Tahoe Keys
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March 15, 2023

Mr. Mike Plaziak, Executive Officer
Lahontan Regional Water Quality Control Board
2501 Lake Tahoe Boulevard
South Lake Tahoe, CA 96150
Via Email: Lahontan@waterboards.ca.gov

Subject: TKPOA 2022 Annual Report for Tahoe Keys Lagoons Aquatic Weed Control Methods Test; Lahontan Regional Water Quality Control Board Order No. R6T-2022-0004, NPDES No. CA6202201, WDID No. 6A091701001

Dear Mr. Plaziak:

In accordance with the Monitoring and Reporting Program (MRP) requirements of the subject Order (Attachment E to NPDES No. CA6202201, Section V.C.), the Tahoe Keys Property Owners Association (TKPOA) submits this annual report for the Tahoe Keys Lagoons Aquatic Weed Control Methods Test (also referred to as the Control Methods Test Project or CMT Project). The enclosed report presents a summary of the 2022 activities performed for the CMT Project, and an assessment of compliance with all requirements of the subject Order.

The 2022 activities for the CMT Project were extensive. Twelve implementation and monitoring team contractors and consultants were retained by TKPOA and the Tahoe Regional Planning Agency (TRPA) to collect and analyze over 75,000 monitoring data points, which are summarized in the enclosed Annual Report. Because of the tremendous amount of data collected in 2022, TKPOA created, organized, and presents the raw data in a Dropbox account that can be accessed when reviewing the summaries, analyses, and appendices of the Annual Report. Separate correspondence will be supplied to you and your staff in the near future with guidance on how to access and view the raw data.

<u>Annual Report Contents</u>

The CMT Project permits and approvals contained multiple environmental monitoring and data submittal provisions. Certain permit and approval provisions contain similar information requirements. To assist with review of the Annual Report and other Lahontan Regional Water Quality Control Board (Lahontan Water Board) annual submittal requirements, TKPOA prepared the enclosed table (Annual Report Requirements Table) that identifies the section(s) of the Annual Report or appendix(es) where reporting information for the following permits/approvals can be found:

- Lahontan Water Board NPDES Permit No. R6T-2022-0004 (January 13, 2022)
- Tahoe Regional Planning Agency EIP Permit No. EIPC2018-0011 (January 26, 2022)
- Mitigation Monitoring and Reporting Program (February 25, 2022)
- Lahontan Water Board Approval of Revised Amendment 1 to the Aquatic Pesticide Application Plan (May 18, 2022)
- Final Quality Assurance Project Plan (June 15, 2022)

Compliance with Order

As described in the enclosed Annual Report and as the Lahontan Water Board staff was previously notified, the CMT Project experienced exceedances and incursions of the NPDES Permit limitations. Four types occurred related to: 1) receiving water limits (RWLs) for Endothall herbicide immediately outside of the double turbidity curtains at one location in the West Lagoon following extreme wind events that dislodged the barrier curtains, 2) RWLs for Endothall herbicide inside of the double turbidity curtains within the Lake Tallac treatment area following the 21 DAT permit limit, 3) RWLs for Endothall herbicide for internal receiving waters adjacent to herbicide treatment sites inside of the double turbidity curtains, and 4) Basin Plan Water Quality Objectives (WQOs), both within and outside of the treatment areas and including in untreated CMT Project Control sites.

For the Endothall concentration exceedances (> 100 µg/L) in the West Lagoon, transient exceedances occurred immediately outside of the double turbidity curtains adjacent to CMT Project Site 2. The dates of the recorded exceedances were May 28, June 2, June 7, June 8, and June 10, 2022 at monitoring site ORW-RHC2. For the Endothall concentration exceedances within the Lake Tallac treatment area (treatment side of the double turbidity curtains), the dates of recorded exceedances were on June 25 and 28, 2022, which were beyond the 21 DAT limit for treated areas. For the internal receiving waters adjacent to herbicide treatment sites, Endothall concentrations were above RWLs for both the West Lagoon and Lake Tallac at various times during the period May 28 through June 28, 2022.

The above herbicide issues are itemized by CMT Project site in Table 14-1 (Section 14) of the Annual Report. The Lahontan Water Board staff notifications are referenced in Section 3.2.3 (Notifications) of the Annual Report and listed in Appendix Q (List of Correspondence with Permitting Agencies, TKPOA Homeowners, and Stakeholders). No other herbicide concentration issues occurred within or outside of the herbicide treatment areas in the West Lagoon or Lake Tallac. Notably, the 10 µg/L limit for Rhodamine WT Dye was not exceeded at any time.

For the Basin Plan WQOs, multiple exceedances for several water quality parameters were recorded in 2022. Some of these exceedances can be attributed to CMT Project activities (CMT treatments, including the presence of the double turbidity curtains). Others can be attributed to the pre-CMT existing or "natural" conditions of the Tahoe Keys lagoons and the differences in water quality characteristics compared to Lake Tahoe proper (which raises the issue of whether site specific objectives are needed for the Keys). The large number of recorded compliance level exceedances for the multiple WQO parameters makes it impractical to include the locations and dates in this transmittal letter, but the data are presented in Sections 4 through 17 of the Annual Report and are in detailed tabular format in Appendix X (Instances of Elevated Herbicide and Water Quality Parameters).

Lastly, TKPOA is pleased to report that greater than 90 percent of all required field data collection was achieved in 2022, despite the numerous challenges posed by field operations of this type and scale in an environmental (i.e., non-laboratory) setting. These challenges were beyond the control of TKPOA and TKPOA/TRPA contractors and consultants and were created by extreme weather conditions, wildlife interference, equipment and material supply chain delays, labor shortages and turnover, and unhealthy air quality caused by regional wildfires. These events are further explained in the data completeness Section 3.7 of the Annual Report. Based on the experience gained from the first year of CMT Project implementation, including the 2022 challenges, several improvements are planned for 2023 in communications, reporting procedures, and scheduling that will help increase and improve data gathering and monitoring for the second year of the Project.

Changes in Facility Contact Information

TKPOA recently changed its management structure and is now operated by First Service Residential. With this change in management, near-term changes in general managers will occur as TKPOA concludes the transition.

As current Interim General Manager, I will continue to serve TKPOA through March 17, 2023. From March 18 through 26, 2023, TKPOA will be managed by Shane Gillaspie, who also serves as Executive Vice President to First Service Residential. Effective March 27, 2023, Hallie Kirkingberg will become TKPOA's new General Manager. The contact information for Mr. Gillaspie and Mr. Kirkingberg will remain the same as my current business telephone and address.

Certification

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations. (40 C.F.R. §122.22(d).)

Respectfully submitted,

Mark J. Madison, P.E.
Interim General Manager
Tahoe Keys Property Owners Association

Enclosures

- CMT Project 2022 Annual Report Requirements Table
- CMT Project 2022 Annual Report and Appendices

Cc (electronically with Enclosures):

- TKPOA Board of Directors
- TKPOA Water Quality Committee
- Kimberly Chevallier, Environmental Improvement Program Division Manager, Tahoe Regional Planning Agency
- Dennis Zabaglo, Aquatic Resources Program Manager, Tahoe Regional Planning Agency
- Shane Gillaspie, Executive Vice President, First Service Residential
- Hallie Kirkingberg, General Manager, TKPOA (effective March 27, 2023)
- Melissa Thorme, Downey Brand LLP
- Robert Tucker, P.E., Senior Water Resource Control Engineer, Lahontan Regional Water Quality Control Board
- Russell Norman, P.E., Water Resource Control Engineer, Lahontan Regional Water Quality Control Board
- Tiffany Racz, M.S., Water Resource Control Engineer, Lahontan Regional Water Quality Control Board

CMT Project Annual Report Requirements Table

Permit/ Approval Document Section	Summary Reporting/ Compliance Requirement	Annual Report Section/Appendix
NPDES Permit NO. R6T-2022-0004 (January 13, 2022)		
IV. Other Monitoring Requirements, C. Water Supply Monitoring; pg. E-14	"Include all Table E-5 Drinking Water Supply Monitoring Requirements."	Multiple Sections including 1.3, 12.0
V. Reporting Requirements, A. General Monitoring and Reporting Requirements, No. 1; pg. E-16	"Comply with all Standard Provisions (Attachment D) related to monitoring, reporting, and recordkeeping."	Multiple Appendices including G, H, I, M, O, P, Q, S, U, X, Y, Z, EE, FF, GG
V. Reporting Requirements, A. General Monitoring and Reporting Requirements, No. 2; pg. E-16	"The reports must present in tabular and graphical formats, all data collected for the entire project. Any additional water quality monitoring samples collected and analyzed beyond requirements in this Order must be reported."	Multiple Sections including 2.6, 4.1.1, 4.1.2, 4.1.3, 4.2.1, 4.2.2, 4.2.3, 5.2.1, 5.2.2, 5.2.3, 5.3.3, 6.2.1, 6.2.2, 6.2.3, 6.3.3, 7.2.1, 7.2.2, 7.2.3, 7.3.3, 8.2.1, 8.2.2, 8.2.3, 9.2.1, 9.2.2, 9.2.3, 9.3.3, 10.2.1, 10.2.2, 10.2.3, 10.3.3, 11.0 Multiple Appendices including S, R, Y, Z
V. Reporting Requirements, A. General Monitoring and Reporting Requirements, No. 3; pg. E-16	"For each parameter with a receiving water limitation, the Discharger must determine and report compliance status with respect to the receiving water limitation... All exceedances of receiving water limitations must be identified within the table(s)."	Multiple Sections including 1.4.1, 1.4.2, 2.2, 12.1, 14.1 Multiple Appendices including X, Z
V. Reporting Requirements, B. Annual Information Collection, No. 1; pg. E-16	"A summary discussing compliance/ violation of this Order and effectiveness of the BMPs implemented in reducing or preventing non-compliance with this Order associated with aquatic herbicide, Rhodamine WT and lanthanum-modified clay applications."	Section 16.0
V. Reporting Requirements, B. Annual Information Collection, No. 2; pg. E-16	"Monitoring data and recommendations for improvements to the APAP including BMPs and the monitoring program based on evaluation of the monitoring results. All receiving water monitoring data must be compared to receiving water limitations and existing receiving water quality."	Multiple Sections including 2.2, 5.3.2, 14.0, 16.0, 16.1, 16.2, 16.6
V. Reporting Requirements, B. Annual Information Collection, No. 3; pg. E-16	"Identification of BMPs currently in use and a discussion of their effectiveness in meeting the requirements in this Order."	Multiple Sections including 1.3, 1.4, 2.1, 2.2.1, 16.2
V. Reporting Requirements, B. Annual Information Collection, No. 4; pg. E-16	"A discussion of any BMP modifications made to address violations of this Order."	Multiple Sections including 2.7.1, 2.7.2

Permit/ Approval Document Section	Summary Reporting/ Compliance Requirement	Annual Report Section/Appendix
V. Reporting Requirements, B. Annual Information Collection, No. 5; pg. E-17	"Map(s) showing the location/ size of each treatment area including locations of all monitoring conducted with unique monitoring station identifiers for each monitoring station, the specific herbicide applied to each treatment area denoted."	Multiple Sections including 1.1, 1.3
V. Reporting Requirements, B. Annual Information Collection, No. 6; pg. E-17	"Quantity of aquatic herbicides, Rhodamine WT and lanthanum-modified clay applied to each application area during each application event."	Multiple Sections including 1.3, 3.2.1 Appendix U
V. Reporting Requirements, B. Annual Information Collection, No. 7; pg. E-17	"Information utilized to establish target mixed chemical concentration and the quantity of each chemical discharged in each treatment area including measurements and calculations of treatment area, volume, and any other information utilized for these calculations."	Multiple Sections including 1.3, 3.2.1 Appendix U
V. Reporting Requirements, B. Annual Information Collection, No. 8; pg. E-17	"Information on the herbicide applied to each treatment area and plant survey data collected and include any other treatment (non-chemical or mitigation effort) performed on each area."	Multiple Appendices including EE, U
V. Reporting Requirements, B. Annual Information Collection, No. 10; pg. E-17	"Sampling results indicating the name of the staff performing the sampling and their affiliation, location/ name of each monitoring station, date, map showing each treatment area and associated treatment area/ receiving water sampling locations, name of parameter and its concentration detected, minimum levels, method utilized, method detection limits for each analysis, comparison of monitoring results to receiving water limits, and description of the QA/QC Plan measures and results."	Multiple Sections including 1.1, 14.0, 17.0 Multiple Appendices including G, H, Z, GG
V. Reporting Requirements, B. Annual Information Collection, No. 11; pg. E-17	"An application log containing: Date of application; Location of application; Name of applicator; Type/ amount of aquatic herbicide, Rhodamine WT; level of water body, time application started/ stopped, application method, rate/ concentration; visual monitoring assessment; and Certification that applicator(s) followed the APAP and implemented the BMPs"	Appendix U
V. Reporting Requirements, B. Annual Information Collection, No. 12; pg. E-17	"Records of all applicator and associated staff safety training including name of all staff trained, date/time of training and summary of training material covered. Training records are to include documentation of aquatic pesticide applicator daily, morning safety briefings in addition to any other one-time or routine training conducted."	Appendix O

Permit/ Approval Document Section	Summary Reporting/ Compliance Requirement	Annual Report Section/Appendix
V. Reporting Requirements, C. Annual Report; E-17-18	“If there is no herbicide and rhodamine application during the annual report period, the Discharger must provide the Executive Officer a certification that no discharge to any surface waters occurred.”	N/A
V. Reporting Requirements, E. Reporting Protocols, No. 6-a; pg. E-19	“Report data in a tabular format. Summarize data to illustrate whether the herbicide applications are conducted in compliance with effluent and receiving water limitations…”	Multiple Sections including 1.4.1, 5.3.2, 14.1, 14.2, 16.2 Appendix S
V. Reporting Requirements, E. Reporting Protocols, No. 6-b; pg. E-19	“Attach a cover letter that identifies any violations; discusses corrective actions taken/ planned; and provides a schedule for corrective actions. Identified violations must include a description of the requirement that was violated and a description of the violation.”	See cover letter
V. Reporting Requirements, E. Reporting Protocols, No. 6-c; pg. E-19	“Submit to the Lahontan Water Board, signed and certified as required by the Standard Provisions (Attachment D).”	See cover letter
V. Reporting Requirements, Table E-6 Summary of Reports; pg. E-22	“Pre-Biological Monitoring Report- March 1 of the year following pre-biological monitoring”	Appendix CC
V. Reporting Requirements, Table E-6 Summary of Reports; pg. E-22	“Post-Biological Monitoring Report- March 1 of the Year following completion of post-biological monitoring”	Appendix DD
Revised Amendment 1 Aquatic Pesticide Application Plan (May 18, 2022)		
9.0 Sample Methods and Guidelines, 9.9 Reporting Procedures and Record Retaining, No. 1; pg. 80	“Summary that discusses overall results, issues concerning compliance of the permit and effectiveness of the APAP.”	Section 16.0
9.0 Sample Methods and Guidelines, 9.9 Reporting Procedures and Record Retaining, No. 2; pg. 80	“Summary of monitoring data, including improvements/ degradation in water quality because of the use of herbicides.”	Multiple Sections including 5.2, 6.2, 7.2, 9.2, 10.2, 16.4
9.0 Sample Methods and Guidelines, 9.9 Reporting Procedures and Record Retaining, No. 3; pg. 80	“Discussion of BMP’s used and recommendation for improvements.”	Multiple Sections including 1.3, 1.4, 2.1, 2.2.1, 16.2
9.0 Sample Methods and Guidelines, 9.9 Reporting Procedures and Record Retaining, No. 4; pg. 81	“Final map showing location of each herbicide application.”	Section 1.1

Permit/ Approval Document Section	Summary Reporting/ Compliance Requirement	Annual Report Section/Appendix
9.0 Sample Methods and Guidelines, 9.9 Reporting Procedures and Record Retaining, No. 5; pg. 81	"Amount and type (product) of herbicide used."	Section 1.3 Appendix U
9.0 Sample Methods and Guidelines, 9.9 Reporting Procedures and Record Retaining, No. 6; pg. 81	"Detailed table showing sampling locations (GPS referenced) and associated results by date and the site."	Appendix S
9.0 Sample Methods and Guidelines, 9.9 Reporting Procedures and Record Retaining, No. 7; pg. 81	"Summary of herbicide application logs."	Appendix U
Mitigation Monitoring and Reporting Program NO. R6T-2022-0005 (February 25, 2022)		
3.0 Water Quality Parameters; pg. 22	"Provide the location of the water quality measurements and the measurements themselves in an annual report."	Multiple Appendices including EE, R, S, Y
7.1 Reporting; pg. 25	"Provide documentation of the selection/ performance of the herbicide application by a QAL holder following herbicide application."	Appendix U
7.2 Reporting; pg. 25	"Describe the spill control BMPs implemented during herbicide application."	Section 2.2.1 Multiple Appendices including F, L
7.3 Reporting; pg. 25	"Describe the contingency plans implemented following aquatic herbicide application."	Section 2.2.1 Appendix M
7.4 Reporting; pg. 26	"If herbicides are detected in nearby wells, provide documentation of the contingency plans implemented following herbicide application."	Section 12.2
7.5 Reporting; pg. 26	"Report if aeration systems were implemented."	Section 2.8
7.6 Reporting; pg. 26	"Report whether workers received awareness training and the Tribal Cultural Resources Awareness brochure."	Appendix O

Final Quality Assurance Project Plan (June 15, 2022)		
3.7 Project Tasks, Action 19. Removal of Curtains, No. 3; pg. 34	"Samples of turbidity must be taken at surface, mid-depth, and bottom and reported in the annual report. Calibration reports must be included."	Multiple Sections including 2.5, 2.7.1, 2.7.2, 3.7.1, 3.7.4, 3.7.5, 3.7.7 Multiple Appendices including P, R
10.0 Data Verification and Validation, 10.2 Field Measurements; pg. 62	"Data verification/ validation results will be included. These results will include explanations of any qualifiers attached to sample results by the laboratory during data verification, or by the Contractors' Data QA manager during data validation, including the rationale behind rejecting any data as unusable. Data verification will be reviewed by CMT Project managers."	Section 1.9 Multiple Appendices including F, G
12.0 Documentation and Reporting; pg. 62-63	"Documentation will include original field notes, photographs, field forms, calibration records, laboratory data packages that include completed chain-of-custody forms, electronic files from water quality data loggers, water level recorders, and a rain gauge. All the information will be summarized in a report, with written records provided in appendices. The report will be provided as electronic pdf files. Photographs, laboratory data packages, and electronic files from water quality and hydrology instruments will be made available electronically on portable file storage devices."	Multiple Appendices including EE, H Cover letter (paragraph 2)
12.0 Documentation and Reporting; pg. 63	"The report will provide much of the information used to evaluate CMT and evaluate water quality compliance in an antidegradation analysis; however, the data report will not include these evaluations and analyses. Data analyses and interpretation included in the data report will include comparisons of results to Basin Plan water quality objectives, estimating a seasonal water balance for the lagoons, and preparing a conceptual model that describes nutrient loading to and nutrient cycling within the Tahoe Keys lagoons."	Multiple Sections including 4.1.1, 4.1.2, 4.1.3, 4.2.1, 4.2.2, 4.2.3, 5.2.1, 5.2.2, 5.2.3, 5.3.3, 6.2.1, 6.2.2, 6.2.3, 6.3.3, 7.2.1, 7.2.2, 7.2.3, 7.3.3, 8.2.1, 8.2.2, 8.2.3, 9.2.1, 9.2.2, 9.2.3, 9.3.3, 10.2.1, 10.2.2, 10.2.3, 10.3.3
TRPA Permit EIPC2018-0011 (January 26, 2022)		
Special Conditions, No.22; pg. 10, 11	"Submit annual efficacy monitoring reports for three years from the date of project implementation. Effects of the treatments on plant biovolume, plant species composition, and water quality within the CMT test areas shall be compared with reference sites. Specific efficacy monitoring will determine if the following CMT goals are achieved, including the following:	Appendix E

	• Reduction of 75% in total invasive and nuisance plant biomass (biovolume) within treated sites. • Increase in occurrence and percent composition of native plants relative to non-native plants. • Reduction of non-native plant and fish habitat, therefore improving habitat for native species.”	
Special Conditions, No.22; pg. 11	“Improved water quality in the test sites, such that water quality objectives are more frequently met, therefore improving water quality and associated clarity. This includes the following: • Reduction in suspended nitrogen, phosphorus, and total dissolved solids in the fall months during normal senescence; • Improvement in clarity of the water as measured by turbidity; and • Improve water column pH stability in all test areas to achieve pH values between 7.0 and 8.4. • Maintenance of the three (3)-foot vessel hull clearance.” • Improved recreational and aesthetic values.”	Multiple Sections including 16.4, 16.5

*To find the page numbers for the referenced section/ appendix numbers, go to the table of contents located in the body of the Annual Report.

TAHOE KEYS PROPERTY OWNERS ASSOCIATION

TAHOE KEYS LAGOONS AQUATIC WEED CONTROL METHODS TEST: ANNUAL REPORT – YEAR 1

PREPARED PURSUANT TO

CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD
LAHONTAN REGION
ORDER NO. R6T-2022-0004
NPDES NO. CA6202201
WDID NO. 6A091701001

AND

TAHOE REGIONAL PLANNING AGENCY
FILE No: EIPC2018-0011
PROJECT NUMBER: 510-101-00

MARCH 2023

TAHOE KEYS PROPERTY OWNERS ASSOCIATION

TAHOE KEYS LAGOONS AQUATIC WEED CONTROL METHODS TEST: ANNUAL REPORT – YEAR 1

MARCH 2023

Prepared for
Tahoe Keys Property Owners Association

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Prepared by
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Appendix P.	Calibration Logs for Monitoring Equipment
Appendix Q.	List of Correspondence with Permitting Agencies, TKPOA Homeowners, and Stakeholders
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LIST OF ABBREVIATIONS AND ACRONYMS

AIP	Aquatic Invasive Plants (includes non-native and native plants)
APAP	Aquatic Pesticide Application Plan
BMI	Benthic macroinvertebrates
CalEPA	California Environmental Protection Agency
CMT	Control Methods Test
COC	Chain of Custody
DAT	days after treatment
DO	dissolved oxygen
EIP	Environmental Improvement Program
EIR	Environmental Impact Report
EIS	Environmental Impact Statement
EPA	Environmental Protection Agency
ERS	External Reference Sample
ESA	Environmental Science Associates
EWM	Eurasian watermilfoil
HABs	harmful algal blooms
IRI	Inventive Resources, Inc
Lahontan Order	Lahontan Water Board Order No. R6T-2022-0004
Lahontan Water Board	California Regional Water Quality Control Board, Lahontan Region
LFA	Laminar Flow Aeration
LMC	Lanthanum-Modified Clay
LMCAP	Lanthanum-Modified Clay Application Plan
MDL	method detection limit
µg/L	microgram per liter
mg/L	milligram per liter
MMRP	Mitigation Monitoring and Reporting Program
MWG	Monitor Working Group
N	Nitrogen
N/A	not applicable
ND	not detected
NPDES	National Pollutant Discharge Elimination System permit
NR	data not reported
NT	not treated
NTU	Nephelometric Turbidity Units
Ortho-P	Orthophosphate
ORP	oxidation reduction potential
Permit	Tahoe Regional Planning Agency Permit No. EIPC2018-0011
PAR	Photosynthetically Active Radiation
P	Phosphorous
Project	Tahoe Keys Lagoons Aquatic Weed Control Methods Test
PPB	parts per billion
PPM	parts per million
QA/QC	Quality Assurance/Quality Control

QAL	Qualified Applicator License
QAPP	Quality Assurance Project Plan
RL	reporting limit
RWL	Receiving Water Limits
RWT	Rhodamine Water Tracer
SEA	Sierra Ecosystem Associates
SpC	specific conductivity
TA	Test Area
TCP	3,5,6-Trichloro-2-pyridinol
TKN	Total Kjeldahl Nitrogen
TKPOA	Tahoe Keys Property Owners Association
TMP	3,5,6-trichloro-2-methoxypyridine
Total N	Total Nitrogen
Total P	Total Phosphorus
TRPA	Tahoe Regional Planning Agency
TRPA EIP Permit	Tahoe Regional Planning Agency Permit File No. EIPC2018-0011 (Project 510-101-00)
UV/UV-C	Ultraviolet light/ UV-C= 253.7 nm
VEL	vessel exit log
VHC	vessel hull clearance
WDR	Waste Discharge Requirements

1.0 EXECUTIVE SUMMARY

This document reports on the specific regulatory compliance actions and the results as part of implementation of the requirements of Lahontan Regional Water Quality Control Board National Pollutant Discharge Elimination System (NPDES) Permit Order R6T-2022-0004 (Lahontan Order) and required Amendments to the Aquatic Pesticide Application Plan (APAP). Additionally, Tahoe Regional Planning Agency (TRPA) Permit EIPC2018-0011, Special Condition #2 incorporates Mitigation Monitoring and Reporting Program (MMRP) requirements, Special Condition #3 incorporates Waste Discharge Requirements (WDR) and Lahontan Order permit requirements.

The following provides a brief overview and orientation to the "Tahoe Keys Lagoons Aquatic Weed Control Methods Test" (CMT) project, the compliance and mitigation context, and the organizational structure of the Report in compliance with the Lahontan Order.

The development of the CMT and its implementation required a productive collaboration among many agencies, nonprofit advocacy groups, and other stakeholders. The history and process leading to the CMT can be found in Appendix A and Appendix B (Anderson 2022; SEA 2023).

1.1 Setting of CMT Project

The Lahontan Order (see Appendix C) permitted the implementation of the CMT in the Tahoe Keys West Lagoon and Lake Tallac, immediately south of the West Lagoon (Figure 1-1) in South Lake Tahoe.

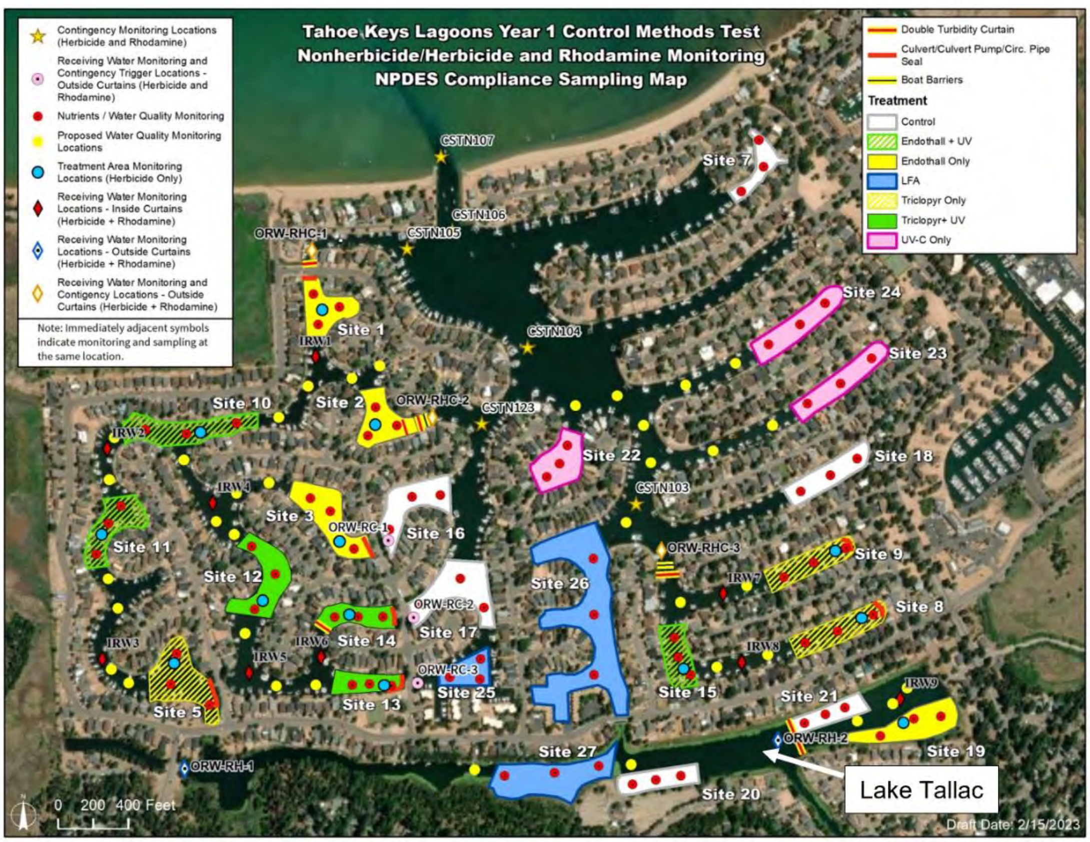

Figure 1-1. Overview Map of CMT Sites and Monitoring Locations

1.2 Goal and Objectives of the Three-Year CMT

The overarching objective of the CMT project is to acquire useful information on the capabilities and feasible uses of several control methods to manage aquatic weeds in the Keys lagoons including non-native Eurasian watermilfoil (*Myriophyllum spicatum*), non-native curlyleaf pondweed (*Potamogeton crispus*) and excessive growth of native coontail (*Ceratopyllum demersum*). In this report, these target plants are referred to as Aquatic Invasive Plants (AIP). Specific goals are to achieve 75% reduction in AIP biovolume, provide sufficient vessel mobility, and provide better environmental conditions for desirable native aquatic plants. The goal of Year 1 of the CMT was to determine the ability of the Year 1 test methods (also referred to as "Group A" methods) to achieve a 75% reduction in AIP biovolume. In CMT sites where 75% reduction is achieved, (Group B) methods can be tested for effectiveness in sustaining AIP control in Years 2 and 3.

1.3 Herbicide Use

The Lahontan Order and the accompanying APAP provided the specific protocols for herbicide applications and regulatory limits or thresholds for both water quality and levels of herbicides including their degradants. In the West Lagoon, the CMT included a one-time, limited-use test application ("treatment") using two Environmental Protection Agency (EPA) and California Environmental Protection Agency (CalEPA)-approved aquatic herbicides: 1) Endothall (Aquathol K potassium salt), and 2) Triclopyr Renovate 3 (liquid) and Renovate "OTF" (granular). Both were tested in the Tahoe Keys West Lagoon but in Lake Tallac, only Endothall (Aquathol K) was applied at a single site. Renovate was applied to achieve a concentration of 1 mg/L (1 ppm). (Renovate is the formulation of Triclopyr containing triclopyr acetic acid triethylamine salt.) Aquathol K was applied to achieve a concentration of 2 mg/L (2 ppm). These application rates are less than one-half the permitted maximum concentrations based on EPA and CalEPA approved product labeling.

The surface area to which herbicides were applied in replicated treatment sites was 15.5 acres within the total West Lagoon area of 110 acres and a single 2-acre site in the 23-acre Lake Tallac. Note that for Combination herbicide/ultraviolet light (UV) sites, herbicides were applied only to the near shore areas; thus, the actual area to which herbicides were applied was less than one-third the total areas of these sites, and usually less than 25% of the water volume in the site.

1.4 Monitoring and Mitigations

The CMT was implemented in accordance with required mitigation and monitoring actions prescribed in the Lahontan Order, the APAP and its amendments, and the MMRP. These actions included monitoring for herbicide active ingredients and their degradants as well as a wide range of water quality variables. Mitigation included the installation and maintenance of double turbidity curtains at strategic points to separate herbicide treated CMT sites from the rest of the West Lagoon and to restrict herbicide application to one site in Lake Tallac. The Lahontan Order also prescribed specific monitoring following use of non-herbicide "treatments" that are critical components of the CMT, including UV treatments alone, combinations of UV and herbicide treatments, and the use of Laminar Flow Aeration (LFA). (Note: UV in this report refers specifically to UV-C, germicidal UV with a wave length of 253.7 nm.)

This report documents all compliance required actions during the implementation of the CMT, including pre-project training and certifications as required by the Lahontan Order. A summary of the implementation process and actions is provided in Appendix A (Anderson 2022).

The report documents the following exceedances and incursions in regulatory limits:

1.4.1 Herbicides and RWT Dye

a) RWL for Endothall (100 µg/L) inside Site 19 (Lake Tallac) more than 21 DAT;
b) Endothall outside of Site 19 within the double turbidity curtains;
c) transient RWL for Endothall outside all sites in Area A except Sites 13, 14;
d) RWL for Endothall outside double turbidity curtains in the West Lagoon near Site 2 (Area A).
e) Detection of Triclopyr less than RWL outside double turbidity curtains at Site 15.
f) RWT dye less than RWL was detected adjacent to treatment sites and outside double turbidity curtains. (See Table 2-2.)

There were no RWL exceedances of Triclopyr (400µg/L) or RWT dye (10µg/L) at any time. Dates, Endothall levels, and duration of exceedances are provided in Table 14-1.

1.4.2 Water Quality

a) Exceedances in turbidity (>10% higher NTU than controls) occurred in most treatment sites as described in Section 3.7.7.
b) Exceedances in DO occurred in most bottom water samples in controls and in some mid-depth samples in Area A and to a lesser extent in Areas B and C (Lake Tallac).
c) Exceedances in pH ranges occurred in all sites including controls. However, pH ranges in some herbicide- and UV-only sites had transient excursions to within the regulatory range (due primarily to reduced aquatic plant carbon assimilation and reduced photosynthesis).
d) The water quality exceedances are shown graphically in Sections 4.0 through 12.0.

1.5 TRPA EIP Permit

In addition to the NPDES, the TRPA required specific monitoring actions to determine the effectiveness of the CMT (Group A) treatments. These compliance actions were delineated in an Environmental Improvement Program (EIP) permit issued by TRPA on January 26, 2022 (Project 510-101-00; File No. EIP C2018-0011; Appendix D), referred to in this report as TRPA EIP Permit.

1.6 TRPA Monitoring Role

A key component of the CMT project is the deliberate use of independent on-the-water monitoring teams separate from the herbicide application team and Tahoe Keys Property Owners Association (TKPOA) monitoring teams, particularly for monitoring herbicide and herbicide degradant levels in surface water. To implement the independent monitoring approach, TRPA contracted with highly skilled and experienced contractors expressly for monitoring herbicides, RWT dye, water quality outside sites, nutrients, benthic macroinvertebrates (BMI), nutrients associated with harmful algal blooms (HABs), and the effectiveness of treatments on AIP and native aquatic plants. This approach was intended to reduce the potential for perceived bias in key sampling and data collection, including the effects of CMT (Group A) methods on AIP, and to provide a higher level of confidence for regulators. High confidence in the data is critical for valid assessments of the test methods results. The CMT results will be used to improve and sustain management of AIP in the entire Keys lagoon system going forward.

1.7 Field Sampling and Data Collection

Monitoring to comply with CMT permits (Lahontan Order and TRPA EIP Permit) resulted in many thousands of data points, field action documentations, laboratory analyses, photo-records, as well specific compliance and notification reporting to permitting agencies during key CMT implementation events. These data sets and their interpretation are provided under specific headings below for the monitoring or other contingency actions taken. The Tahoe Keys Lagoons Macrophyte Control Efficacy Monitoring Report: Year 1 for the TRPA EIP Permit is provided in Appendix E (ESA 2023). However, since data on effectiveness and some water quality monitoring variables may be related (correlated or causal), the final section of this report provides a brief discussion of these results for context of the overall monitoring results of the CMT with AIP responses.

1.8 Organization of Reporting

a) Focus on Treatment

The CMT is designed to compare effects of the different treatments on AIP and native species, water quality and BMI levels. Therefore, the monitoring reports are organized by each type of treatment, and comparisons with untreated “control” sites. Except for specific training, certifications compliance, and monitoring compliance, the results are presented in the following format (Figure 1-2) with each CMT treatment described separately. The emphasis on “treatment” reflects both the Environmental Impact Report and Environmental Impact Statement (EIR/EIS) documents that focused on potential impacts of CMT treatments, and the monitoring specified in the Lahontan Order.

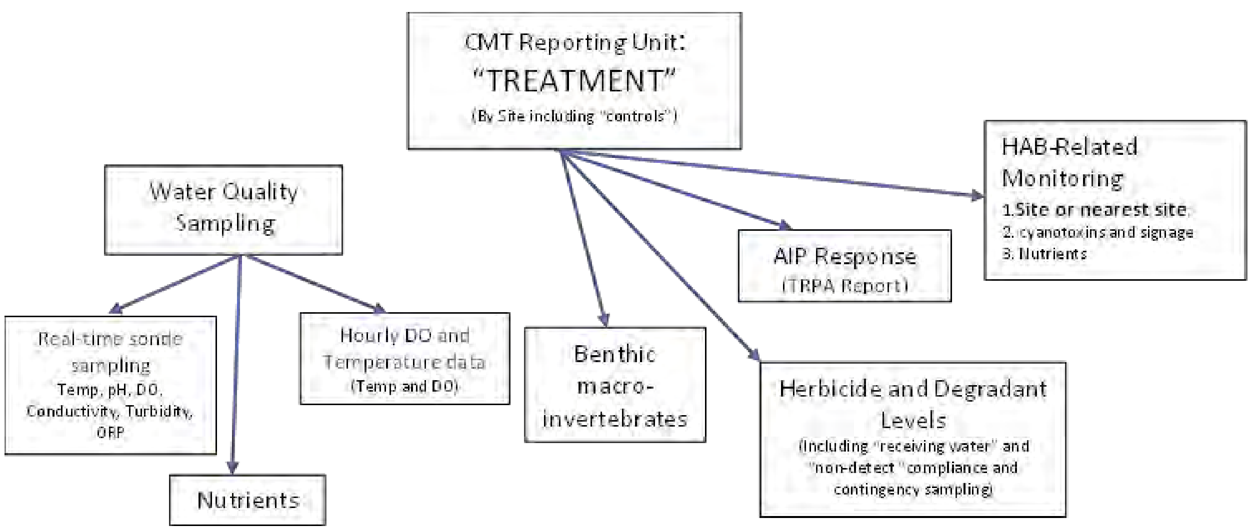

Figure 1-2. Organization of CMT Monitoring Reporting

The NPDES required several compliance actions including those associated with preparation for CMT treatments (pre-CMT). These pre-CMT actions included certifications and training of field staff and contractors, mitigation actions, contingency event planning and actions, site-specific water quality monitoring, herbicide monitoring, BMI and HABs monitoring, and AIP species presence and abundance (biovolume) surveys.

Therefore, the compliance reporting is separated into two sections: “pre-CMT” results and “post-CMT treatments” results. Post-CMT includes monitoring data collected on and after the first treatment date (May 25, 2022 to November 30, 2022). Most monitoring is highly “CMT site-specific” which means “Treatment-Specific.” However certain required monitoring was conducted outside of designated sites (e.g., between sites within the curtained areas; and outside mitigation curtains). This format therefore addresses the question: How did each CMT (Group A) treatment affect the monitoring variables?

b) Sequence of Reporting

There are seven types of CMT (Group A) treatments (including controls). The treatments and their associated monitoring information are provided in the following order:

(1) Control (non-treated sites)
(2) Endothall-only sites (West Lagoon and Lake Tallac)
(3) Triclopyr-only sites
(4) UV-only sites
(5) Endothall/UV sites
(6) Triclopyr/UV sites
(7) LFA Sites

For each type of treatment, the specific monitoring data is provided in the following sequence:

- Control sites: Nutrients, Water Quality, AIP Responses
- Herbicide-only sites and Combination sites: Nutrients, Water Quality, Herbicide and Degradants, AIP Responses
- UV-only sites: Nutrients, Water Quality, AIP Responses
- Laminar Flow Aeration: Nutrients, Water Quality, AIP Responses

c) Graphic Data Representation

For ease and clarity in comparing the various treatments conditions with untreated “control” sites, data pertaining to treatments (2) through (7) are provided graphically with side-by-side control site data. In graphs that pertain to specified regulatory limits such as dissolved oxygen (DO), pH, Total Nitrogen (Total N), Total Phosphorous (Total P), and herbicides, the appropriate limits (single limit or limit range) are indicated on each graph. Appropriate limits are also shown on graphs showing data from control sites.

1.9 Quality Assurance/Quality Control (QA/QC)

The CMT Quality Assurance Project Plan (QAPP) (see Appendix F) defines the steps and documentation required to ensure that monitoring is conducted properly and consistently, and results in reliable data. The section also provides information on the reasons for exclusion of data (if any) and appropriate substitute data sources. In addition, Technical Memos and/or tables describe specific water quality sampling and analyses procedures for quality control actions (see Appendix G).

QAPP compliance includes daily monitoring, team meetings, and coordination. For monitoring samples analyzed by off-site laboratories, proper Chain of Custody (COC) records are provided in Appendix H.

2.0 PRE-CMT COMPLIANCE ACTIONS (PRIOR TO MAY 25, 2022)

2.1 Management and Coordination of CMT Project

The CMT project was coordinated and managed pre- and post-implementation through a TKPOA/TRPA/Dr. Lars Anderson/Sierra Ecosystem Associates (SEA) leadership team and with weekly meetings of a larger CMT Monitor Working Group (MWG). The MWG consisted of key leadership in TKPOA, SEA, TRPA and representatives from all contractors hired to install and remove curtains, apply CMT treatments, and conduct monitoring. Other stakeholders participated in the MWG including The League to Save Lake Tahoe. When specific regulatory questions arose, representatives from Lahontan Water Board participated. Through the MWG weekly meetings, pre-CMT and post-CMT activities were identified, aligned for action by responsible team(s), and any problems that surfaced were resolved through these discussions. As of the date of this report, over 70 MWG meetings have been held with written notes taken and reviewed by MWG members. The CMT organizational structure is shown in Figure 2-1 (Anderson 2022). The record of the MWG and other coordination meetings between January 2022 and January 2023 is provided in Appendix I.

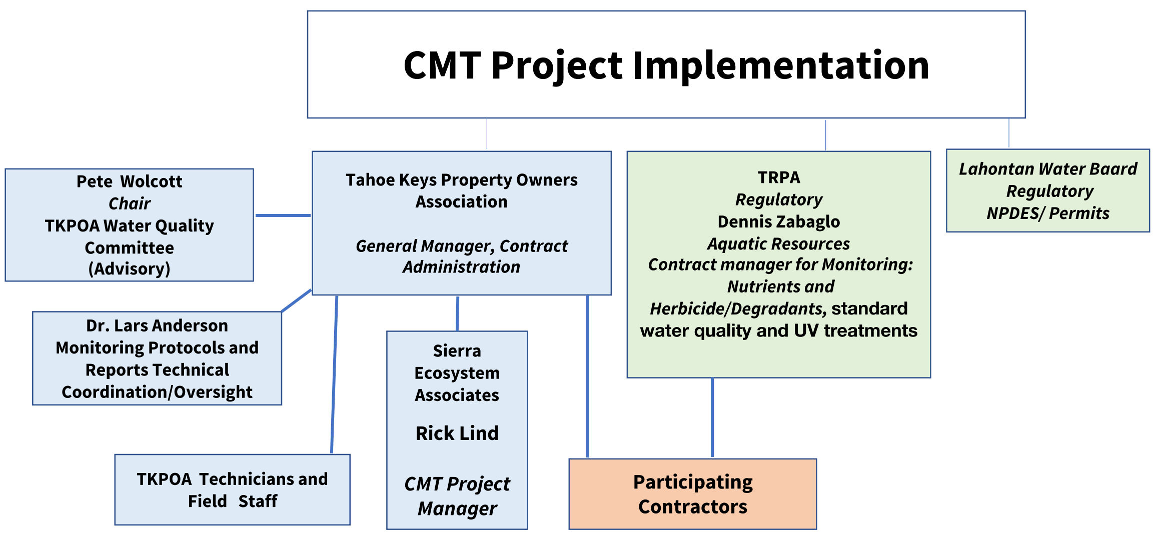

Figure 2-1. Organization Structure for Management and Coordination of CMT Actions

This structure ensured scientific rigor and independent oversight (TRPA) for the implementation and monitoring of the CMT and to comply with the permits. Multiple team efforts and frequent coordination meetings were held to coordinate actions including:

a) Reviewing and communicating compliance and scheduling requirements to contractors.
b) Coordinating installation of containment curtains, culvert and pipe seals, and boat barriers.

c) Notifying homeowners and boating community of CMT actions that might affect them.
d) Pre-CMT treatment sampling for BMI in sediment, water quality, and macrophytes.
e) Scheduling and coordinating herbicide and UV light treatments.
f) Monitoring schedules, documentation, and quality assurance post-treatment.
g) Coordinating sample shipments to laboratories.
h) Coordinating available watercraft (work boats) to accomplish monitoring tasks.
i) Determining if hydraulic conditions were acceptable before herbicides could be applied.
j) Responding rapidly to changing conditions and taking contingency mitigation steps where necessary.
k) Preparing and submitting all pre-herbicide application compliance documents to Lahontan and TRPA.
l) Meeting with permitting agencies (Lahontan Water Board and TRPA) to ensure compliance actions were taken, and to communicate any conditions warranting contingency measures or additional monitoring.

2.1.1 Coordination and Readiness of CMT Teams

For each CMT activity, training and field practice of each "action" was conducted by the requisite team whether TKPOA staff, TRPA staff, or through contracted service providers. Since this was the first time such a complex and large, multi-team effort had been undertaken in the Keys, and since this was the first permitted use of aquatic herbicides in or near Lake Tahoe, both training and coordination were essential to successfully executing the actions needed.

Specific actions included:

a) On-site team meetings: Daily briefing for each team was conducted to ensure that needed equipment, supplies, staff, and boats were ready.
b) Calibration of equipment/field instruments was done regularly according to equipment manufacturer- or more frequently.
c) Teams documented their compliance/schedules using uploaded forms to a common data collection/file submittal system.
d) Coordination and review meetings:

    (1) MWG met weekly (via Zoom) to discuss the status of monitoring and CMT treatment progress. Any problems identified were discussed and resolved either at subsequent MWG meetings, or at separate follow-up focused meetings. The participants of the MWG included all contractors, in-house staff (TKPOA, TRPA), the League to Save Lake Tahoe, and Lahontan Water Board representatives when specific permit clarifications were necessary. At the time of this report, the MWG had met 73 times.

    (2) Agency/TKPOA meetings. Two to four times per month TRPA, TKPOA (representatives from TKPOA Water Quality Committee and the General Manager for TKPOA), TKPOA consultants, and The League to Save Lake Tahoe met (via Zoom) to discuss the status of CMT implementation, to coordinate field activities as needed, and to make any adjustments to activities.

    (3) TKPOA Staff/TKPOA Management/TKPOA consultants and representative(s) of the TKPOA Water Quality Committee met weekly (Zoom/in person). Specific

planning for CMT implementation, compliance, field activities, and other monitoring and weed control activities were discussed.

(4) TKPOA Water Quality Committee meetings: Monthly and then quarterly meetings (Zoom/in person) were held to discuss water quality and related matters affecting TKPOA. The agenda always includes an update and discussion of CMT progress, issues, and proposed actions.

2.2 Aquatic Pesticide Application Plan Amendments 1 and 2

In order to obtain final approval to start the CMT treatments, the original APAP (April 30, 2021) was amended twice to clarify and finalize monitoring sites and two treatment sites that differed from the original APAP (specifically delineation of sites 13 and 14 for Triclopyr/UV treatments), and provide a Spill Response Plan and contingency plan for use of Lanthanum-Modified Clay (LMC). TKPOA received final approval of APAP Amendments 1 (Appendix J) and 2 (Appendix K) on May 25, 2022. (Note Figure 1-1 shows the final treatment and monitoring sites as provided in APAP Amendment 2.)

2.2.1 Spill Prevention and Response Plan

As part of the mitigation and contingency planning, a professional certified hazardous waste removal team was deployed during all applications of herbicides. Preventative protocols are provided in the QAPP (Appendix F). During herbicide applications, the spill contingency team maintained mobile pumping and storage systems adjacent to each treated site until the application was finished. The spill contingency contractor information is provided in Appendix L. As planned, no spills occurred during any of the CMT herbicide applications (see Appendix M). An example of the deployed spill response equipment is shown in Figure 2-2 below. The equipment was moved to each site prior to herbicide application at the site. (Note: storage tank and hoses as well as the black culvert plug at the water's edge.)

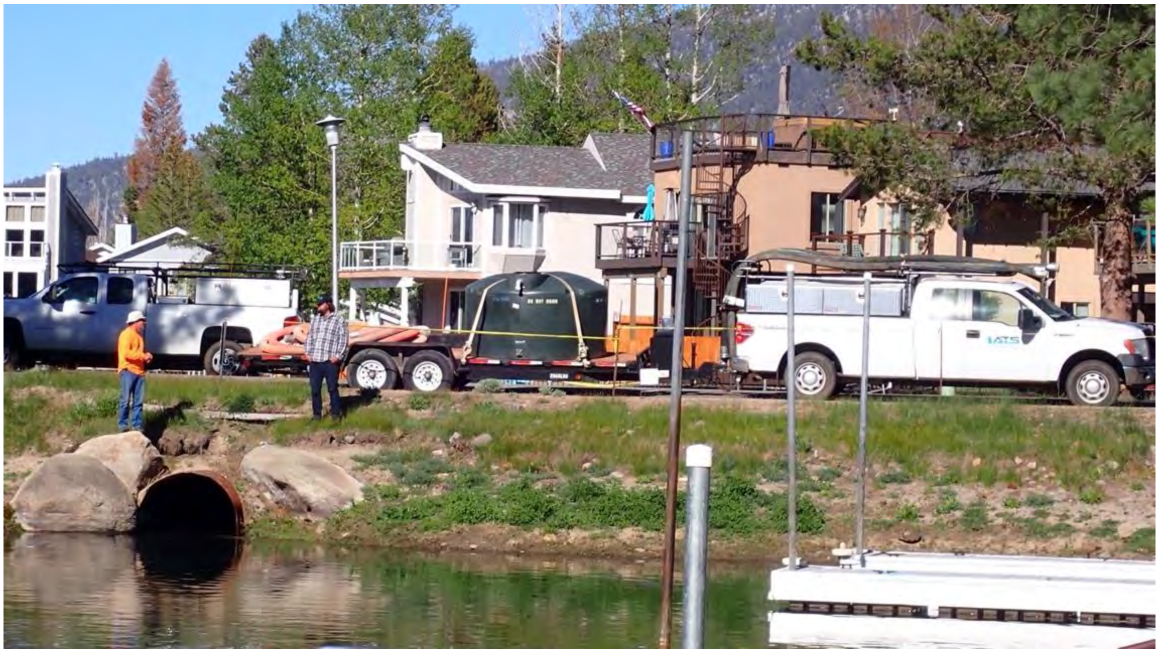

Figure 2-2. Example of Spill Prevention and Contingency Pumping Equipment Deployed During Herbicide Applications

2.2.2 Lanthanum-Modified Clay Application Plan

The potential for increased phosphorous (P) in the CMT sites was recognized as was the potential for P stimulated HABs. The Lanthanum-Modified Clay Application Plan (LMCAP) was developed as a possible mitigation action to reduce P if it became elevated. The LMCAP provided the criteria on which a voluntary decision could be made to apply a modified lanthanum clay product (PhosLock) (Appendix N).

2.3 Documentation of Training, Qualifications, and Experience

Due to the diversity and technical nature of CMT team actions, specific training and verification of certifications and qualifying experience were documented in compliance with the Lahontan Order (see Appendix O).

2.4 Protocols for Monitoring

The QAPP was submitted to the Lahontan Water Board and to contractors and managers (Amendment F). The QAPP provided detailed instructions on materials, equipment, and their use for all types of CMT monitoring and was part of the overall CMT QA/QC.

2.5 Calibration Records

Several types of field monitoring equipment and instrumentation were used during the CMT. Most equipment and instrumentation have manufacturer specifications for calibration methods and frequency. These protocols were followed although, in some cases, more frequent calibrations were made (e.g., for water quality measurements using multiprobe sonde units). Calibration Logs for monitoring equipment can be found in Appendix P.

2.6 Hydraulic Flow Conditions at the West Channel

A key prerequisite for initiating herbicide applications specified in the Lahontan Order and MMRP was the presence of a hydraulic gradient driving flow from Lake Tahoe into the Keys via the West Channel (see top of Figure 1-1). The reason for this requirement was to add an additional mitigating “buffer” (or resource protection measure) to reduce the likelihood of herbicides or their degradants from entering either the West Channel or Lake Tahoe proper. Typically, melting spring snowpack drives increases in Lake Tahoe water elevation, which in turn results in filling the Tahoe Keys lagoons. Due to drought conditions, the winter and early spring snowpack was below normal for 2022 and the lake level in general was low. The snowpack and projected snowmelt-rise in Lake Tahoe was carefully monitored and the flow within the West Channel was measured in the weeks and days before and during the applications of herbicides. TKPOA provided Lahontan with the monitoring data showing predictive lake level elevations indicating a window of likely inflow to the Keys during late May. Before the planned first herbicide applications, lake elevations were monitored and net inflow in the West Channel was measured with an in-line flow meter mounted on an anchored vessel approximately 12 hours before the first applications on May 25, 2022. Inflow continued through the last application on May 31, 2022. A series of storms beginning May 27, 2022, contributed additional snowpack to the higher elevations, which produced additional lake-level and Keys lagoon level rise until mid-June. As the snowpack/hydrologic flow model predicted, hydrologic conditions had a net inflow before and during herbicide applications (see Appendix Q. List of Correspondence with Permitting Agencies, TKPOA Homeowners, and Stakeholders). Table 2-1 displays a summary of hydraulic flow conditions at the West Channel.

Table 2-1. Summary of Hydraulic Flow Conditions at the West Channel

Date	Time	Shallow (ft./sec)	Mid (ft./sec)	Deep (ft./sec)	Average (ft./sec)
5/24/2022 *Test	5:00 PM	.025	.023	.033	.027
5/25/2022	6:00 AM	.08	.04	-.09	.03
	6:30 AM	.13	.01	-.12	.01
	7:00 AM	.12	.06	-.10	.03
	7:30 AM	.11	.09	-.10	.03
	8:00 AM	.11	.00	-.12	.00
2-hour Average Flow (ft./sec)					.01
5/27/2022	6:00 AM	-.04	.15	.07	.06
	6:30 AM	-.01	.17	.05	.07
	7:00 AM	.00	.19	.13	.10
	7:30 AM	-.02	.17	.11	.08
	8:00 AM	.03	.13	.05	.07
	9:00 AM	-.05	.09	.09	.05
	10:00 AM	-.04	.05	.07	.03
	11:00 AM	-.03	.10	.11	.06
2-hour Average Flow (ft./sec)					.08
Daily Average (ft./sec)					.06
5/29/2022	6:00 AM	-.10	.02	.08	.01
	6:30 AM	-.06	.19	.11	.08
	7:00 AM	-.06	-.02	.06	-.01
	7:30 AM	.00	.27	.13	.13
	8:00 AM	-.02	.06	.11	.05
	9:00 AM	.01	.09	.06	.05

Date	Time	Shallow (ft./sec)	Mid (ft./sec)	Deep (ft./sec)	Average (ft./sec)
	10:00 AM	-.09	.01	.02	-.02
	11:00 AM	.14	.17	.02	.11
2-Hour Average (ft./sec)					.05
Daily Average (ft./sec)					.05
5/31/2022	6:00 AM	.00	.05	.04	.03
	6:30 AM	.01	.12	.05	.06
	7:00 AM	.07	.20	.03	.10
	7:30 AM	.05	.12	.01	.06
	8:00 AM	.02	.11	-.01	.04
	9:00 AM	.00	.00	.03	.01
	11:00 AM	.05	.01	-.02	.01
	12:00 PM	-.02	-.02	.00	-.01
2- Hour Average (ft./sec)					.06
Daily Average (ft./sec)					.03

2.7 Curtain and Boat Barrier Installations and Integrity Assurance

2.7.1 Installation

As part of the CMT permit requirements, sites identified for herbicide applications were required to be isolated from the main waterway areas of the West Lagoon and Lake Tahoe. The use of containment curtains effectively isolated three major boating exclusion zones of the CMT sites: Area A (west side of the West Lagoon behind curtains installed at Site 2); Area B (containing sites 8, 9 and 15 in southeast area of the West Lagoon); and Area C (Lake Tallac, all non-motorized boating). Figure 2-3 shows the boating restricted areas (A, B, and C).

Figure 2-3. Designated Boating Restricted Areas (A, B, C) Separated by Double Turbidity Curtains and Barriers

The double turbidity curtain installation and removal required divers to manipulate heavy curtain materials and hardware so that curtains were placed properly, anchored securely to the bottom, and adjusted to fit the specific site. Divers must manipulate these materials while in some contact with the bottom. The bottom sediments in the Keys are comprised of highly organic, unconsolidated materials that are easily disturbed by the physical activity needed to install (and remove) the curtains. This process was routinely monitored to assess effects on turbidity in the local areas of curtain placement and, as anticipated, turbidity was elevated compared to areas not disturbed, and to levels in the same areas before installations began (see Appendix R). It should be noted that when storm-driven disturbance of some curtains occurred, the highest priority was reestablishing curtain integrity; in some cases, this resulted in delayed or absent turbidity monitoring. These circumstances are noted in Table 2-2.

To protect the integrity of the curtains, and to prevent boats from breaching the curtains, physical metal barriers (pilings) and plastic fencing were installed outside the curtains for Areas A and B. Figures 1-1 and 2-3 show where the curtains were installed prior to applications of herbicides. During installation and removal of curtains, turbidity was monitored to ensure disturbance was minimized (Appendix R). Examples of the double turbidity curtain installations are shown in Figures 2-4 and 2-5.

Figure 2-4. Double Curtain in the West Lagoon

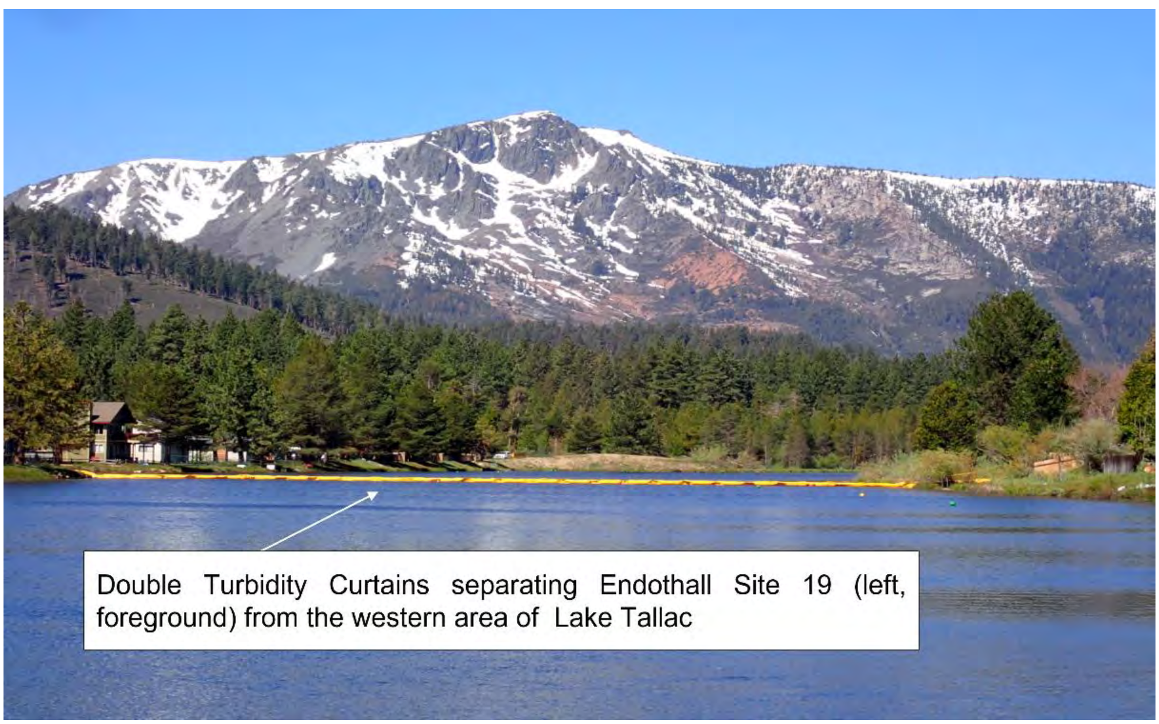

Figure 2-5. Double Curtain Installed in Lake Tallac

2.7.2 Responses to Storm-Driven Partial Curtain Dislodging

Heavy storm events occurred within a few days after initiation of the first CMT treatments, which required rapid responses to re-secure curtains affected by winds and choppy waters. At Site 2, an additional double turbidity curtain was installed outside of the original outer curtain to prevent movement of detected herbicide. No herbicides or degradants were detected at contingency monitoring stations nearest to the West Channel ("CSTN 105" or "CSTN 106", Figure 1-1). Table 2-2 summarizes the curtain installation and response actions taken.

Table 2-2. Summary of Double Turbidity Curtain Installation, Removal and Response Actions

CMT Test Area	Installation Date(s)	Incident & Date (if applicable)	Action & Adjustment Date (if applicable)	Associated Sampling (Detected Endothall level µg/L) Numbers in bold indicate exceedance.	Removal Date(s)
Site 1	5/19	N/A	N/A	9/21 2 consecutive ND	9/23
Site 2	• 5/17-5/18 (Inner) • 5/28 (Outer)	• 5/28 RWT Dye detection, curtain malfunction confirmed, exceedance • 6/2 Exceedance • 6/7 Exceedance • 6/8 Exceedance • 6/10 Exceedance	• 5/28 24-hour notification, contingency sampling, curtain inspection • 5/28-5/29 Readjustment, second double curtain installation • 6/2 24-hour notification, contingency sampling • 6/5 5-day report • 6/7 24-hour notification, contingency sampling • 6/12 Notification with lab results from contingency sampling • 6/15 Report of noncompliance • 6/16 Notification with lab results through 6/13	• 5/28 ORW-RHC2 (210), CSTN123 (ND) 5/29- ORW-RHC2 (82), CSTN123 (29) 5/30- ORW-RHC2 (20), CSTN123 (10) 5/31- ORW-RHC2 (33), CSTN123 (6.4) • 6/1 ORW-RHC2 (61), CSTN123 (4.7) • 6/2 ORW-RHC2 (**110/120**), CSTN123 (4.1) • 6/3 ORW-RHC2 (82), CTSN123 (2.5) • 6/7 ORW-RHC2 (**110**), CSTN123 (7.4) • 6/8 ORW-RHC2 (**140**), CSTN123 (7.5) • 6/9 ORW-RHC2 (66), CSTN123 (3.8) • 6/10 ORW-RHC2 (**110**), CSTN123 (ND) • 6/11 ORW-RHC2 (29), CSTN123 (ND) • 9/21 2 consecutive ND	9/13-9/14 (Inner) 9/22 (Outer)
Site 14	• 5/31-6/1	• N/A	• N/A		7/6
Site 15	• 5/12-5/16, 5/23-5/24	• 5/30 RWT Dye detection	• 5/30 Notification, contingency sampling • 9/1 Lahontan confirms removal	• 5/30 ORW-RHC3 (20), CSTN103 (ND), 8/26, 8/29- 2 consecutive ND	9/2

Lake Tallac	• 5/5-5/11	• 6/21 Exceedance (21 DAT) • 6/28 Exceedance (28 DAT)	• 7/5 24-hour notification, contingency sampling • 7/13 5-day report	• 6/21 IRW9 (**380**), TA19 (**360**) • 6/28 IRW9 (**220**), TA19 (**220**) • 7/5 IRW9 (5.4) TA19 (61) • 8/16, 8/23 2 consecutive ND	9/20

2.8 Preparations and Installation of Contingency Sub-surface Aeration Systems

At each CMT site, power access for contingency aeration systems was identified and aeration systems were assigned and staged (Figure 2-6). Use of the aeration was intended to mitigate potential reductions in DO and increase water-column mixing. Table 2-3 provides aeration activation dates. No aeration systems were installed in control sites.

Figure 2-6. Location of Contingency Sub-Surface Aerator Systems in each CMT Treatment Site (except LFA Site 26)

Table 2-3. Aeration Activation Dates

Site(s)	Activation Date	Turn-off Date(s)
1, 2, 3	6/27	9/26- 9/30
5, 8, 9	6/28	9/5-9/9
14, 15	7/6	9/26-9/30
19	7/6	9/21- 9/23
10, 11, 12, 13	7/7	9/26- 9/30

2.9 Notifications to Permitting Agencies, TKPOA Homeowners, and Stakeholders

Prior to, and during the CMT treatments and monitoring, formal notifications were required to Lahontan Water Board, TRPA, TKPOA Homeowners, and others. A list of correspondence throughout the CMT project is presented in Appendix Q. Figure 2-7 below shows a partial group of observers that witnessed initial herbicide applications in the vicinity of CMT Sites 9 and 15.

Figure 2-7. Observers of Initial CMT Project Herbicide Applications

3.0 MONITORING CONTEXT AND CONDITIONS

3.1 Treatment Focused Reporting

The objective of the extensive CMT monitoring was to determine how the different CMT treatments (herbicide-only, UV-only, herbicide/UV combinations, and LFA-only) affected water quality, herbicide, and degradant residence time (persistence), BMI populations, and responses of both the targeted AIP and desirable native aquatic plants. Therefore, the results are organized by treatment type. Figures (graphs) and tabular data contain mean (average) values for the three replicate sites for each treatment and control. With each graph or tabular summary, reporting limits (or acceptable ranges of values, such as pH) are indicated. However, as observed with several monitoring variables in “control” sites, regulatory limits were breached absent of any CMT treatments, particularly with pH, Total N, Total P, turbidity, and in some cases DO. Similarly, some of the water quality limits stated in the Lahontan Order and MMRP were driven by conditions and standards related to Lake Tahoe proper. However, because the Tahoe Keys lagoons (and Lake Tallac) have very different “baseline” conditions, the Lake Tahoe values are regularly exceeded for nutrients and turbidity in the Keys. For example, see Table 1 in APAP Amendment 1 for a comparison of Tahoe Keys Lagoons with Lake Tahoe (Appendix J).

Several appendices are included that provide detailed monitoring data by site or by adjacent sampling areas as appropriate. The water quality monitoring data included in the body of this report are means (averages) for the triplicate treatment sites for CMT herbicide and related control sites. Detailed data by individual site is provided in Appendix S with links to that data set. For UV treatments, water quality data is provided by each site because the UV treatments in separate sites were both sequential and staggered by more than a week and included repeat UV treatments. This UV treatment regime necessitated breaks in monitoring to adhere to required post-UV sampling schedules.

For herbicide and degradant level reporting, data is presented for each CMT herbicide site (herbicide alone or “combination herbicide/UV” sites), for other required sampling locations outside the perimeters (boundaries) of the sites, and for areas outside the curtain boundaries. The following information is provided in each graphic: CMT treatment, dates of monitoring, variable measured, and the same variables for the representative control sites at the same or nearby dates. Each graph provides a demarcation line(s) or symbol that shows the “regulatory” level (Reporting Limit or Receiving Water Limit), or range (e.g., for pH). References to the appendices for data used for the graphs are provided.

3.2 Post-CMT Activities. (May 25, 2022 through November 30, 2022)

3.2.1 Herbicide Application Schedule

Table 3-1 shows the CMT herbicide sites treated by date, type of herbicide, and site number (see also Final Herbicide and Rhodamine Water Tracer Dye Monitoring Plan in Appendix T and QAL/Aquatechnex Report/McNabb, 2022 in Appendix U). Applicators adhered to BMPs as described in the APAP to insure save transport, loading and use of aquatic herbicides and RWT dye. Note that applications were purposefully “staggered” with a one-day break between sets of treatments to provide sufficient time for post-application monitoring for herbicides and degradants. The last day of herbicide applications was May 31, 2022. Therefore, a 6-day difference was seen between treatments in Sites 8, 9, 15 (Area B) and the last treatment in Sites 12, 13, 14 (Area A). In the results, this sequence is reflected in reporting dates and in calculating “days after treatment”

(DAT). Examples of the herbicide and Rhodamine Water Tracer (RWT) dye applications are shown in Figure 3-1.

Table 3-1. Record of CMT Herbicide Applications (2022) *

Site Number	Treatment	Proposed Herbicide	Herbicide Rate (final concentration)	Application Date	Application Day
8	Herbicide-only	Triclopyr	1.0 ppm	5/25/22	1
9	Herbicide-only	Triclopyr	1.0 ppm	5/25/22	1
15	Combination	Endothall	2.0 ppm	5/25/22	1
No Applications				5/26/22	
1	Herbicide-only	Endothall	2.0 ppm	5/27/22	2
2	Herbicide-only	Endothall	2.0 ppm	5/27/22	2
3	Herbicide-only	Endothall	2.0 ppm	5/27/22	2
No Applications				5/28/22	
5	Herbicide-only	Triclopyr	1.0 ppm	5/29/22	3
10	Combination	Endothall	2.0 ppm	5/29/22	3
11	Combination	Endothall	2.0 ppm	5/29/22	3
No Applications				5/30/22	
12	Combination	Triclopyr	1.0 ppm	5/31/22	4
13	Combination	Triclopyr	1.0 ppm	5/31/22	4
14	Combination	Triclopyr	1.0 ppm	5/31/22	4
19 (Lake Tallac)	Herbicide-only	Endothall	2.0 ppm	5/31/22	4

(Source: TKPOA APAP Amendment 2 dated May 24, 2022 and Aquatechnex Report)
*Note: All applications were done in concert with the injection of RWT dye (<10 ppb) which was monitored using a flow-through fluorometer to assess movement of herbicides post-application.

Figure 3-1. Examples of the Herbicide and RWT Applications

Figure 3-1 above shows (a) Liquid Endothall plus RWT dye; (b) Near-shore (Combination site) Triclopyr pellet application by air blower; (c) RWT dye injection immediately following air blower Triclopyr pellet application.

3.2.2 Contingency Spill Report

No spills occurred during loading of herbicides, RWT dye, or applications of herbicides and RWT dye. See Appendix M for more information.

3.2.3 Notifications

Prior to and during CMT treatments and monitoring, specific notifications were provided to appropriate recipients (see Appendix Q). These notices included planned herbicide application dates, West Channel flow conditions, weather-related problems, initiation of contingency aeration systems, status of herbicide dissipation, curtain integrity, responses to curtain dislodging, and conditions allowing removal of curtains (based on herbicide “non-detect” status).

3.2.4 Calibration Records

All monitoring equipment and instrumentation requires calibration to ensure that the data obtained from these devices is accurate and meets the technical specifications provided by the product manufacturer. Each monitoring team from TKPOA, Environmental Science Associates (ESA), Blankinship & Associates, Inc., and Stratus Environmental, Inc. documented the calibrations made during their monitoring actions. These records are provided in Appendix P.

3.3 Unreliable or Uncertain Data

During the numerous CMT monitoring events and related field data collection, some data appear to not be reliable. This may be due to equipment malfunction or other anomalous circumstances. These events are summarized in Appendix G, which includes explanations for non-inclusion of the specific unreliable data points.

3.4 Missing Data or Missing Monitoring Events

In some cases, a monitoring event (date/time/site) is missing. This may be due to errors in scheduling, inclement weather making on-water monitoring hazardous, equipment malfunction, physical equipment dislodging, or damaging of anchored loggers (e.g., displacement of hourly miniDOT DO and temperature loggers by wildlife).

In some cases, other data may be substituted from other instrumentation if it was obtained within a reasonable date and location of the missing data. Note that the Lake Tallac “control” Site 21 has been disqualified and was not included as a representative control due to migration of Endothall to Site 21 from nearby CMT Site 19 (see referenced initial control Site 21 in the Endothall-only treatment results in Section 3.5 and 4.2). These events are summarized in Section 3.5.1 with explanations for the causes of missing data.

3.5 Control Sites in West Lagoon and Lake Tallac (Sites 16,17,18, 7, 20, 21)

3.5.1 General

Control Sites 16 and 17 were located mid-West Lagoon, outside of turbidity curtains. Site 18 was located in the east area of the West Lagoon. No boating restrictions occurred in any of the control sites in the West Lagoon. Control Site 20 was located in Lake Tallac several hundred feet outside the turbidity curtains that isolated Site 19 (and 21) from the rest of Lake Tallac. Note: AIP response and monitoring for RWT dye and Endothall near Site 21 suggested that this original “control” site was compromised by exposures to Endothall from nearby Site 19. Since Lake Tallac is in effect a separate waterbody from the West Lagoon, control Site 20 is the only one used to compare pre-CMT and post-CMT results with the Endothall treatment at Site 19.

3.5.2 Limitations on Control Site Comparisons with CMT Treatment Sites

Figures 1-1 and 2-3 show that none of the West Lagoon control sites were located behind the turbidity curtains. The Lake Tallac control Site 20 was also located outside the turbidity curtains. These locations were chosen to provide a certainty of "un-treated" conditions, particularly free of any herbicide contact, for a direct comparison of conditions in treatment sites. Therefore, unlike the CMT-herbicide sites, none of the control sites were subject to the turbidity curtain-induced constraints in water movement, boating restrictions, or harvesting restriction, all of which activities contribute to surface and sub-surface water exchange that normally occur with the West Lagoon unrestrained waters, including influences of West Channel water flows. In contrast, for the CMT-herbicide treated sites, water movement and exchange with areas outside the site were restricted from typical boating and mechanical harvesting which, taken together typically mix water within sites and adjacent water. In an attempt to mitigate the more stagnant conditions in Area A, a twin outboard vessel was temporarily anchored near some CMT sites in Area A and run for several hours to move surface water. The same vessel was also run within Area A for several days to improve mixing. In addition, sub-surface aerators were installed and activated (see Section 2.8).

Another important difference between controls sites and CMT treatment sites is that harvesting was used in the West Lagoon controls sites, two Endothall/UV sites, and LFA Site 26, whereas no harvesting occurred in the CMT-herbicide or UV-only sites (Table 3-2). The harvesting, which occurred mid- to late-summer, potentially affected two types of monitoring results: 1) Comparisons of AIP biovolume in control sites and CMT treatment sites; and 2) comparisons of nutrients and water quality between control sites and CMT treatment sites. This meant that CMT treatment efficacy was evaluated against harvested conditions beginning in August and not directly compared with truly "untreated" conditions. This suggests that results for efficacy would have been more favorable- *for all methods*- had comparisons been made with unharvested conditions.

Therefore, control site conditions cannot be assumed to have strictly "equivalent" conditions compared to the CMT sites. However, these sites provide the nearest approximation of conditions expected to be "unaffected" by the CMT treatments. The potential ramifications of these differences in control and CMT treatment sites are addressed in the summary and recommendations section of this report (Section 16.0), and in the Tahoe Keys Lagoons Macrophyte Control Efficacy Monitoring Report: Year 1 (Appendix E).

Table 3-2. Harvest Events in CMT Sites

CMT Site	Harvest Dates
Control Site 16	8/9, 8/30, 8/26,9/23
Control Site 17	8/11,8/31,9/15,9/21
Control Site 18	8/17, 10/7, 10/14
Endothall/UV Site 11	9/27
Endothall/UV Site 15	9/8, 9/9, 10/10, 10/11
LFA Site 26	8/15, 8/16, 9/2, 9/12, 9/13, 9/19, 10/12, 10/13

3.6 Pre-CMT Treatment Monitoring Results

Pre-CMT treatment monitoring occurred before any herbicide or UV treatments began. For convenience in comparisons of pre- and post- CMT data, and for consistency in graphic formats, the “pre-CMT” results are shown sequentially as part of the entire period of monitoring, or in tabular format so that a continuous record of results pre-CMT data through post-CMT data is shown. Similarly, control site data is initially presented separately (Section 4.0) including pre-CMT and post-CMT sampling dates.

For ease of reference, the data on graphs and tables showing sample or monitoring dates after May 25, 2022 are “post-CMT”; since the data was collected after the first CMT-herbicide application on May 25, 2022 (Table 3-1). Monitoring was scheduled to comply with the Lahontan Order, APAP, and MMRP, and physical locations were located as shown in Figure 1-1 map and legend. See Appendix V for a summary of monitoring schedules, frequency, and locations.

3.7 Assessment of Monitoring Completeness

The purpose of the data completeness assessment is to evaluate and document the extent to which complete monitoring data sets were generated during Year 1 monitoring activities of the CMT project. The monitoring completed in Year 1 resulted in a voluminous number of data points. This extensive data also illustrates the complexities of the sampling events and monitoring sequences. Monitoring activities and schedules are set forth in the approved permits, EIR/EIS, MMRP, and the QAPP.

The organization of the data completeness tables, factors affecting data collection, the method used to calculate the provided statistics, details of each monitoring activity, and additional sampling events that occurred are described here. Changes made to the sampling procedure are addressed as well as percent of data completion, data points that were not addressed in the provided statistic, and how the data sets are displayed on the data completeness table. (Note: The summary tables provided throughout Section 3.7 do not address data QA/QC as the data was only reviewed for completeness). (QA/QC documentation is in Appendix G).

Completeness Table Organization

The columns shown on Tables 3-3 through 3-9 represent the different monitoring activities while the rows represent monitoring stations and site numbers. The tabular content is color-coded with symbols as appropriate to show the completeness of monitoring actions as follows:

- Green represents a complete data set.
- Blue represents weather, instrument error, or other factors that prevented a complete data set although other data exists to supplement for a full evaluation of the monitoring activity.
- Yellow represents insufficient data was collected and no supporting data exists to allow for a full evaluation of the monitoring activity.
- The ∆ symbol signifies that the site was not confirmed until later in the CMT.
- Diagonal lines signify that the site was not fully treated so the associated sampling did not occur.
- Boxes containing N/R signify there is ‘No Record’ of the data as the monitoring activity does not apply to that site.

3.7.1 Circumstances Affecting Data Collection

A variety of conditions affected data collection. High velocity wind events occurred during May 27-28, June 3-5 and June 11-12 that interfered with monitoring. The Mosquito Fire created hazardous air quality from September 11-12. In mid-July, some miniDOTs loggers were lost possibly due to failures with miniDOTs rigging, buoy malfunction, and boat collisions. On at least one occasion, bears were observed displacing the miniDOTs loggers, which were never found. Since the turbidity curtains remained in place longer than planned, Combination Treatment Sites 12-14 were not treated with UV during Year 1, so the monitoring events that would have been associated with those treatments did not occur. Similarly, LFA Sites 25 and 27 were not installed on schedule due to delays in equipment availability that delayed the start of sampling and monitoring at those sites. The LFA systems for Sites 25 and 27 were installed mid-November 2022.

Another factor affecting turbidity data collection was the terminology used to describe the water quality objective for turbidity. The Lahontan Order states, “Increases in turbidity must not exceed natural levels by more than 10%.” The term ‘natural levels’ was difficult to interpret and implement since the CMT project created a combination of unique environments within the test areas. For turbidity curtain monitoring, “natural levels” as used in this Annual Report meant pre-installation levels measured one hour prior to curtain installation/ removal at the location of the curtains. “Natural levels” was not represented by control sites because of the substantial differences in the water quality characteristics between the control sites and where the curtains were in place. (Note: For standard water quality monitoring, control sites were used for comparing trends in turbidity conditions relative to treated sites)

3.7.2 Data Completeness Evaluation Method

All of the planned dates for sampling/monitoring events were checked against the recorded and documented actual monitoring. The percentage of successful sampling/data collection was calculated by dividing the number of actual sampling data points by the expected or required number of data points, and then multiplying by one hundred to provide the percentage of data completion.

3.7.3 Herbicide Residue and Degradant/RWT Dye Monitoring

Herbicide Residue and Degradant sampling was performed concurrently with RWT dye monitoring. Sampling for herbicides in water was comprised of composite samples (Surface/Mid/Bottom water column). Sediment grab samples for herbicide analysis was done with a Petite Ponar sampler per MMRP and QAPP. Water samples and sediment samples were analyzed for Endothall, Triclopyr, 3,5,6-trichloro-2-methoxypyridine (TMP), and 3,5,6-trichloro-2-pyridinol (TCP). Sampling the water column inside test areas required one pre-treatment sample followed by a frequency of 7 DAT, then weekly sampling until 2 non-detects occurred 48 hours apart. Water samples outside the curtains (receiving water) were collected 3 DAT, 7 DAT, then weekly until 21 DAT or until 2 consecutive non-detects occurred.

RWT dye was measured three times a week at receiving water stations behind the curtains or until the dye was no longer detectable at sampling stations between/adjacent to treatment sites. Receiving water stations outside the curtains were monitored starting 2 DAT, and continued at 48-hour intervals until 14 DAT or until the dye was non-detect. RWT dye detected at a receiving water station outside of the curtains triggered monitoring of the nearest contingency station. Once detected, contingency station monitoring occurred in 48-hour intervals until 2 consecutive non-detects occurred 48 hours apart.

Sediment sampling required one pre-treatment sample as well as one post-treatment sample that was 90-120 DAT. Data collected but not addressed in this report includes weather measurements, depth measurements, general field observations, GPS coordinates, and certain water quality measurements. Of the 3,570 scheduled samples to be collected, this number plus additional samples taken resulted in a 100% data completion for herbicide, sediment, and RWT dye monitoring. Tables 3-3 and 3-9 show this information with green boxes for all applicable CMT Year 1 sites.[1]

3.7.4 Standard Water Quality Monitoring (Inside CMT Treatment Sites)

Standard water quality inside test areas was measured at three buoys per CMT site. Monitoring was initially planned to be measured at three depths, but upon consulting with agency staff, it was agreed that a single mid-depth monitoring sample would be performed to meet the 11 am–2 pm requirement for water quality monitoring. Due to logistics, mid-depth measurements were deemed most representative. Pre-treatment measurements were scheduled for all sites. Herbicide sites were monitored at 3 DAT to 30 DAT, three times a week, then weekly until November. Similarly, UV sites were monitored at 3 DAT, three times a week until November. Once herbicide was applied, combination and control sites were monitored at 3 DAT to 30 DAT, three times per week. Then, once UV treatment began, the combination sites were monitored at 3 DAT, three times a week until November. LFA sites were monitored every other week. Data points collected but not addressed in this report are weather measurements, depth measurements, and general field observations.

Measurements included in the completeness calculations are:

- Temperature
- DO
- pH
- Turbidity
- ORP
- SpC

Of the 19,512 data points scheduled to be collected, 17,460 were gathered resulting in 89.5% data completion for standard water quality monitoring inside test areas. Table 3-3 shows all sites, except Site 7, as blue due to all sites having at least one late or missed sampling event. Even with these minor issues, the quantity of standard water quality data collected during Year 1 was sufficient to evaluate all parameters as intended for the CMT project requirements at these locations. Site 7 was designated as yellow with a ∆ symbol to signify that insufficient data was collected because the final location of Site 7 location was decided late in the year. Sites 10-14 and 25-27 are blue but have diagonal lines because they were not fully treated due to the inaccessibility for UV treatment and delay in LFA installations, respectively.[2] The percent completeness would have been higher had all the combination sites been accessible to UV treatments. (Note: Sites 10 and 11 were treated once with UV September 26 and October 5, respectively.)

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[1] Revised APAP Amendment 1, Section 8.2.4, Herbicide Active Ingredient Residues and Degradants; pg. 68 – 70 & Table 7. CMT Monitoring Details – Herbicide Only Treatment; pg. 54.

[2] Revised APAP Amendment 1, Tables 7-10 - CMT Monitoring Details; pg. 53-58 & MMRP- Attachment B, Section 3.0, Water Quality Parameters; pg. 22-23

Table 3-3. Level of Completeness Summary for Key Year 1 CMT Monitoring Activities

	Complete data set.
	Weather, Instrument error, or other factors prevented a complete data set although other data exists to supplement for a full evaluation of the monitoring activity.
	Insufficient data was collected, and no supporting data exists to allow for a full evaluation of the monitoring activity.
Δ	The site wasn't confirmed until later in the CMT.
	Site wasn't fully treated so the associated monitoring did not occur.
N/R	No Record as the monitoring activity does not apply to that site.

Stations	Herbicide & RWT Dye	Turbidity	WQ (Inside)	WQ (miniDOTs)	HABs	Scans	Nutrients	Macrophyte	BMI
Site 1									
TA1			N/R						
H1	N/R	N/R		N/R	N/R		N/R	N/R	N/R
H2	N/R	N/R		N/R	N/R		N/R	N/R	N/R
H3	N/R	N/R		N/R	N/R		N/R	N/R	N/R
Site 2									
TA2			N/R						
H4	N/R	N/R		N/R	N/R	N/R	N/R	N/R	N/R
H5	N/R	N/R		N/R	N/R	N/R	N/R	N/R	N/R
H6	N/R	N/R		N/R	N/R	N/R	N/R	N/R	N/R
Site 3									
TA3		N/R	N/R						
H7	N/R	N/R		N/R	N/R	N/R	N/R	N/R	N/R
H8	N/R	N/R		N/R	N/R	N/R	N/R	N/R	N/R
H9	N/R	N/R		N/R	N/R	N/R	N/R	N/R	N/R
Site 5									
TA5		N/R	N/R						
H10	N/R	N/R		N/R	N/R	N/R	N/R	N/R	N/R
H11	N/R	N/R		N/R	N/R	N/R	N/R	N/R	N/R
H12	N/R	N/R		N/R	N/R	N/R	N/R	N/R	N/R
Site 7	N/R	N/R	Δ	Δ	N/R		Δ	Δ	Δ
Site 8									
TA8		N/R	N/R						

	Complete data set.
	Weather, Instrument error, or other factors prevented a complete data set although other data exists to supplement for a full evaluation of the monitoring activity.
	Insufficient data was collected, and no supporting data exists to allow for a full evaluation of the monitoring activity.
△	The site wasn't confirmed until later in the CMT.
	Site wasn't fully treated so the associated monitoring did not occur.
N/R	No Record as the monitoring activity does not apply to that site.

Stations	Herbicide & RWT Dye	Turbidity	WQ (Inside)	WQ (miniDOTs)	HABs	Scans	Nutrients	Macrophyte	BMI
H13	N/R	N/R		N/R	N/R	N/R	N/R	N/R	N/R
H14	N/R	N/R		N/R	N/R	N/R	N/R	N/R	N/R
H15	N/R	N/R		N/R	N/R	N/R	N/R	N/R	N/R
Site 9									
TA9		N/R	N/R						
H16	N/R	N/R		N/R	N/R	N/R	N/R	N/R	N/R
H17	N/R	N/R		N/R	N/R	N/R	N/R	N/R	N/R
H18	N/R	N/R		N/R	N/R	N/R	N/R	N/R	N/R
Site 10									
TA10		N/R	N/R						
HC22	N/R	N/R		N/R	N/R	N/R	N/R	N/R	N/R
HC23	N/R	N/R		N/R	N/R	N/R	N/R	N/R	N/R
HC24	N/R	N/R		N/R	N/R	N/R	N/R	N/R	N/R
Site 11									
TA11		N/R	N/R						
HC25	N/R	N/R		N/R	N/R	N/R	N/R	N/R	N/R
HC26	N/R	N/R		N/R	N/R	N/R	N/R	N/R	N/R
HC27	N/R	N/R		N/R	N/R	N/R	N/R	N/R	N/R
Site 12									
TA12		N/R	N/R						
HC28	N/R	N/R		N/R	N/R	N/R	N/R	N/R	N/R
HC29	N/R	N/R		N/R	N/R	N/R	N/R	N/R	N/R
HC30	N/R	N/R		N/R	N/R	N/R	N/R	N/R	N/R
Site 13									

	Complete data set.
	Weather, Instrument error, or other factors prevented a complete data set although other data exists to supplement for a full evaluation of the monitoring activity.
	Insufficient data was collected, and no supporting data exists to allow for a full evaluation of the monitoring activity.
△	The site wasn't confirmed until later in the CMT.
	Site wasn't fully treated so the associated monitoring did not occur.
N/R	No Record as the monitoring activity does not apply to that site.

Stations	Herbicide & RWT Dye	Turbidity	WQ (Inside)	WQ (miniDOTs)	HABs	Scans	Nutrients	Macrophyte	BMI
TA13		N/R	N/R						
HC31	N/R	N/R		N/R	N/R	N/R	N/R	N/R	N/R
HC32	N/R	N/R		N/R	N/R	N/R	N/R	N/R	N/R
HC33	N/R	N/R		N/R	N/R	N/R	N/R	N/R	N/R
Site 14									
TA14			N/R						
HC34	N/R	N/R		N/R	N/R	N/R	N/R	N/R	N/R
HC35	N/R	N/R		N/R	N/R	N/R	N/R	N/R	N/R
HC36	N/R	N/R		N/R	N/R	N/R	N/R	N/R	N/R
Site 15									
TA15			N/R						
HC37	N/R	N/R		N/R	N/R	N/R	N/R	N/R	N/R
HC38	N/R	N/R		N/R	N/R	N/R	N/R	N/R	N/R
HC39	N/R	N/R		N/R	N/R	N/R	N/R	N/R	N/R
Site 16			N/R						
C40	N/R	N/R		N/R	N/R	N/R	N/R	N/R	N/R
C41	N/R	N/R		N/R	N/R	N/R	N/R	N/R	N/R
C42	N/R	N/R		N/R	N/R	N/R	N/R	N/R	N/R
Site 17			N/R						
C43	N/R	N/R		N/R	N/R	N/R	N/R	N/R	N/R
C44	N/R	N/R		N/R	N/R	N/R	N/R	N/R	N/R
C45	N/R	N/R		N/R	N/R	N/R	N/R	N/R	N/R
Site 18			N/R		N/R				
C46	N/R	N/R		N/R	N/R	N/R	N/R	N/R	N/R

	Complete data set.
	Weather, Instrument error, or other factors prevented a complete data set although other data exists to supplement for a full evaluation of the monitoring activity.
	Insufficient data was collected, and no supporting data exists to allow for a full evaluation of the monitoring activity.
△	The site wasn't confirmed until later in the CMT.
	Site wasn't fully treated so the associated monitoring did not occur.
N/R	No Record as the monitoring activity does not apply to that site.

Stations	Herbicide & RWT Dye	Turbidity	WQ (Inside)	WQ (miniDOTs)	HABs	Scans	Nutrients	Macrophyte	BMI
C47	N/R	N/R		N/R	N/R	N/R	N/R	N/R	N/R
C48	N/R	N/R		N/R	N/R	N/R	N/R	N/R	N/R
Site 19									
TA19		N/R	N/R		N/R				
H19	N/R	N/R		N/R	N/R	N/R	N/R	N/R	N/R
H20	N/R	N/R		N/R	N/R	N/R	N/R	N/R	N/R
H21	N/R	N/R		N/R	N/R	N/R	N/R	N/R	N/R
Site 20			N/R						
C49	N/R	N/R		N/R	N/R	N/R	N/R	N/R	N/R
C50	N/R	N/R		N/R	N/R	N/R	N/R	N/R	N/R
C51	N/R	N/R		N/R	N/R	N/R	N/R	N/R	N/R
Site 21			N/R		N/R				
C52	N/R	N/R		N/R	N/R	N/R	N/R	N/R	N/R
C53	N/R	N/R		N/R	N/R	N/R	N/R	N/R	N/R
C54	N/R	N/R		N/R	N/R	N/R	N/R	N/R	N/R
Site 22			N/R		N/R				
U55	N/R	N/R		N/R	N/R	N/R	N/R	N/R	N/R
U56	N/R	N/R		N/R	N/R	N/R	N/R	N/R	N/R
U57	N/R	N/R		N/R	N/R	N/R	N/R	N/R	N/R
Site 23			N/R		N/R				
U58	N/R	N/R		N/R	N/R	N/R	N/R	N/R	N/R
U59	N/R	N/R		N/R	N/R	N/R	N/R	N/R	N/R
U60	N/R	N/R		N/R	N/R	N/R	N/R	N/R	N/R
Site 24			N/R		N/R				

	Complete data set.
	Weather, Instrument error, or other factors prevented a complete data set although other data exists to supplement for a full evaluation of the monitoring activity.
	Insufficient data was collected, and no supporting data exists to allow for a full evaluation of the monitoring activity.
Δ	The site wasn't confirmed until later in the CMT.
	Site wasn't fully treated so the associated monitoring did not occur.
N/R	No Record as the monitoring activity does not apply to that site.

Stations	**Herbicide & RWT Dye**	**Turbidity**	**WQ (Inside)**	**WQ (miniDOTs)**	**HABs**	**Scans**	**Nutrients**	**Macrophyte**	**BMI**
U61	N/R	N/R		N/R	N/R	N/R	N/R	N/R	N/R
U62	N/R	N/R		N/R	N/R	N/R	N/R	N/R	N/R
U63	N/R	N/R		N/R	N/R	N/R	N/R	N/R	N/R
Site 25			N/R	Δ			Δ	Δ	
A64	N/R	N/R	Δ	N/R	N/R	N/R	N/R	N/R	N/R
A65	N/R	N/R	Δ	N/R	N/R	N/R	N/R	N/R	N/R
A66	N/R	N/R	Δ	N/R	N/R	N/R	N/R	N/R	N/R
Site 26			N/R						
A67	N/R	N/R		N/R	N/R		N/R	N/R	N/R
A68	N/R	N/R		N/R	N/R		N/R	N/R	N/R
A69	N/R	N/R		N/R	N/R		N/R	N/R	N/R
Site 27			N/R		N/R				
A70	N/R	N/R		N/R	N/R	N/R	N/R	N/R	N/R
A71	N/R	N/R		N/R	N/R	N/R	N/R	N/R	N/R
A72	N/R	N/R		N/R	N/R	N/R	N/R	N/R	N/R

3.7.5 Standard Water Quality Monitoring (Outside CMT Treatment Sites)

Standard water quality outside test areas was measured at mid-depth with the same frequency as inside test areas. Data points collected but not addressed in the following statistic are weather measurements, depth measurements, and general field observations. The parameters measured and addressed were:

- Temperature
- DO
- pH

Of the 3,663 data points scheduled to be collected, 3,321 were collected resulting in a 90.6% data collection completion. Sites in this category are labeled with NT (Not Treated) following a station number to identify the multiple monitoring station locations outside each treatment site. Due to different nomenclature for these sites, this monitoring activity is provided in a separate table (Table 3-4). Sites NT3, 21, 22, and 23 are blue because they were not monitored as originally scheduled, but have the correct number of samples, whereas Sites NT29, 30, 32, 35, 43, and 44 are blue because they only missed one sampling event. Sites NT11, 38, 41 and 46 are yellow because they never got sampled. Due to the great number of monitoring stations so close together, it was decided that it would not be necessary to sample NT11, 38, 41, and 46 as sufficient data would be collected at the nearby monitoring stations.[3]

Table 3-4. Standard Water Quality Monitoring (Outside Test Areas)

	Complete data set.
	Weather, Instrument error, or other factors prevented a complete data set although other data exists to supplement for a full evaluation of the monitoring activity.
	Insufficient data was collected, and no supporting data exists to allow for a full evaluation of the monitoring activity.

Station	Level of Completeness
NT1	
NT2	
NT3	
NT4	
NT5	
NT6	
NT7	
NT8	
NT9	
NT10	
NT11	
NT12	
NT13	
NT14	
NT15	
NT16	
NT17	
NT18	

[3] Revised APAP Amendment 1, Tables 7-10 - CMT Monitoring Details; pg. 53-58 & MMRP- Attachment B, Section 3.0, Water Quality Parameters; pg. 22-23

	Complete data set.
	Weather, Instrument error, or other factors prevented a complete data set although other data exists to supplement for a full evaluation of the monitoring activity.
	Insufficient data was collected, and no supporting data exists to allow for a full evaluation of the monitoring activity.

Station	Level of Completeness
NT19	
NT20	
NT21	
NT22	
NT23	
NT24	
NT28	
NT29	
NT30	
NT31	
NT32	
NT33	
NT34	
NT35	
NT36	
NT37	
NT38	
NT39	
NT40	
NT41	
NT42	
NT43	
NT44	
NT45	
NT46	
NT47	

3.7.6 Continuous Water Quality: Hourly Loggers (miniDOTs)

Continuous (hourly) water temperature and DO measurements were automatically collected and logged using miniDOTs sensors, which were downloaded weekly. (Note that pH, DO, and temperature were also measured using sondes three times per week at mid-depth in each site and outside all CMT sites.) The miniDOTs loggers were attached to a buoy affixed to an anchoring chain and line so that one logger was stationed near the surface, and one was located near the bottom. As the aquatic macrophyte growing season progressed, plants were observed growing around the miniDOTs that could affect the data collection sensors. To solve this issue, TKPOA staff installed meshed cages around each miniDOT. Also, during the 2022 summer, water levels in the lagoons decreased that in turn gradually reduced the distance between loggers at the surface and those attached near the bottom. Following the loss of several miniDOTs (July-August), TKPOA staff created and installed reinforced buoy and anchorage systems with newly purchased miniDOTs. Appendix W provides a record of the dates miniDOTs went missing and when they were reinstalled. The completed calculations for this monitoring activity were based on daily averages calculated from weekly downloads of the miniDOT and whether every site received a full download. Of the 17,800 expected data points to be collected, 14,586 were collected resulting in 81% data collection completion. Table 3-3 shows most of the sites as blue due to the missing miniDOTs for the reasons mentioned above. However, other standard water quality measurements provided supplemental data for temperature and DO.[4]

3.7.7 Turbidity Monitoring During Curtain/Barrier Installment and Removal

The turbidity monitoring schedule during installation and removal of the curtains began 1 hour before and continued hourly during in-water activity with rotations between both sides of the curtains. A turbidity measurement was to be collected 24 hours post-installation/removal to determine whether turbidity levels exceeded 25% above pre-installation conditions. Additionally, a turbidity measurement was taken 24 hours pre- installation/removal to confirm baseline conditions.

If turbidity levels exceeded 10% above pre-installation/removal measurements, then turbidity monitoring was to continue daily until values met the Tahoe Basin Plan water quality objectives. If turbidity levels did not exceed 10% above pre-installation measurements, then turbidity monitoring was deemed complete. As noted in Section 3.7.1, 'natural levels' is used as pre-installation measurements recorded one hour prior to curtain installation/removal at the location of the curtains. Turbidity was initially planned to be measured at three depths, but consultation with agency staff resulted in single mid-depth monitoring samples. The data completeness statistic presented in Table 3-3 is based on individual monitoring events as opposed to total data points. There were 24 monitoring events scheduled and 18 were completed for curtain/barrier installation and removal resulting in 75% data completion. The missing events were due to a combination of emergency actions associated with new curtain installations following extreme wind events, communication gaps between the installers and the water quality technicians, changes in staffing, and other factors. Sites 1, 2, 14, and 15 are yellow on Table 3-3 because there was one or more missed monitoring events that prevented a full evaluation of this monitoring activity.[5]

The tables in Appendix R display all turbidity measurements collected for turbidity curtain installation and removal. The pale-yellow color represents the measurements where turbidity levels exceeded the pre-installation measurement by more than 10%. Due to the extended presence of herbicides, the turbidity curtains remained in place longer than anticipated creating stagnant water and increased turbidity behind the curtains in Lake Tallac, Area C, and Sites in Areas A and B (Figure 2-3). Appendix X presents more information on the dates that turbidity exceedances occurred.

Section 2.7.1 describes the loose, organic sediment in the Keys lagoons that is readily suspended by minor disturbances and contributes to turbidity levels during activities such as turbidity curtain installation and removal. As shown in Appendix R, turbidity measurements outside the curtains increased during curtain removal due to a combination of effects related to the curtain removal,

[4] Revised APAP Amendment 1, Tables 7-10 - CMT Monitoring Details; pg. 53-58 & MMRP- Attachment B, Section 3.0, Water Quality Parameters; pg. 22-23

[5] Revised APAP Amendment 1, Tables 7-10 - CMT Monitoring Details; pg. 53-58 & MMRP- Attachment B, Section 3.0, Water Quality Parameters; pg. 22-23

prior treatment activities, and mixing of the water outside and inside of the curtains. Elevated turbidity levels during curtain removal were unavoidable and work had to continue to conclude extraction of the curtains. As a result, work was not paused, and the associated 48-hour post turbidity measurements were not taken during the curtain removal period. None of the increased turbidity levels noted above caused a nuisance as defined in Water Code section 13050(m) or was demonstrated to adversely affect the water for beneficial uses, which is the primary objective.

3.7.8 Turbidity Monitoring of LFA Systems and Culvert Bladders/Plugs

Monitoring for LFA and culvert bladders/plugs was to be completed 1-hour prior to installation/removal consisting of visual monitoring of the surface water and water column surrounding area. If increases in turbidity were observed, a turbidity measurement was to be completed. If turbidity levels increased 10% above pre-installation/removal measures, then all work was to cease, and turbidity monitoring was to continue daily until measurements returned to baseline conditions. (Note: The Site 26 LFA system was installed prior to the CMT project in 2019 so no turbidity monitoring was required during 2022.) In mid-November 2022, the LFA systems for Sites 25 and 27 were installed and visual turbidity monitoring was completed. No observations of elevated turbidity were reported.

The lagoons water level was low (about 1 foot above invert of culverts) at the time of installation and below the culverts during removal of the culvert plugs. When installing the culvert bladders and plugs, vacuum trucks were utilized to remove sediment contents out of the culverts to establish a tight seal for the bladders. No visual indications of elevated turbidity were reported during the culvert bladders/plugs installation. TKPOA staff subsequently completed inspections morning and night to ensure the bladders remained inflated and no seepage occurred (Table 3-5).[6] Of the 134 days of scheduled inspection for the turbidity curtains/culvert plugs, two days were missed as a result of wildfire smoke causing unhealthy air quality conditions, resulting in 98.5% data completion. (The extremely poor air quality would have been a risk to the health of staff doing outside activities.) Table 3-5 displays this information as the box for September is blue showing that some data was not collected, but supplemental data exists for a full evaluation of the monitoring activity.

Table 3-5. Turbidity Curtain/Culvert Plug Inspection

(green)	Complete data set.
(blue)	Weather, Instrument error, or other factors prevented a complete data set although other data exists to supplement for a full evaluation of the monitoring activity.

Month	Level of Completeness
May	(green)
June	(green)
July	(green)
August	(green)
September	(blue)

[6] APAP Amendment 1, 10.9 Measures to Minimize Sediment Disturbance (Turbidity Curtain Installation /Removal & LFA System Installation); pg.102, QAPP, 3.7 Project Tasks, Action 13. Installation/Removal of double “turbidity” curtains and culvert “plug”/“bladder” and “Boat Barriers”; pg. 17

New procedures will be implemented in 2023 for bottom barrier and diver-assisted hand suction turbidity monitoring. See Section 16. for a more detailed description of what these procedures will entail.

3.7.9 Nutrient Grab Water Quality Sampling

Nutrient Grab samples were collected as composite samples (surface/mid-depth/bottom) of the water column on a weekly basis, except LFA sites, which were sampled in spring and fall only. Pre-treatment sampling was conducted at all sites except LFA. Herbicide site sampling occurred at 7-30 DAT, whereas UV site sampling occurred at 12-60 DAT. Combination and control sites were a mix of the two depending on which treatment cycle they were following at a given time. Data points that were not addressed in the following calculations are weather measurements, depth measurements, general field observations, photos, dominant species present, and water quality measurements. Data points that were included were the lab results for:

- Total N
- Nitrate+Nitrite
- Total Kjeldahl Nitrogen (TKN)
- Total P
- Orthophosphate (Ortho-P)

Of the 1,100 planned data points to be collected, 1,088 were gathered, resulting in 98% data completion. Table 3-3 shows Site 7 as yellow because its location was not decided until late in Year 1. Site 15 is blue because although treated with UV, the associated sampling began a few days late. Sites 16, 17, 21, and 22 are blue due to one missed sampling event. Sites 23 and 24 are blue because they began sampling too early. Sites 10-14 have blue diagonal lines because they weren't fully treated (no UV treatments due to lack of access from extended presence of boat barriers and turbidity curtains), so the associated sampling did not occur. Sites 25-27 have green diagonal lines as the treatments didn't occur, but complete data sets exist.[7]

3.7.10 HABs Monitoring and Responses

Monitoring for HABs followed standard protocols used at LFA Site 26 in prior years as part of Lahontan Water Board's regional monitoring program. The sequence of monitoring included initial visual inspection for the presence of algae, and if present, follow up water samples were taken for laboratory analysis for presence of cyanobacteria and cyanotoxins, and sampling began for Total P, alkalinity, and Cyanotoxins. If a visual indicator was confirmed by lab results, then sampling in that area continued every two weeks until cyanotoxin levels became non-detect. Depending on the results, appropriate signs were posted in the area to inform the public. Data points not addressed in the following statistic are weather measurements and general field observations whereas data points included the lab analyses for:

- Microcystins
- Cylindrospermopsin
- Anatoxins

Of the 380 anticipated monitoring events, 344 were completed, resulting in 90.53% data completion for cyanobacteria grabs. As shown on Table 3-3, Sites 1, 2, 5, 8, 12, and 13 are blue

[7] Revised APAP Amendment 1, Tables 7-10. CMT Monitoring Details; pg. 53-58

due to one or more missed sampling events. However, despite the missed sampling event(s), the data missed does not affect a full evaluation of the monitoring activity.[8]

Responses to HABs sampling included notifications to Lahontan, posting of proper signage based on presence and level of cyanotoxins, and review of nutrients and alkalinity for the potential use the LMCAP (see Table 3-6). LMCAP option was considered based on criteria of cyanotoxin presences, elevated Total P and sufficient alkalinity (MMRP). This sequence, however, did not provide a practical response time for effective mitigation of the rapid increases of cyanobacteria in mid- to late- summer for the following reasons: 1) the time between a visual indication of potential HABs to obtaining laboratory analysis for cyanotoxins and laboratory analysis for nutrients often required 10-14 days; 2) within a 10- to 14-day period, during the elevated water temperatures (>23 C), cyanobacteria typically would have increased 3 to 5 fold; 3) Total P and Ortho-P levels (susceptible to LMCAP) would already have driven the bloom beyond the utility of modified Lanthanum. This condition was discussed thoroughly at the weekly MWG meetings and the consensus was that the LMCAP would not mitigate the already rapidly increasing HABs. Thus, there was too much lag-time between the visual indication of HABs and receiving the data needed to determine if criteria were met for potential deployment of LMCAP to ensure that the use of modified Lanthanum would be effective (see Appendix Y. Harmful Algal Blooms Nutrients Data). However, mitigation actions were taken through the continuous use of subsurface aerators. Recommendations to improve HAB detection and improve mitigation are provided in Section 16.6.

Table 3-6. HAB Signage Posting

7/20/2022 **Caution** Signs Posted:	15th Street, Tahoe Keys Blvd, Lighthouse Shores, West Channel Bulkhead, Beach and Harbor, kayak launches.
8/30/2022 **Warning** Signs Posted:	15th Street, Tahoe Keys Blvd, Lighthouse Shores, West Channel Bulkhead Beach and Harbor, kayak launches.
9/22/2022 **Danger** Signs Posted:	Site TA5 (Warning level signs in all other areas)
9/29/2022 **Danger** Signs Posted:	Site TA3 and Site TA5 (Warning level signs in all other areas)
10/14/2022 **Warning** Signs Posted:	Site TA3, Site TA5, 15th Street, Tahoe Keys Blvd, Lighthouse Shores, West Channel Bulkhead, Beach and Harbor, kayak launches.
10/26/2022 **Danger** Sign Posted:	Site TA5 (Warning level signs in all other areas)
11/16/2022 **Signs** Removed:	Results indicate Caution is highest level in the Keys; instructed by Lahontan to remove HAB advisory signs. HAB signs removed prior to Thanksgiving Holiday.

Regarding visual observations and frequency of sampling: if a visual observation was noted, either by TKPOA or another entity, the site was sampled following the initial visual observation, then re-sampled every 2 weeks through October regardless of the presence or absence of visual indicators.

[8] APAP Amendment 1, Section 8.2.3, Cyanobacteria and Harmful Algal Bloom (HAB) Monitoring, pg. 67-68; MMRP- Attachment B, Section 6.0, Adverse Conditions Reporting, pg. 25; QAPP, Table 5-1: CMT Water and Sediment Quality Monitoring (See summary in Attachments H-1 and H-2), pg. 43-44

3.7.11 Macrophyte Point Rake Sampling

Macrophyte point rake sampling required twice monthly completion of thirty (30) point rake samples per site to collect data on the frequency of occurrence, percent composition of species, plant health ratings, and rake fullness (QAPP Attachment H in Appendix F). Herbicide, UV, combo, and control sites required one pre-treatment sample followed by sampling at 14 DAT, then twice monthly sampling until 120 DAT. LFA sites had a sampling frequency of one pre-treatment, one mid-season, and one in the fall. Data points not addressed in the statistic are weather measurements, general field observations, photos taken for each rake sample, percent composition of species, record of the lagoon zone (shoreline, mid channel etc.), and health ratings of the presented species.

Of the anticipated 7,830 data points to be collected, 7,739 were completed, resulting in 98% data completion for macrophyte point rake sampling. Table 3-3 shows Sites 1, 2, 3, 9, 13, 22, and 23 as blue due to a small number of sampling events missed. The location of Sites 7 and 25 (labeled with the ∆ symbol), were not decided until later in the season so much of the previously planned sampling did not occur in those sites. Sites 10-14 have diagonal lines to show that these Combination sites did not get treated with the intended UV light applications. Diagonal lines are also shown for Sites 25-27 because of the late LFA installation. Site 26 is blue because the schedule for sampling occurred later than originally planned; however, this timing did not affect a full evaluation of the monitoring activity as all three required samplings were collected for this site.[9]

3.7.12 Hydroacoustic Scans

Hydroacoustic scans were performed twice per month using boat-mounted transducer (Lowrance HDS 7 Live) and Biobase software to measure and interpolate plant biovolume and height. Data points collected but not addressed in the completeness statistic are weather measurements, general field observations, GPS coordinates, and the boat used to complete the scan. There were 13 anticipated hydroacoustic scans to be completed, and more were performed, resulting in 100% data completion with additional data to complement existing data. Table 3-3 represents this information with green boxes for all sites.[10]

3.7.13 BMI Sampling

BMI sampling occurred in the spring using a Petite Ponar grab, and D net as explained in the permit. Sites 7 and 25 were an exception since BMI sampling did not occur in these sites until the fall when their locations were determined. Additionally, Site 27 was sampled in both the spring and fall. Data points collected but not addressed in the statistic are weather measurements, depth measurements, percent of submerged vegetation, percent abundance, taxa richness, percent biovolume, traits of the taxa, temperature and DO. The percentage of completeness was calculated based on the amount of sampling events that occurred. All 25 scheduled sampling events were accomplished for BMI monitoring, resulting in 100% data completion. Additional sampling events were completed that will complement existing data. Table 3-3 represents this information with green boxes for all sites.[11]

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[9] Revised APAP Amendment 1, Section 8.2.1.2, Species Identification and Relative Abundance; pg. 62-63; Table 7-10. CMT Monitoring Details, pg. 53-58
[10] QAPP, Attachment H
[11] Revised APAP Amendment 1, Section 8.2.5, Benthic Macroinvertebrates (BMI), pg. 69

3.7.14 Well Water Sampling

Well water sampling required one pre-treatment sample, a sampling 2 DAT, and then sampling every 48 hours until 14 DAT. Two samples were taken at each of the three wells per event and analyzed for herbicides. Data points collected but not addressed in the statistic are weather measurements and general field observations. The following herbicide laboratory analyses were undertaken:

- Triclopyr
- Endothall
- TCP
- TMP

All 132 of the scheduled data points were collected with additional sampling, resulting in a 100% data completion for this monitoring activity. Table 3-7 represents this information with green boxes for all sites.[12]

Table 3-7. Well Water Sampling

(green)	Complete data set.
Well Number	**Level of Completeness**
1	(green)
2	(green)
3	(green)

3.7.15 Other Monitoring Activities and Additional Sampling Events

Certain monitoring activities were not addressed in the tables presented above due to their unique characteristics. These monitoring activities include spill prevention and response (Table 3-8), West Lagoon Channel hydrologic monitoring (Table 3-9), receiving water/contingency stations (herbicide degradants/residue monitoring) (Table 3-10), and additional sampling events (Table 3-11). To calculate the completeness of these activities, their scheduled frequencies were checked against actual monitoring/sampling events. All these tables, except water quality monitoring outside of test areas, are displayed with green boxes to show complete data sets. There were 14 additional sampling days (51 sampling events) (see Table 3-11) that were deemed necessary for a variety of reasons including curtain relocation/removal, filter investigations, RWT meter evaluation, discrete depth evaluation, and confirmation sampling.[13]

[12] Revised APAP Amendment 1, Section 8.1.4, Monitoring Actions for Each CMT Treatment Type; pg. 54 & 56

[13] QAPP, Action 2. Use of Proper Equipment, Supplies, and Services Section, 13. Installation/Removal of double “turbidity” curtains and culvert “plug”/“bladder”, pg. 17

Table 3-8. Spill Response/Prevention Monitoring

■	Complete data set.

Station	Level of Completeness
TA1	
TA2	
TA3	
TA5	
TA8	
TA9	
TA11	
TA12	
TA13	
TA14	
TA15	
TA19	

Table 3-9. West Lagoon Channel Hydrologic Inflow Monitoring

■	Complete data set.

Date	Level of Completeness
5/24/2022	
5/25/2022	
5/27/2022	
5/29/2022	
5/31/2022	

Table 3-10. Receiving Water and Contingency Stations

	Complete data set.
N/R	No Record as the monitoring activity does not apply to that site.

Station	Herbicide Completeness	RWT Dye Completeness	Cyanobacteria
ORW-RH1			N/R
ORW-RH2			N/R
ORW-RC1			N/R
ORW-RC2			N/R
ORW-RC3			N/R
ORW-RHC1			N/R
ORW-RHC2			
ORW-RHC3			
IRW9			N/R
IRW1			N/R
IRW4			N/R
IRW5			N/R
IRW6			N/R
IRW2			N/R
IRW3			
IRW7			N/R
IRW8			N/R
CSTN123			
CSTN103			N/R
CSTN104			N/R
CSTN106			N/R

Table 3-11. Additional Samples

Date	Station	Additional Sampling Type
5/3/2022	TA26	BMI sampling (2X)
5/3/2022	All	Hydroacoustic scan of W. Lagoon
5/5/2022	TA27	BMI sampling (2X)
7/21/2022	CAC1 & CAC2	Curtain Relocation (Herb.)
8/1/2022	All	Hydroacoustic scan of W. Lagoon
8/16/2022	IRW6, TA13, TA14	Filtering Investigation (Herb.)
8/16/2022	IRW4, CTSN123	RWT Meter Evaluation (Herb.)
8/18/2022	IRW3, TA2	Discrete Depth Sampling (Herb.)
8/19/2022	ORW-RH3, IRW7, IRW8, TA8, TA9, TA15	Accelerated Monitoring (Herb.)
8/26/2022	ORW-RH3, IRW7, IRW8, TA8, TA9, TA15	Accelerated Monitoring (Herb.)
8/29/2022	ORW-RH3, IRW7, IRW8, TA8, TA9, TA15	Accelerated Monitoring (Herb.)
9/16/2022	IRW3, TA12	Accelerated Monitoring (Herb.)
9/19/2022	IRW1-6, TA1-3, TA5, TA10-14	Accelerated Monitoring (Herb.)
9/26/2022	CTSN104, CTSN106	Confirmation Sampling (Herb.)

3.7.16 Monitoring Completeness Summary

The first year of the CMT was a tremendous logistical effort with 12 contractors, 14 monitoring activities, 4 control method treatments, and 25 sites resulting in 75,177 data points collected over the course of several months. This data was used to evaluate Year 1 CMT project results and efficacy. Table 3-12 below summarizes the completeness evaluations.

The CMT, as with any project, experienced challenges and CMT crews succeeded in overcoming many unpredicted or unexpected circumstances. Upon evaluation of data completeness for all monitoring activities, over 90% of the data scheduled to be collected for Year 1 was accomplished.

Table 3-12. Summary of CMT Monitoring Completeness Evaluation

Monitoring Activity	Data Points	Data Completion
Herbicide Residue and Degradant and RWT Dye Monitoring	3,600	+100%
Standard WQ Monitoring (Inside Test Areas)	17,460	89.5%
Standard WQ Monitoring (Outside Test Areas)	3,321	90.6%
Continuous WQ Monitoring (miniDOTs)	14,586	81%
Turbidity Curtain Monitoring	227	75%
Nutrient Grab WQ Monitoring	1,088	98%
HABs Cyanobacteria Grab Sampling	271	90.9%
Macrophyte Point Rake Sampling	34,068	99.9%
Hydroacoustic Scans	15	+100%
BMI Sampling	168	+100%
Well Water Sampling	138	+100%
Inspection of Turbidity Curtains/Culvert Plugs	132	98.5%
Spill Prevention and Response	13	100%
West Lagoon Channel Hydrologic Monitoring	90	100%
Totals for Year 1 of the CMT:	75,177	90%

4.0 CONTROL SITE MONITORING RESULTS

4.1 Control Sites in West Lagoon (Sites 16, 17, 18, 7)

4.1.1 General Description

The untreated "control" sites 16,17,18 located in the West Lagoon are most proximate to the CMT herbicide, UV, and combination treatments sites in the West Lagoon. Monitoring data from these control sites were therefore used for comparisons with CMT treatments in the West Lagoon except for LFA (Site 26). For LFA Site 26, control Site 7 was used for comparison. (The control site monitoring descriptions and data related to Endothall-only treatment in Lake Tallac is provided in Section 4.2).

The untreated control sites had initial characteristics similar to "treated" sites in terms of bathymetry, water quality, AIP composition, and light penetration (based on turbidity). However, the installation of double turbidity curtains as part of precautionary mitigation against movement of herbicides (or degradants) to Lake Tahoe proper created a significant difference in the environmental conditions between treatment sites and control Sites 16,17,18 and 7. For example, while the control sites were freely exposed to water movements and water exchanges to/from the West Lagoon areas, as well as boating activity and harvesting, none of the CMT treatment sites had this connectivity to "open water." The curtains in effect created a series of CMT treatment "stagnant" zones (Figure 2-3), which remained in place for over three months. These confined conditions would have impacted several components of water quality including oxygen exchanges, mixing of nutrients, vertical mixing of water column constituents, turbidity, light penetration, and wind-driven events that produce surface water exchanges with open West Lagoon waters when curtains are not present.

However, the dissimilar conditions between controls and the CMT sites in Area A and B did not apply to the UV-only sites because neither the controls nor the UV-only site were constrained by curtains. This suggests that the conditions in the controls were similar to UV-only sites at least prior to -UV treatments.

The result of this condition for Year 1 of the CMT suggests that 1) to some degree, the confining curtains created a non-equivalent status between "controls" and CMT treatment sites not directly related to treatment effects; 2) any impairment of water quality within treatment sites may have been exacerbated by the "stagnant" conditions, which in turn may have affected water quality; and, 3) controls and UV-only sites did not have any impediment to water exchange. Notwithstanding these limitations, the comparison between controls and treatments, as provided in the following graphics and descriptions, represents the best and most useful comparison of CMT treatments and untreated sites.

4.1.2 Synopsis of Nutrient and Water Quality Results

Nutrients: (Figures 4-1 through 4-5) For nearly all monitoring events, the data showed that in control sites, Total P, Total N, and pH all were outside the regulatory limits stated in the Lahontan Order. Total N and TKN exhibited a gradual increase to mid-summer whereas Total P and Ortho-P remained relatively constant. These appear to be "normal" conditions for the Keys lagoons based on 2019 EIR/EIS baseline data.

Water Quality: (Figures 4-6 through 4-8) The water temperature pattern was typical for the lagoons, rapidly increasing from about 15-16^{o} C in May and reaching a peak of about 24^{o} C by mid-summer, then decreasing to well below 15° C by October. Turbidity increased from near 1-2 Nephelometric Turbidity Units (NTU) in May to a maximum of 5 NTU in September. Mid-depth DO remained at acceptable levels (>5 mg/L) until October. However, the hourly logger data showed that bottom DO was consistently < 5 mg/L during most of the season. Oxidation reduction potential (ORP) decreased during mid-summer and then increased during late summer and fall. Conductivity gradually increased from May to October. These changes may be related to cycling and leakage of plant and algae constituents, particularly during late summer senescence. Growth of AIP (macrophytes) also increased from spring to mid-summer, a typical pattern in response to rising temperatures and increasing day-length. Taken together, these results demonstrate the contrast between conditions in the Keys lagoons and Lake Tahoe proper.

4.1.2.1 Supporting Graphical Data for Nutrients

a) Total N

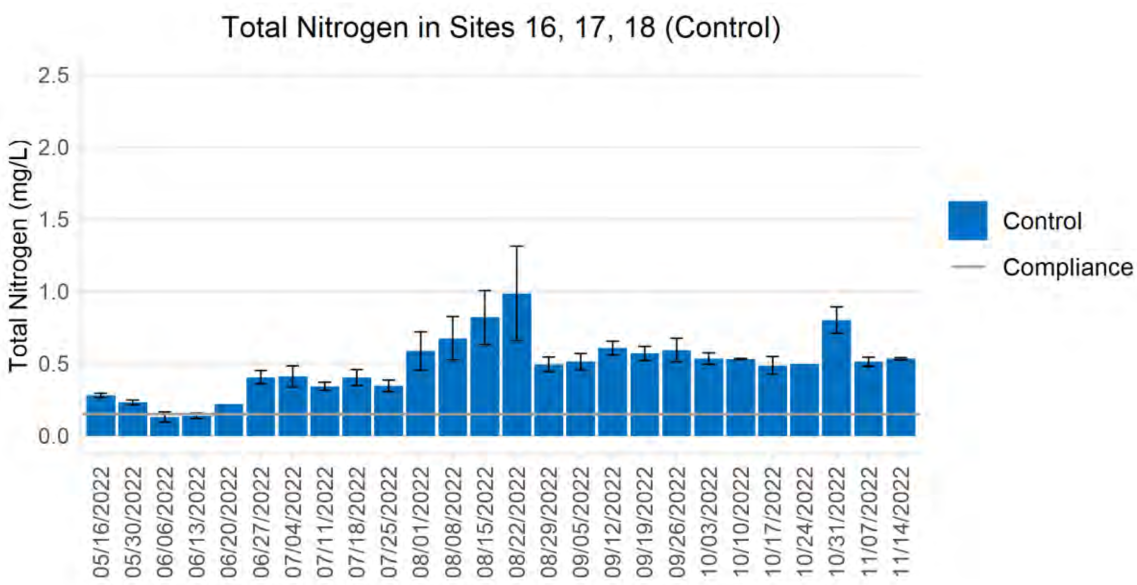


Figure 4-1. Total N at Mid-Depth in West Lagoon Control Sites

b) Nitrate+Nitrite

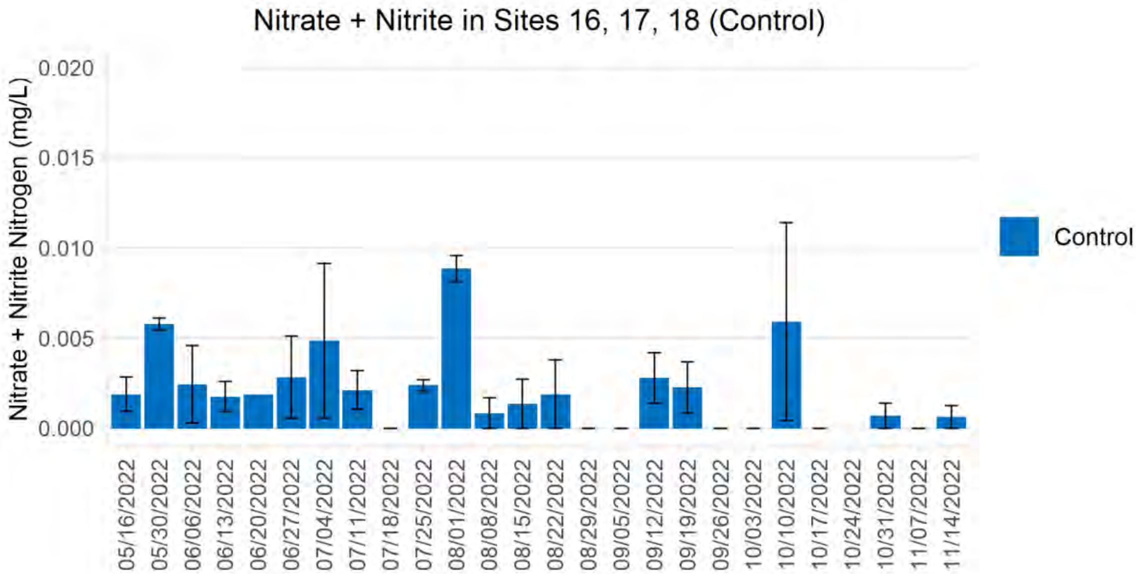


Figure 4-2. Nitrate Nitrite at Mid-depth in West Lagoon Control Sites

c) TKN

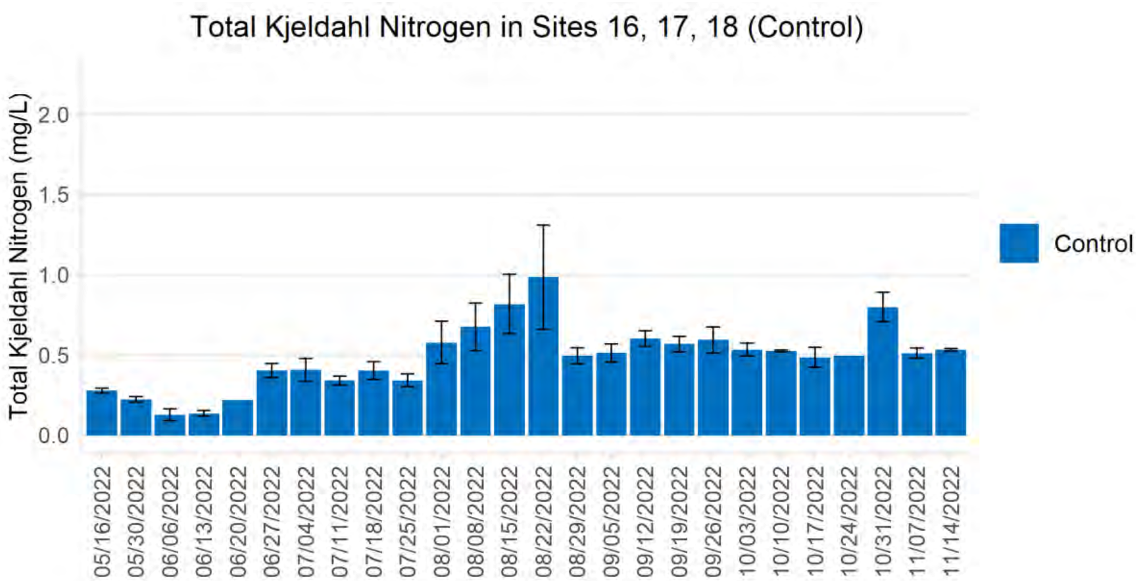


Figure 4-3. TKN at Mid-depth in West Lagoon Controls Sites

d) Total P

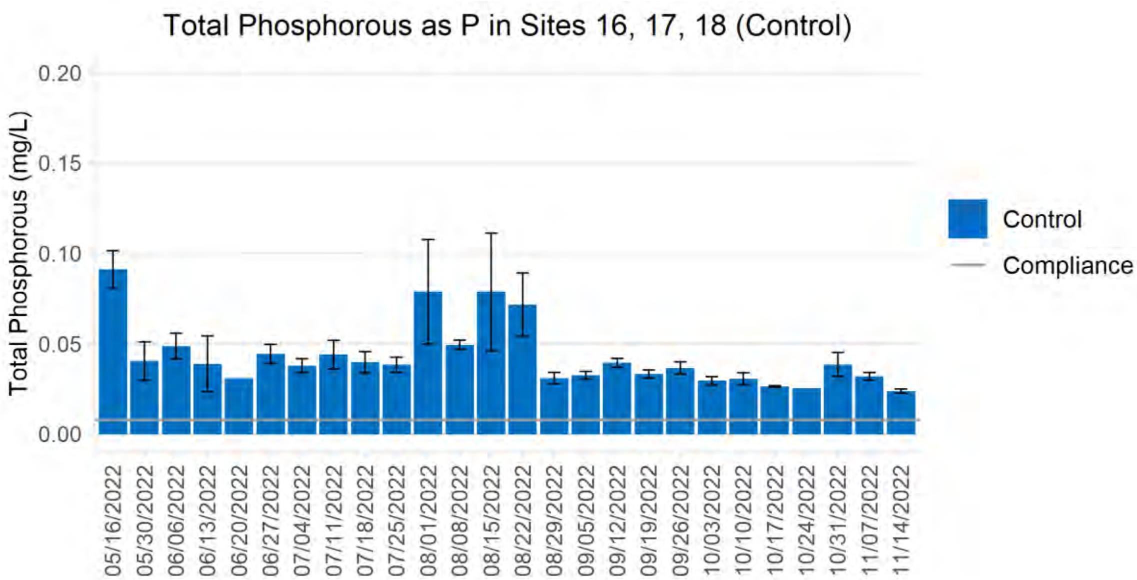


Figure 4-4. Total P at Mid-depth in West Lagoon Control Sites

e) Ortho-P

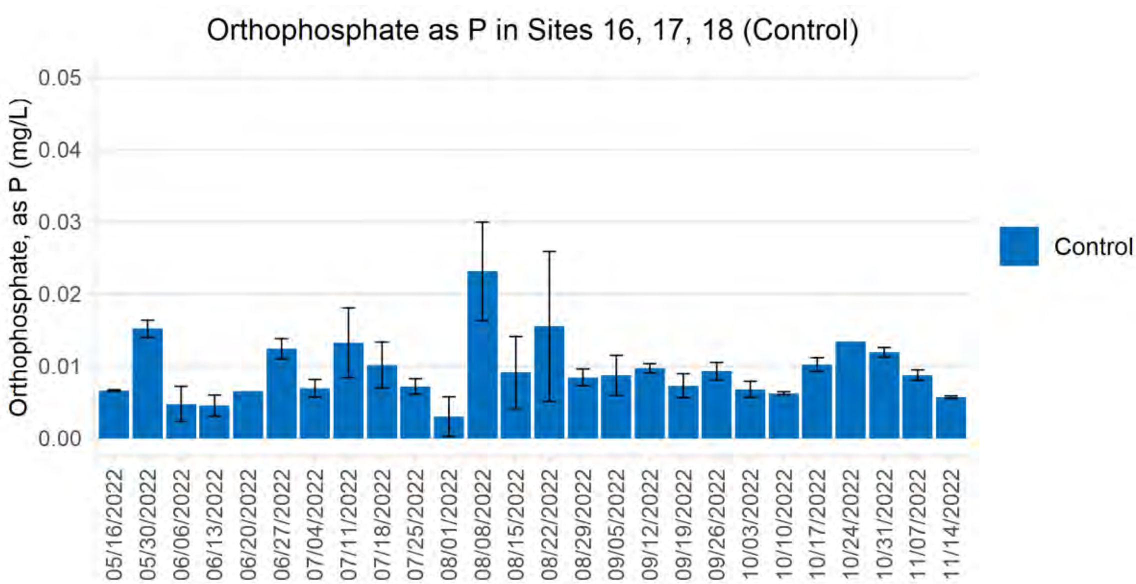


Figure 4-5. Ortho-P at Mid-depth in West Lagoon Control Sites

4.1.2.2 Supporting Graphical Data for Water Quality

a) Temperature, DO, pH

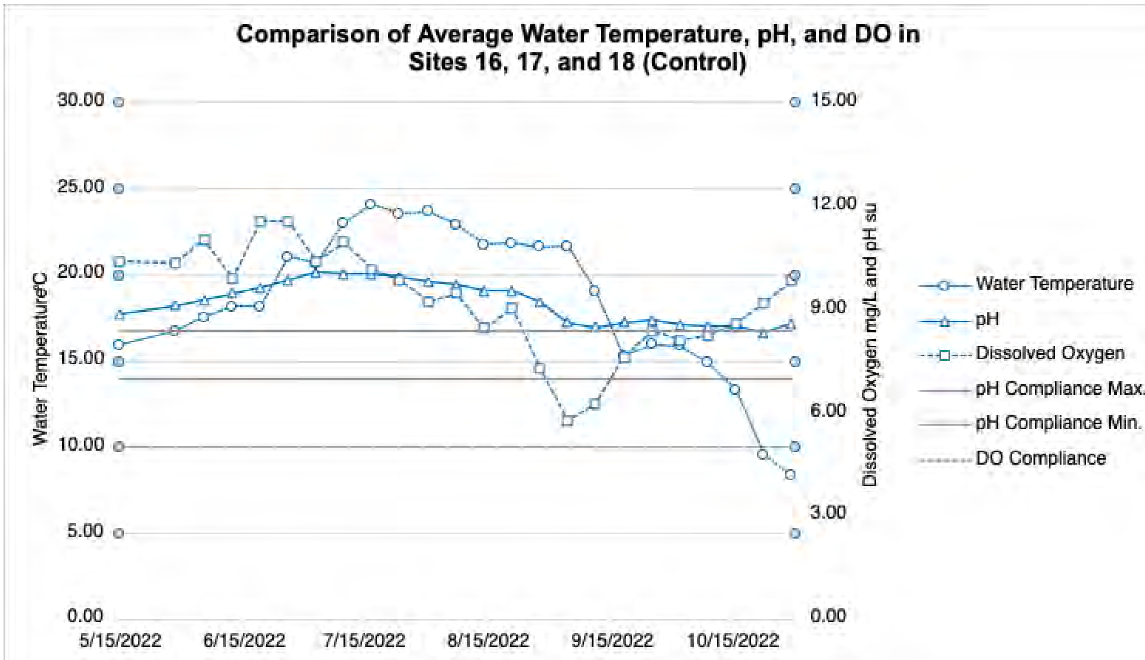


Figure 4-6. Mid-depth Temperature, pH, DO in West Lagoon Controls Sites (means from three sample stations in each site taken 3 times per week)

b) Turbidity, Conductivity and ORP

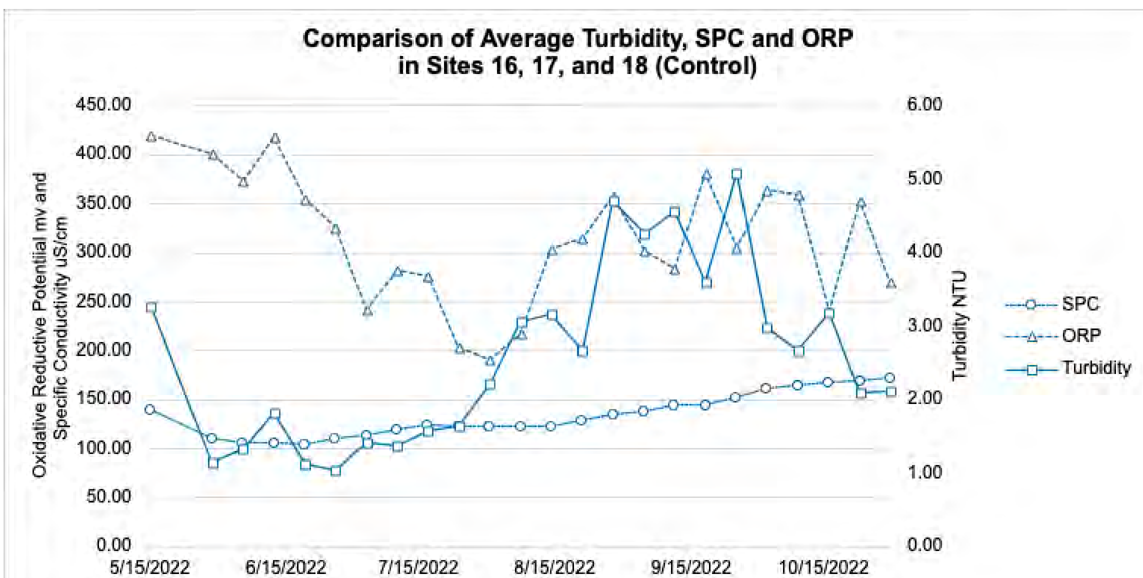


Figure 4-7. Mid-depth Turbidity, SpC and ORP in West Lagoon Control Sites (means from three sample stations in each site from samples taken 3 times per week)

c) DO and Temperature from miniDOTs Hourly Loggers

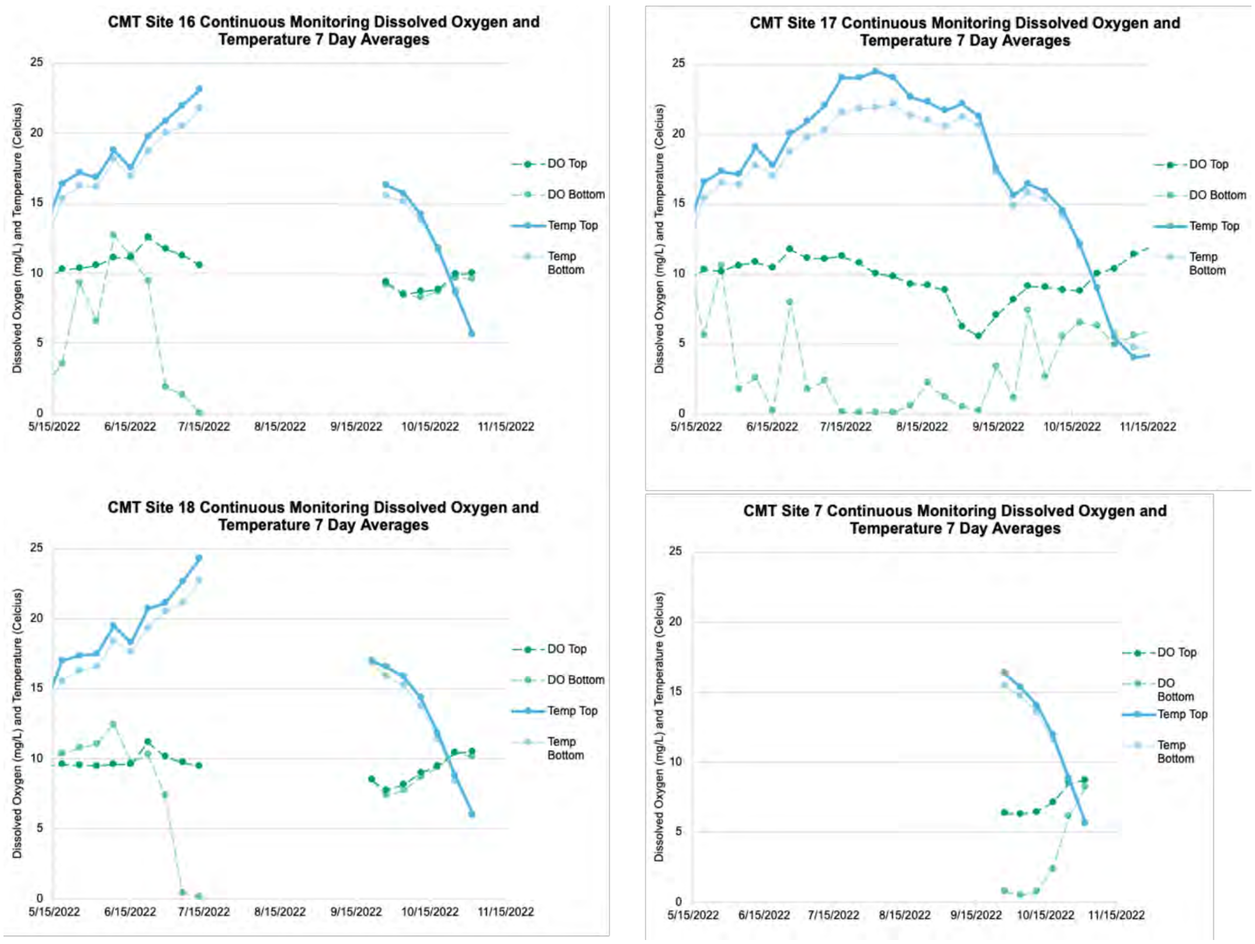


Figure 4-8. DO and Water Temperature in Control Sites 16,17,18,7 Derived from Hourly Data Used to Generate Weekly Averages

In Figure 4-8, gaps in Sites 16 and 18 are due to lost miniDOTs. The location of control Site 7 (for LFA comparison) was established late.

4.1.3 AIP Response

Although there were some differences in species occurrences between Sites 16,17,18, generally biovolume increased from May to September but the relative abundance of species did not change very much. Similarly, native plant abundance and occurrence had very little change over the growing season. (See Appendix E. Tahoe Keys Lagoons Macrophyte Control Efficacy Monitoring Report: Year 1).

4.2 Control Sites in Lake Tallac (Sites 20, 21)

4.2.1 General Description

The installation of the double curtain across east end of Lake Tallac effectively isolated that area from water mixing and exchange with the main body of Lake Tallac, and from mixing with inflows from the creek flowing north into Lake Tallac (Figure 1-1). Thus, Area C is similar to the isolated conditions created in the West Lagoon boating restricted areas A and B. For this reason, control Site 21 was originally located behind the curtains, in addition to control Site 20, which is located outside the curtains. However, due to post Endothall treatment monitoring for Endothall in Site 19 and levels found in samples adjacent to Site 19 (IRW9, Figure 6-14) as well as movement of RWT, Endothall appeared to have migrated from Site 19 into Site 21. Furthermore, AIP manifested symptoms of herbicide exposure (low plant health ratings) and reduced biovolume of AIP in Site 21, which also points to incursion of Endothall into Site 21 (see Figures 6-15 and 6-16 and Appendix E). Therefore, only control Site 20 (outside the curtain) was used for comparison of “untreated” conditions (water quality, nutrients, AIP) to the Endothall treatment in Site 19. (See Section 6.0)

4.2.2 Synopsis of Nutrient and Water Quality Results

Nutrients: (Figures 4-9 through 4-13) Total N and Total P were higher than regulatory values during the entire monitoring period, a similar condition to controls in the West Lagoon, and unlikely to be related to the CMT. These conditions are typical for Lake Tallac based on data from 2019 EIR/EIS reporting.

Water Quality: (Figures 4-14 through 4-16) Similar to the control sites in West Lagoon, pH was consistently above regulatory ranges and mid-depth DO was below 5 mg/L in late summer. The loggers showed that DO in bottom of the water column was consistently < 5 mg/L, although some logger data is missing due to dislodging by bears. The temperature pattern was also similar to the West Lagoon controls. Turbidity gradually increased from 1-2 NTU to over 5 NTU by fall. Conductivity also gradually increased from May to November, with a steep rise from mid-summer to fall which is likely due to leakage of plant and algal constituents during fall senescence. ORP was highly variable but exhibited a decreasing trend from May to October.

4.2.2.1 *Supporting Graphical Data for Nutrients*

a) Total N

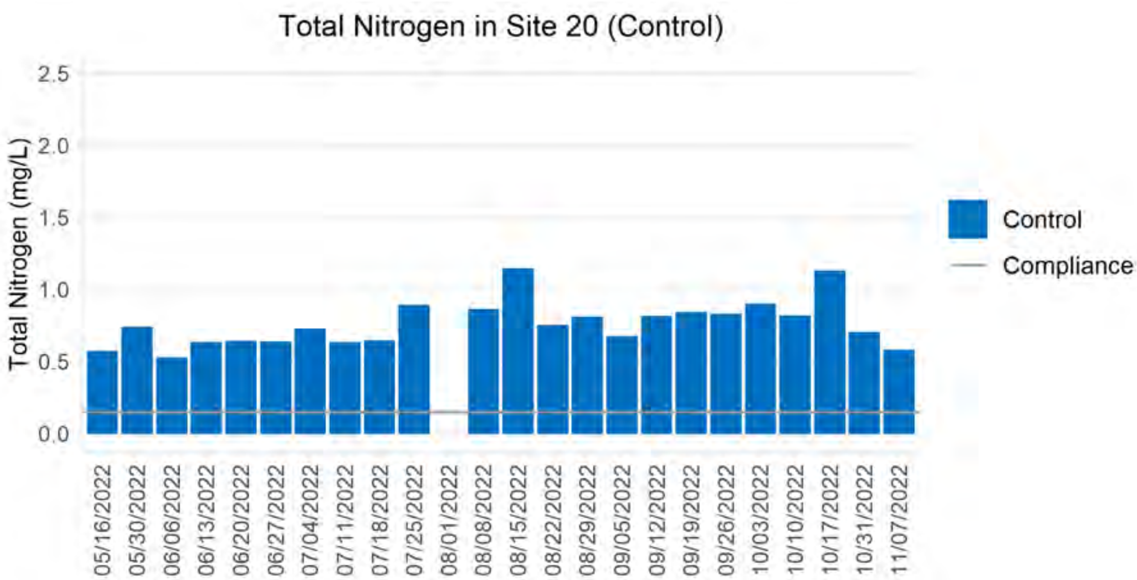


Figure 4-9. Total N at Mid-depth in Lake Tallac Control Site 20

b) Nitrate+Nitrite

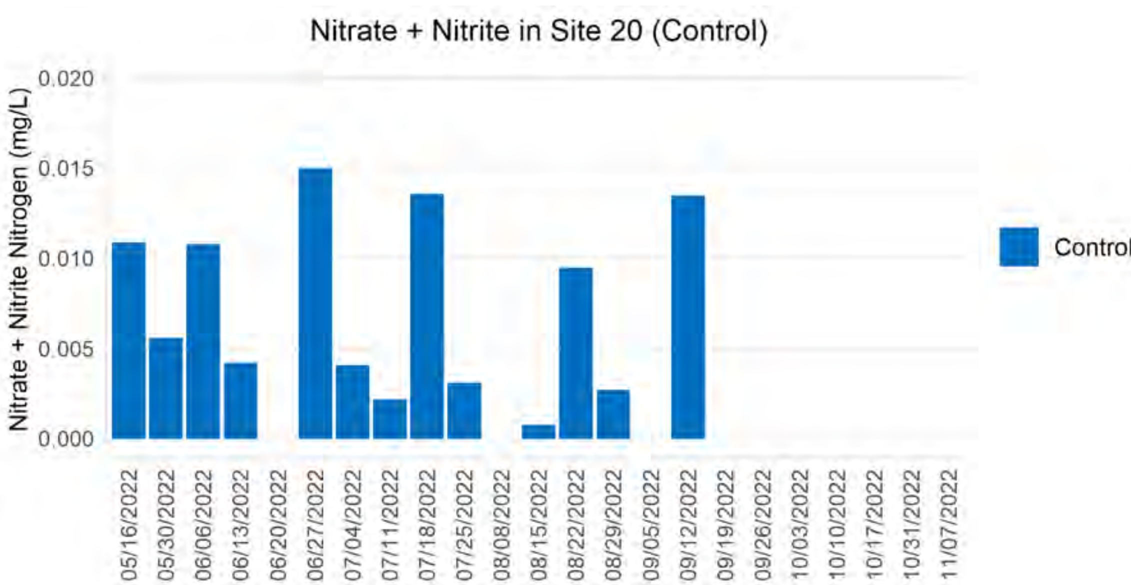


Figure 4-10. Nitrate+Nitrite in Mid-depth in Lake Tallac Control Site 20

c) TKN

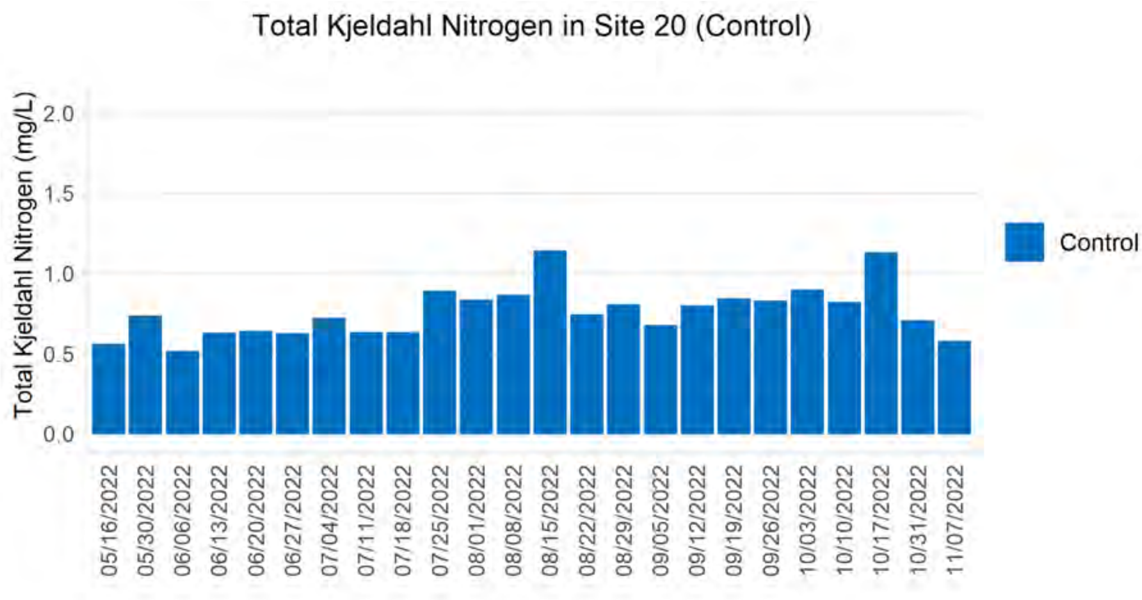


Figure 4-11. TKN in Mid-depth in Lake Tallac Control Site 20

d) Total P

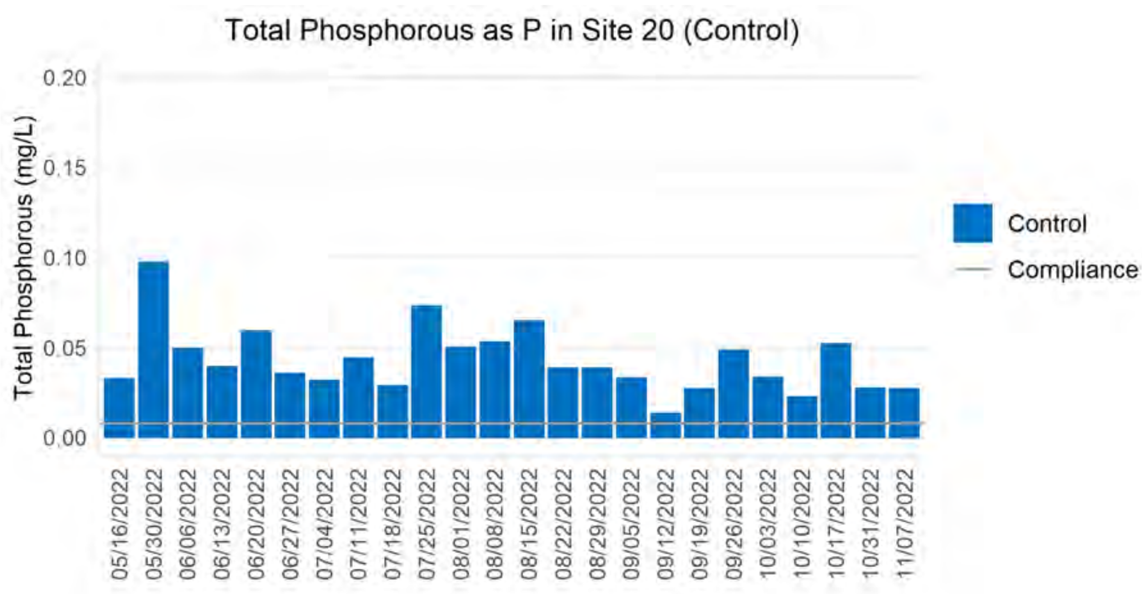


Figure 4-12. Total P at Mid-depth in Lake Tallac Control Site 20

e) Ortho-P

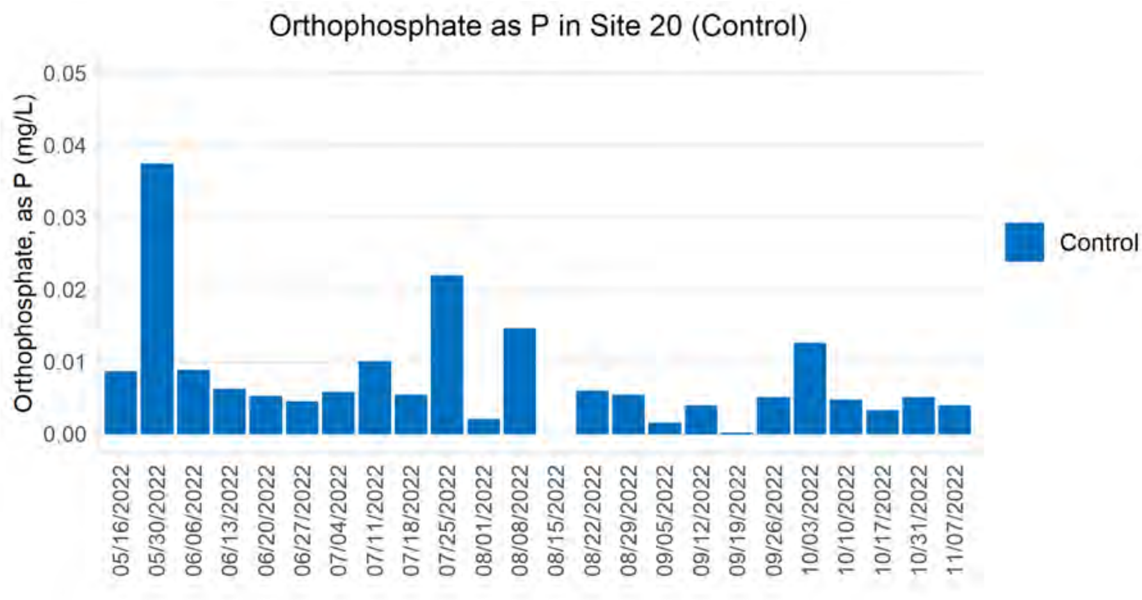


Figure 4-13. Ortho-P at Mid-depth in Lake Tallac Control Site 20

4.2.2.2 Supporting Graphical Data for Water Quality

a) Temperature, DO, and pH

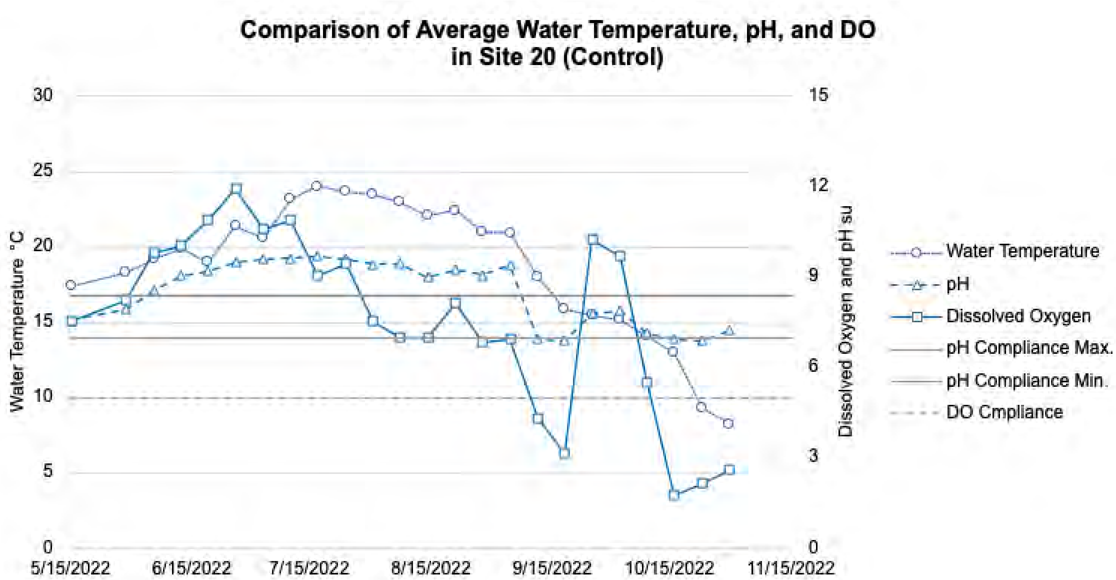


Figure 4-14. Temperature, DO, and pH at Mid-depth in Lake Tallac Control Site 20

b) Turbidity, ORP, SpC

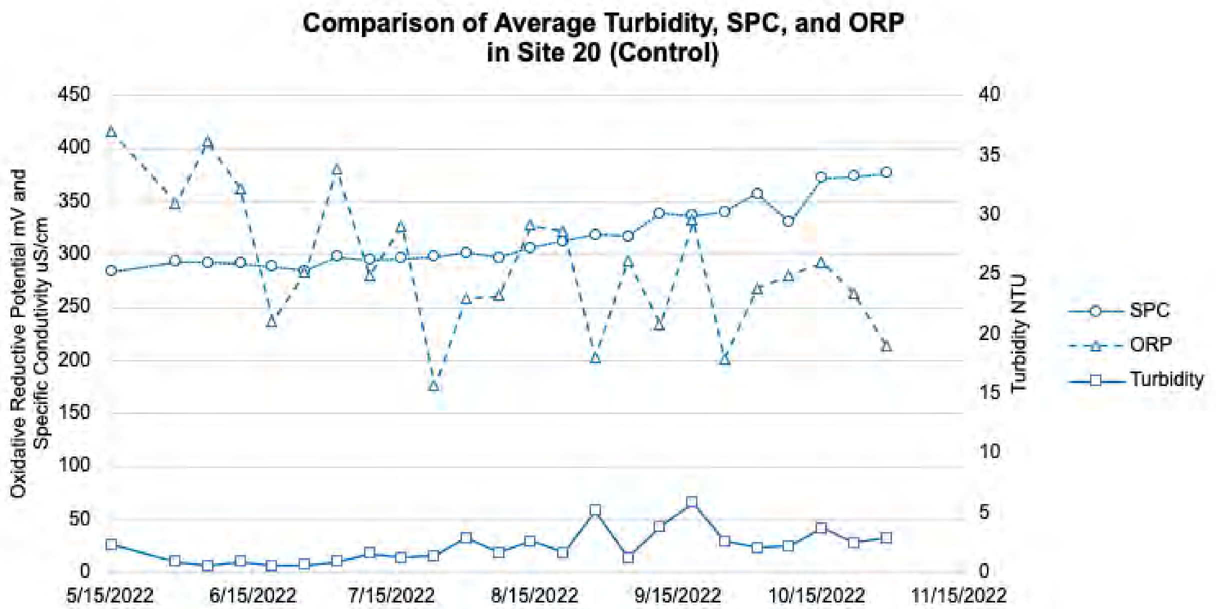


Figure 4-15. Turbidity, ORP and Conductivity at Mid-depth in Lake Tallac Control Site 20

4.2.2.3 Supporting Graphical Data for Continuous Logger DO and Temperature

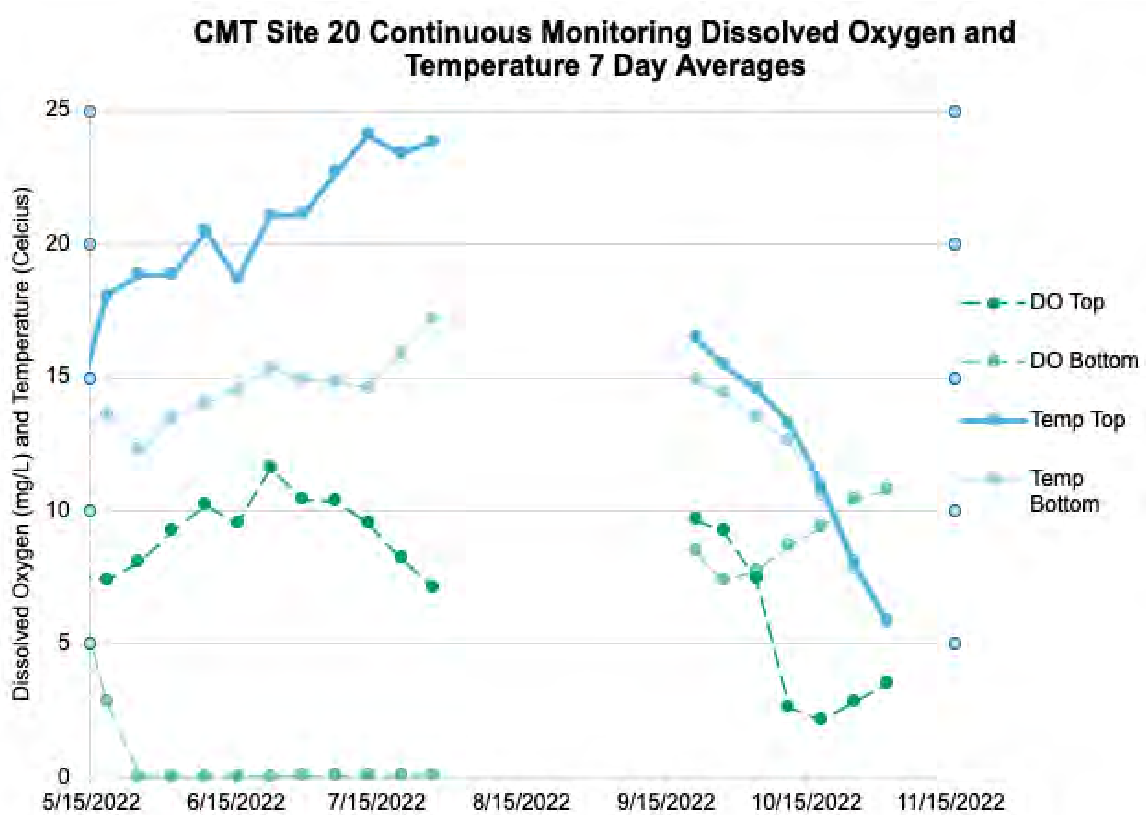


Figure 4-16. DO and Water Temperature in Upper and Lower Water Column in Lake Tallac Control Site 20 (weekly means derived from hourly recording)

Gaps in data displayed in Figure 4-16 are due to wildlife (bears) dislodging and moving loggers to unknown locations.

4.3 AIP Responses

Macrophyte surveys in the untreated control sites showed that AIP biovolume increased during the spring to fall period as would be expected, and that the relative species composition remained about the same during this period. The increasing abundance of AIP and some native plants all contributed to the elevated pH and mid-depth DO, while turbidity remained fairly low and stable. However, DO levels near the bottom were depressed and, at times, below regulatory levels (< 5 mg/L). Note that control sites were also harvested in mid-summer, which may have mitigated some influence on pH and DO but may also have released some plant constituents. Harvesting was therefore an AIP management action that created conditions in control sites unlike any of the CMT treatments with the exception of late season harvests in Site 14, which was not harvested or treated with UV (Appendix E). Note that harvesting affects “vessel hull clearance” and therefore this CMT goal metric is assessed as a stand-alone value by treatment site (“three-foot” distance between the top of AIP canopy and water surface).

The responses of AIP in Site 21 (Figure 4-17, 4-18) strongly suggest that this site was exposed to Endothall from Site 19. Therefore, Site 21 was not used as a comparison control site.

5.0 WEST LAGOON ENDOTHALL TREATMENT SITES MONITORING RESULTS (SITES 1, 2, 3)

5.1 General Description

These sites were all in restricted boating area A (Figure 2-3). Sites 1, 2, and 3 were treated with liquid Endothall (Aquathol K) on May 27, 2022, and Lake Tallac Site 19 was treated May 31, 2022. RWT dye was injected with Endothall. The applications were uneventful. No spills occurred. An example showing the dispersal of dye is provided in Figure 3-1.

5.2 Synopsis of Nutrient and Water Quality Results

Nutrients: (Figures 5-1 through 5-5) For Total N, most of the “control” values were higher than the regulatory limits, and only the June 6 and June 13 values appear to have been equal to or slightly less than the regulatory limits. In the Endothall sites, the pre-treatment Total N (also above the prescribed level) was maintained through June 20 (about 20 DAT) but increased above the pre-treatment level on June 27. However, Total N in the Endothall sites was approximately twice as high as Total N in controls from May 30 to June 27, and in particular, appeared to increase the most from June 13 to June 27, which is approximately between 16 DAT and 30 DAT. This increase may be due to gradual decomposition of AIP since typically symptoms of Endothall exposure are readily observed at 15 DAT. The total N values were also elevated compared to pre-treatment and controls in most samples and approximately twice the control levels on June 6 and June 13. However, on June 20, Nitrate+Nitrite was lower or similar to controls, and not different from control levels on June 27. These trends again suggest the effects of decomposing AIP from 10 DAT to about 25 DAT.

The TKN levels were higher than control levels and pre-treatment levels. This pattern is similar to Total N in that most of the increase occurred during June 13 to June 27, or 16 DAT to 30 DAT. Since both TKN and Total P probably best represent potential N-nutrient “leakage” from affected AIP, these similar patterns seem consistent. Total P was also higher than regulatory levels in control sites and Endothall-treated sites from pre-treatment to June 27 (30 DAT). However, Total P in the pre-Endothall treatment sample was about half the pre-control treatment levels (0.05 vs 0.9 mg/L, respectively). By 4 DAT a three-fold increase in Total P was seen in the Endothall site, but this extreme difference did not persist. Endothall site Total P remained higher than controls until June 27 when Total P was the same. Mid-depth temperature did not differ between Endothall sites and control sites. Ortho-P levels in the Endothall sites exceeded control site levels beginning June 6 (10 DAT) through June 20 (25 DAT), after which, by June 27, levels of Ortho-P in controls and Endothall sites were not different. Ortho-P is rapidly biologically cycled, which may explain the rise and fall of these levels.

Water Quality: (Figures 5-6 through 5-12) Both mid-depth DO and pH were depressed in the Endothall sites: Mid-depth DO was only < 5 mg/L between the end of August and beginning of September. However, weekly logger data showed that bottom water column DO remained <5 mg/L for most of the season even though DO in the upper column was > 5mg/L except for late summer. Both ORP and conductivity increased in Endothall sites compared with controls. Turbidity exhibited the largest divergence from controls or pre-treatment conditions, reaching a maximum of over 35 NTU compared with 5 NTU in controls during August but declining to below 7 NTU by October. Even though nutrients levels in control sites were higher than regulatory levels Endothall-only treatments resulted in several consistent changes in nutrients, water quality including elevated Total P, elevated Total N, depressed pH (though these effects tended to bring pH into the regulatory prescribed range), depressed DO in bottom water areas, and highly elevated turbidity. Some of these perturbations were transient and tended to diminish by late summer and may well have diminished sooner if the turbidity curtains had been removed earlier, which would have reduced the duration of stagnant conditions.

The temperature pattern in the Endothall sites is typical of the Keys lagoons: Rapid rise in spring temperatures from about 16° C to a peak and plateau of 22-24° C for three months mid-summer and gradual decline to below 12° C by November. No difference in this pattern existed between Endothall sites and control sites (16,17,18). Notably, 2022 was a very low water level year and though this general temperature pattern is common, subsequent “normal” (higher water level) years would likely alter the rates of increase, maxima, plateau, and rates of decline.

Figure 5-7 shows the mid-depth DO levels in the West Lagoon Endothall treatment. Controls showed a steady decline in DO from June to September. In the West Lagoon Endothall sites, the only period of < 5 mg L was end of August to mid-September when levels reached about 3 mg/L, after which DO increased. The pattern of depressed DO is no doubt attributable to three drivers following application of Endothall: 1) suppressed oxygen production due to dying target AIP; 2) microbial degradation of senescing AIP; and 3) restricted water column exchange caused by placements of the double turbidity curtains. The cause of DO decline in control sites is not clear although the rapid and sustained rise in temperature coupled with higher rates of respiration during the night during mid-summer may have reduced the capacity to retain DO in the water column.

In the West Lagoon control sites, pH was above the prescribed upper limit (Figure 5-8 and 6-8). This situation is not surprising since the increasing biovolume of AIP (and native plants) through the spring and summer results in elevated pH in the water column due to photosynthesis and use of a CO_2 (carbon dioxide) and HCO_3 (bicarbonate) by plants and algae. These shifts typically occur on a diurnal cycle with the highest pH normally occurring in mid- to late-afternoon during maximum rates of photosynthesis; and minimum pH occurs just before sunrise after several hours of no light for photosynthesis. Notwithstanding those variations, Endothall treatment areas had pH values mostly within the prescribed range. The “positive” effect on pH no doubt reflects the response to the Endothall treatment in reducing AIP biovolume and associated photosynthesis.

5.2.1 Supporting Graphical Data for Nutrients

a) Total N

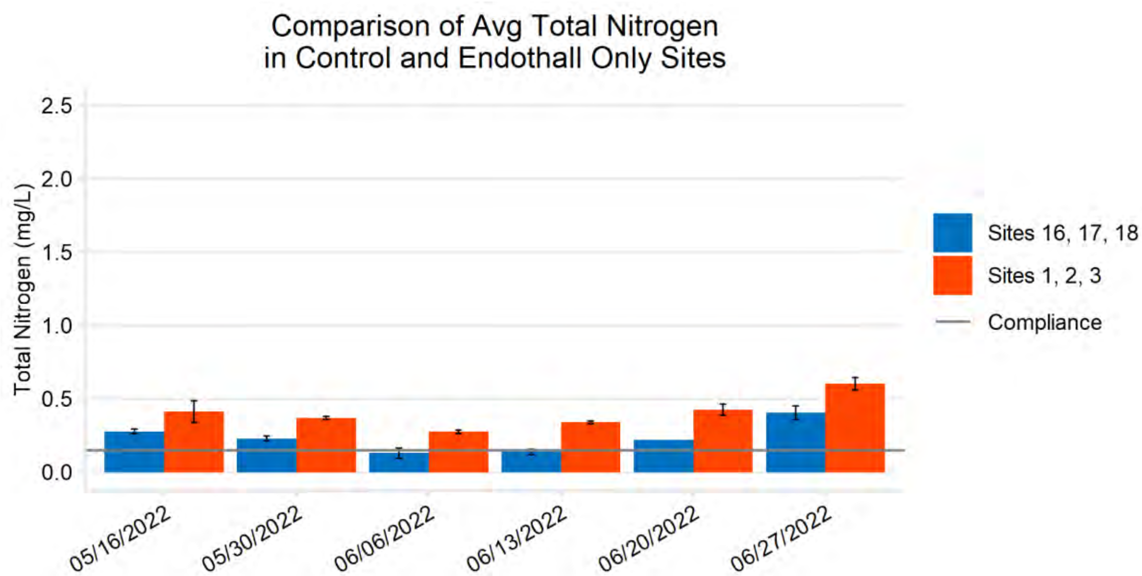


Figure 5-1. Total N in Endothall-only Sites Compared with Control Site Levels

b) Nitrate+Nitrite

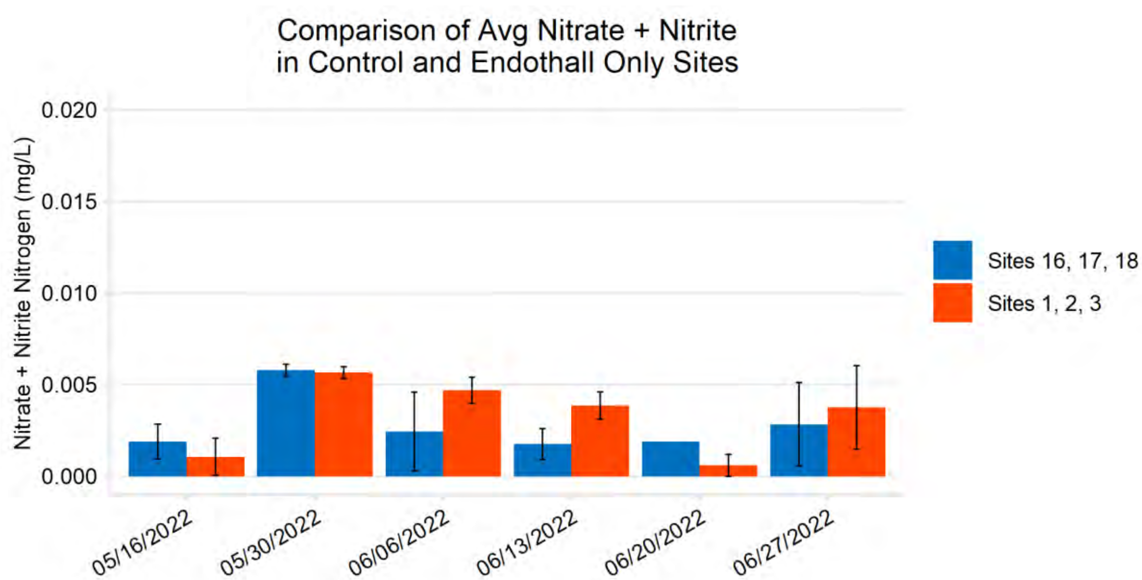


Figure 5-2. Nitrate+Nitrite Levels in Endothall-only Sites Compared with Control Site Levels

c) TKN

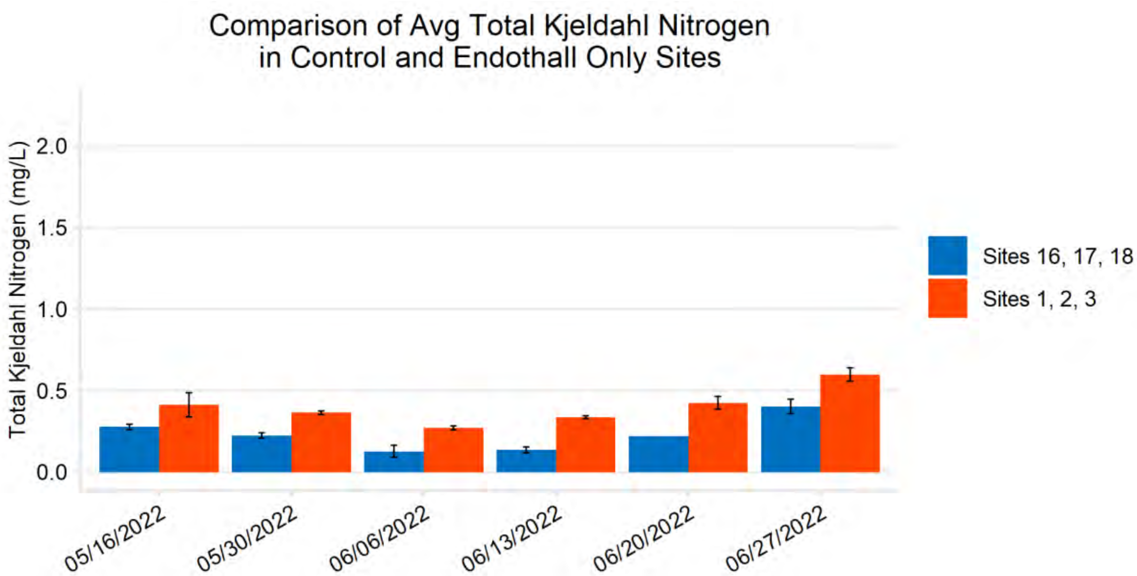


Figure 5-3. TKN Levels in Endothall-only Sites Compared with Control Site Levels

d) Total P

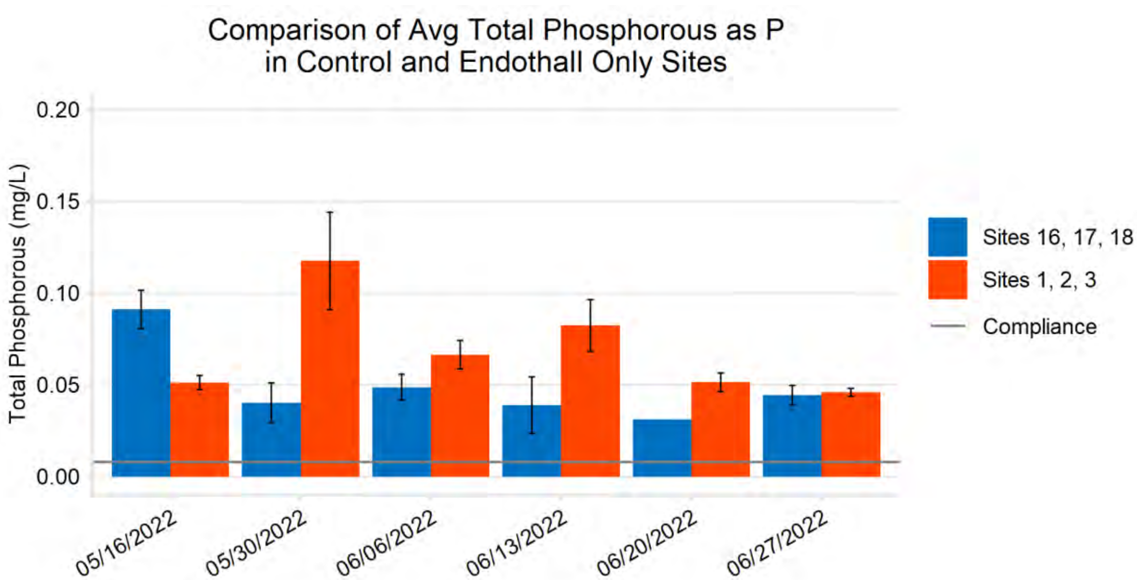


Figure 5-4. Total P Levels in Endothall-only Sites Compared with Levels in Controls Sites

e) Ortho-P

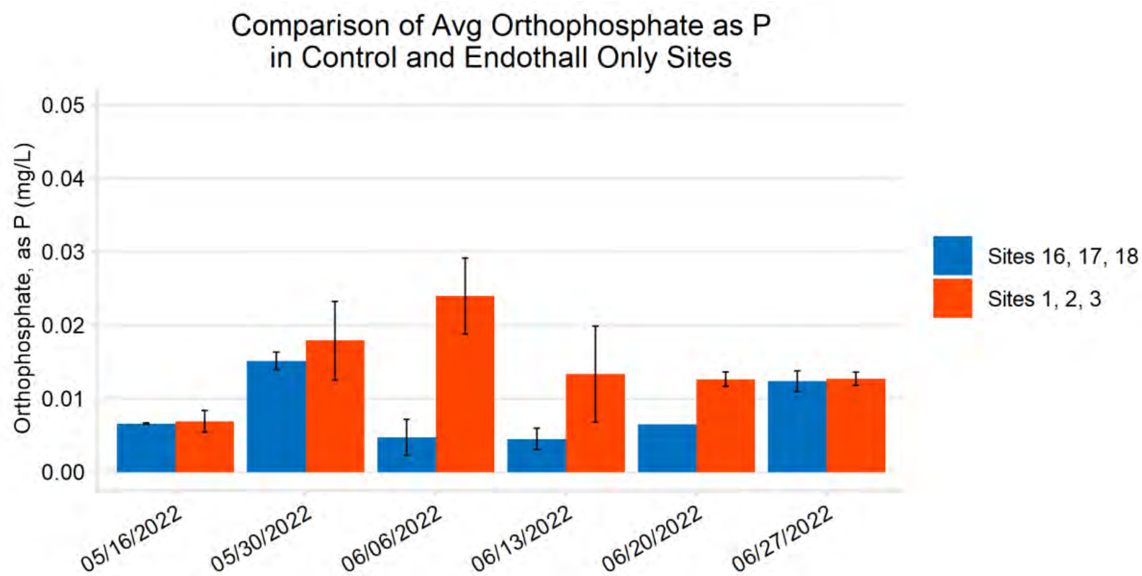


Figure 5-5. Ortho-P Levels in Endothall-only Sites Compared with Levels in Control Sites

5.2.2 Supporting Graphical Data for Standard Water Quality

Sonde data was obtained 3 times per week.

a) Water Temperature

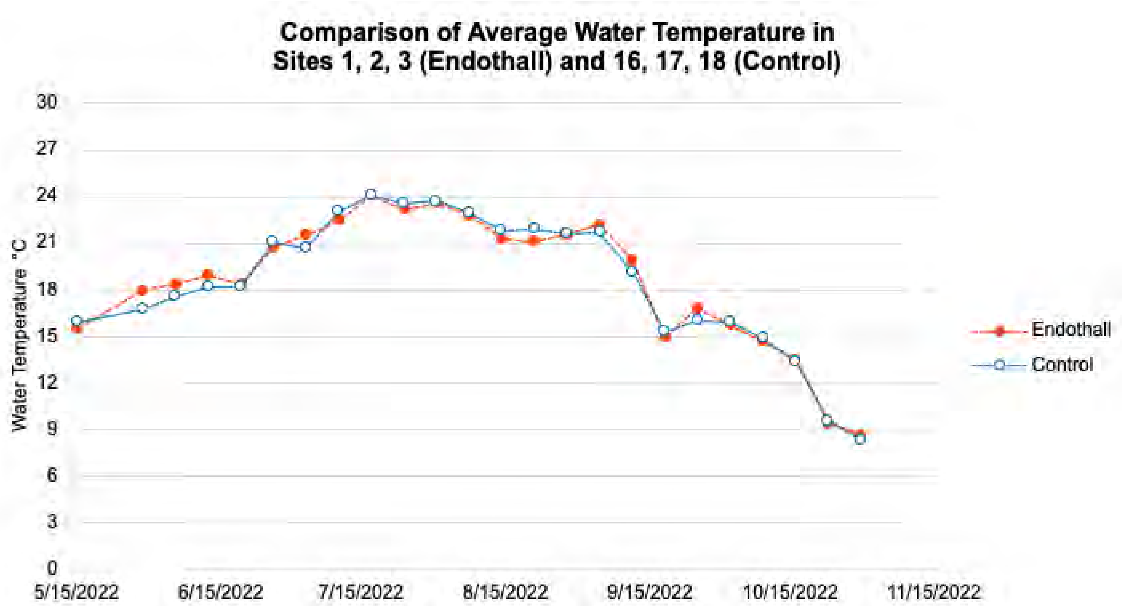


Figure 5-6. Water Temperatures in West Lagoon Endothall-only Sites

b) DO

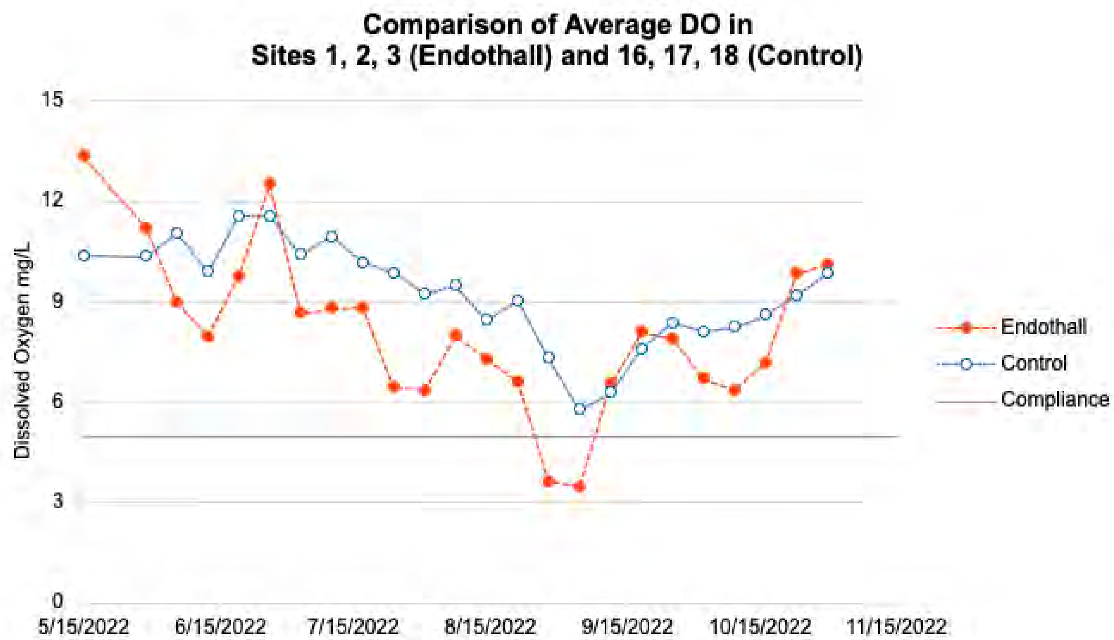


Figure 5-7. DO Levels in Mid-depth West Lagoon Endothall-only Sites Compared with Levels in Control Sites

c) pH

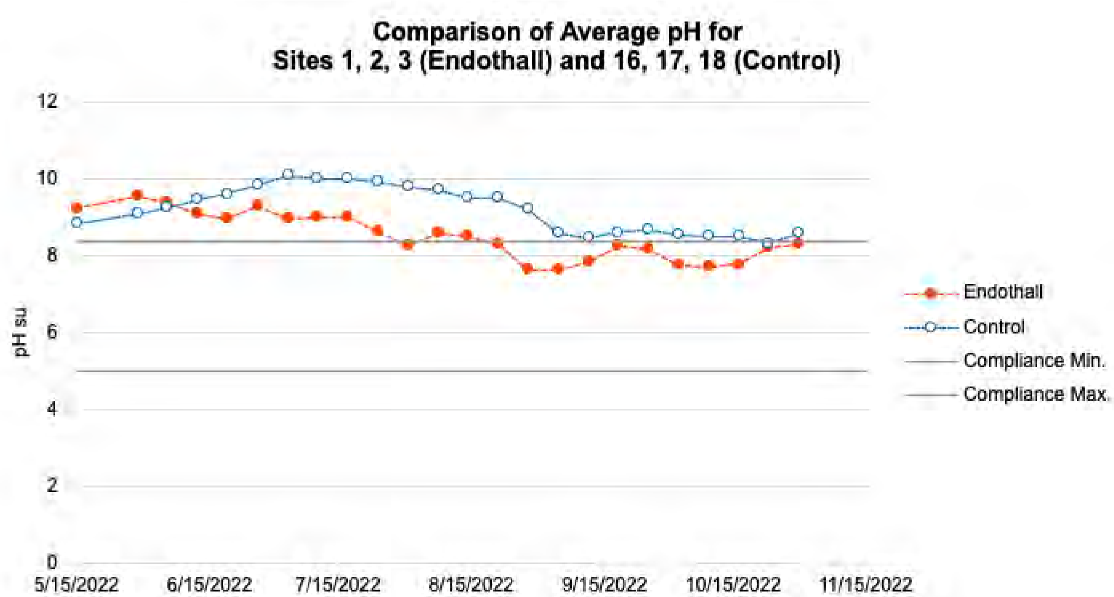


Figure 5-8. pH Levels in West Lagoon Endothall-only Sites Compared with Levels in Control Sites

d) Turbidity

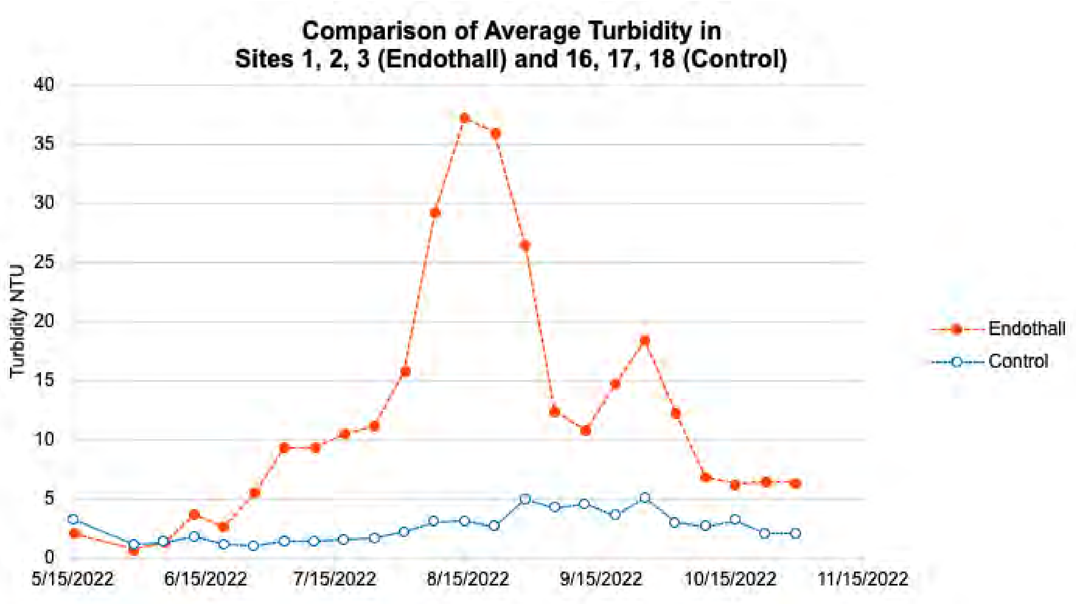


Figure 5-9. Turbidity in West Lagoon Endothall-only Sites

e) ORP

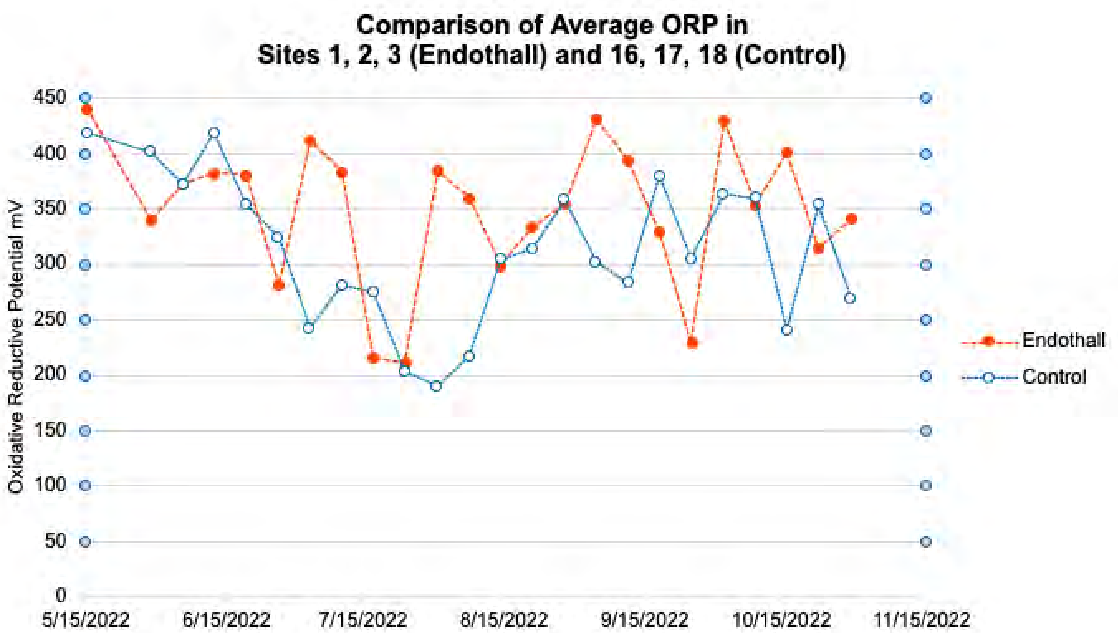


Figure 5-10. ORP in West Lagoon Endothall-only sites

f) Conductivity

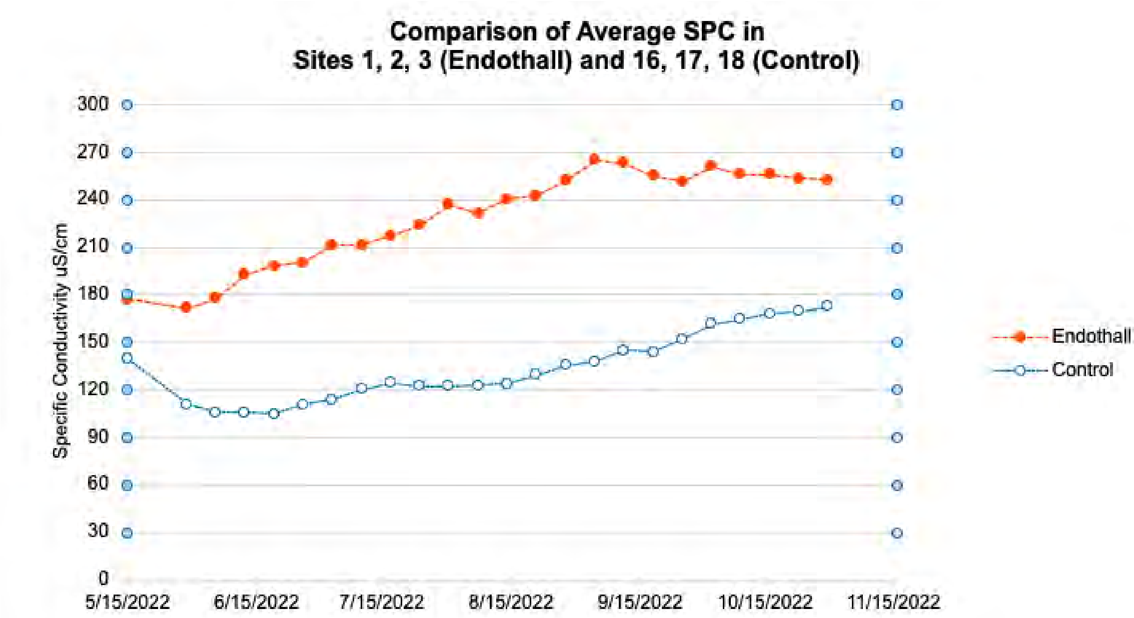


Figure 5-11. Conductivity in West Lagoon Endothall-only Sites

5.2.3 Supporting Graphical Data for Continuous Logger DO and Temperature

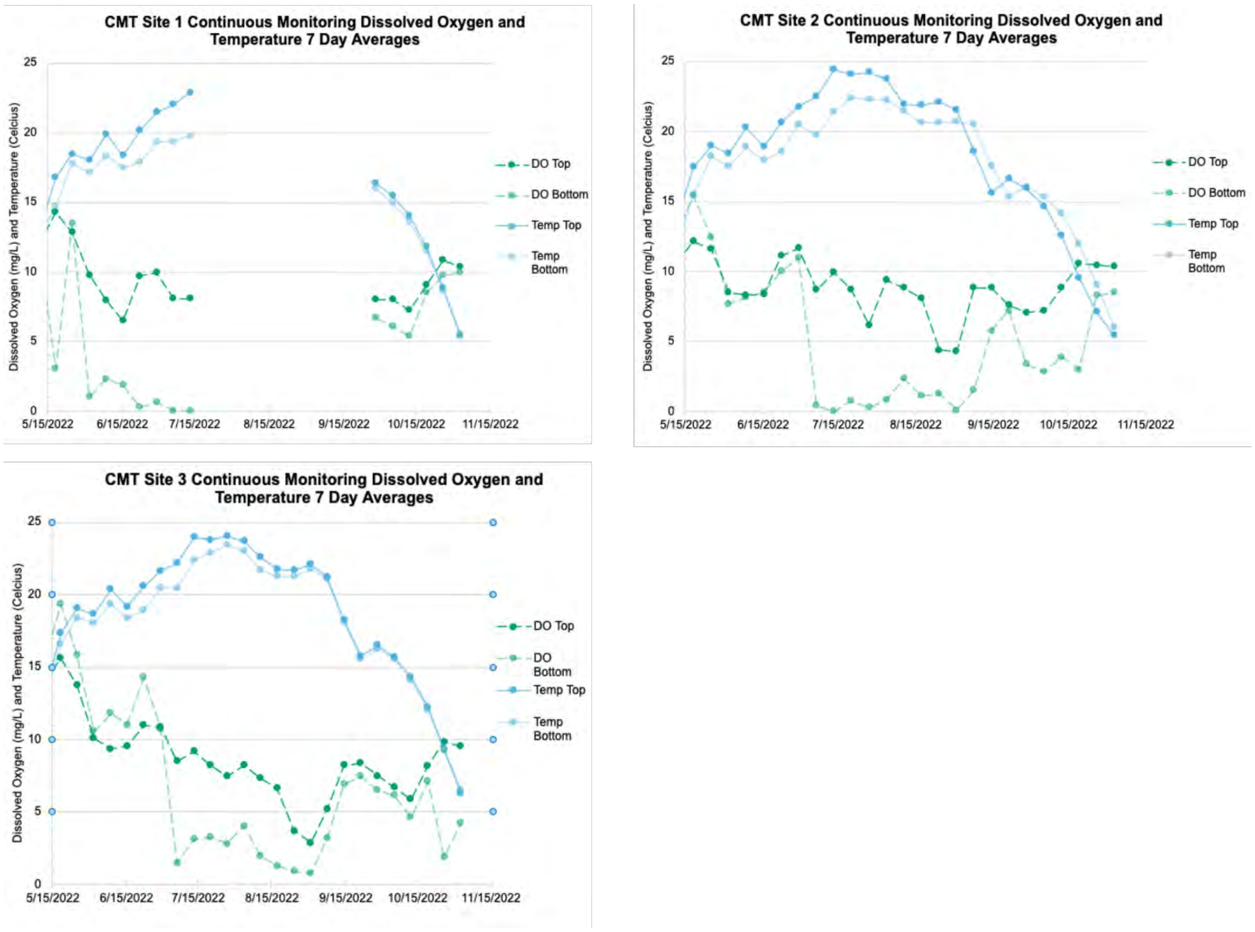


Figure 5-12. DO and Water Temperature in Upper and Lower Water Column in Endothall-only Sites 1, 2, 3

5.3 Herbicide Residue and Degradant/RWT Dye in West Lagoon Sites

5.3.1 General Description

The following graphs (5-13 to 5-18) show the levels of Endothall and Triclopyr, including Triclopyr degradants TCP and TMP. Two graphs are presented for each CMT Site: A large-scale graph that encompasses the maximum herbicide levels followed by a graph with an expanded lower scale to better depict the lower levels of herbicides over time. Even though sites are separated by their nominal (intended) type of herbicide applications, levels of Triclopyr were also detected in the other non-Triclopyr sites. This is particularly true for sites in Area A (Figure 2-3) since no physical barriers were placed between several sites (except for Site 14) and thus herbicides could diffuse, which would result in incursions to adjacent areas. (Supporting tabular data for the graphs is provided in Appendix S and Z)

5.3.2 Synopsis of Herbicide and RWT Dye Monitoring Results

Note that the Receiving Water Limit (RWL) (100 µg/L) applied to areas outside Sites 1, 2, 3 and that levels greater than the RWL were permitted INSIDE treatment sites up to 21 DAT. The pattern of Endothall levels in Sites 1,2,3 was similar with peak levels (940 to 970 µg/L) occurring by June 3 (10 DAT, after which levels fell rapidly to below detection (<5 µg/L)) at all three sites by July 18 (45 DAT). A transient RWL limit event occurred outside the turbidity curtains and was reported to Lahontan (see Table 14-1 and Appendix Z). Migration of Triclopyr into Endothall-only sites occurred, reaching a maximum of 25 µg/L, and persisting above “non-detect” levels (1 µg/L) until September 9 (100 DAT). This condition, and other Triclopyr detections in Area A, prevented removal of turbidity curtains until September 19-23. Transient detections of Triclopyr degradants were also noted; however, the degradant level reached non-detect well before Triclopyr reached non-detect and therefore did not affect criteria for curtain removal. Tabular data documenting levels of Endothall, Triclopyr, and Triclopyr degradants are provided in Appendices S and Z)

5.3.3 Supporting Graphical Data for Herbicide Levels

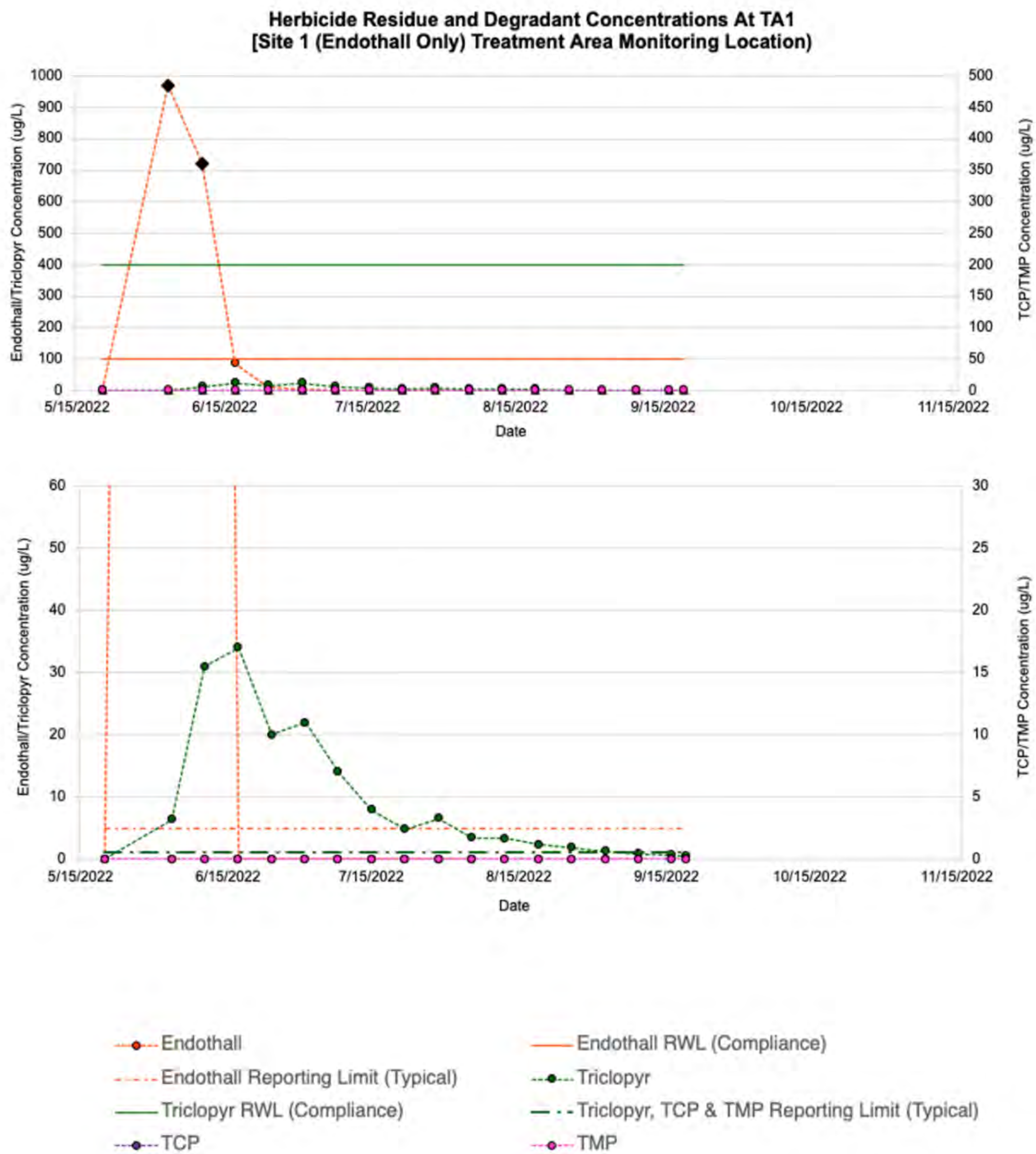


Figure 5-13. Level of Endothall and Triclopyr and Degradants in Endothall-only Treatment Site 1

Incursions of Triclopyr are shown in the expanded scale graph in Figure 5-13.

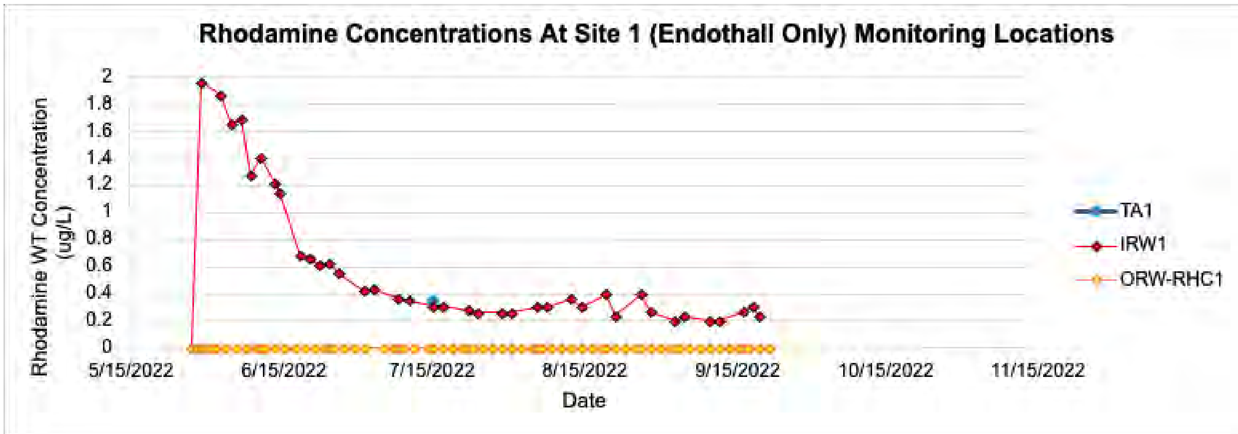


Figure 5-14. RWT Dye in Site 1

IRW1 are sampling stations adjacent to Site 1. ORW-RHC1 are sample sites outside double turbidity curtains (see Figure 1-1).

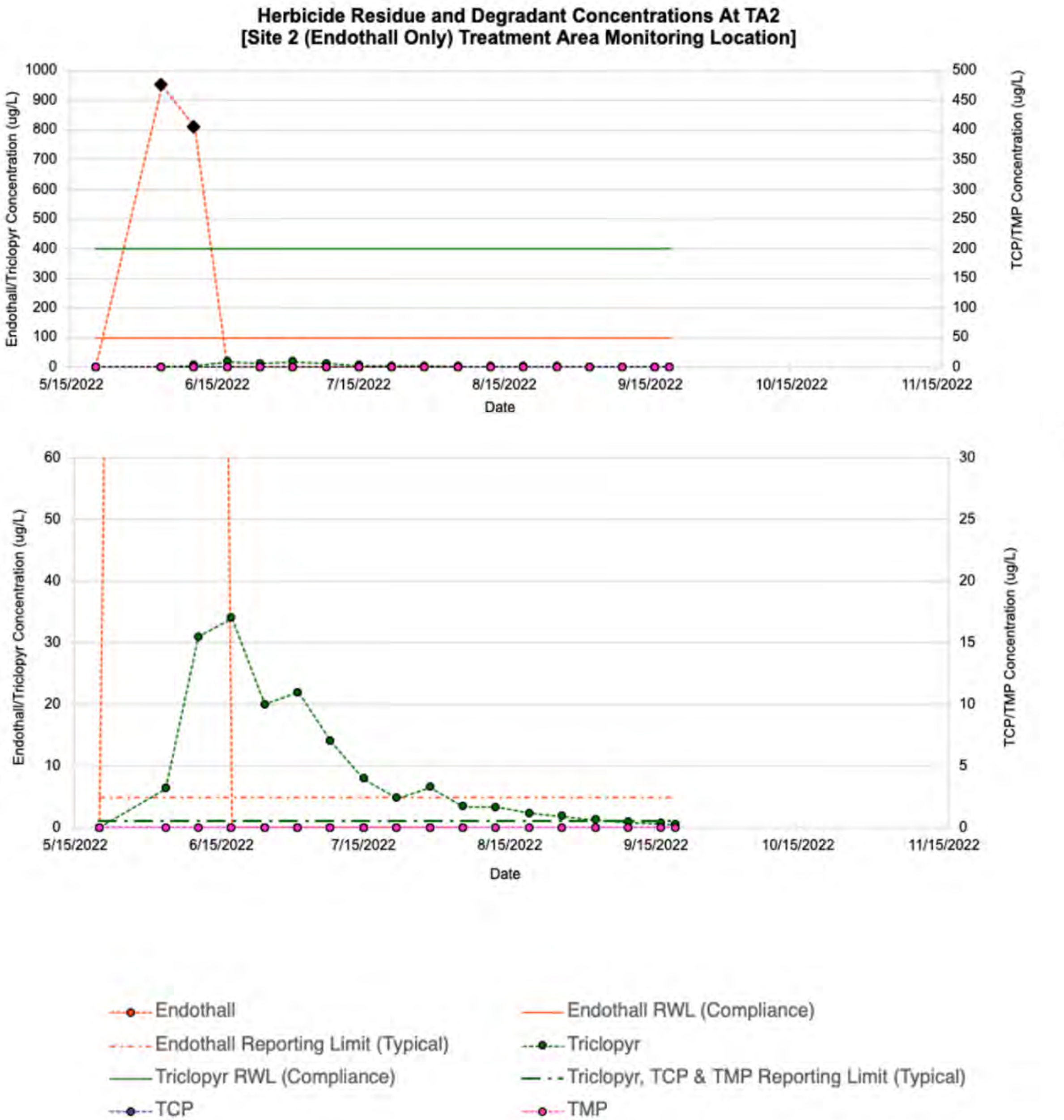


Figure 5-15. Level of Endothall and Triclopyr and degradants in Endothall-only Treatment Site 2

Incursions of Triclopyr are shown in the expanded scale graph in Figure 5-15.

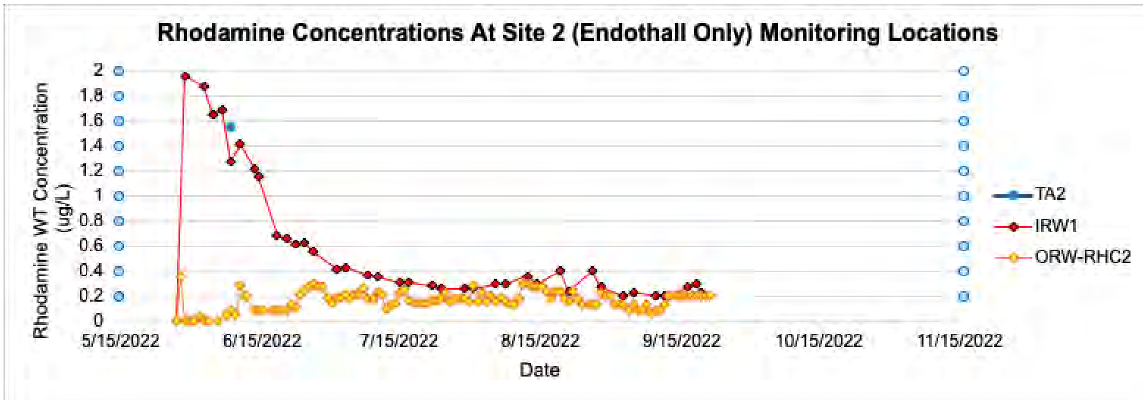


Figure 5-16. RWT Dye in Site 2

IRW1 samples are adjacent to Site 2. ORW-RHC2 are samples taken outside double turbidity curtains. RWT detections triggered contingency samples for presence of herbicides at contingency stations.

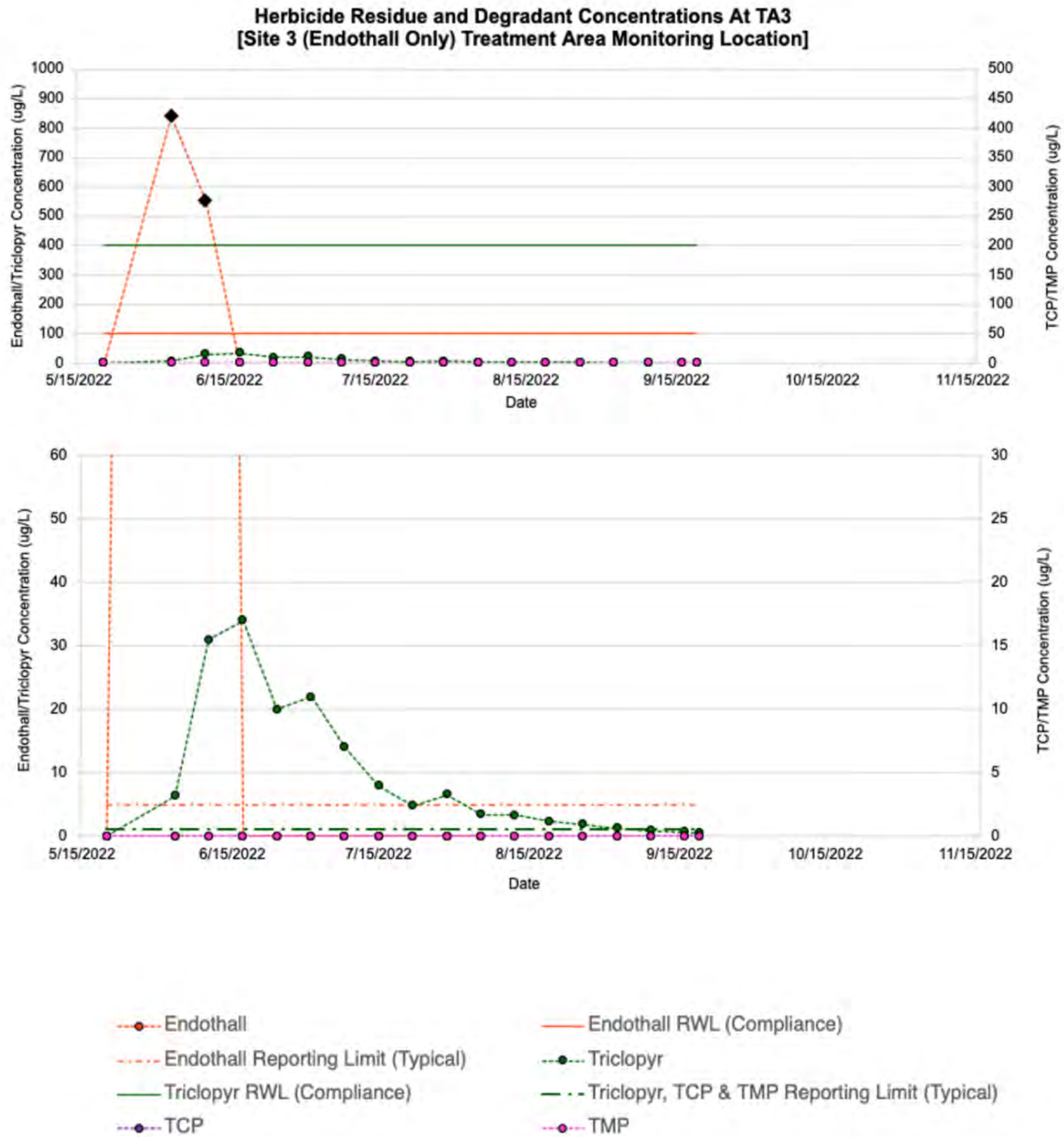


Figure 5-17. Endothall and Triclopyr and degradant Levels in Endothall-only Treatment Site 3

Incursions of Triclopyr are shown in expanded scale graph in Figure 5-17.

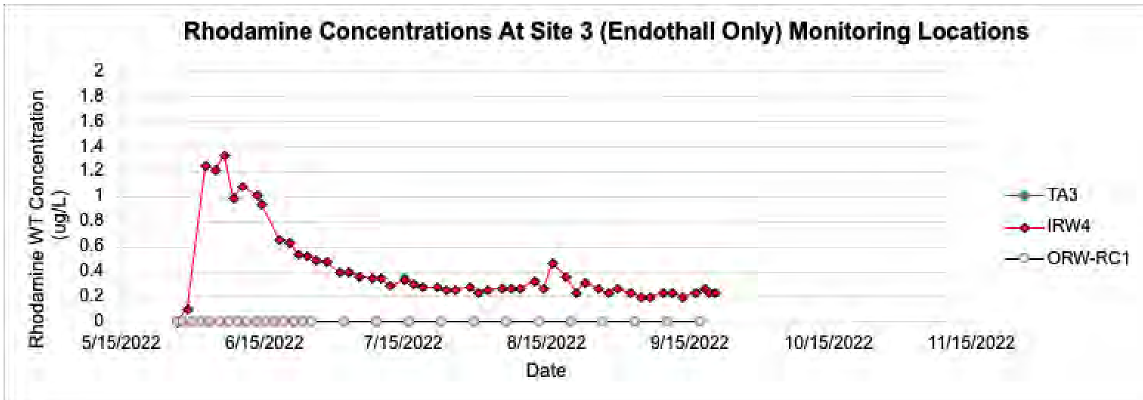


Figure 5-18. RWT Dye in Site 3

IRW4 sample station is adjacent to Site 3 and ORW-RHC1 is located outside the curtains near Site 3.

5.4 AIP Responses

Endothall is selective for the targeted AIP and was able to reduce all AIP biovolume and occurrence by 75%. This reduction in multispecies AIP reduced pH temporarily, and led to increases in Total P and Total N. The pH returned to control levels by October. Importantly, native plant occurrence increased compared with control sites. Vessel hull clearance was also achieved in the Endothall-only sites. The decomposition of AIP coupled with increased algal production together led to a spike in turbidity well above control levels and above those observed in the Triclopyr or UV treatments. Unfortunately, high turbidity was pervasive throughout Area A (Figure 5-9), which in turn probably reduced the photolysis of Triclopyr in the same area. Thus, although Endothall was very effective in controlling AIP, this success was somewhat offset by the elevated turbidity that may have driven long persistence of Triclopyr, all of which resulted in keeping the double curtains in place for over three months. The occurrence of HABs in these sites, and in general in Area A may be due to general release of both N and P. However, HABs occurred in control sites as well. Sustaining the curtains for such a long period also prevented normal water exchange and mixing, which might have lessened turbidity and improved conditions in Area A.

6.0 LAKE TALLAC ENDOTHALL TREATMENT SITES MONITORING RESULTS (SITE 19)

6.1 General Description

Endothall (Aquathol K) was applied as a liquid formulation to Site 19 in Lake Tallac using drop hoses on May 31, 2022. RWT dye was injected with Endothall. Treatment Site 19 was within 100 feet from the initial control Site 21 (Figure 1-1) with no physical barrier between these sites. Post-treatment water sampling outside Site 19 (near Site 21) revealed that Endothall and RWT dye had migrated toward Site 21. Subsequent macrophyte sampling also revealed that AIP demonstrated herbicide effects (reduced biovolume, poor plant health). Therefore, control Site 21 was deemed compromised for use as an untreated site. For this reason, Lake Tallac control Site 20, located outside the double curtains (Figure 1-1) was used to compared effects of Endothall and "untreated" conditions. (See Appendix E for results of macrophyte responses in Sites 19, 20,21.)

6.2 Synopsis of Nutrient and Water Quality Results

<u>Nutrients</u>: (Figures 6-1 through 6-5) Total N and Total P were higher than regulatory levels in both control Site 20 and Endothall treated Site 19 during the entire monitoring period. However, both Total P and Ortho-P were elevated about 2-fold in Site 19 compared with control site levels. Neither Total N, Nitrate+Nitrite, nor TKN changed appreciably after Endothall application in Site 19 compared with control Site 20.

<u>Water Quality</u>: (Figures 6-6 through 6-12) A similar temperature pattern occurred in Lake Tallac as in the West Lagoon, except that the spring temperature was slightly higher than the West Lagoon sites (about 17.5° C vs. 16° C) but reached a similar peak and plateau of 22-24° C by mid-summer, followed by decline to <10° C by mid-October. However, both mid-depth DO, and pH decreased in Site 19 within 2 to 3 weeks after Endothall treatments. Mid-depth DO was below limit levels (<5 mg/L) until late August. The pH levels in the Endothall treatment areas were lower than controls which resulted in maintaining pH within the regulatory range for most of the summer (Figure 6-8).

Although turbidity increased in controls during the summer, turbidity in the Endothall site increased 2 to 3-fold above control levels reaching a maximum at 9 to10 NTU when control levels were 2 to 5 NTU. ORP was highly variable, though elevated in Endothall treatment. Conductivity increased more rapidly during the summer in the Endothall site compared with control Site 20. Taken together, other than turbidity, which increased less in the Lake Tallac site, similar patterns were observed in the West Lagoon Endothall treatment sites.

6.2.1 Supporting Graphical Data for Nutrients

a) Total N

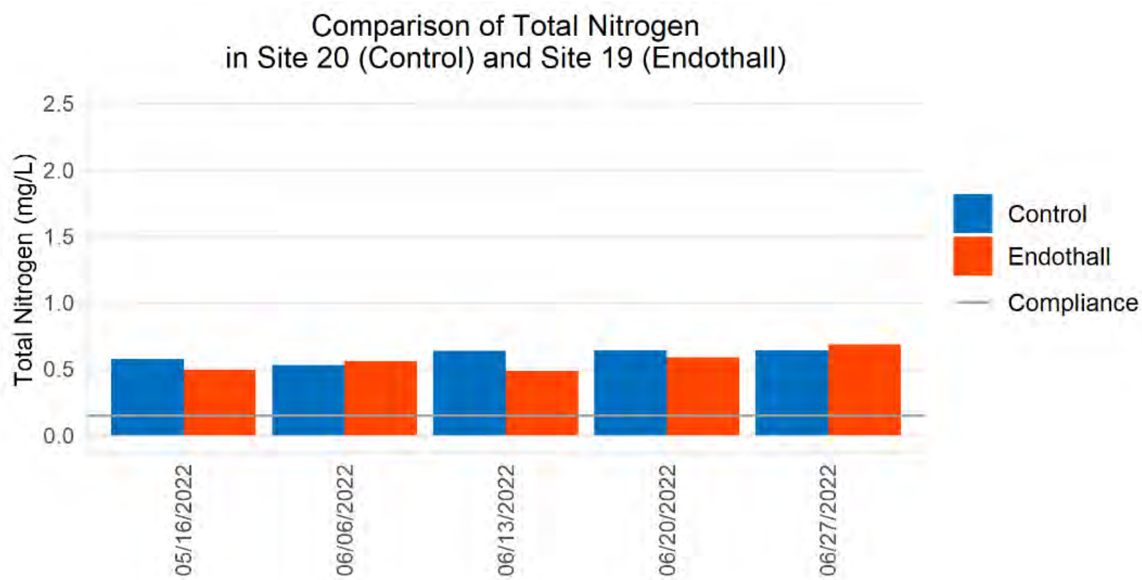


Figure 6-1. Total N in Lake Tallac Endothall-only Site 19 and Control Site 20

b) Nitrate+Nitrite

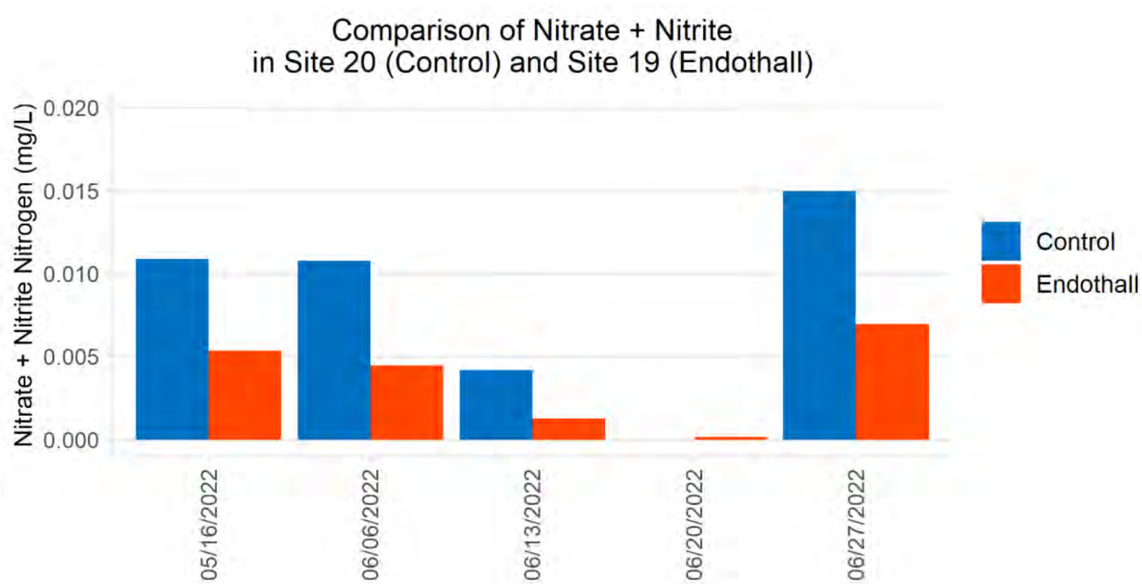


Figure 6-2. Nitrate+Nitrite in Lake Tallac Endothall Site 19 and Control Site 20

c) TKN

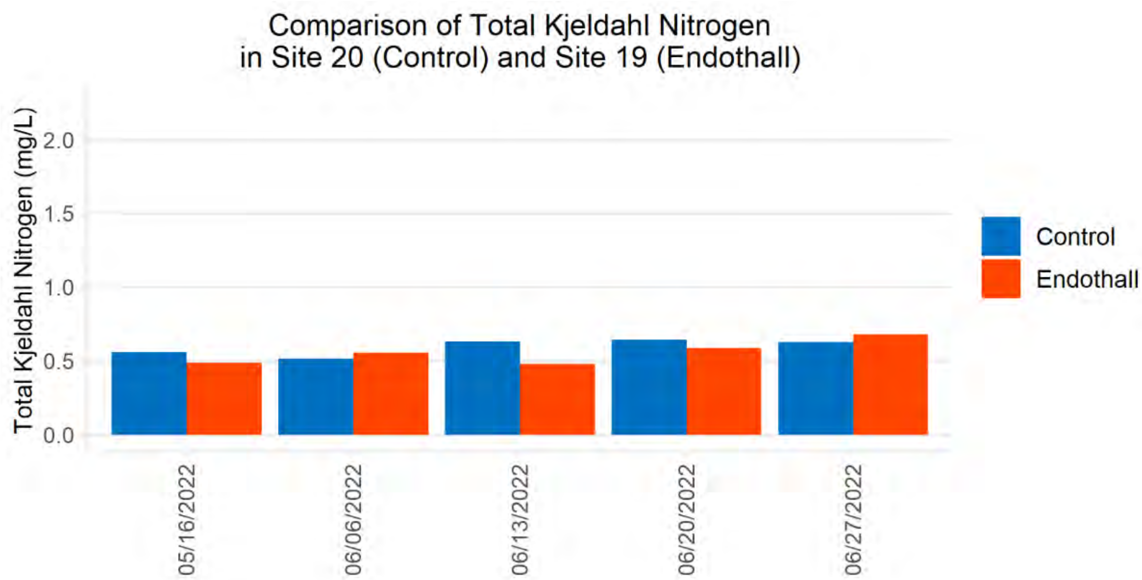


Figure 6-3. TKN in Lake Tallac Endothall-only Site 19 and Control Site 20

d) Total P

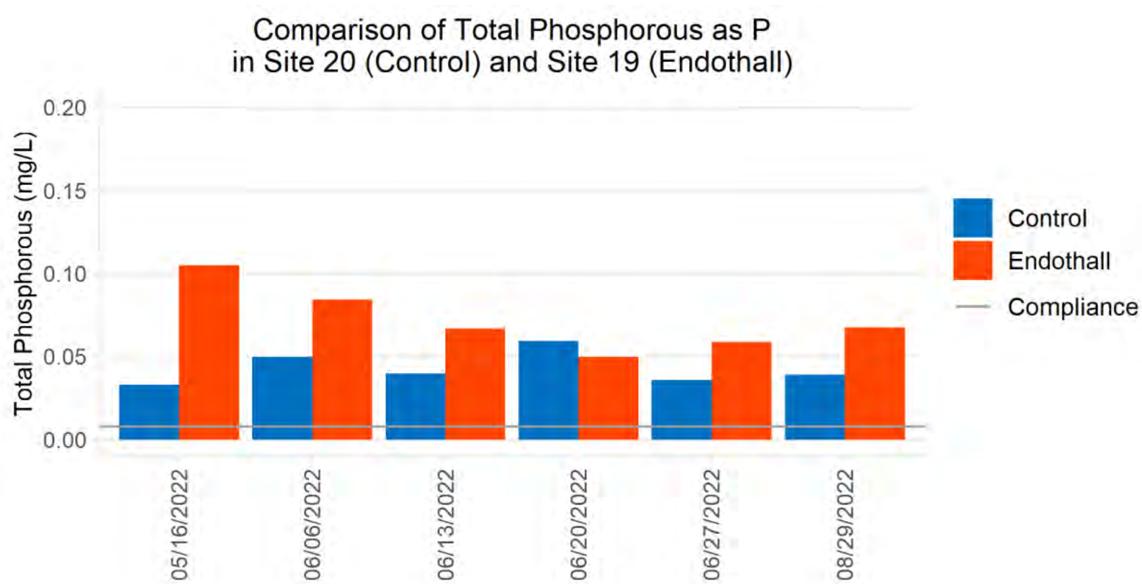


Figure 6-4. Total P in Lake Tallac Endothall-only Site 19 and Control Site 20

e) Ortho-P

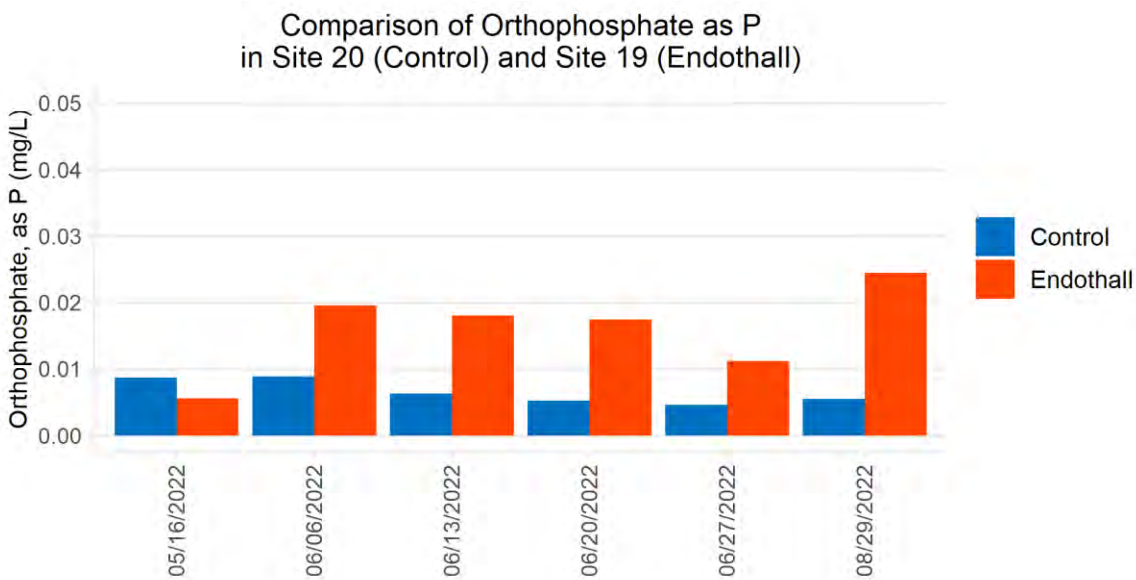


Figure 6-5. Ortho-P in Lake Tallac Endothall-only Site 19 and Control Site 20

6.2.2 Supporting Graphical Data for Standard Water Quality

a) Temperature

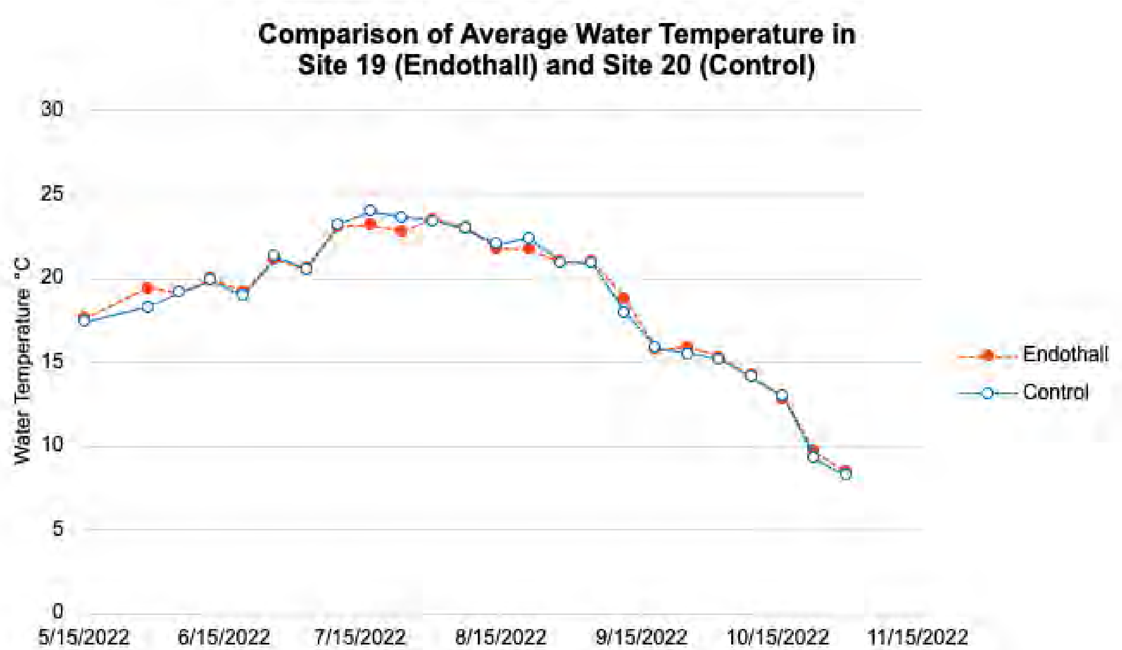


Figure 6-6. Water Temperature at Mid-depth in Endothall-only Site 19 and Control Site 20

b) DO

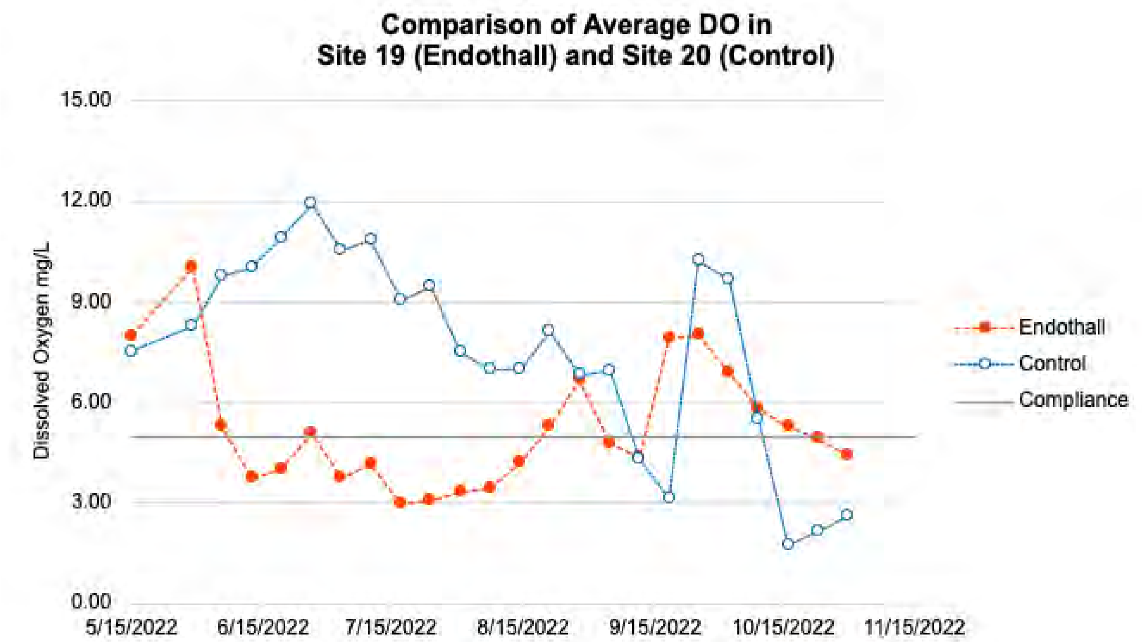


Figure 6-7. DO at Mid-depth in Lake Tallac Endothall Site 19 and Control Site 20

c) pH

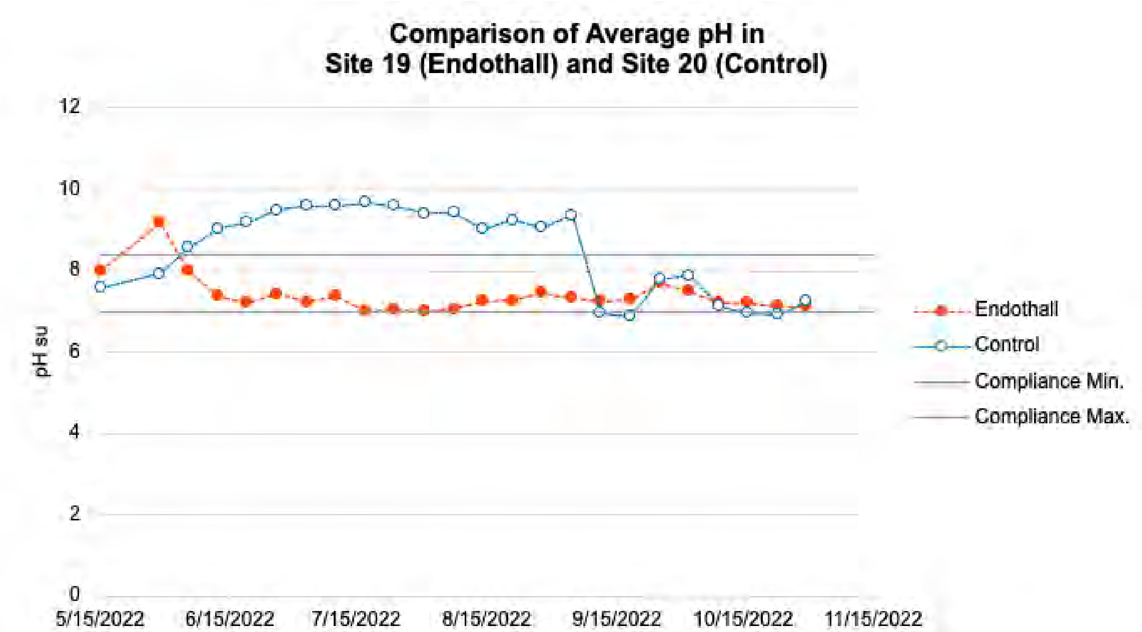


Figure 6-8. pH at Mid-depth in Lake Tallac Endothall Site 19 and Control Site 20

d) Turbidity

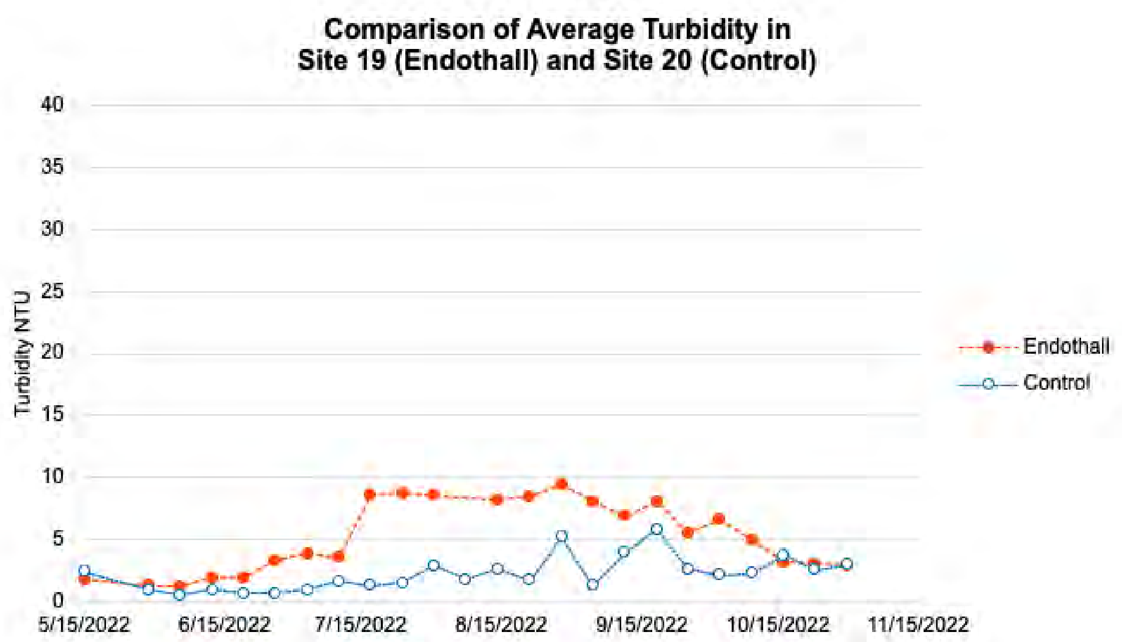


Figure 6-9. Turbidity at Mid-depth in Lake Tallac Endothall Site 19 and Control Site 20

e) ORP

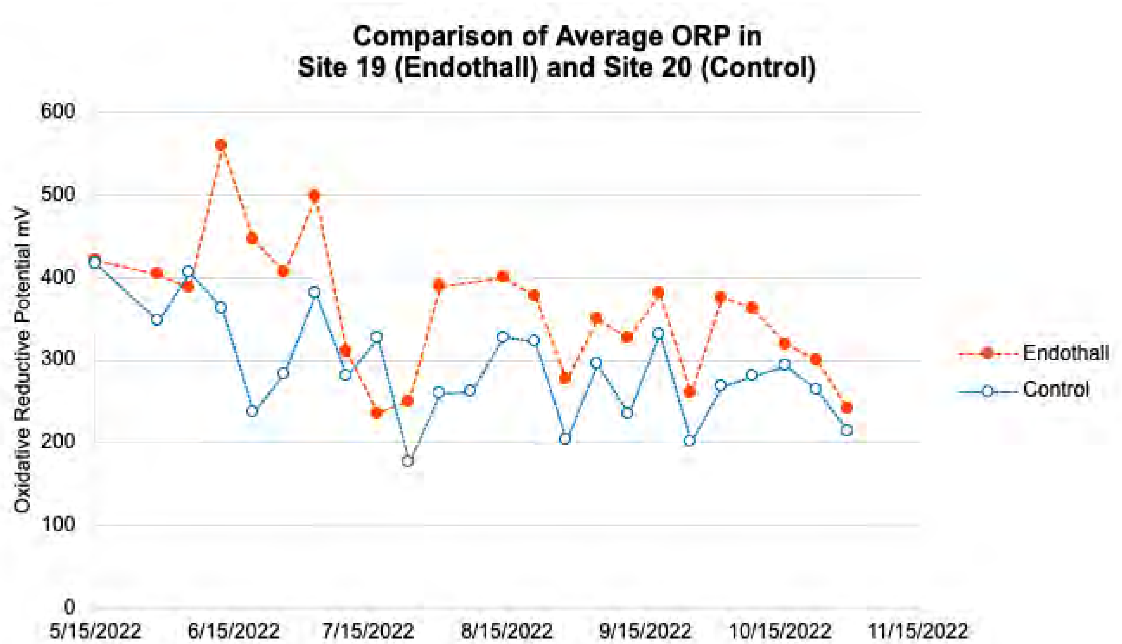


Figure 6-10. ORP at Mid-depth in Lake Tallac Endothall Site 19 and Control Site 20

f) Conductivity

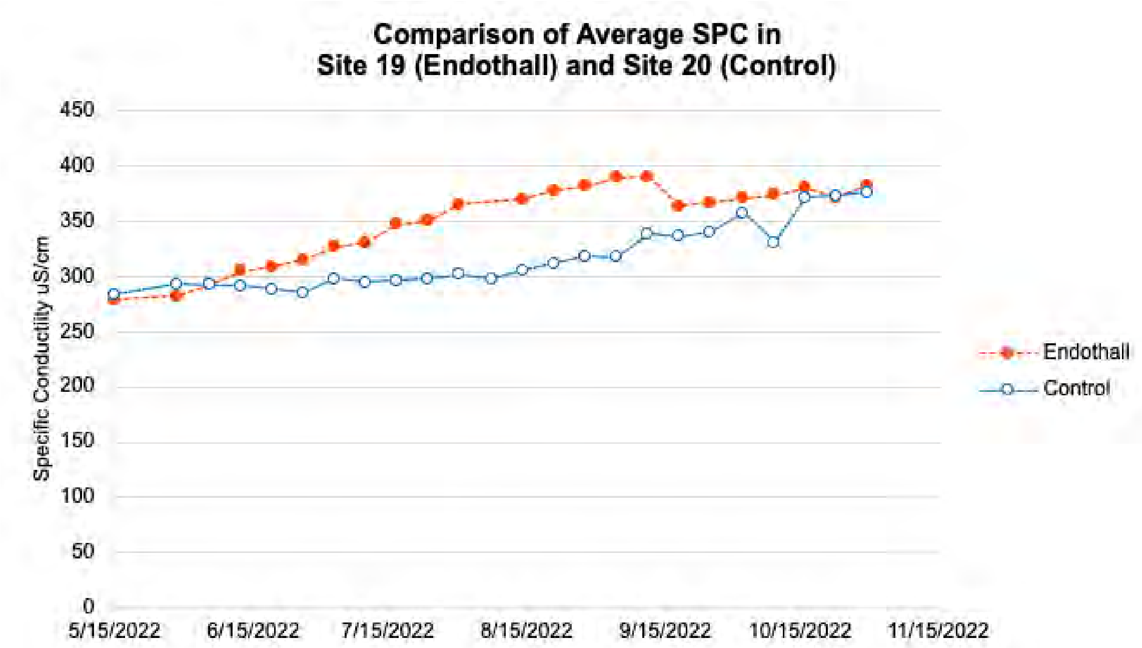


Figure 6-11. Conductivity at Mid-depth in Lake Tallac Endothall Site 19 and Control Site 20

6.2.3 Supporting Graphical Data Continuous Logger DO and Temperature

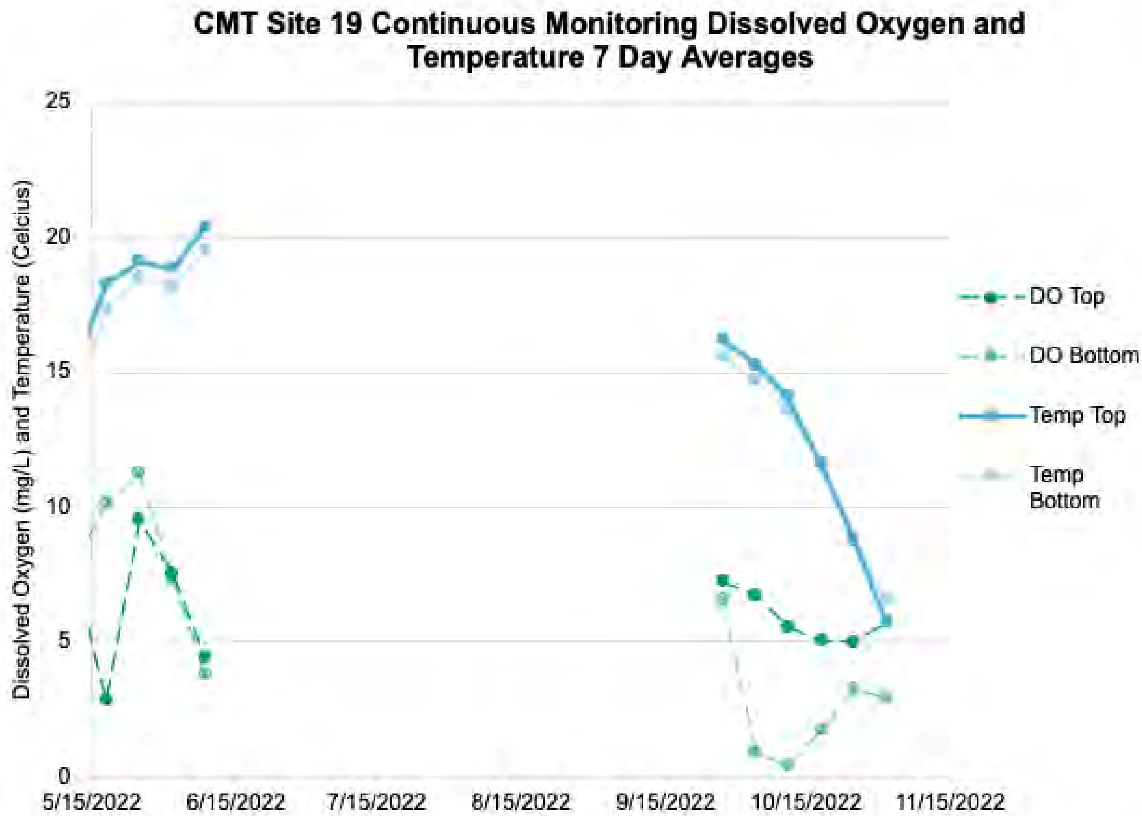


Figure 6-12. DO and Temperature at Upper and Lower Water Column in Lake Tallac Endothall Site 19

Values shown in Figure 6-12 are weekly means derived from hourly measurement. Gaps in data are due to dislodging and removing loggers by wildlife (bears) to unknown locations. Loggers were replaced in September.

6.3 Herbicide Residue and Degradant/RWT Dye in Lake Tallac

6.3.1 General Description

Endothall was applied on May 31, 2022 using drop hoses in this 2-acre site. RWT dye was injected with Endothall. There were no applications of Triclopyr in Lake Tallac. Neither Triclopyr nor its degradants were detected in any samples.

6.3.2 Synopsis of Endothall Levels

RWL for Endothall (100 µg/L) applies to areas outside Site 19, but that levels above RWL are permitted inside treatment Site 19 up to 21 DAT and are not deemed out of compliance (Figures 6-13 and 6-14). Endothall levels reached a maximum of 440 µg/L within 10 DAT but was transiently in exceedance of the 100 µg/L RWL 21 DAT inside Site 19: June 21st (360 µg/L at 21 DAT), and on June 28 (220 µg/L at 28 DAT). (See Table 14-1.) Endothall non-detect level (<5 µg/L) was reached by mid-August, or 75 DAT. RWT dye from Site 19 was detected outside Site

19 (IRW9, toward prior control Site 21) within 3 DAT and detection persisted through August. The RWT dye detections outside Site 19 prompted contingency sampling for Endothall at ORW RH-2 (outside the curtain) and ORW RH-1 (west end of Lake Tallac near 15th St) (Figure 1-1, Table 14-1). Endothall at the IRW9 sampling station (outside of Site 19 toward Site 21, Figure 1-1) was above the RWL (100 µg/L) between June 3rd and June 21st (21 DAT). During this time, Endothall levels ranged from 350 to 460 µg/L, and gradually decreased to non-detect (<5 µg/L) by August 23. However, Endothall was always contained behind the double turbidity curtains during this period. These data further suggest that an incursion of Endothall occurred into original control Site 21 and that it could have had been exposed to 200 to 400 µg/L Endothall for several days. The responses of AIP in Site 21 also are consistent with Endothall exposure. The macrophyte surveys in Site 19 revealed herbicide symptoms including poor plant condition ratings and impacts on the target AIP (Figures 6-15 and 6-16). Taken together, it appears that Site 21 was compromised and thus could not be used as an “untreated” control site. (See Section 6.4 and Appendix E.)

6.3.3 Supporting Graphical Data for Herbicide Levels

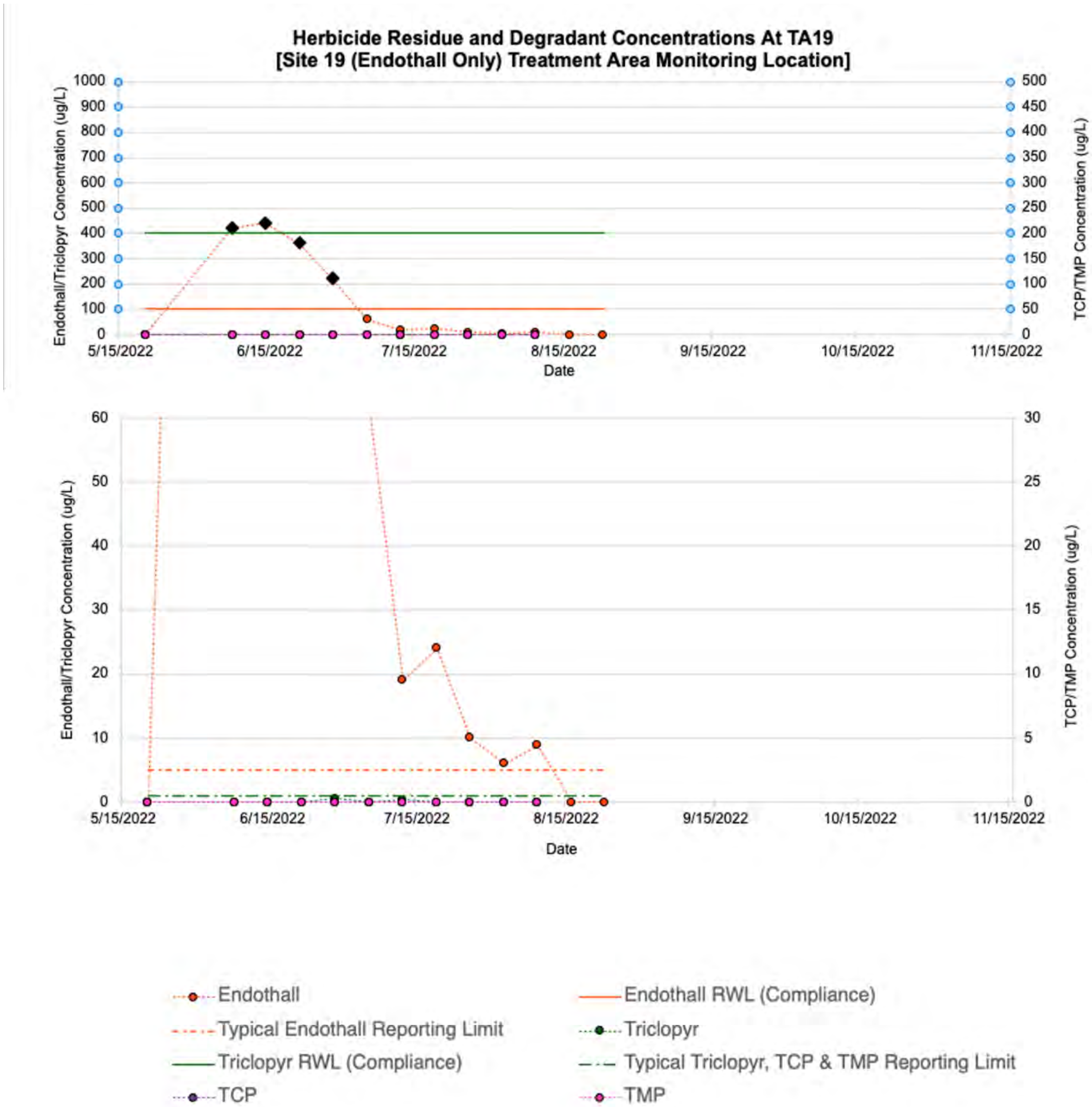


Figure 6-13. Endothall Levels in Site 19 in Lake Tallac

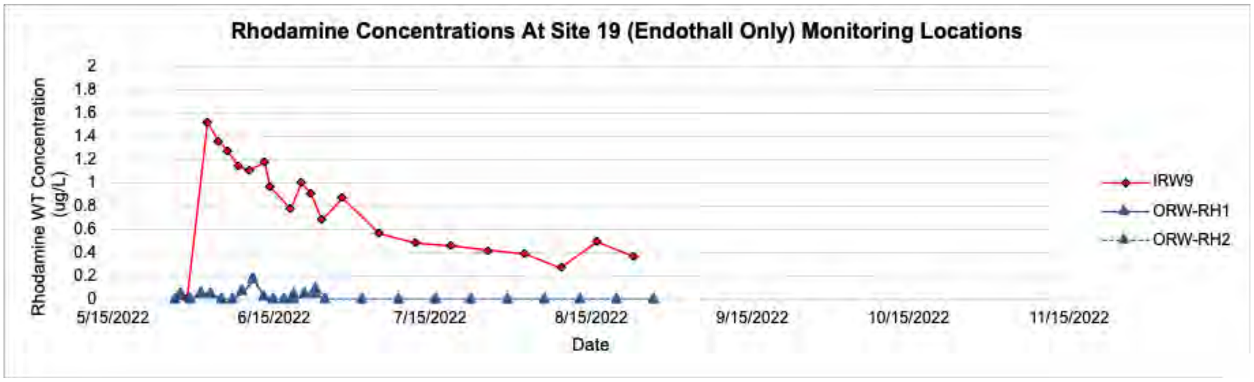


Figure 6-14. Dissipation of RWT Dye in Site 19

The IRW9 sample station is adjacent to Site 19 and between Site 19 and original control Site 21. ORW-RH1 samples are outside the double curtains in west Lake Tallac near 15th St; ORW-RH2 sample.

6.4 AIP Responses

Endothall is selective for the targeted AIP and was able to reduce all AIP biovolume and occurrence by 75%. This multispecies AIP reduction clearly led to reduced pH, DO, and some increase in Total P and Total N. The decomposition of AIP coupled with increased algal production led to a spike in turbidity (10 NTU; Figure 6-9), which were above control levels and above those observed in the Triclopyr or UV treatments in the West lagoon, this was a smaller increase than the turbidity “spike” in the Endothall-only treatments in West Lagoon Sites 1,2,3. Thus, although Endothall was very effective in controlling AIP in Lake Tallac, this success resulted in moderately elevated turbidity. Importantly, AIP conditions in Site 21 strongly suggest that Endothall reached this site with sufficient duration of exposure levels to affect the plants (Figures 6-15 and 6-16). These results disqualified Site 21 as an untreated “control” site.

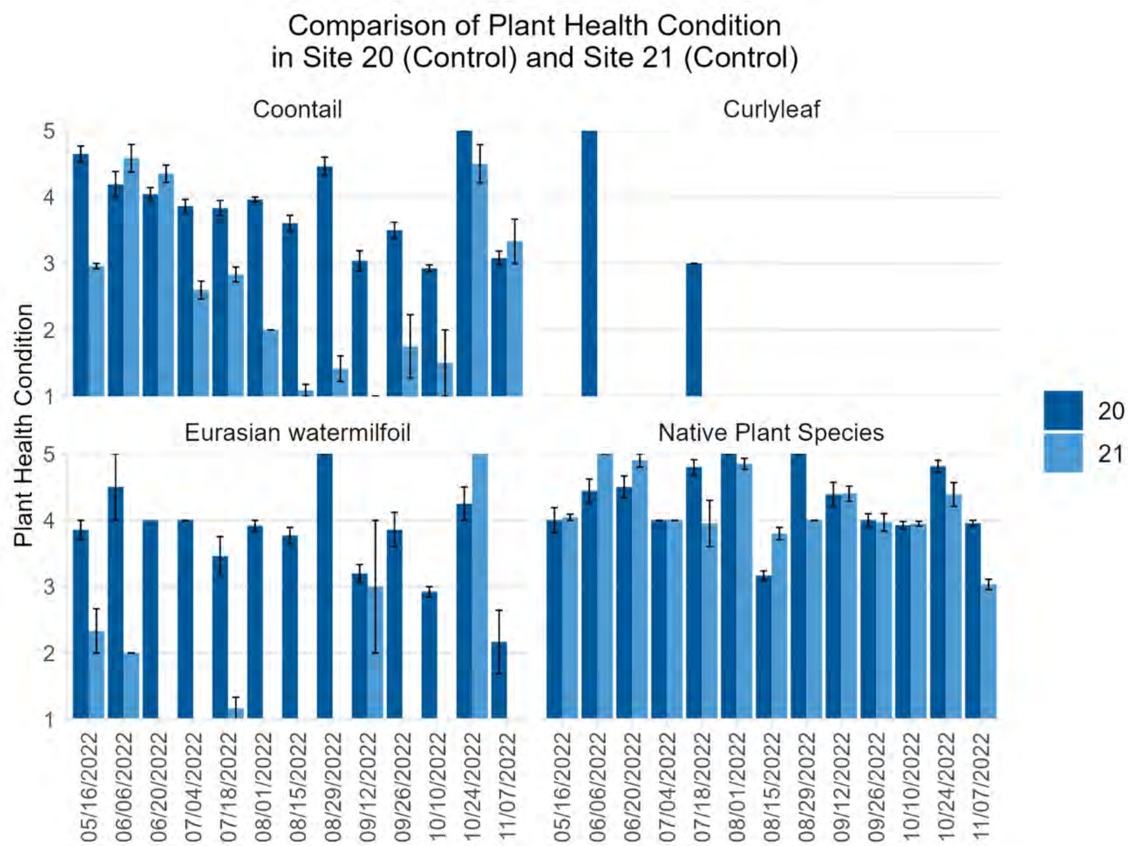


Figure 6-15. Macrophyte Health Condition Ratings in Site 21 (Formerly “Control Site 21”) Ranking of 1 or 2=Dead/Dying Plants; Ranking of 4-5= Healthy Plants

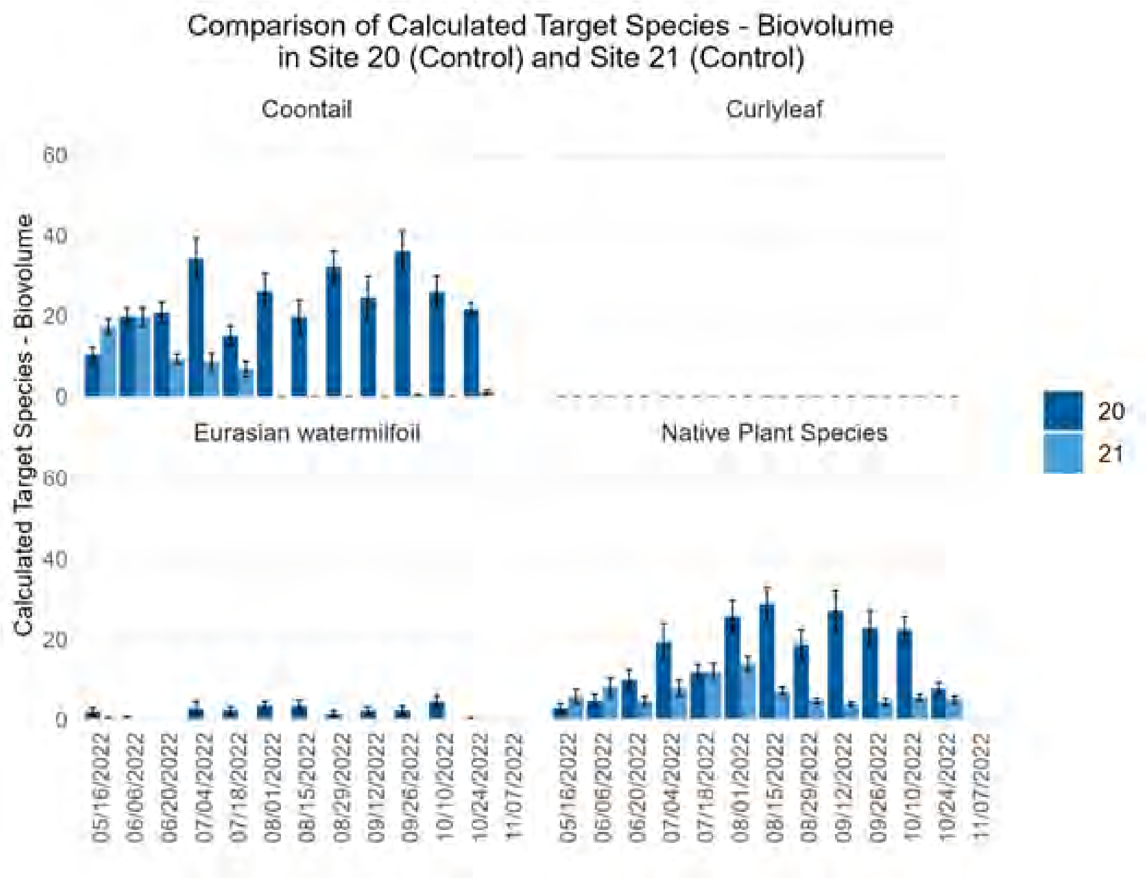


Figure 6-16. Biovolume of Plants in Lake Tallac Control Site 20 and Former Control Site 21

7.0 WEST LAGOON TRICLOPYR TREATMENT SITES MONITORING RESULTS (SITES 5, 8, 9)

7.1 General Description

Triclopyr was applied using drop hoses as Renovate 3 (liquid) in Sites 8 and 9 on May 25, 2022 and in Site 5 on May 29, 2022 without incident. RWT dye was injected with the herbicide. (See Figure 3-1a.) Sites 8 and 9 were located in restricted boating Area B and Site 5 was located in restricted boating Area A (Figure 2-3). Triclopyr is selective for control of Eurasian watermilfoil and was not expected to significantly affect other AIP or native plants, such as Elodea (*Elodea canadensis*). This also suggests that Triclopyr treatment effects on nutrients and water quality would be a result of Eurasian watermilfoil decomposition but that non-target, unaffected AIP would not cause similar effects.

7.2 Synopsis of Nutrient and Water Quality

Nutrients: (Figures 7-1 through 7-5) Total N in control sites was within regulatory levels, or slightly above at the end of summer. However, Triclopyr treatment resulted in increased Total N, reaching a maximum of 0.5 mg/L. TKN was also elevated in Triclopyr sites as compared with controls. In contrast, Total P was above regulatory limits in controls and in Triclopyr sites throughout the summer. Total P levels in Triclopyr treatment areas were not different from control levels (Figure 7-4).

Water Quality: (Figures 7-6 through 7-12) Water temperature at mid-depth was the same for Triclopyr and control sites and exhibited the same pattern as other CMT sites. Mid-depth DO and pH were slightly depressed in Triclopyr sites compared with control sites, and was outside the regulatory level (<5mg/L) in early August and early September. Triclopyr-driven reduction in Eurasian watermilfoil probably brought pH down to within regulatory prescribed range in mid-to-late summer compared with control site pH. Note that control which was consistently above the prescribed regulatory pH range. Conductivity increased similarly in both control and Triclopyr sites, although pre-treatment levels were higher in the Triclopyr sites.

Turbidity gradually increased in control sites during the summer reaching a maximum of 5 NTU. However, in Triclopyr sites, turbidity rapidly increased from pre-treatment levels to 12 to 15 NTU by mid-August (75 DAT), and then declined to control NTU levels (5 NTU) by early September (80 DAT). The hourly loggers showed that DO near the bottom was outside regulatory requirements (<5 mg/L) most of the summer, especially in Site 5 (Area A); whereas surface DO was > 5 mg/L most of the summer except in Site 5 mid-July to mid-September. A temperature differential of 1 to 2° C existed between surface and near bottom locations in all Triclopyr sites.

7.2.1 Supporting Graphical Data for Nutrients

a) Total N

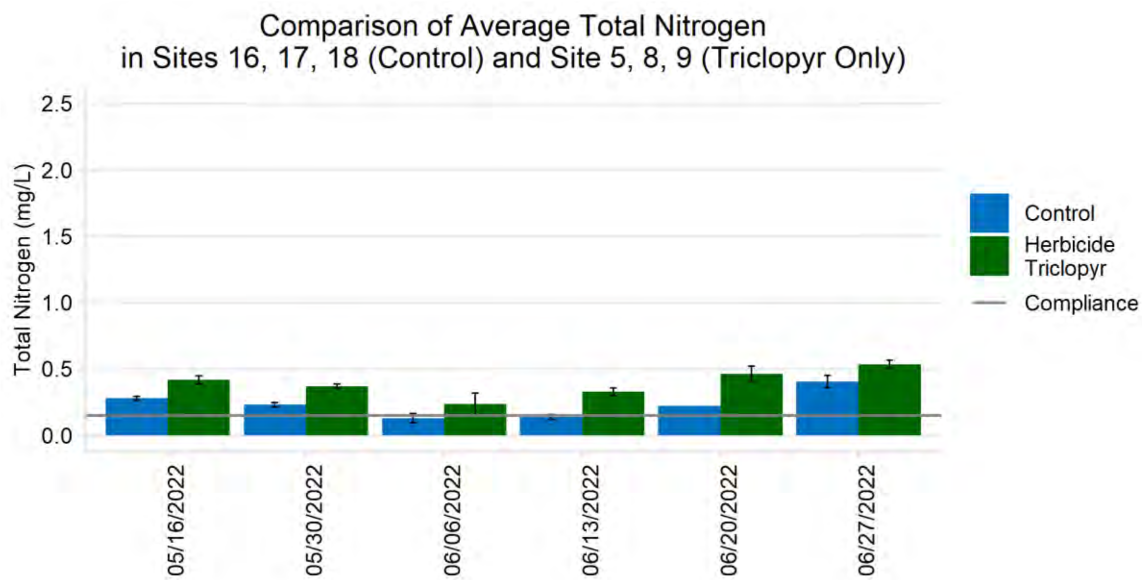


Figure 7-1. Total N in Triclopyr-only Sites Compared with Levels in Control Sites

b) Nitrate+Nitrite

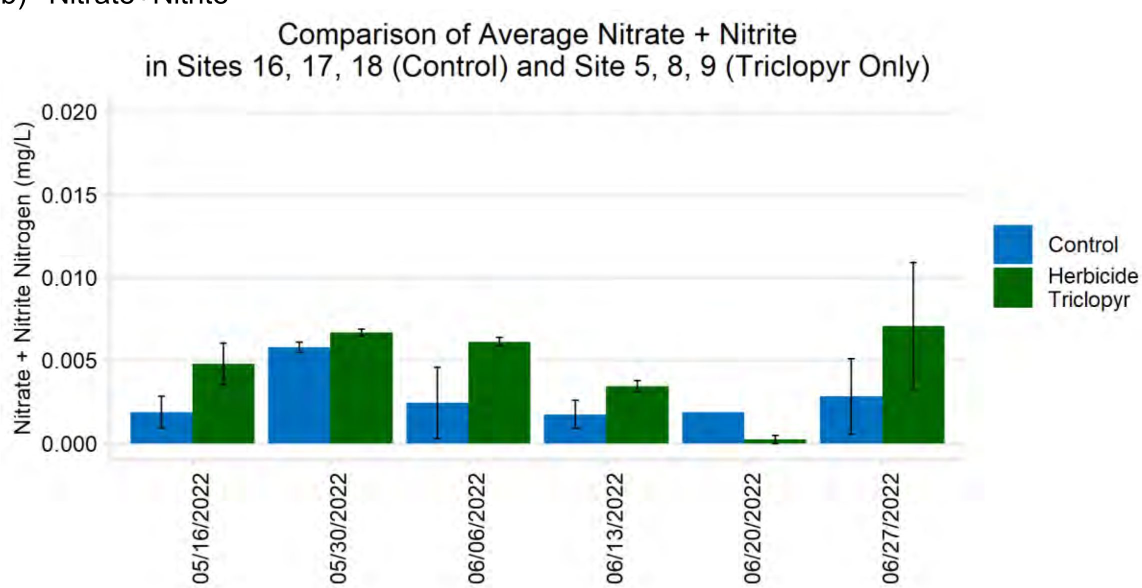


Figure 7-2. Nitrate+Nitrite Levels in Triclopyr-only Sites Compared with Levels in Control Sites

c) TKN

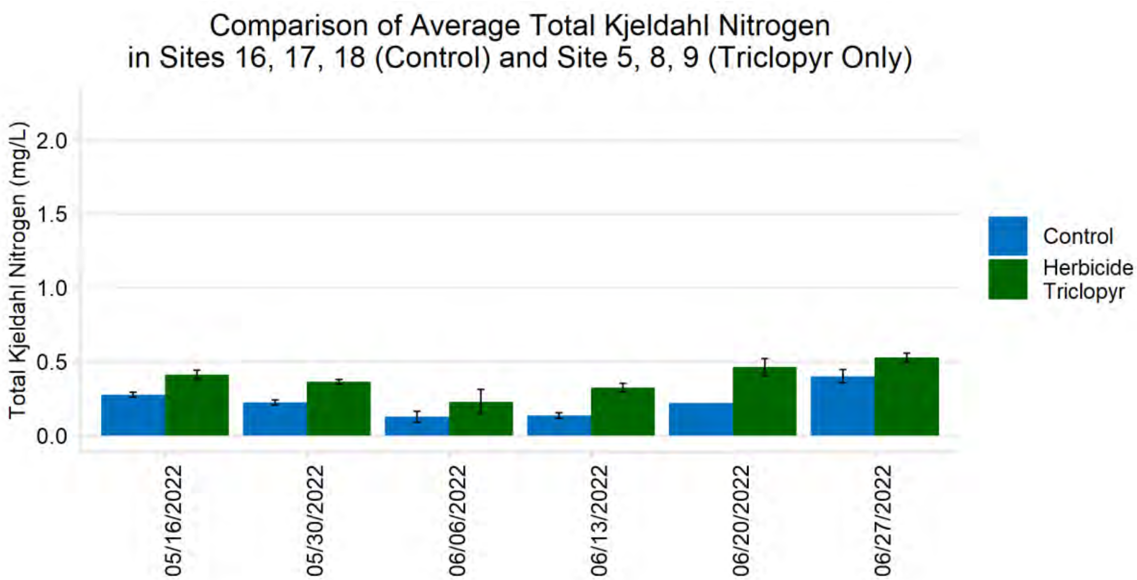


Figure 7-3. TKN in Triclopyr-only Sites Compared with Control Sites

d) Total P

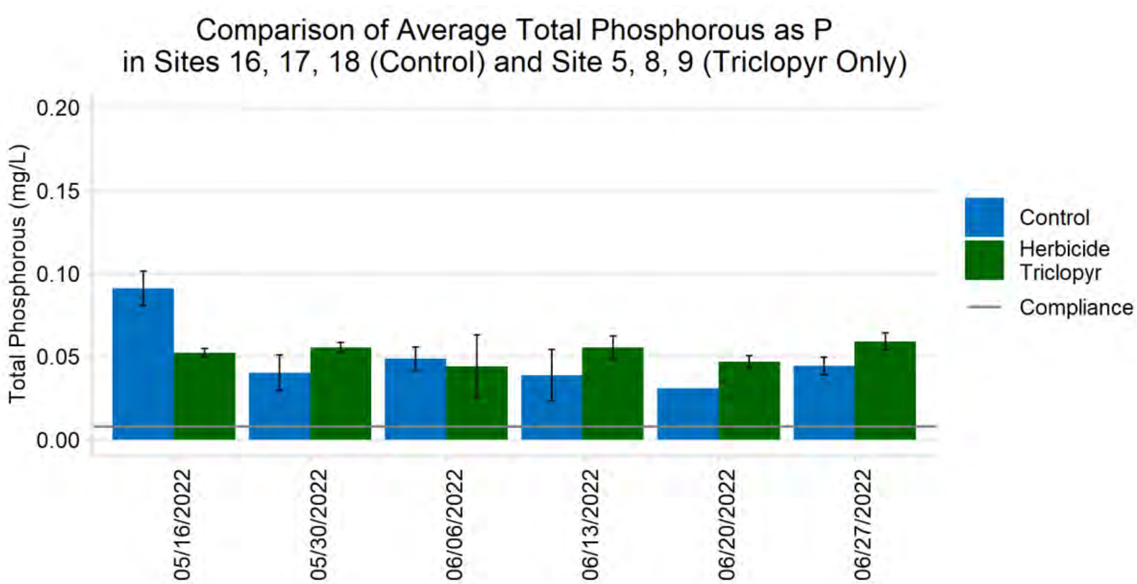


Figure 7-4. Total P in Triclopyr-only Sties Compared with Levels in Control Sites

e) Ortho-P

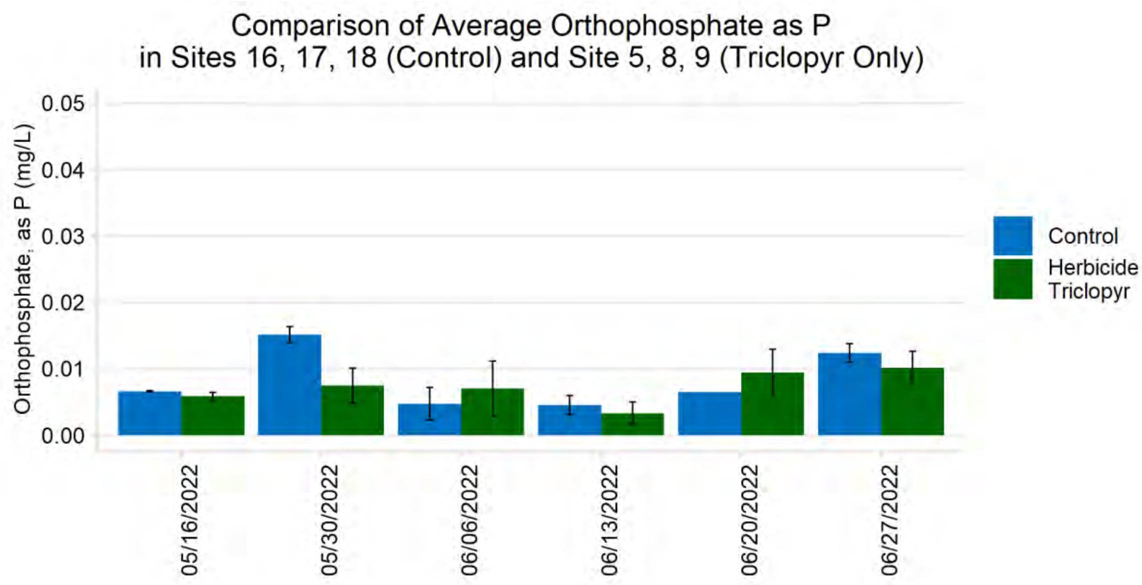


Figure 7-5. Ortho-P in Triclopyr-only Sites Compared to Control Sites

7.2.2 Supporting Graphical Data for Standard Water Quality

Sonde data was obtained 3 times per week.

a) Temperature

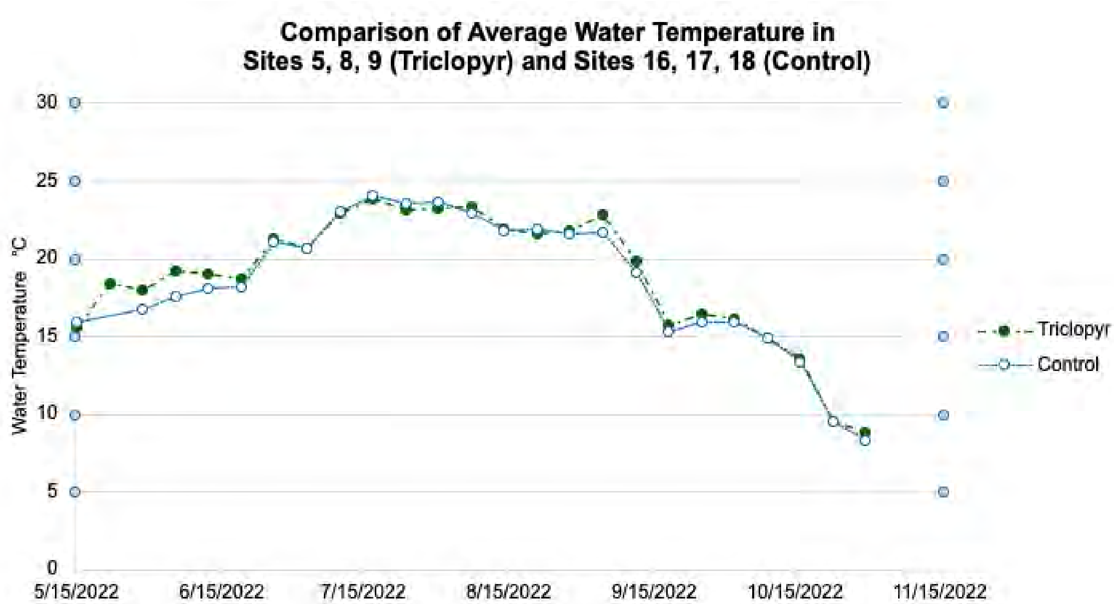


Figure 7-6. Water Temperature in Triclopyr-only Sites Compared with Control Sites

b) DO

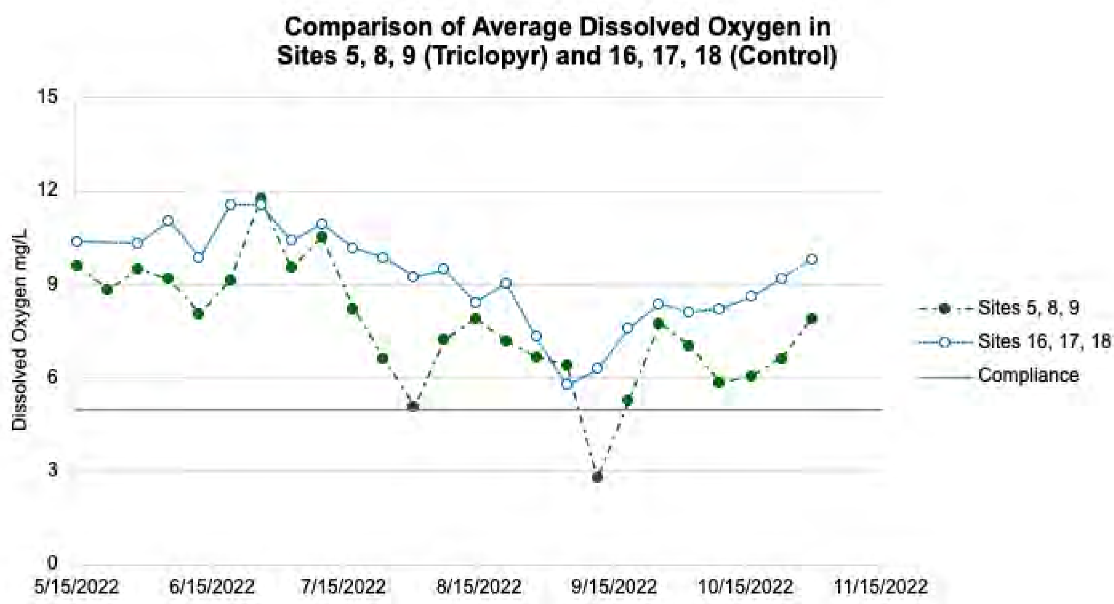


Figure 7-7. DO in Triclopyr-only Sites Compared to Control Sites

c) pH

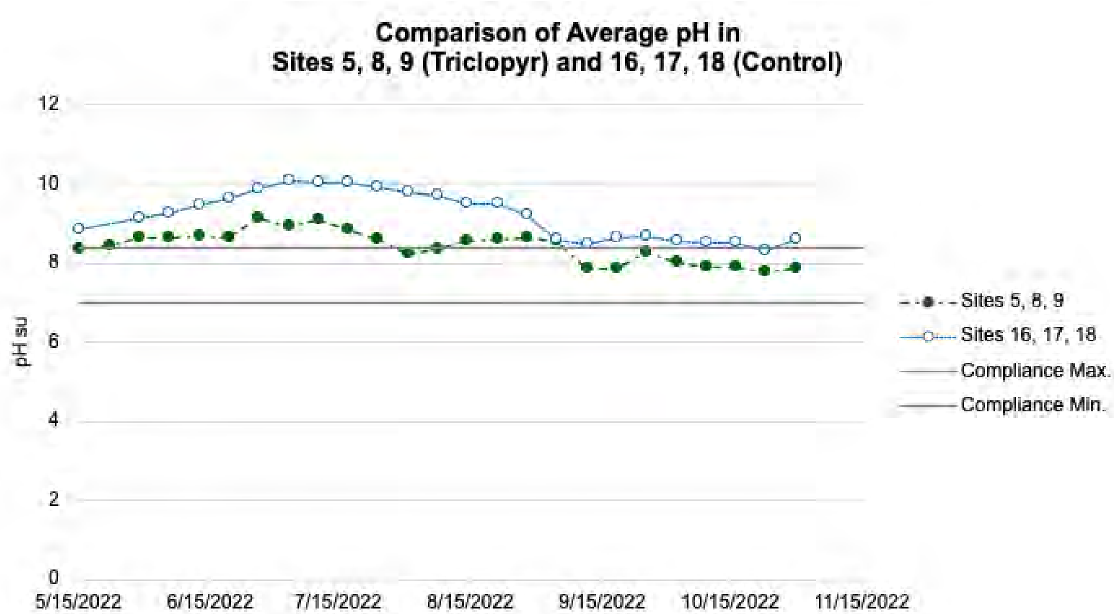


Figure 7-8. pH in Triclopyr-only Sites Compared with Control Sites

d) Turbidity

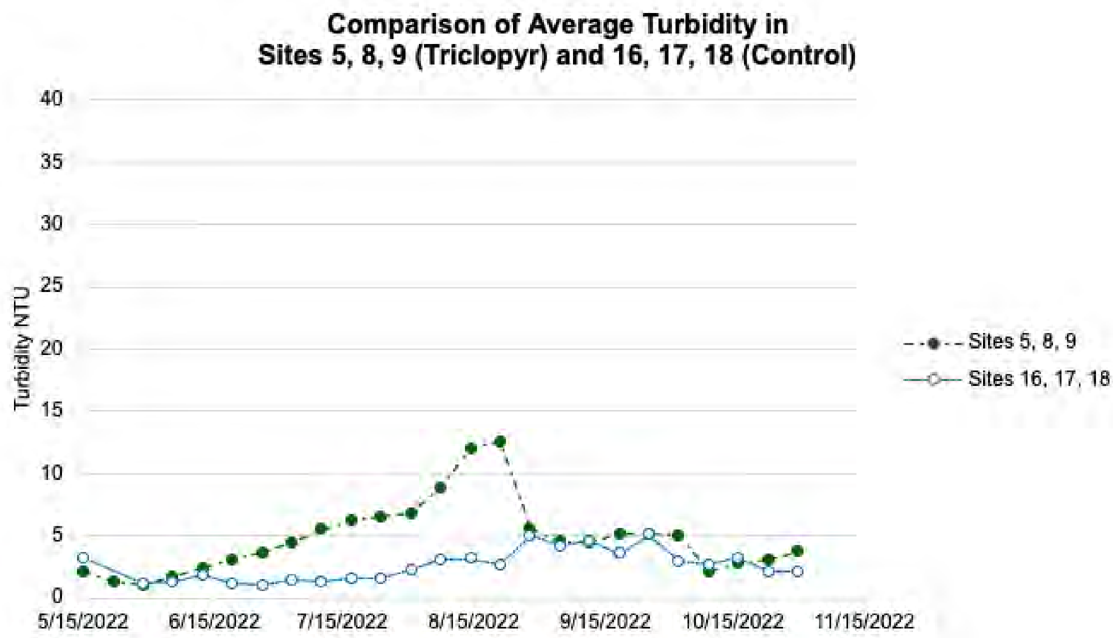


Figure 7-9. Turbidity in Triclopyr-only Sites Compared to Control Levels

e) ORP

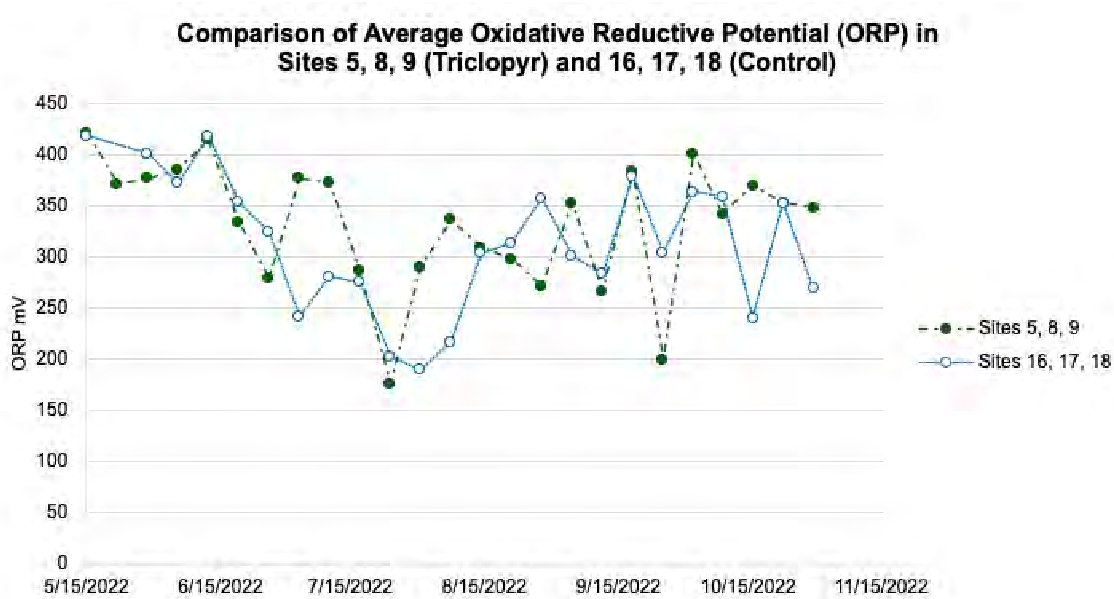


Figure 7-10. ORP in Triclopyr-only Sites

f) Conductivity

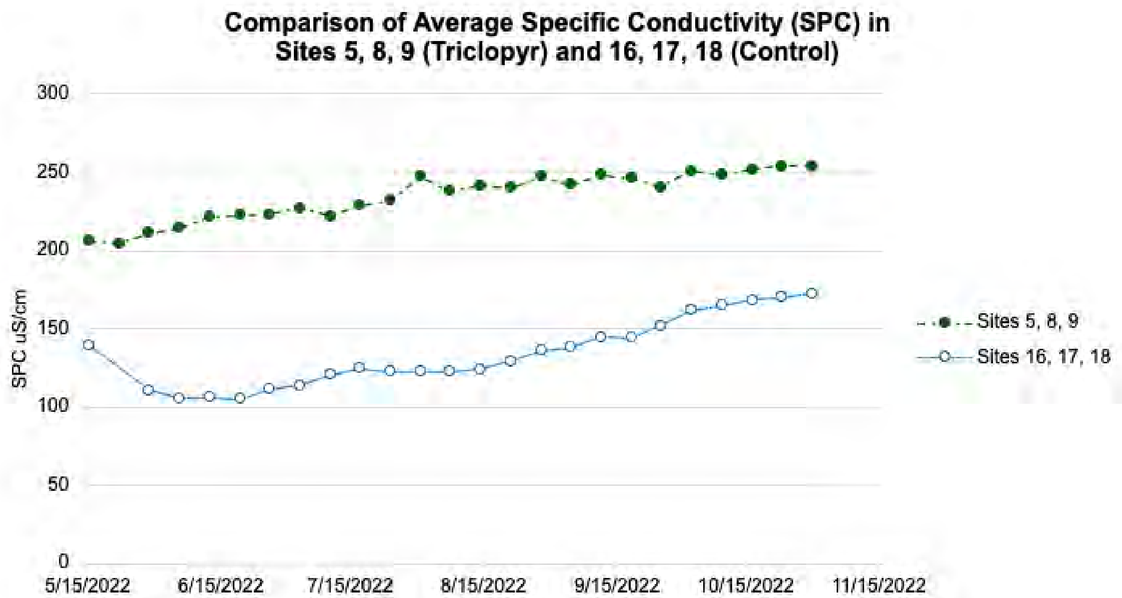


Figure 7-11. SpC in Triclopyr-only Sites Compared with Control Sites

7.2.3 Supporting Graphical Data for Continuous Logger DO and Temperature

Figure 7-12. DO and Water Temperature in Upper and Lower Water Column in Triclopyr-only Sites 5, 8, 9 (weekly means derived from hourly logged data)

7.3 Herbicide Residue and Degradant/RWT Dye in Triclopyr-only Sites

7.3.1 General Description

Triclopyr was applied as a liquid (Renovate 3) via dropped hoses. Site 5 was in boating restricted Area A and Sites 8 and 9 were in boating restricted Area B. Triclopyr applications were made at Site 8 and 9 on May 25, 2022 and at Site 5 on May 29, 2022. For each Triclopyr site, herbicide levels are shown in two graphs: a large-scaled graph to encompass the maximum herbicide levels followed by an expanded lower scale graph to better depict the lower levels of herbicide over time. RWT dye levels are shown on a separate graph.

7.3.2 Synopsis of Herbicide Results

The level of Triclopyr was never higher than RWL (400 µg/L) in any Triclopyr-only sites (Figures 7-13 to 7-18). Maximum Triclopyr level in Site 5 was 320 µg/L and non-detect was reached on September 11-18. Maximum Triclopyr in Site 8 was 230 µg/L on June 1, and non-detect was on August 17-19. Site 9 had the highest Triclopyr level of 220 µg/L on June 1 and declined to non-detect levels August 17-19. Site 5 had an incursion of Endothall at 45 µg/L on June 5 and 9.1 µg/L on June 13; thereafter Endothall was non-detect in Site 5. Site 8 had an incursion of Endothall of 85 µg/L on June 1, but was not detected thereafter. Site 9 also had an incursion of Endothall at 61 µg/L on June 1, but was not detected thereafter.

7.3.3 Supporting Graphical Data for Herbicide Levels

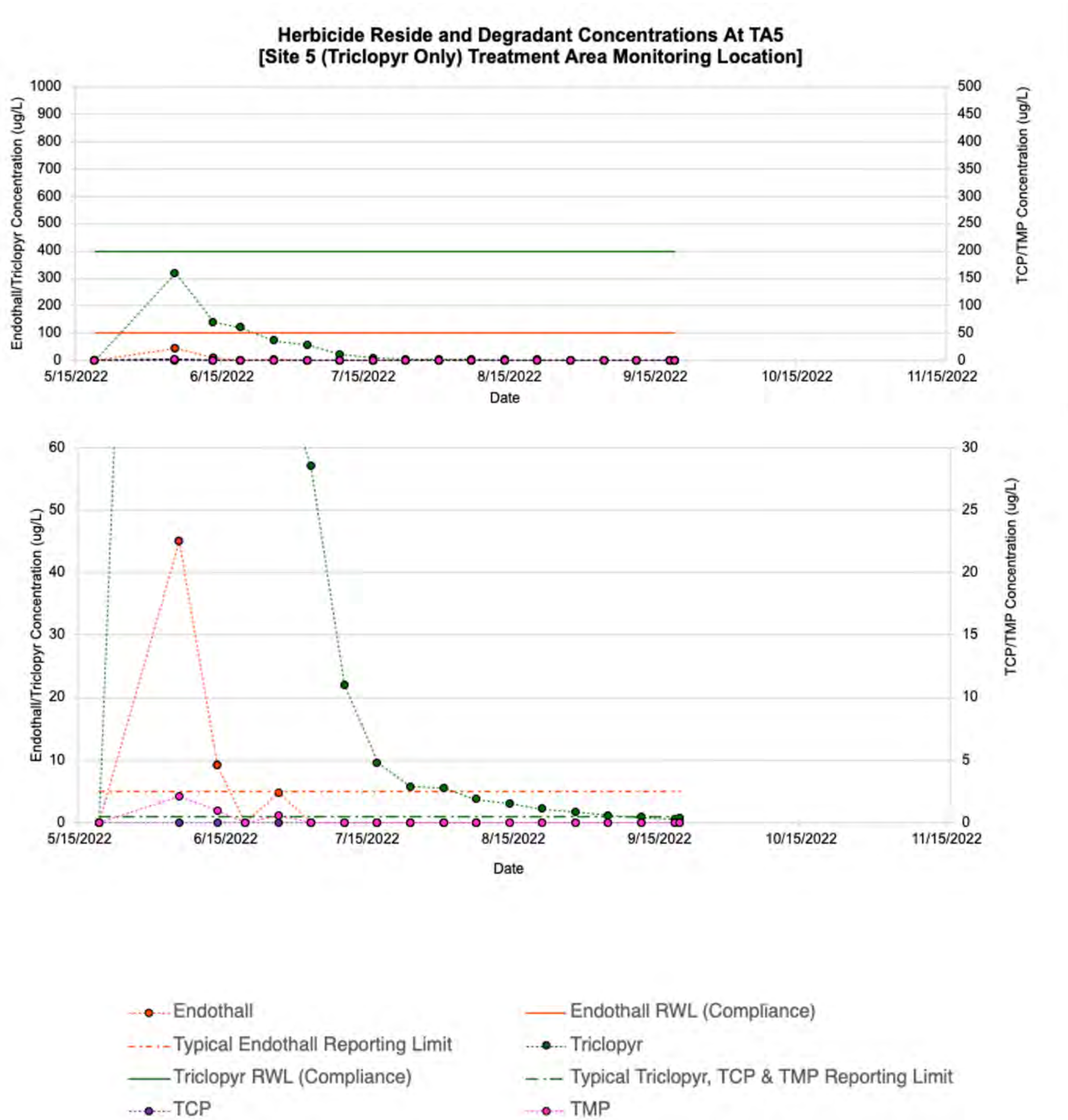


Figure 7-13. Herbicide and Degradant Levels in Triclopyr-only Site 5

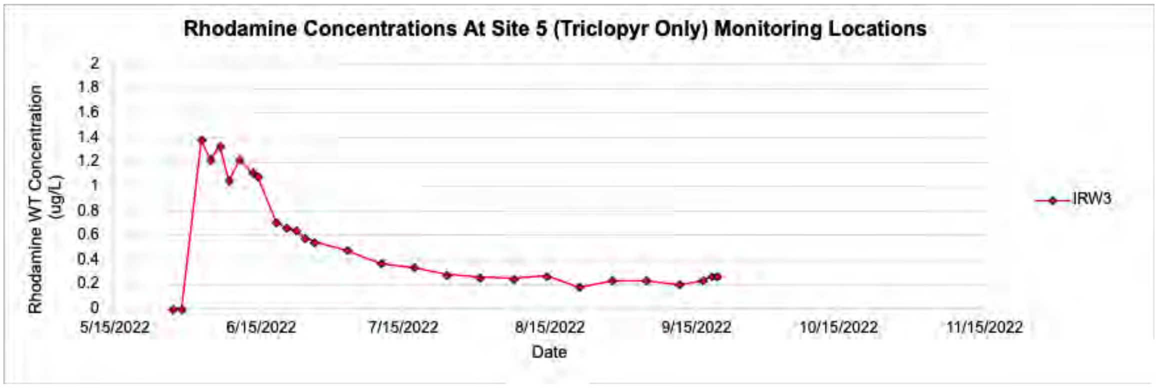


Figure 7-14. RWT in Triclopyr-only Site 5

IRW3 sample location is adjacent to Site 5.

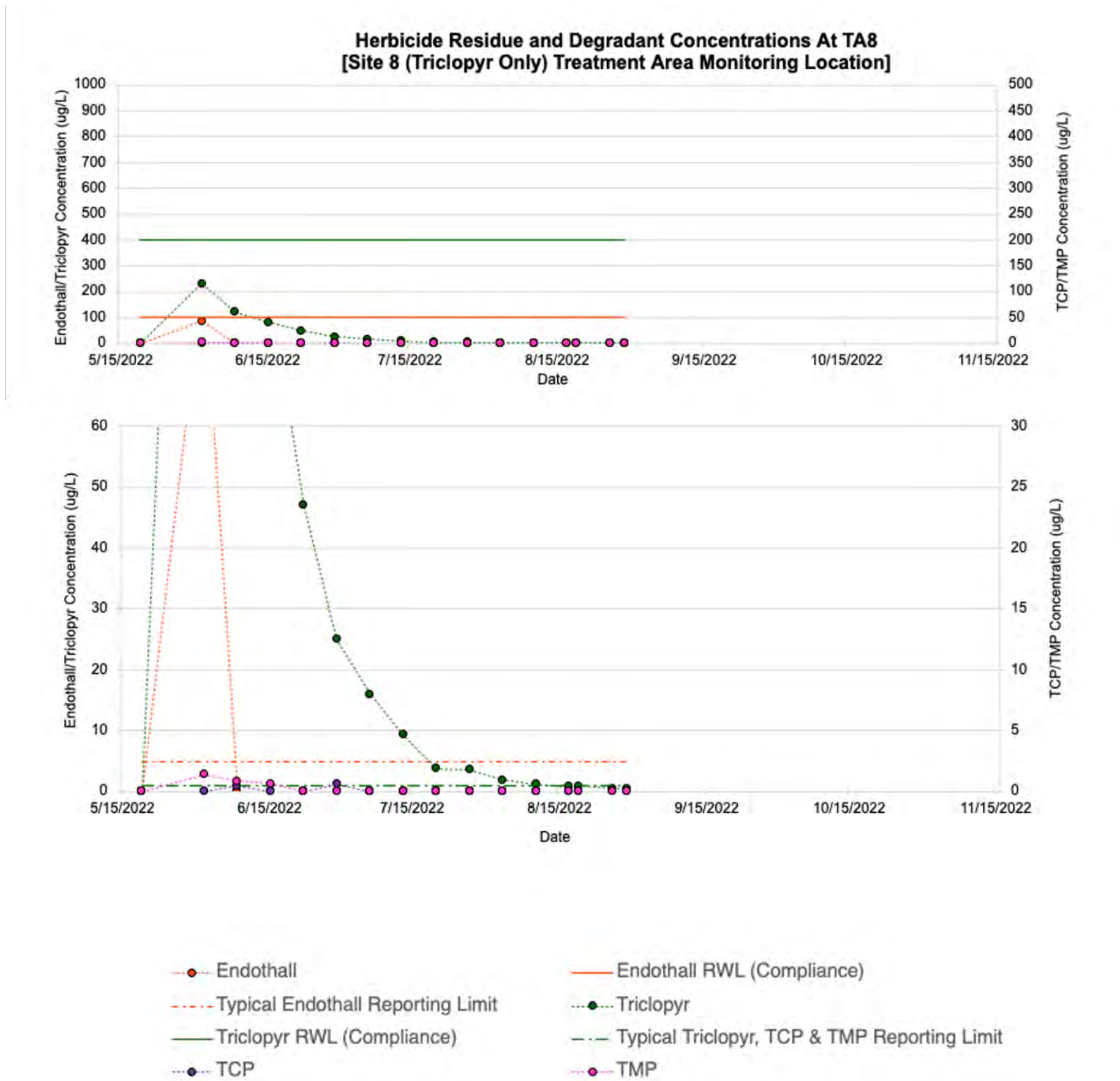


Figure 7-15. Herbicide and Degradant Levels in Triclopyr-only Site 8

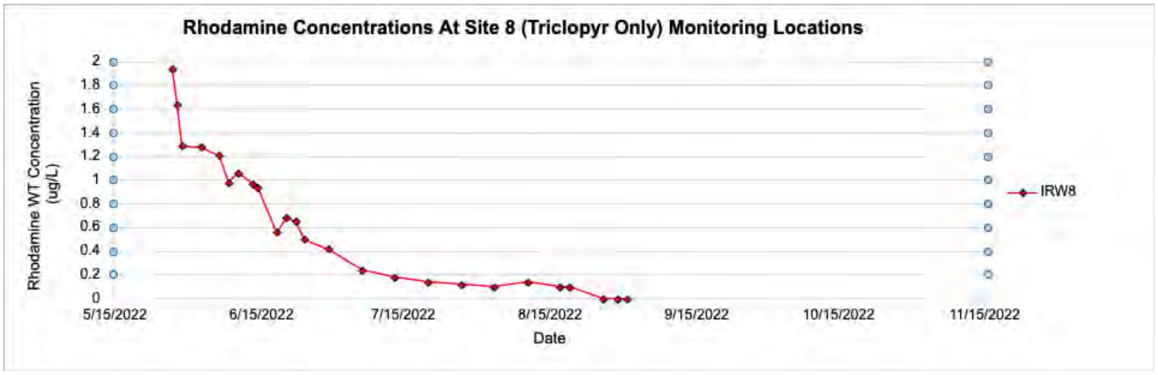


Figure 7-16. RWT in Site 8

IRW8 sample location is adjacent to Site 8.

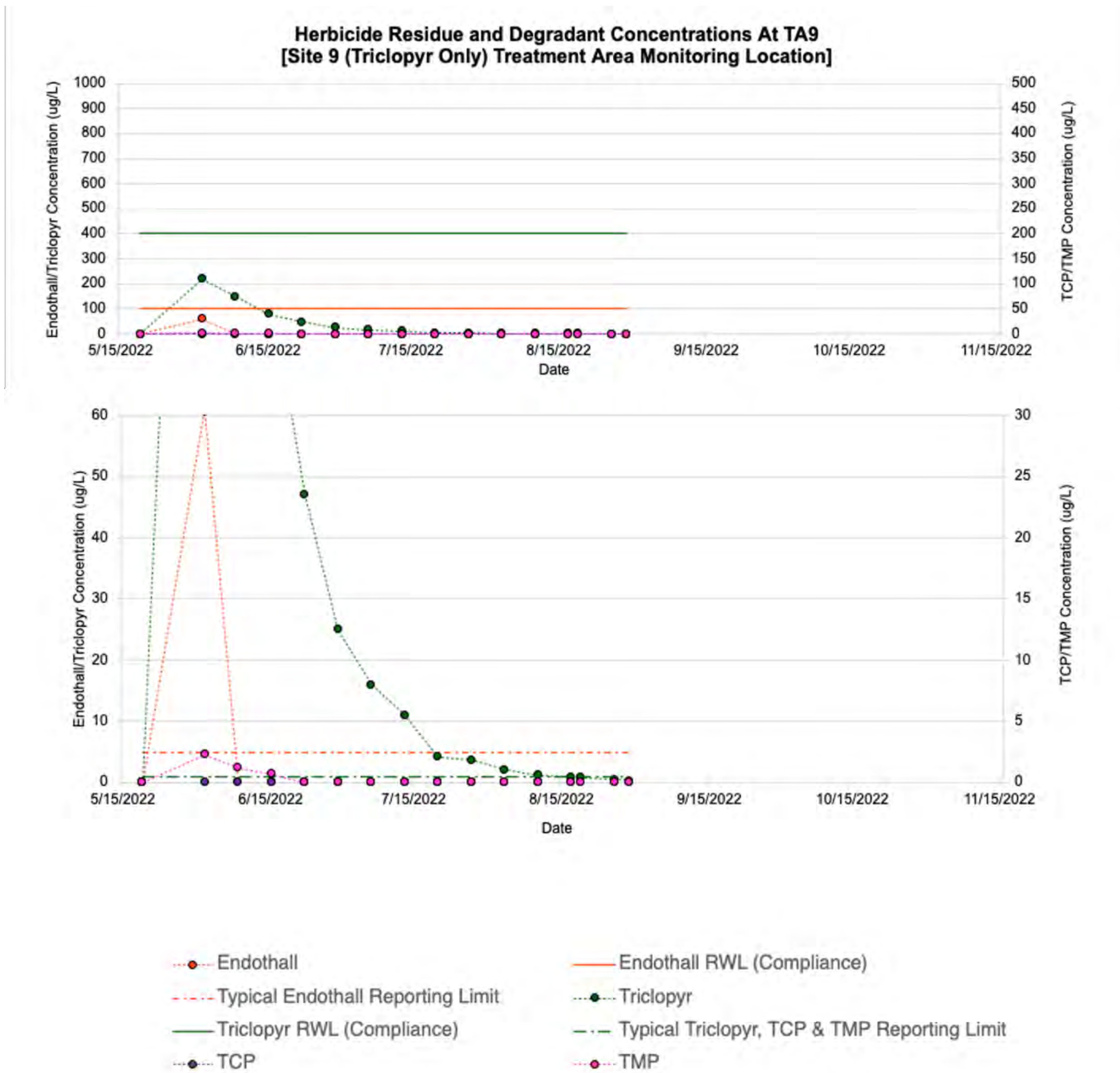


Figure 7-17. Triclopyr and Degradants in Triclopyr-only Site 9

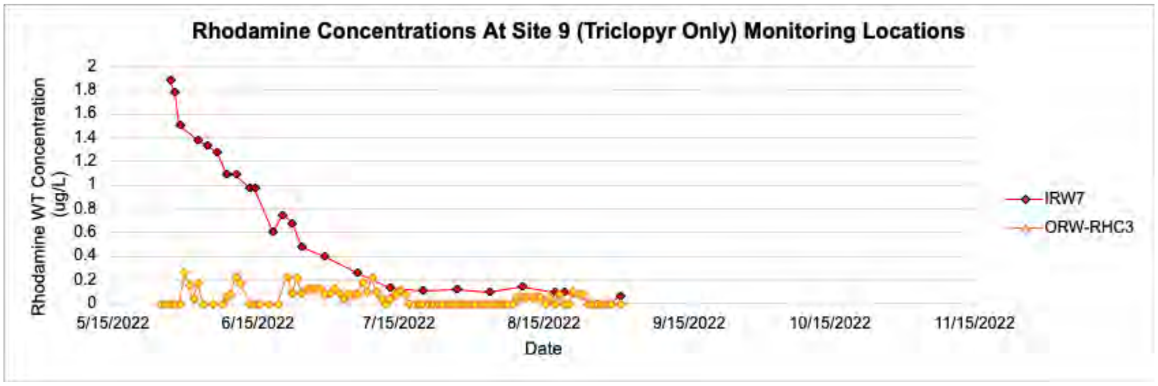


Figure 7-18. RWT in Site 9.

IRW7 sample location is adjacent to Site 9. ORW-RHC3 sample location is outside double curtains in Area B.

7.4 AIP Responses

Triclopyr is selective for control of Eurasian watermilfoil, therefore the growth of other AIP and native plants is expected to be similar to untreated control sites. Macrophyte surveys showed that frequency of occurrence of EWM and calculated biovolume of EWM was reduced by over 75%. Therefore, decomposition of EWM would be expected to release nutrients and reduce both pH and DO, but to a lesser extent than the Endothall-only treatments would. This outcome is reflected in the nutrient and water quality monitoring including a moderate increase in turbidity (Figure 7-9) compared with the Endothall-only treatments in the West Lagoon Sites 1, 2, 3. (Details of AIP effects and species-specific responses are provided in Appendix E.)

8.0 UV-ONLY SITES MONITORING RESULTS (SITES 24, 23, 22)

8.1 General Description

The UV-only sites were located outside all double turbidity curtains and were thus exposed to normal mixing of water in the West Lagoon and indirectly by water movement in the West Channel. No herbicides were applied in any UV-only sites. None of the UV-only sites were harvested. The treated areas were located toward the “dead” ends of Sites 24 and 23 and included most of Site 22 (Figure 1-1) The UV treatments were made in the following sequence: Site 24 before Site 23 before Site 22. Thus, Site 24 received the earliest treatment in the spring (May 31st); whereas Site 23 was not treated until June 7th and Site 22 not until June 21st. This treatment regime resulted in untreated growth of AIP to occur, and biovolume to accrue in Sites 23 and 22 while treatments occurred in Site 24. This schedule also resulted in a staggered post-UV treatment monitoring sequences in order to meet MMRP requirements. The details and scheduling of UV treatments are provided in Appendix AA.

8.2 Synopsis of Nutrients and Water Quality

Since no herbicide was applied in UV-only sites, regulatory criteria were primarily focused on nutrient levels (Total N, Total P), and water quality variables (Temperature, pH, DO, Turbidity).

<u>Nutrients</u>: (Figures 8-1 through 8-5) Total N and Total P were 2 to 3 times the regulatory levels in controls and in all UV-only sites. This was a consistent pattern for all CMT sites. Nitrate+Nitrite levels were highly variable and exceeded regulatory levels even in control sites. TKN levels gradually increased in controls and UV-only sites, with no difference between controls and UV-sites except for mid-August and late October when control site TKN was slightly higher than in UV-treatment sites. Ortho-P was highly variable with little difference between control site levels and UV sites, except for mid-August when control site levels were slightly higher than those in UV-only sites.

<u>Water Quality</u>: (Figures 8-6 through 8-12) Mid-depth temperatures in all three UV-only sites were similar and consistent with temperatures in other CMT sites. The logger data showed a 1 to 3^{o} C differential between surface and bottom during mid-summer indicating some stratification of the water column. The lack of temperature differences between controls and UV-only sites suggests that the UV lamp arrays did not affect water temperature within the UV treatment sites.

Mid-depth DO was depressed in all UV-only sites compared with control sites and was below regulatory levels (<5 mg/L) in mid-September. However, hourly logger data showed that DO near the bottom of all UV-only sites was <5 mg/L during most of the summer, especially in Sites 24 and 23. All UV-only sites had slightly depressed pH compared with controls during late spring and summer. Turbidity was similar in all UV-only sites and control sites reaching a maximum of 5 NTU by late summer. ORP was highly variable, but the patterns were essentially identical in controls and UV-only sites suggesting no treatment effects on this variable. Conductivity gradually increased from spring through late summer in controls and UV-only sites, but UV sites consistently had slightly lower levels than controls. This difference may reflect effects of harvesting in control sites, which can release plant tissue constituents that contribute to conductivity. In general, the UV-only treatments produced less of an effect on both nutrients and water quality than Endothall only and Triclopyr-only treatments.

8.2.1 Supporting Graphical Data for Nutrients

a) Total N

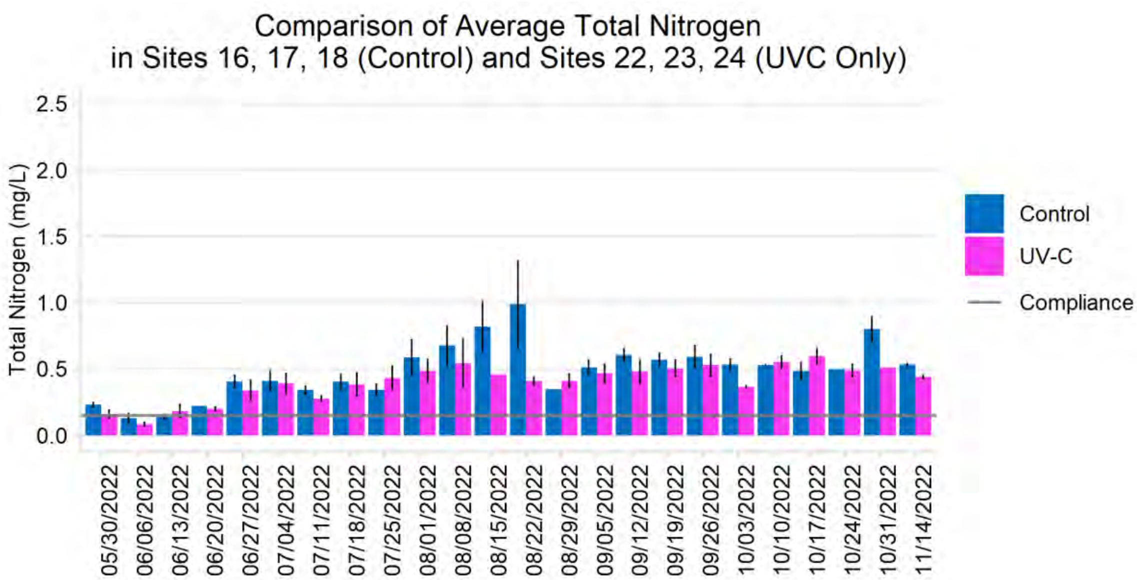


Figure 8-1. Total N in UV-only Treatment Sites Compared with Control Sites

b) Nitrate+Nitrite

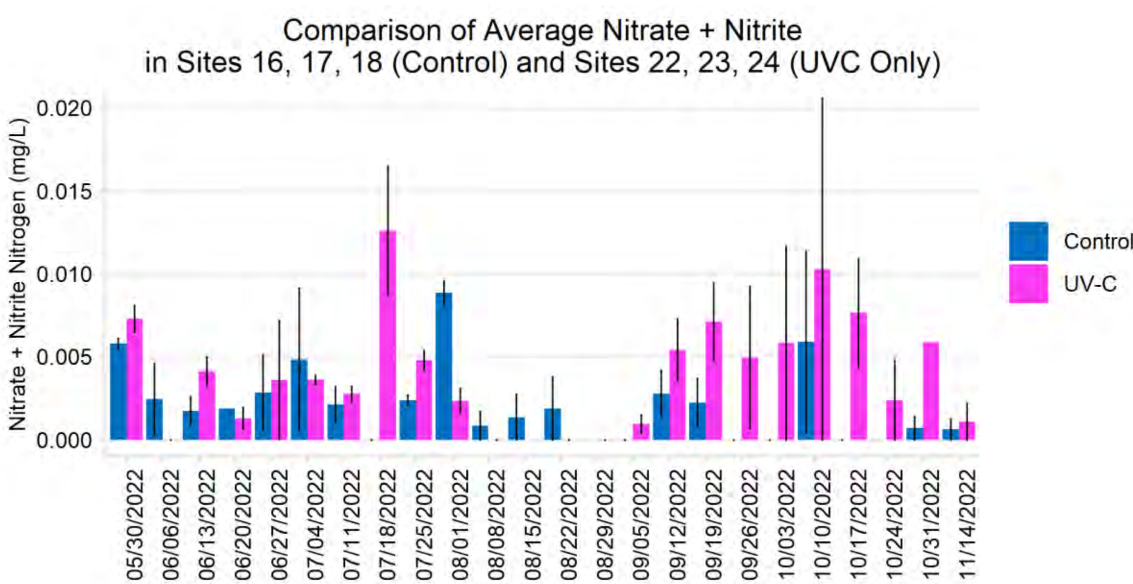


Figure 8-2. Nitrate+Nitrite Levels in UV-only Sites Compared with Control Sites

c) TKN

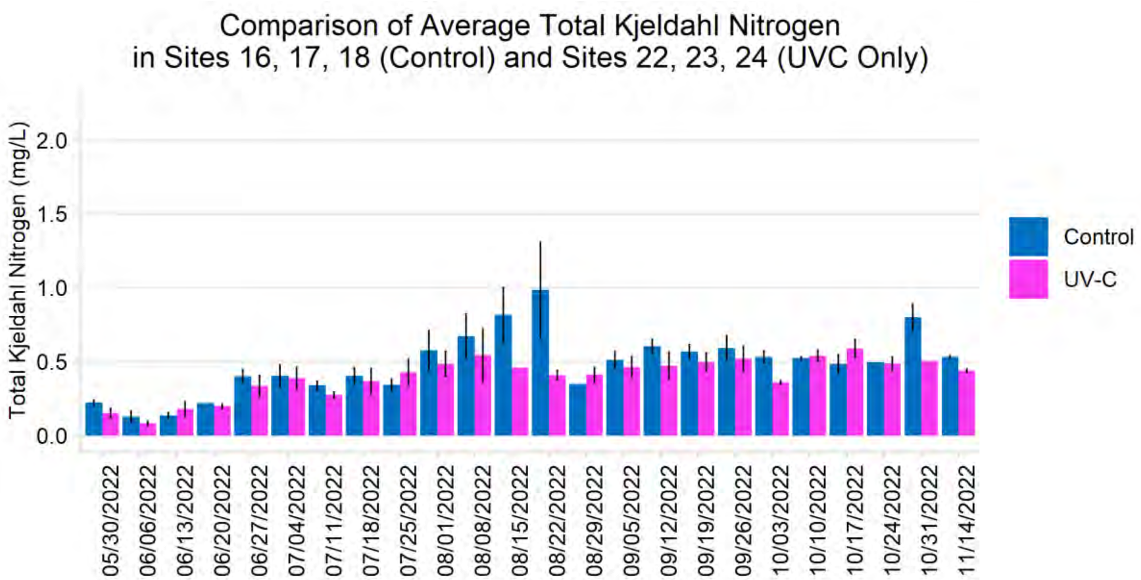


Figure 8-3. TKN in UV-only Sites Compared with Control Sites

d) Total P

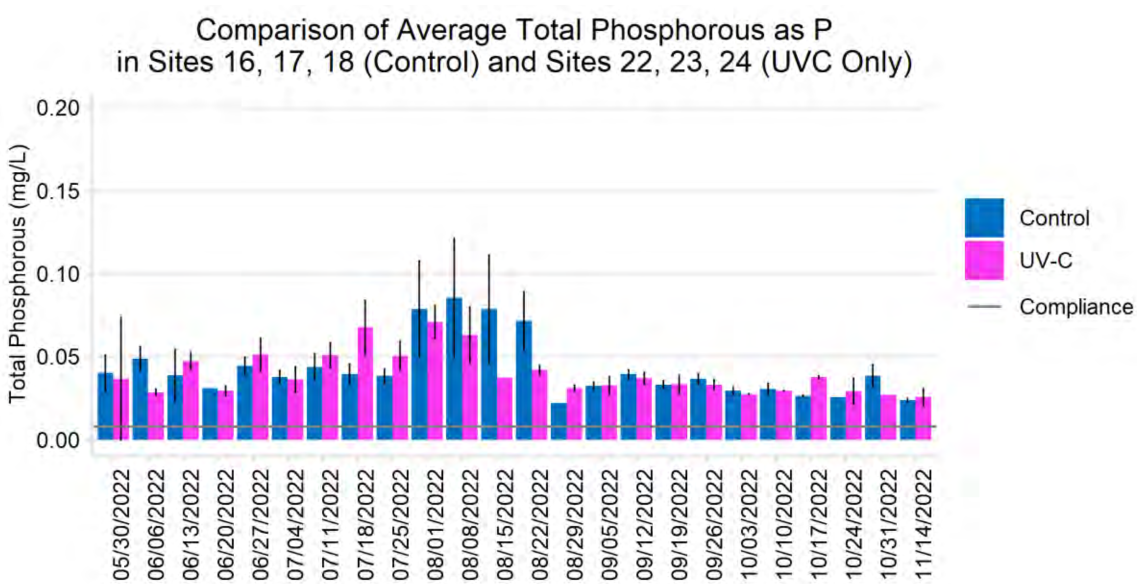


Figure 8-4. Total P in UV-only Sites Compared with Control Sites

e) Ortho-P

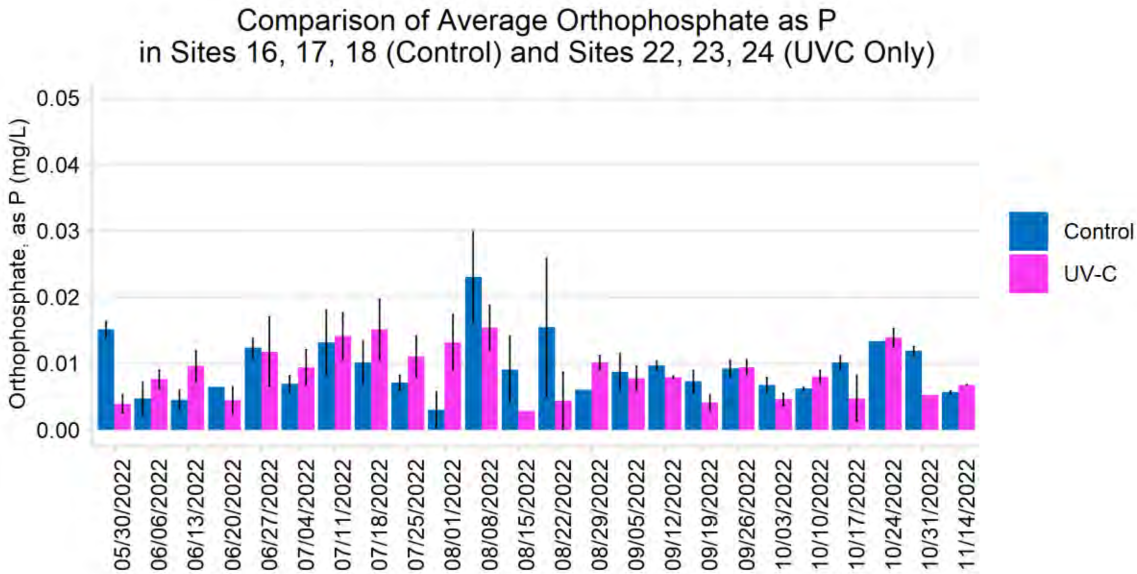
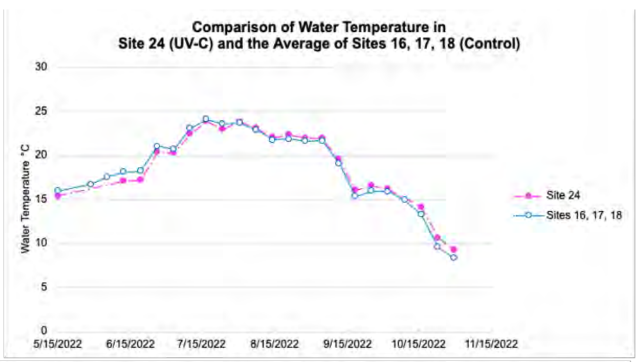


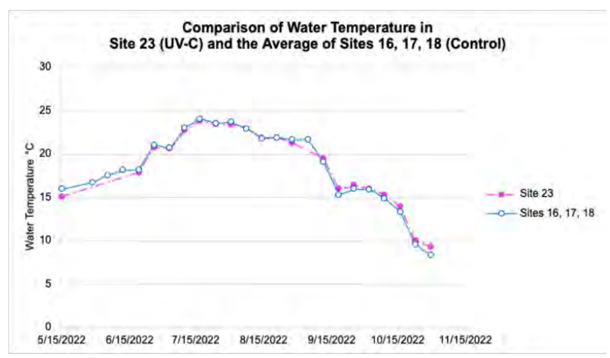
Figure 8-5. Ortho-P Levels in UV only Sites Compared with Control Sites

8.2.2 <u>Supporting Graphical Data for Standard Water Quality</u>

Sonde data was obtained 3 times per week.

a) Temperature





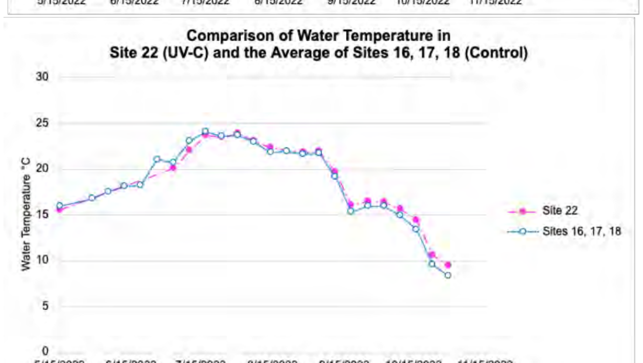


Figure 8-6. Water Temperatures in UV-only Sites 24, 23, 22 Compared with Control Sites

b) DO

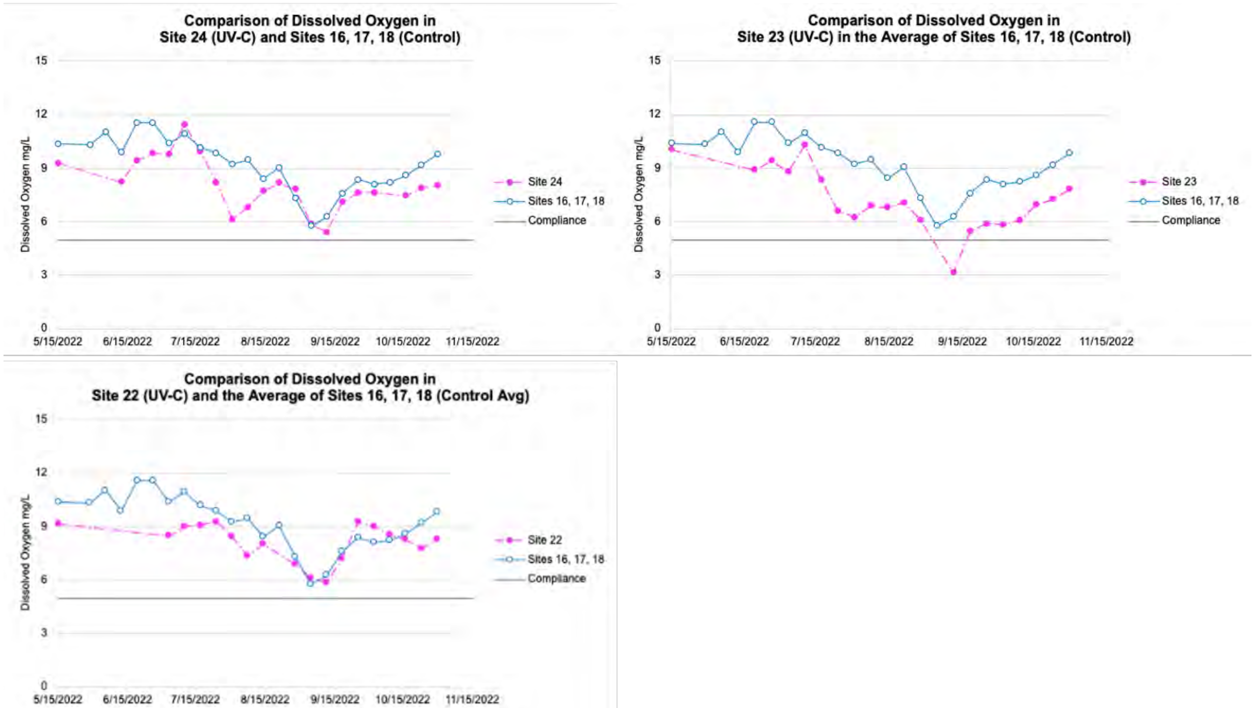


Figure 8-7. DO in UV-only Site

c) pH

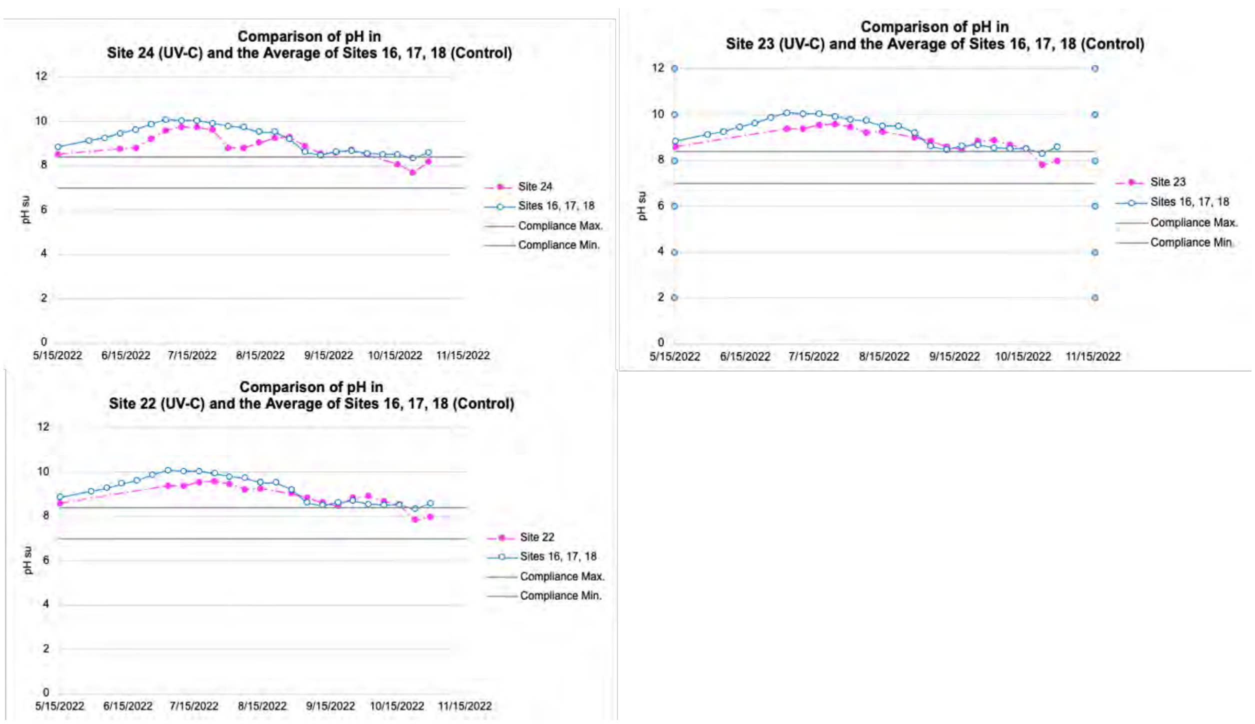


Figure 8-8. pH in UV-only Treated Sites Compared with Control Sites

d) Turbidity

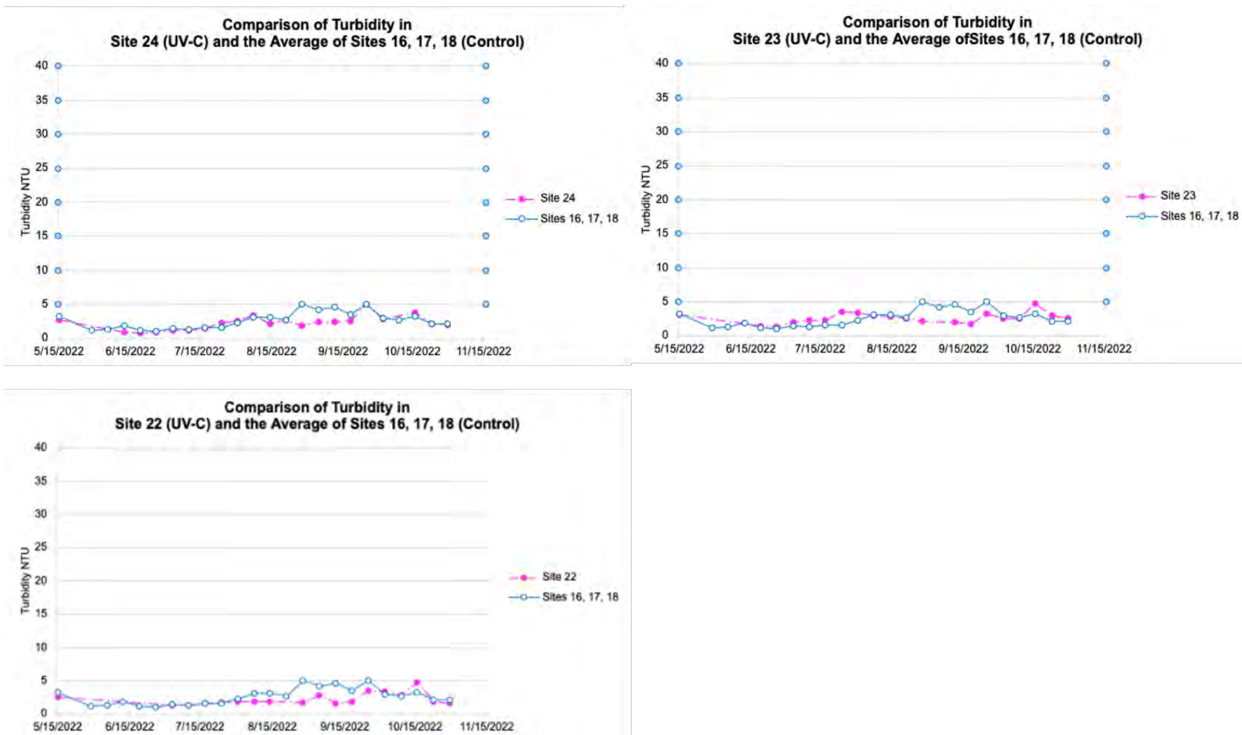


Figure 8-9. Turbidity in UV-only Sites 24, 23, 22

e) ORP

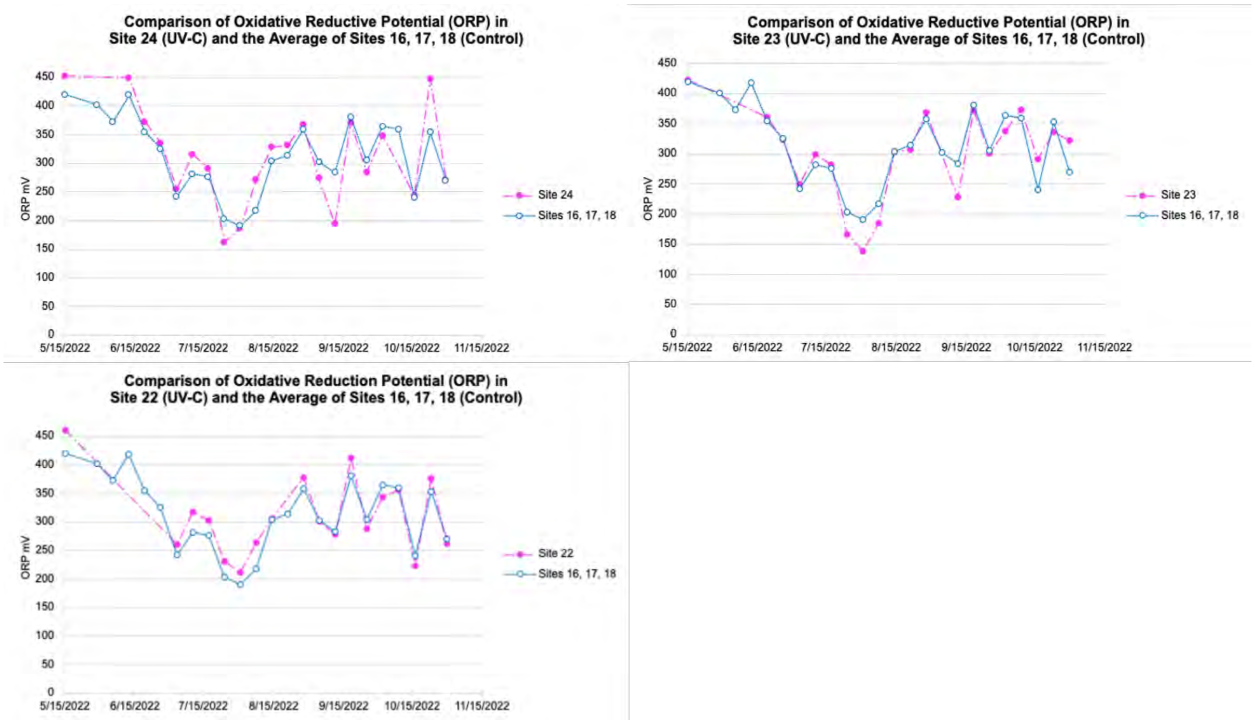


Figure 8-10. ORP in UV-only Sites 24, 23, 22 Compared with Control Sites

f) Conductivity

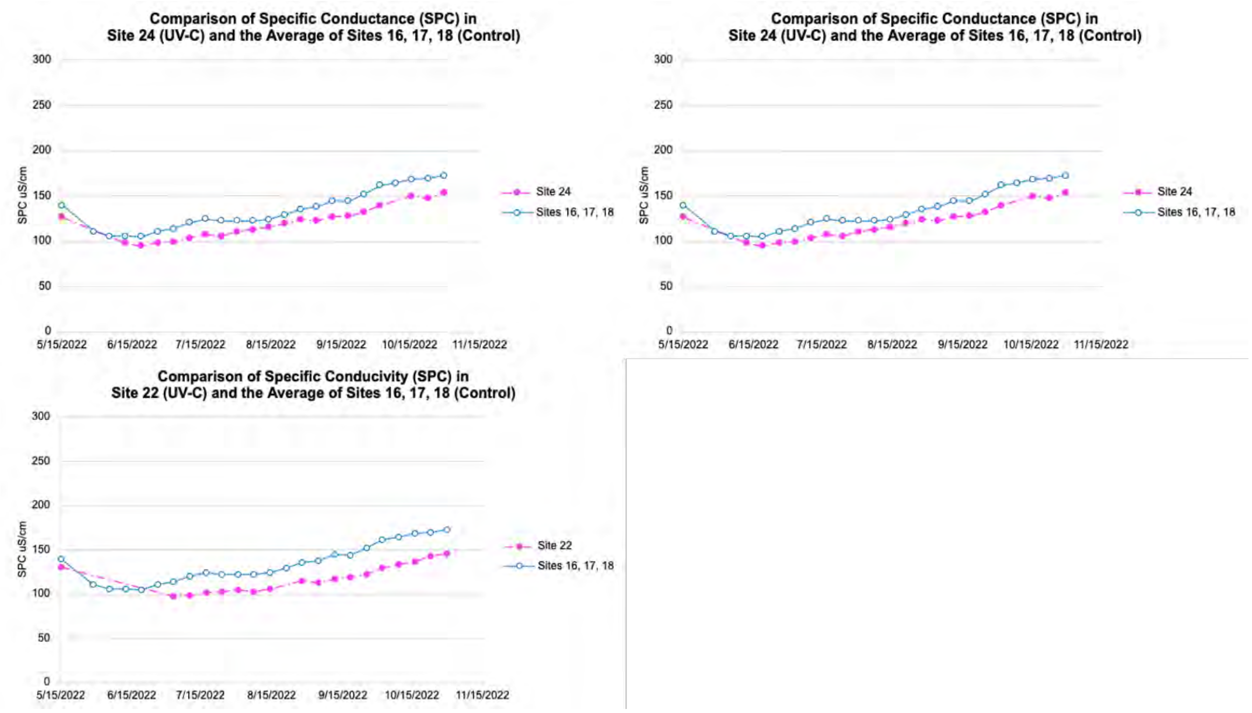


Figure 8-11. SpC in UV-only Sites 24, 23, 22 Compared with Control Sites

8.2.3 Supporting Graphical Data for Continuous Logger DO and Temperature

Figure 8-12. DO and Water Temperature in Upper and Lower Water Column in UV-only Sites 24, 23, 22

8.3 AIP Responses

UV-only treatment reduced overall biovolume by 50 to 75 % compared to controls. However, a higher frequency of 75% reduction in estimated biovolume was achieved in the central area of these sites where the UV treatment was mainly used. Also, the UV-only efficacy may be under-rated because the AIP metrics are compared with control sites that were harvested several times from early August to September (see Table 3-2 and Appendix E). This suggests that if UV-only treatments were compared to non-harvested sites, the efficacy of UV treatment would have been more pronounced. The reduction in biovolume no doubt caused release of some plant constituents and also reduced AIP normal contribution to elevated pH and DO. This is seen in the nutrient and water quality data provided in the graphs below.

Unlike the Endothall or Triclopyr treatments, UV treatments did not result in elevated turbidity, presumably due to the somewhat more gradual effects on AIP compared to more immediate effects from Endothall treatments on AIP. This in turn may have caused plant-tissue nutrients to be released more slowly compared with the herbicide treatments. The absence of double turbidity curtains and free water exchange with the West Lagoon may also have alleviated potential elevation of Total N and Total P.

The UV treatments also resulted in a reduction of native plants compared with controls, and especially compared with Endothall treatments, which appeared to promote native plant occurrence. This difference suggests that UV treatments in Sites 24, 23, 22 were not selective and that UV negatively affected desirable native plants. Thus, UV may have the advantage of creating less rapid nutrients releases and lesser effects on water quality variables, and importantly does not require using turbidity curtains. The disadvantage appears to be access to shallow areas near shore, and (at least with the currently available 2 UV boats), requiring more time per site, which in turn allows plants in other sites to grow beyond the optimal early growth stages in spring. (See Appendix E for detailed analysis of UV-only efficacy.)

9.0 COMBINATION ENDOTHALL/UV SITES MONITORING RESULTS (SITES 10, 11, 15)

9.1 General Description

For Endothall/UV applications, Endothall was applied in near shore areas from the outer edge of docks to the shoreline. Endothall applications were made in Site 15 on May 25, 2022 and Sites 10 and 11 on May 29, 2022. RWT dye was injected with Endothall. Although it was anticipated that these combination sites would be accessible for UV treatments around the end of June to early July, the curtains could not be removed until September, which prevented access for UV treatments. This resulted in the following limited, early fall UV treatments: Site 10 (9/26 to 9/29; Site 11 (10/5 to 10/8); and Site 15 (9/12 to 9/16). Therefore, the main effects on monitoring variables during spring and summer are most likely due to the initial near-shore Endothall applications.

Nutrient monitoring was sampled during the first 30 days following Endothall applications, primarily to determine effects from nearshore applications. Monitoring was then suspended until the first UV treatments began as indicated by the brackets in the nutrient graphs below. (This monitoring sequence complied with MMRP and QAPP and was designed to assess AIP responses to UV treatments about 14 DAT UV exposures.)

9.2 Synopsis of Nutrients and Water Quality

Nutrients: (Figures 9-1 through 9-5) Total N and Total P levels were above regulatory limits in controls and in Endothall/UV sites during most of the summer and fall. However, Total N and Total P were higher than in controls following UV treatments. Nitrate+Nitrite levels were highly variable and were higher following Endothall treatment and some post-UV treatment dates. TKN was slightly elevated following Endothall treatments compared with controls but was two-fold higher than controls during UV treatment periods. The elevated Total N and Total P were similar to the changes in the Endothall-only Sites 1,2,3.

Water Quality: (Figures 9-6 through 9-12) The temperature patterns were the same in controls and UV-only sites. Hourly logger data showed there was a differential of about 2^{o} C between surface and bottom water. Mid-depth DO was slightly depressed following Endothall application and during UV treatments, but otherwise remained above 5 mg/L, except for one point in late August. Hourly logger data showed that bottom water DO was below 5 mg/L from July to October in these sites.

The pH in controls and Endothall/UV sites were outside the prescribed pH ranges although pH values in UV sites were slightly lower than control sites and reached the regulatory accepted range by the end of August. Turbidity in the Endothall/UV sites ranged from 1-3 NTU to almost 30 NTU by mid-August. This change was likely due to Endothall effects on AIP and not UV effects since UV treatment did not begin until September. ORP was variable and similar in UV and control sites, initially decreasing from pre-Endothall treatment to mid-August, after which ORP increased. Conductivity increased similarly in controls and UV sites but was initially higher in the UV sites and increased similarly to controls. but the differences between the sites did not change markedly.

9.2.1 Supporting Graphical Data for Nutrients

a) Total Nitrogen

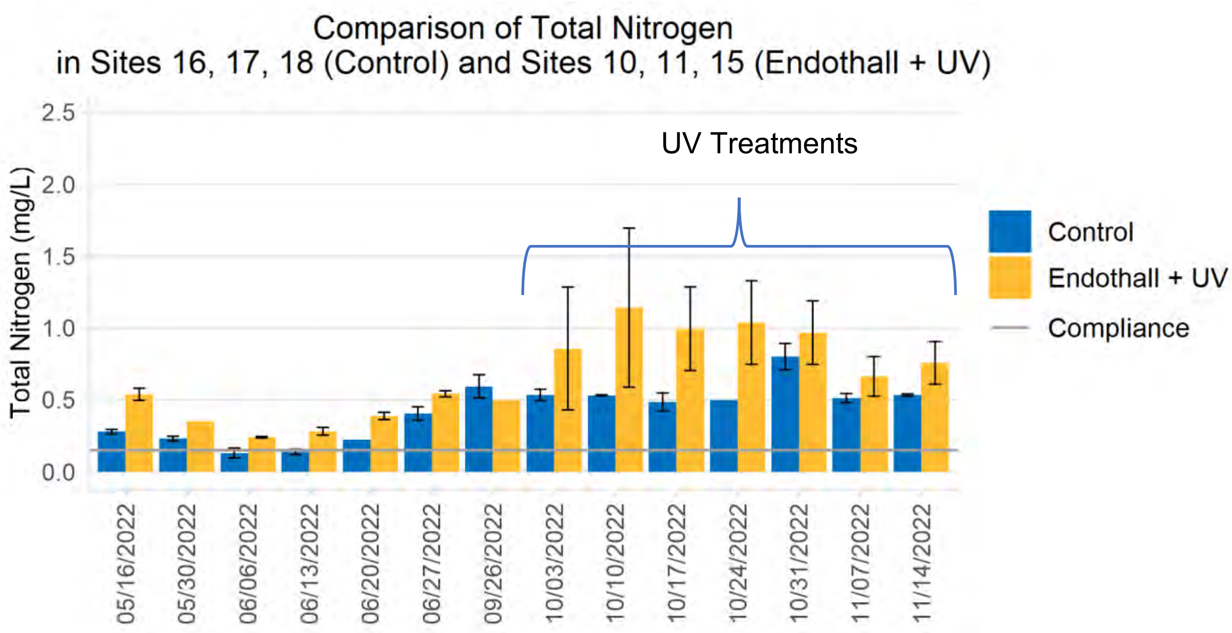


Figure 9-1. Total N in Endothall/UV Sites Compared with Control Sites

b) Nitrate+Nitrite

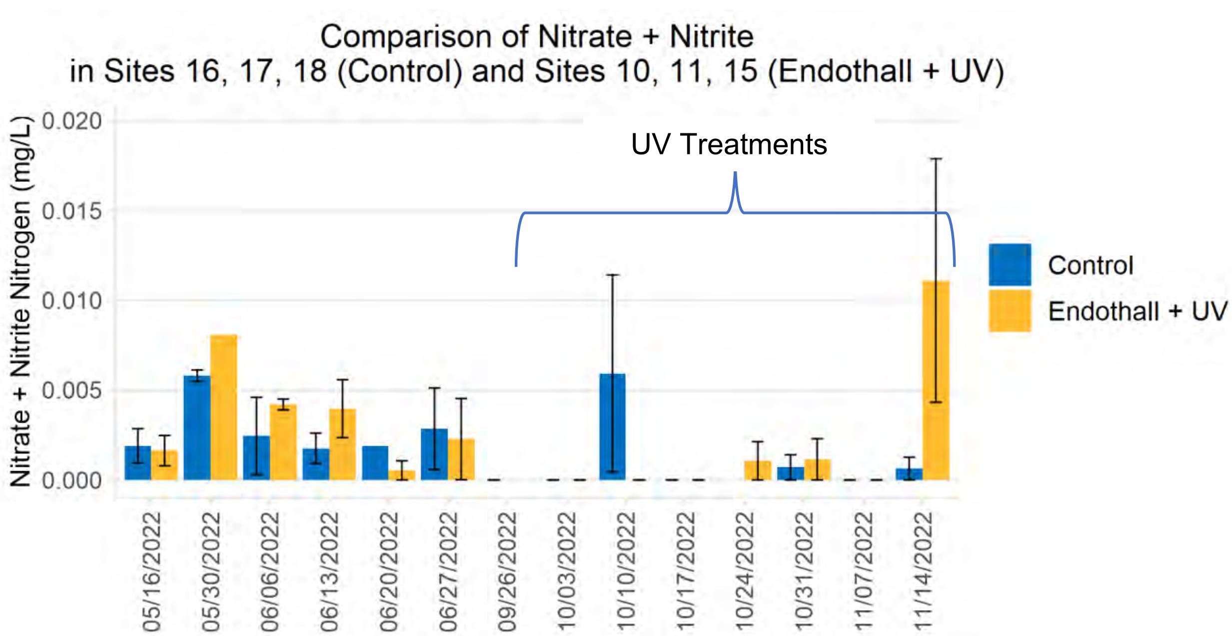


Figure 9-2. Nitrate+Nitrite in Endothall/UV Sites Compared with Control Sites

c) TKN

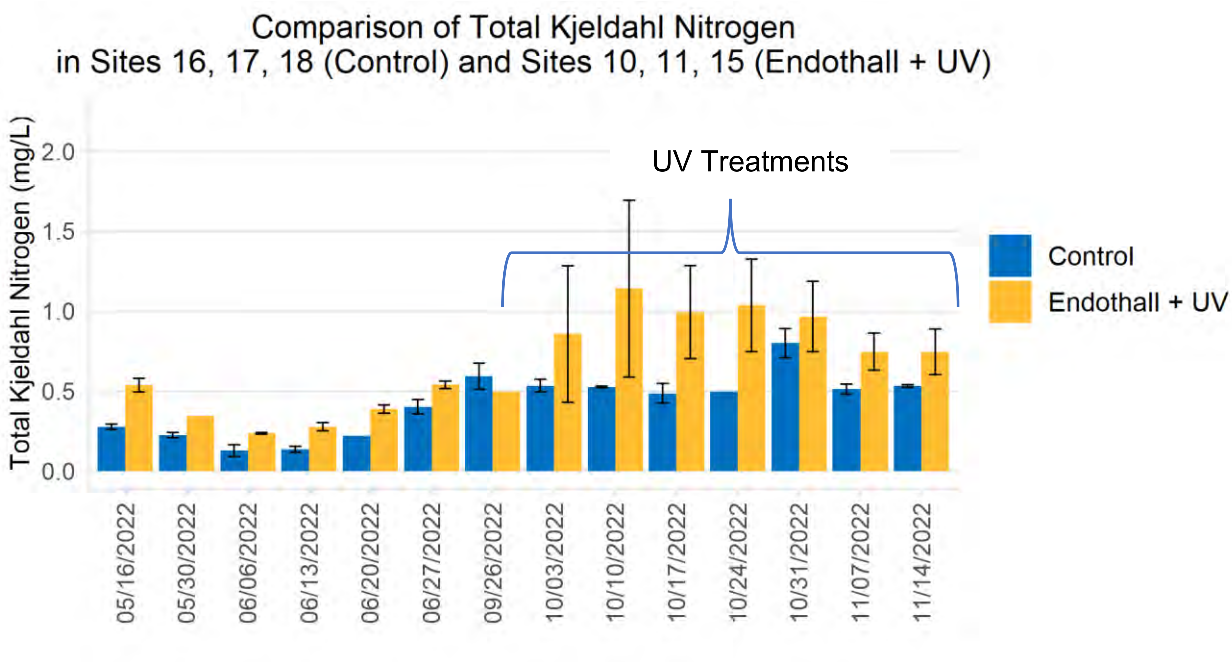


Figure 9-3. TKN in Endothall/UV Sites Compared with Control Sites

d) Total P

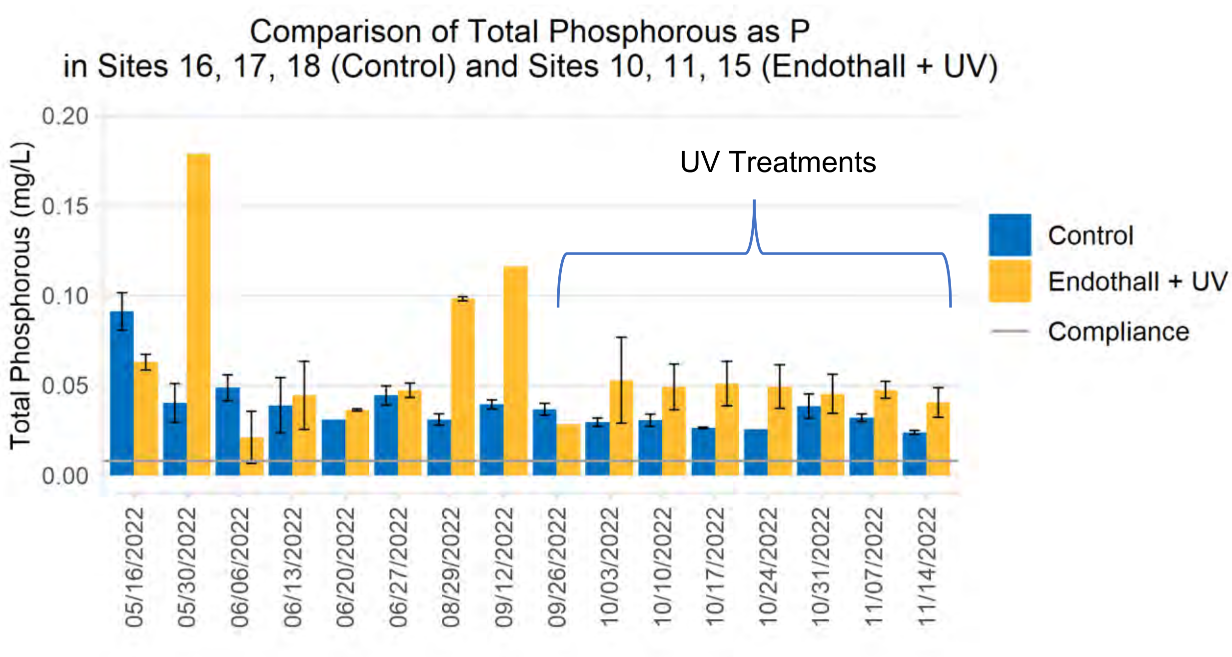


Figure 9-4. Total P in Endothall/UV Sites Compared with Control Sites

e) Ortho-P

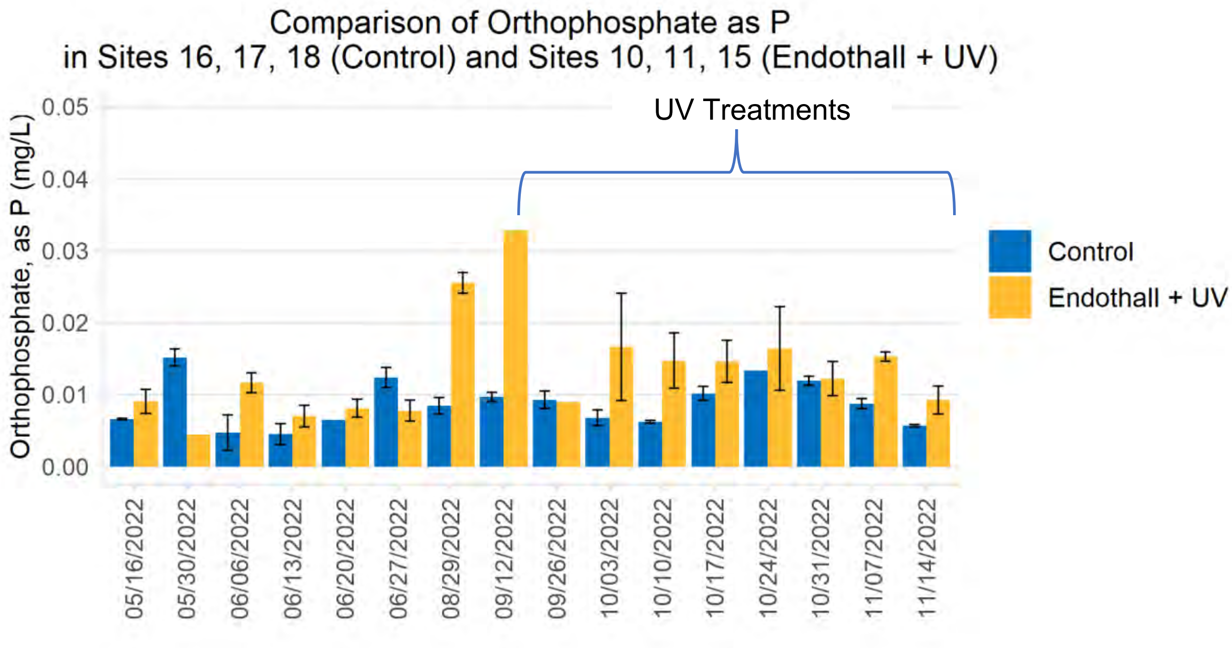


Figure 9-5. Ortho-P in Endothall/UV Sites Compared with Control Sites

9.2.2 Supporting Graphical Data for Standard Water Quality

Sonde derived data 3 times per week.

a) Temperature

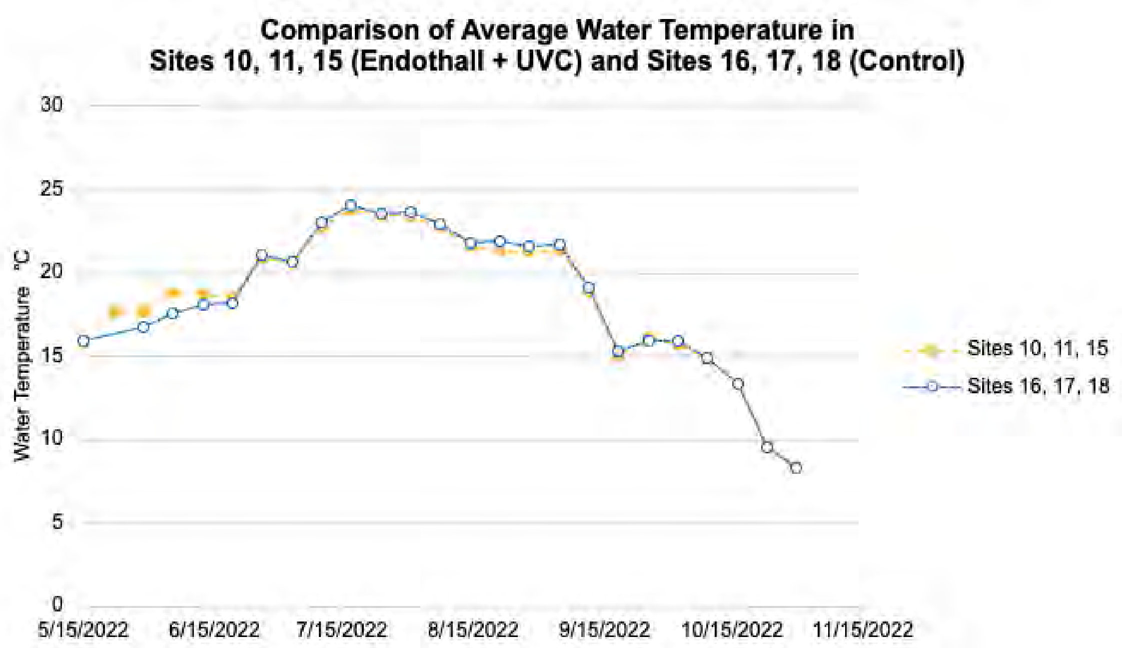


Figure 9-6. Water Temperature in Endothall/UV Sites Compared with Control Sites

b) DO

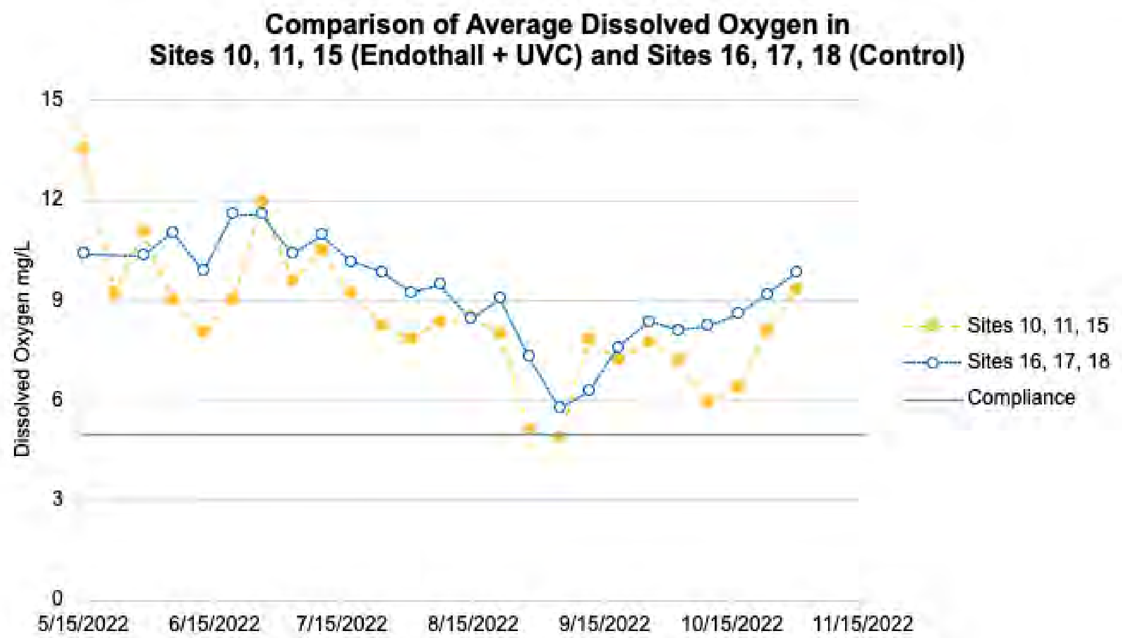


Figure 9-7. DO in Endothall/UV Sites Compared with Controls

c) pH

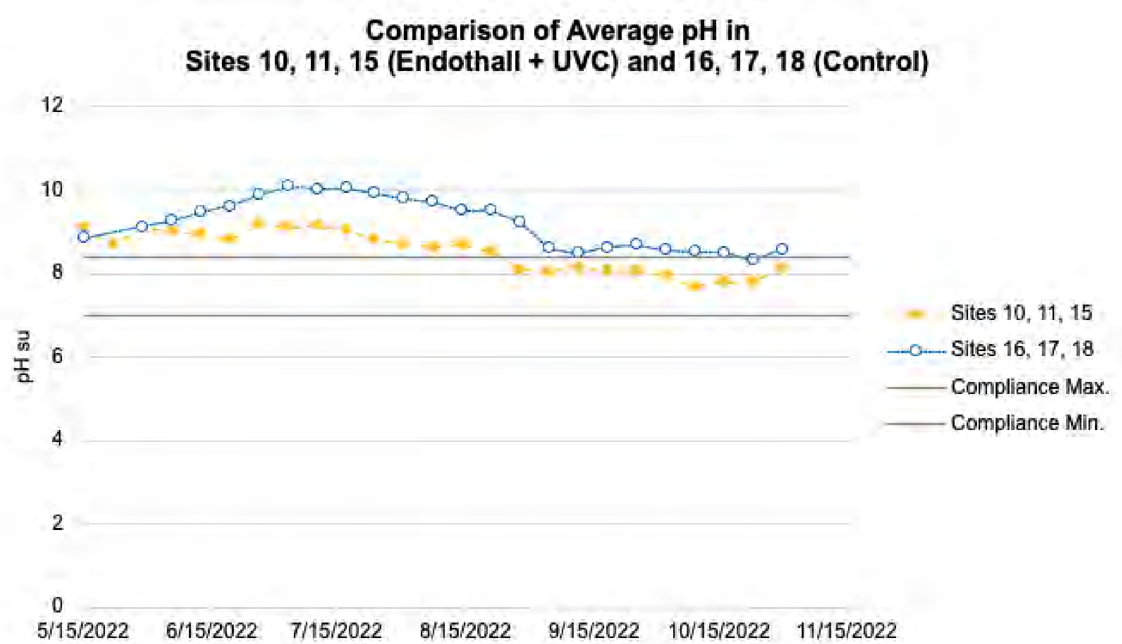


Figure 9-8. pH in Endothall/UV Sites Compared with Control Sites

d) Turbidity

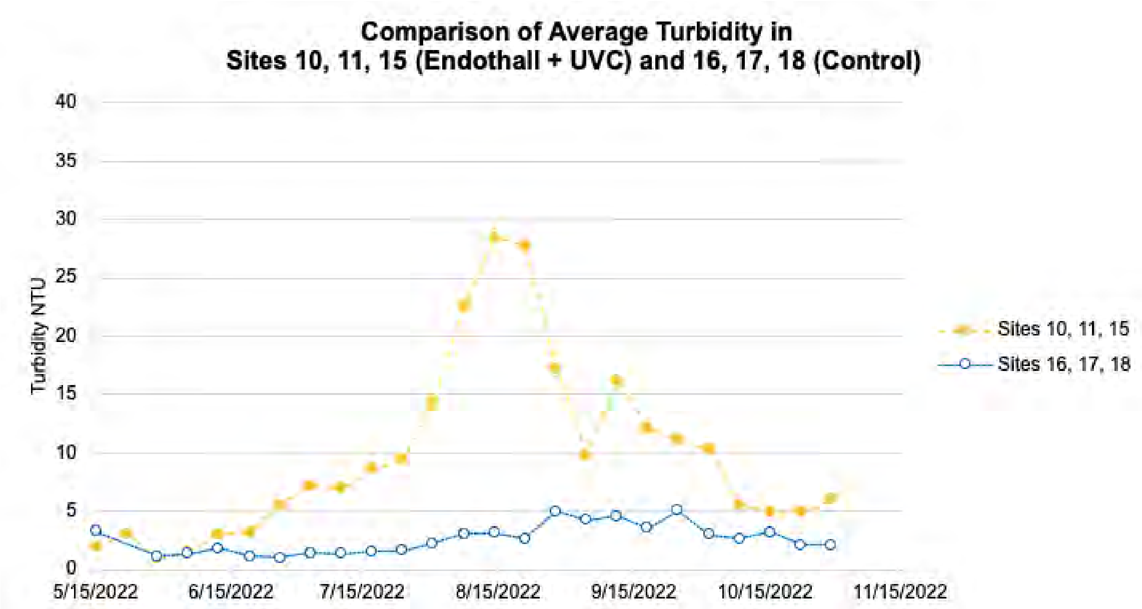


Figure 9-9. Turbidity in Endothall/UV Sites Compared with Control Sites

e) ORP

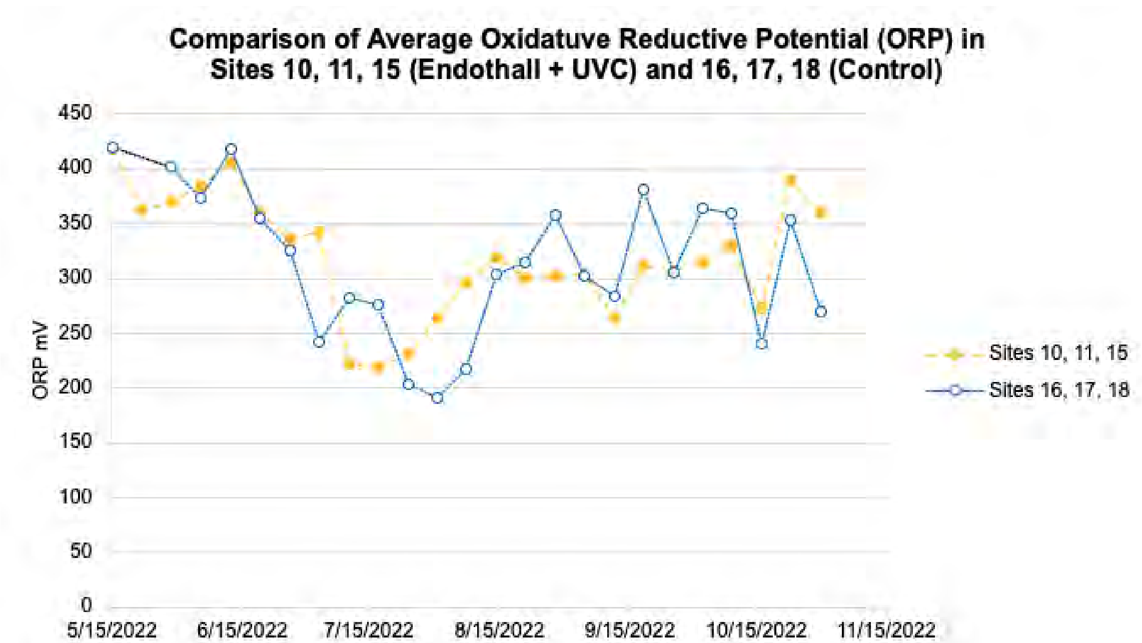


Figure 9-10. ORP in Endothall/UV Sites Compared with Control Sites

f) Conductivity

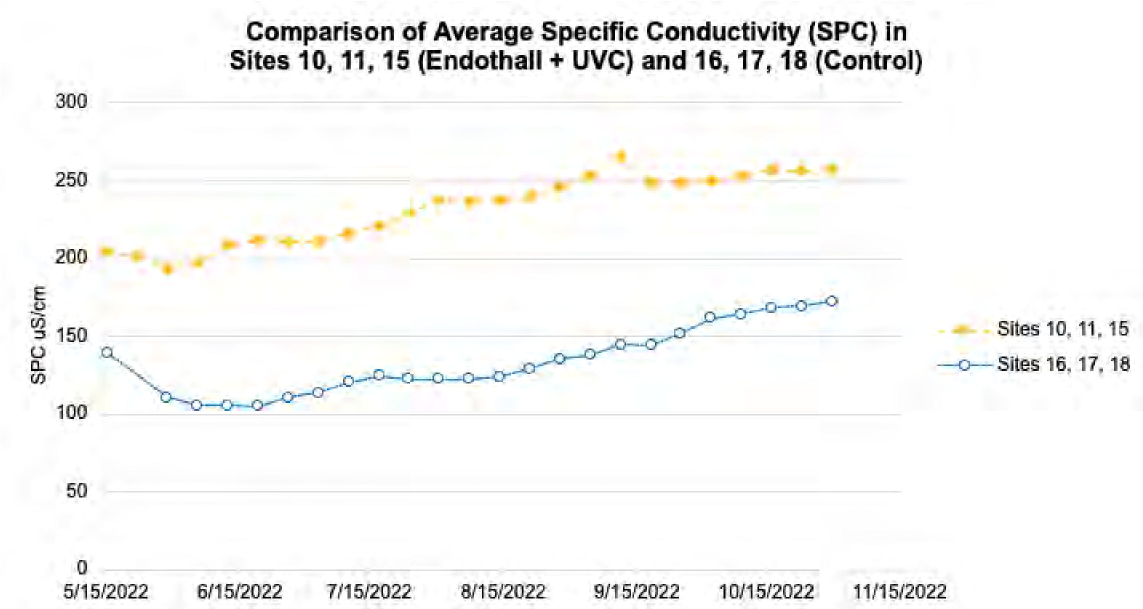


Figure 9-11. Conductivity in Endothall/UV Sites Compared with Control Sites

9.2.3 Supporting Graphical Data for Continuous Logger DO and Temperature

Figure 9-12. DO and Water Temperature in Upper and Lower Water Column in Endothall/UV Sites 10, 11, 15

9.3 Herbicide Residue and Degradant/RWT Dye in Endothall/UV Sites

9.3.1 General Description

Endothall was applied through drop hoses to near shore areas as a liquid formulation (Aquathol K) in Sites 10 and 11 (Area A) on May 29, 2022, and in Site 15 (Area B) on May 25, 2022. RWT dye was injected with the Endothall applications.

9.3.2 Synopsis of Results

Maximum Endothall levels were observed in Site 10 (530 µg/L) and Site 11 (330 µg/L) on June 5 (7 DAT) (Figures 9-13 through 9-18). Levels in both these sites declined rapidly to non-detect (<5 µg/L) by June 19 (21 DAT). RWL limits were never exceeded inside the sites. However, Endothall levels were detected above 100 µg/L occurred outside 10,11,15 (See Table 14-1), but these were transient events ending by June 13 (about 14 DAT). Also, both Site 10 and 11 had incursions of Triclopyr (possibly from nearby Site 12). Site 10 had a maximum of 35 µg/L Triclopyr and Site 11 had a maximum of 58 µg/L Triclopyr on June 13. Both slowly degraded to non-detect (<1 µg/L) by September 11-18th. None of the Triclopyr levels in these sites were above RWL although the lingering low levels of Triclopyr prevented removal of the turbidity curtains for Area A.

Site 15 appears to be an anomaly since the maximum Endothall level was a single 85 µg/L sample and non-detect (<5 µg/L) was established on June 8 (14 DAT). However, Site 15, which was near Triclopyr-only Sites 8 and 9 (Figure 1-1) had much higher than expected Triclopyr levels of 230 µg/L and 140 µg/L on June 1 and June 8, respectively. Triclopyr at Site 15 did not decline to non-detect levels until August 17-19, but this may have been due to movement of Triclopyr from nearby Sites 8 and 9. The incursion of Triclopyr into Site 15 may have resulted from easterly wind events occurring within a few days after application, coupled with the small scale of Area B and the proximity of Triclopyr-only Sites 8 and 9 to Site 15. Although the concentration of Triclopyr in Site 15 is below typical efficacious levels, it may have had sub-lethal effects on the EWM. (See AIP Responses Section 9.4.)

9.3.3 Supporting Graphical Data for Herbicides

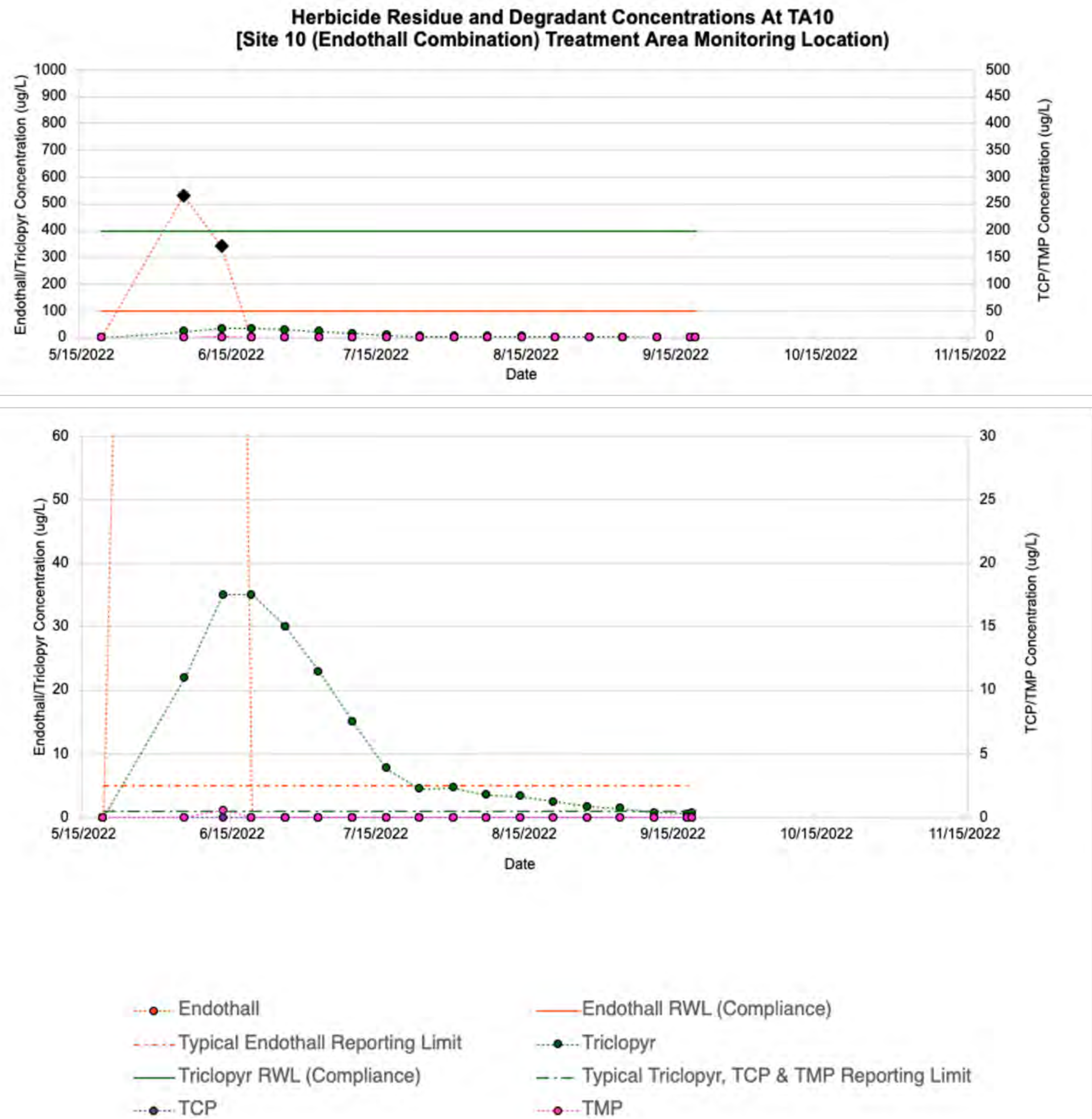


Figure 9-13. Herbicide and Degradant Levels in Endothall/UV Site 10

Figure 9-14. RWT in Site 10

IRW1, IRW2 and IRW4 sample locations were adjacent to Site 10.

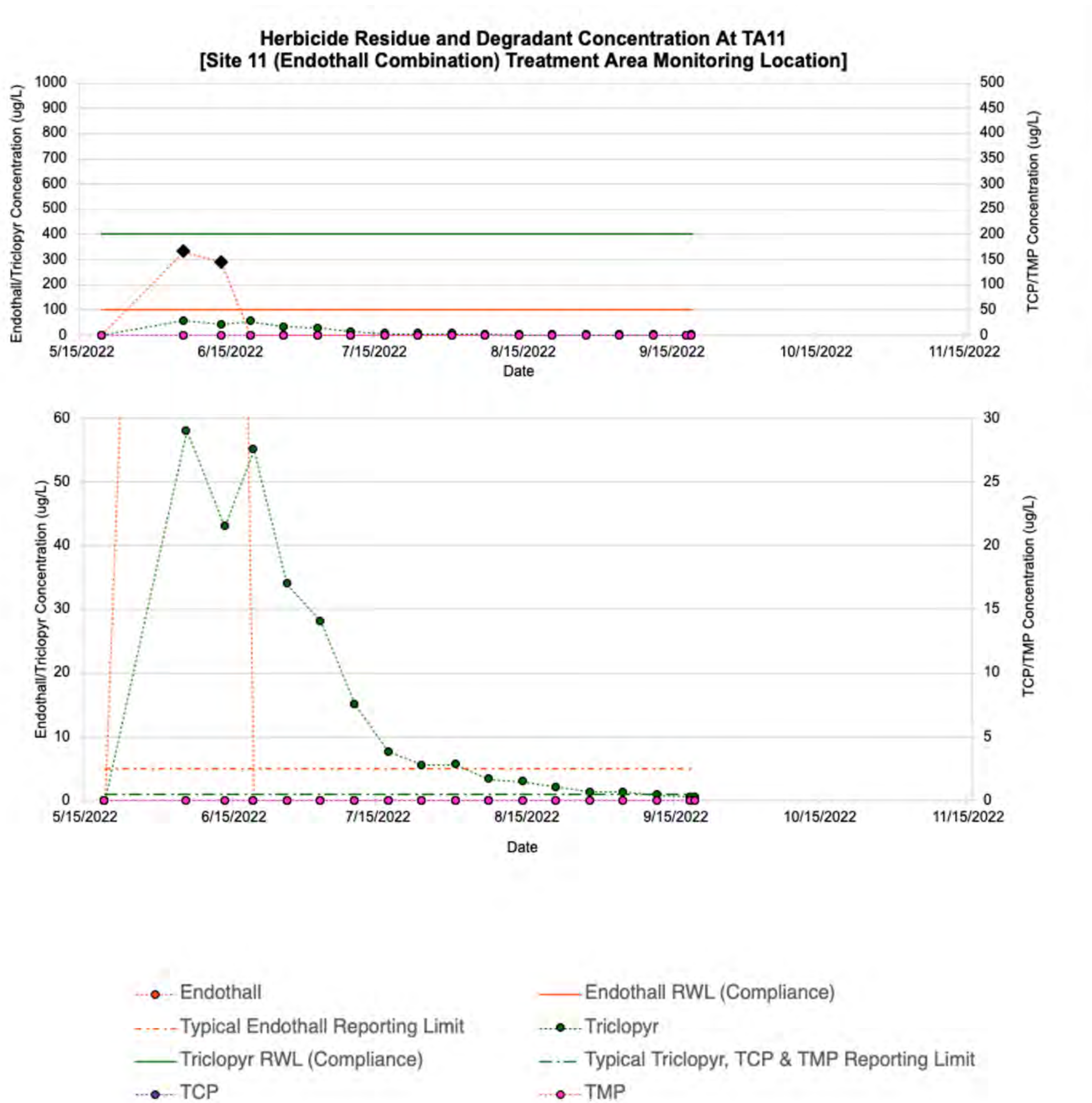


Figure 9-15. Herbicide and Degradant Levels in Endothall/UV Site 11

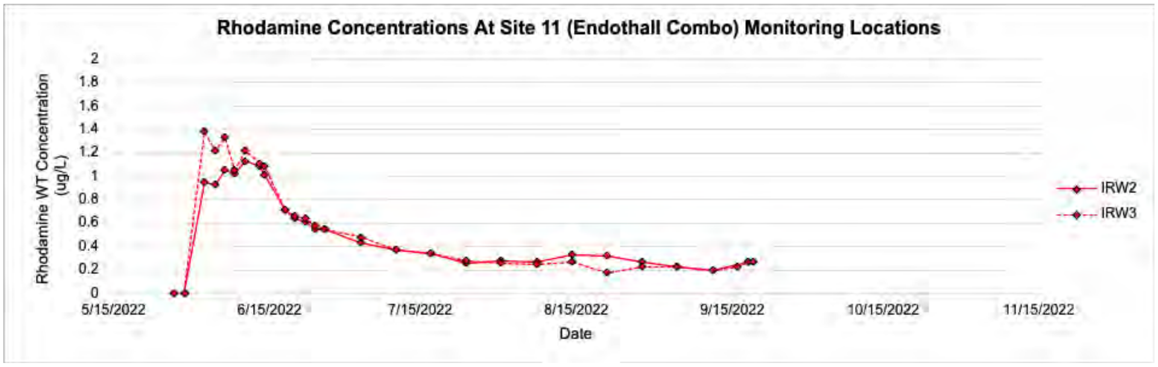


Figure 9-16. RWT in Site 11.

IRW2 and IRW4 Sample Locations were Adjacent to Site 11.

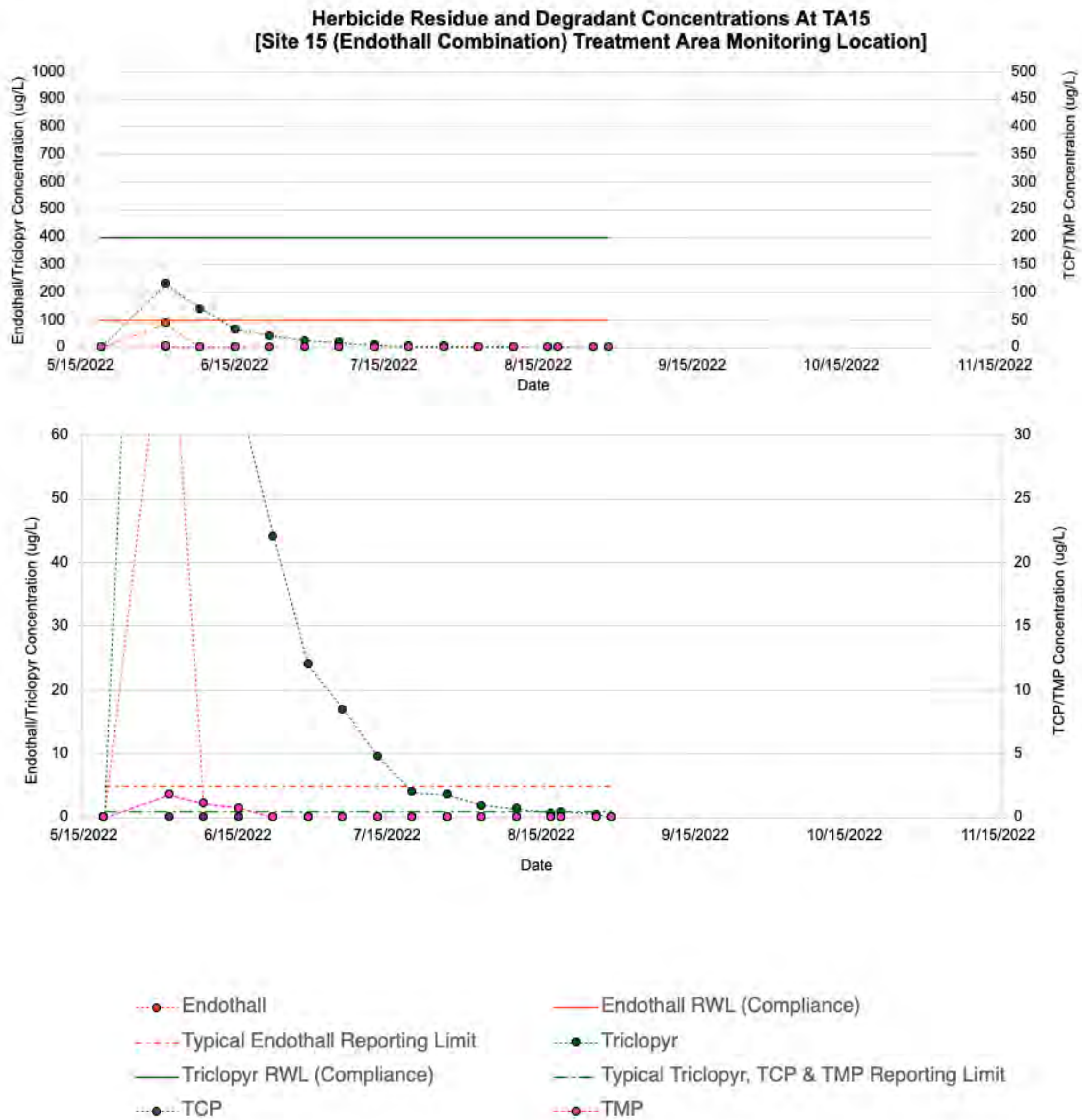


Figure 9-17. Herbicide Residue and Degradant Concentrations at Site 15

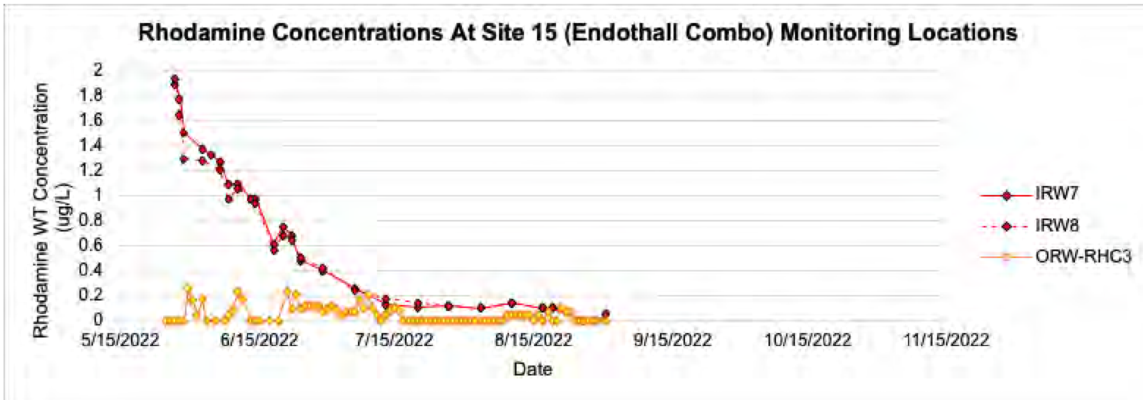


Figure 9-18. RWT in Site 15

IRW7 and IRW8 are samples taken adjacent to Site 15. ORW-RHC3 are samples taken outside double curtains nearest to Site 15 in Area B.

9.4 AIP Responses

Target AIP in Sites 10 and 11 in Area A were reduced by 50-75% and EWM was particularly well controlled (75% reduction in biovolume and frequency of occurrence). Although Endothall levels were fairly low between 3 DAT and 7 DAT, if Endothall concentration was near the nominal (target) rate of 1-2 ppm for the first 48 hours after application, this exposure would be expected to be effective on EWM. Since UV access to these sites was delayed unit late September and early October, AIP responses in these sites were primarily due to spring Endothall applications (details of AIP responses are provided in Appendix E).

10.0 COMBINATION TRICLOPYR/UV SITES MONITORING RESULTS (SITES 12, 13, 14)

10.1 General Description

Triclopyr applications were made in Sites 12, 13, and 14 on May 31, 2022. For these combination sites, applications of pelleted formulation of Triclopyr (Renovate OTF) were made with a calibrated air-blower unit from the outer edge of the docks to the shoreline. (See Figure 3-1 for example.) Immediately after Triclopyr applications, RWT dye was injected using drop hoses in the same nearshore areas where the Triclopyr application was made. Due to the prolonged deployment of turbidity curtains in Area A, these sites were not accessible to the UV treatment equipment until October. By October, shallow water prevented UV treatments equipment from entering these sites and treating them as planned. Therefore, the main effects on monitoring variables in these combination sites during spring and summer are most likely due to the initial near shore Triclopyr applications.

10.2 Synopsis of Nutrient and Water Quality Results

Nutrients: (Figures 10-1 through 10-5) As in other CMT sites, Total N was above regulatory limits based on control sites from late spring to August. Total phosphorous in Triclopyr/UV sites were above regulatory levels during the entire monitoring period. Ortho-P was highly variable but was higher in Triclopyr/UV sites from spring to early June. However, Total N in Triclopyr/UV sites was about twice as high as control sites by August. Similarly, Nitrate+Nitrite was often elevated in Triclopyr/UV sites compared to control sites. TKN increased in both control sites and Triclopyr/UV sites spring to early August.

Water Quality: (Figures 10-6 through 10-12) The temperature pattern was similar in control sites and Triclopyr/UV sites. Hourly logger data showed a differential of about 2° C between surface and bottom of the sites during the summer months, followed by more uniform temperatures during cooling and mixing of water columns in the fall.

Mid-depth DO was lower in control sites and Triclopyr/UV sites during the summer but DO in Triclopyr/UV sites was more depressed and was outside the regulatory limit (<5 mg/L) periodically throughout August and September. Hourly logger data showed that in the Triclopyr/UV sites, DO near the bottom was <5 mg/L for most of the summer. However, these bottom DO levels are similar to DO in control sites 16, 17, 18 (Figure 4-8).

Triclopyr/UV sites had lower pH compared with control sites for most of the summer, but these levels were close to or within regulatory pH ranges, whereas pH in control sites were consistently outside regulatory ranges. Turbidity in Triclopyr/UV sites began increasing from pre-treatment levels (2-3 NTU) by 15 DAT and continued to rise to 25 NTU by mid-August, which differed from the 3-5 NTU in control sites. ORP was variable, but control sites and Triclopyr/UV sites had a similar pattern. Conductivity gradually increased in control sites and Triclopyr/UV sites with a similar pattern throughout the summer, although conductivity was initially higher in Triclopyr sites in spring and this difference was sustained. These shifts in nutrients and water quality are consistent with expected EWM decomposition and release of plant-bound nutrients following effective treatments of Triclopyr..

10.2.1 Supporting Graphical Data for Nutrients

a) Total N

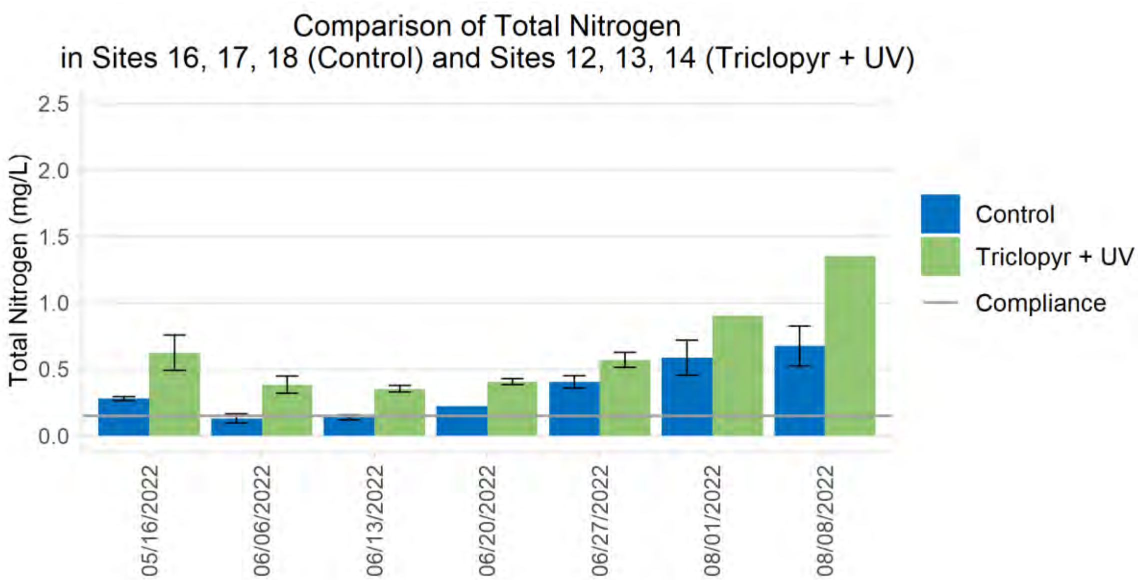


Figure 10-1. Total N in Triclopyr/UV Sites Compared with Control Sites

b) Nitrate+Nitrite

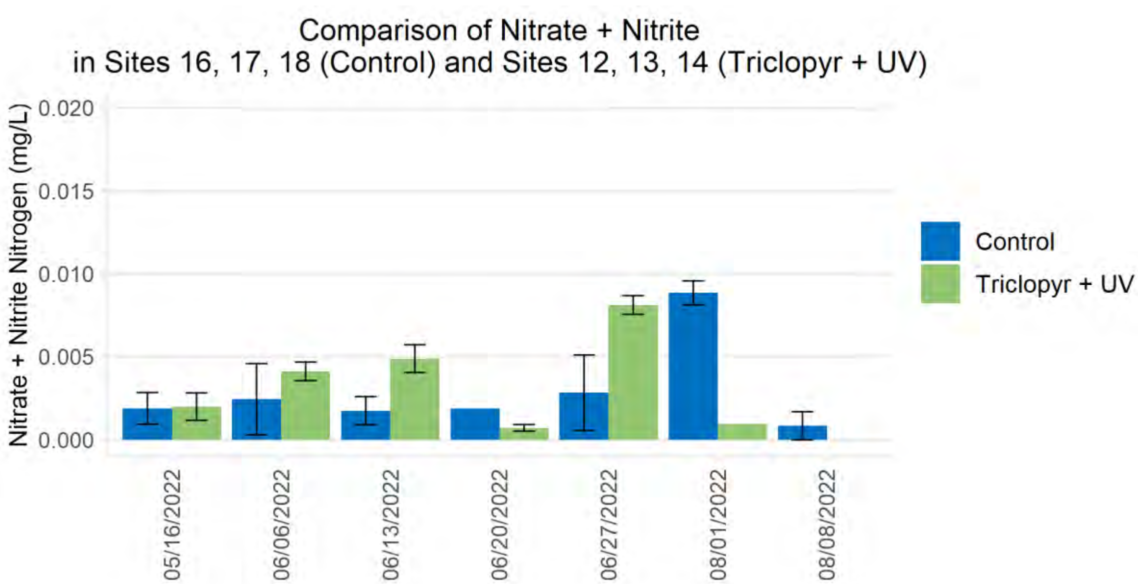


Figure 10-2. Nitrate+Nitrite in Triclopyr/UV Sites Compared with Control Sites

c) TKN

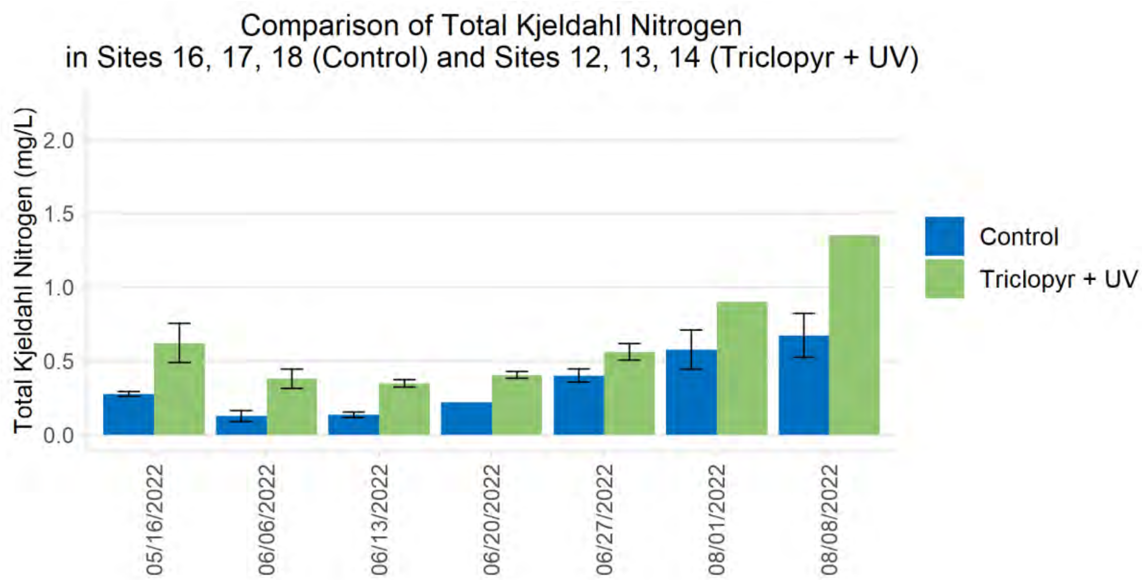


Figure 10-3. TKN in Sites Compared with Control Sites

d) Total P

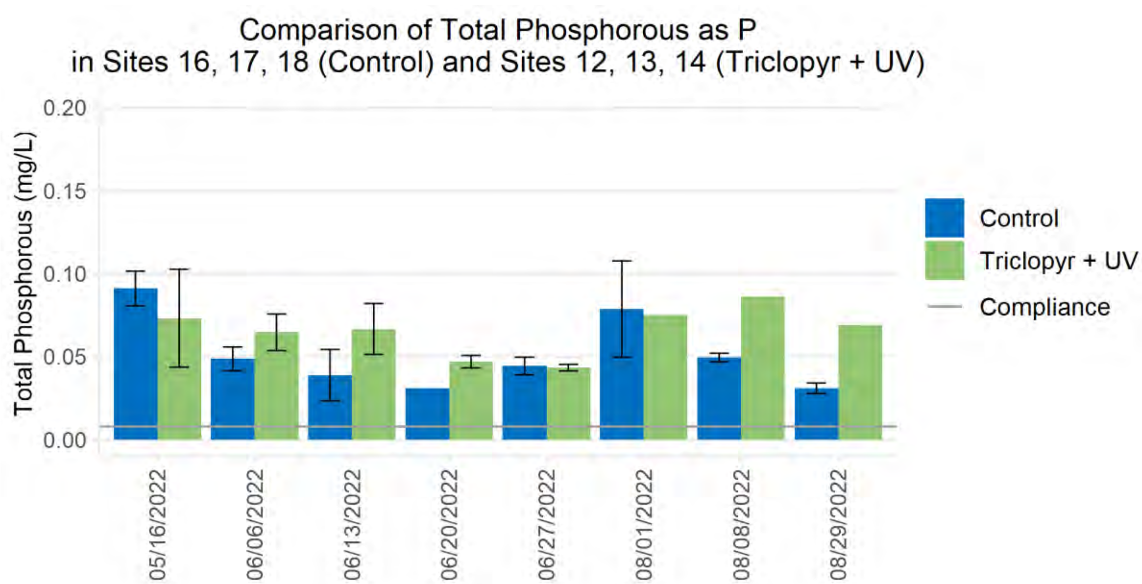


Figure 10-4. Total P in Triclopyr/UV Sites Compared with Control Sites

e) Ortho-P

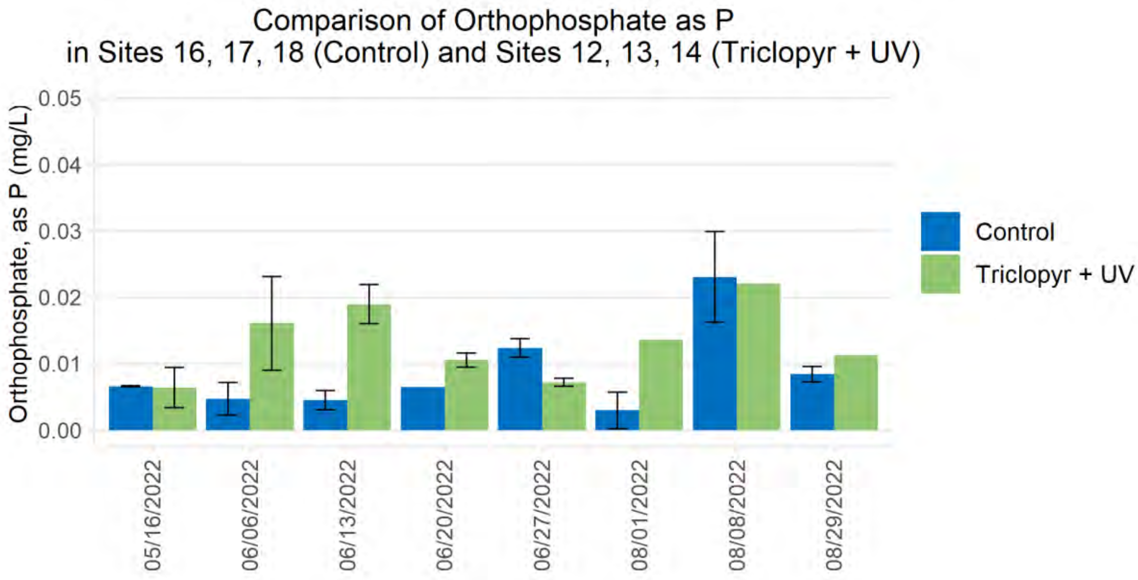


Figure 10-5. Ortho-P in Triclopyr/UV Sites Compared with Control Sites

10.2.2 Supporting Graphical Data for Standard Water Quality

a) Temperature

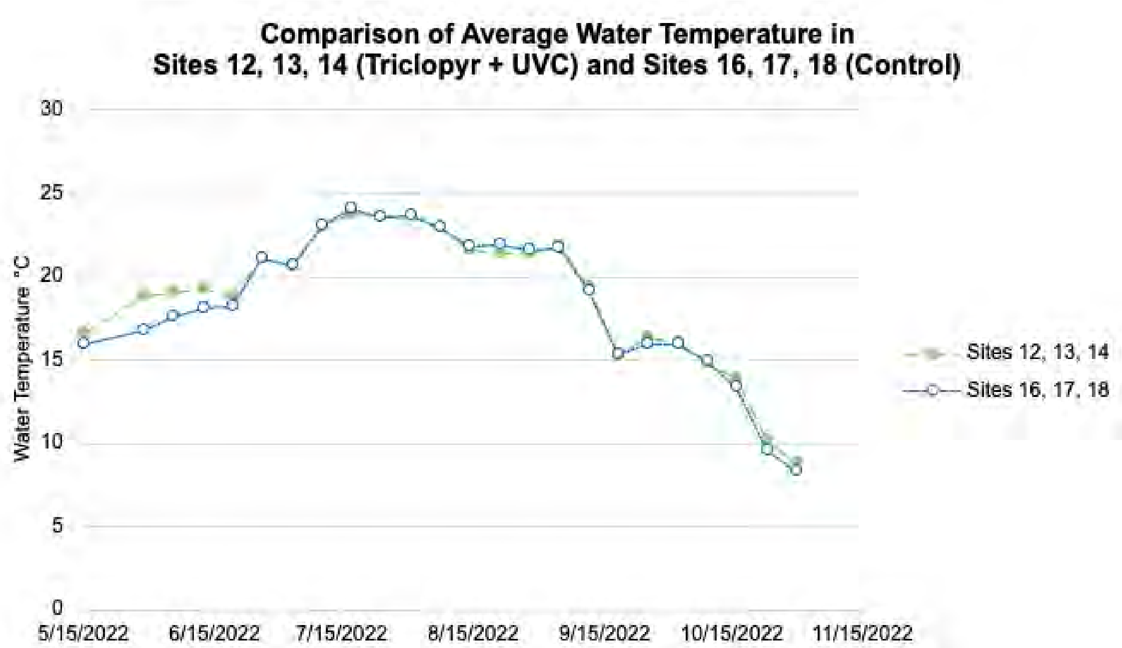


Figure 10-6. Water Temperature in Triclopyr/UV Sites Compared with Control Sites

b) DO

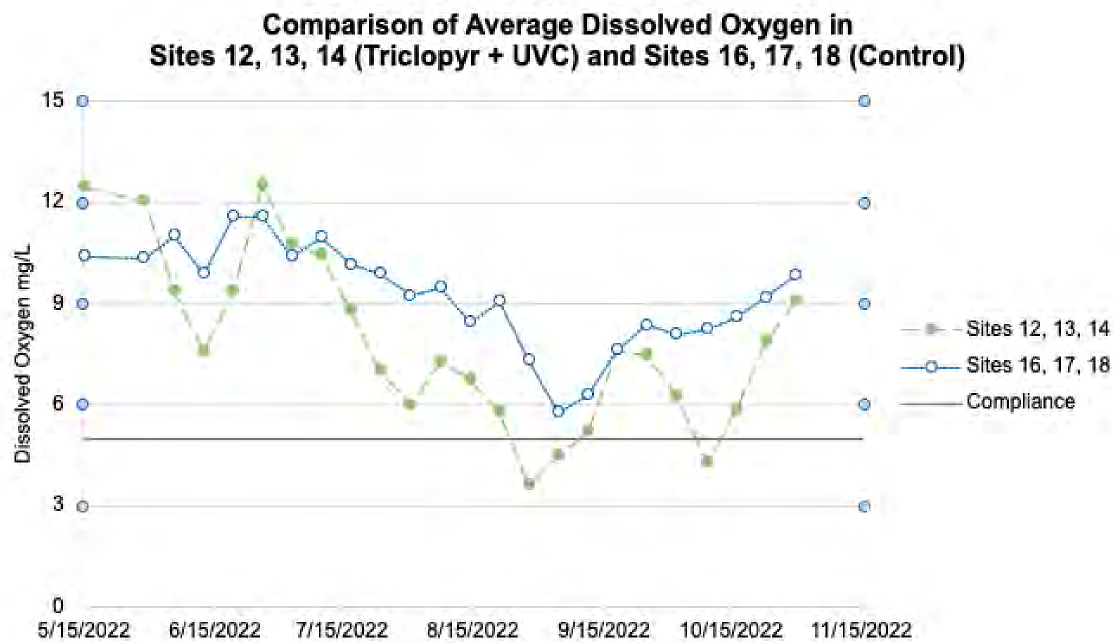


Figure 10-7. DO in Triclopyr/UV Sites Compared with Control Sites

c) pH

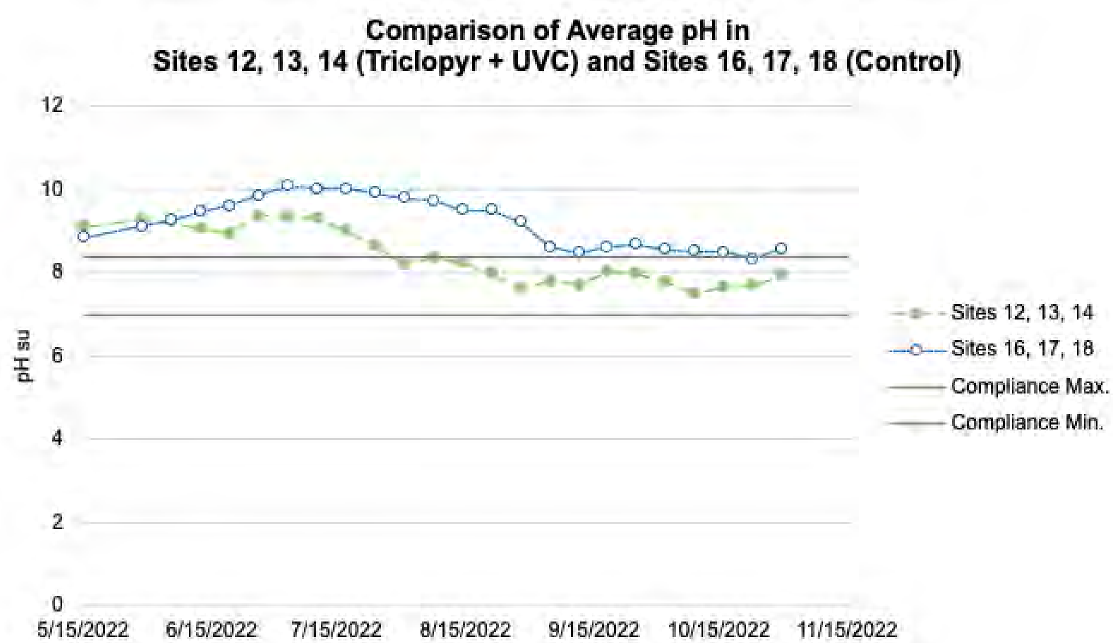


Figure 10-8. pH in Triclopyr/UV Sites Compared with Control Sites

d) Turbidity

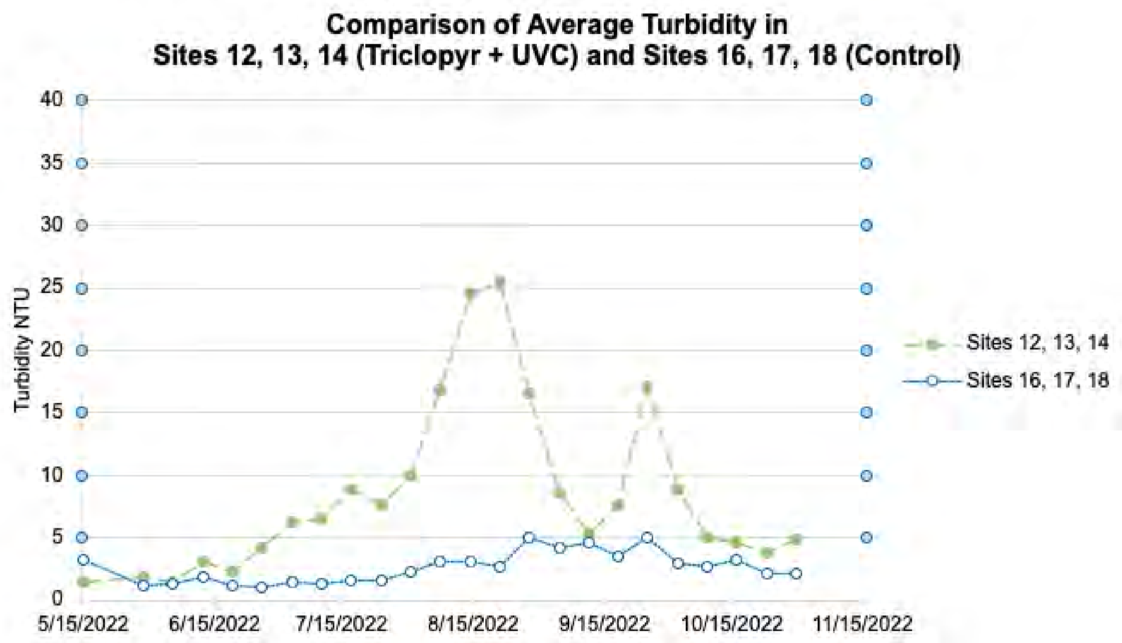


Figure 10-9. Turbidity in Triclopyr/UV Sites Compared with Control Sites

e) ORP

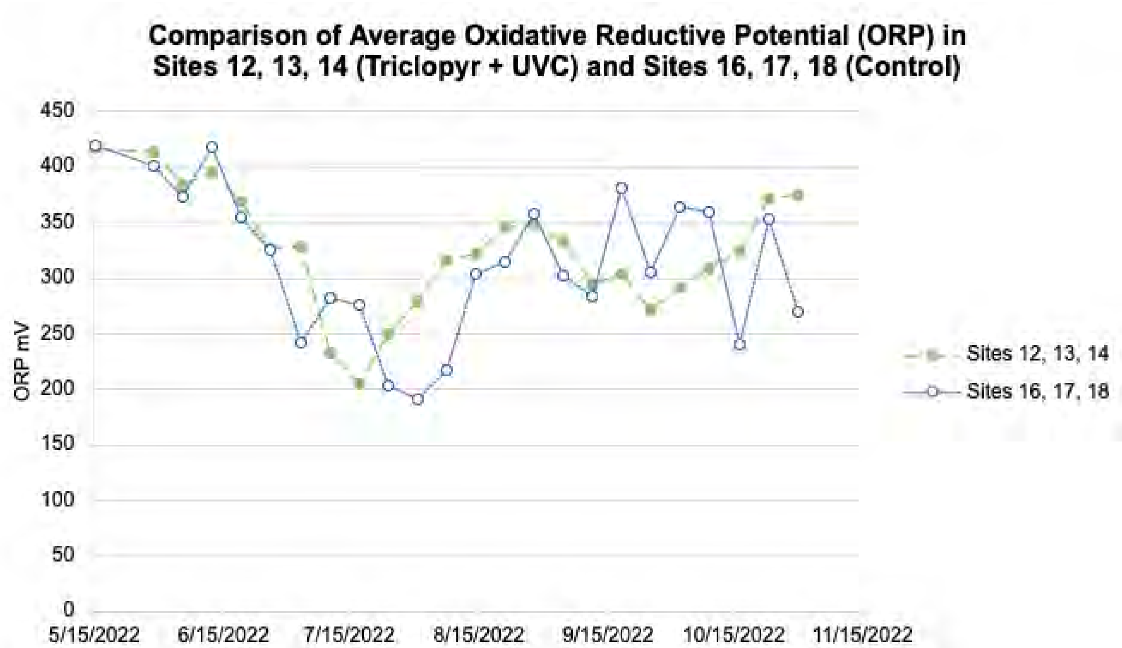


Figure 10-10. ORP in Triclopyr/UV Sites Compared with Control Sites

f) Conductivity

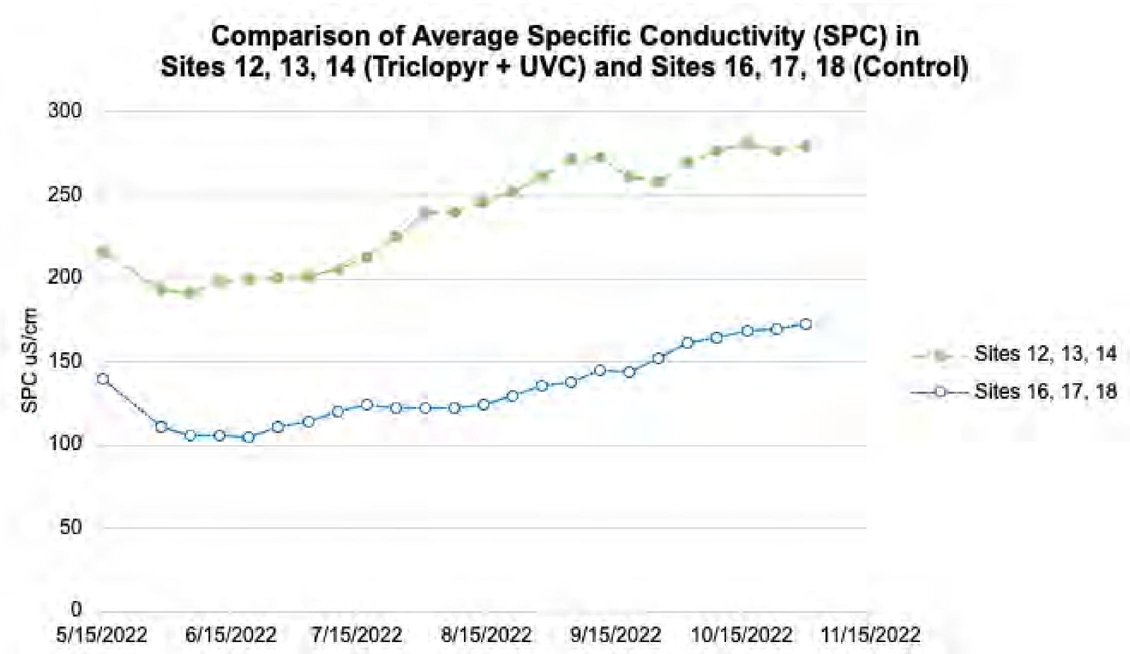


Figure 10-11. Conductivity in Triclopyr/UV Sites Compared with Control Sites

10.2.3 Supporting Graphical Data for Continuous Logger DO and Temperature

Figure 10-12. DO and Water Temperature in Upper and Lower Water Column in Triclopyr/UV Sites 12, 13, 14

10.3 Herbicide Residue and Degradant/RWT Dye in Triclopyr/UV Sites

10.3.1 General Description

Triclopyr (Renovate OTF granular) applications were made to these sites on May 31, 2022 without incident. RWT dye was injected with drop hoses immediately after Triclopyr was applied in the same near shore zones. Site 14 was isolated from nearby Site 13 by a double turbidity curtain to prevent potential mixing of herbicide, even though both sites were treated with Triclopyr. Due to delay in removal of double turbidity curtains, the UV treatment vessel did not have access to Sites 12, 13, 14 until October at which time the water was too shallow for safe and effective UV treatments. Therefore, the main effects on monitoring variables during spring and summer are most likely due to the initial near shore Triclopyr applications and possible transient incursions of Endothall from Sites 10 and 3.

10.3.2 Synopsis of Herbicide Monitoring

Site 12 had a maximum Triclopyr level of 92 µg/L on June 6, which degraded slowly and did not reach non-detect levels (<1 µg/L) until September 13 (Figures 10-13 through 10-18). Site 13 had maximum Triclopyr level of 250 µg/L and Site 14 had a maximum Triclopyr level of 370 µg/L on June 7 (7 DAT). Triclopyr in both sites did not reach non-detect levels until August 30 to September 6. Triclopyr levels were never above RWLs (400 µg/L). However, monitoring showed that Site 12 was exposed to 200 µg/L Endothall by June 7 and 71 µg/L on June 14, but thereafter Endothall was not detected at that site. Site 13 was also subjected to 250 µg/L of Endothall exposure by June 7, which decreased to 67 µg/L on June 14 and 37 µg/L on June 21, and thereafter was not detected. Site 14, which was isolated by turbidity curtains did not have detectable Endothall. RWT dye and Triclopyr was detected near Site 12 at IRW4 and IRW5.

10.3.3 Supporting Graphical Data for Herbicide Levels

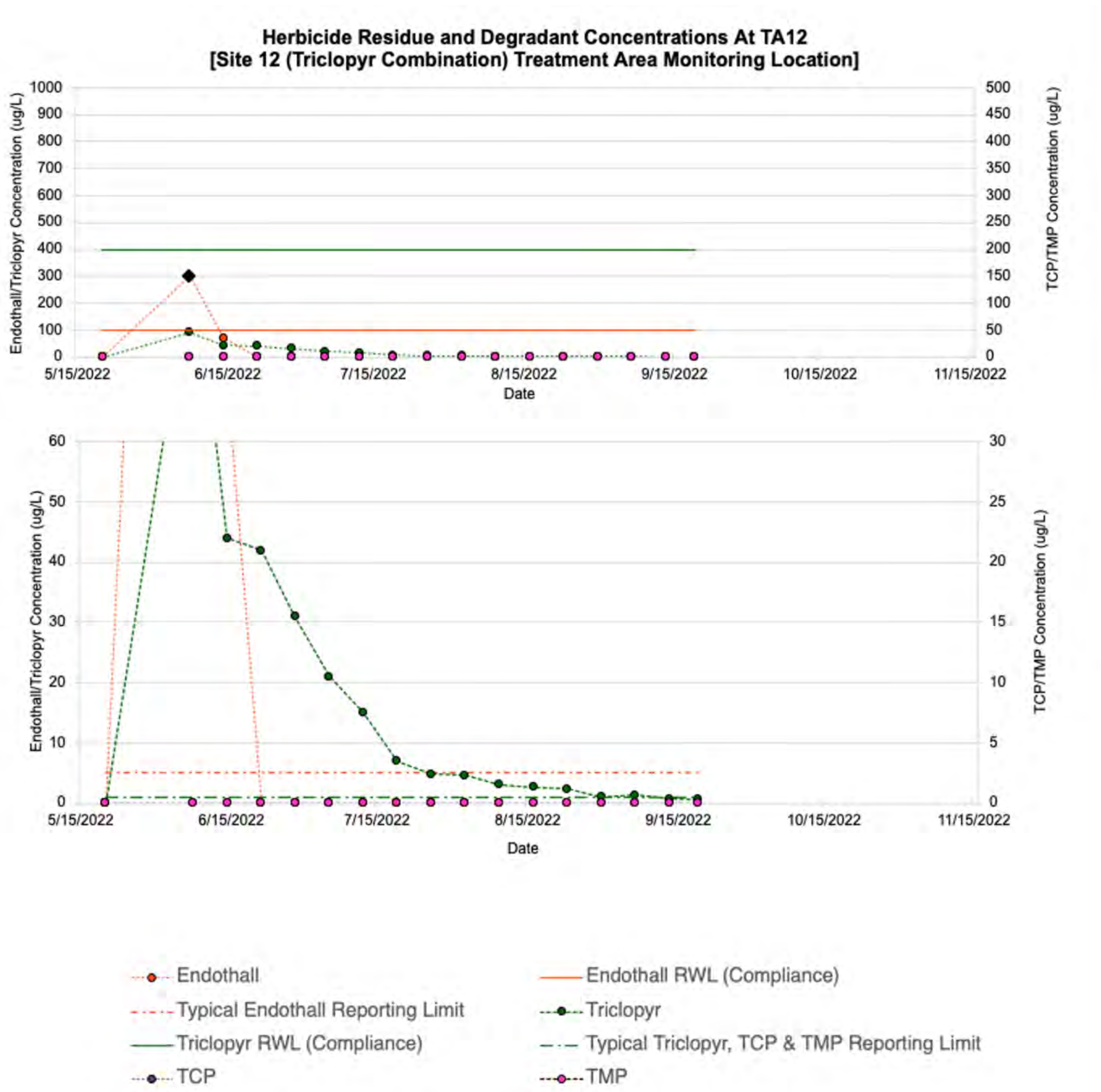


Figure 10-13. Herbicide Levels in Triclopyr/UV Site 12

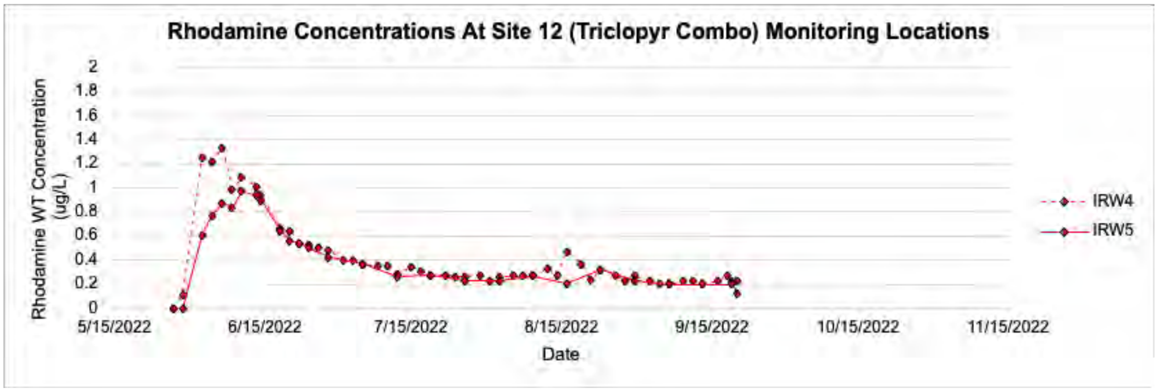


Figure 10-14. RWT in Site 12

IRW4 AND IRW5 are samples taken adjacent to Site 12.

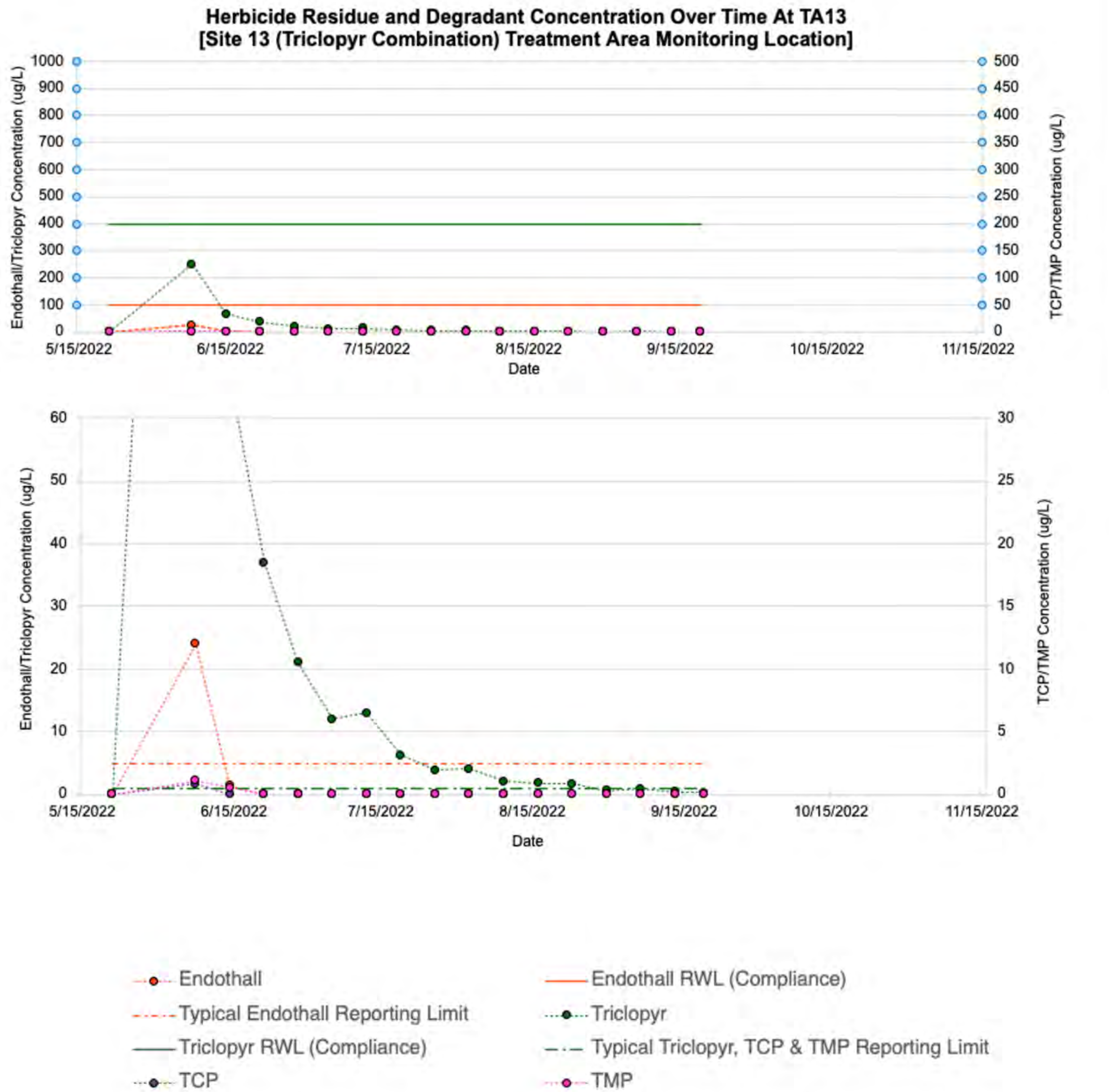


Figure 10-15. Herbicide Levels in Triclopyr/UV Site 13

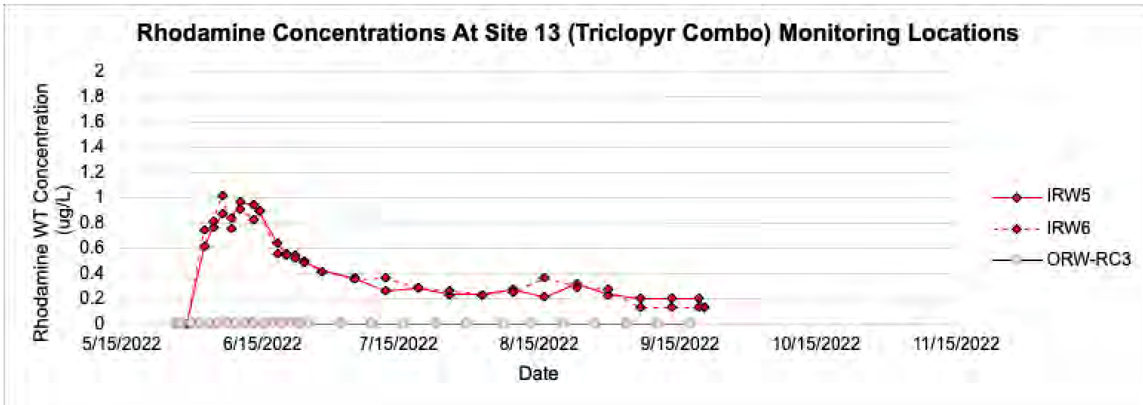


Figure 10-16. RWT Dye in Site 13

IRW5 and IRW6 are samples taken adjacent to Site 13. ORW-RC3 are samples taken outside double curtains near Site 13 (Area A).

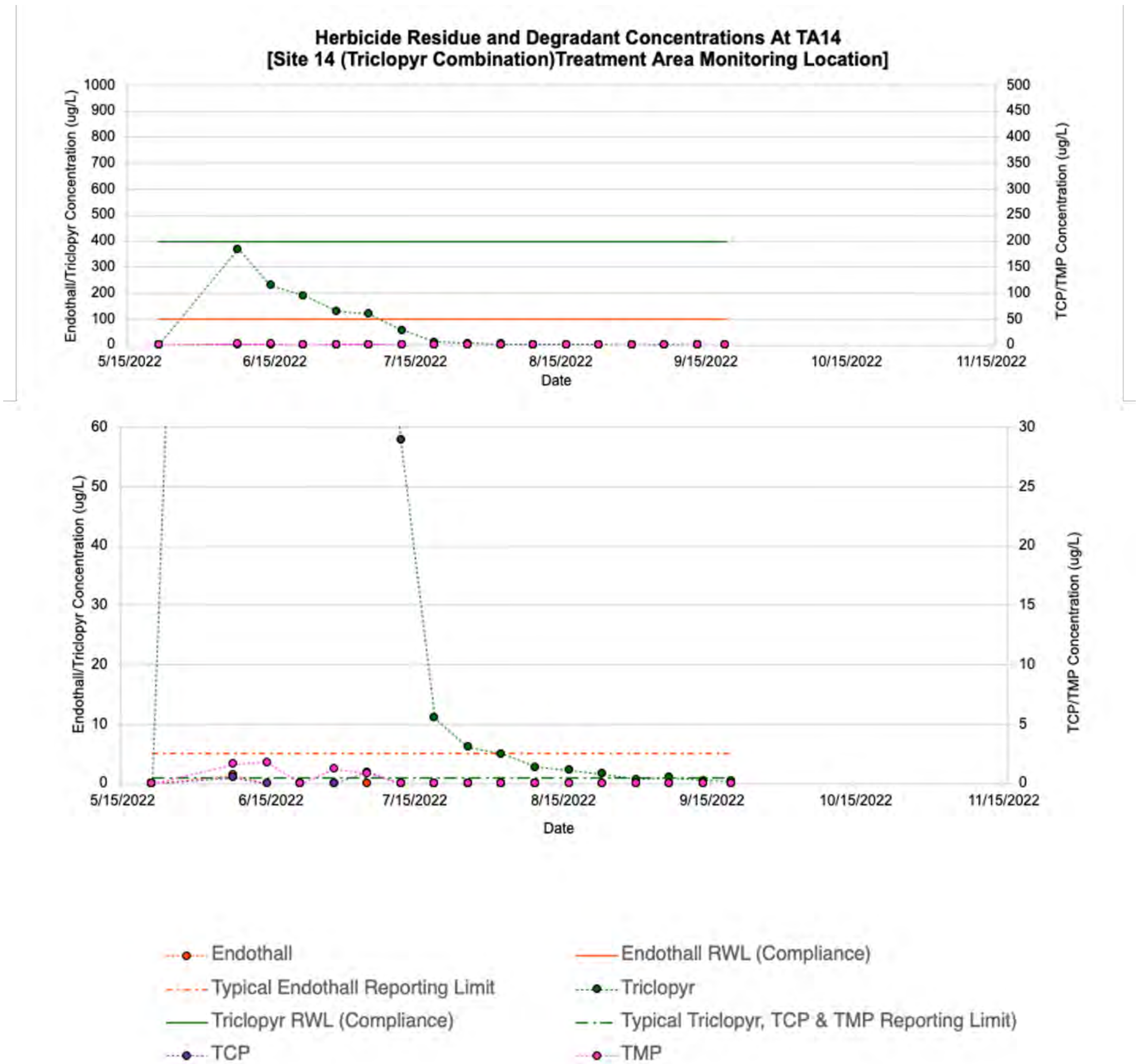


Figure 10-17. Herbicide Levels in Triclopyr/UV Site 14

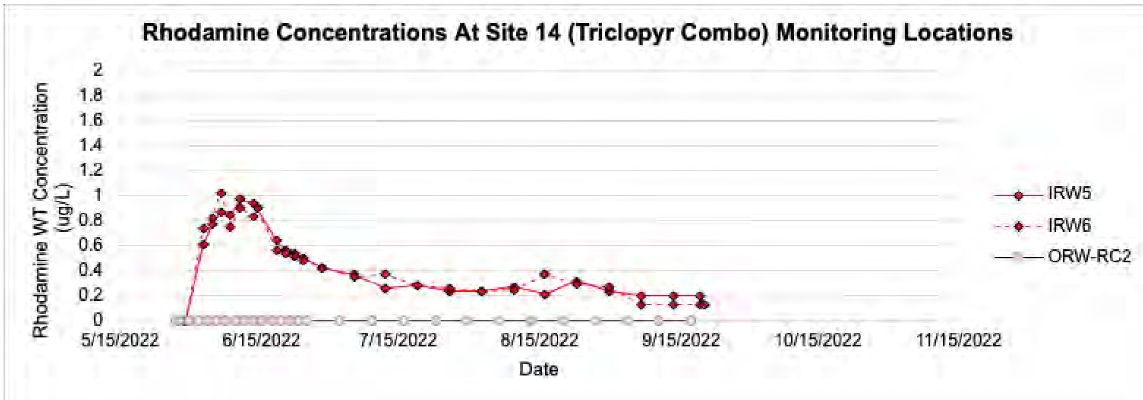


Figure 10-18. RWT in Site 14

IRW5 and IRW6 are samples taken adjacent to Site 14. ORW-RC2 are samples taken outside the nearest culvert plug seal (Area A).

10.4 AIP Responses

Triclopyr is selective for control of EWM and the biovolume and occurrence of this target AIP was effectively reduced by 75%. This level of efficacy coupled with the restricted mixing in Site 14, and Area A in general, likely contributed to the high turbidity observed (see Figure 10-9). Details of AIP and native plant responses are provided in Appendix E.

11.0 LFA SITES MONITORING RESULTS (SITE 26)

11.1 General Description

LFA is designed to provide a continuous injection of fine air bubbles through diffusor arrays secured to the bottom of each site. Although three sites (25, 26, 27) were designated to have the LFA system installed in 2022, only Site 26 was installed prior to the start of the CMT. Sites 25 and 27 were not installed and operating until late 2022 due to delays in the shipments of materials and equipment. Control Site 7 was added later as additional LFA control (Figure 1-1), so monitoring was less frequent than CMT control sites 16, 17, 18.

The designated LFA sites (25 and 27) shown in Figure 1-1 are located outside of the double turbidity curtains and thus these sites are not restricted from normal boating traffic, water exchanges, mixing with the rest of the West Lagoon, or the West Channel. The LFA treatments are anticipated to require long-term application (meaning multiple applications over years) before detectable changes occur in sediment, water quality, or other conditions. The potential effects of LFA on the target AIP are uncertain but are being assessed for the technology manufacturer's reported long-term ability to reduce nutrients available for AIP growth. For this reason, monitoring in LFA Sites 26, 25 and 27 is less frequent than either the herbicide only or combination treatment sites. For comparison of nutrient levels in 2022, control Sites 16, 17, 18 were used. Control Site 7 was used for comparison of water quality variables. This was due to changes in designated control Site 7, which will be used to compare to all LFA treatment sites in 2023 and 2024. However, since control Sites 16, 17, 18 will be monitored in Years 2 and 3 along with control Site 7, nutrient, and water quality data from all four control sites can be used to compare to the LFA sites in the West Lagoon.

11.2 Synopsis of LFA Results

<u>Nutrients</u>: (Figures 11-1 through 11-5) Total N and Total P levels were above regulatory levels in both control sites and LFA Site 26. However, Total N, TKN, Total P and Ortho-P were lower in the LFA site compared to control Sites 16,17,18 both in the spring and fall monitoring date.

<u>Water Quality</u>: (Figures 11-6 through 11-12) The temperature pattern was similar for the LFA and control Site 7 (and similar when compared with temperatures in control Sites 16, 17, 18 (Figures 4-6 and 4-8). The LFA treatment also appeared to sustain mid-water DO above 5 mg/L whereas control Site 7 DO declined steeply from July to mid-August and fell below 5 mg/L in early September. The hourly logger data confirmed the near surface water DO. The DO near the bottom was below 5 mg/L. ORP was variable and did not appear to follow a similar pattern in the LFA Site 26 and control Site 7. However, conductivity increased between spring and fall in the LFA Site 26 but remained lower and more stable in control Site 7.

11.2.1 Supporting Graphical Data for Nutrients

a) Total N

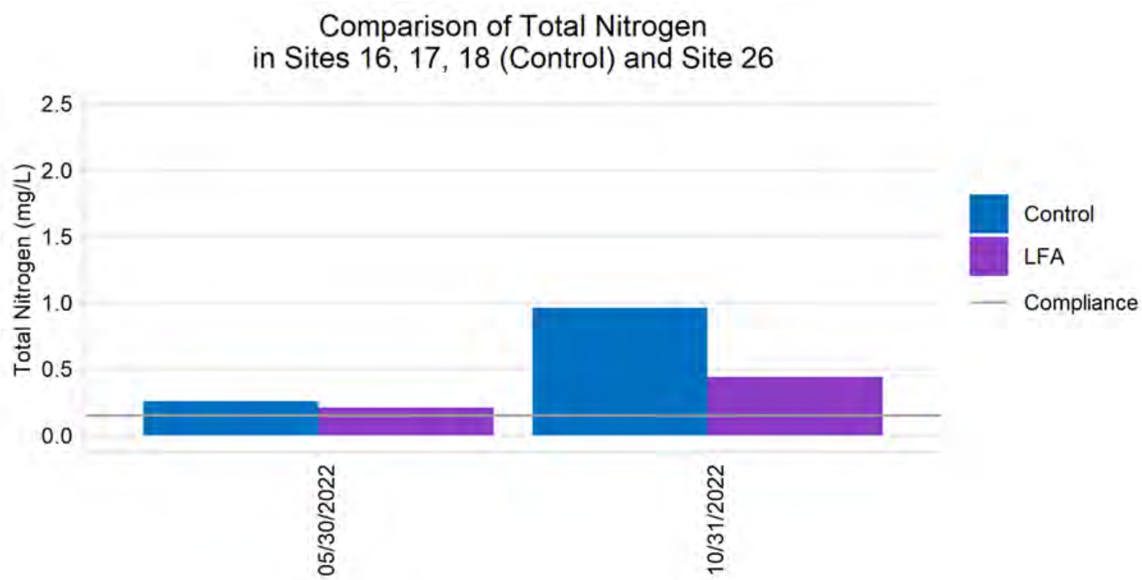


Figure 11-1. Total N in LFA Site 26 Compared with Control Sites

b) Nitrate+Nitrite

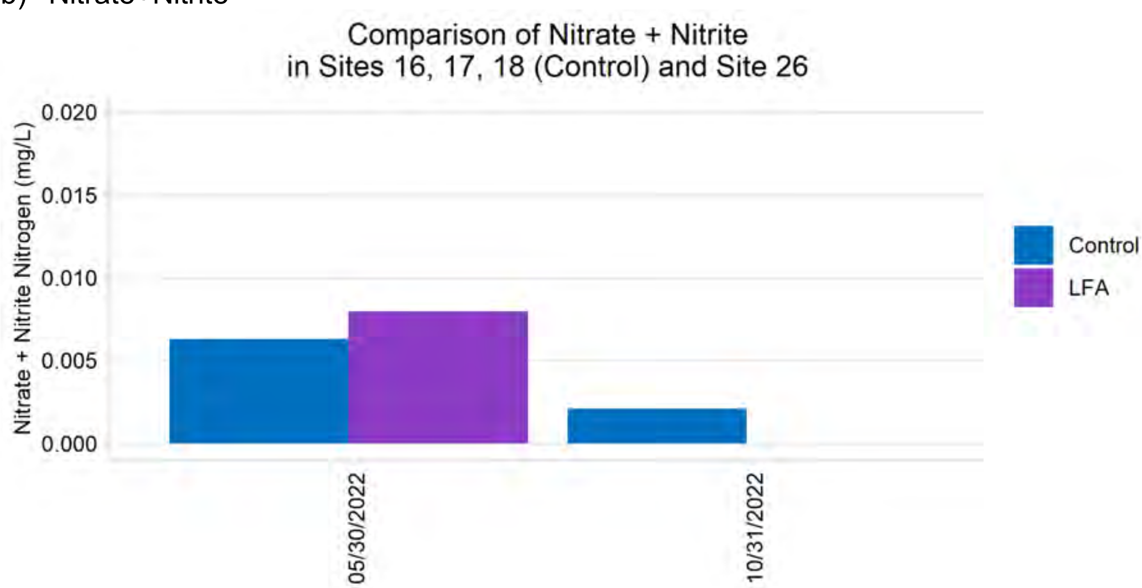


Figure 11-2. Nitrate+Nitrite in LFA Site 26 Compared with Control Sites

Nitrate+Nitrite in LFA Site 26 Compared with Control Sites

c) TKN

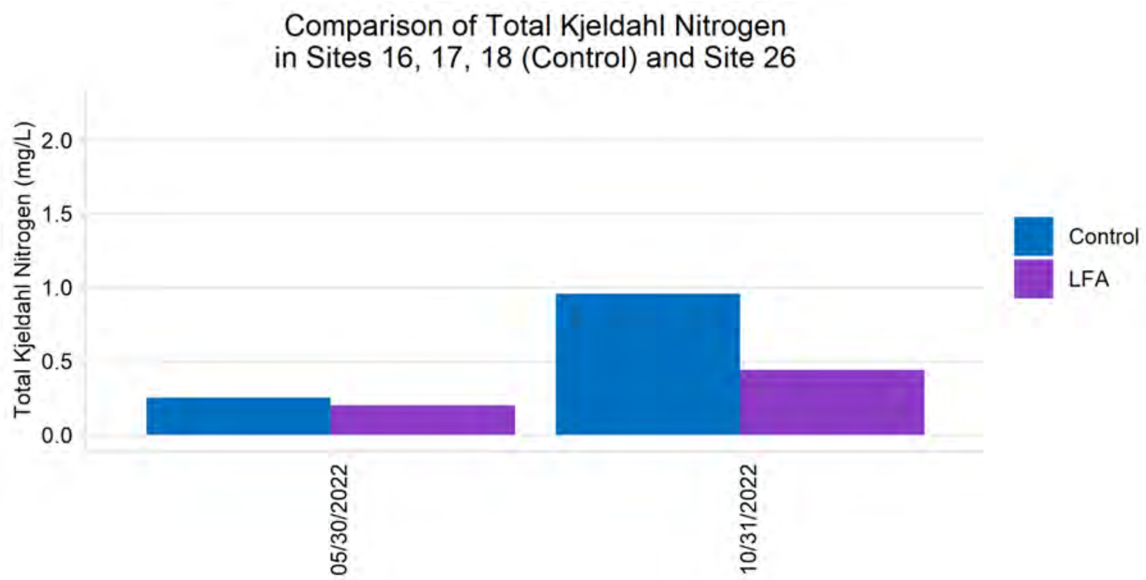


Figure 11-3. TKN in LFA Site 26 Compared with Control Sites

d) Total P

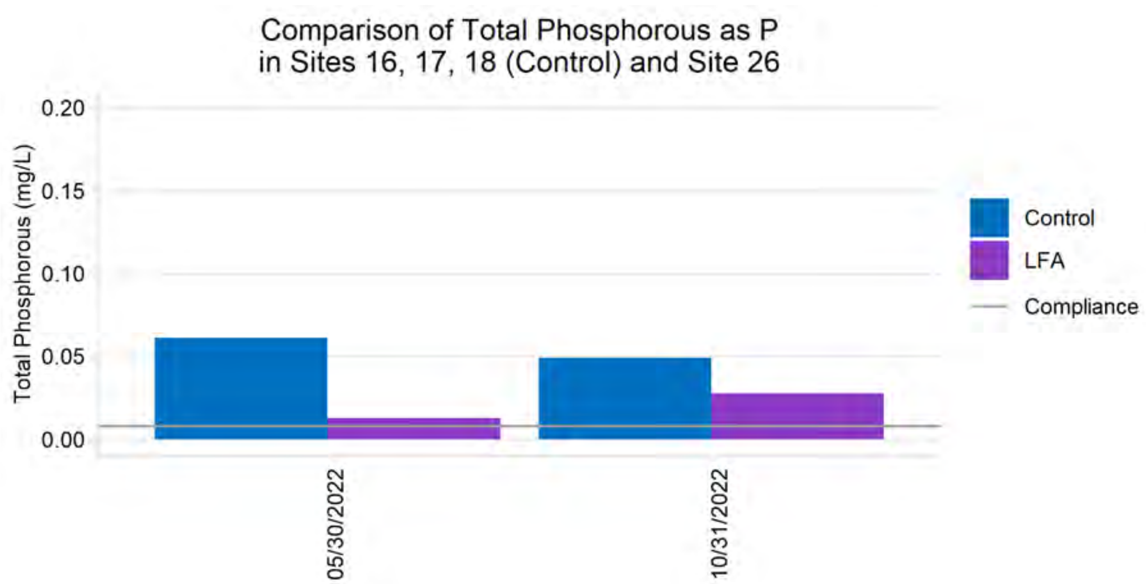


Figure 11-4. Total P in LFA Site 26 Compared with Control Sites

e) Ortho-P

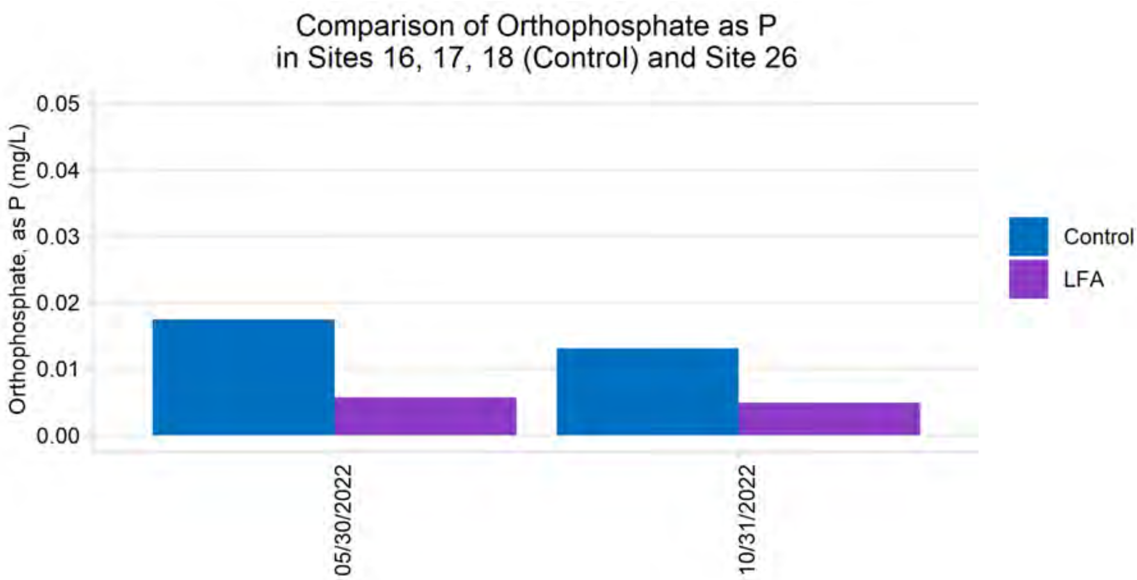


Figure 11-5. Ortho-P in FLA Site 26 Compared with Control Sites

11.2.2 Supporting Graphical Data for Standard Water Quality

a) Temperature

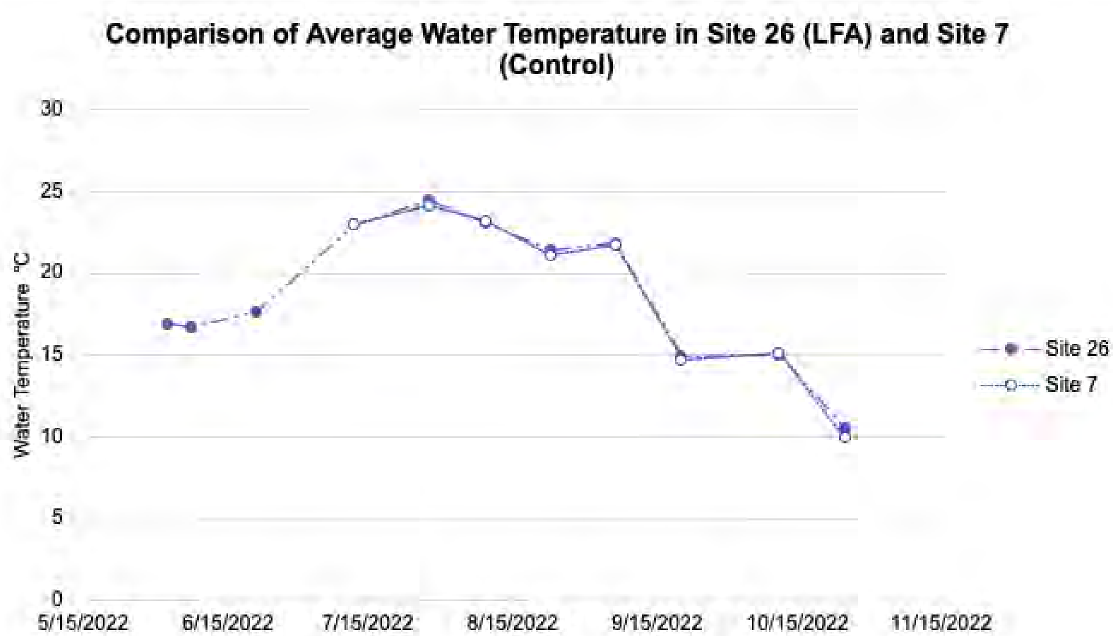


Figure 11-6. Water Temperature in LFA Site 26 Compared with Control Site 7

b) DO

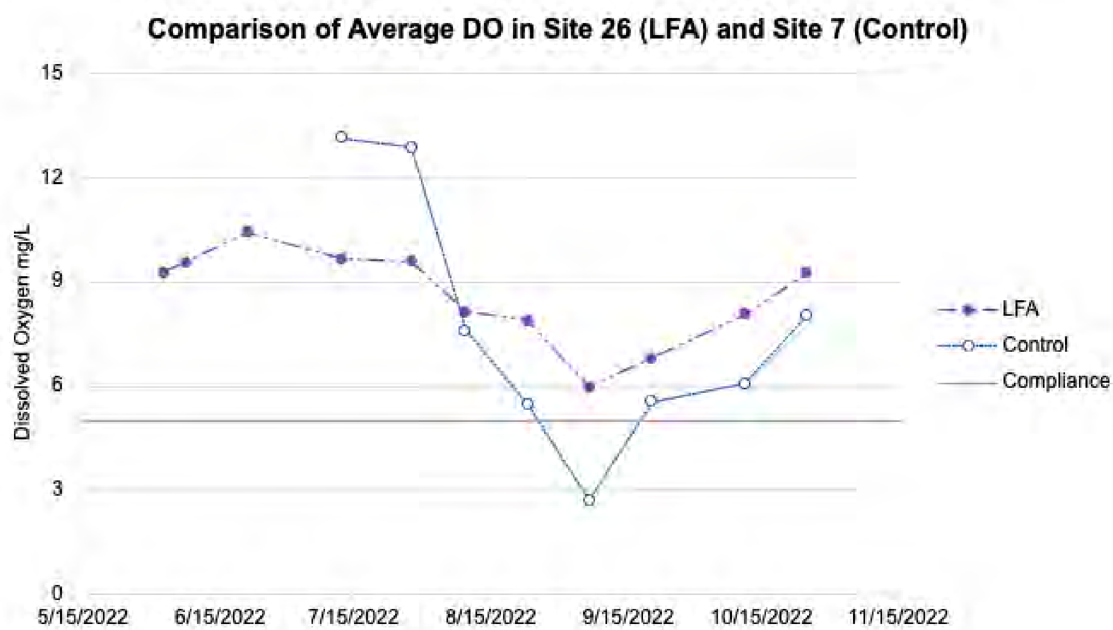


Figure 11-7. DO in LFA Site 26 Compared to Control Site 7

c) pH

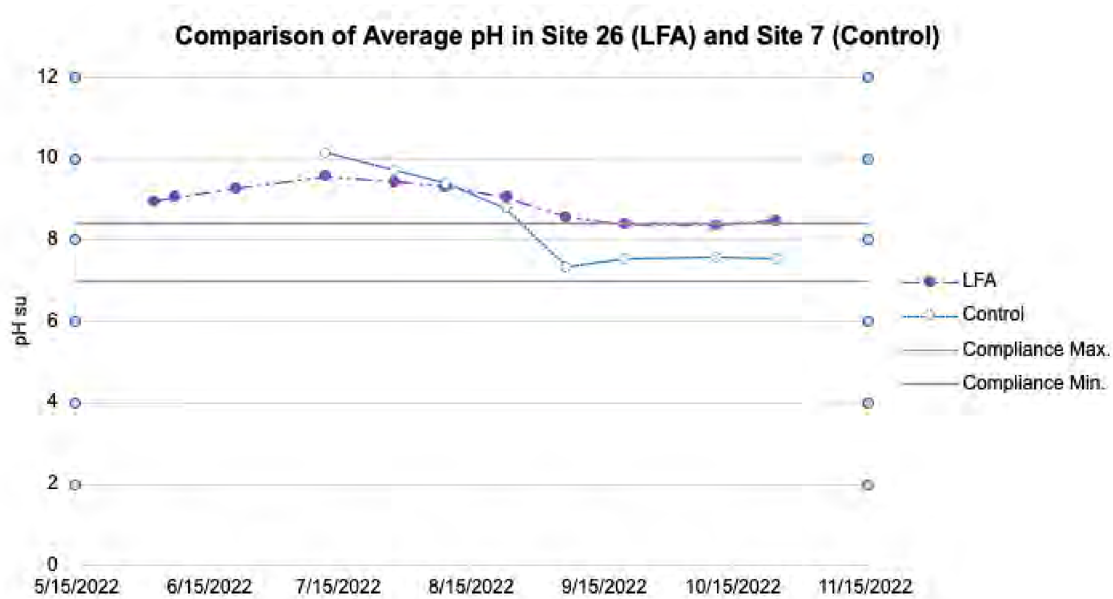


Figure 11-8. pH in LFA Site 26 Compared with Control Site 7

d) Turbidity

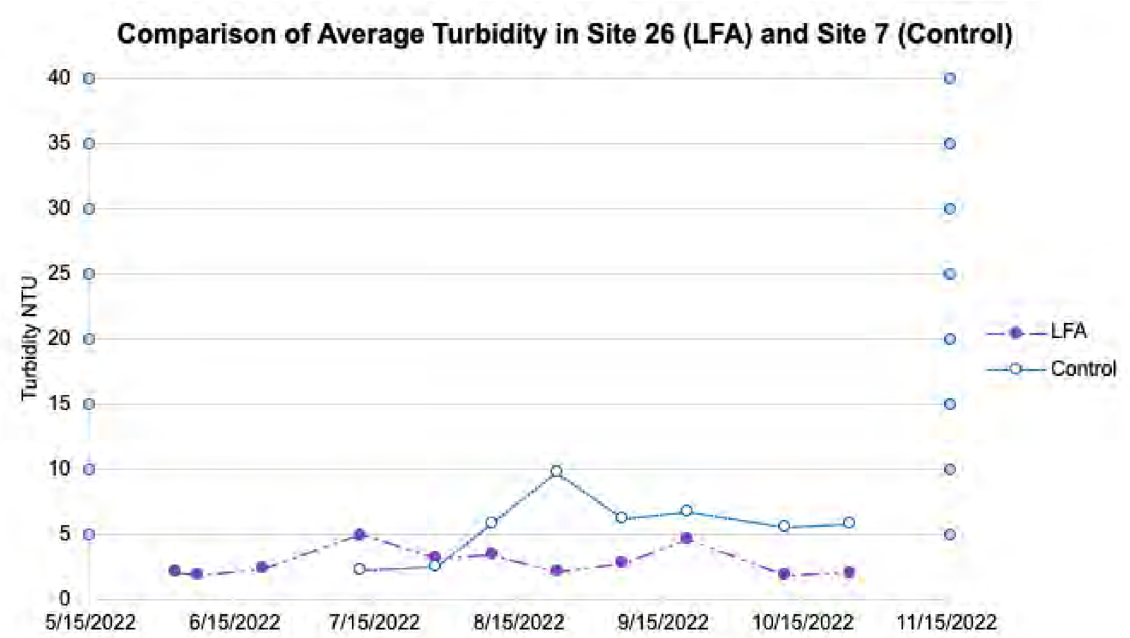


Figure 11-9. Turbidity in LFA Site 26 Compared with Control Site 7

e) ORP

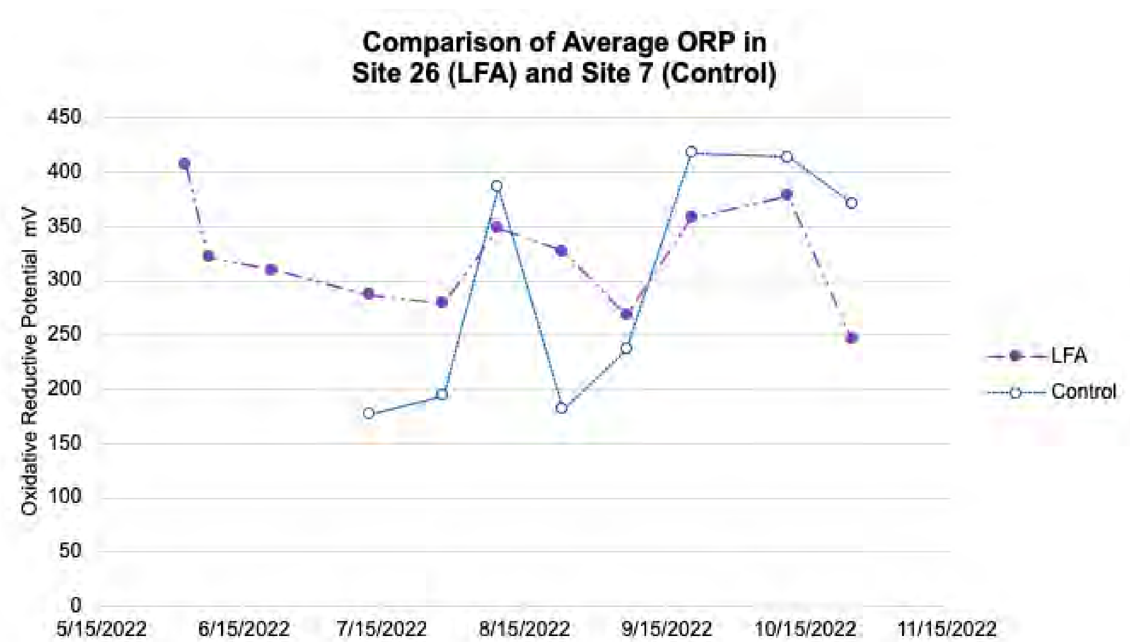


Figure 11-10. ORP in LFA Site 26 Compared to Control Sites

f) Conductivity

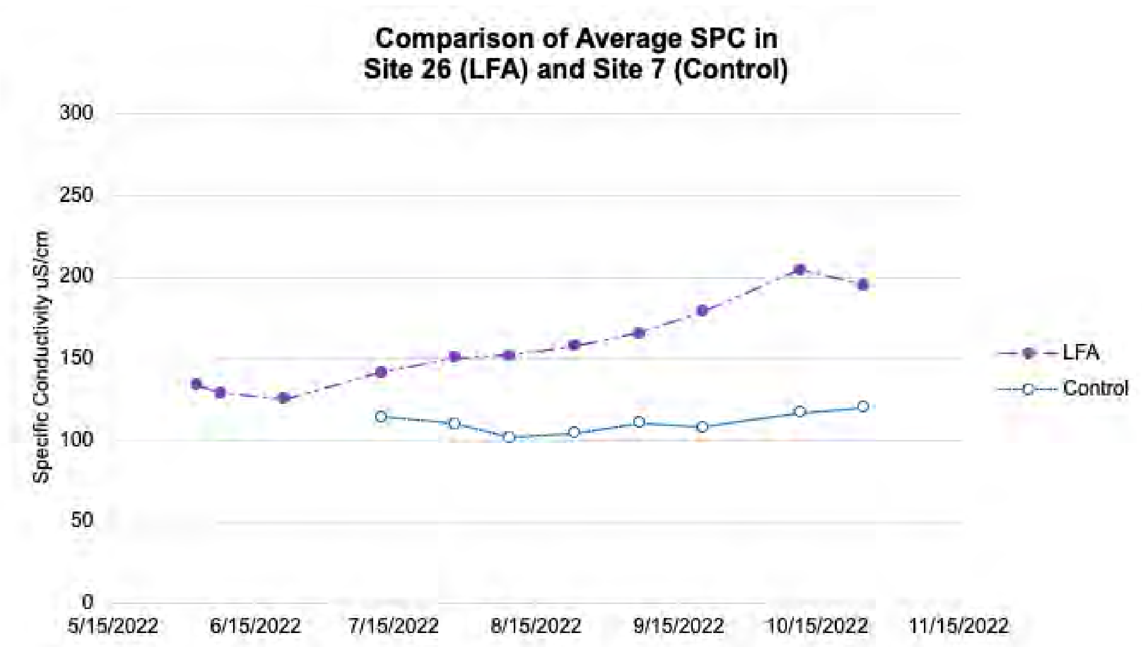


Figure 11-11. Conductivity in LFA Site 26 Compared to Control Site 7

11.2.3 Supporting Graphical Data for Continuous Logger DO and Temperature

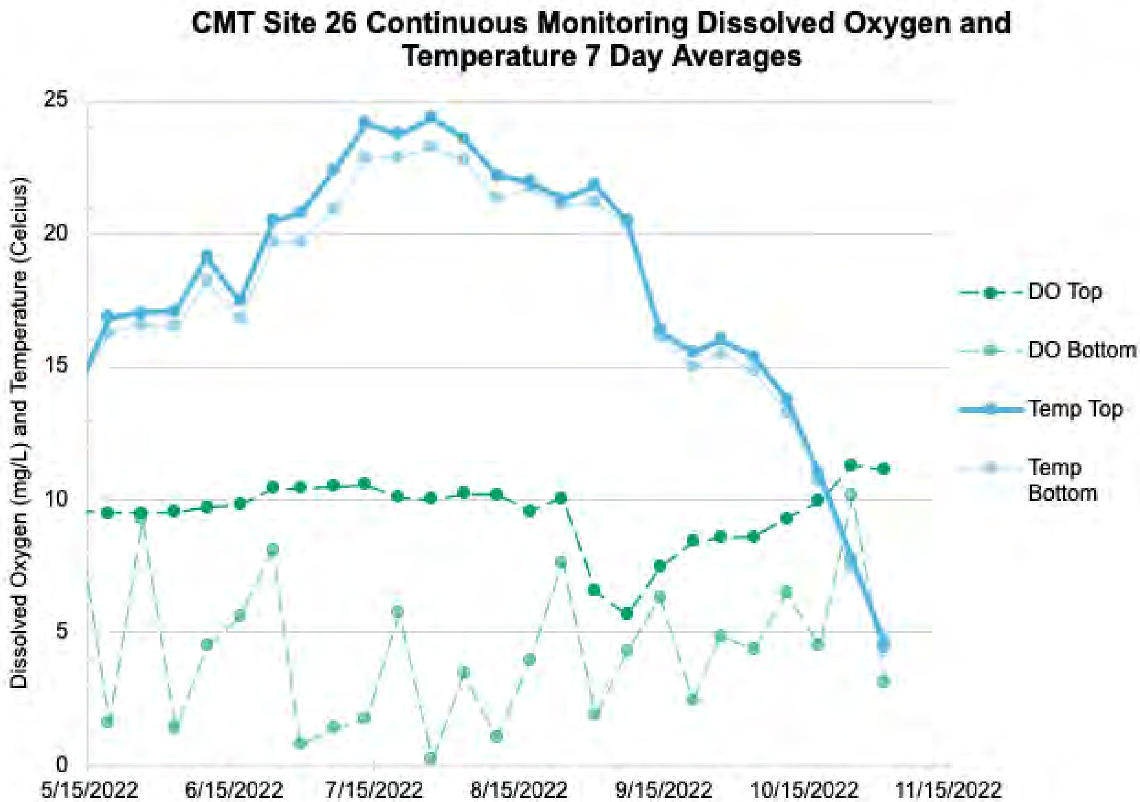


Figure 11-12. DO and Water Temperature in Upper and Lower Water Column in LFA Site 26

11.3 AIP Responses

The macrophyte surveys in LFA sites indicated little difference between biovolume and species composition compared with control sites. LFA impacts plants differently than the other CMT treatment methods. LFA can affect sediment/ nutrient availability as well as reduce sediment organic matter. These effects may provide a more indirect approach by gradually changing conditions for plant and algae growth rather than affecting plants and algae directly. Therefore, these changes are expected to take multiple seasons to observe measurable change in the plants or algae. (Note: Site 26 was also harvested in August, September, and October, which would have reduced biovolume to some extent for a few weeks.)

12.0 WELL WATER MONITORING RESULTS.

12.1 General Description

The Lahontan Order Section IV.C. (Water Supply Monitoring) of Attachment E – Monitoring and Reporting Program – specifies the background and post-event drinking water supply well monitoring requirements associated with herbicide applications in Year 1 of the CMT project. Appendix H of this annual report presents the lab results from the eleven sampling events at TKPOA's three water supply wells (Well 1, 2 and 3), which includes background (pre-herbicide application) sampling on May 24, 2022 and ten subsequent, post-herbicide application sampling events through June 14, 2022.

12.2 Well Water Analysis Results

Table 12-1 below presents summary results for the laboratory analyses of the drinking water supply well samples. Two samples (May 31, 2022 for Well 1, and June 6, 2022 for Well 2) produced laboratory results for Triclopyr and Endothall, respectively, that were above the laboratory minimum detection limits (MDL) but were "J Qualified" by the lab and below the Lahontan Order reporting limit (RL). The RL for Triclopyr is 1.0 ppb and the RL for Endothall is 5.0 ppb.

For the Well 1 sample on May 31, 2022, the laboratory analysis estimated Triclopyr at 0.52 ppb, which is above the laboratory MDL of 0.28 ppb. For the Well 2 sample on June 6, 2022, the laboratory analysis estimated Endothall at 1.4 ppb, which is slightly above the laboratory MDL of 1.3 ppb.

TKPOA's contractor (Stratus Engineering Associates LLC) that collected the well water samples obtained duplicate samples on all sampling dates in the event that additional laboratory analyses were warranted. Because the May 31 and June 6 analyses produced results that were "J Qualified" by the laboratory, the duplicate samples gathered for those locations and dates were also analyzed. As shown in the summary table below, the laboratory reported the results of both duplicate analyses to be below the MDL.

Table 12-1. Summary of Lab Results for Well Water Monitoring
(ND - Non-detect; N/A - no sample collected; Red - J Qualified/ Duplicate sample analyzed.)

	Site	W1		W2		W3	
	Description	Well 1		Well 2		Well 3	
	Constituent	Endothall	Triclopyr	Endothall	Triclopyr	Endothall	Triclopyr
Date	Unit	in ppb		in ppb		in ppb	
5/24/2022		ND	ND	ND	ND	ND	ND
5/25/2022		N/A	N/A	N/A	N/A	N/A	N/A
5/26/2022		N/A	N/A	N/A	N/A	N/A	N/A
5/27/2022		ND	ND	ND	ND	ND	ND
5/28/2022		N/A	N/A	N/A	N/A	N/A	N/A
5/29/2022		ND	ND	ND	ND	ND	ND
5/30/2022		N/A	N/A	N/A	N/A	N/A	N/A
5/31/2022		ND	**0.52**/ND	ND	ND	ND	ND
6/1/2022		N/A	N/A	N/A	N/A	N/A	N/A
6/2/2022		ND	ND	ND	ND	ND	ND
6/3/2022		N/A	N/A	N/A	N/A	N/A	N/A
6/4/2022		ND	ND	ND	ND	ND	ND
6/5/2022		N/A	N/A	N/A	N/A	N/A	N/A
6/6/2022		ND	ND	**1.4**/ND	ND	ND	ND
6/7/2022		N/A	N/A	N/A	N/A	N/A	N/A
6/8/2022		ND	ND	ND	ND	ND	ND
6/9/2022		N/A	N/A	N/A	N/A	N/A	N/A
6/10/2022		N/A	N/A	N/A	N/A	N/A	N/A
6/11/2022		ND	ND	ND	ND	ND	ND
6/12/2022		N/A	N/A	N/A	N/A	N/A	N/A
6/13/2022		ND	ND	ND	ND	ND	ND
6/14/2022		ND	ND	ND	ND	ND	ND

13.0 SUPPLEMENTARY AND CONTINGENCY HERBICIDE SAMPLING

13.1 Herbicide Detection in Filtered and Unfiltered Water

To better understand and determine the potential effects of background (“matrix”) constituents on herbicide detection limits and accuracy, a comparison was made between field-collected water that was either unfiltered or filtered and analyzed using the standard protocols for CMT herbicide and degradant analysis. Results are in Table 13-1 and suggest that with the water samples used, there was no significant difference between filtered and unfiltered water.

Table 13-1. Summary of Supplemental Sampling Filtering Study

		Unfiltered			0.45 um Filtered		
Date	**Location**	**Triclopyr (µg/L)**	**TCP (µg/L)**	**TMP (µg/L)**	**Triclopyr (µg/L)**	**TCP (µg/L)**	**TMP (µg/L)**
8/16/2022	IRW6	2.1	ND (<0.39)	ND (< 0.55)	2.1	ND (< 0.39)	ND (< 0.55)
8/16/2022	TA13	1.8	ND (< 0.39)	ND (< 0.55)	1.7	ND (< 0.39)	ND (< 0.55)
8/16/2022	TA14	2.0	ND (< 0.39)	ND (< 0.55)	1.7	ND (< 0.39)	ND (< 0.55)

Notes:
1. To assess the contribution of triclopyr and triclopyr degradants adsorbed to suspended solids present in the water column, filtered and unfiltered samples were collected from three (3) sites on August 16, 2022 and submitted for analysis.
2. All samples were collected from mid-depth, using decontaminated sampling equipment.
3. Filtered samples were pumped through a 0.45 um filter.

13.2 Accelerated Frequency of Surface Water Sampling

Establishment of non-detect levels of Triclopyr required results from two sets of samples separated by at least 48 hours and with below 1 µg/L. Due to the prolonged presence of Triclopyr above 1 µg/L in Areas A and B, and the resultant delay in removal of double turbidity curtains confining those areas, the routine sampling frequency of 7-day intervals was shortened in order to determine as timely as possible when non-detect criteria were met. These data are provided in Appendix Z.

13.3 Contingency Monitoring

Herbicide monitoring tables are included in Appendix Z.

14.0 RECEIVING WATER MONITORING SUMMARY

14.1 General Description

There were two RWLs specified for the CMT in the Lahontan Order and MMRP: (a) RWLs of 400 µg/L for Triclopyr and 100 µg/L for Endothall *inside* herbicide treated site after 21 DAT; and (b) RWLs for herbicides detected *outside* CMT herbicide treatment sites at any DAT.

14.2 Results of Surface Water Herbicide Analysis

Surface water herbicide analysis results are provided in detail in Appendix Z. These data have been graphically represented in previous sections of this report (Sections 5.0, 6.0, 8.0, 9.0 and 10.0). The locations and dates of RWL events are summarized below in Table 14-1.

Table 14-1. Summary of Endothall Incursions and Site 19 RWL

	Incursions: Adjacent areas Dates/range (ug/L) >RWL	**Endothall Detected Outside Curtains Dates/range (µg/L) >RWL**
Site No.	Monitoring Station (Figure 1-1)	Monitoring Station (Figure 1-1)
1	IRW1: 5/30 to 6/13 (500 to 1000)	ND
2	IRW1: 5/30 to 6/13 (500 to 1000)	ORW-RHC2 5/28 (210) 6/2 (120) 6/7 (110) 6/8 (140) 6/10 (110)
3	IRW4: 5/30 to 6/14: (120 to 490)	ND
5	IRW3: 6/1 to 6/13 (110 to 190)	ND
8	IRW8: 5/28 (130)	ND
9	NE	ND
10	IRW2: 6/1 to 6/13: (350 to 510) IRW4: 5/30 to 6/14: (120 to 490) IRW1: 5/30 to 6/13 (500 to 1000)	ND
11	IRW2: 6/1 to 6/13: (350 to 510) IRW3: 6/1 to 6/13 (110 to 190)	ND
12	IRW4: 6/3 to 6/7 (120 to 260) IRW5: 6/3 to 6/7 (120 to 260)	ND
15	IRW8: 5/28 (130)	ND
19 (L. Tallac)	IRW9: 6/3 to 6/28 (220 to 460)	ND
19 (L. Tallac) Inside Site	TA 19: 6/21 to 6/28 (220 to 360) Level above RWL > 21 DAT within Site 19	

15.0 SEDIMENT MONITORING

Two components of sediment monitoring were required as part of the CMT project: 1) Biological assessments for benthic organisms through sampling of BMI; and 2) Monitoring for herbicide residual levels in bottom sediments.

15.1 Benthic Macroinvertebrates Assessment

The protocol for BMI assessment is provided in the QAPP. The 2019 Fish and Benthic Macroinvertebrate Surveys in Tahoe Keys Lagoons (ESA 2020) is presented in Appendix BB.

15.2 Herbicide Sampling and Analysis in Sediments

The protocol for field sampling and analyzing sediments in the CMT sites is provided in the QAPP. Post-CMT sediment sampling was performed September 26, 2022. Both elutriate and whole sediment analysis was done. No herbicides were detected in the elutriate. No Triclopyr or its degradants were detected in any of the whole sediment samples. The only detections of Endothall in whole sediment are summarized in Table 15-1.

Table 15-1. Herbicide Levels in Whole Sediment Samples from CMT Sites

Site	Endothall Level (µg/L) (two samples each site)
1	68, 50
2	100, 420
3	740, 270
10	220, 140
12	220, 210

16.0 SUMMARY, IMPLICATIONS, AND RECOMMENDATIONS FOR REMAINDER OF THE CMT PROJECT

16.1 General Findings

Year 1 of the CMT project was completed with relatively few major problems related to required monitoring actions. Most of the experiences were directly due to severe weather conditions or other natural phenomena, such as wildlife activity. Monitoring to meet the Lahontan NPDES extensive requirements was completed with a high level of completeness. The main problems were associated with losses of the hourly loggers used to record surface and near-bottom water DO and temperature. Fortunately, real-time mid-depth water quality measurements taken three times per week in each CMT site provided continuous data throughout the 2022 CMT from May through November. This data was also supplemented by real-time temperature, DO, and pH measured outside the CMT sites (Appendix S).

The most serious and consequential issues arising from Year 1 CMT were directly related to the prolonged presence of Triclopyr above (1 µg/L) “non-detect” levels, which in turn resulted in the unexpected long-term, continued deployment of double turbidity curtains that isolated Areas A and B (Figure 2-3). Not only did this prohibit access for timely UV treatments in the combination sites, it also resulted in blocking public and recreational access to these restricted areas, and created stagnant water zones that typically promote algal growth, increase turbidity, and depress DO. The high turbidity in turn reduced light and impaired the expected photodegradation of Triclopyr.

16.2 Herbicide Levels and Persistence

The careful CMT mitigation and monitoring actions, such as double turbidity curtains, use of RWT dye, and diligent contingency sampling insured that neither herbicides nor their degradants ever were in proximity to the West Channel, nor did they enter Lake Tahoe proper. In fact, the few detections immediately outside the curtains were transient and, with few exceptions, always well below RWL. As described above, the unexpected, prolonged presence of Triclopyr above the 1 µg/L non-detect level in Areas A and B may have been due to a combination of conditions: low light due to high turbidity, particularly in Area A; and restricted mixing that may have kept Triclopyr in deeper water and thus further restricted for photolysis (Pozdnyakov et al. 2022).

This issue is directly linked to the difference between the prescribed standards for RWL for Endothall (100 µg/L) and Triclopyr (400 µg/L) in contrast to the Lahontan Order, which required “non-detect” levels for Endothall (5 ug /L) and Triclopyr (1 µg/L) before mitigation curtains could be removed. The result was an extremely long deployment of the curtains, which probably created a compounding feed-back condition: The longer stagnation occurred, the higher the turbidity, resulting in impaired photodegradation of Triclopyr. Considering the unlikely non-target effects of low Triclopyr levels existing 20 to 30 DAT, the removal of curtains earlier may have been beneficial to water quality in general without increased risk (Antunes-Kenyon and G. Kennedy 2004).

Residues of Triclopyr above 1 µg/L persisted in Area A until 105 DAT and in Area B until 85 DAT, whereas the prescribed RWL (400 µg/L) for Triclopyr was met within 7-14 DAT. Figures 16-1, 16-2, 16-3 below show the slow decline of Triclopyr in Areas A and B and the DAT required to achieve “non-detect” thresholds for removal of double turbidity curtains.

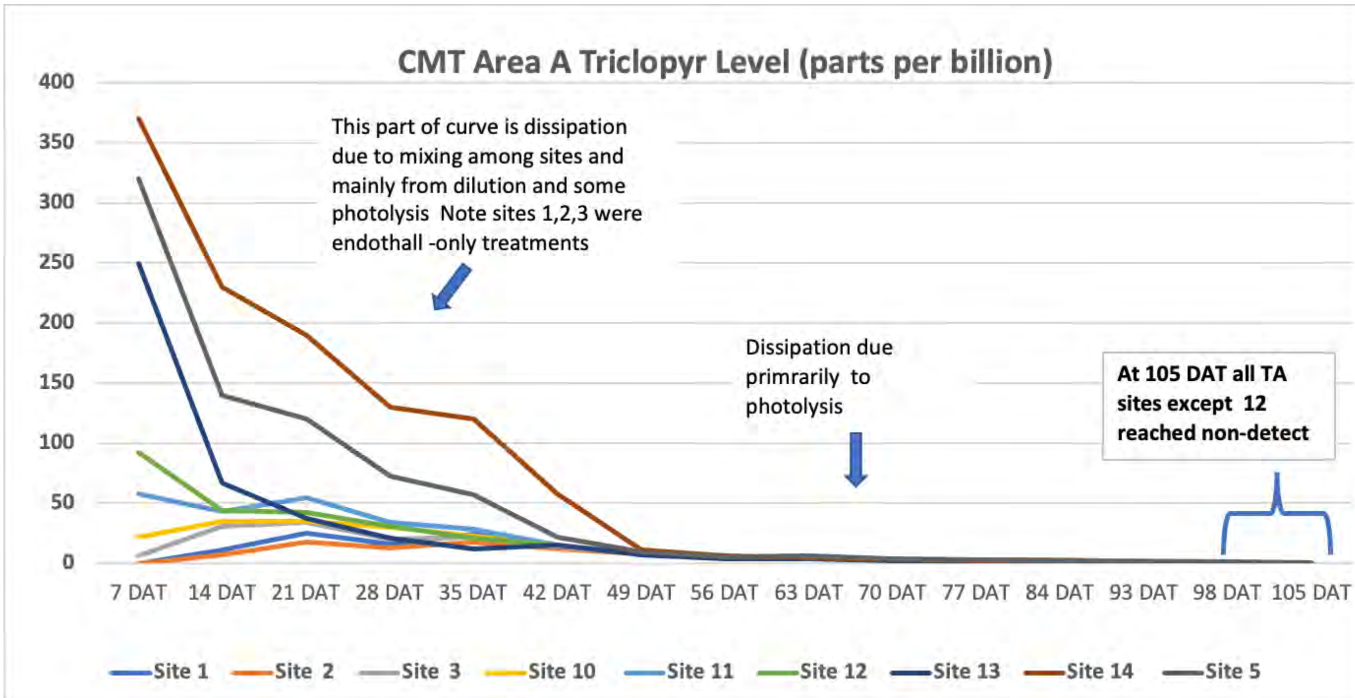


Figure 16-1. Triclopyr in Area A Sites: PPB Nominal Target Applications at 1,000 PPB

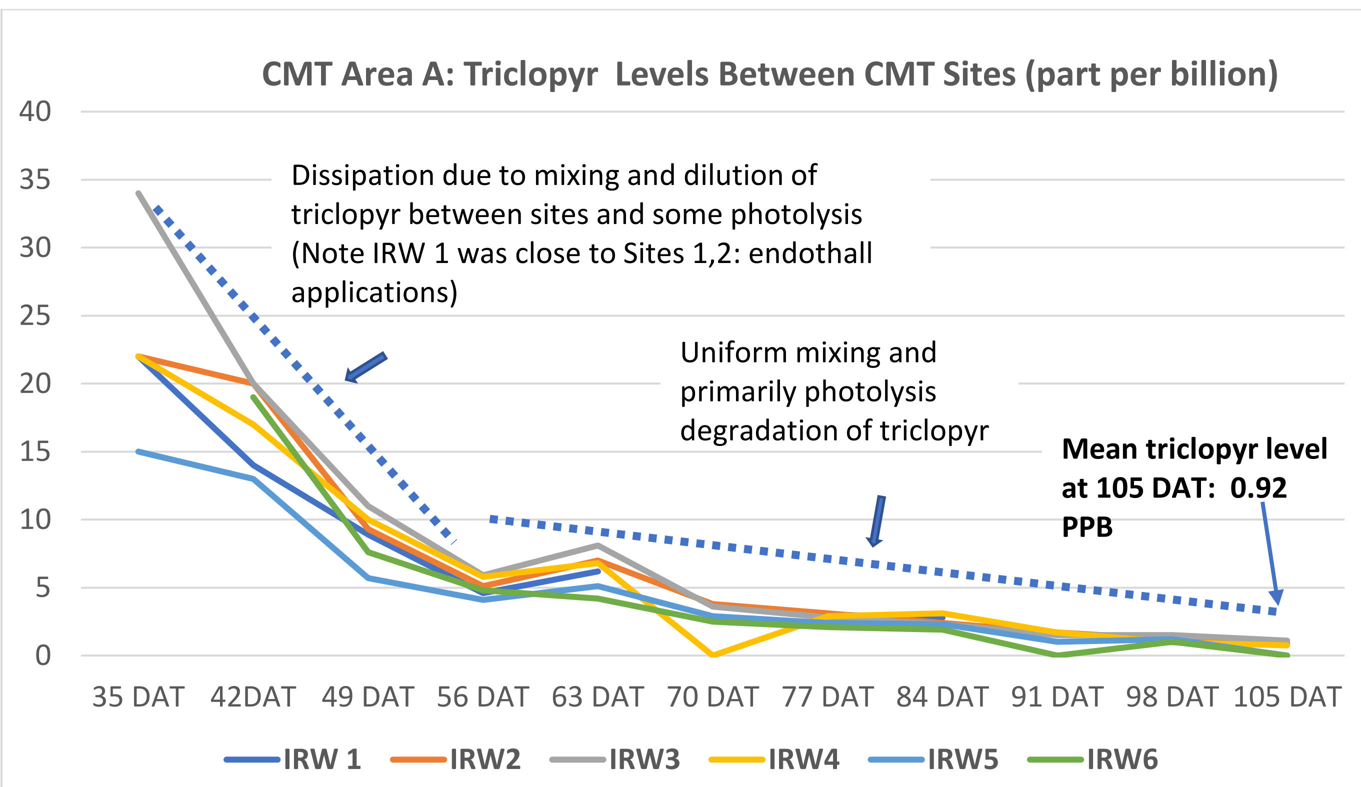


Figure 16-2. Area A: Triclopyr Levels Between CMT Sites: PPB

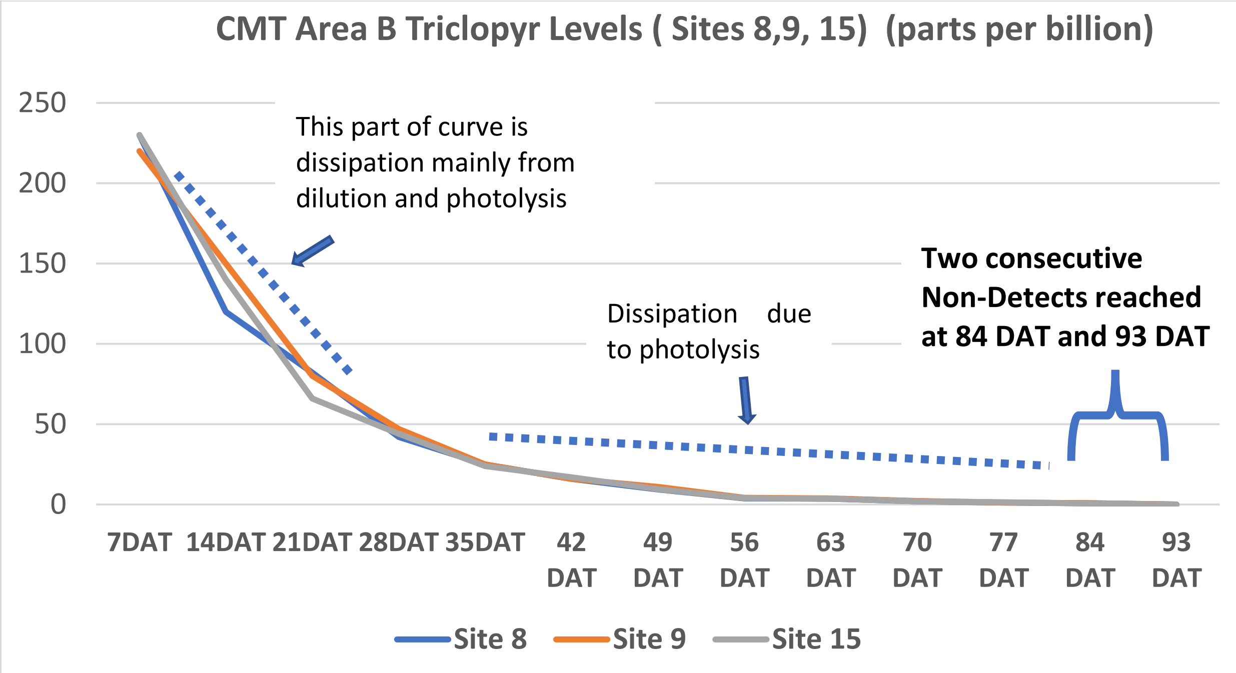


Figure 16-3. Triclopyr Levels in Area B: Sites 8, 9, 15 (ppb). Nominal Target Applications in Site 9 and 9: 1000

Endothall levels were far less problematic since non-detect levels were met within 70 DAT in the West Lagoon; however, the “non-detect” limit (<5 µg/L) still resulted in stagnant conditions and restricted recreational boating access longer than was desirable. We note that the Endothall RWL (100 µg/L) had been reached within about four weeks. The West Lagoon Endothall sites reached RWL within 20 DAT. In Lake Tallac, RWL was reached by 30 DAT (Figure 6-13). However, the “non-detect” levels (5 µg/L) of Endothall in Lake Tallac were not reached until about 75 DAT (Figure 6-13).

The incursions of Endothall to adjacent areas within Area A were due to both wind-driven currents (especially the major storm that occurred within a few DAT), as well as diffusion. There were no barriers between sites in Area A (except for Site 14), and the proximity of the sites allowed some inter-site movement, though the Endothall level in those adjacent sites was low. Similarly, the incursion of Endothall toward (and no doubt) into “control site” 21 was due to the proximity of the two sites and no barriers between them. However, these incursions were maintained within the double curtain areas.

Careful CMT mitigation and monitoring actions, such as double turbidity curtains, use of RWT dye, and diligent contingency sampling insured that neither herbicides nor their degradants were even in proximity to the West Channel, nor did they enter Lake Tahoe proper. In fact, the few detections of Endothall immediately outside the curtains were highly transient and with the exception of a few events at ORW-RHC2 and one event at ORW-RHC3, were well below the RWL (Table 14-1).

The slow degradation of Triclopyr behind the curtains may have been due to a combination of conditions: low light due to high turbidity, particularly in Area A; and restricted mixing that may have kept Triclopyr in deeper water and thus further restricted for photolysis (Pozdnyakov et al. 2022).

The result was an extremely long deployment of the curtains, which probably created a feed-back loop: The longer stagnation, the higher the turbidity, resulting in impaired photodegradation of Triclopyr and prolonged stagnation from delayed curtain removal.

Taken together, the requirement for using the RL (non-detect) threshold for curtain removal had four major effects (some positive and some negative):

(1) Insured that no detectible herbicide or degradants would move from Area A or B to the rest of the West Lagoon, nor to any proximity to the West Channel, nor any potential for entering Lake Tahoe proper, which they never did.

(2) Created stagnant water conditions, which in turn decreased desirable mixing of water with adjacent (outside curtain) water and could have mitigated the persistent conditions of high turbidity and depressed DO and may have reduced the degradation rate of Triclopyr.

(3) Restricted normal boating activity that would have increased mixing of stagnant water and might have mitigated the high turbidity and depressed DO and prolonged presence of Triclopyr.

(4) Delayed removal of double turbidity curtains for two months beyond projected timeline due primarily to (a) “non-detect” requirements (as opposed to “RWL”); and (b) a “compounding feedback” condition whereby continued restricted water exchange further exacerbated turbidity and promoted algal growth.

16.3 Nutrient Levels

All sites, including control sites, exhibited Total P and Total N above regulatory levels. Endothall-only treatments and to a lesser extent Triclopyr-only treatments also increased these levels above control site levels. TKN levels were also elevated in Endothall and Triclopyr sites. The apparent reduction in nutrients (N, P) in LFA Site 26 compared to controls is encouraging. Year 2 monitoring should help confirm this trend as well as continued monitoring in the additional LFA sites in the West Lagoon and Lake Tallac.

The increase in Total P and Total N constituents in herbicide sites likely resulted from decomposing AIP since the increases correspond to 10 to 14 DAT during which herbicide-affected plants typically begin to lose tissue integrity and “leak” nutrients. The UV-only treatments exhibited smaller increases in Total N and Total P. These changes are consistent with 1) Endothall’s broader effects on reducing all targeted AIP; 2) Triclopyr’s selective effects on EWM; and 3) UV’s less selective effect on AIP and native plants as well on more limited areas of exposure compared with Endothall and Triclopyr treatments.

The occurrences of HABs, though not confined to CMT treatment sites, were probably promoted by the combination of Total N and Total P releases and the stagnant water conditions especially within Area A. The required HABs monitoring action sequences were followed. These included visual detection, field sampling, laboratory analysis for nutrients and for presence of cyanobacteria and cyanotoxins, and proper signage posting (APAP/QAPP). However, the inherent delays in this process due to shipping constraints, laboratory analysis reporting time, and receipt of data meant that by the time HABs and nutrient levels were confirmed, about 10 to 14 had had passed from the day of visual detection. With the high temperatures (24-26^{o} C) during mid- to late-summer, cyanobacteria could easily increase by 5 to 10-fold during a two-week period, obviating the ability of Phoslock to mitigate the problem if applied even within 3 weeks of detection. A potential solution to this problem is noted in the recommendations.

16.4 Water Quality

The most consistent feature in all sites was the pattern of water temperature from May to November. This is a major driver of plant growth and also a driver (along with shortening day length) of plant senescence in the fall. However, since 2022 was an extremely low water year, the onset of higher temperatures in spring during “normal” water level years may be delayed. For example, 2023 appears to be a high-water year based on current heavy snowpack and moisture content. This may delay onset of rapid AIP growth (and desirable native plants growth) into mid-June 2023.

An important finding regarding water temperature was that UV exposures had no discernable effect on water temperatures compared with control sites. This was a concern since the UV light arrays generate some heat. The brief (5- to 20- minute) exposures of the UV light array, coupled with the high heat capacity of water, probably explains the lack of heating. Thus, the UV treatments do not appear to have an adverse effect on water temperature.

All control sites exhibited pH outside the regulatory ranges and all control sites had DO below 5 mg/L near bottom levels based upon the hourly logger data. Endothall and Triclopyr-only treatments resulted in low DO at some points in the upper surface, but primarily in bottom areas. Interestingly, both Endothall and Triclopyr treatments, and to a lesser extent UV-only treatments, tended to reduce pH closer to regulatory ranges (pH 7.0-8.4). This is reasonable since high rates of AIP photosynthesis in control sites typically elevate pH well above 8.5. Therefore, treatments that reduce AIP biovolume and photosynthesis would normally result in lower pH than control sites.

A common feature seen was the gradual increase in conductivity in controls and slightly higher increases in conductivity in Endothall and Triclopyr sites and UV sites. This pattern is typically due to an increased release of constituents from plants and algae, but can also be increased in response to herbicide, which can create a “pulse” of releases from plant tissues.

16.5 AIP Responses:

The details of the efficacy of CMT treatments on AIP is provided in the Tahoe Keys Lagoons Macrophyte Control Efficacy Monitoring Report: Year 1 (ESA 2023) (see Appendix E). However, review of the data suggests the following:

(1) Comparisons of CMT treatment effects were inherently undervalued since the “Control” sites were harvested several times beginning in early August.

(2) Endothall-only treatments resulted in successful reduction of all target AIP by over 75% and met the Vessel Hull Clearance goal.

(3) Triclopyr-only treatments resulted in successful reduction of EWM by over 75%; however, due to unaffected AIP (i.e., curlyleaf pondweed and coontail), Vessel Hull Clearance was not consistently met.

(4) Endothall and Triclopyr also resulted in moderate increases in the presence and frequency of native plants.

(5) UV treatment resulted in successful reduction of EWM and curlyleaf pondweed by 40 to 70% but had lesser effect on coontail. However, if contrasted with unharvested conditions, these levels might have achieved closer to a 75% reduction in biovolume, particularly in sites treated early in spring, and with the use of near shore (combination) herbicide applications.

(6) UV treatments reduced the occurrence of native plants in addition to the AIP. This indicates that UV treatments are less selective against only AIP than either Endothall or Triclopyr.

(7) The extremely low water level conditions in the CMT test areas in 2022 probably reduced the likelihood of obtaining consistent “Biovolume” reduction and vessel hull clearance of three feet, although both of these metrics were achieved with the herbicide-only and UV-only treatments.

(8) The successful reductions of AIP in Year 1 in certain test sites provide opportunities to test the effectiveness of non-herbicide “Group B” methods in Years 2 and 3.

16.6 Recommendations

Since a major problem in monitoring completeness was the loss of hourly loggers, and since real-time monitoring can provide weekly status of more water quality variables than just DO and temperature, it might be advisable to only deploy these loggers in one of the replicate sites for each treatment type and check these installations more frequently, possibly daily. Because bottom DO was consistently low in all sites, a single replicate site of each treatment will suffice. These loggers also might be deployed strategically close to locations where Group B methods are being tested.

Group B methods will be deployed in more localized (smaller) areas within certain 2022 Group A treatment sites, so monitoring might be best adjusted to match those locally applied, specific Group B activities.

New procedures will be utilized in 2023 to help ensure turbidity monitoring will take place when/where necessary. First, both the TKPOA contract manager and the field supervisor for the contractor completing the work will verbally notify and email the technicians of needed monitoring events. Second, a new field form will be developed for the turbidity monitoring that gives greater detail on requirements for monitoring of bottom barriers and diver-assisted hand suction. This form will contain detailed instructions describing monitoring actions and timing for supplemental monitoring when turbidity levels exceed the monitoring thresholds.

Water levels in 2023 will no doubt greatly exceed levels in 2022. This suggests that monitoring of water temperature near the bottom (e.g., in a replicate of each treatment) will help signal onset of plant growth. Water levels at or above average in 2023 may also provide more volume (habitat) in which AIP and native plants can occupy. Therefore, comparisons with 2022 AIP impacts need to be carefully assessed.

HAB monitoring could be greatly improved with the use of real-time remote-reporting sensors for cyanobacteria. These could be deployed in historically problematic areas such as “dead-end” sites (e.g., Site 5), based on 2022 HAB occurrences. However, the assumption that phosphorous alone can predict HAB development, or that reducing P levels will necessarily stop HAB formation has been challenged recently (Helleger et al. 2022; Pennisi 2022). This suggests that a better understanding of HAB-drivers is needed, particularly since HABs occurred in control sites, CMT sites, and in the shoreline areas of Lake Tahoe proper.

The Year 1 herbicide treatments clearly decreased AIP biovolume and selectively reduced target AIP. 2023 conditions for macrophyte growth, competition and population dynamics in spring/summer may be unlike any plant growth conditions occurring in the past several years. To better understand how this may affect AIP recruitment and AIP/native plant interactions, continued physical (point) sampling is essential and perhaps should be "stratified" (i.e., targeted) to capture localized populations as part of the Group B methods. This should also include regular (bi-weekly) measurements of the resulting "light field" in the water column as it is affected by AIP canopy and turbidity. This can be accomplished using commercially available PAR sensors (preferably with a spherical detector) so the differences between control sites, treated sites, and Group B treatment sites can be determined at least at surface, mid-depth, and bottom depths. This comparison is important because AIP and native plants compete for light and measuring PAR in the water column will help understand the growth patterns of AIP and native plants in 2023 and Year 3 of the CMT project.

16.7 Summary of BMPs

16.7.1 Compliance

The NPDES permit for the CMT Project required implementation of a wide range of monitoring and related compliance actions. Instances of potential noncompliance included levels above the RWL for Endothall in Site 19 beyond 21 DAT and excursions of Endothall outside Site 19 and sites in the West Lagoon, and outside curtains at Site 2 and Site 15. However, these instances represented transient events and the successful use of BMPs for curtains installation and maintenance insured that neither Endothall nor Triclopyr reached beyond the local curtain areas, thus preventing movement toward the West Channel and Lake Tahoe proper, which was the goal of the CMT Project.

Nutrient levels (specifically Total N and Total P) and water quality variables (specifically DO and pH) fell outside regulatory limits in several instances, including in the untreated control sites. Turbidity in the Endothall-only sites and to a lesser extent the Triclopyr-only sites had elevated levels compared to control sites. Use of subsurface aeration and physical mixing of surface water probably alleviated the magnitude of these events. However, the prolonged deployment of the curtains also impeded mixing and likely exacerbated these conditions. Levels of RWT dye were always in compliance. The target application concentration of 5 µg/L provided a reasonable assurance that 10 µg/L would not be exceeded. Lanthanum-modified clay was not employed because the lag-time between visual HAB detection and data supporting the criteria for potential LMCAP negated the likely benefit of added lanthanum.

16.7.2 Monitoring Data and Recommendations for Improvements to the APAP

The successfulness of monitoring has been discussed in detail in the Report. Given the extent, complexity, and frequency, monitoring represented a very successful component of the CMT. However, an underlying issue with most of the water quality and nutrient monitoring was the use of WQOs in the Keys as equivalent to Lake Tahoe proper. This problem is illustrated in the untreated control sites data that exhibited exceedances of Total N, Total P, DO, and pH for most of the Summer of 2022. Although turbidity was elevated in several treatment sites, these effects in general could have been lessened by earlier applications of herbicide when plant growth had just started. However, optimal timing of herbicides generally requires early spring growth so more detailed monitoring of plant growth status could better inform timing of applications.

16.7.3 BMPs Currently in Use

BMPs successfully used were:

a) protocols for curtain installations,
b) training and safety precautions during herbicide and RWT dye applications,
c) training and field-orientations of monitoring teams,
d) specific field sampling, shipping, COC and numerous other protocols described in the QAPP, and
e) communications among monitoring teams.

16.7.4 BMP Modifications

BMP changes were implemented and designed predominantly to improve overall monitoring and data collections. The main changes in BMPs were:

a) Increased sampling and laboratory analysis to determine any matrix interferences (documented in this Report);
b) increased sampling frequency to better determine when “non-detect” levels of Endothall and Triclopyr were reached so that curtains could be removed to allow better surface water mixing and thus help improve water quality conditions;
c) increased frequency of communications between monitoring teams to ensure compliance with monitoring frequency and proper protocols;
d) improved anchoring methods for turbidity curtains following severe wind events that dislodged the originally installed double turbidity curtains;
e) improved anchoring systems for miniDOT loggers; and
f) continued and frequent (weekly) scheduled communication and discussions with contractors and, as appropriate, regulators.

Taken together, these changes improved overall monitoring and compliance with the NPDES permitting requirements.

17.0 ACKNOWLEDGEMENTS

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18.0 REFERENCES

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Appendix A.

Implementation Special Report
Dr. Lars Anderson, September 30, 2022

Link provided to Lahontan Water Board.

Appendix B.

Tahoe Keys Lagoons Aquatic Weed Control Methods Test Year Preliminary Results
Sierra Ecosystem Associates, February 10, 2023

Link provided to Lahontan Water Board.

Appendix C.

Lahontan Regional Water Quality Control Board NPDES Permit (Order NO. R6T-2022-0004 NPDES NO. CA6202201; WDID NO. 6A091701001)

Link provided to Lahontan Water Board.

Appendix D.

Tahoe Regional Planning Agency Permit File No. EIPC2018-0011 (Project 510-101-00)

Link provided to Lahontan Water Board.

Appendix E.

Tahoe Keys Lagoons Macrophyte Control Efficacy Monitoring Report: Year 1
Environmental Science Associates 2023

Link provided to Lahontan Water Board.

Appendix F.

Quality Assurance Project Plan
Dr. Lars Anderson, Draft June 2022

Link provided to Lahontan Water Board.

Appendix G.

QA/QC Documentation

Link provided to Lahontan Water Board.

Appendix H.

Final Lab Reports with COCs

(Index and single compiled PDF)

Link provided to Lahontan Water Board.

Appendix I.

Record of Project Meetings (January 2022 – January 2023)

Link provided to Lahontan Water Board.

Appendix J.

Aquatic Pesticide Application Plan Amendment 1
Revised May 18, 2022

Link provided to Lahontan Water Board.

Appendix K.

Aquatic Pesticide Application Plan Amendment 2
Updated Revised May 24, 2022

Link provided to Lahontan Water Board.

Appendix L.

Spill Prevention and Response Plan
Stratus Engineering Associates LLC, May 2022

Link provided to Lahontan Water Board.

Appendix M.

Contingency Spill Report
Stratus Engineering Associates LLC, May 2022

Link provided to Lahontan Water Board.

Appendix N.

Lanthanum-Modified Clay Application Plan
Revised May 18, 2022

Link provided to Lahontan Water Board.

Appendix O.

Required Certifications and Training Documentation

- QAL/Record of Experience for Aquatechnex Staff
- Diver Certifications for Hiuga Diving Co.
- TKPOA Certifications for Pesticide Handling, Boating Safety and Good Laboratory Practice
- List of Cultural Awareness Training Acknowledgement Signatures
- Description of Pre-CMT Trainings

Link provided to Lahontan Water Board.

Appendix P.

Calibration Logs for Monitoring Equipment

- Aquatechnex: Herbicide Application Vessel and Equipment
- Blankinship: YSI Pro
- Blankinship: RWT Meter
- ESA: Hydro Lab Sonde Equipment (HL1, HL3, HL4, HL5)
- TKPOA: Hydro Lab Sonde Equipment (HL1, HL2, HL3, HL4, HL8)
- miniDOTs (User's Manual)

Link provided to Lahontan Water Board.

Appendix Q.

List of Correspondence with Permitting Agencies, TKPOA Homeowners, and Stakeholders

Link provided to Lahontan Water Board.

Appendix R.

Turbidity Monitoring Data During Curtain Install and Removal

Link provided to Lahontan Water Board.

Appendix S.

Directory of Tabular Data

(Folders organized by monitoring activity)

Link provided to Lahontan Water Board.

Appendix T.

Final Herbicide and Rhodamine Water Tracer Dye Monitoring Plan
May 20, 2022

Link provided to Lahontan Water Board.

Appendix U.

Herbicide Application Report
McNabb 2022

Link provided to Lahontan Water Board.

Appendix V.

Summary of Monitoring Schedules, Frequency and Locations

Link provided to Lahontan Water Board.

Appendix W.

Record of Missing and Reinstallation of miniDOTs

Link provided to Lahontan Water Board.

Appendix X.

Instances of Elevated Herbicide and Water Quality Parameters

Link provided to Lahontan Water Board.

Appendix Y.

Harmful Algal Blooms Nutrients Data

Link provided to Lahontan Water Board.

Appendix Z.

Herbicide Monitoring Tables

Link provided to Lahontan Water Board.

Appendix AA.

UVC Light Aquatic Invasive Plant Control Pilot Project-Summary of Treatment Field Activities Material
Inventive Resources, Inc. (IRI), January 24, 2023

Link provided to Lahontan Water Board.

Appendix BB.

2019 Fish and Benthic Macroinvertebrate Surveys in Tahoe Keys Lagoons
Environmental Science Associates, April 2020

Link provided to Lahontan Water Board.

Appendix CC.

Pre-Project Ecotonal Report
Sierra Ecosystem Associates, May 19, 2022

Link provided to Lahontan Water Board.

Appendix DD.

Fall 2022 Routine Ecotonal Report
Sierra Ecosystem Associates, November 10, 2022

Link provided to Lahontan Water Board.

Appendix EE.

Directory of Raw Data

(Folders organized by monitoring activity)

Link provided to Lahontan Water Board.

Appendix FF.

Control Methods Test Field Day Report (Google Forms)

(Index and single compiled PDF)

Link provided to Lahontan Water Board.

Appendix GG.

Catalog of Data Collection Binders

(Organized by date for each monitoring activity)

Link provided to Lahontan Water Board.