CONCEPTUAL MITIGATION PLAN

CASCADE LOGISTICS PARK (NWS-2020-571)

DECEMBER 2020

Soundview Consultants
Environmental Assessment
Planning + Land Use Solutions

CONCEPTUAL MITIGATION PLAN
CASCADE LOGISTICS PARK (NWS-2020-571)

DECEMBER 22, 2020

PROJECT LOCATION

6600 172ND STREET NORTHEAST
ARLINGTON, WASHINGTON 98223

15223 51ST AVENUE NORTHEAST
MARYSVILLE, WASHINGTON 98271

16015 51ST AVENUE NORTHEAST
MARYSVILLE, WASHINGTON 98271

5414 152ND STREET EAST
MARYSVILLE, WASHINGTON 98271

PREPARED FOR

NORTHPOINT HOLDINGS, LLC
4825 NORTHWEST 41ST STREET, SUITE 500
RIVERSIDE, MISSOURI 64150

PREPARED BY

SOUNDVIEW CONSULTANTS LLC
2907 HARBORVIEW DRIVE, SUITE D
GIG HARBOR, WASHINGTON 98335
(253) 514-8952

Soundview Consultants
Environmental Assessment
Planning + Land Use Solutions

Executive Summary

Soundview Consultants LLC (SVC) is assisting NorthPoint Holdings, LLC (Applicant) with this mitigation plan for the Cascade Logistics Park project located on a 361.19-acre site in the Cities of Arlington and Marysville, Washington. The subject property consists of 14 tax parcels situated in the Northeast and Southwest ¼ of Section 27 and Northwest and Southwest ¼ of Section 34, Township 31 North, Range 5 East, W.M. (Snohomish County Tax Parcel Numbers 31052700100100, 31052700100300, 31052700300200, 31052700300500, 31052700300700, 31052700300800, 31052700300900, 31052700400300, 31053400200300, 31053400200400, 31053400200500, 31053400200600, 31053400200700, and 31053400300300).

SVC investigated the subject property for the presence of potentially regulated wetlands, waterbodies, and other fish and wildlife habitat on multiple dates in March, April, May, June, July, August, September, and October of 2020. SVC delineated one stream (Edgecomb Creek), one fish-bearing agricultural ditch (Ditch X), and 37 wetlands (Wetlands A-Z, AA-AK) and identified additional agricultural or roadside ditches (51st Avenue East Ditch, two 152nd Street Ditches, and Ditch U) in the project area. The 51st Avenue East Ditch is also being treated as a wetland at the local and state levels. Refer to SVC's *Wetland and Fish and Wildlife Habitat Assessment Report* (2020) for additional information including a detailed description of onsite aquatic features.

The Applicant proposes to restore Edgecomb Creek and develop a regional industrial park to include multiple double-loaded and single-loaded buildings and associated infrastructure such as parking, access roads, frontage improvements, utilities, and stormwater management facilities utilizing enhanced water quality treatment for runoff from all impervious surfaces. Frontage improvements along 51st Avenue Northeast will include widening the existing two-lane road to a three-lane road and half street improvements (multi-modal path, curb, and gutter). Frontage improvements and roadway upgrades along 152nd Street East include expansion of the existing two-lane road to include up to five lanes with a curb, sidewalk, and gutter.

The project was carefully designed in attempts to minimize impacts to wetlands and waterbodies to the greatest extent feasible, and the project will avoid impacts to a large Category II wetland (Wetland AH), four smaller wetlands, and existing meandering sections of Edgecomb Creek on the northeast and southeast corners of the site. These avoidance measures are targeted towards the higher functioning aquatic areas onsite. However, complete avoidance of aquatic features is not possible due to the central location of the ditched Edgecomb Creek on the subject property, the scattered distribution of wetlands throughout the subject property, and the large spatial footprints required for industrial buildings and associated utilities and road infrastructure. In order to accommodate the purpose and need for the industrial site development, the project requires the necessary and unavoidable fill, realignment, and restoration of Edgecomb Creek (10,165 linear feet), fill and realignment of Ditch X (1,167 linear feet), and total fill of 2.66 acres of federally jurisdictional wetlands (plus 0.71 acres of additional fill of the non-jurisdictional 51st Avenue East Ditch which is being treated as a wetland at the local and state levels) for a total of 3.36 acres of direct wetland impacts. In addition, the proposed project will indirectly impact approximately 960 linear feet of offsite swales connected to Edgecomb Creek, and other onsite ditches will be filled or piped.

The compensatory mitigation actions outlined herein are intended to compensate for lost wetland and stream functions and values by providing an overall improvement in water quality, hydrologic, and

habitat functions according to the needs of the site, local sub-basin, and overall Snohomish River watershed. To offset the necessary impacts to Edgecomb Creek, the project proposes to realign Edgecomb Creek within a restored riparian corridor on the eastern portion of the project area. The riparian corridor will be 215 feet wide in the City of Arlington and up to 315 feet wide in the City of Marysville, and a pedestrian trail will provide public access through the riparian corridor from 172nd Street Northeast to 152nd Street Northeast. Edgecomb Creek will be realigned through a restored stream channel that meanders through the riparian corridor; additional side channels will be created and connected to the mainstem stream channel to provide off-channel habitat and flood refugia for fish. Suitable streambed substrates will be added the new channels, and stream functions will be further enhanced by small and large woody debris placement within channels and in the flood terrace. Riparian functions will be restored by diverse native plantings to create forested, scrub-shrub, and emergent habitats. The re-aligned main-stem stream channel and created side-channel habitat will provide mitigation at a minimum of 1:1 for the fill of the existing Edgecomb Creek stream channel. Ditch X will also be re-aligned, lengthened, and reconnected to the re-aligned Edgecomb Creek.

Compensatory wetland re-establishment and creation will occur within the riparian corridor, meeting local, state, and federal mitigation ratios for direct wetland impacts. A minimum of 5.84 acres of wetland re-establishment/creation is required to compensate for the 3.36 acres of necessary wetland fill, although the conceptual mitigation design estimates that the mitigation corridor will achieve approximately 18 acres of wetland creation and 3 acres of wetland enhancement. Any excess wetland mitigation credits are proposed for use by the Applicant as advanced mitigation for any future wetland impact proposal(s).

As a non-compensatory mitigation measure, the Applicant proposes to replace two partial fish barrier culverts underneath the BNSF railroad with box culverts designed to allow fish access and convey Edgecomb Creek beneath the railroad. A box culvert will also be added beneath 152nd Street Northeast to convey the re-aligned stream channel.

The table below identifies the wetlands and other waters identified during the site investigations and summarizes the expected regulatory status.

Wetland / Waterbody	Size/Length Onsite	Local Jurisdiction Location	Category/ Type[1]	Regulated under Section 404 of the CWA[2]
A	1,369 SF	Arlington	IV	Assumed[3]
B	4,859 SF	Arlington	IV	Assumed[3]
C	4,841 SF	Arlington	IV	Assumed[3]
D	3,537 SF	Arlington	IV	Assumed[3]
E	775 SF	Arlington	III	Likely
F	386 SF	Arlington	III	Likely
G	987 SF	Arlington	III	Likely
H	6,279 SF	Arlington	II	Likely
I	377 SF	Marysville	III	Likely
J	334 SF	Marysville	IV	Assumed[3]
K	16,836 SF	Marysville	IV	Assumed[3]
L	15,756 SF	Marysville	IV	Likely
M	1,969 SF	Marysville	IV	Assumed[3]
N	8,133 SF	Marysville	IV	Assumed[3]
Offsite O	N/A	Arlington/ Marysville	III	Assumed[3]
P	550 SF	Arlington	IV	Assumed[3]
Q	2,522 SF	Arlington	IV	Assumed[3]
R	1,773 SF	Arlington	IV	Assumed[3]
Offsite S	N/A	Marysville	IV	Assumed[3]
Offsite T	N/A	Marysville	IV	Assumed[3]
U	4,909 SF	Marysville	IV	Assumed[3]
V	5,945 SF	Arlington	III	Assumed[3]
W	258 SF	Marysville	IV	Assumed[3]
X	4,492 SF	Marysville	IV	Assumed[3]
Y	662 SF	Arlington	III	Likely
Z	483 SF	Marysville	III	Likely
AA	574 SF	Marysville	III	Likely
AB	1,166 SF	Marysville	III	Likely

AC	4,866 SF	Marysville	IV	Assumed[3]
AD	2,462 SF	Marysville	III	Likely
AE	11,346 SF	Marysville	IV	Assumed[3]
AF	615 SF	Marysville	IV	Assumed[3]
AG	285 SF	Marysville	IV	Assumed[3]
AH	180,709 SF	Marysville	II	Likely
AI	3,873 SF	Marysville	III	Likely
AJ	2,471 SF	Marysville	III	Likely
AK	696 SF	Marysville	IV	Assumed[3]
Edgecomb Creek	10,723 LF	Arlington/ Marysville	F-ESA / F	Likely
51st Avenue East Ditch	44,087 LF	Marysville	N/A (non-typed)[5]	North of 152nd Avenue: Non-Jurisdictional (USACE, 2020); South of 152nd Avenue: Unlikely
Ditch U	1,223 LF	Marysville	N/A (non-typed)	Unlikely
Ditch X	1,167 LF	Arlington	F-ESA	Assumed[3]
152nd Street Ditches	~0.33 mile	Marysville	N/A (non-typed)	Unlikely

Notes:

1. Current Washington State Department of Ecology (WSDOE) wetland rating system (Hruby, 2014) per MMC 22E.010.060.1 and AMC 20.93.800.a. DNR Water Typing system per MMC 22E.010.060.1. and AMC 20.93.700.
2. Per 2020 Navigable Waters Protection Rule.
3. Potentially non-jurisdictional federally; however, regulation under Section 404 of the CWA assumed in order to expedite permitting process.
4. Does not include approximately 732 linear feet of ditch located on Parcels 31052700300600, 31052700301000, and 31053400201400, outside of the project area but likely affected by frontage improvement requirements along 51st Avenue Northeast.
5. The 51st Avenue East Ditch, which is non-jurisdictional federally, is being treated as a Category III wetland to expedite the local and state permitting processes.

Table of Contents

Chapter 1. Regulatory Considerations 1
1.1 Local Regulations 1
1.2 State and Federal Considerations 7
Chapter 2. Conceptual Mitigation Plan 10
2.1 Purpose and Need 10
2.2 Description of Impacts 10
2.3 Mitigation Strategy 15
2.4 Approach and Best Management Practices 21
2.5 Mitigation Implementation 22
2.6 Goals, Objectives, and Performance Standards 24
2.7 Plant Materials and Installation 27
2.8 Maintenance & Monitoring Plan 29
2.9 Reporting 29
2.10 Contingency Plan and Long-Term Management Plan 29
2.11 Critical Areas Easement 30
2.12 Financial Assurances 31
Chapter 3. Closure 32
Chapter 4. References 33

Tables

Table 1. Wetland Impact Summary 11
Table 2. Summary of Existing Stream Habitat Conditions. 14
Table 3. Compensatory Wetland Mitigation Summary 17
Table 4. Stream Habitat Parameters Targeted for Restoration. 19

Appendices

Appendix A – Conceptual Mitigation Plan Exhibits
Appendix B – Basis of Design
Appendix C – Qualifications

Chapter 1. Regulatory Considerations

The site assessments in the winter, spring, summer, and fall of 2020 identified a total of 37 potentially regulated wetlands (Wetlands A-Z and AA-AK), one stream (Edgecomb Creek), one fish-bearing ditch (Ditch X), one non-wetland agricultural ditch (Ditch U) that is likely considered a Water of the State, and one roadside ditch (51st Avenue East Ditch) that will be treated as a wetland for local and state permitting purposes. No other potentially regulated wetlands, waterbodies, or other fish and wildlife habitat were identified in the project area.

The proposed project area is located within both the City of Arlington and the City of Marysville. A total of 13 delineated wetlands (Wetlands A-H, P-R, V and Y) are located entirely in the City of Arlington jurisdiction, and 23 delineated wetlands (Wetlands I-N, S-U, W, X, Z, and AA-AK) are located entirely in the City of Marysville jurisdiction. One delineated wetland (Wetland O) is located on the jurisdictional boundary between the two cities. Ditch X is located in the City of Arlington, and the onsite 51st Avenue East Ditch is located in the City of Marysville. Edgecomb Creek is located in both the City of Arlington and the City of Marysville.

The Applicant is currently negotiating development agreements with the Cities of Arlington and Marysville. The proposed mitigation actions specified herein have generally been designed according to the standards and conditions of the proposed development agreements.

1.1 Local Regulations

1.1.1 Wetland Buffers

City of Arlington

Arlington Municipal Code (AMC) 20.93.800(a) has adopted the 2014 *Revised Washington State Wetland Rating System for Western Washington* (Hruby, 2014). Under the 2014 wetland rating system, Category IV wetlands are those that generally provide low levels of function and score less than 16 points. Category IV wetlands are often heavily disturbed and are wetlands that should be replaceable. Category III wetlands are those that generally provide moderate levels of function and score between 16 and 19 points. Category III wetlands have generally been disturbed in some ways and are often less diverse or more isolated from other natural resources in the landscape than Category II wetlands. Category III wetlands can often be adequately replaced with a well-planned mitigation project. Category II wetlands provide high levels of some functions and score between 20 and 22 points. Category II wetlands are difficult, though not impossible, to replace. AMC 20.93.830 identifies standard buffers for wetlands based on habitat score assuming the implementation of all minimization measures listed in AMC Table 20.93-5. Category II, III, and IV wetlands were identified during the site investigations:

- Category II wetland with habitat score of 6 (Wetland H)
- Category III wetlands with habitat score of 5 (Wetland G and Wetland V)
- Category III wetlands with habitat score of 4 (Wetlands E, F, Offsite Wetland O, and Y)
- Category IV wetlands with habitat scores of 4 or less (Wetlands A-D and P-R)

The standard buffer for a Category IV wetland is 40 feet; a Category III wetland with a habitat score less than 5 points is 60 feet; a Category III wetland with habitat score of 5 is 105 feet; and a Category II wetland with a habitat score of 6 or 7 points is 165 feet. Per AMC 20.93.340, a 15-foot building setback is required from the edge of any critical area buffer.

City of Marysville

Marysville Municipal Code (MMC) 22E.010.060.1 has also adopted the 2014 wetland rating system. The following Category II, III and IV wetlands were delineated during the site investigations:

- Category II wetland with a habitat score of 6 (Wetland AH)
- Category III wetland with habitat score of 4 (Wetlands AA, AB, AI, AJ, I, and Z and Offsite Wetland O)
- Category IV wetlands with habitat score of 4 or less (Wetlands AC, AE-AG, AK, J-N, U, W, and X and Offsite Wetlands U, S and T)

Although the 51st Avenue East Ditch is an artificially and intentionally created drainage feature, WSDOE believes that the ditch meets of the definition of a wetland under the Revised Code of Washington (RCW) 36.70A.030 and RCW 90.48. WSDOE has concluded the roadside ditch was likely constructed from a wetland in the early 1900s (email correspondence between Soundview Consultants and Neil Molstad, WSDOE, 10/28/2020). The Applicant has indicated their disagreement with WSDOE's determination; however, the Applicant has decided to accept the positive wetland determination for the Cascade Logistics Park project. The 51st Avenue East Ditch is being treated as a Category III wetland and subject to a standard 75-foot buffer per MMC 22E.010.100(4).

Per MMC 22E.010.380, a 15-foot building and structure setback is required from the edge of critical area buffers.

1.1.2 Stream Buffers

City of Arlington

Per AMC 20.93.700, the City of Arlington has adopted the state water classification system specified in WAC 222-16-030. Per AMC 20.93.700(b), a Type F water includes segments of natural waters that are not classified as Type S (shoreline) and have a substantial fish, wildlife, or human use. Per AMC 20.93.700(a)(2), Type F-ESA water is a water that meets the criteria of a Type F stream and has been identified as having presumed use by ESA-listed fish species. Edgecomb Creek is likely considered a Type F-ESA water due to modeled Chinook and steelhead presence identified by the WDFW SalmonScape inventory. While Ditch X is an artificially created feature, this ditch is likely considered a Type F-ESA water due to the provision of off-channel habitat for salmonids. Per AMC Table 20.93-3, the standard buffer for a Type F-ESA water is 150 feet. Per AMC 20.93.440(a)(1) this 150-foot buffer shall consist of a 100-foot designated native growth protection easement in which no human activity is allowed (unless specified by AMC 20.93.430) and a 50-foot management zone in which vegetation may be managed for public health and safety reasons.

City of Marysville

Per MMC 22E.010.210(1), streams shall be classified according to the water type system as provided by WAC 222-16-030 as amended. Per MMC 22E.010.210(1)(b) a Type F stream is a stream segment that is not a Type S (shoreline) and is presumed to be used by salmonid fish. Edgecomb Creek is considered a Type F stream due to documented salmonid use. Per MMC 22E.010.220(1)(a), Type F streams are subject to a standard 150-foot buffer.

Per MMC 22E.010.220(3)(a) and 22E.010.220(3)(b), stream buffers shall be measured from the ordinary high water mark as defined in the field, or, if that cannot be determined, from the top of the bank. In braided channels and alluvial fans, the OHW mark or top of bank shall be determined so as to include the entire stream feature. As Edgecomb Creek enters Wetland AH at the far southern project extent, the channel begins to braid and contains several side channels. As such, the standard 150-foot Type F stream buffer projects from the OHW of the main stem and side channels of Edgecomb Creek.

1.1.3 Mitigation Sequencing

Per AMC 20.93.740, AMC 20.93.840, AMC 20.08.010, MMC 22E.010.110(1) and MMC 22E.010.230(1), all adverse impacts to stream and wetland functions and values shall be mitigated using the following sequence:

a) Avoiding the impact altogether by not taking a certain action or parts of actions;

The Applicant proposes industrial development on the subject property to include nine buildings, City and private roads, loading and parking areas, stormwater infrastructure, and other associated infrastructure and utilities. The proposed project has been carefully designed to avoid and minimize impacts to wetland and streams where feasible. Avoidance and minimization measures are targeted at higher functioning aquatic areas onsite, and the proposed site plan avoids impacts to the large Category II Wetland AH and meandering sections of Edgecomb Creek on the northeast and southeast corners of the site. Several small Category IV wetlands (Wetlands O, S, T, and AK) will also be preserved in the riparian corridor. Due to the central location of Edgecomb Creek, the scattered distribution of wetlands across the site, and the large spatial requirements of an industrial park, relocation of Edgecomb Creek and direct wetland impacts are unavoidable. The proposed impacts are necessary in order to achieve the project objectives, including the development of large industrial buildings and maintenance of traffic conductivity on public and private roads across the large site. The Cities of Arlington and Marysville have long recognized the public need to relocate and restore Edgecomb Creek to avoid the long-term effects of retaining the existing degraded stream amidst an industrially zoned area. Relocating Edgecomb Creek beneficially allows for restoration of the existing degraded and ditched salmonid habitat within the urban landscape.

Overall, the project requires the necessary and unavoidable fill, realignment, and restoration of Edgecomb Creek (10,165 linear feet), fill and realignment of Ditch X (1,167 linear feet), and total fill of 2.656 acres of federally jurisdictional wetlands (plus 0.706 acres of additional fill of the non-jurisdictional 51st Avenue East Ditch which is being treated as a wetland at the local and state levels) for a total of 3.362 acres of direct wetland impacts. In addition, the proposed project will

indirectly impact approximately 960 linear feet of offsite swales connected to Edgecomb Creek, and other onsite ditches must be filled or piped.

b) Minimizing impacts by limiting the degree or magnitude of the action and its implementation, by using appropriate technology, or by taking affirmative steps to avoid or reduce impacts;

The proposed project has been carefully designed to minimize impacts on the onsite critical areas. The proposed relocation is primarily limited to the stream segments that were historically ditched and avoids impacts to the more naturally formed meandering stream reaches at the northern and southern ends of the project area. Water quality and hydrology impacts from the development will be minimized through the use of stormwater infrastructure that will consist of enhanced water quality treatment, detention ponds, and dispersion into the proposed riparian corridor. Temporary impacts to the stream and fish during relocation will be minimized through water quality monitoring and fish exclusion and protection following plans provided under separate covers. Appropriate best management practices (BMPs) and temporary erosion and sediment control (TESC) measures will be implemented for the duration of project activities to minimize potential construction impacts to the stream and remaining onsite and offsite wetlands.

c) Rectifying the impact by repairing, rehabilitating, or restoring the affected environment;

Compensatory mitigation for the unavoidable and direct stream and wetland impacts will be rectified through onsite, in-kind stream restoration and wetland creation/re-establishment actions. The 51st Avenue East Ditch is being treated as a wetland for local and state permitting purposes, and compensatory mitigation will be provided for the proposed fill of this ditch in addition to the other wetland and stream impacts. Non-compensatory riparian and wetland enhancement and coordination of two culvert replacements with the BNSF Railroad is also proposed to improve existing riparian and wetland functions and improve fish passage through the site.

d) Reducing or eliminating the impact over time by preservation and maintenance operations;

The proposed riparian mitigation corridor will be protected through placement in a separate protective tract as required under AMC 20.93.830 and MMC 22E.010.350(2). The location and limitations associated with this protection will be shown on the face of the deed applicable to the property and shall be recorded with Snohomish County's recording department. Critical areas fencing and signage will be installed around the riparian mitigation corridor as required per AMC 20.93.290(a) and MMC 22E.010.370. Maintenance and monitoring actions will be provided as outlined in Chapter 2 of this report.

e) Compensating for the impact by replacing or providing substitute resources or environments;

See response to criteria (c) above. Compensatory mitigation for the unavoidable and direct stream and wetland impacts will be rectified through onsite, in-kind stream and wetland creation. Onsite wetland creation and enhancement will be provided according to the mitigation ratios established by AMC 20.93.840(d) and MMC 22E.010.120(3). [A minimum of 5.844 acres of wetland re-establishment/creation is required to compensate for the 3.362 acres of necessary wetland fill, although the conceptual mitigation design estimates that the mitigation corridor will achieve approximately 18 acres of wetland creation and 3 acres of wetland enhancement. Any excess

wetland mitigation credits are proposed for use by the Applicant as advanced mitigation for any future wetland impact proposal(s).]

f) Monitoring the impact and taking appropriate corrective measures.

The riparian mitigation corridor will be monitored for a period of 10 years. Monitoring and contingency plans are provided in Chapter 2 of this report.

1.1.4 Wetland Mitigation Requirements

City of Arlington

Per AMC 20.93.840(a), unavoidable wetland impacts shall be compensated in order to avoid significant environmental impacts. In order of preference, compensation may be provided by: 1) onsite wetlands restoration/improvement, 2) onsite wetlands creation, 3) onsite wetlands buffer restoration, and 4) offsite wetlands protection. Due to the scattered distribution of wetlands and large spatial requirements of the proposed industrial park, complete fill of most onsite wetlands (including all wetlands within the City of Arlington jurisdiction) is unavoidable. Onsite compensatory wetland creation and enhancement will be provided according to the mitigation ratios established by AMC 20.93.840(d) and AMC Table 20.93-6. The mitigation site as a whole (within the Cities of Arlington and Marysville) is expected to create wetland credits in excess of local mitigation ratios; the additional wetland mitigation areas may be used as advance mitigation for future projects. The proposed protective buffers for the wetland mitigation areas will be provided by the 215-foot-wide riparian mitigation corridor within the City of Arlington or as established in the development agreement.

City of Marysville

MMC 22E.010.120(1) provides the following standards regarding the location and timing of wetland mitigation:

a) Restoration, creation, or enhancement actions should be undertaken on or adjacent to the site, or where restoration or enhancement of a former wetland is proposed, within the same watershed. Replacement in-kind of the impacted wetland is preferred for creation, restoration, or enhancement actions. The city may accept or recommend restoration, creation, or enhancement which is off-site and/or out-of-kind, if the applicant can demonstrate that on-site or in-kind restoration, creation, or enhancement is infeasible due to constraints such as parcel size or wetland type or that a wetland of a different type or location is justified based on regional needs or functions;

Onsite, in-kind, permittee-responsible compensatory wetland creation will be provided according to the mitigation ratios established by MMC 22E.010.120(3).

b) Whether occurring on-site or off-site, the mitigation project shall occur near an adequate water supply with a hydrologic connection to the wetland to ensure a successful wetlands development or restoration;

The proposed wetland creation actions will occur within the riparian restoration corridor. Created wetlands will be located adjacent to the realigned Edgecomb Creek and excavated down to tie into groundwater levels as necessary to provide adequate hydrology. Wetland enhancement actions will occur within existing wetlands within the restoration corridor.

c) Any agreed-upon proposal shall be completed before initiation of other permitted activities, unless a phased or concurrent schedule has been approved by the community development department;

Timing of mitigation activities will occur according to the standards and conditions of the development agreement. Construction of the mitigation site is currently anticipated to commence the summer of 2021, once appropriate authorizations are obtained.

d) Wetland acreage replacement ratios shall be as specified in subsection (3) of this section.

The proposed compensatory wetland mitigation actions will occur according to the mitigation ratios established by MMC 22E.010.120(3).

Additionally, MMC 22E.010.120(2) states that proposals which include compensatory mitigation shall demonstrate the following:

a) All feasible and reasonable measures will be taken to reduce impacts and losses to the original wetland;

The proposed project reduces impacts to onsite wetlands by avoiding impacts to the large Category II Wetland AH. Wetland AH provides high levels of water quality and hydrologic functions and moderate levels of habitat functions. Proposed habitat enhancement will improve habitat functions within the wetland by reducing non-native, invasive species cover and increasing native tree and shrub cover. Several small Category IV wetlands (Wetlands O, S, T, and AK) will also be avoided. The proposed project will minimize water quality and hydrology impacts to these wetlands through the use of enhanced stormwater treatment, detention ponds, and dispersion of the treated and attenuated runoff into the riparian corridor. Additional reduction of wetland impacts and losses is not feasible due to the scattered wetland distribution across the site, the large spatial footprint required for an industrial park, and required frontage improvements.

b) No overall net loss will occur in wetland functions, values and acreage; and

Wetland creation in the restored riparian corridor is proposed according to according to the mitigation ratios established by MMC 22E.010.120(3), and no net loss in wetland functions, values, or acreage will occur.

c) The restored, created or enhanced wetland will be as persistent and sustainable as the wetland it replaces.

The created wetlands will be located within the restored riparian corridor with hydrology provided by the realigned Edgecomb Creek, runoff, and precipitation. The existing wetlands are primarily located in agricultural fields and along the ditched Edgecomb Creek. The proposed wetland creation area is anticipated to contain forest, scrub-shrub, and emergent vegetation and be protected by a separate tract or easement from future development. Given the proposed hydrology sources and native plantings, the created wetlands will be as persistent and sustainable as the impacted wetlands.

1.1.5 Stream Mitigation Requirements

City of Arlington

AMC 20.93.740(a) describes required mitigation for activities not allowed per AMC 20.93.720 (Streams, Creeks, Rivers, Lakes, and Other Surface Waters – Allowed activities). The proposed project requires the relocation of Edgecomb Creek and Ditch X in order to develop the regional industrial park. The proposed project requires the realignment of Ditch X and will indirectly impact offside swales connected to Edgecomb Creek on tax parcel number 31052700200900. Mitigation ratios for stream impacts will be implemented according to the standards and conditions of the proposed Development Agreement.

City of Marysville Mitigation Requirements

Per MMC 22E.010.230(3)(b) alteration of Type F streams may be permitted provided that the applicant mitigates adverse impacts consistent with the performance standards and other requirements of the chapter and provided that no net loss will occur in stream functions and fish habitat. Per MMC 22E.010.230(3)(c) relocation of a stream may only occur when it is part of an approved mitigation or rehabilitation plan and will result in equal or better habitat and water quality and will not diminish flow capacity of the stream. The proposed project requires the relocation of Edgecomb Creek in order to achieve traffic connectivity across the site on public and private roads, provide utility connections, and accommodate the large spatial footprint required by industrial buildings and associated infrastructure. The re-aligned main-stem stream channel and created side-channel habitat will provide mitigation at a minimum of 1:1 for the fill of the existing Edgecomb Creek stream channel, and no reduction in flow capacity is anticipated based on the proposed channel design. The proposed Edgecomb Creek will be restored to a meandering stream channel through a riparian corridor of native vegetation and provide significantly improved stream functions and fish wildlife habitat.

1.2 State and Federal Considerations

1.2.1 Federal Requirements

WSDOE regulates surface waters of the state under RCW 90.48 and WAC 173-201A for potential impacts to water quality. WAC-173-201A-020 provides definitions of surface waters of the state and wetlands.

Per WAC 173-201A-020, surface waters of the state are defined as:

> *"includes lakes, rivers, ponds, streams, inland waters, saltwaters, wetlands and all other surface waters and water courses within the jurisdiction of the state of Washington.*"

Per WAC 173-201A-020, wetlands are defined as:

> *"wetlands means areas that are inundated or saturated by surface water or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs, and similar areas. Wetlands do not include those artificial wetlands intentionally created from nonwetland sites including, but not limited to, irrigation and drainage ditches, grass-lined swales, canals, detention facilities,*

wastewater treatment facilities, farm ponds, and landscape amenities, or those wetlands created after July 1, 1990, that were unintentionally created as a result of the construction of a road, street, or highway. Wetlands may include those artificial wetlands intentionally created from nonwetland areas to mitigate the conversion of wetlands. (Water bodies not included in the definition of wetlands as well as those mentioned in the definition are still waters of the state.)"

All identified onsite wetlands (including the 51st Avenue East Ditch), Edgecomb Creek, and Ditch X are likely to be regulated as waters of the state of Washington under the RCW 90.48 and WAC 173-201A. Ditch U acts as a feeder ditch to the 51st Avenue East Ditch, indirectly contributing surface water runoff to a downgradient tributary (Edgecomb Creek). As such, Ditch U is likely to be regulated as a waters of the state as a non-wetland water. The 152nd Street Ditches are artificially and intentionally created ditches that convey only ephemeral runoff that appears to primarily infiltrate. These ditches are not likely regulated as waters of the state. An Administrative Order (AO) will be sought from WSDOE for the proposed impacts to the waters of the state (e.g., Ditch U and the 51st Avenue East Ditch) that are not considered federally jurisdictional.

1.2.2 Federal Requirements

The Federal Register published "The Navigable Waters Protection Rule: Definition of "Waters of the United States" on April 21, 2020. The Navigable Waters Protection Rule was the second step in reviewing and revising the definition of WOTUS as intended by the Executive Order "Restoring the Rule of Law, Federalism, and Economic Growth by Reviewing the 'Waters of the United States Rule." The Navigable Waters Protection Rule became effective June 22, 2020.

The Navigable Waters Protection Rule effectively replaced the "Definition of Waters of the United States – Recodification of Pre-Existing Rules" rule published on October 22, 2019 (repealing the Clean Water Rule) and the 2008 joint guidance memorandum from USACE and EPA. The following describes potential regulatory classifications for the onsite stream, wetlands, and ditches under the Navigable Waters Protection Rule. Of note, the proposed project is assuming USACE jurisdiction over Edgecomb Creek and all onsite wetlands in order to support an expedited permitting process. Due to the proposed fill of the existing stream channel and onsite wetlands, the proposed project will require an Individual Section 404 Permit from the USACE. No direct impacts are proposed to the offsite wetlands or ditches; thus, potential regulatory classification for these offsite features is not described in this report.

Under the final Navigable Waters Protection Rule, the agencies interpret the term WOTUS to encompass: 1) the territorial seas and traditional navigable waters; 2) perennial and intermittent tributaries that contribute surface water flow to such waters; 3) certain lakes, ponds, and impoundments of jurisdictional waters; and 4) wetlands adjacent to other jurisdictional waters.

The Navigable Waters Protection Rule specifies that WOTUS do not include: a) groundwater, including groundwater drained through subsurface drainage systems; b) ephemeral features that flow only in direct response to precipitation, including ephemeral streams, swales, gullies, rills, and pools; c) diffuse stormwater runoff and directional sheet flow over upland; d) ditches that are not traditional navigable waters, tributaries, or that are not constructed in adjacent wetlands, subject to certain limitations; e) prior converted cropland; f) artificially irrigated areas that would revert to upland if artificial irrigation ceases; g) artificial lakes and ponds that are not jurisdictional impoundments and that are constructed or excavated in upland or non-jurisdictional waters; h) water-filled depressions

constructed or excavated in upland or in non-jurisdictional waters incidental to mining or construction activity, and pits excavated in upland or in non-jurisdictional waters for the purpose of obtaining fill, sand, or gravel; i) stormwater control features constructed or excavated in upland or in non-jurisdictional waters to convey, treat, infiltrate, or store stormwater runoff; j) groundwater recharge, water reuse, and wastewater recycling structures constructed or excavated in upland or in non-jurisdictional waters; and k) waste treatment systems.

Under the Navigable Waters Protection Rule, Edgecomb Creek is likely regulated through category 2 of WOTUS because it is a perennial, natural tributary within a stream network that eventually drains into Puget Sound, a traditionally navigable water. It will be assumed that Ditch X is regulated to expedite the overall permitting process. The onsite ditches (Ditches U and X; 51st Avenue East Ditch, and the two 152nd Street Ditches) are artificially excavated ditches constructed for agricultural or roadside drainage purposes; these ditches are not constructed within tributaries nor do they relocate a tributary. USACE has determined that the 51st Avenue East Ditch north of 152nd Street is not a WOTUS because it is an excluded non-waters of the U.S. per 33 CFR Part 328.3(b) (USACE, 2020; Appendix J). Similarly, the onsite stormwater ponds are artificial features that have been excavated for the purposes of collecting stormwater runoff and are likely non-jurisdictional by USACE through category i above of waters that are not considered to be WOTUS.

Of the delineated wetlands, Wetlands E, F, G, H, I, L, Y, Z, AA, AB, AD, AH, AI, and AJ abut Edgecomb Creek and are likely regulated by USACE outright through category 3 above. The remaining onsite delineated wetlands (Wetlands A, B, C, D, J, K, M, N, Q, R, U, V, W, X, AC, AE, AF, AG, and AK) do not abut Edgecomb Creek, are not located within a FEMA mapped floodplain, and are therefore potentially not regulated by USACE.

The Navigable Waters Protection Rule establishes that prior converted cropland is not considered WOTUS (category e above). Prior converted cropland means any area that, prior to December 23, 1985, was drained or otherwise manipulated for the purpose, or having the effect, of making production of an agricultural product possible. USACE and the EPA will recognize designations of prior converted cropland made by the Secretary of Agriculture. All of the onsite wetlands, except for Wetland AH, are located within active agricultural fields and may be eligible for prior converted cropland status, although no prior converted cropland determination has been made for these wetlands according to documents received from local public records requests for wetland documentation on the subject property.

Due to the proposed fill of the jurisdictional Edgecomb Creek and other wetlands under the Navigable Waters Protection Rule, the proposed project presumes the need for an Individual Permit application with USACE. While several onsite wetlands are potentially not regulated as WOTUS and most of the onsite wetlands may be eligible for prior converted cropland status under the Navigable Waters Protection Rule (excluding Wetland AH), the proposed project is assuming USACE jurisdiction over all onsite wetlands in order to support a streamlined and expedited permitting process, though an approved jurisdictional determination will be sought for Ditch U and the remainder of the 51st Avenue East Ditch. If these ditches are confirmed to be non-jurisdictional waters, then an administrative order from WSDOE will be required for required impacts.

Chapter 2. Conceptual Mitigation Plan

The proposed mitigation actions for the project attempt to strike a balance between achieving project goals as well as a positive result in terms of ecological lift. In general, joint USACE and EPA rules have been established that require more careful mitigation planning efforts utilizing a watershed approach in site selection, establishment of enforceable performance standards, and preference for use of mitigation banks or ILF's wherever most ecologically feasible (USACE & EPA, 2008). The proposed wetland and stream impacts and mitigation actions attempt to closely adhere to these rules and to the local critical areas regulations specified in AMC Chapter 20.93 and MMC Chapter 22E.010 and the Applicant's development agreements (currently not finalized) while also utilizing the best available science (Granger et al., 2005; Hruby et al., 2009; Sheldon et al., 2005; and WSDOE, 2006). In addition to the proposed compensation for onsite wetland loss, the mitigation actions may result in additional wetland mitigation credits that may be used as advanced mitigation for future wetland loss within the watershed. This chapter presents the overall mitigation details for the proposed Cascade Logistics Park project.

2.1 Purpose and Need

The purpose of the proposed project is to develop a regionally significant industrial park that will provide industrial building space within the Cascade Industrial Center, a Manufacturing and Industrial Center as designated by the Puget Sound Regional Council and located in the Cities of Arlington and Marysville. A more robust purpose and need is included in SVC's Clean Water Action Section 404(b)1 alternatives analysis (2020).

2.2 Description of Impacts

In order to accommodate the purpose and need for the industrial site development, the project requires the necessary and unavoidable fill, realignment, and restoration of Edgecomb Creek (10,165 linear feet; 147,522 square feet), fill and realignment of Ditch X (1,167 linear feet; 18,074 square feet), and total fill of wetlands located west of the proposed mitigation corridor (3.66 acres). The majority of onsite wetlands to be filled consist of low and moderate functioning Category IV and Category III wetlands; one small Category II wetland will also be filled.

2.2.1 Impact Avoidance and Minimization

The project was carefully designed in attempts to minimize impacts to wetlands and waterbodies to the greatest extent feasible. The proposed project preserves an approximately 4.15-acre Category II wetland (Wetland AH) and several smaller Category IV wetlands within the proposed riparian mitigation corridor. Wetland AH currently contains a meandering and braided section of Edgecomb Creek and provides high levels of water quality and hydrologic functions and a moderate level of habitat function. The proposed project will also preserve a meandering section of Edgecomb Creek that passes through an alluvial fan on the northeast corner of the site.

Dewatering activities associated with the relocation and fill of Edgecomb Creek may impact fish and other aquatic species present in the channel at the time of dewatering; disturbance and mortality of individuals is likely to occur. Stream relocation activities will occur during low stream flow conditions and during the regulatory in-water work window to minimize impacts to fish. Fish exclusion, capture,

and relocation actions will be used to temporarily block fish access to impacted areas and relocate fish out of the impacted areas during the dewatering process. Depending on flow conditions at the time of dewatering, the existing stream channel will be divided into at least two sections for dewatering to allow for effective fish capture and relocation efforts. The fish protection efforts will be completed using a combination of electro-fishing and netting to capture fish and relocate them to non-impacted areas of Edgecomb Creek. A *Fish Exclusion and Protection* Plan has been prepared by SVC under separate cover to avoid and minimize impacts to fish.

Temporary turbidity increases within the existing and new stream channels may result from site clearing and grading activities and are likely to occur during the rewatering of the new stream channel. The new channel will be rewatered in at least two sections to reduce the channel length that is exposed to rewatering at a given time. WAC 173-201A-200(1)(e) makes allowances for a temporary area of mixing during and immediately after in-water construction activities subject to the constrains of WAC 173-201A-400(4) and (6). For waters less than or equal to 10 cubic feet per second flow at the time of construction, the point of compliance shall be 100 feet downstream of the action. Water quality monitoring will be completed to evaluate compliance during rewatering, and fish exclusion nets will remain in place until suspended sediment levels match background levels. The proposed fish exclusion and sediment controls are anticipated to lead to an avoidance or significant reduction in direct fish exposure to elevated suspended sediments. A *Water Quality Monitoring Plan* will be provided to WSDOE under separate cover to outline and document these details.

2.2.2 Wetland Impacts

A summary of impacted wetlands is provided in Table 1, and a wetland function impact analysis is outlined below.

Table 1. Wetland Impact Summary

Wetland	HGM[1]	Cowardin Class[2]	WSDOE Rating[3]	Direct Impact Area (sf)	Direct Impact Area (acre)
A	Depressional	PEMA	IV	1,369	0.031
B	Depressional	PEMA	IV	4,859	0.112
C	Depressional	PEMA	IV	4,841	0.111
D	Depressional	PEMA	IV	3,537	0.081
E	Riverine	PEMA	III	775	0.018
F	Riverine	PEMA	III	386	0.009
G	Riverine	PEMA	III	987	0.023
H	Riverine	PFO/SS/EMA C	II	6,279	0.144
I	Riverine	PSSA	III	377	0.009
J	Depressional	PEMA	IV	334	0.008
K	Depressional	PEMA	IV	16,836	0.387

L	Depressional	PEMA	IV	15,756	0.362
M	Depressional	PEMA	IV	1,969	0.045
N	Depressional	PEMA	IV	8,133	0.187
P	Depressional	PEMA	IV	550	0.013
Q	Depressional	PEMA	IV	2,522	0.058
R	Depressional	PEMA	IV	1,773	0.041
U	Depressional	PEMA	IV	4,909	0.113
V	Depressional	PEMA	III	5,945	0.136
W	Depressional	PEMA	IV	258	0.006
X	Depressional	PEMA	IV	4,492	0.103
Y	Riverine	PSSC	III	662	0.015
Z	Riverine	PEMA	III	483	0.011
AA	Riverine	PEMA	III	574	0.013
AB	Riverine	PEMA	III	1,166	0.027
AC	Depressional	PEMA	IV	4,866	0.112
AD	Riverine	PEMA	III	2,462	0.057
AE	Depressional	PEMA	IV	11,346	0.260
AF	Depressional	PEMA	IV	615	0.014
AG	Depressional	PEMA	IV	285	0.007
AI	Riverine	PEMAB	III	3,873	0.089
AJ	Riverine	PEMA	III	2,471	0.057
51st Avenue East Ditch - North	Depressional	PEMC	III	17,099	0.393
51st Avenue East Ditch - South	Depressional	PEMC	III	13,670	0.314
			Total Wetland Fill	**146,459**	**3.362**

Notes:

1. Brinson, M. M. (1993).
2. WSDOE rating according to Washington State wetland rating system for Western Washington – Revised (Hruby, 2014).
3. Cowardin et al. (1979) or NWI Class based on vegetation: PFO = Palustrine Forested, PSS = Palustrine Scrub-Shrub, PEM = Palustrine Emergent; Modifier for Water Regime: A = Temporarily Flooded; B = Seasonally Saturated; C = Seasonally Flooded.

- **Water Quality:** The wetlands to be impacted consist of 20 depressional wetlands and 12 riverine wetlands along the existing ditched Edgecomb Creek. The depressional wetlands provide low levels of water quality functions. While the depressional wetlands generally lack outlets and the agricultural surrounding land use generates pollutants, the wetlands only temporarily hold surface

waters, and there is limited retention to trap pollutants. In addition, the depressional wetlands are generally located within actively managed agricultural fields with limited cover of persistent, ungrazed/unmowed vegetation to trap sediments and filter pollution. The riverine wetlands generally provide high levels of water quality functions. While the level of retention is relatively low (depressions within the wetlands generally cover less than ½ of the wetland area), shrubs and herbaceous plants cover the majority of the wetland area and provide sediment capture and pollutant filtration. The opportunity for these riverine wetlands to provide water quality improvements is high due to their urban locations and a substantial agricultural presence in the contributing basins. The proposed impacts to wetland water quality functions will be offset by the onsite creation of riverine wetlands that will provide increased retention and filtration functions. In addition, the proposed project stormwater system will disperse treated stormwater into buffer areas, further improving water quality. With the proposed onsite, in-kind wetland creation and proposed stormwater infrastructure, the project will result in a net increase in water quality functions for the Snohomish watershed.

- **Hydrologic:** Hydroperiods within the depressional wetlands are generally temporarily flooded, and hydrology is provided by direct precipitation, surface sheet flow, and a seasonally high groundwater table. The depressional wetlands provide low levels of hydrologic functions. Any ponding that occurs within the wetlands is extremely shallow, and the wetlands are also extremely small relative to the size of the contributing basin (less than 1% the size of the contributing basin). The riverine wetlands provide moderate levels of hydrologic functions. While the wetlands are relatively narrow relative to the adjacent stream (Edgecomb Creek), at least 2/3 of the wetland areas are covered by emergent vegetation that can slow water velocities and reduce erosion. In addition, the surrounding urbanizing watershed likely supports increased runoff flows within the stream. The proposed impacts to wetland hydrologic functions will be offset by the onsite creation of riverine wetlands along a created floodplain that will slow water flows and detain and infiltrate flood flows. In addition, the proposed project stormwater system includes detention and dispersion to attenuate runoff into the mitigation corridor. As such, the proposed onsite, in-kind wetland creation and proposed stormwater infrastructure will result in a net increase in hydrologic functions for the Snohomish watershed.

- **Habitat:** Onsite habitat has been degraded due to decades of agricultural use on the subject property. The wetlands to be impacted consist of wetlands within actively managed agricultural fields and wetlands adjacent to Edgecomb Creek. The agricultural wetlands generally provide low levels of habitat functions. Some of these wetlands are dominated by native emergent vegetation, while others are sparsely vegetated and surrounded by fields. These wetlands generally exhibit minimal habitat diversity and structure. Wetlands adjacent to Edgecomb Creek provide low to moderate levels of habitat functions. These wetlands are also generally dominated by emergent vegetation. Special habitat features include undercut banks/overhanging vegetation and stable, steep banks that provide denning areas for beaver or muskrat. The riverine Wetland H provides moderate level of habitat diversity and structure with three Cowardin classes and special habitat features that include large, downed woody debris, undercut banks/overhanging vegetation, and stable, steep banks. The surrounding landscape has been significantly altered by residential, commercial, and agricultural land uses, and there is extremely limited landscape connectivity to nearby undisturbed habitat. The proposed impacts to wetland habitat functions will be offset by the onsite creation of wetlands adjacent to Edgecomb Creek within a large riparian corridor, which will provide foraging, nesting, and rearing opportunities for a variety of

aquatic species and greatly improved habitat suitability and complexity for a variety of terrestrial fauna. The proposed compensatory mitigation activities will establish new wetlands that provide habitat diversity, structural complexity, and special habitat features that are generally absent from the existing wetlands, resulting in a net-gain in wetland habitat functions onsite. Due to the low-functioning habitat conditions, the proposed wetland fill will result in limited habitat removal, and additional wetland habitat functions will be replaced and increased via the proposed onsite, in-kind mitigation actions, which aim to increase species diversity and habitat complexity.

2.2.3 Stream Impacts

The onsite Edgecomb Creek channel has been ditched for decades and provides relatively low quality habitat due to the lack of channel complexity, in-stream habitat structures, floodplain connectivity and riparian cover. The stream sections to be permanently filled consist of north-to-south and east-to-west channels; existing habitat conditions within these channels are described in Table 2. The proposed stream relocation will result in the permanent loss of existing habitat in both Edgecomb Creek and Ditch X.

Table 2. Summary of Existing Stream Habitat Conditions.

Habitat Parameter	Existing Conditions
Habitat Accessibility	Degraded – Fish access within the project area is impeded by several partial fish passage barrier culverts located beneath the BNSF railroad, within the agricultural fields, and at the 152nd Street Northeast crossing.
Riparian Buffer	Degraded – Streambanks are lined with narrow strip of vegetation dominated by non-native, invasive Himalayan blackberry and reed canarygrass. Agricultural fields extend up to stream bank along most of the channel. Stream shading is limited to individual clusters of red alder and willows. The greatest degree of stream shading is provided by the offsite habitat enhancement site on tax parcel number 31052700200900. Red alder and salmonberry provide overhanging vegetation along approximately 660 linear feet of stream.
Channel Morphology	Minimally complex – Linear excavated channels connected by 90-degree turns lead to sections of stream with cross-gradient, stagnant flows. The excavated streambanks are almost vertical, and pool and riffle formations within the linear excavated channels are limited to north-south sections of the stream. Approximately 225 linear feet of meandering stream with pools and riffles are located in the far northeast corner of the site.
Off-Channel Habitat and Flood Refugia	Present with low habitat quality – Off-channel habitat on the subject property consists of the linear Ditch X. Ditch X is connected to an offsite artificial drainage system that provides marginal off-channel habitat. Ditch X and the offsite artificial drainage system lack riparian cover and habitat diversity. While groundwater likely supplies hydrology (at least to the onsite Ditch X) and Ditch X also receives backflows from Edgecomb Creek, these features were constructed to convey stormwater runoff and as an outlet for drain tile in the agricultural fields. Untreated runoff flows likely impact water quality within the off-channel habitat due to higher temperatures and pollutant

	conveyance. Seasonal flows and depressions within this off-channel habitat present a risk of fish stranding during summer months. The offsite habitat enhancement site on tax parcel number 31052700200900 was likely designed to provide flood refugia. The degree of hydrologic connectivity between the offsite habitat enhancement and the mainstem has likely increased due to beaver activity along this section of stream.
Substrate Composition	Sand and silt – The existing substrates limit salmonid spawning opportunities. Sorted gravels are present along the approximately 225 linear feet of meandering stream located in the far northeast corner of the site.
Large Woody Debris (LWD)	Absent - Generally absent from the highly modified and degraded linear stream channel which extends through maintained agricultural fields
Small Woody Debris	Low presence – Small woody debris is limited by the lack of riparian cover. Some small woody debris is present, particularly at locations of existing beaver dams. Individual clusters of alders and willows provide limited small woody debris at point locations along the stream.
Peak and Base Flows	Summer base flows are low, and a large section of stream downgradient of beaver dams was observed to be dry during the summer of 2020.
Floodplain Capacity and Wetland Connectivity	Limited - Floodplain capacity is extremely limited by the manmade, linear channels. Linear, agricultural feeder ditches provide limited flood storage capacity with poor habitat conditions for fish. Several small, low-functioning riverine wetlands with low species diversity are located along the existing stream. Some floodplain capacity is present in the offsite habitat enhancement site on tax parcel number 31052700200900.
Water Quality	Degraded – Onsite water quality is degraded by a minimally functioning riparian buffer separating the stream from active agricultural fields. Previous water quality monitoring on Edgecomb Creek by WSDOE indicates high water temperatures and low dissolved oxygen in the stream.

2.3 Mitigation Strategy

Compensatory mitigation actions are intended to compensate for lost wetland and stream functions and values by providing an overall improvement in the quality of water quality, hydrologic, and habitat functions according to the needs of the site, local sub-basin, and overall Snohomish River watershed. To offset proposed impacts to Edgecomb Creek, the project proposes to realign Edgecomb Creek within a restored riparian corridor adjacent to the west side of the BNSF railroad. The riparian corridor will be up to 315 feet wide and is preliminary designed to contain 9,559 linear feet of restored mainstem Edgecomb Creek channel, 6,767 linear feet of side channel, 2,094 linear of Ditch X re-alignment, and a minimum of 5.84 acres of wetland re-establishment/creation, although the conceptual mitigation design estimates that the mitigation corridor will achieve approximately 18 acres of wetland creation and 3 acres of wetland enhancement. Any excess wetland mitigation credits are proposed for use by the Applicant as advanced mitigation for any future wetland impact proposal(s).

The re-aligned main-stem stream channel and created side-channel habitat will provide mitigation that exceeds 1:1 for the fill of the existing Edgecomb Creek stream channel. Ditch X will also be realigned, lengthened, and reconnected to the realigned Edgecomb Creek. Compensatory wetland re-establishment and creation will occur within the riparian corridor, meeting local, state, and federal mitigation requirements for direct wetland impacts. As a non-compensatory mitigation measure, the Applicant proposes to replace two partial fish barrier culverts underneath the BNSF railroad with box culverts designed to allow fish access and convey Edgecomb Creek beneath the railroad. A box culvert will also be added beneath 152nd Street Northeast to convey the realigned stream channel.

These combined restoration actions will provide a net gain in function and improved protection to the wetlands and streams from the proposed development. Refer to Appendix A for a detailed planting plan and Appendix B for the Basis of Design which includes an engineered 60% stream design.

The mitigation actions include the following:

- Realign and restore the onsite Edgecomb Creek (9,559 linear feet; 134,769 square feet);
- Create off-channel habitat connected to the restored Edgecomb Creek (6,767 linear feet; 43,031 square feet);
- Add substrate to restored Edgecomb Creek and side channels;
- Add large woody debris to restored Edgecomb Creek and side channels;
- Create wetlands along Edgecomb Creek (minimum 5.84 acres);
- Realign Ditch X (2,094 linear feet; 9,566 square feet);
- Enhance Wetland AH and Wetland AK with native plantings (142,148 square feet);
- Add large woody debris to preserved Edgecomb Creek side channels in Wetland AH;
- Replant all impacted areas targeted for mitigation with native trees, shrubs, and groundcovers listed in Appendix A, or substitutes approved by the responsible Project Scientist, to help retain soils, filter stormwater, and increase biodiversity;
- An approved native seed mix will be used to seed the disturbed mitigation areas after planting to reduce short-term erosion potential;
- Maintain and control invasive plants annually, at a minimum, or more frequently if necessary. Maintenance to reduce the growth and spread of invasive plants is not restricted to chemical applications but may include hand removal, if warranted;
- Provide dry-season irrigation as necessary to ensure native plant survival;
- Install fencing and critical area signage along the outer boundary of the mitigation corridor facing the proposed development;
- Direct exterior lights away from the wetland and stream areas wherever possible; and
- Place all activities that generate excessive noise (e.g., generators and air conditioning equipment) away from the wetland and stream areas where feasible.

2.3.1 Wetland Mitigation Strategy

The proposed onsite mitigation actions are intended to allow the fill of onsite wetlands (Wetlands A-P, Q, R, U-Z, AA-AG, AI, and AJ) while maintaining and improving existing wetland functions via the creation and enhancement of higher-functioning wetland and buffer areas. Proposed wetland creation actions generally include treatment and removal of invasive vegetation, planting with native

trees and shrubs, and an establishment of an herbaceous understory to allow the establishment of wetland area, retention of water and sediments, and improvements in water quality and habitat protection functions provided by the wetlands.

All wetland creation areas will occur on a created flood terrace along the restored Edgecomb Creek; the terrace is expected to exhibit hydrologic connectivity and soil conditions conducive to wetland creation. A minimum of 5.84 acres of existing upland area will be carefully excavated and converted to riverine wetlands on the new flood terrace. Table 3 below provides a compensatory wetland mitigation summary.

Table 3. Compensatory Wetland Mitigation Summary

Wetland	Cowardin Class[1]	WSDOE Rating[2]	Impact (acre)	Compensation	
				Creation/Re-Establishment Ratio[3]	Area (acre)
A	PEMA	IV	0.031	1.5:1	0.047
B	PEMA	IV	0.112	1.5:1	0.167
C	PEMA	IV	0.111	1.5:1	0.167
D	PEMA	IV	0.081	1.5:1	0.122
E	PEMA	III	0.018	2:1	0.036
F	PEMA	III	0.009	2:1	0.018
G	PEMA	III	0.023	2:1	0.045
H	PFO/SS/EMAC	II	0.144	3:1	0.432
I	PSSA	III	0.009	2:1	0.017
J	PEMA	IV	0.008	1.5:1	0.012
K	PEMA	IV	0.387	1.5:1	0.580
L	PEMA	IV	0.362	1.5:1	0.543
M	PEMA	IV	0.045	1.5:1	0.068
N	PEMA	IV	0.187	1.5:1	0.280
P	PEMA	IV	0.013	1.5:1	0.019
Q	PEMA	IV	0.058	1.5:1	0.087
R	PEMA	IV	0.041	1.5:1	0.061
U	PEMA	IV	0.113	1.5:1	0.169
V	PEMA	III	0.136	2:1	0.273
W	PEMA	IV	0.006	1.5:1	0.009
X	PEMA	IV	0.103	1.5:1	0.155
Y	PSSC	III	0.015	2:1	0.030
Z	PEMA	III	0.011	2:1	0.022

AA	PEMA	III	0.013	2:1	0.026
AB	PEMA	III	0.027	2:1	0.054
AC	PEMA	IV	0.112	1.5:1	0.168
AD	PEMA	III	0.057	2:1	0.113
AE	PEMA	IV	0.260	1.5:1	0.391
AF	PEMA	IV	0.014	1.5:1	0.021
AG	PEMA	IV	0.007	1.5:1	0.010
AI	PEMAB	III	0.089	2:1	0.178
AJ	PEMA	III	0.057	2:1	0.113
51st Avenue East Ditch - North[4]	PEMC	III	0.393	2:1	0.785
51st Avenue East Ditch – South[5]	PEMC	III	0.314	2:1	0.628
		Total	**3.362**	**--**	**5.844 acres**

1. Cowardin et al. (1979) or NWI Class based on vegetation: PFO = Palustrine Forested, PSS = Palustrine Scrub-Shrub, PEM = Palustrine Emergent; Modifier for Water Regime: A = Temporarily Flooded; B = Seasonally Saturated; C = Seasonally Flooded.
2. WSDOE rating according to Washington State wetland rating system for Western Washington (Hruby, 2014).
3. Ratios outlined in AMC 20.93.840 and MMC 22E.010.120(3).
4. Non-jurisdictional federally.
5. Likely non-jurisdictional federally.

The wetland creation and enhancement areas will meet local and state mitigation ratio requirements. The mitigation plan proposes an increase in vertical and horizontal canopy structure by planting a variety of native tree, shrub, and groundcover species appropriately located to match existing species wetland indicator statuses, targeted hydroperiods, and local topography. The mitigation areas are anticipated to provide greater functions when compared to the existing degraded conditions of the onsite farmed wetlands ditched stream, and buffers proposed to be impacted. The wetland creation areas will be excavated to provide necessary depressions to hold sufficient hydrology to generate wetland conditions. The wetland creation areas will be excavated to the existing groundwater table where possible. Hydrology will be provided by the realigned Edgecomb Creek, groundwater, and precipitation (consistent with the existing wetlands on the subject property). Stormwater from the site will be treated to meet enhanced water quality treatment standards and pass through detention ponds for flow control prior to being dispersed into the riparian corridor.

Through careful design and utilization of best available science, the proposed mitigation plan has a high probability of success and persistence. The newly created wetland areas will be installed in the same environment that provides adequate conditions for the existing wetlands. By following the site preparation specifications outlined herein (e.g., excavation and plantings) the wetland creation areas will be able to maintain wetland hydrology during the growing season in most years to match the existing functional hydrologic regimes of the wetlands. The proposed native species have been carefully selected to ensure the plants take root and thrive in the newly created wetland environments: selection criteria included indicator status and those species that are currently present in existing onsite wetland areas. As the existing wetlands have low species richness and are degraded by the presence of invasive species, the mitigation actions will include a selection of native trees, shrubs, and

groundcover suitable for the site conditions that will result in increased habitat functions by providing greater habitat suitability for a wide range of fauna. Woody debris placement will provide additional habitat.

2.3.2 Stream Mitigation Strategy

The proposed stream restoration will provide several improvements in stream ecological functions over the existing degraded stream channel. The majority of the onsite channel consists of excavated linear ditches in agricultural fields that lack substantial native riparian trees and shrubs, meanders, cobbles or sorting, riffle or pool structures, large woody debris, or floodplain connectivity. The restored stream channel will consist of a meandering channel connected to side channels and wetland habitats within a riparian corridor containing native forest, shrub, and emergent plant communities. Side channels will have different degrees of hydrological connectivity to Edgecomb Creek. Flow-through side channels will provide off-channel habitat throughout much of the year, while dendrite side channels will provide seasonal off-channel habitat. In addition, the mainstem and side channels will be enhanced with large woody debris, small woody debris, streambed gravels, and pool and riffle creations. Fish accessibility to the site and upstream reaches of Edgecomb Creek will be improved by the replacement or removal of culverts that currently act as partial fish passage barriers, including two culverts beneath the BNSF Railroad. Once established, riparian habitat corridor will provide immediate and long-term benefits for salmonids and other fish through native plantings that will provide streambank stability, stream shading, stormwater filtration, and wood recruitment; a complex channel system with natural channel sinuosity, pool and riffle structures, and side channels that will provide spawning, rearing and foraging opportunities; and connectivity to wetland and floodplain habitats that will provide additional water quality improvements, hydrologic regulation, and flood refugia benefits. Table 4 below summarizes the stream habitat parameters targeted for restoration.

Table 4. Stream Habitat Parameters Targeted for Restoration.

Habitat Parameter	Proposed Conditions
Habitat Accessibility	Accessible onsite stream – The replacement of two culverts beneath the BNSF railroad and installation of a new culvert beneath 152nd Street Northeast will provide improved fish passage to the site and upstream areas. In addition, existing farm culverts that act as partial fish passage barriers will be removed.
Riparian Buffer	Native buffer establishment and restoration – The restored stream and riparian buffers will be located in an up to 315-foot-wide restoration/mitigation corridor. The riparian buffer will be planted with a diverse assemblage of native trees, shrubs, and groundcover to establish a mosaic of habitats. Once established, the riparian buffer will provide maximum stream shading to help cool water temperatures.
Channel Morphology	Meandering stream – The channel will be realigned to follow the general north to south gradient change, eliminating the existing cross-gradient flows that currently exist within east-west channels. The stream channel will be widened and meanders will be incorporated to mimic natural conditions to the maximum extent feasible while maintaining positive flow. The meandering, north-south flowing stream will provide channel complexity and support pool and riffle development.

Off-Channel Habitat and Flood Refugia	Connected off-channel habitat – Side channels will be created with varying degrees of branching and hydrological connectivity to the stream to improve habitat diversity. Side channel hydrology will be maintained by groundwater connections and the realigned stream. The groundwater connections would support cooler water temperatures within the side channel habitat. In addition, the side channels morphology and hydrology connections will be designed to avoid fish standing. Ditch X will be realigned and continue to provide off-channel habitat.
Substrate Composition	Well-graded – The stream restoration will include installation of a well-graded mix of cobbles, gravels, sand, and silt to the stream substrate. The substrate addition will increase habitat diversity for benthic macro-invertebrates (salmonid prey) and spawning habitat.
Large Woody Debris (LWD)	Prevalent along the entire onsite reach – LWD will be added throughout length of realigned stream and within side channels to restore in-stream habitat complexity and natural geomorphic processes such as pool formation, flow complexity, bank roughness, hyporheic flow, shade cover, woody substrate, thermal refugia, and recruitment of wood and organic debris.
Small Woody Debris	Prevalent along the entire onsite reach – Riparian restoration will restore sources of small woody debris, supporting in-stream habitat complexity and food webs. Additional small woody debris will be added to the restored stream system to provide immediate improvements in organic matter supply and habitat for small mammals, birds, and macroinvertebrates.
Peak and Base Flows	Potential minor alterations – No significant changes in hydrology are anticipated due to the proposed stormwater system and channel design, which will provide a minimum of the same flow capacity as the existing channel.
Floodplain Capacity and Wetland Connectivity	Wetlands and floodplains connected to stream channels – Wetlands will be created on floodplain benches adjacent to the mainstem and side channels. These wetlands will increase habitat complexity, provide water quality improvements, and regulate hydrology within the stream.
Water Quality	Minimization of stormwater impacts - The proposed onsite conversion of agricultural land to industrial development will alter potential pollutants conveyed by runoff. The proposed enhanced water quality treatment stormwater system will provide filtration of sediment, hydrocarbons, and metals that accumulate on roadways. The stream relocation will bring the stream nearer to the onsite railroad, which is a source of potential pollutants. The riparian buffer plantings will increase stream shading, decreasing water temperatures.

2.3.3 Native Vegetation and Enhancement Strategy

The proposed mitigation actions will improve ecological conditions and protection of the critical areas by providing additional functions according to the needs of the site and watershed and providing an overall improvement to wetland, stream, and buffer functions. The proposed native plant communities will be established according to location relative to the stream channels, anticipated hydroperiod within the wetland creation areas, and topographic position within the remaining riparian corridor buffer areas. Willows (*Salix* spp.) will dominate the banks of the main-stem stream channel and the flow-through side channels to provide bank stability and shading. Anticipated hydroperiods within the created wetlands include seasonally and permanently ponding. Forested and scrub-shrub communities will be established within seasonally ponded wetlands, and emergent communities will be established across permanently ponded wetlands. The upland buffer will be primarily forested with shrub communities adjacent to the proposed development and railroad. An "Airport Approach Wildlife Hazard Management Area" is located on the northern end of restoration corridor. To avoid the risk of trees entering airspace or obstructing pilot visibility, this area will be dominated by a shrub canopy. The proposed native species have been carefully selected according to indicator status and local vegetation observations to ensure the plants take root and thrive in the newly created riparian corridor. Planting specifications and schedule are provided in Appendix A.

Wetland and riparian enhancement actions will be completed in Wetlands AH and AK and within the riparian corridor adjacent to the non-impacted section of Edgecomb Creek on the northern portion of the project area. Wetland AH is currently degraded by dominant non-native, invasive Himalayan blackberry and reed canarygrass and Wetland AK is dominated by common field species and lacks species diversity and overall habitat complexity. The riparian corridor adjacent to the non-disturbed section of Edgecomb Creek is similarly degraded by non-native, invasive Himalayan blackberry and contains minimal native species diversity. Wetland and riparian enhancement actions will consist of replacing non-native, invasive and low-complexity vegetation with native tree and shrub species to improve habitat functions. Willow species will be established along the non-impacted stream channel to provide bank stability and shading. Large woody debris will be added to the preserved Edgecomb Creek side channels within Wetland AH to provide cover within these off-channel habitats.

The proposed native vegetation strategy will support wetland and stream habitat, hydrologic, and water quality functions. The proposed plantings will restore native forest conditions throughout the majority of the upland buffer and create a variety of wetland habitats. The riparian corridor will provide structural and species diversity to provide browse, cover, and nesting for birds, mammals, and aquatic species. The native plantings will also provide shading and cooling functions for the wetlands and stream. With construction of the mitigation site, establishment of the protective riparian corridor, installation of permanent fencing and signage around the entire sensitive areas tracts, and implementation of the required monitoring and maintenance actions, the mitigation areas are projected to be highly functional, persistent, and successful.

2.4 Approach and Best Management Practices

The proposed onsite compensatory mitigation actions will provide increased wetland and stream protections by maintenance or improvement of wetland, stream, and buffer functions onsite. Planting should occur immediately after grading is complete to the extent practicable. TESC measures will be implemented that consists of high-visibility fencing (HVF) installed around existing wetland and stream areas proposed to be not impacted, silt fencing between the graded areas and buffers, plastic

sheeting on stockpiled materials, and seeding of disturbed soils. These TESC measures should be installed prior to the start of development or mitigation actions and actively managed for the duration of the project.

All equipment staging and materials stockpiles will be kept out of the wetlands, streams and associated buffer areas, and the areas will need to be kept free of spills and/or hazardous materials. Construction materials along with all construction waste and debris will be effectively managed and stockpiled on paved surfaces and kept free of the wetland, stream, and buffer areas. Following completion of the development, the entire site will be cleaned and detail graded using hand tools wherever necessary, and TESC measures will be removed.

2.5 Mitigation Implementation

Compensatory mitigation actions will occur concurrently with the construction of the project. Two pre-construction meetings should be held. Representatives from the Applicant, Contractor, the designated Project Scientist, and interested reviewing agencies (e.g., Cities of Arlington and Marysville) should be present at both meetings. The overall purpose of the first pre-construction meeting should be to discuss the primary intent of the wetland creation, stream relocation and regulatory requirements, identify points of contact, establish communication lines between the Project Scientist, Project Manager, and landscaping personnel, review project scheduling, and address any questions or issues associated with the mitigation plan. The first pre-construction meeting should occur prior to commencement, and the second meeting should occur onsite after construction staking has been placed by professional surveyors. The overall purpose of the second pre-construction meeting should be to discuss project implementation, protection of onsite habitat, construction BMPs, and identify invasive species management actions.

Following the pre-construction meeting, TESC measures will be implemented according to the TESC plan prepared for the proposed project. TESC measures may consist of silt fencing where appropriate to protect sensitive areas, plastic sheeting on stockpiled materials, and seeding of disturbed soils which should be actively managed for the duration of the project. Equipment used will be typical for land clearing, grading, and excavation activities and will be kept in good working conditions and free of leaks. Equipment to be used will likely include excavators, backhoes, bulldozers, dump trucks, graders, et cetera. All clean fill material will be sourced from upland areas onsite or from approved suppliers and will be free of pollutants and hazardous materials.

The Project Scientist should be consulted during pre-treatment and installation actions to ensure that all wetland creation, stream relocation, and other mitigation actions are conducted according to the intent of the mitigation plan, and that the LWD, hummocks, and native plantings are placed in a functional manner. The Project Scientist will also inspect and approve the planting stock and review the plans with the field superintendent to ensure clear understanding of the plan prior to installation of plant materials. The Project Scientist should assist the landscape contractor in making any final adjustments in the planting schedule as needed, in response to field conditions.

Two post-construction inspections of all mitigation areas will be necessary to verify the installation conforms to the approved plan. The first inspection should occur after completion of the stream relocation, wetland creation, and seeding and planting and the second inspection should occur after project completion. Post-construction review and verification of grading and planting actions may be conducted with Cities of Arlington and Marysville staff or their representatives. Once approved, the

Project Scientist and Project Engineer will prepare an As-Built (Year 0) Report. Any significant changes to the mitigation design should also be coordinated with regulatory staff and presented in the As-Built Report to be submitted within 90 days following the post-construction inspection.

The riparian corridor creation will include the excavation of material to create the new Edgecomb Creek mainstem channel, side channels, wetland benches, and floodplain areas. Riparian corridor creation may be completed separately from clearing, grading, and wetland fill actions in the rest of the project area. Excavated material may be temporarily stored and then may be used to fill the existing stream channel. Any remaining excavated material will be removed from the site or used as needed for grading in the rest of the project area. The new stream channel will be entirely excavated prior to the stream relocation, with a berm left on the upstream end to prevent the stream from immediately diverting into the new channel. Large woody debris and new substrates should be installed following channel excavation.

Dewatering and rewatering of the existing and new stream channels will be completed using temporary dams and bypass pipes. The stream relocation will be divided into at least two sections in order to minimize fish loss and turbidity impacts. Sediment control structures, including coir logs, will be installed in the new channel, and water quality monitoring will proceed according to the Water Quality Monitoring Plan which will be provided under separate cover. The existing stream channel will be dewatered and the new stream channel rewatered from the downstream end of the proposed impact length to the upstream end. Following the dewatering of each existing channel section, the dried channel section may be immediately filled. Prior to dewatering, nets will be installed at the upstream and downstream ends of the selected channel section, and fish capture and relocation efforts completed according to the *Fish Exclusion and Protection Plan* provided under separate cover. Water will be gradually reintroduced, with time allowed for sediments to settle before moving to the downstream phases of the stream. The biodegradable coir logs may be left in place following stream relocation to provide sustained sediment control for the new channel. Once the stream has been fully relocated, the berm will be removed and the area restored.

During the second post-construction inspection, the Project Scientist will identify and mark long-term monitoring transects and photographic stations in the field that represent typical conditions of the wetland creation, stream relocation, and other mitigation areas. The transects and stations should be surveyed or GPS located and included in the As-Built Report.

The intended project sequencing follows:

- Pre-construction conference(s) and regulatory notifications;
- Install TESC measures;
- Remove debris and invasive plant material from the wetland creation and other mitigation areas;
- Rough grade the stream relocation and wetland creation areas according to the approved grading plan;
- Rough grade inspection;
- Finish grade and prepare grounds for planting in all mitigation areas;
- Install LWD;
- Install streambed substrates;
- Dewater existing stream channel and rewater new stream channel;
- Seed entire mitigation area;

- Monitor site hydrology;
- Plant inspections;
- Install plant materials;
- Post-construction inspection and as-built survey; and
- Post-construction maintenance, monitoring, and annual reporting.

Plant installation may occur prior to re-watering actions, at the discretion of the Contractor and Project Scientist.

2.6 Goals, Objectives, and Performance Standards

The goals and objectives for the proposed onsite, in-kind mitigation actions are based on establishing and enhancing wetland areas to compensate for the loss of onsite wetlands and establishing and enhancing stream functions for the stream channel relocation actions. Non-compensatory stream restoration actions also include the replacement of two undersized culverts beneath the BNSF rail line with box culverts to improve fish passage. In addition to the proposed compensation for onsite wetland loss, the mitigation actions may result in additional wetland creation that may be used as advanced mitigation for future wetland loss within the watershed. The proposed wetland and riparian enhancements will increase habitat functions and provide greater screening and protection for the onsite wetlands and stream channel to be preserved. These actions are capable of establishing wetlands with superior water quality and hydrologic functions and providing a moderate to high level of habitat function for wetland-associated wildlife within the watershed. In addition, the stream relocation will significantly improve overall habitat conditions. The goals and objectives of the proposed mitigation actions are as follows:

Goal 1 – Compensate for the loss of the existing Edgecomb Creek channel by creating a meandering stream channel with associated side channels.

Objective 1.1 – Create a new stream channel and enhanced habitat components.

Performance Standard 1.1.1 – The new stream channel system will be created according to the final approved design.

Goal 2 – Improve stream flow conditions, fish passage conditions, and habitat accessibility for the restored Edgecomb Creek channel and upstream areas. [This is a non-compensatory mitigation measure.]

Objective 2.1 – Replace two undersized culverts with box culverts that allow for unimpeded fish passage beneath the BNSF Railroad.

Performance Standard 2.1.1 – The culverts will meet fish passage criteria (no greater than 0.80-foot channel spawning jump height or slope greater than 20 percent).

Performance Standard 2.1.2 – Stream processes, including open unobstructed conveyance, will be readily observed and functional in all monitoring years.

Goal 3 – Compensate for the loss of 3.36 acres of wetlands, including the 51st Avenue East Ditch that is being treated as a wetland for local and state permitting processes, by creating a minimum of 5.84 acres of wetlands that provide a moderate to high level of water quality and habitat functions.

Objective 3.1 – Establish a minimum of 5.84 acres of wetland creation areas along the re-aligned Edgecomb Creek.

Performance Standard 3.1.1 – The wetland creation areas will measure at least 5.84 acres in size as demonstrated by wetland delineations in the final year of the 10-year monitoring period required by the USACE.

Objective 3.2 – Establish wetland hydrology through grading to establish depressions/benches that intersect shallow groundwater elevations similar to nearby wetlands and/or receive hydrologic influence from Edgecomb Creek.

Performance Standard 3.2.1 – The approximately 5.84 acres of wetland creation areas will have seasonally saturated soils (or greater hydroperiod) within 12 inches of the surface over all the wetland creation areas that persists for a minimum of 14 consecutive days during the growing season in years with normal precipitation levels over the monitoring period.

Objective 3.3 – Establish targeted forested wetland habitat with diverse horizontal and vertical vegetation structure and species richness to provide habitat for wetland-associated wildlife.

Performance Standard 3.2.1 – Native shrub species in the targeted forest wetland habitat will provide at least 10 percent total cover by Year 1, at least 20 percent total cover by Year 2, at least 30 percent total cover by Year 3, and at least 50 percent total cover for Years 5-10.

Performance Standard 3.2.2 – Native tree species in the targeted forest wetland habitat will provide at least 10 percent total cover by Year 5 and at least 20 percent total cover by Year 10.

Performance Standard 3.2.3 – In all monitoring years, the targeted forested wetland habitat will have at least 2 species of native trees and 5 species of native shrubs.

Objective 3.4 – Establish targeted scrub-shrub wetland habitat with diverse horizontal and vertical vegetation structure and species richness to provide habitat for wetland-associated wildlife.

Performance Standard 3.4.1 – Native shrub species will provide at least 30 percent total cover by Year 2, 50 percent total cover by Year 3, and 60 percent total cover for Years 5-10.

Performance Standard 3.4.2 – In all monitoring years, the targeted scrub-shrub wetland habitat will have at least 5 species of native shrubs.

Objective 3.5 – Establish targeted emergent wetland habitat to provide habitat for wetland-associated wildlife.

Performance Standard 3.5.1 – Native emergent species will provide at least 20 percent total cover of the targeted emergent wetland habitat by Year 2, at least 30 percent total cover by Year 3, and at least 50 percent total cover for Years 5-10. Permanently ponded wetland areas that lack vegetation will be excluded from the area used to determine percent cover.

Objective 3.6 – Effectively control and/or eliminate non-native invasive species from the wetland creation areas.

Performance Standard 3.6.1 – Non-native invasive plants will not make up more than 20 percent total cover in any growing season during the monitoring period following Year 1.

Goal 4 – Enhance 3.26 acre of existing Wetlands AH and AK to improve habitat functions.

Objective 1 – Establish native plant cover within the enhancement areas to create diverse horizontal and vertical vegetation structure and additional wildlife habitat.

Performance Standard 4.1.1 – Native tree and shrub species will provide at least 20 percent total cover of the wetland enhancement areas by Year 2, at least 30 percent total cover by Year 3, and at least 50 percent total cover for Years 5-10.

Performance Standard 4.1.2 – At least 3 native shrub and/or tree species will be present in the enhancement areas in all monitoring years.

Objective 2 – Effectively control non-native invasive species within the enhancement areas.

Performance Standard 4.2.1 – Non-native invasive plants (excluding reed canary grass) will not make up more than 20 percent total cover in any growing season during the monitoring period following Year 1.

Goal 5 – Establish of upland/buffer for the newly realigned Edgecomb Creek to provide protection for the stream and wetlands.

Objective 1 – Establish native plant cover within the targeted upland/buffer areas to create diverse horizontal and vertical vegetation structure and additional wildlife habitat.

Performance Standard 6.1.1 – Native tree and shrub species will provide at least 20 percent total cover of the upland/buffer areas by Year 2, at least 30 percent total cover by Year 3, at least 50 percent total cover for Year 5, and 70 percent total cover for Year 10.

Performance Standard 6.1.2 – In all monitoring years, the upland/buffer area will have at least 3 species of native trees and 5 species of native shrubs.

Objective 2 – Effectively control and/or eliminate non-native invasive species from the enhancement areas.

Performance Standard 6.2.1 – Non-native invasive plants will not make up more than 20 percent total cover in any growing season during the monitoring period following Year 2.

For all native species coverage or native species richness performance standards, replacement of dead or dying plants is allowed and native recruits may be counted during all monitoring years.

The performance standards outlined herein may be modified, with approval from the reviewing agencies, during preparation of the Final Mitigation Plan.

2.7 Plant Materials and Installation

2.7.1 Plant Materials

All plant materials to be used for the mitigation actions will be nursery grown stock from a reputable, local source. Only native species are to be used; no hybrids or cultivars will be allowed. Plant material provided will be typical of their species or variety; if not cuttings they will exhibit normal, densely developed branches and vigorous, fibrous root systems. Plants will be sound, healthy, vigorous plants free from defects, and all forms of disease and infestation.

Seed mixture used for hand or hydroseeding shall contain fresh, clean, and new crop seed mixed by an approved method. The mixture is specified in the plan set.

All plant material shall be inspected by the qualified Project Scientist upon delivery. Plant material not conforming to the specifications below will be rejected and replaced by the planting contractor. Rejected plant materials shall be immediately removed from the site.

Mulch if used will consist of sterile wheat straw for seeded areas (if necessary) and clean recycled wood chips approximately ½-inch to 1-inch in size and ½-inch thick for woody plants.

2.7.2 Plant Scheduling, Species, Size, and Spacing

Plant installation should occur as close to conclusion of the proposed grading activities as possible to limit erosion and limit the temporal loss of function provided by the critical areas and associated buffers. All planting should occur between September 1 and May 1 to ensure plants do not dry out after installation, or temporary irrigation measures may be necessary. All planting will be installed according to the procedures detailed in the following subsections and as outlined on the site plans in Appendix A.

2.7.3 Quality Control for Planting Plan

All plant material shall be inspected by the Project Scientist upon delivery. Plant material not conforming to the specifications above will be rejected and replaced by the planting contractor. Rejected plant materials shall be immediately removed from the site. Under no circumstances shall container stock be handled by their trunks, stems, or tops.

The landscape contractor shall provide the Project Scientist with documentation of plant material that includes the supplying nursery contact information, location of genetic source, plant species, plant quantities, and plant sizes.

2.7.4 Product Handling, Delivery, and Storage

All seed should be delivered in original, unopened, and undamaged containers showing weight, analysis, and name of manufacturer. This material should be stored in a manner to prevent wetting and deterioration. All precautions customary in good trade practice shall be taken in preparing plants for moving. Workmanship that fails to meet industry standards will be rejected. Plants will be packed, transported, and handled with care to ensure protection against injury and from drying out. If plants cannot be planted immediately upon delivery they should be protected with soil, wet peat moss, or in a manner acceptable to the Project Scientist. Plants and mulch not installed immediately upon delivery shall be secured on the site to prevent theft or tampering. No plant shall be bound with rope or wire in a manner that could damage or break the branches. Plants transported on open vehicles should be secured with a protective covering to prevent windburn.

2.7.5 Preparation and Installation of Plant Materials

The planting contractor shall verify the location of all elements of the mitigation plan with the responsible Project Scientist prior to installation. The responsible Project Scientist reserves the right to adjust the locations of landscape elements during the installation period as appropriate.

The plant pits should accommodate the entire root system of the plants. Please refer to planting detail in Appendix A. Broken roots should be pruned with a sharp instrument and rootballs should be thoroughly soaked prior to installation. Set plant material upright in the planting pit to proper grade and alignment. Water plants thoroughly midway through backfilling. Water pits again upon completion of backfilling. No filling should occur around trunks or stems. Do not use frozen or muddy mixtures for backfilling. Where mulch is used, form a ring of soil around the edge of each planting pit to retain water, and install a 4- to 6-inch layer of mulch around the base of each container plant.

2.7.6 Temporary Irrigation Specifications

While the native species selected for the mitigation actions are hardy and typically thrive in northwest conditions and the proposed actions are planned in areas with sufficient hydroperiods for the species selected, some individual plants might perish due to dry conditions. Therefore, irrigation or regular watering may be provided as necessary for the duration of the first two growing seasons, up to two times per week while the native plantings become established, particularly in the upland buffer area. If used, irrigation will be discontinued after two growing seasons. Frequency and amount of irrigation will be dependent upon climatic conditions and may require more or less frequent watering than two times per week.

2.7.7 Invasive Plant Control

Invasive species to be controlled include Himalayan blackberry and all listed noxious weeds that may potentially be present within the mitigation areas; such non-native invasive species will require an effective control strategy. To ensure non-native invasive species do not expand following the mitigation actions, it is recommended that non-native invasive plants within the mitigation corridor are pretreated with a root-killing herbicide approved for use in aquatic sites (i.e. Rodeo) a minimum of two weeks prior to being cleared and grubbed from the mitigation area. A second application is strongly recommended. The pre-treatment with herbicide should occur prior to all planned mitigation actions, and spot treatment of surviving non-native invasive vegetation should be performed again each fall prior to senescence for a minimum of three years.

2.8 Maintenance & Monitoring Plan

The Applicant is committed to compliance with the proposed mitigation plan and overall success of the project. As such, the Applicant will continue to maintain the project, keeping the site free from introduced non-native invasive vegetation, trash, and yard waste. Depending on the success of the mitigation site, maintenance frequency may be decreased or increased at the discretion of the responsible Project Scientist.

The mitigation actions will require continued monitoring and maintenance to ensure the mitigation actions are successful. Therefore, the mitigation site will be monitored for a period of 10 years with formal inspections by a qualified Project Scientist. Monitoring events will be scheduled at the time of construction, 30 days after planting, twice during Years 1 and 2, and on an annual basis for Years 3, 5, 7, and 10. Closeout assessment with delineation by a qualified Wetland Scientist will also be conducted in Year 10 to ensure the success of the compensatory actions. Informal monitoring events will also be performed in Years 4, 6, 8, and 9 as needed.

Monitoring will consist of percent cover measurements at permanent monitoring stations, walk-through surveys to identify invasive species presence and dead or dying restoration plantings, photographs taken at fixed photo points, wildlife observations, and general qualitative habitat and wetland function observations.

To determine percent cover, observed vegetation will be identified and recorded by species and an estimate of areal cover of dominant species within each sampling plots. Circular sample plots, approximately 30 feet in diameter (706 square feet), are centered at each monitoring station. The sample plots encompass the specified wetland areas and terminate at the observed wetland boundary. Trees and shrubs within each 30-foot diameter monitoring plot are then recorded to species and areal cover. Herbaceous vegetation is sampled from a 10-foot diameter (78.5 square feet) within each monitoring plot, established at the same location as the center of each tree and shrub sample plot. Herbaceous vegetation within each monitoring plot is then recorded to species and includes an estimate of percent areal cover. A list of observed tree, shrub, and herbaceous species including percent areal cover of each species and wetland status will be included within the monitoring report.

2.9 Reporting

Following the creation of the mitigation areas, the responsible Project Scientist will prepare an As-Built (Year 0) Report and will be submitted to the Cities of Arlington and Marysville and the USACE within 90 days following the post-construction monitoring event. Following each formal monitoring event, a monitoring report detailing the current ecological status of the mitigation actions, measurement of performance standards, and management recommendations will be prepared and submitted to the Cities of Arlington and Marysville and the USACE by December 31st of each formal monitoring year to ensure full compliance with the mitigation plan, performance standards, and regulatory conditions of approval.

2.10 Contingency Plan and Long-Term Management Plan

If monitoring results indicate that performance standards are not being met, it may be necessary to implement all or part of the contingency plan. Careful attention to maintenance is essential in ensuring that problems do not arise. Should any portion of the site fail to meet the success criteria, a

contingency plan will be developed and implemented with approval from the Cities of Arlington and Marysville and the USACE. Such plans are adaptive and should be prepared on a case-by-case basis to reflect the failed mitigation characteristics. Contingency plans can include additional plant installation, erosion control, and plant substitutions including type, size, and location. In addition, in compliance with 33 CFR 332.7(d)(2) and to ensure long-term success of the mitigation site, the landowner will be responsible for implementing long-term maintenance; informal site inspections will occur periodically. The contingency measures outlined below can also be utilized in perpetuity to maintain the wetland, stream, and buffers associated with the proposed mitigation site.

This project proposes 10 years of monitoring for the wetland creation and stream channel relocation actions in compliance with the goals and performance standards outlined in Section 2.6 of this report. However, USACE may request additional years of monitoring and formal reporting if the site has not met the goals and performance standards by Year 10. In compliance with 33 CFR 332.7(d)(2), the mitigation areas on the project site will be maintained in perpetuity by the landowner. No additional formal reporting beyond the Year 10 As-Built is proposed at this time.

Beaver dams are currently located along Edgecomb Creek on the subject property, and beaver use of the proposed realigned Edgecomb Creek is anticipated. The proposed mitigation site will be monitored for beaver activity and impacts, and significant alteration in hydrology or vegetation may require an adaptive management plan to be prepared. If significant alterations in hydrology, vegetation, or other site conditions necessitate beaver management measures, a Hydraulic Project Approval from Washington State Department of Fish and Wildlife will be sought.

Additional contingency/maintenance activities may include, but are not limited to:

1. Using plugs instead of seed for emergent vegetation coverage where seeded material does not become well established;
2. Replacing plants lost to vandalism, drought, or disease, as necessary;
3. Replacing any plant species with a 20 percent or greater mortality rate after 2 growing seasons with the same species or native species of similar form and function;
4. Irrigating the mitigation areas only as necessary during dry weather if plants appear to be too dry, with a minimal quantity of water;
5. Reseeding and/or repair of wetland and buffer areas as necessary if erosion or sedimentation occurs;
6. Spot treat non-native invasive plant species, and
7. Removing all trash or undesirable debris from all mitigation areas as necessary.

2.11 Critical Areas Easement

Per AMC 20.93.290 and MMC 22E.010.350(2) long-term protection of the mitigation site shall be provided by placement in a separate tract in which development is prohibited or by execution of an easement dedicated to the City of Arlington, a conservation organization, land trust, or similarly preserved through a permanent protective mechanism acceptable to the city. The location and limitations associated with the mitigation area shall be shown on the face of the deed or plat applicable to the property and shall be recorded with the Snohomish County recording department.

In addition, fencing and signage will be provided around the wetland mitigation and associated buffer areas as required per AMC 20.93.290(a) and MMC 22E.010.370. A temporary fence along the

construction limits will prevent encroachment into the critical area during construction, which will be replaced by permanent fencing and signage after completion of the project.

2.12 Financial Assurances

Per AMC 20.93.390(5) and MMC 22E.010.140(2)(e), performance security is required to assure that all actions approved under this mitigation plan are satisfactorily completed in accordance with the mitigation plan, performance standards, and regulatory conditions of approval. The Applicant will provide a performance bond (prior to the issuance of any building permits) and monitoring and maintenance bond for the total estimated fair market cost of labor, materials, and irrigation, as applicable, plus required continencies. The bond quantity worksheet will be provided under the Final Mitigation Plan.

Chapter 3. Closure

The findings and conclusions documented in this report have been prepared for specific application for the Cascade Logistics Park project. These findings and conclusions have been developed in a manner consistent with that level of care and skill normally exercised by members of the environmental science profession currently practicing under similar conditions in the area. The conclusions and recommendations presented in this assessment report are professional opinions based on an interpretation of information currently available to us and are made within the operation scope, budget, and schedule of this project. No warranty, expressed or implied, is made. In addition, changes in government codes, regulations, or laws may occur. Due to such changes, our observations and conclusions applicable to this assessment may need to be revised wholly or in part in the future.

Wetland and stream status and boundaries identified by SVC are based on conditions present at the time of the site visit and considered preliminary until the flagged wetland and OHW boundaries are validated by the jurisdictional agencies. Validation of the wetland and OHW boundaries and jurisdictional status of such features by the regulatory agencies provides a certification, usually written, that the wetland and stream determination and boundaries verified are the units that will be regulated by the agencies until a specific date or until the regulations are modified. Only the regulatory agencies can provide this certification.

As wetlands and streams are dynamic communities affected by both natural and human activities, changes in boundaries may be expected; therefore, delineations cannot remain valid for an indefinite period of time. Regulatory agencies typically recognize the validity of wetland and stream delineations for a period of five years after completion of an assessment report. Development activities on a site five years after the completion of this assessment report may require reassessment of the wetland and stream delineations. In addition, changes in government codes, regulations, or laws may occur. Due to such changes, our observations and conclusions applicable to this site may need to be revised wholly or in part.

Chapter 4. References

Arlington Municipal Code (AMC). 2020. *Chapter 20.93 — Environmentally Critical Areas*. Website: https://library.municode.com/wa/arlington/codes/code_of_ordinances?nodeId=TIT20ZO_CH20.93ENCRAR. Current through September 29, 2020.

Granger, T., T. Hruby, A. McMillan, D. Peters, J. Rubey, D. Sheldon, S. Stanley, and E. Stockdale. 2005. *Wetlands in Washington State - Volume 2: Guidance for Protecting and Managing Wetlands*. Washington State Department of Ecology. Publication #05-06-008. Olympia, Washington. April 2005.

Hruby, T., K. Harper, and S. Stanley. 2009. *Selecting Wetland Mitigation Sites Using a Watershed Approach*. Washington State Department of Ecology. Publication #09-06-032.

Hruby, T. 2014. *Washington State Wetland Rating System for Western Washington*: 2014 Update. (Publication #14-06-029). Olympia, WA: Washington Department of Ecology.

LDC. 2020. *Cascade Industrial Center: Macro Analysis*. November 2020. Woodinville, Washington.

Marysville Municipal Code (MMC). 2020. *Chapter 22E.010 – Critical Areas Management*. Website: https://www.codepublishing.com/WA/Marysville/#!/Marysville22E/Marysville22E010.html#22E.010. Current through October 13, 2020.

Sheldon, D., T. Hruby, P. Johnson, K. Harper, A. McMillan, T. Granger, S. Stanley, and E. Stockdale. 2005. *Wetlands in Washington State - Volume 1: A Synthesis of the Science*. Washington State Department of Ecology. Publication #05-06-006. Olympia, Washington. March 2005.

Soundview Consultants LLC. 2020a. *Alternatives Analysis – Clean Water Act Section 404(b)1 Documentation: Cascade Logistics Park*. December 2020. Gig Harbor, Washington.

Soundview Consultants LLC. 2020b. *Wetland and Fish and Wildlife Assessment Report: Cascade Logistics Park*. December 2020. Gig Harbor, Washington.

Soundview Consultants LLC. 2020c. *Biological Assessment: Cascade Logistics Park*. December 2020. Gig Harbor, Washington.

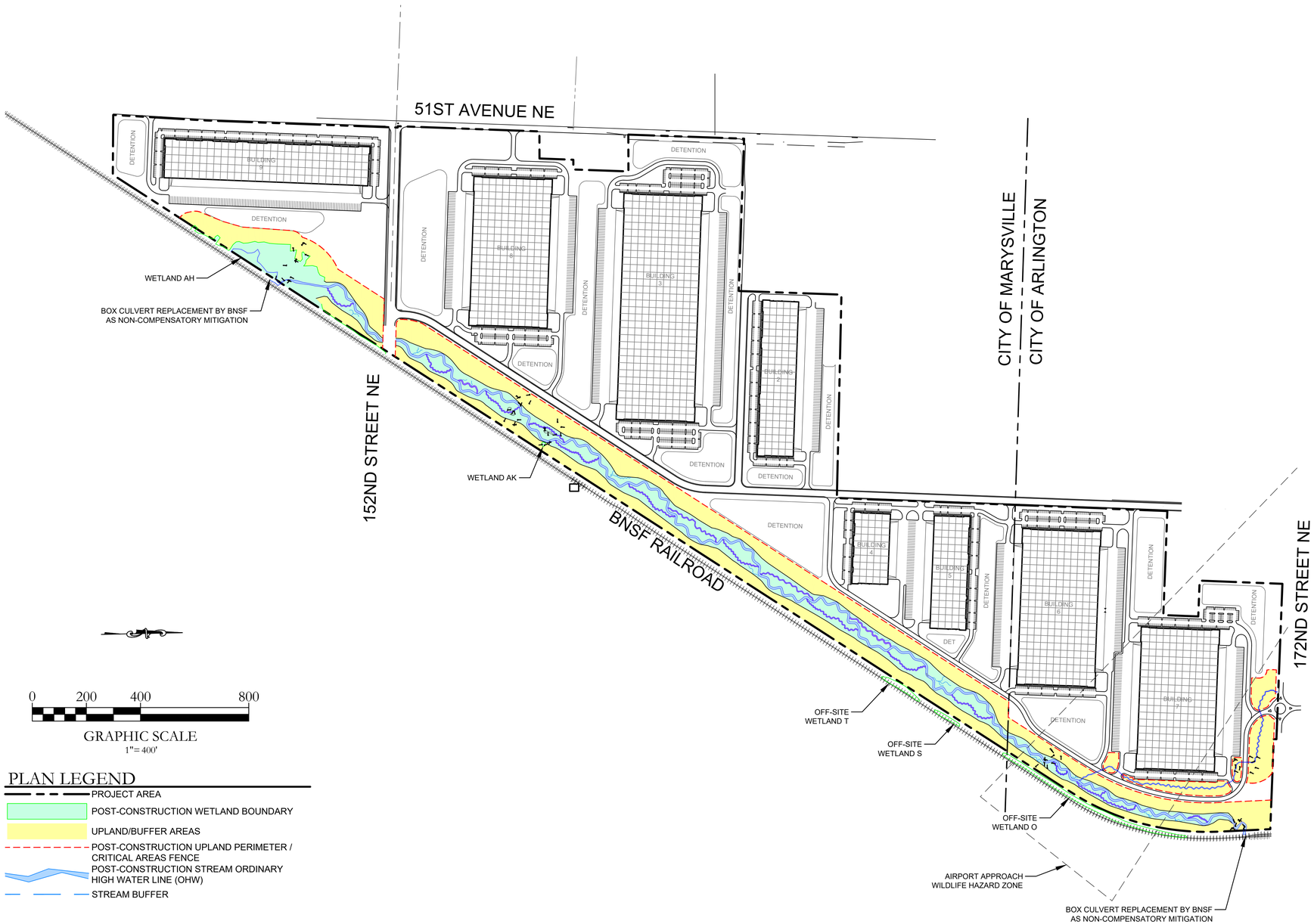
Soundview Consultants LLC. 2020d. *Fish Exclusion and Protection Plan: Cascade Logistics Park*. December 2020. Gig Harbor, Washington.

U.S. Army Corps of Engineers (USACE) and U.S. Environmental Protection Agency (EPA). 2008. *Compensatory Mitigation for Losses of Aquatic Resources; Final Rule*. Federal Register. Volume 73, Number 70 (33 CFR Parts 325 & 332, 40 CFR Part 230)

USACE. 2010. *Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Western Mountains, Valleys, and Coast Region (Ver2.0),* ed. J.S. Wakeley, R.W. Lichvar, and C.V. Noble. ERDC/EL TR-10-3. U.S. Army Engineer Research and Development Center. Vicksburg, Mississippi.

Washington State Department of Ecology (WSDOE), USACE, and EPA. 2006. *Wetland Mitigation in Washington State Part 2: Developing Mitigation Plans (Version 1.0, March 2006, WSDOE publication # 06-06-11b)*. WSDOE Shorelands and Environmental Assistance Program. Olympia, Washington.

Appendix A – Conceptual Mitigation Plan Exhibits



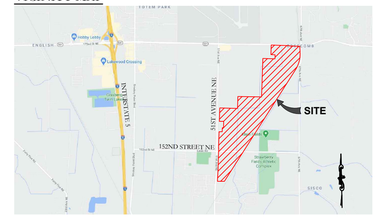
0 200 400 800

GRAPHIC SCALE
1"= 400'

PLAN LEGEND

- PROJECT AREA
- POST-CONSTRUCTION WETLAND BOUNDARY
- UPLAND/BUFFER AREAS
- POST-CONSTRUCTION UPLAND PERIMETER / CRITICAL AREAS FENCE
- POST-CONSTRUCTION STREAM ORDINARY HIGH WATER LINE (OHW)
- STREAM BUFFER

VICINITY MAP



SOURCE: GOOGLE MAPS;
WWW.MAPS.GOOGLE.COM
(ACCESSED 11/4/2020)

APPLICANT

NORTHPOINT HOLDINGS, LLC
4825 NORTHWEST 41ST STREET, SUITE 500
RIVERSIDE, MISSOURI 6415

SITE ADDRESS/PARCEL #

6600 172ND STREET NORTHEAST
ARLINGTON, WASHINGTON 98223
15223 & 16015 51ST AVENUE NORTHEAST
5415 152ND STREET EAST
MARYSVILLE, WASHINGTON 98271

SNOHOMISH COUNTY TAX PARCELS:
31052700100100, 31052700100300, 31052700300200, 31052700300500, 31052700300700, 31052700300800, 31052700300900, 31052700400300, 31053400200300, 31053400200400, 31053400200500, 31053400200600, 31053400200700, 31053400300300
SNOHOMISH COUNTY TAX PARCELS (NOT ASSESSED):
31052700100900, 31053400200100, 31053400200900, 31053400201300

ENVIRONMENTAL CONSULTANT

SOUNDVIEW CONSULTANTS LLC
2907 HARBORVIEW DRIVE, SUITE D
GIG HARBOR, WASHINGTON 98355
(253) 514-8952

SHEET INDEX

SHEET NUMBER	SHEET TITLE
1	SITE PLAN OVERVIEW
2	IMPACTS & MITIGATION VIEWPORT 1
3	IMPACTS & MITIGATION VIEWPORT 2
4	IMPACTS & MITIGATION VIEWPORT 3
5	PLANTING PLAN OVERVIEW
6	PLANTING TYPICALS 1 & 2
7	PLANTING TYPICALS 3-6
8	PLANT SCHEDULE AND DETAILS

PRELIMINARY
INFORMATION ONLY

NOT FOR CONSTRUCTION

SOUNDVIEW CONSULTANTS LLC ASSUMES NO LIABILITY OR RESPONSIBILITY FOR CONSTRUCTION, IMPROVEMENTS, OR ESTIMATES BASED ON THIS PLAN SET

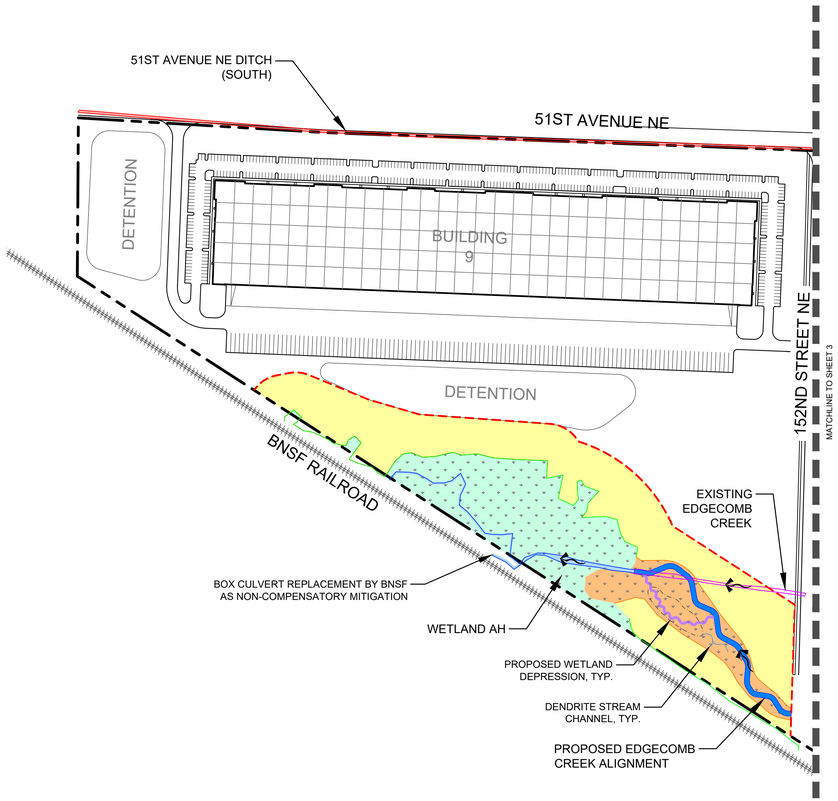
SOURCES:
LDC | Surveying Engineering Planning
Woodinville: 20210 142nd Avenue NE, Woodinville, WA 98072
Kent: 1851 Central Pl S, #101, Kent, WA 98032
T 425.806.1869 www.LDCcorp.com F 425.482.2893

Soundview Consultants LLC
Environmental Assessment • Planning • Land Use Solutions
2907 HARBORVIEW DRIVE, SUITE D P. 253.514.8952
GIG HARBOR, WASHINGTON 98335 F. 253.514.8954
WWW.SOUNDVIEWCONSULTANTS.COM

CASCADE LOGISTICS PARK
THE NE & SE¼ OF SECTION 27
NW & SW¼ OF SECTION 34
TOWNSHIP 31N, RANGE 5E, W.M.

DATE: 12/18/2020
JOB: 1703.0004
BY: MW
SCALE: AS SHOWN
SHEET: 1

S:\CURRENT_1703 NorthPoint Holdings LLC\1703.0004 Cascade Logistics Park\Graphics & Maps\CAD\A - CURRENT SVC DRAWINGS\A - Current Base DWGs\1703.0004 (2020-12) Cascade Logistics.dwg
Plotted: December 16, 2020



IMPACTS & MITIGATION PLAN - VIEWPORT 1

PLAN LEGEND

- PROJECT LIMITS
- WETLAND BOUNDARY TO BE RETAINED
- STREAM TO BE RETAINED
- STREAM FLOW DIRECTION
- UPLAND PERIMETER / CRITICAL AREAS FENCE
- UPLAND/BUFFER AREAS - 1,728,023 SF

0 200 400 800

GRAPHIC SCALE
1"= 400'

IMPACTS LEGEND

WETLAND FILL

WETLAND A	1,369 SF
WETLAND B	4,859 SF
WETLAND C	4,841 SF
WETLAND D	3,537 SF
WETLAND E	775 SF
WETLAND F	386 SF
WETLAND G	987 SF
WETLAND H	6,279 SF
WETLAND I	377 SF
WETLAND J	334 SF
WETLAND K	16,836 SF
WETLAND L	15,756 SF
WETLAND M	1,969 SF
WETLAND N	8,133 SF
WETLAND P	550 SF
WETLAND Q	2,522 SF
WETLAND R	1,773 SF
WETLAND U	4,909 SF
WETLAND V	5,945 SF
WETLAND W	258 SF
WETLAND X	4,492 SF
WETLAND Y	662 SF
WETLAND Z	483 SF
WETLAND AA	574 SF
WETLAND AB	1,166 SF
WETLAND AC	4,866 SF
WETLAND AD	2,462 SF
WETLAND AE	11,346 SF
WETLAND AF	615 SF
WETLAND AG	285 SF
WETLAND AI	3,873 SF
WETLAND AJ	2,471 SF
51ST AVE E DITCH - NORTH TREATED AS WETLAND BY CITY & STATE, NON-JURISDICTIONAL FEDERALLY	17,099 SF
51ST AVE E DITCH - SOUTH TREATED AS WETLAND BY CITY & STATE, NON-JURISDICTIONAL FEDERALLY	13,670 SF
TOTAL WETLAND FILL:	146,459 SF

STREAM FILL

EDGECOMB CREEK	10,165 LF (147,522 SF)
DITCH X	1,167 LF (18,074 SF)
TOTAL STREAM IMPACTS:	11,332 LF (165,596 SF)

DITCH FILL

DITCH U LIKELY NON-JURISDICTIONAL FEDERALLY	1,223 LF (4,891 SF)

MITIGATION LEGEND

WETLAND ENHANCEMENT

WETLANDS AH & AK	142,148 SF

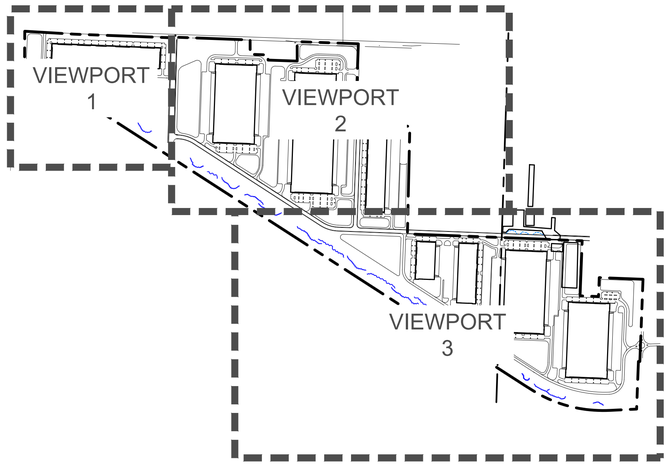
WETLAND CREATION

EDGECOMB CREEK CORRIDOR	799,510 SF

NOTE: WETLAND MITIGATION AREA TO COMPENSATE FOR THE PROPOSED PROJECT'S DIRECT IMPACTS. EXCESS MITIGATION CREDITS MAY BE UTILIZED AS ADVANCE MITIGATION.

STREAM CREATION

EDGECOMB CREEK REALIGNMENT	9,559 LF (134,769 SF)
DITCH X REALIGNMENT	2,094 LF (9,566 SF)
EDGECOMB CREEK SIDE CHANNELS	6,767 LF (43,031 SF)
TOTAL STREAM CREATION:	18,420 LF (187,366 SF)



IMPACTS & MITIGATION KEY

SCALE: 1"=1000'

PRELIMINARY
INFORMATION ONLY

NOT FOR CONSTRUCTION

SOUNDVIEW CONSULTANTS LLC ASSUMES NO LIABILITY OR RESPONSIBILITY FOR CONSTRUCTION, IMPROVEMENTS, OR ESTIMATES BASED ON THIS PLAN SET

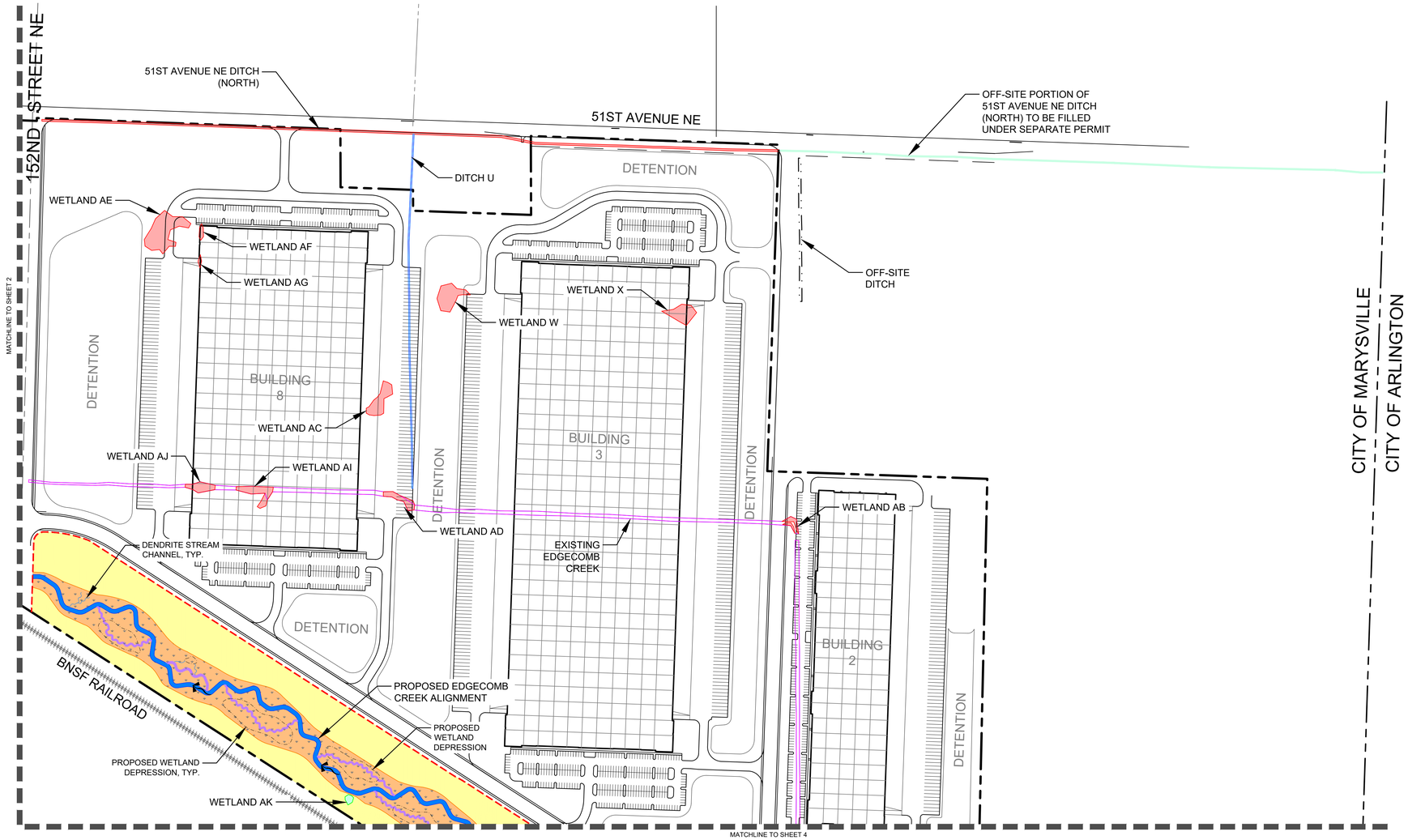
SOURCES:
LDC
Surveying
Engineering
Planning
Woodinville
20210 142nd Avenue NE
Woodinville, WA 98072
T 425.806.1869
Kent
1851 Central Pl S, #101
Kent, WA 98030
www.LDCcorp.com
F 425.482.2893

Soundview Consultants LLC
Environmental Assessment • Planning • Land Use Solutions
2907 HARBORVIEW DRIVE, SUITE D
GIG HARBOR, WASHINGTON 98335
P. 253.514.8952
F. 253.514.8954
WWW.SOUNDVIEWCONSULTANTS.COM

CASCADE LOGISTICS PARK
THE NE & SE ¼ OF SECTION 27
NW & SW ¼ OF SECTION 34
TOWNSHIP 31N, RANGE 5E, W.M.

DATE: 12/18/2020
JOB: 1703.0004
BY: MW
SCALE: AS SHOWN
SHEET: 2

S:\CURRENT\1703 NorthPoint Holdings LLC\1703.0004 Cascade Logistics Park\Graphics & Maps\CAD\A - CURRENT SVC DRAWINGS\A - Current Base DWGs\1703.0004 (2020-12) Cascade Logistics.dwg
Plotted December 16, 2020



IMPACTS & MITIGATION PLAN - VIEWPORT 2

0 200 400 800

GRAPHIC SCALE
1"= 400'

PLAN LEGEND

- PROJECT LIMITS
- WETLAND BOUNDARY TO BE RETAINED
- STREAM TO BE RETAINED
- STREAM FLOW DIRECTION
- UPLAND PERIMETER / CRITICAL AREAS FENCE
- UPLAND/BUFFER AREAS - 1,728,023 SF

IMPACTS LEGEND

- WETLAND FILL
- STREAM FILL

MITIGATION LEGEND

- WETLAND ENHANCEMENT
- WETLAND CREATION

STREAM CREATION

- EDGECOMB CREEK & DITCH X
- EDGECOMB CREEK SIDE CHANNELS

PRELIMINARY
INFORMATION ONLY

NOT FOR CONSTRUCTION

SOUNDVIEW CONSULTANTS LLC ASSUMES NO LIABILITY OR RESPONSIBILITY FOR CONSTRUCTION, IMPROVEMENTS, OR ESTIMATES BASED ON THIS PLAN SET

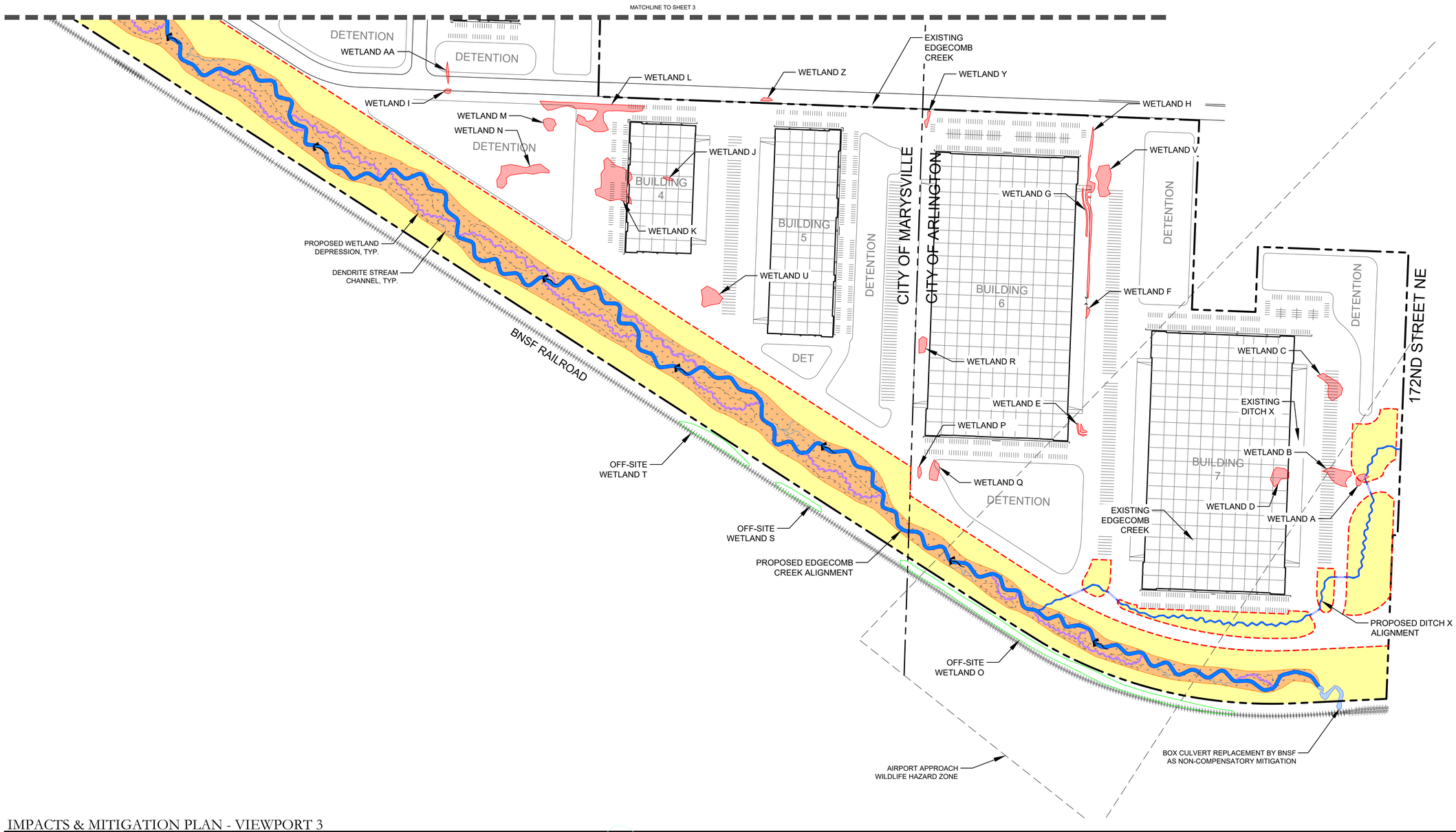
SOURCES:
LDC | Surveying Engineering Planning
Woodinville
20210 142nd Avenue NE
Woodinville, WA 98072
T 425.806.1869
Kent
1851 Central Pl S, #101
Kent, WA 98032
www.LDCcorp.com F 425.482.2893

Soundview Consultants LLC
Environmental Assessment • Planning • Land Use Solutions
2907 HARBORVIEW DRIVE, SUITE D
GIG HARBOR, WASHINGTON 98335
P. 253.514.8952
F. 253.514.8954
WWW.SOUNDVIEWCONSULTANTS.COM

CASCADE LOGISTICS PARK
THE NE & SE ¼ OF SECTION 27
NW & SW ¼ OF SECTION 34
TOWNSHIP 31N, RANGE 5E, W.M.

DATE: 12/18/2020
JOB: 1703.0004
BY: MW
SCALE: AS SHOWN
SHEET: 3

S:\CURRENT\1703 NorthPoint Holdings LLC\1703.0004 Cascade Logistics Park\Graphics & Maps\CAD\A — CURRENT SVC DRAWINGS\A — Current Base DWGs\[1703.0004 (2020-12) Cascade Logistics.dwg
Plotted December 16, 2020



IMPACTS & MITIGATION PLAN - VIEWPORT 3

0 200 400 800

GRAPHIC SCALE
1"= 400'

PLAN LEGEND

- PROJECT LIMITS
- WETLAND BOUNDARY TO BE RETAINED
- STREAM TO BE RETAINED
- STREAM FLOW DIRECTION
- UPLAND PERIMETER / CRITICAL AREAS FENCE
- UPLAND/BUFFER AREAS - 1,728,023 SF

IMPACTS LEGEND

- WETLAND FILL
- STREAM FILL

MITIGATION LEGEND

- WETLAND ENHANCEMENT
- WETLAND CREATION

STREAM CREATION

- EDGECOMB CREEK & DITCH X
- EDGECOMB CREEK SIDE CHANNELS

PRELIMINARY
INFORMATION ONLY

NOT FOR CONSTRUCTION

SOUNDVIEW CONSULTANTS LLC ASSUMES NO LIABILITY OR RESPONSIBILITY FOR CONSTRUCTION, IMPROVEMENTS, OR ESTIMATES BASED ON THIS PLAN SET

SOURCES:

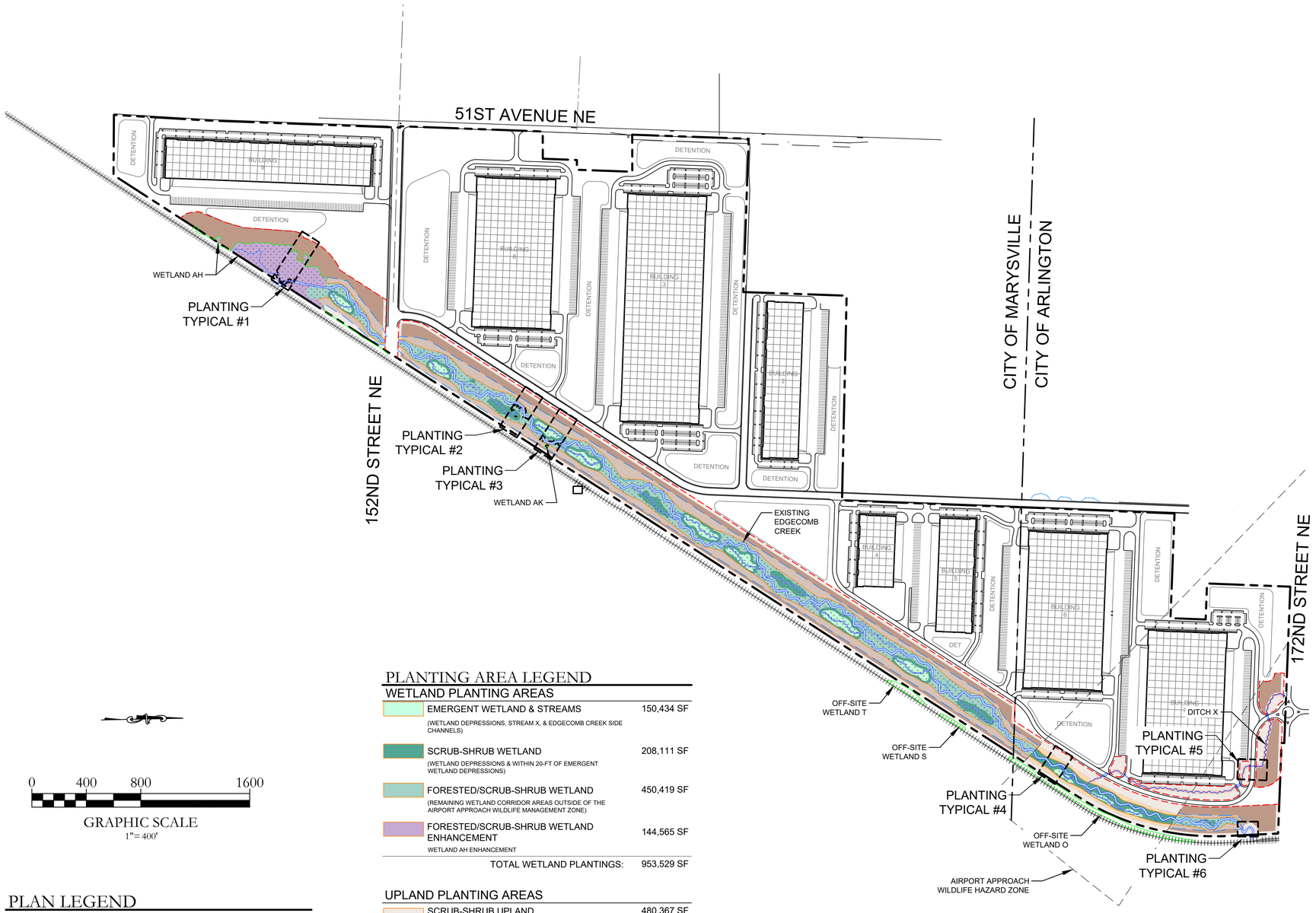
LDC | Surveying Engineering Planning
Woodinville
20210 142nd Avenue NE
Woodinville, WA 98072
T 425.806.1869
Kent
1851 Central Pl S, #101
Kent, WA 98030
www.LDCcorp.com
F 425.482.2893

Soundview Consultants LLC
Environmental Assessment • Planning • Land Use Solutions
2907 HARBORVIEW DRIVE, SUITE D
GIG HARBOR, WASHINGTON 98335
P. 253.514.8952
F. 253.514.8954
WWW.SOUNDVIEWCONSULTANTS.COM

CASCADE LOGISTICS PARK
THE NE & SE ¼ OF SECTION 27
NW & SW ¼ OF SECTION 34
TOWNSHIP 31N, RANGE 5E, W.M.

DATE: 12/18/2020
JOB: 1703.0004
BY: MW
SCALE: AS SHOWN
SHEET: 4

S:\CURRENT\1703 NorthPoint Holdings LLC\1703.0004 Cascade Logistics Park\Graphics & Maps\CAD\A - CURRENT SYC DRAWINGS\A - Current Base DWGs\1703.0004 (2020-12) Cascade Logistics.dwg
Plotted December 16, 2020



0 400 800 1600

GRAPHIC SCALE
1"= 400'

PLAN LEGEND

- PROJECT LIMITS
- WETLAND BOUNDARY TO BE RETAINED
- STREAM TO BE RETAINED
- STREAM FLOW DIRECTION
- UPLAND PERIMETER / CRITICAL AREAS FENCE

PLANTING AREA LEGEND

WETLAND PLANTING AREAS

	EMERGENT WETLAND & STREAMS (WETLAND DEPRESSIONS, STREAM X, & EDGECOMB CREEK SIDE CHANNELS)	150,434 SF
	SCRUB-SHRUB WETLAND (WETLAND DEPRESSIONS & WITHIN 20-FT OF EMERGENT WETLAND DEPRESSIONS)	208,111 SF
	FORESTED/SCRUB-SHRUB WETLAND (REMAINING WETLAND CORRIDOR AREAS OUTSIDE OF THE AIRPORT APPROACH WILDLIFE MANAGEMENT ZONE)	450,419 SF
	FORESTED/SCRUB-SHRUB WETLAND ENHANCEMENT WETLAND AH ENHANCEMENT	144,565 SF
	TOTAL WETLAND PLANTINGS:	953,529 SF

UPLAND PLANTING AREAS

	SCRUB-SHRUB UPLAND (ALL UPLAND AREAS OUTSIDE OF THE 100 YEAR FLOOD PLAIN THAT ARE WITHIN THE AIRPORT APPROACH WILDLIFE MANAGEMENT ZONE OR WITHIN 20-FT OF ROADS & RAILROAD BOUNDARIES)	480,367 SF
	SCRUB-SHRUB UPLAND - FLOOD PLAIN (ALL UPLAND AREAS WITHIN 100 YEAR FLOOD PLAIN ALONG DITCH X & WITHIN THE AIRPORT APPROACH WILDLIFE MANAGEMENT ZONE)	77,075 SF
	FORESTED UPLAND (ALL UPLAND AREAS BETWEEN SCRUB-SHRUB UPLAND AREAS AND THE 100 YEAR FLOOD PLAIN; OUTSIDE OF THE AIRPORT APPROACH WILDLIFE MANAGEMENT ZONE)	674,391 SF
	FORESTED UPLAND - FLOOD PLAIN (ALL UPLAND AREAS WITHIN THE 100 YEAR FLOOD PLAIN)	496,190 SF
	TOTAL UPLAND PLANTINGS:	1,728,023 SF
	TOTAL PLANTED AREAS:	2,681,552 SF (61.53 AC)

PRELIMINARY INFORMATION ONLY

NOT FOR CONSTRUCTION

SOUNDVIEW CONSULTANTS LLC ASSUMES NO LIABILITY OR RESPONSIBILITY FOR CONSTRUCTION, IMPROVEMENTS, OR ESTIMATES BASED ON THIS PLAN SET

SOURCES:

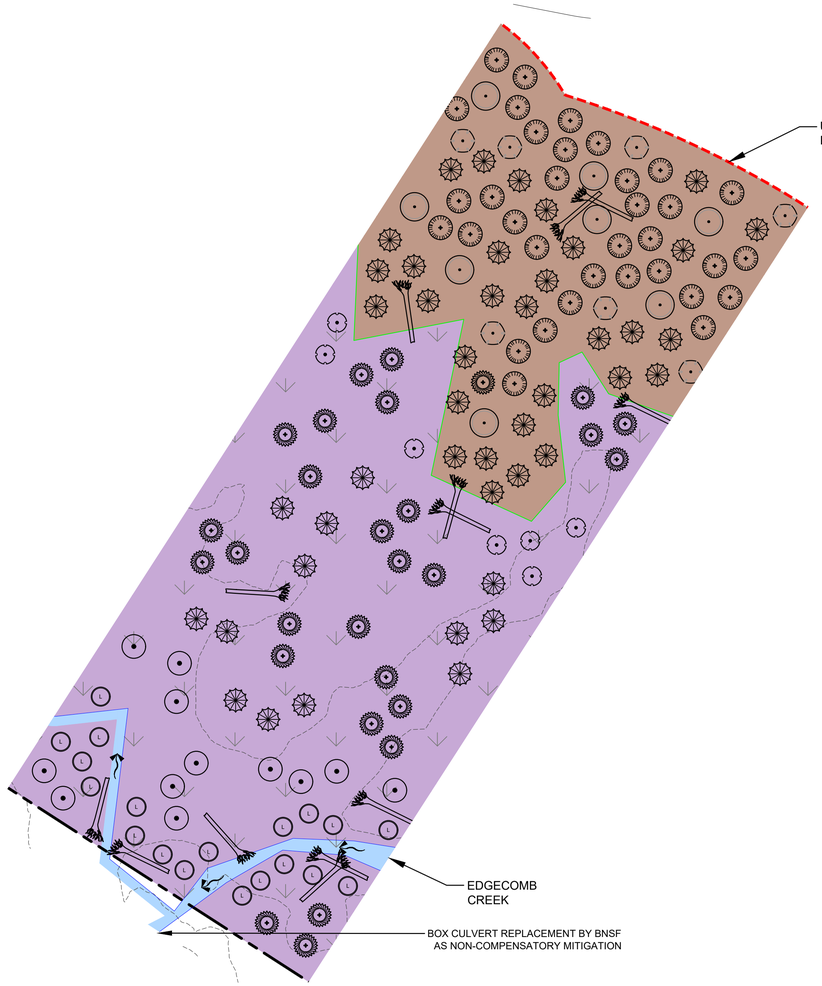
LDC | Surveying Engineering Planning
Woodinville
20210 142nd Avenue NE
Woodinville, WA 98072
Kent
1851 Central Pl S, #101
Kent, WA 98030
T 425.806.1869 www.LDCcorp.com F 425.482.2893

Soundview Consultants LLC
Environmental Assessment • Planning • Land Use Solutions
2907 HARBORVIEW DRIVE, SUITE D P. 253.514.8952
GIG HARBOR, WASHINGTON 98335 F. 253.514.8954
WWW.SOUNDVIEWCONSULTANTS.COM

CASCADE LOGISTICS PARK
THE NE & SE ¼ OF SECTION 27
NW & SW ¼ OF SECTION 34
TOWNSHIP 31N, RANGE 5E, W.M.

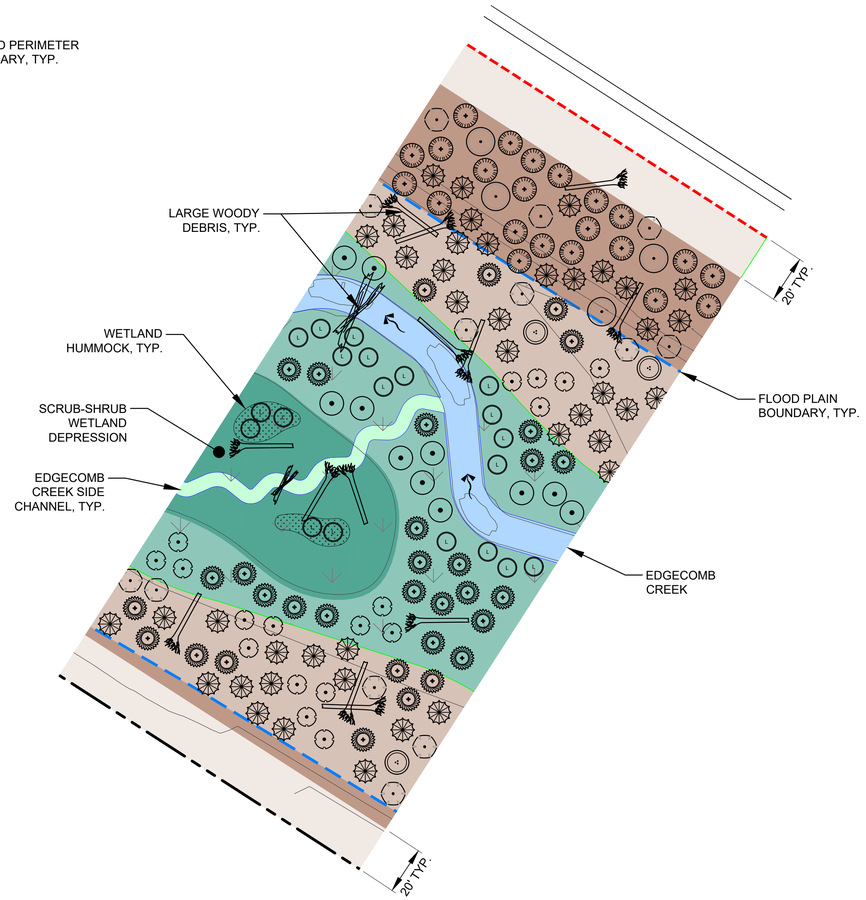
DATE: 12/18/2020
JOB: 1703.0004
BY: MW
SCALE: AS SHOWN
SHEET: 5

S:\CURRENT\1703 NorthPoint Holdings LLC\1703.0004 Cascade Logistics Park\Graphics & Maps\CAD\A - CURRENT SVC DRAWINGS\A - Current Base DWGs\1703.0004 (2020-12) Cascade Logistics.dwg
Plotted December 18, 2020



PLANTING TYPICAL #1 - WETLAND AH ENHANCEMENT *

* ONLY LARGE TREES AND LIVE STAKES TO BE PLANTED WITHIN WETLAND ENHANCEMENT AREAS



PLANTING TYPICAL #2 - WETLAND CORRIDOR WITH SCRUB-SHRUB DEPRESSION

SCALE: 1"=20'

0 30 60 120

GRAPHIC SCALE
1"= 30'

PLAN LEGEND

- PROJECT LIMITS
- WETLAND BOUNDARY TO BE RETAINED
- STREAM TO BE RETAINED
- STREAM FLOW DIRECTION
- UPLAND PERIMETER / CRITICAL AREAS FENCE
- FLOOD PLAIN BOUNDARY

PLANTING AREA LEGEND

WETLAND PLANTING AREAS

- EMERGENT WETLAND & STREAMS
  (WETLAND DEPRESSIONS, DITCH X, & EDGECOMB CREEK SIDE CHANNELS)
- SCRUB-SHRUB WETLAND
  (WETLAND DEPRESSIONS & WITHIN 20-FT OF EMERGENT WETLAND DEPRESSIONS)
- FORESTED/SCRUB-SHRUB WETLAND
  (REMAINING WETLAND CORRIDOR AREAS OUTSIDE OF THE AIRPORT APPROACH WILDLIFE MANAGEMENT ZONE)
- FORESTED/SCRUB-SHRUB WETLAND ENHANCEMENT
  WETLAND AH ENHANCEMENT

UPLAND PLANTING AREAS

- SCRUB-SHRUB UPLAND
  (ALL UPLAND AREAS OUTSIDE OF THE FLOOD PLAIN THAT ARE WITHIN THE AIRPORT APPROACH WILDLIFE MANAGEMENT ZONE OR WITHIN 20-FT OF ROADS & RAILROAD BOUNDARIES)
- SCRUB-SHRUB UPLAND - FLOOD PLAIN
  (ALL UPLAND AREAS WITHIN FLOOD PLAIN ALONG DITCH X & WITHIN THE AIRPORT APPROACH WILDLIFE MANAGEMENT ZONE)
- FORESTED UPLAND
  (ALL UPLAND AREAS BETWEEN SCRUB-SHRUB UPLAND AREAS AND THE 100 YEAR FLOOD PLAIN; OUTSIDE OF THE AIRPORT APPROACH WILDLIFE MANAGEMENT ZONE)
- FORESTED UPLAND - FLOOD PLAIN
  (ALL UPLAND AREAS WITHIN THE 100 YEAR FLOOD PLAIN)

PLANT LIST

TREES

SCIENTIFIC NAME	COMMON NAME
ACER CIRCINATUM	VINE MAPLE
ACER MACROPHYLLUM	BIG LEAF MAPLE
FRANGULA PURSHIANA	CASCARA
MALUS FUSCA	PACIFIC CRABAPPLE
PICEA SITCHENSIS	SITKA SPRUCE
POPULUS BALSAMIFERA	BLACK COTTONWOOD
PRUNUS EMARGINATA	BITTER CHERRY
PSEUDOTSUGA MENZIESII	DOUGLAS FIR
SALIX LUCIDA	PACIFIC WILLOW
THUJA PLICATA	WESTERN REDCEDAR

PRELIMINARY INFORMATION ONLY

NOT FOR CONSTRUCTION

SOUNDVIEW CONSULTANTS LLC ASSUMES NO LIABILITY OR RESPONSIBILITY FOR CONSTRUCTION, IMPROVEMENTS, OR ESTIMATES BASED ON THIS PLAN SET

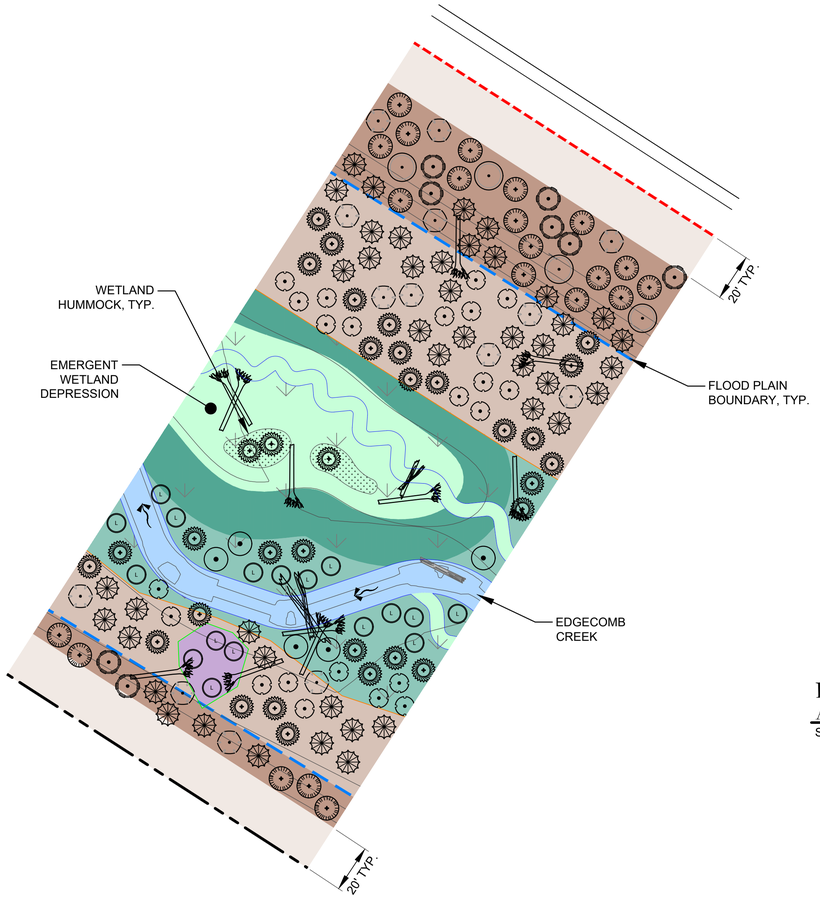
SOURCES:
LDC | Surveying Engineering Planning
Woodinville: 20210 142nd Avenue NE, Woodinville, WA 98072
Kent: 1851 Central Pl S, #101, Kent, WA 98030
T 425.806.1869 www.LDCcorp.com F 425.482.2893

Soundview Consultants LLC
Environmental Assessment • Planning • Land Use Solutions
2907 HARBORVIEW DRIVE, SUITE D
GIG HARBOR, WASHINGTON 98335
P. 253.514.8952
F. 253.514.8954
WWW.SOUNDVIEWCONSULTANTS.COM

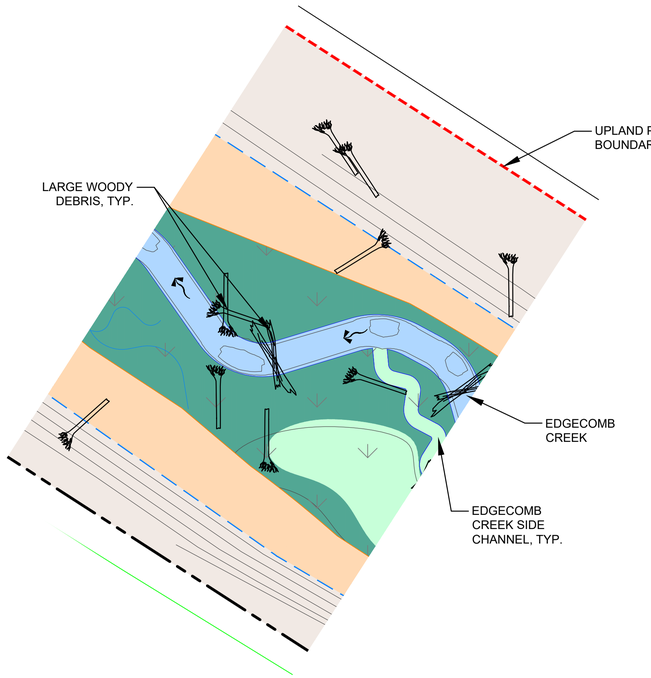
CASCADE LOGISTICS PARK
THE NE & SE ¼ OF SECTION 27
NW & SW ¼ OF SECTION 34
TOWNSHIP 31N, RANGE 5E, W.M.

DATE: 12/18/2020
JOB: 1703.0004
BY: MW
SCALE: AS SHOWN
SHEET: 6

S:\CURRENT\1703 NorthPoint Holdings LLC\1703.0004 Cascade Logistics Park\Graphics & Maps\CAD\A - CURRENT SYC DRAWINGS\A - Current Base DWGs\1703.0004 (2020-12) Cascade Logistics.dwg
Plotted December 16, 2020

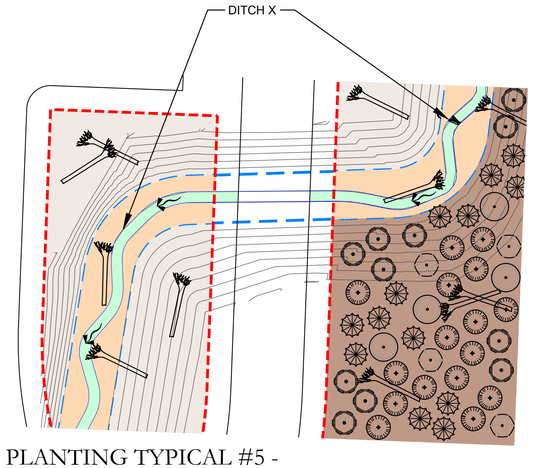


PLANTING TYPICAL #3 -
WETLAND CORRIDOR WITH EMERGENT DEPRESSION



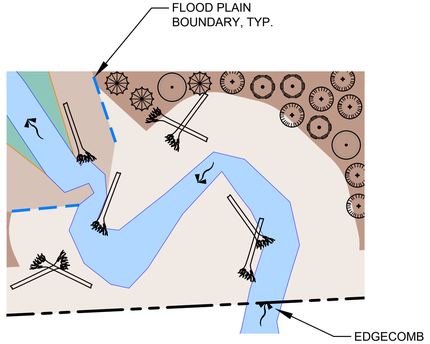
PLANTING TYPICAL #4 -
AIRPORT APPROACH

SCALE: 1"=20'



PLANTING TYPICAL #5 -
STREAM X CORRIDOR

SCALE: 1"=20'



PLANTING TYPICAL #6 -
EDGECOMB CREEK ALLUVIAL FAN

0 30 60 120

GRAPHIC SCALE
1"= 30'

PLAN LEGEND
- PROJECT LIMITS
- WETLAND BOUNDARY TO BE RETAINED
- STREAM TO BE RETAINED
- STREAM FLOW DIRECTION
- UPLAND PERIMETER / CRITICAL AREAS FENCE
- FLOOD PLAIN BOUNDARY

PLANT LIST
TREES

SCIENTIFIC NAME	COMMON NAME
ACER CIRCINATUM	VINE MAPLE
ACER MACROPHYLLUM	BIG LEAF MAPLE
FRANGULA PURSHIANA	CASCARA
MALUS FUSCA	PACIFIC CRABAPPLE
PICEA SITCHENSIS	SITKA SPRUCE
POPULUS BALSAMIFERA	BLACK COTTONWOOD
PRUNUS EMARGINATA	BITTER CHERRY
PSEUDOTSUGA MENZIESII	DOUGLAS FIR
SALIX LUCIDA	PACIFIC WILLOW
THUJA PLICATA	WESTERN REDCEDAR

PLANTING AREA LEGEND
WETLAND PLANTING AREAS
- EMERGENT WETLAND & STREAMS
  (WETLAND DEPRESSIONS, DITCH X, & EDGECOMB CREEK SIDE CHANNELS)
- SCRUB-SHRUB WETLAND
  (WETLAND DEPRESSIONS & WITHIN 20-FT OF EMERGENT WETLAND DEPRESSIONS)
- FORESTED/SCRUB-SHRUB WETLAND
  (REMAINING WETLAND CORRIDOR AREAS OUTSIDE OF THE AIRPORT APPROACH WILDLIFE MANAGEMENT ZONE)
- FORESTED/SCRUB-SHRUB WETLAND ENHANCEMENT
  WETLAND AH ENHANCEMENT

UPLAND PLANTING AREAS
- SCRUB-SHRUB UPLAND
  (ALL UPLAND AREAS OUTSIDE OF THE FLOOD PLAIN THAT ARE WITHIN THE AIRPORT APPROACH WILDLIFE MANAGEMENT ZONE OR WITHIN 20-FT OF ROADS & RAILROAD BOUNDARIES)
- SCRUB-SHRUB UPLAND - FLOOD PLAIN
  (ALL UPLAND AREAS WITHIN FLOOD PLAIN ALONG DITCH X & WITHIN THE AIRPORT APPROACH WILDLIFE MANAGEMENT ZONE)
- FORESTED UPLAND
  (ALL UPLAND AREAS BETWEEN SCRUB-SHRUB UPLAND AREAS AND THE 100 YEAR FLOOD PLAIN, OUTSIDE OF THE AIRPORT APPROACH WILDLIFE MANAGEMENT ZONE)
- FORESTED UPLAND - FLOOD PLAIN
  (ALL UPLAND AREAS WITHIN THE 100 YEAR FLOOD PLAIN)

PRELIMINARY INFORMATION ONLY

NOT FOR CONSTRUCTION

SOUNDVIEW CONSULTANTS LLC ASSUMES NO LIABILITY OR RESPONSIBILITY FOR CONSTRUCTION, IMPROVEMENTS, OR ESTIMATES BASED ON THIS PLAN SET

SOURCES:

LDC | Surveying Engineering Planning
Woodinville
20210 142nd Avenue NE
Woodinville, WA 98072
T 425.806.1869
Kent
1851 Central Pl S, #101
Kent, WA 98030
www.LDCcorp.com
F 425.482.2893

Soundview Consultants LLC
Environmental Assessment • Planning • Land Use Solutions
2907 HARBORVIEW DRIVE, SUITE D
GIG HARBOR, WASHINGTON 98335
P. 253.514.8952
F. 253.514.8954
WWW.SOUNDVIEWCONSULTANTS.COM

CASCADE LOGISTICS PARK
THE NE & SE ¼ OF SECTION 27
NW & SW ¼ OF SECTION 34
TOWNSHIP 31N, RANGE 5E, W.M.

DATE: 12/18/2020
JOB: 1703.0004
BY: MW
SCALE: AS SHOWN
SHEET: 7

S:\CURRENT\1703 NorthPoint Holdings LLC\1703.0004 Cascade Logistics Park\Graphics & Maps\CAD\A - CURRENT SYC DRAWINGS\A - Current Base DWGs\1703.0004 (2020-12) Cascade Logistics.dwg
Plotted December 16, 2020

PLANT SCHEDULE

Landscape Types:															
Type 1 - Emergent Wetland & Streams															
Type 2 - Scrub-Shrub Wetland															
Type 3 - Forested/Scrub-Shrub Wetland															
Type 4 - Forested/Scrub-Shrub Wetland Enhancement															
Type 5 - Scrub-Shrub Upland		**Area (SF):**	150,434	208,111	450,419	144,565	480,367	77,075	674,391	496,190					
Type 6 - Scrub-Shrub Upland - Flood Plain		**Cov'g %**	100	100	100	50	100	100	100	100					
Type 7 - Forested Upland		**Tree %**	0	0	34	34	0	0	50	50					
Type 8 - Forested Upland - Flood Plain		**Shrub %**	0	100	66	66	100	100	50	50					
Plant Name			**Quantity**												
Scientific	**Common**	**Plant Status**	**Type 1**	**Type 2**	**Type 3**	**Type 4**	**Type 5**	**Type 6**	**Type 7**	**Type 8**	TOTAL	**Spacing**	**Size**	**Condition**	**Planting Area**
Tree															
Acer macrophyllum	Bigleaf Maple	FACU	-	-	-	-	-	-	500	-	**500**	**10 ft**	**3 - 4 ft**	**2 gal.**	**Dry**
Frangula purshiana	Cascara	FAC	-	-	-	-	-	-	500	500	**1000**	**10 ft**	**3 - 4 ft**	**2 gal.**	**Dry**
Malus fusca	Pacific crabapple	FACW	-	-	250	25	-	-	-	500	**775**	**10 ft**	**3 - 4 ft**	**2 gal.**	**Wet - in wetland**
Picea sitchensis	Sitka spruce	FAC	-	-	400	60	-	-	-	800	**1260**	**10 ft**	**3 - 4 ft**	**2 gal.**	**Moist - on hummock**
Populus balsamifera	Black cottonwood	FAC	-	-	350	50	-	-	-	-	**400**	**10 ft**	**3 - 4 ft**	**2 gal.**	**Moist/Wet - on hummock**
Prunus emarginata	Bitter cherry	FACU	-	-	-	-	-	-	500	-	**500**	**10 ft**	**3 - 4 ft**	**2 gal.**	**Dry**
Pseudotsuga menziesii	Douglas fir	FACU	-	-	-	-	-	-	1594	-	**1594**	**10 ft**	**3 - 4 ft**	**2 gal.**	**Dry**
Salix lucida	Pacific willow	FACW	-	-	768	100	-	-	-	-	**868**	**10 ft**	**3 - 4 ft**	**Stakes**	**Wet**
Thuja plicata	Western red cedar	FAC	-	-	-	49	-	-	800	1065	**1914**	**10 ft**	**3 - 4 ft**	**2 gal.**	**Moist - on hummock**
		Total	0	0	1768	284	0	0	3894	2865	**8811**				
Shrubs															
Acer circinatum	Vine maple	FAC	-	-	-	-	-	-	1500	500	**2000**	**10 ft**	**2 - 4 ft**	**2 gal.**	**Dry/Moist**
Amelanchier alnifolia	Serviceberry	FACU	-	-	-	-	1000	-	1000	-	**2000**	**8 ft**	**2 - 4 ft**	**2 gal.**	**Dry**
Cornus sericea	Red-twig dogwood	FACW	-	1500	3300	225	-	-	-	1800	**6825**	**2 - 5 ft**	**2 - 4 ft**	**Stakes**	**Moist/Wet**
Corylus cornuta californica	Western hazlenut	FACU	-	-	-	-	1000	-	500	-	**1500**	**10 ft**	**2 - 4 ft**	**2 gal.**	**Moist**
Crataegus douglasii	Douglas hawthorn	FAC	-	1000	2000	-	-	200	-	-	**3200**	**5 ft**	**2 - 4 ft**	**2 gal.**	**Moist**
Gaultheria shallon	Salal	FACU	-	-	-	-	5188	-	3000	1000	**9188**	**5 ft**	**2 - 4 ft**	**1 gal.**	**Dry**
Mahonia nervosa	Low Oregon grape	FACU	-	-	-	-	-	-	3000	-	**3000**	**5 ft**	**2 - 4 ft**	**1 gal.**	**Dry/Moist**
Oemleria cerasiformis	Indian plum	FACU	-	-	-	-	3000	-	2000	-	**5000**	**5 ft**	**2 - 4 ft**	**1 gal.**	**Dry**
Physocarpus capitatus	Pacific ninebark	FACW	-	500	500	-	1500	400	-	-	**2900**	**5 ft**	**2 - 4 ft**	**1 gal.**	**Moist/Wet**
Ribes divaricatum	Wax currant	FAC	-	313	-	-	-	-	-	429	**742**	**5 ft**	**2 - 4 ft**	**1 gal.**	**Moist/Wet**
Rosa gymnocarpa	Bald hip rose	FACU	-	-	-	-	-	-	575	-	**575**	**5 ft**	**2 - 4 ft**	**1 gal.**	**Dry/Moist**
Rosa nutkana	Nootka rose	FAC	-	-	-	-	2000	400	-	-	**2400**	**5 ft**	**2 - 4 ft**	**1 gal.**	**Dry**
Rosa pisocarpa	Clustered wild rose	FAC	-	500	605	-	-	-	-	1000	**2105**	**5 ft**	**2 - 4 ft**	**1 gal.**	**Wet**
Rubus parviflorus	Thimbleberry	FACU	-	-	-	-	3500	-	-	-	**3500**	**5 ft**	**2 - 4 ft**	**1 gal.**	**Moist**
Rubus spectabilis	Salmonberry	FAC	-	1000	1000	-	-	210	-	1000	**3210**	**5 ft**	**2 - 4 ft**	**1 gal.**	**Moist**
Salix hookeriana	Dune willow	FAC	-	-	-	-	-	1175	-		**1175**	**2 - 5 ft**	**2 - 4 ft**	**Stakes**	**Dry/Moist**
Salix scouleriana	Scouler's willow	FAC	-	2400	5200	380	-	1175	-	2865	**12020**	**2 - 5 ft**	**2 - 4 ft**	**Stakes**	**Dry/Moist**
Salix sitchensis	Sitka willow	FACW	-	2400	5200	380	-	-	-	2865	**10845**	**2 - 5 ft**	**2 - 4 ft**	**Stakes**	**Moist/Wet**
Sambucus racemosa	Red elderberry	FACU	-	-	-	-	2000	-	1000	-	**3000**	**5 ft**	**2 - 4 ft**	**1 gal.**	**Dry**
Spirea douglasii	Douglas Spirea/Hardhack	FACW	-	-	3000	150	-	-	-	-	**3150**	**5 ft**	**2 - 4 ft**	**1 gal.**	**Moist/Wet**
Symphoricarpos albus	Snowberry	FACU	-	-	-	-	3000	-	3000	-	**6000**	**5 ft**	**2 - 4 ft**	**1 gal.**	**Dry**
		Total	0	9613	20805	1135	22188	3560	15575	11459	**84335**				
Habitat Structures	**18,420**	**LF of Stream**													
Large Woody Debris (large)	**2,026**	**EA**	18-20 feet long, 8 inch minimum diameter at top, with root wad attached												
Large Woody Debris (small)	**4,973**	**EA**	12-15 feet long, 6 inch minimum diameter at top												
Native Wetland Grass Seed Mix 20 lbs/acre			**Quantity (lbs)**											**% by wt.**	
Glyceria occidentalis	Western mannagrass	OBL												40	
Beckmannia syzigachne	American sloughgrass	OBL												30	
Hordeum brachyantherum	Meadow barley	FACW												20	
Alopecurus aequalis	Shortawn foxtail	OBL												10	
			50	100	200	-	-	-	-	-	**350**				
Moist Soil Sedge & Rush Mix 20 lbs/acre			**Quantity (lbs)**											**% by wt.**	
Carex unilateralis	One-sided sedge	FACW												70	
Carix densa	Dense sedge	OBL												12	
Juncus effusus	Common rush	FACW												5	
Juncus tenuis	Slender rush	FACW												5	
Juncus bufonius	Toad rush	FAC												5	
Carex stipata	Awl fruited sedge	OBL												2	
Carex obnupta	Slough sedge	OBL												1	
			20	-	-	-	-	40	-	230	**290**				
Native Upland Grass Seed Mix 20 lbs/acre			**Quantity (lbs)**											**% by wt.**	
Elymus glaucus	Blue wildrye	FACU												30	
Bromus carinatus	California brome	FACU												25	
Hordeum brachyantherum	Meadow barley	FACW												10	
Festuca romeri	Roemer's fescue	FACU												10	
Deschampsia elongata	Slender hairgrass	FACW												10	
Agrostis exarata	Spike bentgrass	FACW												5	
Deschampsia cespitosa	Tufted hairgrass	FACW												5	
Festuca rubra rubra	Red fescue	FACU												5	
			-	-	-	65	220	-	310	-	**595**				

LIVE STAKE PLANTING DETAIL

NOT TO SCALE

NOTES:
1. LIVE STAKES TO BE 1 TO 2 INCH DIAMETER 24 TO 32 INCHES LENGTH.
2. USE 1/2 INCH DIAMETER REBAR OR ROCK BAR TO MAKE PILOT HOLE.
3. INSTALL LIVE STAKES TAPER END DOWN WITH BUDS POINTED UP.
4. MINIMUM TWO BUDS ABOVE GRADE.
5. SET LIVE STAKES WITH DEAD-BLOW HAMMER.
6. WATER IMMEDIATELY AFTER INSTALLATION.

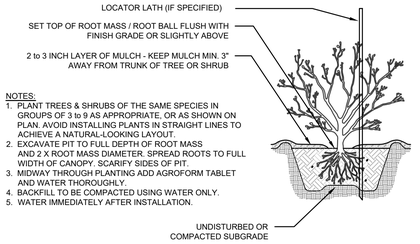
STORAGE OF LIVE STAKES
ALL WOODY PLANT CUTTINGS COLLECTED MORE THAN 12 HR PRIOR TO INSTALLATION, MUST BE CAREFULLY BOUND, SECURED, AND STORED OUT OF DIRECT SUNLIGHT AND SUBMERGED IN CLEAN FRESH WATER FOR A PERIOD OF UP TO TWO WEEKS.

OUTDOOR TEMPERATURES MUST BE LESS THAN 50 DEGREES F AND TEMPERATURE INDOORS AND IN STORAGE CONTAINERS MUST BE BETWEEN 34 AND 50 DEGREES F.

IF THE LIVE STAKES CANNOT BE INSTALLED DURING THE DORMANT SEASON, CUT DURING THE DORMANT SEASON AND HOLD IN COLD STORAGE AT TEMPERATURES BETWEEN 33 AND 39 DEGREES F FOR UP TO 2 MONTHS.

TREE AND SHRUB PLANTING DETAIL (TYPICAL)

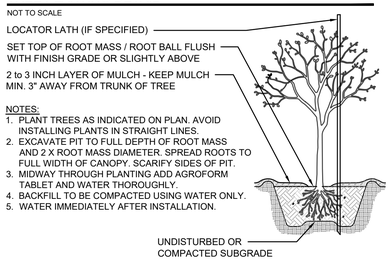
NOT TO SCALE



NOTES:
1. PLANT TREES & SHRUBS OF THE SAME SPECIES IN GROUPS OF 3 to 9 AS APPROPRIATE, OR AS SHOWN ON PLAN. AVOID INSTALLING PLANTS IN STRAIGHT LINES TO ACHIEVE A NATURAL-LOOKING LAYOUT.
2. EXCAVATE PIT TO FULL DEPTH OF ROOT MASS AND 2 X ROOT MASS DIAMETER. SPREAD ROOTS TO FULL WIDTH OF CANOPY. SCARIFY SIDES OF PIT.
3. MIDWAY THROUGH PLANTING ADD AGROFORM TABLET AND WATER THOROUGHLY.
4. BACKFILL TO BE COMPACTED USING WATER ONLY.
5. WATER IMMEDIATELY AFTER INSTALLATION.

TREE PLANTING DETAIL

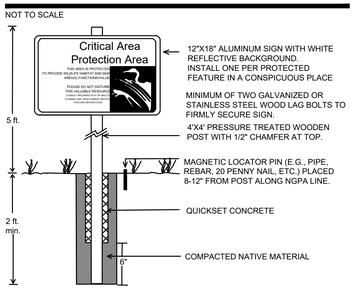
NOT TO SCALE



NOTES:
1. PLANT TREES AS INDICATED ON PLAN. AVOID INSTALLING PLANTS IN STRAIGHT LINES.
2. EXCAVATE PIT TO FULL DEPTH OF ROOT MASS AND 2 X ROOT MASS DIAMETER. SPREAD ROOTS TO FULL WIDTH OF CANOPY. SCARIFY SIDES OF PIT.
3. MIDWAY THROUGH PLANTING ADD AGROFORM TABLET AND WATER THOROUGHLY.
4. BACKFILL TO BE COMPACTED USING WATER ONLY.
5. WATER IMMEDIATELY AFTER INSTALLATION.

CRITICAL AREA PROTECTION AREA SIGN DETAIL

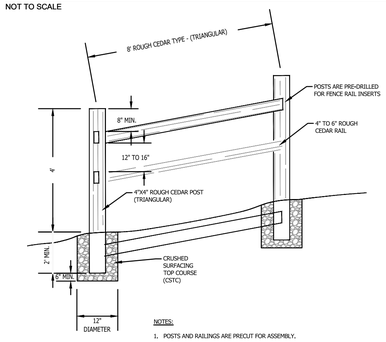
NOT TO SCALE



NATIVE GROWTH / CAPA SIGN NOTES:
1. NGPA/CAPA SIGNS SHALL BE PLACED NO GREATER THAN 100 FEET APART AROUND THE PERIMETER OF THE NATIVE GROWTH CRITICAL AREA PROTECTION AREA.
2. SIGN PLACEMENT SHALL BE SUBJECT TO THE APPROVAL OF SNOHOMISH COUNTY STAFF. ALTERNATIVE SIGN DESIGNS MAY NE SUBMITTED TO SNOHOMISH COUNTY FOR APPROVAL.
3. ALL SIGNS MUST BE SECURE AND PERMANENT.

SPLIT RAIL FENCE DETAIL

NOT TO SCALE



NOTES:
1. POSTS AND RAILINGS ARE PRECUT FOR ASSEMBLY.
2. 3 RAILS ARE PERMITTED.
3. FENCES SHALL BE PLACED AT THE APPROVED BUFER EDGE.

PRELIMINARY INFORMATION ONLY

NOT FOR CONSTRUCTION

SOUNDVIEW CONSULTANTS LLC ASSUMES NO LIABILITY OR RESPONSIBILITY FOR CONSTRUCTION, IMPROVEMENTS, OR ESTIMATES BASED ON THIS PLAN SET

SOURCES:
LDC | Surveying Engineering Planning
Kent
1851 Central Pl S, #101
Kent, WA 98032
Woodinville
20210 142nd Avenue NE
Woodinville, WA 98072
T 425.806.1869 www.LDCcorp.com F 425.482.2893

Soundview Consultants LLC
Environmental Assessment • Planning • Land Use Solutions
2907 HARBORVIEW DRIVE, SUITE D
GIG HARBOR, WASHINGTON 98335
P. 253.514.8952
F. 253.514.8954
WWW.SOUNDVIEWCONSULTANTS.COM

CASCADE LOGISTICS PARK
THE NE & SE ¼ OF SECTION 27
NW & SW ¼ OF SECTION 34
TOWNSHIP 31N, RANGE 5E, W.M.

DATE: 12/18/2020
JOB: 1703.0004
BY: MW
SCALE: AS SHOWN
SHEET: 8

S:\CURRENT\1703 NorthPoint Holdings LLC\1703.0004 Cascade Logistics Park\Graphics & Maps\CAD\A - CURRENT SYC DRAWINGS\A - Current Base DWGs\1703.0004 (2020-12) Cascade Logistics.dwg
Plotted December 16, 2020

Appendix B – Basis of Design

GEOMORPHIC ASSESSMENT AND BASIS OF DESIGN REPORT FOR EDGECOMB CREEK STREAM RESTORATION

DECEMBER 2020

PREPARED FOR

NorthPoint Development

PREPARED BY

SWCA Environmental Consultants

This page intentionally left blank.

GEOMORPHIC ASSESSMENT AND BASIS OF DESIGN REPORT FOR EDGECOMB CREEK STREAM RESTORATION

Prepared for

NorthPoint Development
4825 NW 41st Street, Suite 500
Riverside, MO 64150

Prepared by

SWCA Environmental Consulting and Engineering, Inc.
116 Alexandria Drive
Mooresville, NC 28115
(919) 624-1458
www.swca.com

SWCA Project No. 062897

December 2020

This page intentionally left blank.

CONTENTS

1 Project Background 4
1.1 Water Quality Degradation and Habitat Impairments 5
1.2 Project Purpose and Objective 7

2 Watershed Characteristics 7
2.1 Ecoregion and Physiographic Province 8
2.2 Soils

3 Geomorphic Assessment 9
3.1 Existing Conditions 10
3.2 Reference Reaches 11

4 Summary of Stability Conditions and Impairment 13

5 Stream Restoration Design 14
5.1 Multi-Criteria Decision Analysis 15
5.2 Design Parameters 16
5.2.1 Flow Hydraulics 17
5.2.2 Stream Structures 18
5.2.3 Flood Terrace Features 19
5.2.4 Riparian Buffer and Floodplain Roughness Features 19
5.2.5 Revegetation, Transplants, and Invasive Species Control 20
5.2.6 Culvert Design 20

6 Summary 21

7 References 23

Appendices

Appendix A. Geomorphic Data
Appendix B. Design Calculations
Appendix C. HEC-RAS Results
Appendix D. MCDA
Appendix E. Photo Log
Appendix F. 60% Design Plan Set

Figures

Figure 1. Edgecomb Creek project area map. 4
Figure 2. Township No. 31 North, Range No. 5 East Survey, 1875 (Bureau of Land Managment). 5
Figure 3. Aerial photograph, 1990 (Google Earth). 6
Figure 4. Edgecomb Creek representative stream substrate……..9

Figure 5. Edgecomb Creek representative cross-section……10
Figure 6. Edgecomb Creek representative photograph. 11
Figure 7. Reference Reach representative riffle cross-section. 12
Figure 8. Reference Reach representative photograph. 12
Figure 9. Example of a MCDA Matrix……16

Tables

Table 1. Project Area NRCS-mapped Soils and their Hydric Characteristics 8
Table 2. Reference Reach Summary and Dimensionless Ratios 13
Table 3. Stability and Impairment Variables for Existing and Reference Conditions 14
Table 4. Summary of Design Parameters..... 16

This page intentionally left blank.

1 PROJECT BACKGROUND

SWCA Environmental Consultants (SWCA) was retained by NorthPoint Development (Owner) to assess channel impairments on a reach of Edgecomb Creek and associated Unnamed Tributary (UT) 'X' in Snohomish County, Washington, as shown in Figure 1. This Basis of Design Report (BODR) documents the assessment and design process for the development of the proposed restoration for Edgecomb Creek and UT 'X' as part of the proposed development known as the Cascade Commerce Center (Site).

Edgecomb Creek is a tributary to Middle Fork Quilceda Creek that flows from east to west along the south side of 172nd St NE for approximately one mile before turning south after passing under the BNSF railroad. Edgecomb Creek then flows through the Site for roughly 2 miles along agricultural fields through a series of 90-degree channel bends, then flows back under the BNSF railway and joins with Middle Fork Quilceda Creek.

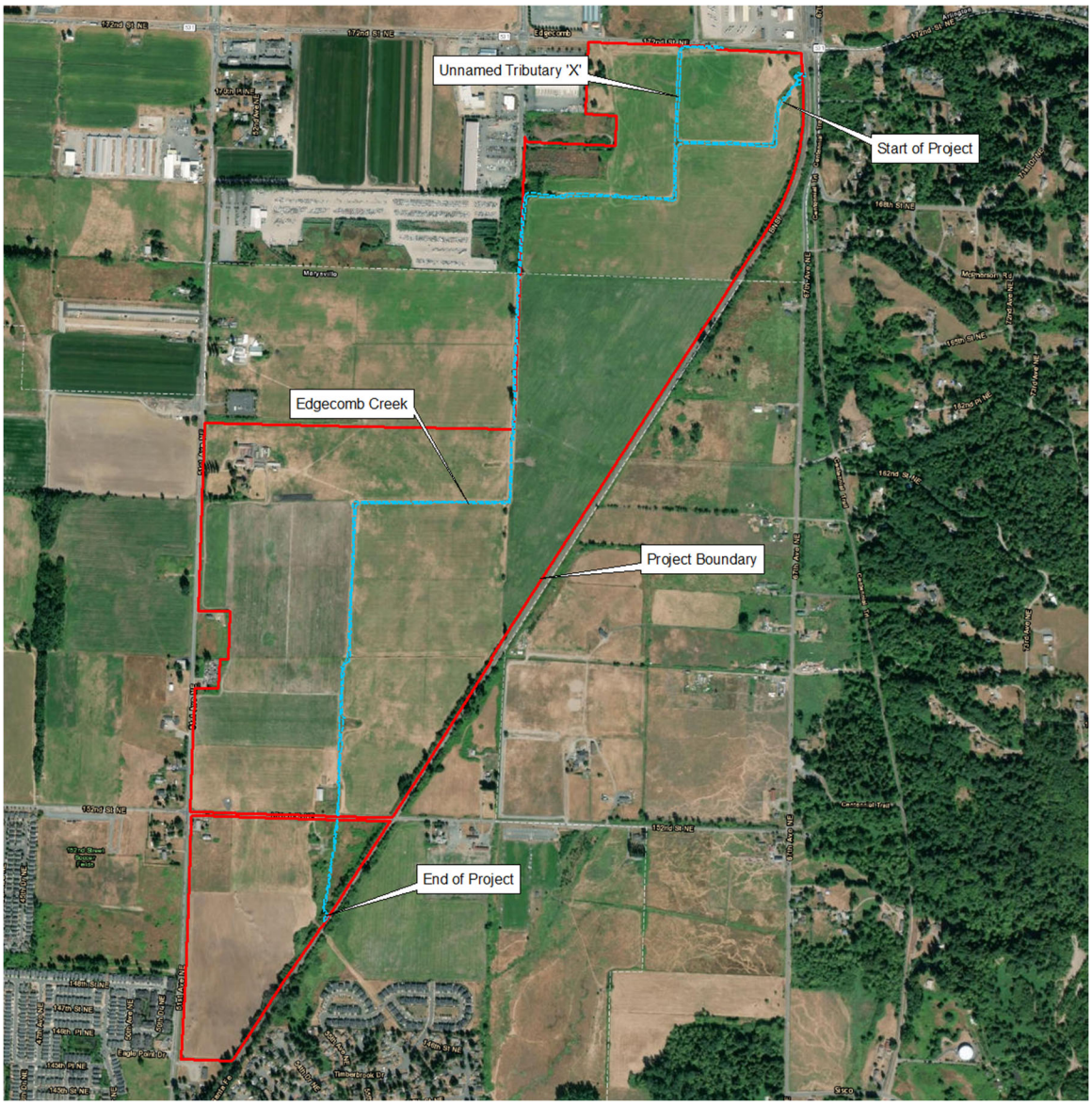


Figure 1. Edgecomb Creek project area map.

1.1 Water Quality Degradation and Habitat Impairments

Prior to development, the Site was likely marshland, based on the Site's location relative to the transition from the steep, confined valley for Edgecomb Creek to the east and the wide, flat nature of the Site. The evidence for this assumption can be seen in the 1875 survey shown in Figure 2.

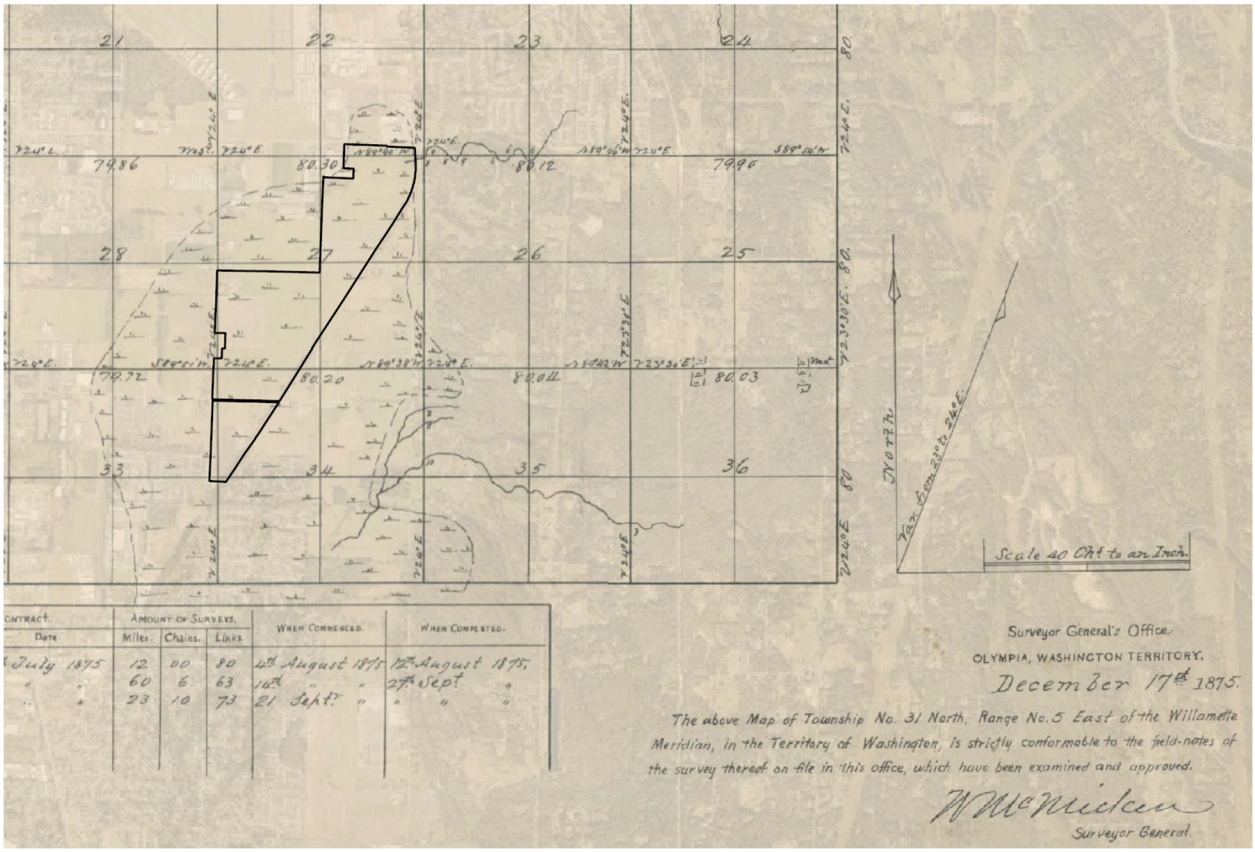


Figure 2. Township No. 31 North, Range No. 5 East Survey, 1875 (Bureau of Land Management).

This survey indicates that Edgecomb Creek was possibly once a low gradient, anastomosing channel that meandered through the marshland as there is no channel shown on the survey through the project area. Today, there is clear evidence that Edgecomb Creek has been significantly modified through the Site by means of ditching and dredging, likely to drain the area for agricultural use. Aerial photographs from 1990 (Figure 3) show the project area has remained largely unchanged in recent history. These actions have caused Edgecomb Creek to become impaired, resulting in a significant loss of ecological function.

Figure 3. Aerial photograph, 1990 (Google Earth).

As a result of the agricultural modification of the Edgecomb Creek, little to no riparian vegetation exists within the project area. Past land use practices and changes in the plant community have further contributed to habitat impairments and water quality degradation. In summary, these include:

- Deforestation and reduced biologic diversity,
- Stream channel and riparian habitat heterogeneity,
- Fragmented and reduced riparian buffer,
- Channelization,

- Disconnected and abandoned stream channels,
- Channel degradation and aggradation,
- Disconnected floodplain,
- Decreased wetland perimeter and hyporheic exchange of the stream(s), and
- Decline in water quality.

1.2 Project Purpose and Objective

The purpose of this design report is to provide a geomorphic assessment to evaluate the existing conditions and reference reach conditions that inform the design process and develop design criteria for natural channel design and restoration treatments. The impetus for this work is to evaluate stream morphology and relationships that pertain to channel form, profile, dimensions, and floodplain connection. Design objectives include:

1. Evaluate reference reach conditions to developing design criteria.
2. Restore channel stability and create a self-maintaining quasi-geomorphic state.
3. Restore floodplain connection.
4. Restore habitat diversity.
5. Restore riparian vegetation and stream channel buffer, including removal of non-native species.
6. Reduce anthropogenic impacts (deforestation, hydromodifications, and invasive species).
7. Improve water quality by a reduction in fine sediment loading.
8. Design for cost-effective restoration treatments.
9. Develop restoration treatments to meet the above objectives.

2 WATERSHED CHARACTERISTICS

Edgecomb Creek is a tributary of Quilceda Creek, which enters the Possession Sound just west of the town of Marysville. At the low end of the Site where Edgecomb Creek passes under the BNSF railroad, the watershed is approximately 1,234 acres (1.92 square miles) in size. Approximately 75 percent of the land cover throughout the watershed consists of commercial, residential, and agricultural development, with remaining 25 percent consisting of forested areas. As noted in the Basis of Design Report completed by the Washington State Department of Transportation for the restoration of the reach of Edgecomb Creek immediately upstream of the Site, the publication titled Quilceda Creek Drainage Needs Report DNR No. 1 written in December 2002 by the Snohomish County Public Works Department Surface Water Management Division was used to find flows and delineate the watershed for this project.

According to the jurisdictional wetland determination performed by Soundview Consultants, there are wetlands within the Site. The Federal Emergency Management Agency (FEMA) Flood Insurance Rate Map (FIRM) panel 53061C0395E shows that there is no mapped 100-year flood zone for Edgecomb Creek. The site is within the Snohomish Watershed in 8-digit USGS Hydrologic Unit 17110011. It is in the Puget Lowland Geologic Province, as delineated by the Arkansas Geological Survey. According to Rosgen 2016, the geomorphic characteristics of the project area matches the description of an Unconfined Alluvial: Inactive Fan (U-AL-IF), which is a valley consisting of a non-building, stable fan with low sediment supply and generally well-established riparian vegetation.

2.1 Ecoregion and Physiographic Province

The physiographical region of the Edgecomb Creek Site is the Eastern Puget Riverine Lowlands Level III Ecoregion. Ecoregions denote areas of general similarity in ecosystems and in the type, quality, and quantity of environmental resources (Pater et al. 1998). The discussion of ecoregions and land use is important in the discussion of water quality because land cover and the biotic and abiotic community surrounding a water body are determinative of how nonpoint sources move over the land and what pollutants may or may not enter the surface water.

The Puget Lowland Ecoregion is an area in the northwestern corner of Washington and is situated in a continental glacial trough that has many islands, peninsulas, and bays. Varying annual average precipitation greatly influences vegetation and soil type in the ecoregion. In the Puget Lowland Ecoregion, soils are dominated by Inceptisols in the north and Ultisols in the south (Jones, 2003). Before European settlement, most of the ecoregion was covered by coniferous forests, with species composition dependent on local climate (U.S. Environmental Protection Agency, 1999).

2.2 Soils

According to the Natural Resources Conservation Service (NRCS) Soil Survey for Snohomish County, Washington (U.S. Department of Agriculture [USDA] 2020), three major soil map units are present within the project area. Of the three NRCS soil map units, two soil map units are listed as a hydric soil or includes components that are listed as hydric (Table 1) (USDA 2020).

Table 1. Project Area NRCS-mapped Soils and their Hydric Characteristics

Map Unit Name (Unit Code)	Hydric Map Unit (Yes/No)	Hydric Component Characteristics			Acreage within Project Area
		Name (Unit Percent)	Landform	Hydric Criteria	
Custer fine sandy loam (13)	Yes	Custer-Undrained	Outwash plains	2	119.3
	Yes	Norma-Undrained	Depressions	2,3	
	No	Indianola	---	---	
	Yes	Custer-Drained	Depressions	2	
Lynnwood loamy sand, 0 to 3 percent slopes (30)	No	Lynnwood	Outwash plains, terraces	---	0.1
	Yes	Custer-Undrained	Depressions	2	
Norma loam (39)	Yes	Norma-Undrained	Depressions, drainageways	2,3	264.7
	Yes	Norma-Drained	Depressions	2	
	Yes	Bellingham-Undrained	Depressions	2,3	
	Yes	Terric Medisaprists-Undrained	Depressions	1,3	

USDA. 2020. Web Soil Survey.

3 GEOMORPHIC ASSESSMENT

Field surveys were performed using a multi-disciplinary approach by our team of engineers and scientists in September 2020. A reconnaissance level survey of the project area included visual observations of stream bank conditions, riparian vegetation structure, land use, adjacent utilities, road crossings, and other general observations. The team noted the general quality of existing habitats features (e.g., pool depth, cover availability, hydraulic heterogeneity, etc.), substrate composition, floodplain connectivity, and the existence of design constraints. A detailed survey was then conducted to collect topographic and hydrographic data of the Site including cross sections and longitudinal profiles of the stream channels, water surface elevations, and upland and floodplain topography. Particular attention was given to bankfull indicators, locations of bank erosion, denuded bank vegetation, areas showing vertical or lateral instability, areas of aggradation/degradation, riffle-pool complexes, and other indicators of the existing geomorphic state.

All the streams are situated in an Unconfined Alluvial: Inactive Fan (U-AL-IF), which is a valley consisting of a non-building, stable fan with low sediment supply and generally well-established riparian vegetation (Rosgen 2016). Stream reaches within the Site have a low upland sediment supply, likely because of the development which has occurred on the alluvial fan, rendering it inactive. Because of the hydraulic modification associated with the agricultural development of the Site and the ditching and dredging of Edgecomb Creek, it cannot progress towards natural recovery through the channel evolution. For this stream to reach its potential, a Rosgen E stream type active channel restoration is required.

Edgecomb Creek crosses 67th Avenue NE in a 72-inch corrugated metal pipe. 30 feet downstream of the 67th Avenue crossing, Edgecomb Creek crosses the BNSF railroad through a 24-inch corrugated metal pipe culvert, which is proposed to be replaced with an open-bottom culvert to improve fish passage. The culvert for UT ‘X’ under 172nd St. NE is a 36-inch corrugated metal pipe and is to remain in place as part of this project.

During the September 2020 site visit, bankfull widths were measured at various locations throughout the Site. Widths were measured between 5.9 feet and 8.2 feet. During both site inspections, the stream substrate was observed to consist of a mixture of silt, sand, and organics (Figure 4).

Figure 4. Edgecomb Creek representative stream substrate.

3.1 Existing Conditions

Edgecomb Creek flows from northeast to southwest through the Site, while the Unnamed Tributary (UT) 'X' flows from north to south and ties in with Edgecomb Creek approximately 1,650 linear feet downstream of the upstream culvert. UT 'X' is also proposed to be restored along with Edgecomb Creek. The Stream Survey Map in Appendix A shows the stream reaches and the representative segments that were surveyed within them.

Edgecomb Creek is a perennial stream approximately 10,700 linear feet in length beginning at the culvert under the BNSF railroad in the northeast corner of the Site. The entire Edgecomb Creek reach flows along agricultural fields through a series of 90-degree channel bends in a ditched and dredged channel. The channel was lacking any bedform diversity or gradated bed material. The existing bed material was comprised mostly of silt, sand, clay, and organics. The banks of Edgecomb Creek throughout the reach are heavily vegetated with grasses, but ultimately lacking riparian vegetation. In-stream physical habitat is homogenous with no obvious riffles or pools. Without restoration, the stream would continue to be impaired. A representative cross-section of Crooked Creek is presented in Figure 5. In the cross-section, the spoil from the channel excavation is easily recognizable along the right bank of Edgecomb Creek.

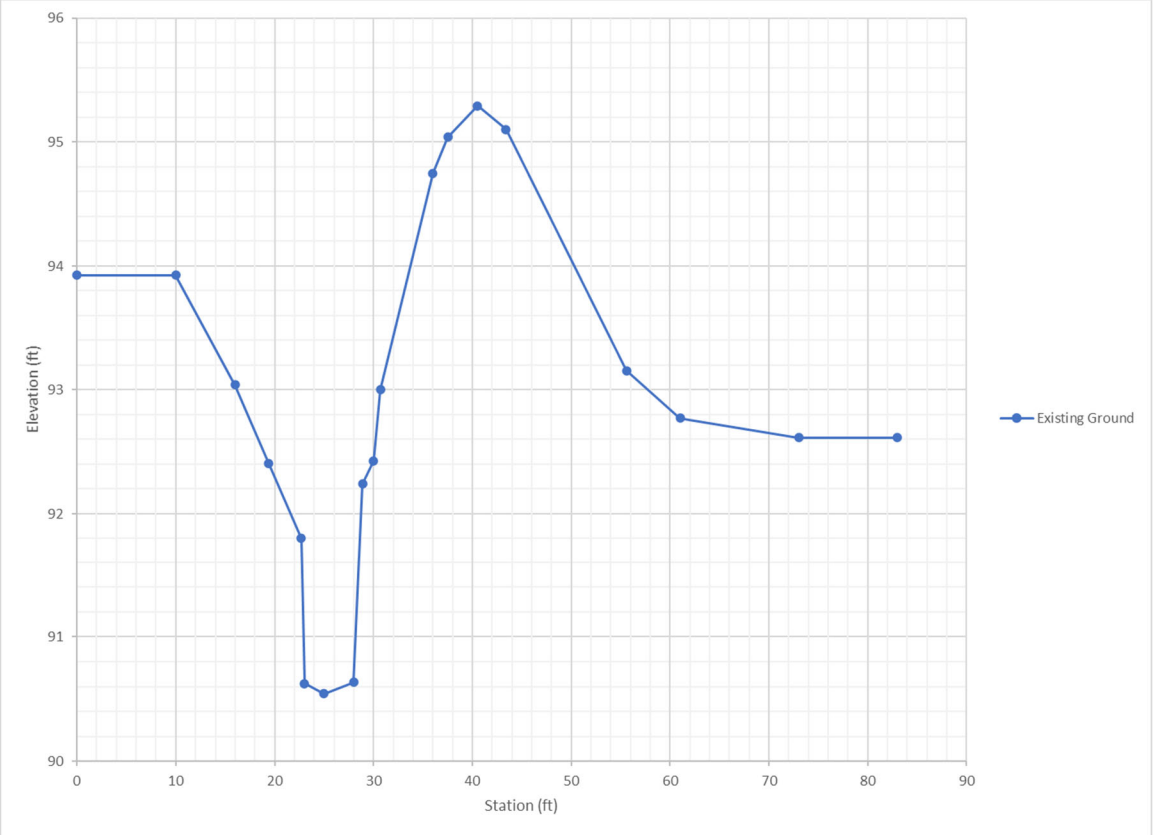


Figure 5. Edgecomb Creek representative cross-section.

Edgecomb Creek has a low Width-to-Depth Ratio (WDR) at 5.36 which is indicative of a ditched system, a low sinuosity of 1.00 reflecting channelization, an Entrenchment Ratio (ER) of 5.21, and a Bank Height Ratio (BHR) of 2.72 showing the channel is slightly entrenched. All these parameters are indicators that

Edgecomb Creek is impaired due to its low sinuosity, homogenous channel habitat, and high departure from reference conditions. Because the channel has been ditched and dredged, it is likely that Edgecomb Creek will continue to degrade over time. Detailed geomorphic data is provided in Appendix B. A representative photograph of Crooked Creek as is presented in Figure 6, and more photos of the existing Site can be found in Appendix E.

Figure 6. Edgecomb Creek representative photograph.

3.2 Reference Reaches

A reference reach is a stable stream that maintains dimension, pattern, and profile over time without aggrading or degrading (Rosgen 1996). Rosgen discusses the reference reach concept in detail in several publications (Rosgen 1996, 2006, and 2007). In natural channels using the Rosgen geomorphic design approach, it is often advantageous to have an undisturbed and/or stable river reach immediately upstream of the restoration reach, or within proximity to the site with same stream type and watershed characteristics. Reference reach data are obtained and converted to dimensionless ratio relations to extrapolate channel dimension, pattern, and profile to streams and valleys of the same type. One reference reach was identified and selected based on same geophysical characteristics within, or proximity to, the project site.

The reference reach data for this project is from an approximately 300 linear foot reach of Trail Creek (Rosgen, 2011). The reference reach can be characterized as an E4 stream type. A representative cross-section and photograph are presented in Figures 7 and 8, respectively.

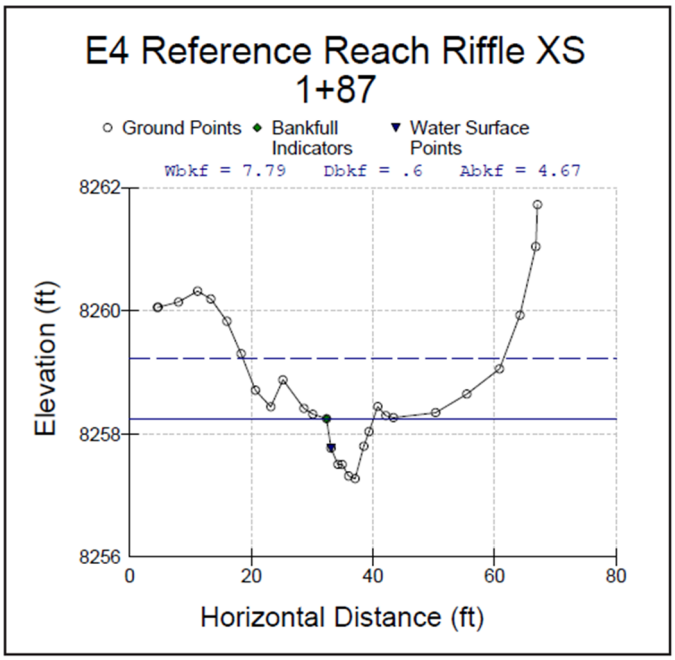


Figure 7. Reference Reach representative riffle cross-section.

Figure 8. Reference Reach representative photograph.

Table 2 presents a summary of the geomorphic characteristics of the reference reach. Dimensionless ratios are calculated to evaluate key geomorphic parameters to use as design reference targets.

Table 2. Reference Reach Summary and Dimensionless Ratios

Variables	Reference Reach		
	min	mean	max
Stream Type		E4	
Drainage Area (ac)		5,056	
Drainage Area (mi^2)		7.9	
Bankfull Width, W_{bkf} (ft)		5.73	
Floodprone Width, W_{fpn} (ft)		35.78	
Mean Bankfull Depth, Db_{kf} (ft)		0.73	
Bankfull Cross-Section Area, A_{bkf} (ft^2)		4.17	
Surveyed Stream Length (ft)		261.5	
Surveyed Valley Length (ft)		212.7	
Sinuosity, k		1.23	
Channel Slope (ft/ft)		0.0101	
Max BKF Depth (ft)	0.83	1.03	1.34
Bank Height (ft)	0.83	1.03	1.37
Radius of Curvature, Rc (ft)	10.2	17.9	27.8
Pool to pool spacing, p-p (ft)	12.3	31.6	48.4
Riffle length, Rl (ft)	12.3	13.9	16.9
Entrenchment Ratio ER	5.2	7.8	14.4
Width Depth Ratio, WDR	5.2	8.9	16.8
Bank Height Ratio, BHR	1.0	1.0	1.0
Radius of curvature to bankfull width (R_c/W_{bkf})	1.76	3.09	4.80
Pool to pool spacing to Bankfull Width ($p\text{-}p/W_{bkf}$)	2.12	5.46	8.36

4 SUMMARY OF STABILITY CONDITIONS AND IMPAIRMENT

Several key variables evaluated in the geomorphic assessment are used to identify impairments and stability issues that need to be addressed in the design phase. For Edgecomb Creek, those impairments are channel degradation, channelization, diminished riparian buffer, and lack of aquatic habitat. The impaired reach of Crooked Creek has potential to support ecological functions by restoring geomorphic processes and natural channel stability, connection to the floodplain, and establishing an adequate riparian buffer.

Our stability assessment methods to determine impairment and the need for restoration is based on departure from reference conditions combined with Rosgen geomorphic parameters that guide the degree of stability and impairment, as well as our field surveys and aerial photograph interpretation that show evidence of change and loss of natural channel functions caused from anthropogenic impacts. Table 3 presents an existing conditions summary and shows departure from reference conditions.

Table 3. Stability and Impairment Variables for Existing and Reference Conditions

Variable	Edgecomb Creek	Reference
Stream Type	E	E
Flow Regime	P	P
Pool to Pool Spacing (Range)	N/A	12-48
Riffle Length (Range)	N/A	12-17
Average Slope	0.0026	0.0101
Sinuosity	1.00	1.23
Width to Depth Ratio (WDR)	5.36	5.2-16.8
Bank Height Ratio (BHR)	2.72	1.0
Entrenchment Ratio	5.21	7.8

The existing agricultural operations on the Site has resulted in most of the stream impairments and limited natural channel features. All these parameters are indicators that Edgecomb Creek is impaired due to its low sinuosity, homogenous channel habitat, and high departure from reference conditions. Because the channel has been ditched and dredged, and it would likely continue to progress towards a state of instability without direct intervention.

5 STREAM RESTORATION DESIGN

It is proposed to restore Edgecomb Creek using a Priority 1 approach. Priority 1 restoration involves reconnection of a stream to its historic floodplain. This approach maximizes restoration potential by reconnecting the broadest possible floodplain, thereby maximizing channel stability by dissipating flood flows over land, providing flood attenuation and fine sediment accretion, and hydrologic connection to off-channel wetlands and oxbows that support floodplain habitats. This project proposes to restore the appropriate dimension, pattern, and profile of Edgecomb Creek and UT ‘X’, restore aquatic and riparian habitat, improve water quality, and re-connect the floodplain, to restore the functional attributes that support the physical, chemical, and biological characteristics of the stream.

To achieve long-term stability and geomorphic functions for the Priority 1 restoration, the channel dimensions, profile, and pattern design parameters need to be determined. Proposed design parameters were developed based on relationships to reference conditions and adjustments were made using best professional judgement. Two critical design parameters to develop morphological variables are the bankfull cross-sectional area and WDR.

In situations where bankfull elevations and associated bankfull cross-sectional areas cannot be identified in the channel, validated regional hydraulic geometry curves, also known as regional curves, can be used to estimate bankfull cross-sectional dimensions (Rosgen 2006). Such regional curves relate bankfull cross-sectional dimensions vs. drainage areas, allowing for the estimation of the bankfull cross-sectional dimensions when drainage area is known. For Edgecomb Creek, the Pacific Mountain System – Pacific Border curve (Bieger et al, 2015) was used to estimate the bankfull cross-sectional area for the channel. Applying the approximated drainage area of the project reach (1.92 square miles) to the hydraulic relationship, SWCA calculated the bankfull cross-sectional area to be 11.9 square feet (ft2). SWCA then

used this approximated value to evaluate the stability of the channel, as described in the following sections.

We utilized the Breakline program for Natural Channel Design in AutoCAD Civil 3D, developed by Greg Jennings, David Bidelspach, and Michael Geenen, as a blueprint tool (Jennings, Bidelspach, Geenen, NC State University Bio & Ag Engineering). This blueprint develops stable dimensions (e.g., width, mean depth, maximum depth, inner berm width), pattern (e.g., sinuosity, wavelength, belt width, meander width, and radius of curvature), and profile (e.g., average water surface slope, riffle-pool sequencing).

The proposed design parameters for dimension, pattern, and profile are based on data inputs for:

a.) The bankfull cross-sectional area Abkf (square feet) determined from the Pacific Border regional curve.

b.) The WDR was selected based on reference conditions, coupled with best professional judgement for typical stable conditions. Rosgen type E channels are considered stable with WDR of 5-17 (Rosgen 1996).

c.) The average channel slope to calculate bankfull discharge was based on surveyed segments average channel slope.

d.) The bankfull profile slope was adjusted to fit the profile to a smooth slope line (assumes slope as energy grade based on uniform flow).

e.) The riffle and pool side-slopes were based on soil characteristics. An input of 3:1 side slopes was selected based on sand and gravelly characteristics and angle of repose for stable wet material.

f.) The point bar side-slopes were based on channel substrate. An input of 5:1 side-slopes was assumed as a conservative estimate based on fine sand channel substrate.

g.) The low flow channel was defined to contain 10 percent of flow, assumed to be adequate to maintain a wetted perimeter for base flows based on geometric relationships. This should also help to maintain higher velocities in the low-flow channel.

The Breakline program outputs a series of points that are imported into AutoCAD Civil 3D to create a surface to overlay onto the existing conditions surface. Utilizing this tool is an iterative approach overlying the proposed channel surface onto the existing landscape and adjusting the pattern, profile, and dimensions to fit within the existing landscape. Once adjusted to the existing landscape the proposed channel alignment is imported back into the Breakline program to double check the design fits within defined reference targets (design criteria).

5.1 Multi-Criteria Decision Analysis

Multi-Criteria Decision Analysis (MCDA) is a process that uses a numerical scoring system to compare project design options (or alternatives) based on goals and objectives (or criteria). A goal is an overarching principle that guides decision-making, while an objective is a more specific and measurable step that can be made to meet the goal. Goals and objectives are identified, and each objective is given a weighting factor based on its level of importance. A golf score system from 1 to 5 is used, meaning that a score of 1 indicates highest importance while a score of 5 indicates lowest importance. Scores of 2 through 4 indicate partial importance. Each design option is then given a ranking, also from 1 to 5, on how it achieves the objectives. Objective scores for each design option are multiplied by their weighting factors and summed to make the overall score (MCDA Matrix Score) for each option. Options are then ranked and compared, with the lowest value being the most optimal.

Weighting factors are assigned by the shareholders to consider the needs and interests of all shareholders. Shareholders may only rank objectives that they have knowledge about. Objectives may be added or deleted as desired. A ranking of zero is used to indicate the removal of an objective.

Several design options are developed by the engineer based on the goals of the project and the engineer's professional judgement. A "Do Nothing" option is always included to be used as a baseline comparison for the design options. Natural Channel Design can include channel realignment, in-stream structures, revegetation, etc. The MCDA for Edgecomb Creek can be found in Appendix D.

		Stream Stability GOAL			No Increase Risk			Water Quality GOAL				Buffer GOAL			
		Stop in-stream head cutting	Self-sustaining, natural, stable stream	Stream and floodplain manage shear stresses	Flooding to Downstream County Road	Dam Failure	Upstream flooding	Improve water quality and habitat of stream	Reduce sediment deposition and supply	Improve floodplain functions of water storage and habitat	SW control feature in watershed	Minimize impacts to wetland vegetation	Improve riparian buffer functions of stability, habitat, and aesthetics	MCDA Matrix Score	MCDA RANKING
	Concept Option Description	4	2	3	2	3	1	1	1	2	1	2	1		
Option #1	Do Nothing	5	5	5	1	1	1	5	5	5	5	2	2	82	5
Option #2	Dam and Reservoir Construction	1	5	2	1	4	5	4	1	1	1	5	4	61	4
Option #3	Enhancement/Stabilization Priority III - Small Floodplains at Existing Elevation grade banks at 4:1	2	2	3	1	1	2	2	2	3	4	3	3	51	3
Option #4	Restoration Priority II - Large Floodplain at lower Elevation grade floodplain banks at 4:1	2	2	2	1	1	1	1	2	2	3	4	2	44	2
Option #5	Restoration Priority I - Reconnect floodplain and wetlands	1	1	1	1	1	1	1	1	1	3	1	1	25	1

Objectives/ Criteria

Weighting Factor

Figure 9. Example of MCDA Matrix.

5.2 Design Parameters

The design process developed stable dimension, profile, and planform for natural channels to effectively convey bankfull flows and connect to the floodplain. Maintaining the average water surface slope equal to the energy grade line revealed the vertical pattern for riffle-pool sequencing, glide-run, and grade controls for the thalweg profile. Appendix F provides the Edgecomb Creek Stream Restoration 60% Design Plan Set. Table 4 summarizes the design parameters that were developed utilizing the Breakline program and the iterative approach referencing design criteria compounded with the existing landscape conditions.

Table 4. Summary of Design Parameters

Variable	Edgecomb Creek	UT 'X'
Stream type	E4	E4
Drainage Area (DA) sq. mi.	1.92	0.24
Bankfull Discharge (Qbkf) cfs	41.8	5.9
Stream Length (SL) ft.	11,565	2,272
Bankfull Area (Abkf) sq.ft.	11.9	1.7
Width/depth ratio (Wbkf/Dbkf)	16.8	16.8
Bankfull width (Wbkf)	14.1	5.0

Variable	Edgecomb Creek	UT 'X'
Bankfull max depth (Dmax) ft.	1.2	0.5
Bankfull mean depth (Dbkf) ft.	0.9	0.4
Max Depth/Mean Depth	1.4	1.4
Width of flood prone area (Wfpa)	42.4 (min)	16
Entrenchment ratio (Wfpa/Wbkf)	3.6	3.2
Radius of Curvature (ft) Range	25-68	9-24
Riffle Length Average (ft)	30-41	11-15
Pool Spacing Average (ft)	78	28
Sinuosity	1.47	1.08
Bankfull slope (SBKF)	0.0026	0.0006

Design parameters were populated from the Breakline Reports.

Radius of Curvature was measured from 60% design drawings.

5.2.1 Flow Hydraulics

The hydraulic analysis of the proposed restoration of Edgecomb Creek was performed using the U.S. Army Corps of Engineers' Hydrologic Engineering Center's River Analysis System (HEC-RAS) software, a one-dimensional, gradually varied, steady flow numerical model. The channel geometry data in the model was obtained from the AutoCAD Civil 3D surface created as part of the design.

Channel cross sections for the model were located so the unique features of the channel and floodplain that affect flow were included. Breaks between channel and overbank areas in each cross section were identified by reviewing the cross-section geometry and selecting the locations where the defined main channel changed to an overbank floodplain type area.

The Manning's n value for the proposed main channel was set to 0.035 based on the anticipated channel bed material placed during construction and the average flow characteristics. Manning's n values for the overbank areas at cross sections where the proposed grading will occur ranged from 0.06-0.10 to simulate the anticipated effects of riparian plantings and the flood terrace features after the vegetation has matured.

The average velocities for the reach ranged from 0.8-4.6 feet per second for the 2-year, 10-year, 25-year, and 100-year storm events. The average shear stresses for the reach ranged from 0-0.25 pounds per square foot for the 2-year, 10-year, 25-year, and 100-year storm events. More detailed data of the hydraulic analysis can be found in Appendix C.

One of the stated objectives of the project is to design a stream to handle applied shear stresses with minimized erosion at the 100-year event. Flows greater than bankfull spread out across the floodplain and have minimal hydraulic effect on the design channel. The design assumes a constant bankfull discharge with uniform steady flow based on qualitative examination rather than numerical computations of flow parameters along entire reach lengths. This approach is adequate because the designed channels have consistent channel slope, with gradual and minor changes in geometry and channel undulations that can be ignored and would not cause significant energy changes. The channel profiles were based on normal depth, predicted by a constant Manning's n parameter. The designed bankfull slope was assumed to be equal to the bankfull water surface slope. The bankfull slope was fit to a smooth straight line and represents a smooth consistent hydraulic gradient. Energy is dissipated at flood flows by restoring a meandering channel and connecting the floodplain at the bankfull elevation.

5.2.2 Stream Structures

Stream restoration using natural channel design techniques normally involves the use of in-stream structures for channel hydraulic function, stabilization, grade control, and habitat improvement. The proposed in-stream structures for this project have been selected to emulate natural coastal plain, low gradient stream systems, provide diverse habitat throughout the stream corridor, and stability. Systems within the coastal physiographic region are dominated by in-stream structures comprised of woody materials. Wood structures mimic tree roots that would naturally traverse the stream banks and channel, aiding in soil stabilization and grade control. Over time, the woody material naturally degrades but provides time for vegetation to establish, which will provide permanent stabilization.

5.2.2.1 WOOD STRUCTURES

At meander bends and pool segments, log structures are typically installed on the outside lower third of the bend (downstream apex) to direct flow to the thalweg and away from the stream bank. Roughened log toe and log vanes are not channel wide but provide additional relief to bank shear stress and are typically installed at locations to dissipate energy and direct flow away from the bank. Roughened log toe will enhance aquatic habitat cover and harbor insects for additional food sources.

Spanner logs will be located randomly throughout the restored reach of Edgecomb Creek, but mostly spanning the pools. These logs will provide cover for aquatic species from predators, promote leaf mats which harbor insects for food, and provide shade which helps to keep water temperatures low.

Log A-Vanes are installed across the entire width of the channel to reduce bank erosion, increase pool depths, promote the diversity of habitat, and provide grade control. The vanes for this structure have an adverse slope relative to the stream which reduces velocity and shear stress along the banks of the channel. It also can offer habitat diversity by providing a deeper scour pool downstream of the structure and undercut banks below the vane arms. The logs used for this structure shall be 12” diameter and should be submerged throughout the year to slow down decaying.

Brush and Roll Riffles are installed in riffle beds and promotes bed diversity and provides grade control. Logs are placed at alternating patterns along the riffle to create areas of turbulence to benefit microhabitat scour pockets, which further increases habitat diversity. The logs are designed to be installed into the bed and banks such that the top of the log is even with the channel bed. Brush and branches are used to fill the voids between logs, which help to divert flow, create turbulence, and aerate the water column.

5.2.2.2 BANK STRUCTURES

Roughened Log Toe structures shall be installed on the certain banks to provide short-term protection that promotes long-term stability. Roughened log toe is proposed at the outside of pool meander bends to protect the bank toe and provide lateral stability. These structures provide lateral bank roughness and act as stable undercut bank cover for aquatic habitat. Roughened log toe shall be installed in the bank from the bottom of the pool to just above the low-flow water level.

Roughened log toe shall be overlaid by live brush layering. These live tree cuttings take root at the toe and eventually replace the deadwood toe protection with live wood growth. Live tree cuttings shall be used throughout the project, either above roughened log toe, or between coir bags.

Coir bags are proposed above roughened log toe at the outside of pool meander bends to ensure lateral stability until robust riparian vegetation is established. Coir bags are constructed approximately 0.75-feet thick of all-natural biodegradable coir blankets, with tensile strength strong enough to hold native channel

material. Coir bags are installed from the top of the roughened log toe to the bankfull elevation. Live stakes are installed in a staggered manner throughout the coir bags to promote riparian growth.

Brush Mattresses will be installed over newly graded and prepared riffle banks to increase roughness, reduce scour, and promote habitat diversity. Native live dormant trees and shrubs will be harvested for the brush. A light layer of soil will cover the live cuttings to promote rapid growth.

5.2.2.3 STONE STRUCTURES

Stone structures provide long-term stability for grade control and bank protection, as well as habitat diversity. Gravel, though sometimes found in streams, is not typically the dominant channel material size relative to sediment transport. However, some in-stream structures may incorporate these materials for improved scour pools and variations for microhabitats.

Augmented Riffles are features that incorporate media into the channel bottom that would not be transported during bankfull flow events. The project proposes to install material with a larger diameter gradation (gravels) to create channel with rigid grade control. The larger media enhances turbulence during low flows, which promotes aeration of the water, benefiting water quality for macro-organisms.

Rock and Roll Riffles are installed in riffle beds and promotes bed diversity and provides grade control. Logs are placed at alternating patterns along the riffle to create areas of turbulence to benefit microhabitat scour pockets, which further increases habitat diversity. The logs are designed to be installed into the bed and banks such that the top of the log is even with the channel bed. Native stream gravels are used to fill the voids between logs, which help to divert flow, create turbulence, and aerate the water column.

5.2.3 Flood Terrace Features

Throughout the flood terrace for Edgecomb Creek there are proposed features which will provide off-channel habitat and flow regime diversity. Floodplain depressions are proposed throughout the flood terrace and will vary in depth from 0 to 9 inches. Woody material such as spanner logs will be incorporated into the depressions to provide habitat and increase roughness. Areas within the depressions will be either temporarily or permanently inundated and will help to diversify the habitat, raise the water table, and naturally widen the riparian buffer. This off-line feature will improve near-stream habitat, provide additional off-channel habitat, and increase the potential to improve overall biological function.

Secondary channels will serve as a hydraulic connection between the floodplain depressions and Edgecomb Creek, as well as provide a diversity of flow through the Edgecomb Creek corridor.

The proposed dendrite channels are like the floodplain depressions in terms of water table and habitat but will have a different flow regime. The dendrite channels are designed to intercept ground water and provide backwater rearing habitat during low flow conditions.

5.2.4 Riparian Buffer and Floodplain Roughness Features

The project proposes to establish a robust riparian buffer within the stream corridor. The riparian buffer will vary in width throughout the corridor depending on site-specific conditions. The final planting schedule for the riparian corridor will be developed in the final design phase.

Planting vegetation on cleared stream banks and the floodplains is an essential component to site rehabilitation, bank stability, and the re-establishment of native/historic community patterns within the corridor. Re-vegetating the site's floodplains and stream banks will provide stream bank stability, provide

canopy cover, reduce surface water temperatures, filter pollutants from adjacent runoff, and provide food sources and nesting areas. The project proposes to utilize transplants and live cuttings as the primary source for plant material. Streamside trees and shrubs will be planted (bare root cuttings, and/or small containerized saplings). Shrub elements will be planted along the reconstructed stream banks, concentrated along outer bends. A native seed mix will be applied under all soil blankets, and at flat topographic areas with a tackifier adhesive for erosion control. The streamside plant community will include species with high value for sediment stabilization, rapid growth rate, and the ability to withstand hydraulic forces associated with bankfull flow and overbank flood events. The overbank plant community will include species with high value to diversify community composition. Salvaged sod mats, and reuse of on-site appropriate grasses will be utilized in re-vegetating disturbed areas and those areas where invasive species have been removed.

Scarification of floodplain surfaces is proposed prior to final planting to provide undulations and microtopographic variability. Appropriate vegetative remnants (root mats, topsoil, shrubs, woody debris, etc.) will be also redistributed across the riparian buffer area at the completion of construction wherever possible.

5.2.5 Revegetation, Transplants, and Invasive Species Control

Invasive species control prior to construction is imperative to project success. Invasive species control conducted prior to site disturbance greatly reduces the potential for the spread of invasive species within the restored meander belt width. In addition, invasive species control prior to construction will provide a greater amount of reused sod mats and other material salvaged on-site. Focus will be on areas of transplanting material, and reestablishment. Timing considerations, prescriptive herbicide, and mechanical removal efforts will be developed during the final design phase.

The re-use of all native riparian grasses and wetland vegetation that can be salvaged at 3x3 feet at 12 inches deep or greater will be used as sod mats. These will be prioritized for stream bank protection and may be used at outer fringe areas of the constructed oxbow pond areas. Willow clusters and other appropriate native riparian shrubs will be transplanted within the riparian corridor. These transplants shall have a minimum root ball that is salvaged at twice the size of the basal rootmass and will be immediately transplanted or stored in the shade and provided adequate water to ensure successful relocation. Transplants will be prioritized at the outside of meander bends and set at elevations at, or below, the low water elevation to ensure connection to the hyphoreic area.

Live stakes will be harvested on-site from willows and other appropriate native material. Stakes will be from the canopy of transplants or donor plants where the rootmass was not able to be salvaged. These stakes will be installed to half of the bankfull elevation or a minimum of 12 inches from the low-water surface elevation.

5.2.6 Culvert Design

There are three culverts for Edgecomb Creek that are proposed to be replaced as part of this project, the two culverts under the BNSF railroad at both ends of the project, and the culvert under 152nd St NE. There are four proposed culverts for UT ‘X’, as the tributary meanders through the proposed Site. These culverts will have a natural channel bottom and are designed to promote aquatic life passage and safely convey flood flows.

6 SUMMARY

The existing agricultural operations on the Site has resulted in most of the stream impairments and limited natural channel features. The existing condition of Edgecomb Creek and UT 'X' has low sinuosity, homogenous channel habitat, and high departure from reference conditions. Because the channels have been ditched and dredged, and it would likely continue to progress towards a state of instability without direct intervention. As a result of the agricultural modification of the Edgecomb Creek, little to no riparian vegetation exists within the project area. Past land use practices and changes in the plant community have further contributed to habitat impairments and water quality degradation. In summary, the stream reach within the Site is identified as unstable and impaired primarily due to the agricultural operations, loss of aquatic habitat, reduced water quality, and lack of riparian vegetation. If no action is taken to restore Edgecomb Creek, it is expected that the system will continue to be impaired, contribute to non-point source pollution impacts, and have limited physical habitat to support biological functions. It is SWCA's recommendation to take active restoration measures as our assessment revealed that natural recovery solutions are not feasible. Priority 1 restoration is the most effective alternative to achieve a stable natural channel through the Site. The Edgecomb Creek Restoration 60% design proposes to restore the geomorphic processes and natural channel functions that will maximize ecological potential at the Site.

The proposed design parameters were based on reference reach conditions and best professional judgement for site specific implementation. Designing for an appropriate bankfull flow within these alluvial systems is imperative to balance sediment transport, overbank processes, formation of in-channel features, and stability. The proposed pattern, dimensions, and profile of the relocated channel(s) are designed to be conducive of forming natural channel riffles, point bars, and pools to increase physical habitat complexity. The proposed pattern of the designed channels consists of a slightly sinuous alternating meander system that reflects sinuosity of the reference reaches. The channel dimensions generally set elevations for an inner berm, and bankfull overbank is designed to support complex plant community types. The proposed design will support wetland grasses and forbs by the creation of an inner berm, as well as the overbank features connected to bankfull flows such as floodplain depressions, secondary channels, and dendrite channels. The bankfull area will support a robust riparian buffer, with overbanking flows connected to the floodplain to support transitional riparian species. Our assumption is that by restoring natural channel processes and physical habitat, there will be a positive biological and water quality response. In addition, the site will implement control and mechanical removal measures of invasive vegetation, reseed, and replant with native species to diversify and improve the plant community.

In-stream structures are designed to withstand flood flows, add grade control where necessary, and provide habitat diversity. In-stream structures will be placed throughout the Site to redirect the shear stress from the channel banks of the newly constructed channel, to create the hydraulics necessary to transport the sediment through the pools, to increase bank stability, and to introduce additional aquatic habitat diversity. Many of these structures will be placed at the point-of-tangent of the meander bends. Log structures will be installed at riffle sections to ensure vertical stability and allow for scour and create microhabitat features. Some sections are proposed as an augmented riffle to provide grade control without scour and provide the riffle-complex habitat type and morphology.

Other in-stream structures are designed for and will be placed in pool sections strictly to increase lateral stability and to introduce additional aquatic habitat diversity. These structures may be placed along the entire length of the outside meander bends in pool sections and may be installed in conjunction with the other in-stream pool structures described above. These types of in-stream pool structures include roughened log toe, spanner logs, and brush mattresses for bank and toe protection.

The design team proposes a restoration path that would satisfy the objectives stated in Section 1 of this report. The protection and management of the riparian corridor is critical for the sustainability and function of the restoration. The design team will continue to refine the design and analysis to ensure a successful restoration project. A detailed riparian management plan will need to be developed as part of the detailed design and implementation plan.

7 REFERENCES

Jones, J.A., 2003, Soils, chap. 11 of Jackson, P.L., and Kimerling, A.J., eds., Atlas of the Pacific Northwest: Corvallis, Oregon State University Press, p. 90.

Pater, D.E., S.A. Bryce, T.D. Thorson, J. Kagan, C. Chappell, J.M. Omernik, S.H. Azevedo, and A. J. Woods. 1998. Ecoregions of Western Washington and Oregon (2-sided color poster with map, descriptive text, summary tables, and photographs). U.S. Geological Survey, Reston, VA.

RiverMorph. 2015. RIVERMorph Stream Restoration Software. RIVERMorph, LLC. 1901 Nelson Parkway, Louisville, Kentucky, 40223

Rosgen, D.L. 1996. *Applied River Morphology*. Pagosa Springs, Colorado: Wildland Hydrology Books.

———. 2006. *Watershed Assessment of River Stability and Sediment Supply.* 2nd Edition. Pagosa Springs, Colorado: Wildland Hydrology Books.

———. 2007. Rosgen Geomorphic Channel Design. Chapter 11, Part 654 Stream Restoration Design.

———. 2011. *Trail Creek Watershed Assessment & Conceptual Restoration Plan*. Appendix B – Reference Reach Data.

U.S. Department of Agriculture (USDA). 2020. Web Soil Survey. U.S. Department of Agriculture, Natural Resources Conservation Service.

U.S. Environmental Protection Agency, 1999, Primary distinguishing characteristics of level III ecoregions of the continental United States: U.S. Environmental Protection Agency database, accessed July, 2007, at http://www.epa.gov/wed/pages/ecoregions/level_iii.htm.

APPENDIX A

Geomorphic Data

D:\DROPBOX (SSSR)\SWCA EDGECOMB CREEK\C3D\SHEETS\EDGECOMBCK SURVEY MAP.DWG | JOSEPH.ZHANG | SAVED: Monday, December 21, 2020 4:56:19 PM | PLOTTED: Tuesday, December 22, 2020 9:54:07 AM | BDG STANDARD.CTB |

Prepared by:

SWCA ENVIRONMENTAL CONSULTANTS

Operating in North Carolina as SWCA Environmental Consulting and Engineering of NC, PC

116 Alexandria Drive
Mooresville, NC 28115
(p) 919.624.1458

Prepared for:

NorthPoint DEVELOPMENT

ANSI D (22"x34") SCALE: 1" = 300'

0 150 300 600

TABLOID (11"x17") SCALE: 1" = 600'

0 300 600 1200

Stamp:

Project Title:

EDGECOMB CREEK
60% DESIGN

Sheet Title:

APPENDIX A
STREAM SURVEY MAP

Date:	12/21/2020
Scale:	AS SHOWN
Drawn by:	JYZ
Checked by:	DMP
File #	

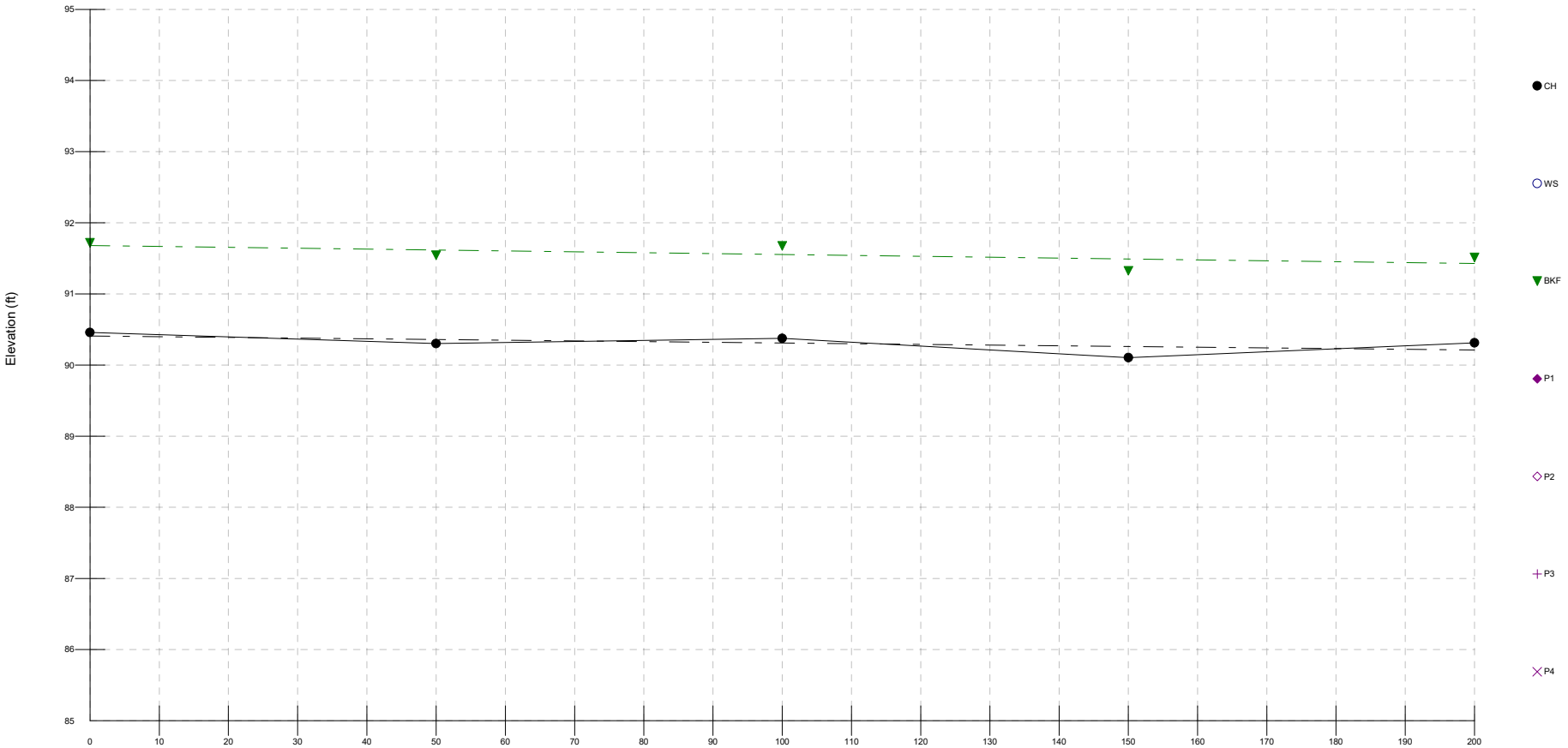
REVISIONS

Date:	By:	Note:
09/30/20	JYZ	30% CONCEPT DESIGN
10/21/20	JYZ	30% REVISION
12/04/20	JYZ	60% DESIGN
12/09/20	JYZ	60% REVISION

Sheet No:

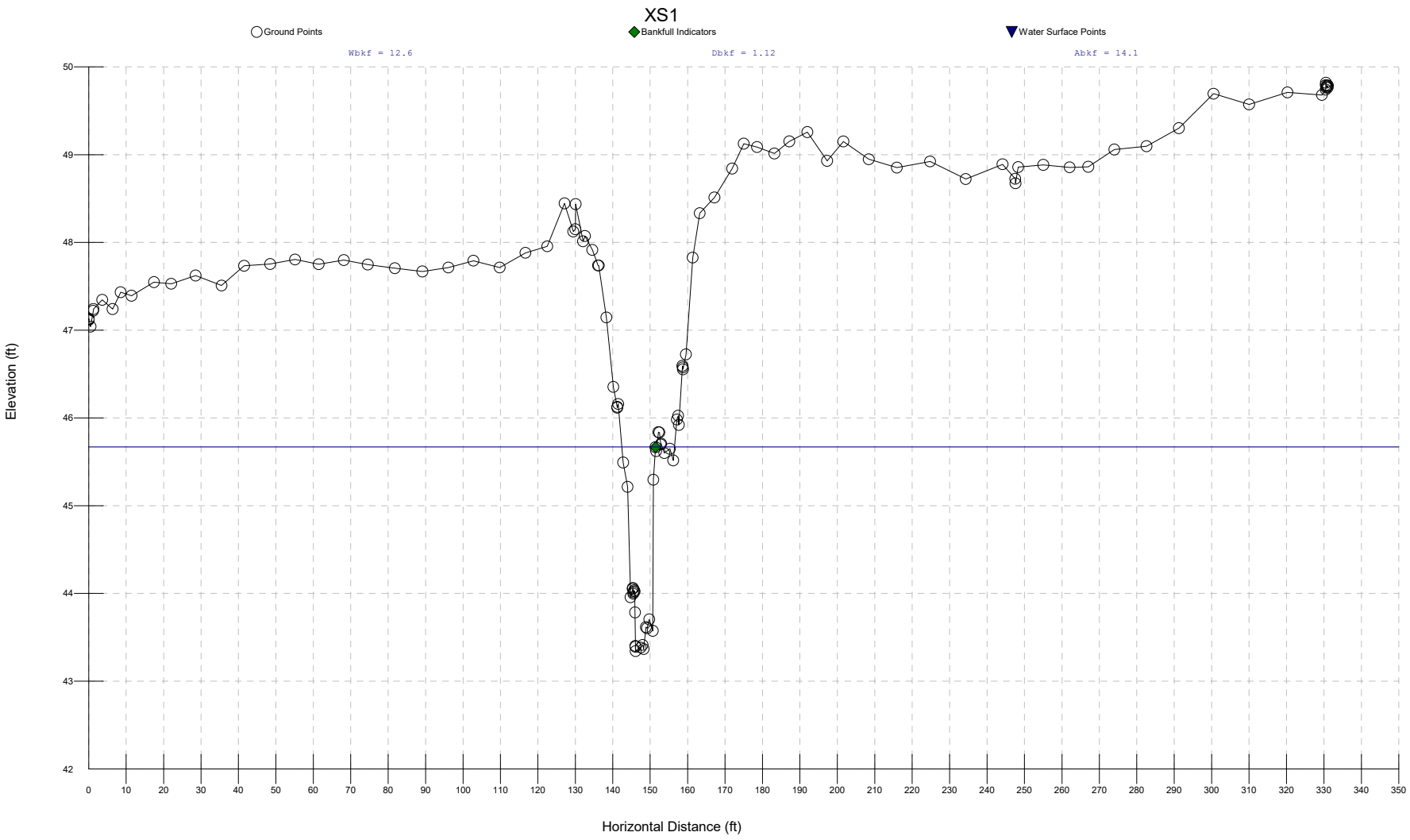
1 OF 1

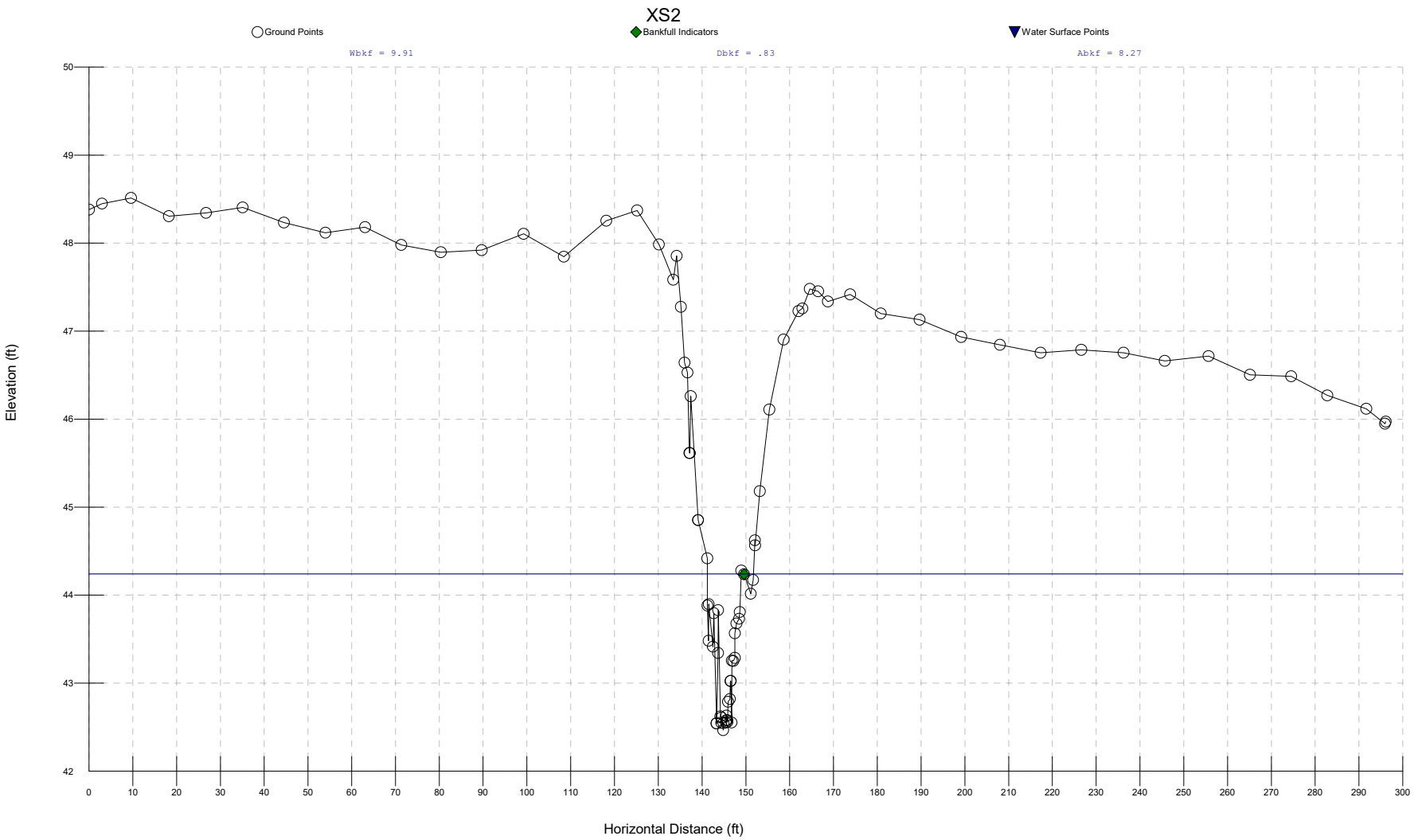
Longitudinal Profile

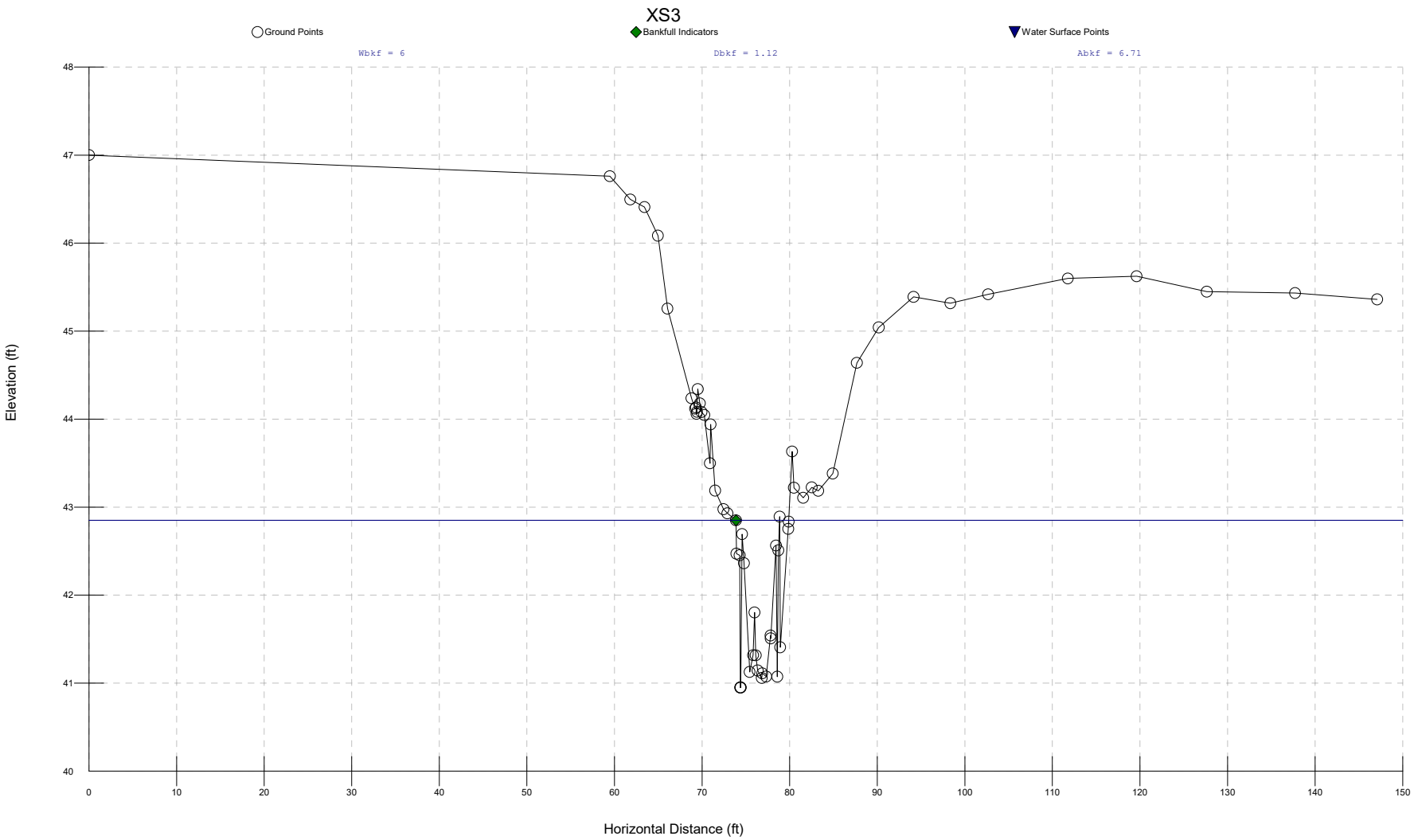


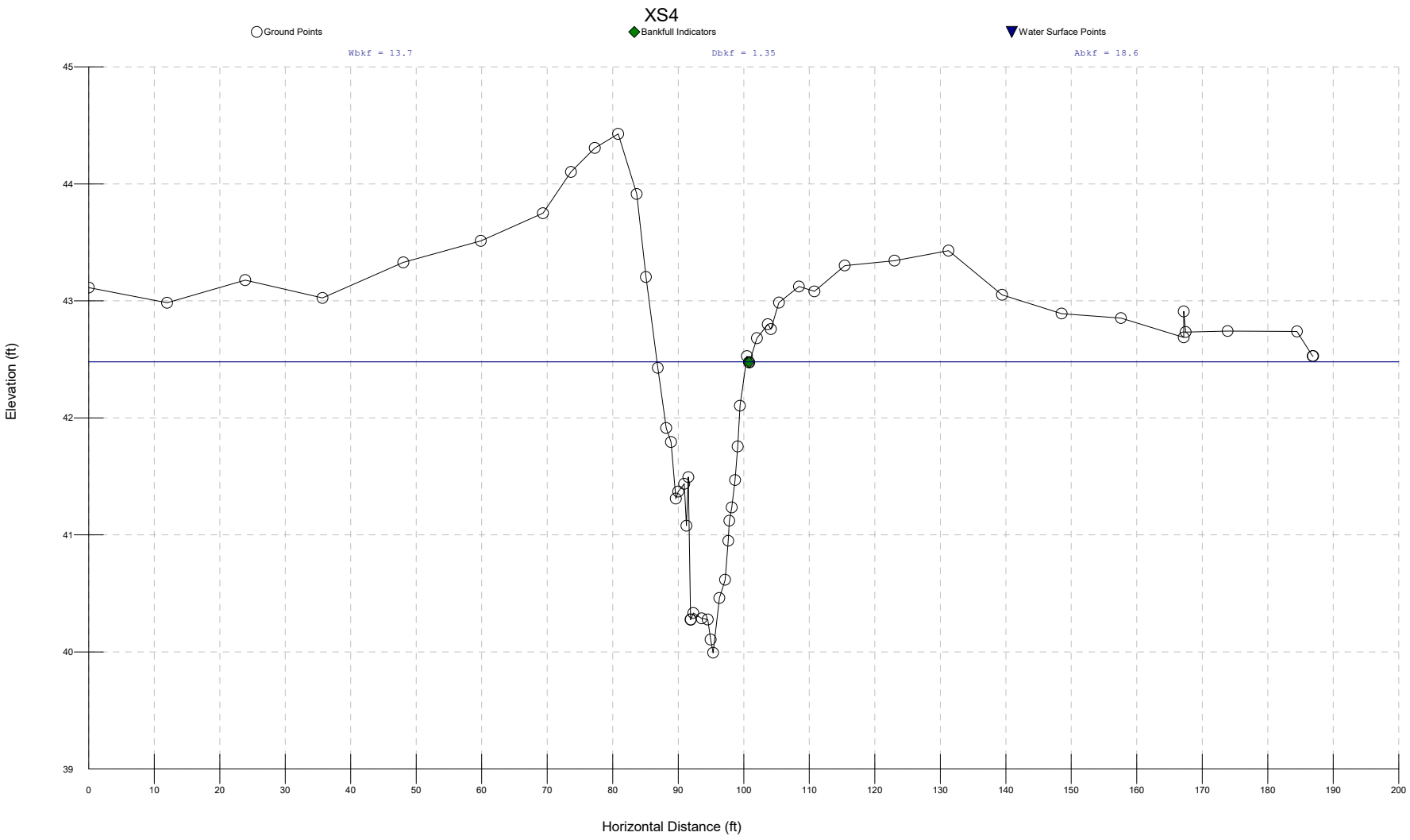
CH Best Fit Slope = 0.00098

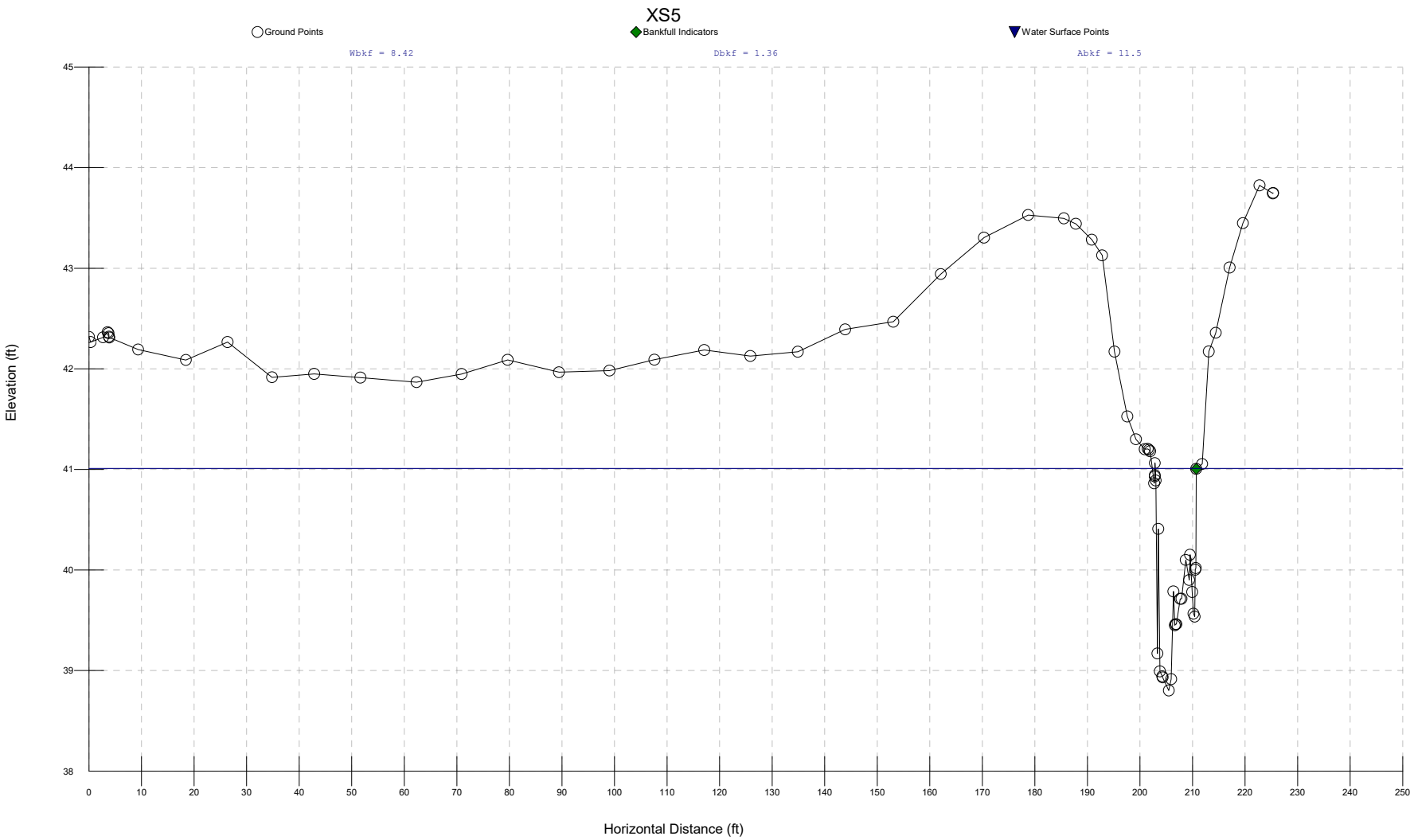
BKF Best Fit Slope = 0.00126

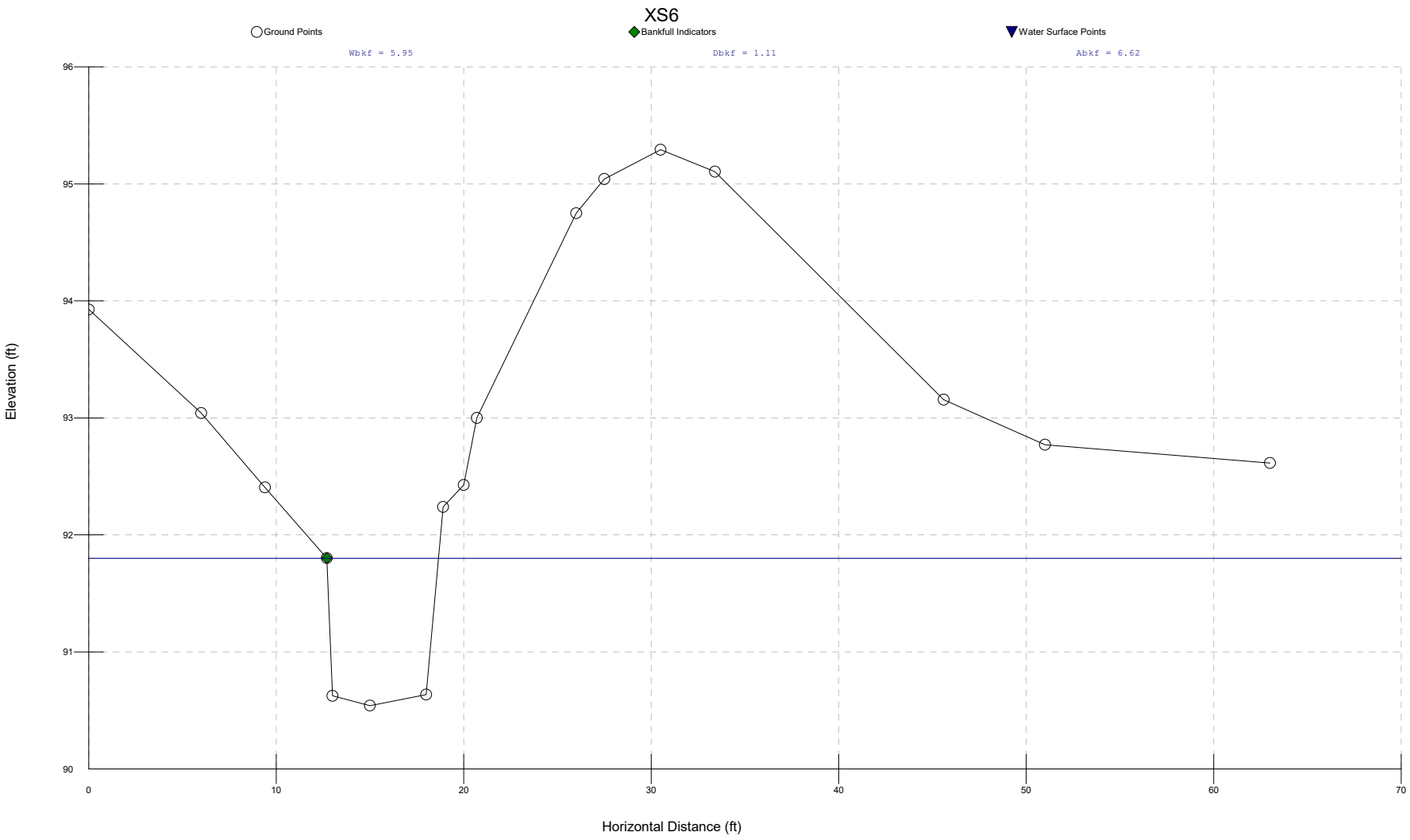

XS1
Ground Points
Bankfull Indicators
Water Surface Points
Wbkf = 12.6
Dbkf = 1.12
Abkf = 14.1
Elevation (ft)
Horizontal Distance (ft)
50
49
48
47
46
45
44
43
42
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150
160
170
180
190
200
210
220
230
240
250
260
270
280
290
300
310
320
330
340
350


XS2
Ground Points
Bankfull Indicators
Water Surface Points
Wbkf = 9.91
Dbkf = .83
Abkf = 8.27
Elevation (ft)
Horizontal Distance (ft)
50
49
48
47
46
45
44
43
42
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150
160
170
180
190
200
210
220
230
240
250
260
270
280
290
300


XS3
Ground Points
Bankfull Indicators
Water Surface Points
Wbkf = 6
Dbkf = 1.12
Abkf = 6.71
Elevation (ft)
Horizontal Distance (ft)
48
47
46
45
44
43
42
41
40
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150


XS4
Ground Points
Bankfull Indicators
Water Surface Points
Wbkf = 13.7
Dbkf = 1.35
Abkf = 18.6
Elevation (ft)
Horizontal Distance (ft)
45
44
43
42
41
40
39
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150
160
170
180
190
200


XS5
Ground Points
Bankfull Indicators
Water Surface Points
Wbkf = 8.42
Dbkf = 1.36
Abkf = 11.5
Elevation (ft)
Horizontal Distance (ft)
45
44
43
42
41
40
39
38
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150
160
170
180
190
200
210
220
230
240
250


XS6
Ground Points
Bankfull Indicators
Water Surface Points
Wbkf = 5.95
Dbkf = 1.11
Abkf = 6.62
96
95
94
93
92
91
90
Elevation (ft)
0
10
20
30
40
50
60
70
Horizontal Distance (ft)

APPENDIX B

Design Calculations

Edgecomb Creek Design Channel Parameters

$$Reach\ Slope = \frac{Reach\ Drop}{Reach\ Length} = \frac{28\ ft}{10{,}979\ ft} = 0.0026\ \frac{ft}{ft} = 0.26\%$$

Watershed Area = 1.92 mi^2

Watershed Area km^2 *= Area* mi^2 **Unit conversion (2.58999* $^{km^2}/_{mi^2}$)

$= 1.92\ mi^2 * 2.58999\ ^{km^2}/_{mi^2} = 4.98\ km^2$

$Pacific\ Border\ Regional\ Curve: Bankfull\ Area(km^2) = 0.71 * Drainage\ Area(km^2)^{0.7}$

Bankfull Area (ft^2) *=Pacific Border RC Bankfull Area* (km^2) $*$ *Unit Conversion (10.7639* $^{ft^2}/_{km^2}$)

$= (0.71 * (4.98\ km^2)^{0.71}) * 10.7639\ ^{ft^2}/_{km^2} = 23.9\ ft^2$

$Design\ Area = 23.9\ ft^2 * 0.5 = 11.9\ ft^2$

Design area decreased by half to encourage over bank flooding

$$Width\ to\ Depth\ Ratio = WDR = 16.8\ \frac{ft}{ft}$$

$$Design\ Width = \sqrt{Design\ Area\ * Bankfull\ WDR} = \sqrt{11.9 ft^2 * 16.8\ ^{ft}/_{ft}} = 14.1\ ft$$

$$Design\ Depth = \frac{Bankfull\ Width}{WDR} = \frac{14.1\ ft}{16.8\ ^{ft}/_{ft}} = 0.8 ft$$

Edgecomb Creek Inner Berm Design

$$Inner\ Berm\ Area = Design\ Area\ * \%\ Low\ Flow\ Channel = 11.9\ ft^2 * 10\% = 1.19 ft^2$$

$$Inner\ Berm\ \ WDR = 80\%\ * Bankfull\ WDR = 80\% * 16.8\ ^{ft}/_{ft} = 13.4\ ^{ft}/_{ft}$$

$$Inner\ Berm\ Width = \sqrt{Inner\ Berm\ Area\ * Inner\ Berm\ WDR} = \sqrt{1.19 ft^2 * 13.4\ ^{ft}/_{ft}} = 4\ ft$$

Edgecomb Creek Flood Terrace Design

Flood Terrace =300% of Bankfull Channel

$$Flood\ Terrace\ Area = Bankfull\ Area\ * (\%\ of\ Channel) = 11.9\ ft^2 * 300\% = 35.7\ ft^2$$

$$Flood\ Terrace\ WDR = Bankfull\ WDR\ * (\%\ of\ Channel) = 16.8\ ^{ft}/_{ft} * 300\% = 50.4\ ^{ft}/_{ft}$$

$$Flood\ Terrace\ Width = \sqrt{Flood\ Terrace\ Area\ * Flood\ Terrace\ WDR} = \sqrt{35.7 ft^2 * 50.4\ ^{ft}/_{ft}} = 42.4\ ft$$

$$Flood\ Terrace\ Depth = \frac{Flood\ Terrace\ Area}{Flood\ Terrace\ Width} = \frac{35.7\ ft^2}{42.4\ ft} = 0.84\ ft$$

*Flood Terrace Shear Stress =Reach Slope * Density of Water (62.4* $^{lbs}/_{ft^3}$ *)* $*$ *Depth*

$= 62.4\ ^{lbs}/_{ft^3} * 0.0026\ ^{ft}/_{ft} * 0.84 ft = 0.14\ ^{lbs}/_{ft^2}$

Edgecomb Creek 100-Year Design

$100\ YR\ Design\ Discharge = 81.5\ {ft^3}/{s}$

$100\ YR\ Design\ Average\ Depth = 3.5ft$

100 YR Shear Stress=Reach Slope∗Density of Water $(62.4\ {lbs}/{ft^3}) *$ *Depth*

$= 0.0026\ {ft}/{ft} * 62.4\ {lbs}/{ft^3} * 3.5ft = 0.56\ {lbs}/{ft^2}$

Mannings n = 0.06

$$Manning\ Equation\ for\ Velocity = \frac{1.49\ * Shear\ Stress^{0.67}\ * Slope^{0.5}}{Mannings\ n}$$

$$= \frac{1.49 * \left(0.81\ {lbs}/{ft^2}\right)^{0.67} * \left(0.0026\ {ft}/{ft}\right)^{0.5}}{0.06} = 0.85\ {ft}/{s}$$

$$100\ YR\ Floodplain\ Area = \frac{100\ YR\ Discharge}{100\ YR\ Velocity} = \frac{81.5\ {ft^3}/{s}}{0.85\ {ft}/{s}} = 96.2\ ft^2$$

$$100\ YR\ Floodplain\ Width\ = \frac{100\ YR\ Area}{100\ YR\ Shear\ Stress} = \frac{96.2\ ft^2}{0.56\ {lbs}/{ft^2}} = 173\ ft$$

Edgcomb Creek D84 Calculations

$$Edgecomb\ Creek\ Reach\ Slope = S = \frac{Reach\ Drop}{Reach\ Length} = 0.0025\ \frac{ft}{ft} = 0.25\%$$

$$Edgecomb\ Creek\ 100\ YR\ Discharge = Q_{100} = 81.5\ {ft^3}/{s}$$

$$Edgecomb\ Creek\ Bankfull\ Width\ = W_{BKF} = 14.1\ ft$$

$$Edgecomb\ Creek\ Critical\ Unit\ Discharge = q_c = \frac{Q_{100}}{W_{BKF}} = \frac{81.5\ {ft^3}/{s}}{14.1\ ft} = 5.8\ {ft^3}/{s}$$

$$Edgecomb\ Creek\ D_{84}(ft) = \frac{3.45 * S^{0.747} * (1.25 * {q_c}^{2/3})}{g^{1/3}} = \frac{3.45 * 0.0025\ {ft}/{ft}^{0.747} * (1.25 * (5.8\ {ft^3}/{s})^{2/3})}{(32.2\ {ft}/{s^2})^{1/3}} = 0.05\ ft$$

$$Edgecomb\ Creek\ D_{84}(in) = 0.05ft * 12\ {in}/{ft} = 0.6\ in$$

UT X Design Channel Parameters

$$Reach\ Slope = \frac{Reach\ Drop}{Reach\ Length} = 0.0017\ \frac{ft}{ft} = 0.17\%$$

Watershed Area = 0.24 mi^2

Watershed Area km^2*= Area* mi^2 **Unit conversion (2.58999* $km^2/_{mi^2}$)

$= 0.24\ mi^2 * 2.58999\ km^2/_{mi^2}$ *=0.62* km^2

$Pacific\ Border\ Regional\ Curve: Bankfull\ Area(km^2) = 0.71 * Drainage\ Area(km^2)^{0.7}$

Bankfull Area (ft^2*)=Pacific Border RC Bankfull Area (*km^2*)* $*$ *Unit Conversion (10.7639* $ft^2/_{km^2}$)

$= (0.71 * (0.62\ km^2)^{0.71}) * 10.7639\ ft^2/_{km^2} = 5.45\ ft^2$

$Design\ Area = 5.45\ ft^2 * 0.31 = 1.7\ ft^2$
$Design\ area\ to\ be\ 31\%\ of\ bankfull\ to\ increase\ over\ bank\ flooding$

$$Width\ to\ Depth\ Ratio = WDR = 16.8\ \frac{ft}{ft}$$

$$Design\ Width = \sqrt{Design\ Area\ * Bankfull\ WDR} = \sqrt{1.7 ft^2 * 16.8\ ft/_{ft}} = 5.3\ ft$$

$$Design\ Depth = \frac{Bankfull\ Width}{WDR} = \frac{5.3\ ft}{16.8\ ft/_{ft}} = 0.32 ft$$

UT X Flood Terrace Design

Flood Terrace =300% of Bankfull Channel

$$Flood\ Terrace\ Area = Bankfull\ Area\ * (\%\ of\ Channel) = 1.7\ ft^2 * 300\% = 5.1\ ft^2$$

$$Flood\ Terrace\ WDR = Bankfull\ WDR\ * (\%\ of\ Channel) = 16.8\ ft/_{ft} * 300\% = 50.4\ ft/_{ft}$$

$$Flood\ Terrace\ Width = \sqrt{Flood\ Terrace\ Area\ * Flood\ Terrace\ WDR} = \sqrt{5.1 ft^2 * 50.4\ ft/_{ft}} = 16\ ft$$

$$Flood\ Terrace\ Depth = \frac{Flood\ Terrace\ Area}{Flood\ Terrace\ Width} = \frac{5.1\ ft^2}{16\ ft} = 0.32\ ft$$

*Flood Terrace Shear Stress =Reach Slope * Density of Water (62.4* $lbs/_{ft^3}$ *) * Depth*

$= 62.4\ lbs/_{ft^3} * 0.0017\ ft/_{ft} * 0.32 ft = 0.034\ lbs/_{ft^2}$

UT X 100 Year Design

$100\ YR\ Design\ Discharge = 28.4\ {ft^3}/{s}$

$100\ YR\ Design\ Average\ Depth = 8ft$

100 YR Shear Stress=Reach Slope∗Density of Water (62.4 ${lbs}/{ft^3}$) ∗ Depth

$= 0.0017\ {ft}/{ft} * 62.4\ {lbs}/{ft^3} * 8ft = 0.85\ {lbs}/{ft^2}$

Mannings n = 0.06

$$Manning\ Equation\ for\ Velocity = \frac{1.49\ * Shear\ Stress^{0.67}\ * Slope^{0.5}}{Mannings\ n}$$

$$= \frac{1.49 * \left(0.85\ {lbs}/{ft^2}\right)^{0.67} * \left(0.0017\ {ft}/{ft}\right)^{0.5}}{0.06} = 0.92\ {ft}/{s}$$

$$100\ YR\ Floodplain\ Area = \frac{100\ YR\ Discharge}{100\ YR\ Velocity} = \frac{28.4\ {ft^3}/{s}}{0.92\ {ft}/{s}} = 30.9\ ft^2$$

$$100\ YR\ Floodplain\ Depth\ = \frac{100\ YR\ Area}{100\ YR\ Shear\ Stress} = \frac{30.9\ ft^2}{0.85\ {lbs}/{ft^2}} = 36.4\ ft$$

UT X D84 Calculations

$$UT\ X\ Reach\ Slope = S = \frac{Reach\ Drop}{Reach\ Length} = 0.0006\ \frac{ft}{ft} = 0.06\%$$

$$UT\ X\ 100\ YR\ Discharge = Q_{100} = 50.2\ {ft^3}/{s}$$

$$UT\ X\ Bankfull\ Width\ = W_{BKF} = 5.3\ ft$$

$$UT\ X\ Critical\ Unit\ Discharge = q_c = \frac{Q_{100}}{W_{BKF}} = \frac{50.2\ {ft^3}/{s}}{5.3\ ft} = 9.5\ {ft^3}/{s}$$

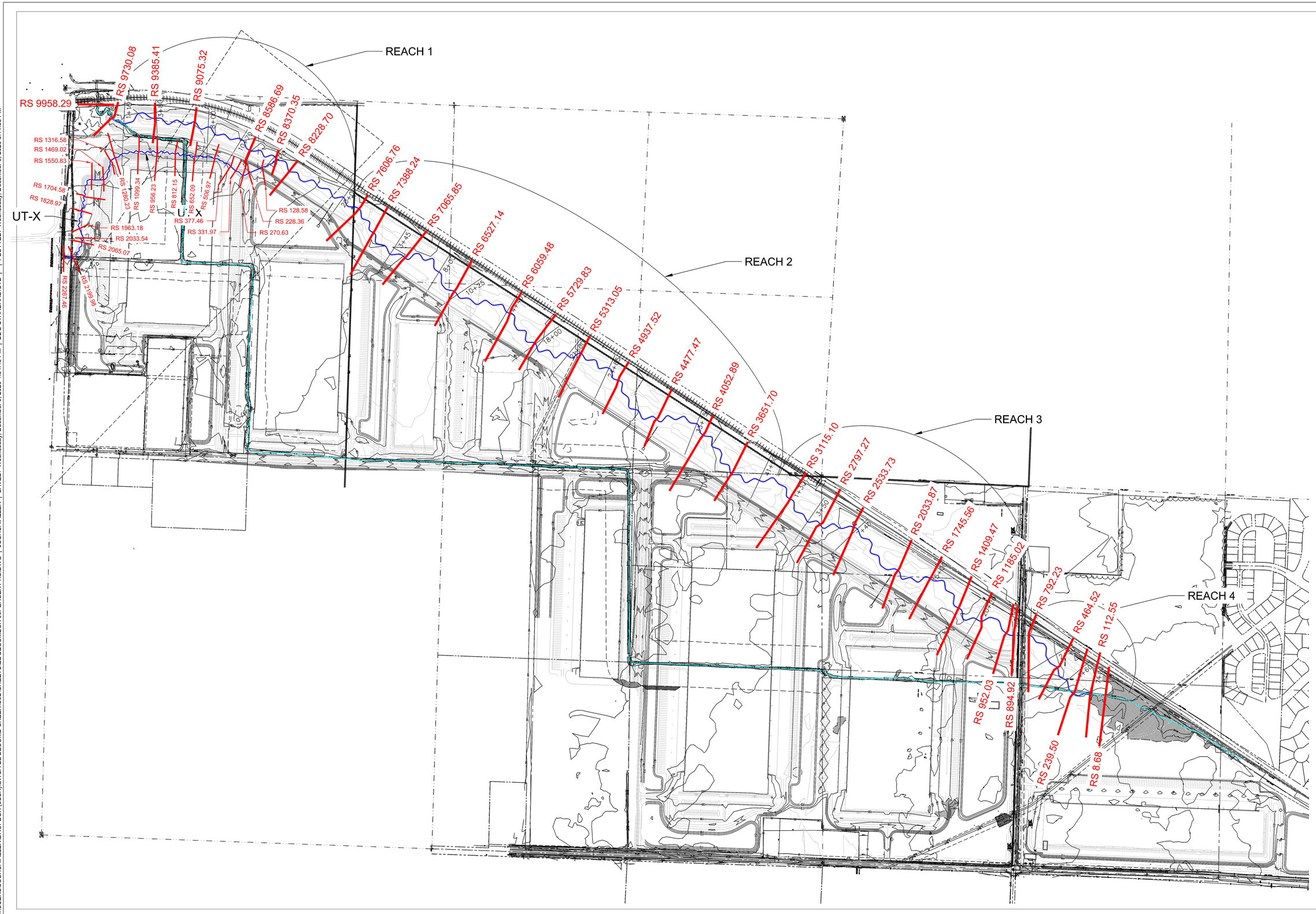
$$UT\ X\ D_{84}(ft) = \frac{3.45 * S^{0.747} * (1.25 * {q_c}^{2/3})}{g^{1/3}} = \frac{3.45 * 0.0006\ {ft}/{ft}^{0.747} * (1.25 * (9.5\ {ft^3}/{s})^{2/3})}{(32.2\ {ft}/{s^2})^{1/3}} = 0.02ft$$

$$UT\ X\ D_{84}(in) = 0.09ft * 12\ {in}/{ft} = 0.3\ in$$

APPENDIX C

HEC-RAS Results

C:\USERS\JOSHUA.ALLEN\DROPBOX (SSSR)\SWCA EDGECOMB CREEK\C3D\SHEETS\EDGECOMBCK 60PERCENT XS.DWG | JOSHUA.ALLEN | SAVED: Wednesday, December 9, 2020 4:54:43 PM | BDG STANDARD.CTB | | PLOTTED: Wednesday, December 9, 2020 5:11:53 PM



Prepared by:

SWCA ENVIRONMENTAL CONSULTANTS

Operating in North Carolina as
SWCA Environmental Consulting
and Engineering of NC, PC

116 Alexandria Drive
Mooresville, NC 28115
(p) 919.624.1458

Prepared for:

NorthPoint DEVELOPMENT

ANSI D (22"x34") SCALE: 1" = 300'

0 150 300 600

TABLOID (11"x17") SCALE: 1" = 600'

0 300 600 1200

Stamp:

Project Title:

EDGECOMB CREEK
60% DESIGN

Sheet Title:

OVERVIEW
CROSS-SECTIONS

Date:	12/04/2020
Scale:	NTS
Drawn by:	JYZ
Checked by:	DMP
File #	

REVISIONS

Date:	By:	Note:
09/30/20	JYZ	30% CONCEPT DESIGN
10/21/20	JYZ	30% REVISON
12/04/20	JYZ	60% DESIGN
12/09/20	JYZ	60% REVISION

Sheet No:

28 OF 47

HEC-RAS Plan: EC PG1 River: Edgecomb Reach: Edgecomb PG

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Shear Chan	Shear LOB	Shear ROB
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(lb/sq ft)	(lb/sq ft)	(lb/sq ft)
Edgecomb PG	9958.29	2year	35.10	131.77	132.74	132.74	133.09	0.022224	4.77	0.91		
Edgecomb PG	9958.29	10year	50.20	131.77	132.94	132.94	133.37	0.020947	5.28	1.04		
Edgecomb PG	9958.29	25year	60.90	131.77	133.06	133.06	133.54	0.020382	5.58	1.12		
Edgecomb PG	9958.29	100year	81.50	131.77	133.28	133.28	133.85	0.019460	6.03	1.25		
Edgecomb PG	9730.08	2year	35.10	126.77	128.16		128.21	0.001851	1.91	0.12	0.02	0.03
Edgecomb PG	9730.08	10year	50.20	126.77	128.27	127.77	128.34	0.002417	2.33	0.18	0.02	0.06
Edgecomb PG	9730.08	25year	60.90	126.77	128.37	128.01	128.44	0.002481	2.48	0.20	0.02	0.08
Edgecomb PG	9730.08	100year	81.50	126.77	128.51	128.13	128.59	0.002537	2.69	0.22	0.05	0.10
Edgecomb PG	9385.41	2year	35.10	125.51	126.35	126.35	126.65	0.021965	4.37	0.79		
Edgecomb PG	9385.41	10year	50.20	125.51	126.65	126.65	126.84	0.009563	3.70	0.50	0.08	0.07
Edgecomb PG	9385.41	25year	60.90	125.51	126.71	126.71	126.92	0.009657	3.90	0.55	0.12	0.11
Edgecomb PG	9385.41	100year	81.50	125.51	126.82	126.82	127.03	0.009789	4.22	0.62	0.18	0.18
Edgecomb PG	9075.32	2year	35.10	123.11	125.06		125.11	0.001588	1.85	0.11		
Edgecomb PG	9075.32	10year	50.20	123.11	125.31		125.38	0.001792	2.14	0.15	0.00	0.01
Edgecomb PG	9075.32	25year	60.90	123.11	125.43		125.50	0.001844	2.29	0.16	0.02	0.02
Edgecomb PG	9075.32	100year	81.50	123.11	125.59	124.72	125.68	0.002016	2.56	0.20	0.04	0.04
Edgecomb PG	8586.69	2year	35.10	122.31	123.28	123.19	123.46	0.011032	3.45	0.47	0.11	
Edgecomb PG	8586.69	10year	50.20	122.31	123.44	123.37	123.64	0.010025	3.75	0.52	0.11	0.06
Edgecomb PG	8586.69	25year	60.90	122.31	123.52	123.50	123.73	0.009872	3.95	0.56	0.12	0.11
Edgecomb PG	8586.69	100year	81.50	122.31	123.66	123.62	123.86	0.008813	4.08	0.57	0.17	0.16
Edgecomb PG	8370.35	2year	35.10	121.55	122.51		122.56	0.001999	1.43	0.08	0.01	0.13
Edgecomb PG	8370.35	10year	50.20	121.55	122.73		122.78	0.001960	1.71	0.11	0.01	0.07
Edgecomb PG	8370.35	25year	60.90	121.55	122.85		122.90	0.001864	1.82	0.11	0.03	0.07
Edgecomb PG	8370.35	100year	81.50	121.55	123.05		123.10	0.001721	1.97	0.13	0.04	0.08
Edgecomb PG	8228.7	2year	35.10	120.19	122.36		122.39	0.000808	1.43	0.06	0.01	0.00
Edgecomb PG	8228.7	10year	50.20	120.19	122.56		122.60	0.000879	1.64	0.08	0.02	0.01
Edgecomb PG	8228.7	25year	60.90	120.19	122.68		122.72	0.000901	1.74	0.09	0.02	0.02
Edgecomb PG	8228.7	100year	81.50	120.19	122.88		122.92	0.000921	1.89	0.10	0.04	0.02
Edgecomb PG	7606.76	2year	35.10	120.17	121.40		121.48	0.003346	2.34	0.19	0.04	0.04
Edgecomb PG	7606.76	10year	50.20	120.17	121.56		121.64	0.003288	2.56	0.22	0.07	0.07
Edgecomb PG	7606.76	25year	60.90	120.17	121.64		121.74	0.003424	2.75	0.25	0.09	0.09
Edgecomb PG	7606.76	100year	81.50	120.17	121.79		121.90	0.003703	3.08	0.30	0.07	0.12
Edgecomb PG	7388.24	2year	35.10	119.68	120.87	120.41	120.90	0.002089	1.77	0.11	0.05	0.02
Edgecomb PG	7388.24	10year	50.20	119.68	120.98	120.53	121.02	0.002329	2.03	0.14	0.07	0.04
Edgecomb PG	7388.24	25year	60.90	119.68	121.06	120.60	121.10	0.002332	2.14	0.16	0.08	0.05
Edgecomb PG	7388.24	100year	81.50	119.68	121.18	120.80	121.23	0.002435	2.34	0.18	0.08	0.07
Edgecomb PG	7065.85	2year	35.10	118.93	119.56		119.60	0.010396	2.46	0.28	0.38	
Edgecomb PG	7065.85	10year	50.20	118.93	119.79		119.84	0.006561	2.45	0.25	0.31	
Edgecomb PG	7065.85	25year	60.90	118.93	119.91		119.96	0.005920	2.54	0.25	0.22	
Edgecomb PG	7065.85	100year	81.50	118.93	120.07		120.12	0.005189	2.69	0.27	0.15	0.03
Edgecomb PG	6527.14	2year	35.10	116.60	118.64	117.64	118.66	0.000687	1.25	0.05	0.02	
Edgecomb PG	6527.14	10year	50.20	116.60	118.79	117.85	118.81	0.000887	1.51	0.07	0.03	0.00
Edgecomb PG	6527.14	25year	60.90	116.60	118.88	118.05	118.91	0.000951	1.64	0.08	0.03	0.01
Edgecomb PG	6527.14	100year	81.50	116.60	119.04	118.31	119.07	0.001004	1.80	0.10	0.04	0.02
Edgecomb PG	6059.48	2year	35.10	116.60	117.50	117.44	117.75	0.016517	4.01	0.65		
Edgecomb PG	6059.48	10year	50.20	116.60	117.78	117.78	117.90	0.006746	3.18	0.37	0.05	0.06
Edgecomb PG	6059.48	25year	60.90	116.60	117.82	117.82	117.95	0.007048	3.36	0.40	0.07	0.09
Edgecomb PG	6059.48	100year	81.50	116.60	117.88	117.88	118.03	0.008205	3.78	0.50	0.11	0.13
Edgecomb PG	5729.83	2year	35.10	114.82	116.52		116.55	0.001436	1.65	0.09	0.03	
Edgecomb PG	5729.83	10year	50.20	114.82	116.74		116.77	0.001336	1.70	0.10	0.05	
Edgecomb PG	5729.83	25year	60.90	114.82	116.87		116.90	0.001338	1.77	0.10	0.05	0.00
Edgecomb PG	5729.83	100year	81.50	114.82	117.04		117.07	0.001314	1.90	0.11	0.06	0.02
Edgecomb PG	5313.05	2year	35.10	114.09	115.95		116.00	0.001241	1.68	0.09	0.00	0.00
Edgecomb PG	5313.05	10year	50.20	114.09	116.10		116.17	0.001577	2.04	0.13	0.02	0.01
Edgecomb PG	5313.05	25year	60.90	114.09	116.19		116.26	0.001711	2.22	0.15	0.03	0.02
Edgecomb PG	5313.05	100year	81.50	114.09	116.33		116.41	0.001957	2.51	0.19	0.04	0.03
Edgecomb PG	4937.52	2year	35.10	113.98	115.12	114.82	115.21	0.004329	2.46	0.22	0.02	0.03
Edgecomb PG	4937.52	10year	50.20	113.98	115.25	115.14	115.31	0.003558	2.44	0.21	0.04	0.05
Edgecomb PG	4937.52	25year	60.90	113.98	115.31	115.20	115.37	0.003380	2.48	0.21	0.05	0.06
Edgecomb PG	4937.52	100year	81.50	113.98	115.43		115.48	0.003147	2.57	0.22	0.07	0.08
Edgecomb PG	4477.47	2year	35.10	112.92	114.08		114.10	0.001484	1.48	0.08	0.04	0.01
Edgecomb PG	4477.47	10year	50.20	112.92	114.20		114.22	0.001668	1.70	0.10	0.05	0.02
Edgecomb PG	4477.47	25year	60.90	112.92	114.27		114.30	0.001703	1.80	0.11	0.06	0.02
Edgecomb PG	4477.47	100year	81.50	112.92	114.40		114.42	0.001734	1.96	0.13	0.08	0.04
Edgecomb PG	4052.89	2year	35.10	111.93	112.59		112.66	0.013679	2.95	0.39		0.35

HEC-RAS Plan: EC PG1 River: Edgecomb Reach: Edgecomb PG (Continued)

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Shear Chan	Shear LOB	Shear ROB
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(lb/sq ft)	(lb/sq ft)	(lb/sq ft)
Edgecomb PG	4052.89	10year	50.20	111.93	112.79		112.85	0.008550	2.79	0.32		0.31
Edgecomb PG	4052.89	25year	60.90	111.93	112.89		112.96	0.007510	2.82	0.31		0.31
Edgecomb PG	4052.89	100year	81.50	111.93	113.06		113.12	0.006603	2.94	0.32	0.03	0.25
Edgecomb PG	3651.7	2year	35.10	109.98	111.81		111.83	0.000779	1.26	0.05	0.03	
Edgecomb PG	3651.7	10year	50.20	109.98	111.98		112.00	0.000918	1.44	0.07	0.04	
Edgecomb PG	3651.7	25year	60.90	109.98	112.08		112.10	0.000969	1.55	0.08	0.03	0.00
Edgecomb PG	3651.7	100year	81.50	109.98	112.23		112.26	0.001030	1.72	0.09	0.04	0.01
Edgecomb PG	3115.1	2year	35.10	109.79	111.05	110.63	111.11	0.002661	2.12	0.16	0.02	0.03
Edgecomb PG	3115.1	10year	50.20	109.79	111.19	110.98	111.24	0.002447	2.22	0.17	0.04	0.05
Edgecomb PG	3115.1	25year	60.90	109.79	111.26		111.31	0.002478	2.33	0.18	0.05	0.06
Edgecomb PG	3115.1	100year	81.50	109.79	111.37		111.43	0.002546	2.51	0.20	0.07	0.08
Edgecomb PG	2797.27	2year	35.10	109.25	110.27		110.29	0.002387	1.65	0.11	0.07	0.00
Edgecomb PG	2797.27	10year	50.20	109.25	110.40		110.43	0.002537	1.91	0.13	0.07	0.01
Edgecomb PG	2797.27	25year	60.90	109.25	110.48		110.52	0.002509	2.02	0.14	0.08	0.02
Edgecomb PG	2797.27	100year	81.50	109.25	110.61		110.64	0.002410	2.15	0.16	0.09	0.04
Edgecomb PG	2533.73	2year	35.10	108.57	109.23		109.26	0.007315	2.16	0.21		0.23
Edgecomb PG	2533.73	10year	50.20	108.57	109.38		109.42	0.006516	2.34	0.23		0.26
Edgecomb PG	2533.73	25year	60.90	108.57	109.46		109.50	0.006496	2.49	0.25		0.29
Edgecomb PG	2533.73	100year	81.50	108.57	109.61		109.66	0.006402	2.76	0.29	0.01	0.21
Edgecomb PG	2033.87	2year	35.10	106.91	107.95		107.96	0.001322	1.25	0.06	0.06	0.00
Edgecomb PG	2033.87	10year	50.20	106.91	108.09		108.11	0.001388	1.44	0.08	0.06	0.01
Edgecomb PG	2033.87	25year	60.90	106.91	108.17		108.19	0.001413	1.54	0.08	0.07	0.02
Edgecomb PG	2033.87	100year	81.50	106.91	108.30		108.32	0.001462	1.70	0.10	0.07	0.03
Edgecomb PG	1745.56	2year	35.10	106.10	107.36	106.95	107.42	0.002832	2.17	0.17	0.03	0.02
Edgecomb PG	1745.56	10year	50.20	106.10	107.47	107.27	107.54	0.002958	2.39	0.19	0.05	0.04
Edgecomb PG	1745.56	25year	60.90	106.10	107.53	107.36	107.60	0.003166	2.55	0.22	0.07	0.05
Edgecomb PG	1745.56	100year	81.50	106.10	107.62	107.49	107.70	0.003367	2.77	0.25	0.09	0.07
Edgecomb PG	1409.47	2year	35.10	105.04	106.03		106.11	0.005756	2.51	0.25	0.19	
Edgecomb PG	1409.47	10year	50.20	105.04	106.21		106.28	0.004795	2.64	0.25	0.11	0.03
Edgecomb PG	1409.47	25year	60.90	105.04	106.30		106.37	0.004277	2.66	0.25	0.10	0.05
Edgecomb PG	1409.47	100year	81.50	105.04	106.44		106.50	0.003689	2.70	0.25	0.12	0.08
Edgecomb PG	1185.02	2year	35.10	103.56	105.59		105.63	0.001067	1.61	0.08	0.00	0.00
Edgecomb PG	1185.02	10year	50.20	103.56	105.76		105.81	0.001176	1.84	0.10	0.01	0.01
Edgecomb PG	1185.02	25year	60.90	103.56	105.86		105.91	0.001183	1.92	0.11	0.02	0.02
Edgecomb PG	1185.02	100year	81.50	103.56	106.04		106.08	0.001108	1.99	0.12	0.03	0.03
Edgecomb PG	952.03	2year	35.10	103.92	105.21	104.76	105.26	0.002486	2.08	0.15	0.03	0.04
Edgecomb PG	952.03	10year	50.20	103.92	105.39	105.07	105.44	0.002210	2.19	0.16	0.05	0.06
Edgecomb PG	952.03	25year	60.90	103.92	105.46	105.15	105.53	0.002373	2.37	0.18	0.07	0.07
Edgecomb PG	952.03	100year	81.50	103.92	105.61	105.26	105.69	0.002690	2.72	0.23	0.09	0.06
Edgecomb PG	894.92	2year	35.10	103.78	104.62	104.62	104.92	0.022191	4.42	0.81		
Edgecomb PG	894.92	10year	50.20	103.78	104.85	104.85	105.15	0.015704	4.42	0.74	0.04	0.07
Edgecomb PG	894.92	25year	60.90	103.78	105.00	105.00	105.25	0.011209	4.20	0.63	0.10	0.14
Edgecomb PG	894.92	100year	81.50	103.78	105.12	105.12	105.40	0.011144	4.56	0.71	0.18	0.22
Edgecomb PG	870		Culvert									
Edgecomb PG	792.23	2year	35.10	103.25	104.73	104.09	104.75	0.001493	1.29	0.06		
Edgecomb PG	792.23	10year	50.20	103.25	104.90	104.37	104.94	0.001445	1.46	0.08	0.01	0.01
Edgecomb PG	792.23	25year	60.90	103.25	105.01	104.43	105.05	0.001380	1.54	0.08	0.02	0.01
Edgecomb PG	792.23	100year	81.50	103.25	104.97	104.53	105.05	0.002846	2.16	0.17	0.03	0.02
Edgecomb PG	464.52	2year	35.10	102.02	104.54	103.06	104.55	0.000329	1.05	0.03	0.01	0.01
Edgecomb PG	464.52	10year	50.20	102.02	104.67	103.28	104.70	0.000437	1.27	0.05	0.01	0.01
Edgecomb PG	464.52	25year	60.90	102.02	104.76	103.41	104.78	0.000515	1.42	0.06	0.01	0.01
Edgecomb PG	464.52	100year	81.50	102.02	104.84	103.62	104.85	0.000220	0.96	0.03	0.01	0.01
Edgecomb PG	239.5	2year	35.10	103.07	104.46	103.71	104.46	0.000441	0.77	0.02	0.02	0.01
Edgecomb PG	239.5	10year	50.20	103.07	104.58	103.79	104.58	0.000528	0.92	0.03	0.02	0.01
Edgecomb PG	239.5	25year	60.90	103.07	104.65	103.85	104.66	0.000592	1.02	0.04	0.03	0.01
Edgecomb PG	239.5	100year	81.50	103.07	104.76	103.93	104.77	0.000692	1.19	0.05	0.04	0.01
Edgecomb PG	112.55	2year	35.10	103.02	104.33	103.86	104.36	0.001656	1.72	0.10	0.03	0.02
Edgecomb PG	112.55	10year	50.20	103.02	104.42	104.14	104.46	0.002104	2.05	0.14	0.04	0.03
Edgecomb PG	112.55	25year	60.90	103.02	104.47	104.21	104.52	0.002382	2.24	0.17	0.04	0.04
Edgecomb PG	112.55	100year	81.50	103.02	104.55	104.31	104.61	0.002725	2.52	0.21	0.05	0.06
Edgecomb PG	8.68	2year	35.10	103.50	104.26	103.94	104.27	0.000500	0.58	0.01	0.00	0.01
Edgecomb PG	8.68	10year	50.20	103.50	104.35	103.97	104.35	0.000500	0.64	0.02	0.00	0.01
Edgecomb PG	8.68	25year	60.90	103.50	104.40	104.00	104.41	0.000500	0.68	0.02	0.01	0.01
Edgecomb PG	8.68	100year	81.50	103.50	104.49	104.05	104.49	0.000501	0.75	0.02	0.01	0.01

HEC-RAS Plan: UT X PG River: UT X Reach: Ditch PG

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Shear Chan	Shear LOB	Shear ROB
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(lb/sq ft)	(lb/sq ft)	(lb/sq ft)
Ditch PG	2267.46	2year	6.60	122.00	123.32		123.32	0.000258	0.74	0.02	0.00	0.01
Ditch PG	2267.46	100year	21.90	122.00	124.53		124.53	0.000107	0.77	0.02	0.00	0.01
Ditch PG	2199.98	2year	6.60	121.96	123.31		123.31	0.000136	0.54	0.01	0.01	0.01
Ditch PG	2199.98	100year	21.90	121.96	124.52		124.52	0.000091	0.71	0.01	0.01	0.01
Ditch PG	2065.07	2year	6.60	121.88	123.29		123.29	0.000126	0.54	0.01	0.00	0.01
Ditch PG	2065.07	100year	21.90	121.88	124.51		124.51	0.000083	0.69	0.01	0.01	0.01
Ditch PG	2033.54	2year	6.60	121.86	123.29	122.47	123.29	0.000140	0.57	0.01	0.01	0.01
Ditch PG	2033.54	100year	21.90	121.86	124.51	122.74	124.51	0.000093	0.73	0.01	0.01	0.01
Ditch PG	2030		Culvert									
Ditch PG	1963.18	2year	6.60	121.82	123.24		123.25	0.000202	0.69	0.02	0.01	0.01
Ditch PG	1963.18	100year	21.90	121.82	124.37		124.38	0.000162	0.95	0.02	0.02	0.01
Ditch PG	1828.97	2year	6.60	121.75	123.13		123.13	0.000121	0.53	0.01	0.01	0.01
Ditch PG	1828.97	100year	21.90	121.75	124.27		124.27	0.000094	0.72	0.01	0.01	0.01
Ditch PG	1704.58	2year	6.60	121.68	123.12		123.12	0.000082	0.44	0.01	0.00	0.00
Ditch PG	1704.58	100year	21.90	121.68	124.26		124.26	0.000068	0.62	0.01	0.01	0.01
Ditch PG	1550.83	2year	6.60	121.59	123.11	122.19	123.11	0.000098	0.50	0.01	0.00	0.01
Ditch PG	1550.83	100year	21.90	121.59	124.25	122.46	124.25	0.000087	0.71	0.01	0.01	0.01
Ditch PG	1545		Culvert									
Ditch PG	1469.02	2year	6.60	121.54	123.04		123.04	0.000215	0.74	0.02	0.01	0.01
Ditch PG	1469.02	100year	21.90	121.54	124.10		124.11	0.000198	1.05	0.03	0.01	0.01
Ditch PG	1316.58	2year	6.60	121.45	123.02	122.05	123.02	0.000098	0.50	0.01	0.00	0.01
Ditch PG	1316.58	100year	21.90	121.45	124.08	122.33	124.09	0.000112	0.79	0.02	0.01	0.01
Ditch PG	1310		Culvert									
Ditch PG	1280.23	2year	6.60	121.43	122.98		122.99	0.000175	0.68	0.01	0.01	0.01
Ditch PG	1280.23	100year	21.90	121.43	124.01		124.02	0.000200	1.06	0.03	0.01	0.02
Ditch PG	1099.34	2year	6.60	121.33	122.97		122.97	0.000052	0.39	0.00	0.00	0.00
Ditch PG	1099.34	100year	21.90	121.33	124.00		124.00	0.000070	0.64	0.01	0.01	0.01
Ditch PG	956.23	2year	6.60	121.25	122.96		122.96	0.000045	0.38	0.00	0.00	0.00
Ditch PG	956.23	100year	21.90	121.25	123.99		123.99	0.000064	0.63	0.01	0.01	0.01
Ditch PG	812.15	2year	6.60	121.16	122.96		122.96	0.000033	0.33	0.00	0.00	0.00
Ditch PG	812.15	100year	21.90	121.16	123.98		123.98	0.000053	0.57	0.01	0.01	0.01
Ditch PG	652.09	2year	6.60	121.07	122.95		122.95	0.000027	0.31	0.00	0.00	0.00
Ditch PG	652.09	100year	21.90	121.07	123.97		123.97	0.000049	0.57	0.01	0.01	0.01
Ditch PG	506.97	2year	6.60	120.99	122.95		122.95	0.000030	0.34	0.00	0.00	0.00
Ditch PG	506.97	100year	21.90	120.99	123.96		123.96	0.000063	0.66	0.01	0.01	0.01
Ditch PG	377.46	2year	6.60	120.92	122.94	121.50	122.94	0.000064	0.51	0.01	0.00	0.00
Ditch PG	377.46	100year	21.90	120.92	123.94	121.87	123.95	0.000141	1.00	0.02	0.01	0.01
Ditch PG	370		Culvert									
Ditch PG	331.97	2year	6.60	120.89	122.93		122.93	0.000061	0.50	0.01	0.00	0.00
Ditch PG	331.97	100year	21.90	120.89	123.89		123.89	0.000134	0.97	0.02	0.01	0.01
Ditch PG	270.63	2year	6.60	120.85	122.92		122.93	0.000020	0.29	0.00	0.00	0.00
Ditch PG	270.63	100year	21.90	120.85	123.89		123.89	0.000045	0.57	0.01	0.01	0.01
Ditch PG	228.36	2year	6.60	120.83	122.92	121.42	122.92	0.000025	0.32	0.00	0.00	0.00
Ditch PG	228.36	100year	21.90	120.83	123.88	121.69	123.89	0.000055	0.62	0.01	0.01	0.01
Ditch PG	215		Culvert									
Ditch PG	128.58	2year	6.60	120.77	122.89	121.35	122.90	0.000066	0.53	0.01	0.00	0.00
Ditch PG	128.58	100year	21.90	120.77	123.78	121.74	123.79	0.000184	1.13	0.03	0.02	0.02
Ditch PG	20.03	2year	6.60	120.71	122.89	121.29	122.89	0.000044	0.46	0.01	0.00	0.00
Ditch PG	20.03	100year	21.90	120.71	123.78	121.88	123.78	0.000032	0.49	0.01	0.00	0.00

APPENDIX D

MCDA

					Fisheries and Habitat Improvement GOAL							Fish Passage Goal			Flood and Property Protection Goal					Aestetics and Demonstration Goal					Water Quality Goal					Stakeholder Approval and Permitting			River Morphology and Stability GOAL			Wildlife Habitat Goals and Revegetation								
					Establish Riparian Native Vegetation for Shade and fishing	Deep Sustainable Pools and other in-stream cover	Overhead Cover in-bank	Ponds for Side Channel fish habitat	Side Channel with 25% percent of low flow and no more than 10% of bankfull discharge	Increased Fisheries Length and Area	Implement low profile "natural" structures	No major vertical Drops greater than 0.25ft	Pools below larger drops for resting	Woody Debris incorperated for adding in passage	No Rise upstream	Protect Perimeter Roadway from Horizontal Migration	Vertical Stability without potential for scour into utility zones	Contain the entire 100-year discharge within Drainage Eastment	No Rise within the project Reach	Increase Habitat Diversity within the channel	Lansacping opertunities to be incorperated into the Design	Training and Education Opportunities	Potential for Signage for interpterion	Reduce Temperature	Increase Disolved Oxygen	Reduce Sediment Inputs	Reduce Turbidity	Nutrient Reduction and Transformantion	Natural Looking Riparian Corridor	Non-Engineered Materials	Minimize Future River maintenance	Reduction of Bank Erosion and Lateral Bank Migration	Sustainable Sediment Transport Balance	No significant bank erosion	Protect All Existing Trees	Revegation Potential and Planting Density	Improve Duck Habitat	Improve habitat for Herps						
	Concept Option Description	Length of Unadjusted reach	Length of Restored Re-Aligned Edcomb Creek	Length of Restored Re-Aligned UT X	*5*	*5*	*5*	*5*	*10*	*2*	*10*	*10*	*10*	*10*	*20*	*15*	*20*	*20*	*5*	*5*	*10*	*5*	*5*	*10*	*10*	*5*	*10*	*5*	*20*	*25*	*15*	*5*	*5*	*10*	*5*	*10*	*5*	*5*	*Linear Feet of Proposed Project*	*Preliminary Cost Estimate of Proposed Project Construction Cost*	*UNIT COST*	MCDA Matrix Score	MCDA RANKING	MCDA Multiplier	Adjusted Unit Cost	Adjusted Ranking
Option #1	Do Nothing	10,590	---	---	5	5	5	5	5	5	5	2	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	4	4	5	5	5	5	1	5	5	5	10590	$ -	$ 500.00	**1515**	8	3.5	$ 1,725.51	7
Option #2	NCD with 4 stage Channel – Stream Restoration- Priority II	---	11,814	894	1	1	1	3	3	4	2	2	1	3	1	1	1	1	1	3	2	1	1	2	2	1	1	2	3	2	1	1	1	1	4	1	4	3	12708	$ -	$ 750.00	**548**	3	1.2	$ 936.22	5
Option #3	UT X confluence at Fall and Step-pools – Under sized Stream Restoration- Priority I	---	11,565	1,141	3	1	1	2	2	2	3	3	1	2	1	1	2	1	1	2	2	2	1	3	3	1	1	3	3	3	2	2	2	1	5	1	3	2	12706	$ -	$ 1,000.00	**639**	5	1.5	$ 1,455.58	6
Option #4	UT X Snaked through Development – Preserve Fan and Valley Restoration (Alternative A)	---	11,565	3,506	2	2	1	1	1	1	2	1	2	2	1	2	1	1	3	2	1	1	2	2	2	2	2	2	3	2	2	3	1	2	2	2	1	15071	$ -	$ 400.00	**557**	4	1.3	$ 507.52	3
Option #5	Valley Restoration UT X Backwater from Fan and Engineered flood control	---	11,565	1,141	1	2	1	1	1	3	1	1	2	1	1	2	1	2	4	1	2	2	3	2	2	3	3	1	1	4	4	3	4	2	1	3	1	1	12706	$ -	$ 600.00	**641**	6	1.5	$ 876.08	4
Option #6	Valley Restoration of Edgecomb and Piping UT X	---	11,565	2,189	1	2	1	1	1	4	3	2	2	3	3	3	1	2	4	2	3	2	3	1	1	3	3	2	2	3	3	3	4	2	1	3	1	1	13754	$ -	$ 1,200.00	**728**	7	1.7	$ 1,989.98	8
Option #7	Preferred - UT X Separated by Development Road (Alternative C)	---	11,565	2,272	1	2	1	1	1	2	1	1	1	2	1	2	1	1	3	1	2	1	2	1	1	2	2	1	1	2	2	2	2	1	2	2	2	1	13837	$ -	$ 215.00	**439**	1	1.0	$ 215.00	1
Option #8	UT X Parallel in Edgecomb Valley (Alternative B)	---	11,565	2,696	1	2	1	1	1	2	1	1	2	2	1	3	1	1	3	1	2	1	2	1	1	2	2	1	1	2	2	3	2	3	1	3	2	2	1	14261	$ -	$ 200.00	**534**	2	1.2	$ 243.28	2

APPENDIX E

Photo Log

Edgecomb Creek, Upstream of Project (previously restored)

Edgecomb Creek, Upstream of Project (previously restored)

Edgecomb Creek Riparian Vegetation, Upstream of Project (previously restored)

Edgecomb Creek Channel Material, Upstream of Project (previously restored)

Edgecomb Creek Bank Scour, Upstream of Project (previously restored)

Edgecomb Creek Log Structure, Upstream of Project (previously restored)

Upstream End of the Project, Looking Downstream

Existing Upstream Culvert Under BNSF Railroad

Existing Agricultural Fields

Existing Edgecomb Creek through Agricultural Fields

Existing Beaver Dam on Edgecomb Creek

Impoundment Upstream of Beaver Dam

Dry Channel, Downstream of Beaver Dam

Existing Channel Material, Edgecomb Creek

Existing Edgecomb Creek

Edgecomb Creek, Downstream of 152nd Street NE

Existing Culvert at Downstream End of Project, Under the BNSF railroad

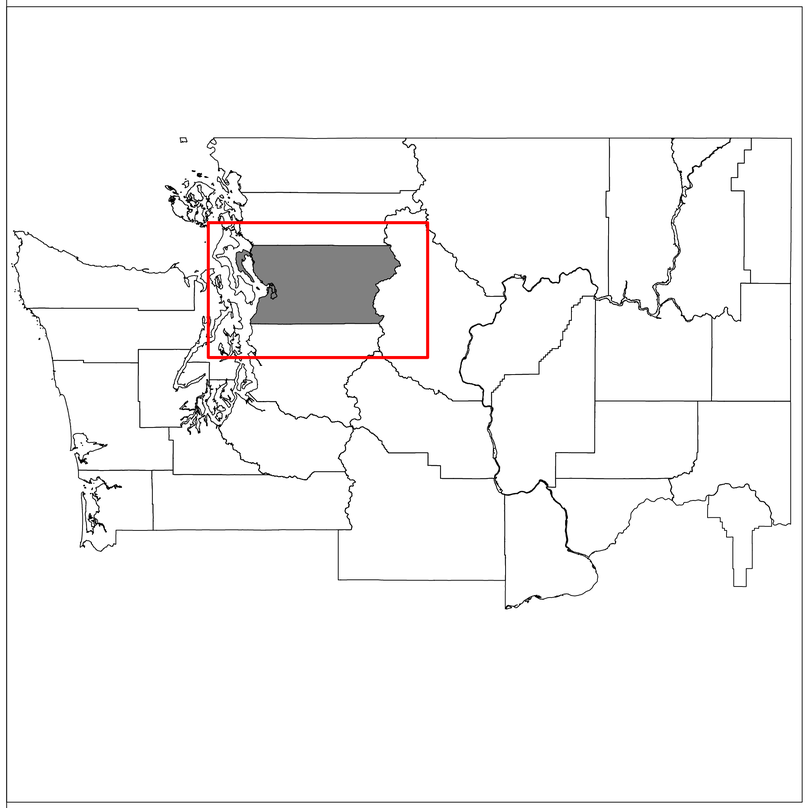
Existing Culvert at Downstream End of Project, Under the BNSF railroad

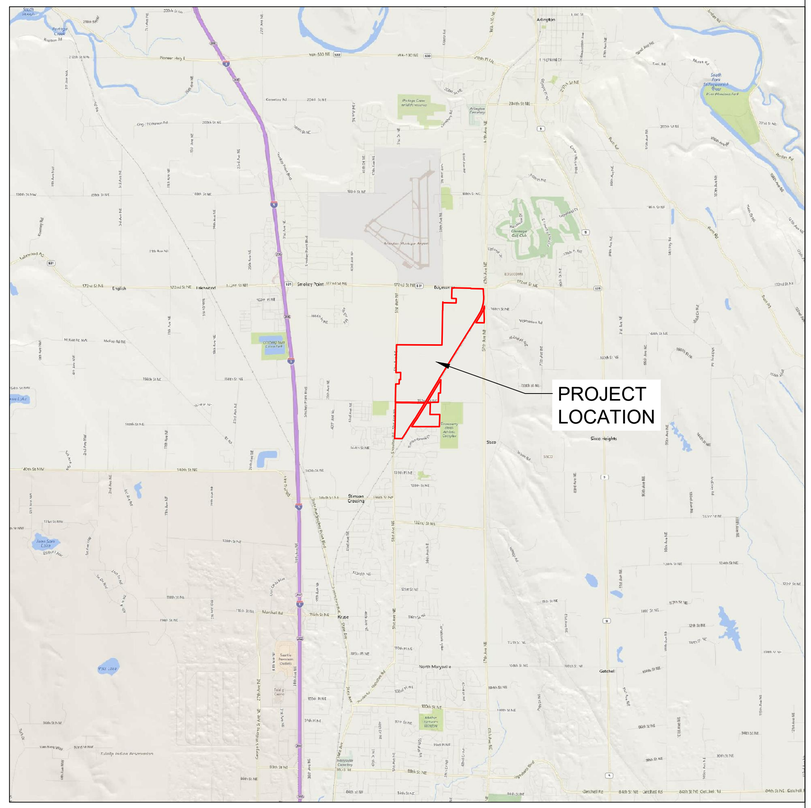
APPENDIX F

60% Design Plan Set

60% DESIGN PLAN SET
EDGECOMB CREEK RESTORATION

ARLINGTON
SNOHOMISH COUNTY, WA
12/09/2020





SHEET #	SHEET
1	COVER
2	GENERAL NOTES
3	QUANTITIES
4	EXISTING CONDITION OVERVIEW
5	PROPOSED GROUND OVERVIEW
6	REACH 1 PLAN AND PROFILE - (1)
7	REACH 1 PLAN AND PROFILE - (2)
8	REACH 1 PLAN AND PROFILE - (3)
9	REACH 1 PLAN AND PROFILE - (4)
10	REACH 2 PLAN AND PROFILE - (1)
11	REACH 2 PLAN AND PROFILE - (2)
12	REACH 2 PLAN AND PROFILE - (3)
13	REACH 2 PLAN AND PROFILE - (4)
14	REACH 2 PLAN AND PROFILE - (5)
15	REACH 2 PLAN AND PROFILE - (6)
16	REACH 2 PLAN AND PROFILE - (7)
17	REACH 2 PLAN AND PROFILE - (8)
18	REACH 3 PLAN AND PROFILE - (1)
19	REACH 3 PLAN AND PROFILE - (2)
20	REACH 3 PLAN AND PROFILE - (3)
21	REACH 3 PLAN AND PROFILE - (4)
22	REACH 4 PLAN AND PROFILE - (1)
23	REACH 4 PLAN AND PROFILE - (2)
24	UNKNOWN TRIB X PP - (1)
25	UNKNOWN TRIB X PP - (2)

SHEET #	SHEET
26	UNKNOWN TRIB X PP - (3)
27	UNKNOWN TRIB X PP - (4)
28	CROSS SECTIONS OVERVIEW
29	REACH 1 SECTIONS -(1)
30	REACH 2 SECTIONS -(1)
31	REACH 2 SECTIONS -(2)
32	REACH 3 SECTIONS -(1)
33	REACH 4 SECTIONS -(1)
34	DETAILS - TYPICAL XS EDGECOMB
35	DETAILS - TYPICAL XS UT X
36	DETAILS - AUGMENTED RIFFLE
37	DETAILS - BRUSH AND ROLL RIFFLE
38	DETAILS - LOG A-VANE
39	DETAILS - BRUSH MATTRESS
40	DETAILS - LOG VANE
41	DETAILS - ROUGHENED TOE LOG
42	DETAILS - ROCK AND ROLL RIFFLE
43	DETAILS - SPANNER LOG
44	DETAILS - FLOODPLAIN DEPRESSION
45	DETAILS - DENDRITE CHANNEL
46	BNF - NE CULVERT
47	BNF - SE CULVERT

SWCA®
ENVIRONMENTAL CONSULTANTS

NorthPoint™
DEVELOPMENT

D:\DROPBOX (SSSR)\SWCA EDGECOMB CREEK\C3D\SHEETS\EDGECOMBCK COVERSHEET.DWG | JOSHUA.ALLEN | SAVED: Friday, December 11, 2020 1:54:26 PM | ACAD.CTB | | PLOTTED: Tuesday, December 22, 2020 11:01:21 AM

GENERAL CONSTRUCTION NOTES

1. INSTREAM STRUCTURES SHALL BE INSTALLED AS THE CHANNEL IS BEING CONSTRUCTED AND NOT POST CONSTRUCTION.
2. WHERE PRACTICABLE, EXISTING TREES AND VEGETATION SHOULD BE LEFT IN PLACE TO FACILITATE NATURAL REGENERATION AND SOIL STABILIZATION.
3. DEFINITIONS
   A. BANKFULL ELEVATION IS THE POINT OF INCIPIENT FLOODING IN AN ALLUVIAL CHANNEL. THIS ELEVATION IS THE REFERENCE FOR DEPTHS ON OR ALONG THE CHANNEL PROFILE AND STRUCTURES DESCRIBED IN THESE SHEETS.
   B. THE BANKFULL BENCH IS A CONSTRUCTED FLOODPLAIN ADJACENT TO THE CHANNEL. THE BANKFULL BENCH IS CONSTRUCTED AT THE BANKFULL ELEVATION.
   C. THE THALWEG IS THE LOWEST PORTION OF THE CHANNEL.
   D. THE VANE LENGTH IS THE STRAIGHT LINE DISTANCE BETWEEN THE VANE ARM AND A LINE TANGENT TO THE STREAMBANK AT THE POINT WHERE THE VANE ARM INTERSECTS THE STREAMBANK.
   E. THE VANE ANGLE IS THE ANGLE BETWEEN THE VANE ARM AND A LINE TANGENT TO THE STREAMBANK AT THE POINT WHERE THE VANE ARM INTERSECTS THE STREAMBANK.
   F. A FLOODPLAIN SILL IS THE BURIED EXTENSION OF THE STRUCTURE PERPENDICULAR TO THE FLOW DIRECTION OF THE BANKFULL CHANNEL BENEATH THE FLOODPLAIN.
   G. ROOT WADS ARE THE ROOT MASS OF A TREE AND ATTACHED TRUNK. ROOT WADS AND LOGS MAY BE HARVESTED FROM THE SITE AS APPROVED BY THE ENGINEER. IF ROOT WADS OR LOGS ARE HARVESTED ON-SITE, THE REMOVAL OF TREES SHALL BE IN ACCORDANCE WITH APPLICABLE PERMITS. HARVESTING SHALL BE EXECUTED IN A MANNER AS TO ONLY DISTURB TREES THAT MUST BE REMOVED FOR GRADING PURPOSES OR SPECIFIC SPECIES REMOVAL.
   H. LOG STRUCTURES SHALL BE CONSTRUCTED FROM LOGS THAT ARE INTACT AND IN NON-DECOMPOSED CONDITION AND APPROVED BY ENGINEER.
5. THE CONTRACTOR SHALL STAKE OUT THE PROPOSED STREAM CENTERLINE FOR REVIEW BY THE ENGINEER BEFORE INITIATING EXCAVATION. DEPENDING ON ENCOUNTERED CONDITIONS SOME SHIFTING OF THE STREAM CHANNEL MAY BE NECESSARY. ANY COST ASSOCIATED WITH CHANGING STRUCTURE LOCATIONS OR ALIGNMENT SHALL BE CONSIDERED INCIDENTAL TO CONSTRUCTION. STAKING MAY BE OMITTED FOR PORTIONS OF THE STREAM WHEN SURVEY-GRADE GPS IS USED TO CONSTRUCT THE CHANNEL. IF GPS IS USED IN LIEU OF STAKING THE CHANNEL IN THE FIELD, THE CONTRACTOR ASSUMES ALL RESPONSIBILITY FOR THE STREAM BEING CONSTRUCTED AS DESIGNED, INCLUDING ANY ISSUES RELATED TO PROJECTIONS, BASE POINTS OR CONVERSION OF DIGITAL TERRAIN MODELS.
6. PRIOR TO CLEARING AND GRUBBING, CONTRACTOR SHALL MARK THE LIMITS OF CLEARING NEAR TREES FOR VERIFICATION OF INTENT BY THE ENGINEER. SOME MINOR ADJUSTMENT OF CHANNEL ALIGNMENT MAY BE REQUIRED TO PRESERVE TREES OR MINIMIZE IMPACT TO TREES.
7. ANY HARVESTING OF TREES FROM ONSITE MUST BE APPROVED BY THE ENGINEER.
8. CONTRACTOR SHALL MINIMIZE, TO THE MAXIMUM EXTENT POSSIBLE, IMPACTS TO THE ADJACENT TREES. CONSTRUCTION EQUIPMENT TRACKS AND PATHWAYS SHALL BE GRADED AND RECONTOURED AFTER CONSTRUCTION TO PREVENT RILL AND GULLY EROSION.
9. THE PROPOSED GRADING IS SHOWN ON THESE PLAN SHEETS. THE CONTRACTOR MAY EXTEND THE LIMITS OF DISTURBANCE ONLY WITH THE APPROVAL OF THE ENGINEER.
10. CONTRACTOR SHALL USE AN EXCAVATOR WITH A HYDRAULIC THUMB TO INSTALL IN-STREAM STRUCTURES.
11. ELEVATIONS OF TRIBUTARIES AT CONFLUENCES MAY NEED TO BE ADJUSTED TO MEET CONSTRUCTED CONDITIONS. PROFILES MAY NEED TO BE ADJUSTED TO AVOID ABRUPT CHANGES IN ELEVATION. CHANGES SHALL BE MADE IN CONJUNCTION WITH AN ENGINEER.
12. CHANNEL RELOCATION WORK SHALL BE COMPLETED AND STABILIZED PRIOR TO ALLOWING FLOW TO ENTER INTO THE NEWLY CONSTRUCTED STREAM CHANNEL. THE CONTRACTOR SHALL NOT OPEN UP MORE THAN 200 FEET OF CHANNEL WITHOUT EROSION CONTROL BLANKET IN PLACE OR BY APPROVAL OF THE ENGINEER. IF THE CHANNEL RELOCATION WORK IS NOT COMPLETED PRIOR TO ABANDONING THE OLD CHANNEL, A TEMPORARY DAM AND PUMP-AROUND SHALL BE INSTALLED TO FACILITATE CONSTRUCTION OF THE CHANNEL "IN THE DRY". DIVERSION PUMP SHALL BE CAPABLE OF PUMPING LOW FLOW. DAM SHALL BE PLACED SUCH THAT IT CAN BE OVERTOPPED DURING HIGH FLOWS WITHOUT RESULTING IN FLOODING. THE USE OF A TEMPORARY DAM AND PUMP-AROUND SHALL BE AT THE CONTRACTOR'S EXPENSE. A DIVERSION DITCH MAY ALSO BE USED WITH APPROVAL OF ENGINEER.
13. THE PROPOSED STREAM CHANNEL SHALL BE CONSTRUCTED BY FIRST GRADING THE FLOODPLAIN ADJACENT TO THE CHANNEL TO THE ELEVATION INDICATED ON THESE PLANS. THIS MAY BE DONE AS GENERAL EXCAVATION. THE PROPOSED STREAM CHANNEL SHALL THEN BE EXCAVATED TO THE PROPER DEPTHS INDICATED ON THE PROFILE AND PROPOSED CONTOURS. THIS SHALL BE DONE AS SPECIALIZED EXCAVATION AND IS TYPICALLY ACCOMPLISHED WITH A TRACK EXCAVATOR. THE PROFILES AND CONTOURS SHOWN PROVIDE WIDTHS AND SLOPES FOR AID IN CONSTRUCTING THE CHANNEL TO THE APPROPRIATE DIMENSIONS. THE THALWEG CAN FIRST BE EXCAVATED TO THE POINT INDICATED ON THE PROFILE. EXCAVATION AND FINE GRADING OF THE CROSS SECTIONS SHALL THEN BE PERFORMED AS SHOWN ON THE TYPICAL CROSS SECTIONS AND PROPOSED CONTOURS. ANY STOCKPILING OF MATERIALS OR "DOUBLE HANDLING" NECESSARY TO BUILD THE CHANNEL SHALL BE CONSIDERED INCIDENTAL TO CONSTRUCTION.
14. IF THE EXISTING GROUND IS WITHIN 0.2 FEET OF PROPOSED BANKFULL ELEVATION, IT IS NOT NECESSARY TO EXCAVATE MATERIAL TO THE PROPOSED ELEVATION SHOWN ON THE PROFILE.
15. THE SURFACE OF ALL IN-STREAM, FLOODPLAIN, AND WETLAND STRUCTURES SHALL BE FINISHED TO A SMOOTH LINE IN ACCORDANCE WITH THE LINES, GRADES, AND CROSS SECTIONS OR ELEVATIONS SHOWN ON THE DRAWINGS. THE DEGREE OF FINISH FOR THE VANE SLOPES AND INVERT ELEVATIONS SHALL BE WITHIN 0.1 VERTICAL FEET OF THE GRADES AND ELEVATIONS INDICATED. ALL GAPS OR VOIDS BETWEEN LOGS SHALL BE PLUGGED WITH SMALLER WOOD TO FORM A TIGHT-FITTING SEAL.
16. CONSTRUCTION SPECIFICATIONS FOR BANKFULL CHANNEL DIMENSIONS OR CROSS SECTIONS WILL BE HELD TO THE DIMENSIONS SHOWN ON THE TYPICAL CROSS SECTIONS. ELEVATIONS SHALL BE CONSTRUCTED WITHIN 0.1 VERTICAL FEET; WIDTHS AND MAX DEPTHS MUST FALL WITHIN THE RANGES SHOWN IN THE DRAWINGS.
17. THE IN-STREAM, FLOODPLAIN AND WETLAND STRUCTURE BID ITEMS SHALL INCLUDE ALL LABOR AND MATERIALS NECESSARY TO CONSTRUCT THE STRUCTURE. BID ITEMS INCLUDE SEEDING, PLANTING, MULCH AND EROSION CONTROL BLANKETS INCLUDE ALL LABOR AND MATERIALS NECESSARY TO STABILIZE AREAS DISTURBED DURING CONSTRUCTION OF STRUCTURES. AFTER THE STRUCTURE IS COMPLETE AND FLOW IS RESTORED TO THE CHANNEL SOME ADJUSTMENT TO THE STRUCTURE OR ADDITIONAL STABILIZATION MEASURES MAY BE NECESSARY TO ACHIEVE DESIRED EFFECT. ANY COSTS ASSOCIATED WITH THESE ADJUSTMENTS SHALL BE CONSIDERED INCIDENTAL TO CONSTRUCTION.
18. THE CONSTRUCTED STREAM CHANNEL SHALL BE STABILIZED AS SOON AS POSSIBLE BY SEEDING IN ACCORDANCE WITH THE PLOT SCHEDULE, ADDING STRAW MULCH TO BARE SOIL, AND BY INSTALLING EROSION CONTROL BLANKET FROM THE INNER BERM TO BEYOND THE TOP OF THE BANKFULL CHANNEL. PRIOR TO INSTALLING BLANKET, PREPARE THE BED BY LOOSENING THE SOIL 3 TO 6 INCHES, APPLY SEED AND THEN STRAW MULCH. SEED SHALL BE BROADCAST EVENLY OVER THE AREA USING A BROADCAST SPREADER PRIOR TO COVERING WITH THE EROSION CONTROL BLANKET. THE BLANKET SHALL BE ROLLED OUT IN THE DIRECTION OF THE ANTICIPATED RUN-OFF FLOW. INSTALL BLANKET IN ACCORDANCE WITH DETAIL SHOWN HEREIN. REWORKING OF AREAS THAT DO NOT ESTABLISH VEGETATION OR BECOME UNSTABLE SHALL BE NECESSARY IF THE EROSION CONTROL BLANKET SEPARATES FROM THE SOIL. SEEDING OF THE BANKFULL BENCH SHALL BE IN ACCORDANCE WITH THE PLANTING TABLE. REFER TO EROSION CONTROL BLANKET DETAIL FOR PLACEMENT OF EROSION CONTROL BLANKET.
19. IF THE TIMING OF PROJECT IS SUCH THAT RIPARIAN SEED MIX CANNOT BE PLACED IN THE FALL, THEN THE CONTRACTOR SHALL SEED WITH TEMPORARY COVER ACCORDING TO THE EROSION AND SEDIMENT PLAN OR APPROVED BY THE ENGINEER UNTIL RIPARIAN MIX CAN BE SEEDED IN THE SPRING.
20. THE HARVESTING AND INSTALLATION OF LIVE STAKES SHALL BE PERFORMED ONLY DURING THE DORMANT SEASON TYPICALLY BETWEEN DECEMBER 1 AND FEBRUARY 15. CONTRACTOR SHALL NOTIFY ENGINEER 7 DAYS PRIOR TO HARVESTING TO REVIEW AND APPROVE ALL HARVESTING SITES. UPON APPROVAL BY ENGINEER, THE CONTRACTOR SHALL BE RESPONSIBLE FOR HARVESTING AND TRANSPORTING THE LIVE STAKE CUTTINGS TO THE JOB SITE.
21. LIVE STAKES SHALL BE INSTALLED ALONG THE FLOODPLAIN SILLS, OUTSIDE MEANDER BENDS, AND ALONG RIFFLES WHERE INDICATED ON THE DRAWINGS AND DETAILS. LIVE STAKES SHALL BE INSTALLED INTO THE EROSION CONTROL BLANKET IN ADDITION TO THE DEAD STAKES.
22. TOPSOIL SHALL BE REMOVED FROM EXCAVATION AND SPOIL AREAS PRIOR TO CUT OR FILL AND RE-APPLIED TO AREAS AFTER ROUGH GRADING IS COMPLETE. SIX INCHES OF TOPSOIL SHALL BE PLACED ON DISTURBED AREAS TO MEET GRADE. STOCKPILING AND PLACEMENT OF TOPSOIL SHALL BE CONSIDERED INCIDENTAL TO CONSTRUCTION AND APPROVED BY THE ENGINEER.
23. BORROW AREAS SHALL BE SEEDED WITH TEMPORARY VEGETATION WITHIN 7 DAYS FOLLOWING GRADING.
24. THE PLACEMENT OF STRAW MULCH SHALL OCCUR A MAXIMUM 48 HOURS AFTER SEEDING. MULCH WILL BE SPREAD TO COVER THE INSTALLED AREAS AT A MINIMUM RATE OF 1.5 TONS PER ACRE. MULCH SHALL BE KEPT OUT OF THE CROWNS OF SHRUBS AND GROUND COVER.
25. CONTRACTOR SHALL CALL FOR UTILITY MARKING AT LEAST 48 HOURS PRIOR TO START OF CONSTRUCTION. IT MAY BE NECESSARY FOR THE CONTRACTOR TO CONTACT THE COUNTY CLERK TO DETERMINE WHAT UTILITY COMPANIES HAVE FACILITIES IN THE PROJECT AREA. THE LOCATIONS OF THE UTILITIES SHOWN ON THESE DRAWINGS ARE APPROXIMATE ONLY AND MAY NOT BE ACCURATE. LOCATING UTILITIES IS THE SOLE RESPONSIBILITY OF THE CONTRACTOR. THE ENGINEER AND PROJECT OWNER WILL NOT BE RESPONSIBLE FOR ANY DAMAGES TO UTILITIES.
26. CONTRACTOR SHALL UTILIZE NATIVE MATERIAL FROM THE SITE WHERE AVAILABLE AND ALLOWED BY THE ENGINEER. NATIVE MATERIAL THAT CAN BE FOUND ON SITE INCLUDE TREES THAT CAN PROVIDE LIVE STAKES AND TREES THAT CAN BE USED FOR LOG STRUCTURES AND WOOD DEBRIS.
27. AFTER CONSTRUCTION, THE ACCESS ROADS LEADING TO THE PROJECT SITE SHALL BE RESTORED TO AS GOOD OR BETTER CONDITION THAN BEFORE CONSTRUCTION.
28. FOOTER DEPTH ON ALL STRUCTURES REQUIRING FOOTERS SHALL BE 6 TIMES GREATER THAN THE DROP BETWEEN THE STRUCTURE AND THE FOOTERED STRUCTURE DIRECTLY UPSTREAM.

EROSION/SEDIMENTATION CONTROL NOTES

1. ALL CONTROL MEASURES SHALL BE CHECKED, AND REPAIRED AS NECESSARY, MONTHLY IN DRY PERIODS, AND WITHIN 24 HOURS AFTER ANY RAINFALL AT THE SITE OF .75 INCHES OR GREATER WITHIN A 24 HOUR PERIOD. DAILY CHECKING AND, IF NECESSARY, REPAIRING SHALL BE DONE DURING PROLONGED RAINFALLS. THE PERMITTEE SHALL MAINTAIN WRITTEN RECORDS OF SUCH CHECKS AND REPAIRS ON SITE AT ALL TIMES, AND RECORDS SHALL BE SUBJECT TO INSPECTION AT ANY REASONABLE TIME.
2. THE CONSTRUCTION ENTRANCE SHALL BE MAINTAINED AS REQUIRED TO PREVENT SILT/SEDIMENT FROM LEAVING THE SITE. THIS INCLUDES BUT IS NOT LIMITED TO WASH DOWN OF THE CONSTRUCTION ENTRANCE, INSTALLING AND UTILIZING A VEHICLE WASH DOWN AREA, INSTALLING ADDITIONAL STONE, ETC.
3. ANY AND ALL SILT/SEDIMENTATION SHALL BE FREQUENTLY REMOVED FROM THE SILT FENCE, DITCHES, CHECK DAMS AND RETENTION AREAS. AT THE END OF CONSTRUCTION THESE AREAS SHALL BE COMPLETELY FREE OF SILT/SEDIMENTATION AND SHALL BE STABILIZED AS STATED IN THE PLANS AND SPECIFICATIONS.
4. ALL BMPS SHALL BE DESIGNED AND INSTALLED IN ACCORDANCE WITH THE WASHINGTON HANDBOOK FOR EROSION CONTROL, SEDIMENT CONTROL AND STORM WATER MANAGEMENT ON CONSTRUCTION SITES AND URBAN AREAS, LOCAL STANDARDS FOR EROSION AND SEDIMENT CONTROL AND THE PLANS AND SPECIFICATIONS. IF CONFLICTS ARISE BETWEEN THESE REQUIREMENTS, THE MORE STRINGENT SHALL APPLY.
5. BMP'S SHOWN ALONG THE PERIMETER OF THE DISTURBED AREAS SHALL BE INSTALLED PRIOR TO DISTURBANCE ACTIVITY. OTHER BMP'S SHALL BE INSTALLED AS SOON AS CONSTRUCTION SEQUENCES ALLOW.
6. TEMPORARY DIVERSION OF RUNOFF/RUNON WATER SHALL BE INSTALLED AS NEEDED TO FACILITATE CONSTRUCTION OR AS DIRECTED ON-SITE BY THE ENGINEER.
7. ALL DISTURBED AREAS SHALL BE PERMANENTLY STABILIZED IMMEDIATELY AFTER THE COMPLETION OF THE GRADING OPERATION. AREAS REQUIRING COCONUT COIR MATTING, SHALL BE SEEDED AND MULCHED FOR STABILIZATION PRIOR TO THE INSTALLATION OF THE MATTING.
8. TEMPORARY STABILIZATION OF DISTURBED AREAS MUST BE INITIATED IMMEDIATELY WHENEVER WORK TOWARD PROJECT COMPLETION AND FINAL STABILIZATION OF ANY PORTION OF THE SITE HAS TEMPORARILY CEASED AND WILL NOT RESUME FOR A PERIOD EXCEEDING THIRTEEN (13) CALENDAR DAYS. THOSE AREAS SHALL BE SEEDED AND MULCHED IN ACCORDANCE WITH THE PLANS AND SPECIFICATIONS.
9. NECESSARY MEASURES SHALL BE TAKEN TO PRODUCE AND MAINTAIN AN ACCEPTABLE STAND OF GRASS. SAID MEASURES TO INCLUDE (BUT NOT LIMITED TO) WATERING, RE-SEEDING, REGRADING ERODED AREAS, RE-FERTILIZING, ETC.
10. CONTRACTOR IS RESPONSIBLE FOR KEEPING MUD AND DEBRIS OFF CITY/STATE STREETS AND ROW. CLEANUP IS REQUIRED DAILY.
11. CONTRACTOR SHALL KEEP A COPY OF THE NPDES CONSTRUCTION GENERAL PERMIT AND THE "CONSTRUCTION BEST MANAGEMENT PRACTICES PLAN" ON SITE AT ALL TIMES FOR THE LIFE OF THE PROJECT.
12. ALL HAZARDOUS SUBSTANCES USED FOR THIS PROJECT (PAINT, OIL, GREASE, AND OTHER PETROLEUM PRODUCTS) SHALL BE STORED IN ACCORDANCE WITH SPCC REGULATIONS. THESE SUBSTANCES SHALL BE STORED AWAY FROM DRAINS AND DITCHES IN WATERTIGHT CONTAINERS. DISPOSAL OF THESE SUBSTANCES SHALL BE IN ACCORDANCE WITH ADEM REGULATIONS. DAILY INSPECTIONS SHALL BE PERFORMED FOR LEAK DETECTION. IF LEAKS OCCUR, APPROPRIATE ACTION SHALL BE TAKEN TO CONTAIN AND REMEDIATE THE SPILL. ADEQUATE TRASH CONTAINERS SHALL BE KEPT ON SITE FOR THE DISPOSAL OF CONSTRUCTION MATERIALS WASTE. NECESSARY MEASURES SHALL BE TAKEN TO PREVENT ANY TRASH OR OTHER POLLUTANTS FROM ENTERING "WATERS OF THE UNITED STATES."
13. ALL TEMPORARY MEASURES SHALL BE REMOVED ONCE ACCEPTABLE PERMANENT STABILIZATION IS ACHIEVED. THE ENGINEER SHALL DETERMINE IF THE PERMANENT STABILIZATION IS ACCEPTABLE.

SPECIAL NOTES:

1. THE ELEVATIONS SHOWN HEREIN ARE BASED ON SURVEY PROVIDED BY LDC, INC. IT ENCOMPASSES THE EXISTING GROUND SURFACE FROM WHICH ALL COMPUTATIONS FOR CUT/FILL ARE BASED. SLIGHT DISCREPANCIES BETWEEN THE EXISTING GROUND DIGITAL SURFACE AND FIELD CONDITIONS CAN RESULT IN SIGNIFICANT VARIATIONS IN TOTAL EXCAVATED QUANTITIES. THUS, QUANTITIES OF MATERIAL EXCAVATED SHOULD BE COMPARED TO THOSE SHOWN ON THE DRAWINGS TO MANAGE THE MOVEMENT OF MATERIAL ACROSS THE SITE.

TOPOGRAPHIC INFORMATION:

EXISTING GROUND SURFACES ARE BASED ON A SURVEY COMPLETED IN AUGUST 2020. SOME SITE CHANGES MAY HAVE OCCURRED SINCE THE SITE SURVEY ESPECIALLY IN HEADCUT AREAS. CHANGES IN EXISTING SURFACES SHALL BE INCIDENTAL TO CONSTRUCTION. THE ENGINEER MAKES NO WARRANTY FOR THE ACCURACY OF ANY SURVEY INFORMATION SHOWN IN THESE DRAWINGS. IF DISCREPANCIES EXIST BETWEEN THE THREE DIMENSIONAL DIGITAL SURFACE AND THE ACTUAL GROUND SURFACE, SIGNIFICANT VARIATIONS IN THE EXCAVATIONS QUANTITIES CAN BE EXPECTED, WHICH COULD AFFECT HANDLING AND PHASING CONSIDERATIONS FOR THE PROJECT. THE ENGINEER ACCEPTS NO RESPONSIBILITY FOR CHANGES TO EXCAVATION QUANTITIES THAT CHANGE AS A RESULT OF ANY DISCREPANCIES BETWEEN THE DIGITAL SURFACE AND EXISTING GROUND.

SPECIAL GRADING NOTE:

THE AGREED UPON INTENT OF THIS GRADING PLAN IS TO MAINTAIN A "LIVE" SURFACE SO THAT ANY CHANGES THAT ARISE DURING CONSTRUCTION CAN BE QUICKLY ENCOMPASSED INTO THE THREE-DIMENSIONAL SURFACE GENERATED DURING THIS DESIGN PROCESS. AS SUCH, FINE TUNING OF THE SURFACE THAT WOULD ELIMINATE THE APPEARANCE OF JAGGED CONTOUR LINES WHERE SLIGHT VARIATIONS BETWEEN THE EXISTING AND PROPOSED SURFACES WAS NOT COMPLETED.

Prepared by:
SWCA ENVIRONMENTAL CONSULTANTS
Operating in North Carolina as SWCA Environmental Consulting and Engineering of NC, PC
116 Alexandria Drive
Mooresville, NC 28115
(p) 919.624.1458

Prepared for:
NorthPoint DEVELOPMENT

Stamp:

Project Title:
EDGECOMB CREEK
60% DESIGN

Sheet Title:
GENERAL NOTES

Date:	12/04/2020
Scale:	NTS
Drawn by:	JYZ
Checked by:	DMP
File #	

REVISIONS

Date:	By:	Note:
09/30/20	JYZ	30% CONCEPT DESIGN
10/21/20	JYZ	30% REVISON
12/04/20	JYZ	60% DESIGN
12/09/20	JYZ	60% REVISION

Sheet No:
2 OF 47

QUANTITY ESTIMATION

ITEM #	SHORT DESCRIPTION	UNIT	QUANTITY
1	MOBILIZATION	LUMP SUM	1
2	EROSION CONTROL	LUMP SUM	1
3	CLEARING AND GRUBBING	ACRE	43
4	EXCAVATION & FILL (ON-SITE)	CUBIC YARD	134,250
5	COIR FIBER MATTING (STREAM BANKS)	SY	11,673
6	AUGMENTED RIFFLE	EACH	2
7	LOG A-VANE	EACH	13
8	BRUSH AND ROLL RIFFLE (EDGECOMB CK)	EACH	19
9	BRUSH AND ROLL RIFFLE (UT X)	EACH	6
10	BRUSH AND ROLL RIFFLE (FLOODPLAIN DEPRESSION)	EACH	28
11	SPANNER LOG (EDGECOMB CK)	EACH	95
12	SPANNER LOG (FLOODPLAIN DEPRESSION)	EACH	42
13	SPANNER LOG (DENDRITE CHANNEL)	EACH	15
14	ROUGHENED LOG TOE (EDGECOMB CK)	EACH	47
15	ROUGHENED LOG TOE (UT X)	EACH	13
16	BRUSH MATTRESS (EDGECOMB CK)	EACH	55
17	BRUSH MATTRESS (UT X)	EACH	13
18	ROCK AND ROLL RIFFLE	EACH	2
19	LOG VANE	EACH	13
20	SLOPE STABILIZATION (MATTING)	SY	2,000
21	SLOPE STABILIZATION (VEGETATED SOIL LIFTS)	SY	700
22	8'w X 4'h OPEN BOTTOM CULVERT (UT X)	LF	280
23	TEMPORARY SEEDING	AC	43
24	PERMANENT SEEDING	AC	43
25	CONTAINERIZED PLANTINGS (TREES)	EA	14,325
26	CONTAINERIZED PLANTINGS (SHRUBS)	EA	19,500
27	LIVE STAKES	EA	37,800

VOLUME OF WOODY MATERIAL

STRUCTURE TYPE	VOLUME OF WOOD/ STRUCTURE (CY)	# OF STRUCTURES	TOTAL VOLUME (CY)
BRUSH AND ROLL RIFFLE (EDGECOMB CK)	19	19	361
BRUSH AND ROLL RIFFLE (UT X)	4	6	24
LOG A-VANE	4	11	44
BRUSH MATTRESS (EDGECOMB CK)	8	55	440
BRUSH MATTRESS (UT X)	5	13	65
LOG VANE	2	13	26
ROUGHENED TOE LOG (EDGECOMB CK)	117	47	5,499
ROUGHENED TOE LOG (UT X)	5	13	65
SPANNER LOG	4	95	380
DENDRITE CHANNEL	5	13	65
FLOODPLAIN DEPRESSION	14	17	238
	TOTAL	**7,207**	**CY**
		0.61	**CY/LF**

REACH NAME	PROPOSED LENGTH (FT)
EDGECOMB CREEK - REACH 1	2236
EDGECOMB CREEK - REACH 2	4293
EDGECOMB CREEK - REACH 3	4334
EDGECOMB CREEK - REACH 4	702
UNNAMED TRIBUTARY 'X'	2272
TOTAL	13837

D:\DROPBOX (SSSR)\SWCA EDGECOMB CREEK\C3D\SHEETS\EDGECOMBCK COVERSHEET.DWG | JOSHUA.ALLEN | SAVED: Friday, December 11, 2020 1:54:26 PM | ACAD.CTB | | PLOTTED: Tuesday, December 22, 2020 11:01:21 AM

Prepared by:
SWCA ENVIRONMENTAL CONSULTANTS
Operating in North Carolina as SWCA Environmental Consulting and Engineering of NC, PC
116 Alexandria Drive
Mooresville, NC 28115
(p) 919.624.1458

Prepared for:
NorthPoint DEVELOPMENT

Stamp:

Project Title:
EDGECOMB CREEK
60% DESIGN

Sheet Title:
QUANTITIES

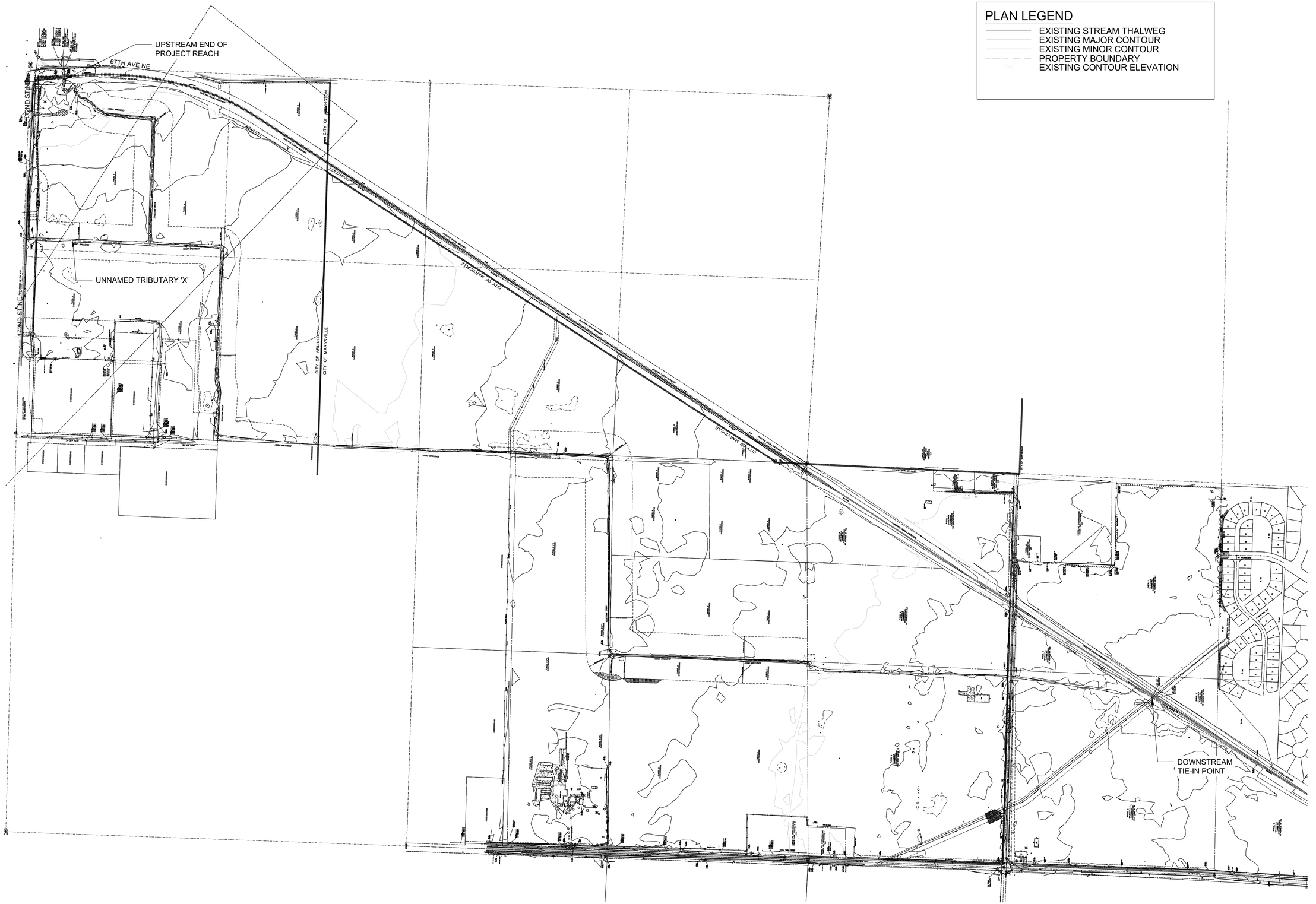
Date:	12/04/2020
Scale:	NTS
Drawn by:	JYZ
Checked by:	DMP
File #	

REVISIONS

Date:	By:	Note:
09/30/20	JYZ	30% CONCEPT DESIGN
10/21/20	JYZ	30% REVISON
12/04/20	JYZ	60% DESIGN
12/09/20	JYZ	60% REVISION

Sheet No:
3 OF 47

D:\DROPBOX (SSSR)\SWCA EDGECOMB CREEK\C3D\SHEETS\EDGECOMBCK 60PERCENT OVERVIEW.DWG | JOSHUA.ALLEN | SAVED: Wednesday, December 9, 2020 3:13:05 PM | BDG STANDARD.CTB | | PLOTTED: Tuesday, December 22, 2020 10:48:58 AM



PLAN LEGEND

- EXISTING STREAM THALWEG
- EXISTING MAJOR CONTOUR
- EXISTING MINOR CONTOUR
- PROPERTY BOUNDARY
- EXISTING CONTOUR ELEVATION

Prepared by:

SWCA ENVIRONMENTAL CONSULTANTS

Operating in North Carolina as
SWCA Environmental Consulting
and Engineering of NC, PC

116 Alexandria Drive
Mooresville, NC 28115
(p) 919.624.1458

Prepared for:

NorthPoint DEVELOPMENT

ANSI D (22"x34") SCALE: 1" = 300'

0 150 300 600

TABLOID (11"x17") SCALE: 1" = 600'

0 300 600 1200

Stamp:

Project Title:

EDGECOMB CREEK
60% DESIGN

Sheet Title:

OVERVIEW
EXISTING CONDITION

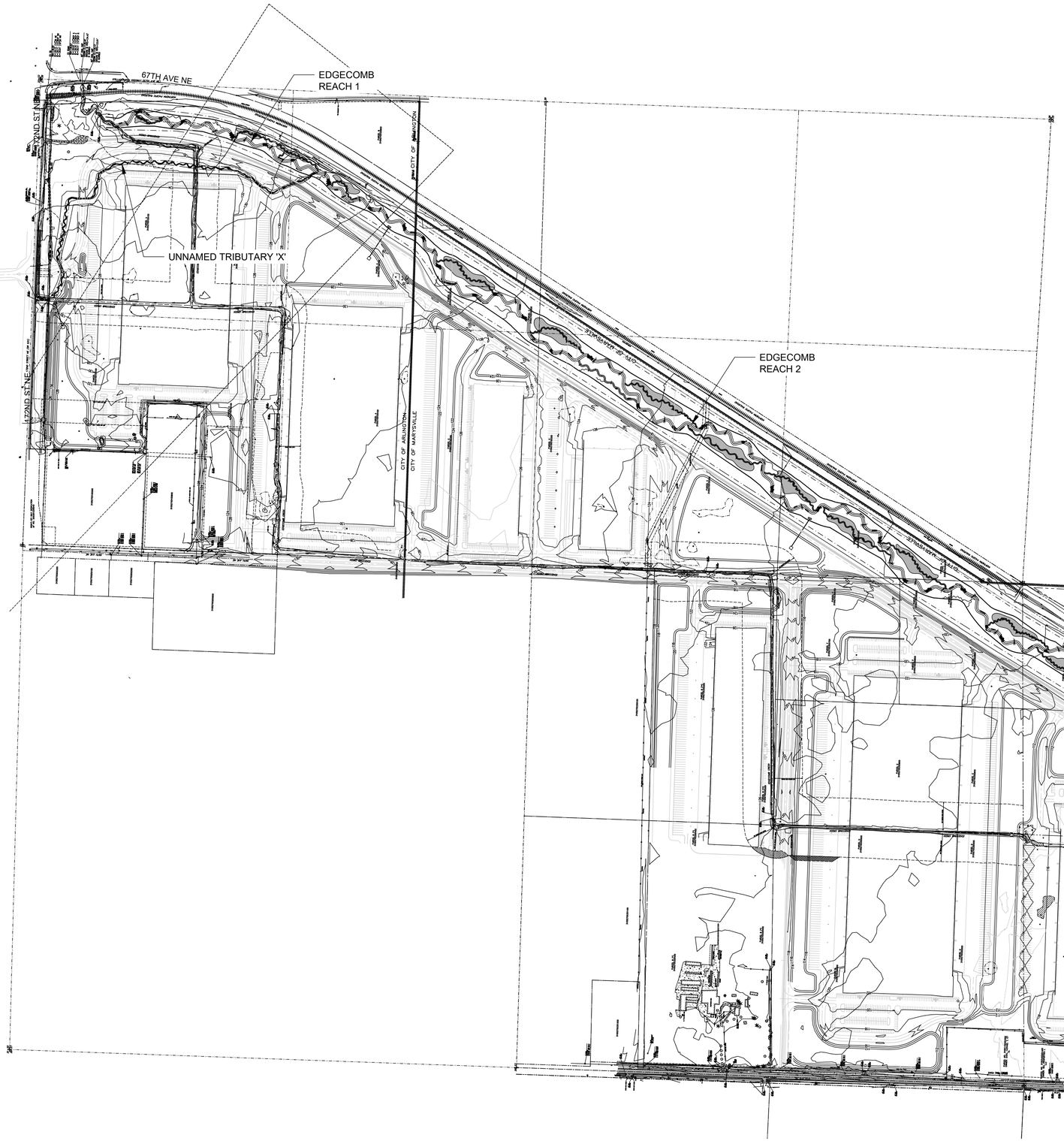
Date:	12/04/2020
Scale:	AS SHOWN
Drawn by:	JCA/JYZ
Checked by:	DMP
File #	

REVISIONS

Date:	By:	Note:
09/30/20	JYZ	30% CONCEPT DESIGN
10/21/20	JYZ	30% REVISION
12/04/20	JYZ	60% DESIGN
12/09/20	JYZ	60% REVISION

Sheet No:

4 OF 47



PLAN LEGEND

- PROPOSED STREAM CENTER LINE
- PROPOSED CHANNEL TOB
- EXISTING MAJOR CONTOUR
- EXISTING MINOR CONTOUR
- PROPERTY BOUNDARY
- PROPOSED FLOOD TERRACE TOE/TOB
- PROPOSED FLOODPLAIN TOE
- EXISTING CONTOUR ELEVATION
- AUGMENTED GRAVEL RIFFLE
- LOG A-VANE
- OUTLET OUTFALL STRUCTURE
- PROPOSED WETLAND

Prepared by:

SWCA ENVIRONMENTAL CONSULTANTS

Operating in North Carolina as
SWCA Environmental Consulting
and Engineering of NC, PC

116 Alexandria Drive
Mooresville, NC 28115
(p) 919.624.1458

Prepared for:

NorthPoint DEVELOPMENT

ANSI D (22"x34") SCALE: 1" = 300'

0 150 300 600

TABLOID (11"x17") SCALE: 1" = 600'

0 300 600 1200

Stamp:

Project Title:

EDGECOMB CREEK
60% DESIGN

Sheet Title:

OVERVIEW
PROPOSED STREAMS

Date:	12/04/2020
Scale:	AS SHOWN
Drawn by:	JCA/JYZ
Checked by:	DMP
File #	

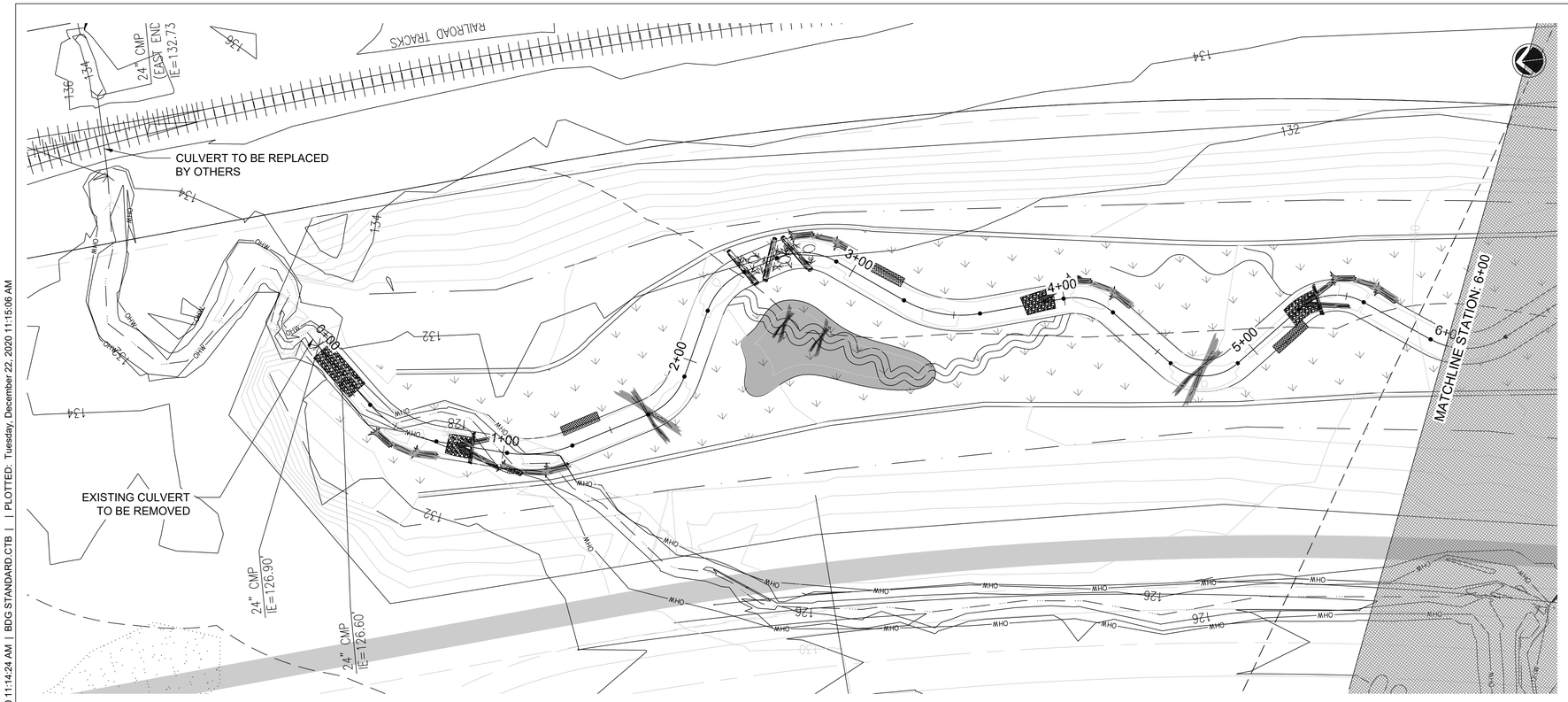
REVISIONS

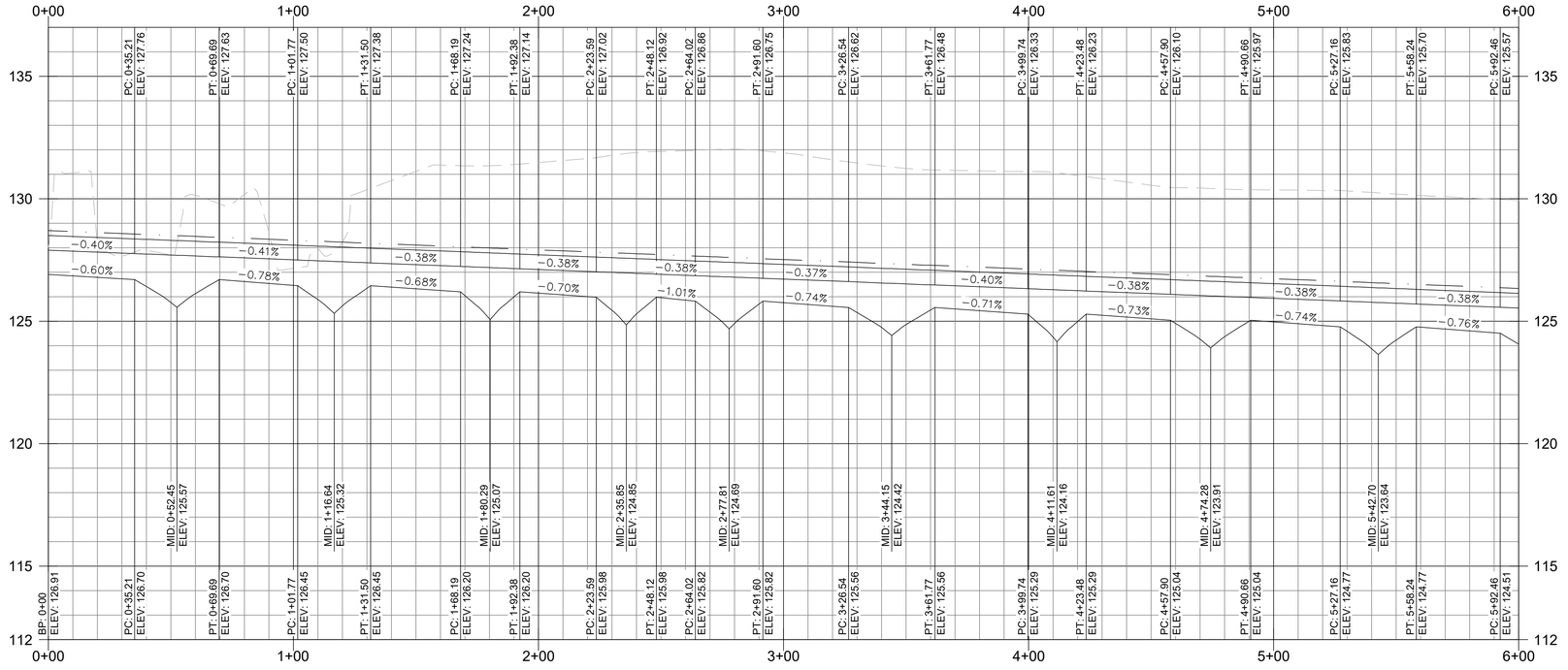
Date:	By:	Note:
09/30/20	JYZ	30% CONCEPT DESIGN
10/21/20	JYZ	30% REVISION
12/04/20	JYZ	60% DESIGN
12/09/20	JYZ	60% REVISION

Sheet No:

5 OF 47

D:\DROPBOX (SSSR)\SWCA EDGECOMB CREEK\C3D\SHEETS\EDGECOMBCK 60PERCENT OVERVIEW.DWG | JOSHUA.ALLEN | SAVED: Wednesday, December 9, 2020 3:13:05 PM | BDG STANDARD.CTB | | PLOTTED: Tuesday, December 22, 2020 10:49:05 AM





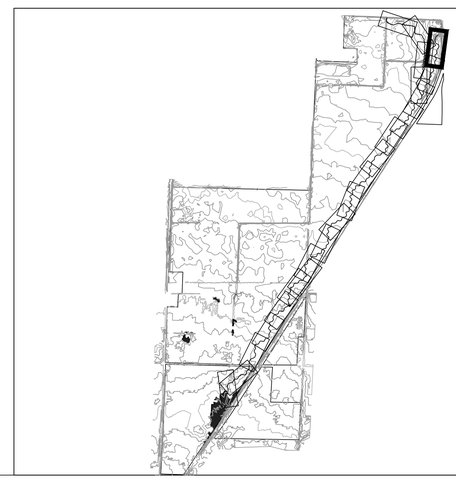
SCALE: HOR 1" =30"; VERT 1"= 3'

PLAN LEGEND

- PROPOSED STREAM CENTER LINE
- PROPOSED CHANNEL TOB
- EXISTING MAJOR CONTOUR
- EXISTING MINOR CONTOUR
- PROPOSED MAJOR CONTOUR
- PROPOSED MINOR CONTOUR
- PROPERTY BOUNDARY
- PROPOSED FLOOD TERRACE TOE/TOB
- PROPOSED FLOODPLAIN TOE
- EXISTING CONTOUR ELEVATION
- AUGMENTED GRAVEL RIFFLE
- LOG A-VANE
- OUTLET OUTFALL STRUCTURE
- FLOODPLAIN DEPRESSION
- BRUSH AND ROLL RIFFLE
- TOE WOOD
- ROCK AND ROLL RIFFLE
- BRUSH MATTRESS
- LOG VANE
- SPANNER LOG
- ROUGHENED TOE LOG
- DENDRITE CHANNEL
- WETLAND AREA

PROFILE LEGEND

- PROPOSED STREAM THALWEG
- PROPOSED BANKFULL TOB
- EXISTING GROUND
- FLOOD TERRACE TOP
- FLOODPLAIN TOE



NOT TO SCALE

Prepared by:
SWCA ENVIRONMENTAL CONSULTANTS
Operating in North Carolina as SWCA Environmental Consulting and Engineering of NC, PC
116 Alexandria Drive
Mooresville, NC 28115
(p) 919.624.1458

Prepared for:
NorthPoint DEVELOPMENT

ANSI D (22"x34") SCALE: 1" = 30'
0 15 30 60

TABLOID (11"x17") SCALE: 1" = 60'
0 30 60 120

Stamp:

Project Title:

EDGECOMB CREEK
60% DESIGN

Sheet Title:

PLAN AND PROFILE
REACH 1 - (1)

Date:	12/10/2020
Scale:	AS SHOWN
Drawn by:	JYZ
Checked by:	DMP
File #	

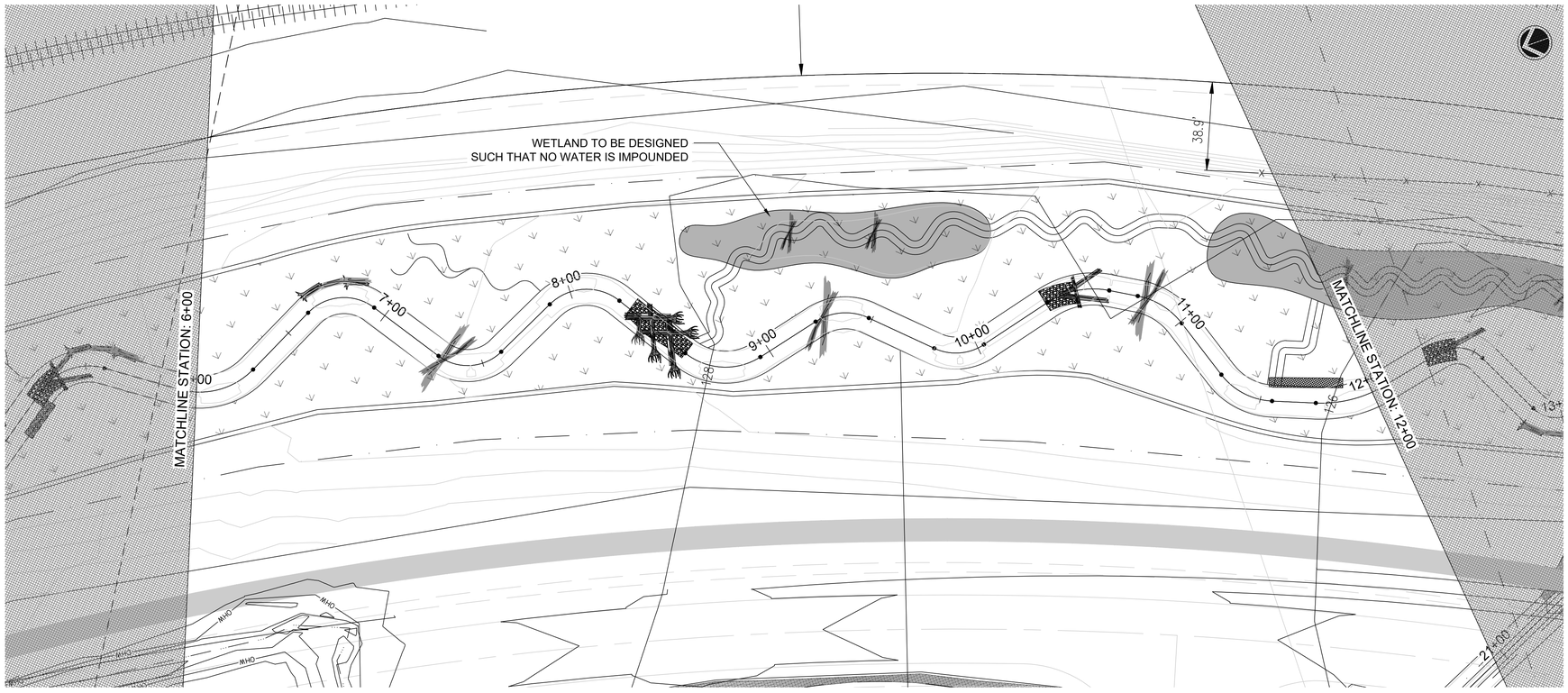
REVISIONS

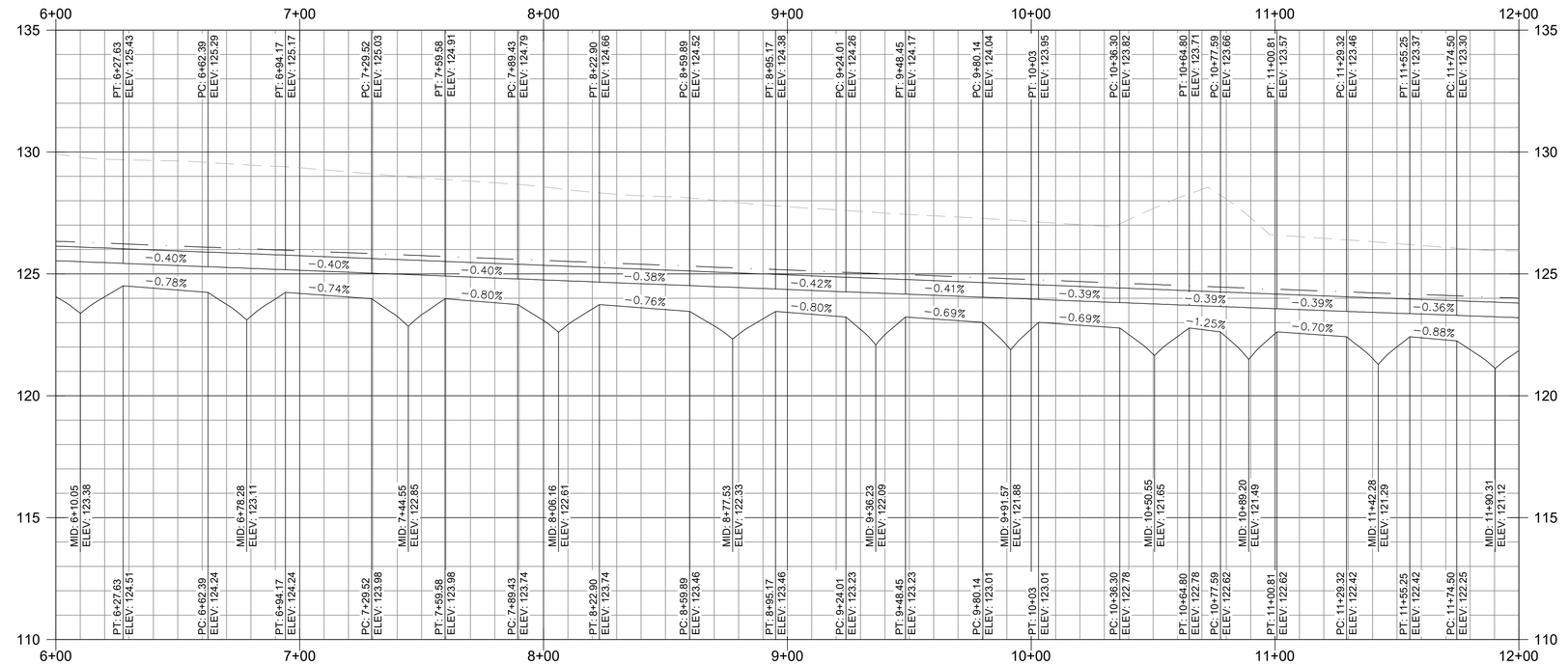
Date:	By:	Note:
09/30/20	JYZ	30% CONCEPT DESIGN
10/21/20	JYZ	30% REVISON
12/04/20	JYZ	60% DESIGN
12/10/20	JYZ	60% REVISION

Sheet No:

6 OF 47

D:\DROPBOX (SSR)\SWCA EDGECOMB CREEK\C3D\SHEETS\EDGECOMBCK 60PERCENT PP.DWG | JOSHUA.ALLEN | SAVED: Tuesday, December 22, 2020 11:14:24 AM | BDG STANDARD.CTB | | PLOTTED: Tuesday, December 22, 2020 11:15:06 AM





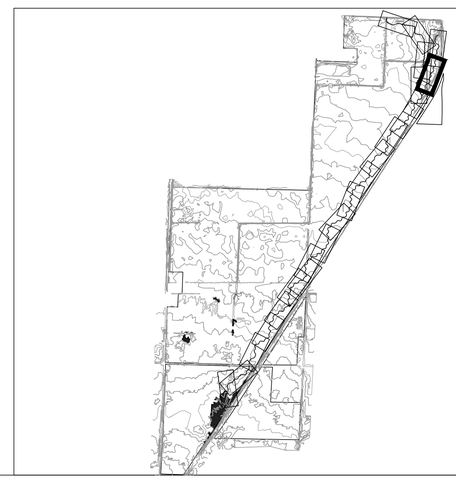
SCALE: HOR 1" =30"; VERT 1"= 3'

PLAN LEGEND

- PROPOSED STREAM CENTER LINE
- PROPOSED CHANNEL TOB
- EXISTING MAJOR CONTOUR
- EXISTING MINOR CONTOUR
- PROPOSED MAJOR CONTOUR
- PROPOSED MINOR CONTOUR
- PROPERTY BOUNDARY
- PROPOSED FLOOD TERRACE TOE/TOB
- PROPOSED FLOODPLAIN TOE
- EXISTING CONTOUR ELEVATION
- AUGMENTED GRAVEL RIFFLE
- LOG A-VANE
- OUTLET OUTFALL STRUCTURE
- FLOODPLAIN DEPRESSION
- BRUSH AND ROLL RIFFLE
- TOE WOOD
- ROCK AND ROLL RIFFLE
- BRUSH MATTRESS
- LOG VANE
- SPANNER LOG
- ROUGHENED TOE LOG
- DENDRITE CHANNEL
- WETLAND AREA

PROFILE LEGEND

- PROPOSED STREAM THALWEG
- PROPOSED BANKFULL TOB
- EXISTING GROUND
- FLOOD TERRACE TOP
- FLOODPLAIN TOE



NOT TO SCALE

Prepared by:
SWCA ENVIRONMENTAL CONSULTANTS
Operating in North Carolina as SWCA Environmental Consulting and Engineering of NC, PC
116 Alexandria Drive
Mooresville, NC 28115
(p) 919.624.1458

Prepared for:
NorthPoint DEVELOPMENT

ANSI D (22"x34") SCALE: 1" = 30'
0 15 30 60

TABLOID (11"x17") SCALE: 1" = 60'
0 30 60 120

Stamp:

Project Title:

EDGECOMB CREEK
60% DESIGN

Sheet Title:

PLAN AND PROFILE
REACH 1 - (2)

Date:	12/10/2020
Scale:	AS SHOWN
Drawn by:	JYZ
Checked by:	DMP
File #	

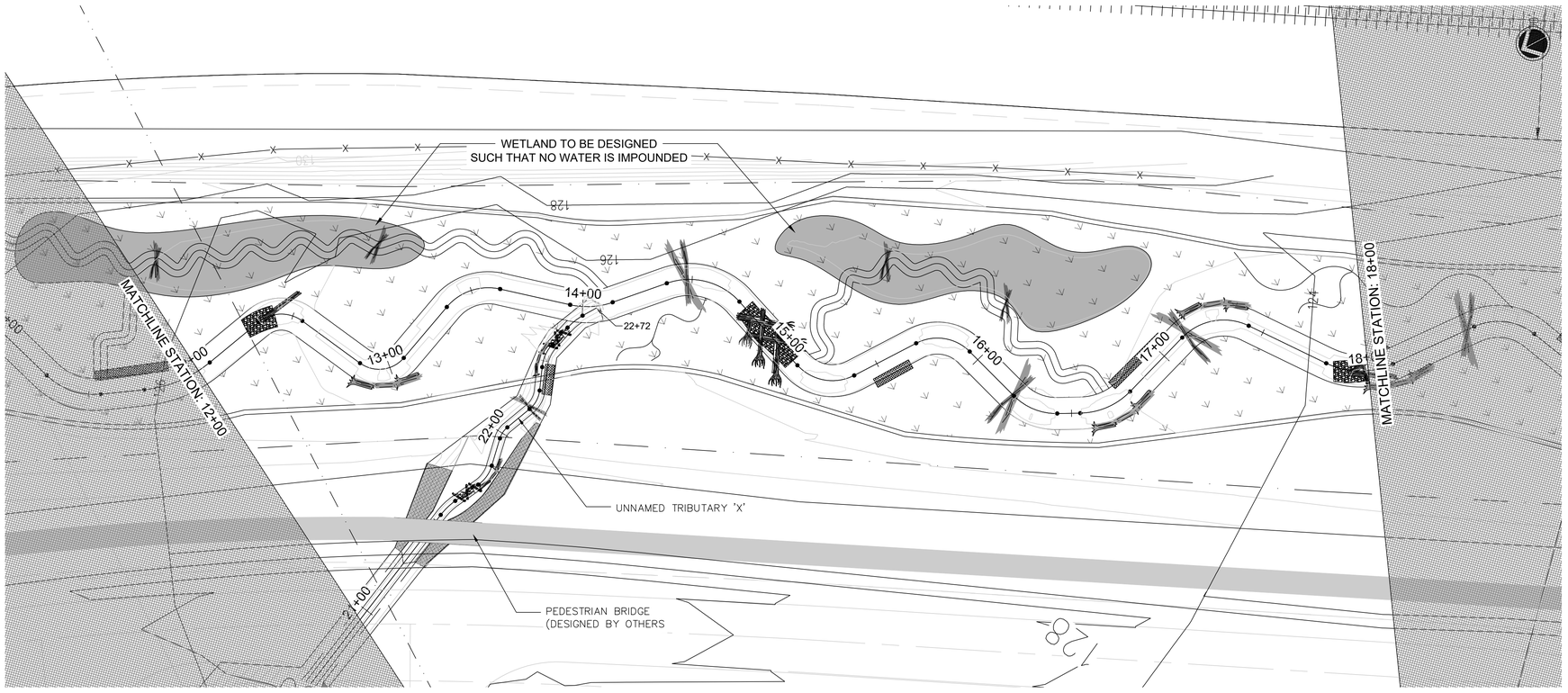
REVISIONS

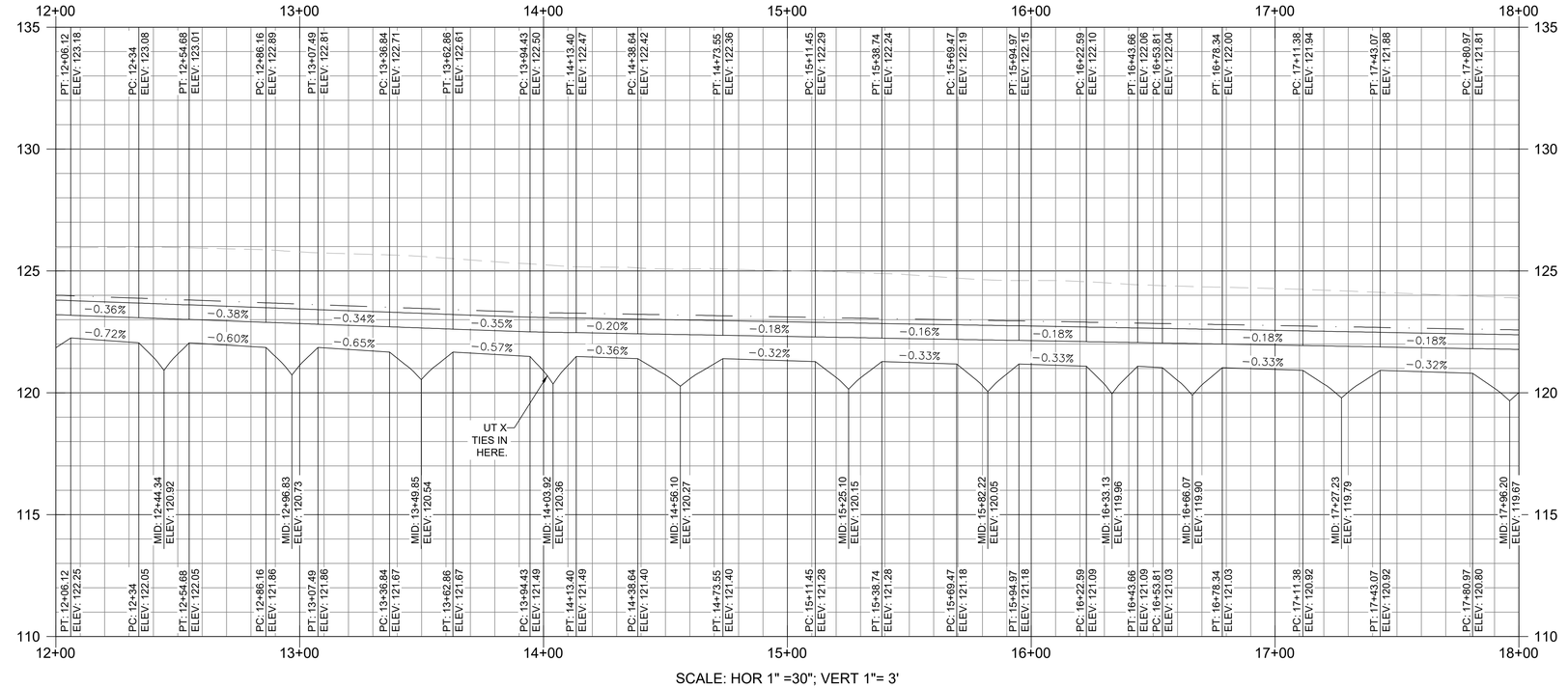
Date:	By:	Note:
09/30/20	JYZ	30% CONCEPT DESIGN
10/21/20	JYZ	30% REVISON
12/04/20	JYZ	60% DESIGN
12/10/20	JYZ	60% REVISION

Sheet No:

7 OF 47

D:\DROPBOX (SSR)\SWCA EDGECOMB CREEK\C3D\SHEETS\EDGECOMBCK 60PERCENT PP.DWG | JOSHUA.ALLEN | SAVED: Tuesday, December 22, 2020 11:14:24 AM | BDG STANDARD.CTB | | PLOTTED: Tuesday, December 22, 2020 11:15:39 AM





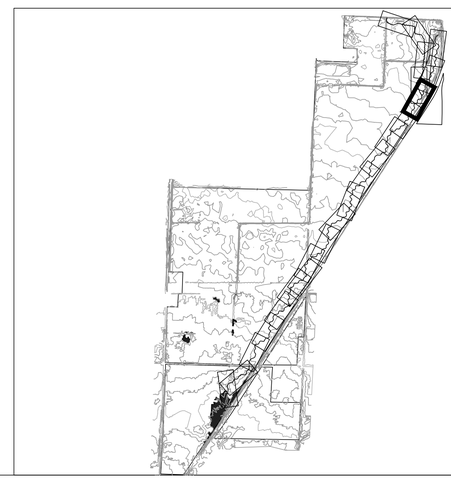
SCALE: HOR 1" =30"; VERT 1"= 3'

PLAN LEGEND

- PROPOSED STREAM CENTER LINE
- PROPOSED CHANNEL TOB
- EXISTING MAJOR CONTOUR
- EXISTING MINOR CONTOUR
- PROPOSED MAJOR CONTOUR
- PROPOSED MINOR CONTOUR
- PROPERTY BOUNDARY
- PROPOSED FLOOD TERRACE TOE/TOB
- PROPOSED FLOODPLAIN TOE
- EXISTING CONTOUR ELEVATION
- AUGMENTED GRAVEL RIFFLE
- LOG A-VANE
- OUTLET OUTFALL STRUCTURE
- FLOODPLAIN DEPRESSION
- BRUSH AND ROLL RIFFLE
- TOE WOOD
- ROCK AND ROLL RIFFLE
- BRUSH MATTRESS
- LOG VANE
- SPANNER LOG
- ROUGHENED TOE LOG
- DENDRITE CHANNEL
- WETLAND AREA

PROFILE LEGEND

- PROPOSED STREAM THALWEG
- PROPOSED BANKFULL TOB
- EXISTING GROUND
- FLOOD TERRACE TOP
- FLOODPLAIN TOE



NOT TO SCALE

Prepared by:
SWCA ENVIRONMENTAL CONSULTANTS
Operating in North Carolina as SWCA Environmental Consulting and Engineering of NC, PC
116 Alexandria Drive
Mooresville, NC 28115
(p) 919.624.1458

Prepared for:
NorthPoint DEVELOPMENT

ANSI D (22"x34") SCALE: 1" = 30'
0 15 30 60

TABLOID (11"x17") SCALE: 1" = 60'
0 30 60 120

Stamp:

Project Title:

EDGECOMB CREEK
60% DESIGN

Sheet Title:

PLAN AND PROFILE
REACH 1 - (3)

Date:	12/10/2020
Scale:	AS SHOWN
Drawn by:	JYZ
Checked by:	DMP
File #	

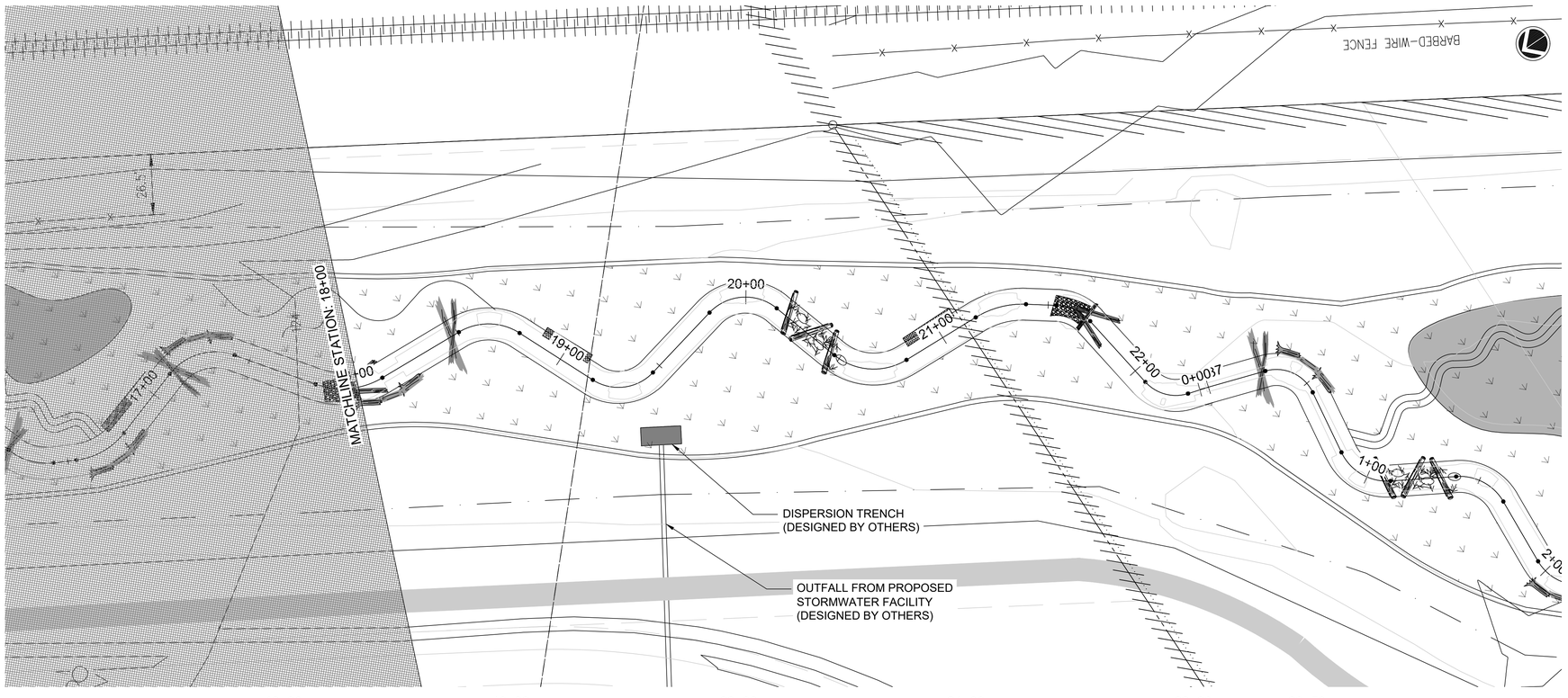
REVISIONS

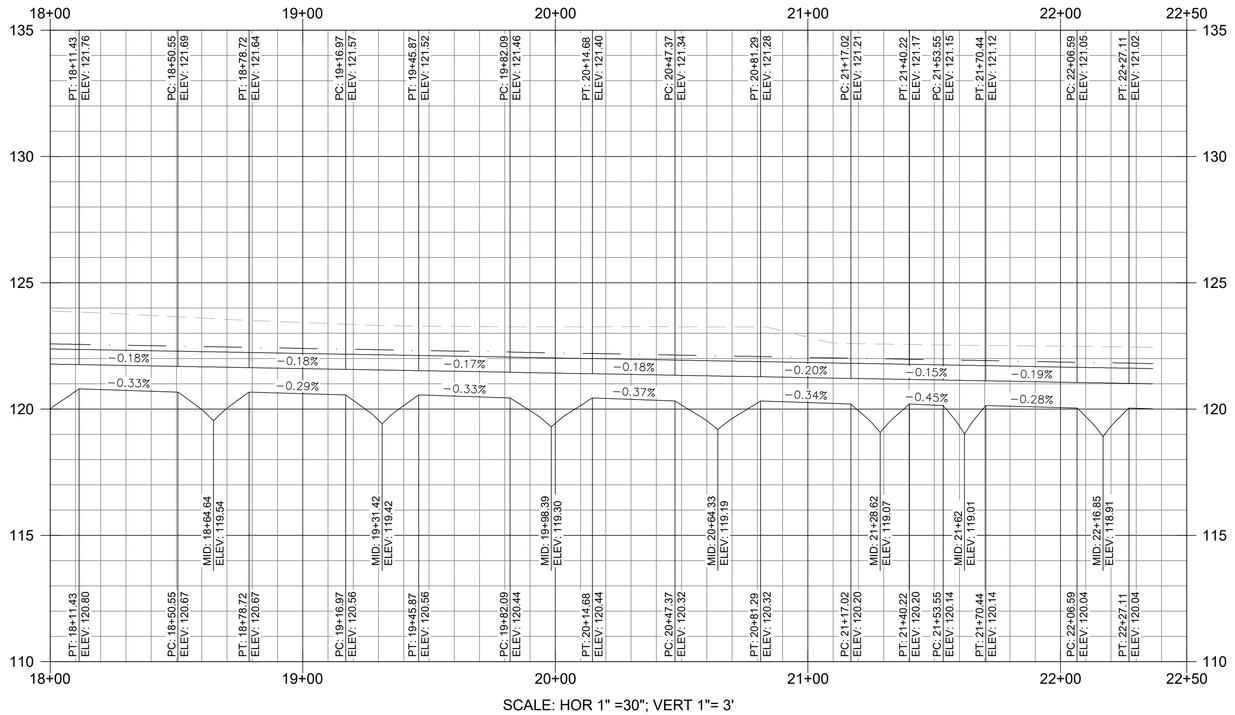
Date:	By:	Note:
09/30/20	JYZ	30% CONCEPT DESIGN
10/21/20	JYZ	30% REVISON
12/04/20	JYZ	60% DESIGN
12/10/20	JYZ	60% REVISION

Sheet No:

8 OF 47

D:\DROPBOX (SSR)\SWCA EDGECOMB CREEK\C3D\SHEETS\EDGECOMBCK 60PERCENT PP.DWG | JOSHUA.ALLEN | SAVED: Tuesday, December 22, 2020 11:14:24 AM | BDG STANDARD.CTB | | PLOTTED: Tuesday, December 22, 2020 11:16:14 AM





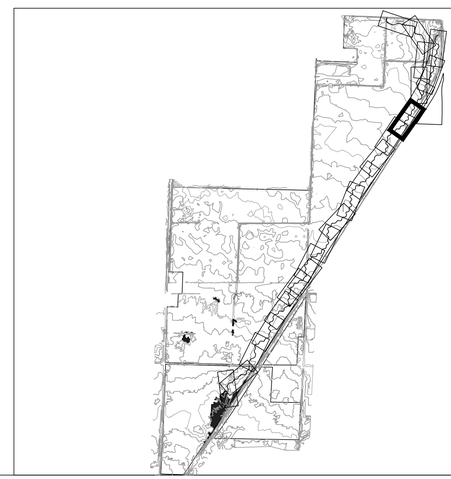
SCALE: HOR 1" =30"; VERT 1"= 3'

PLAN LEGEND

- PROPOSED STREAM CENTER LINE
- PROPOSED CHANNEL TOB
- EXISTING MAJOR CONTOUR
- EXISTING MINOR CONTOUR
- PROPOSED MAJOR CONTOUR
- PROPOSED MINOR CONTOUR
- PROPERTY BOUNDARY
- PROPOSED FLOOD TERRACE TOE/TOB
- PROPOSED FLOODPLAIN TOE
- EXISTING CONTOUR ELEVATION
- AUGMENTED GRAVEL RIFFLE
- LOG A-VANE
- OUTLET OUTFALL STRUCTURE
- FLOODPLAIN DEPRESSION
- BRUSH AND ROLL RIFFLE
- TOE WOOD
- ROCK AND ROLL RIFFLE
- BRUSH MATTRESS
- LOG VANE
- SPANNER LOG
- ROUGHENED TOE LOG
- DENDRITE CHANNEL
- WETLAND AREA

PROFILE LEGEND

- PROPOSED STREAM THALWEG
- PROPOSED BANKFULL TOB
- EXISTING GROUND
- FLOOD TERRACE TOP
- FLOODPLAIN TOE



NOT TO SCALE

Prepared by:
SWCA ENVIRONMENTAL CONSULTANTS
Operating in North Carolina as
SWCA Environmental Consulting
and Engineering of NC, PC
116 Alexandria Drive
Mooresville, NC 28115
(p) 919.624.1458

Prepared for:
NorthPoint DEVELOPMENT

ANSI D (22"x34") SCALE: 1" = 30'
0 15 30 60

TABLOID (11"x17") SCALE: 1" = 60'
0 30 60 120

Stamp:

Project Title:

EDGECOMB CREEK
60% DESIGN

Sheet Title:

PLAN AND PROFILE
REACH 1 - (4)

Date:	12/10/2020
Scale:	AS SHOWN
Drawn by:	JYZ
Checked by:	DMP
File #	

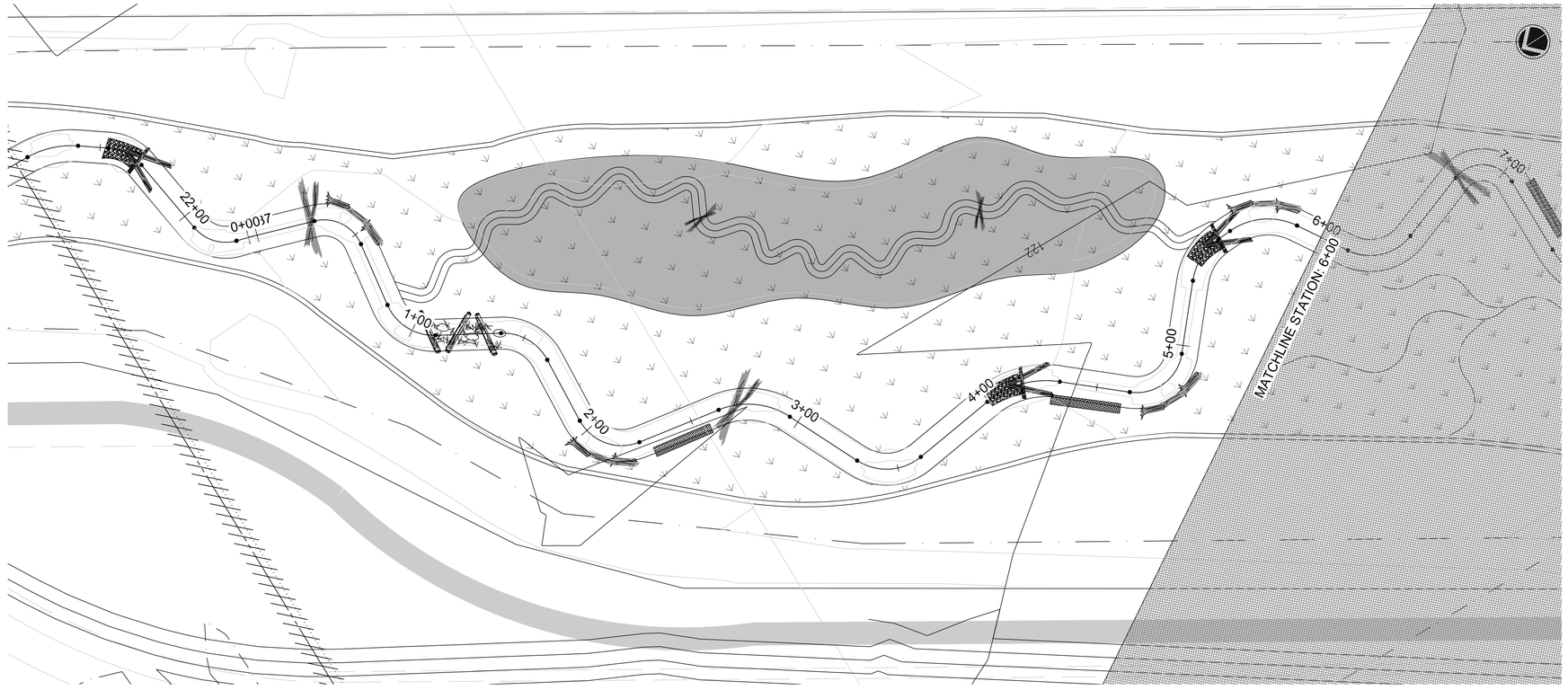
REVISIONS

Date:	By:	Note:
09/30/20	JYZ	30% CONCEPT DESIGN
10/21/20	JYZ	30% REVISON
12/04/20	JYZ	60% DESIGN
12/10/20	JYZ	60% REVISION

Sheet No:

9 OF 47

D:\DROPBOX (SSR)\SWCA EDGECOMB CREEK\C3D\SHEETS\EDGECOMBCK 60PERCENT PP.DWG | JOSHUA.ALLEN | SAVED: Tuesday, December 22, 2020 11:14:24 AM | BDG STANDARD.CTB | | PLOTTED: Tuesday, December 22, 2020 11:16:49 AM



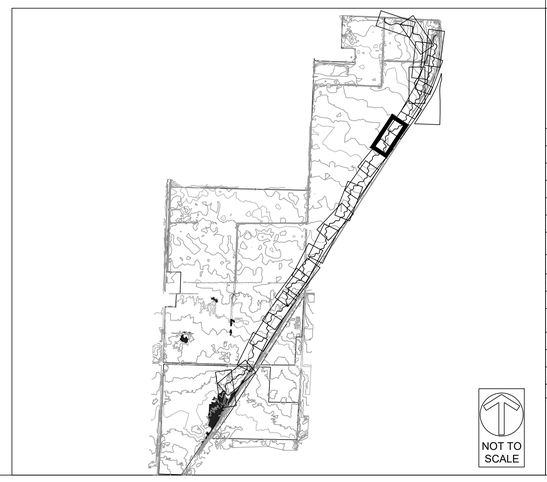
SCALE: HOR 1" =30"; VERT 1"= 3'

PLAN LEGEND

- PROPOSED STREAM CENTER LINE
- PROPOSED CHANNEL TOB
- EXISTING MAJOR CONTOUR
- EXISTING MINOR CONTOUR
- PROPOSED MAJOR CONTOUR
- PROPOSED MINOR CONTOUR
- PROPERTY BOUNDARY
- PROPOSED FLOOD TERRACE TOE/TOB
- PROPOSED FLOODPLAIN TOE
- EXISTING CONTOUR ELEVATION
- AUGMENTED GRAVEL RIFFLE
- LOG A-VANE
- OUTLET OUTFALL STRUCTURE
- FLOODPLAIN DEPRESSION
- BRUSH AND ROLL RIFFLE
- TOE WOOD
- ROCK AND ROLL RIFFLE
- BRUSH MATTRESS
- LOG VANE
- SPANNER LOG
- ROUGHENED TOE LOG
- DENDRITE CHANNEL
- WETLAND AREA

PROFILE LEGEND

- PROPOSED STREAM THALWEG
- PROPOSED BANKFULL TOB
- EXISTING GROUND
- FLOOD TERRACE TOP
- FLOODPLAIN TOE



NOT TO SCALE

Prepared by:

SWCA ENVIRONMENTAL CONSULTANTS

Operating in North Carolina as
SWCA Environmental Consulting
and Engineering of NC, PC

116 Alexandria Drive
Mooresville, NC 28115
(p) 919.624.1458

Prepared for:

NorthPoint DEVELOPMENT

ANSI D (22"x34") SCALE: 1" = 30'

0 15 30 60

TABLOID (11"x17") SCALE: 1" = 60'

0 30 60 120

Stamp:

Project Title:

EDGECOMB CREEK
60% DESIGN

Sheet Title:

PLAN AND PROFILE
REACH 2 - (1)

Date:	12/10/2020
Scale:	AS SHOWN
Drawn by:	JYZ
Checked by:	DMP
File #	

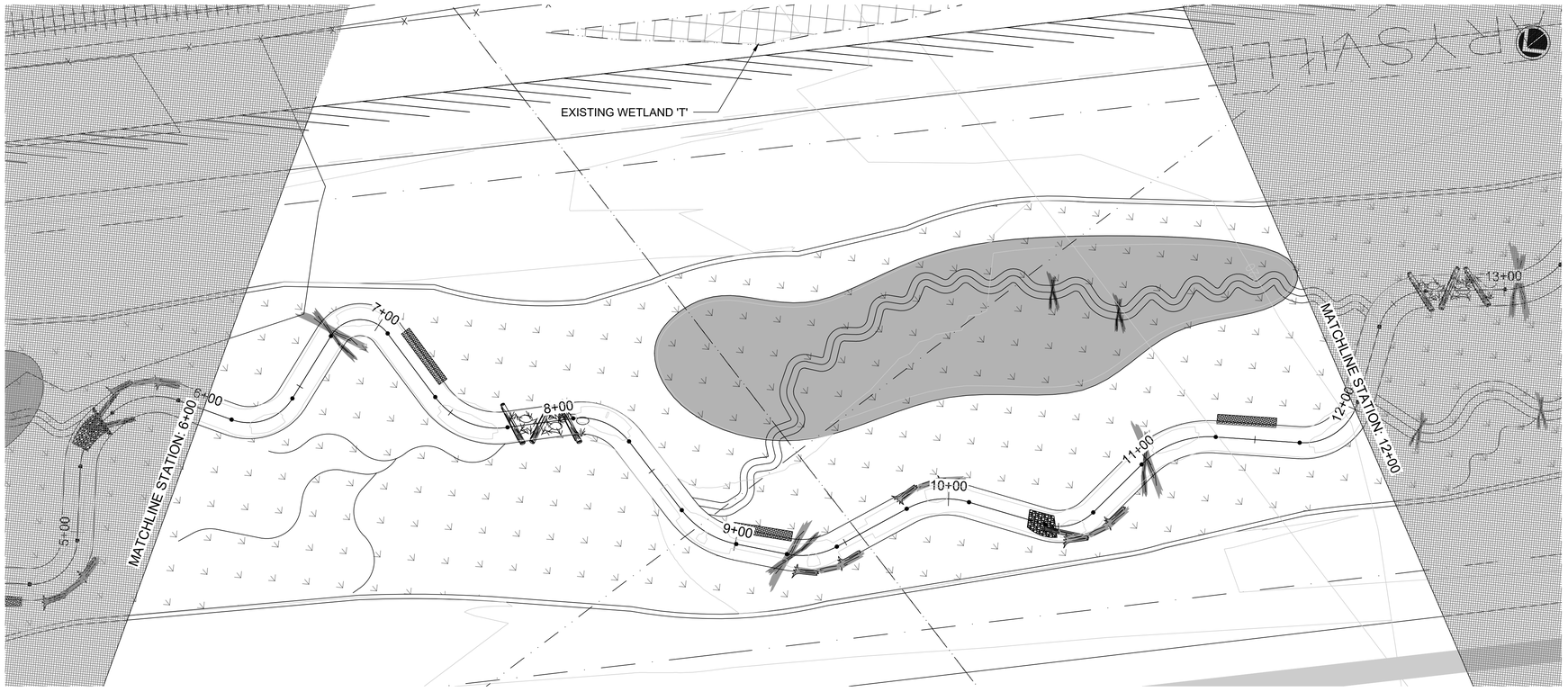
REVISIONS

Date:	By:	Note:
09/30/20	JYZ	30% CONCEPT DESIGN
10/21/20	JYZ	30% REVISON
12/04/20	JYZ	60% DESIGN
12/10/20	JYZ	60% REVISION

Sheet No:

10 OF 47

D:\DROPBOX (SSR)\SWCA EDGECOMB CREEK\C3D\SHEETS\EDGECOMBCK 60PERCENT PP.DWG | JOSHUA.ALLEN | SAVED: Tuesday, December 22, 2020 11:14:24 AM | BDG STANDARD.CTB | | PLOTTED: Tuesday, December 22, 2020 11:17:20 AM



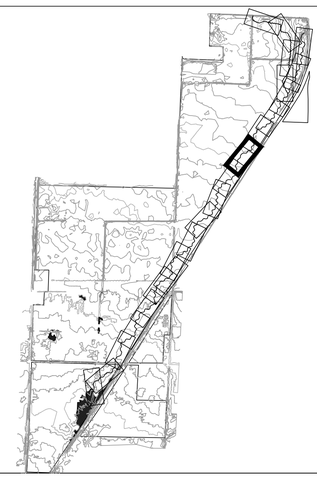
SCALE: HOR 1" =30"; VERT 1"= 3'

PLAN LEGEND

- PROPOSED STREAM CENTER LINE
- PROPOSED CHANNEL TOB
- EXISTING MAJOR CONTOUR
- EXISTING MINOR CONTOUR
- PROPOSED MAJOR CONTOUR
- PROPOSED MINOR CONTOUR
- PROPERTY BOUNDARY
- PROPOSED FLOOD TERRACE TOE/TOB
- PROPOSED FLOODPLAIN TOE
- EXISTING CONTOUR ELEVATION
- AUGMENTED GRAVEL RIFFLE
- LOG A-VANE
- OUTLET OUTFALL STRUCTURE
- FLOODPLAIN DEPRESSION
- BRUSH AND ROLL RIFFLE
- TOE WOOD
- ROCK AND ROLL RIFFLE
- BRUSH MATTRESS
- LOG VANE
- SPANNER LOG
- ROUGHENED TOE LOG
- DENDRITE CHANNEL
- WETLAND AREA

PROFILE LEGEND

- PROPOSED STREAM THALWEG
- PROPOSED BANKFULL TOB
- EXISTING GROUND
- FLOOD TERRACE TOP
- FLOODPLAIN TOE



NOT TO SCALE

Prepared by:
SWCA ENVIRONMENTAL CONSULTANTS
Operating in North Carolina as SWCA Environmental Consulting and Engineering of NC, PC
116 Alexandria Drive
Mooresville, NC 28115
(p) 919.624.1458

Prepared for:
NorthPoint DEVELOPMENT

ANSI D (22"x34") SCALE: 1" = 30'
0 15 30 60

TABLOID (11"x17") SCALE: 1" = 60'
0 30 60 120

Stamp:

Project Title:

EDGECOMB CREEK
60% DESIGN

Sheet Title:

PLAN AND PROFILE
REACH 2 - (2)

Date:	12/10/2020
Scale:	AS SHOWN
Drawn by:	JYZ
Checked by:	DMP
File #	

REVISIONS

Date:	By:	Note:
09/30/20	JYZ	30% CONCEPT DESIGN
10/21/20	JYZ	30% REVISON
12/04/20	JYZ	60% DESIGN
12/10/20	JYZ	60% REVISION

Sheet No:

11 OF 47

D:\DROPBOX (SSR)\SWCA EDGECOMB CREEK\C3D\SHEETS\EDGECOMBCK 60PERCENT PP.DWG | JOSHUA.ALLEN | SAVED: Tuesday, December 22, 2020 11:14:24 AM | BDG STANDARD.CTB | | PLOTTED: Tuesday, December 22, 2020 11:17:52 AM

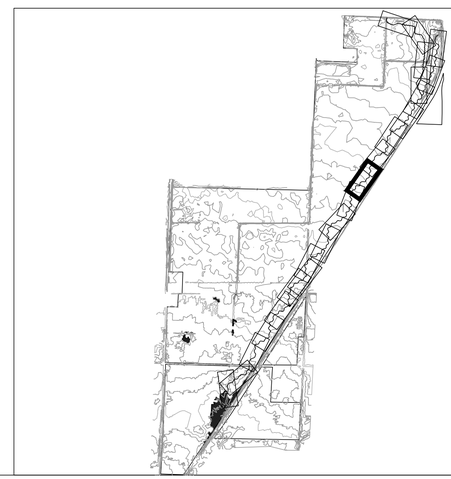
SCALE: HOR 1" =30"; VERT 1"= 3'

PLAN LEGEND

- PROPOSED STREAM CENTER LINE
- PROPOSED CHANNEL TOB
- EXISTING MAJOR CONTOUR
- EXISTING MINOR CONTOUR
- PROPOSED MAJOR CONTOUR
- PROPOSED MINOR CONTOUR
- PROPERTY BOUNDARY
- PROPOSED FLOOD TERRACE TOE/TOB
- PROPOSED FLOODPLAIN TOE
- EXISTING CONTOUR ELEVATION
- AUGMENTED GRAVEL RIFFLE
- LOG A-VANE
- OUTLET OUTFALL STRUCTURE
- FLOODPLAIN DEPRESSION
- BRUSH AND ROLL RIFFLE
- TOE WOOD
- ROCK AND ROLL RIFFLE
- BRUSH MATTRESS
- LOG VANE
- SPANNER LOG
- ROUGHENED TOE LOG
- DENDRITE CHANNEL
- WETLAND AREA

PROFILE LEGEND

- PROPOSED STREAM THALWEG
- PROPOSED BANKFULL TOB
- EXISTING GROUND
- FLOOD TERRACE TOP
- FLOODPLAIN TOE



NOT TO SCALE

Prepared by:
SWCA ENVIRONMENTAL CONSULTANTS
Operating in North Carolina as SWCA Environmental Consulting and Engineering of NC, PC
116 Alexandria Drive
Mooresville, NC 28115
(p) 919.624.1458

Prepared for:
NorthPoint DEVELOPMENT

ANSI D (22"x34") SCALE: 1" = 30'
0 15 30 60

TABLOID (11"x17") SCALE: 1" = 60'
0 30 60 120

Stamp:

Project Title:

EDGECOMB CREEK
60% DESIGN

Sheet Title:

PLAN AND PROFILE
REACH 2 - (3)

Date:	12/10/2020
Scale:	AS SHOWN
Drawn by:	JYZ
Checked by:	DMP
File #	

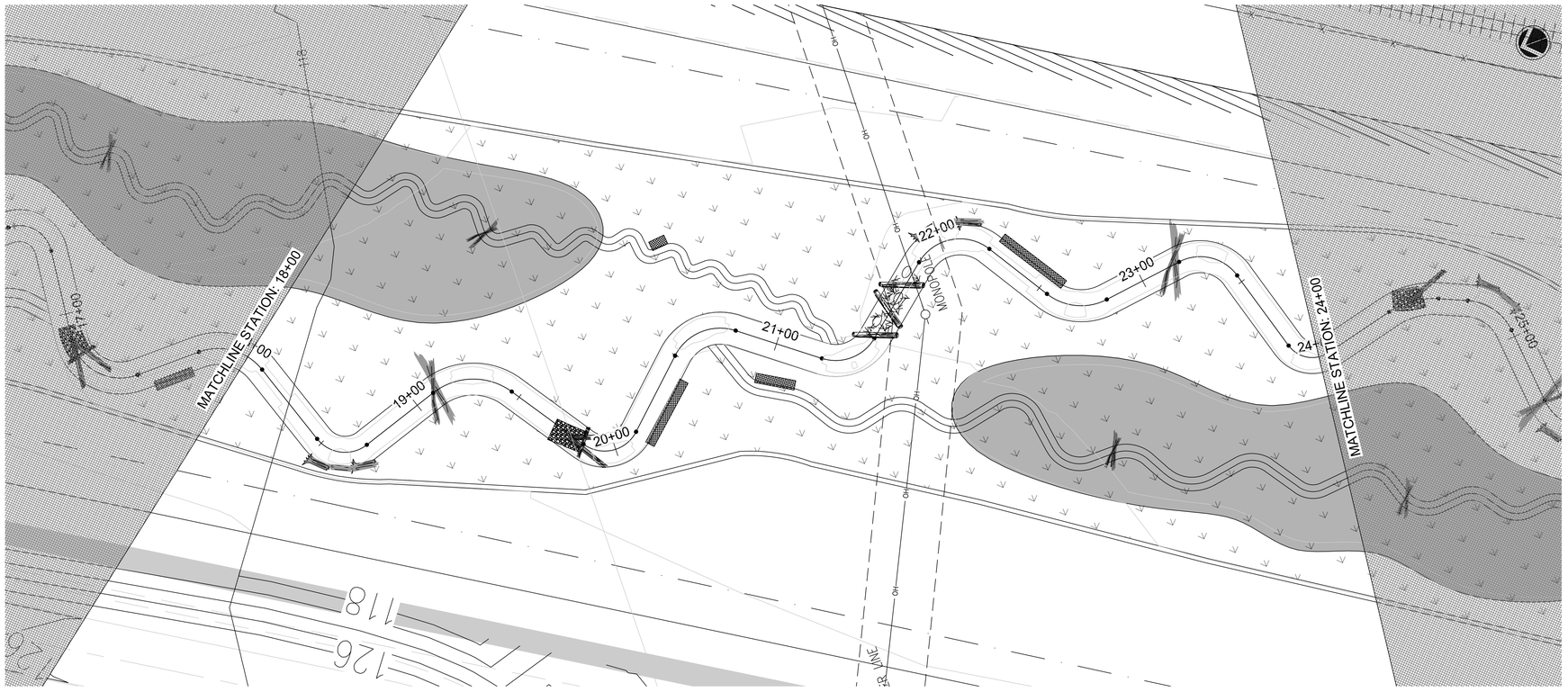
REVISIONS

Date:	By:	Note:
09/30/20	JYZ	30% CONCEPT DESIGN
10/21/20	JYZ	30% REVISON
12/04/20	JYZ	60% DESIGN
12/10/20	JYZ	60% REVISION

Sheet No:

12 OF 47

D:\DROPBOX (SSR)\SWCA EDGECOMB CREEK\C3D\SHEETS\EDGECOMBCK 60PERCENT PP.DWG | JOSHUA.ALLEN | SAVED: Tuesday, December 22, 2020 11:14:24 AM | BDG STANDARD.CTB | | PLOTTED: Tuesday, December 22, 2020 11:18:24 AM



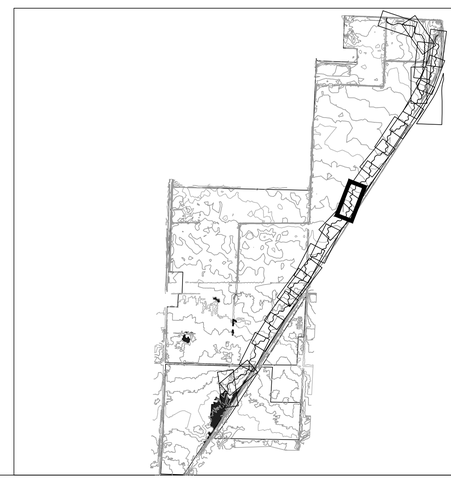
SCALE: HOR 1" =30"; VERT 1"= 3'

PLAN LEGEND

- PROPOSED STREAM CENTER LINE
- PROPOSED CHANNEL TOB
- EXISTING MAJOR CONTOUR
- EXISTING MINOR CONTOUR
- PROPOSED MAJOR CONTOUR
- PROPOSED MINOR CONTOUR
- PROPERTY BOUNDARY
- PROPOSED FLOOD TERRACE TOE/TOB
- PROPOSED FLOODPLAIN TOE
- EXISTING CONTOUR ELEVATION
- AUGMENTED GRAVEL RIFFLE
- LOG A-VANE
- OUTLET OUTFALL STRUCTURE
- FLOODPLAIN DEPRESSION
- BRUSH AND ROLL RIFFLE
- TOE WOOD
- ROCK AND ROLL RIFFLE
- BRUSH MATTRESS
- LOG VANE
- SPANNER LOG
- ROUGHENED TOE LOG
- DENDRITE CHANNEL
- WETLAND AREA

PROFILE LEGEND

- PROPOSED STREAM THALWEG
- PROPOSED BANKFULL TOB
- EXISTING GROUND
- FLOOD TERRACE TOP
- FLOODPLAIN TOE



NOT TO SCALE

Prepared by:

SWCA ENVIRONMENTAL CONSULTANTS

Operating in North Carolina as
SWCA Environmental Consulting
and Engineering of NC, PC

116 Alexandria Drive
Mooresville, NC 28115
(p) 919.624.1458

Prepared for:

NorthPoint DEVELOPMENT

ANSI D (22"x34") SCALE: 1" = 30'

0 15 30 60

TABLOID (11"x17") SCALE: 1" = 60'

0 30 60 120

Stamp:

Project Title:

EDGECOMB CREEK
60% DESIGN

Sheet Title:

PLAN AND PROFILE
REACH 2 - (4)

Date:	12/10/2020
Scale:	AS SHOWN
Drawn by:	JYZ
Checked by:	DMP
File #	

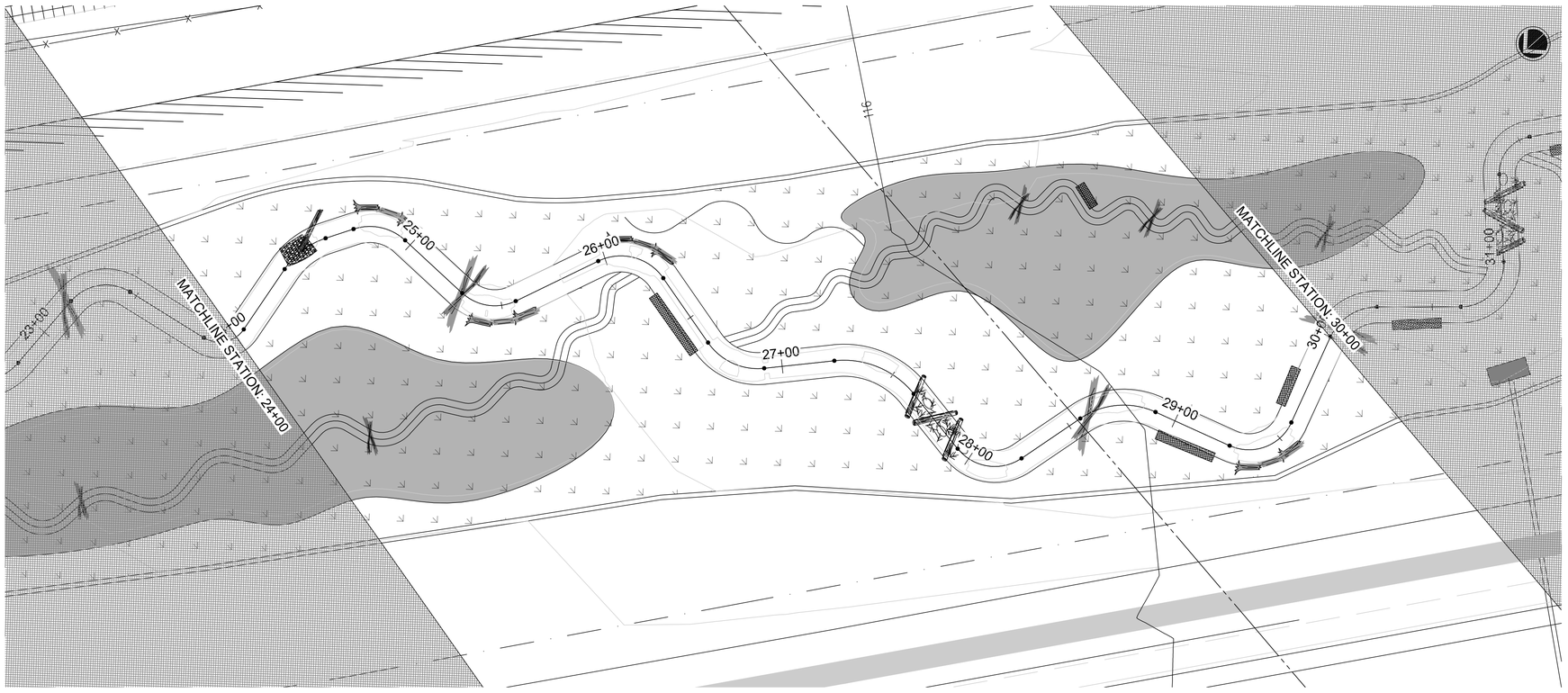
REVISIONS

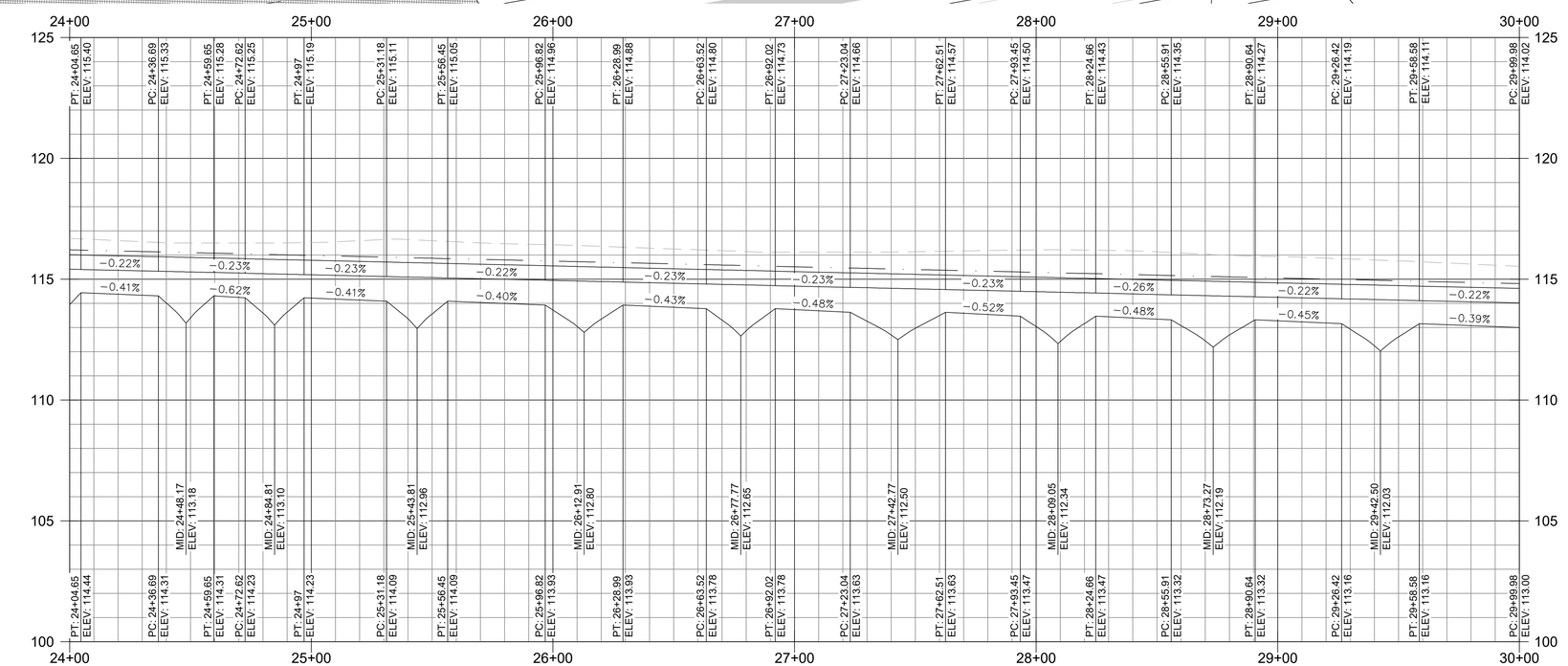
Date:	By:	Note:
09/30/20	JYZ	30% CONCEPT DESIGN
10/21/20	JYZ	30% REVISON
12/04/20	JYZ	60% DESIGN
12/10/20	JYZ	60% REVISION

Sheet No:

13 OF 47

D:\DROPBOX (SSR)\SWCA EDGECOMB CREEK\C3D\SHEETS\EDGECOMBCK 60PERCENT PP.DWG | JOSHUA.ALLEN | SAVED: Tuesday, December 22, 2020 11:14:24 AM | BDG STANDARD.CTB | | PLOTTED: Tuesday, December 22, 2020 11:18:55 AM





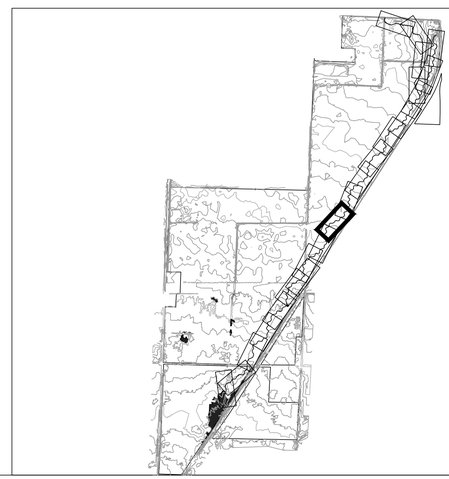
SCALE: HOR 1" =30"; VERT 1"= 3'

PLAN LEGEND

- PROPOSED STREAM CENTER LINE
- PROPOSED CHANNEL TOB
- EXISTING MAJOR CONTOUR
- EXISTING MINOR CONTOUR
- PROPOSED MAJOR CONTOUR
- PROPOSED MINOR CONTOUR
- PROPERTY BOUNDARY
- PROPOSED FLOOD TERRACE TOE/TOB
- PROPOSED FLOODPLAIN TOE
- EXISTING CONTOUR ELEVATION
- AUGMENTED GRAVEL RIFFLE
- LOG A-VANE
- OUTLET OUTFALL STRUCTURE
- FLOODPLAIN DEPRESSION
- BRUSH AND ROLL RIFFLE
- TOE WOOD
- ROCK AND ROLL RIFFLE
- BRUSH MATTRESS
- LOG VANE
- SPANNER LOG
- ROUGHENED TOE LOG
- DENDRITE CHANNEL
- WETLAND AREA

PROFILE LEGEND

- PROPOSED STREAM THALWEG
- PROPOSED BANKFULL TOB
- EXISTING GROUND
- FLOOD TERRACE TOP
- FLOODPLAIN TOE



NOT TO SCALE

Prepared by:

SWCA ENVIRONMENTAL CONSULTANTS

Operating in North Carolina as
SWCA Environmental Consulting
and Engineering of NC, PC

116 Alexandria Drive
Mooresville, NC 28115
(p) 919.624.1458

Prepared for:

NorthPoint DEVELOPMENT

ANSI D (22"x34") SCALE: 1" = 30'

0 15 30 60

TABLOID (11"x17") SCALE: 1" = 60'

0 30 60 120

Stamp:

Project Title:

EDGECOMB CREEK
60% DESIGN

Sheet Title:

PLAN AND PROFILE
REACH 2 - (5)

Date:	12/10/2020
Scale:	AS SHOWN
Drawn by:	JYZ
Checked by:	DMP
File #	

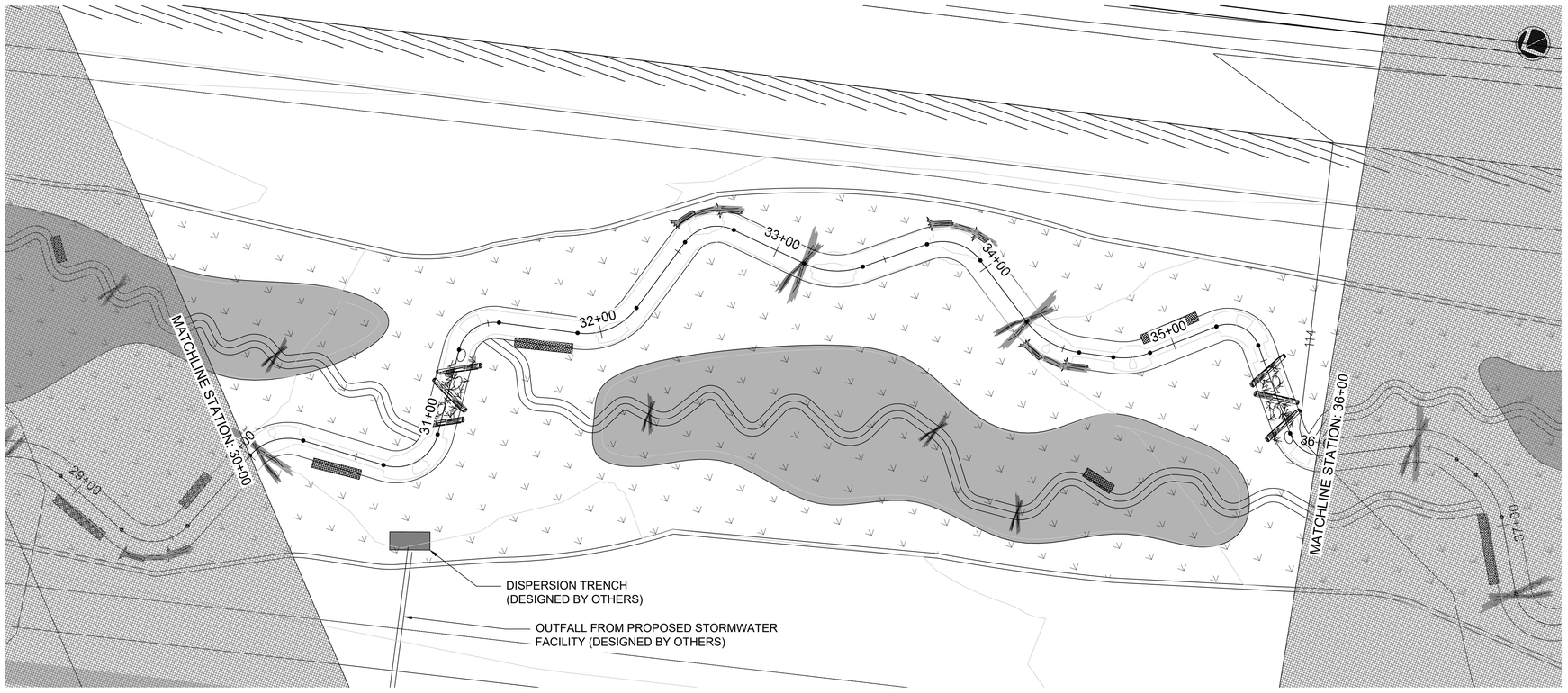
REVISIONS

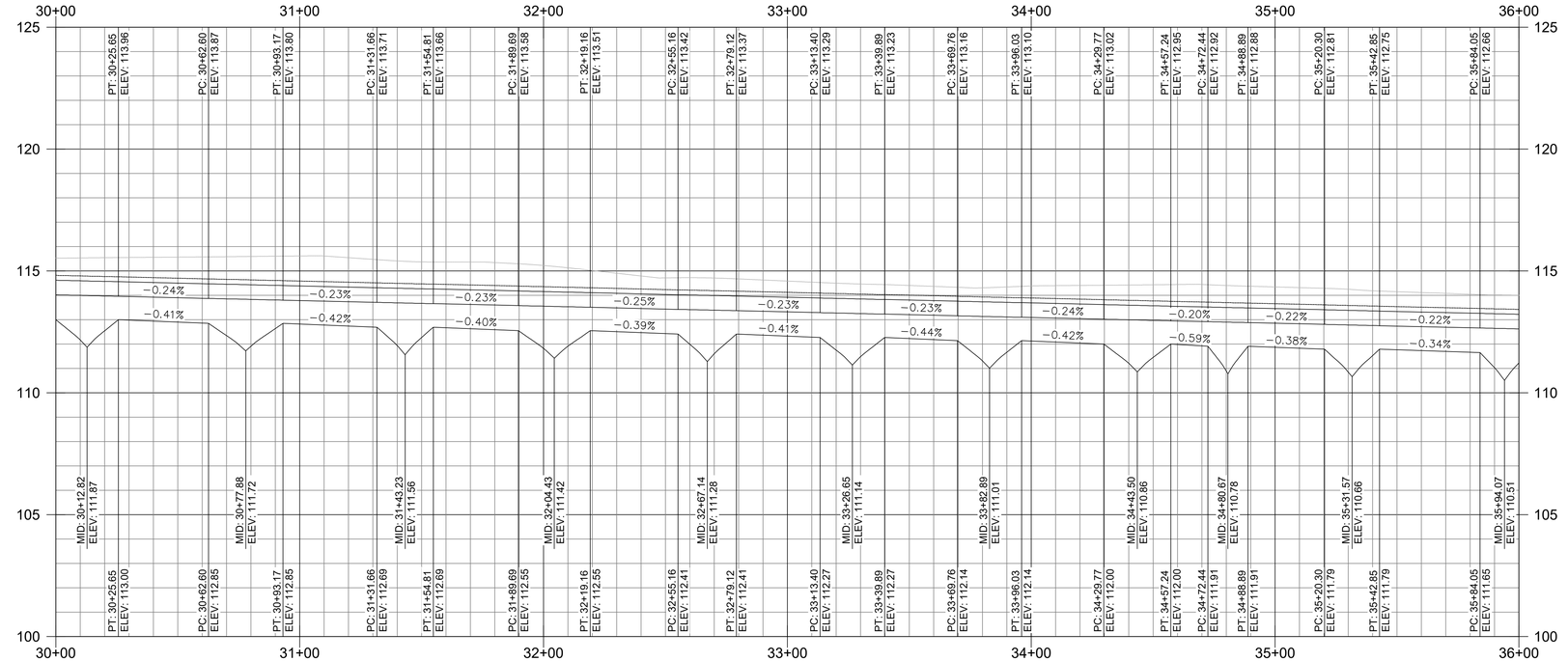
Date:	By:	Note:
09/30/20	JYZ	30% CONCEPT DESIGN
10/21/20	JYZ	30% REVISON
12/04/20	JYZ	60% DESIGN
12/10/20	JYZ	60% REVISION

Sheet No:

14 OF 47

D:\DROPBOX (SSR)\SWCA EDGECOMB CREEK\C3D\SHEETS\EDGECOMBCK 60PERCENT PP.DWG | JOSHUA.ALLEN | SAVED: Tuesday, December 22, 2020 11:14:24 AM | BDG STANDARD.CTB | | PLOTTED: Tuesday, December 22, 2020 11:19:26 AM





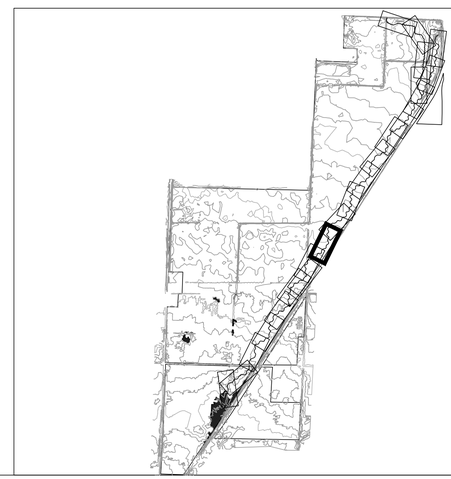
SCALE: HOR 1" =30"; VERT 1"= 3'

PLAN LEGEND

- PROPOSED STREAM CENTER LINE
- PROPOSED CHANNEL TOB
- EXISTING MAJOR CONTOUR
- EXISTING MINOR CONTOUR
- PROPOSED MAJOR CONTOUR
- PROPOSED MINOR CONTOUR
- PROPERTY BOUNDARY
- PROPOSED FLOOD TERRACE TOE/TOB
- PROPOSED FLOODPLAIN TOE
- EXISTING CONTOUR ELEVATION
- AUGMENTED GRAVEL RIFFLE
- LOG A-VANE
- OUTLET OUTFALL STRUCTURE
- FLOODPLAIN DEPRESSION
- BRUSH AND ROLL RIFFLE
- TOE WOOD
- ROCK AND ROLL RIFFLE
- BRUSH MATTRESS
- LOG VANE
- SPANNER LOG
- ROUGHENED TOE LOG
- DENDRITE CHANNEL
- WETLAND AREA

PROFILE LEGEND

- PROPOSED STREAM THALWEG
- PROPOSED BANKFULL TOB
- EXISTING GROUND
- FLOOD TERRACE TOP
- FLOODPLAIN TOE



NOT TO SCALE

Prepared by:
SWCA ENVIRONMENTAL CONSULTANTS
Operating in North Carolina as
SWCA Environmental Consulting
and Engineering of NC, PC
116 Alexandria Drive
Mooresville, NC 28115
(p) 919.624.1458

Prepared for:
NorthPoint DEVELOPMENT

ANSI D (22"x34") SCALE: 1" = 30'
0 15 30 60

TABLOID (11"x17") SCALE: 1" = 60'
0 30 60 120

Stamp:

Project Title:

EDGECOMB CREEK
60% DESIGN

Sheet Title:

PLAN AND PROFILE
REACH 2 - (6)

Date:	12/10/2020
Scale:	AS SHOWN
Drawn by:	JYZ
Checked by:	DMP
File #	

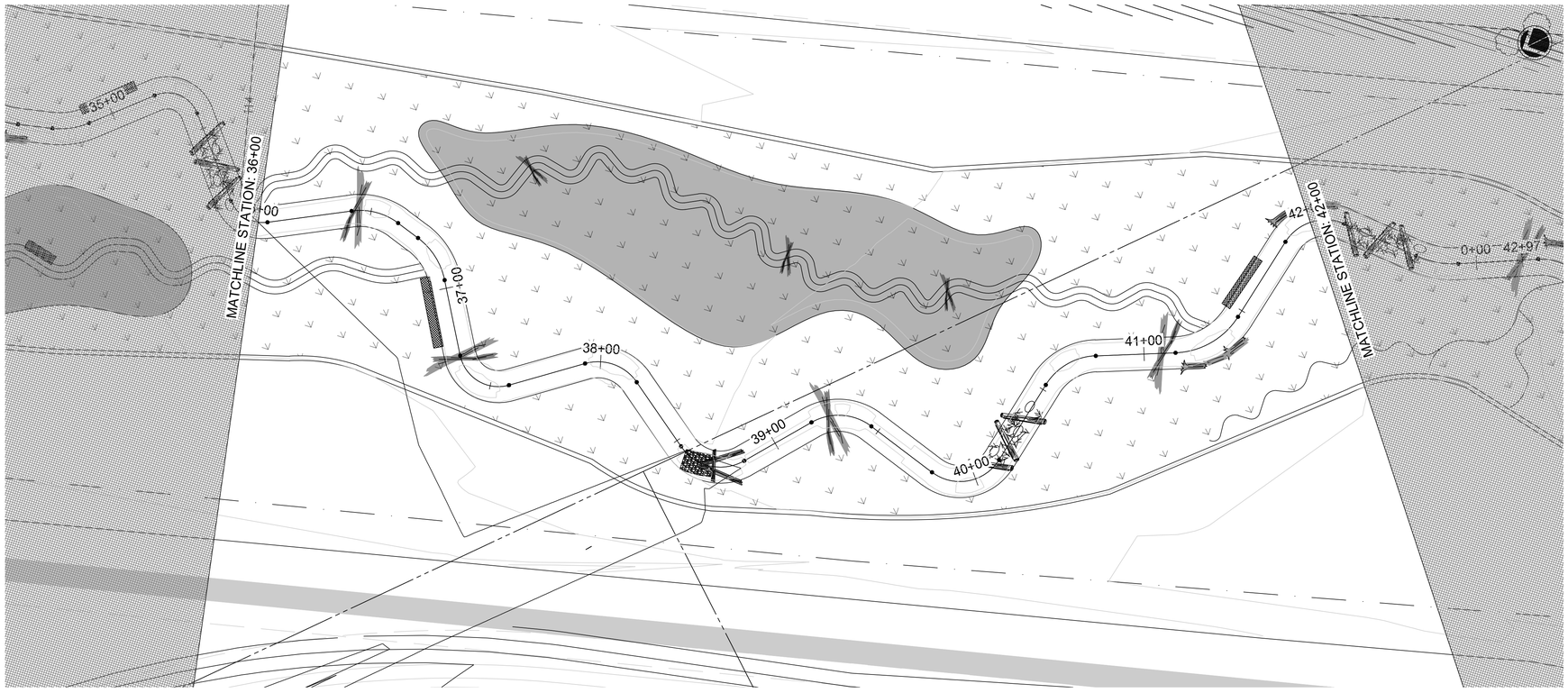
REVISIONS

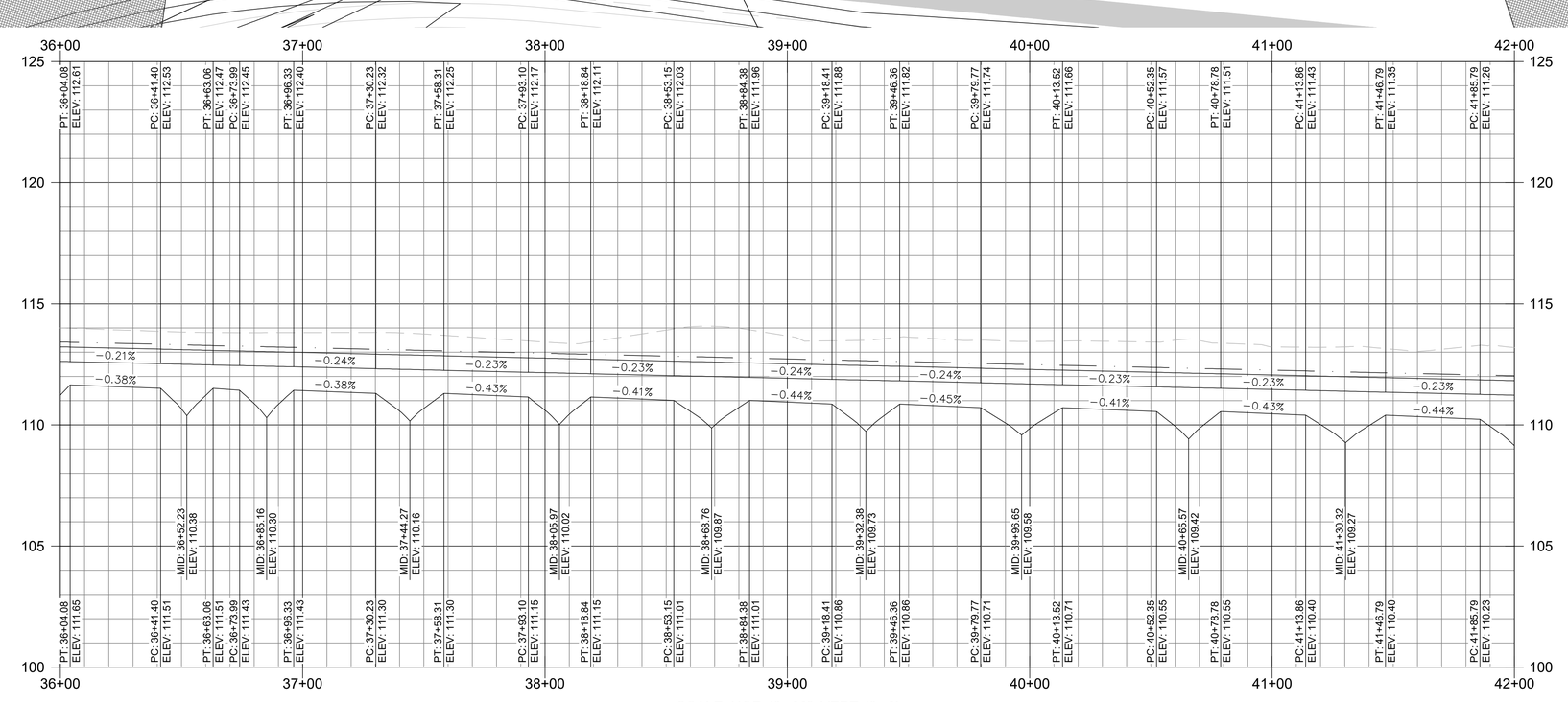
Date:	By:	Note:
09/30/20	JYZ	30% CONCEPT DESIGN
10/21/20	JYZ	30% REVISON
12/04/20	JYZ	60% DESIGN
12/10/20	JYZ	60% REVISION

Sheet No:

15 OF 47

D:\DROPBOX (SSR)\SWCA EDGECOMB CREEK\C3D\SHEETS\EDGECOMBCK 60PERCENT PP.DWG | JOSHUA.ALLEN | SAVED: Tuesday, December 22, 2020 11:14:24 AM | BDG STANDARD.CTB | | PLOTTED: Tuesday, December 22, 2020 11:20:00 AM





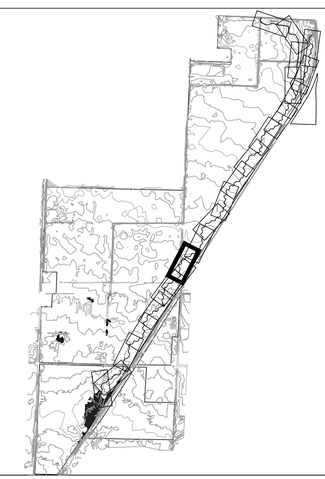
SCALE: HOR 1" =30"; VERT 1"= 3'

PLAN LEGEND

- PROPOSED STREAM CENTER LINE
- PROPOSED CHANNEL TOB
- EXISTING MAJOR CONTOUR
- EXISTING MINOR CONTOUR
- PROPOSED MAJOR CONTOUR
- PROPOSED MINOR CONTOUR
- PROPERTY BOUNDARY
- PROPOSED FLOOD TERRACE TOE/TOB
- PROPOSED FLOODPLAIN TOE
- EXISTING CONTOUR ELEVATION
- AUGMENTED GRAVEL RIFFLE
- LOG A-VANE
- OUTLET OUTFALL STRUCTURE
- FLOODPLAIN DEPRESSION
- BRUSH AND ROLL RIFFLE
- TOE WOOD
- ROCK AND ROLL RIFFLE
- BRUSH MATTRESS
- LOG VANE
- SPANNER LOG
- ROUGHENED TOE LOG
- DENDRITE CHANNEL
- WETLAND AREA

PROFILE LEGEND

- PROPOSED STREAM THALWEG
- PROPOSED BANKFULL TOB
- EXISTING GROUND
- FLOOD TERRACE TOP
- FLOODPLAIN TOE



NOT TO SCALE

Prepared by:

SWCA ENVIRONMENTAL CONSULTANTS

Operating in North Carolina as
SWCA Environmental Consulting
and Engineering of NC, PC

116 Alexandria Drive
Mooresville, NC 28115
(p) 919.624.1458

Prepared for:

NorthPoint DEVELOPMENT

ANSI D (22"x34") SCALE: 1" = 30'

0 15 30 60

TABLOID (11"x17") SCALE: 1" = 60'

0 30 60 120

Stamp:

Project Title:

EDGECOMB CREEK
60% DESIGN

Sheet Title:

PLAN AND PROFILE
REACH 2 - (7)

Date:	12/10/2020
Scale:	AS SHOWN
Drawn by:	JYZ
Checked by:	DMP
File #	

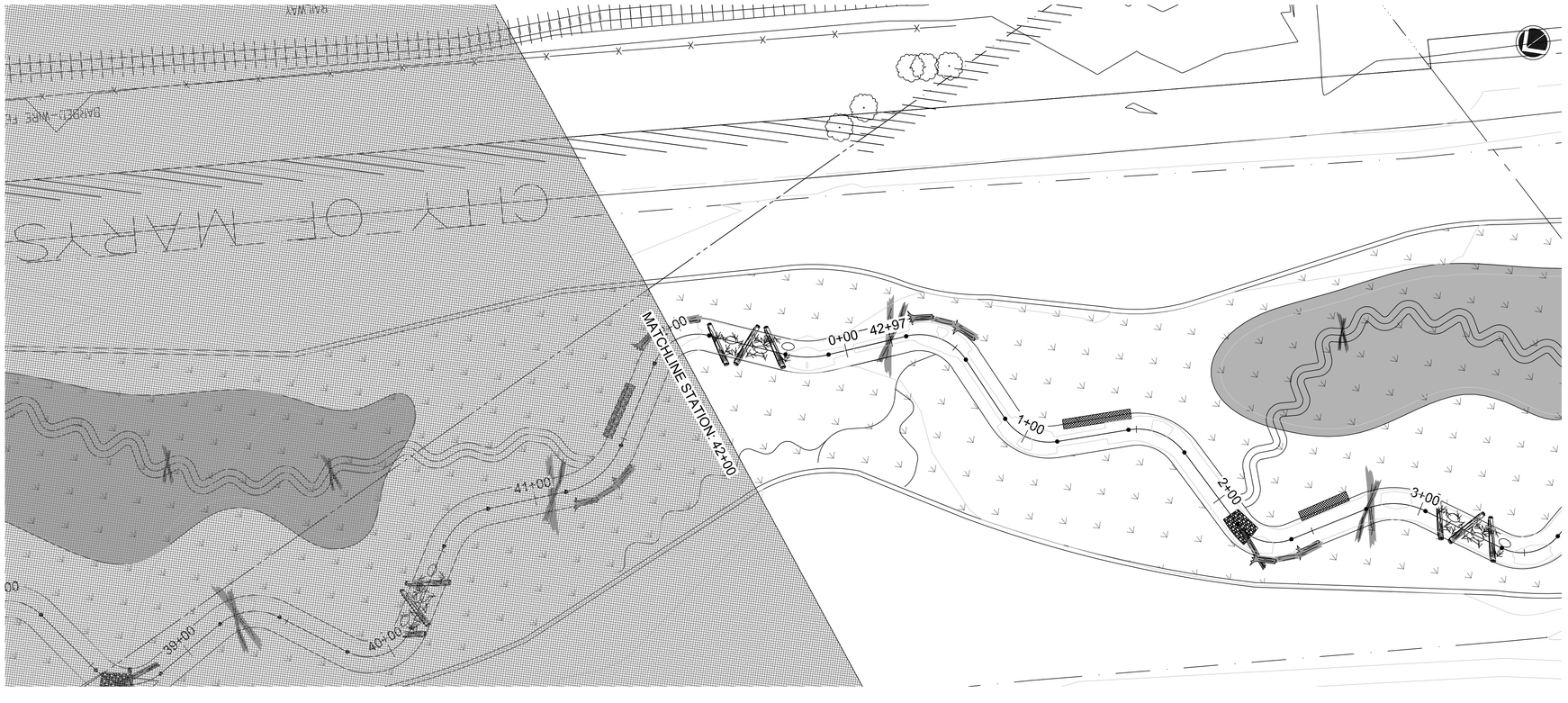
REVISIONS

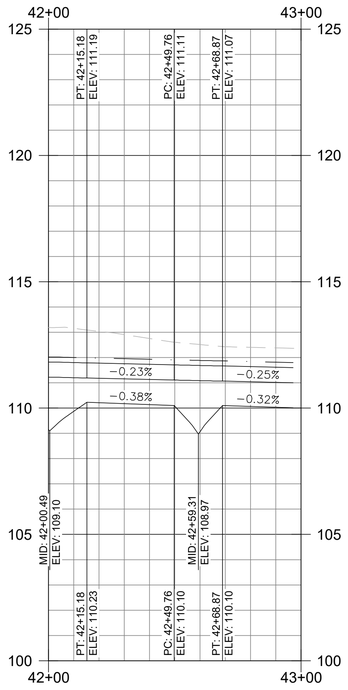
Date:	By:	Note:
09/30/20	JYZ	30% CONCEPT DESIGN
10/21/20	JYZ	30% REVISON
12/04/20	JYZ	60% DESIGN
12/10/20	JYZ	60% REVISION

Sheet No:

16 OF 47

D:\DROPBOX (SSR)\SWCA EDGECOMB CREEK\C3D\SHEETS\EDGECOMBCK 60PERCENT PP.DWG | JOSHUA.ALLEN | SAVED: Tuesday, December 22, 2020 11:14:24 AM | BDG STANDARD.CTB | | PLOTTED: Tuesday, December 22, 2020 11:20:31 AM





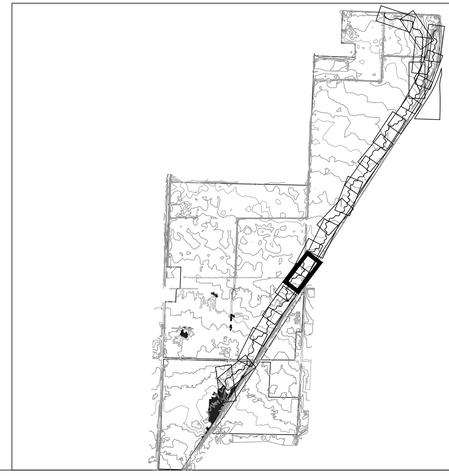
SCALE: HOR 1" =30"; VERT 1"= 3'

PLAN LEGEND

- PROPOSED STREAM CENTER LINE
- PROPOSED CHANNEL TOB
- EXISTING MAJOR CONTOUR
- EXISTING MINOR CONTOUR
- PROPOSED MAJOR CONTOUR
- PROPOSED MINOR CONTOUR
- PROPERTY BOUNDARY
- PROPOSED FLOOD TERRACE TOE/TOB
- PROPOSED FLOODPLAIN TOE
- EXISTING CONTOUR ELEVATION
- AUGMENTED GRAVEL RIFFLE
- LOG A-VANE
- OUTLET OUTFALL STRUCTURE
- FLOODPLAIN DEPRESSION
- BRUSH AND ROLL RIFFLE
- TOE WOOD
- ROCK AND ROLL RIFFLE
- BRUSH MATTRESS
- LOG VANE
- SPANNER LOG
- ROUGHENED TOE LOG
- DENDRITE CHANNEL
- WETLAND AREA

PROFILE LEGEND

- PROPOSED STREAM THALWEG
- PROPOSED BANKFULL TOB
- EXISTING GROUND
- FLOOD TERRACE TOP
- FLOODPLAIN TOE



NOT TO SCALE

Prepared by:

SWCA ENVIRONMENTAL CONSULTANTS

Operating in North Carolina as
SWCA Environmental Consulting
and Engineering of NC, PC

116 Alexandria Drive
Mooresville, NC 28115
(p) 919.624.1458

Prepared for:

NorthPoint DEVELOPMENT

ANSI D (22"x34") SCALE: 1" = 30'

0 15 30 60

TABLOID (11"x17") SCALE: 1" = 60'

0 30 60 120

Stamp:

Project Title:

EDGECOMB CREEK
60% DESIGN

Sheet Title:

PLAN AND PROFILE
REACH 2 - (8)

Date:	12/10/2020
Scale:	AS SHOWN
Drawn by:	JYZ
Checked by:	DMP
File #	

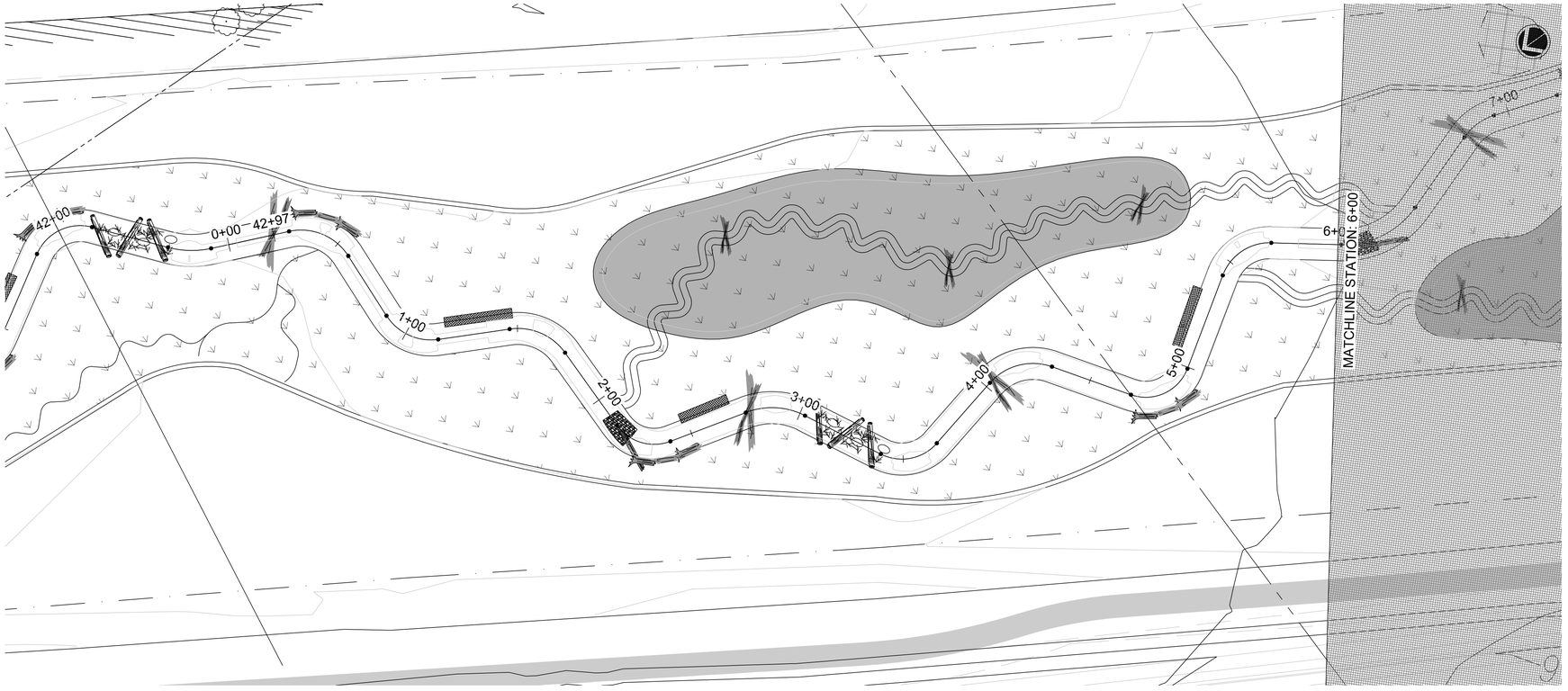
REVISIONS

Date:	By:	Note:
09/30/20	JYZ	30% CONCEPT DESIGN
10/21/20	JYZ	30% REVISON
12/04/20	JYZ	60% DESIGN
12/10/20	JYZ	60% REVISION

Sheet No:

17 OF 47

D:\DROPBOX (SSSR)\SWCA EDGECOMB CREEK\C3D\SHEETS\EDGECOMBCK 60PERCENT PP.DWG | JOSHUA.ALLEN | SAVED: Tuesday, December 22, 2020 11:21:03 AM | BDG STANDARD.CTB | | PLOTTED: Tuesday, December 22, 2020 11:14:24 AM



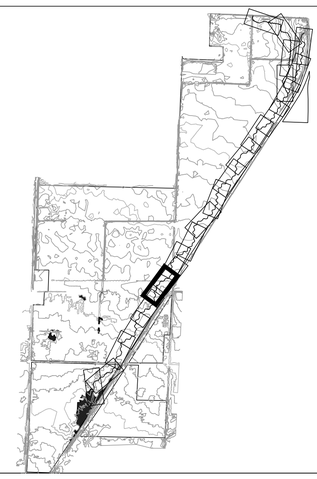
SCALE: HOR 1" =30"; VERT 1"= 3'

PLAN LEGEND

- PROPOSED STREAM CENTER LINE
- PROPOSED CHANNEL TOB
- EXISTING MAJOR CONTOUR
- EXISTING MINOR CONTOUR
- PROPOSED MAJOR CONTOUR
- PROPOSED MINOR CONTOUR
- PROPERTY BOUNDARY
- PROPOSED FLOOD TERRACE TOE/TOB
- PROPOSED FLOODPLAIN TOE
- EXISTING CONTOUR ELEVATION
- AUGMENTED GRAVEL RIFFLE
- LOG A-VANE
- OUTLET OUTFALL STRUCTURE
- FLOODPLAIN DEPRESSION
- BRUSH AND ROLL RIFFLE
- TOE WOOD
- ROCK AND ROLL RIFFLE
- BRUSH MATTRESS
- LOG VANE
- SPANNER LOG
- ROUGHENED TOE LOG
- DENDRITE CHANNEL
- WETLAND AREA

PROFILE LEGEND

- PROPOSED STREAM THALWEG
- PROPOSED BANKFULL TOB
- EXISTING GROUND
- FLOOD TERRACE TOP
- FLOODPLAIN TOE



NOT TO SCALE

Prepared by:

SWCA ENVIRONMENTAL CONSULTANTS

Operating in North Carolina as
SWCA Environmental Consulting
and Engineering of NC, PC

116 Alexandria Drive
Mooresville, NC 28115
(p) 919.624.1458

Prepared for:

NorthPoint DEVELOPMENT

ANSI D (22"x34") SCALE: 1" = 30'

0 15 30 60

TABLOID (11"x17") SCALE: 1" = 60'

0 30 60 120

Stamp:

Project Title:

EDGECOMB CREEK
60% DESIGN

Sheet Title:

PLAN AND PROFILE
REACH 3 - (1)

Date:	12/10/2020
Scale:	AS SHOWN
Drawn by:	JYZ
Checked by:	DMP
File #	

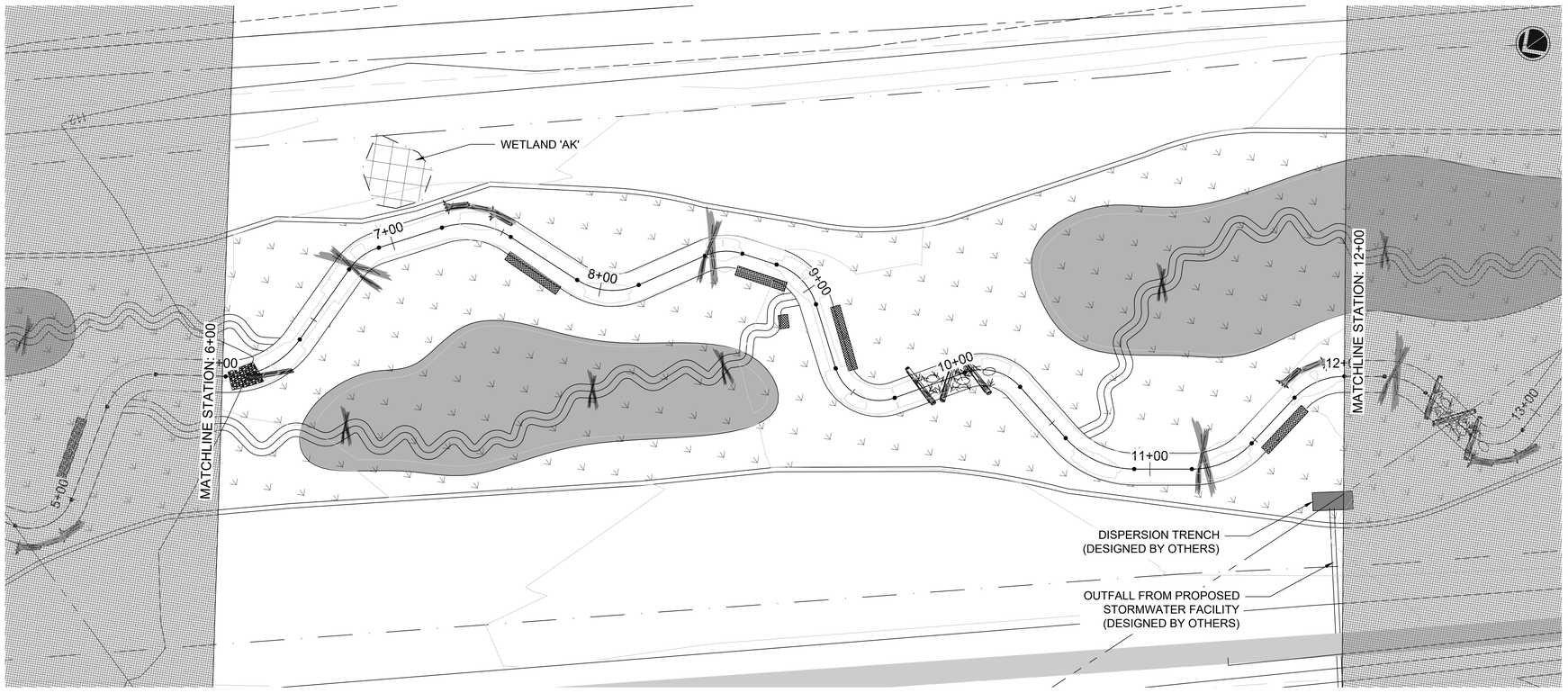
REVISIONS

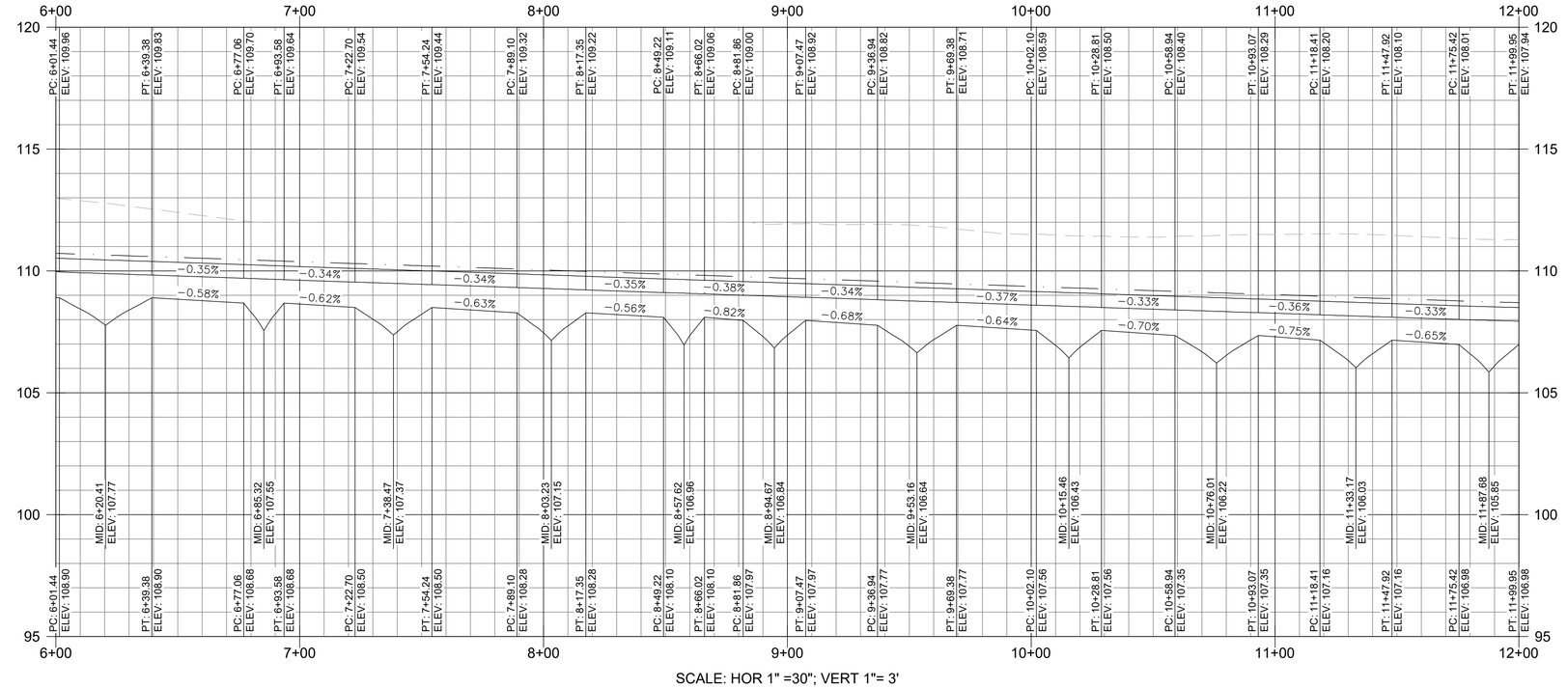
Date:	By:	Note:
09/30/20	JYZ	30% CONCEPT DESIGN
10/21/20	JYZ	30% REVISON
12/04/20	JYZ	60% DESIGN
12/10/20	JYZ	60% REVISION

Sheet No:

18 OF 47

D:\DROPBOX (SSR)\SWCA EDGECOMB CREEK\C3D\SHEETS\EDGECOMBCK 60PERCENT PP.DWG | JOSHUA.ALLEN | SAVED: Tuesday, December 22, 2020 11:14:24 AM | BDG STANDARD.CTB | | PLOTTED: Tuesday, December 22, 2020 11:21:36 AM





SCALE: HOR 1" =30"; VERT 1"= 3'

PLAN LEGEND

- PROPOSED STREAM CENTER LINE
- PROPOSED CHANNEL TOB
- EXISTING MAJOR CONTOUR
- EXISTING MINOR CONTOUR
- PROPOSED MAJOR CONTOUR
- PROPOSED MINOR CONTOUR
- PROPERTY BOUNDARY
- PROPOSED FLOOD TERRACE TOE/TOB
- PROPOSED FLOODPLAIN TOE
- EXISTING CONTOUR ELEVATION
- AUGMENTED GRAVEL RIFFLE
- LOG A-VANE
- OUTLET OUTFALL STRUCTURE
- FLOODPLAIN DEPRESSION
- BRUSH AND ROLL RIFFLE
- TOE WOOD
- ROCK AND ROLL RIFFLE
- BRUSH MATTRESS
- LOG VANE
- SPANNER LOG
- ROUGHENED TOE LOG
- DENDRITE CHANNEL
- WETLAND AREA

PROFILE LEGEND

- PROPOSED STREAM THALWEG
- PROPOSED BANKFULL TOB
- EXISTING GROUND
- FLOOD TERRACE TOP
- FLOODPLAIN TOE

NOT TO SCALE

Prepared by:
SWCA ENVIRONMENTAL CONSULTANTS
Operating in North Carolina as SWCA Environmental Consulting and Engineering of NC, PC
116 Alexandria Drive
Mooresville, NC 28115
(p) 919.624.1458

Prepared for:
NorthPoint DEVELOPMENT

ANSI D (22"x34") SCALE: 1" = 30'
0 15 30 60

TABLOID (11"x17") SCALE: 1" = 60'
0 30 60 120

Stamp:

Project Title:

EDGECOMB CREEK
60% DESIGN

Sheet Title:

PLAN AND PROFILE
REACH 3 - (2)

Date:	12/10/2020
Scale:	AS SHOWN
Drawn by:	JYZ
Checked by:	DMP
File #	

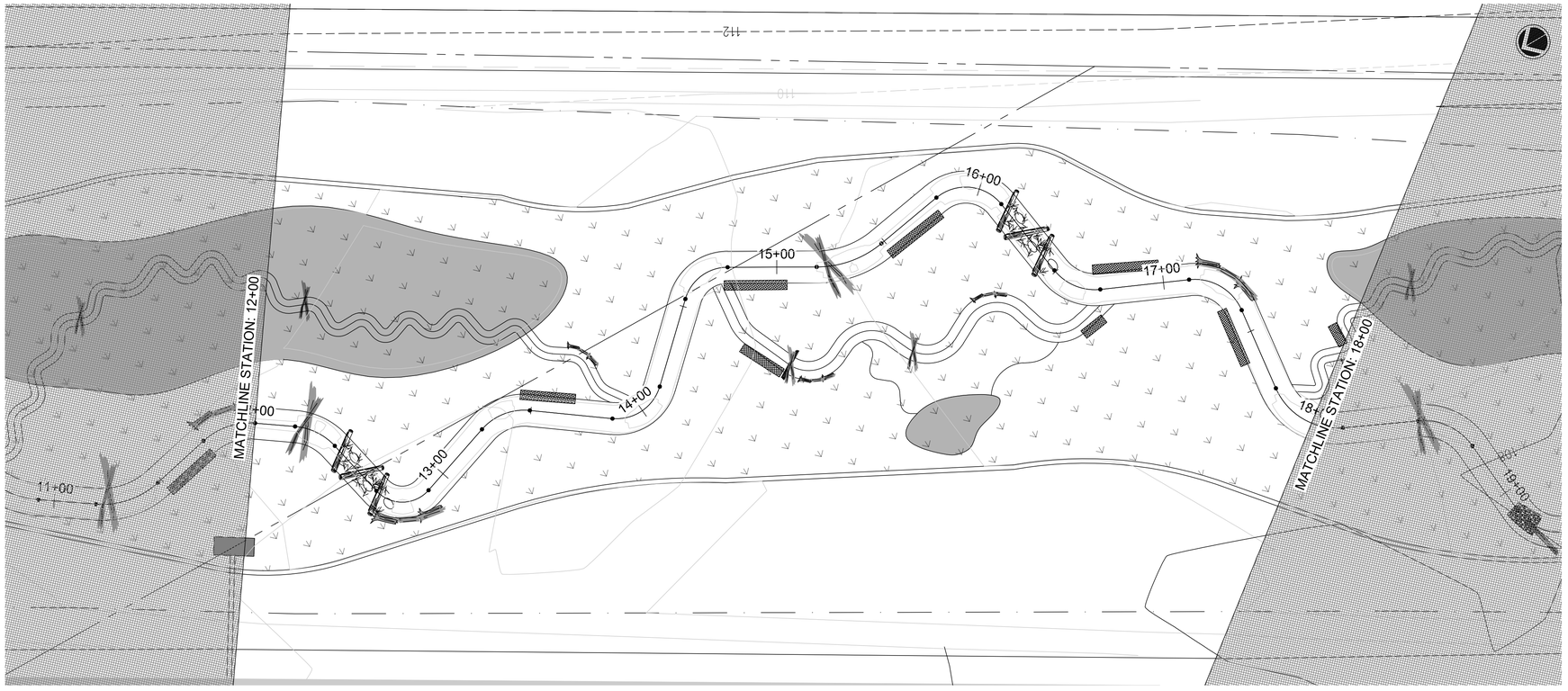
REVISIONS

Date:	By:	Note:
09/30/20	JYZ	30% CONCEPT DESIGN
10/21/20	JYZ	30% REVISON
12/04/20	JYZ	60% DESIGN
12/10/20	JYZ	60% REVISION

Sheet No:

19 OF 47

D:\DROPBOX (SSR)\SWCA EDGECOMB CREEK\C3D\SHEETS\EDGECOMBCK 60PERCENT PP.DWG | JOSHUA.ALLEN | SAVED: Tuesday, December 22, 2020 11:14:24 AM | BDG STANDARD.CTB | | PLOTTED: Tuesday, December 22, 2020 11:22:08 AM



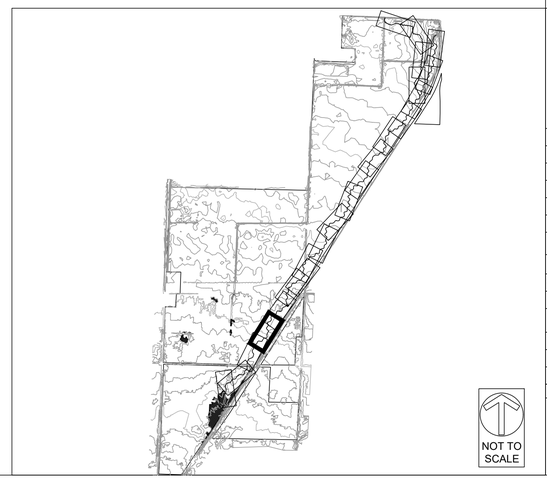
SCALE: HOR 1" =30"; VERT 1"= 3'

PLAN LEGEND

- PROPOSED STREAM CENTER LINE
- PROPOSED CHANNEL TOB
- EXISTING MAJOR CONTOUR
- EXISTING MINOR CONTOUR
- PROPOSED MAJOR CONTOUR
- PROPOSED MINOR CONTOUR
- PROPERTY BOUNDARY
- PROPOSED FLOOD TERRACE TOE/TOB
- PROPOSED FLOODPLAIN TOE
- EXISTING CONTOUR ELEVATION
- AUGMENTED GRAVEL RIFFLE
- LOG A-VANE
- OUTLET OUTFALL STRUCTURE
- FLOODPLAIN DEPRESSION
- BRUSH AND ROLL RIFFLE
- TOE WOOD
- ROCK AND ROLL RIFFLE
- BRUSH MATTRESS
- LOG VANE
- SPANNER LOG
- ROUGHENED TOE LOG
- DENDRITE CHANNEL
- WETLAND AREA

PROFILE LEGEND

- PROPOSED STREAM THALWEG
- PROPOSED BANKFULL TOB
- EXISTING GROUND
- FLOOD TERRACE TOP
- FLOODPLAIN TOE



NOT TO SCALE

Prepared by:

SWCA ENVIRONMENTAL CONSULTANTS

Operating in North Carolina as
SWCA Environmental Consulting
and Engineering of NC, PC

116 Alexandria Drive
Mooresville, NC 28115
(p) 919.624.1458

Prepared for:

NorthPoint DEVELOPMENT

ANSI D (22"x34") SCALE: 1" = 30'

0 15 30 60

TABLOID (11"x17") SCALE: 1" = 60'

0 30 60 120

Stamp:

Project Title:

EDGECOMB CREEK
60% DESIGN

Sheet Title:

PLAN AND PROFILE
REACH 3 - (3)

Date:	12/10/2020
Scale:	AS SHOWN
Drawn by:	JYZ
Checked by:	DMP
File #	

REVISIONS

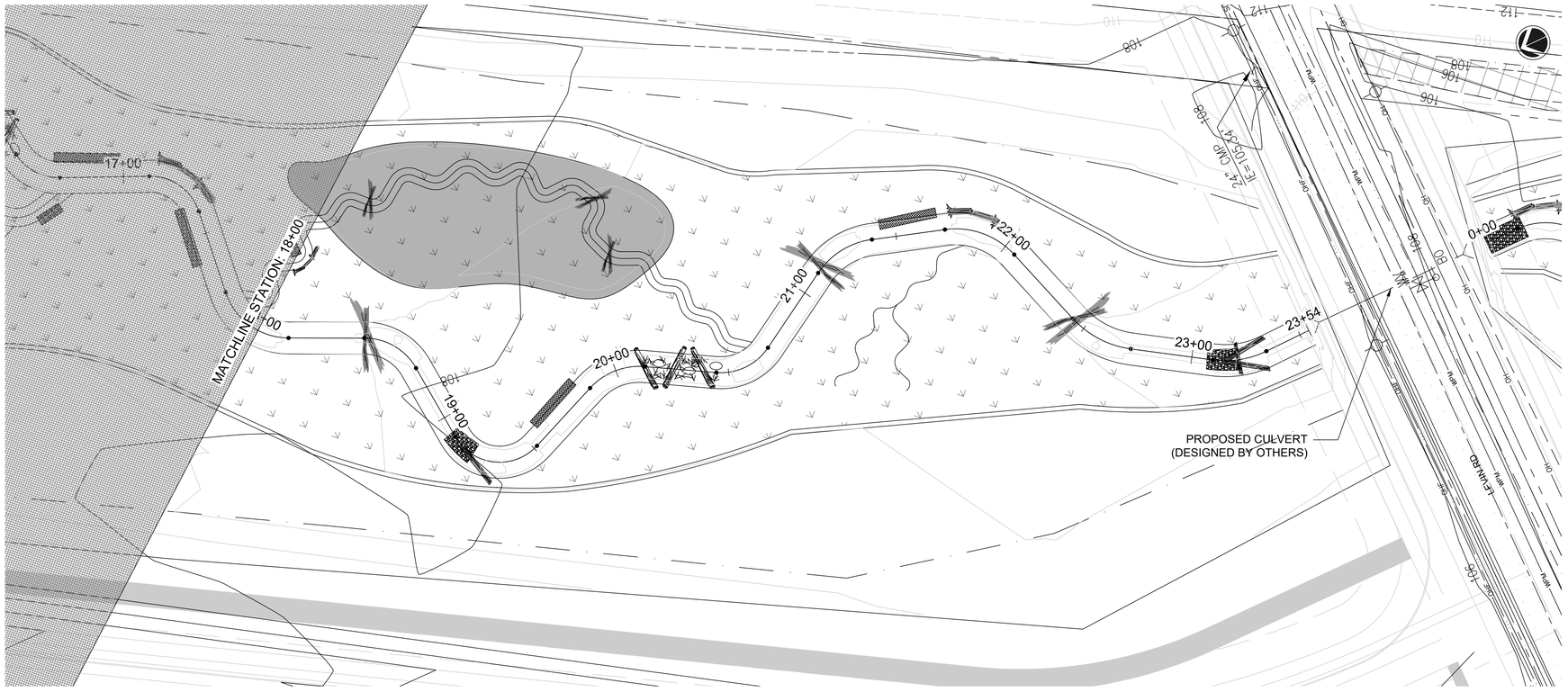
Date:	By:	Note:
09/30/20	JYZ	30% CONCEPT DESIGN
10/21/20	JYZ	30% REVISON
12/04/20	JYZ	60% DESIGN
12/10/20	JYZ	60% REVISION

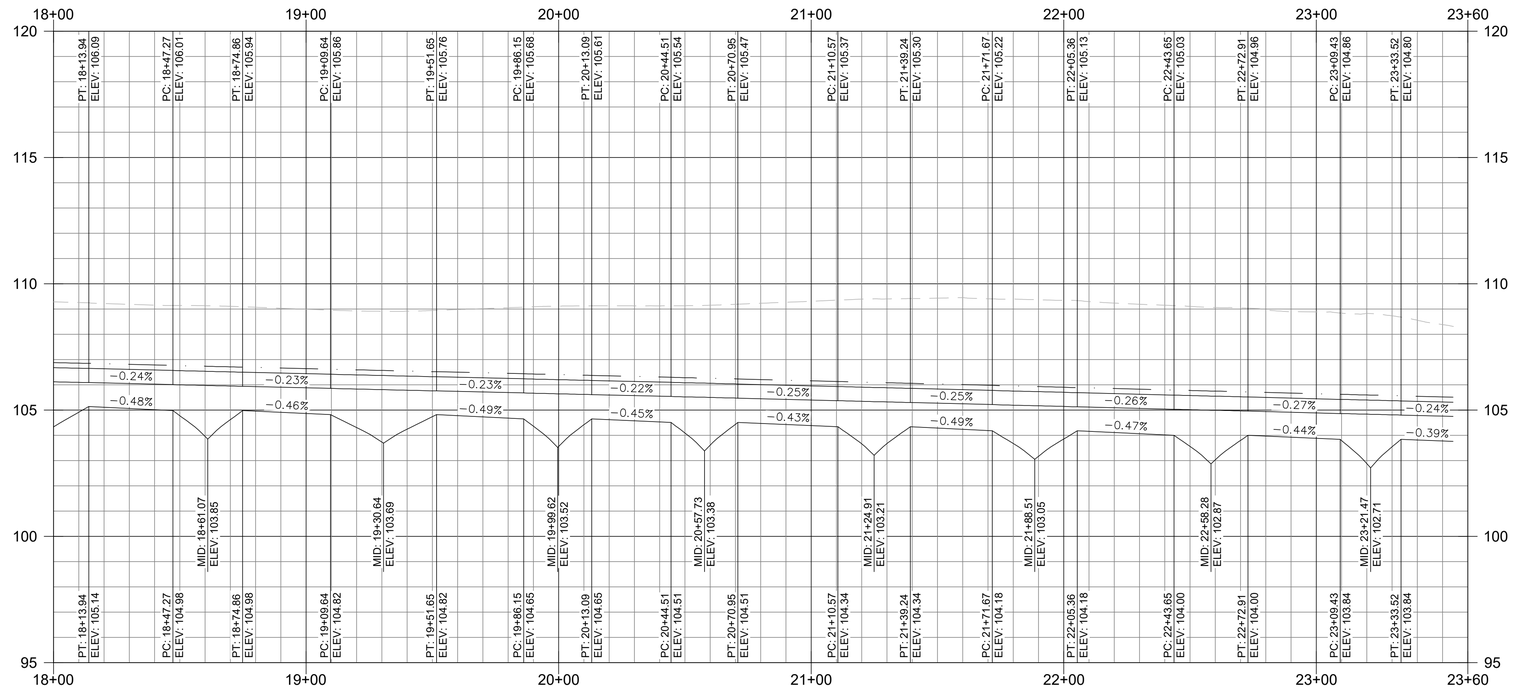
Sheet No:

20 OF 47

D:\DROPBOX (SSR)\SWCA EDGECOMB CREEK\C3D\SHEETS\EDGECOMBCK 60PERCENT PP.DWG | JOSHUA.ALLEN | SAVED: Tuesday, December 22, 2020 11:14:24 AM | BDG STANDARD.CTB | | PLOTTED: Tuesday, December 22, 2020 11:22:41 AM

D:\DROPBOX (SSR)\SWCA EDGECOMB CREEK\C3D\SHEETS\EDGECOMBCK 60PERCENT PP.DWG | JOSHUA.ALLEN | SAVED: Tuesday, December 22, 2020 11:14:24 AM | BDG STANDARD.CTB | | PLOTTED: Tuesday, December 22, 2020 11:23:15 AM





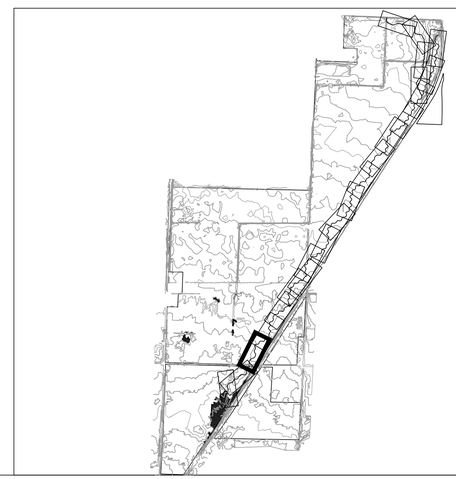
SCALE: HOR 1" =30"; VERT 1"= 3'

PLAN LEGEND

- PROPOSED STREAM CENTER LINE
- PROPOSED CHANNEL TOB
- EXISTING MAJOR CONTOUR
- EXISTING MINOR CONTOUR
- PROPOSED MAJOR CONTOUR
- PROPOSED MINOR CONTOUR
- PROPERTY BOUNDARY
- PROPOSED FLOOD TERRACE TOE/TOB
- PROPOSED FLOODPLAIN TOE
- EXISTING CONTOUR ELEVATION
- AUGMENTED GRAVEL RIFFLE
- LOG A-VANE
- OUTLET OUTFALL STRUCTURE
- FLOODPLAIN DEPRESSION
- BRUSH AND ROLL RIFFLE
- TOE WOOD
- ROCK AND ROLL RIFFLE
- BRUSH MATTRESS
- LOG VANE
- SPANNER LOG
- ROUGHENED TOE LOG
- DENDRITE CHANNEL
- WETLAND AREA

PROFILE LEGEND

- PROPOSED STREAM THALWEG
- PROPOSED BANKFULL TOB
- EXISTING GROUND
- FLOOD TERRACE TOP
- FLOODPLAIN TOE



NOT TO SCALE

Prepared by:

SWCA ENVIRONMENTAL CONSULTANTS

Operating in North Carolina as
SWCA Environmental Consulting
and Engineering of NC, PC

116 Alexandria Drive
Mooresville, NC 28115
(p) 919.624.1458

Prepared for:

NorthPoint DEVELOPMENT

ANSI D (22"x34") SCALE: 1" = 30'

0 15 30 60

TABLOID (11"x17") SCALE: 1" = 60'

0 30 60 120

Stamp:

Project Title:

EDGECOMB CREEK
60% DESIGN

Sheet Title:

PLAN AND PROFILE
REACH 3 - (4)

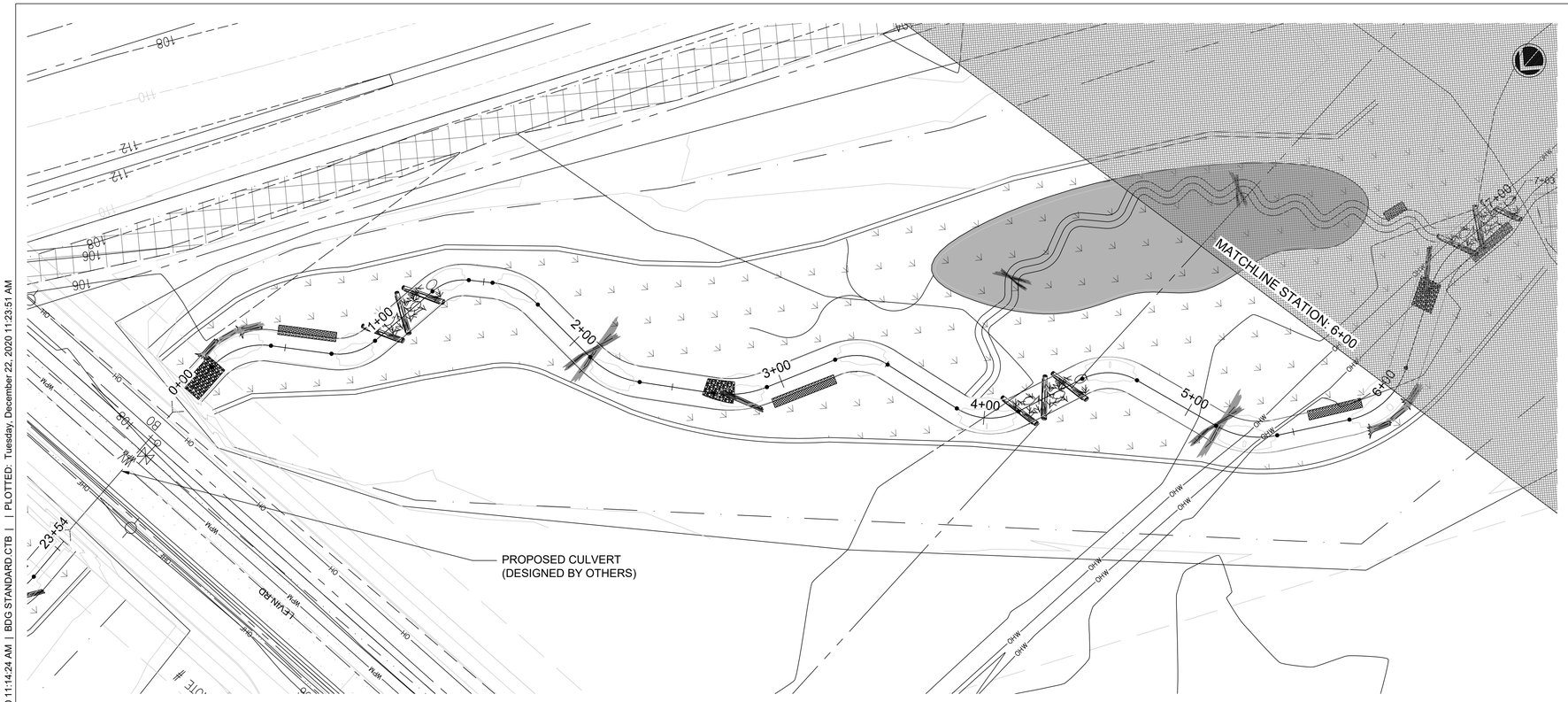
Date:	12/10/2020
Scale:	AS SHOWN
Drawn by:	JYZ
Checked by:	DMP
File #	

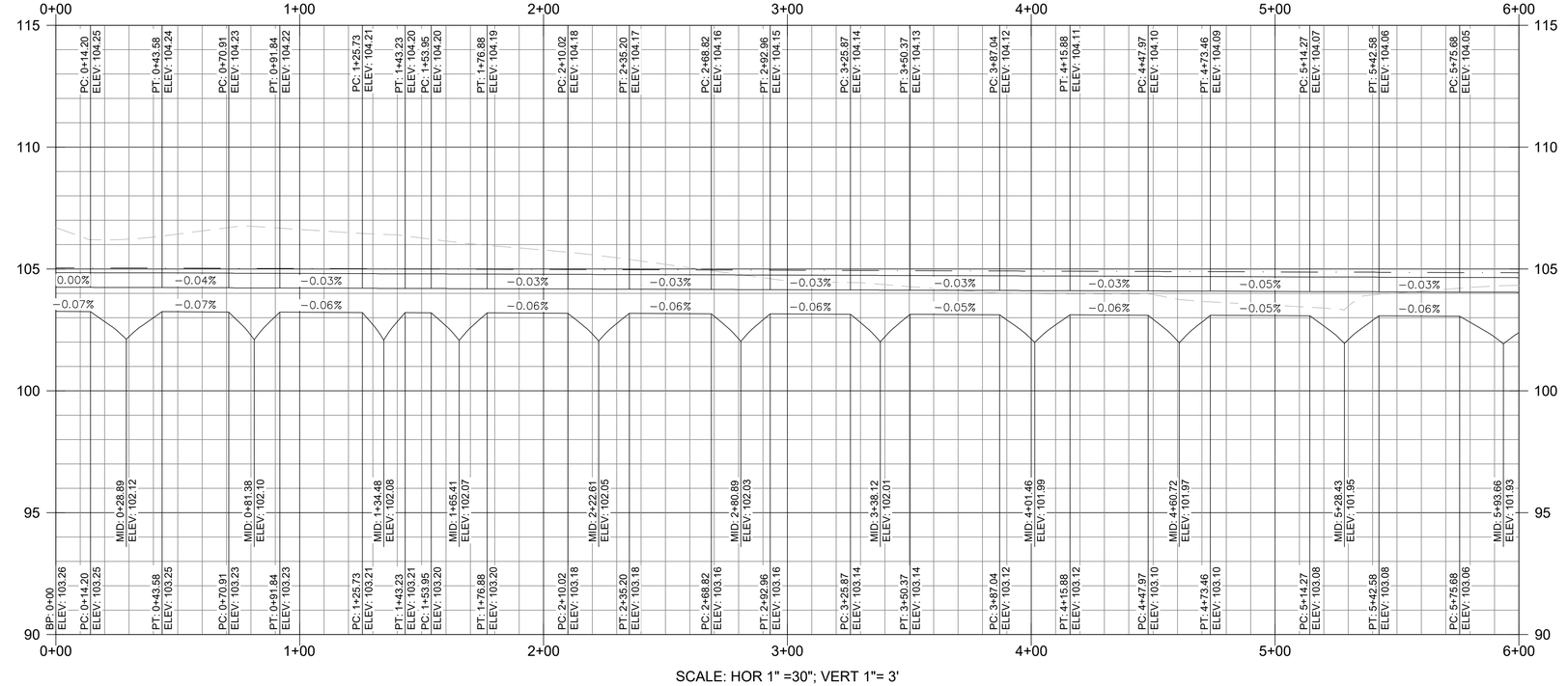
REVISIONS

Date:	By:	Note:
09/30/20	JYZ	30% CONCEPT DESIGN
10/21/20	JYZ	30% REVISON
12/04/20	JYZ	60% DESIGN
12/10/20	JYZ	60% REVISION

Sheet No:

21 OF 47





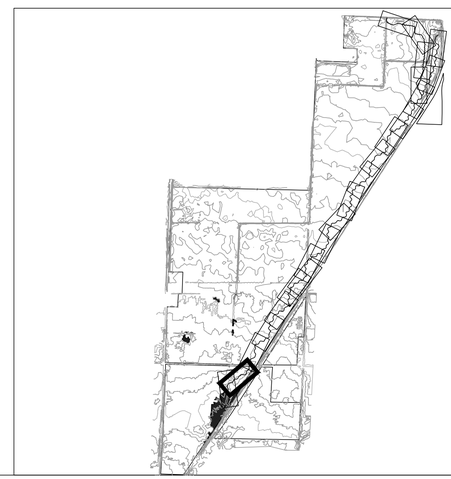
SCALE: HOR 1" =30"; VERT 1"= 3'

PLAN LEGEND

- PROPOSED STREAM CENTER LINE
- PROPOSED CHANNEL TOB
- EXISTING MAJOR CONTOUR
- EXISTING MINOR CONTOUR
- PROPOSED MAJOR CONTOUR
- PROPOSED MINOR CONTOUR
- PROPERTY BOUNDARY
- PROPOSED FLOOD TERRACE TOE/TOB
- PROPOSED FLOODPLAIN TOE
- EXISTING CONTOUR ELEVATION
- AUGMENTED GRAVEL RIFFLE
- LOG A-VANE
- OUTLET OUTFALL STRUCTURE
- FLOODPLAIN DEPRESSION
- BRUSH AND ROLL RIFFLE
- TOE WOOD
- ROCK AND ROLL RIFFLE
- BRUSH MATTRESS
- LOG VANE
- SPANNER LOG
- ROUGHENED TOE LOG
- DENDRITE CHANNEL
- WETLAND AREA

PROFILE LEGEND

- PROPOSED STREAM THALWEG
- PROPOSED BANKFULL TOB
- EXISTING GROUND
- FLOOD TERRACE TOP
- FLOODPLAIN TOE



NOT TO SCALE

Prepared by:
SWCA ENVIRONMENTAL CONSULTANTS
Operating in North Carolina as
SWCA Environmental Consulting
and Engineering of NC, PC
116 Alexandria Drive
Mooresville, NC 28115
(p) 919.624.1458

Prepared for:
NorthPoint DEVELOPMENT

ANSI D (22"x34") SCALE: 1" = 30'
0 15 30 60

TABLOID (11"x17") SCALE: 1" = 60'
0 30 60 120

Stamp:

Project Title:

EDGECOMB CREEK
60% DESIGN

Sheet Title:

PLAN AND PROFILE
REACH 4 - (1)

Date:	12/10/2020
Scale:	AS SHOWN
Drawn by:	JYZ
Checked by:	DMP
File #	

REVISIONS

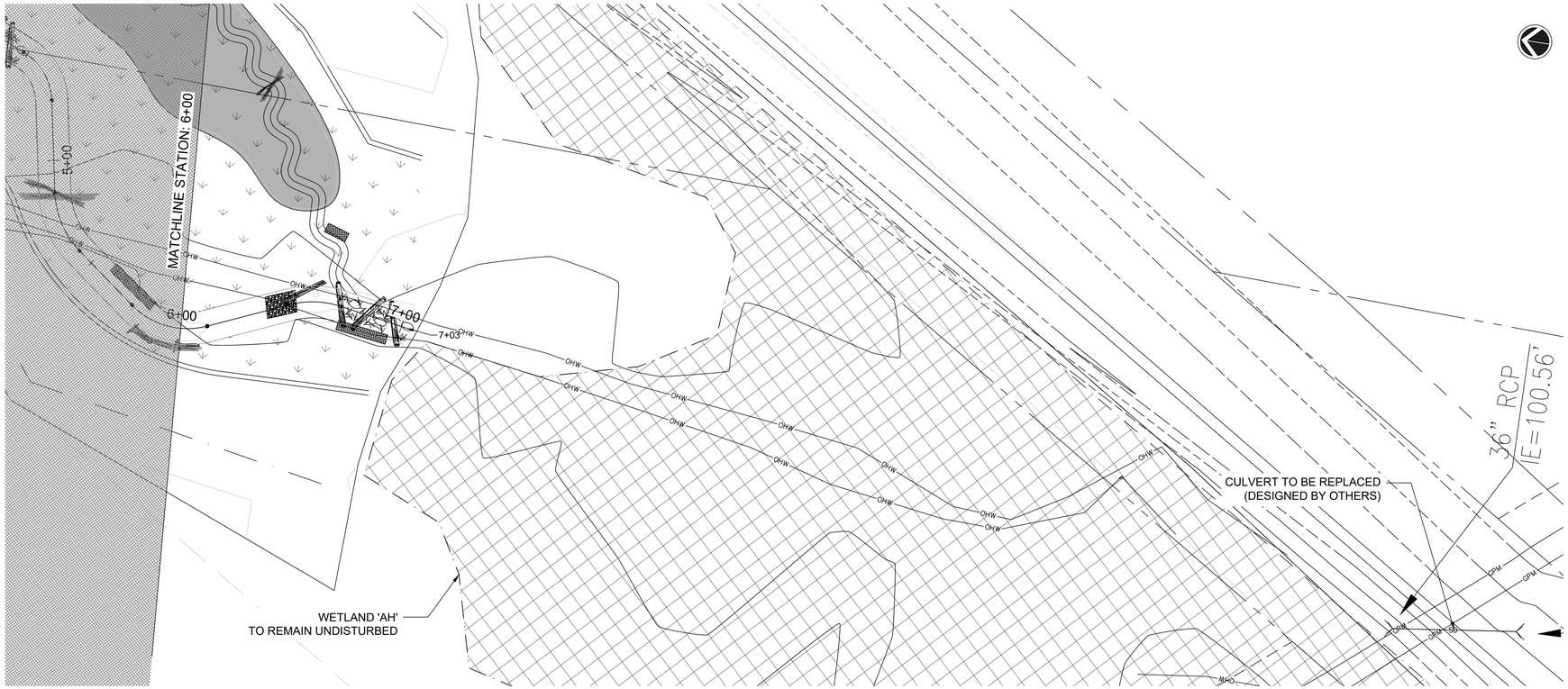
Date:	By:	Note:
09/30/20	JYZ	30% CONCEPT DESIGN
10/21/20	JYZ	30% REVISON
12/04/20	JYZ	60% DESIGN
12/10/20	JYZ	60% REVISION

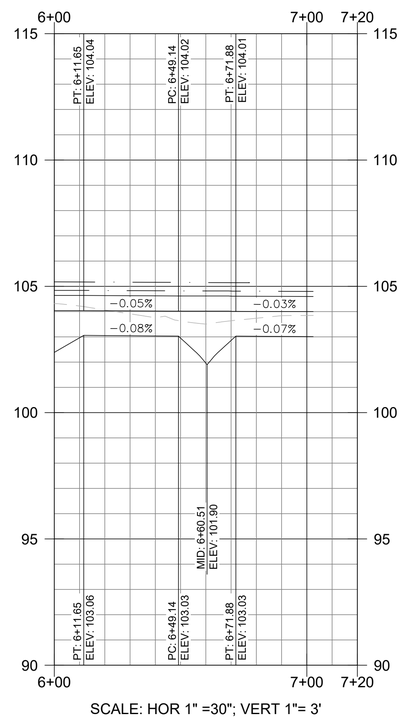
Sheet No:

22 OF 47

D:\DROPBOX (SSR)\SWCA EDGECOMB CREEK\C3D\SHEETS\EDGECOMBCK 60PERCENT PP.DWG | JOSHUA.ALLEN | SAVED: Tuesday, December 22, 2020 11:14:24 AM | BDG STANDARD.CTB | | PLOTTED: Tuesday, December 22, 2020 11:23:51 AM

D:\DROPBOX (SSSR)\SWCA EDGECOMB CREEK\C3D\SHEETS\EDGECOMBCK 60PERCENT PP.DWG | JOSHUA.ALLEN | SAVED: Tuesday, December 22, 2020 11:14:24 AM | BDG STANDARD.CTB | | PLOTTED: Tuesday, December 22, 2020 11:24:25 AM





SCALE: HOR 1" =30"; VERT 1"= 3'

PLAN LEGEND

- PROPOSED STREAM CENTER LINE
- PROPOSED CHANNEL TOB
- EXISTING MAJOR CONTOUR
- EXISTING MINOR CONTOUR
- PROPOSED MAJOR CONTOUR
- PROPOSED MINOR CONTOUR
- PROPERTY BOUNDARY
- PROPOSED FLOOD TERRACE TOE/TOB
- PROPOSED FLOODPLAIN TOE
- EXISTING CONTOUR ELEVATION
- AUGMENTED GRAVEL RIFFLE
- LOG A-VANE
- OUTLET OUTFALL STRUCTURE
- FLOODPLAIN DEPRESSION
- BRUSH AND ROLL RIFFLE
- TOE WOOD
- ROCK AND ROLL RIFFLE
- BRUSH MATTRESS
- LOG VANE
- SPANNER LOG
- ROUGHENED TOE LOG
- DENDRITE CHANNEL
- WETLAND AREA

PROFILE LEGEND

- PROPOSED STREAM THALWEG
- PROPOSED BANKFULL TOB
- EXISTING GROUND
- FLOOD TERRACE TOP
- FLOODPLAIN TOE

NOT TO SCALE

Prepared by:

SWCA ENVIRONMENTAL CONSULTANTS

Operating in North Carolina as
SWCA Environmental Consulting
and Engineering of NC, PC

116 Alexandria Drive
Mooresville, NC 28115
(p) 919.624.1458

Prepared for:

NorthPoint DEVELOPMENT

ANSI D (22"x34") SCALE: 1" = 30'

0 15 30 60

TABLOID (11"x17") SCALE: 1" = 60'

0 30 60 120

Stamp:

Project Title:

EDGECOMB CREEK
60% DESIGN

Sheet Title:

PLAN AND PROFILE
REACH 4 - (2)

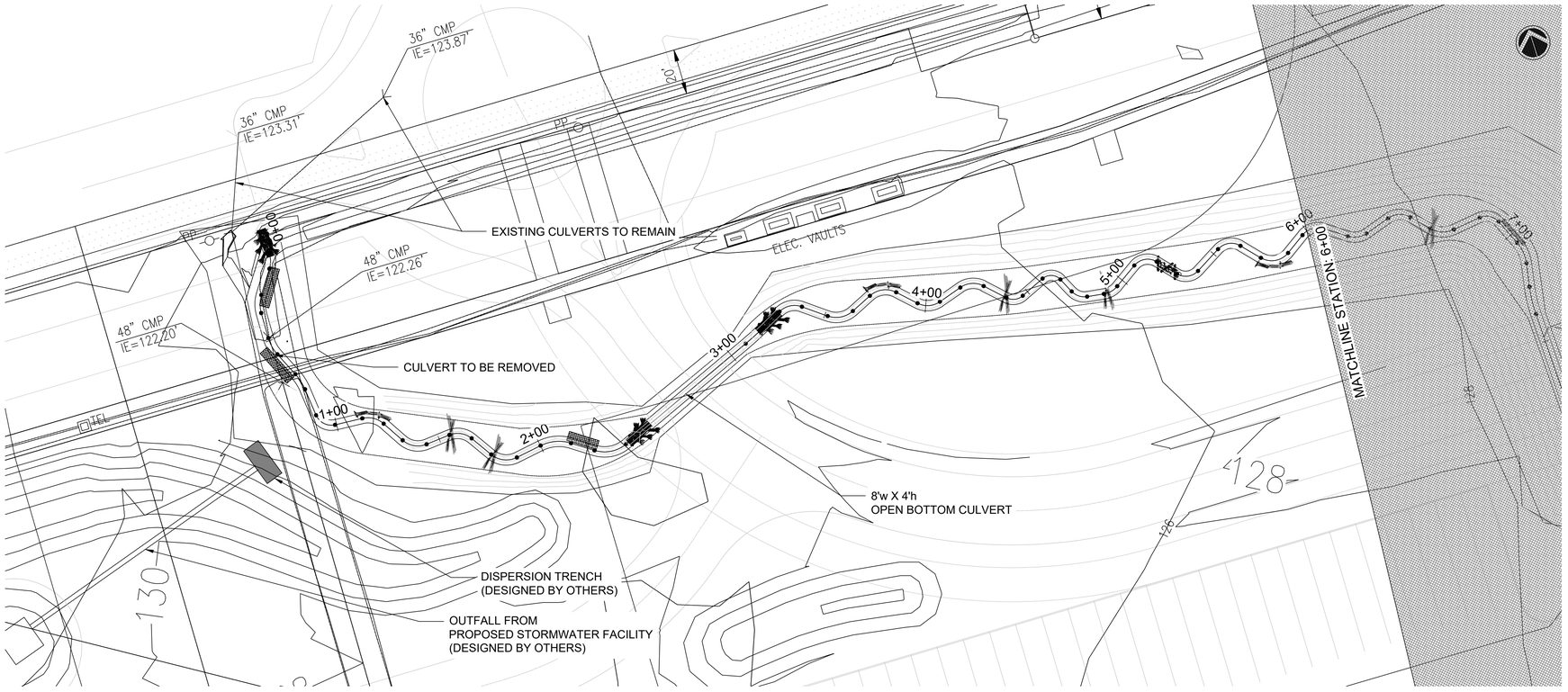
Date:	12/10/2020
Scale:	AS SHOWN
Drawn by:	JYZ
Checked by:	DMP
File #	

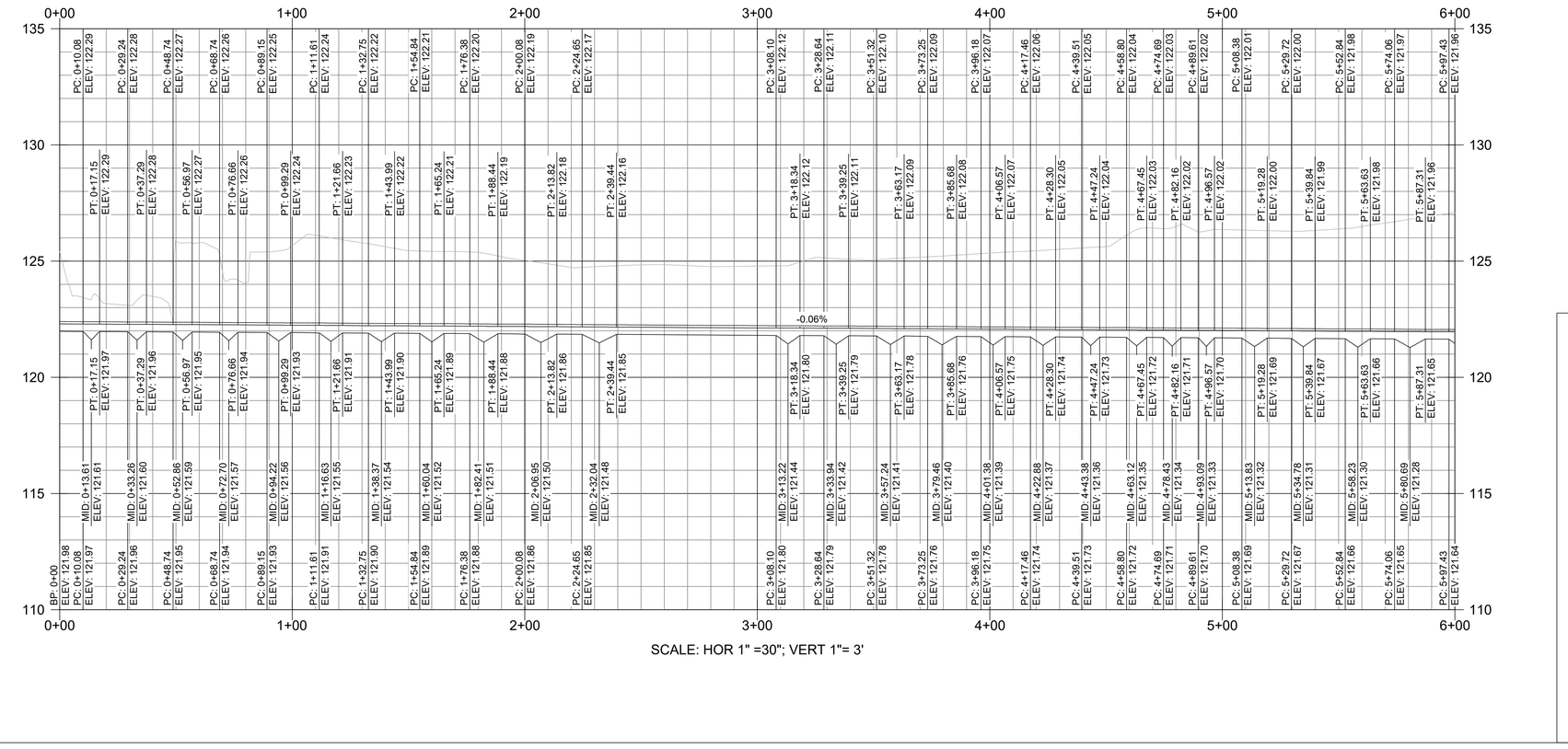
REVISIONS

Date:	By:	Note:
09/30/20	JYZ	30% CONCEPT DESIGN
10/21/20	JYZ	30% REVISON
12/04/20	JYZ	60% DESIGN
12/10/20	JYZ	60% REVISION

Sheet No:

23 OF 47





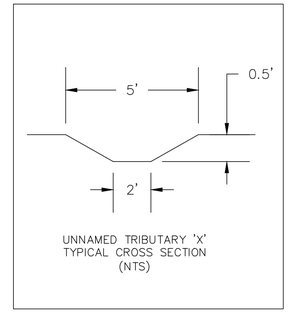
SCALE: HOR 1" =30"; VERT 1"= 3'

PLAN LEGEND

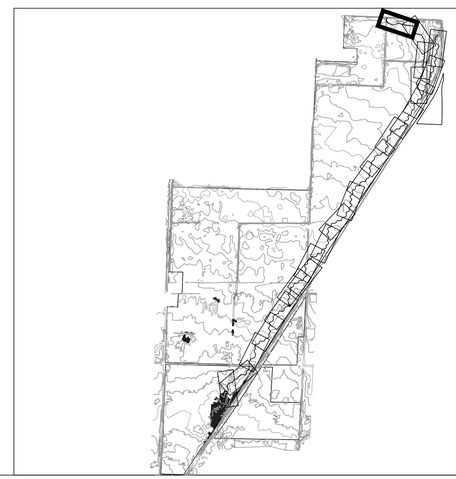
- PROPOSED STREAM CENTER LINE
- PROPOSED CHANNEL TOB
- EXISTING MAJOR CONTOUR
- EXISTING MINOR CONTOUR
- PROPOSED MAJOR CONTOUR
- PROPOSED MINOR CONTOUR
- PROPERTY BOUNDARY
- PROPOSED FLOOD TERRACE TOE/TOB
- PROPOSED FLOODPLAIN TOE
- EXISTING CONTOUR ELEVATION
- AUGMENTED GRAVEL RIFFLE
- LOG A-VANE
- OUTLET OUTFALL STRUCTURE
- FLOODPLAIN DEPRESSION
- BRUSH AND ROLL RIFFLE
- TOE WOOD
- ROCK AND ROLL RIFFLE
- BRUSH MATTRESS
- LOG VANE
- SPANNER LOG
- ROUGHENED TOE LOG
- DENDRITE CHANNEL
- AREA STABILIZED BY VEGETATED SOIL LIFTS
- AREA STABILIZED BY MATTING

PROFILE LEGEND

- PROPOSED STREAM THALWEG
- PROPOSED BANKFULL TOB
- EXISTING GROUND
- FLOOD TERRACE TOP
- FLOODPLAIN TOE



UNNAMED TRIBUTARY 'X'
TYPICAL CROSS SECTION
(NTS)



NOT TO SCALE

Prepared by:
SWCA ENVIRONMENTAL CONSULTANTS
Operating in North Carolina as
SWCA Environmental Consulting
and Engineering of NC, PC
116 Alexandria Drive
Mooresville, NC 28115
(p) 919.624.1458

Prepared for:
NorthPoint DEVELOPMENT

ANSI D (22"x34") SCALE: 1" = 30'
0 15 30 60

TABLOID (11"x17") SCALE: 1" = 60'
0 30 60 120

Stamp:

Project Title:

EDGECOMB CREEK
60% DESIGN

Sheet Title:

PLAN AND PROFILE
UNNAMED
TRIBUTARY X - (1)

Date:	12/10/2020
Scale:	AS SHOWN
Drawn by:	JYZ
Checked by:	DMP
File #	

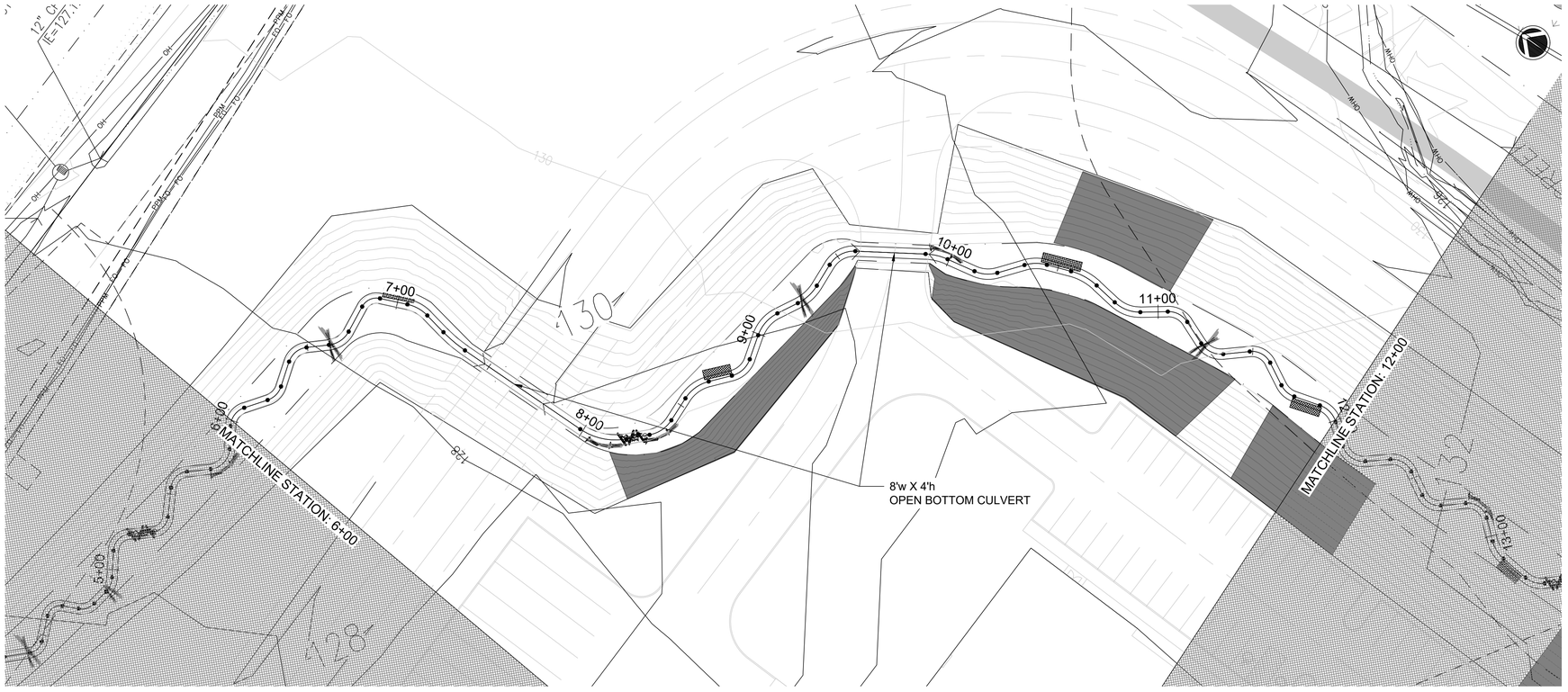
REVISIONS

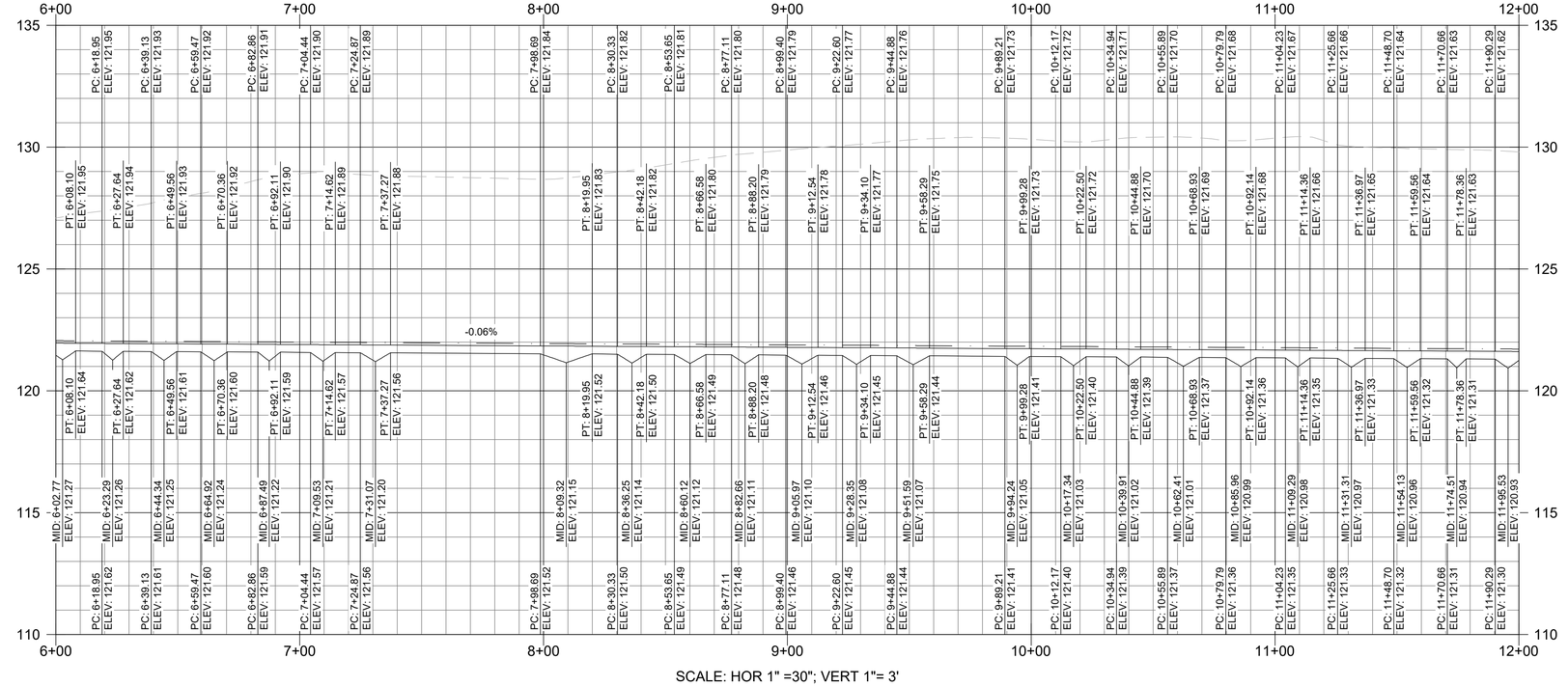
Date:	By:	Note:
09/30/20	JYZ	30% CONCEPT DESIGN
10/21/20	JYZ	30% REVISON
12/04/20	JYZ	60% DESIGN
12/10/20	JYZ	60% REVISION

Sheet No:

24 OF 47

D:\DROPBOX (SSR)\SWCA EDGECOMB CREEK\C3D\SHEETS\EDGECOMBCK 60PERCENT PP.DWG | JOSHUA.ALLEN | SAVED: Tuesday, December 22, 2020 11:14:24 AM | BDG STANDARD.CTB | | PLOTTED: Tuesday, December 22, 2020 11:25:00 AM





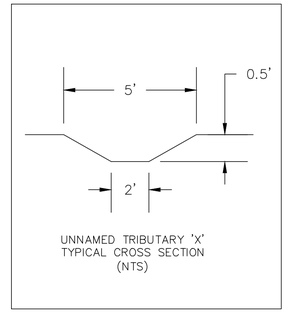
SCALE: HOR 1" =30"; VERT 1"= 3'

PLAN LEGEND

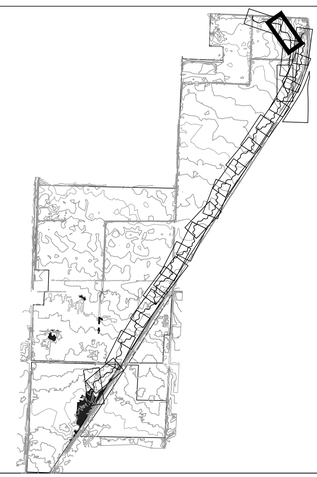
- PROPOSED STREAM CENTER LINE
- PROPOSED CHANNEL TOB
- EXISTING MAJOR CONTOUR
- EXISTING MINOR CONTOUR
- PROPOSED MAJOR CONTOUR
- PROPOSED MINOR CONTOUR
- PROPERTY BOUNDARY
- PROPOSED FLOOD TERRACE TOE/TOB
- PROPOSED FLOODPLAIN TOE
- EXISTING CONTOUR ELEVATION
- AUGMENTED GRAVEL RIFFLE
- LOG A-VANE
- OUTLET OUTFALL STRUCTURE
- FLOODPLAIN DEPRESSION
- BRUSH AND ROLL RIFFLE
- TOE WOOD
- ROCK AND ROLL RIFFLE
- BRUSH MATTRESS
- LOG VANE
- SPANNER LOG
- ROUGHENED TOE LOG
- DENDRITE CHANNEL
- AREA STABILIZED BY VEGETATED SOIL LIFTS
- AREA STABILIZED BY MATTING

PROFILE LEGEND

- PROPOSED STREAM THALWEG
- PROPOSED BANKFULL TOB
- EXISTING GROUND
- FLOOD TERRACE TOP
- FLOODPLAIN TOE



UNNAMED TRIBUTARY 'X'
TYPICAL CROSS SECTION
(NTS)



NOT TO SCALE

Prepared by:
SWCA ENVIRONMENTAL CONSULTANTS
Operating in North Carolina as SWCA Environmental Consulting and Engineering of NC, PC
116 Alexandria Drive
Mooresville, NC 28115
(p) 919.624.1458

Prepared for:
NorthPoint DEVELOPMENT

ANSI D (22"x34") SCALE: 1" = 30'
0 15 30 60

TABLOID (11"x17") SCALE: 1" = 60'
0 30 60 120

Stamp:

Project Title:
EDGECOMB CREEK
60% DESIGN

Sheet Title:
PLAN AND PROFILE
UNNAMED
TRIBUTARY 'X'
- (2)

Date:	12/10/2020
Scale:	AS SHOWN
Drawn by:	JYZ
Checked by:	DMP
File #	

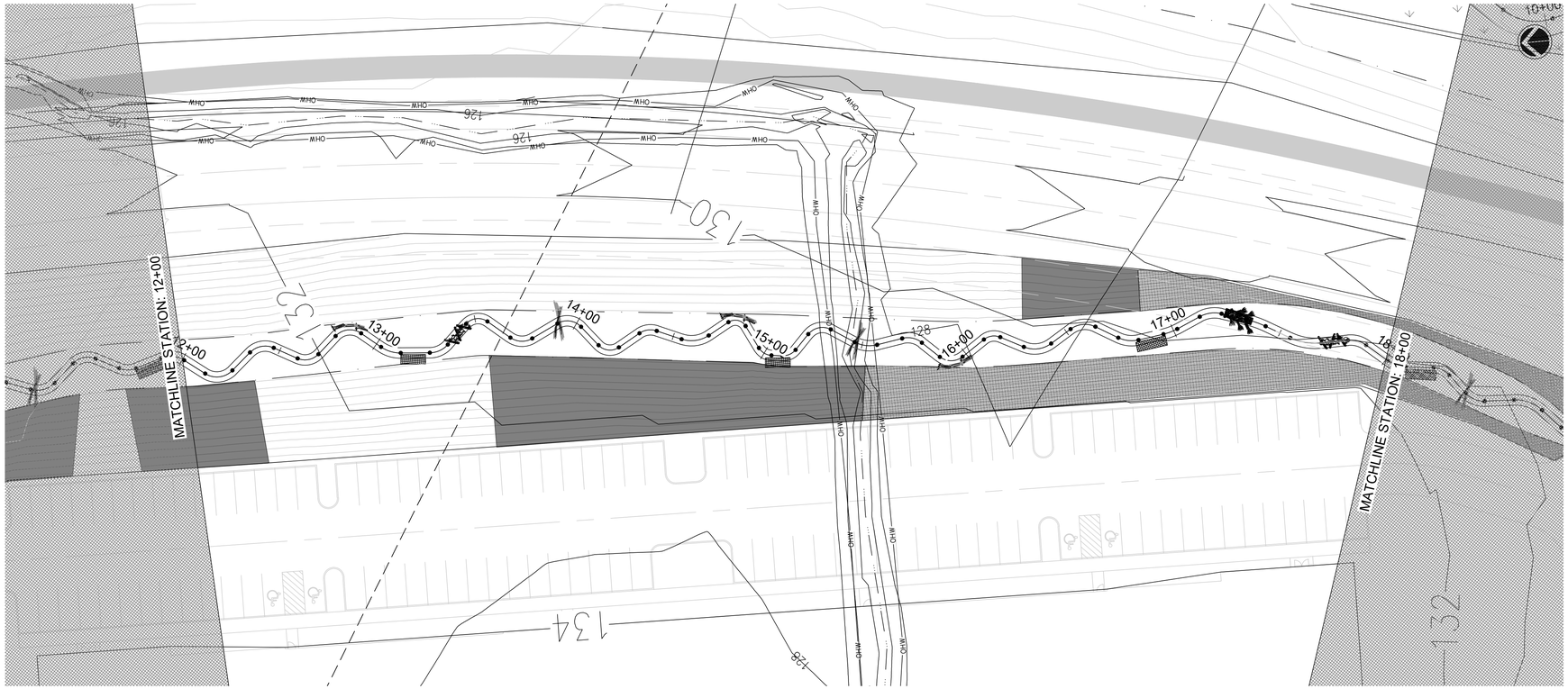
REVISIONS

Date:	By:	Note:
09/30/20	JYZ	30% CONCEPT DESIGN
10/21/20	JYZ	30% REVISON
12/04/20	JYZ	60% DESIGN
12/10/20	JYZ	60% REVISION

Sheet No:
25 OF 47

D:\DROPBOX (SSR)\SWCA EDGECOMB CREEK\C3D\SHEETS\EDGECOMBCK 60PERCENT PP.DWG | JOSHUA.ALLEN | SAVED: Tuesday, December 22, 2020 11:14:24 AM | BDG STANDARD.CTB | | PLOTTED: Tuesday, December 22, 2020 11:25:32 AM

D:\DROPBOX (SSR)\SWCA EDGECOMB CREEK\C3D\SHEETS\EDGECOMBCK 60PERCENT PP.DWG | JOSHUA.ALLEN | SAVED: Tuesday, December 22, 2020 11:14:24 AM | BDG STANDARD.CTB | | PLOTTED: Tuesday, December 22, 2020 11:26:07 AM

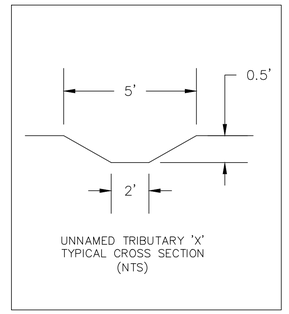


PLAN LEGEND

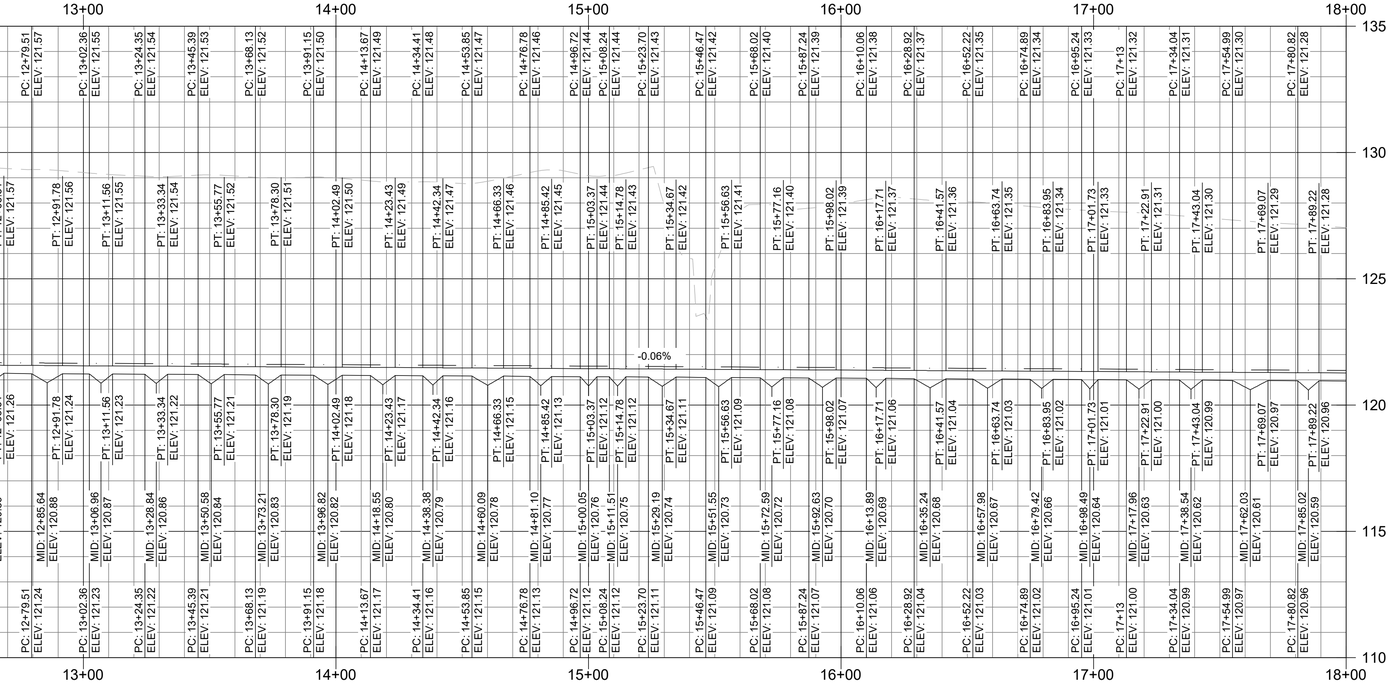
- PROPOSED STREAM CENTER LINE
- PROPOSED CHANNEL TOB
- EXISTING MAJOR CONTOUR
- EXISTING MINOR CONTOUR
- PROPOSED MAJOR CONTOUR
- PROPOSED MINOR CONTOUR
- PROPERTY BOUNDARY
- PROPOSED FLOOD TERRACE TOE/TOB
- PROPOSED FLOODPLAIN TOE
- EXISTING CONTOUR ELEVATION
- AUGMENTED GRAVEL RIFFLE
- LOG A-VANE
- OUTLET OUTFALL STRUCTURE
- FLOODPLAIN DEPRESSION
- BRUSH AND ROLL RIFFLE
- TOE WOOD
- ROCK AND ROLL RIFFLE
- BRUSH MATTRESS
- LOG VANE
- SPANNER LOG
- ROUGHENED TOE LOG
- DENDRITE CHANNEL
- AREA STABILIZED BY VEGETATED SOIL LIFTS
- AREA STABILIZED BY MATTING

PROFILE LEGEND

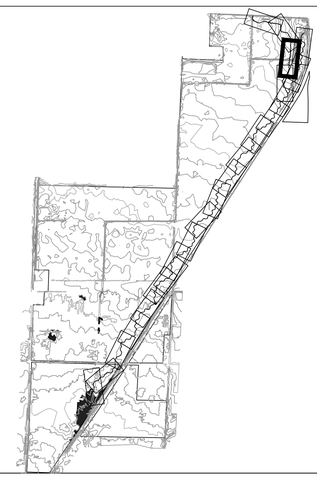
- PROPOSED STREAM THALWEG
- PROPOSED BANKFULL TOB
- EXISTING GROUND
- FLOOD TERRACE TOP
- FLOODPLAIN TOE



UNNAMED TRIBUTARY 'X'
TYPICAL CROSS SECTION
(NTS)



SCALE: HOR 1" =30"; VERT 1"= 3'



NOT TO SCALE

Prepared by:

SWCA ENVIRONMENTAL CONSULTANTS

Operating in North Carolina as
SWCA Environmental Consulting
and Engineering of NC, PC

116 Alexandria Drive
Mooresville, NC 28115
(p) 919.624.1458

Prepared for:

NorthPoint DEVELOPMENT

ANSI D (22"x34") SCALE: 1" = 30'

0 15 30 60

TABLOID (11"x17") SCALE: 1" = 60'

0 30 60 120

Stamp:

Project Title:

EDGECOMB CREEK
60% DESIGN

Sheet Title:

PLAN AND PROFILE
UNNAMED
TRIBUTARY X - (3)

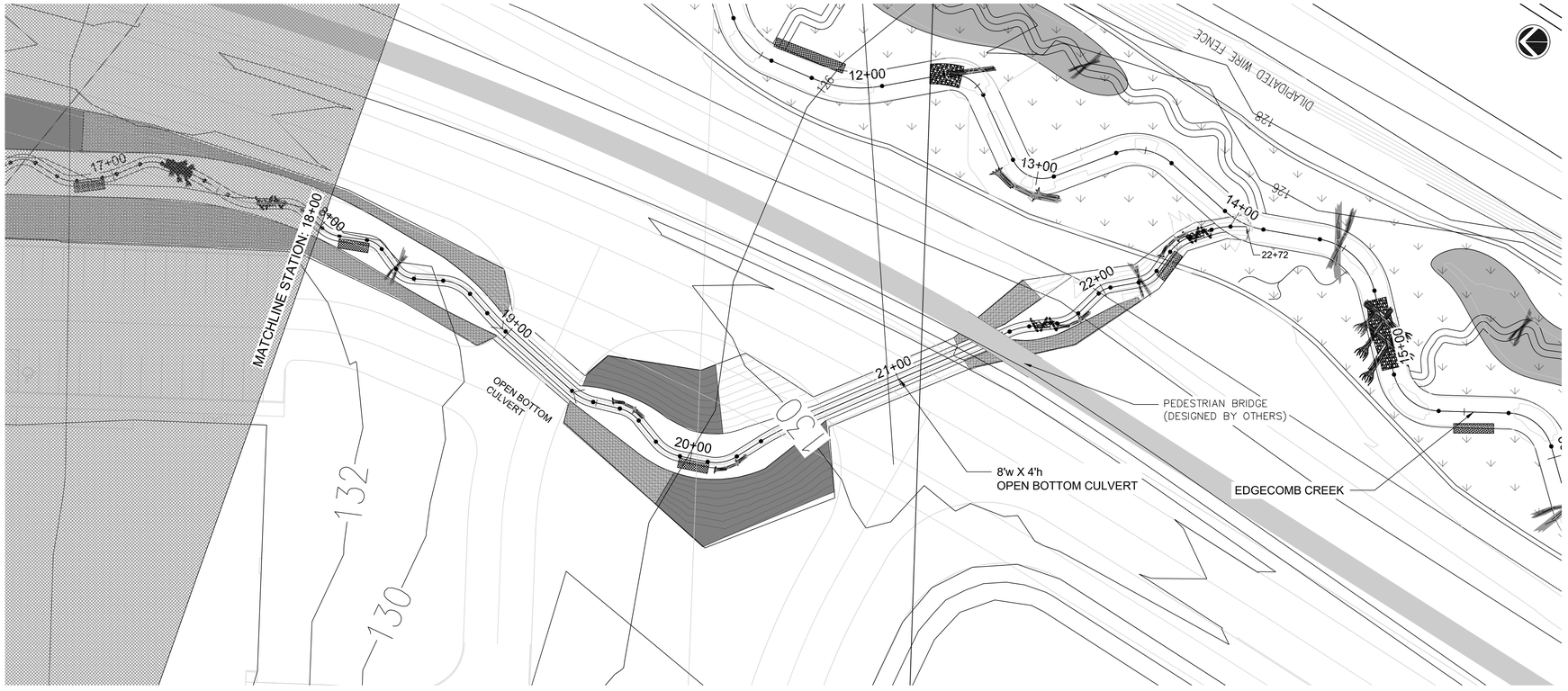
Date:	12/10/2020
Scale:	AS SHOWN
Drawn by:	JYZ
Checked by:	DMP
File #	

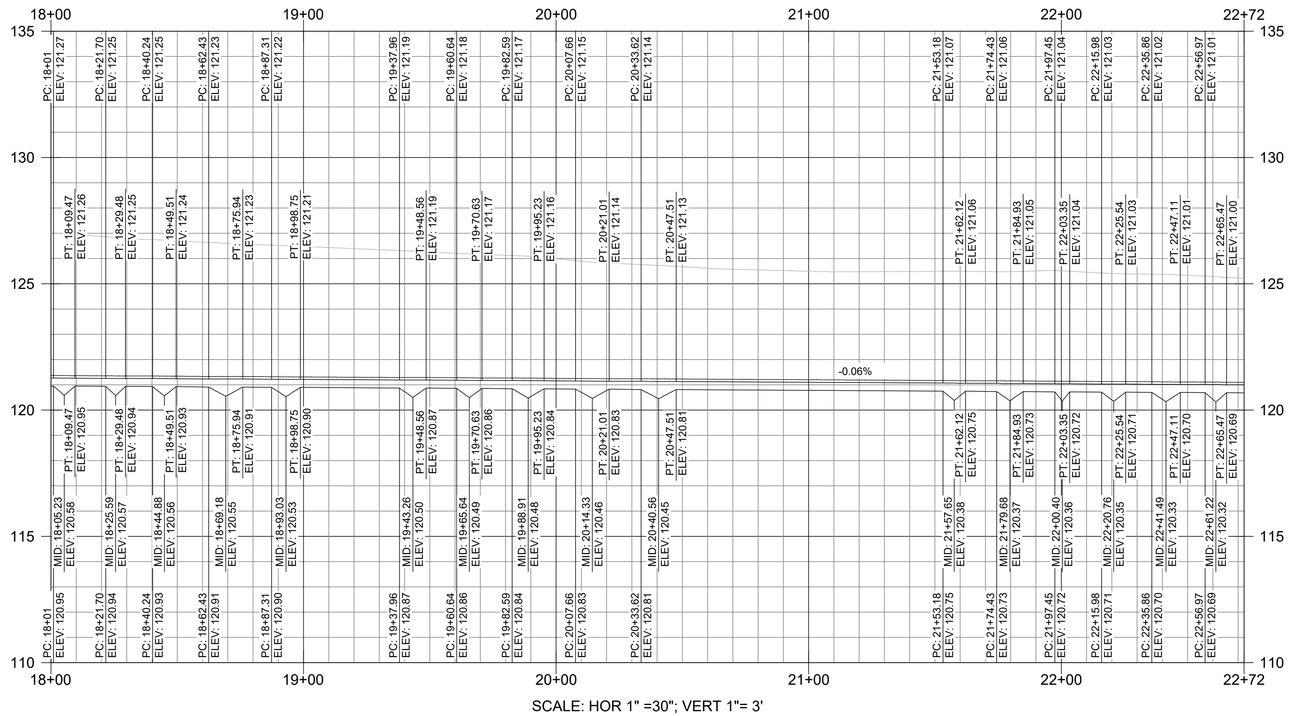
REVISIONS

Date:	By:	Note:
09/30/20	JYZ	30% CONCEPT DESIGN
10/21/20	JYZ	30% REVISON
12/04/20	JYZ	60% DESIGN
12/10/20	JYZ	60% REVISION

Sheet No:

26 OF 47





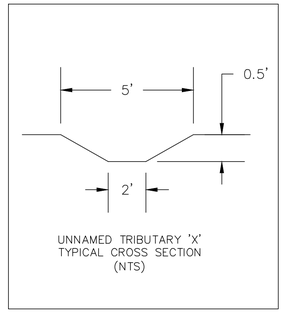
SCALE: HOR 1" =30"; VERT 1"= 3'

PLAN LEGEND

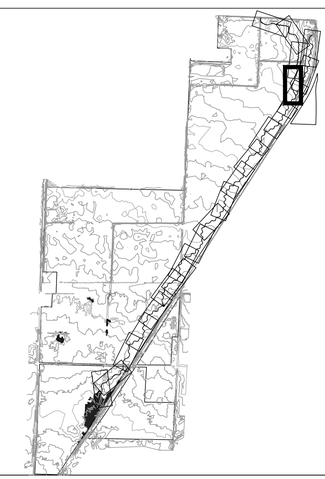
- PROPOSED STREAM CENTER LINE
- PROPOSED CHANNEL TOB
- EXISTING MAJOR CONTOUR
- EXISTING MINOR CONTOUR
- PROPOSED MAJOR CONTOUR
- PROPOSED MINOR CONTOUR
- PROPERTY BOUNDARY
- PROPOSED FLOOD TERRACE TOE/TOB
- PROPOSED FLOODPLAIN TOE
- EXISTING CONTOUR ELEVATION
- AUGMENTED GRAVEL RIFFLE
- LOG A-VANE
- OUTLET OUTFALL STRUCTURE
- FLOODPLAIN DEPRESSION
- BRUSH AND ROLL RIFFLE
- TOE WOOD
- ROCK AND ROLL RIFFLE
- BRUSH MATTRESS
- LOG VANE
- SPANNER LOG
- ROUGHENED TOE LOG
- DENDRITE CHANNEL
- AREA STABILIZED BY VEGETATED SOIL LIFTS
- AREA STABILIZED BY MATTING

PROFILE LEGEND

- PROPOSED STREAM THALWEG
- PROPOSED BANKFULL TOB
- EXISTING GROUND
- FLOOD TERRACE TOP
- FLOODPLAIN TOE



UNNAMED TRIBUTARY 'X'
TYPICAL CROSS SECTION
(NTS)



NOT TO SCALE

Prepared by:
SWCA ENVIRONMENTAL CONSULTANTS
Operating in North Carolina as SWCA Environmental Consulting and Engineering of NC, PC
116 Alexandria Drive
Mooresville, NC 28115
(p) 919.624.1458

Prepared for:
NorthPoint DEVELOPMENT

ANSI D (22"x34") SCALE: 1" = 30'
0 15 30 60

TABLOID (11"x17") SCALE: 1" = 60'
0 30 60 120

Stamp:

Project Title:

EDGECOMB CREEK
60% DESIGN

Sheet Title:

PLAN AND PROFILE
UNNAMED
TRIBUTARY X - (4)

Date:	12/10/2020
Scale:	AS SHOWN
Drawn by:	JYZ
Checked by:	DMP
File #	

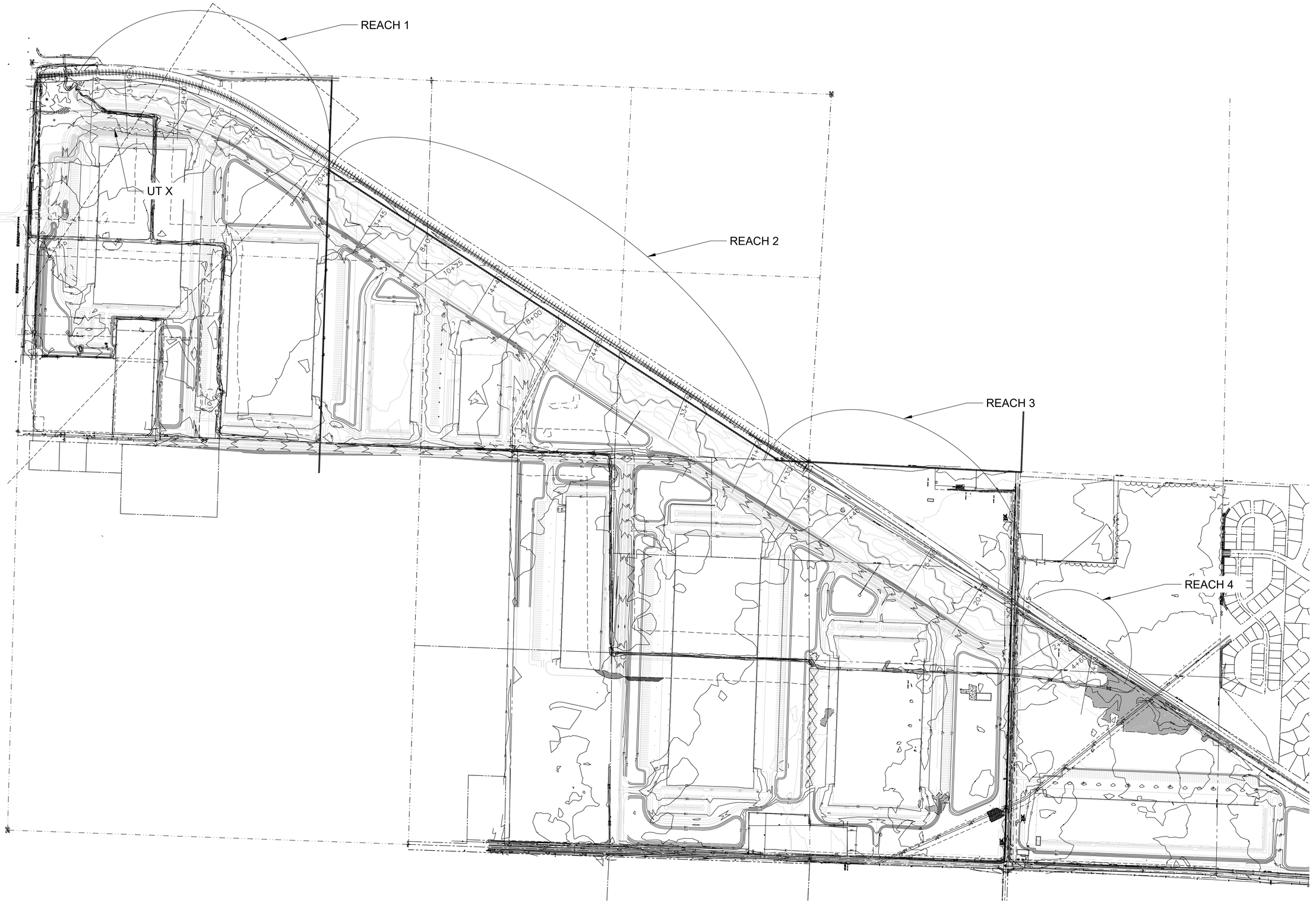
REVISIONS

Date:	By:	Note:
09/30/20	JYZ	30% CONCEPT DESIGN
10/21/20	JYZ	30% REVISON
12/04/20	JYZ	60% DESIGN
12/10/20	JYZ	60% REVISION

Sheet No:

27 OF 47

D:\DROPBOX (SSR)\SWCA EDGECOMB CREEK\C3D\SHEETS\EDGECOMBCK 60PERCENT PP.DWG | JOSHUA.ALLEN | SAVED: Tuesday, December 22, 2020 11:14:24 AM | BDG STANDARD.CTB | | PLOTTED: Tuesday, December 22, 2020 11:26:41 AM



D:\DROPBOX (5SSR)\SWCA EDGECOMB CREEK\C3D\SHEETS\EDGECOMBCK 60PERCENT XS.DWG | JOSHUA.ALLEN | SAVED: Wednesday, December 9, 2020 4:54:43 PM | BDG STANDARD.CTB | | PLOTTED: Tuesday, December 22, 2020 11:01:09 AM

Prepared by:

SWCA ENVIRONMENTAL CONSULTANTS

Operating in North Carolina as
SWCA Environmental Consulting
and Engineering of NC, PC

116 Alexandria Drive
Mooresville, NC 28115
(p) 919.624.1458

Prepared for:

NorthPoint DEVELOPMENT

ANSI D (22"x34") SCALE: 1" = 300'

0 150 300 600

TABLOID (11"x17") SCALE: 1" = 600'

0 300 600 1200

Stamp:

Project Title:

EDGECOMB CREEK
60% DESIGN

Sheet Title:

OVERVIEW
CROSS-SECTIONS

Date:	12/04/2020
Scale:	NTS
Drawn by:	JYZ
Checked by:	DMP
File #	

REVISIONS

Date:	By:	Note:
09/30/20	JYZ	30% CONCEPT DESIGN
10/21/20	JYZ	30% REVISON
12/04/20	JYZ	60% DESIGN
12/09/20	JYZ	60% REVISION

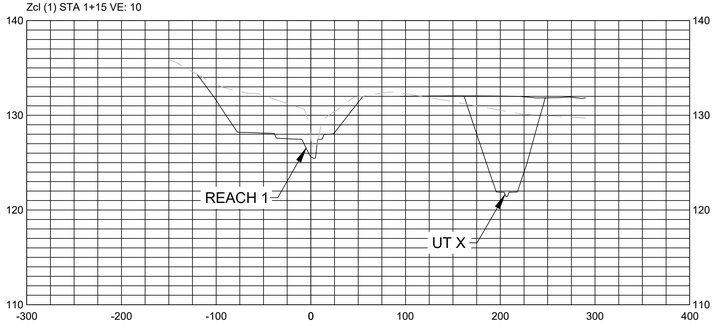
Sheet No:

28 OF 47

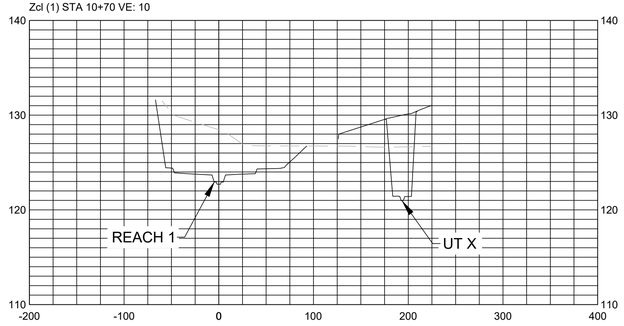
SECTION LEGEND

- STREAM DESIGN SURFACE
- EXISTING GROUND
- PROPOSED SITE GROUND

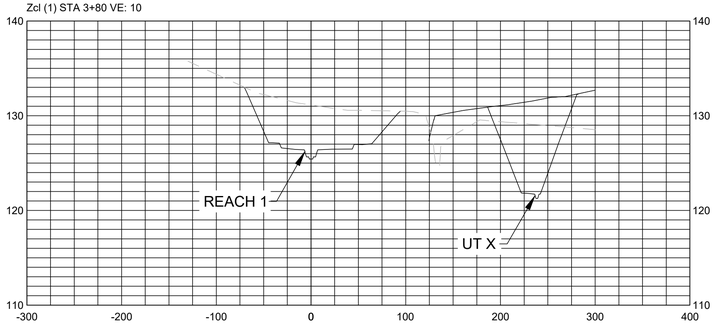
Zcl (1) STA 1+15 VE: 10



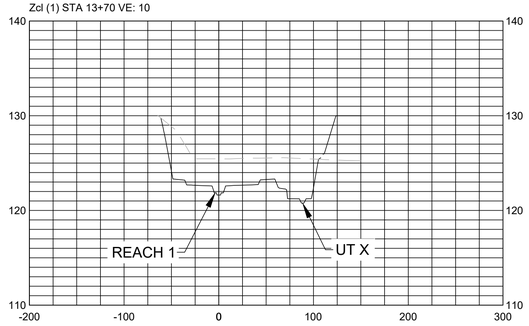
Zcl (1) STA 10+70 VE: 10



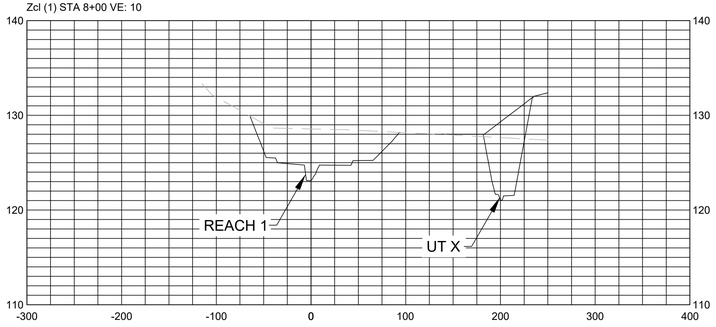
Zcl (1) STA 3+80 VE: 10



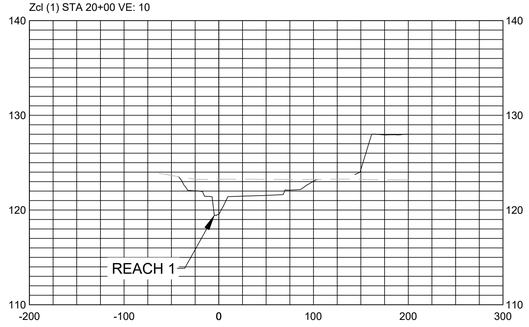
Zcl (1) STA 13+70 VE: 10



Zcl (1) STA 8+00 VE: 10



Zcl (1) STA 20+00 VE: 10



Prepared by:

SWCA ENVIRONMENTAL CONSULTANTS

Operating in North Carolina as
SWCA Environmental Consulting
and Engineering of NC, PC

116 Alexandria Drive
Mooresville, NC 28115
(p) 919.624.1458

Prepared for:

NorthPoint DEVELOPMENT

NOT TO SCALE

Stamp:

Project Title:

EDGECOMB CREEK
60% DESIGN

Sheet Title:

SECTIONS
REACH 1 - (1)

Date:	12/04/2020
Scale:	NTS
Drawn by:	JYZ
Checked by:	DMP
File #	

REVISIONS

Date:	By:	Note:
09/30/20	JYZ	30% CONCEPT DESIGN
10/21/20	JYZ	30% REVISON
12/04/20	JYZ	60% DESIGN
12/09/20	JYZ	60% REVISION

Sheet No:

29 OF 47

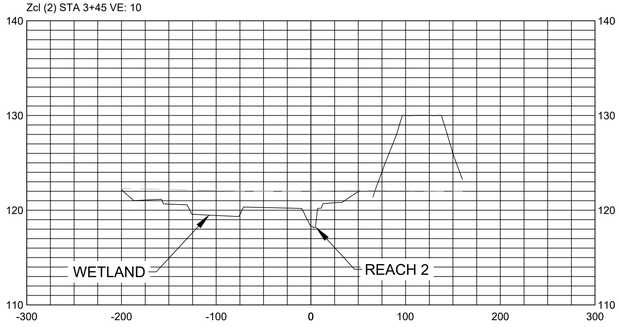
D:\DROPBOX (SSSR)\SWCA EDGECOMB CREEK\C3D\SHEETS\EDGECOMBCX 60PERCENT XS.DWG | JOSHUA.ALLEN | SAVED: Wednesday, December 9, 2020 4:54:43 PM | BDG STANDARD.CTB | | PLOTTED: Tuesday, December 22, 2020 11:01:10 AM

D:\DROPBOX (SSR)\SWCA EDGECOMB CREEK\C3D\SHEETS\EDGECOMBCK 60PERCENT XS.DWG | JOSHUA.ALLEN | SAVED: Wednesday, December 9, 2020 4:54:43 PM | BDG STANDARD.CTB | | PLOTTED: Tuesday, December 22, 2020 11:01:11 AM

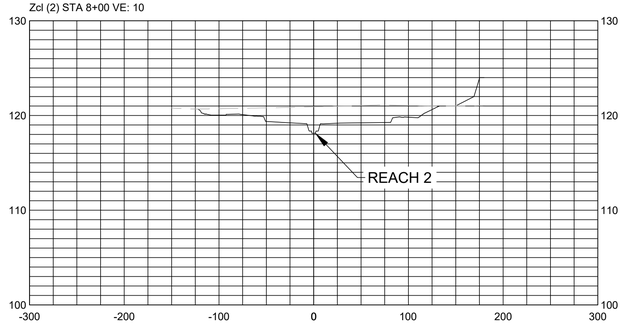
SECTION LEGEND

- STREAM DESIGN SURFACE
- EXISTING GROUND
- PROPOSED SITE GROUND

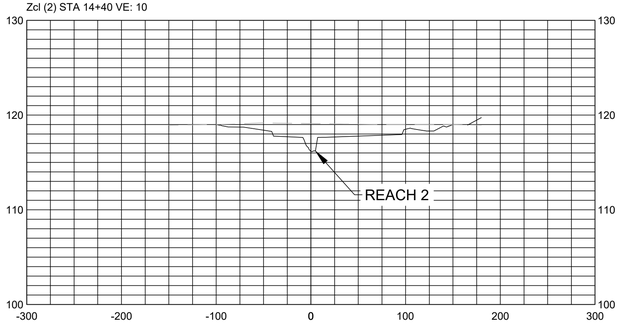
Zcl (2) STA 3+45 VE: 10



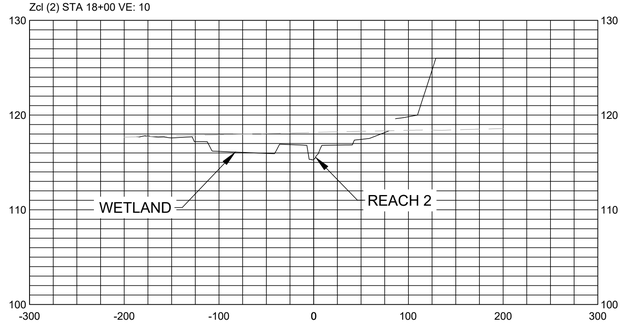
Zcl (2) STA 8+00 VE: 10



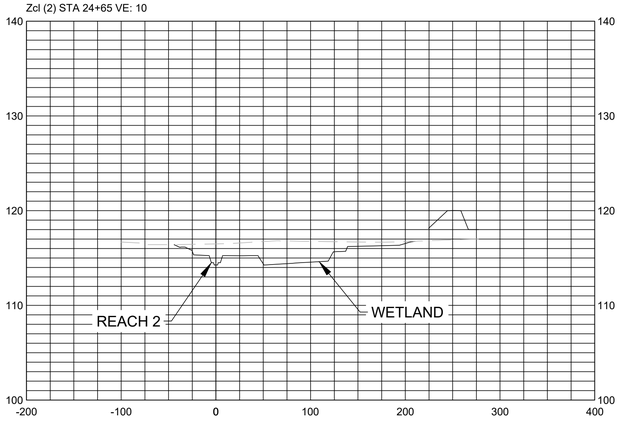
Zcl (2) STA 14+40 VE: 10



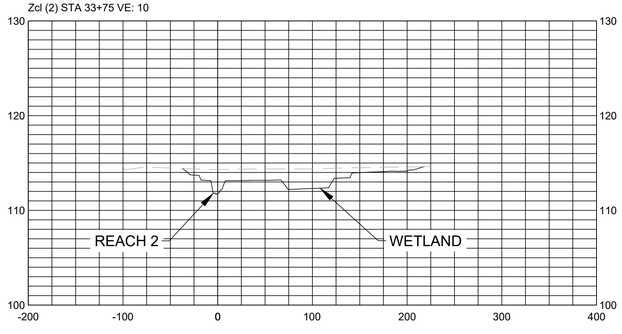
Zcl (2) STA 18+00 VE: 10



Zcl (2) STA 24+65 VE: 10



Zcl (2) STA 33+75 VE: 10



Prepared by:

SWCA ENVIRONMENTAL CONSULTANTS

Operating in North Carolina as
SWCA Environmental Consulting
and Engineering of NC, PC

116 Alexandria Drive
Mooresville, NC 28115
(p) 919.624.1458

Prepared for:

NorthPoint DEVELOPMENT

NOT TO SCALE

Stamp:

Project Title:

EDGECOMB CREEK
60% DESIGN

Sheet Title:

SECTIONS
REACH 2 - (1)

Date:	12/04/2020
Scale:	NTS
Drawn by:	JYZ
Checked by:	DMP
File #	

REVISIONS

Date:	By:	Note:
09/30/20	JYZ	30% CONCEPT DESIGN
10/21/20	JYZ	30% REVISON
12/04/20	JYZ	60% DESIGN
12/09/20	JYZ	60% REVISION

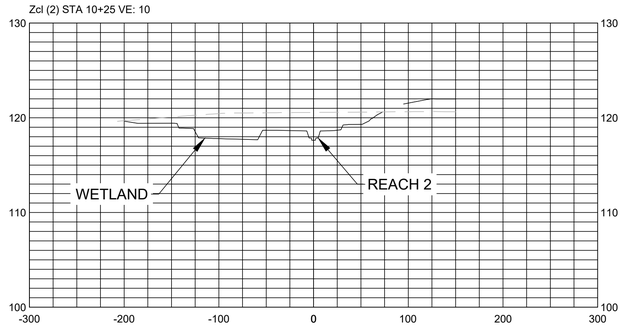
Sheet No:

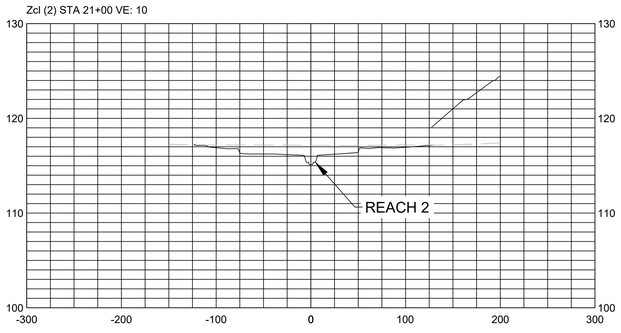
30 OF 47

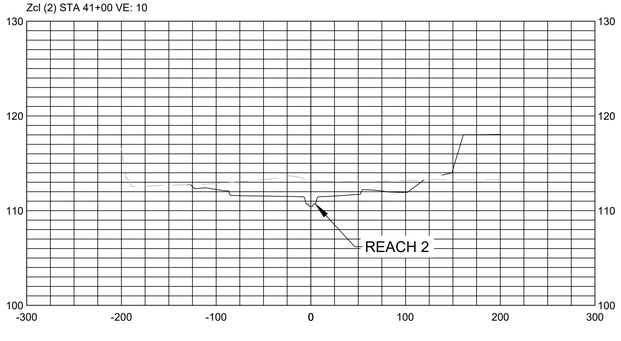
D:\DROPBOX (5SSR)\SWCA EDGECOMB CREEK\C3D\SHEETS\EDGECOMBCK 60PERCENT XS.DWG | JOSHUA.ALLEN | SAVED: Wednesday, December 9, 2020 4:54:43 PM | BDG STANDARD.CTB | | PLOTTED: Tuesday, December 22, 2020 11:01:13 AM

SECTION LEGEND

- STREAM DESIGN SURFACE
- EXISTING GROUND
- PROPOSED SITE GROUND







Prepared by:

SWCA ENVIRONMENTAL CONSULTANTS

Operating in North Carolina as
SWCA Environmental Consulting
and Engineering of NC, PC

116 Alexandria Drive
Mooresville, NC 28115
(p) 919.624.1458

Prepared for:

NorthPoint DEVELOPMENT

NOT TO SCALE

Stamp:

Project Title:

EDGECOMB CREEK
60% DESIGN

Sheet Title:

SECTIONS
REACH 2 - (2)

Date:	12/04/2020
Scale:	NTS
Drawn by:	JYZ
Checked by:	DMP
File #	

REVISIONS

Date:	By:	Note:
09/30/20	JYZ	30% CONCEPT DESIGN
10/21/20	JYZ	30% REVISON
12/04/20	JYZ	60% DESIGN
12/09/20	JYZ	60% REVISION

Sheet No:

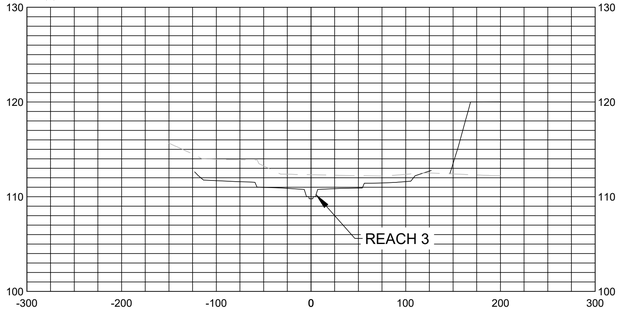
31 OF 47

D:\DROPBOX (SSR)\SWCA EDGECOMB CREEK\C3D\SHEETS\EDGECOMBCX 60PERCENT XS.DWG | JOSHUA.ALLEN | SAVED: Wednesday, December 9, 2020 4:54:43 PM | BDG STANDARD.CTB | | PLOTTED: Tuesday, December 22, 2020 11:01:14 AM

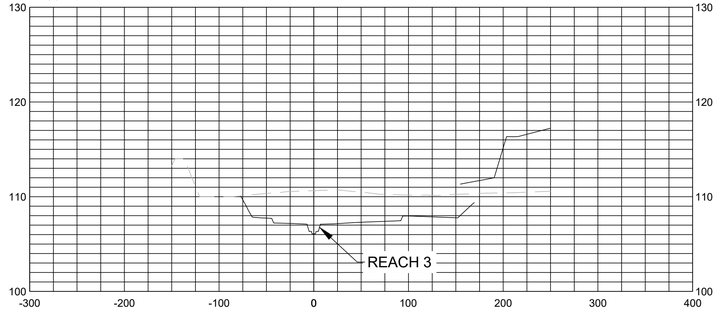
SECTION LEGEND

- STREAM DESIGN SURFACE
- EXISTING GROUND
- PROPOSED SITE GROUND

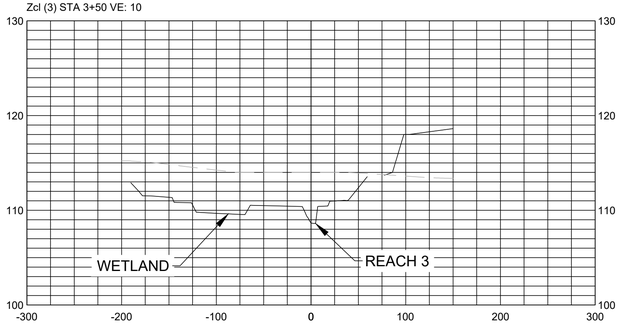
Zcl (3) STA 1+30 VE: 10



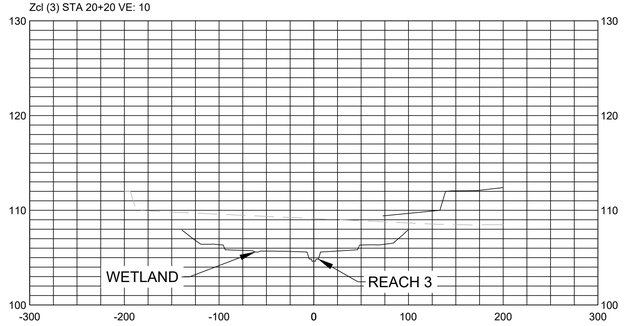
Zcl (3) STA 15+00 VE: 10



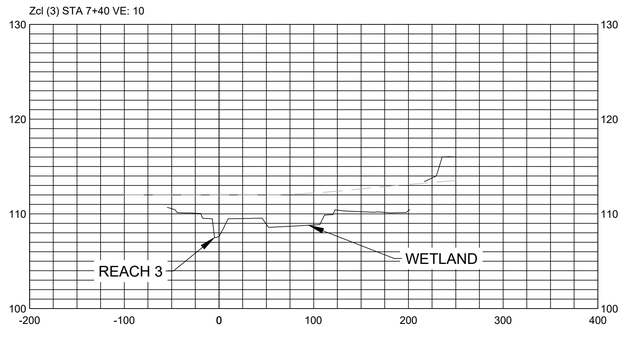
Zcl (3) STA 3+50 VE: 10



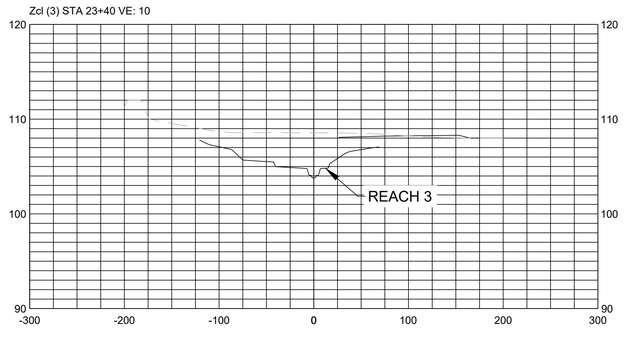
Zcl (3) STA 20+20 VE: 10



Zcl (3) STA 7+40 VE: 10



Zcl (3) STA 23+40 VE: 10



Prepared by:

SWCA ENVIRONMENTAL CONSULTANTS

Operating in North Carolina as
SWCA Environmental Consulting
and Engineering of NC, PC

116 Alexandria Drive
Mooresville, NC 28115
(p) 919.624.1458

Prepared for:

NorthPoint DEVELOPMENT

NOT TO SCALE

Stamp:

Project Title:

EDGECOMB CREEK
60% DESIGN

Sheet Title:

SECTIONS
REACH 3 - (1)

Date:	12/04/2020
Scale:	NTS
Drawn by:	JYZ
Checked by:	DMP
File #	

REVISIONS

Date:	By:	Note:
09/30/20	JYZ	30% CONCEPT DESIGN
10/21/20	JYZ	30% REVISON
12/04/20	JYZ	60% DESIGN
12/09/20	JYZ	60% REVISION

Sheet No:

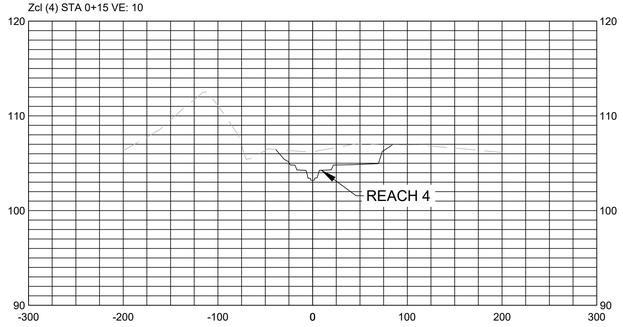
32 OF 47

D:\DROPBOX (5SSR)\SWCA EDGECOMB CREEK\C3D\SHEETS\EDGECOMBCX 60PERCENT XS.DWG | JOSHUA.ALLEN | SAVED: Wednesday, December 9, 2020 4:54:43 PM | BDG STANDARD.CTB | | PLOTTED: Tuesday, December 22, 2020 11:01:16 AM

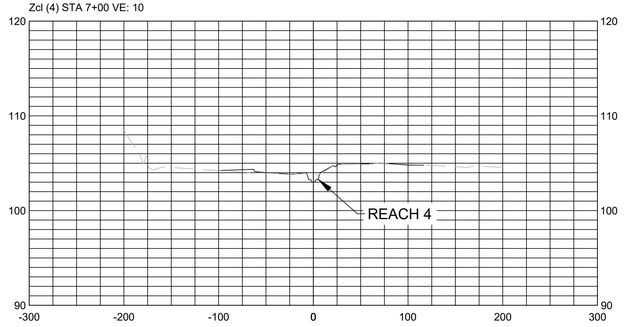
SECTION LEGEND

- STREAM DESIGN SURFACE
- EXISTING GROUND
- PROPOSED SITE GROUND

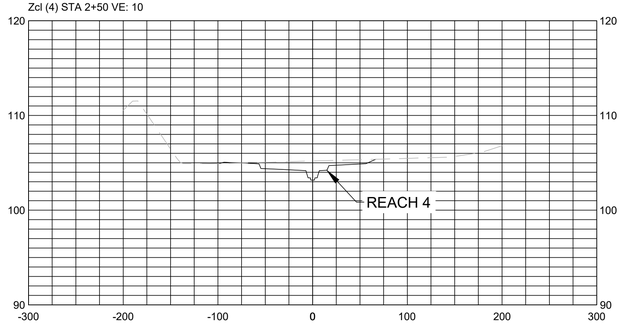
Zcl (4) STA 0+15 VE: 10



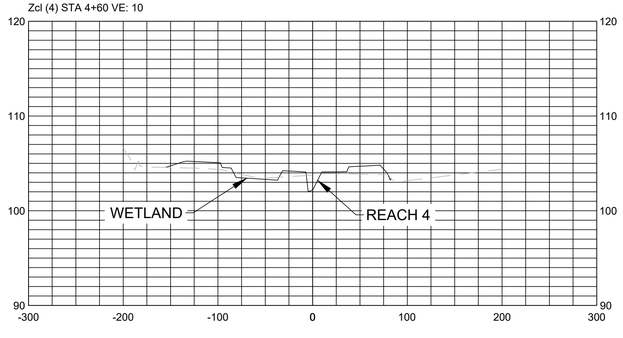
Zcl (4) STA 7+00 VE: 10



Zcl (4) STA 2+50 VE: 10



Zcl (4) STA 4+60 VE: 10



Prepared by:

SWCA ENVIRONMENTAL CONSULTANTS

Operating in North Carolina as
SWCA Environmental Consulting
and Engineering of NC, PC

116 Alexandria Drive
Mooresville, NC 28115
(p) 919.624.1458

Prepared for:

NorthPoint DEVELOPMENT

NOT TO SCALE

Stamp:

Project Title:

EDGECOMB CREEK
60% DESIGN

Sheet Title:

SECTIONS
REACH 4 - (1)

Date:	12/04/2020
Scale:	NTS
Drawn by:	JYZ
Checked by:	DMP
File #	

REVISIONS

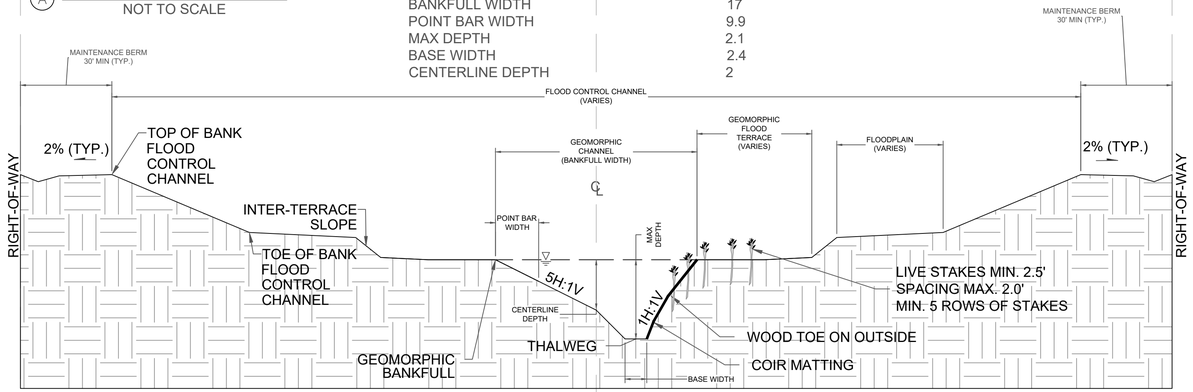
Date:	By:	Note:
09/30/20	JYZ	30% CONCEPT DESIGN
10/21/20	JYZ	30% REVISON
12/04/20	JYZ	60% DESIGN
12/09/20	JYZ	60% REVISION

Sheet No:

33 OF 47

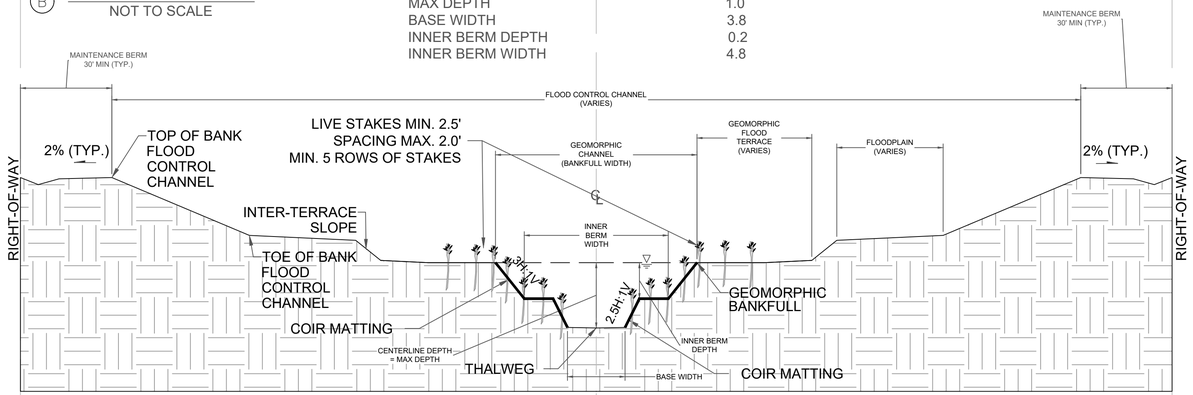
(A) TYPICAL SECTION - POOL RIGHT
NOT TO SCALE

DESIGN PARAMETERS	SIZE (FT)
BANKFULL WIDTH	17
POINT BAR WIDTH	9.9
MAX DEPTH	2.1
BASE WIDTH	2.4
CENTERLINE DEPTH	2



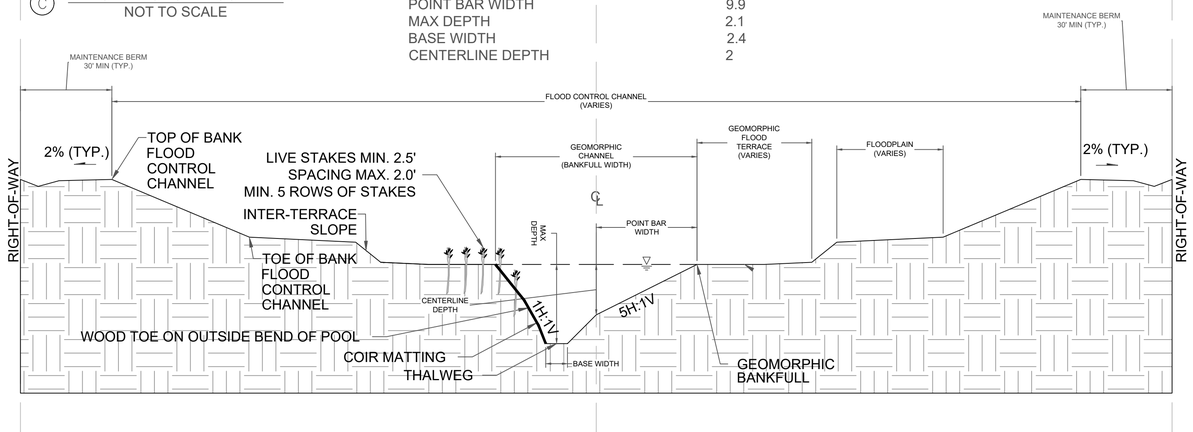
(B) TYPICAL SECTION - RIFFLE
NOT TO SCALE

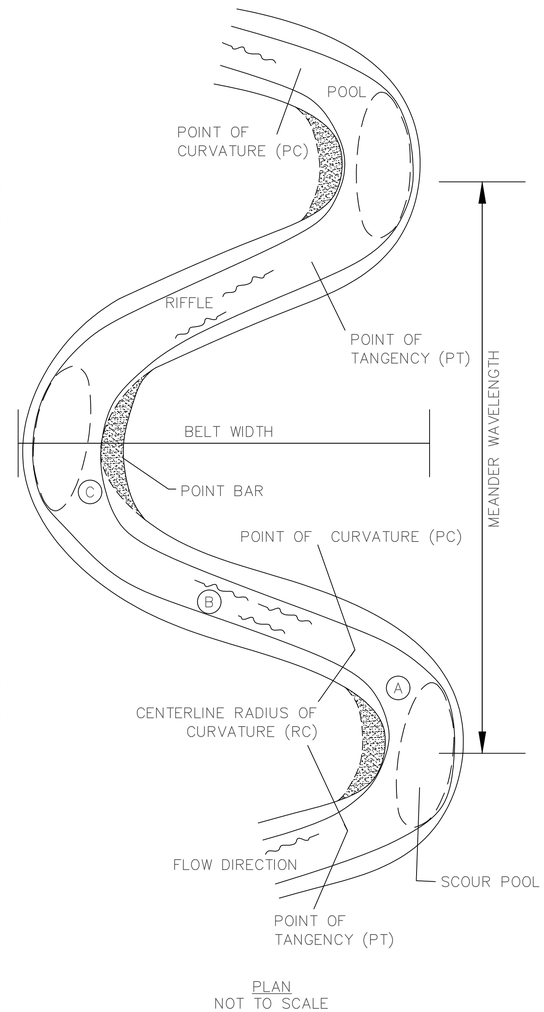
DESIGN PARAMETERS	SIZE (FT)
BANKFULL WIDTH	14.1
MAX DEPTH	1.0
BASE WIDTH	3.8
INNER BERM DEPTH	0.2
INNER BERM WIDTH	4.8



(C) TYPICAL SECTION - POOL LEFT
NOT TO SCALE

DESIGN PARAMETERS	SIZE (FT)
BANKFULL WIDTH	17
POINT BAR WIDTH	9.9
MAX DEPTH	2.1
BASE WIDTH	2.4
CENTERLINE DEPTH	2





PLAN
NOT TO SCALE

STREAM NAME	EDGECOMB CREEK		
STREAM TYPE	C4		
DESIGN PARAMETERS	MINIMUM	MEDIAN	MAXIMUM
MEAN RIFFLE DEPTH, DBKF (FT)		0.7	
RIFFLE WIDTH, WBKF (FT)		14	
WIDTH-TO-DEPTH RATIO, [WBKF/DBKF]		20.0	
RIFFLE CROSS-SECTION AREA, ABKF (SQ FT)		10	
MAX RIFFLE DEPTH, DMBKF (FT)		1.00	
POOL WIDTH, WBKFP (FT)		17.0	
POOL CROSS-SECTION AREA, ABKFP (SQ FT)		30.0	
MAX POOL DEPTH, DMBKFP (FT)		2.1	
RIFFLE LENGTH, LRIF (FT)	13	26	34
POOL LENGTH, LP (FT)	10	22	32
ENTRENCHMENT RATIO, ER [WFPA/WBKF]		2.2	
BANKFULL DISCHARGE, QBKF (CFS)		70	
MEANDER LENGTH, LM (FT)	59	155	237
BELT WIDTH, WBLT (FT)	39	46	53
RADIUS OF CURVATURE, RC (FT)	25	43	68
POOL-TO-POOL SPACING, P-P (FT)	27	49	59
VALLEY SLOPE, VS (FT/FT)	0.0035		
WATER SURFACE SLOPE, WS (FT/FT)	0.0031		
SINUOSITY, K = SL/VL (FT/FT)	1.14		

Prepared by:
SWCA ENVIRONMENTAL CONSULTANTS
Operating in North Carolina as SWCA Environmental Consulting and Engineering of NC, PC
116 Alexandria Drive
Mooresville, NC 28115
(p) 919.624.1458

Prepared for:
NorthPoint DEVELOPMENT

Stamp:

Project Title:
EDGECOMB CREEK
60% DESIGN

Sheet Title:
DETAILS - TYPICAL CROSS SECTION EDGECOMB CREEK

Date:	12/04/2020
Scale:	NOT TO SCALE
Drawn by:	JYZ
Checked by:	DMP
File #	

REVISIONS

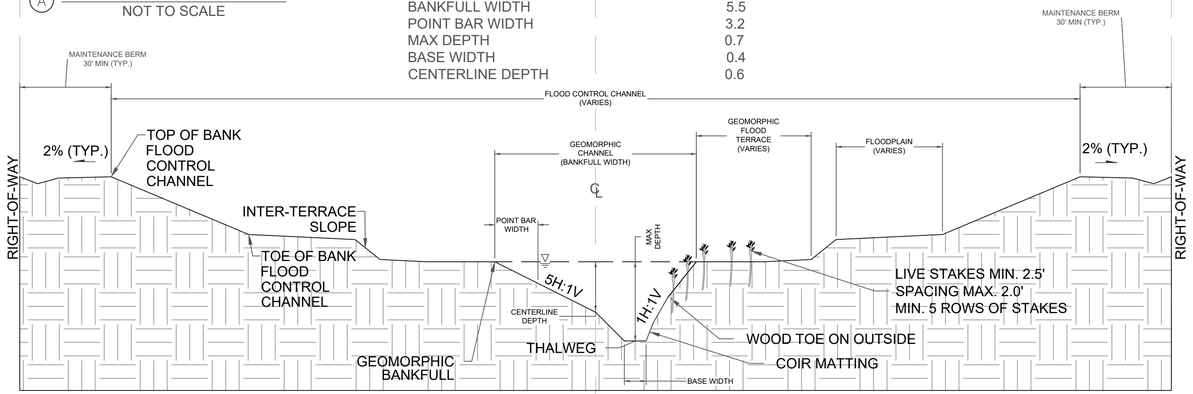
Date:	By:	Note:
09/30/20	JYZ	30% DESIGN
10/21/20	BPW	30% REVISION
12/04/20	JYZ	60% DESIGN
12/09/20	JYZ	60% REVISION

Sheet No:
34 OF 47

D:\DROPBOX (SSSR)\SWCA EDGECOMB CREEK\C3D\SHEETS\EDGECOMBCK_DETAILS SUMMARY.DWG | JOSHUA.ALLEN | SAVED: Thursday, December 10, 2020 9:47:43 PM | ACAD.CTB | | PLOTTED: Tuesday, December 22, 2020 11:01:33 AM

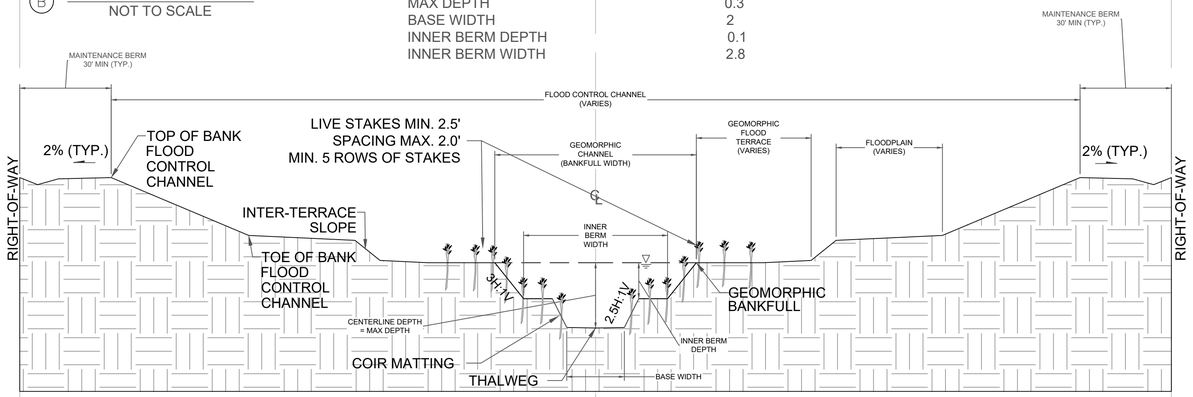
A TYPICAL SECTION - POOL RIGHT
NOT TO SCALE

DESIGN PARAMETERS	SIZE (FT)
BANKFULL WIDTH	5.5
POINT BAR WIDTH	3.2
MAX DEPTH	0.7
BASE WIDTH	0.4
CENTERLINE DEPTH	0.6



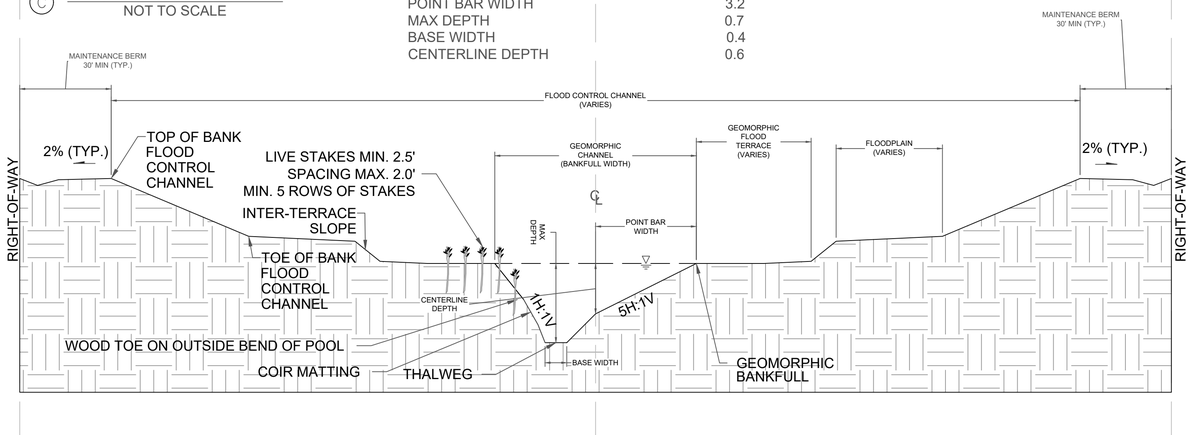
B TYPICAL SECTION - RIFFLE
NOT TO SCALE

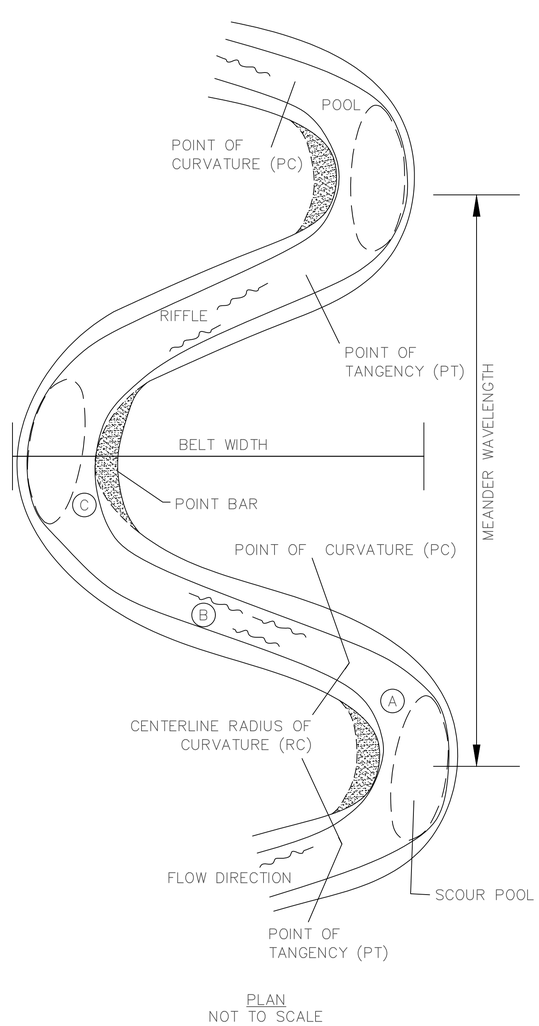
DESIGN PARAMETERS	SIZE (FT)
BANKFULL WIDTH	4.6
MAX DEPTH	0.3
BASE WIDTH	2
INNER BERM DEPTH	0.1
INNER BERM WIDTH	2.8



C TYPICAL SECTION - POOL LEFT
NOT TO SCALE

DESIGN PARAMETERS	SIZE (FT)
BANKFULL WIDTH	5.5
POINT BAR WIDTH	3.2
MAX DEPTH	0.7
BASE WIDTH	0.4
CENTERLINE DEPTH	0.6





PLAN
NOT TO SCALE

STREAM NAME	UNKNOWN TRIB X		
STREAM TYPE	C4		
DESIGN PARAMETERS	MINIMUM	MEDIAN	MAXIMUM
MEAN RIFFLE DEPTH, DBKF (FT)		0.23	
RIFFLE WIDTH, WBKF (FT)		4.6	
WIDTH-TO-DEPTH RATIO, [WBKF/DBKF]		20.0	
RIFFLE CROSS-SECTION AREA, ABKF (SQ FT)		1	
MAX RIFFLE DEPTH, DMBKF (FT)		0.32	
POOL WIDTH, WBKFP (FT)		5.5	
POOL CROSS-SECTION AREA, ABKFP (SQ FT)		3.0	
MAX POOL DEPTH, DMBKFP (FT)		0.7	
RIFFLE LENGTH, LRIF (FT)	5	14	23
POOL LENGTH, LP (FT)	6	10	21
ENTRENCHMENT RATIO, ER [WFPA/WBKF]		2.0	
BANKFULL DISCHARGE, QBKF (CFS)		7	
MEANDER LENGTH, LM (FT)	19	51	77
BELT WIDTH, WBLT (FT)	13	15	18
RADIUS OF CURVATURE, RC (FT)	8	14	22
POOL-TO-POOL SPACING, P-P (FT)	10	25	39
VALLEY SLOPE, VS (FT/FT)	6.2000E-04		
WATER SURFACE SLOPE, WS (FT/FT)	5.7000E-04		
SINUOSITY, K = SL/VL (FT/FT)	1.07		

Prepared by:
SWCA ENVIRONMENTAL CONSULTANTS
Operating in North Carolina as SWCA Environmental Consulting and Engineering of NC, PC
116 Alexandria Drive
Mooresville, NC 28115
(p) 919.624.1458

Prepared for:
NorthPoint DEVELOPMENT

Stamp:

Project Title:
EDGECOMB CREEK
60% DESIGN

Sheet Title:
DETAILS - TYPICAL CROSS SECTION UNNAMED TRIBUTARY 'X'

Date:	12/04/2020
Scale:	NOT TO SCALE
Drawn by:	JYZ
Checked by:	DMP
File #	

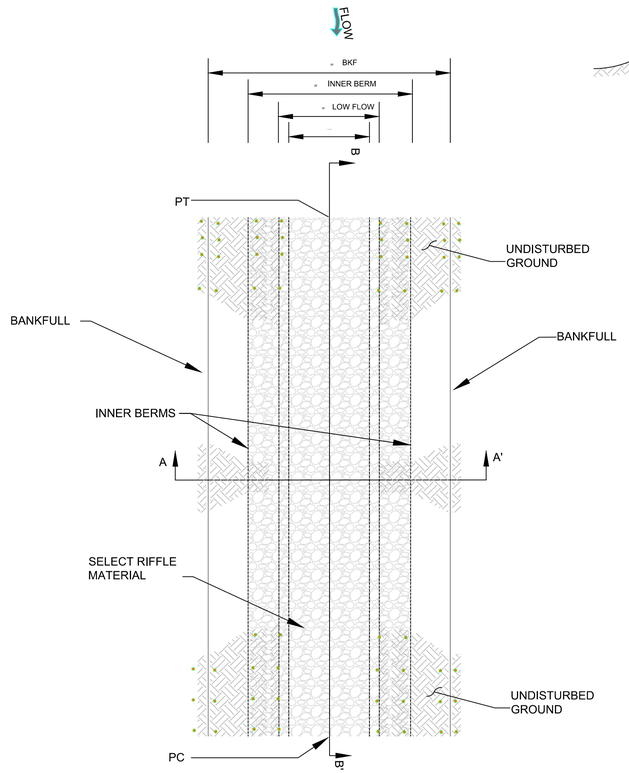
REVISIONS

Date:	By:	Note:
09/30/20	JYZ	30% DESIGN
10/21/20	BPW	30% REVISION
12/04/20	JYZ	60% DESIGN
12/09/20	JYZ	60% REVISION

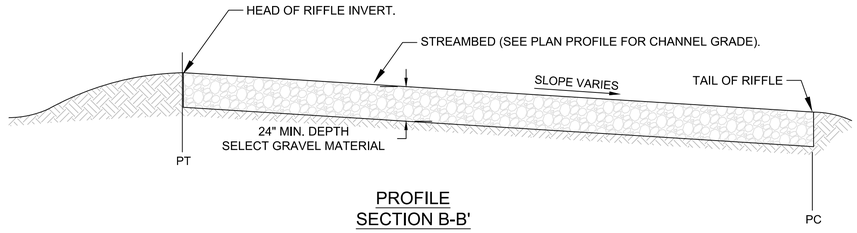
Sheet No:
35 OF 47

D:\DROPBOX (SSSR)\SWCA EDGECOMB CREEK\C3D\SHEETS\EDGECOMBCK_DETAILS SUMMARY.DWG | JOSHUA.ALLEN | SAVED: Thursday, December 10, 2020 9:47:43 PM | ACAD.CTB | | PLOTTED: Tuesday, December 22, 2020 11:01:34 AM

PLAN SYMBOL



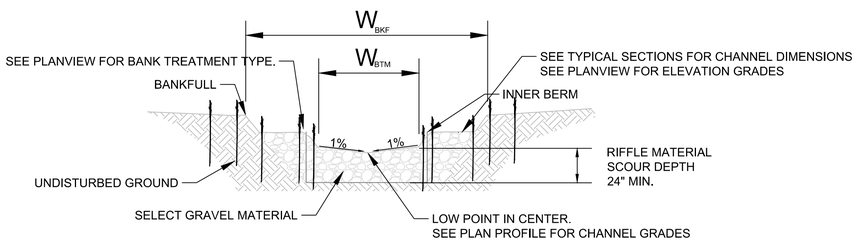
PLANVIEW



PROFILE
SECTION B-B'

NOTES:

1. THE AUGMENTED RIFFLE IS COMPRISED OF NATIVE STREAMBED GRAVEL. THE GRADATION REQUIRED VARIES BY REACH.
2. WHILE THE USE OF LOCAL MATERIAL IS TO BE ENCOURAGED, THE CONTRACTOR SHOULD NOT ASSUME THAT THE MATERIAL REQUIRED TO CONSTRUCT THE AUGMENTED RIFFLE WILL BE AVAILABLE ON SITE. IF THE CONTRACTOR WANTS TO USE LOCAL MATERIAL, IT MUST BE APPROVED BY THE ENGINEER. SORTING AND SIEVING OF ANY MATERIAL HARVESTED LOCALLY USED FOR CONSTRUCTION OF AUGMENTED RIFFLES IS INCIDENTAL TO THE WORK.
3. IF THE CONTRACTOR IMPORTS MATERIAL FOR THE AUGMENTED RIFFLES, IT SHALL BE CLEAN WASHED COARSE GRAVELS WITH THE APPROPRIATE GRADATION.
4. AUGMENTED RIFFLES SHALL BE INSTALLED TO THE BASE WIDTH AS SPECIFIED IN THE TYPICAL SECTIONS, AND INSTALLED SUCH THAT, IN CROSS-SECTION, THERE IS A 1% SLOPE TO THE CENTER OF THE CHANNEL OR AS GENERATED BY THE 3D SURFACE.
5. SET RIFFLE HEAD AND TAIL INVERT ELEVATIONS AS SHOWN IN THE REACH PROFILE.
6. RIFFLE MATERIAL SHALL BE COMPACTED USING EQUIPMENT SUCH THAT FUTURE SETTLEMENT OF THE MATERIAL WILL BE MINIMAL.
7. THE SURFACE OF RIFFLE SHALL BE FINISHED TO FINAL GRADES AS SHOWN ON THE PROJECT DRAWINGS (REACH PROFILE PLANS, TYPICAL SECTIONS, AND PLANVIEW), THE DEGREE OF TOLERANCE FOR ALL INVERT ELEVATIONS SHALL BE WITHIN +/-0.1' OF THE GRADES AND ELEVATIONS SPECIFIED ON THE PLANS.
8. FINAL GRADING AND TOP DRESSING OF INNER BERM AND BANKFULL BENCH TO FLOODPLAIN WILL BE REQUIRED FOLLOWING THE INSTALLATION OF CONSTRUCTED RIFFLE SHALL BE CONSIDERED INCIDENTAL TO CONSTRUCTION.
9. BANK TREATMENTS SHALL BE INSTALLED AFTER INSTALLATION OF CONSTRUCTED RIFFLES AND ROUGH BANK GRADING. SEE PLANVIEW FOR BANK TREATMENT TYPE.
10. THE REQUIRED GRADATION WILL BE DETERMINED BASED ON THE APPLIED SHEAR STRESS OF THE DESIGN DISCHARGE AND IS REFERENCED BELOW IN THE TABLE.
11. GRAVEL MATERIAL SHOULD EXTEND AT LEAST 1/4 BANKFULL HEIGHT TO HELP PROTECT TOE OF BANKS.



SECTION A-A'

MAX DESIGN SHEAR STRESS	D16 "	D50 "	D84 "	D100 "
1 LB/FT^2 OR LESS	1.0	4.0	6.0	9.0
1 LB/FT^2 - 2 LB/FT^2	1.0	7.0	11.0	12.0
2 LB/FT^2 - 3 LB/FT^2	2.0	10.0	15.0	18.0

DETAIL - AUGMENTED RIFFLE
NOT TO SCALE

Prepared by:
SWCA ENVIRONMENTAL CONSULTANTS
Operating in North Carolina as SWCA Environmental Consulting and Engineering of NC, PC
116 Alexandria Drive
Mooresville, NC 28115
(p) 919.624.1458

Prepared for:
NorthPoint DEVELOPMENT

Stamp:

Project Title:
EDGECOMB CREEK
60% DESIGN

Sheet Title:
DETAILS - AUGMENTED RIFFLE

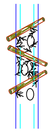
Date:	12/04/2020
Scale:	NOT TO SCALE
Drawn by:	JYZ
Checked by:	DMP
File #	

REVISIONS

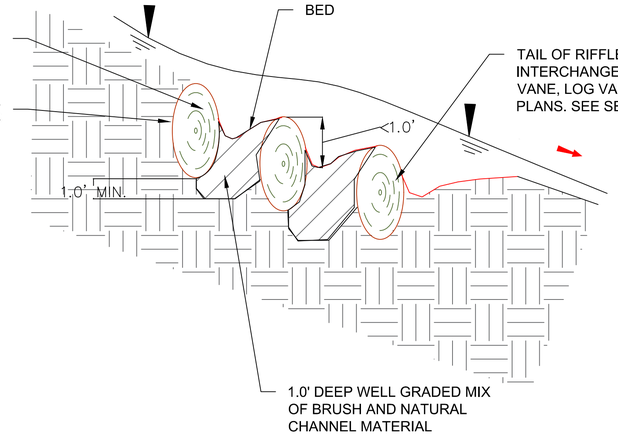
Date:	By:	Note:
09/30/20	JYZ	30% DESIGN
10/21/20	BPW	30% REVISION
12/04/20	JYZ	60% DESIGN
12/09/20	JYZ	60% REVISION

Sheet No:
36 OF 47

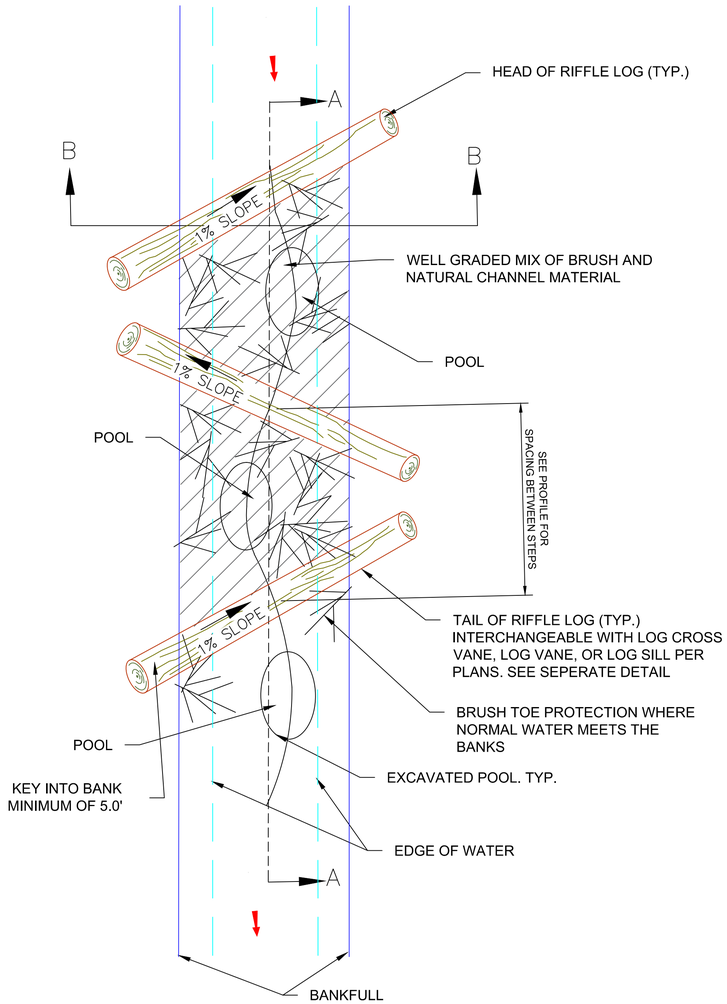
D:\DROPBOX (SSSR)\SWCA EDGECOMB CREEK\C3D\SHEETS\EDGECOMBCK_DETAILS SUMMARY.DWG | JOSHUA.ALLEN | SAVED: Thursday, December 10, 2020 9:47:43 PM | ACAD.CTB | | PLOTTED: Tuesday, December 22, 2020 11:01:35 AM



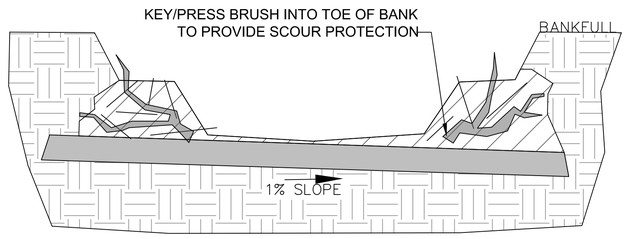
PLAN-SYMBOL



SECTION A-A



PLANVIEW



SECTION B-B

NOTES:

1. PLACE FABRIC ON THE UPSTREAM SIDE OF THE MOST UPSTREAM LOG SILL IN THE CONSTRUCTED RIFFLE.
2. THE LOG SILLS SHALL BE DESIGNED TO BE SUBMERGED OR COVERED AT LOW FLOWS.
3. LOGS USED IN STRUCTURE FOR LOG SILLS SHALL BE HARDWOOD SPECIES AND A MINIMUM OF 12" IN DIAMETER.
4. TAIL OF RIFFLE LOG IS INTERCHANGEABLE WITH LOG CROSS VANE, LOG VANE, OR LOG SILL PER PLANS. SEE SEPERATE DETAIL.

DETAIL - BRUSH AND ROLL RIFFLE
NOT TO SCALE

Prepared by:

SWCA ENVIRONMENTAL CONSULTANTS

Operating in North Carolina as SWCA Environmental Consulting and Engineering of NC, PC

116 Alexandria Drive
Mooresville, NC 28115
(p) 919.624.1458

Prepared for:

NorthPoint DEVELOPMENT

Stamp:

Project Title:

EDGECOMB CREEK
60% DESIGN

Sheet Title:

DETAILS -
BRUSH AND ROLL
RIFFLE

Date:	12/04/2020
Scale:	NOT TO SCALE
Drawn by:	JYZ
Checked by:	DMP
File #	

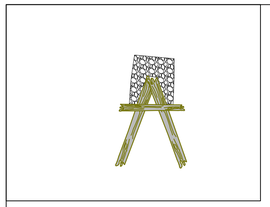
REVISIONS

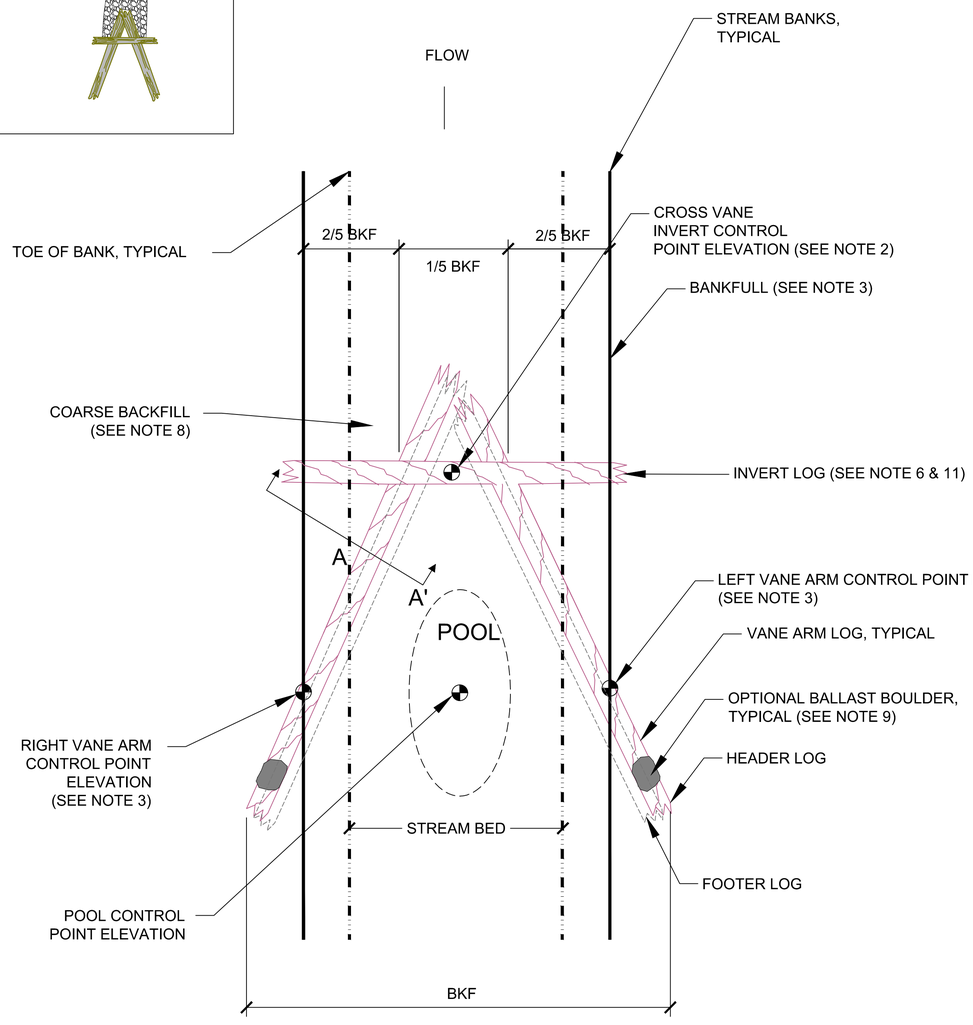
Date:	By:	Note:
09/30/20	JYZ	30% DESIGN
10/21/20	BPW	30% REVISION
12/04/20	JYZ	60% DESIGN
12/09/20	JYZ	60% REVISION

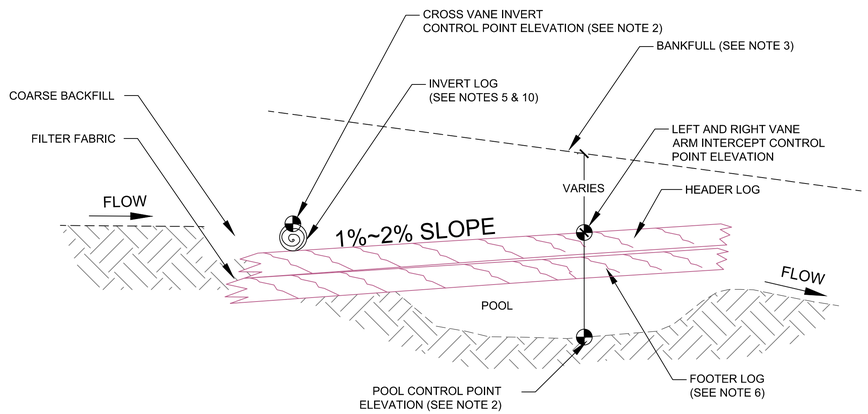
Sheet No:

37 OF 47

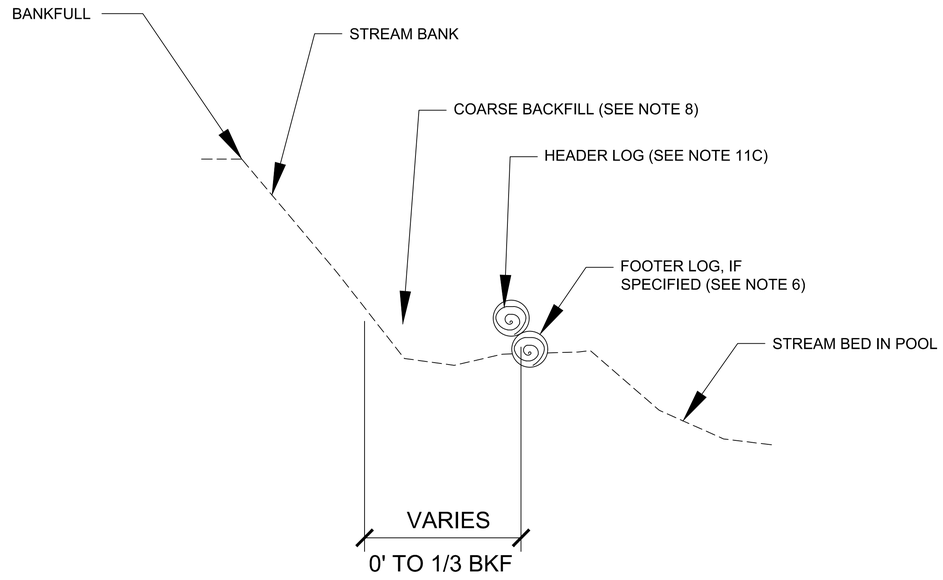
D:\DROPBOX (SSSR)\SWCA EDGECOMB CREEK\C3D\SHEETS\EDGECOMBCK_DETAILS SUMMARY.DWG | JOSHUA.ALLEN | SAVED: Thursday, December 10, 2020 9:47:43 PM | ACAD.CTB | | PLOTTED: Tuesday, December 22, 2020 11:01:36 AM







DETAIL - LOG A-VANE
NOT TO SCALE



NOTES:

1. A LOG CROSS VANE IS A GRADE CONTROL, IN-STREAM STRUCTURE THAT DIRECTS STREAM FLOW AWAY FROM THE STREAM BANKS AND IN TOWARD THE CENTER OF THE CHANNEL.
2. ELEVATION CONTROL POINTS SHALL BE DESIGNATED AT THE UPSTREAM INVERT (CENTER) OF THE CROSS VANE TO ESTABLISH PART OF THE PROFILE. A NOTCH MAY BE CUT INTO THE LOG AT THE INVERT LOCATION. POOL ELEVATION CONTROL POINTS OR EXCAVATION TO A SPECIFIED MAXIMUM POOL DEPTH SHALL BE DESIGNATED TO ESTABLISH THE REMAINING PROFILE. SURVEY OF CONTROL POINTS SHALL BE REQUIRED TO ESTABLISH ACCURATE INSTALLATION WITHIN THE TOLERANCE SPECIFIED BY THE DESIGNER.
3. THE VANE ARM SHALL INTERCEPT THE STREAM BANK AT A HEIGHT EQUAL TO BETWEEN ½ BANKFULL STAGE AND BANKFULL STAGE. ELEVATION CONTROL POINTS MAY BE ESTABLISHED AT THE LEFT AND RIGHT STREAM BANK/VANE ARM INTERCEPT POINTS. THE VANE ARM INTERCEPT LOCATION MAY BE OTHERWISE DESCRIBED BY ITS RELATIONSHIP TO BANKFULL STAGE OR BY THE LENGTH AND SLOPE OF THE VANE ARM. BANKFULL IS NOT NECESSARILY THE TOP OF THE STREAM BANK SLOPE.
4. TYPICAL RIFFLE AND POOL CROSS SECTIONS SHALL BE PROVIDED ELSEWHERE IN THE PLANS TO ESTABLISH THE DIMENSIONS OF THE CHANNEL GRADING INTO WHICH THE LOG CROSS VANES ARE TO BE INSTALLED.
5. LOGS SHALL BE 12" DIAMETER SPECIFIED BY THE DESIGNER AND RELATIVELY STRAIGHT HARDWOOD, RECENTLY HARVESTED. THE LENGTH SHALL BE SUCH THAT THE LOG IS BURIED INTO THE SOIL OF THE STREAM BANK (ON ONE END) AND STREAM BED (ON THE OTHER END) A MINIMUM DISTANCE AS SPECIFIED BY THE DESIGNER. THE INVERT LOG SHALL BE EQUAL TO THE STREAM BED WIDTH AS DEPICTED IN THE RIFFLE TYPICAL SECTION.
6. A SINGLE LOG MAY BE USED IN LIEU OF A HEADER/FOOTER LOG COMBINATION IF SINGLE LOG DIAMETER IS LARGER THAN THE MINIMUM REQUIRED DIAMETER AND IS APPROVED BY THE ENGINEER PRIOR TO INSTALLATION.
7. COARSE BACKFILL OF THE LOG CROSS VANE SHALL BE OF A TYPE, SIZE, AND GRADATION AS SPECIFIED BY THE DESIGNER. COARSE BACKFILL SHALL BE PLACED TO A THICKNESS EQUAL TO THE DEPTH OF THE HEADER (AND ANY FOOTER) LOGS AND SHALL EXTEND OUT FROM THE VANE ARMS TO THE STREAM BANK AND UPSTREAM A DISTANCE SPECIFIED BY THE DESIGNER.
8. AS AN OPTION, FLAT-SIDED BOULDERS OF A SIZE (LENGTH, WIDTH, AND THICKNESS) AS SPECIFIED BY THE DESIGNER MAY BE PLACED AS BALLAST ON TOP OF THE STREAM BANK SIDE OF THE EMBEDDED VANE ARMS. DUCK BILL ANCHORS MAY BE USED IN LIEU OF BALLAST BOULDERS.
9. THE VANE ARMS OF THE LOG CROSS VANE SHALL BE CONSTRUCTED FIRST, FOLLOWED BY THE LOG INVERT.
10. LOG CROSS VANES SHALL BE BUILT TYPICALLY AS FOLLOWS:

    A. OVER-EXCAVATE STREAM BED TO A DEPTH EQUAL TO THE TOTAL THICKNESS OF THE HEADER (AND FOOTER IF SPECIFIED) LOGS.
    B. PLACE VANE ARM FOOTER LOGS, IF SPECIFIED. THE SLOPE OF THE VANE ARM IS MEASURED ALONG THE VANE ARM WHICH IS INSTALLED AT AN ANGLE TO THE STREAM BANK AND PROFILE.
    C. INSTALL VANE ARM HEADER LOG ON TOP OF AND SET SLIGHTLY FORWARD OR BACK FROM THE FOOTER LOG.
    D. INSTALL INVERT LOG AND DUCKBILL ANCHOR.
    E. PLACE COARSE BACKFILL BEHIND LOG(S) ENSURING THAT ANY VOIDS BETWEEN THE LOGS ARE FILLED.

11. IF ANY EROSION CONTROL MATTING IS SPECIFIED FOR USE IN THE VICINITY OF THE VANE ARM INTERCEPT POINTS, ALL MATTING EDGES SHALL BE NEATLY SECURED AROUND THE LOGS.

Prepared by:
SWCA ENVIRONMENTAL CONSULTANTS
Operating in North Carolina as SWCA Environmental Consulting and Engineering of NC, PC
116 Alexandria Drive
Mooresville, NC 28115
(p) 919.624.1458

Prepared for:
NorthPoint DEVELOPMENT

Stamp:

Project Title:
EDGECOMB CREEK
60% DESIGN

Sheet Title:
DETAILS -
LOG A-VANE

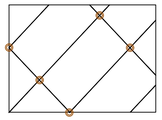
Date:	12/04/2020
Scale:	NOT TO SCALE
Drawn by:	JYZ
Checked by:	DMP
File #	

REVISIONS

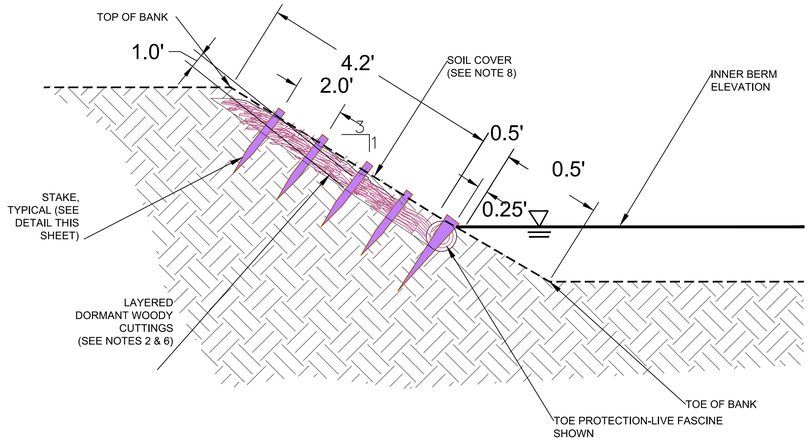
Date:	By:	Note:
09/30/20	JYZ	30% DESIGN
10/21/20	BPW	30% REVISION
12/04/20	JYZ	60% DESIGN
12/09/20	JYZ	60% REVISION

Sheet No:
38 OF 47

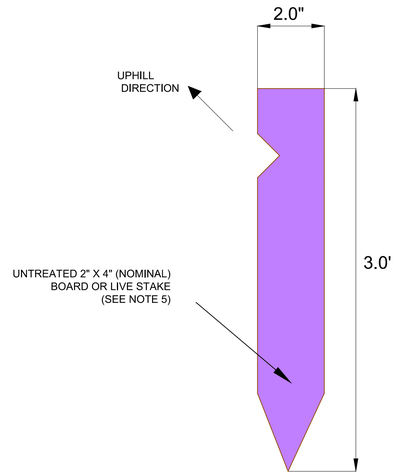
D:\DROPBOX (SSSR)\SWCA EDGECOMB CREEK\C3D\SHEETS\EDGECOMBCK_DETAILS SUMMARY.DWG | JOSHUA.ALLEN | SAVED: Thursday, December 10, 2020 9:47:43 PM | ACAD.CTB | | PLOTTED: Tuesday, December 22, 2020 11:01:37 AM



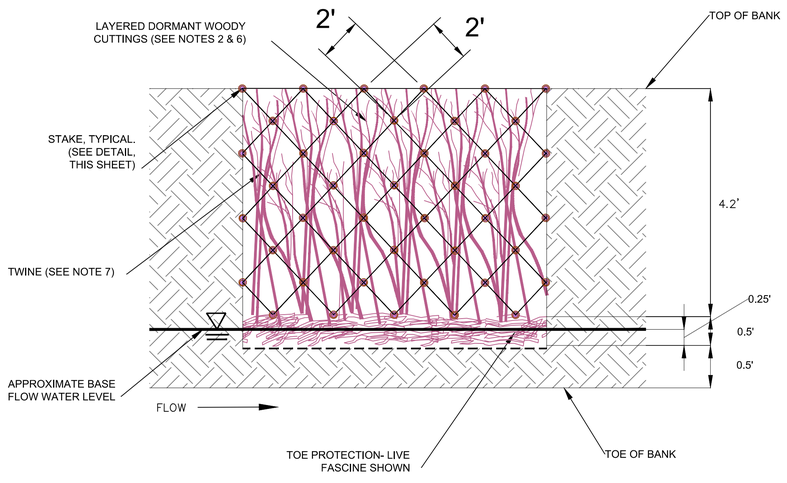
PLAN-SYMBOL



CROSS-SECTION



STAKE DETAIL



PLAN VIEW
(SEE NOTE 9)

NOTES:

1. BRUSH MATTRESS SHALL BE INSTALLED OVER GRADED AND PREPARED (ROTO-TILLED, RAKED, AND AMENDED) STREAM BANKS AS SPECIFIED BY THE DESIGNER:
2. BRUSH MATTRESS SHALL BE MADE FROM LIVE DORMANT CUTTINGS FROM WOODY PLANT SPECIES (TREES AND SHRUBS) SPECIFIED BY THE DESIGNER. THE CUTTINGS SHALL BE OF A SPECIFIED LENGTH AND DIAMETER, APPROPRIATELY SIZED ACCORDING TO THE HEIGHT OF THE CHANNEL BANKS.
3. STAKES SHALL BE INSTALLED, PER THE SPECIFIED PATTERN AND SPACING, INTO THE FACE OF THE STREAM BANK. LIVE STAKES MAY BE USED IN LIEU OF STAKES FOR DEEPER ROOTING. TWINE (NOT WIRE) IS TO BE USED TO FASTEN THE BRUSH MATTRESS IF LIVE STAKES ARE USED. SPECIFIC INFORMATION REGARDING LIVE STAKES SHALL BE ADDED TO THE BRUSH MATTRESS DETAIL OR DETAILED SEPARATELY AND REFERENCED HEREIN.
4. A SPECIFIED NUMBER OF CUTTINGS PER UNIT AREA SHOULD BE PLACED FLUSH AGAINST THE SOIL OF THE STREAM BANK, WITH THE CUTTINGS LAID IN BETWEEN THE STAKES.
5. THE CUTTINGS SHALL BE HELD IN PLACE BY TWINE. THE TWINE SHOULD BE RUN PERPENDICULAR TO THE CUTTINGS AND DIAGONALLY FROM STAKE TO STAKE AND TIED BY USE OF A CLOVE-HITCH. WHEN THIS IS COMPLETE, THE STAKES SHOULD BE DRIVEN INTO THE GROUND A LITTLE FURTHER TO COMPRESS THE CUTTINGS TO THE SLOPE FACE.
6. THE BRUSH MATTRESS, STAKES, AND TWINE SHALL BE COVERED WITH A LAYER OF SOIL AND LIGHTLY COMPACTED SO THAT THERE IS CONTACT BETWEEN CUTTINGS AND THE SOIL TO PROMOTE MORE RAPID GROWTH. ALL BUT THE OUTER BRANCHES OF THE BRUSH MATTRESS SHOULD BE COVERED WITH SOIL.
7. THE PLAN VIEW ILLUSTRATES A PERPENDICULAR PERSPECTIVE OF EACH SURFACE DEPICTED IN THE CROSS SECTION. THERE IS NO FORESHORTENING OF THE STREAM BANK (OR ANY OTHER SLOPED SURFACE) IN THE PLAN VIEW.

DETAIL - BRUSH MATTRESS
NOT TO SCALE

Prepared by:

SWCA ENVIRONMENTAL CONSULTANTS

Operating in North Carolina as SWCA Environmental Consulting and Engineering of NC, PC

116 Alexandria Drive
Mooresville, NC 28115
(p) 919.624.1458

Prepared for:

NorthPoint DEVELOPMENT

Stamp:

Project Title:

EDGECOMB CREEK
60% DESIGN

Sheet Title:

DETAILS -
BRUSH MATTRESS

Date:	12/04/2020
Scale:	NOT TO SCALE
Drawn by:	JYZ
Checked by:	DMP
File #	

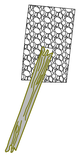
REVISIONS

Date:	By:	Note:
09/30/20	JYZ	30% DESIGN
10/21/20	BPW	30% REVISION
12/04/20	JYZ	60% DESIGN
12/09/20	JYZ	60% REVISION

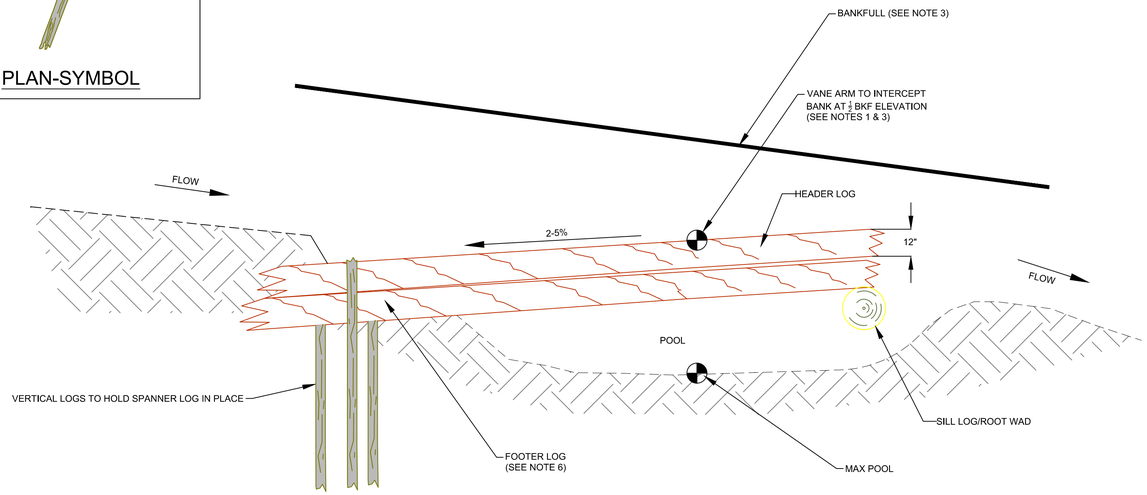
Sheet No:

39 OF 47

D:\DROPBOX (SSSR)\SWCA EDGECOMB CREEK\C3D\SHEETS\EDGECOMBCK_DETAILS SUMMARY.DWG | JOSHUA.ALLEN | SAVED: Thursday, December 10, 2020 9:47:43 PM | ACAD.CTB | | PLOTTED: Tuesday, December 22, 2020 11:01:38 AM



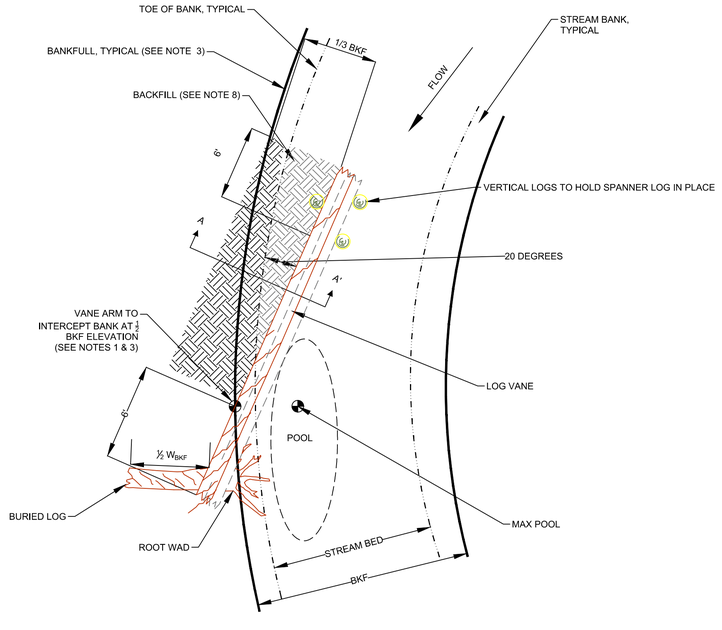
PLAN-SYMBOL



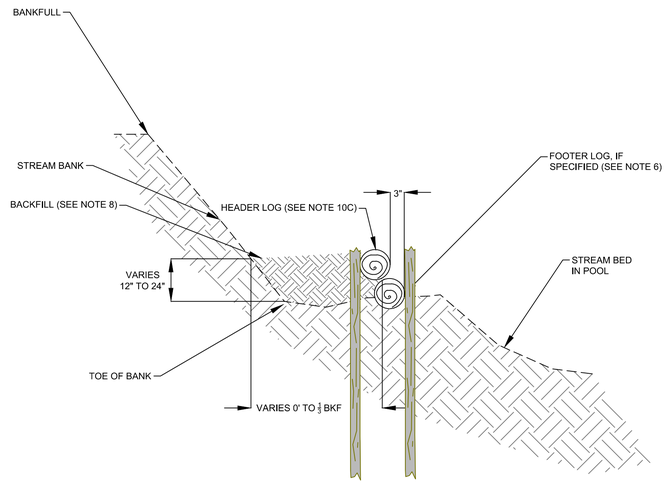
PROFILE VIEW

NOTES:

1. A LOG VANE IS A STREAM BANK PROTECTION, IN-STREAM STRUCTURE THAT DIRECTS STREAM FLOW AWAY FROM THE STREAM BANK AND IN TOWARD THE CENTER OF THE CHANNEL. THE DETAIL SHALL BE "FLIPPED" DEPENDING ON WHICH STREAM BANK (LEFT OR RIGHT) IS ON THE OUTSIDE OF THE MEANDER BEND.
2. THE VANE SHALL INTERCEPT THE STREAM BANK AT A HEIGHT EQUAL TO ½ BANKFULL STAGE THE VANE INTERCEPT LOCATION MAY BE OTHERWISE DESCRIBED BY ITS RELATIONSHIP TO BANKFULL STAGE OR BY THE LENGTH AND SLOPE OF THE VANE ARM. BANKFULL IS NOT NECESSARILY THE TOP OF THE STREAM BANK SLOPE.
3. LOG VANES SHALL BE CONSTRUCTED OF ONE OR MORE LOGS PINNED IN PLACE BY EMBEDDED LOGS. LOGS SHALL BE OF A LENGTH AND DIAMETER SPECIFIED BY THE DESIGNER AND BE RELATIVELY STRAIGHT HARDWOOD, RECENTLY HARVESTED. THE LENGTH SHALL BE SUCH THAT THE LOG IS BURIED INTO THE SOIL OF THE STREAM BANK (ON ONE END) AND STREAM BED (ON THE OTHER END) A MINIMUM DISTANCE AS SPECIFIED BY THE DESIGNER.
4. BACKFILL OF THE LOG VANE SHALL BE OF A TYPE, SIZE, AND GRADATION AS SPECIFIED BY THE DESIGNER. BACKFILL SHALL BE PLACED TO A THICKNESS EQUAL TO THE DEPTH OF THE HEADER AND FOOTER LOGS AND SHALL EXTEND OUT FROM THE VANE TO THE STREAM BANK.
5. LOG VANES SHALL BE BUILT TYPICALLY AS FOLLOWS:
   - A. OVER-EXCAVATE STREAM BED TO A DEPTH EQUAL TO THE TOTAL THICKNESS OF THE HEADER (AND FOOTER IF SPECIFIED) LOGS.
   - B. PLACE FOOTER LOG OF THE VANE ARM IF SPECIFIED. THE SLOPE OF THE VANE ARM IS MEASURED ALONG THE VANE ARM WHICH IS INSTALLED AT AN ANGLE TO THE STREAM BANK AND PROFILE.
   - C. INSTALL HEADER LOG OF THE VANE ARM ON TOP OF AND SLIGHTLY FORWARD OR BACK FROM THE FOOTER LOG.
   - D. PLACE BALLAST BOULDERS ON THE VANE.
   - E. PLACE BACKFILL BEHIND LOGS ENSURING THAT ANY VOIDS BETWEEN THE LOGS ARE FILLED.
   - F. BACKFILL REMAINDER OF VANE WITH PREVIOUSLY EXCAVATED MATERIAL.
10. IF ANY EROSION CONTROL MATTING IS SPECIFIED FOR USE IN THE VICINITY OF THE STREAM BANK/VANE INTERCEPT POINT THE MATTING EDGES SHALL BE NEATLY SECURED AROUND THE LOGS.



PLAN VIEW



ARM SECTION A - A'

DETAIL - LOG VANE
NOT TO SCALE

Prepared by:
SWCA ENVIRONMENTAL CONSULTANTS
Operating in North Carolina as SWCA Environmental Consulting and Engineering of NC, PC
116 Alexandria Drive
Mooresville, NC 28115
(p) 919.624.1458

Prepared for:
NorthPoint DEVELOPMENT

Stamp:

Project Title:
EDGECOMB CREEK
60% DESIGN

Sheet Title:
DETAILS -
LOG VANE

Date:	12/04/2020
Scale:	NOT TO SCALE
Drawn by:	JYZ
Checked by:	DMP
File #	

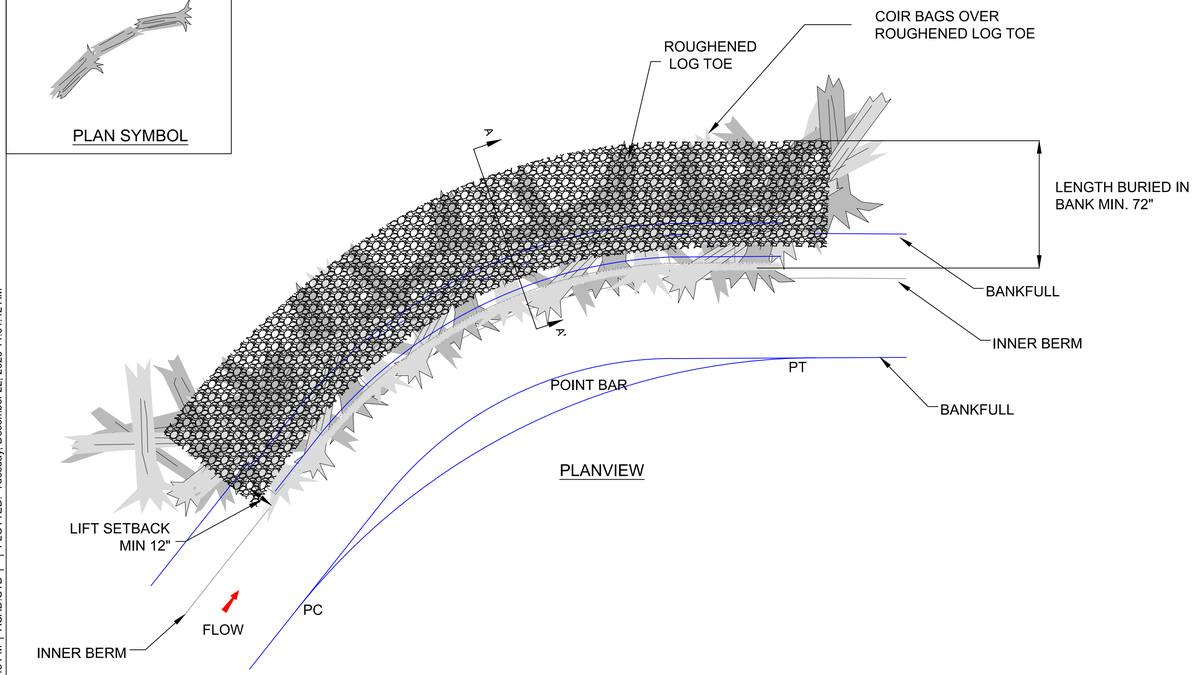
REVISIONS

Date:	By:	Note:
09/30/20	JYZ	30% DESIGN
10/21/20	BPW	30% REVISION
12/04/20	JYZ	60% DESIGN
12/09/20	JYZ	60% REVISION

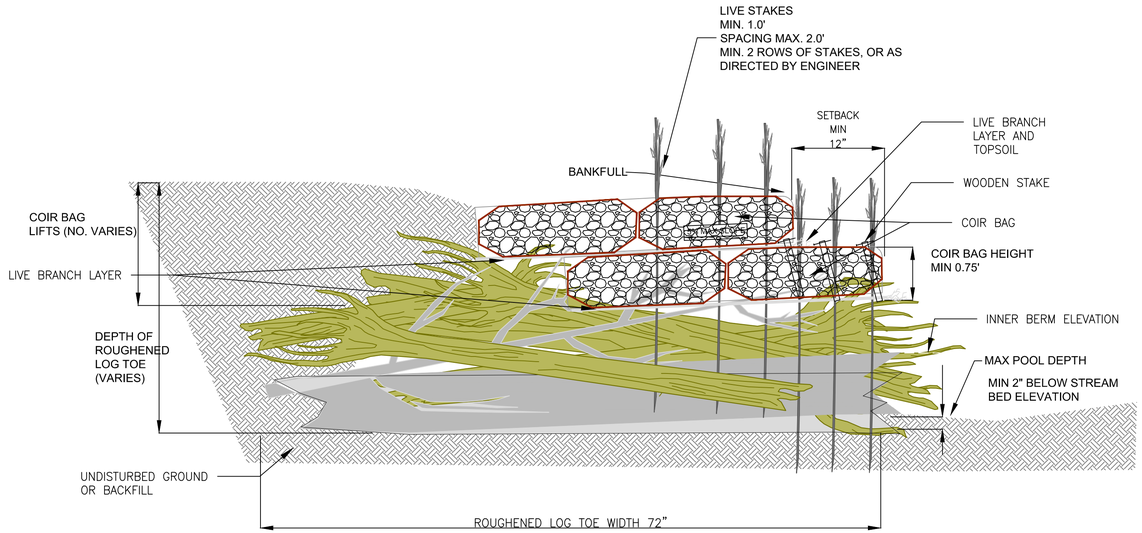
Sheet No:
40 OF 47

D:\DROPBOX (SSSR)\SWCA EDGECOMB CREEK\C3D\SHEETS\EDGECOMBCK_DETAILS SUMMARY.DWG | JOSHUA.ALLEN | SAVED: Thursday, December 10, 2020 9:47:43 PM | ACAD.CTB | | PLOTTED: Tuesday, December 22, 2020 11:01:39 AM

PLAN SYMBOL



PLANVIEW



SECTION A-A'

DETAIL - ROUGHENED LOG TOE
NOT TO SCALE

NOTES:

1. THIS STRUCTURE PROVIDES PROTECTION TO THE BANKS OF NEWLY CONSTRUCTED STREAM CHANNELS. WOODY DEBRIS OF ALL SIZES CAN BE USED IN THE CONSTRUCTION OF THIS STRUCTURE. THE STABILITY OF THE LOWER PORTION OF THE STREAMBANK IS CRITICAL TO THE SUCCESS OF THE PROJECT.
2. COARSE/LARGE WOODY DEBRIS CONSISTS OF LOGS, ROOTWADS, AND LARGE BRANCHES WHICH ARE NOT SUITABLE FOR CONSTRUCTION OF LOG STRUCTURES. ALL MATERIALS ARE TO BE APPROVED BY THE ENGINEER.
3. A TRENCH SHALL BE EXCAVATED ALONG THE OUTER BANK OF THE POOL. THE ELEVATION OF THE TRENCH SHALL BE AT OR BELOW MAX. POOL DEPTH.
4. COARSE/LARGE WOODY DEBRIS SHALL BE INSTALLED IN THE TRENCH WITH THE LARGEST MATERIAL PLACED FIRST. THE LOGS OR WOOD MATERIAL SHALL BE PLACED PERPENDICULAR TO THE FLOW OF WATER. LOGS SHALL BE PLACED IN A CROSSING PATTERN OR WEAVE SUCH THAT EACH LOG/BRANCH IS ANCHORED BY ANOTHER LOG/BRANCH. THE COARSE/LARGE WOODY DEBRIS SHALL BE INSTALLED TO A HEIGHT OF 3/4 OF THE FINISHED HEIGHT OF THE WOODY DEBRIS WITH THE FINE/SMALL WOODY DEBRIS MAKING UP THE REMAINING 1/4 OF THE TOTAL HEIGHT.
5. FINE/SMALL WOODY DEBRIS CONSISTS OF MEDIUM TO SMALL LIMBS, BRANCHES, BUSHES, AND/OR SMALL LOGS. INVASIVE SPECIES SHALL NOT BE USED. ALL MATERIALS ARE TO BE APPROVED BY THE ENGINEER.
6. FINE/SMALL WOODY DEBRIS SHALL BE PLACED ON TOP OF THE COARSE/LARGE WOODY DEBRIS WITH THE LARGEST MATERIAL BEING PLACED FIRST AND THE SMALLEST MATERIAL PLACED LAST. THE FINE WOODY DEBRIS SHALL BE INSTALLED TO AN ELEVATION EQUAL TO THE INVERT OF THE DOWNTREAM RIFFLE.
7. ALL WOODY DEBRIS SHALL BE COMPACTED WITH THE EXCAVATOR BUCKET IN ORDER TO REDUCE THE PRESENCE OF VOIDS IN THE SMALL/FINE WOODY DEBRIS LAYER.
8. SELECT BACKFILL/TOPSOIL SHALL BE INSTALLED ON TOP OF WOODY DEBRIS TO CREATE A LEVEL SUBSTRATE FOR THE COIR BAGS.
9. COIR BAGS SHALL BE INSTALLED IN LAYERS SO THAT THE FINISHED ELEVATION OF THE LAST LAYER MATCHES THE SPECIFIED BANKFULL ELEVATION.
10. THE SURFACE OF THIS STRUCTURE SHALL BE FINISHED TO A SMOOTH AND COMPACT SURFACE IN ACCORDANCE WITH THE LINES, GRADES, AND CROSS-SECTIONS OR ELEVATIONS SHOWN ON THE DRAWINGS. THE DEGREE OF FINISH FOR ELEVATIONS SHALL BE WITHIN +/- 0.05 FT OF THE GRADES AND ELEVATIONS INDICATED ON THE PLANS OR APPROVED BY THE ENGINEER
11. DRESSING OF CHANNEL AND BANKFULL BENCH/FLOODPLAIN WILL LIKELY BE REQUIRED FOLLOWING INSTALLATION OF BANK STRUCTURES AND SHALL BE CONSIDERED INCIDENTAL TO CONSTRUCTION.
12. LIVE STAKES SHALL BE OF SPECIES APPROVED BY THE ENGINEER. LIVE STAKES SHALL BE 2-3' LONG AND A MIN. OF 1" IN DIAMETER AND INSTALLED WITH 2/3 OF THE LENGTH BELOW GROUND WITH A MINIMUM OF 2 BUD SCARS BELOW THE GROUND AND 2 ABOVE GROUND.
13. LIVE STAKES SHALL BE PLACED ON THE SLOPE FROM THE INNER BERM TO HALF BANK FULL HEIGHT.
14. WOOD STAKES SHALL BE 1" X 2" AND A MIMIMUM OF 18" LONG. WOODEN STAKES SHALL BE INSTALLED FROM THE HALF BANK FULL TO BANKFULL.
15. COIR BAGS SHALL CONSIST OF 7 OUNCE COIR FIBER AND HAVE MINIMUM DIMENSIONS OF 26 INCHES LONG AND 14 INCHES WIDE. THE COIR BAGS SHALL BE FILLED WITH STREAM BED MATERIAL WITH A MEDIAN DIAMETER OF 2.5 INCHES. EACH COIR BAG SHOULD BE LIMITED TO 50 POUNDS OF MATERIAL.

Prepared by:
SWCA ENVIRONMENTAL CONSULTANTS
Operating in North Carolina as SWCA Environmental Consulting and Engineering of NC, PC
116 Alexandria Drive
Mooresville, NC 28115
(p) 919.624.1458

Prepared for:
NorthPoint DEVELOPMENT

Stamp:

Project Title:
EDGECOMB CREEK
60% DESIGN

Sheet Title:
DETAILS - ROUGHENED TOE LOG

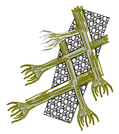
Date:	12/04/2020
Scale:	NOT TO SCALE
Drawn by:	JYZ
Checked by:	DMP
File #	

REVISIONS

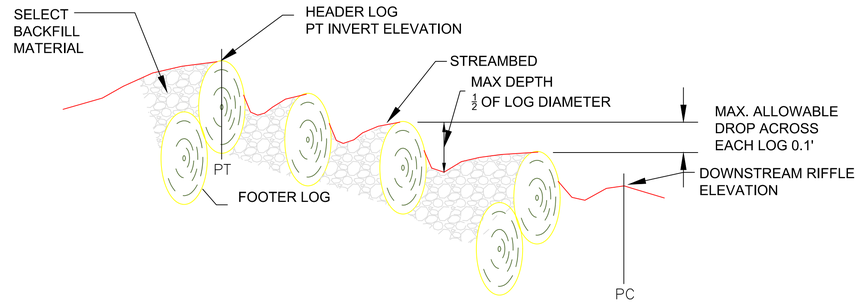
Date:	By:	Note:
09/30/20	JYZ	30% DESIGN
10/21/20	BPW	30% REVISION
12/04/20	JYZ	60% DESIGN
12/09/20	JYZ	60% REVISION

Sheet No:
41 OF 47

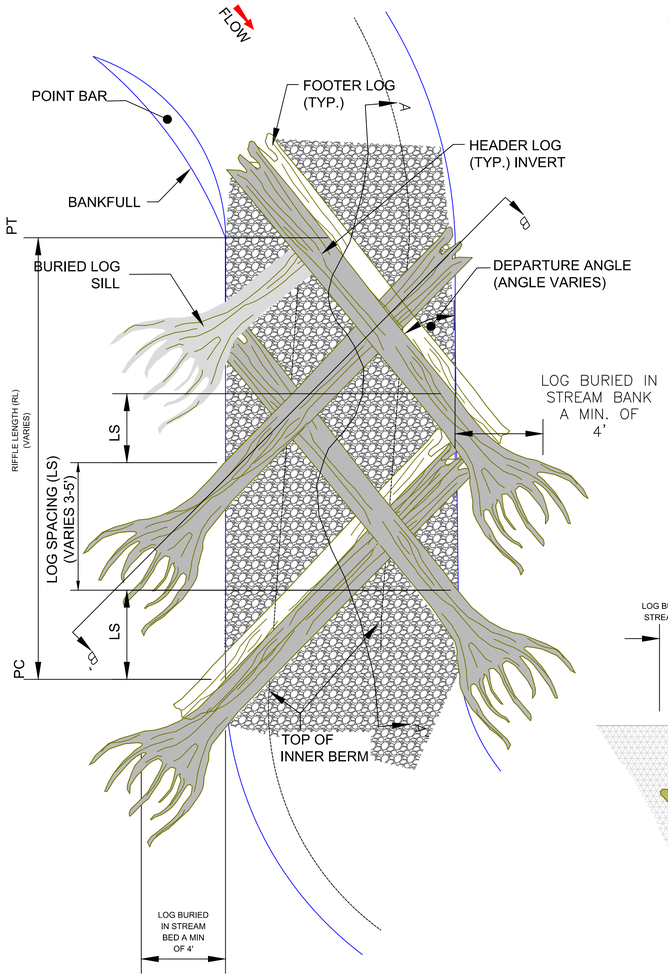
D:\DROPBOX (SSSR)\SWCA EDGECOMB CREEK\C3D\SHEETS\EDGECOMBCK_DETAILS SUMMARY.DWG | JOSHUA.ALLEN | SAVED: Thursday, December 10, 2020 9:47:43 PM | ACAD.CTB | | PLOTTED: Tuesday, December 22, 2020 11:01:42 AM



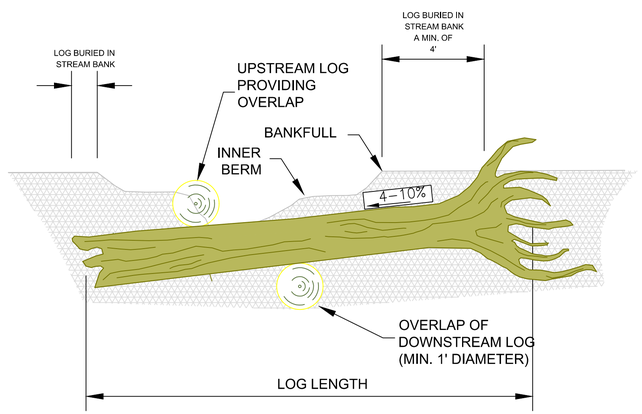
PLAN-SYMBOL



PROFILE A-A'



PLANVIEW



SECTION B-B'

DETAIL - ROCK AND ROLL RIFFLE

NOT TO SCALE

NOTES:

1. THIS STRUCTURE HELPS MAINTAIN GRADE WITHIN A NEWLY CONSTRUCTED STREAM CHANNEL. IN GENERAL, IT IS USED IN LOCATIONS WHERE COARSE SUBSTRATE USED TO CONSTRUCT OTHER GRADE CONTROL STUCTURES (E.G., AUGMENTED RIFFLE) IS NOT AVAILABLE. IF SUITABLE COARSE SUBSTRATE IS DISCOVERED ON SITE, THE CONTRACTOR MAY INSTALL A DIFFERENT GRADE CONTROL STRUCTURE WITH THE ENGINEER'S APPROVAL.
2. THE ROCK AND ROLL RIFFLE SHALL BE INSTALLED ON PERENNIAL REACHES THAT ARE REMOTE. BANKFULL WIDTHS OF THESE REACHES WILL BE BETWEEN 8-11', WITH SLOPES THAT RANGE FROM OF 1.5-2.5%. THE CONSTRUCTED LOG RIFFLE STRUCTURES ARE INTENDED FOR REACHES WITH LIMITED ACCESS AND WITH TREES AVAILABLE ONSITE.
3. LOGS SHALL HAVE MIN. DIAMETER OF 12". LOGS SHALL HAVE A MINIMUM LENGTH OF 10-50' DEPENDING ON THE REACH.
4. ALL LOGS SHALL BE RELATIVELY STRAIGHT AND LIMBS SHALL BE TRIMMED FLUSH.
5. THE LOGS AT THE UPSTREAM AND DOWNSTREAM END OF THE STRUCTURE WILL BE UNDERLAIN BY A FOOTER LOG (SOMETIMES CALLED A BACKER LOG) UNLESS OTHERWISE DIRECTED BY ENGINEER. THE HEADER LOG IS THE TOP LOG USED IN EACH PAIR. WHEN FINISHED, THE HEADER LOG IS VISIBLE ONLY BETWEEN THE INNER BERMS. THE HEADER LOG SHALL BE INSTALLED BEFORE THE FOOTER LOG. THE HEADER LOG DOES NOT REST ON THE TOP OF THE FOOTER LOG. THE FOOTER LOG IS INSTALLED FROM THE UPSTREAM SIDE AND INSTALLED AGAINST THE LOWER HALF OF THE HEADER LOG RESULTING IN A STAGGER WITH THE HEADER LOG BEING SLIGHTLY MORE DOWNSTREAM THAN THE FOOTER LOG.
6. THE OTHER LOGS IN THE STRUCTURE ARE SINGLE LOGS WITH NO FOOTER LOG.
7. SET INVERTS AT ELEVATIONS SHOWN ON THE PLAN AND PROFILE SHEETS. PLAN AND PROFILE SHEETS WILL BE PROVIDED TO THE CONTRACTOR AS A 2004 FORMAT DWG FILE AND LN3 FILE. THE ELEVATIONS OF THE LOGS COMPRISING THE LOG CONSTRUCTED RIFFLE SHALL NOT VARY FROM THE PLAN UNLESS OTHERWISE DIRECTED BY THE ENGINEER.
8. THE MOST UPSTREAM LOG SHALL BE PLACED SUCH THAT THE BANK TIE-IN IS ON THE SAME SIDE AS THE NEXT UPSTREAM OUTSIDE BEND IN ORDER TO SERVE AS A VANE AND HELP DIRECT STREAM FLOW AWAY FROM THE PREVIOUS OUTSIDE BEND. LOCATION OF ALL RIFFLE LOG ARMS ARE SHOWN ON THE PLAN AND PROFILE SHEETS AND WILL BE PROVIDED TO THE CONTRACTOR AS A 2004 FORMAT DWG FILE AND LN3 FILE. NO ELEVATIONS OF THE CONSTRUCTED RIFFLE ARMS MAY VARY FROM THE PLAN LOCATIONS WITHOUT DIRECTION FROM ENGINEER.
9. THE MOST DOWNSTREAM LOG SHALL BE PLACED SUCH THAT THE HIGH POINT IS ON THE SAME SIDE AS THE NEXT DOWNSTREAM OUTSIDE BEND IN ORDER TO HELP DIRECT STREAM FLOW AWAY FROM THE NEXT OUTSIDE BEND.
10. ALL LOGS ARE PLACED SUCH THAT THEY OVERLAP THE NEXT DOWNSTREAM LOG. THEREFORE, IT IS RECOMMENDED THAT THIS STRUCTURE BE CONSTRUCTED FROM DOWNSTREAM TO UPSTREAM.
11. THE VERTICAL SLOPE OF EACH LOG SHALL NOT EXCEED 10% WITH THE SPECIFIC VERTICAL SLOPE OF EACH LOG DETERMINED BY THE ENGINEER.
12. IT IS LIKELY THAT THE LOGS WILL REQUIRE NOTCHING WHERE THEY OVERLAP IN ORDER TO NOT EXCEED THE MAXIMUM VERTICAL SLOPE SPECIFICATION. THE CONTRACTOR SHOULD CHOOSE LOGS THAT CAN MEET THE SPECIFICATIONS OF THIS DETAIL
13. THE NOTCH DEPTH FOR ANY LOG SHALL NOT EXCEED HALF THE DIAMETER OF THE LOG UNLESS OTHERWISE DIRECTED BY THE ENGINEER. ANY NOTCHED LOGS SHALL BE APPROVED BY THE ENGINEER BEFORE THE LOGS ARE BACKFILLED.
14. ALL GAPS/VOIDS LARGER THAN 1" BETWEEN THE HEADER AND FOOTER LOGS SHALL BE CHINKED WITH LIMBS AND/OR BRUSH ON THE UPSTREAM SIDE PRIOR TO PLACEMENT OF THE GEOTEXTILE.
15. SELECT BACKFILL MATERIAL SHALL BE PLACED UPSTREAM OF EACH LOG SUCH THAT FUTURE SETTLEMENT OF THE MATERIAL WILL BE MINIMAL. SELECT BACKFILL MATERIAL SHALL BE HAVE A MINIMUM D50 OF 60 MM. ANY DEVIATIONS IN THE GRADATION MUST BE APPROVED BY THE ENGINEER.
16. THE SURFACE OF THIS STRUCTURE SHALL BE FINISHED TO A SMOOTH AND COMPACT SURFACE IN ACCORDANCE WITH THE LINES, GRADES, AND CROSS-SECTIONS OR ELEVATIONS SHOWN ON THE DRAWINGS. THE DEGREE OF FINISH FOR INVERT ELEVATIONS SHALL BE WITHIN 0.1' OF THE GRADES AND ELEVATIONS INDICATED, PROVIDED ANY HEIGHT DOES NOT EXCEED MAX. ALLOWABLE DROP OF 0.1' OVER ANY ONE LOG AND 0.5' FOR THE ENTIRE STRUCTURE.
17. DRESSING OF CHANNEL AND BANKFULL BENCH/FLOODPLAIN WILL LIKELY BE REQUIRED FOLLOWING INSTALLATION OF IN-STREAM STRUCTURES.
18. THE DEPARTURE ANGLE SHOWN IN THE PLANVIEW DRAWING IS DEPICTED IN SUCH A WAY TO EMPHASIZE DETAIL. ACTUAL DEPARTURE ANGLE SHALL BE AS SHOWN ON THE PLAN AND PROFILE SHEETS AND WILL BE PROVIDED TO THE CONTRACTOR AS A 2004 FORMAT DWG FILE AND LN3 FILE.

Prepared by:

SWCA ENVIRONMENTAL CONSULTANTS

Operating in North Carolina as SWCA Environmental Consulting and Engineering of NC, PC

116 Alexandria Drive
Mooresville, NC 28115
(p) 919.624.1458

Prepared for:

NorthPoint DEVELOPMENT

Stamp:

Project Title:

EDGECOMB CREEK
60% DESIGN

Sheet Title:

DETAILS -
ROCK AND ROLL
RIFFLE

Date:	12/04/2020
Scale:	NOT TO SCALE
Drawn by:	JYZ
Checked by:	DMP
File #	

REVISIONS

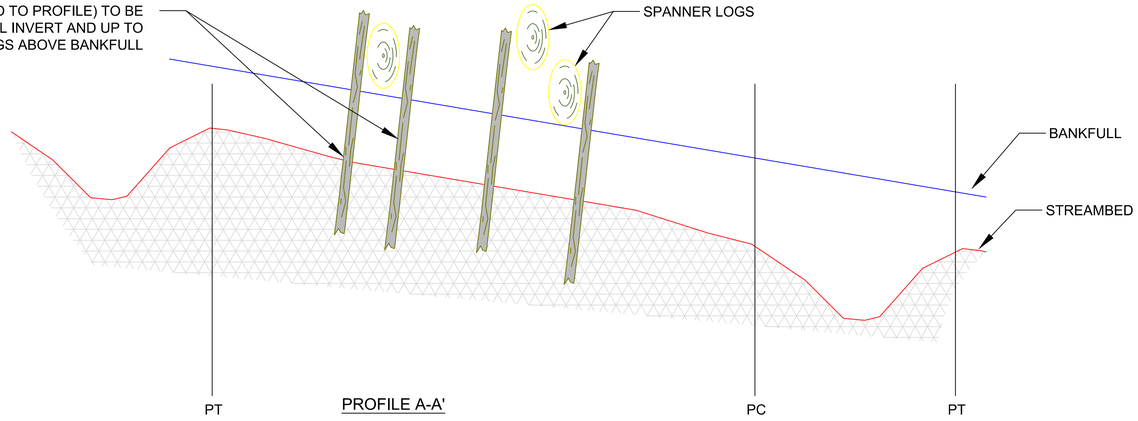
Date:	By:	Note:
09/30/20	JYZ	30% DESIGN
10/21/20	BPW	30% REVISION
12/04/20	JYZ	60% DESIGN
12/09/20	JYZ	60% REVISION

Sheet No:

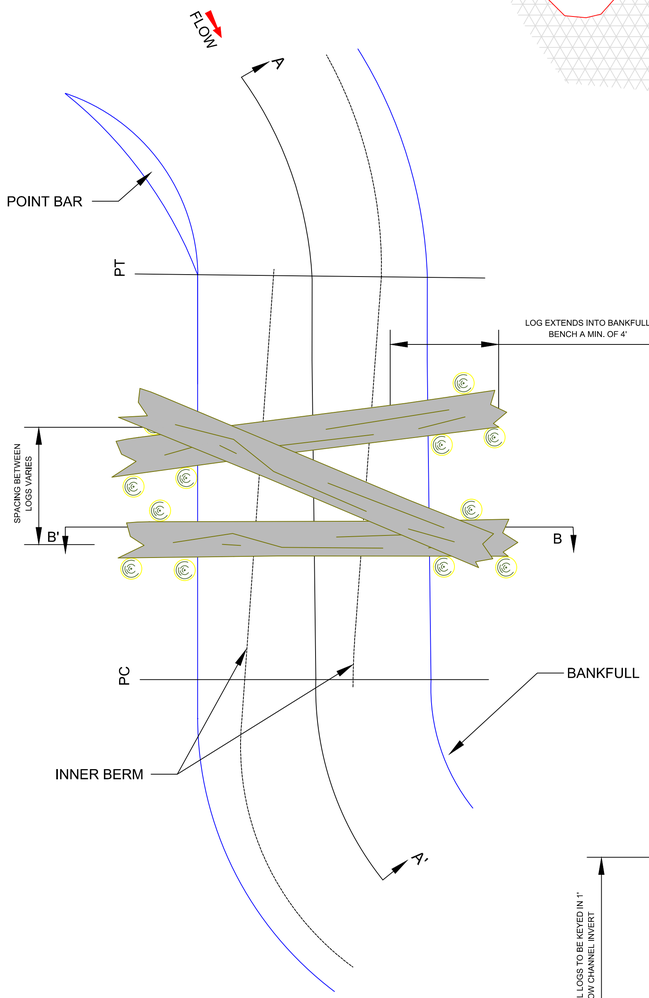
42 OF 47

D:\DROPBOX (SSSR)\SWCA EDGECOMB CREEK\C3D\SHEETS\EDGECOMBCK_DETAILS SUMMARY.DWG | JOSHUA.ALLEN | SAVED: Thursday, December 10, 2020 9:47:43 PM | ACAD.CTB | | PLOTTED: Tuesday, December 22, 2020 11:01:44 AM

PLAN-SYMBOL



PROFILE A-A'



PLANVIEW

NOTES:

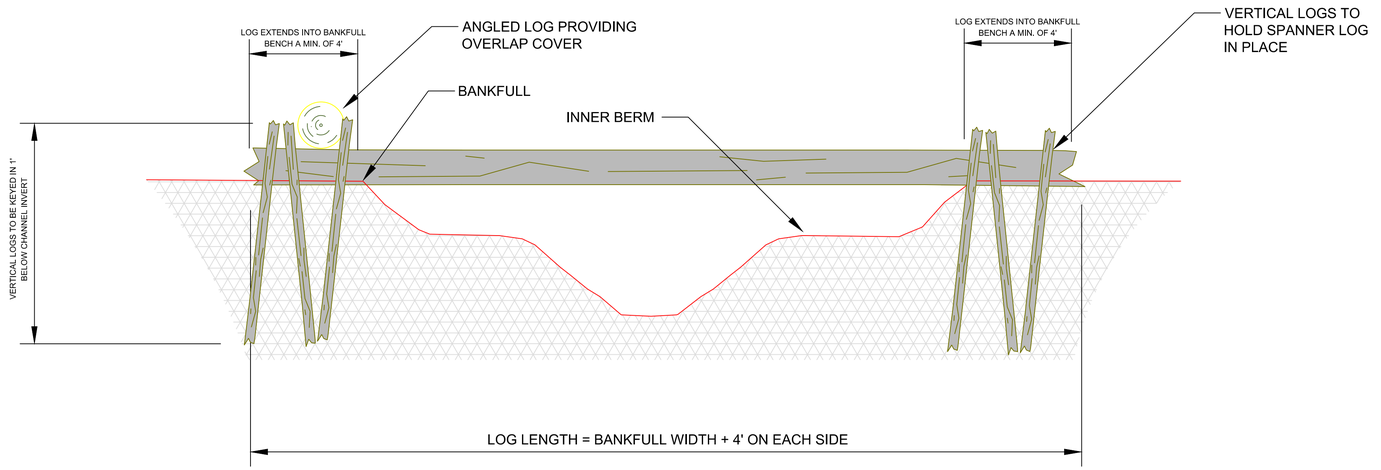
1. SPANNER LOGS SHALL BE USED FOR ENHANCEMENT OF HABITAT WITHIN THE STREAM CORRIDOR. THE WOODY DEBRIS WILL PROVIDE SUNNING AREAS FOR REPTILES AND AMPHIBIANS, LOAFING SITES FOR WATERFOWL, AND COVER FOR AQUATIC SPECIES.

2. SPANNER LOGS SHALL CONSIST OF CLEARED OR CUT TREES. TREES USED FOR SHALL HAVE A MINIMUM TRUNK DIAMETER OF 12 INCHES. WOODY DEBRIS WITH ROOT WADS ATTACHED ARE DESIRABLE. HOWEVER, SAW CUT TREES ARE ALSO ACCEPTABLE.

3. SPANNER LOG PLACEMENT
   - 3.1. SPANNER LOGS SHALL ONLY BE PLACED OVER THE RIFFLE SECTIONS OF THE STREAM.
   - 3.2. WHEN PLACED, THE MAIN TRUNK OF THE TREE SHOULD BE GENTLY SLOPED SO THAT WITH CHANGING WATER LEVELS, THE TREE WILL PROVIDE LOAFING AREAS FOR WILDLIFE MOST OF THE TIME.
   - 3.3. SEVERAL SMALLER TREES MAY BE USED IN LIEU OF A SINGLE LOG AS LONG AS THEY PROVIDE COVER FOR THE FULL HYDROLOGIC REGIME AS SHOWN IN THE DETAILS.

4. NO PART OF THE SPANNER LOG SHALL BE PLACED WITHIN THE BANKFULL CHANNEL.

5. THE VERTICAL LOG SHALL HAVE A MINIMUM DIAMETER OF 6 INCHES.



SECTION B-B'

DETAIL - SPANNER LOG
NOT TO SCALE

Prepared by:

SWCA ENVIRONMENTAL CONSULTANTS

Operating in North Carolina as SWCA Environmental Consulting and Engineering of NC, PC

116 Alexandria Drive
Mooresville, NC 28115
(p) 919.624.1458

Prepared for:

NorthPoint DEVELOPMENT

Stamp:

Project Title:

EDGECOMB CREEK
60% DESIGN

Sheet Title:

DETAILS -
SPANNER LOG

Date:	12/04/2020
Scale:	NOT TO SCALE
Drawn by:	JYZ
Checked by:	DMP
File #	

REVISIONS

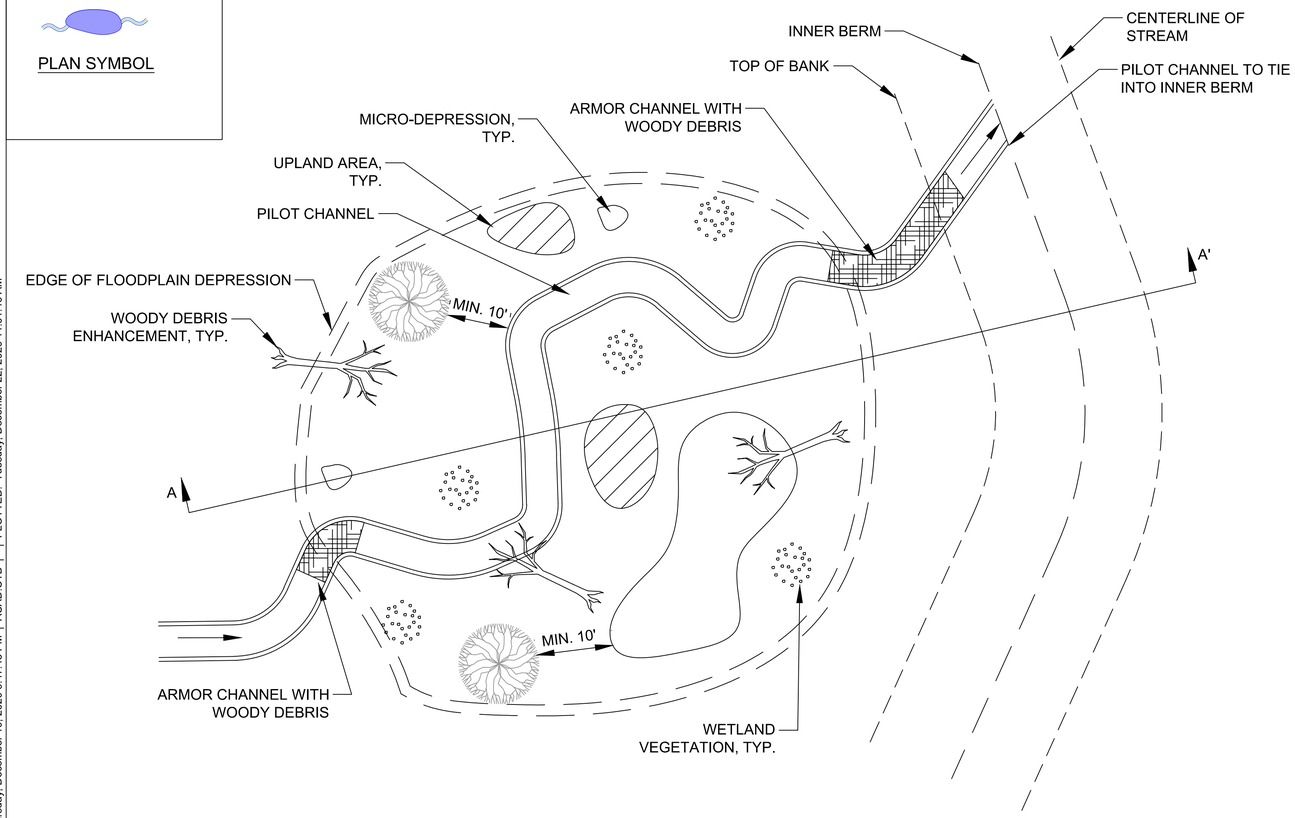
Date:	By:	Note:
09/30/20	JYZ	30% DESIGN
10/21/20	BPW	30% REVISION
12/04/20	JYZ	60% DESIGN
12/09/20	JYZ	60% REVISION

Sheet No:

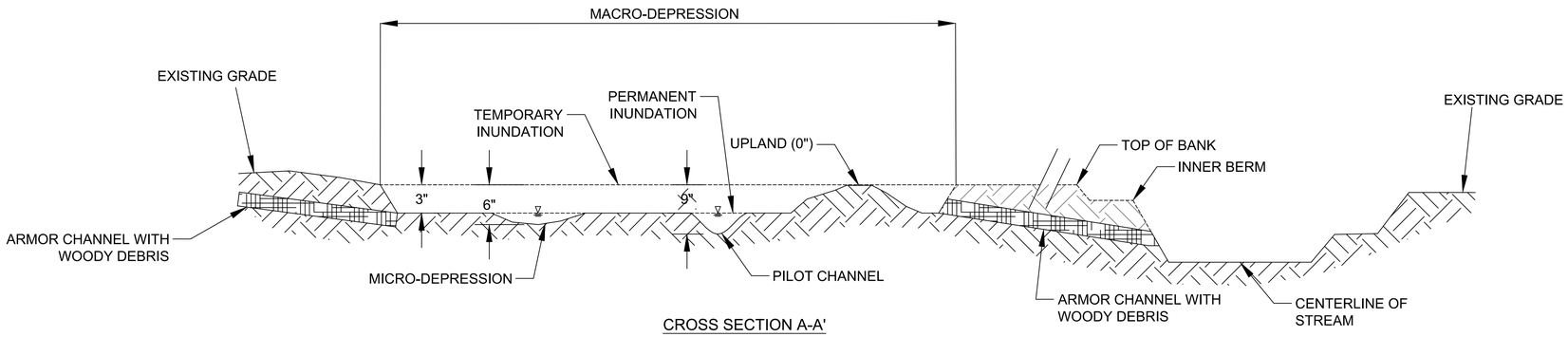
43 OF 47

D:\DROPBOX (SSSR)\SWCA EDGECOMB CREEK\C3D\SHEETS\EDGECOMBCK_DETAILS SUMMARY.DWG | JOSHUA.ALLEN | SAVED: Thursday, December 10, 2020 9:47:43 PM | ACAD.CTB | | PLOTTED: Tuesday, December 22, 2020 11:01:45 AM

PLAN SYMBOL



PLAN VIEW



CROSS SECTION A-A'

NOTES:

1. MICRO-DEPRESSIONS AND UPLAND AREAS ARE INTENDED TO INCREASE THE VARIABILITY OF WETLAND HABITAT WITHIN THE FLOODPLAIN DEPRESSION.
2. FLOODPLAIN DEPRESSIONS SHALL BE LOCATED AND SIZED PER THE PROJECT PLAN SHEETS.
3. THERE MINIMUM SLOPE REQUIREMENT FOR THE EDGE OF THE MICRO- AND FLOODPAIN DEPRESSIONS IS 4:1.
4. THE PILOT CHANNEL SHALL BE LOCATED AND SIZED PER THE PROJECT PLAN SHEETS. THE PILOT CHANNEL SHALL HAVE NO SLOPE THROUGH THE FLOODPLAIN DEPRESSIONS.
5. THE FLOODPLAIN DEPRESSIONS ARE TO BE PLANTED WITH A WETLAND SEED MIX AND PLANTS THAT CAN WITHSTAND TEMPORARY INUNDATION. THE MICRO-DEPRESSIONS ARE TO BE PLANTED WITH PLANT SPECIES THAT CAN WITHSTAND PERMANENT INUNDATION.
6. MICRO-DEPRESSIONS AND UPLAND AREAS ARE TO BE CREATED THROUGHOUT THE FLOODPLAIN DEPRESSTION IN A RANDOM PATTERN. THERE SHOULD BE NO MICRO-DEPRESSIONS OR PILOT CHANNELS EXCAVATED WITHIN 10' OF THE DRIP LINE OF ANY PLANTED TREES.

DETAIL - FLOODPLAIN DEPRESSION

NOT TO SCALE

Prepared by:

SWCA ENVIRONMENTAL CONSULTANTS

Operating in North Carolina as SWCA Environmental Consulting and Engineering of NC, PC

116 Alexandria Drive
Mooresville, NC 28115
(p) 919.624.1458

Prepared for:

NorthPoint DEVELOPMENT

Stamp:

Project Title:

EDGECOMB CREEK
60% DESIGN

Sheet Title:

DETAILS - FLOODPLAIN DEPRESSION

Date:	12/04/2020
Scale:	NOT TO SCALE
Drawn by:	JYZ
Checked by:	DMP
File #	

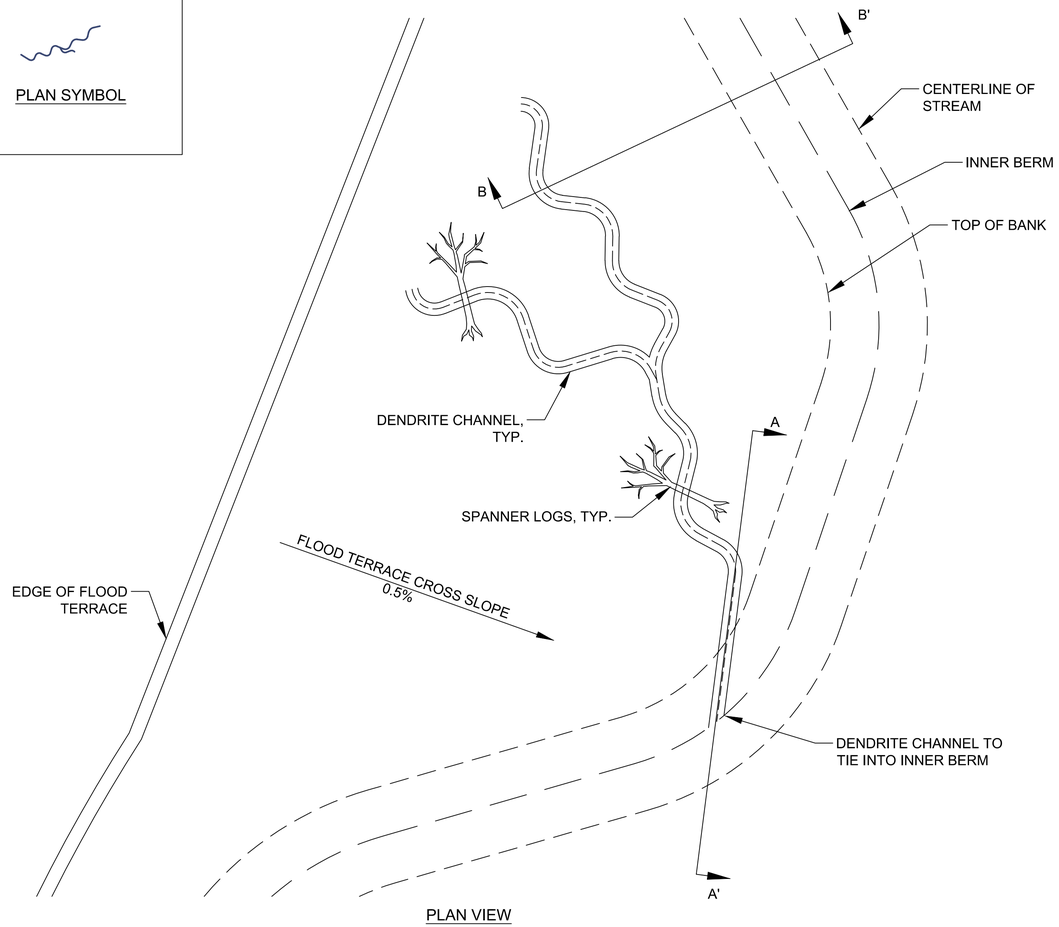
REVISIONS

Date:	By:	Note:
09/30/20	JYZ	30% DESIGN
10/21/20	BPW	30% REVISION
12/04/20	JYZ	60% DESIGN
12/09/20	JYZ	60% REVISION

Sheet No:

D:\DROPBOX (SSSR)\SWCA EDGECOMB CREEK\C3D\SHEETS\EDGECOMBCK_DETAILS SUMMARY.DWG | JOSHUA.ALLEN | SAVED: Thursday, December 10, 2020 9:47:43 PM | ACAD.CTB | | PLOTTED: Tuesday, December 22, 2020 11:01:46 AM

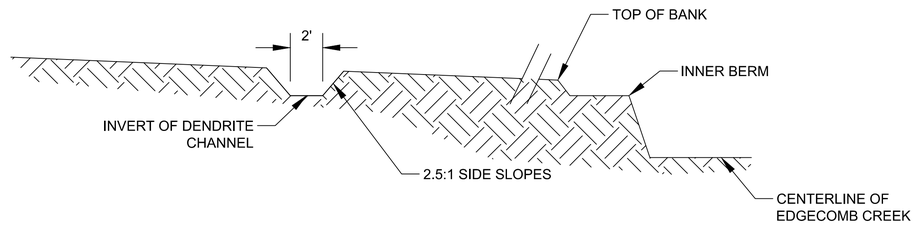
PLAN SYMBOL



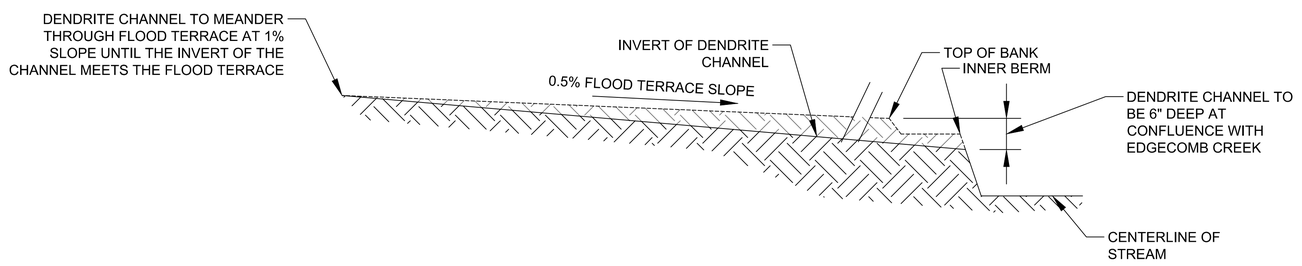
PLAN VIEW

NOTES:

1. DENDRITE CHANNELS ARE INTENDED TO INCREASE THE VARIABILITY OF HABITAT WITHIN THE FLOODPLAIN TERRACE.
2. DENDRITE CHANNELS SHALL BE LOCATED AND SIZED PER THE PROJECT PLAN SHEETS.
3. DENDRITE CHANNELS SHALL HAVE A 1% LONGITUDINAL SLOPE, AND TERMINATE WHEN THE INVERT ELEVATION OF THE CHANNEL IS EQUAL WITH THE FLOOD TERRACE ELEVATION.
4. THE DENDRITE CHANNELS SHALL HAVE A BOTTOM WIDTH OF 2 FEET AND SIDE SLOPES OF 2.5:1.
5. THE DENDRITE CHANNELS ARE TO BE PLANTED IN ACCORDANCE WITH THE PLANTING PLAN.
6. SPANNER LOGS AND OTHER WOODY DEBRIS SHALL BE PLACED IN AND AROUND THE DENDRITE CHANNELS IN A RANDOM PATTERN.



CROSS SECTION B-B'



CROSS SECTION A-A'

DETAIL - DENDRITE CHANNEL

NOT TO SCALE

Prepared by:

SWCA® ENVIRONMENTAL CONSULTANTS

Operating in North Carolina as SWCA Environmental Consulting and Engineering of NC, PC

116 Alexandria Drive
Mooresville, NC 28115
(p) 919.624.1458

Prepared for:

NorthPoint DEVELOPMENT

Stamp:

Project Title:

EDGECOMB CREEK
60% DESIGN

Sheet Title:

DETAILS - DENDRITE CHANNEL

Date:	12/04/2020
Scale:	NOT TO SCALE
Drawn by:	JYZ
Checked by:	DMP
File #	

REVISIONS

Date:	By:	Note:
09/30/20	JYZ	30% DESIGN
10/21/20	BPW	30% REVISION
12/04/20	JYZ	60% DESIGN
12/09/20	JYZ	60% REVISION

Sheet No:

45 OF 47

D:\DROPBOX (SSSR)\SWCA EDGECOMB CREEK\C3D\SHEETS\EDGECOMBCK_DETAILS SUMMARY.DWG | JOSHUA.ALLEN | SAVED: Thursday, December 10, 2020 9:47:43 PM | ACAD.CTB | | PLOTTED: Tuesday, December 22, 2020 11:01:46 AM

Appendix C – Qualifications

All determinations and supporting documentation, including this ***Conceptual Mitigation Plan*** prepared for the ***Cascade Logistics Park*** project were prepared by, or under the direction of, Matt DeCaro of SVC. In addition, conceptual mitigation planning was provided by Ben Wright, and report preparation was completed by Laura Livingston and Kyla Caddey.

Matt DeCaro

Associate Principal
Professional Experience: 10+ years

Matt DeCaro is an Associate Principal and Senior Scientist with a diverse background in environmental planning, wetland science, stream ecology, water quality, site remediation, NEPA compliance, and project management. He manages a wide range of industrial, commercial, and multi-family residential projects throughout Western Washington, providing environmental permitting and regulatory compliance assistance for land use projects from their planning stages through entitlement and construction. His local expertise, diverse professional background, and positive relationships with regulatory personnel are integral components of his successful project outcomes.

Matt earned a Bachelor of Science degree with a focus in Environmental Science from the Evergreen State College in Olympia, Washington, with additional graduate-level coursework and research in aquatic restoration and salmonid ecology. Matt has received 40-hour wetland delineation training (*Western Mountains, Valleys, & Coast and Arid West Regional Supplements*) and regularly performs wetland, stream, and shoreline delineations. Matt has been formally trained in the use of the *2014 Washington State Wetland Rating System* and *Determination of Ordinary High Water Mark* by WSDOE, and he is a Pierce County Qualified Wetland Specialist and Wildlife Biologist. He has attended USFWS survey workshops for multiple threatened and endangered species, and he is a Senior Author of WSDOT Biological Assessments. Matt holds 40-hour HAZWOPER training and has managed Phase I Environmental Site Assessments, subsurface investigations, and contaminant remediation projects throughout the Pacific Northwest. His diverse experience also includes NEPA compliance for federal permitting projects; noxious weed abatement; army ant research in the Costa Rican tropical rainforest; spotted owl surveys on federal and private lands; and salmonid spawning and migration surveys.

Ben Wright

Environmental Scientist
Professional Experience: 18 years

Ben Wright is an Environmental Scientist with a varied background in lake ecology, stream ecology, fisheries biology, water quality and climate science. Ben has 13 years of experience at the federal level providing technical assistance for both the development of infrastructure projects and management of aquatic resources. He has experience developing biological assessments, water quality monitoring plans, and fisheries management plans. Ben has an additional 10 years of experience working on long-term ecological monitoring programs related to lakes, streams, water quality and climate.

Ben earned a Bachelor of Science degree in Genetics and Cell Biology with an emphasis in aquatic ecology from Washington State University and has a graduate certificate in Fisheries Management from Oregon State University. Ben's expertise includes endangered species monitoring, assessments

and permitting, and NEPA documentation across disciplines gained during his work on federal highway projects. Ben also has experience in fish population assessments, utilizing genetic analysis, spawning escapement and movement studies. Ben has received formal training from the Washington State Department of Ecology in the Using the Revised 2014 Wetland Rating System for Western Washington, How to Determine the Ordinary High Water Mark, Navigating SEPA, How to Conduct a Forage Fish Survey and Puget Sound Costal Processes, Shoreline Modifications and Beach Restoration.

Laura Livingston

Environmental Planner
Professional Experience: 7 years

Laura Livingston is an Environmental Planner with a background in water quality monitoring, invasive species monitoring, wildlife monitoring, wilderness stewardship, and erosion control projects. Laura has field experience working on natural resources projects, with an emphasis on stream and river projects, in the Northwest, Northeast, and Southwest United States. She has also worked on a variety of environmental science research, grant, and teaching projects requiring scientific writing, science communication, laboratory work, and statistical analysis. She currently performs ordinary high water delineations; conducts environmental code analysis; and prepares environmental assessment and mitigation reports, biological evaluations, and permit applications to support clients through the regulatory and planning process. Laura has a particular interest in shoreline projects and has prepared a variety of application materials to support projects within Shoreline Master Program jurisdictions.

Laura earned a Master of Science degree in Environmental Science from Washington State University, Pullman. In addition, she has received training from the Washington State Department of Ecology in How to Administer Shoreline Development Permits in Western Washington's Shorelines, Determining the Ordinary High Water Mark, the revised Washington State Wetland Rating System, Puget Sound Coastal Processes, How to Conduct a Forage Fish Survey, and Using the Credit-Debit Method for Estimating Mitigation Needs. Laura has also received training from the Washington State Department of Transportation in Biological Assessment Preparation for Transportation Projects and is listed by WSDOT as a junior author for preparing Biological Assessments.