

Appendix J:

EO 11988 Floodplain Management and EO 11990 Wetlands Protection Determination

West Lumberton Flood Gate at VFW Road and Railroad Underpass Project
EO 11988 Floodplain Management and EO 11990 Protection of Wetlands Determination
Infrastructure Recovery Program

January 5, 2024

Introduction & Overview

The purpose of Executive Order (EO) 11988 Floodplain Management is “to avoid to the extent possible the long- and short-term adverse impacts associated with occupancy and modification of floodplains and to avoid direct or indirect support of floodplain development wherever there is a practicable alternative.” The purpose of EO 11990 Protection of Wetlands is “to avoid to the extent possible the long- and short-term adverse impacts associated with the destruction or modification of wetlands and to avoid direct or indirect support of new construction in wetlands wherever there is a practicable alternative.” This determination contains the analysis prescribed by 24 CFR Part 55.

The North Carolina Office of Recovery and Resiliency (NCORR) has received an application from the City of Lumberton to use Community Development Block Grant – Mitigation (CDBG-MIT) funding from the Infrastructure Recovery Program to implement the West Lumberton Flood Gate at VFW Road and Railroad Underpass project (“proposed action”) located near Interstate 95 (I-95) in the vicinity of VFW Road, Cox Road, Hackett Street, and the CSX railroad crossing within the City of Lumberton (City), Robeson County, North Carolina. The analysis that follows focuses on floodplain and wetland impacts, as there are direct floodplain impacts and an incidental wetland on the proposed action site’s parcels. Based on the City’s historic flooding, type of land use and improvements, need for the proposed action and use, and other case characteristics described herein, it is concluded that there is a reasonable basis to proceed with funding for this proposed action despite modification of floodplain and new construction on a parcel containing an incidental wetland. The CDBG-MIT funding is administered through the NCORR Infrastructure Recovery Program which is developing sustainable and resilient communities. Thus, alternatives preventing or impeding the development of sustainable and resilient communities are not considered reasonable alternatives.

Description of Proposed Action and Land Use

Purpose and Need for the Proposed Action

The City is seeking to mitigate future storm flooding as experienced and exacerbated by the effects of the landfall of Hurricanes Matthew (October 8, 2016) and Florence (September 14, 2018). The purpose of this proposed action is to enhance the City’s existing earthen levee and flood control system to mitigate against 100-year flood events flowing from the west side of the I-95 underpass via the CSX railroad crossing in the vicinity of VFW Road, Cox Road, and Hackett Street.

The City of Lumberton, incorporated in 1859, was established on the banks of the Lumber River with the first businesses situated along the waterfront. The City maintains an existing earthen levee system built in 1977 by the U.S Department of Agriculture (USDA) Soil Conservation Service in coordination with Robeson County Drainage District #1 and the City. This levee is considered a key feature in the Lumber River Basin (see 2018 Lumber River Basin Flood Analysis and Mitigation Strategies Study [Lumber River Mitigation Study], pg. 5). “The VFW and CSX Railroad underpass at I-95 was constructed at a lower elevation than designs specified, and a 10-foot wide earthen dike was to have been constructed in the area though the improvements never made, and controlling the breach depended on an emergency sandbagging effort at the underpass [to] prevent water spilling landward of the levee during a significant

event” according to the Lumber River Mitigation Study (pgs. 5-6). At the time of construction, the City was obligated by written agreement to maintain and operate the levee system including the responsibility to provide a temporary flood barrier at the CSX railroad underpass. The proposed action site (I-95 overpass opening at CSX railroad, Cox Road, and VFW Road) was identified during the levee design as a weak point where 100-year and greater flood events can penetrate to the protected side of the levee. During storm events, the City is supposed to coordinate and implement a detailed sandbag closure protocol which involves placing sandbags over the railroad and stretching from the south and north I-95 bridge abutments. As Hurricane Matthew approached the area in October 2016, the original forecast predicted that the storm would turn east out to sea, avoiding the City. Thus, the sandbag protocol action threshold was not met and was not implemented. At the last minute, the storm track forecast and intensity changed leaving no time for the sandbag protocol implementation. Flood waters entered the protected side of the levee through this opening, flooding southern and western Lumberton. In September 2018, Hurricane Florence was forecasted to impact the area, so the City, NC DOT and NC National Guard constructed a temporary sandbag and earthen barrier that only provided approximately 48 hours of protection before succumbing to the extreme river flooding. Again, flood waters entered the protected side of the levee through this opening, flooding the same general areas of southern and western Lumberton. According to the 2020 Preliminary Engineering Report, “[s]everal days are needed to properly construct a temporary flood barrier capable of protecting West and South Lumberton during an intense flood event.” The City undertook to find an expeditious and cost-effective way to address the issues encountered relying on a temporary sandbag protocol during past storms and hurricanes. Further discussion on the plans and need for a flood gate at this proposed location are discussed in the Lumber River Mitigation Study.

The City proposes this permanent flood gate system and related drainage improvements to mitigate future flooding on the protected side of the existing levee system by eliminating the ability for flood waters from the Lumber River from entering through the opening under I-95 at the CSX railroad, which is critical to protect lives and property in southern and western Lumberton. By prohibiting the type of catastrophic flooding that was seen during Hurricane Matthew, the City of Lumberton will be able to confidently restore much needed housing and businesses to these historically low- to moderate-income and predominately minority neighborhoods, without the threat of future flooding. The flood gate construction and operation will require close coordination between the City of Lumberton, CSX railroad and the North Carolina Department of Transportation (NC DOT) including routine test closures and maintenance performed by the City of Lumberton. An operational protocol will be established between the City of Lumberton and CSX for activation of the flood gates. City staff will work directly with the CSX Roadmaster in determining the timing for clearance of the railroad and closure of the gates. This activity shall only take place during times of imminent flooding danger. A routine maintenance schedule shall also be established for insuring the safe and continued operation of the gates into the foreseeable future.

During Hurricane Matthew in 2016 and again with Hurricane Florence in 2018, flood waters entered the protected side of the levee and disrupted City-wide services such as the potable water supply and electric utility grid for several days. The levee system helps maintain access to and operation of several critical facilities behind the levee, such as the City’s water treatment plant, two power grid point of delivery transformer sub stations, the City’s Electric Utility Department, and a City Fire Station. Failure to make the proposed improvements will result in the area continuing to experience flooding during future storm events, which in turn has impacts across the entire city. In the case of Hurricane Matthew, the loss of the water treatment plant as a result of flooding left residents City-wide completely without public water for 10 days, with only restricted use non-potable water available another 20 days. Without the necessary improvements, the City will continue to experience flooding with resultant property damage, utility and municipal service interruptions, and threat to public health and safety. As properties are repeatedly damaged, owners will likely stop making repairs and instead choose to relocate their businesses, possibly outside of the City’s jurisdiction. The City will potentially experience impacts to the local economy both

directly from the lost businesses, as well as indirectly through the elimination of jobs that local residents rely upon. The devastation suffered by the residents, churches, businesses and industries in the affected areas could have been avoided had a flood gate system been in place. There has been broad community support for this proposed action from not only the residents of South and West Lumberton but also from the City's industrial base, which will also be protected by these efforts.

Proposed Action Description

The proposed action entails construction of an approximately 30-foot flood gate to swing over the CSX railroad tracks with concrete wing flood walls extending outward from both sides of the gate and connecting concrete wing wall sections to a proposed earthen berm with supportive sheet piling that ties the system into the I-95 proposed embankment; slope revetment; riprap groin protection; two 15-foot-wide gravel access drives with turnout onto Cox Road and corresponding 34-linear-foot (lf) and 36-1f, 15-inch reinforced concrete piping (RCP) culverts; 2-foot x 2-foot and 3-foot x 3-foot sluice gates; water main offset; railroad ditch grading; removal and reinstallation of steel casing and 6-inch watermain south of the flood gate, as needed; abandonment of AT&T line; and all surfaces to be restored to existing grade after construction. Temporary construction includes four construction entrances, a staging area, two check dams, and a 26-1f, 15-inch HDPE. The sluice gates shall be self-contained stainless steel slide gates with a wall thimble offset sufficient to accommodate handwheel operation. CSX will remove and reinstall 34-foot rail sections and two timber crossties from each track with contractor to install sections of shoring (TRS) sheet piling which will remain in-place and be cut off a minimum of 2-feet below the top-of-tie. The contractor shall coordinate with CSX to schedule the final construction sequence including track windows for all phases of work where track(s) will be blocked or out of service and execute with CSX a temporary construction crossing agreement. CSX and contractor will schedule a 12-hour track window to install the jump span bridge with CSX removing a 50-foot track section and contractor excavating materials, cutting off piles, and installing wales, struts, pile caps, and jump span bridge. Erosion and sediment control measures include filter fabric under 24-inch class 2 riprap east of the flood gate; geotextile fabric under 18-inch class B riprap and 6-inch stone groin protection riprap along southeastern portion of the earthen berm; two stone riprap check dams; site grading; and silt fencing. The proposed action location maps and site plans are included in **Appendix 1**.

The project components will be elevated well above the 100-year base flood elevation (BFE) in order to protect lives and property from potential flash floods. The 100-year floodplain in the proposed flood gate system area has a BFE from 123.56 feet to 123.71 feet (North American vertical datum [NAVD]88). The proposed flood wall will have a 134-foot top-of-wall elevation compared to the top of the railroad bed elevation which is around 120 feet. Therefore, the wall extension will be approximately 14 feet high above the railroad bed. According to the proposed action's Hydrologic and Hydraulic Analysis (H&H Analysis), the City desires to pursue Federal Emergency Management Agency (FEMA) accreditation of the levee protection system which requires a minimum top elevation equal to the 100-year BFE plus 4.5 feet of freeboard (128.5 feet, NAVD88). Thus, as designed, the top of flood gate elevation will meet this requirement. The flood gate over the railroad tracks will be swing-hinged closed in line with the concrete wing walls during future storm events and flooding. This design will provide long-term flood prevention and minimize potential flood damage to the surrounding properties.

NC DOT is undertaking the widening of this section of I-95 and site conditions anticipated upon completion of this NC DOT project are shown on C-102, Existing Conditions (Post-I-95 Construction), in the attached site plans (**Appendix 1**). The NC DOT project includes realignment of Cox Road, VFW Road and Hackett Street, I-95 embankment and bridge surfacing, a drainage channel, I-95 replacement bridge, retaining walls near Cox Road, and temporary and permanent NC DOT easements and ROWs, to be completed by NC DOT in this proposed action area.

Proposed Action Location

The proposed action is located near Interstate 95 (I-95) in the vicinity of VFW Road, Cox Road, Hackett Street, and the CSX railroad crossing within the City of Lumberton, Robeson County, North Carolina. The proposed limits of disturbance (LOD) consist of public rights-of-way, Hackett Street, Cox Road, VFW Road, the CSX railroad line, and portions of five parcels. According to the Robeson County online parcel data, two parcels are owned by Freeman Investments Inc., a 7.16-acre lot at VFW and Hackett Rd., Parcel Pin #938280300700 and an 0.83-acre lot at 550 VFW Rd., Parcel Pin #938189443052; one 6.3-acre lot is owned by Spartan LLC (fka Titan Flow Control) at 2400 Cox Rd., Parcel Pin #938179684407; one 6.34-acre lot is owned by Lumberton Recycling Co. Inc./ Omnisource Southeast LLC at 2460 Cox Rd., Parcel Pin #938179143700; and a 2.8-acre lot owned by the West Lumberton Baptist Church at 2306 W. 5th St., Parcel Pin #938189201500 (**Appendix 1**). The proposed action will disturb approximately 4.9 acres mostly within previously disturbed railroad and roadway easements and industrial businesses' lawns.

All of the proposed action site is located in 100-year floodplain with the five parcels totaling 23.43 acres and no areas in regulatory floodway. The proposed action will result in temporary impacts to approximately 4.9 acres of 100-year floodplain (Zone AE) which includes four construction entrances, a staging area, two check dams, and a 26-lf, 15-inch HDPE. The permanent impacts to 4.7 acres of 100-year floodplain includes the construction of an approximately 30-foot flood gate to swing over the CSX railroad tracks with concrete wing flood walls extending outward from both sides of the gate and connecting concrete wing wall sections to a proposed earthen berm with supportive sheet piling that ties the system into the I-95 proposed embankment; slope revetment; riprap groin protection; two 15-foot-wide gravel access drives with turnout onto Cox Road and corresponding 34-lf and 36-lf, 15-inch reinforced concrete piping culverts; 2-foot x 2-foot and 3-foot x 3-foot sluice gates; water main offset; railroad ditch grading; removal and reinstallation of steel casing and 6-inch watermain south of the flood gate, as needed; and all surfaces to be restored to existing grade after construction. CSX will remove and reinstall 34-foot rail sections and two timber crossties from each track with contractor to install sections of shoring sheet piling cut off a minimum of 2-feet below the top-of-tie. CSX and contractor will schedule a 12-hour track window to install the jump span bridge with CSX removing a 50-foot track section and contractor excavating materials, cutting off piles, and installing wales, struts, pile caps, and jump span bridge.

Applicable Regulatory Procedure Per EO 11988 and EO 11990

The proposed action corresponds with a noncritical action not excluded under 24 CFR §55.12. The regulations under 24 CFR 55 apply to all HUD (or responsible entity) actions that are subject to potential harm by location in floodplains or wetlands. According to 24 CFR 55.1(a)(3), “[c]overed actions include the proposed acquisition, construction, demolition, improvement, disposition, financing, and use of properties located in floodplains or wetlands for which approval is required either from HUD, under any applicable HUD program, or from a responsible entity authorized by 24 CFR part 58.” Funding is permissible for the use in floodplain and at a parcel with incidental wetland if the proposed action is processed under 24 CFR §55.20 and the findings of the determination are affirmative to suggest that the proposed action may proceed.

In accordance with 24 CFR 55, the proposed action involves construction of a permanent flood gate system and related drainage improvements in Robeson County which is a participating community in good standing in the regular program of the National Flood Insurance Program (NFIP). Substantial Improvement/ Substantial Damage calculations do not apply to this proposed action. However, this proposed action involves “modification” of floodplain. As such, the full eight-step floodplain

determination process in §55.20 is required, and the following analysis examines each step in an EO 11988 Floodplain Management Determination process.

Based on the U.S. Fish and Wildlife Service (USFWS) National Wetlands Inventory (NWI) map, there will be “new construction” on a parcel containing an approximately 4.44 acre wetland located on one parcel in the proposed action area. The Freshwater Forested/ Shrub Wetland (PFO4Ad) located on the VFW Rd. and Hackett St. parcel #938280300700 is part of a 69.51-acre wetland feature (**Appendix 1**). There are no other wetlands located on the other parcels. Due to the use of HUD funds, compliance with EO 11990 through completion of the eight-step process under 24 CFR 55.20 is required for projects with potential wetland impacts. Thus, in accordance with the decision-making process set forth in 24 CFR Part 55, the following analysis examines each step in an EO 11990 Protection of Wetlands Determination process.

Step 1. Determine Whether the Proposed Action is Located in the 100-year Floodplain (500-year for Critical Actions) or results in New Construction in Wetlands.

According to the FEMA Flood Insurance Rate Map (FIRM) panels 3710938100K and 3710938200K, both effective on 12/6/2019, and Preliminary FIRMs (PFIRMs), effective on 8/29/2014, all five parcels (23.43 acres) are located in 100-year floodplain (Zone AE, Special Flood Hazard Area [SFHA]) with a BFE from 123.56 feet to 123.71 feet (NAVD 88) in the proposed flood gate system area (**Appendix 1**). The I-95 corridor (only highway and embankment on current FIRM) is located within Zone X – Area of Minimal Flood Hazard and Zone X – Area with Reduced Flood Risk Due to Levee. There is no FEMA-designated regulatory floodway on the proposed action site. The City of Lumberton (370203K) is a participating community in the NFIP. The proposed action will result in approximately 4.9 acres of temporary impacts and approximately 4.7 acres of permanent impacts to the 100-year floodplain. This proposed action involves constructing a permanent flood gate system with concrete wing walls and an earthen berm, two access drives and associated improvements. These are not insurable structures according to the NFIP Flood Insurance Manual effective October 1, 2022. As such, the full eight-step floodplain determination process in §55.20 is required, and the following analysis examines each step in an EO 11988 Floodplain Management Determination process.

Based on the USFWS NWI map, there is a wetland located on one parcel in the proposed action area. The proposed action involves new construction and there is an approximately 4.44-acre NWI-mapped Freshwater Forested/ Shrub Wetland (PFO4Ad) located on the VFW Rd. and Hackett St. parcel #938280300700 that is part of a 69.51-acre wetland feature (**Appendix 1**). There are no other wetlands located on the other parcels. Since no activities are proposed in wetlands, a US Army Corps of Engineers (USACE) Approved Jurisdictional Determination and No Permit Required Letter are being obtained and Clean Water Act Section 404 and 401 permits will not be required. Applicable recommendations from the NC Department of Environmental Quality (DEQ) Division of Water Resources (DWR) will be followed. The full eight-step wetlands determination process in §55.20 is required, and the following analysis examines each step in an EO 11990 Protection of Wetlands Determination process.

The proposed action will comply with a Floodplain Development Permit, NC DEMLR Erosion and Sediment Control Permit, NPDES Construction Stormwater Permit (NCG010000), and all applicable federal, State and local laws, regulations, and permit requirements and conditions. All necessary permits will be identified and obtained prior to commencing work and appended to the *West Lumberton Flood Gate at VFW Road and Railroad Underpass Project Environmental Assessment (EA) Environmental Review Record (ERR) (West Lumberton Flood Gate Project EA ERR)* when received from the permitting agencies.

Step 2. Initiate Public Notice for Early Review of Proposal.

Because the proposed action is located in floodplain and wetlands, NCORR published an early notice and posted supporting documentation that allowed for public and agency input on the decision to provide funding for construction and development activities. Supporting documentation incorporated into the early notice was posted for public review to the NCORR ReBuild NC website and included: proposed action location maps with boundaries shown; Robeson County parcel data; site plans; FEMA FIRMs, NEPA Assist FEMA FIRMs, and PFIRMs with parcel boundaries shown; the NFIP Community Status Book; H&H Analysis; USFWS NWI Map; Total Wetlands Area Map, and USACE correspondence. The early public notice and 15-day comment period is complete. No new, substantive public comments were received.

The early notice and corresponding 15-day public comment period started on December 9, 2023 with the "*Early Notice and Public Review of a Proposed Activity in a 100-Year Floodplain and Wetland*" being published in The Robesonian newspaper, with the 15-day period expiring on December 26, 2023. The notice targeted local residents within the community. The notice was also posted at <https://www.rebuild.nc.gov/about/plans-policies-reports/environmental-reviews> and sent via Federal Express and email to the following federal and state agencies on December 9, 2023: HUD NC Field Office; FEMA; U.S. Environmental Protection Agency (EPA); USFWS; and NC State Environmental Clearinghouse. The notice was also sent to Robeson County and the City of Lumberton (where it was posted at the City Hall). Project information was sent to the NC State Historic Preservation Office (SHPO) and Catawba Indian Nation for review and comment under Section 106 of the National Historic Preservation Act of 1966 (NHPA) and a project notification letter was sent to the Lumbee Tribe of North Carolina (See *West Lumberton Flood Gate Project EA ERR*). (See **Appendix 2** for the early notice distributed to these agencies, the newspaper publication affidavit, and distribution documentation).

Step 3. Identify and Evaluate Practicable Alternatives to Locating the Proposed Action in a 100-year Floodplain or Wetland.

The North Carolina Infrastructure Recovery Program empowers the State's most impacted communities with the technical expertise needed to develop thorough and implementable reconstruction plans to build physically, socially, and economically resilient and sustainable communities.

Alternative resiliency strategies and solutions were evaluated to address the flooding experienced in Lumberton during Hurricane Matthew. The North Carolina Resilient Redevelopment Planning (NCRRP) program as part of the 2016 Disaster Recovery Act relied upon stakeholder engagement and public involvement as an essential component. Meetings were held on strategies for resilient redevelopment in Robeson County with local officials on March 2, March 23, and April 17, 2017. Each meeting incorporated a public open house and an in-depth working session with county officials, subject matter experts, and county and municipal planners. North Carolina Emergency Management (NCEM) utilized data, resources, and technical expertise from State agencies, the private sector, and the University of North Carolina system to determine innovative best practice strategies (HMRRP-RC, pg. 1-4). A master list of mitigation strategies for the Lumber River Basin to be explored was presented in the Lumber River Mitigation Study (pg. 46). The twelve mitigation strategies were established by NCEM based on similar project's strategies, resilient redevelopment plans, and input from partners and stakeholders. These identified twelve strategies include: 1) New Detention Structures, 2) Retrofit of Existing Detention Structures, 3) Offline Storage, 4) Channel Modification, 5) New Embankment Structures, 6) *Existing Levee Repair/ Enhancement* (proposed action), 7) Roadway Elevation/ Clear Spanning, 8) Large Scale Wet Floodproofing, 9) Elevation/ Acquisition/ Relocation, 10) Land Use Strategies, 11) River Corridor Greenspace, and 12) Wildlife Management. Alternative strategies including conveyance routes and

methods were researched but not recommended for further study (Lumber River Mitigation Study, pg. 66-67). A bypass channel of the Lumber River around Lumberton was determined to be significantly more expensive, disturb a much larger area, and potentially cause significant environmental issues. Similarly, an upstream impoundment area would require the purchase of several hundred acres of property located upstream from Lumberton. This impoundment strategy was determined to significantly alter the landscape of the region and be cost-prohibitive for initial land acquisition and continual operations and maintenance associated with the system.

The “Lumberton Levee Enhancements” (proposed action) was identified as a high priority infrastructure strategy with a 2nd overall ranking according to the Robeson County Hurricane Matthew Resilient Redevelopment Plan (HMRRP-RC) (pg. 4-1). This entailed “[i]nstallation of flood gates and reinforcements that will prevent the 500-year flood from flowing through the I-95 overpass opening at VFW Road and CXS crossing. Also, rebuilding and reinforcing I-95 bridge abutments to minimize opening and protect from scour during flooding” (pg. 4-34). The proposed action was also acknowledged as necessary and “pending” in the Lumber River Mitigation Study under 6) *Existing Levee Repair/Enhancement*. The pending implementation of the flood gate system altered potential flood damage cost estimates and resultant cost-benefit ratios accordingly for other evaluated mitigation strategies. The City has identified the proposed action site to mitigate flooding experienced on the protected side of the existing levee system, which is critical to protect lives and property in southern and western Lumberton. In addition, the levee system helps maintain access to and operation of several critical facilities behind the levee, such as the City’s water treatment plant, two power grid point of delivery transformer sub stations, the City’s Electric Utility Department, and a City Fire Station. Failure to make the proposed improvements will result in the area continuing to experience flooding during future storm events, which in turn has impacts across the entire city.

Alternative locations and designs for the flood gate system were considered during the lengthy design phase. The proposed action has been designed with agency input, particularly the NC DOT which is undertaking the widening of I-95. The proposed action had been designed in different locations along I-95 before NC DOT and the City agreed upon this final design. One alternative location on the east side of I-95 was identified and considered for the proposed action. During initial stakeholder meetings with representatives from the City of Lumberton, Atkins Global, CSX, FHWA, NC DOT, NC Dam Safety Program, USACE, NCEM Floodplain Mapping, NC Golden Leaf Foundation and other entities, it was decided that the proposed flood gate would be positioned on the east side of I-95 at the CSX undercrossing. The City proceeded with the design of the flood gate which included extensive hydrologic and hydraulic modeling, geotechnical investigation, earthen levee profiles and existing road realignments. During these early stages of conceptual planning, before the I-95 improvements were proposed, the City was given direction from NC DOT to place the flood gate on the east side of I-95, so that in case of an overtopping event or gate failure, the bridge over the railroad would not get washed out. After the City was about 60 percent complete with the east side design, NC DOT began discussing plans for I-95 improvements. At this time, NC Dam Safety and FHWA expressed concerns about flood waters impounded under the bridge for a prolonged time when the east side gates are closed, saturating the soil under the bridge, and potentially causing damage or failure. As a result, these entities required the City to move the gate to the west side of I-95 and design with a safety factor that no overtopping will occur. The proposed east side of I-95 location was therefore eliminated from further consideration.

The purpose of this proposed action is to enhance the City’s existing earthen levee and flood control system to mitigate against 100-year flood events flowing from the west side of the I-95 underpass via the CSX railroad crossing in the vicinity of VFW Road, Cox Road, and Hackett Street. Due to the type of improvement and its connection to the City’s existing earthen levee and flood control system, floodplain impacts were unavoidable (see Existing Levee System Map in **Appendix A** of *West Lumberton Flood Gate Project EA ERR*). However, the proposed action was designed not to encroach into the onsite

wetland. The proposed action and site location are the most suitable, feasible options selected by the City after a costly and lengthy design process to assist its residents and community to be protected from future storm events.

The “No Action” Alternative is not considered feasible since flooding in the area causes property damage to homes, churches, public facilities, businesses and industries; interrupts City-wide services such as the potable water supply and electric utility grid for days; and blocks transportation accessibility with roadway flooding during and after storm events. The proposed action site was identified during levee design as a vulnerable weak point where 100-year and greater flood events can penetrate to the protected side of the levee. This proposed action is critically necessary to protect the residents and community from future storm events. Whereas, the “No Action” Alternative would leave the community vulnerable to future flooding and mitigation action would be compromised due to lack of financial support. Thus, the “No Action” Alternative is not feasible in relation to the desired objective of creating area resiliency to future flooding events and the proposed action is still practicable in light of potential adverse impacts on the floodplain.

The above-identified alternatives will be re-evaluated in response to public comments received.

Step 4. Identify and Evaluate Potential Direct and Indirect Impacts Associated with the Occupancy or Modification of 100-year Floodplain and Wetland and the Potential Direct and Indirect Support of Floodplain and Wetland Development that Could Result from Proposed Action.

The focus of floodplain evaluation should be on adverse impacts to lives and property, and on natural and beneficial floodplain values. Natural and beneficial values include consideration of potential for adverse impacts on water resources such as natural moderation of floods, water quality maintenance, and groundwater recharge.

According to the FEMA Report – A Unified National Program for Floodplain Management, the two definitions commonly used in evaluating actions in floodplain are “structural” and “non-structural” activities. Per the report, structural activity is usually intended to mean adjustments that modify the behavior of flood waters through the use of measures such as public works dams, levees, and channel work. Non-structural is usually intended to include all other adjustments (e.g., regulations, insurance, etc.) in the way society acts when occupying or modifying a floodplain. These definitions are used in describing impacts that may arise in association with potential advancement of this case.

Natural Moderation of Floods, Water Quality Maintenance, and Groundwater Recharge

Natural floodplains and wetlands provide flood risk reduction benefits by slowing runoff and storing flood water, maintaining water quality, and recharging groundwater. Flood water storage and conveyance will be affected by the proposed action during storm events. The proposed action is designed to protect the area from flooding that causes property damage to homes, churches, public facilities, businesses and industries; interrupts City-wide services such as the potable water supply and electric utility grid for days; and blocks transportation accessibility with roadway flooding (including access to and operation of several critical facilities located behind the levee, such as the City’s water treatment plant, two power grid point of delivery transformer sub stations, the City’s Electric Utility Department, and a City Fire Station) during and after storm events. The flood gate over the railroad tracks will be swing-hinged closed in line with the concrete wing walls during future storm events and flooding. This design will provide long-term flood prevention and minimize potential flood damage to the surrounding properties.

The proposed action will construct a permanent flood gate system and related drainage improvements. During hurricanes and large flood events, the proposed flood gate system will quickly and efficiently block flood waters from penetrating the protected side of the levee through the proposed action site. Currently, the community is reliant upon a burdensome temporary sandbag protocol that has failed to protect western and southern Lumberton during Hurricanes Matthew and Florence. The flood gate system, like the sandbag protocol, aims to keep flood waters from entering the properties located in the levee interior. This barricade will keep flood waters from flowing through the City and instead allow it to remain outside of the levee protected area where it will dissipate back to the Lumber River and potentially upstream. The Lumber River Basin consists of and connects to multiple streams and wetlands in the area. According to NC DEQ DWR, these streams include the Cotton Mill Branch, Gum Branch Canal, Jacob Swamp (Branch), Little Jacob Branch, Five Mile Branch, Raft Swamp, and the Lumber River (two stream indices). The NC DEQ DWR review identified the presence of surface waters classified as Water Supply Critical Area and WS-IV, B, Sw, HQW; High Quality Waters of the State in the project study area, see table below.

Stream Name	River Basin	Stream Classification(s)	Stream Index Number
Cotton Mill Branch	Lumber	C:Sw	14-14
Lumber River	Lumber	WS-IV,B,Sw, HQW	14-(7)
Lumber River	Lumber	C:Sw	14-(13)
Gum Branch Canal	Lumber	C:Sw	14-14-1
Jacob Swamp (Branch)	Lumber	C:Sw	14-17
Little Jacob Branch	Lumber	C:Sw	14-17-1
Five Mile Branch	Lumber	C:Sw	14-12-6
Raft Swamp	Lumber	WS-IV:Sw	14-10-(5.5)

surface water present in the general vicinity of project area

The area located north and west of the proposed action area is mostly forested, heavily vegetated and relatively flat with a pond, open water, wetlands, and the Lumber River which will decrease upstream erosion and provide an avenue for dissipation and wetland hydrology recharge after storms. Extreme rainfall events create significant stream discharge throughout the Lumber River Basin area. Flooding in the urban area that should be protected by the levee creates a greater hazard not only to the population and properties located therein but by allowing industrial, commercial, and residential waste and debris including sewage and chemical storage structures such as aboveground storage tanks to enter into the water which in turn can retreat back into the pond, open water, wetlands, and the Lumber River Basin. According to the HMRRP-RC (pg. 3-7), Hurricane Matthew created a large amount of natural debris that required removal including along W 5th Street in West Lumberton where tons of sand flowed through the I-95 underpass and was deposited throughout the area.” There were numerous fuel and waste spills throughout the area (pg. 4-98). Further, “[m]ovement of polluted sediments with chemical or biological contaminants from urban areas poses unknown long-term risks to water quality of the region as well as to the human health” (Water Quality Responses from Major Hurricanes in Robeson County: A Review and Historic Data Analysis, Liudmila Maslova, 2017, at <https://repository.lib.ncsu.edu/server/api/core/bitstreams/a4012d02-7386-439f-8b88-a194f93090fd/content>). The installation of this permanent flood gate system will mitigate the flood waters that are allowed to flow from the Lumber River into the urban areas of West and South Lumberton and recede back into the Lumber River Basin which is beneficial.

The flood gate will have a more efficient effect than temporary sandbags in keeping water out and towards the Lumber River Basin. This will have an impact on flood water storage and conveyance. The H&H Analysis completed for the proposed action discusses potential upstream impacts more in depth (**Appendix 1**). However, the NC DOT I-95 widening and improvements project is also a contributing factor which is evaluated in the H&H Analysis. According to the proposed action’s H&H Analysis, the

City desires to pursue FEMA accreditation of the levee protection system which requires a minimum top elevation equal to the 100-year BFE plus 4.5 feet of freeboard (128.5 feet, NAVD88). Thus, as designed, the top of flood gate elevation will meet this requirement.

The NC DEQ's Division of Energy, Mineral and Land Resources (DEMLR) "determined in October 2021 that the proposed flood gate is subject to the jurisdiction of the Dam Safety Law of 1967 and will have a Class C high hazard and large size classification. This classification implies that the proposed flood gate should be designed to withstand the $\frac{3}{4}$ Probable Maximum Flood (PMF). In determining the design elevation of the gate, a statistical analysis was performed and the recurrence interval of the flood of record was estimated to be about 200-years. Hydraulic simulations were performed without the gate and with the gate and the proposed I-95 configuration in place, to estimate the resulting peak elevations of the 100-year through the PMF return period events, and the flood of record" (H&H Analysis, pg. 1). During 100-year flood conditions, peak water surface elevation upstream of the gate is estimated to increase 0.3 feet from both installation of the flood gate system and raising of I-95. During $\frac{1}{4}$ PMF flood conditions, peak water surface elevation upstream of the gate is estimated to increase 1.2 feet from both installation of the flood gate system and raising of I-95. During 500-year and $\frac{1}{3}$ PMF flood conditions, peak water surface elevation upstream of the gate is estimated to increase 2.1 feet from both installation of the flood gate system and raising of I-95. During 1,000-year and $\frac{3}{4}$ PMF flood conditions, peak water surface elevation upstream of the gate is estimated to increase 2.3 feet from both installation of the flood gate system and raising of I-95. In cases of extreme flooding, the Lumber River Basin and surrounding communities will be inundated including the protected side of the levee. The City will consult NC DEQ DWR with the results of the H&H Analysis and follow any applicable regulations, guidelines, recommendations, and permit condition and requirements. Given the potential for the proposed project to impact surface waters classified as Water Supply Critical Area and WS-IV, B, Sw, HQW; High Quality Waters of the State, NC DEQ DWR requests the City strictly adhere to NC regulations entitled *Design Standards in Sensitive Watersheds* (15A NCAC 04B .0124) throughout design and construction (See **Appendix V** in *West Lumberton Flood Project EA ERR*).

The proposed action is not anticipated to result in direct or indirect, temporary or permanent impacts to an approximately 4.44-acre NWI-mapped Freshwater Forested/ Shrub Wetland (PFO4Ad) located on the VFW Rd. and Hackett St. parcel #938280300700 that is part of a 69.51-acre wetland feature. There are no other wetlands located on the other parcels. The proposed action designs have been completed in accordance with agency input to minimize impacts to the wetlands, environment and community. Since no activities are proposed in wetlands, a USACE Approved Jurisdictional Determination and No Permit Required Letter are being obtained and Clean Water Act Section 404 and 401 permits will not be required. Applicable recommendations from the NC DEQ DWR will be followed. The proposed action will comply with a Floodplain Development Permit, NC DEMLR Erosion and Sediment Control Permit, NPDES Construction Stormwater Permit (NCG010000), and all applicable federal, State and local laws, regulations, and permit requirements and conditions which shall be obtained before commencing work and appended to the *West Lumberton Flood Gate Project EA ERR*. Applicable regulations and recommendations from the NC DEQ DWR will be followed. Best Management Practices (BMPs) and erosion and sedimentation control measures include filter fabric under 24-inch class 2 riprap east of the flood gate; geotextile fabric under 18-inch class B riprap and 6-inch stone groin protection riprap along southeastern portion of the earthen berm; two stone riprap check dams; temporary stabilizing vegetation; silt fencing; and site grading. Native plants will be utilized during landscaping and site restoration at the proposed action site. Additionally, the proposed action can implement the following voluntary conservation measures to benefit wildlife and, in particular, pollinators: plant native trees, shrubs, and flowering plants in landscaping, use plants that bloom spring through fall, and remove/control invasive plant species present. Further, the City has full-time staff in charge of inspecting and maintaining the system post-installation to ensure proper performance and address routine repairs as needed. With proper maintenance, any eroded area can be repaired and stabilized. Thus, measures will be implemented to

ensure the proposed action will have no significant direct or indirect impacts to floodplain and wetlands during construction and operation as a permanent flood gate system. This will ensure that water quality, the ability to maintain water quality, and groundwater recharge are not impacted by the proposed action.

Living Resources such as Flora and Fauna

The proposed action will disturb approximately 4.9 acres mostly within previously disturbed railroad and roadway easements and industrial businesses' lawns. For this proposed action, the USFWS Raleigh Ecological Services' online 10-step project review process was completed. The proposed action was determined to have "No Effect" on proposed, threatened, endangered, or candidate species and proposed or designated critical habitat under USFWS jurisdiction, a "Not Likely to Jeopardize the Species' Continued Existence" determination for the proposed Tricolored Bat, and a "No Eagle Act Permit Required" determination for the Bald Eagle. A Self-certification Letter and 10-step Project Review Package were prepared and submitted to the USFWS Raleigh Ecological Services Field Office (FO) on December 11, 2023. On December 21, 2023, Ms. Kathy Matthews, USFWS Fish and Wildlife Biologist, responded that the "*Service agrees that the project is not likely to adversely affect any listed species.*" **The City and its contractors are recommended to not cut trees during the coldest months (December 15-February 14). The City and its contractors are prohibited from cutting trees during the pup season (April 15 - July 31). Once the Tricolored Bat is officially listed, the City and its contractors will need to consult with USFWS unless tree cutting has been completed.**

The proposed action designs have been completed in accordance with agency input to minimize impacts to the wetlands, environment and community. The proposed action will comply with a Floodplain Development Permit, NC DEMLR Erosion and Sediment Control Permit, NPDES Construction Stormwater Permit (NCG010000), and all applicable federal, State and local laws, regulations, and permit requirements and conditions which shall be obtained before commencing work and appended to the *West Lumberton Flood Gate Project EA ERR*. Applicable regulations and recommendations from the NC DEQ DWR will be followed. BMPs and erosion and sedimentation control measures include filter fabric under 24-inch class 2 riprap east of the flood gate; geotextile fabric under 18-inch class B riprap and 6-inch stone groin protection riprap along southeastern portion of the earthen berm; two stone riprap check dams; temporary stabilizing vegetation; silt fencing; and site grading. Native plants will be utilized during landscaping and site restoration at the proposed action site. Additionally, the proposed action can implement the following voluntary conservation measures to benefit wildlife and, in particular, pollinators: plant native trees, shrubs, and flowering plants in landscaping, use plants that bloom spring through fall, and remove/control invasive plant species present. Further, the City has full-time staff in charge of inspecting and maintaining the system post-installation to ensure proper performance and address routine repairs as needed. With proper maintenance, any eroded area can be repaired and stabilized. Thus, as designed and with mitigation measures implemented, the proposed action will have no or minimal impacts to living resources, such as flora and fauna, during construction and operation as a permanent flood gate system.

Impacts to Property and Lives

The State of North Carolina was adversely impacted by the landfall of Hurricanes Matthew (October 8, 2016) and Florence (September 14, 2018). During the Hurricane Matthew storm event, the City of Lumberton experienced widespread flood damage, especially in areas to the south and west, causing residents in these areas to be stranded, disruption of City-wide services such as the potable water supply and electric utility grid for several days, and widespread damage to property. According to the HMRRP-RC (pg. 3-6), roads and bridges overtopping are common flood occurrences in Robeson County and at the

“height of the flooding, residents of South Lumberton needed to be rescued by boat and helicopter since the road[s] were impassable even by the most robust of vehicles.” Thus, the “Lumberton Levee Enhancements” (proposed action) was identified as a high priority infrastructure strategy with a 2nd overall ranking according to the HMRRP-RC (pg. 4-1).

Due to Hurricane Matthew, the City of Lumberton suffered damages to 2,367 structures totaling \$251,574,000 as a direct result of flooding and backwater from the main stem of the Lumber River (Lumber River Mitigation Study, pg. 27). According to the HMRRP-RC (pg. 4-44), WH Knuckles Elementary School, Lumberton Junior High School, and West Lumberton Elementary School were identified as requiring restoration after Hurricane Matthew. West Lumberton Elementary School was declared a total loss after being inundated with flood waters and students temporarily attended classes at Lumberton Junior High School. According to the HMRRP-RC (pg. 3-4 and 3-5), Lumberton accounted for 71% of Public Assistance claims (often closely tied to infrastructure) in Robeson County. In “West and South Lumberton, a majority of the homes were flooded with water from the Lumber River overtopping I-95 and running through the VFW Road/CSX underpass of I-95, plus runoff from Jacobs Swamp and its tributaries” (HMRRP-RC, pg. 3-3).

Due to Hurricane Matthew, the City of Lumberton suffered damages to 2,367 structures totaling \$251,574,000 as a direct result of flooding and backwater from the main stem of the Lumber River (Lumber River Mitigation Study, pg. 27). This area is further identified as *most at risk* for continued flooding (HMRRP-RC, pg. 3-4). Table 5-4 in the Lumber River Mitigation Study (pg. 44) shows the baseline estimated damages on a community level, without considering structures interior to the levee at Lumberton. This information was used to compare potential damages with and without the flood gate system at the Lumberton levee. According to the 2020 BCR Regional Hazard Mitigation Plan (pg. 243), there are a total of 128 critical facilities exposed to 100-year river flooding in the City with an estimated \$4,166,242 in potential damages. There are 20 identified high potential loss properties in the City with an estimated \$2,213,828 in potential damages (pg. 248). Thus, without the necessary improvements, the City will continue to experience flooding with resultant property damage, utility and municipal service interruptions, and threat to public health and safety. As properties are repeatedly damaged, owners will likely stop making repairs and instead choose to relocate their businesses, possibly outside of the City’s jurisdiction. The City will potentially experience impacts to the local economy both directly from the lost businesses, as well as indirectly through the elimination of jobs that local residents rely upon. The devastation suffered by the residents, churches, public facilities, businesses and industries in the affected areas could have been avoided had a flood gate system been in place. There has been broad community support for this project from not only the residents of South and West Lumberton but also from the City’s industrial base, which will also be protected by these efforts. By mitigating the type of catastrophic flooding that was seen during Hurricane Matthew, the City of Lumberton will be able to confidently restore much needed housing and businesses to these historically low- to moderate-income and predominately minority neighborhoods, without the threat of future flooding. Additionally, the proposed action will further protect the residents’ public health and safety by reducing flood impacts to infrastructure and enhancing emergency response operations and accessibility during and after severe storm events. Therefore, the proposed action is not anticipated to have adverse impacts to property and lives, but rather aims to provide critically necessary protection to property and public health and safety in the surrounding area during storm events.

Cultural Resources such as Archaeological, Historic and Recreational Aspects

The proposed action will disturb approximately 4.9 acres mostly within previously disturbed railroad and roadway easements and industrial businesses' lawns. As part of this review, the SHPO, Chief and Tribal Historic Preservation Offices (THPO) of all applicable Tribes, Nations, and Communities were consulted by NCORR regarding any historic properties of religious and cultural significance in the area that could be affected by the proposed action. On December 6, 2023 (revised plans email) and October 29, 2021 (original plans submission), NCORR submitted the proposed action to the North Carolina State Historic Preservation Office (NC SHPO) for review and concurrence of a preliminary finding of "No Historic Properties Affected" pursuant to 36 CFR 800.4(d)(1). NC SHPO responses to the revised plans were received on December 8, 2023 and December 7, 2023, and to the original plans on November 17, 2021. The NC SHPO Environmental Review Coordinator stated on December 8, 2023 that "[w]e have conducted a review of the project and are aware of no historic resources which would be affected by the project. Therefore, we have no comment on the project as proposed." The December 7, 2023 NC SHPO response stated that "[b]ased on the results of no NRHP eligible sites identified during the 2020 archaeological survey of the original APE as part of TIP I-6064, PA 19-04-0007, it is unlikely that any archaeological resources that may be eligible for inclusion in the National Register of Historic Places will be affected by the project within the revised flood gate APE. We, therefore, recommend that no archaeological investigation be conducted in connection with the revised APE. We have determined that the project as proposed will not have an effect on any historic structures."

According to the HUD Tribal Directory Assessment Tool (TDAT), the Catawba Indian Nation is the only federally-recognized tribe with interests in Robeson County, North Carolina. On December 6, 2023 (revised plans email), NCORR consulted with the Catawba Indian Nation for discussion of historic properties in the proposed action area that may have religious and cultural significance. The original Section 106 review packages were sent to the Catawba Indian Nation's Chief Bill Harris and Dr. Wenonah G. Haire, THPO on October 29, 2021. On December 7, 2023 (revised plans email), Ms. Caitlin Rogers responded that the "Catawba THPO has no concerns with the revised West Lumberton Flood Gate Project." On December 3, 2021 (original plans submission), Ms. Caitlin Rogers responded that "[t]he Catawba have no immediate concerns with regard to traditional cultural properties, sacred sites or Native American archaeological sites within the boundaries of the proposed project areas. **However, the Catawba are to be notified if Native American artifacts and / or human remains are located during the ground disturbance phase of this project.**" The proposed action is in compliance with Section 106 of the NHPA. On October 29, 2021, NCORR Director Ms. Laura Hogshead sent a notification letter for the proposed action to the Lumbee Tribe of North Carolina's Chairman Harvey Godwin, Jr., and no response was received. The SHPO and Catawba Indian Nation Section 106 review and consultation documentation is included in the *West Lumberton Flood Gate Project EA ERR* along with the Lumbee Tribe of NC project notification letter.

There are several parks and recreational facilities located in the City of Lumberton according to the City website (<https://www.lumbertonnc.gov/Facilities?clear=True>). The closest park to the proposed action site is the Jaycee Ballfield followed by McMillan's Beach, Velcord Park, PC Brooks Play Lot, James L. Stephens Park, Optimist Airport Park, and Lumber River State Park. The Lumber River is a designated Wild and Scenic River with numerous paddling put-in/take-out access points within a mile of the proposed action site including McMillan's Beach and Stephens Park. Tom Avent Landing is a Lumber River State Park paddle-in/canoe campsite located approximately 1.5 miles southwest of the proposed action site. The City's Luther Britt Park at 671 Branch Street has walking trails around two lakes, playground equipment (Lumberton Play Park), picnic facilities with three shelters, a bike trail, a beach/swimming, fishing, paddle boats, canoes, horse shoe pits, and two basketball courts. The proposed action will not introduce new development that would generate demand for parks, open spaces or recreational areas or impede their access. Rather, this public infrastructure improvement project aims to

protect the area from flooding that causes property damage; interrupts City-wide services; and blocks transportation accessibility with roadway flooding during and after storm events. Thus, the proposed action would not have an adverse effect on existing parks, open spaces or recreational areas.

Agricultural, Aquacultural, and Forestry Resources

The proposed action's activities will disturb approximately 4.9 acres mostly within previously disturbed railroad and roadway easements and industrial businesses' lawns which are not ideal for agricultural and forestry resources. This proposed action involves constructing a permanent flood gate system with concrete wing walls and an earthen berm, two access drives and associated improvements which has the potential to irreversibly convert agricultural land. According to the USDA Natural Resources Conservation Service (NRCS) Web Soil Survey, the proposed action site contains Johns sandy loam (Jo) and Lumbee sandy loam (Lu) which are classified as *Prime Farmland, if drained*. Lakeland sand, 0 to 6 percent slopes (LaB) is also present onsite but is designated as *Not Prime Farmland*. Projects are subject to Farmland Protection Policy Act (FPPA) requirements if they may irreversibly convert farmland to nonagricultural use and are completed by a Federal agency or with assistance from a Federal agency. "Farmland" does not include "land already in or committed to urban development or water storage." According to the TIGERweb Urban Areas Map, a majority of the proposed action site is located in a designated Urban Area except for a small triangular portion located between VFW Road and I-95. The remaining non-Urban area is slated for redevelopment by NC DOT. According to Mr. Ryan Janway, USDA NRCS Natural Resource/ Acting GIS Specialist, "[a]s you said, the majority of the proposed project area is already classified as an Urban area. If I am understanding the NCDOT design plans correctly it looks like they are planning to shift Hackett St. about 80 feet north. This would put the remaining "non-Urban" area under the exemption category for Urban Development and/or Construction within an existing right-of-way (the new ROW from these repositioned roads). Therefore, the FPPA process will not be applicable for this project." Thus, the proposed action will not directly affect agricultural land.

The proposed action was redesigned for the NC DOT I-95 widening project in the proposed action area. NC DOT will be performing significant ground disturbance and cutting trees in our proposed action area for the realignment of Cox Road, VFW Road and Hackett Street, I-95 embankment and bridge surfacing, a drainage channel, I-95 replacement bridge, retaining walls near Cox Road, and temporary and permanent NC DOT easements and ROWs. There is an estimated 0.25 acres of woody vegetation that will be cleared. This is a conservative estimate since some areas will be cleared during the I-95 widening construction. Thus, the proposed action will not have a direct adverse impact on forestry resources.

The project designs have been completed in accordance with agency input to minimize impacts to the wetlands, environment and community. The proposed action is not anticipated to result in direct or indirect, temporary or permanent impacts to an approximately 4.44-acre NWI-mapped Freshwater Forested/ Shrub Wetland (PFO4Ad) located on the VFW Rd. and Hackett St. parcel #938280300700 that is part of a 69.51-acre wetland feature. There are no other wetlands located on the other parcels. Since no activities are proposed in wetlands, a USACE Approved Jurisdictional Determination and No Permit Required Letter are being obtained and Clean Water Act Section 404 and 401 permits will not be required. Applicable recommendations from the NC DEQ DWR will be followed. The proposed action will comply with a Floodplain Development Permit, NC DEMLR Erosion and Sediment Control Permit, NPDES Construction Stormwater Permit (NCG010000), and all applicable federal, State and local laws, regulations, and permit requirements and conditions which shall be obtained before commencing work and appended to the *West Lumberton Flood Gate Project EA ERR*. Applicable regulations and recommendations from the NC DEQ DWR will be followed. BMPs and erosion and sedimentation control measures include filter fabric under 24-inch class 2 riprap east of the flood gate; geotextile fabric

under 18-inch class B riprap and 6-inch stone groin protection riprap along southeastern portion of the earthen berm; two stone riprap check dams; temporary stabilizing vegetation; silt fencing; and site grading. Native plants will be utilized during landscaping and site restoration at the proposed action site. Additionally, the proposed action can implement the following voluntary conservation measures to benefit wildlife and, in particular, pollinators: plant native trees, shrubs, and flowering plants in landscaping, use plants that bloom spring through fall, and remove/control invasive plant species present. Further, the City has full-time staff in charge of inspecting and maintaining the system post-installation to ensure proper performance and address routine repairs as needed. With proper maintenance, any eroded area can be repaired and stabilized. Overall, the proposed action site consists of mostly previously disturbed railroad and roadway easements and industrial businesses' lawns and is not used for agriculture, aquaculture or forestry and, thus, the proposed action is not expected to have an adverse impact on agricultural, aquacultural or forestry resources.

Wetland Evaluation

The purpose of wetland evaluation is to consider factors relevant to a proposed action's effect on the survival and quality of wetlands. These factors should include public health (including water supply and water quality), maintenance of natural systems, cost increases attributed to construction in wetland, and other uses of wetland in the public interest. The natural approximately 4.44-acre Freshwater Forested/Shrub Wetland (PFO4Ad) will remain intact because the proposed action has been designed so as to not encroach into the wetland. Since the proposed action will avoid the wetland and incorporate BMPs and erosion and sedimentation controls, negative impacts to wetland functions and values are not anticipated to this approximately 4.44-acre wetland located on the VFW Rd. and Hackett St. parcel #938280300700 or offsite wetlands. The proposed action's potential to impact wetland functions and values is evaluated further below.

The proposed action is not anticipated to result in direct or indirect, temporary or permanent impacts to this Freshwater Forested/ Shrub Wetland (PFO4Ad) located on the VFW Rd. and Hackett St. parcel #938280300700 that is part of a 69.51-acre wetland feature. There are no other wetlands located on the other parcels. Since no activities are proposed in wetlands, a USACE Approved Jurisdictional Determination and No Permit Required Letter are being obtained and Clean Water Act Section 404 and 401 permits will not be required. Applicable recommendations from the NC DEQ Division of Water Resources (DWR) will be followed. The proposed action will comply with a Floodplain Development Permit, NC DEMLR Erosion and Sediment Control Permit, NPDES Construction Stormwater Permit (NCG010000), and all applicable federal, State and local laws, regulations, and permit requirements and conditions which shall be obtained before commencing work and appended to the *West Lumberton Flood Gate Project EA ERR*. Applicable regulations and recommendations from the NC DEQ DWR will be followed. BMPs and erosion and sedimentation control measures include filter fabric under 24-inch class 2 riprap east of the flood gate; geotextile fabric under 18-inch class B riprap and 6-inch stone groin protection riprap along southeastern portion of the earthen berm; two stone riprap check dams; temporary stabilizing vegetation; silt fencing; and site grading. Native plants will be utilized during landscaping and site restoration at the proposed action site. Additionally, the proposed action can implement the following voluntary conservation measures to benefit wildlife and, in particular, pollinators: plant native trees, shrubs, and flowering plants in landscaping, use plants that bloom spring through fall, and remove/control invasive plant species present. Further, the City has full-time staff in charge of inspecting and maintaining the system post-installation to ensure proper performance and address routine repairs as needed. With proper maintenance, any eroded area can be repaired and stabilized. Thus, measures will be implemented to ensure the proposed action will have no significant direct or indirect impacts to wetlands during construction and operation as a permanent flood gate system.

Public Health, Safety, and Welfare, Including Water Supply, Quality, Recharge, and Discharge; Pollution; Flood and Storm Hazards and Hazard Protection; and Sediment and Erosion

Wetlands have unique natural characteristics that play an integral role in the ecology of the watershed. The natural and beneficial functions and values related to hydrology and water quality include slowing down stormwater runoff, providing surface and subsurface retention, and filtering out pollutants. Further, wetlands provide flood risk reduction benefits by slowing runoff and storing flood water.

Currently, the natural approximately 4.44 acre wetland located on the VFW Rd. and Hackett St. parcel functions as a collection point for Lumber River overflow and stormwater from the surrounding properties. The natural and beneficial functions and values for hydrology and water quality include slowing down stormwater runoff, providing surface and subsurface retention, and filtering out pollutants. The natural approximately 4.44-acre Freshwater Forested/ Shrub Wetland (PFO4Ad) will remain intact because the proposed action has been designed so as to not encroach into the wetland. Thus, the proposed action is not anticipated to result in direct or indirect impacts to the natural wetland which will continue to provide these functions and values.

Public Health, Safety, and Welfare and Flood and Storm Hazards and Hazard Protection

The State of North Carolina was adversely impacted by the landfall of Hurricanes Matthew (October 8, 2016) and Florence (September 14, 2018). During the Hurricane Matthew storm event, the City of Lumberton experienced widespread flood damage, especially in areas to the south and west, causing residents in these areas to be stranded, disruption of City-wide services such as the potable water supply and electric utility grid for several days, and widespread damage to property. According to the HMRRP-RC (pg. 3-6), roads and bridges overtopping are common flood occurrences in Robeson County and at the “height of the flooding, residents of South Lumberton needed to be rescued by boat and helicopter since the road[s] were impassable even by the most robust of vehicles.” In “West and South Lumberton, a majority of the homes were flooded with water from the Lumber River overtopping I-95 and running through the VFW Road/CSX underpass of I-95, plus runoff from Jacobs Swamp and its tributaries” (HMRRP-RC, pg. 3-3). According to the HMRRP-RC (pg. 3-4 and 3-5), Lumberton accounted for 71% of Public Assistance claims (often closely tied to infrastructure) in Robeson County. In addition, WH Knuckles Elementary School, Lumberton Junior High School, and West Lumberton Elementary School were identified as requiring restoration after Hurricane Matthew (HMRRP-RC, pg. 4-44). West Lumberton Elementary School was declared a total loss after being inundated with flood waters and students temporarily attended classes at Lumberton Junior High School. This area is further identified as *most at risk* for continued flooding (HMRRP-RC, pg. 3-4). Thus, the “Lumberton Levee Enhancements” (proposed action) was identified as a high priority infrastructure strategy with a 2nd overall ranking according to the HMRRP-RC (pg. 4-1).

The purpose of this proposed action is to enhance the City’s existing earthen levee and flood control system to mitigate against 100-year flood events flowing from the west side of the I-95 underpass via the CSX railroad crossing in the vicinity of VFW Road, Cox Road, and Hackett Street. The City of Lumberton, incorporated in 1859, was established on the banks of the Lumber River with the first businesses situated along the waterfront. The City maintains an existing earthen levee system built in 1977 which is considered a key feature in the Lumber River Basin (Lumber River Mitigation Study, pg. 5). “The VFW and CSX Railroad underpass at I-95 was constructed at a lower elevation than designs specified, and a 10-foot wide earthen dike was to have been constructed in the area though the improvements never made, and controlling the breach depended on an emergency sandbagging effort at the underpass [to] prevent water spilling landward of the levee during a significant event” according to the Lumber River Mitigation Study (pgs. 5-6). During Hurricane Matthew in 2016 and again with Hurricane Florence in 2018, flood waters entered the protected side of the levee through the proposed

action site which is the identified weak point in the levee design. This flooding disrupted City-wide services such as the potable water supply and electric utility grid for several days. The levee system helps maintain access to and operation of several critical facilities behind the levee, such as the City's water treatment plant, two power grid point of delivery transformer sub stations, the City's Electric Utility Department, and a City Fire Station. During Hurricane Matthew, the loss of the water treatment plant as a result of flooding left residents City-wide completely without public water for 10 days, with only restricted use non-potable water available another 20 days.

Without the necessary improvements, the City will continue to experience flooding with resultant property damage, utility and municipal service interruptions, and threat to public health and safety. As properties are repeatedly damaged, owners will likely stop making repairs and instead choose to relocate their businesses, possibly outside of the City's jurisdiction. The City will potentially experience impacts to the local economy both directly from the lost businesses, as well as indirectly through the elimination of jobs that local residents rely upon. The devastation suffered by the residents, churches, public facilities, businesses and industries in the affected areas could have been avoided had a flood gate system been in place. There has been broad community support for this proposed project from not only the residents of South and West Lumberton but also from the City's industrial base, which will also be protected by these efforts. The proposed action aims to finally address this opening in the existing deficient levee and flood control system, receive FEMA accreditation, provide long-term flood hazard prevention for the levee interior properties, and protect the public health, safety and welfare. Therefore, the proposed action should strengthen flood and storm hazard protection in the community during and after future storm events which is critical for the public health, safety, and welfare.

Water Supply, Quality, Recharge, Discharge, Pollution, and Sediment and Erosion

The proposed action involves the construction of a permanent flood gate system and related drainage improvements and, therefore, will not increase the demand on the local water supply. West and South Lumberton are currently provided potable water service from the City of Lumberton's potable water distribution system. The City produces water from a combination of surface water drawn from the Lumber River and ground water pulled from local wells. Water is treated at the City's Water Treatment Facility prior to distribution to its customers. This project is not expected to directly impact the potable water consumption patterns within West and South Lumberton. During construction, the water mains near the flood gate might be offset, as needed, to minimize interruption of service with a maximum allowable service interruption of 4 hours. The water main offset can be used as temporary of final location of pipe with final pipe penetration through the wall as detailed in the structural plans in **Appendix 1**. All pipes will be ductile iron. Steel casings, spacers, and carrier pipe shall be restored in-place with no offset allowed. The Contractor will provide the City with at least two weeks prior notice of service interruption and coordinate on location and operation of cutoff valves. The maximum allowable service interruption for water lines inside steel casing is two weeks.

The proposed action will not introduce any new development that would generate wastewater. The proposed action will not increase demands on wastewater or sanitary sewer infrastructure. Any additional wastewater generated during construction activities would be temporary. The proposed action will not include the discharge of sewer to surfaces of the proposed action site or surrounding properties. BMPs will be utilized during construction to prevent soil and/ or debris from being washed offsite.

For the construction, expansion, or alteration of a public water system, plans and specifications must be approved by the DWR / Public Water Supply Section prior to the award of a contract or the initiation of construction as per 15A NCAC 18C .0300 et. seq. In addition, all public water supply systems must comply with State and federal drinking water monitoring requirements. If any wells are discovered on

the proposed action site, then abandonment of wells must be in accordance with Title 15A. Subchapter 2C.0100. Further, any relocation of existing water lines will require plans to be submitted to the DWR / Public Water Supply Section prior to construction. All applicable federal, State and local permits will be obtained for the proposed action prior to construction and activities will comply with their requirements and conditions. Therefore, the proposed action is not anticipated to have an adverse impact on water supply quality or capacity onsite and in the surrounding area.

The natural approximately 4.44-acre Freshwater Forested/ Shrub Wetland (PFO4Ad) will remain intact because the proposed action has been designed so as to not encroach into the wetland. Thus, the functions and values provided by this and nearby wetlands for recharge, discharge, pollution filtration and sediment and erosion control are not anticipated to be adversely impacted by this proposed action. Normal stormwater discharge is not anticipated to negatively impact natural wetland hydrology and should aid in recharging downstream wetland hydrology. Erosion control capabilities of wetlands can be overwhelmed during hurricanes and extreme flooding. The proposed action will cause increased standing and receding flood waters upstream and outside of the levee interior during future storm and flooding events compared to the City using the sandbag protocol or no mitigation measures. As discussed above, a tremendous amount of sand and natural debris can be transported during extreme flooding. The Lumber River is heavily vegetated in this area which should prevent significant erosion. The vicinity of the proposed action area has been subject to heavy erosion during Hurricanes Matthew and Florence and other flooding events. The proposed action incorporates BMPs and erosion and sedimentation control measures such as filter fabric under 24-inch class 2 riprap east of the flood gate; geotextile fabric under 18-inch class B riprap and 6-inch stone groin protection riprap along southeastern portion of the earthen berm; two stone riprap check dams; temporary stabilizing vegetation; silt fencing; and site grading. Further, the City has full-time staff in charge of inspecting and maintaining the system post-installation to ensure proper performance and address routine repairs as needed. With proper maintenance, any eroded area can be repaired and stabilized. The proposed action will comply with a Floodplain Development Permit, NC DEMLR Erosion and Sediment Control Permit, NPDES Construction Stormwater Permit (NCG010000), and all applicable federal, State and local laws, regulations, and permit requirements and conditions which shall be obtained before commencing work and appended to the *West Lumberton Flood Gate Project EA ERR*. Applicable regulations and recommendations from the NC DEQ DWR will be followed. Since no activities are proposed in wetlands, a USACE Approved Jurisdictional Determination and No Permit Required Letter are being obtained and Clean Water Act Section 404 and 401 permits will not be required. Further, the City has full-time staff in charge of inspecting and maintaining the system post-installation to ensure proper performance and address routine repairs as needed. With proper maintenance, any eroded area can be repaired and stabilized. Therefore, the proposed action is not anticipated to have a significant adverse impact on the wetlands functions for water supply, quality, recharge, and discharge; pollution filtration; flood and storm hazards and hazard protection; and sediment and erosion.

Maintenance of Natural Systems, Including Conservation and Long-Term Productivity of Existing Flora and Fauna; Species and Habitat Diversity and Stability; Natural Hydrologic Function; Wetland Type; Fish; Wildlife; Timber; and Food and Fiber Resources

Maintenance of Natural Systems, Including Conservation and Long-Term Productivity of Existing Flora and Fauna; and Species and Habitat Diversity and Stability; Wetland Type; Fish; and Wildlife

The natural approximately 4.44-acre Freshwater Forested/ Shrub Wetland (PFO4Ad) will remain intact because the proposed action has been designed so as to not encroach into the wetland. Construction for the proposed action will result in approximately 0.25 acres of wooded habitat loss. However, the flood reduction benefits of the proposed action will outweigh this loss of wooded area. Native plants are

recommended to be utilized during landscaping and site restoration. The proposed action is not anticipated to exceed 4.9 acres of disturbance. The proposed action has been designed and re-designed, and mitigation measures incorporated to have the minimal impacts on these features.

For this proposed action, the USFWS Raleigh Ecological Services' online 10-step project review process was completed. The USFWS Official Species List identified a total of six threatened, endangered or candidate species and no critical habitat for the proposed action area. These species include the proposed endangered Tricolored Bat (*Perimyotis subflavus*), endangered Red-cockaded Woodpecker (*Picoides borealis*), threatened Wood Stork *Mycteria americana*), threatened American Alligator (*Alligator mississippiensis*), endangered Michaux's Sumac *Rhus michauxii*), and candidate Monarch Butterfly (*Danaus plexippus*). There are additional responsibilities under the Migratory Bird Treaty Act (MBTA) and the Bald and Golden Eagle Protection Act (BGEPA) to protect native birds from project-related impacts. The Official Species List identified two migratory birds including the Brown-headed Nuthatch (*Sitta pusilla*) and Chimney Swift (*Chaetura pelagica*) within the vicinity of the proposed action area. According to the NC NHP database, there are no federally-listed species within the proposed action area. Based on the USFWS IPaC and USFWS and National Marine Fisheries Service (NMFS) Critical Habitat Mappers results, there are no critical habitats identified within one mile of the proposed action area.

The NC NHP was consulted for additional information on the Tricolored Bat which is proposed for listing. According to Ms. Judith Ratcliffe, Zoologist at the NC NHP, “[t]here are no documented Tricolored Bat maternity roost trees within 150 feet of this project boundary. There are no documented Tricolored Bat hibernacula within 0.25 mile of this project boundary.” **The City and its contractors are recommended to not cut trees during the coldest months (December 15- February 14). The City and its contractors are prohibited from cutting trees during the pup season (April 15 - July 31). Once the Tricolored Bat is officially listed, the City and its contractors will need to consult with USFWS unless tree cutting has been completed.**

The revised proposed action is anticipated to be completed after NC DOT completes its I-95 widening in the proposed action area. NC DOT will be performing significant ground disturbance and cutting trees in our proposed action area for the realignment of Cox Road, VFW Road and Hackett Street, I-95 embankment and bridge surfacing, a drainage channel, I-95 replacement bridge, retaining walls near Cox Road, and temporary and permanent NC DOT easements and ROWs, all to be completed by NC DOT. There is an estimated 0.25 acres of woody vegetation that will be cleared for this proposed action. This is a conservative estimate since some areas will be cleared during the I-95 widening construction. It is anticipated that due to the proposed action any migratory birds in the area will temporarily leave the area during construction which will have been previously significantly disturbed with the NC DOT project. The proposed action was determined to have “No Effect” on threatened, endangered, or candidate species and proposed or designated critical habitat under USFWS jurisdiction, a “Not Likely to Jeopardize the Species’ Continued Existence” determination for the proposed Tricolored Bat, and a “No Eagle Act Permit Required” determination for the Bald Eagle. A Self-certification Letter and 10-step Project Review Package were prepared and submitted to the USFWS Raleigh Ecological Services Field Office (FO) on December 11, 2023. On December 21, 2023, Ms. Kathy Matthews, USFWS Fish and Wildlife Biologist, responded that the “Service agrees that the project is not likely to adversely affect any listed species.”

Natural Hydrologic Function

The effects of Hurricane Matthew on Robeson County riverine flooding were high especially along the Lumber River and in Lumberton where several major streams converge with the Lumber River (HMRRP-RC, pg. 3-1). The hydrology of the Lumber River Basin has been studied in various reports. The City of Lumberton levee is considered a key feature in the Lumber River Basin (Lumber River Mitigation Study, pg. 5). The Lumber River Mitigation Study calibrated the hydrologic model to Hurricane Matthew.

However, “[a]ll storms have many variables that contribute to magnitude of flooding.” According to the Lumber River Mitigation Study (pg. 29), there are “portions of the Lumber River watershed that exhibit behavior not easily modeled using 1-dimensional hydrologic analysis, such as flood wave attenuation and the complex diversion occurring from the short-circuiting of the levee in Lumberton during Hurricane Matthew at the VFW Road and CSX Railroad underpass breach. This behavior is not necessarily captured by parameters used in this model, making the calibration effort increasingly difficult moving downstream (specifically at Lumberton). However, the approach implemented provides a useful benchmark for the hydrologic response of the Lumber River watershed during Matthew, pertinent to this high planning-level analysis.” Further, “there are particular difficulties with the diversion of flow that was visually observed, though with no discharge measurement, that occurred at the VFW Road and CSX Railroad underpass. In order to account for this discharge through the underpass which was not captured by the USGS gage in Lumberton, multiple diversions were added to the HMS model to represent this situation. A coarse 1-dimensional unsteady hydraulic model was developed, utilizing lateral structures along the levee and this underpass, in order to develop a rating curve for this breach in the levee. This aspect of the levee at Lumberton presented difficulties in calibrating the hydrologic model, and should be revisited with much greater detail in future studies, including detailed 2-dimensional rain on grid combined hydrologic and hydraulic modeling.” As for the hydraulic modeling, the study notes that water surface elevations on the interior side of the Lumberton levee were based on NCEM models calibrated to observe Hurricane Matthew high water marks along the main stem using discharges from the calibrated rainfall-runoff model. “However, the models provided are 1-dimensional, and do not include a natural valley analysis of the levee at Lumberton. A natural valley analysis is a method for determining flood elevations for the interior or landward area of a levee, generally reserved for levees that are not certified as providing sufficient protection from the 1% annual chance event like the levee at Lumberton” (see Lumber River Mitigation Study, pgs. 37-38). “Therefore, water surface elevations on the riverward side of the levee were also used for the landward side of the levee for this planning level analysis.” “Further complicating the issue is the pending installation of a flood gate at the existing VFW Road and CSX Railroad underpass breach in the levee; the behavior of this breach is depicted in Figure 4-8. As mentioned previously, it is highly recommended that more refined study be performed for this area using more detailed methods, including 2-dimensional hydraulic modeling, before any sort of flood protection design take place.”

The H&H Analysis completed for the design of the flood gate is included in **Appendix 1**. The H&H Analysis includes a hydrologic analysis of the Lumber River from the headwaters located near Eagle Springs, North Carolina (NC) to the confluence of the Lumber River and Jacob Swamp located about 4 miles downstream of Lumberton. A hydraulic model was developed along the Lumber River and of its tributaries near the city of Lumberton to establish flood elevations for use in the flood gate closure design. The minimum elevation of the flood gate will therefore have to be above the 100-year water surface elevation plus 4.5 feet to meet FEMA accreditation requirements. The levee is currently not FEMA accredited. It is the desire of the City of Lumberton to have a flood gate that can, at a minimum, prevent flooding from events like that of Hurricanes Matthew and Florence, which are the highest recorded flooding events in Lumberton. Flood frequency analysis was performed to estimate the recurrence intervals of historic floods (Hurricane Matthew and Hurricane Florence) near the site.

The project designs have been completed in accordance with agency input to minimize impacts to the wetlands, environment and community. The proposed action will comply with a Floodplain Development Permit, NC DEMLR Erosion and Sediment Control Permit, NPDES Construction Stormwater Permit (NCG010000), and all applicable federal, State and local laws, regulations, and permit requirements and conditions which shall be obtained before commencing work and appended to the *West Lumberton Flood Gate Project EA ERR*. Applicable regulations and recommendations from the NC DEQ DWR will be followed. BMPs and erosion and sedimentation control measures include filter fabric under 24-inch class 2 riprap east of the flood gate; geotextile fabric under 18-inch class B riprap and 6-inch stone groin

protection riprap along southeastern portion of the earthen berm; two stone riprap check dams; temporary stabilizing vegetation; silt fencing; and site grading. Native plants will be utilized during landscaping and site restoration at the proposed action site. Additionally, the proposed action can implement the following voluntary conservation measures to benefit wildlife and, in particular, pollinators: plant native trees, shrubs, and flowering plants in landscaping, use plants that bloom spring through fall, and remove/control invasive plant species present. Further, the City has full-time staff in charge of inspecting and maintaining the system post-installation to ensure proper performance and address routine repairs as needed. With proper maintenance, any eroded area can be repaired and stabilized. The proposed action will disturb approximately 4.9 acres mostly within previously disturbed railroad and roadway easements and industrial businesses' lawns (urban areas) which are not ideal nor used for timber, and food and fiber resources. Thus, there will be minimal to no effect on living resources such as natural systems such as flora and fauna, timber, and food and fiber resources.

Cost Increases Attributed to Wetland-Required New Construction and Mitigation Measures to Minimize Harm to Wetlands that May Result from Such Use

Alternative locations and designs were considered during the lengthy design phase. However, this proposed action design was coordinated in conjunction with NC DOT to accommodate their I-95 widening project in the area. The proposed action had been designed in different locations, including east of I-95, before NC DOT and the City agreed upon this final design. The proposed action site (I-95 overpass opening at CSX railroad, Cox Road, and VFW Road) was identified during the levee design as a weak point where 100-year and greater flood events can penetrate to the protected side of the levee. Due to the type of improvement and its connection to the City's existing earthen levee and flood control system, floodplain impacts were unavoidable (see Existing Levee System Map in **Appendix A** of *West Lumberton Flood Gate Project EA ERR*). However, the proposed action was designed not to encroach into the onsite wetland.

The costs of damages incurred during past hurricanes and the estimated damages from future storms have been identified in various reports. This area is further identified as most at risk for continued flooding (HMRRP-RC, pg. 3-4). Table 5-4 in the Lumber River Mitigation Study (pg. 44) shows the baseline estimated damages on a community level, without considering structures interior to the levee at Lumberton. This information was used to compare potential damages with and without the flood gate system at the Lumberton levee. According to the 2020 BCR Regional Hazard Mitigation Plan (pg. 243), there are a total of 128 critical facilities exposed to 100-year river flooding in the City with an estimated \$4,166,242 in potential damages. There are 20 identified high potential loss properties in the City with an estimated \$2,213,828 in potential damages (pg. 248). Thus, without the necessary improvements, the City will continue to experience flooding with resultant property damage, utility and municipal service interruptions, and threat to public health and safety. As properties are repeatedly damaged, owners will likely stop making repairs and instead choose to relocate their businesses, possibly outside of the City's jurisdiction. The City will potentially experience impacts to the local economy both directly from the lost businesses, as well as indirectly through the elimination of jobs that local residents rely upon. The devastation suffered by the residents, churches, public facilities, businesses and industries in the affected areas could have been avoided had a flood gate system been in place. There has been broad community support for this project from not only the residents of South and West Lumberton but also from the City's industrial base, which will also be protected by these efforts. By mitigating the type of catastrophic flooding that was seen during Hurricane Matthew, the City of Lumberton will be able to confidently restore much needed housing and businesses to these historically low- to moderate-income and predominately minority neighborhoods, without the threat of future flooding.

The proposed action is not anticipated to result in direct or indirect, temporary or permanent impacts to approximately 4.44 acres of NWI-mapped Freshwater Forested/ Shrub Wetland (PFO4Ad) located on the VFW Rd. and Hackett St. parcel #938280300700 that is part of a 69.51-acre wetland feature. There are no other wetlands located on the other parcels. No activities are proposed in wetlands and a USACE Approved Jurisdictional Determination and No Permit Required Letter are being obtained. Since no direct or indirect, temporary or permanent wetland impacts are proposed, then Clean Water Act Section 404 and 401 permits and compensatory mitigation are not required. The project designs have been completed in accordance with agency input to minimize impacts to the wetlands, environment and community. The proposed action will comply with a Floodplain Development Permit, NC DEMLR Erosion and Sediment Control Permit, NPDES Construction Stormwater Permit (NCG010000), and all applicable federal, State and local laws, regulations, and permit requirements and conditions which shall be obtained before commencing work and appended to the *West Lumberton Flood Gate Project EA ERR*. Applicable regulations and recommendations from the NC DEQ DWR will be followed. BMPs and erosion and sedimentation control measures include filter fabric under 24-inch class 2 riprap east of the flood gate; geotextile fabric under 18-inch class B riprap and 6-inch stone groin protection riprap along southeastern portion of the earthen berm; two stone riprap check dams; temporary stabilizing vegetation; silt fencing; and site grading. Native plants will be utilized during landscaping and site restoration at the proposed action site. Additionally, the proposed action can implement the following voluntary conservation measures to benefit wildlife and, in particular, pollinators: plant native trees, shrubs, and flowering plants in landscaping, use plants that bloom spring through fall, and remove/control invasive plant species present. Further, the City has full-time staff in charge of inspecting and maintaining the system post-installation to ensure proper performance and address routine repairs as needed. With proper maintenance, any eroded area can be repaired and stabilized. Measures will be implemented to ensure the proposed action will have no significant direct or indirect impacts to onsite or offsite wetlands during construction and operation as a permanent flood gate system. Thus, there are no identifiable costs associated with the incidental wetland anticipated to be incurred. However, there are numerous identifiable costs that can be attributed to not implementing the proposed action.

Other Uses of Wetland in the Public Interest, Including Recreational, Scientific, and Cultural Uses

The natural approximately 4.44-acre Freshwater Forested/ Shrub Wetland (PFO4Ad) will remain intact because the proposed action has been designed so as to not encroach into the wetland. Further, no direct or indirect impacts to onsite or offsite wetlands are proposed or anticipated.

The natural wetland located on the VFW Rd. and Hackett St. parcel #938280300700 has no identifiable recreational, scientific, or cultural uses that will be impacted by the proposed action. The site is currently used as a borrow pit. As part of the 24 CFR 58 environmental review, the SHPO and Catawba Indian Nation were consulted regarding historic properties of religious and cultural significance in the area that could be affected by the proposed action. On December 6, 2023 (revised plans email), NCORR consulted with the Catawba Indian Nation for discussion of historic properties in the proposed action area that may have religious and cultural significance. The original Section 106 review packages were sent to the Catawba Indian Nation's Chief Bill Harris and Dr. Wenonah G. Haire, THPO on October 29, 2021. On December 7, 2023 (revised plans email), Ms. Caitlin Rogers responded that the "Catawba THPO has no concerns with the revised West Lumberton Flood Gate Project." On December 3, 2021 (original plans submission), Ms. Caitlin Rogers responded that "[t]he Catawba have no immediate concerns with regard to traditional cultural properties, sacred sites or Native American archaeological sites within the boundaries of the proposed project areas. **However, the Catawba are to be notified if Native American artifacts and / or human remains are located during the ground disturbance phase of this project.**" The proposed action is in compliance with Section 106 of the National Historic Preservation Act of 1966

NHPA. On October 29, 2021, NCORR Director Ms. Laura Hogshead sent a notification letter for the proposed action to the Lumbee Tribe of North Carolina's Chairman Harvey Godwin, Jr., and no response was received. The SHPO and Catawba Indian Nation Section 106 review and consultation documentation is included in the *West Lumberton Flood Gate Project EA ERR* along with the Lumbee Tribe of NC project notification letter. Thus, the proposed action does not have any foreseeable impact on recreational, scientific, or cultural uses of this wetland or offsite wetlands.

Step 5. Where Practicable, Design or Modify the Proposed Action to Minimize the Potential Adverse Impacts to and from the 100-Year Floodplain and the Wetland and to Restore and Preserve its Natural and Beneficial Functions and Values.

The purpose of this proposed action is to enhance the City's existing earthen levee and flood control system to mitigate against 100-year flood events flowing from the west side of the I-95 underpass via the CSX railroad crossing in the vicinity of VFW Road, Cox Road, and Hackett Street. The proposed action site (I-95 overpass opening at CSX railroad, Cox Road, and VFW Road) was identified during the levee design as a weak point where 100-year and greater flood events can penetrate to the protected side of the levee. The City has identified the proposed action site to mitigate flooding experienced on the protected side of the existing levee system, which is critical to protect lives and property in southern and western Lumberton. In addition, the levee system helps maintain access to and operation of several critical facilities behind the levee, such as the City's water treatment plant, two power grid point of delivery transformer sub stations, the City's Electric Utility Department, and a City Fire Station. Failure to make the proposed improvements will result in the area continuing to experience flooding during future storm events, which in turn has impacts across the entire City. The proposed action has been designed with agency input, particularly the NC DOT which is undertaking the widening of I-95. The NC DOT project includes realignment of Cox Road, VFW Road and Hackett Street, I-95 embankment and bridge surfacing, a drainage channel, I-95 replacement bridge, retaining walls near Cox Road, and temporary and permanent NC DOT easements and ROWs, all to be completed by NC DOT in this proposed action area.

Alternative locations and designs were considered during the lengthy design phase. However, this proposed action design was coordinated in conjunction with NC DOT to accommodate their I-95 widening project in the area. The proposed action had been designed in different locations along I-95 before NC DOT and the City agreed upon this final design. Due to the type of improvement and its connection to the City's existing earthen levee and flood control system, floodplain impacts were unavoidable (see Existing Levee System Map in **Appendix A** of *West Lumberton Flood Gate Project EA ERR*). However, the proposed action was designed not to encroach into the onsite wetland.

All of the proposed action site is located in 100-year floodplain with the five parcels totaling 23.43 acres and no areas in regulatory floodway. The proposed action will result in temporary impacts to approximately 4.9 acres of 100-year floodplain (Zone AE) and permanent impacts to 4.7 acres of 100-year floodplain. The proposed action is not anticipated to result in direct or indirect, temporary or permanent impacts to approximately 4.44 acres of NWI-mapped Freshwater Forested/ Shrub Wetland (PFO4Ad) located on the VFW Rd. and Hackett St. parcel #938280300700 that is part of a 69.51-acre wetland feature. There are no other wetlands located on the other parcels. Since no activities are proposed in wetlands, a USACE Approved Jurisdictional Determination and No Permit Required Letter are being obtained and Clean Water Act Section 404 and 401 permits are not required. The proposed action designs have been completed in accordance with agency input to minimize impacts to the wetlands, environment and community. The proposed action will comply with a Floodplain Development Permit, NC DEMLR Erosion and Sediment Control Permit, NPDES Construction Stormwater Permit (NCG010000), and all applicable federal, State and local laws, regulations, and permit requirements and conditions which shall be obtained before commencing work and appended to the *West Lumberton Flood*

Gate Project EA ERR. Applicable regulations and recommendations from the NC DEQ DWR will be followed. BMPs and erosion and sedimentation control measures include filter fabric under 24-inch class 2 riprap east of the flood gate; geotextile fabric under 18-inch class B riprap and 6-inch stone groin protection riprap along southeastern portion of the earthen berm; two stone riprap check dams; temporary stabilizing vegetation; silt fencing; and site grading. Native plants will be utilized during landscaping and site restoration at the proposed action site. Additionally, the proposed action can implement the following voluntary conservation measures to benefit wildlife and, in particular, pollinators: plant native trees, shrubs, and flowering plants in landscaping, use plants that bloom spring through fall, and remove/control invasive plant species present. Further, the City has full-time staff in charge of inspecting and maintaining the system post-installation to ensure proper performance and address routine repairs as needed. With proper maintenance, any eroded area can be repaired and stabilized. Thus, measures will be implemented to ensure the proposed action will have no significant direct or indirect impacts to floodplain and wetlands during construction and operation as a permanent flood gate system. The proposed action and location are the most suitable, feasible options selected by the City after a costly and lengthy design process to assist its residents and community to be protected from future storm events; the “No Action” alternative would not effectively address the area’s flooding; and mitigation measures include erosion and sedimentation controls, permit conditions, a project design that minimizes impacts, and native plants used in site restoration.

Step 6. Reevaluate the Alternatives and Proposed Action.

This public infrastructure improvement project aims to protect the area from flooding that causes property damage to homes, churches, public facilities, businesses and industries; interrupts City-wide services such as the potable water supply and electric utility grid for days; and blocks transportation accessibility with roadway flooding during and after storm events. West and South Lumberton have been devastated during Hurricanes Matthew and Florence and remain vulnerable to future storm events without the proposed action. The proposed action site was identified during levee design as a vulnerable weak point where 100-year and greater flood events can penetrate to the protected side of the levee. The City has selected the proposed action site to mitigate flooding experienced on the protected side of the existing levee system, which is critical to protect lives and property in southern and western Lumberton. The flood gate system will provide a new level of flood hazard protection that will allow the community to invest in a safer and more resilient and sustainable future in an area that has previously been threatened and devastated by flooding. The City of Lumberton will be able to confidently restore much needed housing and businesses to these historically low- to moderate-income and predominately minority neighborhoods without the threat of future flooding.

NCORR has considered the alternatives and mitigation measures to be taken to minimize adverse impacts and to restore and preserve natural and beneficial values. Alternative resiliency strategies were evaluated to address the flooding experienced in Lumberton during Hurricane Matthew. A series of meetings were held including public open houses and in-depth working sessions with county officials, subject matter experts, and county and municipal planners. North Carolina Emergency Management utilized data, resources, and technical expertise from State agencies, the private sector, and the UNC system to determine innovative best practice strategies. The proposed action was identified as a high priority infrastructure strategy. This location at the CSX railroad I-95 underpass was identified as the most vulnerable weak point where flood events can penetrate to the protected side of the levee. Alternative locations and designs for the flood gate system were considered during the lengthy design phase using agency input, particularly the NC DOT which is undertaking the widening of I-95. The proposed action was designed in different locations, including east of I-95, before NC DOT and the City agreed upon this final design. The NC DOT project includes realignment of Cox Road, VFW Road and Hackett Street, I-95 embankment and bridge surfacing, a drainage channel, I-95 replacement bridge, retaining walls near

Cox Road, and temporary and permanent NC DOT easements and ROWs in the area of this proposed action. The proposed action is not anticipated to exceed 4.9 acres of disturbance. The “No Action” Alternative is not considered feasible since flooding in the area causes property damage to homes, churches, businesses and industries; interrupts City-wide services such as the potable water supply and electric utility grid for days; and blocks transportation accessibility with roadway flooding during and after storm events. This proposed action is critically necessary to protect the residents and community from future storm events. Whereas, the “No Action” Alternative would leave the community vulnerable to future flooding and mitigation action would be compromised due to lack of financial support. Due to the type of improvement and its connection to the City’s existing earthen levee and flood control system, floodplain impacts were unavoidable. However, the proposed action was designed not to encroach into the onsite wetland.

Implementation of the proposed action will abide by all applicable federal, State and local laws, regulations, and permit requirements and conditions. Permits required for this proposed action shall be obtained before commencing work and appended to the *West Lumberton Flood Gate Project EA ERR* when received from the permitting agencies. The impacts of these alternatives will be re-evaluated in response to any public comments received.

Step 7. Issue Findings and Public Explanation.

It is the finding of this report that there is no better alternative than to provide funding for the West Lumberton Flood Gate Project. The City has selected this public infrastructure improvement project to protect the area from flooding that causes property damage to homes, churches, public facilities, businesses and industries; interrupts City-wide services such as the potable water supply and electric utility grid for days; and blocks transportation accessibility with roadway flooding during and after storm events. Further, the proposed action will mitigate flooding experienced on the protected side of the existing levee system, which is critical to protect lives and property in southern and western Lumberton.

A final notice, formally known as “*Final Notice and Public Explanation of a Proposed Activity in a 100-Year Floodplain and Wetland*” is being published in accordance with 24 CFR 55. However, this notice was combined with the *Notice of Finding of No Significant Impact (FONSI) and Notice of Intent to Request Release of Funds (NOI-RROF)* for a 15-day comment period. The 15-day comment period starts with the combined notice publishing in The Robesonian newspaper on January 6, 2024 and ends on January 22, 2024. The notice will be posted at <https://www.rebuild.nc.gov/about/plans-policies-reports/environmental-reviews> and sent via Federal Express and email to the following state and federal agencies: HUD NC Field Office; FEMA; EPA; USFWS; USACE; NPS; and NC State Environmental Clearinghouse. The notice will also be sent to Robeson County and the City of Lumberton. Project information was sent to the NC SHPO and Catawba Indian Nation for review and comment under Section 106 of the NHPA and a project notification letter was sent to the Lumbee Tribe of North Carolina (see *West Lumberton Flood Project EA ERR*). (See **Appendix 3** for the final notice distributed to these agencies).

Supporting documentation, including this EO 11988 Floodplain Management and EO 11990 Protection of Wetlands Determination, incorporated into the Final Notice, was posted for public review to the NCORR ReBuild NC website and included the Early Notice documentation (proposed action location maps with boundaries shown; Robeson County parcel data; site plans; FEMA FIRMette, NEPAassist FEMA FIRMs, and PFIRMSs with parcel boundaries shown; the NFIP Community Status Book; H&H Analysis; USFWS NWI Map; Total Wetlands Area Map, and USACE correspondence) and additional appendices noted herein. The EA was also posted to the NCORR ReBuild NC website allowing for public and agency input on the decision to provide funding for construction and development activities. Any substantive

comments received will be addressed, and incorporated into the EA prior to proceeding with the submission of a request for release of funds.

Step 8. Implementation and Continuing Responsibility of the Responsible Entity and Recipient.

NCORR is the responsible entity and will provide educational materials, when available. It is acknowledged there is a continuing responsibility by the responsible entity to ensure, to the extent feasible and necessary, compliance with the Steps herein.

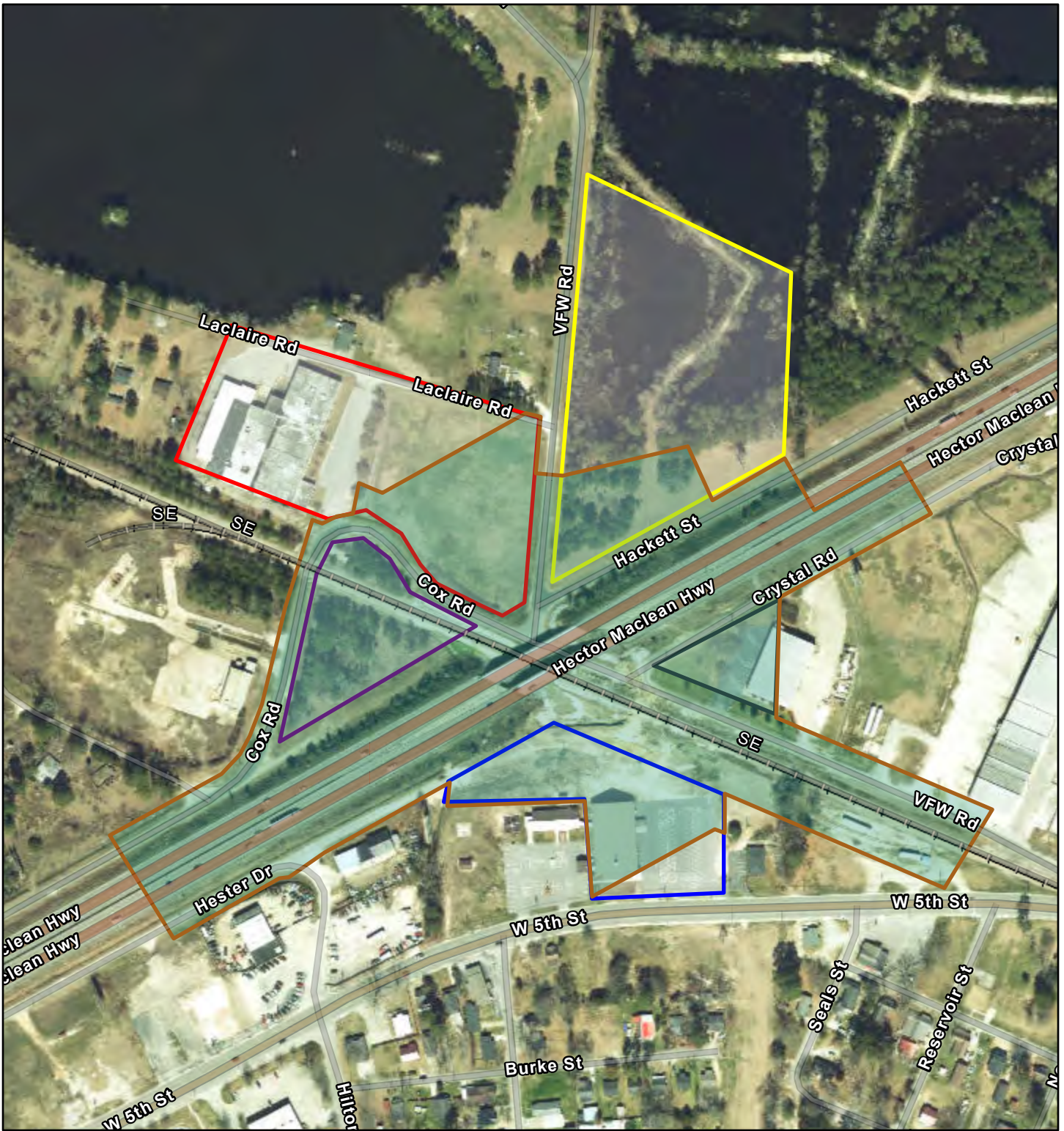
APPENDIX I

EARLY NOTICE FLOODPLAIN AND WETLANDS MAPS

- **Proposed Project Location Maps, Robeson County Parcel Data, and Site Plans**
- **FEMA FIRMette, NEPAassist FEMA FIRMs, PFIRMs, NFIP Community Status Book, and Hydrologic and Hydraulic Analysis**
- **USFWS National Wetlands Inventory (NWI) Map, Total Wetlands Area Map, and USACE Correspondence**

- **Proposed Project Location Maps**
- **Robeson County Parcel Data**
- **Site Plans**

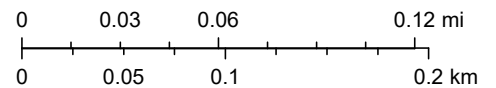
West Lumberton Flood Gate - Aerial Map



December 1, 2023

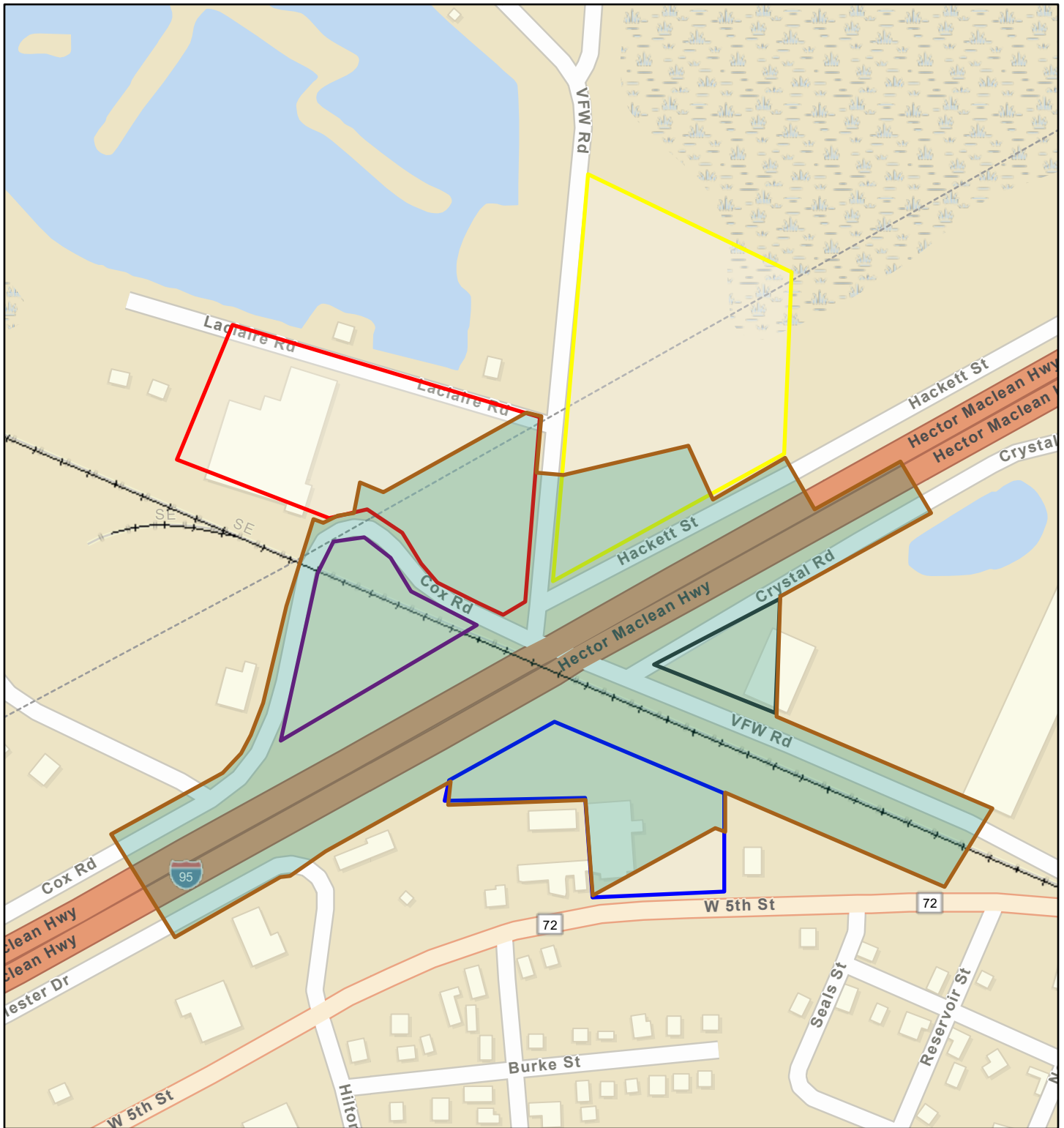
1:4,514

- WLFG Project Action Area
- 2460 Cox Rd #938179143700
- 550 VFW Rd #938189443052
- VFW & Hackett #938280300700
- 2306 W 5th St #938189201500
- 2400 Cox Rd #938179684407
- Railroads



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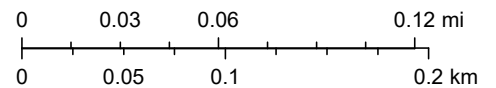
West Lumberton Flood Gate - Street Map



December 1, 2023

1:4,514







- WLF Project Action Area
- 2460 Cox Rd #938179143700
- VFW & Hackett #938280300700
- 2306 W 5th St #938189201500
- 2400 Cox Rd #938179684407
- Railroads



West Lumberton Flood Gate - Topographic Map

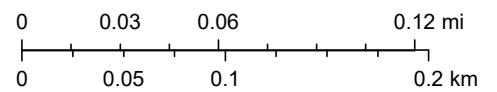


December 1, 2023

-  WFLG Project Action Area
-  2460 Cox Rd #938179143700
-  550 VFW Rd #938189443052
-  VFW & Hackett #938280300700
-  2306 W 5th St #938189201500
-  2400 Cox Rd #938179684407

 Railroads

1:4,514



County of Robeson, NC



MAPNO	101102012
PIN_NUMBER	938280300700
PARCELTYPE	Base Parcel
CONFLICTNOTATION	
DEEDEDACRES	7.71000004
OWNERTYPE	null
STATUS	null
OLDMAPNO	1011-02-012
NUMMOD	null
LOT	null
NBHD_CODE	32C27
TAX_YEAR	2023
PAR_CODE	
MAP	9382
SUBMAP	
BLOCK	80
PARCEL	3007
SUBPARCEL	00
PHYLOCAT	56700
CITYCODE	
ROUTENUM	0
OWNERID	8543007
CUROWNID	8543007

OWNAM1	FREEMAN INVESTMENTS INC
OWNAM2	
OWNAM3	
OWADR1	P O BOX 162
OWADR2	
OWADR3	
OWADR4	
OWCITY	LUMBERTON
OWSTATE	NC
OWZIP	283590000
STNUM	0
STSUFFIX	
STDIR	
STNAME	VFW & HACKETT
STTYPE	RD
STDIRSUF	
UNITNO	
DEEDACRE	7.16
MAPACRE	7.16
DISTCODE	27
TOWNCODE	10
PARDESC3	J62
PARDESC1	I-00
NBHCLASS	
NBHCODE	32C27
EXEMCODE	
DEEDBOOK	
DEEDPAGE	
DEEDYEAR	1989
PLATBOOK	
PLATPAGE	
DATESOLD	0
LEGDESC1	A JC BENNETT BORROW PIT
LEGDESC2	
LEGDESC3	
PARDESC4	
GROUPPAR	938280300700
REQREVIEW	
PHYSTRADR	VFW & HACKETT RD
SCHCODE	0
AREACODE	1
LNDASVCUR	19800
IMPASVCUR	0
QUALCODE	

RECTYPE	null
SALEAMT	0
SALEINST	
DEEDSTMP	0



Robeson County Government

PROPERTY REPORT - PRINT

Property Owner	Owner's Mailing Address	Property Location Address
FREEMAN INVESTMENTS INC	P O BOX 162 LUMBERTON , NC 283590000	VFW & HACKETT RD

Administrative Data	Administrative Data	Valuation Information
Parcel Ref No. 101102012 PIN 938280300700 Account No. 8543007 Tax District RAFT SWAMP FIRE Land Use Code I-00 Land Use Desc INDUSTRIAL VACANT Subdiv Code Subdiv Desc Neighborhood 32C27	Legal Desc A JC BENNETT BORROW PIT Deed Bk/Pg 00691 / 0078 Plat Bk/Pg / <hr/> Sales Information Grantor Sold Date 0--0 Sold Amount \$ 0	Market Value \$ 19,800 Market Value - Land and all permanent improvements, if any, effective January 1, 2010, date of County's most recent General Reappraisal Assessed Value \$ 19,800 If Assessed Value not equal Market Value then subject parcel designated as a special class -agricultural, horticultural, or forestland and thereby eligible for taxation on basis of Present-Use and/or reduction from a formal appeal procedure <hr/> Land Supplemental Map Acres 7.16 Tax District Note JACOB SWAMP MAINTENANCE Present-Use Info

Improvement Detail	
(1st Major Improvement on Subject Parcel)	
Year Built	0
Built Use/Style	
Current Use	/
* Percent Complete	0
Heated Area (S/F)	0
** Bathroom(s)	0 Full Bath(s) 0 Half Bath(s)
** Bedroom(s)	0
Fireplace (Y/N)	N
Basement (Y/N)	N
Attached Garage (Y/N)	N
*** Multiple Improvements	000
* Note - As of January 1 ** Note - Bathroom(s), Bedroom(s), shown for description only *** Note - If multiple improvements equal "MLT" then parcel includes additional major improvements	

Improvement Valuation (1st Major Improvement on Subject Parcel)	
* Improvement Market Value \$	** Improvement Assessed Value \$
0	0
* Note - Market Value effective Date equal January 1, 2010, date of County's most recent General Reappraisal ** Note - If Assessed Value not equal Market Value then variance resulting from formal appeal procedure	

Land Value Detail (Effective Date January 1, 2010, date of County's most recent General Reappraisal)		
Land Market Value (LMV) \$	Land Present-Use Value (PUV) \$ **	Land Total Assessed Value \$
19,800	19,800	19,800
** Note: If PUV equal LMV then parcel has not qualified for present use program		

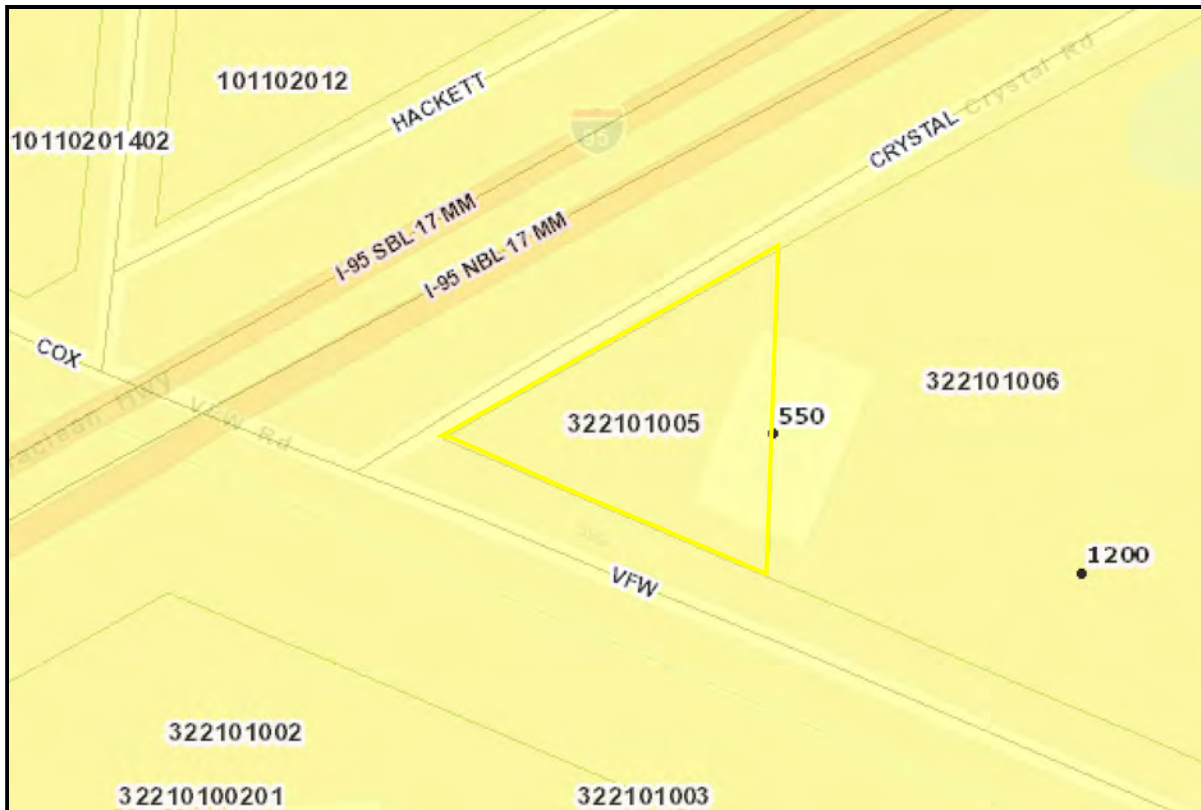
Parcel Sketch:

No Sketch Available

Parcel Photo:

No Photo Available

County of Robeson, NC



MAPNO	322101005
PIN_NUMBER	938189443052
PARCELTYPE	Base Parcel
CONFLICTNOTATION	null
DEEDEDACRES	null
OWNERTYPE	Private
STATUS	null
OLDMAPNO	3221-01-005
NUMMOD	null
LOT	null
NBHD_CODE	000000
TAX_YEAR	2023
PAR_CODE	
MAP	9381
SUBMAP	
BLOCK	89
PARCEL	4420
SUBPARCEL	00
PHYLOCAT	36171
CITYCODE	
ROUTENUM	0
OWNERID	8543000
CUROWNID	8543000

OWNAM1	FREEMAN INVESTMENTS INC
OWNAM2	
OWNAM3	
OWADR1	P O BOX 162
OWADR2	
OWADR3	
OWADR4	
OWCITY	LUMBERTON
OWSTATE	NC
OWZIP	283590000
STNUM	550
STSUFFIX	
STDIR	
STNAME	V. W. F.
STTYPE	RD
STDIRSUF	
UNITNO	
DEEDACRE	0.83
MAPACRE	0.83
DISTCODE	52
TOWNCODE	32
PARDESC3	
PARDESC1	C-80
NBHCLASS	
NBHCODE	32C25
EXEMCODE	
DEEDBOOK	
DEEDPAGE	
DEEDYEAR	1989
PLATBOOK	
PLATPAGE	
DATESOLD	0
LEGDESC1	LT JC BENNETT S/S I 95 OF
LEGDESC2	B1 IS HOUSING FOR A/C UNI
LEGDESC3	T ATTACHED TO REAR OF BLD
PARDESC4	
GROUPPAR	938189442000
REQREVIEW	
PHYSTRADR	550 V. W. F. RD
SCHCODE	0
AREACODE	1
LNDASVCUR	18700
IMPASVCUR	226500
QUALCODE	

RECTYPE	null
SALEAMT	0
SALEINST	
DEEDSTMP	0



Robeson County Government

PROPERTY REPORT - PRINT

Property Owner	Owner's Mailing Address	Property Location Address
FREEMAN INVESTMENTS INC	P O BOX 162 LUMBERTON , NC 283590000	550 V. W. F. RD

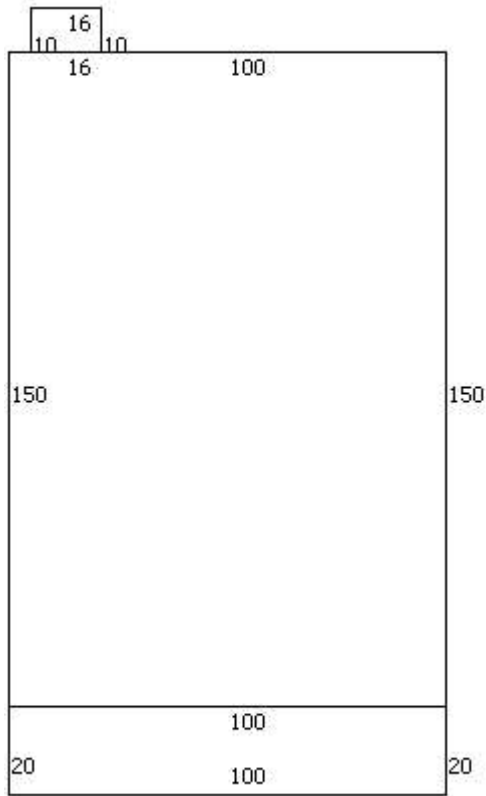
Administrative Data	Administrative Data	Valuation Information
Parcel Ref No. 322101005 PIN 938189442000 Account No. 8543000 Tax District TOWN LUMBERTON Land Use Code C-80 Land Use Desc WAREHOUSES Subdiv Code Subdiv Desc Neighborhood 32C25	Legal Desc LT JC BENNETT S/S I 95 OF B1 IS HOUSING FOR A/C UNI Deed Bk/Pg 00691 / 0078 Plat Bk/Pg / <hr/> Sales Information Grantor <hr/> Sold Date 0--0 Sold Amount \$ 0	Market Value \$ 245,200 Market Value - Land and all permanent improvements, if any, effective January 1, 2010, date of County's most recent General Reappraisal Assessed Value \$ 245,200 If Assessed Value not equal Market Value then subject parcel designated as a special class -agricultural, horticultural, or forestland and thereby eligible for taxation on basis of Present-Use and/or reduction from a formal appeal procedure <hr/> Land Supplemental Map Acres 0.83 Tax District Note Present-Use Info

Improvement Detail	
(1st Major Improvement on Subject Parcel)	
Year Built	1990
Built Use/Style	WAREHOUSE
Current Use	C /
* Percent Complete	100
Heated Area (S/F)	17,000
** Bathroom(s)	0 Full Bath(s) 0 Half Bath(s)
** Bedroom(s)	0
Fireplace (Y/N)	N
Basement (Y/N)	N
Attached Garage (Y/N)	N
*** Multiple Improvements	001
* Note - As of January 1 ** Note - Bathroom(s), Bedroom(s), shown for description only *** Note - If multiple improvements equal "MLT" then parcel includes additional major improvements	

Improvement Valuation (1st Major Improvement on Subject Parcel)	
* Improvement Market Value \$	** Improvement Assessed Value \$
226,500	226,500
* Note - Market Value effective Date equal January 1, 2010, date of County's most recent General Reappraisal ** Note - If Assessed Value not equal Market Value then variance resulting from formal appeal procedure	

Land Value Detail (Effective Date January 1, 2010, date of County's most recent General Reappraisal)		
Land Market Value (LMV) \$	Land Present-Use Value (PUV) \$ **	Land Total Assessed Value \$
18,700	18,700	18,700
** Note: If PUV equal LMV then parcel has not qualified for present use program		

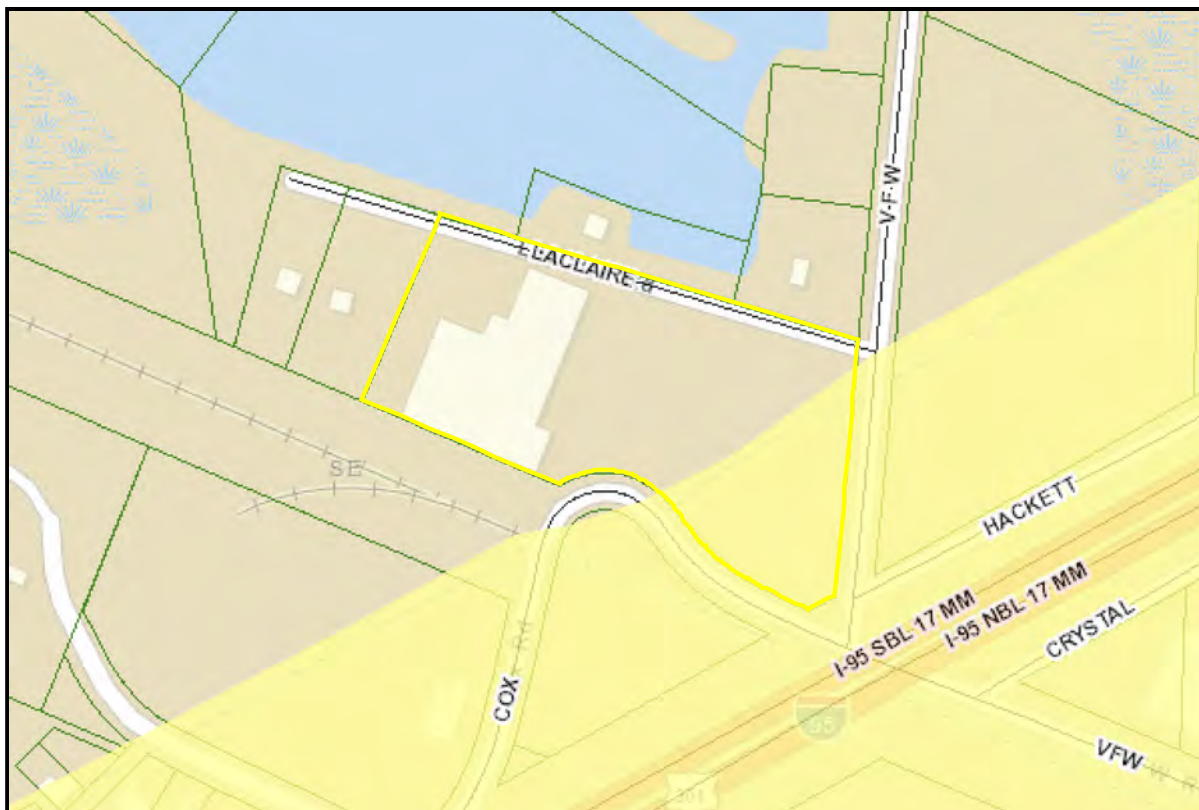
Parcel Sketch:



Parcel Photo:

No Photo Available

County of Robeson, NC



MAPNO	10110201402
PIN_NUMBER	938179684407
PARCELTYPE	Base Parcel
CONFLICTNOTATION	
DEEDEDACRES	6.3
OWNERTYPE	null
STATUS	null
OLDMAPNO	1011-02-01402
NUMMOD	null
LOT	null
NBHD_CODE	32C27
TAX_YEAR	2023
PAR_CODE	
MAP	9381
SUBMAP	
BLOCK	79
PARCEL	6844
SUBPARCEL	07
PHYLOCAT	13183
CITYCODE	
ROUTENUM	0
OWNERID	1073076
CUROWNID	1226876

OWNAM1	FIRST INDUSTRIAL B&L LLC
OWNAM2	
OWNAM3	
OWADR1	101 S TRYON STREET SUITE 2420
OWADR2	
OWADR3	
OWADR4	
OWCITY	CHARLOTTE
OWSTATE	NC
OWZIP	28202
STNUM	2400
STSUFFIX	
STDIR	
STNAME	COX
STTYPE	RD
STDIRSUF	
UNITNO	
DEEDACRE	6.3
MAPACRE	6.3
DISTCODE	27
TOWNCODE	10
PARDESC3	
PARDESC1	I-20
NBHCLASS	
NBHCODE	32C27
EXEMCODE	
DEEDBOOK	null
DEEDPAGE	null
DEEDYEAR	null
PLATBOOK	null
PLATPAGE	null
DATESOLD	null
LEGDESC1	A N/S SR1598
LEGDESC2	TITAN FLOW CONTROL
LEGDESC3	
PARDESC4	
GROUPPAR	938179684407
REQREVIEW	
PHYSTRADR	2400 COX RD
SCHCODE	0
AREACODE	1
LNDASVCUR	115000
IMPASVCUR	435700
QUALCODE	null

RECTYPE	null
SALEAMT	null
SALEINST	null
DEEDSTMP	null



Robeson County Government

PROPERTY REPORT - PRINT

Property Owner	Owner's Mailing Address	Property Location Address
SPARTAN LLC	290 CORPORATE DR LUMBERTON , NC 28358	2400 COX RD

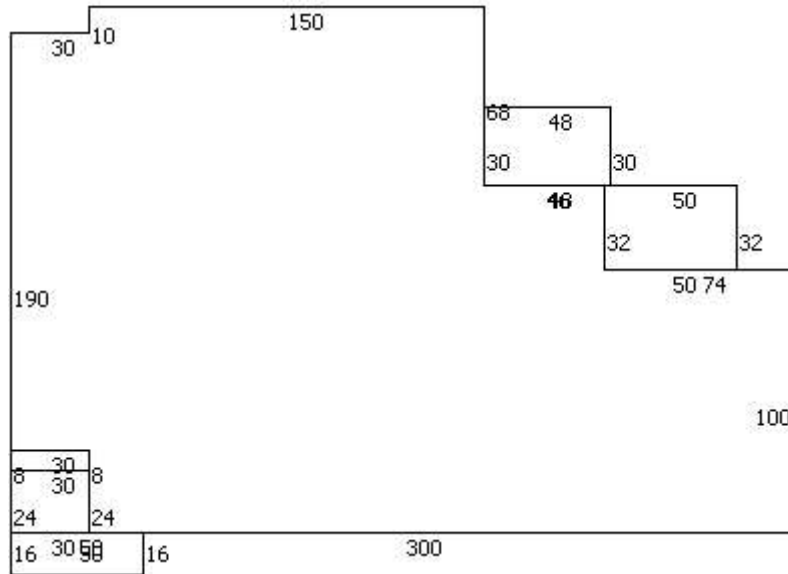
Administrative Data	Administrative Data	Valuation Information
Parcel Ref No. 10110201402 PIN 938179684407 Account No. 1073076 Tax District RAFT SWAMP FIRE Land Use Code I-20 Land Use Desc LIGHT INDUSTRIAL Subdiv Code Subdiv Desc Neighborhood 32C27	Legal Desc A N/S SR1598 TITAN FLOW CONTROL Deed Bk/Pg 01637 / 0232 Plat Bk/Pg / Sales Information Grantor SPARTAN LLC Sold Date 2023-04-26 Sold Amount \$ 50,000	Market Value \$ 550,700 Market Value - Land and all permanent improvements, if any, effective January 1, 2010, date of County's most recent General Reappraisal Assessed Value \$ 550,700 If Assessed Value not equal Market Value then subject parcel designated as a special class -agricultural, horticultural, or forestland and thereby eligible for taxation on basis of Present-Use and/or reduction from a formal appeal procedure Land Supplemental Map Acres 6.3 Tax District Note Present-Use Info

Improvement Detail	
(1st Major Improvement on Subject Parcel)	
Year Built	1977
Built Use/Style	MFG/PROCESSING
Current Use	C /
* Percent Complete	100
Heated Area (S/F)	49,972
** Bathroom(s)	0 Full Bath(s) 0 Half Bath(s)
** Bedroom(s)	0
Fireplace (Y/N)	N
Basement (Y/N)	N
Attached Garage (Y/N)	N
*** Multiple Improvements	001
* Note - As of January 1 ** Note - Bathroom(s), Bedroom(s), shown for description only *** Note - If multiple improvements equal "MLT" then parcel includes additional major improvements	

Improvement Valuation (1st Major Improvement on Subject Parcel)	
* Improvement Market Value \$	** Improvement Assessed Value \$
435,700	435,700
* Note - Market Value effective Date equal January 1, 2010, date of County's most recent General Reappraisal ** Note - If Assessed Value not equal Market Value then variance resulting from formal appeal procedure	

Land Value Detail (Effective Date January 1, 2010, date of County's most recent General Reappraisal)		
Land Market Value (LMV) \$	Land Present-Use Value (PUV) \$ **	Land Total Assessed Value \$
115,000	115,000	115,000
** Note: If PUV equal LMV then parcel has not qualified for present use program		

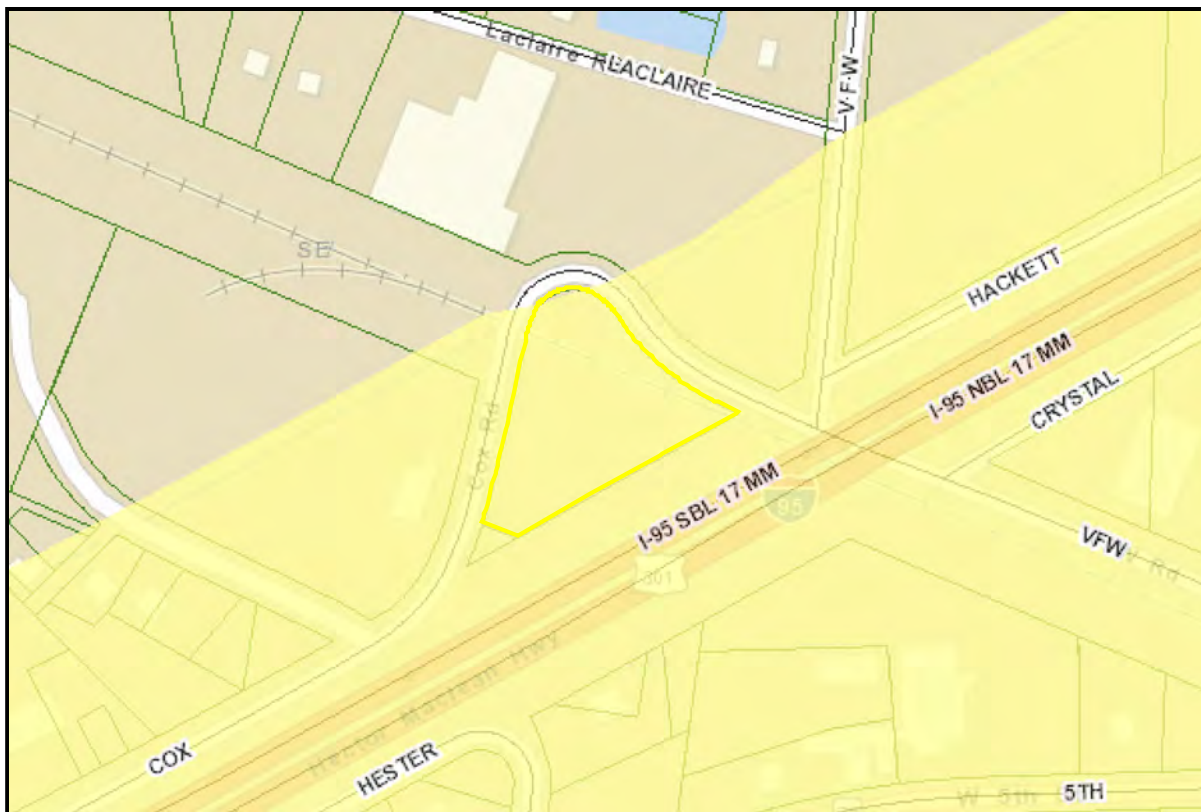
Parcel Sketch:



Parcel Photo:

No Photo Available

County of Robeson, NC



MAPNO	101103010
PIN_NUMBER	938179143700
PARCELTYPE	Base Parcel
CONFLICTNOTATION	
DEEDEDACRES	6.73000002
OWNERTYPE	Private
STATUS	null
OLDMAPNO	1011-03-010
NUMMOD	null
LOT	null
NBHD_CODE	32C27
TAX_YEAR	2023
PAR_CODE	
MAP	9381
SUBMAP	
BLOCK	79
PARCEL	1437
SUBPARCEL	00
PHYLOCAT	13200
CITYCODE	
ROUTENUM	0
OWNERID	1004662001
CUROWNID	1004662001

OWNAM1	OMNISOURCE SOUTHEAST LLC
OWNAM2	
OWNAM3	
OWADR1	7575 W JEFFERSON BLVD
OWADR2	
OWADR3	
OWADR4	
OWCITY	FORT WAYNE
OWSTATE	IN
OWZIP	46508-4131
STNUM	2460
STSUFFIX	
STDIR	
STNAME	COX
STTYPE	RD
STDIRSUF	
UNITNO	
DEEDACRE	6.34
MAPACRE	6.34
DISTCODE	52
TOWNCODE	10
PARDESC3	
PARDESC1	C-80
NBHCLASS	
NBHCODE	32C27
EXEMCODE	
DEEDBOOK	null
DEEDPAGE	null
DEEDYEAR	null
PLATBOOK	null
PLATPAGE	null
DATESOLD	null
LEGDESC1	AC CHARLES STEVENS DIV LU
LEGDESC2	MBERTON RECYCLING CO
LEGDESC3	
PARDESC4	
GROUPPAR	938179143700
REQREVIEW	
PHYSTRADR	2460 COX RD
SCHCODE	0
AREACODE	1
LNDASVCUR	58600
IMPASVCUR	35000
QUALCODE	null

RECTYPE	null
SALEAMT	null
SALEINST	null
DEEDSTMP	null



Robeson County Government

PROPERTY REPORT - PRINT

Property Owner	Owner's Mailing Address	Property Location Address
OMNISOURCE SOUTHEAST LLC	7575 W JEFFERSON BLVD FORT WAYNE , IN 46508-4131	2460 COX RD

Administrative Data	Administrative Data	Valuation Information
Parcel Ref No. 101103010 PIN 938179143700 Account No. 1004662001 Tax District TOWN LUMBERTON Land Use Code C-80 Land Use Desc WAREHOUSES Subdiv Code Subdiv Desc Neighborhood 32C27	Legal Desc AC CHARLES STEVENS DIV LU MBERTON RECYCLING CO Deed Bk/Pg 01994 / 0786 Plat Bk/Pg / <hr/> Sales Information Grantor LUMBERTON RECYCLING CO INC C/O OMNISOURCE SOUTHEAST Sold Date 2015-05-29 Sold Amount \$ 0	Market Value \$ 93,600 Market Value - Land and all permanent improvements, if any, effective January 1, 2010, date of County's most recent General Reappraisal Assessed Value \$ 93,600 If Assessed Value not equal Market Value then subject parcel designated as a special class -agricultural, horticultural, or forestland and thereby eligible for taxation on basis of Present-Use and/or reduction from a formal appeal procedure <hr/> Land Supplemental Map Acres 6.34 Tax District Note Present-Use Info

Improvement Detail	
(1st Major Improvement on Subject Parcel)	
Year Built	1981
Built Use/Style	WAREHOUSE
Current Use	C /
* Percent Complete	100
Heated Area (S/F)	4,600
** Bathroom(s)	0 Full Bath(s) 0 Half Bath(s)
** Bedroom(s)	0
Fireplace (Y/N)	N
Basement (Y/N)	N
Attached Garage (Y/N)	N
*** Multiple Improvements	001
* Note - As of January 1 ** Note - Bathroom(s), Bedroom(s), shown for description only *** Note - If multiple improvements equal "MLT" then parcel includes additional major improvements	

Improvement Valuation (1st Major Improvement on Subject Parcel)	
* Improvement Market Value \$	** Improvement Assessed Value \$
35,000	35,000
* Note - Market Value effective Date equal January 1, 2010, date of County's most recent General Reappraisal ** Note - If Assessed Value not equal Market Value then variance resulting from formal appeal procedure	

Land Value Detail (Effective Date January 1, 2010, date of County's most recent General Reappraisal)		
Land Market Value (LMV) \$	Land Present-Use Value (PUV) \$ **	Land Total Assessed Value \$
58,600	58,600	58,600
** Note: If PUV equal LMV then parcel has not qualified for present use program		

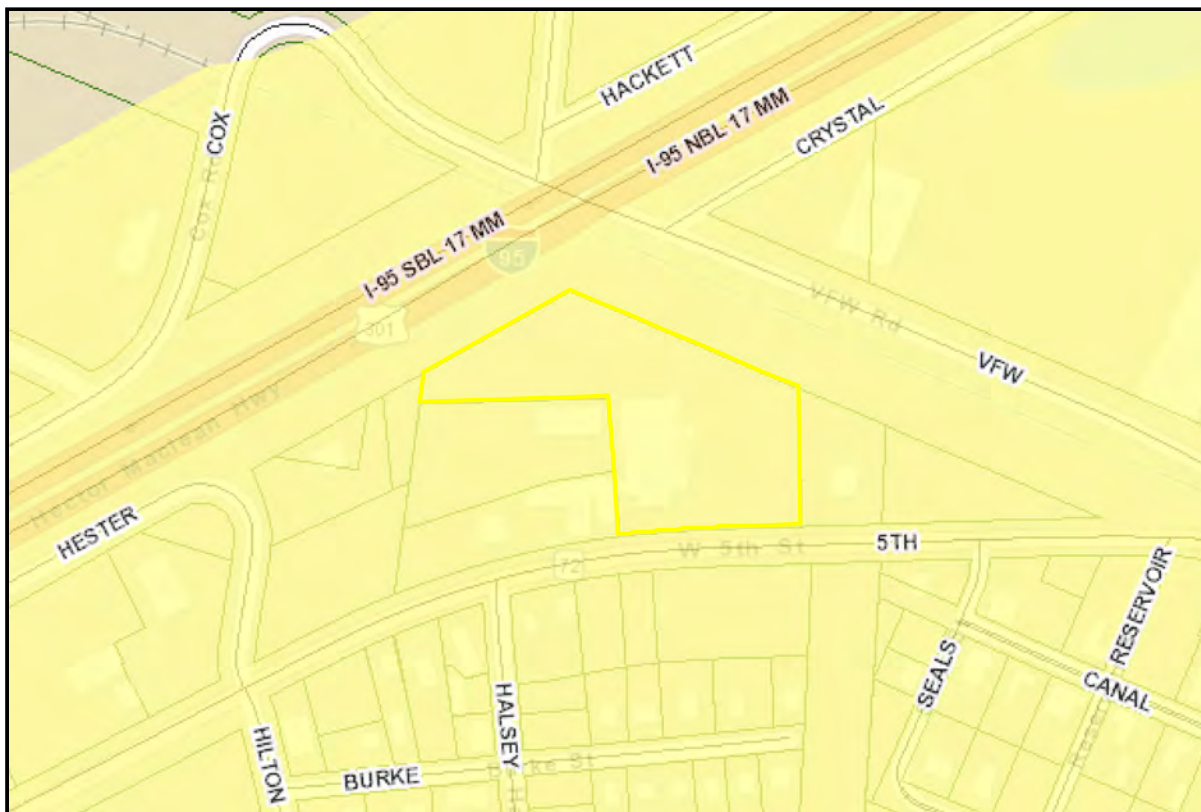
Parcel Sketch:



Parcel Photo:

No Photo Available

County of Robeson, NC



MAPNO	322101002
PIN_NUMBER	938189201500
PARCELTYPE	Base Parcel
CONFLICTNOTATION	
DEEDEDACRES	2.81999993
OWNERTYPE	null
STATUS	null
OLDMAPNO	3221-01-002
NUMMOD	null
LOT	null
NBHD_CODE	32080
TAX_YEAR	2023
PAR_CODE	
MAP	9381
SUBMAP	
BLOCK	89
PARCEL	2015
SUBPARCEL	00
PHYLOCAT	36168
CITYCODE	LUMB
ROUTENUM	0
OWNERID	47029000
CUROWNID	47029000

OWNAM1	WEST LUMBERTON BAPTIST CHURCH
OWNAM2	
OWNAM3	
OWADR1	2320 W 5TH STREET
OWADR2	
OWADR3	
OWADR4	
OWCITY	LUMBERTON
OWSTATE	NC
OWZIP	283580000
STNUM	2306
STSUFFIX	
STDIR	
STNAME	5TH
STTYPE	ST
STDIRSUF	
UNITNO	
DEEDACRE	2.8
MAPACRE	2.8
DISTCODE	52
TOWNCODE	32
PARDESC3	
PARDESC1	E-10
NBHCLASS	
NBHCODE	32080
EXEMCODE	E10
DEEDBOOK	01160
DEEDPAGE	0884
DEEDYEAR	2001
PLATBOOK	
PLATPAGE	
DATESOLD	0
LEGDESC1	A N/S W 5TH STREET BENNET
LEGDESC2	T S GARAGE
LEGDESC3	
PARDESC4	
GROUPPAR	938189201500
REQREVIEW	
PHYSTRADR	2306 5TH ST
SCHCODE	0
AREACODE	1
LNDASVCUR	176200
IMPASVCUR	2005300
QUALCODE	

RECTYPE	null
SALEAMT	0
SALEINST	
DEEDSTMP	0



Robeson County Government

PROPERTY REPORT - PRINT

Property Owner WEST LUMBERTON BAPTIST CHURCH		Owner's Mailing Address 2320 W 5TH STREET LUMBERTON , NC 283580000		Property Location Address 2306 5TH ST	
Administrative Data		Administrative Data		Valuation Information	
Parcel Ref No.	322101002	Legal Desc	A N/S W 5TH STREET BENNET T S GARAGE	Market Value \$	2,181,500
PIN	938189201500	Deed Bk/Pg	01160 / 0884	Market Value - Land and all permanent improvements, if any, effective January 1, 2010, date of County's most recent General Reappraisal	
Account No.	47029000	Plat Bk/Pg	/	Assessed Value \$ 2,181,500	
Tax District	TOWN LUMBERTON	Sales Information		If Assessed Value not equal Market Value then subject parcel designated as a special class -agricultural, horticultural, or forestland and thereby eligible for taxation on basis of Present-Use and/or reduction from a formal appeal procedure	
Land Use Code	E-10	Grantor		Land Supplemental	
Land Use Desc	RP CHURCHES	Sold Date	0--0	Map Acres	2.8
Subdiv Code		Sold Amount \$	0	Tax District Note	
Subdiv Desc				Present-Use Info	
Neighborhood	32080				

Improvement Detail

(1st Major Improvement on Subject Parcel)

Year Built	2005
Built Use/Style	RELIGIOUS
Current Use	B /
* Percent Complete	100
Heated Area (S/F)	18,000
** Bathroom(s)	0 Full Bath(s) 0 Half Bath(s)
** Bedroom(s)	0
Fireplace (Y/N)	N
Basement (Y/N)	N
Attached Garage (Y/N)	N
*** Multiple Improvements	001

* Note - As of January 1

** Note - Bathroom(s), Bedroom(s), shown for description only

*** Note - If multiple improvements equal "MLT" then parcel includes additional major improvements

Improvement Valuation (1st Major Improvement on Subject Parcel)

* Improvement Market Value \$	** Improvement Assessed Value \$
2,005,300	2,005,300

* Note - Market Value effective Date equal January 1, 2010, date of County's most recent General Reappraisal

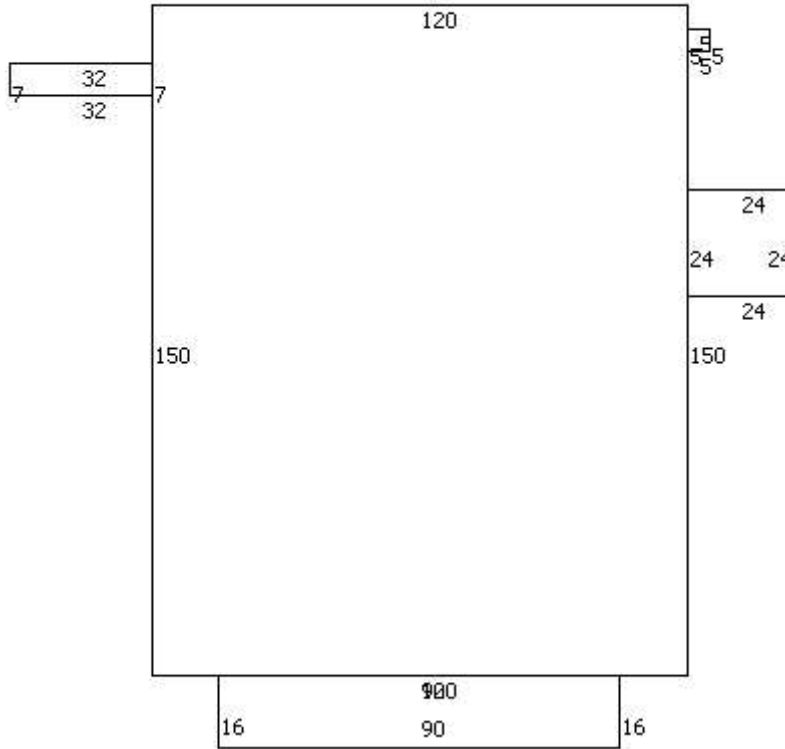
** Note - If Assessed Value not equal Market Value then variance resulting from formal appeal procedure

Land Value Detail (Effective Date January 1, 2010, date of County's most recent General Reappraisal)

Land Market Value (LMV) \$	Land Present-Use Value (PUV) \$ **	Land Total Assessed Value \$
176,200	176,200	176,200

** Note: If PUV equal LMV then parcel **has not** qualified for present use program

Parcel Sketch:

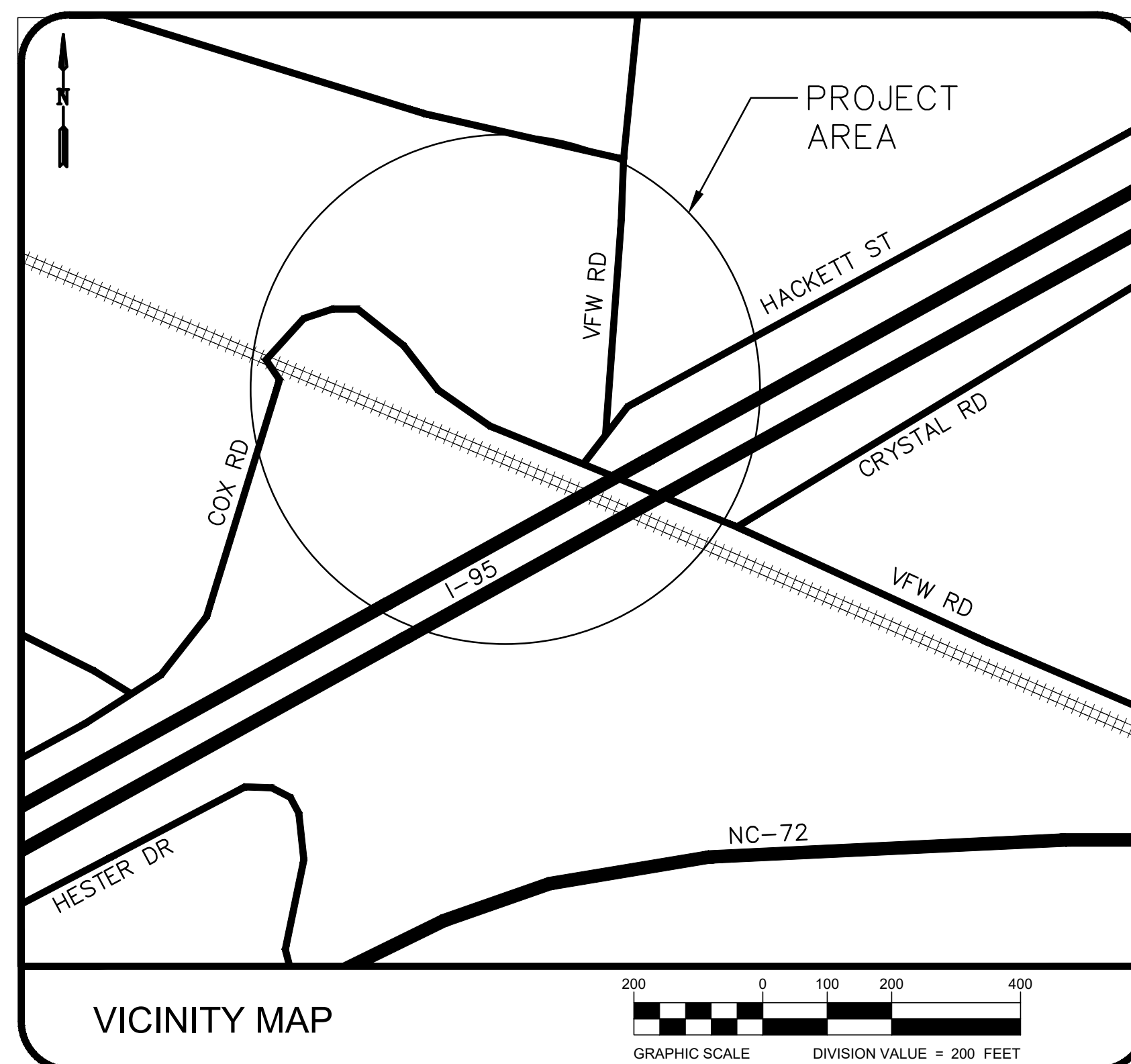


Parcel Photo:

No Photo Available

WEST LUMBERTON FLOODGATE AT VFW ROAD AND RAILROAD UNDERPASS CITY OF LUMBERTON

ROBESON COUNTY, NORTH CAROLINA



95% SUBMITTAL
- FOR REVIEW PURPOSES ONLY -
DO NOT USE FOR
CONSTRUCTION

APRIL 2023

ATKINS

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LINFIELD, HUNTER & JUNIUS, INC.



1616 East Millbrook Road
Suite 160
Raleigh, NC 27519

Tel: +1 (919) 876-6888
Fax: +1 (919) 876-6848

www.atkinsglobal.com

3608 18th Street
Suite 200
Metairie, LA 70002

Tel: +1 (504) 833-5300
Fax: +1 (504) 833-5350

www.LHJunius.com

5400 Trinity Road
Suite 107
Raleigh, NC 27607

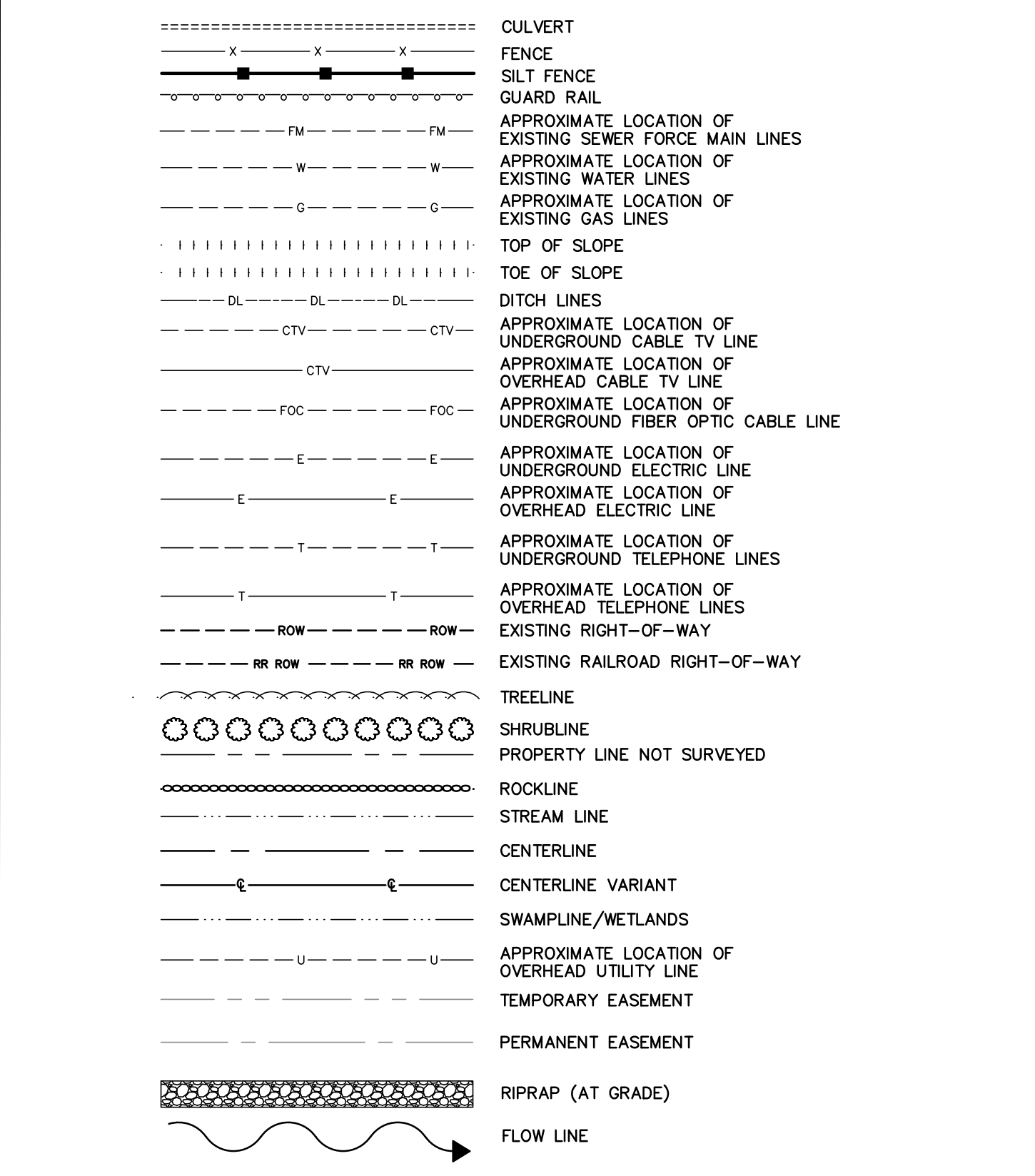
Tel: +1 (919) 378-9111
NC Firm License # C-0459

mcgillassociates.com



LEGEND

- TELEPHONE PEDESTAL
ELECTRIC PEDESTAL
CABLE TV PEDESTAL
SIGN
UNDERGROUND CABLE TV SIGN
UNDERGROUND FIBER OPTIC CABLE SIGN
UNDERGROUND TELEPHONE CABLE SIGN
UNDERGROUND GAS LINE SIGN
UNDERGROUND ELECTRIC LINE SIGN
LIGHT POLE
UTILITY POLE
NCDOT UTILITY POLE
GUY WIRE ANCHOR
TRAFFIC SIGNAL POLE
RAILROAD CROSSING SIGNAL
MANHOLE
SANITARY SEWER MANHOLE
STORM DRAIN MANHOLE
COMMUNICATION MANHOLE
ELECTRICAL MANHOLE
JUNCTION BOX
SPIGOT/YARD HYDRANT
SEWER CLEAN-OUT
ELECTRIC SERVICE STUB-OUT
GAS SERVICE STUB-OUT
CATCH BASIN
CURB INLET
WATER METER
FIRE HYDRANT
WATER VALVE
BLOW OFF VALVE
GAS METER
GAS VALVE
IRRIGATION CONTROL VALVE
POST INDICATOR VALVE
ELECTRIC JUNCTION BOX OR OUTLET
TRAFFIC SIGNAL BOX



- IPS IRON PIN SET
CMU CONCRETE MASONRY UNIT
R/W RIGHT OF WAY
C CENTERLINE
C CURVE (SEE CURVE TABLE)
POB POINT OF BEGINNING
CP CALCULATED POINT
PB PLAT BOOK
DB DEED BOOK
L LINE (SEE LINE TABLE)
BLDG BUILDING
CIP CAST IRON PIPE
CMP CORRUGATED METAL PIPE
CONC CONCRETE
PROP PROPOSED
EX/EXIST EXISTING
CPP CORRUGATED PLASTIC PIPE
DIP DUCTILE IRON PIPE
E&T ELECTRIC & TELEPHONE
FOC FIBER OPTIC CABLE
GIP GALVANIZED IRON PIPE
O/H OVERHEAD
RCP REINFORCED CONCRETE PIPE
U/G UNDERGROUND
VCP VITRIFIED CLAY PIPE
PVC POLYVINYL CHLORIDE PIPE
FFE FINISHED FLOOR ELEVATION
PG PAGE
REF REFERENCE
DOT DEPARTMENT OF TRANSPORTATION
NGS NATIONAL GEODETIC SURVEY
NCSP NORTH CAROLINA STATE PLANE
MTR BOX METER BOX
EL ELEVATION

GENERAL CONSTRUCTION NOTES

- 1. SURVEY IS REFERENCED TO HORIZ: NAD83, STATE PLANE (FEET) NORTH CAROLINA (FIFS 3200) VERTICAL: NORTH AMERICAN VERTICAL DATUM OF 1988 (NAVD 88) BY MCGILL ASSOCIATES.
2. CONSTRUCTION OF THE FLOODGATE PROJECT IS ANTICIPATED TO PRECEDE THE CONSTRUCTION OF THE I-95 CONSTRUCTION PROJECT BY OTHERS. THE DESIGN OF THE FLOODGATE IS BASED ON BEST AVAILABLE DATA OF ANTICIPATED FIELD CONDITIONS BASED ON DESIGN DRAWINGS FOR THE I-95 PROJECT PROVIDED BY OTHERS. CONTRACTOR SHALL VERIFY THAT BUILT CONDITIONS MATCH THE DESIGN AS SHOWN ON SHEET C-201 PRIOR TO BID. NO CHANGE ORDER IS ALLOWED FOR DIFFERING FIELD CONDITIONS.
3. CONTRACTOR SHALL VERIFY ALL ELEVATIONS BEFORE INSTALLATION OF FACILITIES.
4. NOT ALL UTILITIES ARE SHOWN. CONTRACTOR IS RESPONSIBLE FOR VERIFYING THE EXISTING UTILITIES AND UTILITY INFORMATION PRESENTED ON THESE DRAWINGS. ANY DISCREPANCIES SHALL BE ADDRESSED TO THE ENGINEER IN WRITING. THE CONTRACTOR IS RESPONSIBLE FOR NOTIFYING AND COORDINATING WORK WITH THE AFFECTED UTILITY COMPANIES WHETHER THE CONTRACTOR PERFORMS THE WORK OR A UTILITY COMPANY PERFORMS THE WORK. ANY DAMAGE DONE TO EXISTING UTILITIES (SHOWN OR NOT SHOWN ON PLANS) SHALL BE THE RESPONSIBILITY OF THE CONTRACTOR. THE CONTRACTOR SHALL CONTACT NC ONE CALL AT 1-800-632-4949 AT LEAST THREE WORKING DAYS PRIOR TO CONSTRUCTION. NON-SUBSCRIBERS SHALL BE CONTACTED DIRECTLY.
5. UNLESS OTHERWISE STATED, ALL FILL AREAS SHALL BE CONSTRUCTED IN LAYERS OF 8" MAXIMUM THICKNESS, WITH WATER ADDED OR SOIL CONDITIONED TO THE OPTIMUM MOISTURE CONTENT AS DETERMINED BY THE ENGINEER AND COMPACTED WITH A SHEEP'S FOOT ROLLER TO A COMPACTION EQUAL TO OR GREATER THAN 95% OF THE DENSITY OBTAINED BY COMPACTING A SAMPLE OF THE MATERIAL IN ACCORDANCE WITH THE STANDARD PROCTOR METHOD OF MOISTURE-DENSITY RELATIONSHIP TEST, ASTM D696 OR AASHTO-99 UNLESS SPECIFIED IN OTHER SPECIFICATIONS. MATERIAL AND COMPACTION REQUIREMENTS FOR LEVEE AND LEVEE TIE-IN ARE INCLUDED IN GEOTECHNICAL SPECIFICATIONS.
6. ALL PUBLIC ROADWAYS SHALL REMAIN OPEN AT ALL TIMES. IT IS THE CONTRACTOR'S RESPONSIBILITY TO MAINTAIN ROAD SURFACES CLEAN AND FREE OF CONSTRUCTION SEDIMENT AND DEBRIS AT ALL TIMES.
7. ALL WORK SHALL BE PERFORMED IN ACCORDANCE WITH APPLICABLE LOCAL CITY, STATE, AND FEDERAL REGULATIONS AND PERMIT REQUIREMENTS.
8. CONTRACTOR SHALL OBTAIN AND PROVIDE TO THE OWNER TEMPORARY STREET AND DRIVEWAY ACCESS PERMIT FOR CONSTRUCTION ENTRANCES PRIOR TO ANY CONSTRUCTION ACTIVITY.
9. ALL DISTURBED AREAS SHALL BE SEEDED AND MULCHED OR SODDED UPON COMPLETION OF CONSTRUCTION UNLESS OTHERWISE SPECIFIED.

GENERAL EROSION CONTROL NOTES

- 1. ENTIRE AREA TO BE GRADED SHALL BE CLEARED AND GRUBBED. NO FILL SHALL BE PLACED ON ANY AREA NOT CLEARED AND GRUBBED.
2. ALL DISTURBED NATURAL GROUND SHALL BE SEEDED.
3. ALL SOIL EROSION CONTROL MEASURES REQUIRED BY THE GRADING PLAN SHALL BE PERFORMED PRIOR TO GRADING, CLEARING, OR GRUBBING. ALL EROSION CONTROL DEVICES SUCH AS SILT FENCES, ETC. SHALL BE MAINTAINED IN WORKABLE CONDITION FOR THE LIFE OF THE PROJECT AND SHALL BE REMOVED AT THE COMPLETION OF THE PROJECT ONLY ON THE ENGINEER'S APPROVAL. PAYMENT SHALL BE CONSIDERED INCIDENTAL TO CLEARING AND GRUBBING. IF DURING THE LIFE OF THE PROJECT A STORM CAUSES SOIL EROSION WHICH CHANGES FINISH GRADES OR CREATES "GULLIES" AND "WASHED AREAS," THESE SHALL BE REPAIRED AT NO EXTRA COST, AND ALL SILT WASHED OFF OF THE PROJECT SITE ONTO ADJACENT PROPERTY SHALL BE REMOVED AS DIRECTED BY THE ENGINEER AT NO EXTRA COST. THE CONTRACTOR SHALL ADHERE TO ANY APPROVED EROSION CONTROL PLANS WHETHER INDICATED IN THE CONSTRUCTION PLANS OR UNDER SEPARATE COVER.
4. DISPOSABLE MATERIAL
4.1. CLEARING AND GRUBBING WASTES SHALL BE REMOVED FROM THE SITE AND PROPERLY DISPOSED OF BY THE CONTRACTOR AT HIS EXPENSE, UNLESS OTHERWISE SPECIFIED.
4.2. THE CONTRACTOR SHALL REMOVE SOLID WASTE FROM THE SITE AND PROPERLY DISPOSE OF IT AT HIS EXPENSE.
4.3. ON SITE BURNING IS NOT ACCEPTABLE.
5. ALL DEVICES SHALL BE MAINTAINED ON ALL CONSTRUCTION SITES, BORROW SITES, AND WASTE PILE (SPOIL) SITES, INCLUDING CONTRACTOR OWNED OR LEASED BORROW PITS ASSOCIATED WITH THE PROJECT. SUFFICIENT MATERIALS REQUIRED FOR STABILIZATION AND/OR REPAIR OF EROSION CONTROL MEASURES AND STORMWATER ROUTING AND TREATMENT SHALL BE ON-SITE AT ALL TIMES.
6. AN NPDES CONSTRUCTION STORMWATER PERMIT (NCG010000) IS REQUIRED FOR CONSTRUCTION PROJECTS THAT DISTURB ONE OR MORE ACRES OF LAND. THE NCG010000 PERMIT ALLOWS STORMWATER TO BE DISCHARGED DURING LAND DISTURBING CONSTRUCTION ACTIVITIES AS STIPULATED IN THE CONDITIONS OF THE PERMIT. IF THE PROJECT IS COVERED BY THE PERMITS, FULL COMPLIANCE WITH PERMIT CONDITIONS INCLUDING THE EROSION AND SEDIMENTATION CONTROL PLAN, INSPECTIONS AND MAINTENANCE, SELF-MONITORING, RECORD KEEPING AND REPORTING REQUIREMENTS IS REQUIRED.
7. ALL PROPOSED AND APPROVED TEMPORARY FILL AND CULVERTS MUST BE REMOVED AND THE IMPACTED AREA RETURNED TO NATURAL CONDITIONS WITHIN 60 CALENDAR DAYS AFTER THE TEMPORARY IMPACT IS NO LONGER NECESSARY. THE IMPACTED AREAS WILL BE RETURNED TO ORIGINAL GRADE, INCLUDING EACH STREAM'S ORIGINAL CROSS SECTIONAL DIMENSIONS, PLANFORM PATTERN, AND LONGITUDINAL BED PROFILE. ALL TEMPORARY IMPACTS SHOULD BE RESTORED AND STABILIZED WITH NATIVE VEGETATION.
8. THE CONTRACTOR OR OTHER RESPONSIBLE ENTITY WILL REPORT ANY PETROLEUM SPILL OF 25 GALLONS OR MORE; ANY SPILL REGARDLESS OF AMOUNT THAT CAUSES A SHEEN ON SURFACE WATER; ANY PETROLEUM SPILL REGARDLESS OF SIZE THAT OCCURS WITHIN 100-FEET OF SURFACE WATER; AND ANY PETROLEUM SPILL LESS THAN 25 GALLONS THAT CANNOT BE CLEANED UP WITHIN 24 HOURS.

NORTH CAROLINA LAND QUALITY SECTION EROSION CONTROL NOTES

GENERAL: ALL EROSION CONTROL MEASURES ARE TO BE PERFORMED IN STRICT ACCORDANCE WITH REQUIREMENTS OF THE NORTH CAROLINA DEPARTMENT OF ENVIRONMENTAL QUALITY (NCEQ), DIVISION OF ENERGY, MINERAL, AND LAND RESOURCES (DEMRLR), LAND QUALITY SECTION. THE FOLLOWING CONSTRUCTION SEQUENCE SHALL BE COMPLIED WITH FOR ALL WORK.

- 1. INSTALL ALL EROSION CONTROL MEASURES AS REQUIRED BY THE NCEQ.
2. PROCEED WITH GRADING, CLEARING, AND GRUBBING. NO OFF SITE DISPOSAL OF MATERIAL IS ALLOWED UNLESS THE DISPOSAL SITE HAS AN APPROVED EROSION CONTROL PLAN.
3. SEED AND MULCH DENUDEED AREA WITHIN TIME FRAME SPECIFIED (SEE TABLE). SEED AND SOIL AMENDMENTS SHALL BE PLACED ON A PREPARED SEEDBED AT THE FOLLOWING RATES PER ACRE. STRAW MULCH SHALL BE TACKED WITH TACKING AGENT APPLIED BY HYDROSEEDER.

Table with 2 columns: Material Name and Rate. Includes CREeping RED FESCUE (100 LBS), STRAW MULCH (60-80 BALES), and seed rates for GERMAN MILLET, SMALL-STEMMED SUDAN GRASS, RYE GRAIN, and BROWN TOP MILLET.

ALL SEEDING SHALL BE MAINTAINED, WATERED, ETC., UNTIL A PERMANENT VEGETATIVE GROUND COVER IS ESTABLISHED OVER ALL DISTURBED AREAS. FOR ALL SLOPES 2:1 OR STEEPER, ADD TO THE ABOVE: PURGE LIVE SEED SWITCHGRASS 4 LBS, BROWNTOP MILLET OR PEARL MILLET (PENNISETUM GLAUCUM) 8 LBS, GRAIN SORGHUM (SORGHUM BICOLOR (L.) MOENCH SSP. BICOLOR) 2 LBS. ALL SLOPES 2:1 OR STEEPER SHALL BE COVERED BY EROSION CONTROL MATTING.

CSX GENERAL NOTES

- FOR ALL WORK WITHIN THE CSX RAILROAD, CONTRACTOR SHALL ABIDE WITH THE FOLLOWING:
1. ANY SOIL REMOVAL WILL COMPLY WITH CSX SOIL AND WATER MANAGEMENT POLICY. CSX REQUIRES THAT SOILS GENERATED FROM ITS PROPERTY BE EITHER PROPERLY DISPOSED OF IN A CSX APPROVED DISPOSAL FACILITY OR REUSED ON CSX PROPERTY. THE MANAGEMENT OF SOILS GENERATED FROM CSX PROPERTY SHOULD BE PLANNED FOR AND PROPERLY PERMITTED (IF APPLICABLE) PRIOR TO INITIATING ANY WORK ON CSX PROPERTY.
2. IN THE EVENT SOILS CANNOT BE REUSED ON CSX PROPERTY, THE CSX ENVIRONMENTAL DEPARTMENT WILL HANDLE WASTE CHARACTERIZATION AND PROFILING INTO AN APPROVED DISPOSAL FACILITY. AN ESTIMATED QUANTITY OF WASTE TO BE REMOVED FROM THE PROJECT AREA WILL BE PROVIDED TO CSX BY THE CONTRACTOR.
3. ANY PETROLEUM SPILL OR RELEASE OF HAZARDOUS SUBSTANCES WITHIN A CSX RIGHT-OF-WAY SHALL BE REPORTED TO CSX'S PSCC NUMBER AT (904) 359-7551 OR (800) 232-0144 IMMEDIATELY.

NOT TO SCALE

Table with 2 columns: Seal and Seal.

Table with 5 columns: Rev, Date, Description, By, Chk'd, App'd.

Table with 2 columns: Drawing Status and Suitability.

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Client: City of Lumberton North Carolina logo.

Project Title: WEST LUMBERTON FLOOD G AT VFW ROAD AND RAILROAD UNDERP ENGINEERING SERVICES

Drawing Title: NOTES AND LEGEND

Table with 6 columns: Scale, Designed, Drawn, Checked, Authorized. Values include NTS, CH, DS, MH, 22x34, 100068207-CG-003, 000.

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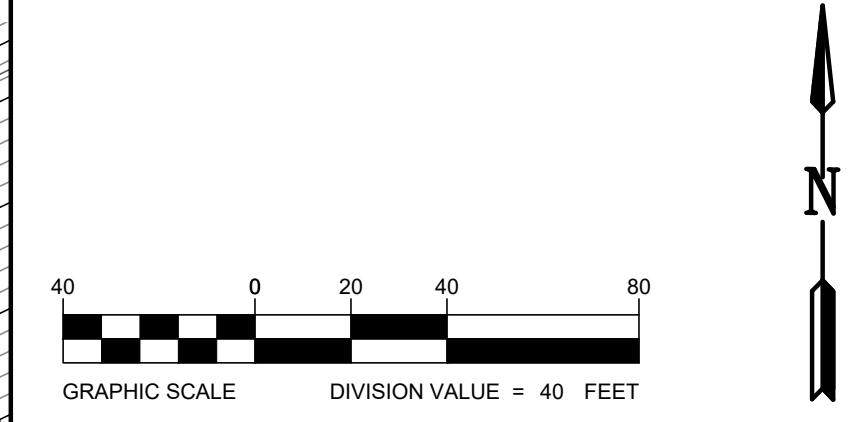
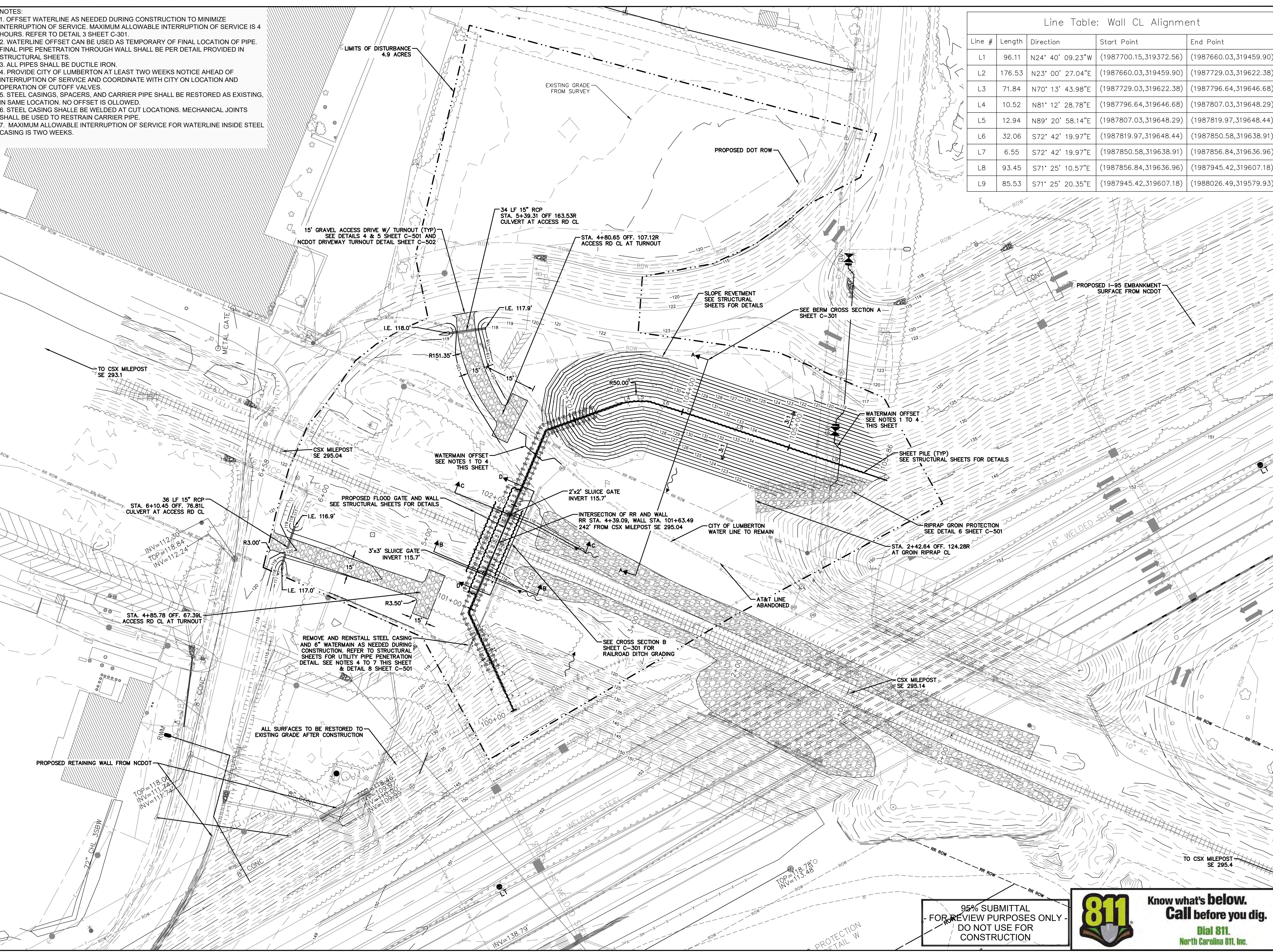
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- NOTES:
 1. OFFSET WATERLINE AS NEEDED DURING CONSTRUCTION TO MINIMIZE INTERRUPTION OF SERVICE. MAXIMUM ALLOWABLE INTERRUPTION OF SERVICE IS 4 HOURS. REFER TO DETAIL 3 SHEET C-301.
 2. WATERLINE OFFSET CAN BE USED AS TEMPORARY OF FINAL LOCATION OF PIPE. FINAL PIPE PENETRATION THROUGH WALL SHALL BE PER DETAIL PROVIDED IN STRUCTURAL SHEETS.
 3. ALL PIPES SHALL BE DUCTILE IRON.
 4. PROVIDE CITY OF LUMBERTON AT LEAST TWO WEEKS NOTICE AHEAD OF INTERRUPTION OF SERVICE AND COORDINATE WITH CITY ON LOCATION AND OPERATION OF CUTOFF VALVES.
 5. STEEL CASINGS, SPACERS, AND CARRIER PIPE SHALL BE RESTORED AS EXISTING, IN SAME LOCATION. NO OFFSET IS ALLOWED.
 6. STEEL CASING SHALL BE WELDED AT CUT LOCATIONS. MECHANICAL JOINTS SHALL BE USED TO RESTRAIN CARRIER PIPE.
 7. MAXIMUM ALLOWABLE INTERRUPTION OF SERVICE FOR WATERLINE INSIDE STEEL CASING IS TWO WEEKS.

Line Table: Wall CL Alignment

Line #	Length	Direction	Start Point	End Point
L1	96.11	N24° 40' 09.23"W	(1987700.15,319372.56)	(1987660.03,319459.90)
L2	176.53	N23° 00' 27.04"E	(1987660.03,319459.90)	(1987729.03,319622.38)
L3	71.84	N70° 13' 43.98"E	(1987729.03,319622.38)	(1987796.64,319646.68)
L4	10.52	N81° 12' 28.78"E	(1987796.64,319646.68)	(1987807.03,319648.29)
L5	12.94	N89° 20' 58.14"E	(1987807.03,319648.29)	(1987819.97,319648.44)
L6	32.06	S72° 42' 19.97"E	(1987819.97,319648.44)	(1987850.58,319638.91)
L7	6.55	S72° 42' 19.97"E	(1987850.58,319638.91)	(1987856.84,319636.96)
L8	93.45	S71° 25' 10.57"E	(1987856.84,319636.96)	(1987945.42,319607.18)
L9	85.53	S71° 25' 20.35"E	(1987945.42,319607.18)	(1988026.49,319579.93)

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Seal	Seal
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Rev.	Date	Description	By	Chkd	App'd

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 13608 18th Street
 Suite 200
 Metairie, LA 70002
 Tel: +1 (504) 833-5300
 Fax: +1 (504) 833-5350
 www.ljunius.com

mcgill
 5400 Trinity Road
 Suite 107
 Raleigh, NC 27607
 Tel: +1 (919) 378-9111
 NC Firm License # C-0459
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City of LUMBERTON
 North Carolina

Project Title
**WEST LUMBERTON FLOOD G
 AT VFW ROAD AND RAILROAD UNDERP
 ENGINEERING SERVICES**

Drawing Title
SITE PLAN

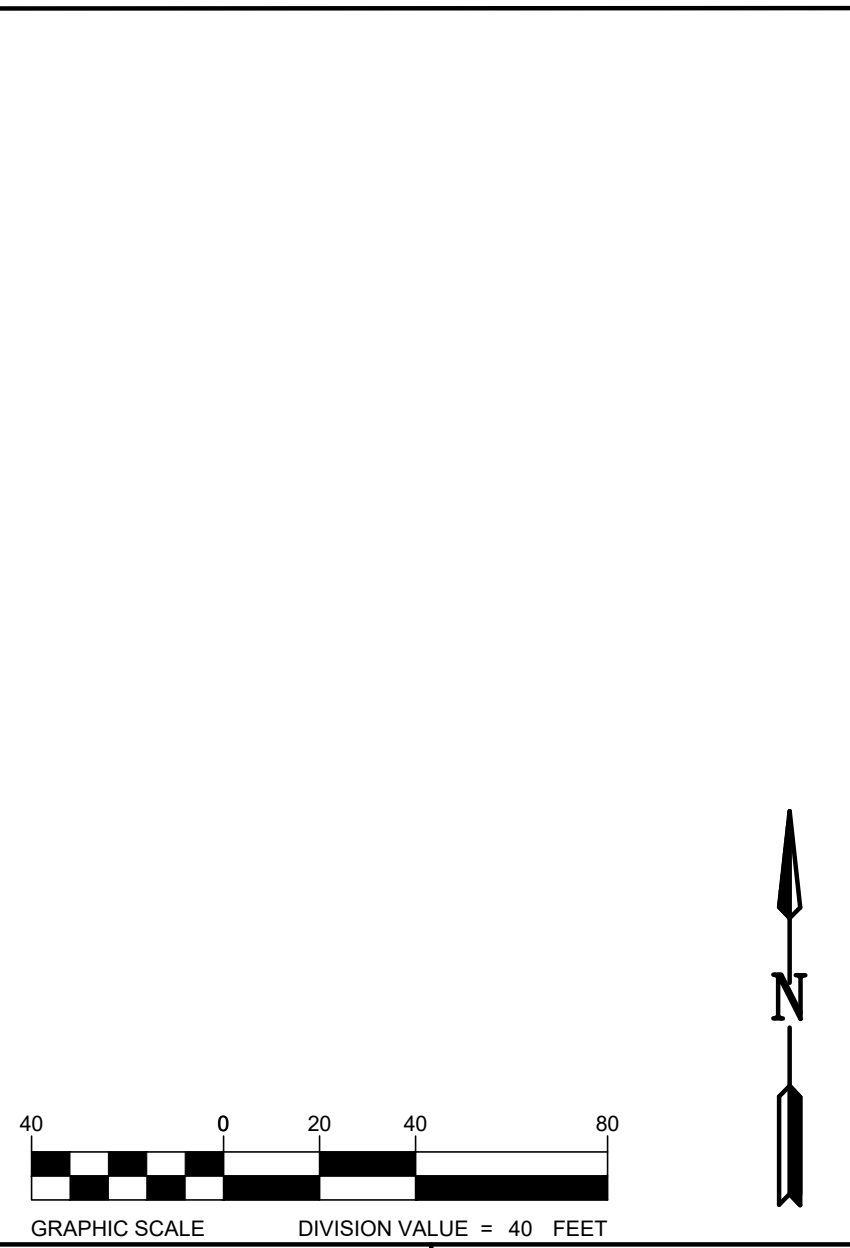
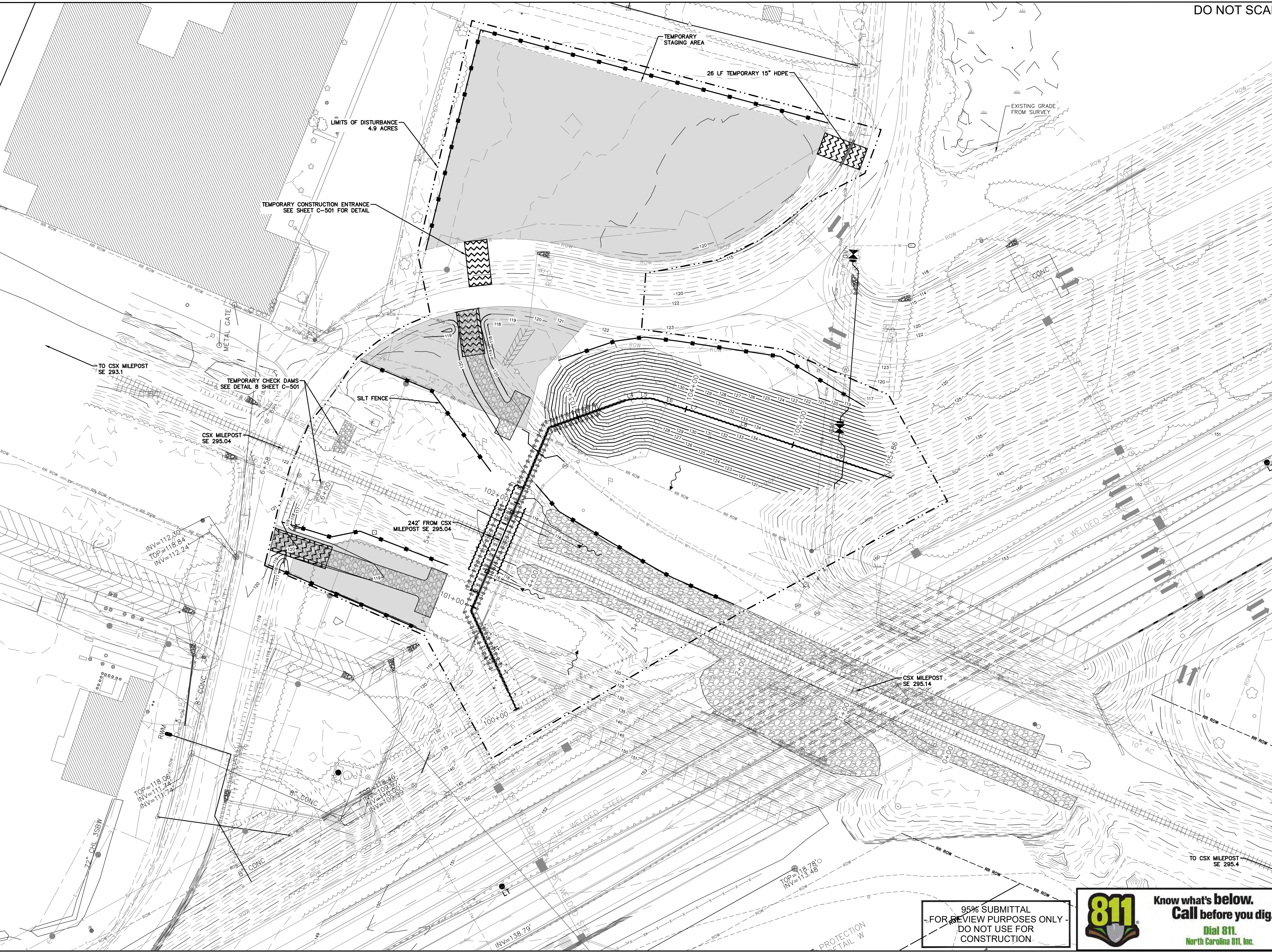
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5400 Trinity Road
Suite 107
Raleigh, NC 27607
Tel: +1 (919) 378-9111
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Project Title
**WEST LUMBERTON FLOOD G
AT VFW ROAD AND RAILROAD UNDERP
ENGINEERING SERVICES**

Drawing Title
EROSION CONTROL PLAN

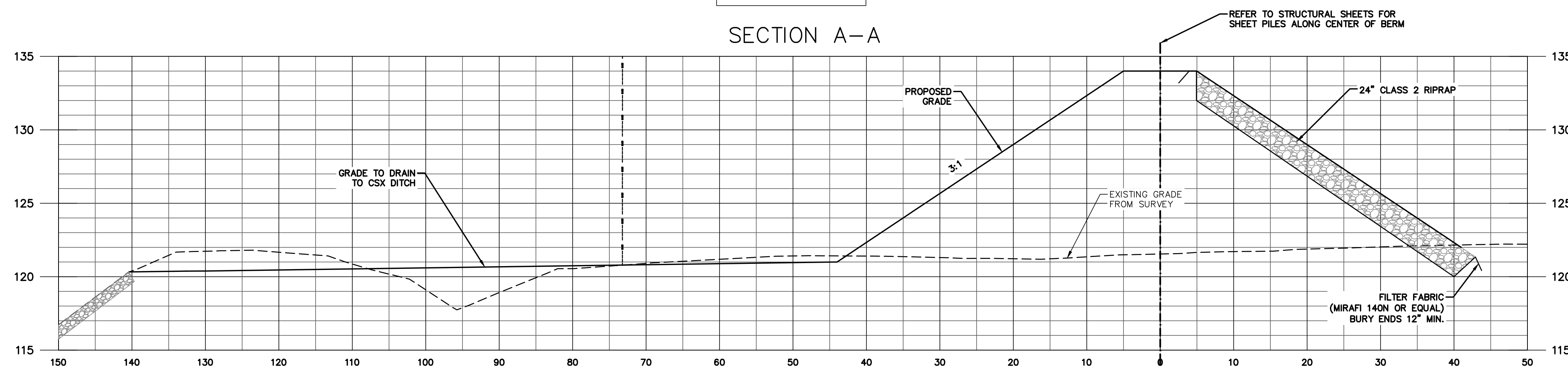
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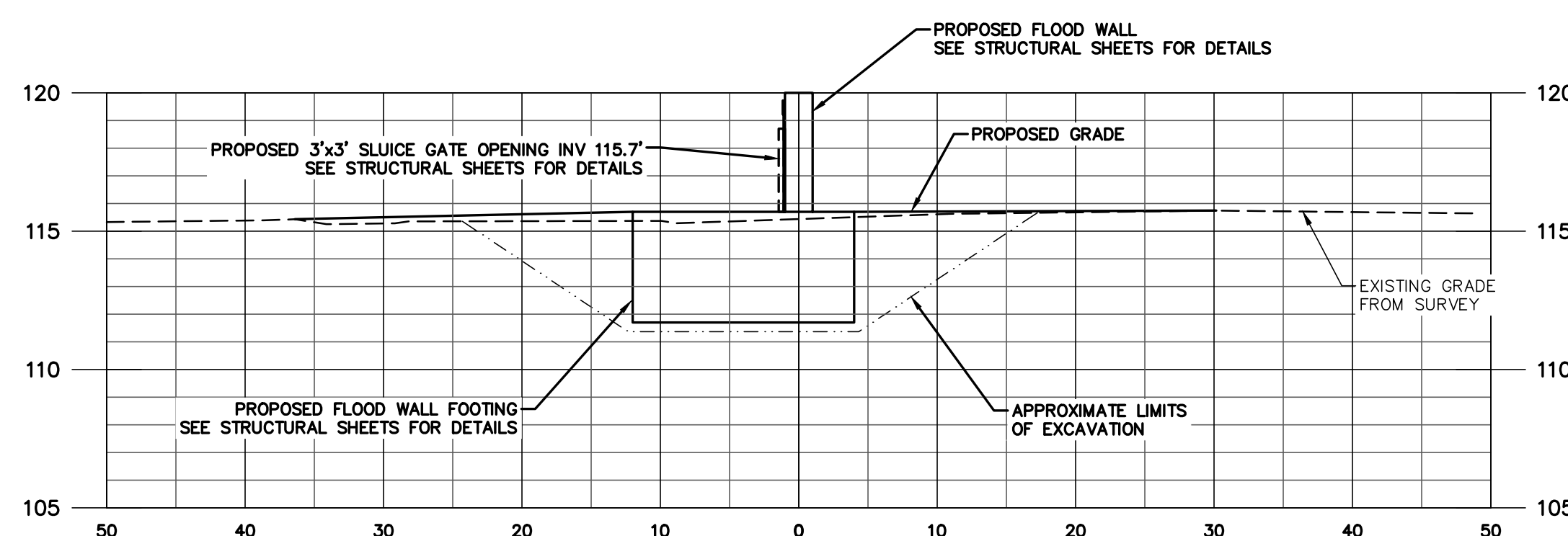
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SECTION
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VERT. 1"= 20'

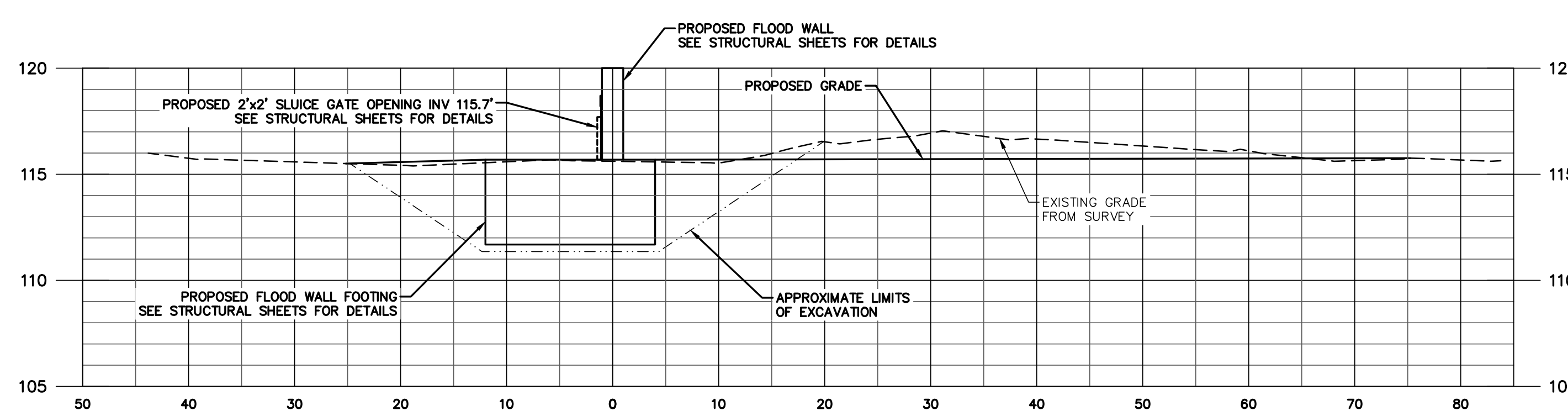
SECTION A-A



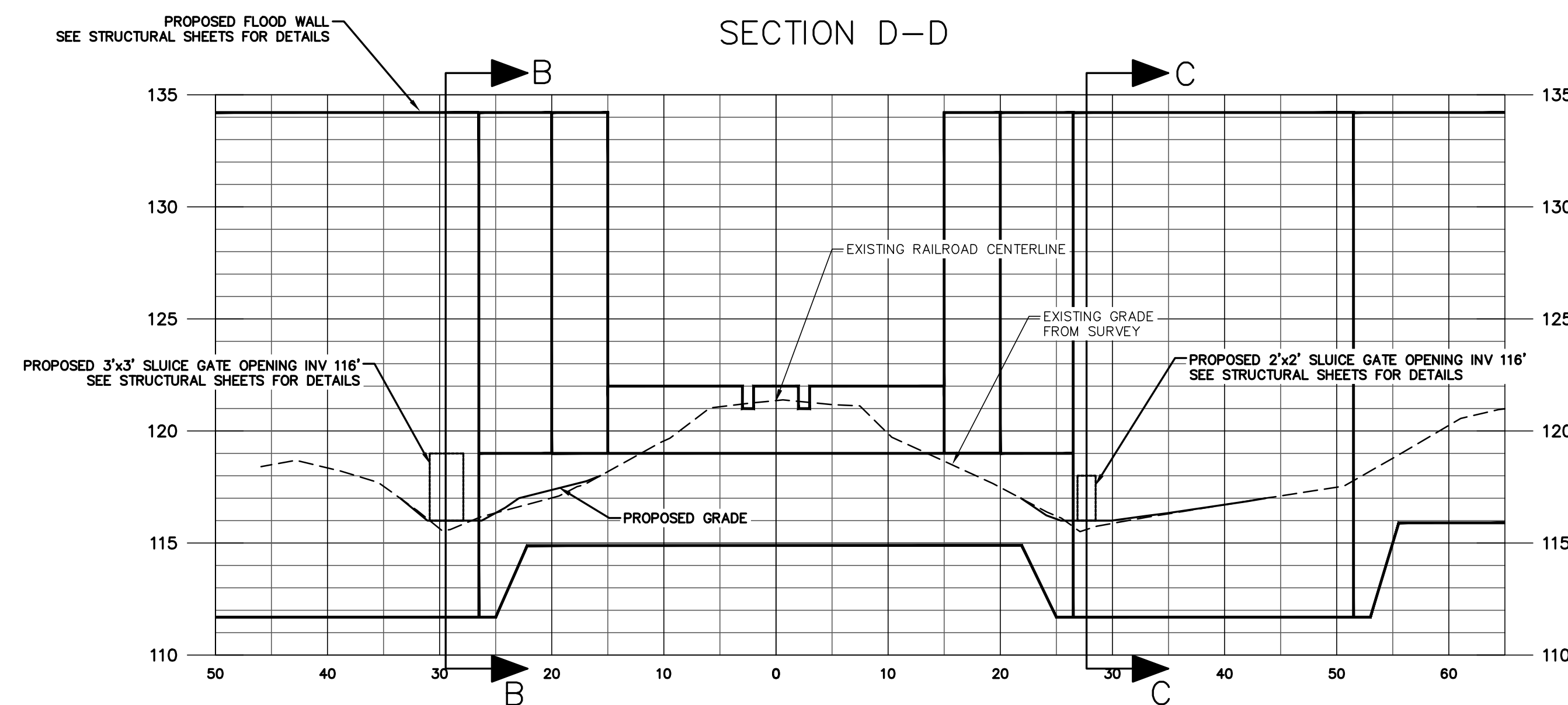
SECTION B-B



SECTION C-C



SECTION D-D



NOTE:
SLUZICE GATES SHALL BE SELF-CONTAINED STAINLESS STEEL SLIDE GATES BY RODNEY HUNT OR EQUIVALENT WITH A WALL THIMBLE OFFSET SUFFICIENT TO ACCOMMODATE HANDWHEEL OPERATION

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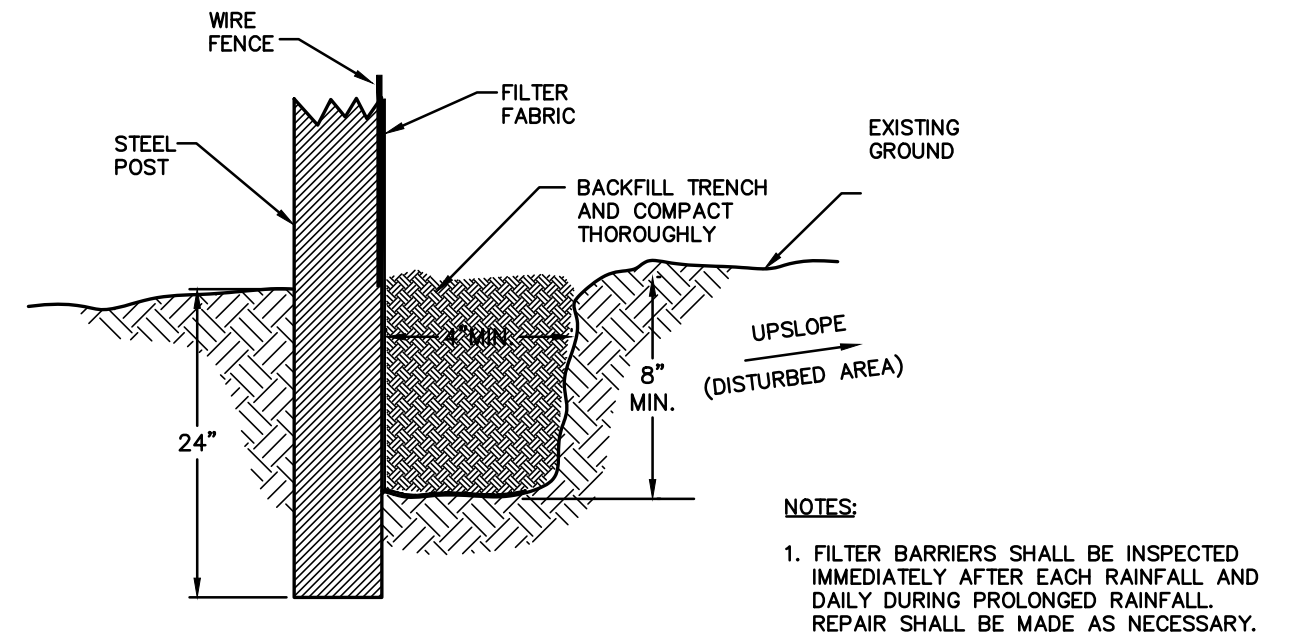
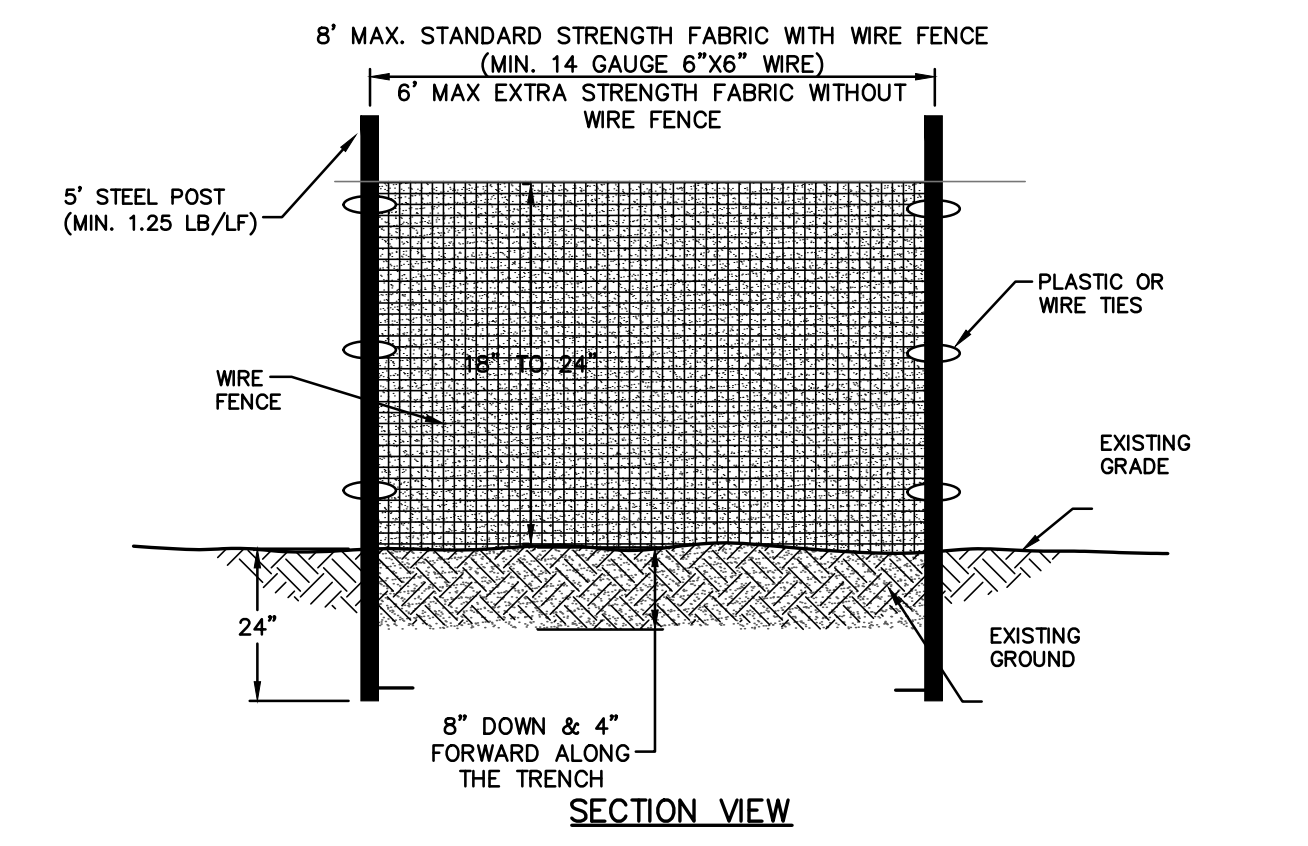
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Tel: +1 (919) 378-9111
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Client: **City of LUMBERTON North Carolina**

Project Title: **WEST LUMBERTON FLOOD G AT VFW ROAD AND RAILROAD UNDERP ENGINEERING SERVICES**

Drawing Title: **CROSS SECTIONS**

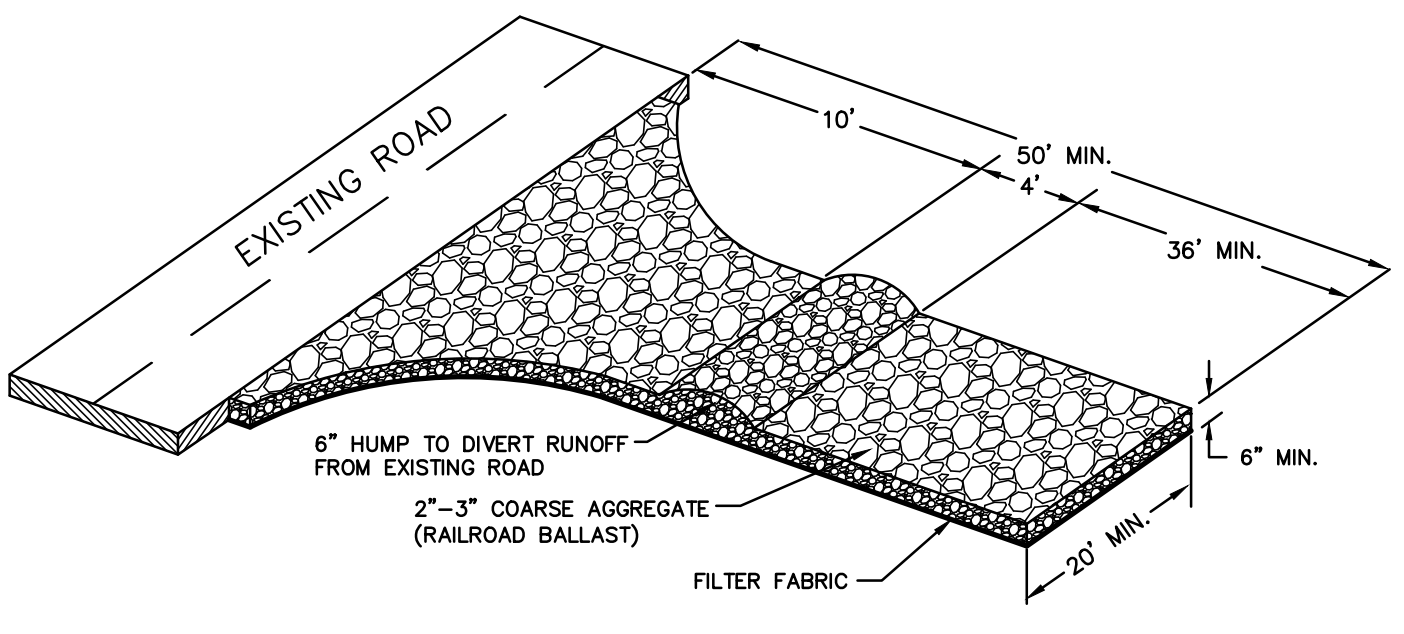
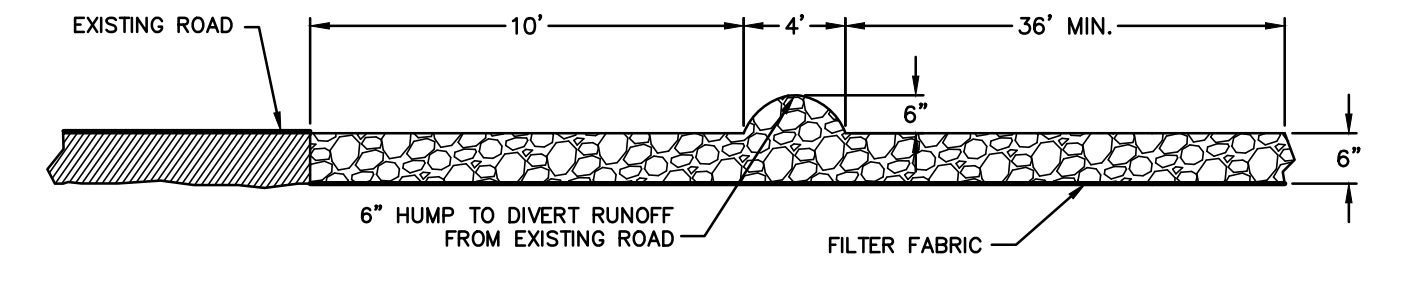
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Original Size 22x34	Date --/--	Date --/--	Date --/--	Date --/--
Drawing Number 100068207-C-301	Revision 000			



SLOPE	SLOPE LENGTH(FT)	MAXIMUM AREA(SQFT)
<2%	100	10,000
2 TO 5%	75	7,500
5 TO 10%	50	5,000
10 TO 20%	25	2,500
>20%	15	1,500

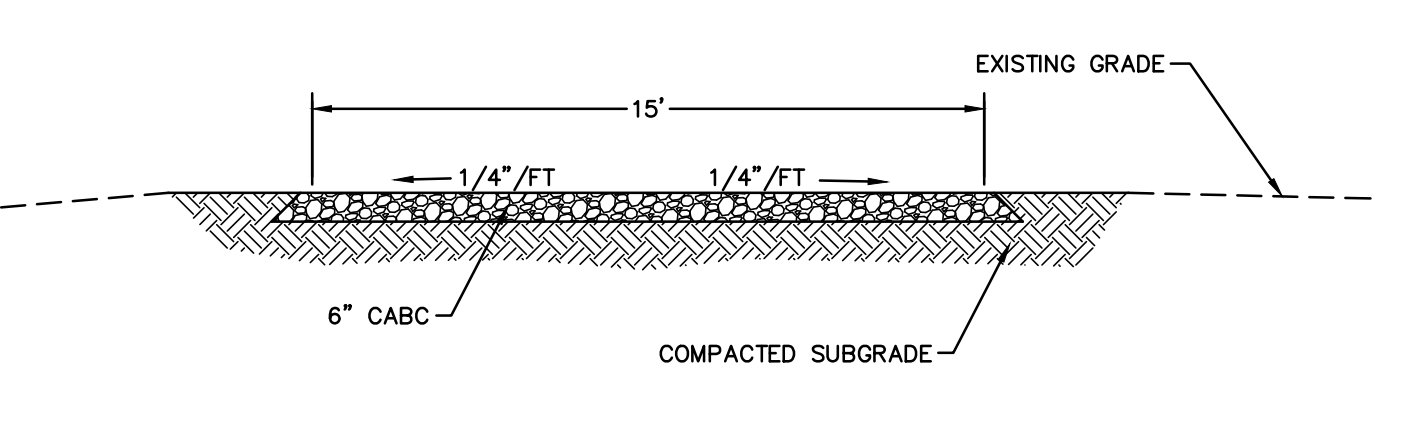
- NOTES:**
- FILTER BARRIERS SHALL BE INSPECTED IMMEDIATELY AFTER EACH RAINFALL AND DAILY DURING PROLONGED RAINFALL. REPAIR SHALL BE MADE AS NECESSARY.
 - FABRIC SHALL BE REPLACED PROMPTLY IF FOUND TO BE IN DISREPAIR.
 - SEDIMENT DEPOSITS SHALL BE REMOVED AFTER EACH STORM EVENT AND WHEN DEPOSITS REACH APPROXIMATELY 1/3 HEIGHT OF BARRIER.
 - REFERENCE NCDQ LAND QUALITY SECTION DESIGN MANUAL: 6.62.

1 SILT FENCE
NOT TO SCALE

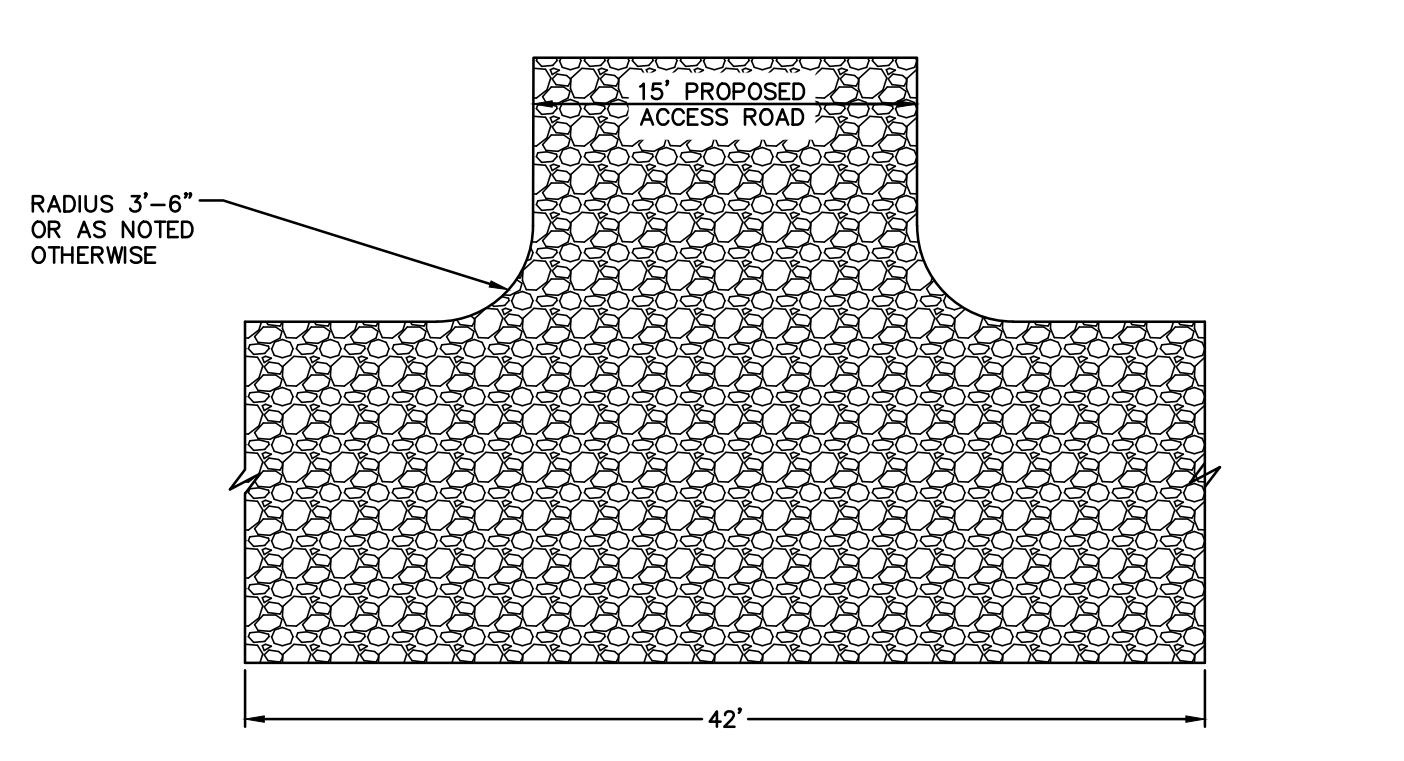


- NOTES:**
- A STABILIZED PAD OF CRUSHED STONE SHALL BE LOCATED WHERE TRAFFIC WILL BE ENTERING OR LEAVING A CONSTRUCTION SITE TO OR FROM AN EXISTING ROAD.
 - STONE TO BE 2 - 3 INCH WASHED STONE RAILROAD BALLAST.
 - THE ENTRANCE SHALL BE MAINTAINED IN A CONDITION WHICH WILL PREVENT TRACKING OR FLOWING OF SEDIMENT ONTO PUBLIC STREETS OR EXISTING PAVEMENT. THIS MAY REQUIRE PERIODIC TOP DRESSING WITH ADDITIONAL STONE AS CONDITIONS DEMAND AND REPAIR AND/OR CLEANOUT OF ANY MEASURES USED TO TRAP SEDIMENT.
 - ALL SEDIMENT SPILLED, DROPPED, WASHED OR TRACKED ONTO PUBLIC STREETS MUST BE REMOVED IMMEDIATELY.
 - WHEN NECESSARY WHEELS MUST BE CLEANED TO REMOVE SEDIMENT PRIOR TO ENTERING A PUBLIC STREET, WHEN WASHING IS REQUIRED, IT SHALL BE DONE ON AN AREA STABILIZED WITH CRUSHED STONE WHICH DRAINS INTO AN APPROVED SEDIMENT BASIN.
 - REFERENCE NCDQ LAND QUALITY SECTION DESIGN MANUAL: 6.06.

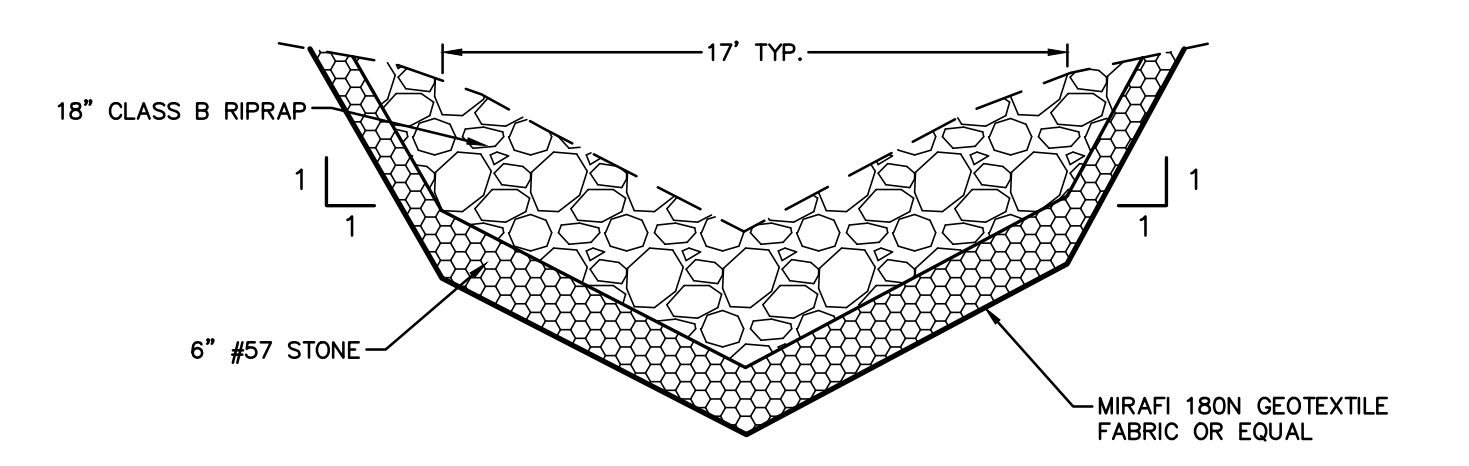
3 TEMPORARY CONSTRUCTION ENTRANCE
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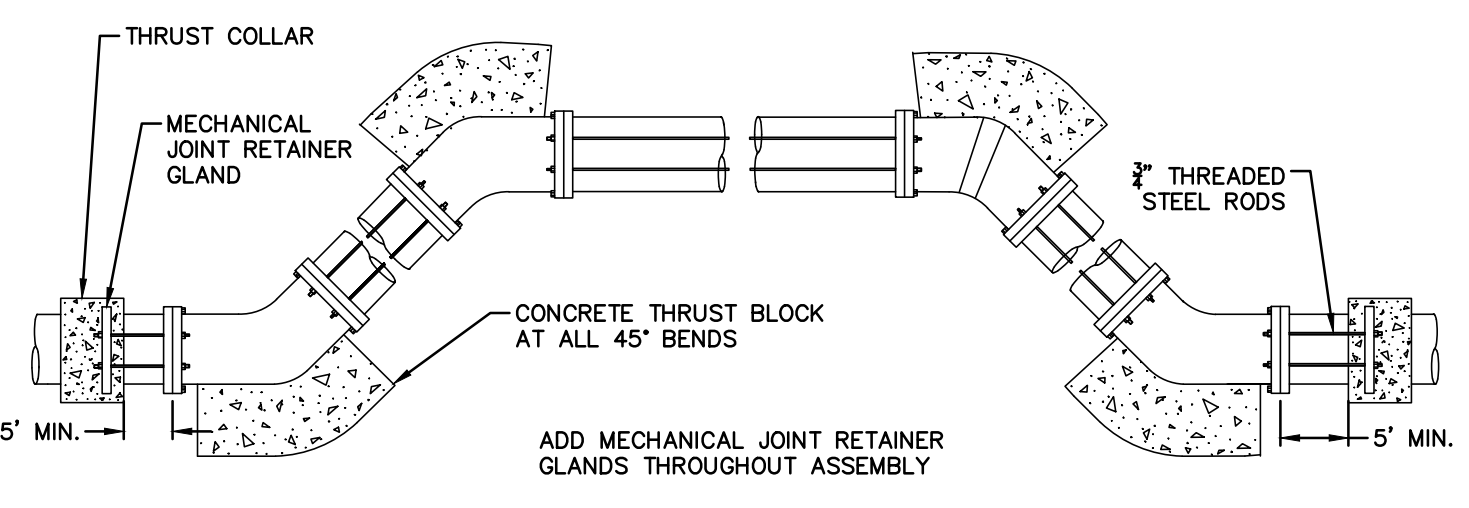
4 TYPICAL GRAVEL ACCESS ROAD CROSS-SECTION
NOT TO SCALE



5 GRAVEL ROAD TURNOUT
NOT TO SCALE

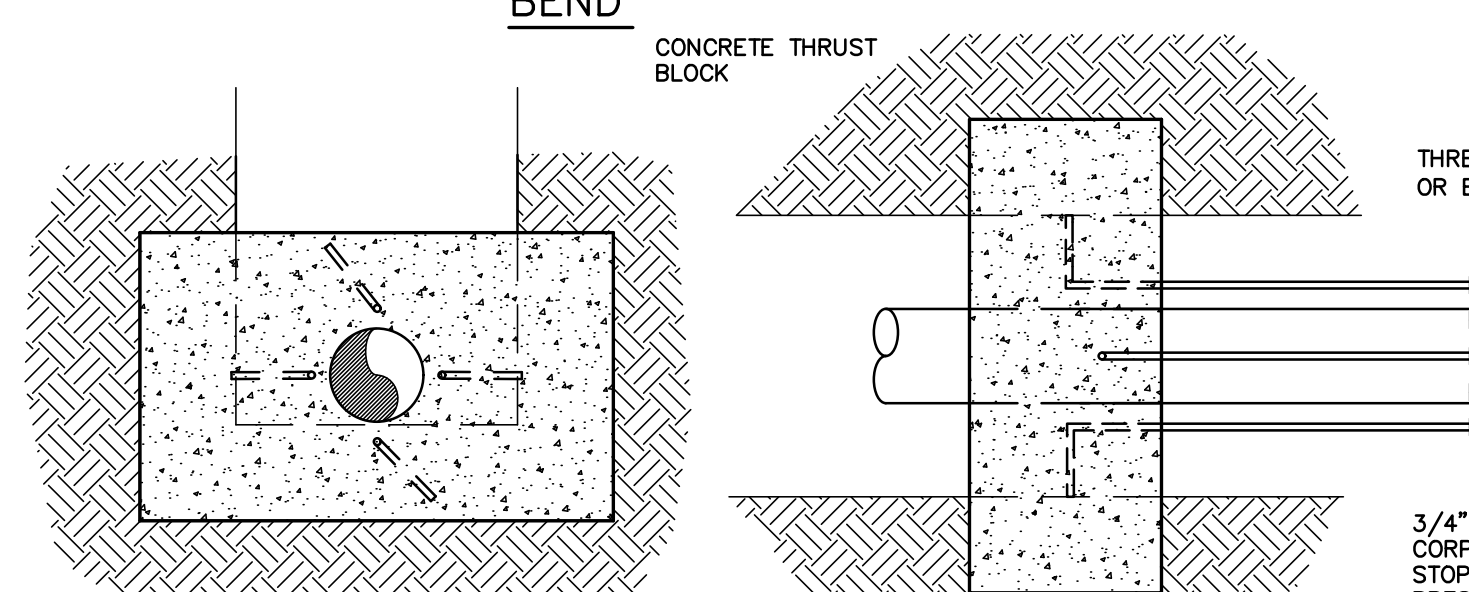
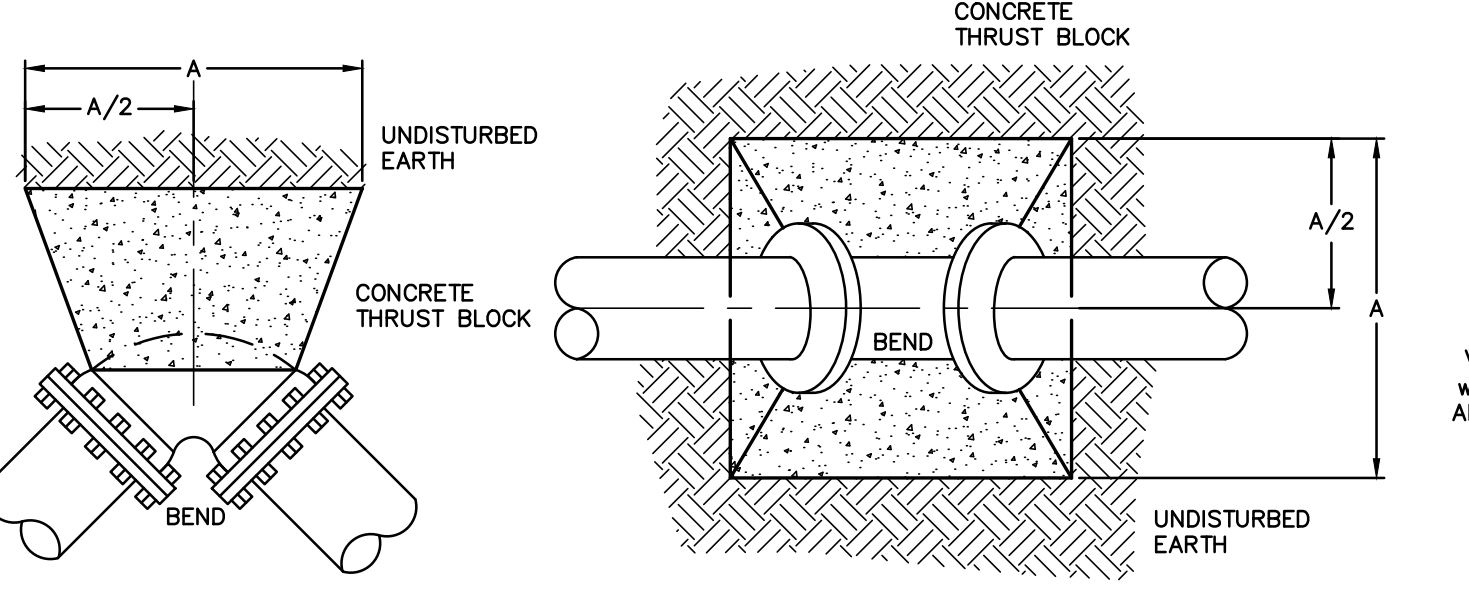


6 GROIN PROTECTION RIPRAP
NOT TO SCALE



- NOTES:**
- FITTING JOINTS SHALL NOT BE POURED IN CONCRETE OR HAVE CONCRETE SPILLED ON THE BOLTS OR NUTS. THE FITTING SHALL BE WRAPPED IN A LAYER OF POLYETHYLENE PLASTIC PRIOR TO POURING THE THRUST BLOCK.
 - ROD AND EYE BOLT DIAMETER SHALL BE A MINIMUM OF 3/4" AND SHALL MATCH THE SIZE OF THE BOLT PROVIDED WITH THE FITTING.
 - CONTRACTOR SHALL REPLACE FITTING BOLTS WITH THREADED ROD FOR 1/2 OF THE BOLTS SUPPLIED WITH EACH FITTING. RODS SHALL BE EQUALLY SPACED.

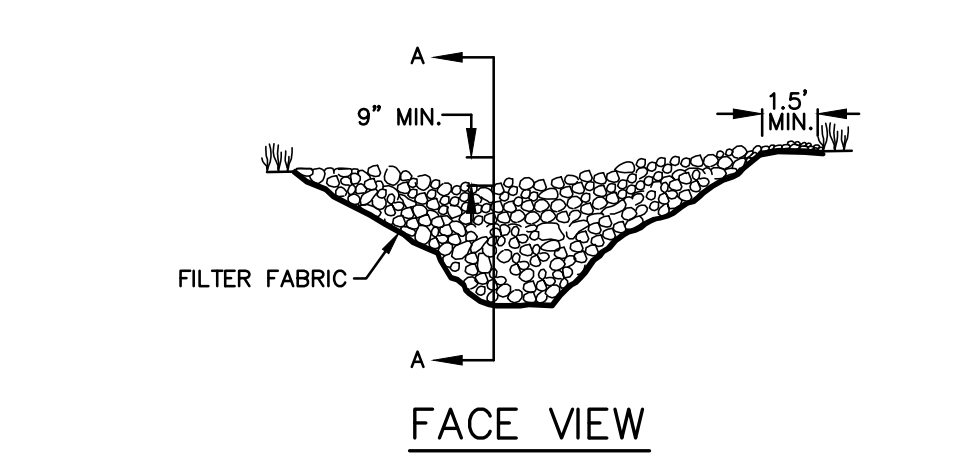
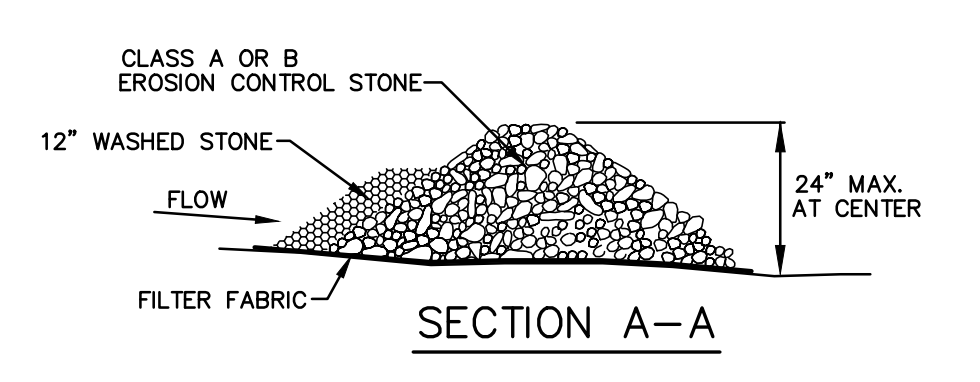
7 WATER MAIN OFFSET
NOT TO SCALE



9 TYPICAL THRUST BLOCKS
NOT TO SCALE

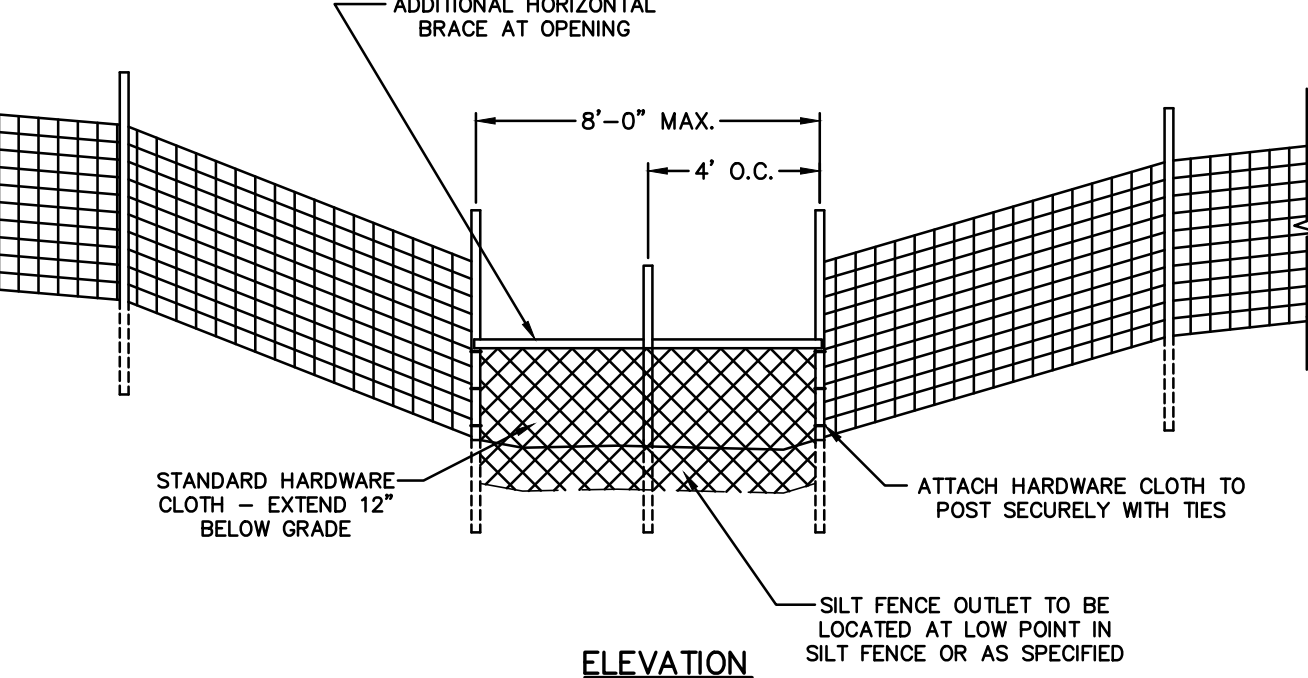
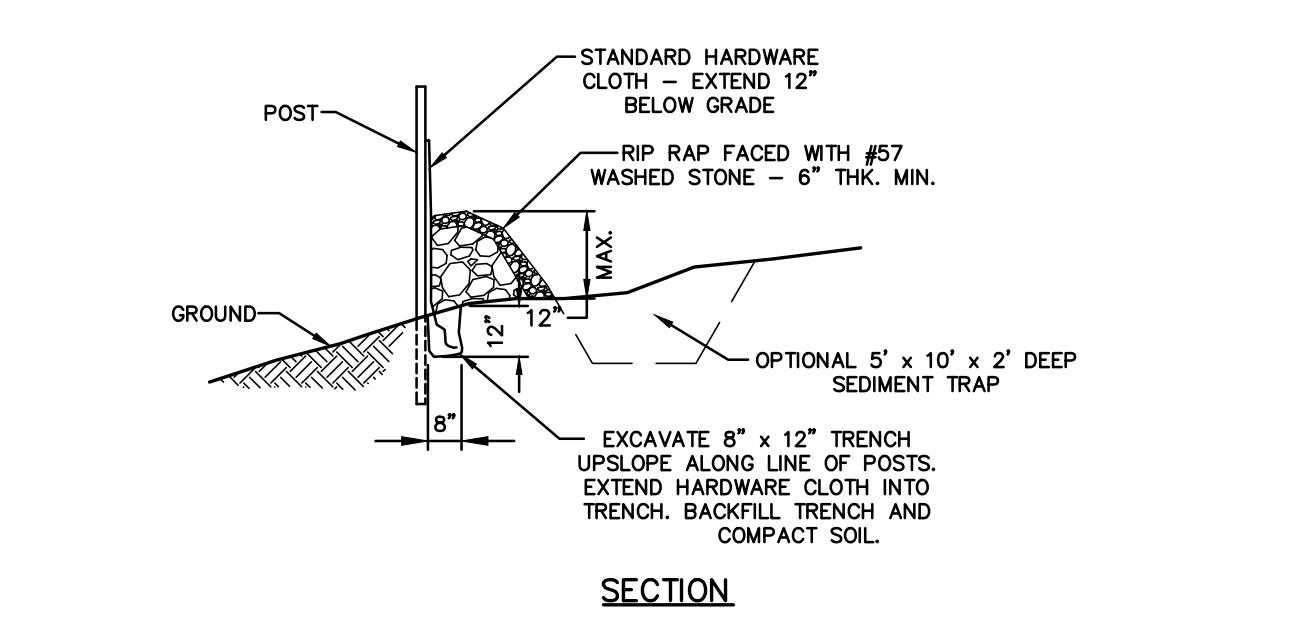
SIZE	TYPE					
	11-1/4" BEND	22-1/2" BEND	45° BEND	90° BEND	TEE	PLUG
2-6	12	12	12	16	16	14
8	12	12	16	22	22	18
10	12	14	20	28	28	22
12	12	18	24	32	32	28
14	14	20	28	38	38	32
16	16	22	32	42	42	36
18	18	26	36	48	48	40
20	20	28	40	52	52	44
24	24	34	46	64	64	54
30	30	42	58	78	78	66
36	36	50	70	94	94	80
42	40	58	80	108	108	92
48	46	66	90	124	124	104

THRUST BLOCK DIMENSION "A"



- STONE CHECK DAM:**
STONE SHOULD BE PLACED OVER THE CHANNEL BANKS TO KEEP WATER FROM CUTTING AROUND THE DAM. L = THE DISTANCE SUCH THAT POINTS A AND B ARE OF EQUAL ELEVATION.
- THE FOLLOWING CRITERIA SHOULD BE USED WHEN DESIGNING A CHECK DAM:**
- ENSURE THAT THE DRAINAGE AREA ABOVE THE CHECK DAM DOES NOT EXCEED 2 ACRES.
 - KEEP THE MAXIMUM HEIGHT AT 2 FT AT THE CENTER OF THE DAM.
 - KEEP THE CENTER OF THE CHECK DAM AT LEAST 9 INCHES LOWER THAN THE OUTER EDGES AT NATURAL GROUND ELEVATION.
 - KEEP THE SIDE SLOPES OF THE DAM AT 2:1 OR FLATTER.
 - STABILIZE OVERFLOW AREAS ALONG THE CHANNEL TO RESIST EROSION CAUSED BY CHECK DAMS.

8 RIP RAP CHECK DAM
NOT TO SCALE



- NOTES:**
- FILTER BARRIERS SHALL BE INSPECTED IMMEDIATELY AFTER EACH RAINFALL AND DAILY DURING PROLONGED RAINFALL. REPAIR SHALL BE MADE AS NECESSARY.
 - FABRIC SHALL BE REPLACED PROMPTLY IF FOUND TO BE IN DISREPAIR.
 - SEDIMENT DEPOSITS SHALL BE REMOVED AFTER EACH STORM EVENT AND WHEN DEPOSITS REACH APPROXIMATELY 1/3 HEIGHT OF BARRIER.
 - SILT FENCE OUTLETS SHALL BE LOCATED AT LOW POINTS IN CONTINUOUS RUNS OF SILT FENCE.

2 SILT FENCE - OUTLET
NOT TO SCALE

NOT TO SCALE

Rev.	Date	Description	By	Chk'd	App'd

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Fax: +1 (919) 876-6848
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ENGINEERS ARCHITECTS SURVEYORS

13608 18th Street
Suite 200
Metairie, LA 70002
Tel: +1 (504) 833-5300
Fax: +1 (504) 833-5350
www.lhjunius.com

mcgill

5400 Trinity Road
Suite 107
Raleigh, NC 27607
Tel: +1 (919) 378-9111
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City of Lumberton North Carolina

Project Title: **WEST LUMBERTON FLOOD G AT VFW ROAD AND RAILROAD UNDERP ENGINEERING SERVICES**

Drawing Title: **DETAILS 1 OF 2**

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Scale	Designed	Drawn	Checked	Authorized
NTS	CH	CH	DS	MH
Original Size	Date	Date	Date	Date
22x34	-/-/-	-/-/-	-/-/-	-/-/-
Drawing Number	Revision			Revision
100068207-C-501				000

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STEEL NOTES:

- 1. ALL WELDING SHALL BE ELECTRIC WELDING. WORKMANSHIP AND TECHNIQUE, WHERE APPLICABLE, SHALL CONFORM TO THE AMERICAN WELDING SOCIETY (SEE SPECS.) STRUCTURAL WELDING CODE.
2. WELDING SYMBOLS SHOWN ARE THOSE ADOPTED BY THE AMERICAN WELDING SOCIETY AND INDICATE ONLY SIZE AND TYPE OF WELDS REQUIRED. DETAILED INFORMATION SHALL BE SHOWN ON THE SHOP DRAWINGS AND SUBMITTED BY THE CONTRACTOR FOR APPROVAL.
3. DIMENSIONS SHOWN OR CALLED FOR ARE THE FINAL DIMENSIONS; ALLOWANCES MUST BE MADE FOR MACHINING.
4. ITEMS MARKED C.R.S. SHALL BE CORROSION RESISTANT STEEL (STAINLESS STEEL), SEE SPECIFICATIONS.
5. STEEL SHEET PILING SHALL CONFORM TO ASTM A572, GRADE 50.
6. STEEL H-PILES SHALL CONFORM TO ASTM A572, GRADE 50.

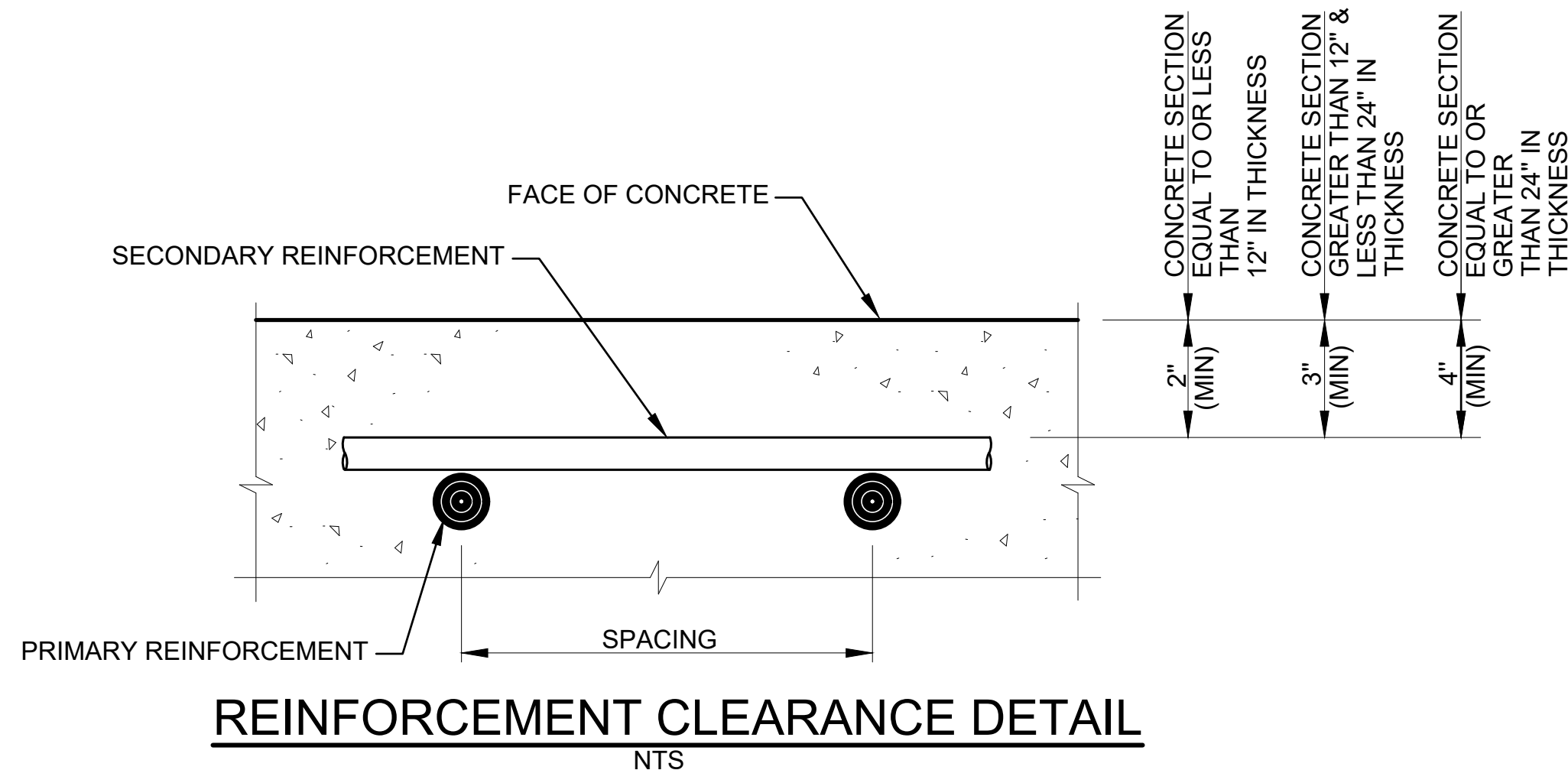
CONCRETE NOTES:

- 1. CONCRETE SHALL HAVE A COMPRESSIVE STRENGTH (F'c) OF 4000 PSI AT 28 DAYS (90 DAYS IF POZZOLAN IS USED), UNLESS OTHERWISE NOTED.
2. STABILIZATION SLAB CONCRETE SHALL HAVE A COMPRESSIVE STRENGTH (F'c) OF 2500 PSI AT 28 DAYS (90 DAYS IF POZZOLAN IS USED).
3. REINFORCING STEEL SHALL HAVE A MINIMUM YIELD STRENGTH (Fy) OF 60,000 PSI.
4. CONSTRUCTION JOINTS SHALL BE PROVIDED WHERE SHOWN. WHERE NOT SHOWN, CONSTRUCTION JOINTS SHALL BE PLACED AT LOCATIONS LEAST LIKELY TO IMPAIR THE INTEGRITY OF THE CONCRETE STRUCTURE. CONSTRUCTION JOINT LOCATIONS NOT OTHERWISE SHOWN ON THE PLANS SHALL BE APPROVED BY THE CONTRACTING OFFICER.
5. UNLESS OTHERWISE NOTED, PROVIDE 3/4" CHAMFER AT ALL EXPOSED JOINTS, EDGES, EXTERNAL CORNERS, AND VERTICAL EXPANSION JOINTS.
6. UNLESS NOTED OTHERWISE, CLEAR COVER SHALL BE: 2" FOR SECTIONS EQUAL TO OR LESS THAN 12" THICK 3" FOR SECTIONS GREATER THAN 12" AND LESS THAN 24" THICK 4" FOR SECTIONS GREATER THAN 24" THICK
7. ALL BENDS OF REINFORCEMENT AND ALL BAR SPACERS AND SUPPORTS SHALL BE IN ACCORDANCE WITH SP-66, AMERICAN CONCRETE INSTITUTE DETAILING MANUAL - 2004.
8. REINFORCING BAR DESIGNATION NUMBERS CONFORM TO THE NUMBERING SYSTEM OF THE CONCRETE REINFORCING STEEL INSTITUTE.
9. REINFORCING BARS SHALL BE CONTINUOUS AT ALL CORNERS UNLESS OTHERWISE NOTED.
10. REINFORCEMENT, WHERE NECESSARY TO AVOID OPENINGS, PIPES, EMBEDDED ITEMS AND OTHER OBSTRUCTIONS, SHALL BE BENT OR SHIFTED AS DIRECTED BY THE CONTRACTING OFFICER.
11. THE EMBEDMENT AND SPLICE TABLE SHALL BE USED IN DETERMINING LAP SPLICES AND EMBEDMENT LENGTHS WHERE LENGTHS ARE NOT OTHERWISE INDICATED. SPLICE LENGTHS SHALL BE BASED ON THE SMALLER BAR BEING LAPPED. THE CONTRACTOR WILL BE ALLOWED TO MAKE SPLICES IN ADDITION TO THOSE INDICATED IN THE DRAWINGS, WHERE ESSENTIAL TO CONSTRUCTIBILITY, SUBJECT TO APPROVAL BY THE CONTRACTING OFFICER. SPLICES OTHER THAN THOSE SHOWN ON THE DRAWINGS AND OTHER THAN ANY ADDITIONAL SPLICES REQUIRED BY THE CONTRACTING OFFICER, WILL BE AT THE CONTRACTOR'S EXPENSE.
12. ALL EXTERIOR FORMED SURFACES NOT COVERED BY BACK FILL SHALL BE CLASS "A" FINISH AND SURFACES COVERED BY BACK FILL SHALL BE CLASS "D" FINISH, UNLESS OTHERWISE NOTED.
13. FOR "T-WALL" STEMS, CONCRETE PLACEMENT SHALL BE BY PUMP / TREMIE OR THE CONTRACTOR SHALL EMPLOY TEMPORARY "WINDOWS" IN THE FORMS TO FACILITATE CONCRETE PLACEMENT AND CONSOLIDATION.

Table with 9 columns: BAR SIZE, BASIC TABLE (MINIMUM EMBEDMENT LENGTH, INCHES), ALTERNATE TABLE (MINIMUM EMBEDMENT LENGTH, INCHES). Rows include bar sizes 3 through 11.

NOTES:

- 1. USE THE BASIC TABLE IF ALL OF THE FOLLOWING CONDITIONS ARE MET: A) CENTER TO CENTER BAR SPACING LATERALLY IS AT LEAST 4 BAR DIAMETERS B) CONCRETE COVER IS AT LEAST 2 BAR DIAMETERS, AND C) EDGE DISTANCE TO THE FIRST BAR IN A LAYER IS AT LEAST 2 BAR DIAMETERS.
2. THE ALTERNATE TABLE MAY BE USED IF ALL OF THE FOLLOWING CONDITIONS ARE MET: A) CENTER TO CENTER BAR SPACING LATERALLY IS AT LEAST 6 BAR DIAMETERS B) CONCRETE COVER IS AT LEAST 2 BAR DIAMETERS, AND C) EDGE DISTANCE TO THE FIRST BAR IN A LAYER IS AT LEAST 2.5 BAR DIAMETERS.
3. IF CONCRETE COVER OR EDGE DISTANCE IS LESS THAN 2 BAR DIAMETERS OR THE CENTER TO CENTER BAR SPACING LATERALLY IS LESS THAN 4 DIAMETERS, SEE ACI 318 FOR APPROPRIATE GUIDANCE.
4. TOP BARS ARE HORIZONTAL BARS AND BARS INCLINED LESS THAN 45 DEGREES WITH RESPECT TO A HORIZONTAL PLANE WHICH ARE PLACED SUCH THAT MORE THAN 12 INCHES OF CONCRETE IS CAST IN THE MEMBER BELOW THE BAR.



REINFORCEMENT CLEARANCE DETAIL NTS

ABBREVIATIONS

* UNLESS OTHERWISE NOTED ON EACH SHEET

Table of abbreviations including APP (APPARENT), APPROX (APPROXIMATE), ALT W (ALTERNATE WITH), ALUM (ALUMINUM), B/L (BASELINE), BITUM (BITUMINOUS), BOT (BOTTOM), C/L (CENTER LINE), C&G (CURB & GUTTER), CLR (CLEAR), CJ (CONSTRUCTION JOINT), CMP (CORRUGATED METAL PIPE), CONC (CONCRETE), DIA, Ø (DIAMETER), DWG. (DRAWING), E.F. (EACH FACE), EJ (EXPANSION JOINT), ELEV. (ELEVATION), E.W. (EACH WAY), EXIST. (EXISTING), EQ. (EQUAL), FTG (FOOTING), FF (FAR FACE), FES (FLARED END SECTION), GALV (GALVANIZED), HT (HEIGHT), IF (INSIDE FACE), LG (LONG), L/W (LANDWARD), MAX (MAXIMUM), MIN (MINIMUM), MIRR (MIRRORED), MISC (MISCELLANEOUS), N/S (NORFOLK SOUTHERN), NF (NEAR FACE), NO (NUMBER), OF (OUTSIDE FACE), OC (ON CENTER), PROJ (PROJECT), R/W (RIGHT OF WAY), RCP (REINFORCED CONCRETE PIPE), REQ'D (REQUIRED), R.R. (RAILROAD), SP (SPACE), S/W (SIDEWALK), SAN (SANITARY), SPEC (SPECIFICATIONS), SST (STAINLESS STEEL), SURV (SURVEY), T&B (TOP AND BOTTOM), T.O.C. (TOP OF CASTING), TYP (TYPICAL), UNO (UNLESS NOTED OTHERWISE), UGND (UNDERGROUND), W/ (WITH), W/L (WALL LINE), WM (WATER MAIN).

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Table with columns: Rev., Date, Description, By, Chk'd, App'd. Includes a section for Drawing Status with 'FOR INFORMATION' and 'S0'.

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Project Title: WEST LUMBERTON FLOOD G AT VFW ROAD AND RAILROAD UNDERP ENGINEERING SERVICES

GENERAL NOTES

Table with columns: Scale, Designed, Drawn, Checked, Authorized, Original Size, Date, Drawing Number, Revision. Includes drawing number 100068207-G-001 and revision 000.

Inches
0 1/2 1 4

DO NOT SCALE

Drawing Legend


SHEET NO.	SHEET TITLE
G	GENERAL
G-001	GENERAL NOTES
G-002	SHEET INDEX
S	STRUCTURAL - GATE BAY AND T-WALLS
S-101	OVERALL FOUNDATION PLAN AND PROFILE VIEW (1 OF 2)
S-102	OVERALL FOUNDATION PLAN AND PROFILE VIEW (2 OF 2)
S-103	MONOLITH 1 PLAN VIEW
S-104	MONOLITH 2 PLAN VIEW
S-105	MONOLITH 3 PLAN VIEW
S-106	MONOLITH 4 PLAN VIEW
S-107	MONOLITH 5 PLAN VIEW
S-108	MONOLITH 6 PLAN VIEW
S-109	MONOLITH 7 PLAN VIEW
S-110	MONOLITH 8 PLAN VIEW
S-111	MONOLITH 9 PLAN VIEW
S-112	MONOLITH 10 PLAN VIEW
S-113	I-WALL 1 PLAN VIEW
S-114	I-WALL 2 PLAN VIEW
S-115	RAILROAD PLAN VIEW
S-301	MONOLITH 1 SECTION
S-302	MONOLITH 2 SECTION
S-303	MONOLITH 3 SECTION
S-304	MONOLITH 4 SECTION
S-305	MONOLITH 5 SECTION
S-306	MONOLITH 6 SECTION
S-307	MONOLITH 7 SECTION
S-308	MONOLITH 8 SECTION
S-309	MONOLITH 9 SECTION
S-310	MONOLITH 10 SECTION
S-311	I-WALL 1 SECTION
S-312	I-WALL 2 SECTION
S-501	GATE ELEVATION
S-502	SWING GATE DETAIL (1 OF 3) -NOT INCLUDED IN SET
S-503	SWING GATE DETAIL (2 OF 3) -NOT INCLUDED IN SET
S-504	SWING GATE DETAIL (3 OF 3) -NOT INCLUDED IN SET
S-505	SWING GATE LOWER HINGE DETAIL (1 OF 6) -NOT INCLUDED IN SET
S-506	SWING GATE LOWER HINGE DETAIL (2 OF 6) -NOT INCLUDED IN SET
S-507	SWING GATE LOWER HINGE DETAIL (3 OF 6) -NOT INCLUDED IN SET
S-508	SWING GATE LOWER HINGE DETAIL (4 OF 6) -NOT INCLUDED IN SET
S-509	SWING GATE LOWER HINGE DETAIL (5 OF 6) -NOT INCLUDED IN SET
S-510	SWING GATE LOWER HINGE DETAIL (6 OF 6) -NOT INCLUDED IN SET
S-511	SWING GATE UPPER HINGE DETAIL -NOT INCLUDED IN SET
S-512	SWING GATE LATCHING DETAIL
S-513	LATCHING DETAIL (1 OF 2) -NOT INCLUDED IN SET
S-514	LATCHING DETAIL (2 OF 2) -NOT INCLUDED IN SET
S-515	LADDER DETAIL (1 OF 3)
S-516	LADDER DETAIL (2 OF 3)
S-517	LADDER DETAIL (3 OF 3)
S-518	MISCELLANEOUS DETAILS -NOT INCLUDED IN SET
S-519	SETTLEMENT DETAILS -NOT INCLUDED IN SET
S-520	SWING GATE SEAL DETAILS (1 OF 2)
S-521	SWING GATE SEAL DETAILS (2 OF 2)
S-522	SCOUR PROTECTION DETAIL (1 OF 2)
S-523	SCOUR PROTECTION DETAIL (2 OF 2)
S-524	DRAINAGE AND UTILITY DETAILS
S-525	T-WALL JOINT DETAILS -NOT INCLUDED IN SET
S-526	RAILS AND COMPONENT PART DETAIL (1 OF 2)
S-527	RAILS AND COMPONENT PART DETAIL (2 OF 2)
S-528	TYPICAL PILE DETAIL
CS	RAILROAD TRS
CS-100	RAILROAD TRS (1 OF 6)
CS-101	RAILROAD TRS (2 OF 6)
CS-102	RAILROAD TRS (3 OF 6)
CS-103	RAILROAD TRS (4 OF 6)
CS-104	RAILROAD TRS (5 OF 6)
CS-105	RAILROAD TRS (6 OF 6)

Seal	Seal
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Rev.	Date	Description	By	Chk'd	App'd

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Project Title
**WEST LUMBERTON FLOOD G
 AT VFW ROAD AND RAILROAD UNDERP
 ENGINEERING SERVICES**

Drawing Title
SHEET INDEX

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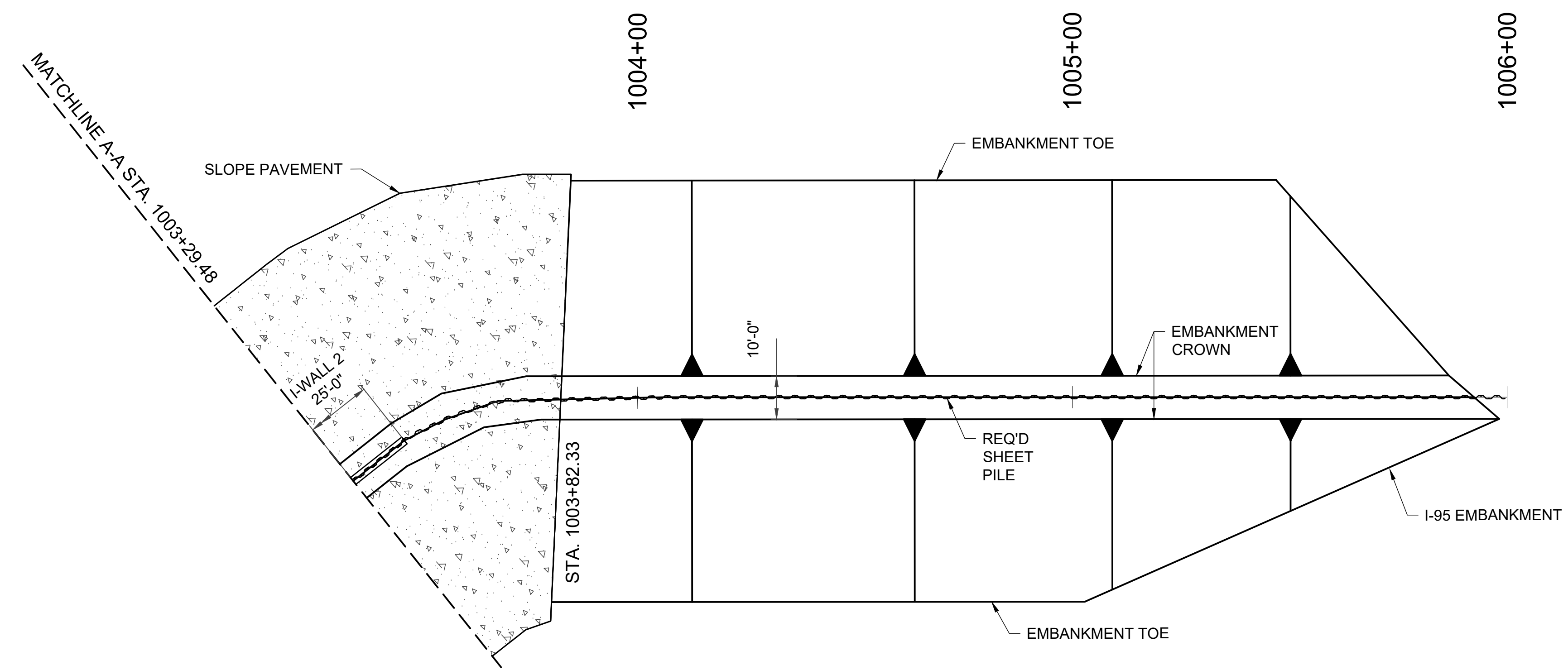
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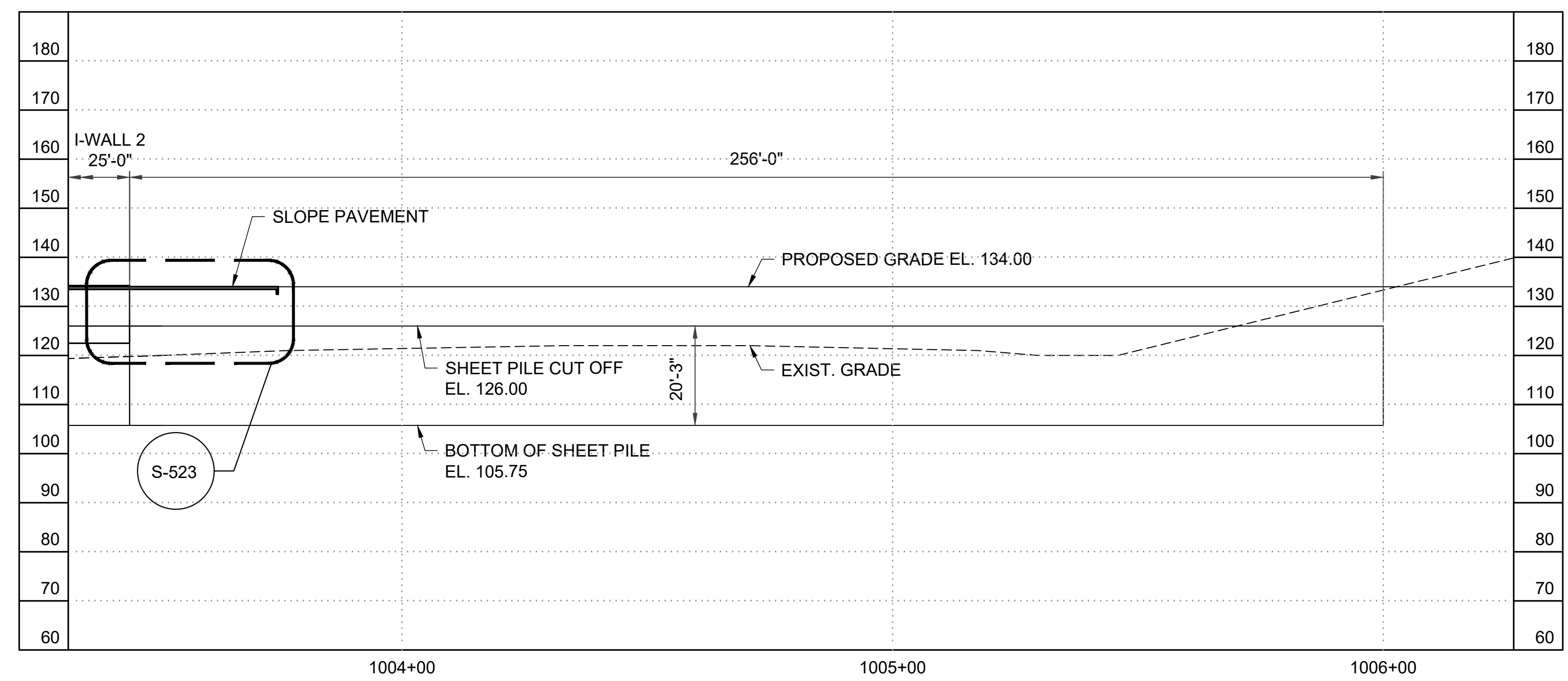
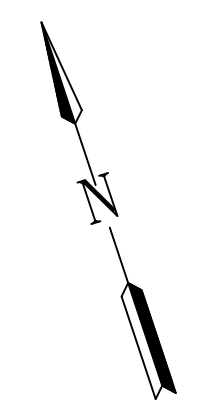
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Inches

DO NOT SCALE

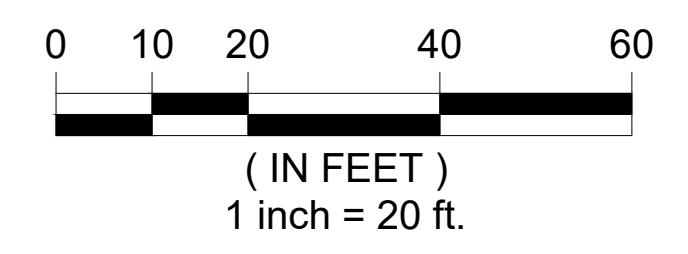
Drawing Legend



PLAN VIEW
SCALE: 1"=20'



PROFILE VIEW
SCALE: 1"=20'



Seal	Seal
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ENGINEERS ARCHITECTS SURVEYORS

13608 18th Street
Suite 200
Metairie, LA 70002
Tel: +1 (504) 833-5300
Fax: +1 (504) 833-5350
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Raleigh, NC 27607
Tel: +1 (919) 378-9111
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Project Title
WEST LUMBERTON FLOOD G AT VFW ROAD AND RAILROAD UNDERP ENGINEERING SERVICES

Drawing Title
OVERALL FOUNDATION PLAN VIEW (2 OF 2)

Scale	Designed	Drawn	Checked	Authorized
1"=20'	--	--	--	--
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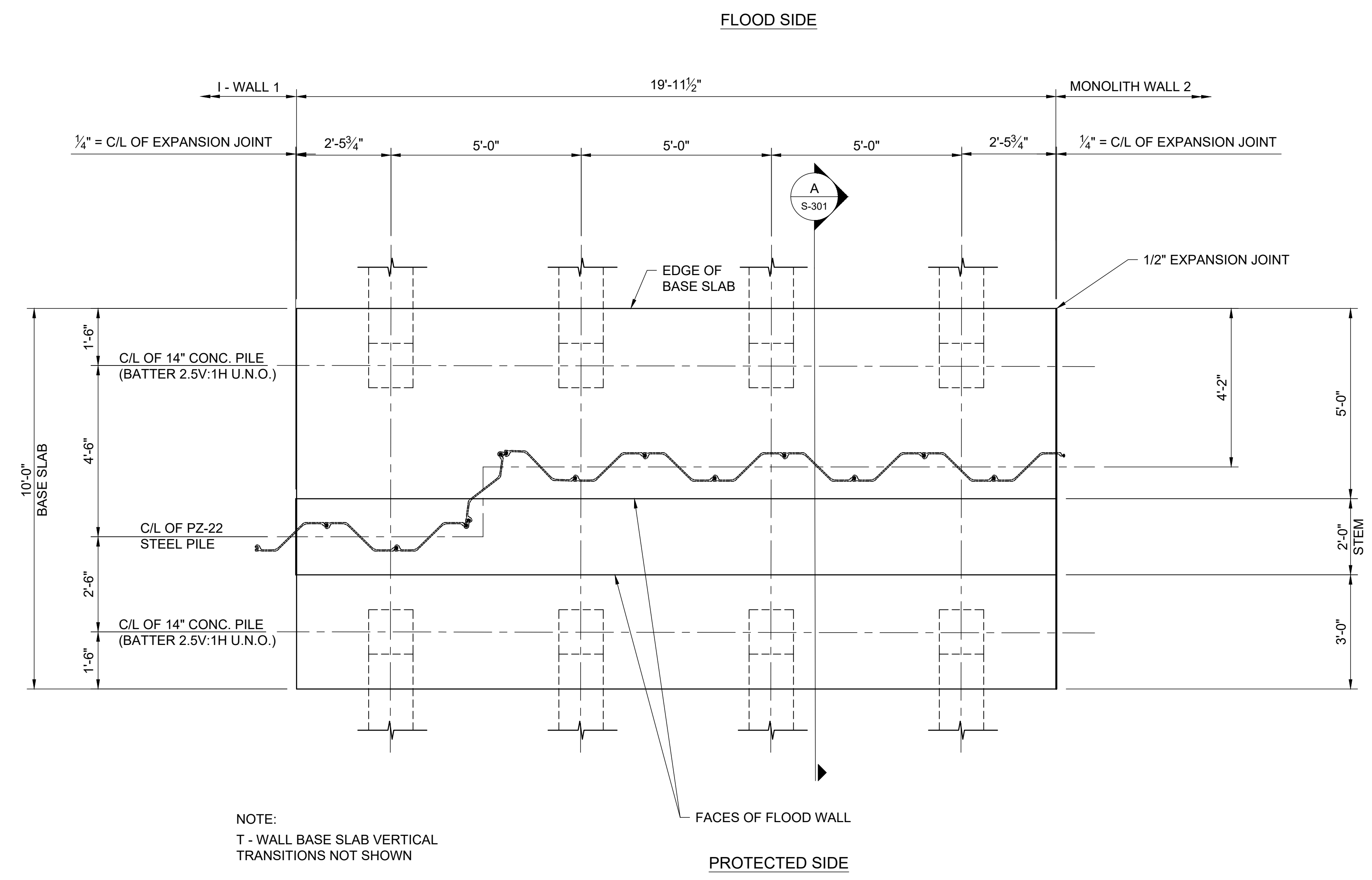
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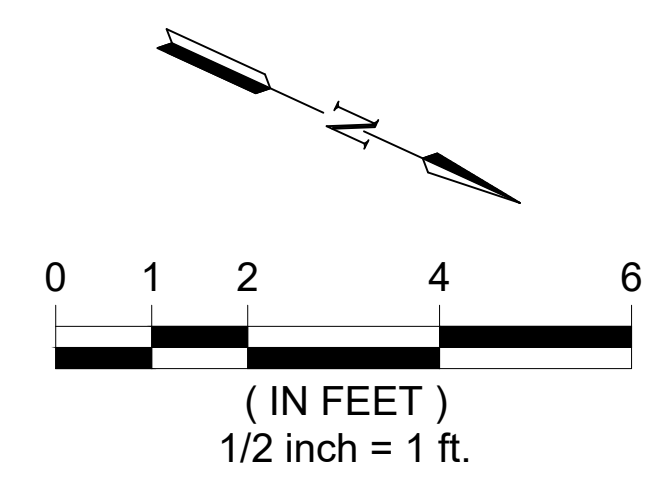
Drawing Legend



NOTE:
T - WALL BASE SLAB VERTICAL
TRANSITIONS NOT SHOWN

FACES OF FLOOD WALL
PROTECTED SIDE

MONOLITH 1 PLAN VIEW
SCALE: 1/2"=1'



Seal	Seal
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Rev.	Date	Description	By	Chk'd	App'd

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Project Title
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AT VFW ROAD AND RAILROAD UNDERP
ENGINEERING SERVICES**

Drawing Title
**MONOLITH 1
PLAN VIEW**

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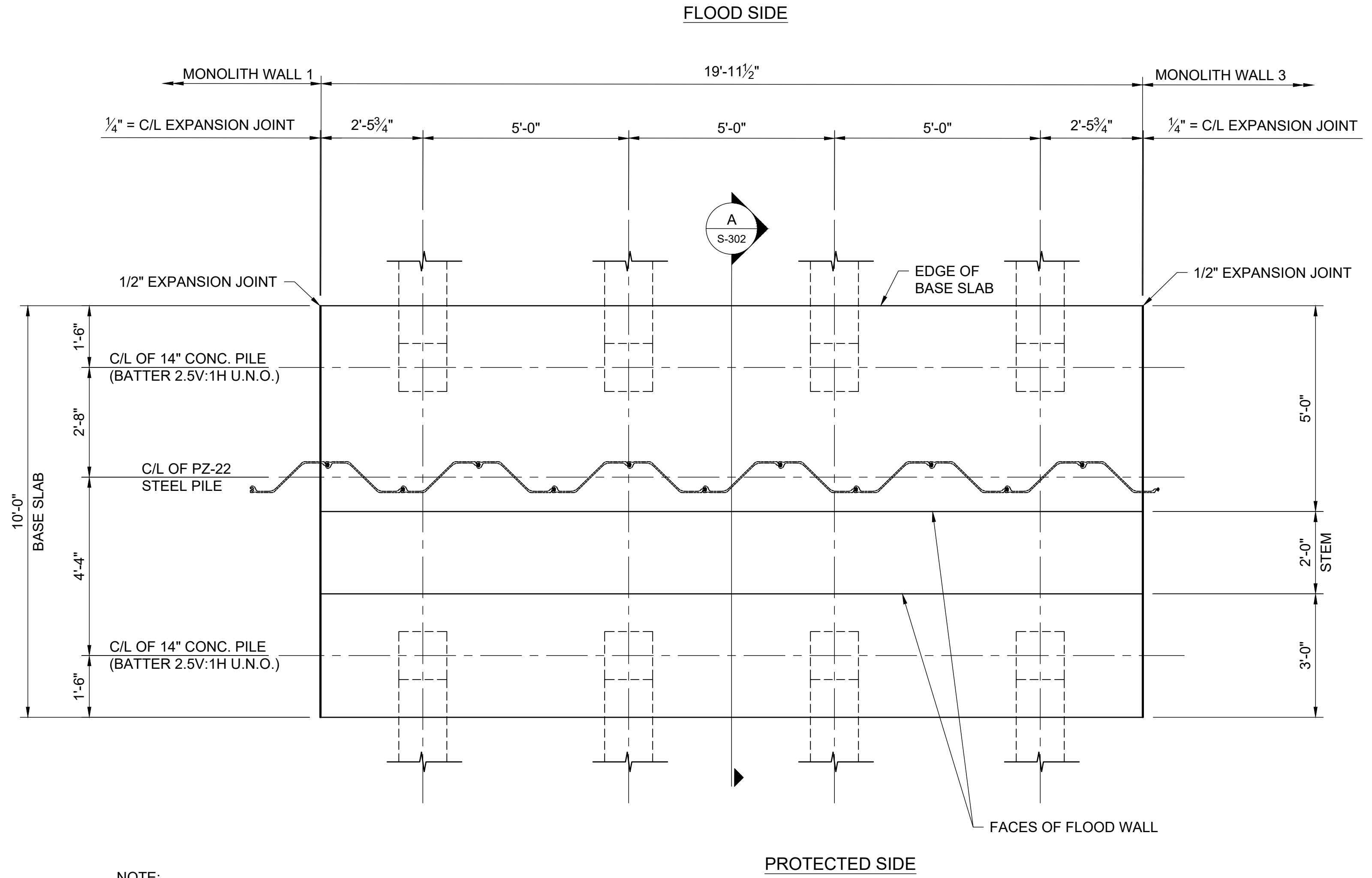
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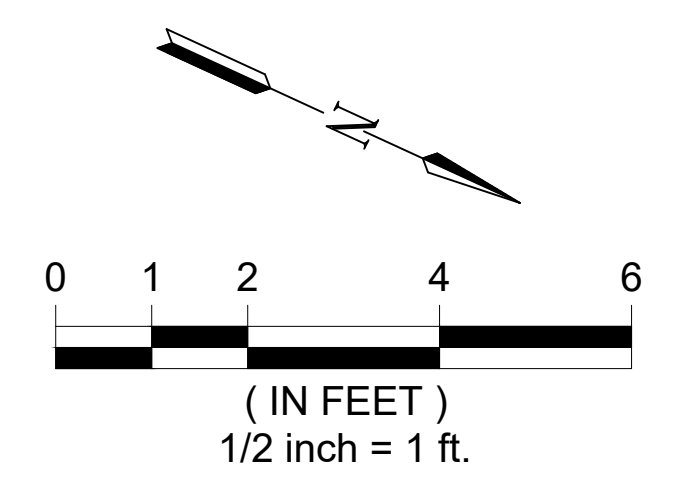
DO NOT SCALE

Drawing Legend



NOTE:
T - WALL BASE SLAB VERTICAL TRANSITIONS NOT SHOWN

MONOLITH 2 PLAN VIEW
SCALE: 1/2"=1'



Seal	Seal
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Rev.	Date	Description	By	Chk'd	App'd

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Drawing Title: **MONOLITH 2 PLAN VIEW**

Scale: 1/2"= 1'	Designed: --	Drawn: --	Checked: --	Authorized: --
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Drawing Number: 100068207-S-104	Revision: 000			

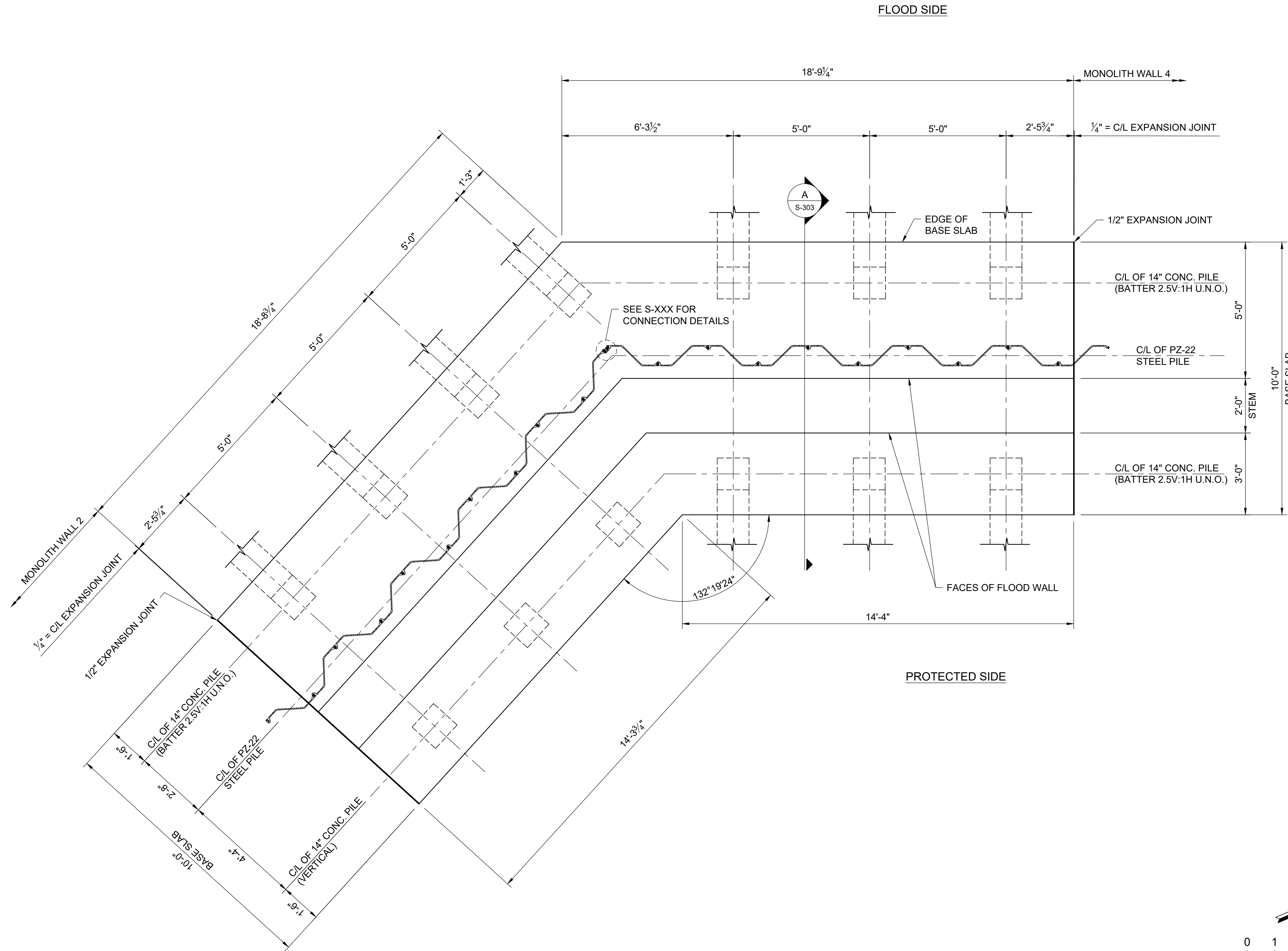
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Inches
0
1/2
1
4

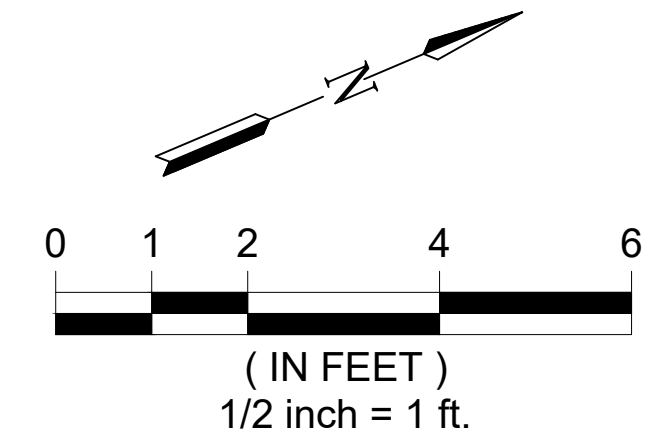
DO NOT SCALE

Drawing Legend



NOTE:
T - WALL BASE SLAB VERTICAL
TRANSITIONS NOT SHOWN

MONOLITH 3 PLAN VIEW
SCALE: 1/2"=1'



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Project Title
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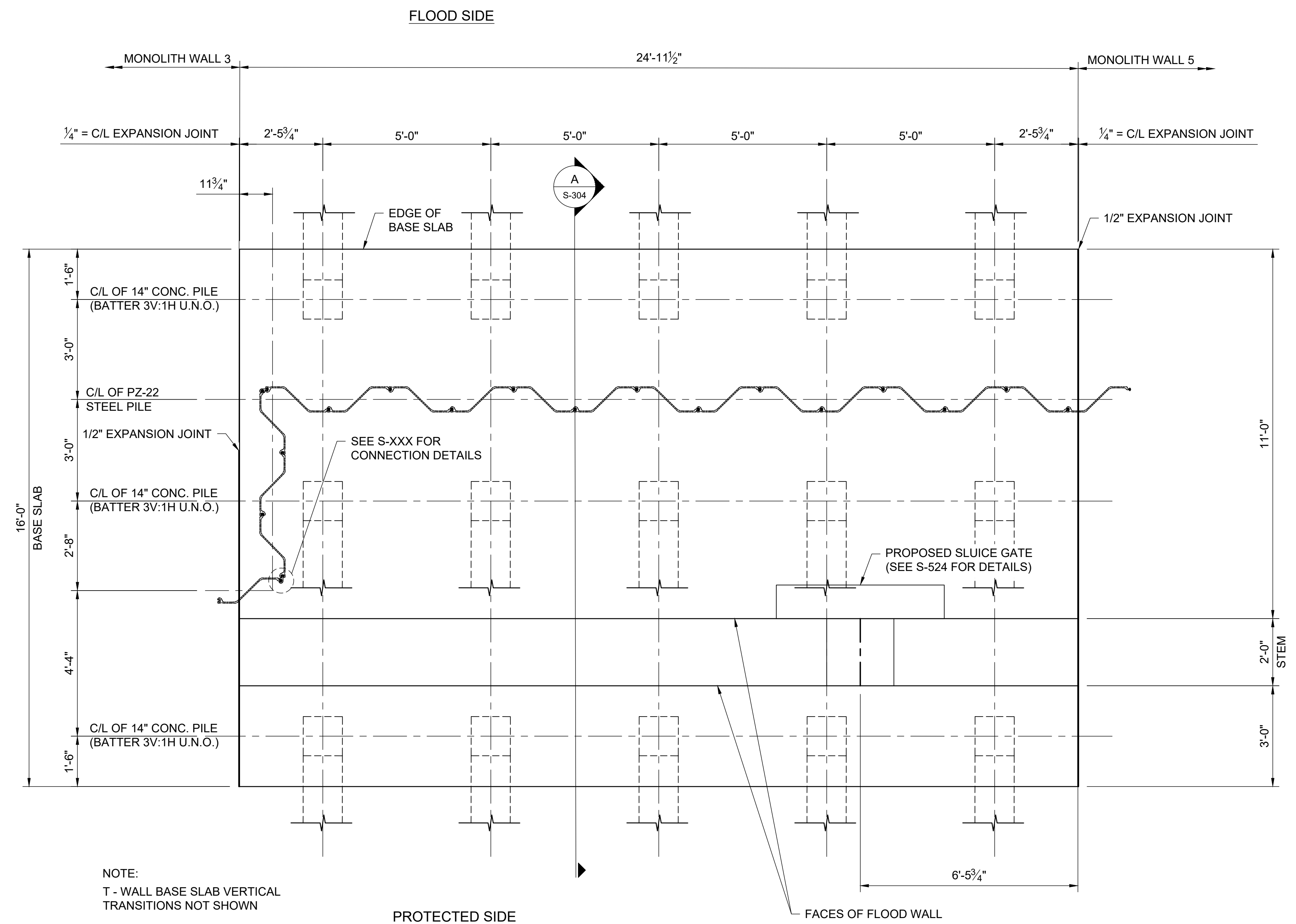
Drawing Title
**MONOLITH 3
PLAN VIEW**

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Drawing Number	Revision			
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Inches
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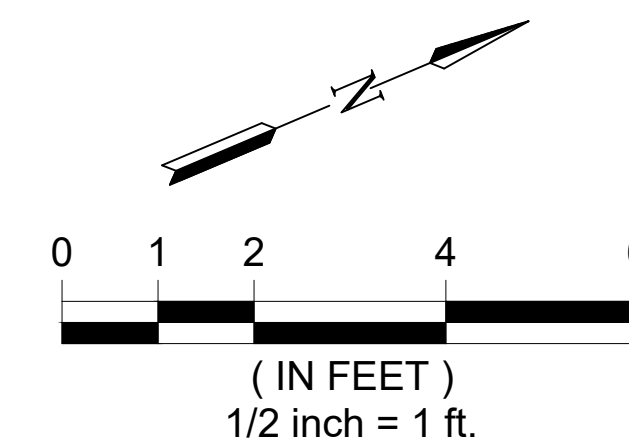
DO NOT SCALE

Drawing Legend



NOTE:
T - WALL BASE SLAB VERTICAL
TRANSITIONS NOT SHOWN

DRAINAGE MONOLITH 4 PLAN VIEW
SCALE: 1/2"=1'



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City of **LUMBERTON**
North Carolina

Project Title
**WEST LUMBERTON FLOOD G
AT VFW ROAD AND RAILROAD UNDERP
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Drawing Title
**MONOLITH 4
PLAN VIEW**

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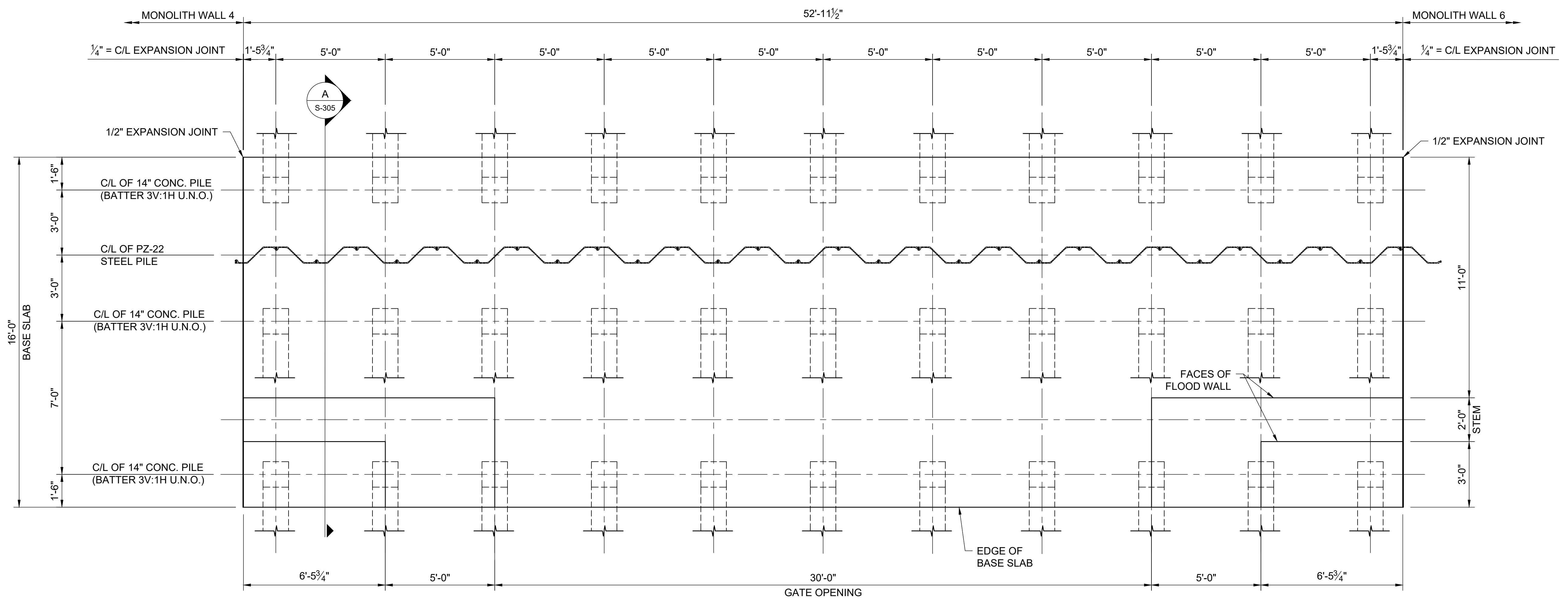
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Drawing Number	Revision			
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Inches
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DO NOT SCALE

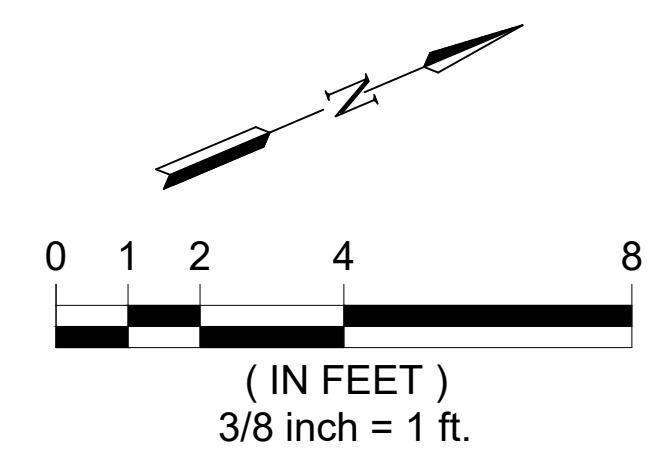
Drawing Legend

FLOOD SIDE



NOTE:
T - WALL BASE SLAB VERTICAL
TRANSITIONS NOT SHOWN

MONOLITH 5 (GATE) PLAN VIEW
SCALE: 3/8"=1'



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Drawing Title
**MONOLITH 5
PLAN VIEW**

Scale	Designed	Drawn	Checked	Authorized
3/8"= 1'	--	--	--	--
Original Size	Date	Date	Date	Date
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Drawing Number	Revision			
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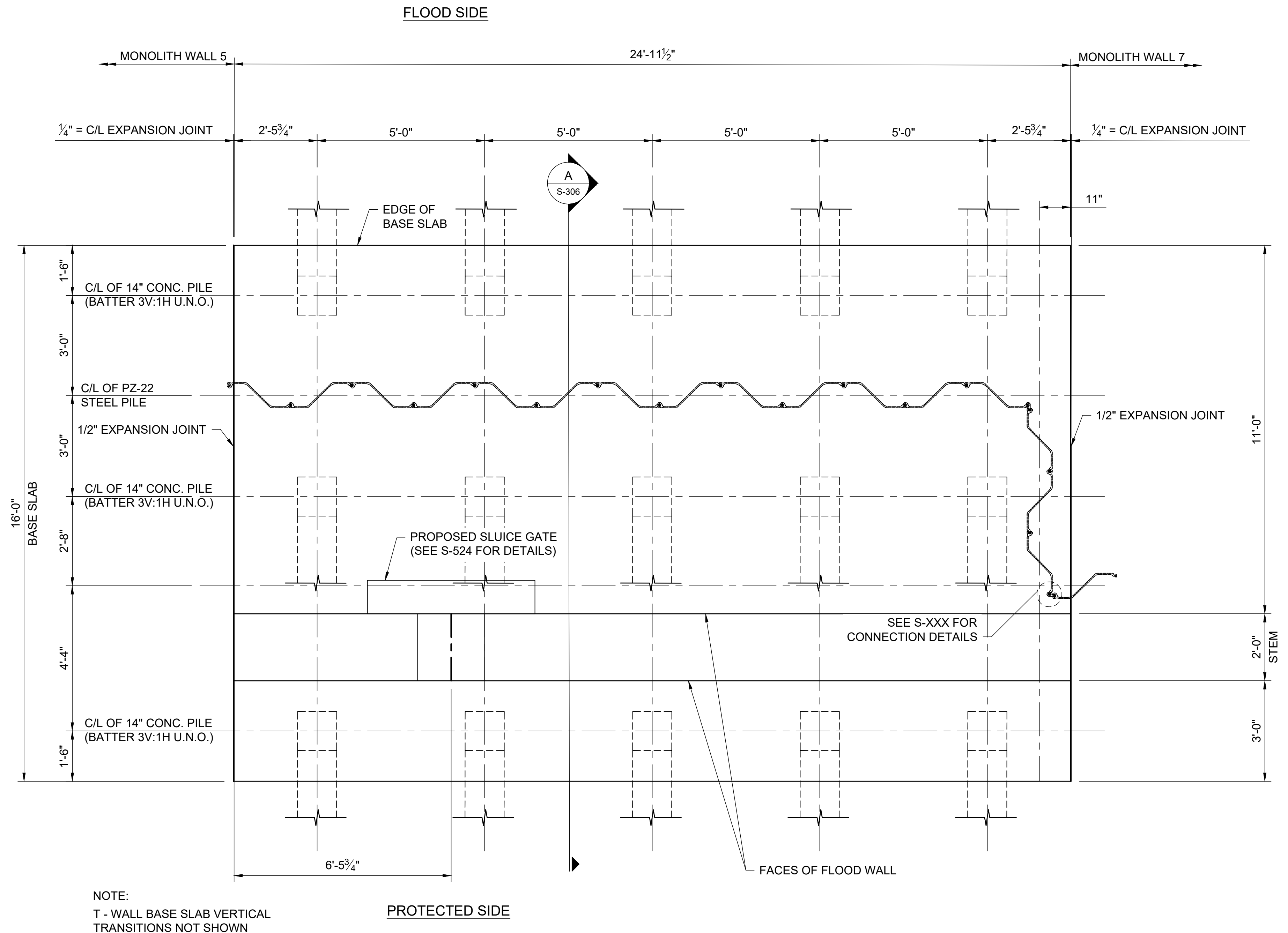
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Inches
0 1/2 1 2

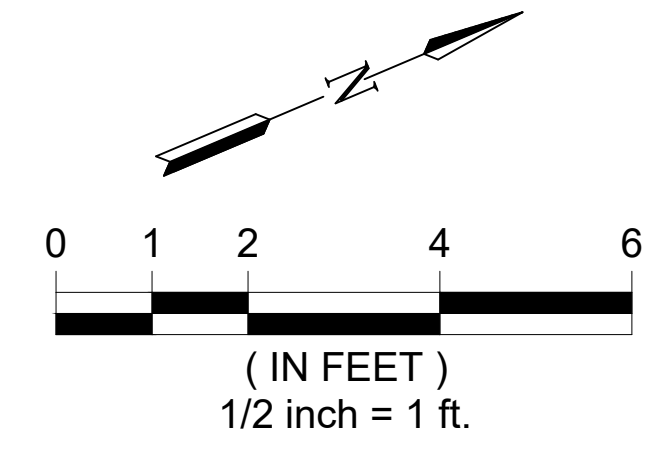
DO NOT SCALE

Drawing Legend



NOTE:
T - WALL BASE SLAB VERTICAL TRANSITIONS NOT SHOWN

DRAINAGE MONOLITH 6 PLAN VIEW
SCALE: 1/2"=1'



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Drawing Title
MONOLITH 6 PLAN VIEW

Scale	Designed	Drawn	Checked	Authorized
1/2" = 1'	--	--	--	--
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Drawing Number	Revision			
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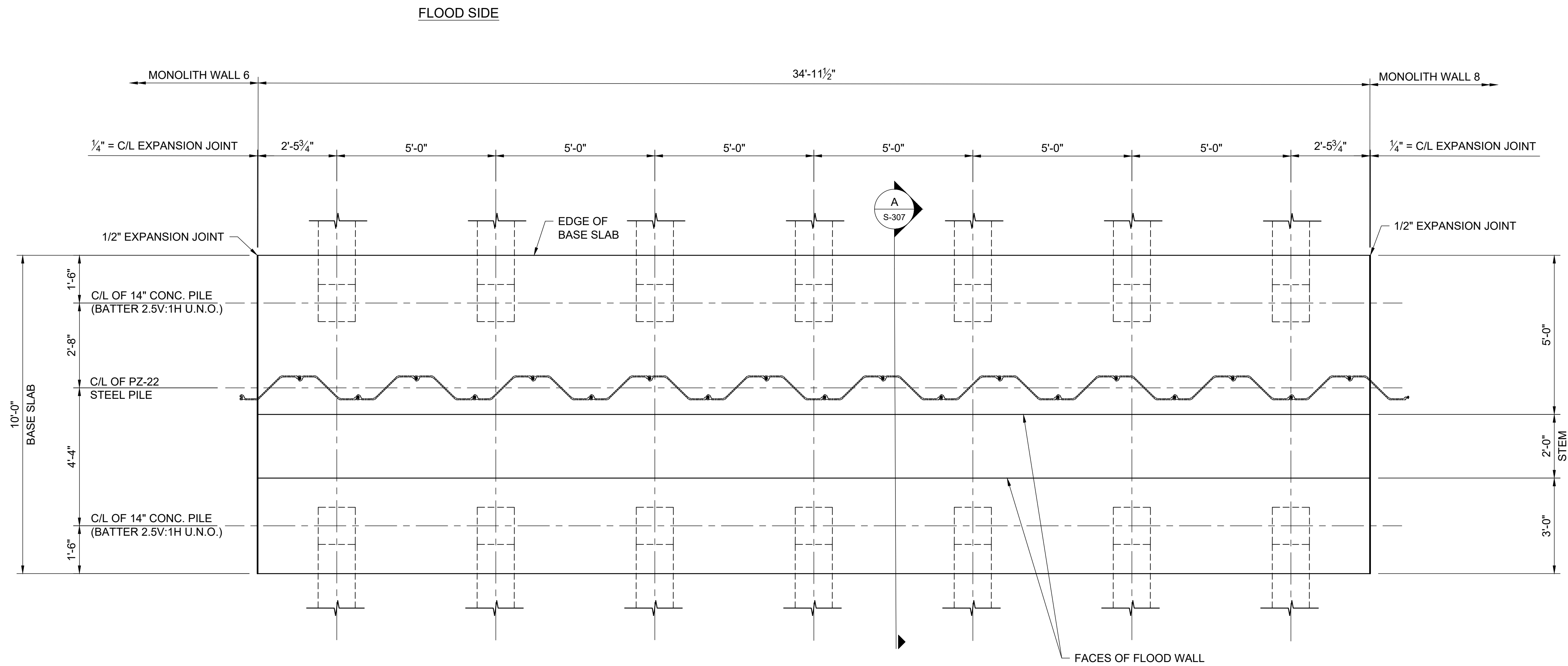
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Inches
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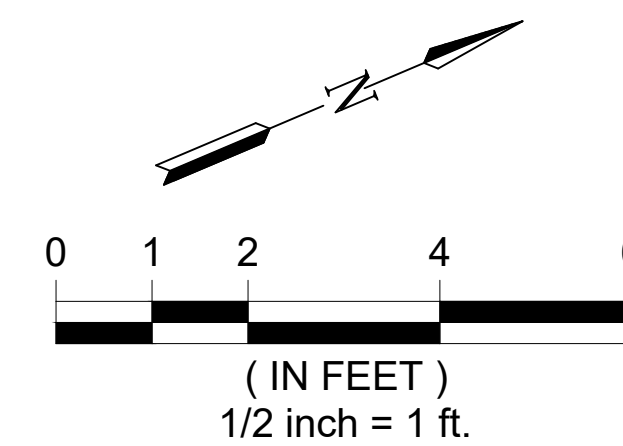
Drawing Legend



NOTE:
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TRANSITIONS NOT SHOWN

PROTECTED SIDE

MONOLITH 7 PLAN VIEW
SCALE: 1/2"=1'



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ENGINEERING SERVICES**

Drawing Title
**MONOLITH 7
PLAN VIEW**

Scale	Designed	Drawn	Checked	Authorized
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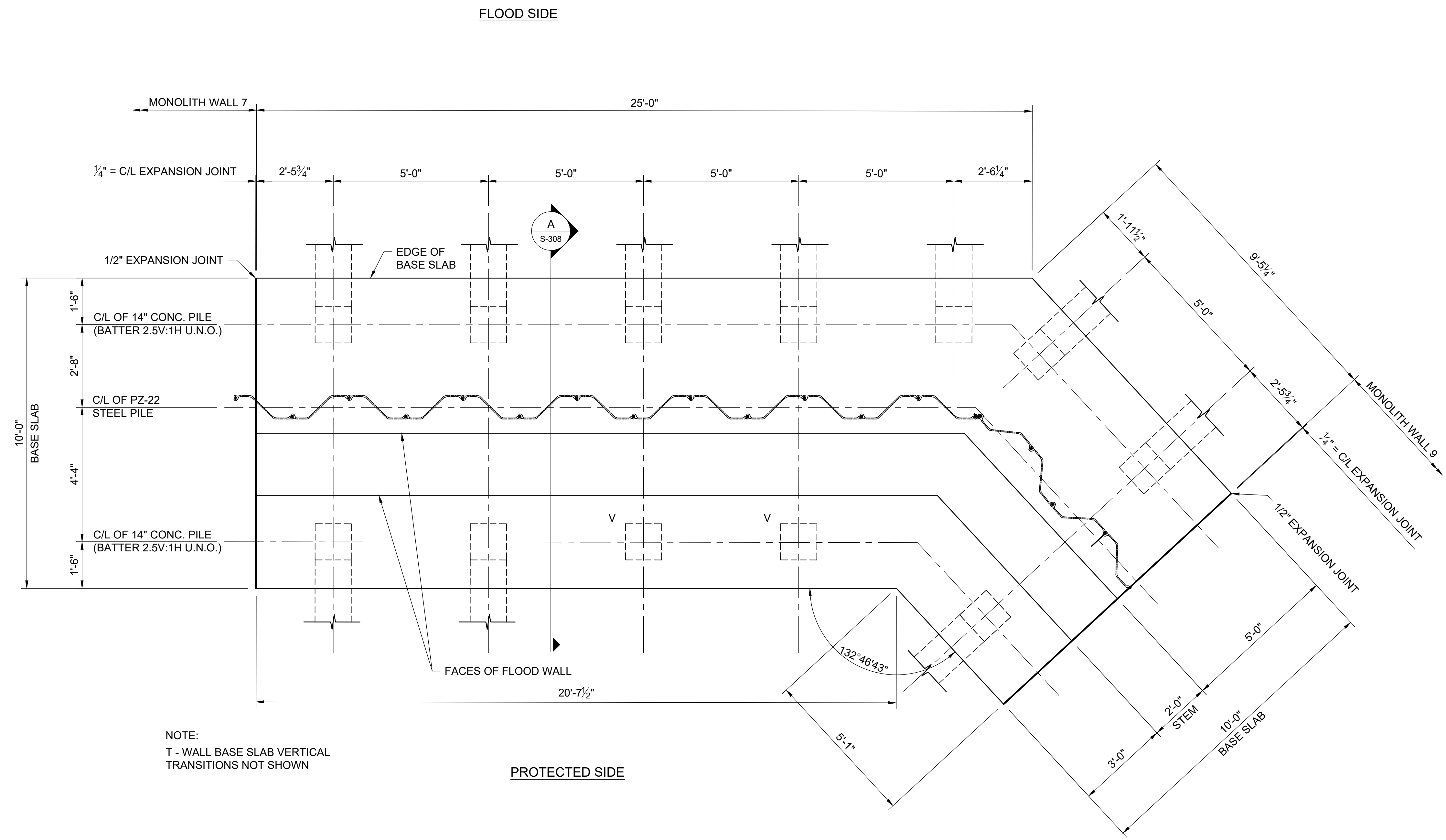
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Inches
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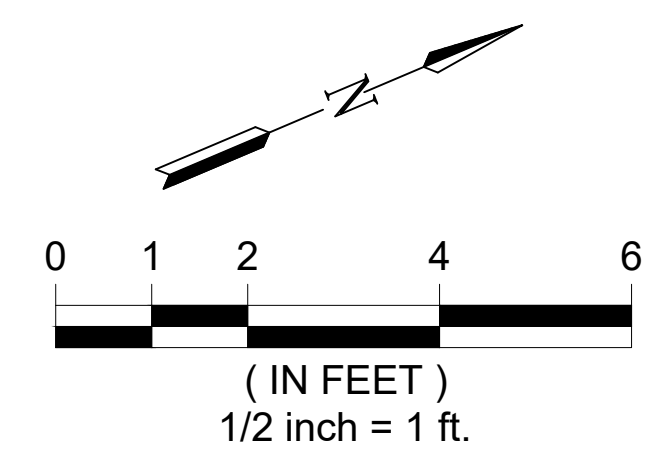
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Drawing Legend



NOTE:
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MONOLITH 8 PLAN VIEW
SCALE: 1/2"=1'



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Drawing Title
**MONOLITH 8
PLAN VIEW**

Scale	Designed	Drawn	Checked	Authorized
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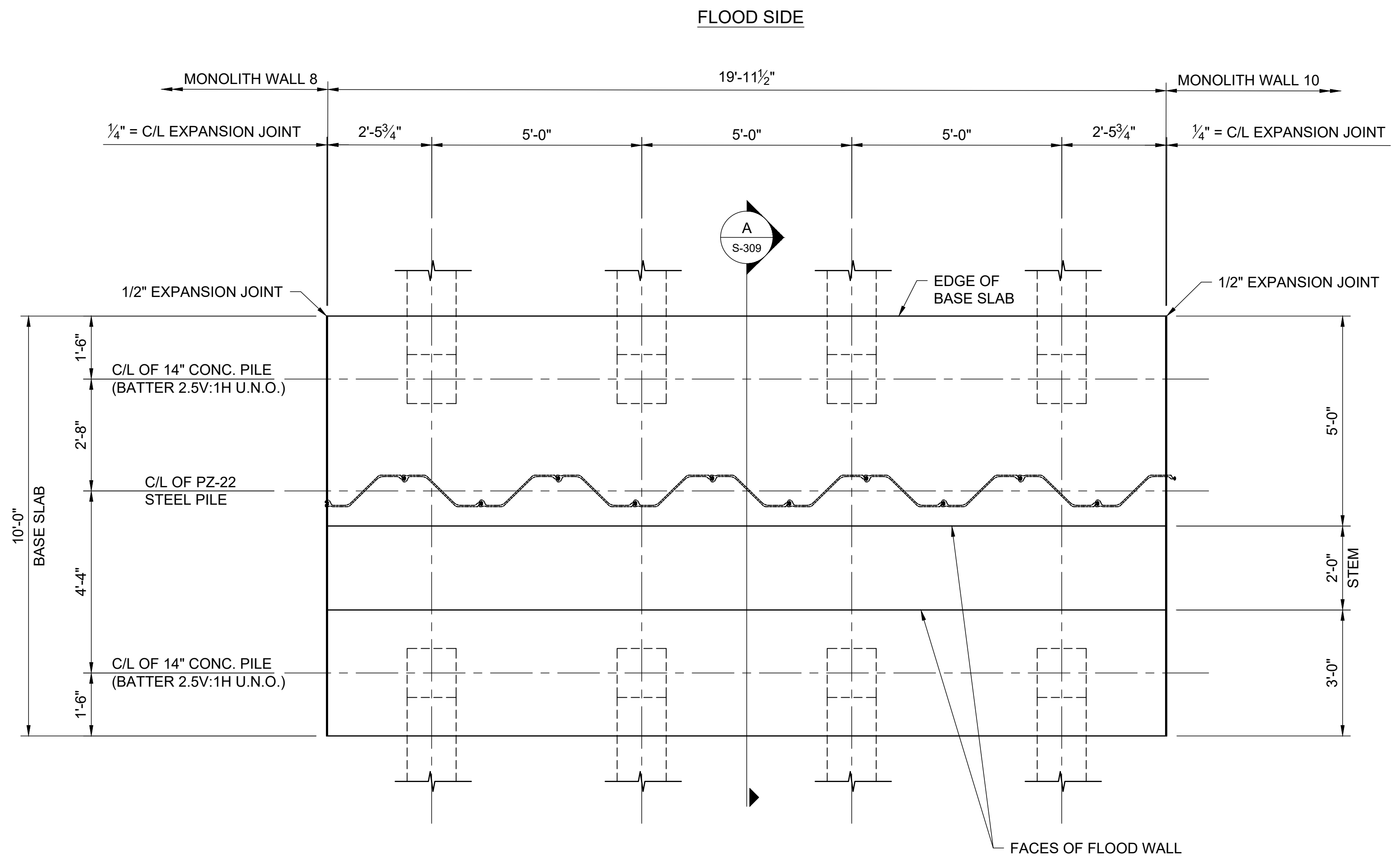
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Inches
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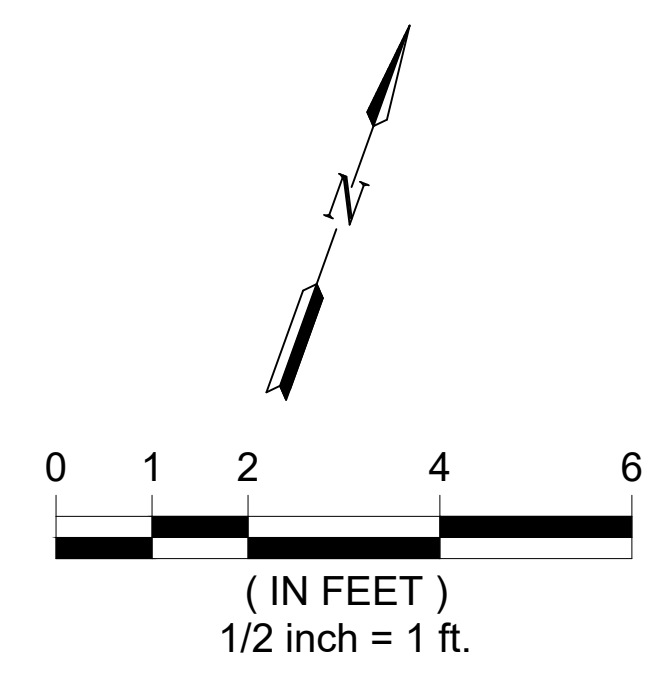
DO NOT SCALE

Drawing Legend



NOTE:
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TRANSITIONS NOT SHOWN

MONOLITH 9 PLAN VIEW
SCALE: 1/2"=1'



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Drawing Title
**MONOLITH 9
PLAN VIEW**

Scale	Designed	Drawn	Checked	Authorized
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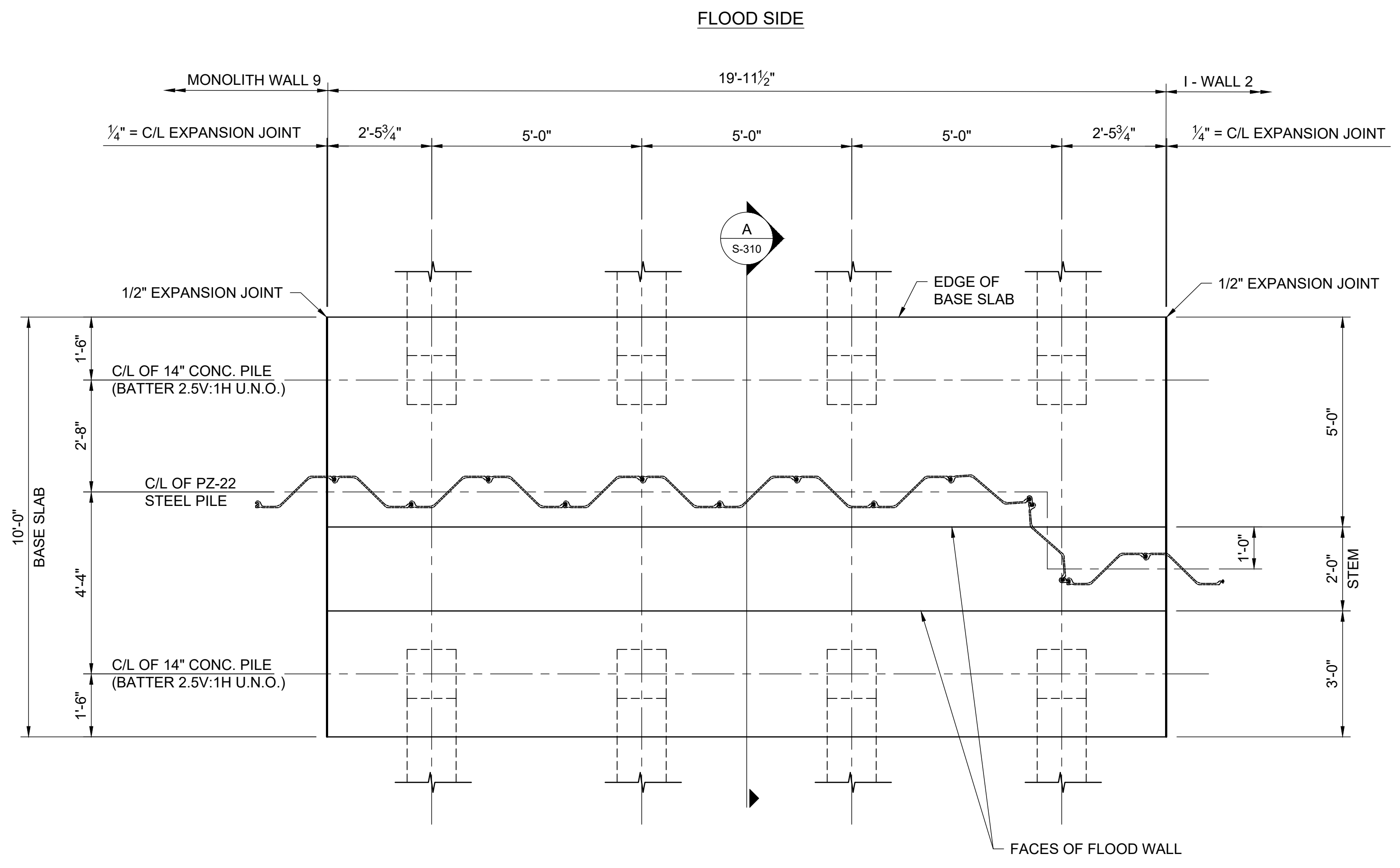
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Inches
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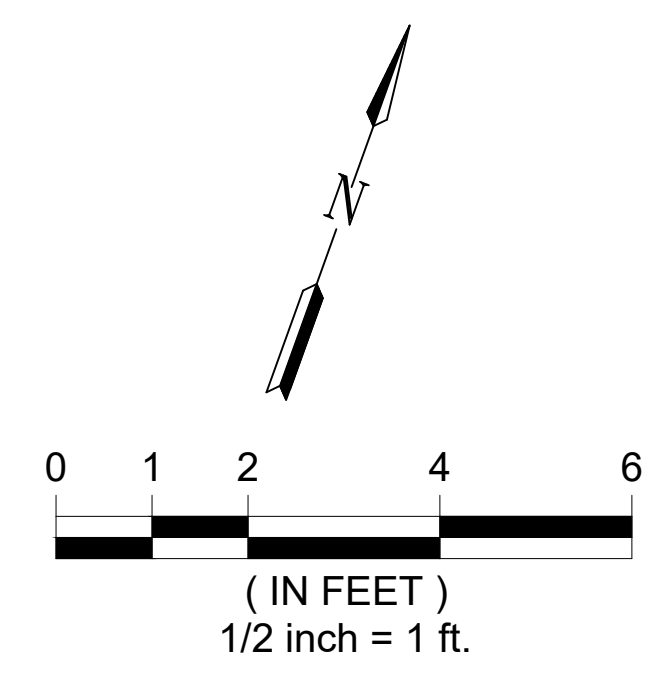
Drawing Legend



NOTE:
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PROTECTED SIDE

MONOLITH 10 PLAN VIEW
SCALE: 1/2"=1'



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Drawing Title
**MONOLITH 10
PLAN VIEW**

Scale	Designed	Drawn	Checked	Authorized
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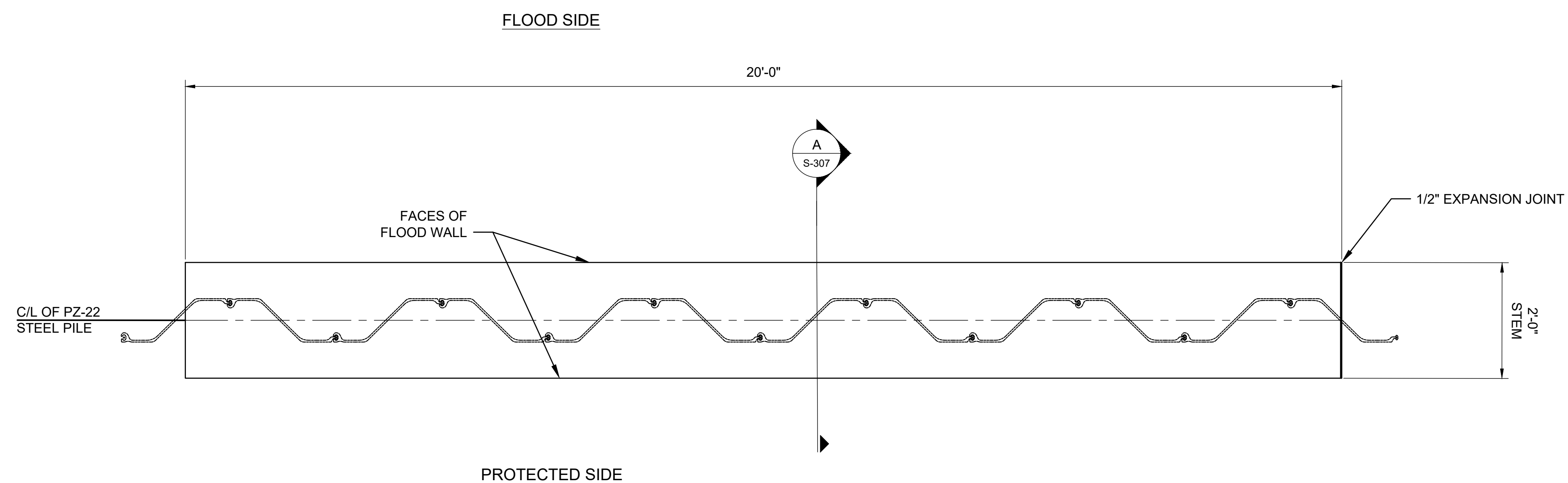
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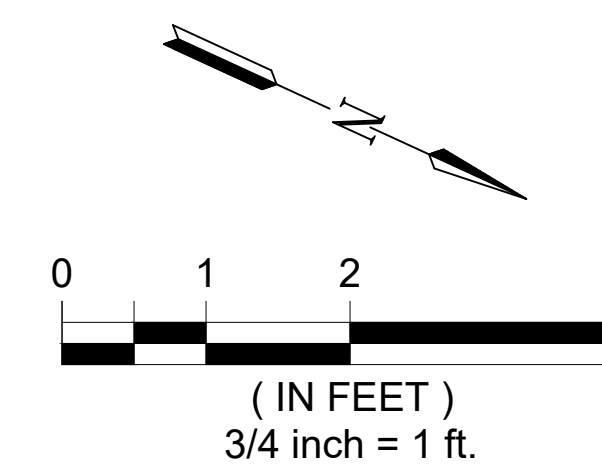
Inches
0 1/2 1 4

DO NOT SCALE

Drawing Legend



I-WALL 1 PLAN VIEW
SCALE: 3/4"=1'



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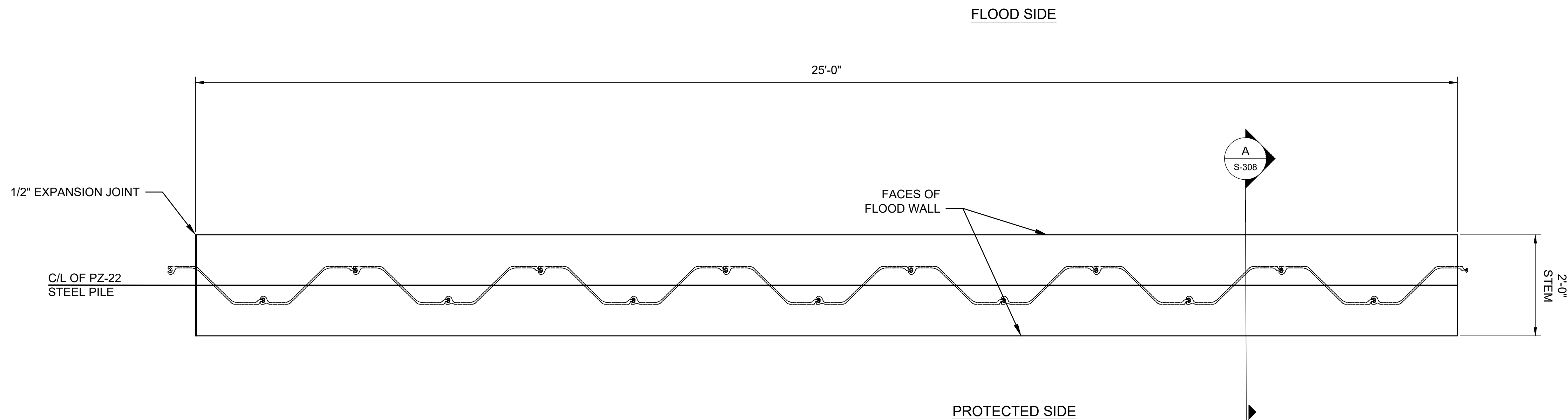
Drawing Title
**I-WALL 1
PLAN VIEW**

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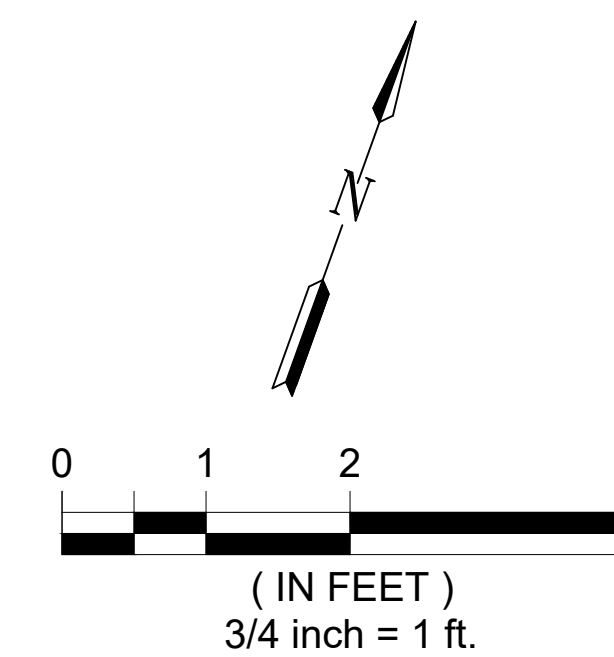
Inches
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DO NOT SCALE

Drawing Legend



I-WALL 2 PLAN VIEW
SCALE: 3/4"=1'



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**I-WALL 2
PLAN VIEW**

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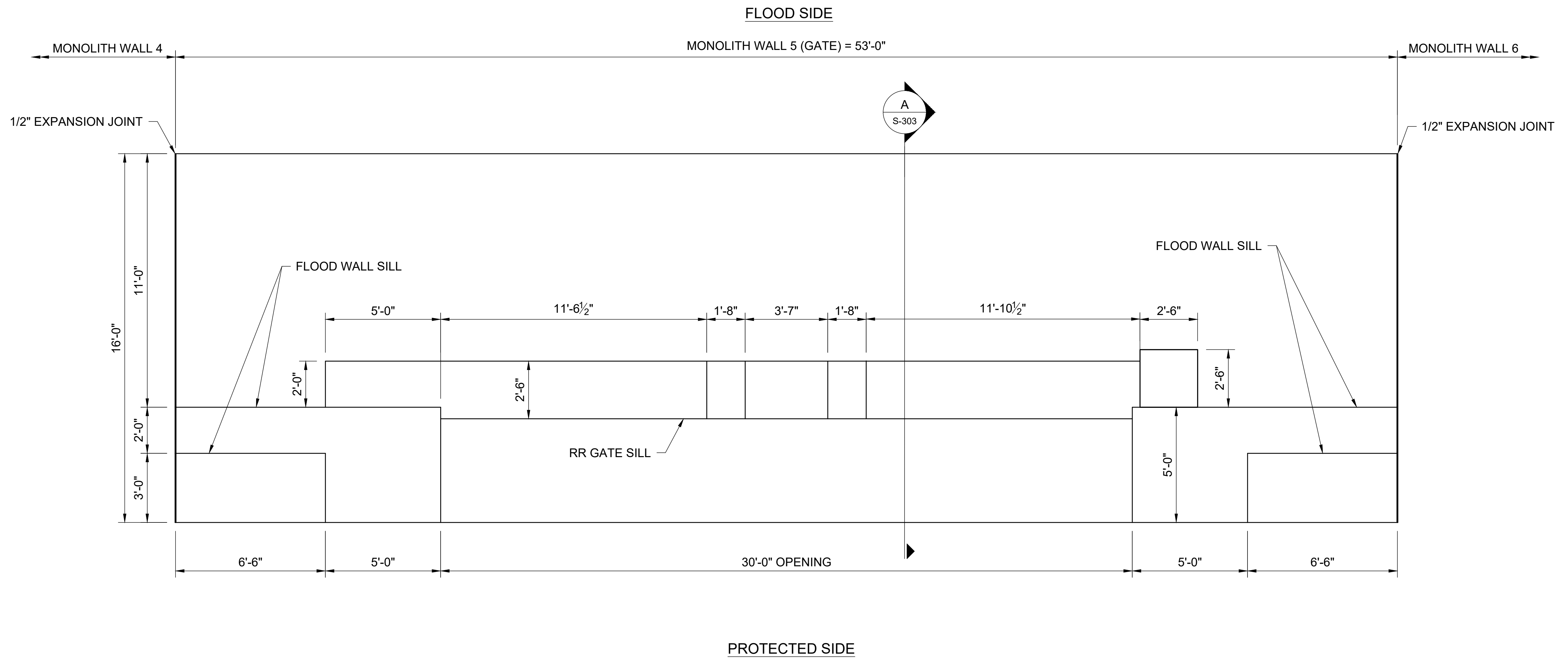
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Scale	Designed	Drawn	Checked	Authorized
3/4"= 1'	--	--	--	--
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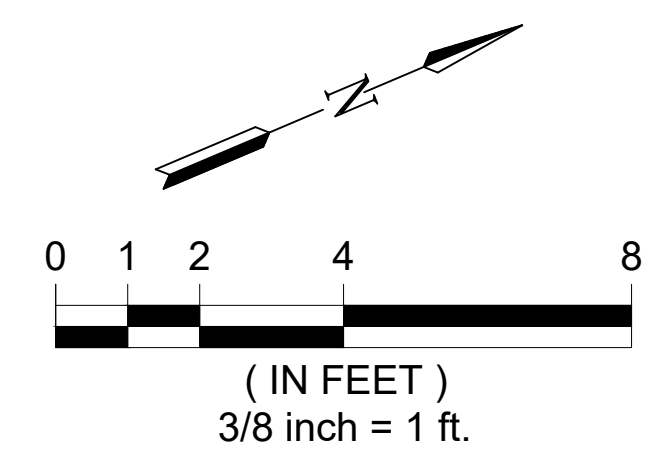
Inches
0 1/2 1 4

DO NOT SCALE

Drawing Legend



RAILROAD PLAN VIEW
SCALE: 3/8"=1'



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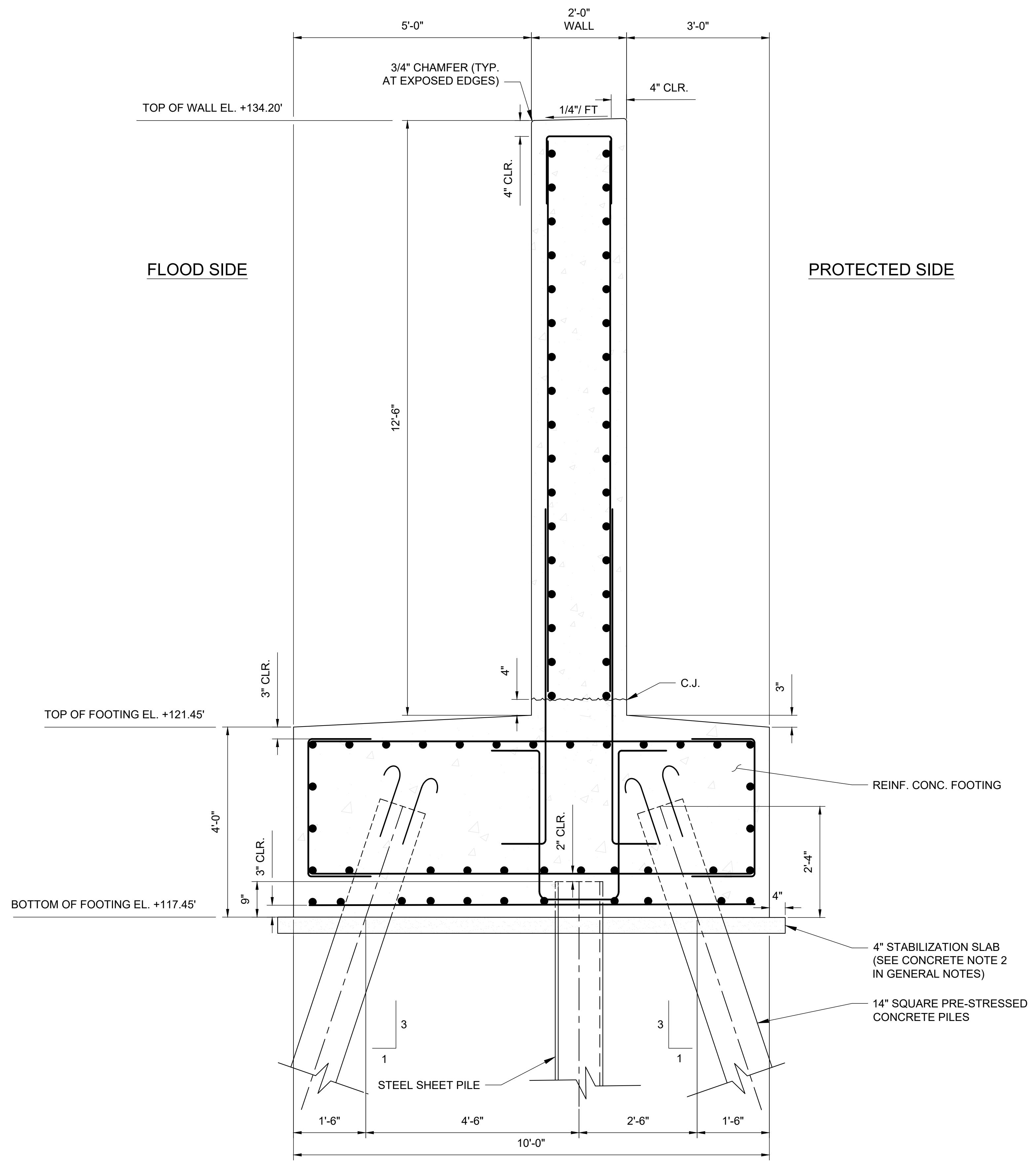
811 Know what's below.
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Scale	Designed	Drawn	Checked	Authorized
3/8"= 1'	--	--	--	--
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Drawing Number	Revision			
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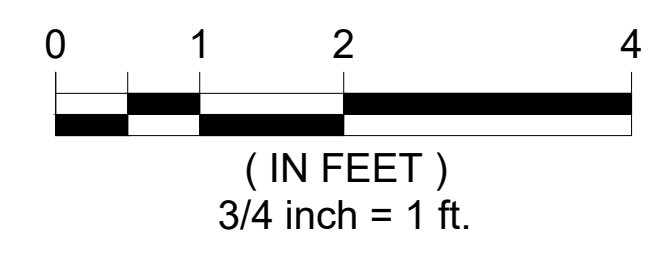
Inches
0 1/2 1 4

DO NOT SCALE

Drawing Legend



MONOLITH 1 SECTION
SCALE: 3/4"=1'



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AT VFW ROAD AND RAILROAD UNDERP
ENGINEERING SERVICES**

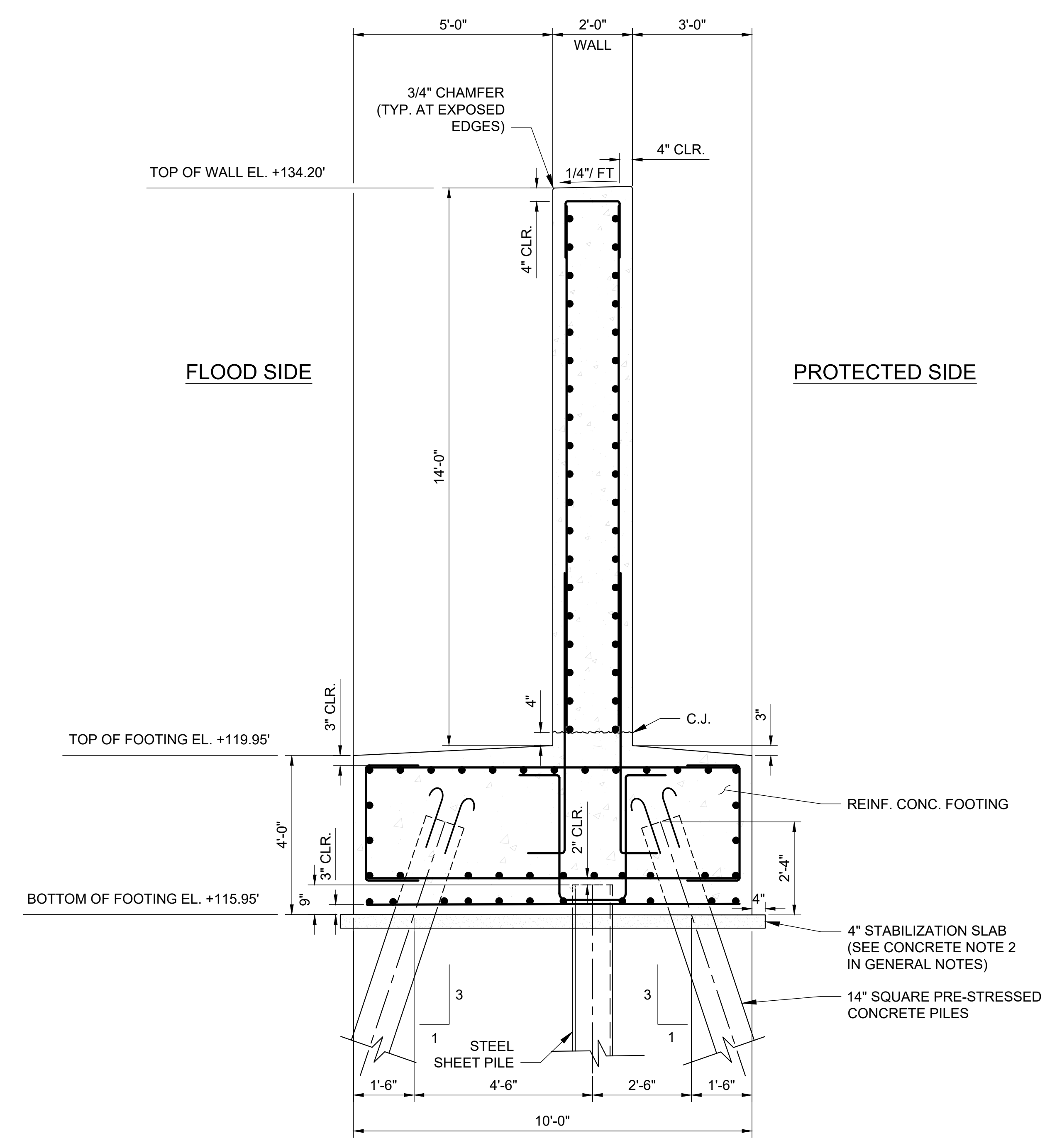
Drawing Title
**MONOLITH 1
SECTION**

Scale	Designed	Drawn	Checked	Authorized
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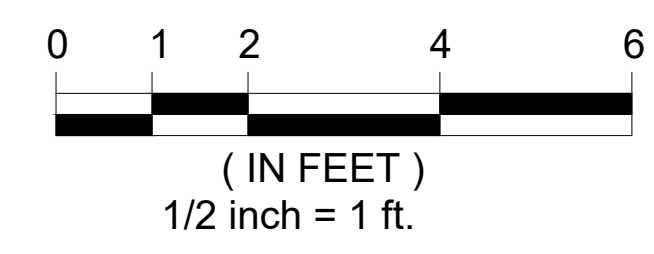
Inches
0 1/2 1 4

DO NOT SCALE

Drawing Legend



MONOLITH 2 SECTION
SCALE: 1/2"=1'



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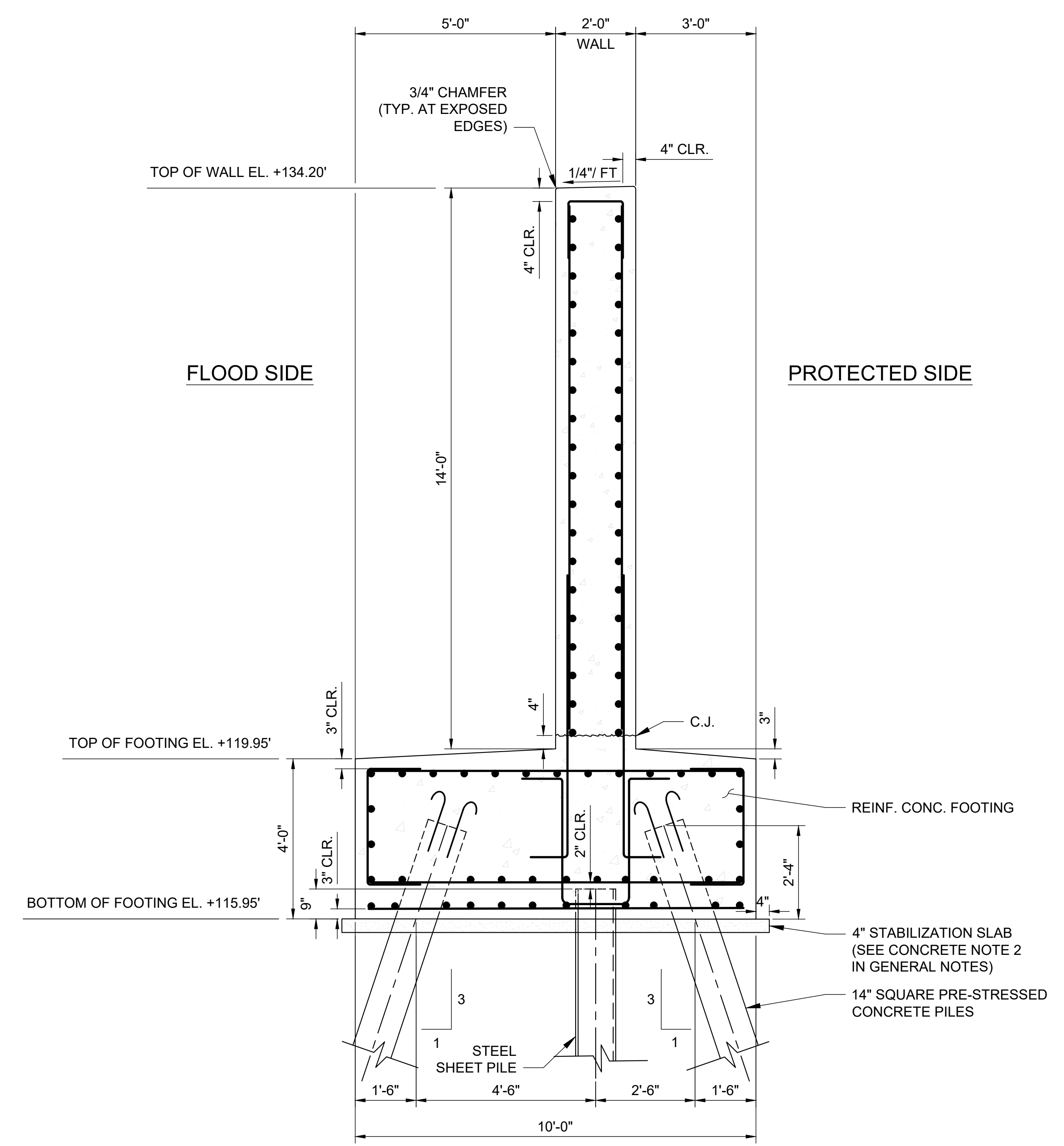
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**MONOLITH 2
SECTION**

Scale	Designed	Drawn	Checked	Authorized
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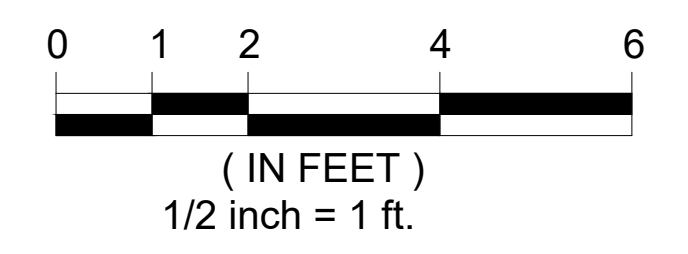
Inches
0 1/2 1 4

DO NOT SCALE

Drawing Legend



MONOLITH 3 SECTION
SCALE: 1/2"=1'



Seal	Seal
------	------

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Drawing Title
MONOLITH 3 SECTION

Scale	Designed	Drawn	Checked	Authorized
1/2" = 1'	--	--	--	--
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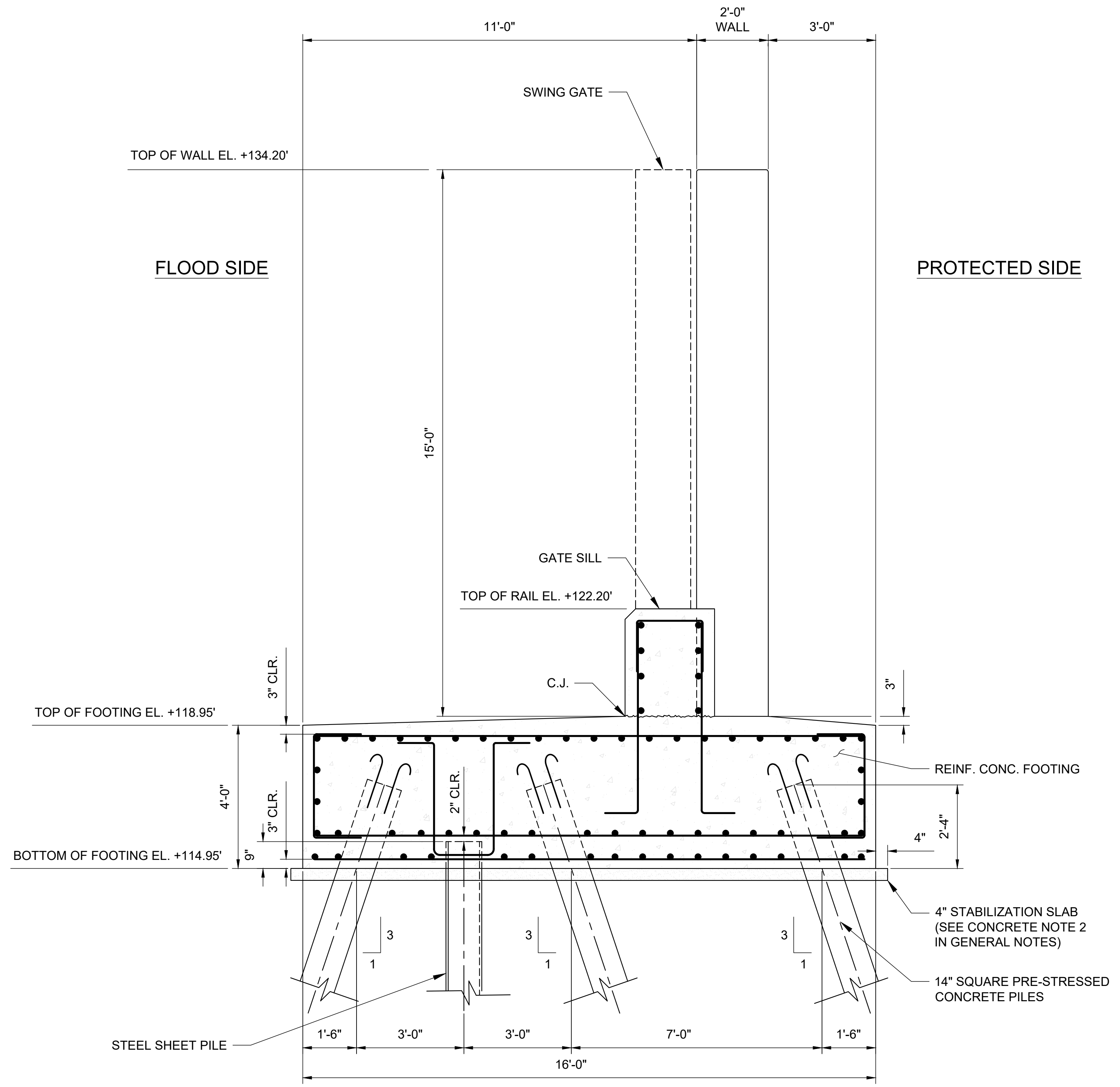
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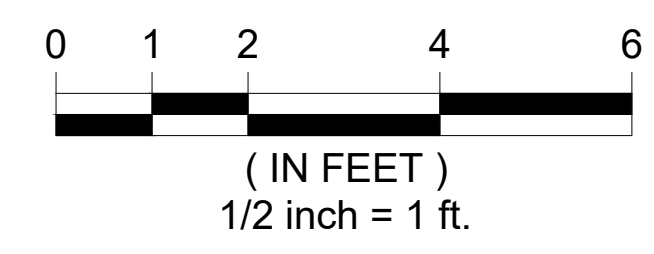
Inches
0
1/2
1
4

DO NOT SCALE

Drawing Legend



MONOLITH 5 (GATE) SECTION
SCALE: 1/2"=1'



Seal	Seal
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Drawing Title
**MONOLITH 5
SECTION**

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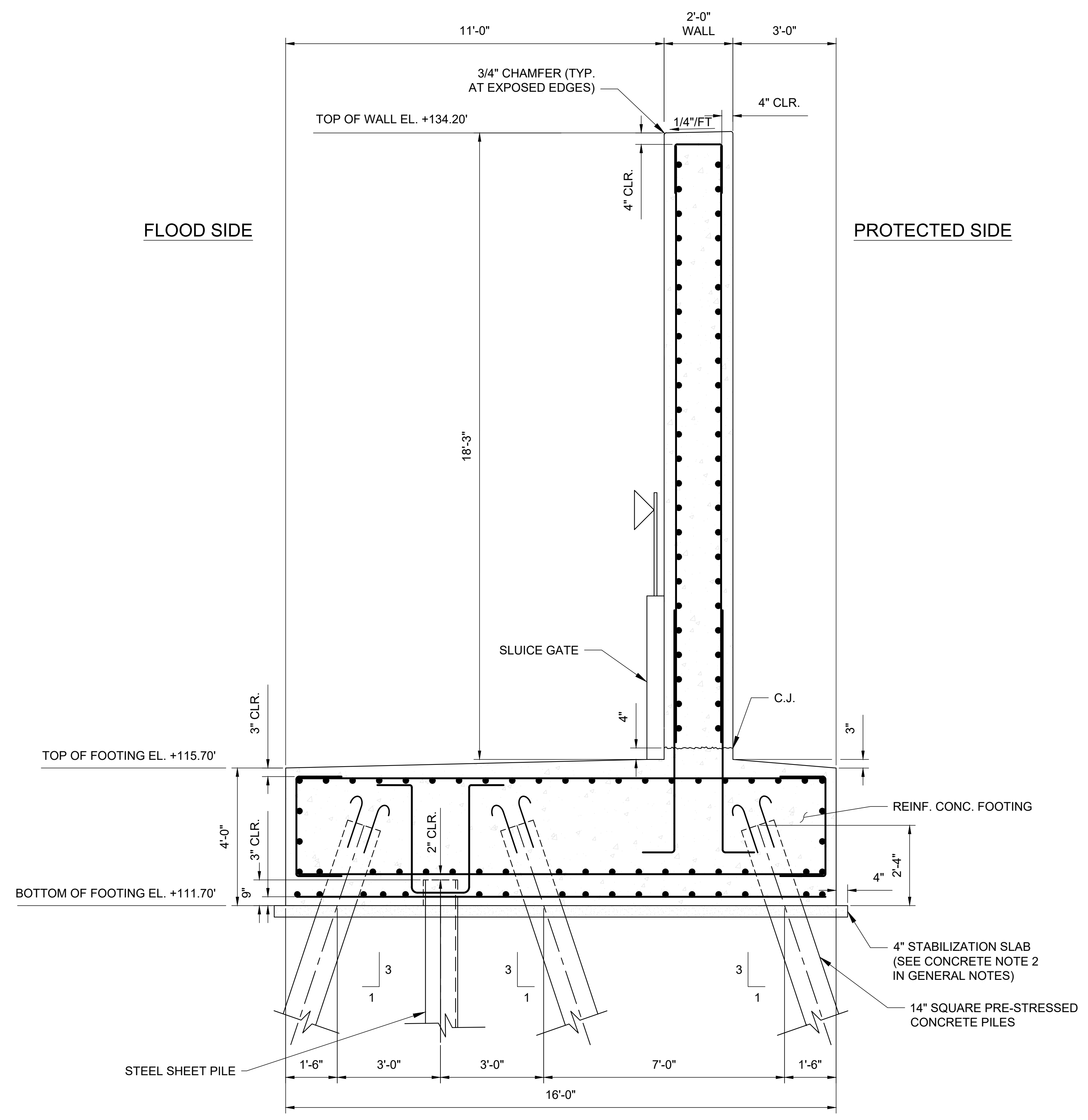
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Scale	Designed	Drawn	Checked	Authorized
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Drawing Number	Revision			
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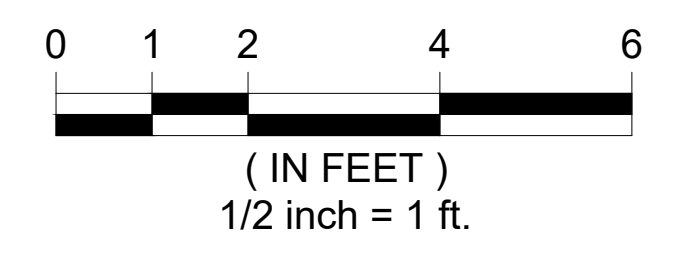
Inches
0 1/2 1 4

DO NOT SCALE

Drawing Legend



MONOLITH 6 (DRAINAGE) SECTION
SCALE: 1/2"=1'



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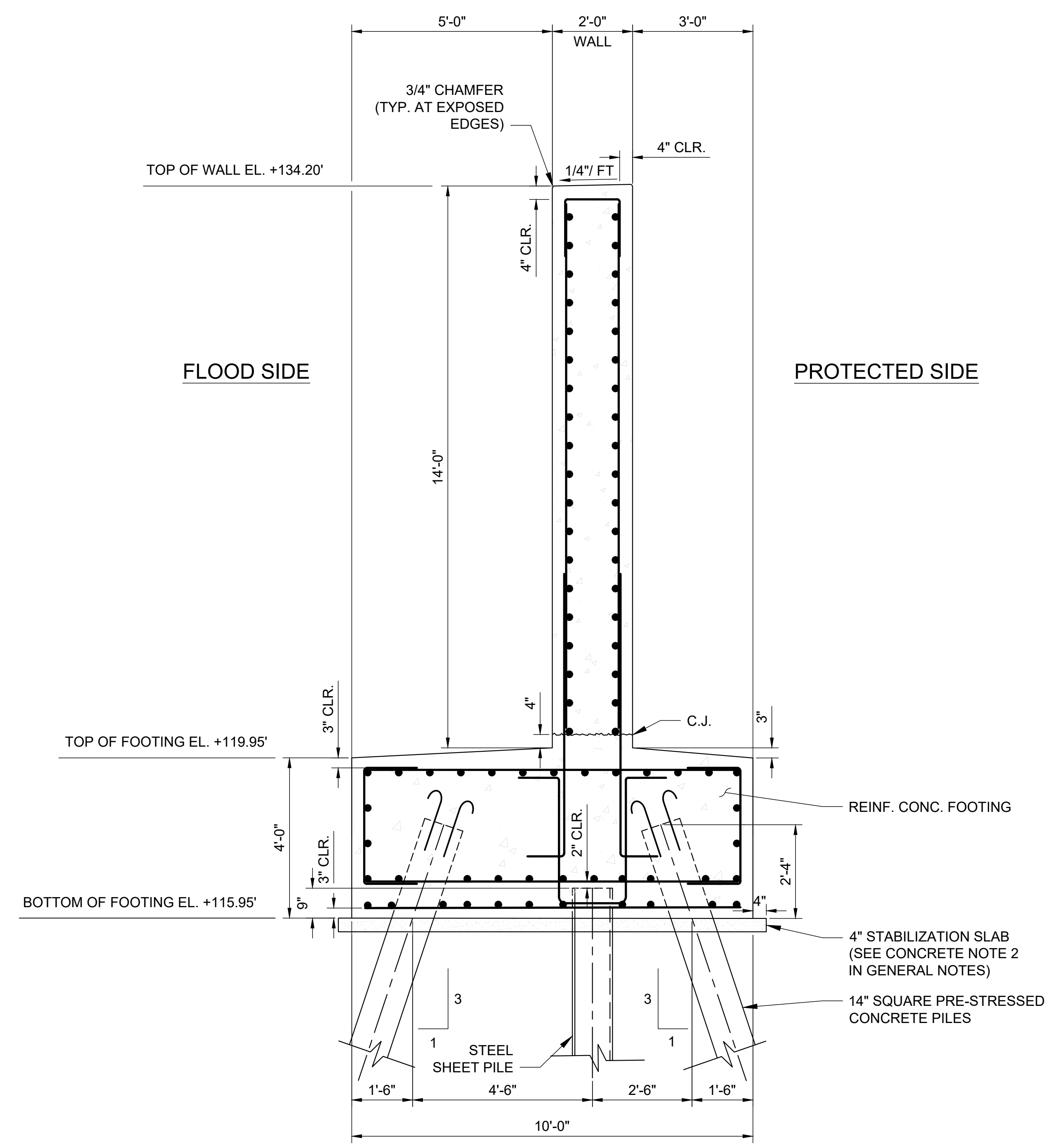
Drawing Title
**MONOLITH 6
SECTION**

Scale	Designed	Drawn	Checked	Authorized
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Drawing Number	Revision			
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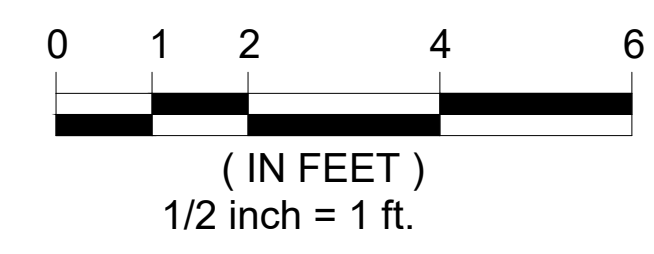
Inches
0 1/2 1 4

DO NOT SCALE

Drawing Legend



MONOLITH 7 SECTION
SCALE: 1/2"=1'



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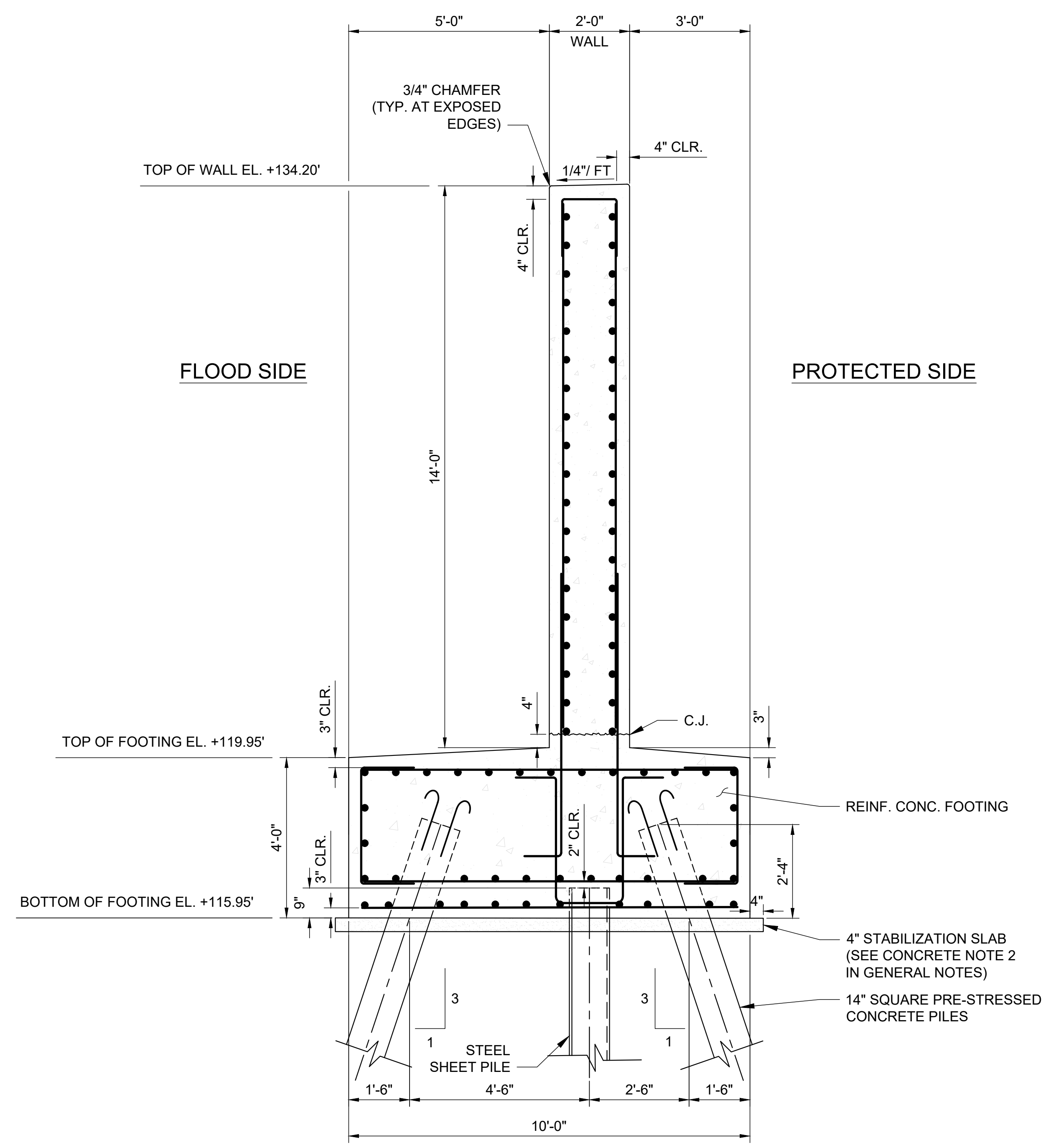
Drawing Title
**MONOLITH 7
SECTION**

Scale	Designed	Drawn	Checked	Authorized
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Drawing Number	Revision			
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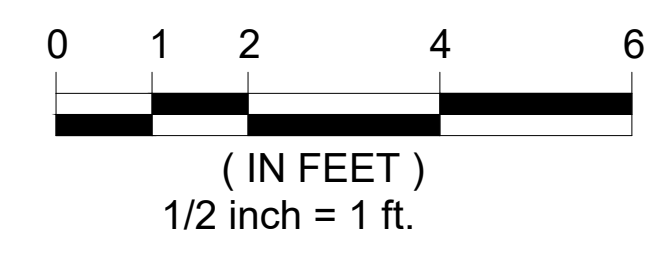
Inches
0 1/2 1 4

DO NOT SCALE

Drawing Legend



MONOLITH 8 SECTION
SCALE: 1/2"=1'



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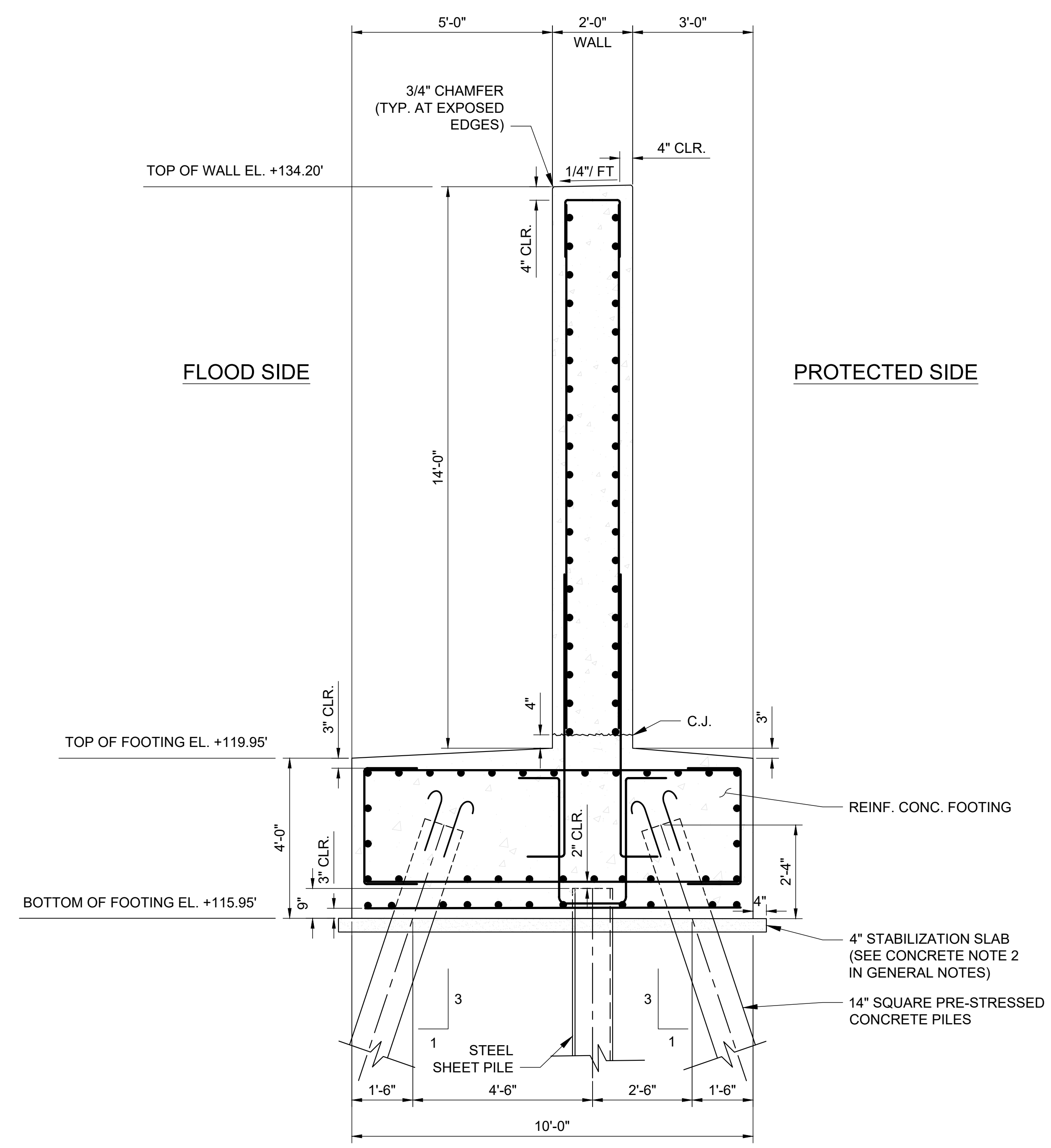
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**MONOLITH 8
SECTION**

Scale	Designed	Drawn	Checked	Authorized
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Drawing Number	Revision			
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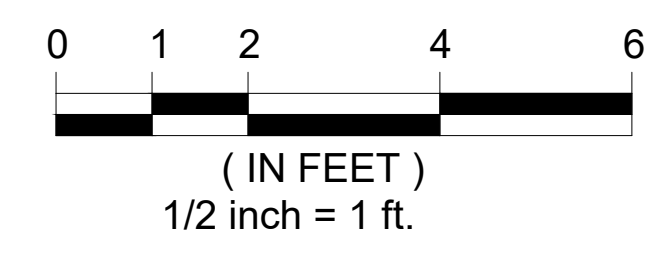
Inches
0 1/2 1 4

DO NOT SCALE

Drawing Legend



MONOLITH 9 SECTION
SCALE: 1/2"=1'



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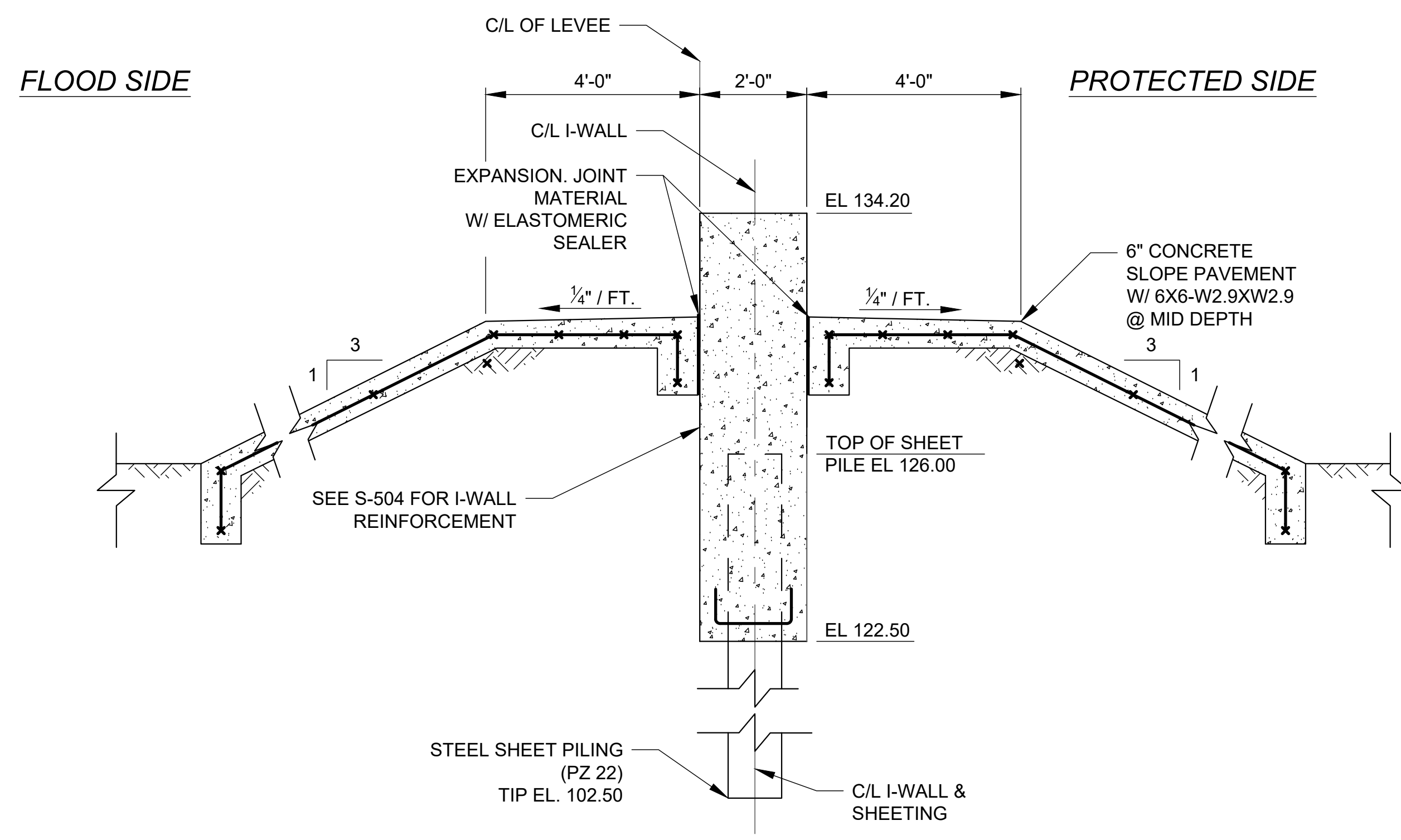
Drawing Title
**MONOLITH 9
SECTION**

Scale	Designed	Drawn	Checked	Authorized
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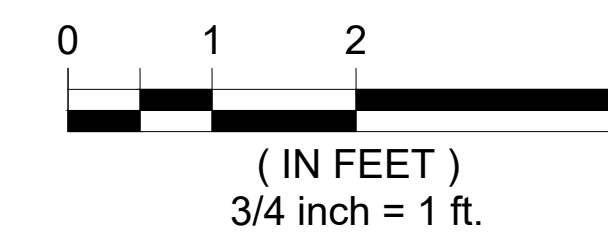
Inches
0 1/2 1 4

DO NOT SCALE

Drawing Legend



I-WALL 1 SECTION
SCALE: 3/4"=1'



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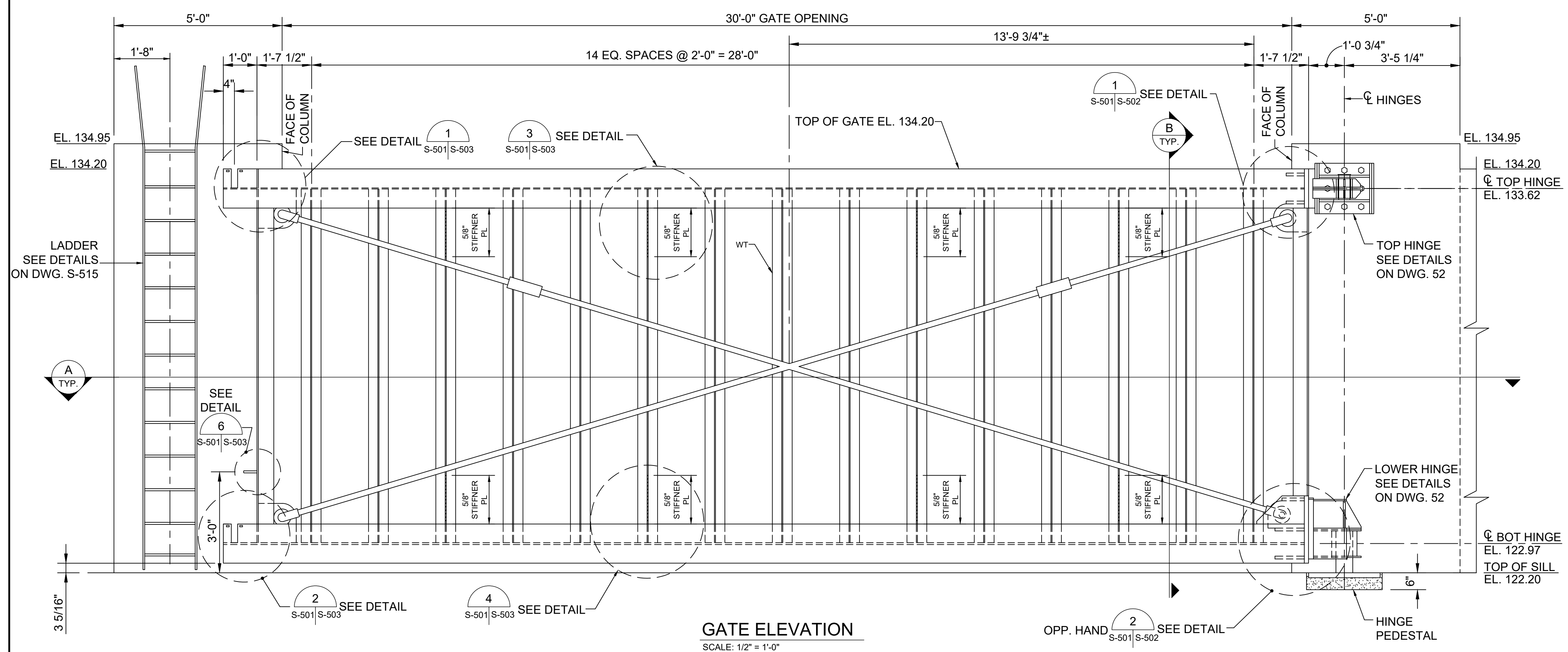
Drawing Title
**I-WALL 1
SECTION**

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Drawing Number	Revision			
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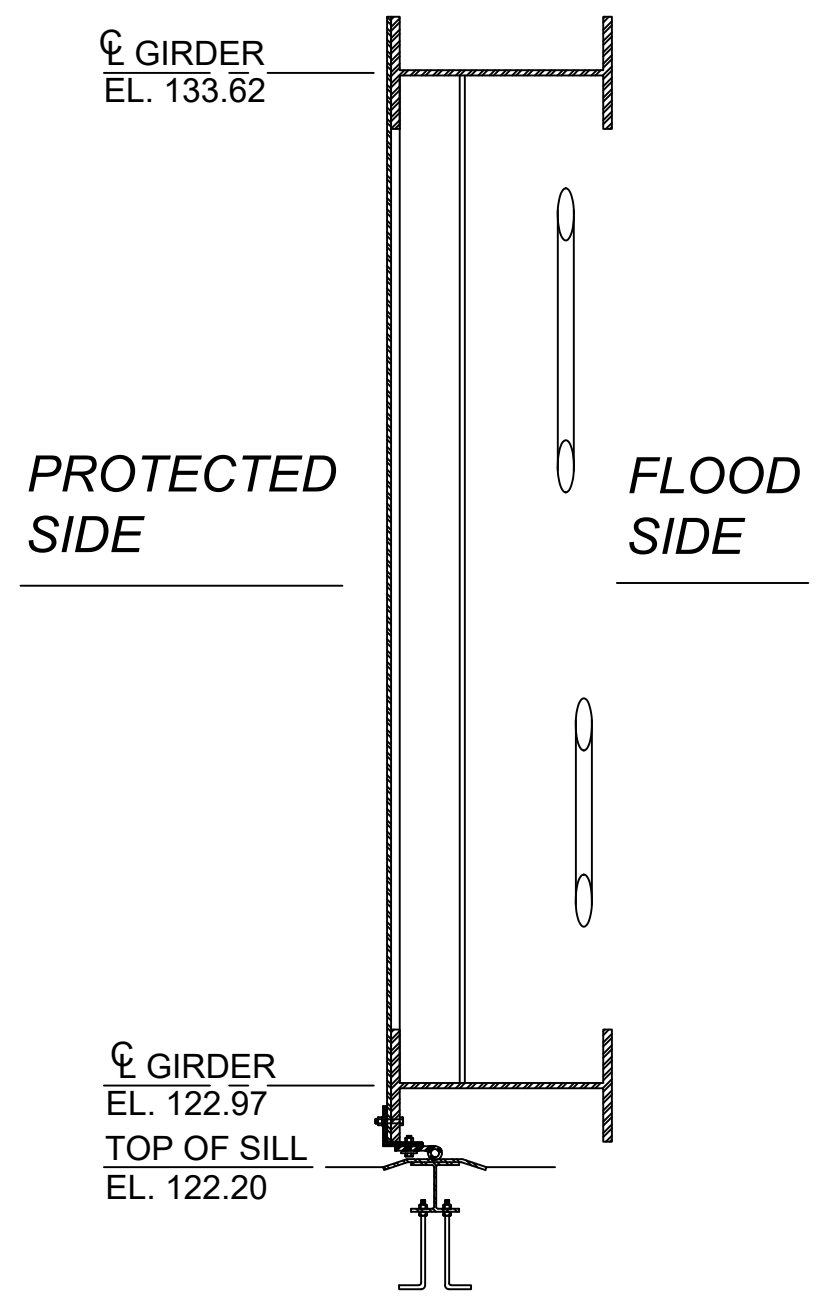
Inches
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1/2
1
4

DO NOT SCALE

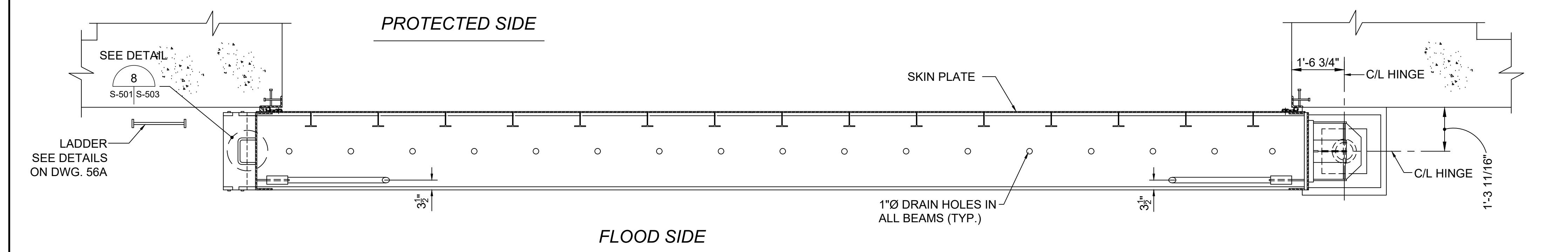
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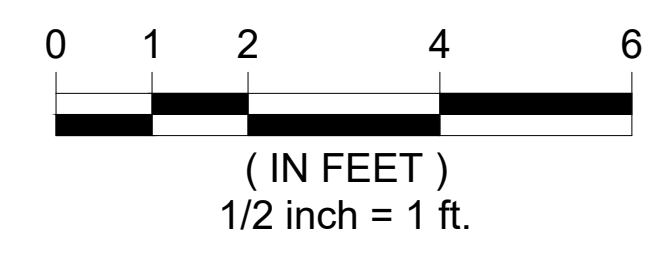
GATE ELEVATION
SCALE: 1/2" = 1'-0"



SECTION B
TYP. TYP. SCALE: 1/2" = 1'-0"



SECTION A
TYP. TYP. SCALE: 1/2" = 1'-0"



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Drawing Title
GATE ELEVATION

Scale	Designed	Drawn	Checked	Authorized
1/2" = 1'	--	--	--	--
Original Size	Date	Date	Date	Date
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Drawing Number	Revision			
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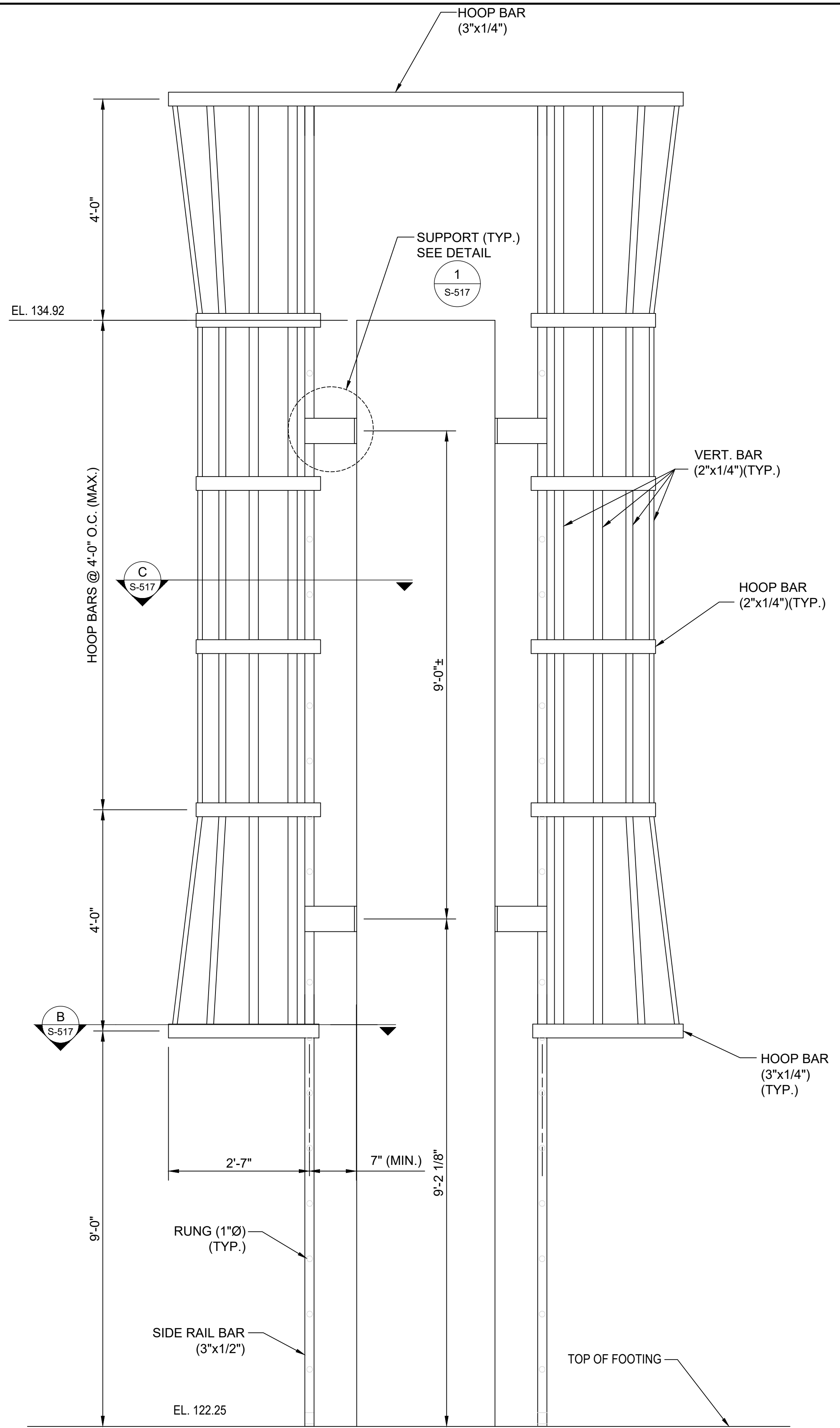
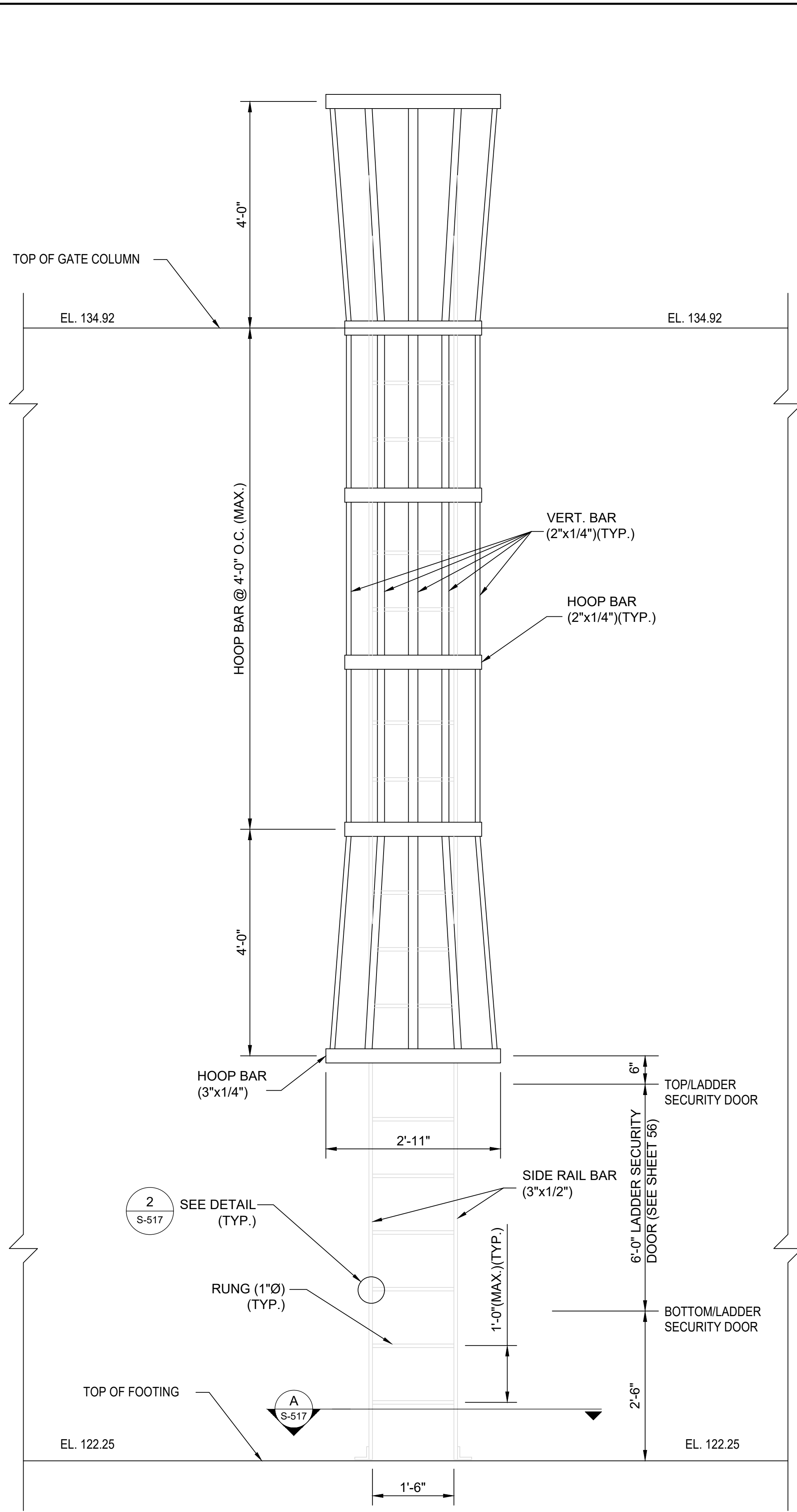
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4
1
0 1/2
Inches

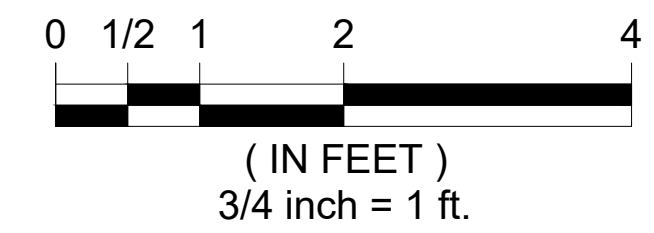
DO NOT SCALE

Drawing Legend



TYPICAL LADDER ELEVATIONS
SCALE: 3/4" = 1'-0"

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Suite 200
Metairie, LA 70002
Tel: +1 (504) 833-5300
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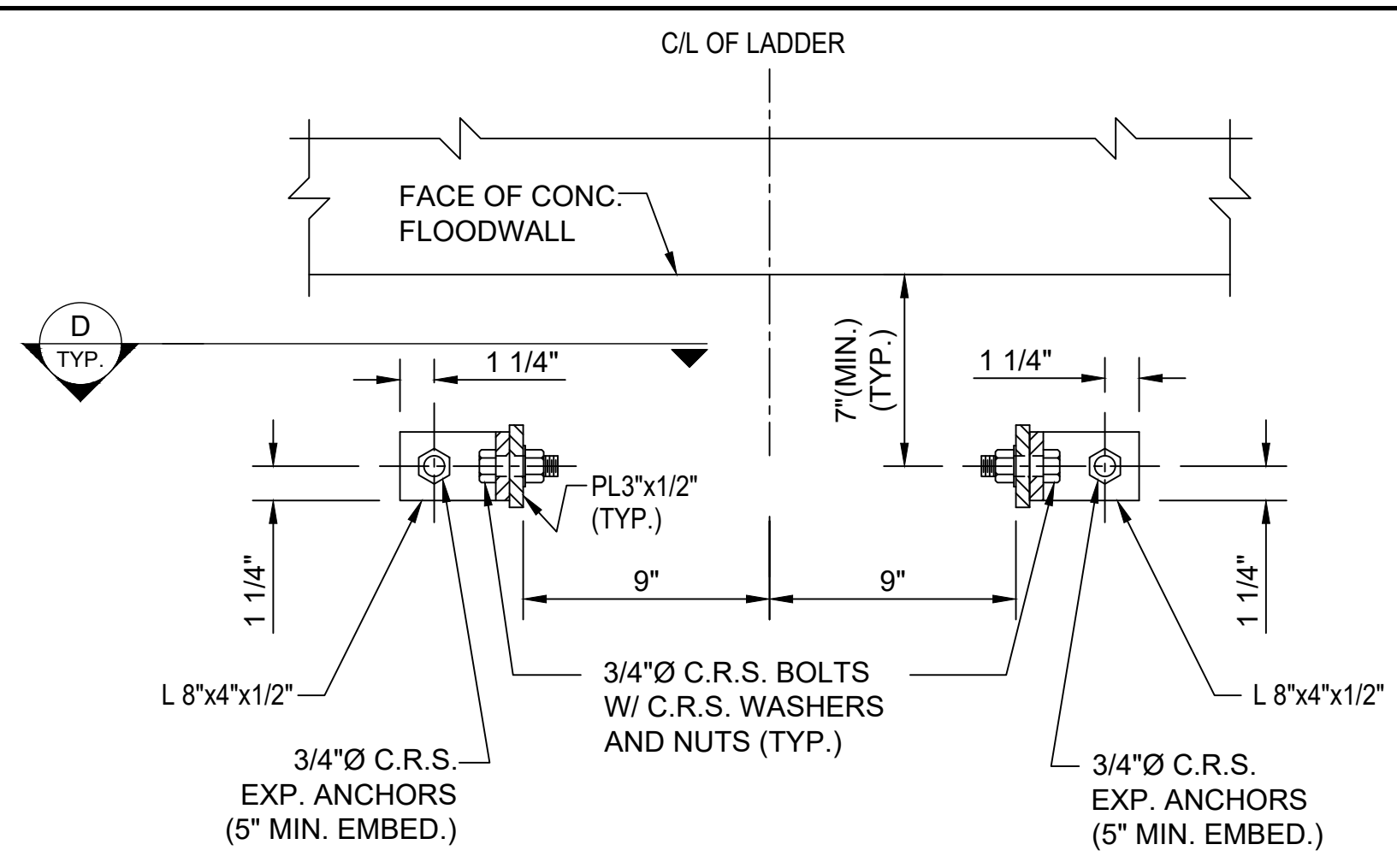


Project Title
**WEST LUMBERTON FLOOD G
AT VFW ROAD AND RAILROAD UNDERP
ENGINEERING SERVICES**

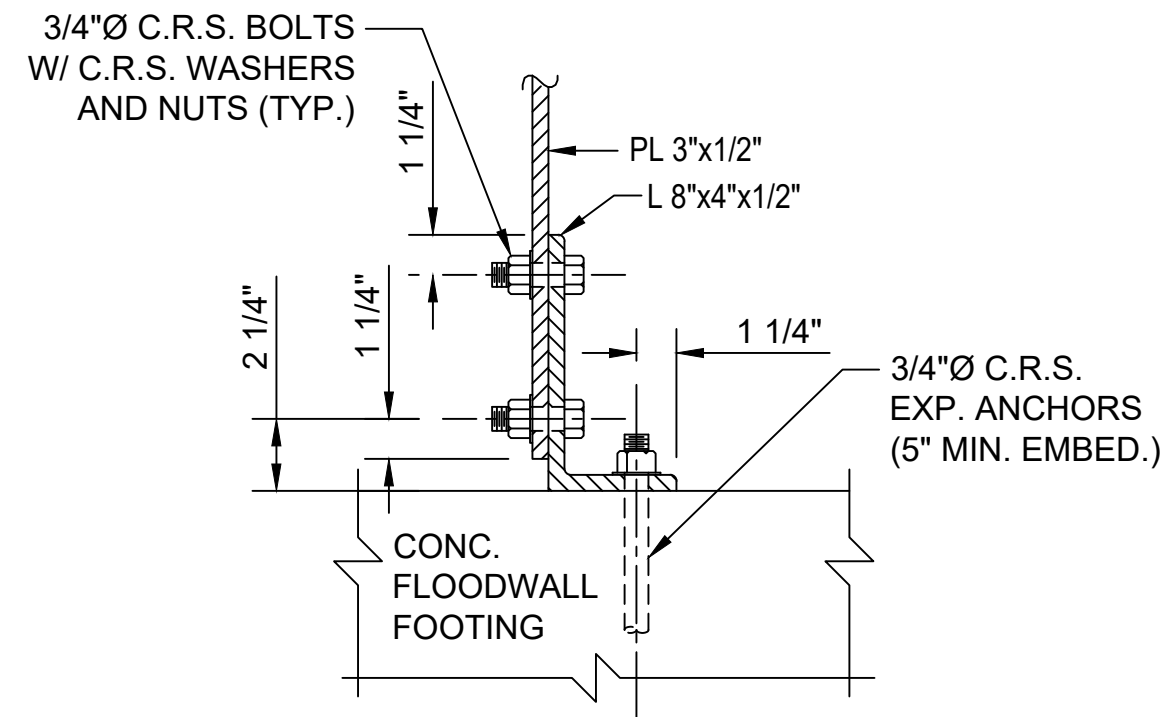
Drawing Title
LADDER DETAIL (2 OF 3)

Scale	Designed	Drawn	Checked	Authorized
3/4" = 1'-0"	--	--	--	--
Original Size	Date	Date	Date	Date
22x34	--/--	--/--	--/--	--/--
Drawing Number	Revision			
100068207-S-516				000

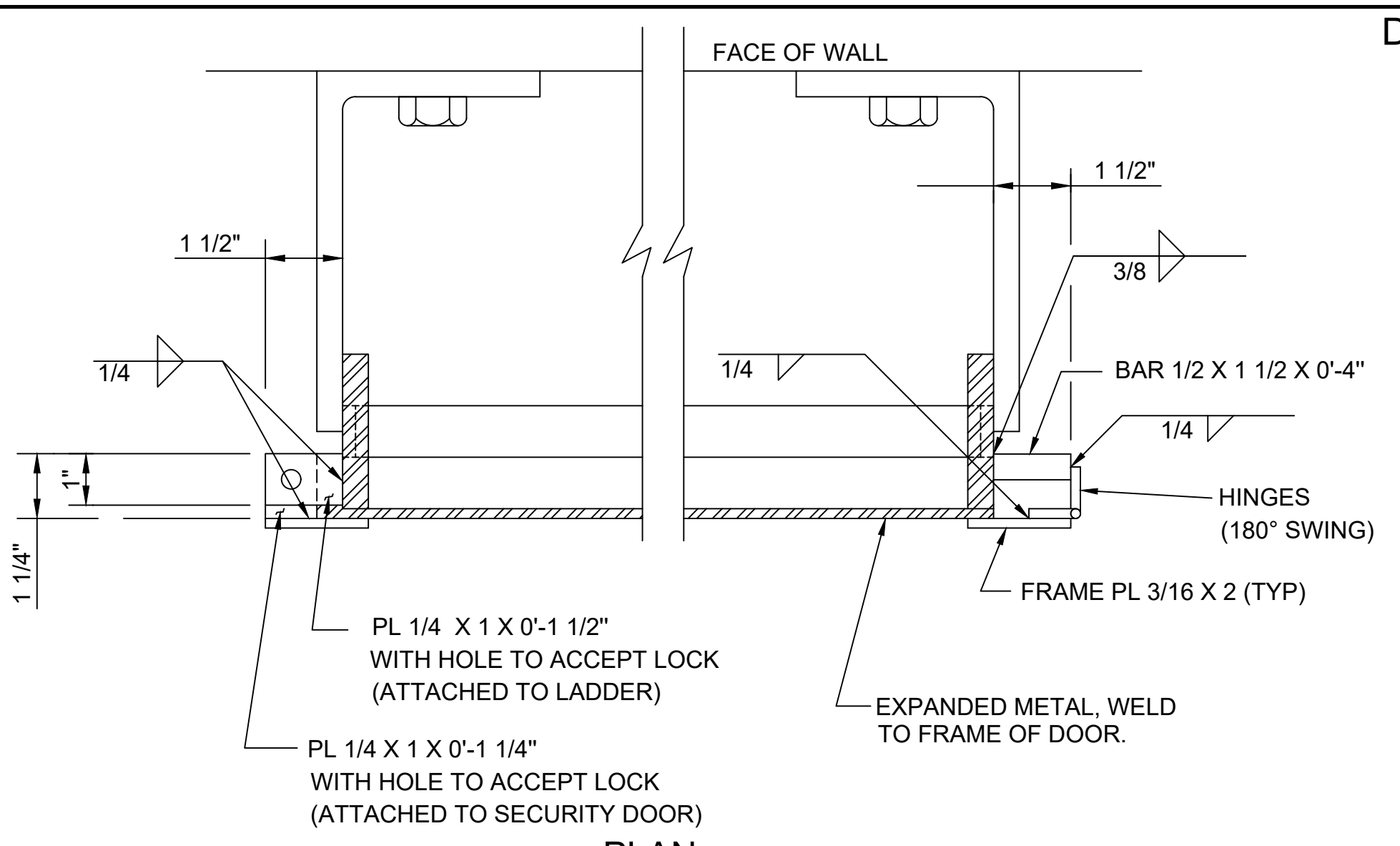
Inches
0
1/2
1
2
3
4



SECTION A
S-516 | S-517 SCALE: 2" = 1'-0"

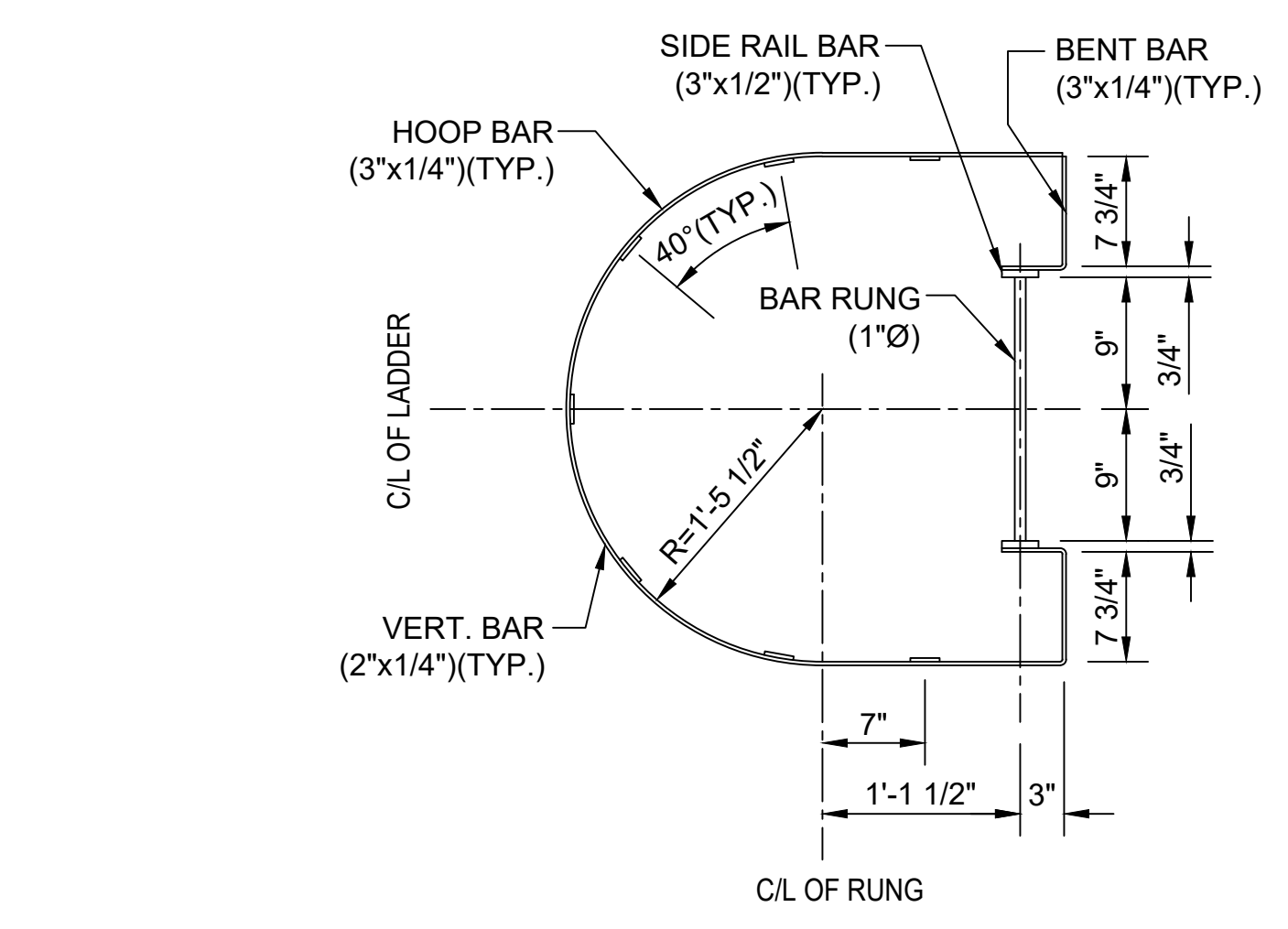


SECTION D
TYP. | TYP. SCALE: 2" = 1'-0"

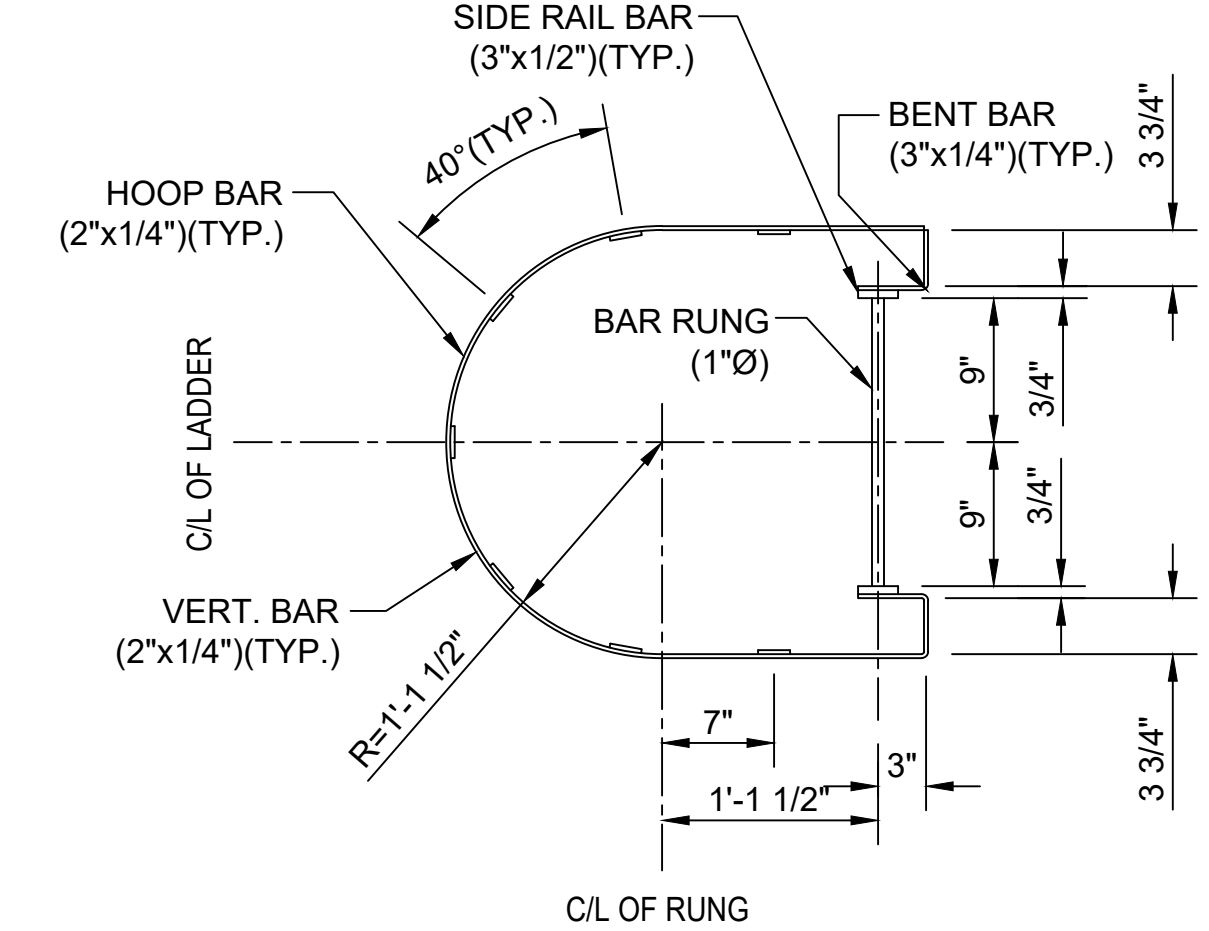


PLAN
SCALE: 3/8" = 1"

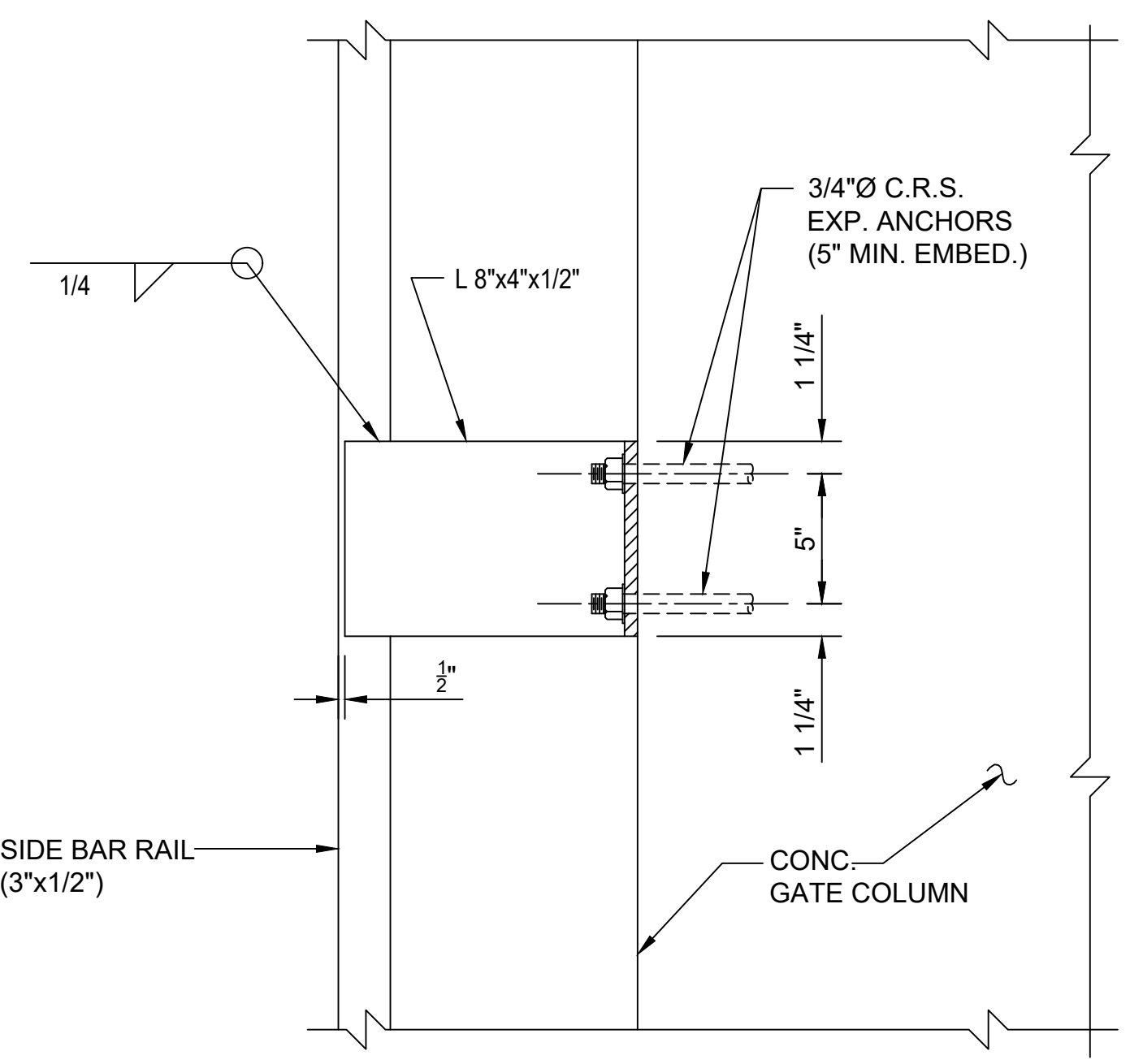
NOTE:
CONTRACTOR TO PROVIDE A SECURITY DOOR FOR ALL LADDERS ON THE PROTECTED SIDE OF THE WALL ONLY



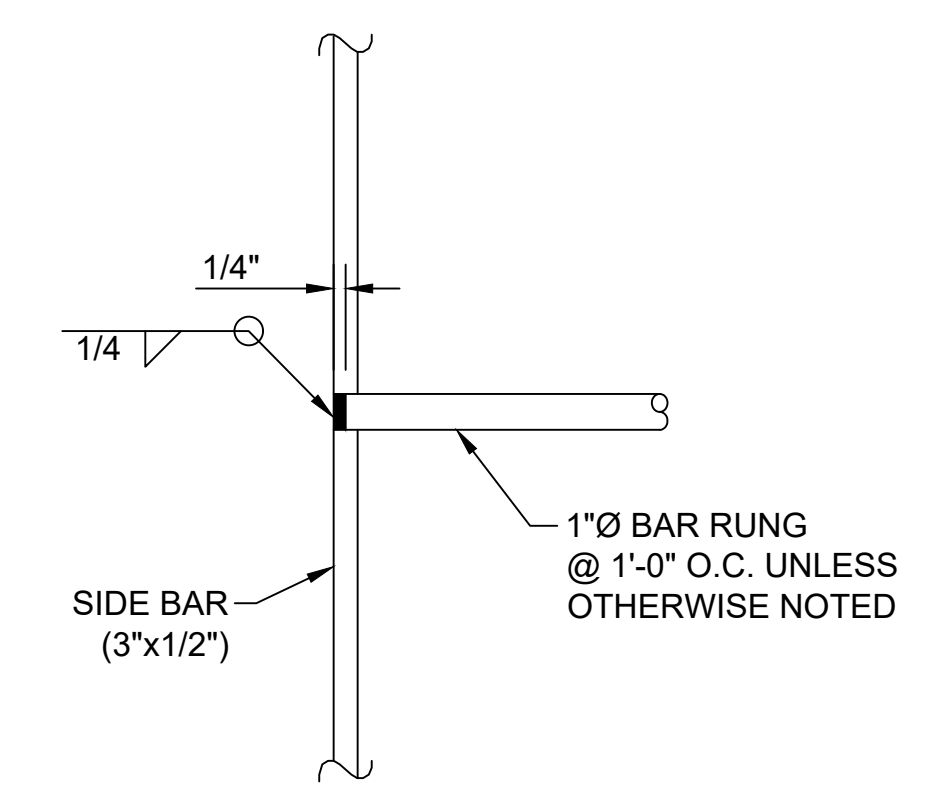
SECTION B
S-516 | S-517 SCALE: 1" = 1'-0"



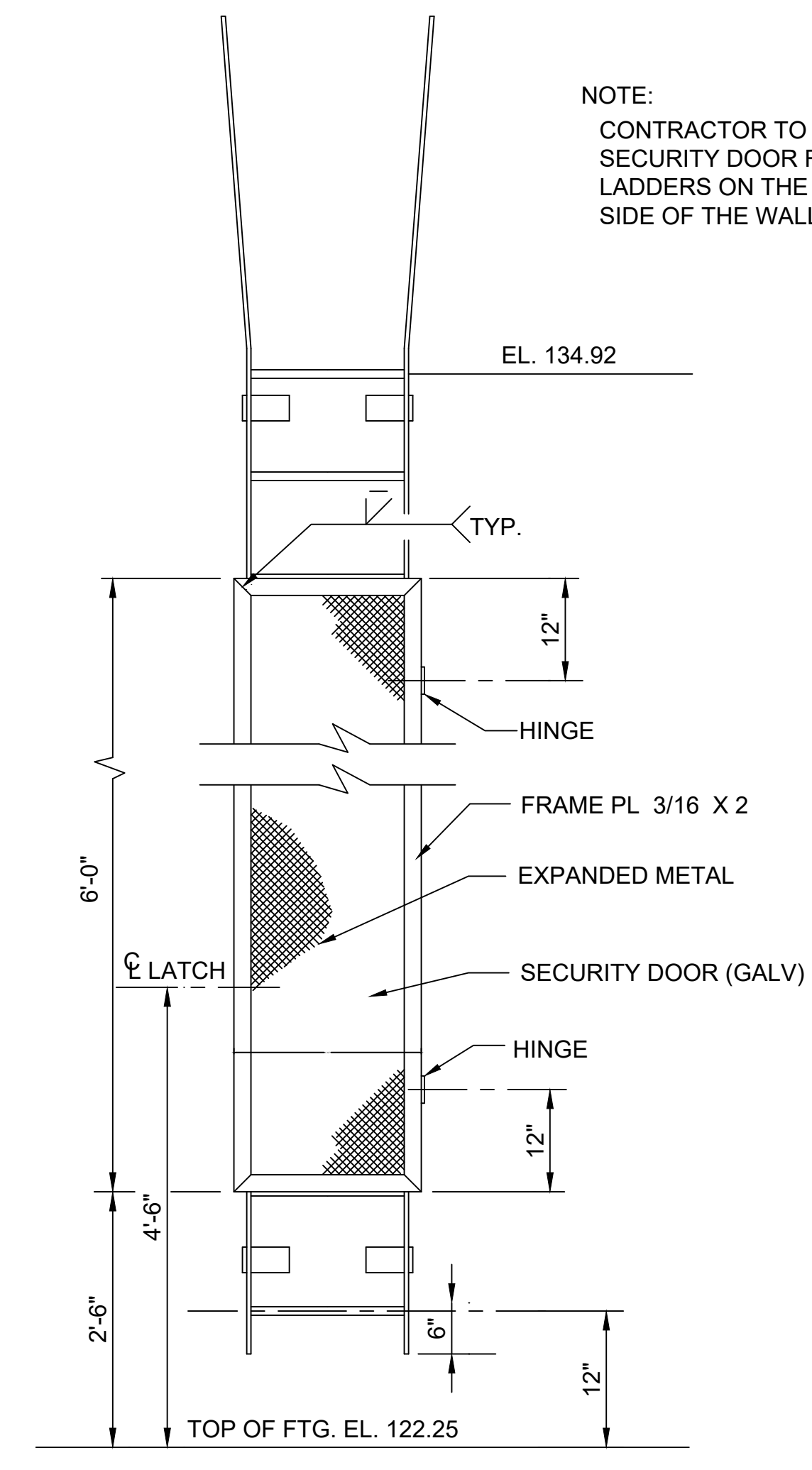
SECTION C
S-516 | S-517 SCALE: 1" = 1'-0"



1 DETAIL
S-516 | S-517 SCALE: 2" = 1'-0"

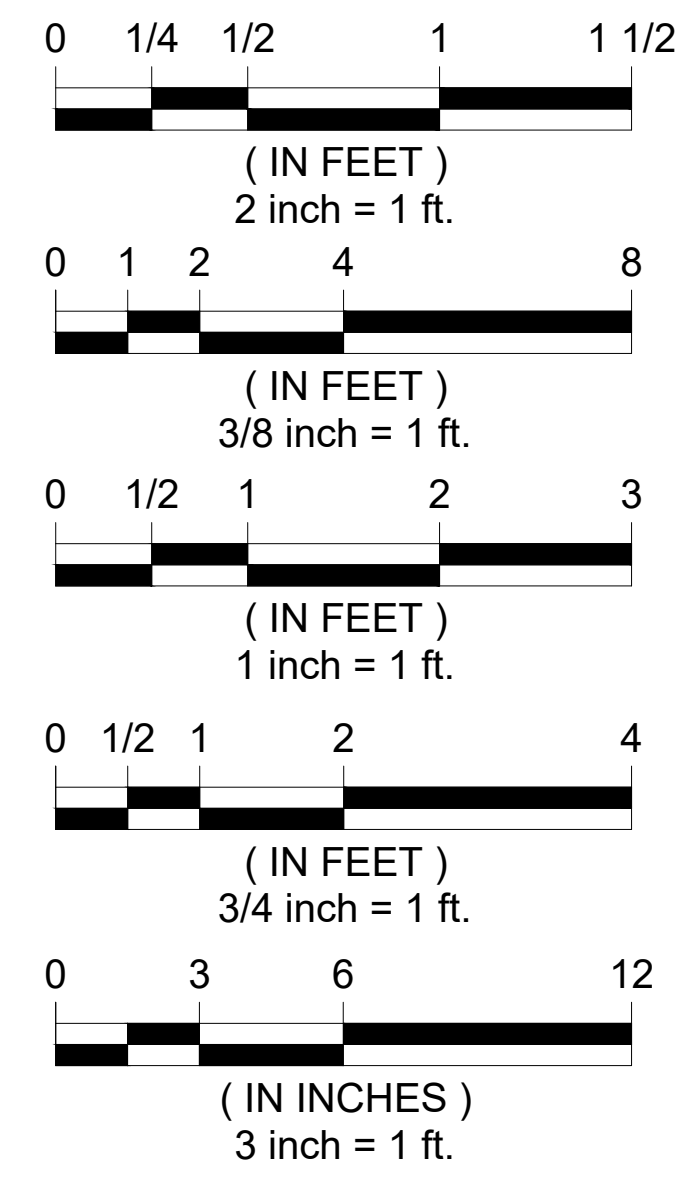


2 DETAIL
S-516 | S-517 SCALE: 3" = 1'-0"



PROTECTED SIDE ELEVATION
SCALE: 3/4" = 1'-0"

LADDER SECURITY DOOR DETAILS



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Drawing Legend

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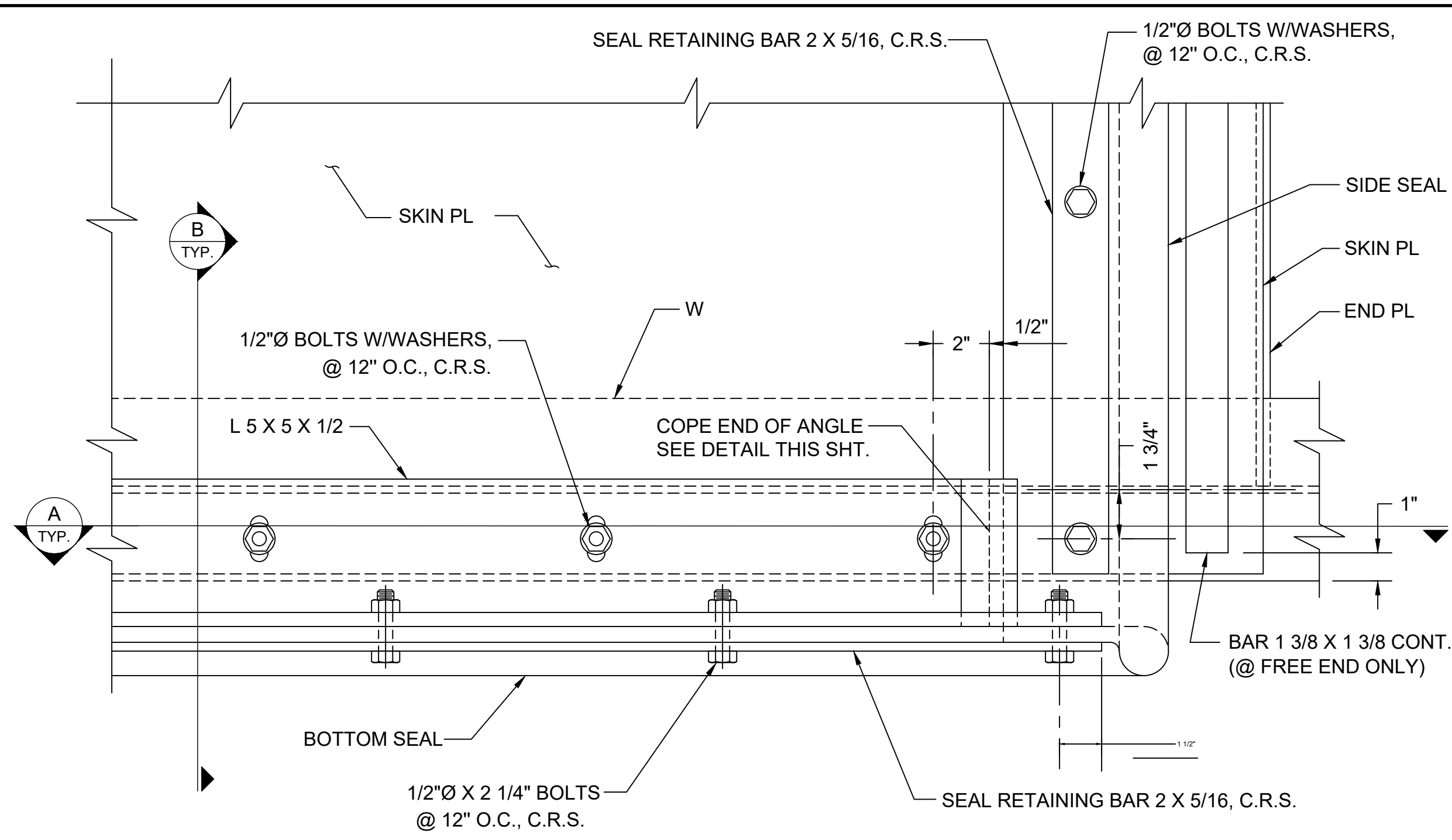
City of **LUMBERTON**
North Carolina

Project Title
**WEST LUMBERTON FLOOD G
AT VFW ROAD AND RAILROAD UNDERP
ENGINEERING SERVICES**

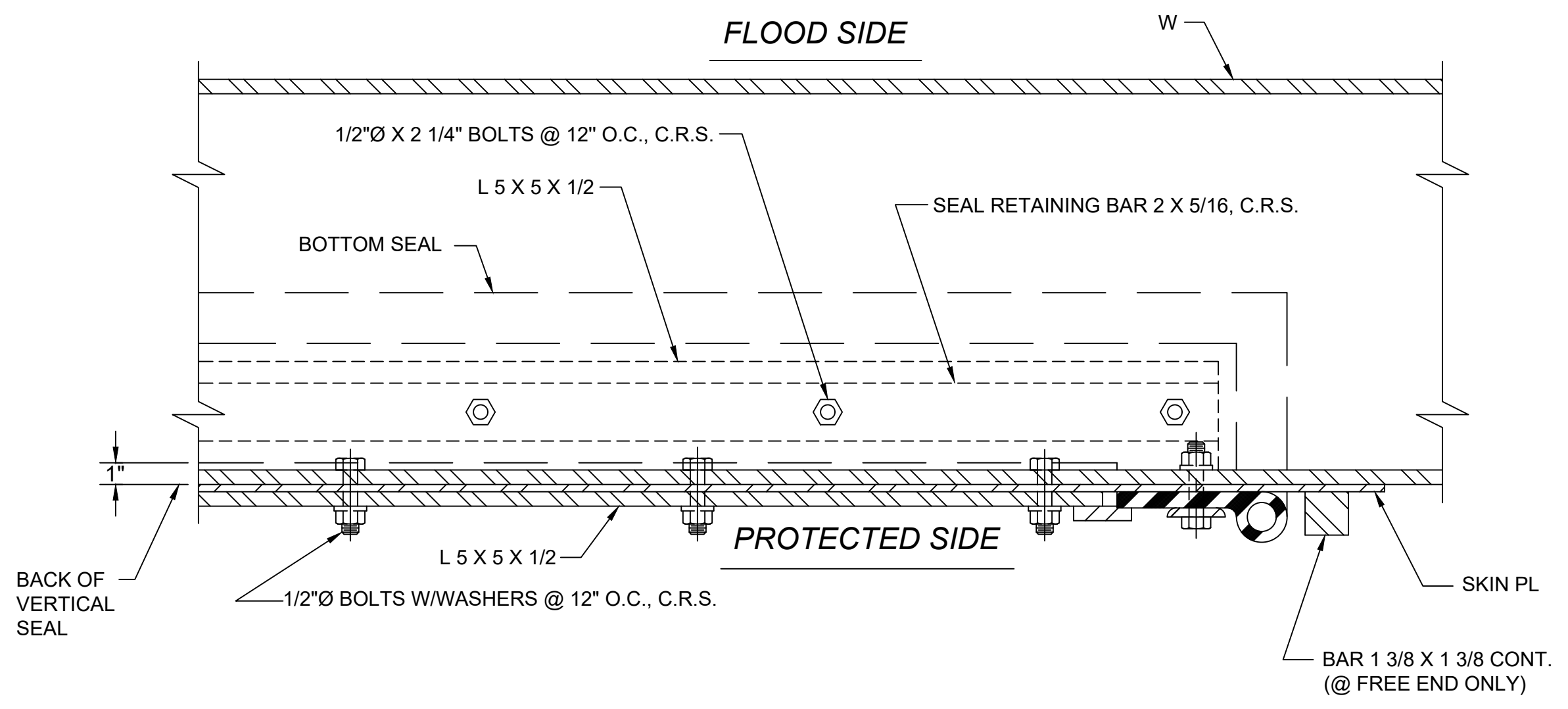
Drawing Title
LADDER DETAIL (3 OF 3)

Scale	Designed	Drawn	Checked	Authorized
SEE DWG.	--	--	--	--
Original Size	Date	Date	Date	Date
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Drawing Number	Revision			
100068207-S-517				000

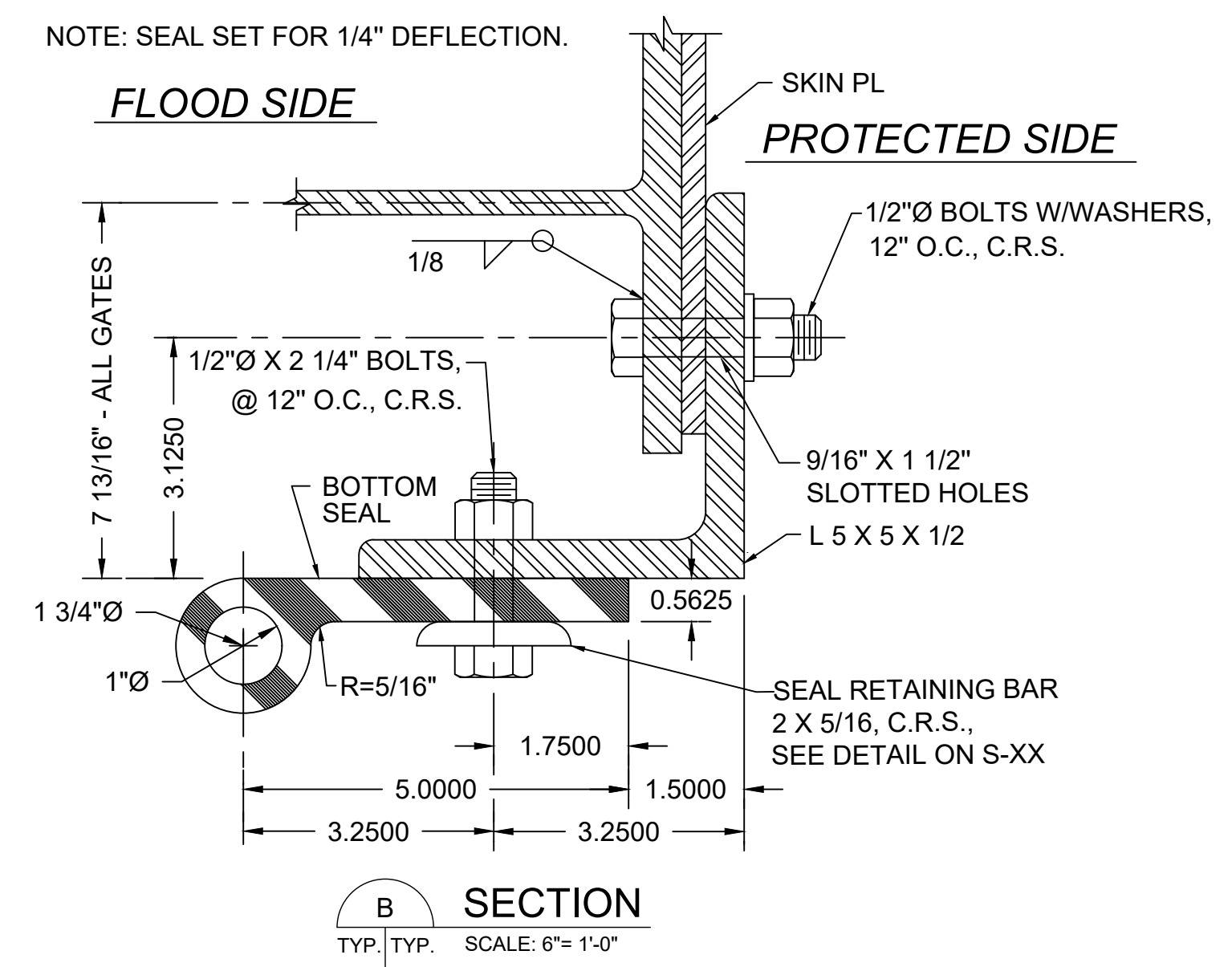
Inches
0
1/2
1
4



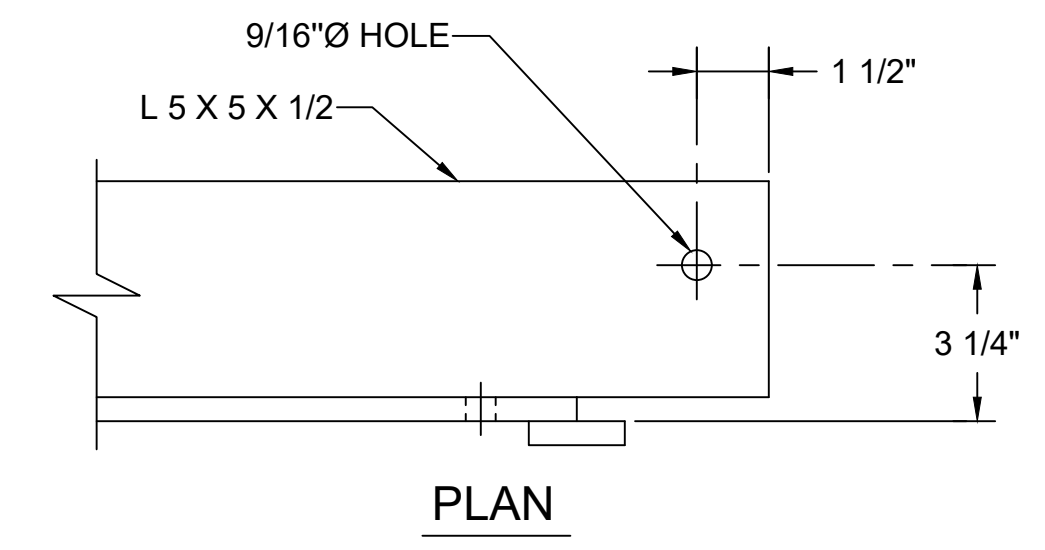
END ELEVATION - PROTECTED SIDE
SCALE: 3" = 1'-0"



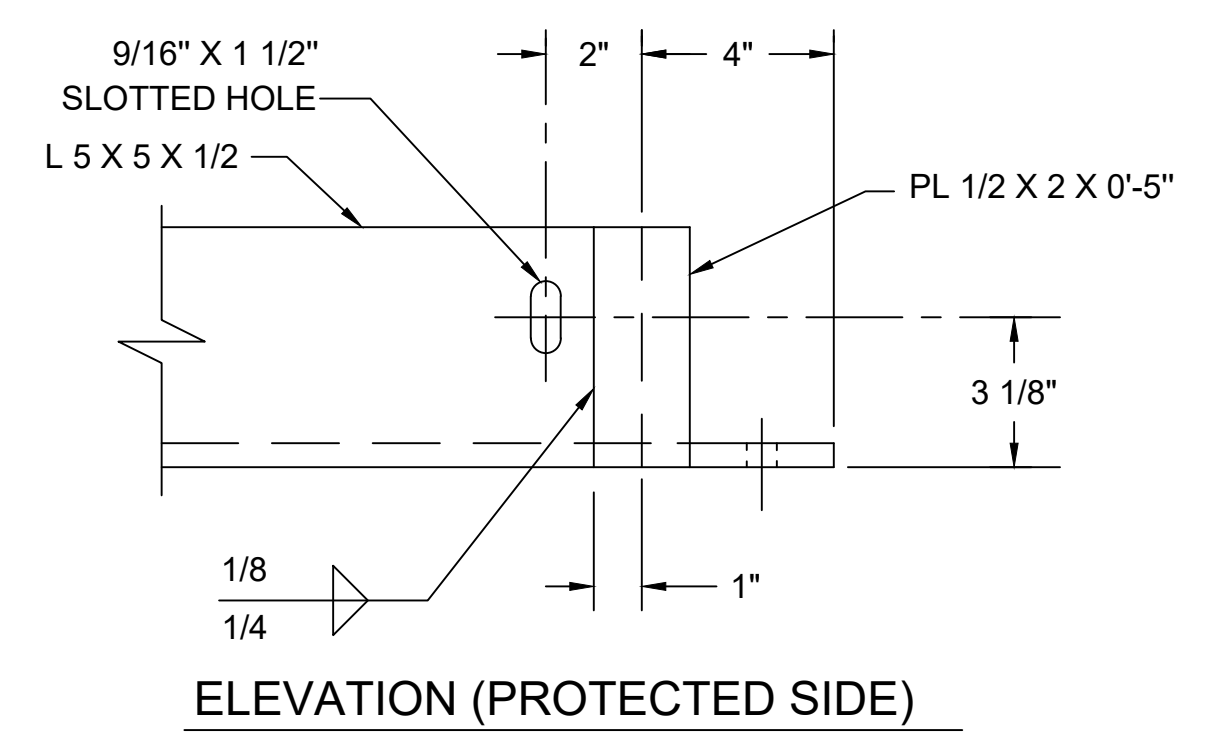
A SECTION
TYP. TYP. SCALE: 3" = 1'-0"



B SECTION
TYP. TYP. SCALE: 6" = 1'-0"



PLAN



ELEVATION (PROTECTED SIDE)

END OF L 5 X 5 X 1/2
SCALE: 3" = 1'-0"

DO NOT SCALE

Drawing Legend

Seal	Seal
------	------

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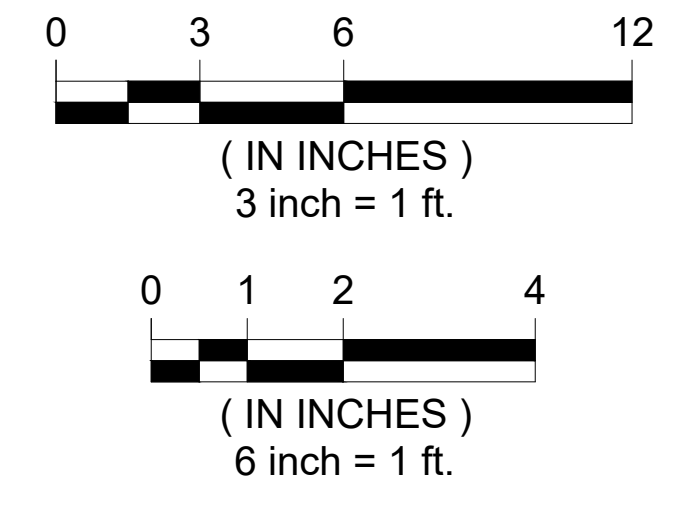
Client

Project Title
**WEST LUMBERTON FLOOD G
AT VFW ROAD AND RAILROAD UNDERP
ENGINEERING SERVICES**

Drawing Title
**SWING GATE
SEAL DETAIL (2 OF 2)**

Scale	Designed	Drawn	Checked	Authorized
SEE DWG.	--	--	--	--
Original Size	Date	Date	Date	Date
22x34	--/--	--/--	--/--	--/--
Drawing Number	Revision			
100068207-S-521				000

- NOTES:**
- FOR GENERAL NOTES, SEE G-001.
 - ALL SPLICES WILL BE FACTORY MADE IN HEAVY STEEL PRESS TYPE MOLDS UNDER PRESSURE AND HEAT.
 - ALL SPLICE JOINTS MUST DEVELOP STRENGTH OF AT LEAST 50% OF THE MINIMUM TENSILE STRENGTH REQUIRED OF THE RUBBER.
 - SEAL CLAMP ANGLES SHALL BE PAINTED ON ALL SIDES PRIOR TO ASSEMBLY.
 - AFTER ASSEMBLY AND SEAL ADJUSTMENTS ARE MADE, ALL GAPS IN SEALS AND SEAL SUPPORTS SHALL BE SEALED WITH A SILICONE RUBBER SEALANT TO PROVIDE WATERTIGHT JOINTS.



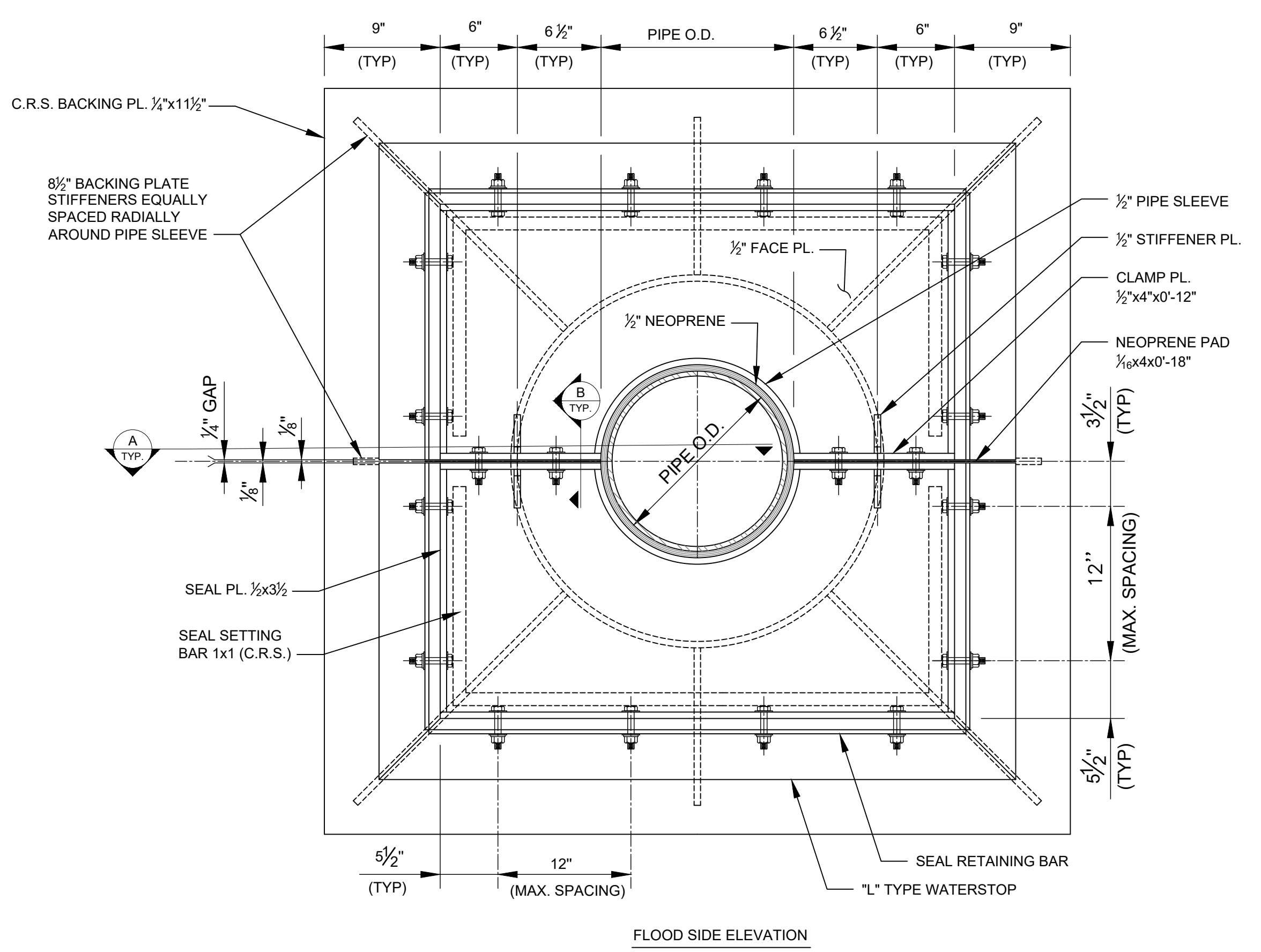
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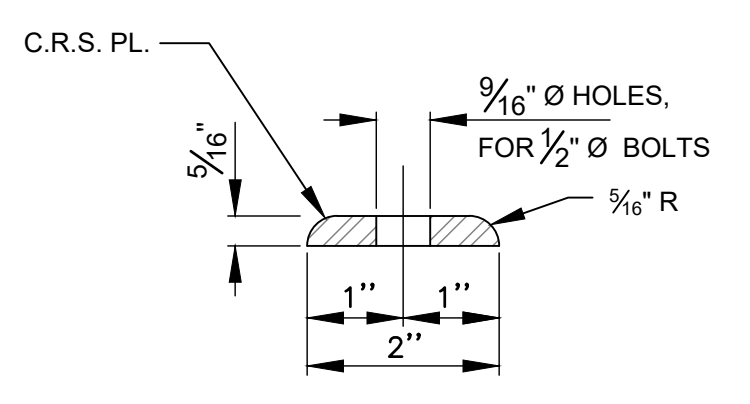
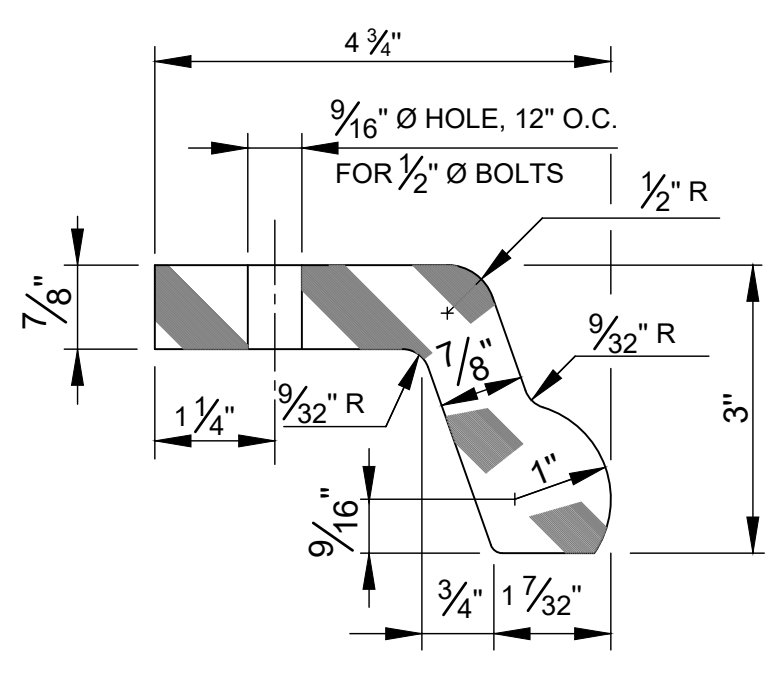
DO NOT SCALE

Drawing Legend

4
1
0 1/2
0
Inches



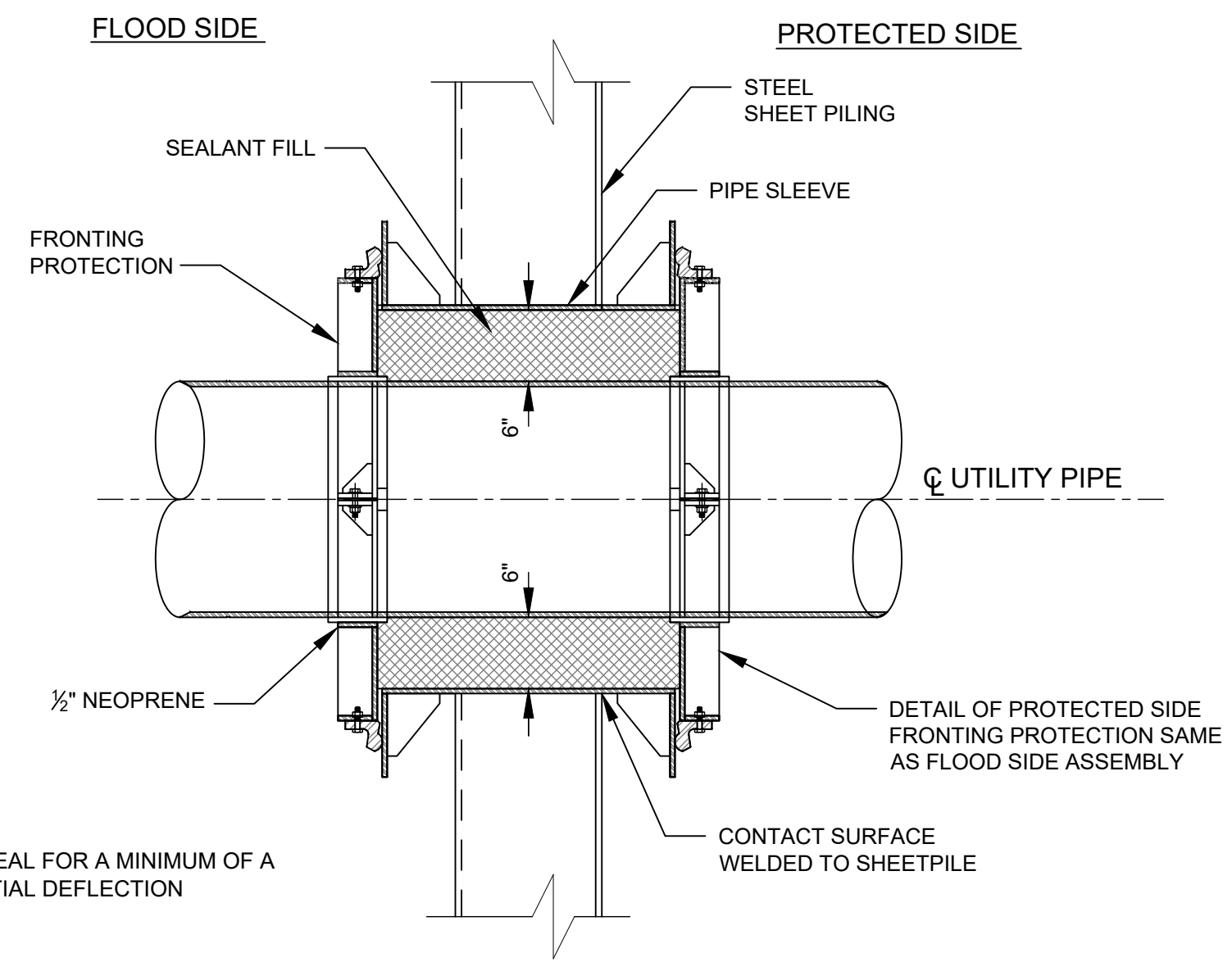
I-WALL PIPE PENETRATION DETAIL
SCALE: N.T.S.



SEAL RETAINING BAR
SCALE: 6\" = 1'-0"

BUCKHORN RUBBER PRODUCTS, INC.
MOLD NO. 5404
SPECIFICATION: NATURAL-177
OR EQUAL

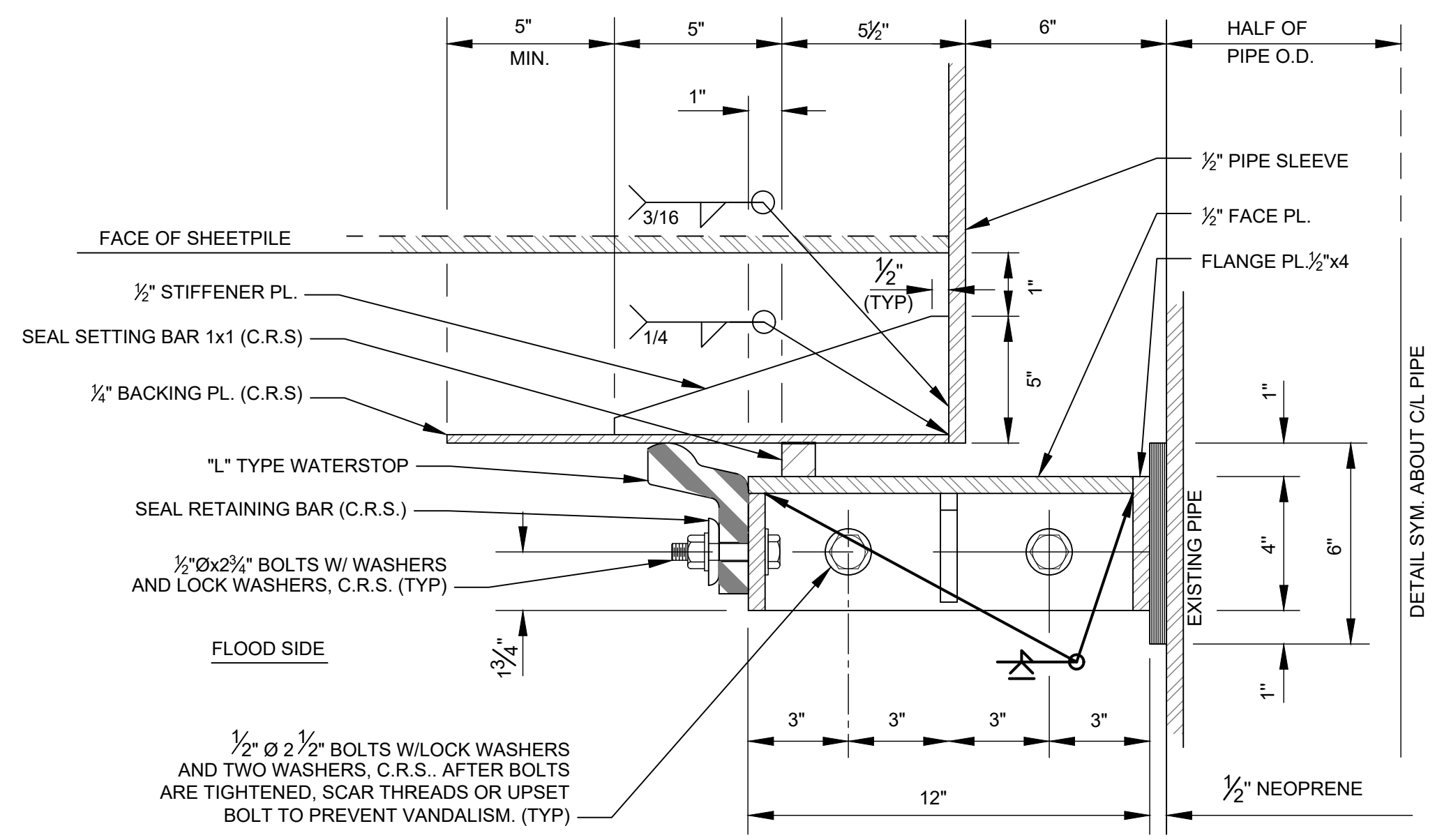
SEE SHEET C-201
FOR LOCATION OF
THESE PENETRATIONS



SECTION THRU SHEETPILE WALL
SCALE: N.T.S.

NOTES:

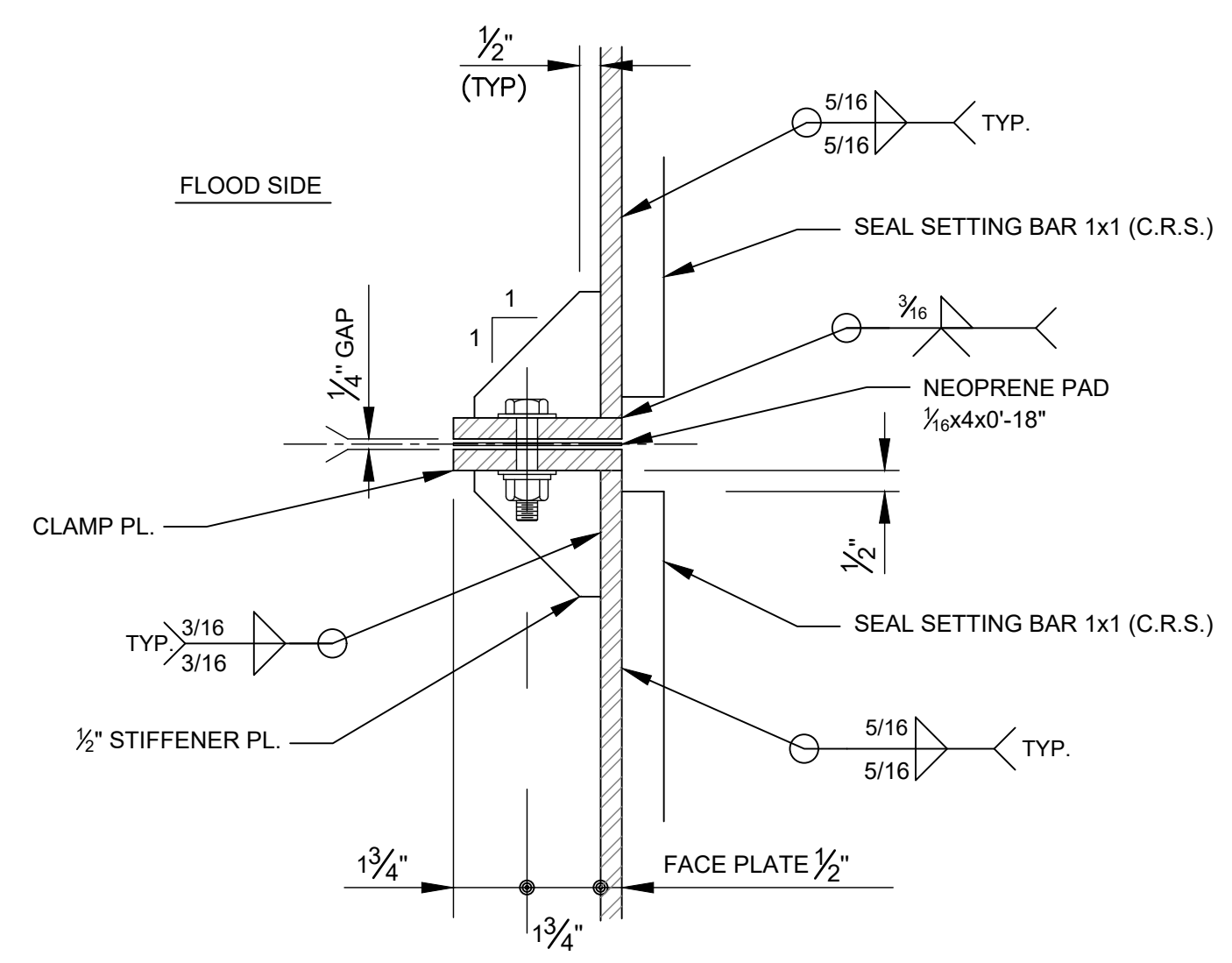
- THIS DETAIL IS BASED ON THE NEW WALL FACE BEING PERPENDICULAR TO THE PIPE.
- ALL FLANGE MATERIAL ATTACHED TO THE SHEETPILE SHALL BE ALUMINUM, UNLESS OTHERWISE NOTED.
- ALL MATERIAL FOR FRONTING PROTECTION SHALL BE ALUMINUM, UNLESS OTHERWISE NOTED.
- ALL STRUCTURAL ALUMINUM PLATES SHALL BE ASTM B 209, TYPE 6061-T6.
- ALL CORROSION-RESISTANT STEEL (C.R.S.) SHALL BE TYPE 316.
- WELDS SHOWN ARE TYPICAL FOR SIMILAR JOINTS AND ALL WELDS ON WALL SIDE OF FACE PLATE SHALL BE FLUSH WITH BASE METAL.
- AFTER THE TWO FRAMES ARE LOOSELY CLAMPED ON THE PIPE, THE TOTAL ASSEMBLY SHALL BE PUSHED AGAINST THE WALL, SETTING THE SEALS, THEN TIGHTEN CLAMP PLATES TO CLOSE THE 1/4" GAP.
- UPON COMPLETION OF THE ASSEMBLY, APPLY AN ANAEROBIC ADHESIVE (LOCTITE THREADLOCKER 290 OR EQUAL) TO ALL NUT AND BOLT JUNCTURES.
- INCLUDE THE COST OF THE WORK ON THIS SHEET IN THE LUMP SUM PRICE FOR "DRAINAGE CANAL CROSSINGS AND END TREATMENT"



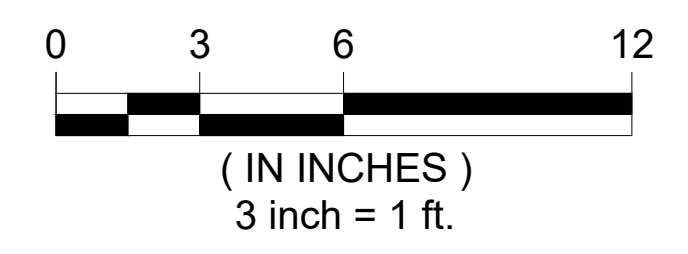
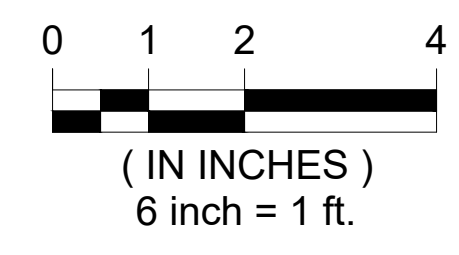
ALL PLATE 1/2" UNLESS OTHERWISE NOTED

NOTE:
SET SEAL FOR A MINIMUM OF A 1/4" INITIAL DEFLECTION

A SECTION
TYP. | TYP. SCALE: 3" = 1'-0"



B SECTION
TYP. | TYP. SCALE: 3" = 1'-0"



Seal	Seal
------	------

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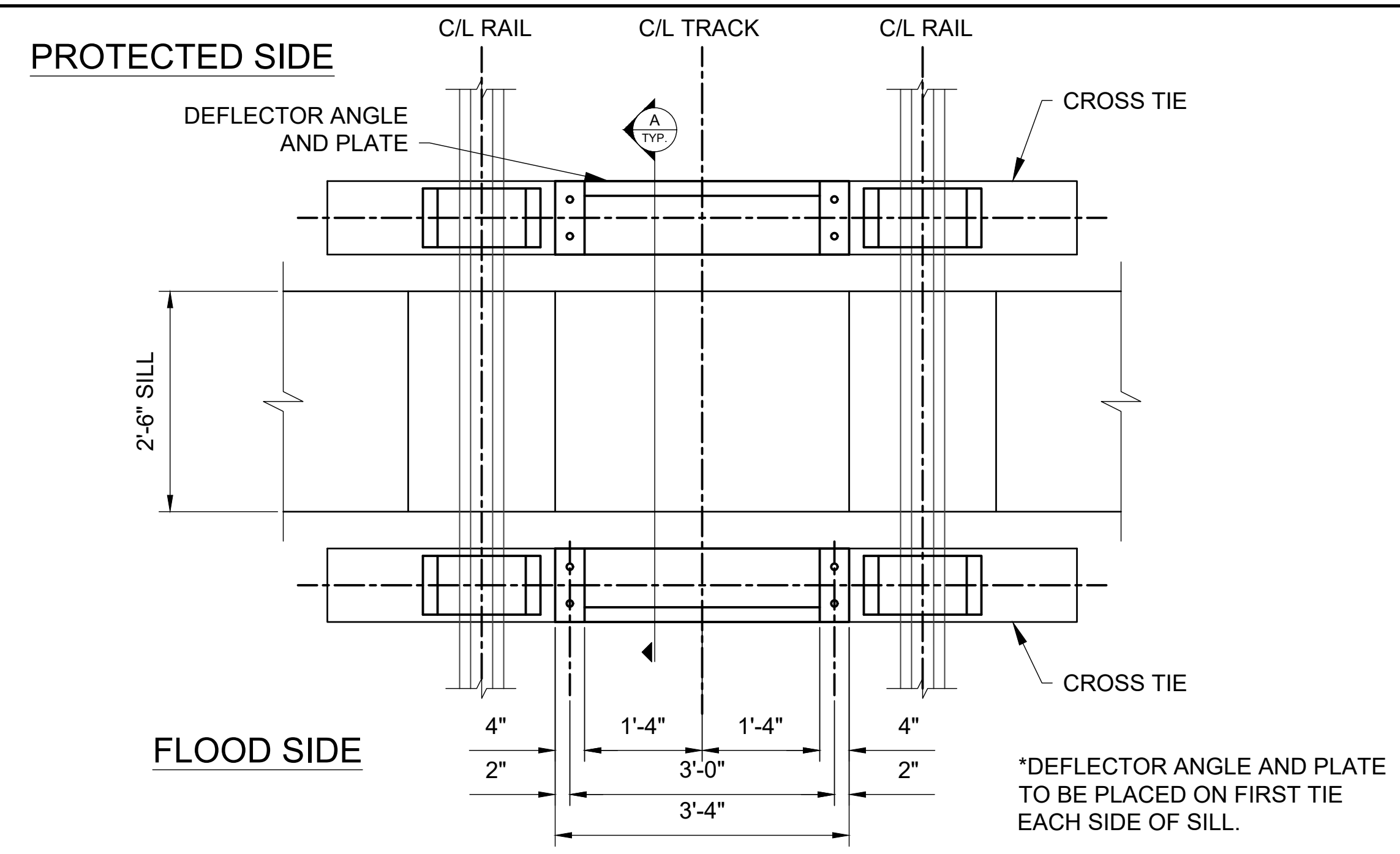
Drawing Title
DRAINAGE AND UTILITY DETAILS

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SEE DWG.	--	--	--	--
Original Size	Date	Date	Date	Date
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Drawing Number	Revision			
100068207-S-524				000

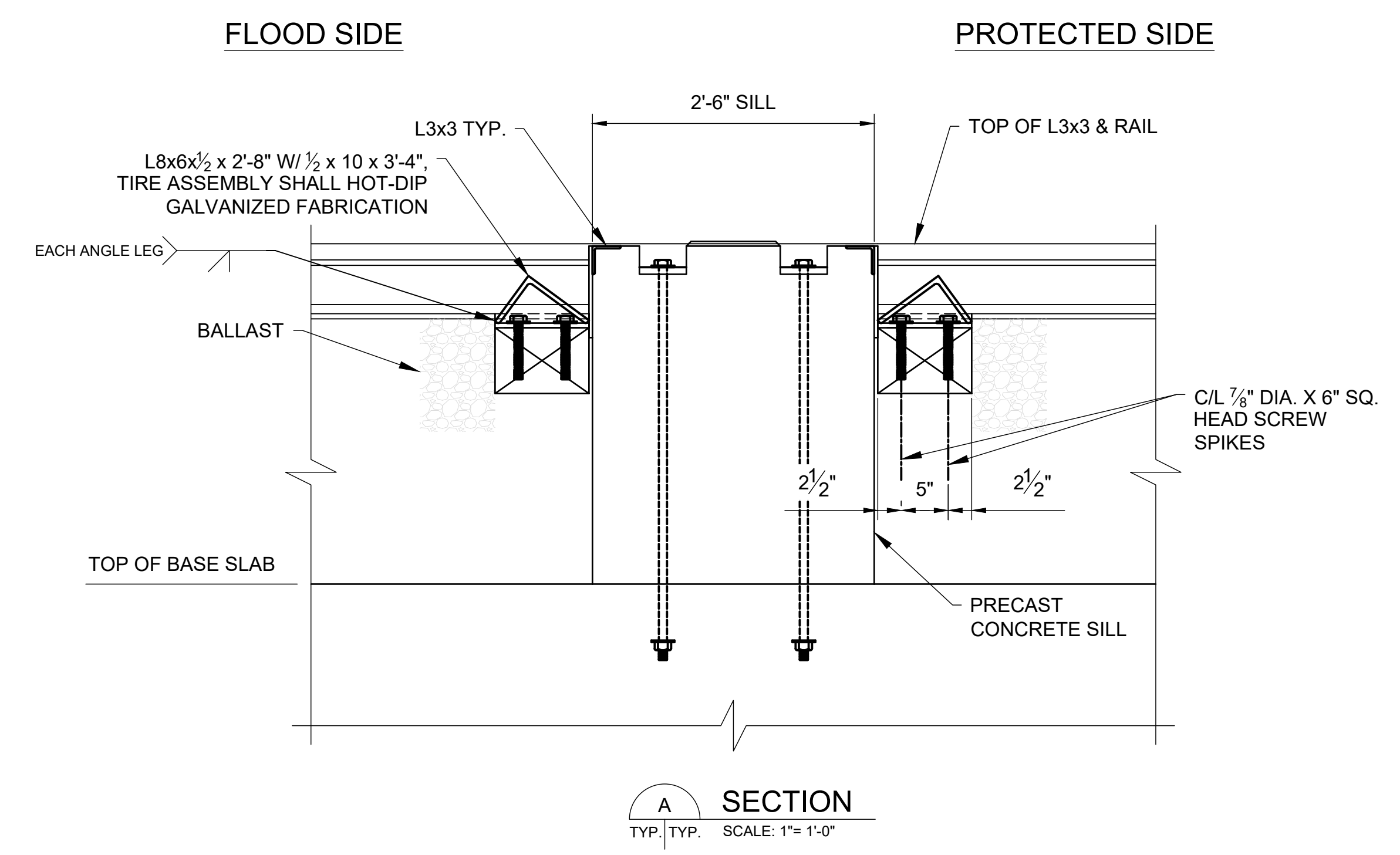
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Inches
0 1/2 1 4



PLAN - DEFLECTOR ANGLE AND PLATE DETAIL
SCALE: 3/4" = 1'-0"



SECTION A
TYP. TYP. SCALE: 1" = 1'-0"

DO NOT SCALE

Drawing Legend

Seal	Seal
------	------

Rev.	Date	Description	By	Chk'd	App'd

Drawing Status					Suitability
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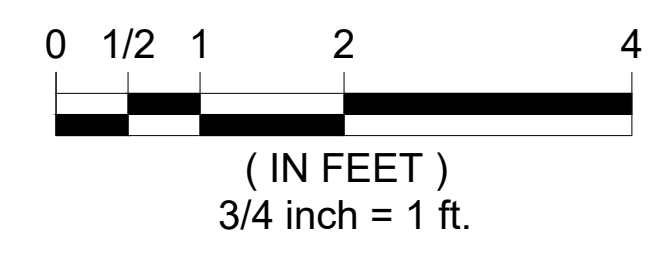
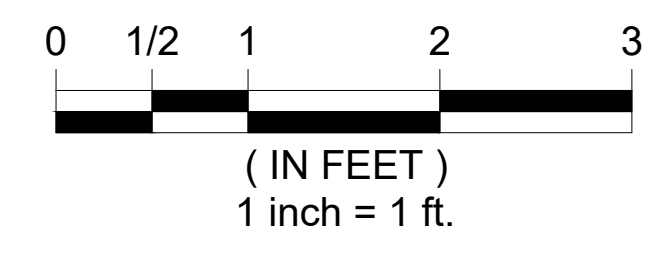
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Project Title
WEST LUMBERTON FLOOD G AT VFW ROAD AND RAILROAD UNDERP ENGINEERING SERVICES

Drawing Title
RAIL AND COMPONENT PART DETAIL (2 OF 2)



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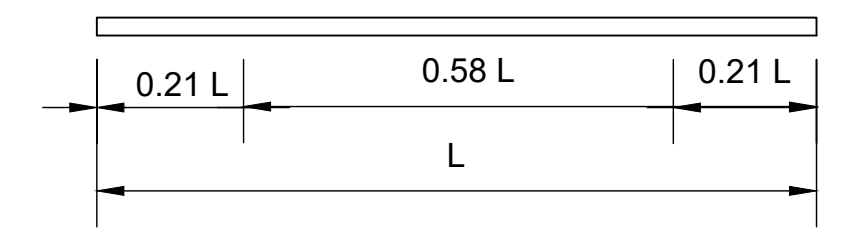
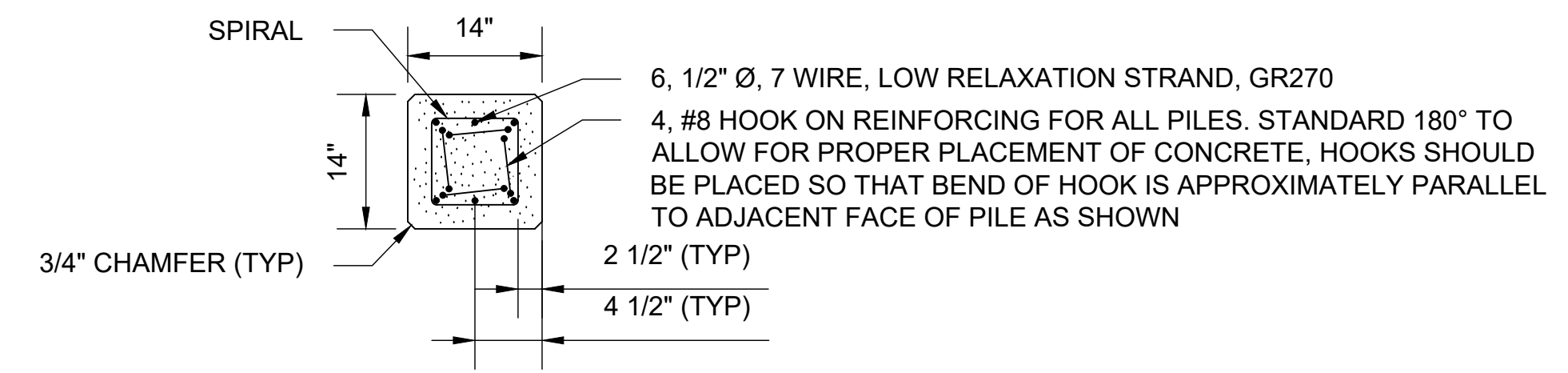
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Original Size	Date	Date	Date	Date
22x34	--/--	--/--	--/--	--/--
Drawing Number	Revision			
100068207-S-527				000

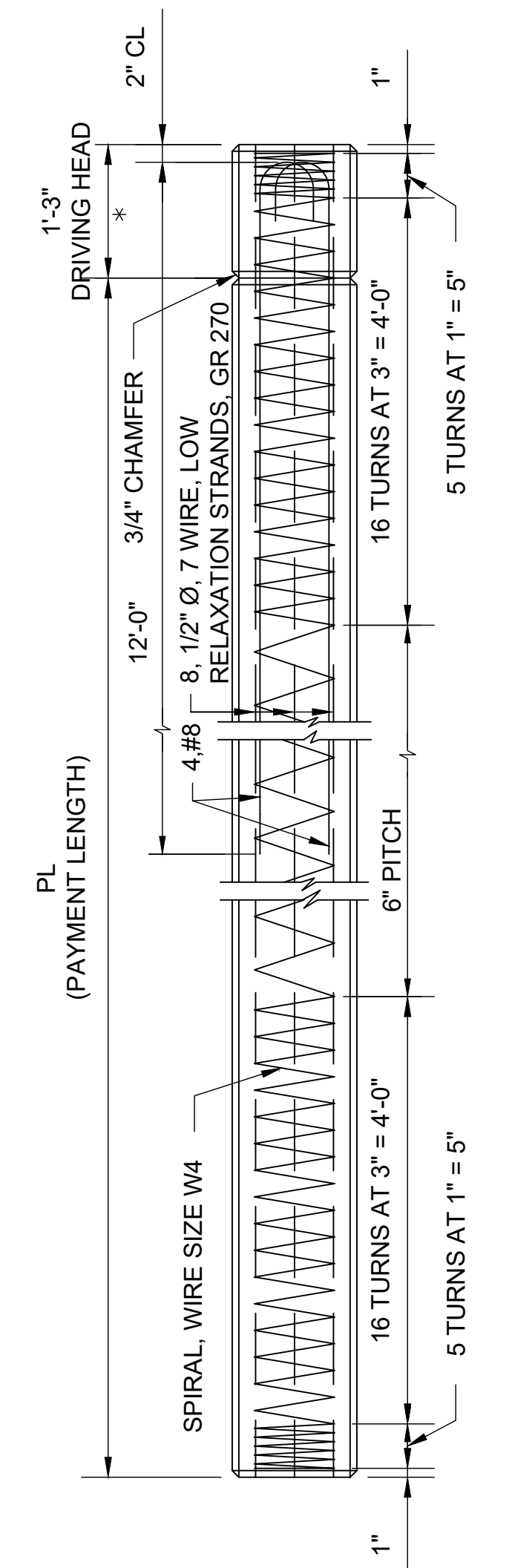
Inches
0 1/2 1 2 3 4

DO NOT SCALE

Drawing Legend



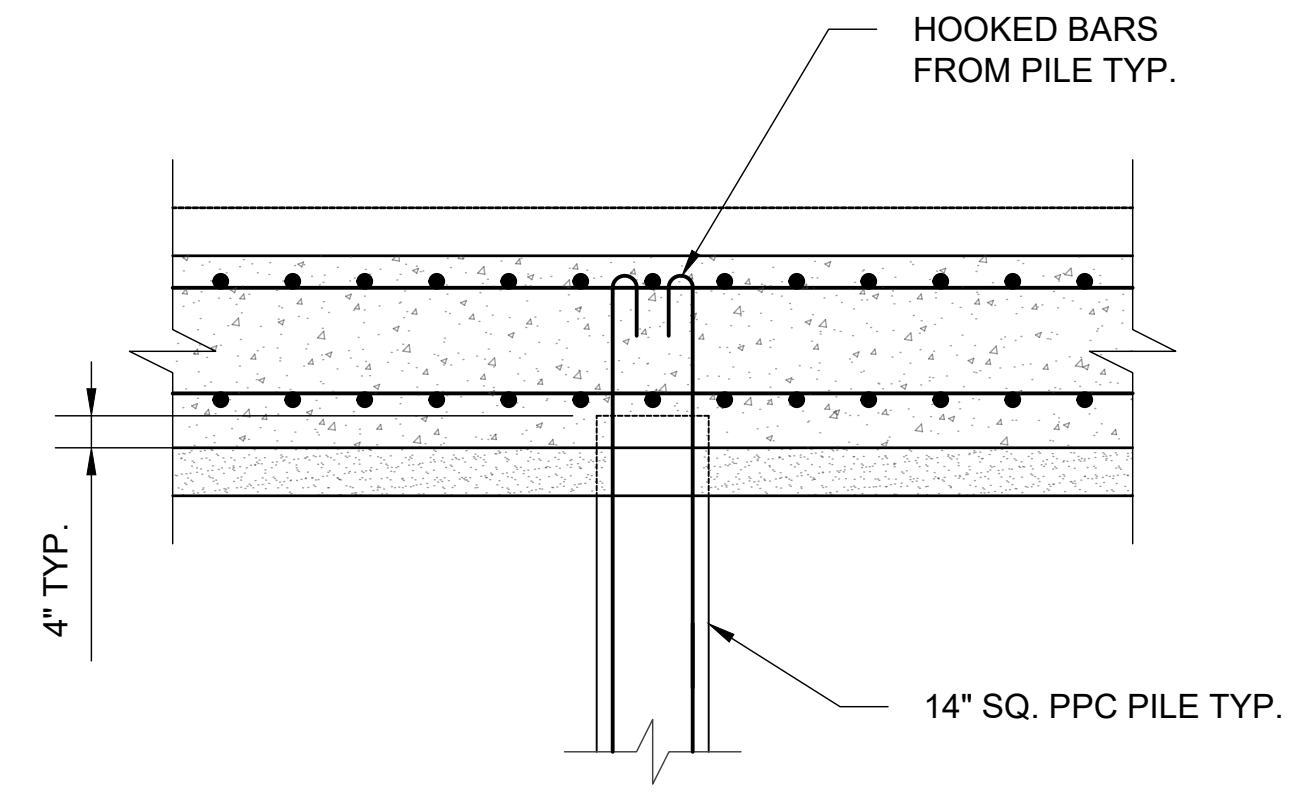
2 POINT PICKUP (L ≤ 83') 14" X 14" PILE
NOTE: PICKUP POINTS TO BE PLAINLY MARKED ON PILES



* DRIVING HEAD CONCRETE, STRANDS AND SPIRAL TIES TO BE REMOVED AFTER DRIVING TO EXPOSE HOOKS (NO PAYMENT)

NOTE:
GRIND PRESTRESSED STRANDS FLUSH WITH PILE HEAD AND PILE TIP.

14" X 14" PRESTRESSED
PRECAST CONCRETE PILE
NTS



TENSION CONNECTOR DETAIL
NTS

Seal	Seal
------	------

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North Carolina

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AT VFW ROAD AND RAILROAD UNDERP
ENGINEERING SERVICES

Drawing Title
TYPICAL PILE DETAIL

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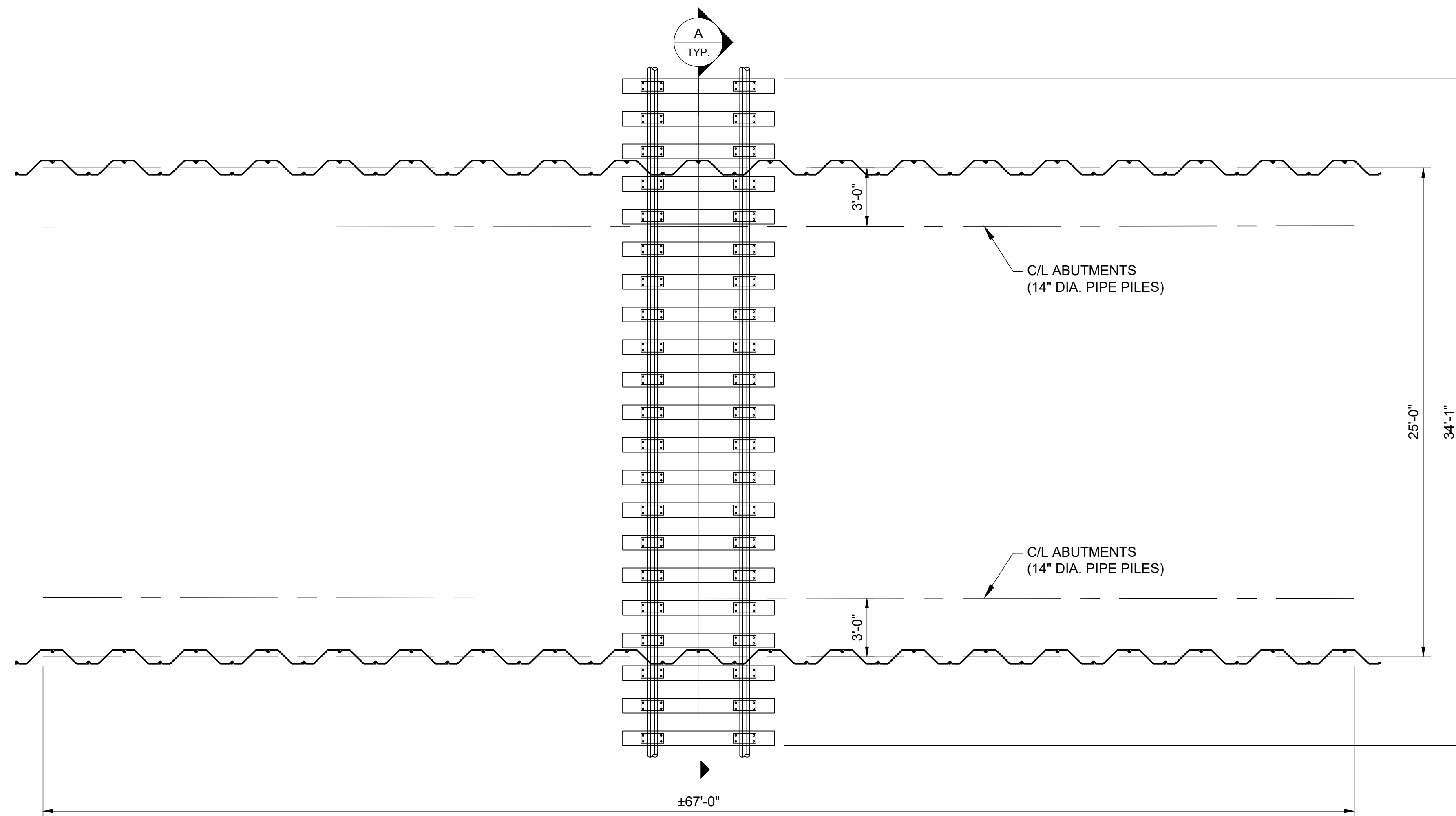
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NTS	--	--	--	--
Original Size	Date	Date	Date	Date
22x34	--/--	--/--	--/--	--/--
Drawing Number	Revision			
100068207-S-528				000

DO NOT SCALE

Drawing Legend

Inches
4
1
1/2
0

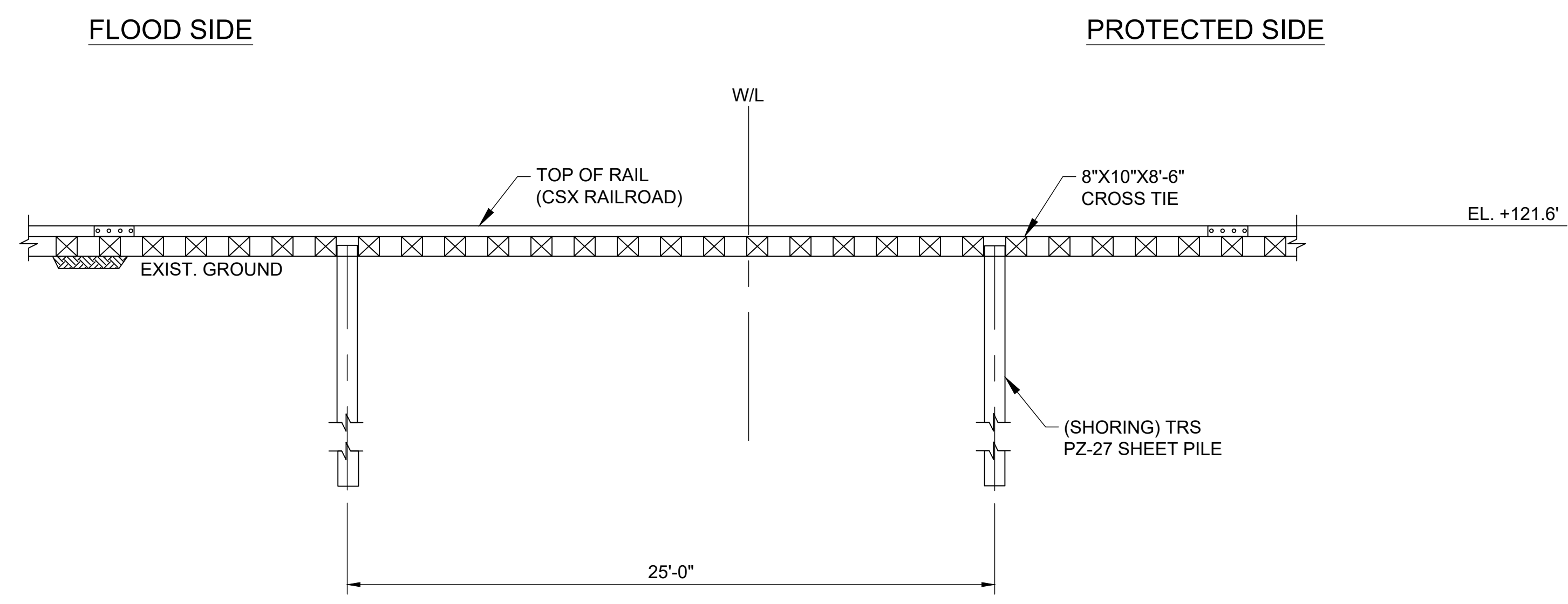


1 PHASE 1 PLAN VIEW
TYP. TYP. SCALE: 1/4" = 1'-0"

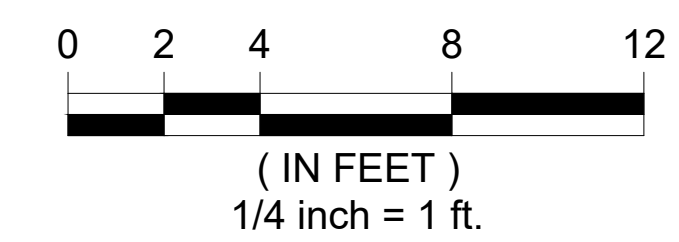
TRACK WINDOWS WILL BE REQUIRED FOR ALL PHASES OF WORK WHERE TRACK(S) WILL BE BLOCKED OR OUT OF SERVICE, TRACK WINDOWS TO BE COORDINATED WITH CSX.

PHASE 1 CONSTRUCTION SEQUENCING:

1. CONTRACTOR COORDINATES FINAL CONSTRUCTION SEQUENCE WITH THE RAILROAD COMPANY AND EXECUTES A TEMPORARY CONSTRUCTION CROSSING AGREEMENT WITH CSX RAILROAD.
2. THE CONTRACTOR SHALL COORDINATE WITH THE RAILROAD COMPANY TO SCHEDULE TRACK WINDOWS TO INSTALL SECTIONS OF SHORING SHEET PILING. THE RAILROAD COMPANY WILL REMOVE 34-FOOT SECTIONS OF RAIL FROM EACH TRACK. CONTRACTOR TO INSTALL SECTIONS OF SHORING (TRS) SHEET PILING. FINAL ELEVATION OF SHORING SHEET PILING SHALL BE AS SHOWN IN THE PLANS. SHORING SHEET PILING SHALL REMAIN IN-PLACE AT THE COMPLETION OF THE PROJECT AND WILL BE CUT-OFF A MINIMUM OF 2-FT BELOW THE TOP-OF-TIE.



A SECTION
TYP. TYP. SCALE: 1/4" = 1'-0"



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Seal	Seal
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Rev.	Date	Description	By	Chk'd	App'd	Suitability
						SO

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Project Title
WEST LUMBERTON FLOOD G AT VFW ROAD AND RAILROAD UNDERP ENGINEERING SERVICES

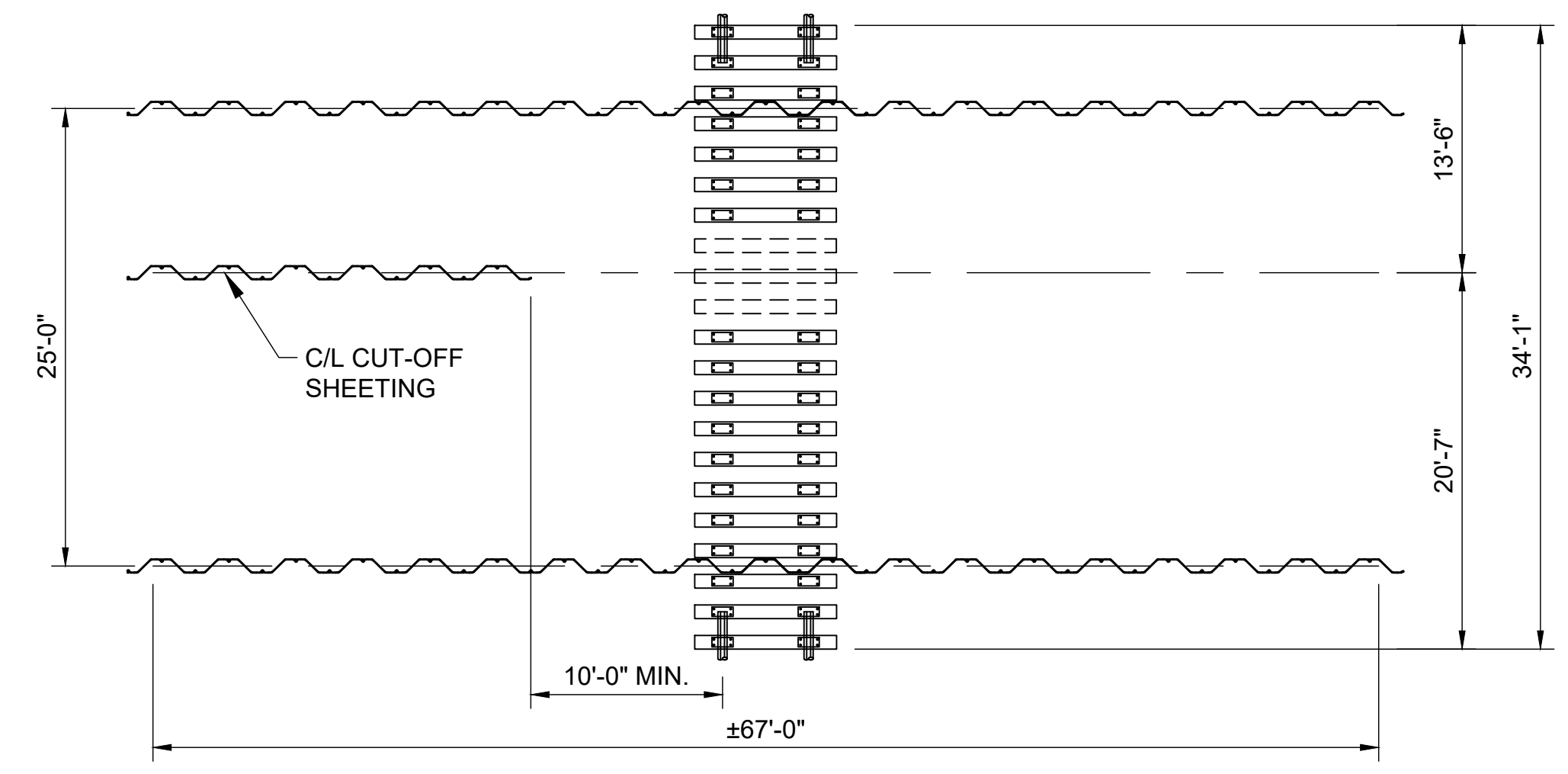
Drawing Title
RAILROAD TRS (1 OF 6)

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Drawing Number	Revision			
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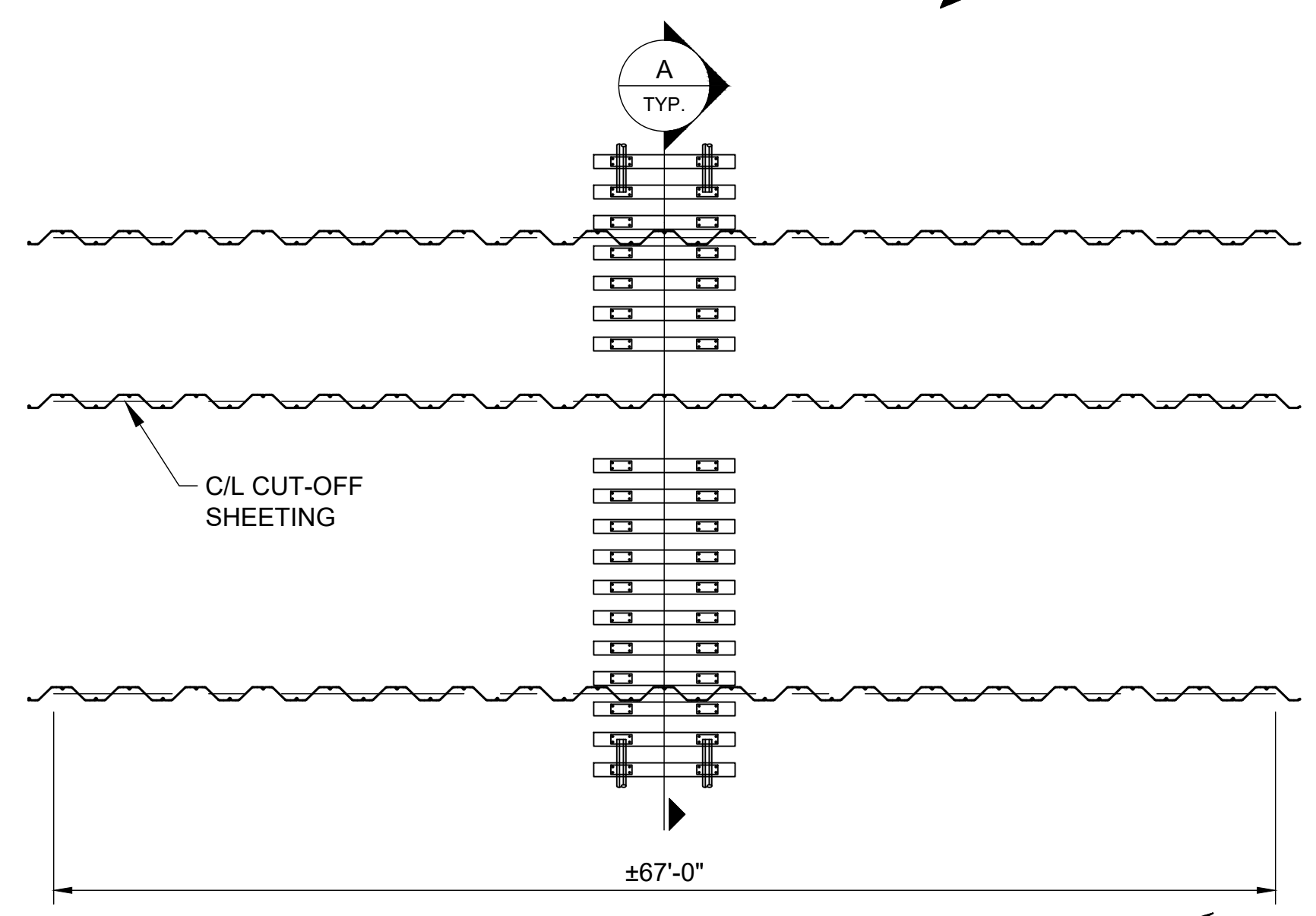
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DO NOT SCALE

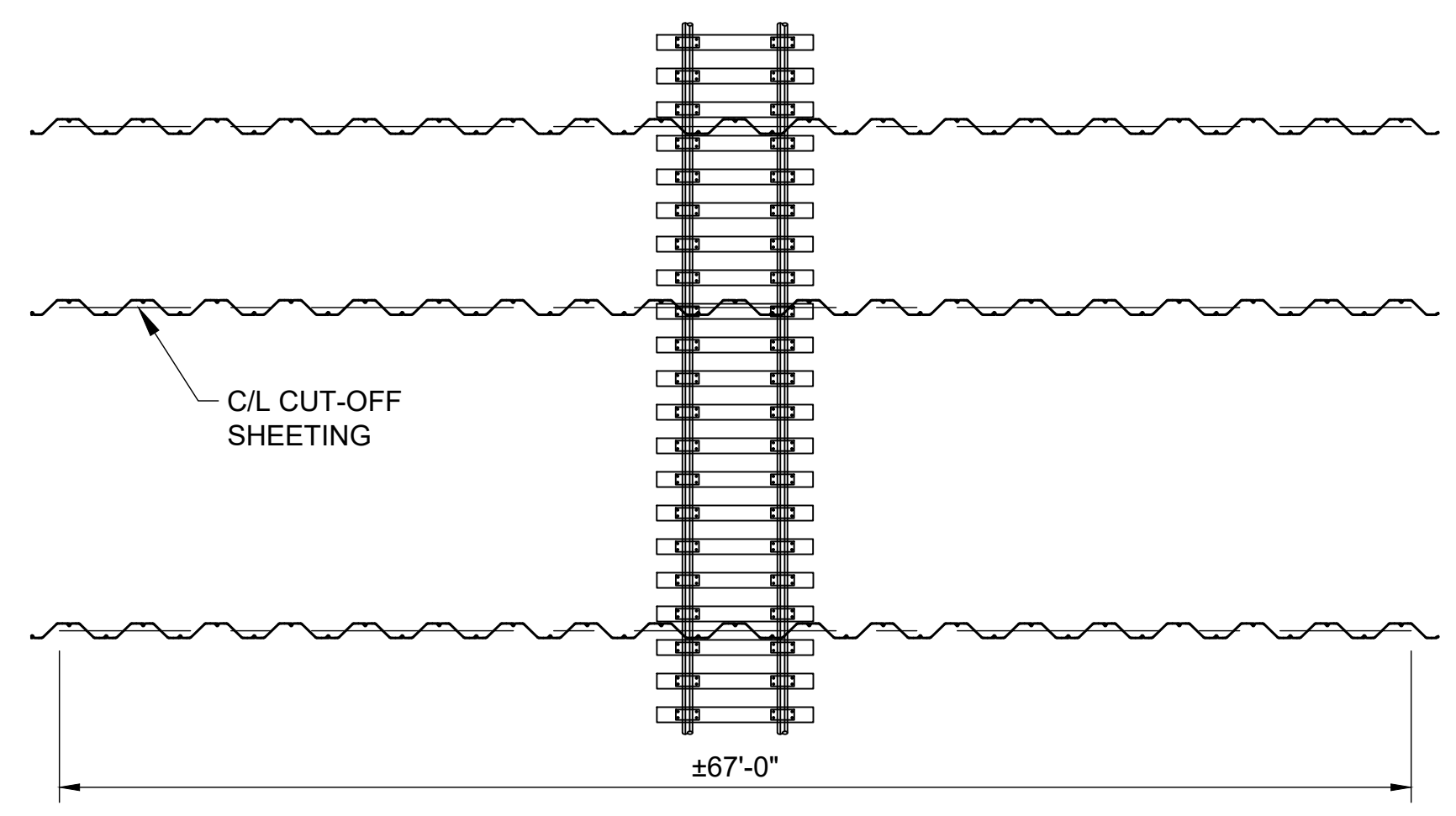
Drawing Legend



1 PHASE 2 PLAN VIEW
TYP. | TYP. SCALE: 1/8" = 1'-0"



2 PHASE 3 PLAN VIEW
TYP. | TYP. SCALE: 1/8" = 1'-0"



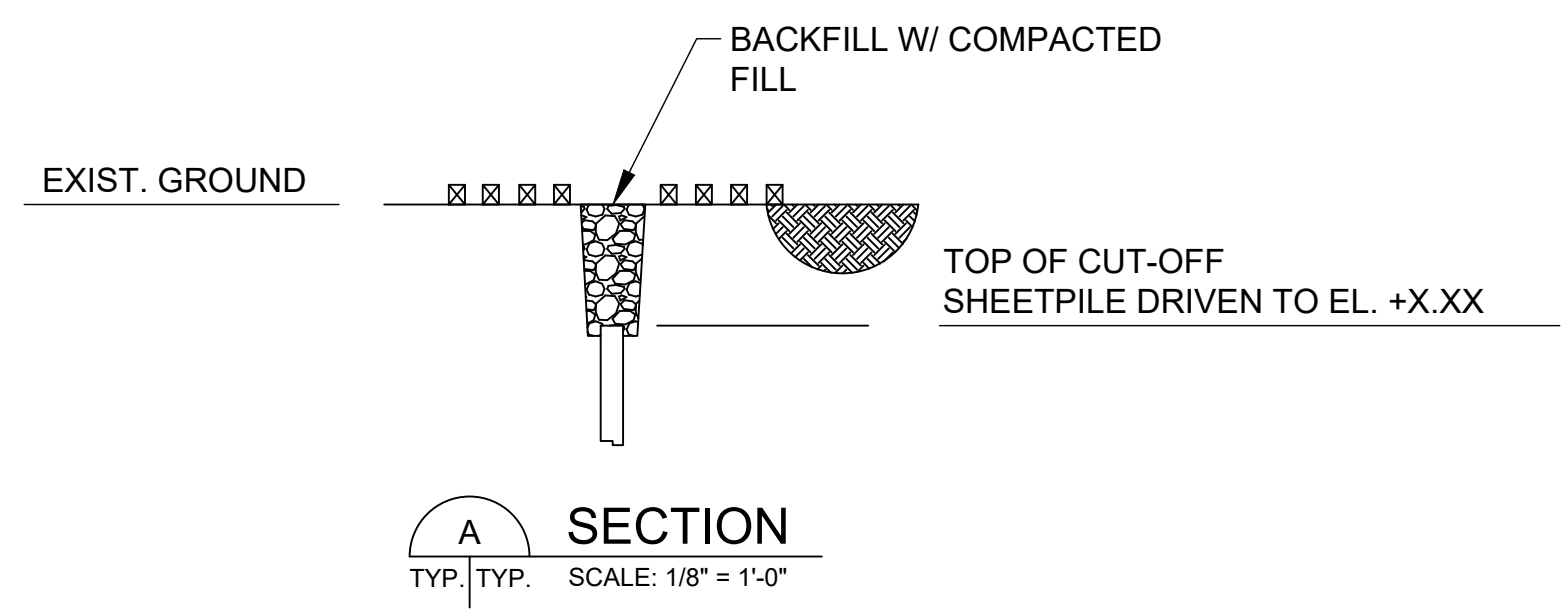
3 PHASE 4 PLAN VIEW
TYP. | TYP. SCALE: 1/8" = 1'-0"

PHASE 2 CONSTRUCTION SEQUENCING:

1. CONTRACTOR AND RAILROAD COMPANY WILL COORDINATE AND SCHEDULE STOPPAGE OF TRAIN OPERATIONS (TRACK WINDOW) ON ALL TRACKS TO INSTALL PERMANENT CUT OFF SHEET PILING.
2. RAILROAD COMPANY WILL REMOVE 34-FT TRACK SECTIONS & TWO TIMBER CROSSTIES FROM EACH TRACK. CONTRACTOR TO DRIVE CUT-OFF SHEET PILING AFTER RAILS AND CROSS TIES ARE REMOVED.
3. CONTRACTOR TO INSTALL PERMANENT CUT-OFF SHEET PILING BEGINNING AT OWNER'S NORTH PROPERTY LINE AND PROGRESSING SOUTHWARD TO A POINT TEN FEET NORTH OF TRACK.

PHASE 3 CONSTRUCTION SEQUENCING:

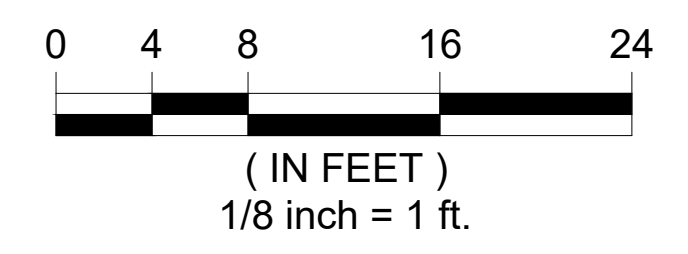
1. CONTRACTOR DRIVES PERMANENT CUT-OFF SHEET PILING FROM A POINT TEN FEET NORTH OF THE TRACK TO INTERSECT WITH THE PZ-27 SHEET PILING. CUT-OFF SHEET PILING SHALL BE "CHASED DOWN" BELOW THE ELEVATION OF THE BOTTOM CHORD OF THE PROPOSED JUMP SPAN BRIDGE.



A SECTION
TYP. | TYP. SCALE: 1/8" = 1'-0"

PHASE 4 CONSTRUCTION SEQUENCING:

1. RAILROAD COMPANY WILL REINSTALL TWO TIMBER CROSS TIES AND TWO 34-FOOT SECTIONS OF RAIL ON EACH TRACK, USING STAGGERED JOINTS AND NO WELDS.



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Metairie, LA 70002
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Project Title
WEST LUMBERTON FLOOD G AT VFW ROAD AND RAILROAD UNDERP ENGINEERING SERVICES

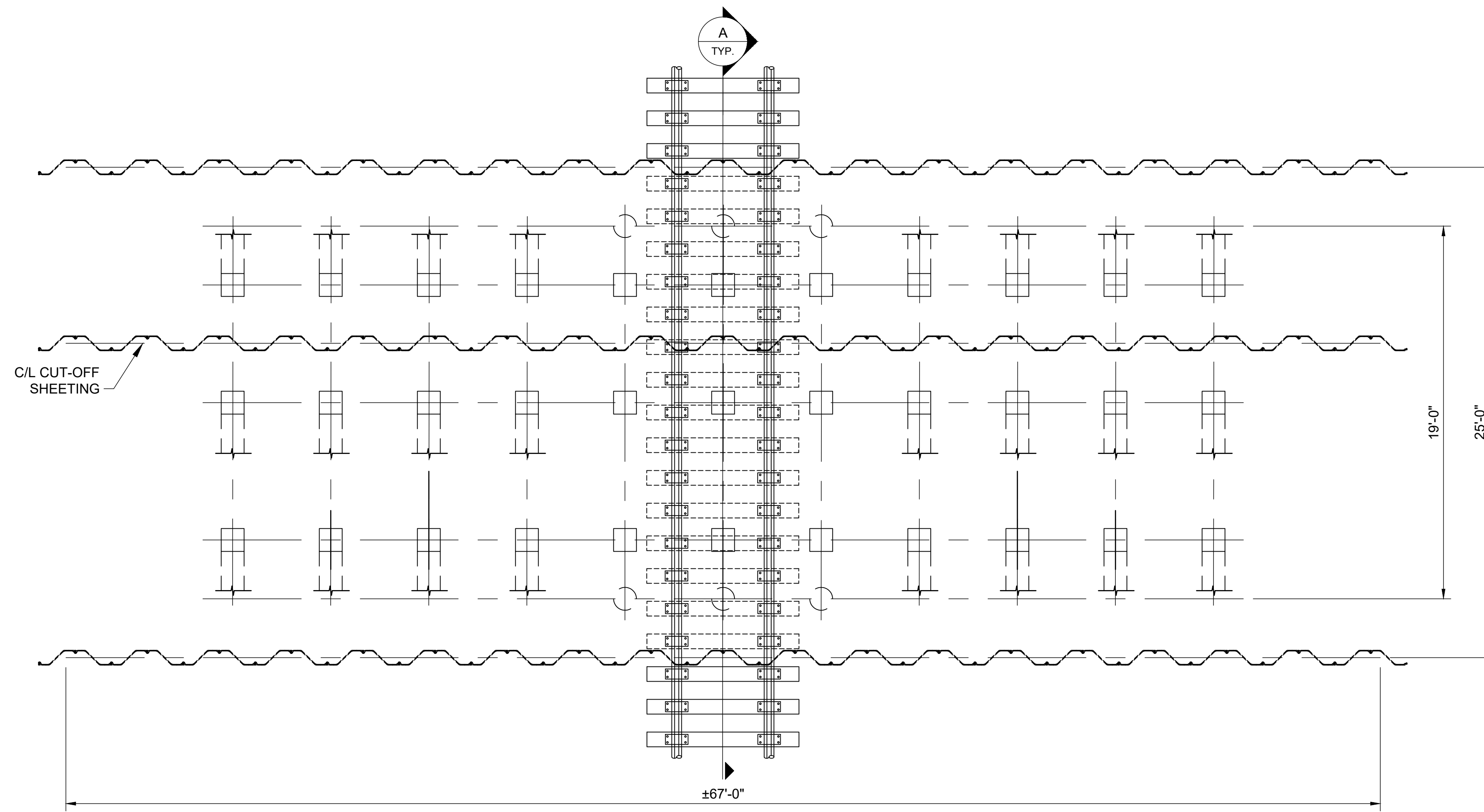
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RAILROAD TRS (2 OF 6)

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Drawing Legend

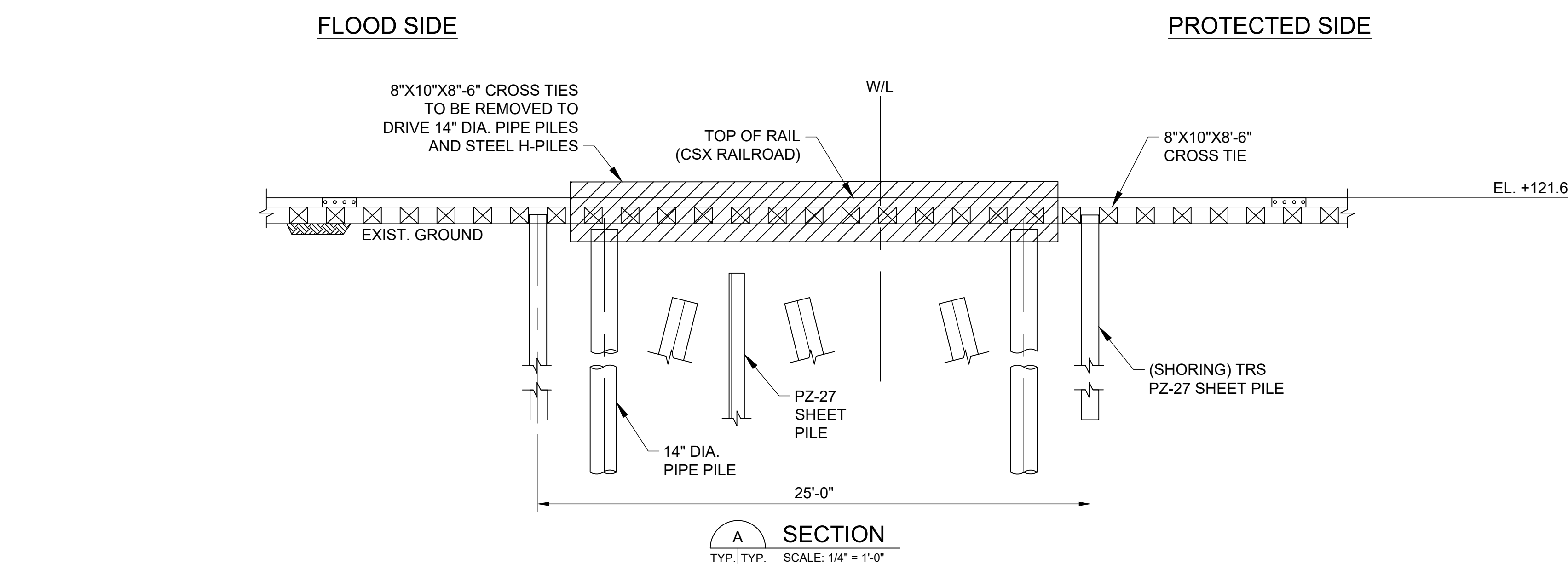
4
1
1/2
0
Inches



1 PHASE 5 PLAN VIEW
TYP. TYP. SCALE: 1/4" = 1'-0"

PHASE 5 CONSTRUCTION SEQUENCING:

1. CONTRACTOR AND RAILROAD COMPANY WILL COORDINATE AND SCHEDULE TRACK WINDOWS FOR PILING INSTALLATION (14" DIA. PIPE, AND CONCRETE PILES). THE RAILROAD COMPANY WILL REMOVE TIMBER CROSSTIES AT EACH PILE INSTALLATION LOCATION AS SHOWN IN THE PLANS. PIPE PILES SHALL BE "CHASED-DOWN" (DRIVEN WITH FOLLOWERS) TWELVE INCHES BELOW TOP-OF-TIE (TOP OF RAILROAD TIMBER CROSSTIE). CONCRETE PILES SHALL BE DRIVEN TO FINAL GRADE.



A SECTION
TYP. TYP. SCALE: 1/4" = 1'-0"

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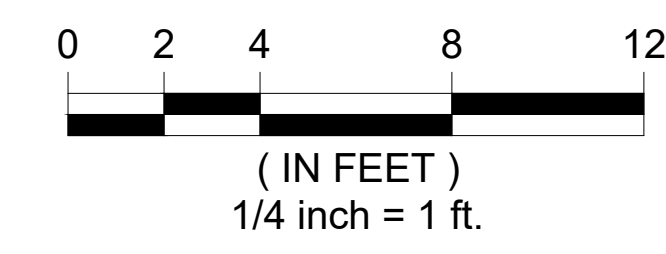
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WEST LUMBERTON FLOOD G AT VFW ROAD AND RAILROAD UNDERP ENGINEERING SERVICES

Drawing Title
RAILROAD TRS (3 OF 6)



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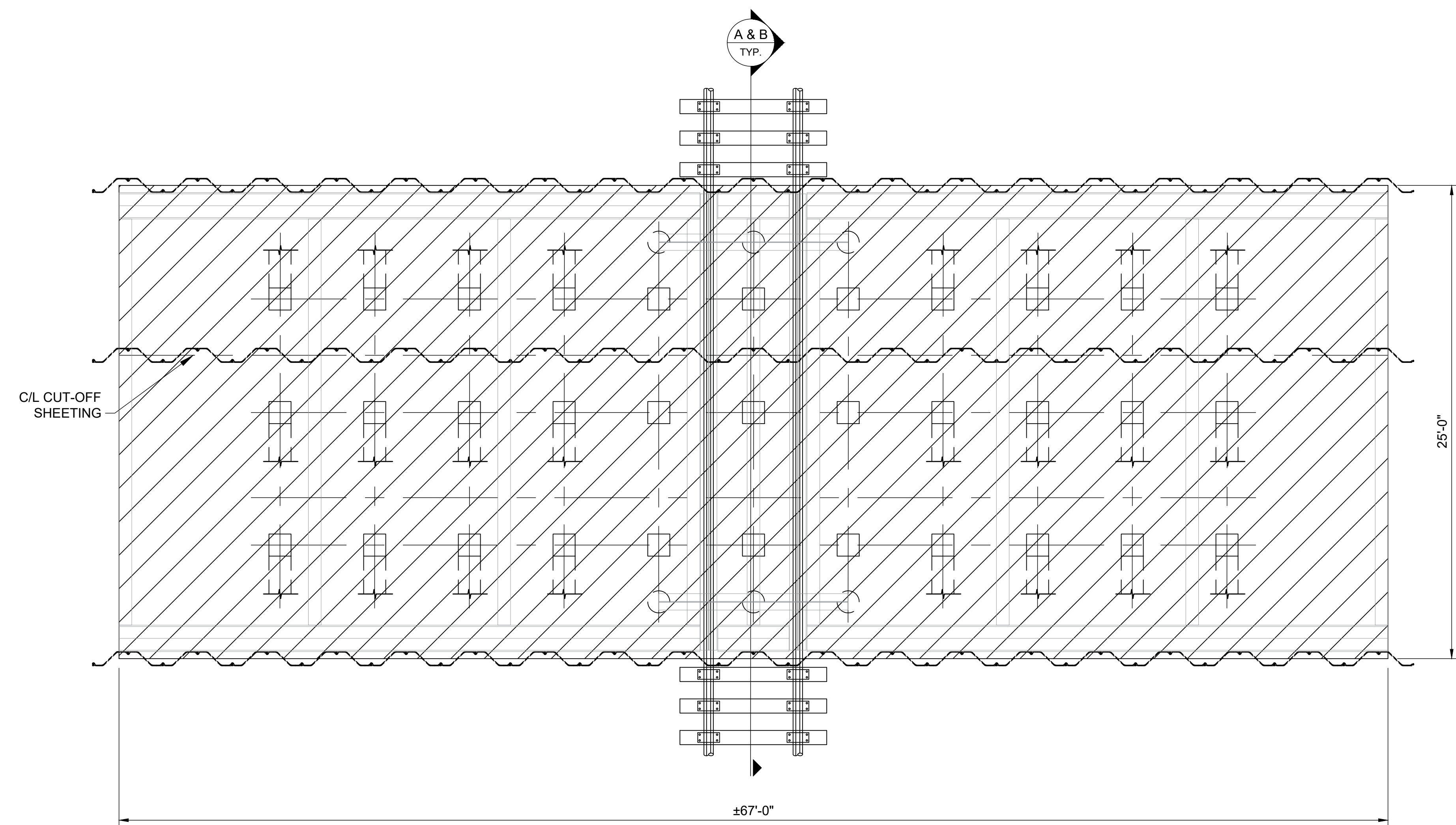
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DO NOT SCALE

Drawing Legend

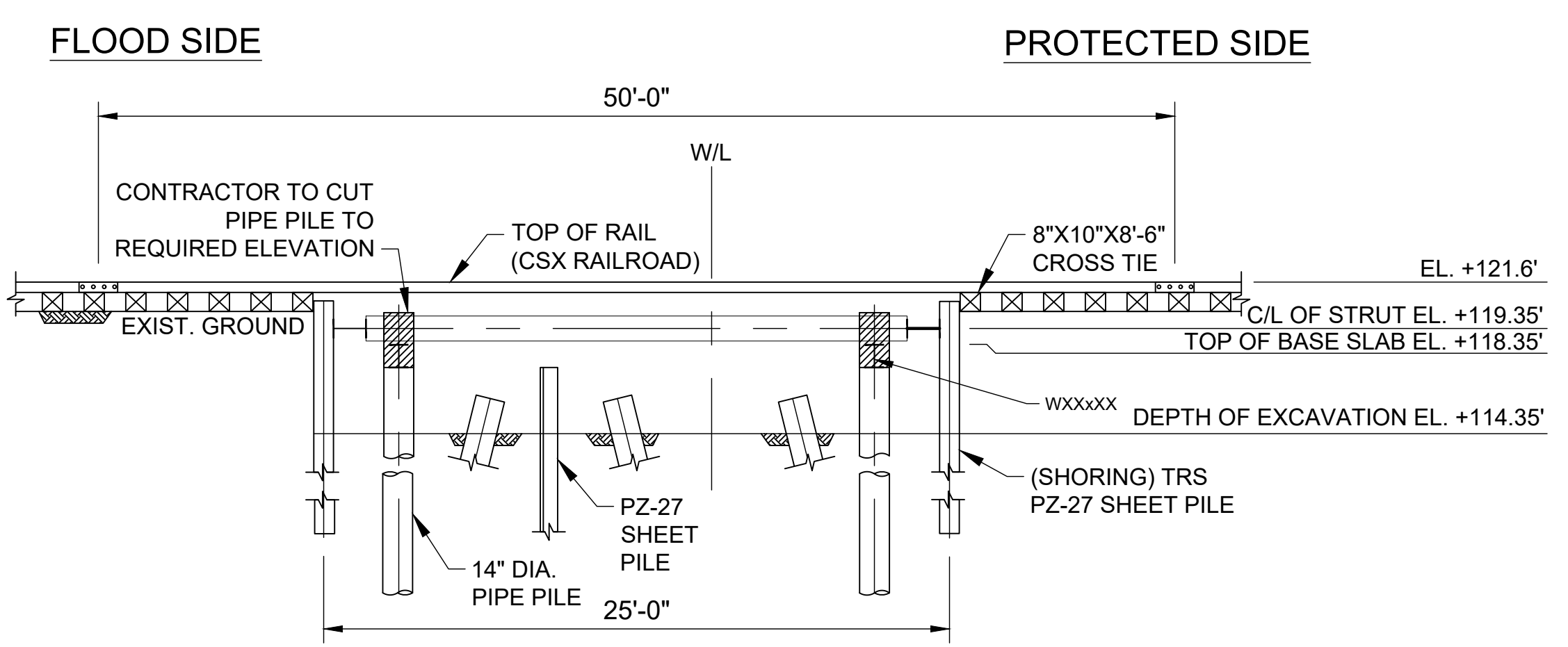
4
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Inches



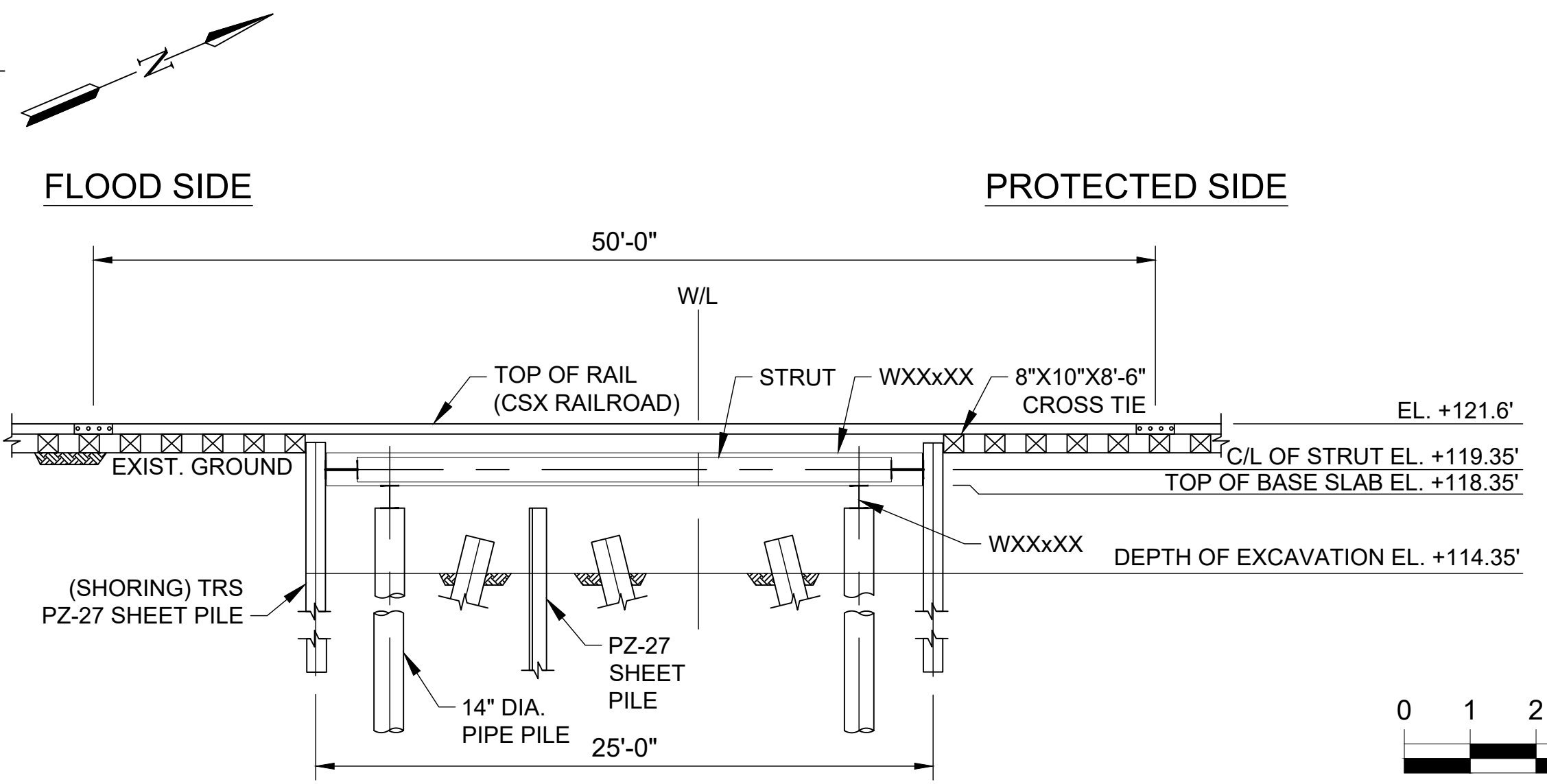
- PHASE 6 CONSTRUCTION SEQUENCING:
1. CONTRACTOR AND RAILROAD COMPANY WILL COORDINATE AND SCHEDULE ONE 12-HR TRACK WINDOW TO INSTALL THE JUMP SPAN BRIDGE.
 2. RAILROAD COMPANY WILL REMOVE ONE 50-FT. SECTION OF TRACK.
 3. CONTRACTOR TO EXCAVATE MATERIAL, CUT-OFF PILES, INSTALL WALES & STRUTS, INSTALL PILE CAPS, AND INSTALL THE JUMP SPAN BRIDGE.
 4. RAILROAD COMPANY WILL INSTALL ONE 50-FT. PRE-ASSEMBLED TRACK PANEL, AND WELD JOINTS ON EACH TRACK.

- NOTES:
1. HATCHED AREA DENOTES APPROXIMATE LIMITS OF EXCAVATION

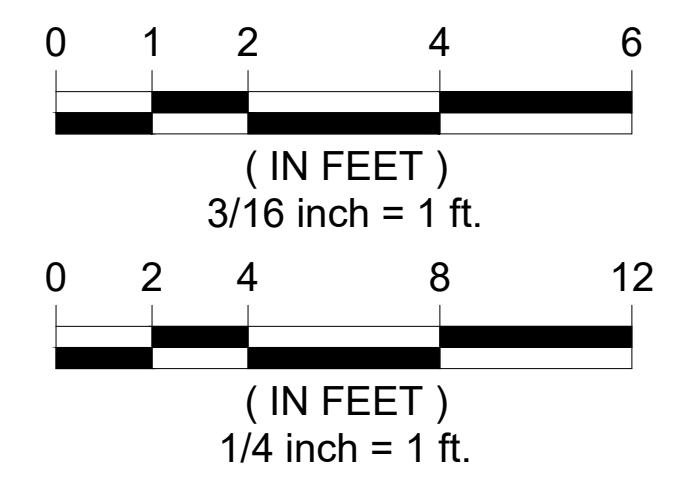
2 PHASE 6 PLAN VIEW
TYP. TYP. SCALE: 1/4" = 1'-0"



A SECTION
TYP. TYP. SCALE: 3/16" = 1'-0"



B SECTION
TYP. TYP. SCALE: 3/16" = 1'-0"



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Drawing Title
RAILROAD TRS (4 OF 6)

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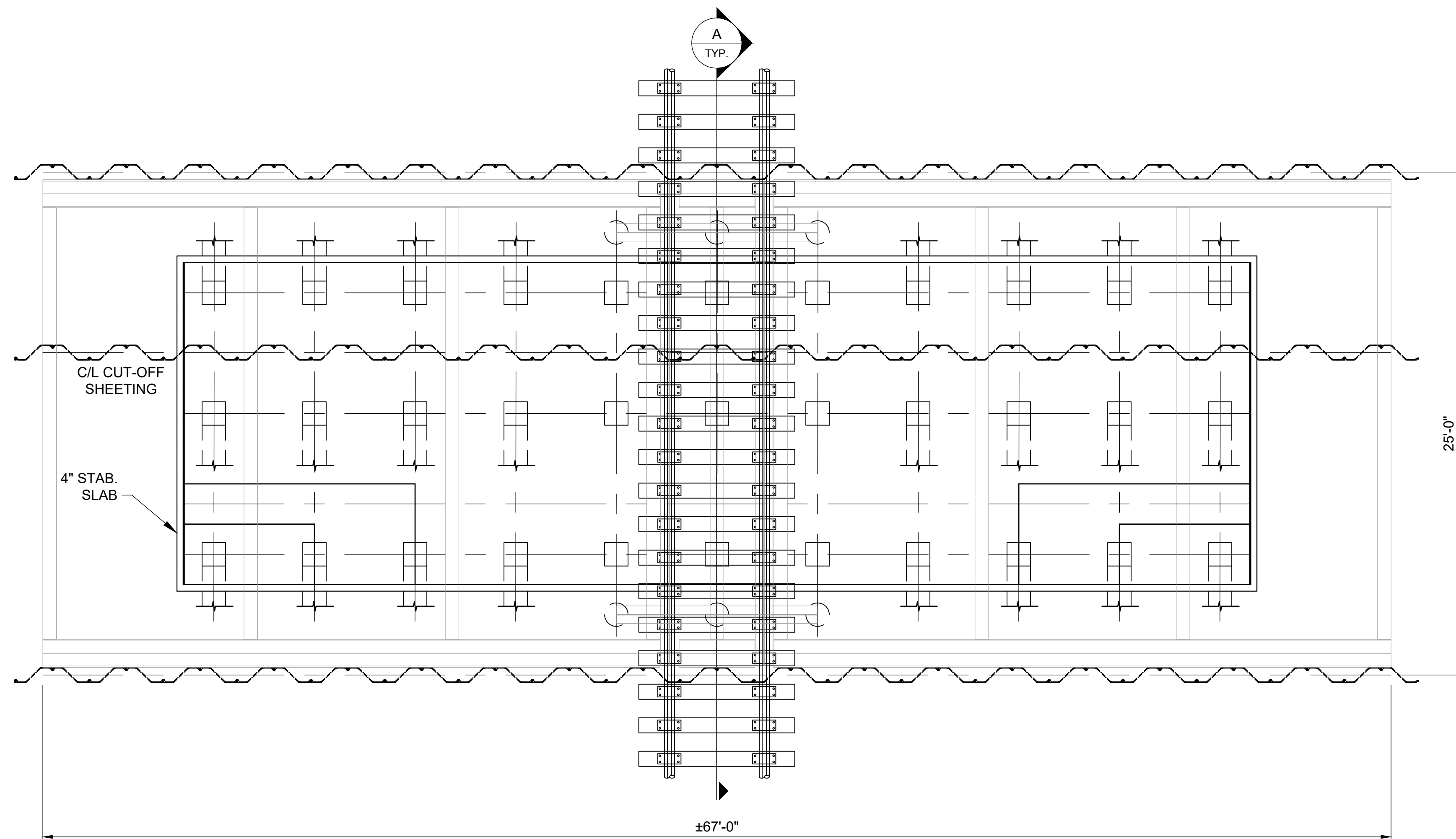
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Drawing Number	Revision			
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DO NOT SCALE

Drawing Legend

4
1
1/2
0



1 PHASE 10 PLAN VIEW
TYP. TYP. SCALE: 1/4" = 1'-0"

PHASE 8 CONSTRUCTION SEQUENCING:

1. CONTRACTOR AND RAILROAD COMPANY WILL COORDINATE AND SCHEDULE TRACK WINDOWS TO REMOVE JUMP SPAN BRIDGE AND COMPLETE THE INSTALLATION OF THE SILL WALL.
2. RAILROAD COMPANY WILL CUT RAILS ON SECTIONS OF TRACK OVER JUMP SPAN BRIDGE.
3. CONTRACTOR REMOVES JUMP SPAN BRIDGE, INCLUDING THE CUT TRACK SECTIONS.
4. CONTRACTOR INSTALLS CAST-IN-PLACE SILL, CUT OFF SHORING AND JUMP SPAN BRIDGE PILES, AND INSTALLS SUBGRADE TO AN ELEVATION 21 INCHES BELOW TOP-OF-TIE.

PHASE 9 CONSTRUCTION SEQUENCING:

1. RAILROAD COMPANY WILL PLACE TWELVE INCHES OF BALLAST ROCK, INSTALL PRE-FABRICATED TRACK PANELS ON ALL TRACKS, AND SURFACE THE TRACKS.
2. RAILROAD COMPANY WILL SCHEDULE TRACK WINDOWS TO WELD JOINTS ON TRACK PANELS ON ALL TRACKS.

PHASE 10 CONSTRUCTION SEQUENCING:

1. THE CONTRACTOR AND RAILROAD COMPANY TO SCHEDULE TRACK WINDOWS TO PLACE STEEL SWING GATE DURING PLACEMENT OF THE GATE. THE CONTRACTOR SHALL MAINTAIN A MINIMUM CLEARANCE OF 15'-0" FROM THE CENTERLINE OF TRACKS. IF CLEARANCE REQUIRED IS LESS THAN 15'-0", A FLAGMAN AND RAILROAD INSPECTOR SHALL BE PRESENT.

Seal	Seal
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Rev.	Date	Description	By	Chk'd	App'd
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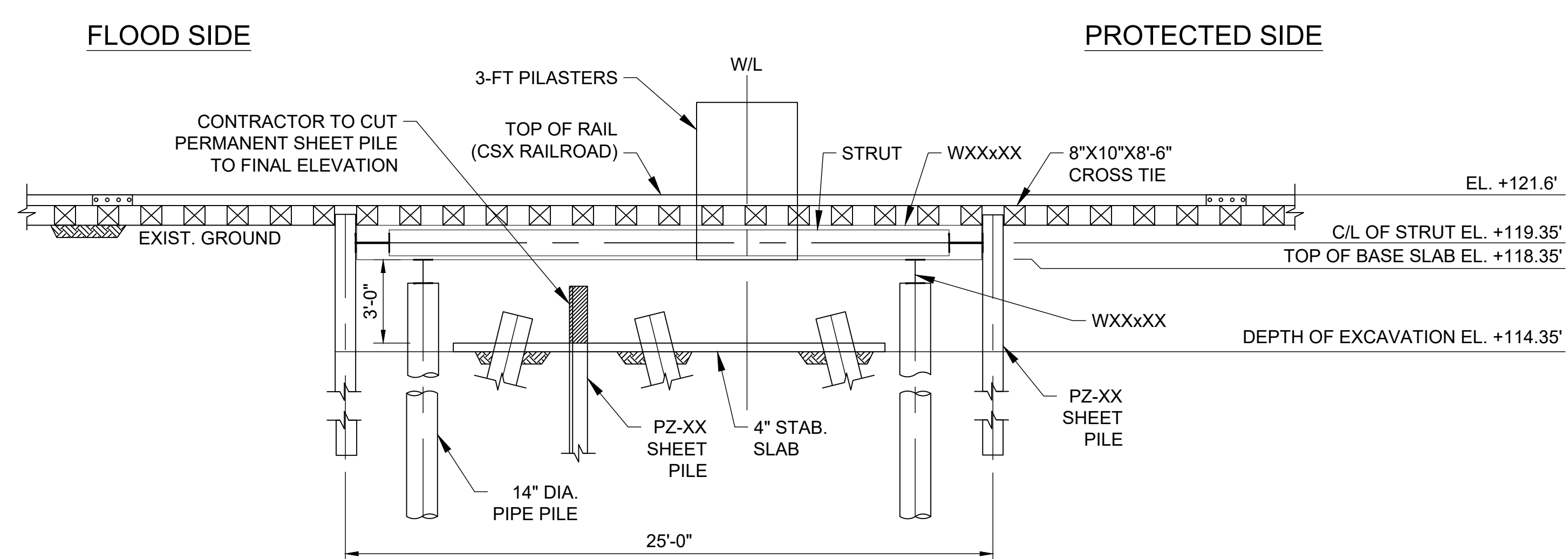
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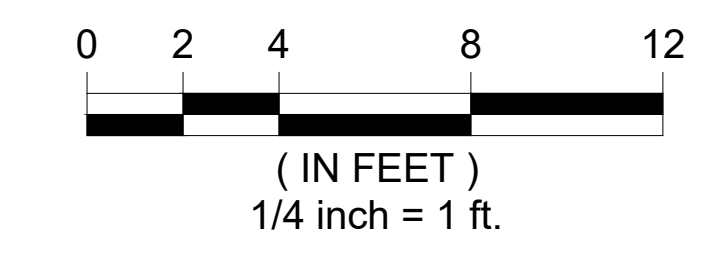
Client
City of LUMBERTON North Carolina

Project Title
WEST LUMBERTON FLOOD G AT VFW ROAD AND RAILROAD UNDERP ENGINEERING SERVICES

Drawing Title
RAILROAD TRS (6 OF 6)



A SECTION
TYP. TYP. SCALE: 1/4" = 1'-0"



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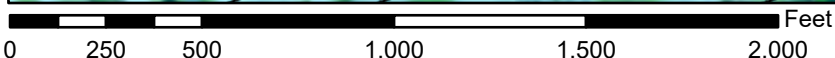
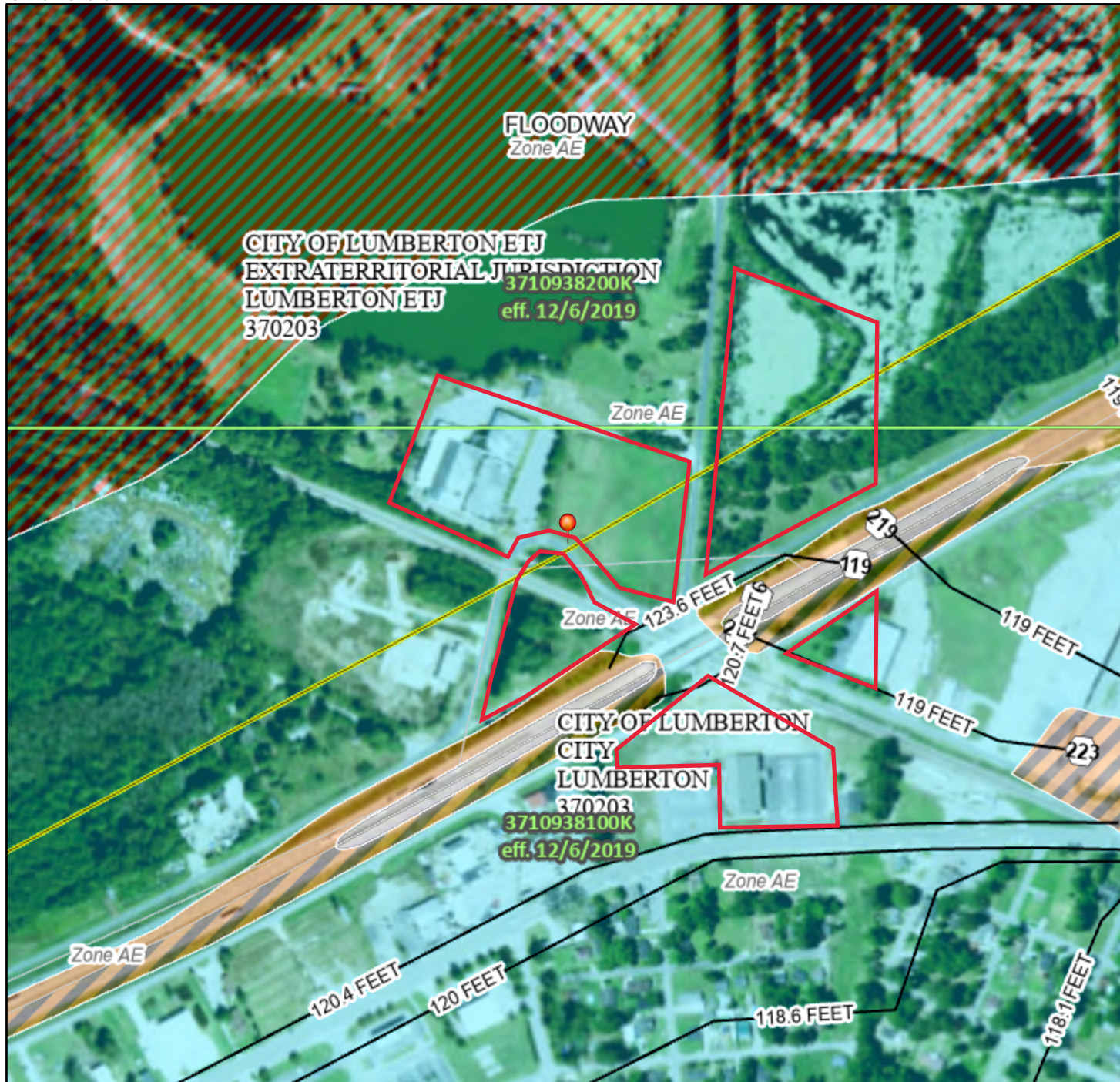
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Original Size	Date	Date	Date	Date
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Drawing Number	Revision			
100068207-CS-105				000

- **FEMA FIRMette**
- **NEPAssist FEMA FIRMs**
- **PFIRMs**
- **NFIP Community Status Book**
- **Hydrologic and Hydraulic Analysis**

National Flood Hazard Layer FIRMMette



79°2'46"W 34°37'57"N



1:6,000

79°2'9"W 34°37'27"N

Basemap Imagery Source: USGS National Map 2023

Legend

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT

- | | |
|-------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p>SPECIAL FLOOD HAZARD AREAS</p> | <ul style="list-style-type: none"> Without Base Flood Elevation (BFE)
<i>Zone A, V, A99</i> With BFE or Depth <i>Zone AE, AO, AH, VE, AR</i> Regulatory Floodway |
| <p>OTHER AREAS OF FLOOD HAZARD</p> | <ul style="list-style-type: none"> 0.2% Annual Chance Flood Hazard, Areas of 1% annual chance flood with average depth less than one foot or with drainage areas of less than one square mile <i>Zone X</i> Future Conditions 1% Annual Chance Flood Hazard <i>Zone X</i> Area with Reduced Flood Risk due to Levee. See Notes. <i>Zone X</i> Area with Flood Risk due to Levee <i>Zone D</i> |
| <p>OTHER AREAS</p> | <ul style="list-style-type: none"> NO SCREEN Area of Minimal Flood Hazard <i>Zone X</i> Effective LOMRs Area of Undetermined Flood Hazard <i>Zone D</i> |
| <p>GENERAL STRUCTURES</p> | <ul style="list-style-type: none"> Channel, Culvert, or Storm Sewer Levee, Dike, or Floodwall |
| <p>OTHER FEATURES</p> | <ul style="list-style-type: none"> B 20.2 Cross Sections with 1% Annual Chance Water Surface Elevation 17.5 Coastal Transect Base Flood Elevation Line (BFE) Limit of Study Jurisdiction Boundary Coastal Transect Baseline Profile Baseline Hydrographic Feature |
| <p>MAP PANELS</p> | <ul style="list-style-type: none"> Digital Data Available No Digital Data Available Unmapped |



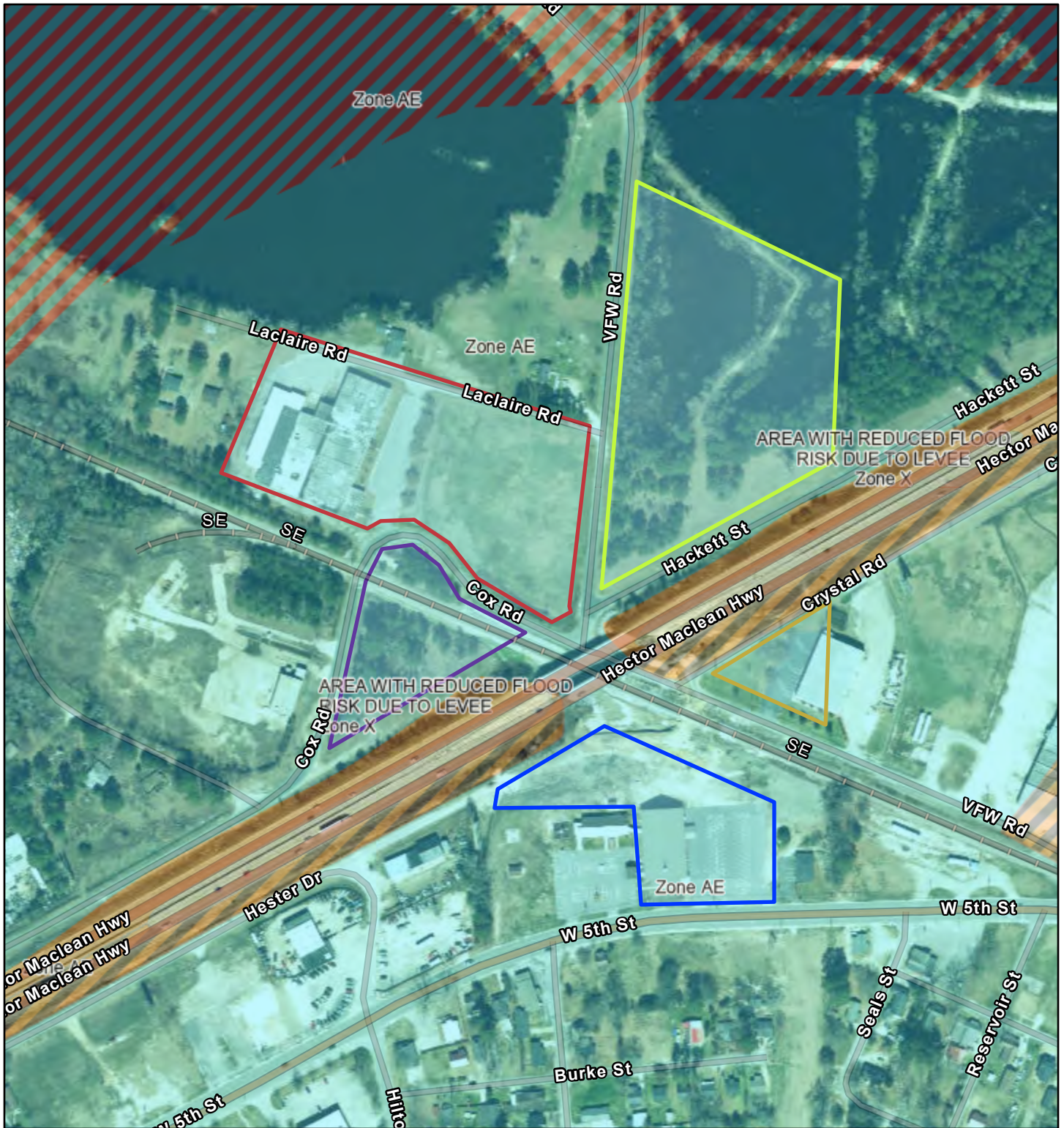
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The flood hazard information is derived directly from the authoritative NFHL web services provided by FEMA. This map was exported on **11/28/2023 at 1:00 PM** and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time.

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West Lumberton Flood Gate - FEMA FIRM



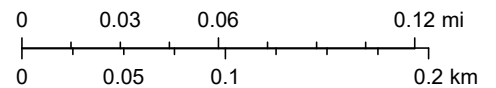
November 29, 2023

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Flood Hazard Zones

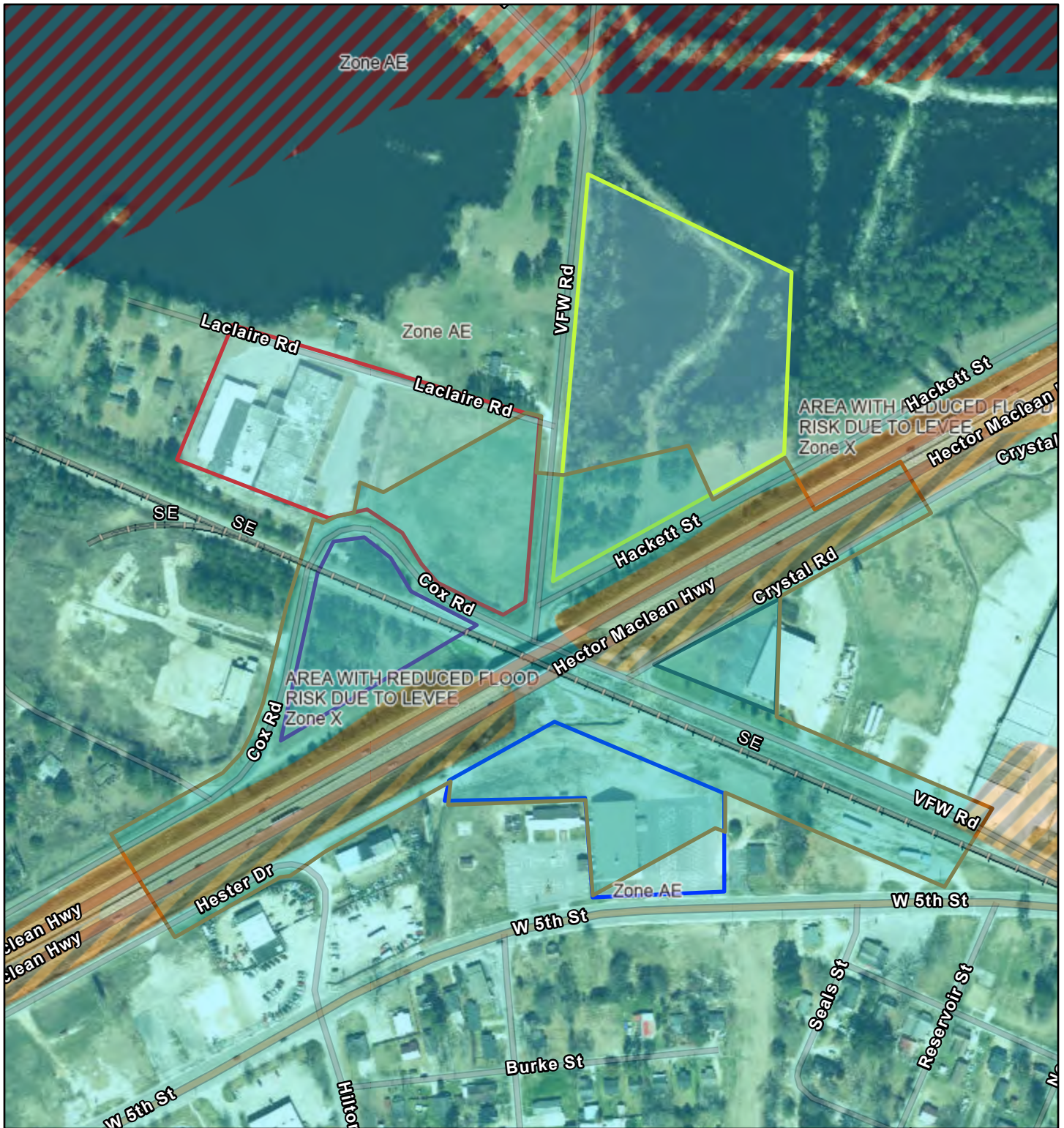
- 1% Annual Chance Flood Hazard
- Regulatory Floodway
- Special Floodway
- Area of Undetermined Flood Hazard
- 0.2% Annual Chance Flood Hazard
- Future Conditions 1% Annual Chance Flood Hazard

- Area with Reduced Risk Due to Levee
- Area with Risk Due to Levee
- 2400 Cox Rd #938179684407
- 2306 W 5th St #938189201500
- 2460 Cox Rd #938179143700
- 550 VFW Rd #938189443052
- VFW & Hackett #938280300700



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West Lumberton Flood Gate - FEMA FIRM with Action Area



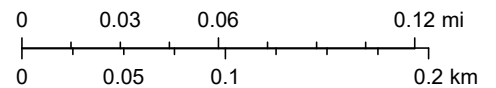
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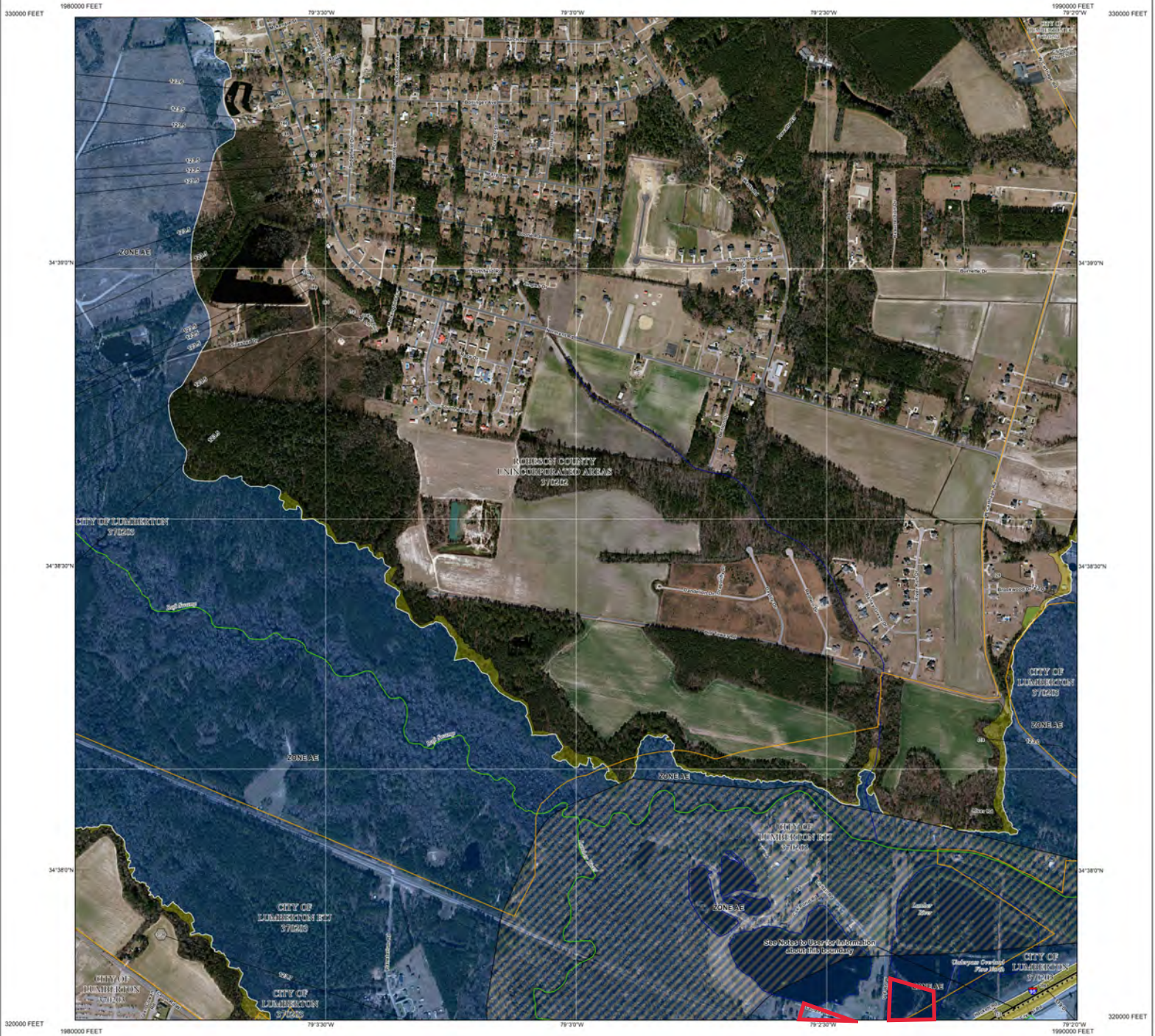
Flood Hazard Zones

- 1% Annual Chance Flood Hazard
- Regulatory Floodway
- Special Floodway
- Area of Undetermined Flood Hazard
- 0.2% Annual Chance Flood Hazard
- Future Conditions 1% Annual Chance Flood Hazard
- Area with Reduced Risk Due to Levee

- Area with Risk Due to Levee
- WLFG Project Action Area
- 550 VFW Rd #938189443052
- 2306 W 5th St #938189201500
- 2400 Cox Rd #938179684407
- 2460 Cox Rd #938179143700
- VFW & Hackett #938280300700
- Railroads



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Cooperating Technical State
State of North Carolina

The digital Flood Insurance Rate Map (FIRM) was produced through a unique cooperative partnership between the State of North Carolina and the Federal Emergency Management Agency (FEMA). The State of North Carolina has implemented a long term approach to floodplain management to decrease the costs associated with flooding. This is demonstrated by the State's commitment to map flood hazard areas at the local level. As a part of this effort, the State of North Carolina has joined in a Cooperating Technical State agreement with FEMA to produce and maintain this digital FIRM.

FLOOD HAZARD INFORMATION

SEE FIS REPORT FOR ZONE DESCRIPTIONS AND INDEX MAP FOR FIRM PANEL LAYOUT
 THE INFORMATION DEPICTED ON THIS MAP AND SUPPORTING DOCUMENTATION ARE ALSO AVAILABLE IN DIGITAL FORMAT AT [HTTPS://FRIS.NC.GOV/FRIS](https://fris.nc.gov/fris)

- SPECIAL FLOOD HAZARD AREAS**
 - Without Base Flood Elevation (BFE) Zone A, V, AE, AH, AL, VE, AR
 - With BFE or Depth Zone AE, AH, AL, VE, AR
 - Regulatory Floodway
 - 0.2% Annual Chance Flood Hazard, Areas of 1% Annual Chance Flood with Average Depth Less Than One Foot or With Drainage Areas of Less Than One Square Mile Zone X
 - Future Conditions 1% Annual Chance Flood Hazard Zone X
 - Area with Reduced Flood Risk due to Levee See Notes Zone X
- OTHER AREAS OF FLOOD HAZARD**
 - Areas Determined to be Outside the 0.2% Annual Chance Floodplain Zone X
 - Channel, Culvert, or Storm Sewer
 - Levee, Dike, or Floodwall
 - Secluded Levee
 - Cross Sections with 1% Annual Chance Water Surface Elevation (BFE)
 - Coastal Transect
 - Coastal Transect Baseline
 - Profile Baseline
 - Hydrographic Feature
 - Limit of Study
 - Jurisdiction Boundary

NOTES TO USERS

For information and questions about this map, available products associated with the FIRM including historic versions of this FIRM, how to order products or the National Flood Insurance Program in general, please call the FEMA Map Information eXchange at 1-877-FEMA-MAP (1-877-368-2627) or visit the FEMA Map Service Center website at <https://msc.fema.gov>. An accompanying Flood Insurance Study report, Letter of Map Revision (LORM) or Letter of Map Amendment (LOMA) viewing portions of this panel, and digital versions of the FIRM may be available. Visit the North Carolina Floodplain Mapping Program website at <http://www.ncfloodmaps.com> or contact the FEMA Map Service Center.

Communities annexing land on adjacent FIRM panels must obtain a current copy of the adjacent panel as well as the current FIRM index. These may be ordered directly from the Map Service Center or a number listed above.

For community and countywide map data refer to the Flood Insurance Study report for this jurisdiction.

To determine if flood insurance is available in the community, contact your insurance agent or call the National Flood Insurance Program at 1-800-638-6622.

Flood Insurance Study (FIS) means an examination, evaluation, and determination of flood hazards, corresponding water surface elevations, flood hazard risk zones, and other flood data in a community issued by the North Carolina Floodplain Mapping Program (NCFMP). The Flood Insurance Study (FIS) is comprised of the following products used together: the Digital Flood Hazard Database, the Water Surface Elevation System, the digitally derived, subsegmented Flood Insurance Rate Map and the Flood Insurance Survey Report. A Flood Insurance Survey is a compilation and presentation of flood risk data for specific watercourses, lakes, and coastal flood hazard areas within a community. This report contains detailed flood elevation data, data bases and FIRM indices. When a flood study is completed for the NCFMP, the digital information, reports and maps are assembled into an FIS. Information shown on this FIRM is provided in digital format by the NCFMP. Base map information shown on this FIRM was provided in digital format by the NCFMP. The source of this information can be determined from the metadata available in the Digital Flood Database and in the Technical Support Data Notebook (TSDN).

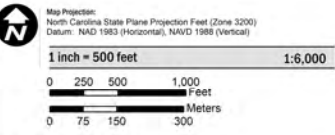
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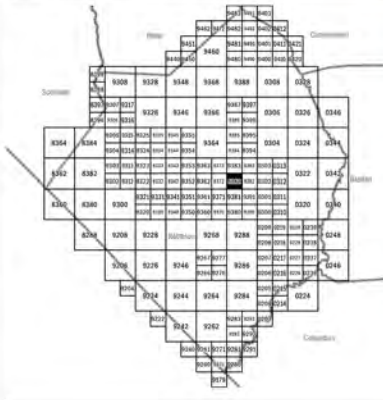
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SCALE



PANEL LOCATOR



NATIONAL FLOOD INSURANCE PROGRAM

FEDERAL EMERGENCY MANAGEMENT AGENCY

FEMA

National Flood Insurance Program

NORTH CAROLINA FLOODPLAIN MAPPING PROGRAM

NATIONAL FLOOD INSURANCE RATE MAP

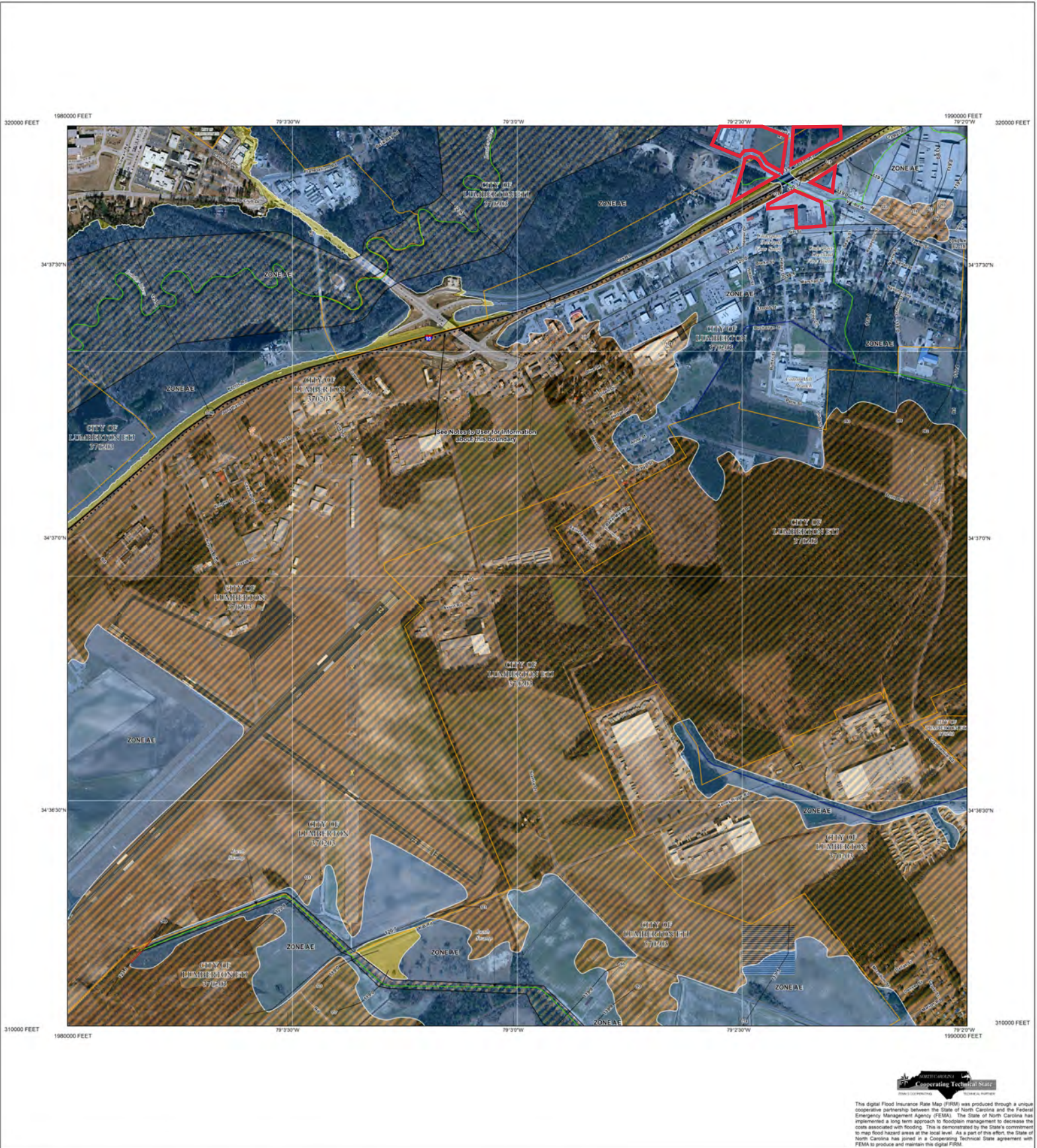
NORTH CAROLINA

PANEL 9382

Panel Contains:
 COMMUNITY: LUMBERTON, CITY OF
 ROBESON COUNTY

CID: 370003
 PANEL: 9382
 SUFFIX: K

VELOCITY NUMBER: 2.3.3.2
 MAP NUMBER: 3710938200K
 MAP REVISED: December 06, 2019



The digital Flood Insurance Rate Map (FIRM) was produced through a unique cooperative partnership between the State of North Carolina and the Federal Emergency Management Agency (FEMA). The State of North Carolina has implemented a long term approach to floodplain management to decrease the costs associated with flooding. This is demonstrated by the State's commitment to map flood hazard areas at the local level. As a part of this effort, the State of North Carolina has joined in a Cooperating Technical State agreement with FEMA to produce and maintain this digital FIRM.

FLOOD HAZARD INFORMATION

SEE FIS REPORT FOR ZONE DESCRIPTIONS AND INDEX MAP FOR FIRM PANEL LAYOUT
THE INFORMATION DEPICTED ON THIS MAP AND SUPPORTING DOCUMENTATION ARE ALSO AVAILABLE IN DIGITAL FORMAT AT [HTTPS://FRIS.NC.GOV/FRIS](https://fris.nc.gov/fris)

- SPECIAL FLOOD HAZARD AREAS**
 - Without Base Flood Elevation (BFE) Zone A, V, AE2
 - With BFE or Depth Zone AE, AH, AH, VE, AR
 - Regulatory Floodway
 - 0.2% Annual Chance Flood Hazard, Areas of 1% Annual Chance Flood with Average Depth Less Than One Foot or With Drainage Areas of Less Than One Square Mile Zone X
 - Future Conditions 1% Annual Chance Flood Hazard Zone X
 - Area with Reduced Flood Risk due to Levee See Notes Zone X
- OTHER AREAS OF FLOOD HAZARD**
 - Areas Determined to be Outside the 0.2% Annual Chance Floodplain Zone X
- OTHER AREAS**
 - Channel, Culvert, or Storm Sewer
 - Levee, Dike, or Floodwall
 - Secluded Levee
 - Cross Sections with 1% Annual Chance Water Surface Elevation (BFE)
 - Coastal Transect
 - Coastal Transect Baseline
 - Profile Baseline
 - Hydrographic Feature
 - Limit of Study
 - Jurisdiction Boundary

NOTES TO USERS

For information and questions about this map, available products associated with the FIRM including historic versions of this FIRM, how to order products or the National Flood Insurance Program in general, please call the FEMA Map Information Exchange at 1-877-FEMA-MAP (1-877-368-2627) or visit the FEMA Map Service Center website at <https://maps.fema.gov>. An accompanying Flood Insurance Study report, Letter of Map Revision (LOMR) or Letter of Map Amendment (LOMA) reviewing portions of this panel, and digital versions of the FIRM may be available. Visit the North Carolina Floodplain Mapping Program website at <http://www.ncfloodmaps.com> or contact the FEMA Map Service Center.

Communities annexing land on adjacent FIRM panels must obtain a current copy of the adjacent panel as well as the current FIRM index. These may be ordered directly from the Map Service Center or the number listed above.

For community and countywide map data refer to the Flood Insurance Study report for this jurisdiction.

To determine if flood insurance is available in the community, contact your insurance agent or call the National Flood Insurance Program at 1-800-638-6622.

Flood Insurance Study (FIS) means an examination, evaluation, and determination of flood hazards, corresponding water surface elevations, flood hazard risk zones, and other flood data in a community issued by the North Carolina Floodplain Mapping Program (NCFMP). The Flood Insurance Study (FIS) is comprised of the following products used together: the Digital Flood Hazard Database, the Water Surface Elevation System, the digitally derived, automated Flood Insurance Rate Map and the Flood Insurance Survey Report. A Flood Insurance Survey is a compilation and presentation of flood risk data for specific watercourses, lakes, and coastal flood hazard areas within a community. This report contains detailed flood elevation data, data tables and FIRM indices. When a flood study is completed for the NCFMP, the digital information, reports and maps are assembled into an FIS. Information shown on this FIRM is provided in digital format by the NCFMP. Base map information shown on this FIRM was provided in digital format by the NCFMP. The source of this information can be determined from the metadata available in the Digital Flood Database and in the Technical Support Data Worksheet (TSDW).

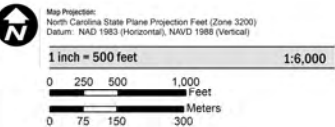
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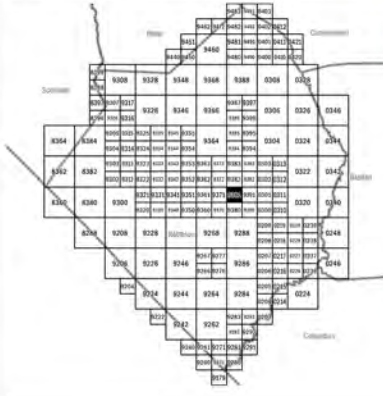
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SCALE



PANEL LOCATOR



FEMA National Flood Insurance Program

NORTH CAROLINA FLOODPLAIN MAPPING PROGRAM
NATIONAL FLOOD INSURANCE PROGRAM
FLOOD INSURANCE RATE MAP
NORTH CAROLINA

PANEL 9381

Panel Contains:
COMMUNITY LUMBERTON, CITY OF CID 37023 PANEL SUFFIX 9381 K

VELOCITY NUMBER 2.3.3.2
MAP NUMBER 3710938100K
MAP REVISED
December 06, 2019



CID	Community Name	County	Init FHBM Identified	Init FIRM Identified	Curr Eff Map Date	Reg-Emer Date	Tribal	CRS Entry Date	Curr Eff Date	Curr Class	% Disc SFHA	% Disc Non SFHA
370323#	LOWELL, CITY OF	GASTON COUNTY	08/15/75	03/05/90	11/04/09	03/05/90	No					
370537#	LUCAMA, TOWN OF	WILSON COUNTY		11/03/04	04/16/13	11/03/04	No					
370203K	LUMBERTON, CITY OF ←	ROBESON COUNTY	06/28/74	11/05/80	12/06/19	11/05/80	No					
370090K	MACCLESFIELD, TOWN OF	EDGEcombe COUNTY	12/28/73	03/18/80	06/02/15	03/25/80	No					
370150#	MACON COUNTY *	MACON COUNTY	06/30/78	06/01/01	04/19/10	06/01/01	No					
370152#	MADISON COUNTY *	MADISON COUNTY	07/22/77	09/02/82	01/06/10	09/02/82	No					
370207#	MADISON, TOWN OF	ROCKINGHAM COUNTY	11/22/74	11/16/77	01/02/09	11/16/77	No					
370389#	MAGGIE VALLEY, TOWN OF	HAYWOOD COUNTY	07/08/77	04/17/84	04/03/12	04/17/84	No					
370669#	MAGNOLIA, TOWN OF	DUPLIN COUNTY		02/16/06	02/16/07	07/23/10	No					
370056#	MAIDEN, TOWNSHIP OF	LINCOLN COUNTY/CATAWBA COUNTY	09/20/74	09/03/80	07/07/09	09/03/80	No					
375355K	MANTEO, TOWN OF	DARE COUNTY	01/12/73	01/12/73	06/19/20	01/05/73	No	10/01/91	10/01/21	5	25%	10%
370266#	MARION, CITY OF	MCDOWELL COUNTY	09/10/82	07/15/88	01/06/10	05/01/87	No					
370385#	MARS HILL, TOWN OF	MADISON COUNTY	07/02/76	08/19/87	01/06/10	08/19/87	No					
370154#	MARSHALL, TOWN OF	MADISON COUNTY	06/14/74	05/15/78	01/06/10	05/15/78	No					
370474#	MARSHVILLE, TOWN OF	UNION COUNTY		07/05/94	03/02/09	12/15/09	No					
370155K	MARTIN COUNTY *	MARTIN COUNTY	11/29/74	07/16/91	06/19/20	07/16/91	No					
370514#	MARVIN, VILLAGE OF	UNION COUNTY		01/17/97	02/19/14	12/28/98	No					
370310#	MATTHEWS, TOWN OF	MECKLENBURG COUNTY		02/04/04	02/19/14	02/04/04	No					
370587F	MAXTON, TOWN OF	SCOTLAND COUNTY/ROBESON COUNTY		01/19/05	12/06/19	05/26/20	No					
370208#	MAYODAN, TOWN OF	ROCKINGHAM COUNTY		07/18/77	01/02/09	07/18/77	No					
370330#	MAYSVILLE, TOWN OF	JONES COUNTY		07/02/04	02/16/06	08/19/86	No					
370101#	MCADENVILLE, TOWN OF	GASTON COUNTY	06/21/74	06/01/87	11/04/09	06/01/87	No					
370148#	MCDOWELL COUNTY*	MCDOWELL COUNTY	12/20/74	07/15/88	01/06/10	07/15/88	No					
370390J	MEBANE, CITY OF	ORANGE COUNTY/ALAMANCE COUNTY		11/05/80	11/17/17	11/05/80	No					
370158F	MECKLENBURG COUNTY *	MECKLENBURG COUNTY	10/22/76	06/01/81	11/16/18	06/01/81	No	10/01/91	04/01/21	5	25%	10%
370426L	MESIC, TOWN OF	PAMLICO COUNTY		07/02/04	06/19/20	09/04/85	No	05/01/19	04/01/21	8	10%	05%
370500J	MICRO, TOWN OF	JOHNSTON COUNTY		10/20/00	06/20/18	11/08/16	No					
370445#	MIDDLESEX, TOWN OF	NASH COUNTY		01/20/82	07/07/14	03/19/99	No					
370182L	MIDLAND, TOWN OF	CABARRUS COUNTY	12/27/74	05/05/81	11/16/18	06/01/09	No					
370393#	MIDWAY, TOWN OF	DAVIDSON COUNTY		03/16/09	06/16/09	02/05/19	No					
370529#	MINERAL SPRINGS, TOWN OF	UNION COUNTY		07/18/83	03/02/09	05/17/00	No					
370418K	MINNESOTT BEACH, TOWN OF	PAMLICO COUNTY	03/02/79	08/05/85	06/19/20	09/23/85	No	10/01/92	10/01/21	8	10%	05%
370539E	MINT HILL, TOWN OF	MECKLENBURG COUNTY		02/04/04	11/16/18	12/21/07	No					
370026#	MISENHEIMER, VILLAGE OF	STANLY COUNTY		09/03/08	06/16/09	02/17/10	No					
370161#	MITCHELL COUNTY *	MITCHELL COUNTY	06/30/78	09/04/86	06/02/09	09/04/86	No					
370309#	MOCKSVILLE, TOWN OF	DAVIE COUNTY	07/11/75	06/27/00	06/16/09	09/17/08	No					
370657#	MOMEYER, TOWN OF	NASH COUNTY		11/03/04	(NSFHA)	12/29/05	No					
370236#	MONROE, CITY OF	UNION COUNTY	09/20/74	01/19/83	03/02/09	01/19/83	No					
370336#	MONTGOMERY COUNTY*	MONTGOMERY COUNTY	10/13/78	06/01/81	06/16/09	02/20/97	No					
370476#	MONTREAT, TOWN OF	BUNCOMBE COUNTY		05/06/96	01/06/10	09/19/05	No					
370164H	MOORE COUNTY *	MOORE COUNTY	10/13/78	12/15/89	11/17/17	12/15/89	No					
370314#	MOORESVILLE, TOWN OF	IREDELL COUNTY	04/25/75	05/01/80	06/16/09	05/01/80	No					
370048#	MOREHEAD CITY, TOWN OF	CARTERET COUNTY	02/22/74	02/16/77	11/03/05	02/16/77	No	10/01/92	05/01/20	6	20%	10%
370035#	MORGANTON, CITY OF	BURKE COUNTY	03/22/74	02/19/87	07/07/09	02/19/87	No					
370242K	MORRISVILLE, TOWN OF	WAKE COUNTY	10/29/76	11/01/78	07/19/22	11/01/78	No					
370226B	MOUNT AIRY, CITY OF	SURRY COUNTY	06/28/74	12/01/81	11/18/16	12/01/81	No					
370102L	MOUNT HOLLY, CITY OF	GASTON COUNTY	01/09/74	09/28/79	09/02/15	09/28/79	No					
370369K	MOUNT OLIVE, TOWN OF	DUPLIN COUNTY/WAYNE COUNTY	06/17/77	02/17/82	06/20/18	02/17/82	No					
370470J	MOUNT PLEASANT, TOWN OF	CABARRUS COUNTY		11/02/94	11/16/18	02/24/12	No					
370419#	MURFREESBORO, TOWN OF	HERTFORD COUNTY	11/10/78	06/01/87	08/03/09	06/01/87	No					
370061#	MURPHY, TOWN OF	CHEROKEE COUNTY	03/08/74	07/03/86	04/19/10(M)	07/03/86	No					
375356K	NAGS HEAD, TOWN OF	DARE COUNTY		11/10/72	06/19/20	11/10/72	No	10/01/91	04/01/22	5	25%	10%

West Lumberton Flood Gate Closure Structure

at the VFW Road and CSX Railroad Interstate 95
Underpass

Hydrologic and Hydraulic Analysis

City of Lumberton

9 January 2023



Notice

This document and its contents have been prepared and are intended solely as information for City of Lumberton and use in relation to the design of the flood gate closure structure at the VFW Road and CSX Railroad Interstate 95 Underpass.

SNC-Lavalin assumes no responsibility for the use of the information presented in this report for purposes other than for the design of the flood gate closure structure.

This document has 174 pages including the cover.

Document history

Revision	Purpose description	Originated	Checked	Reviewed	Authorized	Date
Rev 0.0	Floodgate Closure Structure Design	KH	EB	DS	AS	3/19/2020
Rev 1.0	Floodgate Closure Structure Design	KH	EB	DS	AS	10/19/2020
Rev 2.0	Floodgate Closure Structure Design	KH	EB	DS	AS	1/09/2023

Client signoff

Client	City of Lumberton
Project	West Lumberton Flood Gate Closure Structure at the VFW Road and CSX Railroad Interstate 95 Underpass
Job number	100068207
Client signature / date	

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Acronyms and Abbreviations

1D	one-dimensional
2D	two-dimensional
C	conversion factor
cfs	cubic foot per second
CFR	Code of Federal Regulations
CN	curve number
C_p	peaking coefficient
C_t	basin coefficient
D	average depth of water along fetch line
DEMLR	Division of Energy, Mineral and Land Resources (NCDEQ)
ECONet	North Carolina Environment and Climate Observing Network
FEMA	Federal Emergency Management Agency
F_s	maximum fetch distance
F_t	feet
FWL	ratio of winds over water to winds over land
g	gravity
GIS	Geographic Information System
GPS	Global Positioning System
H	wave height at the toe of the structure
HEC-HMS	Hydrologic Engineering Center's Hydrologic Modeling System
HEC-MetVue	Hydrologic Engineering Center's Meteorological Visualization Utility Engine
HEC-RAS	Hydrologic Engineering Center's River Analysis System
H&H	hydrologic and hydraulic
HMR	Hydrometeorological Reports
hr	hour
HWM	high water mark
I_a	initial loss
in	inch
in/hr	inch per hour
KFAY	Fayetteville Airport CRONOS rainfall gage
KMEB	Laurinburg-Maxton Airport CRONOS rainfall gage
KSOP	Moore County Airport CRONOS rainfall gage
L	length of main channel
L_d	deep water wavelength
L_c	length of main channel to the centroid
LiDAR	Light Detection and Ranging
LILE	NC Electric Cooperative Anson Peaking Plant CRONOS rainfall gage
mi	mile
MOVE	Maintenance of variance estimator
PMF	Probable Maximum Flood
PMP	Probable Maximum Precipitation
mph	miles per hour
NAVD	North American Vertical Datum
NC	North Carolina

NC CRONOS	North Carolina Climate Retrieval and Observations Network of the Southeast Database
NC DOT	North Carolina Department of Transportation
NC DEQ	North Carolina Department of Environmental Quality
NC FMP	North Carolina Floodplain Mapping Program
NC SCO	North Carolina State Climate Office
NLCD	National Land Cover Database
NLUM	Lumberton CRONOS rainfall gage
NOAA	National Oceanic and Atmospheric Administration
NRCK	Rockingham CRONOS rainfall gage
NRCS	Natural Resources Conservation Service
NUWH	Uwharrie-Troy CRONOS rainfall gage
NWS	National Weather Service
R	wave runup
s	seconds
SCS	Soil Conservation Service
S _e	set-up
sq mi	square mile
SSURGO	Soil Survey Geographic Database
t	time
T _d	deep water wave period
T _p	hydrograph lag
U	average wind velocity
U _{1hr}	one hour averaged wind speed
U ₃₃	wind speed at height of 33 feet
USACE	United States Army Corps of Engineers
USDA	United States Department of Agriculture
USGS	United States Geological Survey
U _t	fastest wind speed at a specified duration
U _w	overwater wind speed
U _z	wind speed at a distance of z above surface
WHIT	Border Belt Tobacco Res Station CRONOS rainfall gage
WSE	water surface elevation
yr	year
z	elevation

Executive Summary

The western part of the City of Lumberton is protected from flooding from the Lumber River by a levee system that consists of three segments: the levee that was designed and constructed by the Natural Resources Conservation Service (NRCS) (formerly the Soil Conservation Service), a portion of I-95 highway embankment, and a portion of Alamac Road. An opening exists within the I-95 highway embankment portion of the levee system to allow a CSX rail corridor and VFW Road to traverse under the highway. During extreme storms, the Lumber River overflows its banks and floods the western part of the city through this opening. Flow also overtops low segments of the I-95 portion of the levee protection system. Floodwaters from recent extreme weather events, like Hurricane Matthew (2016) and Hurricane Florence (2018) flooded the city through the opening in the I-95 embankment, causing major damages to residences and businesses. The City of Lumberton plans to improve its flood resiliency by installing a flood gate closure structure along the opening within the I-95 highway embankment to prevent future flooding. The North Carolina Department of Transportation (NCDOT) also plans to widen and raise the I-95 portion of the flood protection system to increase capacity and to prevent the I-95 highway embankment from overtopping. This report documents the detailed hydrologic and hydraulic (H&H) study of the Lumber River that was performed to establish the height of the proposed flood gate closure structure.

It is the desire of the City of Lumberton to be protected from flooding events with magnitudes like that of the flood of record (Hurricane Florence) and to pursue FEMA accreditation of the levee protection system. For the levee system to be accredited, its minimum top elevation must be equal to the 100-year elevation plus 4.5 feet of freeboard (128.5 feet, North American Vertical Datum [NAVD]88). The North Carolina Department of Environmental Quality’s Division of Energy, Mineral and Land Resources (DEMLR) determined in October 2021 that the proposed floodgate is subject to the jurisdiction of the Dam Safety Law of 1967 and will have a Class C high hazard and large size classification. This classification implies that the proposed floodgate should be designed to withstand the ¾ Probable Maximum Flood (PMF). In determining the design elevation of the gate, a statistical analysis was performed and the recurrence interval of the flood of record was estimated to be about 200-years. Hydraulic simulations were performed without the gate and with the gate and the proposed I-95 configuration in place, to estimate the resulting peak elevations of the 100-year through the Probable Maximum Flood (PMF) return period events, and the flood of record.

Based on the results of the analysis, the recommended range of top of gate elevations and gate heights that meets the objectives of the City of Lumberton and regulatory requirements are shown in tabular form below:

Design Storm	Recommended Top of Gate Elevation and Gate Height			
	Max. Stillwater Elevation (feet, NAVD88)	Freeboard (feet)	Top of Gate Elevation (feet, NAVD88)	Gate Height (feet)
100 YR	124.0	5.4	129.4	9.4
¾ PMF	126.0	6.6	132.6	12.6
500 YR	127.6	6.6	134.2	14.2

Reference Elevations: 1. Minimum elevation for levee accreditation = 128.5 feet (ft), NAVD88
 2. Flood of record elevation at gate location assuming gate is in place and I-95 raised = 125.6 ft, NAVD88
 3. Elevation of ¾ PMF at gate location assuming gate is in place and I-95 raised = 128.8 ft, NAVD88
 4. Elevation of PMF at gate location assuming gate is in place and I-95 raised = 129.2 ft, NAVD88
 5. Average ground elevation at gate location is 120.0 ft
 6. ¾ PMF is the largest storm that does not overtop the levee and proposed I-95
 7. Levee is overtopped during the 500-year storm.

The recommended range of top of flood gate elevations of 129.4 to 134.2 feet, NAVD88 ensures that the gate is not overtopped up to the PMF if freeboard is not accounted and meets all the regulatory requirements. The ¾ PMF is the largest event that does not overtop the levees. Minor overtopping of the levee occurs during the 500-year event. Selection of the design gate height from this range should be based on cost, floodplain impacts, and minimum desired level of service.

1. Introduction

1.1. Authorization and Study Purpose

Atkins was authorized to conduct this study through its contract with City of Lumberton dated October 18, 2019. The contract is to provide engineering services for the design of a flood gate closure structure at the VFW Road and CSX Railroad Interstate 95 (I-95) Underpass in the City of Lumberton.

The City of Lumberton is susceptible to flooding from the Lumber River. A levee system provides flood prevention to the City of Lumberton. The levee system consists of three segments: the levee that was designed and constructed by the Natural Resources Conservation Service (NRCS) (formerly the Soil Conservation Service), a portion of I-95 highway embankment, and a portion of Alamac Road (**Figure 1-1**). The levee begins at the tie in with I-95, approximately 1,100 feet north-east of VFW Road and extends south-east to the tie-in with Alamac Road, running parallel to the Lumber River. An opening exists within the I-95 highway embankment to allow a CSX rail corridor and VFW Road to traverse under the highway. During extreme storms, the Lumber River overflows its banks and through the opening in I-95 flooding portions of the City of Lumberton. Floodwaters from recent extreme weather events, like Hurricane Matthew (2016) and Hurricane Florence (2018) flooded the city through the opening in the I-95 embankment, causing major damages to residences and businesses. During Hurricane Matthew, no attempts were made to close the opening, resulting in significant flows into the protected area. In preparation for Hurricane Florence, sandbags and temporary barriers were placed across the opening. Although these measures provided temporary protection they eventually failed. And, therefore, the City of Lumberton wants to install permanent protection such as flood gates within the opening under I-95. The gate would have to be closed over the CSX railroad corridor and local road to protect the southern part of the city from flooding.. The purpose of this project is to design and install the flood gate at this most vulnerable location to improve the flood resilience of the City of Lumberton.

To establish the height of the flood gate closure structure, a detailed hydrologic and hydraulic (H&H) study of the Lumber River is required. The H&H study includes a hydrologic analysis of the Lumber River from the headwaters located near Eagle Springs, North Carolina (NC) to the confluence of the Lumber River and Jacob Swamp located about 4 miles downstream of Lumberton. A hydraulic model was developed along the Lumber River and of its tributaries near the city of Lumberton to establish flood elevations for use in the flood gate closure design.

It is worth noting that there is a second opening in the levee protection system along Alamac Road. This opening is a bridge that allows Jacob Swamp to connect with the Lumber River. Although flow in the Lumber River backs up through this opening under extreme flooding conditions, it does not result in extensive flooding compared to flow through the I-95 opening. The opening within Alamac road is not a focus of this study.



Figure 1-1. Lumberton site location map.

1.2. Assumptions and Limitations

The assumptions and limitations of the analysis and report are as follows:

- a. The analysis and results presented in this report are for the sole purpose of designing the flood gate.
- b. Top elevations of the Lumberton levee system including the existing I-95 highway are based on terrain data described in **Section 3.1**. The top of levee elevations from the terrain match elevations from a survey performed by others as described in this report. Atkins does not guarantee the accuracy of this data.
- c. The geometry of the proposed I-95 embankment and hydraulic structures that traverse the highway embankment are based on 25-percent design plans from NCDOT and is subject to change. Atkins does not guarantee the accuracy of this data.
- d. Atkins relied on hydraulic structure data included in the effective Federal Emergency Management Agency (FEMA) models. Atkins spot checked the information gathered on these structures by comparing them to field observations but does not guarantee the accuracy of all the data.
- e. Atkins relied on the high-water mark, streamflow, and stage data collected by the United States Geological Survey (USGS) for model calibration. Atkins does not guarantee the accuracy of this data.

2. Hydrological Setting

2.1. Watershed Location and Size(s)

The Lumber River basin is in southeastern North Carolina, approximately 30 miles (mi) south of Fayetteville, NC, and has a total drainage area of 748 mi² at the confluence of the Lumber River and Jacob Swamp (**Figure 2-1**). The drainage area to the USGS gage along Lumber River in Lumberton is 708 mi². The location of the USGS gage is approximately 1.7 miles downstream from the proposed flood gate closure location. The Lumber River basin at the gage location is entirely within the state of North Carolina and encompasses portions of six different counties: Robeson, Hoke, Scotland, Moore, Richmond, and Montgomery.

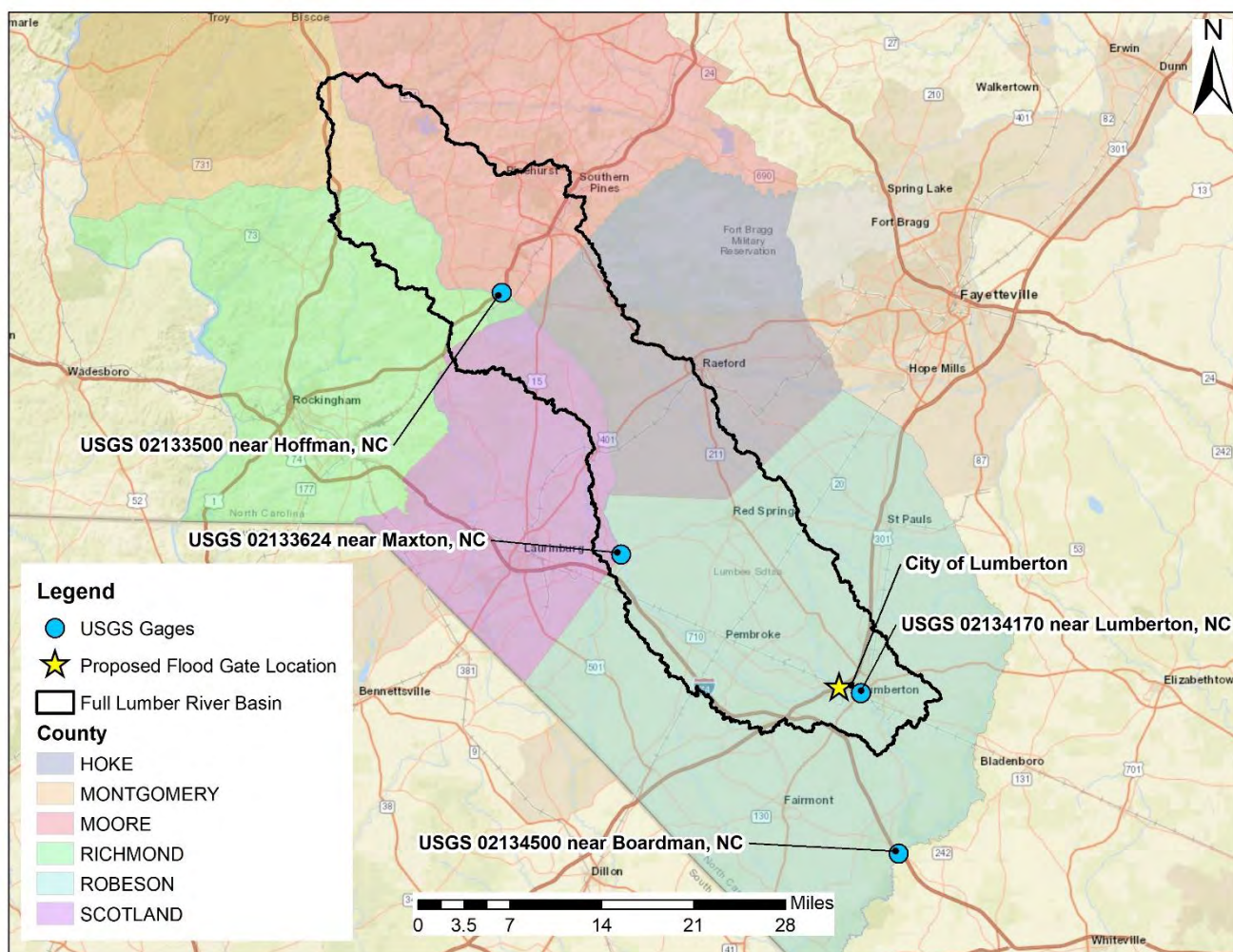


Figure 2-1. Lumber River basin location within southeastern North Carolina.

2.2. Climate

The National Oceanic and Atmospheric Administration (NOAA) provides precipitation and temperature data for the entire United States. The state of North Carolina is divided into eight climate regions (NOAA, 2020). The Lumber River basin is in two of the regions: Southern Piedmont for the northern quarter and Southern Coastal Plains for much of the basin. The mean annual temperature for these regions is 59.7°F and 61.5°F, respectively. This is above the national average of 52.02°F. The mean annual precipitations for the NOAA-defined NC climate regions of Southern Piedmont and Southern Coastal Plain are 46.59-in and 49.23-in, respectively, which are well above the national average of 29.94-in (NOAA, 2020).

Due to its proximity to the Atlantic seaboard, eastern NC is highly susceptible to coastal events including tropical events that mainly occur during the official hurricane season (June 1st to November 30th) as well as extratropical events such as nor'easters and storms that trail along stalled frontal boundaries. Historical data shows that the North Carolina coast is most likely to have a hurricane in September and October based on the prevailing wind patterns (NOAA, 2019a). In 2015, 2016, and 2018, annual precipitation depths were about 14-in, 11-in, and 22-in, respectively, above the annual North Carolina mean (1901-2019) (NOAA, 2020), primarily due to tropical storms and hurricanes.

2.3. Historical Floods

2.3.1. Storms Prior to 2000

Records of major flooding caused by tropical storms dates to the 1600s. However, no flow measurements were available until after the installation of the USGS Gage 02134170 (on Lumber River at Lumberton, NC) circa the year 2000. Notable storms that occurred prior to 2000 include:

- The flood of October 1954 was the result of Hurricane Hazel which made landfall on October 14, 1954, as a category 4 storm near Calabash, NC, approximately 70 miles southeast from Lumberton, NC. Total rainfall was reported to be over 7 inches in parts of NC, including near the upstream portion of the Lumber River basin, with totals between 5 to 6 inches closer to Lumberton, NC (North Carolina State Climate Office (NCSCO), 2015). While tropical events occurred prior to 1954, Hurricane Hazel was noted as one of the most catastrophic in the twentieth century (Barnes, 1998), thus selected as the earliest record of interest.
- The flood of September 1996 was the result of Hurricane Fran which made landfall on September 5, 1996, as a category 3 storm near where the Cape Fear River reaches the Atlantic Ocean (NCSCO, 2015). This is approximately 75 miles southeast of Lumberton, NC. A total of 5 to 10 inches of rainfall across parts of eastern and central NC was reported (USGS, 2016).
- The flood of September 1999 was the result of Hurricane Floyd, which made landfall on September 16, 1999, as a category 2 storm near Cape Fear, NC, approximately 75 miles southeast of Lumberton, NC. Rainfall records across the state ranged from 12 to 20 inches. The rainfall total at the Lumberton Airport was 8.48 inches (NOAA, 2019b) and 7.62 inches in Lumberton (USGS, 2016).

2.3.2. Storm and Flood of September 2004

Significant rainfall fell across the entire state of North Carolina in September 2004 as a result of Hurricane Frances. Hurricane Frances impacted North Carolina from September 7-8 and mainly hit the western part of the state but did result in significant rainfall in the eastern half (National Weather Service [NWS], 2004). Rainfall gages near the Lumber River basin reported total rainfall depths from the storm from 4.31 to 11.87 inches (NCSCO, 2020). The USGS gage on Lumber River at Lumberton (USGS 02134170) reported a peak streamflow of 7,420 cubic feet per second (cfs) in the early hours of September 11, 2004 (USGS, 2020).

2.3.3. Storm and Flood of October 2016

The flood of October 2016 was the result of Hurricane Matthew which made landfall on October 8, 2016, as a Category 1 storm southeast of McClellanville, South Carolina, approximately 110 miles southwest of Lumberton, NC. A front moved inland, pushing the storm north and east towards North Carolina. The storm moved back into the Atlantic Ocean on October 9. While the storm was only over land for two days the sharp turn of the path slowed down the forward speed, resulting in heavy precipitation for 2 days over the eastern portions of both North Carolina and South Carolina (NOAA, 2019c). The total recorded precipitation depth in Lumberton, NC from this storm was 12.53 inches, which is the highest recorded until 2018 (previously 7.62 inches in 1999) (Weaver et al., 2016). Recorded peak flows at the USGS gages in Lumberton (02134170) and Boardman, NC (02134500) were 14,600 cfs and 38,200 cfs, respectively (USGS, 2020). The recorded peak of 38,200 cfs at the USGS gage in Boardman, NC is the highest ever recorded flow to date and it resulted in a peak stage of 14.43 ft (USGS, 2016). The Boardman gage is approximately 15 miles downstream of the USGS Lumberton gage.

Based on high water marks (HWM) provided by the USGS, flood depths in and around Lumberton ranged from 0.65 to 6.89 ft. The levee did not overtop or fail during Hurricane Matthew. Flooding in the area was caused by overtopping of I-95, flow through the I-95 opening at VFW Road/CSX Railroad underpass, and inadequate capacity of the internal drainage system (**Figure 2-2**).



Figure 2-2. Flooding along I-95 and inside the Lumberton Levee from Hurricane Matthew; area to right of road is the levee protected side of Lumberton (Source: City of Lumberton).

2.3.4. Storm and Flood of September 2018

The flood of September 2018 was the result of Hurricane Florence. Hurricane Florence made landfall on September 14, 2018, as a Category 1 storm at Wrightsville Beach, NC, approximately 75 miles southeast of Lumberton, NC. After making landfall, the storm turned southwest into South Carolina, where it moved inland and then turned north before becoming a tropical depression. While the winds were lower as a result of being a Category 1 storm, the system moved slowly at about 2 to 3 miles per hour over North and South Carolina, resulting in large rainfall amounts. Rainfall continued over a four-day period across the southeastern portion of North Carolina (NOAA, 2019c). Total rainfall values reported by NOAA at stations 2.3 miles northeast of Lumberton and 2.6 east-southeast of Lumberton are 22.8 inches and 21.4 inches, respectively. Hurricane Florence resulted in the highest ever recorded peak flow at the USGS gage in Lumberton (02134170 Lumber River at Lumberton) of 17,100 cfs with a peak stage of 22.21 ft. Hurricane Florence caused major flooding within the City of Lumberton as floodwaters passed through the opening under I-95 at the VFW Road and CSX railroad intersection into the city (**Figure 2-3**). USGS estimates about 12-percent of the total recorded peak flow passed through the opening under I-95.



Figure 2-3. Flooding under I-95 at VFW Road and CSX railroad in Lumberton, NC from Hurricane Florence (Source: City of Lumberton).

3. Data Collection

Data used for modeling included field data along with available hydrologic, terrain, and land data. Field data, including high water marks and survey, is provided in **Appendix A**. Hydrologic data, including rainfall, streamflow, and parameter calculations, is provided in **Appendix B**. Hydraulic data, including levee data, is provided in **Appendix C**.

3.1. Terrain and Watershed Data

Terrain tiles were QL2 Light Detection and Ranging (LiDAR) obtained from the North Carolina Floodplain Mapping Program (NCFMP). QL2 data has a standard of 2 points per square meter, allowing for higher resolution than previous LiDAR. The projection of the data source was in NAD_1983_StatePlane_North_Carolina_FIPS_3200_Feet. The vertical datum is NAVD 88. The terrain was for the entirety of Robeson County and portions of Hoke, Scotland, Moore, Richmond, and Montgomery counties and all are 10 ft resolution. The tiles within the project area were mosaiced using ArcGIS. The elevation within the Lumber River basin ranges from 102 to 734 ft NAVD 88 (**Figure 3-1**).

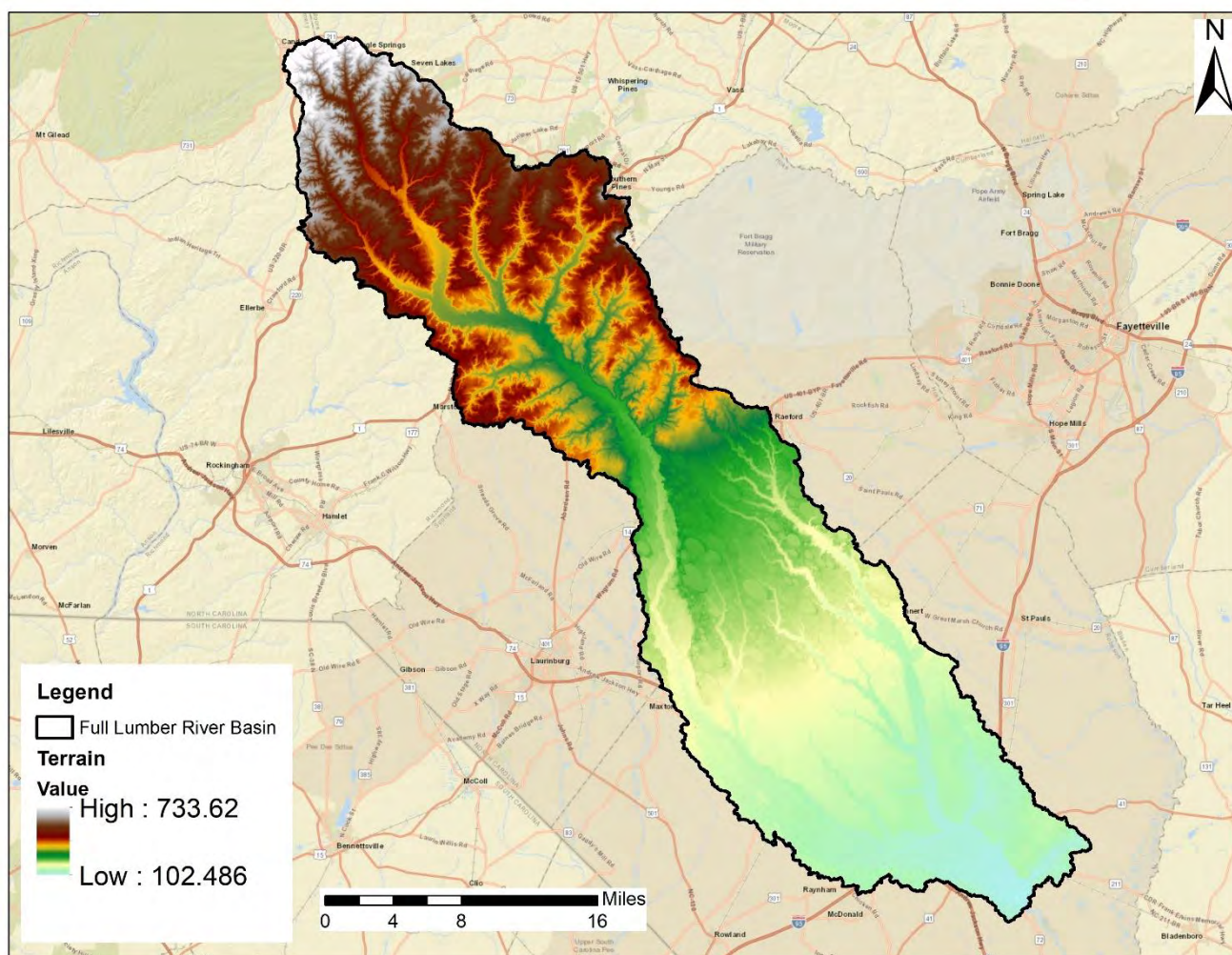


Figure 3-1. Lumber River basin terrain.

The LiDAR terrain source did not account for bathymetry. Bathymetric data for Lumber River were obtained from the Preliminary Lumber River one-dimensional (1D) Hydrologic Engineering Center's River Analysis System (HEC-RAS) model obtained from NCFMP as part of this project. Channel banks were edited to ensure that the channel thalweg and top width were captured. The bank-to-bank elevations at each cross-section were

exported as the bathymetry using RASMapper. This same procedure was followed for Jacob Swamp and Little Jacob Swamp.

For Fivemile Branch, Meadow Branch, Gum Branch, Cotton Mill Branch and Collection Canal, cross section data was obtained in the field for at least two points along the channel. This procedure is explained in further detail in **Section 3.6.2**. A slope was interpolated from the two surveyed cross sections, and the slope was used to drop the channel inverts along each reach. This procedure was completed using 1D HEC-RAS models and the bathymetry generated using the approach described for Lumber River and Jacob Swamp.

The separate bathymetric terrains were then mosaiced with the original terrain, giving bathymetry the priority in ArcGIS. At confluences, tributary elevations were altered to match that of the main reach to ensure the terrain merged smoothly.

3.2. Precipitation Data

Hourly precipitation in the area was obtained from the North Carolina Climate Retrieval and Observations Network of the Southeast Database (NC CRONOS)/ North Carolina Environment and Climate Observing Network (ECONet) Database, which was developed by the State Climate Office of North Carolina (2019). There are eleven precipitation gages within or nearby the drainage basin, eight of which had precipitation data for selected calibration and verification storms (**Figure 3-2**). Gages with available data varied across storms (**Table 3-1**).

For each event, Thiessen polygons were created based on the rainfall gages with available data to estimate the rainfall contribution from each gage for each sub-basin (**Figure 3-3**). Thiessen polygons were created for each event based on gages with available data to determine which gages to use for precipitation data for each sub-basin. Depending on the outcome of the Thiessen polygon divisions, some gages with available data were not used, as highlighted for the 2004 event in **Figure 3-3**. Sub-basin delineation is discussed in **Section 5.3**. Additional details on the Thiessen polygon procedure are included in **Appendix B1**. The area proportions determined from the Thiessen polygons were applied as weights to the precipitation data from the contributing gages. The storm hyetograph applied to a sub-basin is the weighted average from all contributing rainfall gages. A summary of gage availability, weighted rainfall data sets, and the applied range of rainfall per event is provided in **Table 3-1**.

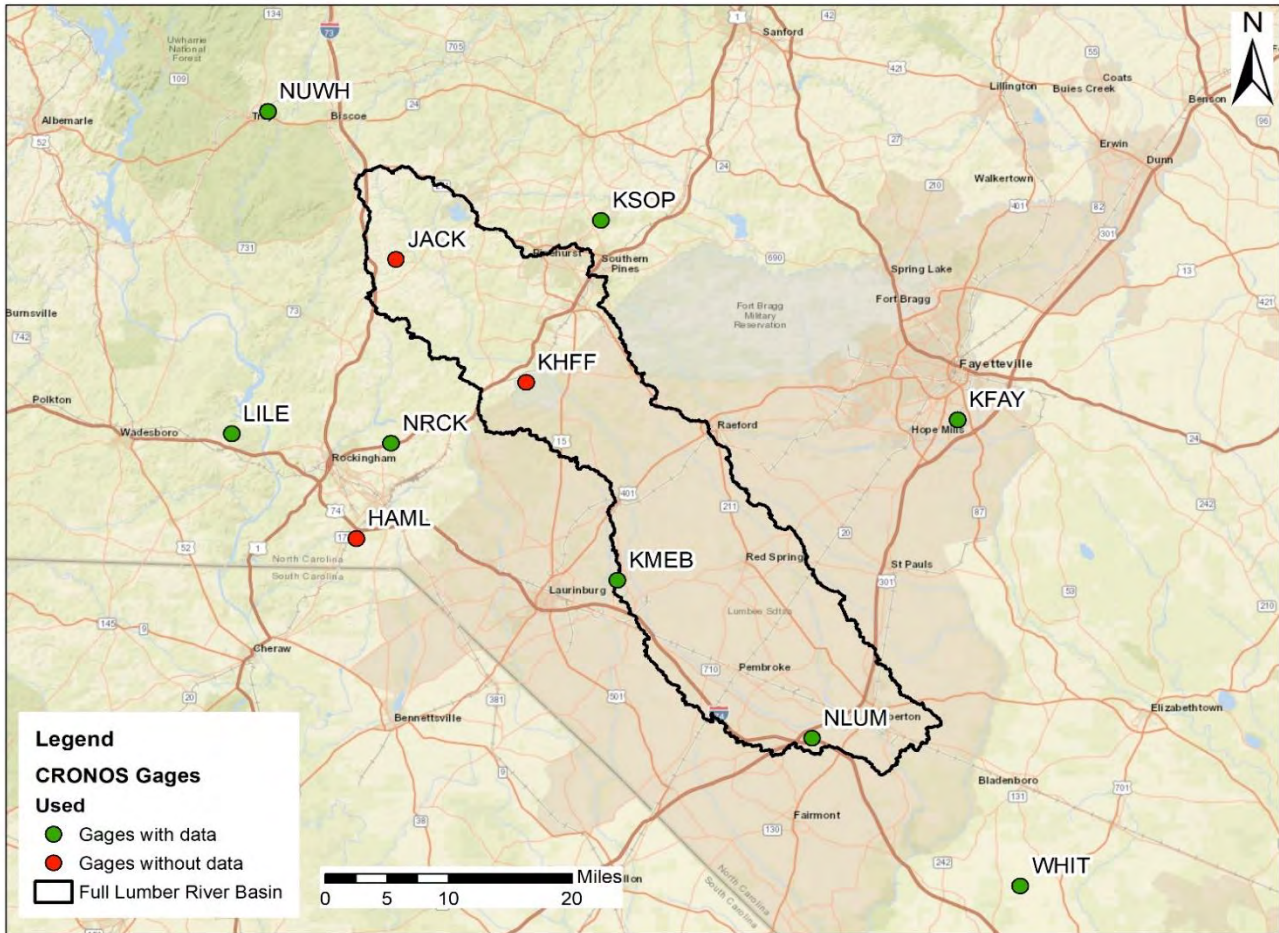


Figure 3-2. CRONOS rainfall gages in and near the Lumber River basin.

Table 3-1. Precipitation gage availability and utilization in models.

Event	Gages Available	Gages Used
Sept 2004	5 (KFAY, HAML, KMEB, NRCK, WHIT)	KFAY, KMEB, NRCK, WHIT
Oct 2015	4 (LILE, NLUM, NUWH, WHIT)	LILE, NLUM, NUWH
Oct 2016	5 (KSOP, LILE, NLUM, NUWH, WHIT)	KSOP, LILE, NLUM, NUWH
Sept 2018	4 (LILE, NLUM, NRCK, WHIT)	NLUM, NRCK

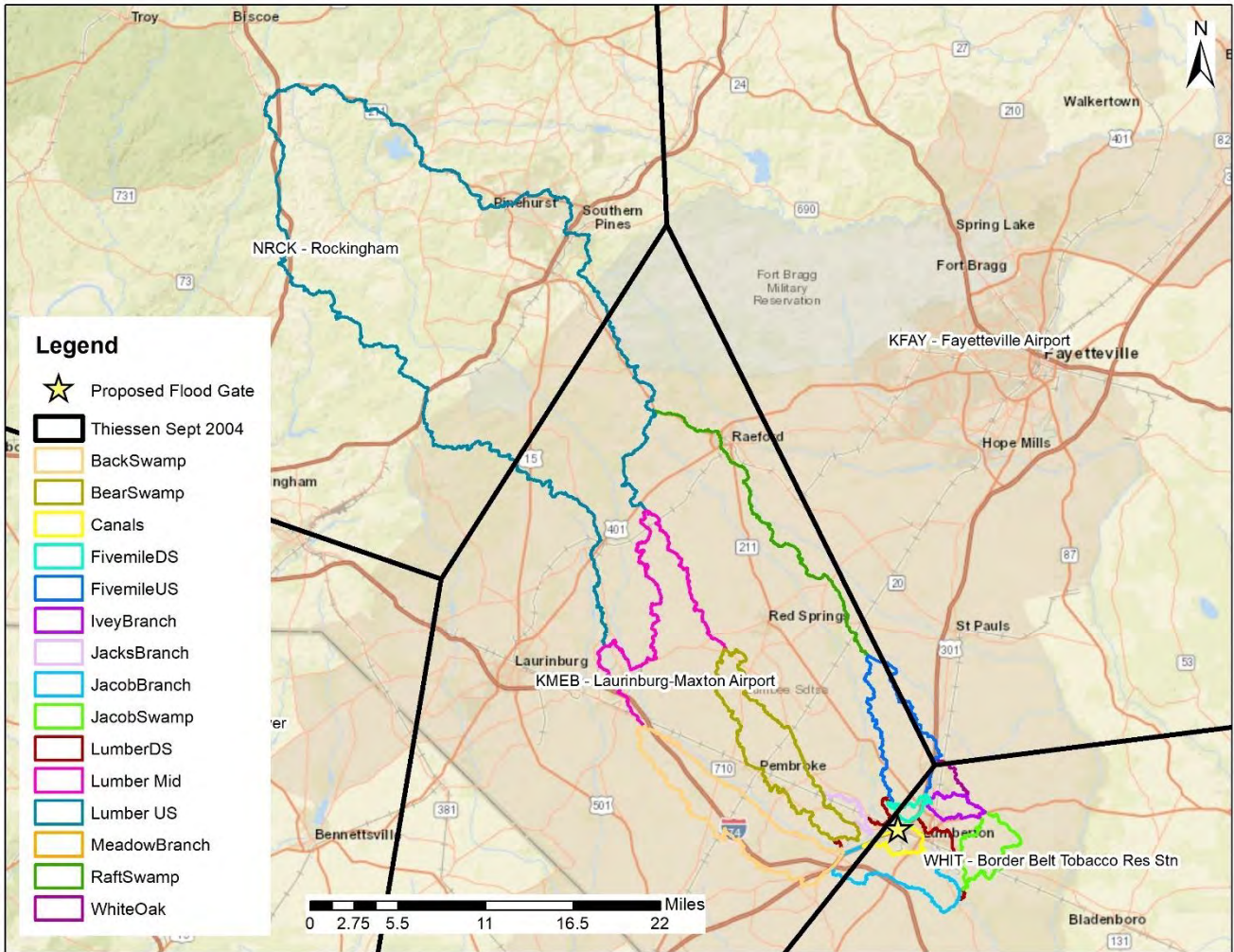


Figure 3-3. Example of Thiessen polygons used to calculate weighted rainfall; shown is the 2004 event Thiessen polygons.

3.3. Streamflow Data

There is a USGS stream gage approximately 1.7 miles downstream of the Lumberton flood gate location, USGS 02134170 Lumber River at Lumberton, NC (**Figure 3-4**). Fifteen (15) minute river discharge (cfs) and gage height (ft) were obtained for the full period of record (July 2, 2000 to present) (USGS, 2020) (**Appendix E2.1**). Additionally, there is a gage upstream on Lumber River in Maxton, NC (USGS 02133624) with a drainage area of 365 sq mi and a gage downstream of our modeled basin on Lumber River in Boardman, NC (USGS 02134500) with a drainage area of 1,228 sq mi (**Figure 3-4**).

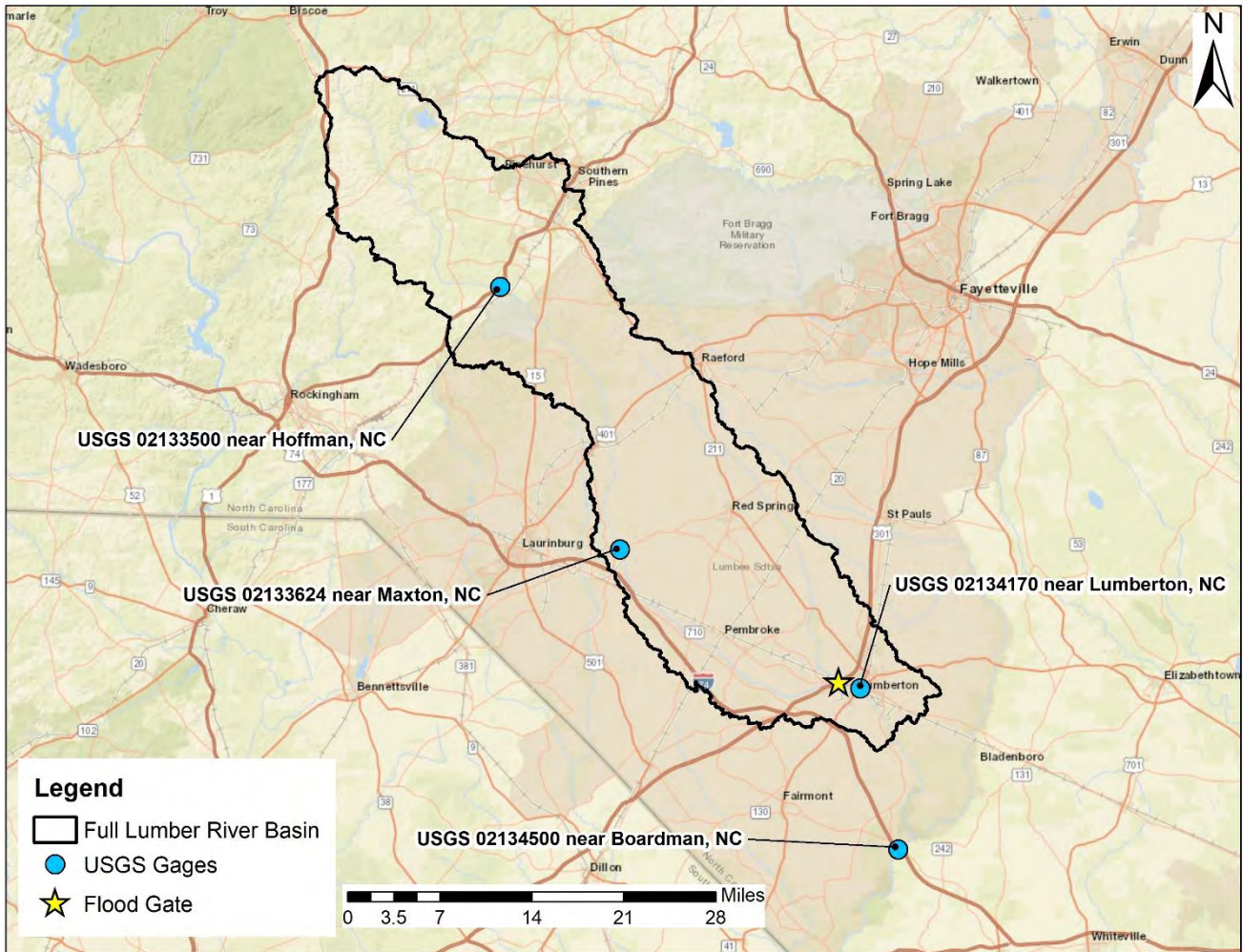


Figure 3-4. USGS gage (02134170 Lumber River at Lumberton, NC) within the Lumber River basin.

3.4. Soils Data

Hydrologic soil group data was obtained from the United States Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS) GeoSpatial Data Gateway (USDA, 2020). Gridded soil survey from the Soil Survey Geographic (gSSURGO) database was downloaded for all required counties. Most of the basin consists of B and C soils, with some D soils and minimal A soils (**Figure 3-5**).

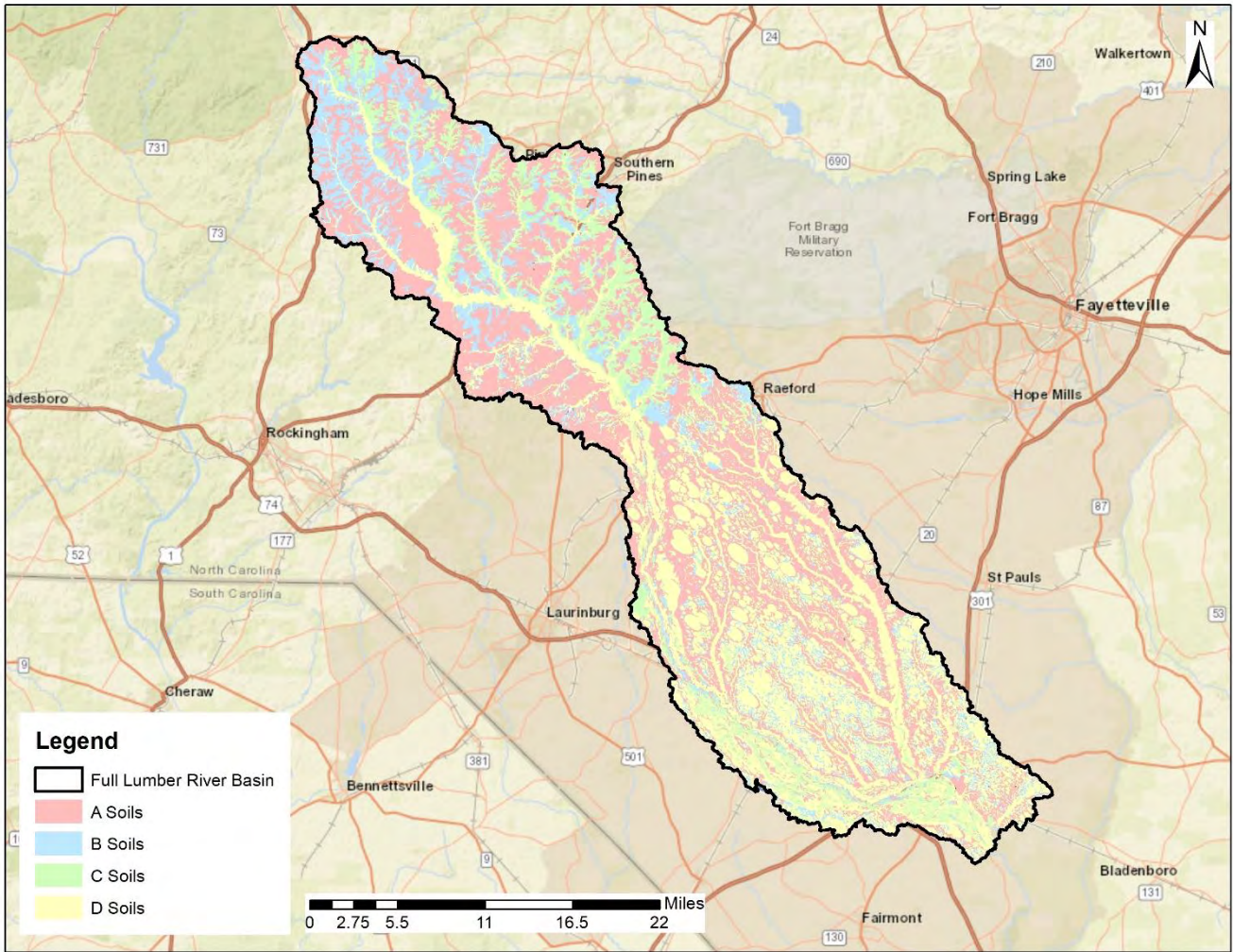


Figure 3-5. Lumber River basin soil type distribution.

3.5. Land Use Data

Land use data was obtained from the 2016 National Land Cover Database (NLCD) (**Figure 3-6**) (USDA, 2020). The northern portion of the watershed is primarily evergreen forest, while the southern half is cultivated crops and the developed area of Lumberton, NC.

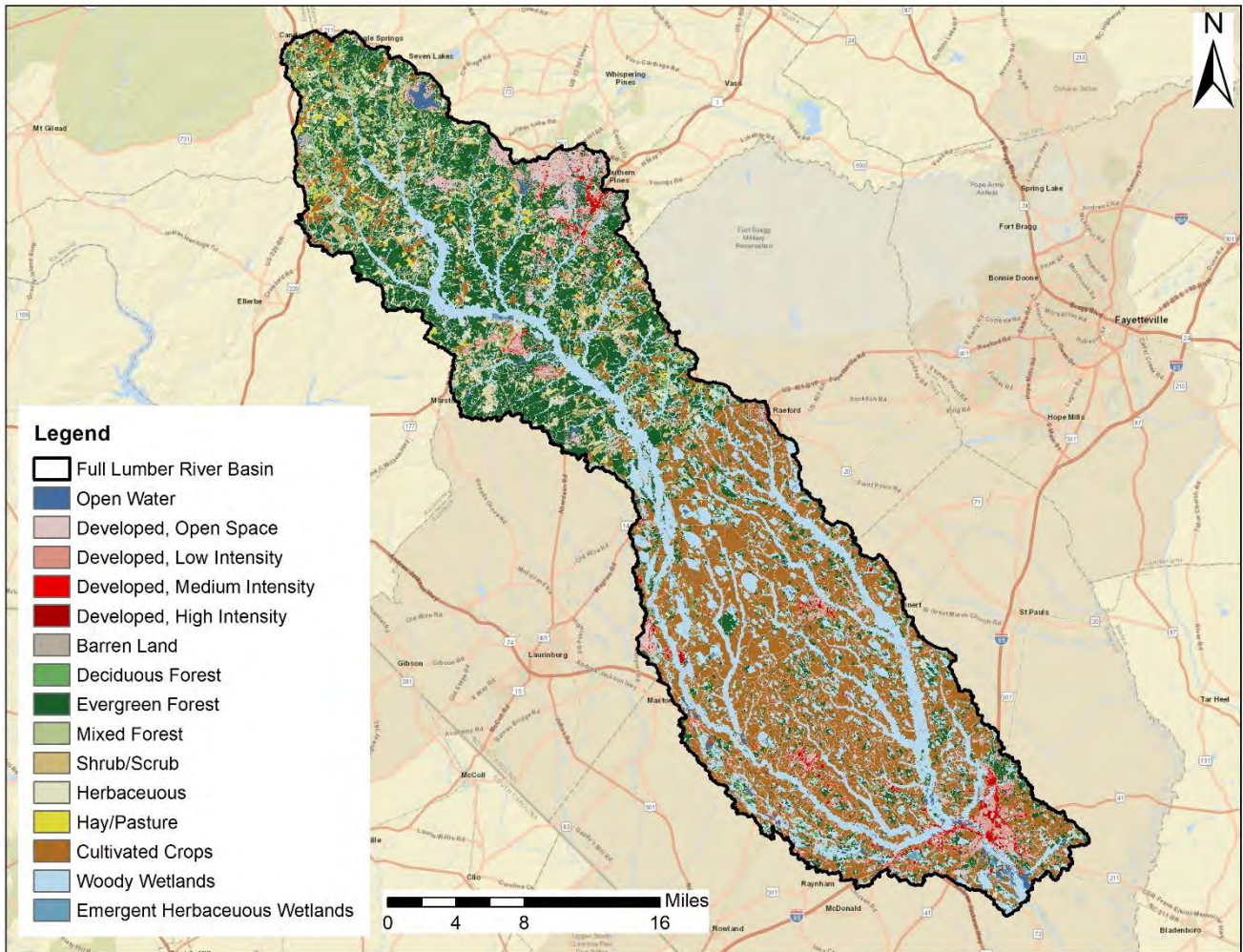


Figure 3-6. Lumber River basin 2016 land cover type.

3.6. Field Survey and Data Collection

A field survey was conducted to validate structure dimensions from effective models/inspection reports and collect dimensions for structures without pre-existing data. A field survey was also conducted to gather cross section information for reaches within the levee protected area that did not have an effective model with bathymetry. **Figure 3-7** below shows the locations of these structures and the cross-section locations. The location map and field measurements are provided in **Appendix A1** and photographs for each structure are shown in **Appendix E1**. The team also gathered high water mark information from Hurricanes Florence and Matthew.

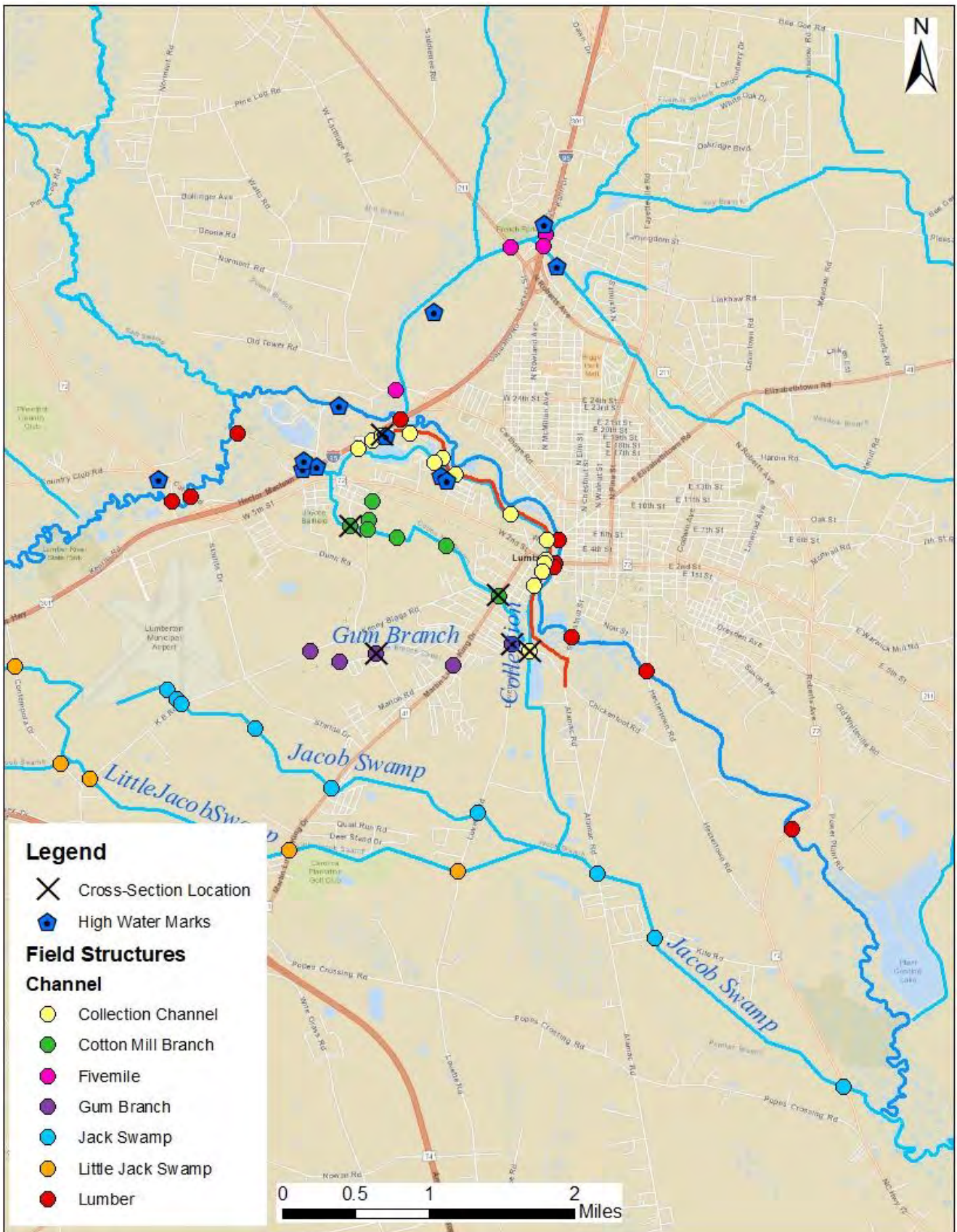


Figure 3-7. Collected field data for structures, high water marks, and survey points.

Additional structure surveys were conducted by McGill Associates for selected structures along the main reaches, Lumber River, and Fivemile Branch. McGill surveyed one structure on Lumber River/I-95 in the vicinity of the proposed flood gate and four structures on Fivemile Branch.

3.6.1. Structure Data

An inventory of hydraulic structures within the project area was derived before the field survey. The initial list of structures came from the effective FEMA models for Lumber River, Jacob Swamp, Little Jacob Swamp, Fivemile Branch, Collection Canal, Cotton Mill Branch, and Raft Swamp. These were all obtained from the North Carolina Flood Risk Information System website (NCFMP, 2019). The second source of known structures was the NCDOT Bridges Map (NCDOT, 2019). Inspection reports were obtained from NCDOT for the structures found on the NCDOT Bridges Map. Other structures were found using aerial imagery or data. Levee data was obtained from AECOM Project No. 60548447, Lumberton Flood Mitigation Report Levee Plans, provided in **Appendix C2**.

The team collected general structure dimensions, material, skew, bed material and condition, normal depth, channel width, structure condition, scour, sedimentation, obstructions, and guardrail height. More specifically, data for bridges included: number of spans, width of spans, pier dimensions, cap dimensions, girder thickness, seat dimensions, depth from low chord to channel invert, length of bridge, and width of bridge. Data collection for culverts included: culvert type, number of barrels, rise, span/diameter, bed to crown, abutment type, scour, and length of culvert.

The above data was obtained using Global Positioning System (GPS), measuring tapes, measuring wheels and rods. The team also looked for any additional structures not found in aerial imagery or ongoing construction.

3.6.2. Cross Sections

Collection Canal, Gum Branch, and Cotton Mill Branch were surveyed at a minimum of two locations along the reach. This allowed for a slope to be interpolated along the channel bed. The cross sections were taken at the upstream side of a structure.

To collect the cross-section data, the survey team used a laser level, GPS, and rod. A benchmark was determined using GPS coordinates (at top of bank). The elevation of the benchmark was estimated using LiDAR data. The team then took a back sight reading and found the height of instrument. Foresight readings were taken throughout the channel. Points were taken approximately every 5 feet across the channel to capture top of bank, edge of water and channel inverts. calculations were performed to determine the channel elevations from the collected measurements. Cross-section data and plots are provided in **Appendix A3**.

3.6.3. High Water Marks

Eleven high water mark (HWM) locations and depths were obtained from a field visit with City of Lumberton waterworks department personnel (**Figure 3-8**). The City of Lumberton personnel provided the history of each water mark during the field visit. At each mark, the location, height of water from the ground, and event were noted, along with photos for each. An example of a recorded HWM photo is shown in **Figure 3-9**. Measured HWM depths were converted to elevations based on the terrain data described in **Section 3.1**.

Additionally, HWM for Hurricanes Matthew and Florence were obtained from the USGS Flood Event Viewer application ((United States Geological Survey, 2019) (**Figure 3-8**).

The high-water mark located just upstream of the proposed gate location was surveyed by McGill Associates. This HWM can be seen in **Figure 3-8** below. Additional details are included in **Appendix A2**.

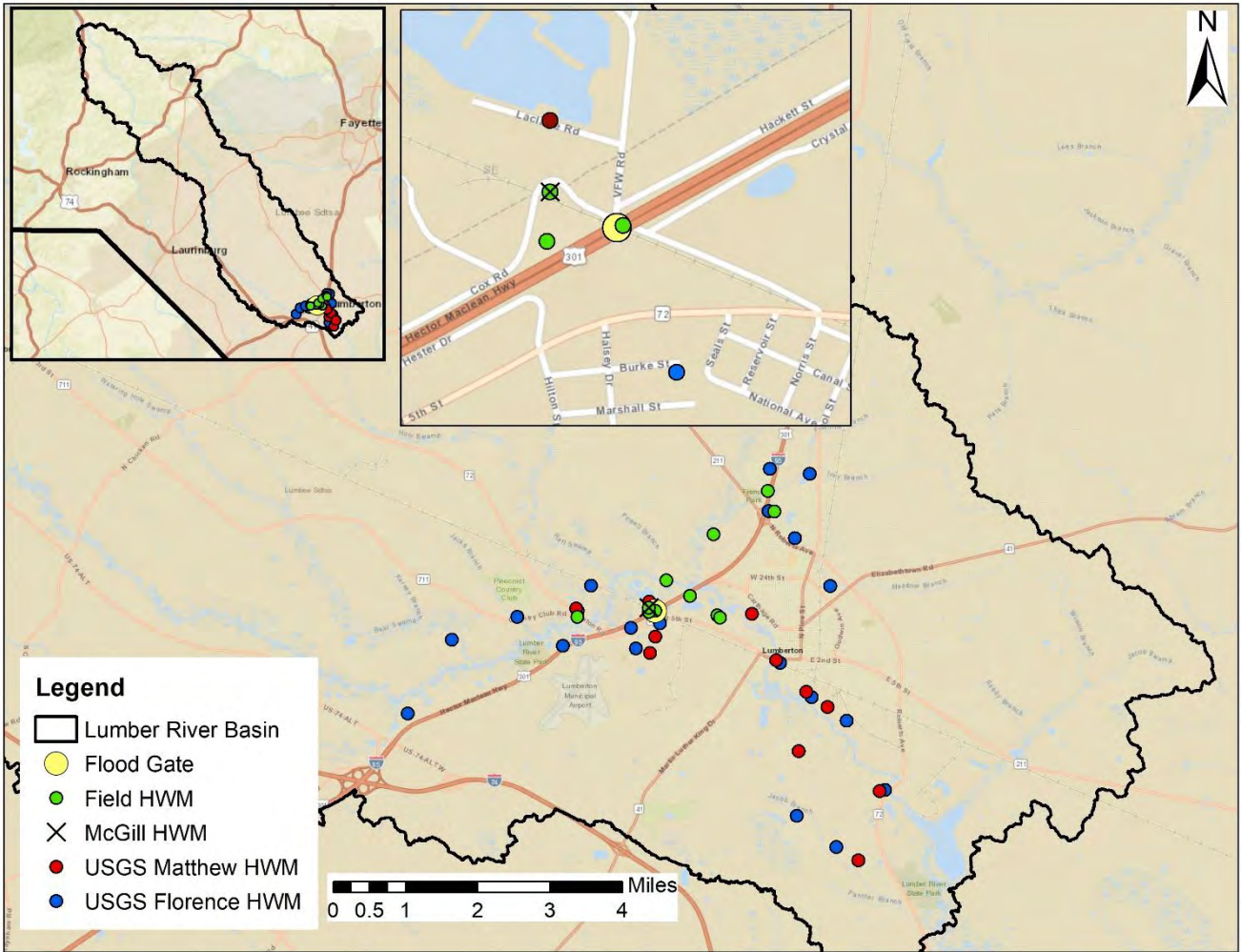


Figure 3-8. Location of field and USGS high water marks.



Figure 3-9. Example of HWM from Lumberton field visit near the VFW Road and railroad intersection by the flood gate location.

4. Design Flood Selection

4.1. Review of FEMA Levee Accreditation Guidelines

FEMA provides guidelines and requirements that must be met for levee systems to be accredited (FEMA, 1986). The FEMA requirements, as specified in 44 Code of Federal Regulations (CFR) 65.10 (FEMA, 2006), related to levee height are as follows:

- Levees must have a minimum freeboard of 3 feet above the 100-year flood elevation (base flood elevation), with
- an additional 1 foot of freeboard at locations within 100 feet of structures (such as bridges) or wherever the flow is restricted, and
- an additional 0.5 foot of freeboard at the upstream end of a levee.

The minimum elevation of the flood gate will therefore have to be above the 100-year water surface elevation plus 4.5 feet to meet FEMA accreditation requirements. The levee is currently not FEMA accredited.

4.2. Flood Frequency Analysis

It is the desire of the City of Lumberton to have a flood gate that can, at a minimum, prevent flooding from events like that of Hurricanes Matthew and Florence, which are the highest recorded flooding events in Lumberton. Flood frequency analysis was performed to estimate the recurrence intervals of historic floods (Hurricane Matthew and Hurricane Florence) near the site. For reference, the recorded peak flow rate from Hurricane Matthew at the Lumberton and Boardman gages were 14,600 cfs and 38,200 cfs, respectively, and the recorded peak flows for Hurricane Florence at the Lumberton and Boardman gages were 17,100 cfs and 35,400 cfs, respectively.

Flow measurements at the Lumberton gage during Hurricane Matthew did not account for flow that was diverted through the I-95 opening at the VFW Road and the CSX railroad track. The actual peak flow at Lumberton from Hurricane Matthew is therefore larger than the reported peak flow of 14,600 cfs. USGS records indicate that diverted flow through the I-95 opening during Hurricane Florence was about 2,000 cfs, approximately 12% of the total flow (USGS Correspondence, **Appendix B6**). Based on the recorded water surface elevations at the USGS gage in Lumberton (119.7 feet for Hurricane Florence versus 119.4 feet for Hurricane Matthew) for the two events, a similar amount of flow can be assumed to have been diverted through the I-95 opening during Hurricane Matthew. This implies that the actual peak flow at Lumberton from Hurricane Matthew is about 16,600 cfs. This estimate is consistent with the simulated peak flow from the Hydrologic Engineering Center's Hydrologic Modeling System (HEC-HMS) model as described in **Section 5.6** and **Table 5-8**. Additional analysis was performed with the adjusted peak flow for Hurricane Matthew to assess the sensitivity of the estimated return periods to the change in the peak flowrate for that event.

PeakFQ (version 7.3) (USGS, 2019a) was utilized for the analysis. This version of the software was released in 2019 and uses Bulletin #17C methodology (USGS, 2019b) for the flood frequency computation. Log Pearson Type III distribution was used for the analysis. Peak streamflow data was downloaded for two USGS gages:

1. USGS 02134170 – Lumber River at Lumberton, NC
 - Near proposed Lumberton flood gate site
2. USGS 02134500 – Lumber River at Boardman, NC
 - Approximately 15 miles downstream of the Lumberton gage

The flood frequency analysis was conducted for the gage at Lumberton (Gage 1). This gage had a record from 2001-2018 and the downstream gage (Gage 2) had a record from 1901-2018.

Two different methods were used in estimating the return periods to assess the impact gage record length and method for gage adjustment based on nearby gage(s) with longer records:

- Method 1 uses Gage 1 observed data only.
- Method 2 extends the record at Gage 1 based on Gage 2 using the MOVE method.

4.2.1. Method 1

The results of the analysis based only on the Gage 1 records with the reported and adjusted peak flow rates of 14,600 cfs, and 16,600 cfs for Hurricane Matthew are shown in **Table 4-1** and **Figures 4-1** and **4-2**. Based on this data, the return periods for Hurricane Matthew and Florence are between 30 to 50 years. The Log Pearson Type III analysis for this is included in **Appendix E4.2**. The upper (95%) and lower (5%) confidence limits of the peak flow estimates are also reported to show the potential range of peak flows that could occur for each return period.

Table 4-1. Calculated discharge per return period at the Lumberton gage (USGS 02134170).

Return Period (years)	With Reported Matthew Peak Flow Rate			With Adjusted Matthew Peak Flow Rate		
	Peak Flow (cfs)	Peak Flow 5% Lower Bound	Peak Flow 95% Upper Bound	Peak Flow (cfs)	Peak Flow 5% Lower Bound	Peak Flow 95% Upper Bound
1.25	1,654	1,122	2,269	1,645	1,109	2,267
2	3,130	2,283	4,375	3,145	2,282	4,427
5	6,139	4,389	9,687	6,254	4,440	9,979
10	8,856	6,103	15,830	9,099	6,218	16,510
25	13,240	8,603	28,460	13,740	8,836	30,140
50	17,270	10,680	43,080	18,050	11,030	46,170
100	22,020	12,920	64,080	23,170	13,410	69,470
200	27,600	15,330	94,040	29,230	15,990	130,100
500	36,460	18,760	153,600	38,940	19,700	171,000

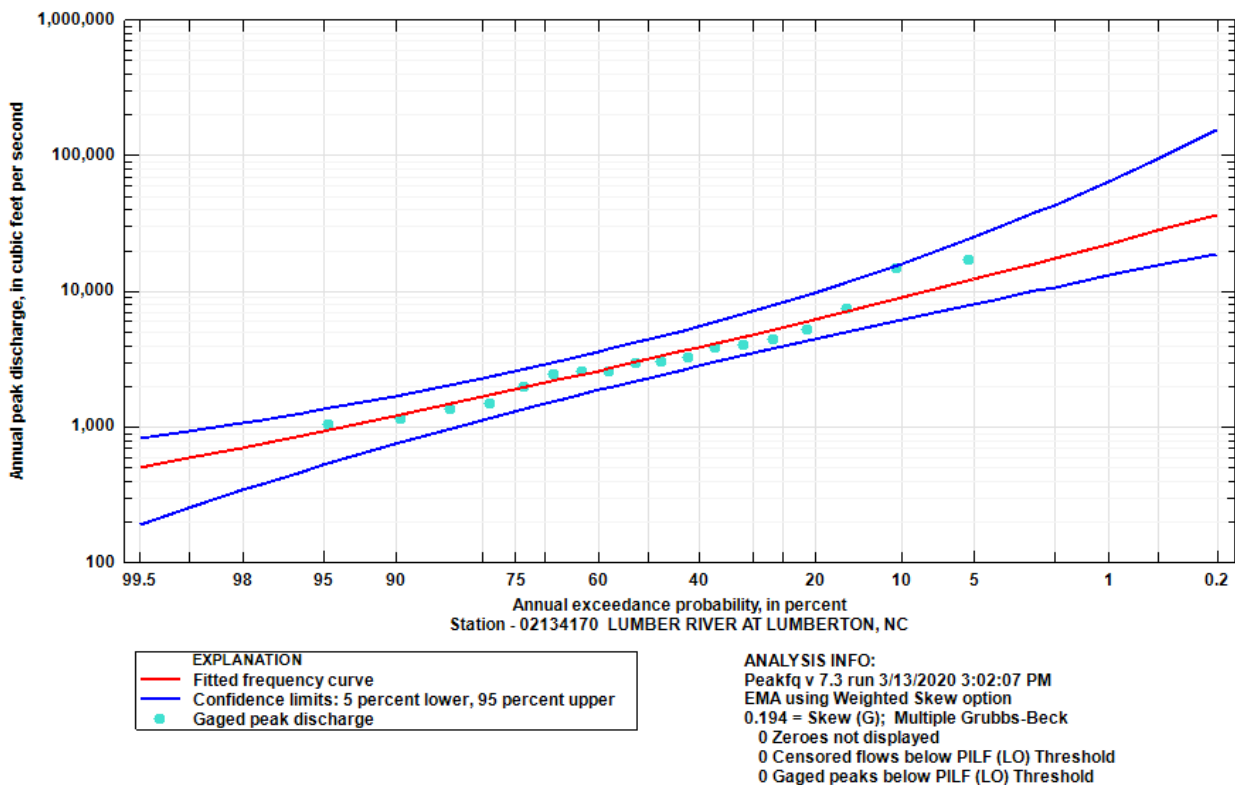


Figure 4-1. Discharge-Frequency curve for Lumberton gage with reported Hurricane Matthew peak flow rate.

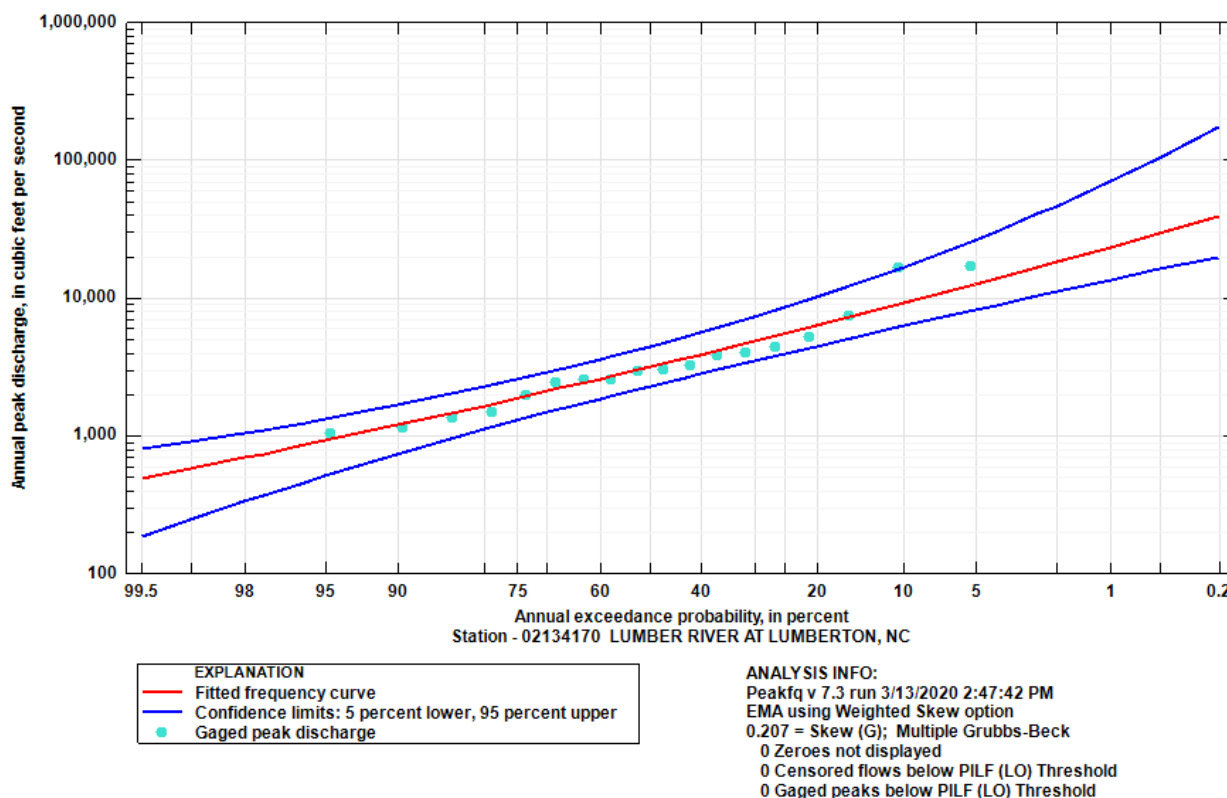


Figure 4-2. Discharge-Frequency curve for Lumberton gage with adjusted Hurricane Matthew peak flow rate.

4.2.2. Method 2

The maintenance of variance estimator (MOVE) method described in Bulletin #17C (USGS, 2019 b) was used to extend Gage 1 records. This method extends a shorter record series using a supplemental series while maintaining the variance of the extended series. The procedure of the MOVE adds observations (ne) to the original records (y). The values of the new observations have the information to transfer the mean and variance of the original records. The statistical analysis following this procedure resulted in a total of 38 records (n1+ne), compared to 18 in the original records (n1). A linear regression model was developed to estimate an additional 20 observations (ne). The 38 records were used as inputs for PeakFQ analysis (**Appendix E4.2**). **Table 4-2** and **Figure 4-3** below show the frequency analysis results.

Table 4-2. Calculated discharge per return period based on the extended Lumberton gage records (USGS 02134170).

Return Period (years)	Peak Flow (cfs)	Peak Flow 5% Lower Bound	Peak Flow 95% Upper Bound
1.25	2,080	1,736	2,442
2	3,305	2,821	3,898
5	5,419	4,547	6,734
10	7,109	5,826	9,393
25	9,588	7,561	14,000
50	11,700	8,923	18,580
100	14,040	10,330	24,370
200	16,640	11,800	31,680
500	20,530	13,820	44,300

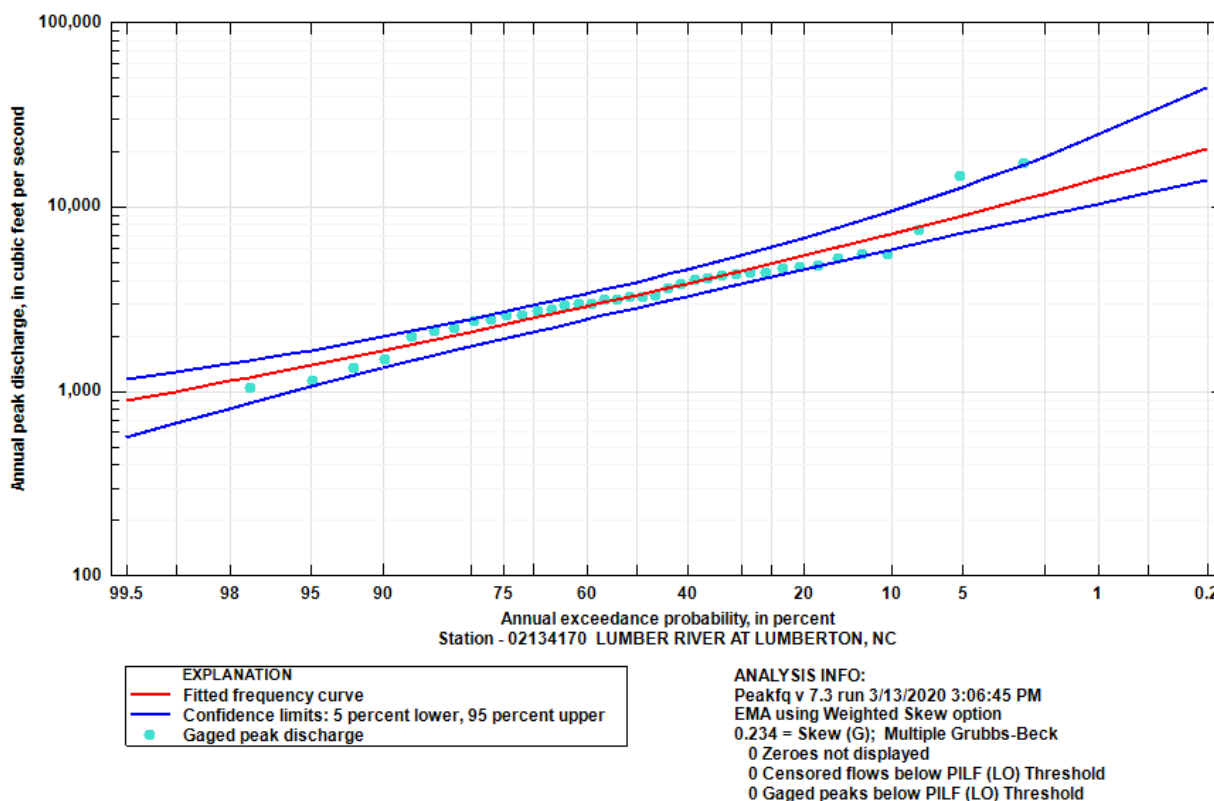


Figure 4-3. Discharge-Frequency curve for Lumberton gage with extended record.

The estimated return periods for Hurricane Matthew and Florence are approximately 120 and 235 years, respectively. The extended record calculations and the Log Pearson Type III analysis for this is included in **Appendix E4.1**.

When using the updated peak flow value of 16,600 cfs for Hurricane Matthew in the analysis, the return period for hurricane Matthew and Florence are approximately 170 and 190 years, respectively. The extended record calculations and the Log Pearson Type III analysis is included in **Appendix E4.1**. **Table 4-3** and **Figure 4-4** below show the results of the analysis using the adjusted flow for Hurricane Matthew.

Table 4-3. Calculated discharge per return period based on the extended Lumberton gage records (USGS 02134170) and altered Hurricane Matthew.

Return Period (years)	Peak Flow (cfs)	Peak Flow 5% Lower Bound	Peak Flow 95% Upper Bound
1.25	2,080	1,742	2,436
2	3,325	2,844	3,916
5	5,500	4,626	6,837
10	7,255	5,964	9,609
25	9,852	7,795	14,460
50	12,080	9,242	19,320
100	14,560	10,750	25,500
200	17,340	12,320	33,340
500	21,520	14,500	46,990

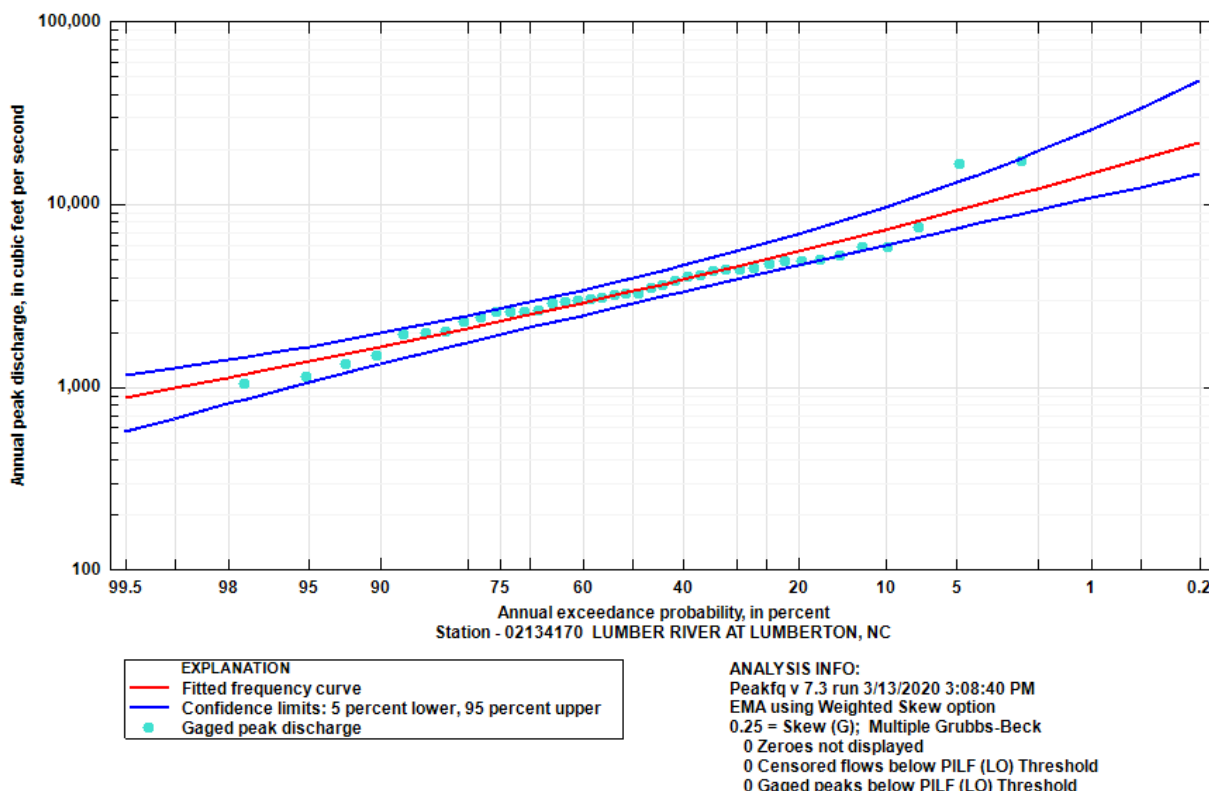


Figure 4-4. Discharge-Frequency curve for Lumberton gage (USGS 02134170) with extended record and altered Hurricane Matthew.

4.2.3. Gage Weighted Regression Estimates

Regional regression flow rate for each return period was calculated using USGS-developed regional regression equations for North Carolina (USGS, 2009). StreamStats was used to determine the basin percentage in each hydrologic region (1-5). A total of 45-percent of Lumber River basin is in Region 3 and 55-percent is in Region 4 (USGS, 2016). Based on the PeakFQ estimated gage peak flow at the Lumberton gage (USGS 02134170), regression estimated peak flow, and variance of prediction for each value, the gage weighted peak flow was estimated for the 2 – 500-year return periods (Table 4-4). The resulting return periods for Hurricanes Matthew and Florence remain the same as using only the gage estimates. The gage weighted regression calculation is included in Appendix E4.3.

Table 4-4. Regional regression weighted peak flow rate estimates for Methods 2 approaches.

Return Period (yrs)	Regression Peak Flow Rate (cfs)	Weighted Peak Flow Rate (cfs)	
		Method 2 – unaltered Matthew	Method 2 – altered Matthew
2	4,006	3,410	3,429
5	6,740	5,546	5,616
10	8,797	7,320	7,449
25	11,440	9,903	10,125
50	13,620	12,090	12,400
100	15,799	14,463	14,864
200	18,043	17,029	17,539
500	20,993	20,678	21,347

4.3. Recommended Design Flood Frequency

The results of the analysis indicate that there is a high amount of uncertainty regarding the return periods for floods produced by Hurricanes Matthew and Florence at Lumberton, NC. This is due to the limited gage records at that location. Updating the limited gage data at the USGS gage at Lumberton based on the longer record at the USGS gage in Boardman provides more realistic estimates of the return periods. Based on this approach, the return periods for the flood produced by both Hurricanes Matthew and Florence are about 170 and 190 years, respectively.

The minimum top of gate elevation must be the higher of the peak water surface elevation from Hurricane Florence at the gate location or the 100-year elevation at the gate plus 4.5 feet of freeboard. The return period of such a flood will be about 200-years or greater.

5. Hydrologic Model Development

5.1. General Methodology

The Hydrologic Engineering Center Hydrologic Modeling System (HEC-HMS) version 4.2.1 software was used to model the Lumber River basin and develop outflow hydrographs for each sub-basin. HEC-HMS is a rainfall-runoff model developed by the U.S. Army Corps of Engineers (USACE, 2017) and is widely used for detailed rainfall-runoff modeling across the United States.

HEC-HMS has three main components: watershed physical description (basin model), meteorology description (meteorological model), and hydrologic simulation. For each basin and/or sub-basin a method can be selected for canopy, surface, loss, transform, and baseflow. The meteorological model represents the precipitation input needed by sub-basin elements in the basin model. Hydrologic simulation encompasses control specifications, which detail the simulation times (dates, times, time interval).

The watershed physical description process involved the addition of sub-basins, junctions at the end of each sub-basin, and reaches connecting the junctions. This allowed all sub-basins to be connected and set up how water will move through the model from upstream to downstream.

5.2. HEC-HMS Model Parameters

The modeling methods were selected from methods available in HEC-HMS Version 4.2.1. The hydrologic modeling methods selected were chosen based on the availability of data and ability to define modeling method parameters with this data. Predictive ability of the modeling method based on experience was also a factor. Based on these factors, the Snyder Unit Hydrograph method was selected and used to characterize the rainfall-runoff relationship of the sub-basins within the watershed. The Snyder Unit Hydrograph method allows for parameters to be compared across events and sub-basins so that the method can be transformed to ungagged sub-basins. The method is relatively simple yet detailed enough to provide an adequate unit runoff response for predicting large floods based on calibrated parameters.

For all the sub-basins, the loss method was set to 'Initial and Constant' and a transform method of 'Snyder Unit Hydrograph'. **Table 5-1** summarizes the watershed physical parameters required for the selected modeling methods. A summary of the equations and required parameters for each method are included in the HEC-HMS Technical Reference Manual (USACE, 2000). The initial loss was calculated using the Soil Conservation Service (SCS) runoff curve number method (USDA, 1986). Imperviousness was set to zero (0%) for all sub-basins as this was incorporated into the curve number and thus initial loss value. The remaining loss parameter is constant loss. The two parameters required for the transform method are the standard lag and peaking coefficient. The constant loss, lag time, and peaking coefficient are variables based on basin characteristics and thus were calibrated. Initial losses were also adjusted during calibration based on known antecedent soil conditions for each calibration and verification storm.

The hydrologic simulation control specifications were individually set for each simulation event based on the corresponding dates and times.

Rainfall and streamflow data were added as time series data. A precipitation gage was added for each basin for each simulated event. The number of precipitation gages added per event was based on the number of rainfall gages with available data and the associated weighted rainfall developed. The precipitation gages included values covering the full time period of the control specification with a one-hour interval. Discharge gages were added for each event at the calibration points within the model (USGS Gage 02133624 at Maxton and USGS Gage 02134170 at Lumberton). The discharge gages contained the discharge data for each storm as recorded at those gage locations. Discharge was added at a fifteen-minute interval.

Cross-section data was also added for each reach for use in flow routing.

Initial parameter approximations were estimated using Geographic Information System (GIS) data and applicable parameter ranges. Model parameters were refined through calibration and validated by comparing model results to historic flow measurements.

The calibrated and verified model was then used to simulate design flood hydrographs that were routed in a hydraulic model.

Table 5-1. HEC-HMS modeling methods and required parameters.

Modeling Method	Parameter	Description	Acceptable Values
Initial and Constant-Rate Loss Method	Initial Loss (in)	Initial loss parameter that accounts for the moisture condition in the watershed at the beginning of the simulation – loss from canopy interception, surface storage, and infiltration.	Based on curve number (CN)
	Constant Loss (in/hr)	Infiltration rate during saturated soil conditions.	0+
	Impervious Area (%)	Impervious area directly connected to the channel network (no losses are computed).	0% (for this study)
Snyder Synthetic Unit Hydrograph	Standard Lag (hr)	The time from the center of mass of excess rainfall to the hydrograph peak.	Based on C_t , which ranges from 0.4 to 8, and sub-basin lengths
	Peaking Coefficient (C_p)	Dimensionless parameter affecting hydrograph shape.	0.4 to 0.8

5.3. Sub-basin Delineation

Sub-basins were based on delineation of smaller channels/ tributaries within the Lumber River basin (**Figure 5-1**) using StreamStats, which uses coarser terrain (30 ft x 30 ft) (USGS, 2016). Delineation was done where each channel joins into Lumber River. Additionally, a sub-basin was delineated at the USGS gage in Maxton, NC to allow for hydrograph calibration at the location. The streamstats delineated sub-basins were verified using the QL2 LiDAR, which has a finer tile size of 10 ft x 10 ft and edits were made to the sub-basin boundaries as necessary. Fourteen (14) sub-basins were delineated. There are twelve (12) sub-basins for tributaries to the Lumber River and an additional two (2) sub-basins within the HEC-HMS model to account for the drainage area right along the channel, which was not accounted for in the other basins. The sub-basins are called: Back Swamp, Bear Swamp, Fivemile downstream, Fivemile upstream, Lumberton Canals, Ivey Branch, Jacks Branch, Jacob Branch, Jacob Swamp, Lumber downstream, Lumber upstream, Meadow Branch, Raft Swamp, and White Oak (**Figure 5-1** and **Figure 5-2**). StreamStats for each basin are provided in **Appendix E2.2**.

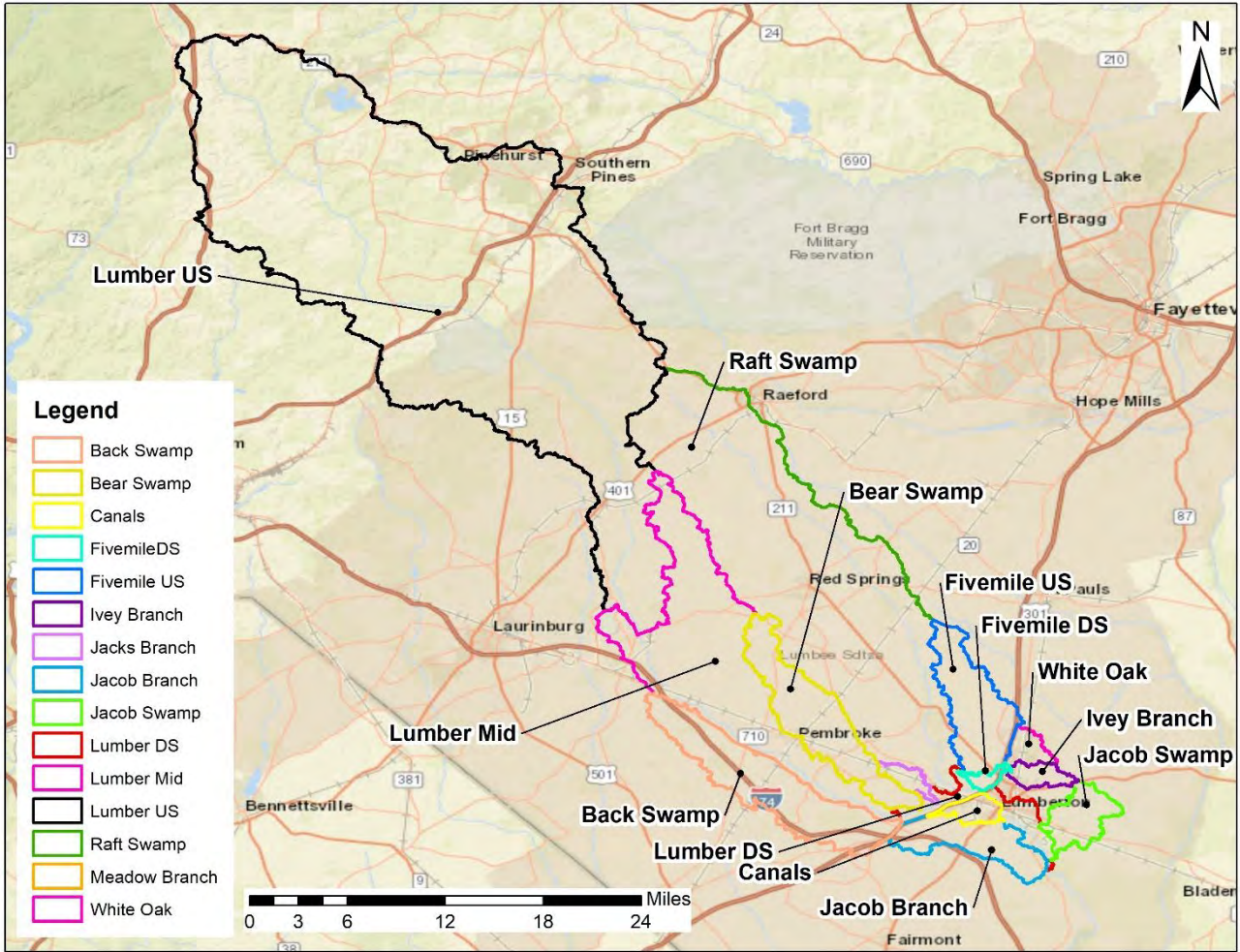


Figure 5-1. Lumber River sub-basin delineation.

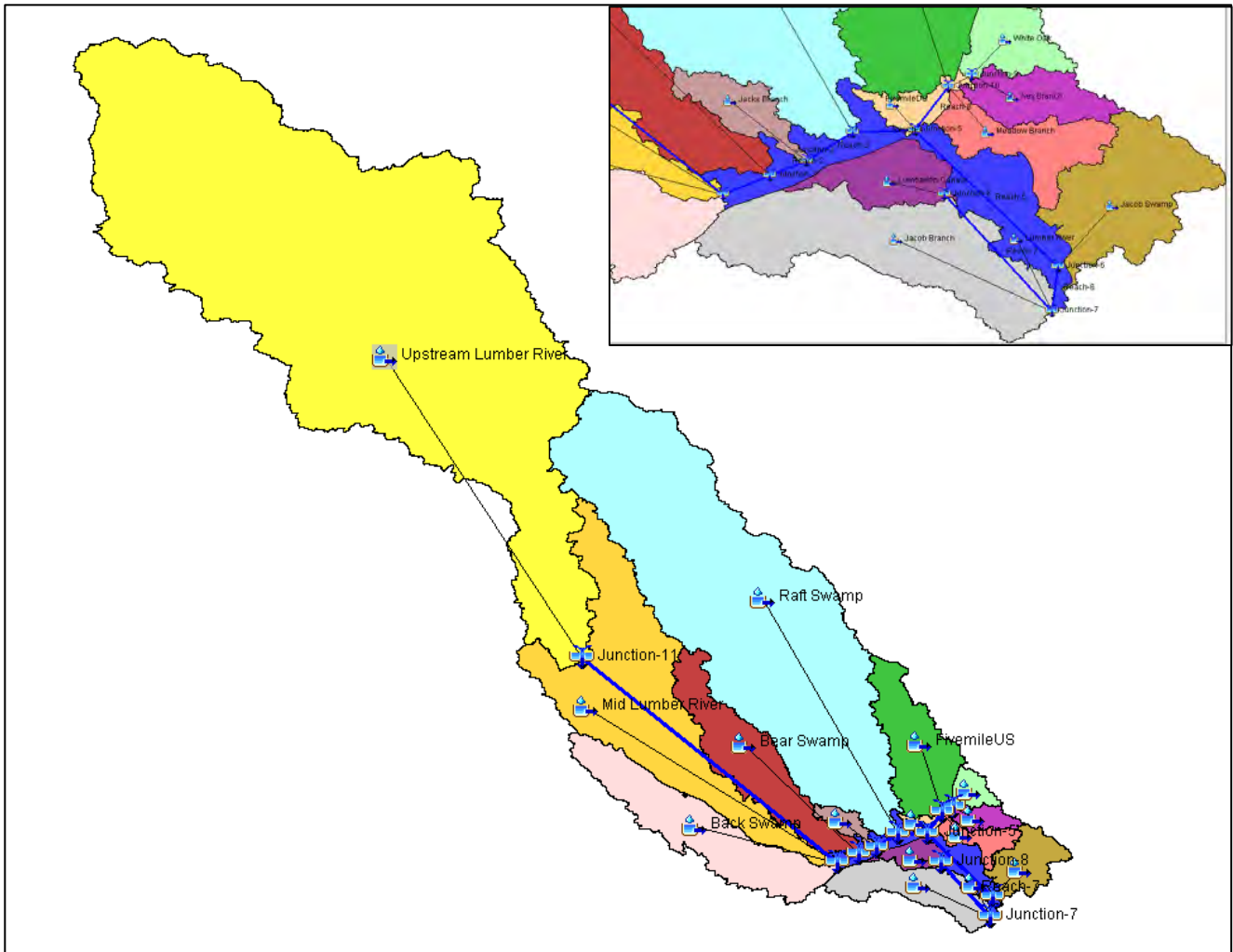


Figure 5-2. HEC-HMS sub-basins, reaches, and junctions.

5.4. Initial Parameter Estimation

Initial parameters were set constant across all sub-basins using: constant loss of 0.4 in/hr, basin coefficient (C_t) of 2.2, and peaking coefficient (C_p) of 0.4. The values were selected as they were the lower end for each parameter range. The starting initial loss estimates for the basins were estimated based on the sub-basin curve number, CN. The standard lag was calculated using the C_t and the previously calculated length of main channel (L , mi) and length of channel to centroid (L_c , mi). The initial loss, constant loss, C_t , and C_p were changed during the calibration process.

5.4.1. Curve Number and Initial Losses

5.4.1.1. Curve Number

The curve number for each sub-basin is a useful basin characteristic and is needed to calculate other parameters, such as the initial loss rate. To calculate a sub-basin curve number, the soil type and land cover is required.

A composite curve number was calculated for each sub-basin because each sub-basin had multiple soil types and land use classifications. Good condition curve numbers (USDA, 1986) were paired with the associated 2016 NLCD land cover classifications. ArcGIS was used to calculate the area of each land use classification associated with each soil type. The area of each land use per soil type was used to create a curve number for each soil type, and then those were used to calculate a composite curve number for each sub-basin (**Table 5-2**). Curve number calculation are provided in **Appendix B4**.

Table 5-2. Sub-basin composite curve numbers.

Sub-basin	Curve Number
Back Swamp	85.7
Bear Swamp	83.1
Fivemile DS	82.8
Fivemile US	81.7
Lumberton Canals	83.2
Ivey Branch	79.4
Jacks Branch	82.2
Jacob Branch	85.2
Jacob Swamp	79.9
Lumber DS	84.3
Lumber Mid	82.9
Lumber US	62.1
Meadow Branch	78.0
Raft Swamp	78.9
White Oak	79.6

5.4.1.2. Initial Losses

Based on the curve number, the initial loss was calculated using the SCS runoff method (USACE, 1986). The good condition curve number was used to calculate S (**Equation 5-1**), a value related to soil and cover conditions, which was then used to calculate the initial loss (I_a) (**Equation 5-2**) (**Table 5-3**). The initial loss for each sub-basin was input into the HEC-HMS model and was not altered during calibration.

$$S = \frac{1000}{CN} - 10 \quad (5-1)$$

$$I_a = 0.2S \quad (5-2)$$

Table 5-3. Calculated sub-basin initial losses.

Sub-basin	S	I_a (in)
Back Swamp	1.67	0.33
Bear Swamp	2.03	0.41
Fivemile DS	2.08	0.42
Fivemile US	2.24	0.45
Lumberton Canals	2.02	0.40
Ivey Branch	2.59	0.52
Jacks Branch	2.17	0.43
Jacob Branch	1.74	0.35
Jacob Swamp	2.52	0.50
Lumber DS	1.86	0.37
Lumber Mid	2.06	0.41
Lumber US	6.10	1.22
Meadow Branch	2.82	0.56
Raft Swamp	2.67	0.53
White Oak	2.56	0.51

5.4.2. Snyder Unit Hydrograph Parameters

As previously stated, Snyder unit hydrograph was selected for the transform method. The equation for lag is (Equation 5-3):

$$t_p = CC_t(LL_c)^{0.3} \tag{5-3}$$

Where t_p is the hydrograph lag (hr), C is a conversion factor (1 for foot-pound system), C_t is a basin coefficient, L is the length of the main channel (mi), and L_c is the length of the channel from the outlet to the nearest watershed centroid (mi).

GIS was used to calculate L and L_c . The flow path was drawn from the outlet of the sub-basin along the channel to the most remote point in the watershed. A centroid for each sub-basin was calculated in GIS (Figure 5-3). Based on the centroid, the length of channel to this point was measured. Values for L and L_c are available in Appendix B3.

The basin coefficient, C_t , is a dimensionless parameter that can range from 0.4 in the mountains to 8.0 along the coast. Since this is not a physically-based parameter it was determined via calibration.

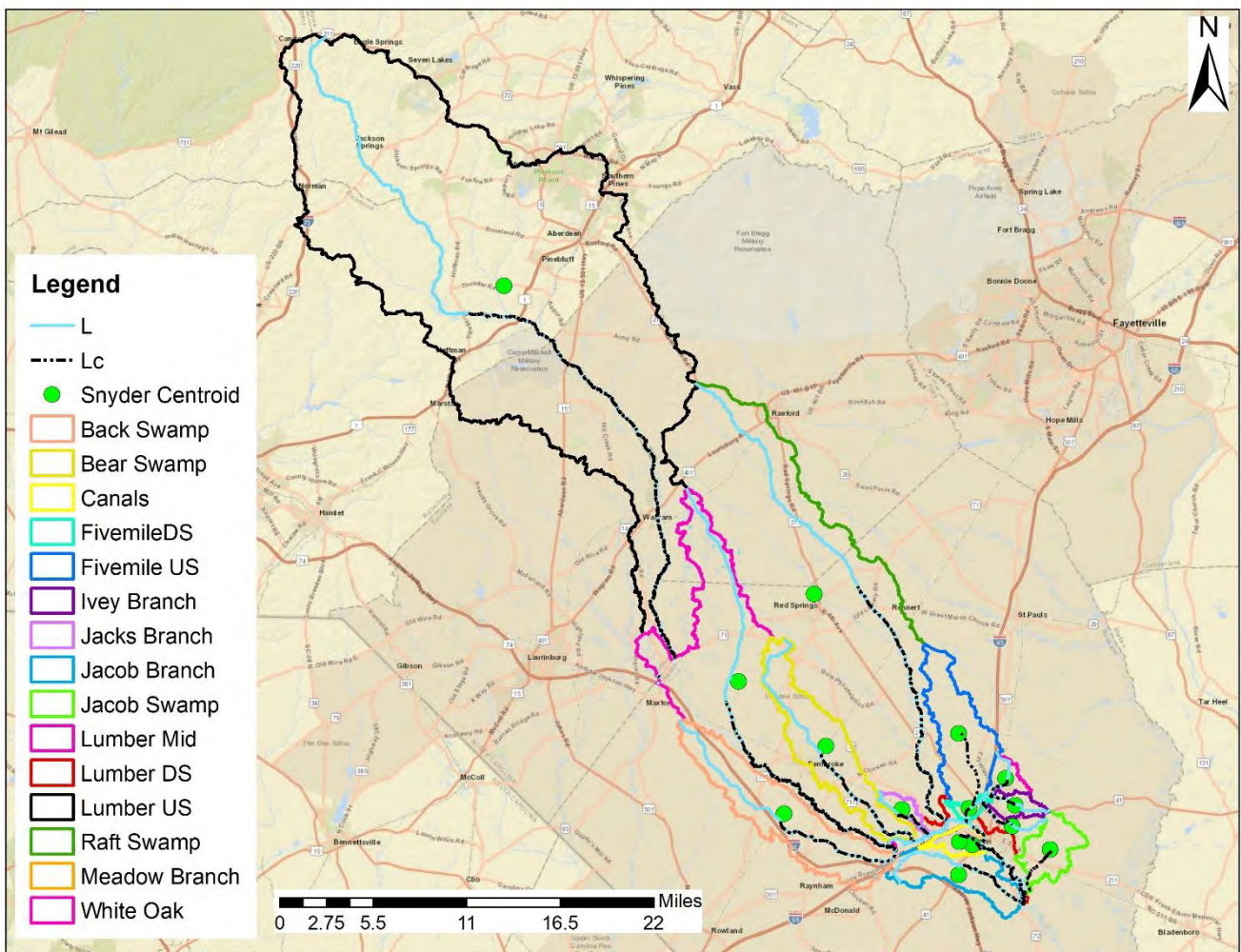


Figure 5-3. Centroid, channel length (L), and channel length to centroid (L_c) of each sub-basin for Snyder hydrograph development.

5.4.3. Reach Routing Parameters

Routing of sub-basin hydrographs within a watershed is necessary to capture the attenuation of flow while moving downstream through the channel and floodplain. In the hydrologic model this is performed using routing

reaches. The Muskingum-Cunge hydrologic routing method was used for the main river reaches throughout the Lumber River watershed. This method was chosen based on the need for a routing method capable of properly calculating discharge through a routing reach for a wide range of flow conditions.

A representative 8-point cross-section was derived for each reach from representative 1-D HEC-RAS cross-sections from the FEMA effective model or LiDAR data and used to characterize the reach channel and floodplain. A location was selected that was reasonably characteristic of the reach of interest. This primarily relates to the typical channel and floodplain width under high flow conditions. The 8-point cross-sections are included in **Appendix B5**. The adopted routing parameters used for this study are listed in **Table 5-4**.

Table 5-4. Muskingum-Cunge routing parameters used for hydrologic modeling.

Reach	HMS Junctions	Length (ft)	Slope (ft/ft)	Channel N-Value	Left N-Value	Right N-Value	Cross-section
1	0 to 1	11284	0.0002	0.045	0.1	0.1	8-point
2	1 to 2	10922	0.0006	0.045	0.13	0.1	8-point
3	2 to 3	14490	0.0002	0.045	0.15	0.09	8-point
4	3 to 4	7220	0.0003	0.045	0.13	0.11	8-point
5	4 to 5	39679	0.0002	0.045	0.125	0.125	8-point
6	5 to 6	7849	0.0003	0.045	0.125	0.125	8-point
7	7 to 6	24525	0.0008	0.065	0.035	0.16	8-point
8	8 to 4	6644	0.0002	0.045	0.12	0.12	8-point
9	11 to 1	183005	0.0003	0.08	0.16	0.16	8-point

5.5. Model Calibration to Historic Events

Four events were selected based on peak discharge: September 2004, October 2015, October 2016 (Hurricane Matthew), and September 2018 (Hurricane Florence) (**Table 5-5**). A complete hydrograph (rising limb, peak, and falling limb) was needed for analysis to allow for calibration to the storm peak and full storm volume. Of these, three calibration events were selected: September 2004, October 2015, and September 2018. The 2004 and 2015 events were peak water-year gage events, with peaks of 7,420 and 2,390 respectively. The 2018 event corresponds to Hurricane Florence, which is one of the largest rainfall events to hit the state of North Carolina. The peak flow at the USGS Lumberton gage set a peak record at 17,100 cfs. Hydrographs of the selected events for both gages are provided in **Appendix B2**.

Table 5-5. Peak streamflow reported at USGS gages in Lumberton and Maxton for each study event.

Event	USGS Gage 02134170 at Lumberton, NC		USGS Gage 02133624 at Maxton, NC	
	Peak Streamflow (cfs)	Time of Peak	Peak Streamflow (cfs)	Time of Peak
Sept 2004	7,420	9/11/2004 2:00	2,280	9/11/2004 8:00
Oct 2015	2,390	10/9/2015 15:45	2,460	10/6/2015 12:15
Oct 2016	14,600	10/10/2016 7:00	6,790	10/11/2016 6:45
Sept 2018	17,100	9/17/2018 11:00	12,300	9/19/2018 4:00

The points of comparing simulated and observed peak flow rate, volume, and time of peak are at a junction along Lumber River where the USGS gage in Lumberton is located and at the location of the USGS gage in Maxton. During calibration trials the peak simulated flow rate, hydrograph shape, and time of peak flowrate were compared to what was observed at the USGS gages from the respective storm event.

Calibration of the model to the observed values at the USGS gage in Lumberton was prioritized over the observed values at the USGS gage in Maxton due to the proximities of the two gage locations to the location of the proposed gate.

Hurricane Florence was the first event to be calibrated due to its magnitude. The calibration parameters were changed for each of the sub-basins, relative to basin characteristics, until the peak flow rate, volume, and time to peak were as close to that of the observed as the model could achieve (**Figure 5-4**). The first set of

calibrated constant loss, C_t , and C_p values were applied to the other two calibration events for an initial baseline and adjusted iteratively until the simulated hydrographs matched reasonably well with the observed hydrographs for those storms. Results for each calibration are shown in **Tables 5-6, 5-7, and 5-8**. The calibrated parameters were able to accurately model the peak flow rate and time of peak for all the storms. Except for the October 2015 storm, the calibrated parameters were also able to accurately model the hydrograph shapes and volumes for the storms. The October 2015 storm is the smallest of the three storms, with a return period of less than 2 years. Since the design storms are more like the other two storms in terms of magnitude, additional iterations of the calibration parameters to get a better match for the volume for that storm was not necessary.

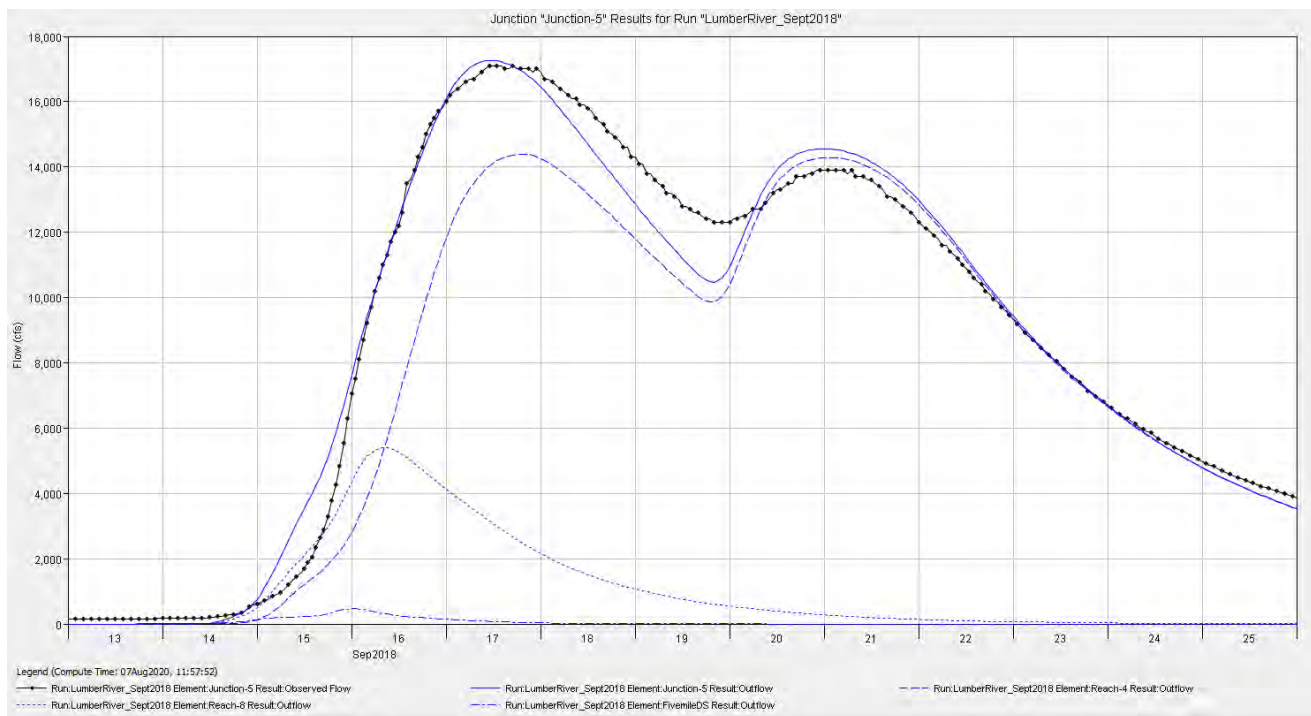


Figure 5-4. Comparison of observed gage flow (black) and simulated flow (solid blue) for the September 2018 (Hurricane Florence) calibrated event.

Table 5-6. Peak flow comparison between observed and simulated calibrated events.

Storm	Peak Flow rate (cfs)		
	Observed	Simulated	% Difference
At Lumberton Gage (USGS 02134170)			
Sept 2004	7,420	7,097	-4%
Oct 2015	2,390	2,421	1%
Sept 2018	17,100	17,257	1%
At Maxton Gage (USGS 02133624)			
Sept 2004	2,280	3,439	51%
Oct 2015	2,460	2,330	-5%
Sept 2018	12,300	8,281	-33%

Table 5-7. Time of peak comparison between observed and simulated calibrated events.

Storm	Time Date and Time		
	Observed	Simulated	Difference (hrs)
At Lumberton Gage (USGS 02134170)			
Sept 2004	9/11/2004 0:30	9/11/2004 12:00	10
Oct 2015	10/9/2015 15:45	10/9/2015 12:00	-3.75
Sept 2018	9/17/2018 11:00	9/17/2018 11:00	0
At Maxton Gage (USGS 02133624)			
Sept 2004	9/11/2004 8:00	9/11/2004 6:00	-2
Oct 2015	10/6/2015 14:00	10/6/2015 11:00	-3
Sept 2018	9/19/2018 4:00	9/19/2018 11:00	7

Table 5-8. Volume comparison between observed (USGS 02134170 at Lumberton) and simulated calibrated events.

Storm	Volume (ac-ft)		
	Observed	Simulated	% Difference
At Lumberton Gage (USGS 02134170)			
Sept 2004	152,897	149,569	-2%
Oct 2015	38,912	27,568	-29%
Sept 2018	230,179	229,185	-0.4%
At Maxton Gage (USGS 02133624)			
Sept 2004	59,436	39,728	-33%
Oct 2015	29,054	21,498	-26%
Sept 2018	79,108	59,424	-25%

The calibrated parameters for each of the three calibration storms were averaged to obtain the calibrated parameters for the sub-basins. The calibrated parameters are shown in **Table 5-9**.

Table 5-9. Average calibrated HEC-HMS parameters.

Sub-basin	Constant Loss (in/hr)	Initial Loss (in)	C _t	Lag Time based on C _t (hr)	C _p
Back Swamp	0.14	0.36	7	31.3	0.40
Bear Swamp	0.14	0.41	7	31.8	0.40
Fivemile DS	0.05	0.44	7	9.1	0.40
Fivemile US	0.05	0.42	7	23.7	0.40
Lumberton Canals	0.05	0.43	7	13.9	0.40
Ivey Branch	0.05	0.58	7	12.6	0.40
Jacks Branch	0.05	0.39	7	21.1	0.40
Jacob Branch	0.05	0.34	7	22.4	0.40
Jacob Swamp	0.05	0.52	7	18.2	0.40
Lumber DS	0.05	0.37	7	33.0	0.40
Lumber Mid	0.14	0.43	8	62.7	0.40
Lumber US	0.14	5	7	76.0	0.73
Meadow Branch	0.05	0.68	7	15.2	0.40
Raft Swamp	0.19	0.46	8	56.2	0.40
White Oak	0.05	0.5	7	12.3	0.40

It is noted that the calibrated initial loss for the Lumber US sub-basin is higher than normal. This will likely lead to underestimation of more frequent storm events. The calibrated parameters noted in Table 5-9 are appropriate for storms with recurrence intervals similar to that of the design storm for the flood gate project (100yr or greater). A spreadsheet with the simulated results and calibrated parameters is provided in **Appendix E2.3**.

5.6. Model Validation to Historic Events

Following calibration, the average parameters were applied to a verification event. Hurricane Matthew, October 2016, was selected as the verification event. As previously discussed, Matthew was another large hurricane to hit North Carolina, setting many rainfall and streamflow records prior to Florence. Verification using the average parameters overpredicted the peak flow rate but matched the time of peak (**Tables 5-10, 5-11, and 5-12**). Graphical inspection of the observed and simulated hydrographs also indicates a good match of the rising and falling limbs (**Figure 5-5**). As discussed in **Section 4.2**, the recorded peak flow at the USGS gage of 14,600 cfs during Hurricane Matthew did not account for the diverted flow through the I-95 opening. Thus, this verification, while higher, is an accurate representation of the peak flows in the area.

Table 5-10. Peak flow comparison between observed and simulated for a verification event.

Storm	Peak Flow rate (cfs)		
	Observed	Simulated	% Difference
At Lumberton Gage (USGS 02134170)			
Oct 2016	14,600	16,550	13%
At Maxton Gage (USGS 02133624)			
Oct 2016	6,750	3,277	-51%

Table 5-11. Time of peak flow comparison between observed and simulated for a verification event.

Storm	Time Date and Time		
	Observed	Simulated	Difference (hrs)
At Lumberton Gage (USGS 02134170)			
Oct 2016	10/10/2016 7:00	10/10/2016 10:00	3
At Maxton Gage (USGS 02133624)			
Oct 2016	10/11/2016 8:00	10/11/2016 14:00	6

Table 5-12. Volume comparison between observed and simulated for a verification event.

Storm	Volume (acre-ft)		
	Observed	Simulated	% Difference
At Lumberton Gage (USGS 02134170)			
Oct 2016	223,956	197,598	-12%
At Maxton Gage (USGS 02133624)			
Oct 2016	82,111	27,026	-67%

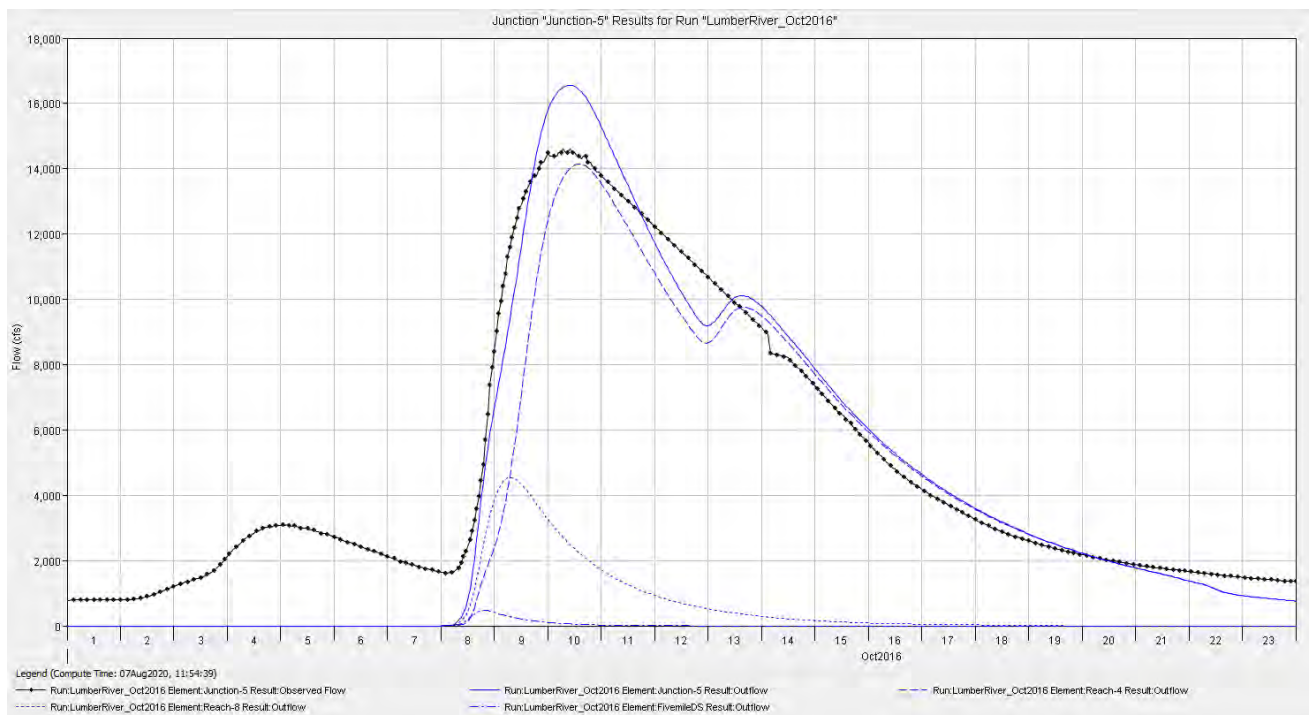


Figure 5-5. Comparison of observed gage flow (black) and simulated flow (solid blue) for the October 2016 (Hurricane Matthew) verification event.

5.7. Design Flood Simulations

Using the calibrated and verified parameters, floods from a 100-year through the Probable Maximum Flood (PMF) were simulated in HEC-HMS. The 100-year through 1,000-year flows were generated using the procedure described in Section 5.7.1. The Probable Maximum Precipitation (PMP) and resulting PMF values were estimated using the procedure described in Section 5.7.2

5.7.1. 100-Year through 1,000-Year Flows

Analysis of the durations of previous rainfall events within the Lumber Basin ranged from 24 to 72 hours, with most of the major events having a duration of 48-hours. Thus, a 48-hour rainfall event was selected as the design flood duration for the 100-year to 1000-year return period events. Based on the location, an SCS Type II rainfall distribution (NRCS, 2019) was used. A spreadsheet with the distribution was downloaded from the NRCS website (NRCS, 2019). The spreadsheet provides the distribution for the peak 24-hour period which is assumed to occur during the first 24-hour period for any duration storm. Based on our sensitivity analysis, this assumption provided more conservative peak flow estimates compared to other placements of the peak 24-hour period. For the 48-hour duration storm, the difference between the total 24-hour and 48-hour total rainfall depths is distributed evenly on the second day. For the 72-hour storm, the difference between the total 24-hour and 72-hour total rainfall depths is distributed evenly on the second and third days. Electronic files of the sensitivity analysis are included in **Appendix E2.7**. NOAA Atlas 14 was used to find the rainfall totals associated with 100-year to 1000-year return periods, assuming a 48-hour event.

5.7.2. PMP and PMF Estimation

The PMP values for the Lumberton flood gate dam were estimated using the Hydrologic Engineering Center's HEC-MetVue (version 3.0) and HEC-HMS (version 4.8) software packages (**Appendix E5**). The HEC-MetVue software has HMR52 plugin extension that allows the modeler to use NOAA's Hydrometeorological Reports HMR 51 and 52 (HMR 51/52) to estimate the storm characteristics and generate PMP hyetographs. The initial storm parameters obtained from the HEC-MetVue model were optimized to maximize peak flow at the watershed outlet. The parameters were optimized using the HMR 52 precipitation method in the HEC-HMS meteorologic model. The calibrated HEC-HMS model described in the above sections was used for the

optimization run. This calibrated model required an upgrade from version 4.2.1 to version 4.8 to perform the optimization run. The initial and optimized storm parameters are summarized below in **Table 5-13** and the positions of the storms based on the initial and optimized parameters are shown in **Figure 5-6** and **Figure 5-7**, respectively.

The optimized storm parameters were used in the HEC-MetVue model (**Appendix E5**) to generate the average PMP depths and hyetographs. The resulting 72-hour PMP depths and volumes for the sub-basins are summarized below in **Table 5-14**. The hyetographs from HEC-MetVue were then saved to a DSS file and linked to the calibrated HEC-HMS (version 4.2.1) model to estimate the Probable Maximum Flood (PMF).

Discharge ratio factors of 0.25, 0.5, 0.67, and 0.75 were applied to the subbasins in the HEC-HMS simulation run to generate the ¼ PMF, 1/3 PMF, ½ PMF, 2/3 PMF, and ¾ PMF, respectively (**Appendix E5**).

Table 5-13. Initial and optimized parameters for the HEC-METVue model.

HMR 52 Storm Characteristics	HEC-MetVue (Initial Parameters)	HEC-HMS (Optimized Parameters)
X Coordinate	-79.33	-79.413
Y Coordinate	34.93	34.995
Orientation (deg.)	145.63	141.51
Peak Intensity	Hours 36 to 42	Hours 36 to 42
Area (sq. mi.)	984.04	982.84

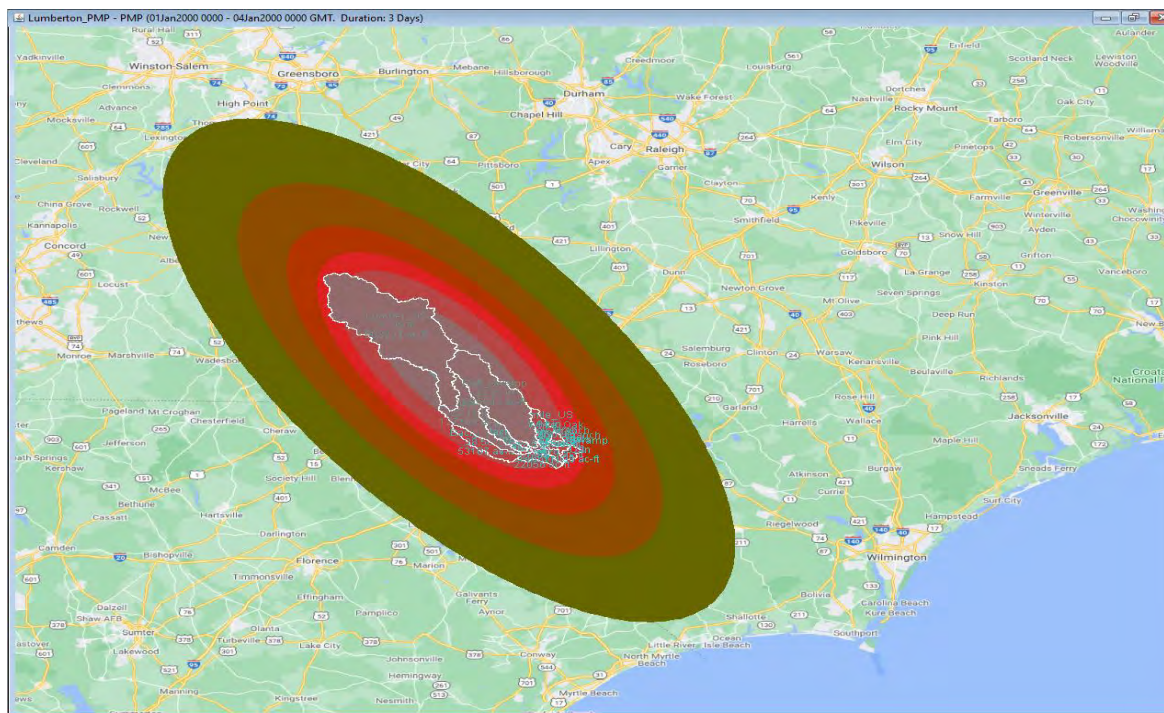


Figure 5-6. HMR 52 storm position with HEC-MetVue (initial) parameters

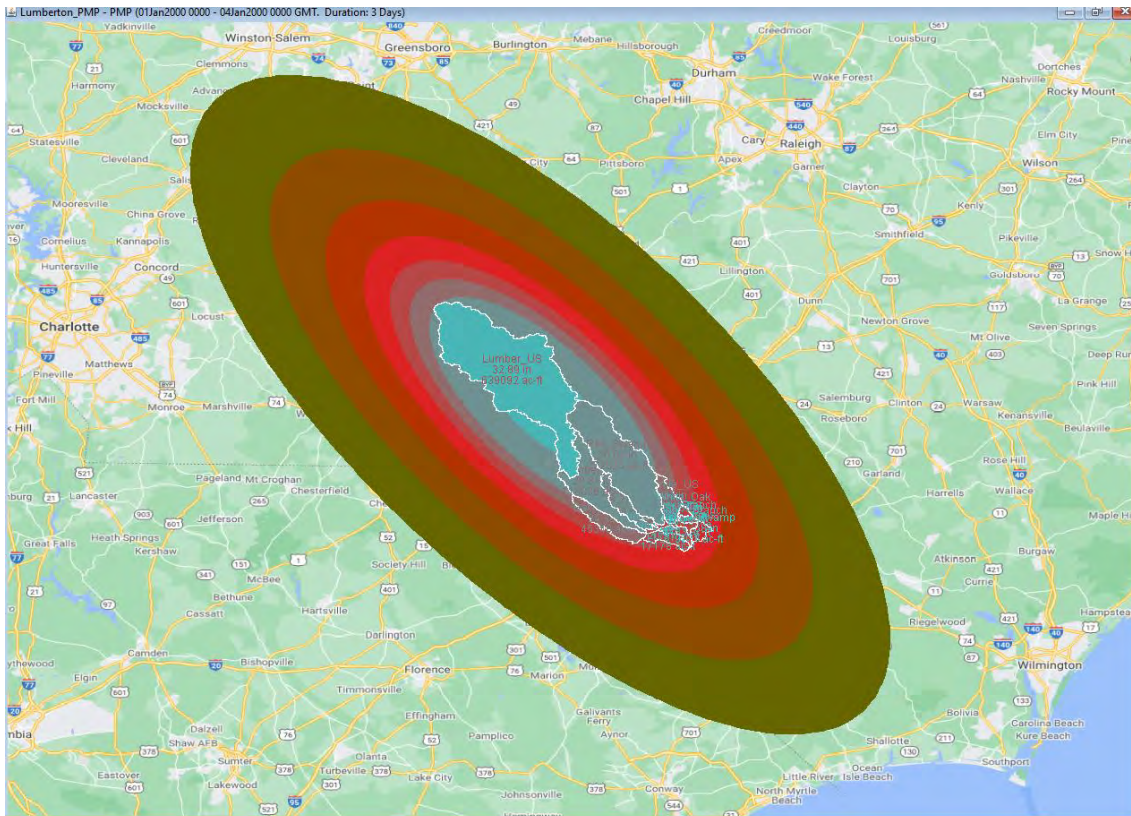


Figure 5-7. HMR 52 storm position with HEC-HMS (optimized) parameters.

Table 5-14. Average PMP depths from optimized HMR 52 storm parameters.

Name	Average Depth (in)	Volume (ac-ft)
Back Swamp	24.38	45340
Bear Swamp	28.27	42664
Fivemile DS	23.17	2092
Fivemile US	25.33	29744
Ivey Branch	20.97	4214
Jacks Branch	25.55	4100
Jacob Branch	20.91	17178
Jacob Swamp	18.68	9531
Lumber DS	21.79	11787
Lumber Mid	29.81	118036
Lumber US	32.89	639092
Lumberton Canals	22.3	4616
Meadow Branch	20.73	5483
Raft Swamp	30.63	272525
White Oak	21.8	4322
Watershed	30.4	1210726

5.7.3. Results

The total rainfall depths ranged from 10.2 inches (100-yr) to 14.9 inches (1,000-yr) (**Table 5-15**). The total rainfall for watershed for the full PMP storm event is 30.4 inches. The design flood hydrographs are provided in **Appendix E2.2**. Rainfall distributions are provided in **Appendix E2.4**.

Table 5-15. Design Rainfall Depths.

Recurrence Interval (Yrs)	Rainfall Duration		
	24 Hours	48 Hours	72 Hours
100	8.99	10.20	10.60
500	11.90	13.30	13.70
1,000	13.30	14.90	15.20
Full PMP (Watershed Average)	30.4		

The developed rainfall distribution was added to the HEC-HMS model as a cumulative precipitation gage for each event (**Appendix E2.4**). The simulated peak flow rates, FEMA peak flow rates (FEMA, 2014) and gage statistics (**Section 4.2**), at the location of the USGS gage in Lumberton are shown in **Table 5-16**. Simulated peak flow rates were lower than both those from FEMA and the gage statistics. The FEMA peak flow estimates are based on regression equations which are regionally based and not specific to the Lumber River Basin. The simulated results are from a calibrated and verified model for the basin and hence provide a more reliable estimate of both the peak flow and streamflow hydrograph for the basin.

Table 5-16. Peak flow comparison between simulated HEC-HMS, FEMA reports, and gage statistics.

Recurrence Interval (Yrs)	Simulated Peak Flow (cfs)	FEMA Peak Flow (cfs)	Gage Statistics Flow (cfs)	% Difference FEMA	% Difference Gage
100	13,140	14,900	14,000	-13%	-11%
500	22,110	20,200	20,530	9%	3%
1,000	26,990	-	-	-	-
1/4 PMF	17,370	-	-	-	-
1/3 PMF	23,590	-	-	-	-
1/2 PMF	36,210	-	-	-	-
2/3 PMF	48,990	-	-	-	-
3/4 PMF	55,450	-	-	-	-
Full PMF	74,960	-	-	-	-

Additionally, partial duration rainfall distributions were created based on the NOAA Atlas 14 precipitation-frequency data for each return period and simulated in HEC-HMS. The partial duration rainfall distribution is an updated distribution compared to the SCS distribution (NRCS, 2019). The spreadsheet to develop the rainfall temporal distribution was also downloaded from the NRCS website (NRCS, 2019). However, this distribution produced lower stream flows than that of the SCS method and thus were not utilized for the hydraulic analysis. A comparison of the 48-hour duration peak flows from the SCS and partial duration distribution methods are shown in **Table 5-17**. Partial distributions are provided in **Appendix E2.4**. The HEC-HMS model is included the electronic **Appendix E2.1**.

Table 5-17. Comparison of Peakflows from SCS and Partial Duration Rainfall Distributions.

Recurrence Interval (Yrs)	SCS Type II Peak Flow (cfs)	Partial Duration Peak Flow (cfs)
100	13,140	10,670
500	22,110	19,330
1,000	26,990	23,980

6. Hydraulic Model Development

A detailed two-dimensional model of the City of Lumberton, Lumber River, and its tributaries in the vicinity of the city was developed to help determine design flood elevations for the proposed gate. The model was developed using version 6.0 of the USACE HEC-RAS model (USACE, 2021). This section summarizes data used, assumptions and results of the hydraulic modeling effort.

6.1. Model Development

The two-dimensional (2D) domain was selected to include all areas of flood concern within the extents of Lumber River. The domain extends along each river that confluences with Lumber River: Raft Swamp, Back Swamp, Bear Swamp, White Oak Branch, Meadow Branch, Jacob Swamp, Ivey Branch, Jack’s Branch and Fivemile Branch. It also extends in the Northeast region to include North Lumberton so that project impacts related to flooding levels can be assessed at those locations. Except for inflow and outflow boundary locations, the model boundary was placed at relatively high ground so that flooding is fully contained within the computational mesh. The locations of the boundary conditions were placed far enough from the location of the proposed gate so that boundary condition impacts would be negligible. The location and geometry of the flood gate within the model is based on the proposed layout of the flood gate. The model domain is shown in **Figure 6-1** (see **Section 6.1.2**).

6.1.1. Manning’s N Coefficients

Base model Manning’s n coefficients were based on land use classes selected from **Table 6-1**. Values were based on the “normal” column. A GIS shapefile of Lumber River and Fivemile Branch was used to override the land use of Lumber River and Fivemile Branch. The channel segment was assigned a base Manning’s n coefficient of 0.045. The initial roughness coefficients were modified during the model calibration phase. The calibrated roughness values and the procedure followed are documented in **Section 6.2.5**.

Table 6-1. Manning’s n coefficient ranges per land cover type.

	NLCD Classification	Manning’s Roughness			Source
		Minimum	Normal	Maximum	
11	Open Water	0.025	0.03	0.033	Chow, 1959
21	Developed, Open Space	0.01	0.013	0.016	Calenda et al., 2005
22	Developed, Low Intensity	0.038	0.05	0.063	Calenda et al., 2005
23	Developed, Medium Intensity	0.056	0.075	0.094	Calenda et al., 2005
24	Developed, High Intensity	0.075	0.1	0.125	Calenda et al., 2005
31	Barren Land	0.025	0.03	0.035	Chow, 1959
41	Deciduous Forest	0.1	0.12	0.16	Chow, 1959
42	Evergreen Forest	0.1	0.12	0.16	Chow, 1959
43	Mixed Forest	0.1	0.12	0.16	Chow, 1959
52	Scrub/Shrub	0.035	0.05	0.07	Chow, 1959
71	Grassland Herbaceous	0.025	0.03	0.035	Chow, 1959
81	Pasture/Hay	0.03	0.04	0.05	Chow, 1959
82	Cultivated Crops	0.025	0.035	0.045	Chow, 1959
90	Woody Wetlands	0.08	0.1	0.15	Chow, 1959
95	Emergent Herbaceous Wetland	0.075	0.1	0.15	Chow, 1959
	Channel	0.035	0.045	0.05	Chow, 1959

6.1.2. Mesh Development

The 2D model domain for the hydraulic analysis is shown in **Figure 6-1**. The mesh utilized refinement regions, 2D connections, and breaklines to accurately capture focal points and variations within the terrain. **Figure 6-1-A(1)** shows the extent of the 2D domain with breaklines and 2D Connections. **Figure 6-1-A(2)** is an example of one of the refinement regions utilized in the mesh. This one is located at the gate. **Figure 6-1-A(3)** is a zoomed in example of how breaklines were applied and enforced. This breakline is representing the centerline of Lumber River.

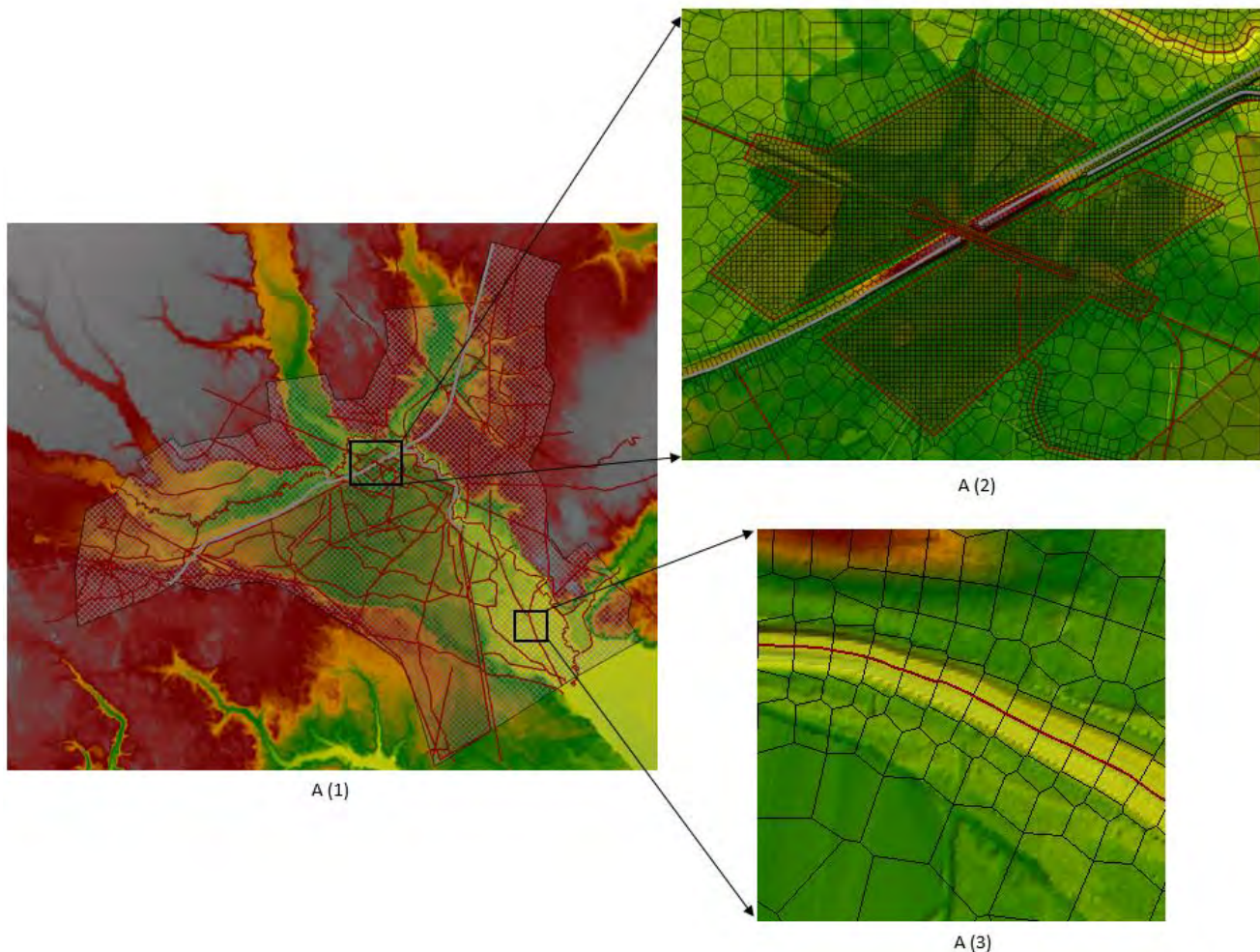


Figure 6-1. Lumber River 2D external model domain.

A mesh resolution of 250-feet was applied to the 2D flow area. Refinement regions were used to represent areas of higher urbanization, Lumber River, and the flood gate location. A resolution of 100-ft was applied for urban areas and Lumber River, while a resolution of 50-feet was used for the flood gate location.

A breakline was enforced with 100-foot spacing along the Lumber River stream centerline to capture the lowest points in the terrain and account for total storage capacity. Breaklines were drawn and enforced with 50-foot spacing along all additional channels within the domain. Breaklines were then drawn along points of higher elevation representing roads, railroads, or berms. These were enforced with a spacing that varied between 50 and 100-feet. Within the flood gate opening, breaklines were also drawn with a spacing of 25-feet to properly align the grid representing the railroad.

6.1.3. Lumberton Levee System

The Lumberton levee was included as a 2D connection with top of levee elevations taken from AECOM Project No. 60548447, Lumberton Flood Mitigation Report. Provided surveyed top of levee elevations were within a few inches of the top of levee elevations in the terrain. See **Appendix C2** for detailed comparison. For levee segments that were not surveyed, LiDAR elevations were utilized. Levee grid size was enforced as 20x20-feet to define the top width.

Gravity drains were not modeled. Gravity drains are pipes within the levee embankments that drain rainfall trapped on the landward side of the levee system through the levee embankment. The gravity drains have gates on the pipe outlet to restrict river backwater from backing up in the pipe during periods of high river flows. The gravity drains therefore do not serve any hydraulic purpose when modelling flows in the Lumber River.

6.1.4. Hydraulic Structures

HEC-RAS v6.0 provides the capability to model bridges within a 2D model. This version was utilized to model all the hydraulic structures within the modeled domain as either culverts or bridges. The normal 2D equation was selected as the overflow computation method as it is computationally more stable compared to the weir equation option. A full list of structures within the hydraulic model and their areas are included in **Appendices C1 and E3.3**.

Bridges along Lumber River were modeled using bridge geometry data from the effective model. **Figure 6-2** below shows an example of a bridge that was modeled.

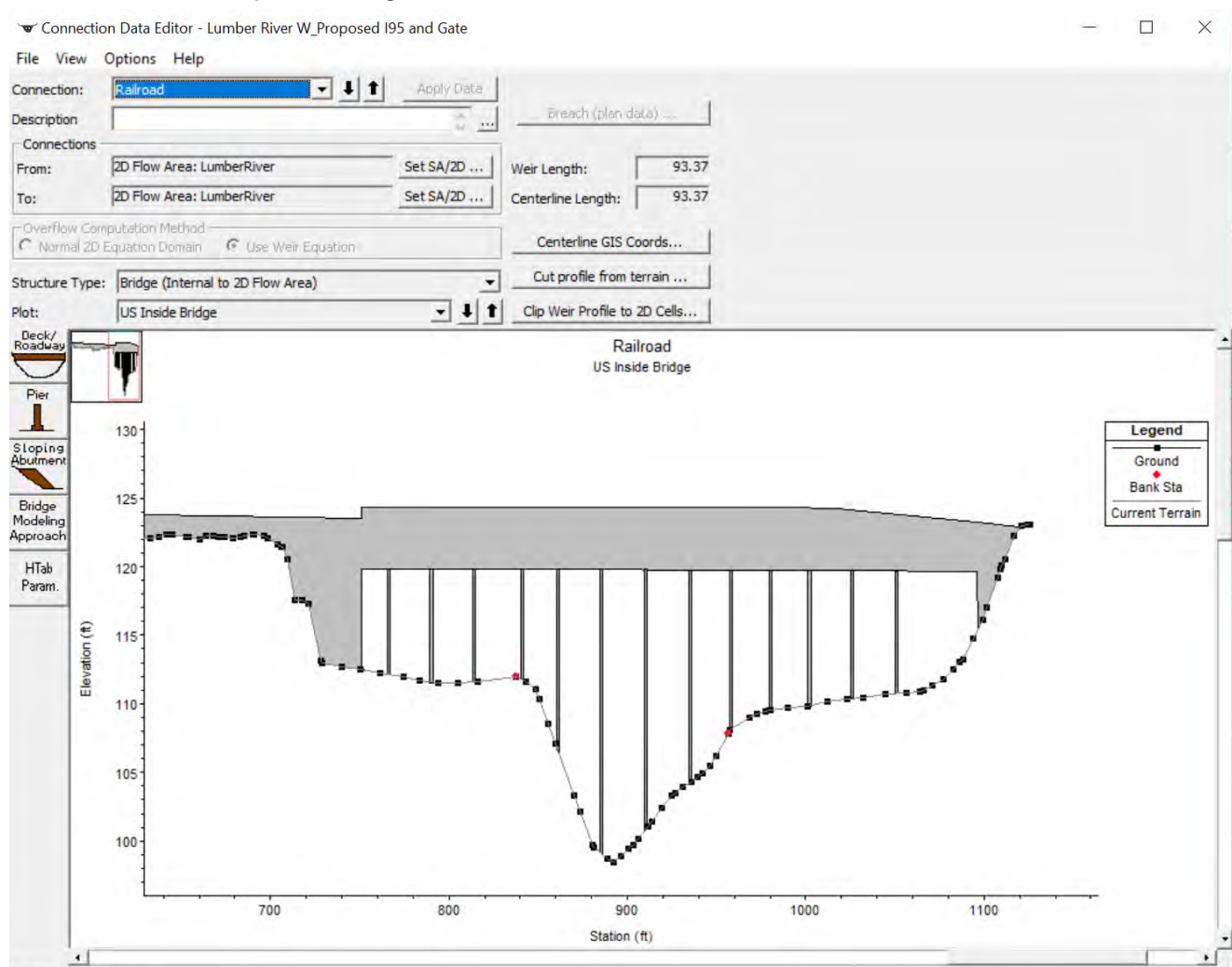


Figure 6-2. Bridge example.

Large culverts on Fivemile Branch were modeled as 2D connections with a rectangular notch when possible. However, for the culverts on I-95, the structure length was too long to be considered for a notch, so they were modeled as culverts. For these structures, roadway and deck elevations were taken from LiDAR. See **Figure 6-3** for an example of a long culvert on I-95.

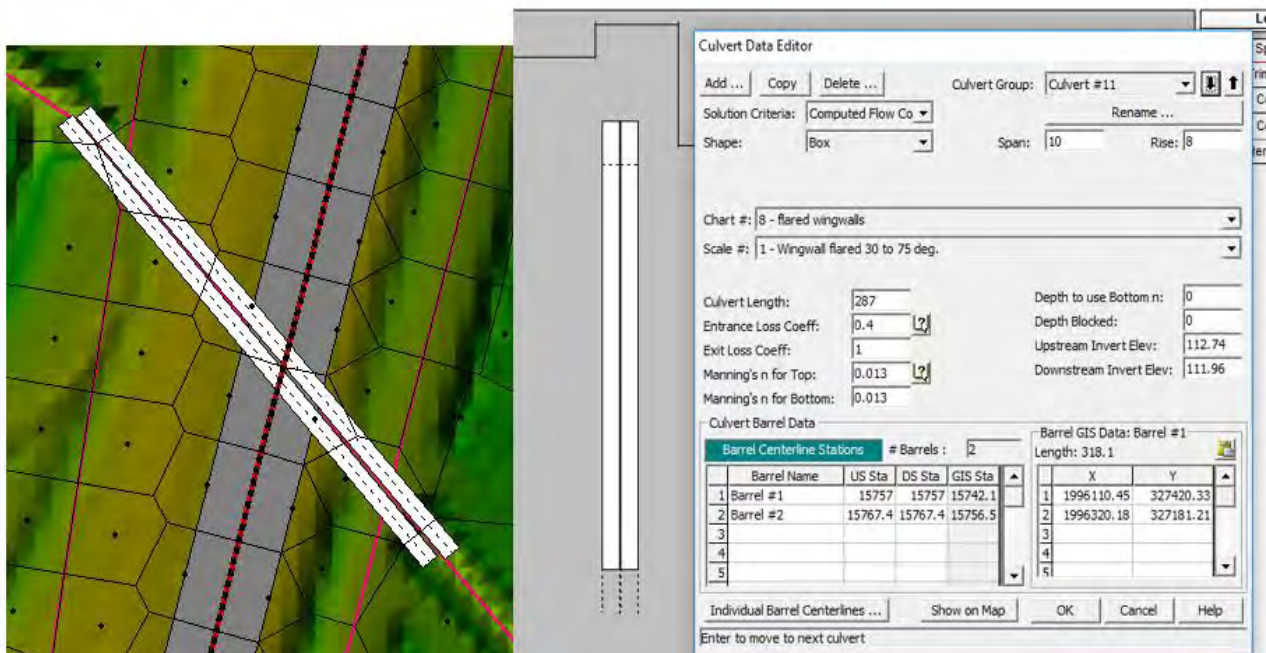


Figure 6-3. I-95 Meadow Branch culvert 2D connection example.

6.2. Boundary Conditions

There are nine inflow locations representing flow from Lumber River, Raft Swamp, Jacob Swamp, Jacks Branch, Fivemile Branch, Meadow Branch, Ivey Branch, and White Oak Branch. Flows from Back Swamp were included in the flows for Lumber River. There are no significant inflows within the project area that would cause direct impact. A normal depth boundary condition was applied at the downstream end of the model and upstream along Back Swamp to prevent flows reaching that boundary from piling up. The normal depth was set to a friction slope of 0.001 after averaging the slope of several locations along the boundary. The boundary condition locations are shown in **Figure 6-4**.

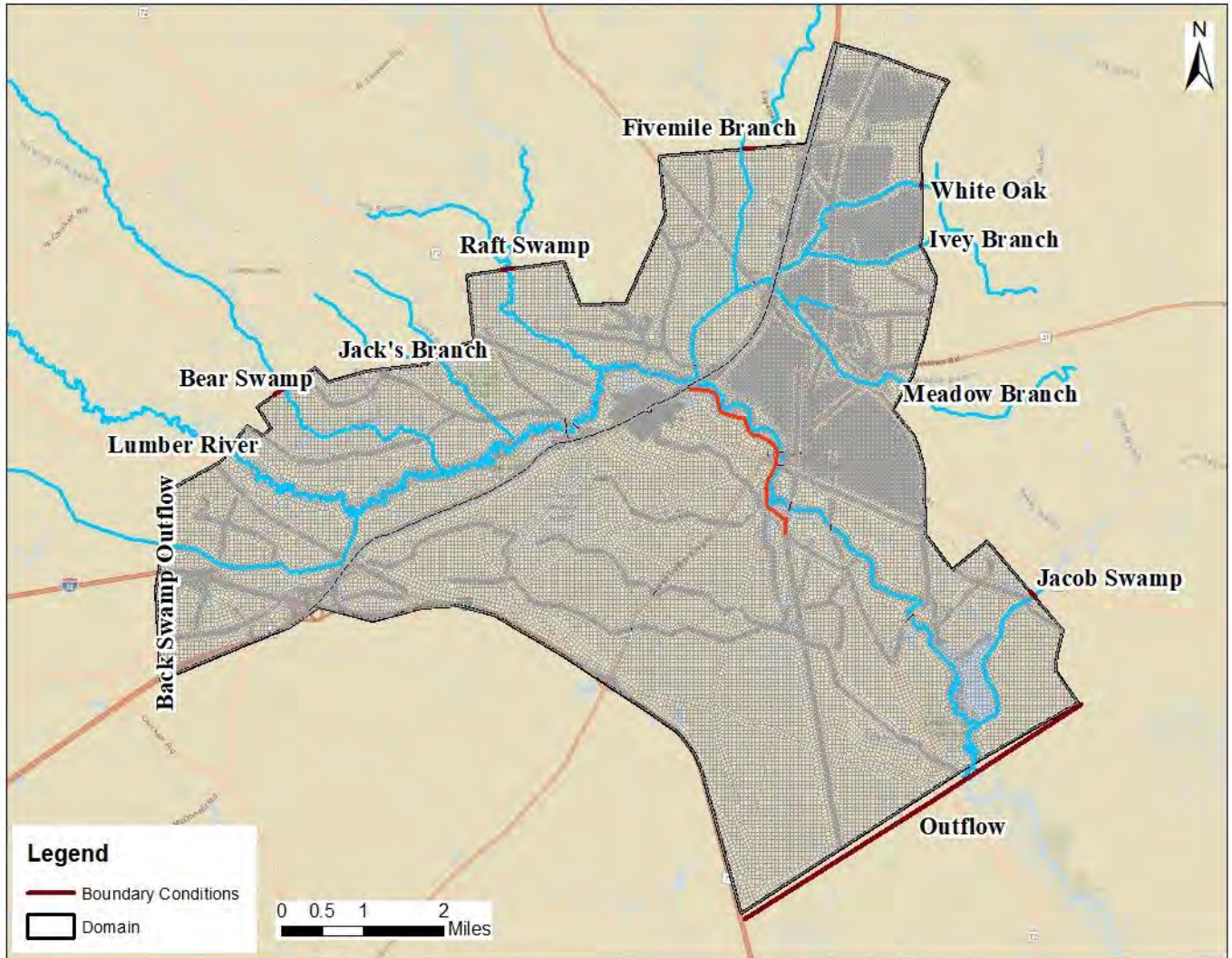


Figure 6-4. Boundary condition locations.

6.3. Model Execution

The completed models were executed using a fixed timestep of 5 seconds. The selected timestep provided stable results without unduly prolonging the simulation time. The Shallow Water Equations with a Eulerian-Lagrangian approach to solving for advection (SWE-ELM equation set) was used for all simulations.

Stage and flow hydrograph data at hydraulic structure locations were reviewed and verified to be appropriate. In certain cases, minor instabilities were noted in the flow data going through the structures, however, this did not impact the stages and hence do not impact the accuracy of the results.

6.4. Model Calibration and Verification

The 2D HEC-RAS model was calibrated and verified by comparing the simulated peak stages and flows to observed peak stages and flows, and high-water marks.

Observed data used for calibration and verification included USGS streamflow gage data at the USGS gage in Lumberton (USGS Gage 02134170), high water marks obtained during field data collection, a surveyed high-water mark, and high-water marks from the USGS National Water Information System Database (USGS, 2019).

Available peak flows and stages at the USGS gage in Lumberton were reviewed to identify significant flooding events for use in calibration and verification. Two flooding events were identified and selected for use in

calibration and verification (**Table 6-2**). Hurricane Florence in September 2018 was used for calibration and Hurricane Matthew from October 2016, was used for verification.

Table 6-2. Lumber River historical storms used for calibration and verification.

Storm	Peak Flow (cfs)	Peak Stage (ft, NAVD88)	Purpose
Sept 2018 (Hurricane Florence)	17,100	119.69	Calibration
Oct 2016 (Hurricane Matthew)	16,600 ¹	119.36	Verification

¹ Flow adjusted to account for bypass flow through I-95 opening. Recorded flow at gate without bypass flow was 14,600 cfs.

The inflows for these storms were derived from the HEC-HMS model generated in the hydrology phase of this project. Manning’s n-coefficients were adjusted iteratively until the simulated values matched the observed values at both the USGS gage location and at the high-water mark locations. The comparison between the calibrated model results and observed data for the two storms are provided in **Table 6-3**. **Figure 6-5** shows the differences between the simulated water surface elevations and the observed high-water marks for Hurricane Florence (September 2018).

Matching HWMs in the vicinity of the proposed gate was prioritized over matching water surface elevations at the USGS gage location during the calibration process.

Table 6-3. Observed versus simulated results at the USGS Gage in Lumberton.

Gage vs. Simulated Results						
Storm	Peak Flowrate (cfs)			Peak Stage (ft, NAVD88)		
	Observed	Simulated	% Difference	Observed	Simulated	Difference (ft)
Calibration						
Sept 2018 (Hurricane Florence)	17,100	15,877	-7.2	119.69	120.63	0.94

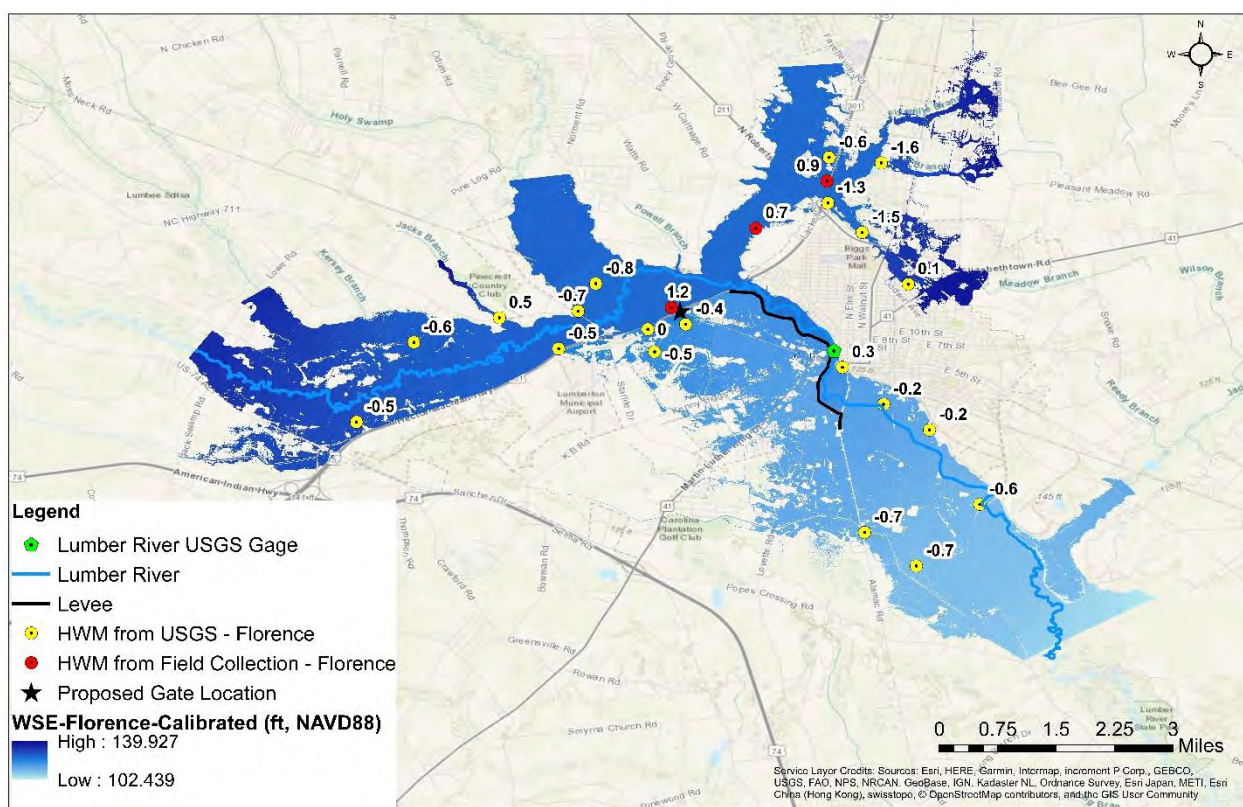


Figure 6-5. High water marks comparison for Hurricane Florence.

The difference between the simulated peak water surface elevation and the USGS high-water marks ranges from -1.6 feet to 1.2 feet. Near the gate, the model results are within 0.5 feet of the USGS HWM elevations. The simulated peak water surface elevation is about 1.2 feet higher than the observed elevation at the location of the surveyed high-water mark near the proposed gate location. Along Lumber River, the results indicate that the simulated results are within 1 foot of the HWM elevations, although mostly lower than the HWM elevations. The model results at the USGS gage location were 0.9 feet higher than the recorded gage elevation. The analysis shows that for USGS high-water marks around the gate location, the model tends to underpredict values. Whereas for field collected high-water marks around the gate location, the model overpredicts values. This trend may reflect inherent errors associated with the collection of the high-water mark data. Achieving calibration results that fall in-between the two data sets was the desired goal.

Note that the resulting flows in HEC-RAS at the USGS gage location are slightly different from those applied as boundary conditions due to attenuation of the peak flows within the HEC-RAS model and 2-dimensional distribution of the flows.

The final calibrated roughness coefficients that were assigned to the various land use classifications are provided in **Table 6-4**. Results of the various calibration iterations are included in **Appendix C3**.

During the calibration process, the Manning's n values were generally increased to achieve a better match between simulated and observed water levels. Changes to the Manning's n values for all land use classes are within the published Manning's n value ranges (**Table 6-1**). Additionally, Manning's n refinement regions were created for portions of the Lumber River and the area in the immediate vicinity of the proposed gate location. This was done to better capture the variations in land uses in those areas and were necessary in achieving good calibration results. The land use classes and assigned Manning's n values for the refinement regions are included in **Table 6-4**.

The calibrated Manning's n coefficient was used to simulate Hurricane Matthew for verification. The results are shown in **Table 6-5**.

Table 6-4. Calibrated Manning's n coefficients.

NLCD Code	NLCD Classification	Base N	Final Calibrated N
11	Open Water	0.03	0.033
21	Developed, Open Space	0.013	0.016
22	Developed, Low Intensity	0.05	0.063
23	Developed, Medium Intensity	0.075	0.094
24	Developed, High Intensity	0.1	0.125
31	Barren Land	0.03	0.03
41	Deciduous Forest	0.12	0.12
42	Evergreen Forest	0.12	0.12
43	Mixed Forest	0.12	0.12
52	Scrub/Shrub	0.05	0.05
71	Grassland Herbaceous	0.03	0.03
81	Pasture/Hay	0.04	0.04
82	Cultivated Crops	0.035	0.045
90	Woody Wetlands	0.1	0.15
95	Emergent Herbaceous Wetland	0.1	0.1
	Channel	0.045	0.065
	Area Upstream of Gate	0.05	0.05
	Black's Tire and Auto Service	0.1	0.1
	I-95	0.013	0.013
	Ponds	0.03	0.033
	Railroad Area	0.02	0.02
	Wetland Upstream of I-95	0.1	0.1
	Wooded Area	0.12	0.12

Table 6-5. Lumber River verification historical storms data versus simulated results.

Gage vs. Simulated Results						
Storm	Peak Flowrate (cfs)			Peak Stage (ft, NAVD88)		
	Observed	Simulated	% Difference	Observed	Simulated	Difference (ft)
Verification						
Oct 2016 (Hurricane Matthew)	16,600	14,924	-10.1	119.36	120.42	1.06

Like Hurricane Florence, final water surface elevations produced from the Hurricane Matthew simulation were compared to the USGS high-water mark elevations. The results of this comparison can be seen in **Figure 6-6**. The trend noted in calibration was consistent throughout the verification process.

The results of calibration trial runs are included in **Appendix C3**. The calibration of HEC-RAS model is included in the electronic **Appendix E3.1**. The calibration model consists of 2 geometries, 2 unsteady flow files and 3 plans. Each unsteady flow file is a different storm event, and each geometry is a different trial, utilizing different roughness coefficients. Ultimately, there was a base Manning’s n coefficient plan, and three trials were run for the calibration storm. The verification storm (Hurricane Matthew) was only run once with the final geometry.

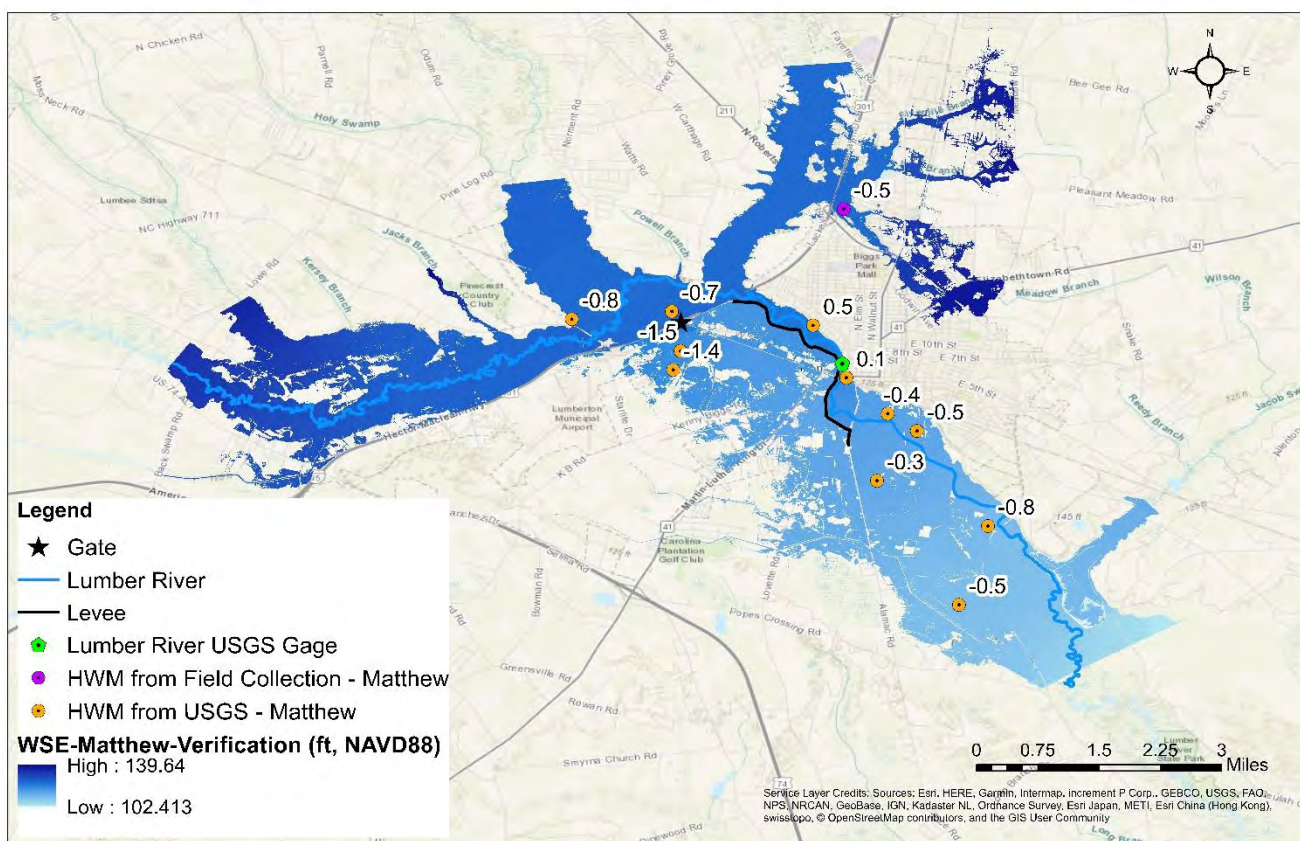


Figure 6-6. High water marks comparison for Hurricane Matthew.

6.5. Design Flood Simulations and Results

6.5.1. Design Flood Simulations

The 100-year, 500-year, 1,000-year, ¼ PMF, 1/3 PMF, ½ PMF, 2/3 PMF, ¾ PMF and PMF peak stages at the proposed gate location were simulated using the calibrated HEC-RAS model. The hydrographs developed in

Section 5.7 were used as the inflow boundary conditions for the simulations. As stated in **Section 5.7**, the duration of all the design storms was 48 hours.

Geometry files were created for the existing conditions (without the proposed gate), and for the proposed conditions (with the proposed floodgate in place and I-95 embankment raised). Both geometry files use the calibrated and verified Manning's n-coefficients.

Nineteen different runs were performed using two different geometry files. The ten plans are:

1. **100yr Without Gate** – Unsteady flow: 100YR, Geometry: Lumber River without Gate
2. **100yr with Gate and Proposed I-95** – Unsteady flow: 100YR, Geometry: Lumber River with Proposed I-95 and Gate
3. **500yr Without Gate** – Unsteady flow: 500YR, Geometry: Lumber River without Gate
4. **500yr With Gate and Proposed I-95** – Unsteady flow: 500YR, Geometry: Lumber River with Proposed I-95 and Gate
5. **1,000yr Without Gate** – Unsteady flow: 1,000YR, Geometry: Lumber River without Gate
6. **1,000yr With Gate and Proposed I-95** – Unsteady flow: 1,000YR, Geometry: Lumber River with Proposed I-95 and Gate
7. **Florence Design** – Unsteady flow: Hurricane Florence, Geometry: Lumber River with Proposed I-95 and Gate
8. **0.25PMF Without Gate** – Unsteady flow: 0.25PMP, Geometry: Lumber River without Gate
9. **0.25 PMF With Gate and Proposed I-95** – Unsteady flow: 0.25PMP, Geometry: Lumber River with Proposed I-95 and Gate
10. **0.33 PMF Without Gate** – Unsteady flow: 0.33PMP, Geometry: Lumber River without Gate
11. **0.33 PMF With Gate and Proposed I-95** – Unsteady flow: 0.33PMP, Geometry: Lumber River with Proposed I-95 and Gate
12. **0.5 PMF Without Gate** – Unsteady flow: 0.5PMP, Geometry: Lumber River without Gate
13. **0.5 PMF With Gate and Proposed I-95** – Unsteady flow: 0.5PMP, Geometry: Lumber River with Proposed I-95 and Gate
14. **0.67 PMF Without Gate** – Unsteady flow: 0.67PMP, Geometry: Lumber River without Gate
15. **0.67 PMF With Gate and Proposed I-95** – Unsteady flow: 0.67PMP, Geometry: Lumber River with Proposed I-95 and Gate
16. **0.75 PMF Without Gate** – Unsteady flow: 0.75PMP, Geometry: Lumber River without Gate
17. **0.75 PMF With Gate and Proposed I-95** – Unsteady flow: 0.67PMP, Geometry: Lumber River with Proposed I-95 and Gate
18. **FullPMP Without Gate** – Unsteady flow: FullPMP, Geometry: Lumber River without Gate
19. **PMF With Gate and Proposed I-95** – Unsteady flow: FullPMP, Geometry: Lumber River with Proposed I-95 and Gate

Plans using the geometry “Lumber River without Gate” represent existing conditions; without the gate in place and without a raised I-95. Plans with the geometry “Lumber River with Proposed I-95 and Gate” represent proposed conditions with the flood gate and proposed I-95 raised embankment configuration in place.

Simulations with and without the gate provide insights into possible impacts from the installation of the flood gate and raising of I-95.

Hurricane Florence was also simulated with the proposed conditions geometry to determine the resulting peak water surface elevation at the proposed gate location for the flood of record.

The models are included in the electronic **Appendix E3.2**.

6.5.2. Hydraulic Results

6.5.2.1. Water Surface Elevations

The maximum water surface elevations from the ten simulations are summarized in **Table 6-6**. The maximum water surface elevations were extracted from a profile line along the upstream end of the proposed gate location in RasMapper.

Table 6-6. Maximum Water Surface Elevation (WSE) from simulations at the flood gate location .

Storm Event	Maximum WSE (feet, NAVD88)	
	Existing Conditions	Proposed Conditions
100 YR	123.7	124.0
Hurricane Florence	124.8	125.6
¼ PMF	124.8	126.0
500 YR	125.5	127.6
1/3 PMF	125.6	127.7
1,000 YR	125.8	128.1
½ PMF	126.1	128.4
2/3 PMF	126.4	128.7
¾ PMF	126.5	128.8
PMF	126.8	129.2

Under the 100-year flood conditions, Lumber River overtops its banks and flows through the I-95 opening at the VFW Road (proposed gate location). The peak water surface elevation upstream of the gate is 123.7 feet, NAVD88. No segments of the levee system are overtopped. Installing the floodgate and raising I-95 results in an increase in the peak water surface elevation of 0.3 feet (Table 6-6) upstream of the gate. Inundation maps for these simulations are included in **Appendix C4**.

Under the ¼ PMF flood conditions, Lumber River overtops its banks and flows through the I-95 opening at the VFW Road (proposed gate location). The peak water surface elevation upstream of the gate is 124.8 feet, NAVD88. No segments of the levee system are overtopped. Installing the floodgate and raising I-95 results in an increase in the peak water surface elevation by 1.2 feet (Table 6-6) upstream of the gate. Inundation maps for these simulations are included in **Appendix C4**.

Under the 500-year flood conditions, Lumber River overtops its banks and flows through the I-95 opening at the VFW Road (proposed gate location). About 2,500 cfs of flow goes through the I-95 opening. In addition to flow through the I-95 opening, flow overtops the low segments of I-95 east and west of the proposed gate location. The overtopping flowrate at the low segments of I-95 is about 2,800 cfs on the west side and about 2,500 cfs on the east side. No overtopping occurs with the gate in place and I-95 raised. However, minor overtopping of the levee occurs at the intersection of the levee and NC72 where the levee is relatively low. Peak water surface elevation upstream of the gate under this scenario is 127.6 feet, NAVD88. Installing the floodgate and raising I-95 results in an increase in the peak water surface elevation 2.1 feet (Table 6-6) upstream of the gate. Inundation maps for these simulations are included in **Appendix C4**.

Under the 1/3 PMF flood conditions, Lumber River overtops its banks and flows through the I-95 opening at the VFW Road (proposed gate location). In addition to flow through the I-95 opening, flow overtops at multiple locations along I-95 and causes widespread inundation in the city. Overtopping occurs on the west side of I-95 farther away from the gate location when the gate is in place and I-95 raised. The levee is also overtopped at multiple locations. Peak water surface elevation upstream of the gate under this scenario is 127.7 feet, NAVD88. Installing the floodgate and raising I-95 results in an increase in the peak water surface elevation 2.1 feet (Table 6-6) upstream of the gate. Inundation maps for these simulations are included in **Appendix C4**.

Under the 1,000-year flood conditions, Lumber River overtops its banks and flows through the I-95 opening at the VFW Road (proposed gate location). In addition to flow through the I-95 opening, flow overtops at multiple locations along I-95 and the levee and causes widespread inundation in the city. Overtopping occurs on the west side of I-95 farther away from the gate location when the gate is in place and I-95 raised. Peak water surface elevation upstream of the gate under this scenario is 128.1 feet, NAVD88. Installing the floodgate and raising I-95 will result in an increase in the peak water surface elevation of 2.3 feet (Table 6-6) upstream of the gate. Inundation maps for these simulations are included in **Appendix C4**.

Under the ½ PMF, 2/3 PMF, ¾ PMF and full PMF flood conditions, Lumber River overtops its banks and flows through the I-95 opening at the VFW Road (proposed gate location). Flow also overtops at multiple locations along I-95 and the levee and causes widespread inundation in the city. The peak water surface elevations upstream of the gate without the gate and with the gate installed and I-95 raised for the different PMF runs are listed in **Table 6-6**. For the ¾ PMF flood condition, the peak water surface elevation upstream of the gate is 128.8 feet when the gate is in place and I-94 raised. Installing the floodgate and raising I-95 results in an increase in the peak water surface elevation by 2.3 feet (**Table 6-6**) upstream of the gate for the ¾ PMF flood condition.

Peak water surface elevations upstream of the gate for the flood of record (Hurricane Florence) under existing conditions is 124.8 feet, NAVD88. Installing the gate and raising I-95 to prevent overtopping increases the peak water surface elevation to 125.6 feet, NAVD88.

When comparing the simulated 100-year existing conditions (without gate) inundation boundary to the effective floodplain, the internal flooding estimated by the model is less extensive (**Figure 6-7**). This difference is due to the fact that the effective floodplain includes mapping for Jacob Swamp and Little Jacob Swamp, whereas the model does not include either stream as an inflow. However, in the northeast and northwest corners of the domain, the simulated boundary is predicted to spread further. Jack’s Branch, to the west of Raft Swamp, is not included in the effective floodplain, but shows substantial flow within the model. The same scenario occurs with Ivey Branch, north of Meadow Branch.

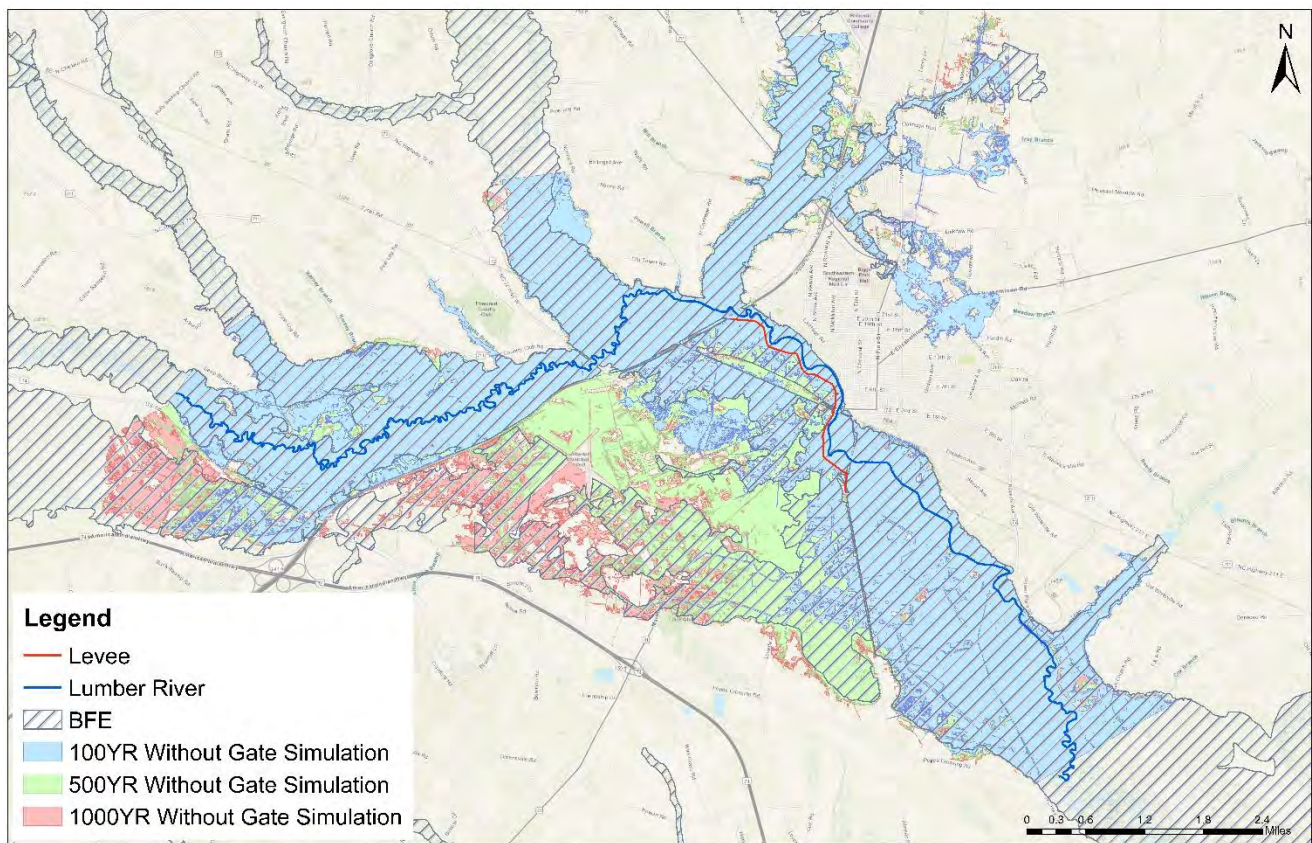


Figure 6-7. Inundation boundaries without floodgate

6.5.2.2. Impacts of Flood Gate Installation

The impacts of the flood gate installation in terms of increases in water surface elevations were assessed by comparing flood depths and inundation areas from model simulations with and without the flood gate for the 100-year, and 500-year floods.

Figures 6-8 and 6-9 show the difference in water surface elevations and extents of impact of the proposed projects (floodgate and raising of I-95) for the 100-year and 500-year storms. The results show that proposed projects will result in peak water surface elevation increases of up to about 0.4 feet are expected during the 100-year flood (**Figure 6-8**) and up to about 3 feet during the 500-year flood (**Figure 6-9**).

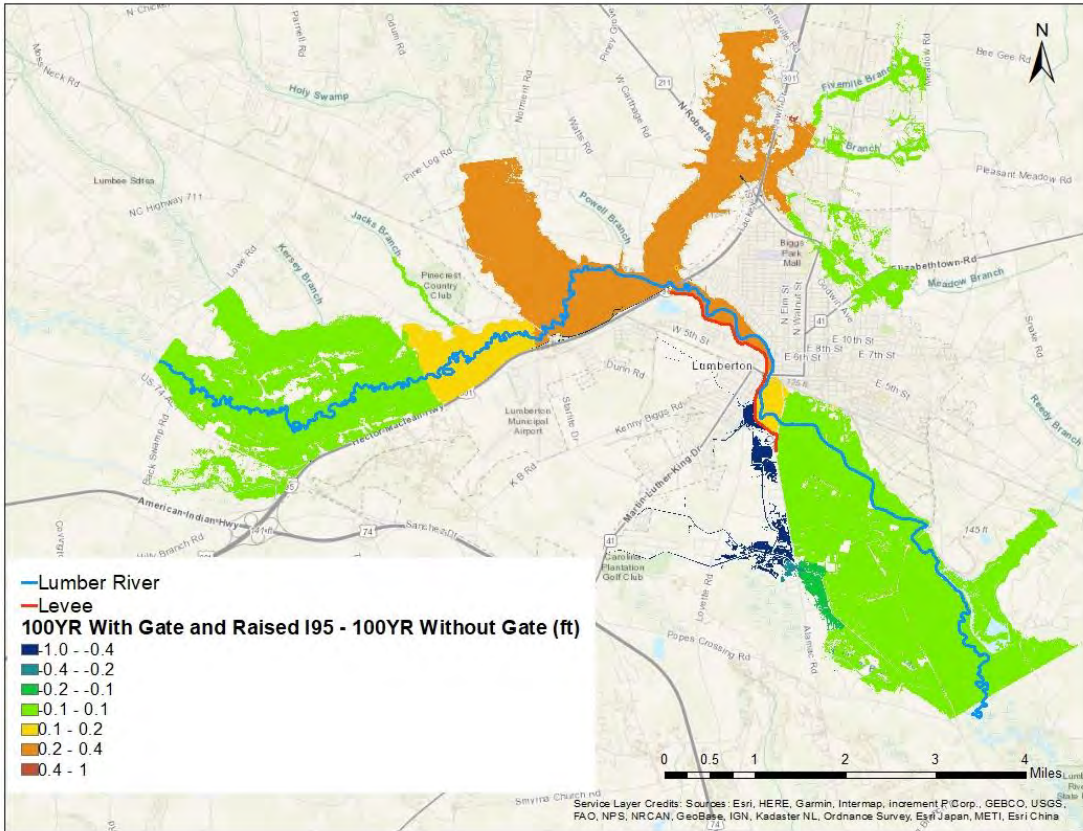


Figure 6-8. WSE (ft) without flood gate compared to with flood gate and I-95 raised for 100YR storm.

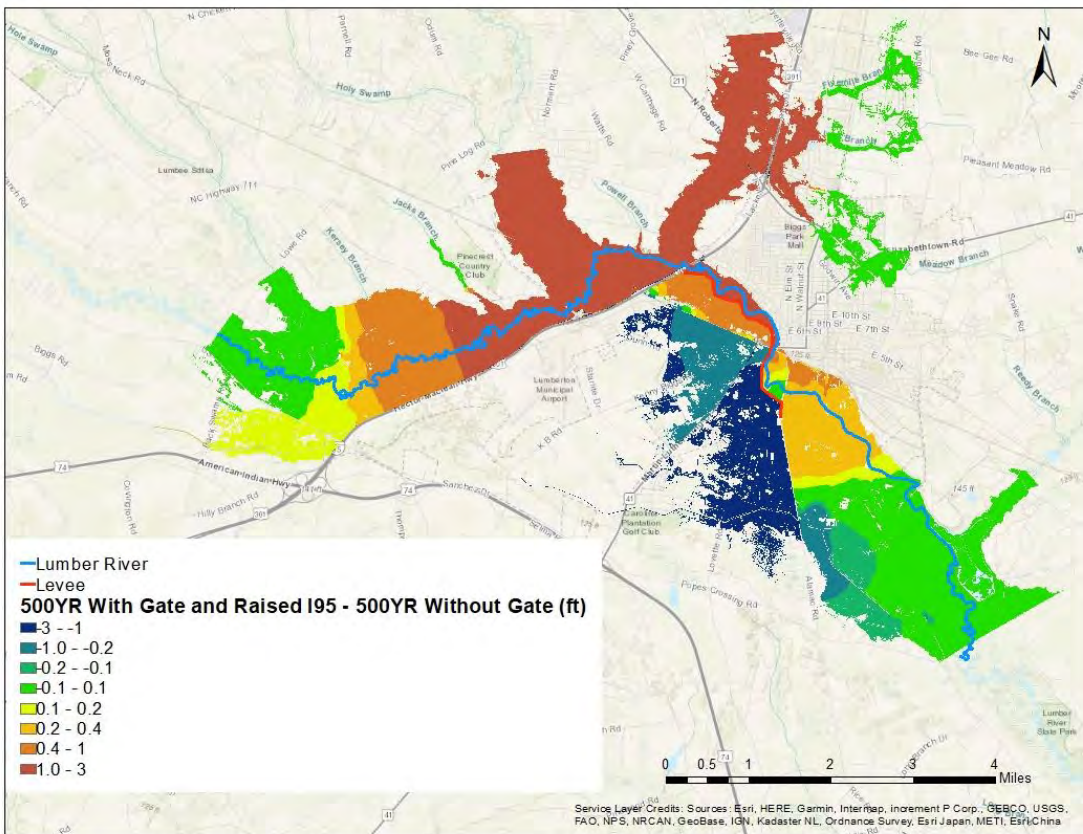


Figure 6-9. WSE (ft) without flood gate compared to with flood gate and I-95 raised for 500YR storm.

7. Freeboard Estimation

The proposed flood gate will impound water leading to temporary pond-like situation at the northern side of the gate. This situation is expected to last for about 5 days during the design flood. During this temporary pond-like situation, wind setup caused by the horizontal stress exerted on the water surface by the winds and runup associated with wind generated waves (**Figure 7-1**) may develop. The height of the flood gate should include freeboard allowance that considers these wind effects on the surface of water.

This section outlines the procedure used to calculate the wind setup and wave run-up based on simplified wave models.

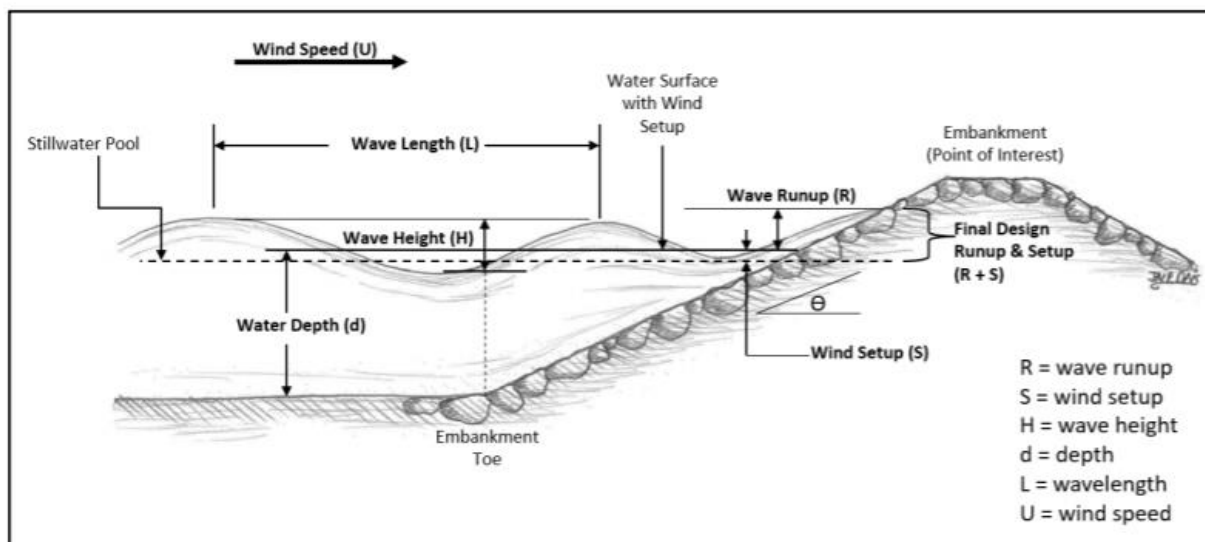


Figure 7-1. Definition sketch for wave runup and wind setup (USACE, 1997).

In general, the different steps involved in calculating wave run-up are as follows:

- Estimate average wind speed over an appropriate fetch
- Estimate wave height and wave period
- Estimate wind setup and wave-runup

Above steps are described in more detail in the following sections.

7.1. Estimate average wind speed over an appropriate fetch

7.1.1. Fetch

Fetch is defined as the unobstructed distance along which wind blows over the surface of water to create wind generated waves. The inundation extents computed from H&H modeling for the 500-year storm with gate and I-95 raised was superimposed on satellite imagery to determine the longest unobstructed distance (measured along a straight line) that is exposed to wind effects when water pools behind the Lumberton Flood Gate during the flood. The longest fetch was estimated to be around 2 miles to the northwest of the flood gate (red line in **Figure 7-2**).

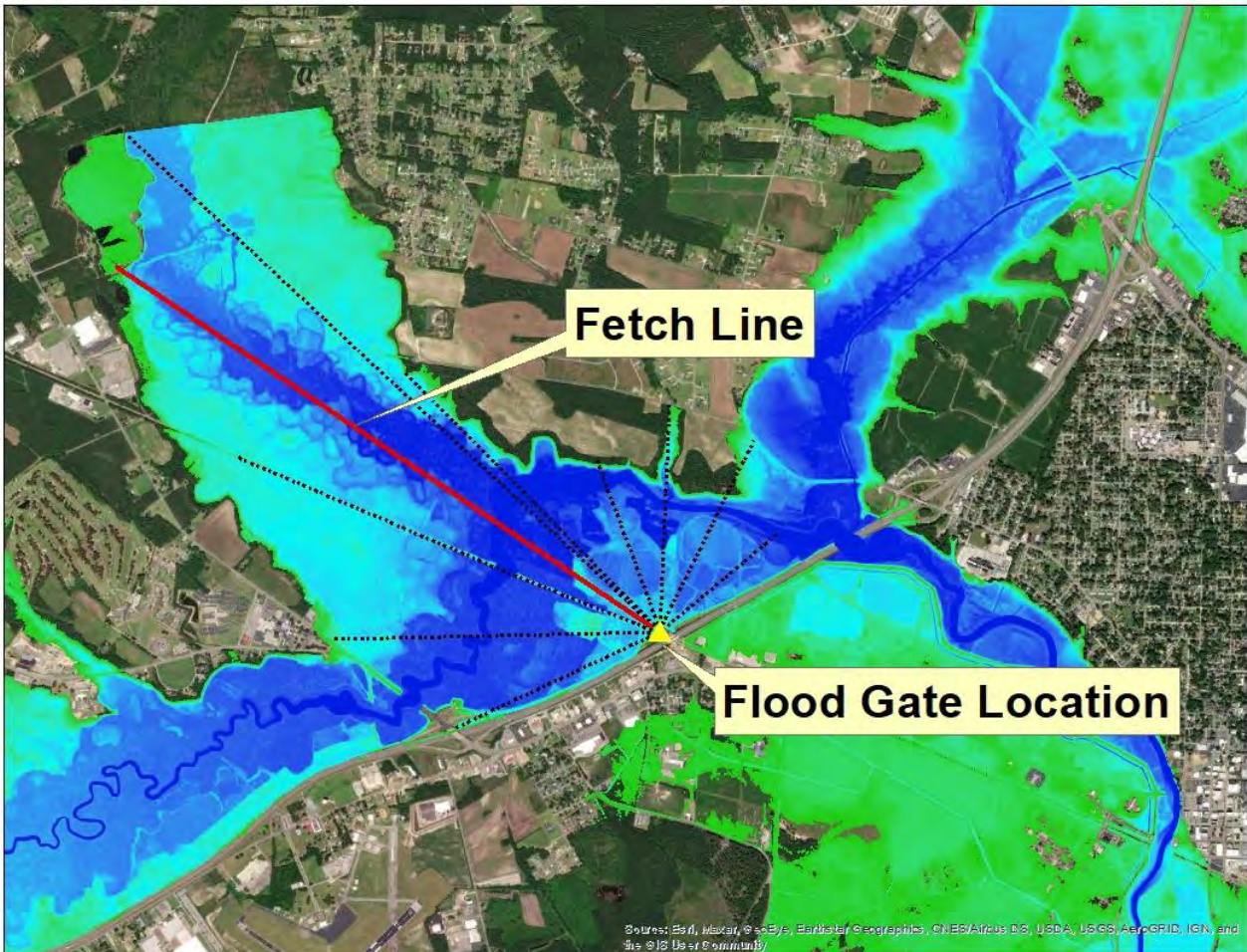


Figure 7-2. Fetch line (red) superimposed on 500-year depth raster and satellite imagery.

7.1.2. Wind Speed

Annual extreme fastest mile wind speed measured at 30 feet for 138 stations around United States was used to draw maps for the 2-year, 50-year and 100-year mean recurrence intervals (Thorn, 1968, shown in **Appendix D**). The 2-yr return period wind speed from that dataset was used as the input to compute the design wind speed. The estimated 2-year fastest mile wind speed over the state of North Carolina is 50 miles per hour.

The following assumptions (USACE, 1989) are made about the wind speed used as input for wave growth models:

- Wind fields are well organized and can be adequately described using an average wind speed and direction over the entire fetch
- Wind speed should be corrected to the 33-foot (10 meter) level.
- Wind speed should be representative of the average wind speed measured over the fetch
- When the fetch length is 10 miles (16 kilometers) or less, the wind has not fully adjusted to the frictional characteristics of the waves.
- When the fetch length is greater than 10 miles (16 kilometers), thermal stability effects must be included in the wind speed transformation.

To satisfy these assumptions, the following adjustments are made to the wind speed.

7.1.2.1. Height Adjustment

Since the wind speed was measured at 30 feet, an adjustment was applied to get the equivalent wind speed at a height of 33 feet using the 1/7 power law (USACE, 1989) (**Equation 7-1**):

$$U_{33} = \left(\frac{33}{z}\right)^{\frac{1}{7}} * U_z \quad (7-1)$$

Where U_{33} is the wind speed at the 33-foot level (miles per hour [mph]), z is the elevation above the surface (ft), and U_z is the wind speed at a distance of z above the surface (mph). When z is 30 feet and U_{30} is 50 mph, U_{33} is equal to 50.68 mph.

7.1.2.2. Overland Wind Adjustment

The fastest mile data is based on measurements at land-based stations. Under comparable meteorological conditions, wind velocities over water are higher than over land surfaces because of smoother and more uniform surface conditions. Factors to adjust land-based wind speed measurements to account for these effects are presented on page 15-2 of USACE, 1997 (see **Appendix D**). For a wind fetch of 2 miles (see **section 7.1.1**), the ratio of winds over water to the winds over land (FWL) was estimated to be 1.21. The overwater wind speed, U_w was calculated using **Equation 7-2**.

$$U_w = FWL * U_{33} \quad (7-2)$$

$$U_w = 1.21 * 50.68 = 61.32 \text{ mph}$$

Where FLW is the ratio of winds over water to winds over land, and U_{33} is the previously calculated wind speed at the 33-foot level (mph). With an FWL of 1.21 and the U_{33} of 50.68 mph, the U_w is 61.32 mph.

7.1.2.3. Computing Adjusted Wind Speeds based on Averaging Time

There are two approaches (fetch-limited and duration-limited) for determining the characteristics of wind generated waves. Fetch-limited conditions assume that the wind blows with a constant speed and direction over a certain fetch for sufficient time for the waves to travel the entire fetch length (Ozeren et al., 2009). Within this time steady state conditions are achieved within the fetch. If the wind duration is less than the required time for the waves to travel the fetch, then the wave conditions will be time dependent, and such wave conditions are described as duration-limited.

In the present work, since the wind generated waves are limited by the extent of the ponded areas adjacent to the flood gate, the assumption of fetch-limited conditions is appropriate. Therefore, a minimum duration (t) must be selected to meet the assumptions of the fetch-limited conditions discussed above. An averaging interval (larger than the minimum duration, t) over which wind speeds are relatively constant should also be selected and the corresponding averaged wind speed must be computed.

The equations for computing wind speeds over different averaging intervals are based on Figure 5-26 in USACE, 1989 (also shown in **Appendix D**).

First, the duration corresponding to a fastest mile wind speed of 50 mph was determined from the relationship $t=3600/U$ (from Figure 5-35 in USACE, 1989), where U_t is the fastest mile wind speed. Thus, $t = 72$ s.

The 72s fastest mile winds to which overland adjustment has been applied is converted to 1 hour averaged wind speed using equation below (**Equation 7-3**):

$$\frac{U_t}{U_{1hr}} = 1.277 + 0.296 \tanh\left(0.9 \log\left(\frac{49}{t}\right)\right) \quad (7-3)$$

$$\frac{U_{72}}{U_{1hr}} = 1.277 + 0.296 \tanh\left(0.9 \log\left(\frac{49}{72}\right)\right)$$

$$U_{1hr} = 50.13 \text{ mph}$$

7.2. Estimate Wave Height and Wave Period

Deepwater wave characteristics based on the fetch and adjusted wind speeds computed in **Section 7.1** are determined using hindcasting charts for deep water waves (Figure 5-34, USACE, 1989, shown in **Appendix D**). The computed wave heights, periods and minimum duration are shown in **Table 7-1**

Table 7-1. Deep water wave characteristics.

Adjusted Wind Speed (mph)	Fetch (miles)	Duration (min)	Deep water Wave Height (ft)	Deep water Wave Period (s)
50.13	2	45	3	3

The minimum duration computed from the chart is around 45 minutes, therefore the assumption of fetch-limited conditions is valid if we assume a duration of 1 hour. Therefore, the design deep water wave height and period is selected to be equal to 3 ft and 3 seconds (s) respectively.

Next, we compute the deep-water wavelength (**Equation 7-4**) using the dispersion relationship to verify the assumption of deep-water conditions.

$$L_d = \frac{gT_d^2}{2\pi} \quad (7-4)$$

Where L_d is the deep-water wavelength (ft), g is gravity (ft/s^2), and T_d is the deep-water wave period (s). When T_d is 3 s, the deep-water wavelength (L_d) is 46.12 ft.

$$L_d = \frac{32.2 \cdot 3^2}{2\pi} = 46.12 \text{ feet}$$

For deep water wave growth to be unimpeded by the bottom, the ratio of water depth to wavelength must be equal to or greater than 0.5 (USACE, 1989). Design flood depth at the gate is about 8 feet so the ratio of the water depth to wavelength is 0.17 which is significantly less than half the wavelength. Therefore, the assumption of deep-water wave growth is not applicable. The wave height and period should therefore be based on shallow water curves. The hindcasting charts for computing shallow water wave characteristics at a depth of ten feet is shown in **Appendix D**, Figure D-5 (or Figure 5-36 USACE, 1989). For a wind speed of 50.13 mph and fetch of 2 miles, the shallow water wave height and wave period are **2.5 feet** and **2.75 s** respectively.

7.3. Estimate wind setup and wave runup

7.3.1 Wind Setup

Set-up (S_e) is the piling up of water at the leeward end, and a lowering of water level at the windward end in a reservoir caused by wind (**Figure 7-1**). Wind set-up can be estimated for the reservoir, based on the following equation (USACE, 1989) (**Equation 7-5**):

$$S_e = \frac{U^2 \cdot F_s}{1400D} \quad (7-5)$$

Where S_e is set-up in feet above the still water level (ft), U is the average wind velocity (mph) over the maximum fetch distance (F_s) (mi) that influences the wind, and D is the average depth of water along the fetch line (ft). When D is 13 ft and F_s is 2 ft the S_e is 0.3 ft.

$$S_e = \frac{50.13^2 \cdot 2}{1400 \cdot 13} = 0.3 \text{ ft}$$

7.3.2 Wave Runup

Wave runup is defined as the height above still water level to which a wave will rise on a structure or beach (**Figure 7-1**).

The upper limit for relative runup on smooth vertical walls (derived from laboratory experiments), is presented in the U.S Army Corps of Engineers miscellaneous paper CERC-90-4 (USACE, 1990) and is equal to (**Equation 7-6**):

$$\frac{R}{H} = 2.5 \quad (7-6)$$

Where R is the wave runup (ft) and H is the wave height at the toe of the structure (ft). For a wave height of 2.5 ft, the runup is 6.25 ft.

$$R = 2.5 * 2.5 = 6.25 \text{ ft}$$

7.4. Sensitivity Analysis

A sensitivity analysis was performed to understand the variability of the computed wave runup and was setup with changes in the fetch and wind speed for the 100-year, 500-year and the ¼ PMF return period events. As stated in Section 3, the top elevation of the flood gate should be at a minimum higher than the elevation from the flood of record, which has a return period of about of 200 years. The sensitivity analysis provides a range of values for freeboard for the 100-year and 500-year floods to provide lower and upper freeboard threshold estimates.

The direction of the prevailing winds determines the fetch length. The black dashed lines in **Figure 7-2** indicate the different fetch lines that may be applicable depending on the wind direction over the study area. Thus, the fetch length can vary between a maximum of 2 feet to a minimum of 0.6 feet. Also plotted were the modeled depths along the fetch to confirm that the average depth along the fetch length (around 12 feet) is large enough to overtop the vegetation in that area and thereby provide an unobstructed path for the winds. The wind setup and wave runup computed for the different fetch-wind speed combinations are summarized in **Table 7-2**. These quantities were found to be sensitive to changes in the fetch.

Table 7-2. Summary of sensitivity analysis.

Design Storm	Fetch (mi)	Wind Speed (mph)	Wave Runup (ft)	Wind Setup (ft)	Total Wind and Wave Component (ft)
100-Year	2	50	5	0.4	5.4
	0.6	50	3.8	0.1	3.9
500-Year	2	50	6.3	0.3	6.6
	0.6	50	3.8	0.1	3.9
¼ PMF	2	50	6.3	0.3	6.6
	0.6	50	3.8	0.1	3.9

7.5. Results

The estimated range of freeboard to account for wind-wave action is 3.9 feet to 5.4 feet for the 100-year flood and 3.9 feet to 6.6 feet for the 500-year and ¼ PMF return period events. The lower bound estimate of 3.9 feet results from the use of a fetch of 0.6 miles during either the 100-year or 500-year or ¼ PMF event. The upper bound estimates of 5.4 and 6.6 feet corresponds to a fetch of 2 miles during the 100-year and 500-year or ¼ PMF events, respectively.

8. Recommendations

The recommended range of top of gate elevations and gate heights are shown in **Table 8.1**.

Table 8-1. Recommended Range of Gate Heights

Design Storm	Recommended Top of Gate Elevation and Gate Height			
	Max. Stillwater Elevation (feet, NAVD88)	Freeboard (feet)	Top of Gate Elevation (feet, NAVD88)	Gate Height (feet)
100 YR	124.0	5.4	129.4	9.4
¼ PMF	126.0	6.6	132.6	12.6
500 YR	127.6	6.6	134.2	14.2

Reference Elevations: 1. Minimum elevation for levee accreditation = 128.5 feet (ft), NAVD88
 2. Flood of record elevation at gate location assuming gate is in place and I-95 raised = 125.6 ft, NAVD88
 3. Elevation of ¾ PMF at gate location assuming gate is in place and I-95 raised = 128.8 ft, NAVD88
 4. Elevation of PMF at gate location assuming gate is in place and I-95 raised = 129.2 ft, NAVD88
 5. Average ground elevation at gate location is 120.0 ft
 6. ¼ PMF is the largest storm that does not overtop the levee and proposed I-95
 7. Levee is overtopped during the 500-year storm.

The resulting peak elevation upstream of the gate for the flood of record, the minimum elevation required for levee accreditation, and the ¾ PMF and PMF peak water surface elevations are also shown in the table for reference. The range of recommended top of flood gate elevation of 129.4 feet, NAVD88 to 134.2 feet, NAVD88 all meet the minimum requirements for levee certification. The recommended top of gate elevation also ensures that the gate is not overtopped even during the PMF, if freeboard is not considered. Selection of the gate height from the range provided should consider the following factors:

- Cost;
- Floodplain Impacts; and
- Minimum desired level of service

9. References

1. Barnes, J., 1998. *North Carolina's Hurricane History, Revised and updated version*. University of North Carolina Press.
2. Calenda et al., 2005. Distribution of the extreme peak floods of the Tiber River from the XV century. *Advances in water resources*, 28(6), 615-625.
3. Chow, 1959. *Open Channel Hydraulics*. McGraw-Hill, New York.
4. Federal Emergency Management Agency, 2008. *Meeting the Criteria for Accrediting Levee Systems on NFIP Flood Maps*. Federal Emergency Management Agency (FEMA), 2008, *Meeting the Criteria for Accrediting Levee Systems on NFIP Flood Maps*, www.fema.gov/media-library-data/20130726-1600-20490-4180/lv_accredit_checklist_nov08.pdf.
5. Federal Emergency Management Agency, 2006. Mapping of areas protected by levee systems. Code of Federal Regulations Title 44 Section 65.10. Federal Emergency Management Agency, Aug. 25, 1986
6. Federal Emergency Management Agency, 2014. A Report of Flood Hazards in Robeson County, North Carolina and Incorporated Areas, Flood Insurance Study Number 37155CV000, Federal Emergency Management, Atlanta, GA.
7. National Institute of Standards and Technology, 2015. Maps of Non-hurricane Non-tornadic Wind Speeds with Specified Mean Recurrence Intervals for the Contiguous United States Using a Two-dimensional Poisson Process Extreme Value Model and Local Regression, National Institute of Standards and Technology Special Publication 500-301, 102 pages
8. National Oceanic and Atmospheric Administration, 2019a. Tropical Cyclone Climatology. National Oceanic and Atmospheric Administration National Hurricane Center and Central Pacific Hurricane Center. Available at: nhc.noaa.gov/climo
9. National Weather Service, 2019a. Hurricane Floyd: September 16, 1999. National Oceanic and Atmospheric Administration National Weather Service. Available at: <http://weather.gov/ilm/Floyd>
10. National Weather Service, 2019b. Hurricane Florence: September 14, 2018. National Oceanic and Atmospheric Administration National Weather Service. Available at: <http://weather.gov/ilm/HurricaneFlorence>
11. National Oceanic and Atmospheric Administration, 2020. Climate at a Glance-Statewide Time Series. National Oceanic and Atmospheric Administration National Centers for Environmental Information. Available at: ncdc.noaa.gov/cag/statewide/time-series
12. National Weather Service, 2017. Hurricane Matthew in the Carolinas: October 8, 2016. National Oceanic and Atmospheric Administration National Weather Service. Available at: <http://weather.gov/ilm/Matthew>
13. North Carolina Department of Transportation, 2019. North Carolina Department of Transportation Bridges Map, ncdot.maps.arcgis.com/home/webmap/viewer.html?webmap=db3b56c3228743b3811e36761393d661. Date accessed: 9 Dec. 2019
14. North Carolina Flood Risk Information System, North Carolina Floodplain Mapping Program, fris.nc.gov/fris/Index.aspx?user=General Public&ST=NC&FIPS=161.
15. Natural Resources Conservation Service, 2019. National Engineering Handbook, Part 630 Hydrology., United States Department of Agriculture, Natural Resources Conservation Service, August 2019. Rainfall Distribution spreadsheet available at <https://www.nrcs.usda.gov/wps/portal/nrcs/detailfull/national/water/?&cid=stelprdb1044959>
16. Ozeren, Yavuz & Wren, D., 2009. Technical Note: Predicting Wind-Driven Waves in Small Reservoirs. *Transactions of the American Society of Agricultural and Biological Engineers*, Vol. 52(4), pages 1213 – 1221.

17. Rucker, Gregory C. *Hurricane Matthew: Sources of Flooding and Mitigation Strategies in Lumberton, NC*. AECOM, 2017, pp. Appendix C, *Hurricane Matthew: Sources of Flooding and Mitigation Strategies in Lumberton, NC*.
18. State Climate Office of North Carolina, 2015. NC Extremes: Damaging hurricanes from slopes to shores. NC State University. Available at: <http://climate.ncsu.edu/climateblog?id=157>
19. State Climate Office of North Carolina, NC State University. CRONOS [internet database] available at <http://climate.ncsu.edu/cronos/>. Accessed December 20, 2019.
20. Thorn, H.C.S, 1968. New Distributions of Extreme Winds in the United States. *Journal of the Structural Division*, 1968, Vol. 94, Issue 7, Pg. 1787-1802
21. United States Army Corps of Engineers, 1984. Shore protection manual. Vicksburg, Miss: Dept. of the Army, Waterways Experiment Station, Corps of Engineers, Coastal Engineering Research Center.
22. United States Army Corps of Engineers, 1989. "Water Levels and Wave Heights for Coastal Engineering Design," US Army Corps of Engineers EM 1110-2-1414, July 5, 1989.
23. United States Army Corps of Engineers, 1990. "Maximum Periodic Wave Runup on smooth slopes", US Army Corps of Engineers Miscellaneous Paper CERC-90-4.
24. United States Army Corps of Engineers, 1997. "Hydrologic Engineering Requirements 1. for Reservoirs," US Army Corps of Engineers EM 1110-2-1420.
25. United States Army Corps of Engineers, 2000. Hydrologic Modeling System HEC-HMS Technical Reference Manual. Report CPD-74B. United States Army Corps of Engineers, Davis, CA.
26. United States Army Corps of Engineers, 2017. Hydrologic Modeling System Version 4.2.1, United States Army Corps of Engineers, March 2017, Davis, CA.
27. United States Army Corp of Engineers (USACE). 2021. Hydrologic Engineering Center's River Analysis System (HEC-RAS), *Version 6.0*. February 2021.
28. United States Department of Agriculture Natural Resources Conservation Service. Geospatial Data Gateway [internet database] available at: <http://datagateway.nrcs.usda.gov>. Accessed October 30, 2019.
29. United States Geological Survey, 2009. Magnitude and Frequency of Rural floods in the Southeastern United States, through 2006: Volume 2, North Carolina. U.S department of Interior, U.S Geological Survey.
30. United States Geological Survey, 2016. The StreamStats program. Available at: <http://streamstats.usgs.gov>. Accessed on: November 1, 2019.
31. United States Geological Survey, 2019 a. PeakFQ Version 7.3. November 21, 2019.
32. United States Geological Survey, 2019 b. U.S. Guidelines for Determining Flood Frequency. Bulletin 17C. Techniques and Methods 4-B5 version 1.1., Department of Interior, U.S. Geological Survey, May 2019.
33. United States Geological Survey, 2020. USGS Current Conditions for North Carolina. Available at: <https://waterdata.usgs.gov/nc/nwis/uv?>. Accessed on January 4, 2020.
34. *USGS Flood Event Viewer*, 2019. United States Geological Survey National Water Information System Database, stn.wim.usgs.gov/fev/.
35. Weaver, J.C., Feaster, T.D., and Robbins, J.C., 2016. Preliminary peak stage and streamflow data at selected streamgaging stations in North Carolina and South Carolina for flooding following Hurricane Matthew, October 2016: US Geological Survey Open-File Report 2016-1205, 38: <https://doi.org/10.3133/ofr20161205>

Appendices



Appendix A. Field Data

HYDRAULIC STRUCTURE DATA

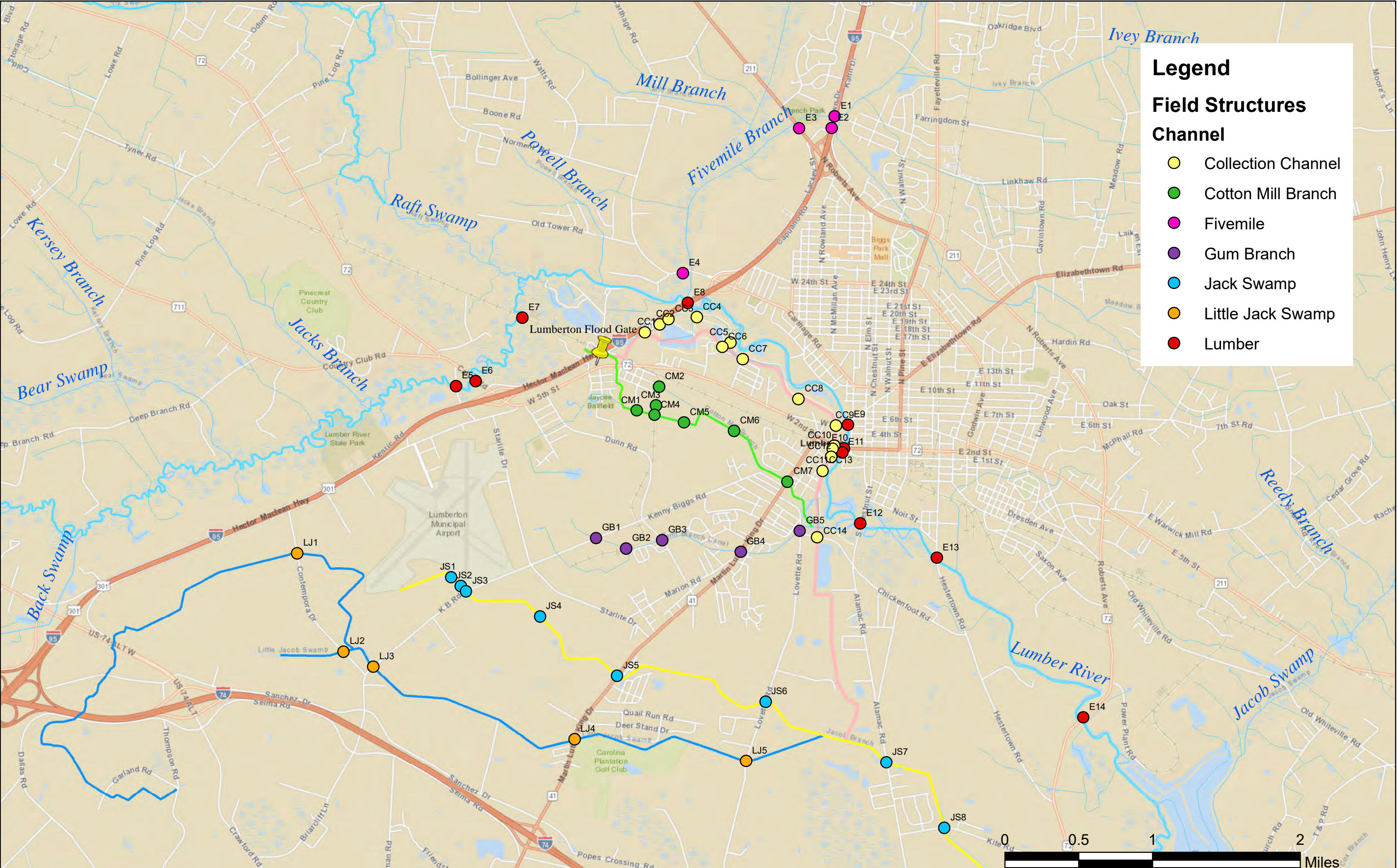
Complete Structure List from Field Data Collection

Label Name	Channel	Street Name	Field Accessible?	Status	Latitude	Longitude	Structure Type	Material	Inlet	Rise	Span	Diameter	# Piers	Culvert Length	Obstruction/Buried
E1	Fivemile Branch	Dawn Dr (next to I-95)		Will be surveyed	34.650605	-79.012221	2RCBC	Concrete		8	10				
E2	Meadow Branch	Dawn Dr (next to I-95)		Will be surveyed	34.649444	-79.012578	2RCBC	Concrete		8	10				
E3	Fivemile Branch	N Roberts Ave (SR 211)		Will be surveyed	34.649424	-79.016424	3RCBC	Concrete		9	14				
E4	Fivemile Branch	W Carthage Rd (SR 1536)		Will be surveyed	34.635177	-79.030266	3RCBC	Concrete		11	14				
E5	Lumber River	Kenric Rd (SR 1539)		Effective	34.624071	-79.057228	Bridge				194.9		2		
E6	Lumber River	S Caton Rd		Effective	34.624567	-79.054882	Bridge				354.9		4		
E7	Lumber River	CSX Railroad	Not accessible	Effective	34.630821	-79.04933	Bridge				350		14		
E8	Lumber River	I-95		Effective	34.632279	-79.029675	2 Bridges						7		
E9	Lumber River	5th Street		Effective	34.620186	-79.010729	Bridge				236.6		5		
E10	Lumber River	W 2nd St		Effective	34.617969	-79.011103	Bridge				282.9		5		
E11	Lumber River	CSX Railroad		Effective	34.617576	-79.011324	Bridge						14		
E12	Lumber River	Alamac Rd (SR 2289)		Effective	34.610595	-79.009171	Bridge				330.5		6		
E13	Lumber River	S Chippewa St/ Hestertown Rd		Will be surveyed	34.607211	-79.000088	Bridge				198		4		
E14	Lumber River	NC HWY 72		Effective	34.591539	-78.982678	Bridge				360.9		7		
E15	Small Trib	NC Hwy 72		Missing	34.584553	-79.986302	Arch Culvert	Aluminum		6.4	26				
L11	Little Jacob Swamp Diversion	Contempora Dr (SR 2513)		Effective	34.607631	-79.076069	Circular Culverts (2)	CMP	Headwall			4.5		60	Look at field sketch; Left = 3.1', Right = 1.8'
L12	Little Jacob Swamp	Contempora Dr (SR 2513)		Effective	34.597965	-79.070544	Circular Culvert	Concrete	Square edge entrance with headwall			5		40	
L13	Little Jacob Swamp	KB Rd (SR 2413)		Effective	34.596479	-79.067027	Circular Culverts (2)	CMP	L @ Mitered to conform to slope; R @ Headwall					60	
L14	Little Jacob Swamp	MLK Dr (NC 41)		Effective	34.589393	-79.043117	Arch (2)	Corrugated Metal	90 degree headwall	7.1	15			60	
L15	Little Jacob Swamp	Lovette Rd (SR 2204)		Effective	34.587254	-79.022739	Arch	Corrugated Metal	90 degree headwall	8	20			40	
J51	Jacob Swamp	Culvert in Field		Missing	34.605287	-79.057754									
J52	Jacob Swamp	Culvert in Field		Missing	34.604426	-79.056623									
J53	Jacob Swamp	KB Rd (SR 2413)		Effective	34.603918	-79.055988	CMP	Corrugated Metal	Thin wall projecting			6		50	
J54	Jacob Swamp	Culvert in Field	Not accessible	Missing	34.601447	-79.047198	Culvert								
J55	Jacob Swamp	MLK Dr (NC 41)		Effective	34.595612	-79.038041	Box Culverts (2)	Concrete	Wingwall flared 30 to 75 deg	4.5	6			40	
J56	Jacob Swamp	Lovette Rd (SR 2204)		Effective	34.59306	-79.020421	Bridge			7.4 to LC	24		0	40	
J57	Jacob Swamp	Alamac Rd (SR 2289)	Not accessible	Effective	34.587111	-79.006068	Bridge								
J58	Jacob Swamp	SR 2305		Effective	34.580668	-78.99918	Bridge			11 to LC	90		1		
J59	Jacob Swamp	Wilmington Hwy (NC 72)		Effective	34.565913	-78.976465	Bridge			14 to LC	90		2		
GB1	Gum Branch	Kenny Biggs Rd (SR 2413)		Missing	34.609149	-79.040569	Elliptical CMP (2)	CMP	90-deg HW	5	8				
GB2	Gum Branch	Railroad	Not accessible	Missing	34.608131	-79.036988	Culvert								
GB3	Gum Branch	Crandlemire Rd		Missing	34.608943	-79.032704	2 CMP	CMP	Stone HW			6			
GB4	Gum Branch	MLK Dr (NC 41)		Missing	34.60779	-79.023378	Arched Bridge			7.3	23.5	5.5		39	
GB4.5	Gum Branch						CMP	CMP							
GB5	Gum Branch	Lovette Rd (SR 2204)		Missing	34.609855	-79.016345	2 Arched CMP	CMP		6	12				
CM1	Cotton Mill Branch	School St		Missing	34.621688	-79.035749	Culvert	Plastic				4			
CM2	Cotton Mill Branch	Railroad	Not accessible	Missing	34.624044	-79.033085	Culvert								
CM3	Cotton Mill Branch	Railroad	Not accessible	Missing	34.622187	-79.033458	Culvert								
CM4	Cotton Mill Branch	Railroad	Not accessible	Missing	34.621246	-79.033609	Culvert								
CM5	Cotton Mill Branch	Culvert in Field	Not accessible	Missing	34.620526	-79.030114	Culvert								
CM6	Cotton Mill Branch	Culvert in Field	Not accessible	Missing	34.619697	-79.024166	Culvert								
CM7	Cotton Mill Branch	MLK Dr (NC 41)		Effective	34.614704	-79.01783	2RCBC	Concrete	Flared WW, Beveled	8	9				
CC1	Collection Canal	Crystal Rd		Missing	34.629362	-79.03478	Pipe Culvert	Concrete	Proj.			2		52	
CC2	Collection Canal	Crystal Rd		Missing	34.630156	-79.033034	Pipe Culvert	Concrete, Open Bottom	3:1 Tapered Inlet, Proj.	3	1			54	
CC3	Collection Canal	Crystal Rd	Obstructed	Missing	34.630653	-79.03194	Culvert								Completely obstructed
CC4	Collection Canal	The Riverwalk (Levee)		Missing	34.630864	-79.028611	Bridge	Aluminum			37.4		0	3	
CC5	Collection Canal	The Riverwalk (Levee)		Missing	34.628388	-79.024622	Arched Bridge	Aluminum		9' to LC	59		0	8.9	
CC6	Collection Canal	Lowery St	Not accessible	Missing	34.62794	-79.025577	Culvert								Outlet Submersed, no inlet found
CC6.5	Collection Canal						Pipe Culvert	Concrete				1.5			Couldn't located inlet
CC7	Collection Canal	The Riverwalk (Levee)		Missing	34.62674	-79.023144	Bridge	Wood			51		2	5.7	
CC8	Collection Canal	The Riverwalk (Levee)		Missing	34.622822	-79.016516	2 Pipes	CMP				4			
CC9.5	Collection Canal						Bridge				41		2	7	
CC9	Collection Canal	W 5th Street		Missing	34.62021	-79.01208	RCP	Concrete	90 degree headwall			6			
CC10	Collection Canal	MLK Dr (NC 41)		Missing	34.618242	-79.012282	Pipe Culvert	CMP	90 degree headwall			7			
CC11	Collection Canal	Railroad	Not accessible	Missing	34.61793	-79.012451	Pipe Culvert	CMP				7			Completely blocked with Sediment
CC12	Collection Canal	Bullard St/ The Riverwalk		Missing	34.617154	-79.012644	2 CMP	CMP	Proj.			4		29.5	
CC12.5	Collection Canal			Missing			RCP	Concrete				3		76	
CC13	Collection Canal	Fig St/ The Riverwalk		Missing	34.615763	-79.013626	Culvert (long)	RCP	Proj.			5/7			
CC14	Collection Canal	Chicken Foot Rd		Missing	34.609231	-79.014287	Arch Culvert	CMP	HW	9	22				

Legend

Field Structures

- Collection Channel
- Cotton Mill Branch
- Fivemile
- Gum Branch
- Jack Swamp
- Little Jack Swamp
- Lumber



HIGH-WATER MARKS DATA



Number	Street Name	Business/Address	Height	Latitude	Longitude	Storm	Notes
1	1451 Lowery St	Lumberton Water Plant	39" from floor	34.626688	-79.024735	Matthew	
2	1451 Lowery St	Lumberton Water Plant Maintenance Building	41" from floor	34.626243	-79.024175	Matthew	
3		Well Site #2 (Park)	42-43" from ground	34.630742	-79.031307	Matthew	
4		VFW Crest by future Flood Gate	36" from crest	34.627654	-79.039719	Florence	
5	2460 Cox Rd	Lift Station #23	85"	34.627352	-79.04139	Florence	Top of barbed wire
6		Steel building by CSX Railroad (by gate location)	36"	34.628221	-79.041324	Florence	
7		Raw Water Intake	120"	34.633669	-79.037256	Matthew; Florence	
8	415 County Club Dr	Lift Station #21		34.626366	-79.058788	Florence	68" from mound to bottom of generator; 40" from ground to mound base
9	2385 Lackey St	Lift Station #25	77"	34.64292	-79.025638	Florence	
10	3621 Dawn Drive	Lift Station #27	66"	34.65168	-79.012432	Florence	
11		Ramada Inn - Lift Station #31	45" from floor	34.647553	-79.010911	Matthew?	

CHANNEL CROSS-SECTION DATA



Legend

- X Survey Backsight
- Levee
- Lumber River

0 0.05 0.1 0.2 0.3 0.4 Miles

Cross Section Data Analysis

Table 1. CC3 Survey Data

Station	BS	HI	FS	Elev
BM	4.36	119.2087		114.8487
0			4.36	114.8487
5			5.99	113.2187
15.5			9.15	110.0587
19			11.8	107.4087
22.5			11.3	107.9087
25.7			8	111.2087
30			5.82	113.3887
33			5.44	113.7687

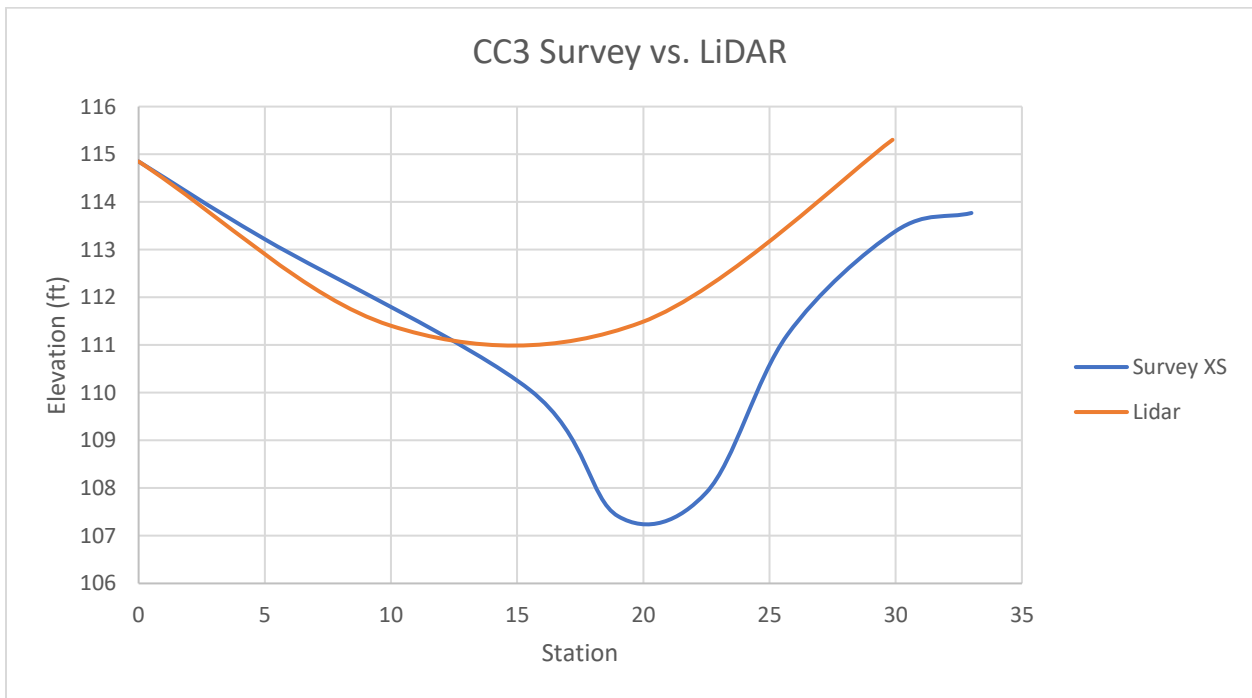


Figure 1. CC3 cross section

Table 2. CC14 Survey Data

Station	BS	HI	FS	Elev
BM	3.39	115.75		112.36
0			3.39	112.36
5			3.79	111.96
13			6.92	108.83
21			13.14	102.61
34			14.35	101.4
48			14.37	101.38
56			10.16	105.59
64			5.71	110.04
75			3.93	111.82

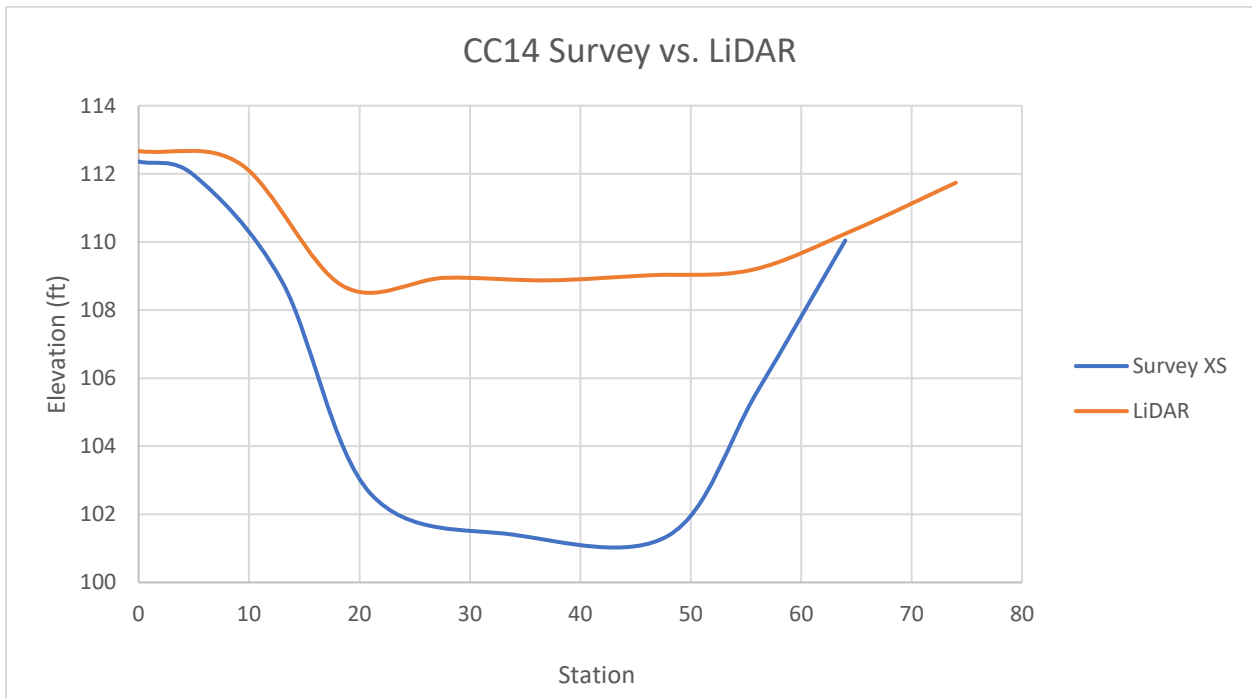


Figure 2. CC14 cross section

Table 3. CM7 Survey Data

Station	BS	HI	FS	Elev
BM	3.35	119.37		116.02
0			4.97	114.4
8			6.03	113.34
13			11.78	107.59
16			12.84	106.53
20			13.4	105.97
22			12.46	106.7
26			12.67	106.9
27.5			12.47	111.07
33			8.3	113.85
37			5.52	114.31
43			5.06	119.37

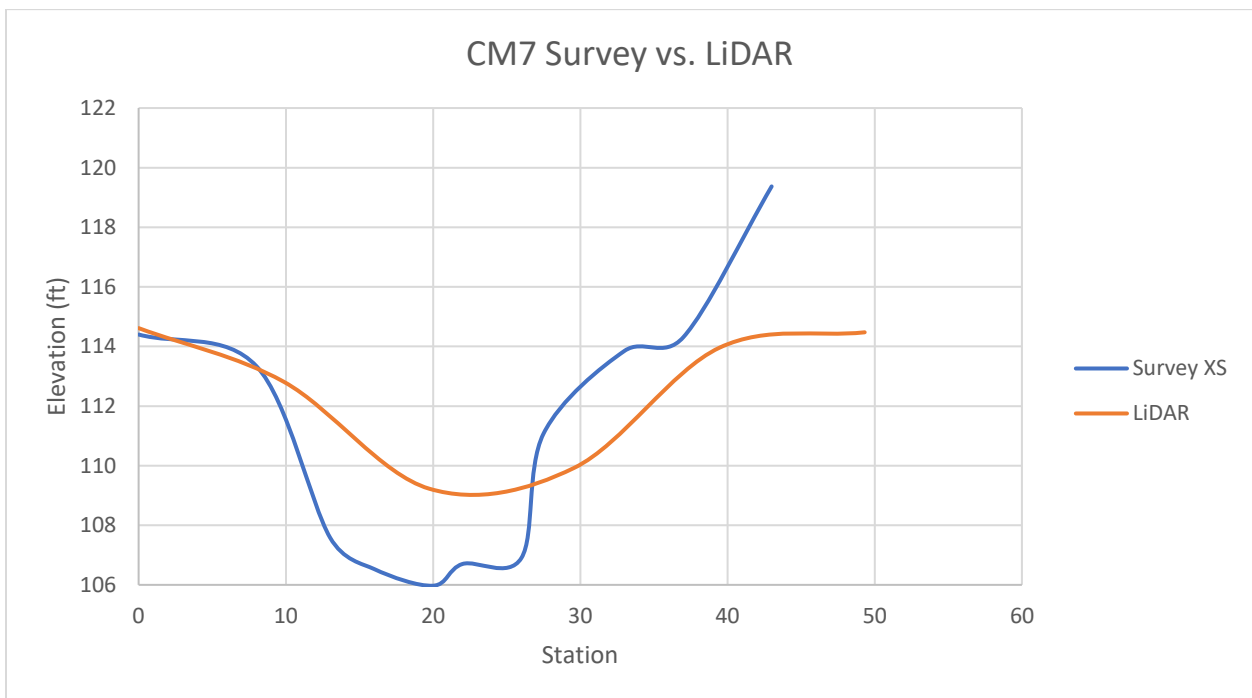


Figure 3. CM7 cross section

Table 4. GB3 Survey Data

Station	BS	HI	FS	Elev
BM	4.52	121.16		116.64
0			5.88	115.28
17			5.64	115.52
25			8.04	113.12
30			11.43	109.73
34.5			12.45	108.71
44			11.69	110.53
48.5			10.63	114.26
53			6.9	114.94
60			6.22	121.16

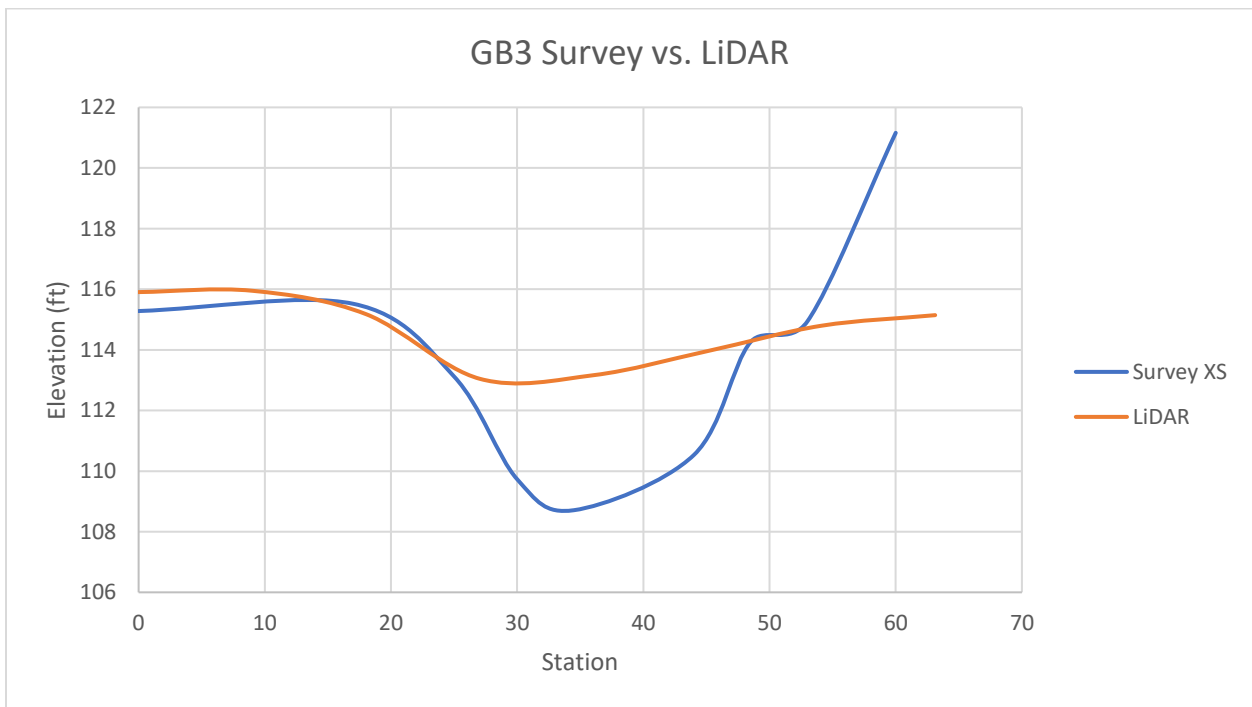


Figure 4. GB3 cross section

Table 5. GB5 Survey Data

Station	BS	HI	FS	Elev
BM	4.48	117.3		112.82
0			6.39	110.91
6			6.76	110.54
11			10.23	107.07
21			12.46	104.84
35			10.4	106.9
42.5			4.32	117.3

not reliable

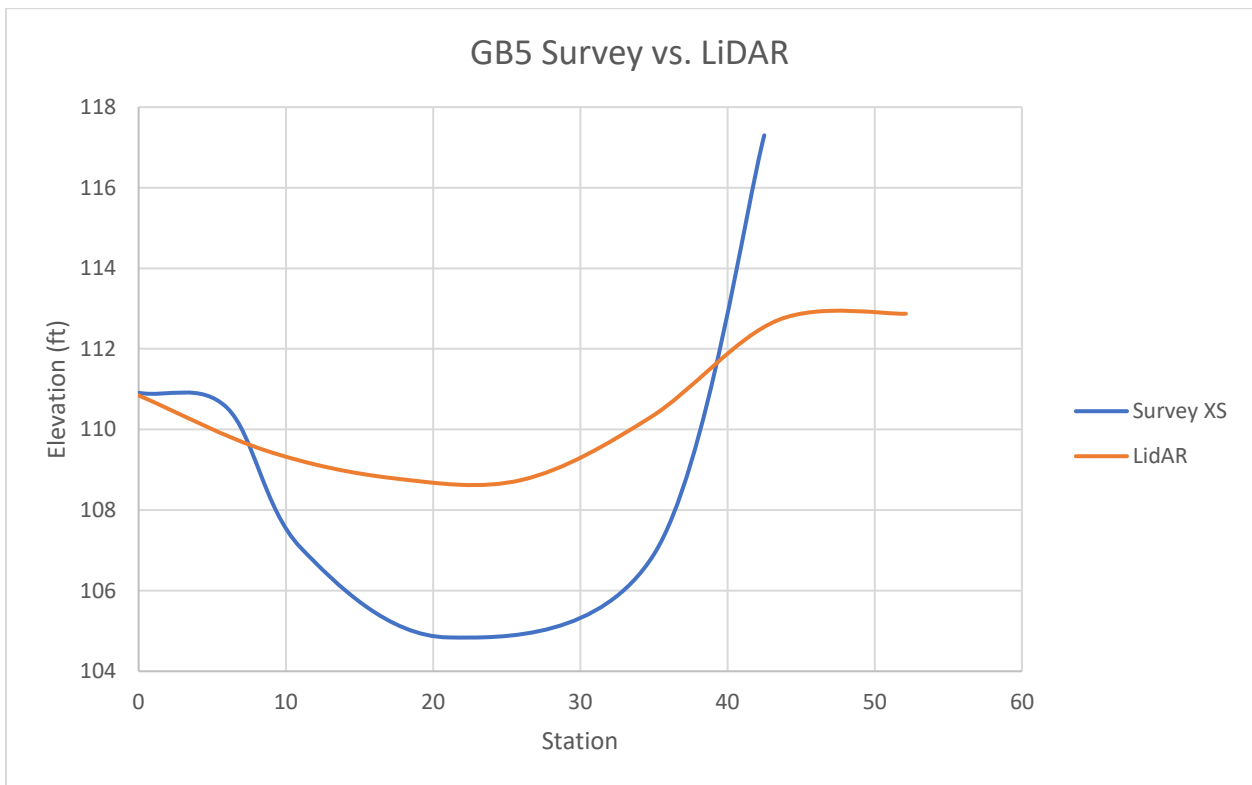


Figure 5. GB5 cross section

Table 6. CM1 Survey Data

Station	BS	HI	FS	Elev
BM	5.42	122.15		116.73
0			6.21	115.94
9			5.89	116.26
13			8.78	113.37
17			10.59	111.56
21			11.67	110.48
27			10.6	111.55
30.5			8.72	113.43
36			5.22	116.93

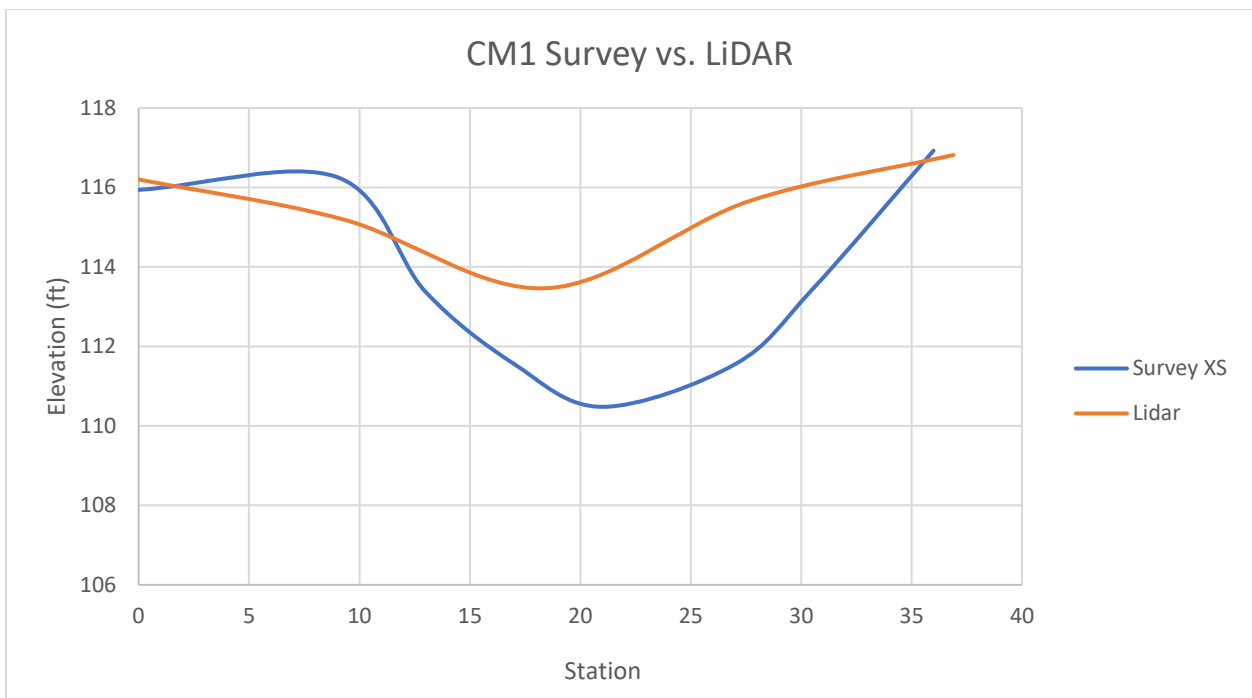


Figure 6. CM1 cross section

Appendix B. Hydrologic Analysis

B1 Rainfall Data and Analysis

Thiessen Polygon Procedure

1. Determine precipitation gage data availability for specific event (see table below)
2. Use a point shapefile with only the available gages to create a set of Thiessen polygons in GIS
3. Determine which polygons overlay the sub-basins
4. If a basin is within two or more polygons, calculate the area in each polygon and its proportion in relation to the sub-basin's total area. This proportion will become the weight
5. For sub-basins that have area-based weights collect the raw data from all rainfall gages being used (polygons falling within). The incremental rainfall for each gage will be multiplied by the appropriate area-based weight. The weighted rainfall from each of the gages utilized will be added across each time interval to get the new weighted rainfall.
6. Any sub-basin that completely falls within one thiessen polygon will use the rainfall gage data from that one gage with no weighting applied

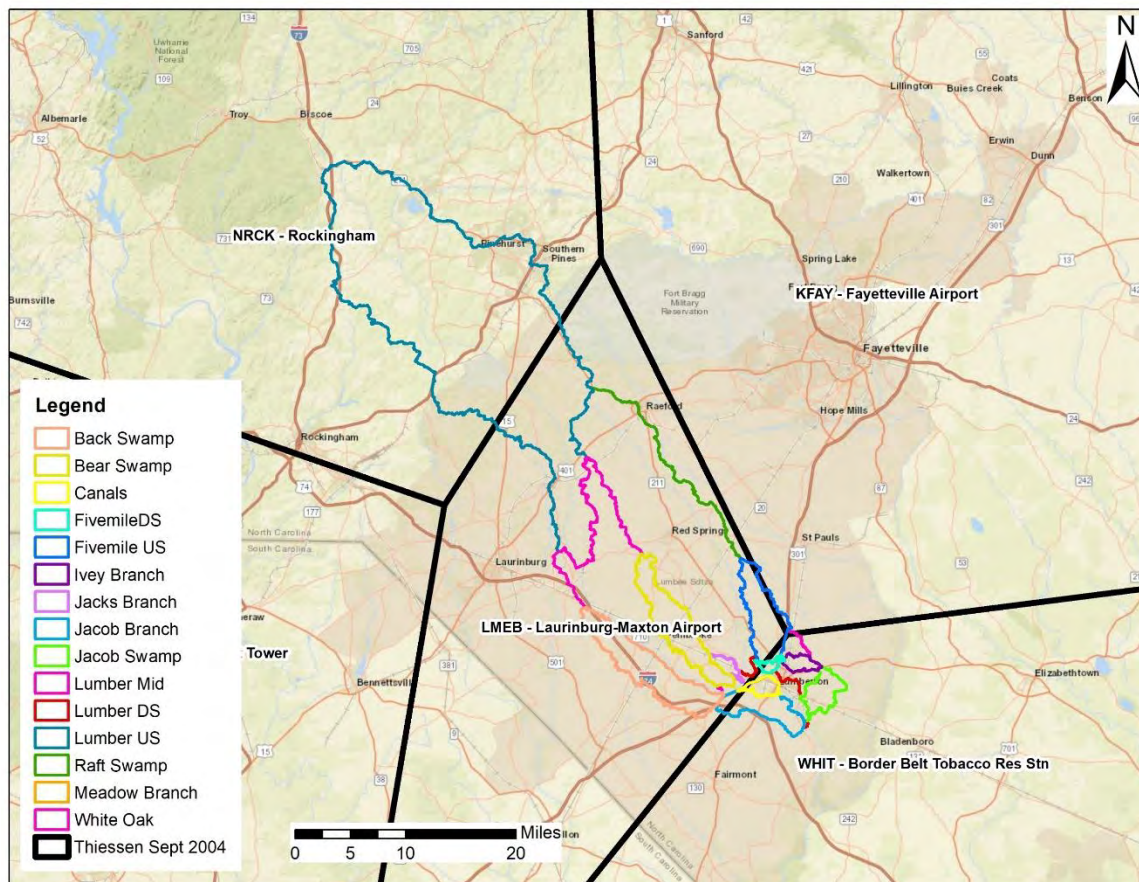
Gage	Sep-04	Oct-15	Oct-16	Sep-18
Fayetteville Airport				
Hamlet				
Jackson Springs				
Laurinburg				
Lilesvile				
Lumberton				
Mackall Airfield				
Moore Airport				
Rockingham				
Troy				
Whiteville				

Event	Gage Rainfall Range (in)
Sept 2004	4.31 – 11.87
Oct 2015	5.74 – 7.40
Oct 2016	8.12 – 12.59
Sept 2018	12.95 – 17.53

Thiessen Weights

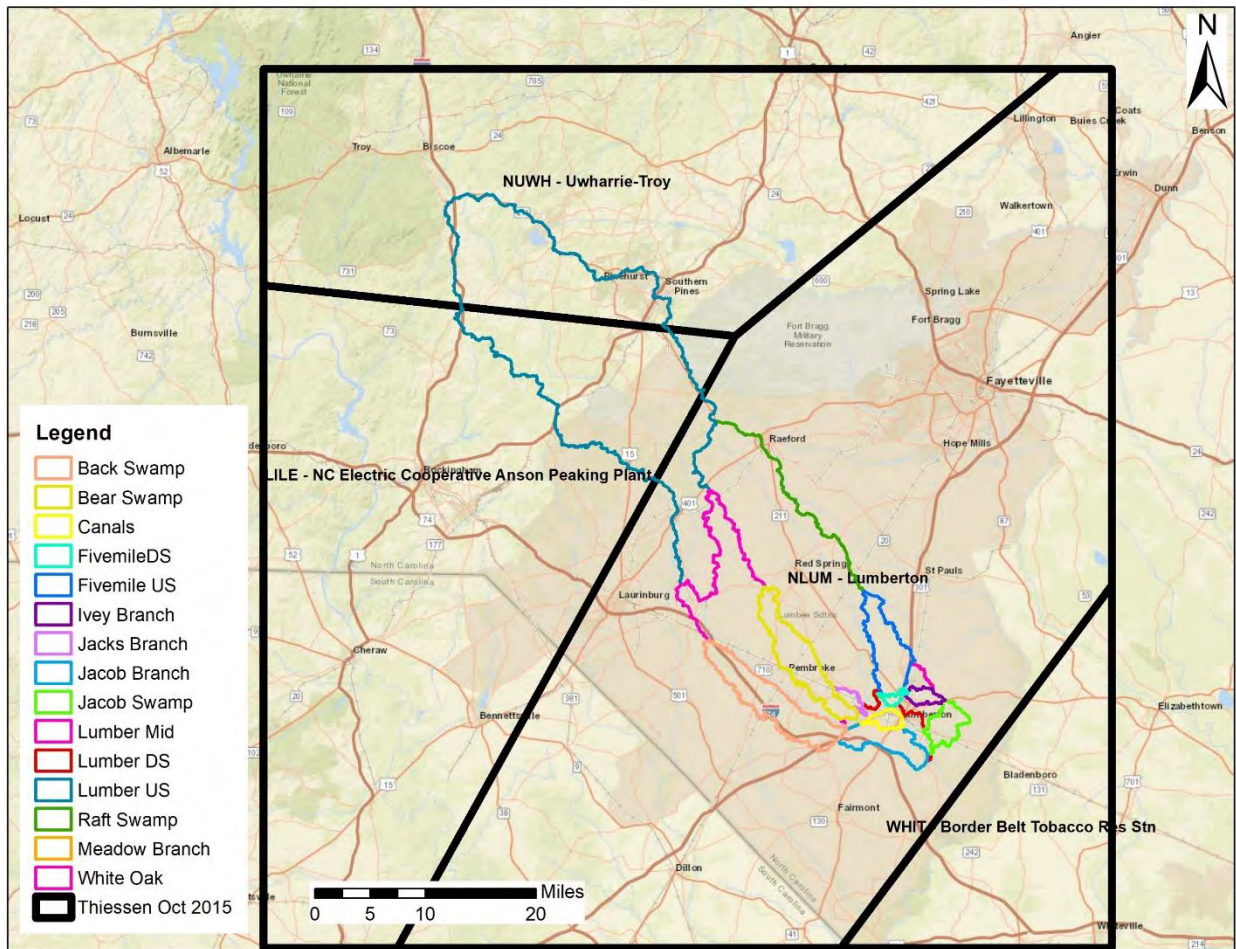
September 2004

Sub-basin	KFAY	KMEB	NRCK	WHIT
Back Swamp	0	1	0	0
Bear Swamp	0	1	0	0
Fivemile DS	0	0.13	0	0.87
Fivemile US	0.08	0.86	0	0.06
Internal Canals	0	0.03	0	0.97
Ivey Branch	0	0	0	1
Jacks Branch	0	1	0	0
Jacob Branch	0	0.14	0	0.86
Jacob Swamp	0	0	0	1
Lumber DS	0	0.32	0	0.68
Lumber Mid	0	1	0	0
Lumber US	0	0.24	0.76	0
Meadow Branch	0	0	0	1
Raft Swamp	0	1	0	0
White Oak	0.05	0	0	0.95



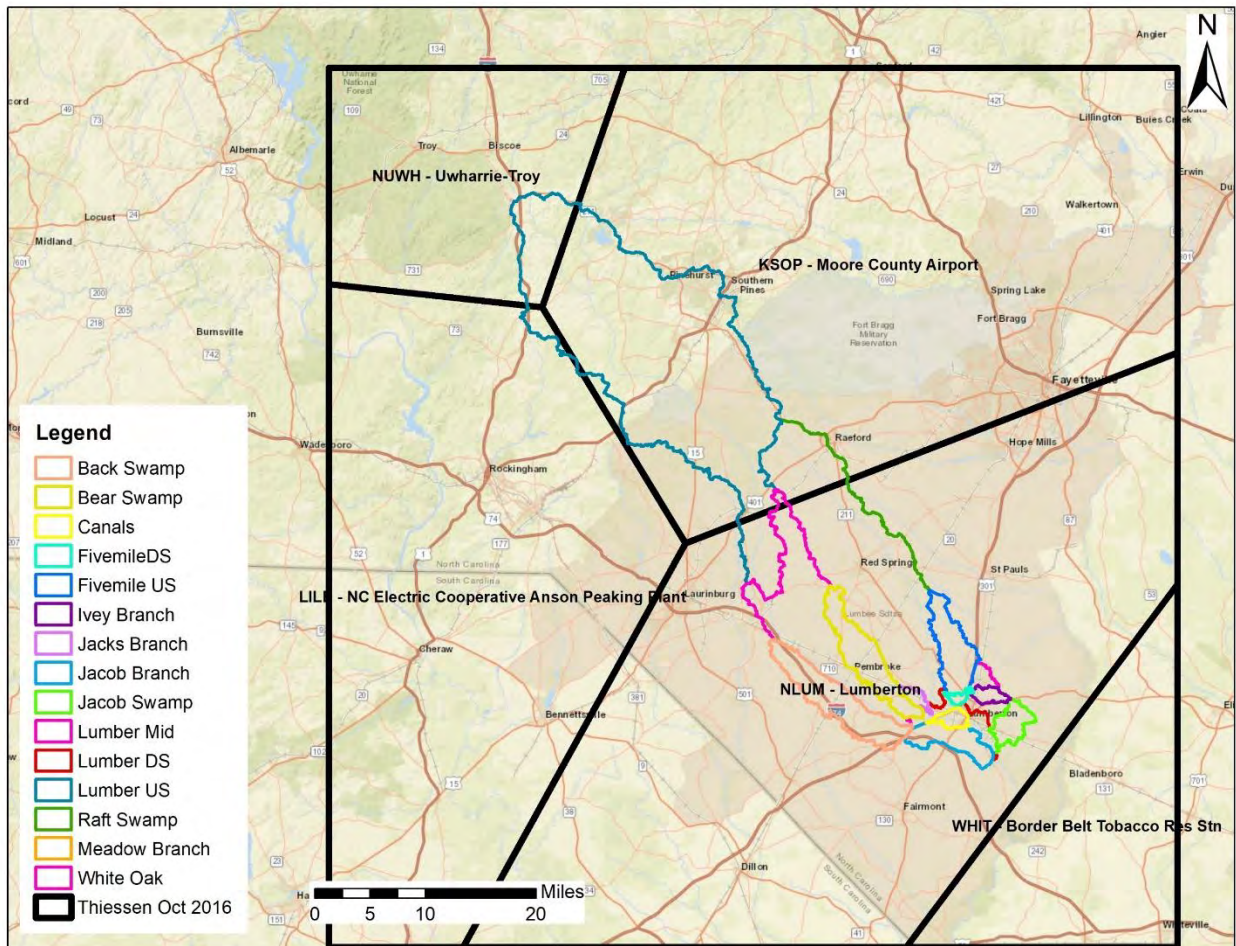
October 2015

Sub-basin	LILE	NLUM	NUWH
Back Swamp	0	1	0
Bear Swamp	0	1	0
Fivemile DS	0	1	0
Fivemile US	0	1	0
Internal Canals	0	1	0
Ivey Branch	0	1	0
Jacks Branch	0	1	0
Jacob Branch	0	1	0
Jacob Swamp	0	1	0
Lumber DS	0	1	0
Lumber Mid	0	1	0
Lumber US	0.5	0.14	0.36
Meadow Branch	0	1	0
Raft Swamp	0	1	0
White Oak	0	1	0



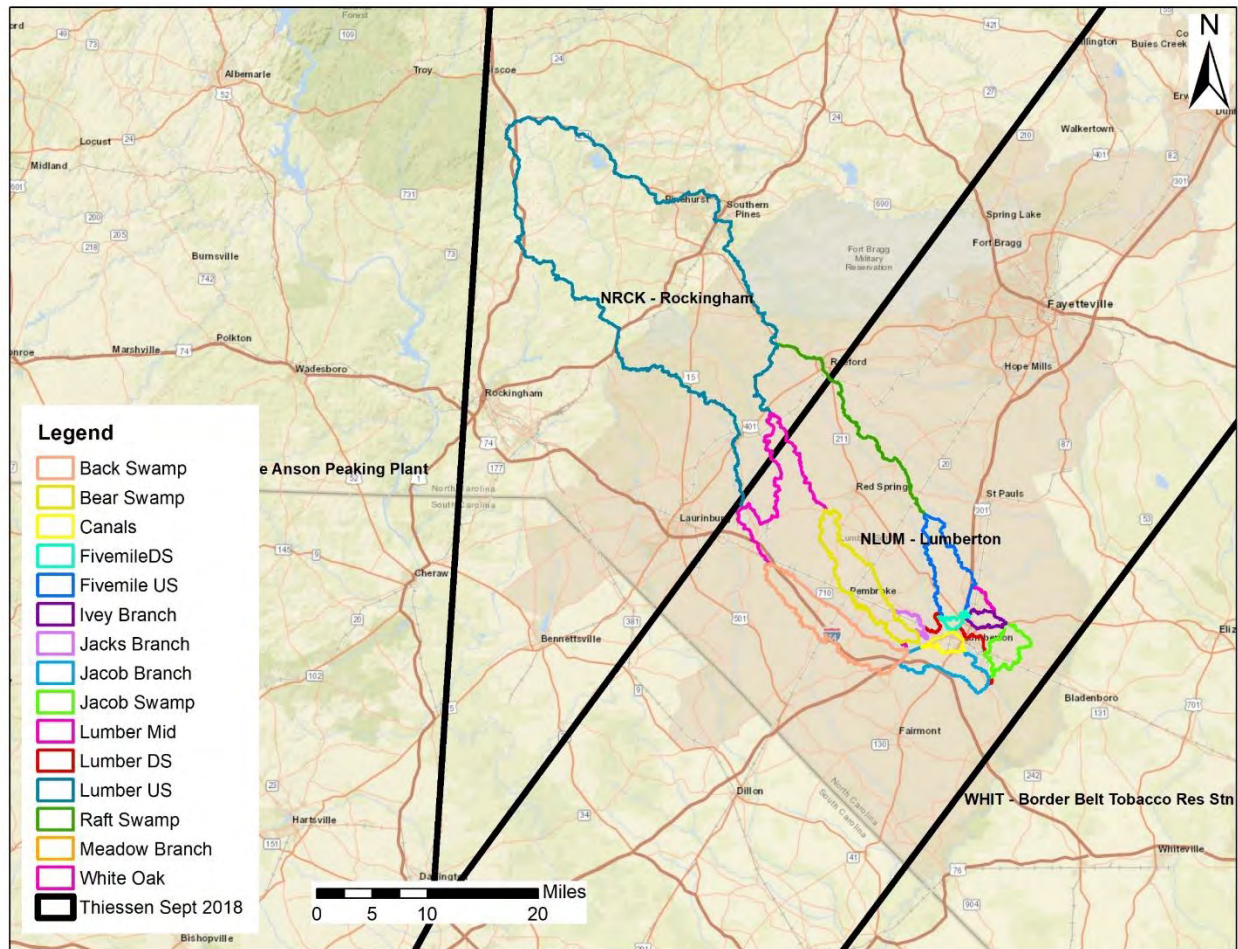
October 2016

Sub-basin	KSOP	LILE	NLUM	NUWH
Back Swamp	0	0	0	0
Bear Swamp	0	0	0	0
Fivemile DS	0	0	0	0
Fivemile US	0	0	0	0
Internal Canals	0	0	0	0
Ivey Branch	0	0	0	0
Jacks Branch	0	0	0	0
Jacob Branch	0	0	0	0
Jacob Swamp	0	0	0	0
Lumber DS	0	0	0	0
Lumber Mid	0.02	0	0.98	0
Lumber US	0.82	0.02	0.06	0.1
Meadow Branch	0	0	0	0
Raft Swamp	0.22	0	0.78	0
White Oak	0	0	0	0



September 2018

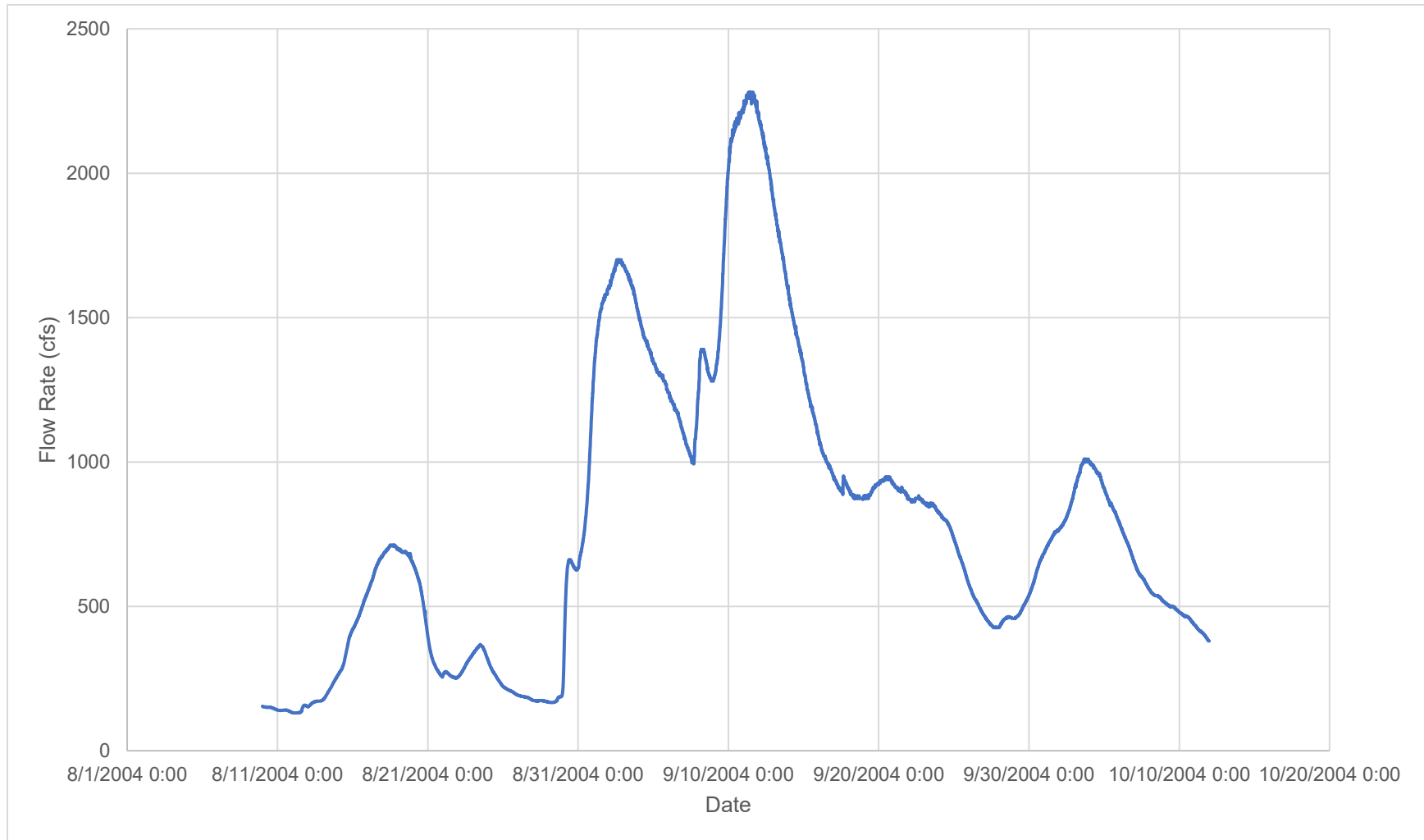
Sub-basin	NLUM	NRCK
Back Swamp	1	0
Bear Swamp	1	0
Fivemile DS	1	0
Fivemile US	1	0
Internal Canals	1	0
Ivey Branch	1	0
Jacks Branch	1	0
Jacob Branch	1	0
Jacob Swamp	1	0
Lumber DS	1	0
Lumber Mid	0.95	0.05
Lumber US	0.03	0.97
Meadow Branch	1	0
Raft Swamp	0.81	0.19
White Oak	1	0



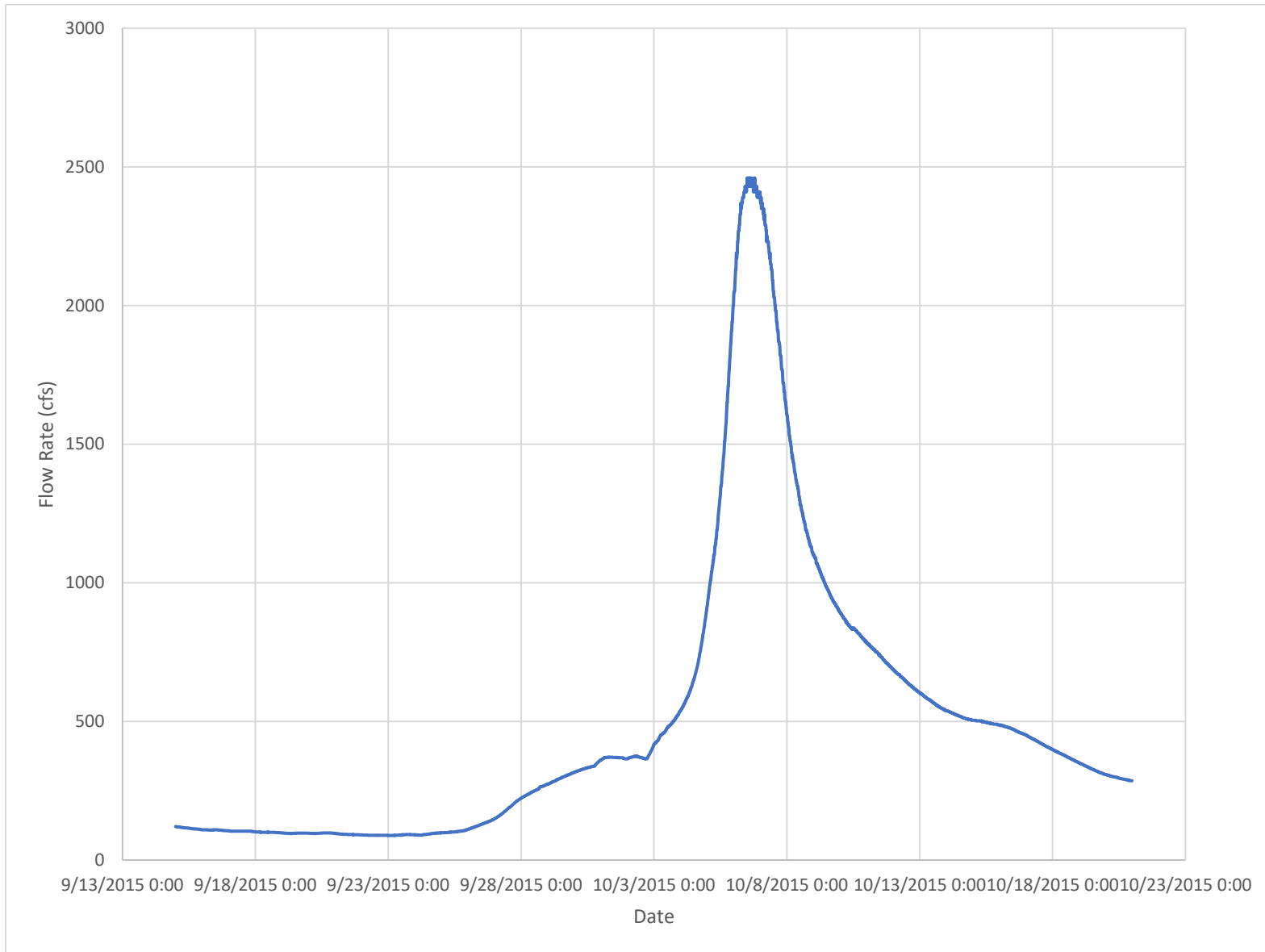
B2 Streamflow Data

USGS 02133624 Lumber River at Maxton, NC

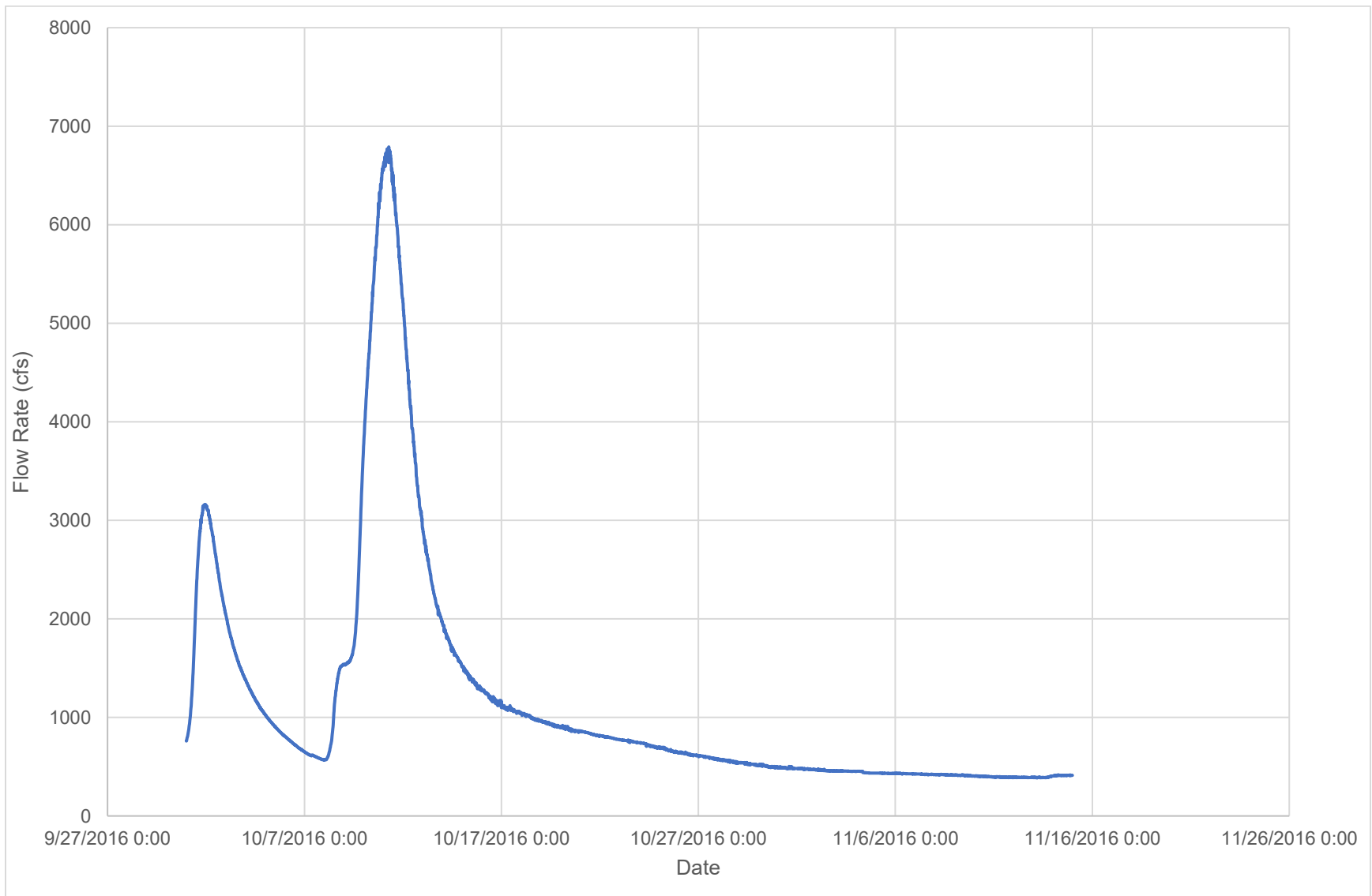
September 2004



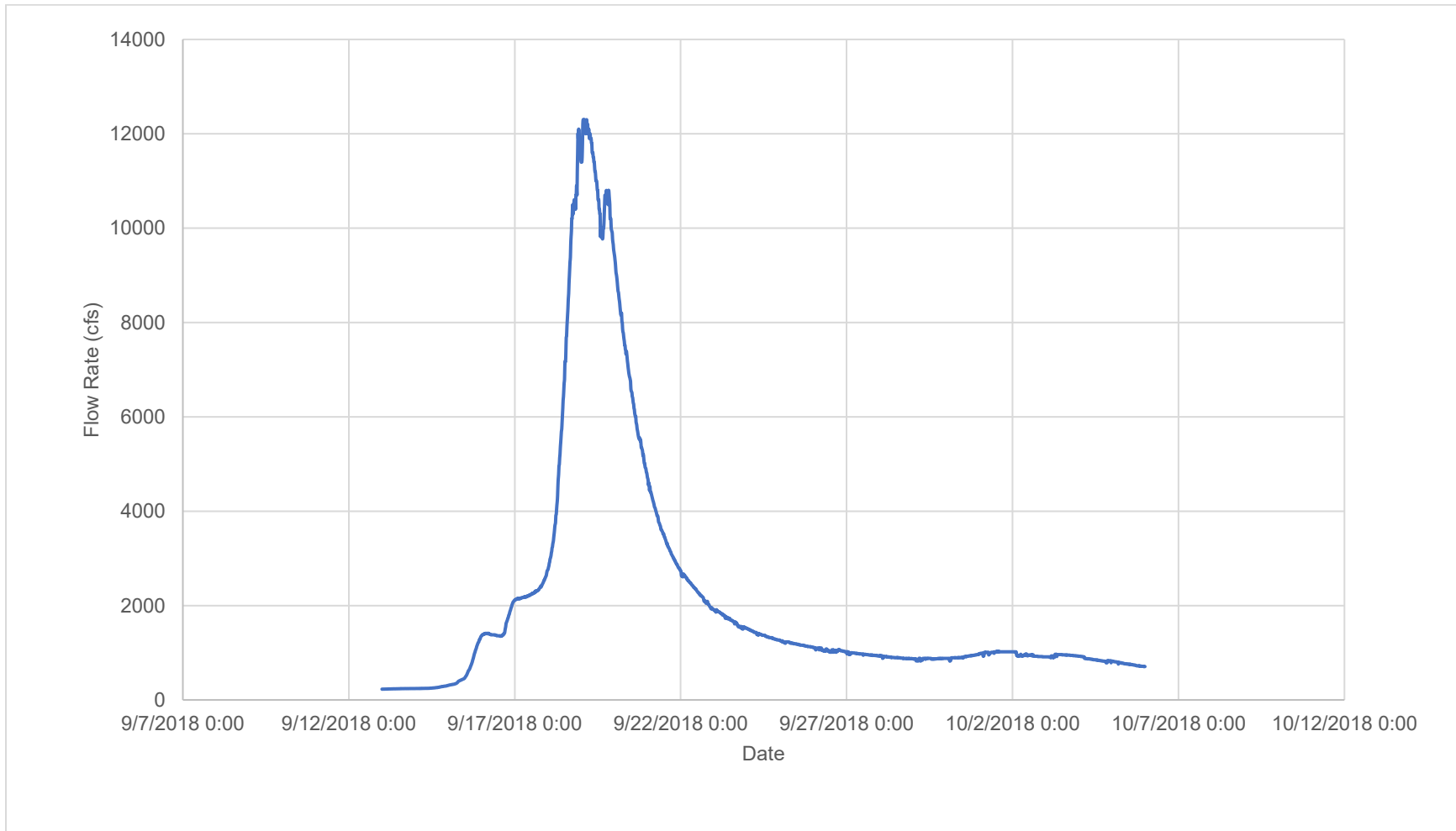
October 2015



October 2016

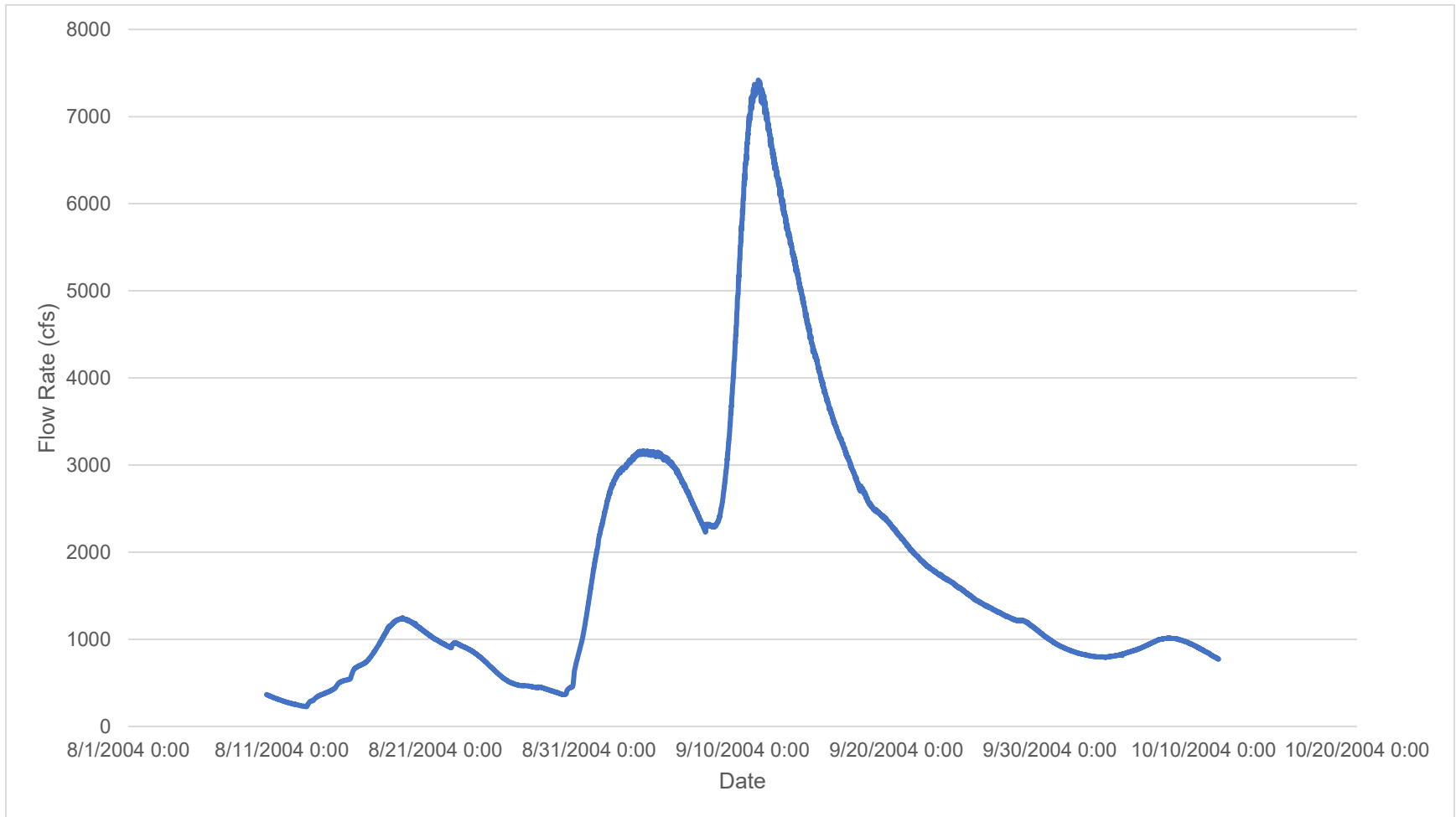


September 2018

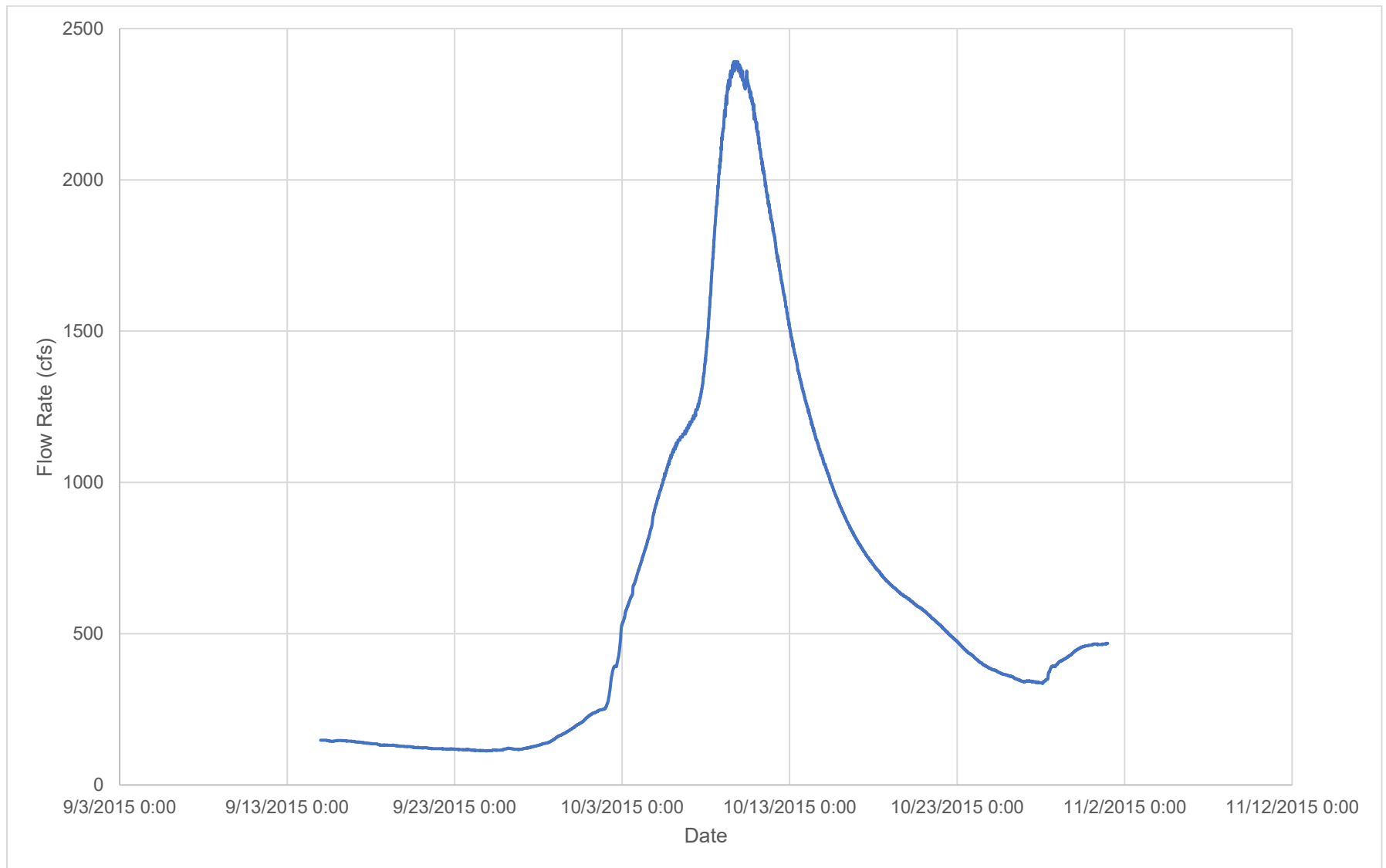


USGS 02134170 Lumber River at Lumberton, NC

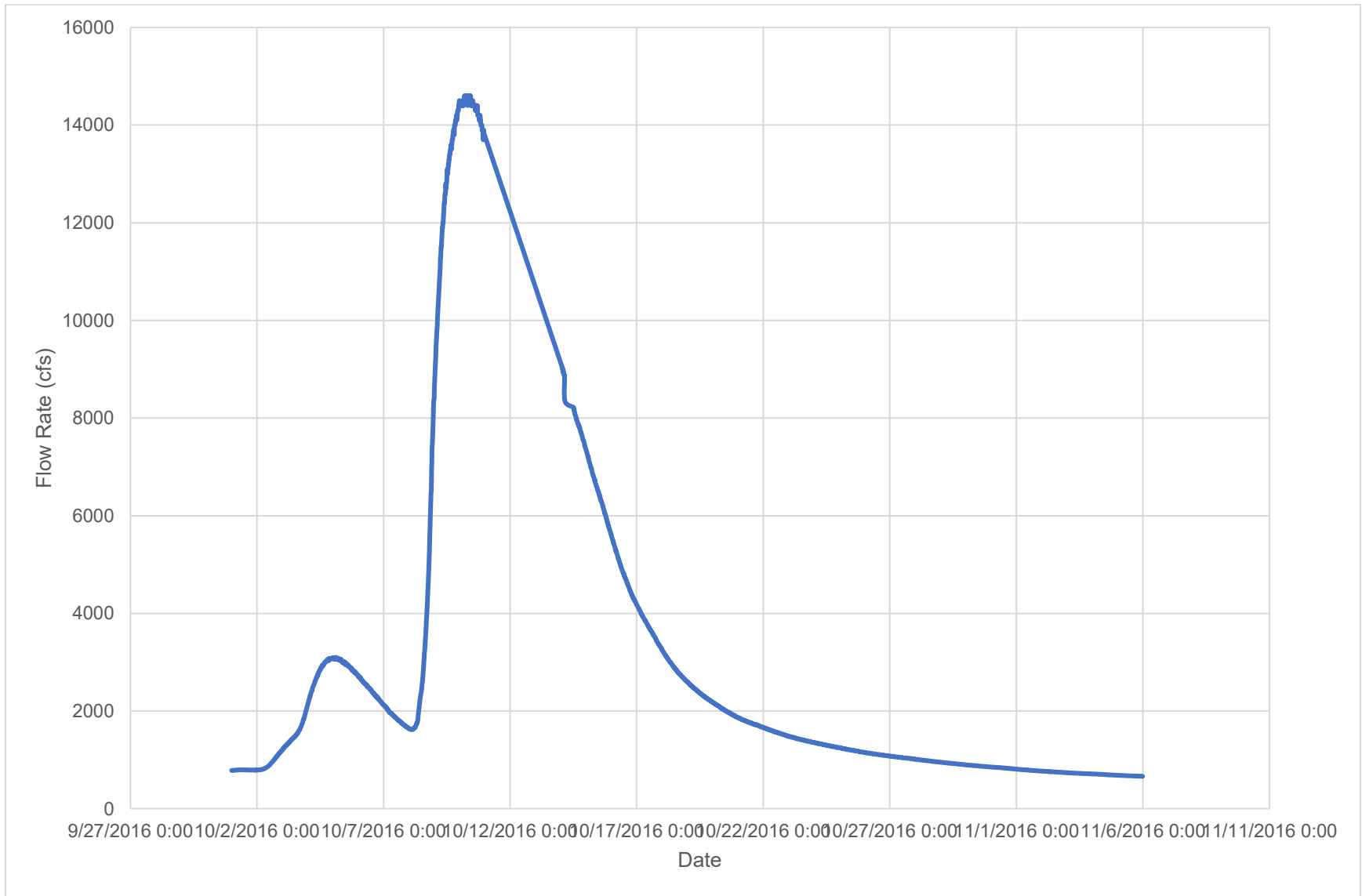
September 2004



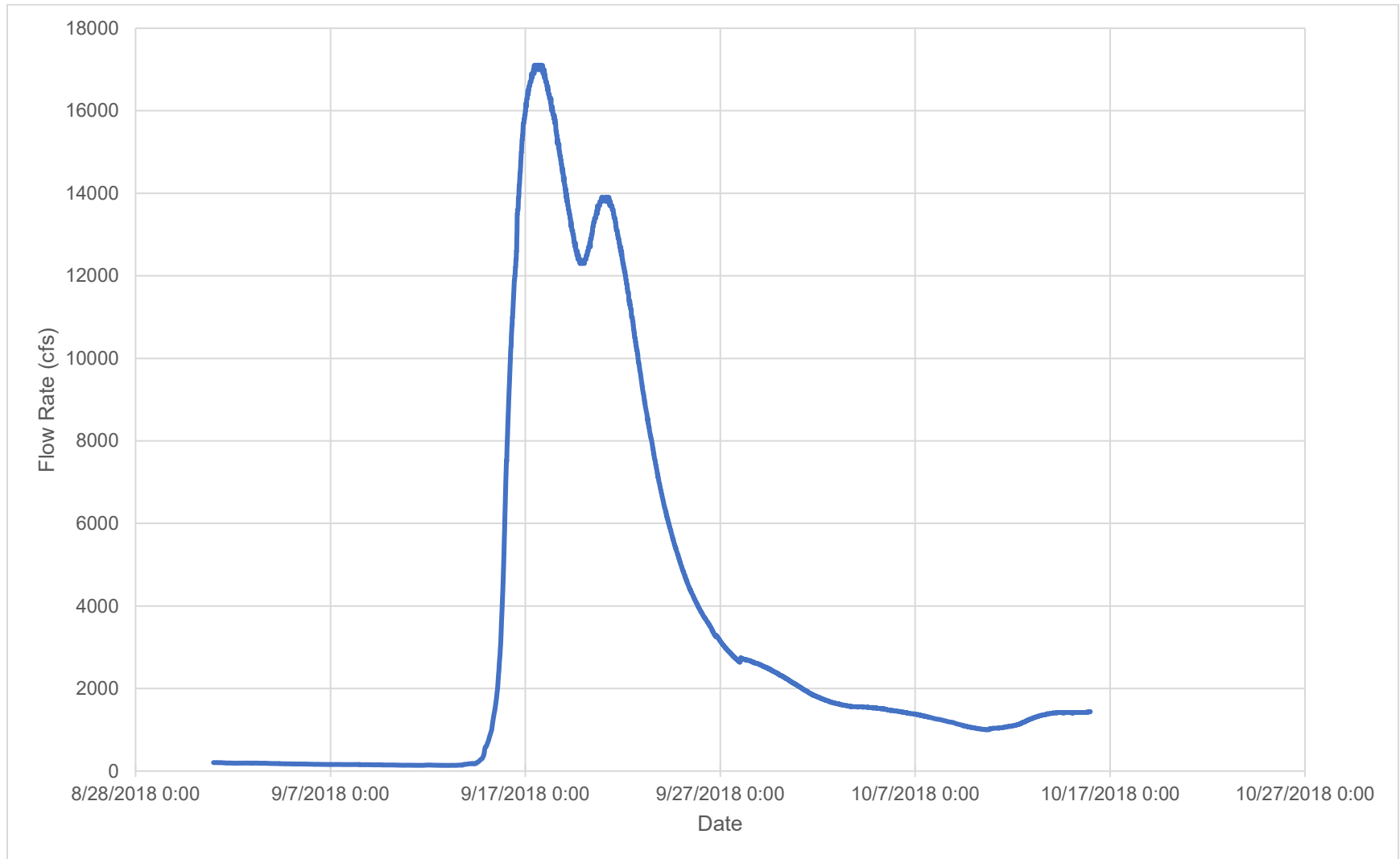
October 2015



October 2016



September 2018



B3 HEC-HMS Model Calibration and Verification Results

HEC-HMS Calibration

Junction 5

Storm	Approx. Return Period (Yrs)	Peak Flowrate (cfs)			Time Date and Time			Notes	Observed volume	Computed Volume	Volume Differential
		Observed	Simulated	% Difference	Observed	Simulated	Difference (hrs)				
Sep 2004		7420	7097.2	-4%	9/11/2004 2:00	9/11/2004 12:00	10		152897	149569	-2%
Oct 2015		2390	2421.1	1%	10/9/2015 15:45	10/9/2015 12:00	-3.75	10/9/2015 18:00	38912	27568	-29%
Sept 2018		17100	17257	1%	9/17/2018 11:00	9/17/2018 11:00	0	Hurricane Florence	230179	229185	-0.4%

Junction 11

Storm	Approx. Return Period (Yrs)	Peak Flowrate (cfs)			Time Date and Time			Notes
		Observed	Simulated	% Difference	Observed	Simulated	Difference (hrs)	
Sep 2004		2280	3438.8	51%	9/11/2004 8:00	9/11/2004 6:00	-2	
Oct 2015		2460	2329.6	-5%	10/6/2015 14:00	10/6/2015 11:00	-3	10/9/2015 18:00
Sept 2018		12300	8281	-33%	9/19/2018 4:00	9/19/2018 11:00	7	Hurricane Florence

Reach 9 Routing 0.0003 0.08 Reach 9 Routing 0.0003 0.08 Reach 9 Routing 0.001 0.03

	Sep-18				Oct-15				Sep-04				AVERAGE		
	Initial Loss	Constant Loss	Ct	Cp	Initial Loss	Constant Loss	Ct	Cp	Initial Loss	Constant Loss	Ct	Cp	Constant Loss	Ct	Cp
Back Swamp		0.15	7	0.4		0.15	7	0.4		0.12	7	0.4	0.14	7	0.40
Bear Swamp		0.15	7	0.4		0.15	7	0.4		0.12	7	0.4	0.14	7	0.40
Fivemile DS		0.05	6	0.4		0.05	7	0.4		0.05	7	0.4	0.05	7	0.40
Fivemile US		0.05	6	0.4		0.05	7	0.4		0.05	7	0.4	0.05	7	0.40
Internal Canals		0.05	6	0.4		0.05	7	0.4		0.05	7	0.4	0.05	7	0.40
Ivey Branch		0.05	6	0.4		0.05	7	0.4		0.05	7	0.4	0.05	7	0.40
Jacks Branch		0.05	6	0.4		0.05	7	0.4		0.05	7	0.4	0.05	7	0.40
Jacob Branch		0.05	6	0.4		0.05	7	0.4		0.05	7	0.4	0.05	7	0.40
Jacob Swamp		0.05	6	0.4		0.05	7	0.4		0.05	7	0.4	0.05	7	0.40
Lumber DS		0.05	6	0.4		0.05	7	0.4		0.05	7	0.4	0.05	7	0.40
Lumber Upper	5	0.14	6	0.8	3.3	0.14	8	0.8	4	0.14	8	0.6	0.14	7	0.73
Lumber Mid		0.15	8	0.4		0.15	8	0.4		0.12	8	0.4	0.14	8	0.40
Meadow Branch		0.05	6	0.4		0.05	7	0.4		0.05	7	0.4	0.05	7	0.40
Raft Swamp		0.18	8	0.4		0.18	8	0.4		0.2	8	0.4	0.19	8	0.40
White Oak		0.05	6	0.4		0.05	7	0.4		0.05	7	0.4	0.05	7	0.40

HEC-HMS Design Storm Comparison

Recurrence Interval (Yrs)	SCS-24HR	SCS-48HR	SCS-72HR	SCS 24HR		SCS-48HR		SCS-72HR			
	Simulated Peak Flow (cfs)			FEMA Peakflows(cfs)	Gage Statistics (cfs)	% Diff_FEMA	% Diff_Gage	% Diff_FEMA	% Diff_Gage	% Diff_FEMA	% Diff_Gage
10	5,334	5,506	5,520	8,150	7,255	-53%	-36%	-48%	-32%	-48%	-31%
25	6,991	7,191	7,204	10,700	9,852	-53%	-41%	-49%	-37%	-49%	-37%
50	8,451	9,683	10,569	12,800	12,080	-51%	-43%	-32%	-25%	-21%	-14%
100	10,103	13,141	13,993	14,900	14,560	-47%	-44%	-13%	-11%	-6%	-4%
500	18,720	22,105	23,025	20,200	21,520	-8%	-15%	9%	3%	12%	7%
1000	22,920	26,991	27,634								

NOAA Partial - 48HR

Recurrence Interval (Yrs)	Simulated Peak Flow (cfs)	FEMA Peakflows(cfs)	Gage Statistics (cfs)	% Diff_FEMA	% Diff_Gage
10	5,661	8,150	7,255	-44%	-28%
25	7,030	10,700	9,852	-52%	-40%
50	8,487	12,800	12,080	-51%	-42%
100	10,665	14,900	14,560	-40%	-37%
500	19,333	20,200	21,520	-4%	-11%
1000	23,977				

HEC-HMS Verification

Storm	Approx. Return Period (Yrs)	Peak Flowrate (cfs)			Time Date and Time			Notes	Observed volume	Computed Volume	Volume Differential
		Observed	Simulated	% Difference	Observed	Simulated	Difference (hrs)				
Oct 2016		14600	16551.3	13%	10/10/16 7:00	10/10/16 10:00	3	Hurricane Matthew	223956	197598	-12%

Sub-basin Snyder Characteristics

Subbasin	L (mi)	Lc (mi)
Back Swamp	17.61	8.39
Bear Swamp	17.94	8.66
Fivemile DS	2.48	0.98
Fivemile US	12.49	4.67
Internal Canals	5.31	1.85
Ivey Branch	4.17	1.69
Jacks Branch	8.21	4.85
Jacob Branch	10.5	4.59
Jacob Swamp	7.32	3.33
Lumber DS	18.84	9.34
Lumber US	101.36	68.64
Meadow Branch	5.21	2.57
Raft Swamp	35.77	18.55
White Oak	3.87	1.69

B4 Curve Number Calculations

Sub-basin Curve Number

Sub-basin	Basin Area (sq. mi)	Good Conditions Composite CN
Back Swamp	35.09	85.7
Bear Swamp	28.39	83.1
Fivemile DS	1.71	82.8
Fivemile US	22.14	81.7
Lumberton Canals	3.88	83.2
Ivey Branch	3.76	79.4
Jacks Branch	3	82.2
Jacob Branch	15.28	85.2
Jacob Swamp	9.61	79.9
Lumber DS	10.15	84.3
Lumber Mid	73.54	82.9
Lumber US	365.27	62.1
Meadow Branch	4.94	78
Raft Swamp	167.02	78.9
White Oak	3.73	79.6

Back Swamp

Existing Landuse Conditions													
LUCODE	Land Use Descriptions	CN for Soil Type A			CN for Soil Type B			CN for Soil Type C			CN for Soil Type D		
		Area (ac)	Area (%)	CN	Area (ac)	Area (%)	CN	Area (ac)	Area (%)	CN	Area (ac)	Area (%)	CN
11	Open Water	58.5	2.5	100	16.3	0.9	100	89.0	1.7	100	284.7	2.2	100
21	Developed, Open Space	269.1	11.4	49	167.6	9.4	69	441.5	8.2	79	742.4	5.7	84
22	Developed, Low Intensity	133.1	5.6	54	103.0	5.8	70	242.6	4.5	80	376.9	2.9	85
23	Developed, Medium Intensity	38.9	1.6	61	31.2	1.7	75	71.1	1.3	83	90.5	0.7	87
24	Developed, High Intensity	3.4	0.1	77	0.2	0.0	85	7.2	0.1	90	12.0	0.1	92
31	Barren Land	1.7	0.1	77	1.0	0.1	86	1.1	0.0	91	1.3	0.0	94
41	Deciduous Forest	60.3	2.5	36	11.5	0.6	60	205.3	3.8	73	334.7	2.6	79
42	Evergreen Forest	150.5	6.4	36	99.7	5.6	60	766.1	14.3	73	1589.9	12.3	79
43	Mixed Forest	13.4	0.6	36	3.9	0.2	60	39.3	0.7	73	98.7	0.8	79
52	Shrub/Scrub	54.9	2.3	35	19.4	1.1	56	194.5	3.6	70	331.9	2.6	77
71	Grassland/Herbaceous	5.5	0.2	30	7.0	0.4	58	19.3	0.4	71	40.4	0.3	78
81	Pasture/Hay	4.2	0.2	39	0.0	0.0	61	4.7	0.1	74	3.1	0.0	80
82	Cultivated Crops	1230.2	52.0	67	1193.8	66.7	78	2323.4	43.3	85	4176.3	32.3	89
90	Woody Wetlands	341.3	14.4	100	132.4	7.4	100	946.4	17.6	100	4789.2	37.0	100
95	Emergent Herbaceous Wetlands	1.1	0.0	100	2.6	0.1	100	16.0	0.3	100	63.9	0.5	100
Total		2365.9	100.0	65.9	1789.6	100.0	77.0	5367.6	100.0	84.3	12936.0	100.0	91.0
Weighted Average CN =		85.7											

Bear Swamp

Existing Landuse Conditions													
LUCODE	Land Use Descriptions	CN for Soil Type A			CN for Soil Type B			CN for Soil Type C			CN for Soil Type D		
		Area (ac)	Area (%)	CN	Area (ac)	Area (%)	CN	Area (ac)	Area (%)	CN	Area (ac)	Area (%)	CN
11	Open Water	7.9	0.2	100	0.0	0.0	100	0.0	0.0	100	55.1	0.5	100
21	Developed, Open Space	364.5	8.4	49	288.3	10.4	69	7.5	9.1	79	822.1	7.5	84
22	Developed, Low Intensity	130.1	3.0	54	135.8	4.9	70	2.6	3.2	80	348.8	3.2	85
23	Developed, Medium Intensity	34.1	0.8	61	31.5	1.1	75	0.2	0.3	83	145.5	1.3	87
24	Developed, High Intensity	8.0	0.2	77	18.9	0.7	85	0.0	0.0	90	33.8	0.3	92
31	Barren Land	0.0	0.0	77	0.0	0.0	86	0.0	0.0	91	0.0	0.0	94
41	Deciduous Forest	29.0	0.7	36	8.5	0.3	60	1.4	1.7	73	62.0	0.6	79
42	Evergreen Forest	151.9	3.5	36	183.8	6.6	60	5.1	6.2	73	881.4	8.1	79
43	Mixed Forest	6.1	0.1	36	8.3	0.3	60	1.0	1.2	73	28.9	0.3	79
52	Shrub/Scrub	36.1	0.8	35	45.4	1.6	56	2.4	2.9	70	146.3	1.3	77
71	Grassland/Herbaceous	5.2	0.1	30	6.8	0.2	58	0.0	0.0	71	23.8	0.2	78
81	Pasture/Hay	0.0	0.0	39	0.0	0.0	61	0.0	0.0	74	0.2	0.0	80
82	Cultivated Crops	3052.5	70.1	67	1846.5	66.5	78	53.7	65.5	85	4830.1	44.2	89
90	Woody Wetlands	525.6	12.1	100	200.7	7.2	100	7.2	8.7	100	3528.8	32.3	100
95	Emergent Herbaceous Wetlands	3.4	0.1	100	0.2	0.0	100	0.9	1.1	100	29.4	0.3	100
Total		4354.4	100.0	67.5	2774.8	100.0	76.6	82.0	100.0	84.2	10936.2	100.0	91.0
Weighted Average CN =		83.1											

Lumberton Canals

Existing Landuse Conditions													
LUCODE	Land Use Descriptions	CN for Soil Type A			CN for Soil Type B			CN for Soil Type C			CN for Soil Type D		
		Area (ac)	Area (%)	CN	Area (ac)	Area (%)	CN	Area (ac)	Area (%)	CN	Area (ac)	Area (%)	CN
11	Open Water	2.1	1.2	100	1.0	1.3	100	15.1	1.4	100	85.0	7.3	100
21	Developed, Open Space	27.1	16.1	49	13.3	17.0	69	220.3	20.6	79	233.6	20.0	84
22	Developed, Low Intensity	32.4	19.2	54	12.6	16.2	70	258.0	24.2	80	151.2	13.0	85
23	Developed, Medium Intensity	19.1	11.4	61	14.7	18.8	75	174.4	16.3	83	57.3	4.9	87
24	Developed, High Intensity	7.3	4.4	77	8.0	10.3	85	81.7	7.7	90	13.5	1.2	92
31	Barren Land	0.0	0.0	77	0.0	0.0	86	0.0	0.0	91	0.0	0.0	94
41	Deciduous Forest	1.1	0.7	36	0.0	0.0	60	1.7	0.2	73	8.4	0.7	79
42	Evergreen Forest	30.7	18.2	36	0.1	0.1	60	86.6	8.1	73	123.9	10.6	79
43	Mixed Forest	0.0	0.0	36	0.0	0.0	60	0.0	0.0	73	0.7	0.1	79
52	Shrub/Scrub	15.2	9.0	35	0.0	0.0	56	8.5	0.8	70	24.5	2.1	77
71	Grassland/Herbaceous	0.0	0.0	30	0.0	0.0	58	0.5	0.0	71	7.6	0.6	78
81	Pasture/Hay	4.4	2.6	39	0.0	0.0	61	0.0	0.0	74	0.5	0.0	80
82	Cultivated Crops	19.1	11.4	67	28.2	36.0	78	197.3	18.5	85	234.9	20.1	89
90	Woody Wetlands	9.9	5.9	100	0.3	0.3	100	23.4	2.2	100	224.8	19.3	100
95	Emergent Herbaceous Wetlands	0.0	0.0	100	0.0	0.0	100	0.1	0.0	100	1.0	0.1	100
Total		168.5	100.0	54.2	78.2	100.0	75.7	1067.6	100.0	82.0	1166.9	100.0	88.9
Weighted Average CN =		83.2											

Fivemile DS

Existing Landuse Conditions													
LUCODE	Land Use Descriptions	CN for Soil Type A			CN for Soil Type B			CN for Soil Type C			CN for Soil Type D		
		Area (ac)	Area (%)	CN	Area (ac)	Area (%)	CN	Area (ac)	Area (%)	CN	Area (ac)	Area (%)	CN
11	Open Water	0.7	0.2	100	0.0	0.0	100	0.0	0.0	100	18.1	3.0	100
21	Developed, Open Space	36.1	9.8	49	11.1	16.9	69	6.2	10.2	79	47.0	7.9	84
22	Developed, Low Intensity	23.0	6.2	54	5.0	7.6	70	4.9	8.0	80	23.7	4.0	85
23	Developed, Medium Intensity	11.6	3.1	61	9.7	14.8	75	24.6	40.3	83	23.2	3.9	87
24	Developed, High Intensity	3.5	0.9	77	3.4	5.1	85	8.0	13.1	90	6.7	1.1	92
31	Barren Land	0.0	0.0	77	0.0	0.0	86	0.0	0.0	91	0.0	0.0	94
41	Deciduous Forest	0.0	0.0	36	1.1	1.7	60	0.0	0.0	73	3.9	0.7	79
42	Evergreen Forest	19.9	5.4	36	9.7	14.8	60	6.8	11.2	73	33.2	5.6	79
43	Mixed Forest	0.1	0.0	36	0.0	0.0	60	0.3	0.5	73	5.9	1.0	79
52	Shrub/Scrub	3.8	1.0	35	0.1	0.1	56	0.7	1.1	70	9.8	1.6	77
71	Grassland/Herbaceous	0.0	0.0	30	0.0	0.0	58	0.0	0.0	71	0.0	0.0	78
81	Pasture/Hay	0.0	0.0	39	0.0	0.0	61	0.0	0.0	74	0.0	0.0	80
82	Cultivated Crops	227.8	61.8	67	12.7	19.3	78	5.6	9.2	85	109.0	18.2	89
90	Woody Wetlands	41.1	11.1	100	12.9	19.7	100	3.9	6.4	100	311.7	52.1	100
95	Emergent Herbaceous Wetlands	1.3	0.4	100	0.0	0.0	100	0.0	0.0	100	5.6	0.9	100
Total		368.9	100.0	66.2	65.7	100.0	77.1	61.0	100.0	83.2	597.8	100.0	93.7
Weighted Average CN =		82.8											

Fivemile US

Existing Landuse Conditions													
LUCODE	Land Use Descriptions	CN for Soil Type A			CN for Soil Type B			CN for Soil Type C			CN for Soil Type D		
		Area (ac)	Area (%)	CN	Area (ac)	Area (%)	CN	Area (ac)	Area (%)	CN	Area (ac)	Area (%)	CN
11	Open Water	8.4	0.2	100	0.0	0.0	100	0.0	0.0	100	32.4	0.4	100
21	Developed, Open Space	446.2	11.3	49	116.7	6.1	69	30.3	16.5	79	362.0	4.5	84
22	Developed, Low Intensity	215.3	5.4	54	46.0	2.4	70	20.0	10.9	80	147.3	1.8	85
23	Developed, Medium Intensity	64.0	1.6	61	16.6	0.9	75	18.7	10.2	83	52.4	0.6	87
24	Developed, High Intensity	21.7	0.5	77	6.2	0.3	85	1.0	0.5	90	6.2	0.1	92
31	Barren Land	0.4	0.0	77	0.0	0.0	86	0.0	0.0	91	0.0	0.0	94
41	Deciduous Forest	26.7	0.7	36	17.2	0.9	60	1.3	0.7	73	92.8	1.1	79
42	Evergreen Forest	279.7	7.1	36	300.8	15.8	60	12.3	6.7	73	1223.9	15.1	79
43	Mixed Forest	4.2	0.1	36	4.3	0.2	60	0.0	0.0	73	24.9	0.3	79
52	Shrub/Scrub	68.9	1.7	35	27.2	1.4	56	4.0	2.2	70	162.9	2.0	77
71	Grassland/Herbaceous	11.8	0.3	30	39.7	2.1	58	2.6	1.4	71	30.0	0.4	78
81	Pasture/Hay	8.4	0.2	39	0.0	0.0	61	0.0	0.0	74	6.7	0.1	80
82	Cultivated Crops	2393.1	60.5	67	1091.3	57.4	78	57.6	31.4	85	2662.2	32.9	89
90	Woody Wetlands	403.8	10.2	100	227.6	12.0	100	35.0	19.0	100	3230.7	39.9	100
95	Emergent Herbaceous Wetlands	3.7	0.1	100	7.2	0.4	100	1.0	0.6	100	64.5	0.8	100
Total		3956.3	100.0	64.5	1900.8	100.0	76.2	183.9	100.0	84.8	8098.9	100.0	91.3
Weighted Average CN =		81.7											

Ivey Branch

Existing Landuse Conditions													
LUCODE	Land Use Descriptions	CN for Soil Type A			CN for Soil Type B			CN for Soil Type C			CN for Soil Type D		
		Area (ac)	Area (%)	CN	Area (ac)	Area (%)	CN	Area (ac)	Area (%)	CN	Area (ac)	Area (%)	CN
11	Open Water	0.0	0.0	100	0.0	0.0	100	0.0	0.0	100	5.7	0.4	100
21	Developed, Open Space	52.2	11.8	49	56.4	11.8	69	27.7	26.5	79	176.6	12.7	84
22	Developed, Low Intensity	76.3	17.3	54	36.9	7.8	70	32.4	31.0	80	131.8	9.5	85
23	Developed, Medium Intensity	56.5	12.8	61	14.3	3.0	75	13.5	12.9	83	75.9	5.5	87
24	Developed, High Intensity	16.8	3.8	77	5.8	1.2	85	2.9	2.8	90	20.7	1.5	92
31	Barren Land	0.0	0.0	77	0.0	0.0	86	0.0	0.0	91	0.0	0.0	94
41	Deciduous Forest	2.6	0.6	36	2.8	0.6	60	0.0	0.0	73	22.7	1.6	79
42	Evergreen Forest	29.2	6.6	36	46.9	9.9	60	1.4	1.4	73	235.1	17.0	79
43	Mixed Forest	0.0	0.0	36	0.7	0.1	60	0.0	0.0	73	1.9	0.1	79
52	Shrub/Scrub	1.1	0.2	35	8.3	1.7	56	0.9	0.9	70	18.4	1.3	77
71	Grassland/Herbaceous	0.0	0.0	30	0.1	0.0	58	0.0	0.0	71	0.1	0.0	78
81	Pasture/Hay	0.0	0.0	39	0.0	0.0	61	0.0	0.0	74	0.0	0.0	80
82	Cultivated Crops	199.3	45.2	67	289.6	60.8	78	25.4	24.3	85	582.7	42.0	89
90	Woody Wetlands	7.4	1.7	100	14.0	2.9	100	0.3	0.3	100	114.6	8.3	100
95	Emergent Herbaceous Wetlands	0.0	0.0	100	0.0	0.0	100	0.0	0.0	100	0.0	0.0	100
Total		441.2	100.0	60.5	476.0	100.0	74.7	104.6	100.0	81.5	1386.2	100.0	86.8
Weighted Average CN =		79.4											

Jacks Branch

Existing Landuse Conditions													
LUCODE	Land Use Descriptions	CN for Soil Type A			CN for Soil Type B			CN for Soil Type C			CN for Soil Type D		
		Area (ac)	Area (%)	CN	Area (ac)	Area (%)	CN	Area (ac)	Area (%)	CN	Area (ac)	Area (%)	CN
11	Open Water	0.0	0.0	100	0.0	0.0	100	0.0	0.0	100	3.4	0.3	100
21	Developed, Open Space	52.7	18.5	49	40.0	6.8	69	1.2	3.5	79	46.3	4.6	84
22	Developed, Low Intensity	13.6	4.8	54	13.3	2.2	70	1.4	4.2	80	11.7	1.2	85
23	Developed, Medium Intensity	6.1	2.1	61	3.2	0.5	75	0.7	2.0	83	1.4	0.1	87
24	Developed, High Intensity	1.3	0.5	77	4.2	0.7	85	0.1	0.3	90	0.0	0.0	92
31	Barren Land	0.0	0.0	77	0.0	0.0	86	0.0	0.0	91	0.0	0.0	94
41	Deciduous Forest	0.0	0.0	36	0.3	0.0	60	0.0	0.0	73	4.9	0.5	79
42	Evergreen Forest	19.2	6.7	36	111.2	18.8	60	10.6	31.2	73	227.1	22.5	79
43	Mixed Forest	0.1	0.0	36	0.4	0.1	60	0.0	0.0	73	6.7	0.7	79
52	Shrub/Scrub	0.2	0.1	35	17.9	3.0	56	0.0	0.0	70	29.6	2.9	77
71	Grassland/Herbaceous	0.6	0.2	30	8.3	1.4	58	0.0	0.0	71	2.8	0.3	78
81	Pasture/Hay	0.0	0.0	39	0.0	0.0	61	0.0	0.0	74	0.0	0.0	80
82	Cultivated Crops	154.9	54.3	67	279.0	47.2	78	15.5	45.6	85	307.2	30.4	89
90	Woody Wetlands	35.0	12.3	100	111.2	18.8	100	4.4	12.8	100	369.0	36.5	100
95	Emergent Herbaceous Wetlands	1.3	0.5	100	2.1	0.3	100	0.1	0.4	100	0.9	0.1	100
Total		285.0	100.0	65.0	590.9	100.0	77.1	34.1	100.0	82.8	1011.1	100.0	90.0
Weighted Average CN =		82.2											

Jacob Branch

Existing Landuse Conditions													
LUCODE	Land Use Descriptions	CN for Soil Type A			CN for Soil Type B			CN for Soil Type C			CN for Soil Type D		
		Area (ac)	Area (%)	CN	Area (ac)	Area (%)	CN	Area (ac)	Area (%)	CN	Area (ac)	Area (%)	CN
11	Open Water	41.0	2.3	100	18.1	2.8	100	101.1	5.1	100	273.4	5.1	100
21	Developed, Open Space	167.3	9.3	49	45.0	7.0	69	188.9	9.5	79	381.1	7.1	84
22	Developed, Low Intensity	111.5	6.2	54	29.8	4.7	70	150.7	7.6	80	160.9	3.0	85
23	Developed, Medium Intensity	54.1	3.0	61	21.6	3.4	75	81.2	4.1	83	60.5	1.1	87
24	Developed, High Intensity	11.1	0.6	77	2.3	0.4	85	20.3	1.0	90	16.4	0.3	92
31	Barren Land	0.5	0.0	77	0.0	0.0	86	0.0	0.0	91	1.0	0.0	94
41	Deciduous Forest	3.2	0.2	36	6.2	1.0	60	41.5	2.1	73	46.3	0.9	79
42	Evergreen Forest	97.9	5.4	36	71.5	11.2	60	271.3	13.6	73	526.0	9.9	79
43	Mixed Forest	3.8	0.2	36	1.7	0.3	60	6.7	0.3	73	9.1	0.2	79
52	Shrub/Scrub	33.0	1.8	35	6.6	1.0	56	42.3	2.1	70	108.3	2.0	77
71	Grassland/Herbaceous	43.3	2.4	30	9.5	1.5	58	21.4	1.1	71	47.1	0.9	78
81	Pasture/Hay	0.4	0.0	39	0.1	0.0	61	2.9	0.1	74	3.1	0.1	80
82	Cultivated Crops	984.2	54.5	67	315.3	49.3	78	795.7	39.9	85	1308.4	24.5	89
90	Woody Wetlands	195.9	10.8	100	111.2	17.4	100	211.8	10.6	100	2177.3	40.8	100
95	Emergent Herbaceous Wetlands	58.1	3.2	100	0.4	0.1	100	60.6	3.0	100	220.3	4.1	100
Total		1805.2	100.0	66.5	639.4	100.0	78.6	1996.4	100.0	84.4	5339.2	100.0	92.6
Weighted Average CN =		85.2											

Jacob Swamp

Existing Landuse Conditions													
LUCODE	Land Use Descriptions	CN for Soil Type A			CN for Soil Type B			CN for Soil Type C			CN for Soil Type D		
		Area (ac)	Area (%)	CN	Area (ac)	Area (%)	CN	Area (ac)	Area (%)	CN	Area (ac)	Area (%)	CN
11	Open Water	0.8	0.0	100	3.5	0.4	100	0.0	0.1	100	65.0	2.1	100
21	Developed, Open Space	219.1	10.5	49	58.0	7.2	69	0.3	0.5	79	159.2	5.0	84
22	Developed, Low Intensity	99.3	4.7	54	35.9	4.5	70	0.2	0.3	80	61.2	1.9	85
23	Developed, Medium Intensity	11.1	0.5	61	6.1	0.8	75	0.0	0.0	83	12.5	0.4	87
24	Developed, High Intensity	2.5	0.1	77	0.7	0.1	85	0.0	0.0	90	4.1	0.1	92
31	Barren Land	0.0	0.0	77	0.0	0.0	86	0.0	0.0	91	0.2	0.01	94
41	Deciduous Forest	13.8	0.7	36	4.9	0.6	60	0.4	0.8	73	31.3	1.0	79
42	Evergreen Forest	158.7	7.6	36	113.5	14.1	60	22.6	44.6	73	506.9	16.0	79
43	Mixed Forest	5.0	0.2	36	1.2	0.1	60	0.6	1.2	73	14.3	0.5	79
52	Shrub/Scrub	33.0	1.6	35	15.2	1.9	56	0.3	0.6	70	58.0	1.8	77
71	Grassland/Herbaceous	1.8	0.1	30	0.4	0.0	58	0.03	0.1	71	2.4	0.1	78
81	Pasture/Hay	0.0	0.0	39	0.0	0.0	61	0.0	0.0	74	0.0	0.0	80
82	Cultivated Crops	1380.1	65.9	67	464.5	57.6	78	20.6	40.7	85	1014.0	32.0	89
90	Woody Wetlands	168.8	8.1	100	102.1	12.7	100	5.7	11.3	100	1224.9	38.7	100
95	Emergent Herbaceous Wetlands	0.8	0.0	100	0.2	0.03	100	0.0	0.0	100	13.7	0.4	100
Total		2094.6	100.0	64.0	806.1	100.0	76.8	50.7	100.0	81.0	3167.7	100.0	91.2
Weighted Average CN =		79.9											

Lumber DS

Existing Landuse Conditions													
LUCODE	Land Use Descriptions	CN for Soil Type A			CN for Soil Type B			CN for Soil Type C			CN for Soil Type D		
		Area (ac)	Area (%)	CN	Area (ac)	Area (%)	CN	Area (ac)	Area (%)	CN	Area (ac)	Area (%)	CN
11	Open Water	24.5	1.4	100	5.4	1.1	100	66.8	10.8	100	703.0	19.2	100
21	Developed, Open Space	329.7	18.5	49	118.4	24.3	69	73.3	11.8	79	309.5	8.5	84
22	Developed, Low Intensity	374.3	21.0	54	156.1	32.0	70	57.7	9.3	80	249.6	6.8	85
23	Developed, Medium Intensity	178.2	10.0	61	56.5	11.6	75	76.5	12.4	83	98.8	2.7	87
24	Developed, High Intensity	83.7	4.7	77	12.0	2.5	85	21.5	3.5	90	28.4	0.8	92
31	Barren Land	3.1	0.2	77	0.0	0.0	86	1.4	0.2	91	3.8	0.1	94
41	Deciduous Forest	9.4	0.5	36	0.7	0.1	60	11.7	1.9	73	16.1	0.4	79
42	Evergreen Forest	113.9	6.4	36	20.1	4.1	60	50.3	8.1	73	166.6	4.5	79
43	Mixed Forest	2.7	0.2	36	0.4	0.1	60	1.3	0.2	73	5.1	0.1	79
52	Shrub/Scrub	27.4	1.5	35	7.2	1.5	56	8.0	1.3	70	31.4	0.9	77
71	Grassland/Herbaceous	2.6	0.1	30	0.3	0.1	58	1.7	0.3	71	11.3	0.3	78
81	Pasture/Hay	0.2	0.0	39	0.0	0.0	61	0.0	0.0	74	0.2	0.01	80
82	Cultivated Crops	369.6	20.8	67	76.5	15.7	78	98.6	15.9	85	191.5	5.2	89
90	Woody Wetlands	249.1	14.0	100	33.2	6.8	100	121.4	19.6	100	1774.6	48.5	100
95	Emergent Herbaceous Wetlands	10.1	0.6	100	0.8	0.2	100	28.5	4.6	100	71.3	1.9	100
Total		1778.5	100.0	63.3	487.7	100.0	73.7	618.6	100.0	87.6	3661.3	100.0	95.3
Weighted Average CN =		84.3											

Lumber Mid

Existing Landuse Conditions													
LUCODE	Land Use Descriptions	CN for Soil Type A			CN for Soil Type B			CN for Soil Type C			CN for Soil Type D		
		Area (ac)	Area (%)	CN	Area (ac)	Area (%)	CN	Area (ac)	Area (%)	CN	Area (ac)	Area (%)	CN
11	Open Water	54.9	0.4	100	64.5	1.5	100	12.8	0.5	100	679.5	2.7	100
21	Developed, Open Space	1041.5	7.2	49	391.0	9.3	69	681.4	24.1	79	1195.1	4.7	84
22	Developed, Low Intensity	382.7	2.6	54	175.0	4.2	70	215.9	7.6	80	518.6	2.0	85
23	Developed, Medium Intensity	63.9	0.4	61	65.0	1.5	75	118.4	4.2	83	163.6	0.6	87
24	Developed, High Intensity	23.7	0.2	77	20.1	0.5	85	34.7	1.2	90	48.6	0.2	92
31	Barren Land	0.2	0.002	77	0.4	0.01	86	0.0	0.0	91	0.1	0.0003	94
41	Deciduous Forest	176.4	1.2	36	41.4	1.0	60	15.4	0.5	73	222.6	0.9	79
42	Evergreen Forest	867.0	6.0	36	225.6	5.4	60	136.9	4.8	73	1486.8	5.8	79
43	Mixed Forest	39.1	0.3	36	13.4	0.3	60	10.1	0.4	73	82.6	0.3	79
52	Shrub/Scrub	314.5	2.2	35	70.4	1.7	56	47.2	1.7	70	274.5	1.1	77
71	Grassland/Herbaceous	123.5	0.9	30	26.2	0.6	58	12.5	0.4	71	77.0	0.3	78
81	Pasture/Hay	23.8	0.2	39	7.6	0.2	61	5.0	0.2	74	11.4	0.04	80
82	Cultivated Crops	9680.8	66.6	67	2698.8	64.3	78	1306.5	46.2	85	8541.3	33.5	89
90	Woody Wetlands	1705.8	11.7	100	395.2	9.4	100	224.0	7.9	100	11896.2	46.6	100
95	Emergent Herbaceous Wetlands	27.3	0.2	100	5.5	0.1	100	6.3	0.2	100	314.3	1.2	100
Total		14525.1	100.0	66.1	4200.0	100.0	77.5	2826.9	100.0	83.4	25512.2	100.0	93.4
Weighted Average CN =		82.9											

Lumber US

Existing Landuse Conditions													
LUCODE	Land Use Descriptions	CN for Soil Type A			CN for Soil Type B			CN for Soil Type C			CN for Soil Type D		
		Area (ac)	Area (%)	CN	Area (ac)	Area (%)	CN	Area (ac)	Area (%)	CN	Area (ac)	Area (%)	CN
11	Open Water	96.2	0.1	100	3603.7	7.3	100	275.7	0.7	100	304.3	0.8	100
21	Developed, Open Space	12212.7	11.2	49	3287.0	6.7	69	3659.3	9.5	79	863.2	2.3	84
22	Developed, Low Intensity	3886.1	3.6	54	823.6	1.7	70	809.9	2.1	80	130.6	0.4	85
23	Developed, Medium Intensity	1077.9	1.0	61	285.2	0.6	75	256.0	0.7	83	31.7	0.1	87
24	Developed, High Intensity	243.3	0.2	77	36.3	0.1	85	49.8	0.1	90	3.5	0.01	92
31	Barren Land	692.7	0.6	77	379.2	0.8	86	76.4	0.2	91	13.3	0.04	94
41	Deciduous Forest	3299.2	3.0	36	2152.4	4.4	60	1789.9	4.7	73	374.7	1.0	79
42	Evergreen Forest	44799.7	41.2	36	20704.5	42.0	60	17445.5	45.3	73	4677.0	12.5	79
43	Mixed Forest	2070.3	1.9	36	5405.0	11.0	60	2229.7	5.8	73	894.8	2.4	79
52	Shrub/Scrub	6893.8	6.3	35	2137.8	4.3	56	1887.5	4.9	70	338.2	0.9	77
71	Grassland/Herbaceous	14772.7	13.6	30	4267.2	8.7	58	2355.9	6.1	71	457.6	1.2	78
81	Pasture/Hay	3576.2	3.3	39	1142.3	2.3	61	631.1	1.6	74	60.3	0.2	80
82	Cultivated Crops	12211.6	11.2	67	2687.9	5.5	78	1673.7	4.3	85	2381.4	6.4	89
90	Woody Wetlands	2763.4	2.5	100	2311.1	4.7	100	5214.6	13.5	100	26340.0	70.6	100
95	Emergent Herbaceous Wetlands	99.5	0.1	100	57.2	0.1	100	130.5	0.3	100	419.6	1.1	100
Total		108695.4	100.0	43.2	49280.3	100.0	66.6	38485.6	100.0	78.1	37290.2	100.0	95.0
Weighted Average CN =		62.1											

Meadow Branch

Existing Landuse Conditions													
LUCODE	Land Use Descriptions	CN for Soil Type A			CN for Soil Type B			CN for Soil Type C			CN for Soil Type D		
		Area (ac)	Area (%)	CN	Area (ac)	Area (%)	CN	Area (ac)	Area (%)	CN	Area (ac)	Area (%)	CN
11	Open Water	0.5	0.1	100	0.2	0.0	100	0.0	0.0	100	0.7	0.0	100
21	Developed, Open Space	115.2	15.1	49	108.0	18.3	69	20.1	15.0	79	275.7	16.6	84
22	Developed, Low Intensity	161.0	21.1	54	152.2	25.8	70	27.1	20.2	80	265.1	16.0	85
23	Developed, Medium Intensity	73.4	9.6	61	61.7	10.5	75	35.8	26.7	83	162.9	9.8	87
24	Developed, High Intensity	36.9	4.8	77	17.2	2.9	85	49.5	37.0	90	50.3	3.0	92
31	Barren Land	0.0	0.0	77	0.0	0.0	86	0.0	0.0	91	0.0	0.0	94
41	Deciduous Forest	3.0	0.4	36	3.0	0.5	60	0.0	0.0	73	10.7	0.6	79
42	Evergreen Forest	40.9	5.3	36	34.1	5.8	60	1.4	1.1	73	180.0	10.8	79
43	Mixed Forest	0.5	0.1	36	0.0	0.0	60	0.0	0.0	73	3.3	0.2	79
52	Shrub/Scrub	5.7	0.7	35	6.9	1.2	56	0.0	0.0	70	21.5	1.3	77
71	Grassland/Herbaceous	0.4	0.1	30	0.4	0.1	58	0.0	0.0	71	1.2	0.1	78
81	Pasture/Hay	0.0	0.0	39	0.0	0.0	61	0.0	0.0	74	0.0	0.0	80
82	Cultivated Crops	307.3	40.2	67	185.9	31.5	78	0.0	0.0	85	505.0	30.4	89
90	Woody Wetlands	19.9	2.6	100	20.1	3.4	100	0.0	0.0	100	184.0	11.1	100
95	Emergent Herbaceous Wetlands	0.0	0.0	100	0.0	0.0	100	0.0	0.0	100	0.0	0.0	100
Total		764.6	100.0	60.3	589.8	100.0	73.5	134.0	100.0	84.3	1660.3	100.0	87.3
Weighted Average CN =		78.0											

Raft Swamp

Existing Landuse Conditions													
LUCODE	Land Use Descriptions	CN for Soil Type A			CN for Soil Type B			CN for Soil Type C			CN for Soil Type D		
		Area (ac)	Area (%)	CN	Area (ac)	Area (%)	CN	Area (ac)	Area (%)	CN	Area (ac)	Area (%)	CN
11	Open Water	110.5	0.2	100	6.3	0.1	100	44.5	1.5	100	896.3	1.9	100
21	Developed, Open Space	3527.5	7.5	49	672.0	7.3	69	135.8	4.7	79	1501.3	3.1	84
22	Developed, Low Intensity	1386.9	2.9	54	351.2	3.8	70	57.4	2.0	80	723.6	1.5	85
23	Developed, Medium Intensity	213.0	0.5	61	112.8	1.2	75	19.9	0.7	83	131.8	0.3	87
24	Developed, High Intensity	68.3	0.1	77	45.3	0.5	85	12.8	0.4	90	41.9	0.1	92
31	Barren Land	10.4	0.02	77	0.2	0.002	86	0.6	0.02	91	0.6	0.001	94
41	Deciduous Forest	746.3	1.6	36	151.4	1.6	60	60.7	2.1	73	426.1	0.9	79
42	Evergreen Forest	4666.1	9.9	36	1335.4	14.5	60	482.7	16.8	73	4057.3	8.5	79
43	Mixed Forest	274.7	0.6	36	94.8	1.0	60	27.9	1.0	73	235.7	0.5	79
52	Shrub/Scrub	1594.4	3.4	35	357.5	3.9	56	89.2	3.1	70	723.4	1.5	77
71	Grassland/Herbaceous	788.1	1.7	30	114.9	1.2	58	60.1	2.1	71	225.9	0.5	78
81	Pasture/Hay	103.6	0.2	39	12.7	0.1	61	1.6	0.1	74	11.3	0.02	80
82	Cultivated Crops	27567.2	58.6	67	5091.3	55.3	78	954.5	33.2	85	12306.4	25.8	89
90	Woody Wetlands	5916.2	12.6	100	834.4	9.1	100	916.1	31.8	100	26044.2	54.5	100
95	Emergent Herbaceous Wetlands	66.6	0.1	100	20.8	0.2	100	15.5	0.5	100	448.5	0.9	100
Total		47039.8	100.0	64.0	9200.9	100.0	74.9	2879.4	100.0	86.6	47774.3	100.0	93.9
Weighted Average CN =		78.9											

White Oak

Existing Landuse Conditions													
LUCODE	Land Use Descriptions	CN for Soil Type A			CN for Soil Type B			CN for Soil Type C			CN for Soil Type D		
		Area (ac)	Area (%)	CN	Area (ac)	Area (%)	CN	Area (ac)	Area (%)	CN	Area (ac)	Area (%)	CN
11	Open Water	1.2	0.7	100	0.3	0.05	100	0.0	0.0	100	11.3	0.7	100
21	Developed, Open Space	32.5	18.6	49	81.9	14.7	69	3.3	20.3	79	253.8	15.5	84
22	Developed, Low Intensity	39.5	22.7	54	59.0	10.6	70	5.3	32.3	80	145.9	8.9	85
23	Developed, Medium Intensity	37.1	21.3	61	25.8	4.6	75	4.0	24.4	83	64.9	4.0	87
24	Developed, High Intensity	21.3	12.2	77	11.3	2.0	85	0.5	2.7	90	24.9	1.5	92
31	Barren Land	0.0	0.0	77	0.0	0.0	86	0.0	0.0	91	0.0	0.0	94
41	Deciduous Forest	2.3	1.3	36	4.6	0.8	60	0.0	0.0	73	13.8	0.8	79
42	Evergreen Forest	16.0	9.2	36	232.2	41.8	60	1.8	10.8	73	619.7	37.7	79
43	Mixed Forest	0.0	0.0	36	5.5	1.0	60	0.0	0.0	73	5.4	0.3	79
52	Shrub/Scrub	1.5	0.9	35	16.3	2.9	56	0.0	0.0	70	68.8	4.2	77
71	Grassland/Herbaceous	0.0	0.0	30	0.1	0.03	58	0.0	0.0	71	3.6	0.2	78
81	Pasture/Hay	0.0	0.0	39	0.0	0.0	61	0.0	0.0	74	0.0	0.0	80
82	Cultivated Crops	12.7	7.3	67	88.0	15.8	78	0.0	0.0	85	128.8	7.8	89
90	Woody Wetlands	10.2	5.8	100	31.0	5.6	100	1.6	9.5	100	297.8	18.1	100
95	Emergent Herbaceous Wetlands	0.0	0.0	100	0.1	0.02	100	0.0	0.0	100	3.7	0.2	100
Total		174.3	100.0	59.3	556.1	100.0	68.6	16.4	100.0	81.9	1642.4	100.0	85.5
Weighted Average CN =		79.6											

B5 Reach Routing Parameters

Muskingum-Cunge Routing Parameters

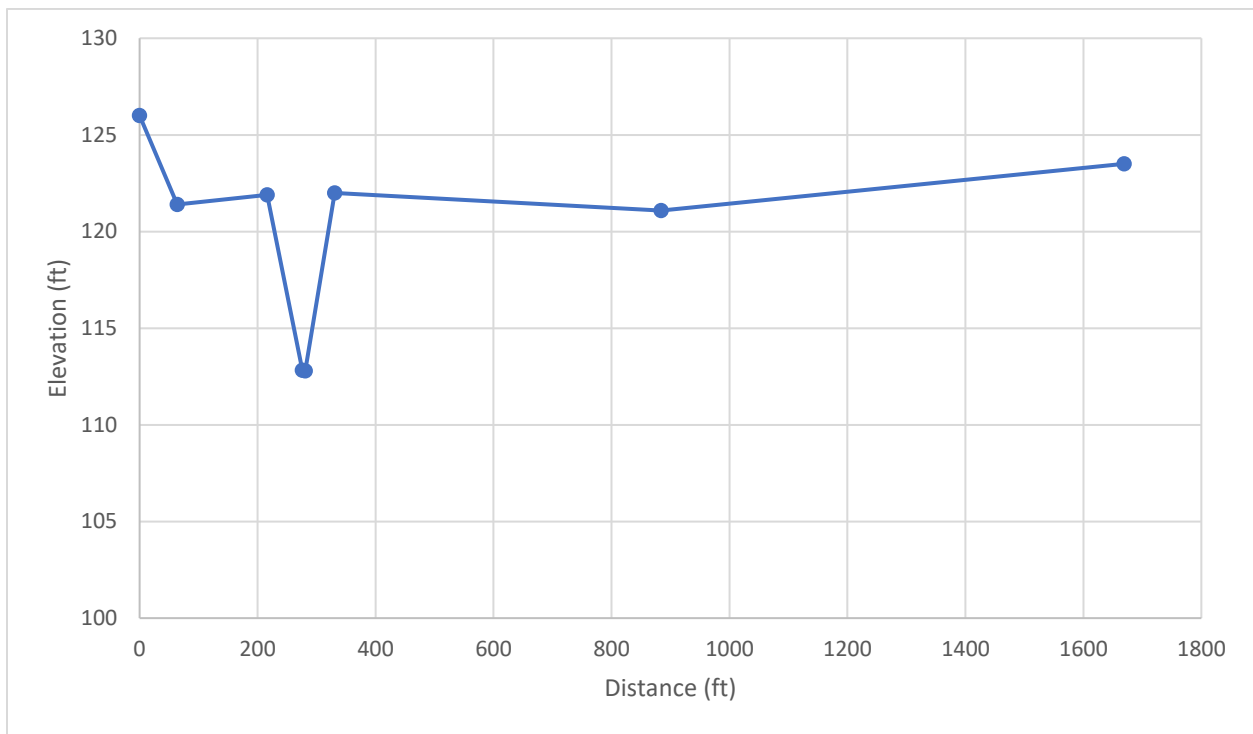
Notes:

- Cross-section data from terrain with bathymetry for all reaches

Reach	HMS Junctions	Length (ft)	Slope (ft/ft)	Channel N-Value	Left N-Value	Right N-Value	8pt XS #
1	0 to 1	11284	0.0002	0.045	0.1	0.1	XS1
2	1 to 2	10922	0.0006	0.045	0.13	0.1	XS2
3	2 to 3	14490	0.0002	0.045	0.15	0.09	XS3
4	3 to 4	7220	0.0003	0.045	0.13	0.11	XS4
5	4 to 5	39679	0.0002	0.045	0.125	0.125	XS5
6	5 to 6	7849	0.0003	0.045	0.125	0.125	XS6
7	7 to 6	24525	0.0008	0.065	0.035	0.16	XS7
8	8 to 4	6644	0.0002	0.045	0.12	0.12	XS8
9	11 to 1	183005	0.0003	0.08	0.16	0.16	XS9

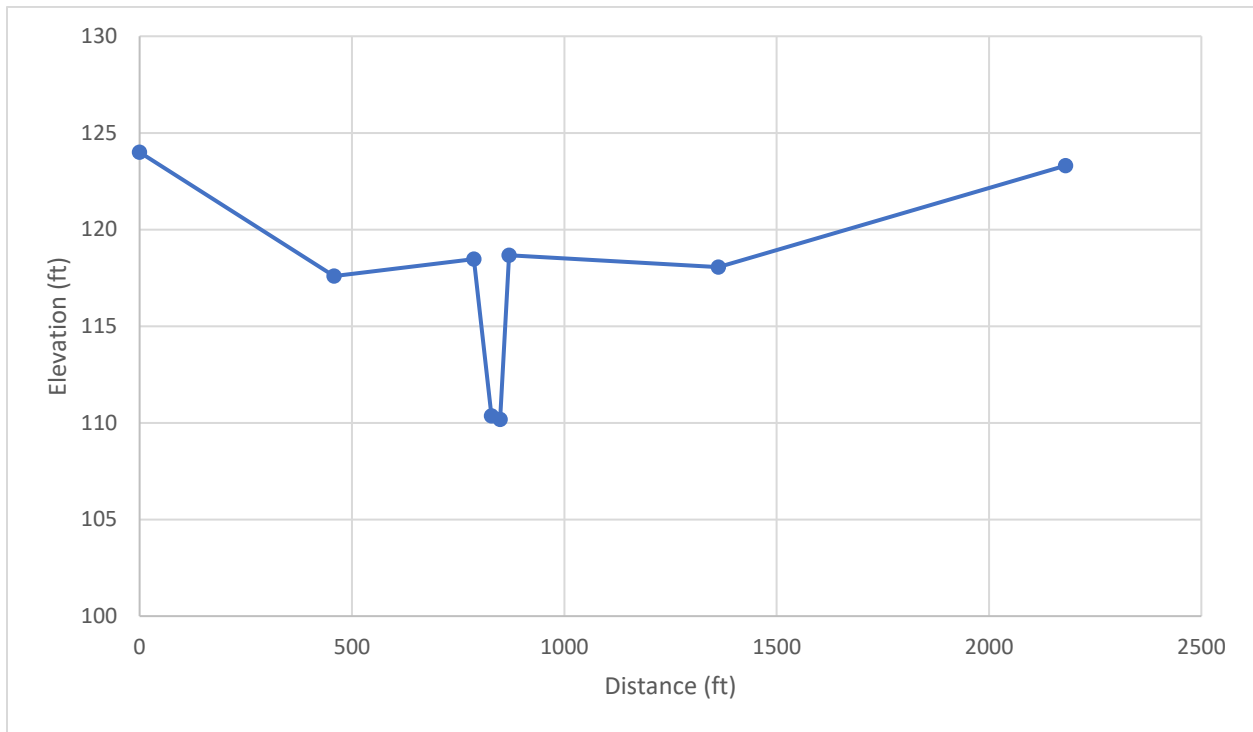
Cross-Section 1

Station (ft)	Elevation (ft)
0	126
64	121.4
216	121.9
275.78	112.82
281	112.79
330.5	122
884	121.09
1669	123.5



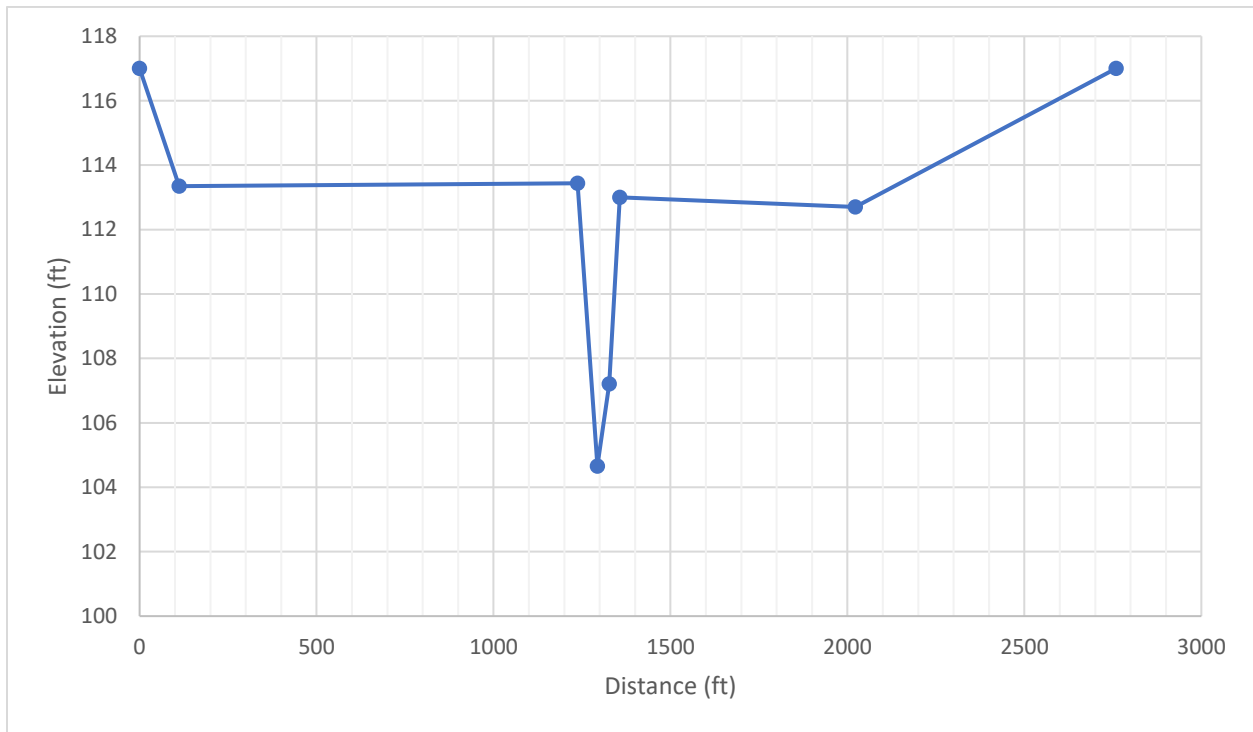
Cross-Section 2

Station (ft)	Elevation (ft)
0	124
458	117.6
787	118.47
828.42	110.36
849.05	118.67
870.1	118.67
1362.6	118.05
2180	123.3



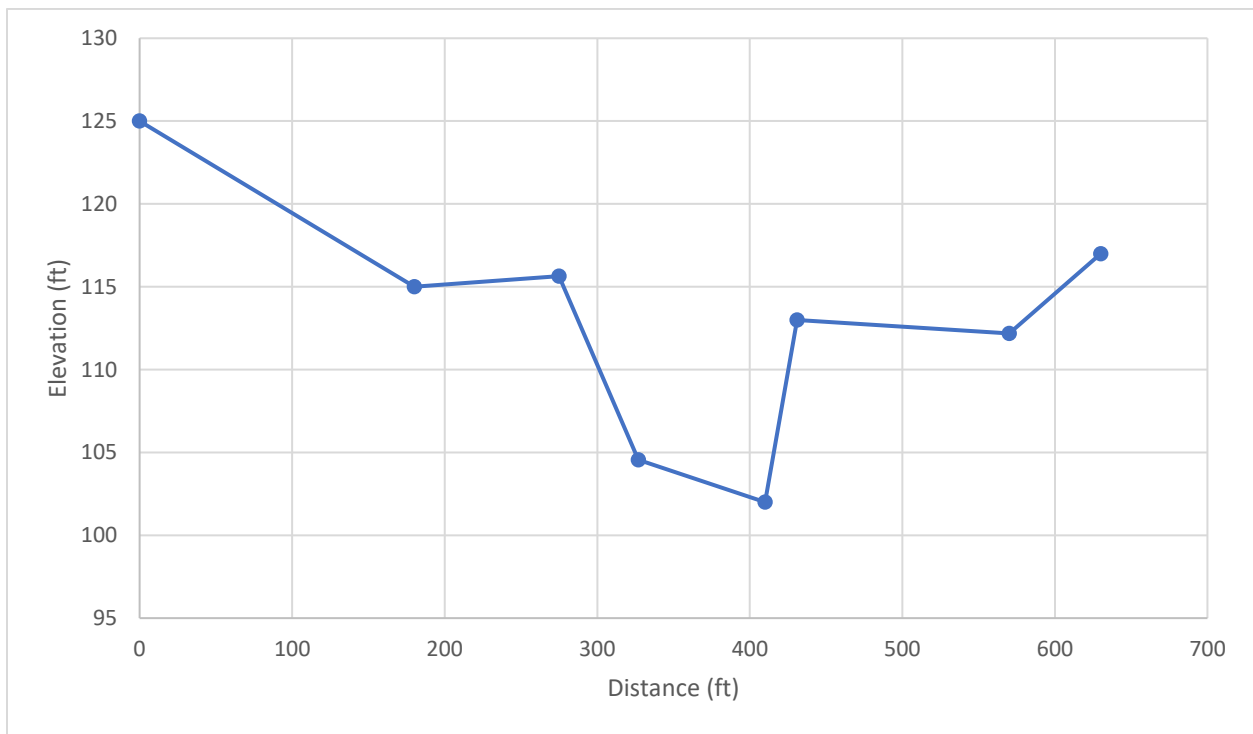
Cross-Section 3

Station (ft)	Elevation (ft)
0	117
112	113.35
1237	113.44
1293.34	104.66
1327	107.21
1356.5	113
2022.5	112.7
2759	117



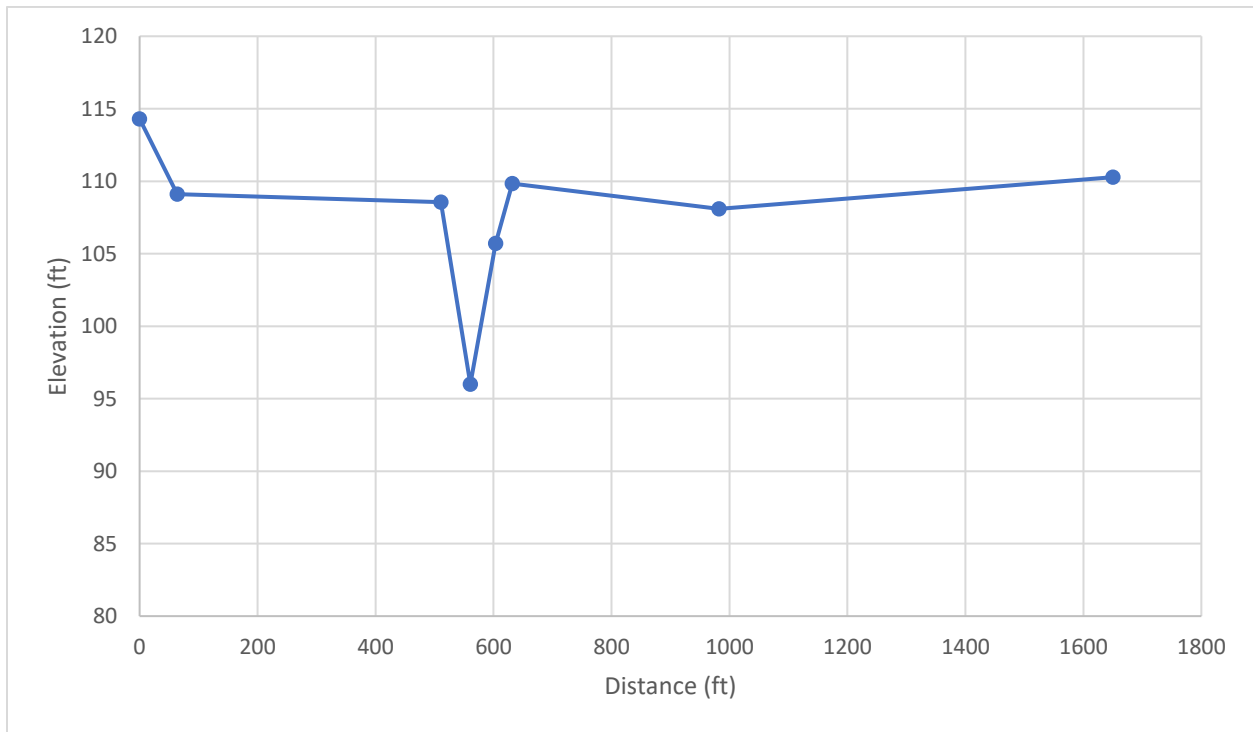
Cross-Section 4

Station (ft)	Elevation (ft)
0	125
180	115
275	115.65
327	104.56
410	102
431	113
570	112.19
630	117



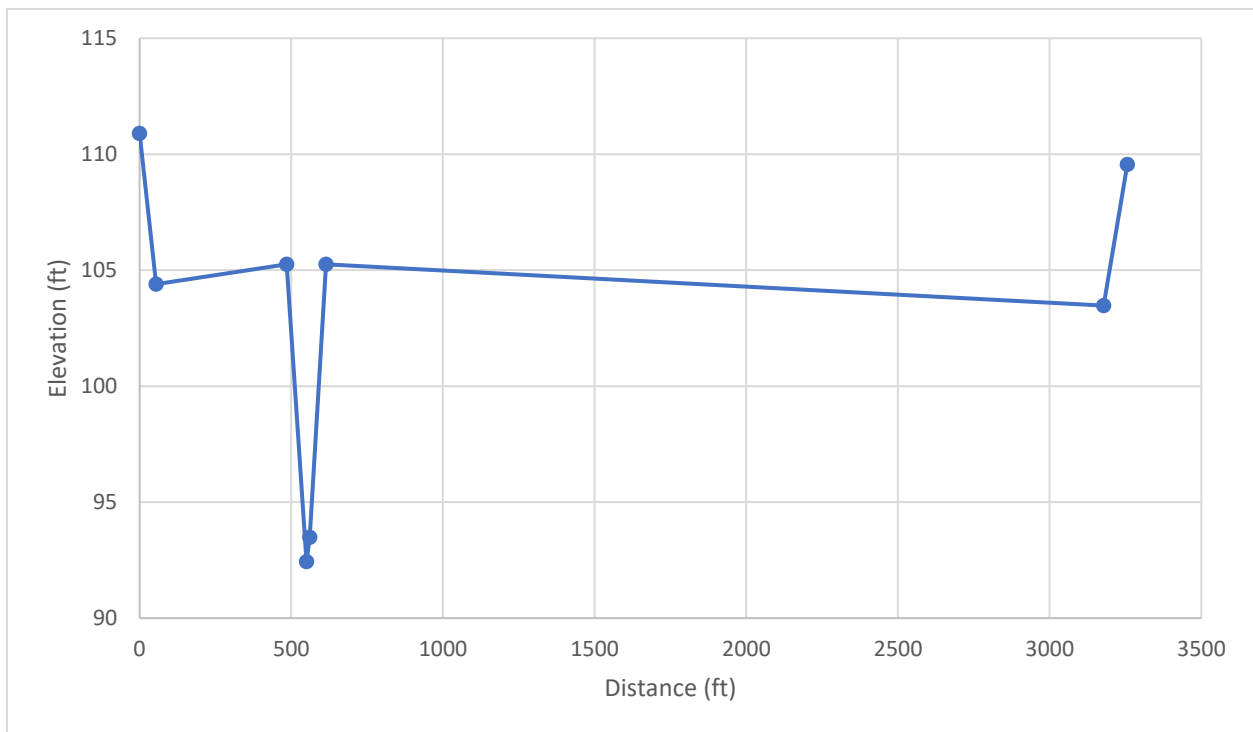
Cross-Section 5

Station (ft)	Elevation (ft)
0	114.3
64	109.1
510.9	108.55
560.6	96
603.4	105.71
632	109.83
982.5	108.1
1650	110.27



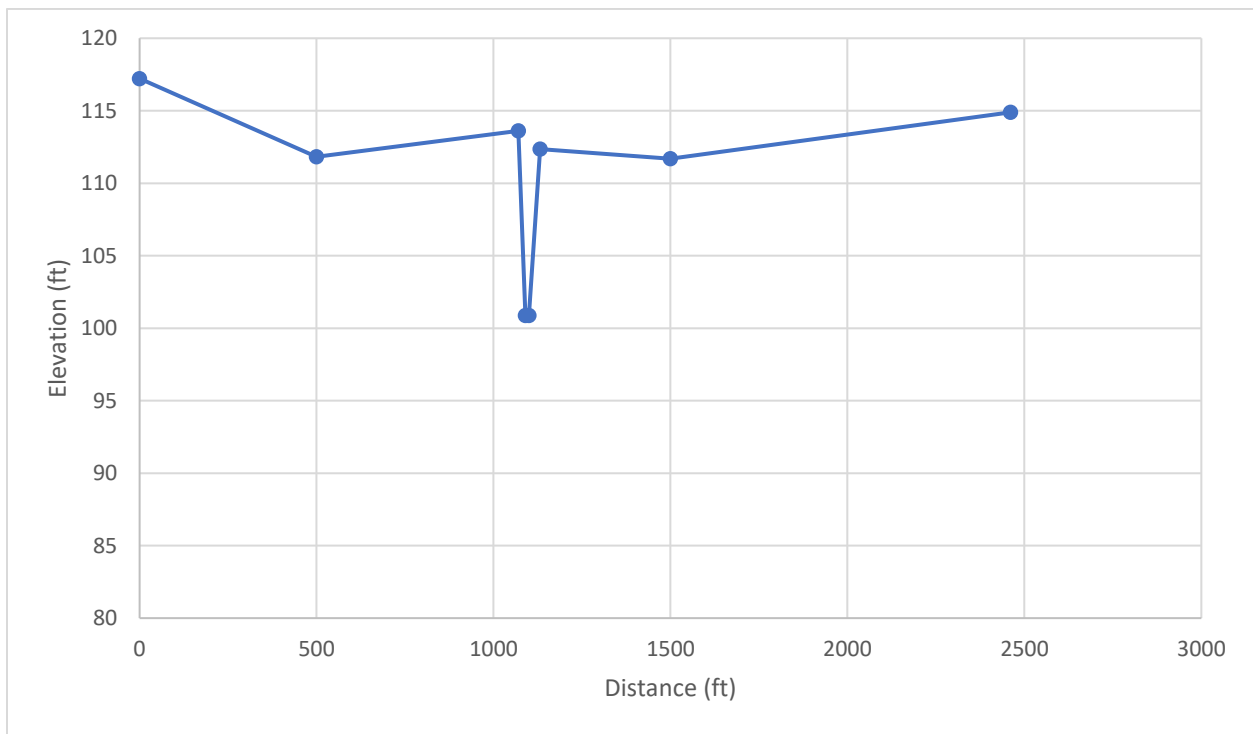
Cross-Section 6

Station (ft)	Elevation (ft)
0	110.9
54	104.4
485.1	105.25
550	92.43
560.5	93.48
614.4	105.26
3178.25	103.48
3256	109.56



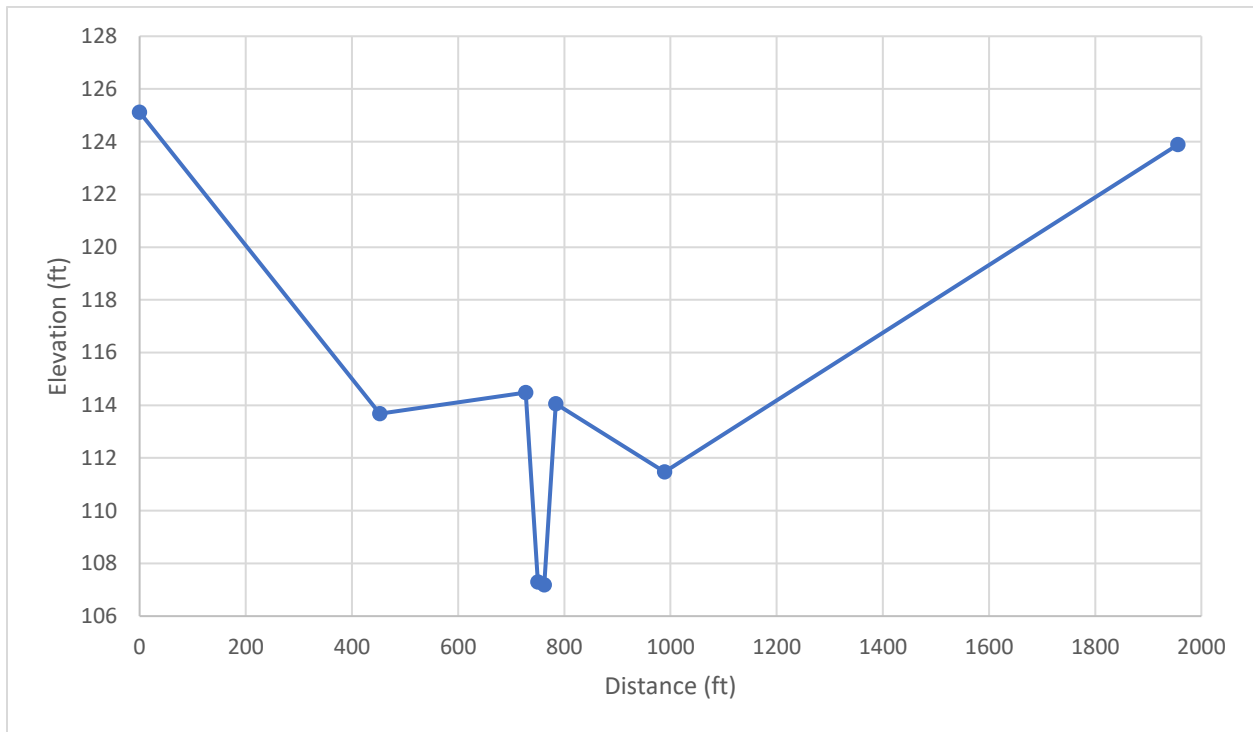
Cross-Section 7

Station (ft)	Elevation (ft)
0	117.22
500	111.83
1070	113.62
1090	100.88
1100	100.88
1131.25	112.36
1500	111.69
2461	114.9



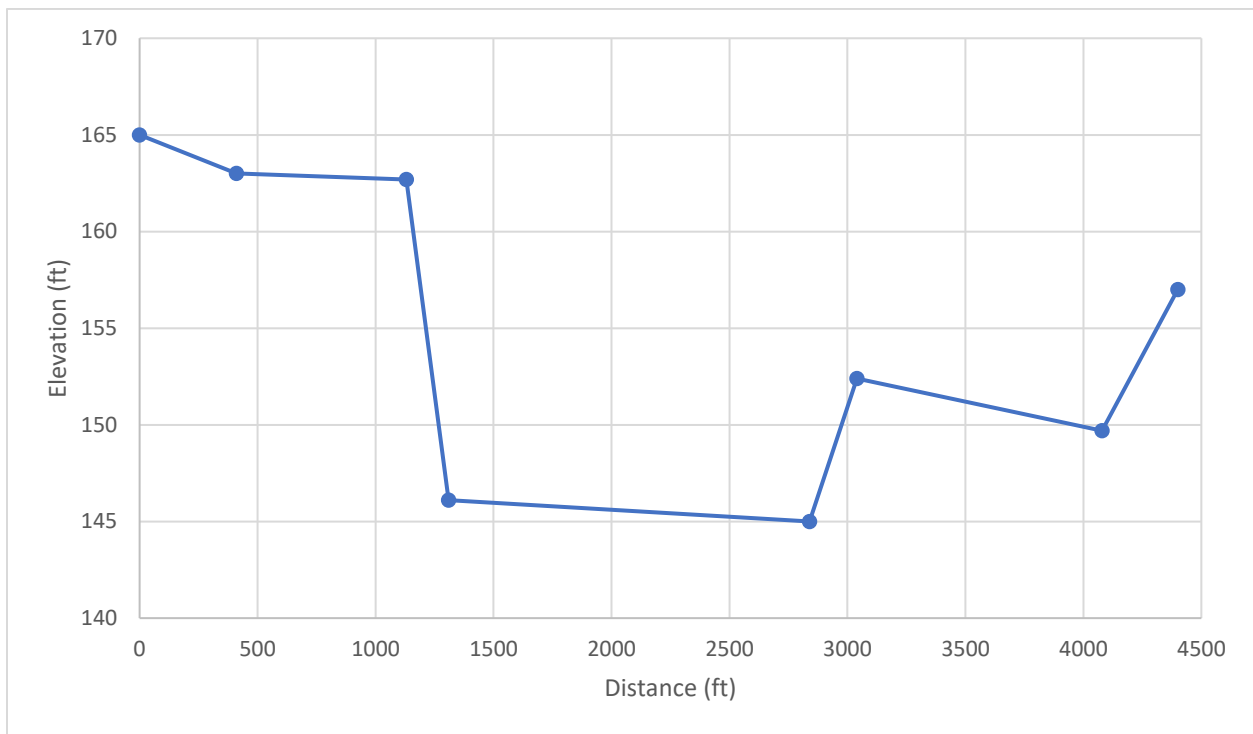
Cross-Section 8

Station (ft)	Elevation (ft)
0	125.12
452.65	113.68
727.02	114.48
750.33	107.29
762.12	107.19
784	114.06
989	111.47
1956	123.89



Cross-Section 9

Station (ft)	Elevation (ft)
0	165
410	163
1130	162.7
1310	146.1
2840	145
3039.7	152.4
4079.7	149.7
4400	157



B6 USGS Correspondence

From: McClenney, Bryce J <bjmcclen@usgs.gov>
Sent: Monday, February 3, 2020 12:38 PM
To: Sachan, Amit
Cc: Walters, Douglas A; Weaver, John C; Hunu, Kenneth; Beadenkopf, Edward G
Subject: Re: Lumber River flows discussion

Per your request after our conversation today, I looked into the Hurricane Matthew peak discharges. We did make a slight change to the rating based on the measurement made during Florence. The peak recorded gage height for the Matthew event was 21.87 ft. Rating 4.0 was in use at the time a gives a value of 14,600 cfs for this peak. Rating 5.0 was developed following the Florence measurement in 2018 and activated in September 2018. It computes a discharge of 15,700 cfs for the 21.87 peak gage height for Matthew. This is around 7% different. We would not have issues a revision based on this as the uncertainty of the measurements are higher than the percent difference of the computed discharges.

There were three measurements made during Matthew as follows:

142- GH=19.85 Q=9900

143- GH=19.05 Q=8000

144-GH=19.02 Q=7380

It was noted during all three measurements that large pumps were setup behind the levee that were pumping water back into the channel downstream of the gage from behind the levee. This flow was not able to be measured. There was no note of any secondary channel being measured such as with Florence, however, the gage height was roughly 2.5 ft lower than the Florence measurement at 22.20 ft so there likely would not have been as much flow through the breach at that time.

Hope this helps.

Bryce McClenney

Hydrologic Technician

USGS South Atlantic Water Science Center

Raleigh, NC (919)417-7021

From: Sachan, Amit <Amit.Sachan@atkinglobal.com>

Sent: Friday, January 31, 2020 9:28 AM

To: McClenney, Bryce J <bjmcclen@usgs.gov>

Cc: Walters, Douglas A <dwalters@usgs.gov>; Weaver, John C <jcweaver@usgs.gov>; Hunu, Kenneth

<Kenneth.Hunu@atkinglobal.com>; Beadenkopf, Edward G <Edward.Beadenkopf@atkinglobal.com>

Subject: [EXTERNAL] RE: Lumber River flows discussion

Thanks Bryce. We will call you on Monday (2/3) at 11 AM.

Amit Sachan, PE, CFM

Project Director, Public & Private Business Unit

Tel: +1 919 431 5253 Cell: +1 919 985 1095

Atkins, member of the SNC-Lavalin Group

1616 East Millbrook Road, Suite 160, Raleigh, NC 27519

From: McClenney, Bryce J <bjmcclen@usgs.gov>

Sent: Friday, January 31, 2020 7:44 AM

To: Sachan, Amit <Amit.Sachan@atkinglobal.com>

Cc: Walters, Douglas A <dwalters@usgs.gov>; Weaver, John C <jcweaver@usgs.gov>; Hunu, Kenneth

<Kenneth.Hunu@atkinglobal.com>; Beadenkopf, Edward G <Edward.Beadenkopf@atkinglobal.com>

Subject: Re: Lumber River flows discussion

That should work for me. I could do Monday or Tuesday mornings.

Bryce McClenney

Hydrologic Technician

USGS South Atlantic Water Science Center

Raleigh, NC (919)417-7021

From: Sachan, Amit <Amit.Sachan@atkinglobal.com>

Sent: Thursday, January 30, 2020 1:57 PM

To: McClenney, Bryce J <bjmcclen@usgs.gov>

Cc: Walters, Douglas A <dwalters@usgs.gov>; Weaver, John C <jcweaver@usgs.gov>; Hunu, Kenneth

<Kenneth.Hunu@atkinsglobal.com>; Beadenkopf, Edward G <Edward.Beadenkopf@atkinsglobal.com>
Subject: [EXTERNAL] RE: Lumber River flows discussion

Hi Bryce, Hope that you are doing well. We would like to learn about your experience during hurricanes Florence and Matthew. Would you be available for a brief call sometime in next few days? Let me know and we will plan accordingly. Thanks

Amit Sachan, PE, CFM
Project Director, Public & Private Business Unit
Tel: +1 919 431 5253 Cell: +1 919 985 1095

Atkins, member of the SNC-Lavalin Group
1616 East Millbrook Road, Suite 160, Raleigh, NC 27519

From: Walters, Douglas A <dwalters@usgs.gov>
Sent: Friday, January 24, 2020 7:36 AM
To: Hunu, Kenneth <Kenneth.Hunu@atkinsglobal.com>; Sachan, Amit <Amit.Sachan@atkinsglobal.com>; Beadenkopf, Edward G <Edward.Beadenkopf@atkinsglobal.com>
Cc: Weaver, John C <jcweaver@usgs.gov>; McClenney, Bryce J <bjmcclen@usgs.gov>
Subject: Re: Lumber River flows discussion

Amit, Ken and Ed,

I spoke with the technician, Bryce McClenney, who measured Lumberton flows during Florence. As you can see below, they did measure the main channel at the gage (15,100 cfs) as well as the the overflow (1,977 cfs) under I-95 (railroad opening). The overflow was significant, comprising almost 12% of the total flow. The overflow was measured by wading the flows (split into 2 sections) overtopping 5th street, downstream of the I-95 opening. I hope this information is helpful. If you have further questions about the measurement or the conditions at the time, you can contact Bryce directly (cc'd in this email or at 919-417-7021). Bryce also has pictures and video of the conditions which he can share with you, if you like.

Discharge Values		Discharge (ft ³ /s)
overflow 2		457
main		15100
overflow 1		1520
	Subtotal	17100
	Adjustment	0.00
	Adjusted Total Discharge:	17100



U.S. DEPARTMENT OF THE INTERIOR
U.S. Geological Survey
SITE VISIT NOTES

Meas #: 157
Processed by _____
Checked by _____

11/18/2018 14:35:00-17:00:00 (EST)

Site Visit Summary
02124170 - LUMBER RIVER AT LUMBERTON, NC
 Date: 2018-09-17 Start Time: 14:35:00-05:00 (EST) End Time: 17:00:00-05:00
 Party: BJM/JES
Site Visit Tasks
 Discharge Measurement: Water Temp with Acoustic Heas:
 Control Inspection:

Discharge Measurement Summary
Meas No: 157
 Gage Ht: 22.20 ft
 Meas Start Time: 14:50:00-05:00 Total Meas Flow: 17038.46 cfs (Measured)
 Meas End Time: 17:00:24-05:00
 Meas Rating: Pass (9%+)
 Base Flow? Non-base flow
Rating Information
 Meas. Rating: _____ Different from rating no. _____ Indicated shift: _____
Comments:
 likely holding steady due to levy breach

Channel 1 (main) Summary - QMIDSECTION Measurement
Bridge downstream side Measurement
 Meas Flow: 15072.46 cfs Vel Method: ADCP
 Horiz Flow: Uneven Vel Desc:
 Vert Vel Desc: Unspecified Channel Conditions: Unspecified, Unspecified, Unspecified
 Sect Loc.: At the gage - 0 ft. to gage
ADCP Measurement Details
 Stations: 31 Total Width: 236.00 ft
 Total Area: 2893.57 ft² Mean Vel: 5.21 ft/s
 Start Point: Right edge of water Mtr Type: ADCP
 Serial No: RFO_P9_1425 Mtr Susp: Tethered boat
 Mtr Insp Alt: true

Channel 2 (overflow 1) Summary - QMIDSECTION Measurement
Wading Measurement
 Meas Flow: 1520 cfs Vel Method: ADV
 Horiz Flow: Uneven Vel Desc:
 Vert Vel Desc: Unspecified Channel Conditions: Unspecified, Unspecified, Unspecified
 Sect Loc.: At the gage - 0 ft. to gage
ADV Measurement Details
 Stations: 19 Total Width: 181 ft
 Total Area: 1775 Mean Vel: .26
 Start Point: Left edge of water Mtr Type:
 Serial No: RFO_FT_P1245 Mtr Susp: Top-setting wading rod
 Mtr Insp Alt: true

Channel 3 (overflow 2) Summary - QMIDSECTION Measurement
Wading Measurement
 Meas Flow: 457 cfs Vel Method: ADV
 Horiz Flow: Unspecified Vel Desc:
 Vert Vel Desc: Unspecified Channel Conditions: Unspecified, Unspecified, Unspecified
 Sect Loc.: Unspecified - R. to gage
ADV Measurement Details
 Stations: 14 Total Width: 154 ft
 Total Area: 1420 Mean Vel: .32
 Start Point: Left edge of water Mtr Type:
 Serial No: RFO_FT_P1245 Mtr Susp: Top-setting wading rod
 Mtr Insp Alt: true

Gage Readings

Time	Non-Subm Pres Tran (Unspecified)	Wire Weight Gage (Unspecified)
14:36:00	22.20 (Rating)	22.25 (+/- .1) (Reference - Primary)
15:24:00	22.20 (Rating)	22.25 (+/- .1) (Reference)

Key: Blue=Primary Reference Green=RawTime (Kier) Rating Black=Unsp/Reference

Sensor Inspection
Non-Subm Pres Tran
 Name: _____ Serial Number: Unspecified
 Gas Type: _____ Orif Serviced: _____ Service Time: _____

Sensor Inspection
Wire Weight Gage
 Name: _____ Serial Number: Unspecified
 Checkbar Found: _____ Checkbar Chng Time: _____
 Checkbar Chng: _____ Checkbar Eley: _____

Streamflow Control Inspection

Type	Dist to gage (ft)	Cleaned?	Time Cleaned	Condition
Channel		Unspecified		Unspecified

Comments:
 Levy under 195 has breached and overflows were over 5th street

Doug,

Can you swing by for a few minutes before you leave for the day?

JCWeaver

J. Curtis Weaver, Hydrologist, PE
USGS South Atlantic Water Science Center
North Carolina - South Carolina - Georgia
3916 Sunset Ridge Road
Raleigh, NC 27607
Phone: (919) 571-4043 // Fax: (919) 571-4041

Email: jcweaver@usgs.gov
Online: <https://www.usgs.gov/centers/sa-water>

From: Sachan, Amit <Amit.Sachan@atkinglobal.com>
Sent: Wednesday, January 22, 2020 2:33 PM
To: Weaver, John C <jcweaver@usgs.gov>
Cc: Hunu, Kenneth <Kenneth.Hunu@atkinglobal.com>; Beadenkopf, Edward G <Edward.Beadenkopf@atkinglobal.com>
Subject: [EXTERNAL] RE: Lumber River flows discussion

Hi Curtis, Here are few questions for our discussion. I'll send out a meeting invite for everyone's calendars. Thanks

- Does the USGS have any official estimate of the frequency of Matthew and Florence at Lumberton?
- Can the USGS comment to how Atkins has done the frequency analyses and offer any suggestions for what we have not done?
- Can we discuss the rating curve at Lumberton? Is the backup available? Is the USGS comfortable with the observed hydrographs and peaks for the two major Hurricanes?
- Significant flow left the Lumber River at I-95 during these events and we were told for Florence that was overtopped and/or out of service for a time. How was the rating curve developed and how reliable are the flow estimated and hydrographs for Florence and Matthew?

From: Sachan, Amit
Sent: Tuesday, January 21, 2020 11:43 AM
To: Weaver, John C <jcweaver@usgs.gov>
Cc: Hunu, Kenneth <Kenneth.Hunu@atkinglobal.com>; Beadenkopf, Edward G <Edward.Beadenkopf@atkinglobal.com>
Subject: RE: Lumber River flows discussion

Curtis, Thanks for your prompt response. Our discussion will be focused on a flood gate design project for the City of Lumberton on opening under I-95. Our questions will be based on flood frequency

analysis and rating curves on Lumber River stream gages. We will send few specific questions this afternoon. Let me know if we can meet on Thursday (1/23) afternoon (say 3 PM). Thanks

Amit Sachan, PE, CFM

Project Director, Public & Private Business Unit
Tel: +1 919 431 5253 Cell: +1 919 985 1095

Atkins, member of the SNC-Lavalin Group
1616 East Millbrook Road, Suite 160, Raleigh, NC 27519

From: Weaver, John C <jcweaver@usgs.gov>
Sent: Tuesday, January 21, 2020 11:14 AM
To: Sachan, Amit <Amit.Sachan@atkinglobal.com>
Cc: Weaver, John C <jcweaver@usgs.gov>
Subject: Re: Lumber River flows discussion

Amit,

Aside from an appointment on Thursday morning, I am generally available the coming several days.

In the interest of transparency, I just completed a review for NCDOT a few weeks ago of several FF analyses for the streamgage on the Lumber River at Lumberton that were completed as part of their planning for future I-95 work near Lumberton. Please let me know if you're interest in the Lumber River issues is related to this NCDOT planning.

Also, it would be helpful to get a heads up on the specific questions you have on the Lumber River so I could plan accordingly in advance of a conversation.

Thank you.

JCWeaver

J. Curtis Weaver, Hydrologist, PE
USGS South Atlantic Water Science Center
North Carolina - South Carolina - Georgia
3916 Sunset Ridge Road
Raleigh, NC 27607
Phone: (919) 571-4043 // Fax: (919) 571-4041

Email: jcweaver@usgs.gov
Online: <https://www.usgs.gov/centers/sa-water>

From: Sachan, Amit <Amit.Sachan@atkinglobal.com>
Sent: Monday, January 20, 2020 3:30 PM

To: Weaver, John C <jcweaver@usgs.gov>
Subject: [EXTERNAL] Lumber River flows discussion

Hi Curtis, Hope that you are doing well. We have talked briefly at the NCAFPM conferences. I would like to request a quick meeting to discuss a project that we are working on. It is flood control project for the City of Lumberton and we want to get your input on Lumber River gages and flows. Let me know a convenient time in next few days and we'll plan accordingly. Regards

Amit Sachan PE, CFM
Project Director, Mid-Atlantic
Private & Public Business Unit

[View my profile](#)

+1(919) 431 5253 +1(919) 985 1095 

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1616 E. Millbrook Road, Suite 160, Raleigh, NC 27609



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Member of the SNC-Lavalin Group

Company    

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Consider the environment. Please don't print this e-mail unless you really need to.

Appendix C. Hydraulic Analysis

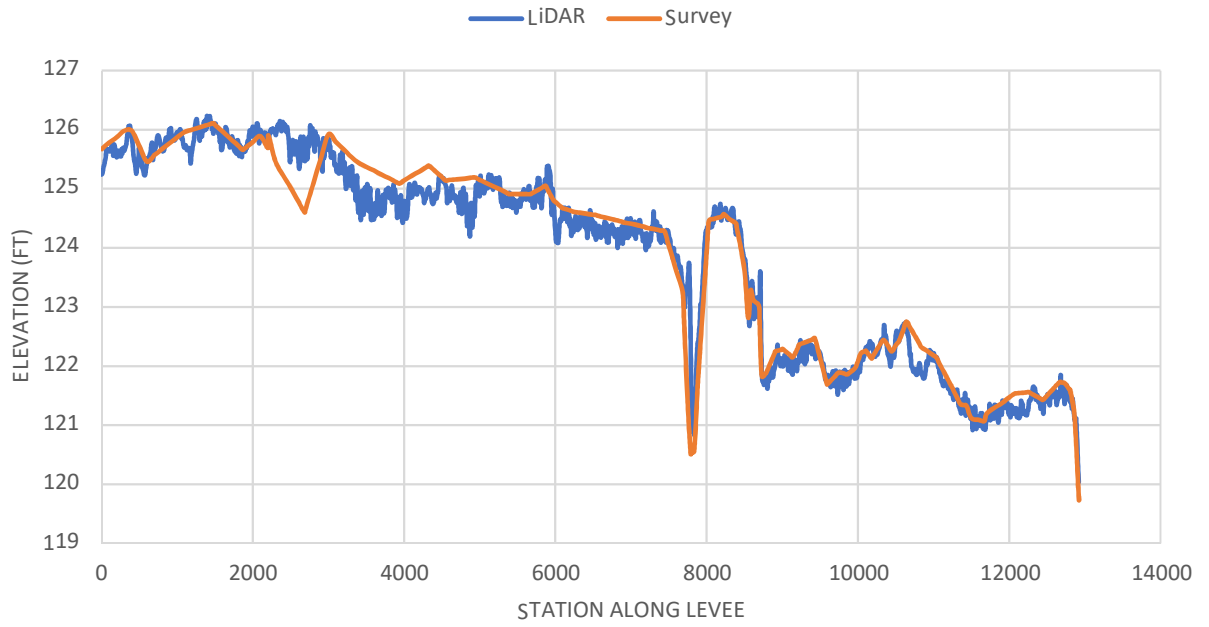
C1 Hydraulic Structures Data

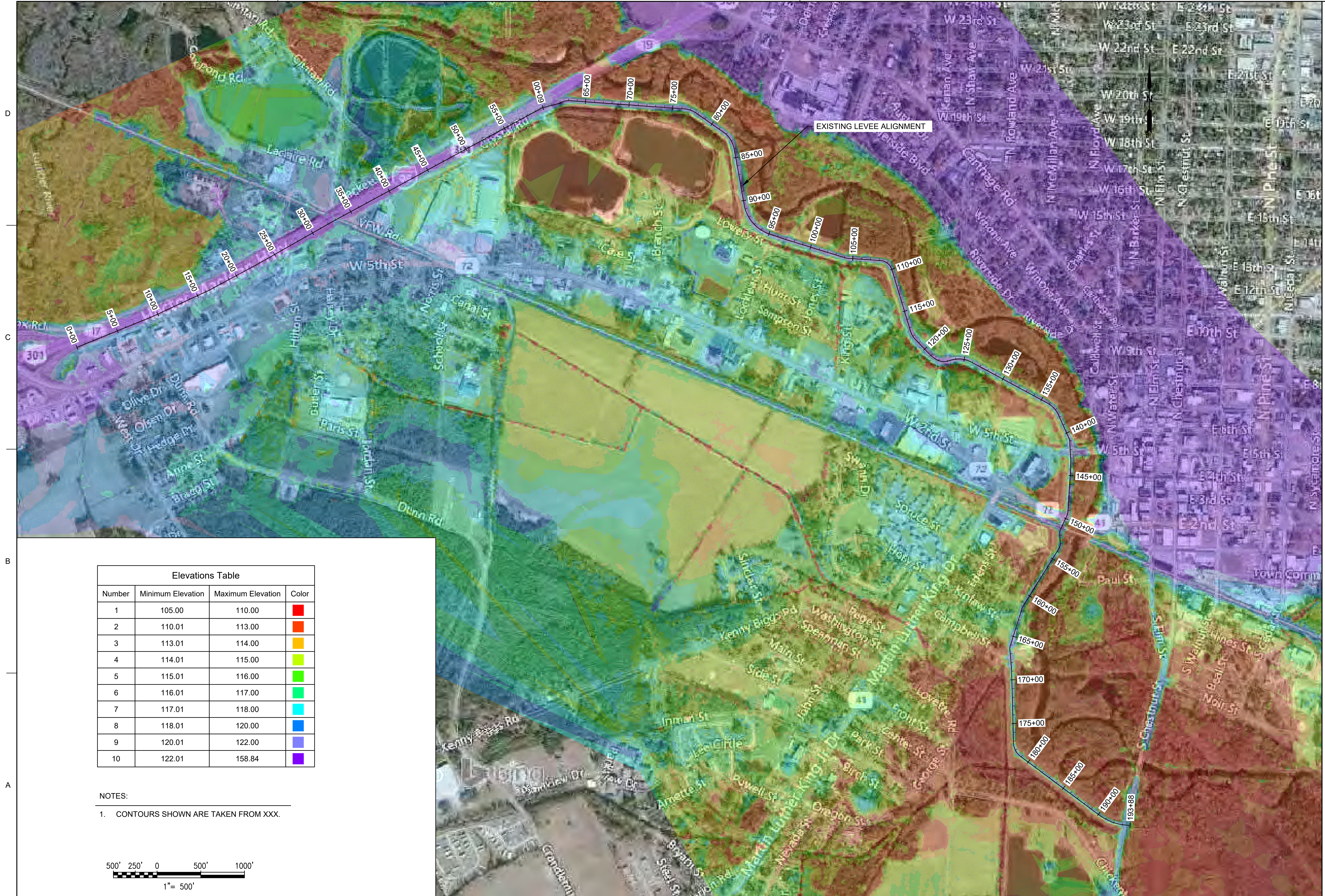
Summary of Final Structures in External Hydraulic Model

Label Name	Channel	Street Name	Effective Model XS	Data Origin	Structure Type	Rise	Span or Diameter	# Piers
E1	Fivemile Branch	Dawn Dr (next to I-95)	NA	McGill Survey	2RCBC	7.67	10	
E2	Meadow Branch	Dawn Dr (next to I-95)	NA	McGill Survey	2RCBC	8	10	
E3	Fivemile Branch	N Roberts Ave (SR 211)	NA	McGill Survey	3RCBC	10	14	
E4	Fivemile Branch	W Carthage Rd (SR 1536)	NA	McGill Survey	3RCBC	11	13	
E5	Lumber River	Kenric Rd (SR 1539)	376455	Effective Model	Bridge		194.9	2
E6	Lumber River	S Caton Rd	375387	Effective Model	Bridge		354.9	4
E8	Lumber River	I-95	360856	Effective Model	Bridge		214.7	7
E9	Lumber River	5th Street	350697	Effective Model	Bridge		236.6	5
E10	Lumber River	W 2nd St	349864	Effective Model	Bridge		282.9	5
E12	Lumber River	S Chestnut St [Alamac Rd (SR 2289) in model]	345664	Effective Model	Bridge		330.5	6
E13	Lumber River	S Chippewa St/ Hestertown Rd	NA	McGill Survey	Bridge		197.7	2
E14	Lumber River	Structure 44 on NC HWY 72	323321.5	Effective Model	Bridge		360.9	7
E15	Lumber River	I-95 Proposed Bridge	360856	Preliminary Model	Bridge		428.8	4
E16	Lumber River	CSX Railroad	370045	Effective Model	Bridge		350	14
E17	Lumber River	Railroad	349691	Effective Model	Bridge		345	13
LJ4	Little Jacob Swamp	MLK Dr (NC 41)	NA	Field Data	Arch (2)	7.1	15	
JS5	Jacob Swamp	MLK Dr (NC 41)	25316.41	Effective Model	Box Culverts (2)	4.5	6	
CC9	Collection Canal	W 5th Street	NA	Field Data	RCP		6	
CC10	Collection Canal	MLK Dr (NC 41)	NA	Field Data	Pipe Culvert		7	

C2 Lumber Levee and I-95 Data

LIDAR VS. SURVEY ELEVATIONS





MARK	DESCRIPTION	DATE	APPR

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PRELIMINARY SUBMITAL

DESIGNED BY:	DATE: 08/15/2017	SOLICITATION NO.:	
DWN BY:		CONTRACT NO.:	
SUBMITTED BY:		FILE NUMBER:	
NOTED:		FILE NAME:	

CITY OF LUMBERTON
NORTH CAROLINA
115 S CEDAR STREET
LUMBERTON, NC 28358

AECOM
AECOM PROJECT
1515 PONDRAIS ST STE 2700
NEW ORLEANS, LA 70112

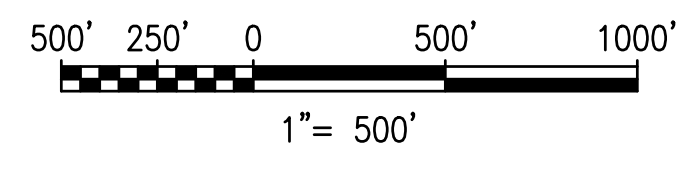
LUMBERTON FLOOD MITIGATION

PROJECT OVERVIEW

SHEET IDENTIFICATION
G-101

Number	Minimum Elevation	Maximum Elevation	Color
1	105.00	110.00	Red
2	110.01	113.00	Orange
3	113.01	114.00	Yellow
4	114.01	115.00	Light Green
5	115.01	116.00	Green
6	116.01	117.00	Light Blue
7	117.01	118.00	Blue
8	118.01	120.00	Dark Blue
9	120.01	122.00	Very Dark Blue
10	122.01	158.84	Purple

- NOTES:
- CONTOURS SHOWN ARE TAKEN FROM XXX.



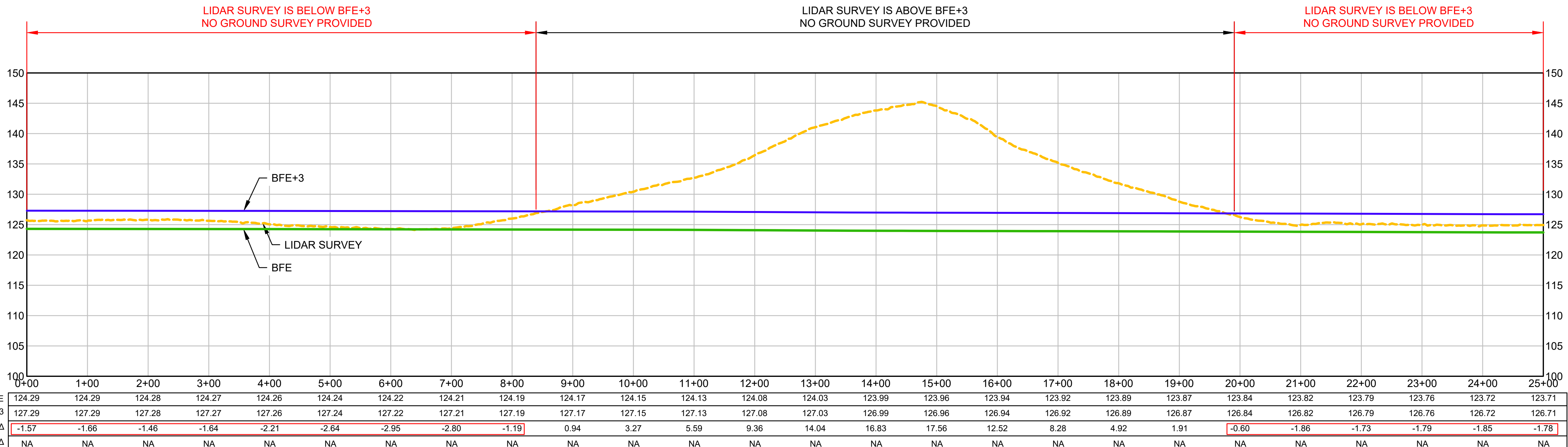


MATCHLINE STA 25+00
SHEET C-101

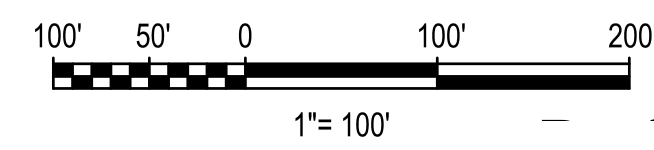
PLAN
SCALE: 1" = 100'

- LEGEND:**
- BASE FLOOD ELEVATION (BFE)
 - BASE FLOOD ELEVATION +3' (BFE+3)
 - - - LIDAR SURVEY
 - GROUND SURVEY

- NOTES:**
- GROUND SURVEY SHOTS WERE COLLECTED IN NOVEMBER 2009.
 - BASE FLOOD ELEVATION (BFE) TAKEN FROM THE NORTH CAROLINA FLOOD RISK INFORMATION SYSTEM (NC FRIS) WEBSITE.



PROFILE
SCALE: 1" = 100'



MARK	DESCRIPTION	DATE	APPR

NOT FOR CONSTRUCTION
PRELIMINARY SUBMITTAL

DESIGNED BY:	DATE:	DESIGN NO.:
DWN BY:	DATE:	DESIGN NO.:
SUBMITTED BY:	DATE:	DESIGN NO.:
NOTED:	DATE:	DESIGN NO.:
FILE NAME:	FILE NAME:	FILE NAME:
ANSI D:	ANSI D:	ANSI D:

CITY OF LUMBERTON
NORTH CAROLINA
115 S CEDAR STREET
LUMBERTON, NC 28358

AECOM PROJECT
No. 00548477
1515 PONDRAIS ST STE 2700
NEW ORLEANS, LA 70112

LUMBERTON FLOOD MITIGATION
PLAN AND PROFILE

SHEET IDENTIFICATION
C-100

D

C

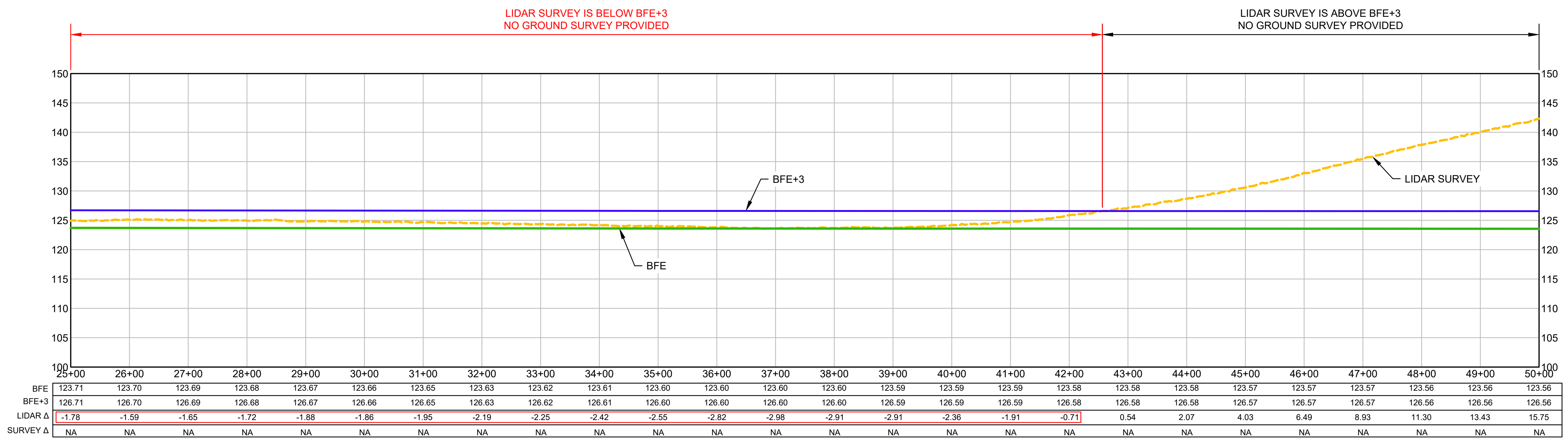
B

A



PLAN
SCALE: 1" = 100'

- LEGEND:**
- BASE FLOOD ELEVATION (BFE)
 - BASE FLOOD ELEVATION +3' (BFE+3)
 - - - LIDAR SURVEY
 - GROUND SURVEY



PROFILE
SCALE: 1" = 100'

	25+00	26+00	27+00	28+00	29+00	30+00	31+00	32+00	33+00	34+00	35+00	36+00	37+00	38+00	39+00	40+00	41+00	42+00	43+00	44+00	45+00	46+00	47+00	48+00	49+00	50+00
BFE	123.71	123.70	123.69	123.68	123.67	123.66	123.65	123.63	123.62	123.61	123.60	123.60	123.60	123.60	123.59	123.59	123.59	123.58	123.58	123.58	123.58	123.57	123.57	123.56	123.56	123.56
BFE+3	126.71	126.70	126.69	126.68	126.67	126.66	126.65	126.63	126.62	126.61	126.60	126.60	126.60	126.60	126.59	126.59	126.59	126.58	126.58	126.58	126.58	126.57	126.57	126.56	126.56	126.56
LIDAR Δ	-1.78	-1.59	-1.65	-1.72	-1.88	-1.86	-1.95	-2.19	-2.25	-2.42	-2.55	-2.82	-2.98	-2.91	-2.91	-2.36	-1.91	-0.71	0.54	2.07	4.03	6.49	8.93	11.30	13.43	15.75
SURVEY Δ	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA



MARK	DESCRIPTION	DATE	APPR

NOT FOR CONSTRUCTION
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DESIGNED BY:	DATE:	DESIGNED BY:	DATE:
DWN BY:	AUGUST 2017	CHK BY:	
SUBMITTED BY:	SOLICITATION NO.:	SUBMITTED BY:	SOLICITATION NO.:
PLOT SCALE:	NA	PLOT SCALE:	NA
NOTED:	CONTRACT NO.:	NOTED:	CONTRACT NO.:
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	NA		NA

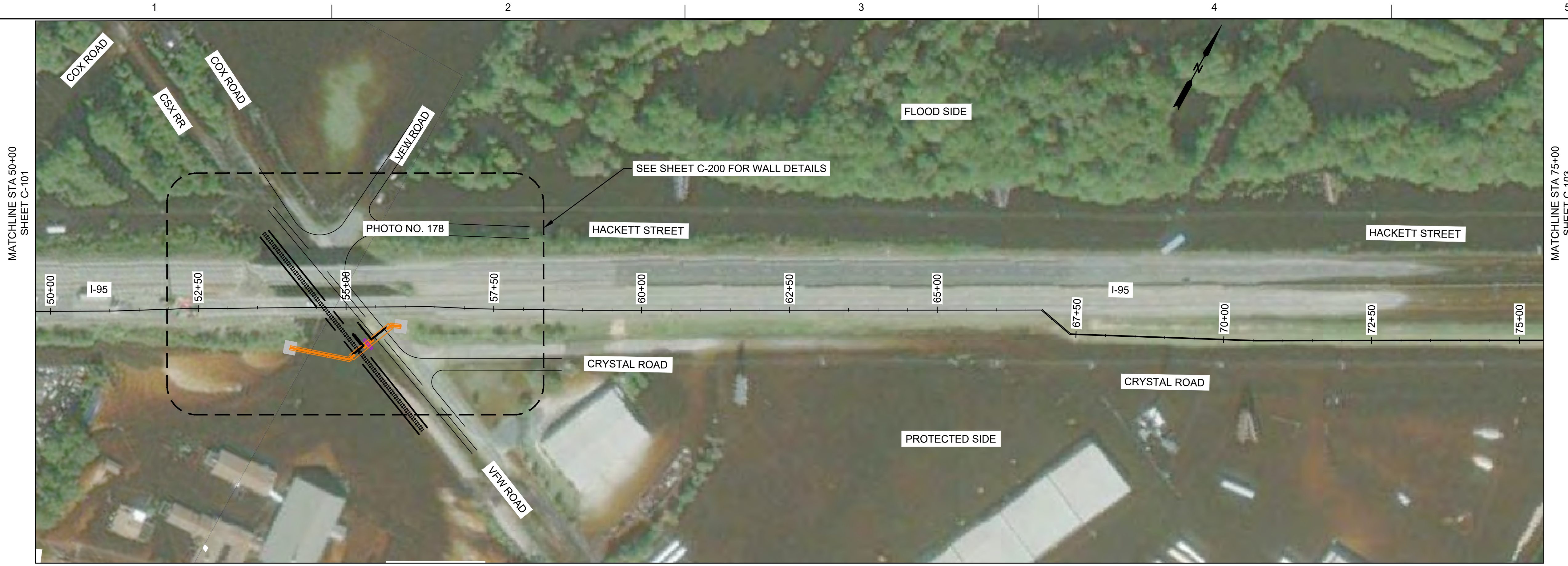
CITY OF LUMBERTON
NORTH CAROLINA
115 S. CEDAR STREET
LUMBERTON, NC 28358

AECOM PROJECT
No. 60548477
1515 PONDRAIS ST STE 2700
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LUMBERTON FLOOD MITIGATION
PLAN AND PROFILE

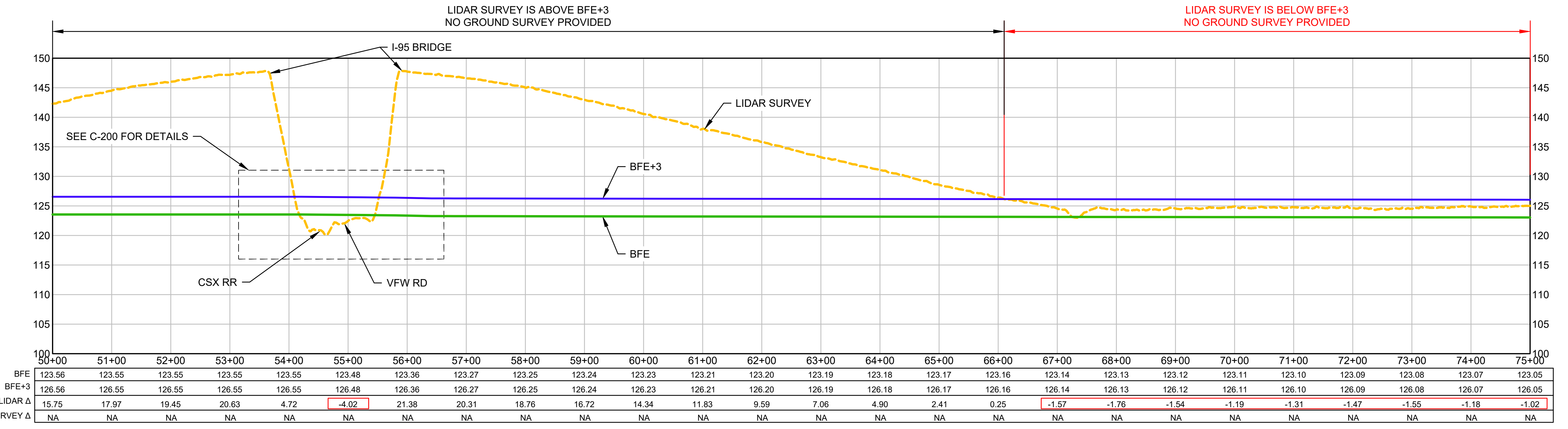
SHEET IDENTIFICATION
C-101

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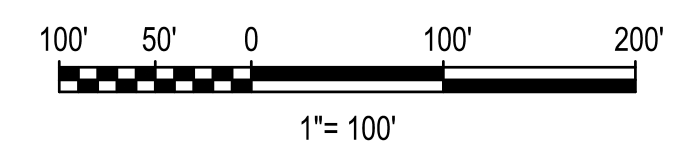


PLAN
SCALE: 1" = 100'

- LEGEND:
- BASE FLOOD ELEVATION (BFE)
 - BASE FLOOD ELEVATION +3' (BFE+3)
 - - - LIDAR SURVEY
 - GROUND SURVEY



PROFILE
SCALE: 1" = 100'



MARK	DESCRIPTION	DATE	APPR

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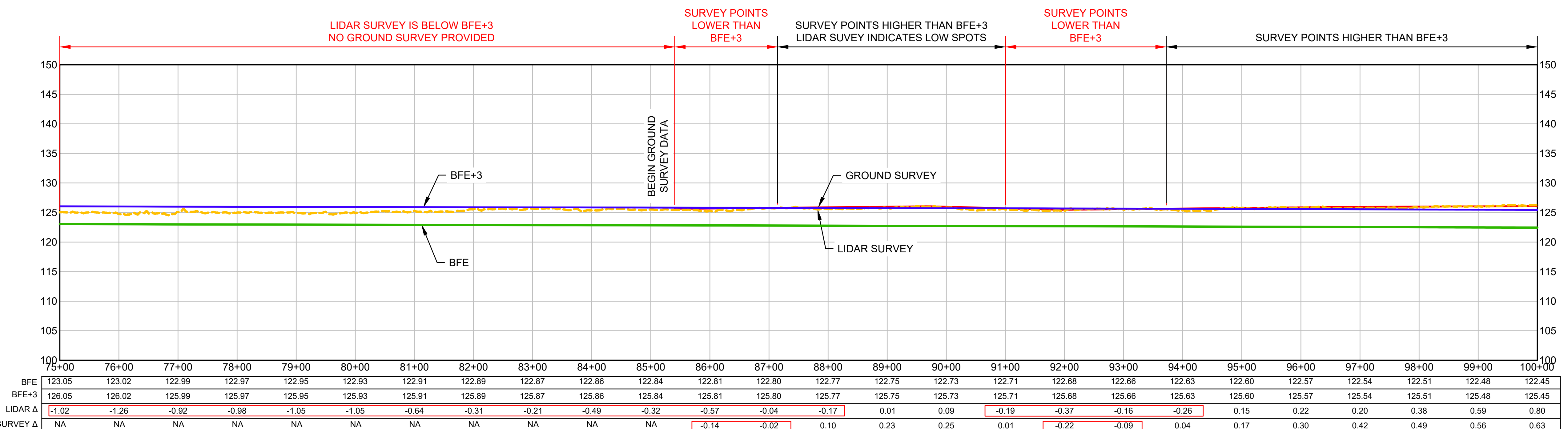
DESIGNED BY:	DATE:	DESIGNED BY:	DATE:
DWN BY:	08/18/2017	CHKD BY:	
SUBMITTED BY:		SUBMITTED BY:	

LUMBERTON FLOOD MITIGATION
PLAN AND PROFILE

SHEET IDENTIFICATION
C-102



PLAN
SCALE: 1" = 100'



PROFILE
SCALE: 1" = 100'

LEGEND:
 — BASE FLOOD ELEVATION (BFE)
 — BASE FLOOD ELEVATION +3' (BFE+3)
 - - LIDAR SURVEY
 — GROUND SURVEY



MARK	DESCRIPTION	DATE	APPR

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PRELIMINARY SUBMITTAL

DESIGNED BY:	DATE:	DESIGNED BY:	DATE:
DWN BY:	08/18/2017	DWN BY:	08/18/2017
SUBMITTED BY:	SOLICITATION NO.:	SUBMITTED BY:	SOLICITATION NO.:
NOTED	NA	NOTED	NA
FILE NAME:	FILE NUMBER:	FILE NAME:	FILE NUMBER:
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LUMBERTON, NC 28358

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No. 0054847

AECOM
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NEW ORLEANS, LA 70112

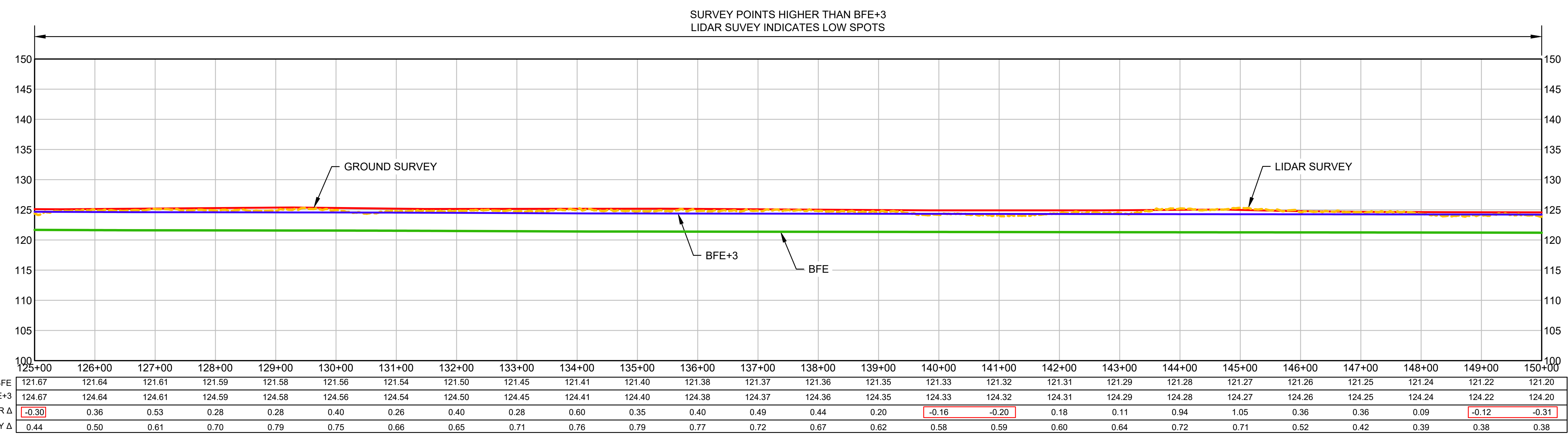
LUMBERTON FLOOD MITIGATION
PLAN AND PROFILE

SHEET IDENTIFICATION
C-103

N:\Projects\Lumberton\CAO\Current Drawings\Plan and Profile.dwg, Aug 18, 2017 - 2:24:20PM, philip.oliver



PLAN
SCALE: 1" = 100'



PROFILE
SCALE: 1" = 100'

LEGEND:
 ——— BASE FLOOD ELEVATION (BFE)
 ——— BASE FLOOD ELEVATION +3' (BFE+3)
 - - - LIDAR SURVEY
 ——— GROUND SURVEY



MARK	DESCRIPTION	DATE	APPR

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PRELIMINARY SUBMITTAL

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DWN BY:	08/18/2017	CHK BY:	08/18/2017
SUBMITTED BY:	SOLICITATION NO.:	FILE NUMBER:	FILE NAME:

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NORTH CAROLINA
115 S CEDAR STREET
LUMBERTON, NC 28558

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No. 60548477
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NEW ORLEANS, LA 70112

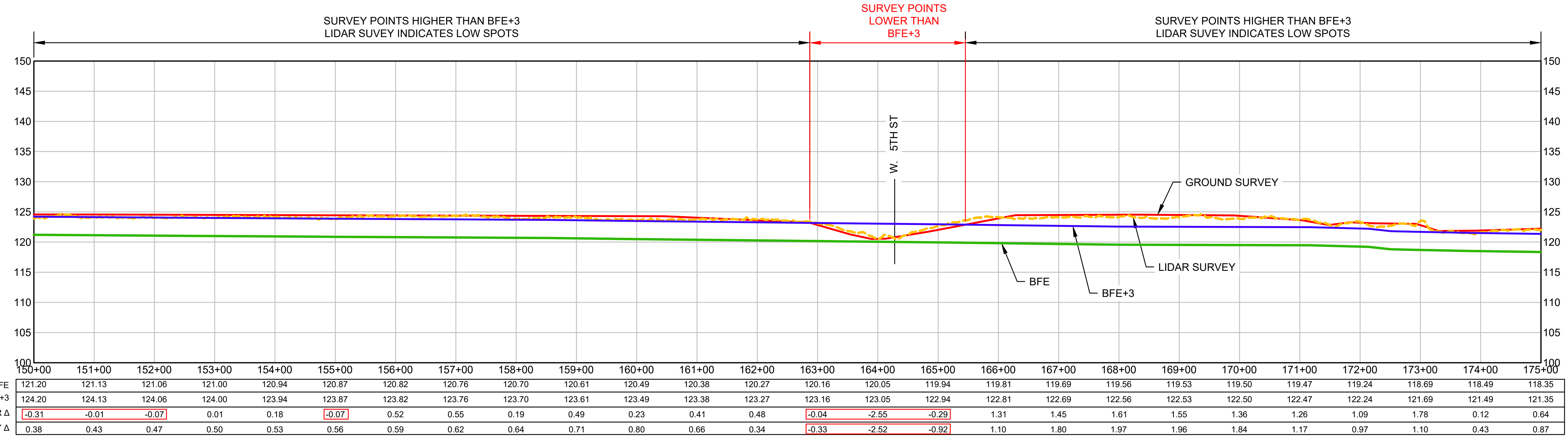
LUMBERTON FLOOD MITIGATION
PLAN AND PROFILE

SHEET IDENTIFICATION
C-105



- LEGEND:**
- BASE FLOOD ELEVATION (BFE)
 - BASE FLOOD ELEVATION +3' (BFE+3)
 - - - LIDAR SURVEY
 - GROUND SURVEY

PLAN
SCALE: 1" = 100'



PROFILE
SCALE: 1" = 100'



MARK	DESCRIPTION	DATE	APPR

**NOT FOR CONSTRUCTION
PRELIMINARY SUBMITTAL**

DESIGNED BY:	DATE:	DESIGNED BY:	DATE:
DWN BY:	AUGUST 2017	DWN BY:	AUGUST 2017
SUBMITTED BY:	SOLICITATION NO.:	SUBMITTED BY:	SOLICITATION NO.:
NOTED	NA	NOTED	NA
FILE NUMBER:	CONTRACT NO.:	FILE NUMBER:	CONTRACT NO.:
NA	60548477	NA	60548477
FILE NAME:	PLOT DATE:	FILE NAME:	PLOT DATE:
ANSI D	NA	ANSI D	NA
CITY OF LUMBERTON NORTH CAROLINA 115 S. CEDAR STREET LUMBERTON, NC 28358	AECOM PROJECT No. 60548477	CITY OF LUMBERTON NORTH CAROLINA 115 S. CEDAR STREET LUMBERTON, NC 28358	AECOM PROJECT No. 60548477

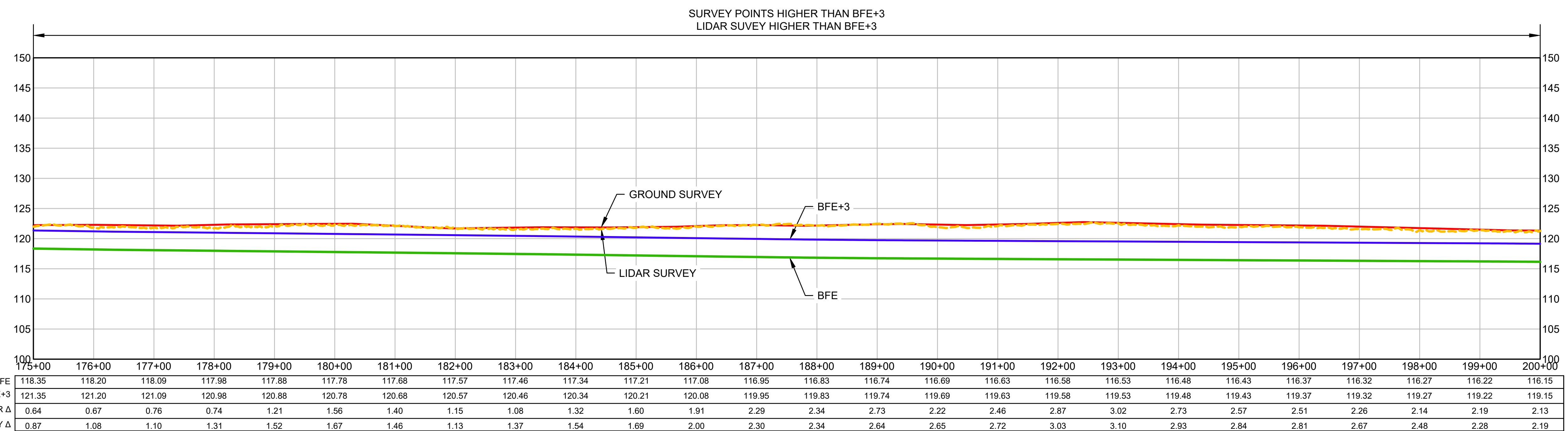
LUMBERTON FLOOD MITIGATION
PLAN AND PROFILE

**SHEET IDENTIFICATION
C-106**



PLAN
SCALE: 1" = 100'

- LEGEND:**
- BASE FLOOD ELEVATION (BFE)
 - BASE FLOOD ELEVATION +3' (BFE+3)
 - - - LIDAR SURVEY
 - GROUND SURVEY



PROFILE
SCALE: 1" = 100'



MARK	DESCRIPTION	DATE	APPR

**NOT FOR CONSTRUCTION
PRELIMINARY SUBMITTAL**

DESIGNED BY:	DATE:	DESIGNED BY:	DATE:
DWN BY:	AUGUST 2017	CHK BY:	
SUBMITTED BY:	SOLICITATION NO.:	SUBMITTED BY:	CONTRACT NO.:
PLOT SCALE:	NA	PLOT SCALE:	60548477
FILE NAME:	FILE NUMBER:	FILE NAME:	FILE NUMBER:
ANSI D:	NA	ANSI D:	NA

**LUMBERTON FLOOD MITIGATION
PLAN AND PROFILE**

**SHEET
IDENTIFICATION
C-107**

D

C

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A

MATCHLINE STA 200+00
SHEET C-107



- LEGEND:**
- BASE FLOOD ELEVATION (BFE)
 - BASE FLOOD ELEVATION +3' (BFE+3)
 - - - LIDAR SURVEY
 - GROUND SURVEY

MATCHLINE STA 225+00
SHEET C-109

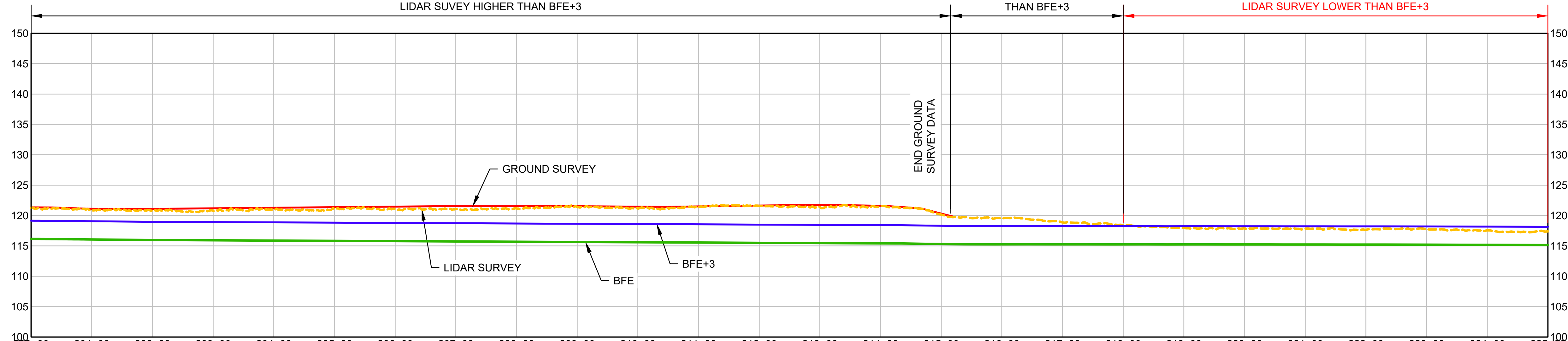
PLAN

SCALE: 1" = 100'

SURVEY POINTS HIGHER THAN BFE+3
LIDAR SURVEY HIGHER THAN BFE+3

LIDAR SURVEY HIGHER THAN BFE+3

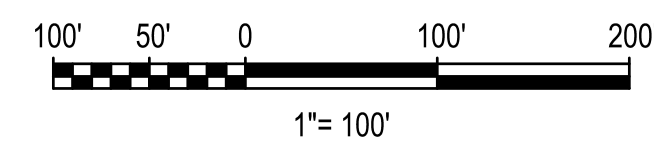
LIDAR SURVEY LOWER THAN BFE+3



	200+00	201+00	202+00	203+00	204+00	205+00	206+00	207+00	208+00	209+00	210+00	211+00	212+00	213+00	214+00	215+00	216+00	217+00	218+00	219+00	220+00	221+00	222+00	223+00	224+00	225+00
BFE	116.15	116.06	115.97	115.93	115.88	115.83	115.78	115.74	115.69	115.64	115.60	115.55	115.51	115.46	115.41	115.31	115.25	115.25	115.25	115.24	115.23	115.23	115.22	115.20	115.18	115.15
BFE+3	119.15	119.06	118.97	118.93	118.88	118.83	118.78	118.74	118.69	118.64	118.60	118.55	118.51	118.46	118.41	118.31	118.25	118.25	118.25	118.24	118.23	118.23	118.22	118.20	118.18	118.15
LIDAR Δ	2.13	1.74	1.78	1.86	2.04	2.23	2.25	2.34	2.49	2.79	2.56	2.89	3.07	2.94	3.10	1.85	1.31	0.61	0.13	-0.31	-0.35	-0.40	-0.57	-0.44	-0.62	-0.76
SURVEY Δ	2.19	2.06	2.12	2.26	2.41	2.54	2.69	2.80	2.86	2.89	2.86	2.95	3.13	3.26	3.19	2.01	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

PROFILE

SCALE: 1" = 100'



MARK	DESCRIPTION	DATE	APPR

**NOT FOR CONSTRUCTION
PRELIMINARY SUBMITTAL**

DESIGNED BY:	DATE:	DESIGNED BY:	DATE:
DWN BY:	08/18/2017	DWN BY:	08/18/2017
SUBMITTED BY:	SOLICITATION NO.:	SUBMITTED BY:	SOLICITATION NO.:
NOTED	NA	NOTED	NA
FILE NUMBER:	FILE NUMBER:	FILE NUMBER:	FILE NUMBER:
NA	NA	NA	NA

CITY OF LUMBERTON
NORTH CAROLINA
115 S. CEDAR STREET
LUMBERTON, NC 28358

AECOM PROJECT
No. 00548447

AECOM
1515 PONDRASS ST STE 2700
NEW ORLEANS, LA 70112

LUMBERTON FLOOD MITIGATION

PLAN AND PROFILE

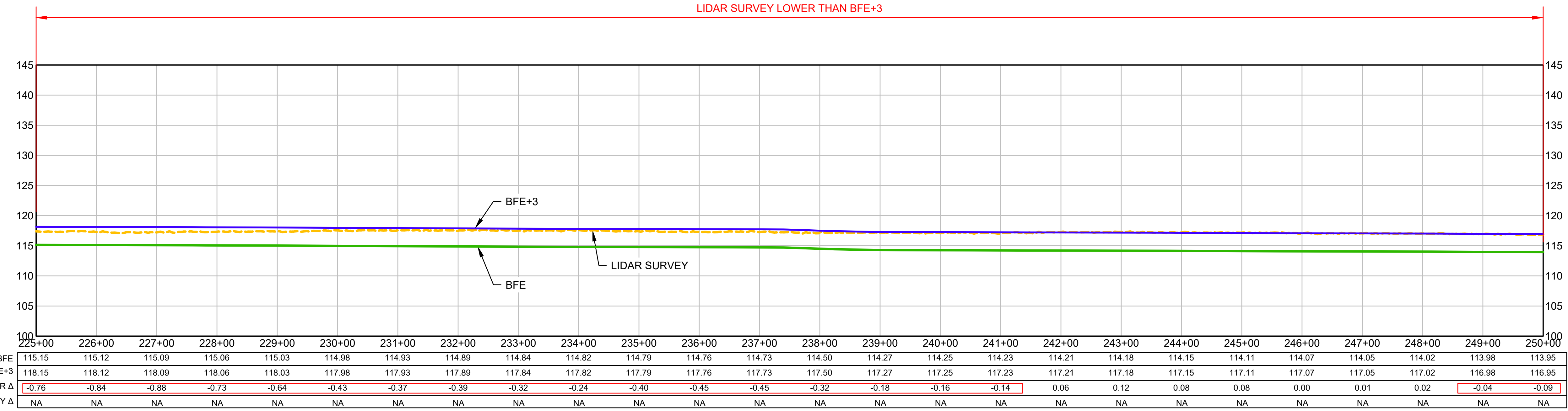
SHEET IDENTIFICATION
C-108

N:\Projects\Lumberton\CAO\Current Drawings\Plan and Profile.dwg, Aug 18, 2017 - 2:29:48PM, philip.olivier

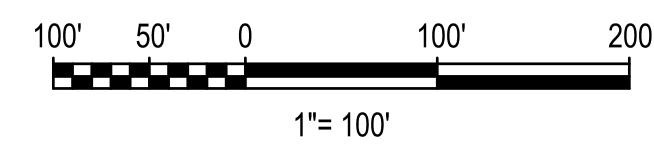


PLAN
SCALE: 1" = 100'

- LEGEND:**
- BASE FLOOD ELEVATION (BFE)
 - BASE FLOOD ELEVATION +3' (BFE+3)
 - - - LIDAR SURVEY
 - GROUND SURVEY



PROFILE
SCALE: 1" = 100'



MARK	DESCRIPTION	DATE	APPR

**NOT FOR CONSTRUCTION
PRELIMINARY SUBMITTAL**

CITY OF LUMBERTON NORTH CAROLINA 115 S. CEDAR STREET LUMBERTON, NC 28358	DESIGNED BY:	DATE:	DESIGNATION NO.:
	DWN BY:	AUGUST 2017	NA
AECOM AECOM PROJECT No. 00548477 1515 PONDRAIS ST STE 2700 NEW ORLEANS, LA 70112	SUBMITTED BY:	CONTRACT NO.:	FILE NUMBER:
	NOTED	00548477	NA
	PLOT SCALE:	PLOT DATE:	FILE NAME:
	ANSI D		

LUMBERTON FLOOD MITIGATION
PLAN AND PROFILE

SHEET
IDENTIFICATION
C-109

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MATCHLINE STA 175+00
SHEET C-106



PLAN
SCALE: 1" = 100'

- LEGEND:
- BASE FLOOD ELEVATION (BFE)
 - BASE FLOOD ELEVATION +3' (BFE+3)
 - - - LIDAR SURVEY
 - GROUND SURVEY



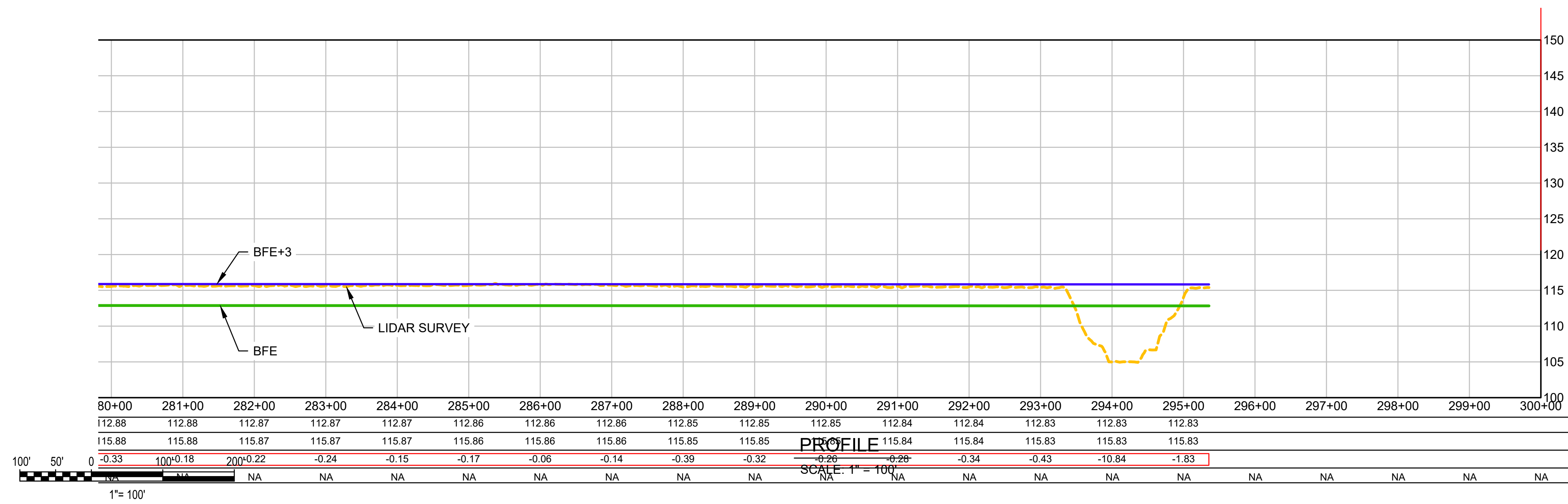
MARK	DESCRIPTION	DATE	APPR

NOT FOR CONSTRUCTION
PRELIMINARY SUBMITTAL

DESIGNED BY:	DATE:	DESIGNED BY:	DATE:
DWN BY:	AUGUST 2017	CHK BY:	
SUBMITTED BY:	SOLICITATION NO.:	SUBMITTED BY:	SOLICITATION NO.:
PLOT SCALE:	NA	CONTRACT NO.:	
NOTED:		FILE NUMBER:	
ANSI D:		FILE NAME:	

LUMBERTON FLOOD MITIGATION
PLAN AND PROFILE

SHEET IDENTIFICATION
C-111



C3 Calibration Results

Table 1. Roughness coefficients used for calibration trial runs

	NLCD Classification	Base N	Min. Value	Max. Value	Final Calibrated N
11	Open Water	0.03	0.025	0.033	0.033
21	Developed, Open Space	0.013	0.01	0.016	0.016
22	Developed, Low Intensity	0.05	0.038	0.063	0.063
23	Developed, Medium Intensity	0.075	0.056	0.094	0.094
24	Developed, High Intensity	0.1	0.075	0.125	0.125
31	Barren Land	0.03	0.025	0.035	
41	Deciduous Forest	0.12	0.1	0.16	
42	Evergreen Forest	0.12	0.1	0.16	
43	Mixed Forest	0.12	0.1	0.16	
52	Scrub/Shrub	0.05	0.035	0.07	
71	Grassland Herbaceous	0.03	0.025	0.035	
81	Pasture/Hay	0.04	0.03	0.05	
82	Cultivated Crops	0.035	0.025	0.045	0.045
90	Woody Wetlands	0.1	0.08	0.15	0.15
95	Emergent Herbaceous Wetland	0.1	0.075	0.15	
	Channel	0.045	0.035	0.05	Override Region 0.065
	Area Upstream of Gate	0.05			
	Black's Tire and Auto Service	0.1			
	I-95	0.013			
	Ponds	0.03			0.033
	Railroad Area	0.02			
	Wetland Upstream of I-95	0.1			
	Wooded Area	0.12			

Hurricane Florence Calibration Results at USGS Gage Location

Table 2. Hurricane Florence water surface elevations for calibration trial runs.

Water Surface Elevation (ft)		
Gage Peak	Base n	Final
119.69	120.02	120.63

Table 3. Hurricane Florence peak discharges for calibration trial runs.

Peak Flow Rate (cfs)		
Gage Peak	Base n	Final
17,100	16,092	15,877

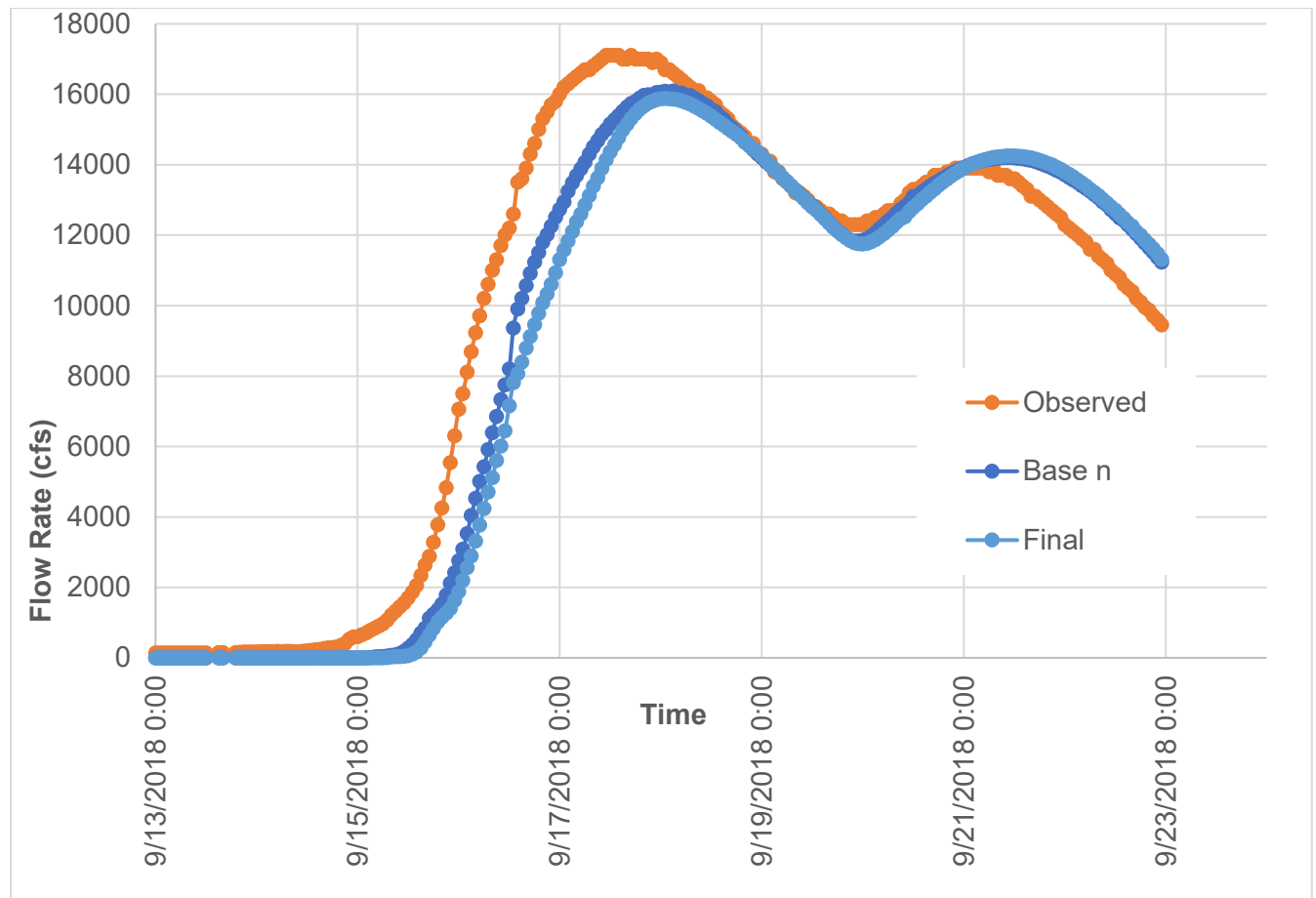


Figure 1- Hurricane Florence hydrographs for calibration trial runs.

Hurricane Matthew Verification Results at USGS Gage Location

Table 4. Hurricane Matthew water surface elevations for verification.

Water Surface Elevation (ft)	
Gage Peak	Verification
119.36	120.42

Table 5. Hurricane Matthew peak discharges for verification

Peak Flow Rate (cfs)	
Gage Peak	Verification
14,600	14,924

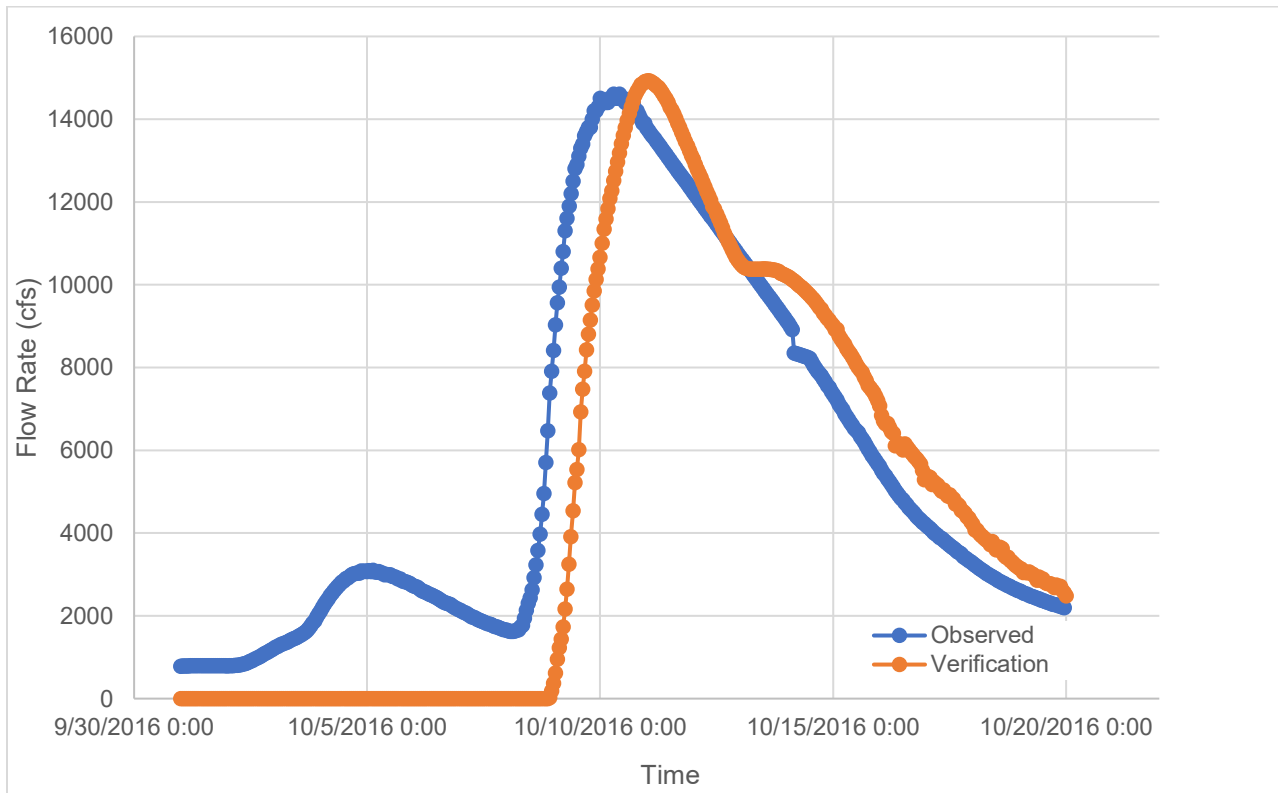


Figure 2. Hurricane Matthew hydrographs for verification run.

C4. Inundation Maps

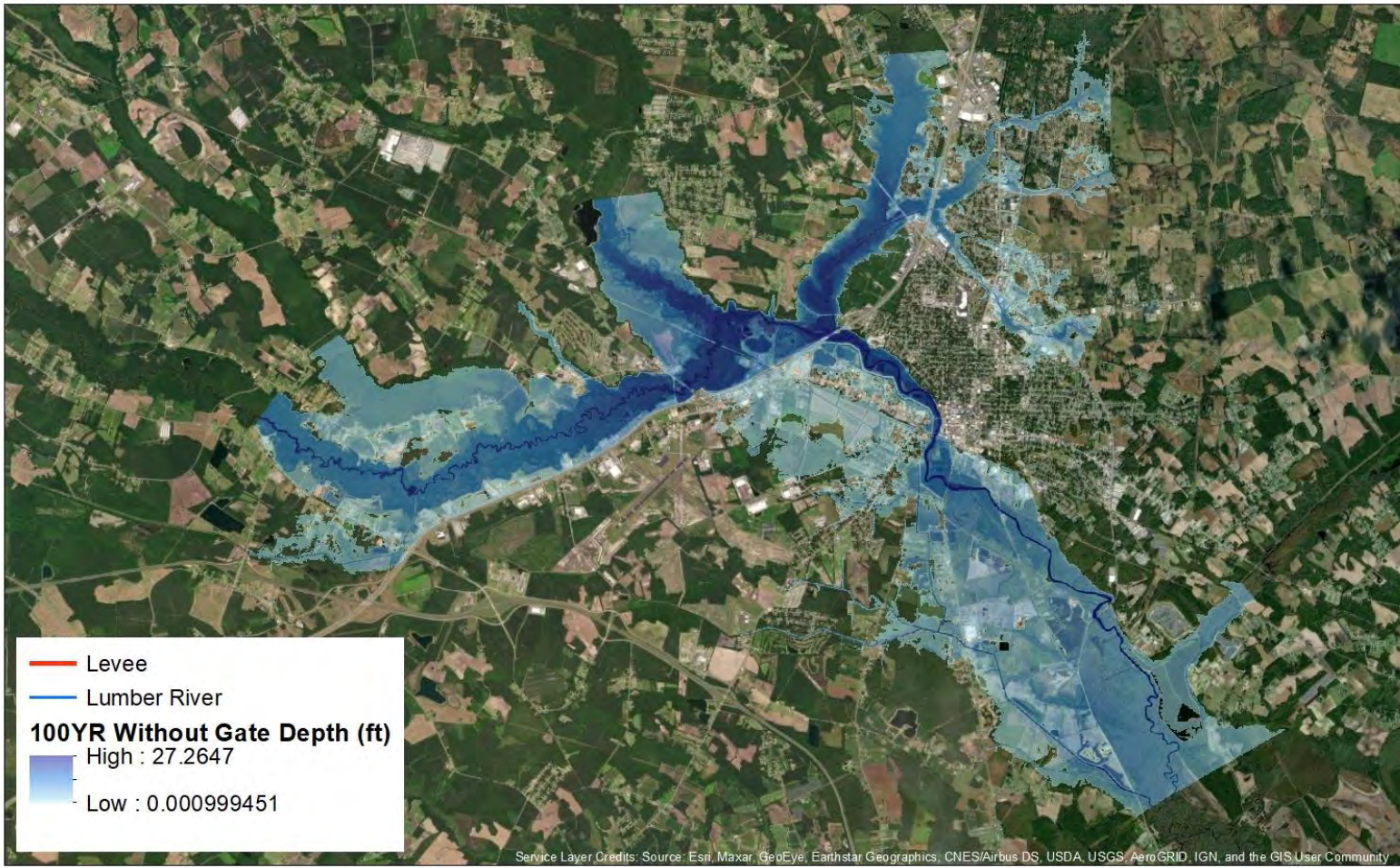


Figure C4-1 – Water depths (ft) for the 100YR flood event during the Scenario - Without Gate.

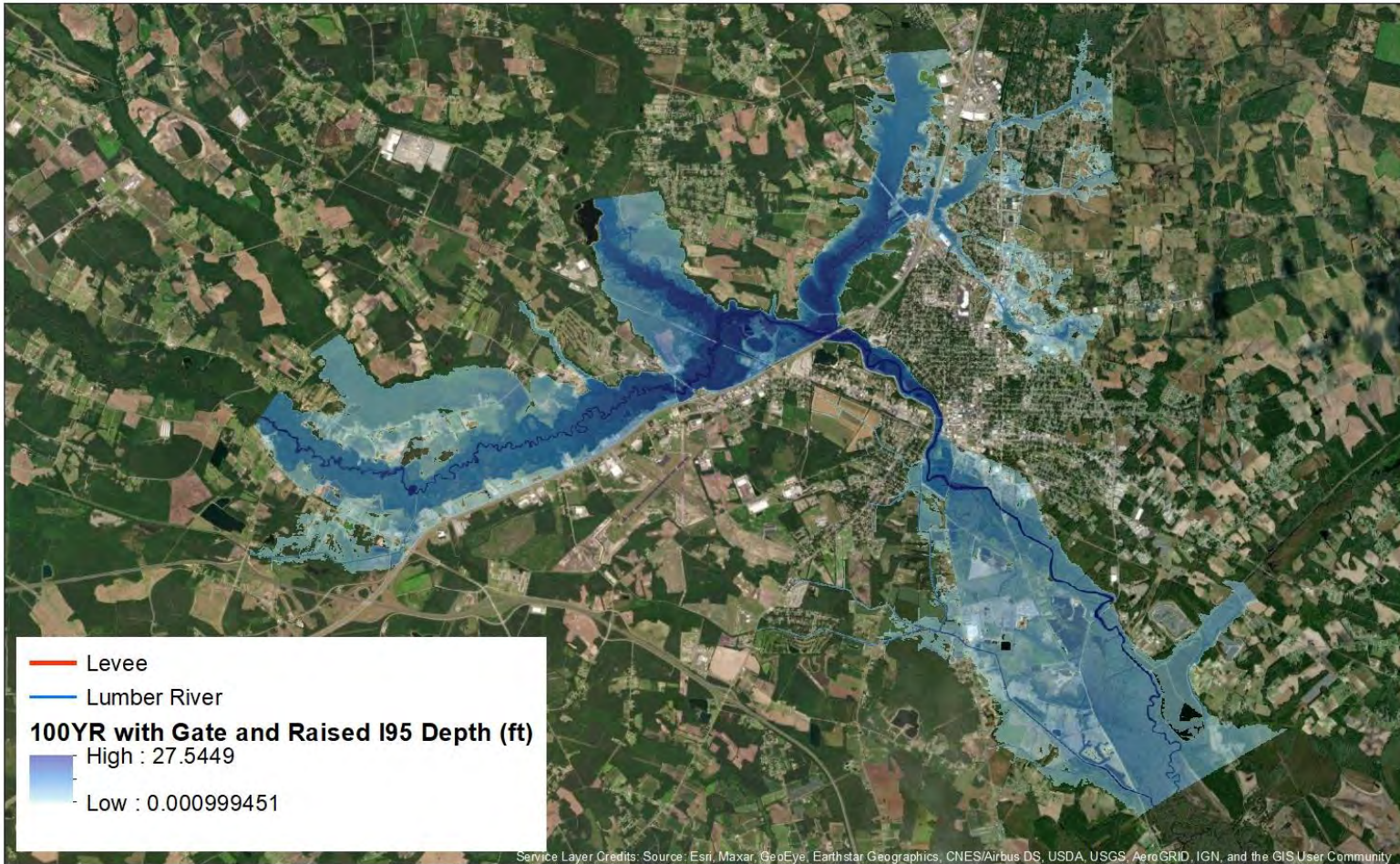


Figure C4-2 – Water depths (ft) for the 100YR flood event during the Scenario – With Gate and I-95 raised

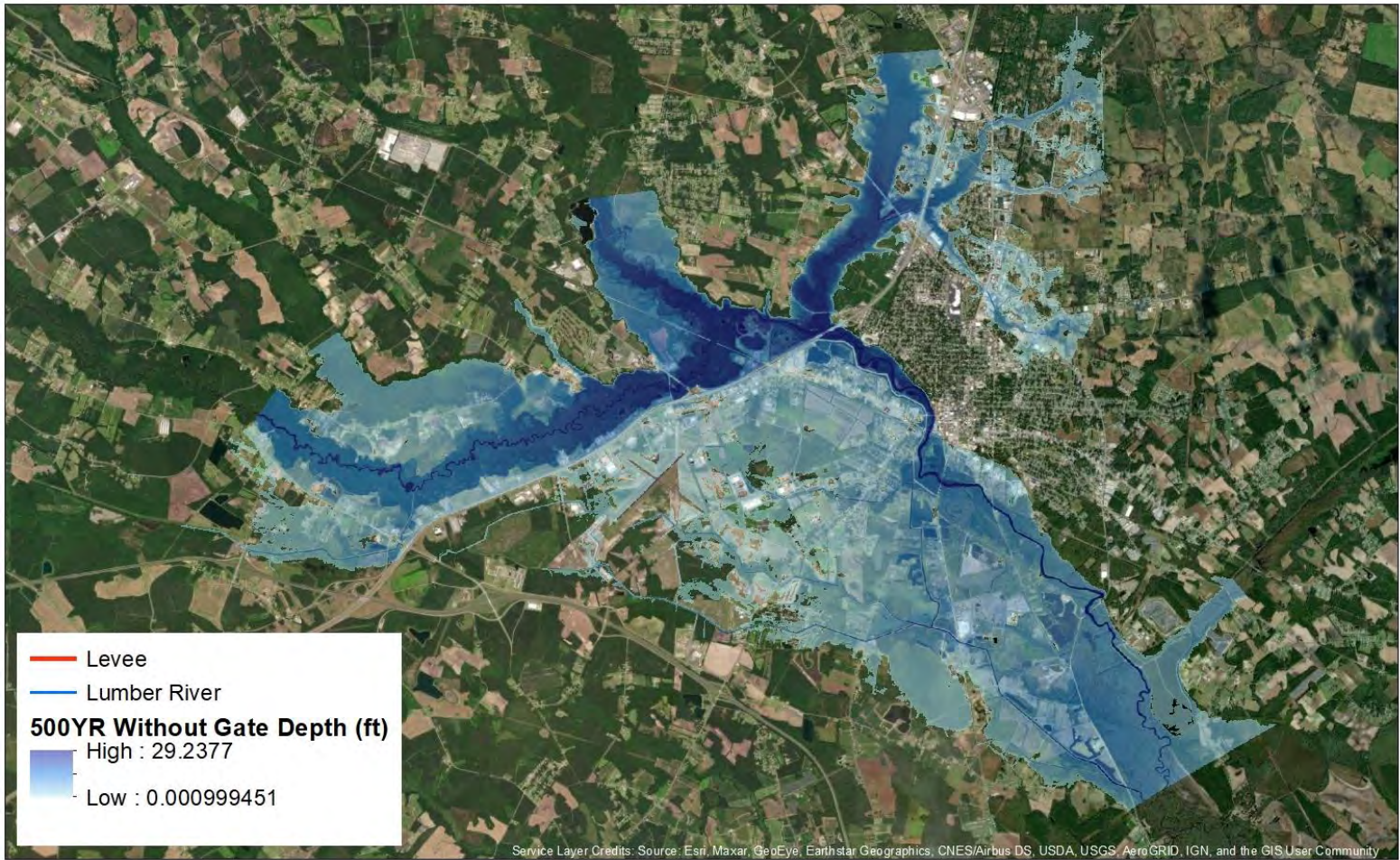


Figure C4-3 – Water depths (ft) for the 500YR flood event during the Scenario - Without Gate.

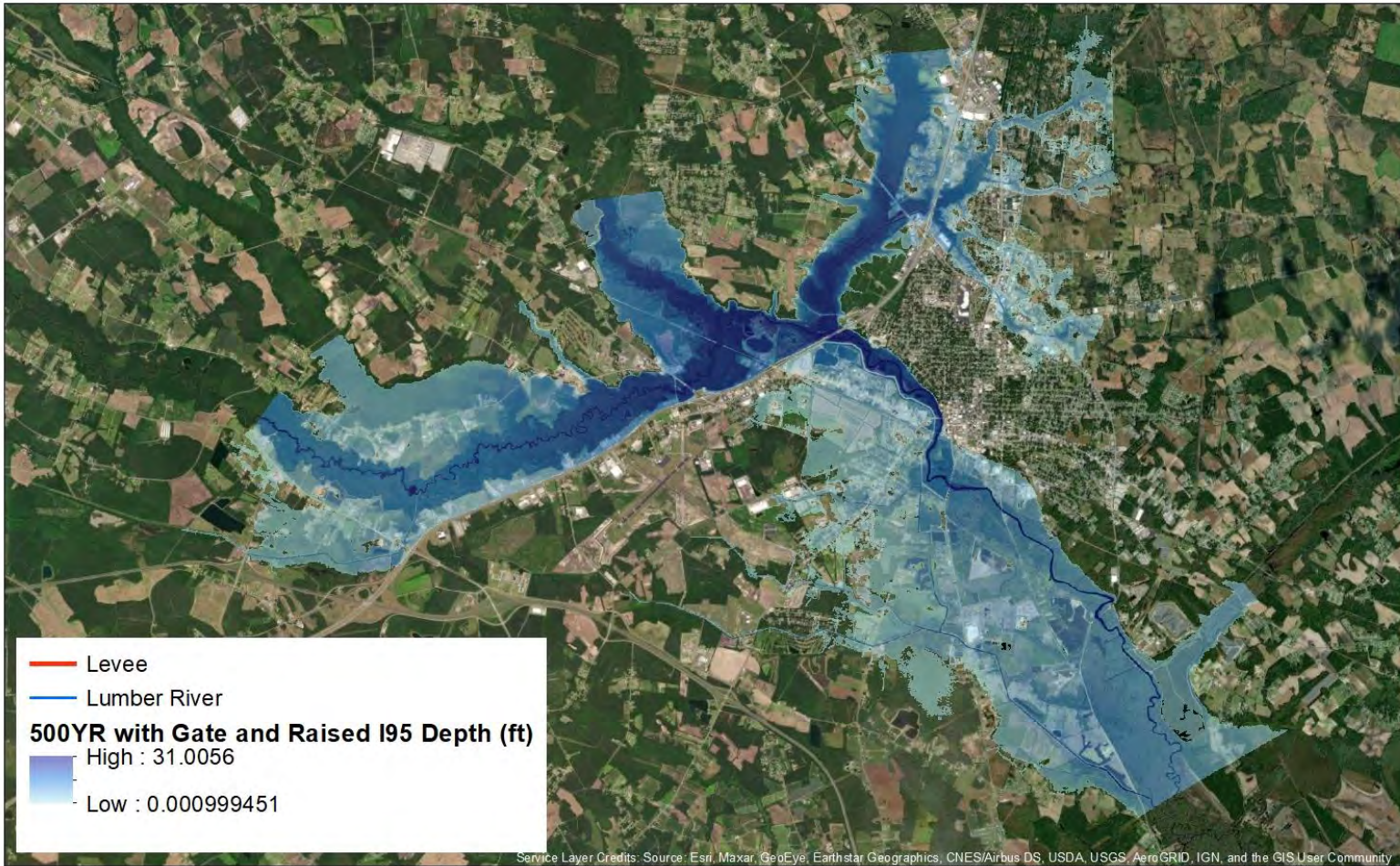


Figure C4-4 – Water depths (ft) for the 500YR flood event during the Scenario – With Gate and I-95 raised.

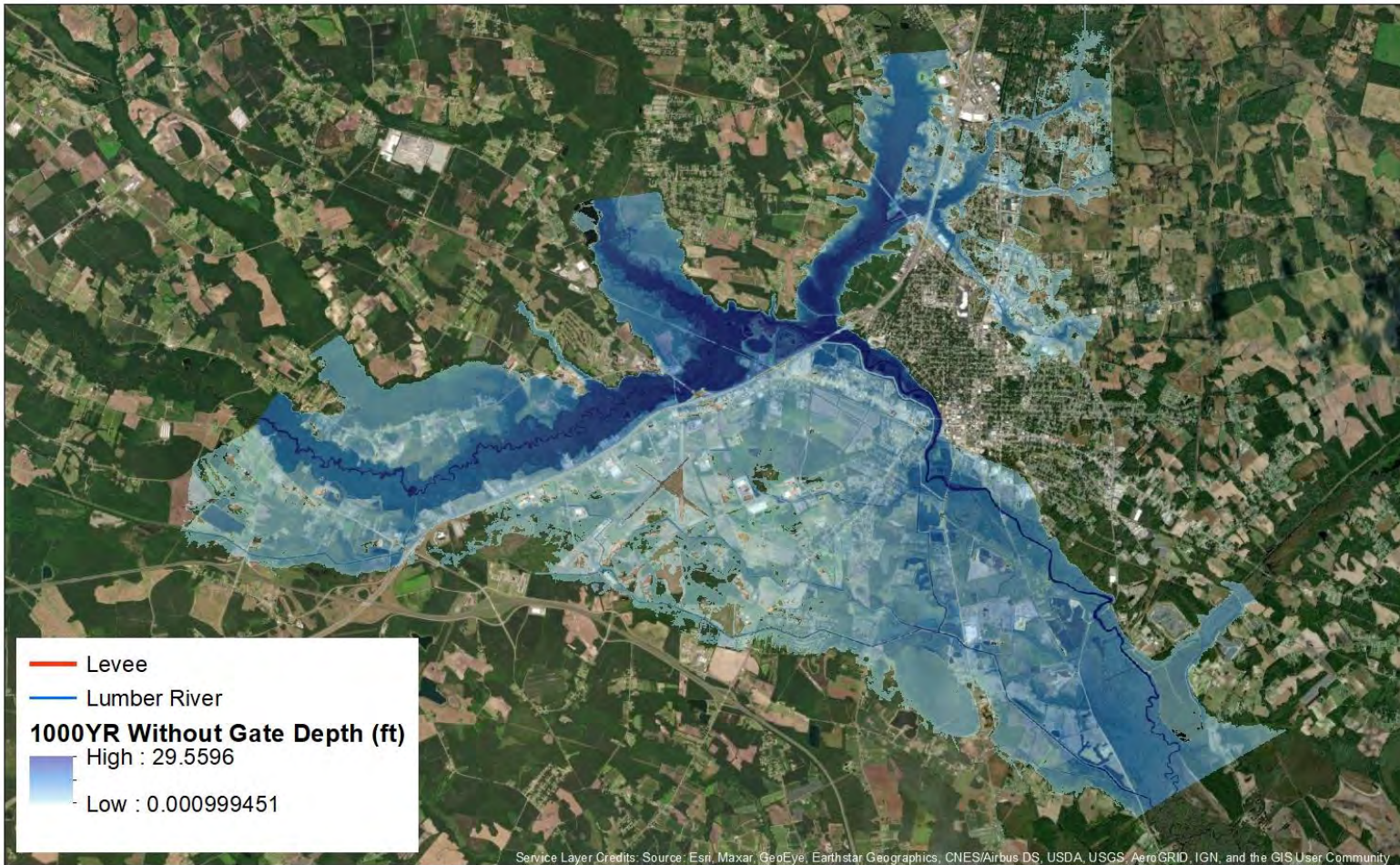


Figure C4-5 – Water depths (ft) for the 1000YR flood event during the Scenario - Without Gate.

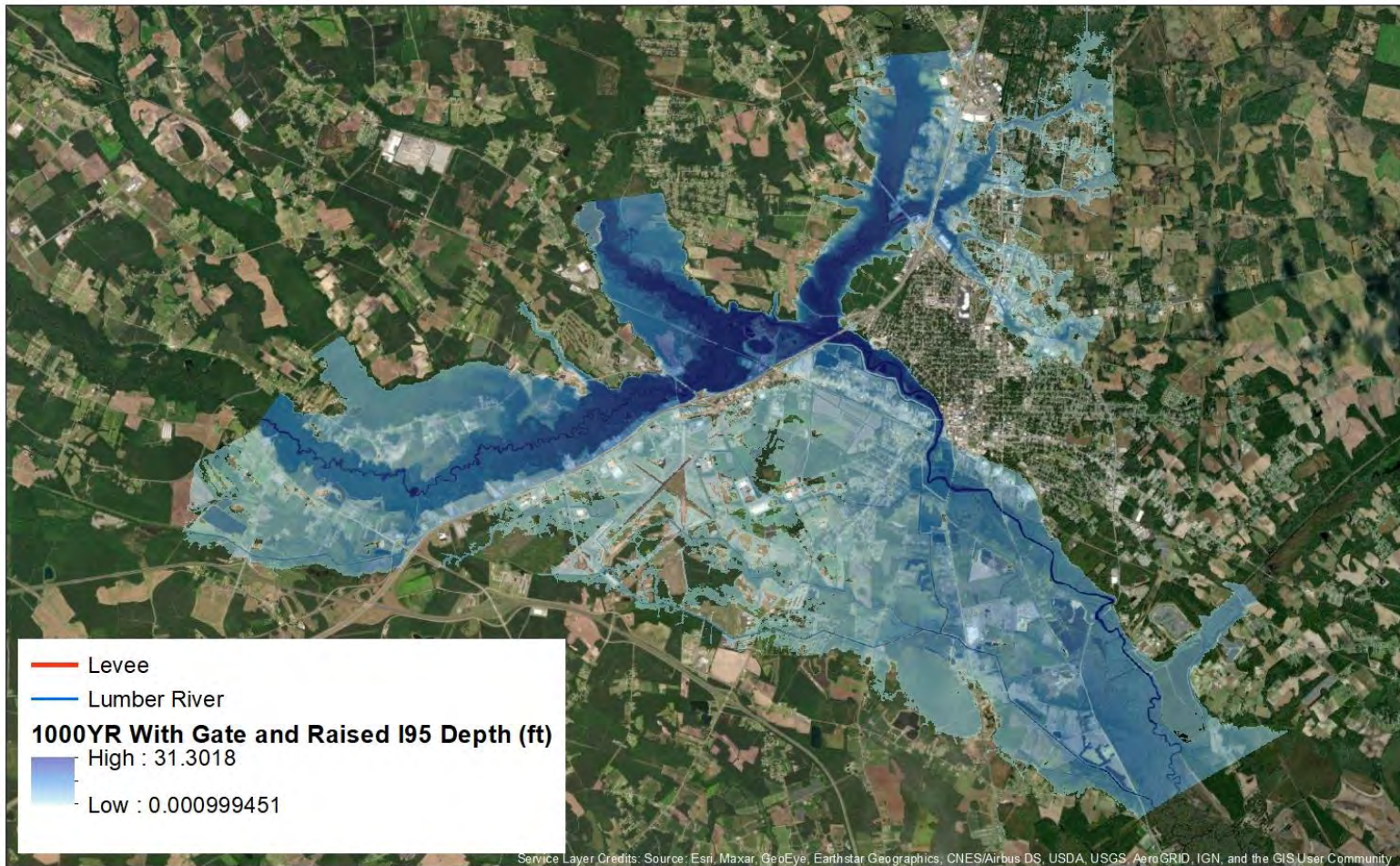


Figure C4-6 – Water depths (ft) for the 1000YR flood event during the Scenario – With Gate and I-95 raised.

Appendix D. Wind Wave Analysis

FIGURES FOR WIND SET-UP AND WAVE RUNUP CALCULATIONS

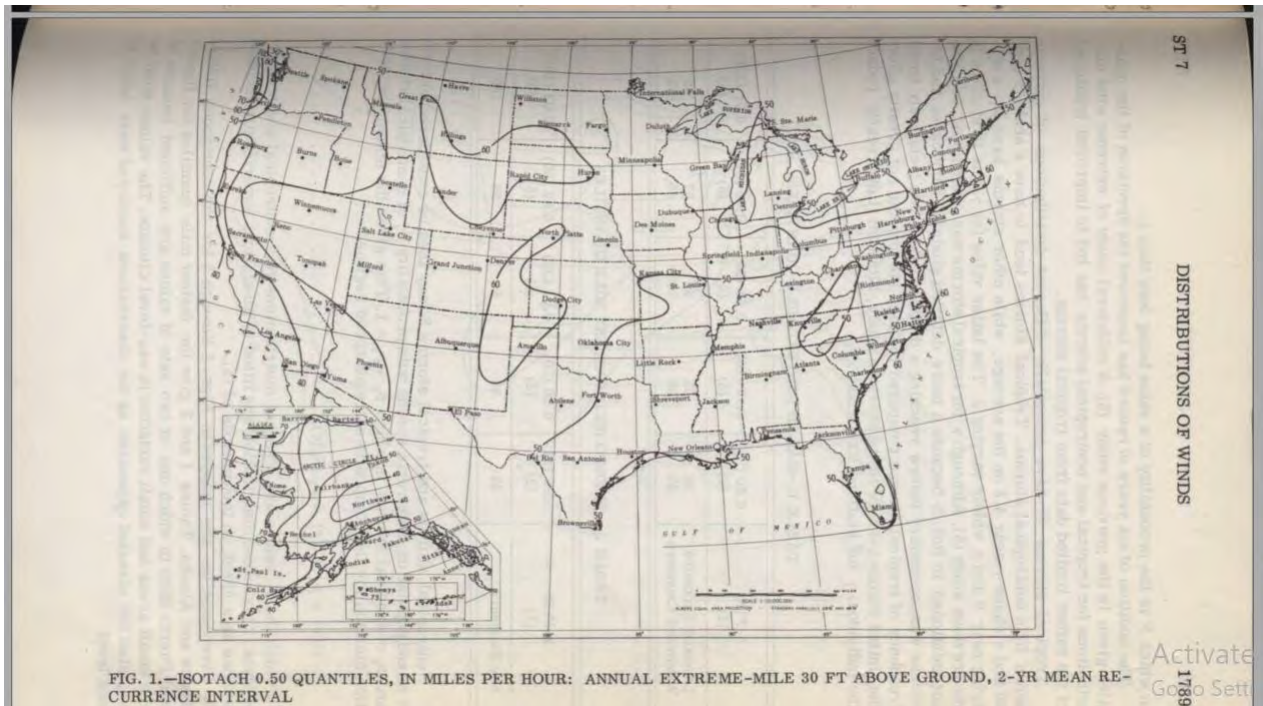


Figure D-1. Isotachs showing wind speeds with a recurrence interval of 2 years over the United States (Thorn, 1968)

Fetch (F_o) in Miles	Wind ratio <u>Over Water</u> <u>Over Land</u>
0.5	1.08
1	1.13
2	1.21
3	1.26
4	1.28
5 (or over)	1.30

Figure D-2 Table for overland to over water conversion of wind speeds from USACE, 1997

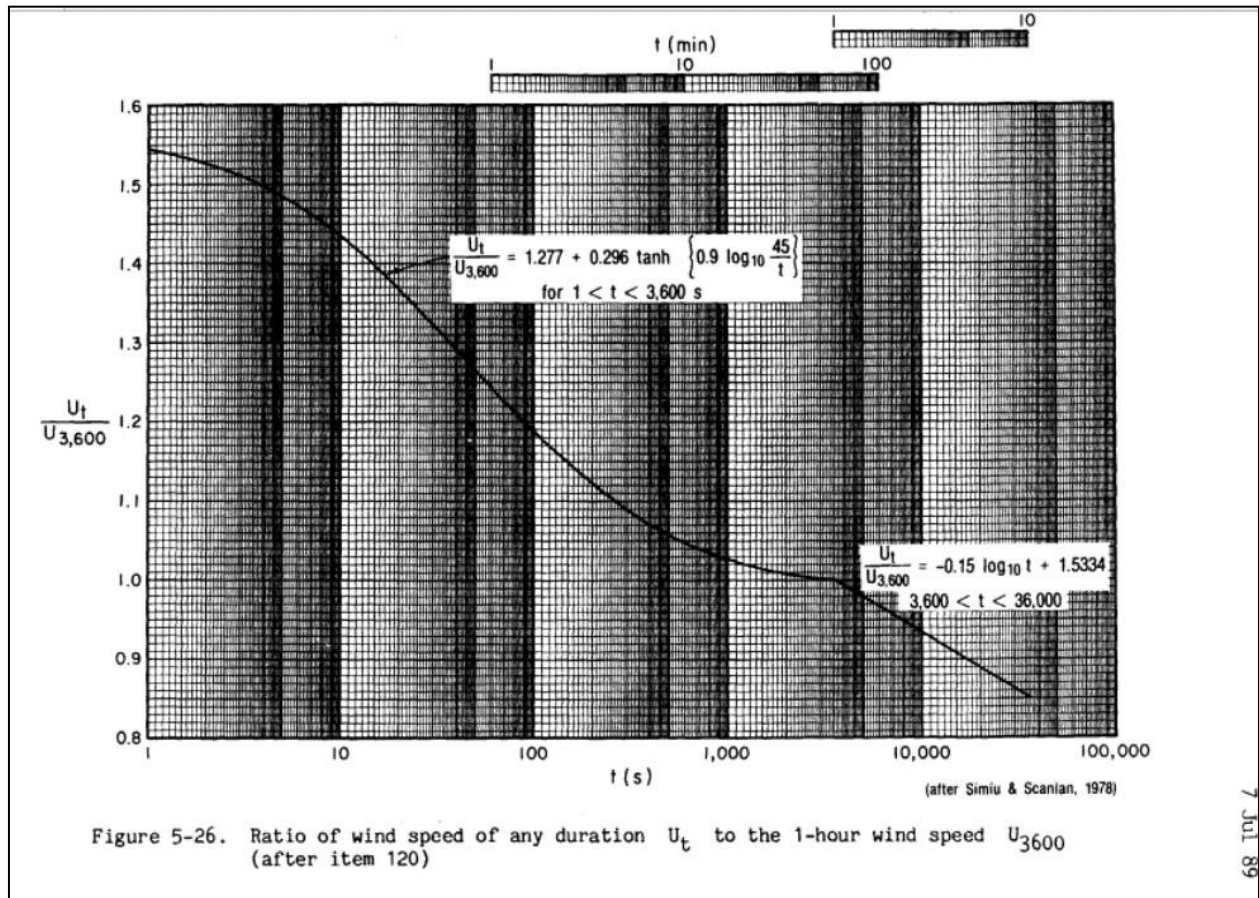


Figure D-3 Chart for converting wind speeds between various averaging intervals from USACE, 1989

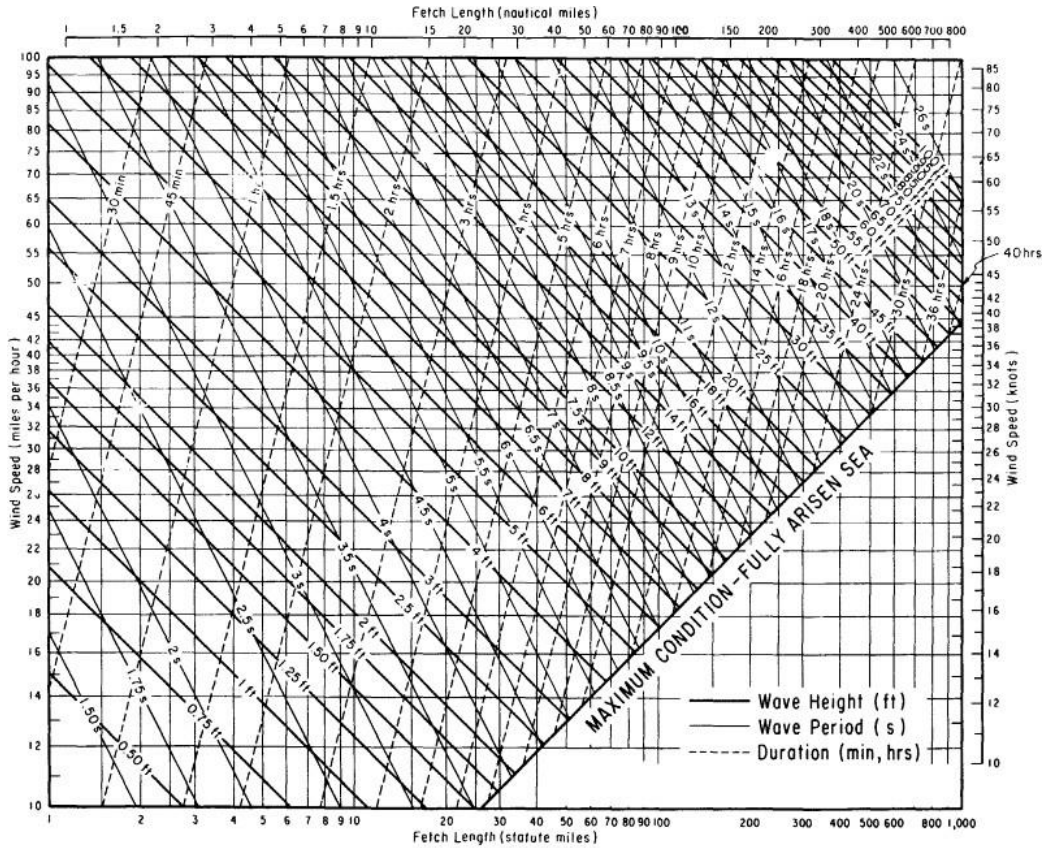


Figure 5-34. Nomograms of deepwater significant wave prediction curves as functions of wind speed, fetch length, and wind duration

Figure D-4 Hindcasting Charts for Deep water Wave Characteristics from USACE, 1989

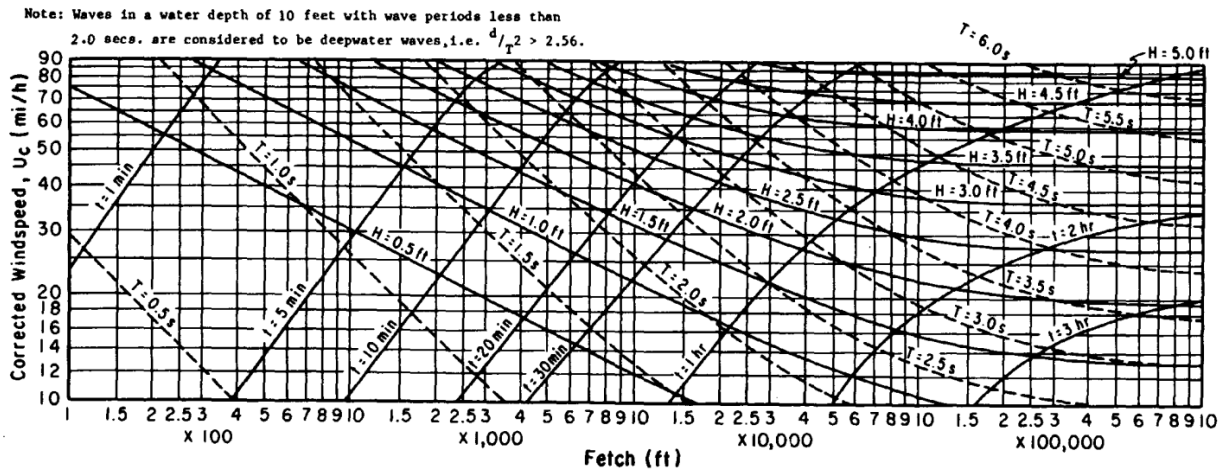


Figure 5-36. Forecasting curves for shallow-water waves (constant depth = 10 ft)

Figure D-5 Hindcasting Charts for Shallow water Wave Characteristics from USACE, 1989

Appendix E. Electronic Attachments

Items submitted electronically are:

1. E1 – Field Data
 - a. F1 – Photo Log
2. E2 – Hydrologic Analysis
 - a. E2.1 – HEC-HMS Model
 - b. E2.2 – Design Flood Hydrographs
 - c. E2.3 – Calibration and Verification Spreadsheets
 - d. E2.4 – Rainfall Hyetographs and Thiessen Polygon Weights
 - e. E2.5 – StreamStats Reports
 - f. E2.6 – USGS Gage Data
 - g. E2.7 – Hydrograph Sensitivity
3. E3 – Hydraulic Analysis
 - a. E3.1 – Final HEC-RAS Model
 - b. E3.2 – Calibration Runs
 - c. E3.3 – Hydraulic Structure Data
4. E4 – Flood Frequency Analysis
 - a. E4.1 – Gage Data Record Extension
 - b. E4.2 – PeakFQ Analysis
 - c. E4.3 – Regional Regression Weighted Peak Flowrates

Atkins North America

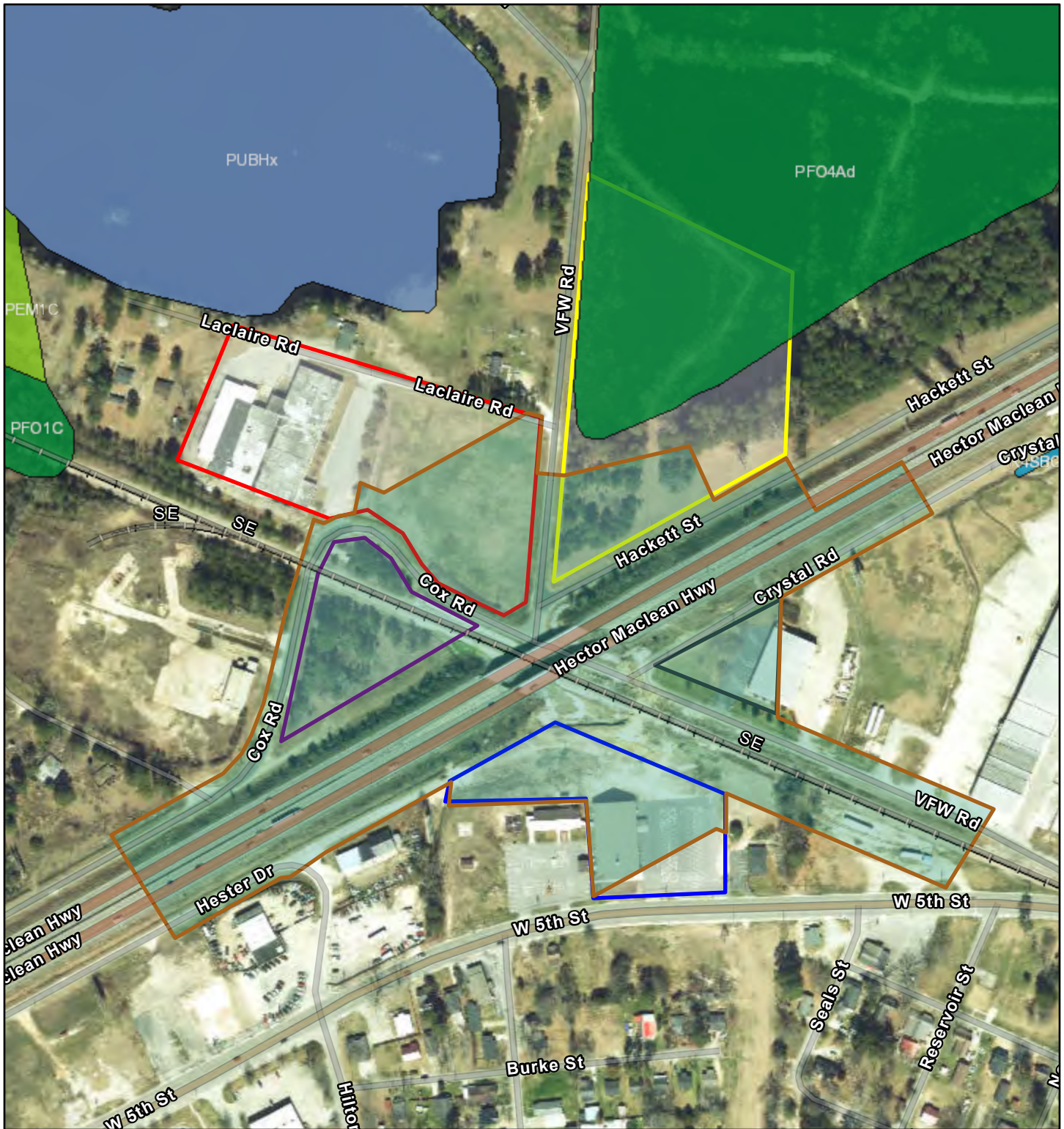
1616 East Millbrook Road
Raleigh, NC
27609

Ken Hunu, PE, DWRE, PMP, CFM
Kenneth.hunu@atkinsglobal.com

© SNC-Lavalin except where stated otherwise

- **USFWS NWI Map**
- **Total Wetlands Area Map**
- **USACE Correspondence**

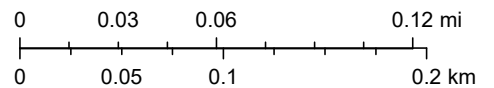
West Lumberton Flood Gate - NWI Map



December 1, 2023

1:4,514

- | | |
|-----------------------------------|-----------------------------|
| Wetlands | Riverine |
| Estuarine and Marine Deepwater | WLFG Project Action Area |
| Estuarine and Marine Wetland | 550 VFW Rd #938189443052 |
| Freshwater Emergent Wetland | 2306 W 5th St #938189201500 |
| Freshwater Forested/Shrub Wetland | 2400 Cox Rd #938179684407 |
| Freshwater Pond | 2460 Cox Rd #938179143700 |
| Lake | VFW & Hackett #938280300700 |
| Other | Railroads |



U.S. Fish and Wildlife Service, National Standards and Support Team, wetlands_team@fws.gov, NC CGIA, Maxar, Esri Community Maps Contributors, State of North Carolina DOT, © OpenStreetMap, Microsoft, Esri, HERE, Garmin, SafeGraph, GeoTechnologies, Inc, METI/NASA, USGS, EPA, NPS, US Census Bureau, USDA, EPA OEI

West Lumberton Flood Gate – Total Wetlands Area Map



Gievers, Andrea

From: Gievers, Andrea
Sent: Monday, December 20, 2021 12:06 PM
To: Beecher, Gary H CIV USARMY CESAW (USA)
Cc: Hair, Sarah E CIV USARMY CESAW (USA); matt.cusack@atkinsglobal.com; Sachan, Amit
Subject: FW: West Lumberton Flood Gate Project (Previous Correspondence)
Attachments: I-95 Flood Gate Lidar.pdf; WLFG CONCEPTUAL Plan 11.3.21.pdf

Hello:

Please see the email below from August 18, 2020 regarding the West Lumberton Flood Gate project. Matt Cusack is the contact along with Amit Sachan at Atkins, cc'd on this email. The original design was located on the eastern side and the current proposal is for the *western* side of I-95. I am attaching the conceptual plan as well. As you can see in the emails below, the proposed project is being conducted in concert with the I-95 widening team. Please let me know if you have any questions. Thank you.

Sincerely,

Andrea

Andrea Gievers, JD, MSEL, ERM
Environmental SME
Community Development
NC Office of Recovery and Resiliency
Andrea.L.Gievers@Rebuild.NC.Gov
(845) 682-1700

From: Beecher, Gary H CIV USARMY CESAW (USA) <Gary.H.Beecher@usace.army.mil>
Sent: Tuesday, August 18, 2020 8:26 AM
To: Cusack, Matthew T <matt.cusack@atkinsglobal.com>
Cc: Hair, Sarah E CIV CESAW CESAD (US) <Sarah.E.Hair@usace.army.mil>; Mickey Sugg <Mickey.t.sugg@usace.army.mil>
Subject: RE: City of Lumberton floodgate project overlapped by I-6064 DRAFT waters of the US Delineations

Mr. Cusack,

Based on the Lidar Image and Soils Map for the site it does appear that the proposed project area will not be in wetlands or Waters of the US.

I can write a No Permit Required, however I must issue an Approved JD with it. I've attached a Jurisdictional Determination Request Form for you to fill out. If you already have one filled out, please send it to me.

Respectfully,

Gary

From: Hair, Sarah E CIV CESAW CESAD (US) <Sarah.E.Hair@usace.army.mil>
Sent: Monday, August 17, 2020 2:33 PM
To: Beecher, Gary H CIV USARMY CESAW (USA) <Gary.H.Beecher@usace.army.mil>; Sugg, Mickey T CIV USARMY CESAW

(USA) <Mickey.T.Sugg@usace.army.mil>

Subject: RE: City of Lumberton floodgate project overlapped by I-6064 DRAFT waters of the US Delineations

Gary/Mickey,

I issued a PJD for the NC DOT I-6064 project (I-95 widening). If the City of Lumberton is asking for a No permit required, then I believe you would need to do an AJD for the project area. I believe the site is all uplands based on the PJD and information provided by Matt Cusack.

Please let me know if you have any questions.

Liz

From: Cusack, Matthew T <matt.cusack@atkinglobal.com>

Sent: Monday, August 17, 2020 2:22 PM

To: Beecher, Gary H CIV USARMY CESAW (USA) <Gary.H.Beecher@usace.army.mil>; Hair, Sarah E CIV CESAW CESAD (US) <Sarah.E.Hair@usace.army.mil>

Cc: Boot, Robert A <Robert.Boot@atkinglobal.com>; Price, Gregory W <gwprice2@ncdot.gov>; Huff, Christy <chuff@ncdot.gov>; Sachan, Amit <Amit.Sachan@atkinglobal.com>; rarmstrong@ci.lumberton.nc.us

Subject: [Non-DoD Source] RE: City of Lumberton floodgate project overlapped by I-6064 DRAFT waters of the US Delineations

Greetings Mr. Beecher,

I am following up with regards to this email below. I also tried to reach your office voicemail, which instructed me to correspond with you via email.

There are more project details below, but the essential question is whether you will agree to use the NCDOT data from I-6064 to issue a "No Permit Required" form for the City of Lumberton's floodgate project, or whether independent project review is required. The NCDOT data is current, and has recently been reviewed by Ms. Hair.

Please let me know if you would like to setup a Webex to screenshare and discuss this request and the associated information we have that is pertinent.

Thanks!

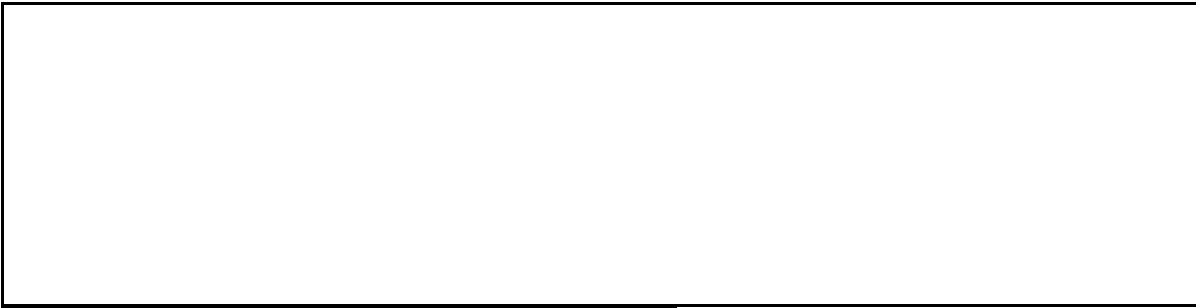
Best,
Matt

Matt Cusack PWS

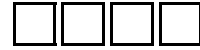
Senior Project Manager/Scientist, Technical Professional Organization
North America
Engineering, Design, and Project Management

919-431-5255 919-800-1234

1616 E. Millbrook Road, Suite 160, Raleigh, NC 27609



Company



From: Cusack, Matthew T
Sent: Friday, June 12, 2020 8:52 AM
To: gary.h.beecher@usace.army.mil; sarah.e.hair@usace.army.mil
Cc: Boot, Robert A <Robert.Boot@atkinglobal.com>; Price, Gregory W <gwprice2@ncdot.gov>; Huff, Christy <chuff@ncdot.gov>; Sachan, Amit <Amit.Sachan@atkinglobal.com>; rarmstrong@ci.lumberton.nc.us
Subject: City of Lumberton floodgate project overlapped by I-6064 DRAFT waters of the US Delineations

Greetings,

For the benefit of this email, please see a screen capture below for an overlap area between a proposed natural resources Study Area related to the City of Lumberton’s flood gate project and the I-6064 corridor that Liz Hair is currently reviewing for NCDOT. The flood gate project is possibly new to USACE regulatory, but Civil Works has been involved. The proposed floodgate is located where the CSX rail line and Cox Rd/VFW Road passes under I-95 centered at 34.6227789,-79.0329097.

We understand that Liz has been working with NCDOT to evaluate delineations performed by their consultants for I-6064. Through coordination with NCDOT, Atkins and the City of Lumberton have determined that the entire natural resources Study Area for flood gate project has already been evaluated for I-6064. Further, the entirety of the City’s Study Area did not have any waters of the U.S. features. Please see the Study Area for the flood gate project (red outline below) appears to contain no waters of the US. Correspondence with NCDOT is also provided below.

To support everyone’s goal of avoiding overlapping work between these projects, the City of Lumberton would like to rely upon NCDOT’s findings for the flood gate project once Liz has completed her review. This would include the PJD and NRTR prepared by NCDOT (when available) as basis for the environmental documentation related to waters of the U.S. for the proposed floodgate. **All we need right now is agreement from Gary that he will consider those resources when they are available, and will be willing to issue a “No Permit Required” determination for the City’s Study Area if the documents approved by Liz for NCDOT end up demonstrating what is explained in this email.**

Please let me know if that is an agreeable plan. If you have any questions, please let Amit Sachan and/or me know and we can set up a teleconference to better describe this situation. I am available to coordinate as necessary.

Best,
Matt

Yellow is I-6064 Study Limits with blue/white depicting waters of the US as identified by NV5. Red is the natural resources study area for the City of Lumberton floodgate project



Matt Cusack *PWS*
Senior Project Manager/Scientist, Technical Professional Organization
North America
Engineering, Design, and Project Management

919-431-5255 919-800-1234

1616 E. Millbrook Road, Suite 160, Raleigh, NC 27609

Company

From: Rerko, James J <jjrerko@ncdot.gov>
Sent: Tuesday, May 19, 2020 9:37 AM
To: Cusack, Matthew T <matt.cusack@atkinglobal.com>; Huff, Christy <chuff@ncdot.gov>; Price, Gregory W <gwprice2@ncdot.gov>
Cc: Boot, Robert A <Robert.Boot@atkinglobal.com>; Heather Wallace <Heather.Wallace@nv5.com>; Nick Mountcastle <Nick.Mountcastle@nv5.com>; Sachan, Amit <Amit.Sachan@atkinglobal.com>; rarmstrong@ci.lumberton.nc.us
Subject: RE: [External] City of Lumberton floodgate project overlapped by I-6064 DRAFT Wetland Delineations

Matt

I am fine with the plan. We are getting together with the Corps and DWR virtually to start the review today.

James J. Rerko, PWS

Project Development and Environmental Analysis Engineer
North Carolina Department of Transportation

910 364-0834 office
910 486 1959 fax
jjrerko@ncdot.gov Email

1000 Transportation Drive
Fayetteville, NC 28302



Email correspondence to and from this address is subject to the North Carolina Public Records Law and may be disclosed to third parties.

From: Cusack, Matthew T <matt.cusack@atkinsglobal.com>
Sent: Monday, May 18, 2020 7:43 PM
To: Huff, Christy <chuff@ncdot.gov>; Rerko, James J <jjrerko@ncdot.gov>; Price, Gregory W <gwprice2@ncdot.gov>
Cc: Boot, Robert A <robert.boot@atkinsglobal.com>; Heather Wallace <Heather.Wallace@nv5.com>; Nick Mountcastle <Nick.Mountcastle@nv5.com>; Sachan, Amit <amit.sachan@atkinsglobal.com>; rarmstrong@ci.lumberton.nc.us
Subject: [External] City of Lumberton floodgate project overlapped by I-6064 DRAFT Wetland Delineations

CAUTION: External email. Do not click links or open attachments unless you verify. Send all suspicious email as an attachment to report.spam@nc.gov

Greetings,

For the benefit of this email, please see a screen capture of the overlap area between the I-6064 corridor and the natural resources Study Area for the City of Lumberton's flood gate project.

I understand that NCDOT and it's consultants are waiting on a field concurrence meeting with the USACE to approve the delineation for I-6064. I am also curious if the other environmental work, specifically the protected species surveys, identified anything that isn't resolved at this location in Lumberton where the rail line and Cox Rd/VFW Road passes under I-95 centered at 34.6227789,-79.0329097.

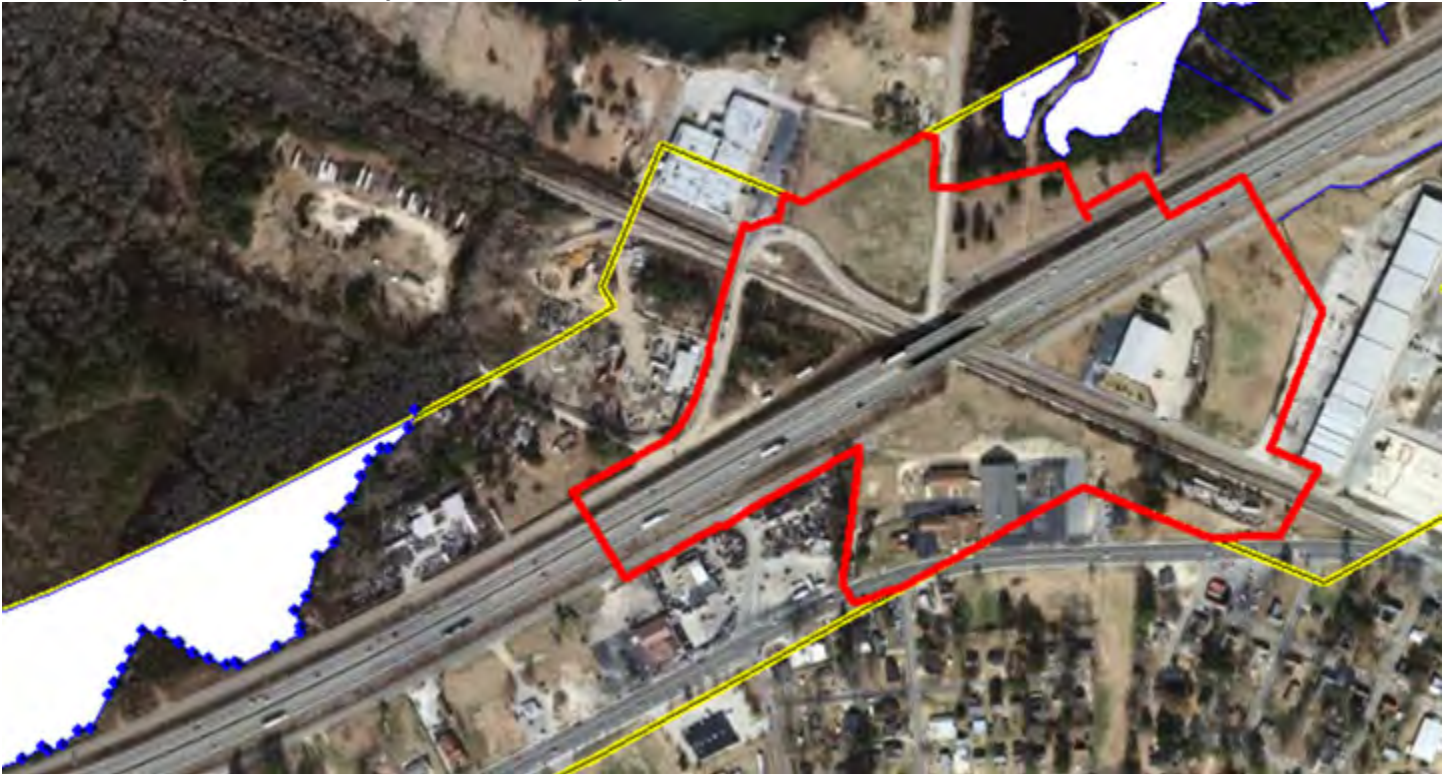
To support everyone's goal of avoiding overlapping work between these projects, we would like to rely upon NCDOT's findings for our project. This would include the PJD and NRTR prepared for NCDOT (when available) as our basis for our environmental documentation. Since my understanding is that the City's Study Area (red outline below) appears to

contain no waters of the US or protected species (assumption), this seems to be the logical choice. Obviously, we don't need NCDOT's documents at this time, but I wanted to confirm there isn't an issue of the City proceeding in this manner. If NCDOT is amenable to this approach, Atkins will reach out to the NCDOT and private Corps reps and confirm that our project will be relying upon NCDOT's findings and environmental documentation and that our project has no impacts.

Please let me know if that is an agreeable plan. If you have any questions, please let Amit Sachan and/or me know and we can coordinate as necessary.

Best,
Matt

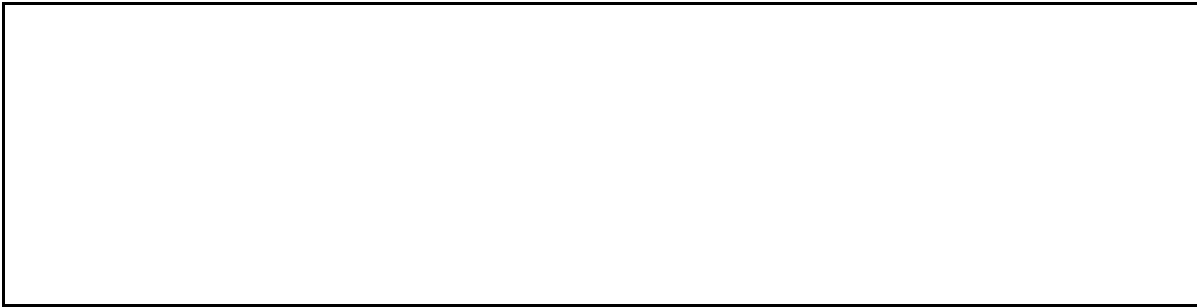
Yellow is I-6064 Study Limits with blue/white depicting waters of the US as identified by NV5. Red is the natural resources study area for the City of Lumberton project



Matt Cusack PWS
Senior Project Manager/Scientist, Technical Professional Organization
North America
Engineering, Design, and Project Management

919-431-5255 919-800-1234

1616 E. Millbrook Road, Suite 160, Raleigh, NC 27609



Company

From: Brian Yamamoto <Brian.Yamamoto@nv5.com>
Sent: Monday, April 20, 2020 4:46 PM
To: Sachan, Amit <Amit.Sachan@atkinglobal.com>
Cc: Huff, Christy <chuff@ncdot.gov>; Nick Mountcastle <Nick.Mountcastle@nv5.com>; Rerko, James J <jjrerko@ncdot.gov>; Price, Gregory W <gwprice2@ncdot.gov>; Heather Wallace <Heather.Wallace@nv5.com>; Boot, Robert A <Robert.Boot@atkinglobal.com>; Cusack, Matthew T <matt.cusack@atkinglobal.com>
Subject: RE: I-6064 DRAFT Wetland Delineations

OK Amit.

Sounds like there is no way right now to put a schedule on that, but we will stay tuned to what is happening with COVID-19 situation.

Brian Yamamoto, PE | Senior Project Development Engineer | **NV5**
6750 Tryon Road | Cary, NC 27518 | P: 919.858.1865 | C: 919.606.9716

[Electronic Communications Disclaimer](#)

From: Sachan, Amit <Amit.Sachan@atkinglobal.com>
Sent: Monday, April 20, 2020 4:35 PM
To: Brian Yamamoto <Brian.Yamamoto@nv5.com>
Cc: Huff, Christy <chuff@ncdot.gov>; Nick Mountcastle <Nick.Mountcastle@nv5.com>; Rerko, James J <jjrerko@ncdot.gov>; Price, Gregory W <gwprice2@ncdot.gov>; Heather Wallace <Heather.Wallace@nv5.com>; Boot, Robert A <Robert.Boot@atkinglobal.com>; Cusack, Matthew T <matt.cusack@atkinglobal.com>
Subject: RE: I-6064 DRAFT Wetland Delineations

Thanks for sending these over, Brian. Please let us know when these have been verified by the USACE. Regards

Amit Sachan, PE, CFM
Project Director, Public & Private Business Unit
Tel: +1 919 431 5253 Cell: +1 919 985 1095

Atkins, member of the SNC-Lavalin Group
1616 East Millbrook Road, Suite 160, Raleigh, NC 27519

From: Brian Yamamoto <Brian.Yamamoto@nv5.com>
Sent: Monday, April 20, 2020 2:11 PM

To: Sachan, Amit <Amit.Sachan@atkinsglobal.com>; Boot, Robert A <Robert.Boot@atkinsglobal.com>
Cc: Huff, Christy <chuff@ncdot.gov>; Nick Mountcastle <Nick.Mountcastle@nv5.com>; Rerko, James J <jjrerko@ncdot.gov>; Price, Gregory W <gwprice2@ncdot.gov>; Heather Wallace <Heather.Wallace@nv5.com>
Subject: I-6064 DRAFT Wetland Delineations

Hey guys,

See attached DRAFT delineations for the I-6064 (I-95 widening from Exit 13 to Exit 22 in Robeson County near Lumberton). These probably cover your study area for the Lumberton Floodgate Project that you are currently working on. Because of the COVID-19 situation, the USACE is restricted from doing field work. As such, these delineations are unverified at this stage. I don't know if you all were planning to conduct delineations as part of your project, but this will help USACE to avoid dual delineations in overlapping areas. We plan to have these delineations (conducted by NV5 biologists) verified as soon as restrictions are lifted on the USACE.

Let me know if you have any questions.

Brian Yamamoto, PE | Senior Project Development Engineer | **NV5**
6750 Tryon Road | Cary, NC 27518 | P: 919.858.1865 | C: 919.606.9716

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Consider the environment. Please don't print this e-mail unless you really need to.

Email correspondence to and from this sender is subject to the N.C. Public Records Law and may be disclosed to third parties.

APPENDIX 2

- **Early Notice and Public Review of a Proposed Activity in Wetlands and 100-Year Floodplain**
- **Affidavit for Publication of Early Notice**
- **Distribution List to Interested Agencies, Groups and Individuals**
- **Early Notice Comments**



North Carolina Department of Public Safety

Office of Recovery and Resiliency

Roy Cooper, Governor
Eddie M. Buffaloe, Jr., Secretary

Laura H. Hogshead, Director

EARLY NOTICE AND PUBLIC REVIEW OF A PROPOSED ACTIVITY IN A 100-YEAR FLOODPLAIN AND WETLAND

WEST LUMBERTON FLOOD GATE AT VFW ROAD AND RAILROAD UNDERPASS NEAR INTERSTATE 95 IN THE VICINITY OF VFW ROAD, COX ROAD, HACKETT STREET, AND THE CSX RAILROAD CROSSING, LUMBERTON, ROBESON COUNTY, NC

December 9, 2023

To: All interested Agencies, Groups and Individuals

This is to give notice that the North Carolina Office of Recovery and Resiliency (NCORR) has received an application from the City of Lumberton to use Community Development Block Grant – Mitigation (CDBG-MIT) funding from the Infrastructure Recovery Program to implement the West Lumberton Flood Gate at VFW Road and Railroad Underpass project (“Proposed Activity”) and is conducting an evaluation as required by Executive Order 11988 and Executive Order 11990 in accordance with U.S. Department of Housing and Urban Development (HUD) regulations (24 CFR Part 55). There are three primary purposes for this notice. First, to provide the public an opportunity to express their concerns and share information about the Proposed Activity, including alternative locations outside of the floodplain and wetland. Second, adequate public notice is an important public education tool. The dissemination of information about floodplains and wetlands facilitates and enhances governmental efforts to reduce the risks associated with the occupancy and modification of these special areas. Third, as a matter of fairness, when the government determines it will participate in actions taking place in floodplain and wetland, it must inform those who may be put at greater or continued risk. Funding for the Proposed Activity will be provided by the HUD CDBG-MIT program for storm recovery activities in North Carolina.

The Proposed Activity is needed to mitigate future storm flooding as experienced and exacerbated by the effects of the landfall of Hurricanes Matthew (October 8, 2016) and Florence (September 14, 2018). The purpose of this Proposed Activity is to enhance the City’s existing earthen levee and flood control system to mitigate against 100-year flood events flowing from the west side of the I-95 underpass via the CSX railroad crossing in the vicinity of VFW Road, Cox Road, and Hackett Street. The City has identified the Proposed Activity site to mitigate flooding experienced on the protected side of the existing levee system, which is critical to protect lives and property in southern and western Lumberton. In addition, the levee system helps maintain access to and operation of several critical facilities behind the levee, such as the

Mailing Address:
Post Office Box 110465
Durham, NC 27709



Phone: (984) 833-5350
www.ncdps.gov
www.rebuild.nc.gov

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City's water treatment plant, two power grid point of delivery transformer sub stations, the City's Electric Utility Department, and a City Fire Station. Failure to make the proposed improvements will result in the area continuing to experience flooding during future storm events, which in turn has impacts across the entire city.

The Proposed Activity entails construction of a permanent floodgate system and related drainage and flood improvements to prevent future flood occurrences from the Lumber River through a CSX railroad underpass beneath I-95 in an area of Lumberton that has suffered devastation, primarily associated with hurricanes. The Proposed Activity is located near Interstate 95 (I-95) in the vicinity of VFW Road, Cox Road, Hackett Street, and the CSX railroad crossing within the City of Lumberton (City), North Carolina. The proposed limits of disturbance consist of public rights-of-way, Hackett Street, Cox Road, VFW Road, the CSX railroad line, and portions of five parcels, including a 7.16-acre lot at VFW and Hackett Rd., Parcel Pin #938280300700; an 0.83-acre lot at 550 VFW Rd., Parcel Pin #938189443052; a 6.3-acre lot at 2400 Cox Rd., Parcel Pin #938179684407; a 6.34-acre lot at 2460 Cox Rd., Parcel Pin #938179143700; and a 2.8-acre lot at 2306 W. 5th St., Parcel Pin #938189201500. The Proposed Activity will disturb approximately 4.9 acres mostly within previously disturbed railroad and roadway easements and industrial businesses' lawns. The Proposed Activity has been designed with agency input particularly the NC Department of Transportation (DOT) which is undertaking the widening of I-95. The NC DOT project includes realignment of Cox Road, VFW Road and Hackett Street, I-95 embankment and bridge surfacing, a drainage channel, I-95 replacement bridge, retaining walls near Cox Road, and temporary and permanent NC DOT easements and ROWs, all to be completed by NC DOT before construction commences on this Proposed Activity.

All of the Proposed Activity site is located in 100-year floodplain with the five parcels totaling 23.43 acres and no areas in regulatory floodway. The Proposed Activity will result in temporary impacts to approximately 4.9 acres of 100-year floodplain (Zone AE) which includes four construction entrances, a staging area, two check dams, and a 26-linear-foot (lf), 15-inch HDPE. The permanent impacts to 4.7 acres of 100-year floodplain includes the construction of an approximately 30-foot flood gate to swing over the CSX railroad tracks with concrete wing flood walls extending outward from both sides of the gate and connecting concrete wing wall sections to a proposed earthen berm with supportive sheet piling that ties the system into the I-95 proposed embankment; slope revetment; riprap groin protection; two 15-foot-wide gravel access drives with turnout onto Cox Road and corresponding 34-lf and 36-lf, 15-inch reinforced concrete piping culverts; 2-foot x 2-foot and 3-foot x 3-foot sluice gates; water main offset; railroad ditch grading; removal and reinstallation of steel casing and 6-inch watermain south of the flood gate, as needed; and all surfaces to be restored to existing grade after construction. CSX will remove and reinstall 34-foot rail sections and two timber crossties from each track with contractor to install sections of shoring sheet piling cut off a minimum of 2-feet below the top-of-tie. CSX and contractor will schedule a 12-hour track window to install the jump span bridge with CSX removing a 50-foot track section and contractor excavating materials, cutting off piles, and installing wales, struts, pile caps, and jump span bridge.

Natural floodplains and wetlands provide flood risk reduction benefits by slowing runoff and storing flood water. In addition, floodplains and wetlands are beneficial by providing diverse wildlife habitat, flood and erosion control, surface water quality maintenance, groundwater recharge, and educational, scientific, cultural, and recreational opportunities. Floodwater storage and conveyance and erosion control will be affected by the Proposed Activity. The flood gate over the railroad tracks will be swing-hinged closed in line with the concrete wing walls during future storm events and flooding. This design will provide long-term flood prevention and minimize potential flood damage to the surrounding properties. Erosion and sediment control measures include filter fabric under 24-inch class 2 riprap east of the flood gate; geotextile fabric under 18-inch class B riprap and 6-inch stone groin protection riprap along southeastern portion of the earthen berm; two stone riprap check dams; temporary stabilizing vegetation; site grading;

and silt fencing. Under 100-year flood conditions, peak water surface elevation upstream of the gate is estimated to increase 0.3 feet from both installation of the flood gate system and raising of I-95 (see posted H&H Analysis for more details). The project components will be elevated well above the 100-year base flood elevation (BFE) in order to protect lives and property from potential flash floods. The 100-year floodplain in the proposed floodgate system area has a BFE from 123.56 feet to 123.71 feet (vertical datum, NAVD88). The proposed flood wall will have a 134-foot top-of-wall elevation compared to the top of the railroad bed elevation which is around 120 feet. Therefore, the wall extension will be approximately 14 feet high above the railroad bed. The Proposed Activity will comply with a Floodplain Development Permit, NC DEMLR Erosion and Sediment Control Permit, NPDES Construction Stormwater Permit (NCG010000), and all applicable federal, State and local laws, regulations, and permit requirements and conditions which shall be obtained before commencing work.

Wetlands are beneficial by providing diverse wildlife habitat, flood and erosion control, surface water quality maintenance, groundwater recharge, and educational, scientific, cultural, and recreational opportunities. Wetlands have unique natural characteristics that play an integral role in the ecology of the watershed. The Proposed Activity will result in no direct or indirect, temporary or permanent impacts to approximately 4.44 acres of NWI-mapped Freshwater Forested/ Shrub Wetland (PFO4Ad) located on the VFW Rd. and Hackett St. parcel #938280300700 that is part of a 69.51-acre wetland feature. There are no other wetlands located on the other parcels. No activities are proposed in wetlands and a US Army Corps of Engineers (USACE) Approved Jurisdictional Determination and No Permit Required Letter are being obtained. Therefore, no wetland impacts are expected, Clean Water Act Section 404 and 401 permits will not be required, and mitigation is not required. Best management practices for erosion and sedimentation control such as silt fencing will be utilized during construction and native plants used in landscaping and site restoration. Since the Proposed Activity will avoid the wetland and incorporate these measures, no indirect wetland impacts or negative impacts to wetland functions and values are anticipated.

Floodplain maps based on the FEMA Flood Insurance Rate Map (FIRM), Preliminary FIRMs, NWI wetlands map, Hydrologic and Hydraulic Analysis, USACE correspondence, site plans and supporting documentation are available for review at <https://www.rebuild.nc.gov/about/plans-policies-reports/environmental-reviews>. A full description of the Proposed Activity may also be viewed in person, by appointment only, at: NCORR, 200 Park Offices Drive, Durham, NC 27709. Call (984) 833-5350 to make an appointment.

Written comments must be received by NCORR at the following address on or before December 26, 2023: Laura Hogshead, Director, NCORR, ATTN: West Lumberton Flood Gate, P.O. Box 110465, Durham, NC 27709. Comments may also be submitted by email to publiccomments@rebuild.nc.gov with “ATTN: West Lumberton Flood Gate Comments” in the subject line.

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12-9-23

EARLY NOTICE FLOODPLAIN AND WETLAND DISTRIBUTION LIST

**WEST LUMBERTON FLOOD GATE AT VFW ROAD AND RAILROAD UNDERPASS
NEAR INTERSTATE 95 IN THE VICINITY OF VFW ROAD, COX ROAD, HACKETT STREET,
AND THE CSX RAILROAD CROSSING, LUMBERTON, ROBESON COUNTY, NC**

Published in The Robesonian on 12/9/23, comments end 12/26/23

FEDERAL AGENCIES

Agency	Name & Address	Method
HUD NC	Mr. Lenwood E. Smith, II Environmental Protection Specialist Greensboro Field Office U.S. Dept. of Housing and Urban Development 1500 Pinecroft Road, Suite 401 Greensboro, NC 27407-3838	Lenwood.E.Smith@hud.gov
FEMA, Region IV	Ms. Gracia B. Szczech, Regional Administrator U.S. Dept. of Homeland Security FEMA, Region IV 3003 Chamblee Tucker Road Atlanta, GA 30341	FedEx
FEMA ATTN: 11988	<i>Hard copies may also be mailed to</i> Attn: 11988/11990 NEPA Reviewer (EHP) DHS/FEMA RIV 3003 Chamblee Tucker Road Atlanta, GA 30341	FEMA-R4EHP@fema.dhs.gov with the subject line REVIEW REQUEST: 11988/NEPA
US EPA, Region 4	Ms. Ntale Kajumba, NEPA Coordinator U.S. EPA, Region 4 Laboratory Services & Applied Science Div. 980 College Station Road Athens, GA 30605-2720	Kajumba.ntale@epa.gov
USFWS – Raleigh Field Office	USFWS – Raleigh Field Office ATTN: John Ellis P.O. Box 33726 Raleigh, NC 27636 ph.: 919-856-4520, ext. 26	john_ellis@fws.gov cc: leigh_mann@fws.gov
TRIBES, NATIONS AND COMMUNITIES (who asked to be notified)		
	Dr. Wenonah George Haire, THPO ATTN: THPO Archaeology Dept. Catawba Indian Nation 1536 Tom Steven Road	Does not want Notice

Catawba Indian Nation	Rock Hill, SC 29730	
Catawba Indian Nation	Chief Bill Harris Catawba Indian Nation 996 Avenue of the Nations Rock Hill, SC 29730	Does not want Notice
NC STATE AGENCIES		
STATE CLEARING-HOUSE	Ms. Crystal Best North Carolina Department of Administration State Environmental Review Clearinghouse 1301 Mail Service Center Raleigh, North Carolina 27699-1301	State.Clearinghouse@doa.nc.gov crystal.best@doa.nc.gov
LOCAL AGENCIES		
COUNTY	Kellie Blue County Manager Robeson County. NC 550 North Chestnut Street Lumberton, NC 28358 Phone: 910-671-3022	kellie.blue@co.robeson.nc.us
COUNTY	Tammy Freeman Clerk to the Board Robeson County. NC 550 North Chestnut Street Lumberton, NC 28358 Phone: 910-671-3022	tammy.freeman@co.robeson.nc.us
COUNTY	Myron Neville Director of Public Works Robeson County. NC Phone: 910-671-3488	myron.neville@co.robeson.nc.us
CITY	M. Brandon Love, AIA Deputy City Manager City of Lumberton P.O. Box 1388 Lumberton, NC 28359 (910) 671-3806	blove@ci.lumberton.nc.us cc: Karen.kiehna@mcgillassociates.com bill.blankenship@rebuild.nc.gov
CITY	Rob Armstrong Director of Public Works City of Lumberton P.O. Box 1388 Lumberton, NC 28359 (910) 671-3851	rarmstrong@ci.lumberton.nc.us

CITY	Laney Mitchell-McIntosh, City Clerk City of Lumberton P.O. Box 1388 Lumberton, NC 28359 910-671-3807	lmitchell- mcintosh@ci.lumberton.nc.us
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Gievers, Andrea

From: Gievers, Andrea
Sent: Saturday, December 9, 2023 8:15 AM
To: Smith, Lenwood E
Subject: Public Notice - Early Notice - West Lumberton Flood Gate at VFW Road and Railroad Underpass
Attachments: NCORR Early Notice West Lumberton Flood Gate 12.9.23.pdf

Hello:

Please find attached the Public Notice for HUD 24 CFR §55.20(b) - *Early Notice and Public Review of a Proposed Activity in a 100-Year Floodplain and Wetland* publishing December 9, 2023 for the NCORR Infrastructure Recovery Program's West Lumberton Flood Gate at VFW Road and Railroad Underpass proposed project located near Interstate 95 (I-95) in the vicinity of VFW Road, Cox Road, Hackett Street, and the CSX railroad crossing within the City of Lumberton, Robeson County, North Carolina. Please feel free to contact me if you have any questions. Thank you for your time and assistance.

Sincerely,

Andrea

Andrea Gievers, JD, MSEL, ERM
Environmental SME
Community Development
NC Office of Recovery and Resiliency
Andrea.L.Gievers@Rebuild.NC.Gov
(845) 682-1700

Gievers, Andrea

From: Gievers, Andrea
Sent: Saturday, December 9, 2023 8:16 AM
To: FEMA-R4EHP
Subject: REVIEW REQUEST: 11988/NEPA - Early Notice - West Lumberton Flood Gate at VFW Road and Railroad Underpass
Attachments: NCORR Early Notice West Lumberton Flood Gate 12.9.23.pdf

Hello:

Please find attached the Public Notice for HUD 24 CFR §55.20(b) - *Early Notice and Public Review of a Proposed Activity in a 100-Year Floodplain and Wetland* publishing December 9, 2023 for the NCORR Infrastructure Recovery Program's West Lumberton Flood Gate at VFW Road and Railroad Underpass proposed project located near Interstate 95 (I-95) in the vicinity of VFW Road, Cox Road, Hackett Street, and the CSX railroad crossing within the City of Lumberton, Robeson County, North Carolina. Please feel free to contact me if you have any questions. Thank you for your time and assistance.

Sincerely,

Andrea

Andrea Gievers, JD, MSEL, ERM
Environmental SME
Community Development
NC Office of Recovery and Resiliency
Andrea.L.Gievers@Rebuild.NC.Gov
(845) 682-1700

Gievers, Andrea

From: Gievers, Andrea
Sent: Saturday, December 9, 2023 8:17 AM
To: Kajumba, Ntale
Subject: Public Notice - Early Notice - West Lumberton Flood Gate at VFW Road and Railroad Underpass
Attachments: NCORR Early Notice West Lumberton Flood Gate 12.9.23.pdf

Hello:

Please find attached the Public Notice for HUD 24 CFR §55.20(b) - *Early Notice and Public Review of a Proposed Activity in a 100-Year Floodplain and Wetland* publishing December 9, 2023 for the NCORR Infrastructure Recovery Program's West Lumberton Flood Gate at VFW Road and Railroad Underpass proposed project located near Interstate 95 (I-95) in the vicinity of VFW Road, Cox Road, Hackett Street, and the CSX railroad crossing within the City of Lumberton, Robeson County, North Carolina. Please feel free to contact me if you have any questions. Thank you for your time and assistance.

Sincerely,

Andrea

Andrea Gievers, JD, MSEL, ERM
Environmental SME
Community Development
NC Office of Recovery and Resiliency
Andrea.L.Gievers@Rebuild.NC.Gov
(845) 682-1700

Gievers, Andrea

From: Gievers, Andrea
Sent: Saturday, December 9, 2023 8:18 AM
To: john_ellis@fws.gov
Cc: Mann, Leigh
Subject: Public Notice - Early Notice - West Lumberton Flood Gate at VFW Road and Railroad Underpass
Attachments: NCORR Early Notice West Lumberton Flood Gate 12.9.23.pdf

Hello:

Please find attached the Public Notice for HUD 24 CFR §55.20(b) - *Early Notice and Public Review of a Proposed Activity in a 100-Year Floodplain and Wetland* publishing December 9, 2023 for the NCORR Infrastructure Recovery Program's West Lumberton Flood Gate at VFW Road and Railroad Underpass proposed project located near Interstate 95 (I-95) in the vicinity of VFW Road, Cox Road, Hackett Street, and the CSX railroad crossing within the City of Lumberton, Robeson County, North Carolina. Please feel free to contact me if you have any questions. Thank you for your time and assistance.

Sincerely,

Andrea

Andrea Gievers, JD, MSEL, ERM
Environmental SME
Community Development
NC Office of Recovery and Resiliency
Andrea.L.Gievers@Rebuild.NC.Gov
(845) 682-1700

Gievers, Andrea

From: Gievers, Andrea
Sent: Saturday, December 9, 2023 8:19 AM
To: State Clearinghouse
Cc: Best, Crystal
Subject: Public Notice - Early Notice - West Lumberton Flood Gate at VFW Road and Railroad Underpass
Attachments: NCORR Early Notice West Lumberton Flood Gate 12.9.23.pdf

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Sincerely,

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Environmental SME
Community Development
NC Office of Recovery and Resiliency
Andrea.L.Gievers@Rebuild.NC.Gov
(845) 682-1700

Gievers, Andrea

From: Gievers, Andrea
Sent: Saturday, December 9, 2023 8:20 AM
To: Blue; Kellie
Subject: Public Notice - Early Notice - West Lumberton Flood Gate at VFW Road and Railroad Underpass
Attachments: NCORR Early Notice West Lumberton Flood Gate 12.9.23.pdf

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Community Development
NC Office of Recovery and Resiliency
Andrea.L.Gievers@Rebuild.NC.Gov
(845) 682-1700

Gievers, Andrea

From: Gievers, Andrea
Sent: Saturday, December 9, 2023 8:21 AM
To: tammy.freeman@co.robeson.nc.us
Subject: Public Notice - Early Notice - West Lumberton Flood Gate at VFW Road and Railroad Underpass
Attachments: NCORR Early Notice West Lumberton Flood Gate 12.9.23.pdf

Hello:

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Environmental SME
Community Development
NC Office of Recovery and Resiliency
Andrea.L.Gievers@Rebuild.NC.Gov
(845) 682-1700

Gievers, Andrea

From: Gievers, Andrea
Sent: Saturday, December 9, 2023 8:21 AM
To: myron.neville@co.robeson.nc.us
Subject: Public Notice - Early Notice - West Lumberton Flood Gate at VFW Road and Railroad Underpass
Attachments: NCORR Early Notice West Lumberton Flood Gate 12.9.23.pdf

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Community Development
NC Office of Recovery and Resiliency
Andrea.L.Gievers@Rebuild.NC.Gov
(845) 682-1700

Gievers, Andrea

From: Gievers, Andrea
Sent: Saturday, December 9, 2023 8:26 AM
To: Love, Brandon
Cc: Karen Kiehna; Blankenship, Bill
Subject: Public Notice - Early Notice - West Lumberton Flood Gate at VFW Road and Railroad Underpass
Attachments: NCORR Early Notice West Lumberton Flood Gate 12.9.23.pdf

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NC Office of Recovery and Resiliency
Andrea.L.Gievers@Rebuild.NC.Gov
(845) 682-1700

Gievers, Andrea

From: Gievers, Andrea
Sent: Saturday, December 9, 2023 8:27 AM
To: Armstrong, Robert
Subject: Public Notice - Early Notice - West Lumberton Flood Gate at VFW Road and Railroad Underpass
Attachments: NCORR Early Notice West Lumberton Flood Gate 12.9.23.pdf

Hello:

Please find attached the Public Notice for HUD 24 CFR §55.20(b) - *Early Notice and Public Review of a Proposed Activity in a 100-Year Floodplain and Wetland* publishing December 9, 2023 for the NCORR Infrastructure Recovery Program's West Lumberton Flood Gate at VFW Road and Railroad Underpass proposed project located near Interstate 95 (I-95) in the vicinity of VFW Road, Cox Road, Hackett Street, and the CSX railroad crossing within the City of Lumberton, Robeson County, North Carolina. Please feel free to contact me if you have any questions. Thank you for your time and assistance.

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Environmental SME
Community Development
NC Office of Recovery and Resiliency
Andrea.L.Gievers@Rebuild.NC.Gov
(845) 682-1700

Gievers, Andrea

From: Gievers, Andrea
Sent: Saturday, December 9, 2023 8:28 AM
To: Mitchell-Mcintosh, Laney
Subject: Public Notice - Early Notice - West Lumberton Flood Gate at VFW Road and Railroad Underpass
Attachments: NCORR Early Notice West Lumberton Flood Gate 12.9.23.pdf

Hello:

Please find attached the Public Notice for HUD 24 CFR §55.20(b) - *Early Notice and Public Review of a Proposed Activity in a 100-Year Floodplain and Wetland* publishing December 9, 2023 for the NCORR Infrastructure Recovery Program's West Lumberton Flood Gate at VFW Road and Railroad Underpass proposed project located near Interstate 95 (I-95) in the vicinity of VFW Road, Cox Road, Hackett Street, and the CSX railroad crossing within the City of Lumberton, Robeson County, North Carolina. Please feel free to contact me if you have any questions. Thank you for your time and assistance.

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Environmental SME
Community Development
NC Office of Recovery and Resiliency
Andrea.L.Gievers@Rebuild.NC.Gov
(845) 682-1700

1 From Please print and press hard.
 Date 12/9/23 Sender's FedEx Account Number 8950-9899-0
 Sender's Name Andrea Gievers Phone (845) 682-1700
 Company NCORR
 Address 123 Kings Hill Road Dept./Floor/Suite/Room
 City Walden State NY ZIP 12586

2 Your Internal Billing Reference NLFG EN OPTIONAL
 First 24 characters will appear on invoice.

3 To
 Recipient's Name Ms. Gracia Szczech Phone ()
 Company FEMA, Region 4
 Address 3003 Chamblee Tucker Rd Dept./Floor/Suite/Room
 We cannot deliver to P.O. boxes or P.O. ZIP codes.
 Address _____
 Use this line for the HOLD location address or for continuation of your shipping address.
 City Atlanta State GA ZIP 30341

Hold Weekday
 FedEx location address REQUIRED. NOT available for FedEx First Overnight.
 Hold Saturday
 FedEx location address REQUIRED. Available ONLY for FedEx Priority Overnight and FedEx 2Day to select locations.

4 Express Package Service * To most locations. Packages up to 150 lbs. For packages over 150 lbs., use the FedEx Express Freight US Airbill.

Next Business Day	2 or 3 Business Days
<input type="checkbox"/> FedEx First Overnight Earliest next business morning delivery to select locations. Friday shipments will be delivered on Monday unless Saturday Delivery is selected.	<input type="checkbox"/> FedEx 2Day A.M. Second business morning.* Saturday Delivery NOT available.
<input type="checkbox"/> FedEx Priority Overnight Next business morning.* Friday shipments will be delivered on Monday unless Saturday Delivery is selected.	<input checked="" type="checkbox"/> FedEx 2Day Second business afternoon.* Thursday shipments will be delivered on Monday unless Saturday Delivery is selected.
<input type="checkbox"/> FedEx Standard Overnight Next business afternoon.* Saturday Delivery NOT available.	<input type="checkbox"/> FedEx Express Saver Third business day.* Saturday Delivery NOT available.

5 Packaging * Declared value limit \$500.

FedEx Envelope* FedEx Pak* FedEx Box FedEx Tube Other

6 Special Handling and Delivery Signature Options Fees may apply. See the FedEx Service Guide.

Saturday Delivery
 NOT available for FedEx Standard Overnight, FedEx 2Day A.M., or FedEx Express Saver.

No Signature Required
 Package may be left without obtaining a signature for delivery.

Direct Signature
 Someone at recipient's address may sign for delivery.

Indirect Signature
 If no one is available at recipient's address, someone at a neighboring address may sign for delivery. For residential deliveries only.

Does this shipment contain dangerous goods?
 One box must be checked.
 No Yes As per attached Shipper's Declaration. Yes Shipper's Declaration not required. Dry Ice Dry ice, 9, UN 1845 _____ x _____ kg
 Cargo Aircraft Only

Restrictions apply for dangerous goods — see the current FedEx Service Guide.

7 Payment Bill to: This airbill can be used only when billing to a FedEx account number. For cash, check, or credit card transactions, please go to a staffed shipping location.

Enter FedEx Acct. No. below.
 Sender Acct. No. in Section 1 will be billed. Recipient Third Party

FedEx Acct. No. _____

Total Packages	Total Weight	Total Declared Value*
	lbs. \$ _____ .00	

*Our liability is limited to US\$100 unless you declare a higher value. See back for details. By using this airbill you agree to the service conditions on the back of this airbill and in the current FedEx Service Guide, including terms that limit our liability.
 Rev. Date 3/21 • Part #167002 • ©2012-2021 FedEx • PRINTED IN U.S.A.

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APPENDIX 3

- **Combined FONSI/NOI-RROF/ Final Notice and Public Explanation of a Proposed Activity in a 100-year Floodplain and Wetland**
- **Affidavit for Publication of Final Notice (*to be added*)**
- **Distribution List to Interested Agencies, Groups and Individuals**
- **Final Notice Comments (*to be added*)**



North Carolina Department of Public Safety

Office of Recovery and Resiliency

Roy Cooper, Governor
Eddie M. Buffaloe, Jr., Secretary

Laura H. Hogshead, Director

PUBLIC NOTICE

COMBINED NOTICE OF FINDING OF NO SIGNIFICANT IMPACT (*FONSI*), NOTICE OF INTENT TO REQUEST RELEASE OF FUNDS (*NOI-RROF*), AND FINAL NOTICE AND PUBLIC EXPLANATION OF A PROPOSED ACTIVITY IN A 100-YEAR FLOODPLAIN AND WETLAND

WEST LUMBERTON FLOOD GATE AT VFW ROAD AND RAILROAD UNDERPASS NEAR INTERSTATE 95 IN THE VICINITY OF VFW ROAD, COX ROAD, HACKETT STREET, AND THE CSX RAILROAD CROSSING, LUMBERTON, ROBESON COUNTY, NC

January 6, 2024

To: All interested Agencies, Groups and Individuals

Name of Responsible Entity and Recipient: North Carolina Office of Recovery and Resiliency (NCORR), P.O. Box 110465, Durham, NC 27709. Contact: Director Laura Hogshead (984) 833-5350.

Pursuant to 24 CFR Section 58.43, this combined Notice of Finding of No Significant Impact (FONSI), Notice of Intent to Request Release of Funds (NOI-RROF), and Final Notice and Public Explanation of a Proposed Activity in a Floodplain and Wetland satisfies three separate procedural requirements for project activities proposed to be undertaken by NCORR.

Project Description: NCORR is responsible for the direct administration of the United States Department of Housing and Urban Development (HUD) Community Development Block Grant – Mitigation (CDBG-MIT) program in North Carolina. NCORR proposes to provide CDBG-MIT funding from the Infrastructure Recovery Program of \$1,498,088.00 for the West Lumberton Flood Gate at VFW Road and Railroad Underpass project (“Proposed Activity”) located near Interstate 95 (I-95) in the vicinity of VFW Road, Cox Road, Hackett Street, and the CSX railroad crossing within the City of Lumberton (City), Robeson County, North Carolina. The proposed limits of disturbance consist of public rights-of-way, Hackett Street, Cox Road, VFW Road, the CSX railroad line, and portions of five parcels, including a 7.16-acre lot at VFW and Hackett Rd., Parcel Pin #938280300700; an 0.83-acre lot at 550 VFW Rd., Parcel Pin #938189443052; a 6.3-

Mailing Address:
Post Office Box 110465
Durham, NC 27709



Phone: (984) 833-5350
www.ncdps.gov
www.rebuild.nc.gov

An Equal Opportunity Employer

acre lot at 2400 Cox Rd., Parcel Pin #938179684407; a 6.34-acre lot at 2460 Cox Rd., Parcel Pin #938179143700; and a 2.8-acre lot at 2306 W. 5th St., Parcel Pin #938189201500. The Proposed Activity is anticipated to have a total cost of \$10,878,186.00 and entails construction of a permanent flood gate system and related drainage improvements to prevent future flood occurrences from the Lumber River through a CSX railroad underpass beneath I-95 in an area of Lumberton that has suffered devastation, primarily associated with hurricanes.

The Proposed Activity is needed to mitigate future storm flooding as experienced and exacerbated by the effects of the landfall of Hurricanes Matthew (October 8, 2016) and Florence (September 14, 2018). The purpose of this Proposed Activity is to enhance the City's existing earthen levee and flood control system to mitigate against 100-year flood events flowing from the west side of the I-95 underpass via the CSX railroad crossing in the vicinity of VFW Road, Cox Road, and Hackett Street. The City has identified the Proposed Activity site to mitigate flooding experienced on the protected side of the existing levee system, which is critical to protect lives and property in southern and western Lumberton. In addition, the levee system helps maintain access to and operation of several critical facilities behind the levee, such as the City's water treatment plant, two power grid point of delivery transformer sub stations, the City's Electric Utility Department, and a City Fire Station. Failure to make the proposed improvements will result in the area continuing to experience flooding during future storm events, which in turn has impacts across the entire City. The City has selected the Proposed Activity to assist its residents and community to be protected from future storm damage and flooding.

PUBLIC EXPLANATION OF A PROPOSED ACTIVITY IN A 100-YEAR FLOODPLAIN AND WETLAND

NCORR has conducted an evaluation as required by Executive Orders (EO) 11988 and 11990, in accordance with HUD regulations at 24 CFR 55 Subpart C Procedures for Making Determinations on Floodplain Management and Wetlands Protection. All of the Proposed Activity site is located in 100-year floodplain with the five parcels totaling 23.43 acres and no areas in regulatory floodway. The Proposed Activity will result in temporary impacts to approximately 4.9 acres of 100-year floodplain (Zone AE) which includes four construction entrances, a staging area, two check dams, and a 26-linear-foot (lf), 15-inch HDPE. The permanent impacts to 4.7 acres of 100-year floodplain includes the construction of an approximately 30-foot flood gate to swing over the CSX railroad tracks with concrete wing flood walls extending outward from both sides of the gate and connecting concrete wing wall sections to a proposed earthen berm with supportive sheet piling that ties the system into the I-95 proposed embankment; slope revetment; riprap groin protection; two 15-foot-wide gravel access drives with turnout onto Cox Road and corresponding 34-1f and 36-1f, 15-inch reinforced concrete piping culverts; 2-foot x 2-foot and 3-foot x 3-foot sluice gates; water main offset; railroad ditch grading; removal and reinstallation of steel casing and 6-inch watermain south of the flood gate, as needed; and all surfaces to be restored to existing grade after construction. CSX will remove and reinstall 34-foot rail sections and two timber cross-ties from each track with contractor to install sections of shoring sheet piling cut off a minimum of 2-feet below the top-of-tie. CSX and contractor will schedule a window to install the jump span bridge with CSX removing a 50-foot track section and contractor excavating materials, cutting off piles, and installing wales, struts, pile caps, and jump span bridge. There is one approximately 4.44-acre National Wetland Inventory (NWI)-mapped Freshwater Forested/ Shrub

Wetland (PFO4Ad) located on the VFW Rd. and Hackett St. parcel #938280300700 that is part of a 69.51-acre wetland feature. There are no other wetlands located on the other parcels and no activities proposed in wetland.

NCORR has considered the alternatives and mitigation measures to be taken to minimize adverse impacts and to restore and preserve natural and beneficial values. Alternative resiliency strategies were evaluated to address the flooding experienced in Lumberton during Hurricane Matthew. A series of meetings were held including public open houses and in-depth working sessions with county officials, subject matter experts, and county and municipal planners. North Carolina Emergency Management utilized data, resources, and technical expertise from State agencies, the private sector, and the UNC system to determine innovative best practice strategies. The Proposed Activity was identified as a high priority infrastructure strategy. This location at the CSX railroad I-95 underpass was identified as the most vulnerable weak point where flood events can penetrate to the protected side of the levee. Alternative locations and designs for the flood gate system were considered during the lengthy design phase using agency input, particularly the NC Department of Transportation (DOT) which is undertaking the widening of I-95. The Proposed Activity was designed in different locations, including east of I-95, before NC DOT and the City agreed upon this final design. The NC DOT project includes realignment of Cox Road, VFW Road and Hackett Street, I-95 embankment and bridge surfacing, a drainage channel, I-95 replacement bridge, retaining walls near Cox Road, and temporary and permanent NC DOT easements and ROWs in the area of this Proposed Activity. The “No Action” Alternative is not considered feasible since flooding in the area causes property damage to homes, churches, businesses and industries; interrupts City-wide services such as the potable water supply and electric utility grid for days; and roadway flooding blocks transportation accessibility during and after storm events. This Proposed Activity is critically necessary to protect the residents and community from future storm events. Whereas, the “No Action” Alternative would leave the community vulnerable to future flooding and mitigation action would be compromised due to lack of financial support. Due to the type of improvement and its connection to the City’s existing earthen levee and flood control system, floodplain impacts were unavoidable. However, the proposed action was designed not to encroach into the onsite wetland.

Natural floodplains and wetlands provide flood risk reduction benefits by slowing runoff and storing flood water. In addition, floodplains and wetlands are beneficial by providing diverse wildlife habitat, flood and erosion control, surface water quality maintenance, groundwater recharge, and educational, scientific, cultural, and recreational opportunities. Wetlands have unique natural characteristics that play an integral role in the ecology of the watershed. Floodwater storage and conveyance and erosion control will be affected by the Proposed Activity during storm events. During 100-year flood conditions, peak water surface elevation upstream of the gate is estimated to increase 0.3 feet from both installation of the flood gate system and raising of I-95 (see posted H&H Analysis for more details). The project components will be elevated well above the 100-year base flood elevation (BFE) in order to protect lives and property from potential flash floods. The 100-year floodplain in the proposed flood gate system area has a BFE from 123.56 feet to 123.71 feet (vertical datum, NAVD88). The proposed flood wall will have a 134-foot top-of-wall elevation compared to the top of the railroad bed elevation which is around 120 feet. Therefore, the wall extension will be approximately 14 feet high above the railroad bed. The flood gate over the railroad tracks will be swing-hinged closed in line with the concrete wing walls

during future storm events and flooding. This design will provide long-term flood prevention and minimize potential flood damage to the surrounding properties. The Proposed Activity will disturb approximately 4.9 acres mostly within previously disturbed railroad and roadway easements and industrial businesses' lawns. Since no activities are proposed in wetlands, a US Army Corps of Engineers (USACE) Approved Jurisdictional Determination and No Permit Required Letter are being obtained and Clean Water Act Section 404 and 401 permits will not be required. Applicable recommendations from the NC Dept of Environmental Quality Division of Water Resources will be followed. Thus, additional impacts to floodplain and wetland functions and values are not anticipated.

The Proposed Activity will comply with a Floodplain Development Permit, NC DEMLR Erosion and Sediment Control Permit, NPDES Construction Stormwater Permit (NCG010000), and all applicable federal, State and local laws, regulations, and permit requirements and conditions which shall be obtained before commencing work. Best Management Practices and erosion and sedimentation control measures include filter fabric under 24-inch class 2 riprap east of the flood gate; geotextile fabric under 18-inch class B riprap and 6-inch stone groin protection riprap along southeastern portion of the earthen berm; two stone riprap check dams; temporary stabilizing vegetation; silt fencing; and site grading. The Proposed Activity designs have been completed in accordance with agency input to minimize impacts to the floodplain, wetlands, environment and community. The Proposed Activity and location are the most suitable, feasible options selected by the City after a costly and lengthy design process to assist its residents and community to be protected from future storm events; the "No Action" alternative would not effectively address the area's flooding; and mitigation measures include erosion and sedimentation controls, permit conditions, a project design that minimizes impacts, and native plants used in site restoration.

Since the action will include modification of floodplain and new construction in wetland, EOs 11988 and 11990 require that the Proposed Activity not be supported if there are practicable alternatives to floodplain and wetland impacts. NCORR has reevaluated the alternatives to modification of floodplain and new construction in wetland, and has determined that it has no practicable alternative. The 8-step process has been further documented in the EO 11988 Floodplain Management and EO 11990 Wetlands Protection Determination which is available for viewing and copying as described below in Public Review.

There are three primary purposes for this notice. First, people who may be affected by activities in floodplains and wetlands and those who have an interest in the protection of the natural environment are given an opportunity to express their concerns and provide information about these areas. Second, adequate public notice is an important public education tool. The dissemination of information and request for public comment about floodplains and wetlands can facilitate and enhance federal efforts to reduce the risks and impacts associated with the occupancy and modification of these special areas. Third, as a matter of fairness, when the federal government determines it will participate in actions taking place in floodplains and wetlands, it must inform those who may be put at greater or continued risk.

FINDING OF NO SIGNIFICANT IMPACT

An Environmental Assessment (EA) for the Proposed Activity has been prepared in accordance with the National Environmental Policy Act of 1969 (NEPA) and HUD environmental review regulations at 24 CFR Part 58. The EA is incorporated by reference into this FONSI. Subject to public comments, no further review of the Proposed Activity is anticipated. NCORR has determined that the EA for the project identified herein complies with the requirements of HUD environmental review regulations at 24 CFR Part 58. NCORR has determined that the Proposed Activity will have no significant impact on the human environment and, therefore, does not require the preparation of an environmental impact statement under NEPA.

Public Review: Public viewing of the EA, environmental review record, and EO 11988 Floodplain Management and EO 11990 Wetlands Protection Determination is available online at <https://www.rebuild.nc.gov/about/plans-policies-reports/environmental-reviews>. Documents may also be viewed in person by appointment only at: NCORR, 200 Park Offices Drive, Durham, NC 27709. Call (984) 833-5350 to make an appointment.

Further information may be requested by writing to the above address, emailing publiccomments@rebuild.nc.gov or calling (984) 833-5350. This combined notice is being sent to individuals and groups known to be interested in these activities, local news media, appropriate local, state and federal agencies, the regional office of the U.S. Environmental Protection Agency having jurisdiction, and the HUD Field Office, and is being published in a newspaper of general circulation in the affected community.

Public Comments on the Proposed Activity within Floodplain and Wetland, FONSI and/or NOIRROF: Any individual, group or agency may submit written comments on the Proposed Activity. The public is hereby advised to specify in their comments which “notice” their comments address. Comments should be submitted via email, in the proper format, on or before January 22, 2024 at publiccomments@rebuild.nc.gov. Written comments may also be submitted by mail, in the proper format, to be received on or before January 22, 2024, and addressed to: Laura Hogshead, Director, NCORR, ATTN: West Lumberton Flood Gate Project, P.O. Box 110465, Durham, NC 27709. All comments must be received on or before January 22, 2024 or they will not be considered. If modifications result from public comment, these will be made prior to proceeding with the submission of a request for release of funds.

REQUEST FOR RELEASE OF FUNDS AND CERTIFICATION

On or after January 23, 2024, the NCORR certifying officer will submit a request and certification to HUD for the release of CDBG-MIT funds as authorized by related laws and policies for the purpose of undertaking this project under the North Carolina CDBG-MIT Infrastructure Recovery Program.

NCORR certifies to HUD that Laura Hogshead, in her capacity as Certifying Officer, consents to accept the jurisdiction of the U.S. federal courts if an action is brought to enforce responsibilities in relation to the environmental review process and that these responsibilities have been satisfied.

HUD's approval of the certification satisfies its responsibilities under NEPA and related laws and authorities, and allows NCORR to use CDBG-MIT program funds.

Objection to Release of Funds: HUD will accept objections to its release of funds and NCORR's certification for a period of fifteen days following the anticipated submission date or its actual receipt of the request (whichever is later). Potential objectors should contact HUD or the NCORR Certifying Officer to verify the actual last day of the objection period.

The only permissible grounds for objections claiming a responsible entity's non-compliance with 24 CFR Part 58 are: (a) certification was not executed by NCORR's Certifying Officer; (b) the responsible entity has omitted a step or failed to make a decision or finding required by HUD regulations at 24 CFR Part 58; (c) the grant recipient or other participants in the development process have committed funds, incurred costs or undertaken activities not authorized by 24 CFR Part 58 before HUD's release of funds and approval of environmental certification; or (d) another federal agency acting pursuant to 40 CFR Part 1504 has submitted a written finding that the project is unsatisfactory from the standpoint of environmental quality.

Objections must be prepared and submitted in accordance with the required procedures (24 CFR 58.76) and shall be addressed to Tennille Smith Parker, Director, Office of Disaster Recovery, U.S. Department of Housing and Urban Development, 451 7th Street SW, Washington, DC 20410, Phone: (202) 402-4649, or emailed to disaster_recovery@hud.gov.

Laura Hogshead
Certifying Officer
January 6, 2024

**FONSI/NOI-RROF/FINAL NOTICE FLOODPLAIN AND WETLAND
DISTRIBUTION LIST**

**WEST LUMBERTON FLOOD GATE AT VFW ROAD AND RAILROAD UNDERPASS
NEAR INTERSTATE 95 IN THE VICINITY OF VFW ROAD, COX ROAD, HACKETT STREET,
AND THE CSX RAILROAD CROSSING, LUMBERTON, ROBESON COUNTY, NC**

Published in The Robesonian on 1/6/24, comments end 1/22/24

FEDERAL AGENCIES

Agency	Name & Address	Method
HUD NC	Mr. Lenwood E. Smith, II Environmental Protection Specialist Greensboro Field Office U.S. Dept. of Housing and Urban Development 1500 Pinecroft Road, Suite 401 Greensboro, NC 27407-3838	Lenwood.E.Smith@hud.gov
FEMA, Region IV	Ms. Gracia B. Szczech, Regional Administrator U.S. Dept. of Homeland Security FEMA, Region IV 3003 Chamblee Tucker Road Atlanta, GA 30341	FedEx
FEMA ATTN: 11988	<i>Hard copies may also be mailed to</i> Attn: 11988/11990 NEPA Reviewer (EHP) DHS/FEMA RIV 3003 Chamblee Tucker Road Atlanta, GA 30341	FEMA-R4EHP@fema.dhs.gov with the subject line REVIEW REQUEST: 11988/NEPA
US EPA, Region 4	Ms. Ntale Kajumba, NEPA Coordinator U.S. EPA, Region 4 Laboratory Services & Applied Science Div. 980 College Station Road Athens, GA 30605-2720	Kajumba.ntale@epa.gov
USFWS – Raleigh Field Office	USFWS – Raleigh Field Office ATTN: John Ellis P.O. Box 33726 Raleigh, NC 27636 ph.: 919-856-4520, ext. 26	john_ellis@fws.gov cc: leigh_mann@fws.gov
USACE – Wilmington District	Mr. Gary H. Beecher USACE – Wilmington District 69 Darlington Avenue Wilmington, NC 28403	Gary.H.Beecher@USACE.army.mil

NPS	Mr. Jeffrey R. Duncan, PhD. NPS Southeast Regional Aquatic Ecologist Wild and Scenic Rivers Coordinator Science and Natural Resources Management Ph: (423) 987-6127	Jeff_Duncan@nps.gov
TRIBES, NATIONS AND COMMUNITIES (who asked to be notified)		
Catawba Indian Nation	Dr. Wenonah George Haire, THPO ATTN: THPO Archaeology Dept. Catawba Indian Nation 1536 Tom Steven Road Rock Hill, SC 29730	Does not want Notice
Catawba Indian Nation	Chief Bill Harris Catawba Indian Nation 996 Avenue of the Nations Rock Hill, SC 29730	Does not want Notice
NC STATE AGENCIES		
STATE CLEARING-HOUSE	Ms. Crystal Best North Carolina Department of Administration State Environmental Review Clearinghouse 1301 Mail Service Center Raleigh, North Carolina 27699-1301	State.Clearinghouse@doa.nc.gov crystal.best@doa.nc.gov
LOCAL AGENCIES		
COUNTY	Kellie Blue County Manager Robeson County. NC 550 North Chestnut Street Lumberton, NC 28358 Phone: 910-671-3022	kellie.blue@co.robeson.nc.us
COUNTY	Tammy Freeman Clerk to the Board Robeson County. NC 550 North Chestnut Street Lumberton, NC 28358 Phone: 910-671-3022	tammy.freeman@co.robeson.nc.us
COUNTY	Myron Neville Director of Public Works Robeson County. NC Phone: 910-671-3488	myron.neville@co.robeson.nc.us
CITY	M. Brandon Love, AIA Deputy City Manager City of Lumberton P.O. Box 1388 Lumberton, NC 28359	blove@ci.lumberton.nc.us

	(910) 671-3806	cc: Karen.kiehna@mcgillassociates.com bill.blankenship@rebuild.nc.gov
CITY	Rob Armstrong Director of Public Works City of Lumberton P.O. Box 1388 Lumberton, NC 28359 (910) 671-3851	rarmstrong@ci.lumberton.nc.us
CITY	Laney Mitchell-McIntosh, City Clerk City of Lumberton P.O. Box 1388 Lumberton, NC 28359 910-671-3807	lmitchell- mcintosh@ci.lumberton.nc.us