YEAR 6 (2020) MONITORING REPORT
ABBEY LAMM
STREAM AND WETLAND MITIGATION SITE

ALAMANCE COUNTY, NORTH CAROLINA
FULL DELIVERY CONTRACT NO. 5790
DMS PROJECT NO. 96311
NCDWR PROJECT NO. 20140336
USACE ACTION ID NO. SAW-2014-01710

CAPE FEAR RIVER BASIN
CATALOGING UNIT 03030002

Data Collection – March-October 2020

PREPARED FOR:

NC. DEPARTMENT OF ENVIRONMENTAL QUALITY
DIVISION OF MITIGATION SERVICES
1601 MAIL SERVICE CENTER
RALEIGH, NORTH CAROLINA 27699-1601

December 2020

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Response to Monitoring Year 6 (2020) DMS Comments

Abbey Lamm Stream and Wetland Mitigation Site (DMS #96311)
Cape Fear River Basin 03030002, Alamance County
Contract No. 005790

Comments Received (Black Text) & Responses (Blue Text)

1. Title Page
    a. Please add the following: DMS Project Number: 96311; NCDWR Project Number: 20140336; USACE Action ID Number: SAW-2014-01710

    These items were added to the title page.

2. Appendix D
    a. Please include the surface water gauge figures for UT-1.

    Surface water gauge figures have been included with this submittal.

    b. Please include the groundwater gauge figures after Table 11.

    Groundwater gauge figures have been included with this submittal.

3. Wetland credit around gauges 6 and 6B are at-risk due to each gauge only meeting success once, both in 2018. To date 85% of the total project wetland credits have been released. DMS will hold payment for the wetland component until credit release. Please discuss size of area at risk, factors contributing to falling short of success criteria, and potential, if any, for this wetland area's credit to be realized.

    Understood. To evaluate the wetland restoration credit around gauge 6 and 6B, Raymond Holz and Alex Baldwin (PWS 2221) of Restoration Systems (RS) visited the Site on 12/8/2020 to review the subject area. Site work indicates 0.080 acres around gauge 6 and 6B is not meeting the Site's 10% hydroperiod period success metric.

    To further provide an understanding of the Site's wetland mitigation assets, RS mapped the wetland areas within the old pond bed along the "Mainstem" tributary at the western extent of the Site. RS installed three groundwater monitoring gauges in 2016 (Yr. 2 of monitoring) within this area, and has collected groundwater data for the last five years. In conjunction with 12-2020 field review, the groundwater data indicates successful wetland reestablishment of 0.862 acres.

    Data collected during RS' field investigation is provided in a newly added appendix and supplied in shapefile format within the digital deliverable dataset. RS' position is that although the 0.080 acres around gauge 6 and 6B is not meeting the hydroperiod metric, the Site is providing more than the 1.0 WMU detailed in the Restoration Plan. RS is not asking for additional credit be added to the ledger but that the agreed-upon 1 WMU remains and is not subject to a downward adjustment by the IRT. RS expects to discuss this with the IRT during the 2021 Credit Release Meeting.

4. As required by contract, specifically RFP#16-005568 Addendum No. 1, RS must submit an updated Monitoring Phase Performance Bond (MPPB) good through Monitoring Year 7 (Task 13) to Jeff Jurek for his approval before DMS approves this deliverable and the associated payment.

    A Draft Year 7 MPPB was submitted via email to Jeff Jurek on 12/7, and approved 12/8. A final will be sent via email once it is received from the bonding company.

Abbey Lamm Year 6, 2020 Monitoring Summary

General Notes

- No encroachment was identified in Year 6 (2020)
- No evidence of nuisance animal activity (i.e., beaver, heavy deer browsing, etc.) was observed.

Streams

- Stream monitoring did not occur in monitoring year 6 (2020) per the Site's mitigation plan. Visual observations throughout the year indicate stream channels and structures are stable.

Wetlands

- Nine of eleven groundwater gauges met success for the Year 6 (2020) monitoring period. Wetland hydrology data is in Appendix D.

Success Criteria Achieved/Max Consecutive Days During Growing Season (Percentage)							
Gauge	**Year 1 (2015) February 1st Growing Season Start**	**Year 2 (2016) March 30th Growing Season Start**	**Year 3 (2017) February 28th Growing Season Start**	**Year 4 (2018) March 6th Growing Season Start**	**Year 5 (2019) March 1st Growing Season Start**	**Year 6 (2020) March 2nd Growing Season Start**	**Year 7 (2021)**
1	No*/10 days (3.8 percent)	Yes/75 days (36 percent)	No/12 days (5.1 percent)	Yes/68 days (29 percent)	Yes/28 days (11.9 percent)	Yes/80 days (34 percent)	
1B+	--	--	--	Yes/60 days (26 percent)	Yes/60 days (26 percent)	Yes/42 days (17.9 percent)	
2	Yes/35 days (13.3 percent)	Yes/122 days (59 percent)	Yes/82 days (35 percent)	Yes/30 days (13 percent)	No/19 days# (8.1 percent)	Yes/35 days (15 percent)	
3	No*/14 days (5.3 percent)	Yes/48 days (23 percent)	Yes/135 days (57 percent)	Yes/66 days (29 percent)	Yes/89 days (38 percent)	Yes/119 days (51 percent)	
4	No*/14 days (5.3 percent)	Yes/100 days (48 percent)	Yes/78 days (33 percent)	Yes/28 days (12 percent)	No/18 days# (7.7 percent)	Yes/32 days (13.7 percent)	
5	Yes/32 days (12.1 percent)	Yes/75 days (36 percent)	Yes/48 days (20 percent)	Yes/60 days (26 percent)	No/19 days# (8.1 percent)	Yes/67 days (29 percent)	
6	No*/9 days (3.4 percent)	No/7 days (3.4 percent)	No/5 days (2.1 percent)	Yes/25 days (11 percent)	No/19 days (8.1 percent)	No/12 days (5.1 percent)	
6B+	--	--	--	Yes/28 days (12 percent)	No/17 days# (7.2 percent)	No/19 days (8.1 percent)	
7**	--	Yes/116 days (56 percent)	Yes/153 days (65 percent)	Yes/103 days (45 percent)	Yes/103 days (44 percent)	Yes/125 days (53 percent)	
8**	--	Yes/206 days (100 percent)	Yes/211 days (89 percent)	Yes/231 days (100 percent)	Yes/124 days (53 percent)	Yes/235 days (100 percent)	
9**	--	Yes/54 days (26 percent)	No^/12 days (5.1 percent)	Yes/132 days (57 percent)	Yes/122 days (52 percent)	Yes/91 days (39 percent)	

* Due to Site construction activities, groundwater gauges were not installed until April 8th, 2015. It is expected that all gauges would meet success criteria at the beginning of the growing season.

** These gauges were installed on March 8th, 2016, to show wetland establishment within the old pond bed.

^ This gauge malfunctioned through the majority of the growing season due to continuous inundation. It is expected that this gauge would have met success criteria had it functioned properly.

+ These gauges were installed during Year 4 (2018) near two gauges that had not met success criteria in previous monitoring years to verify the groundwater data at these locations.

These gauges did not meet success criteria due to a data shuttle failure that resulted in the loss of data from March 20th to May 3rd, 2019. Based on rainfall and hydrology data that was not lost, these gauges would have likely met success criteria had the loss of data not occurred.

Vegetation

- Stem count measurements were not taken during Year 6 (2020); however, visual observations indicate that site vegetation is vigorous.

Site Permitting/Monitoring Activity and Reporting History

Activity or Deliverable	Stream Monitoring Complete	Vegetation Monitoring Complete	Data Collection Complete	Completion or Delivery
Technical Proposal (RFP No. 16-005568)	--	--	--	October 2013
EEP Contract No. 5790	--	--	--	February 2014
Mitigation Plan	--	--	--	September 2014
Construction Plans	--	--	--	September 2014
Construction Earthwork	--	--	--	April 3, 2015
Planting	--	--	--	April 7, 2015
As-Built Documentation	April 14th, 2015	April 9th, 2015	May 2015	July 2015
Year 1 Monitoring	October 20th, 2015	September 23rd, 2015	October 2015	November 2015
Fescue Treatment	--	--	--	March, 2016
Year 2 Monitoring	April 7th, 2016	July 6th, 2016	October 2016	December 2016
Remedial Planting	--	--	--	December 8, 2016
Year 3 Monitoring	March 27th, 2017	July 19th, 2017	October 2017	November 2017
Year 4 Monitoring	April 15, 2018	--	October 2018	October 2018
Year 5 Monitoring	March 4th, 2019	September 25th, 2019	November 2019	January 2020
Year 6 Monitoring	NA	NA	October 2020	December 2020

Site Maintenance Report (2020)

Invasive Species Work	Maintenance work
5-5-2020 Microstegium 06-02-2020 Cattail, Privet, Tree-of-Heaven, Rose, Johnson Grass 6-3-2020 Microstegium	None

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Data Collection – March-October 2020

PREPARED BY:

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AND

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December 2020

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Appendices

1.0 PROJECT SUMMARY

The Abbey Lamm Stream and Wetland Mitigation Site (Site) encompasses approximately 17.3 acres located approximately 2.0 miles east of Snow Camp in southern Alamance County within 14-digit Cataloging Unit and Targeted Local Watershed 03030002050050 of the Cape Fear River Basin (Figure 1, Appendix B and Table 4, Appendix A). Before Site construction, the Site consisted of agricultural land used for livestock grazing and hay production. Streams had been cleared of vegetation, dredged of cobble substrate, trampled by livestock, eroded vertically and laterally, and received extensive sediment and nutrient inputs from livestock. Further, streamside wetlands had been drained by channel incision, soils were compacted, cleared of forest vegetation, and altered by land uses. Completed project activities, reporting history, completion dates, project contacts, and project attributes are summarized in Tables 1-4 (Appendix A).

Positive aspects supporting mitigation activities at the Site included the following.

- Streams have a Best Usage Classification of WS-V, NSW (Nutrient Sensitive Waters)
- Located in a Targeted Local Watershed (TLW)
- According to the *Cape Fear River Basin Restoration Priorities 2009,* benthic ratings in the TLW vary from "Fair" to "Good-Fair" indicating a need for improvement of aquatic conditions in the watershed (NCDMS 2009)
- A Significant Natural Heritage Area is located immediately east of the Site

The Site is not included in a Local Watershed Plan; however, this project meets overall goals of the Local Watershed Plans, including 1) reduce sediment loading, 2) reduce nutrient loading, 3) manage stormwater runoff, 4) reduce toxic inputs, 5) provide and improve instream habitat, 6) provide and improve terrestrial habitat, 7) improve stream stability, and 8) improve hydrologic function. The following table summarizes the project goals/objectives and proposed functional uplift based on Site restoration activities and observations of two reference areas located in the vicinity of the Site.

Project Goals and Objectives

Project Goal/Objective	How Goal/Objective will be Accomplished
Improve Hydrology	
Restore Floodplain Access	Building a new channel at the historic floodplain elevation to restore overbank flows
Restore Wooded Riparian Buffer	Planting a woody riparian buffer
Improve Microtopography	Scarifying soils to reduce compaction and hoof shear due to cattle
Restore Stream Stability	Building a new channel, planting a woody riparian buffer, and removing cattle
Increase Sediment Transport	
Improve Stream Geomorphology	
Increase Surface Storage and Retention	Building a new channel at the historic floodplain elevation restoring overbank flows, removing cattle, scarifying compacted soils, and planting woody vegetation
Restore Appropriate Inundation/Duration	
Increase Subsurface Storage and Retention	Raising the stream bed elevation

Project Goals and Objectives (continued)

Project Goal/Objective	How Goal/Objective will be Accomplished
Improve Water Quality	
Increase Upland Pollutant Filtration	Planting a native, woody riparian buffer and installing 8 marsh treatment areas
Increase Thermoregulation	Planting a native, woody riparian buffer
Reduce Stressors and Sources of Pollution	Removing cattle and installing 8 marsh treatment areas
Increase Removal and Retention of Pathogens, Particulates (Sediments), Dissolved Materials (Nutrients), and Toxins from the Water Column	Raising the stream bed elevation, restoring overbank flows, planting with woody vegetation, removing cattle, increasing surface storage and retention, restoring appropriate inundation/duration, and installing 8 marsh treatment areas
Increase Energy Dissipation of Overbank/Overland Flows/Stormwater Runoff	Raising the stream bed elevation, restoring overbank flows, planting with woody vegetation, and installing 8 marsh treatment areas
Restore Habitat	
Restore In-stream Habitat	Building a stable channel with a cobble/gravel bed and planting a woody riparian buffer
Restore Streamside Habitat	Planting a woody riparian buffer
Improve Vegetation Composition and Structure	

Project construction occurred between January and April 2015. Planting was completed in April 2015. Site activities include the restoration of perennial and intermittent stream channels, enhancement (level II) of perennial and intermittent stream channels, and restoration of riparian wetlands. A total of **4734.6 Stream Mitigation Units (SMUs) and 1.0 Riparian Wetland Mitigation Units (WMUs)** are being generated as depicted in the following tables. These tables were revised after realizing that changes in stream footages due to minor construction changes were not accounted for in the as-built document.

Stream Mitigation Type	Perennial Stream Counting Towards Mitigation Credits (linear feet)	Intermittent Stream Counting Towards Mitigation Credits (linear feet)	Ratio	Stream Mitigation Units
Restoration	2625	1775	1:1	4400
Enhancement (Level II)	409	425	2.5:1	333.6
Totals	**3034**	**2200**		**4734.6**

Wetland Mitigation Type	Acreage	Ratio	Riparian Wetland Mitigation Units
Riparian Restoration	1.0	1:1	1.0
Riparian Enhancement*	0.4	--	--
Totals	**1.4**		**1.0**

*Wetland enhancement acreage is not included in mitigation credit calculations as per RFP 16-005568 requirements.

Stream Success Criteria

Monitoring and success criteria for stream restoration should relate to project goals and objectives. From a mitigation perspective, several of the goals and objectives are assumed to be functionally elevated by restoration activities without direct measurement. Other goals and objectives will be considered successful upon achieving vegetation success criteria. The following summarizes stream success criteria related to goals and objectives.

Project Goal/Objective	Stream Success Criteria
Improve Hydrology	
Restore Floodplain Access	Two overbank events will be documented, in separate years, during the monitoring period.
Restore Wooded Riparian Buffer	Attaining Vegetation Success Criteria.
Improve Microtopography	Removal of cattle and scarification of soils during construction
Restore Stream Stability	Cross-sections, monitored annually, will be compared to as-built measurements to determine channel stability and maintenance of channel geomorphology
Improve Stream Geomorphology	
Increase Surface Storage and Retention	Removal of cattle, installing 8 marsh treatment areas, scarification of soils during construction, documentation of two overbank events in separate monitoring years, and attaining Wetland and Vegetation Success Criteria
Restore Appropriate Inundation/Duration	
Increase Subsurface Storage and Retention	Two overbank events will be documented, in separate years, during the monitoring period and attaining Wetland Success Criteria
Increase Sediment Transport	Pebble counts documenting coarsening of bed material from pre-existing conditions.
Improve Water Quality	
Increase Upland Pollutant Filtration	Installation of 8 marsh treatment areas and attaining Wetland and Vegetation Success Criteria
Increase Thermoregulation	Attaining Vegetation Success Criteria
Reduce Stressors and Sources of Pollution	Removal of cattle and installation of 8 marsh treatment areas
Increase Removal and Retention of Pathogens, Particulates (Sediments), Dissolved Materials (Nutrients), and Toxins from the Water Column	Removal of cattle, installation of 8 marsh treatment areas, documentation of two overbank events in separate monitoring years, and attaining Vegetation Success Criteria
Increase Energy Dissipation of Overbank/Overland Flows/Stormwater Runoff	Installation of 8 marsh treatment areas, documentation of two overbank events in separate monitoring years, and attaining Vegetation Success Criteria
Restore Habitat	
Restore In-stream Habitat	Reincorporating natural substrate removed from existing Site streams and stockpiled on-site into proposed stream beds, pebble counts documenting coarsening of bed material from pre-existing conditions and attaining Vegetation Success Criteria (Section 8.3.1)
Restore Streamside Habitat	Attaining Vegetation Success Criteria
Improve Vegetation Composition and Structure	Attaining Vegetation Success Criteria

Intermittent channels (UT 1 and UT 3) were questioned by IRT members with respect to jurisdictional status. Success criteria in these reaches require surface water flow within the stream channels during years with normal climactic conditions for at least 30 consecutive days. Furthermore, IRT members require these systems to have a discernible ordinary high water mark, which will be evaluated and considered towards project success. Iron-oxidizing bacteria and hydric soils within these reaches will be documented by photograph throughout the monitoring period and considered signs of intermittent channels by IRT members.

Vegetation Success Criteria

An average density of 320 planted stems per acre must be surviving in the first three monitoring years. Subsequently, 290 planted stems per acre must be surviving in year 4, 260 planted stems per acre in year 5, and 210 planted stems per acre in year 7. In addition, planted vegetation must average 10 feet in height in each plot at year 7 since this Site is located in the Piedmont. Volunteer stems may be considered on a case-by-case basis in determining overall vegetation success; however, volunteer stems should be counted separately from planted stems.

Wetland Success Criteria

Monitoring and success criteria for wetland restoration should relate to project goals and objectives. From a mitigation perspective, several of the goals and objectives are assumed to be functionally elevated by restoration activities without direct measurement. Other goals and objectives will be considered successful upon achieving vegetation success criteria. The following summarizes wetland success criteria related to goals and objectives.

Project Goal/Objective	Wetland Success Criteria
Improve Hydrology	
Restore Wooded Riparian Buffer	Attaining Vegetation Success Criteria.
Improve Microtopography	Removal of cattle and scarification of soils during construction
Increase Surface Storage and Retention	Removal of cattle, scarification of soils during construction, documentation of two overbank events in separate monitoring years, attaining Vegetation Success Criteria, and documentation of an elevated groundwater table (within 12 inches of the soil surface) for greater than 10 percent of the growing season during average climatic conditions
Restore Appropriate Inundation/Duration	
Increase Subsurface Storage and Retention	
Improve Water Quality	
Increase Upland Pollutant Filtration	Installation of 8 marsh treatment areas and attaining Wetland and Vegetation Success Criteria
Reduce Stressors and Sources of Pollution	Removal of cattle and installation of 8 marsh treatment areas
Increase Removal and Retention of Pathogens, Particulates (Sediments), Dissolved Materials (Nutrients), and Toxins from the Water Column	Removal of cattle, installation of 8 marsh treatment areas, documentation of two overbank events in separate monitoring years, and attaining Vegetation Success Criteria
Increase Energy Dissipation of Overbank/Overland Flows/Stormwater Runoff	Installation of 8 marsh treatment areas, documentation of two overbank events in separate monitoring years, and attaining Vegetation Success Criteria
Restore Habitat	
Restore Streamside Habitat	Attaining Vegetation Success Criteria.
Improve Vegetation Composition and Structure	

According to the *Soil Survey of Alamance County*, the growing season for Alamance County is from April 17th – October 22nd (USDA 1960). However, the start date for the growing season is not typical for the Piedmont region; therefore, for purposes of this project, gauge hydrologic success will be determined using data from February 1st - October 22nd to more accurately represent the period of biological activity. Based on growing season information outlined in the Interim Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Eastern Mountains and Piedmont Region (Environmental Laboratory 2012), this will be confirmed annually by soil temperatures exceeding 41 degrees Fahrenheit at 12 inches depth and/or bud burst.

Target hydrological characteristics include saturation or inundation for 10 percent of the monitored period (February 1-October 22), during average climatic conditions. During years with atypical climatic conditions, groundwater gauges in reference wetlands may dictate threshold hydrology success criteria (75 percent of reference). These areas are expected to support hydrophytic vegetation. If wetland parameters are marginal as indicated by vegetation and/or hydrology monitoring, a jurisdictional determination will be performed. The jurisdictional determination will not supersede monitoring data or overturn a failure in meeting success criteria; however, the IRT may use this information at its discretion to make a final determination on Site wetland re-establishment success.

Summary of Monitoring Period/Hydrology Success Criteria by Year

Year	Soil Temperatures/Date Bud Burst Documented	Monitoring Period Used for Determining Success	10 Percent of Monitoring Period
2015 (Year 1)	--	April 8th*-October 22nd (198 days)	20 days
2016 (Year 2)	Bud burst and soil temperatures documented on March 30th, 2016	March 30-October 22 (207 days)	21 days
2017 (Year 3)	Bud burst and soil temperatures documented on February 28th, 2017	February 28-October 22 (237 days)	24 days
2018 (Year 4)	Bud burst and soil temperatures documented on March 6th, 2018	March 6-October 22 (231 days)	23 days
2019 (Year 5)	March 1st, 2019**	March 1-October 22 (235 days)	24 days
2020 (Year 5)	Bud burst and soil temperatures** documented on March 2nd, 2020.	March 2-October 22 (234 days)	23 days

* Gauges were installed on April 8th during year 1 (2015), so this date was used as the start of the growing season.

** Based on data collected from a soil temperature data logger located on the Site.

Summary information/data related to the occurrence of items such as beaver or encroachment and statistics related to various project and monitoring elements' performance can be found in tables and figures within this report's appendices. Narrative background and supporting information formerly found in these reports can be found in the Baseline Monitoring Report (formerly Mitigation Plan) and in the Mitigation Plan (formerly the Restoration Plan) documents available on the NC Division of Mitigation Services (NCDMS) website. All raw data supporting the tables and figures in the appendices are available from NCDMS upon request.

2.0 METHODOLOGY

Monitoring requirements and success criteria outlined in the latest guidance by NCDMS dated November 7th, 2011 (*Monitoring Requirements and Reporting Standards for Stream and/or Wetland Mitigation*) will be followed and are briefly outlined below. Monitoring data collected at the Site should include reference photos, plant survival analysis, channel stability analysis, and biological data if required explicitly by permit conditions.

Wetland hydrology is proposed to be monitored for seven years (years 1-7). Riparian vegetation and stream morphology will be monitored for seven years, with measurements completed in years 1-3, year 5, and year 7. If monitoring demonstrates the Site is successful by year 5 and no concerns have been identified, Restoration Systems may propose to terminate monitoring at the Site and forego monitoring requirements for years 6 and 7. Early closure will only be provided through written approval from the USACE in consultation with the Interagency Review Team. Monitoring will be conducted by Axiom Environmental, Inc. Annual monitoring reports of the data collected will be submitted to the NCDMS by Restoration Systems no later than December 31st of each monitoring year data is collected.

2.1 Streams

Annual monitoring will include the development of channel cross-sections and substrate on riffles and pools. Data to be presented in graphic and tabular format will consist of 1) cross-sectional area, 2) bankfull width, 3) average depth, 4) maximum depth, and 5) width-to-depth ratio. Post-construction, permanently-monumented cross-sections were installed throughout the Site, at approximately 50-foot intervals. Sixty monitoring cross-sections will be measured annually. Cross-section locations are depicted in Figure 2 (Appendix B); data are included in Appendix C. Longitudinal profiles will not be measured unless monitoring demonstrates channel bank or bed instability, in which case, longitudinal profiles may be required by the USACE along reaches of concern to track changes and demonstrate stability.

Visual assessment of in-stream structures will be conducted to determine if failure has occurred. Failure of a structure may be indicated by collapse of the structure, undermining of the structure, abandonment of the channel around the structure, and/or stream flow beneath the structure. In addition, visual assessments of the entire channel will be conducted in each of the seven years of monitoring as outlined in NCDMS *Monitoring Requirements and Reporting Standards for Stream and/or Wetland Mitigation.* Areas of concern will be depicted on a plan view figure identifying the location of concern along with a written assessment and photograph of the area. Morphology data can be found in Tables 7A-E and 8A-L (Appendix C).

Intermittent stream reaches, including UT 1 and UT 3, received priority 1 stream restoration to restore adjacent wetlands and elevate stream function. Priority 1 stream restoration along intermittent stream reaches was discussed by IRT members with regard to adequate base flow once stream restoration is complete. Therefore, stream flow gauges were installed in the upper and lower reaches of UT 1 and UT 3 to catalog flow for 30 consecutive days. Channel formation was evident in both UT 1 and UT 3 in years 1-6 (2015-2020) (Tables 9a-9b, Appendix D). The approximate locations of stream flow gauges are depicted in Figure 2 (Appendix B); gauge data is included in Appendix D.

2.2 Vegetation

After planting was completed in April 2015, an initial evaluation was performed to verify planting methods and determine initial species composition and density. Supplemental planting and additional Site modifications will be implemented, if necessary.

During quantitative vegetation sampling, 14 sample plots (10-meter by 10-meter) were installed within the Site as per guidelines established in *CVS-EEP Protocol for Recording Vegetation, Version 4.2* (Lee et al.

2008). In each sample plot, vegetation parameters to be monitored include species composition and species density. Visual observations of the percent cover of shrub and herbaceous species will also be documented by photograph.

Stem count measurements were not taken during Year 6 (2020); however, visual observations indicate that site vegetation is vigorous.

Heavy herbaceous competition in the first year (2015) growing season affected planted stems; therefore, on March 10th, 2016, open areas in the upper 2/3 of the Site were treated with a pre-emergent with grass specific herbicide (Appendix E). The treatment successfully knocked back herbaceous growth; however, the amount of new herbaceous growth was similar to the density observed in prior to treatment efforts by the end of the growing season. RS does not plan to continue this form of treatment.

Working with Carolina Silvics, RS planted 1250 1-gallon pots during the week of December 20th, 2016, which included the following species: *Betula nigra, Fraxinus pennsylvanica, Platanus occidentalis, Quercus falcata, Quercus nigra, Quercus palustris, Quercus phellos,* and *Quercus rubra*. A remedial planting plan figure detailing location of planting and density, in addition to photographs, are provided in Appendix E. Of note, no remedial planting was performed within forested areas, i.e., vegetation plot 12. This is an enhancement area within an existing hardwood forest. Given planted species surviving within vegetation plot 12 and the surrounding density of the existing forest, RS did not feel it necessary to replicate this area.

During year 5 (2019), it was observed that Japanese stiltgrass (*Microstegium vimineum*) densities were elevated within the old pond bed and were affecting planted stem survival. In June 2019, RS treated the microstegium with herbicide. Thus far, the treatment appears to have been successful in reducing the density of Japanese stiltgrass. Treatments in this area and throughout the site continued in year 6 (2020).

2.3 Wetland Hydrology

Six groundwater monitoring gauges were installed to take measurements after hydrological modifications were performed at the Site. Groundwater gauges were installed in larger wetland sections along UT 1, UT 2, and the main stem channel. Gauges were installed at various elevations within the floodplain to accurately determine the hydrology of wetland re-establishment areas. Approximate locations of wetland groundwater monitoring gauges are depicted in Figure 2 (Appendix B). Hydrological sampling will continue throughout the growing season at intervals necessary to satisfy jurisdictional hydrology success criteria (USEPA 1990). In addition, an on-site rain gauge will document rainfall data for comparison of groundwater conditions with extended drought conditions, and floodplain crest gauges will confirm overbank flooding events.

Success Criteria Achieved/Max Consecutive Days During Growing Season (Percentage)							
Gauge	**Year 1 (2015) February 1st Growing Season Start**	**Year 2 (2016) March 30th Growing Season Start**	**Year 3 (2017) February 28th Growing Season Start**	**Year 4 (2018) March 6th Growing Season Start**	**Year 5 (2019) March 1st Growing Season Start**	**Year 6 (2020) March 2nd Growing Season Start**	**Year 7 (2021)**
1	No*/10 days (3.8 percent)	Yes/75 days (36 percent)	No/12 days (5.1 percent)	Yes/68 days (29 percent)	Yes/28 days (11.9 percent)	Yes/80 days (34 percent)	
1B+	--	--	--	Yes/60 days (26 percent)	Yes/60 days (26 percent)	Yes/42 days (17.9 percent)	
2	Yes/35 days (13.3 percent)	Yes/122 days (59 percent)	Yes/82 days (35 percent)	Yes/30 days (13 percent)	No/19 days# (8.1 percent)	Yes/35 days (15 percent)	
3	No*/14 days (5.3 percent)	Yes/48 days (23 percent)	Yes/135 days (57 percent)	Yes/66 days (29 percent)	Yes/89 days (38 percent)	Yes/119 days (51 percent)	

4	No*/14 days (5.3 percent)	Yes/100 days (48 percent)	Yes/78 days (33 percent)	Yes/28 days (12 percent)	No/18 days[#] (7.7 percent)	Yes/32 days (13.7 percent)	
5	Yes/32 days (12.1 percent)	Yes/75 days (36 percent)	Yes/48 days (20 percent)	Yes/60 days (26 percent)	No/19 days[#] (8.1 percent)	Yes/67 days (29 percent)	
6	No*/9 days (3.4 percent)	No/7 days (3.4 percent)	No/5 days (2.1 percent)	Yes/25 days (11 percent)	No/19 days (8.1 percent)	No/12 days (5.1 percent)	
6B[+]	--	--	--	Yes/28 days (12 percent)	No/17 days[#] (7.2 percent)	No/19 days (8.1 percent)	
7**	--	Yes/116 days (56 percent)	Yes/153 days (65 percent)	Yes/103 days (45 percent)	Yes/103 days (44 percent)	Yes/125 days (53 percent)	
8**	--	Yes/206 days (100 percent)	Yes/211 days (89 percent)	Yes/231 days (100 percent)	Yes/124 days (53 percent)	Yes/235 days (100 percent)	
9**	--	Yes/54 days (26 percent)	No^/12 days (5.1 percent)	Yes/132 days (57 percent)	Yes/122 days (52 percent)	Yes/91 days (39 percent)	

* Due to Site construction activities, groundwater gauges were not installed until April 8th, 2015. It is expected that all gauges would meet success criteria at the beginning of the growing season.

** These gauges were installed on March 8th, 2016, to show wetland establishment within the old pond bed.

^ This gauge malfunctioned through the majority of the growing season due to continuous inundation. It is expected that this gauge would have met success criteria had it functioned properly.

[+] These gauges were installed during Year 4 (2018) near two gauges that had not met success criteria in previous monitoring years to verify the groundwater data at these locations.

[#] These gauges did not meet success criteria due to a data shuttle failure that resulted in the loss of data from March 20th to May 3rd, 2019. Based on rainfall and hydrology data that was not lost, these gauges would have likely met success criteria had the loss of data not occurred.

2.4 Biotic Community Change

Changes in the biotic community are anticipated from a shift in habitat opportunities as tributaries are restored. In-stream, biological monitoring is proposed to track the changes during the monitoring period. The benthic macroinvertebrate community will be sampled using NCDWR protocols found in the *Standard Operating Procedures for Benthic Macroinvertebrates* (NCDWQ 2006) and *Benthic Macroinvertebrate Protocols for Compensatory Stream Restoration Projects* (NCDWQ 2001). Biological sampling of benthic macroinvertebrates will be used to compare preconstruction baseline data with postconstruction restored conditions.

Two benthic macroinvertebrate monitoring locations were established within restoration reaches. Postrestoration collections occur in the approximate location of the prerestoration sampling. Benthic macroinvertebrate samples will be collected from individual reaches using the Qual-4 collection method. Sampling techniques of the Qual-4 collection method consist of kick nets, sweep nets, leaf packs, and visual searches. Preproject biological sampling occurred on June 26th, 2014; postproject monitoring occurred in June of monitoring years 2-5, and results were reported in those annual monitoring reports.

3.0 REFERENCES

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Lee, M.T., R.K. Peet, SD. Roberts, and T.R. Wentworth. 2008. CVS-EEP Protocol for Recording Vegetation. Version 4.2. North Carolina Department of Environment and Natural Resources, Ecosystem Enhancement Program. Raleigh, North Carolina.

North Carolina Division of Water Quality (NCDWQ). 2001. Benthic Macroinvertebrate Monitoring Protocols for Compensatory Mitigation. 401/Wetlands Unit, Department of Environment and Natural Resources. Raleigh, North Carolina.

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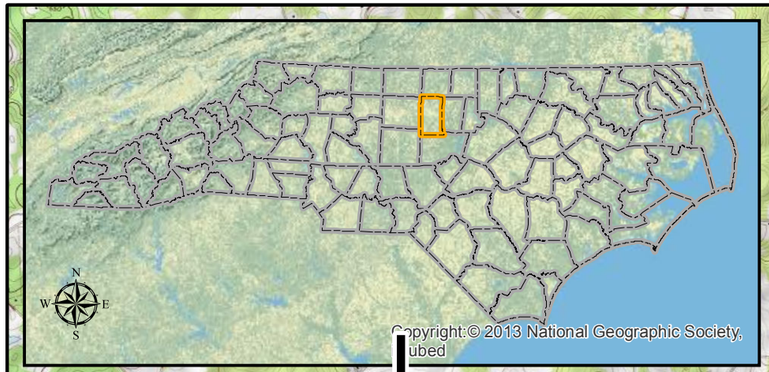
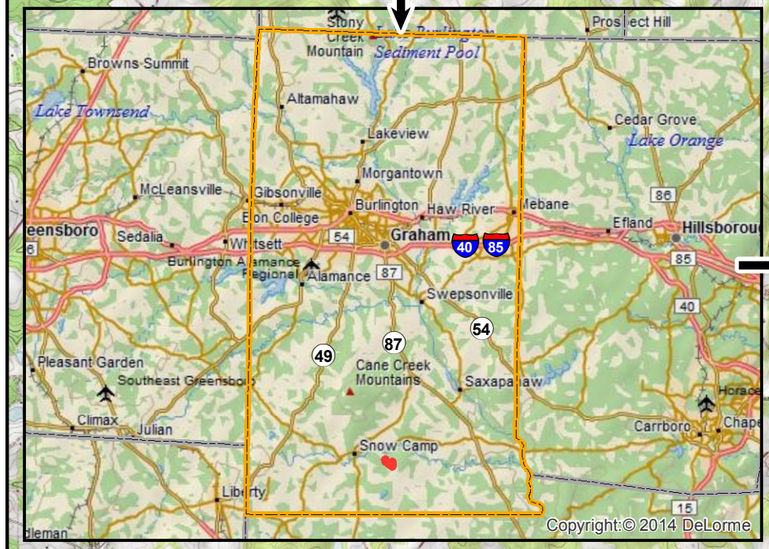
Schafale, M.P. and A.S. Weakley. 1990. Classification of the Natural Communities of North Carolina: Third Approximation. North Carolina Natural Heritage Program, Division of Parks and Recreation, North Carolina Department of Environment, Health, and Natural Resources. Raleigh, North Carolina.

United States Department of Agriculture (USDA). 1960. Soil Survey of Alamance County, North Carolina. Soil Conservation Service.

United States Environmental Protection Agency (USEPA). 1990. Mitigation Site Type Classification (MiST). EPA Workshop, August 13-15, 1989. EPA Region IV and Hardwood Research Cooperative, NCSU, Raleigh, North Carolina.

APPENDIX A: PROJECT BACKGROUND DATA AND MAPS





Directions to the Site from Interstate 40 in Chapel Hill/Durham, NC:
- Travel west on NC 54 for 7 miles,
- Exit onto Jones Ferry Road and turn left,
- Travel west for 1 mile,
- Turn right onto Old Greensboro Road (SR 1005) and travel 16 miles, (The road name changes to Greensboro-Chapel Hill Road at the Haw River)
- Turn left onto Holman Mill Road (SR 2356) and travel 1.5 miles,
- Turn left onto Major Hill Road (SR 2348) and the Site is on the left.

N

SNOW CAMP

East Greensboro Chapel Hill Road

Holman Mill Road

Bethel South Fork Road

Major Hill Road

Snow Camp Road

Abbey Lamm Stream and Wetland Mitigation Site

35.885584 N, -79.394638 W

Legend

Abbey Lamm Stream and Wetland Restoration Site

County lines (inset)

1 0.5 0 1 2 3 Miles

The subject project site is an environmental restoration site of the NCDEQ Division of Mitigation Services (DMS) and is encompassed by a recorded conservation easement, but is bordered by land under private ownership. Accessing the site may require traversing areas near or along the easement boundary and therefore access by the general public is not permitted. Access by state and federal agencies or their designees/contractors involved in the development, oversite, and stewardship of the restoration site is permitted within the terms and timeframes of their defined roles. Any intended site visitation or activit by any person outside of these previously sanctioned roles and activities requires prior coordination with DMS.

Axiom Environmental, Inc.

Prepared for:

RESTORATION SYSTEMS | LLC

Project:

ABBEY LAMM STREAM AND WETLAND MITIGATION SITE

Alamance County, NC

Title:

Site Location

Notes:

Background Imagery sources (provided by ESRI Data and Maps):
1. Physical Map of the United States (2009) created by the U.S. Park Service (upper inset).
2. Delorme World Basemap digital mapping (2010, lower inset).
3. Snow Camp, NC (1978), Crutchfield Crossroads, NC (1974), Saxapahaw, NC (1977), and Silk Hope, NC (1974) 7.5-minute topographic quadrangles provided by the U.S. Geological Survey.

Drawn by:	KRJ
Date:	NOV 2015
Scale:	1:42000
Project No.:	14-005

FIGURE

1

Table 1. Project Components and Mitigation Credits

Mitigation Credits								
Stream	**Stream**	**Riparian Wetland**				**Nonriparian Wetland**		
Restoration	**Enhancement**	**Restoration**				**Restoration**		
4400	**331**	**1.0**				**--**		
Projects Components								
Station Range	**Existing Linear Footage/ Acreage**	**Priority Approach**	**Restoration/ Restoration Equivalent**	**As-built Restoration Linear Footage/ Acreage**	**Mitigation Plan Restoration Linear Footage/ Acreage**	**Mitigation Ratio**	**Mitigation Credits (from Mit Plan)**	**Comment**
UT 1 Station 00+21 to 05+62	531	PI	Restoration	546	541	1:1	546	
UT 1a Station 00+00 to 01+54	154	PI	Restoration	154-9=145	154-8=146	1:1	145	9 lf of UT1a located outside of easement is not credit generating
UT 2 Station 00+22 to 04+75	502	PI	Restoration	453	455	1:1	453	
UT 3a Station 00+00 to 00+93	93		EII	93	93	2.5:1	37.2	
UT 3b Station 00+00 to 01+42	143		EII	142	143	2.5:1	56.8	
UT 3c Station 00+00 to 01+90	190		EII	190	190	2.5:1	76	
UT 3 Station 00+93 to 11+77	1021	PI	Restoration	1084	1084	1:1	1084	
Mainstem Channel Station 04+75 to 16+29	1098	PI	Restoration	1154-61-63= 1030	1154-61-63= 1030	1:1	1030	61 lf and 63 lf of Mainstem located outside of easement at two crossings are not credit generating
Mainstem Channel Station 16+29 to 20+57	428		EII	428-19=409	428-25=403	2.5:1	163.6	19 lf of Mainstem located outside of easement are not credit generating
Mainstem Channel Station 20+57 to 32+57	NA	PI	Restoration	1201-57=1142	1199-55=1144	1:1	1143	57 lf of Mainstem located outside of easement are not credit generating

Component Summation			
Restoration Level	**Stream (linear footage)**	**Riparian Wetland (acreage)**	**Nonriparian Wetland (acreage)**
Restoration	4400*	1.0	--
Enhancement (Level 1)	--	--	--
Enhancement (Level II)	829**	--	--
Enhancement	--	0.4***	--
Totals	**5229**	**--**	**--**
Mitigation Units	**4731 SMUs**	**1.0 Riparian WMUs**	**0.00 Nonriparian WMUs**

*An additional 190 linear feet of stream restoration is proposed outside of the easement and is therefore not included in this total or in mitigation credit calculations.
**An additional 19 linear feet of stream enhancement (level II) is proposed outside of the easement and is therefore not included in this total or in mitigation credit calculations.
***Wetland enhancement acreage is not included in mitigation credit calculations as per RFP 16-005568 requirements.

Table 2. Project Activity and Reporting History

Activity or Deliverable	Stream Monitoring Complete	Vegetation Monitoring Complete	Data Collection Complete	Completion or Delivery
Technical Proposal (RFP No. 16-005568)	--	--	--	October 2013
EEP Contract No. 5790	--	--	--	February 2014
Mitigation Plan	--	--	--	September 2014
Construction Plans	--	--	--	September 2014
Construction Earthwork	--	--	--	April 3, 2015
Planting	--	--	--	April 7, 2015
As-Built Documentation	April 14th, 2015	April 9th, 2015	May 2015	July 2015
Year 1 Monitoring	October 20th, 2015	September 23rd, 2015	October 2015	November 2015
Fescue Treatment	--	--	--	March, 2016
Year 2 Monitoring	April 7th, 2016	July 6th, 2016	October 2016	December 2016
Remedial Planting	--	--	--	December 8, 2016
Year 3 Monitoring	March 27th, 2017	July 19th, 2017	October 2017	November 2017
Year 4 Monitoring	April 15, 2018	--	October 2018	October 2018
Year 5 Monitoring	March 4th, 2019	September 25th, 2019	November 2019	January 2020
Year 6 Monitoring	NA	NA	October 2020	December 2020

Table 3. Project Contacts Table

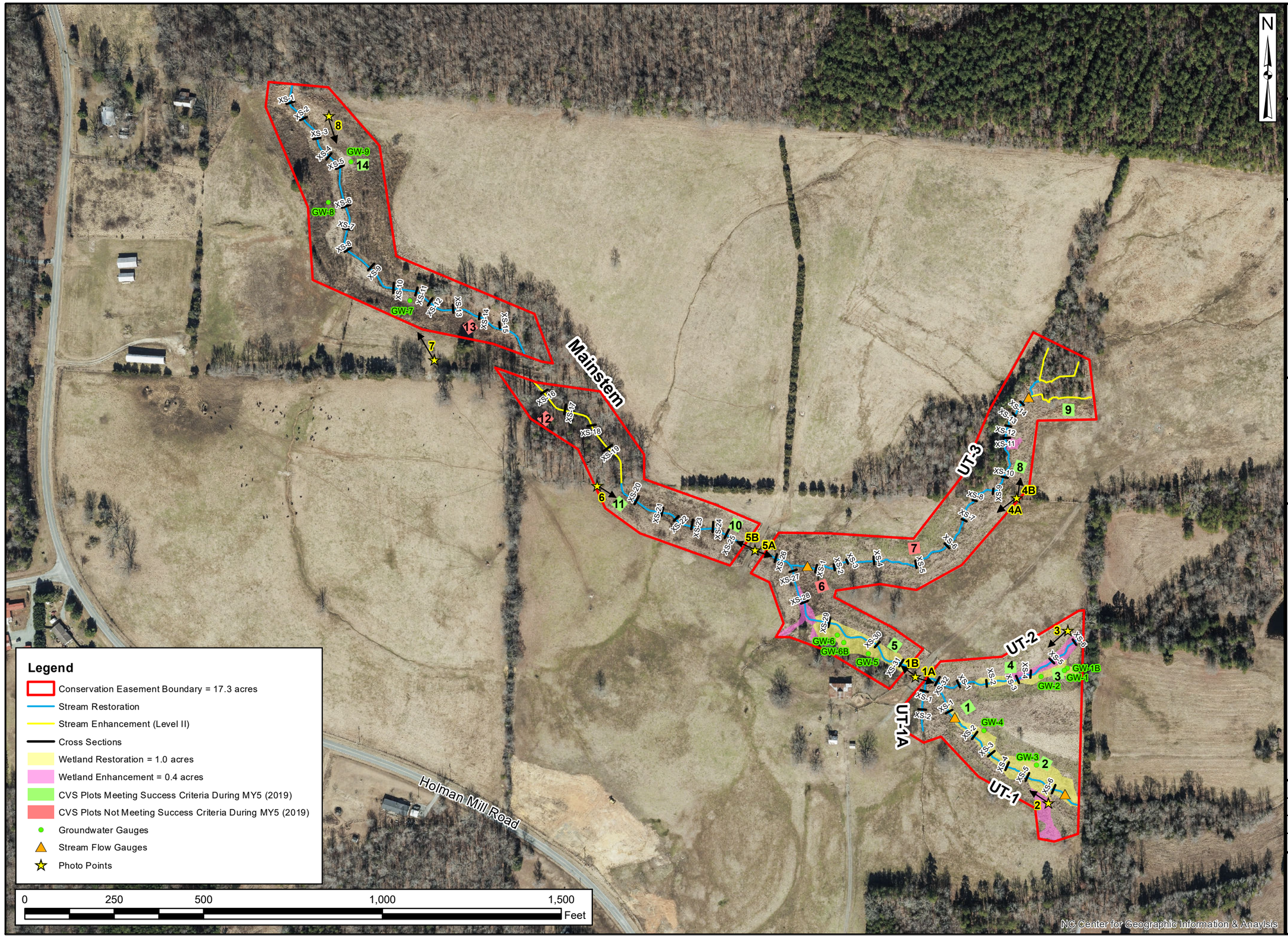
Full Delivery Provider Restoration Systems 1101 Haynes Street, Suite 211 Raleigh, North Carolina 27604 Worth Creech 919-755-9490	**Construction Contractor** Land Mechanic Designs 780 Landmark Road Willow Spring, NC 27592 Lloyd Glover 919-639-6132
Designer Axiom Environmental, Inc. 218 Snow Avenue Raleigh, NC 27603 Grant Lewis 919-215-1693	**Planting Contractor** Carolina Silvics, Inc. 908 Indian Trail Road Edenton, NC 27932 Mary-Margaret McKinney 252-482-8491
Construction Plans and Sediment and Erosion Control Plans Sungate Design Group, PA 915 Jones Franklin Road Raleigh, NC 27606 Joshua G. Dalton, PE 919-859-2243	**As-built Surveyor** K2 Design Group 5688 US Highway 70 East Goldsboro, NC 27534 John Rudolph 919-751-0075
	Baseline & Monitoring Data Collection Axiom Environmental, Inc. 218 Snow Avenue Raleigh, NC 27603 Grant Lewis 919-215-1693

Table 4. Project Attribute Table

Project Information				
Project Name	Abbey Lamm Restoration Site			
Project County	Alamance County, North Carolina			
Project Area (acres)	17.3			
Project Coordinates (latitude & latitude)	35.885584ºN, 79.394638ºW			
Project Watershed Summary Information				
Physiographic Province	Piedmont			
Project River Basin	Cape Fear			
USGS HUC for Project (14-digit)	03030002050050			
NCDWR Sub-basin for Project	03-06-04			
Project Drainage Area (acres)	257			
Percentage of Project Drainage Area that is Impervious	<2%			
Reach Summary Information				
Parameters	**Main**	**UT 1**	**UT 2**	**UT 3**
Length of reach (linear feet)	3258	695	455	1510
Valley Classification	alluvial			
Drainage Area (acres)	257	49	56	32
NCDWR Stream ID Score	--	29	35.25	28
NCDWR Water Quality Classification	WS-V, NSW			
Existing Morphological Description (Rosgen 1996)	Eg5/Fc5	E/G 5	C/G 5	Eg5
Existing Evolutionary Stage (Simon and Hupp 1986)	III/IV	II/III	IV/III	III
Underlying Mapped Soils	Efland silt loam, Goldston slaty silt loam, Herndon silt loam, Moderately gullied land, Orange silt loam			
Drainage Class	Well-drained, well-drained, well-drained, poorly to well-drained, moderately well-drained			
Hydric Soil Status	Nonhydric			
Slope	0.0179	0.0256-0.0362		
FEMA Classification	NA			
Native Vegetation Community	Piedmont Alluvial Forest/Dry-Mesic Oak-Hickory Forest			
Watershed Land Use/Land Cover (Site)	40% forest, 58% agricultural land, <2% low density residential/impervious surface			
Watershed Land Use/Land Cover (Cedarock Reference Channel)	65% forest, 30% agricultural land, <5% low density residential/impervious surface			
Percent Composition of Exotic Invasive Vegetation	<5%			

APPENDIX B: VISUAL ASSESSMENT DATA

Figure 2. Current Conditions Plan View (CCPV)
Tables 5A-5E. Visual Stream Morphology Stability Assessment
Table 6. Vegetation Condition Assessment
Stream Station Photographs



Axiom Environmental, Inc.

Prepared for:

RESTORATION SYSTEMS | LLC

Project:

ABBEY LAMM STREAM AND WETLAND MITIGATION SITE

Alamance County, NC

Title:

Current Conditions Plan View

Notes:

Background Imagery source: 2018 aerial photogarphy provided by the NC OneMap program (online, provided by the NC Geographic Information Coordination Council)

Drawn by:	KRJ
Date:	NOV 2020
Scale:	1:3000
Project No.:	14-005

FIGURE

2

Table 5A **Visual Stream Morphology Stability Assessment**
Reach ID **Lamm Mainstem**
Assessed Length **2781**

Major Channel Category	Channel Sub-Category	Metric	Number Stable, Performing as Intended	Total Number in As-built	Number of Unstable Segments	Amount of Unstable Footage	% Stable, Performing as Intended	Number with Stabilizing Woody Vegetation	Footage with Stabilizing Woody Vegetation	Adjusted % for Stabilizing Woody Vegetation
1. Bed	1. **Vertical Stability** (Riffle and Run units)	1. Aggradation - Bar formation/growth sufficient to significantly deflect flow laterally (not to include point bars)			0	0	100%			
		2. Degradation - Evidence of downcutting			0	0	100%			
	2. Riffle Condition	1. Texture/Substrate - Riffle maintains coarser substrate	56	56			100%			
	3. Meander Pool Condition	1. Depth Sufficient (Max Pool Depth : Mean Bankfull Depth ≥ 1.6)	55	55			100%			
		2. Length appropriate (>30% of centerline distance between tail of upstream riffle and head of downstrem riffle)	55	55			100%			
	4.**Thalweg Position**	1. Thalweg centering at upstream of meander bend (Run)	55	55			100%			
		2. Thalweg centering at downstream of meander (Glide)	55	55			100%			
2. Bank	**1. Scoured/Eroding**	Bank lacking vegetative cover resulting simply from poor growth and/or scour and erosion			0	0	100%			100%
	2. Undercut	Banks undercut/overhanging to the extent that mass wasting appears likely. Does NOT include undercuts that are modest, appear sustainable and are providing habitat.			0	0	100%			100%
	3. Mass Wasting	Bank slumping, calving, or collapse			0	0	100%			100%
				Totals	0	0	100%	0	0	100%
3. Engineered Structures	**1. Overall Integrity**	Structures physically intact with no dislodged boulders or logs.	14	14			100%			
	2. Grade Control	Grade control structures exhibiting maintenance of grade across the sill.	14	14			100%			
	2a. Piping	Structures lacking any substantial flow underneath sills or arms.	14	14			100%			
	3. Bank Protection	Bank erosion within the structures extent of influence does not exceed 15%. (See guidance for this table in EEP monitoring guidance document)	14	14			100%			
	4. Habitat	Pool forming structures maintaining ~ Max Pool Depth : Mean Bankfull Depth ratio ≥ 1.6 Rootwads/logs providing some cover at base-flow.	14	14			100%			

Table 5B **Visual Stream Morphology Stability Assessment**
Reach ID **Lamm UT1-A**
Assessed Length **154**

Major Channel Category	Channel Sub-Category	Metric	Number Stable, Performing as Intended	Total Number in As-built	Number of Unstable Segments	Amount of Unstable Footage	% Stable, Performing as Intended	Number with Stabilizing Woody Vegetation	Footage with Stabilizing Woody Vegetation	Adjusted % for Stabilizing Woody Vegetation
1. Bed	1. **Vertical Stability** (Riffle and Run units)	1. Aggradation - Bar formation/growth sufficient to significantly deflect flow laterally (not to include point bars)			0	0	100%			
		2. Degradation - Evidence of downcutting			0	0	100%			
	2. Riffle Condition	1. Texture/Substrate - Riffle maintains coarser substrate	6	6			100%			
	3. Meander Pool Condition	1. Depth Sufficient (Max Pool Depth : Mean Bankfull Depth ≥ 1.6)	5	5			100%			
		2. Length appropriate (>30% of centerline distance between tail of upstream riffle and head of downstrem riffle)	5	5			100%			
	4.**Thalweg Position**	1. Thalweg centering at upstream of meander bend (Run)	5	5			100%			
		2. Thalweg centering at downstream of meander (Glide)	5	5			100%			
2. Bank	**1. Scoured/Eroding**	Bank lacking vegetative cover resulting simply from poor growth and/or scour and erosion			0	0	100%			100%
	2. Undercut	Banks undercut/overhanging to the extent that mass wasting appears likely. Does NOT include undercuts that are modest, appear sustainable and are providing habitat.			0	0	100%			100%
	3. Mass Wasting	Bank slumping, calving, or collapse			0	0	100%			100%
				Totals	0	0	100%	0	0	100%
3. Engineered Structures	**1. Overall Integrity**	Structures physically intact with no dislodged boulders or logs.	4	4			100%			
	2. Grade Control	Grade control structures exhibiting maintenance of grade across the sill.	4	4			100%			
	2a. Piping	Structures lacking any substantial flow underneath sills or arms.	4	4			100%			
	3. Bank Protection	Bank erosion within the structures extent of influence does not exceed 15%. (See guidance for this table in EEP monitoring guidance document)	4	4			100%			
	4. Habitat	Pool forming structures maintaining ~ Max Pool Depth : Mean Bankfull Depth ratio ≥ 1.6 Rootwads/logs providing some cover at base-flow.	4	4			100%			

Table 5C **Visual Stream Morphology Stability Assessment**
Reach ID **Lamm UT1**
Assessed Length **541**

Major Channel Category	Channel Sub-Category	Metric	Number Stable, Performing as Intended	Total Number in As-built	Number of Unstable Segments	Amount of Unstable Footage	% Stable, Performing as Intended	Number with Stabilizing Woody Vegetation	Footage with Stabilizing Woody Vegetation	Adjusted % for Stabilizing Woody Vegetation
1. Bed	1. **Vertical Stability** (Riffle and Run units)	1. Aggradation - Bar formation/growth sufficient to significantly deflect flow laterally (not to include point bars)			0	0	100%			
		2. Degradation - Evidence of downcutting			0	0	100%			
	2. Riffle Condition	1. Texture/Substrate - Riffle maintains coarser substrate	25	25			100%			
	3. Meander Pool Condition	1. Depth Sufficient (Max Pool Depth : Mean Bankfull Depth ≥ 1.6)	24	24			100%			
		2. Length appropriate (>30% of centerline distance between tail of upstream riffle and head of downstrem riffle)	24	24			100%			
	4.**Thalweg Position**	1. Thalweg centering at upstream of meander bend (Run)	24	24			100%			
		2. Thalweg centering at downstream of meander (Glide)	24	24			100%			
2. Bank	**1. Scoured/Eroding**	Bank lacking vegetative cover resulting simply from poor growth and/or scour and erosion			0	0	100%			100%
	2. Undercut	Banks undercut/overhanging to the extent that mass wasting appears likely. Does NOT include undercuts that are modest, appear sustainable and are providing habitat.			0	0	100%			100%
	3. Mass Wasting	Bank slumping, calving, or collapse			0	0	100%			100%
				Totals	0	0	100%	0	0	100%
3. Engineered Structures	**1. Overall Integrity**	Structures physically intact with no dislodged boulders or logs.	10	10			100%			
	2. Grade Control	Grade control structures exhibiting maintenance of grade across the sill.	10	10			100%			
	2a. Piping	Structures lacking any substantial flow underneath sills or arms.	10	10			100%			
	3. Bank Protection	Bank erosion within the structures extent of influence does not exceed 15%. (See guidance for this table in EEP monitoring guidance document)	10	10			100%			
	4. Habitat	Pool forming structures maintaining ~ Max Pool Depth : Mean Bankfull Depth ratio ≥ 1.6 Rootwads/logs providing some cover at base-flow.	10	10			100%			

Table 5D **Visual Stream Morphology Stability Assessment**
Reach ID **Lamm UT2**
Assessed Length **455**

Major Channel Category	Channel Sub-Category	Metric	Number Stable, Performing as Intended	Total Number in As-built	Number of Unstable Segments	Amount of Unstable Footage	% Stable, Performing as Intended	Number with Stabilizing Woody Vegetation	Footage with Stabilizing Woody Vegetation	Adjusted % for Stabilizing Woody Vegetation
1. Bed	1. **Vertical Stability** (Riffle and Run units)	1. Aggradation - Bar formation/growth sufficient to significantly deflect flow laterally (not to include point bars)			0	0	100%			
		2. Degradation - Evidence of downcutting			0	0	100%			
	2. Riffle Condition	1. Texture/Substrate - Riffle maintains coarser substrate	23	23			100%			
	3. Meander Pool Condition	1. Depth Sufficient (Max Pool Depth : Mean Bankfull Depth ≥ 1.6)	22	22			100%			
		2. Length appropriate (>30% of centerline distance between tail of upstream riffle and head of downstrem riffle)	22	22			100%			
	4.**Thalweg Position**	1. Thalweg centering at upstream of meander bend (Run)	22	22			100%			
		2. Thalweg centering at downstream of meander (Glide)	22	22			100%			
2. Bank	**1. Scoured/Eroding**	Bank lacking vegetative cover resulting simply from poor growth and/or scour and erosion			0	0	100%			100%
	2. Undercut	Banks undercut/overhanging to the extent that mass wasting appears likely. Does NOT include undercuts that are modest, appear sustainable and are providing habitat.			0	0	100%			100%
	3. Mass Wasting	Bank slumping, calving, or collapse			0	0	100%			100%
				Totals	0	0	100%	0	0	100%
3. Engineered Structures	**1. Overall Integrity**	Structures physically intact with no dislodged boulders or logs.	12	12			100%			
	2. Grade Control	Grade control structures exhibiting maintenance of grade across the sill.	12	12			100%			
	2a. Piping	Structures lacking any substantial flow underneath sills or arms.	12	12			100%			
	3. Bank Protection	Bank erosion within the structures extent of influence does not exceed 15%. (See guidance for this table in EEP monitoring guidance document)	12	12			100%			
	4. Habitat	Pool forming structures maintaining ~ Max Pool Depth : Mean Bankfull Depth ratio ≥ 1.6 Rootwads/logs providing some cover at base-flow.	12	12			100%			

Table 5E **Visual Stream Morphology Stability Assessment**
Reach ID **UT3**
Assessed Length **1084**

Major Channel Category	Channel Sub-Category	Metric	Number Stable, Performing as Intended	Total Number in As-built	Number of Unstable Segments	Amount of Unstable Footage	% Stable, Performing as Intended	Number with Stabilizing Woody Vegetation	Footage with Stabilizing Woody Vegetation	Adjusted % for Stabilizing Woody Vegetation
1. Bed	1. **Vertical Stability** (Riffle and Run units)	1. Aggradation - Bar formation/growth sufficient to significantly deflect flow laterally (not to include point bars)			0	0	100%			
		2. Degradation - Evidence of downcutting			0	0	100%			
	2. Riffle Condition	1. Texture/Substrate - Riffle maintains coarser substrate	38	38			100%			
	3. Meander Pool Condition	1. Depth Sufficient (Max Pool Depth : Mean Bankfull Depth ≥ 1.6)	37	37			100%			
		2. Length appropriate (>30% of centerline distance between tail of upstream riffle and head of downstrem riffle)	37	37			100%			
	4.**Thalweg Position**	1. Thalweg centering at upstream of meander bend (Run)	37	37			100%			
		2. Thalweg centering at downstream of meander (Glide)	37	37			100%			
2. Bank	**1. Scoured/Eroding**	Bank lacking vegetative cover resulting simply from poor growth and/or scour and erosion			0	0	100%			100%
	2. Undercut	Banks undercut/overhanging to the extent that mass wasting appears likely. Does NOT include undercuts that are modest, appear sustainable and are providing habitat.			0	0	100%			100%
	3. Mass Wasting	Bank slumping, calving, or collapse			0	0	100%			100%
				Totals	0	0	100%	0	0	100%
3. Engineered Structures	**1. Overall Integrity**	Structures physically intact with no dislodged boulders or logs.	23	23			100%			
	2. Grade Control	Grade control structures exhibiting maintenance of grade across the sill.	23	23			100%			
	2a. Piping	Structures lacking any substantial flow underneath sills or arms.	23	23			100%			
	3. Bank Protection	Bank erosion within the structures extent of influence does not exceed 15%. (See guidance for this table in EEP monitoring guidance document)	23	23			100%			
	4. Habitat	Pool forming structures maintaining ~ Max Pool Depth : Mean Bankfull Depth ratio ≥ 1.6 Rootwads/logs providing some cover at base-flow.	23	23			100%			

Table 6 Vegetation Condition Assessment

Abbey Lamm

Planted Acreage[1] **16.4**

Vegetation Category	Definitions	Mapping Threshold	CCPV Depiction	Number of Polygons	Combined Acreage	% of Planted Acreage
1. Bare Areas	None	0.1 acres	none	0	0.00	0.0%
2. Low Stem Density Areas	None	0.1 acres	none	0	0.00	0.0%
2B. Low Planted Stem Density Areas	None	0.1 acres	none	0	0.00	0.0%
			Total	0	0.00	0.0%
3. Areas of Poor Growth Rates or Vigor	None	0.25 acres	none	0	0.00	0.0%
			Cumulative Total	0	0.00	0.0%

Easement Acreage[2] **17.3**

Vegetation Category	Definitions	Mapping Threshold	CCPV Depiction	Number of Polygons	Combined Acreage	% of Easement Acreage
4. Invasive Areas of Concern[4]	None	1000 SF	none	0	0.00	0.0%
5. Easement Encroachment Areas[3]	None	none	none	0	0.00	0.0%

1 = Enter the planted acreage within the easement. This number is calculated as the easement acreage minus any existing mature tree stands that were not subject to supplemental planting of the understory, the channel acreage, crossings or any other elements not directly planted as part of the project effort.

2 = The acreage within the easement boundaries.

3 = Encroachment may occur within or outside of planted areas and will therefore be calculated against the overall easement acreage. In the event a polygon is cataloged into items 1, 2 or 3 in the table and is the result of encroachment, the associated acreage should be tallied in the relevant item (i.e., item 1,2 or 3) as well as a parallel tally in item 5.

4 = Invasives may occur in or out of planted areas, but still within the easement and will therefore be calculated against the overall easement acreage. Invasives of concern/interest are listed below. The list of high concern spcies are those with the potential to directly outcompete native, young, woody stems in the short-term (e.g. monitoring period or shortly thereafter) or affect the community structure for existing, more established tree/shrub stands over timeframes that are slightly longer (e.g. 1-2 decades). The low/moderate concern group are those species that generally do not have this capacity over the timeframes discussed and therefore are not expected to be mapped with regularity, but can be mapped, if in the judgement of the observer their coverage, density or distribution is suppressing the viability, density, or growth of planted woody stems. Decisions as to whether remediation will be needed are based on the integration of risk factors by DMS such as species present, their coverage, distribution relative to native biomass, and the practicality of treatment. For example, even modest amounts of Kudzu or Japanese Knotweed early in the projects history will warrant control, but potentially large coverages of Microstegium in the herb layer will not likley trigger control because of the limited capacities to impact tree/shrub layers within the timeframes discussed and the potential impacts of treating extensive amounts of ground cover. Those species with the "watch list" designator in gray shade are of interest as well, but have yet to be observed across the state with any frequency. Those in *red italics* are of particular interest given their extreme risk/threat level for mapping as points where isolated specimens are found, particularly ealry in a projects monitoring history. However, areas of discreet, dense patches will of course be mapped as polygons. The symbology scheme below was one that was found to be helpful for symbolzing invasives polygons, particulalry for situations where the conditon for an area is somewhere between isolated specimens and dense, discreet patches. In any case, the point or polygon/area feature can be symbolized to describe things like high or low concern and species can be listed as a map inset, in legend items if the number of species are limited or in the narrative section of the executive summary.

Abbey Lamm
Year 6 Fixed Station Photographs
Taken September 2020

Abbey Lamm
Year 6 Fixed Station Photographs (continued)
Taken September 2020

Photo Point 5A

Photo Point 5B

Photo Point 6

Photo Point 7

Photo Point 8

APPENDIX C: STREAM SURVEY DATA

Tables 7a-e. Baseline Stream Data Summary
Tables 8a-l. Years 1-3, 5 Monitoring Data

Table 7A. Baseline Morphology and Hydraulic Summary
Lamm UT 1

Parameter	USGS Gage Data			Pre-Existing Condition			Project Reference Cedarock Park			Project Reference Causey Farm			Design			As-built		
Dimension	**Min**	**Max**	**Med**	**Min**	**Max**	**Med**	**Min**	**Max**	**Med**	**Min**	**Max**	**Med**	**Min**	**Max**	**Med**	**Min**	**Max**	**Med**
BF Width (ft)	USGS gage data is unavailable for this project			4	12	6.5	8	12.1	8.1	10.7	11.3	11	6.5	7.5	7	6	9.1	8.6
Floodprone Width (ft)				6	27	17	15	25	18	122	140	131	30	90	50			50
BF Cross Sectional Area (ft2)						3.5			8			14.7			3.5	3.6	6.7	4.0
BF Mean Depth (ft)				0.3	0.9	0.6	0.8	1	0.8	1.3	1.4	1.4	0.46	0.55	0.5	0.5	0.7	0.6
BF Max Depth (ft)				0.7	1.3	1	1.1	1.4	1.4	1.9	2	2	0.6	0.8	0.7	0.7	1.2	0.9
Width/Depth Ratio				4.4	40	13.8	8	15.1	10.1	8	9	9	12	16	14	10	19	13
Entrenchment Ratio				1	6.8	2.9	1.9	2.2	2.1	11	13	12	4.3	12.9	7.1	6	8	5.8
Bank Height Ratio				1.3	2.6	1.7	1	1.8	1			1.4	1	1.3	1			1
Wetted Perimeter(ft)						===			===			===			===	6.3	9.6	8.9
Hydraulic radius (ft)						===			===			===			===	0.4	0.7	0.6
Pattern																		
Channel Beltwidth (ft)				No pattern of riffles and pools due to straightening activties			20	38	22.8	17	36	29.8	21	42	28	21	42	28
Radius of Curvature (ft)							11	27	16.5	9	113	30.6	14	70	21	14	70	21
Meander Wavelength (ft)							44	116	68.4	10	91	62.9	42	84	60	42	84	60
Meander Width ratio							2.4	4.7	2.8	1.5	3.5	2.7	3	6	4	3	6	4
Profile																		
Riffle length (ft)				No pattern of riffles and pools due to straightening activties					===			===			===	5	44	15
Riffle slope (ft/ft)							1.00%	5.76%	3.16%	0.20%	1.20%	0.98%	3.71%	7.73%	4.94%	1.10%	9.83%	2.98%
Pool length (ft)									===			===			===	5	12	8
Pool spacing (ft)							25	69	37.2	2	7.4	4	21	56	28	21	56	28
Substrate																		
d50 (mm)						===			===			===			===			===
d84 (mm)						===			===			===			===			===
Additional Reach Parameters																		
Valley Length (ft)						===			===			===			===			466
Channel Length (ft)						===			===			===			===			559
Sinuosity						1.02			1.2			1.46			1.2			1.2
Water Surface Slope (ft/ft)						2.84%			2.58%			0.53%			2.56% - 3.62%			2.56%
BF slope (ft/ft)						===			===			===			===			===
Rosgen Classification						E/G 5			E 4/5			E 4/5			E/C 3/4			E/C 3/4

Table 7B. Baseline Morphology and Hydraulic Summary
Lamm UT 2

Parameter	USGS Gage Data			Pre-Existing Condition			Project Reference Cedarock Park			Project Reference Causey Farm			Design			As-built^		
Dimension	**Min**	**Max**	**Med**	**Min**	**Max**	**Med**	**Min**	**Max**	**Med**	**Min**	**Max**	**Med**	**Min**	**Max**	**Med**	**Min**	**Max**	**Med**
BF Width (ft)	USGS gage data is unavailable for this project			7.1	15.6	9.7	8	12.1	8.1	10.7	11.3	11	6.5	7.5	7	5.9	9.7	7.6
Floodprone Width (ft)				15	40	27	15	25	18	122	140	131	30	90	50			50
BF Cross Sectional Area (ft2)						3.8			8			14.7			3.5	2.3	5.5	3.2
BF Mean Depth (ft)				0.2	0.5	0.4	0.8	1	0.8	1.3	1.4	1.4	0.46	0.55	0.5	0.4	0.6	0.4
BF Max Depth (ft)				0.5	1.3	0.8	1.1	1.4	1.4	1.9	2	2	0.6	0.8	0.7	0.5	1	0.7
Width/Depth Ratio				14.2	78	28.8	8	15.1	10.1	8	9	9	12	16	14	15	21	17
Entrenchment Ratio				1	5.6	3	1.9	2.2	2.1	11	13	12	4.3	12.9	7.1	5	9	6.6
Bank Height Ratio				1	3	1.6	1	1.8	1			1.4	1	1.3	1			1
Wetted Perimeter(ft)						===			===			===			===	6.1	10.1	7.7
Hydraulic radius (ft)						===			===			===			===	0.3	0.5	0.4
Pattern																		
Channel Beltwidth (ft)				No pattern of riffles and pools due to straightening activties			20	38	22.8	17	36	29.8	21	42	28	21	42	28
Radius of Curvature (ft)							11	27	16.5	9	113	30.6	14	70	21	14	70	21
Meander Wavelength (ft)							44	116	68.4	10	91	62.9	42	84	60	42	84	60
Meander Width ratio							2.4	4.7	2.8	1.5	3.5	2.7	3	6	4	3	8	4
Profile																		
Riffle length (ft)				No pattern of riffles and pools due to straightening activties					===			===			===	5	26	12
Riffle slope (ft/ft)							1.00%	5.76%	3.16%	0.20%	1.20%	0.98%	3.71%	7.73%	4.94%	0.84%	4.64%	2.94%
Pool length (ft)									===			===			===	4	14	8
Pool spacing (ft)							25	69	37.2	2	7.4	4	21	56	28	21	56	28
Substrate																		
d50 (mm)						===			===			===			===			===
d84 (mm)						===			===			===			===			===
Additional Reach Parameters																		
Valley Length (ft)						===			===			===			===			387
Channel Length (ft)						===			===			===			===			464
Sinuosity						1.03			1.2			1.46			1.2			1.2
Water Surface Slope (ft/ft)						3.07% - 4.31%			2.58%			0.53%			2.56% - 3.62%			3.01%
BF slope (ft/ft)						===			===			===			===			===
Rosgen Classification						C/G 5			E 4/5			E 4/5			E/C 3/4			E/C 3/4

^Measured as-built numbers do not include D-type reach.

Table 7C. Baseline Morphology and Hydraulic Summary
Lamm UT 3

Parameter	USGS Gage Data			Pre-Existing Condition			Project Reference Cedarock Park			Project Reference Causey Farm			Design			As-built		
Dimension	**Min**	**Max**	**Med**	**Min**	**Max**	**Med**	**Min**	**Max**	**Med**	**Min**	**Max**	**Med**	**Min**	**Max**	**Med**	**Min**	**Max**	**Med**
BF Width (ft)	USGS gage data is unavailable for this project			3.4	12.3	7.2	8	12.1	8.1	10.7	11.3	11	6.5	7.5	7	6.3	8.6	7.3
Floodprone Width (ft)				18	40	26	15	25	18	122	140	131	30	90	50			250
BF Cross Sectional Area (ft2)						2.6			8			14.7			3.5	2	3.1	2.5
BF Mean Depth (ft)				0.2	0.8	0.4	0.8	1	0.8	1.3	1.4	1.4	0.46	0.55	0.5	0.3	0.5	0.3
BF Max Depth (ft)				0.5	1.3	0.8	1.1	1.4	1.4	1.9	2	2	0.6	0.8	0.7	0.4	0.8	0.6
Width/Depth Ratio				4.3	61.5	24	8	15.1	10.1	8	9	9	12	16	14	15	27	23
Entrenchment Ratio				2.4	7	4.1	1.9	2.2	2.1	11	13	12	4.3	12.9	7.1	6	8	6.8
Bank Height Ratio				1	2	1.4	1	1.8	1			1.4	1	1.3	1			1
Wetted Perimeter(ft)						===			===			===			===	6.4	8.8	7.4
Hydraulic radius (ft)						===			===			===			===	0.3	0.4	0.3
Pattern																		
Channel Beltwidth (ft)				No pattern of riffles and pools due to straightening activties			20	38	22.8	17	36	29.8	21	42	28	21	42	28
Radius of Curvature (ft)							11	27	16.5	9	113	30.6	14	70	21	14	70	21
Meander Wavelength (ft)							44	116	68.4	10	91	62.9	42	84	60	42	84	60
Meander Width ratio							2.4	4.7	2.8	1.5	3.5	2.7	3	6	4	3	8	4
Profile																		
Riffle length (ft)				No pattern of riffles and pools due to straightening activties					===			===			===	6	66	21
Riffle slope (ft/ft)							1.00%	5.76%	3.16%	0.20%	1.20%	0.98%	3.71%	7.73%	4.94%	0.82%	6.50%	3.13%
Pool length (ft)									===			===			===	4	14	7
Pool spacing (ft)							25	69	37.2	2	7.4	4	21	56	28	21	56	28
Substrate																		
d50 (mm)						===			===			===			===			===
d84 (mm)						===			===			===			===			===
Additional Reach Parameters																		
Valley Length (ft)						===			===			===			===			846
Channel Length (ft)						===			===			===			===			1015
Sinuosity						1.05			1.2			1.46			1.2			1.2
Water Surface Slope (ft/ft)						3.34%			2.58%			0.53%			2.56% - 3.62%			3.19%
BF slope (ft/ft)						===			===			===			===			===
Rosgen Classification						Fc 5/6			Eg 5			E 4/5			E/C 3/4			C 3/4

Table 7D. Baseline Morphology and Hydraulic Summary
Lamm Main Upstream

Parameter	USGS Gage Data			Pre-Existing Condition			Project Reference Cedarock Park			Project Reference Causey Farm			Design			As-built		
Dimension	**Min**	**Max**	**Med**	**Min**	**Max**	**Med**	**Min**	**Max**	**Med**	**Min**	**Max**	**Med**	**Min**	**Max**	**Med**	**Min**	**Max**	**Med**
BF Width (ft)	USGS gage data is			11.7	26.5	18.5	8	12.1	8.1	10.7	11.3	11	11.2	12.9	12.1	12.3	13.3	12.7
Floodprone Width (ft)	unavailable for this			29	75	56	15	25	18	122	140	131	20	90	40			250
BF Cross Sectional Area (ft2)	project					10.4			8			14.7			10.4	8.8	12.5	10.4
BF Mean Depth (ft)				0.4	0.9	0.6	0.8	1	0.8	1.3	1.4	1.4	0.8	0.9	0.9	0.7	1	0.85
BF Max Depth (ft)				1.1	1.7	1.3	1.1	1.4	1.4	1.9	2	2	1.1	1.4	1.3	1	12.6	1.3
Width/Depth Ratio				11.7	66.3	31.5	8	15.1	10.1	8	9	9	12	16	14	13	17	15
Entrenchment Ratio				1.9	24	6.2	1.9	2.2	2.1	11	13	12	1.7	7.4	3.3	7	7	7.05
Bank Height Ratio				1	1.9	1.2	1	1.8	1			1.4	1	1.3	1			1
Wetted Perimeter(ft)						===			===			===			===	13	13.9	13.2
Hydraulic radius (ft)						===			===			===			===	0.7	0.9	0.8
Pattern																		
Channel Beltwidth (ft)				No pattern of riffles			20	38	22.8	17	36	29.8	36	73	48	36	73	48
Radius of Curvature (ft)				and pools due to			11	27	16.5	9	113	30.6	24	121	36	24	121	36
Meander Wavelength (ft)				straightening activties			44	116	68.4	10	91	62.9	73	145	103	73	145	103
Meander Width ratio							2.4	4.7	2.8	1.5	3.5	2.7	3	6	4	3	6	4
Profile																		
Riffle length (ft)				No pattern of riffles					===			===			===	9	66	26
Riffle slope (ft/ft)				and pools due to			1.00%	5.76%	3.16%	0.20%	1.20%	0.98%	2.15%	4.48%	2.86%	0.00%	3.87%	1.86%
Pool length (ft)				straightening activties					===			===			===	5	34	12
Pool spacing (ft)							25	69	37.2	2	7.4	4	36	97	48	36	97	48
Substrate																		
d50 (mm)						===			===			===			===			===
d84 (mm)						===			===			===			===			===
Additional Reach Parameters																		
Valley Length (ft)						===			===			===			===			949
Channel Length (ft)						===			===			===			===			1139
Sinuosity						1.05			1.2			1.46			1.2			1.2
Water Surface Slope (ft/ft)						1.76%			2.58%			0.53%			1.79%			1.57%
BF slope (ft/ft)						===			===			===			===			===
Rosgen Classification						Eg5/Fc			E 4/5			E 4/5			E/C 3/4			E/C 3/4

Table 7E. Baseline Morphology and Hydraulic Summary
Lamm Main Downstream

Parameter	USGS Gage Data			Pre-Existing Condition			Project Reference Cedarock Park			Project Reference Causey Farm			Design			As-built		
Dimension	**Min**	**Max**	**Med**	**Min**	**Max**	**Med**	**Min**	**Max**	**Med**	**Min**	**Max**	**Med**	**Min**	**Max**	**Med**	**Min**	**Max**	**Med**
BF Width (ft)	USGS gage data is unavailable for this project			8.7	17	13	8	12.1	8.1	10.7	11.3	11	11.2	12.9	12.1	12.8	13.4	13.0
Floodprone Width (ft)				17	24	22	15	25	18	122	140	131	20	90	40			250
BF Cross Sectional Area (ft2)						10.4			8			14.7			10.4	9.7	11.8	11.3
BF Mean Depth (ft)				0.6	1.2	0.9	0.8	1	0.8	1.3	1.4	1.4	0.8	0.9	0.9	0.8	0.9	0.8
BF Max Depth (ft)				0.9	1.9	1.4	1.1	1.4	1.4	1.9	2	2	1.1	1.4	1.3	1.1	1.3	1.3
Width/Depth Ratio				7.3	28.3	17.4	8	15.1	10.1	8	9	9	12	16	14	15	17	16
Entrenchment Ratio				1.2	2.6	1.8	1.9	2.2	2.1	11	13	12	1.7	7.4	3.3	7	7	6.9
Bank Height Ratio				1.3	2.7	2	1	1.8	1			1.4	1	1.3	1			1
Wetted Perimeter(ft)						===			===			===			===	13.2	14.1	13.6
Hydraulic radius (ft)						===			===			===			===	0.7	0.9	0.8
Pattern																		
Channel Beltwidth (ft)				No pattern of riffles and pools due to straightening activties			20	38	22.8	17	36	29.8	36	73	48	36	73	48
Radius of Curvature (ft)							11	27	16.5	9	113	30.6	24	121	36	24	121	36
Meander Wavelength (ft)							44	116	68.4	10	91	62.9	73	145	103	73	145	103
Meander Width ratio							2.4	4.7	2.8	1.5	3.5	2.7	3	6	4	3	6	4
Profile																		
Riffle length (ft)				No pattern of riffles and pools due to straightening activties					===			===			===	15	142	59
Riffle slope (ft/ft)							1.00%	5.76%	3.16%	0.20%	1.20%	0.98%	2.15%	4.48%	2.86%	0.71%	3.22%	1.93%
Pool length (ft)									===			===			===	7	40	18
Pool spacing (ft)							25	69	37.2	2	7.4	4	36	97	48	36	97	48
Substrate																		
d50 (mm)						===			===			===			===			===
d84 (mm)						===			===			===			===			===
Additional Reach Parameters																		
Valley Length (ft)						===			===			===			===			961
Channel Length (ft)						===			===			===			===			1153
Sinuosity						NA			1.2			1.46			1.2			1.2
Water Surface Slope (ft/ft)						NA			2.58%			0.53%			1.79%			1.72%
BF slope (ft/ft)						===			===			===			===			===
Rosgen Classification						Eg5/Fc			E 4/5			E 4/5			E/C 3/4			E/C 3/4

Table 8A. Morphology and Hydraulic Monitoring Summary
Lamm UT-Main (Downstream) - Stream and Wetland Restoration Site

Parameter	XS 1 Pool (Main Down)						XS 2 Riffle (Main Down)						XS 3 Riffle (Main Down)						XS 4 Riffle (Main Down)						XS 5 Pool (Main Down)					
Dimension	**MY 0**	**MY1**	**MY2**	**MY3**	**MY5**	**MY7**	**MY 0**	**MY1**	**MY2**	**MY3**	**MY5**	**MY7**	**MY 0**	**MY1**	**MY2**	**MY3**	**MY5**	**MY7**	**MY 0**	**MY1**	**MY2**	**MY3**	**MY5**	**MY7**	**MY 0**	**MY1**	**MY2**	**MY3**	**MY5**	**MY7**
BF Width (ft)	13	12.2	12.5	11.8	11.4		12.8	14.4	12.6	13.2	14.2		13.1	*	12.9	14.3	20		13	12.7	12.1	12.6	15.1		14.1	14.8	15.7	17.2	20.3	
Floodprone Width (ft)	----	----	----	----	----		90	90	90	90	90		90	*	90	90	90		90	90	90	90	90		----	----	----	----	----	
BF Cross Sectional Area (ft2)	11.2	12.2	9.7	9.4	11.2		9.7	11.1	12.6	9.5	9.7		11.8	*	9.1	8.1	11.8		11.3	10.5	10.3	9.4	11.3		11.8	6.6	7.7	7.6	11.8	
BF Mean Depth (ft)	0.9	1.0	0.8	0.8	1.0		0.8	0.8	1.0	0.7	0.7		0.9	*	0.7	0.6	0.6		0.9	0.8	0.9	0.7	0.7		0.8	0.4	0.5	0.4	0.6	
BF Max Depth (ft)	1.7	1.5	1.6	1.4	1.7		1.1	1.1	1.2	1.2	1.1		1.3	*	1.3	1.2	1.5		1.3	1.4	1.4	1.2	1.2		1.7	0.8	0.8	0.8	1	
Width/Depth Ratio	----	----	----	----	----		16.9	18.7	12.6	18.3	20.8		14.5	*	18.3	25.2	33.9		15.0	15.4	14.2	16.9	20.2		----	----	----	----	----	
Entrenchment Ratio	----	----	----	----	----		7.0	6.3	7.1	6.8	6.3		6.9	*	7.0	6.3	4.5		6.9	7.1	7.4	7.1	6.0		----	----	----	----	----	
Low Bank Height (ft)	1.7	1.7	1.7	1.7	1.8		1.1	1.1	1.1	1.1	1.1		1.3	*	1.3	1.3	1.5		1.3	1.3	1.3	1.3	1.2		1.7	1.7	1.7	1.7	1	
Bank Height Ratio**	----	----	----	----	----		1	1	1.091	1.091	1		1	*	1	<1	1		1	1.077	1.077	<1	1		----	----	----	----	----	
Wetted Perimeter (ft)	13.6	12.7	13.2	12.3	12.2		13.2	14.7	13	13.6	14.3		13.7	*	13.4	14.7	20.4		13.6	13.2	12.8	13	15.5		15	15.1	15.9	17.3	20.5	
Hydraulic Radius (ft)	0.8	0.8	0.7	0.8	0.9		0.7	0.8	1.0	0.7	0.7		0.9	*	0.7	0.6	0.6		0.8	0.8	0.8	0.7	0.7		0.8	0.4	0.5	0.4	0.6	

Parameter	XS 6 Riffle (Main Down)						XS 7 Riffle (Main Down)						XS 8 Riffle (Main Down)						XS 9 Riffle (Main Down)						XS 10 Riffle (Main Down)					
Dimension	**MY 0**	**MY1**	**MY2**	**MY3**	**MY5**	**MY7**	**MY 0**	**MY1**	**MY2**	**MY3**	**MY5**	**MY7**	**MY 0**	**MY1**	**MY2**	**MY3**	**MY5**	**MY7**	**MY 0**	**MY1**	**MY2**	**MY3**	**MY5**	**MY7**	**MY 0**	**MY1**	**MY2**	**MY3**	**MY5**	**MY7**
BF Width (ft)	13.4	13.3	13	12.7	12.7		12.8	11.2	12.2	11.9	12.3		13.6	13.5	14	14.7	18.1		12.3	14	12.5	12.1	14.6		16.1	17.2	17.3	16.9	18	
Floodprone Width (ft)	90	90	90	90	90		90	90	90	90	90		90	90	90	90	90		90	90	90	90	90		90	90	90	90	90	
BF Cross Sectional Area (ft2)	11.3	11	13.4	12.1	11.3		8.7	8.9	9.1	8.8	8.7		11.6	8.2	7.6	6.8	11.6		9.8	9.8	8.9	7.3	9.8		12.4	11.8	12.1	10.1	12.4	
BF Mean Depth (ft)	0.8	0.8	1.0	1.0	0.9		0.7	0.8	0.7	0.7	0.7		0.9	0.6	0.5	0.5	0.6		0.8	0.7	0.7	0.6	0.7		0.8	0.7	0.7	0.6	0.7	
BF Max Depth (ft)	1.3	1.6	1.8	1.7	1.9		1.2	1.2	1.3	1.2	1.2		1.5	0.9	0.8	0.8	1		1.2	1.3	1.2	1.3	1.2		1.3	1.1	1.2	1.2	1.2	
Width/Depth Ratio	15.9	16.1	12.6	13.3	14.3		18.8	14.1	16.4	16.1	17.4		15.9	22.2	25.8	31.8	28.2		15.4	20.0	17.6	20.1	21.8		20.9	25.1	24.7	28.3	26.1	
Entrenchment Ratio	6.7	6.8	6.9	7.1	7.1		7.0	8.0	7.4	7.6	7.3		6.6	6.7	6.4	6.1	5.0		7.3	6.4	7.2	7.4	6.2		5.6	5.2	5.2	5.3	5.0	
Low Bank Height (ft)	1.3	1.3	1.3	1.3	1.4		1.2	1.2	1.2	1.2	1.2		1.5	1.5	1.5	1.5	1		1.2	1.2	1.2	1.2	1.2		1.3	1.3	1.3	1.3	1.2	
Bank Height Ratio	1	1.231	1.385	1.308	<1		1	1	1.083	1	1		1	<1	<1	<1	1		1	1.083	1	1.083	1		1	<1	<1	<1	1	
Wetted Perimeter (ft)	14.1	13.9	13.9	13.4	13.5		13.2	11.6	12.8	12.4	12.7		14.3	13.8	14.4	14.9	18.3		12.9	14.5	12.8	15.2	14.9		16.6	17.5	17.6	17.2	18.3	
Hydraulic Radius (ft)	0.8	0.8	1.0	0.9	0.8		0.7	0.8	0.7	0.7	0.7		0.8	0.6	0.5	0.5	0.6		0.8	0.7	0.7	0.5	0.7		0.7	0.7	0.7	0.6	0.7	

* Note: Cross Section 3 was not measured in MY1 due to yellow jacket nest at cross section.

**MY0-3 BHR were calculated using DMS method of "Dmax year x /Dmax year 0". MY5-7 were calculated using DMS method of area best fit.

Table 8B. Morphology and Hydraulic Monitoring Summary
Lamm UT-Main (Downstream) - Stream and Wetland Restoration Site

Parameter	MY-00 (2015)			MY-01 (2015)			MY-02 (2016)			MY-03 (2017)			MY-05 (2019)			MY-07 (2021)		
	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med
Pattern																		
Channel Beltwidth (ft)	36	73	48															
Radius of Curvature (ft)	24	121	36															
Meander Wavelength (ft)	73	145	103															
Meander Width Ratio	3	6	4															
Profile																		
Riffle Length (ft)	15	142	59															
Riffle Slope (ft/ft)	0.71%	3.22%	1.93%															
Pool Length (ft)	7	40	18															
Pool Spacing (ft)	36	97	48															
Additonal Reach Parameters																		
Valley Length (ft)	961			961			961			961			961					
Channel Length (ft)	1,153			1,153			1,153			1,153			1,153					
Sinuosity	1.2																	
Water Surface Slope (ft/ft)	0.0172																	
BF Slope (ft/ft)	------			------			------			------			------					
D50	16.2			13.6			42.1			40.8			30.6					
D84	60			67			97			99			98					
Rosgen Classification	C/E 3/4			C/E 3/4			C/E 3/4			C/E 3/4			C/E 3/4					

Table 8C. Morphology and Hydraulic Monitoring Summary
Lamm UT-Main (Downstream) - Stream and Wetland Restoration Site

Parameter	XS 11 Pool (Main Down)						XS 12 Riffle (Main Down)						XS 13 Riffle (Main Down)						XS 14 Riffle (Main Down)						XS 15 Pool (Main Down)					
Dimension	**MY 0**	**MY1**	**MY2**	**MY3**	**MY5**	**MY7**	**MY 0**	**MY1**	**MY2**	**MY3**	**MY5**	**MY7**	**MY 0**	**MY1**	**MY2**	**MY3**	**MY5**	**MY7**	**MY 0**	**MY1**	**MY2**	**MY3**	**MY5**	**MY7**	**MY 0**	**MY1**	**MY2**	**MY3**	**MY5**	**MY7**
BF Width (ft)	13.4	10.5	10.7	11	11.1		11.9	11.5	11.8	12.5	14.1		15.4	16	17	15.8	17.6		13	13.3	12.9	13	12.6		16.1	13.8	12.6	12.6	16.6	
Floodprone Width (ft)	----	----	----	----	----		90	90	90	90	90		90	90	90	90	90		90	90	90	90	90		----	----	----	----	----	
BF Cross Sectional Area (ft2)	9.8	11.3	11.2	11.6	9.8		7.2	5.1	5.2	5.5	7.2		8.6	9.2	8.4	7.2	8.6		12.9	15.6	16	14.2	12.6		12.7	10.4	10.1	9.1	12.7	
BF Mean Depth (ft)	0.7	1.1	1.0	1.1	0.9		0.6	0.4	0.4	0.4	0.5		0.6	0.6	0.5	0.5	0.5		1.0	1.2	1.2	1.1	1.0		0.8	0.8	0.8	0.7	0.8	
BF Max Depth (ft)	1.4	1.6	1.6	1.6	1.4		1	1	0.8	0.6	0.8		0.9	1.5	1.1	1.3	1.1		1.4	2.2	1.9	1.9	1.7		1.8	1.6	1.5	1.4	1.5	
Width/Depth Ratio	----	----	----	----	----		19.7	25.9	26.8	28.4	27.6		27.6	27.8	34.4	34.7	36.0		13.1	11.3	10.4	11.9	12.6		----	----	----	----	----	
Entrenchment Ratio	----	----	----	----	----		7.6	7.8	7.6	7.2	6.4		5.8	5.6	5.3	5.7	5.1		6.9	6.8	7.0	6.9	7.1		----	----	----	----	----	
Low Bank Height (ft)	1.4	1.4	1.4	1.4	1.4		1	1	1	1	0.9		0.9	0.9	0.9	0.9	1.1		1.4	1.4	1.4	1.4	1.7		1.8	1.8	1.8	1.8	1.5	
Bank Height Ratio**	----	----	----	----	----		1	1	<1	<1	1.125		1	1.667	1.222	1.444	1		1	1.571	1.357	1.357	1		----	----	----	----	----	
Wetted Perimeter (ft)	13.9	11.3	11.5	11.9	11.7		12.2	11.7	11.7	12.9	14.2		15.6	16.6	17.5	16.5	17.8		13.6	14.5	14.4	14.3	13.7		16.7	14.4	13.4	13.4	17.2	
Hydraulic Radius (ft)	0.7	1	1.0	1.0	0.8		0.6	0.4	0.4	0.4	0.5		0.6	0.6	0.5	0.4	0.5		1	1.1	1.1	1.0	0.9		0.8	0.7	0.8	0.7	0.7	

Parameter	XS 16 Riffle (Main Down)*						XS 17 Riffle (Main Down)*						XS 18 Riffle (Main Down)*						XS 19 Pool (Main Down)*					
Dimension	**MY 0**	**MY1**	**MY2**	**MY3**	**MY5**	**MY7**	**MY 0**	**MY1**	**MY2**	**MY3**	**MY5**	**MY7**	**MY 0**	**MY1**	**MY2**	**MY3**	**MY5**	**MY7**	**MY 0**	**MY1**	**MY2**	**MY3**	**MY5**	**MY7**
BF Width (ft)	16.2	16.0	16.2	16.0	16.9		14.3	14	13.9	14.4	14.6		13.2	13.1	13.3	13.5	13.1		12	12.1	11.8	11.7	12.6	
Floodprone Width (ft)	20.0	20.0	20.0	20.0	20.0		19	19	19	19	19		31	31	31	31	31		----	----	----	----	----	
BF Cross Sectional Area (ft2)	10.1	9.6	9.8	8.6	10.1		11.2	12.6	11.5	13.2	11.2		10.1	11.6	11.9	11.8	10.1		13.1	14.6	14.6	13.4	13.1	
BF Mean Depth (ft)	0.6	0.6	0.6	0.5	0.6		0.8	0.9	0.8	0.9	0.8		0.8	0.9	0.9	0.9	0.8		1.1	1.2	1.2	1.1	1.0	
BF Max Depth (ft)	0.8	0.9	1.0	0.9	0.9		1.3	1.4	1.1	1.2	1.3		1.2	1.4	1.5	1.4	1.1		1.4	1.9	1.7	1.5	1.4	
Width/Depth Ratio	26.0	26.7	26.8	29.8	28.3		18.3	15.6	16.8	15.7	19.0		17.3	14.8	14.9	15.4	17.0		----	----	----	----	----	
Entrenchment Ratio	1.2	1.3	1.2	1.3	1.2		1.3	1.4	1.4	1.3	1.3		2.3	2.4	2.3	2.3	2.4		----	----	----	----	----	
Low Bank Height (ft)	1.9	0.8	0.8	0.8	0.9		1.3	1.3	1.3	1.3	1.3		1.2	1.2	1.2	1.2	1.1		1.4	1.4	1.4	1.4	1.5	
Bank Height Ratio	2.375	1.125	1.25	1.125	1		1	1.077	<1	<1	1		1	1.167	1.25	1.167	1		----	----	----	----	----	
Wetted Perimeter (ft)	16.4	16.2	16.5	16.2	17.1		15.3	14.9	14.9	15.7	15.8		14	14.1	14.7	14.8	13.6		12.9	13	12.8	12.6	13.2	
Hydraulic Radius (ft)	0.6	0.6	0.6	0.5	0.6		0.7	0.8	0.8	0.8	0.7		0.7	0.8	0.8	0.8	0.7		1	1.1	1.1	1.1	1.0	

* Enhancement (Level II) Reach

**MY0-3 BHR were calculated using DMS method of "Dmax year x /Dmax year 0". MY5-7 were calculated using DMS method of area best fit.

Table 8D. Morphology and Hydraulic Monitoring Summary
Lamm UT-Main (Downstream) - Stream and Wetland Restoration Site

Parameter	MY-00 (2015)			MY-01 (2015)			MY-02 (2016)			MY-03 (2017)			MY-05 (2019)			MY-07 (2021)		
	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med
Pattern																		
Channel Beltwidth (ft)	36	73	48															
Radius of Curvature (ft)	24	121	36															
Meander Wavelength (ft)	73	145	103															
Meander Width Ratio	3	6	4															
Profile																		
Riffle Length (ft)	15	142	59															
Riffle Slope (ft/ft)	0.71%	3.22%	1.93%															
Pool Length (ft)	7	40	18															
Pool Spacing (ft)	36	97	48															
Additonal Reach Parameters																		
Valley Length (ft)	961			961			961			961			961					
Channel Length (ft)	1,153			1,153			1,153			1,153			1,153					
Sinuosity	1.2																	
Water Surface Slope (ft/ft)	0.0172																	
BF Slope (ft/ft)	------			------			------			------			------					
D50	16.2			13.6			42.1			40.8			30.6					
D84	60			67			97			99			98					
Rosgen Classification	C/E 3/4			C/E 3/4			C/E 3/4			C/E 3/4			C/E 3/4					

Table 8E. Morphology and Hydraulic Monitoring Summary
Lamm Main (Upstream) - Stream and Wetland Restoration Site

Parameter	XS 20 Pool (Main Up)						XS 21 Riffle (Main Up)						XS 22 Riffle (Main Up)						XS 23 Riffle (Main Up)						XS 24 Pool (Main Up)					
Dimension	**MY 0**	**MY1**	**MY2**	**MY3**	**MY5**	**MY7**	**MY 0**	**MY1**	**MY2**	**MY3**	**MY5**	**MY7**	**MY 0**	**MY1**	**MY2**	**MY3**	**MY5**	**MY7**	**MY 0**	**MY1**	**MY2**	**MY3**	**MY5**	**MY7**	**MY 0**	**MY1**	**MY2**	**MY3**	**MY5**	**MY7**
BF Width (ft)	7.1	8.1	11.8	11.7	11.6		13.3	13	12	13	16.9		12.6	13.4	13	13.3	12.6		12.3	13.3	11.9	12.8	12.7		12.8	13.1	12.1	12.9	15.4	
Floodprone Width (ft)	----	----	----	----	----		90	90	90	90	90		90	90	90	90	90		90	90	90	90	90		----	----	----	----	----	
BF Cross Sectional Area (ft2)	6.7	4.9	5.6	5.6	6.7		12.5	10	9.9	9.1	12.5		12.5	11.3	11.2	11.5	12.5		8.8	9.5	9.1	8.8	8.8		13.1	12.9	13.1	12.9	13.1	
BF Mean Depth (ft)	0.9	0.6	0.5	0.5	0.6		0.9	0.8	0.8	0.7	0.7		1.0	0.8	0.9	0.9	1.0		0.7	0.7	0.8	0.7	0.7		1.0	1.0	1.1	1.0	0.9	
BF Max Depth (ft)	1.3	1	1	1	1.1		1.4	1.5	1.6	1.6	1.5		1.4	1.9	1.9	2.2	2.3		1	1.3	1.5	1.4	1.4		1.8	1.6	1.7	1.6	1.7	
Width/Depth Ratio	----	----	----	----	----		14.2	16.9	14.5	18.6	22.8		12.7	15.9	15.1	15.4	12.7		17.2	18.6	15.6	18.6	18.3		----	----	----	----	----	
Entrenchment Ratio	----	----	----	----	----		6.8	6.9	7.5	6.9	5.3		7.1	6.7	6.9	6.8	7.1		7.3	6.8	7.6	7.0	7.1		----	----	----	----	----	
Low Bank Height (ft)	1.3	1.3	1.3	1.3	1.1		1.4	1.4	1.4	1.4	1.5		1.4	1.4	1.4	1.4	2.4		1	1	1	1	1.5		1.8	1.8	1.8	1.8	1.7	
Bank Height Ratio	----	----	----	----	----		1	1.071	1.143	1.143	1		1	1.357	1.357	1.571	1.043		1	1.3	1.5	1.4	1.071		----	----	----	----	----	
Wetted Perimeter (ft)	8.4	8.6	12.2	12.2	10.9		13.9	13.4	12.4	13.7	17.3		13.3	14.4	13.9	14.7	14.1		13	13.9	12.6	13.3	13.1		13.6	13.9	12.9	13.7	16.3	
Hydraulic Radius (ft)	0.8	0.6	0.5	0.5	0.6		0.9	0.7	0.8	0.7	0.7		0.9	0.8	0.8	0.8	0.9		0.7	0.7	0.7	0.7	0.7		1	0.9	1.0	0.9	0.8	

Parameter	XS 25 Riffle (Main Up)						XS 26 Pool (Main Up)						XS 27 Riffle (Main Up)						XS 28 Pool (Main Up)						XS 29 Riffle (Main Up)					
Dimension	**MY 0**	**MY1**	**MY2**	**MY3**	**MY5**	**MY7**	**MY 0**	**MY1**	**MY2**	**MY3**	**MY5**	**MY7**	**MY 0**	**MY1**	**MY2**	**MY3**	**MY5**	**MY7**	**MY 0**	**MY1**	**MY2**	**MY3**	**MY5**	**MY7**	**MY 0**	**MY1**	**MY2**	**MY3**	**MY5**	**MY7**
BF Width (ft)	13.0	15.4	15.2	15.2	15.8		13.3	13.4	13.9	13.5	14.6		12.0	12.8	12.3	12.4	13.3		11.4	11.0	10.3	10.4	13.2		12.8	12.7	12.5	12.3	14.2	
Floodprone Width (ft)	90.0	90.0	90.0	90.0	90.0		----	----	----	----	----		90.0	90.0	90.0	90.0	90.0		----	----	----	----	----		90.0	90.0	90.0	90.0	90.0	
BF Cross Sectional Area (ft2)	11.3	11.4	10.8	10.6	11.3		12.1	11.8	11.6	10.8	12.1		9.5	9.7	10.8	9.8	9.5		8.4	8.9	7.6	8.3	8.4		12.1	12.1	12.0	11.6	12.1	
BF Mean Depth (ft)	0.9	0.7	0.7	0.7	0.7		0.9	0.9	0.8	0.8	0.8		0.8	0.8	0.9	0.8	0.7		0.7	0.8	0.7	0.8	0.6		0.9	1.0	1.0	0.9	0.9	
BF Max Depth (ft)	1.4	1.2	1.3	1.3	1.3		1.8	1.6	1.7	1.6	1.6		1.2	1.2	1.4	1.2	1.2		1.3	1.5	1.4	1.4	1.3		1.4	1.5	1.4	1.4	1.4	
Width/Depth Ratio	15.0	20.8	21.4	21.8	22.1		----	----	----	----	----		15.2	16.9	14.0	15.7	18.6		----	----	----	----	----		13.5	13.3	13.0	13.0	16.7	
Entrenchment Ratio	6.9	5.8	5.9	5.9	5.7		----	----	----	----	----		7.5	7.0	7.3	7.3	6.8		----	----	----	----	----		7.0	7.1	7.2	7.3	6.3	
Low Bank Height (ft)	1.4	1.4	1.4	1.4	1.3		1.8	1.8	1.8	1.8	1.6		1.2	1.2	1.2	1.2	1.3		1.3	1.3	1.3	1.3	1.3		1.4	1.4	1.4	1.4	1.4	
Bank Height Ratio**	1	<1	<1	<1	1		1	<1	<1	<1	1		1	1	1.167	1	1.083		----	----	----	----	----		1	1.071	1	1	1	
Wetted Perimeter (ft)	13.5	15.8	15.7	15.6	16.1		14.0	14.0	14.4	14.0	15.0		12.4	13.1	12.8	12.8	13.5		11.8	11.7	10.9	11.0	13.8		13.5	13.4	13.3	12.9	14.7	
Hydraulic Radius (ft)	0.8	0.7	0.7	0.7	0.7		0.9	0.8	0.8	0.8	0.8		0.8	0.7	0.8	0.8	0.7		0.7	0.8	0.7	0.8	0.6		0.9	0.9	0.9	0.9	0.8	

Parameter	XS 30 Pool (Main Up)						XS 31 Riffle (Main Up)						XS 32 Riffle (Main Up)					
Dimension	**MY 0**	**MY1**	**MY2**	**MY3**	**MY5**	**MY7**	**MY 0**	**MY1**	**MY2**	**MY3**	**MY5**	**MY7**	**MY 0**	**MY1**	**MY2**	**MY3**	**MY5**	**MY7**
BF Width (ft)	12.3	12.6	11.7	12.4	15.7		11.6	11.4	11.6	11.7	12.2		12.7	13.2	13.9	14.1	14.1	
Floodprone Width (ft)	----	----	----	----	----		90	90	90	90	90		25	25	25	25	25	
BF Cross Sectional Area (ft2)	11.5	11	10	11.1	11.5		8.6	8.3	8.1	8.6	8.6		9	8.7	8.8	8.2	9	
BF Mean Depth (ft)	0.9	0.9	0.9	0.9	0.7		0.7	0.7	0.7	0.7	0.7		0.7	0.7	0.6	0.6	0.6	
BF Max Depth (ft)	1.7	1.8	1.7	1.8	1.7		1	1.2	1.2	1.2	1.2		1	0.9	1	0.8	0.8	
Width/Depth Ratio	----	----	----	----	----		15.6	15.7	16.6	15.9	17.3		17.9	20.0	22.0	24.2	22.1	
Entrenchment Ratio	----	----	----	----	----		7.8	7.9	7.8	7.7	7.4		2.0	1.9	1.8	1.8	1.8	
Low Bank Height (ft)	1.7	1.7	1.7	1.7	1.7		1	1	1	1	1.4		1	1	1	1	1	
Bank Height Ratio	----	----	----	----	----		1	1.2	1.2	1.2	1.167		1	<1	1	<1	1.25	
Wetted Perimeter (ft)	12.9	13.2	12.5	13	16.2		12	11.9	12.3	12.1	12.5		13	13.6	14.2	14.3	14.4	
Hydraulic Radius (ft)	0.9	0.8	0.8	0.9	0.7		0.7	0.7	0.7	0.7	0.7		0.7	0.6	0.6	0.6	0.6	

**MY0-3 BHR were calculated using DMS method of "Dmax year x /Dmax year 0". MY5-7 were calculated using DMS method of area best fit.

Table 8F. Morphology and Hydraulic Monitoring Summary
Lamm Main (Upstream) - Stream and Wetland Restoration Site

Parameter	MY-00 (2015)			MY-01 (2015)			MY-02 (2016)			MY-03 (2017)			MY-05 (2019)			MY-07 (2021)		
	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med
Pattern																		
Channel Beltwidth (ft)	36	73	48															
Radius of Curvature (ft)	24	121	36															
Meander Wavelength (ft)	73	145	103															
Meander Width Ratio	3	6	4															
Profile																		
Riffle Length (ft)	10	66	26															
Riffle Slope (ft/ft)	0.00%	3.87%	1.86%															
Pool Length (ft)	5	34	12															
Pool Spacing (ft)	36	97	48															
Additonal Reach Parameters																		
Valley Length (ft)	949			949			949			949			949					
Channel Length (ft)	1,139			1,139			1,139			1,139			1,139					
Sinuosity	1.2																	
Water Surface Slope (ft/ft)	0.0157																	
BF Slope (ft/ft)	------			------			------			------			------					
D50	16.2			13.6			42.1			40.8			30.6					
D84	60			67			97			99			98					
Rosgen Classification	C/E 3/4			C/E 3/4			C/E 3/4			C/E 3/4			C/E 3/4					

Table 8G. Morphology and Hydraulic Monitoring Summary
Lamm UT-1 - Stream and Wetland Restoration Site

Parameter	XS 1 Pool (UT 1)						XS 2 Riffle (UT 1)						XS 3 Riffle (UT 1)						XS 4 Pool* (UT 1)						XS 5 Riffle (UT 1)					
Dimension	**MY 0**	**MY1**	**MY2**	**MY3**	**MY5**	**MY7**	**MY 0**	**MY1**	**MY2**	**MY3**	**MY5**	**MY7**	**MY 0**	**MY1**	**MY2**	**MY3**	**MY5**	**MY7**	**MY 0**	**MY1**	**MY2**	**MY3**	**MY5**	**MY7**	**MY 0**	**MY1**	**MY2**	**MY3**	**MY5**	**MY7**
BF Width (ft)	8.1	8.2	8	8.3	9.5		8	7.9	8	8.2	8.2		9.1	8.7	8.8	8.4	8.8		6	7.9	7	8.8	7.1		8.7	8.4	9	7.9	9.6	
Floodprone Width (ft)	----	----	----	----	----		50	50	50	50	50		50	50	50	50	50		----	----	----	----	----		50	50	50	50	50	
BF Cross Sectional Area (ft2)	6.4	5.4	5.4	4.5	6.4		5	4.5	4.3	4.6	5		6.7	6.5	6.5	6.4	6.7		3.6	3.6	3.5	4.1	3.6		4	4	3.7	3.5	4	
BF Mean Depth (ft)	0.8	0.7	0.7	0.5	0.7		0.6	0.6	0.5	0.6	0.6		0.7	0.7	0.7	0.8	0.8		0.6	0.5	0.5	0.5	0.5		0.5	0.5	0.4	0.4	0.4	
BF Max Depth (ft)	1.3	1.2	1.1	1.1	1.2		1	0.9	1	1	1.1		1.2	1.3	1.6	2	1.3		0.9	0.9	0.9	0.9	0.9		0.9	0.9	0.9	0.8	0.8	
Width/Depth Ratio	----	----	----	----	----		12.8	13.9	14.9	14.6	13.4		12.4	11.6	11.9	11.0	11.6		----	----	----	----	----		18.9	17.6	21.9	17.8	23.0	
Entrenchment Ratio	----	----	----	----	----		6.3	6.3	6.3	6.1	6.1		5.5	5.7	5.7	6.0	5.7		----	----	----	----	----		5.7	6.0	5.6	6.3	5.2	
Low Bank Height (ft)	1.3	1.3	1.3	1.3	1.3		1	1	1	1	1.4		1.2	1.2	1.2	1.2	1.3		0.9	0.9	0.9	0.9	0.9		0.9	0.9	0.9	0.9	1.1	
Bank Height Ratio**	----	----	----	----	----		1	<1	1	1	1.273		1	1.083	1.333	1.667	1		----	----	----	----	----		1	1	1	<1	1.375	
Wetted Perimeter (ft)	8.6	8.7	8.4	8.8	9.9		8.4	8.3	8.4	8.5	8.6		9.6	9.4	10.2	10.2	9.4		6.3	8.3	7.6	9.1	7.4		9	8.7	9.4	8.1	9.8	
Hydraulic Radius (ft)	0.7	0.6	0.6	0.5	0.6		0.6	0.5	0.5	0.5	0.6		0.7	0.7	0.6	0.6	0.7		0.6	0.4	0.5	0.5	0.5		0.4	0.5	0.4	0.4	0.4	

Parameter	XS 6 Riffle (UT 1)						XS 1 Riffle (UT 1-a)						XS 2 Riffle (UT 1-a)					
Dimension	**MY 0**	**MY1**	**MY2**	**MY3**	**MY5**	**MY7**	**MY 0**	**MY1**	**MY2**	**MY3**	**MY5**	**MY7**	**MY 0**	**MY1**	**MY2**	**MY3**	**MY5**	**MY7**
BF Width (ft)	8.6	8.9	8.3	8.3	8.7		7.4	8	6.8	7.7	6.6		7.8	8.4	8	7.9	7.8	
Floodprone Width (ft)	17	18	17	17	17		50	50	50	14	14		50	50	50	50	50	
BF Cross Sectional Area (ft2)	4	3.8	4.2	3.9	4		2.5	2.7	1.9	2.1	2.5		3.4	3.7	3	3.5	3.4	
BF Mean Depth (ft)	0.5	0.4	0.5	0.5	0.5		0.3	0.3	0.3	0.3	0.4		0.4	0.4	0.4	0.4	0.4	
BF Max Depth (ft)	0.7	0.8	0.9	0.9	0.8		0.5	0.7	0.7	0.6	0.8		0.6	0.8	0.6	0.8	0.7	
Width/Depth Ratio	18.5	20.8	16.4	17.7	18.9		21.3	23.7	24.3	28.2	17.4		17.6	19.1	21.3	17.8	17.9	
Entrenchment Ratio	2.0	2.0	2.0	2.0	2.0		6.8	6.3	7.4	1.8	2.1		6.4	6.0	6.3	6.3	6.4	
Low Bank Height (ft)	0.7	0.7	0.7	0.7	0.9		0.5	0.5	0.5	0.5	0.8		0.6	0.6	0.6	0.6	0.8	
Bank Height Ratio**	1	1.143	1.286	1.286	1.125		1	1.4	1.4	1.2	1		1	1.333	1	1.333	1.143	
Wetted Perimeter (ft)	8.9	9.2	8.9	9	8.9		7.5	8.2	7.2	7.9	6.8		8	8.6	8.1	8.1	8	
Hydraulic Radius (ft)	0.4	0.4	0.5	0.4	0.4		0.3	0.3	0.3	0.3	0.4		0.4	0.4	0.4	0.4	0.4	

*XS-4 (UT-1) was determined to be a pool. It was mislabeled as a riffle during previous monitoring years.

**MY0-3 BHR were calculated using DMS method of "Dmax year x /Dmax year 0". MY5-7 were calculated using DMS method of area best fit.

Table 8H. Morphology and Hydraulic Monitoring Summary
Lamm UT-1 - Stream and Wetland Restoration Site

Parameter	MY-00 (2015)			MY-01 (2015)			MY-02 (2016)			MY-03 (2017)			MY-05 (2019)			MY-07 (2021)		
	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med
Pattern																		
Channel Beltwidth (ft)	21	42	28															
Radius of Curvature (ft)	14	70	21															
Meander Wavelength (ft)	42	84	60															
Meander Width Ratio	3	6	4															
Profile																		
Riffle Length (ft)	5	44	15															
Riffle Slope (ft/ft)	1.10%	9.83%	2.98%															
Pool Length (ft)	5	12	8															
Pool Spacing (ft)	21	56	28															
Additonal Reach Parameters																		
Valley Length (ft)	466			466			466			466			466					
Channel Length (ft)	559			559			559			559			559					
Sinuosity	1.2																	
Water Surface Slope (ft/ft)	0.0256																	
BF Slope (ft/ft)	------			------			------			------			------					
D50	15.2			13.4			11			13.3			7.5					
D84	67			58			73			77			46					
Rosgen Classification	C/E 3/4			C/E 3/4			C/E 3/4			C/E 3/4			C/E 3/4					

Table 8I. Morphology and Hydraulic Monitoring Summary
Lamm UT-2 - Stream and Wetland Restoration Site

Parameter	XS 1 Riffle (UT 2)						XS 2 Riffle (UT 2)						XS 3 Pool (UT 2)						XS 4 Riffle (UT 2)						XS 5 Riffle (UT 2)					
Dimension	**MY 0**	**MY1**	**MY2**	**MY3**	**MY5**	**MY7**	**MY 0**	**MY1**	**MY2**	**MY3**	**MY5**	**MY7**	**MY 0**	**MY1**	**MY2**	**MY3**	**MY5**	**MY7**	**MY 0**	**MY1**	**MY2**	**MY3**	**MY5**	**MY7**	**MY 0**	**MY1**	**MY2**	**MY3**	**MY5**	**MY7**
BF Width (ft)	7.4	7.8	7.3	7.7	6.8		7.6	6.5	6.5	7.0	6.6		7.5	7.3	7.2	7.5	7.7		7.6	8.6	8.1	8.8	9.7		9.7	7.8	7.9	7.3	7.6	
Floodprone Width (ft)	50.0	50.0	50.0	50.0	50.0		50.0	50.0	50.0	50.0	50.0		----	----	----	----	----		50.0	50.0	50.0	50.0	50.0		50.0	50.0	50.0	50.0	50.0	
BF Cross Sectional Area (ft2)	3.2	3.8	3.4	3.1	3.2		2.7	2.6	2.0	2.9	2.7		7.2	6.3	5.9	6.1	7.2		3.6	3.4	3.4	3.4	3.6		5.5	5.6	5.6	5.6	5.5	
BF Mean Depth (ft)	0.4	0.5	0.5	0.4	0.5		0.4	0.4	0.3	0.4	0.4		1.0	0.9	0.8	0.8	0.9		0.5	0.4	0.4	0.4	0.4		0.6	0.7	0.7	0.8	0.7	
BF Max Depth (ft)	0.7	0.9	0.8	0.8	0.8		0.5	0.7	0.6	0.6	0.6		1.4	1.3	1.3	1.3	1.5		0.7	0.8	0.7	0.7	0.8		1.0	1.4	1.5	1.3	1.2	
Width/Depth Ratio	17.1	16.0	15.7	19.1	14.5		21.4	16.3	21.1	16.9	16.1		----	----	----	----	----		16.0	21.8	19.3	22.8	26.1		17.1	10.9	11.1	9.5	10.5	
Entrenchment Ratio	6.8	6.4	6.8	6.5	7.4		6.6	7.7	7.7	7.1	7.6		----	----	----	----	----		6.6	5.8	6.2	5.7	5.2		5.2	6.4	6.3	6.8	6.6	
Low Bank Height (ft)	0.7	0.7	0.7	0.7	0.9		0.5	0.5	0.5	0.5	0.8		1.4	1.4	1.4	1.4	1.7		0.7	0.7	0.7	0.7	0.8		1	1	1	1	1.4	
Bank Height Ratio**	1	1.286	1.143	1.143	1.125		1	1.4	1.2	1.2	1.333		----	----	----	----	----		1	1.143	1	1	1		1	1.4	1.5	1.3	1.167	
Wetted Perimeter (ft)	7.6	8.1	7.6	7.9	7.1		7.7	6.9	7.3	7.2	6.8		8.3	8.1	8.0	8.3	8.4		7.9	8.9	8.4	9.0	9.9		10.1	8.4	9.5	8.2	8.2	
Hydraulic Radius (ft)	0.4	0.5	0.4	0.4	0.5		0.3	0.4	0.3	0.4	0.4		0.9	0.8	0.7	0.7	0.9		0.4	0.4	0.4	0.4	0.4		0.5	0.7	0.6	0.7	0.7	

Parameter	XS 6 Riffle (UT 2)					
Dimension	**MY 0**	**MY1**	**MY2**	**MY3**	**MY5**	**MY7**
BF Width (ft)	5.9	5.9	6.3	5.3	5.9	
Floodprone Width (ft)	50	50	50	50	50	
BF Cross Sectional Area (ft2)	2.3	2.7	2.2	2	2.3	
BF Mean Depth (ft)	0.4	0.5	0.3	0.4	0.4	
BF Max Depth (ft)	0.6	0.8	0.6	0.7	0.7	
Width/Depth Ratio	15.1	12.9	18.0	14.0	15.1	
Entrenchment Ratio	8.5	8.5	7.9	9.4	8.5	
Low Bank Height (ft)	0.6	0.6	0.6	0.6	0.7	
Bank Height Ratio**	1	1.333	1	1.167	1	
Wetted Perimeter (ft)	6.1	6.3	6.7	5.5	6	
Hydraulic Radius (ft)	0.4	0.4	0.3	0.4	0.4	

**MY0-3 BHR were calculated using DMS method of "Dmax year x /Dmax year 0". MY5-7 were calculated using DMS method of area best fit.

Table 8J. Morphology and Hydraulic Monitoring Summary
Lamm UT-2 - Stream and Wetland Restoration Site

Parameter	MY-00 (2015)			MY-01 (2015)			MY-02 (2016)			MY-03 (2017)			MY-05 (2019)			MY-07 (2021)		
	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med
Pattern																		
Channel Beltwidth (ft)	21	42	28															
Radius of Curvature (ft)	14	70	21															
Meander Wavelength (ft)	42	84	60															
Meander Width Ratio	3	6	4															
Profile																		
Riffle Length (ft)	5	26	12															
Riffle Slope (ft/ft)	0.84%	4.64%	2.94%															
Pool Length (ft)	4	14	8															
Pool Spacing (ft)	21	56	28															
Additonal Reach Parameters																		
Valley Length (ft)	387			387			387			387			387					
Channel Length (ft)	464			464			464			464			464					
Sinuosity	1.2																	
Water Surface Slope (ft/ft)	0.0301																	
BF Slope (ft/ft)	------			------			------			------			------					
D50	16.3			16			45.6			43.9			37.9					
D84	110			93			109			103			104					
Rosgen Classification	C/E 3/4			C/E 3/4			C/E 3/4			C/E 3/4			C/E 3/4					

Table 8K. Morphology and Hydraulic Monitoring Summary
Lamm UT-3 - Stream and Wetland Restoration Site

Parameter	XS 1 Riffle (UT 3)						XS 2 Pool (UT 3)						XS 3 Riffle (UT 3)						XS 4 Pool (UT 3)						XS 5 Riffle (UT 3)					
Dimension	**MY 0**	**MY1**	**MY2**	**MY3**	**MY5**	**MY7**	**MY 0**	**MY1**	**MY2**	**MY3**	**MY5**	**MY7**	**MY 0**	**MY1**	**MY2**	**MY3**	**MY5**	**MY7**	**MY 0**	**MY1**	**MY2**	**MY3**	**MY5**	**MY7**	**MY 0**	**MY1**	**MY2**	**MY3**	**MY5**	**MY7**
BF Width (ft)	7.3	7.1	7.2	7.2	6.3		9.7	11.6	10.7	10.2	14.4		7.6	7.6	7.1	6.5	7.2		10.4	11.2	10.8	11.1	13.6		6.9	6.0	6.0	5.8	5.3	
Floodprone Width (ft)	50.0	50.0	50.0	50.0	50.0		----	----	----	----	----		50.0	50.0	50.0	50.0	50.0		----	----	----	----	----		50.0	50.0	50.0	50.0	50.0	
BF Cross Sectional Area (ft2)	2.4	2.4	2.6	2.6	2.4		5.9	5.6	5.5	4.8	5.9		2.5	2.9	2.6	2.0	2.5		7.5	7.1	6.6	6.2	7.5		3.1	4.2	4.1	4.0	3.1	
BF Mean Depth (ft)	0.3	0.3	0.4	0.4	0.4		0.6	0.5	0.5	0.5	0.4		0.3	0.4	0.4	0.3	0.3		0.7	0.6	0.6	0.6	0.6		0.4	0.7	0.7	0.7	0.6	
BF Max Depth (ft)	0.5	0.7	0.7	0.5	0.7		1.0	1.0	1.1	0.9	0.9		0.5	0.8	0.7	0.6	0.7		1.2	1.3	1.4	1.4	1.5		0.8	1.2	1.2	1.1	0.9	
Width/Depth Ratio	22.2	21.0	19.9	19.9	16.5		----	----	----	----	----		23.1	19.9	19.4	21.1	20.7		----	----	----	----	----		15.4	8.6	8.8	8.4	9.1	
Entrenchment Ratio	6.8	7.0	6.9	6.9	7.9		----	----	----	----	----		6.6	6.6	7.0	7.7	6.9		----	----	----	----	----		7.2	8.3	8.3	8.6	9.4	
Low Bank Height (ft)	0.5	0.5	0.5	0.5	0.8		1	1	1	1	0.9		0.5	0.5	0.5	0.5	0.7		1.2	1.2	1.2	1.2	1.5		0.8	0.8	0.8	0.8	1	
Bank Height Ratio**	1	1.4	1.4	1	1.143		----	----	----	----	----		1	1.6	1.4	1.2	1		----	----	----	----	----		1	1.5	1.5	1.375	1.111	
Wetted Perimeter (ft)	7.4	7.3	7.4	7.5	6.5		10.0	11.9	11.2	10.5	14.7		7.7	7.8	7.6	7.4	7.5		10.8	12.1	11.6	11.8	14.3		7.1	6.9	7.6	6.8	5.7	
Hydraulic Radius (ft)	0.3	0.3	0.4	0.3	0.4		0.6	0.5	0.5	0.5	0.4		0.3	0.4	0.3	0.3	0.3		0.7	0.6	0.6	0.5	0.5		0.4	0.6	0.5	0.6	0.5	

Parameter	XS 6 Riffle (UT 3)						XS 7 Pool (UT 3)						XS 8 Riffle (UT 3)						XS 9 Riffle (UT 3)						XS 10 Pool (UT 3)					
Dimension	**MY 0**	**MY1**	**MY2**	**MY3**	**MY5**	**MY7**	**MY 0**	**MY1**	**MY2**	**MY3**	**MY5**	**MY7**	**MY 0**	**MY1**	**MY2**	**MY3**	**MY5**	**MY7**	**MY 0**	**MY1**	**MY2**	**MY3**	**MY5**	**MY7**	**MY 0**	**MY1**	**MY2**	**MY3**	**MY5**	**MY7**
BF Width (ft)	6.9	6.8	6.3	6.6	7.7		6.8	6.7	7.0	6.9	6.1		6.3	6.0	5.9	7.0	5.8		7.9	7.3	7.0	4.1	5.6		7.8	8.4	6.8	5.7	9.2	
Floodprone Width (ft)	50.0	50.0	50.0	50.0	50.0		----	----	----	----	----		50.0	50.0	50.0	50.0	50.0		50.0	50.0	50.0	50.0	50.0		----	----	----	----	----	
BF Cross Sectional Area (ft2)	2.8	3.0	2.6	2.3	2.8		7.1	8.7	8.9	9.9	7.1		2.0	2.3	2.3	2.5	2.0		2.5	2.6	3.1	1.8	2.5		5.0	3.7	3.3	3.4	5.0	
BF Mean Depth (ft)	0.4	0.4	0.4	0.3	0.4		1.0	1.3	1.3	1.4	1.2		0.3	0.4	0.4	0.4	0.3		0.3	0.4	0.4	0.4	0.4		0.6	0.4	0.5	0.6	0.5	
BF Max Depth (ft)	0.6	0.8	0.7	0.5	0.6		1.7	2.1	2.4	2.3	1.8		0.4	0.6	0.7	0.6	0.5		0.5	0.7	0.9	0.8	0.6		1.0	0.9	0.9	1.0	1.1	
Width/Depth Ratio	17.0	15.4	15.3	18.9	21.2		----	----	----	----	----		19.8	15.7	15.1	19.6	16.8		25.0	20.5	15.8	9.3	12.5		----	----	----	----	----	
Entrenchment Ratio	7.2	7.4	7.9	7.6	6.5		----	----	----	----	----		7.9	8.3	8.5	7.1	8.6		6.3	6.8	7.1	12.2	8.9		----	----	----	----	----	
Low Bank Height (ft)	0.6	0.6	0.6	0.6	0.6		1.7	1.7	1.7	1.7	2.3		0.4	0.4	0.4	0.4	0.7		0.5	0.5	0.5	0.5	0.8		1	1	1	1	1.2	
Bank Height Ratio**	1	1.333	1.167	<1	1		----	----	----	----	----		1	1.5	1.75	1.5	1.4		1	1.4	1.8	1.6	1.333		----	----	----	----	----	
Wetted Perimeter (ft)	7.2	7.1	6.7	6.8	7.9		7.8	8.4	9.4	8.8	7.4		6.4	6.2	6.5	7.4	6.0		8.1	7.5	7.6	4.4	5.9		8.3	8.7	7.2	6.2	9.8	
Hydraulic Radius (ft)	0.4	0.4	0.4	0.3	0.4		0.9	1.0	0.9	1.1	1.0		0.3	0.4	0.4	0.3	0.3		0.3	0.3	0.4	0.4	0.4		0.6	0.4	0.5	0.5	0.5	

Parameter	XS 11 Riffle (UT 3)						XS 12 Riffle (UT 3)						XS 13 Pool (UT 3)						XS 14 Riffle (UT 3)					
Dimension	**MY 0**	**MY1**	**MY2**	**MY3**	**MY5**	**MY7**	**MY 0**	**MY1**	**MY2**	**MY3**	**MY5**	**MY7**	**MY 0**	**MY1**	**MY2**	**MY3**	**MY5**	**MY7**	**MY 0**	**MY1**	**MY2**	**MY3**	**MY5**	**MY7**
BF Width (ft)	6.3	7.2	7.0	4.6	5.4		7.9	6.6	6.7	4.2	6.4		7.0	5.5	5.4	5.1	6.0		8.6	8.7	8.0	8.3	9.2	
Floodprone Width (ft)	50.0	50.0	50.0	50.0	50.0		50.0	50.0	50.0	50.0	50.0		----	----	----	----	----		50.0	50.0	50.0	50.0	50.0	
BF Cross Sectional Area (ft2)	2.5	3.8	3.7	2.3	2.5		2.6	3.0	2.9	2.7	2.6		4.1	3.4	2.9	2.6	4.1		2.8	3.4	3.4	3.0	2.8	
BF Mean Depth (ft)	0.4	0.5	0.5	0.5	0.5		0.3	0.5	0.4	0.6	0.4		0.6	0.6	0.5	0.5	0.7		0.3	0.4	0.4	0.4	0.3	
BF Max Depth (ft)	0.6	1.2	1.1	0.9	0.8		0.6	0.9	1.1	1.2	0.8		1.2	0.9	0.8	0.8	1.1		0.7	0.9	0.9	0.8	0.9	
Width/Depth Ratio	15.9	13.6	13.2	9.2	11.7		24.0	14.5	15.5	6.5	15.8		----	----	----	----	----		26.4	22.3	18.8	23.0	30.2	
Entrenchment Ratio	7.9	6.9	7.1	10.9	9.3		6.3	7.6	7.5	11.9	7.8		----	----	----	----	----		5.8	5.7	6.3	6.0	5.4	
Low Bank Height (ft)	0.6	0.6	0.6	0.6	0.9		0.6	0.6	0.6	0.6	0.9		1.2	1.2	1.2	1.2	1.1		0.7	0.7	0.7	0.7	1	
Bank Height Ratio**	1	2	1.833	1.5	1.125		1	1.5	1.833	2	1.125		----	----	----	----	----		1	1.286	1.286	1.143	1.111	
Wetted Perimeter (ft)	6.5	7.7	7.7	5.2	5.8		8.1	6.9	7.6	5.1	6.6		8.2	5.9	5.8	5.7	6.6		8.8	9.3	8.3	8.5	9.7	
Hydraulic Radius (ft)	0.4	0.5	0.5	0.4	0.4		0.3	0.4	0.4	0.5	0.4		0.5	0.6	0.5	0.5	0.6		0.3	0.4	0.4	0.4	0.3	

**MY0-3 BHR were calculated using DMS method of "Dmax year x /Dmax year 0". MY5-7 were calculated using DMS method of area best fit.

Table 8L. Morphology and Hydraulic Monitoring Summary
Lamm UT-3 - Stream and Wetland Restoration Site

Parameter	MY-00 (2015)			MY-01 (2015)			MY-02 (2016)			MY-03 (2017)			MY-05 (2019)			MY-07 (2021)		
	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med
Pattern																		
Channel Beltwidth (ft)	21	42	28															
Radius of Curvature (ft)	14	70	21															
Meander Wavelength (ft)	42	84	60															
Meander Width Ratio	3	6	4															
Profile																		
Riffle Length (ft)	6	66	21															
Riffle Slope (ft/ft)	0.82%	6.50%	3.13%															
Pool Length (ft)	4	14	8															
Pool Spacing (ft)	21	56	28															
Additonal Reach Parameters																		
Valley Length (ft)	846			846			846			846			846					
Channel Length (ft)	1,015			1,015			1,015			1,015			1,015					
Sinuosity	1.2																	
Water Surface Slope (ft/ft)	0.0319																	
BF Slope (ft/ft)	------			------			------			------								
D50	8.7			17.4			6.9			12.2			12.8					
D84	87			95			29			54			60					
Rosgen Classification	C/E 3/4			C/E 3/4			C/E 3/4			C/E 3/4			C/E 3/4					

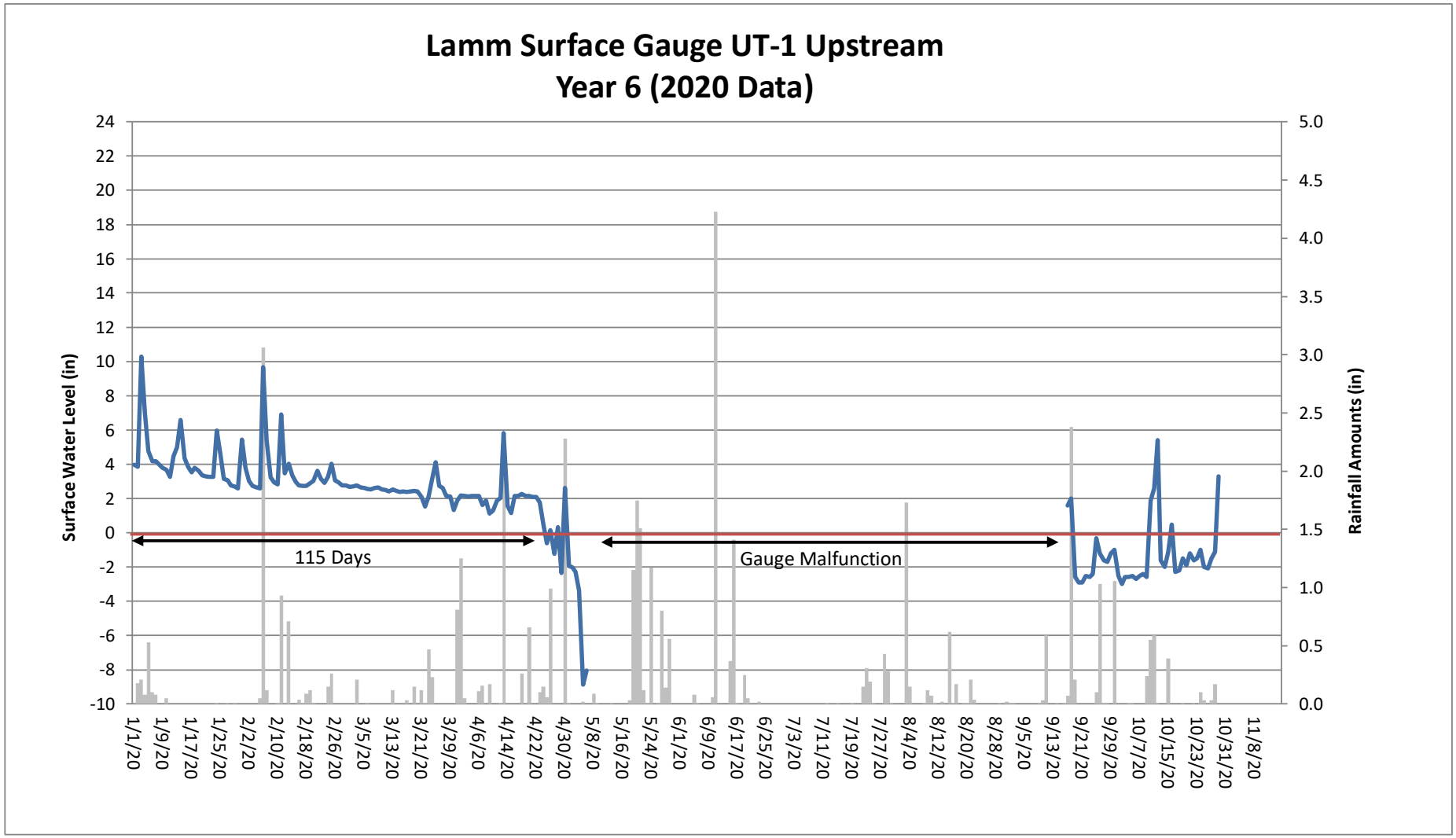
APPENDIX D: HYDROLOGY DATA

Tables 9A-B. UT1 and UT3 Channel Evidence
Stream Gauge Graphs
Table 10. Verification of Bankfull Events
Table 11. Groundwater Hydrology Data
Groundwater Gauge Graphs

Table 9A. UT1 Channel Evidence

UT3 Channel Evidence	Year 1 (2015)	Year 2 (2016)	Year 3 (2017)	Year 4 (2018)	Year 5 (2019)	Year 6 (2020)
Max consecutive days channel flow	64	101	118	119	247	184
Presence of litter and debris (wracking)	Yes	Yes	Yes	Yes	Yes	Yes
Leaf litter disturbed or washed away	Yes	Yes	Yes	Yes	Yes	Yes
Matted, bent, or absence of vegetation (herbaceous or otherwise)	Yes	Yes	Yes	Yes	Yes	Yes
Sediment deposition and/or scour indicating sediment transport	Yes	Yes	Yes	Yes	Yes	Yes
Water staining due to continual presence of water	Yes	Yes	Yes	Yes	Yes	Yes
Formation of channel bed and banks	Yes	Yes	Yes	Yes	Yes	Yes
Sediment sorting within the primary path of flow	Yes	Yes	Yes	Yes	Yes	Yes
Sediment shelving or a natural line impressed on the banks	Yes	Yes	Yes	Yes	Yes	Yes
Change in plant community (absence or destruction of terrestrial vegetation and/or transition to species adapted for flow or inundation for a long duration, including hydrophytes)	Yes	Yes	Yes	Yes	Yes	Yes
Development of channel pattern (meander bends and/or channel braiding) at natural topographic breaks, woody debris piles, or plant root systems	Yes	Yes	Yes	Yes	Yes	Yes
Exposure of woody plant roots within the primary path of flow	No	No	No	No	No	No
Other:						

UT-1 channel formation at the stream gauge


Lamm Surface Gauge UT-1 Upstream
Year 6 (2020 Data)
Surface Water Level (in)
Rainfall Amounts (in)
24
22
20
18
16
14
12
10
8
6
4
2
0
-2
-4
-6
-8
-10
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
115 Days
Gauge Malfunction
1/1/20
1/9/20
1/17/20
1/25/20
2/2/20
2/10/20
2/18/20
2/26/20
3/5/20
3/13/20
3/21/20
3/29/20
4/6/20
4/14/20
4/22/20
4/30/20
5/8/20
5/16/20
5/24/20
6/1/20
6/9/20
6/17/20
6/25/20
7/3/20
7/11/20
7/19/20
7/27/20
8/4/20
8/12/20
8/20/20
8/28/20
9/5/20
9/13/20
9/21/20
9/29/20
10/7/20
10/15/20
10/23/20
10/31/20
11/8/20

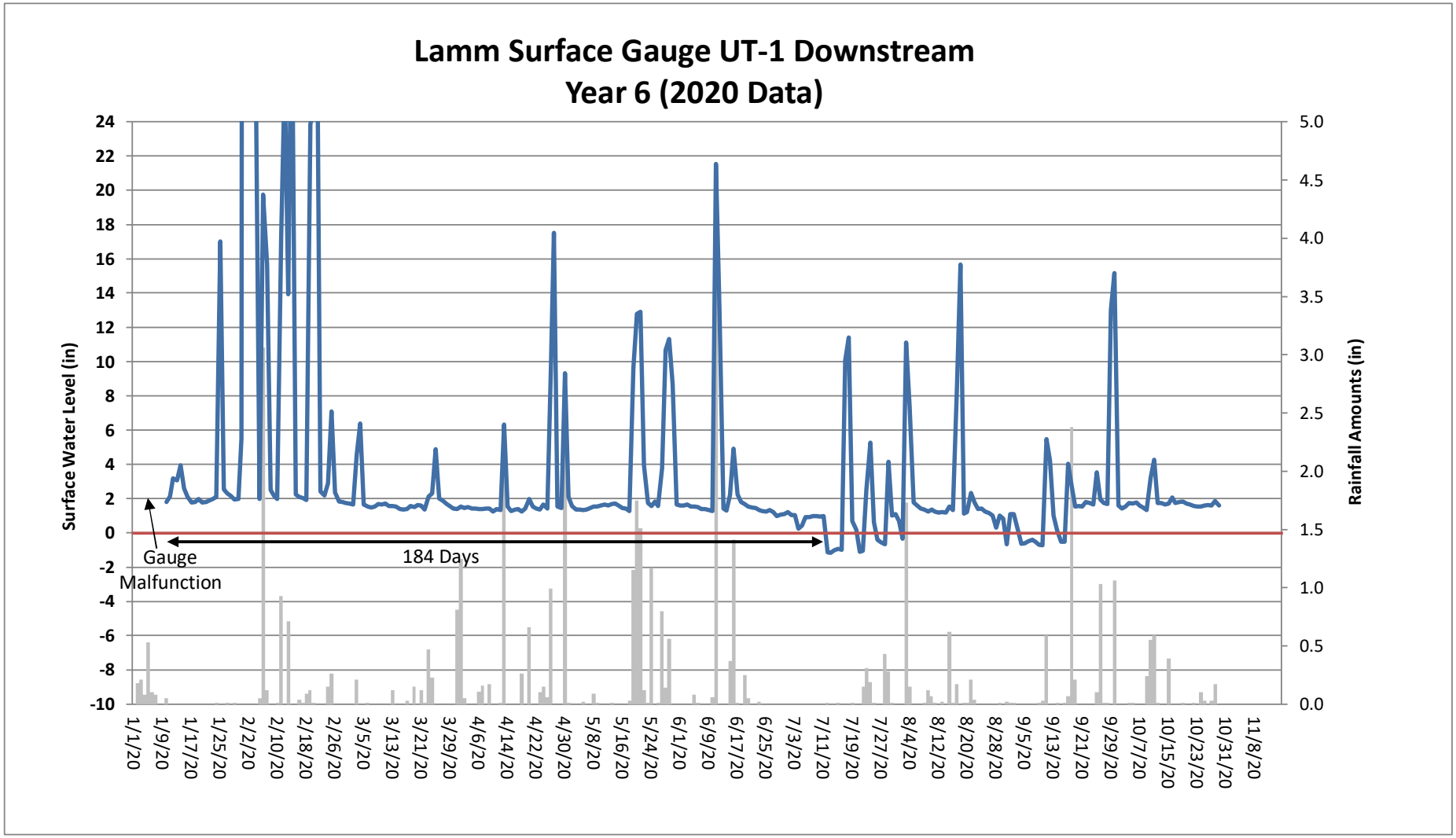
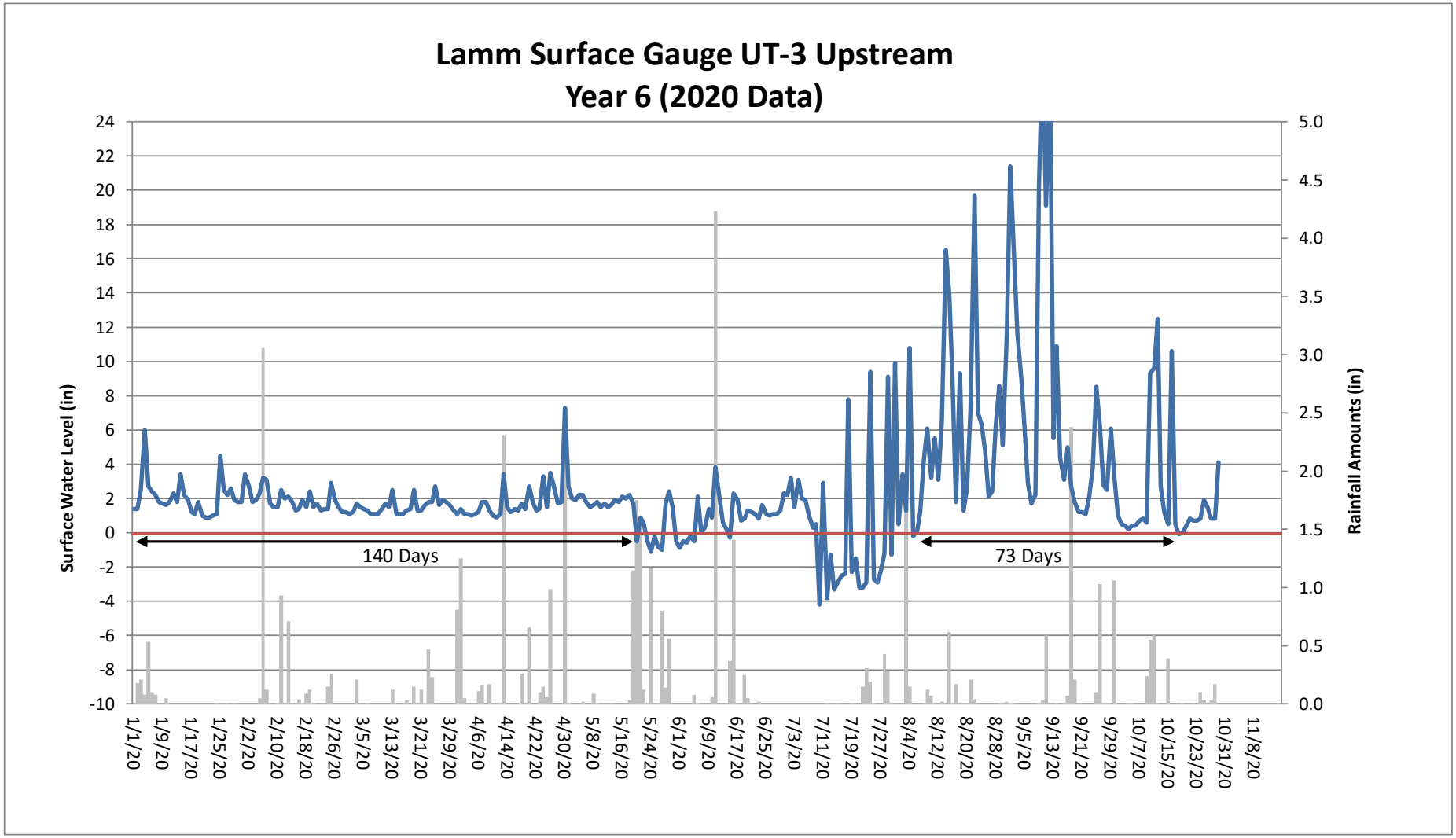

Lamm Surface Gauge UT-1 Downstream
Year 6 (2020 Data)
Surface Water Level (in)
Rainfall Amounts (in)
24
22
20
18
16
14
12
10
8
6
4
2
0
-2
-4
-6
-8
-10
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
Gauge Malfunction
184 Days
1/1/20
1/9/20
1/17/20
1/25/20
2/2/20
2/10/20
2/18/20
2/26/20
3/5/20
3/13/20
3/21/20
3/29/20
4/6/20
4/14/20
4/22/20
4/30/20
5/8/20
5/16/20
5/24/20
6/1/20
6/9/20
6/17/20
6/25/20
7/3/20
7/11/20
7/19/20
7/27/20
8/4/20
8/12/20
8/20/20
8/28/20
9/5/20
9/13/20
9/21/20
9/29/20
10/7/20
10/15/20
10/23/20
10/31/20
11/8/20

Table 9B. UT3 Channel Evidence

UT3 Channel Evidence	Year 1 (2015)	Year 2 (2016)	Year 3 (2017)	Year 4 (2018)	Year 5 (2019)	Year 6 (2020)
Max consecutive days channel flow	51	100	160	104	90	140
Presence of litter and debris (wracking)	Yes	Yes	Yes	Yes	Yes	Yes
Leaf litter disturbed or washed away	Yes	Yes	Yes	Yes	Yes	Yes
Matted, bent, or absence of vegetation (herbaceous or otherwise)	Yes	Yes	Yes	Yes	Yes	Yes
Sediment deposition and/or scour indicating sediment transport	Yes	Yes	Yes	Yes	Yes	Yes
Water staining due to continual presence of water	Yes	Yes	Yes	Yes	Yes	Yes
Formation of channel bed and banks	Yes	Yes	Yes	Yes	Yes	Yes
Sediment sorting within the primary path of flow	Yes	Yes	Yes	Yes	Yes	Yes
Sediment shelving or a natural line impressed on the banks	Yes	Yes	Yes	Yes	Yes	Yes
Change in plant community (absence or destruction of terrestrial vegetation and/or transition to species adapted for flow or inundation for a long duration, including hydrophytes)	Yes	Yes	Yes	Yes	Yes	Yes
Development of channel pattern (meander bends and/or channel braiding) at natural topographic breaks, woody debris piles, or plant root systems	Yes	Yes	Yes	Yes	Yes	Yes
Exposure of woody plant roots within the primary path of flow	No	No	No	No	No	No
Other:						

UT-3 channel formation at the stream gauge


Lamm Surface Gauge UT-3 Upstream
Year 6 (2020 Data)
Surface Water Level (in)
Rainfall Amounts (in)
24
22
20
18
16
14
12
10
8
6
4
2
0
-2
-4
-6
-8
-10
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
140 Days
73 Days
1/1/20
1/9/20
1/17/20
1/25/20
2/2/20
2/10/20
2/18/20
2/26/20
3/5/20
3/13/20
3/21/20
3/29/20
4/6/20
4/14/20
4/22/20
4/30/20
5/8/20
5/16/20
5/24/20
6/1/20
6/9/20
6/17/20
6/25/20
7/3/20
7/11/20
7/19/20
7/27/20
8/4/20
8/12/20
8/20/20
8/28/20
9/5/20
9/13/20
9/21/20
9/29/20
10/7/20
10/15/20
10/23/20
10/31/20
11/8/20

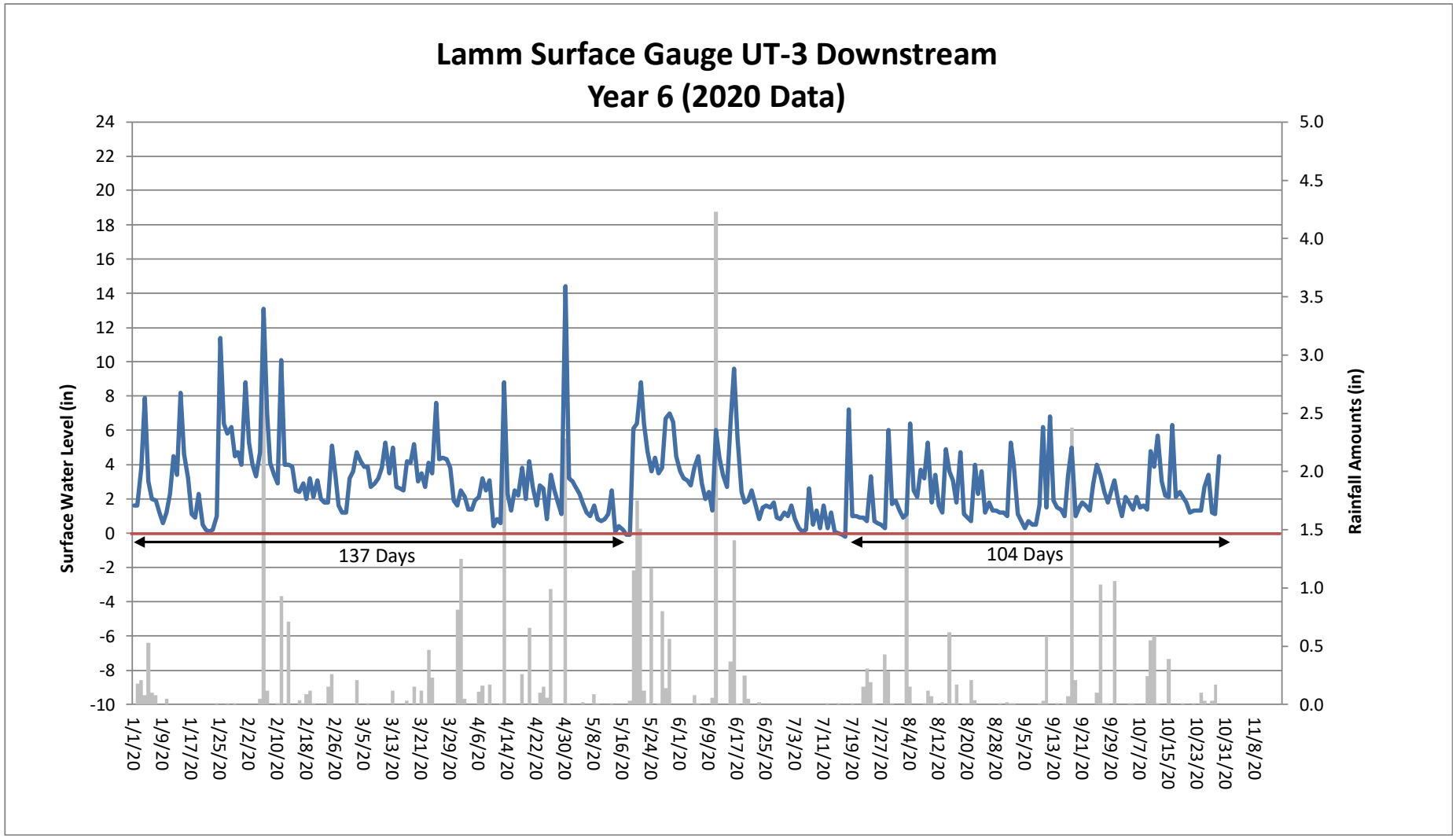

Lamm Surface Gauge UT-3 Downstream
Year 6 (2020 Data)
Surface Water Level (in)
Rainfall Amounts (in)
24
22
20
18
16
14
12
10
8
6
4
2
0
-2
-4
-6
-8
-10
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
137 Days
104 Days
1/1/20
1/9/20
1/17/20
1/25/20
2/2/20
2/10/20
2/18/20
2/26/20
3/5/20
3/13/20
3/21/20
3/29/20
4/6/20
4/14/20
4/22/20
4/30/20
5/8/20
5/16/20
5/24/20
6/1/20
6/9/20
6/17/20
6/25/20
7/3/20
7/11/20
7/19/20
7/27/20
8/4/20
8/12/20
8/20/20
8/28/20
9/5/20
9/13/20
9/21/20
9/29/20
10/7/20
10/15/20
10/23/20
10/31/20
11/8/20

Table 10. Verification of Bankfull Events

Date of Data Collection	Date of Occurrence	Method	Photo (if available)
May 27th, 2015	April 30th, 2015	1.66 inches of rain documented in one day at an on-site rain gauge.	--
June 28th, 2015	June 19th, 2015	Wrack, sediment, and laid-back vegetation observed in the floodplain after 2.28 inches of rain was recorded in one day at an on-site rain gauge.	1-3
October 10, 2016	October 8th, 2016	A trail camera installed on the right bank of UT3 documented a bankfull flow after 3.41 inches of rain was recorded in one day at an on-site rain gauge.	4
April 28, 2017	April 24th, 2017	Wrack and laid-back vegetation observed in the floodplain after 3.41 inches of rain was recorded over two days at an on-site rain gauge.	5
July 19, 2017	June 19th, 2017	2.24 inches of rain documented in one day at an on-site rain gauge.	--
June 11th, 2018	April 24th, 2018	Wrack observed in the floodplain after 2.66 inches of rain documented* between April 23-24, 2018 at an on-site rain gauge.	6
October 23, 2018	August 21st, 2018	Stream gauge data indicates a bankfull event occurred after 2.60 inches of rain documented* between August 20-21, 2018 at an on-site rain gauge.	--
October 23, 2018	September 17, 2018	Stream gauge data indicates a bankfull event occurred after 5.33 inches of rain was recorded between September 15 and 17, 2018 at an on-site rain gauge.	--
October 23rd, 2018	October 11th, 2018	Wrack and laid-back vegetation observed in the floodplain after 2.47 inches of rain was recorded on October 11th, 2018 at an on-site rain gauge.	7-8
March 8, 2019	February 23rd, 2019	Stream gauge data indicates a bankfull event occurred after 3.27 inches of rain was recorded between February 22 and 23, 2019 at an on-site rain gauge.	--
May 4th, 2019	March 20th, 2019	Stream gauge data indicates a bankfull event occurred after 1.75 inches of rain was recorded on March 20th, 2019 at an on-site rain gauge.	--
May 4th, 2019	April 13th, 2019	Stream gauge data indicates a bankfull event occurred after 2.77 inches of rain was recorded between April 12 and 13, 2019 at an on-site rain gauge.	--
September 4th, 2019	July 23rd, 2019	Stream gauge data indicates a bankfull event occurred after 1.92 inches of rain was recorded between July 22 and 23, 2019 at an on-site rain gauge.	--
February 15th, 2020	February 6th, 2020	Wrack and high water visible on a trail camera indicate a bankfull event occurred after 3.06 inches of rain was documented on February 6th, 2020 at an on-site rain gauge.	9
June 10, 2020	April 30th, 2020	Stream gauge data indicates a bankfull event occurred after 2.28 inches of rain was documented on April 30th, 2020 at an on-site rain gauge.	--
June 10th, 2020	May 21st, 2020	Stream gauge data indicates a bankfull event occurred after 4.41 inches of rain was documented between May 19 and 21, 2020 at an on-site rain gauge.	--
July 21st, 2020 (Photo: September 16th, 2020)	June 11th, 2020	Wrack in trees in the floodplain indicate a bankfull event occurred after 4.23 inches of rain was documented on June 11th, 2020 at an on-site rain gauge.	10

Bankfull Photo 1: Wrack and sediment in the floodplain of the mainstem

Bankfull Photo 2: Wrack in the floodplain of the mainstem

Bankfull Photo 3: Wrack and laid back vegetation in the floodplain of UT-3

Bankfull Photo 4: Trail Cam photo of UT-3 during rain event October 08, 2016

Bankfull Photo 5: Wrack and laid back vegetation in the floodplain of UT-2

Bankfull Photo 6: Wrack in streamside vegetation along the mainstem

Bankfull Photo 7: Large wrack and laid back vegetation in the floodplain just upstream of a piped crossing on the mainstem

Bankfull Photo 8: Wrack and laid back vegetation in the floodplain of the mainstem

Bankfull Photo 9: High water and wrack along the top of bank of UT1 after a bankfull event

Bankfull Photo 10: Wrack in the floodplain of the mainstem

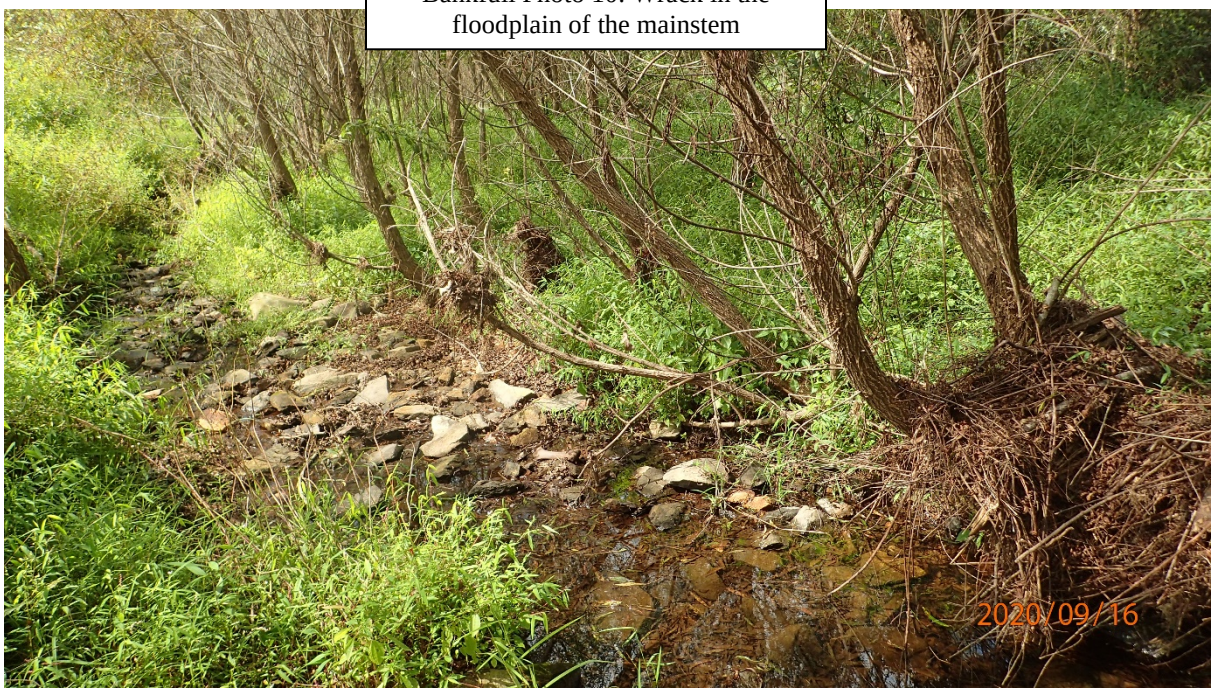


Table 11. Groundwater Hydrology Data

Gauge	Success Criteria Achieved/Max Consecutive Days During Growing Season (Percentage)						
	Year 1 (2015) February 1st Growing Season Start	Year 2 (2016) March 30th Growing Season Start	Year 3 (2017) February 28th Growing Season Start	Year 4 (2018) March 6th Growing Season Start	Year 5 (2019) March 1st Growing Season Start	Year 6 (2020) March 1st Growing Season Start	Year 7 (2021)
1	No*/10 days (3.8 percent)	Yes/75 days (36 percent)	No/12 days (5.1 percent)	Yes/68 days (29 percent)	Yes/28 days (11.9 percent)	Yes/80 days (34 percent)	
1B+	--	--	--	Yes/60 days (26 percent)	Yes/60 days (26 percent)	Yes/42 days (17.9 percent)	
2	Yes/35 days (13.3 percent)	Yes/122 days (59 percent)	Yes/82 days (35 percent)	Yes/30 days (13 percent)	No/19 days# (8.1 percent)	Yes/35 days (15 percent)	
3	No*/14 days (5.3 percent)	Yes/48 days (23 percent)	Yes/135 days (57 percent)	Yes/66 days (29 percent)	Yes/89 days (38 percent)	Yes/119 days (51 percent)	
4	No*/14 days (5.3 percent)	Yes/100 days (48 percent)	Yes/78 days (33 percent)	Yes/28 days (12 percent)	No/18 days# (7.7 percent)	Yes/32 days (13.7 percent)	
5	Yes/32 days (12.1 percent)	Yes/75 days (36 percent)	Yes/48 days (20 percent)	Yes/60 days (26 percent)	No/19 days# (8.1 percent)	Yes/67 days (29 percent)	
6	No*/9 days (3.4 percent)	No/7 days (3.4 percent)	No/5 days (2.1 percent)	Yes/25 days (11 percent)	No/19 days (8.1 percent)	No/12 days (5.1 percent)	
6B+	--	--	--	Yes/28 days (12 percent)	No/17 days# (7.2 percent)	No/19 days (8.1 percent)	
7**	--	Yes/116 days (56 percent)	Yes/153 days (65 percent)	Yes/103 days (45 percent)	Yes/103 days (44 percent)	Yes/125 days (53 percent)	
8**	--	Yes/206 days (100 percent)	Yes/211 days (89 percent)	Yes/231 days (100 percent)	Yes/124 days (53 percent)	Yes/235 days (100 percent)	
9**	--	Yes/54 days (26 percent)	No^/12 days (5.1 percent)	Yes/132 days (57 percent)	Yes/122 days (52 percent)	Yes/91 days (39 percent)	

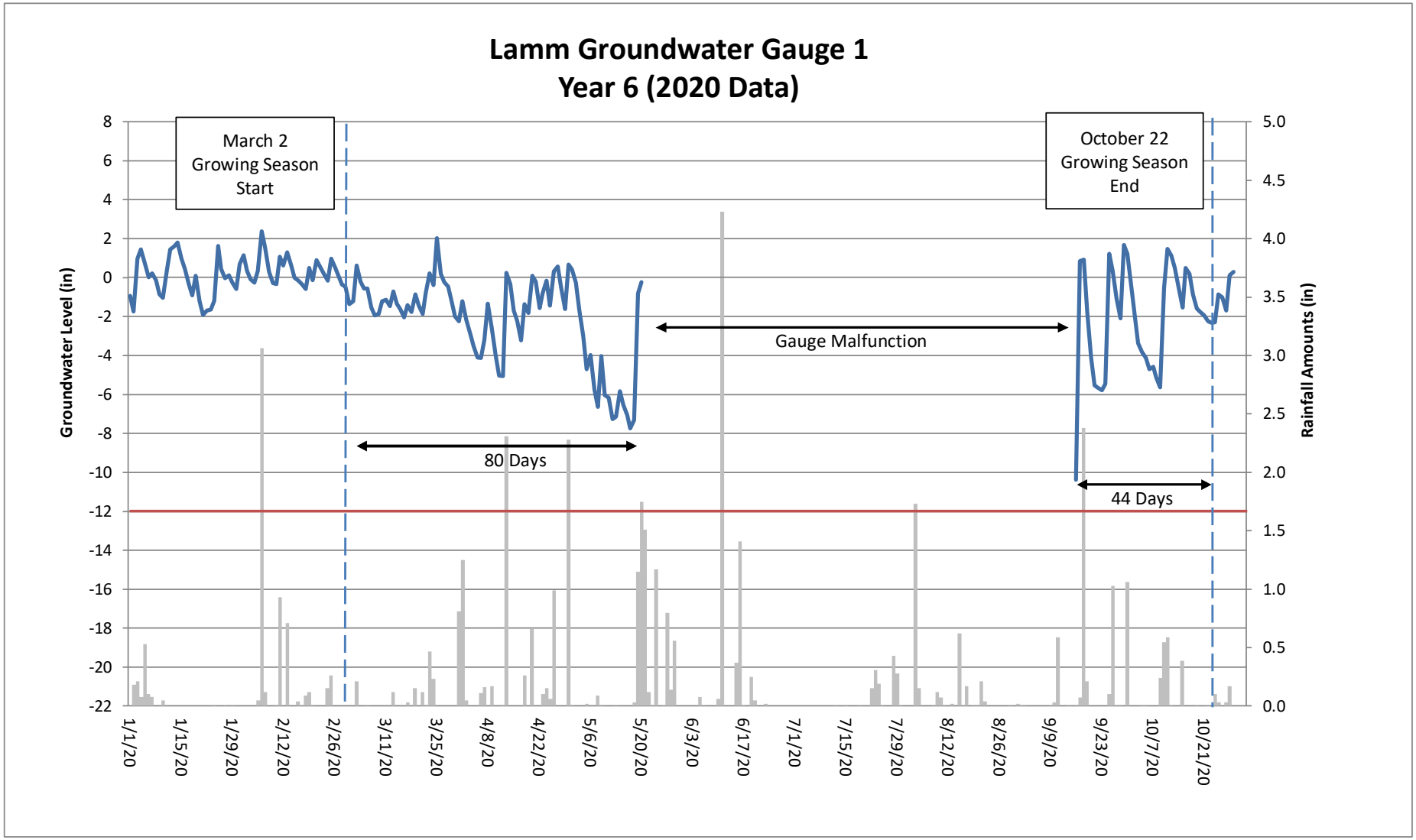
* Due to Site construction activities, groundwater gauges were not installed until April 8th, 2015. It is expected that all gauges would meet success criteria at the beginning of the growing season.

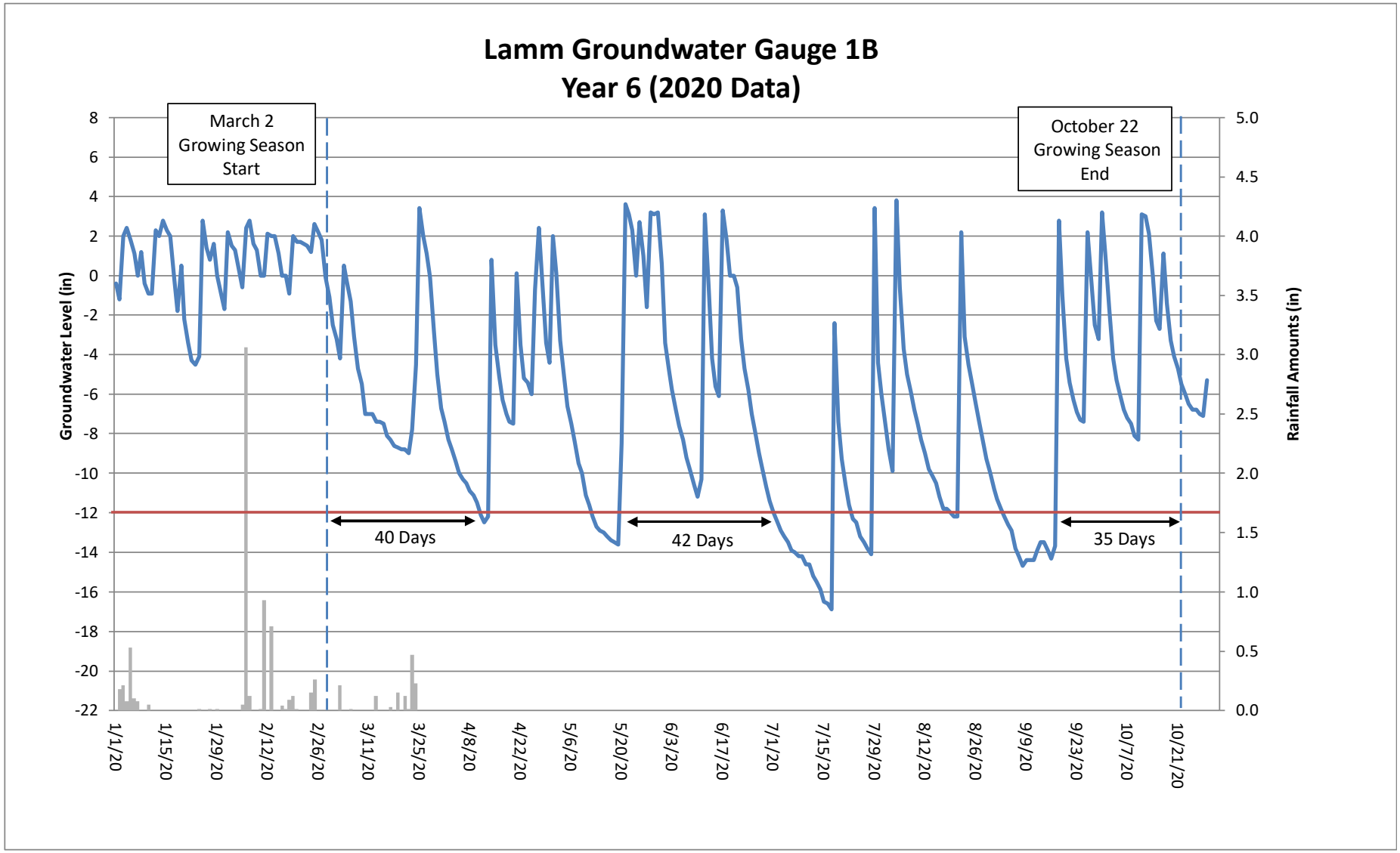
** These gauges were installed on March 8th, 2016 to show wetland establishment within the old pond bed.

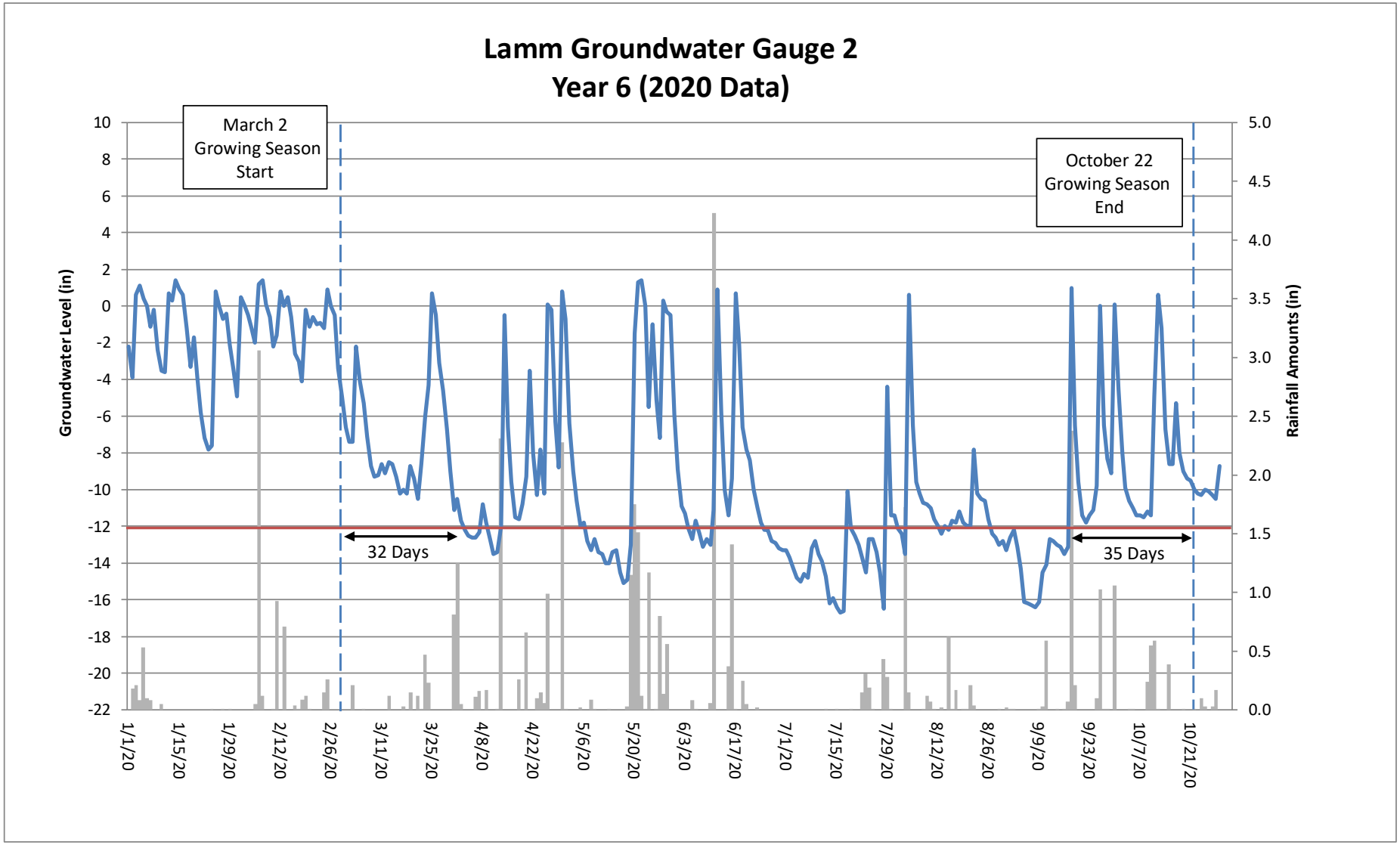
^ This gauge malfunctioned through the majority of the growing season due to continuous inundation. It is expected that this gauge would have met success criteria had it functioned properly.

+ These gauges were installed during Year 4 (2018) near two gauges that had not met success criteria in previous monitoring years to verify the groundwater data at these locations.

These gauges did not meet success criteria due to a data shuttle failure that resulted in the loss of data from March 20th to May 3rd, 2019. Based on rainfall and hydrology data that was not lost, these gauges would have likely met success criteria had the loss of data not occurred.


Lamm Groundwater Gauge 1
Year 6 (2020 Data)
March 2
Growing Season
Start
October 22
Growing Season
End
Gauge Malfunction
80 Days
44 Days
Groundwater Level (in)
Rainfall Amounts (in)
8
6
4
2
0
-2
-4
-6
-8
-10
-12
-14
-16
-18
-20
-22
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
1/1/20
1/15/20
1/29/20
2/12/20
2/26/20
3/11/20
3/25/20
4/8/20
4/22/20
5/6/20
5/20/20
6/3/20
6/17/20
7/1/20
7/15/20
7/29/20
8/12/20
8/26/20
9/9/20
9/23/20
10/7/20
10/21/20


Lamm Groundwater Gauge 1B
Year 6 (2020 Data)
March 2
Growing Season
Start
October 22
Growing Season
End
40 Days
42 Days
35 Days
Groundwater Level (in)
Rainfall Amounts (in)
8
6
4
2
0
-2
-4
-6
-8
-10
-12
-14
-16
-18
-20
-22
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
1/1/20
1/15/20
1/29/20
2/12/20
2/26/20
3/11/20
3/25/20
4/8/20
4/22/20
5/6/20
5/20/20
6/3/20
6/17/20
7/1/20
7/15/20
7/29/20
8/12/20
8/26/20
9/9/20
9/23/20
10/7/20
10/21/20


Lamm Groundwater Gauge 2
Year 6 (2020 Data)
March 2
Growing Season
Start
October 22
Growing Season
End
32 Days
35 Days
Groundwater Level (in)
Rainfall Amounts (in)
10
8
6
4
2
0
-2
-4
-6
-8
-10
-12
-14
-16
-18
-20
-22
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
1/1/20
1/15/20
1/29/20
2/12/20
2/26/20
3/11/20
3/25/20
4/8/20
4/22/20
5/6/20
5/20/20
6/3/20
6/17/20
7/1/20
7/15/20
7/29/20
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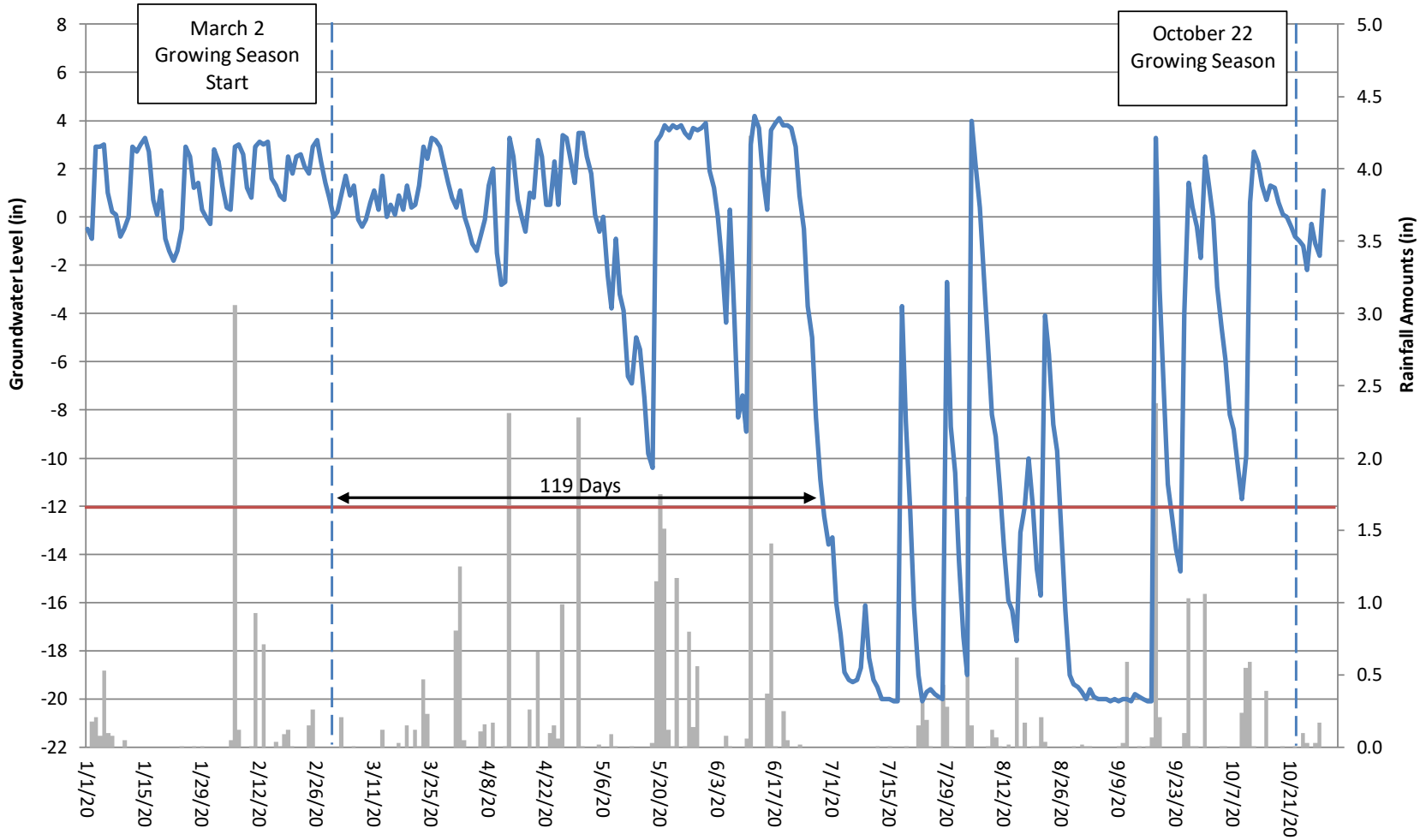
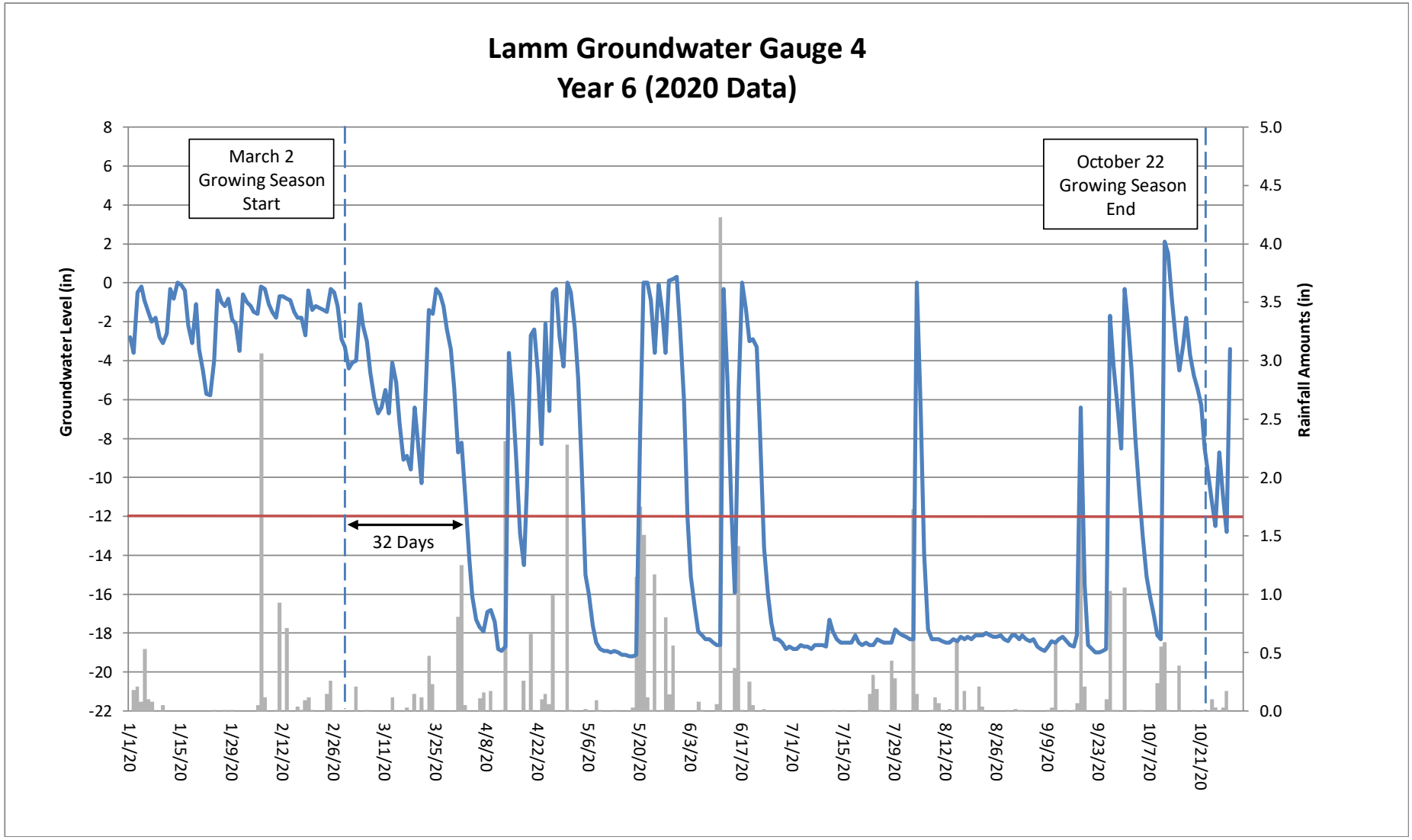
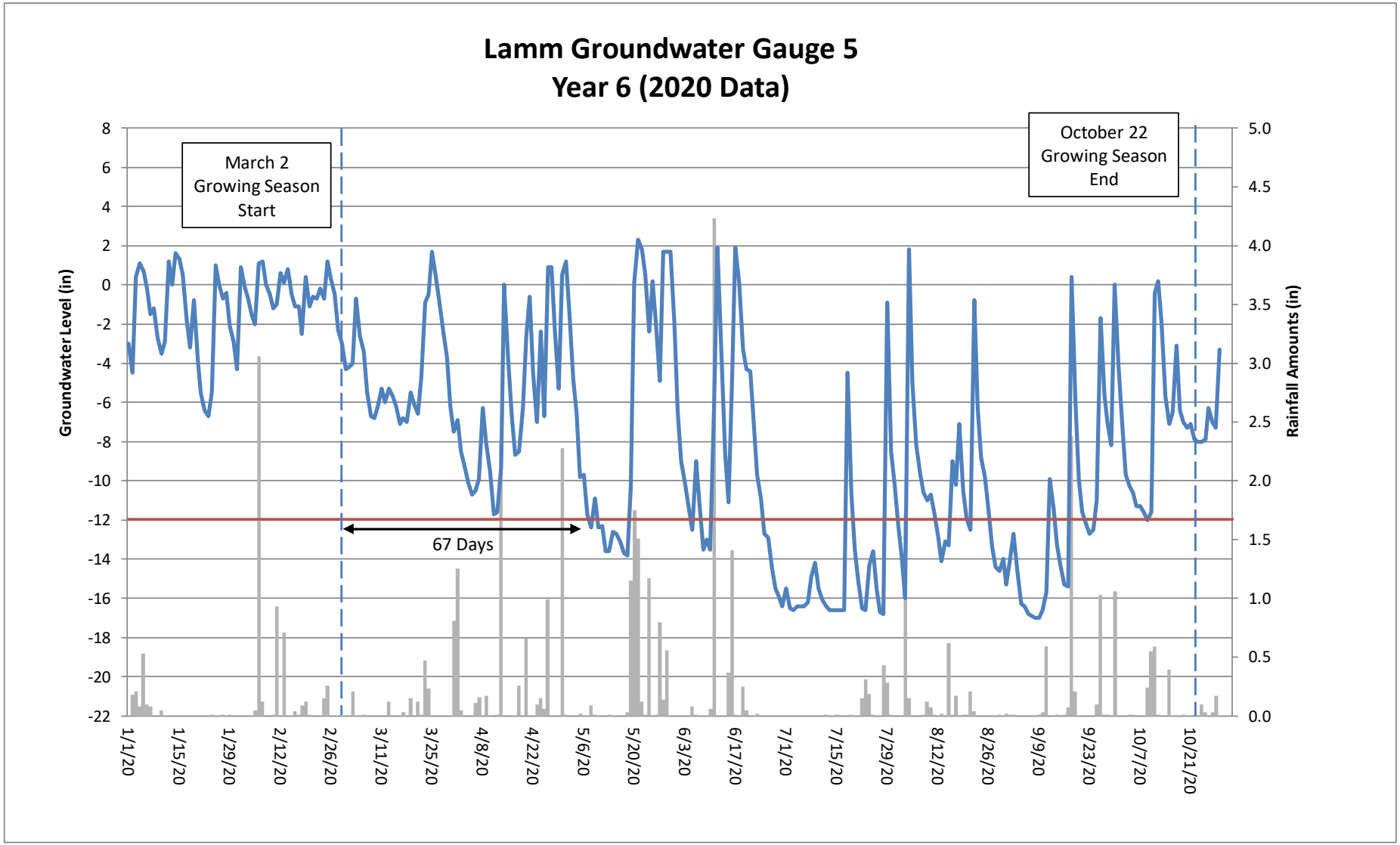
10/7/20
10/21/20

Lamm Groundwater Gauge 3
Year 6 (2020 Data)




Lamm Groundwater Gauge 4
Year 6 (2020 Data)
March 2
Growing Season
Start
October 22
Growing Season
End
32 Days
Groundwater Level (in)
Rainfall Amounts (in)
8
6
4
2
0
-2
-4
-6
-8
-10
-12
-14
-16
-18
-20
-22
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
1/1/20
1/15/20
1/29/20
2/12/20
2/26/20
3/11/20
3/25/20
4/8/20
4/22/20
5/6/20
5/20/20
6/3/20
6/17/20
7/1/20
7/15/20
7/29/20
8/12/20
8/26/20
9/9/20
9/23/20
10/7/20
10/21/20


Lamm Groundwater Gauge 5
Year 6 (2020 Data)
March 2
Growing Season
Start
October 22
Growing Season
End
67 Days
Groundwater Level (in)
Rainfall Amounts (in)
8
6
4
2
0
-2
-4
-6
-8
-10
-12
-14
-16
-18
-20
-22
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
1/1/20
1/15/20
1/29/20
2/12/20
2/26/20
3/11/20
3/25/20
4/8/20
4/22/20
5/6/20
5/20/20
6/3/20
6/17/20
7/1/20
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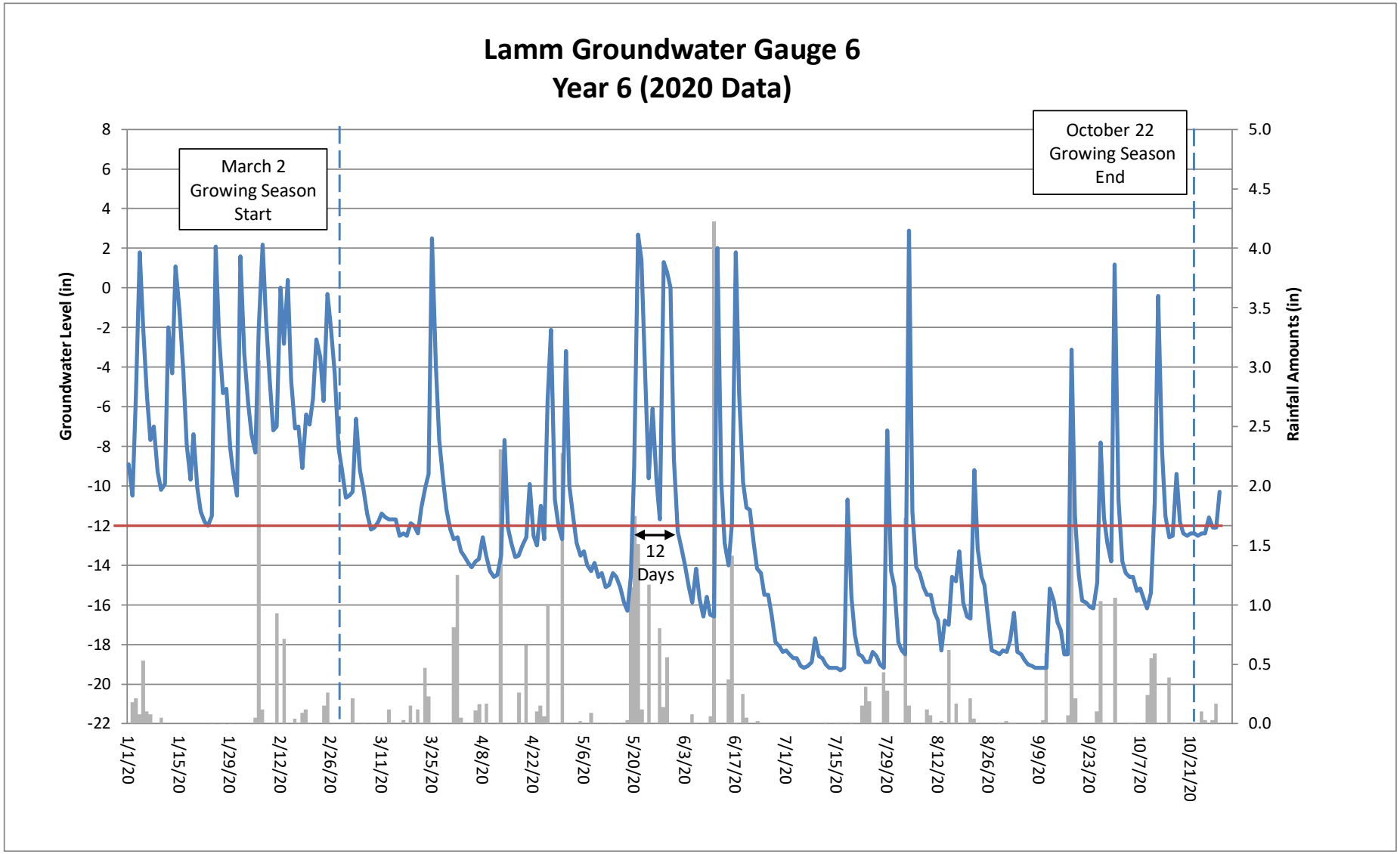
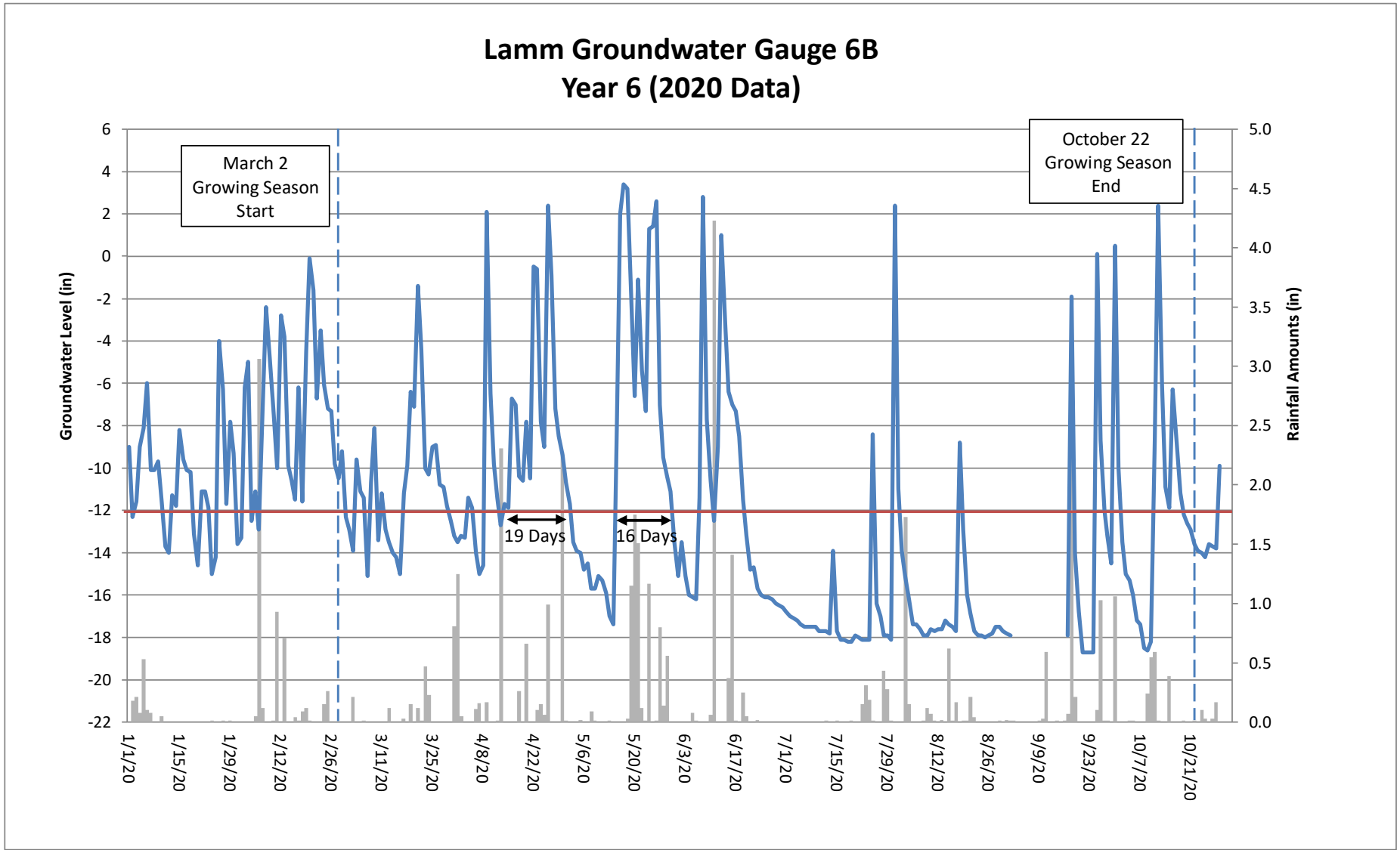
8/26/20
9/9/20
9/23/20
10/7/20
10/21/20


Lamm Groundwater Gauge 6
Year 6 (2020 Data)
March 2
Growing Season
Start
October 22
Growing Season
End
12
Days
Groundwater Level (in)
Rainfall Amounts (in)
8
6
4
2
0
-2
-4
-6
-8
-10
-12
-14
-16
-18
-20
-22
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
1/1/20
1/15/20
1/29/20
2/12/20
2/26/20
3/11/20
3/25/20
4/8/20
4/22/20
5/6/20
5/20/20
6/3/20
6/17/20
7/1/20
7/15/20
7/29/20
8/12/20
8/26/20
9/9/20
9/23/20
10/7/20
10/21/20


Lamm Groundwater Gauge 6B
Year 6 (2020 Data)
March 2
Growing Season
Start
October 22
Growing Season
End
19 Days
16 Days
Groundwater Level (in)
Rainfall Amounts (in)
6
4
2
0
-2
-4
-6
-8
-10
-12
-14
-16
-18
-20
-22
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
1/1/20
1/15/20
1/29/20
2/12/20
2/26/20
3/11/20
3/25/20
4/8/20
4/22/20
5/6/20
5/20/20
6/3/20
6/17/20
7/1/20
7/15/20
7/29/20
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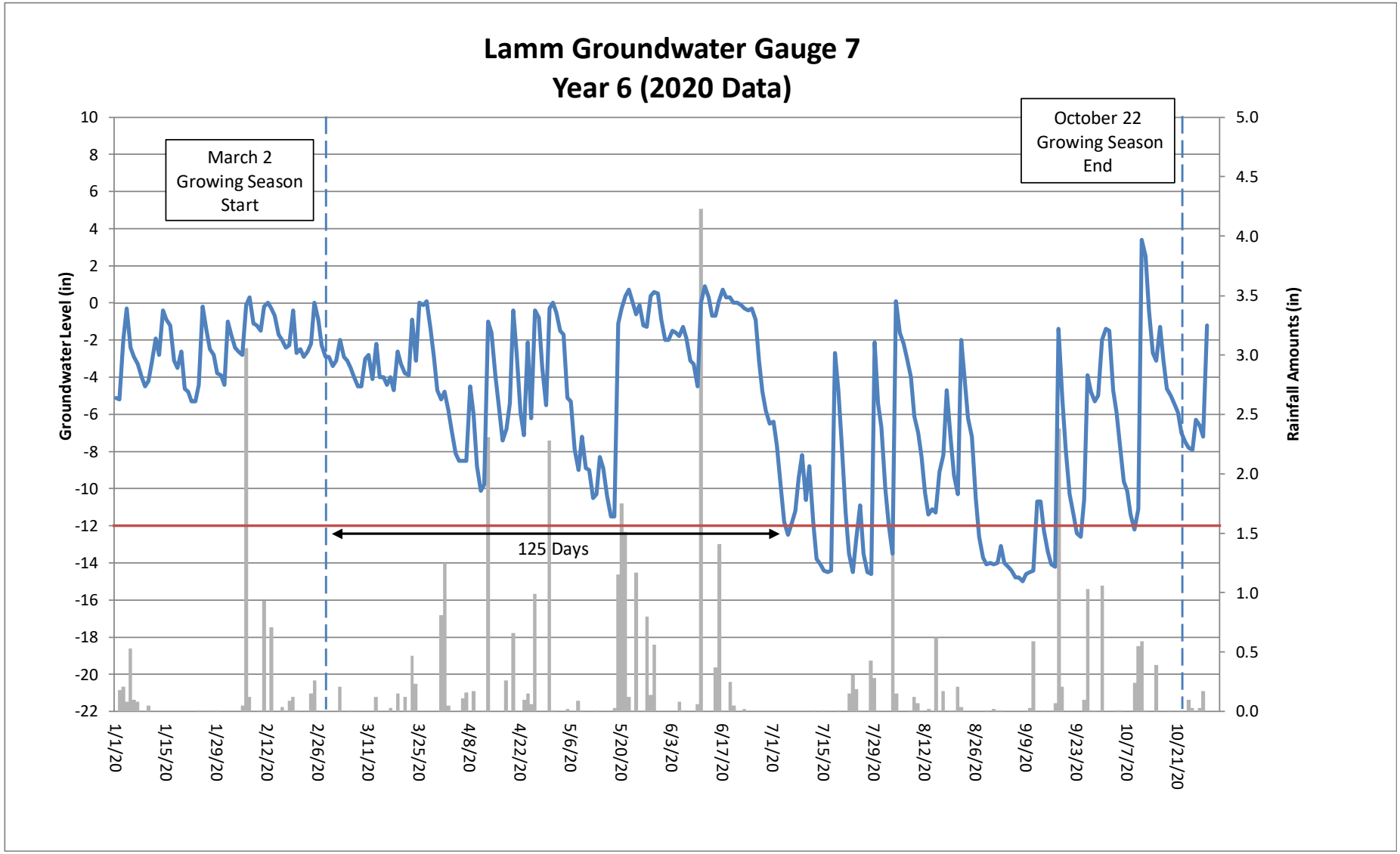
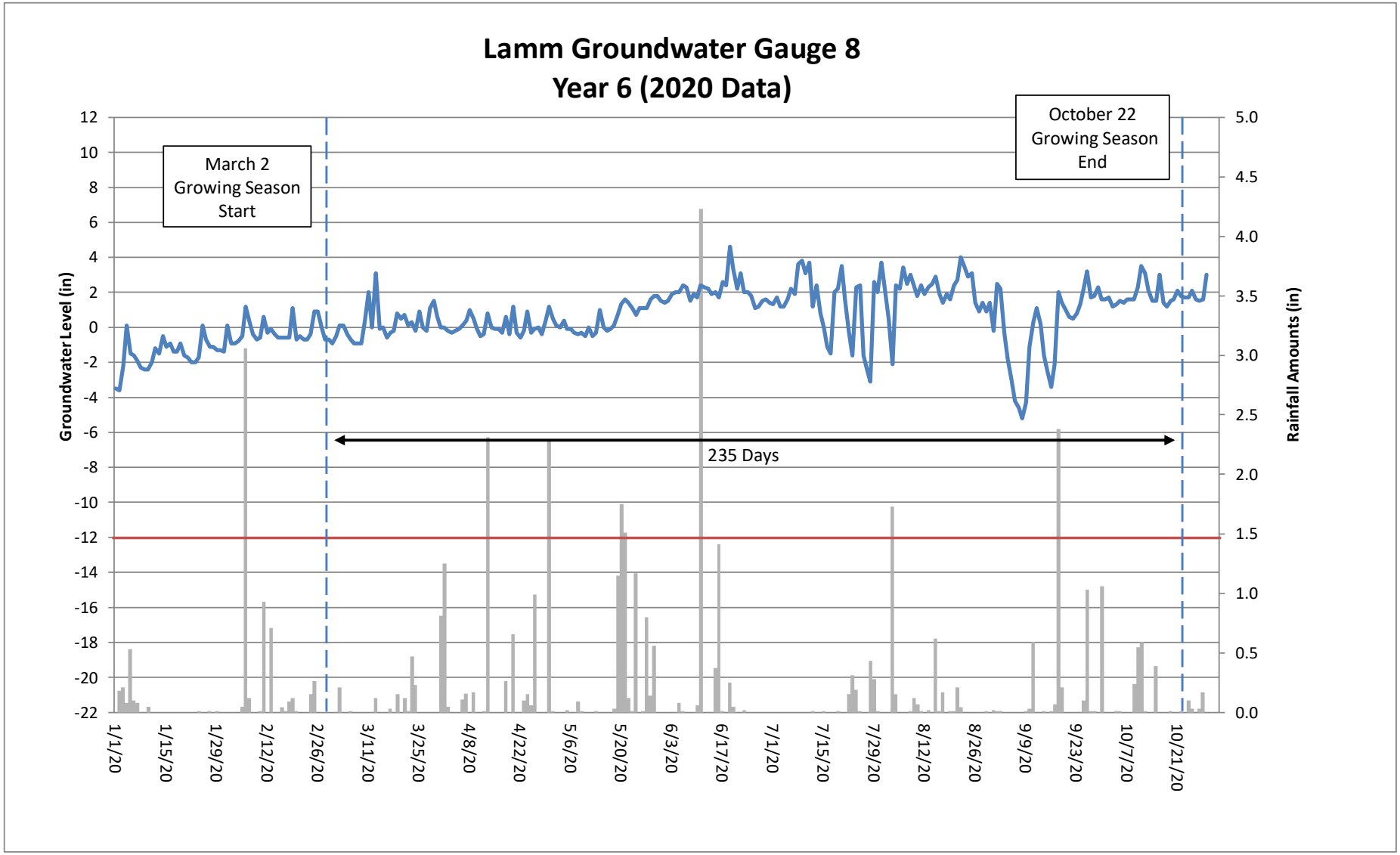
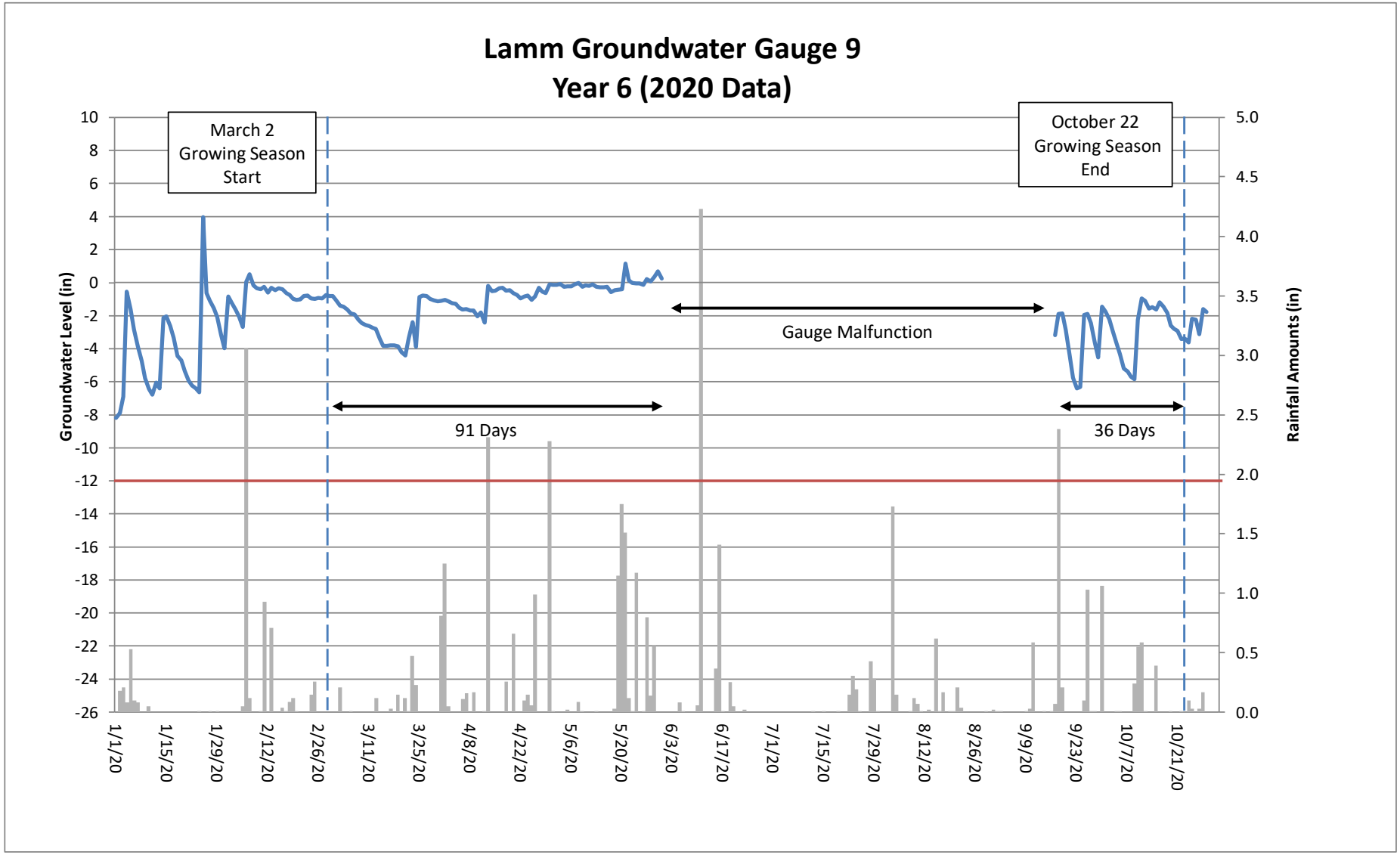
8/26/20
9/9/20
9/23/20
10/7/20
10/21/20

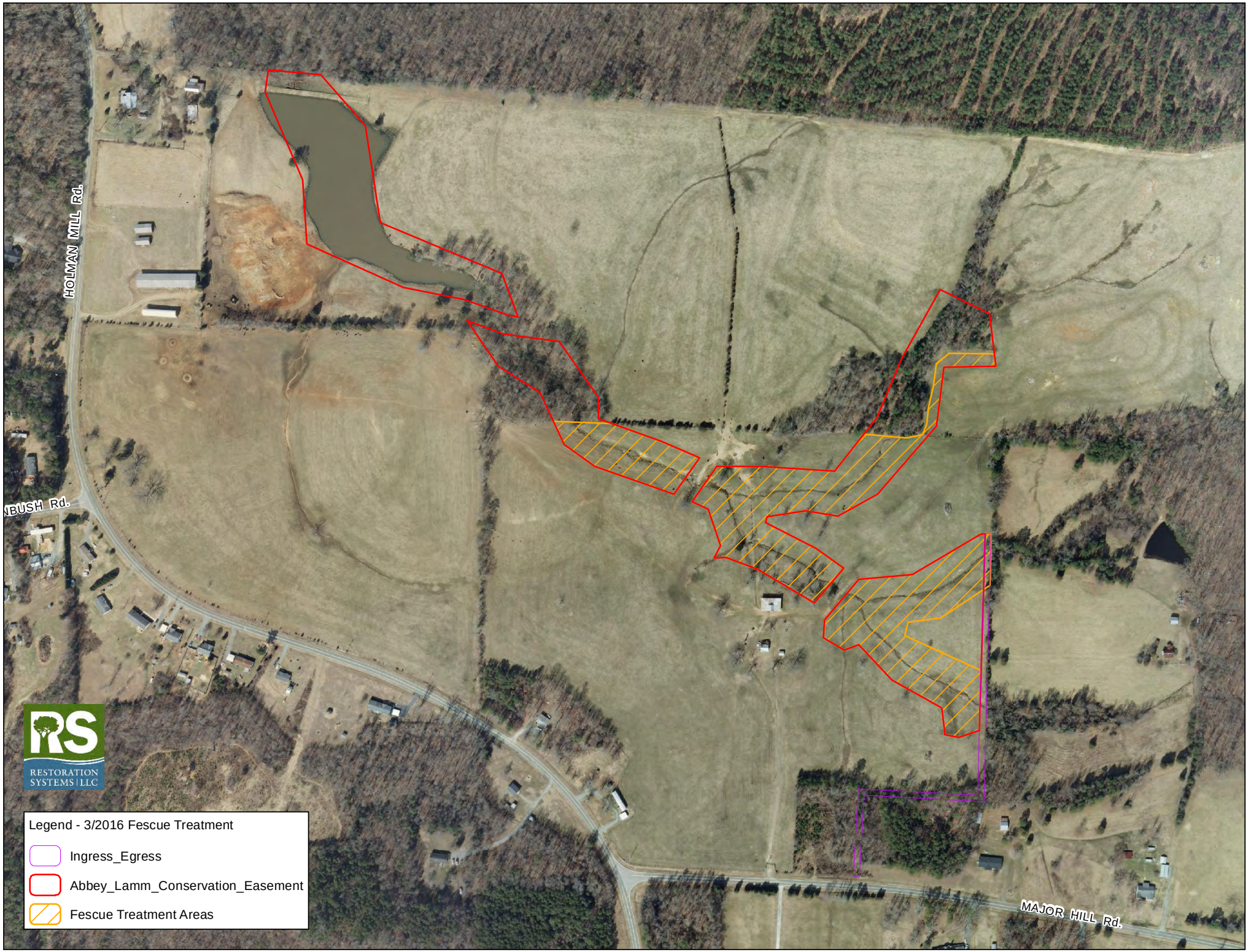

Lamm Groundwater Gauge 7
Year 6 (2020 Data)
March 2
Growing Season
Start
October 22
Growing Season
End
125 Days
Groundwater Level (in)
Rainfall Amounts (in)
10
8
6
4
2
0
-2
-4
-6
-8
-10
-12
-14
-16
-18
-20
-22
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
1/1/20
1/15/20
1/29/20
2/12/20
2/26/20
3/11/20
3/25/20
4/8/20
4/22/20
5/6/20
5/20/20
6/3/20
6/17/20
7/1/20
7/15/20
7/29/20
8/12/20
8/26/20
9/9/20
9/23/20
10/7/20
10/21/20


Lamm Groundwater Gauge 8
Year 6 (2020 Data)
March 2
Growing Season
Start
October 22
Growing Season
End
235 Days
Groundwater Level (in)
Rainfall Amounts (in)
12
10
8
6
4
2
0
-2
-4
-6
-8
-10
-12
-14
-16
-18
-20
-22
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
1/1/20
1/15/20
1/29/20
2/12/20
2/26/20
3/11/20
3/25/20
4/8/20
4/22/20
5/6/20
5/20/20
6/3/20
6/17/20
7/1/20
7/15/20
7/29/20
8/12/20
8/26/20
9/9/20
9/23/20
10/7/20
10/21/20


Lamm Groundwater Gauge 9
Year 6 (2020 Data)
March 2
Growing Season
Start
October 22
Growing Season
End
Gauge Malfunction
91 Days
36 Days
Groundwater Level (in)
Rainfall Amounts (in)
10
8
6
4
2
0
-2
-4
-6
-8
-10
-12
-14
-16
-18
-20
-22
-24
-26
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
1/1/20
1/15/20
1/29/20
2/12/20
2/26/20
3/11/20
3/25/20
4/8/20
4/22/20
5/6/20
5/20/20
6/3/20
6/17/20
7/1/20
7/15/20
7/29/20
8/12/20
8/26/20
9/9/20
9/23/20
10/7/20
10/21/20

APPENDIX E: MISCELLANEOUS

Figure-March 2016 Fescue Treatment
2016 Herbicide Application Forms
Supplemental Photographs
Remedial Planting Plan Figure
2016 Replant Photos


HOLMAN MILL Rd.
NBUSH Rd.
MAJOR HILL Rd.
RESTORATION SYSTEMS | LLC
Legend - 3/2016 Fescue Treatment
Ingress_Egress
Abbey_Lamm_Conservation_Easement
Fescue Treatment Areas

Carolina Silvics, Inc. Pesticide Application Log

CarSilv - 0163

Client	Restoration Systems		
Project SIte	Abbey Lamm		
Date	03-11-2016		
Start Time	8:00	**End Time**	15:30
Only PAL for Site for This Day?	Yes	**If NO, this is PAL # of ##**	
Sky Cover	Partly Cloudy	**Temp (F)**	70
Wind Direction	E	**Wind Speed**	Calm
Applicators	William A Skinner (NC 026-32003/VA 129456)		
Application Method	Foliar Spray (ATV - Broadcast)		
Herbicide	Oust® XP (sulfometuron methyl)		
Herbicide Rate (%)		**Total Concentrate**	30oz
Surfactant or Adjuvant (1)			
Surfactant/Adjudivant 1 Rate (%)			
Other	Grounded (deposition agent)		
Other Rate/Amt	8oz/ac		
Diluent	Water		
Total Solution	125 gallon		
Species Controlled	fescue		
Area Description			
Additional Comments	Oust® application rate was 3oz/ac		

Abbey Lamm Stream & Wetland Mitigation Site: Year 2 (2016) Photos

Photo 1: Downstream end of the Main Stem looking upstream into the old pond bed **Photo Date: 10-19-2016**

Abbey Lamm Stream & Wetland Mitigation Site: Year 2 (2016) Photos

Photo 2: Downstream end of the Main Stem looking upstream into the old pond bed **Photo Date: 10-19-2016**

Abbey Lamm Stream & Wetland Mitigation Site: Year 2 (2016) Photos

Photo 3: Downstream end of the Main Stem looking upstream into the old pond bed **Photo Date: 10-19-2016**

Abbey Lamm Stream & Wetland Mitigation Site: Year 2 (2016) Photos

Photo 4: Upstream end of the old pond looking downstream **Photo Date: 10-19-2016**

Abbey Lamm Stream & Wetland Mitigation Site: Year 2 (2016) Photos

Photo 5: middle crossing looking upstream at the Main Stem and UT-3 on the left **Photo Date: 10-19-2016**

Abbey Lamm Stream & Wetland Mitigation Site: Year 2 (2016) Photos

Photo 6: middle crossing looking upstream at the Main Stem and UT-3 on the left **Photo Date: 10-19-2016**

Abbey Lamm Stream & Wetland Mitigation Site: Year 2 (2016) Photos

Photo 7: UT 1 & UT-2

Photo Date: 10-19-2016

Abbey Lamm Stream & Wetland Mitigation Site: Year 2 (2016) Photos

Photo 8: UT 3 (XC 5, 6, 7)

Photo Date: 10-19-2016

Abbey Lamm Stream & Wetland Mitigation Site: Year 2 (2016) Photos

Photo 9: UT 3 (XC 6, 7, 8)

Photo Date: 10-19-2016

Abbey Lamm Stream & Wetland Mitigation Site: Year 2 (2016) Photos

Photo 10: UT-1, 2, 3, & Main Stem **Photo Date: 10-19-2016**

RESTORATION SYSTEMS, LLC
1101 HAYNES ST, SUITE 211
RALEIGH, NC 27604
PHONE : 919.755.9490
FAX : 919.755.9492

SCALE: 1 in = 213 ft
DATE: 5 - 2016
SITE: Abbey Lamm

Abbey Lamm Mitigation Site
2016 Remedial Planting Plan

Aerial Imagery: (c) ESRI

Coordinate System:
NAD_1983_SP_NC_FIPS_3200_Ft.

Feet
0 50 100 200 300 400

Replant Area 1:
Density: 145 trees in 0.41 ac ~ 350 Trees / Ac.
3 new planted stems added to veg plots 12 & 14

Replant Area 2:
Density: 320 trees in 0.88 ac ~ 360 Trees / Ac.
9 new planted stems added to veg plot 14

Replant Area 3:
Density: 30 trees in 0.21 ac ~ 140 Trees / Ac.
3 new planted stems added to veg plot 13

Replant Area 4:
Density: 25 trees in 0.15 ac ~ 160 Trees / Ac.

Replant Area 5:
Density: 190 trees in 0.62 ac ~ 300 Trees / Ac.
7 new planted stems added to veg plot 7

Replant Area 6:
Density: 60 trees in 0.20 ac ~ 300 Trees / Ac.
6 new planted stems added to veg plot 9

Replant Area 7:
Density: 115 trees in 0.56 ac ~ 200 Trees / Ac.
4 new planted stems added to veg plot 6

Replant Area 8:
Density: 150 trees in 0.43 ac ~ 300 Trees / Ac.
7 new planted stems added to veg plot 4

Replant Area 9:
Density: 40 trees in 0.13 ac ~ 300 Trees / Ac.
7 new planted stems added to veg plot 1

Replant Area 10:
Density: 150 trees in 0.42 ac ~ 350 Trees / Ac.

ABBEY LAMM
STREAM AND WETLAND MITIGATION SITE
ALAMANCE COUNTY, NORTH CAROLINA
FULL DELIVERY CONTRACT NO. 5790

Photographs taken January 13th, 2017

Photo 1: Looking S. along Replant Area -1

Photo Date: 1-13-2017

Photo 2: Looking N. in Replant Area 2, just N. of veg. plot 14 **Photo Date: 1-13-2017**

Photo 3: Looking W. in Replant Area 3, near veg. plot 13 **Photo Date: 1-13-2017**

Photo 4: Looking NE. in Replant Area 5, near veg. plot 7 **Photo Date: 1-13-2017**

Photo 5: Looking N. in Replant Area 6.

Photo Date: 1-13-2017

Photo 6: Looking N. in Replant Area 6, towards veg. plot 9. **Photo Date: 1-13-2017**

Photo 7: Looking SW. in Replant Area 8. **Photo Date: 1-13-2017**

Photo 8: Looking NW. in Replant Area 10. **Photo Date: 1-13-2017**

Photo 9: Surviving bear roots outside of replant area

Photo Date: 1-13-2017

Photo 10: Surviving bear root outside of replant area **Photo Date: 1-13-2017**

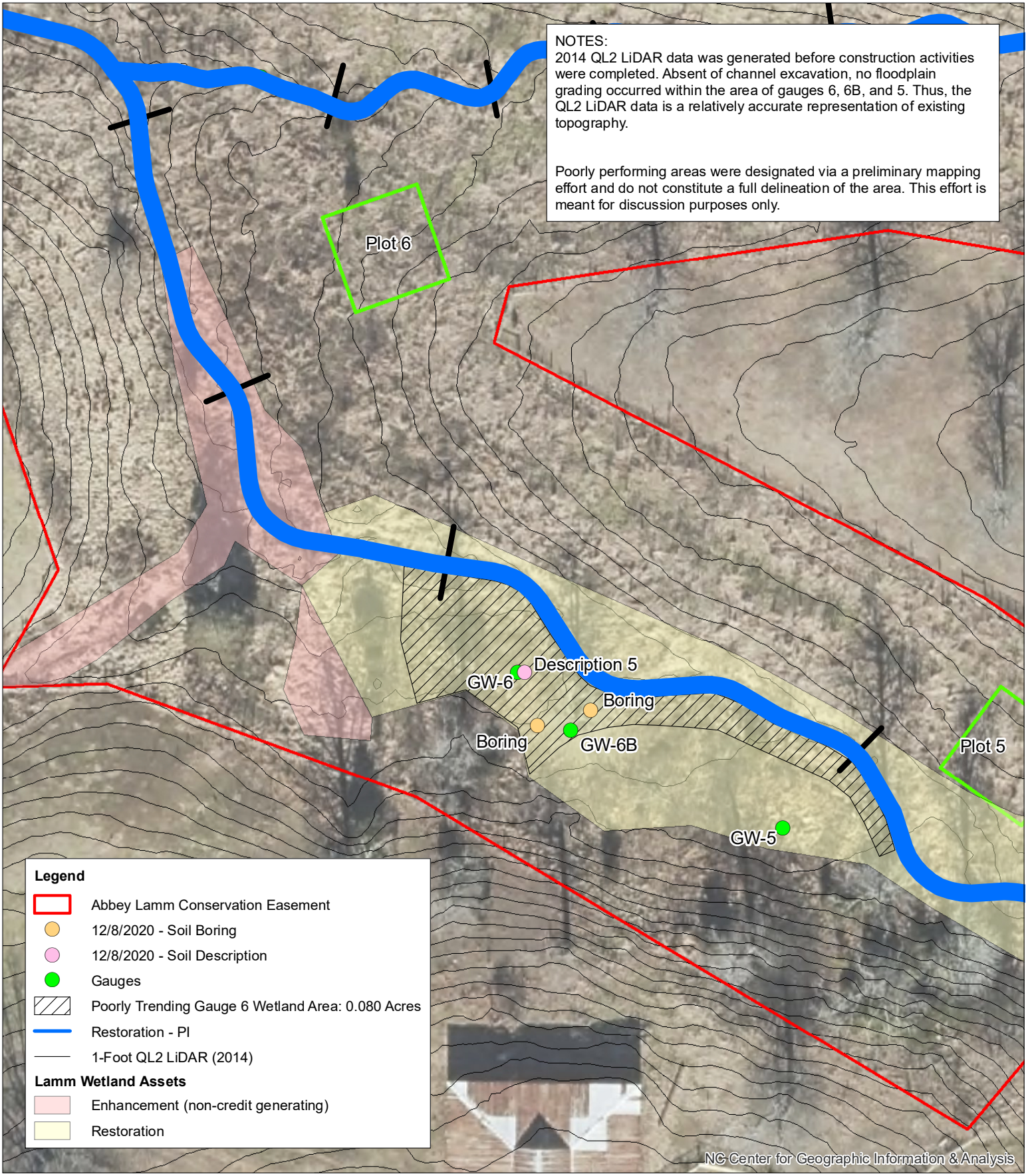
APPENDIX F. WETLAND STUDIES & 12/2020 SITE PHOTOS

Figures
Soil Profiles
Site-wide Photo Log

Understood. To evaluate the wetland restoration credit around gauge 6 and 6B, Raymond Holz and Alex Baldwin (PWS 2221) of Restoration Systems (RS) visited the Site on 12/8/2020 to review the subject area. Site work indicates 0.080 acres around gauge 6 and 6B is not meeting the Site's 10% hydroperiod period success metric.

To further provide an understanding of the Site's wetland mitigation assets, RS mapped the wetland areas within the old pond bed along the "Mainstem" tributary at the western extent of the Site. RS installed three groundwater monitoring gauges in 2016 (Yr. 2 of monitoring) within this area, and has collected groundwater data for the last five years. In conjunction with 12-2020 field review, the groundwater data indicates successful wetland reestablishment of 0.862 acres.

Data collected during RS' field investigation is provided in a newly added appendix and supplied in shapefile format within the digital deliverable dataset. RS' position is that although the 0.080 acres around gauge 6 and 6B is not meeting the hydroperiod metric, the Site is providing more than the 1.0 WMU detailed in the Restoration Plan. RS is not asking for additional credit be added to the ledger but that the agreed-upon 1 WMU remains and is not subject to a downward adjustment by the IRT. RS expects to discuss this with the IRT during the 2021 Credit Release Meeting.



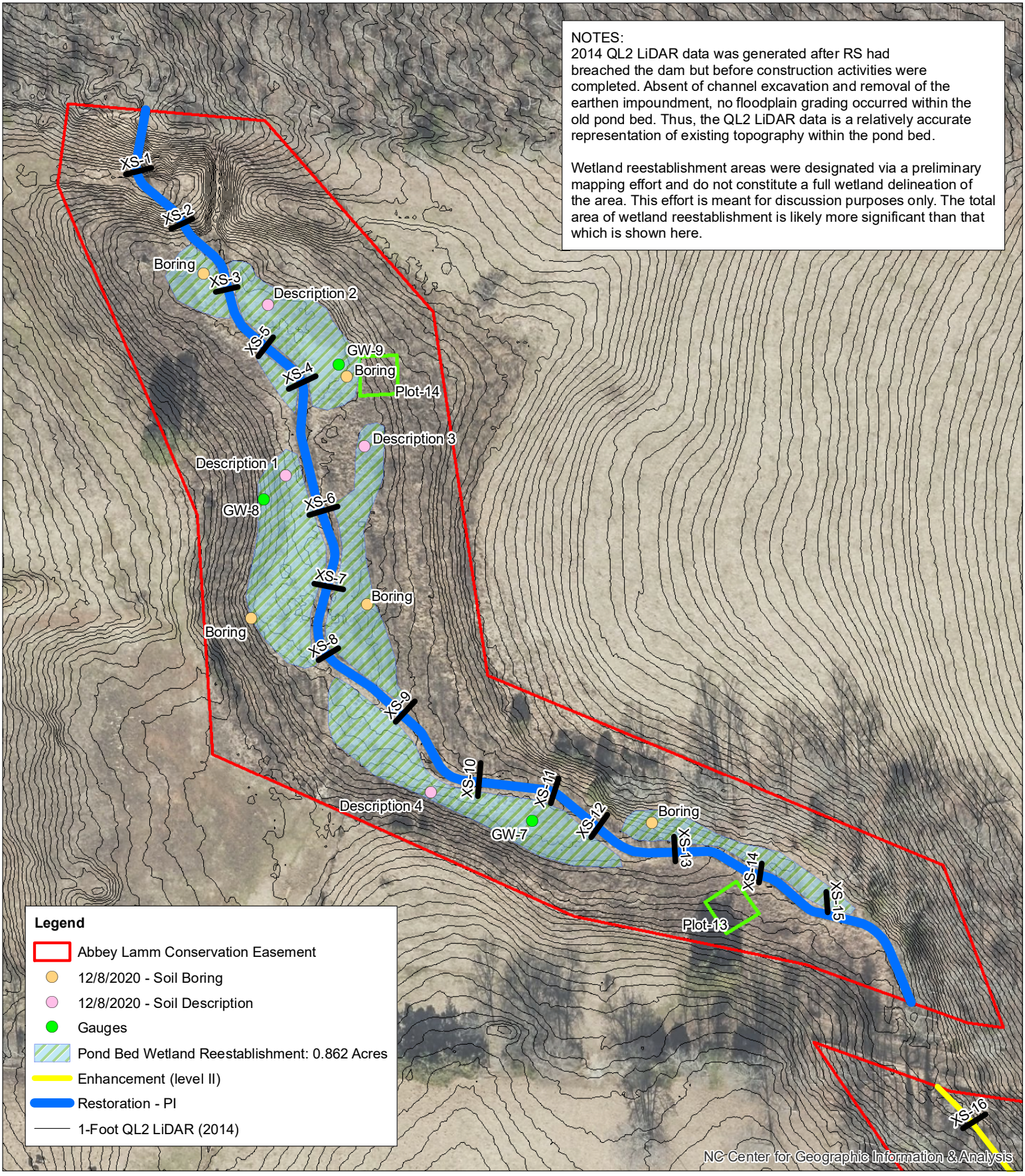
RESTORATION SYSTEMS, LLC
1101 HAYNES ST, SUITE 211
RALEIGH, NC 27604
PHONE : 919.755.9490
FAX : 919.755.9492

SCALE: 1 in = 42 ft
DATE: 12 - 2020
SITE: Abbey Lamm

Abbey Lamm
2020 Gauge 6 & 6B Wetland Study

Aerial Imagery: (c) ESRI
Coordinate System: NAD_1983_SP_NC_FIPS_3200_Ft.

Feet
0 15 30 60 90 120



RESTORATION SYSTEMS, LLC
1101 HAYNES ST, SUITE 211
RALEIGH, NC 27604
PHONE : 919.755.9490
FAX : 919.755.9492

SCALE: 1 in = 108 ft
DATE: 12 - 2020
SITE: Abbey Lamm

Abbey Lamm
2020 Pond Bed Wetland Study

Aerial Imagery: (c) ESRI
Coordinate System: NAD_1983_SP_NC_FIPS_3200_Ft.

Feet
0 50 100 200 300 400

SOIL PROFILE DESCRIPTION FORM **PROFILE ID:** 1

NAME: A. Baldwin DATE: December 8, 2020

PROJECT NUMBER/NAME: Abbey Lamm Stream & Wetland Mitigation Site

LOCATION: Alamance County, NC – Left Bank of Main Stem (Restoration Reach, Between Gauges 7 & 8)

WEATHER: Sunny 35°F

LANDSCAPE POSITION: Toe of slope SLOPE (%): 2

VEGETATION/CROP: Restored Piedmont Alluvial Forest (6-years post construction)

SOIL MAP UNIT: HnC – Herndon silt loam, 6-10% HYDRIC SOIL FIELD INDICATOR: F3 – Depleted Matrix

DEPTH TO WATER: 11-inches DEPTH TO SHWT: 3-inches

DEPTH (inches)	MATRIX		REDOXIMORHPIC FEATURES			TEXTURE
	COLOR	%	TYPE[1]/LOCATION[2]	COLOR	%	
0-3	10YR 3/3	90	C/PL	10YR 5/8	10	SiCL
3-15+	2.5Y 4/2	75	C/PL	7.5YR 3/4	10	C
			C/M	7.5YR 5/8	15	

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, MS=Masked Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

NOTES: Common fine roots in surface horizon and few fine roots in subsurface horizon. Undecomposed woody material in subsurface horizon.

Photo 1

Photo 2

SOIL PROFILE DESCRIPTION FORM **PROFILE ID:** 2

NAME: A. Baldwin DATE: December 8, 2020

PROJECT NUMBER/NAME: Abbey Lamm Stream & Wetland Mitigation Site

LOCATION: Alamance County, NC – Right Bank of Main Stem (Restoration Reach, Downstream of Gauge 9)

WEATHER: Sunny 35°F

LANDSCAPE POSITION: Toe of slope SLOPE (%): 2

VEGETATION/CROP: Restored Piedmont Alluvial Forest (6-years post construction)

SOIL MAP UNIT: HnC – Herndon silt loam, 6-10% HYDRIC SOIL FIELD INDICATOR: F3 – Depleted Matrix

DEPTH TO WATER: 3-inches DEPTH TO SHWT: Surface

DEPTH (inches)	MATRIX		REDOXIMORHPIC FEATURES			TEXTURE
	COLOR	%	TYPE[1]/LOCATION[2]	COLOR	%	
0-3	2.5Y 5/2	85	C/PL	7.5YR 3/4	5	SCL
			C/M	7.5YR 5/8	10	
3-10	10YR 5/2	65	C/M	7.5YR 4/4	10	SCL
			C/M	7.5YR 5/8	25	
10-13+	10YR 5/2	55	C/M	7.5YR 4/4	15	SCL
			C/M	7.5YR 5/8	30	

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, MS=Masked Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

NOTES: Common fine roots and few undecomposed woody material in surface horizon.

Photo 1

Photo 2

SOIL PROFILE DESCRIPTION FORM **PROFILE ID:** 3

NAME: A. Baldwin DATE: December 8, 2020

PROJECT NUMBER/NAME: Abbey Lamm Stream & Wetland Mitigation Site

LOCATION: Alamance County, NC – Right Bank of Main Stem (Restoration Reach, Near Gauge 9)

WEATHER: Sunny 35°F

LANDSCAPE POSITION: Toe of slope SLOPE (%): 2

VEGETATION/CROP: Restored Piedmont Alluvial Forest (6-years post construction)

SOIL MAP UNIT: HnC – Herndon silt loam, 6-10% HYDRIC SOIL FIELD INDICATOR: F8 – Redox Depressions

DEPTH TO WATER: 11-inches DEPTH TO SHWT: 3-inches

DEPTH (inches)	MATRIX		REDOXIMORHPIC FEATURES			TEXTURE
	COLOR	%	TYPE[1]/LOCATION[2]	COLOR	%	
0-3	10YR 3/3	100				CL
3-14+	10YR 5/3	80	C/M	7.5YR 4/6	20	C

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, MS=Masked Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

NOTES: Common fine roots in surface horizon and few fine roots in subsurface horizon. Undecomposed woody material in subsurface horizon.

Photo 1

Photo 2

SOIL PROFILE DESCRIPTION FORM **PROFILE ID:** 4

NAME: A. Baldwin DATE: December 8, 2020

PROJECT NUMBER/NAME: Abbey Lamm Stream & Wetland Mitigation Site

LOCATION: Alamance County, NC – Left Bank of Main Stem (Restoration Reach, Near Gauge 7)

WEATHER: Sunny 35°F

LANDSCAPE POSITION: Toe of slope SLOPE (%): 2

VEGETATION/CROP: Restored Piedmont Alluvial Forest (6-years post construction)

SOIL MAP UNIT: HnC – Herndon silt loam, 6-10% HYDRIC SOIL FIELD INDICATOR: F3 – Depleted Matrix

DEPTH TO WATER: 11-inches DEPTH TO SHWT: 4-inches

DEPTH (inches)	MATRIX		REDOXIMORHPIC FEATURES			TEXTURE
	COLOR	%	TYPE[1]/LOCATION[2]	COLOR	%	
0-4	2.5Y 4/3	100				CL
4-12	10YR 4/2	90	C/M	10YR 5/6	10	C
12-17+	2.5Y 6/2	75	C/M	10YR 5/8	25	SCL

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, MS=Masked Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

NOTES: Common fine roots in surface horizon, seep wetland going up adjacent hillslope with strong hydrology indicators.

Photo 1

Photo 2

SOIL PROFILE DESCRIPTION FORM **PROFILE ID:** 5

NAME: A. Baldwin DATE: December 8, 2020

PROJECT NUMBER/NAME: Abbey Lamm Stream & Wetland Mitigation Site

LOCATION: Alamance County, NC – Left Bank of Main Stem (Restoration Reach, At Gauge 6)

WEATHER: Sunny 40°F

LANDSCAPE POSITION: Toe of slope SLOPE (%): 2

VEGETATION/CROP: Restored Piedmont Alluvial Forest (6-years post construction)

SOIL MAP UNIT: MaC – Mandale/Secrest Complex, 6-10% HYDRIC SOIL FIELD INDICATOR: F3 – Depleted Matrix

DEPTH TO WATER: 8-inches DEPTH TO SHWT: 3-inches

DEPTH (inches)	MATRIX		REDOXIMORHPIC FEATURES			TEXTURE
	COLOR	%	TYPE[1]/LOCATION[2]	COLOR	%	
0-4	10YR 4/3	90				SiCL
4-8	10YR 5/6	40	D/M	10YR 5/2	5	C
	10YR 5/4	40	C/M	7.5YR 5/8	15	
8-10+	10YR 5/2	75	C/M	7.5YR 5/8	5	SCL
			C/M	7.5YR 4/6	20	

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, MS=Masked Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

NOTES: Common 1-2” gravel in subsurface, and auger refusal to rock at 10-inches.

Photo 1

Photo 2

Mainstem – Middle of Old Pond Bed

Old Pond Bed – Soil Profile #1

Old Pond Bed

Mainstem – Old Pond Bed

Old Pond Bed – Gauge 8

Mainstem – Old Pond Bed Soil Profile 2

Old Pond Bed – Gauge 9

Old Pond Bed – Gauge 7

Old Pond Bed – Upstream of Gauge 7

Old Pond Bed – Mainstem

Veg Plot 12

Mainstem Near XC 20, Transition from Restoration to Enhancement 2

Confluence of UT3 and Mainstem

Mainstem Adjacent to Gauge 6

Gauge 6

Gauge 5 (and 6B in Background)

Mainstem Next To Gauge 6B

Soils adjacent to Gauge 6B

Soils Next to Gauge 5

Confluence of UT1 and UT2

Upper Extent of UT1

Upper Extent of UT2

Headwaters of UT3 (near Plot 9)

Middle Headwater Branch of UT3

Confluence of UT3 Headwaters

Mainstem Looking Downstream of the Most Downstream Crossing (Just Below XS 16)