

WELCH STREET DRAINAGE STUDY

City of Natchitoches, Louisiana



September 22, 2017



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Engineering • Architecture • Surveying

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1.0 Introduction

1.1 Study Purpose

The purpose of this Drainage Study is to furnish the City of Natchitoches with a planning document that provides basic information and guidance necessary for the City to make informed decisions on drainage improvements in the area extending from JC Deblieux Dr. to near the intersection of Theophile Alley and Holmes St. Contained within this report and appendices is documentation of the methods and procedures followed to develop the Drainage Study. This study focuses on the drainage system that is mainly open ditch. Even though the drainage system continues further, this study concludes when the open ditch along Theophile Alley enters into the underground system.

The report compiles basic information relevant to the storm drainage system and describes the functional parameters of the system. The data within the report will be used by the City in making informed decisions related to storm-water improvements. The report will highlight known system deficiencies and provide recommended improvements within the study area. Figure 1.1 graphically indicates the limits of the study area included in this report.



Figure 1.1 – Study Area

1.2 Description of Project Study Area

The Study Area is located in the northern part of the City of Natchitoches. The area has experienced flooding conditions frequently in the past. The area would be considered single family low income residential. The elevation change from the upper end of the basin to the lower end exceeds 40 feet. Streets and rights-of-way are very narrow in this section of the City.

At the upper end of the drainage system a natural detention area exists. This is the area bounded by apartments along JC Deblieux Dr. and the roadway of Welch Street. JC Deblieux Dr. and Welch Street are roughly at elevation 146 or higher. The area within this is lower and creates a bowl shape. Flow from this area crosses Welch Street through a 36" Ø pipe. The City has installed a metal sluice gate at the upper end of this pipe and throttles the storm water runoff during times of high intensity storms. The flow through this 36" Ø pipe is reduced to an opening of 7" x 36" by the metal plate shown in figure 2.4. Water within the bowl backs up thereby reducing the impact downstream.

Storm water runoff below the Welch Street cross drain is conveyed by open ditch and pipes when the channel crosses roadways. Ditches are shallow "V" bottom shaped with 2:1 to 3:1 side slopes.



Figure 1.2 – Natural Detention Area



Figure 1.3 – Shallow Ditch Near Welch Street



Figure 1.4 – Meandering Grownup Ditch



Figure 1.5 – Narrow Street & Shallow Ditches

Many of the existing pipes along the drainage course are under-sized for most storm events. This condition can cause backwater to occur upstream. It is unknown if a dedicated easement exists for the drainage ditches that cross private property. The apparent narrow right-of-way will likely require additional property be acquired in order to improve the channel flow characteristics. Figure 1.6 indicates the existing pipes along this section of the channel. In some cases, the pipes become smaller as the runoff flows downstream.

The area of study is located in Zone X according to the FEMA Flood Insurance Rate Map and is outside the 0.2% annual chance floodplain. The total drainage area contributing to this watershed is approximately 98 acres as delineated in figure 2.1.



Figure 1.6 – Existing Pipes Within Study Area

2.0 Methodology

2.1 Development of Existing Conditions

The main channel and pipes associated with the study area were surveyed and data gathered for use in developing flow characteristics. Lidar contours were downloaded from the LSU website and employed to delineate the watershed and calculate an overall basin slope.

It was determined through this study that much of the drainage system in this area is undersized beginning with the first cross drain at Welch Street. To upsize the system to carry a 25-year storm risks adversely impacting the residences downstream. For this reason, the pipes and ditches are suggested to be upsized and be capable of conveying the amount of storm water runoff that the existing pipe under Welch Street carries. The excess storm water runoff would be detained in the natural detention area bounded by JC Deblieux Drive and Welch Street.

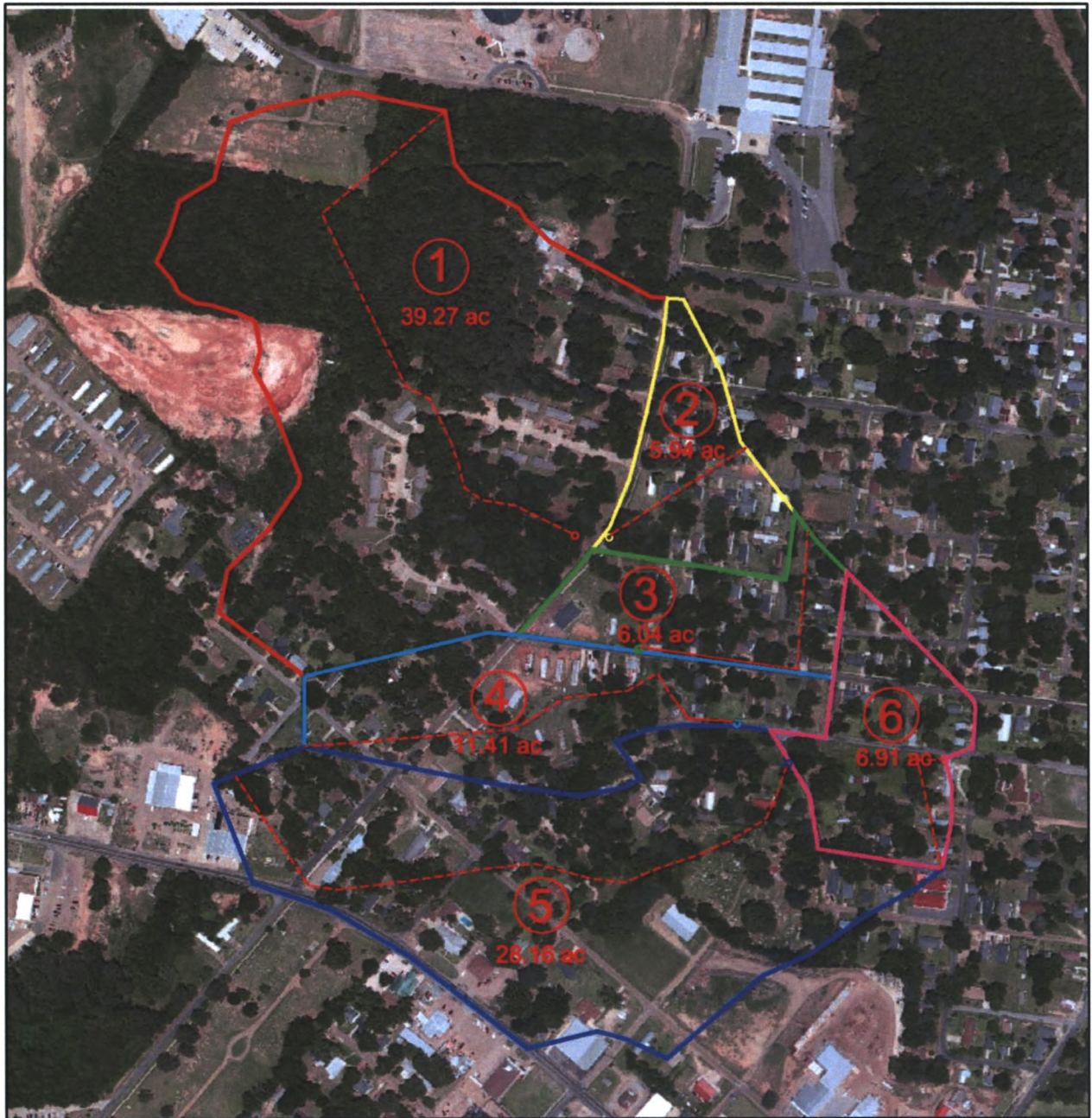


Figure 2.1 – Delineated Watershed

Flows were calculated at each of the cross drains. The ditch and cross drains are identified as follows (figure 2.2):

- Ditch 1- Extends from Welch Street across private property to Stella Street
- Ditch 2 - Extends from Stella Street across private property to Theophile Alley

- Ditch 3 - Parallels Theophile Alley along the right-of-way to Raphiel Street
- Ditch 4 - Parallels Theophile Alley from Raphiel Street to a location that the drainage systems begins underground.



Figure 2.2 – Existing Ditches

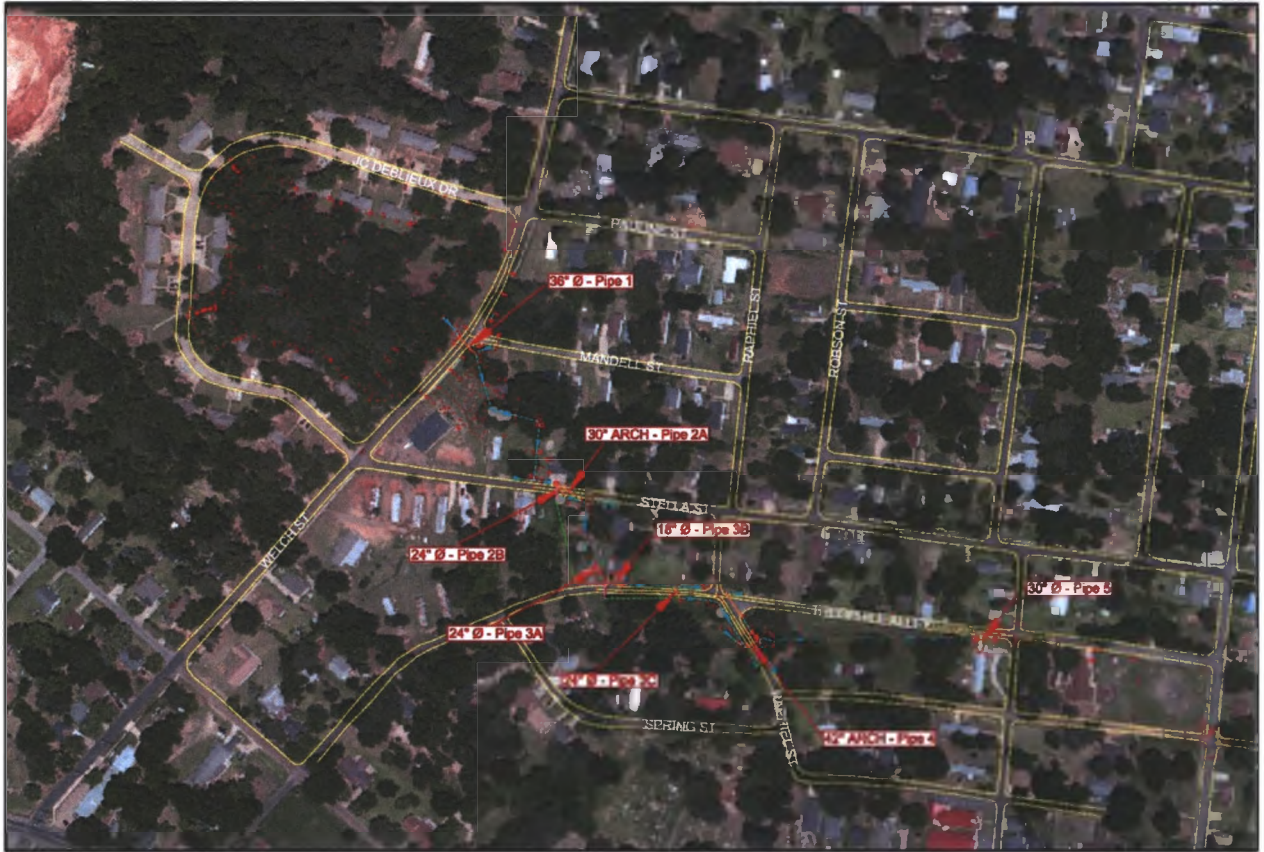


Figure 2.3 – Existing Pipes

2.2 Calculations

The SCS method for determining discharge for a watershed was utilized for this study. A 25-year design storm was assumed for the calculations. The general approach to this drainage study was to establish an existing-condition then compare that to the current channels and pipes and identify deficiencies in the drainage network. Downstream capacities were determined by performing hydrologic and hydraulic analysis of the drainage basin(s). Hydraflow software was utilized to compute the water surface and flow capacities of the pipes and ditches.

2.3 Findings

Pipe Crossing Welch Street:

The pipe crossing Welch Street receives approximately 79 cfs of runoff from the contributing area. The pipe is a 36" Ø reinforced concrete pipe (RCP) and contains a metal plate on the upstream end which restricts flow. The plate is capable of being adjusted. At the time of this study the opening measured 36" wide by 7" vertical. This plate is shown in Figure 2.4. The opening is not capable of conveying this amount of runoff so the water backs up into the natural detention area west of Welch Street.

Rather than the 36" Ø pipe flowing at its capacity, the flow is restricted to approximately 19 cfs by the metal plate. This compares to a calculated flow of nearly 80 cfs that contributes to this crossing. Even flowing full the 36" Ø pipe is not capable of conveying this amount of runoff.



Figure 2.4 – Metal Sluice Gate Restriction

Ditch from Welch Street to Stella Street:

The existing ditch from Welch Street to Stella Street (Ditch 1) meanders through private property and is a "V" bottom ditch with roughly 2:1 to 3:1 side slopes. It is not known whether drainage easements exist for this ditch. The calculated 25-year flow for this ditch is approximately 92 cfs.

Pipe Crossing Stella Street:

There are two pipes that cross Stella Street at a diagonal. One pipe is a 24" Ø and the other is a 30" arch pipe. The calculated 25-year Q at this point is approximately 92 cfs.

Ditch from Stella Street to Theophile Alley:

The ditch from Stella Street to Theophile Alley (Ditch 2) meanders through private property as the others do and has a cross section similar to those upstream. A 90° concrete retaining wall has been constructed along the ditch and directs flow away from a nearby house. A 24" Ø pipe has been installed along a portion of this ditch which is undersized and contributes to the restrictions in the ditch. The ditch along this section contains a 25 year calculated flow of 103 cfs.

Pipe Crossing Theophile Alley:

The pipe crossing Theophile Alley is a 24" Ø pipe. The calculated 25-year flow at this point is 129 cfs.

Ditch from Theophile Alley to Raphiel Street:

The ditch from Theophile Alley to Raphiel Street (Ditch 3) parallels Theophile Alley and then turns south paralleling Raphiel Street. The ditch section is a shallow "V" bottom ditch.

Pipe Crossing Raphiel Street:

The pipe crossing Raphiel Street is a 42" arch pipe. This pipe receives approximately 196 cfs under a 25-year design storm. Headwalls exist along both ends of this pipe.

Ditch from Raphiel Street to End of Study Area:

The study area ends at the point the ditch from Raphiel Street (Ditch 4) enters the underground storm drainage system. The ditch along this section is a roughly a "V" bottom ditch approximately 3' deep with 2:1 to 3:1 side slopes. The ditch is overgrown with vegetation. This ditch has a bench beyond the limits of the ditch with likely contain the overflow from the 200 cfs that flows during a 25-year storm event. This ditch enters the underground drainage system through an existing 30" Ø pipe.

3.0 Conclusion and Recommendations

3.1 Conclusions

The drainage system that was studied contains approximately 98 acres with over 45' of vertical change in elevation. The basin is a combination of forested area and urban conditions. The study area is outside of 0.2% annual chance floodplain. However, the area is still subject to localized

flooding due to inadequacies in the drainage system. The existing storm water pipes and open channels are inadequate to properly convey the amount of storm water that is generated during an event. In addition to the inadequacies of the drainage system, the residential area does not lend itself to major drainage improvements due to proximity of the homes to the channels as well as many of the homes having low finished floor elevations.

This study applied a 25-year storm frequency. It was assumed that the plate serving as a weir would be left in the current position. A flow was calculated thru the weir that would detain runoff up to an elevation just below the centerline of Welch Street. Under this scenario storm water would back up in the bowl area of JC Deblieux Dr. to an elevation of 146.78 +/- . At this elevation the water would top Welch Street before entering into the apartments along JC Deblieux Dr. Referring to Hydrograph #2 of the proposed conditions, the calculated flow for this condition was 18.7 cfs. Once the runoff crosses Welch Street additional area contributes to the drainage system. All of this runoff flows in and out of open channels and cross drain pipes. Calculations indicate that many of the streets are topped during storm events less than the 25-year frequency. Improvements are limited by the effect of increased flow on the existing residential structures. Much effort was made in this study to limit the adverse effect on residential homes as a result of these drainage improvements. This study also recognizes that the recommendations suggested will possibly require additional servitudes that will need to be acquired by the City in order to make the improvements.

3.2 Recommendations

All of the ditches from Welch Street to Raphael St. require deepening and widening to accommodate even a 25-year storm frequency. Given the topography, close proximity to houses and narrowness of the street right-of-way this may be impractical. However, these recommendations assume that widening of the channels can be accomplished.

- It is recommended that the metal sluice gate installed on the Welch Street cross drain remain in the position that currently exists and allow storm water to be detained upstream of this pipe.
- Ditch 1 will require a section consisting of a 2' flat bottom with 3:1 side slopes, a minimum depth of 2' and be capable of conveying approximately 33 cfs.
- The existing pipe crossing Stella Street is to be removed and replaced with a 42" Ø pipe capable of conveying approximately 51 cfs.

- Ditch 2 will require a section consisting of a 2' flat bottom with 3:1 side slopes, a minimum depth of 2' and be capable of conveying approximately 51 cfs. It is recommended that this ditch be rerouted and straightened allowing the headwall to be removed and shifting the ditch further away from existing residential structures.
- The existing pipes around and crossing Theophile Alley are to be removed and replaced with 48" arch pipe.
- Ditch 3 from Theophile Alley to Raphiel Street is to be regraded and have a section consisting of a 3' flat bottom ditch with 3:1 side slopes and a 3' depth. This ditch should be capable of conveying approximately 82 cfs and still remain within the ditch limits.
- The existing cross drain at Raphiel Street is to be removed along with the existing headwalls and replaced with a double 3' x 5' box culvert.
- Ditch 4 from Raphiel Street to the catch basin that marks the limit of this study is to be cleaned and regraded with a cross section of a 3' flat bottom with 3:1 side slopes and a depth of 3.5'. This ditch should be capable of conveying approximately 155 cfs. The underground piping from the very end of the study area is likely deficient in size and would need upsizing. This study did not analyze the underground system beginning at this point.

3.3 Costs

This project budget represents all costs associated with the improvements described herein. This is an estimated cost. Costs could vary higher should conflicts with existing utilities alter the preliminary design. These unknowns cannot be determined at this time. Once the final design has been completed and all field survey information incorporated into that design a better estimate of these improvements can be provided.

Project Costs

Remove existing drainage pipe	\$5,825
Remove existing drainage structures	\$10,000
Regrade ditches	\$43,750
Repair roadways	\$5625
Repair driveways.....	\$1094
Drainage pipe.....	\$64,000
Drainage structures.....	\$25,000
Erosion control	\$18,750
Traffic control	\$12,500
Construction layout	\$7,500
Survey	\$7,800
Design.....	\$17,500
Construction administration.....	\$4,000
 Total project cost.....	 \$215,544