CITY OF
SAN JOSE
CAPITAL OF SILICON VALLEY

Environmental Services Department
SAN JOSE/SANTA CLARA WATER POLLUTION CONTROL PLANT

January 29, 2013

Mr. Bruce Wolfe, Executive Director
California Regional Water Quality Control Board
San Francisco Bay Region
1515 Clay Street, Suite 1400
Oakland, CA 94612

SUBJECT: Pond A18 Annual Self-Monitoring Report for 2012

Dear Mr. Wolfe:

The City of San José (City) submits the Annual Self-Monitoring Report (SMR) in fulfillment of the Waste Discharge Requirements (WDR) for Pond A18 described in Order Number R2-2005-0003. This SMR includes a summary of data and studies conducted in 2012 for Pond A18.

In addition to monitoring Pond A18 and receiving water quality, the City is responsible for maintaining the levees on the south and east sides of A18. The City has budgeted for minor repairs to levees in deteriorated or undercut areas identified in 2012 and is working with the San Francisco Bay Conservation and Development Commission (BCDC) on approval of a procedure to repair the levees prior to the Shoreline Study implementation in the next 5-10 years. A summary of current and long-term plans for A18 is contained in Appendix III of the SMR.

Our monitoring data continue to demonstrate Pond A18 discharge has no measurable effect on receiving water quality. The pond continues to experience low dissolved oxygen levels in the pond during warm summer months, which remains the most challenging management issue. Based on eight years of monitoring data demonstrating no measureable effect of pond discharges on receiving water, the City makes the following recommendations to future monitoring requirements under the A18 WDR:

- Discontinue water quality monitoring in May. This would alter the monitoring season to June through October of each year under the A18 WDR. After eight years of monitoring, the City has never measured low dissolved oxygen conditions in A18 in the month of May.
- Initiate receiving water continuous monitoring only when the weekly 10^{th} percentile dissolved oxygen value in the pond falls below the 3.3 mg/L trigger.

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Additional detail regarding these two significant changes to our monitoring plan and other recommendations can be found on page 18 of the SMR.

As requested by Water Board Staff, the City collaborated with USGS and conducted mercury and methyl mercury sediment monitoring in Artesian Slough in lieu of Pond A18. The City found working with USGS to be productive and informative. The USGS Sediment Mercury Report is attached as an appendix to the SMR.

If you have questions or comments regarding this monitoring report, please contact Eric Dunlavey, Acting NPDES Compliance Supervisor, at 408-945-3065.

Sincerely,

Joanna De Sa
Deputy Director, Water Pollution Control

Enclosures

cc: Robert Schlipf

2012 Self Monitoring Program Annual Report
Pond A18

January 31, 2013

Pond A18 Annual Report 2012

Order No. R2-2005-0003

Prepared for:

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I. Introduction

This report summarizes 2012 water quality monitoring for Pond A18 in Santa Clara County. Monitoring was conducted from May 1st through October 31st in accordance with Waste Discharge Requirements (WDR) Order No. R2-2005-0003 (Order) issued February 16, 2005 by the San Francisco Bay Regional Water Quality Control Board (Regional Water Board).

This was the eighth year of monitoring following the initial release of water and commencement of Continuous Discharge Operations from former Salt Pond A18. The City of San José (City) is responsible for maintaining the levees on the south and east sides of A18. Appendix III of this report summarizes current long and short term plans for levee maintenance and alignment. The City continues to collaborate with the Regional Water Board and U.S. Fish and Wildlife Service (USFWS) by sharing weekly data and management strategies. Ponds A16 and A17, managed by USFWS, are located on the opposite side of Artesian Slough from Pond A18. Pond A16 also discharges into Artesian Slough. Figure 1 shows the location of Pond A18 intake and discharge structures, and sampling sites in the pond and receiving water.

A. Waste Discharge Requirements

The WDR requires the following three discharge limitations for Pond A18:

1. Salinity, DO, and pH requirements as shown in Table 1.

Table 1. Pond A18 discharge requirements

Constituent	Instantaneous Maximum	Instantaneous Minimum	Units
Salinity for continuous circulation	44		ppt
DO[1]		5.0	mg/L
pH[2]	8.5	6.5	

[1] The Discharger may select discharge station A-A18-D, or receiving water station A-A18-5 to evaluate compliance with the DO limitation. In cases where receiving waters do not meet the Basin Plan objective, the Discharger must show, as described in its Operations Plan, that pond discharges do not further depress the DO level in the receiving water.

[2] The Discharger may select discharge station A-A18-D, or receiving water monitoring A-A18-5 to evaluate compliance with the pH limitation.

2. Pond waters discharging to Artesian Slough shall not exceed the natural temperature of the receiving waters by 20°F, or more.
3. DO Trigger. The Discharger shall monitor, report, and take corrective action measures in accordance with the Operations Plan required by Provision D.2, if DO levels in Pond A18 at station A-A18-M fall below 1.0 mg/L during the continuous circulation period [note: the Regional Water Board has allowed the City to monitor A-A18-M at the discharge (D in Figure 1)].

B. Monitoring Requirements

Monitoring requirements for the continuous circulation period are described in Table 2:

Table 2. Continuous circulation monitoring for Pond A18

Sampling Station:	D.O.	pH	Temp	Salinity	Turbidity	Chlorophyll *a*	Metals/Water Column	Sample Function
A-A18-M	A	A	A	A		A		Management
A-A18-D	B	B	B	B			C [Eliminated, 2006]	Discharge
A-A18-1	D	D	D	D	D			Receiving
A-A18-2	D	D	D	D	D			Receiving
A-A18-3	D	D	D	D	D			Receiving
A-A18-4	D	D	D	D	D			Receiving
A-A18-5	E	E	E	E				Receiving

LEGEND FOR TABLE 2

A = Monitoring shall be conducted within Pond A18 monthly from May through October. DO monitoring shall be conducted between 0800 and 1000 hours. Time of monitoring shall be reported. [Note: this can be taken at D].

B = Discharge monitoring shall be conducted before pond water mixes with receiving water using a continuous monitoring device from May through October. Downtime of continuous monitoring devices shall be minimized to the maximum extent feasible, and addressed annually in the Discharger's Operations Plan.

C = Water column samples for total and dissolved arsenic, chromium, nickel, copper, zinc, selenium, silver, cadmium, lead, and mercury shall be collected annually in August or September. When collecting metals samples, the Discharger shall also monitor for salinity, and total suspended solids. **[Note: This requirement was eliminated by the Regional Water Board in 2006 in a revision to the SMP included in a letter to the City dated May 9, 2006.].**

D = Receiving water monitoring shall be conducted at discrete locations from downstream to upstream monthly from May through October. The positions indicated on Figure 1 should be considered approximate. For days it monitors receiving water, the Discharger shall also (1) document if it monitors at flood tide, ebb tide, or slack tide (samples shall be collected as close to low tide as practicable), (2) monitor receiving water for DO, pH, temperature, salinity, and turbidity near the water surface and bottom, and (3) report standard observations, as described in Section D of the SMP.

E = Receiving water continuous monitoring for the purposes of determining compliance with the DO and pH limits shall be conducted from May through October at a location selected by the Discharger and approved by the Executive Officer at a point downstream of the discharge. Downtime of continuous monitoring devices shall be minimized to the maximum extent feasible, and addressed annually in the Discharger's Operations Plan.

In addition to the monitoring requirements listed in Table 2, annual sampling for receiving water (Artesian Slough) sediment mercury and methyl mercury is required in August or September every other year per Regional Board order revision letter dated 15 September 2010.

II. Monitoring Methods and Results

A. Quality Assurance/Quality Control

Sampling instruments were calibrated and maintained to ensure accurate data prior to deployment. Continuous sondes were cleaned and calibrated weekly. The discrete sondes were cleaned and calibrated prior to each use. Post-deployment calibration verification was performed on all sondes after each use.

Data Validation

DO was calibrated using percent saturation in water-saturated air (theoretical reading of 100% saturation). Weekly data with post-deployment readings within ±10% of the theoretical saturation level were accepted. Data with readings between 10 -15% of theoretical were accepted or rejected based on best professional judgment. If an instrument had a post-deployment DO reading exceeding 15% of theoretical, all DO data since the instrument's last calibration were rejected as invalid and the cause of the QA/QC failure was investigated.

For pH, a 2-point calibration (pH 7 and pH 10) was used to establish a slope. Calibrations for conductivity were performed using either a 10,000 or 50,000 micro Sieman standard, depending on the pond salinity. Post-deployment instrument accuracy checks were performed using the same standards. Data within ±5% of the theoretical value were accepted. Data with readings between 5 - 10% of theoretical were accepted or rejected based on best professional judgment. Any readings exceeding 10% error were considered invalid for pH or Conductivity and those data are not reported. The cause of any failure was investigated and steps to correct the error were taken including troubleshooting, probe replacement and sonde unit repair.

A total of four post-deployment QA/QC failures occurred for pH. All of these failures were considered invalid and are not reported based on evaluations of the corresponding data. Other periods of invalid data occurred when sondes in Pond A18 did not function properly (7/18- 7/19 and 8/31- 9/4) due to programming errors.

For the 2012 monitoring season, post-deployment error was in the following ranges:

1. pH: -1.6% to +6.8% (median 0.3%)
2. Conductivity: -2.9% to +4.5% (median -0.1%)
3. DO: -0.9 to +3.1 (median 0.7)

B. Continuous Monitoring

The City monitored receiving water in Artesian Slough (Station 5) and Pond A18 discharge (Station D) continuously for temperature, salinity, pH, and DO from May 1, 2012 to October 31, 2012 (Figure 1). This monitoring was conducted using YSI model 6600 sonde units.

City staff cleaned, serviced, calibrated, deployed, and retrieved the sonde units weekly. While deployed, the sondes recorded water quality measurements every 15 minutes. Following retrieval from the field, staff downloaded data from the sondes to a computer, then validated, summarized, and evaluated the data with respect to discharge requirements and action triggers. Using best professional judgment based on an evaluation of the weekly 10th percentile DO readings for the pond discharge, the City determined any adaptive management responses to undertake for the upcoming week. Adaptive management responses are actions such as additional receiving water monitoring or strategic timing of pond discharges to limit low DO discharge. Regional Water Board staff received weekly data summary reports from the City during the monitoring season.

Temperature

Water temperature in the receiving water (Station 5; Figure 1) and at the Pond A18 discharge gate (Station D), under both discharge and non-discharge conditions, are shown in Table 3.

Table 3. 2012 continuous temperature monitoring results (°C)

Site/Condition	Minimum	Maximum	Mean	Median	# of Measurements (n)
Artesian Slough	20.5	28.5	24.7	24.7	17117
A18 Discharge	14.9	27.7	22.4	22.6	16123
A18 Non-Discharge	16.0	27.2	23.0	23.5	1402

The WDR requires that discharges comply with the State's Thermal Plan. The Plan specifies that discharges shall not exceed the natural temperature of receiving waters by 20°F (~ 11°C) and shall not cause temperatures to rise greater than 4°F above the natural temperature of the receiving water at any one time or place. To evaluate compliance, receiving water temperatures were compared to Pond A18 temperatures during pond discharges (non-discharge periods were excluded from this comparison). Overall, pond temperatures were lower than receiving water (Figure 2). Differences for each concurrent 15-minute monitoring interval were determined by subtracting each discharge temperature from the corresponding receiving water temperature. Positive results indicate that receiving water temperature was higher (Figure 3). Temperature differences ranged from -7.8° to 2.0°C and averaged -2.3°C over 4,416 hours of monitored discharge. At no time was temperature of discharge greater than 11°C above the corresponding receiving water temperature. Pond temperatures at the discharge gate varied little between discharge and non-discharge periods (Table3; Figure 2).

Salinity

Salinity of the receiving water (Station 5; Figure 1) and of water at Pond A18 discharge gate (Station D), under both discharge and non-discharge conditions, are shown in Table 4. Discharge salinity remained below 40 ppt at all times during the 2012 monitoring period (Table 4).

Table 4. 2012 continuous salinity monitoring results (PSU[1])

Site/Condition	Minimum	Maximum	Mean	Median	# of Measurements (n)
Artesian Slough	0.8	7.2	2.2	2.0	17117
A18 Discharge	15.0	26.3	22.2	24.0	16123
A18 Non-Discharge	15.3	26.2	22.1	23.7	1402

Salinity of Pond A18 gradually increased with some variation in late July and mid August before stabilizing in late August (Figure 4). This was then followed by a slight decrease. Receiving water salinity varied greatly due to tidal influence. Salinity in both the pond and receiving water was typical compared to most prior years.

pH

The pH of the receiving water (Station 5; Figure 1) and A18 discharge gate (Station D), under discharge and non-discharge conditions are shown in Table 5. Pond pH levels were consistently higher and more variable throughout the monitoring season compared to receiving water (Figure 5). Shorter-term diurnal fluctuations of pH were greater in the receiving water as a result of daily salinity changes from the tides (Figure 6), altering the buffering capacity for pH.

Table 5. 2012 continuous pH monitoring results

Site/Condition	Minimum	Maximum	Mean	Median	# of Measurements (n)
Artesian Slough	7.1	8.3	7.4	7.4	17117
A18 Discharge	7.9	10.1	9.5	9.7	16123
A18 Non-Discharge	8.4	10.1	9.6	9.8	1402

The Basin Plan Objective for pH requires that receiving water pH remain between 6.5 and 8.5. Receiving water pH remained within this range, which is a contrast to previous seasons when receiving water pH is occasionally above 8.5. Receiving water salinity was lower in 2012 and 2011 compared to previous years. The lower pH this year was confounding considering the weak buffering capacity low salinity water has.

The higher pH levels in the pond did not appear to influence the receiving water pH (Figure 5). Early this season, pond pH levels were between 9 and 10 followed by a decline in September.

As mentioned above, there were four post-deployment sonde QA/QC failures for pH in Pond A18. These failures were relatively high (10-16%), which is outside the ± 5% acceptance criteria. The data showed no major deviations or unusual patterns and were reported after using best professional judgment.

[1] Practical Salinity Units (PSU) are a measurement of salinity from the specific conductance measured in water. An algorithm based on the ion composition of natural sea water converts specific conductance into PSU. One PSU is approximately equivalent to one part-per-thousand salinity.

Dissolved Oxygen

DO concentrations in the receiving water (Station 5; Figure 1) and in pond water at the discharge gate (Station D), under both discharge and non-discharge conditions, are summarized in Table 6.

DO levels in the receiving water fell below the Basin Plan objective of 5.0 mg/L on 22 occasions (Figures 7 and 18). The majority of these incidents were minor (4.5 – 4.9 mg/L), lasting for brief (15 – 30 minutes) to moderate (2.5 hours) periods of time. All incidents were reported to the Regional Water Board. Discrete trigger monitoring did not correlate the low DO receiving water with A18 discharges.

Table 6. 2012 continuous DO monitoring results

Site/Condition	Minimum	Maximum	Mean	Median	# of Measurements (n)
Artesian Slough	4.5	10.3	6.8	6.7	17117
A18 Discharge	0.0	31.0	8.7	8.9	16123
A18 Non-Discharge	0.0	24.5	9.9	9.7	1402

The receiving water DO reflects diurnal and tidal patterns (Figure 7). For example, DO in Artesian Slough is lower at night and higher during the day when photosynthesis is occurring (Figure 8). Dissolved oxygen is also lower during very high tides when Bay water dominates Artesian Slough. The lowest DO values in the receiving water are at night during high tides when pond discharge volume is low. Based on the full-season comparison between pond and slough DO, pond discharge does not appear to affect receiving water DO positively or negatively.

Weekly 10th percentile DO values were calculated for the pond's discharge (Table 7) and reported to the Regional Water Board throughout the monitoring season. The WDR requires corrective action whenever the weekly 10th percentile for DO falls below 3.3 mg/L. There were 5 different weeks when the 10th percentile fell below the trigger. These events began in late September. The initial corrective action was to continue pond discharges while monitoring the receiving water more frequently. If the enhanced receiving water monitoring detects negative effects to receiving water, gate closures are then initiated. Since the enhanced receiving water monitoring did not measure clear effects to receiving water from pond discharges, valve closures were not initiated in 2012.

Table 7. Weekly 10th percentile DO values for Pond A18 discharge and response in 2012

Week and Date Range	10th Percentile Value (mg/L)	Response
1: 5/1/12 – 5/8/12	6.9	None Required
2: 5/8/12 – 5/15/12	6.8	None Required
3: 5/15/12 – 5/22/12	8.6	None Required
4: 5/22/12 – 5/29/12	7.0	None Required
5: 5/29/12 – 6/5/12	7.4	None Required
6: 6/5/12 – 6/12/12	7.6	None Required
7: 6/12/12 – 6/19/12	7.5	None Required
8: 6/19/12 – 6/26/12	6.8	None Required
9: 6/26/12 – 7/3/12	7.4	None Required
10: 7/3/12 – 7/10/12	8.3	None Required
11: 7/10/12 – 7/17/12	8.6	None Required
12: 7/17/12 – 7/24/12	7.5	None Required
13: 7/24/12 – 7/31/12	6.5	None Required
14: 7/31/12 – 8/7/12	4.9	None Required
15: 8/7/12 – 8/14/12	7.2	None Required
16: 8/14/12 – 8/21/12	6.5	None Required
17: 8/21/12 – 8/28/12	6.3	None Required
18: 8/28/12 – 9/4/12	5.5	None Required
19: 9/4/12 – 9/11/12	6.9	None Required
20: 9/11/12 – 9/18/12	5.8	None Required
21: 9/18/12 – 9/25/12	7.5	None Required
22: 9/25/12 – 10/2/12	2.1	Began trigger monitoring on 10/10/12
23: 10/2/12 – 10/9/12	0.1	Continued trigger monitoring – no impacts
24: 10/9/12 – 10/16/12	0.0	Continued trigger monitoring – no impacts
25: 10/16/12 – 10/23/12	0.1	Continued trigger monitoring – no impacts
26: 10/23/12 – 10/31/12	2.4	Trigger monitoring – end of dry season

Low Dissolved Oxygen in Receiving Water

There were 22 occasions where DO in the receiving water fell below 5.0 mg/L with a minimum value of 4.5 mg/L. Most of the episodes were short in duration (15-30 minutes). There was only one longer event that lasted 2 ½ hours. The longer episode occurred on August 4th between 0500 and 0700 during high tide. During these higher tides, pond discharge is minimal, at times reaching zero discharge flow. For these reasons, the low DO events are attributed to high tides combined with the normal diurnal DO cycle. No pond management changes were implemented as the episodes were minor in duration and magnitude and did not appear to be caused by pond discharges.

General Observations

Overall pond DO and salinity were typical compared to other seasons (Figures 9 and 10). Pond water color and clarity changed throughout the monitoring season as observed in prior years, but the succession occurred two-months later than in past years. In May through June, the pond was moderately clear with a brownish-green color. This was followed by opaque dark-green to opaque brown blueish-green from August to September. In October, the pond water color changed rapidly from green to opaque brown, which is a transition that has been accompanied by low DO values in the past.

Fouling of continuous sondes in the pond also occurred in October. This fouling consisted of a dark brown mud-like film covering the entire unit that appeared to be diatoms. Beginning in early October and lasting for the remainder of the season, there were algal mats that formed approximately 50 yards away from the discharge point in the pond. Similar algal mats have formed in previous seasons, but have appeared much earlier in the season (July or August). There did not appear to be any water quality effects related to this growth. The algal mats that typically cover the northern edge of the pond each year formed later in the season and covered less area than in previous years.

C. Discrete Monitoring

In addition to continuous monitoring of pond discharge and receiving water, the WDR requires discrete monthly sampling of water quality at four receiving water locations (Figure 1) during the monitoring season (Table 2). These surface and bottom measurements (Table 8) help describe the mixing of fresh slough water with Bay salt water during tidal exchange and the extent that Pond A18 discharges may affect either bottom or surface general water quality. The WDR also requires these measurements to be taken while Pond A18 was discharging. The City times this monitoring in an effort to document the effects of both ebbing and flooding tides. On August 14^{th}, an equipment malfunction in the field prevented any water quality data from being recorded. On June 12^{th}, water quality data was not recorded at the surface for station Artesian-02 due to an operator error.

Discrete Trigger Monitoring

Discrete trigger monitoring is in addition to the discrete monitoring required in Table 2, and is only conducted in response to a DO trigger event. Discrete trigger monitoring began on 10 October 2012 and continued over the final four weeks of the monitoring season (Table 9). Discrete trigger monitoring was prompted by the weekly 10^{th} percentile DO value during week 22 of 2.1 mg/L, which was below the trigger (3.3 mg/L). This additional monitoring helps detect possible negative impacts of pond discharge to determine if additional management actions should be taken.

Table 8. Artesian Slough monthly surface and bottom water quality measurements

Date and Time	Site	Tide	Depth	Temp (°C)	Salinity (PSU)	pH	DO (mg/L)	Turbidity (NTU)	A18 Flow (cfs)
5/15/12 10:00	1	Flood	Surface	23.19	0.8	7.9	6.7	1.2	15.9
5/15/12 09:58	1	Flood	Bottom	22.11	3.6	8.1	5.8	2.2	15.9
6/12/12 11:03	1	Ebb	Surface	24.84	0.7	8.8	7.8	0.7	18.8
6/12/12 11:02	1	Ebb	Bottom	24.67	1.3	8.9	7.4	1.1	18.8
7/18/12 14:14	1	Flood	Surface	25.75	1.0	7.4	8.4	2.1	9.1
7/18/12 14:13	1	Flood	Bottom	22.59	11.4	8.0	4.6	16.9	9.1
8/14/12 13:14	1	Hi Slack	Surface					1.2	11.7
8/14/12 13:13	1	Hi Slack	Bottom					7.6	11.7
9/11/12 09:40	1	Flood	Surface	25.34	0.6	7.5	6.3	1.4	18.7
9/11/12 09:38	1	Flood	Bottom	22.92	14.5	8.7	5.4	10.3	18.7
10/23/12 09:01	1	Flood	Surface	23.38	0.9	7.6	7.0	1.9	6.0
10/23/12 08:59	1	Flood	Bottom	18.88	11.5	7.4	3.4	17.3	6.0
5/15/12 10:07	2	Hi Slack	Surface	22.85	1.2	7.9	6.8	2.0	15.9
5/15/12 10:06	2	Hi Slack	Bottom	21.55	10.6	8.6	5.7	10.1	15.9
6/12/12 11:17	2	Ebb	Surface					1.6	19.4
6/12/12 11:17	2	Ebb	Bottom	23.61	11.3	8.8	6.8	2.7	19.4
7/18/12 14:29	2	Hi Slack	Surface	25.80	1.4	7.3	7.9	2.3	9.1
7/18/12 14:27	2	Hi Slack	Bottom	22.35	12.7	7.7	4.5	17.9	9.1
8/14/12 13:08	2	Flood	Surface					2.0	11.7
8/14/12 13:07	2	Flood	Bottom					13.2	11.7
9/11/12 09:49	2	Flood	Surface	25.02	1.6	7.5	6.4	2.6	18.7
9/11/12 09:48	2	Flood	Bottom	21.86	13.7	8.3	4.1	12.9	18.7
10/23/12 09:10	2	Flood	Surface	22.57	1.5	7.4	6.8	4.0	6.0
10/23/12 09:08	2	Flood	Bottom	17.55	12.1	7.6	4.1	18.9	6.0
5/15/12 10:28	3	Hi Slack	Surface	21.70	2.9	7.7	4.3	17.9	15.9
5/15/12 10:27	3	Hi Slack	Bottom	20.09	8.4	7.8	2.7	33.8	15.9
6/12/12 11:32	3	Ebb	Surface	24.55	1.9	8.4	5.8	5.0	20.3
6/12/12 11:30	3	Ebb	Bottom	22.19	10.3	8.2	2.4	8.4	20.3
7/18/12 14:36	3	Hi Slack	Surface	22.87	1.3	7.6	4.9	21.1	9.1
7/18/12 14:35	3	Hi Slack	Bottom	21.75	14.8	7.4	4.4	30.3	9.1
8/14/12 13:01	3	Flood	Surface					7.4	11.7
8/14/12 13:00	3	Flood	Bottom					25.1	11.7
9/11/12 10:00	3	Flood	Surface	23.22	4.9	7.6	4.0	19.6	17.1
9/11/12 09:59	3	Flood	Bottom	20.74	14.8	7.8	3.1	20.6	17.1
10/23/12 09:21	3	Hi Slack	Surface	21.12	3.3	7.5	5.0	10.8	4.9
10/23/12 09:20	3	Hi Slack	Bottom	16.96	15.3	7.7	4.3	19.8	4.9
5/15/12 10:44	4	Ebb	Surface	20.33	10.3	7.8	3.3	34.5	15.9
5/12/12 10:43	4	Ebb	Bottom	19.61	14.0	7.8	3.6	42.3	15.9
6/12/12 11:45	4	Ebb	Surface	24.17	3.6	8.2	3.5	6.9	21.2
6/12/12 11:44	4	Ebb	Bottom	21.81	11.1	8.2	3.5	14.2	21.2
7/18/12 14:46	4	Ebb	Surface	21.73	18.1	7.5	5.3	47.1	9.1
7/18/12 14:44	4	Ebb	Bottom	21.51	19.5	7.4	5.4	49.3	9.1
8/14/12 12:52	4	Flood	Surface					31.4	10.8
8/14/12 12:51	4	Flood	Bottom					45.2	10.8
9/11/12 10:10	4	Flood	Surface	20.54	17.2	7.9	4.3	16.7	15.3
9/11/12 10:09	4	Flood	Bottom	20.20	29.0	7.9	4.3	13.1	15.3
10/23/12 09:31	4	Hi Slack	Surface	16.68	18.1	7.8	4.5	22.8	4.9
10/23/12 09:30	4	Hi Slack	Bottom	16.63	20.2	7.7	5.1	45.6	4.9

Under the revised management plan described in the City's Supplemental Report to the 2007 Pond A18 Annual Self-Monitoring Report, discharge valve timing or other adaptive management actions are only implemented if surface receiving water is measured at less than 5.0 mg/L or bottom DO is less than 3.3 mg/L during a period when pond DO was below the 10th percentile trigger value and low DO in the receiving water was due to discharge of low DO water from Pond A18. These conditions were not met at any time during 2012 monitoring season so additional management actions were not implemented.

Table 9. Discrete receiving water trigger monitoring at station Artesian-02

Date and Time	Site	Tide	Depth	Temp (°C)	Salinity (PSU)	pH	DO (mg/L)	A18 Discharge Flow (cfs)
10/10/12 10:35	2	Hi Slack	Surface	24.18	1.7	7.4	6.1	10.4
10/10/12 10:33	2	Hi Slack	Bottom	20.19	13.7	7.7	3.4	10.4
10/19/12 09:17	2	Ebb	Surface	24.37	1.4	7.4	6.4	23.1
10/19/12 09:15	2	Ebb	Bottom	21.08	17.4	8.3	4.8	23.1
10/23/12 09:17	2	Hi Slack	Surface	22.57	1.5	7.4	6.8	4.9
10/23/12 09:15	2	Hi Slack	Bottom	17.55	12.1	7.6	4.1	4.9
10/30/12 10:52	2	Flood	Surface	23.29	1.8	7.7	7.2	14.6
10/30/12 10:49	2	Flood	Bottom	20.28	18.1	8.6	7.9	14.6

The City measured temperature, salinity, pH, DO, and chlorophyll *a* monthly in Pond A18discharge, as required by the WDR (indicated by "A" in Table 2). The WDR requires discrete DO measurements to be taken between 0800 and 1000 hours once per month. The results below (Table 10) were taken from the continuous discharge monitor for the date and time of the Pond A18 chlorophyll *a* sample collection, which also occurred between 0800 and 1000 hours.

Table 10. Monthly water quality measurements at A18 discharge

Date and Time	Temperature (C)	Salinity (PSU)	pH	DO (mg/L)
5/15/2012 09:02	20.9	16.5	9.0	7.7
6/12/2012 09:58	23.6	18.5	9.7	8.2
7/18/2012 09:30	23.2	23.2	10.0	10.3
8/15/2012 09:33	23.7	25.2	9.6	4.9
9/11/2012 09:00	21.4	26.2	9.5	7.0
10/23/2012 09:50	17.3	25.1	8.4	0.2

Temperature

Receiving water temperature decreased in a downstream direction and with depth (Tables 8 and 9). Pond temperature is influenced by ambient air temperature and varied as expected for a large shallow, limited flow waterbody throughout the monitoring season (Table 10).

Salinity

There is a strong pattern of upstream stratification and downstream mixing in the receiving water (Figure 11). This recurring pattern has been observed in all monitoring seasons during flooding tides regardless of whether Pond A18 was discharging (Tables 8 and 9). The overall in pond salinity was typical compared to other years, gradually increasing from 17 to 25 PSU (Table 10). An apparent new trend is the overall decreasing salinity in Artesian Slough. Over the past two monitoring seasons, the salinity has been lower and has fluctuated less compared to previous years.

pH

Artesian Slough pH tends to be stratified at the upstream Stations 1 and 2, with bottom pH higher than surface pH regardless of tidal stage or pond discharge status (Tables 8 and 9, Figure 12). Downstream Stations 3 and 4 were less stratified for pH, unlike the salinity concentrations at these locations. Pond pH was markedly higher (9.0 – 10.0) than that of the receiving water (7.1 – 8.3) for over half of the season (Figure 5). The higher pH of the pond does not have a measureable effect on slough pH. At the end of August, pond pH steadily declined (Figure 5). This decline corresponds to the late summer transition in the phytoplankton community that results in increased decomposition rates as phytoplankton species dominance shifts. Typically, pH drops by mid-season. This year, the drop occurred two months later than usual.

Dissolved Oxygen

Monthly DO measurements at the four Artesian Slough stations (Table 8) show that surface DO was higher than bottom DO along the length of the slough except for Station 4. Although DO peaked at Station 2 for surface water, an overall decrease in DO is evident from upstream to downstream (Figure 14). This is likely due to lower oxygen solubility with increasing salinity. The differences between upstream to downstream DO are also amplified by the oxygen-rich effluent that comes from the San José/Santa Clara Water Pollution Control Plant (Plant).

The WDR requires the Discharger to monitor, report, and take corrective action if monthly discrete DO levels in Pond A18, taken between 8:00am and 10:00am at station A-A18-M [can be taken at station D], fall below 1.0 mg/L. This condition occurred in late October (Table 10). The DO in the receiving water at the time was 6.5 mg/L, making it unnecessary for any corrective actions.

Weekly “trigger” water column profiles for temperature, salinity, pH and DO at Station Artesian-02 began on October 10 when pond DO levels fell below the 3.3 mg/L trigger as a 10^{th} percentile weekly value the week before. This monitoring (Table 9) occurred four times and confirmed that the surface DO was not below 5.0 mg/L and the bottom DO was not below 3.3 mg/L.

Turbidity

Turbidity was measured monthly at four stations in Artesian Slough. Turbidity measurements again confirmed that turbidity increases in a downstream direction from Station 1 to Station 4 (Figure 15). As expected, turbidity was greater at the bottom than at the surface at each station. The lower upstream turbidity is due to the highly filtered Plant discharge. Flooding tides and silty downstream stream beds contribute to higher turbidity in the lower segments of

Artesian Slough. The highly filtered Plant discharge coupled with a relatively scoured and cobbled bottom make the upstream portion of Artesian Slough much less turbid.

D. Sediment Monitoring

The WDR specifies annual monitoring for mercury and methyl mercury from in-pond sediments to be performed in August or September of each year. Per Regional Water Board letter dated 15 September 2010, the 2012 mercury sediment monitoring was conducted in the receiving waters (Artesian Slough) rather than in Pond A18. This monitoring occurred on 30 August 2012.

Mercury/Methyl Mercury

Artesian Slough sediment was sampled for concentrations of total mercury and methyl mercury at six locations (Appendix II; Figure 1) by the United States Geological Survey (USGS). Sediment mercury analyses are summarized in Table 11. Total mercury in sediment samples ranged from 198 to 433 ng/g dry weight (Table 11), which is well below USEPA criteria for total mercury in sediment (1000 ng/g dry weight). Methyl mercury concentrations in sediment ranged from 1.7 to 19.3 ng/g. Total mercury for 2012 was higher at all four stations, whereas methyl mercury is more variable with fluctuating values at different stations.

Table 11. 2011 and 2012 sediment mercury & methyl mercury results for Artesian Slough.

Analyte	Year	s-3	s-4	s-5	s-6
Total Hg (ng/g)	2011	131	310	329	232
	2012	198	433	387	253
Me Hg (ng/g)	2011	2.0	13.1	1.6	1.5
	2012	6.7	3.5	19.3	1.7
Percent Fines (%)	2011	33	92	92	68
	2012	36	80	94	50

Station s-3 is the most upstream station and s-6 is the most downstream station.

E. Chlorophyll *a* Monitoring

The City measured chlorophyll *a* in Pond A18 by taking a monthly grab sample in a 1-liter amber glass jar. The sample was kept cool and out of direct light and was transferred (within 24 hours) to Basic Laboratory services in Redding, CA for analysis.

Chlorophyll *a* levels in Pond A18 were typical of the past few seasons beginning with marginal values and ending with a peak (Table 12). By September, the water was more turbid and changed from green to brown, followed by a change back to green in October.

Table 12. Monthly chlorophyll *a* measurements at A18 discharge
Salinity measurements are included for context to indicate general changes in pond characteristics.

Month	Date sampled	Salinity (PSU)	Chlorophyll *a* (µ/L)
May	5/15/12	16.5	13
June	6/12/12	18.5	ND
July	7/18/12	23.2	2
August	8/14/12	25.2	54
September	9/11/12	26.2	2
October	10/23/12	25.1	82

*ND indicates a non-detect reading.

F. Irradiance Measurements and Relationship to Dissolved Oxygen

Measurements for irradiance as solar radiation were obtained from the Union City CIMIS[2] station. Fluctuations in irradiance affect the rate of photosynthesis, DO concentrations, and over time may affect phytoplankton community structure. As average daily solar radiation decreases during late summer and early fall due to shorter days, the decreased sunlight can favor shade-tolerant phytoplankton species. As less shade-tolerant species die-off, their decomposition consumes oxygen and produces carbonic acid leading to a lower DO and pH.

For each monitoring season, average daily DO levels are typically stable (6.2 to 12.9 mg/L in 2012), followed by a substantial decrease to as low as 0.1 mg/L as a daily average (Figures 7 and 16). Shortly after this decrease, DO concentrations across a 24-hour period increase and decrease sharply from supersaturation to anoxia and average daily values show more variability from one day to the next. The extreme diurnal swings in DO are indicative of phytoplankton community boom and bust cycles typical of late-summer eutrophic conditions. For most of the 2012 season, DO levels were somewhat stable, with gradual fluctuations from May through August. Pond DO levels became unstable in late September, characterized by sharp increases and decreases of large magnitudes as described above. This late season instability is typical of most monitoring seasons in the past except that the DO fluctuations this season were the largest on record with DO ranging between 0.0 and 31.0 mg/L. Previously, the largest DO fluctuations were 0.0 – 27.0 mg/L in 2010.

Short Duration Changes in Daily Irradiance

Short-term fluctuations can be caused by overcast skies, storms, or wildfires (Figure 17). Average daily irradiance decreased gradually from early July to the rest of the season. There were no significant short-term fluctuations in daily irradiance in 2012 that caused a measurable effect on pond DO.

[2] California Irrigation Management Information Systems (CIMIS) at wwwcimis.water.ca.gov/cimis/data.jsp

III. Exceedances and Triggered Actions

A. Summary of Exceedances and Triggers

Table 7 lists the low dissolved oxygen trigger events for pond discharges in 2012. Figures 18 and 19 illustrate the exceedances for DO and pH in the receiving water for 2012. These brief events coincided with tidal and diurnal cycles and were reported to the Regional Water Board.

B. Summary of Corrective Action

There were five weeks in which the weekly 10^{th} percentile DO level in the discharge fell below the established trigger of 3.3 mg/L. The City responded by conducting additional discrete receiving water monitoring. Despite this decrease in pond DO, no negative effects were detected in the receiving water that could be attributed to Pond A18 discharge so no further actions such as gate closures were implemented in 2012.

On two different occasions, receiving water DO fell below the 5.0 mg/L Basin Plan Objective for periods of 1.0 - 2.5 hours (Figure 18). These episodes occurred at night during high tide. Neither incident was attributable to Pond A18 discharge. There were no incidents where receiving water pH rose above 8.5 (Figure 19).

IV. Discussion and Interpretation of 2012 Results

Temperature

Pond and receiving water temperatures in 2012 (Table 3; Figures 2 and 3) were similar to 2011. This was likely due to another mild summer with relatively lower temperatures. Prolonged hot weather, such as the heat wave in 2006, can depress DO levels due to increased respiration.

Salinity

Salinity is the most variable parameter in the pond both within and between years. During 2012, overall pond salinity was slightly higher than the previous two years (Figure 10). Unlike these previous years, 2012 did not have substantial rainfall or dam releases. It is the amount of precipitation in the preceding wet season that strongly affects the pond salinity at the onset of monitoring.

In 2012, there was no observed vertical stratification of receiving waters as a result of Pond A18 discharge (Table 8), an observation that has been consistent since late summer of 2005. The differences between surface and bottom salinity at downstream stations are explained by tidal action in Artesian Slough (Figure 6) and fresh water flows from the San José/Santa Clara Water Pollution Control Plant (Plant). Fresh water from the Plant is less dense and tends to float on top of saline Bay water being pushed into the slough by the flooding tide.

pH

Pond pH increases as a result of photosynthesis when irradiance and temperatures are high.

Increases in pH are limited due to the buffering capacity of salt water. Similar to last season, pond pH was high (mean pH of 9.5) for most the season (Figure 5) followed by a steady decline in early September. Usually the drop in pond pH occurs during July. These decreases in pH have occurred every monitoring season to date and correspond to changes in the algal community. This is evident in observed water color, water clarity changes, and chlorophyll *a* measurements.

Although high pH could cause osmotic stress to aquatic life, the slow rate of pH change in well-buffered pond water likely allows organisms to adjust. Despite high pond pH, there was no apparent effect in the receiving water pH from pond discharges. Rather, the regular fluctuations of receiving water pH are strongly associated with the tidal cycle (Figure 6) and show a diurnal pattern likely due to changes in rates of photosynthesis.

Adaptive Management of Pond DO Levels

Years of monitoring have shown it is unnecessary to close the discharge gate when pond DO falls below the trigger. In 2008, a revised management strategy that helps maintain a more consistent circulation pattern in the pond throughout the dry season replaced the previous strategy of initiating timed discharges after a DO trigger event. Instead of closing discharge valves, weekly "trigger" monitoring is performed at the nearest downstream station (Table 9) if the weekly 10^{th} percentile DO value goes below 3.3 mg/L. This monitoring continues until DO levels rise above the trigger. Gates are closed only if discrete trigger monitoring measures receiving water DO at less than 5.0 mg/L at the surface or less than 3.3 mg/L at the bottom. By following this revised management strategy, there have not been any observations of stressed fish in the pond since 2008. It is noteworthy to point out that receiving water DO remained stable during the end of the season when the pond DO began to have the largest fluctuations on record (Figure 7). This gives further evidence that tidal influence and Plant discharge dominate the water quality in this stretch of Artesian Slough and the influence of pond discharges is negligible.

There were no timed gate closures in 2012. Also, there were no observations of stressed fish and no negative effects to the receiving water as a result of discharges from the pond during low-DO periods.

Average Discharge Flow Volume from Pond A18

Artesian Slough is dominated by tidal influence and continuous freshwater flows from the Plant (100 MGD). During high tides, salt water from San Francisco Bay provides most of the water volume in Artesian Slough as shown by the discrete transect receiving water monitoring (Table 8). The average pond flow is typically only about 16% of the Plant's continuous daily freshwater flow. The average discharge volume from Pond A18 during the 2012 monitoring season was 14.2 MGD, which is slightly lower than 2011 (17.2 MGD). Pond discharge varies due to modified discharge valve settings that maintain a consistent pond water depth. Pond discharge mixes rapidly with receiving waters. These two factors likely account for the negligible effect of pond discharge on receiving water quality even at Artesian Slough Station 2 (Table 8) immediately downstream of the pond discharge point.

Mercury and Methyl Mercury Analysis of Receiving Water Sediment

Mercury and methyl mercury concentrations in A18 sediments have been measured annually since 2005. At the request of the Regional Water Board, Artesian Slough sediment was sampled and analyzed for mercury and methyl mercury in 2011 and again in 2012.

The previous years of pond data did not show any clear spatial patterns. A slight temporal trend was seen in an overall increase in total mercury that peaked in 2009 followed by a substantial decrease in 2010. There are no clear spatial or temporal patterns for methyl mercury in the pond.

Mean (+ SE) sediment mercury and methyl mercury concentrations in Artesian Slough for 2012 were 318 + 55 ng/g and 7.8 + 4.0 ng/g, respectively. Compared to last year, total and methyl mercury have increased. The total mercury concentration in Artesian Slough is lower than Alviso Slough; however, the methyl mercury concentration is higher (Table 13). While these data are limited, it may suggest a higher methylation rate in Artesian Slough.

Table 13. Mercury (mean + SE) in sediments from the receiving water and an adjacent slough[3]

Data Source	Total Mercury (ng/g)	n	Methyl Mercury (ng/g)	n
Artesian Slough	318 + 55	4	7.8 + 4.0	4
Alviso Slough	595 + 75	24	2.25 + 0.23	24

Pond Primary Production and Phytoplankton Community

Due to shallow depths in Pond A18 (average of approximately 2 feet), high summer irradiance, low flow-through rates, and nutrient availability, phytoplankton blooms were common in 2005 and 2006. However, there have not been such dramatic phytoplankton blooms in subsequent seasons from 2007-2012. Chlorophyll *a* levels for 2012 were typical of non-bloom years (Table 12). Although a dramatic bloom did not occur in 2012, water color changes and various fouling situations in the pond indicate a transition in pond community structure.

Typically, chlorophyll *a* levels are low throughout most of the monitoring season and spike near the end. This year, there were two spikes; one in August and another in October. The physical properties of the pond, high irradiance and low flow through rates result in a highly productive system that can become unstable in response to variations in temperature, precipitation, or irradiance.

High rates of photosynthesis, which cause extremely high DO levels measured in the pond (max of 31.0 mg/L, Table 6), are balanced by high rates of ecosystem respiration (ER) by pond algae, zooplankton, benthic invertebrates, decomposers, and fish. At night when photosynthesis ceases, respiration can cause DO to drop to as low as 0.0 mg/L (Table 6). The extremes of GPP

[3] Unpublished Data, M. Marvin-DiPasquale, USGS. Used by permission.

and ER in Pond A18 provide a beneficial food supply function. In 2006, mean Gross Primary Production (GPP) was estimated to be 8.2 g O_2 /m^2/day. This rate of photosynthesis is double the rate of some of the world's most productive estuaries, such as the Chesapeake Bay[4]. However, the extreme levels and apparent tight coupling of GPP and ER also result in a system that is highly susceptible to hypoxia when irradiance decreases, temperature increases (increases metabolism and respiration), and possibly during seasonal and monthly swings in salinity that may induce changes in phytoplankton species dominance. This year, it is unclear what was responsible for the change in phytoplankton dominance two to three months later than normal.

To better understand pond phytoplankton dynamics, the City decided to sample periodically for phytoplankton species composition and abundance in 2007 and 2008. This documented a shift in phytoplankton species abundance despite the absence of an apparent phytoplankton die-off in those years. Declines in pond pH and more extreme swings in the diurnal DO cycle coincided with transitions in pond community structure. Each monitoring season, these transitions showed very typical patterns in water color, clarity, changes in pH, irradiance measurements, and changes in DO. In 2012, a similar cycle of succession was observed that was delayed approximately two to three months compared to most other years.

Nuisance Filamentous Macro-algae

The presence of filamentous macro-algae in Pond A18 varies from year to year. Filamentous algae consist of macroscopic filaments which are of little value to pond productivity since filter-feeding zooplankton (copepods, cladocerans, rotifers, shrimp, aquatic insects) are not able to utilize them effectively. Filamentous algal mats also block light penetration into the water column, thereby decreasing phytoplankton production and overall pond productivity.

In 2012 the amount and distribution of filamentous algae shifted compared to recent years. Typically, mats of algae accumulate at the north end of the pond. This season, those mats were less than half the size of those observed in recent years. Algal mats also appeared near the discharge structure for the first time since the 2007 monitoring season. If these changes in the abundance of filamentous algae, phytoplankton composition and chlorophyll *a* are due to uncontrollable factors such as variations in irradiance, temperature or increasing pond salinity in a pond designed for high evaporation rates, such changes may be unavoidable.

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[4] J. Thebault, Schraga, T.S., Cloern, J.E., Dunlavey, E.G. 2008. Primary Production and Carrying Capacity of Former Salt Ponds after Reconnection to San Francisco Bay. Wetlands 28:841-851.

V. Lessons Learned and Recommendations

1. Pond A18 has shown no low DO events during the month of May.

   Recommendation: Discontinue water quality monitoring during the month of May. There have been no incidences of a 10th percentile going below 3.3 mg/L during the month of May in eight years of monitoring. Water quality parameters have been stable and within their acceptable ranges during May. Commencing dry season monitoring on June 1 of each year will provide sufficient time to characterize pond water quality and respond to low DO incidents if needed.

2. In 2012, Pond A18 discharge caused no observable effects on receiving water quality even when DO levels occasionally fell below the 3.3 mg/L trigger. After eight years of monitoring, water quality of Pond A18 discharge has shown no measurable effect on the water quality of the receiving waters (Artesian Slough) for any parameter. Daily changes in water quality of Artesian Slough are affected most substantially by bay water associated with incoming/outgoing tides.

   Recommendation: Discontinue receiving water continuous monitoring [E in Table 2] until pond DO levels fall below the 3.3 mg/L trigger. The DO trigger will continue to serve as an early warning signal that initiates additional actions. If receiving water continuous monitoring indicates potential effects of pond discharge on receiving water and pond DO levels remain low, additional actions such as weekly receiving water column depth profile monitoring at Station Artesian-02 or valve closures may be implemented.

3. Sampling chlorophyll *a* and tracking irradiance continue to provide useful information for characterizing variability of the Pond A18 phytoplankton community and how climatic and water quality factors affect pond stability.

   Recommendation: Continue monitoring chlorophyll *a* and tracking changes in irradiance.

4. Pond A18 has very high primary productivity due to a large biomass of phytoplankton. Because of this high productivity, short-term decreases in irradiance due to cloud cover, rain events or other uncontrollable conditions can temporarily lower DO due to decreased photosynthesis. No adverse effects on receiving water DO have been measured during these short-term decreases in DO over eight years of monitoring.

   Recommendation: Continue continuous discharge operations, which provides the most stable conditions in the pond. Shutting the discharge valve as a result of temporary low DO due to uncontrollable conditions may exacerbate low DO due to stagnation of pond water.

5. Collaborative Artesian Slough sediment sampling of mercury and methyl mercury with the United States Geological Survey (USGS) was productive and cost-effective.

   Recommendation: Continue collaborative mercury sediment sampling of Artesian Slough with USGS.

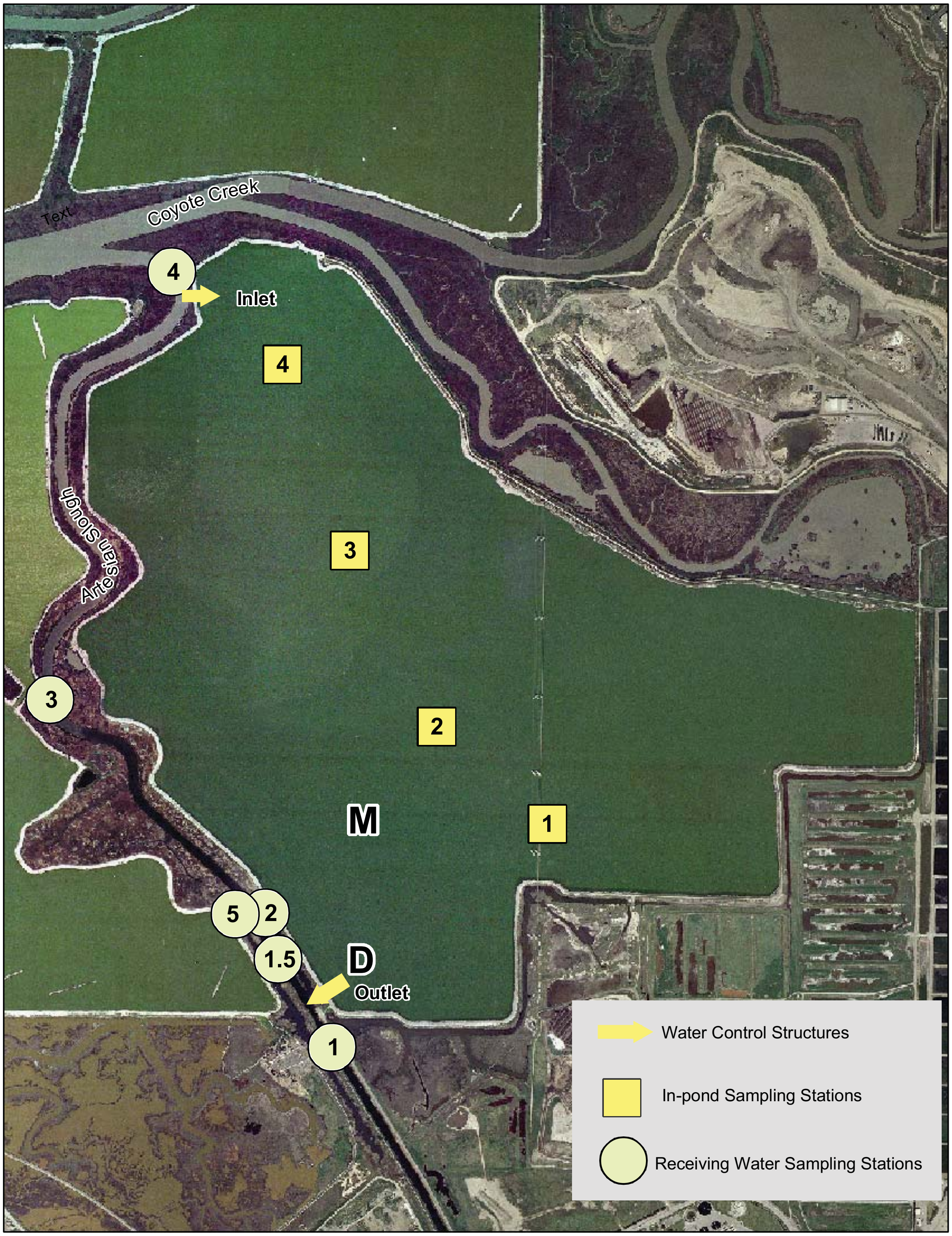


Figure 1. Artesian Slough and Pond A18 Monitoring Stations

Pond stations are referred to in the text as 1,2,3, & 4 (yellow squares). Artesian Slough stations (green circles) and Pond stations D and M are abbreviated in this figure. For example, station A-A18-1 is abbreviated as 1, A-A18-D is abbreviated as D, etc. Stations 2 (for discrete monitoring) and 5 (for continuous monitoring) are located at the same site in Artesian Slough.

Figure 2. 2012 Dry Season Temperature Profiles of Pond A18 and Artesian Slough

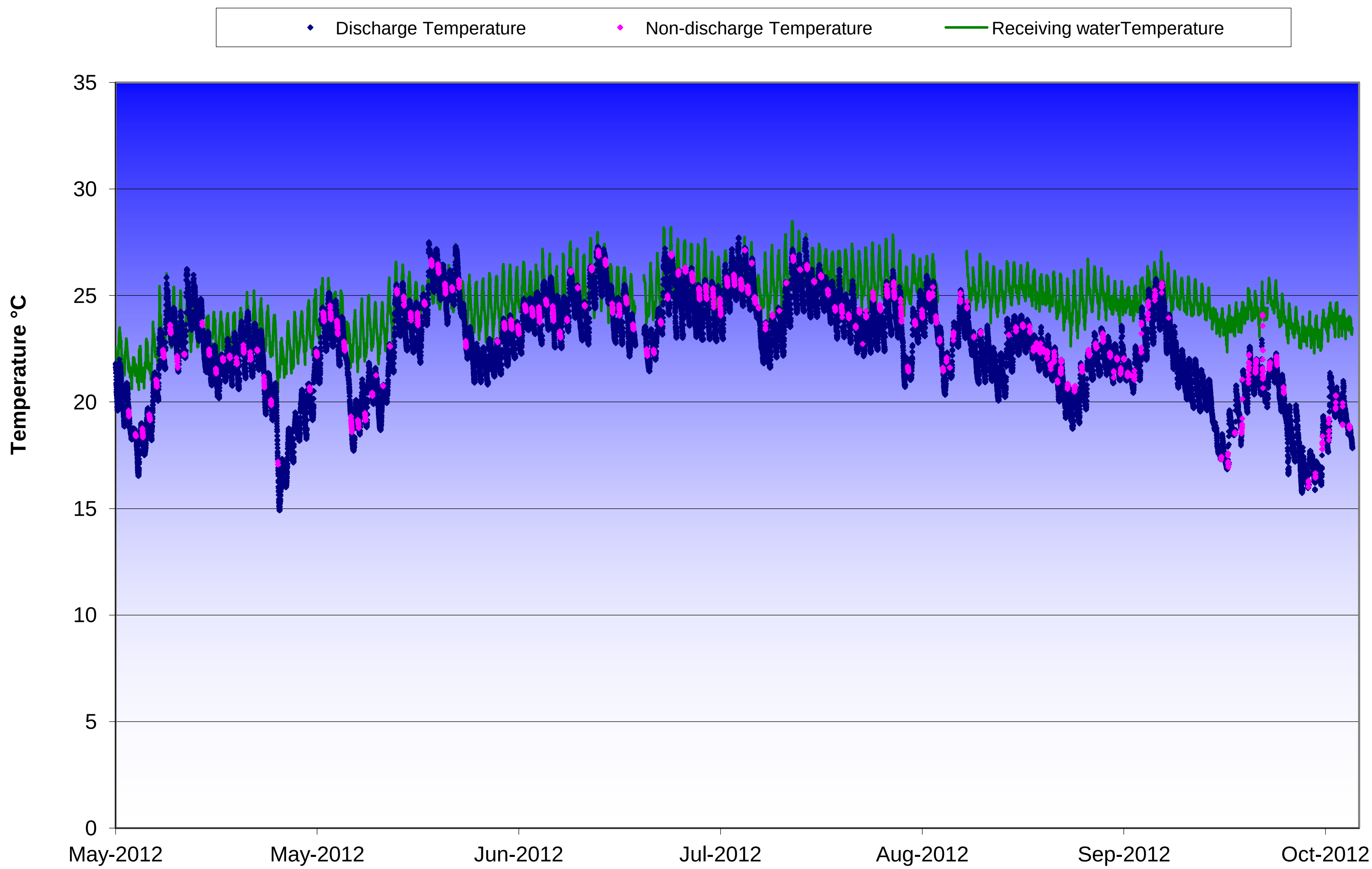


Figure 3. 2012 Temperature Difference between A18 Discharge and Artesian Slough

Positive values indicate that Artesian Slough temperature is greater than Pond A18 discharge.

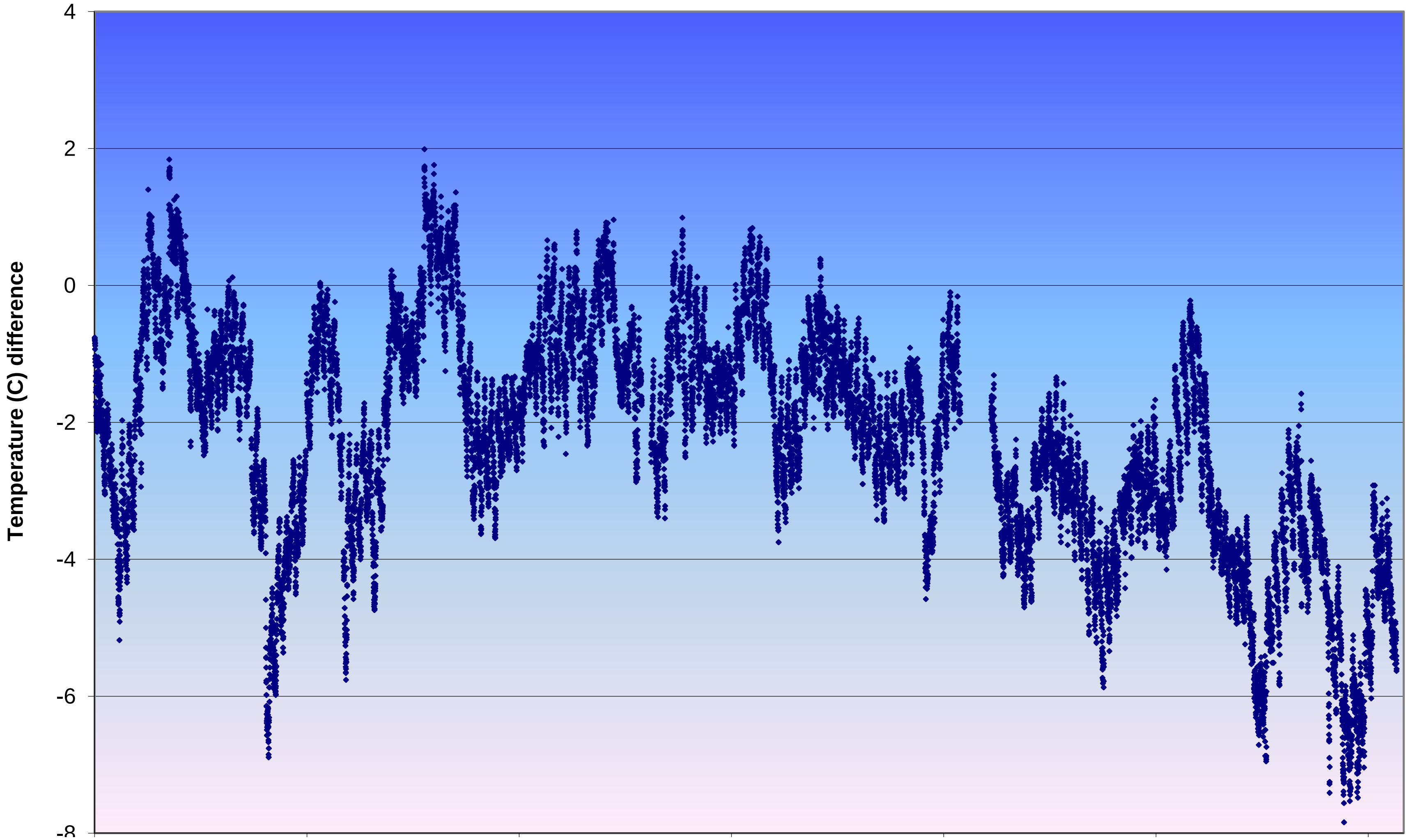


Figure 4. 2012 Dry Season Salinity Profiles of Pond A18 and Artesian Slough

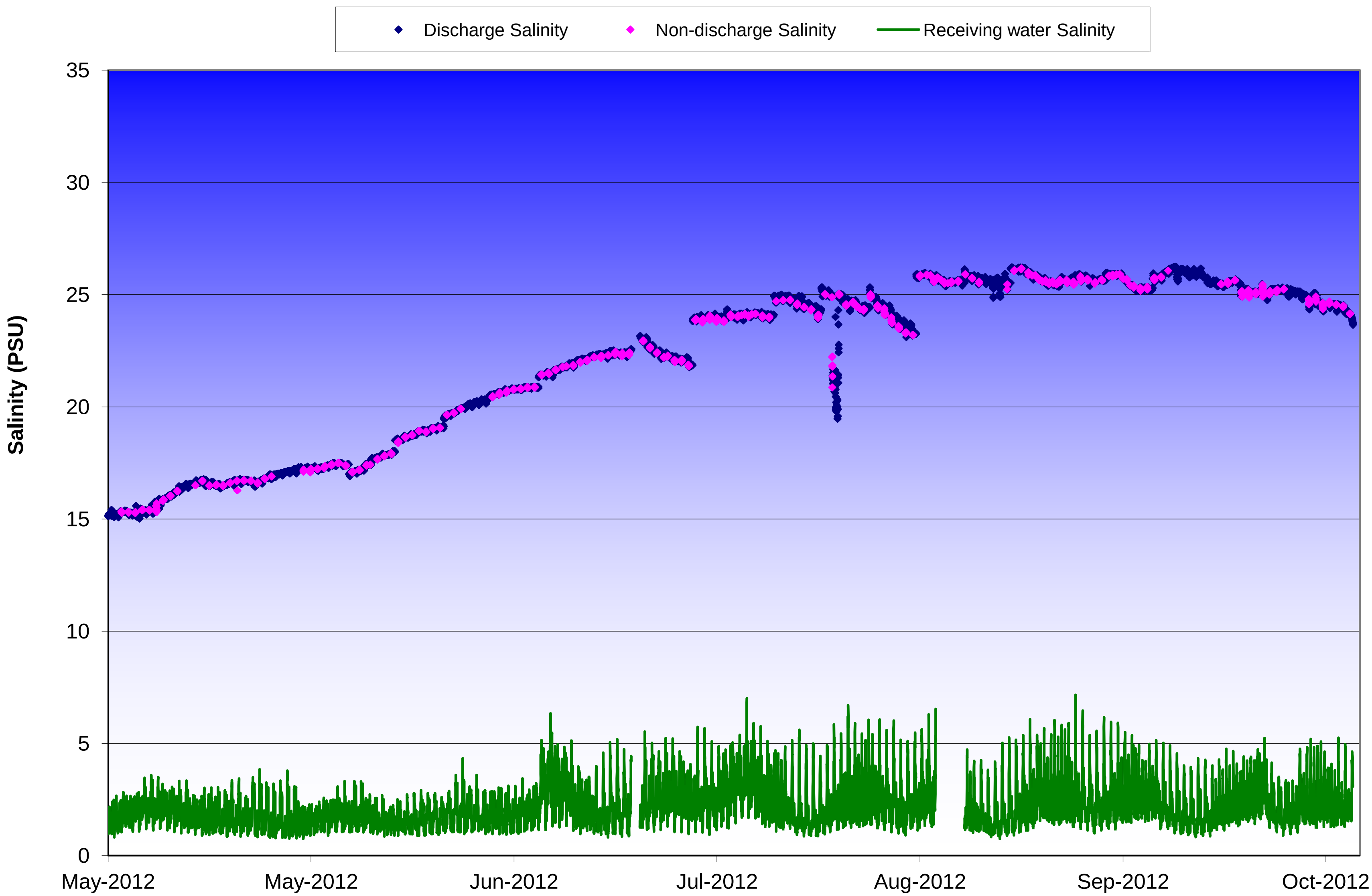


Figure 5. 2012 Dry Season pH Profiles of Pond A18 and Artesian Slough

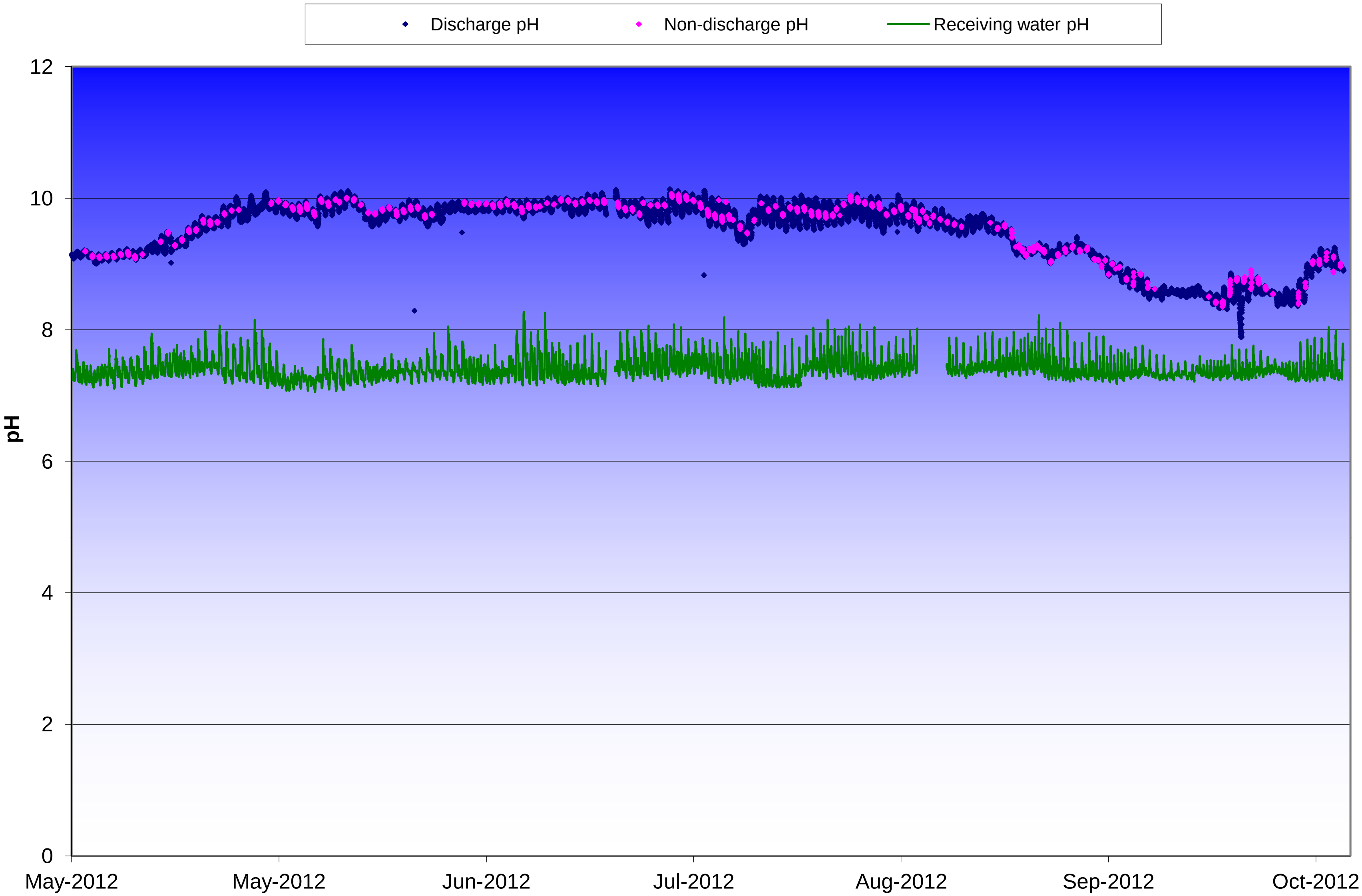


Figure 6. Effect of Tidal Cycle on Salinity and pH of Artesian Slough

Example taken from Week 19 of Receiving Water data

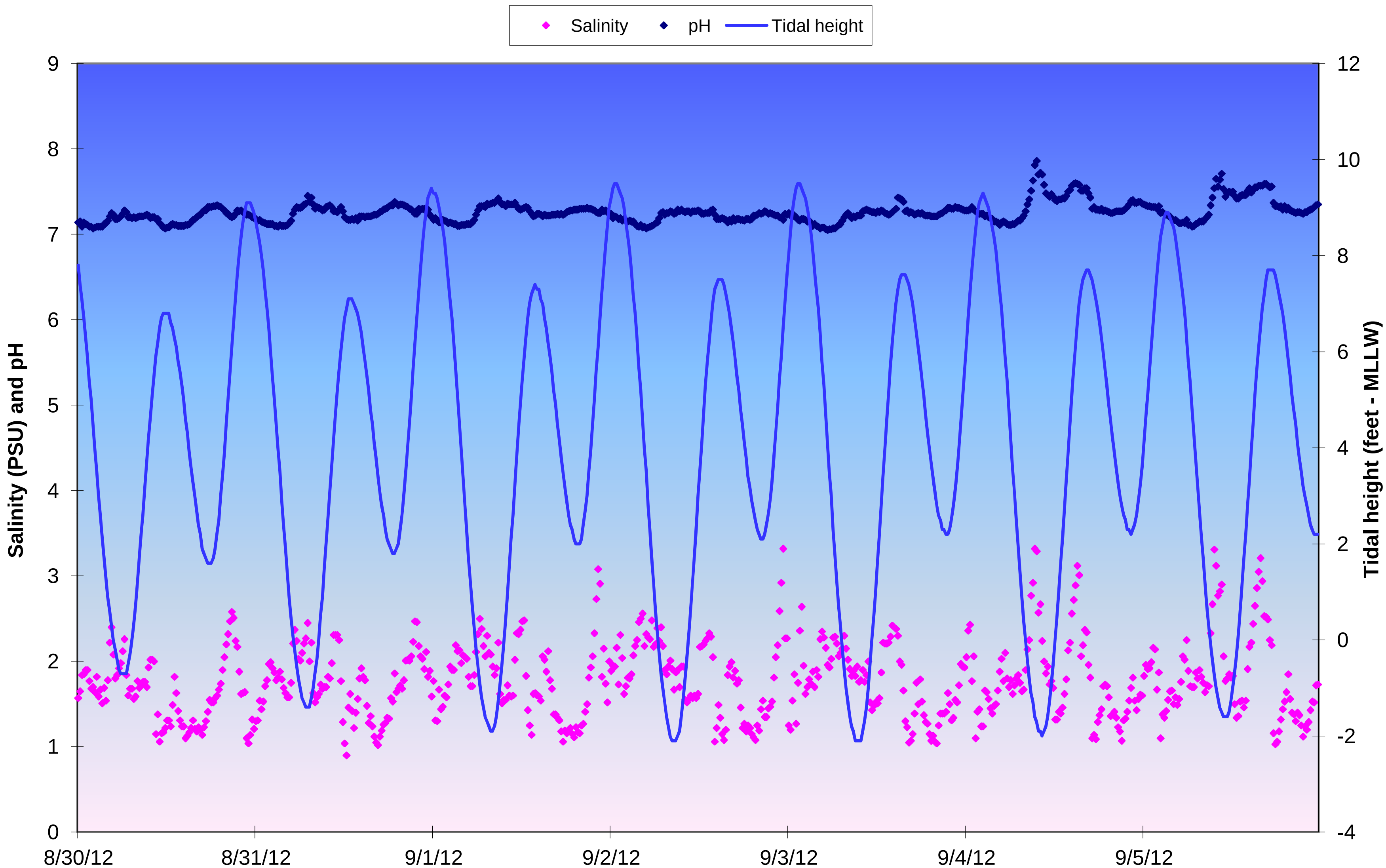


Figure 7. Dissolved Oxygen Profiles of Pond A18 and Artesian Slough

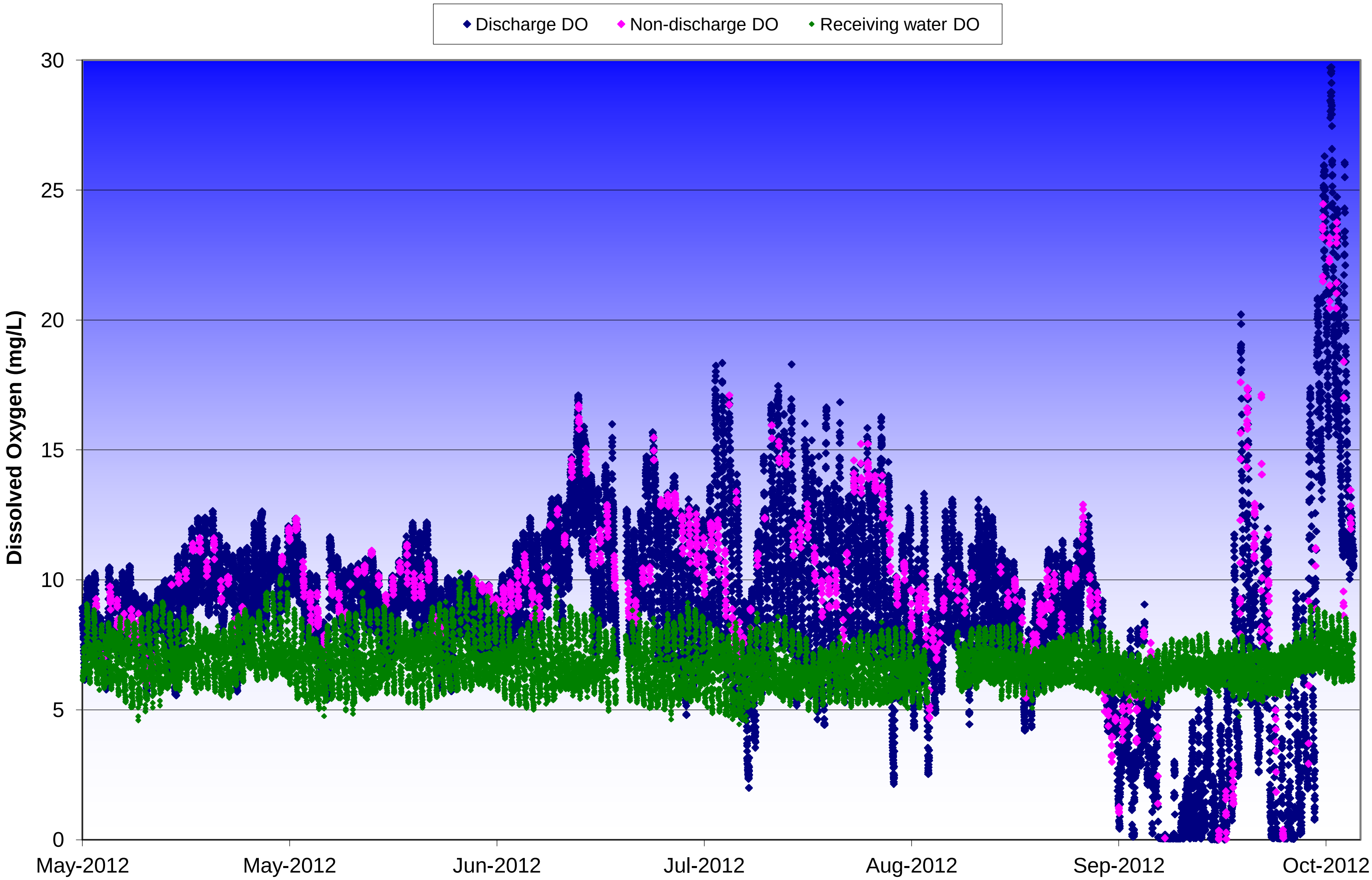


Figure 8. Day and Night Mean (+SE) Dissolved Oxygen Concentrations at High and Low Tides.

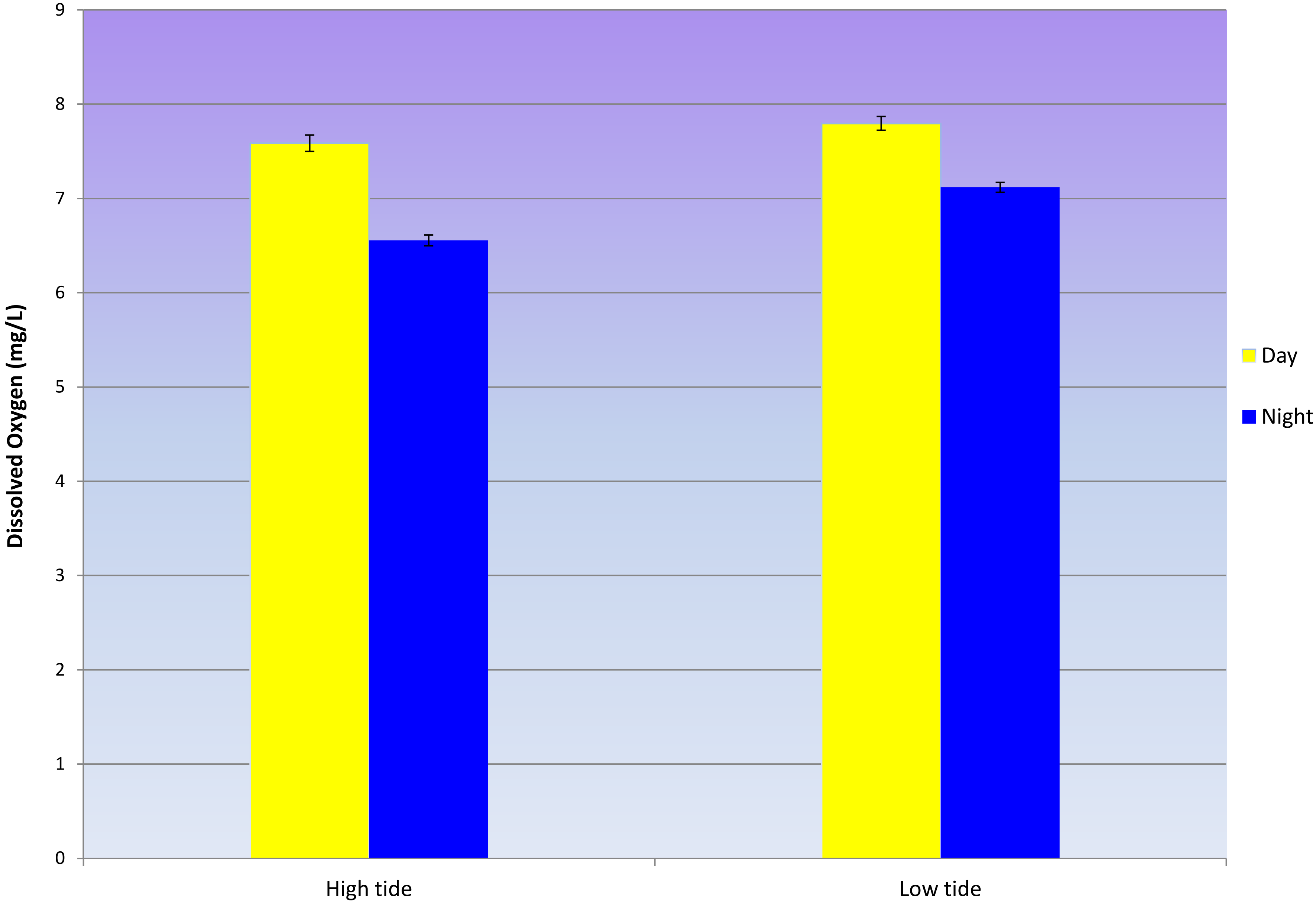


Figure 9. Daily Average Dissolved Oxygen for Pond A18

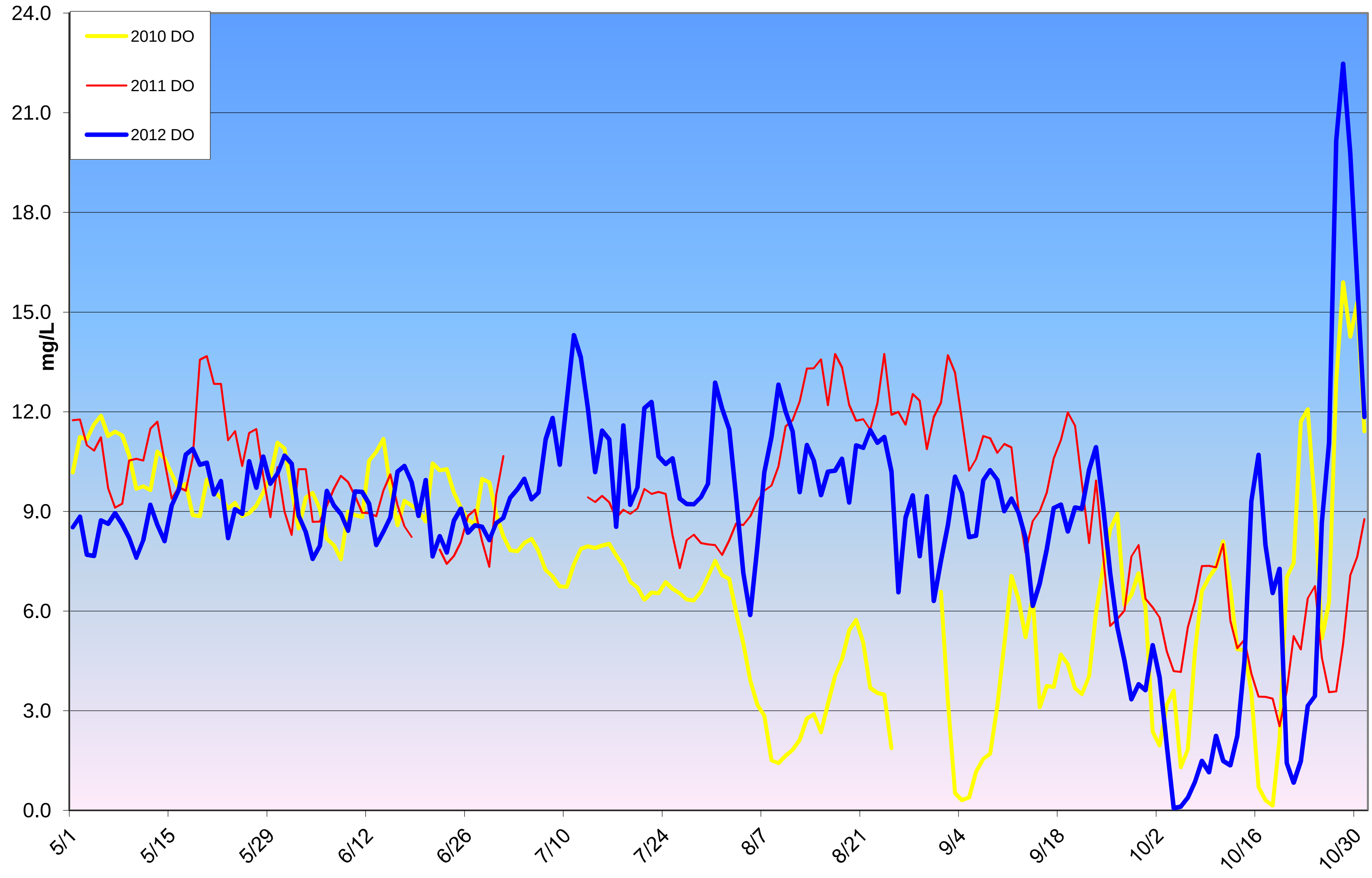


Figure 10. Daily Average Salinity for Pond A18

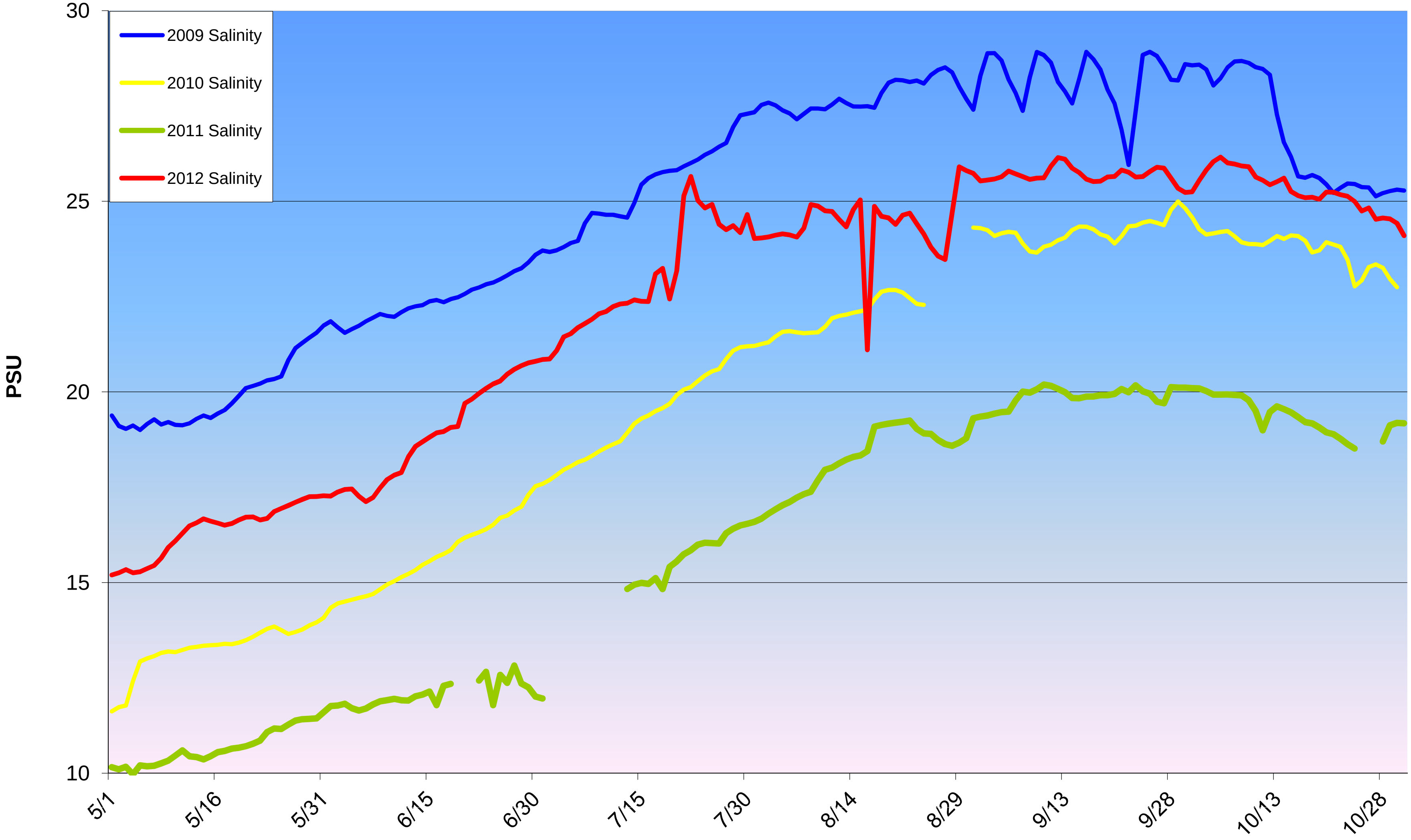


Figure 11. Mean (+ SE) Monthly Salinity in Artesian Slough for 2012

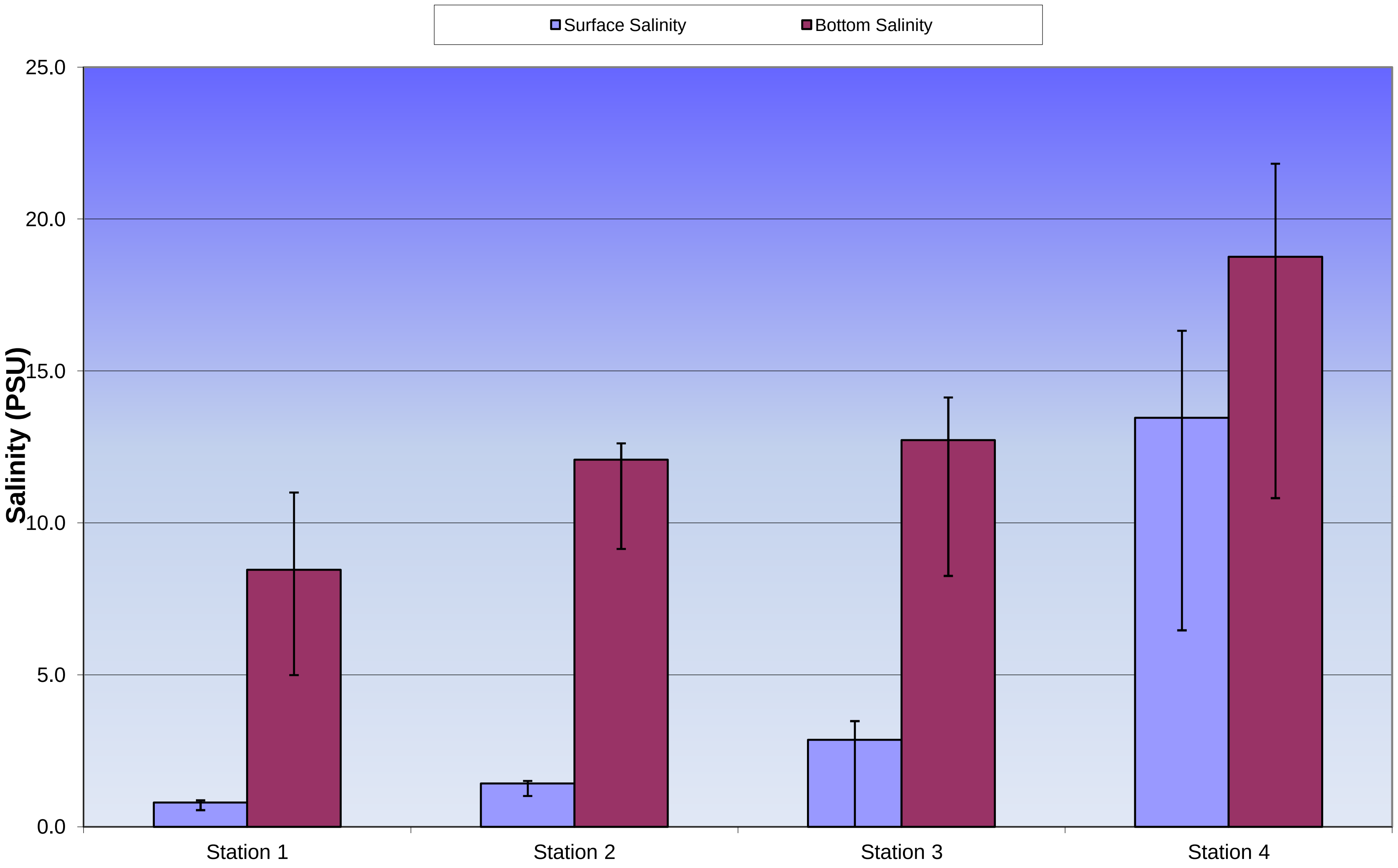


Figure 12. Mean (±SE) Monthly pH in Artesian Slough for 2012

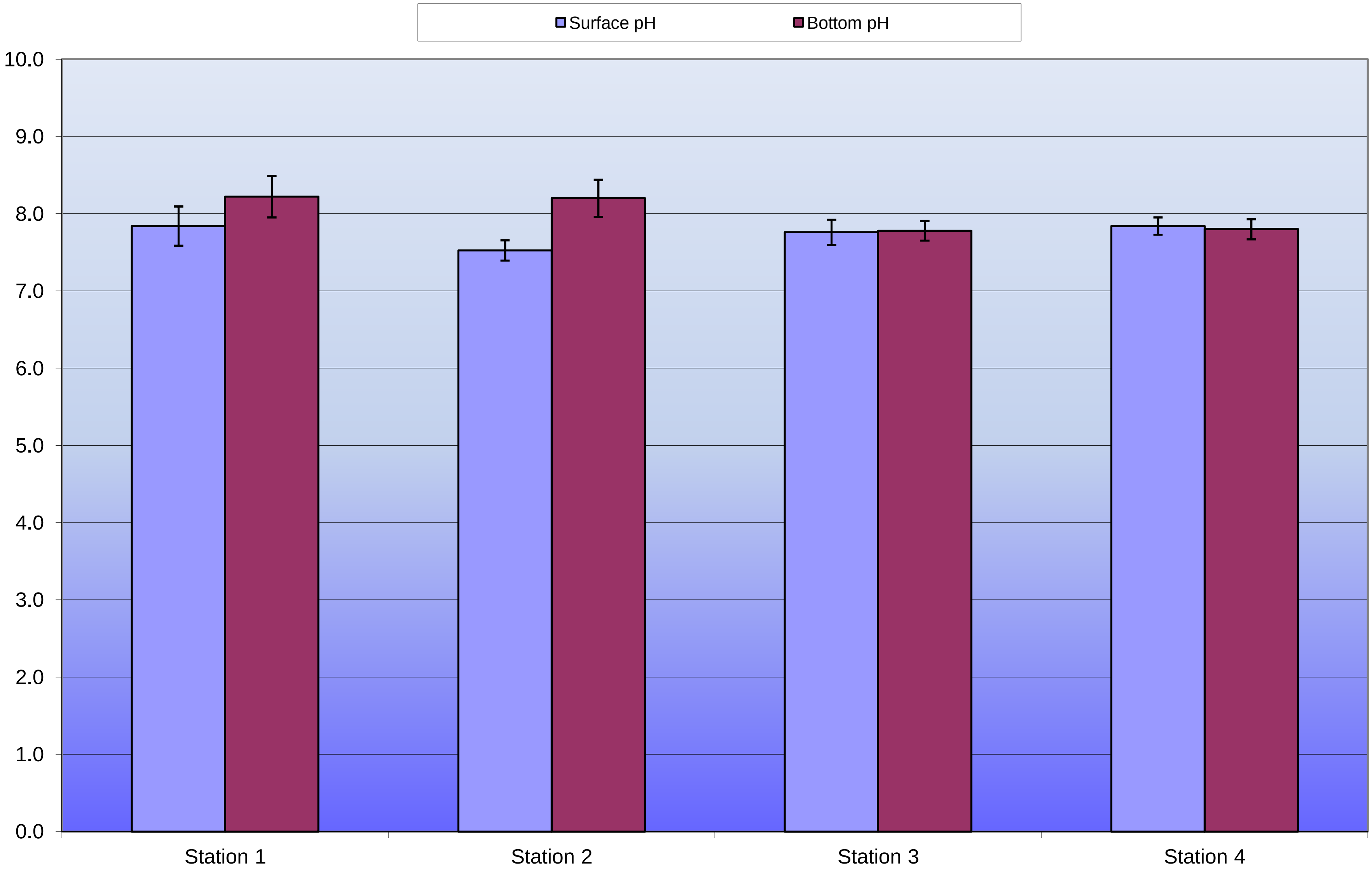


Figure 13. Daily Average pH for Pond A18

Figure 14. Mean (±SE) Monthly Dissolved Oxygen in Artesian Slough for 2012

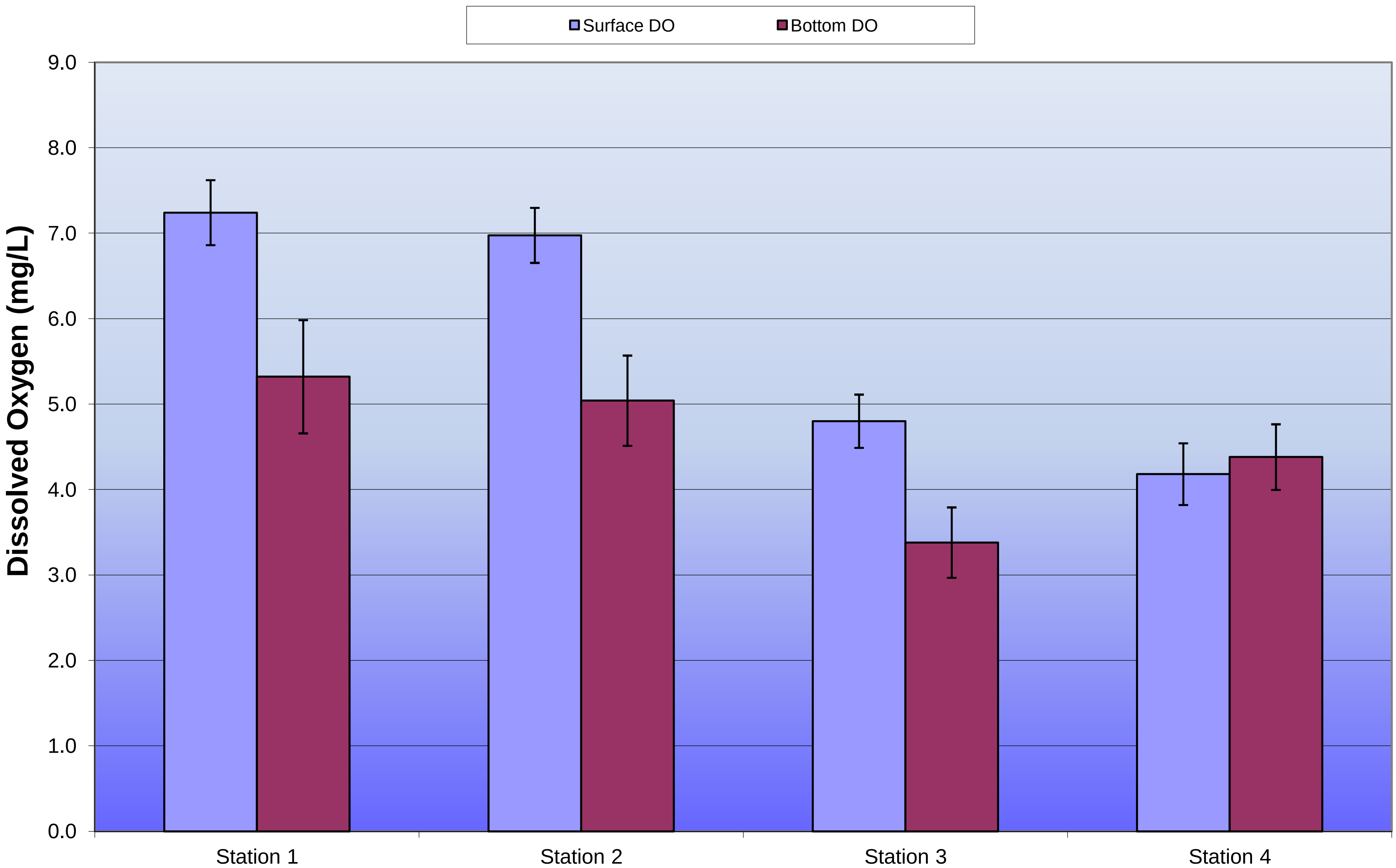


Figure 15. Mean (±SE) Monthly Turbidity in Artesian Slough for 2012

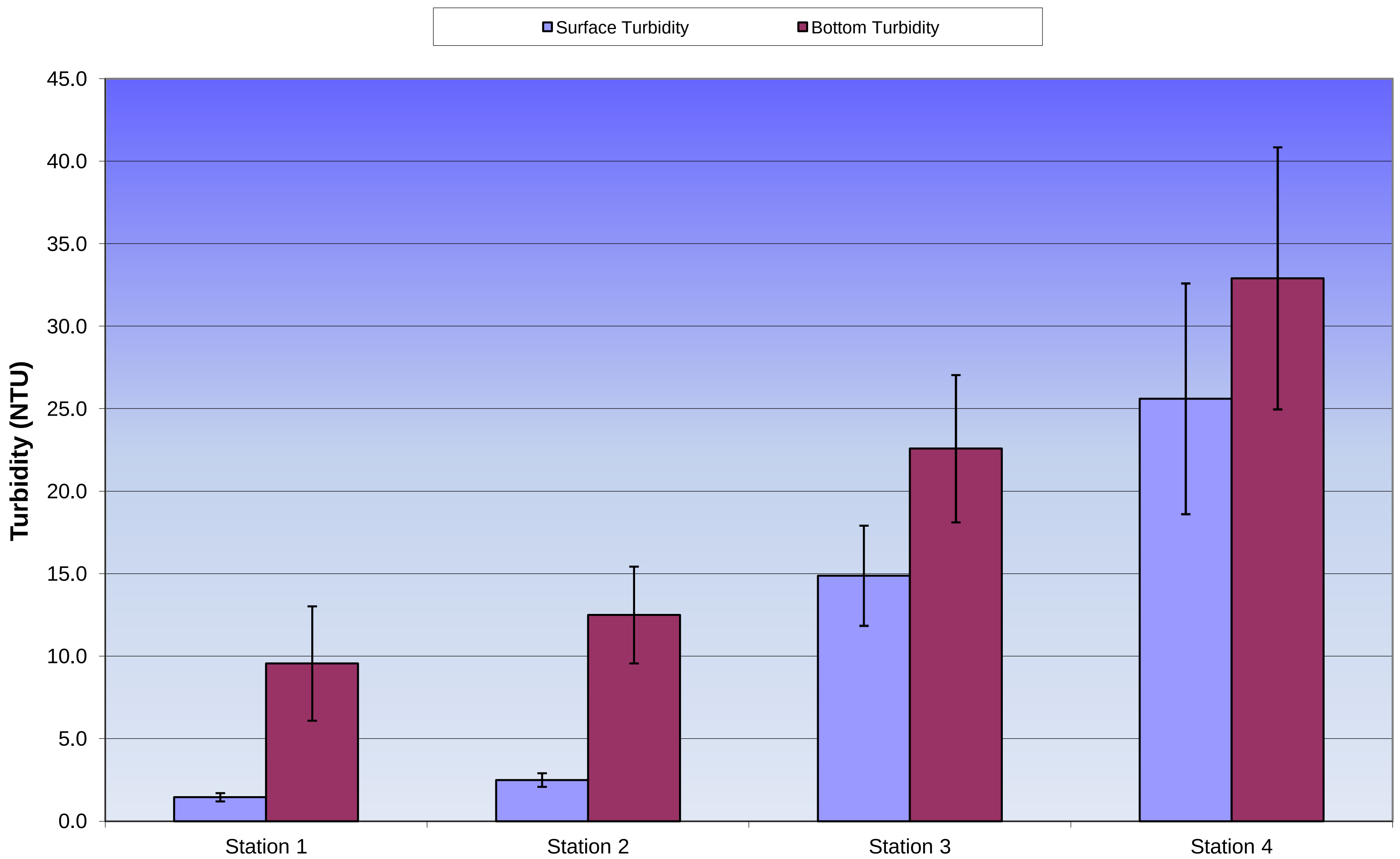


Figure 16. Seasonal DO and Solar Radiation Trends

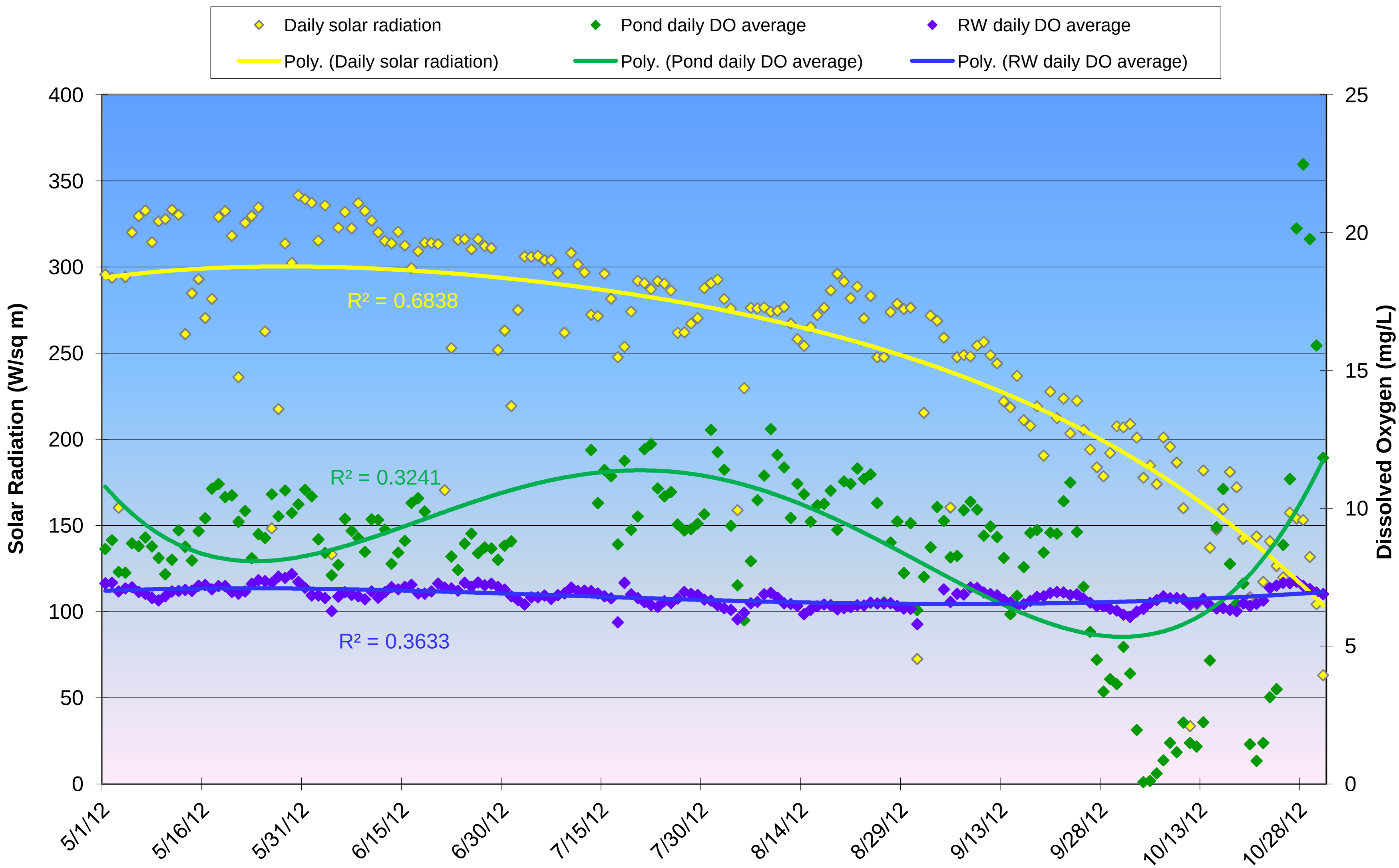


Figure 17. Daily DO and Solar Radiation - weeks 5 and 6

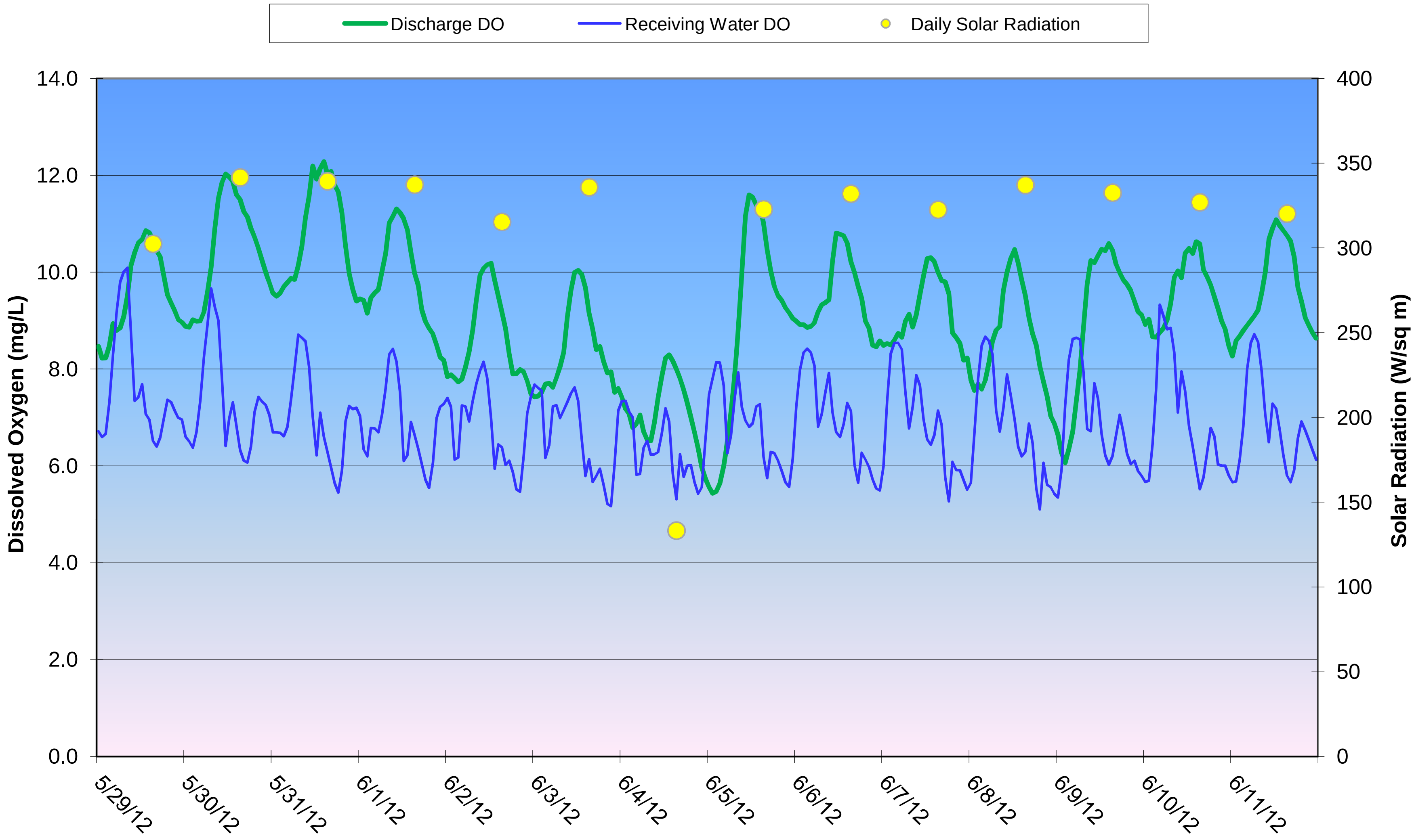


Figure 18. Receiving Water Dissolved Oxygen Comparison to Basin Plan Objective.

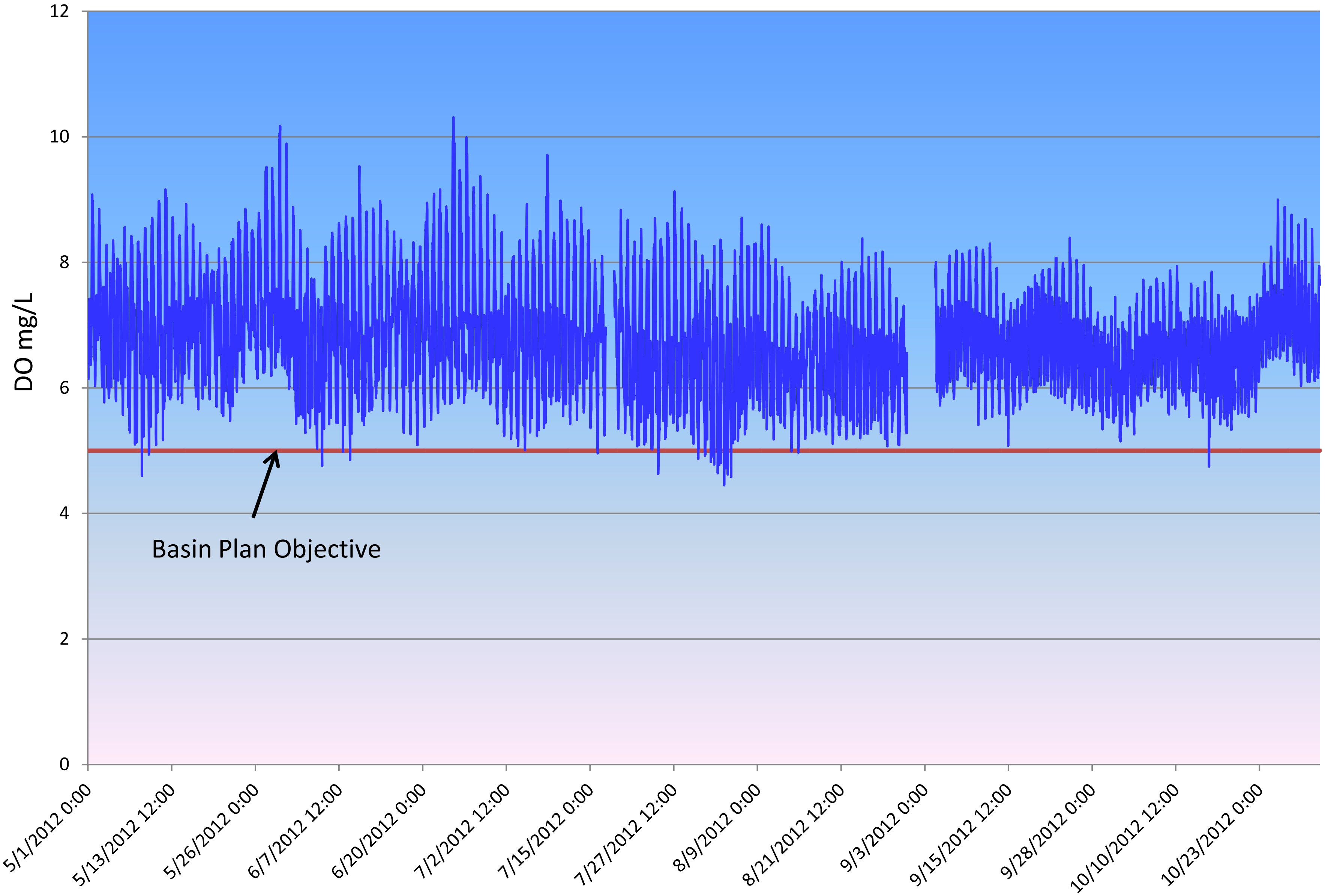
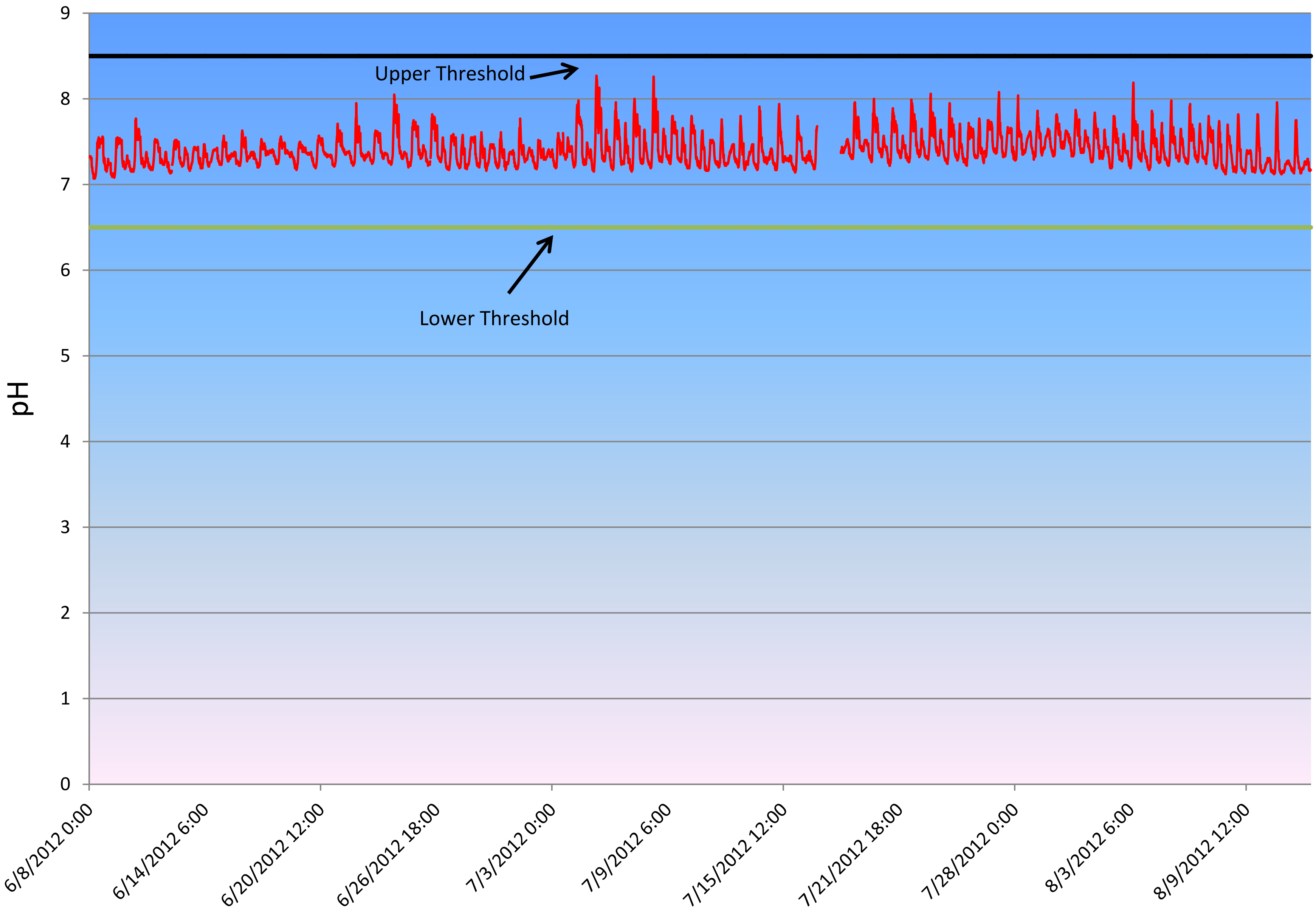


Figure 19. Receiving Water pH Comparison to Basin Plan Objective.



Appendix I. Comparative Monthly Profiles of pH, Salinity and Temperature in A18 and Artesian Slough

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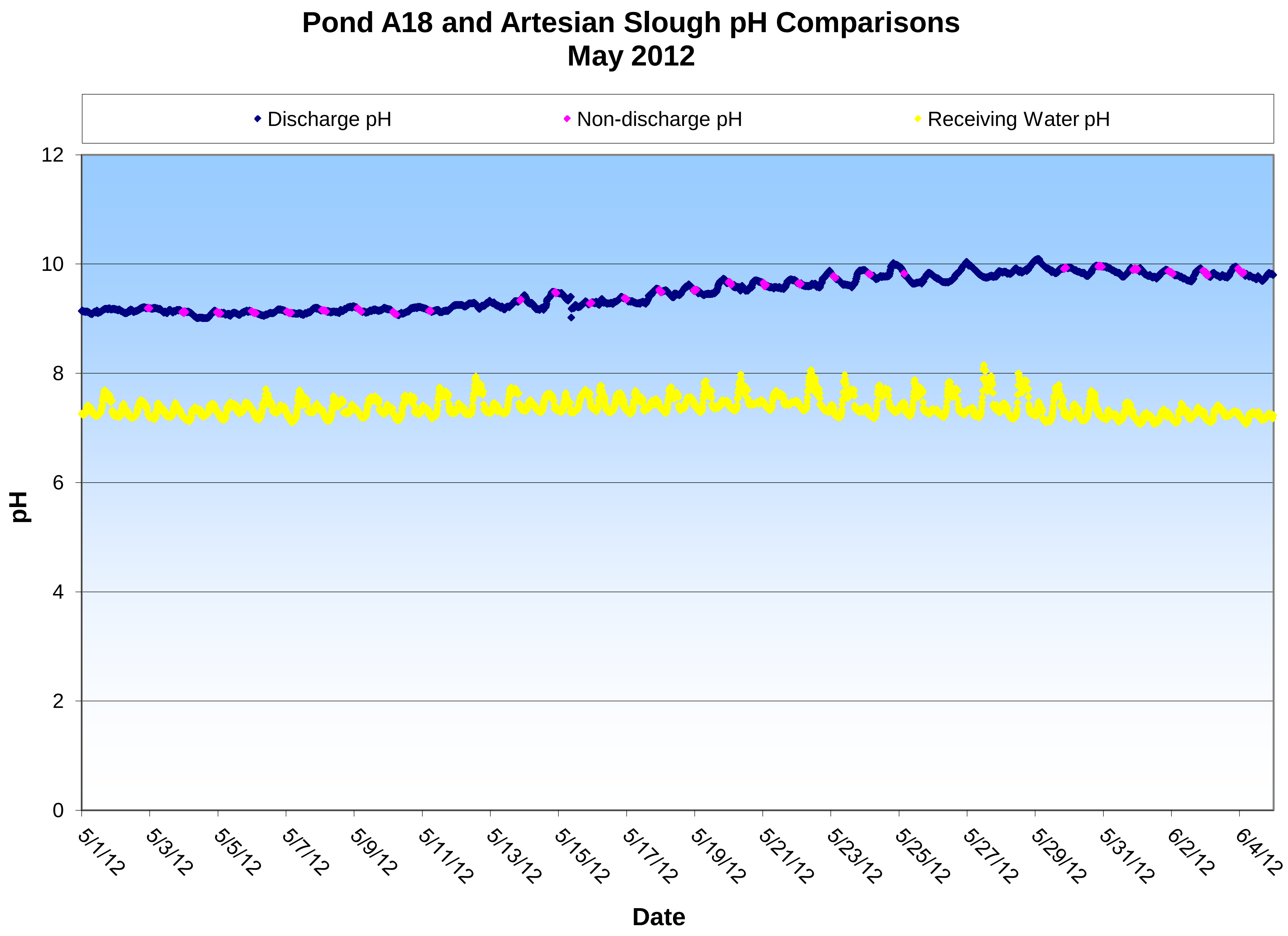
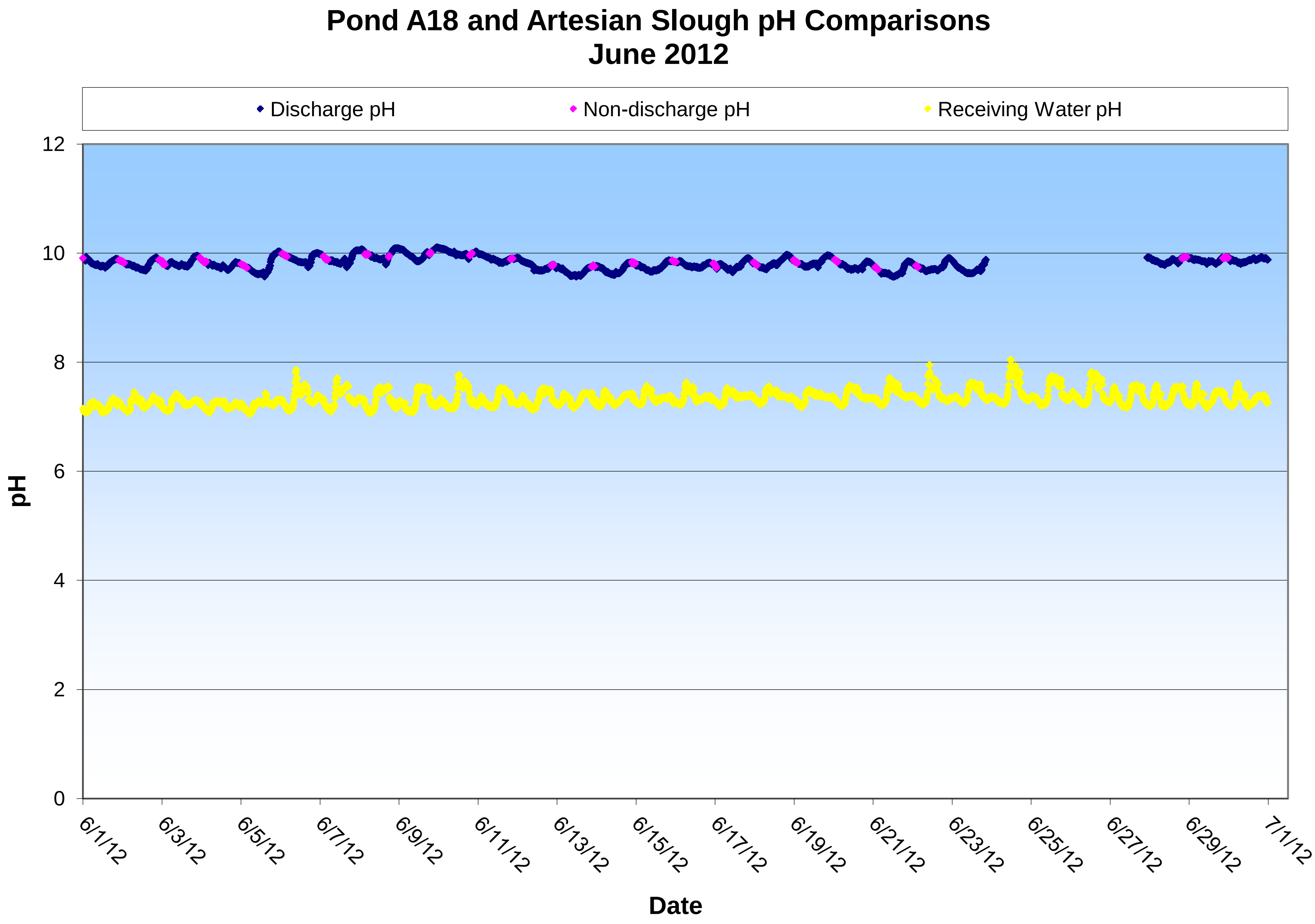


Pond A18 and Artesian Slough pH Comparisons
May 2012
Discharge pH
Non-discharge pH
Receiving Water pH
pH
0
2
4
6
8
10
12
5/1/12
5/3/12
5/5/12
5/7/12
5/9/12
5/11/12
5/13/12
5/15/12
5/17/12
5/19/12
5/21/12
5/23/12
5/25/12
5/27/12
5/29/12
5/31/12
6/2/12
6/4/12
Date



Pond A18 and Artesian Slough pH Comparisons
June 2012
Discharge pH
Non-discharge pH
Receiving Water pH
pH
Date
0
2
4
6
8
10
12
6/1/12
6/3/12
6/5/12
6/7/12
6/9/12
6/11/12
6/13/12
6/15/12
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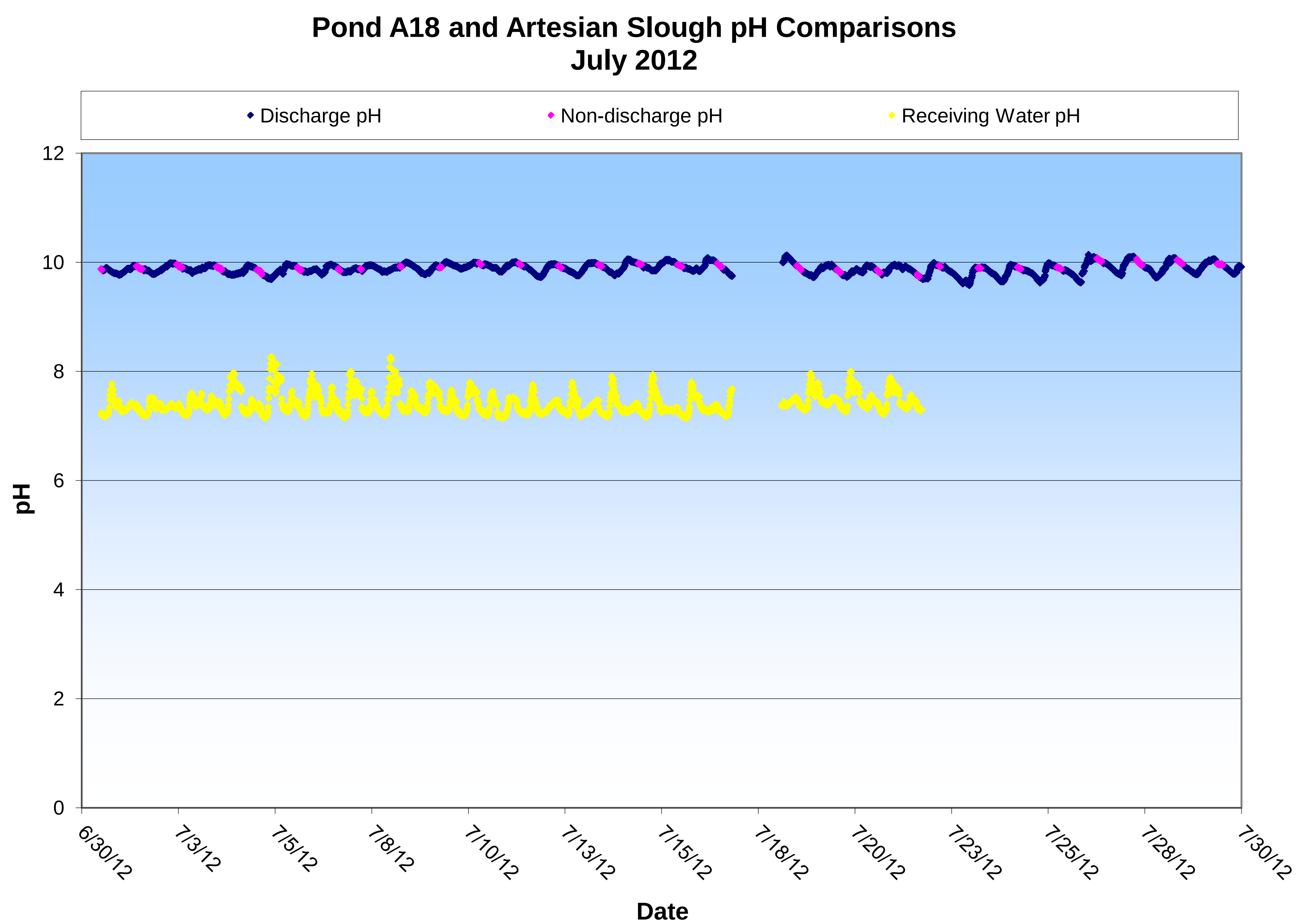
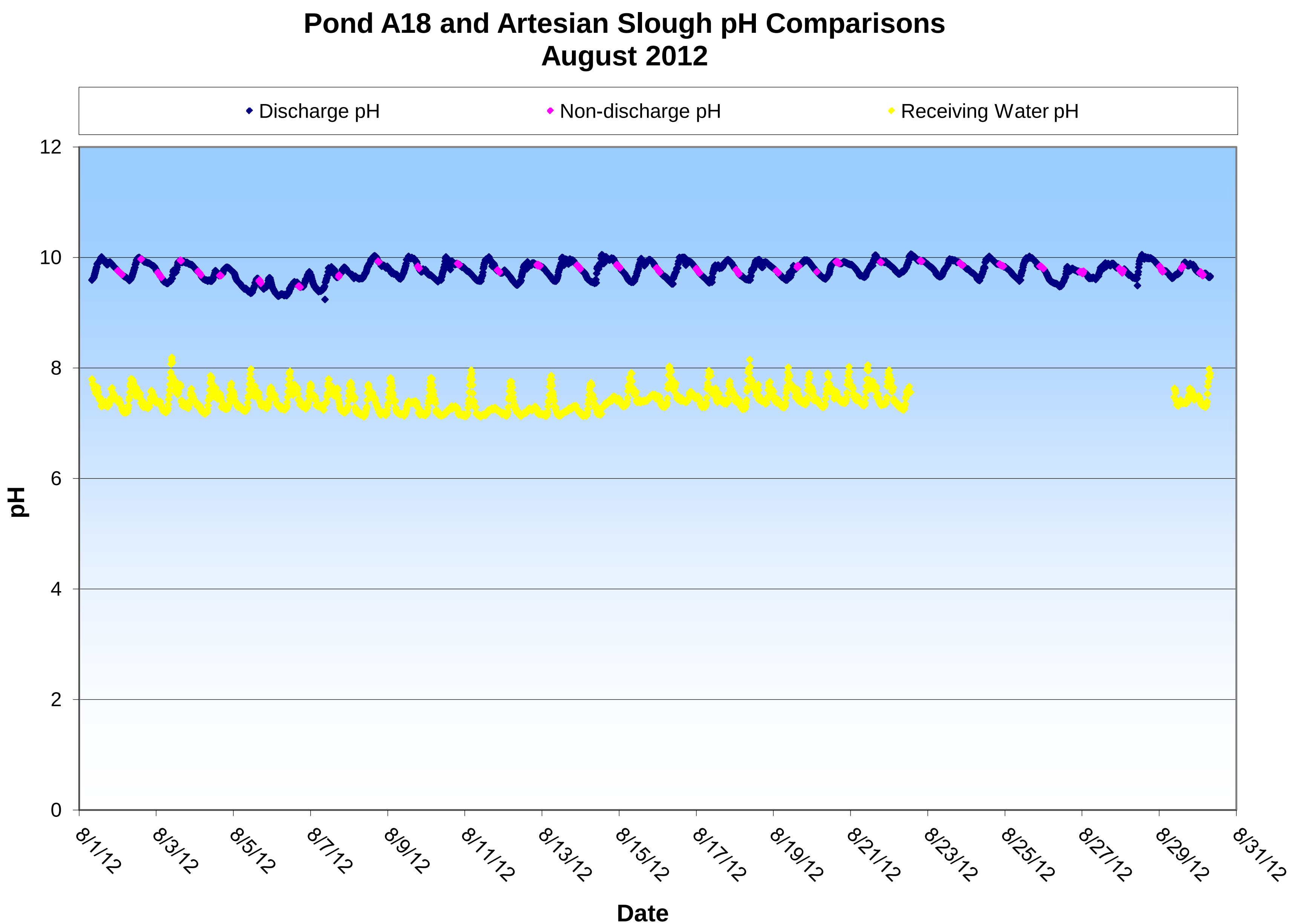
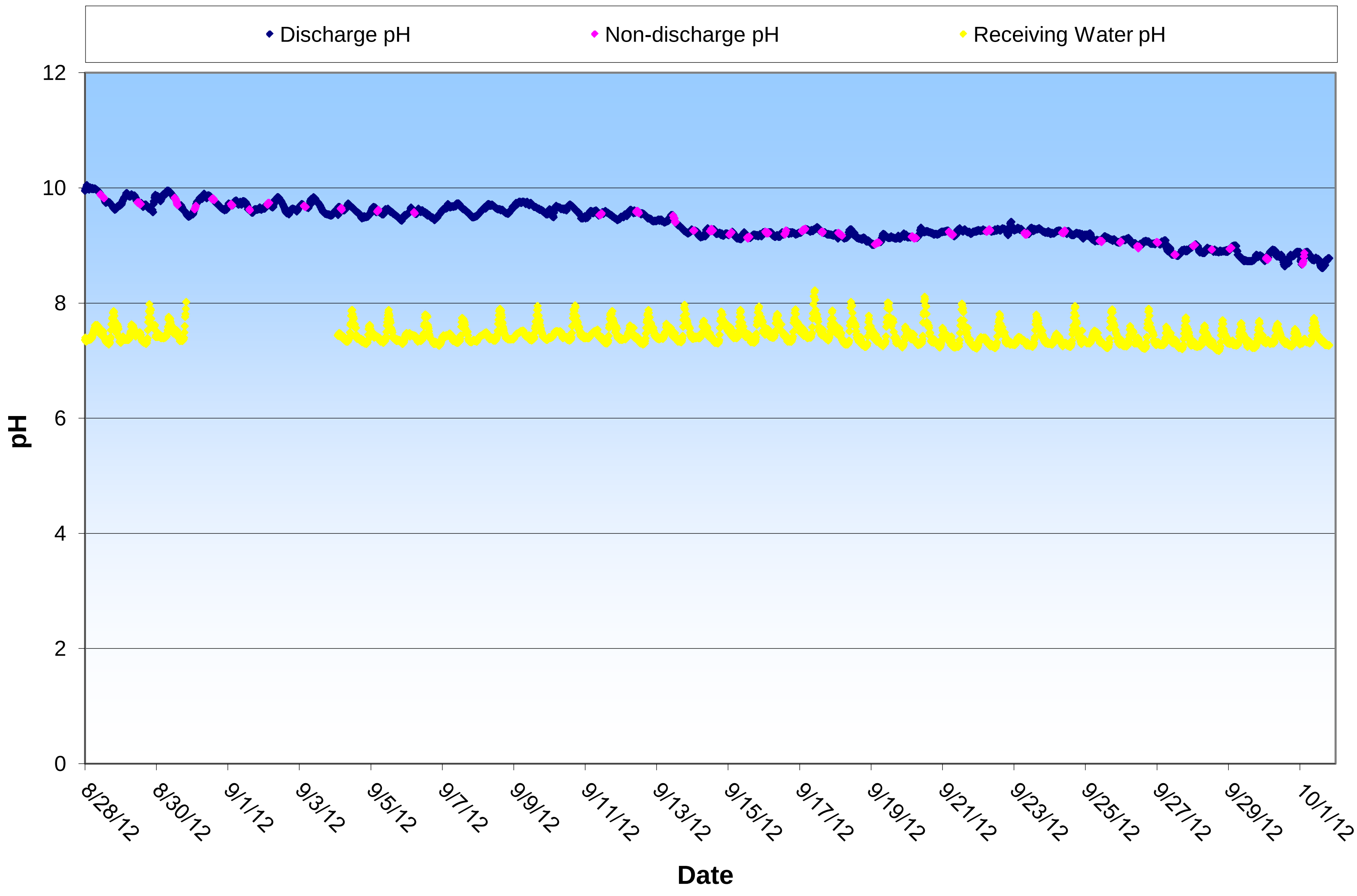
6/29/12
7/1/12

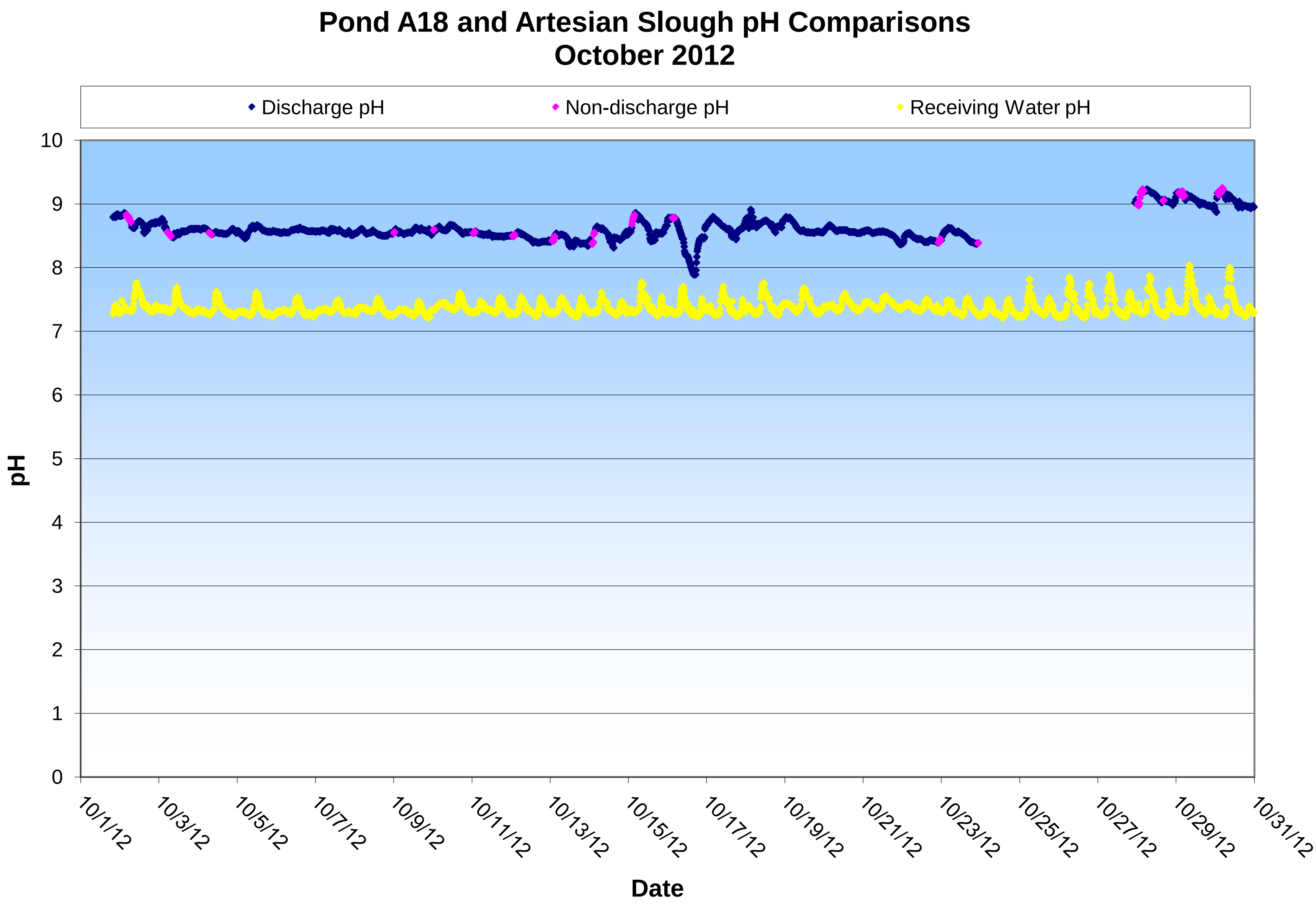

Pond A18 and Artesian Slough pH Comparisons
July 2012
Discharge pH
Non-discharge pH
Receiving Water pH
pH
12
10
8
6
4
2
0
6/30/12
7/3/12
7/5/12
7/8/12
7/10/12
7/13/12
7/15/12
7/18/12
7/20/12
7/23/12
7/25/12
7/28/12
7/30/12
Date



Pond A18 and Artesian Slough pH Comparisons
August 2012
Discharge pH
Non-discharge pH
Receiving Water pH
12
10
8
6
4
2
0
pH
8/1/12
8/3/12
8/5/12
8/7/12
8/9/12
8/11/12
8/13/12
8/15/12
8/17/12
8/19/12
8/21/12
8/23/12
8/25/12
8/27/12
8/29/12
8/31/12
Date

Pond A18 and Artesian Slough pH Comparisons
September 2012




Pond A18 and Artesian Slough pH Comparisons
October 2012
Discharge pH
Non-discharge pH
Receiving Water pH
pH
10
9
8
7
6
5
4
3
2
1
0
10/1/12
10/3/12
10/5/12
10/7/12
10/9/12
10/11/12
10/13/12
10/15/12
10/17/12
10/19/12
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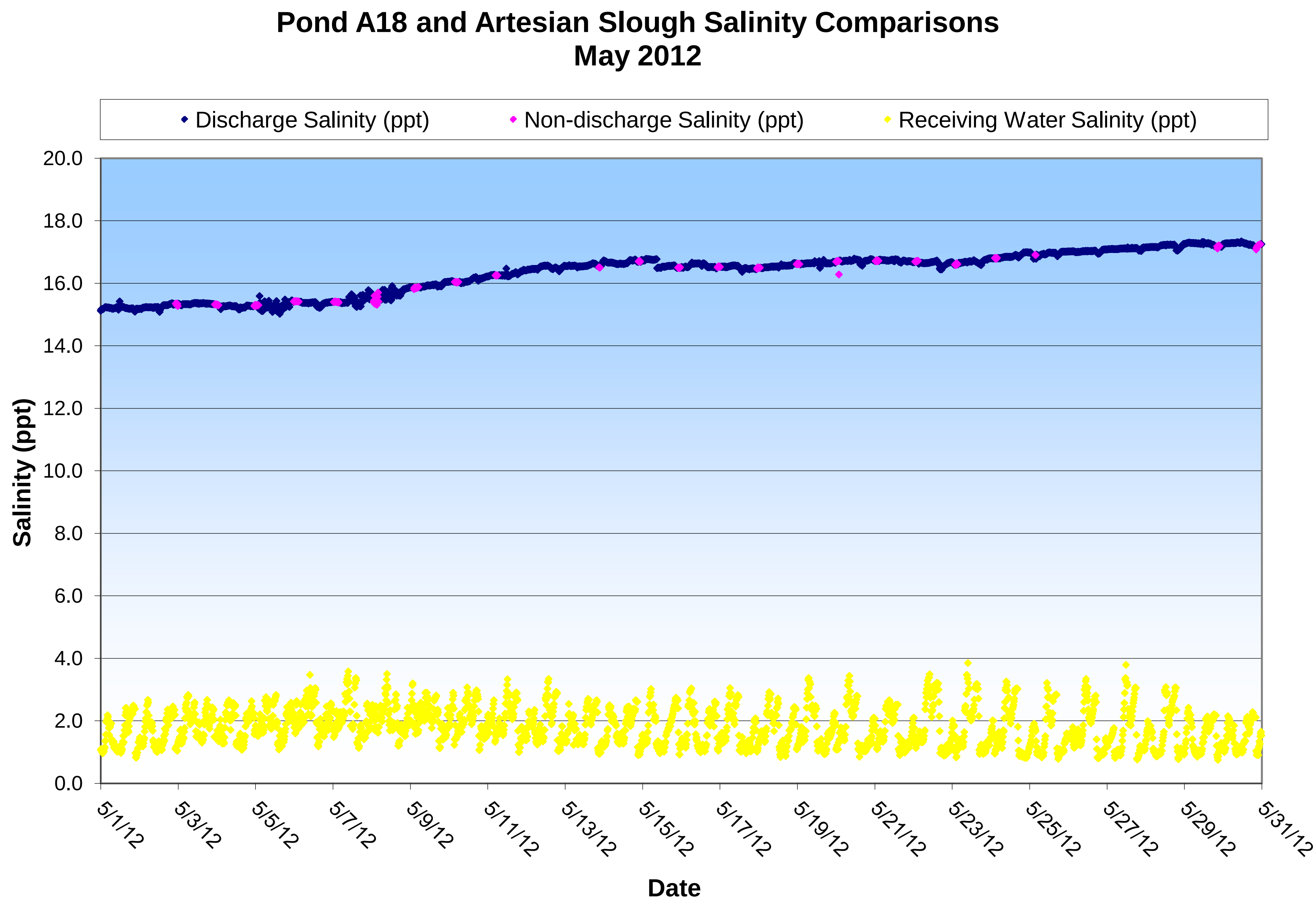
10/25/12
10/27/12
10/29/12
10/31/12
Date


Pond A18 and Artesian Slough Salinity Comparisons
May 2012
Discharge Salinity (ppt)
Non-discharge Salinity (ppt)
Receiving Water Salinity (ppt)
Salinity (ppt)
20.0
18.0
16.0
14.0
12.0
10.0
8.0
6.0
4.0
2.0
0.0
5/1/12
5/3/12
5/5/12
5/7/12
5/9/12
5/11/12
5/13/12
5/15/12
5/17/12
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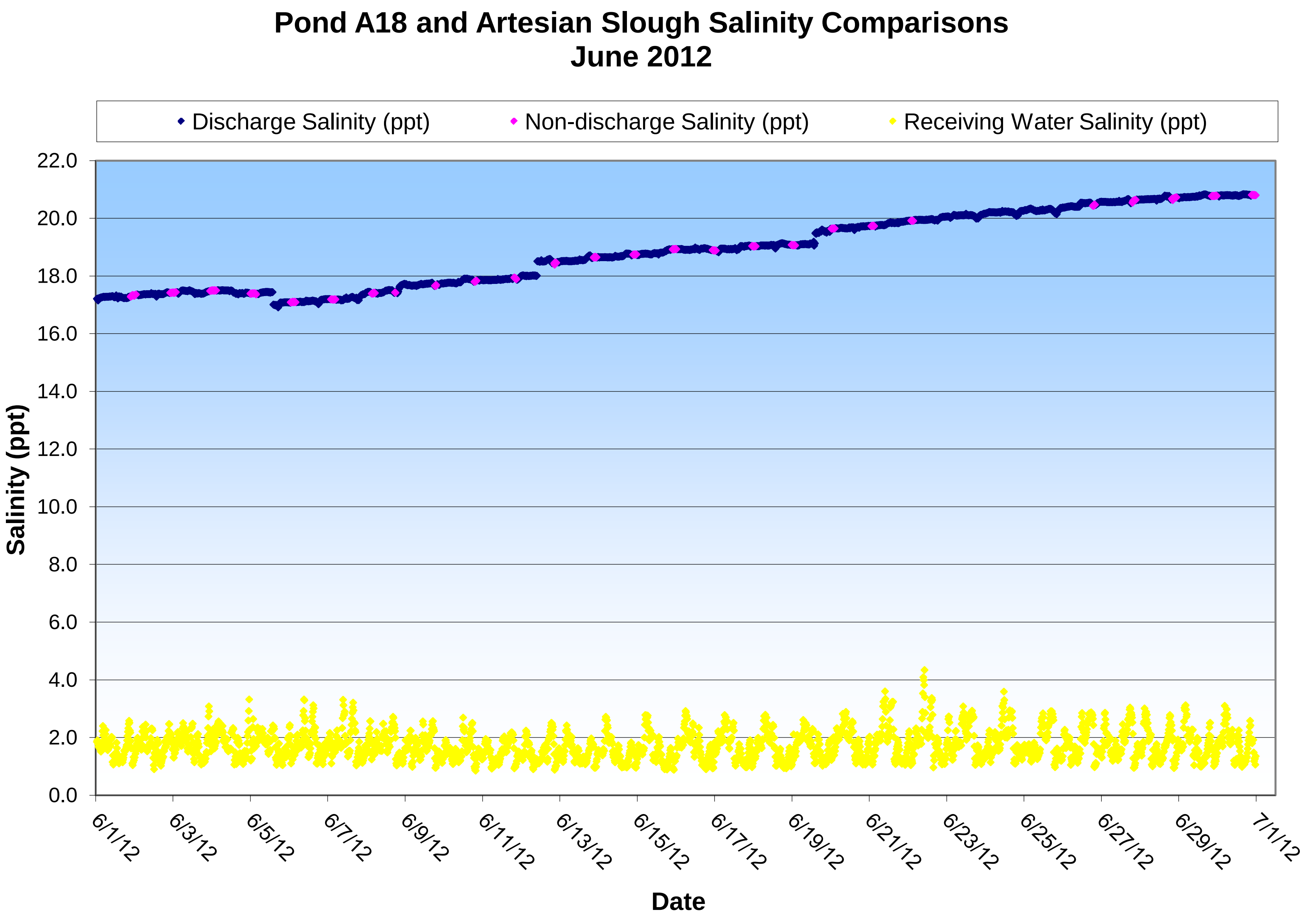
5/29/12
5/31/12
Date



Pond A18 and Artesian Slough Salinity Comparisons
June 2012
Discharge Salinity (ppt)
Non-discharge Salinity (ppt)
Receiving Water Salinity (ppt)
Salinity (ppt)
22.0
20.0
18.0
16.0
14.0
12.0
10.0
8.0
6.0
4.0
2.0
0.0
6/1/12
6/3/12
6/5/12
6/7/12
6/9/12
6/11/12
6/13/12
6/15/12
6/17/12
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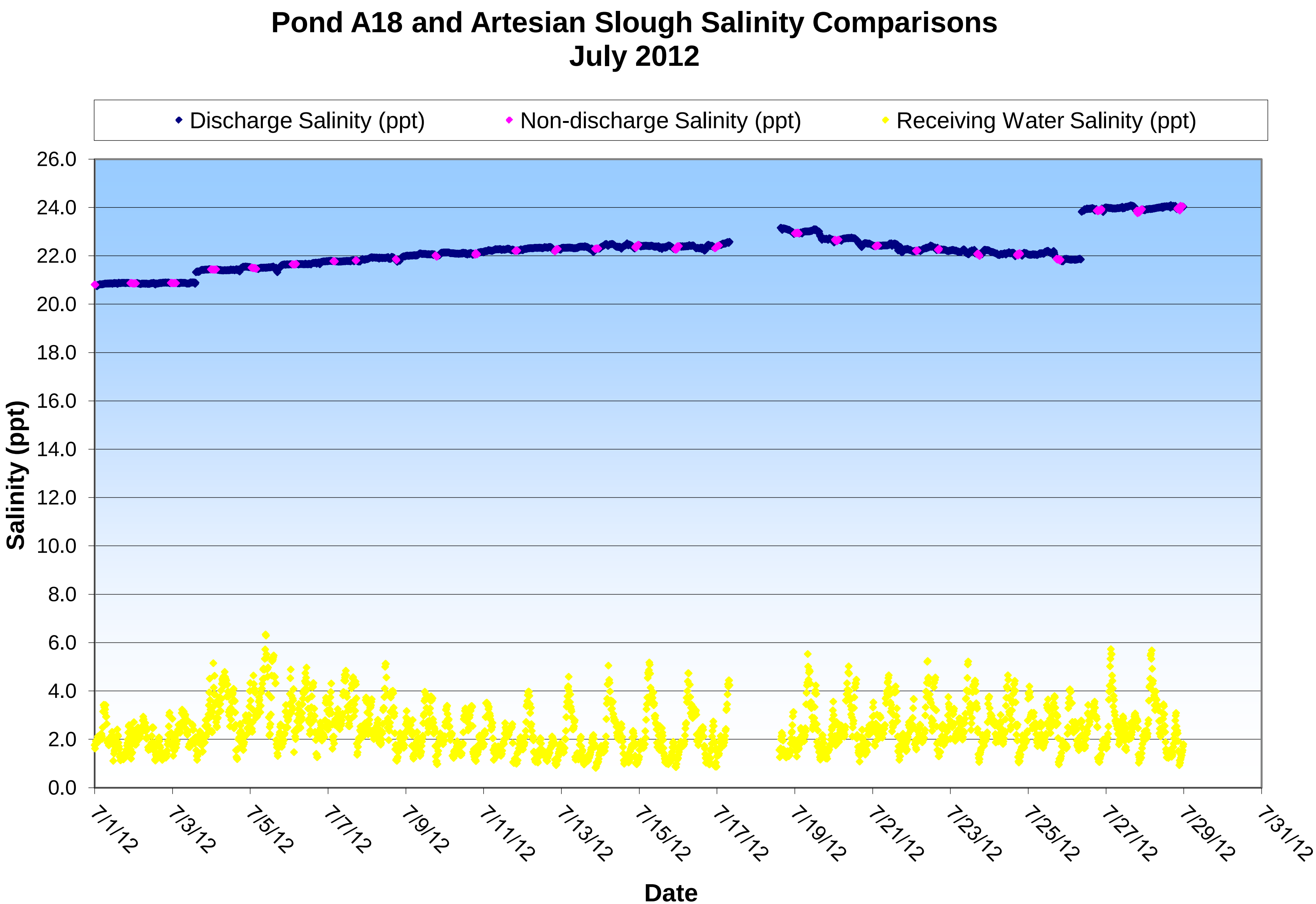
6/27/12
6/29/12
7/1/12
Date



Pond A18 and Artesian Slough Salinity Comparisons
July 2012
Discharge Salinity (ppt)
Non-discharge Salinity (ppt)
Receiving Water Salinity (ppt)
Salinity (ppt)
26.0
24.0
22.0
20.0
18.0
16.0
14.0
12.0
10.0
8.0
6.0
4.0
2.0
0.0
7/1/12
7/3/12
7/5/12
7/7/12
7/9/12
7/11/12
7/13/12
7/15/12
7/17/12
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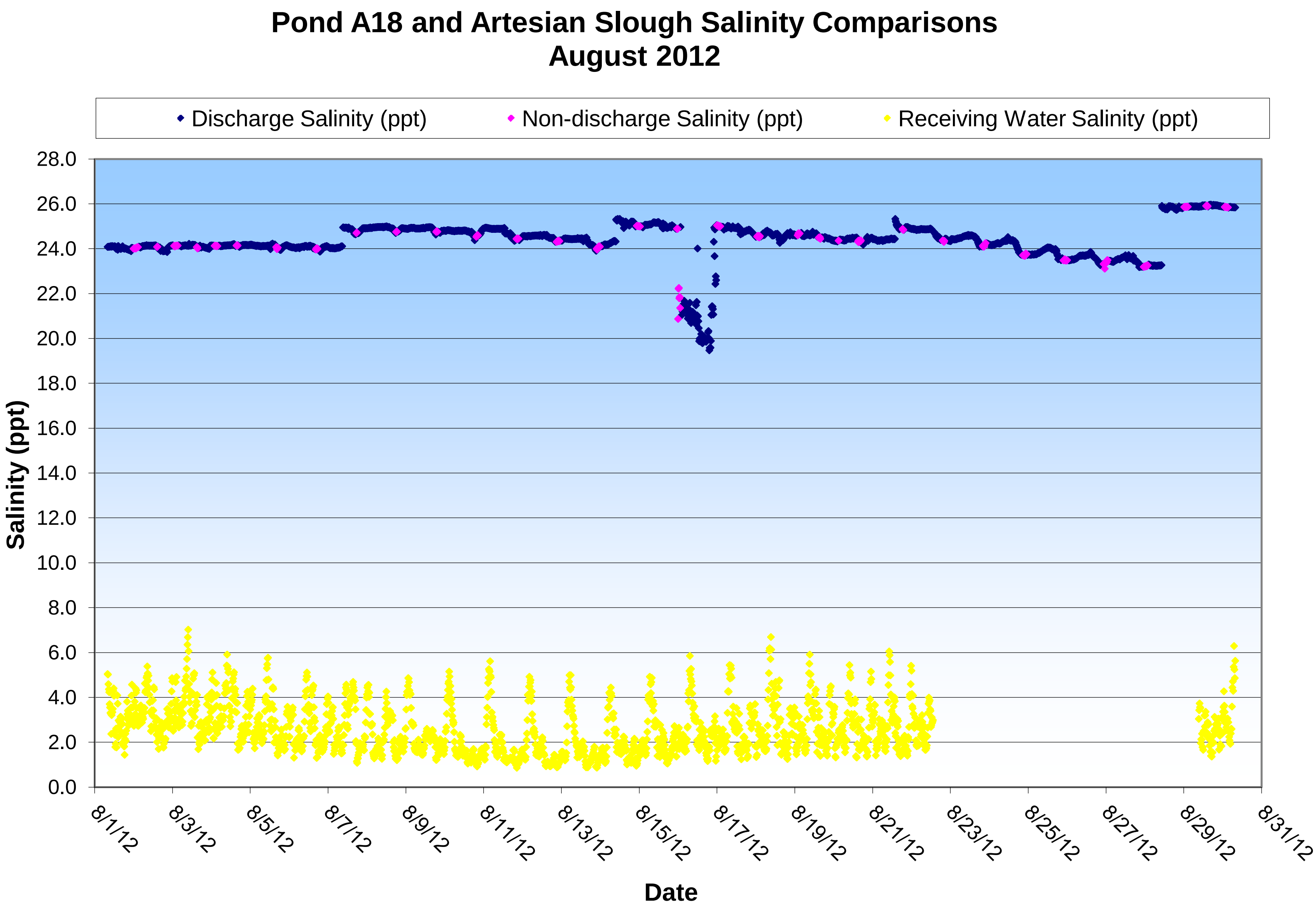
7/29/12
7/31/12
Date


Pond A18 and Artesian Slough Salinity Comparisons
August 2012
Discharge Salinity (ppt)
Non-discharge Salinity (ppt)
Receiving Water Salinity (ppt)
Salinity (ppt)
28.0
26.0
24.0
22.0
20.0
18.0
16.0
14.0
12.0
10.0
8.0
6.0
4.0
2.0
0.0
8/1/12
8/3/12
8/5/12
8/7/12
8/9/12
8/11/12
8/13/12
8/15/12
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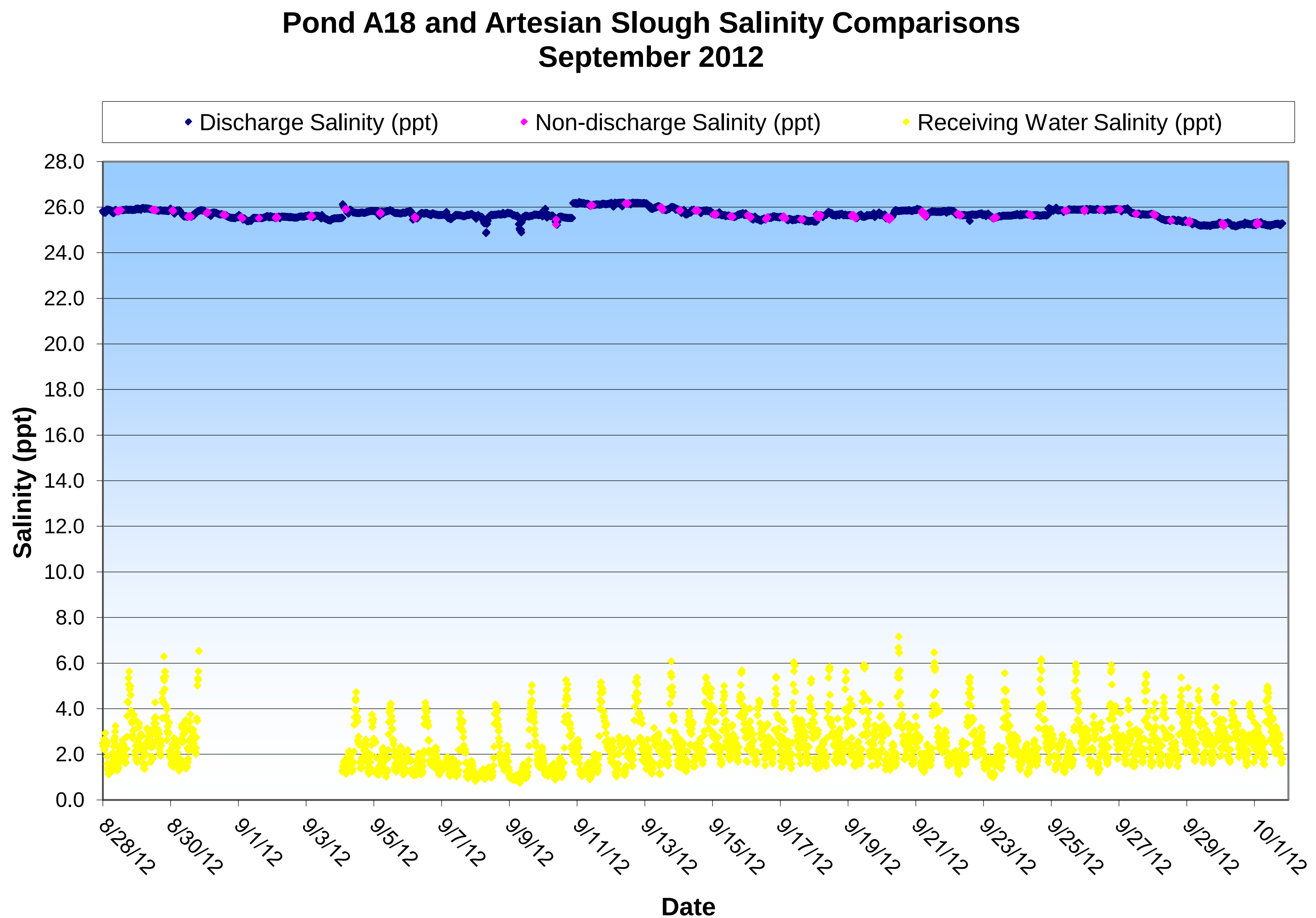
8/29/12
8/31/12
Date



Pond A18 and Artesian Slough Salinity Comparisons
September 2012
Discharge Salinity (ppt)
Non-discharge Salinity (ppt)
Receiving Water Salinity (ppt)
Salinity (ppt)
28.0
26.0
24.0
22.0
20.0
18.0
16.0
14.0
12.0
10.0
8.0
6.0
4.0
2.0
0.0
8/28/12
8/30/12
9/1/12
9/3/12
9/5/12
9/7/12
9/9/12
9/11/12
9/13/12
9/15/12
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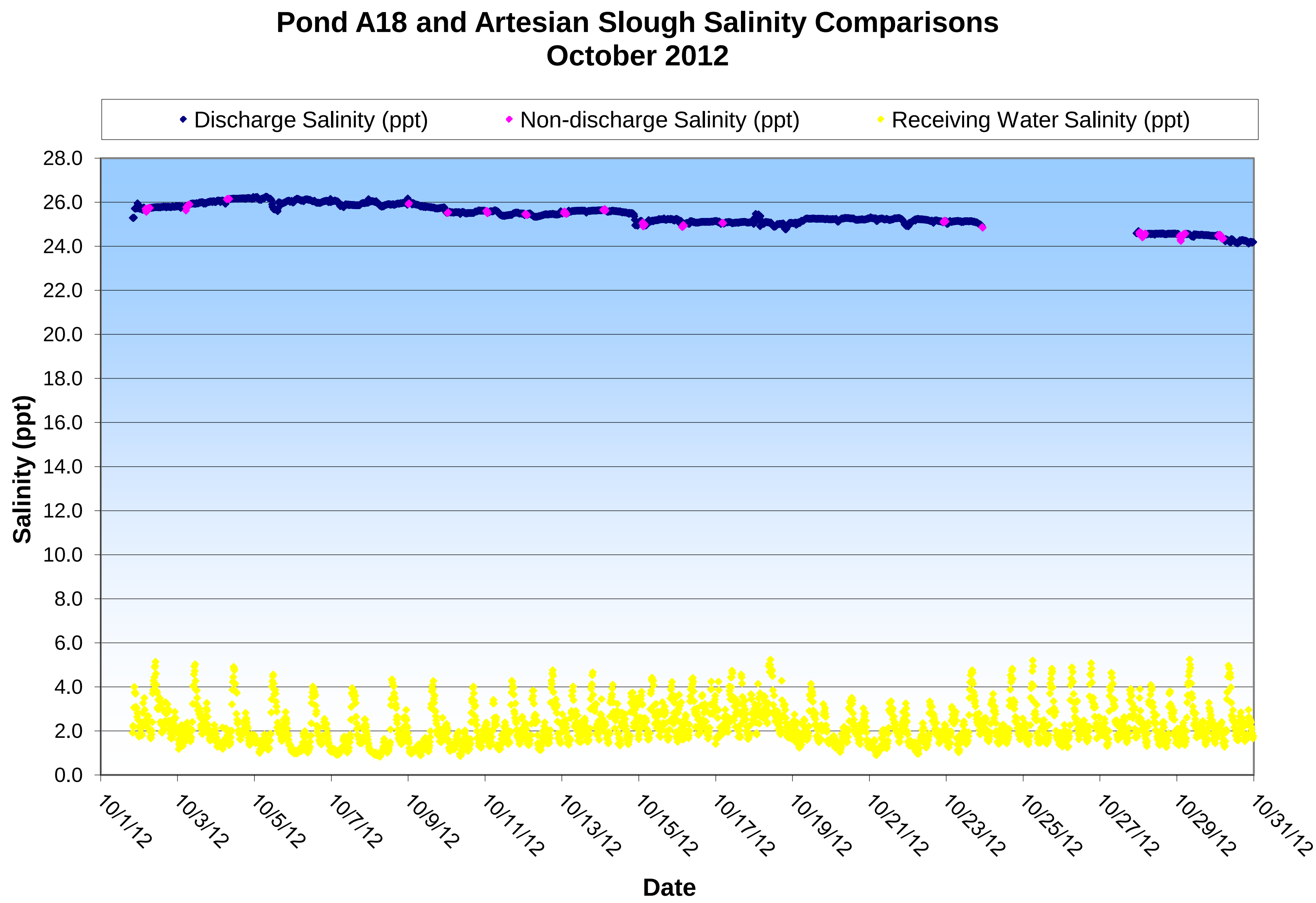
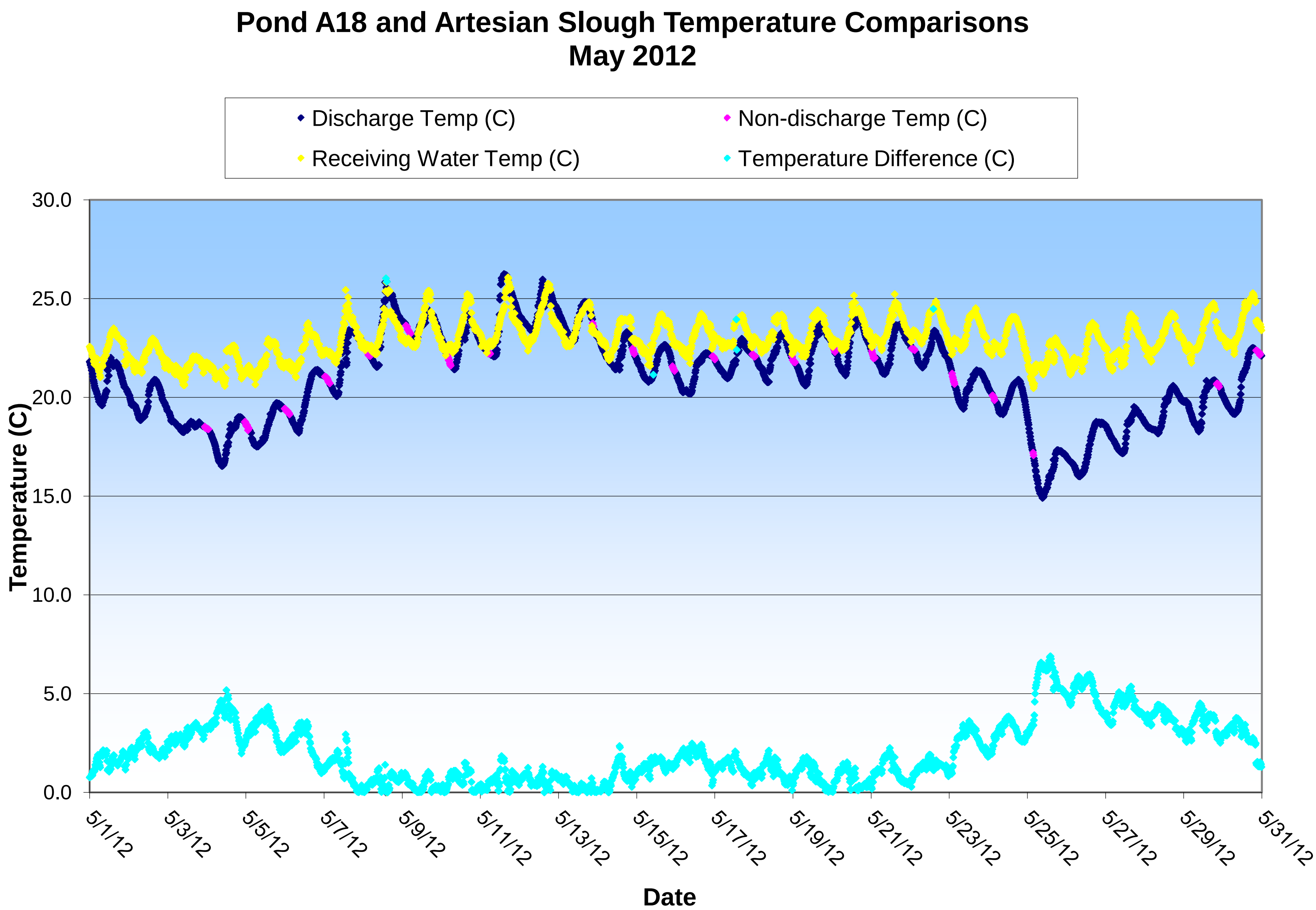
9/23/12
9/25/12
9/27/12
9/29/12
10/1/12
Date


Pond A18 and Artesian Slough Salinity Comparisons
October 2012
Discharge Salinity (ppt)
Non-discharge Salinity (ppt)
Receiving Water Salinity (ppt)
Salinity (ppt)
28.0
26.0
24.0
22.0
20.0
18.0
16.0
14.0
12.0
10.0
8.0
6.0
4.0
2.0
0.0
10/1/12
10/3/12
10/5/12
10/7/12
10/9/12
10/11/12
10/13/12
10/15/12
10/17/12
10/19/12
10/21/12
10/23/12
10/25/12
10/27/12
10/29/12
10/31/12
Date


Pond A18 and Artesian Slough Temperature Comparisons
May 2012
Discharge Temp (C)
Non-discharge Temp (C)
Receiving Water Temp (C)
Temperature Difference (C)
Temperature (C)
30.0
25.0
20.0
15.0
10.0
5.0
0.0
5/1/12
5/3/12
5/5/12
5/7/12
5/9/12
5/11/12
5/13/12
5/15/12
5/17/12
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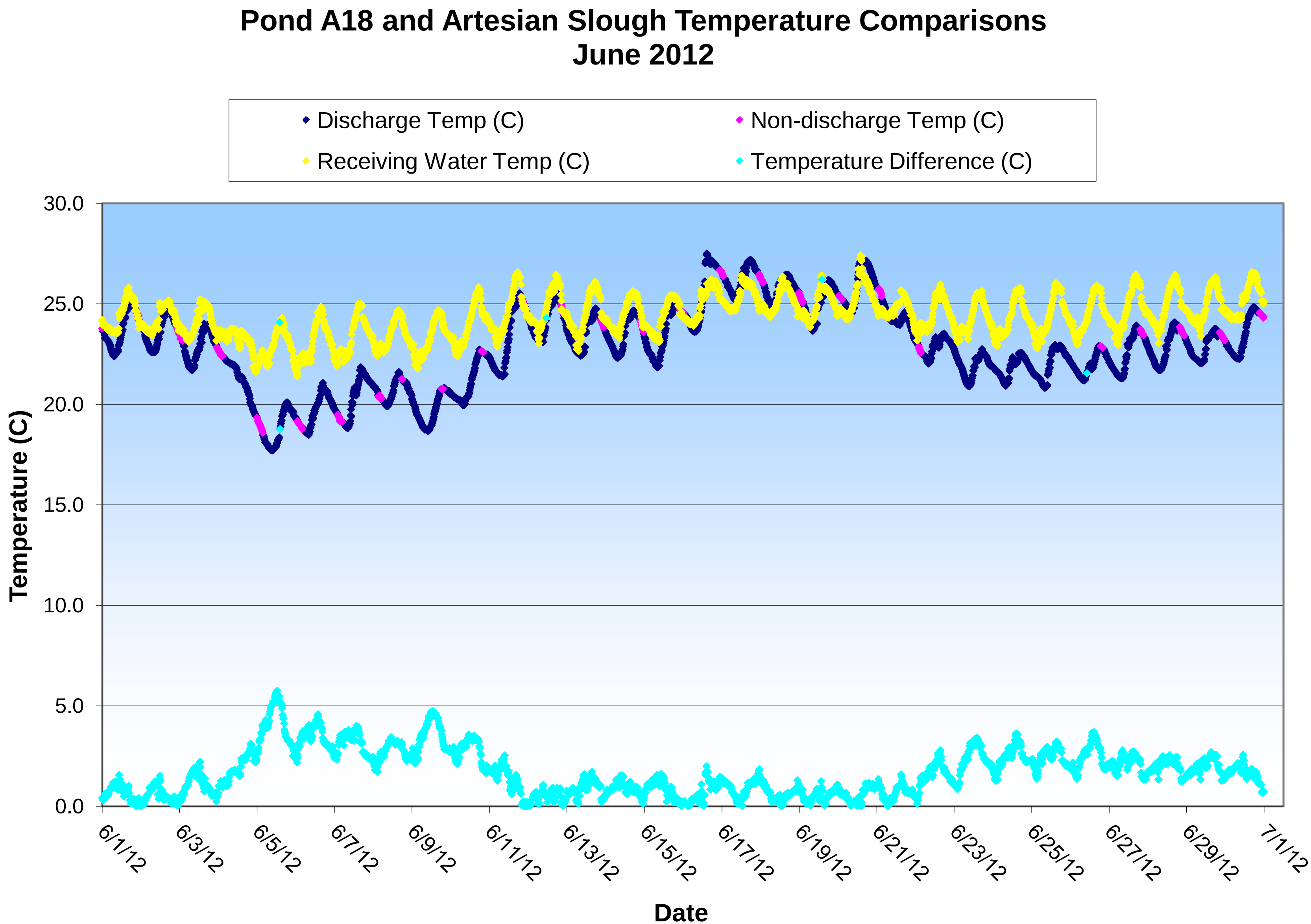
5/21/12
5/23/12
5/25/12
5/27/12
5/29/12
5/31/12
Date



Pond A18 and Artesian Slough Temperature Comparisons
June 2012
Discharge Temp (C)
Non-discharge Temp (C)
Receiving Water Temp (C)
Temperature Difference (C)
30.0
25.0
20.0
15.0
10.0
5.0
0.0
Temperature (C)
6/1/12
6/3/12
6/5/12
6/7/12
6/9/12
6/11/12
6/13/12
6/15/12
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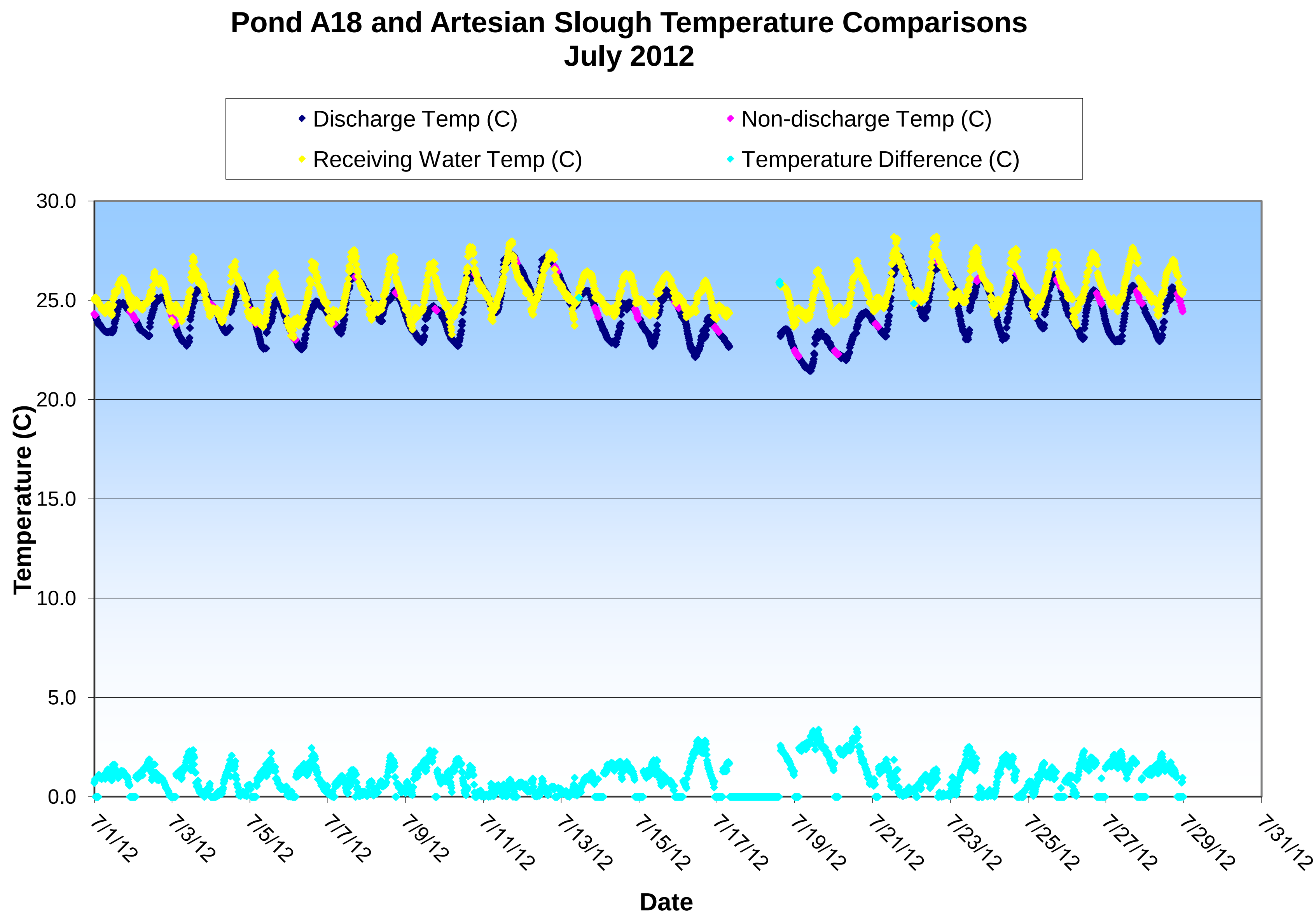
6/27/12
6/29/12
7/1/12
Date



Pond A18 and Artesian Slough Temperature Comparisons
July 2012
Discharge Temp (C)
Non-discharge Temp (C)
Receiving Water Temp (C)
Temperature Difference (C)
30.0
25.0
20.0
15.0
10.0
5.0
0.0
Temperature (C)
7/1/12
7/3/12
7/5/12
7/7/12
7/9/12
7/11/12
7/13/12
7/15/12
7/17/12
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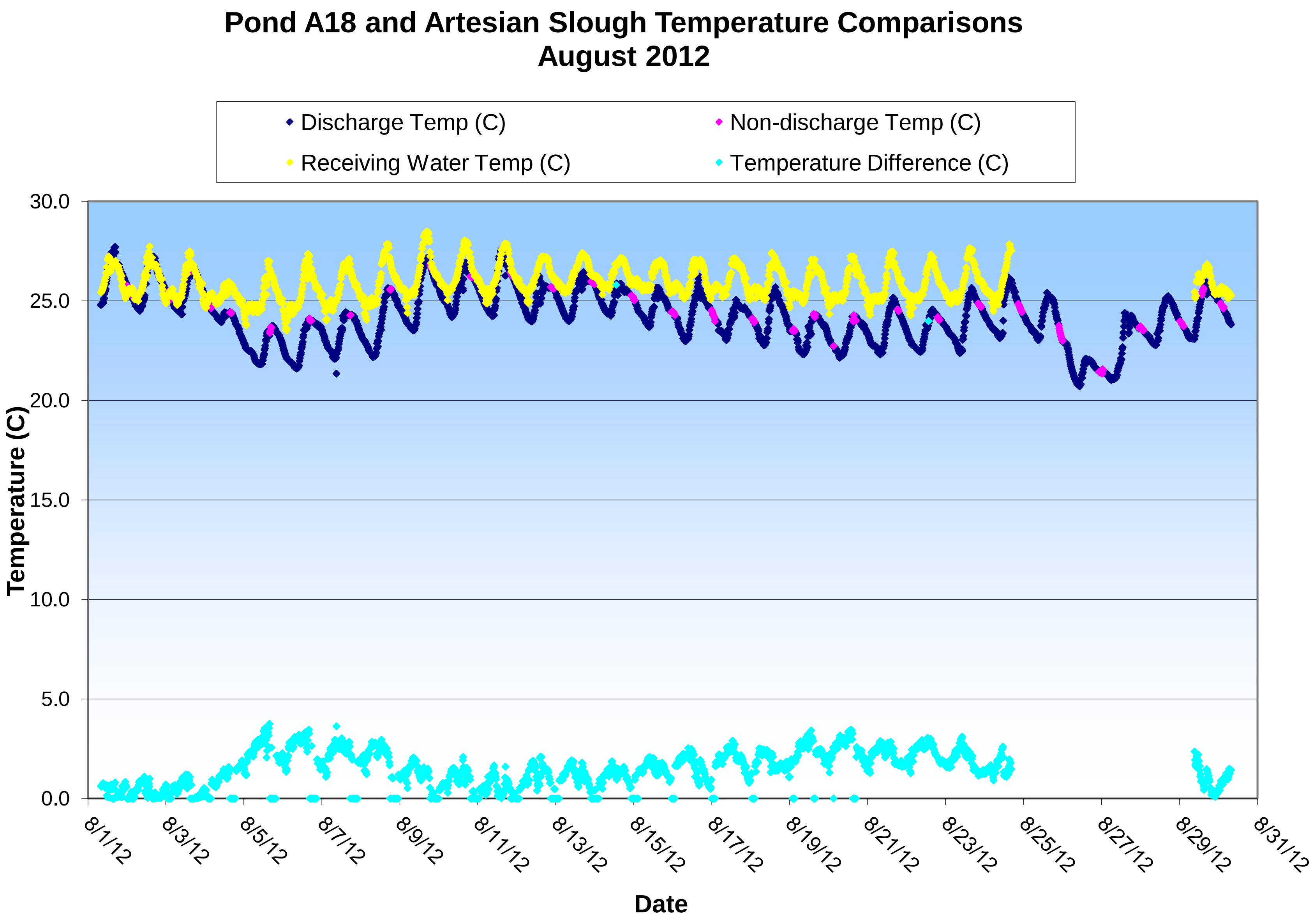
7/29/12
7/31/12
Date



Pond A18 and Artesian Slough Temperature Comparisons
August 2012
Discharge Temp (C)
Non-discharge Temp (C)
Receiving Water Temp (C)
Temperature Difference (C)
Temperature (C)
30.0
25.0
20.0
15.0
10.0
5.0
0.0
8/1/12
8/3/12
8/5/12
8/7/12
8/9/12
8/11/12
8/13/12
8/15/12
8/17/12
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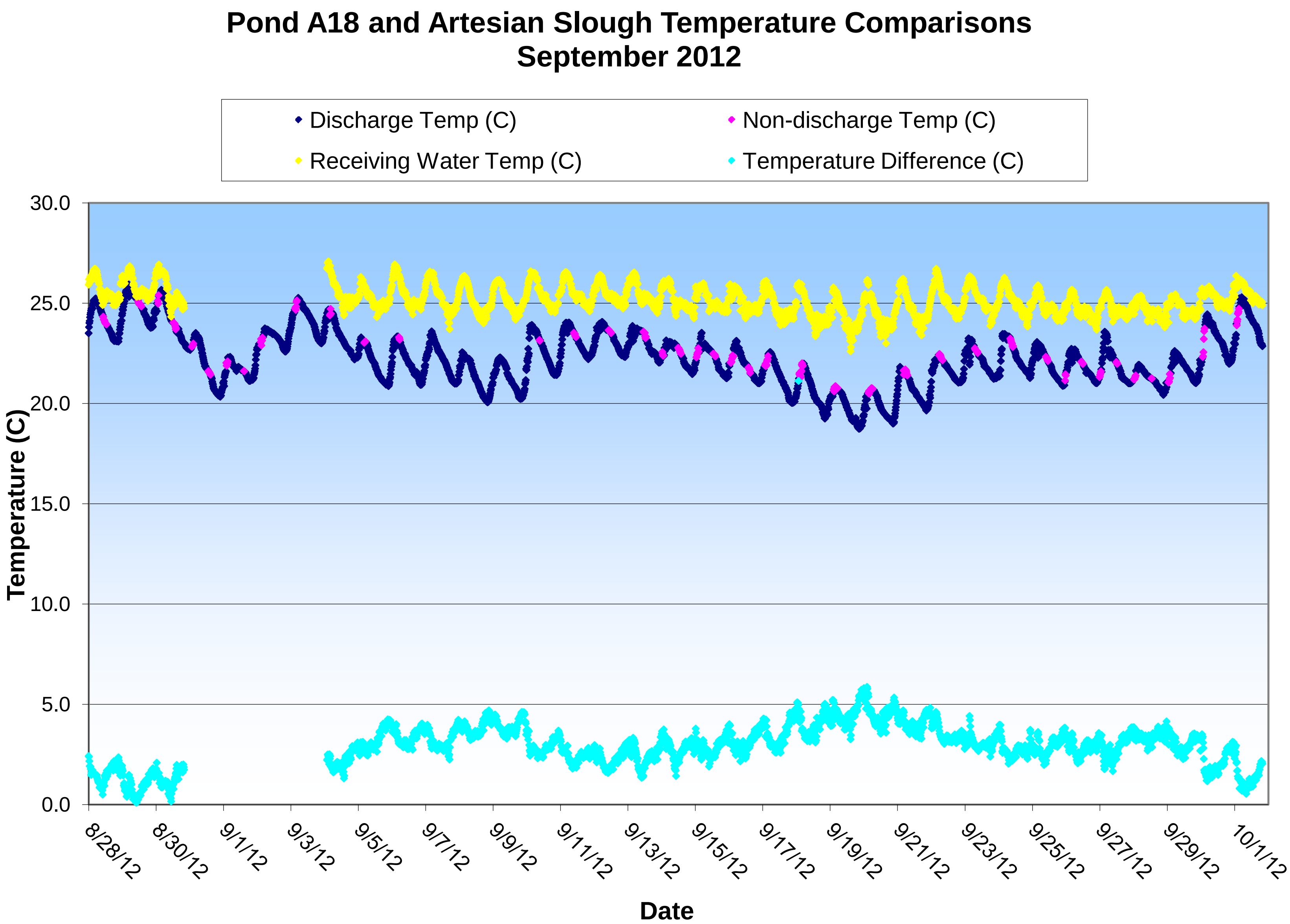
8/29/12
8/31/12
Date



Pond A18 and Artesian Slough Temperature Comparisons
September 2012
Discharge Temp (C)
Non-discharge Temp (C)
Receiving Water Temp (C)
Temperature Difference (C)
Temperature (C)
30.0
25.0
20.0
15.0
10.0
5.0
0.0
8/28/12
8/30/12
9/1/12
9/3/12
9/5/12
9/7/12
9/9/12
9/11/12
9/13/12
9/15/12
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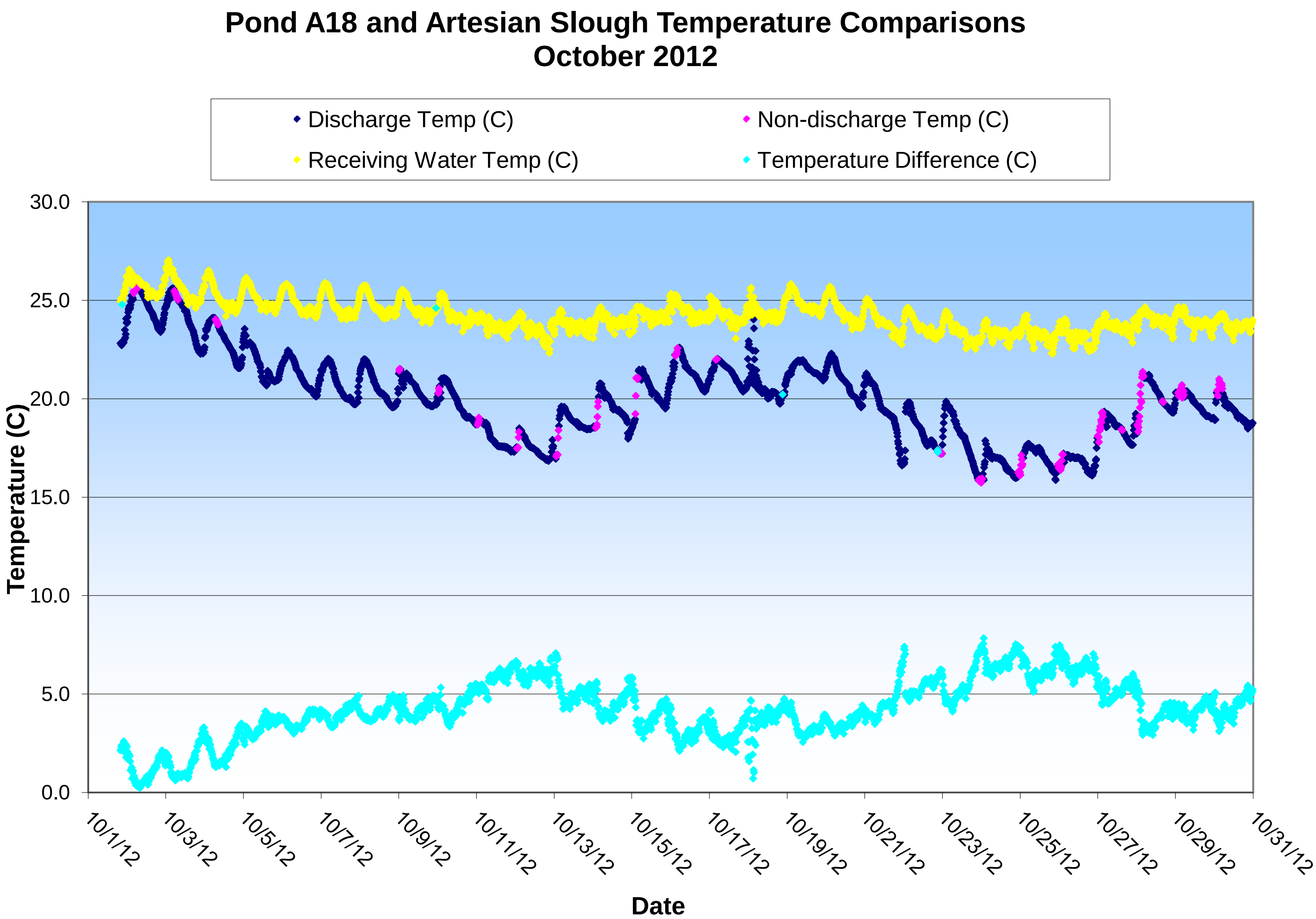
9/29/12
10/1/12
Date



Pond A18 and Artesian Slough Temperature Comparisons
October 2012
Discharge Temp (C)
Non-discharge Temp (C)
Receiving Water Temp (C)
Temperature Difference (C)
Temperature (C)
30.0
25.0
20.0
15.0
10.0
5.0
0.0
10/1/12
10/3/12
10/5/12
10/7/12
10/9/12
10/11/12
10/13/12
10/15/12
10/17/12
10/19/12
10/21/12
10/23/12
10/25/12
10/27/12
10/29/12
10/31/12
Date

Appendix II. Artesian Slough Sediment Mercury Report - 2012

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Artesian Slough Sediment Mercury Report – 2012

Prepared for:
The City of San Jose
Environmental Services Department
700 Los Esteros Road
San Jose, CA 95134

Prepared by:
Mark C Marvin-DiPasquale & Jennifer Agee
U.S. Geological Survey
345 Middlefield Rd. / MS 480
Menlo Park, CA 94025

11 December 2012

Artesian Slough Sediment Mercury Report – 2012

U.S. Geological Survey
11 December 2012

Contents

Artesian Slough Sediment Mercury Report – 2012

U.S. Geological Survey
11 December 2012

1. INTRODUCTION

The City of San Jose, Water Pollution Control Plant (700 Los Esteros Road San Jose, CA 95134) has been directed by the Regional Water Quality Control Board to assess methylmercury (MeHg) concentrations in sediment of Artesian Slough, as part of the Self-Monitoring Program (SMP) Waste Discharge Requirement associated with Pond A-18,(Order No. R2-2005-0003). Concurrently, the U.S. Geological Survey (USGS) has recently conducted a study of mercury cycling in the South San Francisco Bay Alviso Pond and Slough complex, as part of the South Bay Salt Pond Restoration Program (SBSPRP). In addition to sampling a number of former salt ponds, the USGS study had four fixed sampling locations along Alviso Slough and one fixed sampling location in Artesian Slough, which were sampled six times each (May, June and August during both 2010 and 2011). Results suggest that sediment MeHg concentrations at the single Artesian Slough site (median: 6.2, range: 2.9–14.9, ng/g dry weight; n=6) were higher than in Alviso Slough (median: 2.0, range: 1.0–4.6, ng/g dry weight; n=24). This is surprising given that the sediment total mercury concentrations in the Alviso Slough sites (median: 512, range: 119–1696, ng/g dry weight; n=24) were higher than from the single site in Artesian Slough (median: 348, range: 180–547, ng/g dry weight; n=6). It is unclear why sediment in Artesian Slough had higher MeHg concentrations than the heavily mercury contaminated sediment in Alviso Slough, or if this trend is consistent along the length of Artesian Slough, or if the one fixed site was an anomaly.

In May 2011, the City of San Jose (the City) entered into a joint agreement with the U.S. Geological Survey (USGS), whereby the USGS would sample surface sediment from six locations along the full length of Artesian Slough, from the waste water plant outfall to the slough mouth at Coyote Creek, and analyze these samples for MeHg. In addition to sediment MeHg, analyses also included sediment total mercury (THg), reactive inorganic mercury ($Hg(II)_R$), organic content, grain size, iron (Fe) speciation and total reduced sulfur (TRS), to parallel the other key metrics that were measured as part of the larger USGS study for the SBSPRP. That sampling was conducted during September 2011, with the results reported to the City of San Jose in December 2011. These results were subsequently included in the City of San Jose's Self Monitoring report the the Water Board (CSJ-ESD, 2011). The joint agrement between the USGS and the City was renewed in 2012, such that the same six sites were resampled during August 2012. The current document documents the results of the 2012 sampling effort.

2. METHODS

2.1. Field Sampling

A single sampling event was conducted during August 30, 2012 by USGS staff and City of San Jose biologist Ryan Mayfield. Sediment was collected from six locations (S1 thru S6) along the full length of Artesian Slough, from the waste water plant outfall to the slough mouth at Coyote Creek (Fig. 1). One field replicate was collected at site S4 (near fixed continuous monitoring buoy) and was assayed as a unique sample to provide some assessment of within-site variability. Surface sediment (top 10–20 cm, approximately) was initially collected from a boat using an Ekman style box core (16 x 16 x 30 cm) and trace metal clean sampling techniques (USEPA, 1996) as appropriate. The top 0-2 cm interval of sediment was then sub-sampled using a 2 cm high polycarbonate core ring (acid cleaned), and transferred into an acid-cleaned glass mason jar, which was stored chilled until its return to the USGS laboratory the same day. Sediment was subsequently sub-sampled for the suite of sediment parameters listed below in an anaerobic (N_2 flushed) glove bag, as previously described (Marvin-DiPasquale and others, 2009). Surface water (approximately 20-50 cm below the air/water interface) and surface sediment (top 0-2 cm interval) temperature was measured at the time of sample collection using a digital thermometer equipped with a thermocouple probe.

Figure 1. Sediment sampling locations along Artesian Slough on Aug. 30, 2012.

2.2.Total Mercury (THg)

Sediment sub-samples for THg were stored frozen until analysis. After thawing, sediment THg was first extracted overnight in concentrated acid (HNO_3 plus HCl), followed by the addition of the oxidant BrCl and overnight heating at 60°C to ensure all of the Hg is in the divalent inorganic form (i.e. Hg(II)), as per standard USGS protocol (Olund and others, 2004). Quantification of Hg(II) in the extract was then carried out on an automated total mercury analyzer (Tekran 2600) according to EPA method 1631 (USEPA, 2001, 2002). Each batch of analytical samples was accompanied by the analysis of the following minimum number of quality assurance (QA) samples: 1 certified reference material sample, 1 matrix spike sample, 1 analytical duplicate, 1 field duplicate, 1 method blank, and calibration standards prepared from commercially certified $HgCl_2$ solution. The detection limit for the THg assay is approximately 0.5 ng/L at the level of the autoanalyzer.

2.3.Methylmercury (MeHg)

Sediment sub-samples for MeHg were stored frozen until analysis. After thawing, sediment MeHg was first extracted with a solution of 25% KOH in methanol at 60°C for four hours (Xianchao and others, 2005). Quantification of MeHg in the extract was then carried out after ethylation of the analyte using an automated MeHg analyzer (MERX, Brooks Rand, Seattle WA). Further method details are given elsewhere (Marvin-DiPasquale and others, 2011). Each batch of analytical samples was accompanied by the analysis of the following minimum number of QA samples: 1 certified reference material sample, 2 matrix spike samples, 2 analytical duplicates, 1 field duplicate, 1 method blank, and calibration standards prepared from commercial crystalline MeHgCl and compared to a separate, commercially available MeHg standard solution. The detection limit for the MeHg assay is approximately 0.5 pg (absolute mass as Hg).

2.4.Reactive Inorganic Mercury ($Hg(II)_R$)

Sediment "reactive" mercury ($Hg(II)_R$) is methodologically defined as the fraction of total Hg(II), which has not been chemically altered (for example, digested, oxidized, or chemically preserved apart from freezing), that is readily reduced to elemental Hg^0 by an excess of $SnCl_2$ over an exposure time of 15 minutes. Further method details are given elsewhere (Marvin-DiPasquale and Cox, 2007). Sediment sub-samples for $Hg(II)_R$ were stored frozen until analysis. Each batch of analytical samples was accompanied by the analysis of the following minimum number of QA samples: 1 analytical duplicate, 1 field duplicate, 4 bubbler blanks, and calibration standards prepared from a commercial $HgCl_2$ stock solution. No commercially available certified reference material exists for $Hg(II)_R$ in sediment. The detection limit for the $Hg(II)_R$ assay is approximately 40 pg (absolute mass).

2.5.Iron Speciation

Sediment sub-samples for iron (Fe) speciation were stored frozen until analysis. Three forms of sediment iron were assayed: acid extractable ferrous iron ($Fe(II)_{AE}$), amorphous (poorly crystalline) ferric iron ($Fe(III)_a$) and crystalline ferric iron ($Fe(III)_c$). Method details are given elsewhere (Marvin-DiPasquale and others, 2008). The typical detection limit for each Fe-fraction is approximately 0.02 µg/mL at the level of the spectrophotometric analysis. Each batch of analytical samples was accompanied by the analysis of the following minimum number of QA samples: 1 analytical duplicate, 1 field duplicate, 1 matrix spike for $Fe(II)_{AE}$ and $Fe(III)_c$ fractions only, 1 method blank, and $FeSO_4$ calibration standards prepared from analytical grade crystalline reagents. No certified reference material is commercially available for these method-defined iron species.

2.6.Total Reduced Sulfur

Sediment sub-samples for TRS were stored frozen until analysis. After thawing, sediment TRS was extracted by a single-step hot acid chromium reduction approach and quantified spectrophotometrically (Marvin-DiPasquale and others, 2008). Each batch of analytical samples was accompanied by the analysis of the following minimum number of QA samples: 1 analytical duplicate, 1 field duplicate, and

ZnS calibration standards. No certified reference material is commercially available for the TRS assay. The detection limit for this assay is approximately 1 nmol/mL at the level of the colorimetric analysis.

2.7.Grain Size (sand/silt break)

Sediment sub-samples for grain size were stored refrigerated until analysis. Sediment grain size was assayed as the weight percentage of dry sediment less than 63 micrometers (the sand/silt split), and was conducted via wet sieving (Matthes and others, 1992). Each batch of analytical samples was accompanied by the analysis of the following minimum number of QA samples: 2 analytical duplicates and 1 field duplicate. No certified reference material is commercially available for the grain size analysis.

2.8. Dry weight / Bulk Density / Porosity / Organic Content

Sediment sub-samples for general sediment characterization were stored refrigerated until analysis. Sediment bulk density, dry weight, porosity, and organic content (as percent loss on ignition; %LOI) were analyzed consecutively from single sediment sub-samples, as previously detailed (Marvin-DiPasquale and others, 2008). Each batch of analytical samples was accompanied by the analysis of the following minimum number of QA samples: Analytical duplicate at all sites and 1 field duplicate. No certified reference material is commercially available for this suite of sediment analyses.

2.9. Redox and pH

Sediment reduction-oxidation measurements were made with a platinum band ORP electrode (Model EW05990-55, Cole Parmer®, Vernon Hills, Ill.) used in conjunction with a hand-held pH/mV multi-meter (Model 59002-00, Cole Parmer®, Vernon Hills, IL) after verifying probe response with pH adjusted quinhydrone solutions. Similarly, sediment pH measurements were made with a pH electrode used in conjunction with the same hand-held pH/mV multimeter after probe calibration with two commercial pH buffers. Both measurements were made immediately after sediment sub-sampling. Further details on approach and probe calibration are published elsewhere (Marvin-DiPasquale and others, 2009). Each batch of analytical samples was accompanied by the analysis of the following minimum number of QA samples: 1 analytical duplicate and 1 field duplicate. No certified reference material is commercially available for these two sediment analyses.

3. RESULTS

The site specific descriptions, coordinates, sampling times and in-situ temperature data are given in **Table 1**. Parameter results are summarized in **Table 2**.

Table 1. Artesian Slough sites sampled during August 30, 2012

Site	Description	Latitude (degrees, decimal minutes)	Longitude (degrees, decimal minutes)	Sampling Time (hr:min)	Temperature Water / sediment (°C)
S1	below outfall	37 26.012	121 57.172	8:50	25.9 / 25.5
S2	upstream of weir	37 26.368	121 57.467	9:45	26.0 / 25.7
S3	downstream of weir	37 26.431	121 57.518	10:30	26.2 / n.r.
S4	near fixed continuous monitoring buoy	37 26.591	121 57.648	11:00	25.3 / 24.0

S5	mid-slough	37 27.055	121 58.064	11:30	22.8 / 23.3
S6	near mouth / Coyote Cr.	37 27.638	121 57.815	11:50	22.3 / n.r.

n.r. = not recorded

Table 2. Parameter Results for Artesian Slough sites sampled during August 30, 2012

[Values less than the reporting limit are preceded by '<' and the reporting limit is given. Notation: THg, total mercury; MeHg, methylmercury; $Hg(II)_R$, inorganic reactive mercury; $Fe(II)_{AE}$, acid extractable ferrous iron; $Fe(III)_a$, amorphous (poorly crystalline) ferric iron; $Fe(III)_c$, crystalline ferric iron; $Fe(II)_{AE}/Fe_T$, the ratio of $Fe(II)_{AE}$ to total-iron (Fe_T), where FeT = $Fe(II)_{AE}$ + $Fe(III)_a$ + $Fe(III)_c$; TRS, total reduced sulfur; E_h, oxidation-reduction potential corrected for the hydrogen half-cell reaction; LOI, loss on ignition at 500°C, a measure of organic content; ng/g, nanogram per gram; d.w., dry weight; %, percentage, mg/g, milligram per gram; µmol/g, micromole per gram; mV, millivolt; g/cm^3, gram per cubic centimeter; ml PW/cm^3, milliliters of pore water per cubic centimeter; % < 64 µm, percent less than 64 micrometers]

Parameter	Units	Site					
		S1	S2	S3	S4 [a]	S5	S6
THg	(ng/g) d.w.	580	366 [b]	198	433	387 [b]	253
MeHg	(ng/g) d.w.	4.0	1.6	6.7	3.5	19.3 [b]	1.7
MeHg	(% of THg)	0.69	0.44	3.36	0.93	4.99	0.67
$Hg(II)_R$	(ng/g) d.w.	0.11	0.04	<0.02	0.11	0.24	0.21 [b]
$Hg(II)_R$	(% of THg)	0.02	<0.02	<0.02	0.02	0.06	0.08
$Fe(II)_{AE}$	(mg/g) d.w.	3.3 [b]	5.0	5.4	16.7	15.6	6.0
$Fe(III)_a$	(mg/g) d.w.	<0.08	0.37	0.57	0.15	0.09	0.71
$Fe(III)_c$	(mg/g) d.w.	<0.08	3.1	1.1	0.43	<0.08	2.9
$Fe(II)/Fe_T$	(%)	95	59	76	97	99	62
TRS	(µmol/g) d.w.	30	47	98	318 [b]	160	72
E_h	(mV)	-12	-111	-66	-143	-96	-145
pH	pH Units	6.90 [b]	6.96	7.33	6.83	7.15	7.26
dry weight	(% of wet weight)	73.1	63.2 [b]	17.2	18.8	27.5	44.1
LOI	(% of d.w.)	2.7	4.2 [b]	14.3	11.1	7.3	5.7
Bulk density	(g/cm^3)	1.75	1.58 [b]	1.08	1.08	1.15	1.33
Porosity	(ml PW/cm^3)	0.47	0.58 [b]	0.90	0.88	0.83	0.74
Grain Size	(% < 64 µm)	1.8	3.7	35.5 [b]	79.8 [b]	93.5	49.8

[a] For site S4, the average of both the primary sample and the field replicate sample is given. The individual measurements for both field replicates, along with the error, are given for each parameter in **Table 5**.

[b] The value represents the average of analytical duplicates (n=2) assayed for a single site. The error associated with analytical duplicates for each parameter is given in **Table 6**.

4. QUALITY ASSURANCE/QUALITY CONTROL

4.1. Holding Times

All assays were conducted within the prescribed holding times, as established by either USGS or USEPA (**Table 3**).

Table 3. Holding Times and preservation used for Artesian Slough sediment samples collected on August 30, 2012

[Parameter notation as given **Table 2**. Maximum holding times ‘authority’ as established by either the U.S. Environmental Protection Agency (EPA) where indicated. Where no EPA guidance exists, holding times are given as established by our laboratory (USGS).]

Parameter	Authority	Preservation prior to assay	Maximum Prescribed Holding Time	Actual Holding Time
THg	EPA	Frozen	1 year	78 days
MeHg	EPA	Frozen	28 days [a]	12 days
$Hg(II)_R$	USGS	Frozen	90 days	49 days
$Fe(II)_{AE}$	USGS	Frozen	90 days	76 days
$Fe(III)_a$	USGS	Frozen	90 days	76 days
$Fe(III)_c$	USGS	Frozen	90 days	77 days
TRS	USGS	Frozen	90 days	75 days
E_h	USGS	Refrigerated	< 24 hrs	< 24 hrs
pH	USGS	Refrigerated	< 24 hrs	< 24 hrs
dry weight	USGS	Refrigerated	undetermined [b]	27 days
LOI	USGS	Refrigerated	undetermined [b]	27 days
Bulk density	USGS	Refrigerated	undetermined [b]	27 days
Porosity	USGS	Refrigerated	undetermined [b]	27 days
Grain Size	USGS	Refrigerated	Indefinite	35 days

[a] Prescribed for MeHg in acid preserved water samples, although no holding time guidance exists for frozen sediment samples, which are presumably much more stable when frozen than water samples are refrigerated and acidified.

[b] A holding time for this parameter has not been explicitly determined, but based upon many years of experience samples held refrigerated in tightly sealed containers are stable for this parameter for at least 30 days and likely for months.

4.2. Blanks

Method blanks were run to assess contamination introduced in the laboratory for the following parameters: THg, MeHg, $Hg(II)_R$, and Fe-species. In most cases, method blanks were below our method detection limit (**Table 4**) indicating that the methods and equipment used were free of (or did not introduce) contamination.

Table 4. Method blanks and Method Detection Limits.

[Parameter notation as given **Table 2**.]

Parameter	Method Detection Limit	Method Blank
THg	0.5 ng/L at the level of the Tekran 2600	1.2 ng/L

	autoanalyzer	
MeHg	0.5 pg (absolute mass as Hg) at the level of the MERX autoanalyzer	< 0.5 pg
$Hg(II)_R$	0.05 ng (absolute mass as Hg) at the level of the fluorescence detector.	< 0.05 ng
$Fe(II)_{AE}$	0.01 mg/ml at the level of the spectrophotometric analysis	< 0.01 mg/ml
$Fe(III)_a$	0.01 mg/ml at the level of the spectrophotometric analysis	< 0.01 mg/ml
$Fe(III)_c$	0.01 mg/ml at the level of the spectrophotometric analysis	< 0.01 mg/ml

4.3. Field Replicates

One field replicate was collected at site S4 (near fixed continuous monitoring buoy) and treated as a unique sample to provide some assessment of with-site variability for all parameters (**Table 5**). The two samples (S4 and S4-FDUP) were collected approximately 5–10 meters apart. A number of parameters exhibited ≤ 10% deviation between the two adjacent sites (i.e. TRS, E_h pH, bulk density, porosity and grainsize), while a few slightly exceeded 50% (i.e. %MeHg and $Fe(III)_c$), suggesting a moderate degree of spatial variability within Artesian Slough at the scale of meters.

Table 5. Field Replicate Results for Artesian Slough sediment parameters

[Parameter and unit notation as given **Table 2**. The mean value for the n=2 sites is given (as presented in **Table 2**), along with the deviation (DEV), calculated as: DEV = ABS($X_1 - X_2$)/2, where X_1 = S4 data and X_2 = S4-FDUP data. The percent deviation (%DEV) is than calculated as: %DEV = DEV/mean x 100.]

		Sampling Site				
Parameter	**Units**	**S4**	**S4-FDUP**	**Mean**	**DEV**	**%DEV**
THg	(ng/g) d.w.	325	540	433	107	25
MeHg	(ng/g) d.w.	4.7	2.2	3.5	1.3	37
MeHg	(% of THg)	1.5	0.4	0.9	0.5	56
$Hg(II)_R$	(ng/g) d.w.	0.07	0.15	0.11	0.04	37
$Hg(II)_R$	(% of THg)	0.02	0.03	0.02	0.003	13
$Fe(II)_{AE}$	(mg/g) d.w.	20	14	16	2.9	17
$Fe(III)_a$	(mg/g) d.w.	0.16	0.13	0.12	0.02	11
$Fe(III)_c$	(mg/g) d.w.	<0.08	0.78	<0.43	0.35	81
$Fe(II)/Fe_T$	(%)	99	94	96.3	2.5	3
TRS	(µmol/g) d.w.	296	340	318	22	7
E_h	(mV)	-143	-144	-143	-0.8	1
pH	pH Units	6.73	6.93	6.83	0.1	1
dry weight	(% of wet weight)	15.7	21.9	18.8	3.1	16
LOI	(% of d.w.)	11.9	10.2	11.1	0.8	8
Bulk density	(g/cm^3)	1.06	1.11	1.08	0.02	2
Porosity	$(ml\ PW/cm^3)$	0.89	0.87	0.88	0.01	2
Grain Size	(% < 64 µm)	82.6	76.9	79.8	2.8	4

4.4. Laboratory Replicates

Laboratory analytical replicates represent multiple samples taken from the same container of site specific sediment, as a measure of both sample homogeneity and laboratory reproducibility. At least one analytical replicate was run for each sediment parameter, with the results given in **Table 6**.

Table 6. Laboratory Analytical Replicate Results for Artesian Slough sediment parameters

[Parameter and unit notation as given **Table 2**. The percent deviation (%DEV) between n=2 analytical duplicates is calculated as described for **Table 5**. The number of analytical duplicates analyzed for a given parameter is defined as 'N', and the specific sites used for analytical replicate analyses are indicated. If more than one pair of analytical duplicates were run (N>1), the mean %DEV is given, along with the error associated with those multiple assessments. Field duplicates, as given in **Table 5**, are not reflected in the data below. n.d., not determined.]

Parameter	Units	Site(s)	%DEV	N
THg	(ng/g) d.w.	S2,S5	15.9 ± 8.7	2
MeHg	(ng/g) d.w.	S5	1.4	1
$Hg(II)_R$	(ng/g) d.w.	S6	31.5	1
$Fe(II)_{AE}$	(mg/g) d.w.	S1	0.2	1
$Fe(III)_a$	(mg/g) d.w.	S1	n.d. [a]	1
$Fe(III)_c$	(mg/g) d.w.	S1	n.d. [b]	1
TRS	(µmol/g) d.w.	S4	2.3	1
E_h	(mV)		n.d.	0
pH	pH Units	S1	0.7	1
dry weight	(% of wet weight)	S2	0.5	1
LOI	(% of d.w.)	S2	0.002	1
Bulk density	(g/cm^3)	S2	0.56	1
Porosity	(ml PW/cm^3)	S2I	1.5	1
Grain Size	(% < 64 µm)	S2, S4	4.7 ± 0.6	2

[a] The %DEV could not be calculated in this case because both replicates were below our analytical reporting limit of 0.1 mg/g for $Fe(III)_a$.

[b] The %DEV could not be calculated in this case because one of the two replicates was just above (0.5 mg/g) and the other below our analytical reporting limit of 0.1 mg/g for $Fe(III)_c$.

4.5. Matrix Spike Samples

Matrix spike percent recoveries were evaluated to determine acceptable accuracy based on method-specific percent recoveries, which are generally set at 75–125% recovery for our laboratory's control limit. Typically when spikes are reported below this accepted range they indicate a low bias, and when reported above this range they indicate a high bias. However, if the spike concentration was low in comparison with the sample concentration, a poor recovery is not in itself indicative of a QC problem. Further, not all sediment parameters are amenable to matrix spikes. For example, the addition of $HgCl_2$ to sediment quickly partitions itself between Sn-reducible and non-reducible pools, and thus cannot be used as a reliable matrix spike for the $Hg(II)_R$ assay. Similarly, there is no commercially available material that can mimic the operationally defined amorphous Fe(III) sediment pool, and thus the $Fe(III)_a$ assay is not subject to a matrix spike assay. Matrix spike additions were applied to THg (x2), MeHg (x2), $Fe(II)_{AE}$, and $Fe(III)_c$, with the results given in **Table 7**.

Table 7. Matrix Spike Results for Artesian Slough sediment samples

[Parameter and unit notation as given **Table 2**.]

Parameter	Units	Sample amended	Sample Value (non-spiked)	Theoretical Spiked Value	Measured value	Recovery (%)
THg	(ng/g) d.w.	S3	195	934	934	100
THg	(ng/g) d.w.	S6	249	509	499	98
MeHg	(ng/g) wet wt.	S1	1.15	1.72	1.70	99
MeHg	(ng/g) wet wt.	S1	1.15	1.72	1.68	98
$Fe(II)_{AE}$	(mg/g) d.w.	S1 [a]	3.3	4.8	6.0	124
$Fe(III)_{c}$	(mg/g) d.w.	S1 [b]	<0.1	18.9	19.4	103

[a] Spike consisted of $FeSO_4$ solution.

[b] Spike consisted of commercial solid phase powdered magnetite (Fe_2O_3)

4.6. Certified Reference Material

Certified reference material (CRM) is available for only a limited number of the analytes assayed in the current study, specifically for sediment THg and MeHg. Like matrix spike's, CRM recoveries were evaluated to determine acceptable accuracy based on method-specific percent recoveries, which are generally set at 75–125% for our laboratory's control limit. CRM recovery results for THg and MeHg given in **Table 8.**

Table 8. Certified Reference Material Recovery Results

[Parameter and unit notation as given **Table 2**.]

Parameter	Units	CRM Used	Certified Value	Measured value	Recovery (%)
THg	(µg/g) d.w.	PACS-2 marine sediment	3.04	2.83	93
MeHg	(ng/g) d.w.	CC-580 estuarine sediment	75	84.5	113
MeHg	(ng/g) d.w.	CC-580 estuarine sediment	75	76.6	102

5. References

CSJ-ESD, 2011, Pond A18 Annual Report - 2011: Prepared for the California Regional Water Quality Control Board by the City of San Jose, Environmental Services Department, 82 p.

Marvin-DiPasquale, M., Agee, J.L., Kakouros, E., Kieu, L.H., Fleck, J.A., and Alpers, C.N., 2011, The effects of sediment and mercury mobilization in the South Yuba River and Humbug Creek confluence area, Nevada County, California: Concentrations, speciation and environmental fate—Part 2: Laboratory Experiments: U.S. Geological Survey Open-File Report 2010–1325B, 53 p., http://pubs.usgs.gov/of/2010/1325B

Marvin-DiPasquale, M., Alpers, C.N., and Fleck, J.A., 2009, Mercury, Methylmercury, and Other Constituents in Sediment and Water from Seasonal and Permanent Wetlands in the Cache Creek Settling Basin and Yolo Bypass, Yolo County, California, 2005–06: U.S. Geological Survey Open File Report 2009-1182, 69 p., http://pubs.usgs.gov/of/2009/1182/.

Marvin-DiPasquale, M., and Cox, M.H., 2007, Legacy Mercury in Alviso Slough, South San Francisco Bay, California: Concentration, Speciation and Mobility U.S. Geological Survey Open-File Report number 2007-1240, 98 p., http://pubs.usgs.gov/of/2007/1240/.

Marvin-DiPasquale, M.C., Lutz, M.A., Krabbenhoft, D.P., Aiken, G.R., Orem, W.H., Hall, B.D., DeWild, J.F., and Brigham, M.E., 2008, Total Mercury, Methylmercury, Methylmercury Production Potential, and Ancillary Streambed-Sediment and Pore-Water Data for Selected Streams in Oregon, Wisconsin, and Florida, 2003–04: U.S. Geological Survey Data Series 375, 25 p., http://pubs.er.usgs.gov/usgspubs/ds/ds375.

Matthes, W.J.J., Sholar, C.J., and George, J.R., 1992, Quality-Assurance Plan for the Analysis of Fluvial Sediment by Laboratories of the U.S. Geological Survey: U.S. Geological Survey Open-File Report 91-467, 37 p.

Olund, S.D., DeWild, J.F., Olson, M.L., and Tate, M.T., 2004, Methods for the preparation and analysis of solids and suspended solids for total mercury. Chapter 8 of Book 5, Laboratory Analysis; Section A, Water Analysis: U.S. Geological Survey USGS Techniques and Methods Report 5 A 8, 23 p., http://pubs.er.usgs.gov/usgspubs/tm/tm5A8.

USEPA, 1996, Method 1669: Sampling Ambient Water for Trace Metals at EPA Water Quality Criteria Levels: U.S. Environmental Protection Agency, Office of Water Engineering and Analysis Division, 37 p.

USEPA, 2001, Appendix to Method 1631: Total Mercury in Tissue, Sludge, Sediment, and Soil by Acid Digestion and BrCl Oxidation: Environmental Protection Agency EPA-821-R-01-013, 13 p.

USEPA, 2002, Method 1631, Revision E: Mercury in water by oxidation, purge and trap, and cold vapor atomic fluorescence spectrometry: U.S. Environmental Protection Agency, Office of Water EPA-821-R-02-019, 36 p.

Xianchao, Y., Chandrasekhar, T.M., and Tate, K., 2005, Analysis of methyl mercury in sediment and tissue by KOH/CH3OH digestion followed by aqueous phase ethylation: Florida Department of Environmental Protection (FDEP) HG-003-2.2

Appendix III. Status Report on A18 Levee Maintenance, Planning Process, and Long-term Operations

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Status Report on A18 Levee Maintenance, Planning Process, and Long-term Operations

This section provides an update on current efforts to maintain Pond A18 existing levees and efforts to determine the future uses of Pond A18 within the context of the Master Planning effort for the San Jose/Santa Clara WPCP (Plant).

Levee Maintenance and Repair

The City is responsible for maintenance of the levees on the south and east sides of A18 and routine maintenance is conditionally covered under Cargill Salt Division's permit from the San Francisco Bay Conservation and Development Commission (BCDC), permit 4-93 issued to Cargill on March 14, 1995. The southern and eastern levees were granted partial assignment of BCDC permit on August 5, 2005.[1] The City identified and prioritized areas of deterioration and undercutting during the 2012 annual levee inspection. The City has budgeted, and will continue to budget for minor annual repairs and is working with BCDC on approval of a procedure to repair the levees prior to the Shoreline Study implementation in the next 5-10 years.

Plant Master Plan

The Plant Master Plan, which includes planning for A18, is now focused on development of the Environmental Impact Report (EIR) for the preferred alternative selected in 2011. The EIR will provide required analysis under the California Environmental Quality Act (CEQA) to identify impacts associated with the build-out of the Master Plan, along with required mitigations for those impacts. The Draft EIR was released and made available for public review from January through February 26, 2013. Final certification of the EIR is anticipated in June 2013.

The Plan includes a land use plan for the Plant's 2,684 acres, including a long-range vision for Pond A18. Developed with a robust community engagement process, including public workshops and Community Advisory Group meetings, the vision for Pond A18 includes vital flood control for the Plant and neighboring communities while also restoring historic habitats.

The plans for levee alignments and the "terraced habitat" concept for Pond A18 have been closely coordinated with the South Bay Salt Pond Restoration effort and are included as an integral part of the Shoreline Study to address tidal flooding due to projected sea-level rise. Pond A18 is proposed to include only water-based uses dominated by tidal influence as open bay, mudflats, habitat islands, and salt marsh.

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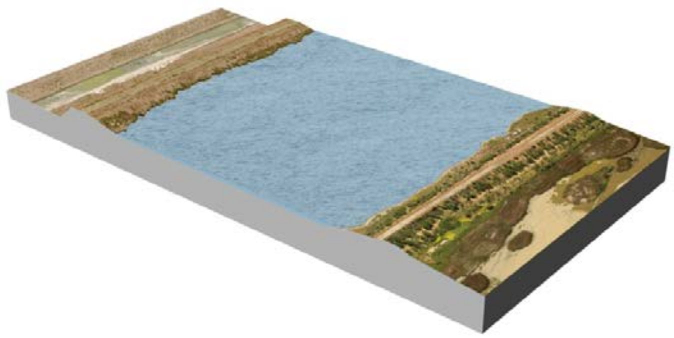
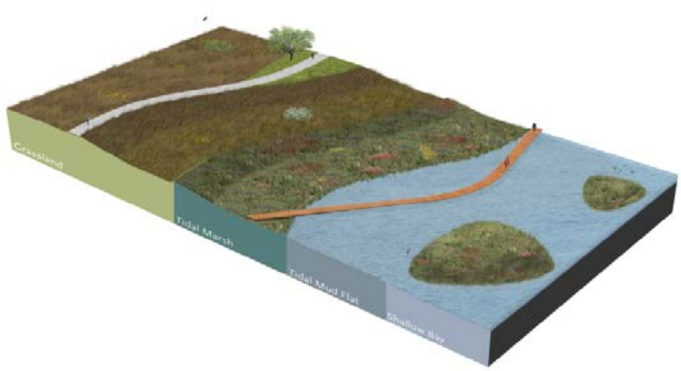
[1] Cargill Salt Division letter from Robert Douglas, Manager, Real Property to Lieutenant Colonel Philip Feir, USACE District Engineer and William Travis, Executive Director San Francisco BCDC.

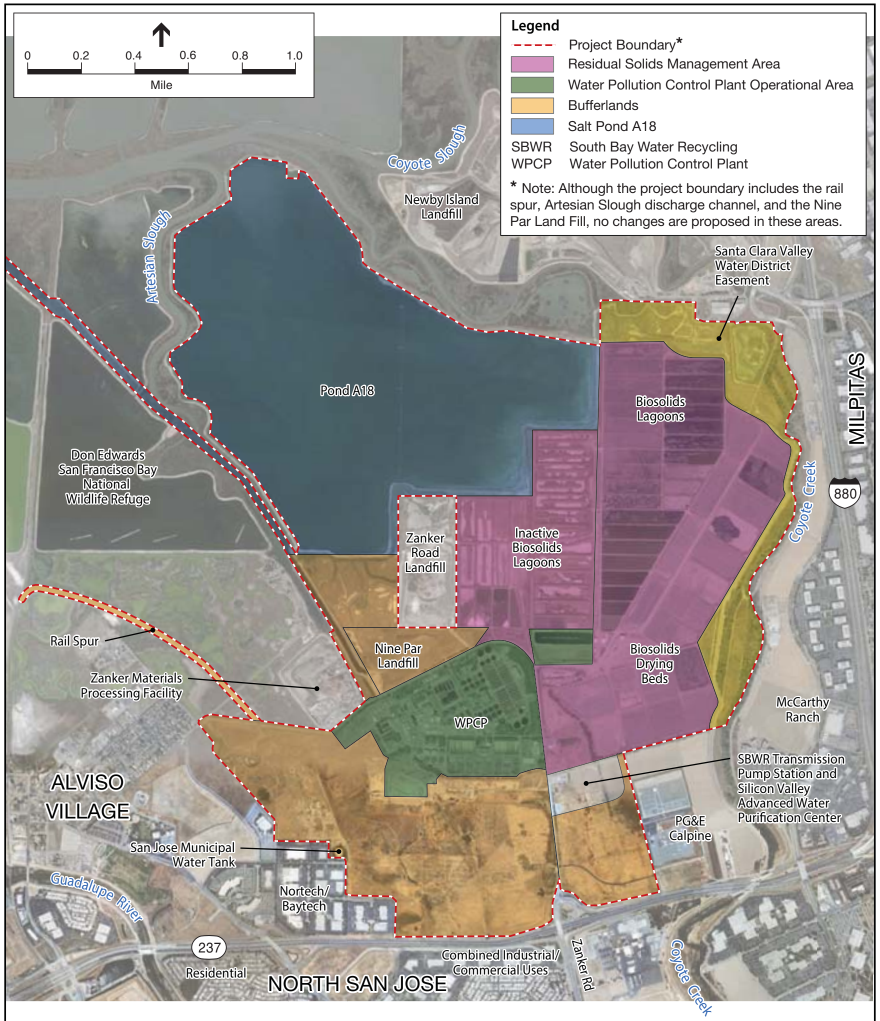
A18 Existing Condition Cross Section



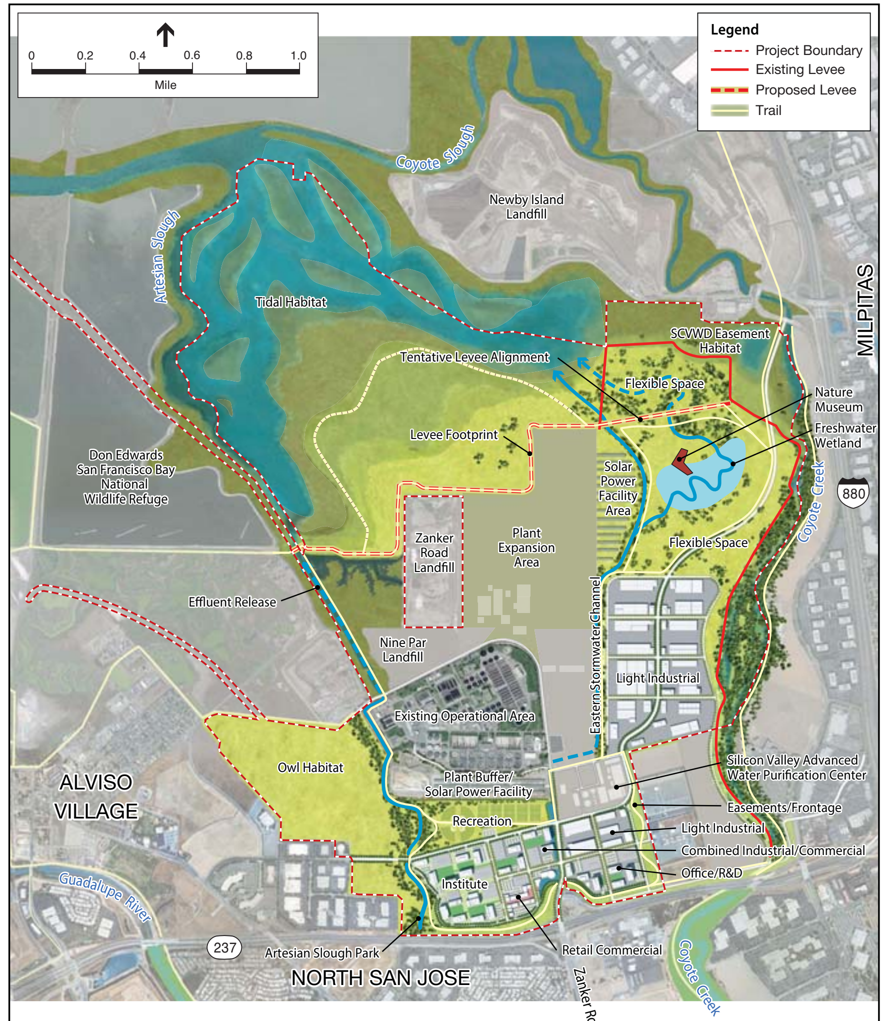
A18 Terraced Habitat Cross Section



Plant Master Plan Land Use Plan



Existing Land Uses



Proposed Site Plan

*Note: The northeastern portion of the PMP planning area includes land owned by others (SCVWD, private property owner) and an area within the City of Milpitas. Location of proposed freshwater wetland is tentative.

SOURCE (Existing): ESA I J&S
SOURCE (Proposed): Skidmore, Owings & Merrill LLP

Figure 3-1
Proposed Site Plan