, as funding allows	- Avg. daily water temperature $\leq$ 18ºC during expected salmonid period of usage - Max. daily water temp $\leq$ 21 ºC during expected salmonid period of usage - Pond G and SE Trib Pond during expected salmonid period of usage: DO $\geq$ 4 ppm, and salinity $\leq$ 4 ppt		- Adaptive management: meet and discuss water quality data with fisheries biologists and agency staff. Depending on this discussion, some possible actions could include: - Increase circulation through MTR gate adjustments - Increase riparian vegetation for shading to cool water and reduce aquatic vegetation growth - Modify inlet/outlet of ponds to increase circulation.
Fisheries	**Salmonids**: Seining and deployment of baited minnow traps at selected locations consisting of varying habitat types (pond vs channel) and longitudinal locations with the project	Approximately once per month during expected salmonid period of usage, as funding allows	Post-construction for 3 years, or up to 8 years as funding allows	Annual average net increase of 50% over pre-project coho salmon numbers (combined total for juvenile young-of-the-year and one-year old fish) monitored by CDFW	Annual average net increase of 50% over pre-project coho salmon numbers (combined total for juvenile young-of-the-year and one-year old fish) monitored by CDFW	None – uncontrollable variables (ocean conditions, run size) can affect numbers; this is a continuation of CDFW's monitoring
	Tidewater goby: Seining	In conjunction with salmonid sampling	Post-construction for 5 years, as funding allows	Presence in new terminal ponds at upper end of new slough channels	Presence in new terminal ponds at upper end of new slough channels	None – uncontrollable variables affect tidewater goby distribution including predation by birds and fish.
Vegetation	Plant survival and species composition	Years 2 and 5. Contingency Years 3 and 4	Spring/summer	Success criteria shown in Table 4 of Monitoring Plan	Success criteria shown in Table 4 of Monitoring Plan	Replant, re-seed until criteria met; mechanically or manually remove invasive plants within revegetated areas of the Project

MONITORING RESULTS

Fisheries

Overview

The objective of fisheries monitoring in Martin Slough is to document the presence/absence of target fish species in different habitats; specifically, the presence/absence of target fish species in aquatic habitat re-established or enhanced as part of the project.

In 2021, monitoring occurred in eleven locations throughout the project area (Figure 1). On the NRLT property, monitoring took place at Pond C, Pond C Terminal Channel, Southeast (SE) Tributary Step Pools, Southeast (SE) Tributary Pond, and the Oxbow. On the Eureka Golf Course property, monitoring took place at Pond D, Pond D Step Pools, Pond E, Pond F, Upper Fairway Drive, and Pond G. Monitoring occurred in January, February, March, April, May, November, and December, although not all sites were monitored each month. Water quality monitoring occurred during each monitoring event (Appendix C).

Fisheries monitoring was conducted by Ross Taylor & Associates (RTA) and HSU fisheries department graduate student Josh Cahill.

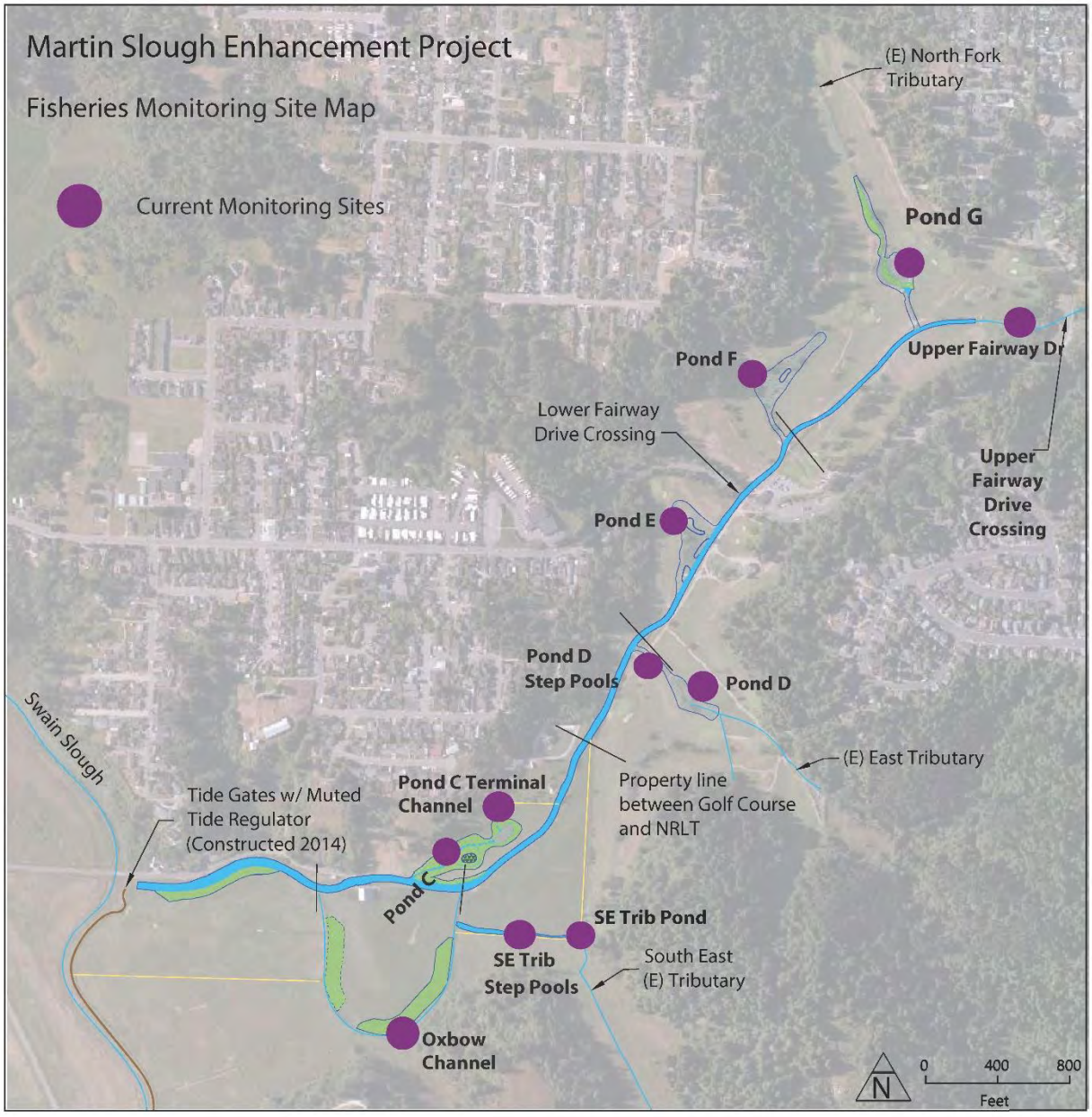
Methods

Fisheries monitoring was conducted primarily with baited minnow traps and a variety of seine nets (including 10-foot, 30-foot, 80-foot and 100-foot nets). Seine nets were set by 1-3 crew members, with 1-3 consecutive seine hauls conducted at each location. The method varied slightly depending on the site (e.g., to accommodate very narrow channels). Fish from each haul were kept separated and placed in aerated 5-gallon buckets prior to processing.

The minnow traps were fished at each site on the bottom of the channel next to habitat structures where possible. Soak time of individual traps ranged from 30 to 180 minutes.

Salmonids captured by seine or minnow traps were anesthetized using Alka Seltzer Gold in order to safely handle them. The lowest concentration of sodium bicarbonate that permitted safe handling was used and ranged from 1 to 2 tablets per gallon of fresh river water depending on fish size and water temperature. The bicarbonate material was allowed to completely dissolve before fish were added to the anesthetic bath. Salmonids were usually able to be handled after 1-2 minutes in the anesthetic bath and were processed immediately following loss of equilibrium. Fish were then allowed to recover in 5-gallon buckets of aerated fresh river water until normal behavior was observed. Water temperature in the recovery bucket was monitored and maintained to be within 2°C of the ambient river temperature. Fish were released to slow water habitat in the location in which they were originally found.

Figure 1. Monitoring Locations in Martin Slough



All of the fish were measured for fork length and weighed. While anesthetized, juveniles were individually placed onto a wetted Plexiglas measuring board and measured to the nearest mm fork length, then transferred to a wetted container on an electronic scale and individually weighed to the nearest 0.01 g.

All fish were scanned for passive integrated transponder (PIT) tags. Anesthetized fish greater than or equal to 70-mm fork length were implanted with 12-mm PIT tags or smaller, fish 60-mm FL to 69-mm FL were implanted with 9-mm PIT tags or smaller, and fish <60-mm were not tagged. A full duplex PIT tag was surgically implanted into the body cavity of the fish; a small incision was made with a sterile scalpel anterior to the pectoral fin and the tag was inserted by hand.

Water quality measurements were taken with YSI handheld meters. Water quality parameters measured include dissolved oxygen, temperature, and salinity (see Appendix C).

Results

Fisheries monitoring in 2021 resulted in the catch of 503 coho and 2,579 tidewater goby. Table 3 shows the total salmonid and goby catch by month for the 2021 monitoring season. The majority of salmonids were found in Pond D and Pond F, from January through December (Tables 4 and 5). No salmonids were injured or killed during monitoring in 2021.

Table 3. Salmonid and Goby Catch by Month in 2021 in Martin Slough

Month	Tidewater Goby	Juvenile Coho Salmon	Coastal Cutthroat Trout	Steelhead
January	271	3	0	0
February	612	179	2	0
March	334	138	0	0
April	40	163	0	0
May	264	15	0	1
November	772	2	0	0
December	286	3	0	0
TOTALS FOR 2021 MONITORING	**2579**	**503**	**2**	**1**

Other species caught during monitoring include three-spine stickleback, staghorn sculpin, juvenile smelt, California roach, red-legged frog tadpoles, pacific giant salamander, rough skinned newt, coastal cutthroat trout, pacific herring, surf smelt, dungeness crab, prickly sculpin, and jack smelt. Table 4 shows the total for each species caught during the 2021 monitoring season by month. Table 5 shows the total for each species caught during the 2021 monitoring season by day and by monitoring location. Appendix B shows the number and species of fish PIT-tagged during monitoring. Select photos from the 2021 fisheries monitoring effort can be found in Appendix A.

Water quality spot sampling occurred alongside each fisheries monitoring event. Monitors used a handheld YSI meter to measure for temperature, salinity, and dissolved oxygen at increasing depths from the surface to the bottom of the sampling site. All water quality data from fisheries monitoring can be found in Appendix C (note: for additional water quality measurements and analysis see the Water Quality parameter section below).

Over the seven-month fisheries sampling period, water temperatures ranged between a maximum of 20.2 degrees C (May) in Pond E at the surface and a minimum of 6.1 degrees C (Feb.) in the SE tributary step pools. Salinity ranged from a maximum of 27.7 ppt (May) in the lower portion of the project area and 0.1 ppt (Jan./Dec.) in the upstream areas on the golf course as well as the SE tributary pond on the NRLT. Dissolved oxygen ranged from a maximum of 13.2 mg/L (May) in Pond E at the surface to 0.21 mg/L (May) in the SE tributary pond at the bottom (see Appendix C).

Table 4. Fisheries Monitoring Results by Month in 2021 in Martin Slough

Month	Tidewater Goby	Juvenile Coho Salmon	Staghorn Sculpin	Three-spine Stickleback	Sculpin (*sp.)*	Juvenile Smelt (*sp.*)	Coastal Cutthroat Trout	Steelhead
January	271	3	16	97	0	0	0	0
February	612	179	53	125	1	311	2	0
March	334	138	219	206	0	75	0	0
April	40	163	8	24	0	0	0	0
May	264	15	17	1275	0	250	0	1
November	772	2	0	1752	5	10	0	0
December	286	3	4	233	0	94	0	0
TOTALS FOR 2021 MONITORING	**2579**	**503**	**317**	**3712**	**6**	**740**	**2**	**1**

Month	California Roach	Pacific Herring	Surf Smelt	Top Smelt	Dungeness Crab	Red Legged Frog tadpoles	Rough skinned Newt	Pacific Giant Salamander
January	0	0	0	0	0	0	0	0
February	0	0	0	1	0	0	0	0
March	0	0	0	0	0	0	1	1
April	0	0	0	0	0	0	0	0
May	11	256	0	0	0	30	36	11
November	0	0	0	4	4	0	0	0
December	6	0	0	0	0	0	0	0
TOTALS FOR 2021 MONITORING	**17**	**256**	**0**	**5**	**4**	**30**	**37**	**12**

Month	Prickly Sculpin	Shiner Perch	True Smelt	Jacks Smelt
January	**4**	**0**	**285**	**0**
February	**0**	**0**	**18**	**2**
March	**0**	**0**	**0**	**1**
April	**1**	**0**	**0**	**0**
May	**0**	**3**	**11**	**0**
November	**0**	**0**	**0**	**0**
December	**0**	**0**	**0**	**0**
TOTALS FOR 2021 MONITORING	**5**	**3**	**314**	**3**

Table 5. Fisheries Monitoring Results by Day and Location in 2021 in Martin Slough

DATE	SITE NAME	Tidewater Goby	Juvenile Coho Salmon	Staghorn Sculpin	Three-spine Stickleback	Sculpin *sp.*	Juvenile Smelt (sp)	Coastal Cutthroat Trout
1/13/2021	POND D STEP POOLS	44	0	9	7	0	0	0
1/13/2021	POND D	45	0	3	12		0	0
1/13/2021	POND E	22	3	3	56	0	0	0
1/13/2021	POND F	11	0	1	22	0	0	0
2/5/2021	SE TRIBUTARY STEP POOLS	18	0	0	55	0	0	0
2/5/2021	SE TRIB POND	0	0	0	10	0	0	0

2/5/2021	OXBOW	2	0	3	5	0	0	0
2/5/2021	POND C	196	0	10	0	1	311	0
2/5/2021	POND C TERMINAL CHANNEL	81	0	0	0	0	0	0
2/24/2021	POND E	55	0	22	0	0	0	0
2/24/2021	POND D	0	1	1	0	0	0	0
2/24/2021	POND F	0	187	0	0	0	0	0
2/24/2021	SE TRIBUTARY STEP POOLS	41	0	0	30	0	0	0
2/24/2021	SE TRIB POND	0	0	0	10	0	0	0
2/24/2021	OXBOW	9	0	0	15	0	0	0
2/24/2021	POND C	71	0	7	0	0	0	0
2/24/2021	POND C TERMINAL CHANNEL	131	0	0	0	0	0	0
3/17/2021	POND D STEP POOLS	30	2	11	1	0	0	0
3/17/2021	POND D	0	35	0	0	0	0	0
3/17/2021	POND E	50	25	200	550	1	0	0
3/17/2021	POND F	34	40	5	0	0	0	0
3/24/2021	SE TRIBUTARY STEP POOLS	11	20	0	79	0	0	0
3/24/2021	SE TRIB POND	0	13	0	25	0	0	0
3/24/2021	OXBOW	32	0	3	25	0	0	0
3/24/2021	POND C	0	0	0	0	0	0	0
3/24/2021	POND C TERMINAL CHANNEL	177	0	0	75	0	75	0
4/14/2021	POND D STEP POOLS	38	28	8	24	0	0	0
4/14/2021	POND D	0	72	0	0	0	0	0

4/14/2021	POND E	0	52	0	55	0	0	0
4/14/2021	POND F	2	36	0	10	0	0	0
5/7/2021	SE TRIBUTARY STEP POOLS STEP POOLS	13	0	0	90	0	0	0
5/7/2021	SE TRIB POND	0	0	0	0	0	0	0
5/7/2021	OXBOW	22	0	5	25	0	0	0
5/7/2021	POND C	11	0	1	0	0	100	0
5/7/2021	POND C TERMINAL CHANNEL	3	0	0	10	0	0	0
5/21/2021	STEP D	0	5	15	113	0	0	0
5/17/2021	POND D	0	3	0	69	0	0	0
5/26/2021	SE TRIBUTARY STEP POOLS	12	0	0	265	0	0	0
5/26/2021	SE TRIB POND	0	0	0	5	0	0	0
5/26/2021	OXBOW	0	0	0	0	0	0	0
5/26/2021	POND C TERMINAL CHANNEL	8	0	0	150	0	0	0
5/26/2021	POND C	2	0	1	75	0	150	0
11/16/2021	POND E	304	0	0	37	3	8	0
11/16/2021	POND D	19	2	0	60	0	0	0
11/16/2021	POND D STEP POOLS	38	0	0	35	1	0	0
11/18/2021	POND F	290	0	0	75	1	2	0
11/18/2021	POND G	87	0	0	820	0	0	0
11/18/2021	SE TRIB POND	34	0	0	725	0	0	0
12/17/2021	POND G	9	0	0	8	0	1	0
12/17/2021	POND F	206	0	0	15	0	28	0
12/20/2021	POND E	13	0	1	3	0	49	0

12/20/2021	POND D	20	2	0	120	0	0	0
12/20/2021	POND D STEP POOLS	2	0	0	1	0	0	0
12/20/2021	POND C	23	0	3	3	0	16	0
12/20/2021	POND C TERMINAL CHANNEL	6	0	0	0	0	0	0
12/20/2021	OXBOW	5	0	0	25	0	0	0
12/20/2021	SE TRIBUTARY STEP POOLS	2	0	0	40	0	0	0
12/20/2021	SE TRIB POND	0	0	0	0	0	0	0
TOTALS FOR 2021 MONITORING		2229	526	312	3835	7	740	0

DATE	**SITE NAME**	**California Roach**	**Pacific Herring**	**Surf Smelt**	**Top Smelt**	**Dungeness Crab**	**Red Legged Frog tadpoles**	**Rough skinned Newt**	**Pacific Giant Salamander**	**True Smelt**	**Prickly Sculpin**	**Jacks smelt**
1/13/2021	POND D STEP POOLS	0	0	0	0	0	0	0	0	6	1	0
1/13/2021	POND D	0	0	0	0	0	0	0	0	0	1	0
1/13/2021	POND E	0	0	0	0	0	0	0	0	3	0	0
1/13/2021	POND F	0	0	0	0	0	0	0	0	276	1	0
2/5/2021	SE TRIBUTARY STEP POOLS	0	0	0	0	0	0	0	0	0	0	0
2/5/2021	SE TRIB POND	0	0	0	0	0	0	0	0	0	0	0
2/5/2021	OXBOW	0	0	0	0	0	0	0	0	0	0	0
2/5/2021	POND C	0	0	0	0	0	0	0	0	0	0	0
2/5/2021	POND C TERMINAL CHANNEL	0	0	0	0	0	0	0	0	0	0	0
2/24/2021	POND E	0	0	0	0	0	0	0	0	0	0	0

2/24/2021	POND D	0	0	0	0	0	0	0	0	0	0	0
2/24/2021	POND F	0	0	0	0	0	0	0	0	0	0	0
2/24/2021	SE TRIBUTARY STEP POOLS	0	0	0	0	0	0	0	0	0	0	0
2/24/2021	SE TRIB POND	0	0	0	0	0	0	0	0	0	0	0
2/24/2021	OXBOW	0	0	0	0	0	0	0	0	0	0	0
2/24/2021	POND C	0	0	0	0	0	0	0	0	0	0	0
2/24/2021	POND C TERMINAL CHANNEL	0	0	0	0	0	0	0	0	0	0	0
3/17/2021	POND D STEP POOLS	0	0	0	0	0	0	0	0	0	0	0
3/17/2021	POND D	0	0	0	0	0	0	0	0	0	0	0
3/17/2021	POND E	0	0	0	0	0	0	0	0	0	0	1
3/17/2021	POND F	2	0	0	0	0	0	0	0	0	0	0
3/24/2021	SE TRIBUTARY STEP POOLS	0	0	0	0	0	0	1	1	0	0	0
3/24/2021	SE TRIB POND	0	0	0	0	0	0	0	0	0	0	0
3/24/2021	OXBOW	0	0	0	0	0	0	0	0	0	0	0
3/24/2021	POND C	0	0	0	0	0	0	0	0	0	0	0
3/24/2021	POND C TERMINAL CHANNEL	0	0	0	0	0	0	0	0	0	0	0
4/14/2021	POND D STEP POOLS	0	0	0	0	0	0	0	0	0	0	0
4/14/2021	POND D	0	0	0	0	0	0	0	0	0	0	0
4/14/2021	POND E	0	0	20	0	0	0	0	0	0	0	0
4/14/2021	POND F	15	0	3	0	6	0	0	0	0	2	0
5/7/2021	SE TRIBUTARY STEP POOLS	0	0	0	0	0	26	3	0	0	0	0

5/7/2021	SE TRIB POND	2	0	0	0	0	2	2	0	0	0	0
5/7/2021	OXBOW	0	0	0	0	0	0	0	0	0	0	0
5/7/2021	POND C	0	0	0	0	0	0	0	0		0	0
5/7/2021	POND C TERMINAL CHANNEL	0	0	0	0	0	0	0	0	0	0	0
5/21/2021	STEP D	0	0	0	0	0	40	5	3	0	0	0
5/17/2021	POND D	0	0	0	0	0	15	0	0	0	0	0
5/26/2021	SE TRIBUTARY STEP POOLS	0	0	0	0	0	2	2	2	0	0	0
5/26/2021	SE TRIB POND	9	0	0	0	0	0	27	9	0	0	0
5/26/2021	OXBOW	0	0	0	0	0	0	0	0	0	0	0
5/26/2021	POND C TERMINAL CHANNEL	0	0	0	0	0	0	0	0	0	0	0
5/26/2021	POND C	0	6	0	0	0	0	0	0	0	0	0
11/16/2021	POND E	0	0	0	0	2	0	0	0	0	0	0
11/16/2021	POND D	0	0	0	4	0	0	0	0	0	0	0
11/16/2021	POND D STEP POOLS	0	0	0	0	0	0	0	0	0	0	0
11/18/2021	POND F	0	0	0	0	2	0	0	0	0	0	0
11/18/2021	POND G	0	0	0	0	0	0	0	0	0	0	0
11/18/2021	SE TRIB POND	0	0	0	0	0	0	0	0	0	0	0
12/17/2021	POND G	0	0	0	0	0	0	0	0	0	0	0
12/17/2021	POND F	0	0	0	0	0	0	0	0	0	0	0
12/20/2021	POND E	0	0	0	0	0	0	0	0	0	0	0
12/20/2021	POND D	0	0	0	0	0	0	0	0	0	0	0
12/20/2021	POND D STEP POOLS	0	0	0	0	0	0	0	0	0	0	0
12/20/2021	POND C	0	0	0	0	0	0	0	0	0	0	0

12/20/2021	POND C TERMINAL CHANNEL	0	0	0	0	0	0	0	0	0	0	0
12/20/2021	OXBOW	0	0	0	0	0	0	0	0	0	0	0
12/20/2021	SE TRIBUTARY STEP POOLS	0	0	0	0	0	0	0	0	0	0	0
12/20/2021	SE TRIB POND	6	0	0	0	0	0	0	0	0	0	0
TOTALS FOR 2021 MONITORING		34	6	23	4	10	85	40	15	285	5	1

Topography

Overview

The objective of monitoring the topography parameter is to monitor persistence of, and identify changes in, post-construction topographic conditions. As scheduled in the Martin Slough Enhancement Project Monitoring Plan (RCAA 2021), topographic monitoring occurs at the end of years 1, 3 and 5 as funding is available. Topographic monitoring was completed by MLA for water year 2019 for the portions of the project constructed on the NRLT (Phase 2). This report covers topographic monitoring for water year 2021 and completes Year 3 monitoring for Phase 2 and Year 1 monitoring for Phases 3-4. Phase 5 is currently at Year 0.

Below is a brief summary of the 2021 topographic monitoring efforts. For a full description and analysis of topographic monitoring, see Appendix D: Martin Slough Enhancement Project 2021 Physical Monitoring Report by MLA, sections 2.1 and 3.1.

Methods

Topographic features were measured using standard survey methods conducted with a robotic total station and with Real Time Kinematic (RTK) methods. Horizontal datum was State Plane Zone 1 feet and the vertical datum was NAVD88 using benchmarks established during construction. Channel change including channel width will be quantified using 10 cross sections established in the Phase 2 reach of the mainstem, meander, and ponds and 10 cross sections established on the golf course (Phase 3-5). Each cross section was monumented for future relocation.

Large wood features placed in Phase 2-4 were visually inspected at the conclusion of water year 2021 and wood structures for Phase 5 were inspected during construction. These included large wood cover structures throughout the constructed project and log weirs installed at Pond D. The inspection focused on determining if any of the wood had moved, if any steel anchors were loose or corroded, and if any undesirable scour induced by the structure had occurred.

Results

Thalweg Profile

Phase 2 Comparison: Except for two locations, the Phase 2, Year 1 thalweg was at, or slightly lower than, design elevations. For the channel reach between Station 15+00 and 25+00 the surveyed thalweg is about 0.3 feet lower than the design grade. It is uncertain if this is from the original grading of the channel or due to scour over the course of Year 1. The Year 3 survey indicates that it is slightly lower suggesting the possibility of some minor scour and downcutting.

Two notable areas of sedimentation warrant further investigation: Station 14+00 and 27+50. The Station 14+00 high spot, located immediately upstream of the new bridge and sheet piles on the NRLT property, was first observed and surveyed in 2019. While a more detailed survey of the reach is needed to ascertain how much of the high spot persists in the channel, the recent photo suggests it has not changed significantly. The second area of note is at Station 27+50, located just downstream of the property line with the golf course. At this location there appears to be

approximately 1.5 feet of sedimentation along 50 feet of the channel and then a deep section of channel upstream of the sedimentation. This location coincides with the Phase 2 temporary grade control. This grade control was constructed of rock and was removed as part of Phase 3 construction in summer of 2019. The over deepened channel section around Station 30+00 was where the rock and sedimentation were removed. The area of sedimentation around Station 27+50 appears to be the tailout from the scour pool downstream of the Phase 2 grade control. This area was beyond the reach of the excavator during the removal of the grade control, and therefore sediment was left in place. Based on the Year 3 survey the material appears to be persistent and flows and tidal action has not transported the material downstream.

Phase 3-5 Comparison: The Year 1 thalweg profile for Phases 3 and 4 and the Year 0 profile for Phase 5 shows that the channel bed is approximately 0.5 feet below the design elevation. This is believed to be associated with over excavation of the channel during construction, and not due to channel downcutting during the first-year post-construction. The high spot in the channel profile at Station 59+00 is associated with the temporary grade rock control that is part of the temporary salinity barrier, slated for removal following planned changes to the golf course's water supply system. Spot checks during the 2021 construction season show that the Pond D log weir crests and the upstream log weirs are 0.5 ft lower than as shown on the design plans. The drop and spacing between weirs are per plan.

Cross Sections

Phase 1 Year 3: Cross sections 1 through 5, Meander 1 and 2, Pond C and the Southeast Tributary represent Phase 2 constructed in 2018. Mainstem cross sections 1, 2, 4 and 5 do not show significant change from Year 1 to Year 3. The SE Tributary Pond shows approximately +0.3 ft difference in the 1- and 3-year pond bottom. This could indicate some sedimentation but is more likely explained by normal variance in the survey due to the soft bottom material of the pond.

Phase 3 and 4 Year 1: Cross sections 6 through 9 and Ponds D, E and F represent Phase 3 and 4 on the Golf Course as constructed in 2019, and 2020, respectively. There were no noteworthy changes to the channel shape at the cross sections after the first year after implementation. However, the sections 6, 7 and Pond E and F show the channel bottom was constructed approximately 0.5 to 0.7 feet lower than the design channel grade.

Area Below Design MHHW: The cross-sectional area below the design MHHW of 5.5 feet (NAVD88) was calculated for each cross section and is provided in MLA's Report in Appendix D. Two cross sections showed a notable increase in cross-sectional area: Mainstem Cross Section 3 (MS3) at 11.39% and Meander Cross Section 2 (M2) at 18.3%. MS3 is located just downstream of the sheet pile installation at the new Barn Bridge, in an area that was slumping and excessively wet from seeps. The current survey was compared to the section data with the Year 1 survey. The channel bottom is unchanged while the left and right banks show some widening along the lower portion. This could be associated with the channel eroding in response to material that originally slumped in from the right bank shortly after construction, and thus the channel is widening towards a more stable cross-sectional area similar to the design cross sectional area. A low tide observation or a survey that provides more detail along the lower banks would clarify conditions. At M2, the current survey was compared to the section data with the Year 1 survey. The channel appears to

have deepened and widened slightly toward the left bank. Some of the increased area is along the top of bank. Meander Cross Section 1 (M1) also shows signs of channel enlargement, but to a lesser degree. In general, it appears that the meander channel has been enlarging in response to the increased tidal prism associated with Marsh Plain B. It is expected that this widening will slow or stop over the next two years. A more detailed survey would clarify the extent of any widening.

Channel Condition

In addition to the two high spots in the mainstem discussed earlier, MLA that the channel alignment at the upstream end of the project is causing some scour along the right bank of the upstream most log weir. This condition may improve as the upstream channel adjusts to the downstream weir elevations. This area should be monitored and may requires some minor bank stabilization measures.

A longitudinal profile of the SE Tributary was conducted in 2021 due to concerns regarding the growth of grass within the SE Tributary channel and the potential for sediment accumulation due to the vegetation. The cross section indicates potentially up to 0.4 feet of sedimentation in the deepest point of the pond. The profile shows that the channel grade, which is controlled by seven log steps, appears to have been constructed up to 0.5 feet below design grade (represented by the as-built surface). Additionally, the as-built surface did not include the pools that were excavated below each log step. The 2021 survey shows that these pools are maintaining approximately 1 to 2 feet of depth, with the lower pools having more depth and volume. This is likely due to the daily draining of the tide and resulting scouring forces that maintain these lower pools combined with the lack of vegetation due to higher salinity that prevents grass growth. The profile does not indicate any notable aggradation has occurred. Subsequent surveys will be useful for tracking any changes to the channel profile associated with grass.

Elevation Discrepancy

The topographic survey data consistently show a discrepancy between the design grade and finished grade elevation of approximately -0.5 feet throughout the Phase 3-5 construction, as can be seen in the surveyed channel profile and cross sections within these phases of the project. This discrepancy was confirmed with grade check surveys in the field during the 2021 construction season. In addition, it was concluded that the existing fairway ground elevation is approximately 1 foot lower than what is shown in the original topography that was based on photogrammetry and provided to the project by the City of Eureka (circa 2001), which the design elevations are based on.

Inspection of Large Wood Structures

The large wood structures were inspected on November 23, 2021 to ensure they were stable and functioning as intended. All structures (Log Cover Structures, Rood Wad Deflectors, and Root Wad Habitat Structures, Log Constrictors, Log Weirs) appeared stable and show no signs of shifting since constructed. Wood features located in the middle of Pond D, E and F were observed from a boat during the profile survey. All anchor points appeared sound. The previous monitoring report (2020) indicated that there was visible erosion against pile logs associated with the log weirs

between Pond D and the mainstem Marin Slough channel. During the 2021 construction season, RCAA staff filled and compacted the voids with facing class rock mixed with soil and gravel. The log weirs constructed as part of Phase 5 in 2021 at the upstream end of the project were modified to include additional rock protection at the piles and downstream plunge pool to protect the piles from scour. Live willow stakes were also installed on the bank near the bridge at Pond D to stabilize some minor bank erosion observed during the first year following construction.

Hydrology

Overview

Hydrologic monitoring was conducted by MLA and consists of monitoring water levels throughout the length of the project to verify the amplitude and longitudinal extent of the muted tide influence. Results are then used to adaptively manage the muted tide through adjustments of the muted tide regulator (MTR) on the tide gate and auxiliary gate. Results are also used to assess frequency and duration of tide gate openness for aquatic organism passage and will aid in interpretation of the water quality monitoring data.

Below is a brief summary of the 2021 hydrologic monitoring efforts. For a full description and analysis of hydrologic monitoring, see Appendix D: Martin Slough Enhancement Project 2021 Physical Monitoring Report by MLA, sections 2.2 and 3.2.

Methods

Water Level Monitoring

Project hydrology was monitored by installing submersible water level loggers in four locations throughout the project reaches on the mainstem of Martin Slough. The loggers measure the hydrostatic pressure above the sensor and is corrected using recorded atmospheric pressure to calculate the stage, or water level, in 15-minute intervals. Each monitoring station consists of a perforated PVC standpipe secured to a T-post or other stable feature. The data logger is placed at the bottom of the standpipe and connected with a cable or cord to the cap for retrieval. A reference benchmark was established at each site and surveyed to determine water surface elevations in North America Vertical Datum 1988 (NAVD88). The data loggers were downloaded approximately every two months and serviced or repaired as needed. At least one water level observation was made during each download period to calibrate the recoded data to the reference benchmark, placing all water level data into the NAVD88 vertical datum.

The following hydrologic monitoring stations were maintained and regularly monitored during water year 2021: Swain Slough, MS-Pond C (NRLT), MS-18 (golf course), MS-NF (golf course) (see Appendix D, Figure 2). For more information on installation dates, and removal for construction or repair, see Appendix D, section 2.2.1 Water Level Monitoring.

Tidal Datums

Humboldt Bay experiences semidiurnal tides: two high tides and two low tides per day. A key metric in sizing and maintaining tidal channel geometry is the average tidal prism, which is defined as the volume of water that drains between MHHW and MLLW.

The North Spit, on Humboldt Bay, tidal datums (converted to NAVD88) were used as a reference for unmuted tidal conditions. Tidal datums for each monitoring station were calculated on a per-month basis and seasonally using the measured water levels. A spreadsheet algorithm was used to identify the daily MHHW, MLHW, MLLW, and MHLW and calculate the monthly averages (Appendix D, sections 2.2.2 and 2.2.3).

Results

Water Level Observations

Water level data for each monitoring station was plotted for each month of the 2021 water year (Appendix D). In Swain Slough, water levels fluctuated similar to those recorded at the NOAA North Spit tidal station (No. 9418767), except that the water level never dropped below 1.0 feet. The plots of Martin Slough water levels at the Pond C gage show water level fluctuating as expected, with the distinct signature of a muted tide that peaks just below elevation 5 feet (NAVD88) and does not drop below an elevation of 1 foot. The highest water level recorded in Martin Slough in 2021 was at Gage Pond C on January 28, 2021 and was 6.9 feet. Gage MS 18 had the highest water level recording on January 28, 2021 at 6.7 feet. During the dry weather monitoring period (June through September) the Hole 18 monitoring station is tidally influenced with a muted tide pattern fluctuating between a low level of 1 foot and a high of 5 feet, closely corresponding to the water levels recorded at the Pond C gage. The North Fork Tributary Confluence gage was installed and operational between December 10, 2020 and May 18, 2021, when it was removed for maintenance and the construction season. The baseflow water level is consistently between elevation 3 and 5 feet. The highest water level peak of 5.47 feet, was recorded on March 21, 2021, note that the data logger was not installed during the January 28, 2021 peaks recorded at the downstream gages. The low tide water levels were controlled by a temporary rock grade control structure located a short distance downstream, on the mainstem.

For a full discussion and analysis of MTR settings and water level observations, including data plots, see Appendix D, section 3.2.1 and 3.2.2.

Tidal Datums

Stage data for the Phase 3 monitoring was analyzed and tidal datums were calculated relative to the NAVD88 vertical datum. The Swain slough data collected during this monitoring period appears similar to North Spit, but slightly higher. At the Pond C gage, when compared to the water year 2020 datums, the MTL and MHHW increased by 0.28 feet, while there was no significant change to the MLLW. At the Hole 18 gage, the MTL and MHHW increased by 0.28 feet, with no significant change to the MLLW. For both the Pond C and Hole 18 gages, the tidal datums for MTL and MHHW are closer to the design values than the previous year.

For a full discussion and analysis of tidal datums, including data tables, see Appendix D, section 3.2.3.

Water Quality

Overview

The objectives of water quality monitoring are to measure salinity, dissolved oxygen, and water temperature to assess sufficiency of water quality for target habitat and species and ensure that salinity does not extend upstream to the golf course pump intake, when in use. These parameters directly influence suitability of aquatic habitat for salmonids, tide water goby, and other aquatic organisms. Surface salinity also influences vegetation communities on marshplains and along the margins of the channels and ponds.

Below is a brief summary of the 2021 water quality monitoring efforts. For a full description and analysis of water quality monitoring, see Appendix D: Martin Slough Enhancement Project 2021 Physical Monitoring Report by MLA, sections 2.3 and 3.3.

Methods

Water quality parameters were measured by installing temperature and salinity data loggers at the same locations as the water level loggers (no salinity logger was installed at the Swain Slough station).

Two salinity data loggers, which also record water temperature, were installed in each perforated standpipe; one at the bottom coupled to the water level logger and one attached to a float that travels the height of the standpipe and measures conditions approximately 10 inches below the surface. The salinity data loggers' period of record matches the water level loggers. Salinity and temperature were recorded continuously on the same 15-minute interval as the stage data loggers. Salinity data loggers were not installed at the Swain Slough station, but Swain Slough water temperatures were recorded by the water level logger placed at the bottom of the water column. Spot measurements of salinity, temperature and dissolved oxygen were also taken using a YSI handheld meter and recorded on data sheets when the data loggers were downloaded. Additional water quality measurements were taken as part of the fisheries monitoring (Appendix C). For more information on installation dates of all monitoring stations, and removal for construction or repair, see Appendix D, section 2.2.1 Water Level Monitoring Table 1.

Results

Water quality data (surface and bottom salinity and water temperature) for each monitoring station was plotted for each month of the 2021 water year (Appendix D). The plots also include daily rainfall totals measured at the NWS office on Woodley Island for reference. In addition, water quality spot measurements were recorded during each data download. These include water temperature, salinity, and dissolved oxygen concentrations.

Salinity was not recorded in Swain Slough. Water temperatures in Swain Slough during the fall of 2020 and early winter of 2021 were similar to those measured in the freshwater reach of Martin Slough near Hole 18 and upstream at MS-NF, with small diurnal temperature fluctuations. However, by mid-April 2021, water temperatures in Swain Slough become more elevated compared to near Hole 18 and both diurnal and tidal influenced temperature fluctuations become more apparent.

In Martin Slough, near Pond C, the salinity was highly correlated to precipitation, and stratification was present during periods not dominated by freshwater inflows. During periods between rainfall events the bottom salinity would fluctuate dramatically with incoming verses outgoing tides, while the surface salinity generally fluctuated less and was less brackish. During periods with precipitation, salinity concentrations became close to zero for days at a time. Several days following the cessation of rainfall, the bottom salinity would increase relatively rapidly, while the surface salinity slowly increased with each tide cycle. This pattern was most pronounced in January and February 2021. Water temperatures in Martin Slough near Pond C remained low throughout the fall and early winter months. Surface and bottom temperatures were nearly identical much of the time, with periods where the surface water temperature was colder and fluctuated much more with tidal cycles than along the bottom. By April 2021, temperatures at this location began to rise, as did salinity, due to minimal rainfall. During the summer months water temperatures were between 18 degrees and 22 degrees C and were consistently warmer than Swain Slough.

Salinity measurements in Martin Slough near Hole 18 show that during winter and early spring both surface and bottom salinity fluctuated between 0 ppt and 15 ppt almost daily with the tidal cycle. However, starting in April, the salinity fluctuated between 9 ppt and 12 ppt with the exception of during rainfall events. Water temperatures in Martin Slough near Hole 18 fluctuated with tides and showed diurnal fluctuation with changes associated with precipitation and ambient air temperature.

Salinity measurements for the gage located on the North Fork Tributary (MS-NF) just upstream of the confluence with the mainstem show that saline water is reaching the upper reach of martin slough in the project area even before the completion of Phase 5. Before the gage was removed in June the surface salinity fluctuated with the tide between 0 and 20 ppt. In March the bottom salinity logger was removed for the rest of the monitoring period due to an extended period of faulty data. Temperature values show normal diurnal fluctuations, with warming during the summer months. The gages at MS-NF were removed in June for construction and therefore no data is available for the latter half of the 2021 water year.

MLA's continuous data (Appendix D) show that during the winter months surface salinity at all three gage stations fluctuates with the tide cycle and is often below the 4 ppt threshold during the low tide and for extended periods during precipitation events. During the warmer and drier summer months the Pond C and Hole 18 surface salinity levels show less fluctuation. Starting in May for Pond C and June for the Hole 18 gage, the salinity levels generally remain above 10 ppt and 7 ppt respectively. The 2021 water year experienced 29.16 inches of rainfall, this drier than normal year during the monitoring period is one likely cause of the high salinity levels due to the lack of freshwater flowing through the project area or up from Swain Slough and Elk River. To evaluate the water quality performance of Pond G (Phase 5, constructed in 2021) the North fork tributary gage should be upgraded with salinity loggers that record the full range of salinity. The data loggers at the Pond C and Hole 18 gages should also be upgraded to better understand the full range of exposure to brackish conditions.

During the months of October 2020 through April 2021 maximum daily and average daily water temperatures are well below the thresholds of 21 degrees C and 18 degrees C respectively. During the summer months daily average temperature increases to between 18 degrees C and 24 degrees

C. From June to August, Swain Slough temperatures are also above the average daily threshold of 18 degrees C with the North Fork recording the lowest values of the three gage stations during the summer months (although the North Fork data set is not complete due to construction). The drier than normal year during the monitoring period is one likely cause of the higher temperatures.

Spot measurements of dissolved oxygen (DO) by RCAA staff during each download are provided in Appendix D. The measured DO levels at the four sites were generally above the minimum performance criteria of 4 mg/l on the surface and were often substantially higher. These DO levels are considered acceptable for rearing salmonids and other aquatic organisms.

For a full discussion and analysis of water quality data, including data plots and data tables, see Appendix D, section 3.3.1,3.3.2, and 3.3.3.

Vegetation

Overview

The principal revegetation goal of the project is to establish, rehabilitate, or re-establish vegetative habitats within the project area, including tidal marsh, brackish marsh, freshwater marsh, riparian, and coastal prairie plant associations through both passive and active revegetation. The monitoring goal is to estimate the absolute vegetative cover of native and nonnative vascular plants species and document species diversity once construction activities are complete. This report covers vegetation monitoring for Year 2 of Phase 2 (NRLT property).

In August of 2021 the Year 2 monitoring of Phase 2 concentrated on quantitative vegetation monitoring on the NRLT property, with a brief qualitative overview of the Year 1 Phase 3 and Year 0 Phase 4 revegetated areas on the Eureka Golf Course property.

Below is a brief summary of the 2021 vegetation monitoring efforts. For a full description and analysis of vegetation monitoring, see Appendix E.

Methods

Four macroplots were established during year one of Phase 2 of the project: Marsh Plain A, Oxbow, Pond C, and SE Tributary. During year two of Phase 2, absolute percent cover of native and non-native plant species data was collected across 34 randomly placed quadrats within the defined four macroplots at the restoration site between August 2-12, 2021. Additional measurements collected within each quadrat included the area of surface water, bare earth, absolute vegetative cover in each stratum present (trees, shrubs, and herbs), native cover, wetland designations (OBL, FAC, FACW, and FACU), and non-native cover.

Map 1. Represents the four Macroplots on the NRLT property, distinguishing the riparian and wetland zones, sampling plot locations, and the distance between plots.

A 1 m^2 PVC quadrat was used to isolate the vegetation distinctive to the wetland plots. While a 3-meter radius sampling area was used to collect the riparian plot data. All the plants inside the sampling areas were counted and identified to the taxonomic level of species. Unknown plant species were collected for identification using the Jepson Manual (Hickman 1993).

The collected data was used to interpret the species diversity of vascular plants and total ground cover and compared to the success criteria in the Martin Slough Enhancement Project Monitoring Plan updated in 2021.

Results

Table 1. 2021 Martin Slough Vegetation Monitoring Phase 2 Wetland Results

Year 2 Success Criteria	2021 Vegetation Monitoring Results
30 percent or greater total absolute vegetation cover	94% absolute wetland vegetation cover.
35 percent or greater relative cover of native wetland species.	58% relative cover of native wetland species.
No more than 20 percent absolute cover of target invasive plants.	0% target invasives found within the sampling wetland plots.

All Years	Native wetland species consist of hydrophytic OBL/FACW/FAC species No major erosional areas

The success criteria for the wetland during Year 2 vegetation monitoring of Phase 2 was met during the summer of 2021. There was an absolute vegetative cover of 94% across the wetland zones, surpassing the 30% minimum set by the Year 2 success criteria in the monitoring plan (RCAA 2021). In addition, 58% of the vegetation found within the wetland zones were identified as native species. Lastly, 0% of the identified target invasive, *Spartina densiflora* was found within the project wetland sampling plots.

Table 2. 2021 Martin Slough Vegetation Monitoring Phase 2 Riparian Results

Year 2 Success Criteria	2021 Vegetation Monitoring Results
30 percent or greater total absolute vegetation cover	84% absolute riparian vegetation cover.
35 percent or greater relative cover of native wetland species.	61% relative cover of riparian native wetland species.
No more than 20 percent absolute cover of target invasive plants.	0% target invasives found within the sampling riparian plots.
All Years	Plant vigor shall be “good” per the qualitative score for assessing the health and vigor of planted stock

The success criteria for the riparian zones during Year 2 vegetation monitoring of Phase 2 were met during the summer of 2021. There was an absolute vegetative cover of 84% across the riparian areas, surpassing the 30% minimum set by the Year 2 success criteria in the monitoring plan (RCAA 2021). In addition, 61% of the vegetation found within the riparian habitats were identified to be native species. 0% of the identified target invasive, *Spartina densiflora* was not found within the project riparian sampling plots.

A qualitative assessment occurred along the four identified macroplots: Marsh Plain A, Oxbow, Pond C, and SE Tributary. Within these areas there was evidence of minor cattle disturbance on plants in the macroplots at Pond C and SE Tributary. During the summer of 2021 drought conditions were severe and supplemental watering was required to maintain the plants' vigor. In addition to the qualitative overview of the lower 40 acres, a brief investigation took place on the upstream Eureka Golf Course property. There was a small percentage of the plant species in the riparian areas on the golf course (Phase 3) that were in poor condition and may have found the soil to be too wet during the winter months, while also experiencing drought conditions in winter and spring of 2021. These plants will be monitored in 2022 and their condition will be observed. Photo monitoring is part of the vegetation parameter and was conducted post-construction along with vegetation monitoring. See Appendix F for the 2021 photo monitoring report.

Appendix A - Photos from Martin Slough Fisheries Monitoring 2021

Photos courtesy of RTA and Morguine Sefcik

Tidewater Goby

Coho Smolt from Pond D

Green Shore and Dungeness Crab

Seining Pond C – 12/20/21

Staghorn Sculpin

Large Sculpin from Pond F

Seining Pond F

Seining Pond F Close-up

Appendix B - PIT Tag Data for 2021
Martin Slough Fisheries Monitoring

DATE	LOCATION OF CATCH	FORK LENGTH (mm)	WEIGHT (g)	PIT TAG NUMBER	BLACK SPOT	COMMENTS
1/13/2021	Pond E	74	3.5	900226000341946	1	
1/13/2021	Pond E	72	3.5	900226000341943	0	
1/13/2021	Pond E	76	4.5	900226000349367	1	
2/24/2021	Pond D	75	4.6	900226001641922	2	
2/24/2021	Pond D	77	5.1	900226001686379	2	
2/24/2021	Pond D	95	9.4	900226001686474	0	
2/24/2021	Pond D	89	7.3	900226001686370	0	
2/24/2021	Pond D	80	6.8	900226001648060	0	
2/24/2021	Pond D	80	6.3	900226001686453	1	
2/24/2021	Pond D	73	4.4	900226001686277	N/A	
2/24/2021	Pond D	85	7	900226001686302	1	
2/24/2021	Pond D	82	6.9	900226001686372	0	
2/24/2021	Pond D	82	6.5	900226000341938	0	
2/24/2021	Pond D	78	5.8	900226001686297	1	
2/24/2021	Pond D	86	7	900226001686425	0	
2/24/2021	Pond D	78	5.6	900226001686362	1	
2/24/2021	Pond D	98	11	900226000348024	3	
2/24/2021	Pond D	82	6.1	900226001686497	3	
2/24/2021	Pond D	76	4.3	900226001686465	4	
2/24/2021	Pond D	85	7.8	900226000341945	0	
2/24/2021	Pond D	94	10	900226001686438	1	
2/24/2021	Pond D	94	9.9	900226001686347	2	
2/24/2021	Pond D	95	9.5	900226001686414	2	
2/24/2021	Pond D	88	6.9	900226000349332	1	
2/24/2021	Pond D	92	8.1	900226001686263	2	
2/24/2021	Pond D	101	11.5	900226000341916	2	
2/24/2021	Pond D	84	6.8	900226001686375	0	
2/24/2021	Pond D	97	10.1	900226001686350	0	
2/24/2021	Pond D	79	6	900226001686431	1	
2/24/2021	Pond D	76	5.2	900226000341971	0	
2/24/2021	Pond D	89	8	900226001686340	0	
2/24/2021	Pond D	82	5.2	900226001686430	0	
2/24/2021	Pond D	94	9.8	900226001686426	0	
2/24/2021	Pond D	98	9.7	900226001686323	3	
2/24/2021	Pond D	76	5.8	900226001686498	0	
2/24/2021	Pond D	88	6.1	900226000349319	0	
2/24/2021	Pond D	78	4	900226000341982	0	
2/24/2021	Pond D	102	9.6	900226001686421	0	
2/24/2021	Pond D	102	9.8	900226001686325	1	
2/24/2021	Pond D	82	4.1	900226001686383	2	
2/24/2021	Pond D	99	10.1	900226001686410	3	
2/24/2021	Pond D	95	9.2	900226001686267	1	
2/24/2021	Pond D	85	6	900226000349349	0	

2/24/2021	Pond D	80	4.9	900226001686254	0	
2/24/2021	Pond D	76	5	900226001686495	1	
2/24/2021	Pond D	80	5.8	900226001686450	1	
2/24/2021	Pond D	94	8.9	900226001686446	0	
2/24/2021	Pond D	83	5.4	900226001686285	0	
2/24/2021	Pond D	85	7.2	900226001686366	0	
2/24/2021	Pond D	76	4.5	900226000341970	0	
2/24/2021	Pond D	77	5.3	900226001686345	2	
2/24/2021	Pond D	85	6	900226000349320	0	
2/24/2021	Pond D	83	6	900226001686274	1	
2/24/2021	Pond D	94	8.5	900226001686481	0	
2/24/2021	Pond D	93	8.7	900226001686283	0	
2/24/2021	Pond D	91	8.6	900226001686397	1	
2/24/2021	Pond D	86	6.2	900226001686360	0	
2/24/2021	Pond D	85	6.8	900226001686377	1	
2/24/2021	Pond D	104	12.7	900226001686298	2	
2/24/2021	Pond D	90	8.4	900226001686343	0	
2/24/2021	Pond D	80	5.2	900226001686359	0	
2/24/2021	Pond D	94	9.5	900226001686310	3	
2/24/2021	Pond D	94	8.9	900226001686333	0	
2/24/2021	Pond D	85	6.8	900226001686493	0	
2/24/2021	Pond D	71	3.9	900226001686276	2	
2/24/2021	Pond D	86	6.6	900226001686416	0	
2/24/2021	Pond D	92	8.4	900226000348055	2	
2/24/2021	Pond D	73	4.1	900226001686258	1	
2/24/2021	Pond D	80	4.9	900226001686462	0	
2/24/2021	Pond D	84	5.8	900226001686478	3	
2/24/2021	Pond D	85	6.4	900226001686433	0	
2/24/2021	Pond D	95	8.5	900226001686304	1	
2/24/2021	Pond D	85	4.2	900226001686402	3	
2/24/2021	Pond D	84	6	900226001686342	3	
2/24/2021	Pond D	82	4.5	900226001686381	0	
2/24/2021	Pond D	93	8.5	900226001686306	3	
2/24/2021	Pond D	83	5.8	900226001686413	1	
2/24/2021	Pond D	82	5.6	900226000349387	2	
2/24/2021	Pond D	86	7	900226000341956	0	
2/24/2021	Pond D	111	17.5	900226001686307	2	
2/24/2021	Pond D	85	6.5	900226001686294	1	
2/24/2021	Pond D	75	5.2	900226001686367	1	
2/24/2021	Pond D	86	7.2	900226001686459	5	
2/24/2021	Pond D	88	7.4	900226001686351	1	
2/24/2021	Pond D	91	9.5	900226000341990	2	
2/24/2021	Pond D	79	4.7	900226000349334	2	
2/24/2021	Pond D	75	6.3	900226001686468	1	
2/24/2021	Pond D	91	8.9	900226001686473	0	
2/24/2021	Pond D	87	7.3	900226000349391	2	
2/24/2021	Pond D	84	5.8	900226001686475	1	

2/24/2021	Pond D	90	8	900226000348042	0	
2/24/2021	Pond D	89	6.8	900226000349396	1	
2/24/2021	Pond D	86	6.9	900226001686319	0	
2/24/2021	Pond D	84	5.6	900226000349346	0	
2/24/2021	Pond D	87	8.1	900226000349310	2	
2/24/2021	Pond D	92	8	900226001686455	1	
2/24/2021	Pond D	73	4.1	900226000348034	0	
2/24/2021	Pond D	76	5.4	900226001686364		
2/24/2021	Pond D	83	6.7	900226000349394	2	
2/24/2021	Pond D	84	5.7	900226001686331	1	
2/24/2021	Pond D	89	6.8	900226001686386	1	
2/24/2021	Pond D	175	56.5	90022600186403	2	
2/24/2021	Pond D	80	5.3	900226001686264	0	
2/24/2021	Pond D	95	N/A	900226001686349	2	Lost 86324
2/24/2021	Pond D	99	9.4	900226001686324	0	
2/24/2021	Pond D	81	5.2	900226001686312	0	
2/24/2021	Pond D	100	10.4	900226000349389	1	
2/24/2021	Pond D	86	6.4	900226001686253	0	
2/24/2021	Pond D	78	5.4	900226001686257	2	
2/24/2021	Pond D	80	5.3	900226001686268	0	
2/24/2021	Pond D	88	8	900226001686259	1	
2/24/2021	Pond D	71	7.3	900226001686315	0	
2/24/2021	Pond D	81	5	900226000341900	4	
2/24/2021	Pond D	90	7	900226000341952	2	
2/24/2021	Pond D	85	6.6	900226001686412	2	
2/24/2021	Pond D	81	6.6	900226001686284	1	
2/24/2021	Pond D	94	8.4	900226001686449	1	
2/24/2021	Pond D	87	7.4	900226001686447	1	
2/24/2021	Pond D	100	10.9	900226001686380	1	
2/24/2021	Pond D	68	4	900226000341940	2	
2/24/2021	Pond F	94	N/A	900226000349377	1	too windy no weight recorded through 2/24
2/24/2021	Pond F	70	N/A	900226000341902	4	
2/24/2021	Pond F	87	N/A	900226000348066	4	
2/24/2021	Pond F	87	N/A	900226001686423	1	
2/24/2021	Pond F	89	N/A	900226001686440	4	
2/24/2021	Pond F	100	N/A	900226000349348	1	
2/24/2021	Pond F	104	N/A	900226000349333	2	
2/24/2021	Pond F	80	N/A	900226001686400	0	
2/24/2021	Pond F	94	N/A	900226000348059	1	
2/24/2021	Pond F	85	N/A	900226001686461	5	
2/24/2021	Pond F	77	N/A	900226001686466	1	
2/24/2021	Pond F	85	N/A	900226000348014	0	
2/24/2021	Pond F	104	N/A	900226000349313	2	
2/24/2021	Pond F	94	N/A	900226000348065	1	
2/24/2021	Pond F	87	N/A	900226000348094	0	
2/24/2021	Pond F	84	N/A	900226000348004	1	

2/24/2021	Pond F	79	N/A	900226000349302	1	
2/24/2021	Pond F	82	N/A	900226000341992	2	
2/24/2021	Pond F	85	N/A	900226001686385	0	
2/24/2021	Pond F	85	N/A	900226001686499	1	
2/24/2021	Pond F	89	N/A	900226001686339	0	
2/24/2021	Pond F	93	N/A	900226000341960	2	
2/24/2021	Pond F	91	N/A	900226000349372	0	
2/24/2021	Pond F	82	N/A	900226000349304	1	
2/24/2021	Pond F	84	N/A	900226001686458	2	
2/24/2021	Pond F	72	N/A	900226001686409	1	
2/24/2021	Pond F	87	N/A	900226001686369	0	
2/24/2021	Pond E	79	5.6	900226001686250	1	
2/24/2021	Pond E	74	4.1	900226001686255	2	
2/24/2021	Pond E	78	4.5	900226001686256	3	
2/24/2021	Pond E	75	4.3	900226001686469	0	
2/24/2021	Pond E	99	9.8	900226001686388	2	
2/24/2021	Pond E	91	8.1	900226001686405	1	
2/24/2021	Pond E	87	7.1	900226001686318	1	
2/24/2021	Pond E	92	8.2	900226001686336	2	
2/24/2021	Pond E	87	7.3	900226000349316	1	
2/24/2021	Pond E	76	5	900226001686355	0	
2/24/2021	Pond E	79	6	900226001686275	0	
2/24/2021	Pond E	80	5.2	900226001686376	0	
2/24/2021	Pond E	78	5.3	900226001686415	1	
2/24/2021	Pond E	80	5.4	900226000349379	1	
2/24/2021	Pond E	75	4.4	900226001686419	1	
2/24/2021	Pond E	72	3.5	900226001686288	0	
2/24/2021	Pond E	83	6	900226000349321	1	
2/24/2021	Pond E	101	10.5	900226001686358	1	
2/24/2021	Pond E	78	4.4	900226001686451	5	
2/24/2021	Pond E	80	5.4	900226001686289	3	
2/24/2021	Pond E	82	5.9	900226000341939	1	
2/24/2021	Pond E	93	8.4	900226000348084	0	
2/24/2021	Pond E	82	7.3	900226001686311	0	
2/24/2021	Pond E	82	6.1	900226001686338	0	
2/24/2021	Pond E	84	5.5	900226001686456	0	
2/24/2021	Pond E	87	7.1	900226000349300	0	
2/24/2021	Pond E	87	6.5	900226000349305	0	
2/24/2021	Pond E	77	3.4	900226001686334	1	
2/24/2021	Pond E	90	7.4	900226001686327	2	Lower caudal torn
2/24/2021	Pond E	91	8.3	900226001686337	3	
2/24/2021	Pond E	72	3.9	900226001686262	1	
2/24/2021	Pond E	85	6.7	900226001686429	1	
2/24/2021	Pond E	89	6.7	900226001686396	0	
2/24/2021	Pond E	78	6.5	900226001686460	0	
2/24/2021	Pond E	82	5	900226000349326	0	
3/17/2021	POND D STEP POOLS	97	8.8	900226000341979	1	

3/17/2021	POND D STEP POOLS	95	N/A		4	Fish in poor condition, not weighed or tagged
3/17/2021	Pond D	92	8.8	900226001686375	0	RECAPTURE
3/17/2021	Pond D	113	15.1	900226001686271	3	RECAPTURE
3/17/2021	Pond D	89	7.5	900226000341942	2	
3/17/2021	Pond D	94	9.2	900226001686335	0	
3/17/2021	Pond D	98	10	900226001686332	0	
3/17/2021	Pond D	96	9.6	900226001686361	0	
3/17/2021	Pond D	91	8.8	900226001649394	3	RECAPTURE
3/17/2021	Pond D	92	8.2	900226001686345	2	RECAPTURE
3/17/2021	Pond D	115	18.4	900226001686398	1	
3/17/2021	Pond D	95	9	900226001686441	1	
3/17/2021	Pond D	100	11	900226001686378	0	
3/17/2021	Pond D	99	10.3	900226001686439	0	
3/17/2021	Pond D	94	8	900226001686352	1	
3/17/2021	Pond D	100	10.7	900226001686343	0	RECAPTURE
3/17/2021	Pond D	104	10.8	900226001686432	0	
3/17/2021	Pond D	89	7.1	900226000349369	0	
3/17/2021	Pond D	94	8.5	900226001686492	2	
3/17/2021	Pond D	99	9.8	900226001686370	1	RECAPTURE
3/17/2021	Pond D	97	10.2	900226000349310	1	RECAPTURE
3/17/2021	Pond D	95	9.7	900226000349354	0	
3/17/2021	Pond D	103	14	900226001686344	2	
3/17/2021	Pond D	98	10.4	900226001686427	2	
3/17/2021	Pond D	85	7	900226001686442	0	
3/17/2021	Pond D	95	8.3	900226001686434	1	
3/17/2021	Pond D	105	13.6	900226000348045	1	
3/17/2021	Pond D	93	8.3	900226001686402	2	RECAPTURE
3/17/2021	Pond D	87	7.2	900226000341910	0	
3/17/2021	Pond D	87	7.4	900226001686479	5	
3/17/2021	Pond D	105	12.9	900226001686305	0	
3/17/2021	Pond D	84	6	900226001686463	0	
3/17/2021	Pond D	101	12.3	900226001686496	1	
3/17/2021	Pond D	94	9	900226001686356	2	
3/17/2021	Pond D	94	9.1	900226001686413	1	RECAPTURE
3/17/2021	Pond D	88	7.1	900226001686314	0	
3/17/2021	Pond D	91	8.3	900226000349346	0	RECAPTURE
3/17/2021	Pond D	86	7.2	900226001686399	0	
3/17/2021	Pond E	86	7.8	900226000341924	2	
3/17/2021	Pond E	101	11.3	900226001686339	0	RECAPTURE
3/17/2021	Pond E	91	8.2	900226001686400	2	RECAPTURE
3/17/2021	Pond E	86	6.9	900226001686395	1	
3/17/2021	Pond E	96	9.8	900226001686287	1	
3/17/2021	Pond E	88	8.8	900226001686281	1	
3/17/2021	Pond E	79	5.7	900226001686329	2	
3/17/2021	Pond E	103	12.6	900226001686489	2	
3/17/2021	Pond E	66	3.2	900226001686477	0	

3/17/2021	Pond E	102	11.1	900226001686317	2	
3/17/2021	Pond E	101	11.1	900226001686390	1	
3/17/2021	Pond E	111	15.5	900226000349378	2	
3/17/2021	Pond E	88	7.4	900226000349345	0	
3/17/2021	Pond E	100	10.3	900226000348046	1	
3/17/2021	Pond E	82	5.8	900226001686454	1	
3/17/2021	Pond E	91	8.9	900226001686330	0	
3/17/2021	Pond E	112	16.7	900226000349373	1	
3/17/2021	Pond E	88	7.4	900226000349392	1	
3/17/2021	Pond E	100	11	900226000341918	0	
3/17/2021	Pond E	99	11.5	900226001686428	1	
3/17/2021	Pond E	85	6.8	900226001686251	1	RECAPTURE
3/17/2021	Pond E	85	6.8	900226001686376	0	
3/17/2021	Pond E	94	8.8	900226001686265	2	
3/17/2021	Pond E	95	8.5	900226000348077	0	
3/17/2021	Pond E	92	8.4	900226000349382	1	
3/17/2021	Pond E	99	10.4	900226000341962	5	
3/17/2021	Pond F	116	17.9	900226001686328	3	
3/17/2021	Pond F	95	10.1	900226001686292	0	
3/17/2021	Pond F	101	12	900226000348059	1	RECAPTURE
3/17/2021	Pond F	82	5.7	900226000348086	0	
3/17/2021	Pond F	95	10.8	900226000349304	1	RECAPTURE
3/17/2021	Pond F	115	17.1	900226001686470	5	
3/17/2021	Pond F	98	10.9	900226001686303	1	
3/17/2021	Pond F	92	9	900226001686365	1	
3/17/2021	Pond F	108	13.2	900226001686279	0	
3/17/2021	Pond F	94	9.3	900226001686280	1	
3/17/2021	Pond F	94	9.3	900226000341966	2	
3/17/2021	Pond F	84	6.2	900226001686422	0	
3/17/2021	Pond F	96	9.7	900226001686374	1	
3/17/2021	Pond F	83	6	900226000349340	0	
3/17/2021	Pond F	103	11.8	900226001686491	1	
3/17/2021	Pond F	109	13.3	900226001686273	0	
3/17/2021	Pond F	88	7.3	900226001686394	0	
3/17/2021	Pond F	110	13.4	900226001686418	0	
3/17/2021	Pond F	100	11.3	900226001686486	2	
3/17/2021	Pond F	86	7.2	900226001686435	1	
3/17/2021	Pond F	95	9.7	900226000348007	0	
3/17/2021	Pond F	109	13.5	900226000348089	1	
3/17/2021	Pond F	84	6.8	900226001686373	1	
3/17/2021	Pond F	87	6.8	900226001686250	0	RECAPTURE
3/17/2021	Pond F	86	7.1	900226001686363	3	
3/17/2021	Pond F	104	11.9	900226000341998	4	
3/17/2021	Pond F	94	10	900226001686490	0	
3/17/2021	Pond F	83	6.3	900226001686368	0	
3/17/2021	Pond F	102	11.9	900226000349359	1	
3/17/2021	Pond F	90	7.8	900226001686407	2	

3/17/2021	Pond F	91	8.5	900226001686457	0	
3/17/2021	Pond F	102	11.8	900226001686389	1	
3/17/2021	Pond F	110	14.9	900226001686266	0	
3/17/2021	Pond F	98	9.2	900226001686387	0	
3/17/2021	Pond F	111	13.6	900226001686308	1	
3/17/2021	Pond F	90	7.7	900226000341959	1	
3/17/2021	Pond F	99	10.1	900226000341977	1	
3/17/2021	Pond F	99	10.6	900226001686295	2	
3/17/2021	Pond F	109	15.2	900226000349347	3	
3/17/2021	Pond F	104	12.8	900226000349314	0	
3/17/2021	Pond F	92	8	900226000349362	0	Balance failure
3/24/2021	SE Tributary Step Pools	87	N/A	No tag		
3/24/2021	SE Tributary Step Pools	102	N/A	No tag	light	
3/24/2021	SE Tributary Step Pools	97	N/A	No tag		
3/24/2021	SE Tributary Step Pools	93	N/A	No tag	light	
3/24/2021	SE Tributary Step Pools	84	N/A	No tag		
3/24/2021	SE Tributary Step Pools	93	N/A	No tag		
3/24/2021	SE Tributary Step Pools	101	N/A	No tag	light	
3/24/2021	SE Tributary Step Pools	95	N/A	No tag		
3/24/2021	SE Tributary Step Pools	90	N/A	No tag		
3/24/2021	SE Tributary Step Pools	93	N/A	No tag		
3/24/2021	SE Tributary Step Pools	105	N/A	No tag		
3/24/2021	SE Tributary Step Pools	101	N/A	No tag		
3/24/2021	SE Tributary Step Pools	87	N/A	No tag		
3/24/2021	SE Tributary Step Pools	94	N/A	No tag		
3/24/2021	SE Tributary Step Pools	90	N/A	No tag		
3/24/2021	SE Tributary Step Pools	103	N/A	No tag		
3/24/2021	SE Tributary Step Pools	91	N/A	No tag		
3/24/2021	SE Tributary Step Pools	86	N/A	No tag		
3/24/2021	SE Tributary Step Pools	93	N/A	No tag		
3/24/2021	SE Tributary Step Pools	95	N/A	No tag		
3/24/2021	SE Trib Pond	102	N/A	No tag		
3/24/2021	SE Trib Pond	90	N/A	No tag		
3/24/2021	SE Trib Pond	88	N/A	No tag		
3/24/2021	SE Trib Pond	100	N/A	No tag		
3/24/2021	SE Trib Pond	95	N/A	No tag		
3/24/2021	SE Trib Pond	83	N/A	No tag		
3/24/2021	SE Trib Pond	84	N/A	No tag		
3/24/2021	SE Trib Pond	101	N/A	No tag		
3/24/2021	SE Trib Pond	95	N/A	No tag		
3/24/2021	SE Trib Pond	93	N/A	No tag		
3/24/2021	SE Trib Pond	100	N/A	No tag		
3/24/2021	SE Trib Pond	83	N/A	No tag		
3/24/2021	SE Trib Pond	86	N/A	No tag		
4/14/2021	Pond D	115	N/A	900226000349346	0	RECAPTURE
4/14/2021	Pond D	111	N/A	900226001686710	2	
4/14/2021	Pond D	112	N/A	900226001686364	0	RECAPTURE

4/14/2021	Pond D	176	N/A	900226001686264	0	RECAPTURE
4/14/2021	Pond D	110	N/A	900226000348042	0	RECAPTURE
4/14/2021	Pond D	109	N/A	900226001686535	1	
4/14/2021	Pond D	111	N/A	900226001686636	1	
4/14/2021	Pond D	118	N/A	900226001686496	0	RECAPTURE
4/14/2021	Pond D	116	N/A	900226001686527	0	
4/14/2021	Pond D	109	N/A	900226001686335	0	RECAPTURE
4/14/2021	Pond D	118	N/A	900226001686473	1	RECAPTURE
4/14/2021	Pond D	108	N/A	900226001686634	1	
4/14/2021	Pond D	121	N/A	900226001686414	2	RECAPTURE
4/14/2021	Pond D	110	N/A	900226001686722	1	
4/14/2021	Pond D	120	N/A	900226001686474	0	RECAPTURE
4/14/2021	Pond D	111	N/A	900226001686735	2	
4/14/2021	Pond D	123	N/A	900226001686505	1	
4/14/2021	Pond D	114	N/A	900226001686453	1	RECAPTURE
4/14/2021	Pond D	105	N/A	900226001686594	0	
4/14/2021	Pond D	107	N/A	900226001686367	0	RECAPTURE
4/14/2021	Pond D	113	N/A	900226001686332	0	RECAPTURE
4/14/2021	Pond D	115	N/A	900226001686622	2	
4/14/2021	Pond D	106	N/A	900226001686498	0	RECAPTURE
4/14/2021	Pond D	107	N/A	900226001686600	1	
4/14/2021	Pond D	120	N/A	900226001686614	1	
4/14/2021	Pond D	112	N/A	900226001686643	1	
4/14/2021	Pond D	122	N/A	900226001686598	0	
4/14/2021	Pond D	115	N/A	900226001686542	0	
4/14/2021	Pond D	117	N/A	900226001686350	0	RECAPTURE
4/14/2021	Pond D	111	N/A	900226001686597	5	
4/14/2021	Pond D	102	N/A	900226001686567	0	
4/14/2021	Pond D	113	N/A	900226001686744	1	
4/14/2021	Pond D	116	N/A	900226001686352	2	RECAPTURE
4/14/2021	Pond D	111	N/A	900226001686561	3	
4/14/2021	Pond D	103	N/A	900226001686576	1	
4/14/2021	Pond D	115	N/A	900226001686304	1	RECAPTURE
4/14/2021	Pond D	104	N/A	900226000341942	1	RECAPTURE
4/14/2021	Pond D	109	N/A	900226001686646	0	
4/14/2021	Pond D	106	N/A	900226001686729	0	
4/14/2021	Pond D	110	N/A	900226001686518	2	
4/14/2021	Pond D	120	N/A	900226001686546	2	
4/14/2021	Pond D	102	N/A	900226001686530	2	
4/14/2021	Pond D	100	N/A	900226001686695	0	
4/14/2021	Pond D	93	N/A	900226001686656	1	
4/14/2021	Pond D	113	N/A	900226001686386	2	RECAPTURE
4/14/2021	Pond D	106	N/A	900226001686524	0	
4/14/2021	Pond D	117	N/A	900226001686717	1	
4/14/2021	Pond D	112	N/A	900226001686446	0	RECAPTURE
4/14/2021	Pond D	106	N/A	900226001686545	0	
4/14/2021	Pond D	103	N/A	900226001686577	1	

4/14/2021	Pond D	119	N/A	900226001686568	2	
4/14/2021	Pond D	115	N/A	900226001686500	3	
4/14/2021	Pond D	109	N/A	900226001686658	1	
4/14/2021	Pond D	116	N/A	900226001686439	0	RECAPTURE
4/14/2021	Pond D	121	N/A	900226001686305	1	RECAPTURE
4/14/2021	Pond D	98	N/A	900226000341922	1	RECAPTURE
4/14/2021	Pond D	107	N/A	900226001686549	2	
4/14/2021	Pond D	111	N/A	900226001686443	1	
4/14/2021	Pond D	115	N/A	900226001686574	0	
4/14/2021	Pond D	114	N/A	900226001686711	0	
4/14/2021	Pond D	110	N/A	900226001686564	0	
4/14/2021	Pond D	100	N/A	900226001686463	0	RECAPTURE
4/14/2021	Pond D	108	N/A	900226001686402	3	RECAPTURE
4/14/2021	Pond D	109	N/A	900226001686532	1	
4/14/2021	Pond D	104	N/A	900226001686692	0	
4/14/2021	Pond D	109	N/A	900226001686618	0	
4/14/2021	Pond D	113	N/A	900226001686370	0	RECAPTURE
4/14/2021	Pond D	107	N/A	900226001686282	1	
4/14/2021	Pond D	118	N/A	900226000349310	2	RECAPTURE
4/14/2021	Pond D	115	N/A	900226001686631	0	
4/14/2021	Pond D	112	N/A	900226000349394	3	RECAPTURE
4/14/2021	Pond D	111	N/A	900226001686294	1	RECAPTURE
4/14/2021	Pond D	101	N/A	900226001686379	1	RECAPTURE
4/14/2021	Pond E	118	N/A	900226001686701	4	
4/14/2021	Pond E	95	N/A	900226001686509	1	
4/14/2021	Pond E	85	N/A	900226001686316	2	
4/14/2021	Pond E	112	N/A	900226001686579	0	
4/14/2021	Pond E	112	N/A	900226001686716	0	
4/14/2021	Pond E	120	N/A	900226001686698	1	
4/14/2021	Pond E	116	N/A	900226001686511	2	
4/14/2021	Pond E	104	N/A	900226001686544	1	
4/14/2021	Pond E	110	N/A	900226001686522	0	
4/14/2021	Pond E	109	N/A	900226001686647	0	
4/14/2021	Pond E	110	N/A	900226001686707	0	
4/14/2021	Pond E	105	N/A	900226001686526	2	
4/14/2021	Pond E	98	N/A	900226001686562	1	
4/14/2021	Pond E	104	N/A	900226001686322	1	
4/14/2021	Pond E	123	N/A	900226001686694	3	
4/14/2021	Pond E	110	N/A	900226001686617	0	
4/14/2021	Pond E	116	N/A	900226001686706	0	
4/14/2021	Pond E	118	N/A	900226000348044	5	
4/14/2021	Pond E	118	N/A	900226001686724	2	
4/14/2021	Pond E	111	N/A	900226001686565	5	
4/14/2021	Pond E	117	N/A	90022600349362	0	RECAPTURE
4/14/2021	Pond E	128	N/A	900226001686730	1	
4/14/2021	Pond E	109	N/A	900226001686371	0	

4/14/2021	Pond E	112	N/A	900226001686609	1	lower caudal lobe damaged
4/14/2021	Pond E	125	N/A	900226001686590	2	
4/14/2021	Pond E	125	N/A	900226000349359	0	RECAPTURE
4/14/2021	Pond E	100	N/A	900226001686635	4	
4/14/2021	Pond E	114	N/A	900226001686605	0	
4/14/2021	Pond E	110	N/A	900226001686745	2	
4/14/2021	Pond E	105	N/A	900226001686261	0	
4/14/2021	Pond E	89	N/A	900226001686560	4	
4/14/2021	Pond E	108	N/A	900226001686583	0	
4/14/2021	Pond E	126	N/A	900226001686512	0	
4/14/2021	Pond E	130	N/A	900226000349304	0	RECAPTURE
4/14/2021	Pond E	128	N/A	900226001686551	0	
4/14/2021	Pond E	118	N/A	900226001686537	0	
4/14/2021	Pond E	126	N/A	900226001686572	1	
4/14/2021	Pond E	120	N/A	900226001686424	0	
4/14/2021	Pond E	120	N/A	900226001686748	1	
4/14/2021	Pond E	120	N/A	900226001686536	0	
4/14/2021	Pond E	108	N/A	900226001686738	2	
4/14/2021	Pond E	114	N/A	900226001686396	0	RECAPTURE
4/14/2021	Pond E	119	N/A	900226001686458	2	RECAPTURE
4/14/2021	Pond E	123	N/A	900226001686749	0	
4/14/2021	Pond E	118	N/A	900226001686586	5	
4/14/2021	Pond E	105	N/A	900226001686684	0	
4/14/2021	Pond E	108	N/A	900226001686723	0	
4/14/2021	Pond E	107	N/A	900226001686727	1	
4/14/2021	Pond E	110	N/A	900226001686368	0	RECAPTURE
4/14/2021	Pond E	109	N/A	900226001686510	5	
4/14/2021	Pond E	121	N/A	900226001686321	1	
4/14/2021	Pond E	104	N/A	900226001686513	2	
4/14/2021	Pond E	107	N/A	900226001686519	3	
4/14/2021	Pond F	120	N/A	900226001686740	0	
4/14/2021	Pond F	112	N/A	900226001686621	1	
4/14/2021	Pond F	110	N/A	900226001686742	5	
4/14/2021	Pond F	115	N/A	900226001686702	1	
4/14/2021	Pond F	103	N/A	900226001686654	4	
4/14/2021	Pond F	114	N/A	900226001686550	3	
4/14/2021	Pond F	110	N/A	900226001686673	1	
4/14/2021	Pond F	100	N/A	900226001686683	1	
4/14/2021	Pond F	110	N/A	900226001686623	0	
4/14/2021	Pond F	104	N/A	900226001686559	2	
4/14/2021	Pond F	118	N/A	900226001686608	5	
4/14/2021	Pond F	96	N/A	900226001686726	0	
4/14/2021	Pond F	111	N/A	900226001686659	2	
4/14/2021	Pond F	103	N/A	900226001686529	0	
4/14/2021	Pond F	105	N/A	900226001686501	2	
4/14/2021	Pond F	119	N/A	900226001686327	1	RECAPTURE

4/14/2021	Pond F	111	N/A	900226001686506	2	No upper caudal lobe
4/14/2021	Pond F	118	N/A	900226001686563	0	
4/14/2021	Pond F	109	N/A	900226001686700	0	
4/14/2021	Pond F	98	N/A	900226001686688	0	Small lower caudal lobe
4/14/2021	Pond F	89	N/A	900226001686657	2	
4/14/2021	Pond F	110	N/A	900226001686584	0	
4/14/2021	Pond F	105	N/A	900226001686629	0	
4/14/2021	Pond F	110	N/A	900226001686644	2	
4/14/2021	Pond F	111	N/A	900226001686541	0	
4/14/2021	Pond F	106	N/A	900226001686672	5	
4/14/2021	Pond F	109	N/A	900226001686472	1	
4/14/2021	Pond F	110	N/A	900226001686696	1	
4/14/2021	Pond F	90	N/A	900226001686718	0	
4/14/2021	Pond F	125	N/A	900226001686674	4	
4/14/2021	Pond F	120	N/A	900226001686611	5	
4/14/2021	Pond F	124	N/A	900226001686747	0	
4/14/2021	Pond F	114	N/A	900226001686571	3	
4/14/2021	Pond F	89	N/A	900226001686666	0	
4/14/2021	Pond F	106	N/A	900226001686620	1	
4/14/2021	Pond F	107	N/A	900226001686665	1	
4/14/2021	Pond F	110	N/A	900226001686500	2	
5/17/2021	Pond D	123	N/A	900226001686606	3	
5/17/2021	Pond D	120	N/A	900226001686689	1	
5/17/2021	Pond D	124	N/A	900226001686257	1	RECAPTURE
5/17/2021	Pond D	119	N/A	900226001686658	1	RECAPTURE
5/17/2021	Pond D	139	N/A	900226000349334	2	RECAPTURE
5/17/2021	Pond D	124	N/A	900226001686714	5	
5/17/2021	Pond D	130	N/A	900226001686681	1	
5/17/2021	Pond D	129	N/A	900226001686569	0	
5/17/2021	Pond D	102	N/A	900226001686553	1	
5/17/2021	Pond F	125	N/A	900226001686721	0	
5/17/2021	Pond F	115	N/A	900226001686539	3	
5/17/2021	Pond F	112	N/A	900226001686639	0	
5/17/2021	Pond F	103	N/A	900226001686599	0	
5/17/2021	Pond F	117	N/A	900226001686570	0	
5/17/2021	Pond F	105	N/A	900226001686420	0	
11/16/2021	Pond D	138	20.7	900.2260002		RECAPTURE
11/16/2021	Pond D	131	18.7	No tag		
12/17/2021	Upper FW drive	76	4.6	989.532		trap
12/20/2021	Pond D	139	20.9	900.2260002		Thin poor condition
12/20/2021	Pond D	142	23.5	No tag		Thin poor condition

Appendix C - Water Quality Spot Measurements at Fish Monitoring Locations in Martin Slough 2021

DATE	TIME (24 HRS)	LOCATION	DEPTH OF READING (ft)	DISSOLVED OXYGEN (mg/L)	TEMP (Celsius)	SALINITY (ppt)
1/13/2021	9:35	POND D STEP POOLS	0	10	11.1	0.4
1/13/2021	9:40	POND D	2	10.1	10.8	0.4
1/13/2021	9:40	POND D	0	10.4	10.9	0.3
1/13/2021	945	POND E	4	3.5	12.7	5.1
1/13/2021	9:45	POND E	0	7.4	11.6	0.1
1/13/2021	10:15	POND F	7	7.4	11.3	0.4
1/13/2021	10:15	POND F	0	7.8	12.1	0.1
1/13/2021	10:15	POND F	4	7.7	11.7	0.2
2/5/2021	9:45	SE TRIB STEP POOLS	0.5	6.88	6.8	0.3
2/5/2021	9:45	SE TRIB STEP POOLS	1	6.28	6.1	0.3
2/5/2021	9:45	SE TRIB STEP POOLS	1.5	6.05	6.1	0.3
2/5/2021	10:30	SE TRIB POND	0.5	4.97	6.8	0.2
2/5/2021	10:30	SE TRIB POND	1	5.04	6.8	0.2
2/5/2021	10:30	SE TRIB POND	2	4.89	6.8	0.2
2/5/2021	10:30	SE TRIB POND	3	4.75	6.7	0.2
2/5/2021	10:30	SE TRIB POND	4	3.73	6.6	0.2
2/5/2021	11:15	OXBOW	0.5	7.04	7	0.5
2/5/2021	11:15	OXBOW	1	6.53	6.7	0.8
2/5/2021	11:50	POND C	0.5	7.55	9.1	0.6
2/5/2021	11:50	POND C	1	6.56	9	0.9
2/5/2021	11:50	POND C	2	3.23	10.3	3.9
2/5/2021	12:35	POND C TERM CHANNEL	0.5	7.58	8.5	0.5
2/5/2021	12:35	POND C TERMCHANNEL	1	7.15	8.2	0.6
2/5/2021	12:35	POND C TERM CHANNEL	2	4.26	9.9	11.4
2/24/2021	11:45	SE TRIB STEP POOLS	0.5	8.08	10.2	0.2
2/24/2021	11:45	SE TRIB STEP POOLS	1	7.87	10	0.2
2/24/2021	11:45	SE TRIB STEP POOLS	1.5	7.42	9.4	0.3
2/24/2021	10:30	SE TRIB POND	0.5	5.57	10.3	0.2
2/24/2021	10:30	SE TRIB POND	1	5.63	9.8	0.2
2/24/2021	10:30	SE TRIB POND	2	5.59	9	0.2
2/24/2021	10:30	SE TRIB POND	3	3.56	8.4	0.2
2/24/2021	10:30	SE TRIB POND	4	3.08	8.4	0.2
2/24/2021	11:15	OXBOW	0.5	7.75	10.1	0.2
2/24/2021	11:15	OXBOW	1	6.73	9.9	0.3
2/24/2021	11:50	POND C	0.5	7.74	10.8	0.5
2/24/2021	11:50	POND C	1	7.45	10.6	0.5
2/24/2021	11:50	POND C	2	6.38	11	2.6
2/24/2021	12:35	POND C TERM CHANNEL	0.5	9.25	14.6	0.4
2/24/2021	12:35	POND C TERM CHANNEL	1	7.12	10.9	0.4
2/24/2021	12:35	POND C TERM CHANNEL	1.5	6.82	10.8	1.5
2/24/2021	10:00	Pond E	0	8.3	9.4	0.2
2/24/2021	10:00	Pond E	5.5	8.3	9.4	0.2
2/24/2021	10:00	Pond D	0	9.82	9.7	0.1

2/24/2021	10:00	Pond D	4	7.5	10.7	0.7
2/24/2021	2:30	Pond F	0	9.7	11.4	0.2
2/24/2021	2:30	Pond F	3.5	9	11.2	0.8
3/17/2021	10:00	Pond D	0	10.9	8.2	0.1
3/17/2021	10:00	Pond D	5	11.1	7.3	0.1
3/17/2021	10:48	Pond E	0	9.5	8.6	0.2
3/17/2021	10:48	Pond E	3.5	8.1	8.9	0.7
3/24/2021	12:30	SE TRIB POND	0.5	5.2	10.4	0.1
3/24/2021	12:30	SE TRIB POND	1	4.39	9.3	0.1
3/24/2021	12:30	SE TRIB POND	2	4.27	9	0.1
3/24/2021	12:30	SE TRIB POND	3	4.2	9	0.1
3/24/2021	12:30	SE TRIB POND	4	4.06	8.9	0.1
3/24/2021	12:40	SE TRIB STEP POOLS	0.5	7.87	10	0.1
3/24/2021	12:40	SE TRIB STEP POOLS	1	7.78	10	0.1
3/24/2021	12:40	SE TRIB STEP POOLS	1.5	7.68	9.9	0.1
3/24/2021	12:50	SE TRIB STEP POOLS	0.5	8.54	9.8	0.2
3/24/2021	12:50	SE TRIB STEP POOLS	1	8.68	9.4	0.9
3/24/2021	12:50	SE TRIB STEP POOLS	1.5	8.68	9.5	1.7
3/24/2021	13:05	OXBOW	0.5	7.75	10.1	0.2
3/24/2021	13:05	OXBOW	1	6.73	9.9	0.3
3/24/2021	14:10	POND C	0.5	8.96	11.6	2.2
3/24/2021	14:10	POND C	1	9.23	11.4	3.3
3/24/2021	14:15	POND C TERM CHANNEL	0.5	10.55	14.1	1.2
3/24/2021	14:15	POND C TERM CHANNEL	1	9.88	13.1	4.1
4/14/2021	11:30	Pond D	0	DO ERROR	15.9	0.2
4/14/2021	11:30	Pond D	3.5	DO ERROR	14.1	0.4
4/14/2021	9:45	Pond E	0	DO ERROR	11.6	1.4
4/14/2021	9:45	Pond E	2.5	DO ERROR	13.8	1.8
4/14/2021	13:15	Pond F	0	DO ERROR	14.4	2.5
4/14/2021	13:15	Pond F	2	DO ERROR	15.2	4.6
5/4/2021	10:50	SE TRIB STEP POOLS	0.5	9.22	16.7	9.1
5/4/2021	10:50	SE TRIB STEP POOLS	1	9.08	16.2	22.5
5/4/2021	10:50	SE TRIB STEP POOLS	1.5	8.88	16.3	23.2
5/4/2021	11:45	SE TRIB POND	0.5	4.29	15.9	0.1
5/4/2021	11:45	SE TRIB POND	1	4.39	15.3	0.1
5/4/2021	11:45	SE TRIB POND	2	0.65	13.2	0.1
5/4/2021	11:45	SE TRIB POND	3	0.31	12.2	0.1
5/4/2021	12:05	OXBOW	0.5	7.83	17.3	9.7
5/4/2021	12:05	OXBOW	1	6.91	16.9	20.3
5/4/2021	13:30	POND C	0.5	9.22	19.2	18
5/4/2021	13:30	POND C	1	9.56	18.3	21.1
5/4/2021	13:30	POND C	2	9.42	16.7	23.1
5/4/2021	13:30	POND C	3	8.67	16.8	23.8
5/4/2021	13:30	POND C	3.5	8.14	16.8	24.1
5/4/2021	13:45	POND C TERM CHANNEL	0.5	12.06	19.2	15.8
5/4/2021	13:45	POND C TERM CHANNEL	1	9.76	18.1	20.3

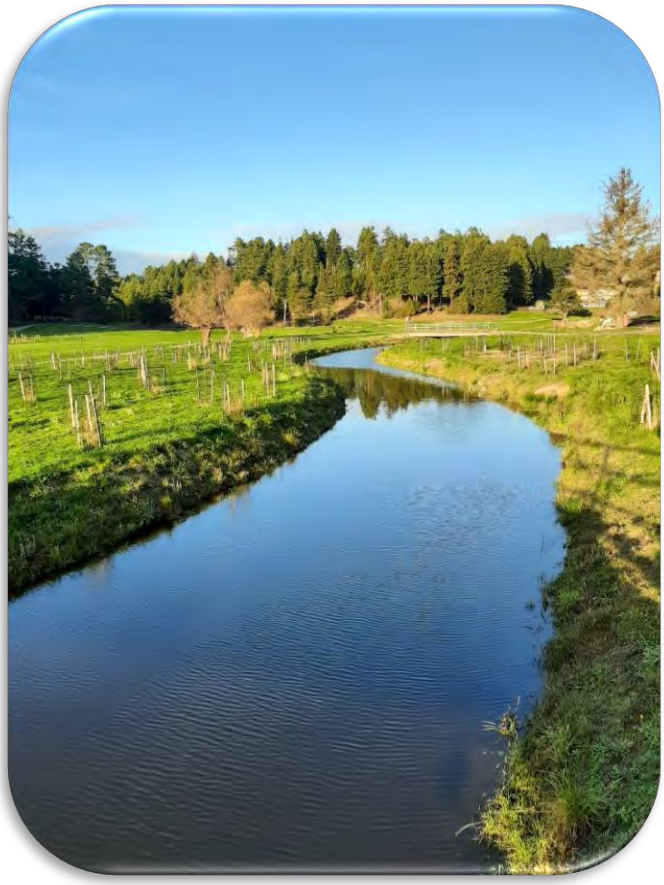
5/4/2021	13:45	POND C TERM CHANNEL	2	8.61	17.3	23.2
5/4/2021	13:45	POND C TERM CHANNEL	3	7.96	17.2	23.8
5/17/2021	9:54	Pond D	0	7.8	16.7	0.3
5/17/2021	9:54	Pond D	4.5	6.7	16.5	0.3
5/17/2021	9:54	Pond E	0	13.2	20.2	6.2
5/17/2021	9:54	Pond E	3.5	11.8	18.5	5.5
5/17/2021	9:54	Pond F	0	10.5	18.7	7.4
5/17/2021	9:54	Pond F	3.5	9.7	18.8	8.1
5/17/2021	9:54	POND D STEP POOLS	0	8.8	16.7	0.9
5/17/2021	9:54	POND D STEP POOLS	2	8.7	16.7	0.9
5/26/2021	10:30	SE TRIB STEP POOLS	0.5	9.33	17.5	10.2
5/26/2021	10:30	SE TRIB STEP POOLS	1	7.53	18.1	27.7
5/26/2021	11:25	SE TRIB POND	0.5	7.31	17.3	0.2
5/26/2021	11:25	SE TRIB POND	1	5.69	17.1	0.2
5/26/2021	11:25	SE TRIB POND	2	2.86	16.8	0.2
5/26/2021	11:25	SE TRIB POND	3	0.3	14.8	0.2
5/26/2021	11:25	SE TRIB POND	4	0.21	13.7	0.2
5/26/2021	13:10	POND C	0.5	8.17	18.3	18.1
5/26/2021	13:10	POND C	1	8.04	18.5	19.8
5/26/2021	13:10	POND C	2	7.93	19	27.5
5/26/2021	13:25	POND C TERM CHANNEL	0.5	8.49	18.4	19.2
5/26/2021	13:25	POND C TERM CHANNEL	1	8.13	18.5	21.2
5/26/2021	13:25	POND C TERM CHANNEL	2	8.07	19.4	29
11/16/2021	12:30	POND E	0.5	6.82	14.5	8.2
11/16/2021	12:30	POND E	1	6.14	13.2	10.9
11/16/2021	12:30	POND E	2	5.12	13.3	12.6
11/16/2021	12:30	POND E	3	2.15	13.8	14.7
11/16/2021	14:30	POND D	0.5	9.11	14.3	1.1
11/16/2021	14:30	POND D	1	10.43	14.4	2.1
11/16/2021	14:30	POND D	2	9.9	17.9	18.9
11/16/2021	14:30	POND D	3	8.71	18.2	22.1
11/16/2021	15:30	POND D STEPPOOLS	0.5	9.12	13.8	1.1
11/16/2021	15:30	POND D STEPPOOLS	1	9.1	13.8	1.1
11/16/2021	15:30	POND D STEPPOOLS	2	9.08	13.8	1.1
11/18/2021	12:30	POND F	0.5	6.48	10.9	5.6
11/18/2021	12:30	POND F	1	6.02	10.7	6.5
11/18/2021	12:30	POND F	2	5.93	10.8	10.6
11/18/2021	12:30	POND F	3	5.82	11.1	12.7
11/18/2021	12:30	POND F	4	5.91	11.2	13.9
11/18/2021	12:30	POND F	5	5.88	11.3	15.7
11/18/2021	12:30	POND E	6	2.18	14.2	20.8
11/18/2021	12:45	POND E	0.5	6.58	11.1	5.5
11/18/2021	12:45	POND E	1	6.14	11.2	6.6
11/18/2021	12:45	POND E	2	5.64	11.6	10.1
11/18/2021	12:45	POND E	3	5.45	11.5	13.4
11/18/2021	12:45	POND E	4	5.28	11.6	13.9

11/18/2021	12:45	POND E	4.5	2.37	14	16.3
11/18/2021	14:00	POND G	0.5	6.78	10.9	0.7
11/18/2021	14:00	POND G	1	6.15	11.4	1.3
11/18/2021	14:00	POND G	2	2.76	14.3	5.6
11/18/2021	14:00	POND G	3	0.79	16.4	18.8
11/18/2021	14:00	POND G	4	0.38	16.8	20
11/18/2021	14:00	POND G	4.5	0.27	16.7	20.8
11/18/2021	15:45	SE TRIB POND	0.5	3.38	12.1	0.1
11/18/2021	15:45	SE TRIB POND	1	3.42	12.1	0.1
11/18/2021	15:45	SE TRIB POND	2	3.35	11.8	0.1
11/18/2021	15:45	SE TRIB POND	3	2.79	11.5	0.1
11/18/2021	15:45	SE TRIB POND	3.5	2.44	11.5	0.1
11/18/2021	16:00	SE TRIB STEP POOLS	0.5	5.42	11.7	1.9
11/18/2021	16:00	SE TRIB STEP POOLS	1	3.82	11.7	15.7
12/17/2021	12:30	POND G	0.5	8.25	8.5	0.1
12/17/2021	12:30	POND G	1	8.21	7.8	0.2
12/17/2021	12:30	POND G	2	8.91	8.7	1.5
12/17/2021	12:30	POND G	3	9.71	10.7	4.3
12/17/2021	12:30	POND G	4	9.31	13.5	14.5
12/17/2021	12:30	POND G	5	1.25	15.5	18.3
12/17/2021	12:30	POND G	6	0.67	15.9	19.7
12/17/2021	12:55	UPPER FW DRIVE	0.5	7.21	8.4	0.1
12/17/2021	12:55	UPPER FW DRIVE	1	6.73	8.1	0.1
12/17/2021	12:55	UPPER FW DRIVE	2	5.57	7.9	0.1
12/20/2021	11:05	POND E	0.5	8.97	9.3	3.8
12/20/2021	11:05	POND E	1	8.95	9.2	3.8
12/20/2021	11:05	POND E	2	8.79	9.2	4
12/20/2021	11:05	POND E	3	7.69	9	6.5
12/20/2021	11:05	POND E	4	6.14	9.1	8.1
12/20/2021	11:05	POND E	4.5	6.04	9.1	9.4
12/20/2021	12:50	POND D	0.5	8.85	9.9	0.2
12/20/2021	12:50	POND D	1	8.56	9.7	0.2
12/20/2021	12:50	POND D	2	8.44	9.6	2.8
12/20/2021	12:50	POND D	3	2.17	11.8	7.8
12/20/2021	12:50	POND D	4	0.71	13.5	20.7
12/20/2021	15:00	SE TRIB POND	0.5	3.91	9.6	0.2
12/20/2021	15:00	SE TRIB POND	1	2.54	9.2	0.2
12/20/2021	15:00	SE TRIB POND	2	2.41	9.2	0.2
12/20/2021	15:00	SE TRIB POND	3	2.24	9.1	0.2
12/20/2021	15:00	SE TRIB POND	4	1.74	8.9	0.2
12/20/2021	15:15	SE TRIBUTARY	0.5	9.71	10.1	5.9
12/20/2021	15:15	SE TRIBUTARY	1	9.24	9.8	10.4
12/20/2021	15:15	SE TRIBUTARY	2	8.93	9.6	16.5
12/20/2021	16:00	POND C	0.5	11.2	10.5	6.6
12/20/2021	16:00	POND C	1	9.29	9.5	15.3
12/20/2021	16:00	POND C	2	8.91	9.5	18.2
12/20/2021	16:00	POND C	3	8.28	9.7	18.8

Appendix D - 2021 Physical Monitoring Report by Michael Love & Associates

Martin Slough Enhancement Project
2021 Physical Monitoring Report

Eureka, California



December 2021

Prepared for:

Redwood Community Action Agency

Prepared by:

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2021 Physical Monitoring Report
Martin Slough Enhancement Project

Eureka, California

Prepared for:

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Division of Natural Resource Services
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December 2021

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1 INTRODUCTION

1.1 Purpose of Report

This report summarizes water year 2021 performance monitoring of topography, hydrology, and water quality conditions for the Martin Slough Enhancement Project in Eureka, California. It also includes field observations and recommendations.

1.2 Background

Martin Slough is part of the Elk River watershed, which is part of the larger Humboldt Bay ecosystem. Martin Slough has been identified by the California Department of Fish and Wildlife as playing a key role in the life cycle of Coho Salmon, providing ideal rearing habitat for juvenile coho. In 2006 the Elk River watershed, including Martin Slough, was listed under the Clean Water Act as impaired for sediment and siltation, citing impaired water quality, impaired spawning habitat, and increased depth of flooding due to sediment. In response to these stressors, the Martin Slough Enhancement Project was developed with the goal of enhancing fish habitat for endangered Coho Salmon and reducing the extent and duration of flooding.

The project area encompasses two properties; 40 acres of pasture owned by the Northcoast Regional Land Trust (NRLT) and 120 acres upstream of the NRLT property owned by the City of Eureka and operated as the Eureka Municipal Golf Course. The project was initiated in 2001 when RCAA and partners began preparing a feasibility study, which was completed in 2006. Between 2007 and 2014, Michael Love & Associates, Inc. (MLA) and GHD Inc developed designs for new tide gates, enhanced slough channel, new tidal marshes, and off-channel brackish and freshwater ponds. Construction of the project has been phased, with the first phase implemented in 2014 and the last phase of implementation completed in October of 2021.

1.3 Project Purpose

While not much is known relative to the historical composition of the lower portions of Martin Slough prior to construction of the existing dikes, it is apparent from its elevation relative to tidewater and its geomorphic features that the lower portions of Martin Slough consisted of estuarine habitat, likely composed of some salt marsh and slough channels along with other more brackish and freshwater habitats. Existing limiting factors that have been identified in Martin Slough include obstructed fish access, poor fish habitat, poor sediment routing, lack of riparian habitat, and frequent prolonged flooding that has a negative economic impact on current land uses.

The purpose of the Martin Slough Enhancement Project is to improve aquatic and riparian habitat and reduce flooding of pasture and golf course greens throughout the project area. Specific goals of the project include the following:

1. Improve fish access from Swain Slough into Martin Slough,
2. Reduce flood impacts to current land use,
3. Improve sediment transport,
4. Increase the amount of riparian corridor and riparian canopy,
5. Improve water quality (increased circulation, decrease nutrient inputs, decrease sedimentation),

6. Increase the extent of the estuarine ecotone in Martin Slough, providing a gradual transition from brackish water to freshwater habitats, and
7. Enhance and create low-velocity off-channel/backwater habitats.

1.4 Project Phasing

Following completion of the project planning elements, implementation of the project occurred in phases due to funding constraints and the logistics associated with implementing the entire project. The project components and phases are shown in **Figure 1**.

1.4.1 Phase 1 – Tide Gate Replacement

Replacement of the Martin Slough tide gates was accelerated due to the dilapidated state of the existing gates. In 2014, the dilapidated tide gates at the confluence at Swain Sloughs were replaced with a new tide gate system that includes two Muted Tide Regulators (MTRs) designed to allow a limited amount of tidal water into the project area. This is considered Phase 1 of the project. With most of the project completed at the end of 2020, the MTR gates were adjusted in October 2020 to allow the intended muted tide into the upstream project reaches. The majority of the muted tide flows into Martin Slough through the 6 ft x 6 ft MTR side hinged gate. Once this larger MTR gate closes additional tidal inflow comes through the 2 ft x 2 ft auxiliary gate, which closes at the set maximum tidal inundation elevation.

1.4.2 Phase 2- NRLT Property

Over the summer and fall of 2018 channel and off-channel enhancements were constructed on the NRLT property (Phase 2). The work included: enlarging approximately 3,000 feet of the Martin Slough channel to accommodate the design muted tidal prism (volume), constructing 3.05 acres of tidal marsh plains (Marsh Plain A and B), 1.7 acres of brackish marsh (Pond C), a new Southeast Tributary channel and terminal freshwater pond, replacing two undersized culverts to improve fish passage through the historical channel meander, installation of log weirs on the Southeast Tributary and woody instream habitat structures, and installation of a bridge over the mainstem of Martin Slough. Revegetation of native wetland and salt marsh plants in restored areas occurred over the winter/spring of 2019. The 2019 Physical Monitoring Report detailed the post project conditions.

1.4.3 Phase 3 – Downstream of Fairway Drive

Phase 3 of the project was constructed during the summer and fall of 2019 on the Eureka Municipal Golf Course downstream of Fairway Drive. Phase 3 consisted of enlarging approximately 1,000 feet of Martin Slough mainstem channel (Reach 4 and 5), enlarging an existing tributary pond (Pond D), installation of 8 log weirs on the tributary downstream of Pond D, installation of 7 woody instream habitat structures and a rock grade control structure in Pond D, and construction of one vehicle bridge across Martin Slough.

1.4.4 Phase 4 – Extending upstream to North Fork Tributary Confluence

Phase 4 of the project was constructed in summer and fall of 2020 and included enlarging and realigning 1,800 feet of the Martin Slough channel from just downstream of Fairway drive to the North Fork Tributary confluence (Reach 6 and lower portions of Reach 7), construction of Pond E and Pond F, and construction of one vehicle bridge across Martin Slough. A temporary rock grade control was installed immediately downstream of the North Fork confluence.

1.4.5 Phase 5 – Pond G and Upstream Limits of Project

The remaining project elements were constructed in 2021. This includes Pond G on the North Fork and final grading of the North Fork channel and marshes, and completion of the upstream-most portion of Reach 7 along the mainstem of Martin Slough which included installation of 6 log weirs. A temporary salinity barrier was installed immediately downstream of the North Fork confluence and is planned for removal once the golf course completes its planned irrigation water supply improvements.

1.5 Physical Monitoring Goals

The goal of project monitoring is to ensure the project is functioning as intended and to provide a means of identifying any shortcomings in project performance to allow for adaptive management as needed.

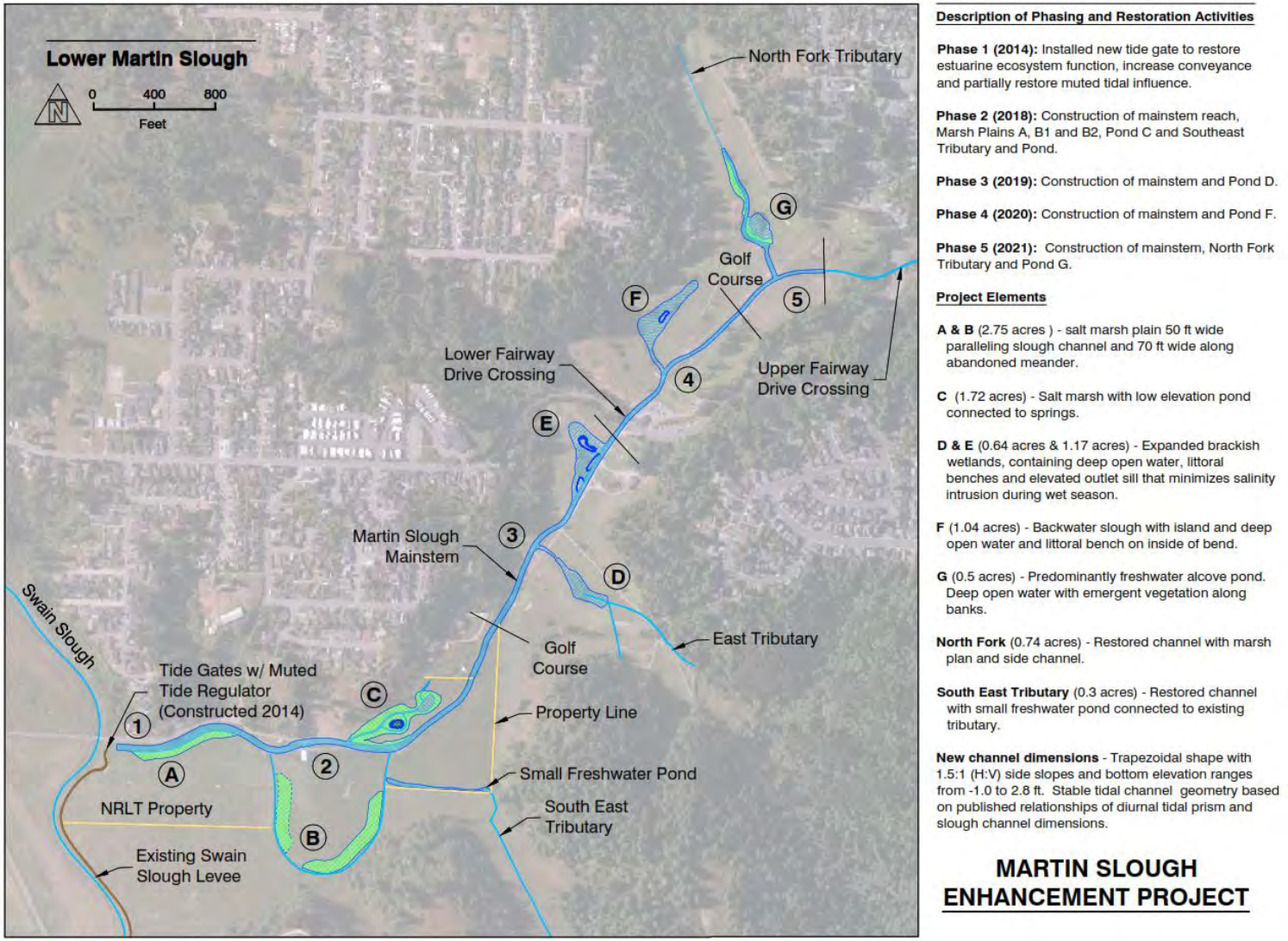


Figure 1. Overview of Martin Slough Enhancement Project. Phase 1 (2014) comprised of tide gate replacement, Phase 2 (2018) comprised of Mainstem channel, Marsh plain A, B, Pond C, and the Southeast tributary on NRLT Property, Phase 3 (2019) included Mainstem channel and Pond D on the Golf Course property, Phase 4 (2020) included mainstem channel and Ponds E and F, and Phase 5 (2021) included Pond G the mainstem and North Fork channel and a temporary Salinity Barrier.

2 MATERIALS AND METHODS

The following physical parameters, as defined by NOAA Restoration Center (NOAA, 2003), are being monitored as part of the Martin Slough Enhancement Project: (1) hydrology, (2) water quality, and (3) topography. Vegetation and fisheries-use are also parameters being monitored for the project and are reported in separate reports. The hydrologic and water quality results are generally organized by water years, which start October 1st and end September 30th. This report is providing monitoring results and findings for water year 2021.

The Martin Slough Enhancement Project Monitoring Plan (RCAA 2021) provides performance and success criteria to evaluate whether the project is performing as intended. With the project fully completed at the end of water year 2021, and the introduction of the intended tidal amplitude, tidal prism, hydrologic circulation, and water quality conditions at the beginning of water year 2022, future monitoring results will be compared to the project performance and success criteria. For water year 2021, monitoring of the three parameters (topography, hydrology, and water quality) will be used to assess interim water quality conditions, evaluate inundation of revegetated wetland areas, and identify areas experiencing topographic changes and determine the causes of those changes.

2.1 Topographical Parameter

The objectives of monitoring topography parameter is to monitor persistence of, and identify changes in, post-construction topographic conditions. As scheduled in the Martin Slough Enhancement Project Monitoring Plan (RCAA 2018), topographic monitoring occurs at the end of years 1, 3 and 5 as funding is available. Topographic monitoring was completed for water year 2019 for the portions of the project constructed on the NRLT (Phase 2). This report covers topographic monitoring for water year 2021 and completes Year 3 monitoring for Phase 2 and Year 1 monitoring for Phases 3-4. Phase 5 is currently at Year 0.

Topographic features were measured using standard survey methods conducted with a robotic total station and with Real Time Kinematic (RTK) methods. Horizontal datum was State Plane Zone 1 feet and the vertical datum was NAVD88 using benchmarks established during construction. Channel change including channel width will be quantified using 10 cross sections established in the Phase 2 reach of the mainstem, meander, and ponds and 10 cross sections established on the golf course (Phase 3-5). Each cross section was monumented for future relocation using rebar with aluminum cap that read "RCAA MONITORING" and a unique ID stamped into the cap. The rebar and aluminum caps were placed at the left and right bank of each cross section and set flush with the ground. A rebar with Plastic cap was used for Pond D and for the Right bank marker at Cross section 9 and 10. **Appendix A** contains coordinate data and location descriptions for each pair of cross section monuments. To evaluate reach-wide channel adjustment, including scour and aggradation, a longitudinal thalweg profile of the mainstem Martin Slough channel bottom and ponds was surveyed. The thalweg survey and wetted portions of the cross-section survey were conducted using a small oar boat.

Cross section and profile survey data was processed and compared to the "Year 0" condition. Year 0 topographic data is based on the As-Built and design surfaces provided by GHD in AutoCAD Civil 3D. This data was supplemented with survey data collected while conducting grade checks during construction; specifically, the mainstem channel between stations 2+25 and 9+00, including Marsh

plain A, and the Marsh plain B1 and B2 areas along the meander, and weir crest elevations for Pond D and at the upstream transition to the undisturbed channel.

Large wood features placed in Phase 2-4 were visually inspected at the conclusion of water year 2021 and wood structures for Phase 5 were inspected during construction. These included large wood cover structures throughout the constructed project and log weirs installed at Pond D. The inspection focused on determining if any of the wood had moved, if any steel anchors were loose or corroded, and if any undesirable scour induced by the structure had occurred.

2.2 Hydrology Parameter

The objectives of monitoring hydrology of the project are to measure water level fluctuations relative to tidal influence within the project area to:

- Evaluate the extent to which the project muted tides match the design muted tidal ranges
- Assess flow conveyance (in both directions) through the project reaches, and
- Assess whether the higher muted tides (spring tides) during the dry season are remaining within acceptable ranges and not inundating adjacent pasture (NRLT) and greens (Eureka Municipal Golf Course).

Results from the monitoring can be used to guide adjustments to the tide gate MTRs (Muted Tide Regulators) and identify if any flow constrictions are affecting project performance.

2.2.1 Water Level Monitoring

The methods used to monitor project hydrology consisted of installation of submersible water level loggers in four locations throughout the project reaches, three on the mainstem of Martin Slough and one on the North Fork Tributary. The loggers measure the hydrostatic pressure above the sensor and is corrected using recorded atmospheric pressure to calculate the stage, or water level, in 15-minute intervals. Each monitoring station consists of a perforated PVC standpipe secured to a T-post or other stable feature. The data logger is placed at the bottom of the standpipe and connected with a cable or cord to the cap for retrieval. A reference benchmark was established at each site and surveyed to convert water levels to water surface elevations in North America Vertical Datum 1988 (NAVD88). The data loggers were downloaded approximately every two months by RCAA staff and serviced or repaired as needed. At least one water level observation was made during each download period to calibrate the recorded data to the reference benchmark, placing all water level data into the NAVD88 vertical datum.

Stage data was recorded after Phase 1 completion starting in March 2017, expanded after Phase 2 completion and expanded further following implementation of Phase 3. The following monitoring stations/locations were maintained during water year 2021 (**Figure 2**). Dates of gage installations and periods when data loggers were removed for servicing are provided in **Table 1**.

Phase 1

Property Line: Middle Reach of Martin Slough on NRLT property, near the property line with the Eureka Municipal Golf Course, a water level gage was installed in Martin Slough on March 14, 2017 and was in operation through July 11, 2018, when it was removed for construction of Phase 2. This gage has been discontinued and was replaced by the Hole 18 (MS-18) gage after construction in 2018.

Swain Slough: In Swain Slough near the tide gate a water level logger was installed on February 11, 2018 and remains operational.

Phase 2

MS-Pond C: Lower Martin Slough on NRLT property, a water level logger was installed in Martin Slough, upstream of the confluence with Pond C on December 17, 2018 and remains operational.

MS-18 (Hole 18): Middle reach of Martin Slough on the Golf Course property, a water level logger was installed in Martin Slough between Hole 17 and 18 (downstream of Pond E) on the golf course on November 19, 2018 and removed on October 22, 2019 for Phase 3 construction. Following Phase 3 construction this water level logger was reinstalled on November 5, 2019 to the newly constructed vehicle bridge and remains operational.

Phase 3

MS-NF: Upper reach of Martin Slough, a water level logger was installed in Martin Slough downstream of the North Fork Tributary confluence on the golf course on November 5, 2019 and removed on September 9, 2020 for Phase 4 construction. They were reinstalled in December 2020, moving the station to a bridge on the North Fork Tributary just downstream of the existing irrigation pond and future Pond G. The gage was removed from May and June of 2021 to November 2021 for maintenance and construction of Phase 5. The gage remains in the North Fork tributary and remains operational.

Table 1. Water year 2021 dates of water level logger installations and periods data loggers were out for servicing.

Gaging Station	Data Type	Operation	Removed	Purpose
Atmospheric	Stage	2021	9/18 to 12/14/20	Maintenance
Swain Slough	Stage	2021	9/25 to 10/2/20	Maintenance
Pond C	Stage	2021		
	Salinity Surface	2021	8/4/21 to 9/4/21	Maintenance
	Salinity Bottom	2021		
MS-18	Stage	2021	3 weeks 10/20 to 11/20	Maintenance
	Salinity Surface	2021	7/21/21 to 9/4/21	Maintenance
	Salinity Bottom	2021		
MS-NF (North Fork Tributary)	Stage	3/21/21 to present	5/19 to 11/12/21	Construction / Maintenance
	Salinity Surface	12/14/20 to present	6/28 to 11/12/21	Construction
	Salinity Bottom	12/14/20 to 3/10/21	3/10/21	Faulty Logger

2.2.2 Tidal Datums

Humboldt Bay experiences semidiurnal tides: two high tides and two low tides per day. The tidal datums of Mean Higher High Water (MHHW), Mean Lower High Water (MLHW), Mean Higher Low Water (MHLW), Mean Lower Low Water (MLLW), and sometimes Mean Tide Level (MTL) are used for designing and evaluating performance of tidal restoration projects. A key metric in sizing and maintaining tidal channel geometry is the average tidal prism, which is defined as the volume of water that drains between MHHW and MLLW.

The tidal datums (in NAVD88) from the Humboldt Bay North Spit NOAA Station No. 9418767 were used as a reference for unmuted tidal conditions. Tidal datums for each monitoring station were calculated on a per-month basis and seasonally using the measured water levels. A spreadsheet algorithm was used to identify the daily MHHW, MLHW, MLLW, and MHLW and calculate the monthly averages.

2.2.3 Tidal Prism

The volume of tidal water exchanged between MHHW and MLLW defines the tidal prism. It is a key parameter in the design and self-sustainability of the project. Though Martin Slough receives freshwater inflows, the hydraulic geometry of the tidal channel of Martin Slough will be governed by the daily tidal flux created by the muted tide rather than less frequent high flow events from upstream. The daily tidal prism is a governing factor in the dimensions of the channel, and a

significant reduction in the tidal prism could cause sedimentation and a decrease in the channel cross-sectional area. Changes in MHHW or MLLW during the dry season would suggest a change in tidal prism, and may require changes in tide gate settings to restore the intended tidal prism and maintain geomorphic stability of the tidal channels.

2.3 Water Quality Parameter

The objectives of monitoring water quality parameters are to measure salinity, dissolved oxygen and water temperature to assess sufficiency of water quality for target habitat and species and ensure that salinity does not extend upstream to the golf course irrigation pump intake, when in use. The methods used to measure water quality parameters consisted of installation of temperature and salinity data loggers at the same locations as the water level loggers (salinity loggers were not installed at Swain Slough).

Two salinity data loggers, which also record water temperature, were installed in each perforated standpipe; one at the bottom coupled to the water level logger and one attached to a float that travels the height of the standpipe and measures conditions approximately 10 inches below the surface. Salinity and temperature were recorded continuously on the same 15-minute interval as the stage data loggers. Salinity data loggers were not installed at the Swain Slough station, but Swain Slough water temperatures were recorded by the water level logger placed at the bottom of the water column. Spot measurements of salinity, temperature and dissolved oxygen were also taken using a YSI handheld meter and recorded on data sheets when the data loggers were downloaded, which typically occurs at a low tide. Additional water quality measurements were taken as part of the fisheries monitoring, as covered in a separate monitoring report.

The four salinity loggers installed at Pond C and MS-18 gage stations were loggers that record a range of salinity between 0 and ~12 ppt, much lower than is commonly found in marine environments. This was done to examine the lower salinity levels that impact salmonid usage. At the end of the WY 2021 monitoring season theses loggers were exchanged for full range salinity loggers. Dates of installation of water quality instruments and periods when data loggers were removed for servicing are provided in Table 1.

Figure 2. Overview of Phases 1 through 5, and location of stage and water quality monitoring stations (image from Google Earth, Oct. 2019).

3 RESULTS AND DISCUSSION

3.1 Topography

To quantify any changes to the channel shape and assess potential sedimentation or scour, annual surveys are planned for years 1, 3 and 5 of each phase of construction as funding allows. Year 1 topographic monitoring was conducted in 2019 for Phase 2. No topographic monitoring was conducted in 2020. This effort covers topographic monitoring for Phase 2 (Year 3), Phase 3 and 4 (Year 1) and Phase 5 (Year 0).

3.1.1 Thalweg Profile

Surveyed points along the channel bottom were referenced to the design alignment, where stationing represents distance upstream of Swain Slough (see Topographic Data **Appendix A**). The survey data shows the Year 0 profile derived from the As-built/design surface as described above, the Year 1 data for Phase 2 through 4, and Year 3 data for Phase 2. Note that the Phase 5 (upstream most portion) is surveyed Year 0 data rather than from As-Builts. The profile survey covered the entire project reach from the tide gate and into the undisturbed channel upstream of the project. The recently constructed section of the North Fork Channel and Ponds C, D, E, F and G were also surveyed. The mainstem profile plot is shown in **Figure 3** and all of the profiles are in **Appendix A**.

Phase 2 Comparison

With the exception of two locations, the Phase 2, Year 1 thalweg was at or slightly lower than design elevations. For the channel reach between Station 15+00 and 25+00 the surveyed thalweg is about 0.3 feet lower than the design grade. It is uncertain if this is from the original grading of the channel or due to scour over the course of Year 1. The Year 3 survey indicates that it is slightly lower suggesting the possibility of some minor scour and downcutting.

Two notable areas of sedimentation warrant further investigation: Station 14+00 and 27+50. The high spot along the profile at Station 14+00 is approximately 1.8 feet above the design grade. This is located immediately upstream of the new bridge and sheet pile retaining wall at the NRLT barn. A section of the right bank has slumped into the channel, as observed at low tide (**Figure 5**). High groundwater along the base of the adjoining hillslope appears to be driving the instability. During construction this area was recognized as unstable, and some short pieces of sheet pile were driven into the bank at the slump. The Year 1 survey revealed a high spot in the channel and the Year 3 survey show that some material is still present. While a more detailed survey of the reach is needed to ascertain how much of the high spot persists in the channel, the recent photo suggests it has not changed significantly.

The second area of note is at Station 27+50, located just downstream of the property line with the golf course. At this location there appears to be approximately 1.5 feet of sedimentation along 50 feet of the channel and then a deep section of channel upstream of the sedimentation. This location coincides with the Phase 2 temporary grade control. This grade control was constructed of rock, and was removed as part of Phase 3 construction in summer of 2019. The over deepened channel section around Station 30+00 was where the rock and sedimentation were removed. The area of sedimentation around Station 27+50 appears to be the tailout from the scour pool downstream of the Phase 2 grade control. This area was beyond the reach of the excavator during the removal of

the grade control, and therefore the sediment was left in place. Based on Year 3 survey the material appears to be persistent and flows and tidal action has not transported this material downstream.

Phase 3-5 Comparison

The Year 1 thalweg profile for Phases 3 and 4 and the Year 0 profile for Phase 5 shows that the channel bed is approximately 0.5 feet below the design elevation. This is believed to be associated with over excavation of the channel during construction, and not due to channel downcutting during the first-year post-construction. The high spot in the channel profile at Station 59+00 is associated with the temporary grade rock control that is part of the temporary salinity barrier, slated for removal following planned changes to the golf course's water supply system.

Spot checks during the 2021 construction season show that the Pond D log weir crests and the upstream log weirs are 0.5 ft lower than as shown on the design plans. The drop and spacing between weirs are per plan.

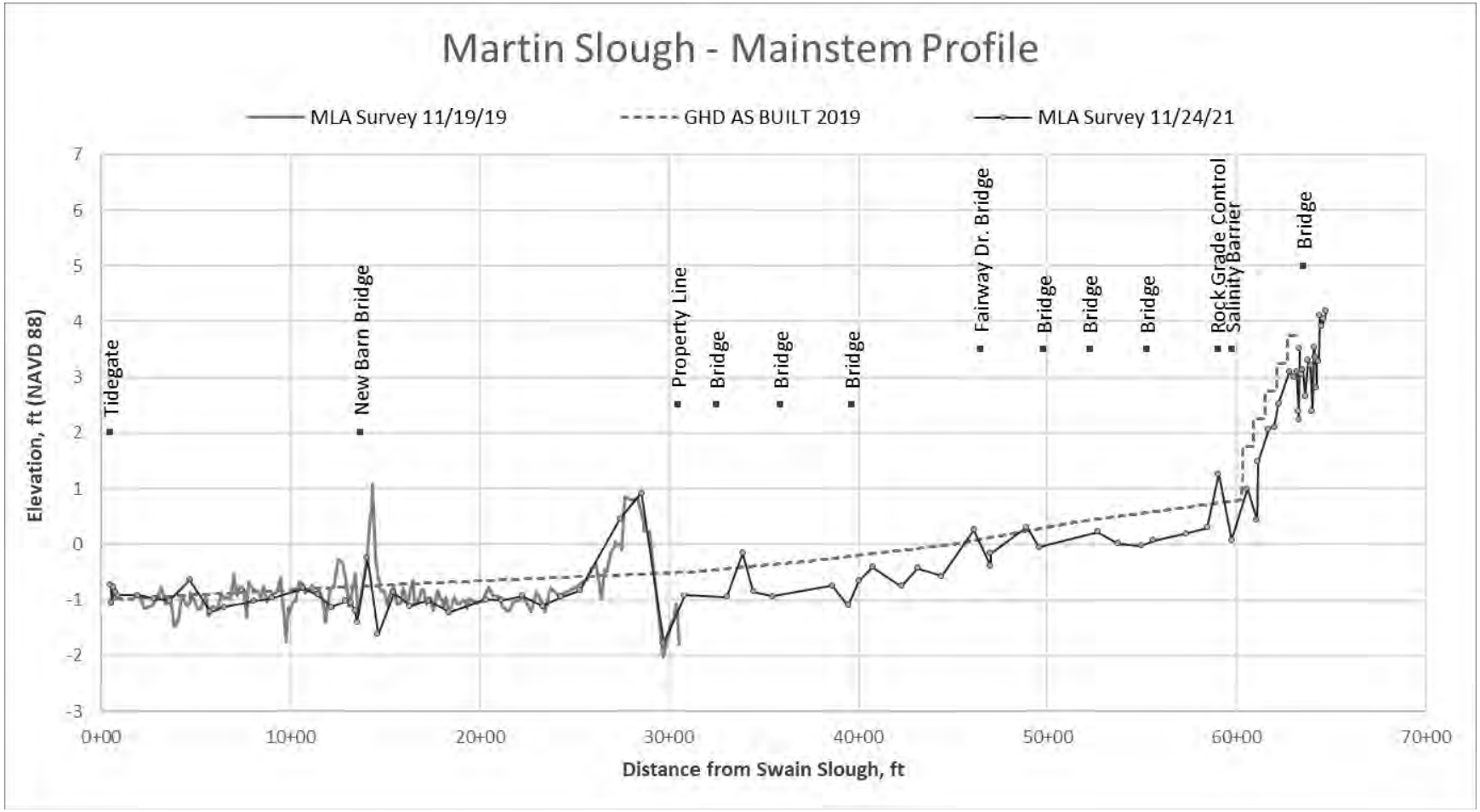


Figure 3. Mainstem channel profile showing the As-Built/Design Condition (Year 0), the Phase 2-4, Year 1 condition and the Phase 2 Year 3 condition. The two high spots in Phase 2 Year 1 at the Barn and Property line are still present in Year 3.

3.1.2 Cross Sections

Cross section locations, descriptions of the benchmarks for each section, and plots of surveyed sections are provided in **Appendix A**.

Phase 1 Year 3

Cross sections 1 through 5, Meander 1 and 2, Pond C and the Southeast Tributary represent Phase 2 constructed in 2018. Mainstem cross sections 1, 2, 4 and 5 do not show significant change from Year 1 to Year 3. Note that the right bank of the mainstem (looking downstream) was left undisturbed during construction and is not accurately represented in the "As-Built" condition shown in the sections. The Pond C cross sections do not show significant change from year 1 to year 3. Mainstem Cross Section 3 and Meander Section 2 show some adjustment to the bank and channel bottom respectively as discussed below.

The Southeast Tributary Pond shows approximately +0.3 ft difference in the 1- and 3-year pond bottom. This could indicate some sedimentation but is more likely explained by normal variance in the survey due to the soft bottom material of the pond.

Phase 3, 4 Year 1

Cross sections 6 through 9 and Ponds D, E and F represent Phase 3 and 4 on the Golf Course as constructed in 2019, and 2020, respectively. There were no noteworthy changes to the channel shape at the cross sections after the first year after implementation. However, the sections 6, 7 and Pond E and F show the channel bottom was constructed approximately 0.5 to 0.7 feet lower than the design channel grade.

Area Below Design MHHW

The cross-sectional area below the design MHHW of 5.5 feet (NAVD88) was calculated for each cross section and is provided in **Table 2**. The Year 1 areas will be used as a baseline for comparison following resurvey of the sections during subsequent monitoring years. A 10-percent increase or decrease in area will warrant further evaluation.

Table 2. Phase 2 (Year 1 and 3) and Phase 3-4 (Year 1) area below design MHHW of 5.5 feet (NAVD88) for surveyed cross sections.

Cross Section	Area Below Design MHHW (square feet)		
Phase 2	**Year 1 (2019)**	**Year 3 (2021)**	**% Change**
MS 1	179.0	178.9	-0.06 %
MS 2	144.5	150.7	4.29 %
MS 3	160.6	178.9	11.39 %
MS 4	156.7	160.8	2.62 %
MS 5	118.5	119.5	0.84 %
Pond C1	84.8	80.5	-5.07 %
Pond C2	427.4	429.1	0.40 %
M1	71.7	74.5	5.04 %
M2	65.4	76.3	18.13 %
SE1	52.7	51.0	-3.23 %
Phase 3-4	**Year 1 (2021)**		
MS 6	140.5		
MS 7	134.9		
MS 8	104.3		
MS 9	69.1		
MS 10	10.7		
D1	234.6		
Pond E	334.0		
Pond F	164.3		

Changes in area that are positive represent and enlarged channel and negative values represent a channel area that has been decreased. For this study the assumption is that an enlarged channel is the result of scour, erosion or transport of stored sediments, and a decreased area indicates material has been deposited.

Mainstem Cross Section 3 shows an increase of 11.39% to the cross-sectional area. Cross Section 3 is located just downstream of the sheet pile installation at the new Barn Bridge, in an area that was slumping and excessively wet from seeps. The current survey was compared to the section data with the Year 1 survey (**Appendix A**). The channel bottom is unchanged while the left and right banks show some widening along the lower portion. This could be associated with the channel eroding in response to material that originally slumped in from the right bank shortly after construction, and thus the channel is widening towards a more stable cross-sectional area similar to the design cross sectional area. A low tide observation or a survey that provides more detail along the lower banks would clarify conditions.

Meander Cross Section 2 (M2) shows an increase of 18.13% to the cross-sectional area. The current survey was compared to the section data with the Year 1 survey (**Appendix A**). The channel appears to have deepened and widened slightly toward the left bank. Some of the increased area is along the

top of bank. Meander Cross Section 1 (M1) also shows signs of channel enlargement, but to a lesser degree. In general, it appears that the meander channel has been enlarging in response to the increased tidal prism associated with Marshplain B. It is expected that this widening will slow or stop over the next two years. A more detailed survey would clarify the extent of any widening.

3.1.3 Mainstem Channel Condition

A high spot in the channel caused by a slumping bank was identified during the Year 1 survey of Phase 2. This is located immediately upstream of the new bridge and sheet pile retaining wall at the NRLT barn. A section of the right bank appears to be slumping into the channel when observed at low tide, and there are numerous seeps emerging from the adjacent hillside (**Figure 5**). High groundwater along the base of the adjoining hillslope appears to be driving the instability. Observations made during low tide on December 14, 2021, confirm that the instability is still present although the extents of the slump appear to be relatively unchanged when compared to observations in 2019.

The high spot near the property line was also identified in the Year 1 survey of Phase 2. The Year 3 survey found that it remains unchanged. Water level data from upstream and downstream of this high point suggests that the high point in the channel is not causing any reducing in flow conveyance.

The channel alignment at the upstream end of the project is causing some scour along the right bank of the upstream most log weir (**Figure 4**). This condition may improve as the upstream channel adjusts to the downstream weir elevations. This area should be monitored and may requires some minor bank stabilization measures.

Figure 4. Upstream of the last weir where the project transitions back to the undisturbed channel. Alignment of the channel is creating some bank scour along the right bank.

3.1.4 Southeast Tributary Channel Condition

The Southeast (SE) Tributary is intended to be predominately freshwater off-channel habitat for salmonids. The previous monitoring effort included a cross section (XS SE Trib 1) through the SE Tributary Pond. Due to concerns regarding the growth of grass within the SE Tributary and the potential for sediment accumulation due to the vegetation, a longitudinal profile (SE Trib 1 Profile) was added to the 2021 survey effort.

The SE Tributary cross section and longitudinal profile are provided in Appendix A. The cross section indicates potentially up to 0.4 feet of sedimentation in the deepest point of the pond. The profile shows that the channel grade, which is controlled by seven log steps, appears to have been constructed up to 0.5 feet below design grade (represented by the as-built surface). Additionally, the as-built surface did not include the pools that were excavated below each log step. The 2021 survey shows that these pools are maintaining approximately 1 to 2 feet of depth, with the lower pools having more depth and volume. This is likely due to the daily draining of the tide and resulting scouring forces that maintain these lower pools combined with the lack of vegetation due to higher salinity that prevents grass growth. The profile does not indicate any notable aggradation has occurred. Subsequent surveys will be useful for tracking any changes to the channel profile associated with grass.

3.1.5 Elevation Discrepancy

The topographic survey data consistently show a discrepancy between the design grade and finished grade elevation of approximately -0.5 feet throughout the Phase 3-5 construction, as can be seen in the surveyed channel profile and cross sections within these phases of the project. This discrepancy was confirmed with grade check surveys in the field during the 2021 construction season. In addition, it was concluded that the existing fairway ground elevation is approximately 1 foot lower than what is shown in the original topography that was based on photogrammetry and provided to the project by the City of Eureka (circa 2001), which the design elevations are based on.

3.1.6 Inspection of Large Wood Structures

The large wood structures were inspected on November 23, 2021 to ensure they were stable and functioning as intended. All structures (Log Cover Structures, Rood Wad Deflectors, and Root Wad Habitat Structures, Log Constrictors, Log Weirs) appeared stable and show no signs of shifting since constructed. Wood features located in the middle of Pond D, E and F were observed from a boat during the profile survey. All anchor points appeared sound.

The previous monitoring report (2020) indicated that there was visible erosion against pile logs associated with the log weirs between Pond D and the mainstem Marin Slough channel. This is a common location for erosion to develop during the first year following construction due to difficulty compacting the soils behind the logs and the lack of well-established vegetation. During the 2021 construction season RCAA staff filled and compacted the voids with facing class rock mixed with soil and gravel. The log weirs constructed as part of Phase 5 in 2021 at the upstream end of the project were modified to include additional rock protection at the piles and downstream plunge pool to protect the piles from scour.

Live willow stakes were also installed on the bank near the bridge at Pond D to stabilize some minor bank erosion observed during the first year following construction.

2020 field discussions with RCAA concluded that the Pond D Training Logs on the weirs were too long and should be cut at 12-18 inches from the anchor bolt on the Training Log. The contractor cut the training logs in November, 2021.

(a)

(b)

Figure 5. Bank slumping along the right side of the channel immediately upstream of the new bridge and sheet pile retaining wall, as seen (a) in December 2020 and (b) in December 2021 at low tide.

3.2 Hydrology

3.2.1 Muted Tide Regulator (MTR) Settings and Target Water Levels

During water year 2021 the muted tide in Martin Slough was controlled using the 6-foot by 6-foot side hinge gate and associated MTR in combination with the 2-foot by 2-foot auxiliary door (slide gate) connected to its MTR. Both MTR float-switches are located on the upstream side of the tide gate. The 6-foot by 6-foot MTR gate was set to close when water levels in Martin Slough reach approximately 3.25 feet (NAVD88). The auxiliary gate closes when the inside Martin Slough water levels approached elevation 5.2 feet. This elevation appears to vary by several tenths of a foot from one tide cycle to the next.

3.2.2 Water Level Observations

Water level data, combined with salinity and water temperature data, was plotted for each month of the 2021 water year and are provided in **Appendix B**.

Swain Slough Water Levels

Swain Slough water levels fluctuated similar to those recorded at the NOAA North Spit tidal station (No. 9418767), except that the water level never dropped below 1.0 feet. Two conditions affect this; 1). The gage is located in an outlet scour pool below a drainage flap gate, and the pool becomes disconnected from Swain Slough at the lowest tides in Swain Slough, and 2) A tidal sill located on Elk River downstream of the confluence with Swain Slough results in the lowest tide levels being between elevation 0.5 to 1 foot (NAVD88). This tidal sill was noted in NOAA's historical Elk River tidal station.

Martin Slough near Pond C Water Levels

The plots of Martin Slough water levels at the Pond C gage show water level fluctuating as expected, with the distinct signature of a muted tide that peaks just above elevation 5 feet (NAVD88) and does not drop below an elevation of 1 foot. Peaks appear to max at about 5.5 feet, with an occasional peak just above 6 feet and the highest peak of 6.9 feet on January 28, of 2021. Peaks above 5.5 feet typically occur over one or two days associated with elevated streamflows due to rainfall events.

Martin Slough near Hole 18 Water Levels

The Hole 18 monitoring station (MS-18) is located in Martin Slough, on the golf course vehicle bridge located approximately 500 feet downstream of Fairway drive. The station is a short distance upstream of the confluence of Pond D with Martin Slough and just downstream of the confluence with Pond E. The Hole 18 water level logger was removed for maintenance for approximately 3 weeks during October and November 2020.

The tidal influence extends to the Hole 18 gage and is reflected in the water level observations in water year 2021. The water level typically peaks at 5.0 feet with occasional peaks near 5.5 feet. Water level approaching 6 feet is usually associated with an exceptionally high tide or rainfall event.

The highest water level recorded at Gage MS-18 was 6.7 feet on January 28, 2021 and followed a similar pattern as recorded at Pond C. During the dry weather monitoring period (June through

September) the Hole 18 monitoring station is tidally influenced with a muted tide pattern fluctuating between a low level of 1 foot and a high of 5 feet, closely corresponding to the water levels recorded at the Pond C gage.

North Fork Martin Slough Water Levels
The North Fork Tributary gage was installed and operational between December 10, 2020 and May 18, 2021, when it was removed for maintenance and construction. The baseflow water level during the period recorded is consistently between elevation 3 and 5 feet. The highest water level peak of 5.47feet, was recorded on March 21, 2021, note that the data logger was not installed during the January 28 peaks recorded at the downstream gages. The low tide water levels were controlled by a temporary rock grade control structure located a short distance downstream, on the mainstem.

Field Observations of Water Level Conditions
Marshplains A and B were observed during high tide (**Figure 6**) while conducting the monitoring survey in November 2021. Both floodplains were inundated by up to 12 in inches of water throughout their extents. This indicates that saline water is reaching the upper marshplains as intended by the design. Wood structures on the marshplains were partially submerged creating cover habitat.

3.2.3 Tidal Datums

Stage data was analyzed and tidal datums were calculated relative to the NAVD88 vertical datum. Monthly values are provided in **Appendix D**, and averages for the dry season of July through October are provided in **Table 3**. This represents periods when there is minimal freshwater influences on the tidal channels. For reference, the yearly tidal datums calculated at the North Spit for the Epoch encompassing 1983 to 2001 and the design muted tidal datums are also included in Table 2. Tidal datums for the North Fork Gage were not computed because data collection was interrupted by construction activities.

Except for MLLW, which is influenced by a tidal sill in the Elk River Slough that limits draining of the tide, the Swain Slough data collected during this monitoring period appears similar to North Spit, but slightly higher. This is likely due to periods of elevated flows in the Elk River that raise water levels in Swain Slough. The tidal datum values where 0.12 feet lower for the 2021 water year than the previous year.

At the Pond C gage, when compared to the water year 2020 datums, the MTL and MHHW increased by 0.34 ft while there was no significant change to the MLLW. At the Hole 18 gage, the MTL and MHHW increased by 0.28 ft, with no significant change to the MLLW. For both the Pond C and Hole 18 gages, the tidal datums for MTL and MHHW are closer to the design values than the previous year.

(a)

(b)

Figure 6. Marshplain A (a) and Marshplain B (b) as seen in November 2021 during high tide.

The design tidal range will be assessed once the Year 1 monitoring of Phase 5 is completed and the golf course establishes an alternative water supply for irrigation. In the interim, the tidal datums can be used to determine the inundation frequency of different areas that have been revegetated with brackish-tolerant plant species. With completion of Phase 4 in 2020, the interim peak muted tide level was raised to 5.5 feet.

Table 3. Tidal Datums for dry period of July through October, 2021 and (2020) at each gage station.

	Water Level (NAVD88)			
Location	**MLLW**	**MTL**	**MHHW**	**Ave. Diurnal Range**
North Spit (for epoch 1983-2001)	-0.34 ft	3.36 ft	6.51 ft	6.85 ft
Swain Slough	1.55 ft (1.52 ft)	3.98 ft (4.09 ft)	6.79 ft (6.91 ft)	5.24 ft (5.39 ft)
Martin Slough				
MS Design	1.50 ft	Not Provided	5.50 ft	4.00 ft
MS at Pond C	1.39 ft (1.37 ft)	3.45 ft (3.11 ft)	5.19 ft (4.86 ft)	3.80 ft (3.50 ft)
MS at Hole 18	1.22 ft (1.24 ft)	3.26 ft (2.98 ft)	5.01 ft (4.73 ft)	3.79 ft (3.50 ft)

3.3 Water Quality

Surface and bottom salinity concentrations and water temperatures recorded at each gaging location in water year 2021 are plotted with water level, and provided in **Appendix B**. The plots also include daily rainfall totals measured at the NWS office on Woodley Island for reference. Included in **Appendix C** is a table of water quality spot measurements recorded during each data download. These include water temperature, salinity and dissolved oxygen concentrations. Plots of daily average and daily maximum water temperatures are provided in **Figure 7**.

3.3.1 Water Quality Performance Criteria

The project monitoring plan defines performance criteria for salinity, water temperature, and dissolved oxygen (DO). The project monitoring plan defines performance criteria for DO concentrations as being no lower than 4 mg/l during periods when salmonids are anticipated to be present. This is generally applied to surface DO concentrations, as bottom concentrations can be substantially lower when fish are present. This is applied primarily to Pond G and the North Fork Tributary, which are intended to provide over-summering habitat for rearing salmonids.

Water temperature performance criteria are based on daily values. Water temperature should maintain a daily average at or below 18° C and daily maximum at or below 21°C during periods when salmonids are expected to be present.

For salinity, the threshold is 4 ppt, and is generally applied to the surface salinity concentrations due to higher DO concentrations near the surface.

3.3.2 Salinity and Water Temperature

The project, when completed, is intended to create a longitudinal gradient of salinity, with highest salinity near the tide gate transitioning to freshwater conditions at the upstream end, with each pond having different concentrations of brackish water. Additionally, stratification is expected to provide a vertical gradient from more saline waters at the bottom to less brackish water near the surface. During rainfall-runoff events the entire project channel length and all the ponds are anticipated to be predominately freshwater. The water year 2021 salinity data show these conditions are moving upstream as expected. With completion of project Phase 5 in 2021, the longitudinal salinity gradient should extend further upstream in the upcoming water year.

Water temperatures within the project area are dependent on air temperature, temperature of freshwater inflow from upstream, and temperatures of inflow from Swain Slough. During winter months temperatures are anticipated to be similar to freshwater streams around Humboldt Bay. During the dry season, areas with brackish water should experience higher water temperatures due to influences from water temperatures in Humboldt Bay and Swain Slough. These can well exceed 20 degrees Celsius due to shallow inundation of mudflats during rising tides in the daytime. Water temperature data from water year 2019 through 2021 show these expected trends.

Swain Slough Salinity and Temperature

Salinity was not recorded in Swain Slough. Water temperatures in Swain Slough during the fall of 2020 and early winter of 2021 were similar to those measured in the freshwater reach of Martin Slough near Hole 18 and upstream at the North Fork Tributary, with small diurnal temperature fluctuations. However, by mid-April 2020, water temperatures become elevated and both diurnal and tidal influenced temperature fluctuations become more apparent.

Martin Slough near Pond C Salinity and Temperature

In Martin Slough at Pond C, the salinity was highly correlated to precipitation, and stratification was present during periods not dominated by freshwater inflows. During periods between rainfall events the bottom salinity would fluctuate dramatically with incoming verses outgoing tides, while the surface salinity generally fluctuated less and was less brackish. During periods with precipitation, salinity concentrations became close to zero for days at a time. Several days following the cessation of rainfall, the bottom salinity would increase relatively rapidly, while the surface salinity slowly increased with each tide cycle. This pattern was most pronounced in January and February 2021.

Water temperatures in Martin Slough near Pond C remained low throughout the fall and early winter months. Surface and bottom temperatures were nearly identical much of the time, with periods where the surface water temperature was colder and fluctuated much more with tidal cycles than along the bottom. This is assumed to be associated with stratification during flood tide and then mixing during ebb tide. By April 2021, temperatures at this location began to rise, as did salinity, due to the decrease in rainfall following the frequent precipitation of February and March. During the summer months water temperatures were between 18° and 22° C and were consistently warmer than Swain Slough.

Martin Slough near Hole 18 Salinity and Temperature
Salinity measurements in Martin Slough near Hole 18 show that during winter and early spring both surface and bottom salinity fluctuated between 0 ppt and 15 ppt almost daily with the tidal cycle. However, starting in April, the measurement became more steady reading between 9 ppt and 12 ppt with the exception of during rainfall events. This pattern persisted through September, the end of the monitoring period. Water temperatures in Martin Slough near Hole 18 fluctuated with tides, and showed diurnal fluctuation with changes associated with precipitation and ambient air temperature. These fluctuations grew more exaggerated in the warmer months starting in April and continuing through September.

The surface salinity (and temperature) logger was removed for repairs in August and sent to the manufacturer for data recovery and was reinstalled in September just before the end of the monitoring period.

North Fork Martin Slough Salinity and Temperature
Salinity measurements for the gage located on the North Fork Tributary just upstream of the confluence with the mainstem show that saline water is reaching the upper reach of martin slough in the project area even before the completion of Phase 5. Before the gage was removed in June the surface salinity fluctuated with the tide between 0 and 20 ppt. In March the bottom Salinity was removed for the rest of the monitoring period due to an extended period of data faulty data.

Temperature values show normal diurnal fluctuations, with warming during the summer months. This is the area of the project that the performance criteria for water temperature is applied year-round, due to the desire to provide year-round conditions suitable for rearing salmonids. Because the North Fork gages were removed in June for construction and was not active during the warmest part of the monitoring period no discussion is presented in this report.

3.3.3 Comparison to Performance Criteria

Salinity
Spot measurements of Salinity (**Appendix C**) where almost always above the 4 ppt threshold with the exception of the North Fork tributary gage which recorded low values of 0.1 and 0.4 ppt during the winter months. During these measurements the Hole 18 Gage also recorded values between 4.5 and 6.6 ppt likely coinciding with precipitation that increases freshwater flow through the project area. The continuous data (**Appendix B**) show that during the winter months surface salinity at all three gage stations fluctuates with the tide cycle and is often below the 4 ppt threshold during the low tide and for extended periods during precipitation events. During the warmer and drier summer months the Pond C and Hole 18 surface salinity levels show less fluctuation. Starting in May for Pond C and June for the Hole 18 gage, the salinity levels generally remain above 10 ppt and 7 ppt respectively. The 2021 water year experienced 29.16 inches of rainfall, this drier than normal year during the monitoring period is one likely cause of the high salinity levels due to the lack of freshwater flowing through the project area or up from Swain Slough and Elk River.

Temperature
Temperature values recorded during the year are shown in **Figure 7**. During the months of October through April maximum daily and average daily water temperatures are well below the thresholds of 21 °C and 18 °C respectively. During the summer months daily average temperature increases to

between 18 °C and 24 °C. From June to August Swain Slough temperatures are also above the average daily threshold of 18 °C with the North Fork recording the lowest values of the three gage stations during the summer months (although the North Fork data set is not complete due to construction). The drier than normal year during the monitoring period is one likely cause of the higher temperatures.

Dissolved Oxygen Spot Measurements

Spot measurements of dissolved oxygen (DO) by RCAA staff during each download are provided in **Appendix C**. The measured DO levels at the four sites were generally above the minimum performance criteria of 4 mg/l on the surface, and were often substantially higher. These DO levels are considered acceptable for rearing salmonids and other aquatic organisms.

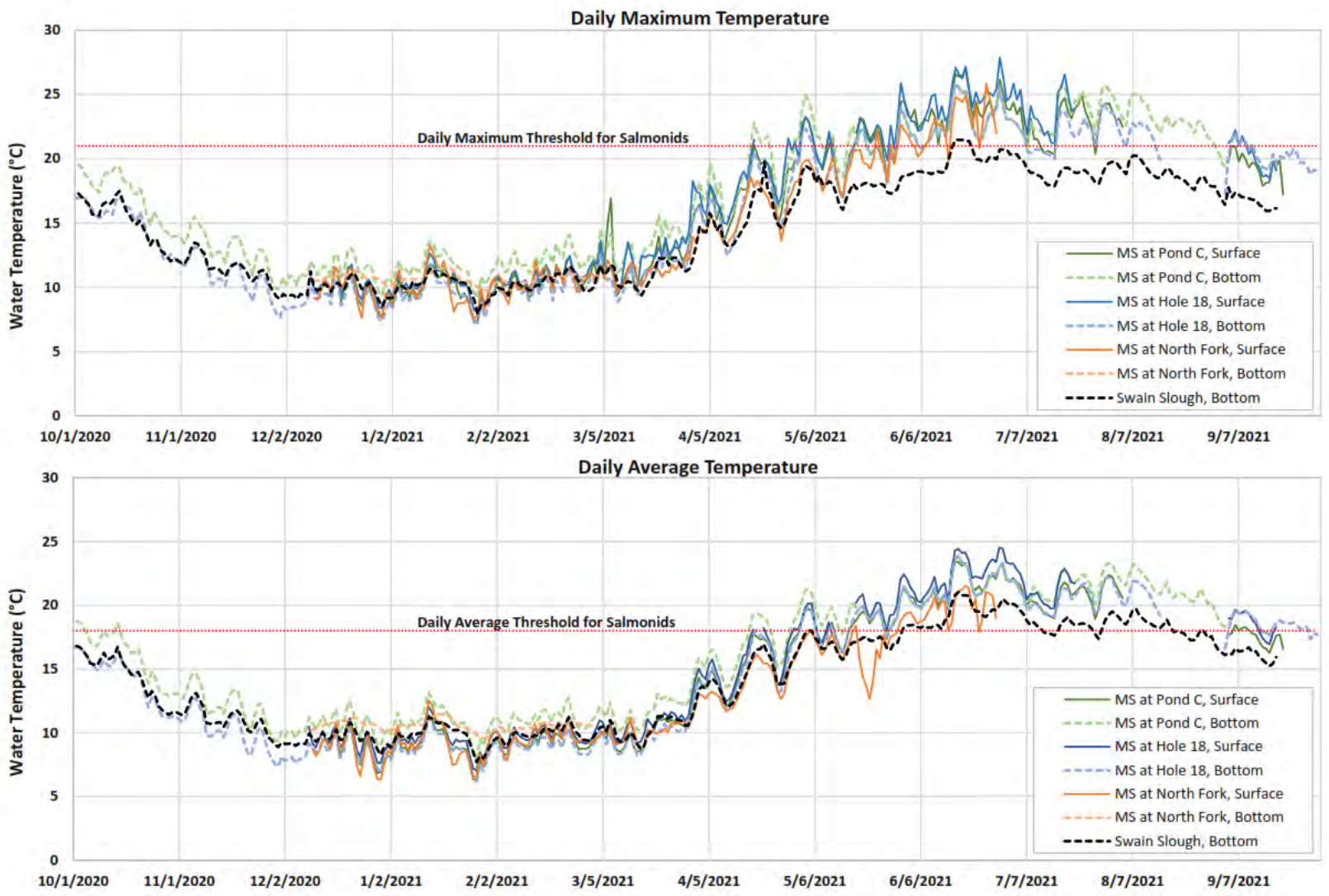


Figure 7. Daily maximum and daily average water temperatures for water year 2021 recorded at the Swain Slough, Martin Slough at Pond C, Martin Slough at Hole 18 and the North Fork tributary gaging stations. Summer salmonid usage assumed to be in the vicinity of the MS at North Fork station.

4 RECOMMENDATIONS

The Martin Slough Enhancement Project has been implemented in phases. The intended project hydrology, including the introduction of the design muted tidal prism, should now be fully functional as all of the project phases have been completed. The findings from the second year of monitoring following completion of Phase 3 (and third year of monitoring following Phase 2) show that the tidal amplitude and prism has increased and is very close to the design range. The estuary environment created with Phase 2 and Phase 3 completed is already present, with brackish water extending up the mainstem, and salinity concentrations fluctuating with rainfall events and with tidal fluctuations.

To evaluate the water quality performance of Pond G (Phase 5, constructed in 2021) the North fork tributary gage should be upgraded with salinity loggers that record the full range of salinity. The data loggers at the Pond C and Hole 18 gages should also be upgraded to better understand the full range of exposure to brackish conditions.

An area of potential concern arising out of the water year 2019 monitoring and persistent in 2021 is the high point identified along the thalweg profile around Station 14+00 due to a slumping bank associated with high groundwater and saturated soils close to the base of the adjoining hillslope. Material may be continuing to slump at this location, but currently is not significantly constricting the channel or influencing the tidal amplitude. Additional channel constriction could cause upstream flooding and channel sedimentation, and would limit upstream tidal influences. The project manager and project engineer should continue to inspect this site to detect if any additional slumping occurs, and if material is being transported.

The second area of sedimentation noted in the 2019 survey at the property line near the previous grade control should also continue to be monitored to see if this material scours out or causes a reduction in tidal exchange or outflow of freshwater.

The stream approach at the upstream end of the project will continue to adjust and should be monitored. Minor bank armoring might be needed to protect the upstream weir and piles. Future channel surveys should include the upstream channel to assess changes to bed elevation and width.

5 REFERENCES

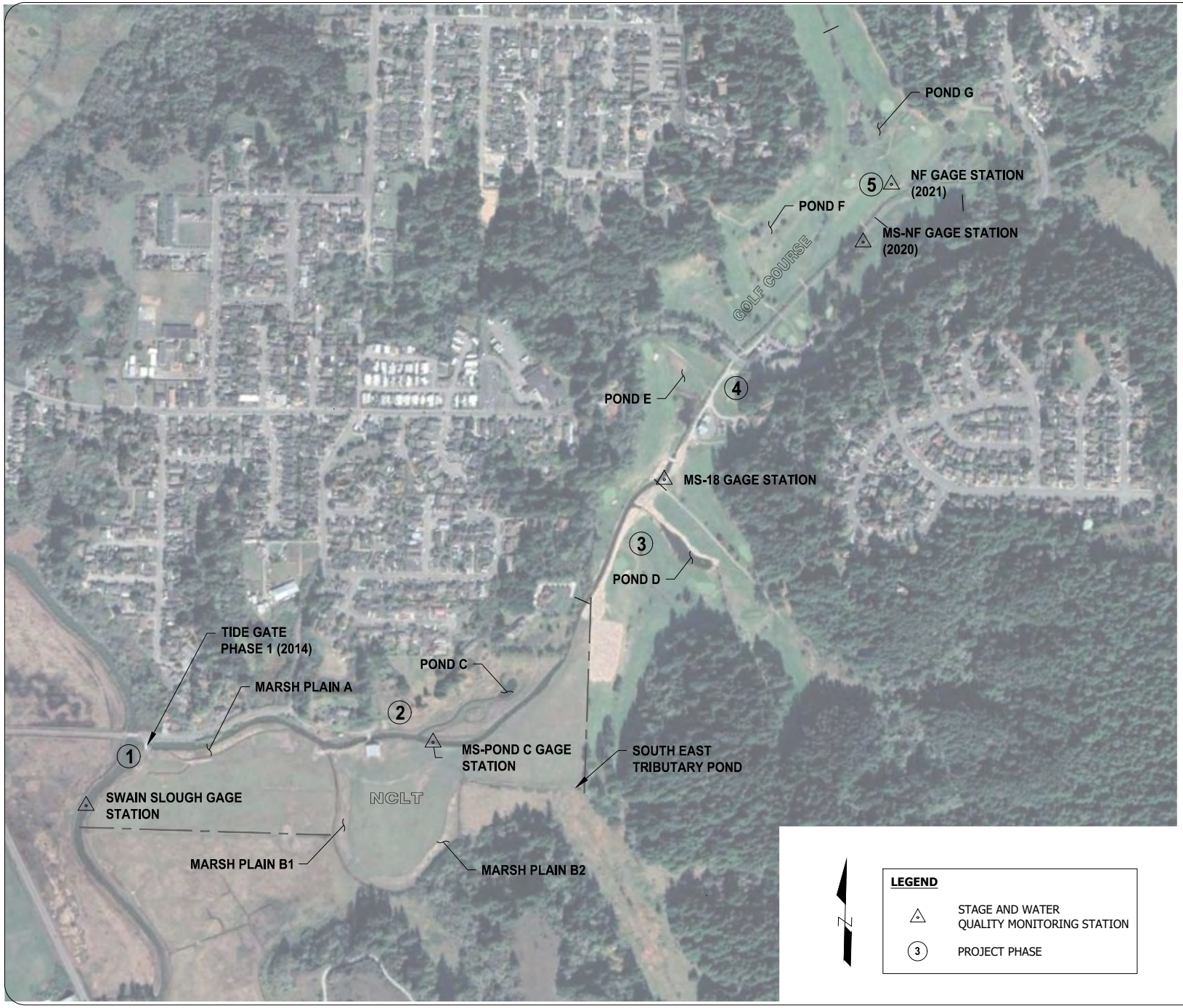
NOAA, 2003. Science-based restoration monitoring of coastal habitats, Volume 1: A framework for monitoring plans under the Estuaries and Clean Water Act of 2000.

RCAA, 2021. Martin Sough Enhancement Project Monitoring Plan. August 2013, Revised November 2021. By Redwood Community Action Agency Natural Resources Services Division.

Appendix A

Topographic Monitoring
Phase 2, Year 3 /Phase 3 and 4, Year 1 / Phase 5, Year 0

Sections and Profiles



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MARTIN SLOUGH ENHANCEMENT PROJECT

MONITORING OVERVIEW

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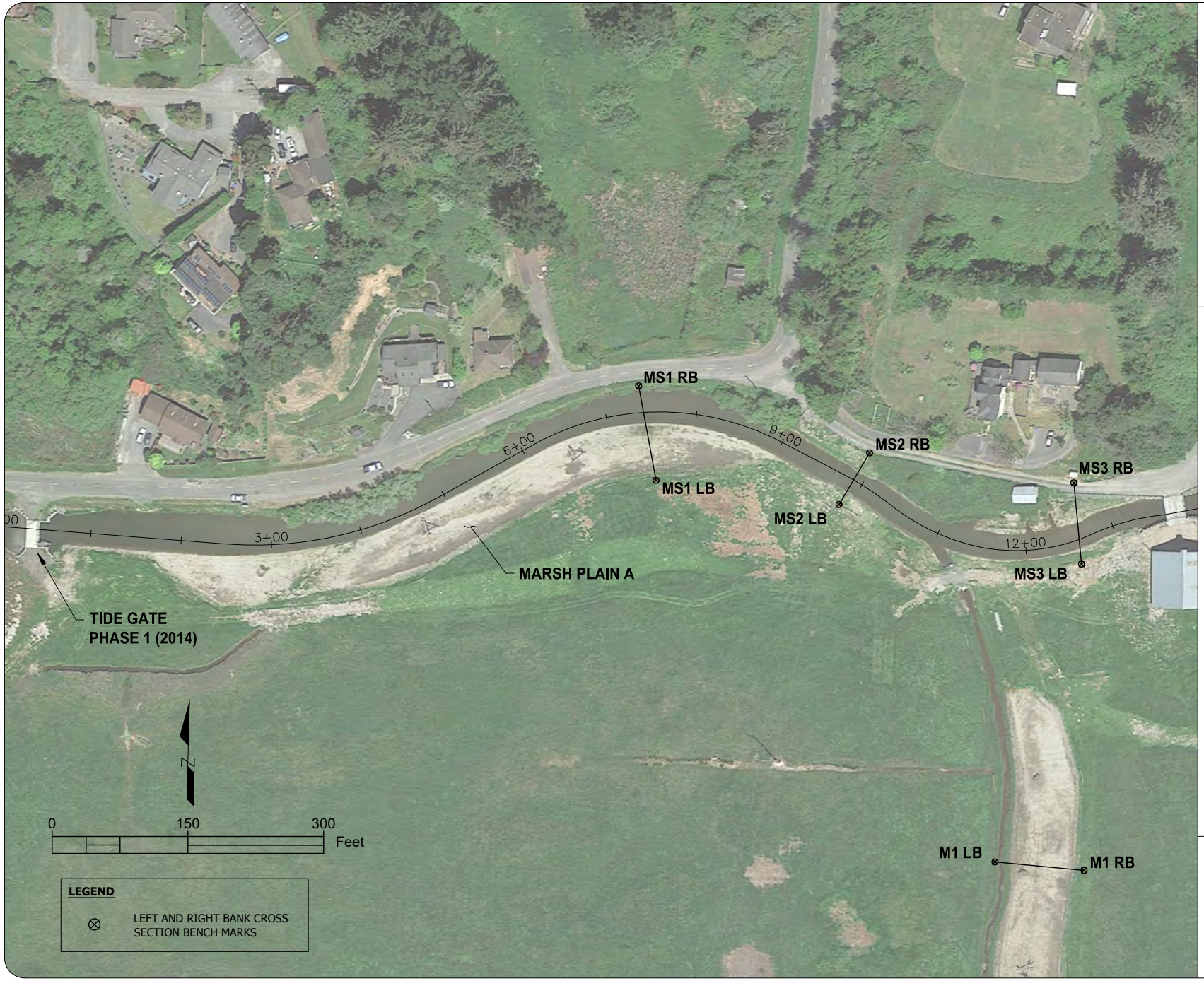

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MARTIN SLOUGH ENHANCEMENT PROJECT

LOCATION OF MONITORING CROSS SECTIONS

FIGURE

1

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MARTIN SLOUGH ENHANCEMENT PROJECT

LOCATION OF MONITORING CROSS SECTIONS

FIGURE
3

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MARTIN SLOUGH ENHANCEMENT PROJECT

LOCATION OF MONITORING CROSS SECTIONS

FIGURE
2

12/17/21 Q:\Martin Slough Design\5_DWG\MONITORING.dwg

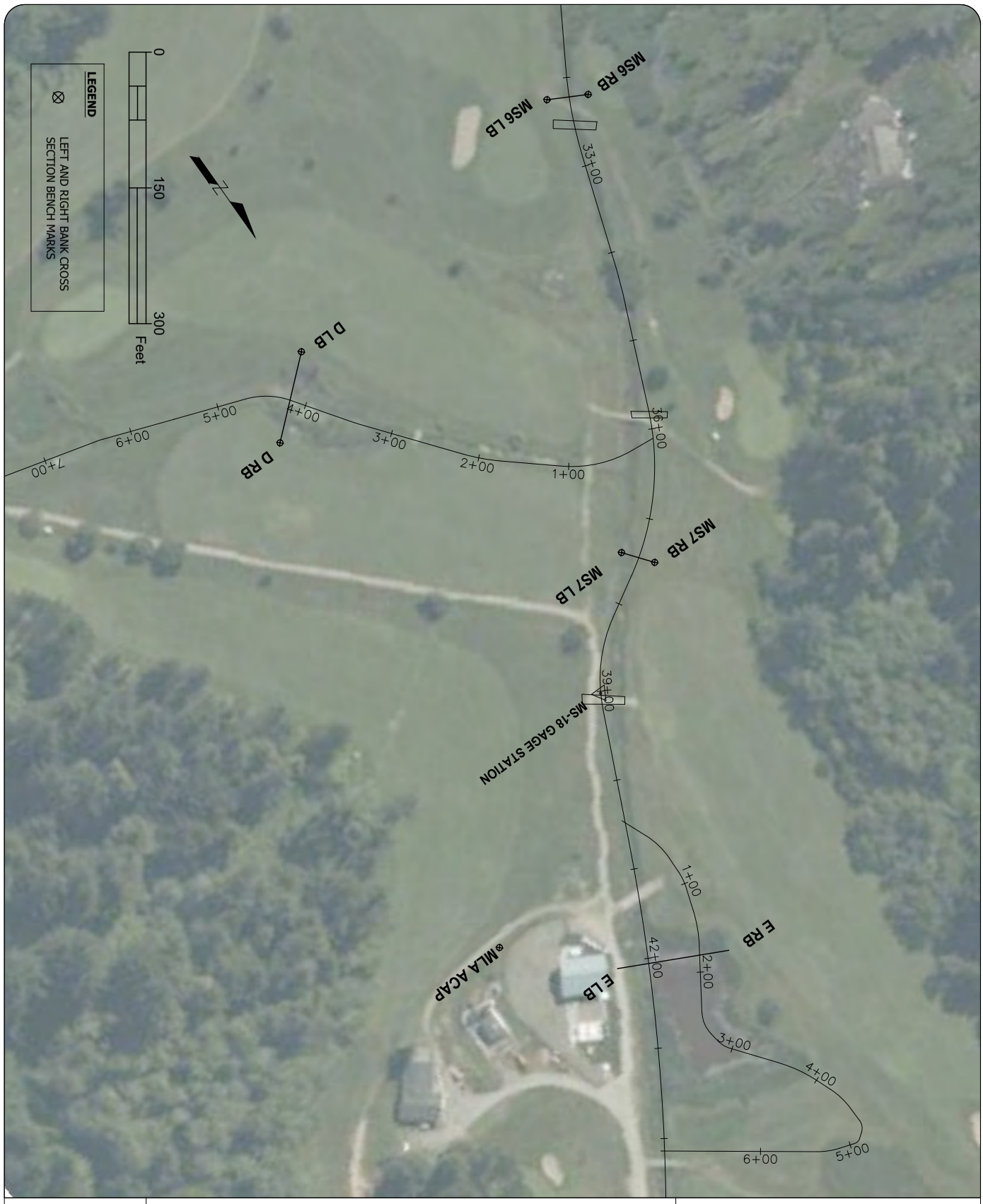

FIGURE 4

MARTIN SLOUGH ENHANCEMENT PROJECT

LOCATION OF MONITORING CROSS SECTIONS

Michael Love & Associates, Inc.
PO Box 4477 • Arcata, CA 95518 • (707) 822-2411

Natural Resources Services
A Division of Redwood Community Action Agency
(707) 269-2065 • 904 G St. Eureka, CA 95501

12/17/21

Q:\Martin Slough Design\5_DWG\MONITORING.dwg

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MARTIN SLOUGH ENHANCEMENT PROJECT

LOCATION OF MONITORING CROSS SECTIONS

FIGURE

5

12/17/21 Q:\Martin Slough Design\5_DWG\MONITORING.dwg

Martin Slough Channel Cross Sections

Phase 2 Project Area

Monument Coordinates:

Aluminum Caps on rebar set at ground level, indicated with “RCAA MONITORING”
Horizontal Datum: NAD83 California State Planes, Zone I, US Foot
Vertical Datum: NAVD 88

Point #	Description	Elevation (feet)	Northing (feet)	Easting (feet)
1,001	ACAP MS 1 RB	8.35	2,165,056.871	5,957,817.412
1,003	ACAP MS 1 LB	7.10	2,164,952.524	5,957,836.559
2,001	ACAP MS 2 RB	13.72	2,164,982.208	5,958,071.795
2,002	ACAP MS 2 LB	8.00	2,164,925.615	5,958,038.971
3,000	ACAP MS 3 RB	12.59	2,164,948.819	5,958,295.800
3,001	ACAP MS 3 LB	6.70	2,164,859.235	5,958,307.188
4,000	ACAP MS 4 LB	6.34	2,164,853.859	5,958,999.086
4,001	ACAP MS 4 LB	7.94	2,164,935.416	5,958,979.772
5,000	ACAP MS 5 LB	6.83	2,165,307.009	5,959,527.293
5,001	ACAP MS 5 RB	7.03	2,165,341.907	5,959,479.276
6,000	ACAP C1 RB	6.63	2,165,157.541	5,958,965.134
6,001	ACAP C1 LB	8.02	2,164,968.928	5,959,036.410
7,001	ACAP C2 LB	6.78	2,165,157.683	5,959,281.769
7,002	ACAP C2 RB	8.62	2,165,265.443	5,959,139.459
8,000	ACAP MEANDER 1 RB	7.16	2,164,521.532	5,958,309.662
8,001	ACAP MEANDER 1 LB	6.30	2,164,530.713	5,958,211.387
9,000	ACAP MEANDER 2 RB	7.90	2,164,452.548	5,958,834.845
9,001	ACAP MEANDER 2 LB	5.75	2,164,441.061	5,958,931.775
10,000	ACAP SE TRIB 1 RB	7.50	2,164,642.735	5,959,593.897
10,001	ACAP SE TRIB 1 LB	7.60	2,164,596.018	5,959,590.624

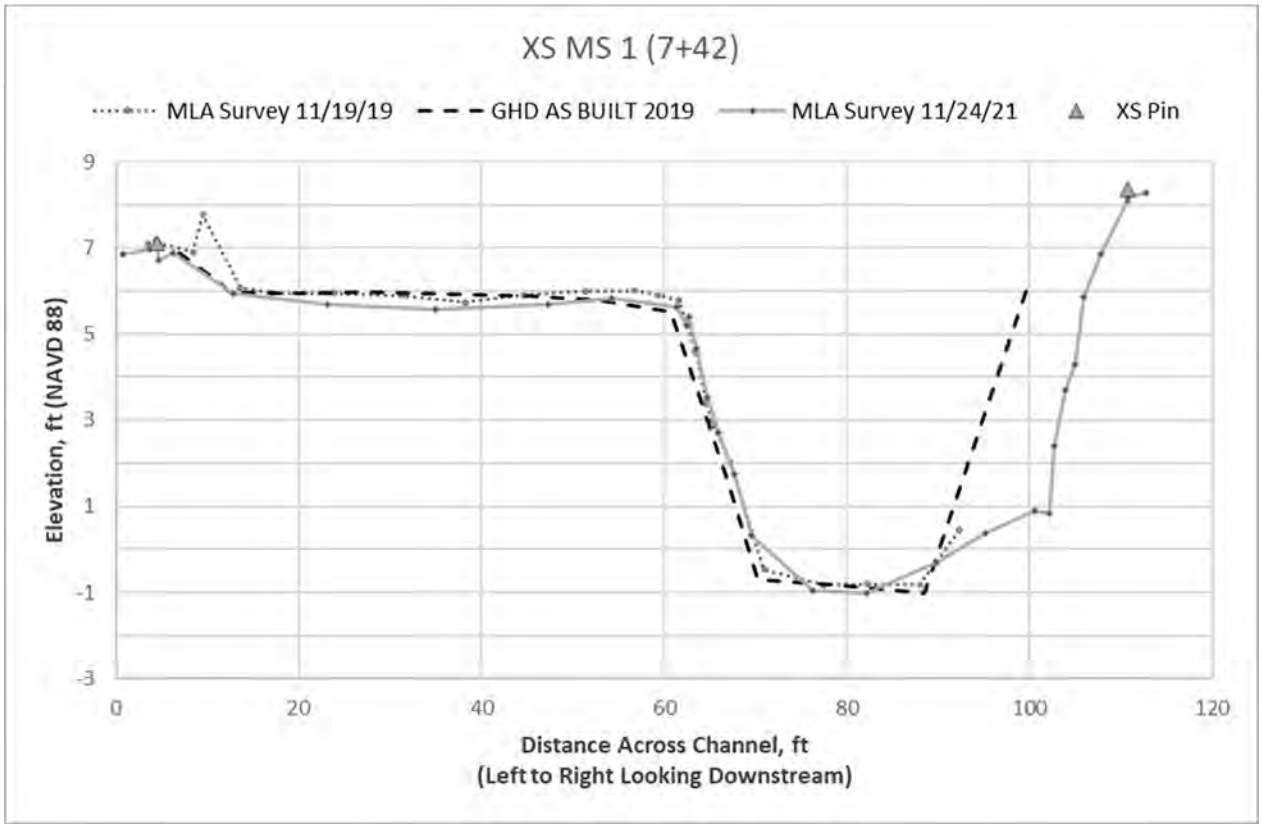
Phase 3-5 Project Area

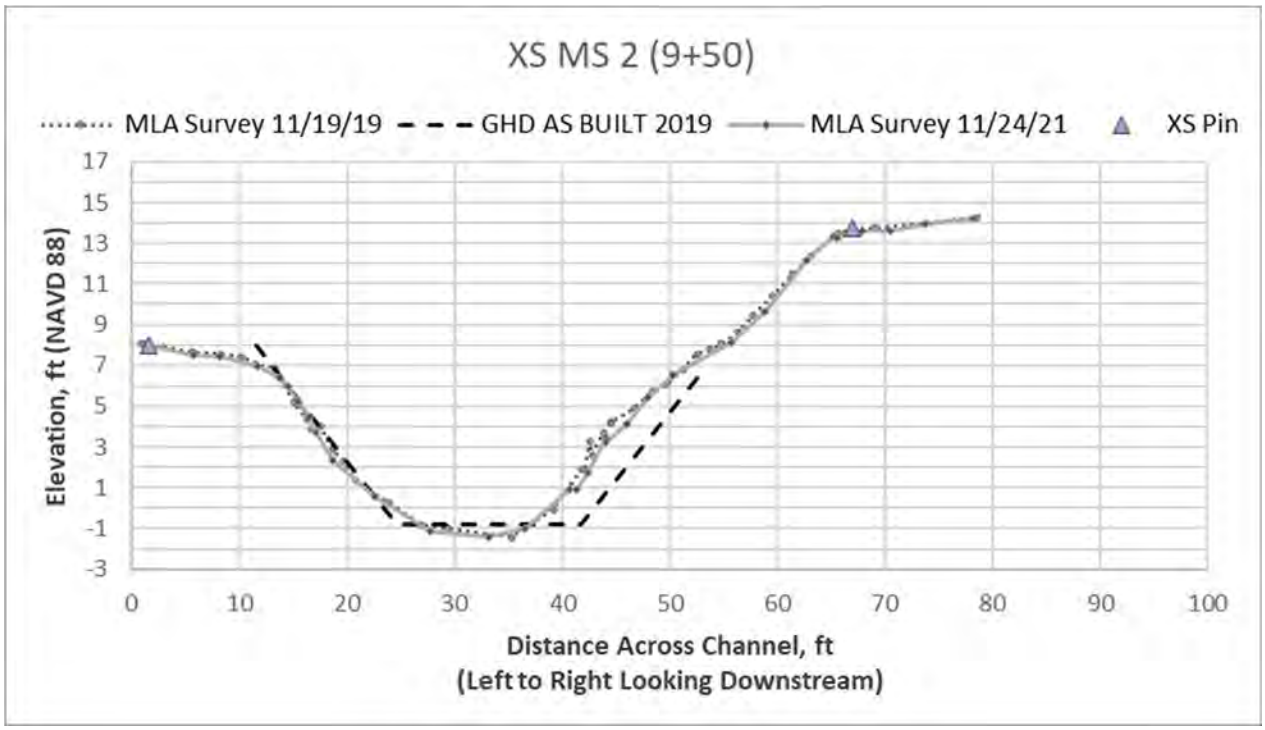
Monument Coordinates:

Aluminum Caps on rebar set at ground level, indicated with "RCAA MONITORING"
Horizontal Datum: NAD83 California State Planes, Zone I, US Foot
Vertical Datum: NAVD 88

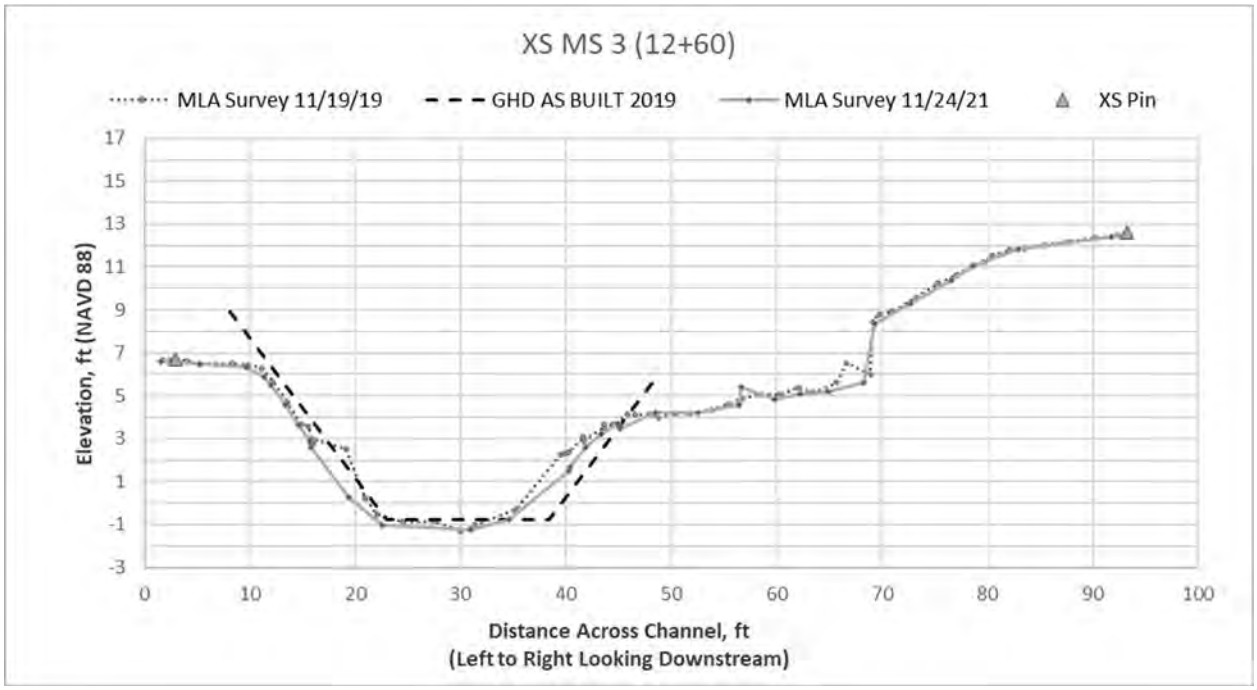
Point #	Description	Elevation (feet)	Northing (feet)	Easting (feet)
50,001	ACAP BASE PUMP STATION	11.39	2166548.783	5960377.190
11,000	ACAP MS 6 LB	7.01	2165828.470	5959775.570
11,001	ACAP MS 6 RB	8.68	2165850.890	5959735.540
12,000	ACAP MS 7 LB	5.53	2166279.120	5960008.350
12,001	ACAP MS 7 RB	6.06	2166309.640	5959985.400
13,001	ACAP MS 8 LB	9.08	2167260.419	5960783.332
13,002	ACAP MS 8 RB	7.50	2167288.277	5960749.862
14,000	ACAP MS 9 LB	7.15	2167686.772	5961199.746
14,001	ACAP MS 9 RB	6.92	2167715.903	5961178.569
15,000	ACAP MS 10 LB	9.60	2167976.505	5961883.499
15,001	ACAP MS 10 RB	9.28	2168006.231	5961886.220
16,001	ACAP F LB	5.99	2167680.685	5960793.719
18,001	PCAP D 1 LB	6.93	2165889.881	5960159.555
18,002	PCAP D 1 RB	6.80	2165956.538	5960238.533

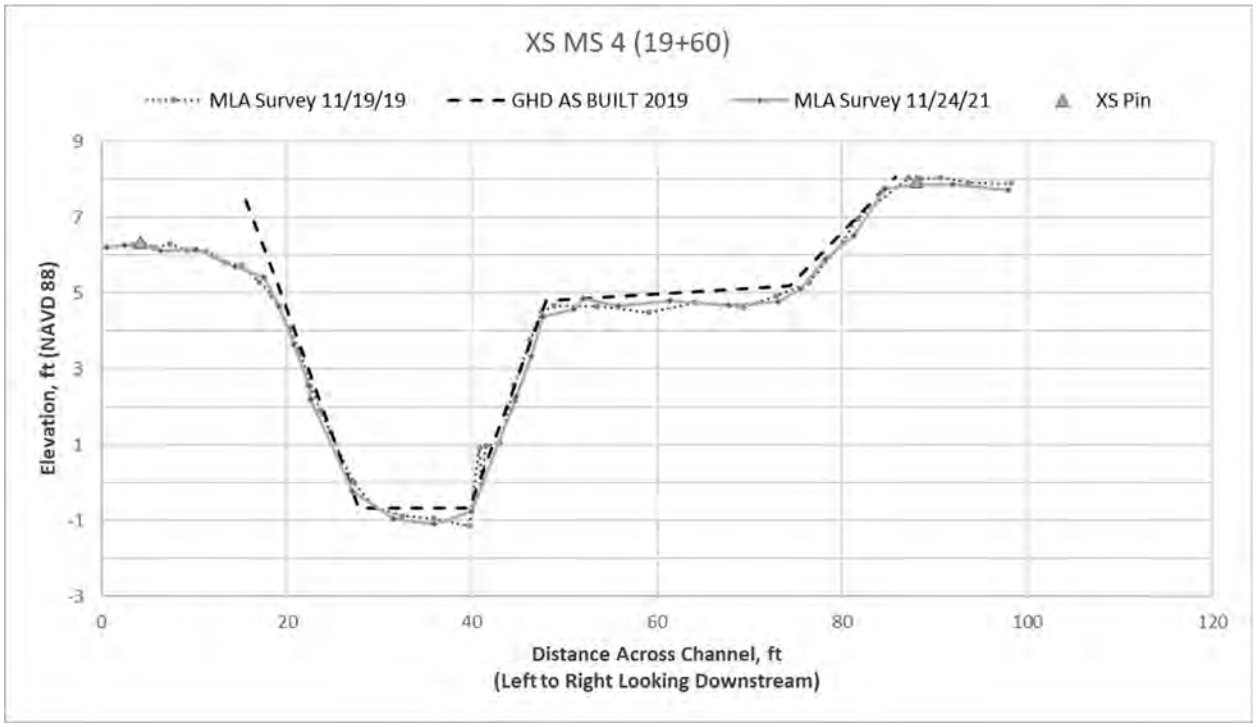
Martin Slough Monitoring Cross Sections



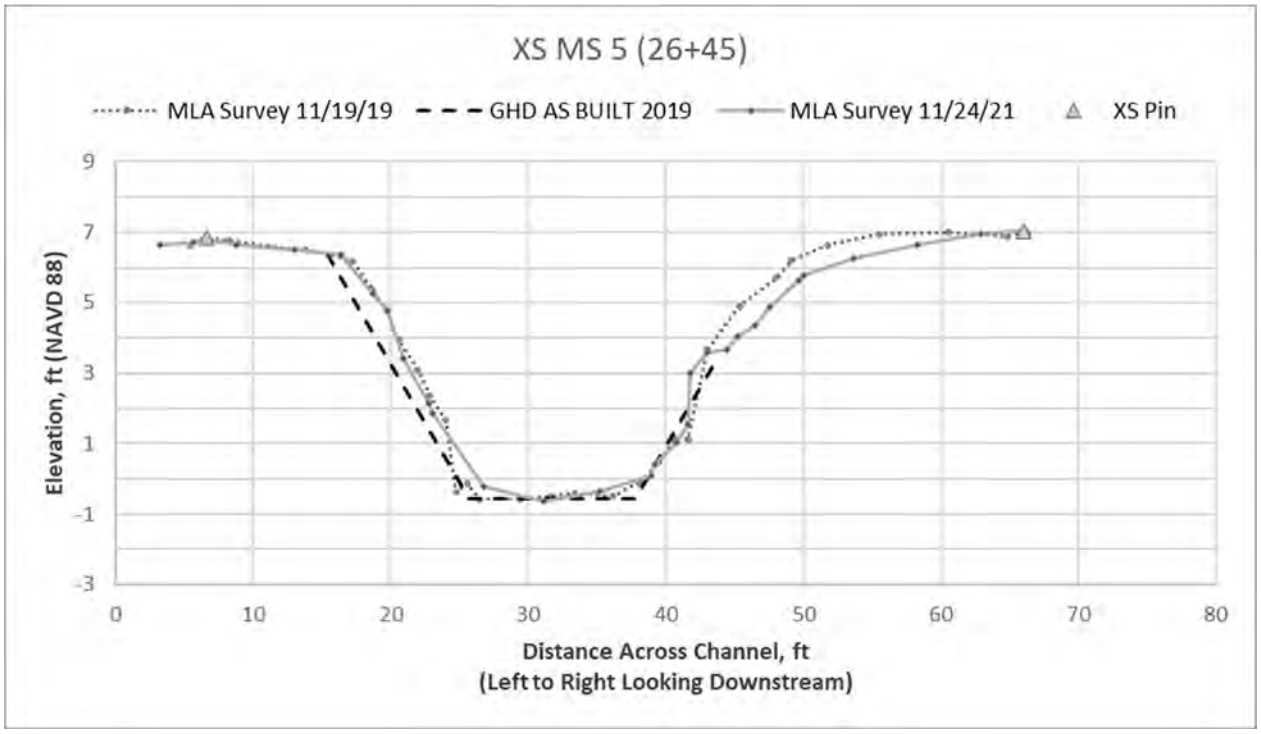


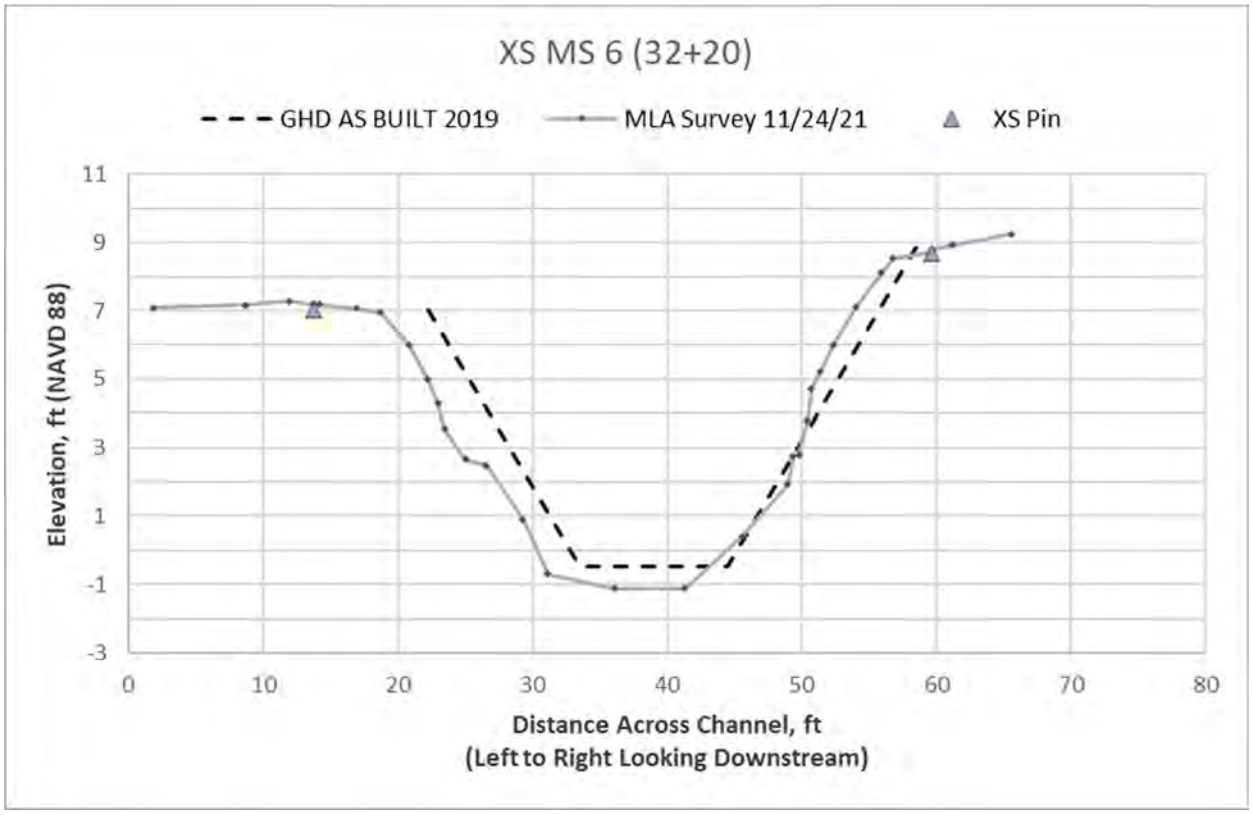
Martin Slough Monitoring Cross Sections

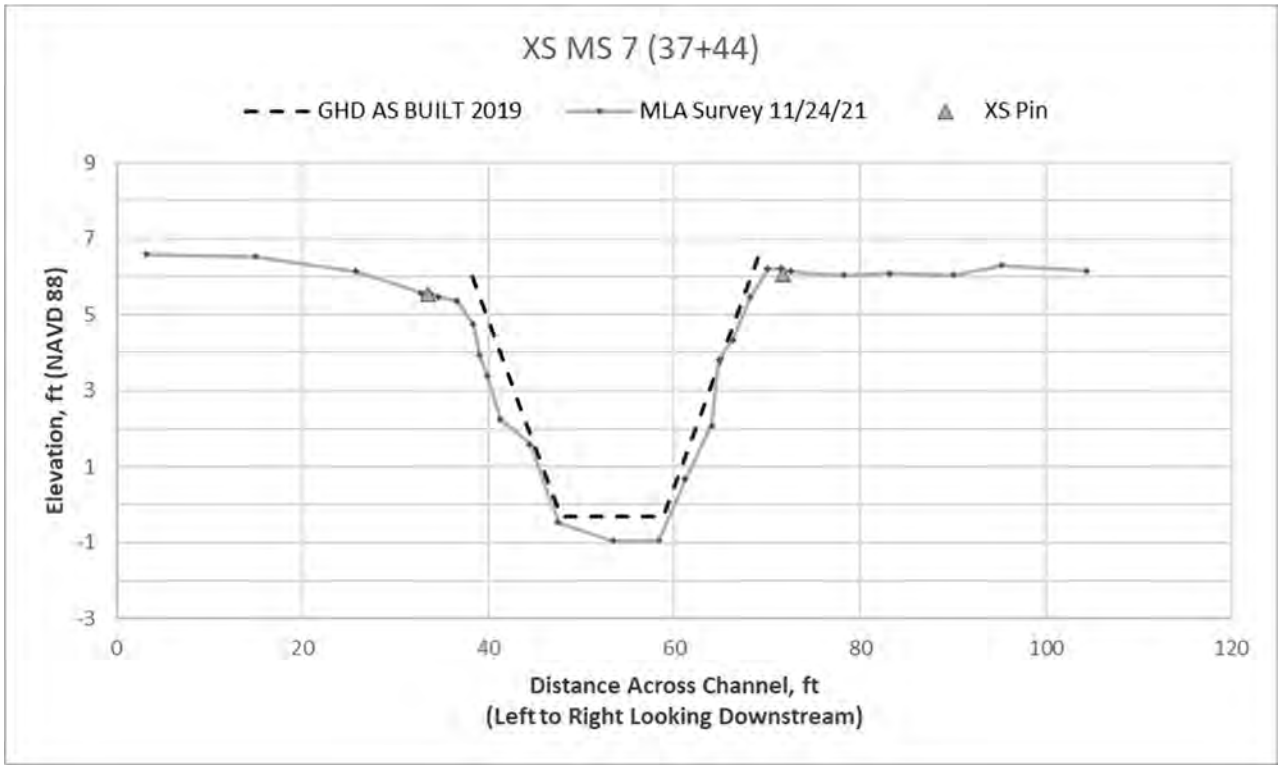


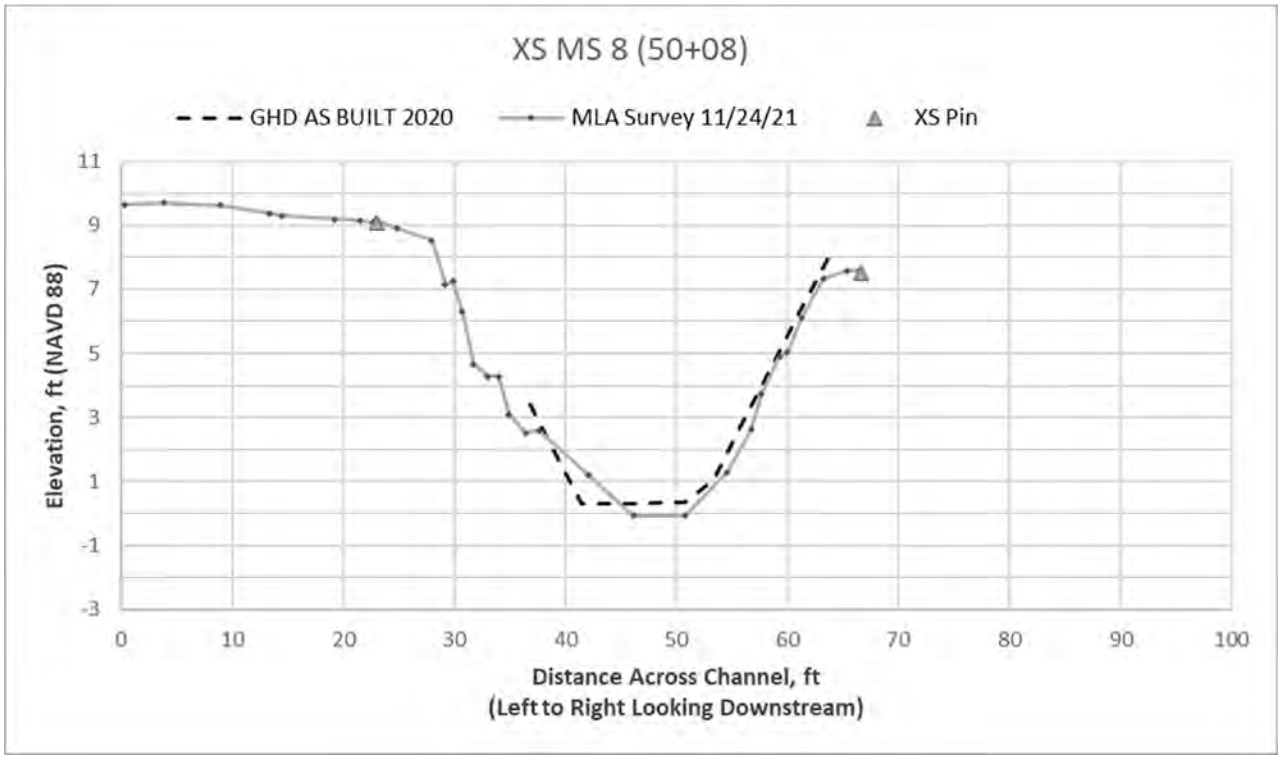


Martin Slough Monitoring Cross Sections

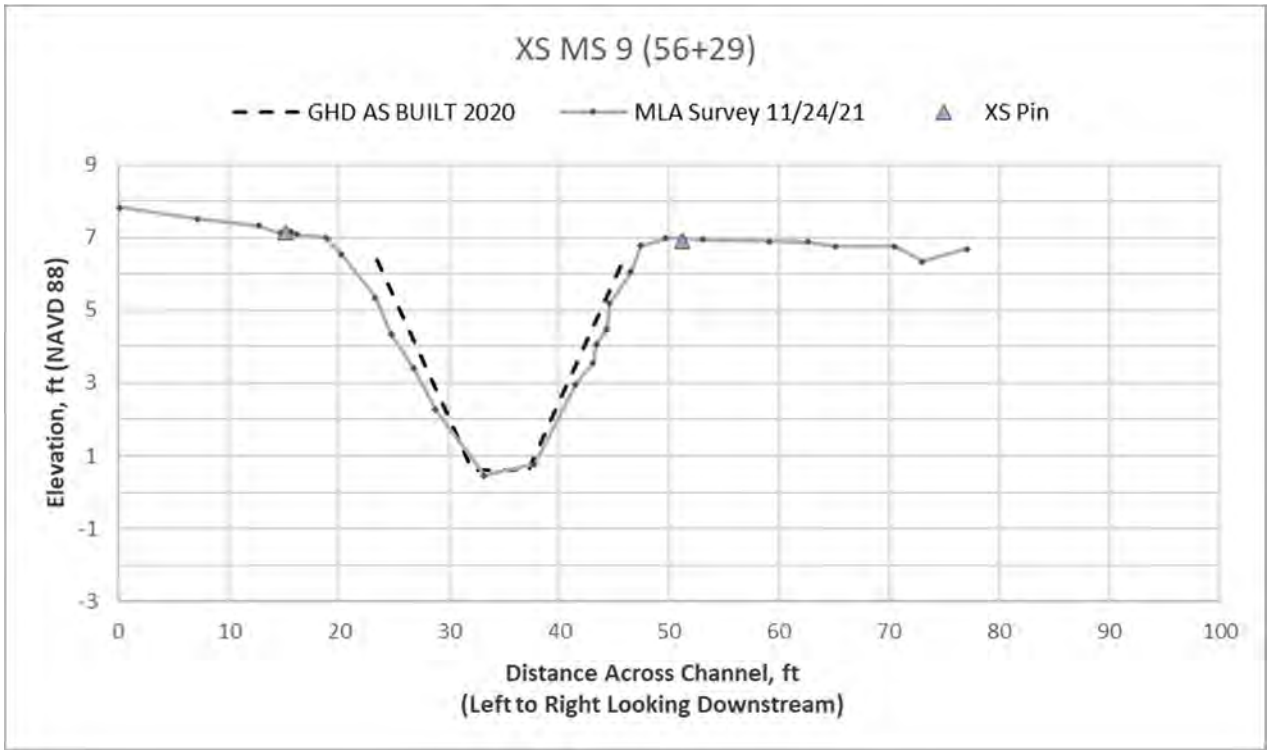


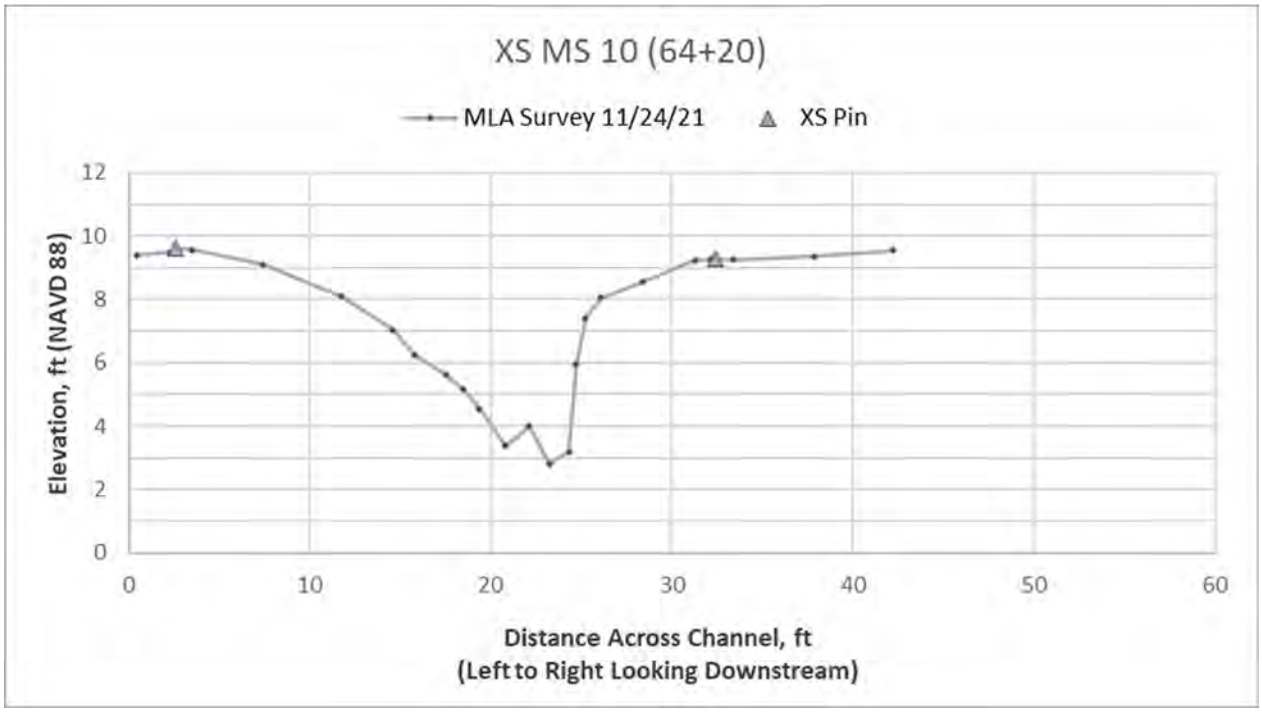



XS MS 7 (37+44)
GHD AS BUILT 2019
MLA Survey 11/24/21
XS Pin
Elevation, ft (NAVD 88)
9
7
5
3
1
-1
-3
0
20
40
60
80
100
120
Distance Across Channel, ft
(Left to Right Looking Downstream)

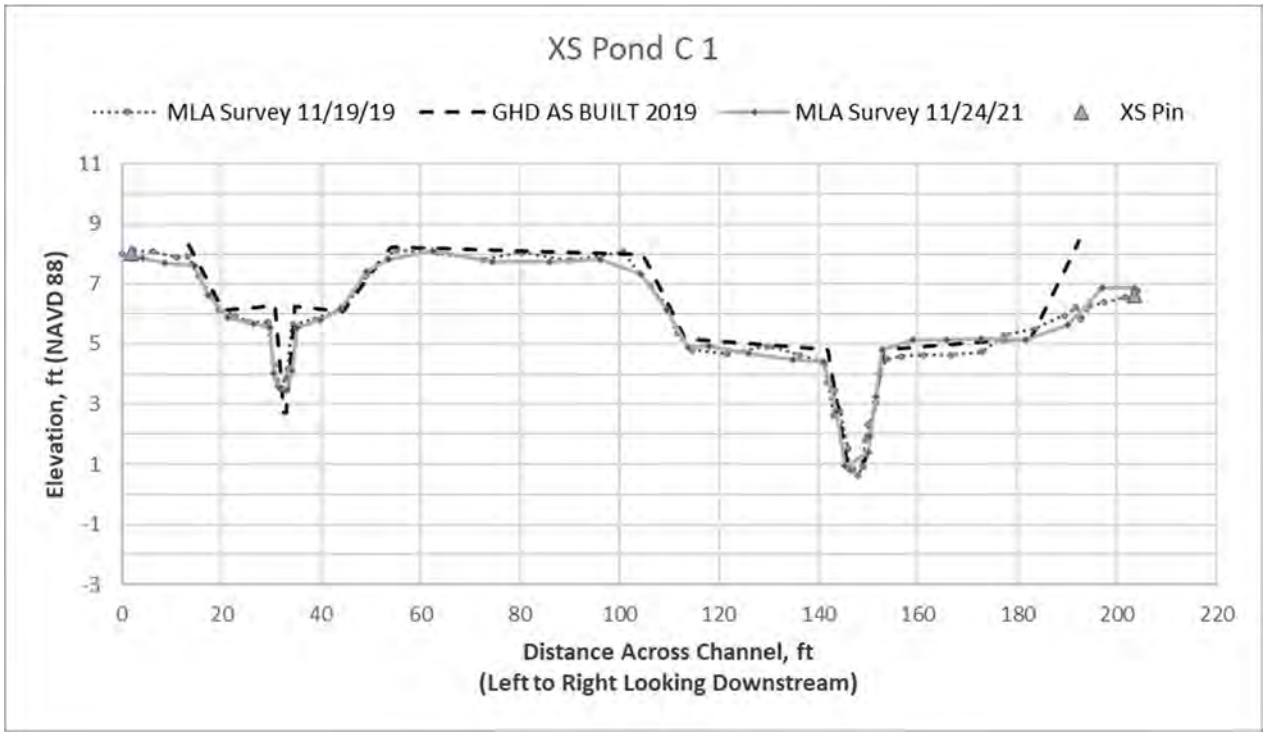

XS MS 8 (50+08)
GHD AS BUILT 2020
MLA Survey 11/24/21
XS Pin
Elevation, ft (NAVD 88)
11
9
7
5
3
1
-1
-3
0
10
20
30
40
50
60
70
80
90
100
Distance Across Channel, ft
(Left to Right Looking Downstream)

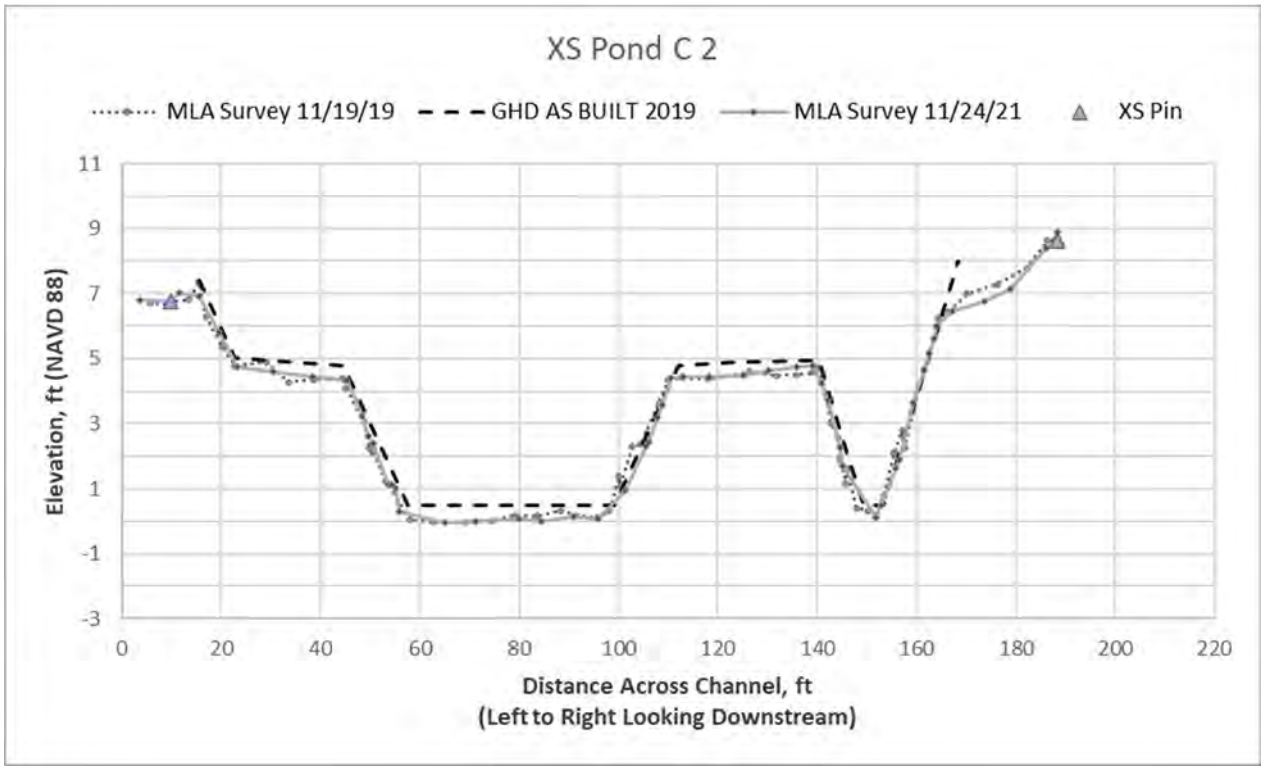
Martin Slough Monitoring Cross Sections



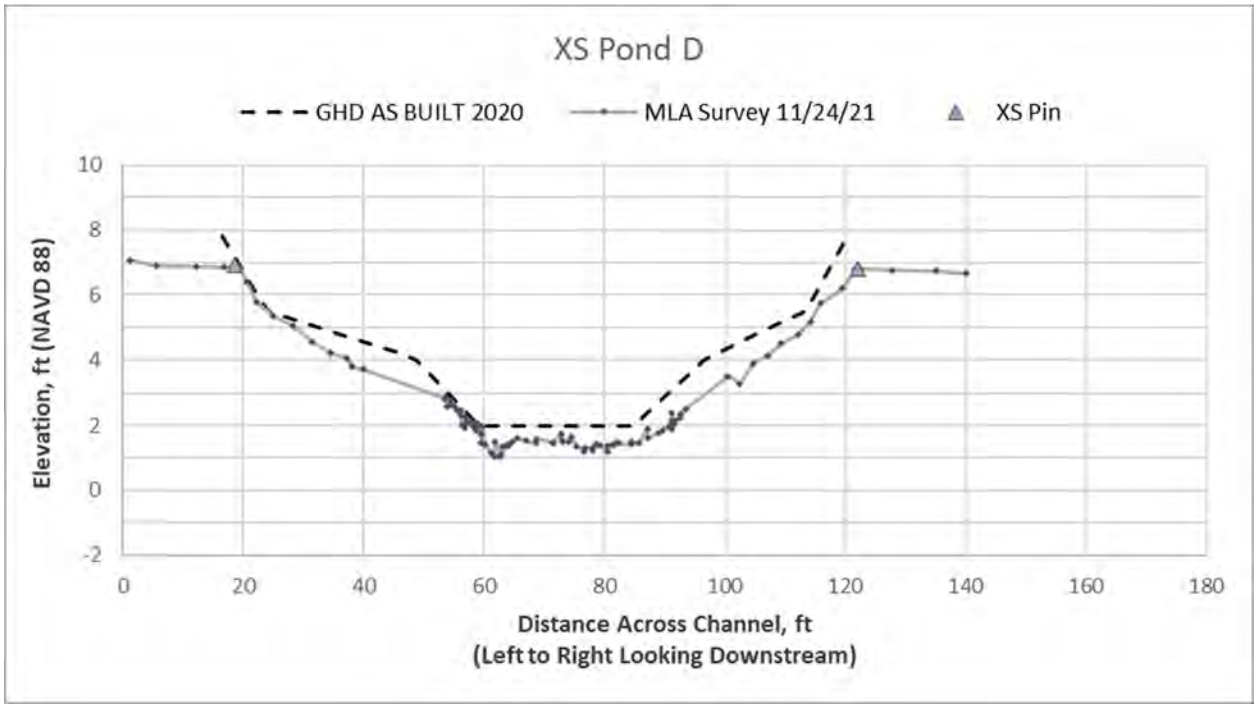


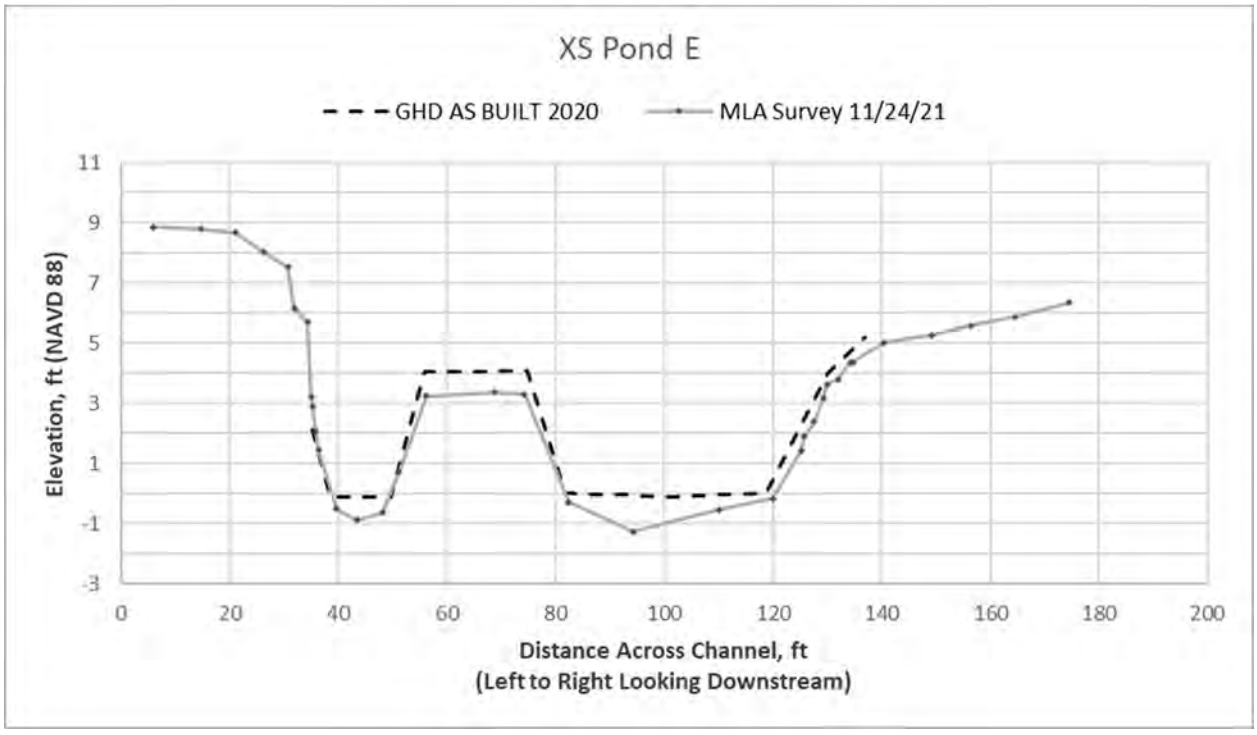
Martin Slough Monitoring Cross Sections



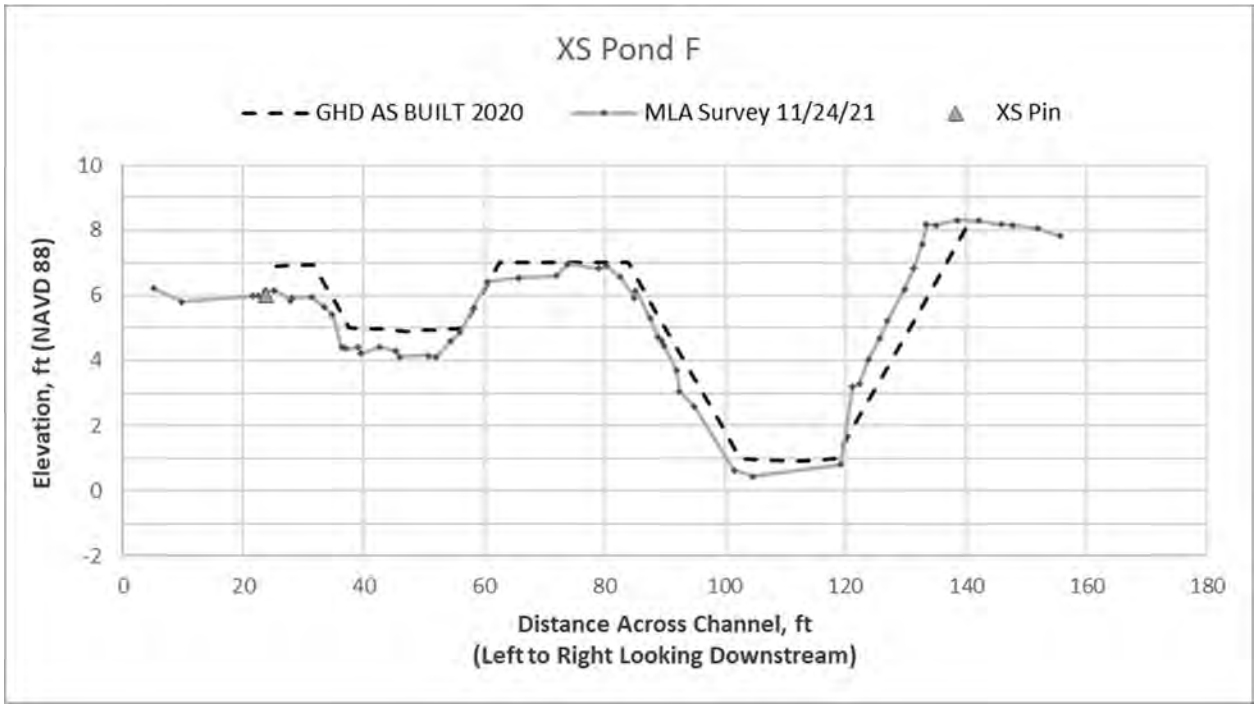


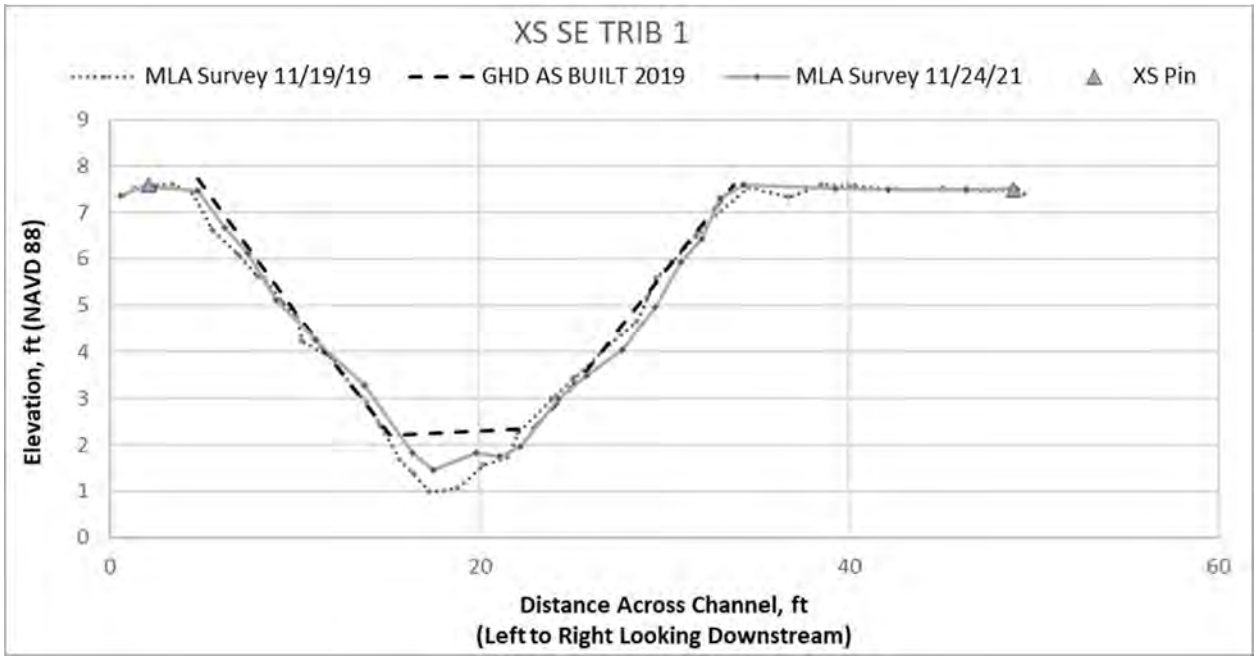
Martin Slough Monitoring Cross Sections



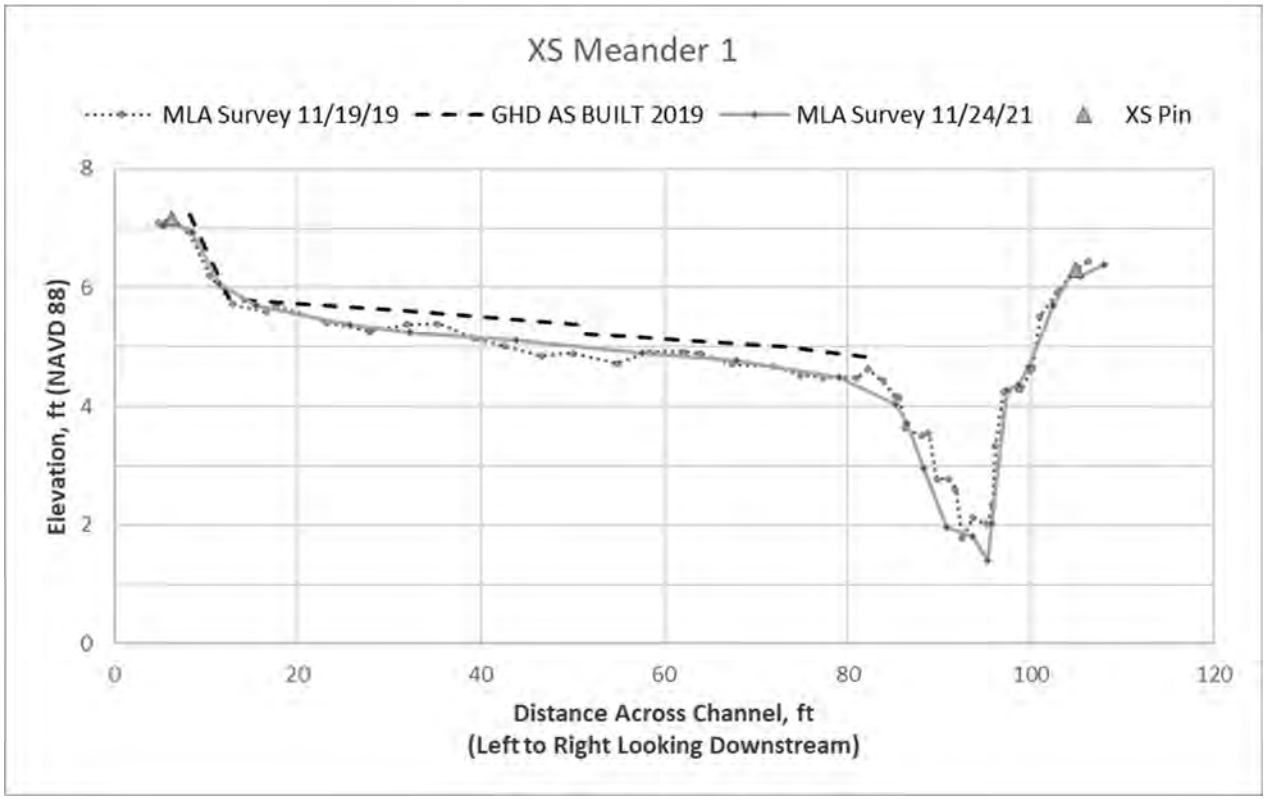


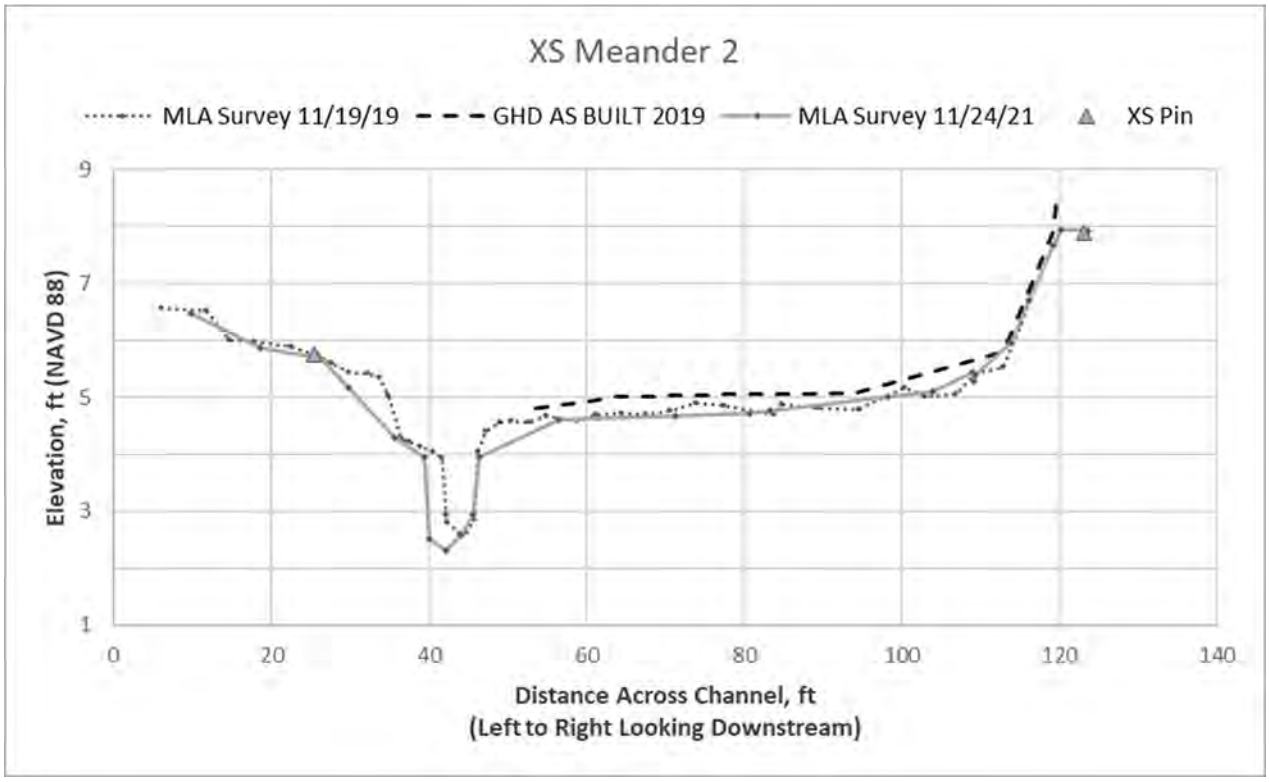
Martin Slough Monitoring Cross Sections



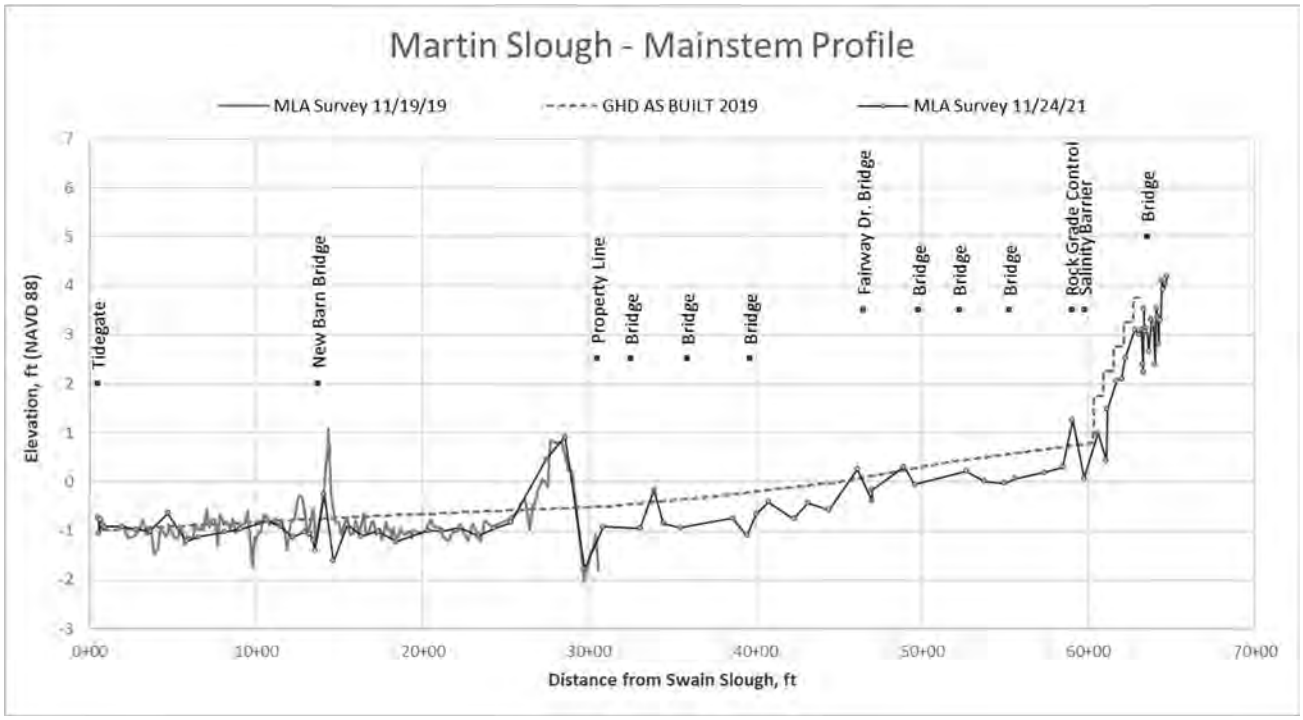


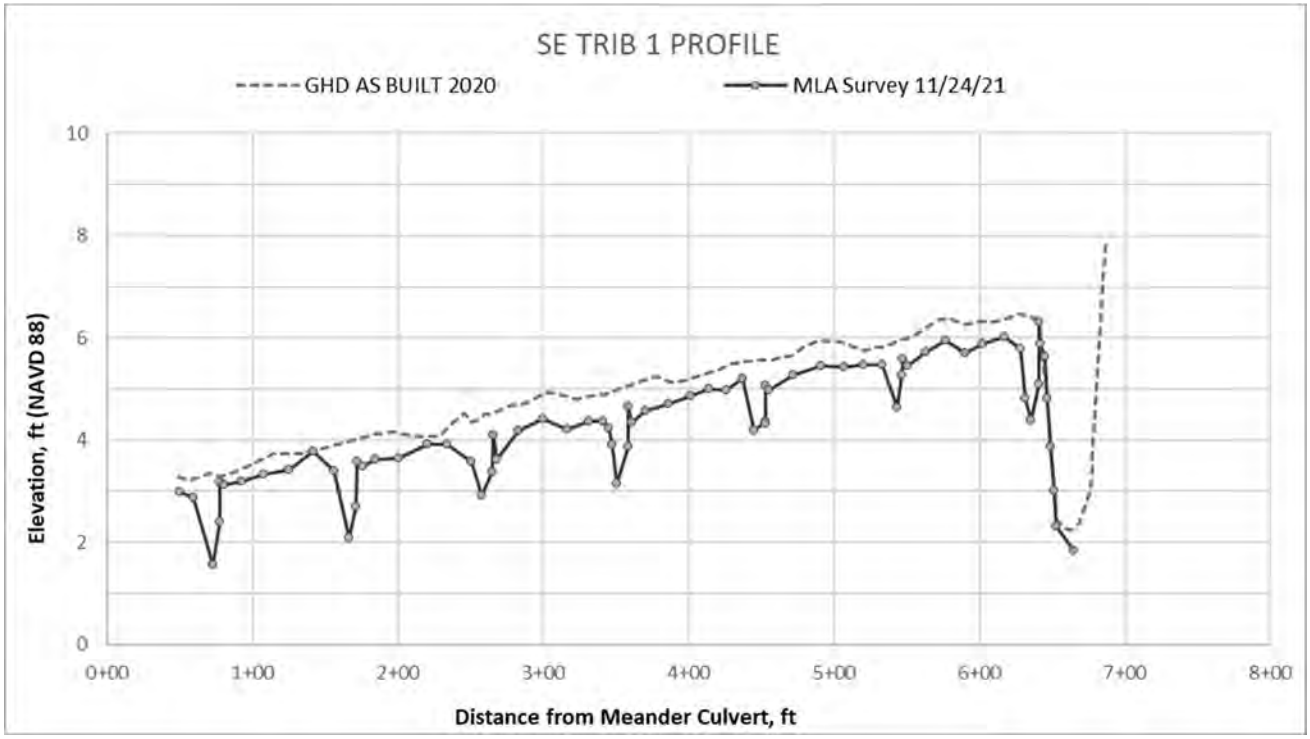
Martin Slough Monitoring Cross Sections



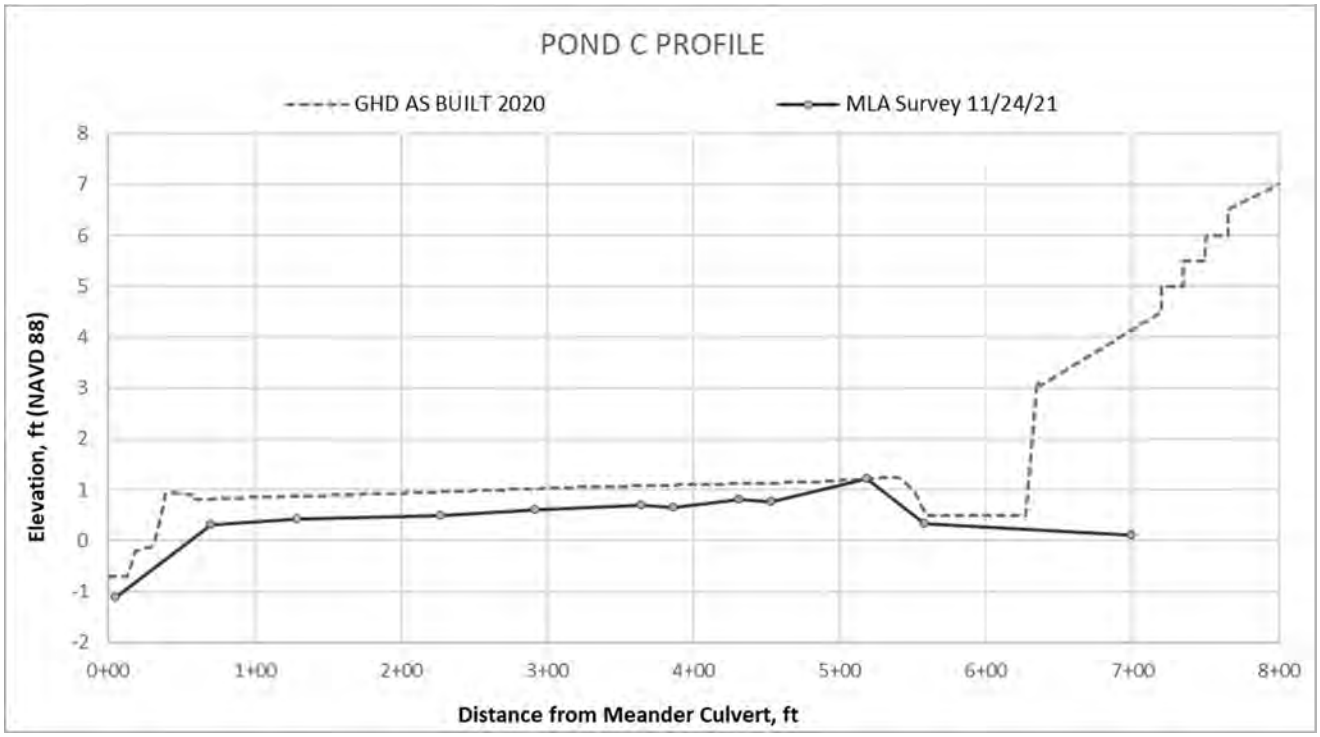


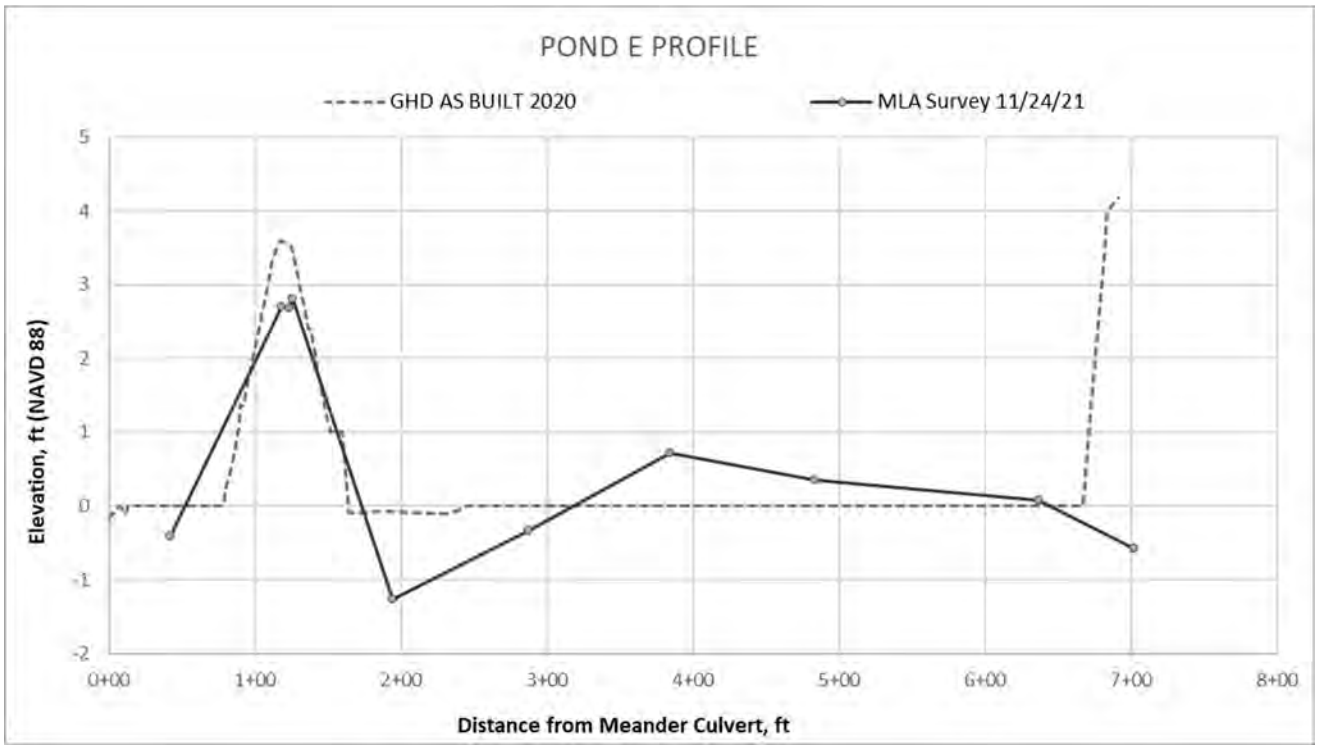
Martin Slough Monitoring Profiles





Martin Slough Monitoring Profiles





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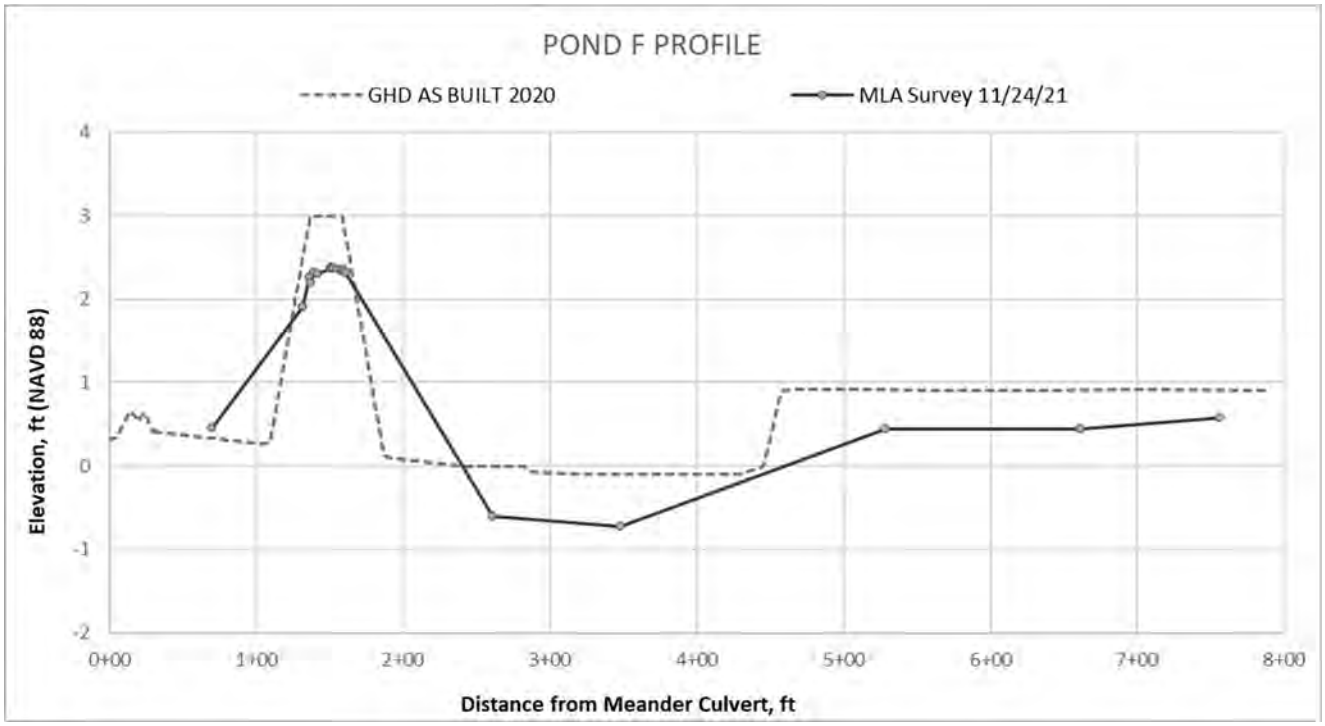


Appendix B

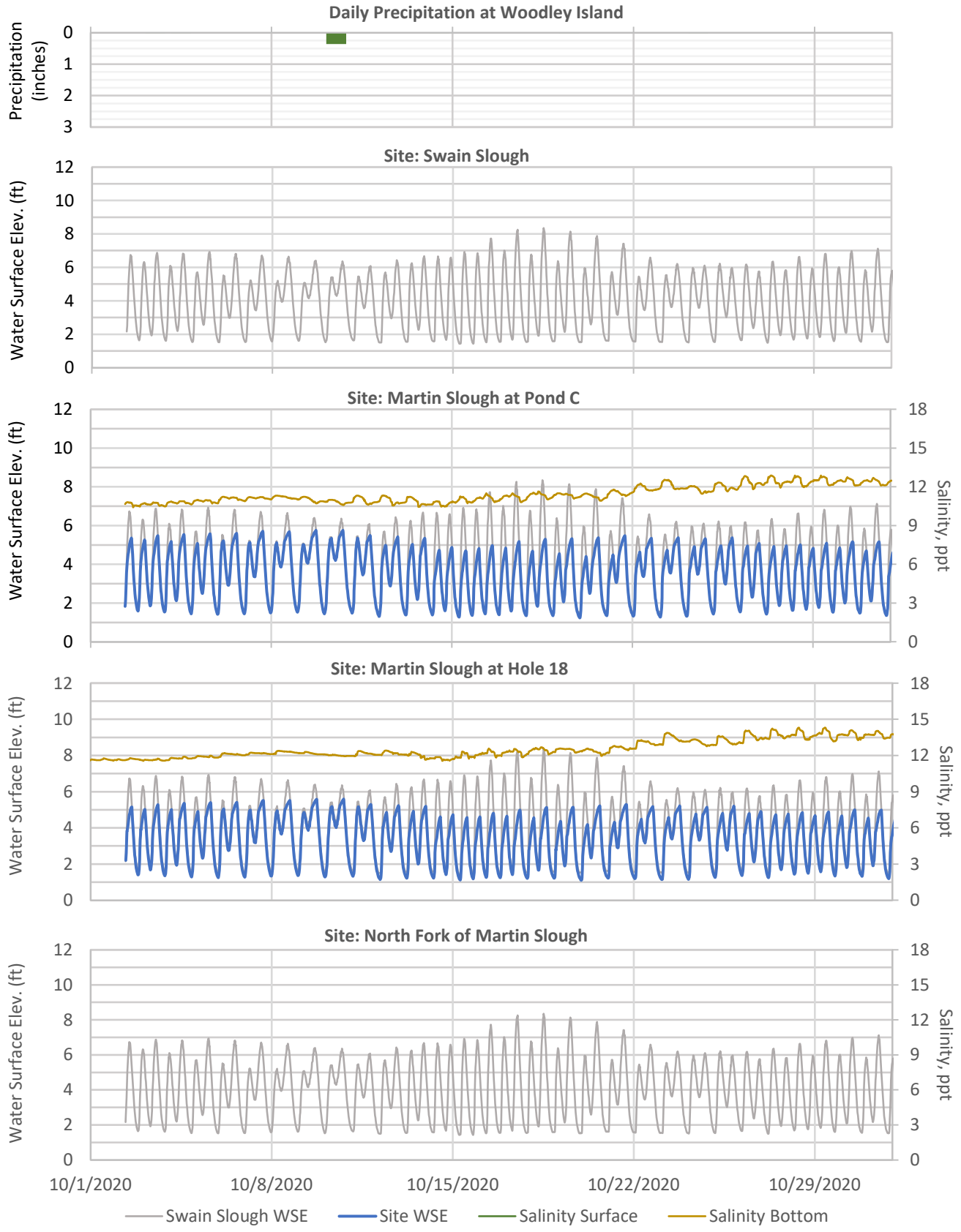
Martin Slough Water Level and Water Quality Data
Water Year 2021:

Stage and Salinity Plots

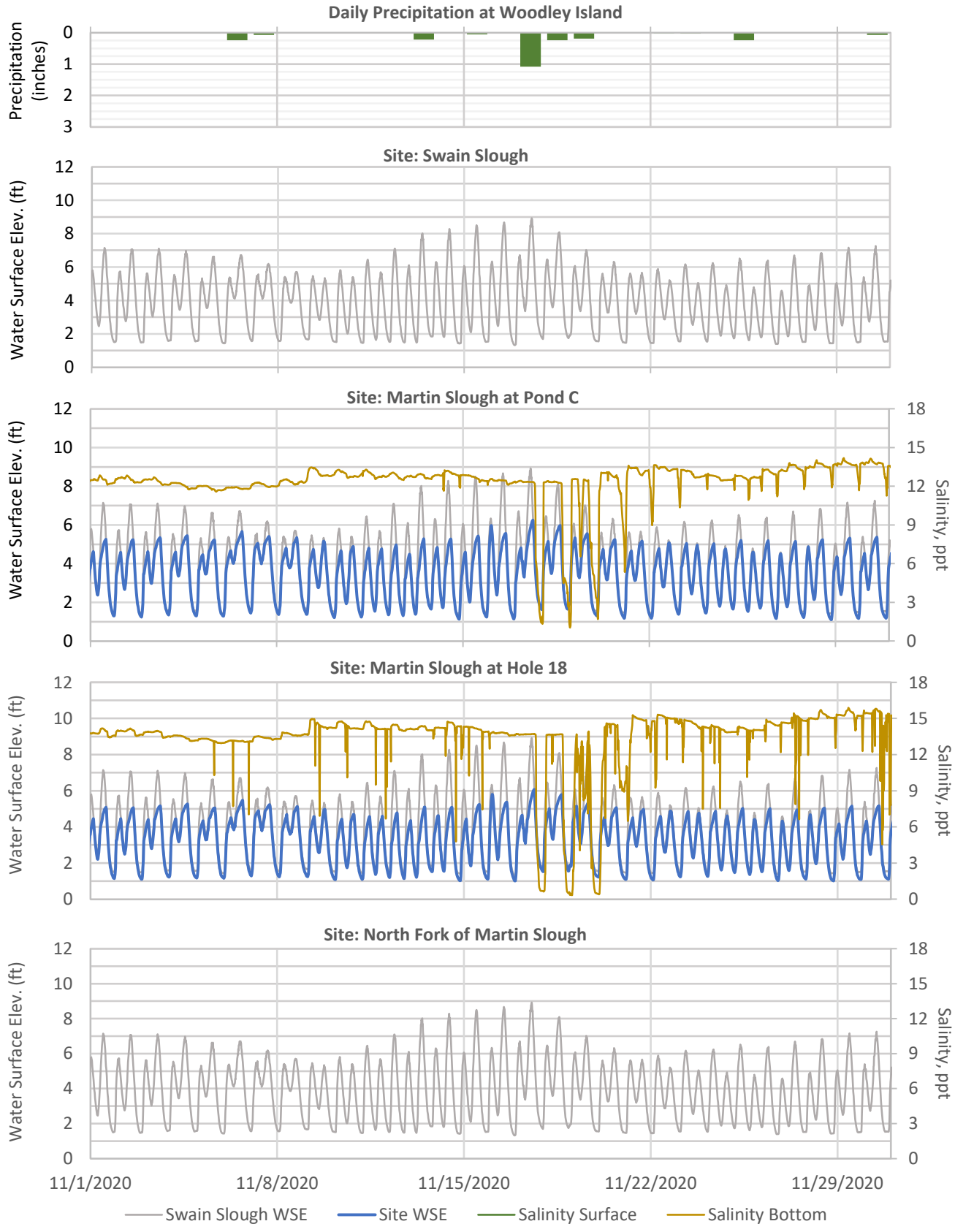
Martin Slough Water Level and Water Quality Data:

Stage and Salinity Plots

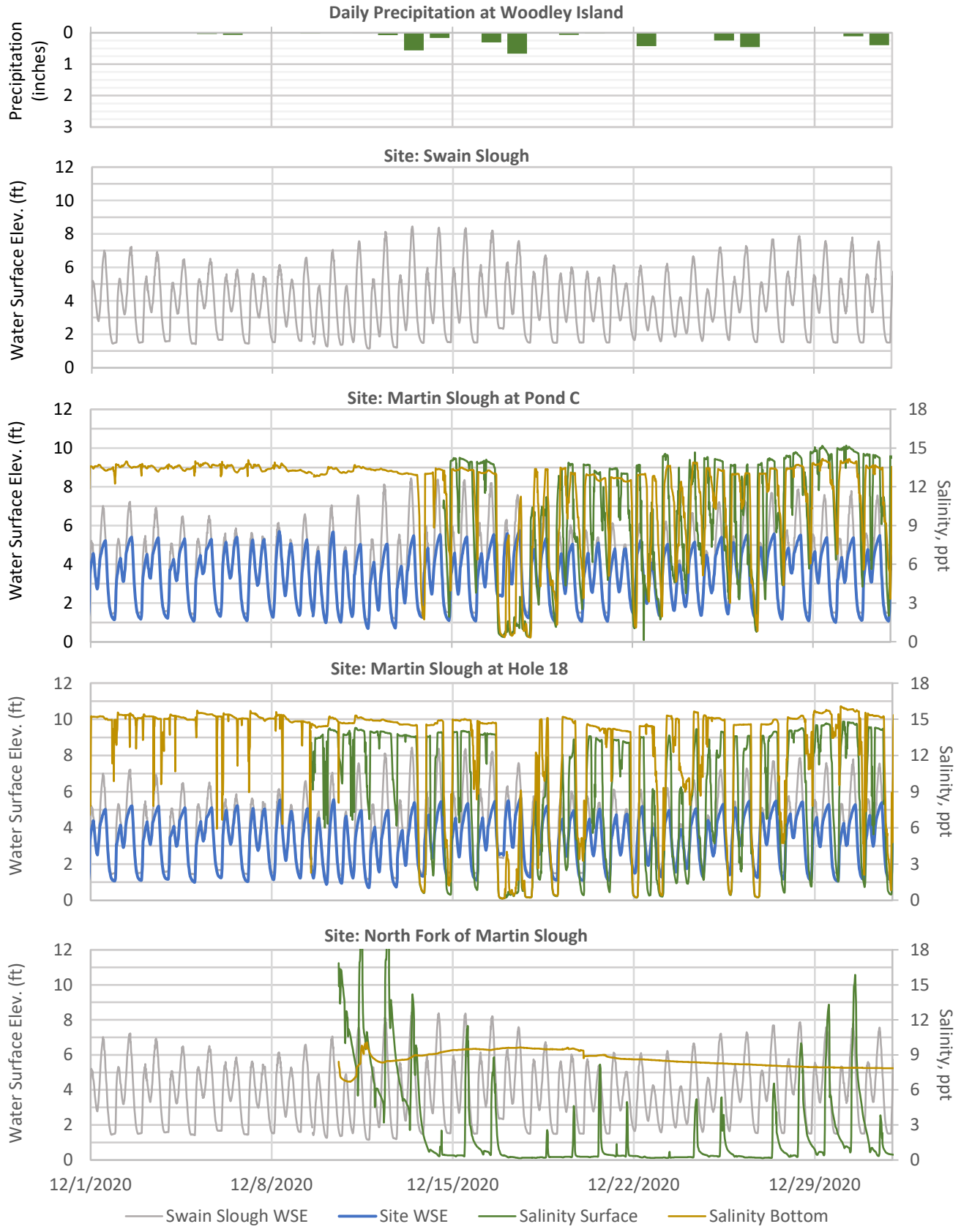
Martin Slough **OCTOBER 2020**



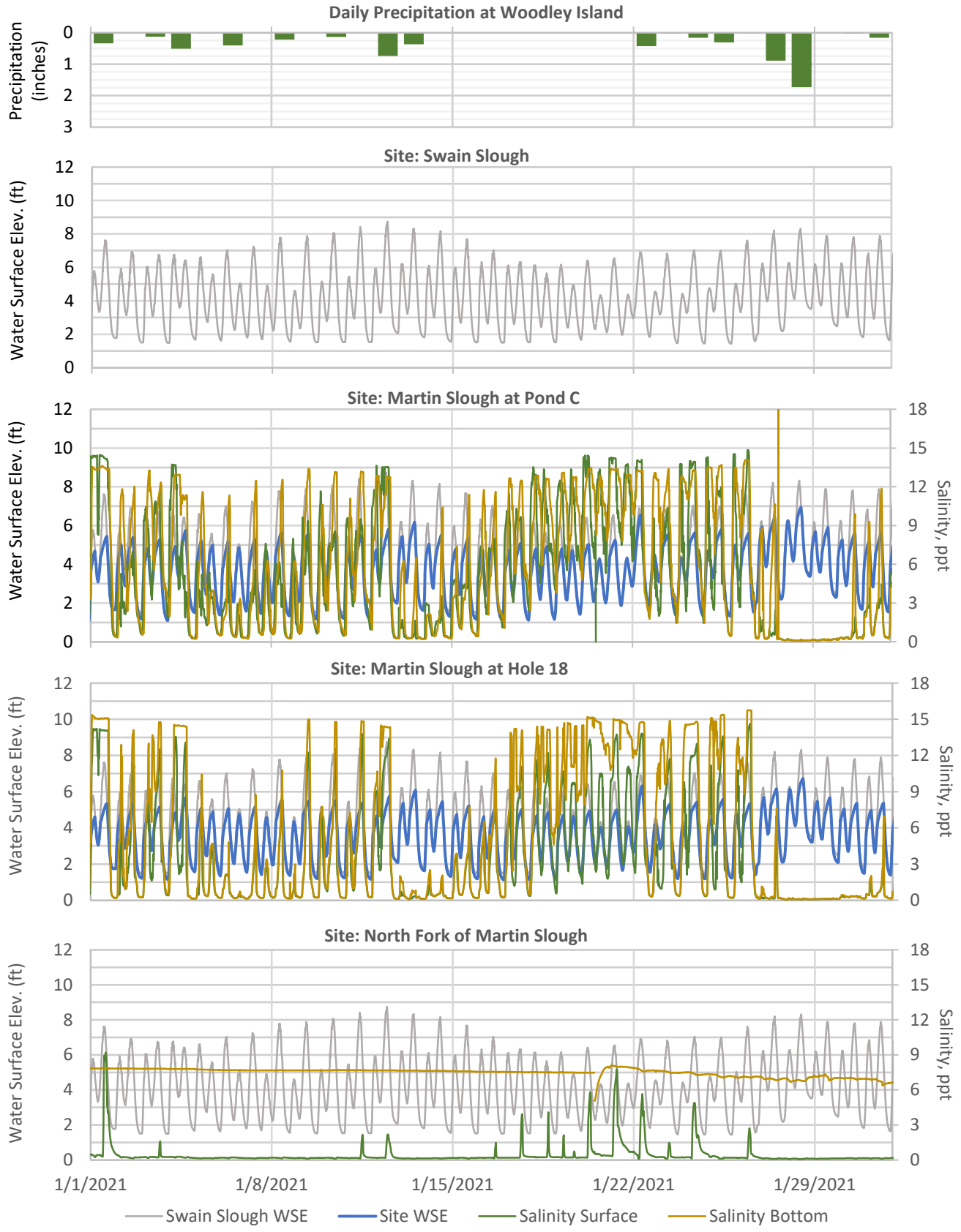
Martin Slough **NOVEMBER 2020**



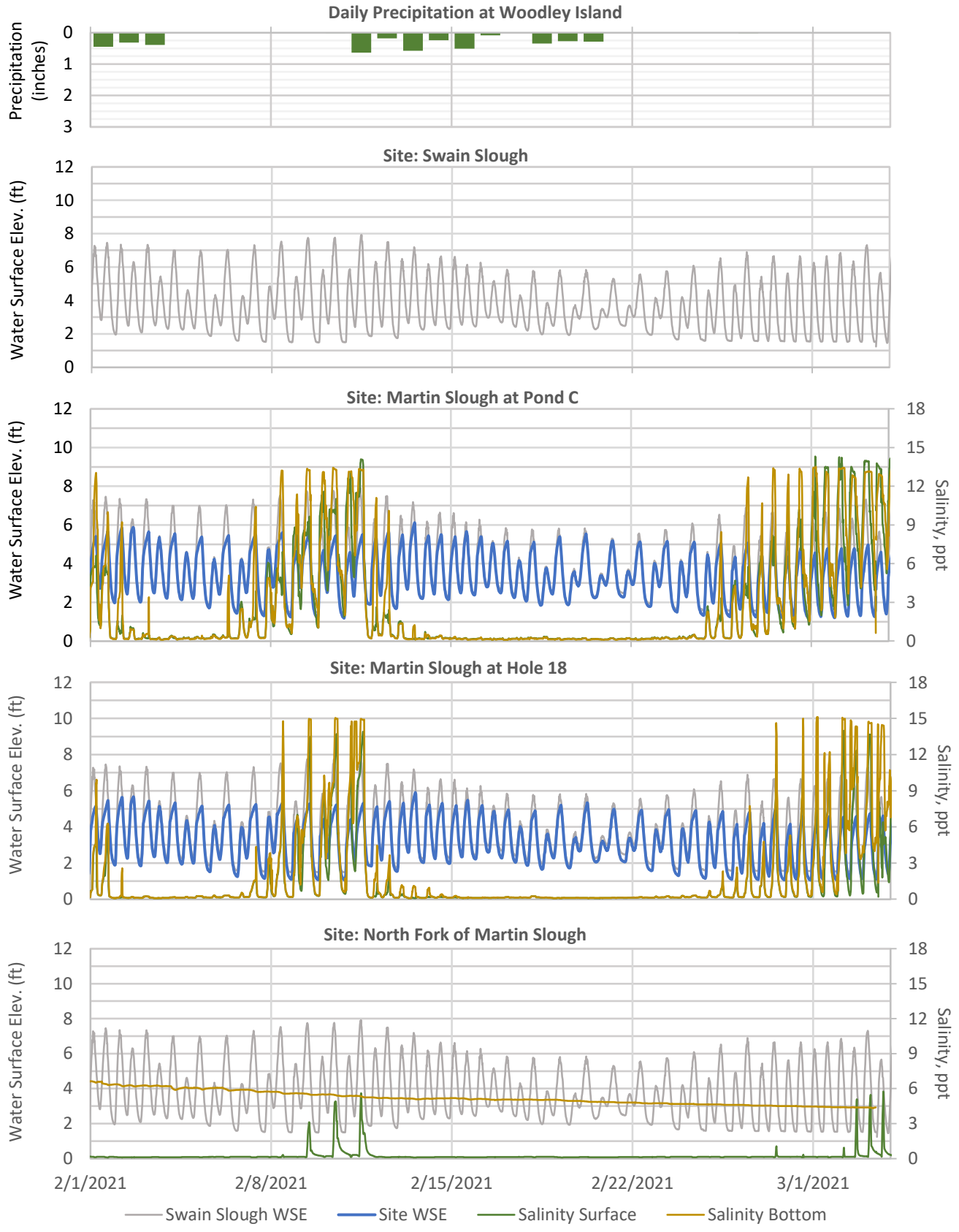
Martin Slough **DECEMBER 2020**



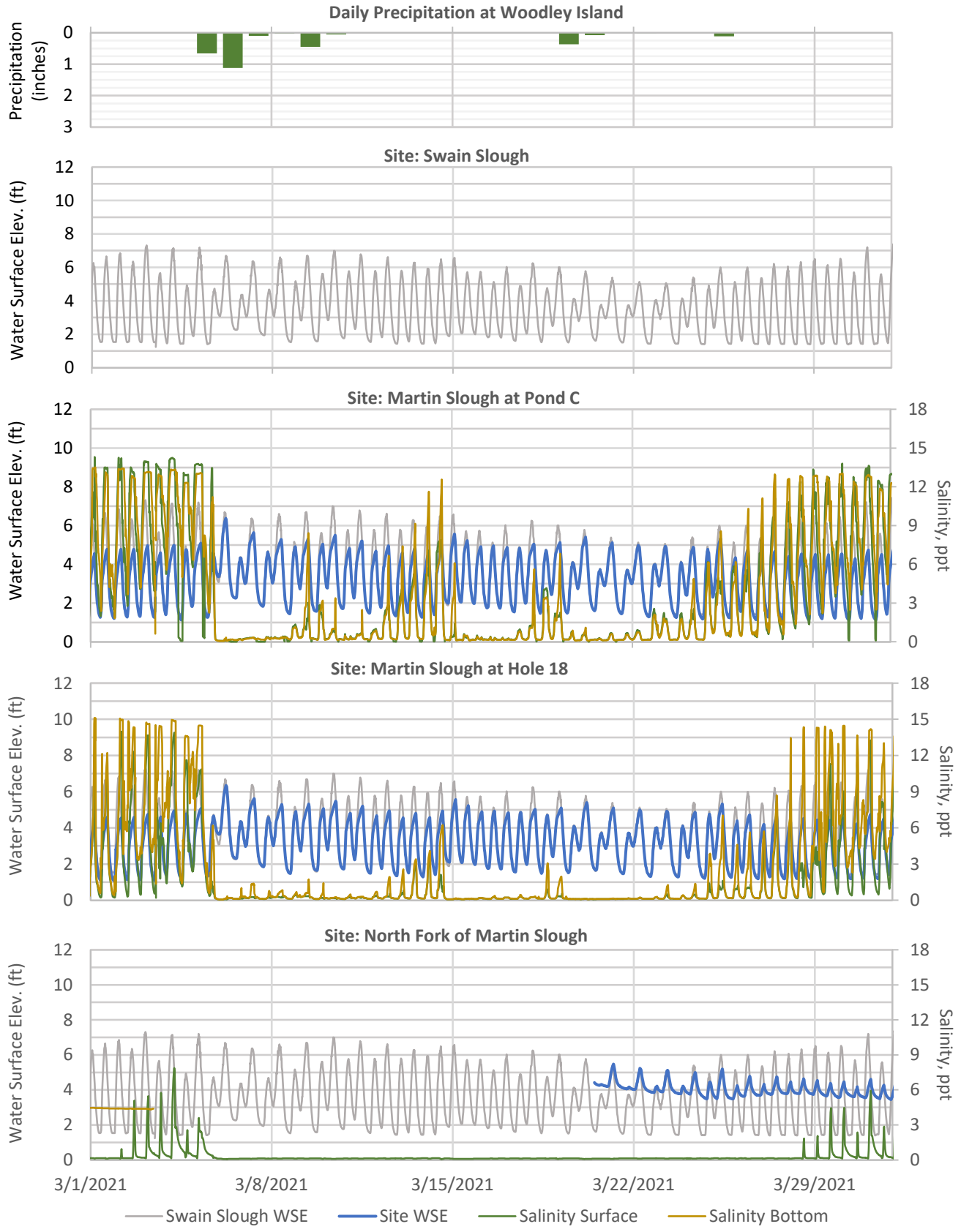
Martin Slough **JANUARY 2021**



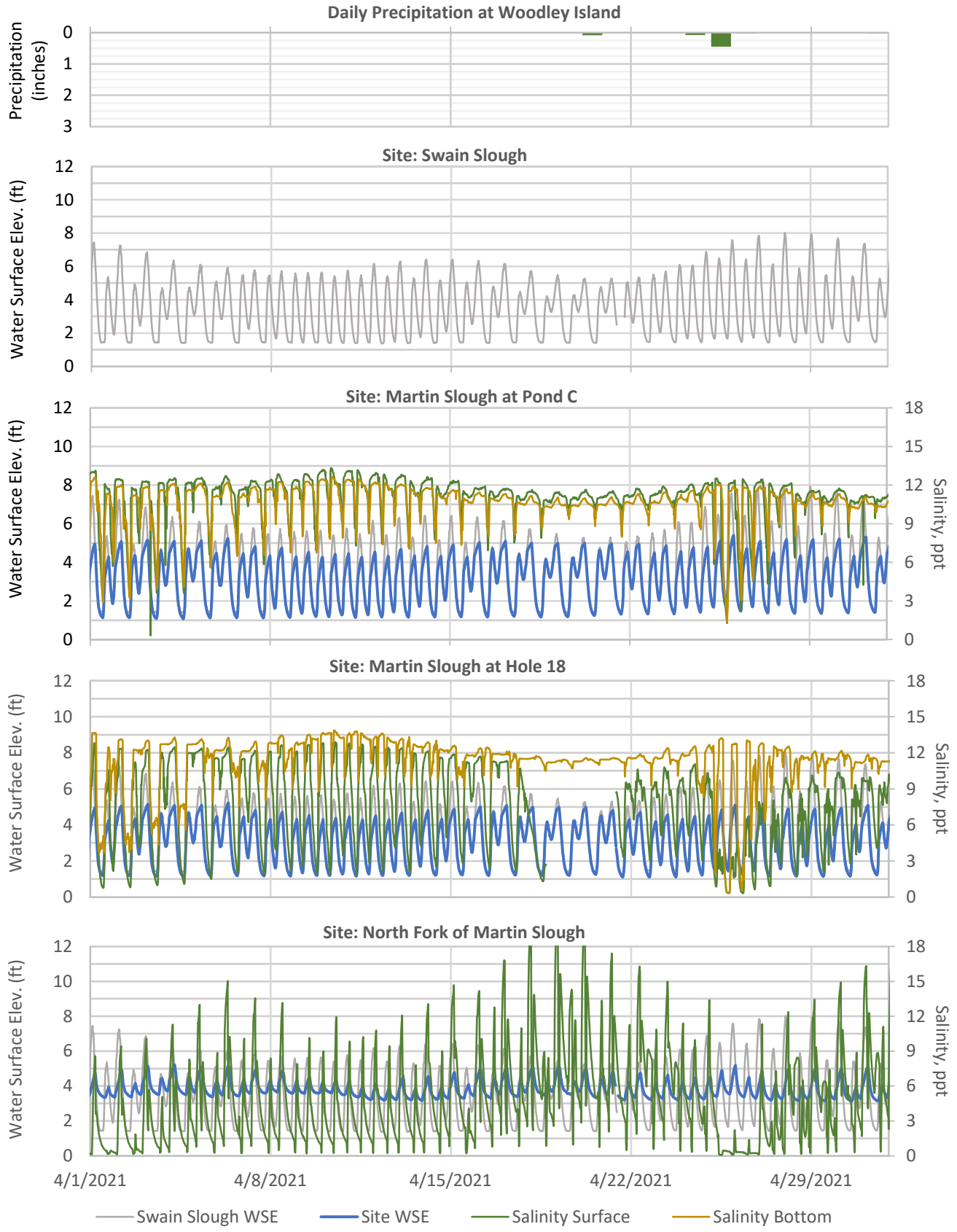
Martin Slough **FEBRUARY 2021**



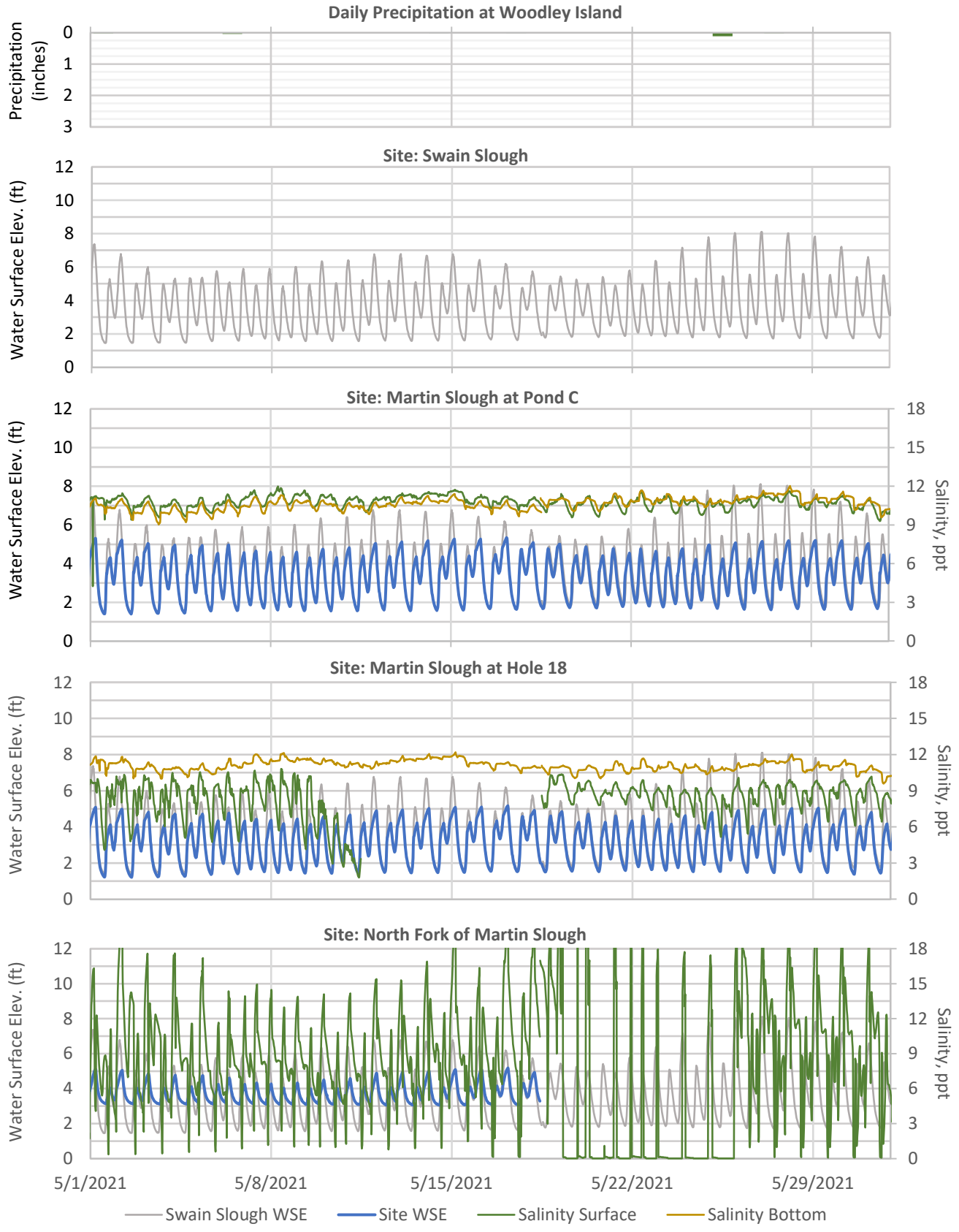
Martin Slough **MARCH 2021**



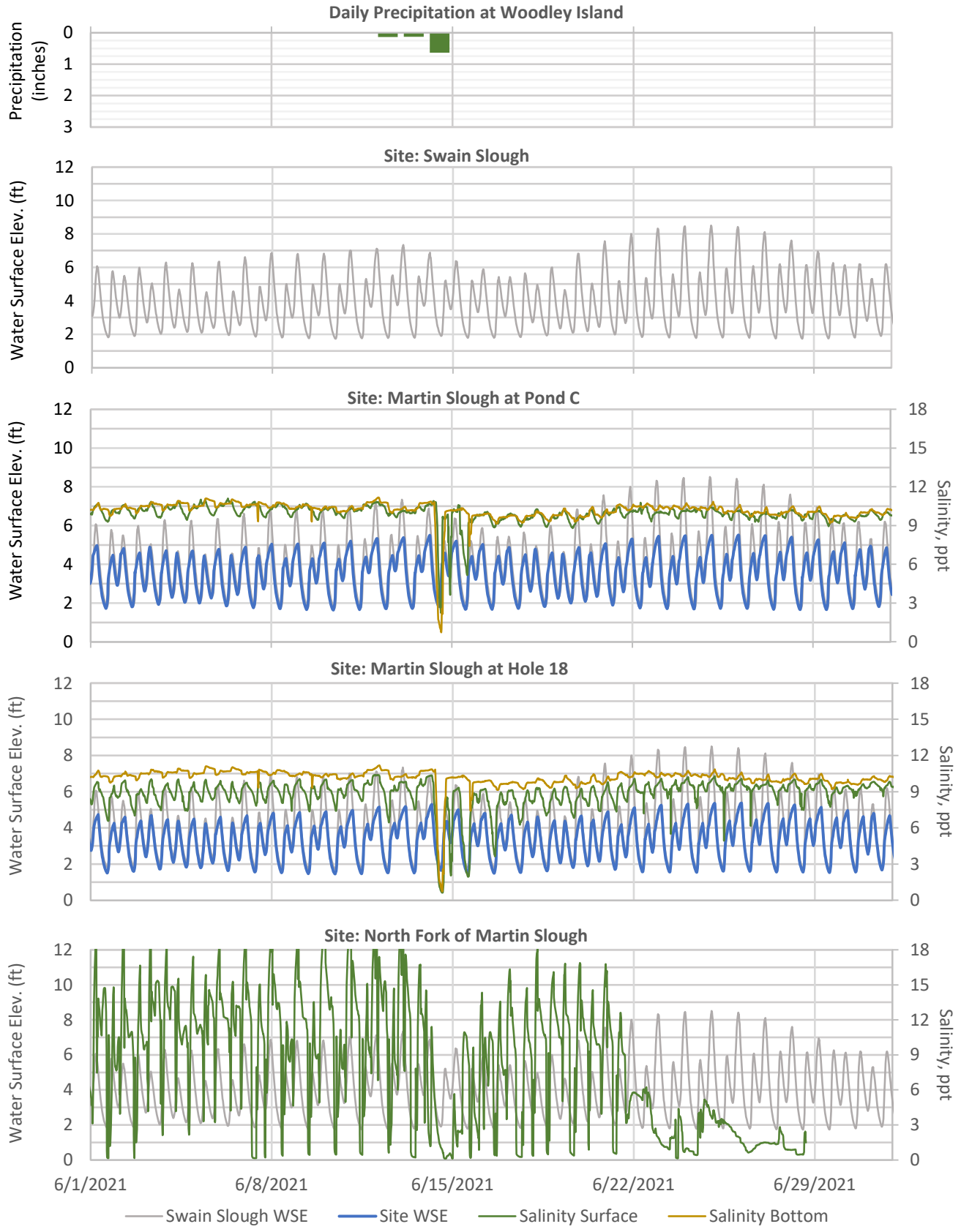
Martin Slough **APRIL 2021**



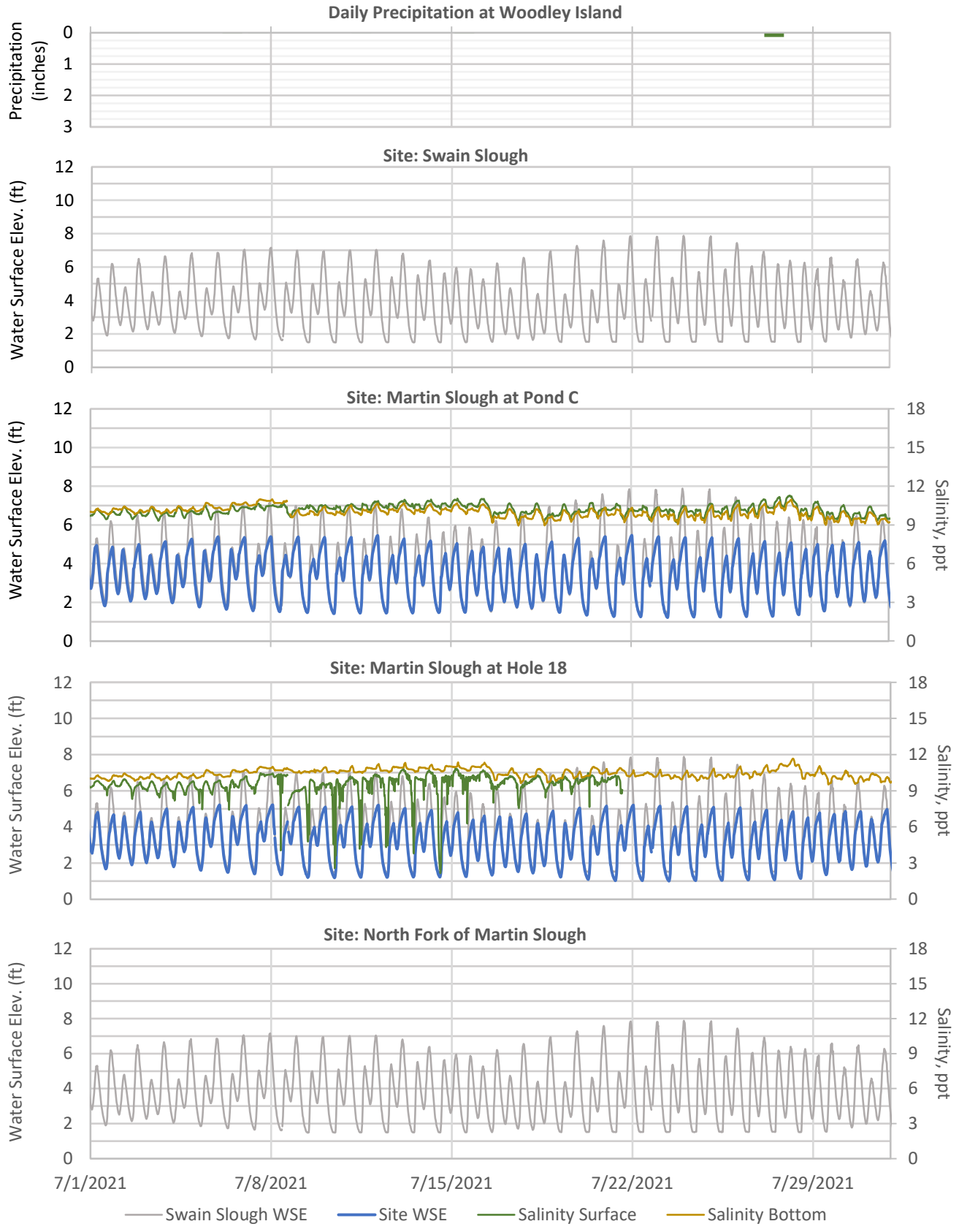
Martin Slough **May 2021**



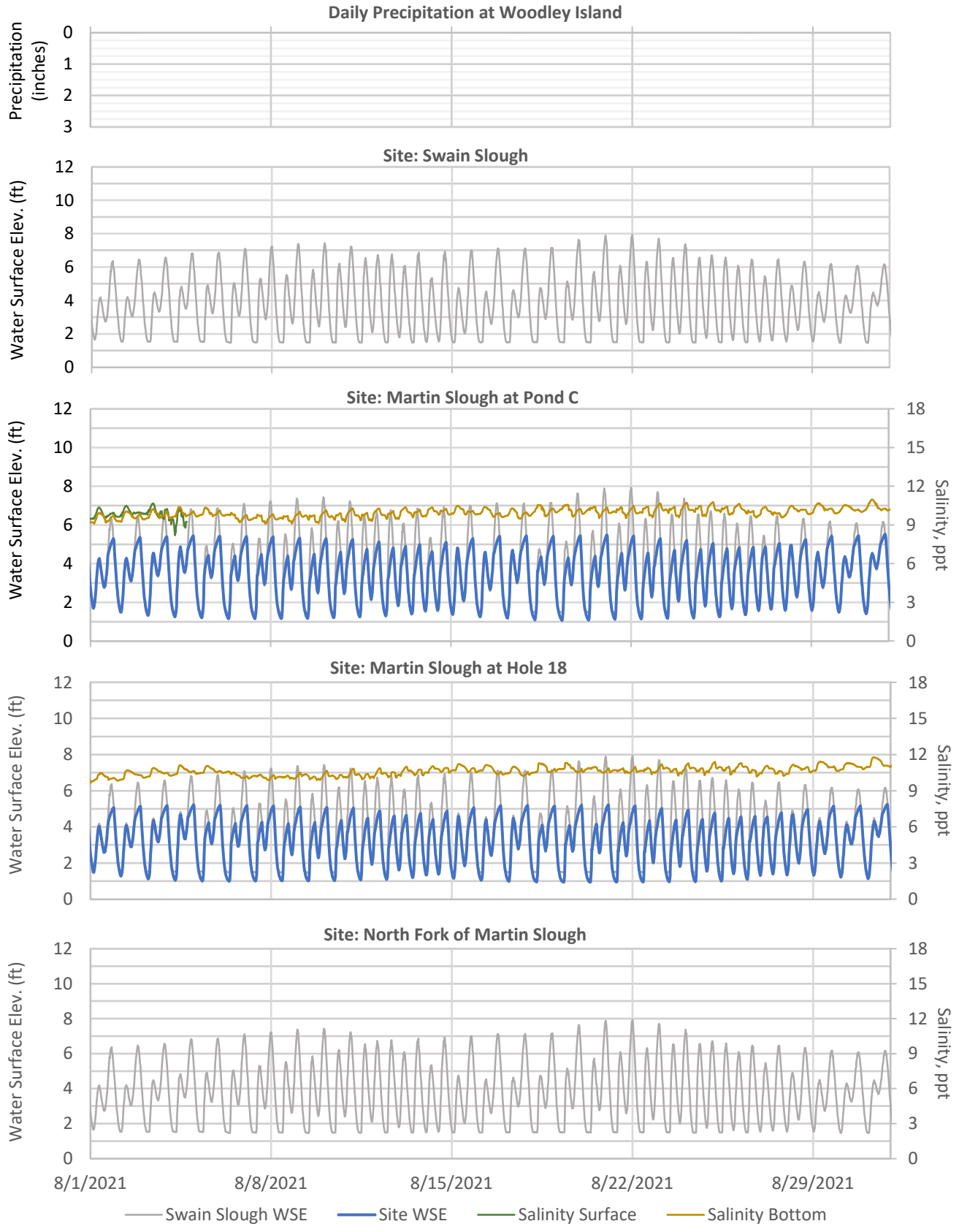
Martin Slough **June 2021**



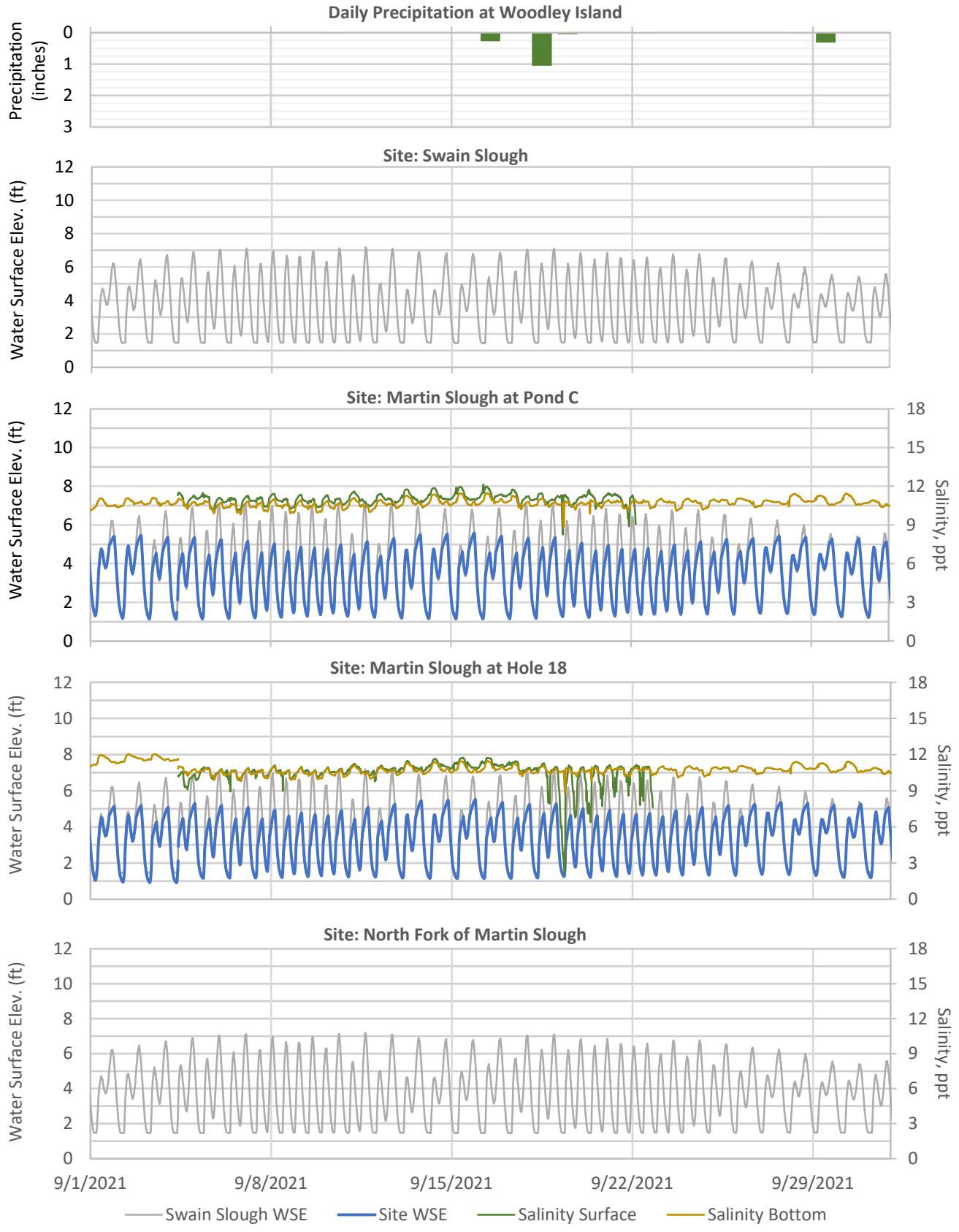
Martin Slough **July 2021**



Martin Slough **August 2021**



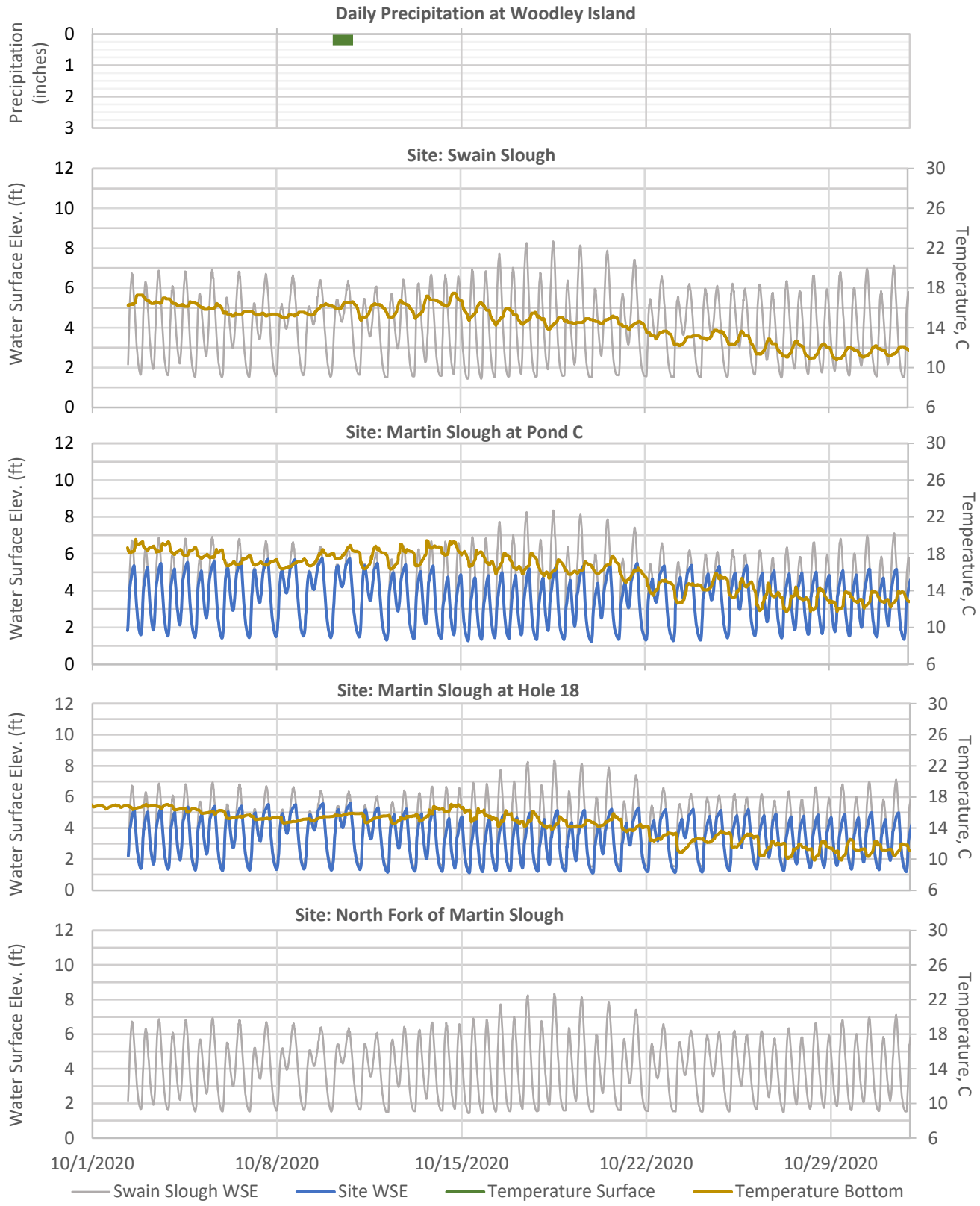
Martin Slough **September 2021**



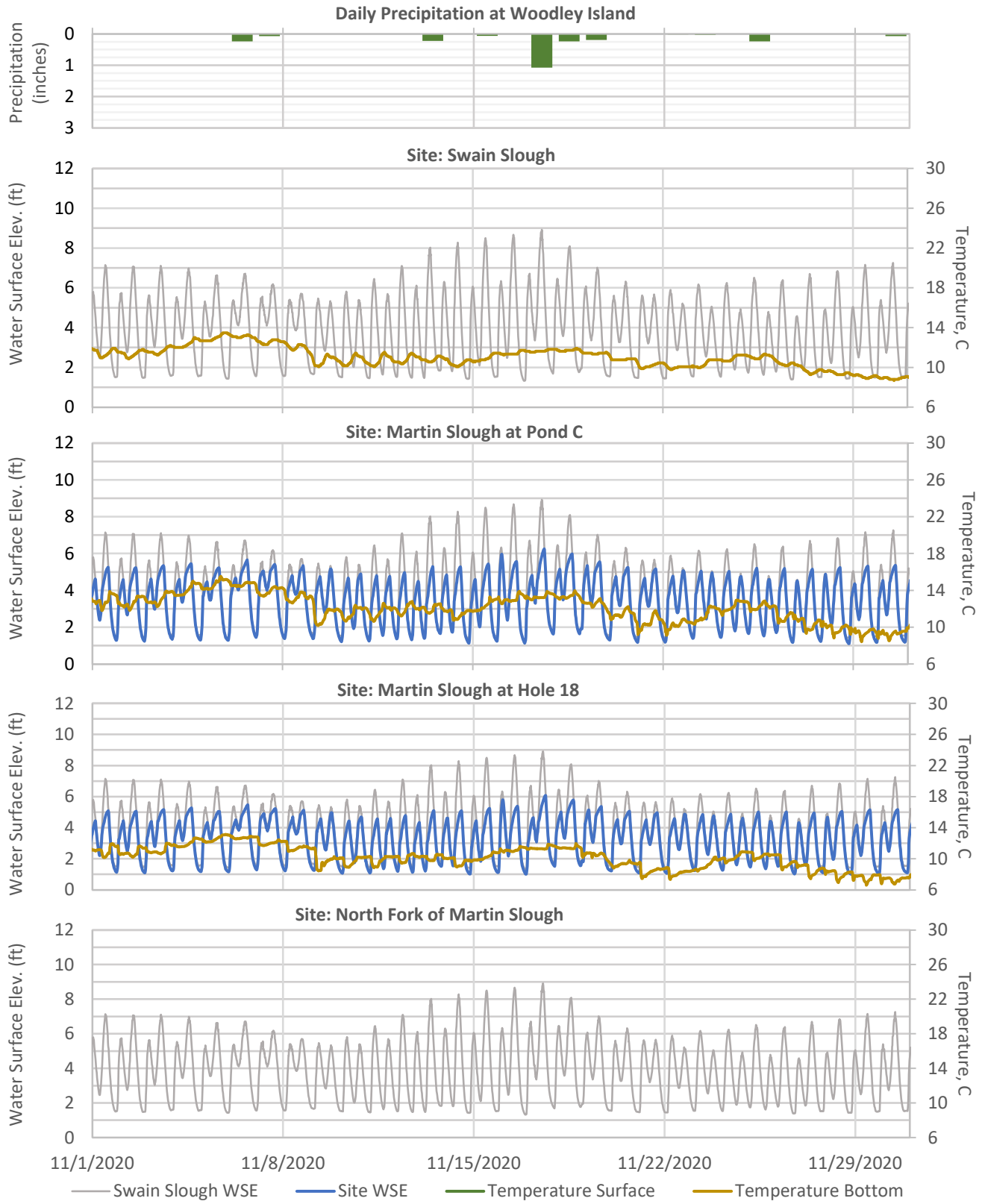
Martin Slough Water Level and Water Quality Data:

Stage and Temperature Plots

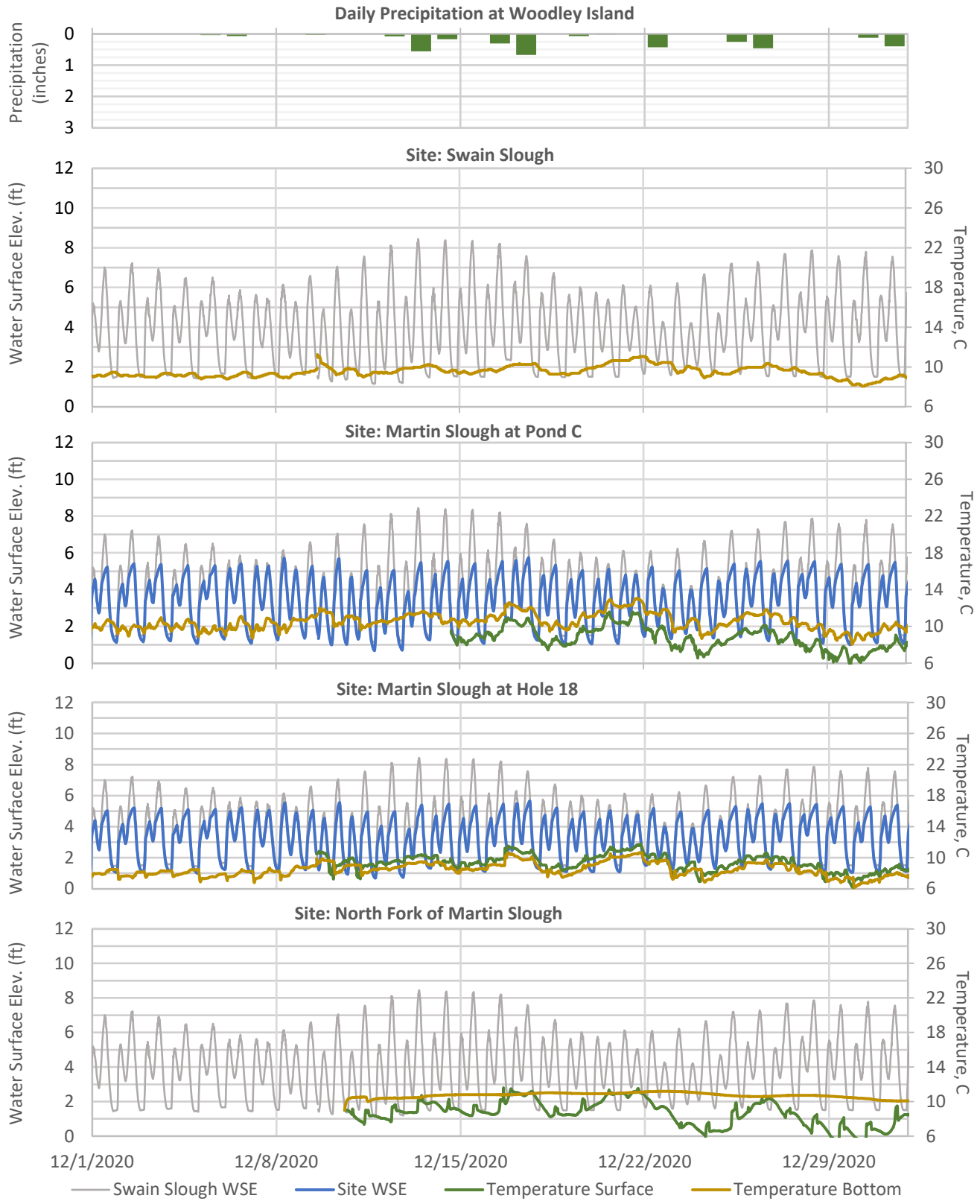
Martin Slough **October 2020**



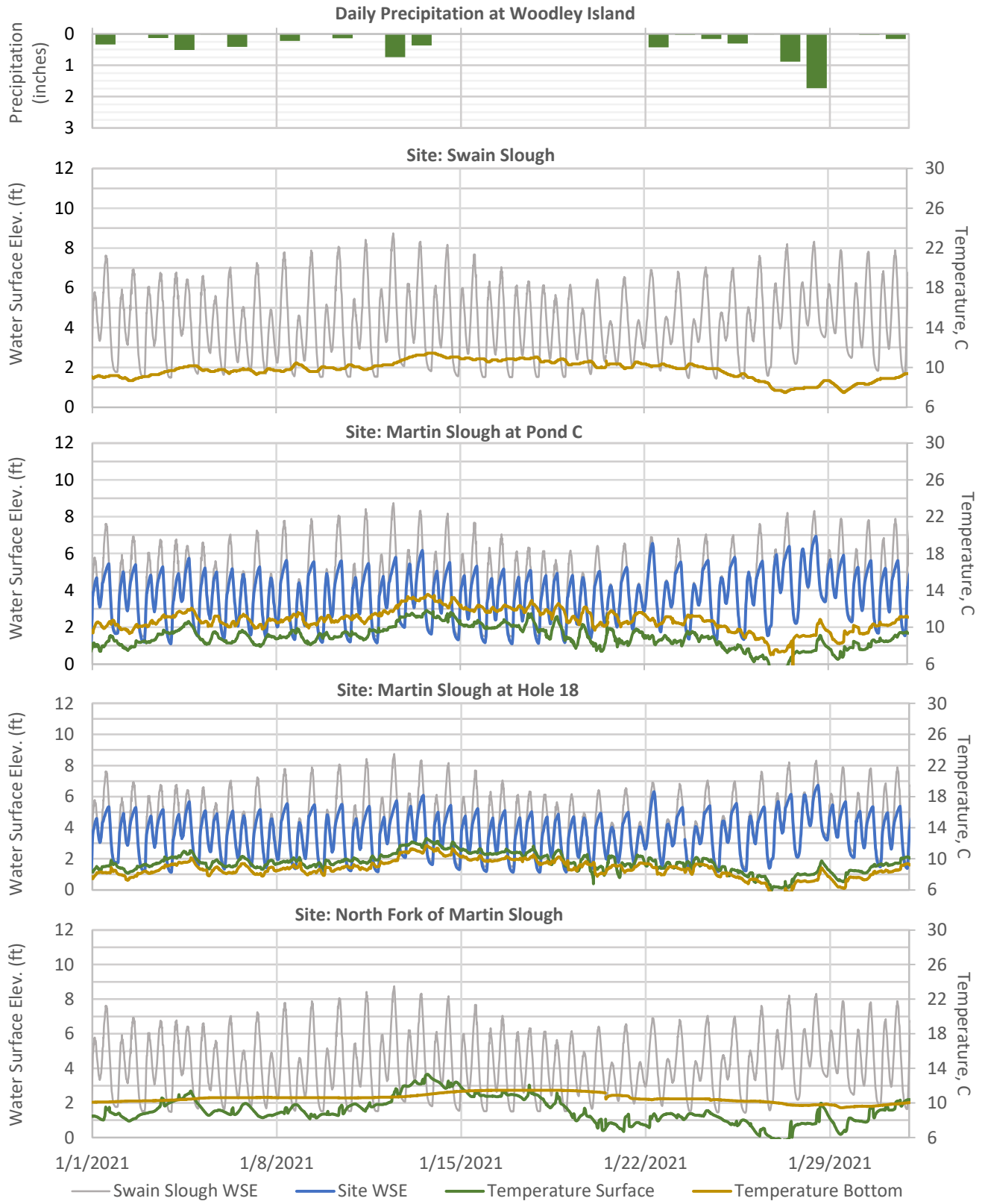
Martin Slough **November 2020**



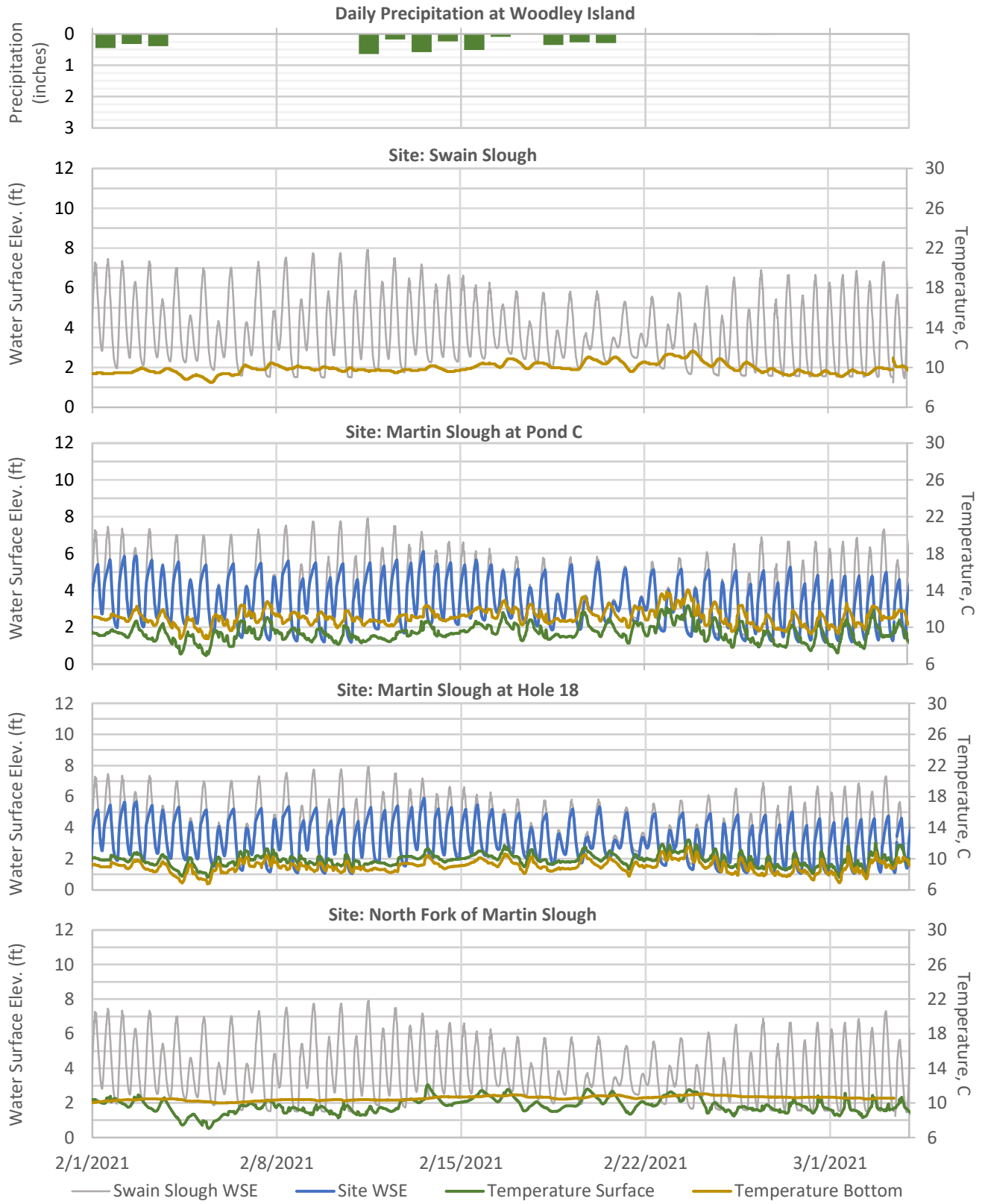
Martin Slough **December 2020**



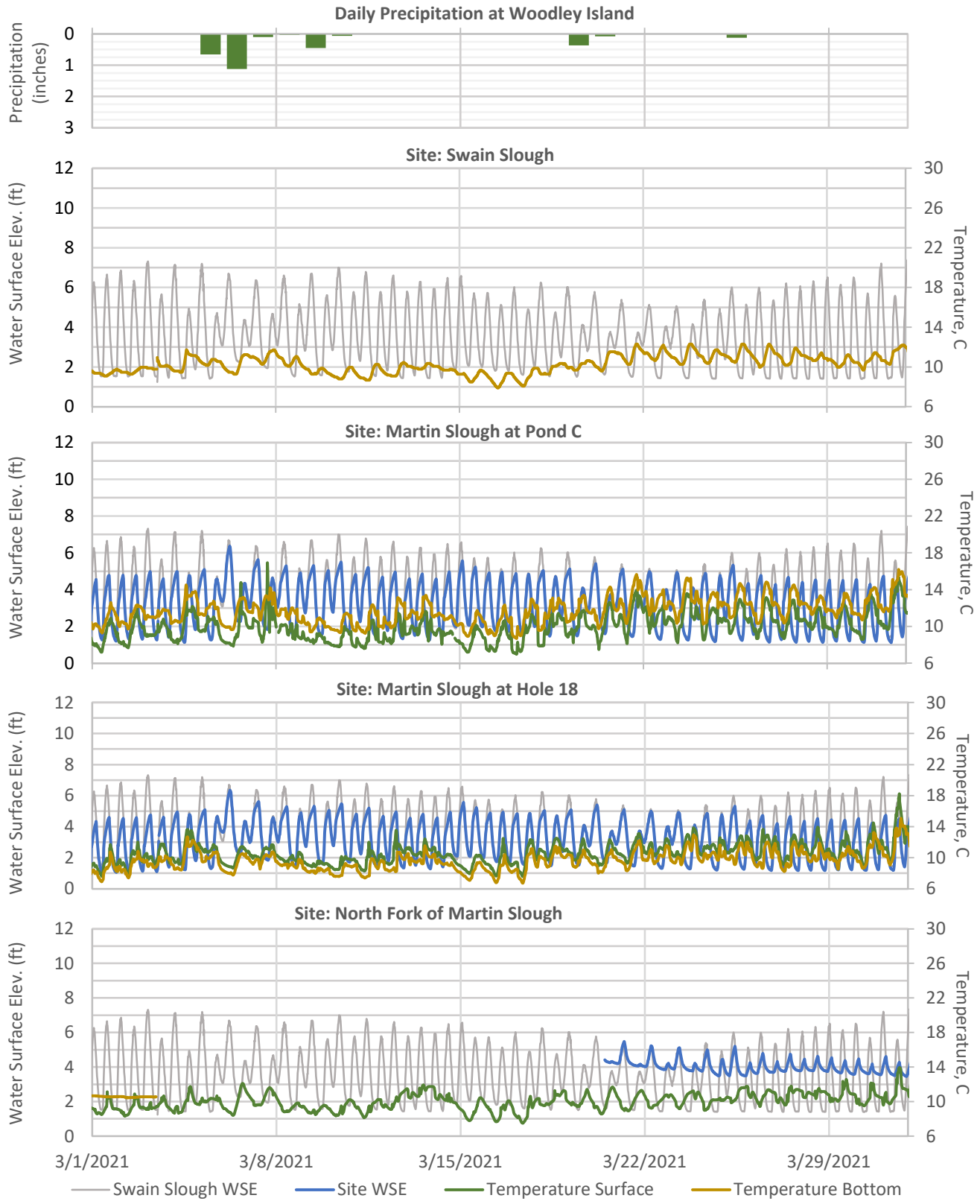
Martin Slough **January 2021**



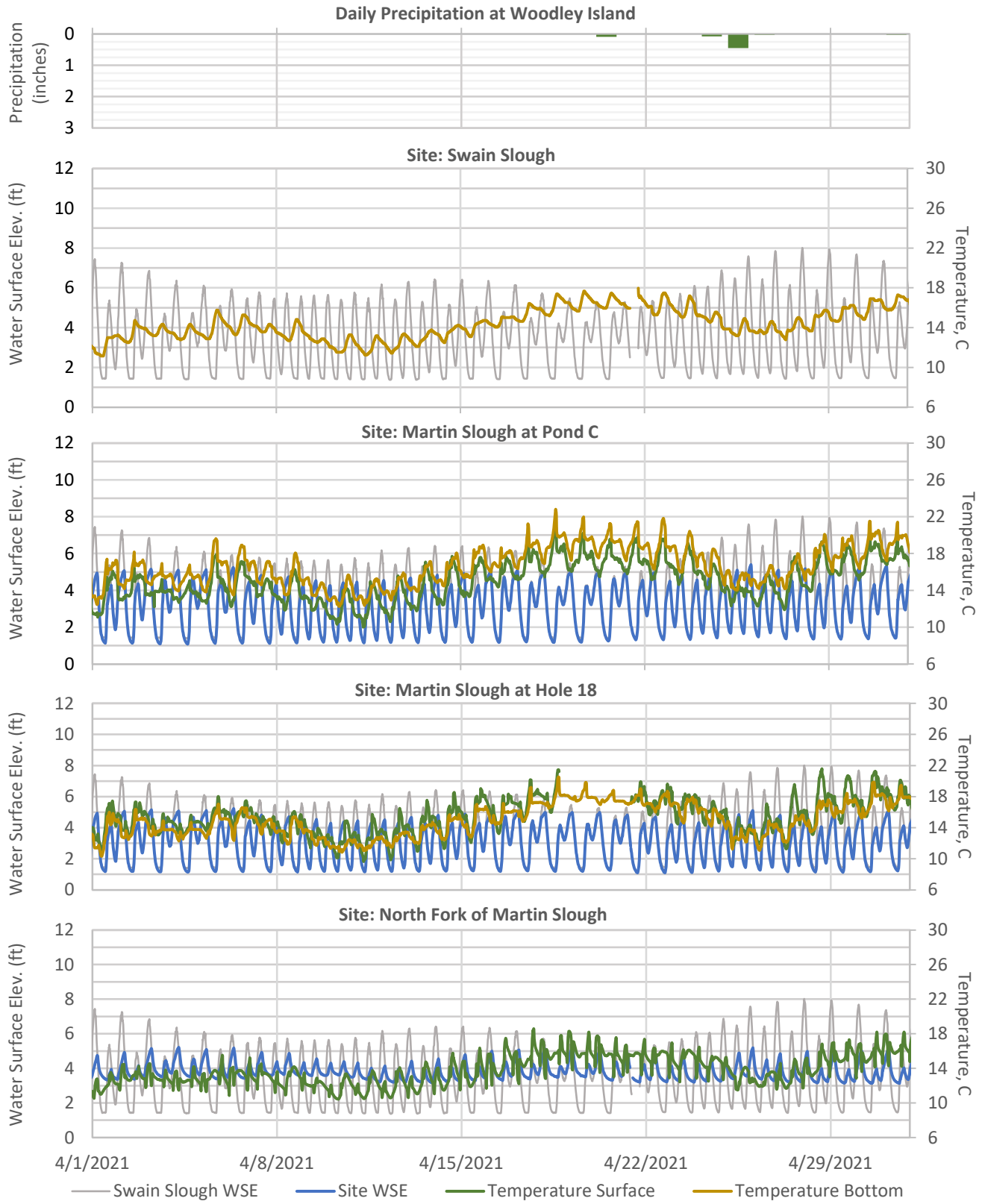
Martin Slough **February 2021**



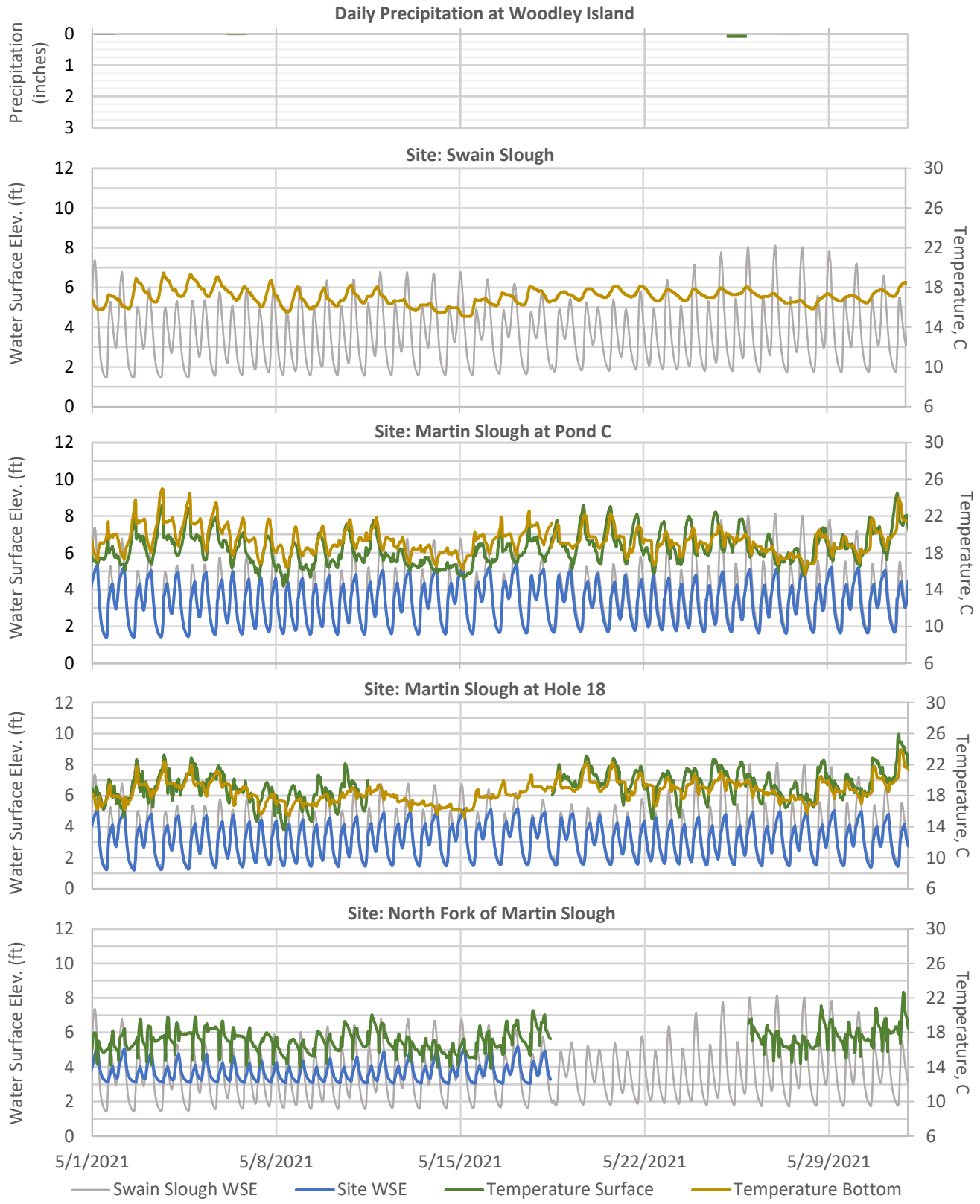
Martin Slough **March 2021**



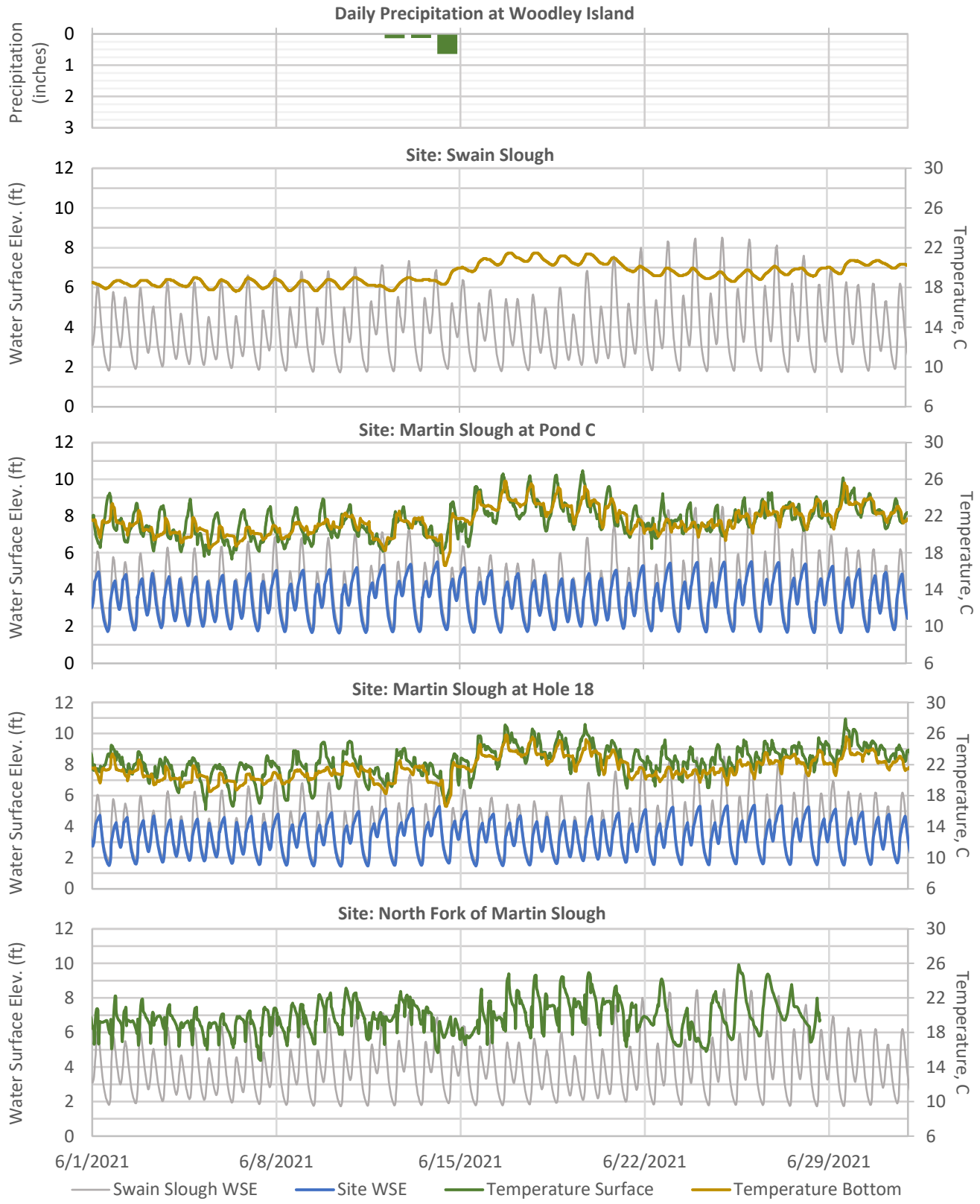
Martin Slough **April 2021**



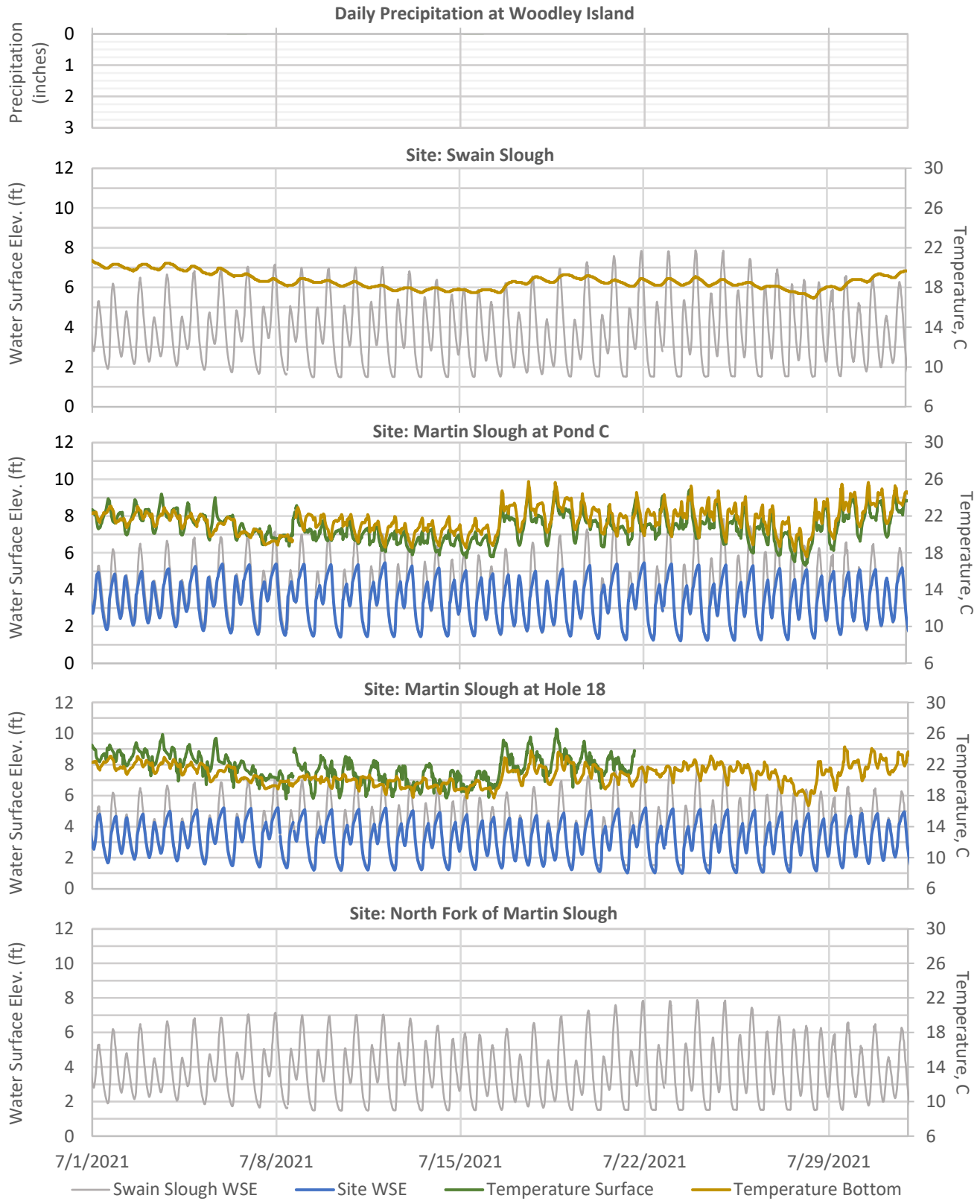
Martin Slough **May 2021**



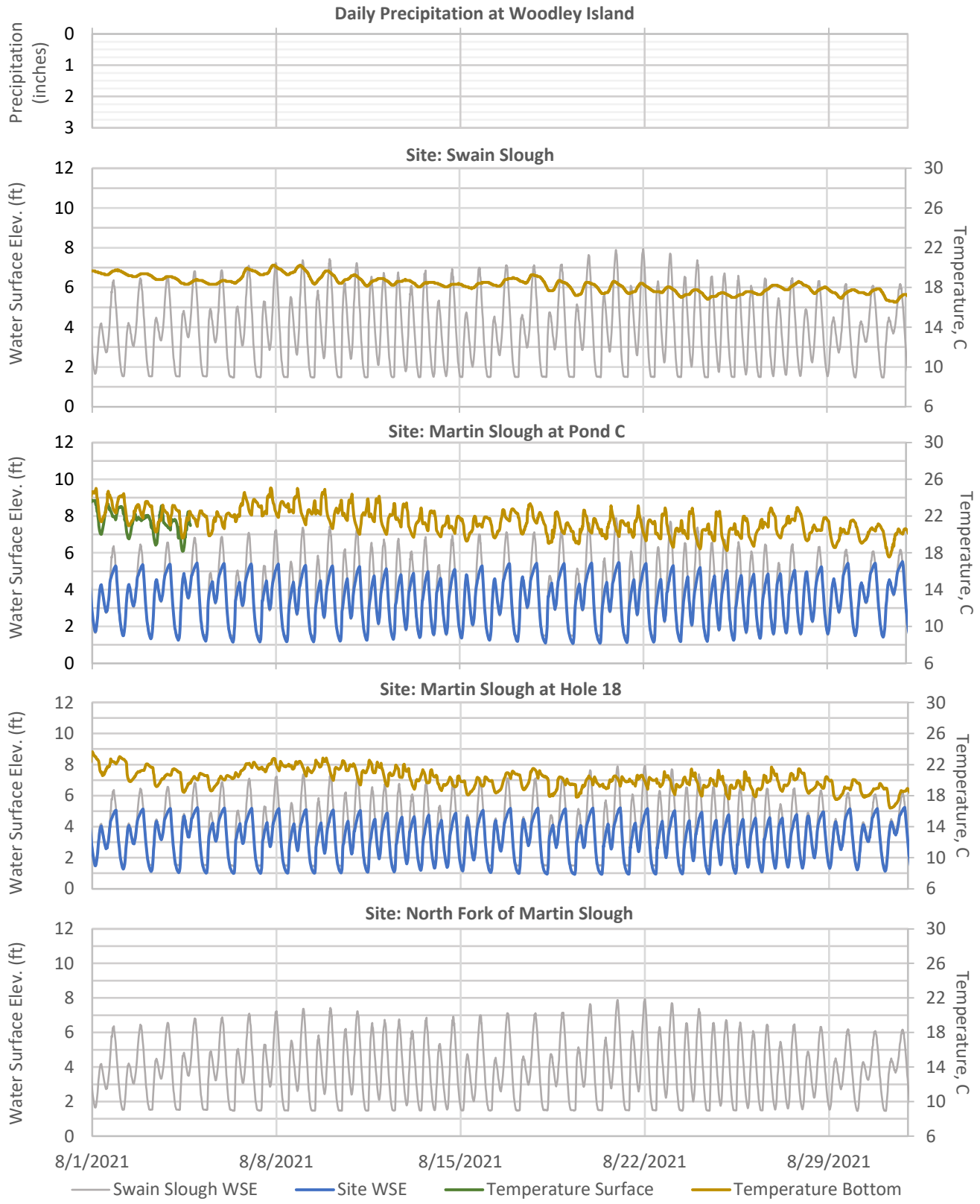
Martin Slough **June 2021**



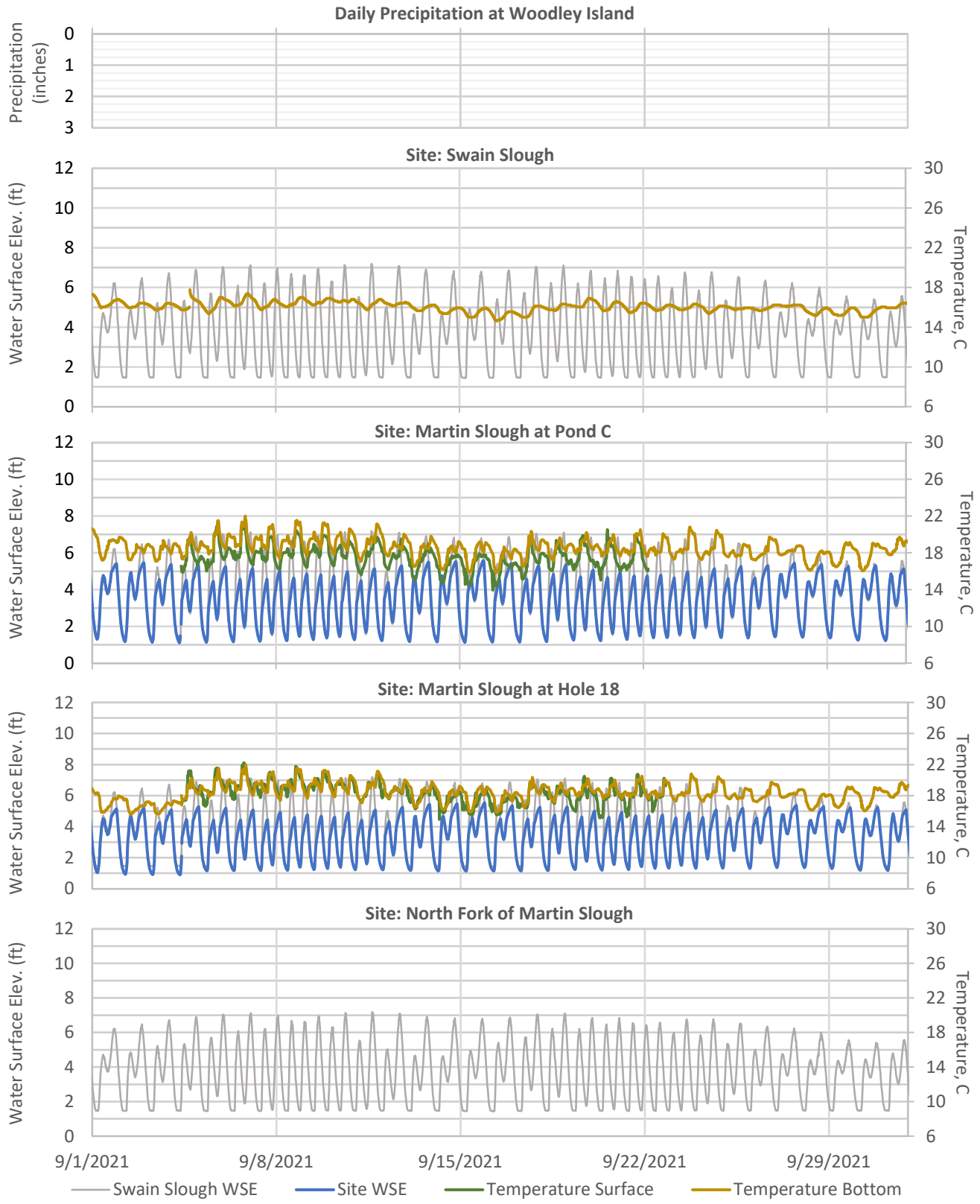
Martin Slough **July 2021**



Martin Slough **August 2021**



Martin Slough **Sepember 2021**



Appendix C

Martin Slough Water Quality Spot Measurements

Martin Slough Channel Enhancement 2021

Discrete Measurements of Water Surface Elevations (WSE) and Water Quality Parameters

Date: September 14, 2020			Period: Post Project						
			Surface			Bottom			
Gage Location	Time (PST)	WSE NAVD88 (ft)	D.O. (mg/L)	Salinity (ppt)	Temp (^{o}C)	D.O. (mg/L)	Salinity (ppt)	Temp (^{o}C)	Tide at Gage
Swain Slough	3:15 PM	3.47	4.6	28.0	17.4	3.2	30.9	16.0	
MS POND C	4:30 PM	2.45	4.6	28.0	17.4	3.2	30.9	16.0	
MS-18	1:45 PM	4.31	6.9	23.7	17.4	3.5	28.0	16.1	
MS-NF	10:45 AM	4.80	6.7	0.1	13.4	5.7	0.1	13.4	

Date: January 20, 2021			Period: Post Project						
			Surface			Bottom			
Gage Location	Time (PST)	WSE NAVD88 (ft)	D.O. (mg/L)	Salinity (ppt)	Temp (^{o}C)	D.O. (mg/L)	Salinity (ppt)	Temp (^{o}C)	Tide at Gage
Swain Slough	1:15 PM	2.60	7.3	10.8	9.7	0.0	0.0	0.0	
MS POND C	2:00 PM	2.74	9.4	8.4	9.2	7.4	16.9	9.3	
MS-18	12:00 PM	2.01	8.2	4.5	7.9	6.9	12.2	8.7	
MS-NF	11:30 AM	4.34	7.3	0.4	6.4	0.0	0.0	0.0	

Date: January 20, 2021			Period: Post Project						
			Surface			Bottom			
Gage Location	Time (PST)	WSE NAVD88 (ft)	D.O. (mg/L)	Salinity (ppt)	Temp (^{o}C)	D.O. (mg/L)	Salinity (ppt)	Temp (^{o}C)	Tide at Gage
Swain Slough	1:15 PM	2.60	7.3	10.8	9.7	0.0	0.0	0.0	
MS POND C	2:00 PM	2.74	9.4	8.4	9.2	7.4	16.9	9.3	
MS-18	12:00 PM	2.01	8.2	4.5	7.9	6.9	12.2	8.7	
MS-NF	11:30 AM	4.34	7.3	0.4	6.4	0.0	0.0	0.0	

Date: March 3, 2021			Period: Post Project						
			Surface			Bottom			
Gage Location	Time (PST)	WSE NAVD88 (ft)	D.O. (mg/L)	Salinity (ppt)	Temp (^{o}C)	D.O. (mg/L)	Salinity (ppt)	Temp (^{o}C)	Tide at Gage
Swain Slough	11:15 AM	1.53	8.0	22.0	9.0	0.0	0.0	0.0	
MS POND C	12:00 PM	3.50	10.5	8.7	9.9	9.6	9.1	9.7	
MS-18	12:45 PM	3.06	9.9	6.6	10.3	9.0	7.3	10.1	
MS-NF	10:30 AM	3.94	8.1	0.4	8.5	0.0	0.0	0.0	

Date: April 21, 2021			Period: Post Project						
			Surface			Bottom			
Gage Location	Time (PST)	WSE NAVD88 (ft)	D.O. (mg/L)	Salinity (ppt)	Temp (^{o}C)	D.O. (mg/L)	Salinity (ppt)	Temp (^{o}C)	Tide at Gage
Swain Slough	11:45 AM	2.58	7.8	23.2	16.2	0.0	0.0	0.0	
MS POND C	12:30 PM	2.09	9.2	12.2	17.4	7.9	17.9	17.3	
MS-18	11:00 AM	2.81	8.3	12.0	16.5	7.8	17.3	17.2	
MS-NF	10:15 AM	4.04	6.3	7.8	14.5	6.0	8.0	14.5	

Martin Slough Channel Enhancement 2021

Discrete Measurements of Water Surface Elevations (WSE) and Water Quality Parameters

Date: May 18, 2021			Period: Post Project						
			Surface			Bottom			
Gage Location	Time (PST)	WSE NAVD88 (ft)	D.O. (mg/L)	Salinity (ppt)	Temp (^{o}C)	D.O. (mg/L)	Salinity (ppt)	Temp (^{o}C)	Tide at Gage
Swain Slough	12:30 PM	1.91	7.2	26.1	15.9	0.0	0.0	0.0	
MS POND C	1:30 PM	1.79	9.3	15.1	19.5	8.5	24.3	20.0	
MS-18	1:30 PM	1.91	7.5	12.4	17.3	6.8	22.9	19.2	
MS-NF	11:00 AM	3.29	4.3	9.4	16.1	0.0	0.0	0.0	

Date: July 8, 2021			Period: Post Project						
			Surface			Bottom			
Gage Location	Time (PST)	WSE NAVD88 (ft)	D.O. (mg/L)	Salinity (ppt)	Temp (^{o}C)	D.O. (mg/L)	Salinity (ppt)	Temp (^{o}C)	Tide at Gage
Swain Slough	10:00 AM	1.66	6.7	29.5	17.0	0.0	0.0	0.0	
MS POND C	5:45 AM	3.39	7.9	20.8	22.6	5.8	27.7	19.8	
MS-18	3:15 AM	3.60	7.0	21.9	22.4	5.1	26.6	19.5	
MS-NF									

Date: September 4, 2021			Period: Post Project						
			Surface			Bottom			
Gage Location	Time (PST)	WSE NAVD88 (ft)	D.O. (mg/L)	Salinity (ppt)	Temp (^{o}C)	D.O. (mg/L)	Salinity (ppt)	Temp (^{o}C)	Tide at Gage
Swain Slough	5:00 AM	2.76	6.2	30.8	17.9	0.0	0.0	0.0	
MS POND C	8:45 AM	1.49	5.2	24.4	16.1	5.3	24.8	16.1	
MS-18	9:30 AM	2.11	5.5	23.0	16.1	5.0	23.1	16.1	
MS-NF									

Appendix D

Martin Slough Calculated Tidal Datums

Martin Slough Tidal Datums

Gage: Swain Slough

Year	Month	MLLW	MLW	MW	MHW	MHHW	MTL	DIURNAL RANGE	MINIMUM STAGE	MAXIMUM STAGE
2020	10	1.56	2.10	4.01	6.41	6.87	4.17	5.31	1.43	8.35
2020	11	1.52	2.12	3.90	6.26	6.90	4.09	5.37	1.32	8.92
2020	12	1.52	2.15	3.92	6.24	7.05	4.10	5.53	1.15	8.44
2021	1	1.75	2.35	4.19	6.50	7.33	4.34	5.58	1.43	8.75
2021	2	1.91	2.19	3.81	5.94	6.70	3.98	4.79	1.48	7.91
2021	3	1.54	1.83	3.54	5.78	6.29	3.72	4.75	1.39	7.31
2021	4	1.42	1.82	3.53	5.85	6.24	3.74	4.83	1.07	8.01
2021	5	1.67	2.14	3.69	5.85	6.47	3.89	4.80	1.45	8.10
2021	6	1.86	2.42	4.01	6.14	6.82	4.19	4.96	1.72	8.51
2021	7	1.64	2.14	3.84	6.03	6.84	4.00	5.20	1.48	7.88
2021	8	1.50	2.01	3.85	6.13	6.90	4.00	5.41	1.46	7.94
2021	9	1.51	1.98	3.76	6.09	6.63	3.94	5.12	1.45	7.19
	Yearly	1.61	2.10	3.84	6.10	6.74	4.01	5.13	1.07	8.92
2021	**July to Sept**	1.55	2.05	3.82	6.08	6.79	3.98	5.24	1.46	7.67

Martin Slough Tidal Datums

Gage: MS-Pond C

Year	Month	MLLW	MLW	MW	MHW	MHHW	MTL	DIURNAL RANGE	MINIMUM STAGE	MAXIMUM STAGE
2020	10	1.43	2.01	3.52	5.14	5.30	3.56	3.87	1.23	5.76
2020	11	1.32	1.93	3.43	5.08	5.32	3.48	4.00	1.11	6.25
2020	12	1.19	1.87	3.37	5.05	5.34	3.43	4.15	0.68	5.75
2021	1	1.54	2.15	3.67	5.25	5.56	3.69	4.02	1.09	6.94
2021	2	1.74	2.06	3.46	5.01	5.39	3.51	3.65	1.17	6.12
2021	3	1.43	1.73	3.18	4.80	4.92	3.24	3.50	1.12	6.37
2021	4	1.23	1.68	3.12	4.69	4.85	3.17	3.62	1.07	5.40
2021	5	1.62	2.09	3.31	4.70	4.98	3.37	3.36	1.40	5.34
2021	6	1.77	2.27	3.51	4.81	5.11	3.53	3.34	1.64	5.52
2021	7	1.57	2.12	3.44	4.87	5.20	3.48	3.63	1.21	5.46
2021	8	1.28	1.94	3.45	4.94	5.24	3.44	3.96	1.07	5.53
2021	9	1.31	1.92	3.40	4.93	5.14	3.42	3.83	1.11	5.58
	Yearly	1.45	1.98	3.41	4.94	5.18	3.44	3.73	0.68	6.94
2021	**July to Sept**	1.39	1.99	3.43	4.91	5.19	3.45	3.81	1.13	5.52

Martin Slough Tidal Datums

Gage: MS-18

Year	Month	MLLW	MLW	MW	MHW	MHHW	MTL	DIURNAL RANGE	MINIMUM STAGE	MAXIMUM STAGE
2020	10	1.26	1.83	3.34	4.97	5.12	3.38	3.86	1.10	5.60
2020	11	1.19	1.77	3.25	4.90	5.12	3.31	3.93	1.01	6.07
2020	12	1.18	1.81	3.27	4.94	5.23	3.34	4.05	0.68	5.66
2021	1	1.48	2.07	3.56	5.11	5.42	3.58	3.94	1.12	6.74
2021	2	1.58	1.88	3.27	4.81	5.17	3.32	3.60	1.04	5.90
2021	3	1.48	1.73	3.16	4.77	4.88	3.22	3.40	1.06	6.34
2021	4	1.18	1.57	3.03	4.59	4.75	3.06	3.57	1.10	5.22
2021	5	1.45	1.90	3.12	4.52	4.77	3.18	3.32	1.21	5.17
2021	6	1.59	2.08	3.33	4.64	4.93	3.35	3.35	1.45	5.38
2021	7	1.34	1.89	3.22	4.65	4.97	3.25	3.64	1.00	5.22
2021	8	1.08	1.71	3.20	4.69	5.00	3.20	3.92	0.94	5.24
2021	9	1.25	1.84	3.31	4.85	5.07	3.33	3.82	0.90	5.53
	Yearly	1.34	1.84	3.26	4.78	5.03	3.29	3.68	0.68	6.74
2021	**July to Sept**	1.22	1.81	3.24	4.73	5.01	3.26	3.79	0.95	5.33

Appendix E - Martin Slough Vegetation Monitoring Report 2021

Introduction

The Martin Slough Enhancement Project Monitoring Plan set forth simple, cost-effective methods for evaluating the degree to which the Martin Slough Enhancement Project progressively meets its intended physical, hydrologic, and biological goals during the initial five years of the project. The primary focus of the Monitoring Plan is *post-construction* monitoring of five parameters (topography, hydrology, water quality, vegetation, and fisheries). This Monitoring Plan outlines a methodology for five years of post-construction monitoring for each phase, as funding allows. The Monitoring Plan includes both quantitative and qualitative measures to evaluate structural and functional components of the project. Implementation of the Monitoring Plan (RCAA 2021) demonstrates ongoing permit compliance and a trajectory of incremental project success as the project meets various annual performance criteria described in the Plan, which cumulatively lead to attaining final success criteria.

The principal revegetation goal of the project is to establish, rehabilitate, or re-establish vegetative habitats within the project area, including tidal marsh, brackish marsh, freshwater marsh, riparian, and coastal prairie plant associations through both passive and active revegetation. This report covers vegetation monitoring for Year 2 of Phase 2 (NRLT property). The Year 2 Phase 2 monitoring goal is to estimate the absolute vegetative percent cover, relative percent cover of native plant species, and document species diversity of revegetated areas two years post-construction. In August 2021, the Year 2 vegetation monitoring took place on the revegetated areas on the NRLT property, a qualitative overview of the revegetated areas on the upstream Eureka Golf Course property (Phase 3-4) was also conducted.

Protocols

The following the protocols were laid out in the Martin Slough Enhancement Project Monitoring Plan, (RCAA 2021).

Estimating Number of Plots and Sample Size

A sample size analysis was conducted to determine the monitoring effort required for vegetation cover analysis (Elzinga et al. 1998). The sample size was calculated according to Equation 1 (p. 346 from Elzinga et al. 1998), using $Z\alpha=1.64$ for the 90 percent confidence interval, s=standard deviation estimate, and $B=10$ for a confidence interval width of ± 10. The allowable certainty for percent cover was a margin of error of ± 10 percent at the 90 percent confidence interval.

Sample Size Equation 1: $n = (Z\alpha)2(s)2/(B)2$

Using a standard deviation estimate of ± 25 percent cover was recommended as modeled by a previous restoration monitoring project on the North Coast. The sample size *n* was calculated to be 17 plots per the two restoration community types, riparian and wetland, with a total of 34 sample plots.

Selecting Plot Points

The establishment of fixed monitoring macroplots allows for a direct qualitative comparison from year to year to highlight vegetation changes and distinguish trends. Four Macroplots were established in the first year of monitoring in Summer 2020: Marsh Plain A, Oxbow, Pond C, and Southeast Tributary (SE Tributary), as shown in Map 1.

Map 1. Represents the four Macroplots on the NRLT property, distinguishing the riparian and wetland zones, sampling plot locations, and the distance between plots.

A random coordinate method was used to determine where to sample within the defined Macroplots. Baselines, x, and y-axis were oriented within the wetlands, with the x-axis running the longitudinal length of the wetland and the y axis running latitudinally. The transects defined the base from which the quadrat plots were placed within the Macroplots. The random coordinates where plots were placed were generated using the ESRI “Create Random Points” tool. For each sampling quadrat plot, a random value was developed for a distance along the x-axis, and a random value was produced for the distance along the y axis. The point of intersection signaled the specific position of each of the sampling units. Any coordinates that fell outside of the Macroplot were rejected.

Field Sampling

Plant species data was collected across the 34 randomly placed quadrats within the defined four Macroplots at the restoration site between August 2-12, 2021. Additional data collected within each quadrat included the area of surface water, bare earth, absolute vegetative cover in each stratum present (trees, shrubs, and herbs), wetland designations (OBL, FAC, FACW, and FACU), native cover, non-native cover, species diversity of vascular plants, and total ground cover.

Wetland Collection

Pin flags were positioned at the center of each assigned plot. A 1 m^2 PVC quadrat was used to isolate the vegetation distinctive to the plot. All the plants inside the sampling area were counted and identified to the taxonomic level of species. Unknown plant species were collected for identification using the Jepson Manual (Hickman 1993).

Riparian Collection

Pin flags were positioned at the center of each assigned plot. Each riparian plot required a 3-meter radius sampling area (RCAA 2021). All the plants inside the sampling area were counted and identified to the taxonomic level of species. Unknown plant species were collected for identification using the Jepson Manual (Hickman 1993).

Monitoring Plots Permanence

To aid in future plot location, 34 pieces of ½ inch diameter rebar stakes were hammered flush to the ground in the original position of the pin flags and topped with OSHA-approved polypropylene S-type square rebar impalement caps.

Mapping

Maps of sampling locations were generated using Google Earth Pro, to visualize where the sampling occurred along the four Macroplots within the NRLT property boundaries. Google Earth Pro was used to create polygons representative of the Macroplots in the sampling area that detailed the riparian and wetland habitats, the plot locations, and showed measured distances between points (Map 1).

Success Criteria

Table 1. Wetland Re-vegetation Success Criteria from Monitoring Plan

Tidal, Brackish, and Freshwater Marsh Success Criteria	
Year 2	30 percent or greater total absolute vegetation cover 35 percent or greater relative cover of native wetland species. No more than 20 percent absolute cover of target invasive plants.
Year 3 (contingency)	40 percent or greater total absolute vegetation cover 40 percent or greater relative cover of native wetland species. No more than 15 percent absolute cover of target invasive plants.
Year 4 (contingency)	50 percent or greater total absolute vegetation cover 45 percent or greater relative cover of native wetland species. No more than 10 percent absolute cover of target invasive plants.
Year 5	60 percent or greater total absolute vegetation cover 50 percent or greater absolute cover of native wetland species. No more than 10 percent relative cover of target invasive plants. Plant vigor shall be “good” per the qualitative score for assessing the health and vigor of planted stock
All Years	Native wetland species consist of hydrophytic OBL/FACW/FAC species No major erosional areas

Table 2. Riparian Re-vegetation Success Criteria from Monitoring Plan

Riparian Success Criteria	
Year 2	30 percent or greater total absolute vegetation cover 35 percent or greater relative cover of native species No more than 20 percent absolute cover of target invasive plants.
Year 3 (contingency)	40 percent or greater total absolute vegetation cover 40 percent or greater relative cover of native species No more than 15 percent absolute cover of target invasive plants
Year 4 (contingency)	50 percent or greater total absolute vegetation cover 45 percent or greater relative cover of native species No more than 10 percent absolute cover of target invasive plants.
Year 5	60 percent or greater total absolute vegetation cover 50 percent or greater relative cover of native species No more than 10 percent absolute cover of target invasive plants. 90 percent total vegetation cover for areas within Golf Course more than 25 feet away from the channel and ponds planted using nonnative species
All years	Plant vigor shall be "good" per the qualitative score for assessing the health and vigor of planted stock No major erosional areas

Qualitative Parameters

General Macroplot qualities were recorded during monitoring efforts to help determine the status of the site as a whole and help identify localized or low-level trends such as new invasive species formations, or changes in species abundance.

Mean absolute total vegetative cover, relative native wetland cover, absolute target invasive plant cover, and species diversity were calculated for tidal, brackish, and freshwater marsh survey areas. Mean absolute total vegetative cover, relative native cover (all wetland and upland plants), absolute target invasive plant cover, and species diversity were calculated for riparian survey areas. The monitoring results were then compared to the defined success criteria to evaluate site progress. As per the Monitoring Plan, if the 90% confidence interval width encompasses the designated success criteria value or outperforms success criteria, the site would be determined as meeting the criteria (RCAA 2021).

Results

Wetland Results & Success Criteria

Table 3. Species Presence within Phase 2 (NRLT) Wetland Monitoring Site.

Scientific Name	Common Name	Wetland Indicator Status	Percent Cover by Species Across all Wetland Area
Argentina anserina	Silverweed	FACW	18%
Atriplex prostrata	Fat hen	FAC	41%
Carex lyngbyei	Lyngby sedge	OBL	41%
Carex obnupta	Slough sedge	OBL	47%
Cotula coronopifolia	Brass buttons	FACW	23%
Deschampsia cespitosa	Tufted hair grass	FAC	65%
Distichlis spicata	Saltgrass	FAC	53%
Festuca rubra	Red fescue	FAC	65%
Hordeum pusillum	Little barley	FACU	6%
Juncus effusus	Soft rush	FACW	6%
Lotus corniculatus	Birdsfoot trefoil	FAC	47%
Plantago coronopus	Bucks horn	FAC	6%
Poa pratensis	Kentucky blue	FACU	18%
Salicornia virginica	Pickleweed	OBL	12%
Spergularia macrotheca var. macrotheca	Sticky sand spurrey	FAC	29%
Triglochin maritima	Arrowgrass	OBL	88%

Table 4. 2021 Martin Slough Vegetation Monitoring Phase 2 Wetland Results

Year 2 Success Criteria	2021 Vegetation Monitoring Results
30 percent or greater total absolute vegetation cover	94% absolute wetland vegetation cover.
35 percent or greater relative cover of native wetland species.	58% relative cover of native wetland species.
No more than 20 percent absolute cover of target invasive plants.	0% target invasives found within the sampling wetland plots.
All Years	Native wetland species consist of hydrophytic OBL/FACW/FAC species No major erosional areas

Additional Data Collected:

Species richness, or the number of species found within the sampled wetland area was 16. The species evenness, also recognized as the abundance of the species in the sampling plot was 96. These values were used to calculate the wetland plot diversity index, which resulted in an index of 16.

Riparian Results & Success Criteria

Table 5. Species Presence within Phase 2 (NRLT) Riparian Monitoring Site.

Scientific Name	Common Name	Full Grown Type	Percent Cover by Species Across All Riparian Area
Lotus corniculatus	Birdsfoot trefoil	Herb	27%
Deschampsia cespitosa	Tufted hair grass	Herb	6%
Juncus effusus	Soft rush	Herb	10%
Triglochin maritima	Arrowgrass	Herb	7%
Carex obnupta	Slough sedge	Herb	14%
Cotula coronopifolia	Brass buttons	Herb	2%
Jaumea carnosa	Marsh jumea	Herb	2%
Achillea millefolium	Yarrow	Herb	2%
Lonicera involucrata	Twinberry	Shrub	2%
Epilobium ciliatum	Willowherbs	Herb	2%
Trfolium hybridum	Alsike clover	Herb	12%
Bromus carinatus var. maritimus	CA Coastal brome	Herb	31%

Poa pratensis	Kentucky blue	Herb	23%
Rubus spectabilis	Salmon berry	Shrub	10%
Salix hookeriana	Coastal willow	Tree	2%
Salix sitchensis	Sitka willow	Shrub	4%
Argentina anserina	Silverweed	Herb	12%
Phalaris arundinacea	Reed canary grass	Herb	4%
Rumex salicifolius	Willow dock	Herb	12%
Rumex crispus	Curly dock	Herb	12%
Festuca rubra	Red fescue	Herb	23%
Alnus rubra	Red alder	Tree	8%
Trifolium repens	White clover	Herb	18%
Ranunculus repens	Creeping buttercup	Herb	21%
Elymus glaucus	Blue wild rye	Herb	12%
Elymus repens	Quack grass	Herb	6%
Picea sitchensis	Sitka Spruce	Tree	14%
Dactylis glomerata	Orchard grass	Herb	2%
Polystichum munitum	Sword fern	Herb	2%
Rosa nutkana	Nootka rose	Shrub	2%
Aster chilensis	Aster	Herb	2%
Distichlis spicata	Saltgrass	Herb	6%
Frangula purshiana	Cascara	Tree	4%
Galium aparine	Catchweed bedstraw	Herb	4%
Oenanthe sarmentosa	Water parsley	Herb	6%
Salix laevigata	Red willow	Tree	8%
Bolboschoenus maritimus	Alkali bullrush	Herb	4%
Pinus contorta var contorta	Shore pine	Tree	2%
Cornus sericea	Redtwig osier dogwood	Shrub	2%
Equisetum telmateia	Giant horsetail	Herb	2%
Athyrium filix-femina	Lady fern	Herb	2%
Rubus armeniacus	Himalayan blackberry	Shrub	2%
Carex lyngbyei	Lyngby sedge	Herb	2%

Table 6. 2021 Martin Slough Vegetation Monitoring Phase 2 Riparian Results

Year 2 Success Criteria	2021 Vegetation Monitoring Results
30 percent or greater total absolute vegetation cover	84% absolute riparian vegetation cover.
35 percent or greater relative cover of native wetland species.	61% relative cover of riparian native wetland species.
No more than 20 percent absolute cover of target invasive plants.	0% target invasives found within the sampling riparian plots.
All Years	Plant vigor shall be "good" per the qualitative score for assessing the health and vigor of planted stock

Additional Data Collected:

Species richness, or the number of species found within the sampled wetland area was 43. The species evenness, also recognized as the abundance of the species in the sampling plot was 178. These values were used to calculate the wetland plot diversity index, which resulted in an index of .24.

Qualitative Observations

Invasive Species

The Humboldt Weed Management Association (HWMA) and California Invasive Plant Council (CAL IPC) were referenced to determine species status. The only target invasive identified in the Monitoring Plan was *Spartina densiflora.* *Spartina* was found within the boundaries of the Marsh Plain A Macroplot and the Oxbow Macroplot. The *Spartina* appeared juvenile in morphology, suggesting recent propagation. None of the young *Spartina* plants fell within the sampling plots. Locations of *Spartina* were mapped and all plants were hand removed from the site.

Thistle (*Cirsium)* species were discovered along the Pond C and SE Trib Macroplots during the early summer of 2021, prior to monitoring. The thistle was removed by hand and discarded off-site. RCAA proposes adaptive management in the form of annual monitoring of these areas where the thistle and *Spartina* were found to ensure that the populations do not inflate and threaten the success of the revegetation efforts.

Observations by Macroplot

An assessment of the overall health and vigor of the planted stock was documented using the attributes defined in the Monitoring Plan (RCAA 2021). Other site characteristics, including patterns of plant die-offs, erosion, hydrological issues, trespass, herbivory or grazing pressure, or other land use issues, were considered in determining the qualitative assessment (Table 7).

Table 7. Qualitative Score for Assessing the Health and Vigor of Planted Stock from Monitoring Plan

Score	Description of Score
Excellent	No evidence of stress; minor pest or pathogen damage may be present. No chlorotic leaves, no or very minor herbivory (browse). Evidence of new growth, flowering, seed set on majority (greater than 75 %) of plants observed.
Good	Some evidence of stress. Pest or pathogen damage present, few chlorotic leaves (> 5%), minor evidence of herbivory (browse). Evidence of new growth, flowering, seed set on most (greater than 50%) of plants observed.
Fair	Moderate level of stress; high levels of pest or pathogen damage, some chlorotic leaves (> 10%), some herbivory damage (few snapped leaves, stems, wear marks etc.). Evidence of new growth, flowering, seed set on some (less than 50%) of plants observed.
Poor	High level of stress; high levels of pest or pathogen damage, many chlorotic leaves (> 30%), severe herbivory damage (massive forage damage, main stems/leaves stripped etc.). No evidence of new growth, flowering, or seed set, or only a few plants (less than 25%) with these characteristics.

1. Marsh Plain A – EXCELLENT - Area showed minimal evidence of standing water in a few locations across the Macroplot. No evidence of herbivory or browsing. Consistent evidence of new growth and stability in vegetation.
2. Oxbow - GOOD - Area showed evidence of standing water and bare ground, plant populations were sparsely arranged. Some evidence of erosion where there was standing water.
3. Pond C - GOOD – Area showed significant grass density. Area showed signs of disturbance from cattle activity with some plant cages collapsed due to cattle resting on them. Minor evidence of herbivory was observed on riparian plants.
4. SE Tributary - EXCELLENT – Area showed significant grass density. Minimal to no evidence of browsing or cattle disturbance.
5. Eureka Municipal Golf Course Property - GOOD - The revegetated areas on the golf course property (Phase 3 - Year 1 and Phase 4 – Year 0) showed evidence of plant stress due to drought. Many of the planted species were experiencing what appeared to be stunted growth habits. There was evidence of herbivory to some of the uncaged plants. Supplemental watering was deemed necessary in summer 2021, along with weeding the base of plant cages to promote intended species growth.

Discussion

The Phase 2 Year 2 (2021) success criteria for the riparian and wetland habitats were met and RCAA recommends quantitative monitoring again in year five (2024) on Phase 2 (NRLT) revegetated areas. Due to the statewide drought, RCAA took adaptive measures such as supplemental watering to ensure plant survival. Plants appeared to be suffering from water loss and potentially stunted growth due to the persistent drought conditions. In the Pond C Macroplot, recent cattle activity influenced the habitat around the riparian plants. Though there was some

damage to cages, no immediate damage occurred to the plants. RCAA repaired plant caging and will continue to do so in the coming year as funding allows. In addition, RCAA will continue to water and weed the riparian plants as funding allows. It is essential to continue to monitor the effect the cattle may have on the growth of the riparian species.

Recommendations

1. Continue to observe the Pond C Macroplot due to new herbivory traffic and cage damage.
2. Continue to supplement water for plants on both NRLT and Eureka Golf Course properties if drought trends continue and funding allows.
3. Continue to work in tandem with Eureka Golf Course representatives to ensure plant success and mitigate disturbances.
4. Continue to weed plant cages as necessary to provide optimal growth for new plants as funding allows.
5. Continue annual inspection of areas where invasive species were discovered and remove invasive plants as feasible and funding allows.

Appendix A Maps

Map 2. Represents the entirety of the Marsh Plain A Macroplot with a distinction between the riparian and wetland zones, as well as the sampling point locations and distance between plots.

Map 3. Represents the entirety of the Oxbow Macroplot with a distinction between the riparian and wetland zones, as well as the sampling point locations, and distance between plots.

Map 4. Represents the entirety of the Pond C Macroplot with a distinction between the riparian and wetland zones, as well as the sampling point locations, and distance between plots.

Map 5. Represents the entirety of the SE Tributary Macroplot showing the riparian zone, as well as the sampling point locations, and distance between plots.

Sources

1. California Invasive Plant Council. 2006. *California Invasive Plant Inventory*. Berkeley, California.

2. Hickman, J. C., & Jepson, W. L., 1993. *The Jepson manual: Higher plants of California*. Berkeley: University of California Press.

3. Humboldt County Weed Management Area. 2019. *Invasive Weeds of Humboldt County: A Guide for Concerned Citizens (3rd Edition)*. Arcata, California.

4. RCAA, 2018. *Martin Sough Enhancement Project Monitoring Plan.* August 2013, Revised July 2018. By Redwood Community Action Agency Natural Resources Services Division.

5. Reed, P.B, Jr. 1988. *National List of plant species that occur in wetlands: national summary*. U.S Fish Wildlife Services Biological Report 88(24). 244 pp.

Appendix F - Martin Slough Photo Monitoring

Photo Point 1 NE - 2019

1/29/19

Photo Point 1 NE - 2020

2/4/20

Photo Point 1 NE - 2021

5/21/21

Photo Point 1 SE - 2019

1/29/19

Photo Point 1 SE - 2020

2/4/20

Photo Point 1 SE - 2021

5/21/21

Photo Point 1 SW - 2019

1/29/19

Photo Point 1 SW - 2020

2/4/20

Photo Point 1 SW - 2021

5/21/21

Photo Point 1 NW - 2019

1/29/19

Photo Point 1 NW - 2020

2/4/20

Photo Point 1 NW - 2021

5/21/21

Photo Point 2 NE - 2019

1/29/19

Photo Point 2 NE - 2020

2/4/20

Photo Point 2 NE - 2021

5/21/21

Photo Point 2 SE - 2019

1/29/19

Photo Point 2 SE - 2020

2/4/20

Photo Point 2 SE - 2021

5/21/21

Photo Point 2 SW - 2019

1/29/19

Photo Point 2 SW- 2020

2/4/20

Photo Point 2 SW - 2021

5/21/21

Photo Point 2 NW - 2019

1/29/19

Photo Point 2 NW - 2020

2/4/20

Photo Point 2 NW - 2021

5/21/21

Photo Point 3 NE - 2019

1/30/19

Photo Point 3 NE - 2020

2/4/20

Photo Point 3 NE - 2021

5/21/21

Photo Point 3 SE - 2019

1/30/19

Photo Point 3 SE - 2020

2/4/20

Photo Point 3 SE - 2021

5/21/21

Photo Point 3 SW - 2019

1/30/19

Photo Point 3 SW - 2020

2/4/20

Photo Point 3 SW - 2021

5/21/21

Photo Point 3 NW - 2019

1/29/19

Photo Point 3 NW - 2020

2/4/20

Photo Point 3 NW- 2021

5/21/21

Photo Point 4 NE - 2019

1/30/19

Photo Point 4 NE - 2020

2/4/20

Photo Point 4 NE - 2021

5/21/21

Photo Point 4 SE - 2019

1/30/19

Photo Point 4 SE - 2020

2/4/20

Photo Point 4 SE - 2021

5/21/21

Photo Point 4 SW - 2019

1/30/19

Photo Point 4 SW - 2020

2/4/20

Photo Point 4 SW - 2021

5/21/21

Photo Point 4 NW - 2019

1/30/19

Photo Point 4 NW – 2020

2/4/20

Photo Point 4 NW - 2021

5/21/21

Photo Point 5 NE - 2019

1/30/19

Photo Point 5 NE - 2020

2/4/20

Photo Point 5 NE - 2021

5/21/21

Photo Point 5 SE - 2019

1/30/19

Photo Point 5 SE - 2020

2/4/20

Photo Point 5 SE - 2021

5/21/21

Photo Point 5 SW - 2019

1/30/19

Photo Point 5 SW - 2020

2/4/20

Photo Point 5 SW - 2021

5/21/21

Photo Point 5 NW - 2019

1/30/19

Photo Point 5 NW - 2020

2/4/20

Photo Point 5 NW - 2021

5/21/21

Photo Point 6 NE - 2019

1/30/19

Photo Point 6 NE - 2020

2/4/20

Photo Point 6 NE - 2021

5/21/21

Photo Point 6 SE - 2019

1/30/19

Photo Point 6 SE - 2020

2/4/20

Photo Point 6 SE - 2021

5/21/21

Photo Point 6 SW - 2019

1/30/19

Photo Point 6 SW - 2020

2/4/20

Photo Point 6 SW - 2021

5/21/21

Photo Point 6 NW - 2019

1/30/19

Photo Point 6 NW - 2020

2/4/20

Photo Point 6 NW - 2021

5/21/21

Photo Point 7 NE - 2019

1/30/19

Photo Point 7 NE - 2020

2/4/20

Photo Point 7 NE - 2021

5/21/21

Photo Point 7 SE - 2019

1/30/19

Photo Point 7 SE - 2020

2/4/20

Photo Point 7 SE - 2021

5/21/21

Photo Point 7 SW - 2019

1/30/19

Photo Point 7 SW - 2020

2/4/20

Photo Point 7 SW - 2021

5/21/21

Photo Point 7 NW - 2019

1/30/19

Photo Point 7 NW - 2020

2/4/20

Photo Point 7 NW - 2021

5/21/21

Photo Point 8 NE - 2021

5/21/21

Photo Point 8 SE - 2021

5/21/21

Photo Point 8 SW - 2021

5/21/21

Photo Point 8 NW - 2021

5/21/21

Photo Point 9 NE - 2021

5/21/21

Photo Point 9 SE - 2021

5/21/21

Photo Point 9 SW - 2021

5/21/21

Photo Point 9 NW - 2021

5/21/21

Photo Point 10 NE - 2021

5/21/21

Photo Point 10 SE - 2021

5/21/21

Photo Point 10 SW - 2021

5/21/21

Photo Point 10 NW - 2021

5/21/21

Photo Point 11 NE - January 2022

1/6/22

PP11 had to be relocated in early 2022 because the pre-construction location set in 2019 was now located within the pond boundaries post-construction and was shot incorrectly in May 2021.

Photo Point 11 SE - January 2022

1/6/22

PP11 had to be relocated in early 2022 because the pre-construction location set in 2019 was now located within the pond boundaries post-construction and was shot incorrectly in May 2021.

Photo Point 11 SW - January 2022

1/6/22

PP11 had to be relocated in early 2022 because the pre-construction location set in 2019 was now located within the pond boundaries post-construction and was shot incorrectly in May 2021.

Photo Point 11 NW - January 2022

1/6/22

PP11 had to be relocated in early 2022 because the pre-construction location set in 2019 was now located within the pond boundaries post-construction and was shot incorrectly in May 2021.

Photo Point 12 NE - 2021

5/21/21

Photo Point 12 SE - 2021

5/21/21

Photo Point 12 SW - 2021

5/21/21

Photo Point 12 NW - 2021

5/21/21

Photo Point 13 NE - 2021

5/21/21

Photo Point 13 SE - 2021

5/21/21

Photo Point 13 SW - 2021

5/21/21

Photo Point 13 NW - 2021

5/21/21

Photo Point 14 NE - 2021

5/21/21

Photo Point 14 SE - 2021

5/21/21

Photo Point 14 SW - 2021

5/21/21

Photo Point 14 NW - 2021

5/21/21

Photo Point 15 NE - 2021

5/21/21

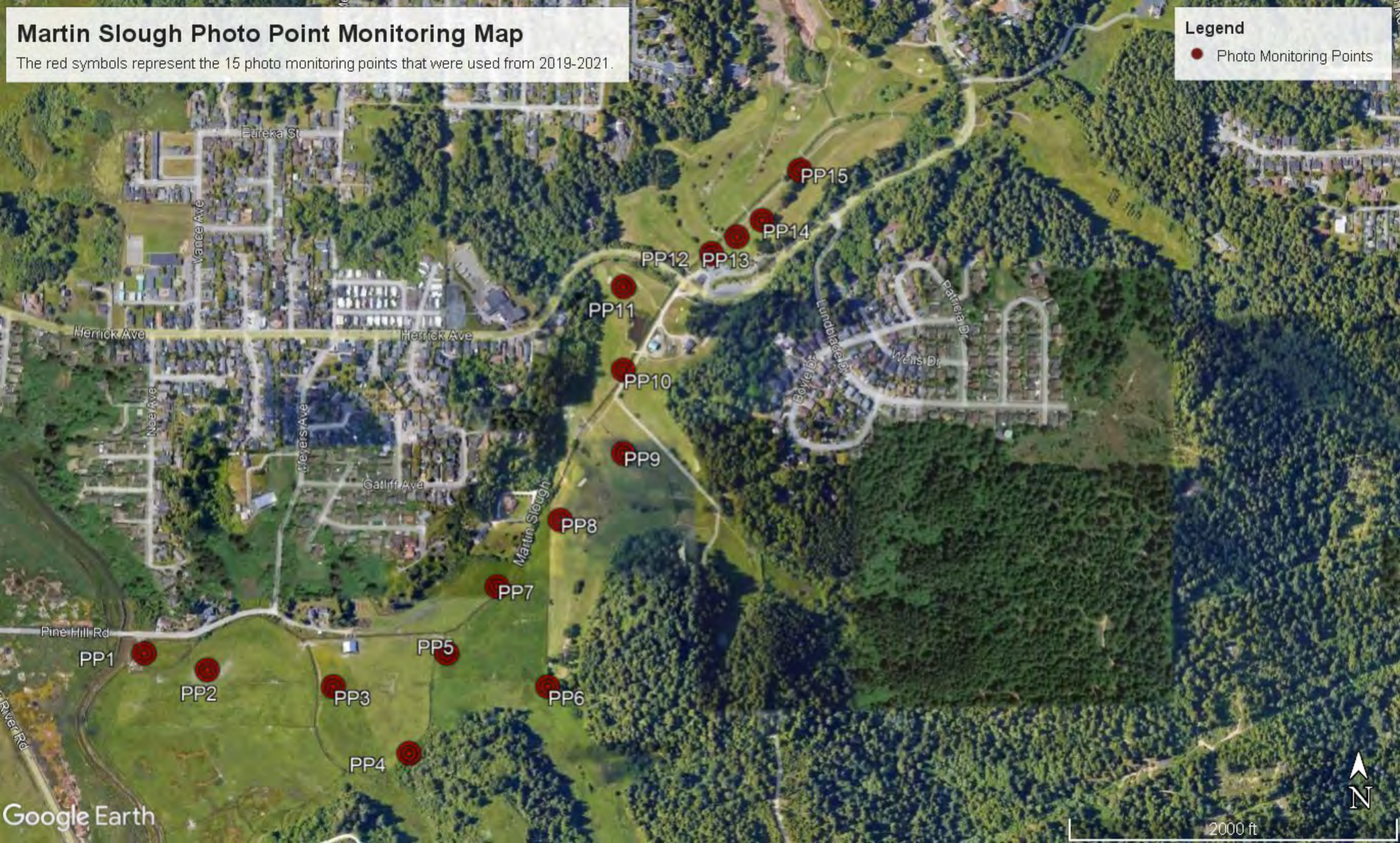
Photo Point 15 SE - 2021

Photo Point 15 SW - 2021

5/21/21

Photo Point 15 NW - 2021

5/21/21


Martin Slough Photo Point Monitoring Map
The red symbols represent the 15 photo monitoring points that were used from 2019-2021.
Legend
Photo Monitoring Points
Eureka St
Vance Ave
Herrick Ave
Herrick Ave
Nace Ave
Meyers Ave
Gatliff Ave
Martin Slough
Pine Hill Rd
River Rd
Lundblad Dr
Patricia Dr
Wells Dr
PP1
PP2
PP3
PP4
PP5
PP6
PP7
PP8
PP9
PP10
PP11
PP12
PP13
PP14
PP15
N
2000 ft
Google Earth

MARTIN SLOUGH PHOTO MONITORING

2019 - 2021

Photo Point 1
Location: On Tide Gate (marked by black circled X on TG deck)
GPS (DMS): 40°45'8" N, 124°10'56"W

Photo #	Bearing	Height
MS_PP1_NE	23° NE	5'
MS_PP1_SE	113° SE	5'
MS_PP1_SW	203° SW	5'
MS_PP1_NW	293° NW	5'

Photo Point 2
Location: Marsh Plain A at ~ sta 4+50 (marked by ½ rebar with pink flagging)
GPS (DMS): 40°45'7" N, 124°10'51" W

Photo #	Bearing	Height
MS_PP2_NE	66° NE	5'
MS_PP2_SE	156° SE	5'
MS_PP2_SW	246° SW	5'
MS_PP2_NW	336° NW	5'

Photo Point 3
Location: Marsh Plain B1 at ~ sta MS 4+00 (marked by ½ rebar with pink flagging)
GPS (DMS): 40°45'6" N, 124°10'41" W

Photo #	Bearing	Height
MS_PP3_NE	275° NE	5'
MS_PP3_SE	05° SE	5'
MS_PP3_SW	95° SW	5'
MS_PP3_NW	185° NW	5'

Photo Point 4
Location: March Plain B2 at ~ sta MS 10+00; near southern apex of meander (marked by ½ rebar with pink flagging)
GPS (DMS): 40°45'2" N, 124°10'35" W

Photo #	Bearing	Height
MS_PP4_NE	130° NE	5'
MS_PP4_SE	220° SE	5'
MS_PP4_SW	310° SW	5'
MS_PP4_NW	40° NW	5'

Photo Point 5
Location: South Side Main Channel at ~ sta MS 19+20; at upstream confluence with meander (marked by ½ rebar with pink flagging)
GPS (DMS): 40°45'8" N 124°10'32" W

Photo #	Bearing	Height
MS_PP5_NE	275° NE	5’
MS_PP5_SE	005° SE	5’
MS_PP5_SW	095° SW	5’
MS_PP5_NW	185° NW	5’

Photo Point 6

Location: North Side Southeast Fork at ~ sta 6+75; adjacent to SE pond (marked by ½ rebar with pink flagging)

GPS(DMS): 40°45’6” N, 124°10’24” W

Photo #	Bearing	Height
MS_PP6_NE	270° NE	5’
MS_PP6_SE	360° SE	5’
MS_PP6_SW	090° SW	5’
MS_PP6_NW	180° NW	5’

Photo Point 7

Location: Northeast Side of Pond C adjacent to ~ sta MS 24+00 (marked by ½ rebar with pink flagging)

GPS (DMS): 40°45’12” N, 124°10’28 W

Photo #	Bearing	Height
MS_PP7_NE	250° NE	5’
MS_PP7_SE	340° SE	5’
MS_PP7_SW	070° SW	5’
MS_PP7_NW	160° NW	5’

Photo Point 8

Location: left bank of main channel at ~ sta. 32+20; 20 ft. from channel

GPS (DMS): 40°45’16’ N, 124°10’23” W

Photo #	Bearing	Height
MS_PP8_NE	20° NE	5’
MS_PP8_SE	110° SE	5’
MS_PP8_SW	200° SW	5’
MS_PP8_NW	290° NW	5’

Photo Point 9

Location: right bank of East Fork at ~sta. 1+90; 10 ft. north of channel; 10 ft west of pedestrian bridge

GPS (DMS): 40°45’20’ N, 124°10’18” W

Photo #	Bearing	Height
MS_PP9_NE	140° NE	5’
MS_PP9_SE	230° SE	5’
MS_PP9_SW	320° SW	5’
MS_PP9_NW	50° NW	5’

Photo Point 10

Location: right bank of main stem at ~ sta 39+90; southwest of Pond E

GPS (DMS): 40°45’25.9”N 124°10’18.0”W

Photo #	Bearing	Height
MS_PP10_NE	30° NE	5’
MS_PP10_SE	120° SE	5’
MS_PP10_SW	193° SW	5’
MS_PP10_NW	300° NW	5’

Photo Point 11

Location: inside Pond E island, cross foot path and on north most edge of island. Preconstruction photos (2019 & 2020) were set within Pond E boundaries and were recalibrated in 2022 to match design. GPS (DMS): 40°45’29.2” N, 124°10’17.5” W

Photo #	Bearing	Height
MS_PP11_NE	23° NE	5’
MS_PP11_SE	113° NE	5’
MS_PP11_SW	203° SW	5’
MS_PP11_NW	293° NW	5’

Photo Point 12

Location: Lower parking lot, in line with north edge of driving range cement

GPS (DMS): 40°45’32”N 124°10’11”W

Photo #	Bearing	Height
MS_PP12_NE	30° NE	5’
MS_PP12_SE	114° SE	5’
MS_PP12_SW	235° SW	5’
MS_PP12_NW	312° NW	5’

Photo Point 13

Location: Pond F – in with the club house flag pole

GPS (DMS): 40°45’33”N 124°10’9”W

Photo #	Bearing	Height
MS_PP1_NE	25° NE	5’
MS_PP13_SE	112° SE	5’
MS_PP13_SW	230° SW	5’
MS_PP13_NW	310° NW	5’

Photo Point 14

Location: Mainstem upstream of Pond F (facing US, in line with large Monterey Pine to the right and spruce upstream)

GPS (DMS): 40°45’34”N 124°10’7”W

Photo #	Bearing	Height
MS_PP14_NE	33° NE	5’
MS_PP14_SE	120° SE	5’

MS_PP14_SW	225° SW	5’
MS_PP14_NW	307° NW	5’

Photo Point 15

Location: Mainstem, downstream of North Fork (in line with willow tree to the right when facing US)
GPS (DMS): 40°45’37”N 124°10’4”W

Photo #	Bearing	Height
MS_PP15_NE	30° NE	5’
MS_PP15_SE	120° SE	5’
MS_PP15_SW	212° SW	5’
MS_PP15_NW	300° NW	5’