City of Waynesville

Stormwater Feasibility Study

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February 7, 2012

Mr. Andy Struckhoff
Senior Project Manager
PGAV Planners
200 North Broadway, Suite 1000
St. Louis, MO 63102

Re: Stormwater Feasibility Study
Waynesville, MO DREAM Community

Dear Mr. Struckhoff:

We appreciate the opportunity to partner with PGAV Planners on the DREAM project for the City of Waynesville. Attached with this letter is the report summarizing the Stormwater Feasibility Study that was completed to address the flooding problems experienced by the property owners on the south side of Business I-44.

In general the existing problem is water draining off the hill behind these buildings. We are proposing that a retaining wall be constructed between this hill and the alley. A stormwater system would be constructed behind this wall consisting of a concrete gutter and a pipe and inlet system. Regrading of the alley and installation of curb and gutter on the south side of the alley is also proposed. The total cost of the project, which is further described within the report, is estimated at approximately $248,000.

We look forward to working with you and the City to make these improvements, part of the solution that will enhance Waynesville's downtown. Please let us know if you have any questions or comments regarding this report.

Sincerely,

Bob Gilbert, P.E.
Project Manager

Attachment

STATE OF MISSOURI
ROBERT ALAN GILBERT
NUMBER
PE-2004014623
PROFESSIONAL ENGINEER
2-7-12

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Introduction

The City of Waynesville has been selected as part of the Downtown Revitalization and Economic Assistance for Missouri (DREAM) Initiative. Improvements are being recommended throughout the downtown area. However, the businesses along the south side of Business I-44, also known as Misouri 17 or Historic Route 66, between Benton Street and Lynn Street are prone to flooding. The intent of this study is to identify the existing stormwater problems in this area and develop a conceptual solution to reduce these problems. Along with a conceptual solution, the study provides an estimate of project cost to help budget for the improvements.

Figure 1: Map showing project location (image taken from MapQuest)

Conceptual Design Criteria

The conceptual design elements were determined using a digital elevation model created from USGS 10' contour maps and an aerial photo. No field surveying was performed, and no underground utilities were located when determining the conceptual designs, other than what could be determined during site visits to the area. The conceptual designs are intended to be used to determine the approximate sizes and lengths of improvements in order to determine a conceptual project cost estimate. The conceptual designs shown in this report should not be used for construction, but they are a starting point for final design.

Hydrologic and hydraulic design criteria was based on Kansas City Metropolitan Chapter, "American Public Works Association Standard Specifications and Design Criteria- Section 5600" (2005) with the following exceptions or clarifications.

Hydrology

- Hydrologic calculations were completed for the 100-year storm.

- Design runoff was based on existing conditions.
- Rational Method was used to determine the peak runoff.
- Time of concentration (Tc) was assumed to be 5 minutes due to the small area and steep topography.
- Rainfall intensity was determined using MoDOT's District 9 intensity-duration-frequency data.
- The runoff coefficient (C) was determined according to APWA Section 5600.

Hydraulics

- Manning's equation for open channel flow was used in sizing storm sewers.
- Pipes were assumed to be high density polyethylene pipe (HDPE) with a roughness coefficient of 0.013 (would also work if reinforced concrete pipe (RCP) were chosen).

Existing Conditions

The buildings on the south side of Business I-44 in Waynesville between Benton Street and Lynn Street are built into the side of a hill. An alley behind the buildings provides access to the back entrances of the buildings at much higher elevations than the front entrances on Business 44. However, there is very little stormwater infrastructure to capture the substantial amount of water that comes off the hillside toward the back of the buildings. We have been informed that during past large rain events large amounts of water entered the backsides of the buildings. One of the historical recollections from residents is that during these storms the front doors needed to be opened to allow the water to pass through, and in one of the storms, many of the shoes from a shoe store that was occupying a building were washed out onto the street.

Figure 2: Looking down the hill towards the backside of buildings (facing north)

The alley behind the buildings provides some stormwater protection. The alley is sloped away from the buildings for the majority of the length and is also sloped to the west, toward Benton Street. To collect any water possible, there is a grated inlet in the southern portion of the alley's entrance off Benton

Street. However, it is expected that in large rain events the slope of the alley is not enough to prevent water coming off the steep hillside to continue north towards the backside of the buildings. It is also unlikely that the grated inlet and small pipe leaving the inlet can handle the quantity of water that is produced from the approximately 3 acre drainage area.

Figure 3: Alley behind the buildings, looking west towards the grated inlet

The buildings do have their own drainage systems as well. These systems have not been analyzed as part of this study. They appear to be routed underneath or around the buildings and drain toward the north, likely into a large conduit that is known to be underneath Business I-44. The systems do not appear large enough to handle large quantities of rain but would likely be sufficient for local drainage from rain falling north of the alley.

Figure 4: A grate inlet and pipe system behind one of the buildings

Proposed Project

In an effort to intercept the flow coming off the hillside to the south, a retaining wall is proposed to be constructed on the south side of the alley. A concrete gutter would be placed behind the wall that would carry the water to inlets. A cross section of the proposed retaining wall is shown below. Multiple alternatives can be considered for the retaining wall including a concrete cast-in-place cantilever wall, a mechanically stabilized earth wall or a modular block gravity wall. This wall would begin near Benton Street and continue to the tree line to the east. These extents would stretch far enough to protect all the buildings along the alley, and this is also the point where water begins to drain toward Lynn Street.

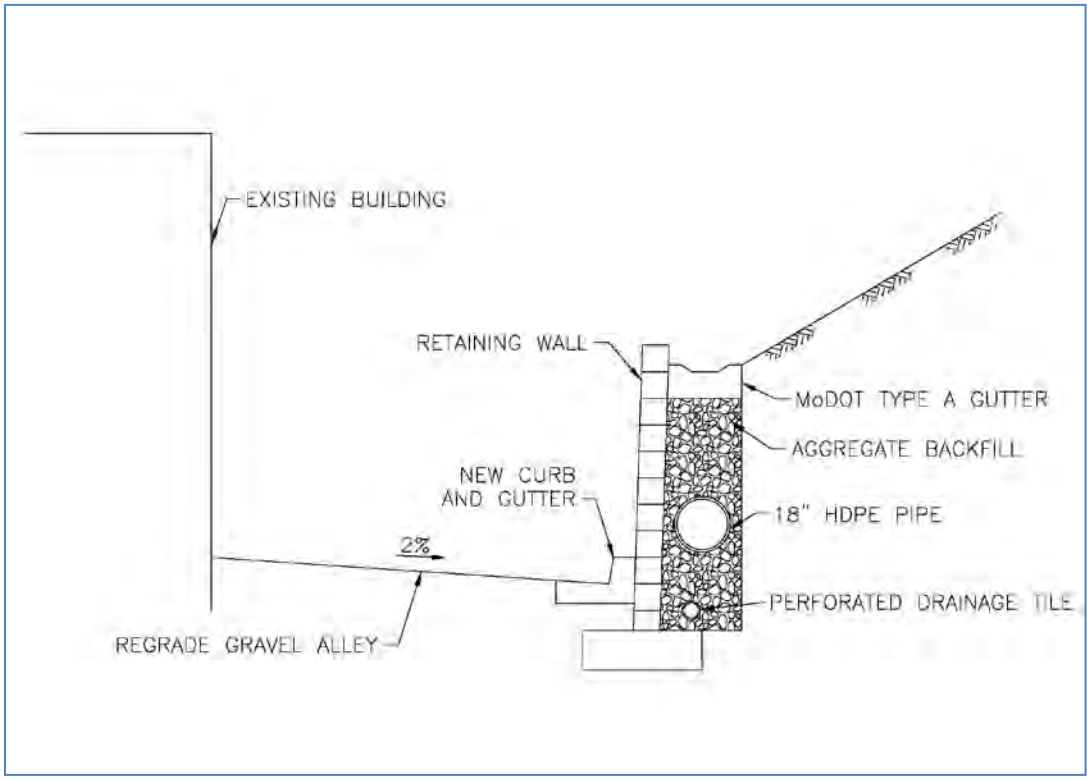

Figure 5: Cross section of proposed retaining wall to be located south of alley (looking east)

Two new inlets are proposed in the conceptual plan, which is shown in Figure 7 located at the end of this report. One area inlet would be placed behind the retaining wall in the low area approximately midway along the retaining wall's length. An 18" pipe would carry the water from this inlet west toward a new curb inlet placed along Benton Street just south of the alley. A 24" pipe would then take the water to a new manhole that would connect this new system to the existing pipe line that runs down Benton Street. The pipe sizes are preliminary and should be evaluated with actual survey data. The capacity of the existing system is unknown at this time and should also be checked after survey data is obtained.

To further alleviate the flooding potential, the alley could be regraded to provide a constant slope away from the buildings. A concrete curb and gutter would then be placed along the south side of the alley to help collect and drain the water to the west. At the existing grate inlet, the gutter would be pitched out toward the inlet to help drain the intersection of the alley and Benton Street.

The improvements would help intercept any water coming from the hillside to the south and any water falling on the alley would also be routed away from the buildings. Therefore, the only water draining toward the buildings would be from north of the alley, in other words the water that falls on the property itself.

The table below displays hydrologic and hydraulic calculations for the proposed improvements. For purposes of rainfall intensities, a five minute time of concentration was used in all calculations as described earlier. The runoff coefficient "C" is between a residential value (0.51) and an undeveloped area (0.30). It was determined that a Type A MoDOT gutter could handle the required flow. However, a Type B gutter has roughly half the capacity and would not meet the demands. The pipes were assumed to be either RCP or HDPE with an "n" value of 0.013.

Table 1: Hydrologic and Hydraulic Calculations

Gutter Flow							
Drainage Area	Area (ac)	C	Rainfall Intensity (in/hr)	100-yr Q (cfs)	Gutter Slope	Gutter Capacity	% Capacity
1	0.89	0.37	9.91	4.08	2.5%	9.00	45%
2	0.79	0.37	9.91	3.62	2%	8.00	45%
3	1.55	0.37	9.91	7.10	2%	8.00	89%
Pipe Flow							
Pipe Size	Area (ac)	C	Rainfall Intensity (in/hr)	100-yr Q (cfs)	Pipe Slope	Pipe Capacity	% Capacity
18"	1.68	0.37	9.91	7.70	1%	10.51	73%
24"	3.23	0.37	9.91	14.80	1%	22.62	65%

Project Cost

The improvements are estimated to cost approximately $248,000 in total project cost. Construction costs are estimated to be $190,300. A detailed breakdown of the project costs is located at the end of this report.

Recommendations

It is recommended to consider moving forward with the proposed project discussed within this report. The project would help alleviate flooding of the properties along Business I-44 by intercepting the water that is currently coming onto the properties from the south. This would help make these buildings more attractive for a redevelopment of the downtown area and promote further redevelopment in the downtown area.

It is also recommended to undergo field surveying and final design of the proposed concept to produce construction plans. The proposed improvements have been laid out with the limited data available at this time.

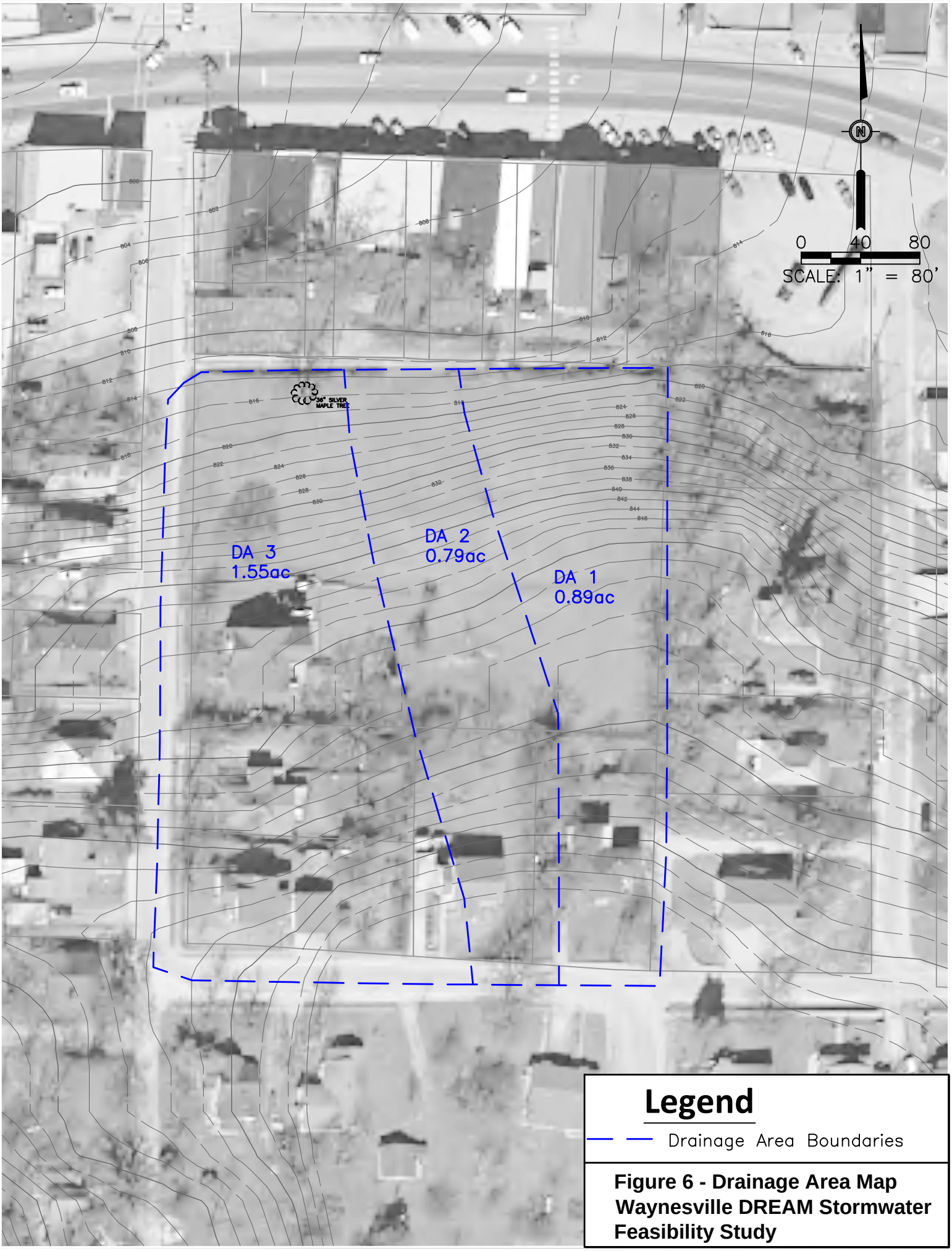

Figure 6 - Drainage Area Map
Waynesville DREAM Stormwater Feasibility Study

Figure 7 - Existing Conditions Waynesville DREAM Stormwater Feasibility Study

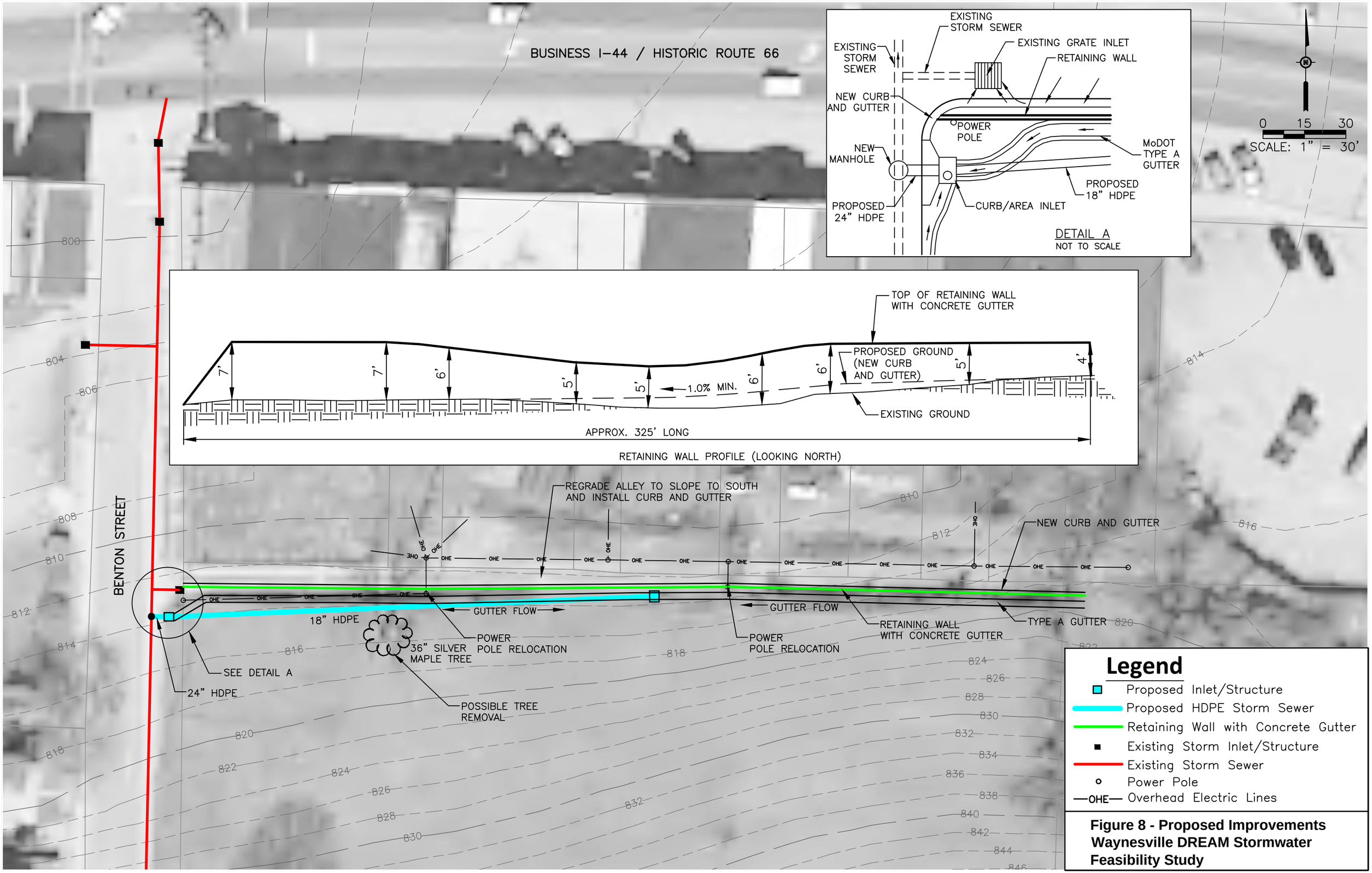

Figure 8 - Proposed Improvements Waynesville DREAM Stormwater Feasibility Study

City of Waynesville DREAM- Stormwater Feasibility Study
Conceptual Project Costs
February 7, 2012

Conceptual Construction Costs:

Item Description	Unit	Quantity	Unit Price	Total
18" HDPE Storm Sewer	LF	175	$50	$8,750
24" HDPE Storm Sewer	LF	10	$65	$650
Curb Inlet	EA	1	$3,500	$3,500
Area Inlet	EA	1	$3,000	$3,000
Manhole	EA	1	$2,500	$2,500
Connect to Ex. Storm Sewer	EA	1	$1,500	$1,500
Retaining Wall	SF	2500	$40	$100,000
Porous Backfill	CY	180	$50	$9,000
MoDOT Type A Gutter	LF	330	$30	$9,900
Concrete Curb & Gutter	LF	350	$20	$7,000
Concrete Pavement	SY	10	$60	$600
Gravel Alley	SY	450	$10	$4,500
Mobilization	LS			$7,400
Erosion Control	LS			$1,000
Site Restoration	LS			$1,000
Utility Relocation (Power Pole)	LS			$30,000
Subtotal - Construction Cost				**$190,300**

Conceptual Non-Construction Costs:

Easements (Record. Fees & Admin.)	EA	12	$100	$1,200
Legal & Financial Consultation	4%			$8,000
Engineering	15%			$29,000
Project Administration & Inspection	10%			$19,500
Subtotal - Non-Construction Cost				**$57,700**

Total - Conceptual Project Cost **$248,000**

This project cost opinion was prepared using bid tabulation information available at the time of preparation, and is prepared in good faith using the engineer's judgment and experience. The engineer makes no guarantee as to the actual costs for construction, administration, professional services, utilities or right-of-way, as these costs are affected by market conditions that may change. This cost opinion is based on 2012 dollars and should be inflated to future years based on when the project goes to actual completion.