BENEFIT-COST ANALYSIS METHODOLOGY
TOWN OF FAIRMONT
HAPPY HILLS AND WALNUT STREET
PUMP STATION RELOCATION(S)

SUBMITTED TO

FEMA BUILDING RESILIENT INFRASTRUCTURE AND

COMMUNITIES GRANT PROGRAM

Town of Fairmont, Robeson County, NC

January 6, 2023

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF APPENDICES

1.0 PROJECT OVERVIEW

This methodology report consists of information used to complete the benefit-cost analysis (BCA), using FEMA's BCA toolkit, for the relocation of the Happy Hills and North Walnut Pump Stations in the Town of Fairmont. Relocation of these two pump stations away from the 100-year floodplain will save the Town of Fairmont valuable time, money, and resources. Determined from information entered into the BCA toolkit, the combined project and maintenance cost of the project is $2,977,785 and the benefits provided to the Town are $4,997,235. Resulting in a benefit-cost ratio of 1.68. Information provided to FEMA's toolkit is broken down below to highlight the driving factors of this relocation project and how the Town of Fairmont will greatly benefit from this project.

1.1 Project Background

The proposed project includes the relocation of two pump stations (Happy Hills Pump Station and North Walnut Pump Station) in the Town of Fairmont. Both stations are located adjacent to Old Field Swamp and become inundated during significant storm events. The Happy Hills Pump Station is located on Leesville Road's northern side. This station will be relocated to the end of South McMillan Drive, moving the pump station east. The North Walnut Pump Station is currently located on the eastern side of North Walnut Street at its intersection with Eldorado Road. The station will be relocated to the western side of North Walnut Street and south of Eldorado Road. Both stations are currently located in the NC Flood Risk Information Systems (FRIS) designated 100-year floodplain, this project will relocate each pump station out of this designated area to grounds not susceptible to 100-year floodwaters. **Figure 1.1** below represents the coordinates of each pump station.

Figure 1.1 Pump Station Locations

Pump Station Name	Latitude	Longitude
Happy Hills Pump Station	34.497236	-79.103038
North Walnut Pump Station	34.510769	-79.109301

The Happy Hills station is the older of the two being constructed in 1988, North Walnut station being later constructed in 2001. Both stations experienced flooding during Hurricanes Florence and Matthew as noted in the attached photographs. This flooding leads to extended service interruptions, damage to essential system components, and excessive amounts of extraneous flow entering the collection system which contributes to downstream sewer overflows. Useful life at each station has declined due to flood events causing failures to numerous components. During heavy rain events, these pump stations are typically completely underwater and inaccessible by Town staff. The relocation of the Happy Hill pump station will consist of modifications to the gravity sewers to direct flow to the new site, construction of a new 80 GPM pump station, and new forcemain piping to connect the new station to the existing forcemain.

The North Walnut pump station relocation will consist of similar work as the Happy Hill station and includes modifications to the gravity sewers to direct flow to the new site, construction of a new 180 GPM pump station, and new forcemain piping to connect the new station to the existing forcemain. The proposed project will relocate both stations to higher elevations outside the FRIS 100-year floodplain as well as providing additional measures of protection to the stations for flood events that exceed the 100-year level.

1.2 Proposed Mitigation and Level of Protection

The Town of Fairmont will contract a qualified engineering and construction team to implement the proposed project. The proposed project will eliminate / greatly reduce the risk of the existing pump stations becoming inundated by future flood events. Relocation will protect the Town's collection system from series of downward spiraling events, causing failure to multiple components within both pump station sewersheds. Failure events consist of wastewater backing up into homes and businesses in the pump station service areas, as well as contaminants from wastewater being released into the surrounding environment at the two pump stations. This will be completed by locating the new pump stations on high ground outside of the 100-year floodplain, elevating rim elevations to at least 2' above the 100-year flood elevation per NCDEQ minimum design standards, using submersible pumps to eliminate damage potential, and protecting electrical equipment from flood effects. These aspects of the proposed project will allow the system to continue operation during emergency conditions, prevent damage to existing components, reduce the potential for downstream sanitary sewer overflows, and improve water quality in the pump station service areas.

Proposed action will relocate and elevate pump stations to a height that allows for continued use in the event of similar floodwater catastrophes. The relocation process will allow for Town staff to access the pump stations throughout flood events if any problems were to occur. Allowing the Town to use its staff and resources on other high priority problems that may occur throughout the Town and shifting their focus from repairing each pump station upon current inevitable failure during a 100-year flood event. Water quality within the Town's surrounding environment will greatly improve with the relocation of the two pump stations. Sanitary sewer overflows within the two pump station service areas currently discharge untreated sewage into Old Field Swamp and surrounding environments, exposing species that inhabit these areas to water that contains harmful elements. Relocation of each pump station will protect animal and plant species within the Town, allowing all that are currently affected to remain healthy and prosper.

Along with relocation another level of flood protection will be provided at each pump station. Current operation components at each station are not protected by floodwaters and fail when submerged. Elevation of the pump stations will provide one layer of protection from floodwaters that surpass the 100-year flood level, however, each station will be equipped with stand-by generators that are elevated for extra protection. The pump station sites will also consist of new submersible pumps, wet well, valve vault emergency bypass connection, electrical, controls, security fencing, and site work to improve aesthetics. Vital components at the pump station will also be accessible by Town staff, allowing for regular maintenance to continue during flood events.

2.0 HISTORIC EVENTS

Hurricane Florence and Matthew have been the two major flood events that have caused the Happy Hills and North Walnut pump stations to fail. Both 100-year flood events have occurred within the last 5 years, not "100-years" apart. It is unknown as to how many storms of the "100-year" magnitude are to come in the future, but the Town of Fairmont wants to be prepared for the worst. Attached photographic evidence from Hurricane Florence reveals the devastating effects to each pump station, making them inoperable during these emergency conditions due to submersion in floodwaters. Currently the pump stations cannot be reached during flood events of the magnitude shown in the attached pictures from Hurricane Florence. The Town of Fairmont wants to have a proactive approach, not a reactive approach as the Town currently does. Community safety is of highest priority for the Town of Fairmont and this pump station relocation project will help to provide the community with a safe and reliable wastewater collection system, along with a cleaner environment.

Figure 2.1 Happy Hills Pump Station During Hurricane Florence

Above in **Figure 2.1** is a picture of the Happy Hills Pump Station completely covered in floodwaters from Hurricane Florence. The pump station was failing and inaccessible to Town Staff for an extended period of time. When Town Staff could finally access the pump station, majority of damage was already over. Gallons of wastewater had entered the environment at the pump station site and potential sanitary sewer overflows at other manhole locations.

Figure 2.2 North Walnut Pump Station During Hurricane Florence

Above in **Figure 2.2** is a photograph of the North Walnut Pump Station submerged in floodwaters left by Hurricane Florence. Although Town Staff could get minimal access to the pump station site, no repairs could be completed due to the station being under water. Customers tied to the station were not being served for an extended period of time, causing back up that can potentially overflow into homes and businesses in the service area.

3.0 PROJECT AND MAINTENANCE COSTS

The total combined project cost for the relocation of the Happy Hills and North Walnut pump stations is represented below in **Figure 3.1**. Combined annual maintenance cost for the two pump stations totals up to approximately $8,750. The maintenance cost includes proper upkeep, testing, and expected repairs to be made at each pump station.

Figure 3.1 Project and Maintenance Costs

Mitigation Activity	Project Cost	Annual Maintenance Cost
Pump Station Relocation	$2,752,650	$8,750

The Golden LEAF Foundation provides economic relief to rural communities in North Carolina, encouraging growth and collaboration. Golden LEAF has already committed $345,000 of funding to initiate improvements at these pump stations, but insufficient funding was available to provide an adequate long-term solution. Therefore, Golden LEAF funding has been provided to the Town of Fairmont to install back-up generators and raise electrical components at the pump station sites. While these steps are beneficial, they will not adequately protect the stations from future damage. A change in the scope of work will be needed to allocate the funding specifically for these two pump stations. If the request for change in scope of work is approved by the GLF, **Figure 3.2** below shows the amount of funding that will be needed to accompany the Golden LEAF Foundation's contribution in order to provide the Town of Fairmont with two reliable pump stations for the community.

4.0 PROJECT USEFUL LIFE

The 2009 FEMA BCA Reference Guide Project Useful Life Summary Table attached in **Appendix E**, states that a Pump Station project should have a standard useful life value of 50 years. Therefore, a standard useful life of 50 years was used for the Happy Hills and North Walnut pump stations, for calculations with the BCA Excel Tool. An export of the Benefit-Cost Analysis summary can be found in **Appendix B**.

5.0 SERVICE POPULATION

According to 2020 U.S. Census data, the Town of Fairmont's total population is 2,191. Fairmont is a disadvantaged community as the population is less than 3,000 and the per capita income is $12,937 (based on data obtained from the NCOSBM website), which is approximately 36% of the National Average of $35, 672. Approximately 46% of households in the Town of Fairmont have a household income of below $25,000 a year (information obtained from EJSCREEN ACS Report). The North Walnut Pump Station directly serves approximately 48 people and the Happy Hill pump station serves approximately 120 people. Relocation of two pump stations to improve wastewater collection service for 168 people within the Town seems like a small percentage, but when considering the benefits this project provides to the Town of Fairmont, many more citizens will be positively impacted. Downstream of the pump stations are crop fields, livestock, homes, businesses, and other ecosystems that are collecting raw sewage water from flooding at these pump stations. Wastewater contains many harmful contaminants that are unhealthy for consumption by humans and animals, as well as detrimental to local wildlife habitats. Sanitary sewer overflows occur due to excessive flooding at each station, causing raw sewage to flow into parts of the community that may not necessarily be tied to the collection system. Relocation of the two pump stations will provide a cleaner and safer environment for all citizens within the Town of Fairmont. See attached sewer service area map in **Appendix F**.

6.0 EFFECTS OF FLOODING

6.1 Source of Flooding

The North Walnut and Happy Hills pump stations have experienced flooding from two major events in the last 5 years, Hurricane Florence in September of 2018 and Hurricane Matthew in October of 2016. At the time of each event, both pump stations were fully inundated with floodwaters and could not be accessed by Town staff. The pump stations were out of service for several days causing wastewater backup throughout the collection system. Floodwaters infiltrated each station, forcing pumps to process more water than designed to handle, and eventual failure due to flood water damage.

6.2 Historical Damages

Recurrence intervals were determined by most recent NOAA rainfall data from October 2016 and September 2018, attached in **Appendix D**. The data presented below in **Figure 6.1** is rainfall data for the Lumberton Area from NOAA Precipitation records. The City of Lumberton is located approximately 10 miles Northeast of the Town of Fairmont, sharing similar rainfall activity due to close proximity.

Figure 6.1 Collection System Impact During Outages

Event	Rainfall Duration (Days)	Rainfall (inches)	Wastewater Impact at North Walnut (days)	Wastewater Impact at Happy Hills (days)
Hurricane Matthew (10/07/2016 - 10/09/2016)	2	12.53	7	7
Hurricane Florence (09/14/2018 - 09/16/2018)	3	17.06	7	7
Outages (From Violations; 2020)	N/A	N/A	4.5	4.5

6.3 Service Impacts

Although these stations process relatively small amounts of flow, flooding at these pump stations cause major inflow and infiltration into the Town's sanitary sewer collection system. Due to the location of each station within the 100-year floodplain, there are large volumes of extraneous flow that enter the Town's collection system in this area during heavy rainfall. It is highly likely that this area is subject to frequent sanitary sewer overflows during heavy rain events due to the large amounts of extraneous flow which poses a significant environmental risk. Due to its close proximity, sanitary sewer overflows in the project area are likely to discharge untreated sewage into the nearby Old Field Swamp. However, as the Town has no way to access this outfall during heavy rain events, the Town is not able to document overflows and they often go unreported. These inflow and infiltration events cause unnecessary water to be processed at the wastewater treatment facility, negatively impacting the Town in multiple ways. Reducing discharge to the Fairmont Regional Wastewater Facility will allow the treatment plant to process flow from other areas, potentially allowing for growth in surrounding areas. Additionally, this inflow and infiltration contributes to sanitary sewer overflows downstream of the project area which has a negative impact on the environment and contributes to fines and penalties. These pump stations must be repaired after each destructive event, using up Town resources to fix a pump station that will inevitably fail in similar future situations. Valuable money and time currently spent to repair each pump station can be allocated for other needs within the Town's wastewater collection system upon relocation of the two pump stations. For these reasons, the relocation of these pump stations will provide a benefit to all residents of the Town of Fairmont.

7.0 RESULTS

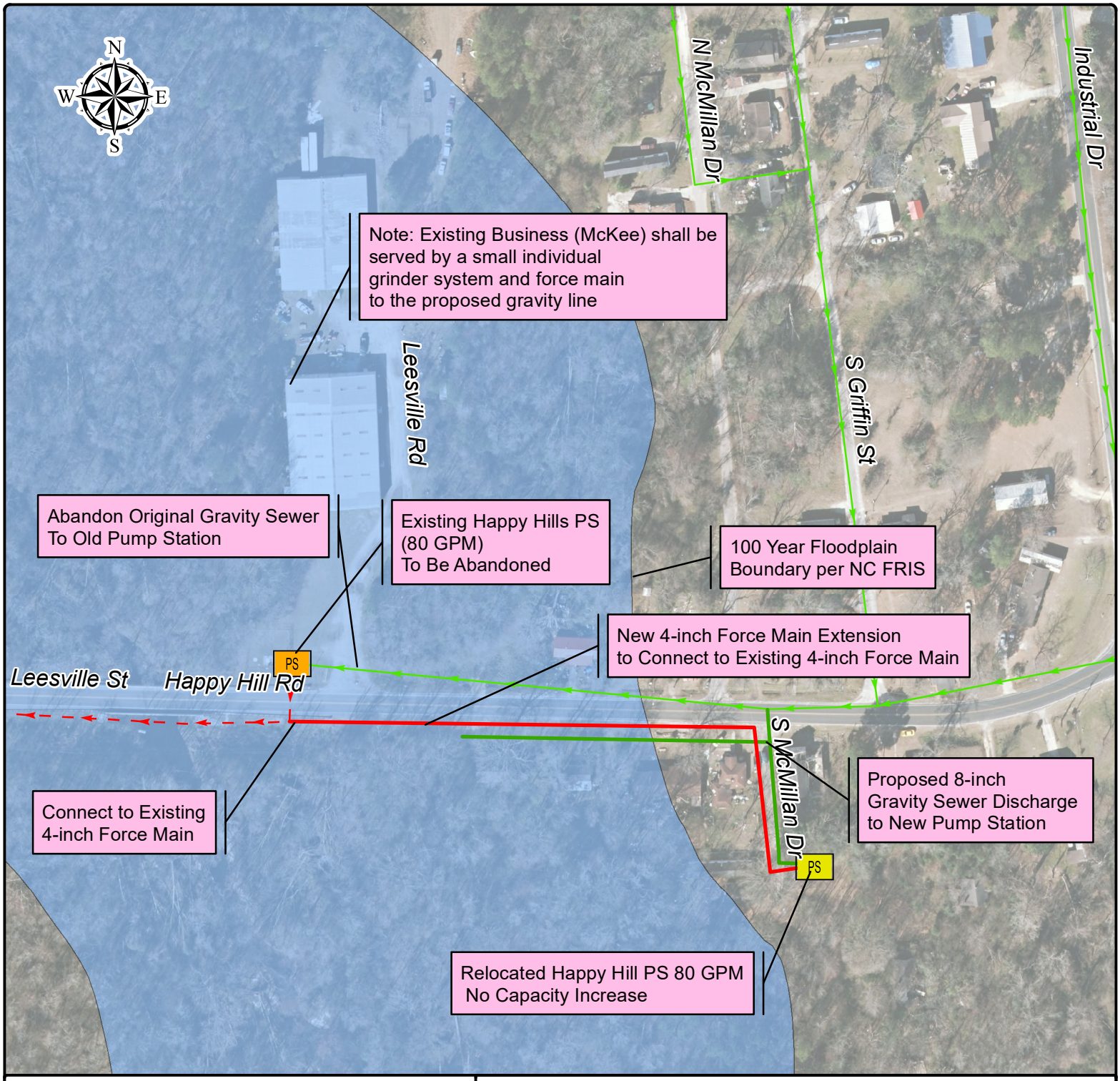
Using the benefit-cost analysis tool provide by FEMA GO through Microsoft Excel, the table below shows the Benefit-Cost Ratio for the Pump Station Relocation Project. After all information required was input into the provided BCA Tool, the determined benefit-cost ratio is 1.68. **Figure 7.1** below shows a summary of total benefits and costs associated with the relocation of the Happy Hills and North Walnut Pump Stations for the Town of Fairmont.

Figure 7.1 Pump Station Relocation Project Benefit-Cost Ratio

Project	Benefits	Costs	Benefit-Cost Ratio
Pump Station Relocation	$4,997,235	$2,977,785	1.68

The total benefits from the implementation of the pump station relocation project approximately outweigh the cost of the project by 1.7 times. Not only will the project provide an exceptional sewer collection service to the areas serviced by each pump station, but the Town of Fairmont will maintain a clean and healthy environment next time a flood event occurs.

APPENDIX A: PROJECT LAYOUT MAPS

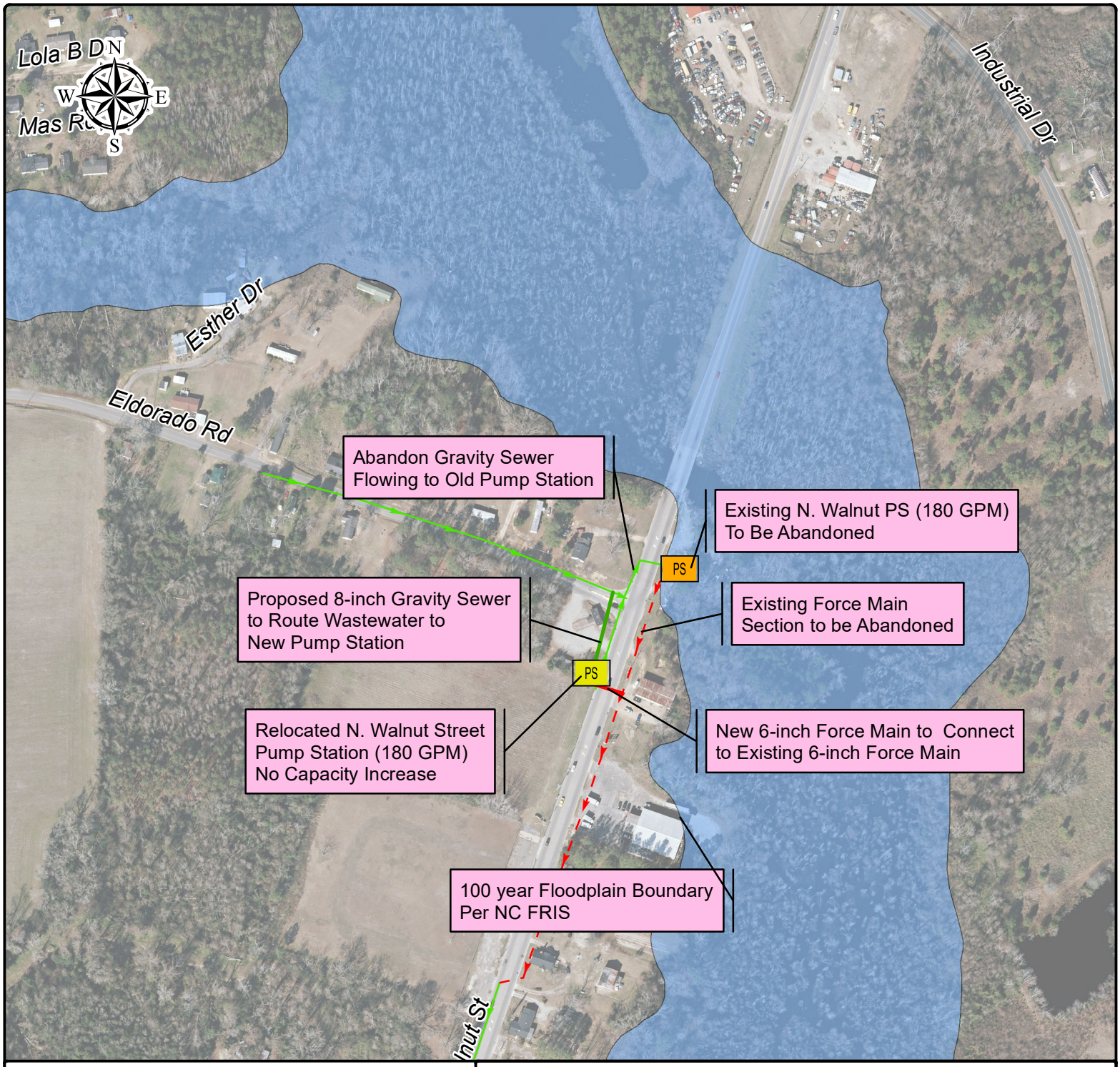


Legend

- PS — Proposed Pump Station
- Proposed Forcemain
- Proposed Gravity Sewer
- PS — Existing Pump Stations
- Forcemain
- GravitySewer
- 100-yr Floodplain

Sewer Pump Station Relocation and Flood Protection Project
Happy Hills Pump Station
Town of Fairmont, NC

0 75 150 300 Feet



Legend

- PS — Proposed Pump Station
- PS — Existing Pump Station
- Proposed Forcemain
- Proposed Gravity Sewer
- Forcemain
- GravitySewer
- 100-yr Floodplain

Sewer Pump Station Relocation and Flood Protection Project North Walnut Pump Station Town of Fairmont, NC

0 75 150 300
Feet

APPENDIX B: BENEFIT-COST ANALYSIS TOOLKIT EXPORT

Build 20211021.0641

Project Summary

Mitigation Title	Hazard	Benefits (B)	Costs (C)	BCR (B/C)
Elevation @ 34.4968000; -79.1142000	FA - Riverine Floc	$6,466,574	$2,188,686	2.95
	Total	$6,466,574	$2,188,686	2.95

Property Configuration

Property Title:	Elevation @ 34.4968000; -79.1142000
Property Location:	28340, Robeson, North Carolina
Property Coordinates:	34.4968, -79.1142
Hazard Type:	Riverine Flood
Mitigation Action Type:	Elevation
Property Type:	Utilities
Analysis Method Type:	Professional Expected Damages

Cost Estimation — Elevation @ 34.4968000; -79.1142000

Project Useful Life (years):	50		
Project Cost:	$2,070,000		
Number of Maintenance Years:	50	Use Default:	Yes
Annual Maintenance Cost:	$8,600		

Damage Analysis Parameters - Damage Frequency Assessment — Elevation @ 34.4968000; -79.1142000

Year of Analysis Conducted:	2021		
Year Property was Built:	1998		
Analysis Duration:	24	Use Default:	Yes

Comments

Year Built:	Project includes two pump stations: North Walnut Pump Station was built in 2001 and Happy Hill Pump Station was built in 1988

Utilities Properties — Elevation @ 34.4968000; -79.1142000

Type of Service:	Wastewater		
Number of Customers Served:	1,600		
Value of Unit of Service ($/person/day):	$58	Use Default:	Yes
Total Value of Service Per Day ($/day):	$92,800		

Comments

Number of Customers Served:	Relocation of each pump station not only affects customers in the pump station service areas, but also affect downstream customers. Total customers in the pump station service areas would total to approximately 168. However, flooding at these pump stations affect all customers within the system, which totals 1,600 customers. The flooding at the pump stations contributes to downstream incidents, including sewage backing up into customers homes and sanitary sewer overflows into yards.

Professional Expected Damages Before Mitigation — Elevation @ 34.4968000; -79.1142000

Recurrence Interval (years)	Wastewater Impact (days)	Optional Damages or Replacemen	Component	Category 3 ($	Volunteer Costs iber of Volun	umber of Da	Total Damages ($)
2.5	14	41,000	65,500	0	0	0	1,405,700

Annualized Damages Before Mitigation

Elevation @ 34.4968000; -79.1142000

Annualized Recurrence Interval (years)	nages and Losses	Damages and Losses ($)
3	1,405,700	468,567
Sum	Damages and Losses	Damages and Losses ($)
	1,405,700	468,567

Professional Expected Damages After Mitigation

Elevation @ 34.4968000; -79.1142000

Recurrence Interval (years)	Wastewater Impact (days)	or Replacemen	Optional Damages Component	Category 3 ($)	Volunteer Costs ber of Volun	umber of Da	Total Damages ($)
2.5	0	0	0	0	0	0	0

Annualized Damages After Mitigation

Elevation @ 34.4968000; -79.1142000

Annualized Recurrence Interval (years)	nages and Losses	Damages and Losses ($)
2.5	0	0
Sum	Damages and Losses	Damages and Losses ($)
	0	0

Benefits-Costs Summary

Elevation @ 34.4968000; -79.1142000

Total Standard Mitigation Benefits:	$6,466,574
Total Social Benefits:	$0
Total Mitigation Project Benefits:	$6,466,574
Total Mitigation Project Cost:	$2,188,686
Benefit Cost Ratio - Standard:	2.95
Benefit Cost Ratio - Standard + Social:	2.95

APPENDIX C: FLOOD INSURANCE RATE MAPS

Northing: = 273,977, Easting = 1,966,561

Northing: = 273,977, Easting = 1,970,030

Northing: = 270,509, Easting = 1,966,561

Northing: = 270,509, Easting = 1,970,030

- Without Base Flood Elevation (BFE) *Zone A, V, A99*
- With BFE or Depth *Zone AE, AO, AH, VE, AR*
- Regulatory Floodway
- 0.2% Annual Chance Flood Hazard
- Future Conditions 1% Annual Chance Flood Hazard *Zone X*
- Areas Determined to be Outside the 0.2% Annual Chance Flood Hazard *Zone X*
- Jurisdiction Boundary
- FIRM Panel Boundary

North Carolina State Plane Projection Feet (Zone 3200)
Datum: NAD 1983 (Horizontal), NAVD 1988 (Vertical)

1 inch = 500 feet 1:6000

0 125 250 500 Feet

0 25 50 100 Meters

FEMA National Flood Insurance Program

NATIONAL FLOOD INSURANCE PROGRAM
FLOOD INSURANCE RATE MAP

Panel(s):9267,9277

CONTAINS:

COMMUNITY	CID
TOWN OF FAIRMONT	370205

Notice to User: The Map Number(s) shown below should be used when placing map orders; the Community Number(s) shown above should be used on insurance applications for the subject community.

SELECTED PANELS:

MAP NUMBER	EFFECTIVE DATE
3710926700J	1/19/2005
3710927700J	1/19/2005

FEMA: National Flood Insurance Program

Panel(s):9267,9277

CONTAINS:

COMMUNITY	CID
TOWN OF FAIRMONT	370205

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MAP NUMBER	EFFECTIVE DATE
3710926700J	1/19/2005
3710927700J	1/19/2005

NOTES TO USERS

This is an official FIRMette of a portion of the effective panels listed in the Title Block shown on Page 1. The information represented on this FIRMette was extracted from the effective digital flood hazard data available at http://fris.nc.gov/fris.

Base flood elevation data, floodway, nonencroachment widths, information on certain areas no in the Special Flood Hazard Areas protected by flood control structures, and other pertinent data are available in the Flood Insurance Study (FIS) available at http://fris.nc.gov/fris. Users should be aware that flood elevations shown on this FIRMette represent elevations rounded to one tenth of a foot (0.1') and should be utilized in conjunction with data available in the FIS.

NOTES TO USERS

Base map information and geospatial data used to develop this FIRMette were obtained from various organizations, including the participating local community(ies), state and federal agencies, and/or other sources. The primary base for this FIRM is aerial imagery acquired by the State in 2010. Information and geospatial data supplied by the local community(ies) that met FEMA base map specifications were considered the preferred source for development of the base map.

See geospatial metadata for the associated digital FIRMette for additional information about base map preparation. Base map features shown on this FIRMette, such as corporate limits, are based on the most up-to-date data available at the time of publication. Changes in the corporate limits may have occurred since this map was published. Map users should consult the appropriate community official or website to verify current conditions of jurisdictional boundaries and base map features. This map may contain roads that were not considered in the hydraulic analysis of streams where no new hydraulic model was created during the production of this statewide format FIRM.

Flood elevations on this map are referenced to either or both the North American Vertical Datum of 1988 (NAVD 88) or National Geodetic Datum of 1929 (NGVD 29), and are labeled accordingly. These flood elevations must be compared to structure and ground elevations referenced to the same vertical datum. To obtain current elevation, description, and/or location information for bench marks shown on this map, or for information regarding conversion between NGVD 29 and NAVD 88, please contact the Information Services Branch of the National Geodetic Survey at (301) 713-3242, or visit its website at http://www.ngs.noaa.gov/.

MORE INFORMATION

Letters of Map Amendment (LOMA)	1-877-336-2627 http://msc.fema.gov/
Letters of Map Revision (LOMR)	919-715-5711 www.ncfloodmaps.com
Flood Insurance Availability	
North Carolina Division of Emergency Management (NCDEM)	919-715-5711 http://www.nccrimecontrol.org/nfip
National Flood Insurance Program (NFIP)	1-877-638-6620 http://www.fema.gov/business/nfip
Questions about this FIRMette	1-877-336-2627 http://fema.gov

LEGEND

LEGEND

MAP REVISIONS

There are no map revisions for the selected area.

Northing: = 278,837, Easting = 1,965,514

Northing: = 278,837, Easting = 1,968,983

Northing: = 275,368, Easting = 1,965,514

Northing: = 275,368, Easting = 1,968,983

Without Base Flood Elevation (BFE)
Zone A, V, A99

With BFE or Depth
Zone AE, AO, AH, VE, AR

Regulatory Floodway

0.2% Annual Chance Flood Hazard

Future Conditions 1% Annual Chance Flood Hazard *Zone X*

Areas Determined to be Outside the 0.2% Annual Chance Flood Hazard
Zone X

Jurisdiction Boundary

FIRM Panel Boundary

North Carolina State Plane Projection Feet (Zone 3200)
Datum: NAD 1983 (Horizontal), NAVD 1988 (Vertical)

1 inch = 500 feet 1:6000

0 125 250 500 Feet

0 25 50 100 Meters

FEMA National Flood Insurance Program

NATIONAL FLOOD INSURANCE PROGRAM
FLOOD INSURANCE RATE MAP

Panel(s):9267

CONTAINS:

COMMUNITY	CID
TOWN OF FAIRMONT	370205

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MAP NUMBER	EFFECTIVE DATE
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FEMA: National Flood Insurance Program

Panel(s):9267

CONTAINS:

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TOWN OF FAIRMONT	370205

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	http://fema.gov

LEGEND

LEGEND

MAP REVISIONS

There are no map revisions for the selected area.

APPENDIX D: NOAA POINT PRECIPITATION FREQUENCY ESTIMATES AND DATA

NOAA Atlas 14, Volume 2, Version 3
Location name: Fairmont, North Carolina, USA*
Latitude: 34.4971°, Longitude: -79.1104°
Elevation: 119.53 ft**
* source: ESRI Maps
** source: USGS

POINT PRECIPITATION FREQUENCY ESTIMATES

G.M. Bonnin, D. Martin, B. Lin, T. Parzybok, M.Yekta, and D. Riley

NOAA, National Weather Service, Silver Spring, Maryland

PF_tabular | PF_graphical | Maps_&_aerials

PF tabular

PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches)[1]

Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	**0.443** (0.406-0.484)	**0.523** (0.480-0.571)	**0.612** (0.561-0.670)	**0.681** (0.622-0.743)	**0.766** (0.697-0.835)	**0.830** (0.753-0.903)	**0.893** (0.805-0.970)	**0.953** (0.855-1.04)	**1.03** (0.917-1.12)	**1.09** (0.964-1.19)
10-min	**0.707** (0.649-0.774)	**0.836** (0.767-0.914)	**0.981** (0.898-1.07)	**1.09** (0.995-1.19)	**1.22** (1.11-1.33)	**1.32** (1.20-1.44)	**1.42** (1.28-1.54)	**1.51** (1.36-1.64)	**1.63** (1.45-1.77)	**1.72** (1.52-1.87)
15-min	**0.884** (0.811-0.967)	**1.05** (0.965-1.15)	**1.24** (1.14-1.36)	**1.38** (1.26-1.50)	**1.55** (1.41-1.69)	**1.67** (1.52-1.82)	**1.79** (1.62-1.95)	**1.91** (1.71-2.07)	**2.05** (1.83-2.23)	**2.16** (1.91-2.35)
30-min	**1.21** (1.11-1.33)	**1.45** (1.33-1.59)	**1.76** (1.61-1.93)	**2.00** (1.82-2.18)	**2.29** (2.09-2.50)	**2.52** (2.29-2.74)	**2.75** (2.48-2.99)	**2.97** (2.66-3.23)	**3.27** (2.90-3.55)	**3.50** (3.09-3.81)
60-min	**1.51** (1.39-1.65)	**1.82** (1.67-1.99)	**2.26** (2.07-2.47)	**2.60** (2.38-2.84)	**3.05** (2.78-3.33)	**3.42** (3.10-3.72)	**3.78** (3.41-4.11)	**4.16** (3.73-4.52)	**4.68** (4.17-5.10)	**5.10** (4.51-5.56)
2-hr	**1.75** (1.60-1.94)	**2.12** (1.94-2.34)	**2.69** (2.45-2.96)	**3.14** (2.85-3.45)	**3.76** (3.40-4.14)	**4.27** (3.85-4.69)	**4.81** (4.31-5.28)	**5.38** (4.79-5.90)	**6.18** (5.44-6.78)	**6.83** (5.97-7.50)
3-hr	**1.86** (1.69-2.07)	**2.25** (2.04-2.50)	**2.86** (2.60-3.17)	**3.36** (3.05-3.73)	**4.08** (3.68-4.51)	**4.69** (4.19-5.18)	**5.33** (4.74-5.89)	**6.03** (5.31-6.64)	**7.05** (6.13-7.77)	**7.90** (6.80-8.70)
6-hr	**2.20** (2.00-2.46)	**2.67** (2.42-2.97)	**3.39** (3.08-3.77)	**4.00** (3.61-4.44)	**4.87** (4.37-5.39)	**5.61** (4.99-6.19)	**6.41** (5.66-7.06)	**7.27** (6.36-8.00)	**8.54** (7.38-9.39)	**9.59** (8.20-10.5)
12-hr	**2.59** (2.34-2.90)	**3.13** (2.82-3.51)	**4.00** (3.60-4.48)	**4.74** (4.25-5.29)	**5.81** (5.18-6.47)	**6.74** (5.96-7.48)	**7.74** (6.78-8.58)	**8.84** (7.67-9.78)	**10.5** (8.95-11.6)	**11.9** (10.0-13.1)
24-hr	**3.03** (2.80-3.30)	**3.68** (3.40-4.02)	**4.74** (4.36-5.16)	**5.61** (5.15-6.11)	**6.87** (6.27-7.47)	**7.93** (7.19-8.62)	**9.07** (8.17-9.87)	**10.3** (9.21-11.2)	**12.1** (10.7-13.2)	**13.6** (11.9-14.9)
2-day	**3.54** (3.27-3.86)	**4.29** (3.96-4.68)	**5.47** (5.04-5.96)	**6.45** (5.93-7.02)	**7.85** (7.17-8.55)	**9.02** (8.19-9.82)	**10.3** (9.27-11.2)	**11.6** (10.4-12.7)	**13.6** (12.0-14.9)	**15.2** (13.3-16.7)
3-day	**3.77** (3.49-4.09)	**4.56** (4.22-4.94)	**5.78** (5.35-6.26)	**6.78** (6.26-7.35)	**8.22** (7.54-8.90)	**9.40** (8.58-10.2)	**10.7** (9.67-11.6)	**12.0** (10.8-13.1)	**14.0** (12.4-15.2)	**15.6** (13.7-17.0)
4-day	**4.00** (3.72-4.32)	**4.83** (4.49-5.20)	**6.09** (5.65-6.57)	**7.12** (6.59-7.67)	**8.58** (7.90-9.25)	**9.78** (8.97-10.6)	**11.1** (10.1-11.9)	**12.4** (11.2-13.4)	**14.4** (12.8-15.6)	**16.0** (14.2-17.4)
7-day	**4.66** (4.34-5.01)	**5.61** (5.22-6.03)	**7.00** (6.51-7.54)	**8.12** (7.53-8.73)	**9.69** (8.95-10.4)	**11.0** (10.1-11.8)	**12.3** (11.2-13.2)	**13.7** (12.4-14.8)	**15.7** (14.1-17.0)	**17.3** (15.4-18.8)
10-day	**5.36** (5.02-5.73)	**6.42** (6.01-6.86)	**7.89** (7.37-8.43)	**9.05** (8.45-9.67)	**10.6** (9.90-11.4)	**11.9** (11.0-12.8)	**13.3** (12.2-14.2)	**14.6** (13.4-15.7)	**16.6** (15.0-17.9)	**18.1** (16.3-19.6)
20-day	**7.20** (6.79-7.65)	**8.58** (8.09-9.11)	**10.4** (9.77-11.0)	**11.8** (11.1-12.5)	**13.7** (12.9-14.6)	**15.3** (14.3-16.2)	**16.9** (15.7-17.9)	**18.5** (17.1-19.7)	**20.7** (19.0-22.2)	**22.5** (20.5-24.2)
30-day	**8.97** (8.50-9.49)	**10.6** (10.1-11.3)	**12.6** (12.0-13.4)	**14.2** (13.4-15.0)	**16.3** (15.3-17.2)	**17.9** (16.8-18.9)	**19.5** (18.2-20.7)	**21.1** (19.7-22.5)	**23.3** (21.6-24.9)	**25.1** (23.1-26.8)
45-day	**11.3** (10.7-11.9)	**13.3** (12.6-14.0)	**15.6** (14.8-16.4)	**17.3** (16.4-18.2)	**19.6** (18.5-20.7)	**21.4** (20.1-22.6)	**23.2** (21.7-24.5)	**24.9** (23.3-26.4)	**27.3** (25.4-29.0)	**29.1** (26.9-31.0)
60-day	**13.5** (12.8-14.2)	**15.9** (15.1-16.7)	**18.4** (17.5-19.4)	**20.4** (19.3-21.4)	**22.9** (21.6-24.0)	**24.8** (23.4-26.1)	**26.6** (25.1-28.1)	**28.5** (26.7-30.1)	**30.9** (28.8-32.7)	**32.7** (30.4-34.7)

[1] Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS).

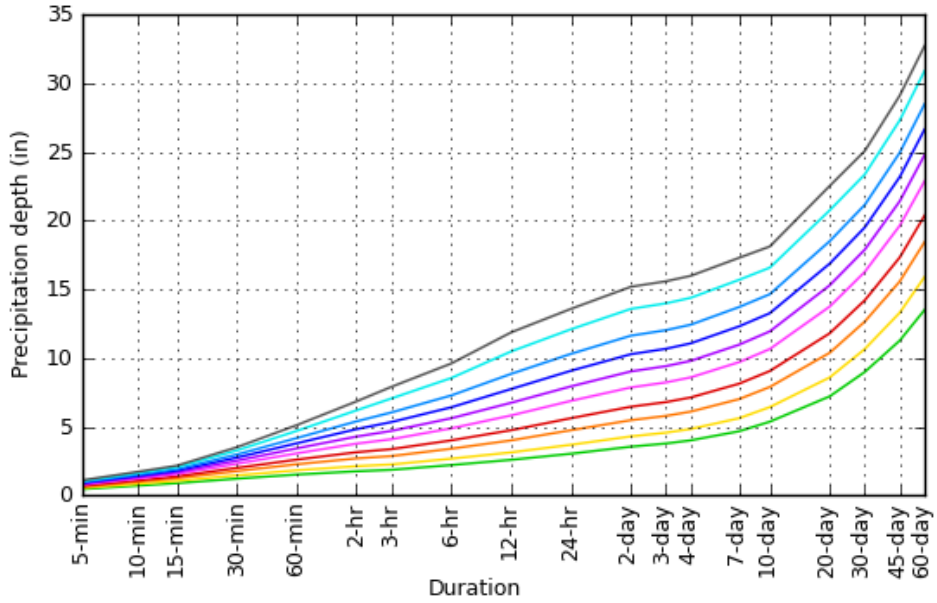
Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values.

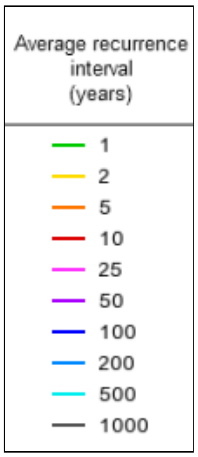
Please refer to NOAA Atlas 14 document for more information.

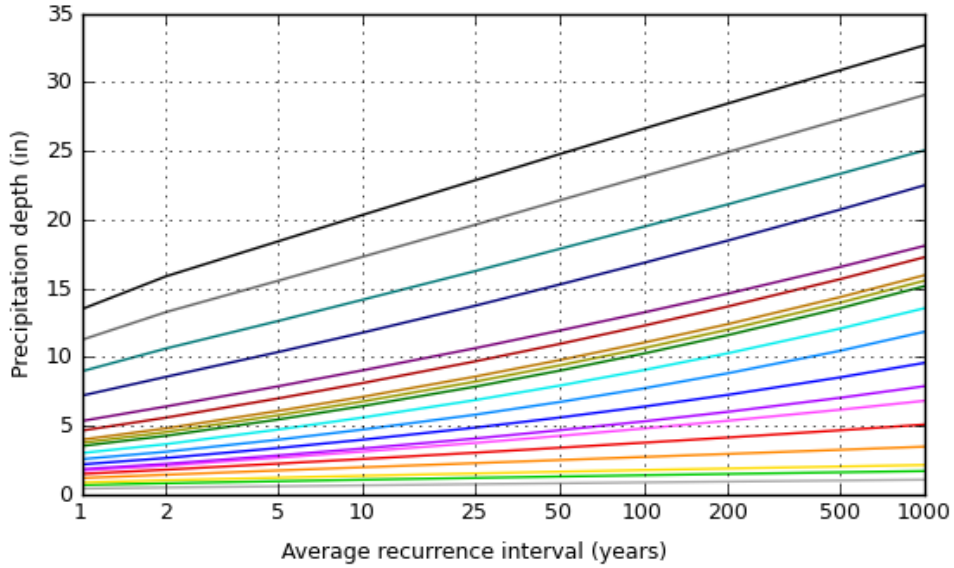
Back to Top

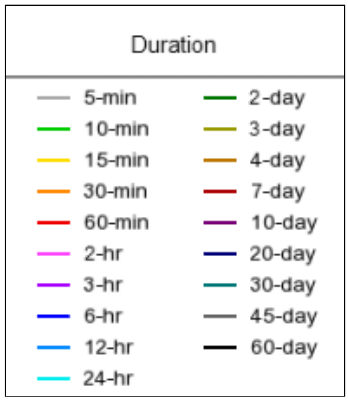
PF graphical

PDS-based depth-duration-frequency (DDF) curves
Latitude: 34.4971°, Longitude: -79.1104°







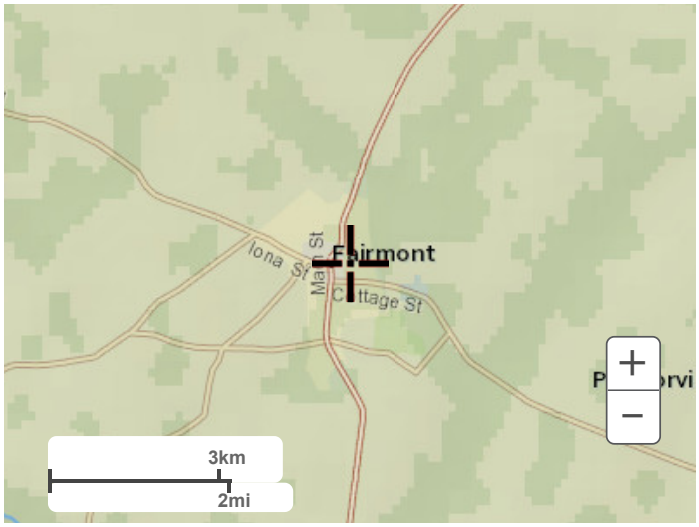


NOAA Atlas 14, Volume 2, Version 3 Created (GMT): Tue Dec 28 20:38:20 2021

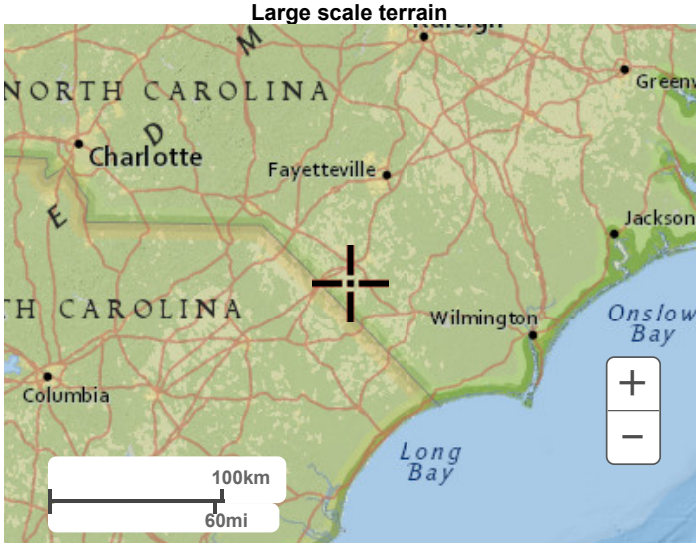
Back to Top

Maps & aerials

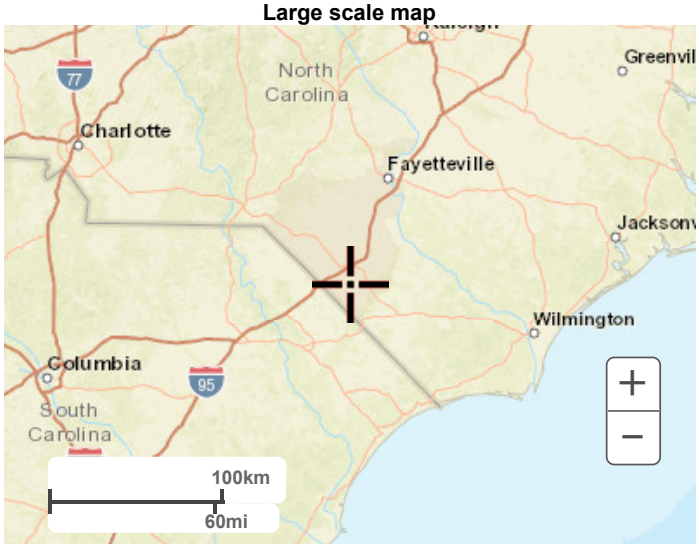
Small scale terrain



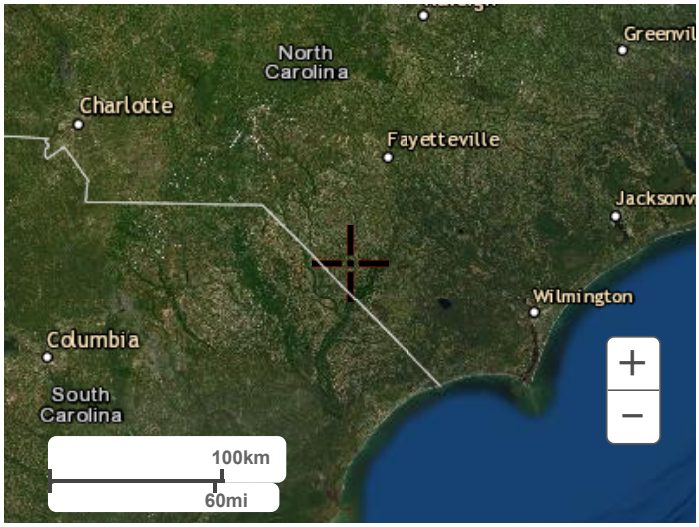
Large scale terrain



Large scale map



Large scale aerial



Back to Top

US Department of Commerce
National Oceanic and Atmospheric Administration
National Weather Service
National Water Center
1325 East West Highway
Silver Spring, MD 20910
Questions?: HDSC.Questions@noaa.gov

Disclaimer

Climatological Data for Lumberton Area, NC (ThreadEx) - October 2016

Date	Temperature				HDD	CDD	Precipitation
	Maximum	Minimum	Average	Departure			
2016-10-01	86	59	72.5	2.7	0	8	T
2016-10-02	84	60	72.0	2.6	0	7	0.00
2016-10-03	84	57	70.5	1.4	0	6	0.00
2016-10-04	79	64	71.5	2.8	0	7	0.00
2016-10-05	76	63	69.5	1.2	0	5	0.00
2016-10-06	73	62	67.5	-0.5	0	3	0.00
2016-10-07	83	67	75.0	7.4	0	10	0.22
2016-10-08	75	M	M	M	M	M	12.53
2016-10-09	M	M	M	M	M	M	0.02
2016-10-10	M	M	M	M	M	M	M
2016-10-11	75	56	65.5	-0.6	0	1	0.00
2016-10-12	79	54	66.5	0.8	0	2	0.00
2016-10-13	82	53	67.5	2.2	0	3	0.00
2016-10-14	76	59	67.5	2.6	0	3	0.00
2016-10-15	75	56	65.5	1.0	0	1	0.00
2016-10-16	81	54	67.5	3.3	0	3	0.00
2016-10-17	83	55	69.0	5.2	0	4	0.00
2016-10-18	M	M	M	M	M	M	0.00
2016-10-19	M	M	M	M	M	M	0.00
2016-10-20	M	M	M	M	M	M	0.00
2016-10-21	83	58	70.5	8.2	0	6	M
2016-10-22	66	43	54.5	-7.4	10	0	0.00
2016-10-23	71	38	54.5	-7.0	10	0	0.00
2016-10-24	81	46	63.5	2.3	1	0	0.00
2016-10-25	70	45	57.5	-3.3	7	0	0.00
2016-10-26	73	40	56.5	-4.0	8	0	0.00
2016-10-27	79	50	64.5	4.4	0	0	0.00
2016-10-28	82	58	70.0	10.2	0	5	0.00
2016-10-29	81	48	64.5	5.1	0	0	0.00
2016-10-30	85	54	69.5	10.4	0	5	0.00
2016-10-31	80	53	66.5	7.8	0	2	0.00
Sum	2042	1352	-	-	36	81	12.77
Average	78.5	54.1	66.4	2.2	-	-	-
Normal	75.9	52.5	64.2	-	110	85	2.29

Observations for each day cover the 24 hours ending at the time given below (Local Standard Time).
Max Temperature : midnight
Min Temperature : midnight
Precipitation : midnight

Climatological Data for Lumberton Area, NC (ThreadEx) - September 2018

Date	Temperature				HDD	CDD	Precipitation
	Maximum	Minimum	Average	Departure			
2018-09-01	94	71	82.5	4.5	0	18	0.00
2018-09-02	95	72	83.5	5.7	0	19	0.00
2018-09-03	94	70	82.0	4.4	0	17	0.00
2018-09-04	94	71	82.5	5.1	0	18	0.00
2018-09-05	94	72	83.0	5.8	0	18	0.00
2018-09-06	94	69	81.5	4.5	0	17	0.00
2018-09-07	95	68	81.5	4.7	0	17	0.00
2018-09-08	94	69	81.5	4.9	0	17	0.00
2018-09-09	94	69	81.5	5.1	0	17	0.00
2018-09-10	94	69	81.5	5.4	0	17	T
2018-09-11	94	69	81.5	5.6	0	17	0.13
2018-09-12	94	73	83.5	7.8	0	19	T
2018-09-13	88	72	80.0	4.6	0	15	0.36
2018-09-14	80	74	77.0	1.9	0	12	4.57
2018-09-15	76	74	75.0	0.1	0	10	10.95
2018-09-16	78	74	76.0	1.4	0	11	1.54
2018-09-17	89	75	82.0	7.7	0	17	0.01
2018-09-18	91	73	82.0	8.0	0	17	0.01
2018-09-19	92	71	81.5	7.8	0	17	0.00
2018-09-20	91	68	79.5	6.1	0	15	0.00
2018-09-21	86	69	77.5	4.4	0	13	0.00
2018-09-22	89	66	77.5	4.7	0	13	0.00
2018-09-23	88	66	77.0	4.5	0	12	0.00
2018-09-24	79	69	74.0	1.8	0	9	0.00
2018-09-25	90	71	80.5	8.6	0	16	0.00
2018-09-26	91	68	79.5	8.0	0	15	0.21
2018-09-27	90	71	80.5	9.3	0	16	0.93
2018-09-28	89	71	80.0	9.2	0	15	0.29
2018-09-29	87	72	79.5	9.0	0	15	0.00
2018-09-30	84	63	73.5	3.4	0	9	0.00
Sum	2688	2109	-	-	0	458	19.00
Average	89.6	70.3	80.0	5.5	-	-	-
Normal	84.2	64.8	74.5	-	7	292	4.93

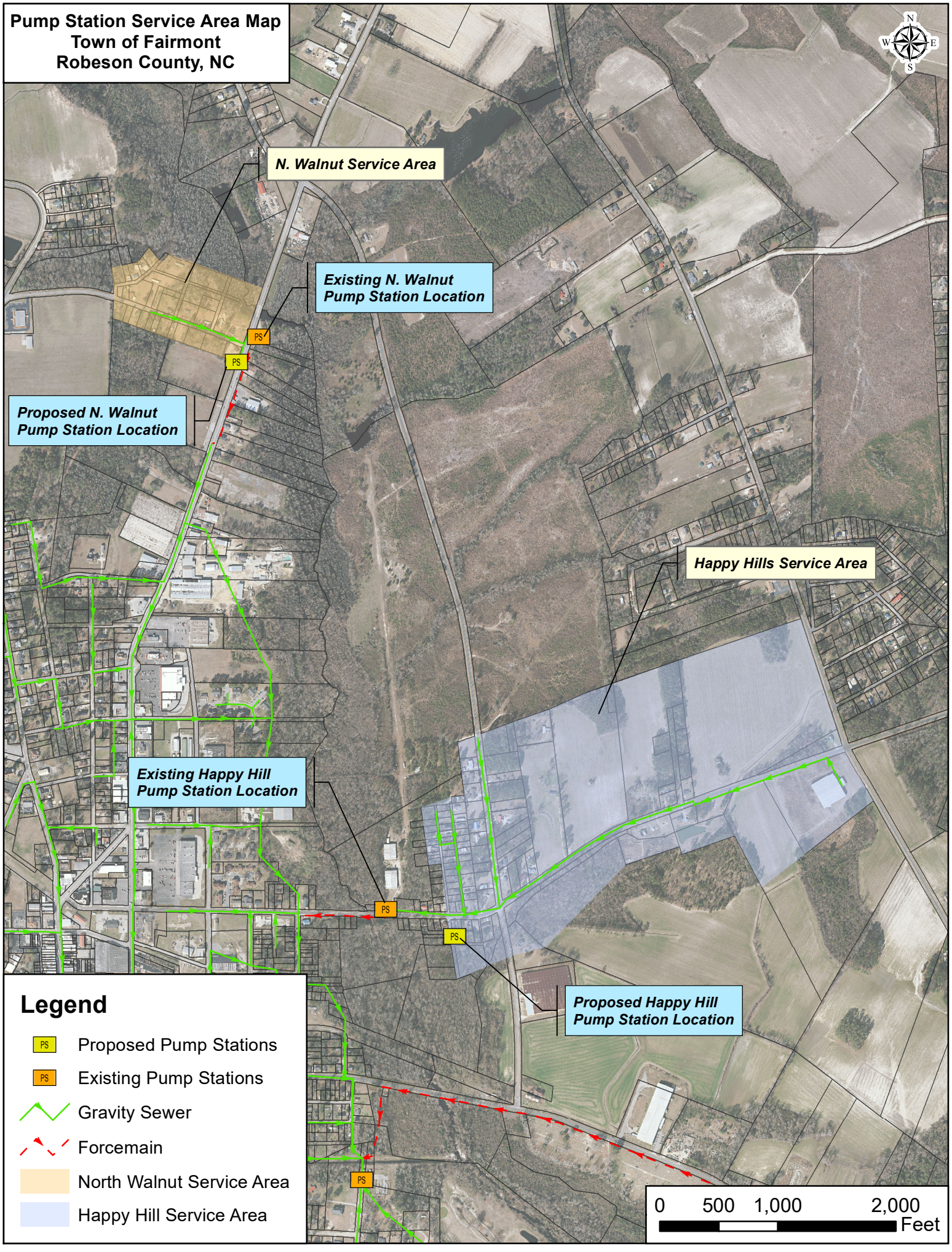
Observations for each day cover the 24 hours ending at the time given below (Local Standard Time).
Max Temperature : midnight
Min Temperature : midnight
Precipitation : midnight

APPENDIX E: FEMA 2009 BCA REFERENCE GUIDE - PROJECT USEFUL LIFE TABLE

Project Type	Useful Life (years)		Comment
	Standard Value	Acceptable Limits (documentation required)	
Acquisition/Relocation			
All Structures	100	100	
Elevation			
Residential Building	30	30–50	
Non-Residential Building	25	25–50	
Public Building	50	50–100	
Historic Buildings	50	50–100	
Structural/Non-Structural Building Project			
Residential Building Retrofit	30	30	
Non-Residential Building Retrofit	25	25–50	
Public Building Retrofit	50	50–100	
Historic Building Retrofit	50	50–100	
Roof Diaphragm Retrofit	30	30	Roof hardening and roof clips
Tornado Safe Room – Residential	30	30	
Tornado Safe Room – Community	30	30–50	Retrofit or small community safe room ≤ 16 people (30 yr), New (50 yr)
Non-Structural Building Elements	30	30	Ceilings, electrical cabinets, generators, parapet walls, or chimneys
Non-Structural Major Equipment	15	15–30	Elevators, HVAC, sprinklers
Non-Structural Minor Equipment	5	5–20	Generic contents, racks, shelves
Infrastructure Projects			
Major Infrastructure (minor localized flood reduction projects)	50	35–100	
Concrete Infrastructure, Flood Walls, Roads, Bridges, Major Drainage System	50	35–50	
Culverts (concrete, PVC, CMP, HDPE, etc.)	30	25–50	Culvert **with** end treatment (i.e., wing walls, end sections, head walls, etc.)
	10	5–20	Culvert **without** end treatment (i.e., wing walls, end sections, head walls, etc.)
Pump Stations, Substations, Wastewater Systems, or Equipment Such as Generators	50	50	Structures
	5	5–30	Equipment
Hurricane Storm Shutters	15	15–30	Depends on type of storm shutter
Utility Mitigation Projects	50	50–100	Major (power lines, cable, hardening gas, water, sewer lines, etc.)
	5	5–30	Minor (backflow values, downspout disconnect, etc.)

Project Type	Useful Life (years)		Comment
	Standard Value	Acceptable Limits (documentation required)	
Miscellaneous Equipment Projects			
Equipment Purchases	2	2–10	Small, portable equipment (e.g., computer)
	30	5–30	Heavy equipment
Wildfire Mitigation Projects			
Defensible Space/Hazardous Fuels Reduction	4	2–4	Brush – Depends on drought conditions
Vegetation Management	1	1	Grass – Depends on geographic location and precipitation
	20	3–20	Forest canopy – Must be maintained every 3 years
Ignition-Resistant Construction	10	10–30	Depends on type of construction and materials used

APPENDIX F: PUMP STATION SERVICE AREA MAP


Pump Station Service Area Map
Town of Fairmont
Robeson County, NC
N
W
E
S
N. Walnut Service Area
Existing N. Walnut
Pump Station Location
PS
PS
Proposed N. Walnut
Pump Station Location
Happy Hills Service Area
Existing Happy Hill
Pump Station Location
PS
PS
PS
Proposed Happy Hill
Pump Station Location
Legend
PS
Proposed Pump Stations
PS
Existing Pump Stations
Gravity Sewer
Forcemain
North Walnut Service Area
Happy Hill Service Area
0
500
1,000
2,000
Feet

APPENDIX G: HISTORIC PHOTOS OF DAMAGE AT PUMP STATION SITES

Town of Fairmont
Pump Station Photos

Happy Hill Pump Station – The flooded pump station is seen in the background following Hurricane Florence with no access to the station, located near the utility pole in center of picture

Town of Fairmont
Pump Station Photos

Happy Hill Pump Station – Leaves on the fence show that the pump station was thoroughly submerged during hurricane / Note location of utility pole for reference to previous photo

Town of Fairmont
Pump Station Photos

N. Walnut Street pump station site during Hurricane Florence flooding / Note station on left of highway and site completely underwater, days following Hurricane Florence

Town of Fairmont
Pump Station Photos

N. Walnut Street pump station site with leaves and debris in the fence that show the water level during hurricane flooding

APPENDIX H: HAPPY HILL PUMP STATION RECORD DRAWINGS

100 S.Y EXTRA

19

COUNTY OF ROBESON

NORTH CAROLINA

FY 90 COMMUNITY DEVELOPMENT PROJECT

HAPPY HILL REVITALIZATION

1992

CHAIRMAN: BOBBY DEAN LOCKLEAR

COMMISSIONERS:

BILLY S. BRITT   SAMMY COX   JOHNNY HUNT
LUTHER SANDERSON   NOAH WOODS

COMMUNITY DEVELOPMENT ADMINISTRATOR:
TOWN OF FAIRMONT - SCOTT DADSON

AS BUILT DRAWINGS:
DATED 1-31-94
By: Hoyt Kinsey
By: [illegible]

TOTAL QUANTITIES:
WATER SERVICE = 9 EA.
SEWER SERVICES = 20 EA.
DEMOLITION - 1-31-94 = 6 EA.
[illegible] = 148.29 C.Y
(15) ASPHALT SURFACE COURSE = 1288.1 S.Y INC PATCH
(14) [illegible]: ABC STONE = 1350 S.Y

The Wooten Company

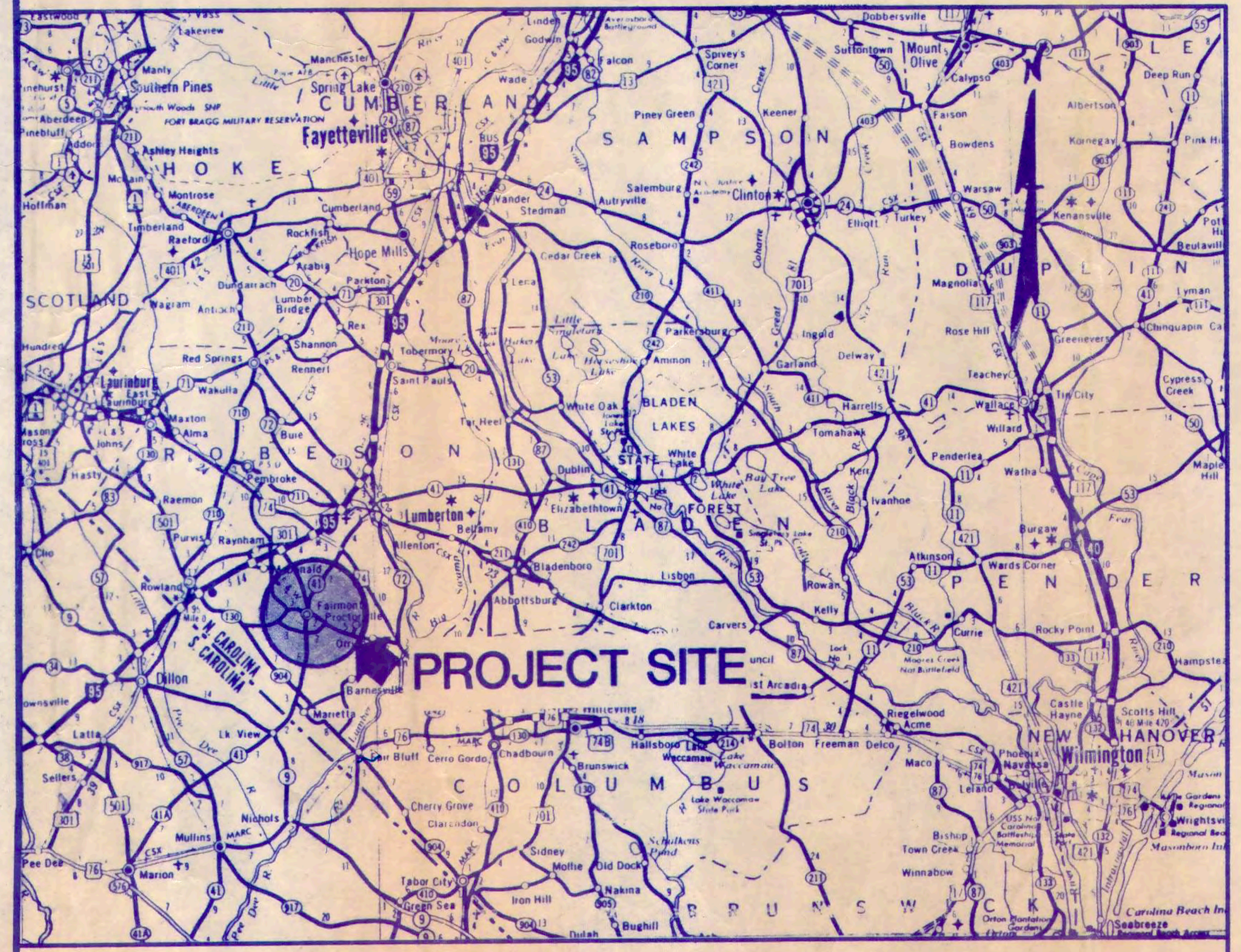
ENGINEERING - PLANNING - ARCHITECTURE

RALEIGH, N. C. - GREENVILLE, N. C.

END:
WATER
SEWER
DEMOLITION

INDEX TO DRAWINGS

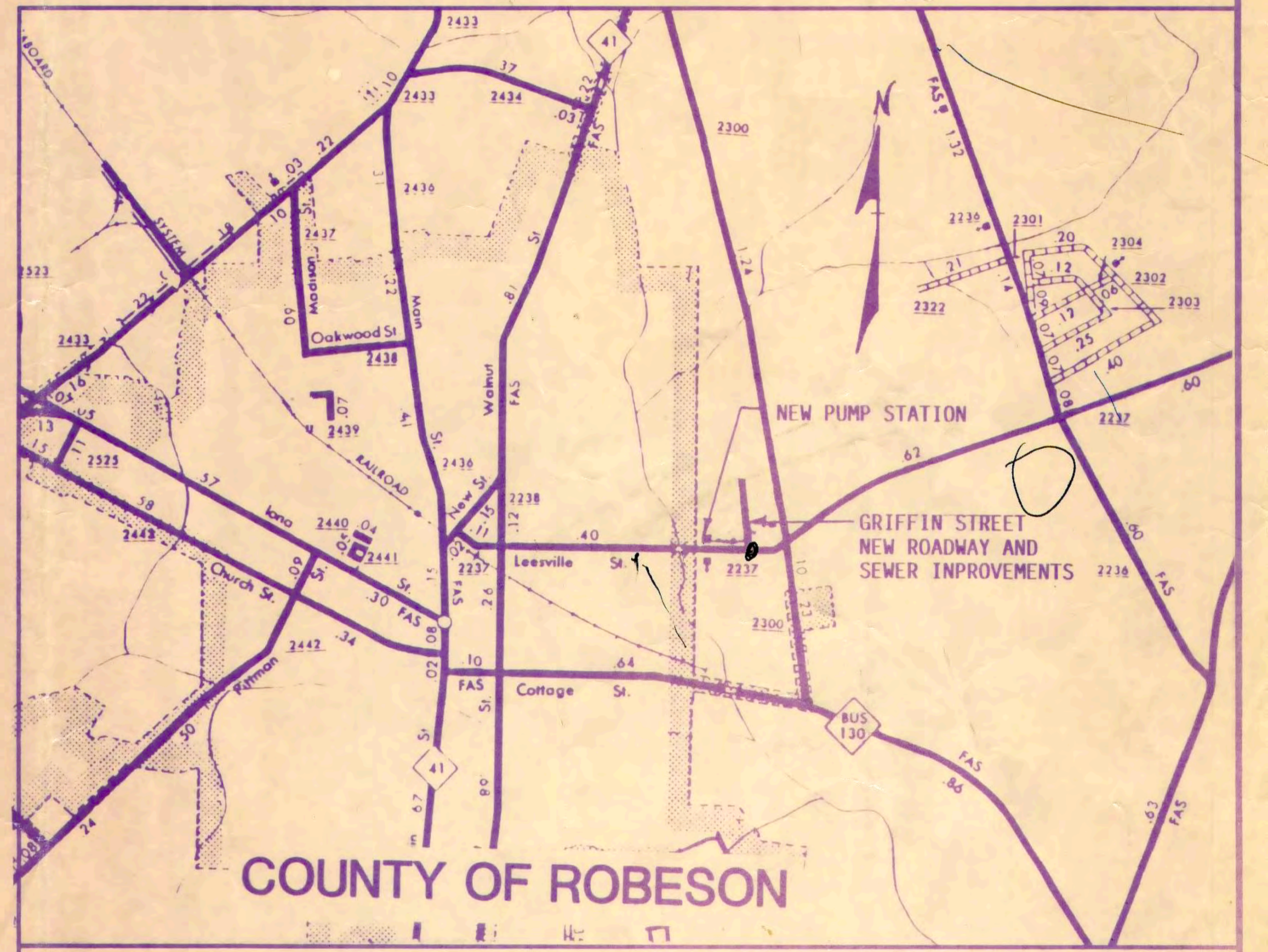
1. COVER / INDEX
2. LEESVILLE ROAD GRAVITY SEWER AND FORCE MAIN
3. GRIFFIN STREET IMPROVEMENTS
4. PUMPING STATION AND RELATED WORK
5. MISCELLANEOUS DETAILS AND ROADWAY IMPROVEMENT DETAILS



VICINITY MAP

NORTH CAROLINA PROFESSIONAL SEAL 8213 ENGINEER LUKE T. KWONG

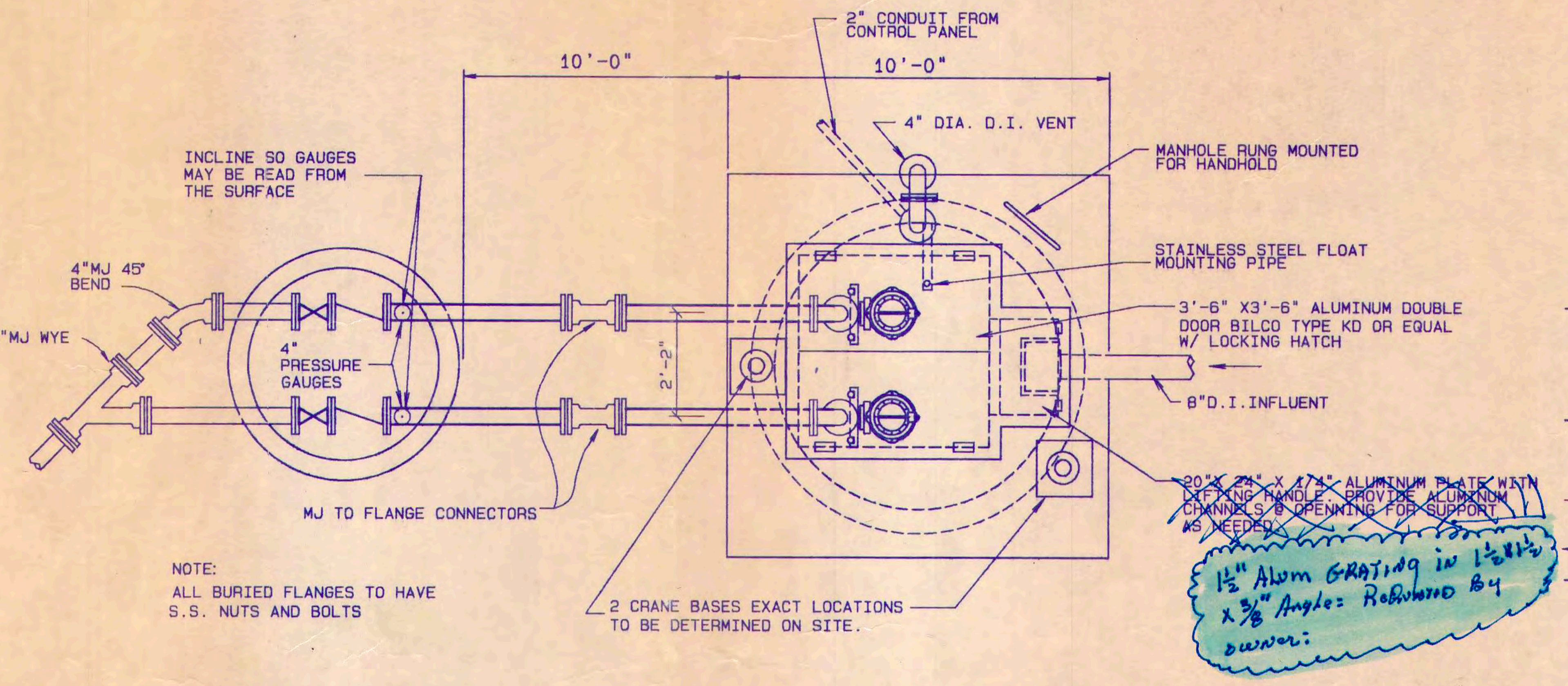
SHEET NO. 1 OF 5 SHEETS



LOCATION MAP

PUMP STATION ELEVATIONS SCHEDULE

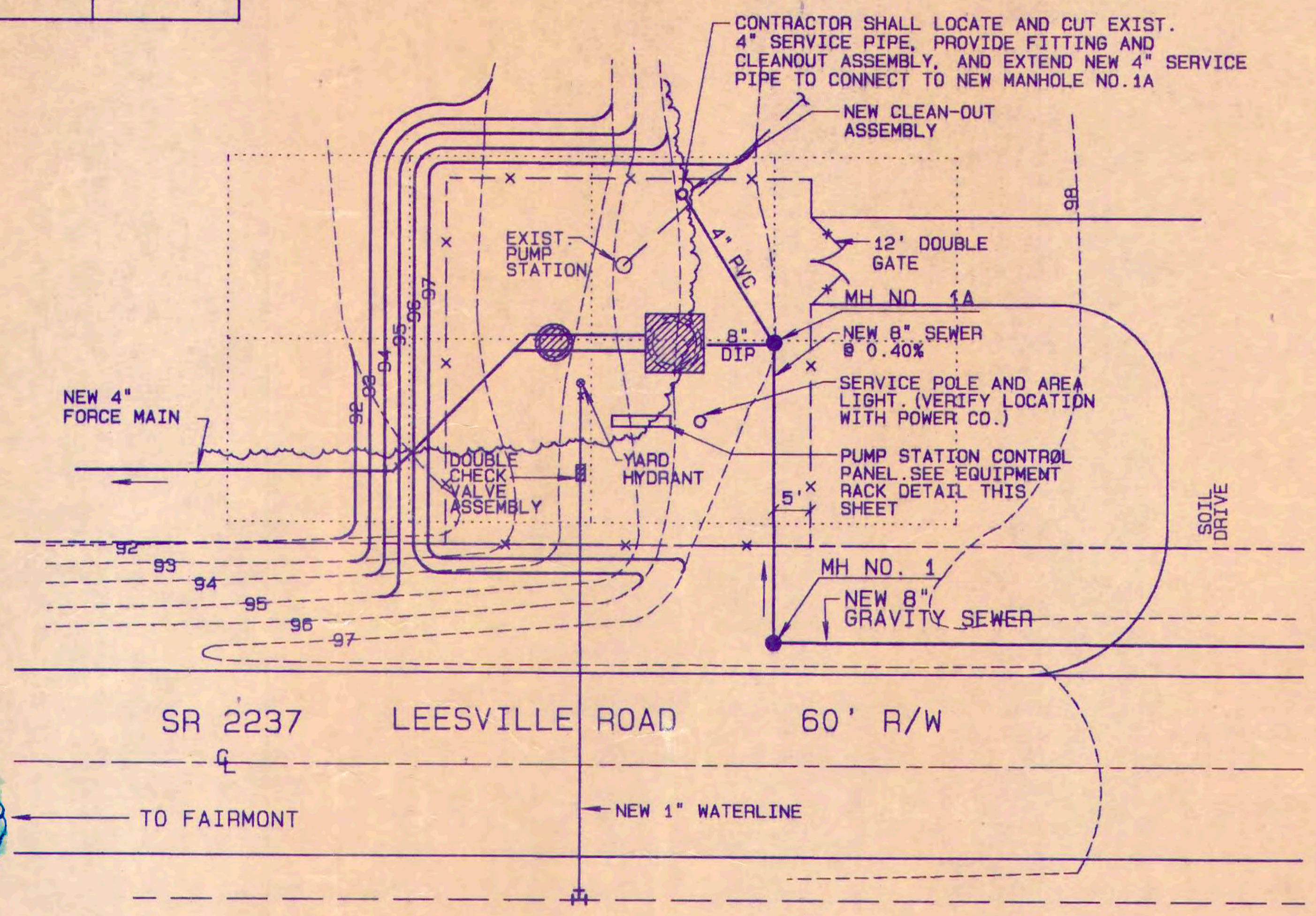
PUMP STA. I.D.	WET WELL DIAMETER (FT.)	CAPACITY (GPM)	T.D.H. (FT.)	MOTOR (HP)	TOP OF STATION ELEV. (FT)	BOTTOM OF STATION ELEV. (FT)	FINISH GRADE (FT)	LOW ALARM ELEV. (FT)	PUMP OFF ELEVATION (FT)	1st PUMP ON ELEV. (FT)	2nd PUMP ON ELEV. (FT)	HI. WATER ALARM ELEV. (FT)	VENT ELEVATION (FT)	INV. IN ELEVATION (FT)
BASE BID PUMP STA. LOCATION	6	100	25	3.0	97.50	84.0	97.0	87.00	87.50	88.50	90.50	90.50	97.9	90.50



NOTE:
ALL BURIED FLANGES TO HAVE S.S. NUTS AND BOLTS

PUMPING STATION PLAN

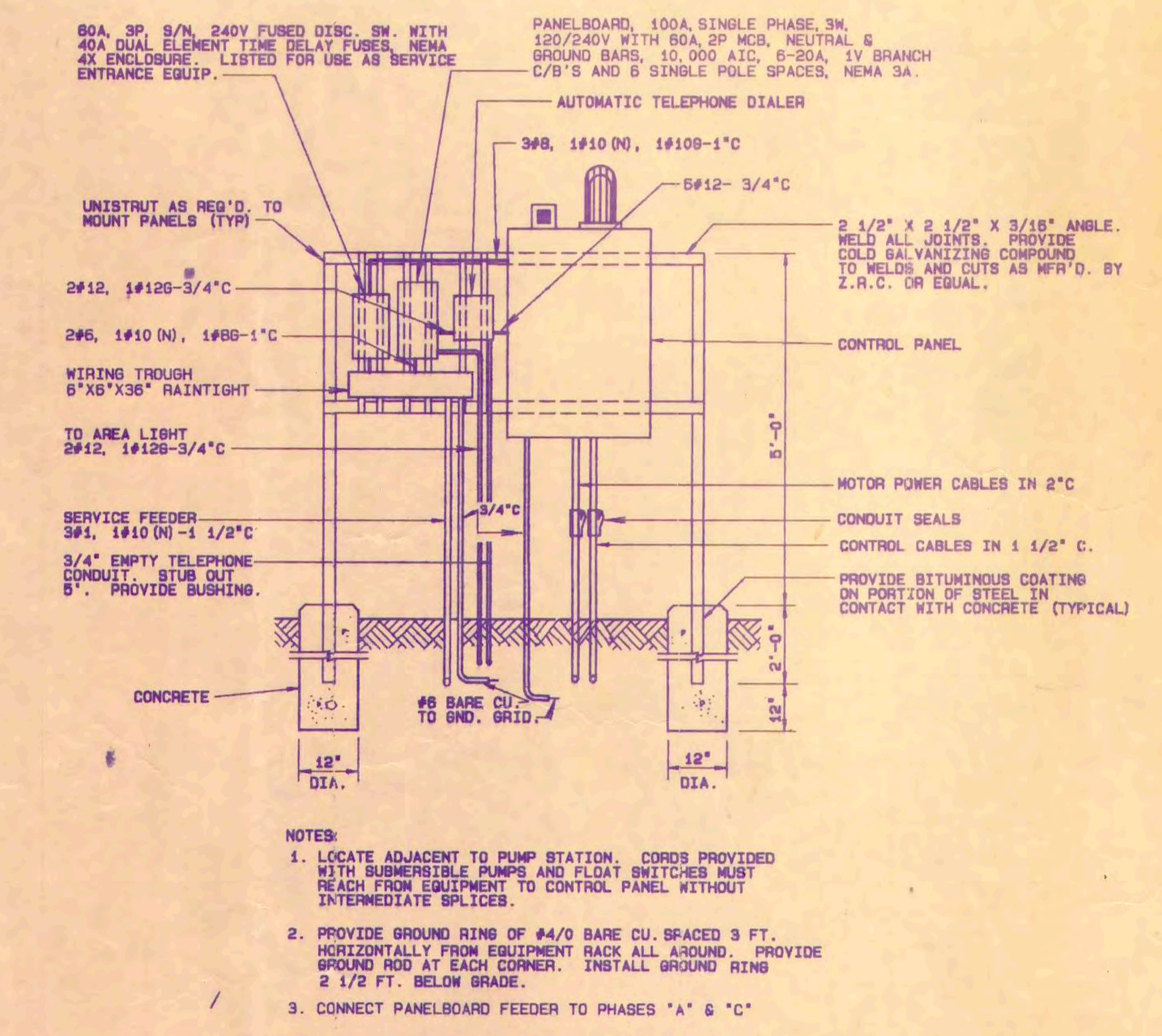
N.T.S.



SITE PLAN AS BUILT

SCALE: 1" = 20'

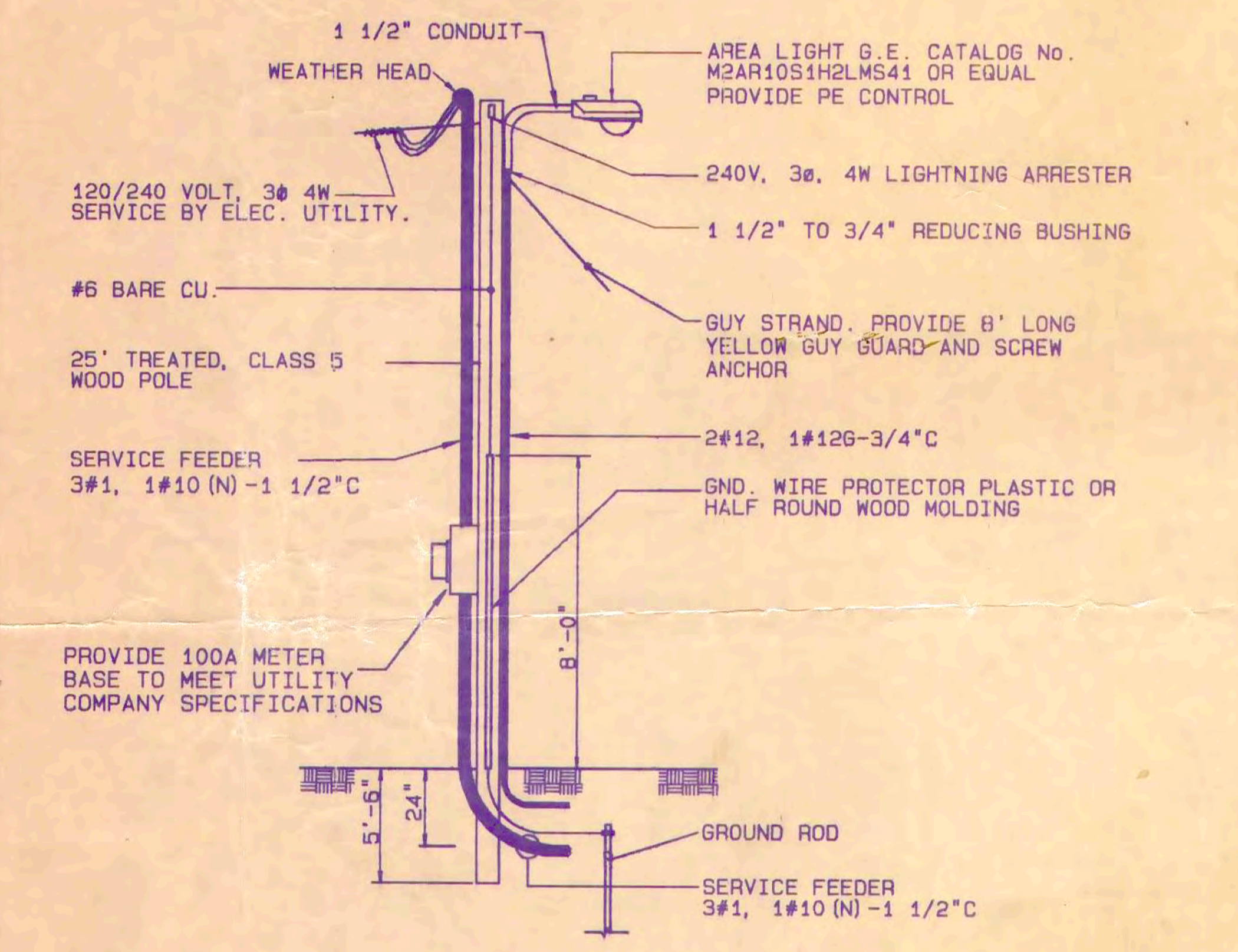
NOTE: #1 = Fence = 200 L.F. / with 1-Ea. 12' Gate.
" #2 = ADD: 6" ABC Stone inside Fence Area.



NOTES:
1. LOCATE ADJACENT TO PUMP STATION. CORDS PROVIDED WITH SUBMERSIBLE PUMPS AND FLOAT SWITCHES MUST REACH FROM EQUIPMENT TO CONTROL PANEL WITHOUT INTERMEDIATE SPLICES.
2. PROVIDE GROUND RING OF #4/0 BARE CU. SPACED 3 FT. HORIZONTALLY FROM EQUIPMENT RACK ALL AROUND. PROVIDE GROUND ROD AT EACH CORNER. INSTALL GROUND RING 2 1/2 FT. BELOW GRADE.
3. CONNECT PANELBOARD FEEDER TO PHASES "A" & "C"

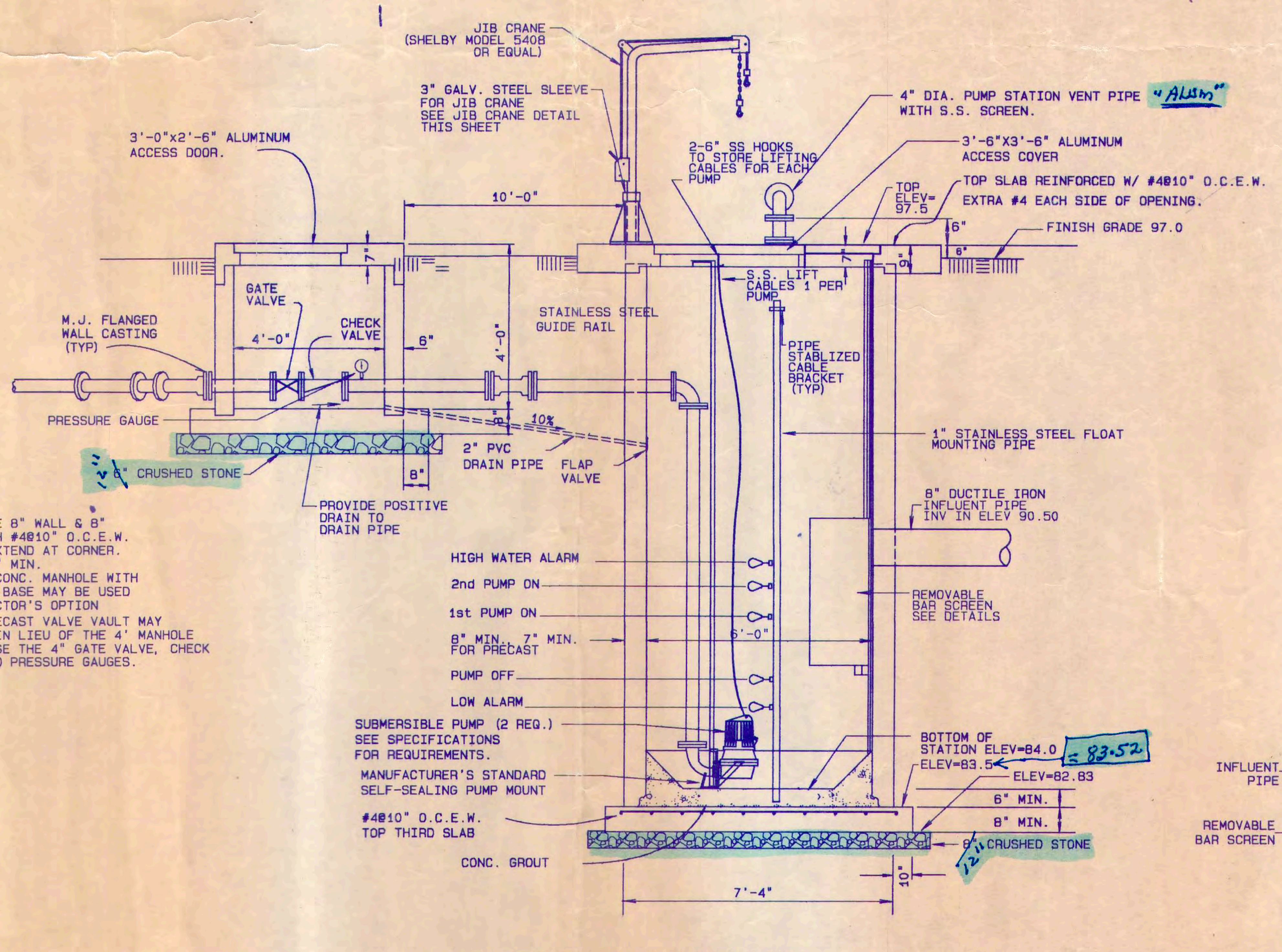
EQUIPMENT RACK DETAIL

N.T.S



SERVICE POLE DETAIL

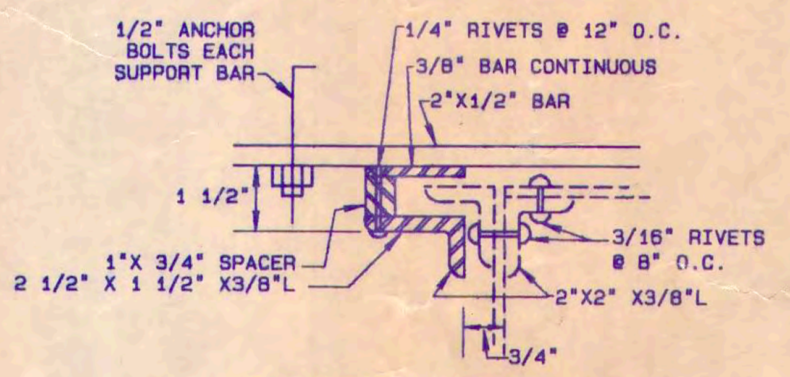
N.T.S.



NOTES:
1. REINFORCE 8" WALL & 8" SLAB WITH #4@10" O.C.E.W. BEND & EXTEND AT CORNER. LAP 1'-3" MIN.
2. PRECAST CONC. MANHOLE WITH EXTENDED BASE MAY BE USED @ CONTRACTOR'S OPTION
3. 4'X4' PRECAST VALVE VAULT MAY BE USED IN LIEU OF THE 4" MANHOLE TO ENCLOSE THE 4" GATE VALVE, CHECK VALVE AND PRESSURE GAUGES.

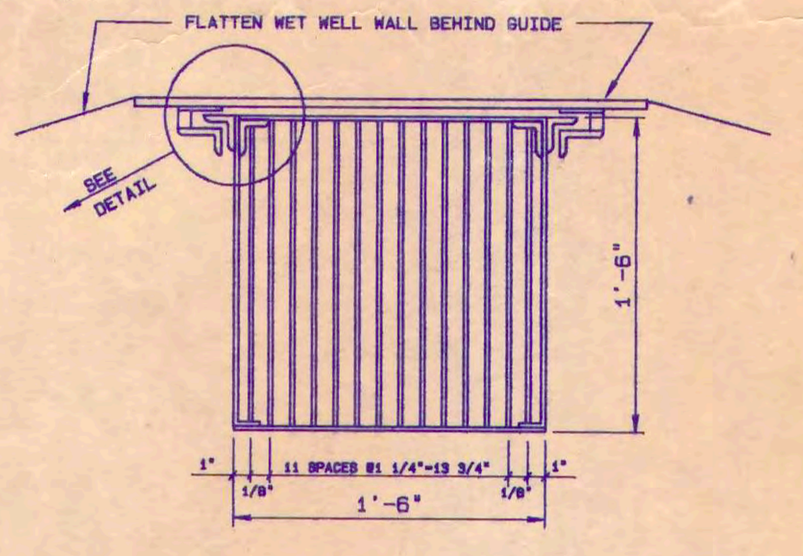
PUMP STATION SECTION

N.T.S.



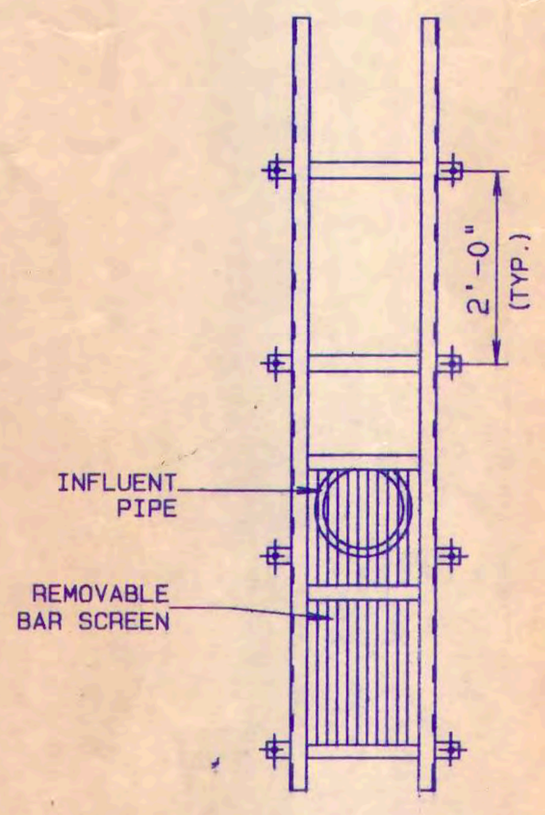
GUIDE DETAIL

SCALE: 3"=1'-0"



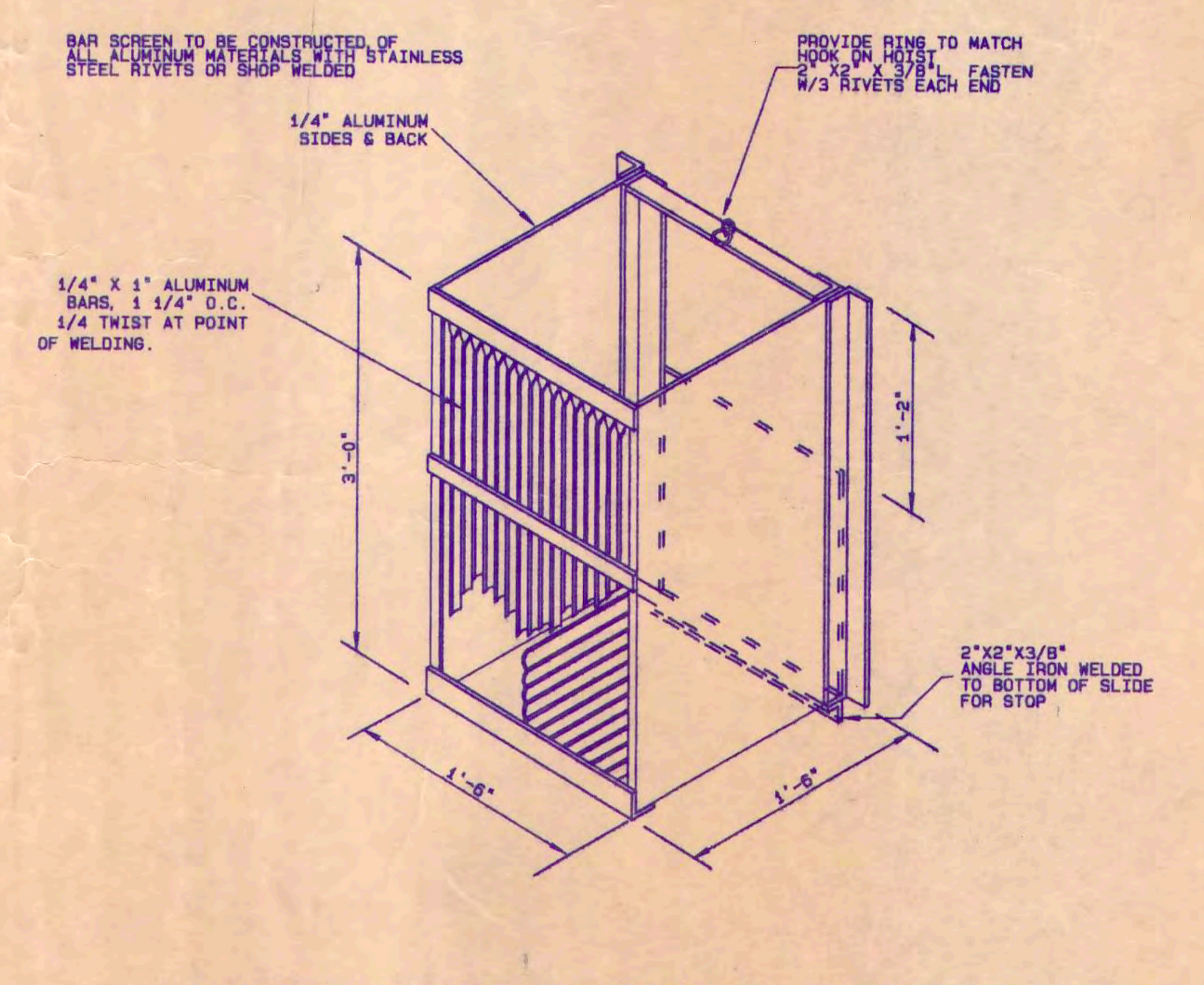
PLAN - REMOVABLE BAR SCREEN

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



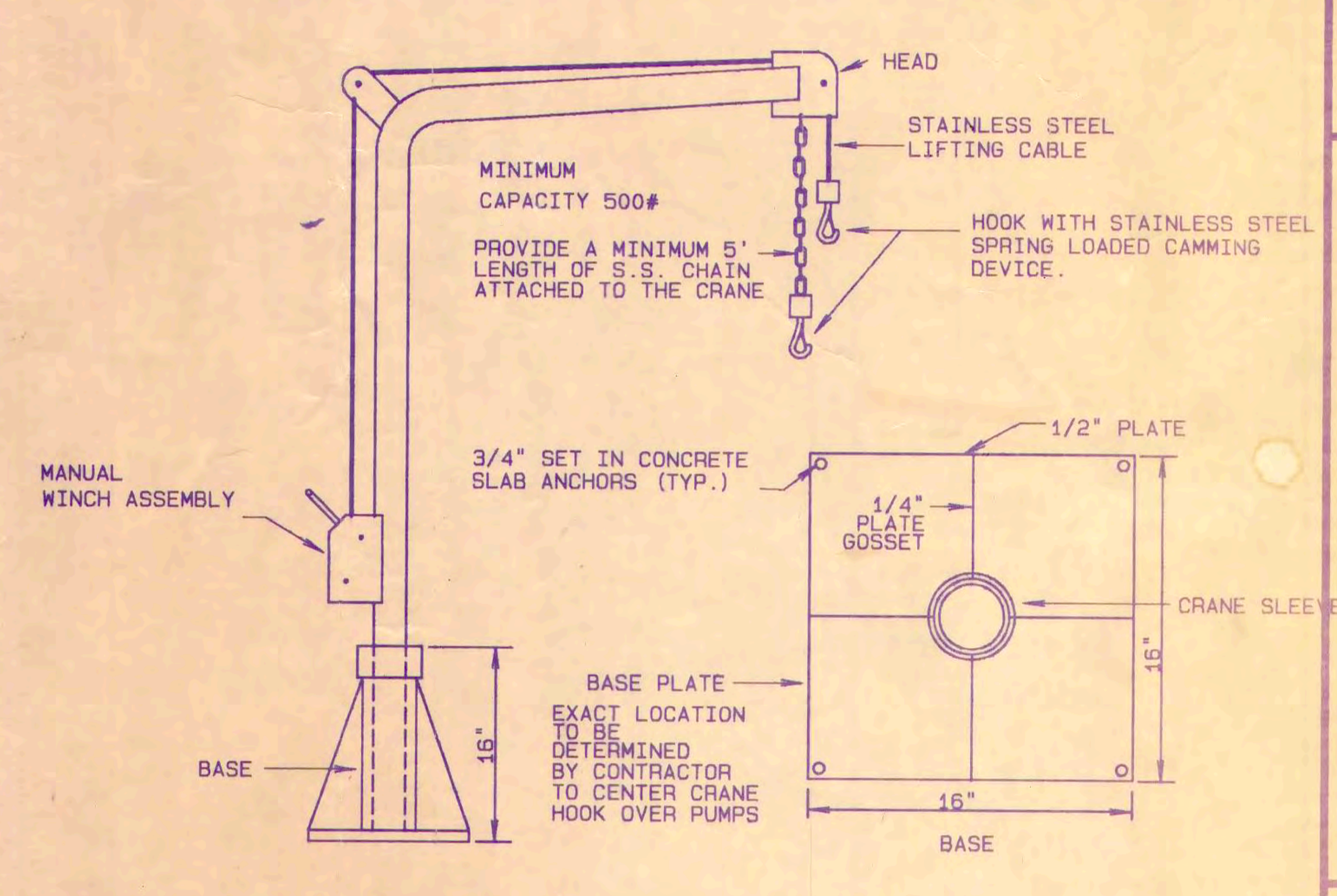
ELEVATION

SCALE: 1/2"=1'



ISOMETRIC OF REMOVABLE BAR SCREEN

SCALE: 1"=1'-0"



JIB CRANE AND BASE DETAIL

N.T.S.

REVISIONS
APRIL 8, 1993
MAY 18, 1993

PROJECT NO. 2650-A
DATE: JAN. 1992
SCALE AS SHOWN
DES. BY: JK
DWN. BY: JK
CHK'D BY: JK

NORTH CAROLINA PROFESSIONAL SEAL 8213 ENGINEER LUKE T-L KWONG

COUNTY OF ROBESON
ROBESON COUNTY NORTH CAROLINA
COMMUNITY DEVELOPMENT PROJECT
PUMPING STATION AND RELATED WORK

The Wooten Company
ENGINEERING
PLANNING
ARCHITECTURE
RALEIGH, N.C.
GREENVILLE, N.C.
SINCE 1936

SHEET NO. 4 OF 5 SHEETS