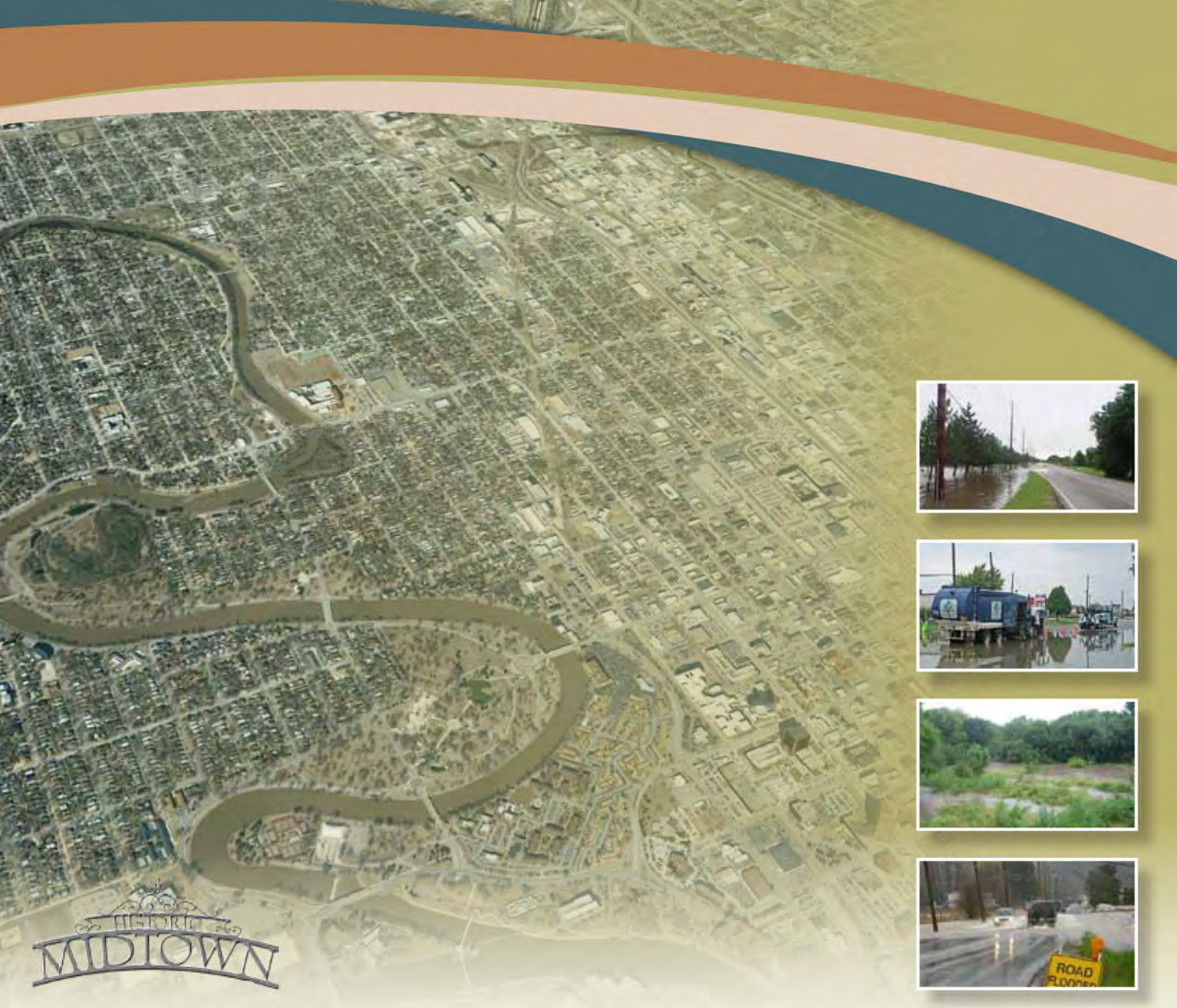

MIDTOWN NEIGHBORHOOD STORMWATER *master plan*

Submitted to:

CITY OF WICHITA

Public Works & Utilities/Stormwater Management

Submitted by:

MKEC in association with CH2MHILL

APRIL 2012

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DEFINITIONS

Analysis Area – The boundary as determined by the existing Little Arkansas River and Wichita Drainage Canal basins and existing storm sewer infrastructure. The area is included in the hydrologic and hydraulic computer model. See Figure 1.2.

Basin – A collection of *sub-basins* from which stormwater is drained by storm sewer infrastructure discharging into a common outfall. For the *Midtown Neighborhood Planning Area*, there are two receiving streams for all basins – the Little Arkansas River and the Wichita Drainage Canal.

Best Management Practices – Abbreviated "BMP", this term refers to any installation or effort made to reduce or treat pollutants found in stormwater.

East Basin System – Within the *Analysis Area*, this is the collection of *basins* from which stormwater drains to the Wichita Drainage Canal. See Figure 1.2.

Event Mean Concentration – A composite that represents the average pollutant concentration throughout an entire storm event

Inlet - Any structure whose purpose is the collect stormwater and direct it into the underground *storm sewer pipe system*.

Midtown Neighborhood – The area bounded by 21st Street to the north, the Little Arkansas River to the west, Central to the south, and Santa Fe to the east. See Figure 1.1.

Midtown Neighborhood Planning Area (Planning Area) – The area bounded by 18th Street to the north, Murdock to the south, the Little Arkansas River to the west, and Santa Fe to the east. The *Analysis Area* extends beyond these boundaries. See Figure 1.1.

Outfall Corridors – Rights-of-way between Santa Fe and the Wichita Drainage Canal; storm sewer systems existing within these rights-of-way that convey stormwater from Midtown outside the Planning Area boundary and east to the Wichita Drainage Canal.

Principle Pollutants of Concern -

Storm Sewer Pipe - Underground pipe or box culverts whose purpose is to convey stormwater.

Storm Sewer System - The collection of inlets, pipes, and other structures whose purpose is to collect and convey stormwater underground.

Sub-basin – The smallest division of land within a *basin* for modeling purposes; land division is based on topography and storm sewer system modeling assumptions. This represents an area where various rain events are applied and runoff hydrographs are developed.

Sump Sub-basin – Sump sub-basins contain low areas where stormwater collects on the land surface when the underground *storm sewer system* capacity is exceeded. In these areas water cannot escape via streets or other over land escape paths and therefore remains in the sump sub-basin until the peak flow from other areas has passed through the underground storm sewer system and inlets and pipes again have the capacity to accept flow.

West Basin System – Within the *Analysis Area*, this is the collection of *basins* from which stormwater drains to the Little Arkansas River. See Figure 1.2.

ACRONYM LIST

BMP – Best Management Practice
cfs – cubic feet per second (ft^3/s)
CN – Curve Number
EMC – Event Mean Concentrations
EPA – United States Environmental Protection Agency
EPA-SWMM – United States Environmental Protection Agency Stormwater Management Model
GIS – Geographic Information System
MS4 – Municipal Separate Storm Sewer Systems
NRCS – Natural Resources Conservation Service
NPDES - National Pollutant Discharge Elimination System
PCSWMM – Personal Computer Stormwater Management Model
PPOC - Principle Pollutants of Concern
RCP – reinforced concrete pipe
RCB – reinforced concrete box culvert
Stormwater Manual – *City of Wichita/Sedgwick County Stormwater Manual* (2011)
SWMM – Stormwater Management Model
TMDL – Total Maximum Daily Limit
TSS – Total Suspended Solids

EXECUTIVE SUMMARY

Authorization, Purpose and Scope

This report, summarizes the work and findings of the *Midtown Neighborhood Stormwater Master Plan (Stormwater Master Plan*). The City of Wichita, Kansas entered into contract November 1, 2010, with MKEC Engineering Consultants, Inc. (MKEC) to accomplish the work. MKEC retained the services of CH2M Hill to assist in both technical and planning tasks.

The project's purpose is to prepare a comprehensive drainage study for the 1,280 acre Planning Area*,* lying roughly between the Little Arkansas River, the Central Rail Corridor, Murdock Street, and 18th Street. Study results and implementation details are being coordinated with and integrated into the concurrent *Midtown Neighborhood Transportation and Streetscape Plan,* being prepared separately by Design Workshop.

As part of the community's commitment to developing sustainable, environmentally responsible infrastructure, the *Stormwater Master Plan* also includes water quality measures. Based on their applicability to the Midtown area, five water quality tools are selected for construction as part of the plan.

Planning Process

The planning process included community participation as a means to assess neighborhood preferences and to corroborate results from technical analyses.

A public outreach effort was instituted as a part of the *Stormwater Master Plan* to keep Midtown residents apprised of the Plan's progress, receive feedback about their experiences during rain events, and educate them about stormwater quantity and stormwater quality issues. Councilmember Janet Miller appointed a steering committee comprising area residents and community leaders to help guide the planning process.

Four Steering Committee meetings and three Community Meetings were conducted between December 2010 and June 2011 to coincide with milestones in the technical analysis process. The purpose of these meetings was to communicate the master planning goals and progress toward those goals, to present analysis results and verify them using the residents' experiences, and to present proposed solutions and receive the public's feedback. These meetings were each held in conjunction with the design team working on the *Midtown Neighborhood Transportation and Streetscape Plan,* so that the two planning efforts received direction from the same community representatives and are consistently informed.

Steering Committee and Community Meetings also provided input to planning for water quality measures. Project team members introduced several alternative tools that would accomplish the City's stormwater pollutant discharge goals and asked for public preferences or other reactions to their viability. From these meetings, the project team developed alternative environmental measures for consideration.

Existing Conditions

The project team developed a simulation of the "lay of the land" within the Planning Area and incorporated several rainfall events. The result was a computer model that can be used to predict flooding areas. The base model was developed using software called PCSWMM to represent current

hydrologic, pollutant loading, and system hydraulic characteristics in all basins. The analyses uses two model setups in PCSWMM. The first allows the analysis to separate flow in the stormwater sewer from flow on the ground surface, and to identify whether the restriction is due to pipes that are too small, or inlets that are too small. The second optimizes system performance by accounting for differences in peak flow timing.

The project team also developed a second model using FLO-2D. This software calculates the expected flooding extent on the surface by routing flows not contained by the storm sewer system.

Early model results indicated that much of the existing stormwater system is overtaxed to the point that the inlets/pipes can't accept more stormwater during a 2-year storm. To confirm performance criteria for the proposed system, the hybrid 2-year/5-year storm that the *Stormwater Manual* specifies was applied to the Analysis Area. For this hybrid return frequency, the model calculated proposed storm sewer sizes that were very large. Subsequent analysis applied a 2-year storm to the entire Analysis Area. Since the pipe sizes required to meet performance criteria for a 2-year storm are more feasible, the City decided to deviate from the *City of Wichita/Sedgwick County Stormwater Manual* criteria for "new development" and size the system for a 2-year return frequency storm, instead of the 2-year/5-year hybrid.

Water quality modeling uses pollutant loads developed from local sampling data if possible. Where local data is inadequate to establish pollutant loads, the model input data is taken from the National Stormwater Quality Database.

Planning Alternatives

The Planning Area is topographically flat, with a low ridge bisecting it. Areas east of this low ridge have historically drained east to the Wichita Drainage Canal across what was once the Chisholm Creek floodplain. The recently raised Central Railroad Corridor presents a new hydraulic barrier, adding to the drainage challenges in the Planning Area.

With this in view, the project team developed two approaches to planning the drainage system. The first alternative improves storm sewer system capacity and moves stormwater more quickly and efficiently to outfalls at the Wichita Drainage Canal. This alternative works with the natural landform by moving more of the stormwater away from the Little Arkansas River toward the Wichita Drainage Canal, but all new outfalls must cross under the Central Railroad Corridor.

The second alternative improves system capacity and directs (or re-directs) runoff more quickly and efficiently to the Little Arkansas River. This alternative requires reconfiguring some of the existing underground storm sewer system and introducing new outfalls in the Little Arkansas River to take stormwater in a direction sometimes opposite the minimal land slope.

Using system design capabilities in the PCSWMM software in conjunction with site constraints and performance criteria, the project team developed a complete set of conceptual improvements for each planning alternative. The conduit sizes, inlet and appurtenance requirements, and site restrictions provide the basis for preliminary opinions of probable construction costs.

In a separate effort, the project team identified two basins or sub-basins and specific locations for constructing the water quality tools affirmed at the Steering Committee and Community Meetings. The two sites offer different application opportunities. The site near 18th Street at the Little Arkansas River Bridge provides end-of-pipe treatment opportunities, whereas the 12th Street and Emporia site offers opportunity to evaluate green infrastructure effectiveness. Measures selected for these sites are

hydrodynamic separation and wetland treatment for the end-of-pipe conditions at 18th Street; and green streets and alleys, tree cover enhancement, and rain gardens for the 12th Street site.

Cost Basis

The project team developed opinions of probable construction costs for each set of conceptual improvements for both Alternatives. For standard reinforced concrete pipe, standard inlets, manholes, outfall structures and flowable fill, recent bids for construction projects in and around Wichita provided the basis for unit costs. Reinforced concrete box prices were provided by the local fabricator. These prices do not include delivery or installation, and so were doubled to estimate the delivered and installed unit costs.

For potential projects requiring significant real estate acquisition, such as the two detention sites in Alternative 2 near 16th Street ant Santa Fe, cost calculations use a total cost formula typically used by the City. Each property's assessed value (as of 2011 County records) is multiplied by 1.8 to account for purchase, administrative, and legal costs, and for potential inflation. The total acquisition cost includes an additional $10,000 per whole parcel for structure demolition and site clean-up.

Selection and Prioritization

Because the two Alternatives can be mutually exclusive, that is, once the initial approach is established, the plan must be carried through with little deviation. For example, once an outfall conduit has been built to carry flow to the Wichita Drainage Canal, changing the outfall for adjacent basins to the Little Arkansas River can raise overall costs significantly.

When selecting between the two Alternatives, three basin groups were identified that each function essentially independently of the others. Figure ES.1shows the proposed plan sub-basins, basins, and the independent groupings. Table ES.1 shows opinions of probable construction costs by basin, aggregated by these groupings, for the recommended plan.

The water quality Best Management Practice tool construction will occur in two pilot projects. These projects will treat first flush discharge and collect samples to track the tools' effectiveness and efficiency, paving the way for future work.

Recommendations

Figure ES.2 shows the recommendations by priority, with a sequence assigned to high priority projects. The primary goal of the sequence for high priority projects is improving health and safety in the neighborhood and in the region; the secondary goal is to encourage economic development in the planning area.

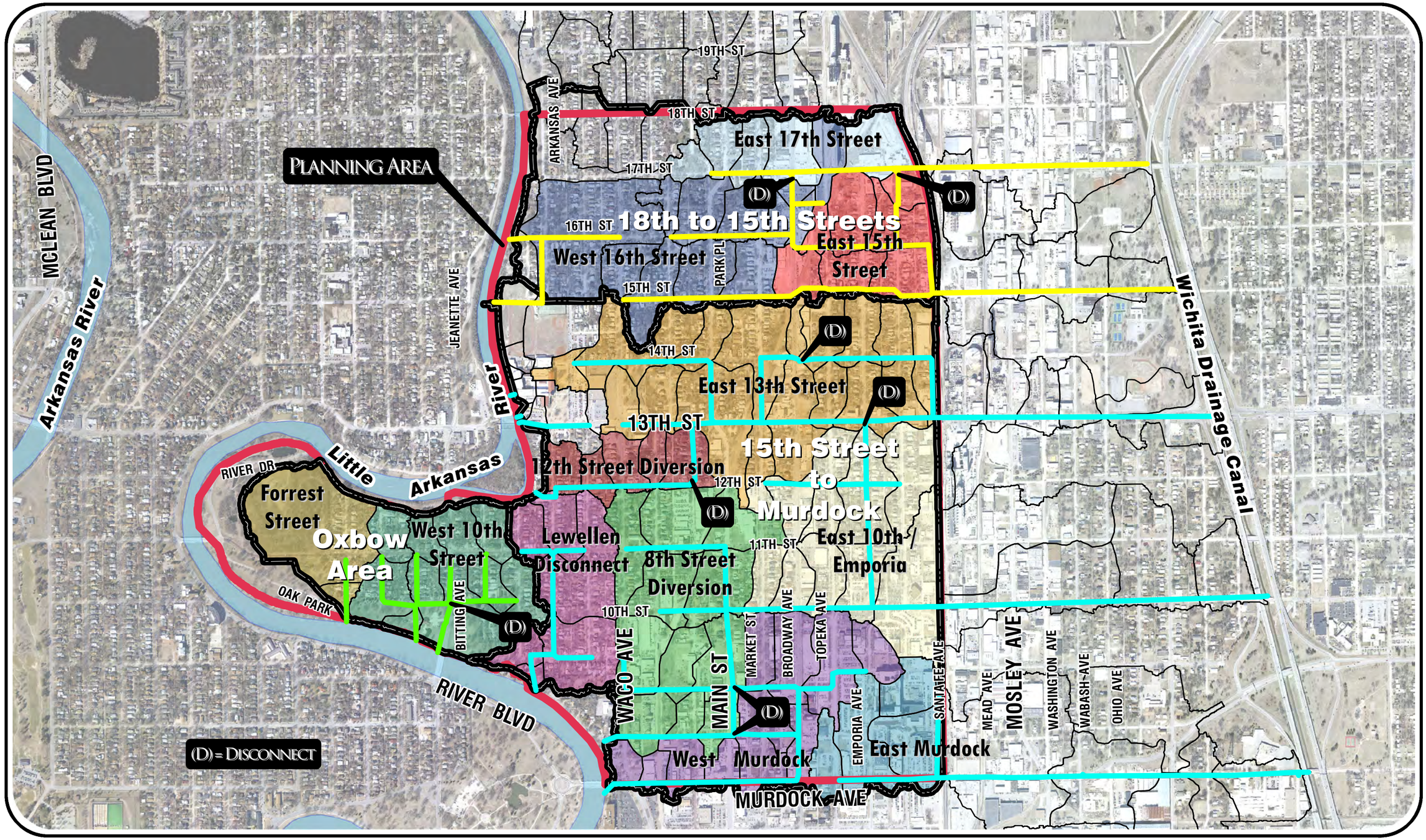
This document is intended for technical planning only, and so does not identify funding sources for any projects described herein. Wichita's City Council and City Administration are properly responsible for identifying how our community's economic resources are best deployed. Priorities established among the projects identified in this report should serve as guides for the City Council as they integrate the needs of the Midtown Neighborhood with the needs of the entire community.

Table ES.1: Probable Construction Cost

ALTERNATIVE 1		
CORRIDOR IMPROVEMENT	**Estimate of Probable Construction Cost**	
18th Street to 15th Street		
East 17th Street	$2,964,312.50	
West 16th Street (Arkansas)	$734,956.25	Group total
East 15th Street	$8,294,450.00	***$11,993,718.75***
15th Street to Murdock		
East 13th Street	$11,828,487.50	
East Murdock	$10,743,344.25	
Lewellen Disconnect	$1,508,443.75	Group total
West Murdock	$1,651,731.25	$25,732,006.75
Oxbow Area		
West 10th Street + Forrest	$2,280,962.50	$2,280,962.50
GRAND TOTAL ALT 1	**$40,006,688.00**	

ALTERNATIVE 2		
CORRIDOR IMPROVEMENT	**Estimate of Probable Construction Cost**	
18th Street to 15th Street		
East 17th Street	$2,964,312.50	
West 16th Street (Arkansas)	$4,912,312.50	Group total
Detention Ponds	$5,554,062.50	$13,430,687.50
15th Street to Murdock		
East 13th Street	$8,907,625.00	
12th Street Diversion	$803,437.50	
East 10th Street	$7,084,737.50	
Lewellen Disconnect	$1,508,443.75	
8th Street Diversion	$5,033,487.50	
Murdock West	$-	Group total
Murdock East	$-	***$23,337,731.25***
Oxbow Area		
West 10th Street + Forrest	$2,280,962.50	***$2,280,962.50***
GRAND TOTAL ALT 2	**$39,049,381.25**	

RECOMMENDED PLAN		
18th Street to 15th Street (Alternative #1)	$	11,993,718.75
15th Street to Murdock (Alternative #2)	$	23,337,731.25
Southwest Area	$	2,280,962.50
Recommended Plan Total	***$***	***37,612,412.50***



MIDTOWN NEIGHBORHOOD

STORMWATER MASTER PLAN

FIGURE ES.1 - RECOMMENDED PLAN

NORTH

CITY OF WICHITA

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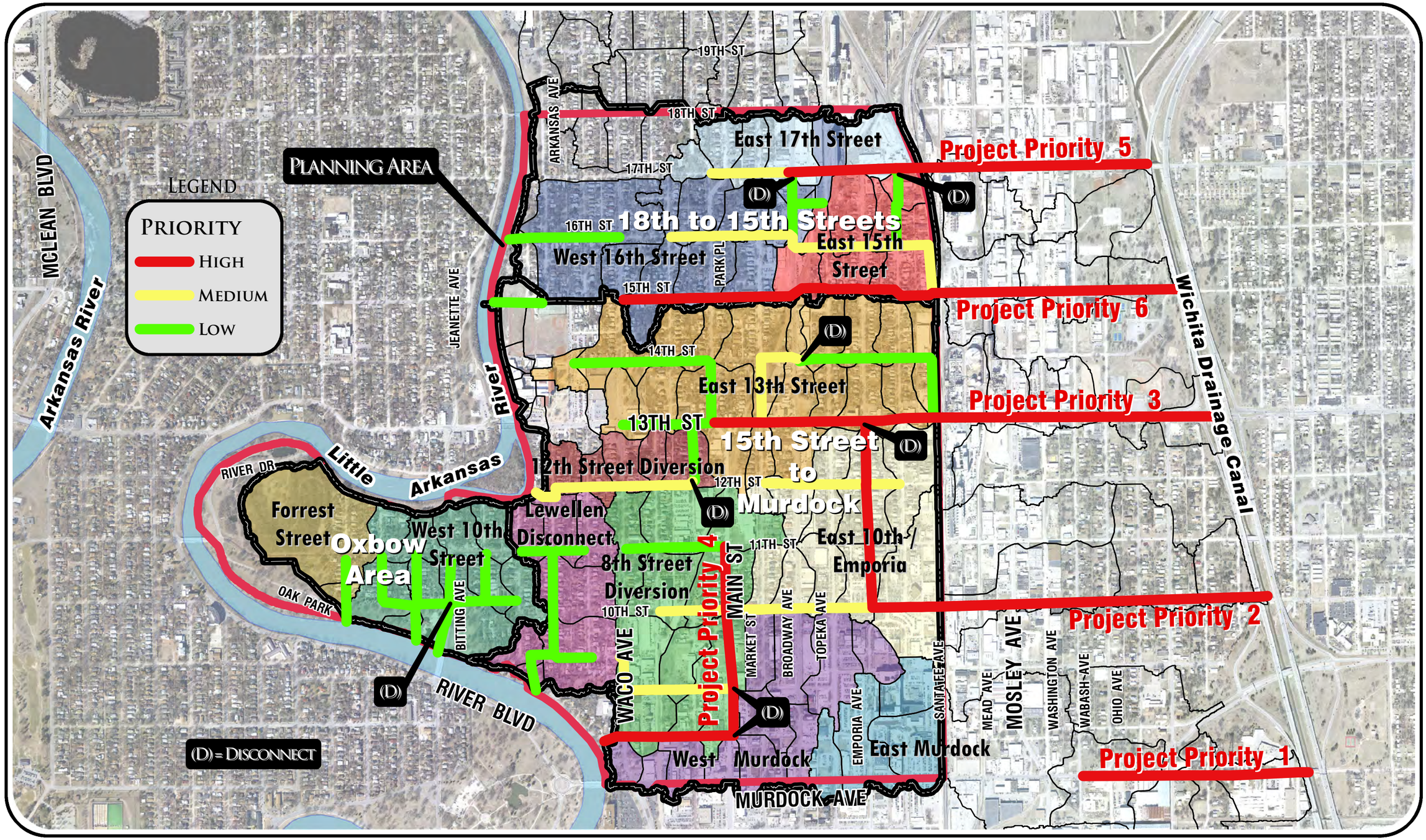

Midtown Neighborhood

Stormwater Master Plan

Figure ES.2 - Project Priorities

North

City of Wichita

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1. INTRODUCTION

The 2004 *Midtown Neighborhood Plan* provides a vision for the year 2020 and establishes goals and objectives for achieving the vision. Goal 7 of that plan focuses on drainage needs. The first and perhaps most critical item in that section is to complete a comprehensive drainage study. The firms of MKEC, CH2M HILL, and Bothner & Bradley were retained to prepare this study, which is now named the *Midtown Neighborhood Stormwater Master Plan (Stormwater Master Plan*).

In addition to this *Stormwater Master Plan*, the City has another related master planning effort underway. The *Midtown Neighborhood Transportation and Streetscape Plan (Transportation and Streetscape Plan)* is now being prepared by Design Workshop. Each plan targets the same planning area, and the analysis and planning efforts undertaken by both consultants are being coordinated. This is to ensure that *Transportation and Streetscape Plan* recommendations are fully integrated into the *Stormwater Master Plan*. The objective is to achieve greater value by coordinating these efforts.

Other documents significant for the *Stormwater Master Plan* are as follows:

- *21st Street North Corridor Revitalization Plan* (2005)
- *Project Downtown: The Master Plan for Wichita (2010)*
- *Wichita/Sedgwick County Stormwater Manual (2011)*

1.1 Historic Midtown and Neighborhood Planning Results

The Historic Midtown Neighborhood is the site of the original 1870's settlement of Wichita and the City's first residential neighborhood. It contains several nationally recognized historic districts and structures, as well as many locally recognized historic structures.

Now, as described in the *Midtown Neighborhood Plan,* "Historic Midtown is an established residential community with public gathering places and thriving businesses in the heart of Wichita. Many of the large Victorian houses and smaller frame bungalows in Historic Midtown have been restored recently, showcasing growing neighborhood pride. These houses are occupied by a variety of cultures and the designs and decorations speak to this diversity and eclectic flavor. Viable Asian and Hispanic food markets sit next to American-style commercial establishments and specialty shops in the distinctly commercial streets."

To conserve and revitalize these assets, various tasks and projects have been completed. In 2004, after many months of work by Midtown Neighborhood residents, Steering Committee members and Wichita-Sedgwick County Metropolitan Area Planning Department Staff, the *Midtown Neighborhood Plan* was finalized in 2004. Adopted as part of the City's Comprehensive Plan by both Sedgwick County and the City of Wichita (City), it provides a descriptive future vision and establishes goals and objectives for that vision. In the intervening years, many of the goals within the descriptive vision have been met. Some of the major completed goals are as follows:

- Major reinvestment has been made to schools within the neighborhood such as North High School, Irving Elementary, Park Elementary and Horace Mann Magnet (K-8)
- A part of the old UP rail corridor has been transformed into a hike-bike path greenway
- An interactive fountain has been constructed for the enjoyment of the area's children and older residents
- Pedestrian and vehicular movements have been separated from train traffic at 13th Street and Murdock as part of the Central Railroad Corridor project

- The 13th Street & Broadway intersection has been improved
- The historic Minisa Bridge has been reconstructed

As noted above, the *Midtown Neighborhood Plan* goal of resolving drainage problems is this *Stormwater Master Plan's* objective.

1.2 Planning Area

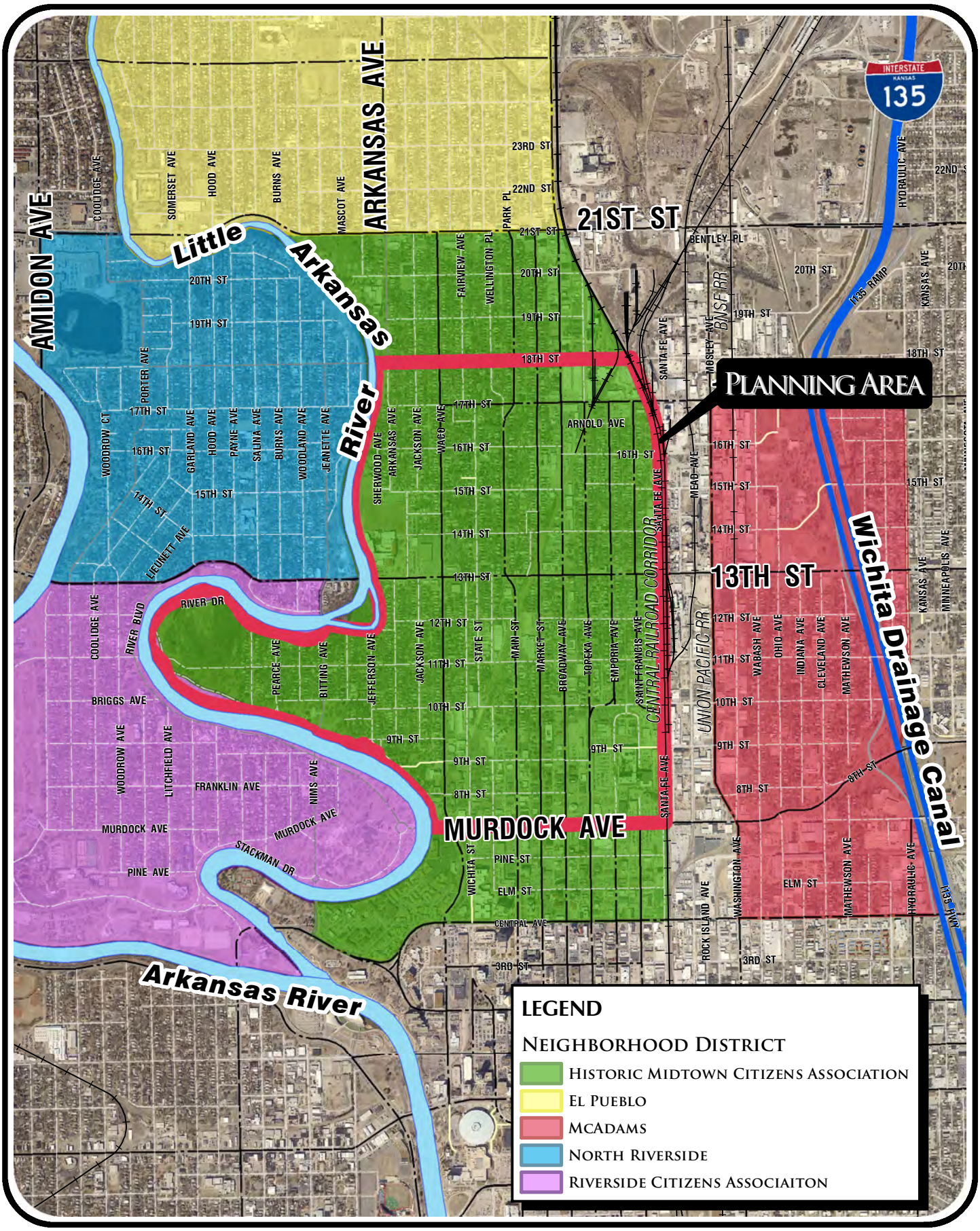
The Planning Area for this report is bounded by 18th Street, Santa Fe, Murdock and the Little Arkansas River, as shown in Figure 1.1. As indicated on this map, the Midtown Neighborhood actually extends north of the Planning Area boundary to 21st Street. The north Planning Area boundary was set at 18th Street because the storm sewer system in the area to the north was studied previously in the *21st Street North Corridor Revitalization Plan* (2005). Similarly, the south Planning Area boundary was set at Murdock even though the Midtown Neighborhood extends south to Central Avenue. This was done to coordinate this Planning Area's southern boundary with the limits of the *Project Downtown: The Master Plan for Wichita* (2010) study area.

As work progressed and a clear understanding of the drainage patterns developed, the Analysis Area had to be extended beyond the Planning Area. This was necessary so that all land areas from which stormwater flows into the storm sewer system that serves Midtown were included in the analysis. If these areas were omitted, the analysis would be incomplete. Therefore, the drainage from the basin north of 18th Street to about 23rd Street was included in the analysis. Further, the outfall corridors from Santa Fe Avenue east to the Wichita Drainage Canal (east of Santa Fe) were necessarily included in the analyses. The Analysis Area studied is then represented in Figure 1.2 by the basins of the Little Arkansas River (purple) and Wichita Drainage Canal (green) that drain the Planning Area.

1.3 Stormwater Master Plan Goal

The built environment of the Midtown Neighborhood includes streets, buildings, lawns, parks, and other features from which stormwater runs off. As in most of Wichita's older neighborhoods, the storm sewer system consists only of curbs and gutters, street inlets and pipes that capture and direct this stormwater downstream. No treatment facilities are present. The only detention is on the St. Francis hospital campus and it serves only that site. In the Planning Area, flows go either west to the Little Arkansas River or east to the Wichita Drainage Canal/Big Arkansas River. See Figure 1.3. With few exceptions, the original Midtown storm sewer system remains basically unchanged since its installation between 80 to 100 years ago. While it has served relatively well, it is now quite aged and overburdened, thereby rendering many elements of the system either functionally and/or physically obsolete.

The existing system is basically "invisible" and has a single basic function – to drain away stormwater and prevent flooding as a public convenience. Still, even this function is unrealized and there are areas within Midtown where minor flooding periodically occurs.



North

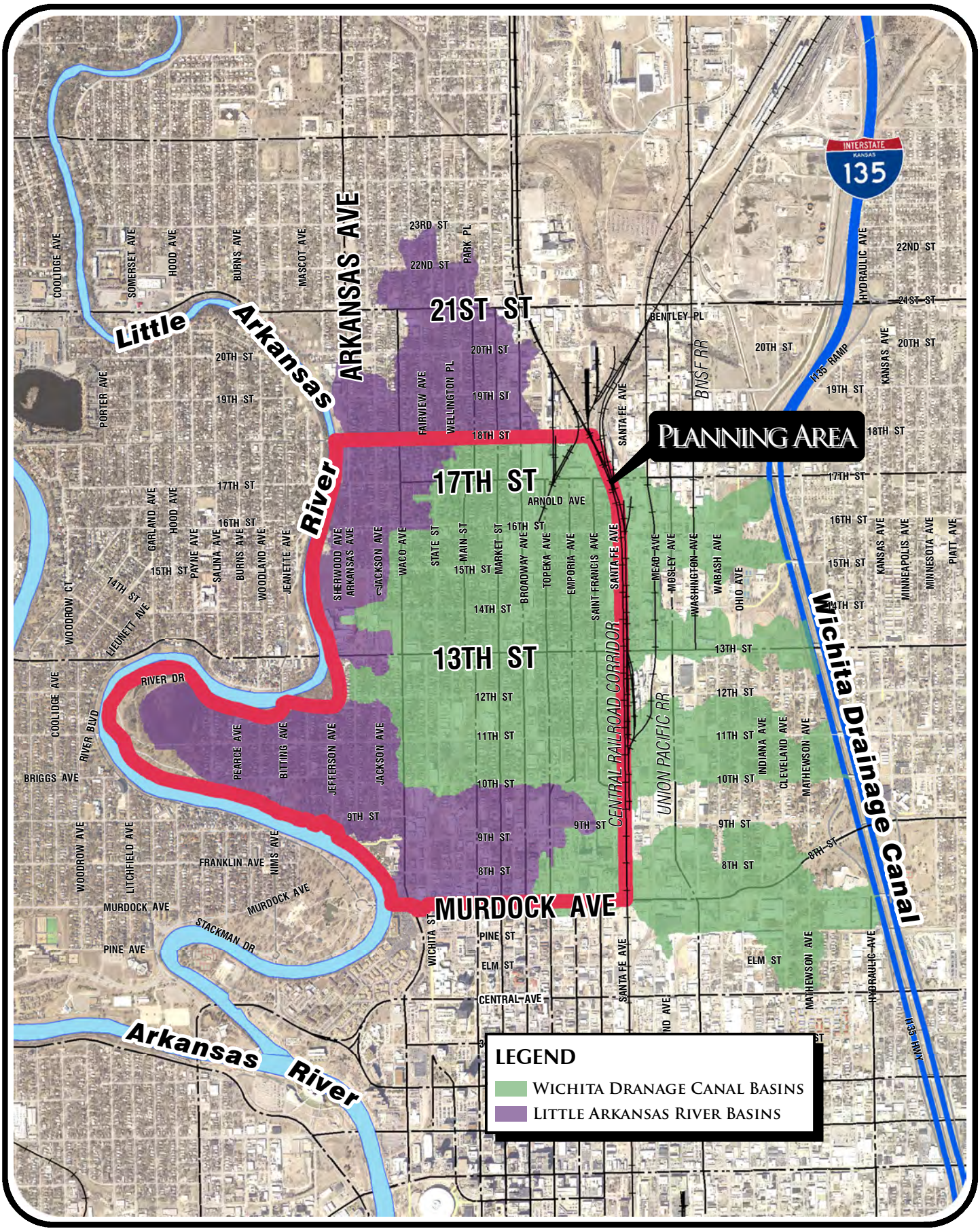
Midtown Neighborhood

Stormwater Master Plan

Figure 1.1: Planning Area

City of Wichita

J:\Civil\10544 - Midtown\GIS\Maps\Final Report\Figures\Figure 1.1 - Planning Area.mxd



NORTH

Midtown Neighborhood

Stormwater Master Plan

Figure 1.2: Analysis Area

J:\Civil\10544 - Midtown\GIS\Maps\Final Report\Figures\Figure 1.2 - AnalysisArea.mxd

NORTH

MIDTOWN NEIGHBORHOOD

STORMWATER MASTER PLAN

FIGURE 1.3: EXISTING CONDITIONS MAP

CITY OF WICHITA

J:\Civil\10544 - Midtown\GIS\Maps\Final Report\Figures\Figure 1.3 - Existing Conditions Map.mxd

The overall goal of this *Stormwater Master Plan* is to establish conceptual improvements appropriate for the aged and obsolete storm sewer system. Possible Improvements include the following:

- More and larger pipes
- Additional inlets with greater capacity
- Additional outfall lines to the Little Arkansas River and Wichita Drainage Canal
- Detention facilities

In addition to these basic improvements, this *Stormwater Master Plan* examines methods by which new "green" infrastructure, such as rain gardens, porous pavement, green roofs, bioswales, and other solutions can be used to complement the more traditional improvements. Such green infrastructure can add aesthetic, social cultural, educational awareness, economic, and environmental benefits – elements that can make significant contributions to the overall quality of life in Midtown. As stated in the *Wichita/Sedgwick County Stormwater Manual*, stormwater should be viewed not as a waste that requires disposal, but as an invaluable resource and an opportunity for enhancing neighborhoods.

1.4 Purposes of this Stormwater Master Plan

The more specific purposes are as discussed in the following sections.

1.4.1 Identify Areas of Flooding and Their Causes

During light and moderate rains, stormwater is adequately handled by the existing storm sewer system. During heavier rain events, some parts of Midtown experience significant flooding, which results in property damage and/or inconvenience to pedestrian and vehicular movement. Through computer simulation, with predictions corroborated by area residents, this study identifies flooding problems during rain storms from 2 ½ inches to almost 8 inches in a 24 hour period. This approach explains how and why certain areas are negatively affected during rain storms and provides a sound basis for improvement proposals.

The computer simulations performed provide the following information on the existing conditions:

- An understanding of the amount of runoff experienced by the neighborhood from various rainfall events
- An evaluation of the capacity of the stormwater infrastructure to convey the stormwater runoff, including inlet structures, pipes, and any existing stormwater storage facilities
- A determination of where surface flooding currently occurs
- The quantification of the magnitude of the existing surface flooding problems

To analyze existing conditions, hydrologic and hydraulic models were constructed for the Midtown Neighborhood. The results of these models are then used to develop combinations of infrastructure improvements that will reduce neighborhood drainage problems.

1.4.2 Identify Storm Sewer System Capital Improvement Projects

Though there have been many capital improvement projects constructed during the past century that have formed the current stormwater drainage system, the two most effective projects were the Wichita Drainage Canal (replacing portions of Chisholm Creek), which the City Council instructed the City Engineer to prepare plans for in 1907; and the Wichita-Valley Center Floodway, which was completed in 1959. These two historic projects have kept the Midtown Neighborhood, as well as

most of the heart of Wichita, protected from catastrophic flooding from the Big and Little Arkansas Rivers and Chisholm Creek.

Also, as a result of the above sizeable, historic projects, Midtown is shown on the Federal Emergency Management Agency (FEMA) Flood Insurance Rate Map (FIRM) (Panel 355) in Flood Insurance Zone X. The following text pertains to Zone X and is included on the FIRM panel:

"Protected from the 1-percent annual chance of flood hazard by levee, dike, or other structure. Overtopping or failure of this structure is possible which could result in destructive flood elevations and water velocities. Proper protection, flood insurance, and adherence to evacuation procedures are strongly recommended."

With protection from catastrophic flooding already provided, today's infrastructure needs in Midtown are more subtle: the storm sewer system's functional and physical deficiencies still must be addressed. Through a discovery process involving significant stakeholder participation and engineering analysis this study identifies structural and non-structural/green projects that can address the community's current stormwater needs.

1.4.3 Determine Capital Improvement Implementation Priorities

The City's expenditures for Capital Improvement are based on many factors and priorities: Some have legal or permit basis; some have health and safety implications; others are founded on customer concerns; and there are many more including financial capacity and operational and maintenance costs related to both existing and new improvements. The City of Wichita Council's adopted process for establishing the Capital Improvement Program prioritizes projects through public hearings and in accord with the following core principles:

- Protect Life
- Protect Property
- Protect Infrastructure Investment
- Promote a Sustainable, Growing Community

This study prioritizes stormwater improvements in a similar manner. This document is intended for technical planning only, and so does not identify funding sources for any of the project described herein. Wichita's City Council and City Administration are properly responsible for identifying how our community's economic resources are best deployed. Priorities established among the projects identified in this report should serve as guides for the City Council as they integrate the needs of the Midtown Neighborhood with the needs of the entire community.

1.4.4 Analyze Impairments to Stormwater Quality and Identify Solutions

The Midtown Neighborhood is anchored to the Little Arkansas River corridor and its stormwater quality for individual and organized recreational events, such as canoeing, fishing, hiking, the North High School WaterFest and Wichita's River Festival. However, its stormwater quality is too often unpredictable. Trash, pet wastes, oil leakage and over-fertilization of lawns are some common causes of polluted stormwater flowing from Midtown both to the Little Arkansas River and the Wichita Drainage Canal. Therefore, another purpose of this study is to review the prevalence of these and other pollutants; to analyze the technical and social issues surrounding them and to recommend solutions.

Newer green approaches are available that can help manage stormwater in ways that would be beneficial to the neighborhood in many ways, such as through:

- Enhanced environmental sustainability
- Improved Little and Big Arkansas Rivers' aquatic habitats and water-based recreation
- Improved overall health and vitality of the general ecosystem
- Improved groundwater and stormwater quality
- Increased groundwater recharge
- Enhanced aesthetic quality of the landscape

1.4.5 Address EPA "Nine Elements"

One of the City's basic goals is to ensure that stormwater planning and improvement projects undertaken on behalf of the community properly address stormwater quality issues. The United States Environmental Protection Agency (EPA) is charged with leading the federal government's efforts to focus state and local efforts toward the national goal of addressing stormwater quality issues. As a result of the stormwater quality goals shared by the City and the EPA, one of the purposes of the *Stormwater Master Plan* is to identify specific content required by EPA's guidelines for watershed plans.

The 1987 amendments to the Clean Water Act (CWA) established the Section 319 Nonpoint Source Management Program. This program provides the framework for documenting how stormwater quality improvement goals are being met, and encourages local entities to participate. As part of administering this program, the EPA published their "Handbook for Developing Watershed Plans to Restore and Protect Our Waters" in 2008. In Chapter 2 of this document the EPA has identified nine key elements that are critical for achieving improvements in stormwater quality. These are the minimum elements to be included in a watershed plan to qualify for funding using incremental Section 319 funds.

Generally, these Nine Minimum Elements are summarized as follows:

1. Causes of impairment and pollution sources
2. Estimate of expected load reductions
3. Description and location of management measures
4. Estimate of technical resources and financial assistance needed
5. Information and education (I/E) component
6. Implementation schedule
7. Interim measureable milestones
8. Criteria for determining whether load reductions are being achieved
9. Monitoring component to evaluate effectiveness

Section 6 describes the ways in which this report specifically addresses these elements.

1.4.6 Stormwater Code Violations

Appendix A shows stormwater code violation categories and fines from the City of Wichita Stormwater Management website.
http://www.wichita.gov/CityOffices/MunicipalCourt/Tickets/FineSchedules.htm

2. MIDTOWN STORMWATER ANALYSIS OVERVIEW

The approach to analyzing stormwater overland flow, collection, conveyance, and discharge within Midtown included both technical analysis and interaction with residents. Information was gathered about the existing topography within Midtown so an understanding of the locations of basins and sub-basins could be developed. Additionally, the City provided GIS information documenting the sizes and locations of the storm sewer system components. This storm sewer system interacts with the basins and sub-basins by collecting stormwater from each sub-basin and conveying it to either the Little Arkansas River or the Wichita Drainage Canal. This information about the existing topography and storm sewer system was used as a basis for the computer model that was developed for analyzing stormwater flow and flooding. Results of the analysis were compared with the experiences of local residents as a step in verifying the accuracy of the computer model.

2.1 Public Outreach

A public outreach effort was instituted as a part of the *Stormwater Master Plan* to keep Midtown residents apprised of the Plan's progress, receive feedback about their experiences during rain events, and educate them about the stormwater and stormwater quality issues. As part of the outreach process, the function of the storm sewer system was explained. The outreach process included efforts to correlate the computer model predictions of flooding areas with the experiences of local residents. Also, issues related with stormwater quality were presented and discussed. These issues include the sources of stormwater pollution and proposed solutions designed to rid stormwater of the pollution load it may carry. Solutions proposed to address both flooding areas and pollution concerns were presented to the public for feedback on which projects were the highest priority.

2.1.1 Community Meetings

The backbone of the public outreach effort was a series of three community meetings. The purpose of these meetings was to communicate the master planning goals and the progress toward those goals, present results of the analysis and verify results with the past experiences of the residents, and present proposed solutions for the public's feedback. These meetings were each held in conjunction with the design team working on the *Midtown Neighborhood Transportation and Streetscape Plan*. Each meeting commenced at 6:30 p.m. and adjourned at 8:30 p.m. The meetings were held as follows:

- December 16, 2010 at the Midtown Community Resource Center
- March 17, 2011 at Horace Mann Dual Language Magnet School
- June 1, 2011 at St. Paul's Lutheran Church

All three meetings followed a similar agenda. The meetings were called to order by City staff. Councilmember Janet Miller then spoke with the audience. Next, each design team gave a formal presentation which provided information specific to each project and the progress to date. This was followed by the "world café", a time of interaction between the citizens and the design team. The final portion of each meeting was reserved for keypad polling of the meeting attendees.

The world café process afforded an opportunity for the public to interact directly with the design team members. Stations dedicated to specific topics were established around the room. The station topics related to the *Stormwater Master Plan* were:

- Stormwater Quantity - the areas within Midtown prone to flooding
- Stormwater Quality – solutions to pollution issues

A moderator assisted in assembling attendees into groups and allowing them to interact at each station for 4 to 5 minutes before rotating to the next. During their time with each group, *Stormwater Master Plan* design team members would educate the public on the results of the analysis work and receive feedback on how the results match real world experiences. Once everyone was given an opportunity to visit each station, the group re-assembled for keypad polling. Information provided by the public during the world café held during the first community meeting is summarized in Appendix B.

Keypad polling is an interactive tool designed to provide instantaneous feedback to the design team of the public's thoughts on the topic. Each member of the public who desires to participate is given a wireless keypad with a series of numbered buttons on it. Then, various questions are presented with a list of numbered response options. The public is instructed on how to utilize the keypad to document their preferred choice. Once all the responses are received, the results are presented to all in attendance. The questions are designed to gauge the public's understanding of the material being presented and their preferences for solutions. The keypad polling questions were posted on the City's website after each meeting to allow members of the public who did not attend the meetings an opportunity to voice their opinion.

In lieu of keypad polling at the third community meeting, the *Stormwater Master Plan* design team developed a Project Prioritization Questionnaire to assist in gathering feedback. The questionnaire and the results received are available in Appendix C.

As an additional opportunity for the public to provide feedback, comment cards were available at each community meeting. The comment cards received at each meeting are included in Appendix D.

2.1.2 Steering Committee Process

A steering committee was selected and assembled by Councilmember Miller for the purpose of providing more specific and thorough interaction between the public and design team members from both the *Stormwater Master Plan* and the *Midtown Neighborhood Transportation and Streetscape Plan*. Committee members acted as visionaries for what the Midtown Neighborhood can and will be. They provided the design teams a voice representing neighbors and business owners and worked to understand the issues associated with both planning efforts. Finally, they served as promoters and in public relations to relay accurate information regarding the status of the Plans and promote the Community Meeting process. Names of the steering committee members are listed at the beginning of both plans.

2.1.2.1 Steering Committee Meetings

Meetings between the Councilmember Janet Miller, the steering committee, City staff, and the design teams were held as follows:

- December 16, 2010 at the Midtown Community Resource Center - this meeting preceded the first Community Meeting
- February 9, 2011 at the Midtown Community Resource Center
- March 3, 2011 at Midtown Community Resource Center
- May 5, 2011 at Evergreen Neighborhood City Hall

These meetings were all chaired by Councilmember Janet Miller and agendas to each are included in Appendix E.

2.1.2.2 Survey of Steering Committee Members

After the February steering committee meeting, a survey specific to the *Stormwater Master Plan* process was made available to the steering committee members. Due to the relatively technical nature of the questions and since detailed information had been presented to the steering committee members, this survey was not given to the public at large. The design team and City staff thought that it would not be adequately understood without sufficient background information, and the scope of this information was too great to be presented in a community meeting setting. The survey was administered using SurveyMonkey and the results are presented in Appendix F.

2.1.3 Communication through "The Midtowner" Newsletter

The design team published articles in "The Midtowner" newsletter. This provided an opportunity to describe the planning effort and process as well as advise the readers of upcoming community meetings. Copies of the newsletter are included as Appendix G.

2.2 Basin Delineation

As described in Section 1, the basins analyzed for this Plan extend outside of the Midtown Neighborhood Planning Area. Basins outside of the Planning Area were modeled because runoff from these areas affects the storm sewer system in the Midtown Neighborhood.

Basin delineation was performed using the City's stormwater infrastructure, terrain, and land use data in Geographical Information System (GIS) format. Two systems were identified. The area draining to the Little Arkansas River was designated the West Basin System, and the area draining to the Wichita Drainage Canal was designated the East Basin System.

Within each of these basin systems, basins were identified based on the current connection to a common stormwater outfall and named based on the street that contains the major trunk line for the system. In each basin, individual sub-basins were developed that provide adequate design detail and generally contain one kind of land use. Surface runoff from each of these sub-basins flows to one design point, and the combined capacity of all the inlets in the sub-basin was applied at the design point. Basin and sub-basin sizes vary.

2.2.1 Existing Little Arkansas River Basins

The West Basin System includes approximately 475 acres and drains to the Little Arkansas River. Land use is primarily single family residential, with occasional multi-family housing, parks and open space, and commercial land uses. There are also schools, including North High School near the Little Arkansas River. The West Basin System includes areas north of the Planning Area that contribute stormwater flow to the Midtown Neighborhood.

The West Basin System includes eleven basins. Generally from north to south these are: W19th, W18th, W17th, W16th, W15th, W13th, WForrest, WPearce, W10th, WBackBay, and WMurdock. Each basin was broken up into sub-basins to identify how runoff enters the storm sewer system incrementally.

2.2.2 Existing Wichita Drainage Canal Basins

The East Basin System includes approximately 805 acres and drains to the Wichita Drainage Canal. Land use is primarily single family residential, with occasional multi-family housing, parks and open space, and commercial land uses. Also, multiple industrial properties exist along the Central Railroad Corridor. Via Christi-St. Francis Hospital is at the northwest corner of Murdock and Santa Fe. The East Basin includes areas east of the Planning Area from which stormwater flows into the storm sewer system between the Midtown Neighborhood and the Wichita Drainage Canal.

The East Basin System is made up of five basins. From north to south these are: E16th, E15th, E13th, E10th, and EMurdock. Each basin was broken up into sub-basins to identify how runoff enters the storm sewer system incrementally.

2.3 Existing Stormwater Infrastructure

As noted in Section 1, the Historic Midtown Neighborhood is the original residential area for the City. The current stormwater infrastructure, consisting of streets, inlets, and conduits, was constructed over the course of many years. Each infrastructure category includes a variety of construction types that reflect the methods and materials used during different time periods, and each construction type has somewhat different drainage characteristics.

2.3.1 Streets

Approximately 50 miles of streets serve the 1,280 acre Analysis Area and they provide benefits beyond transportation. They serve to collect stormwater runoff and convey it to inlets. While these streets are generally in good condition, a few streets in the industrial area near the Central Rail Corridor are unimproved, with sand surfaces and no curb and gutter, and in some cases with no ditch.

2.3.2 Inlets

The City's GIS database indicates that there are 10 different kinds of inlets in the analysis area, with capacities that vary widely.

Typically, each sub-basin has several inlets, which may be situated on slopes, or in street sump. The project team developed a scheme whereby multiple inlets are aggregated into a single representation, with one characteristic inlet capacity table assigned to each sub-basin. Figures in Section 3 present this scheme in detail, and provide examples of composite inlet rating curves.

2.3.3 Pipes

The existing storm sewer system includes a variety of sizes, construction materials, and configurations. Of the approximately 76,000 feet of storm sewer system in the Analysis Area, about 15% is pipe that is 1 foot in diameter or smaller. An additional 32% of the storm sewer system has a vertical dimension between 1 foot and 2 feet, and another 25% of the storm sewer system has a vertical dimension of 2 feet or more, but less than three feet.

With respect to construction materials, approximately 19% is of hand laid brick construction, all larger than 2 feet in the vertical dimension. About ¾ of the storm sewer system (74%)is circular pipe, made of concrete, ductile iron, or vitrified clay. The remaining 7% is in horizontal elliptical concrete pipe and reinforced concrete box.

Conduit size, slope, and construction materials all affect storm sewer system capacity. With nearly half of the current storm sewer system conduits less than 2 feet in diameter, very flat slopes in the analysis area, and almost one fifth of the larger storm sewer system of hydraulically rough materials (brick), poor system performance is expected.

3. EXISTING CONDITIONS MODELING

To analyze the performance of the storm sewer system within the various basins, a computer model representing the topography and storm sewer system in the Analysis Area was developed. This model represents the existing conditions of the Planning Area basins. The topography of each basin is combined with estimated rainfall amounts for various storm events to create a model which simulates how the stormwater flows over land. Once this stormwater is collected by the storm sewer system and taken underground, the model simulates how it is conveyed to either the Little Arkansas River or the Wichita Drainage Canal.

3.1 Model Selection

The computer model includes both hydrologic and hydraulic analysis. The hydrology includes inputs such as rainfall, land use, and topography which the model uses to calculate runoff hydrographs. These hydrographs are then modeled within each basin and the model predicts the amount of stormwater that will enter the storm sewer system and how much bypasses to either collect in the streets or overflow to an adjacent basin. The hydraulic model calculates expected stormwater flow hydrographs between the various basins or in the storm sewer system. The hydrology and storm sewer hydraulic analyses were performed for the entire Analysis Area comprising both the East and West Basin Systems, including areas outside the Planning Area boundary. Surface flooding hydraulic analysis was only performed for the portions of the East and West basins within the Planning Area.

3.1.1 Hydrology, Hydraulics and Stormwater Quality

PCSWMM, a proprietary software system that runs on the EPA-SWMM 5 (SWMM) engine, was selected to perform the model analysis for runoff hydrology, storm sewer system hydraulics and stormwater quality. It provides a user friendly, GIS interface to the SWMM engine. Model output is compatible with open source SWMM, allowing modeling results to be widely accessible.

The SWMM software incorporates hydrology, hydraulics, and stormwater quality modules to accurately characterize water quantity and quality and evaluate proposed project improvements. Detention, stormwater quality, and infrastructure improvements are expected to be key components to flooding solutions for the Planning Area and can all be incorporated into the SWMM model.

3.1.2 Street Flooding Analysis

A second proprietary software system package, FLO-2D, was used to define the expected flood hazard, and surface flow routing of flows not contained within the existing and proposed storm sewer systems. FLO-2D is a two dimensional dynamic flood routing model that simulates unconfined overland flow and street flow and can simulate flood progression over complex topography and variable roughness. This program captures the complex flood interactions and split flows at intersections as an aid in identifying localized flooding issues. This information is used to optimize the proposed storm sewer system improvements in an effort to minimize surface flooding. FLO-2D works well in defining flow paths in extremely flat terrain like that of the Midtown Neighborhood.

3.2 Data Collection and Review

The PCSWMM model was built based upon the infrastructure, terrain, soil, land use, and stormwater quality data provided by the City of Wichita to CH2M HILL and MKEC. This data was provided in a GIS Database format, GIS shape files, or AutoCAD files. It was assumed that all data provided is accurate.

In reviewing the initial data provided, CH2M HILL identified 64 structures and 58 conduits with missing diameters, elevations, depths or inverts. MKEC and the City of Wichita were able to provide resolution in 19 of these instances. CH2M HILL made assumptions as necessary to fill in the remaining data gaps by utilizing upstream and downstream slopes of pipes to estimate missing invert and depth information. In addition, data was provided by the City about the location of collapsed pipes in the Midtown storm sewer system. It was assumed that these pipes would be repaired or replaced and the collapsed condition was not modeled as part of the existing condition analysis.

3.3 Hydrologic Analysis

Hydrologic analysis was performed using PCSWMM to determine the quantity of runoff tributary to the Midtown storm sewer systems. The *City of Wichita/Sedgwick County Stormwater Manual* (*Stormwater Manual*) was the governing criteria for this project. Chapters 4 and 5 of Volume 2 govern hydrologic and hydraulic analyses. The following SWMM parameters were utilized in the Midtown model in accordance with the *Stormwater Manual*.

- The curve number method was used for the infiltration model
- The routing and reporting time steps were five minutes
- The model run duration is 48-hours to allow for full routing of storm runoff
- Rainfall was applied to each sub-basin as a Natural Resources Conservation Service (NRCS) Type 2 distribution of the local 24-hour storm depth
- Curve numbers (CN) for pervious areas were determined using the guidance found in Section 4.3.3 of the *Stormwater Manual*. The SWMM methodology applies CN to the infiltration computation to pervious areas only, therefore CN were selected for pervious areas only and not according to the gross land use of a basin.
- Area-weighted saturated hydraulic conductivity values for pervious areas were taken from Table 4-11 in the *Stormwater Manual*
- Depression storage depths were 0.1 inches for impervious areas and 0.3 inches for pervious areas as specified in Table 4-12 of the *Stormwater Manual*
- Manning's roughness values for sub-basin sheet flow were taken from Appendix A of the *Stormwater Manual*

3.3.1 Rainfall Conditions

The conditions analyzed in this project were 2-, 5-, 10-, 25- and 100-year storms. The NRCS 24-hour, Type 2 cumulative rainfall distribution was applied to each sub-basin with a time step of 5 minutes. Design storm depths are shown in Table 3.1.

Table 3.1: Rainfall Depths for 24-Hour Storm (inches)

Storm Event	2-Year	5-Year	10-Year	25-Year	100-Year
Rainfall (inches)	3.5	4.5	5.2	6.1	7.8

3.3.2 Basin Characteristics

Review of the NRCS soil map indicated that the Planning Area is mapped as urban, with three major soil complexes as shown in Table 3.2.

Table 3.2: Soil Characteristics

Soil Complex	Percentage of Area	Hydrologic Soil Group	Description
Urban land - Tabler complex, 0 to 1 percent slopes	8.7	D	Moderately well drained; runoff is slow and permeability is very slow.
Urban land - Canadian complex, 0 to 3 percent slopes	35.3	B	Well drained; moderately rapid permeability; runoff is negligible on 0 to 1 percent slopes and very low on 1 to 3 percent slopes.
Urban land - Elandco complex, 0 to 1 percent slopes	55.8	B	Well drained; runoff is negligible; moderate permeability.

Land use data was aggregated into seven general classifications: Roads, Single Family/Duplex, Multi-Family, Commercial, Office, Industrial, and Park/Open Space. Percent imperviousness values were assigned for each land use based on Table 4-3 of the *Stormwater Manual*.

Infiltration was calculated using the NRCS curve number method. Curve numbers were used for pervious areas based on soil type and were taken from *Stormwater Manual* Table 4-2. GIS analysis was used to identify the pervious areas within each hydrologic soil group. Pervious areas within group B soils were assigned a curve number of 71, and those within group D soils were assigned a curve number of 84.

GIS analysis was used to identify each land use to estimate the impervious percentage of each sub-basin. The resulting categories are shown in Table 3.3 along with the percent imperviousness for each category. An area-weighting calculation was performed in PCSWMM to provide a composite percent impervious for each sub-basin.

Table 3.3: Impervious Percentage by Land Use

Land Use Category	Percent Impervious
Roads	65
Single Family/Duplex	38
Multi-Family	65
Commercial	85
Office	85
Industrial	72
Park/Open Space	12

Sub-basin width is a parameter used by PCSWMM in conjunction with surface roughness and the Manning equation to calculate each sub-basin's outflow hydrograph. The width of each sub-basin was defined as the sub-basin area in square feet divided by the longest flow path that does not enter a curb and gutter, lined channel or storm sewer. The approximate average overland length for the sub-basins in the Analysis Area is 175 feet. This assumption was used as the basis for calculating the sub-basin widths for the project.

3.3.3 Surface Runoff

Rainfall hydrograph routing was modeled using the runoff module within PCSWMM. Within each sub-basin rainfall is modeled as inflow. Surface runoff occurs in the sub-basin when the depth of the inflow is greater than the depth of depression storage and infiltration. The SWMM model calculates surface runoff using Manning's equation with the characteristic sub-basin width of the channel and the depth of water over the sub-basin. This depth is continuously updated using a water balance equation over the sub-basin. This calculation results in a runoff hydrograph for the basin in the form of runoff versus time.

3.4 PCSWMM Storm Sewer System Conveyance Analysis

Hydraulic analysis was performed using PCSWMM to determine the flow rates within the Midtown storm sewer systems for the five rainfall events. The *City of Wichita/Sedgwick County Stormwater Manual* (*Stormwater Manual*) was the governing criteria for this project. Chapter 5 of Volume 2 governs hydraulic analyses.

3.4.1 Model Layout

PCSWMM was used to identify inlets and pipes in the below grade storm sewer system that do not have sufficient capacity. Hydrographs generated in the runoff module were routed through the City's storm sewer system in the hydraulic module of PCSWMM. Surface flooding that cannot be conveyed in the existing system was modeled separately in a FLO-2D hydraulic model.

To determine whether the existing storm sewer system function is limited by pipe capacity or by inlet capacity, the model was set up to use kinematic wave routing. The existing conditions model was run utilizing the kinematic wave computations to quantify split flows that might occur due to lack of inlet capacity.

Using the kinematic wave routing allowed the capacity of both the inlets and pipes to be considered in the model using divider nodes. When the inlets and pipes are considered separately, the analysis results can be used to establish whether the system is limited by inlet capacity or by pipe capacity. This would not have been possible using dynamic wave routing.

For the proposed condition models, dynamic wave routing was used to minimize pipe sizes by accounting for hydrograph routing through the pipe systems. Using this methodology assumes that inlets will be added in a basin to provide full capture of stormwater runoff for the 2-year event. To provide a consistent comparison for inundation mapping, the existing conditions model was revised to be run with the dynamic wave routing. Surface flows that exceeded the system's capacity according to the dynamic wave analysis were then input into the street flooding model (FLO-2D) to delineate the extent of flooding in the Midtown area.

PCSWMM uses a system of links and nodes to represent the physical properties of the system. Links are used for flow conveyance and are connected by nodes. Types of nodes available are junctions, outfalls, dividers, and storage units. All of these types of nodes were used in the kinematic model. Dividers were not used in the dynamic model. Junctions were used for manholes. Outfalls were used at the end of each trunk line and, in the kinematic model, at all locations where overflows exit the Analysis Area. Dividers were used in the kinematic model to incorporate inlet and pipe capacity information and to control how excess flow was routed to other sub-basins. Storage units were used to represent the storage at Via Christi-St. Francis Hospital campus and in the kinematic model to

account for flows that accumulate in sump areas. Sump areas are low places where water will collect if the underground stormwater system (inlets and pipes) cannot carry it away. In these areas there is no above-ground path (e.g., street gutter) for the water to flow out of the sub-basin, so it remains until the peak flow has passed through the underground system and the inlets and pipes again have capacity to accept flow from the sump. Figure 3.1 shows the sub-basins modeled as sumps.

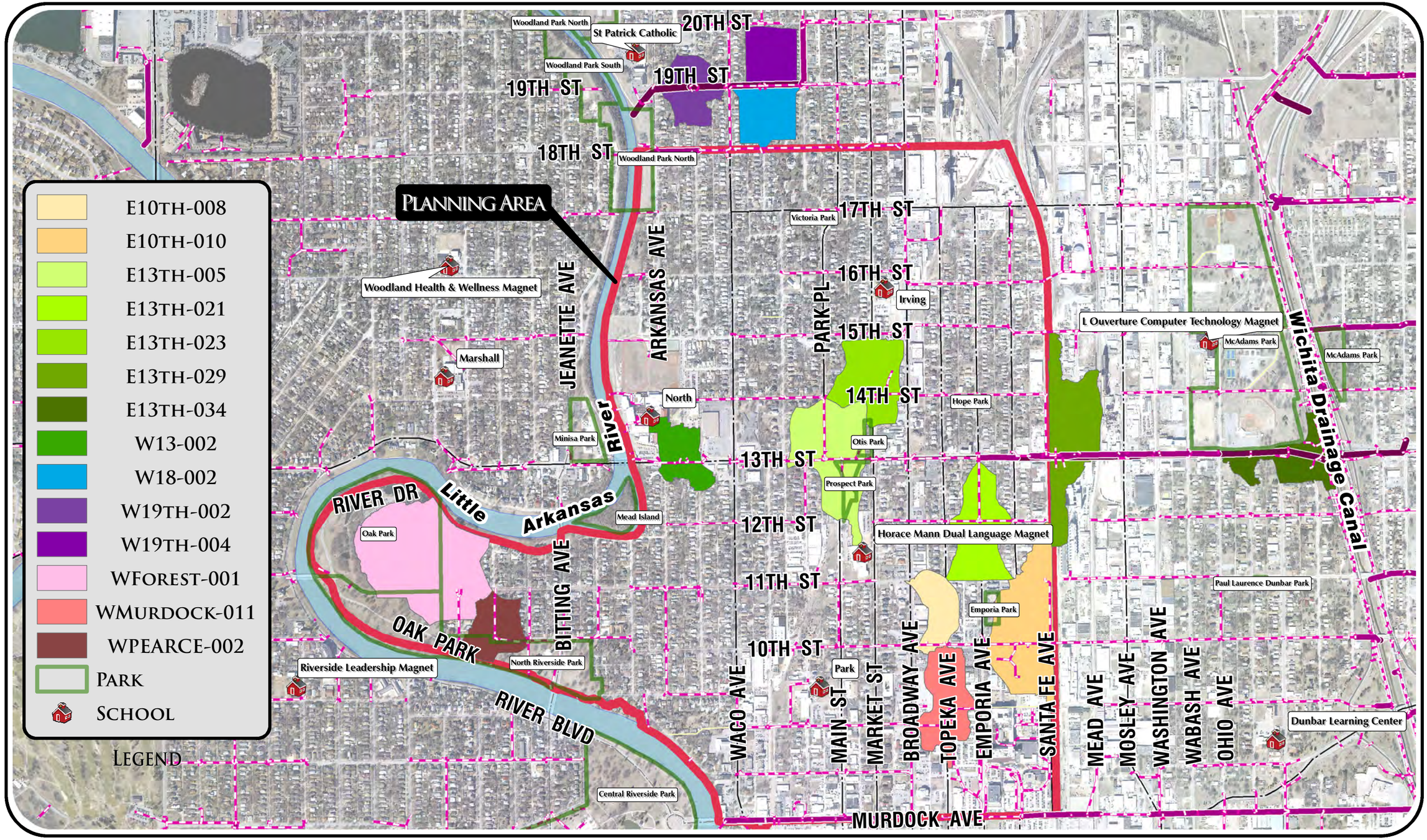
Types of links available in the model are conduits, pumps, orifices, weirs, and outlets. Conduits are the primary means of conveying flow from one node to another. They are used for both closed and open conveyances, and in this project are used for all shapes of pipes, open channels, and street cross sections. Dummy conduits are used in the kinematic model for conveying flow between nodes without any routing properties such as length or roughness that would impact the timing of when the flow reached the downstream node. One of the uses of dummy conduits is to connect inlet and pipe capacity nodes without impacting the timing of the flow hydrograph. Outlet links were used in the kinematic model to simulate the capacity of the inlets in sump areas.

To simplify the model, runoff generated in each sub-basin runoff hydrograph was introduced at a single design point, or node, which represents all inlets in the sub-basin. The lateral conduits upstream of the design points were removed from the model because they would not receive any flow under this configuration.

In the dynamic model, sub-basin flows were routed to the design point node and into the pipe system. The pipe system was made up of conduits and nodes, and terminated at an outfall in either the Wichita Drainage Canal or the Little Arkansas River.

In the kinematic model, most sub-basin representations followed one of two general layouts. The first layout was for sub-basins where runoff that exceeded the inlet or pipe capacity could surface flow into another sub-basin. The second layout was for sump sub-basins. Sub-basins that were directly tributary to an outfall to the Little Arkansas River or to the Wichita Drainage Canal were handled on a case by case basis and did not necessarily fall into one of these two types.

For sub-basins that were not sumps, surface runoff was directed to a divider node representing the capacity of all of the inlets in the sub-basin. The divider node uses a table of inlet capacities in the form total flow versus bypassed flow. The bypassed flow was sent to the next sub-basin through an overflow link, usually representing a street overflow. Intercepted flow was sent through a dummy pipe to another divider node that represented the pipe capacity. The second divider node also functioned as an overflow divider. Any flow that reached the node in excess of the downstream pipe capacity was sent through the diverted link and to an inlet divider node in the receiving sub-basin. A schematic of this set up is provided in Figure 3.2.



Midtown Neighborhood

Stormwater Master Plan

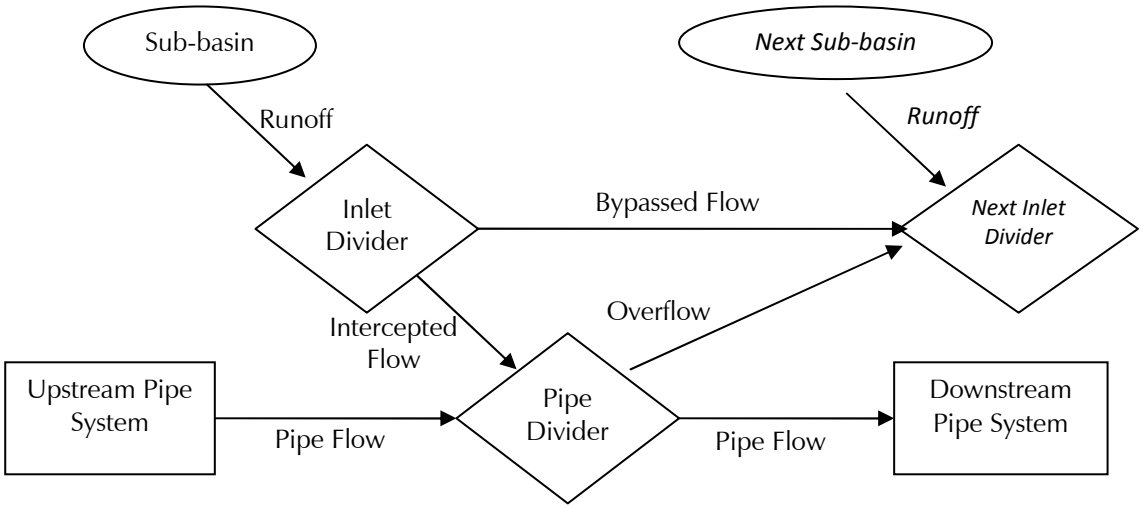
Figure 3.1 - Sump Sub-Basins

North

City of Wichita

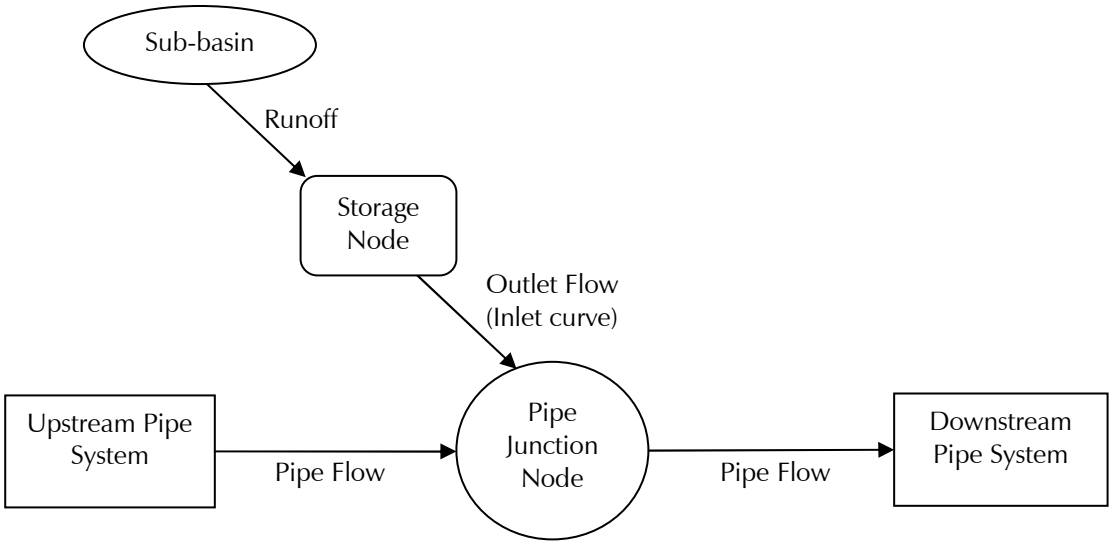
J:\Civil\10544 - Midtown\GIS\Maps\Final Report\Figures\Figure 3.1 - Sump Sub-Basins.mxd

Figure 3.2: Typical Kinematic Sub-basin Routing Schematic



Sump sub-basins were laid out in a similar way, except that excess flow did not leave the sub-basin. Instead of an inlet divider, a storage node was used to represent water stored in the sub-basin until inlet capacity was available to accept flow into the storm sewer system. The storage nodes were set up with a functional curve defining the stage-storage relationship. The curve is set to represent one acre surface area so that for every foot of depth one acre-foot of water is stored. The storage node drains through an outlet link that is controlled by the aggregated inlet curve for the sub-basin and directs flow into the pipe system. A schematic of the routing layout for sump sub-basins is shown in Figure 3.3.

Figure 3.3: Typical Kinematic Sump Sub-basin Routing Schematic



In addition to connecting inlet dividers to pipe dividers, dummy nodes were used in the kinematic model to carry overflows out of the system. In almost all of the locations where a dummy node was used, DUMMY was selected as the shape parameter. PCSWMM does not allow two DUMMY nodes to come out of the same junction, so in places where two dummy links were needed; an approximate dummy was made by using a 10 feet diameter pipe, one foot long, with a roughness coefficient of 0.01.

3.4.2 Model Data

Data provided by the City in the storm conduit and structure GIS databases were the basis for the hydraulic model. This data included information about the structures and conduits in the existing system. Additional model input was created using the provided data and is discussed in this section.

3.4.2.1 Structures and Conduits

The locations and names of each pipe and structure were imported into the PCSWMM model from the GIS database. For the structures, the invert elevations and the depth of each structure were incorporated. The invert elevations were calculated separately in GIS by subtracting the depth of each structure from the rim elevation, both of which were provided in the database. Conduit data imported from GIS were the length, cross section geometry, inlet and outlet node names, pipe material, and Manning's roughness factors. The roughness factors were populated in the database based on Volume 2, Appendix A of the *Stormwater Manual*.

Conduit inverts in PCSWMM are assigned by the model and are equal to the invert elevation of the upstream and downstream structures. The model uses these invert elevations to calculate the conduit slope, which cannot be directly entered into the program.

Invert elevations can be modified if necessary by using inlet and outlet offsets. Inlet and outlet offsets were only added to the model under three conditions. The first condition was if a pipe had an adverse slope. The kinematic wave routing procedure does not allow adverse slopes, so these pipes were assigned inlet offsets to create a positive slope. These offsets were adjusted manually and were increased in 0.1 foot increments until a positive slope was obtained.

The second condition where offsets were used was if the existing pipes looked wrong during a visual check of the trunk line profile. Because the model assigns slopes based on structure elevations, drop inlets are not populated properly. These areas resulted in very large slopes, sometimes in the range of 50%. In areas where this was noted, the outlet offsets were modified to match pipe inverts in the GIS database.

The third condition where invert offsets were used was in the case of surface overflow links. These links represent overflow paths from one sub-basin to another, which occurs when runoff exceeds the pipe or inlet capacity. Offsets were assigned to represent the approximate street slope where the overflow takes place. The inverts of these links are not related to the surface elevations of the streets.

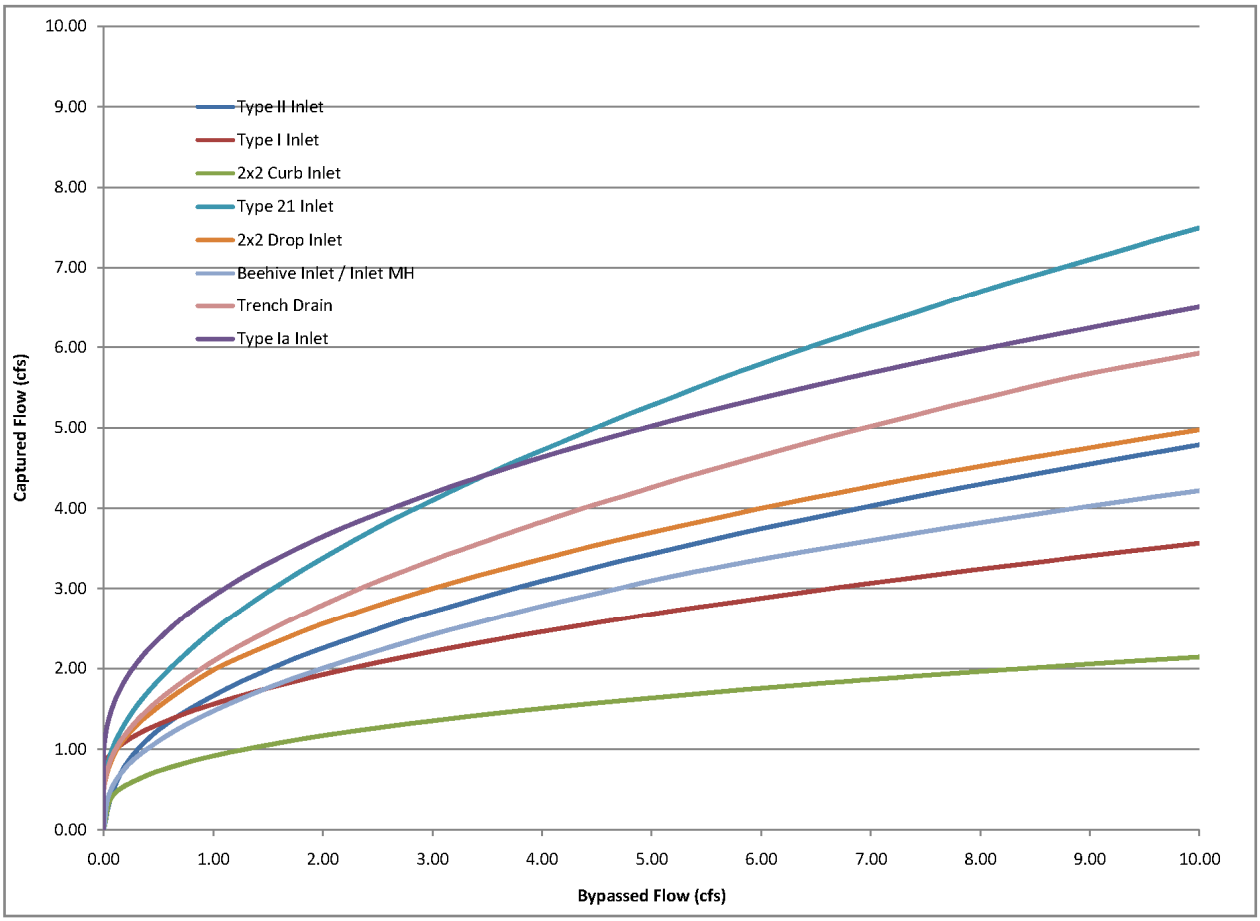
3.4.2.2 Inlet Curves (Kinematic Model Only)

In the kinematic model, flow into the underground storm sewer system was restricted using inlet curves developed from software from the Urban Drainage and Flood Control District. *UD-Inlet* design software version 2.14 (available online at: http://www.udfcd.org) calculates bypassed and captured flow for individual inlet types based on inlet geometry. The software provides curves for both on-grade and sump inlets. For sub-basin inlets located on-grade, a rating curve consisting of

captured versus bypassed flow was developed. For those located in sumps, a rating curve consisting of depth versus captured flow was developed.

On-grade and sump inlet curves were developed for each of the inlet types identified in the City's GIS database for the project area. Ten inlet types were identified; however, the capacity of the Type I inlet and the 2x5 curb inlet were considered similar and described with the same curves. The inlet manhole and the beehive inlet also have similar capacities and share rating curves. The 16 curves developed for the Analysis Area are shown in Figures 3.4 and 3.5.

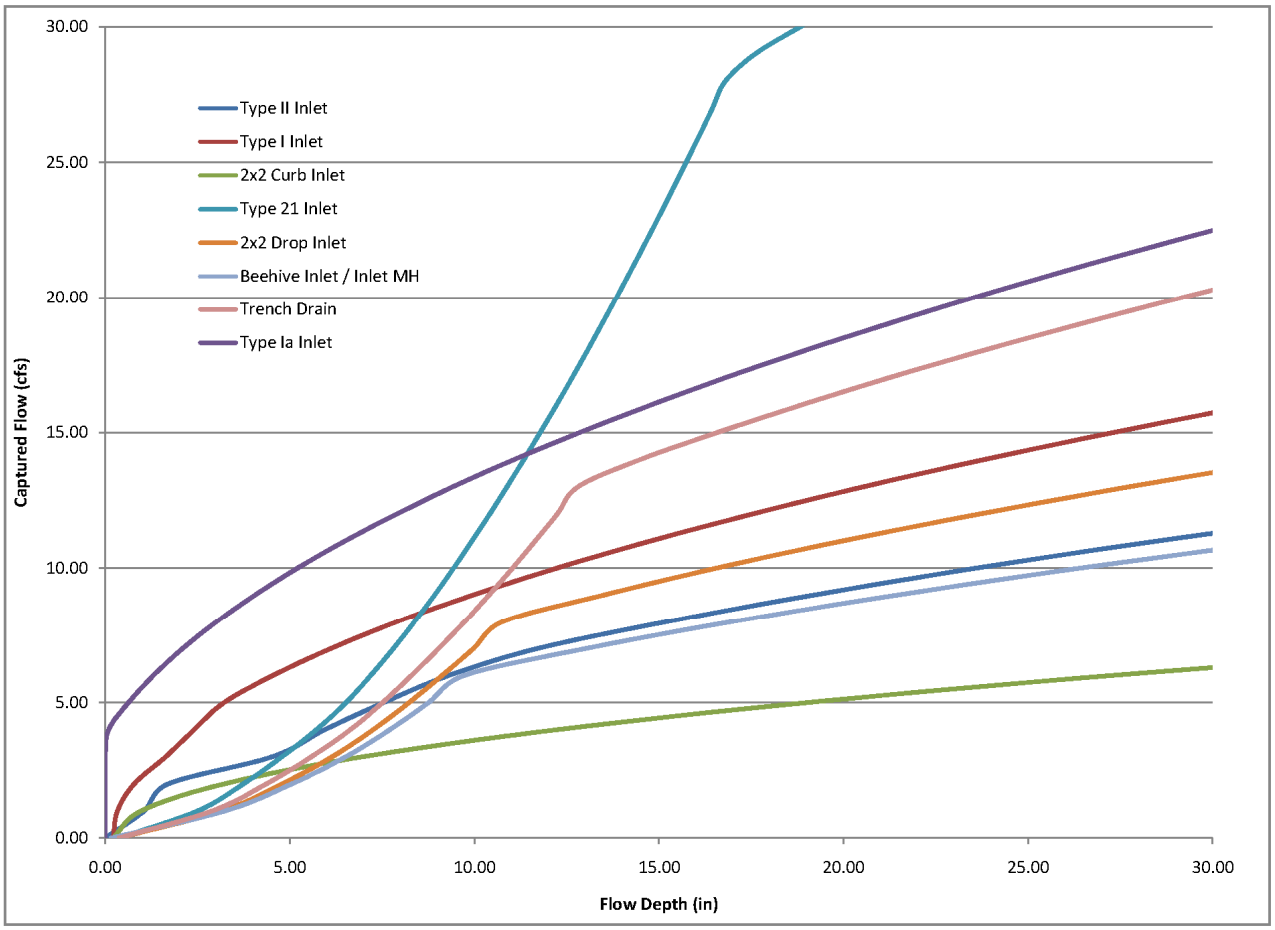
Figure 3.4: On-grade Inlet Capacity Curves



Notes:

1. *On-grade inlets assumed a 0.5% grade. Exact capacity would change with grade, however evaluation at other grades was outside the scope of this analysis.*
2. *All studied inlets were singles.*

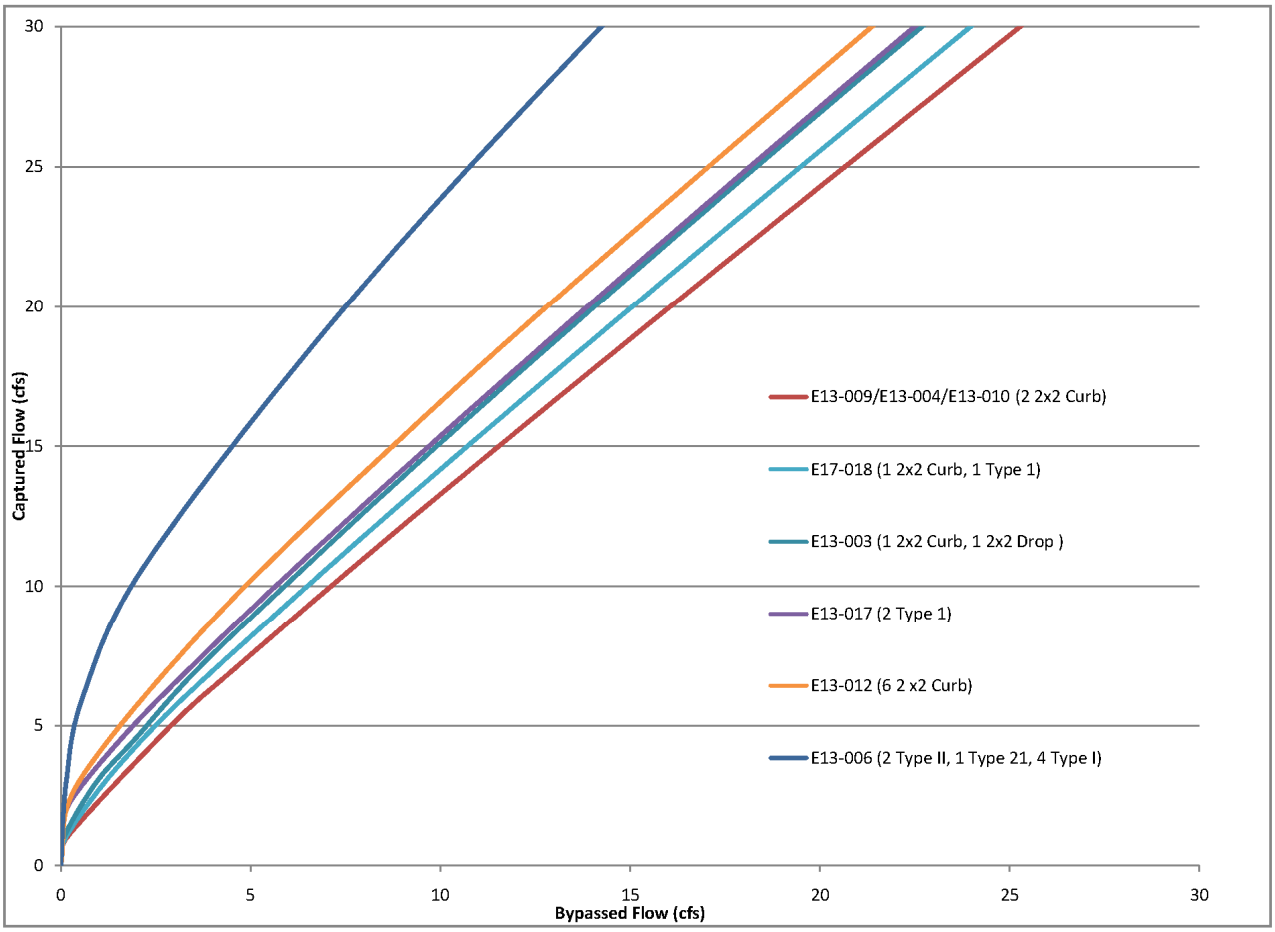
Figure 3.5: Sump Inlet Capacity Curves



Inlets in individual sub-basins were then aggregated to develop an overall rating curve which accounted for the total inlet capacity of the basin. The number of inlets per sub-basin varies, but is generally between 1 and 10. Exceptions to this are in some of the eastern sub-basins outside of the Planning Area but within the Analysis Area which were modeled on a larger scale. Using the East 13th Street Basin as an example, the variability in aggregated inlet curves can be seen. The East 13th Street Basin has a total of 175 inlets distributed through 34 sub-basins. Excluding Basin E13-034, one of the larger scale basins at the eastern edge of the Analysis Area, the average number of inlets per sub-basin is 4.

On-grade rating curves are shown for representative sub-basins in Figure 3.6. This figure shows both small basins with two inlets and larger basins with six and seven inlets. Although there is a general trend toward increasing capacity with increasing inlet number, significant variability is seen between inlet types. Basin E13-006 has the largest number of inlets. It also has more high capacity inlets (two Type II, one 2x5 Drop, four Type I) than the basin with the next highest number of inlets, E13-012 (six 2x2 Curb). The difference in capacity between the two basins is quite large. Curves developed for the smaller basins with two inlets also show variability in capacity related to the type of inlets in the basin.

Figure 3.6: Aggregated On-grade Inlet Rating Curves



3.4.2.3 Street Overflows (Kinematic Model Only)

Street overflows were used to route flows from one sub-basin to the next when the inlet or pipe capacity was exceeded. These overflows were modeled as conduits with the shape of a thirty foot wide street. The street section was assumed to have a 6-inch curb, a 0.02 ft/ft cross slope and bank slope, and a bank-height of 0.75 feet. The slope of these conveyance elements was set by adjusting the inlet and outlet offsets to match the approximate slope of the physical street.

3.4.2.4 Storage

One physical storage location is represented in this model, i.e., the storage below the parking garage at Via Christi-St. Francis. This storage was modeled as a 3-foot deep cylinder with the surface area equal to the parking garage footprint as measured from the aerial photograph. In the kinematic model, if the 3-foot depth was exceeded, the overflows would pass directly to Santa Fe, just east from the parking structure.

3.4.2.5 Outfall Condition

All models include outfall nodes to represent discharge to the Little Arkansas River or to the Wichita Drainage Canal. Kinematic wave models also use outfall nodes to represent runoff flowing out of the

studied basins and flowing into adjacent basins either south of Murdock or east of the Central Railroad Corridor. Tailwater conditions are not considered for the existing conditions kinematic wave analysis, since backwater effects are not calculated by the kinematic wave routing method.

The dynamic wave analysis does account for backwater effects. Selecting the water surface elevation to represent tailwater conditions for different frequency events requires adopting an approach for handling coincidental storms. The standard approach considers two events: 1) the storm that generates runoff to the local storm drain tributary, and 2) the storm that generates flow in the receiving stream.

This analysis views storm sewer system outfalls as small tributaries of large streams; the large streams being the Little Arkansas River and the Wichita Drainage Canal. Under ordinary hydrologic circumstances, floods are neither completely dependent nor completely independent events; the correlation, or degree of dependence, varies. The likelihood that the peak flow from a 100-year storm event would occur at the same time in two adjacent sub-basins in the Planning Area is high; the likelihood that the peak from a 100-year flood on the Little Arkansas River would occur at the same time as the peak from a 100-year flood in one of the Midtown sub-basins, such as the 16th St. West Basin, is much lower. Peak flows from both events are still driven by the weather, but the likelihood that both peaks would coincide, or occur at the same time, is much lower when the difference in basin sizes is great.

The Texas Department of Transportation (TxDOT) *Hydraulic Design Manual* suggests an approach that selects coincidental (coinciding) storm frequencies for design based on the ratio of the receiving stream's basin area to the tributary stream's basin area. Chapter 5, Section 3 of the *Hydraulic Design Manual* includes a table of recommended combinations for analysis, based on the ratio of the tributary and main stream basin areas as well as the stipulated design frequency.

For the *Midtown Neighborhood Stormwater Master Plan*, the following were applied:

- The Wichita Drainage Canal has an approximate basin area near Midtown of about 30 square miles. The Planning Area's sub-basins that discharge to the Wichita Drainage Canal are relatively large (200 acres or 0.3 square miles) so the basin area ratio (in order-of-magnitude) is between 10:1 and 100:1. Frequency selection from the TxDOT table assumes the more conservative basin area ratio of 10:1
- The Little Arkansas River basin area near Midtown is about 1,000 sq. mi. The Planning Area's sub-basins that discharge to Little Arkansas River are relatively small (0.1 square miles), so the basin area ratio (in order-of-magnitude) is approximately 10,000:1

Based on these criteria, the *Hydraulic Design Manual* recommends using the combinations of mainstream/tributary storm frequencies for design as presented in Table 3.4 as follows.

Table 3.4: Storm Frequency Combinations

Storm Frequency for Design	Little Arkansas River (10,000:1) Storm Frequency	Wichita Drainage Canal (10:1) Storm Frequency
2-year	1-year	2-year
5-year	1-year	5-year
10-year	1-year	10-year
25-year	2-year	10-year
100-year	2-year	50-year

Source: http://onlinemanuals.txdot.gov/txdotmanuals/hyd/design_frequency.htm

The *Hydraulic Design Manual* also recommends evaluating two cases for each storm frequency design – one in which the major flooding occurs on the receiving stream and one in which the major flood occurs on the tributary.

For example, the 100-year flood for basins discharging to the Little Arkansas River (receiving stream) would evaluate the 100-year tributary flood with the 2-year receiving stream tailwater elevation, as well as the 2-year tributary flood with the 100-year receiving stream tailwater elevation, and base design on the most severe case.

Computer analyses for this Plan evaluate only the first of these cases, i.e., where the major flood occurs in the tributary basin. Potential effects from major flooding on the receiving streams were evaluated graphically. Tailwater from the 100-year flood is expected to fill all conduits in the local storm drain system. Consequently, the local drainage system would be practically ineffective until flooding in the Little Arkansas River and the Wichita Drainage Canal has passed, and tailwater elevations fall.

Sources for frequency-based water surface elevations on the receiving streams are limited. The following conditions for the PCSWMM dynamic wave modeling were established during discussions with City Staff:

For 2-year and 5-year events:

- For the Wichita Drainage Canal outfall nodes, use "free discharge," i.e., the situation where the tailwater elevation is lower than the outfall flow line elevation. The tailwater elevation value is zero
- Develop the water surface elevation from LIDAR for outfalls to the Little Arkansas River. For 2-year and 5-year events, the tailwater elevation for outfall nodes upstream of the 11th St Bridge is 1297; downstream of the bridge, the tailwater elevation for all outfall nodes is 1296

For 10-year through 100-year events,

- Tailwater elevations in the Little Arkansas River are from preliminary models being developed for a FEMA map change, provided by AMEC at the City's direction
- Tailwater elevations in the Wichita Drainage Canal are from models developed by MKEC and submitted to FEMA to support a Letter of Map Change

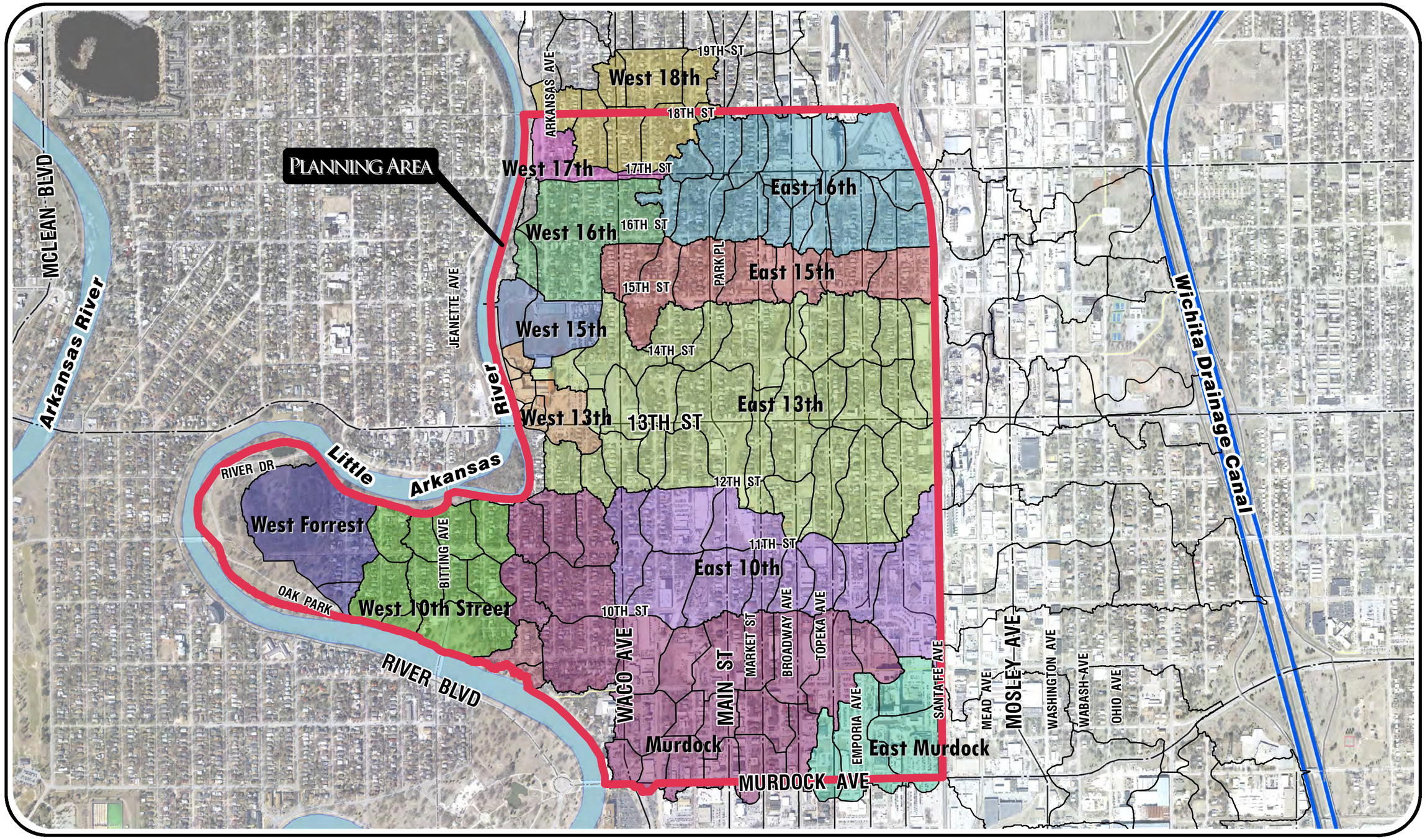
All analyses that use kinematic wave routing show a tailwater elevation in the input file. However, since the kinematic wave method does not account for tailwater, the calculations do not consider these values, i.e., they are ignored whether present or not.

3.5 PCSWMM Existing Conveyance Conditions Results

Kinematic model results show where the existing system has limited capacity. These results were correlated to areas of flooding identified by community members during the neighborhood meeting on December 16, 2010.

3.5.1 West Basin Existing System Capacity

The West Basin System consists of eleven basins that discharge to the Little Arkansas River. The modeling results for each basin are discussed in this section, generally from north to south. See Figure 3.7.



MIDTOWN NEIGHBORHOOD

STORMWATER MASTER PLAN

FIGURE 3.7 - EXISTING BASINS MAP

NORTH

CITY OF WICHITA

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3.5.1.1 West 19th Basin

The West 19th Basin is located at the north end of the West Basin System and is outside the Planning Area but within the Analysis Area. It was included in this analysis because any stormwater flow that bypasses the collection system in this basin will surface flow into the West 18th and East 16th Basins. This basin has 17 sub-basins. The main trunk line in this basin is made up of circular reinforced concrete pipe (RCP) and increases in size from 4.5 feet to 5.5 feet in diameter. There are three major laterals in this system that range in size from 1 foot to 3 feet in diameter.

Inlets serving the Waco lateral are inadequate, so that the pipes in Waco north of 19th Street never flow full. Flooding along the Wellington lateral begins in the 2-year storm due to inlet restrictions. The area downstream from 19th and Waco (where these laterals combine) begins to flood in the 5-year storm, primarily due to undersized pipes.

3.5.1.2 West 18th Basin

The West 18th Basin is made up of eight sub-basins. The main trunk line is reinforced concrete pipe with diameters of 3.25 and 3.5 feet. There are two laterals east of Waco Street, one in 18th Street and one in Waco and 19th Street. The 18th Street lateral is limited by inlet capacity during all of the smaller storms but reaches pipe capacity during the 100-year storm. The 19th Street lateral experiences some flooding during minor storms and the pipes reach capacity during a 10-year storm. The trunk line is limited by inlet capacity during all storms. The most upstream segment of the trunk at Waco reaches capacity during a 5-year storm, but the rest of the line was not fully utilized during this analysis.

3.5.1.3 West 17th Basin

One sub-basin exists in the West 17th Basin; it is a single area that drains to the Little Arkansas River through a 1.25 foot diameter vitrified clay pipe (VCP) culvert. The capacity of the inlet is exceeded in the 2-year storm and the capacity of the pipe is exceeded in the 5-year storm. Stormwater flows leaving this basin enter the W16th Basin and overwhelm the inlets in that basin.

3.5.1.4 West 16th Basin

Three sub-basins make up the West 16th Basin. Two are drained by a 2 foot diameter reinforced concrete stormwater and the third is a sump with no outlet. The inlet capacity and the capacity of the upper section of the trunk line are exceeded in the 2-year storm. The capacity of the lower part of the trunk line is not exceeded in any of the storms considered in this analysis.

Peak runoff volume in the sump sub-basin (W16-003) is approximately 0.6 acre-feet.

3.5.1.5 West 15th Basin

The West 15th Basin contains two sub-basins that are drained by a 1.5 foot diameter reinforced concrete pipe. Both inlet capacity and pipe capacity are exceeded during the 2-year design storm.

3.5.1.6 West 13th Basin

The West 13th Basin has four sub-basins that are drained by individual culverts directly to the Little Arkansas River and three sub-basins that drain to the river through a trunk line. The trunk line is in 13th Street and is 1.5 foot and 2.5 foot diameter reinforced concrete pipe. The capacity of the 1.5-

foot diameter pipe is exceeded during the 2-year storm. The capacity of the 2-foot diameter pipes was not exceeded in this analysis.

The other four sub-basins drain portions of the North High School site. Sub-basin W13-004 is the northwest portion of the high school. It drains to a 1.25-foot diameter reinforced concrete pipe storm sewer. The capacity of the inlets and the outlet pipe of this sub-basin are exceeded during the 2-year design storm.

The next sub-basin to the south is W13-005, which drains to a 1.25 foot pipe. Sub-basin W13-006 drains the southwest portion of the high school buildings. It is drained by a storm sewer system that ends in a 2-foot diameter reinforced concrete pipe. Sub-basin W13-007 drains the northwest portion of the school parking lot to the river through a 1.25-foot diameter pipe. The pipe capacities for these areas are not exceeded during any of the storms.

3.5.1.7 West Forrest Basin

The West Forrest Basin is located within the bend of the Little Arkansas River. It is made up of two sub-basins and is drained by a 1.25-foot diameter vitrified clay pipe trunk line. The upper sub-basin is approximately 60% open space and 40% residential. Inlet and pipe capacity are exceeded in this basin during the 2-year storm, and street flooding is expected at the upstream sump.

3.5.1.8 West Pearce Basin

The storm sewer system in the West Pearce Basin is made up of a vitrified clay pipe lateral that drains to a reinforced concrete pipe main trunk line. The VCP ranges from 0.83 feet to 1 foot in diameter. Most of these pipes reach capacity during the 2-year storm, and by the 5-year storm all of the pipes are full. The RCP trunk line is 3-feet in diameter and receives flow from the pipe system in the West 10th Basin in addition to the flow from the lateral in this basin. The 3-foot pipe section did not reach full flow in this analysis.

3.5.1.9 West 10th Basin

Eight sub-basins make up the West 10th Basin. These sub-basins are drained through a 1.5 and 2 foot diameter reinforced concrete pipe trunk line. Three laterals in the basin are made up of smaller diameter vitrified clay pipe. The capacity of all the lateral pipes is exceed during the 2-year design storm and street flooding is expected. The 1.5-foot diameter sections of the trunk line reach capacity during the 2-year storm, but the capacity of the steeper 2-foot diameter pipe was not exceeded in this analysis.

3.5.1.10West Back Bay Basin

The West Back Bay Basin contains two sub-basins drained by an open channel. This analysis showed that the channel had capacity for all of the flows it received, but the capacity of the curb inlets in the upper sub-basin was exceeded in the 2-year storm and limited inflow to the channel in the model. If the overflows from the inlets make it to the channel it may become capacity limited, however in this model the overflows were allowed to leave the system.

3.5.1.11West Murdock Basin

The West Murdock Basin is made up of 22 sub-basins. The trunk line in Murdock is reinforced concrete box and is primarily 4 feet high by 6 feet wide; with a smaller upstream section that is 3 feet

high by 6 feet wide. The trunk line in Broadway is brick arch pipe two and three feet high. The three laterals in the system are made up of primarily 1 foot to 1.75 foot diameter vitrified clay pipe.

The 8th Street, 9th Street, and Broadway laterals all reach full pipe capacity during the 2-year storm with flooding expected in some areas. Most of the pipes in the trunk line are full during the 2-year storm as well, with overflows leaving the Planning Area and flowing to the south.

3.5.2 East Basin Existing System Capacity

The East Basin System is made up of five major drainage basins that outfall to the Wichita Drainage Canal. Each basin is made up of a western portion in the Planning Area, and an eastern portion that contains the trunk line of the storm sewer system between Santa Fe Avenue and the Wichita Drainage Canal. The results of each basin are discussed in this section, from north to south. See Figure 3.7.

3.5.2.1 East 16th Basin

This Basin is made up of twenty sub-basins, four of which are east of the Planning Area. The main trunk line in 16th Street is 2 to 3 feet high and is made up of a combination of brick arch pipe and circular vitrified clay and reinforced concrete pipe. Three main laterals range in diameter from 0.5 to 2 feet. The laterals are primarily vitrified clay pipe with some section of reinforced concrete. The capacities of the 16th Street and St. Francis laterals are exceeded during the 2-year storm and the rest of the system capacity was exceeded during the 5-year storm.

3.5.2.2 East 15th Basin

The East 15th Basin contains ten sub-basins, seven in the Planning Area and three east of it. The storm sewer system is generally only in 15th Street, although there are some very small laterals that were not included in this model. The pipe in the Midtown Neighborhood is vitrified clay and ranges from 10-inches to 27-inches in diameter. The portion of the system east of Midtown is primarily vitrified clay and reinforced concrete pipe 2-feet in diameter and brick arch pipe 2.5-feet high. There are also sections of ductile iron pipe and concrete box pipe identified in the lower portion of the basin.

Overall the system capacity is exceeded during a 2-year storm. The area between Broadway and Mosley does not reach full capacity, but both upstream and downstream capacities are met. The area that does not reach capacity is circular pipe 21- to 24-inches in diameter. Upstream of this area is smaller diameter pipe and downstream of this area is brick arch pipe.

3.5.2.3 East 13th Basin

The East 13th Basin contains 28 sub-basins in the Planning Area and six sub-basins between Santa Fe and the Wichita Drainage Canal. The storm sewer system contains a trunk line in 13th Street and four main laterals; two in 14th Street and two in 12th Street. The trunk line is made up of a variety of pipe sizes, shapes, and materials. From Waco to Park Place, the line is circular reinforced concrete pipe 1.5 to 2 feet in diameter. Between Park Place and Otis, it is brick arch pipe 2 to 2.5 feet high. Next the line contains a segment of circular pipe, followed by elliptical reinforced concrete pipe between Market and St. Francis. From St. Francis to Ohio the line splits into parallel lines. The north segment is brick arch pipe 3 to 4 feet high and the south segment is reinforced concrete pipe 4 to 4.5 feet in diameter. In the area of Santa Fe the system has three parallel lines. Both of the laterals in 14th Street and the western lateral in 12th Street are primarily made up of vitrified clay pipe. The eastern lateral in 12th Street is a combination of vitrified clay, PVC, and reinforced concrete.

All four of the laterals reach capacity during the 2-year storm. The portion of the trunk line between Waco and St. Francis reaches capacity using the 2-year storm. The parallel system between St. Francis and the Wichita Drainage Canal becomes mostly full during the 5-year storm and its capacity is exceed during the 10-year storm.

3.5.2.4 East 10th Basin

The East 10th Basin contains 14 sub-basins, ten in the Planning Area and four east of Santa Fe. Between Broadway and New York streets the trunk line is primarily brick arch pipe with a height ranging from 2 to 3 feet, with a few sections of reinforced concrete pipe From New York to the outfall the system is circular and elliptical reinforced concrete pipe 4 and 5 feet high. Lateral pipes are vitrified clay and corrugated metal.

During the 2-year storm the East 10th Basin is essentially over capacity. The area between Santa Fe and Ohio does not reach capacity in the model because all of the flows in this area are applied at Ohio, but it is expected that this area would be flowing full during the 2-year storm as well. More detailed modeling was not performed in this area because it is outside the Planning Area.

3.5.2.5 East Murdock Basin

Most of the East Murdock Basin is located outside the Planning Area. Four of the ten sub-basins are located within the Neighborhood, including EMurdock-003 which contains Via Christi-St. Francis Hospital. This basin contains one trunk line and no major laterals. Within the basin and extending to Mead, the line is reinforced concrete pipe between 2 and 4 feet in diameter. Beyond this section, the system is rectangular concrete box 3 to 4 feet high and 6 to 7 feet wide. The remainder of the system is 4 foot high brick arch pipe with the exception of the very last pipe segment which is another concrete box. The arch section of the pipe is offset approximately two feet above the box pipe upstream of it and is not able to effectively convey flow between the Planning Area and the Wichita Drainage Canal. The capacity of the storm sewer system is exceeded during the 2-year storm.

The stormwater storage under the parking garage at Via Christi-St. Francis was modeled with a maximum capacity of 3.68 acre-feet at a depth of 3 feet. This capacity was not exceeded in any of the storms that were modeled.

3.5.3 Use of PCSWMM Results for FLO-2D Model

The Analysis Area was limited for the FLO-2D runs to incorporate only areas within the Midtown Basin. The Analysis Area was limited to the area bordered by the Little Arkansas River to the west, West Murdock to the South, the Burlington Northern and Santa Fe Railway to the East and West 22nd Street to the North. The total area of the model domain is approximately 1,282 acres.

The selection of a grid cell size for the model affects both the accuracy of the ultimate floodplain delineations and the model runtime. Selection of the grid cell size is a balancing act between floodplain accuracy and model run times. The FLO-2D manual recommends that the peak discharge (Q_{peak}) divided by the surface area of the grid element (A_{surf}) should be in the following range:

$$0.1 \text{ cfs/ft}^2 < Q_{peak}/A_{surf} < 1.0 \text{ cfs/ft}^2$$

Resolution of the floodplain delineation was also identified as an important requirement of the FLO-2D model runs.

A grid consisting of 16 foot by 16 foot cells was overlaid on the two-foot LIDAR data for the Analysis Area. This grid size was selected for two specific reasons. First, the City seeks a model that accurately represents the area's flat terrain and topographic nuances, including sumps, curbs and roadway crowns. Roads in the basins are typically 30 – 32 feet in width. The 16-foot cell dimension allowed 2 – 3 cells to define the roadway conveyance, depending on location. In many cases this arrangement captures gutter flow lines and the street crown. The second reason for selecting this cell size included following the recommendation in the FLO-2D literature, which optimizes model run times. When the grid is developed with a 16'x16' cell size, the model has over 218,108 cells. With this level of resolution the model run time is approximately 16 hours. Refining the model and identifying key output parameters further reduced the model run time to approximately 7 hours.

Manning's "N" values for the grid cells were set using land use data was provided by the City of Wichita. This land use data was aggregated into seven categories for the hydrologic evaluation as presented in Table 3.3. This formed the basis for assigning Manning's "N" values. However, there were some notable changes made to the categories originally defined. The first was to combine the land use for single family/duplex, and multifamily into one "residential" category. This category captures the tree cover, lawns, vehicles, fences and buildings and other flow obstructions associated with residential structures. The second change was to combine the commercial and office land use categories into one "commercial" category to capture the pavement and parking lots, landscaping, vehicles, light posts and fences and other flow obstructions typically associated with commercial properties. The final change was to create several new land use categories, further breaking down park/open space land use category. A review of the aerial photography for the City of Wichita revealed several different vegetative covers on open space lands. There are areas of manicured blue grass lawns with sparse tree cover, heavy tree and brush cover and natural areas, and areas with open water. The park/open space land use category was broken into three new categories:

- Lawns, parks, open space with sparse trees and shrubs
- Dense Brush, Trees, Natural Areas
- Water

The revised land use categories for the purpose of the FLO-2D Hydraulic Modeling can be found in Table 3.5 below.

Table 3.5: Revised Land Use Categories for FLO-2D Hydraulic Modeling

Hydrologic Land Use Category (Table 3.3)	Hydraulic Land Use Category
Roads	Concrete/Asphalt
Single Family/Duplex	Residential (Includes structures, fences, cars and vegetation)
Multi-Family	Residential (Includes structures, fences, cars and vegetation)
Commercial	Commercial (Includes parking lots , vegetation and cars)
Office	Commercial (Includes parking lots , vegetation and cars)
Industrial	Industrial
Park/Open Space	Lawns, parks, open space with sparse trees and shrubs Dense Brush, Trees, Natural Areas Open Water

The land use categories defined in Table 3.3 from the hydrologic analysis are appropriate for calculating run-off from a hydrologic sub-basin. By modifying the land use categories for the FLO-2D model, the project team provided a Manning's "N" value raster that better reflected the differing hydraulic flow conditions throughout the basin.

Manning's "N" values were assigned to the refined land use categories as defined in Table 3.5 based on recommendations found in the FLO-2D manual and through a literature search to obtain regionally appropriate values. The results of the search are presented in Table 3.6.

Table 3.6: Manning's "N" Values from Literature

Land Use or Cover	FLO-2D Users Manual		USGS 2-D Blue River Model, between 63rd street and Blue Parkway Missouri		USGS 2-D Blue River Model, between Hickman Mills Drive and 63rd Street Missouri		USGS Water Resources Investigations Report 01-4176 2-D model of the Mississippi River and Horse Island Chute	
	Low	High	Low	High	Low	High	Low	High
Open Water								
Main Channel			0.025	0.04	0.025	0.04	0.025	0.031
Riprap - Lined Channel					0.03	0.045		
Spur Dikes							0.05	0.5
Thick Brush and Timber Banks			0.08	0.11	0.08	0.11	0.16	0.22
Thick timber corridor with thick sprouts			0.092	0.125	0.11	0.125	0.075	0.12
Thick grasses and scattered sprouts			0.04	0.055	0.045	0.055	0.045	0.055
Industrial			0.033	0.05	0.033	0.05	0.045	0.055
Concrete or Asphalt	0.02	0.05	0.025	0.027	0.025	0.027	0.04	0.045
Residential			0.032	0.038	0.04	0.055		
Commercial			0.04	0.15	0.08	0.15		
Sand and gravel stockpile			0.03	0.032				
Brush	0.3	0.4					0.13	0.17
Row Crop	0.08	0.12					0.065	0.1
Grass Urban and Maintained	0.04	0.1						

Literature review sources are listed in the References section at the end of the *Stormwater Plan*.

Manning's "N" values were assigned to the land use categories defined in Table 3.5 based on the literature review, field observations and engineering judgment. The resulting values based on the land use categories that were utilized in the FLO-2D model are defined in Table 3.7.

Table 3.7: Manning's "N" Values for FLO-2D Model

Land Use or Cover	Manning's "N" Value
Open Water	0.011
Concrete or Asphalt	0.020
Industrial	0.100
Commercial (Includes parking lots , vegetation and cars)	0.130
Residential Area (Includes structures, fences, cars and vegetation)	0.200
Lawns, parks, open space with sparse trees and shrubs	0.090
Dense Brush, Trees, Natural Areas	0.110
Notes:	

As outlined previously, each sub-basin contained sump storage nodes where water could be stored. The PCSMM storage model elements were used to identify when water exceeded the capacity of the existing and proposed storm sewer systems bypassing flow to the streets in the PCSWMM model. Hydrographs from the PCSWMM Sump nodes were loaded into the FLO-2D grid at the locations of the flooding inlets. These hydrographs were then used to determine the extents of flooding in the Planning Area and the routing of the floodwaters between storm sewer systems.

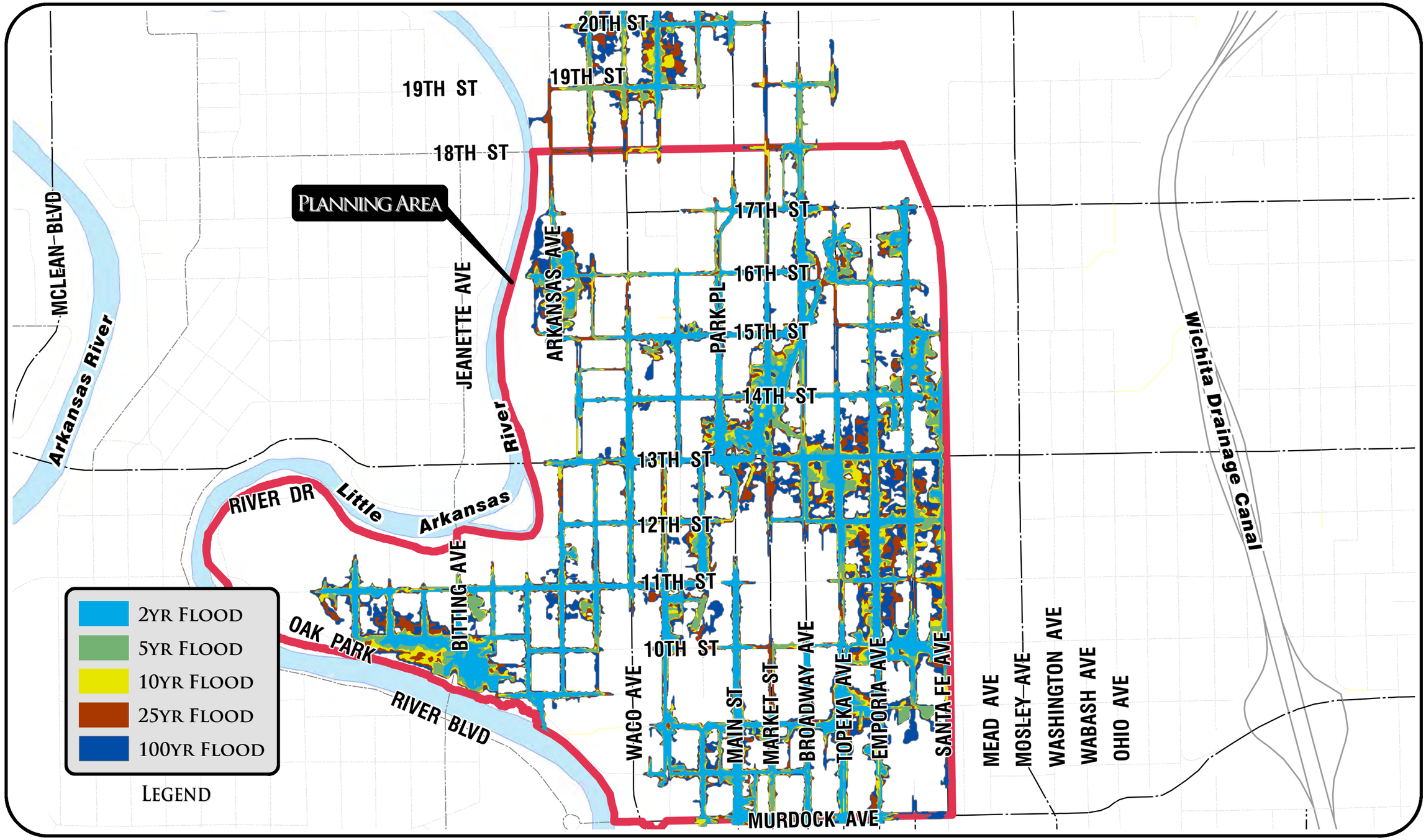
These hydrographs were applied at the location of each flooding inlet to better replicate the flooding characteristics of the Planning Area. The above procedure was replicated for each proposed alternative as well as the existing conditions to determine both the locations and extent of the existing flooding and the reduction of flooding achieved by the proposed storm sewer system improvements. Figure 3.8 shows the flooding extents for existing conditions indicated by the FLO-2D models of the 2-year through 100-year events.

3.5.4 Community Identified Flooding Areas

The results from the preliminary flooding analysis were shared at the community meeting on December 16th, 2010. At that time, problem areas were also identified by community members.

The majority of the flooding issues brought forward by the community members were in two specific areas. The first area is located in the center of the neighborhood and is bounded by 16th Street, Market, 13th Street, and Fairview. The second area includes the Via Christi – St. Francis Hospital campus and is bounded by 12th Street, Emporia, 9th Street, and Topeka. It was noted that these two specific areas correspond closely to a number of sub-basins that had been identified as sump sub-basins in development of the PCSWMM model.

These community identified problem areas were mapped in GIS on top of the FLO-2D preliminary floodplains derived from the PCSWMM models. Overall the models correctly captured the problem flooding areas providing evidence and corroboration that the models were correctly calculating both the quantity of flood waters as well as the location of the flooding problems on the ground.



MIDTOWN NEIGHBORHOOD

STORMWATER MASTER PLAN

FIGURE 3.8 - CURRENT FLOODING EXTENTS

NORTH

CITY OF WICHITA

J:\Civil\105444 - Midtown\GIS\Maps\Final Report\Figures\Figure 3.8 - Current Flooding Extents.mxd

3.6 Geodatabase Integration

A geodatabase was generated using ArcGIS 10 from Environmental Systems Research Institute (ESRI). The database captures the data used in analyses, and documents the details assumed for current conditions in the planning process. This is a spatial database designed to store, query, and manipulate geographic information and spatial data; it provides ready access to analysis results for all scenarios. The data includes, but is not limited to:

- Base map information, including aerial imagery, streets, data from the City's GIS representation of the existing system, ground surface elevations from LIDAR received from the City, and the like that were used to develop figures and maps for the *Stormwater Master Plan*
- Sub-basin hydrologic characteristics – boundaries, current zoning and land use, runoff characteristics
- Sub-basin hydraulic characteristics – aggregated inlet capacity tables; detention facility characteristics; assumed overland flow connections between sub-basin
- Conduit characteristics – material, shape, roughness, dimensions, lengths, slopes, invert elevations, tailwater conditions
- Results from PCSWMM analyses and inundation maps from FLO-2D analyses. This includes map data that show inundated areas (and inundation depth) expected from the 2, 5, 10, 25, and 100 year storm events for existing and proposed conditions

To provide a reasonable starting point for analyzing system modifications, the existing conditions model presumes that anticipated system maintenance to reconstruct several lengths of collapsed small diameter pipe is complete.

The geodatabase provides the data in a format compatible with the City's GIS structure, so that the background assumptions for planning and model results can be incorporated into the City's system for access if desired. As plan implementation proceeds and sub-basin characteristics or other physical conditions change, the City can access, modify, and update the data, and revise models as needed to review, verify, and assess program progress or evaluate new plan alternatives if desired.

3.7 Stormwater Quality Analysis

Stormwater quality modeling uses the hydrographs from the water quantity modeling for select design storm events as the vehicle for pollutant transport, so the stormwater quality analysis is completely integrated with the water quantity analysis. The analysis uses the stormwater quality modeling component of PCSWMM to estimate pollutant loadings in the basin.

3.7.1 Modeled Pollutants

In cooperation with City staff, six pollutants were selected for modeling (Table 3.8). The pollutants were selected from those currently regulated in the City's National Pollutant Discharge Elimination System (NPDES) Municipal Separate Storm Sewer Systems (MS4) permit. A portion of the Planning Area drains to the Little Arkansas River, which currently is listed for nutrients, biochemical oxygen demand (BOD), bacteria, and sediment impairments. The Clean Water Act requires that Total Maximum Daily Loads (TMDLs) be established when receiving stream impairment has been determined. Three metals are listed as Principle Pollutants of Concern (PPOC) for the City of Wichita. PPOCs are typically selected because the monitoring process has occasionally measured high values.

Due to the growth and decay variables associated with BOD and bacteria, these parameters were not suitable to be modeled within this scope.

Table 3.8: Modeled Pollutants

Pollutant	Regulated As
Total Suspended Solids (TSS)	TMDL
Total Nitrogen (TN)	TMDL
Total Phosphorus (TP)	TMDL
Cadmium	PPOC
Copper	PPOC
Zinc	PPOC

3.7.2 Rainfall Conditions

The stormwater quality rainfall depth associated with an 85th percentile storm (1.2 inches for Sedgwick County) was used for the stormwater quality modeling. The NRCS 24-hour, Type 2 rainfall distribution was applied with a time step of 5 minutes for consistency with the water quantity model.

3.7.3 Land Use

Five major land use types were identified in the Planning Area: residential, commercial, industrial, streets, and open space. The City's zoning maps were used to calculate the percentage of each sub-basin occupied by each land use type. The Residential category includes properties zoned for both single family/duplex and multi-family use. The Commercial category includes both office and commercial zoning. Right of way areas were considered to be roads. Areas outside the right of way without zoning information were assigned to the adjacent land use. This methodology was also used in the development of the water quantity model.

3.7.4 Statistical Analysis of Local Data

The City of Wichita provided a wet weather database of first flush (initial runoff) stormwater quality samples collected at eight monitoring sites over a 13 year period of record from 1998 to 2010. Drainage boundaries for sampling locations within the database were also provided. The City sampling data and maps can be found in Appendix H. A review of this data identified eight sites with watershed land uses similar to those found in the Planning Area. Table 3.9 lists these sites and their land uses.

Table 3.9: Local Sample Sites with Similar Land Uses

Site	Land Use	Period of Record	Samples	Receiving Stream
Towne East	Commercial	1998-2010	44	Gympsum Creek
Broadway	Commercial/Residential	1998-2010	46	Arkansas
CC Maple	Commercial/Residential	2009-2010	5	Cowskin Creek
LA 21st	Commercial/Residential	2009-2010	5	Little Arkansas
McLean	Industrial	1998-2010	46	Arkansas
CC Harvest Ln	Residential	2009-2010	5	Cowskin Creek
Huntington	Residential	1998-2010	44	Gypsum Creek
LA 13th	Residential	2009-2010	6	Little Arkansas

Data collected at local sites was pooled based on land use. Median values for each pollutant were calculated to determine the typical first flush concentrations expected for the land uses in the "Analysis" Area. These typical first flush concentrations were converted to Event Mean Concentrations that represent the average concentrations for the land uses throughout a storm event. This average Event Mean Concentration value was used to generate loads within the PCSWMM model.

The National Stormwater Quality Database, Version 1.1 was used to develop Event Mean Concentrations based on the local first-flush data. The Database provides ratios developed from over 400 paired samples of first flush samples and composite Event Mean Concentration samples. If sufficient data was available, the local first-flush values were converted to Event Mean Concentrations using the ratios in the Database. Otherwise, the Event Mean Concentration is taken from national average values.

3.7.5 Event Mean Concentrations

Event Mean Concentration values vary with land use and pollutant. Each pollutant has five Event Mean Concentration values in the model, one for each land use. Model input values are highlighted in Tables 3.10 and 3.11. As described above, this table was developed using local data when possible. Local data for cadmium, nitrogen, and phosphorus did not have adequate sample numbers to develop Event Mean Concentration values. Local data was also unavailable for roads and park/open space.

To supplement local values, national data available from the National Stormwater Quality Database, Version 1.1 was used.

Table 3.10: Event Mean Concentration Values for Metals
(Values selected for use in the model are highlighted.)

	Cadmium Total (ug/L)		Copper Total (ug/L)		Zinc Total (ug/L)	
	*Wichita**	*National***	*Wichita**	*National***	*Wichita**	*National***
Commercial	N/A	0.89	8.09	17.00	48.19	150.00
Industrial	N/A	2.00	22.74	22.00	92.21	210.00
Residential	N/A	0.50	8.98	12.00	74.05	73.00
Roads	N/A	1.00	N/A	34.70	N/A	200.00
Parks/Open Space	N/A	0.38	N/A	10.00	N/A	40.00

** Median value of local data converted to Event Mean Concentration*

*** Event Mean Concentration from National Stormwater Quality Database*

Table 3.11: Event Mean Concentration Values for Nutrients and Sediment.
Values selected for use in the model are highlighted

	TSS (mg/L)		Phosphorus Total (mg/L)		Nitrogen Total (mg/L)	
	Wichita	*National*	*Wichita*	*National*	*Wichita*	*National*
Commercial	31.89	42.00	N/A	0.22	N/A	2.20
Industrial	93.00	78.00	N/A	0.26	N/A	2.13
Residential	43.48	49.00	N/A	0.30	N/A	2.00
Roads	N/A	99.00	N/A	0.25	N/A	0.56
Parks/Open Space	N/A	48.50	N/A	0.31	N/A	1.18

Figure 3.9 provides a chart comparing local and national TSS. A table summarizing the statistical analysis used to develop these charts is in Appendix I.

Figure 3.9: TSS Event Mean Concentration Comparison

3.8 Existing Conditions Stormwater Quality Results

PCSWMM estimates the pollutant mass generated for each parameter within each sub-basin using the pollutant Event Mean Concentration values, land use percentages, and runoff volumes. These mass values were then divided by the sub-basin area to calculate the pollutant load in pounds per acre for each sub-basin. Appendix J provides results in tabular form and on pollutant load maps.

4. IMPROVEMENT ALTERNATIVES

The information gathered while performing previous tasks forms the basis of proposed improvements to the storm sewer system. These proposed improvements are intended to positively affect stormwater collection and conveyance in Midtown as well as improve stormwater quality in the Neighborhood.

Information about the existing storm sewer system, input from City staff, Midtown topography, field investigation, and input from the local residents all contributed to the development of the existing conditions computer model. This model then became the baseline against which the effects of proposed storm sewer or stormwater quality improvements are compared. The proposed improvements are incorporated into proposed alternatives models. These are used to predict whether there will be a benefit.

4.1 Infrastructure Sizing Criteria

Before modeling of improvement alternatives could begin, agreement was required on the definition of "satisfactory performance" of an improved storm sewer system. Decisions were required on the type of model that would be used (dynamic vs. kinematic), how "satisfactory performance" would be defined within that modeling tool, and also on the storm recurrence rainfall amount that would be incorporated.

4.1.1 Use of Dynamic PCSWMM Model for Pipe Sizing

An analysis was done to confirm that for the 2-year through 10-year design storms PCSWMM returns more conservative (larger) pipe sizes if kinematic as opposed to dynamic methodology is used. As the runoff predicted by PCSWMM is already believed to be conservative, the project team proposed to utilize the less conservative sizing tool, or the dynamic PCSWMM model. Use of the dynamic model allows the capacity of existing and proposed piping to be fully maximized. Use of dynamic modeling is also consistent with the *Stormwater Manual*.

The definition of "satisfactory performance" was determined to be keeping 100% of the selected "design storm" runoff within the network of pipes, manholes and inlets and below the ground surface. Surcharging of the pipes in the dynamic model was allowed, provided that the hydraulic grade line remained below the ground surface in all locations.

4.1.2 Selection of "Design Storm" for Pipe Sizing

The requirements in Table 5.1 of the *Stormwater Manual* call for storm sewer systems to be sufficient in size to accommodate a 2-year return frequency storm in a residential area, a 5-year storm in a commercial area, and a 10-year storm for industrial areas.

An analysis in a portion of the Planning Area was done to determine preliminary pipe sizing based on this "hybrid" return frequency criteria. In determining the runoff to use from each basin, the following methodology was used, as directed by the City:

- If a basin is more than 80% Residential, size for the 2-year storm
- If a basin is more than 20% Commercial/Industrial, size for the 5-year storm
- If a basin is Industrial and/or Commercial, size for the 5-year storm

The City's direction was that the storm sewer should not be sized for higher than a 5-year storm, unless necessary to prevent structural flooding. In the case of structural flooding or in areas where no emergency overflow or escape route exists, each case must be reviewed individually before recommending a system that exceeds the 5-year requirement.

The storm sewer pipe sizes calculated by the model for this "hybrid" return frequency were very large. Further analysis compared the effect on storm sewer sizes if a 2-year storm was applied basin-wide, rather than the 2-year/5-year hybrid storm. The pipe sizes required to meet the criteria with a 2-year storm were determined to be more feasible for implementation. Therefore, the decision was made to deviate from the criteria in the *Stormwater Manual* for "new development" and size for a 2-year return frequency storm, instead of the 2-year/5-year hybrid.

4.2 Conveyance Improvement Alternatives

Several natural and man-made conditions guide the methods by which the storm sewer system in the Planning Area can be improved. The Planning Area is topographically flat, with a low ridge bisecting it. These conditions and the existing storm sewer system configuration have resulted in most of the northern and a small portion of the southeastern area draining east to the Wichita Drainage Canal across what was once the Chisholm Creek floodplain. Most areas in the south and southwest and a small northwest area drain west to the Little Arkansas River. However, surface runoff from most of the south area flows east, even though the storm sewer typically flows west to the Little Arkansas River.

Additionally, the raised Central Railroad Corridor presents a hydraulic barrier, adding to the drainage challenges in the Planning Area. Figure 1.3 provides a summary of these conditions. Given these conditions, two approaches to system improvement been developed.

4.2.1 Alternative 1 Overview

The first alternative emphasizes improving storm sewer system capacity and taking more stormwater to the Wichita Drainage Canal. This alternative works with the natural landform by moving more of the stormwater away from the Little Arkansas River toward the Wichita Drainage Canal.

A series of drainage corridors were identified which have existing underground pipe conveyance and surface flows generally from west to east. These corridors would be served by new, dedicated[1] outfalls crossing under the Central Railroad Corridor and continuing to the Wichita Drainage Canal. All new outfalls must cross under the Central Railroad Corridor, so crossings at existing bridges are given preference over crossings that include boring under the Central Railroad Corridor substructure. There are both positive and negative aspects to this approach that bear on feasibility, which include the following:

- An advantage is that shorter outfalls are possible from the Planning Area's north basins compared to those to the south because the Wichita Drainage Canal angles away from the south basins. (see the Existing Conditions Map, Figure 1.3)
- Another advantage is that outfalls north of 13th Street are less costly because construction could go through the open space in McAdams Park

[1] "Dedicated" outfalls will not receive additional flow from basins outside the Planning Area, i.e., east of the Central Railroad Corridor.

- A disadvantage is that in addition to the Central Railroad Corridor crossing (via boring or through bridge openings) railroad crossings are also required at Topeka which has active tracks north of 16th Street; at Mead which has active tracks north of 11th Street; and at Washington which has active tracks north of 13th Street

4.2.2 Alternative 2 Overview

The second alternative emphasizes taking more stormwater to the Little Arkansas River. This alternative requires reconfiguring some of the existing underground storm sewer system to take stormwater in a direction generally opposite the minimal land slope. The advantage of this approach is that it avoids the cost and difficulty of moving stormwater from the Planning Area under the Central Railroad Corridor and across the broad Chisholm Creek floodplain. An ancillary benefit is that this approach could include some detention near the Central Railroad Corridor for basins that cannot be practically drained west to the Little Arkansas River. These smaller basins just west of the Central Railroad Corridor could use the existing small pipes which flow east under the Central Railroad Corridor to the Wichita Drainage Canal.

4.2.3 Alternative 1 – Wichita Drainage Canal Outfalls Emphasis

Under Alternative 1, four new outfalls would drain eastward under the Central Railroad Corridor as dedicated lines serving only the Planning Area. Basins east of the Central Railroad Corridor would not be connected to the new outfall lines. The concept includes new outfall lines along 17th Street, 15th Street, 13th Street, and at Murdock. The 15th Street storm sewer is the only one that would require boring beneath the Central Railroad Corridor. The other outfall lines will pass through bridge openings.

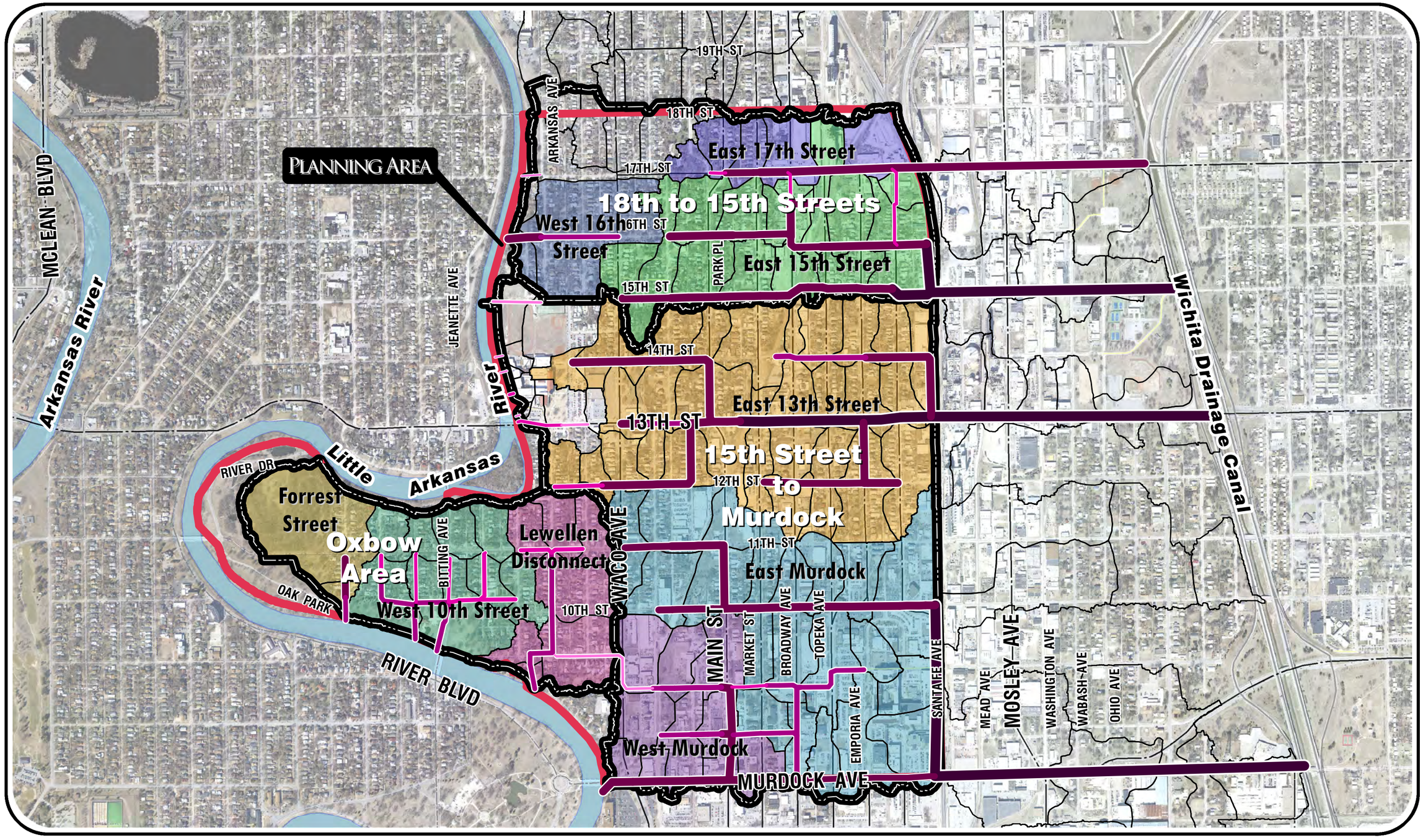
Improvements needed to implement Alternative 1 within each street corridor are presented below and shown in Figure 4.1.

4.2.3.1 East 17th Street Corridor

As part of the Central Railroad Corridor project, a 200 foot long, 5x3 foot reinforced concrete box (RCB) was constructed along 17th Street under the Central Railroad Corridor. This RCB was installed knowing that it would be used in the future to drain a low sump north of 17th Street and west of the Central Railroad Corridor. Currently it is not connected to any basins or outfalls.

The basin served by this RCB would also extend west and upstream to the underserved intersection at 17th Street and Broadway and continue west to Wellington. The total basin represents an area that will produce enough runoff from the design storm to fill the RCB without surcharging, thereby providing a balanced system. The 5x3 foot RCB would also be extended east along 17th Street to the Wichita Drainage Canal. Stormwater pipes, such as those along Broadway and St. Francis that currently carry flows south to 16th Street would be disconnected from this 17th Street RCB. The RCB extensions to the west and east will require crossing active railroad tracks at Topeka, Mead, and Washington.

Stormwater in one basin currently crosses 17th Street from north to south in Topeka via street gutters and is eventually collected by a small underground system at the east end of Arnold. In this alternative, this condition will continue and this stormwater flow would not be collected and conveyed east in the 17th Street RCB.



MIDTOWN NEIGHBORHOOD

STORMWATER MASTER PLAN

NORTH

FIGURE 4.1 - ALTERNATIVE #1 CORRIDOR IMPROVEMENTS

J:\Civil\105444 - Midtown\GIS\Maps\Final Report\Figures\Figure 4.1 - Alternative #1 Corridor Improvements.mxd

4.2.3.2 East 15th Street Corridor

Currently, storm sewer lines cross beneath the Central Railroad Corridor at 16th Street, as well as at 15th Street. However, both pipes are small. In this alternative, the 16th Street storm sewer would continue to function "as is" east of the Central Railroad Corridor, but the 16th Street crossing at the Central Railroad Corridor would be abandoned. At 15th Street, a 9x4 foot RCB would be constructed under the Central Railroad Corridor and east to the Wichita Drainage Canal. A new RCB constructed along this 15th Street alignment also has to cross active railroad lines at Mead and Washington. These actions are proposed for the following reasons:

- Installing a larger conduit under the Central Railroad Corridor is expected to be complex, costly, and difficult to negotiate with the rail companies, so a single crossing is proposed to serve all areas drained by the existing 15th and 16th Street storm sewer systems
- The general landform slopes to the south, so that flows not received in the 16th Street system will easily be collected at the 15th Street storm sewer system near the Central Railroad Corridor
- One new outfall conduit along 15th Street will be adequate and it can take flows from the 16th Street line

The existing 16th Street line would remain in place west to Fairview and would connect to a new 8x4 foot RCB to be installed along Santa Fe from 16th Street to the 15th Street just west of the Central Railroad Corridor. The existing 15th Street line that flows from Waco to Santa Fe would remain in place.

4.2.3.3 East 13th Street Corridor

There are currently conduits at the Central Railroad Corridor bridge opening at 13th Street. These consist of a 4x3 foot brick arch, a 4 foot RCP and a 4.5 foot RCP. However, the 4 foot RCP has limited utility because it joins with the 4x3 foot brick arch about 250 feet east of the Central Railroad Corridor. The system serves essentially all areas south of 15th Street, north of 12th Street, and east of Waco. Lateral collection systems extend north to 14th Street and south to 12th Street.

Alternate 1 includes extending a new 12x5 foot RCB in 13th Street under the Central Railroad Corridor east to the Wichita Drainage Canal, crossing under an active railroad track at Washington. It would be a dedicated RCB and would not receive flow from any areas outside the Planning Area (east of the Central Railroad Corridor).

4.2.3.4 East Murdock Corridor

Currently, a 4 foot RCP passes under the Central Railroad Corridor at the Murdock bridge opening and conveys stormwater flow to the Wichita Drainage Canal. This RCP serves just over 36 acres near Via Christi – St. Francis hospital, roughly from Murdock north to 9th Street between Topeka and the Central Railroad Corridor. Currently, the City has plans to install a 7x4 foot RCB along the "old" Murdock alignment from the Wichita Drainage Canal west to near Wabash. This plan would need to be revised under this Alternative to increase the size of this RCB to 12x4 foot and extend it from just west of the Central Railroad Corridor to the Wichita Drainage Canal. The alignment would remain along Murdock. By doing this the basin expands north and west, roughly to 12th Street and Main, and the area served increases to just over 173 acres.

The small 10th Street line under the Central Railroad Corridor would be abandoned and the 12x4 foot RCB would also be extended north in Santa Fe to take its flows to the new East Murdock outfall. Capacity enhancements would be constructed through the current 10th Street system upstream to 11th Street and Waco.

In the current East Murdock Corridor, flows in the 8th Street and 9th Street pipes west of Main would continue to flow to the Little Arkansas River via a new conduit constructed in Main between 9th Street and Murdock. At Murdock the new conduit would connect to the existing 6x4 foot RCB West Murdock outfall at the Little Arkansas River.

Areas east of Main would continue east to a new conduit in Broadway, which would then flow south to the new 12x4 foot RCB Murdock outfall at the Wichita Drainage Canal.

4.2.3.5 West Murdock/Lewellen Corridor

The current West Murdock system serves an area of approximately 142 acres. The portion of this system that lies west of Waco is currently served by a line in Lewellen. To improve system efficiency and to meet project performance criteria, a new line would be constructed from the intersection of 9th Street and Lewellen to the west along 9th Street and then south to the Little Arkansas River in an existing drainage easement. This would remove approximately 42 acres from the Murdock West Corridor basin and take stormwater flow to the Little Arkansas River via a more direct route.

Modifications to the East Murdock Corridor noted above would remove an additional 44 acres. The remaining 56 acres would be served by the existing 6x4 foot RCB Murdock West outfall at the Little Arkansas River, optimizing its use.

4.2.3.6 West 16th Street Corridor

Inundation mapping indicates significant street flooding north and east of North High School. In this Alternative, a new storm sewer box would be installed in 16th Street from the Little Arkansas River to Arkansas. It would replace the existing smaller pipe. East of Arkansas, new storm sewer pipe would be constructed in 16th Street to Waco. No lateral branches from the 16th Street line are proposed, as the service philosophy in the majority of the Planning Area is to allow the runoff to be conveyed in the street at least one block before being collected and conveyed through underground storm sewer. The existing branch in Arkansas south of 16th Street could remain in its current size, or could be abandoned if it is not compatible with future expansion plans by North High School.

4.2.3.7 Miscellaneous Systems

The Alternative 1 recommendations for smaller systems are as follows:

- Small systems flowing to the Little Arkansas River at 17th , 15th , and 13th Streets will not be modified
- The system in Forrest will be enlarged
- No changes are contemplated for the West 10th Street system that discharges to the Little Arkansas River

4.2.4 Alternative 2 – Little Arkansas River Outfalls Emphasis

Alternative 2 improvements divert as much stormwater flow as is practical from the Planning Area west to the Little Arkansas River. This alternative also seeks to minimize work in the recently

reconstructed Murdock corridor and to avoid constructing any new conduits east of the Central Railroad Corridor.

Several advantages are realized with this alternative. First, basins are generally smaller (fewer sub-basins are served by each outfall), resulting in smaller outfall structures. Second, when compared to Alternative 1, there is one fewer new outfall between the Central Railroad Corridor and the Wichita Drainage Canal. This is accomplished by providing detention storage ponds so that the 15th Street outfall can continue to be used without modification.

In addition to these benefits, the planned detention storage has the following secondary benefits:

- Provides open space and recreation opportunities
- Provides a sight and sound buffer from the Central Railroad Corridor
- Has the potential to increase area property values

A disadvantage is that property must be acquired for the proposed detention ponds.

Specific improvements within Alternative 2 are discussed below and shown in Figure 4.2.

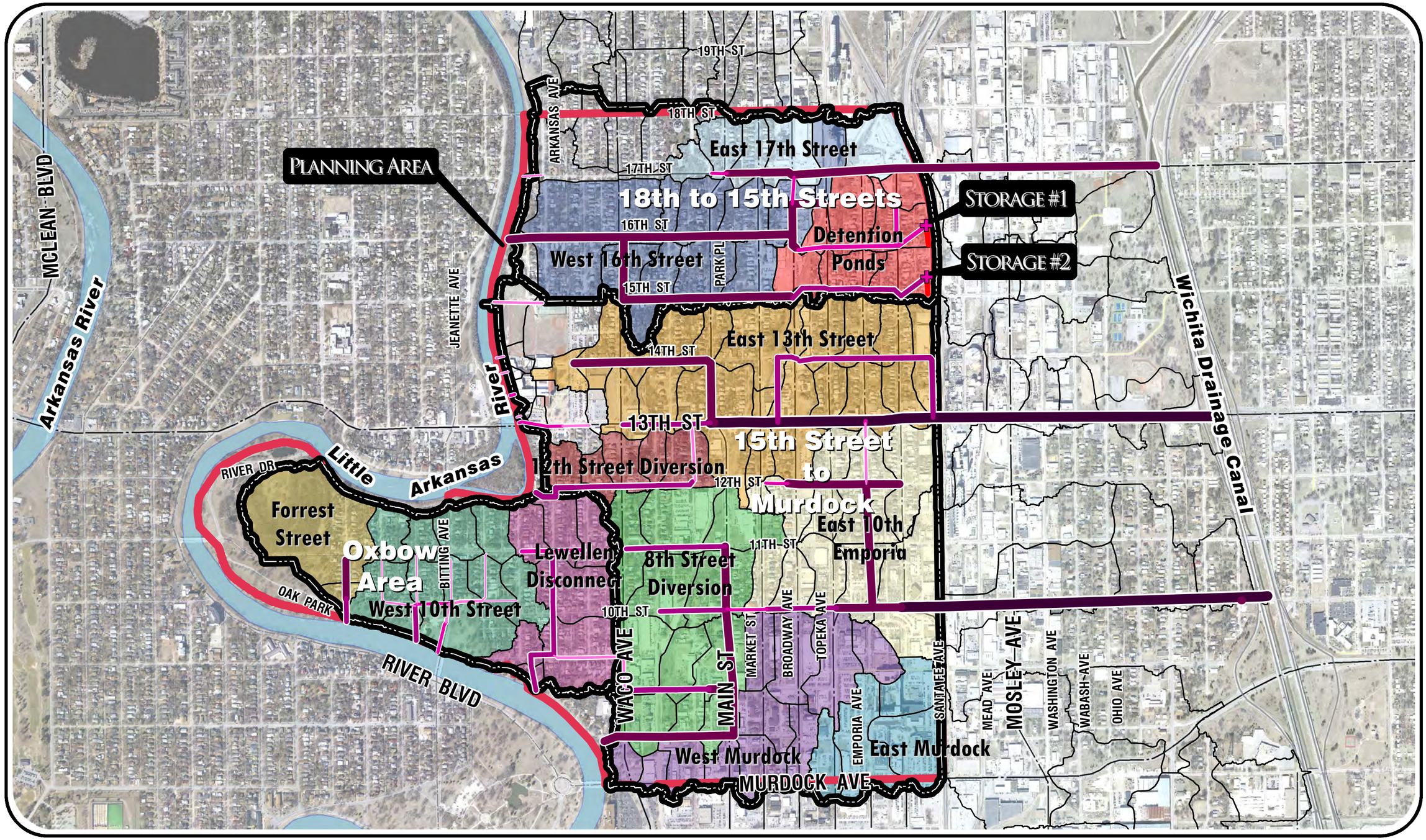
4.2.4.1 East 17th Street Corridor

Improvements to this corridor are the same as presented for Alternative 1. For the reader's convenience that text is repeated, as follows:

> "As part of the Central Railroad Corridor project, a 200 foot long, 5x3 foot reinforced concrete box (RCB) was constructed along 17th Street under the Central Railroad Corridor. This RCB was installed knowing that it would be used in the future to drain a low sump north of 17th Street and west of the Central Railroad Corridor. Currently it is not connected to any basins or outfalls.
>
> The basin served by this RCB would also extend west and upstream to the underserved intersection at 17th Street and Broadway and continue west to Wellington. The total basin represents an area that will produce enough runoff from the design storm to fill the RCB without surcharging, thereby providing a balanced system. The 5x3 foot RCB would be extended east along 17th Street to the Wichita Drainage Canal. Stormwater pipes, such as those along Broadway and St. Francis that currently carry flows south to 16th Street would be disconnected from this 17th Street RCB.
>
> Stormwater in one basin currently crosses 17th Street from north to south in Topeka via street gutters and is eventually collected by a small underground system at the east end of Arnold. In this alternative, this condition will continue and this stormwater flow would not be collected and conveyed east in the 17th Street RCB."

4.2.4.2 Detention Ponds

As a part of Alternative 2, stormwater detention ponds would be constructed near 16th and near 15th Streets at Santa Fe. The preliminary detention cell sizes of 3.6 acres and 1.9 acres, excluding access and buffer areas, would accommodate the 100-year flood event without overtopping. Discharge from the detention ponds would be to the existing lines under the Central Railroad Corridor.



MIDTOWN NEIGHBORHOOD

STORMWATER MASTER PLAN

NORTH

FIGURE 4.2 - ALTERNATIVE #2 CORRIDOR IMPROVEMENTS

J:\CIW\U0544 - Midtown\GIS\Maps\Final Report\Figures\Figure 4.2 - Alternative #2 Corridor Improvements.mxd

The detention ponds' basins will generally extend from the Central Railroad Corridor to Topeka and from 17th Street to 15th Street. Improvements include disconnecting the existing storm sewers at Broadway and diverting flow from basins west of Topeka west to the Little Arkansas River in storm sewer along 15th Street. Improvements upstream from the detention ponds to near Topeka would also be built.

One of the "Redevelopment Policies" stated in Chapter 10, page 45, of the 2004 *Midtown Neighborhood Plan* is as follows:

> *"Santa Fe Buffer: Provide for the acquisition of lands that may become part of the Santa Fe open space buffer as they become available, condemn all dilapidated structures between Murdock and 18th Street, ensure that temporary interim uses exclude heavy industrial uses and encourage the development of infill multi-unit-housing as an alternative to preferred open space/park buffer uses."*

These detention ponds would help implement this policy statement.

4.2.4.3 West 16th Street Corridor

The West 16th Street Corridor service area will be modified to include basins generally between the Little Arkansas River and Topeka from 15th Street to just south of 17th Street. Improvements include disconnecting the existing storm sewer at Broadway and diverting flow from basins west of Topeka to the Little Arkansas River in the West 16th Street Corridor. This will require the following construction:

- Construct/reconstruct the 16th Street storm sewer from the Little Arkansas River east to Broadway, north in Broadway to Arnold, and east in Arnold to Topeka
- Construct a new storm sewer south from 16th Street to 15th Street in Waco
- Reconstruct (redirect) the storm sewer in 15th Street from Waco to Broadway
- Construct a new Fairview storm sewer between 16th to 15th Streets

No modifications are anticipated for the existing system in Arkansas between 15th and 16th Streets as part of this plan. Construction plans have been prepared for improvements to the campus at North High in this area. The service philosophy in the majority of the planning area is to allow runoff to be conveyed in the street at least one block before introducing it into the underground storm sewer. Consequently, the site design for North High improvements should establish the needs, nature, and details for any changes to the storm sewer system in Arkansas between 15th and 16th Streets.

4.2.4.4 East 13th Street Corridor

Demands on the existing 13th Street system east of the Central Railroad Corridor will be reduced by:

- Diverting flow from portions of the 12th Street basin system west of Wellington to the Little Arkansas River via the proposed 12th Street Diversion improvements
- Diverting flow from the 12th Street system between Market and the Central Railroad Corridor south to the East 10th Street/Emporia Corridor

Phasing could start by constructing new larger RCB conduits between St. Francis (the current west end of the parallel outfall pipes) and Park Place, with upstream system enhancements to follow later. In addition, a new storm sewer would be constructed in Market between 14th and 13th Streets and the system east of Market in 14th Street would be disconnected. These internal improvements focus on improving drainage of sump areas west of the rail corridor and conveying those flows more

quickly to the existing parallel outfall pipes. A new 10x4 foot RCB storm sewer box constructed along 13th Street from St. Francis to the Wichita Drainage Canal would ultimately be required to fully comply with the goal criteria, but could be postponed until other street improvements were also planned.

4.2.4.5 East 10th Street/Emporia Corridor

To avoid construction in Murdock east of the Central Railroad Corridor, a new 10x4 foot RCB would be installed east along 10th Street, bored under the Central Railroad Corridor and extended on to the Wichita Drainage Canal. The area served by the 10th Street RCB would no longer include basins west of Main. However, basins north of 12th Street and east of Main that are currently served by the East 13th Street Corridor system would be diverted to the 10th Street/Emporia Corridor. The net effect would be to reduce the total basin area served from 94 acres to 86 acres. To accomplish this, the following major projects are required:

- Construct a new RCB from 12th Street to 10th Street along Emporia
- Disconnect the existing 10th Street system at Main, diverting flow from the area served to the south along Main to the 8th Street Diversion Corridor. (See detailed description below.)

4.2.4.6 East Murdock Corridor

Currently only one storm sewer pipe passes under the Central Railroad Corridor through the Murdock Bridge opening to the Wichita Drainage Canal. It is a 4 foot Reinforced Concrete Pipe (RCP) that serves just over 36 acres near Via Christi – St. Francis hospital, roughly from Murdock to 9th Street between Topeka and the Central Railroad Corridor. The improvements proposed in Alternative 2 would retain the existing facilities in Murdock west of the Central Railroad Corridor; the 4 foot RCP that passes under the Central Railroad Corridor bridge; and would depend on the City's previously planned construction of a 7x4 foot RCB from the Wichita Drainage Canal to Wabash to improve conditions. Since it was included in earlier planning and design is complete, the costs for completing the East Murdock outfall are not included in the construction estimates for this alternative.

4.2.4.7 West Murdock/8th St Diversion/Lewellen Corridor

Improvements for the Lewellen Corridor are the same as for Alternative 1 but are repeated here for the reader's convenience:

"The current West Murdock system serves an area of approximately 142 acres. The portion of this system that lies west of Waco is currently served by a line in Lewellen. To improve system efficiency and to meet project performance criteria, a new line would be constructed from the intersection of 9th Street and Lewellen to the west along 9th Street and then south to the Little Arkansas River in an existing drainage easement. This would remove approximately 42 acres from the Murdock West Corridor basin and take stormwater flow to the Little Arkansas River via a more direct route."

Modifications to the East Murdock Corridor noted above would remove an additional 44 acres. The remaining 56 acres would be served by the existing 6x4 foot RCB Murdock West outfall at the Little Arkansas River, optimizing its use.

Unlike in Alternative 1, improvements proposed in Alternative 2 would divert approximately 49 acres currently served by the 10th Street East system into the Murdock West area and introduce a new Little

Arkansas River outfall at 8th Street, thereby diverting approximately 90 acres away from the existing Murdock outfall. The existing Murdock outfall would serve the remaining 59 acres basin, again optimizing use of the existing 6x4 foot RCB in Murdock that outfalls at the Little Arkansas River.

4.2.4.8 Miscellaneous Systems

Miscellaneous systems recommendations for Alternative 2 are the same as in Alternate 1. They are as follows:

- Small systems adjacent to the Little Arkansas River at 17th, 15th, and 13th Streets will not be modified
- The system in Forrest Ave will be enlarged
- No changes are contemplated for the West 10th St system that discharges to the Little Arkansas River

4.3 Preliminary Concept Evaluation Criteria

Alternative evaluation follows a specific process using consistent criteria used to develop and evaluate the different alternatives. The General Approach section discusses specific conditions encountered, and the assumptions made and approaches taken to these situations when developing alternatives and assigning costs to them. The Cost Estimating section provides the basis for the project cost estimates presented in the next section.

4.3.1 General Approach

Alternative 1 and Alternative 2 share an original point of reference, i.e., what is represented in the existing condition models. The proposed system conduit sizes are conceptually feasible, though the final configuration after detailed design may vary. For example, some conduits in the upper reaches are modeled as 5x2 foot RCBs to accommodate cover requirements. Detailed terrain information and unusual route conditions are not included in model detail. In the final design, other sizes may be more appropriate for site conditions. However, the conceptual system can be translated into a final design that will function as modeled.

In the general approach, franchise utility owners are responsible for all costs to relocate any of their facilities in City right-of-way. Relocation for the City's water distribution and sanitary sewer facilities is incidental to project costs for all conduits with diameters less than 12 inches. Where the storm sewer conflicts with larger public utility pipes, the concept evaluation includes an estimate of the cost to relocate the pipe.

The Conveyance Improvement Alternatives section notes that the Central Railroad Corridor presents a hydraulic barrier to natural flow between the low ridge that bisects the Planning Area and the Wichita Drainage Canal. This new barrier may have established local sumps in the Planning Area. When developing the alternatives and evaluating technical features, the project team selected configurations that minimize the number of closed systems/sump areas, especially where watershed rearrangement would occur. Where sump areas are planned as part of the system, i.e., at the detention areas in Alternative 2, the proposed improvements are sized to accommodate the 100-year event.

Considerations when developing alternatives included avoiding streets where new construction has occurred within the last 5 years, and avoiding boring under the Central Railroad Corridor. While these goals are generally achieved, the concept developed for Alternative 2 includes boring a new

conduit under the Central Railroad Corridor's raised section near 10th Street. Consequently this remains a decision criterion.

With few exceptions, project construction for both alternatives can be completed in existing right-of-way. This both limits property costs and places responsibility for relocating private utilities with the utility owners. The most notable exceptions are the detention facilities included in Alternative 2. These facilities will require the City to purchase several acres currently in residential development. Where a project will require significant additional right-of-way, preliminary estimates include acquisition costs. General right-of-way needs that may be incidental to project construction along current street rights-of-way are considered part of the projects' contingency allowance.

4.3.2 Cost Estimating

Alternatives 1 and 2 each comprise several projects, previously identified and briefly described in this section. Using a separate spreadsheet for each project, cost summaries include project-specific construction items that account for the system improvements as well as for needs and conditions unique to each project. Details are in the next section.

The estimated number of inlets each project will require is based in part on peak flow rates in the primary discharge conduit. Section 3 describes the process for aggregating inlet capacity for each sub-basin. The aggregated inlet capacities correspond well with general performance expectations from experience. Using these two pieces of information and an assumed proportion of inlets on-grade to inlets in sump encountered in the *Analysis Area*, the average inlet capacity is four cubic feet per second.

4.4 Conveyance Alternative Selection

Alternatives 1 and 2 are generally mutually exclusive. Each Alternative comprises several projects, previously identified and briefly described in this section. Once one Alternative is selected over the other, future work must follow that pattern for nearby projects with only minor modifications. Alternative 1 will direct runoff east toward the Wichita Drainage Canal, with new or larger outfall conduits in 16th Street, 13th Street, 10th Street, and Murdock. Alternative 2 will construct new outfalls to the Little Arkansas River at 8th Street, 12th Street, and 16th Street. Outfall construction is the most expensive component for either plan. Once the decision is made regarding the primary discharge direction, changing this direction would dramatically increase system costs.

This situation does not affect two small areas; the 17th Street basin, which discharges to the Wichita Drainage Canal in the planning area's northeast corner, and several basins west of Lewellen that discharge to the Little Arkansas River in the southwest corner. Planned facilities to serve these areas are identical for both alternatives, as the contributing areas and discharge locations do not change.

4.4.1 Construction Cost

Construction cost estimates were generated using a separate spreadsheet for each project in both alternatives. These cost summaries account for project-specific basic construction items as well as needs and conditions unique to each project. Appendix K provides unit construction costs for basic system components and specific incidental costs. Construction cost spreadsheets use these unit costs for all calculations.

4.4.1.1 Material and Installation

The probable construction cost estimate for each project in the two Alternatives includes such items as concrete pipe, reinforced concrete box, curb inlets, manholes, outfall structures, flowable fill treatment for installation under pavement, pavement removal and replacement (pricing is for stand-alone construction projects; they are not considered part of street improvements), and boring under active railroad tracks.

Basic material quantities are from the conduit lengths represented in the PCSWMM model. Derived quantities include such categories as the number of inlets, connecting pipe lengths, manholes, and pavement removal and replacement.

For these components, the number of inlets was established by evaluating each corridor and ensuring first that the total inlet capacity upstream of a design point is greater than the calculated upstream peak flow rate. Second, each intersection is likely to require at least four inlets – one in each corner of the intersection. The average inlet capacity of four cubic feet per second presumes that 30 percent of the inlets are in sump condition, and 70 percent of the inlets are on-grade with street slopes less than 0.5 percent.

Connecting pipe length calculations assume that the stormwater sewer is built in the center of the street, and that each inlet connects to the sewer with a 15″ RCP. For the average street width, the connecting pipe length required for each inlet is 25 feet.

Unit costs for pavement removal and replacement assume a standard width, and costs accrue at $140 per linear foot of pipe regardless of pipe size. This length is adjusted based on whether the proposed pipe will actually lie below paved areas in each project.

The estimated number of manholes each project will require is based on the number of conduit junctions in the PCSWMM file, supplemented so that the maximum distance between structures is 400 feet. Where unusual conditions occur, e.g., where conduits with opening dimensions greater than four feet are joined, the estimate includes costs for special junction structures.

For standard reinforced concrete pipe, standard inlets, manholes, outfall structures and flowable fill, recent bids for construction projects in and around Wichita provided the basis for unit costs. For reinforced concrete box, F.O.B. prices which were provided by the local fabricator were doubled to provide the total installed unit costs.

Estimated costs also include railroad permit application and fees as required for crossing rights-of-way.

4.4.1.2 Incidental

Best Management Practices were selected in Section 3 for two Focus Areas and for specific streets identified in the *Transportation and Streetscape Plan* that will become part of the City's green infrastructure. Costs for these Focus Area improvements do not affect the conveyance alternatives. Section 5 provides preliminary cost estimates for these separate facilities.

Incidental costs in this category include specific items such as excavation for detention facilities, site clearing and restoration, abandoning current stormwater sewers in place, rip rap, and traffic control.

The final calculated cost for each project includes a contingency allowance calculated as 25% of the total construction costs. This amount is intended to fund final route confirmation, engineering, financing, administration, and other non-specific incidental costs.

4.4.1.3 Property Acquisition

Property acquisition will represent minimal cost for most projects, as the projects will typically be within current City right-of-way. For proposed projects requiring whole parcel acquisition, such as the two detention sites, cost calculations use a total cost formula typically used by the City. Each property's assessed value (as of 2011 County records) is multiplied by 1.8 to account for purchase, administrative, and legal costs, and for potential inflation. The total acquisition cost includes an additional $10,000 per whole parcel for structure demolition and site clean-up.

4.4.2 Operation and Maintenance

Modern fabrication and installation methods should provide conduits, inlets, and manholes for the system that will last indefinitely with minimal maintenance. So although the total pipe length constructed is much greater for Alternative 1 than for Alternative 2, there is no difference in operation and maintenance costs.

Detention facilities near the Central Railroad Corridor in Alternative 2 will incur some annual operation and maintenance costs, but those costs can vary widely with different features that the final design could incorporate. There are also a number of options for assigning maintenance responsibilities, both within the City's hierarchy and using volunteers from the community. Just as responsibilities will be meted for the rain gardens in streetscapes, the Midtown Neighborhood Association may be willing to bear some of the responsibilities. Depending on what amenities the final design includes, the City's Park and Recreation Department may become logical agency to manage the area.

4.4.3 Compatibility with Other Plans

Issues identified in portions of previous sections of this report also identify other planning documents that potentially may impact on the implementation issues associated with this plan.

4.5 Geodatabase Integration

The project geodatabase is supplemented to include the details assumed for the recommended plan. This is a spatial database designed to store, query, and manipulate geographic information and spatial data; it provides ready access to model parameters and analysis results for all scenarios. The supplemental data includes, but is not limited to the following:

- Basin configurations and groupings used in the planning process
- Proposed storm sewer alignments and flow directions, proposed outfall locations
- Proposed conduit characteristics – material, shape, roughness, dimensions, lengths, slopes, invert elevations, tailwater conditions
- Results from PCSWMM analyses and inundation maps from FLO-2D analyses for the proposed system

The geodatabase provides the data in a format compatible with the City's GIS structure, so that the background assumptions for planning and model results can be incorporated into the City's system for access if desired. As the recommended plan implementation proceeds and sub-basin characteristics or other physical conditions change, the City can access, modify, and update the data, and revise models as needed to review, verify, and assess plan progress, or evaluate interim conditions or new plan alternatives if desired.

4.6 Proposed Conditions Stormwater Quality Model

In cooperation with City staff, two Focus Areas in the Midtown neighborhood were identified for detailed analysis to study the effectiveness of various Best Management Practices (BMP) tools for improving stormwater quality (Figure 4.3). These focus areas were selected for the following reasons:

East 13th Street Focus Area

- had a good mix of residential and commercial contributing areas
- was served by a fairly isolated storm sewer branch. This condition is conducive to monitoring the effects of improvements (both the modeled effects…as well as the actual effects realized as implementation is made)
- provided a high level of overlap with streets identified in the Transportation/Streetscape Plan for improvements (especially streets where conversion from one-way to two way travel was being considered)
- provided opportunities for incorporating rain gardens, porous pavement, street trees, rain barrels and green roofs.

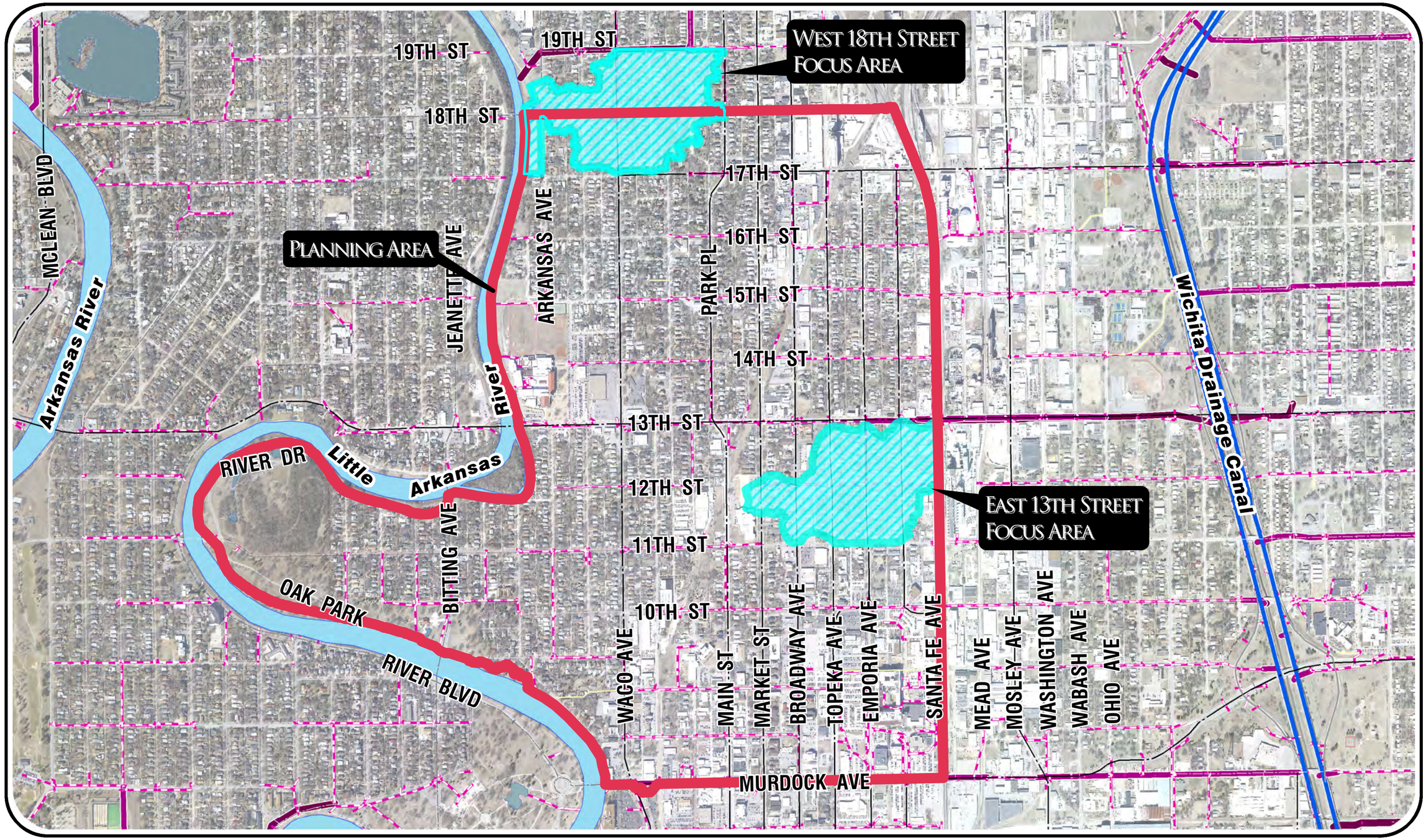
West 18th Street Focus Area

- was comparable in physical size to the East 13th Street Focus Area
- had similar land use conditions to the East 13th Street Focus Area
- was served by a storm sewer that outfalls to the Little Arkansas River, with open space available adjacent to that outfall for construction of End-of-Pipe treatment tools (two focus area alternatives were presented to City that met these criteria. The alternative not selected was located near West 10th Street and Bitting Avenue.)

The selected PCSWMM stormwater quality model was utilized to consider the effect of targeted improvements on both pollutant loading and runoff quantity within these focus areas.

4.6.1 East 13th Street Focus Area (Green Infrastructure)

The East 13th Street Focus Area occupies 41 acres and is composed of five sub-basins. It is located between 11th and 13th Streets and is bounded approximately by Santa Fe on the east and Market on the west. The Focus Area provides a diverse cross section of typical land use within Midtown (Table 4.1). The eastern edge of the Focus Area (sub-basin E13-022) has a small industrial component. The central section (sub-basins E13-021 and E13-020) is highly residential; while the more western sub-basins (E13-018 and E13-019) have a mix of residential and commercial land use. Stormwater runoff from the Focus Area enters the main trunk line at 13th Street and Emporia providing a convenient stormwater quality sampling location for future monitoring.



Midtown Neighborhood

Stormwater Master Plan

Figure 4.3 - Stormwater Quality Focus Areas

North

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Table 4.1: Land Use by Sub-basins for the East 13th Street Focus Area

Sub-basin	Area (ac)	Impervious Area (%)	Residential (%)	Commercial (%)	Industrial (%)	Street (%)
E13-018	2	69%	24	33	0	43
E13-019	6	70%	30	40	0	30
E13-020	9	52%	61	8	0	31
E13-021	13	49%	67	1	0	31
E13-022	12	53%	52	4	12	33

The stormwater control measures evaluated within this Focus Area are considered green infrastructure (GI) or "source control" treatment tools, as they reduce the stormwater runoff quantity and improve stormwater quality before it enters the storm sewer system for conveyance. Much of the Focus Area has been targeted for streetscape improvements. These improvements provide opportunities to incorporate GI practices such as rain gardens, porous parking, porous alleys and tree planting within the public right-of-way and in public parking areas.

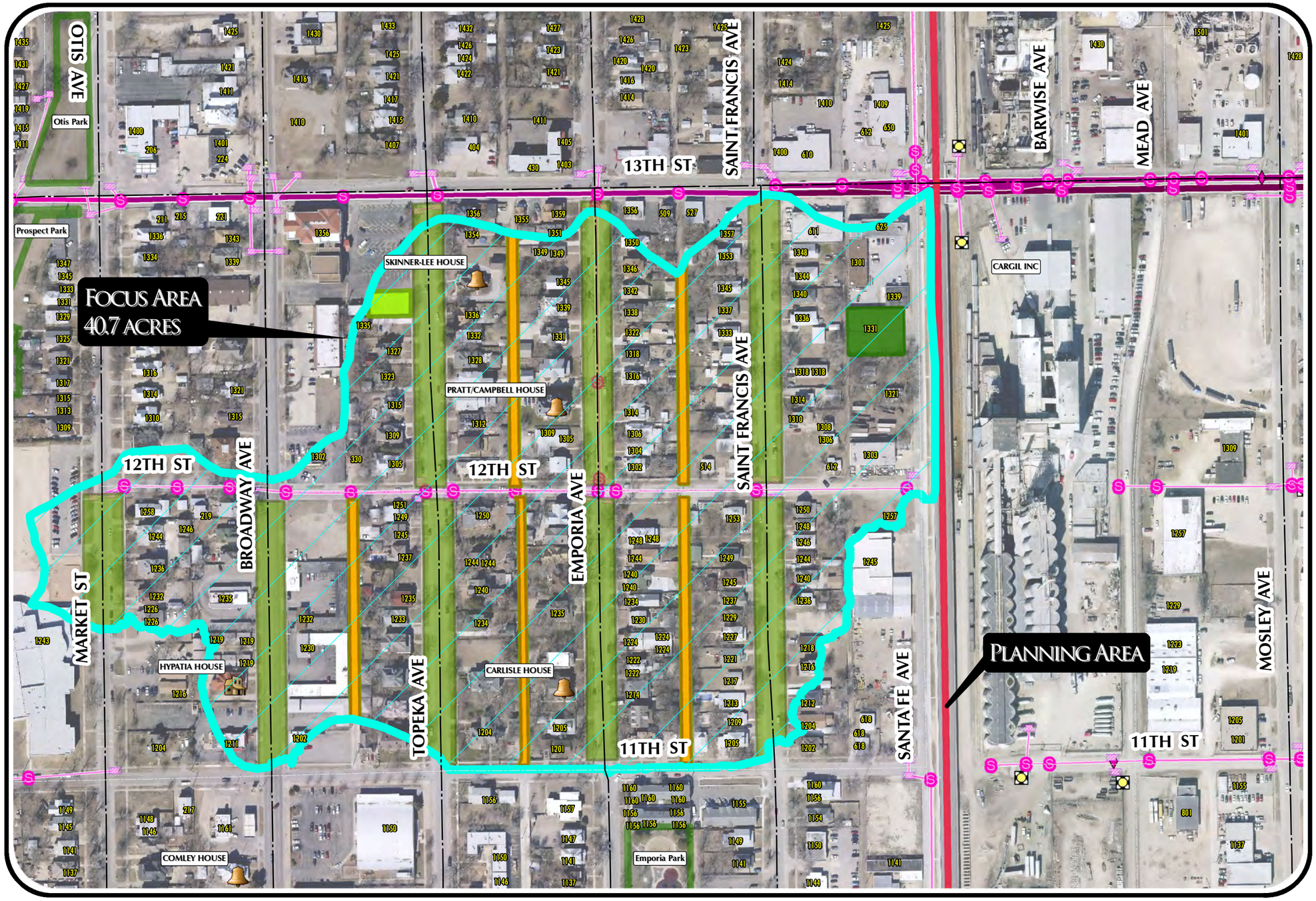
The proposed conditions model evaluates the effect of the above improvements with other GI options such as residential rain barrels with downspout disconnections and a green roof installation. Locations identified for improvements are highlighted in Figure 4.4.

4.6.1.1 East 13th Street Model Inputs

To determine the area available for Green Infrastructure implementation, the preliminary streetscape plans developed as part of the *Midtown Neighborhood Transportation and Streetscape Plan* were evaluated. Aerial photography and site visits were used to determine the impervious area which could be routed to each BMP tool's treatment area. For residential rain barrels, two rain barrels per household with overflow routed across the yard and an 80 percent participation rate were modeled.

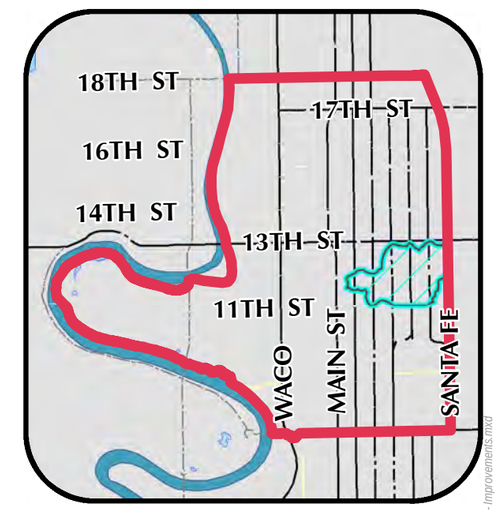
Effects of maximizing tree canopy were not modeled as a specific BMP tool within PCSWMM. Instead the model parameters within the Focus Area were adjusted to simulate the stormwater benefits provided by the increased tree canopy. Two parameters, impervious depression storage and curve number, were adjusted. The curve number for pervious areas was decreased from 71 to 65.6 in the Focus Area to reflect the increased tree canopy. To simulate the effect of tree canopy over impervious areas in the model, impervious depression storage was increased from 0.1 to 0.25 inches.

Table 4.2 summarizes the model input parameters for the Focus Area.



FOCUS AREA
HISTORIC SITE - LOCAL
HISTORIC SITE - NATIONAL
STREET CONVERSION
GREEN ROOFS
GREEN ALLEYS
GREEN PARKING
CITY PARK

LEGEND



LOCATION MAP

MIDTOWN NEIGHBORHOOD

STORMWATER MASTER PLAN

FIGURE 4.4: EAST 13TH STREET FOCUS AREA - IMPROVEMENTS

NORTH

CITY OF WICHITA

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Table 4.2: East 13th Street Focus Area Model Input Parameters

BMP Tool	Area (sq ft)	No. of barrels	Impervious Area Treated (%)
Sub-basin E13-022			
Green Roof	12,000		4%
Rain Barrels		58	11%
Rain Gardens	24,837		37%
Porous Parking	25,578		24%
Porous Alley	2,310		2%
			78% total
Sub-basin E13-021			
Rain Barrels		61	11%
Rain Gardens	20,005		29%
Porous Parking	21,222		19%
Porous Alley	11,187		10%
			69% total
Sub-basin E13-020			
Rain Barrels		42	10%
Rain Gardens	5,841		12%
Porous Parking	8,270		10%
Porous Alley	11,110		14%
			46% total
Sub-basin E13-019			
Rain Barrels		8	2%
Rain Gardens	568		1%
Porous Parking	5,184		8%
Porous Alley	715		1%
			12% total
Sub-basin E13-018			
Rain Barrels		5	1%
Rain Gardens	5,379		42%
Porous Parking	4,554		22%
			65% total

4.6.1.2 East 13th Street Model Results

The model results reflect the potential benefit of implementing each of these BMP tools. PCSWMM is currently tailored for modeling the reduction in runoff quantity as a result of BMP implementation. By reducing the quantity of runoff, quality is also improved as the mass of pollutants carried is reduced proportionally. Although additional pollutant removal would be expected through various treatment mechanisms, PCSWMM does not explicitly allow for these in the software's "LID controls" tool at this point. Table 4.3 summarizes the model results for reduction in TSS discharged from the Focus Area.

Table 4.3: East 13th Street Focus Area Model Results

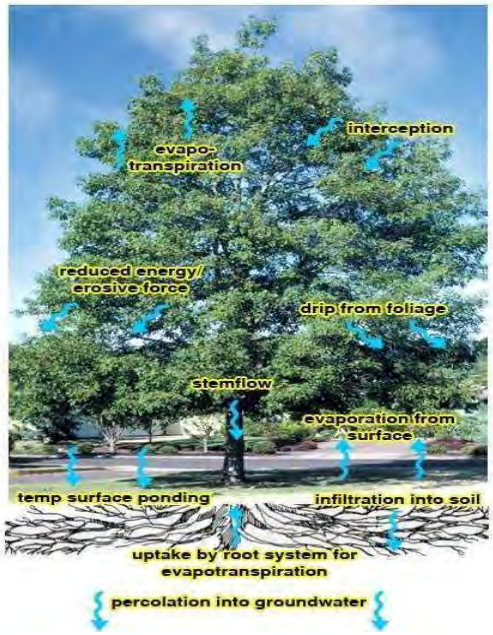
BMP Tool	Area (sq.ft)	Reduction in TSS Discharged (lbs) [1]
Green Roof	12,000	5
Rain Barrels w/downspout disconnection	174 (barrels)	29
Rain Gardens	56,630	92
Porous Pavement (all applications)	90,130	93
Tree Canopy	105 (new trees)	35
TOTAL		254 lbs
[1] Due to Runoff Volume Reduction Only		

Porous pavement street parking lanes are combined with rain gardens located behind the back-of-curb into an implementation category titled "street conversions" to be congruent with the concepts presented in the *Transportation and Streetscape Plan*. The category of Green Parking Lots is also an assemblage of porous pavement together with a rain garden. The category of green alleys is solely envisioned as porous pavement. Allocating the stormwater quality benefits to these respective categories produces the results in Table 4.4.

Table 4.4: East 13th Street Focus Area Model Results by BMP Tool

BMP Tool	Reduction in TSS Discharged (lbs) [1]
Street Conversions	154
Green Alleys	26
Green Parking Lots	5
Green Roofs	5
Rain Barrels	29
Tree Canopy	35
TOTAL	254 lbs
[1] Due to Runoff Volume Reduction Only	

Street conversions to incorporate porous parking lanes together with bulb-out type rain gardens at intersections, and linear rain gardens behind the back-of-curb, provide a tremendous capture of the stormwater runoff from impervious surfaces within the Focus Area. The majority of the street driving lane runoff is captured by the porous parking lane, and a significant portion of the lot fronts are captured by the rain gardens. As a result, the street conversions visualized in the *Transportation and Streetscape Plan* offer the greatest opportunity for total runoff quantity reduction and stormwater quality improvement.



Maximizing tree canopy within the Focus Area is shown to also have high potential for stormwater benefits. It is estimated that 105 new tree plantings would be required to maximize long-term tree canopy within the Focus Area. Once the trees have matured and the canopy is in place, runoff will be reduced through the interception of rainfall by the canopy, the depression storage around the tree's base and roots and the uptake of water by the tree. This BMP tool is also closely tied to the street conversions proposed in the *Transportation and Streetscape Plan*.

As discussed previously, the modeled assumptions for rain barrels reflect an aggressive implementation of two rain barrels per household, barrel overflows routed across pervious surfaces and 80 percent participation. A significant portion of the modeled benefit is a result of the downspout disconnection. If downspouts discharge to pervious surfaces prior to rain barrel installation, the net benefit will not be as great as the model predicts. This is because the existing conditions model assumes that downspouts currently discharge to impervious surfaces.

As noted above, a significant portion of the stormwater runoff from lot fronts is captured by the street conversions. Green alley implementation can have a similar effect by capturing runoff from the backs of the lots. Due to the length of green alley opportunities, a great benefit can be achieved in the Focus Area.

Green parking lots and green roofs are often excellent GI technologies, but they have fewer specific opportunities within the Focus Area. The area of green parking lots modeled was fairly small, and therefore produces a moderate benefit. Similarly, a green roof also occupies a small area. Green roofs are limited to managing stormwater that falls only on the area of the roof itself. In contrast, porous pavement and rain gardens are capable of treating stormwater that falls within their own footprint as well as accepting stormwater runoff from an area two (porous pavement) to five (rain gardens) times than their footprint.

4.6.1.3 East 13th Street Green Infrastructure Costs

Costs could be evaluated either as a total cost to implement, or as the portion of the costs that would be considered a "stormwater improvement" and likely to be incurred by the City's Stormwater Utility department. Table 4.5 shows the Best Management Practice tools identified for implementation in the East 13th Street Focus Area with these costs broken down as well as the calculated cost per pound of Total Suspended Solids removed.

Table 4.5: East 13th Street Focus Area Green Infrastructure Cost Estimates

BMP Tool	Total Cost	Total Cost per lb TSS removed	Implementation Cost to City SW Mgt Div	Cost to SW Dept. per lb TSS removed
Street Conversions	$1,184,000	$7,700	$648,000 (1)	$4,200
Green Alleys	$304,000	$11,700	$152,000 (1)	$5,800
Green Parking Lots	$47,000	$9,400	$24,000 (1)	$4,800
Green Roofs	$216,000	$43,200	$60,000 (2)	$12,000
Rain Barrels	$35,000	$1,200	$13,000 (3)	$400
Tree Canopy	$37,000	$1,100	$11,000 (4)	$300

(1) Represents incremental cost increase only - difference between constructing with porous concrete and rain gardens vs. costs for conventional concrete, topsoil+seed, and commercial landscaping.

(2) Represents only the portion of the cost incurred by City Stormwater Management Division, assuming a financial incentive of $5 per sq.ft. of green roof installed is provided

(3) Represents only the portion of the cost incurred by City Stormwater Management Division, assuming a financial incentive of $75 per barrel is provided

(4) Represents only the portion of the cost incurred by City Stormwater Management Division, assuming a financial incentive of $100 per tree is provided

4.6.2 West 18th Street Focus Area (End-of-Pipe)

The West 18th Street Focus Area generates stormwater runoff from 36 acres comprising of seven primarily residential sub-basins. They generate a peak flow of 23 cubic feet per second (cfs) during the 85th percentile (1.2 inches). Stormwater from the area discharges to the Little Arkansas River near 18th Street and Arkansas. The City is considering a stormwater treatment wetland south of this outfall to treat runoff from the area. The concept includes pre-treatment using a hydrodynamic separator followed by an eyebrow wetland. Both of these are considered "end-of-pipe" treatment tools, as the full runoff quantity is conveyed to the outfall location and then treated immediately prior to discharge.

4.6.2.1 West 18th Street Treatment Tool Sizing

To determine the manufacturer's recommended sizing of the hydrodynamic separators, several vendors were contacted. Each vendor was asked to submit recommended unit selection and sizing to achieve 80% removal of the 200 micron and larger Total Suspended Solid (TSS) particles for the peak flow of 23 cfs. The vendor-supplied information is provided in Table 4.6.

Table 4.6: Hydrodynamic Separator Options

	CONTECH CDS	Hydroworks Hydroguard	HI Downstream Defender
Trash Screen	Yes (2.4 mm)	No	No
Number of Units	1	3	2
Dia. Each Unit	10 ft	8 ft	1 @ 8 ft 1 @ 10 ft
Vendor-Supplied Equipment Cost	$52,000	$81,000	$87,000

All hydrodynamic separators evaluated will separate floatables (buoyant trash as well as oils and other hydrocarbons) and settle the TSS fraction requested. This removal will reduce maintenance and will allow elimination of a sedimentation basin forebay from the constructed wetland. Two parallel units are preferred for redundancy and simplicity in flow splitting, and therefore the HI Downstream Defender layout will be used in the subsequent layout and cost evaluations.

The potential performance of the stormwater treatment wetland was modeled using CH2MHILL's "Treatment Wetlands Toolkit". It was assumed that the wetland would be constrained to a size of 600 feet x 80 feet, with a wetted area of 1 acre. Expected wetland treatment performance is shown in Table 4.7.

Table 4.7: West 18th Street Focus Area Wetlands Treatment

BMP Tool	Area (sq ft)	Reduction in TSS Discharged (lbs)
Wetlands	43,560	125

4.6.2.2 West 18th Street Estimated Costs

Cost estimates for end-of-pipe alternatives assume that the City Stormwater Utility would bear all costs for implementation. Cost per pound of TSS removed is based on the assumption that 50% of the TSS is removed by each BMP tool. Both the hydrodynamic separator and the wetlands are good BMP tools for TSS removal. The hydrodynamic separator will remove most of the larger particles, such as particles larger than medium to coarse sand. The wetlands will then target the remaining fine particles, due to the settling time and plant filtration capabilities.

Table 4.8 presents the cost analysis results. Cost per pound of TSS removed is based on estimated construction cost and pounds of TSS removed in a single water quality storm (1.2 inch) event. A similar relationship of costs will be determined for all BMP alternatives to allow for comparison on a common basis.

Table 4.8: West 18th Street Focus Area Stormwater Quality Improvement Cost Estimate

BMP Tool	Implementation Cost to City	Cost per lb TSS removed
Hydrodynamic Separator (1)	$193,000	$1,500
Wetlands (2)	$210,000	$1,700

(1) Installed cost for HI Downstream Defender plus flow diversion structure on main outfall, flow split structure between hydrodynamic units, and associated piping.
(2) Represents all grading and initial plantings

4.7 Selection of Preferred Stormwater Quality Tools

Both the "End-of-Pipe" tools and the "Green Infrastructure" tools are evaluated in comparable economic terms (cost per pound TSS removed) and with identical non-economic criteria. The goal of the comparison is to select five preferred stormwater quality tools for the Midtown Neighborhood. Additional implementation details will be developed for each of those top five tools.

4.7.1 Economic Comparison

Add stated previously, the cost per pound of TSS removed has been calculated for each BMP tool based on its construction cost and the lbs of TSS it removes in one water quality storm event. The results for comparison are presented in Table 4.9.

Table 4.9: Economic Comparison of Stormwater Quality Tools

BMP Tool	Total Cost per lb TSS removed	Rank
Street Conversions	$7,700	5
Green Alleys	$11,700	7
Green Parking Lots	$9,400	6
Green Roofs	$43,200	8
Rain Barrels	$1,200	2
Tree Canopy	$1,100	1
Hydrodynamic Separator	$1,500	3
Wetlands	$1,700	4

4.7.2 Non-Economic Comparison

An initial list of potential non-economic screening criteria was reviewed with City staff. The relative importance of these criteria was also established in those discussions. The resulting list of criteria and their relative weights are presented in Table 4.10.

Table 4.10: Non-Economic Criteria for Stormwater Quality Tool Analysis

Criterion	Relative Weights 1=lowest priority 5=highest priority	Description
Runoff Quantity Reduction	5	How effective is the tool at reducing the amount of runoff that must be conveyed by the storm sewer pipe network
Maintenance Requirements	4	How maintenance-intensive is the tool? Does it require significant manpower to keep it in proper operating condition or to maintain its appearance?
Aesthetic & Streetscape Benefits	2	Does the tool enhance the appearance and property values of the area where it is applied? How well does the tool align with the streetscape work planned separately by the City?
Contaminant Removal Performance	3	How well does the tool remove not only TSS, but also nutrients and metals?
Community Involvement	1	Does the tool provide the opportunity to engage the community?
Water & Energy Conservation	1	How well does the tool minimize use of potable water? Does the tool provide a cooling effect that can reduce energy consumption?
Contributing Area Treated	3	How much area, beyond the footprint of the tool itself, and be effectively treated by the tool?

The scoring and final non-economic ranking for the alternatives are presented in Table 4.11.

Table 4.11: Non-Economic Comparison of Stormwater Quality Tools

Alternative	Runoff Quantity Reduction	Maintenance Requirements	Aesthetic & Streetscape Benefits	Contaminant Removal Performance	Community Involvement	Water & Energy Conservation	Contributing Area Treated	Raw Score	Weighted Score	Rank
Street Conversions	8	1	8	8	6	4.5	6	41.5	104.50	1
Green Alleys	7	2	3	3.5	3	4.5	5	28	79.00	5
Green Parking Lots	6	3	6	3.5	5	4.5	4	32	80.00	4
Green Roofs	5	4	4	6.5	3	4.5	3	30	81.00	3
Rain Barrels	4	7	2	2	7.5	8	1.5	32	76.00	6
Tree Canopy	3	8	7	1	7.5	7	1.5	35	76.00	6
Hydrodynamic Separator	1	5	1	5	1	1	7.5	21.5	65.50	8
Wetlands	2	6	5	6.5	3	2	7.5	32	86.00	2
1=worst, 8=best										

4.7.3 Selection of Preferred Stormwater Quality Tools

Based on the results of the economic and non-economic analysis presented above, various BMP tools were rejected or selected. The logic behind their rejection or selection is as follows:

Rejected BMP tools:

- Green Roofs – Green roofs scored the lowest in the economic analysis. Within the Focus Area, there are very limited opportunities for green roofs, and the opportunities available are all located on private property. For these reasons, they were not selected as a City-implemented tool for this Focus Area. Due to the fact that green roofs offer aesthetic benefits, cooling effects, and extended roof life, in addition to their stormwater benefits, their implementation is always encouraged
- Green Parking Lots – While green parking lots scored slightly better than Green Alleys in the economic and non-economic analysis, the City already has green parking lot demonstration projects. In addition, the parking lots available within the Focus Area are on private property. However, green parking lots have tremendous opportunities for stormwater and aesthetic benefits, and also potential cooling effects – especially if trees are incorporated into the green parking lot plan. Their use is always encouraged

- Rain Barrels – Rain barrels were shown in the analysis to have significant potential stormwater benefits at a low cost. They also have the benefit, to the property owners, of reduced potable water use resulting in a lowering of their water bills. However, rain barrel implementation is highly dependent upon public-involvement. If the rain barrels aren't installed to overflow onto pervious surfaces, or aren't drained between storms, their stormwater benefits are greatly reduced. Due to the difficulty in controlling or monitoring rain barrel operation on private property, they were not selected as a tool to be implemented through a City project. They are, however, encouraged as something the public can implement in an effort to "do their part"

The five selected BMP tools:

- Street Conversions – received highest non-economic score, provides excellent coordination with the streetscape study, and fell within the top five in the economic analysis
- Green Alleys - good demonstration project opportunity, as implementation can occur within public ROW
- Tree Canopy – received highest economic score, can be implemented within public ROW, is compatible with the street conversions, and coordinates with the *Transportation and Streetscape Plan*. In addition, tree canopy has the added feature that its benefits continue to increase for many years if trees are planted and maintained properly
- Hydrodynamic Separator – scores third in economic analysis but poorly in non-economic criteria. However, its implementation as a demonstration project is recommended to demonstrate the technology as a viable alternative to a wetlands approach
- Wetlands – scores fourth in economic analysis and second in non-economic analysis. In addition to the TSS removal, the wetlands are effective at nitrogen and phosphorus removal due to uptake of these nutrients by the plants

Additional implementation details will be developed for each of these top five tools.

5. IMPLEMENTATION PLAN

Plan implementation should proceed on two levels. Standard stormwater infrastructure improvements (installing larger conduits, additional inlets, and the like) are the most expensive component of the *Stormwater Master Plan*. These stormwater Infrastructure projects will also affect other public infrastructure during installation, and will most often be part of a street improvement project and possibly, in this area, part of a *Transportation and Streetscape Plan* project. Executing this part of the plan will require additional coordination with these other components.

Construction for the water quality projects, on the other hand, can be completed more independent of the other urban infrastructure systems. The end-of-pipe work is especially remote from other projects, as it will be on the Little Arkansas River bank and away from streets. While not as removed, most of the 13th Street Focus Area water quality improvements will be constructed east of Broadway in residential areas, somewhat more "remote" than most other infrastructure projects.

5.1 Infrastructure Improvements

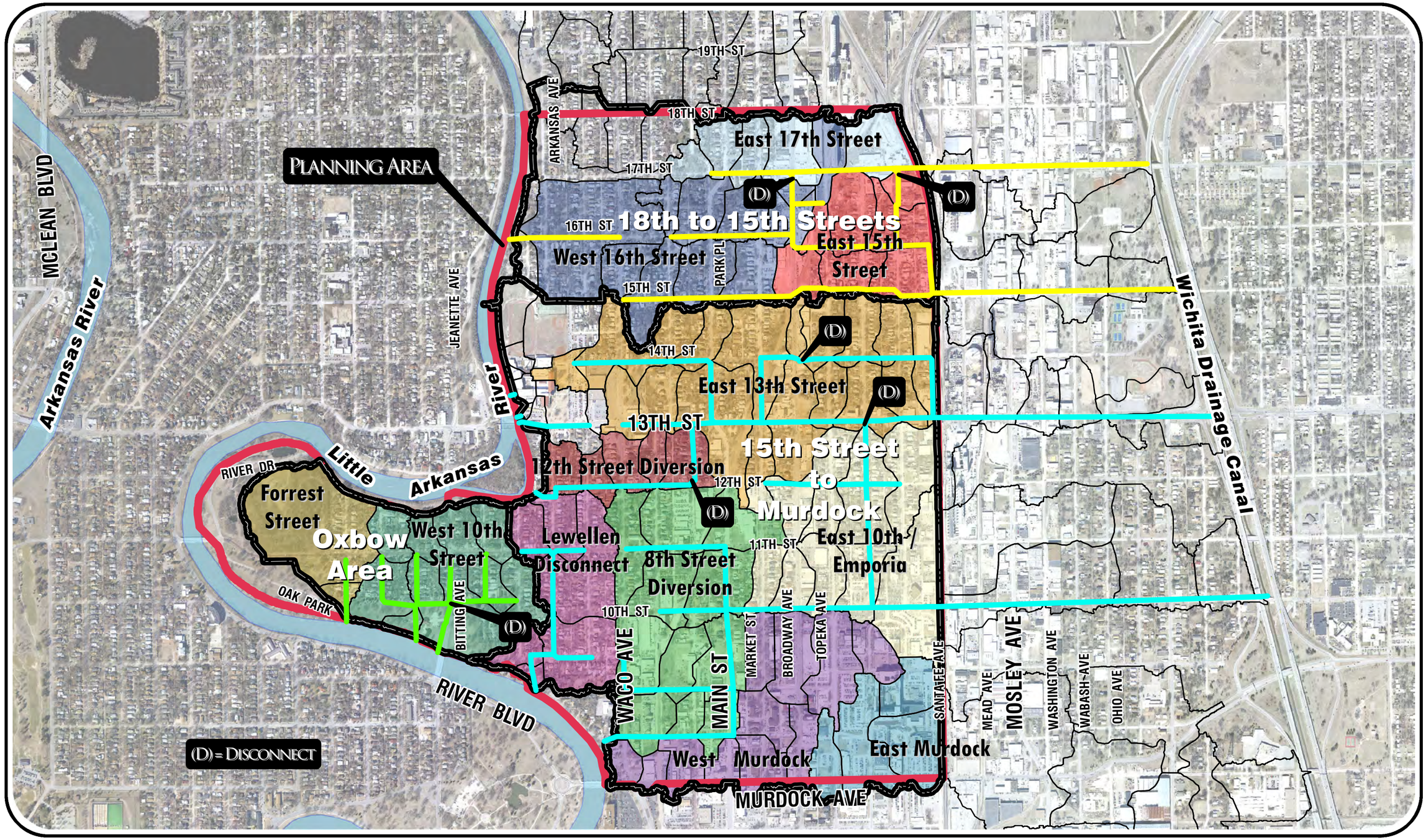
Figure 5.1 shows the recommended plan, independent group boundaries, and the optimum sequence for high priority corridors. As the three groupings may be managed independently, the implementation plan treats these areas separately. The need to alleviate flooding near the Via Christi – St. Francis hospital drives the sequence for high priority projects. Factors that will affect the implementation sequence include the following:

- Project cost in relation to City budget for capital improvements of this nature
- Reduction of inundation area
- Utility conflicts and constructability
- Information provided by GSI
- Project interdependence within the stormwater drainage system, especially considering that in most instances construction should begin at the downstream end of the system and progress upstream
- Project interdependence with other work, such as the work anticipated in the *Transportation and Streetscape Plan* for the same area

The current ground surface has a very mild slope from north to south through most of the area. Where possible, that is, as long as other more pressing requirements do not supersede the concept, projects in the north basins should be completed first. In this way, runoff that overflows to the next sub-basin (which generally occurs from north to south) will be controlled at the source and provide some immediate benefits to the next tier of basins.

5.1.1 Plan Description

Figure 5.1 shows the three independent basin groups used when selecting the best combination of alternatives. The basin groups are 18th Street to 15th Street; 15th Street to Murdock; and the Little Arkansas River Oxbow Area. The internal relationships in each of these independent basin groupings affect the project sequence for the local basin group, which are presented below. More general priorities are discussed later in the Recommended Sequence section.



MIDTOWN NEIGHBORHOOD

STORMWATER MASTER PLAN

FIGURE 5.1 - RECOMMENDED PLAN

NORTH

CITY OF WICHITA

J:\CW\110544 - Midtown\GIS\Maps\Final Report\Figures\Figure 5.1 - Recommended Plan.mxd

5.1.1.1 18th Street to 15th Street

Figure 5.2 shows additional detail for the three basins in the 18th Street to 15th Street group, which includes the East 17th Street, West 16th Street, and East 15th Street Basins. In keeping with the general practice of starting at the Planning Area's north end working south, the first project in this group should be to extend the 17th Street outfall to the Wichita Drainage Canal and extend improvements west to Fairview. The 17th Street crossing at the Central Railroad Corridor is already in place. Removing flow from north of 17th Street that currently continues south will alleviate some of the flooding that occurs in 15th Street and 16th Street.

If possible, 15th Street outfall construction should follow quickly after the 17th Street outfall project is complete. Although boring under the Central Railroad Corridor and installing a 9x4 foot RCB will be expensive, the full system is necessary to reduce inter-basin flow to the south and flooding that occurs in the commercial area along Broadway, especially in larger events. Once the 15th Street outfall to the Wichita Drainage Canal is in place, the 16th Street portion of the system should be constructed to again reduce basin interflow and remove runoff from the north tier of sub-basins. The final project in the 15th Street Basin should extend the improvement west from Broadway to Waco Avenue.

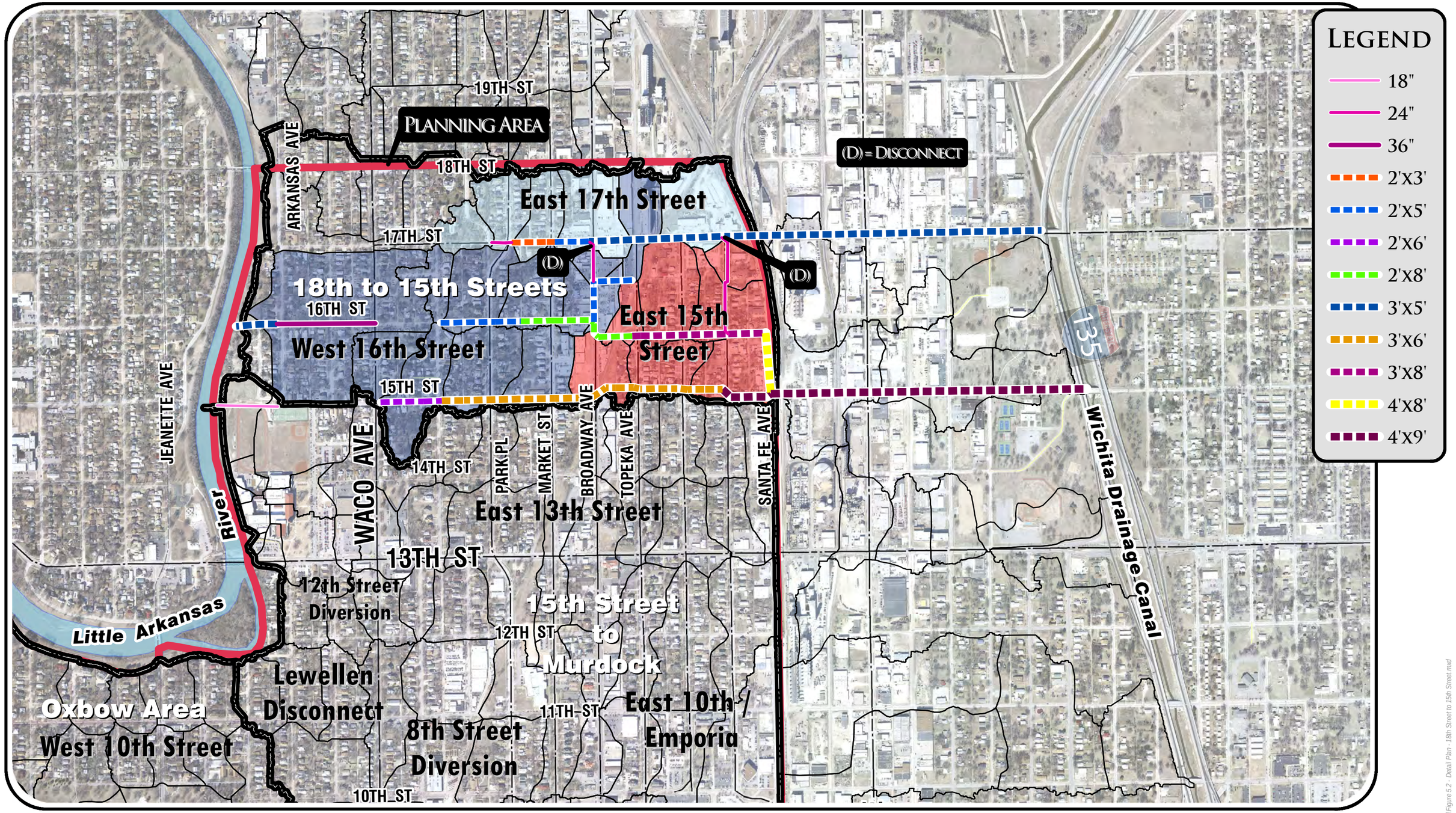
The 16th Street West basin should be treated in a similar fashion, reducing flooding along Waco Avenue and 16th Street. This project can be completed as funds become available, as the basin lies entirely west of the low ridge/natural divide that separates the West Basin System from the East Basin System.

5.1.1.2 15th Street to Murdock

Figure 5.3 shows additional detail for the seven basins in the 15th Street to Murdock group, which includes: East 13th Street; 12th Street Diversion; East 10th Street; Lewellen Disconnect; 8th Street Diversion; East Murdock; and West Murdock Basins. First priority for this group is to relieve flooding near the Via Christi – St Francis Hospital near Murdock and St. Francis in the southeast corner. Figure 3.8 shows the flooding extents that models indicate and that have been generally confirmed by the community. The area most affected by flooding lies north of Murdock along the Central Railroad Corridor west to Topeka and north to about 12th Street, then along 13th Street west from the Central Railroad Corridor to about Main Street.

The first project in this group should finish the 7x4 foot reinforced concrete box conduit along East Murdock**.** Much of this feature is already constructed, and construction plans for all remaining work have been prepared by TranSystems, Inc. The remaining work lies between the Wichita Drainage Canal and a point just east of Wabash Avenue. Upstream from Wabash Avenue, the outfall is already in the plan's final configuration. Current flow restrictions at and just downstream from Wabash Avenue reduce the system's capacity and increase flooding depth near Via Christi – St. Francis Hospital.

Once the East Murdock Outfall is in place, the 10th Street Outfall should be constructed from the Wichita Drainage Canal west to Emporia, then north to 12th Street. This will relieve flooding in the existing sump at 12th and Emporia and remove several sub-basins from the current 13th Street system. Figure 5.4 provides a preliminary profile for the storm sewer between Emporia and the Wichita Drainage Canal along the 10th Street corridor.



Midtown Neighborhood

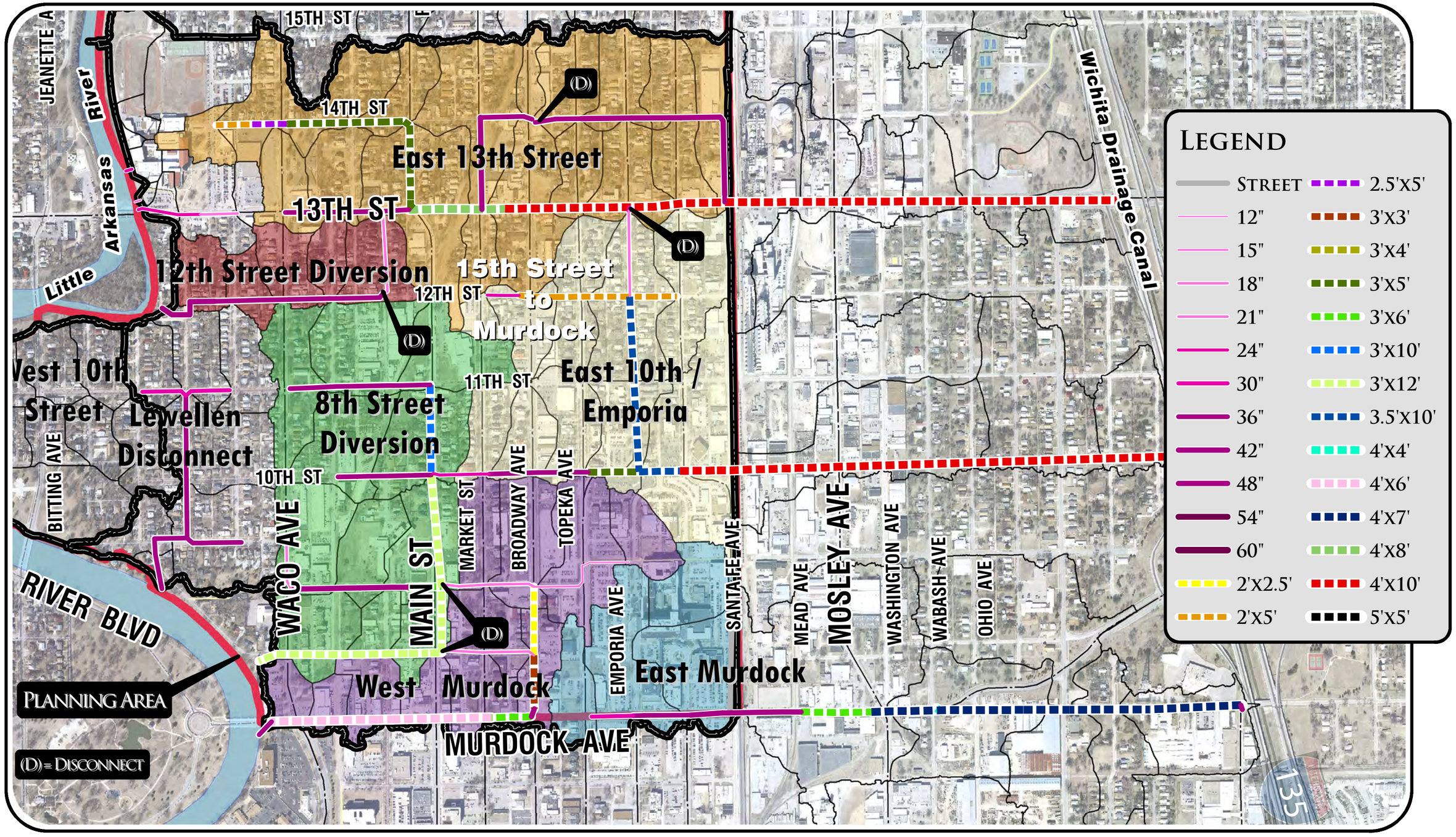
Stormwater Master Plan

North

Figure 5.2 - Detailed Plan 18th Street to 15th Street

City of Wichita

J:\Civil\06544 - Midtown\GIS\Maps\Final Report\Figures\Figure 5.2 - Detail Plan - 18th Street to 15th Street.mxd



MIDTOWN NEIGHBORHOOD

STORMWATER MASTER PLAN

NORTH

FIGURE 5.3 - DETAILED PLAN 15TH STREET TO MURDOCK

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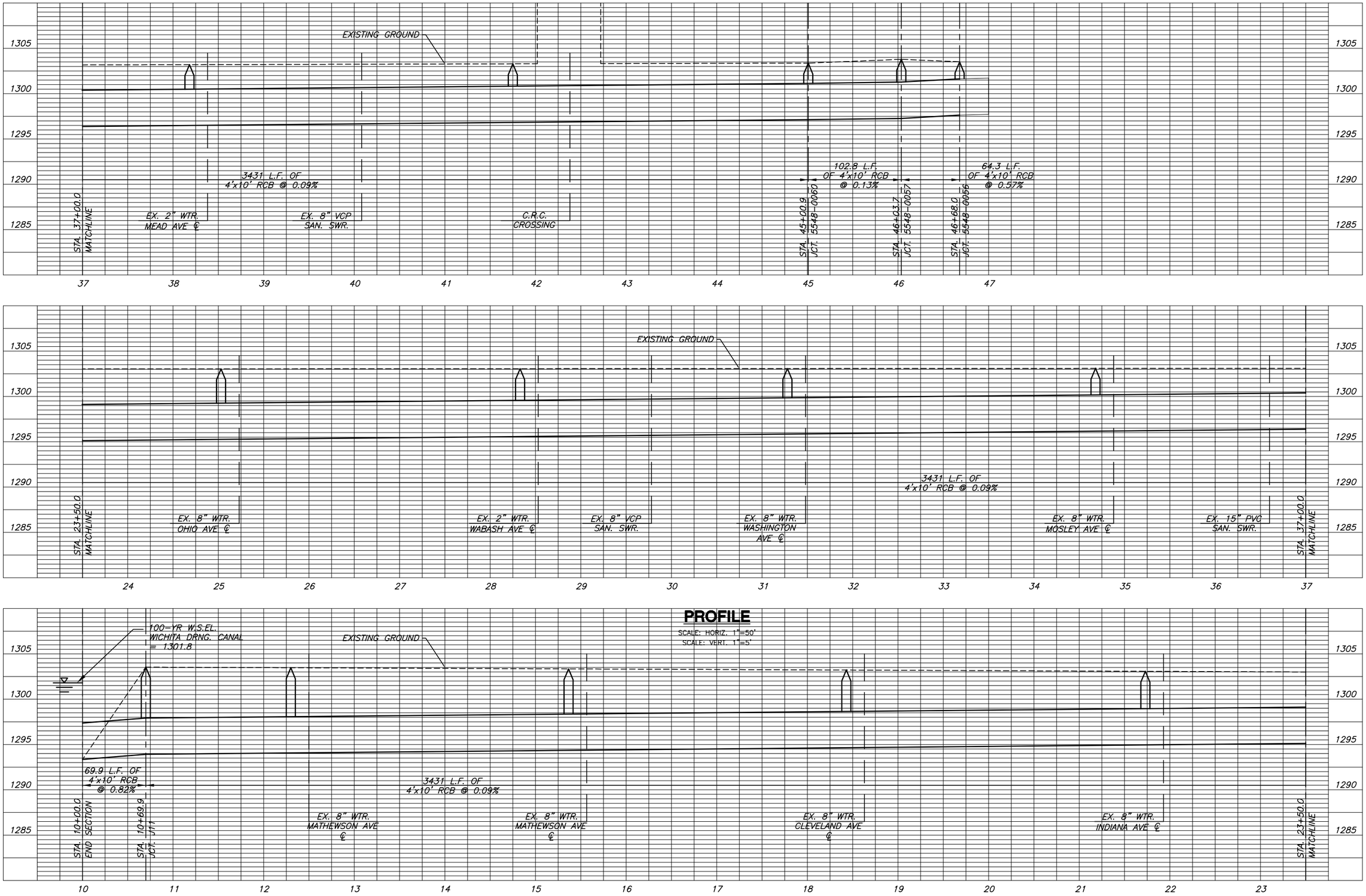

MKEC ENGINEERING CONSULTANTS, INC.
411 N. WEBB ROAD
WICHITA, KS. 67206
316-684-9600

STORMWATER SEWER

MIDTOWN-10TH STREET CORRIDOR

PRELIMINARY PROFILE OF 10TH STREET
STORMWATER IMPROVEMENTS

10th ST. SWS PROFILE
SHEET TITLE

10544
PROJECT NUMBER

MAB / SPE / MAB
DESIGNED DRAWN CHECKED

ISSUED
November 2011
REVISED

SHEET NO.
FIG. 5.4

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PLOTTED: Tuesday, November 08, 2011 @ 10:42AM

After 10th Street Outfall construction, the 13th Street Basin projects should move forward. Conforming to the general approach, the first project in the 13th Street sequence should be the 13th Street Outfall to the Wichita Drainage Canal, with subsequent projects progressing upstream through the system as funds allow. Sumps near 14th Street and Market Avenue and along 13th Street near Main and to the east will benefit quickly from enlarging the outfall to the Wichita Drainage Canal.

The 12th Street Diversion, which would immediately reduce flood risk in the sump near 14th and Waco near North High School, can be completed as is convenient, since the area it diverts west to the Little Arkansas River is relatively small.

Subsequent projects should work to alleviate flooding in the West Murdock Basin and correct remaining deficiencies in the East Murdock Basin. The *Stormwater Master Plan* does not include changes to the current West Murdock outfall, but rather diverts flow from the contributing sub-basins to other outfalls so that the current system in West Murdock will function properly.

In the west half of the existing 10th Street Basin, runoff generally overflows to the south and into the West Murdock basin. Three measures are required to completely address this condition – the 8th Street Diversion; East 10th Street; and the Lewellen Disconnect.

The first project to benefit the West Murdock area should be the 8th Street Diversion. This project will collect and redirect flow from the existing 10th Street basin west of Market Street to a new outlet at the Little Arkansas River, and cutting off the reducing overflow to the West Murdock Basin significantly.

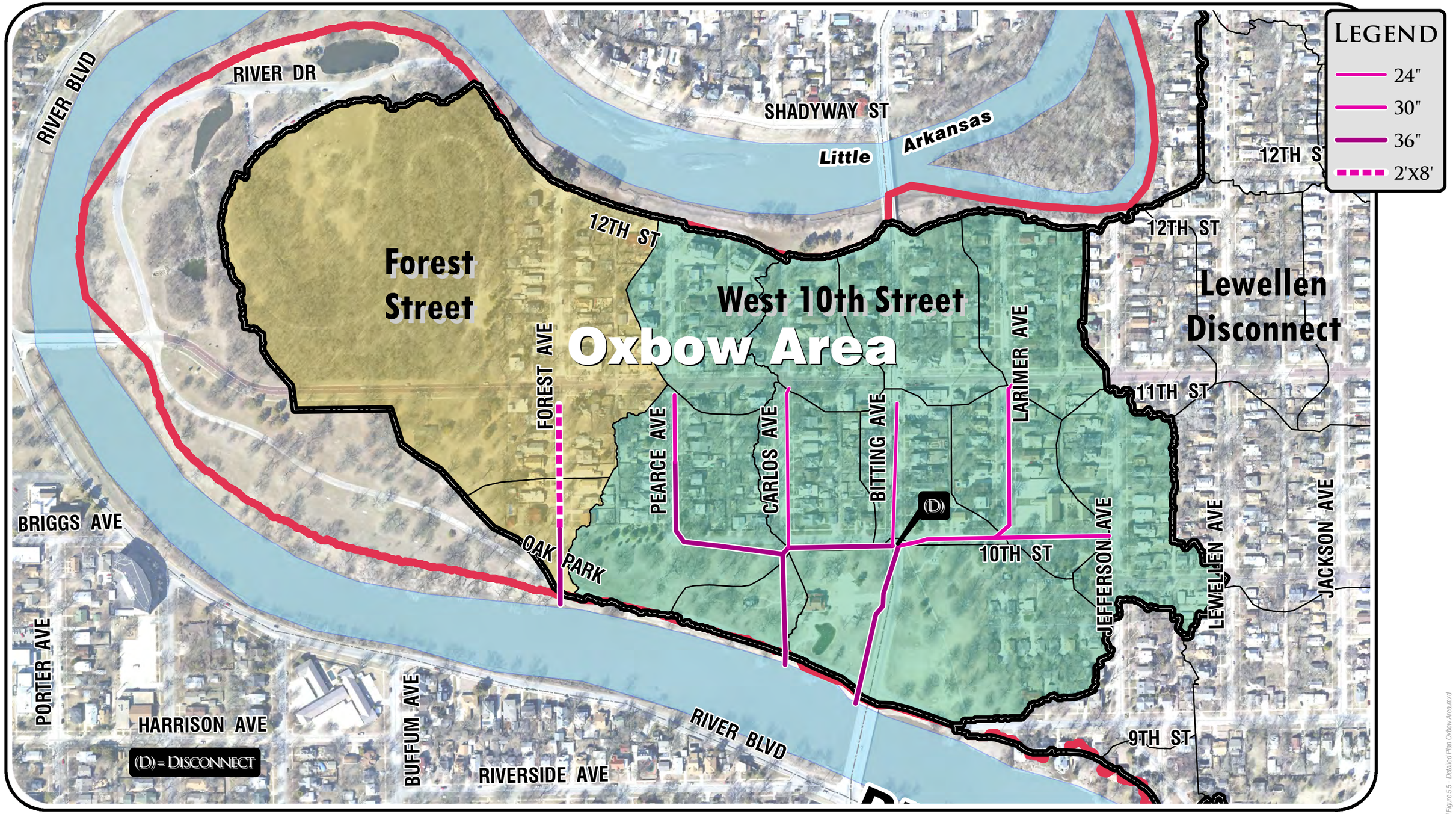
Additional overflow enters the West Murdock Basin from the 10th Street Basin from east of Market to near Topeka under existing conditions. The proposed new 10th Street outfall to the Wichita Drainage Canal (to be completed earlier as noted above) redirects that flow so that existing facilities in Broadway south of 9th Street and in Murdock from Broadway to the outfall will serve the remaining West Murdock Basin with no modifications.

Final projects in this basin should be in the Lewellen Disconnect system, unless other projects such as street improvements offer earlier opportunity. Runoff entering the underground system near Lewellen and 9th Street currently must pass through an 18 inch vitrified clay pipe to move east toward the system in Broadway. The Lewellen area's connection to the 8th Street Diversion could remain in place without excess load on the new system. The existing conditions kinematic wave model for the two year precipitation depth calculates that less than two cubic feet per second would enter the new 8th Street Diversion area through that 18 inch pipe. As soon as opportunity arises, the Lewellen Disconnect outfall construction should proceed, as this will improve conditions at the 9th Street and Lewellen sump and areas north along Lewellen for relatively small cost.

5.1.1.3 Oxbow Area

Figure 5.5 shows additional detail for the Oxbow Area group, which includes the Forrest Street and West 10th Street Basins adjacent to the oxbow in the Little Arkansas River between 9th Street and 12th Street. System deficiencies are generally consistent through these watersheds. As the area is essentially inside an oxbow on the Little Arkansas River, it would make little sense to redirect flow from any of these areas to a new outfall. The general approach should begin improvements at each system's downstream end (outfall) and proceed upstream.

The first system improvements should be for the Carlos Avenue Outfall, with subsequent improvements moving upstream in the system to West 10th Street and Larimer Avenue. According to



MIDTOWN NEIGHBORHOOD

STORMWATER MASTER PLAN

FIGURE 5.5 - DETAILED PLAN OXBOW AREA

NORTH

CITY OF WICHITA

J:\Civil\105544 - Midtown\GIS\Maps\Final Report\Figures\Figure 5.5 - Detailed Plan Oxbow Area.mxd

the plan, changes in this system will include disconnecting the 10th Street/Larimer system from other portions of the West 10th Street Basin. The outfall at Carlos currently receives very little flow from the Larimer system. Consequently, improving the Biting outfall north to 10th Street and removing the connection to the system north and west of that intersection should be the first project in the area, as it will provide the most benefit without exacerbating flood risk.

Improvements to remaining components that flow to the Carlos Avenue outfall, the remaining West 10th Street system, as well as the Forrest system can follow the standard downstream-to-upstream pattern as funds and street project schedules allow.

5.1.2 Costs

Table 5.1 shows the opinion of probable construction cost for improvements to each basin for both Alternatives aggregated by basin group. The alternative (Alternative 1 or Alternative 2) selected for each basin group is near the bottom of the table, and is summed to provide the total estimated construction costs for the *Stormwater Master Plan*. Appendix K includes tables with additional detail, showing the opinions of probable construction costs for individual reaches in each basin for the selected Alternative.

5.1.3 Recommended Sequence

Since there are high priority projects in two of the basin groups, the project team recommends a sequence for these critical projects. From a broad perspective, the highest priority projects should follow a sequence based on the entire Planning Area's needs, with lower priority projects to follow based on more local preferences. The primary goal of the sequence for high priority projects is improving health and safety in the neighborhood and in the region; the secondary goal is to encourage economic development in the planning area. The need to alleviate flooding in near the Via Christi – St. Francis Hospital is consequently the primary criterion for prioritization. When establishing lower priority projects, those serving commercial and industrial areas are given preference.

Figure 5.6 shows project priorities for all conveyance improvements in the recommended plan. High priority projects invariably begin at the system's outfall, or downstream end, and extend far enough upstream into the basin to make a material difference. Medium and low priority projects should follow after the highest priority project is completed in each basin. In practice, complex factors will affect sequencing for medium and low priority projects; projecting the sequence for these lower priority projects can follow the sequence identified for each group in the previous section. The recommended sequence for high priority projects follows the following logic.

The flooding extents mapped in Figure 3.8 show that the problem areas lie generally along the Central Railroad Corridor, and then along 13th Street. Since one of the City's primary responsibilities is to protect public health and safety, the first priority for the *Stormwater Master Plan* should be to reduce flooding at and near Via Christi – St. Francis Hospital. Consequently, the first recommended project completes the East Murdock Outfall, even though all work for this project lies outside the Planning Area. The designer provided the a detailed construction cost estimate for this work.

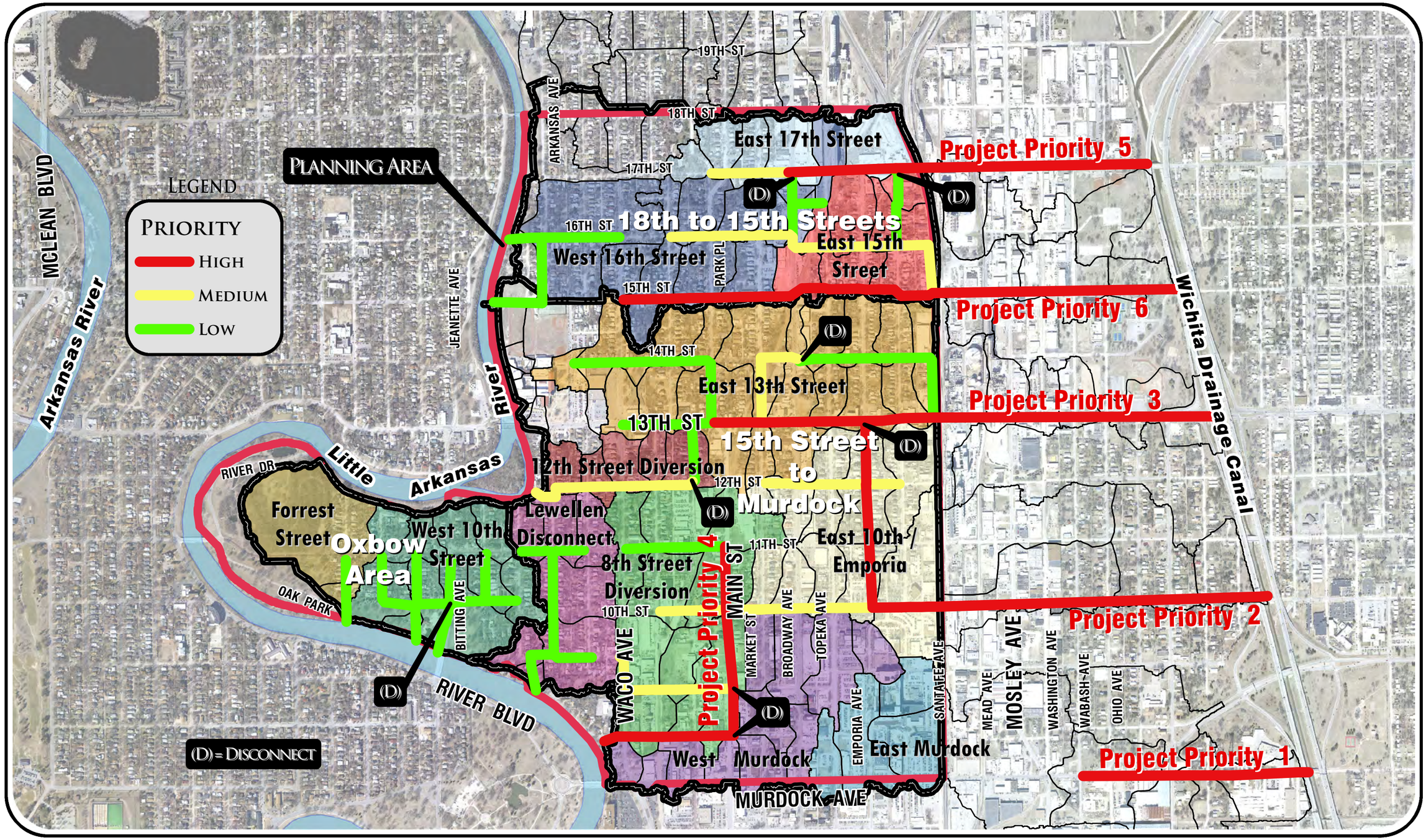
The second project should construct the East 10th Street outfall to the Wichita Drainage Canal. This project mitigates flooding on the Via Christi – St. Francis campus' north side, and so reduces sub-basin overflow to the East Murdock area, further reducing flood risk at the Via Christi –St. Francis campus. From Table 5.1, the capital cost for this project is approximately $7.1 million.

Table 5.1: Probable Construction Cost

ALTERNATIVE 1		
CORRIDOR IMPROVEMENT	**Estimate of Probable Construction Cost**	
18th Street to 15th Street		
East 17th Street	$2,964,312.50	
West 16th Street (Arkansas)	$734,956.25	Group total
East 15th Street	$8,294,450.00	***$11,993,718.75***
15th Street to Murdock		
East 13th Street	$11,828,487.50	
East Murdock	$10,743,344.25	
Lewellen Disconnect	$1,508,443.75	Group total
West Murdock	$1,651,731.25	$25,732,006.75
Oxbow Area		
West 10th Street + Forrest	$2,280,962.50	$2,280,962.50
GRAND TOTAL ALT 1	**$40,006,688.00**	

ALTERNATIVE 2		
CORRIDOR IMPROVEMENT	**Estimate of Probable Construction Cost**	
18th Street to 15th Street		
East 17th Street	$2,964,312.50	
West 16th Street (Arkansas)	$4,912,312.50	Group total
Detention Ponds	$5,554,062.50	$13,430,687.50
15th Street to Murdock		
East 13th Street	$8,907,625.00	
12th Street Diversion	$803,437.50	
East 10th Street	$7,084,737.50	
Lewellen Disconnect	$1,508,443.75	
8th Street Diversion	$5,033,487.50	
Murdock West	$-	Group total
Murdock East	$-	***$23,337,731.25***
Oxbow Area		
West 10th Street + Forrest	$2,280,962.50	***$2,280,962.50***
GRAND TOTAL ALT 2	**$39,049,381.25**	

RECOMMENDED PLAN		
18th Street to 15th Street (Alternative #1)	$	11,993,718.75
15th Street to Murdock (Alternative #2)	$	23,337,731.25
Southwest Area	$	2,280,962.50
Recommended Plan Total	***$***	***37,612,412.50***



Midtown Neighborhood

Stormwater Master Plan

Figure 5.6 - Project Priorities

North

City of Wichita

J:\Civil\10544 - Midtown\GIS\Maps\Final Report\Figures\Figure 5.6 - Project Priority.mxd

The next most critical area showing inundation for the range of events studies is 13th Street west from the Central Railroad Corridor. This high priority project will enlarge and extend current facilities east from Main Street to the Wichita Drainage Canal and reduce flooding in the immediate vicinity while opening opportunity to drain the large sump at 14th Street between Market and Broadway. Capital costs for this entire corridor is estimated at $8.9 million.

The fourth project in the high priority sequence should be the 8th Street Diversion. This project will mitigate flooding in the commercial area near the West Murdock outfall, which currently receives overflow from sub-basins north of 8th Street. The 8th Street Diversion will both divert storm sewer flow from entering the West Murdock Outfall system and intercept overflow from the north. Capital costs for this corridor total approximately $5.0 million.

The final two high priority projects are in the 18th Street to 15th Street group. The 17th Street outfall will be the more convenient of the two to complete, as the 15th Street outfall requires boring under the Central Railroad Corridor. The 17th Street outfall will also pass under some minor railroad spurs, but the more significant crossing at the Central Railroad Corridor was put in place as part of the railroad grade separation project. These improvements provide the foundation for subsequent system enhancements upstream in the basins.

5.2 Stormwater Quality Alternatives

In Section 4, the following five tools were selected as "Preferred Stormwater Quality Tools." This section presents the additional implementation details developed for each tool.

- Street Conversions
- Green Alleys
- Tree Canopy
- Hydrodynamic Separator
- Wetlands

Implementation details are tailored for the focus areas identified in Section 4, Figure 4.3 presented the focus areas. With minor modifications these tools could also be applied in other parts of Wichita and Sedgwick County.

Table 5.2 presents the proposed implementation costs and schedule for the two water quality focus areas. Implementation is spread as evenly as possible over 10 years.

Table 5.2: Implementation Schedule and Costs

BMP Tool	Total Cost	Cost to City SW Dept.	Conceptual Schedule
Street Conversions	$1,184,000	$648,000 [1]	$81,000 per block , 2 blocks ($162,000) first year, 1 block per year for years 4-10
Green Alleys	$304,000	$152,000 [1]	$30,400 per block, 1 block per year for years 6-10
Tree Canopy	$37,000	$11,000 [2]	$1,100 (or approximately 11 trees) per year over 10 years
Hydrodynamic Separator	$193,000 + $850,000 pump station	$193,000 + $850,000 = $1,043,000	$1,043,000 in second year
Wetlands	$210,000	$210,000	$210,000 in third year

[1] Represents incremental cost increase only, i.e., the difference between using porous concrete and rain gardens rather than conventional concrete, topsoil+seed, and commercial landscaping.

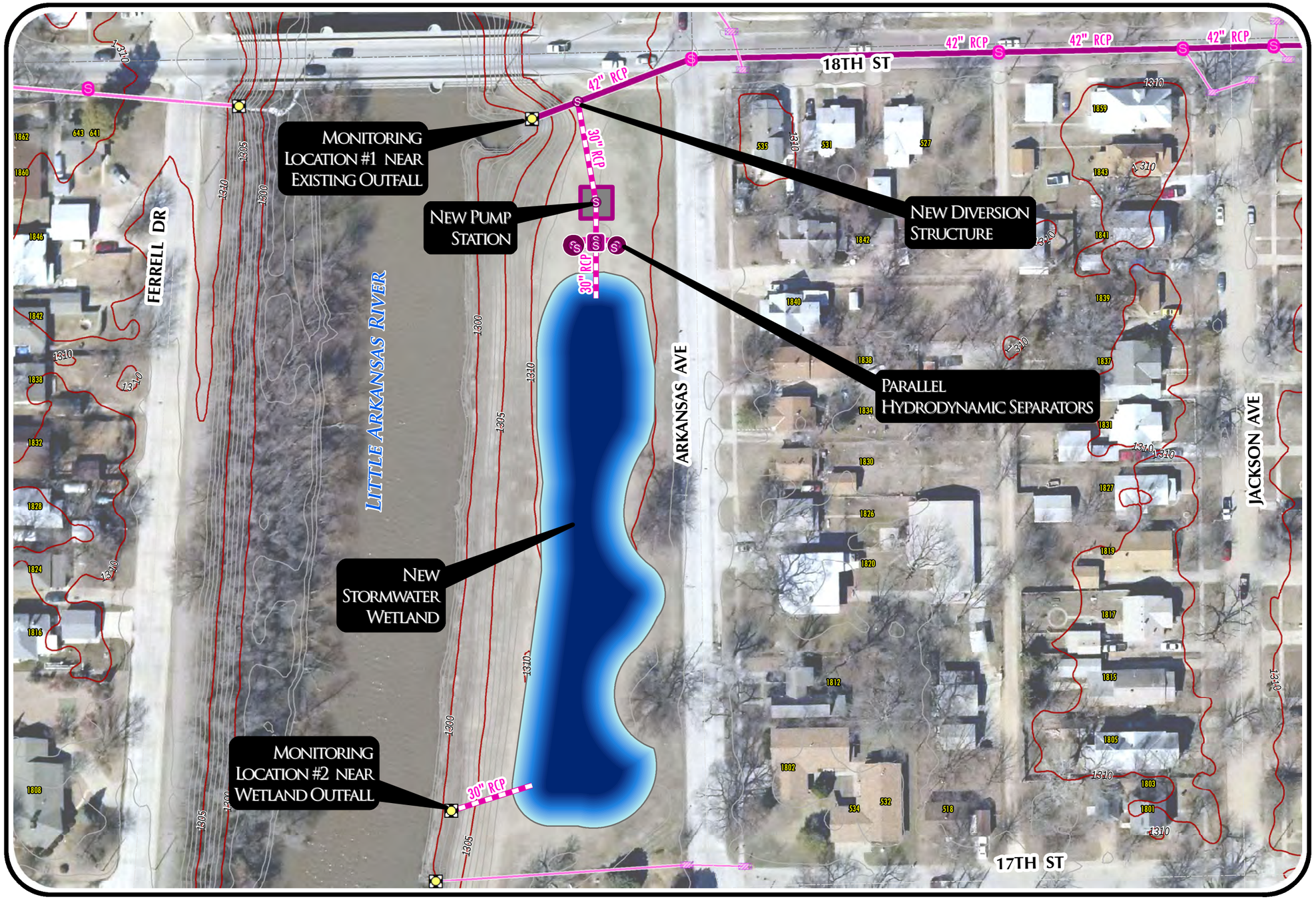
[2] Assumes that the City Stormwater Department makes available to the public a financial incentive of $100 per tree.

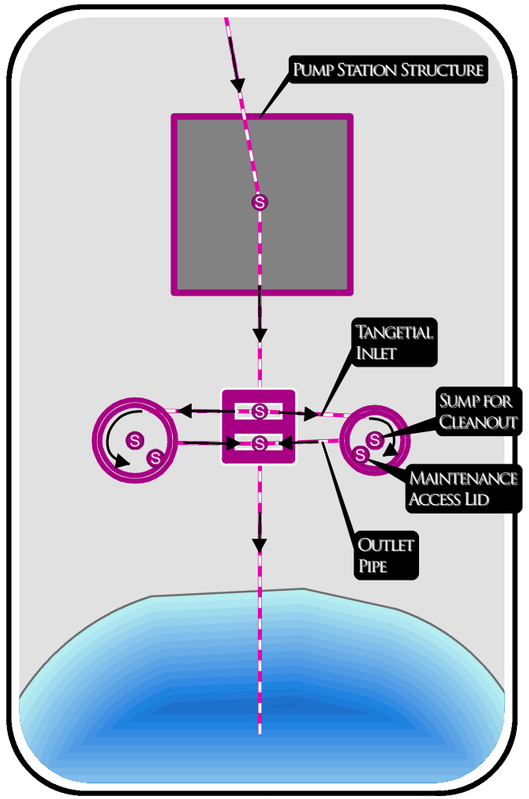
5.2.1 End-of-Pipe Measures

The end-of-pipe tools for water quality include pretreatment with a hydrodynamic separator followed by an eyebrow wetland. Both of these features are expected to handle 23 cfs, or 10,322 gpm. Flows above 23 cfs from heavier storm events would bypass the treatment components.

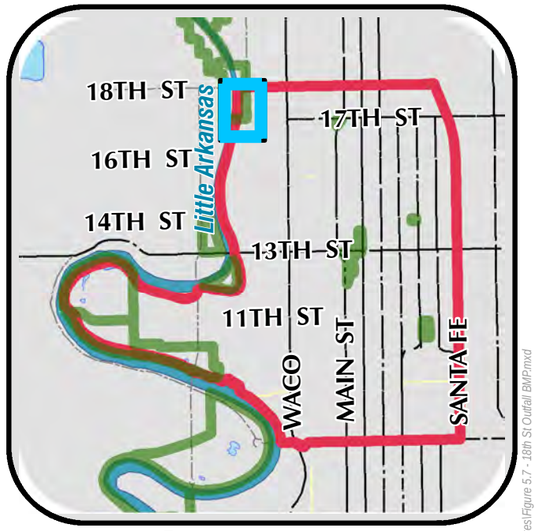
The footprint of these two treatment tools can be accommodated within the publicly owned property located at the SW corner of 18th Street and Arkansas Avenue (or east bank of Little Arkansas River at 18th Street bridge) as shown in Figure 5.7. The desired water quality storm peaks flow rate of 23 cfs should be divered from the existing 42 inch outfall pipe. This pipe is 10-15 feet lower than the area proposed for the wetland – the flat zone at the top of the bank. Due to site restrictions, pumping from the 42 inch outfall pipe to the water quality treatment components is proposed. This is not an uncommon occurrence, as many stormwater wetlands are supplied by pumps. This configuration will minimize the depth of structures the hydrodynamic separators and the earthwork required to construct the wetlands. A pump station capable of 23 cfs is expected to add $850,000 to the end-of-pipe treatment costs estimated in Section 4, tripling their costs.

Detailed design should evaluate whether the wetlands could be constructed near the toe of the bank and flow could enter the wetlands by gravity. At that time, the costs for additional earthwork, deeper structures, and extensive permitting should be compared with the pump station construction and operation pumping.





Hydrodynamic Separator Detail



Location Map

Midtown Neighborhood

Stormwater Master Plan

Figure 5.7 - 18th Street Outfall Best Management Practices

North

City of Wichita

J:\Civil\10544 - Midtown\GIS\Maps\Final Report\Figures\Figure 5.7 - 18th St Outfall BMP.mxd

As monitoring is one of the EPA's Nine Key Elements for watershed plans (see Sections 1 and 6), the City may consider evaluating stormwater runoff to document peak discharge reductions and water quality improvements. Discharge from the Focus Area is through the existing 42 inch SWS. A stormwater monitoring station should be constructed as soon as practical on this outfall line, upstream of the proposed treatment diversion works, so that background data can be collected to clearly establish the current flow quantity and quality discharged for a range of rainfall events. The monitoring station should include a flow meter, precipitation gage, and automated composite sampling equipment. A second point of stormwater runoff evaluation may be considered downstream from the wetland when these stormwater quality tools are constructed. The two monitoring points may permit a comparison of water quality and peak flow rate prior to the treatment components, against water quality and peak flow rate leaving the treatment components for specific events. Grab samples taken between the hydrodynamic separator and the wetlands will also provide data on the water quality improvement being achieved in the respective components.

5.2.1.1 Hydrodynamic Separator

The site layout assumes that two parallel HI Downstream Defenders will be constructed. Two parallel units provide equipment redundancy and simple flow splitting. In addition to providing TSS removal, which eliminates the need for a sedimentation forebay at the wetlands, the hydrodynamic separators will remove buoyant trash debris and separate oils and other hydrocarbons from the water before it enters the wetlands. This will simplify maintenance by providing simple connection points for removal and disposal of materials collected while also enhancing the aesthetics and health of the wetlands.

Vendor supplied dimensional layouts are provided in Appendix L.

5.2.1.2 Wetlands

The wetlands will receive flow from the hydrodynamic separator, and will continue the runoff treatment. In addition to TSS removal, wetlands are effective at nutrient removal and metals removal. Pollutant removal mechanisms include uptake by vegetation and algae, biological decomposition, filtering through the vegetation, and simple particulate settling.

The pump station, hydrodynamic separator, and interconnecting piping capacities are based on peak flow rates from the water quality storms. In contrast, wetlands are constructed using annual, monthly, and 24 hour runoff volumes. Since that 1.2 inch design storm produces 0.53 million gallons in a 24 hour period, it was assumed that for a monthly rainfall depth of 4.5 inches, the total monthly inflow during the wettest months of May or June would be 2 million gallons or a daily average flow into the wetlands of 0.068 million gallons per day.

With the assumption that the stormwater wetland is constrained to 600 foot x 80 foot, with a wetted area of 1 acre, a water balance check was developed for the site. Precipitation and evaporation data were obtained for the area, and evapotranspiration was determined. Average net monthly precipitation ranges from 0.5 inch greater than evapotranspiration (in the winter) to 2 inches less than evapotranspiration in the summer. Using data from other wetlands sites, the long term infiltration rate was estimated at 0.48 inches per day. With these assumptions the average daily flow in the wettest month, the wetlands would have more water in the May and June than in other summer months, but assuming average rainfall, would remain wet throughout the summer.

General wetland implementation considerations are well documented within the *Wichita/Sedgwick County Stormwater Manual* (2011).

5.2.2 Green Infrastructure

Implementation of the green infrastructure tools for water quality includes up to 5,000 linear feet of street conversions, 3,000 linear feet of green alleys and planting 105 new trees. All of these features can be added within public right of way.

A stormwater monitoring station is again required to document the Focus Area's response (for both runoff quantity and quality) before and after the water quality tools are constructed. Runoff from the entire Focus Area flows to the low point at 12th Street and Emporia. Since the drainage from this low point to larger conduits will change as the *Stormwater Master Plan* is implemented, this location at 12th Street and Emporia offers an ideal stormwater monitoring site.

The stormwater monitoring station should be constructed as soon as practicable, so that enough background data is collected to clearly establish the current flow quantity and quality response for a range of rainfall events. The monitoring station should include a flow meter, precipitation gage, and automated composite sampling equipment.

5.2.2.1 Street Conversions

Street conversions incorporate porous parking lanes, bulb-out type rain gardens at intersections, and linear rain gardens behind the curb. This combination captures a tremendous portion of the impervious area runoff in the basin. Most of the runoff from the street driving lane is captured by the porous parking lane, and much of the runoff from the fronts of adjacent lots is captured by the rain gardens. The configuration is consistent with the concepts presented in the *Transportation and Streetscape Plan*, Figure 43. To achieve the stormwater benefits that the model predicts, residential street conversions should correspond to the general cross section in Figure 5.8.

From Table 5.1, the estimated implementation cost to the City Stormwater Department is $648,000. With approximately 5,000 LF of streets included in the implementation, the incremental improvement cost is $130/LF.

Typical implementation parameters for the street conversions include the following:

- Implementation is based on the front-of-lot runoff draining through the rain garden, overflowing over the back of curb in heavier rains, and those heavier rains being carried in the curb & gutter to standard curb inlet(s). This concept is reasonably simple to implement in existing development, as it does not require significant changes in ROW grading.
- The ratio of front-of-lot impervious area (contributing impervious area) to rain garden (infiltration area) is in the range of 5:1, an acceptable ratio for rain garden implementation.
- The porous pavement in the parking lane will receive the rainfall that falls on it directly, as well as runoff from the adjacent 11' travel lane. This results in a ratio of contributing standard pavement (impervious area) to pervious pavement (infiltration area) of 1.2:1, an acceptable ratio for porous pavement implementation. Excess runoff from heavier rains will again enter the curb & gutter section and be carried to the nearest standard curb inlet(s).

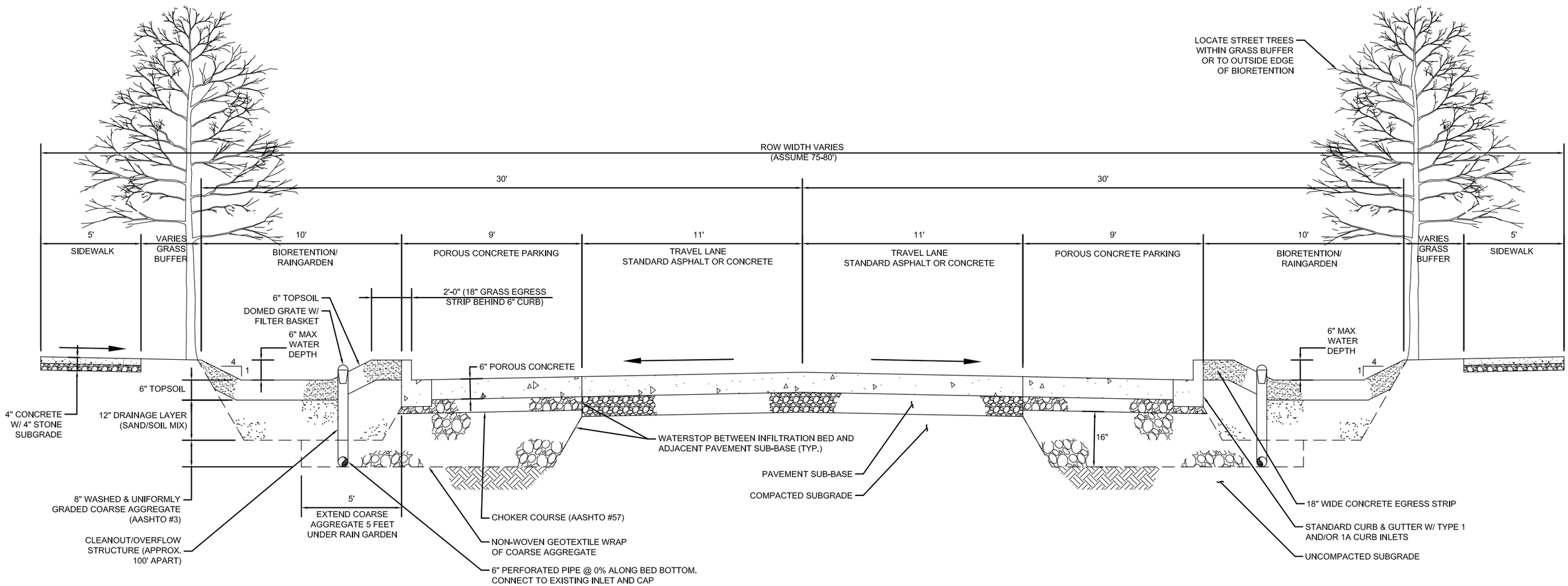


FIGURE 5.8 - GREEN STREET - TYPICAL SECTION

SCALE: 1" = 5'-0" H & 1" = 2'-6"

NORTH

MIDTOWN NEIGHBORHOOD
STORMWATER MASTER PLAN

CITY OF WICHITA

- The coarse aggregate infiltration bed will extend under both the pervious pavement and a portion of the rain garden. Current research supports making the coarse aggregate depth at least 65% of frost depth (so 0.65 * 36″ = 24″ minimum) to minimize problems caused by cold weather (e.g., frost heave, subgrade freezing). A depth of 26″ is proposed as follows:
    - Rain garden section will be 6″ topsoil, 12″ sand/soil mix & 8″ coarse aggregate extending about ½ way under the bioretention cell
    - Porous concrete section will be 26″ from adjacent gutter flowline to bottom of coarse aggregate layer
- Recommended plant species for the rain garden would include, but not be limited to those identified below in Table 5.3.

Table 5.3: Rain Garden Recommended Plant Species

Common Name	Scientific Name	Height	Bloom	Notes
Swamp Milkweed	Asclepias incarnata	2-6′	June- Sep.	[1]
Wild Blue Flag Iris	Iris virginica-shrevei	1-3′	July-Sep.	[1]
Bottle Brush Sedge	Carex hystericina	1-3′	May-June	[1]
Fox Sedge	Carex vulpinoidea	1-3′	May-June	[1]
Hop Sedge	Carex lupulina	1-4′	June-Aug.	[1]
Great Blue Lobelia	Lobelia siphilitica	1-3′	Aug.-Oct.	[1]
Cardinal Flower	Lobelia cardinalis	2-4′	July-Sep.	[1]
Common Boneset	Eupatorium perfoliatum	3-4′	July-Sep.	[1]
Soft Rush	Juncus effusus	12-18″	May-frost	[1]
Muskingum Sedge	Carex muskingumensis	2-3′	May-frost	[1]
Tussock Sedge	Carex stricta	12-18″	May-frost	[1]
Awl-Fruited Sedge	Carex stipata	12-42″	May-June	[1]
Obedient Plant	Physostegia virginiana	24-48″	May-July	[1]
Gray's Sedge	Carex grayi	1-3′	May-June	[1]
Blue Vervain	Verbena hastata	2-7′	June-Sep.	[1]
Purple Coneflower	Echinacea purpurea	24-30″	June-July	[1]
Butterfly Milkweed	Asclepias tuberosa	1-2′	June-Aug.	[1]
Black-eyed Susan	Rudbeckia hirta	1-3′	May-Sep.	[1]
Coralberry				[2]
Side Oats Gramma				[2]
Crested Sedge				[2]
"Prairie Sky" Switch Grass				[2]

[1] Source of Recommended Plantings: Midtown Neighborhood Transportation & Streetscape Plan
[2] Source of Recommended Plantings: Landscape Plan, Parking Lot Reconfiguration, Wichita Water Center

- Since this is a retrofit of existing streets, the dimensions attempt to optimize the use of space available within the ROW. These features are not sized using the *Stormwater Manual's* criteria that apply to new construction.
- The linear rain garden includes an 18″ wide grass egress strip behind the 6″ top of curb. This is necessary to allow a passenger in a parked vehicle to exit the vehicle without stepping down into the rain garden. The egress strip would typically be maintained by regularly cutting a single swath with a push-mower along the back of curb. Grass is preferred for the

egress strip rather than concrete to be consistent with the goal of minimizing impervious surfaces.

- Non-woven geotextile shall be placed at every interface between coarse aggregate infiltration bed and adjacent soil to ensure that voids in the aggregate are not compromised.
- Each coarse aggregate infiltration bed should incorporate a perforated pipe to distribute runoff along the length of the trench; minimum recommended pipe diameter is 6 inches.
- "Cleanout/Overflow" structures with domed grates shall be installed within the rain garden approximately every 100' along the perforated pipe to ensure that the storage volume is fully used before discharge occurs.

Typical rain garden maintenance requirements should include:

- Establishing Responsible Party- establishing a strategy for identifying parties to perform ongoing maintenance, and establishing a source for maintenance funding, is a critical component of the street conversion projects. Without regular maintenance, the aesthetic potential of the street conversions will not be realized. The City stormwater department does not have the number of staff that would be necessary to perform the regular maintenance, and hiring full-time staff for that purpose is not a reasonable approach. This report makes the following suggestions:
    - Alternative 1 – Create an "Adopt-a-Rain Garden" program. Schools, clubs, churches, families, volunteer organizations, non-profit organizations, businesses, etc. can "adopt" block(s) by either volunteering to perform the maintenance, or by making a donation to cover the costs for contracting the maintenance. The adopting entity is provided with a "sponsorship sign" to be mounted in the garden. This alternative would require time from a City staff member for coordination and leadership, and would likely require the City to budget a small amount for replacing non-surviving plants and providing materials to volunteers.
    - Alternative 2 – Identify "Maintenance Associations" (such as Business Improvement Districts or Neighborhood Associations) that collect small fees to cover maintenance material costs (plant replacement, mulching, insect and disease control, etc) and organize volunteers for the labor. (Alternatively, additional funds could be raised to also cover hiring labor.) This alternative could allow the City to place all maintenance responsibility and cost with the maintaining association.
    - Alternative 3 – Solicit bids for maintenance services under the premise of "job creation." Bidder selection could favor small, disadvantaged, or women-owned businesses. This alternative would require the largest budget, and would be more viable later in the program when the City has a large number of rain gardens to maintain.
- Watering – Installed plants should be watered twice a week during the summer months of the first year depending on the amount of natural rainfall. Provide adequate water as required to establish healthy, viable plantings. During other times of the year, if weather requires, watering may be occasionally necessary.
- Growing Season Bi-Monthly Maintenance – Maintenance should be conducted on a bi-monthly basis (April, June, August, October), and consist of the following activities:
    - Removing Litter and debris

    - Pruning broken or damaged twigs and/or branches
    - Replacing non-surviving plants
    - Removing noxious weeds
    - Removing dead foliage from perennials

- Early Spring Annual Maintenance – Prior to new spring growth perform the following:
    - Cut grasses to 3" above the ground.
    - Prune shrubs to remove dead, diseased, damaged or crossing branches that are causing damage by rubbing.
    - Limb trees to provide minimum 7' clearance above walks and 13' above roads.

- Noxious Weed Control
    - Apply pre-emergent control with rotary hand spreaders once in October and again in February.
    - Remove weed growth manually during monthly maintenance visits.
    - Avoid using herbicides.

As the site matures, progressively less effort required in order to control weeds. Attention on a regular basis will be necessary in order to achieve weed free planting areas.

The primary goal of porous pavement maintenance is to prevent the pavement surface and/or underlying infiltration bed from being clogged with fine particles. Typical maintenance requirements for the porous pavement portion of the street conversions include:

- **Vacuuming-** To keep the systems clean and to prolong their life, porous pavement surfaces should typically be vacuumed with a commercial-grade cleaning unit twice per year. Wait a minimum of 48 hours after a rain event before vacuuming. For significantly clogged pavement, vacuuming effectiveness is often improved using a low-pressure wash with non-toxic detergent allowed to soak-in. Vacuuming should follow immediately. There are two types of commercial-grade equipment readily available for this application (Note: simple broom sweepers are not recommended for porous pavement maintenance) :

    - **Vacuum sweepers** – Pure vacuum-type street cleaning equipment is the most effective at loosening and removing sediment from the openings in porous pavement. Fine particles are vacuumed out of the pavement matrix and are collected in the sweeper hopper. Manufacturers include Elgin, Allianz and Nilfisk. It is important to note whether a given sweeper model is a pure vacuum sweeper as often the word "vacuum" is also used to describe regenerative air sweepers (described below)
    - **Regenerative air sweepers** - Regenerative air sweeper units contain blower systems that force a high velocity air column against the pavement at an angle, and creating a "peeling" or "knifing" effect. The high volume air blast loosens debris from the pavement surface, then transports it across the width of the sweeping head and lifts it into the containment hopper via a suction tube. Regenerative air sweepers are generally less effective for porous pavements as they tend to move the sediment rather than remove it.

- **Minimizing Sediment/Contaminant Loading**:

    - Maintain planted areas adjacent to pavement to prevent soil washout onto the porous pavement
    - Immediately clean any soil deposited on porous pavement

- Do not allow construction staging, soil/mulch storage, etc. on unprotected porous pavement surfaces
- Trucks or other vehicles should be prevented from tracking or spilling dirt onto the porous pavement
- All construction or hazardous materials carriers should be discouraged from entering the porous pavement area

- **Snow/Ice Removal**
  - Do not apply abrasives such as sand or cinders on or adjacent to porous pavement
  - Snow plowing is acceptable if done carefully (i.e. set the blade slightly higher than usual and/or use a plastic plow guard)
  - Salt application is acceptable, although more environmentally-benign deicers are preferable

- **Repairs**
  - Never seal-coat the surface.
  - Inspect for pavement rutting/raveling/scuffing on an annual basis (some minor ruts may occur in the porous pavement from stationary wheel rotation)
  - Patch small damaged areas (less than 50 square feet) with porous or standard pavement
  - Patch larger areas patched with an approved porous pavement

Deviatons from Figure 5.8 on non-residential streets (e.g, Broadway) must be coordinated with the *Streetscape Plan*. In general, the following deviations are expected:

A third "travel lane" would be added to function as a center turn lane. As a result, one porous parking lane may be eliminated (porous parking lane may only exist on one side of the street)

Concrete sidewalk could often exist from building storefronts to back of curb. The linear rain garden parallel to the back of curb would then not exist. Instead, bulb-out type rain gardens would exist periodically at locations such as intersections, entrances to alleys, parking lots, or parking garages, etc.

5.2.2.2 Green Alleys

Whereas the street conversions are planned to capture a significant portion of runoff from lot fronts, green alley conversions are planned to capture runoff from the backs of the lots. To achieve the stormwater benefits predicted in the modeling, the green alleys should conform to the conceptual plan in Figure 5.9.

Implementation is based on the back-of-lot runoff draining via overland flow and onto the porous pavement of the alley, with a valley-gutter type cross-section. This concept is reasonably simple to implement in existing development, as it does not require significant changes in right of way grading.

Critical to success of this concept will be healthy vegetation beyond the riverstone edge of the porous pavement to prevent soil washout onto the pavement. If healthy vegetation or other stabilized surface does not exist, or cannot be established and maintained, variations to the green alley concept may need to be considered.

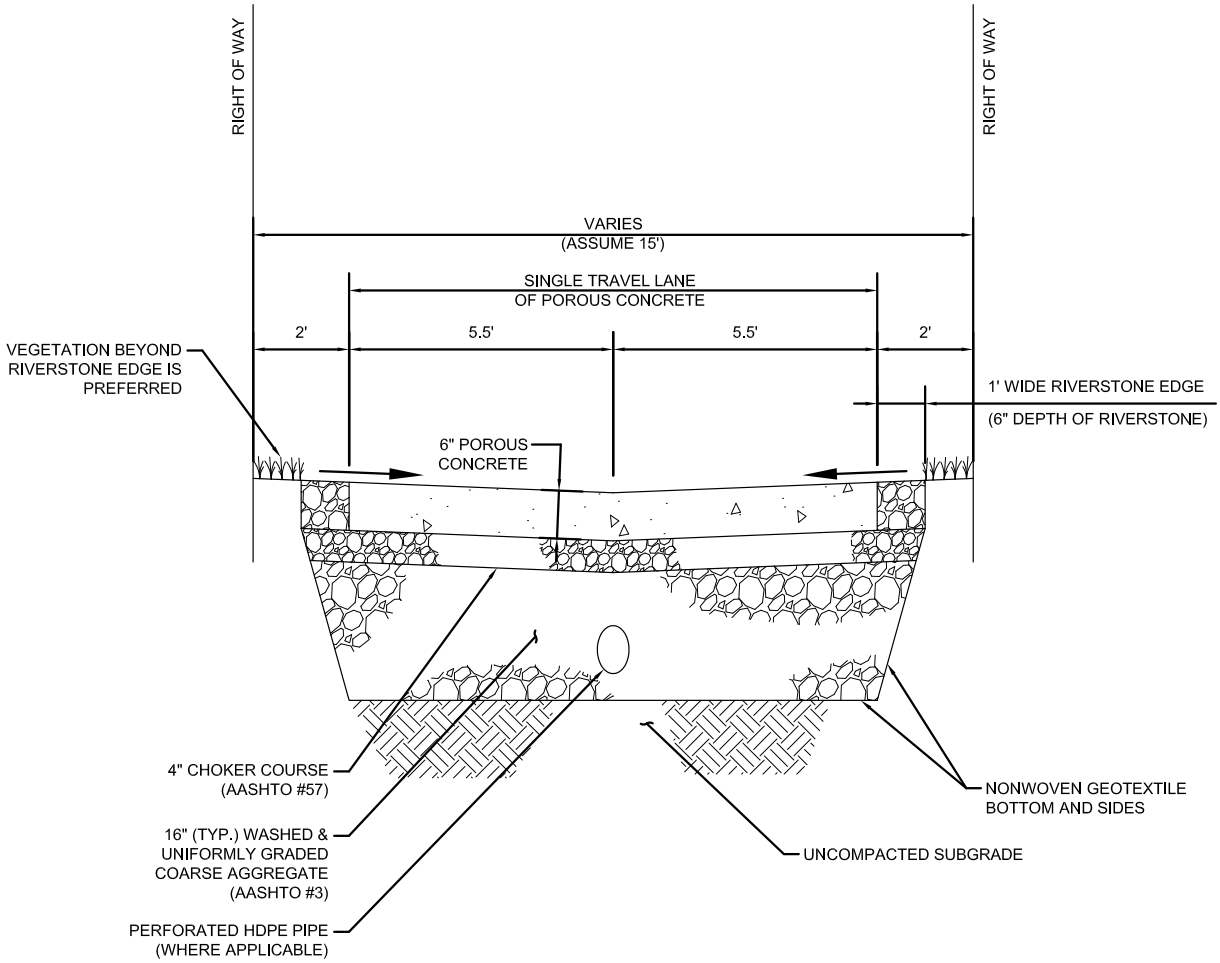


FIGURE 5.9 - GREEN ALLEY - TYPICAL SECTION

SCALE: 1" = 4'-0" H & 1" = 2'-0"

As discussed for the Street Conversion, a depth of 26" is proposed for the bottom of the coarse aggregate infiltration bed.

Maintenance requirements would mirror those discussed previously for the porous pavement portion of the Street Conversions.

5.2.2.3 Tree Canopy

Maximizing the tree canopy also has high potential for providing stormwater benefits. In general, trees are most effective at reducing runoff from smaller, more frequent storms. Trees reduce stormwater runoff by capturing and storing rainfall in the canopy and releasing water into the atmosphere through evapotranspiration. Tree roots create soil conditions that promote the infiltration of rainwater into the soil. The presence of trees also helps to slow down and temporarily store runoff, which further promotes infiltration. Trees take up nutrients and other pollutants from soil and water through their roots.

In addition to these stormwater benefits, trees provide improved air quality, reduced air temperatures in summer, reduced heating and cooling costs, increased property values, increased business traffic in commercial districts, habitat for wildlife, and recreational and aesthetic value. For these reasons, many communities are beginning to evaluate their current tree canopies and are setting goals for increasing the canopy cover. The *Transportation and Streetscape Plan*, pg. 54) incorporates tree canopy improvements in its proposed street conversions.

To achieve the predicted stormwater benefits , this plan recommends enhancing the tree canopy as discussed below. Typical implementation parameters for tree canopy improvements include the following:

- Spacing between trees should average 40 feet, though this spacing will vary based on the size and species used. Approximately 105 new tree plantings are proposed.
- Street Trees: the *Transportation and Streetscape Plan,* pg. 54) recommends tree species for various locations. For street trees implemented in conjunction with Street Conversions discussed previously (and illustrated in Figure 5.8), compatibility of the trees with their proximity to the linear rain garden will be critical. The Midtown Neighborhood Transportation and Streetscape Plan favors use of the American Sycamore and Red Maple in those locations although a number of other species are suitable. The Transportation Plan also recommends species for commercial streets and intersections.
- Private Property Trees: Various strategies are available to increase the tree canopy on private property. These include revising site re-development regulations regarding landscaping or parking lot shading, as well as promoting the planting and care of trees on private land through education, stewardship and incentive programs. An example incentive program is the "RainScapes Rewards Rebates Program" established by Montgomery County, Maryland. (see Sources of Information for a web link). This program provides financial incentives to property owners who implement the same stormwater management tools discussed in Sectoin 4.6.2 for Midtown (tree canopy, rain gardens, porous pavement, green roofs, rain barrels, etc).

As another example, since 2008, Casey Trees, with funding from the District Department of the Environment (DDOE), has provided rebates to Washington D.C. residents who purchase and plant trees on private property in the District. Select tree species noted for their large canopy and

significant environmental benefits qualify for rebates up to $100 per tree. Small and medium canopy trees are eligible for rebates of up to $50 per tree. There is no maximum number of rebates that may be submitted per property.

These concepts are compatible with the approach used in the cost estimates in Section 4, Table 4.8, where the cost to the City stormwater department would only be those financial incentives of $100 per tree (similarly, the cost estimates assume $5 per sq.ft. of green roof installed and $75 per rain barrel). Implementation of such a program in the City of Wichita would enable the stormwater department to grant property owners credits to their stormwater utility bills after the steps of application, application approval, construction, inspection, and proof of expenses have been completed. Applying the "rebate" as a credit to the property owner's normal bill, rather than mailing rebate checks to the property owners, could reduce the implementation costs of the program.

6. EPA'S NINE MINIMUM ELEMENTS TO BE INCLUDED IN A WATERSHED PLAN

As discussed briefly in Section 1, the minimum elements to be included in a watershed plan comprise the following[2]:

1. Causes of impairment and pollution sources
2. Estimate of expected load reductions
3. Description and location of management measures
4. Estimate of technical resources and financial assistance needed
5. Information and education (I/E) component
6. Implementation schedule
7. Interim measureable milestones
8. Criteria for determining whether load reductions are being achieved
9. Monitoring component to evaluate effectiveness

Adhering to these criteria allows projects recommended in this *Stormwater Master Plan* to qualify for Section 319 grants. The following paragraphs describe the ways in which this *Stormwater Master Plan* specifically addresses these elements.

1. Causes of impairment and pollution sources *(EPA Item a)* – Potential sources of pollution within the Planning Area are associated with the various land use categories. Data from local stormwater samples and from nationwide literature reviews provide current pollutant load values for TSS, Total Nitrogen, Total Phosphorus, Cadmium, Copper and Zinc to establish an Event Mean Concentration for each land use. These parameters were selected for analysis because the Little Arkansas River is currently listed for nutrient oxygen demand and sediment impairments. Consequently, the City's MS4 permit regulates TSS and these nutrients, along with the three metals as PPOCs. The Event Mean Concentration values thus established were assigned to land uses within the Planning Area, and the PCSWMM model generated pollutant mass estimates for each parameter in each sub-basin. The pollutant mass estimates were then divided by the sub-basin area to calculate estimated pollutant loads in pounds per acre for each sub-basin (see Appendix J).

2. Estimate of expected load reductions (*EPA Item b)* – Management measures in the form of BMP tools were evaluated within two smaller Focus Areas (see Figure 4.3) The PCSWMM model was used to determine potential pollutant load reductions within the East 13th Street Focus Area, where Green Infrastructure BMP tools were evaluated. Vendors provided performance projections and wetlands sizing criteria, which were used to estimate potential pollutant load reductions for the West 18th Street Focus Area, where "End-of-Pipe" measures were evaluated. These measures were evaluated using a consistent point of comparison (cost per pound of TSS removed) and using identical non-economic criteria to select five preferred BMP tools for implementation in the Planning Area.

[2] Paraphrased from the Handbook for Developing Watershed Plans to Restore and Protect Our Waters, EPA March 2008, pp 2-15 through 2-18.

3. Description and location of management measures *(EPA Item c)* – Implementation details are provided for each of the five preferred BMP tools. These details include expected location, a typical layout, guidelines for success, and expected maintenance requirements (see Section 5).

4. Estimate of technical resources and financial assistance needed *(EPA Item d)* – Probable construction cost estimates are provided for each of the five preferred BMP tools. The implementation plan suggests alternative approaches to managing the various programs. Plan components such as ongoing Stormwater quality monitoring; identifying who will implement the program components; assigning responsibility for the ongoing information and education (I/E) activities; and others as suggested by the *Nine Minimum Elements,* must be implemented by the City after completion of this *Stormwater Master Plan*.

5. Information and education (I/E) component *(EPA Item e)* – A public outreach component was included with the *Stormwater Master Plan* to keep all Midtown residents apprised of the Plan's progress; garner feedback about their experiences during rain events; and educate them about stormwater quantity and quality issues. Additional technical information on each BMP was explored with the steering committee members (see Section 2).

6. Implementation schedule *(EPA Item f)* – In Section 5 this *Stormwater Master Plan* proposes a schedule for implementing the five recommended BMP tools at various locations. Milestones for Green Infrastructure BMPs are measured based on blocks managed per year, or trees planted per year. The schedule proposes specific years for installing each of the End-of-Pipe BMPs. Gauging progress against these milestones will be simple and straightforward.

7. Interim measureable milestones *(EPA Item g)* – Milestones in addition to those established above in EPA Item (f), include:

    - Establishing a party responsible for maintaining the rain gardens that will be constructed with street conversions. This must occur during the first year to ensure that a plan is in place before street conversion for the first two blocks is complete.

    - Implementing a program to reward private property owners for planting trees, and perhaps for implementing other BMP tools, on their property. The *Stormwater Master Plan* recommends implementing this in the first year in order to accrue benefits as quickly as possible.

8. Criteria for determining whether load reductions are being achieved *(EPA Item h)* – Expected pollutant load reduction for each BMP tool was established in Section 3. Section 5 recommends monitoring locations. Monitoring should begin prior to implementing BMP tools so that baseline conditions for both stormwater quantity and stormwater quality parameters can be established. As the five preferred BMP tools are implemented, continued stormwater flow and quality monitoring at the same location will provide direct measurement of the benefit being achieved.

9. Monitoring component to evaluate effectiveness (*EPA Item i)* – As the monitoring discussed in EPA Item (h) above occurs, collected data should be analyzed each year and compared to the pollutant load reductions projected in Section 3 of this *Stormwater Master Plan*.

REFERENCES

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Two-Dimensional Model between Hickman Mills Drive and 63rd Street USGS, Missouri Water Science Center URL: http://mo.water.usgs.gov/indep/kelly/blueriver/model/ph2model.htmlTwo Dimensional Mode between 63rd street and Blue Parkway, USGS, Missouri Water Science Center, http://mo.water.usgs.gov/indep/kelly/blueriver/model/ph1model.html

City of Wichita GIS Information, November 29, 2010

"Handbook for Developing Watershed Plans to Restore and Protect Our Waters," U. S. Environmental Protection Agency, 2008 Section 2.6 *et seq*.

LIDAR information provided by City of Wichita (Merrick & Company, April 8, 2009)

National Stormwater Quality Database, Version 1.1 (A. Maestsre, R. Pitt, and Center for Watershed Protection, 2005)

APPENDIX A – Stormwater Code Violations

- **Minimum Fines Applicable to General Violations**
  - Illegal Discharge/Illegal Dumping (Section 16.32.020)..... $365.00
  - Failure to Comply with Directive, Citation or Order (Section 16.32.100A)..... $565.00
- **Minimum Fines Applicable to Construction Sites**
  - Fail to Maintain or Repair a BMP (Section 16.32.050A.2) $365.00
  - Failure to Prepare or Implement a Pollution Prevention Plan (Section 16.32.050B.2). $365.00
  - Failure to Use Effective BMP (Section 16.32.050A.1) $365.00
  - Malicious Destruction of BMP Devices (Section 16.32.050A.7)..... $365.00
  - Failure to Repair BMP Devices (Section 16.32.050A.7)..... $365.00
- **Minimum Fines Applicable at Industrial Sites**
  - Failure to Prepare or Implement Pollution Prevention Plan (Section 16.32.060A.2) ... $565.00
  - Failure to Implement Sampling or Testing (Section 16.32.060A.12) $560.00
- **Minimum Fines Applicable to Private Ditches or Ponds**
  - Failure to Use Effective BMP Devices (Section 16.32.070A) $365.00

Source of Information:
http://www.wichita.gov/CityOffices/MunicipalCourt/Tickets/FineSchedules.htm

APPENDIX B – Known Flooding Areas Identified by Public

Known Flooding Areas Identified by Public

- Near the APEX business– 12th and Wellington
- Randall Manor St. - Subdivision in the area drains to the backyard of Chris Hernandez. Chris stated that his yard is approx. 3 feet lower than surrounding paved ground. Water typically infiltrates within a few hours.
- 13th and Park
- 11th and Bitting (near the Perk Coffee shop)
- 15th and 16th and Market – Family at the meeting had a paper route in this area. Streets were passable in SUV but high water at these locations was problematic for lower vehicles.
- Fairview and 14th – Street flooding was said to linger for 3 to 4 days.
- 14th and Market – 12-15″ of water in the streets during high rain events. However did not have flooding on Market and Park/Main north of 16th
- 9th and Topeka – St. Francis area
- Topeka and Emporia – b/w 10th and 12th rushing water "you can canoe it" per Councilwoman Janet Miller. She inquired about potential of placing BMP at 10th and Emporia to correct.
- 10th b/w Emporia and St. Francis
- 13th b/w Park and Otis - water covers the crown of the road
- Basement flooding near Emporia and 11th
- Undersized or clogged inlets on 11th 10th Jefferson and Lewellen identified by Councilwoman Miller.

Water Quality Concerns and Questions

- Questioned whether residential driveways could be replaced with porous pavement?
- Homeowner described stormwater runoff smelling of diesel overtopped the curb and killing grass.
- Many expressed interest in rain barrel and rain garden programs. Suggestion that rain barrels be mandatory.
- Homeowners don't know what they can/can't do within easements on their property. (Is it OK to build raingardens within the easements?)
- Concern that maintenance won't occur on BMPs. Lack of maintenance of planters in front of the library was cited as an example.
- Education was felt to be key to successful BMP implementation.

- Questioned whether maintaining green space can be required by law?
- Some did not realize that SW doesn't go through WWTP. Concerned that infiltration might pollute GW…did not realize that alternative is direct discharge to river.
- Questioned whether garden at Otis Park was a rain garden? Andy drove by the park this morning. He noted that it is "almost a raingarden." It is a good example for the public of what a rain garden would look like but receives little runoff.
- Mixed reviews of the linear bike path. APEX employees noted that they saw little traffic on it but others at the meeting reported using it.

APPENDIX C – Project Prioritization Votes

MIDTOWN STORMWATER MASTER PLAN
PROJECT PRIORITIZATION

Project	17th Street Corridor	Cost	Priority
1	17th St. East of Broadway	$ 2,260,000	
2	15th Street	$ 4,600,000	
3	16th Street & Santa Fe	$ 2,400,000	
4	Broadway, 17th to 16th	$ 610,000	
5	St. Francis, 17th to 16th	$ 340,000	
	13th Street Corridor		
6	13th St.	$ 5,770,000	2
7	14th (west) to Park Place, south to 13th	$ 980,000	
8	14th (east) to Santa Fe, south to 13th	$ 1,160,000	
9	12th (west) to Wellington, north to 13th	$ 1,480,000	
10	12th (east) to Emporia, north to 13th	$ 1,680,000	1
	Murdock West Corridor		
11	9th St. - Main to Lewellen	$ 1,090,000	
12	8th St. West of Main	$ 370,000	
13	Lewellen disconnect	$ 1,940,000	
	Murdock East Corridor		
14	11th Street	$ 1,450,000	5
15	10th Street	$ 4,280,000	3
16	Murdock - Broadway to WDC	$ 3,120,000	4
17	North at Broadway to 9th	$ 930,000	
18	9th East of Broadway	$ 460,000	
19	8th Street	$ 360,000	
	West 16th (Arkansas) Corridor		
20	16th Street	$ 690,000	

HISTORIC MIDTOWN

MIDTOWN STORMWATER MASTER PLAN
PROJECT PRIORITIZATION

Project	17th Street Corridor	Cost	Priority
1	17th St. East of Broadway	$ 2,260,000	
2	15th Street	$ 4,600,000	
3	16th Street & Santa Fe	$ 2,400,000	
4	Broadway, 17th to 16th	$ 610,000	
5	St. Francis, 17th to 16th	$ 340,000	
	13th Street Corridor		
6	13th St.	$ 5,770,000	2
7	14th (west) to Park Place, south to 13th	$ 980,000	
8	14th (east) to Santa Fe, south to 13th	$ 1,160,000	
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11	9th St. - Main to Lewellen	$ 1,090,000	
12	8th St. West of Main	$ 370,000	
13	Lewellen disconnect	$ 1,940,000	
	Murdock East Corridor		
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19	8th Street	$ 360,000	
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20	16th Street	$ 690,000	

MIDTOWN STORMWATER MASTER PLAN
PROJECT PRIORITIZATION

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20	16th Street	$ 690,000	

MIDTOWN STORMWATER MASTER PLAN
PROJECT PRIORITIZATION

Project	17th Street Corridor	Cost	Priority
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	Murdock East Corridor		
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20	16th Street	$ 690,000	

MIDTOWN STORMWATER MASTER PLAN
PROJECT PRIORITIZATION

Project	17th Street Corridor	Cost	Priority
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17	North at Broadway to 9th	$ 930,000	3
18	9th East of Broadway	$ 460,000	
19	8th Street	$ 360,000	
	West 16th (Arkansas) Corridor		
20	16th Street	$ 690,000	

APPENDIX D – Comment Cards

City of Wichita Public Works and Utilities Department

Midtown Neighborhood Community Planning Meeting

Historic Midtown Stormwater, Transportation and Streetscape Plan

CITY OF WICHITA

Address: 1313 N. Emporia Date: 12-16-10

My main concern about stormwater in Midtown is: flooding during heavy rains -

My main concern about Transportation and Streetscaping is: lack of lighting I hate the one-way streets

If we could only do one thing to improve Stormwater, Transportation and Streetscaping in Midtown it would be: Get rid of one-way residential streets!

Other:

City of Wichita Public Works and Utilities Department

Midtown Neighborhood Community Planning Meeting

Historic Midtown Stormwater, Transportation and Streetscape Plan

CITY OF WICHITA

Address: 1512 Park Place Date: 12- -10

My main concern about stormwater in Midtown is: Street flooding

My main concern about Transportation and Streetscaping is: speed

If we could only do one thing to improve Stormwater, Transportation and Streetscaping in Midtown it would be:

Other:

City of Wichita Public Works and Utilities Department

Midtown Neighborhood Community Planning Meeting

Historic Midtown Stormwater, Transportation and Streetscape Plan

CITY OF WICHITA

Address: 1733 N. MARKET Date: 12/16/10

My main concern about stormwater in Midtown is: FLOODING - ENVIRONMENT

My main concern about Transportation and Streetscaping is: SPEEDING / SAFETY LIGHTING

If we could only do one thing to improve Stormwater, Transportation and Streetscaping in Midtown it would be:

Other:

City of Wichita Public Works and Utilities Department

Midtown Neighborhood Community Planning Meeting

Historic Midtown Stormwater, Transportation and Streetscape Plan

CITY OF WICHITA

Address: 1346 N Emporia Date: 10/15/10

My main concern about stormwater in Midtown is: ~~[illegible]~~ environmental

My main concern about Transportation and Streetscaping is: Speed Beautification

If we could only do one thing to improve Stormwater, Transportation and Streetscaping in Midtown it would be: increased greenery

Other:

City of Wichita Public Works and Utilities Department

Midtown Neighborhood Community Planning Meeting

Historic Midtown Stormwater, Transportation and Streetscape Plan

CITY OF WICHITA

Address: 1833 N. Market Date: 12-16-10

My main concern about stormwater in Midtown is: 14th & Market flooding & 12th & Topeka

My main concern about Transportation and Streetscaping is: traffic too fast on 1-way streets - would like 2-way or add bike lane to 1-way streets

If we could only do one thing to improve Stormwater, Transportation and Streetscaping in Midtown it would be:

Other:

City of Wichita Public Works and Utilities Department

Midtown Neighborhood Community Planning Meeting

Historic Midtown Stormwater, Transportation and Streetscape Plan

CITY OF WICHITA

Address: 1320 N Topeka St Date: 12/16/10

My main concern about stormwater in Midtown is: Flooding

My main concern about Transportation and Streetscaping is: Speed & lighting

If we could only do one thing to improve Stormwater, Transportation and Streetscaping in Midtown it would be: Speed

Other: Crime

City of Wichita Public Works and Utilities Department

Midtown Neighborhood Community Planning Meeting

Historic Midtown Stormwater, Transportation and Streetscape Plan

CITY OF WICHITA

Address: 1320 N TOPEKA Date: 16 DEC 10

My main concern about stormwater in Midtown is: FLOODING IN STREET

My main concern about Transportation and Streetscaping is: TRAFFIC FLOW AND SPEED ON MY STREET

If we could only do one thing to improve Stormwater, Transportation and Streetscaping in Midtown it would be: TRAFFIC FLOW AND SPEED

Other:

City of Wichita Public Works and Utilities Department

Midtown Neighborhood Community Planning Meeting

Historic Midtown Stormwater, Transportation and Streetscape Plan

CITY OF WICHITA

Address: Date: 12/16/10

My main concern about stormwater in Midtown is: that storm drains are not draining fast enough; water goes up over

My main concern about Transportation and Streetscaping is: speeding; need more crosswalks, bike lanes, & traffic calming features

If we could only do one thing to improve Stormwater, Transportation and Streetscaping in Midtown it would be:

Other:

City of Wichita Public Works and Utilities Department

Midtown Neighborhood Community Planning Meeting

Historic Midtown Stormwater, Transportation and Streetscape Plan

CITY OF WICHITA

Address: 1905 PARK PLACE Date: 3-17-2011

My main concern about stormwater in Midtown is: TRASH / BLOCKAGES IN DRAINS

My main concern about Transportation and Streetscaping is: CONFUSING TRAFFIC FLOW; SHABBY STREETS - TRASH

If we could only do one thing to improve Stormwater, Transportation and Streetscaping in Midtown it would be: HAVE ALL BUSES ON BROADWAY ONLY.

Other:

City of Wichita Public Works and Utilities Department

Midtown Neighborhood Community Planning Meeting

Historic Midtown Stormwater, Transportation and Streetscape Plan

CITY OF WICHITA

Address: 1512 Park Place Date: 3-17-11

My main concern about stormwater in Midtown is: Corner flooding every heavy rain

My main concern about Transportation and Streetscaping is: Cut down Speeding along our street

If we could only do one thing to improve Stormwater, Transportation and Streetscaping in Midtown it would be: Storm sewers large enough to dispel excess water

Other:

City of Wichita Public Works and Utilities Department

Midtown Neighborhood Community Planning Meeting

Historic Midtown Stormwater, Transportation and Streetscape Plan

CITY OF WICHITA

Address: 1313 N. Emporia Date: 3/17/11

My main concern about stormwater in Midtown is: Street Flooding on St. Francis and Emporia

My main concern about Transportation and Streetscaping is: traffic on one-way Streets - make them all 2 way

If we could only do one thing to improve Stormwater, Transportation and Streetscaping in Midtown it would be: fix the drainage problems

Other:

City of Wichita Public Works and Utilities Department

Midtown Neighborhood Community Planning Meeting

Historic Midtown Stormwater, Transportation and Streetscape Plan

CITY OF WICHITA

Address: 1313 N. Emporia Date: 3-17-11

My main concern about stormwater in Midtown is: flooding - standing water

My main concern about Transportation and Streetscaping is: One way streets, lighting

If we could only do one thing to improve Stormwater, Transportation and Streetscaping in Midtown it would be: Change one way to two way

Other:

City of Wichita Public Works and Utilities Department

Midtown Neighborhood Community Planning Meeting

Historic Midtown Stormwater, Transportation and Streetscape Plan

CITY OF WICHITA

Address: 1449 N Fairview Date: 3-17

My main concern about stormwater in Midtown is: New Drains Saving Storm Water

My main concern about Transportation and Streetscaping is: Beautification & flow

If we could only do one thing to improve Stormwater, Transportation and Streetscaping in Midtown it would be: Storm Water

Other:

City of Wichita Public Works and Utilities Department

Midtown Neighborhood Community Planning Meeting

Historic Midtown Stormwater, Transportation and Streetscape Plan

CITY OF WICHITA

Address: 1323 N. Emporia Date: 3-17-11

My main concern about stormwater in Midtown is: the pollution that ~~the~~ runs to the river

My main concern about Transportation and Streetscaping is: our sidewalks in many places are right against the ~~street~~. not pedestrian friendly

If we could only do one thing to improve Stormwater, Transportation and Streetscaping in Midtown it would be: make the street lanes more narrow so sidewalks aren't right against traffic

Other:

City of Wichita Public Works and Utilities Department

Midtown Neighborhood Community Planning Meeting

Historic Midtown Stormwater, Transportation and Streetscape Plan

CITY OF WICHITA

Address: 1833 N Market Date: 3-17-11

My main concern about stormwater in Midtown is: areas that don't drain well

My main concern about Transportation and Streetscaping is: amount & speed of traffic

If we could only do one thing to improve Stormwater, Transportation and Streetscaping in Midtown it would be: make 1-way streets into 2-way street

Other:

City of Wichita Public Works and Utilities Department

Midtown Neighborhood Community Planning Meeting

Historic Midtown Stormwater, Transportation and Streetscape Plan

CITY OF WICHITA

Address: 1245 N. Emporia Date: 3/17/11

My main concern about stormwater in Midtown is: flooding on Emporia

My main concern about Transportation and Streetscaping is: beautification of existing streets & poor lighting on residential street

If we could only do one thing to improve Stormwater, Transportation and Streetscaping in Midtown it would be: beautification / Midtown identity

Other:

City of Wichita Public Works and Utilities Department

Midtown Neighborhood Community Planning Meeting

Historic Midtown Stormwater, Transportation and Streetscape Plan

CITY OF WICHITA

Address: 1218 N. Larimer Date: 03-17-11

My main concern about stormwater in Midtown is:

My main concern about Transportation and Streetscaping is: slower, better managed traffic

If we could only do one thing to improve Stormwater, Transportation and Streetscaping in Midtown it would be: natural ways to manage rain water

Other: (rain barrels, rain gardens)

City of Wichita Public Works and Utilities Department

Midtown Neighborhood Community Planning Meeting

Historic Midtown Stormwater, Transportation and Streetscape Plan

CITY OF WICHITA

Address: publicmail@CFaith.com Date: 3/17/11

My main concern about stormwater in Midtown is: NOT A DIRECT CONCERN

My main concern about Transportation and Streetscaping is: TRAFFIC TOO FAST

If we could only do one thing to improve Stormwater, Transportation and Streetscaping in Midtown it would be: MAKE IT PRETTY!

Other: BUS SERVICE IS NOT COST/TIME EFFECTIVE

City of Wichita Public Works and Utilities Department

Midtown Neighborhood Community Planning Meeting

Historic Midtown Stormwater, Transportation and Streetscape Plan

CITY OF WICHITA

Address: 1245 N. Emporia Date: 17 March 20

My main concern about stormwater in Midtown is: Flooding on Emporia that overflows onto the front lawn & in parked cars

My main concern about Transportation and Streetscaping is: Lighting on side streets & beautification

If we could only do one thing to improve Stormwater, Transportation and Streetscaping in Midtown it would be: Stormwater

Other:

APPENDIX E – Steering Committee Meeting Agendas

AGENDA

Midtown Neighborhood Implementation Plan – Steering Committe

December 16, 2010
5:30-6:30 p.m.

Meeting called by Janet Miller

Meet & Greet	Steering Committee Arival Pop/Pizza	All	15 minutes
Introduction	Welcome	CM Miller	10 minutes
Meet the Team	Introduce core team members/consultants	Gary	10 minutes
Overall Plan/Process	Description of overall process	Britt/Mark	15 minutes
Committee Member Roles & Responsibilities	Describe expectations	Denise	10 minutes
Next Steps	Timeline review/next meeting	Denise	5 minutes

AGENDA

Midtown Plan – Steering Committee Meeting

February 9, 2011
6:30-8:00 p.m.
Midtown Community Resource Center

Host: Janet Miller

Meet & Greet	Steering Committee arrival	CM Janet Miller	5 minutes
Status - Stormwater	• Stormwater System Explanation • Progress Report • Televised conduits • Stormwater quality best practices	Scott Lindebak/ Mark Buckingham	30 minutes
Status Streetscape/ Transportation	• Progress Report • Web survey results • One way/two way street discussion	Tim Aziere	30 minutes
2nd Community Meeting Promotion	• Review promotion plan • Brainstorm new ideas • Sign-up for promotion activities	Denise Peters	15 minutes
Meeting Dates	• Approve Next Steering Committee meeting Date of March 3, 2011 • Plan meeting dates for both Stormwater Study and Streetscape/Transportation	Denise Peters	10 minutes

AGENDA

Midtown Plan – Steering Committee Meeting

March 3, 2011
6:30-8:00 p.m.
Midtown Community Resource Center

Host: Janet Miller

Meet & Greet	Steering Committee arrival	CM Miller	5 minutes
2nd Community Meeting Promotion	• Identify walk territories for door hanger distribution • Fliers for churches and local businesses • School Engagement • Midtown Website (Gladys) • Spanish Radio Announcement	CM Miller	25 minutes
Stormwater	• Revisit City's storm water sewer system/ • How it Works. ▪ Televised conduits • Review Storm Water MP project scope and provide status of effort • Present output from the Water Quality modeling effort (pollutants) • Best Management Practices (BMPs) under consideration to address pollutants • Feedback from the Committee about what BMPs they would most like to see in Midtown-based on material printed at last meeting	Mark Buckingham Scott Lindebak Mark Buckingham	30 minutes
Status Streetscape/ Transportation	• Traffic study results • Street layouts options for 13th & Broadway corridors • Discuss possibilities of rain gardens • Go over keypad polling questions for next public meeting • Update on survey results (the Spanish version is on the web)	Tim Aziere Britt Palmberg	25 minutes
Wrap up & next steps	• Hand-out door hangers and fliers	CM Miller	5 minutes

To report leaf violations: 268-4498 or 'wichita' (942-4482)
For residential, provide address
For commercial, provide company name and phone number

AGENDA

Midtown Plan – Steering Committee Meeting

May 5, 2011
6:30-8:00 p.m.
Evergreen City Hall

Host: Janet Miller

Meet & Greet	Steering Committee arrival	CM Miller	5 minutes

3rd Community Meeting Promotion	• Direct Mailing - Postcard
	• Survey Door Hangers
	• Schools – Backpack Fliers
	• Media Outreach
	  ○ City7
	  ○ Spanish Radio
	  ○ Media Advisory
	• Community Outreach
	  ○ NOMAR Open House 5/7
	  ○ Safe Streets 5/15
	  ○ Others?
		CM Miller	15 minutes

Streetscape/ Transportation	• Review of latest thinking and final recommendations for street layout for Broadway, 13th, Main, Market, Topeka, Emporia, and St Francis • Review of latest thinking and recommendations for streeetscape elements (rain garden, bulbouts, etc.) that will tie with the stormwater plan • Preview of our thinking in terms of phasing and prioritization (and solicitation of feedback from the group) • Review of graphical style and table of contents for the master plan document (which we are working on now). This will include text completed to date	Britt Palmberg	45 minutes
Stormwater	• Stormwater Sewer system improvements – presentation of model output results • Stormwater Quality – presentation of model output results • Review of SurveyMonkey results	Mark Buckingham	20 minutes
Wrap up & next steps		Denise Peters	5 minutes

APPENDIX F – Survey Summary

Midtown Neighborhood Storm Water Master Plan Survey

1. Do you understand the concepts behind these types of Best Management Practices (BMPs) and why they can benefit the storm water system and our local waterways?

	Response Percent	Response Count
Yes	**100.0%**	**8**
No	0.0%	0
	answered question	**8**
	skipped question	**0**

2. The City of Wichita's current policy is for property owners to maintain to the back of curb. If one of these types of BMPs was installed along your street, behind the curb such that you and your neighbors were responsible for its on-going maintenance such as periodic weeding, removal of debris / trash, and mulching, would you support its installation?

	Response Percent	Response Count
Yes	**87.5%**	**7**
No	12.5%	1
	answered question	**8**
	skipped question	**0**

3. These types of storm water BMPs can be installed in either public rights-of-way or on private property. Which location would you be most supportive of these being installed?

	Response Percent	Response Count
Public rights-of-way	37.5%	3
Private property	0.0%	0
Both	**62.5%**	**5**
	answered question	**8**
	skipped question	**0**

4. Who should be responsible for the on-going maintenance?

	Response Percent	Response Count
City at Large	**87.5%**	**7**
Property owners adjacent to BMP	12.5%	1
	answered question	**8**
	skipped question	**0**

5. Would you support the creation of a residential Homeowners Association (HOA), commercial Lot Owners Association, or other type of citizen-run maintenance district who would be responsible for the on-going maintenance of such BMPs?

	Response Percent	Response Count
Yes	**75.0%**	**6**
No	25.0%	2
	answered question	**8**
	skipped question	**0**

6. If you would support such a district to provide on-going maintenance of BMPs, should members pay dues to cover maintenance costs or provide voluntary labor?

	Response Percent	Response Count
Pay dues	0.0%	0
Volunteer labor	14.3%	1
Both pay some dues and volunteer	**85.7%**	**6**
	answered question	**7**
	skipped question	**1**

7. Do you understand the concepts behind Rain Gardens and why they can benefit the storm water system and our local waterways?

	Response Percent	Response Count
Yes	**100.0%**	**8**
No	0.0%	0
	answered question	**8**
	skipped question	**0**

8. Rain Gardens can be installed on either public or private property. Which location would you be most supportive of these being installed?

	Response Percent	Response Count
Public (parks or other publicly owned property)	**87.5%**	**7**
Private property (residential lawns, commercial landscaping areas or parking areas, etc)	12.5%	1
	answered question	**8**
	skipped question	**0**

9. Would you be willing to implement and maintain a Rain Garden on your private property (residential, commercial, etc)

	Response Percent	Response Count
Yes	**87.5%**	**7**
No	12.5%	1
	answered question	**8**
	skipped question	**0**

10. How much would you be willing to pay for a rain garden on your property?

	Response Percent	Response Count
$2,000	14.3%	1
$1,000	14.3%	1
$500	14.3%	1
$100	**28.6%**	**2**
$0	**28.6%**	**2**
	answered question	**7**
	skipped question	**1**

11. Programs can be developed to encourage homeowners and businesses to implement these BMPs. Should participation in such programs be:

	Response Percent	Response Count
Voluntary	**100.0%**	**8**
Mandated	0.0%	0
	answered question	**8**
	skipped question	**0**

12. Currently, City ordinances related to lawn care on private property can be non-conducive to the creation of Rain Gardens. This is due to the use of native vegetation in Rain Gardens which deviates from a manicured lawn look. Would you support modifications to the City ordinances to accommodate Rain Gardens in lawns (front, side, back) of private residences and businesses?

	Response Percent	Response Count
Yes	**100.0%**	**8**
No	0.0%	0
	answered question	**8**
	skipped question	**0**

13. Do you understand the concepts behind these BMPs and why they can benefit the storm water system and our local waterways?

	Response Percent	Response Count
Yes	**100.0%**	**6**
No	0.0%	0
	answered question	**6**
	skipped question	**2**

14. Would you be willing to implement these BMPs on your private property (residential, commercial, etc)

	Response Percent	Response Count
Yes	**100.0%**	**6**
No	0.0%	0
	answered question	**6**
	skipped question	**2**

15. How much would you be willing to pay for a rain barrel on your property?

	Response Percent	Response Count
$100	**60.0%**	**3**
$75	0.0%	0
$50	20.0%	1
$25	0.0%	0
$0	20.0%	1
	answered question	**5**
	skipped question	**3**

16. Programs can be developed to encourage homeowners and businesses to implement these BMPs. Should participation in such programs be

	Response Percent	Response Count
Voluntary	**100.0%**	**7**
Mandated	0.0%	0
	answered question	**7**
	skipped question	**1**

17. Would you support a requirement that new commercial buildings within Midtown incorporate a Vegetated (“Green”) Roof into the building design?

	Response Percent	Response Count
Yes	28.6%	2
No	**71.4%**	**5**
Unsure of what a "Green Roof" is.	0.0%	0
	answered question	**7**
	skipped question	**1**

18. Would you support a requirement that new parking lots within Midtown incorporate porous pavement or rain gardens into the design?

	Response Percent	Response Count
Yes	**85.7%**	**6**
No	14.3%	1
	answered question	**7**
	skipped question	**1**

19. Would you support a requirement that new parking lots within Midtown incorporate a minimum amount of tree canopy into the design?

	Response Percent	Response Count
Yes	**100.0%**	**6**
No	0.0%	0
	answered question	**6**
	skipped question	**2**

20. In general, do you feel that there are enough street trees in the Midtown neighborhood?

	Response Percent	Response Count
Yes	**57.1%**	**4**
No	42.9%	3
	answered question	**7**
	skipped question	**1**

21. If the City provided you a free or low cost tree for the area by the street in front of your property, would you be willing to maintain it? (Water it during droughts, mulch/weed occasionally, etc.)

	Response Percent	Response Count
Yes	**100.0%**	**7**
No	0.0%	0
	answered question	**7**
	skipped question	**1**

APPENDIX G – Midtowner Newsletter

THE MIDTOWNER

March/April 2011

The Official Newsletter of Historic Midtown Citizens Association

Combined Neighborhood Meeting Midtown, Riverside and North Riverside Political Forum on March 8th

At this meeting we will have a candidate forum for the office of Mayor for the City of Wichita. Each candidate will be given four minutes to make a statement in their case for election.

Questions will be solicited from the citizen's attending the political forum and the event will be moderated by the League of Women Voters.

There will be time after the forum to visit with constituents and answer any questions.

The forum will be held at Gloria Dei Lutheran Church at 1101 N. River Blvd. (Next to Campbell Castle in Riverside), and will begin promptly at 7:00pm.

Midtown Planning Project on track

Seeking input from residents Next community meeting March 17 at Horace Mann

As members of a planning and design team continue to examine issues of priority in Midtown, they are scheduling the second of three community meetings from 6:30 to 8:30 p.m. on Thursday, March 17, at Horace Mann Dual Language Magnet, 1234 N. Market Street.

"We want to ensure the residents and business owners in Midtown have every opportunity to share ideas and keep up-to-date on the findings as part of this process," said City Council Member Janet Miller, a resident of Midtown.

The City of Wichita Public Works and Utilities Department is working with a team of engineers, designers and planners to identify potential improvements and prioritize options related to storm water, traffic, streetscaping/lighting, pedestrian safety and mobility.A group of 25 Midtown residents attended a community meeting in December and participated in conversations and electronic polling, offering their experiences about storm water flooding and quality, transportation, historic preservation, lighting and signage, environment and landscape, and general community issues.

"Midtown is an important and significant part of our infrastructure as a community," Miller said. "Our goal is to identify potential solutions and establish priorities for the future."

At the March meeting, community members will be able to learn more about best management practices, particularly related to storm water issues, as well as options that have worked in other communities.

In February, the Midtown Project Steering Committee, made up of residents and business owners from Midtown, met to discuss the design team's preliminary concepts for improvements and to discuss how to gather broader input from the neighborhood.

A third community meeting will be scheduled in May to bring final recommendations back to residents before a final report is submitted. The report is expected to be complete by summer 2011.

The electronic poll from the December community meeting - complete with photos and maps from the planners and designers - is available online at www.wichita.gov/midtown. Residents are encouraged to go online and add their opinions related to living or working in Midtown. Results from this poll will be available at the March 17th community meeting. A second phase of questions and information are being developed for the March meeting.

Midtown Steering Committee Members

Cathy Landwehr Bailey	Chris Hernandez
Jo Bogan	Gladys Hoefer
Gerald Crawford	Magda Hoetmer
David Cullen	Steve Krull
Scott Dunakey	Janie Krull
Alan Fearey	Martha Pulido
Jim Guy	Rev. Cindy Watson

HISTORIC MIDTOWN
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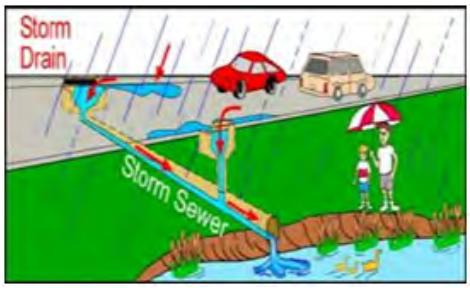
DID YOU KNOW?

In Wichita, our sanitary sewer and storm sewer pipe networks are separate systems. The sanitary sewer pipes collect sewage waste from our homes and businesses and converge at a wastewater treatment facility where the sewage waste is highly treated before discharge. The storm sewer pipes, however, collect rainwater runoff and discharge it directly to the nearest channel, stream or river without treatment. The purpose of the storm pipe network is purely to alleviate localized flooding. Since the rainwater collected in the storm pipe network does not receive treatment, we must keep pollutants out of our rainwater runoff to protect the quality of our streams and rivers. Methods to keep those pollutants out are often called "Best Management Practices" - and will be an important topic at the Midtown community meeting on March 17.



Source: http://www.shawneehillsoh.com/

Midwest Historical & Genealogical Society

1203 N. Main
316-264-3611

What to know who you are, where you came from, why you are here, more about your roots? The Midwest Historical & Genealogical Society (MHGS) library can help!

The MHGS "teaching class" will be held on Saturday, April 9, 1pm at the library, 1203 N. Main, Wichita. "Tips for Donating Materials for Libraries & Museums" will be taught by head librarian, Margaret Lucas.

On May 14, 1pm, the class is "Searching Smarter, Not Harder: Using Online Data Bases, Card & World Catalog, & other tools to Find Facts without Spinning your Wheels."

These classes are free and open to the public. The library is open Tues & Sat, 9am-4pm. 316-264-3611 mhgs1121@aol.com

HISTORIC MIDTOWN

Spring Break at the Library

WICHITA PUBLIC LIBRARY
The Discovery Center
www.wichita.lib.ks.us

The Wichita Public Library will keep the family busy during spring break! From painting to paper airplanes, green slime to the green prairie, Wichita's library has something for everyone. Don't miss a visit from Newbery author Clare Vanderpool. For a complete list of activities, visit your favorite library, or www.wichita.lib.ks.us.

Wichita/Sedgwick County Historical Museum

Wichitan Charles Driscoll (1885-1951) published Kansas Irish, Book One, in 1943. The autobiography traces his Irish family from County Cork to a farmstead at the Arkansas River and S. Hydraulic Street, Wichita.

Noted "Irish in the West" scholar, Dr. Matthew Jockers of Stanford Univ., will be at the Wichita Sedgwick County Historical Museum, 204 S. Main, Wichita, on Tues., March 8, 7pm, for a presentation of the re-publication of this book by Rowfant Press.

Driscoll also wrote extensively on pirates and his very rare book collection, held until 2000 by the Wichita Public Library, sold for $385,000.

The event is free with regular museum admission of $4 for adults, $2 for kids 6-12; free admission for WSCHM and Wichita Historical & Genealogical Society members. Doors open at 6:30pm. (If non-members visit the historical museum during the day, a pass will be issued for the evening program.)

The Historical Museum is located at 204 S. Main in the old 1890 City Hall, across from the Wichita PublicLibrary and Century II. Museum hours are: Tues-Fri, 11am-4pm; Sat-Sun, 1pm-5pm.

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HMCA

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Animal Control	268-8351
Building Permits	268-4461
Evergreen City Hall	303-8042
Gang Activity Report Line	267-7228
HMCA Information	264-2988
Housing Assistance Programs (weatherization/emergency repairs/other)	462-3700
Midtown Community Resource Center	264-4636
Neighborhood Action Line	529-9999
Neighborhood Inspector (To report deteriorated properties, trash junk, tall grass/weeds, graffiti, parking in yards. ect.).	268-4481
North Police Station & Community Police	350-3400
Park Department	268-4361
6th District City Council	268-4331
Storm Sewer Stoppages	268-4090
Street Lights Not Working	268-4448
Street Maintenance Needed	268-4071

Números de Teléfonos Útiles

Mantenimiento de callejones	268-4060
Control de Animales	268-8351
Permiso de Obras	268-4461
Municipalidad (Evergreen)	303-8080
Linea de Informes de Actividad Pandillera	267-7228
La Misión de Ia Asociación Histórica de Midtown (HMCA)	264-2988
Programas de Asistencia para Vivienda	462-3700
El Centro de Recursos de Midtown	264-4636
Linea de Acción del Vecindario	529-9999
Inspector del Vecindario (para reportar propiedades deterioradas, basura y cesped)	268-4481
Estación de Policla del Node y Policía Comunitaria	350-3400
Departamento de Parques	268-4361
Municipalidad Distrito 6	268-4331
Alcantarilla de drenaje	268-4090
Luces de Ia Calle	268-4448
Mantenimiento de Luces de Ia Calle	268-4071

Please Report Graffiti

Remember, the best way to mitigate graffiti is to remove it the minute you see it. Otherwise, it's likely to invite more of it. If you spot graffiti on public property, or on property not owned by you, please report it immediately to the following email address: KeepWichitaClean@wichita.gov. If you are elderly or disabled and need help removing graffiti from your own property, please call 268-4421.

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From Consumer's Report of Feb. 2011

Under rules that went into effect January 1, people with original Medicare will no longer have to pay co-insurance, a co-payment, or a deductible for certain regular preventive services, including mammograms, colonoscopies, and Pap tests. You can download a complete list by going to www.medicarerights.org/pdf/Medicare-Covered-Preventive-Services-2011.pdf.

The new rules also cover a free annual wellness visit, which can include an update of a patient's overall care plan, as well as screening for cognitive impairments and some basics like checking height, weight, and blood pressure.

Nomar Theatre

The Nomar Theatre is now a 501 c 3 non-profit organization. HMCA made a contribution to help fund this application for non-profit status. Check out the Nomar Theatre's Facebook page.

If you haven't recently driven by the Nomar International Market Place at 21st and Broadway, you're in for quite a treat. The area is looking good!

HISTORIC MIDTOWN
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Save the Date
June 25, 2011
Gala to benefit MCRC

The next Midtown Community Resource Center (MCRC) Fund Raising Gala is coming on June 25, 2011. This is an important event for the Center because it provides needed operating dollars so that the Center can carry on its important work of serving our citizens. The Center is currently in the process of establishing a new Computer Lab. This is a vital commodity to citizens in the area who may not have computer access to complete resumes, job searches or general computer training. MCRC will launch the lab in collaboration with TRIO, our first Community Partners, in keeping with MCRC's mission: "Providing and supporting education, programs and resources to enhance the lives of individuals, families and the community."

Please plan now to attend the Gala. Tickets are just $25/person for a wonderful evening of great food, entertainment and silent auction items. Also, if you have an item of value that you would like to donate for the auction, please call Karen Fitzgerald at 265-7178 or email her at karenfitzgerald06@gmail.com.

The Mission of the Historic Midtown Citizens Association (HMCA) is to preserve, develop and promote Wichita's Historic Midtown neighborhood as a unified, vital and diverse residential community.

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Wichita, KS 67203

Wichita Walk against Gang Violence

Are you tired of Gang Violence in Wichita? Come show your support against Gang Violence on Saturday, April 30, 2011 at Evergreen Park, 2700 N. Woodland. Arrive by 9:30 am, walk begins at 10:00 am and will be less than 2 miles.

Educational booths and static displays will be set up at Evergreen Park before and after the walk. These booths will provide education on drug and alcohol abuse, summer activities for kids, local colleges, etc. There will also be Public Officials and local Clergy speaking about the dangers of Gang Violence in our City.

There will be free T-shirts passed out at this event. The T-shirt numbers are limited. A variety of local food vendors will be there selling food.

This event is sponsored by Citizens of Wichita, a private and public business, local and State Colleges and non profic organizations.
For additional information contact:

Randy Wells - 263-1389
randy@safestreetswichita.org

Lt. James Espinoza - 350-3400
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Upcoming Events

Thursday, March 17, Midtown Planning Project
Horace Mann Dual Language Magnet, 1234 N. Market Street 6:30 - 8:30

Monday, March 28, HMCA Board Meeting at MCRC, 6:00 pm.

Saturday, June 25, Midtown Community Resource Center (MCRC) Fund Raising Gala

Please visit HMCA's website: www.midtownwichita.org

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THE MIDTOWNER

May/June 2011

The Official Newsletter of Historic Midtown Citizens Association

Midtown planning projects find common ground in streetscaping, stormwater flooding Upcoming meetings: May 24 and June 1

Since late last year, design teams have been looking at challenges and opportunities in the Midtown neighborhood - from stormwater flooding to streetscaping and lighting.

As the project design teams begin to put the final touches on recommendations, two of the findings appear to have some common ground. "Engineers looking at stormwater flooding have identified several potential recommendations, including porous pavement, which could be used to control the flow of water during a heavy rain storm, as well as the integration of rain gardens, which have positive impact on the environment," said City Council Member Janet Miller, who represents the Midtown area. "These two ideas also are being incorporated into designs that could improve the aesthetic look of streets and common areas."

Members of the two project design teams continue to research and model potential solutions, as well as ask businesses and residents in Midtown for their input and develop recommendations based on best practices. Miller says she anticipates the plan will include recommendations that are cost-effective, as well as those that might take considerable capital investment in infrastructure over the coming years.

"The teams are knowledgeable about the current budget restrictions and are looking at a wide range of options," she said. "We want to make this something we can start implementing in small ways sooner rather than later. It also will give us a roadmap with priorities for the future, so we can wisely invest in infrastructure improvement as funds become available."

The process seeks to develop a plan that will incorporate recommendations about stormwater flooding, traffic, streetscaping and lighting, pedestrian safety and mobility.

The final community meeting examining stormwater recommendations will be May 24. The final community meeting to discuss recommendations for traffic, streetscaping and lighting, pedestrian safety and mobility is planned for June 7. Details about the meetings will be posted on www.wichita.gov/midtown.

"It is important for Midtown residents to attend the final two community meetings to share their opinions and to see how the recommendations could be implemented," Miller said.

The final plan is expected to be complete by summer 2011. In the meantime, an online poll - with photos and maps from the planners and designers - also can be accessed at www.wichita.gov/midtown. Residents are encouraged to go online and fill out the survey.

June 25 Midtown Community Resource Center Gala

For the past 11 years there has been a Gala to support the Midtown Community Resource Center, (MCR) 1150 N. Broadway. And this year it will be held on June 25, 6-9 pm at the MCRC.

Come and enjoy heavy hors d'oeuvres and live music while you browse among the silent auction items. We always have an assortment of items donated by local businesses, some handcrafted items, and unusual "treasures." People have commented throughout the years that the items in the Gala's silent auction are the very best.

Plan to attend June 25, 6-9 pm. The cost is just $25, plus the cost of any items for which you might place the winning bid.

Dyne Quik is Open Again!

After extensive renovations, Dyne Quik is now open! The food is good and a good price. And the building is one of only three "Valentine Diners" in the Wichita area. (See the article in the December 2009/January 2010 Midtowner on Valentine Diners www.midtownwichita.org.)

Summer Reading Club begins May 26

Stop by your favorite Wichita Public Library location beginning Thursday,May 26, to register for the FREE Summer Reading Club, "One World, ManyStories." Children up to age 17 are eligible to set their own reading goalsand win prizes once goals are met. Teens aged 12-17 may instead enter "YouAre Here," the Teens Read program, and enter to win based on the amount of time spent reading. Find complete details at your library orhttp://www.wichita.lib.ks.us/kids/. Don't miss the huge kick-off party atthe Central Library on May 26!

Wanted:
Horace Mann School Memorabilia

Many of our neighbors have been a part of Horace Mann through theyears. We are currently collecting 'memories' from the past to put into our display case. These could include old yearbooks, trophies, pictures,athletic uniforms/shirts, or anything that you think would help our studentsand visitors connect to the past.

If you have anything to donate, please bring it to Horace Mann Dual LanguageSchool at 1243 N. Market. It is helpful to mark on the back your name andinformation about the picture or item donated. Thank you for your support!

Ken Jantz, Principal

Help Wanted
Midwest Historical & Genealogical Society

1203 N. Main

Looking for something to do this summer? Midwest Historical& Genealogical Society Libraryneeds volunteers for a few hours on Tuesday or Saturday to help in the library.

No experience necessary! All ages considered! This could be part of a Scout badge-earning program,hands-on history or library science learning, or a summer program for your home-school history. And if you want to trace your own ancestry, you would have time while you are volunteering. We can use you!

Open from 9am-4pm on Tuesday and Saturday, MHGS is possibly the only library in the USA which is all-volunteer. The building has three floors of research materials, staffed with excellent librarians and computers!
Information: 316-264-3611
http://skyways.lib.ks.us/genweb/mhgs/index.html

May 7 MHGS Program

Searching? Putting in too much time to find what you want? Are your ancestors lost and can't be found? We have the answer for you, and the answer is FREE! Not many bargains like that anymore!

Saturday, May 7, 1pm, at the MHGS, 1203 N. Main, "Working Smarter, Not Harder" will be presented by genealogist and librarian, Margaret Lucas of Leon, KS. She will be teaching how to use online tools to speed your research. Computer hookups are available. Please register by calling 316-264-3611

June 11 MHGS Program

Don't know where to start looking but want to know about your ancestors? If you are a beginner -- or still feel like a beginner -- this is for you: "Absolute Beginner Computer Class". MHGS, 1203 N. Main, is offering a free class, open to the public, at 1pm on Saturday, June 11. Register by calling 316-264-3611.

Hookups for your computer are available. Class is taught by genealogy and computer expert, Margaret Lucas of Leon, KS.

August 13 MHGS Program

Primary? Secondary? Which is best? In genealogy, it really matters! If you are searching for those long, lost ancestors and information about them, you definitely need to know which the best source for your information is.

"Evaluating Primary and Secondary Sources in Genealogy Research" will be taught at MHGS on Saturday, August 13, 1pm, at 1203 N. Main, by expert researcher, Margaret Lucas. Register for this free class by calling 316-264-3611Computer hookups are available.

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call Cano @
316-265-2124
Free Beard Trim with Haircut
Must mention this ad
Hours:
Tuesday - Friday - 10:00 am - 6:00 pm
Saturday - 9:00 am - 3:00 pm

Helpful Telephone Numbers

Alley Maintenance Needed	268-4060
Animal Control	268-8351
Building Permits	268-4461
Evergreen City Hall	303-8042
Gang Activity Report Line	267-7228
HMCA Information	264-2988
Housing Assistance Programs (weatherization/emergency repairs/other)	462-3700
Midtown Community Resource Center	264-4636
Neighborhood Action Line	529-9999
Neighborhood Inspector (To report deteriorated properties, trash junk, tall grass/weeds, graffiti, parking in yards. ect.).	268-4481
North Police Station & Community Police	350-3400
Park Department	268-4361
6th District City Council	268-4331
Storm Sewer Stoppages	268-4090
Street Lights Not Working	268-4448
Street Maintenance Needed	268-4071

Números de Teléfonos Útiles

Mantenimiento de callejones	268-4060
Control de Animales	268-8351
Permiso de Obras	268-4461
Municipalidad (Evergreen)	303-8080
Linea de Informes de Actividad Pandillera	267-7228
La Misión de la Asociación Histórica de Midtown (HMCA)	264-2988
Programas de Asistencia para Vivienda	462-3700
El Centro de Recursos de Midtown	264-4636
Linea de Acción del Vecindario	529-9999
Inspector del Vecindario (para reportar propiedades deterioradas, basura y cesped)	268-4481
Estación de Policla del Node y Policía Comunitaria	350-3400
Departamento de Parques	268-4361
Municipalidad Distrito 6	268-4331
Alcantarilla de drenaje	268-4090
Luces de la Calle	268-4448
Mantenimiento de Luces de la Calle	268-4071

From a Midtown Neighbor -Feral Cats

I've lived in the Topeka & 15th area for nearly 30 years, and there's always been a relatively large population of homeless/stray cats in the area. I know for certain income levels, the idea of paying veterinary care bills to spay/neuter pets, especially in the recent economic climate, isn't high on the list of things people want to do.

However, there are resources available to help with the cost of spaying/neutering pets:
Spay-Neuter Kansas provides low-cost spaying and neutering of cats and dogs for households under certain income levels:
http://www.spayneuterkansas.com/cost.html
Contact Friends of Felines:
http://www.felinefriendsks.com
for information regarding managing local wild cat populations.

From a long-time Midtowner

316-945-2933
Closed Mondays
Open 5:00 am
Paradise DONUTS
Donuts ♦ Longjohns ♦ Cinnamon Rolls ♦ Bear Claws
Sausage Rolls ♦ Biscuits & Gravy ♦ Coffee ♦ Bottled drinks
♦ Call in advance for large or special orders ♦
3107 W. Central
Wichita, KS 67203
www.paradisedonutswichita.com

Clip this coupon and save 10% (*Expires June 30, 2011*
Delano Dog Grooming by Susie
· Certified Professional Quality ·
· All-Breed Dog Grooming ·
Susie D.
Certified Groomer
316-262-3200
809 Maple
Wichita, KS 67213
"Your Pet is the Heart of My Business."
HMCA

We have Good News for YOU!

at
St. Paul's Lutheran Church ELCA
925 N. Waco / 263-0810 / stpauls-wichita.org
Summer Worship Time 9:45 a.m.
(beginning May 22)
Vacation Bible School (Pandamania) June 6-10
9 a.m. - noon for ages 3 to finishing 5th grade
* Kid's Kingdom Learning Center for ages 3-5 at St. Paul's has openings. Full Daycare, pre-school curriculum. Call 263-2433.
Hours are Monday - Friday 7 a.m. - 6 p.m.
*English Classes for Adults M-Th. 9:30 -12.

Don't Forget
June 25, 2011
Gala to benefit MCRC

The next Midtown Community Resource Center (MCRC) Fund Raising Gala is coming on June 25, 2011. This is an important event for the Center because it provides needed operating dollars so that the Center can carry on its important work of serving our citizens. The Center is currently in the process of establishing a new Computer Lab. This is a vital commodity to citizens in the area who may not have computer access to complete resumes, job searches or general computer training. MCRC will launch the lab in collaboration with TRIO, our first Community Partners, in keeping with MCRC's mission: "Providing and supporting education, programs and resources to enhance the lives of individuals, families and the community."

Please plan now to attend the Gala. Tickets are just $25/person for a wonderful evening of great food, entertainment and silent auction items. Also, if you have an item of value that you would like to donate for the auction, please call Karen Fitzgerald at 265-7178 or email her at karenfitzgerald06@gmail.com.

To advertise in the Midtowner call:
Midwest Printing
262-7347
midwestprint0809@sbcglobal.net
123 W. 12th St. N.
Wichita, KS 67203

Dog Days of Sommer
4550 S. Broadway
♦ Doggy Daycare ♦ Grooming
♦ Pet Boarding
529-3800 or 250-1002
Coming soon to Old Town
901 E. 3rd (Corner of 3rd and Mosley)
www.dogdaysofsommer.com

Visit us at:
www.midtownwichita.org

2nd Location Now Open
Riverside Cafe EST. 1946
924 S. WOODLAWN
682-9265
739 W. 13TH ST.
262-6703
FREE WI-FI
BUY 1 MEAL AT REG. PRICE GET 1 MEAL FREE*
1 Drink Min. Required
*Free Meal of Equal or Lesser Value
Breakfast, Lunch or Dinner Entree
Not Valid with any other offer.
Expires 6/30/2011

PAPER MOON ANTIQUES
John & Becky Doan
1940 W. 13th
Wichita, KS 67203
316-440-4560
Purveyors of interesting antiques for your enjoyment
Open
Wednesday thru Saturday
10 - 5
www.paper-moon-antiques.com

The Mission of the Historic Midtown Citizens Association (HMCA) is to preserve, develop and promote Wichita's Historic Midtown neighborhood as a unified, vital and diverse residential community.

St. Paul's & El Mesías
United Methodist Churches
1356 N. Broadway
Wichita, Kansas 67214
316-267-3263 (English)
316-262-3323 (Español)
Pastor: Tim Jepsen
6 to 8 pm
Family Wednesday
Kidz Klub with music, games, crafts, stories, puppetry, etc.
Free Light Dinner
Miercoles Familiar
Classes de ingles ¡Gratis!
Cuidado de niños ¡Gratis!
Un club para sus niños con juegos, manualidadex, historias, titeres, musica y mas
Cena Ligera - ¡Gratis!
Sunday School Times
Tiempo Escuela Dom.
English - 9:30 am
Español - 11:00 am
Sunday Worship Times
Adoración Domingo Tiempo
Español - 9:00 am
English - 11:00 am

Be aware that it is unlawful to sweep or blow yard clippings into the street or storm drains.

Ordinances: Title 10 Streets & Sidewalks

Sec. 10.04.030. Raking or sweeping leaves, paper, etc., into gutters or drainage ditches.
The raking, sweeping or otherwise moving of leaves, dirt, paper and other debris into the gutters or drainage ditches along the sides of any street or alley in the city, without removing the same immediately thereafter, is a misdemeanor.
(Ord. No. 16-556 § 2)

Sec. 10.04.060. Permitting water to run into streets, etc.
It shall be unlawful for any person to cause, permit or allow any water or waste to be discharged to or run into or upon any street, avenue, alley or public place in the City of Wichita except for storm water runoff; provided that fugitive lawn irrigation water which does not result in spraying of water from a sprinkler system onto the portion of a street used by vehicular traffic, street deterioration, mosquito breeding, excessive waste of water, odor, or other nuisance or pollution conditions may be permitted to overflow into the street. The owner and/or occupant of any premises upon or from which a violation of this section occurs shall be guilty of a misdemeanor.
(Ord. No. 41-007 § 1)

Sec. 10.04.100. Sidewalks to be kept clean by abutting property owners or occupants.
It is unlawful for the owner or occupant of any lot or piece of ground abutting upon any street upon which there is a sidewalk to allow earth, dirt, filth, mud, papers, stone, snow, ice, refuse and rubbish to accumulate on such sidewalk.
(Ord. No. 35-100 (part))

Sec. 10.04.105. Property abutting public right-of-way to be kept clean by owner of adjacent land.
(a) It is unlawful for the owner or occupant of any lot or piece of ground abutting any street, or alley within the City to allow filth, papers, refuse or rubbish to accumulate and remain on that portion of the public right-of-way easement between the traveled portion of such street, or alley and said person's lot or piece of ground.
(b) It is unlawful for the owner or occupant of any lot or piece of ground abutting any unopened street, or alley within the City to allow filth, papers, refuse or rubbish to accumulate and remain on the public right-of-way easement abutting said person's lot or piece of ground.
(Ord. No. 38-095 § 1)

Sec. 10.04.130. Obstructing streets and sidewalks by litter, goods, wares, etc.
It is unlawful for any person to obstruct any street, alley, public area, public right-of-way or sidewalk in the City by:
(a) Piling, placing or maintaining thereon any filth, litter or any goods, wares or merchandise; or by
(b) Placing or erecting any buildings or fence thereon; or
(**c)** Placing any benches or seats for public use thereon, except when a street closure has been approved by the City Council pursuant to Section 3.11.150 of the Code of the City of Wichita.

This Section specifically prohibits the using of any public sidewalk in the City for exhibiting goods, wares and merchandise except by special permit granted as provided in Section 10.04.131, and any person violating this Section is guilty of a misdemeanor.

For the purposes of this Section 'public right-of-way' shall mean the entire width of the area from property line to property line including that area between the roadway and the abutting private property line.
(Ord. No. 41-521 § 1; Ord. No. 47-029, § 1, 5-16-06; Ord. No. 47-048, § 1, 6-20-06; Ord. No. 48-757, § 15, 6-22-2010, eff. 1-1-2011)

Seek & Find

PIANO LESSONS: **Beginner thru advance**; Classical, fake, gospel, etc.
Experienced, references. **Also**: Programs & background music for all occasions. **Piano by F#**.
Francene Davis Sharp (Midtown Resident)
316-262-5780.

Tri-Neighborhood Picnic

June 18, 6:00 to 8:00 at Minisa.

The dinner begins at 6 pm. Bring a dish to share and your own table service.
This is a joint project with HMCA, Riverside, and North Riverside Neighborhood Associations.

THE MIDTOWNER
1150 N. Broadway
Wichita, KS 67214

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U.S. Postage
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Wichita, KS
Permit No. 923

HISTORIC MIDTOWN
LIVING HISTORY • CELEBRATING COMMUNITY

Upcoming Events

Tri-Neighborhood Picnic: June 18, 6:00 to 8:00 at Minisa.
The dinner begins at 6 pm. Bring a dish to share and your own table service. This is a joint project with HMCA, Riverside, and North Riverside Neighborhood Associations.

Saturday, June 25, Midtown Community Resource Center (MCRC) Fund Raising Gala

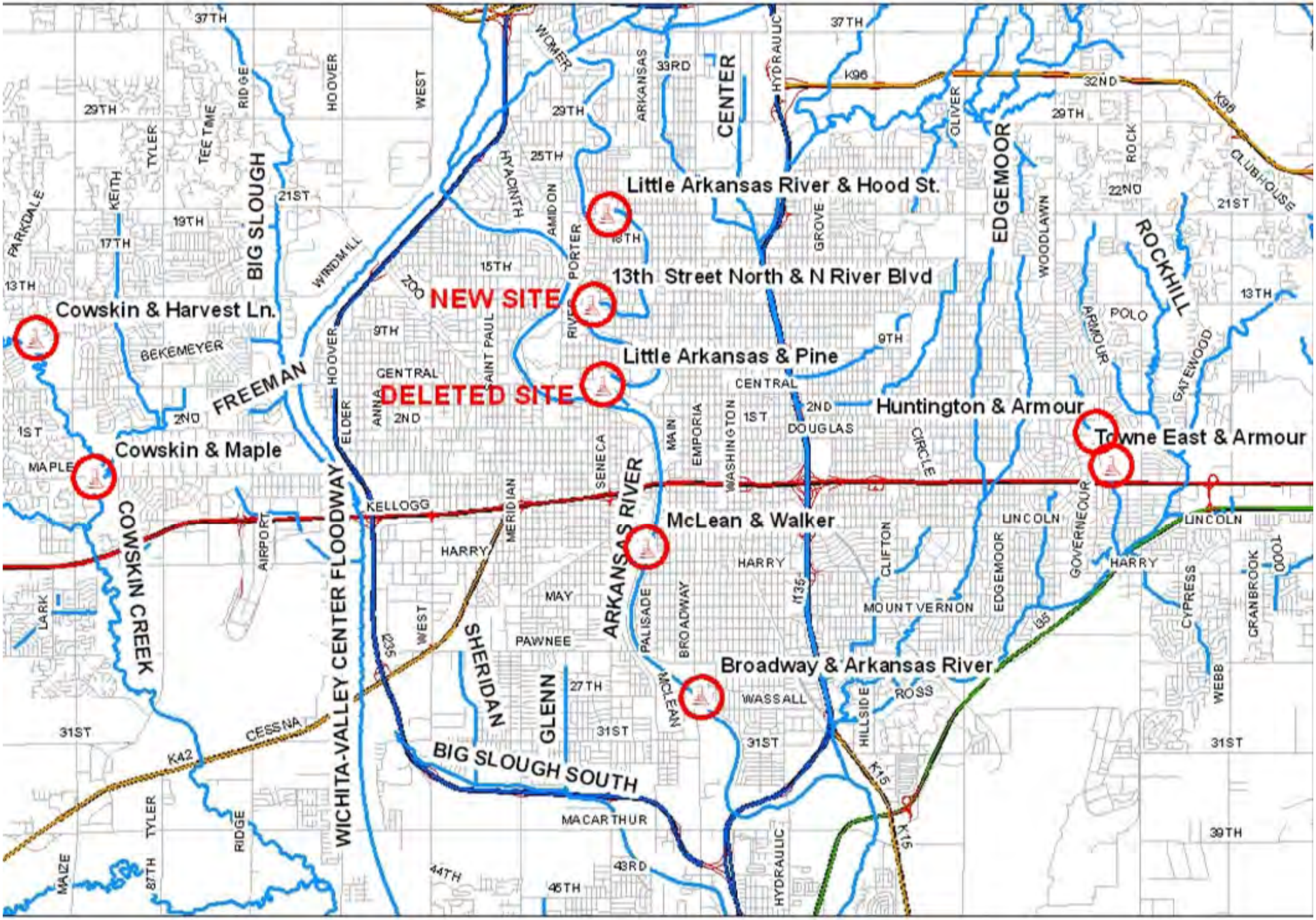
Please visit HMCA's website: www.midtownwichita.org

Randal G. Allen/Photography
Seniors, Engagements, Weddings, and Construction Photos
(316) 264-1642
Midtowner Supporter

YOUR AD SHOULD BE HERE

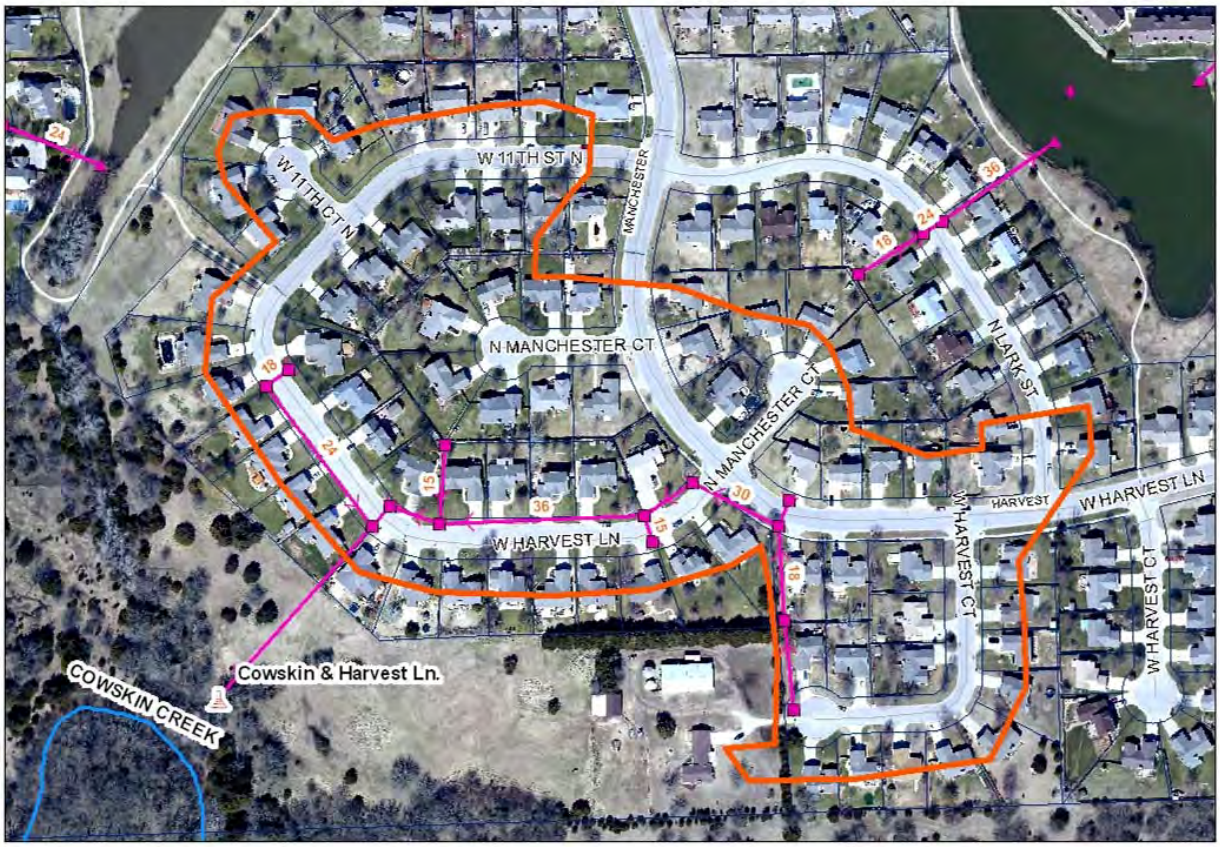
APPENDIX H – Sampling Data & Maps

Wichita Storm Water Discharge Sample Location Map



16.9 acres

Cowskin Creek & Harvest Lane

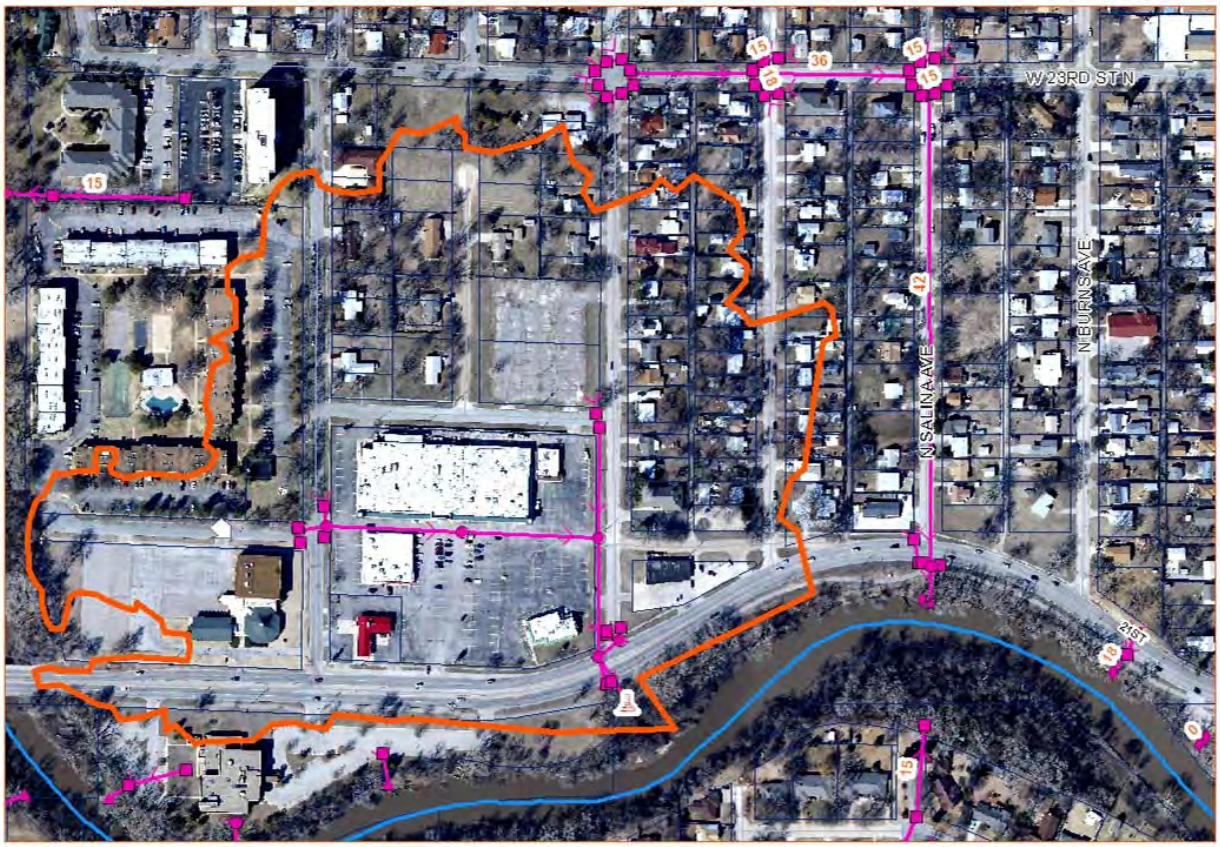


5.2 acres

Huntington & Armour

34.1 acres

Little Arkansas River & Hood St.

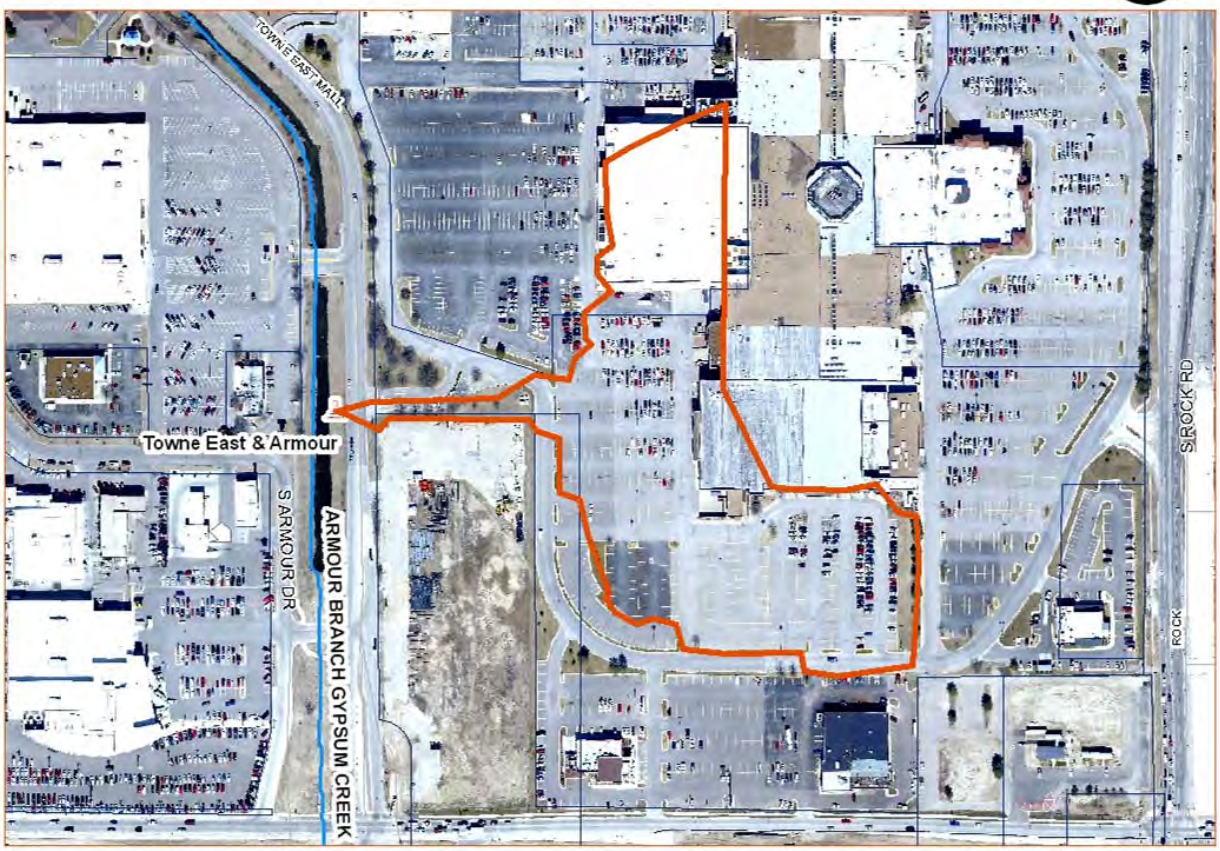


11.8 acres

McLean

62.7 acres

Towne East & Armour

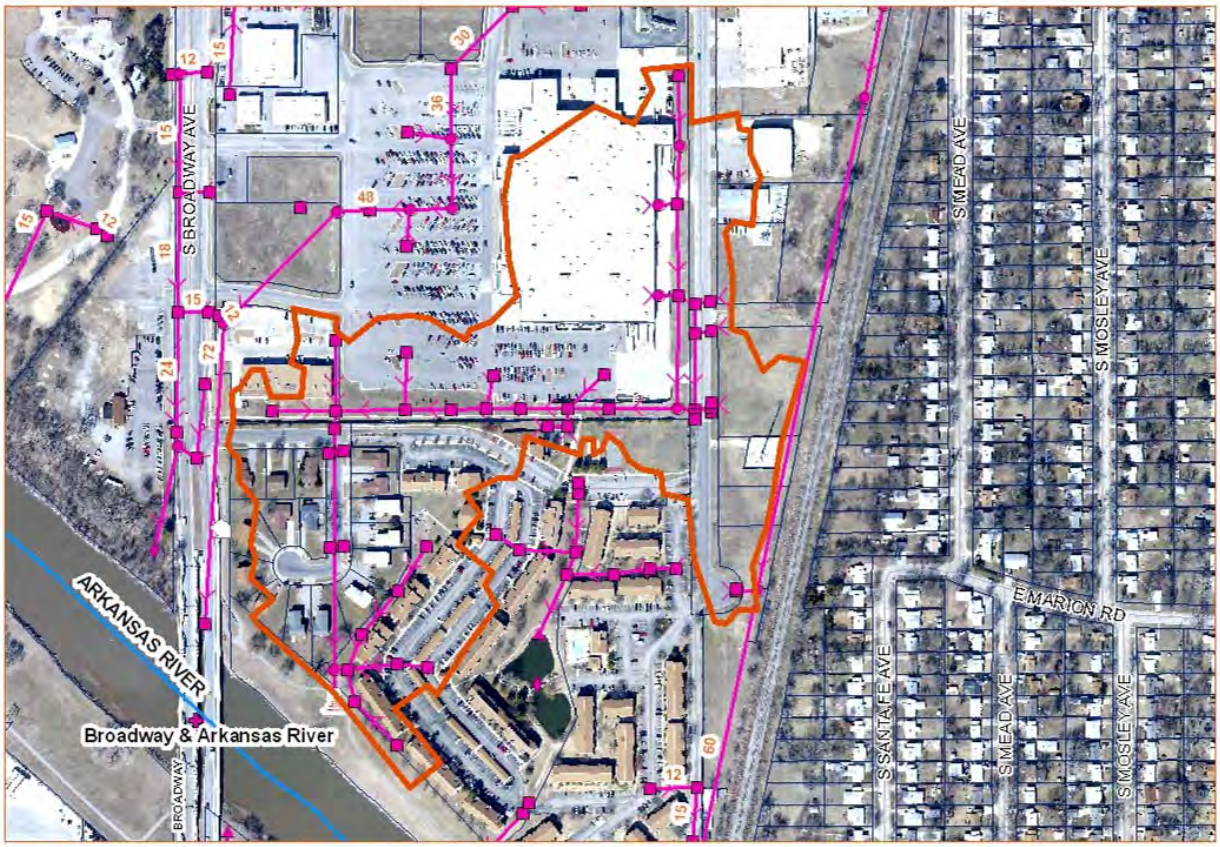


20.4 acres

13th Street North & N. River Blvd.

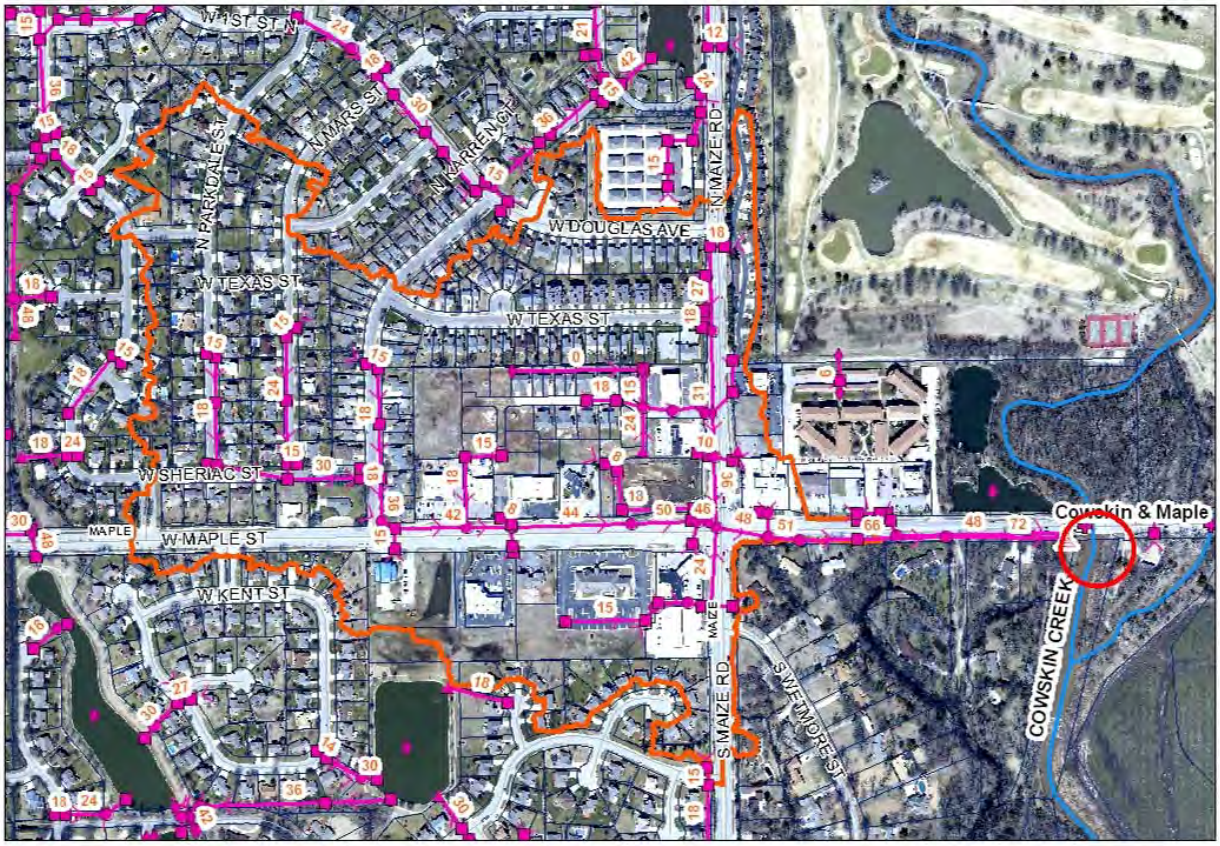
26.5 acres

Broadway & Arkansas River



89.2 acres

Cowskin Creek & W. Maple



ID	SAMPLE_SITE	SAMPLE_DATE	Landuse	Cadmium, Tot Rec (ug/L)	Copper, Tot Rec (mg/L)	ZincTotal	Phosphorus, Total, as P	Solids_Total Suspended (mg/L)	Kjeldahl Nitrogen, as N	Nitrate/Nitrite, as N (FIA)	Nitrate, as N	Total Nitrogen (mg/L)
Commercial												
21	Towne East	2/9/1998	Commercial	ND(0.005)	54	180	No Data	60	No Data	No Data	No Data	No Data
22	Towne East	3/16/1998	Commercial	ND(0.005)	ND(0.020)	75	No Data	34	No Data	No Data	No Data	No Data
23	Towne East	6/13/1998	Commercial	ND(0.005)	5	229	No Data	152	No Data	No Data	No Data	No Data
24	Towne East	7/8/1998	Commercial	ND(0.003)	ND(0.020)	64	No Data	ND(2)	No Data	No Data	No Data	No Data
25	Towne East	10/17/1998	Commercial	ND(0.003)	ND(0.020)	61	No Data	24	No Data	No Data	No Data	No Data
26	Towne East	3/8/1999	Commercial	ND(0.003)	ND(0.020)	186	No Data	70	No Data	No Data	No Data	No Data
27	Towne East	4/13/1999	Commercial	ND(0.003)	22	159	No Data	746	No Data	No Data	No Data	No Data
28	Towne East	9/10/1999	Commercial	5	17	14	No Data	373	No Data	No Data	No Data	No Data
29	Towne East	11/22/1999	Commercial	ND(0.002)	1	1	No Data	26	No Data	No Data	No Data	No Data
30	Towne East	2/22/2000	Commercial	ND(0.002)	ND(0.002)	11	No Data	99	No Data	No Data	No Data	No Data
31	Towne East	6/13/2000	Commercial	ND(0.02)	ND(0.02)	No Data	No Data	1600	No Data	No Data	No Data	No Data
32	Towne East	10/5/2000	Commercial	ND(5.00)	ND(10.0)	No Data	No Data	37	No Data	No Data	No Data	No Data
33	Towne East	1/28/2001	Commercial	ND(0.002)	16	1	No Data	32	No Data	No Data	No Data	No Data
34	Towne East	4/10/2001	Commercial	ND	18.6	No Data	No Data	307	No Data	No Data	No Data	No Data
35	Towne East	6/20/2001	Commercial	ND	14.8	No Data	No Data	222	No Data	No Data	No Data	No Data
36	Towne East	10/5/2001	Commercial	ND	ND	No Data	No Data	185	No Data	No Data	No Data	No Data
37	Towne East	4/8/2002	Commercial	ND	ND	No Data	No Data	18	No Data	No Data	No Data	No Data
38	Towne East	5/23/2002	Commercial	ND	14.5	No Data	No Data	39	No Data	No Data	No Data	No Data
39	Towne East	9/13/2002	Commercial	ND	16.3	No Data	No Data	49	No Data	No Data	No Data	No Data
40	Towne East	10/23/2002	Commercial	ND	10.8	No Data	No Data	38	No Data	No Data	No Data	No Data
41	Towne East	4/6/2003	Commercial	5	25.4	No Data	No Data	297	No Data	No Data	No Data	No Data
42	Towne East	6/5/2003	Commercial	No Data	10	No Data	No Data	23	No Data	No Data	No Data	No Data
43	Towne East	9/11/2003	Commercial	No Data	No Data	No Data	No Data	65	No Data	No Data	No Data	No Data
44	Towne East	12/2/2003	Commercial	No Data	11.7	No Data	No Data	17	No Data	No Data	No Data	No Data
45	Towne East	6/27/2004	Commercial	ND(0.003)	ND(0.020)	23	No Data	59	No Data	No Data	No Data	No Data
46	Towne East	8/19/2004	Commercial	ND(0.003)	ND(0.020)	78	No Data	35	No Data	No Data	No Data	No Data
47	Towne East	10/26/2004	Commercial	0.003	0.067	No Data	No Data	2370	No Data	No Data	No Data	No Data
48	Towne East	4/10/2005	Commercial	ND(0.003)	0.021	158	No Data	83	No Data	No Data	No Data	No Data
49	Towne East	7/18/2005	Commercial	ND(0.003)	ND(0.020)	111	No Data	17	No Data	No Data	No Data	No Data
50	Towne East	10/5/2005	Commercial	ND(0.003)	ND(0.020)	No Data	No Data	43	No Data	No Data	No Data	No Data
51	Towne East	4/28/2006	Commercial	ND(0.003)	ND(0.020)	28	No Data	11	No Data	No Data	No Data	No Data
52	Towne East	8/2/2006	Commercial	0.003	ND(0.020)	66	No Data	236	No Data	No Data	No Data	No Data
53	Towne East	10/10/2006	Commercial	ND(0.003)	ND(0.020)	113	No Data	59	No Data	No Data	No Data	No Data
54	Towne East	3/20/2007	Commercial	ND(0.003)	ND(0.020)	108	No Data	180	No Data	No Data	No Data	No Data
55	Towne East	6/13/2007	Commercial	ND(0.003)	ND(0.020)	111	No Data	203	No Data	No Data	No Data	No Data
56	Towne East	10/2/2007	Commercial	ND(0.003)	23	185	No Data	192	No Data	No Data	No Data	No Data
57	Towne East	4/23/2008	Commercial	ND(1.0)		No Data	No Data	304	No Data	No Data	No Data	No Data
58	Towne East	10/6/2008	Commercial	ND(1.0)	5.8	No Data	No Data	20	No Data	No Data	No Data	No Data
59	Towne East	10/13/2008	Commercial	ND(1.0)	9	No Data	No Data	14	No Data	No Data	No Data	No Data
60	Towne East	6/12/2009	Commercial	ND(1)	8	No Data	No Data	33	No Data	No Data	No Data	No Data
61	Towne East	8/17/2009	Commercial	ND(1)	ND(5)	No Data	No Data	26	No Data	No Data	No Data	No Data
62	Towne East	10/21/2009	Commercial	ND(1)	10	No Data	No Data	No Data	No Data	No Data	No Data	No Data
242	Towne East	4/2/2010	Commercial	ND	37	169	0.32	157	6	ND	2.4	8.4
255	Towne East	8/17/2010	Commercial	No Data	No Data	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Number of Observations				40.00	42.00	22.00	1.00	42.00	1.00	1.00	1.00	1.00
Percent of samples above detection				10.0%	52.4%	100.0%	100.0%	97.6%	100.0%	0.0%	100.0%	100.0%
Minimum Value				0.00	0.02	1.00	0.32	11.00	6.00	0.00	2.40	8.40
Maximum Value				5.00	54.00	229.00	0.32	2370.00	6.00	0.00	2.40	8.40
Median (samples above detection)				2.50	13.10	93.00	0.32	59.00	6.00	N/A	2.40	8.40
Mean (samples above detection				2.50	15.00	96.86	0.32	208.66	6.00	N/A	2.40	8.40
Standard Deviation (samples above detection)				2.89	12.42	69.23	N/A	439.13	N/A	N/A	N/A	N/A
Coefficient of Variation				1.15	0.83	0.71	N/A	2.10	N/A	N/A	N/A	N/A

Commercial/Residential												
152	Broadway	2/9/1998	Commercial/Residential	ND(0.005)	ND(0.020)	127	No Data	80	No Data	No Data	No Data	No Data
153	Broadway	3/16/1998	Commercial/Residential	ND(0.005)	ND(0.020)	81	No Data	14	No Data	No Data	No Data	No Data
154	Broadway	6/13/1998	Commercial/Residential	ND(0.005)	ND(0.020)	54	No Data	114	No Data	No Data	No Data	No Data
155	Broadway	7/8/1998	Commercial/Residential	ND(0.003)	ND(0.020)	52	No Data	ND(2)	No Data	No Data	No Data	No Data
156	Broadway	10/17/1998	Commercial/Residential	ND(0.003)	ND(0.020)	40	No Data	50	No Data	No Data	No Data	No Data
157	Broadway	3/8/1999	Commercial/Residential	ND(0.003)	ND(0.020)	122	No Data	26	No Data	No Data	No Data	No Data
158	Broadway	4/13/1999	Commercial/Residential	ND(0.003)	104	822	No Data	1410	No Data	No Data	No Data	No Data
159	Broadway	9/10/1999	Commercial/Residential	18	35	48	No Data	1319	No Data	No Data	No Data	No Data
160	Broadway	11/22/1999	Commercial/Residential	ND(0.002)	5	7	No Data	19	No Data	No Data	No Data	No Data
161	Broadway	2/22/2000	Commercial/Residential	ND(0.002)	ND(0.002)	5	No Data	20	No Data	No Data	No Data	No Data
162	Broadway	6/13/2000	Commercial/Residential	ND(0.02)	ND(0.02)	No Data	No Data	570	No Data	No Data	No Data	No Data
163	Broadway	10/5/2000	Commercial/Residential	ND(5.00)	ND(10.0)	No Data	No Data	23	No Data	No Data	No Data	No Data
164	Broadway	1/28/2001	Commercial/Residential	ND(0.002)	17	80	No Data	12	No Data	No Data	No Data	No Data
165	Broadway	4/10/2001	Commercial/Residential	ND	18	20	No Data	51	No Data	No Data	No Data	No Data
166	Broadway	6/20/2001	Commercial/Residential	ND	ND	No Data	No Data	33	No Data	No Data	No Data	No Data
167	Broadway	10/5/2001	Commercial/Residential	ND	ND	No Data	No Data	7	No Data	No Data	No Data	No Data
168	Broadway	4/8/2002	Commercial/Residential	ND	ND	No Data	No Data	26	No Data	No Data	No Data	No Data
169	Broadway	5/23/2002	Commercial/Residential	ND	ND	No Data	No Data	7	No Data	No Data	No Data	No Data
170	Broadway	9/13/2002	Commercial/Residential	ND	6	No Data	No Data	87.5	No Data	No Data	No Data	No Data
171	Broadway	10/23/2002	Commercial/Residential	ND	31	No Data	No Data	38	No Data	No Data	No Data	No Data
172	Broadway	4/6/2003	Commercial/Residential	No Data	1	No Data	No Data	21	No Data	No Data	No Data	No Data
173	Broadway	6/5/2003	Commercial/Residential	No Data	No Data	No Data	No Data	875	No Data	No Data	No Data	No Data
174	Broadway	9/11/2003	Commercial/Residential	No Data	1	No Data	No Data	26	No Data	No Data	No Data	No Data
175	Broadway	12/2/2003	Commercial/Residential	No Data	22	No Data	No Data	103	No Data	No Data	No Data	No Data
176	Broadway	3/27/2004	Commercial/Residential	No Data	No Data	No Data	No Data	No Data	No Data	No Data	No Data	No Data
177	Broadway	6/27/2004	Commercial/Residential	ND(0.003)	ND(0.020)	38	No Data	47	No Data	No Data	No Data	No Data
178	Broadway	8/19/2004	Commercial/Residential	ND(0.003)	ND(0.020)	21	No Data	19	No Data	No Data	No Data	No Data
179	Broadway	10/26/2004	Commercial/Residential	ND(0.003)	ND(0.020)	82	No Data	439	No Data	No Data	No Data	No Data
180	Broadway	4/10/2005	Commercial/Residential	ND(0.003)	21	126	No Data	55	No Data	No Data	No Data	No Data
181	Broadway	7/18/2005	Commercial/Residential	ND(0.003)	ND(0.020)	33	No Data	11	No Data	No Data	No Data	No Data
182	Broadway	10/5/2005	Commercial/Residential	ND(0.003)	ND(0.020)	41	No Data	15	No Data	No Data	No Data	No Data
183	Broadway	4/28/2006	Commercial/Residential	ND(0.003)	ND(0.020)	61	No Data	27	No Data	No Data	No Data	No Data
184	Broadway	8/2/2006	Commercial/Residential	3	ND(0.020)	66	No Data	16	No Data	No Data	No Data	No Data
185	Broadway	10/10/2006	Commercial/Residential	3	ND(0.020)	102	No Data	75	No Data	No Data	No Data	No Data
186	Broadway	3/20/2007	Commercial/Residential	4	32	793	No Data	972	No Data	No Data	No Data	No Data
187	Broadway	6/13/2007	Commercial/Residential	4	80	650	No Data	2050	No Data	No Data	No Data	No Data
188	Broadway	10/2/2007	Commercial/Residential	ND(0.003)	ND(0.020)	89	No Data	17	No Data	No Data	No Data	No Data
189	Broadway	4/23/2008	Commercial/Residential	5	46	No Data	No Data	100	No Data	No Data	No Data	No Data
190	Broadway	10/6/2008	Commercial/Residential	ND(1.0)	1	No Data	No Data	20	No Data	No Data	No Data	No Data
191	Broadway	10/13/2008	Commercial/Residential	ND(1.0)	ND(5.0)	No Data	No Data	10	No Data	No Data	No Data	No Data
192	Broadway	6/12/2009	Commercial/Residential	ND(1)	ND(5)	No Data	No Data	6	No Data	No Data	No Data	No Data
193	Broadway	8/17/2009	Commercial/Residential	ND(1)	5	No Data	No Data	30	No Data	No Data	No Data	No Data
194	Broadway	10/8/2009	Commercial/Residential	No Data	No Data	No Data	No Data	No Data	No Data	No Data	No Data	No Data
195	Broadway	10/21/2009	Commercial/Residential	ND(1)	ND(5)	No Data	No Data	17	No Data	No Data	No Data	No Data
248	Broadway	4/2/2010	Commercial/Residential	ND	25	92	0.24	54	2	ND	0.6	2.6
257	Broadway	8/17/2010	Commercial/Residential	No Data	No Data	No Data	No Data	No Data	No Data	No Data	No Data	No Data
197	CC Maple	7/21/2009	Commercial/Residential	ND(1)	6	67	ND(0.20)	69	ND(1)	0.4	No Data	No Data
198	CC Maple	10/8/2009	Commercial/Residential	ND(1)	9	No Data	0.22	33	1	0.4	No Data	No Data
199	CC Maple	10/21/2009	Commercial/Residential	ND(1)	ND(5)	No Data	ND(0.20)	19	ND(1)	0.2	No Data	No Data
238	CC Maple	5/19/2010	Commercial/Residential	ND	12	89	ND	59	ND	ND	0.2	0.2
250	CC Maple	8/24/2010	Commercial/Residential	No Data	No Data	No Data	No Data	No Data	No Data	No Data	No Data	No Data
204	LA 21st St.	7/28/2009	Commercial/Residential	ND(1)	10	No Data	ND(0.20)	26	1	No Data	0.5	0.5
205	LA 21st St.	9/4/2009	Commercial/Residential	ND(1)	13	No Data	0.32	58	2	0.66	0.7	0.7
206	LA 21st St.	10/29/2009	Commercial/Residential	ND(1)	ND(5)	38	ND(0.20)	19	ND(1)	No Data	0.1	0.1
245	LA 21st. St.	4/2/2010	Commercial/Residential	ND	23	142	0.34	57	3	0.2	1.5	1.5
253	LA 21st. St.	8/24/2010	Commercial/Residential	No Data	No Data	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Number of Observations				47.00	50.00	29.00	9.00	51.00	9.00	7.00	6.00	6.00
Percent of samples above detection				12.8%	46.0%	100.0%	44.4%	98.0%	44.4%	71.4%	100.0%	100.0%
Minimum Value				3.00	1.00	5.00	0.22	6.00	1.00	0.20	0.10	0.10
Maximum Value				18.00	104.00	822.00	0.34	2050.00	3.00	0.66	1.50	2.60
Median (samples above detection)				4.00	17.00	67.00	0.28	31.50	2.00	0.40	0.55	0.60
Mean (samples above detection)				6.17	22.74	137.52	0.28	185.03	2.00	0.37	0.60	0.93
Standard Deviation (samples above detection)				5.85	25.19	217.84	0.06	417.50	0.82	0.19	0.50	0.96
Coefficient of Variation				0.95	1.11	1.58	0.21	2.26	0.41	0.51	0.83	1.02

Industrial												
86	McLean	2/9/1998	Industrial	ND(0.005)	ND(0.020)	143	No Data	122	No Data	No Data	No Data	No Data
87	McLean	3/16/1998	Industrial	25	78	552	No Data	172	No Data	No Data	No Data	No Data
88	McLean	6/13/1998	Industrial	ND(0.005)	37	177	No Data	54	No Data	No Data	No Data	No Data
89	McLean	7/8/1998	Industrial	ND(0.003)	20	142	No Data	500	No Data	No Data	No Data	No Data
90	McLean	10/17/1998	Industrial	ND(0.003)	ND(0.020)	110	No Data	38	No Data	No Data	No Data	No Data
91	McLean	3/8/1999	Industrial	4	ND(0.020)	104	No Data	30	No Data	No Data	No Data	No Data
92	McLean	4/13/1999	Industrial	5	38	288	No Data	784	No Data	No Data	No Data	No Data
93	McLean	9/10/1999	Industrial	ND(0.003)	2	7	No Data	285	No Data	No Data	No Data	No Data
94	McLean	11/22/1999	Industrial	4	25	47	No Data	74	No Data	No Data	No Data	No Data
95	McLean	2/22/2000	Industrial	5	0.015	17	No Data	130	No Data	No Data	No Data	No Data
96	McLean	6/13/2000	Industrial	ND(0.02)	ND(0.02)	No Data	No Data	260	No Data	No Data	No Data	No Data
97	McLean	10/5/2000	Industrial	ND(5.00)	27.9	No Data	No Data	116	No Data	No Data	No Data	No Data
98	McLean	1/28/2001	Industrial	21	0.044	31	No Data	93	No Data	No Data	No Data	No Data
99	McLean	4/10/2001	Industrial	ND	10.6	No Data	No Data	755	No Data	No Data	No Data	No Data
100	McLean	6/20/2001	Industrial	ND	23.7	No Data	No Data	51	No Data	No Data	No Data	No Data
101	McLean	10/5/2001	Industrial	44.9	92.2	No Data	No Data	395	No Data	No Data	No Data	No Data
102	McLean	4/8/2002	Industrial	ND	28.5	No Data	No Data	60	No Data	No Data	No Data	No Data
103	McLean	5/23/2002	Industrial	ND	34.5	No Data	No Data	61	No Data	No Data	No Data	No Data
104	McLean	9/13/2002	Industrial	ND	25.4	No Data	No Data	191	No Data	No Data	No Data	No Data
105	McLean	10/23/2002	Industrial	ND	12.5	No Data	No Data	53	No Data	No Data	No Data	No Data
106	McLean	4/6/2003	Industrial	9.39	41.2	No Data	No Data	103	No Data	No Data	No Data	No Data
107	McLean	6/5/2003	Industrial	No Data	35.8	No Data	No Data	1160	No Data	No Data	No Data	No Data
108	McLean	9/11/2003	Industrial	No Data	26.5	No Data	No Data	56	No Data	No Data	No Data	No Data
109	McLean	12/2/2003	Industrial	No Data	37	No Data	No Data	60	No Data	No Data	No Data	No Data
110	McLean	3/27/2004	Industrial	No Data	No Data	No Data	No Data	No Data	No Data	No Data	No Data	No Data
111	McLean	6/27/2004	Industrial	ND(0.003)	ND(0.020)	23	No Data	96	No Data	No Data	No Data	No Data
112	McLean	8/19/2004	Industrial	ND(0.003)	ND(0.020)	118	No Data	73	No Data	No Data	No Data	No Data
113	McLean	10/26/2004	Industrial	ND(0.003)	58	749	No Data	484	No Data	No Data	No Data	No Data
114	McLean	4/10/2005	Industrial	ND(0.003)	36	38	No Data	131	No Data	No Data	No Data	No Data
115	McLean	7/18/2005	Industrial	ND(0.003)	ND(0.020)	109	No Data	10	No Data	No Data	No Data	No Data
116	McLean	10/5/2005	Industrial	5	22	225	No Data	93	No Data	No Data	No Data	No Data
117	McLean	4/28/2006	Industrial	4	31	228	No Data	159	No Data	No Data	No Data	No Data
118	McLean	8/2/2006	Industrial	ND(0.003)	ND(0.020)	417	No Data	116	No Data	No Data	No Data	No Data
119	McLean	10/10/2006	Industrial	ND(0.003)	30	296	No Data	60	No Data	No Data	No Data	No Data
120	McLean	3/20/2007	Industrial	14	335	No Data	No Data	2100	No Data	No Data	No Data	No Data
121	McLean	6/13/2007	Industrial	ND(0.003)	ND(0.020)	105	No Data	40	No Data	No Data	No Data	No Data
122	McLean	10/2/2007	Industrial	ND(0.003)	36	306	No Data	50	No Data	No Data	No Data	No Data
123	McLean	4/23/2008	Industrial	ND(1.0)	43.3	No Data	No Data	270	No Data	No Data	No Data	No Data
124	McLean	10/6/2008	Industrial	ND(1.0)	23.2	No Data	No Data	121	No Data	No Data	No Data	No Data
125	McLean	10/13/2008	Industrial	ND(1.0)	10.4	No Data	No Data	50	No Data	No Data	No Data	No Data
126	McLean	6/12/2009	Industrial	2	16	No Data	No Data	17	No Data	No Data	No Data	No Data
127	McLean	8/17/2009	Industrial	1	13	No Data	No Data	44	No Data	No Data	No Data	No Data
128	McLean	10/8/2009	Industrial	No Data	No Data	No Data	No Data	No Data	No Data	No Data	No Data	No Data
129	McLean	10/21/2009	Industrial	1	12	No Data	No Data	35	No Data	No Data	No Data	No Data
244	McLean	4/2/2010	Industrial	3	31	255	ND	60	2	0.1	1.3	3.3
256	McLean	8/17/2010	Industrial	No Data	No Data	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Number of Observations				40.00	43.00	23.00	1.00	43.00	1.00	1.00	1.00	1.00
Percent of samples above detection				37.5%	79.1%	100.0%	0.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Minimum Value				1.00	0.02	7.00	0.00	10.00	2.00	0.10	1.30	3.30
Maximum Value				44.90	335.00	749.00	0.00	2100.00	2.00	0.10	1.30	3.30
Median (samples above detection)				5.00	28.20	142.00	N/A	93.00	2.00	0.10	1.30	3.30
Mean (samples above detection)				9.89	38.02	195.09	N/A	223.53	2.00	0.10	1.30	3.30
Standard Deviation (samples above detection)				12.07	55.91	182.56	N/A	375.61	N/A	N/A	N/A	N/A
Coefficient of Variation				1.22	1.47	0.94	N/A	1.68	N/A	N/A	N/A	N/A

Residential												
201	CC Harvest Ln.	7/28/2009	Residential	ND(1)	ND(5)		0.32	24	1	No Data	0.5	1.5
202	CC Harvest Ln.	10/8/2009	Residential	ND(1)	ND(5)	No Data	ND(0.20)	38	ND(1)	No Data	0.1	0.1
203	CC Harvest Ln.	10/29/2009	Residential	ND(1)	ND(5)	No Data	ND(0.20)	26	ND(1)	No Data	0.2	0.2
239	CC Harvest Ln.	5/19/2010	Residential	ND	5	ND	ND	19	ND	ND	0.2	0.2
258	CC Harvest Ln.	8/17/2010	Residential	No Data	No Data	No Data	No Data	No Data	No Data	No Data	No Data	No Data
1	Huntington	9/11/2003	Residential	No Data	18.4	135	No Data	303	No Data	No Data	No Data	No Data
2	Huntington	12/2/2003	Residential	No Data	10	100	No Data	48.3	No Data	No Data	No Data	No Data
3	Huntington	6/27/2004	Residential	ND(0.003)	ND(0.020)	20	No Data	153	No Data	No Data	No Data	No Data
4	Huntington	8/19/2004	Residential	ND(0.003)	ND(0.020)	43	No Data	88	No Data	No Data	No Data	No Data
5	Huntington	10/26/2004	Residential	ND(0.003)	ND(0.020)	95	No Data	425	No Data	No Data	No Data	No Data
6	Huntington	4/10/2005	Residential	ND(0.003)	0.064	248	No Data	80	No Data	No Data	No Data	No Data
7	Huntington	7/18/2005	Residential	ND(0.003)	0.038	118	No Data	146	No Data	No Data	No Data	No Data
8	Huntington	10/5/2005	Residential	ND(0.003)	ND(0.020)	48	No Data	32	No Data	No Data	No Data	No Data
9	Huntington	4/28/2006	Residential	ND(0.003)	ND(0.020)	36	No Data	40	No Data	No Data	No Data	No Data
10	Huntington	8/2/2006	Residential	3	ND(0.020)	548	No Data	241	No Data	No Data	No Data	No Data
11	Huntington	10/10/2006	Residential	ND(0.003)	0.021	132	No Data	122	No Data	No Data	No Data	No Data
12	Huntington	3/20/2007	Residential	8	0.057	15	No Data	1600	No Data	No Data	No Data	No Data
13	Huntington	6/13/2007	Residential	7	0.029	15	No Data	1070	No Data	No Data	No Data	No Data
14	Huntington	10/2/2007	Residential	ND(0.003)	0.038	199	No Data	150	No Data	No Data	No Data	No Data
15	Huntington	4/23/2008	Residential	1	59.1	272	No Data	534	No Data	No Data	No Data	No Data
16	Huntington	10/6/2008	Residential	ND(1.0)	17.3	50	No Data	43	No Data	No Data	No Data	No Data
17	Huntington	10/13/2008	Residential	ND(1.0)	10.8	29	No Data	26	No Data	No Data	No Data	No Data
18	Huntington	6/12/2009	Residential	ND(1)	14	54	No Data	72	No Data	No Data	No Data	No Data
19	Huntington	8/17/2009	Residential	ND(1)	11	65	No Data	196	No Data	No Data	No Data	No Data
20	Huntington	10/21/2009	Residential	ND(1)	24	128	No Data	78	No Data	No Data	No Data	No Data
211	Huntington	2/9/1998	Residential	ND(0.005)	31	197	No Data	30	No Data	No Data	No Data	No Data
212	Huntington	3/16/1998	Residential	ND(0.005)	ND(0.020)	189	No Data	40	No Data	No Data	No Data	No Data
213	Huntington	6/13/1998	Residential	ND(0.005)	40	721	No Data	162	No Data	No Data	No Data	No Data
214	Huntington	7/8/1998	Residential	ND(0.003)	23	117	No Data	14	No Data	No Data	No Data	No Data
215	Huntington	10/17/1998	Residential	ND(0.003)	ND(0.020)	185	No Data	86	No Data	No Data	No Data	No Data
216	Huntington	3/8/1999	Residential	ND(0.003)	ND(0.020)	60	No Data	16	No Data	No Data	No Data	No Data
217	Huntington	4/13/1999	Residential	ND(0.003)	ND(0.020)	175	No Data	1360	No Data	No Data	No Data	No Data
218	Huntington	9/10/1999	Residential	ND(0.003)	16	13	No Data	42	No Data	No Data	No Data	No Data
219	Huntington	11/22/1999	Residential	ND(0.002)	5	11	No Data	67	No Data	No Data	No Data	No Data
220	Huntington	2/22/2000	Residential	ND(0.002)	ND(0.002)	5	No Data	54	No Data	No Data	No Data	No Data
221	Huntington	6/13/2000	Residential	ND(0.02)	ND(0.02)	No Data	No Data	240	No Data	No Data	No Data	No Data
222	Huntington	10/5/2000	Residential	ND(5.00)	ND(10.0)	No Data	No Data	21	No Data	No Data	No Data	No Data
223	Huntington	1/28/2001	Residential	ND(0.002)	22	9	No Data	48	No Data	No Data	No Data	No Data
224	Huntington	4/10/2001	Residential	ND	27.9	282	No Data	466	No Data	No Data	No Data	No Data
225	Huntington	6/20/2001	Residential	ND	19.3	No Data	No Data	113	No Data	No Data	No Data	No Data
226	Huntington	10/5/2001	Residential	ND	13.6	No Data	No Data	159	No Data	No Data	No Data	No Data
227	Huntington	4/8/2002	Residential	ND	11.4	No Data	No Data	20	No Data	No Data	No Data	No Data
228	Huntington	5/23/2002	Residential	ND	10.7	No Data	No Data	37	No Data	No Data	No Data	No Data
229	Huntington	9/13/2002	Residential	ND	12.5	145	No Data	129	No Data	No Data	No Data	No Data
230	Huntington	10/23/2002	Residential	ND	11.2	115	No Data	76	No Data	No Data	No Data	No Data
231	Huntington	4/6/2003	Residential	5	33.1	469	No Data	448	No Data	No Data	No Data	No Data
232	Huntington	6/5/2003	Residential	No Data	No Data	140	No Data	35	No Data	No Data	No Data	No Data
240	Huntington	4/2/2010	Residential	ND	39	148	1.38	174	9	0.2	1.7	10.7
254	Huntington	8/17/2010	Residential	No Data	No Data	No Data	No Data	No Data	No Data	No Data	No Data	No Data
196	LA 13th St.	7/20/2009	Residential	ND(1)	6	66	No Data	99	No Data	No Data	No Data	No Data
208	LA 13th St.	7/21/2009	Residential	ND(1)	11	128	ND(0.20)	106	1	No Data	0.4	1.4
209	LA 13th St.	8/17/2009	Residential	ND(1)	5	No Data	ND(0.20)	15	ND(1) H	0.43	No Data	No Data
210	LA 13th St.	10/29/2009	Residential	ND(1)	ND(5)	38	0.21	47	ND(1)	No Data	0.2	0.2
247	LA 13th. St.	4/2/2010	Residential	ND	40	275	0.39	100	5	0.3	1.1	6.1
259	LA 13th. St.	8/17/2010	Residential	No Data	No Data	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Number of Observations				48.00	50.00	42.00	8.00	51.00	8.00	4.00	7.00	7.00
Percent of samples above detection				10.4%	68.0%	97.6%	37.5%	100.0%	37.5%	75.0%	100.0%	100.0%
Minimum Value				1.00	0.02	5.00	0.21	14.00	1.00	0.20	0.10	0.10
Maximum Value				8.00	59.10	721.00	1.38	1600.00	9.00	0.43	1.70	10.70
Median (samples above detection)				5.00	11.95	117.00	0.39	80.00	N/A	N/A	N/A	N/A
Mean (samples above detection)				4.80	16.10	142.39	0.66	190.87	N/A	N/A	N/A	N/A
Standard Deviation (samples above detection)				2.86	14.10	149.65	0.63	319.98	N/A	N/A	N/A	N/A
Coefficient of Variation				0.60	0.88	1.05	0.95	1.68	N/A	N/A	N/A	N/A

APPENDIX I – EMC Stats

Comparison of Wichita First Flush Sample Data with National Stormwater Quality Database Event Mean Concentrations (NSQD)*

*Recommended Model Event Mean Concentrations (EMCs) are highlighted***

	Cadmium Total (ug/L)		Copper Total (ug/L)		Zinc Total (ug/L)		Phosphorus Total (mg/L)		TSS (mg/L)		Kjeldahl Nitrogen (mg/L)		Nitrate/Nitrite (mg/L)***		Total Nitrogen (mg/L)	
	WIC FF	NSQD	WIC FF	NSQD	WIC FF	NSQD	WIC FF	NSQD	WIC FF	NSQD	WIC FF	NSQD	WIC FF	NSQD	WIC FF	NSQD
Commercial																
Number of Observations	40.00	358.00	42.00	387.00	22.00	392.00	1.00	446.00	42.00	458.00	1.00	449.00	1.00	425.00	1.00	425.00
Percent of samples above detection	10%	43%	52%	93%	100%	99%	100%	96%	98%	98%	100%	97%	100%	98%	N/A	N/A
Median Sampled Value	2.50	0.89	13.10	17.00	93.00	150.00	0.32	0.22	59.00	42.00	6.00	1.60	2.40	0.60	8.40	2.20
Estimated EMC****	N/A	N/A	8.09	N/A	48.19	N/A	N/A	N/A	31.89	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Coefficient of Variation	1.15	2.70	0.83	1.50	0.71	1.20	N/A	1.20	2.10	2.00	N/A	0.90	N/A	1.10	N/A	N/A
Commercial/Residential																
Number of Observations	47.00	432.00	50.00	448.00	29.00	531.00	9.00	556.00	51.00	585.00	9.00	525.00	6.00	535.00	N/A	N/A
Percent of samples above detection	13%	40%	46%	84%	100%	93%	44%	96%	98%	99%	44%	95%	100%	98%	N/A	N/A
Median Sampled Value	4.00	0.80	17.00	17.00	67.00	99.50	0.28	0.27	31.50	68.00	2.00	1.35	0.55	0.60	0.60	1.95
Coefficient of Variation	0.95	3.90	1.11	1.10	1.58	1.00	0.21	1.70	2.26	1.60	0.41	1.80	0.83	0.80	N/A	N/A
Industrial																
Number of Observations	40.00	395.00	43.00	416.00	23.00	433.00	1.00	434.00	43.00	428.00	1.00	440.00	1.00	418.00	N/A	N/A
Percent of samples above detection	38%	49%	79%	90%	100%	99%	0%	96%	100%	99%	100%	96%	100%	96%	N/A	N/A
Median Sampled Value	5.00	2.00	28.20	22.00	142.00	210.00	N/A	0.26	93.00	78.00	2.00	1.40	1.30	0.73	3.30	2.13
Estimated EMC****	N/A	N/A	22.74	N/A	92.21	N/A	N/A	N/A	93.00	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Coefficient of Variation	1.22	2.30	1.47	2.00	0.94	2.30	N/A	1.40	1.68	1.50	N/A	1.20	N/A	0.90	N/A	N/A
Residential																
Number of Observations	48.00	723.00	50.00	799.00	42.00	810.00	8.00	963.00	51.00	991.00	8.00	7.00	7.00	927.00	N/A	N/A
Percent of samples above detection	10%	30%	68%	84%	98%	96%	38%	97%	100%	99%	38%	97%	100%	97%	N/A	N/A
Median Sampled Value	5.00	0.50	11.95	12.00	117.00	73.00	0.39	0.30	80.00	49.00	N/A	1.40	N/A	0.60	N/A	2.00
Estimated EMC****	N/A	N/A	8.98	N/A	74.05	N/A	N/A	N/A	43.48	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Coefficient of Variation	0.60	3.40	0.88	1.80	1.05	1.30	0.95	1.10	1.68	1.80	N/A	1.10	N/A	1.10	N/A	N/A
Roads																
Number of Observations	N/A	95.00	N/A	97.00	N/A	93.00	N/A	128.00	N/A	134.00	N/A	25.00	N/A	25.00	N/A	N/A
Percent of samples above detection	N/A	72%	N/A	99%	N/A	97%	N/A	99%	N/A	99%	N/A	96%	N/A	96%	N/A	N/A
Median Sampled Value	N/A	1.00	N/A	34.70	N/A	200.00	N/A	0.25	N/A	99.00	N/A	0.28	N/A	0.28	N/A	0.56
Coefficient of Variation	N/A	0.90	N/A	1.00	N/A	1.00	N/A	1.80	N/A	2.60	N/A	1.20	N/A	1.20	N/A	N/A
Parks/Open Space																
Number of Observations	N/A	38.00	N/A	39.00	N/A	45.00	N/A	46.00	N/A	44.00	N/A	44.00	N/A	44.00	N/A	N/A
Percent of samples above detection	N/A	55%	N/A	74%	N/A	71%	N/A	85%	N/A	96%	N/A	84%	N/A	84%	N/A	N/A
Median Sampled Value	N/A	0.38	N/A	10.00	N/A	40.00	N/A	0.31	N/A	48.50	N/A	0.59	N/A	0.59	N/A	1.18
Coefficient of Variation	N/A	1.90	N/A	2.00	N/A	1.30	N/A	3.50	N/A	1.50	N/A	0.90	N/A	0.90	N/A	N/A

*NSQD Data obtained from The National Stormwater Quality Database, Version 1.1: A Compilation and Analysis of NPDES Stormwater Monitoring Information (A. Maestre, and R. Pitt, University of Alabama; and Center for Watershed Protection, 2005). Available online at: http://rpitt.eng.ua.edu/

** Modeled EMCs developed from local data where adequate sample number and detectable results for statistical significance were available.

***Nitrate data rather than Nitrate/Nitrite is shown from local Wichita data.

****First flush data used to estimate Event Mean Concentrations (EMCs) using methodology proposed by Pitt.

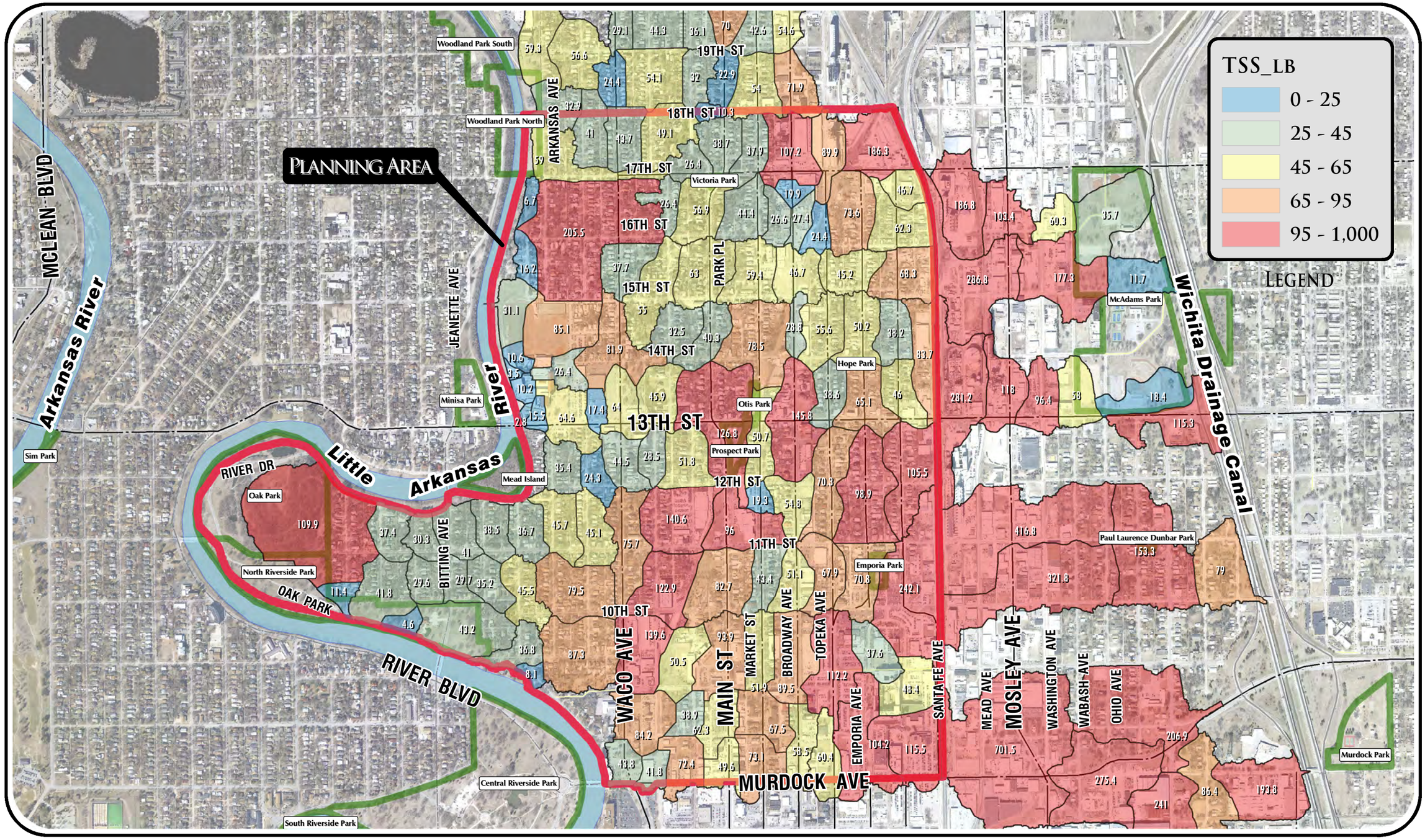
APPENDIX J – Sub-Basin Pollutant Loads

Subcatchment	Area (ac)	TSS (lb)	Zinc (lb)	Copper (lb	Nitrogen (l	Phosphoru	Cadmium (lb)	TSS (lb/ac)	Zinc (lb/ac)	Copper (lb/ac)	Nitrogen (lb/ac)	Phosphorus (lb/ac)	Cadmium (lb/ac)
E10th-001	8.76	75.718	0.142	0.022	1.778	0.332	0.001	8.6436	0.0162	0.0025	0.2030	0.0379	0.0001
E10th-002	11.35	140.592	0.211	0.039	2.997	0.49	0.002	12.3870	0.0186	0.0034	0.2641	0.0432	0.0002
E10th-003	8.73	96.013	0.174	0.029	2.582	0.394	0.001	10.9981	0.0199	0.0033	0.2958	0.0451	0.0001
E10th-004	9.67	122.898	0.182	0.034	2.628	0.427	0.002	12.7092	0.0188	0.0035	0.2718	0.0442	0.0002
E10th-005	10.47	82.725	0.152	0.022	2.361	0.414	0.001	7.9011	0.0145	0.0021	0.2255	0.0395	0.0001
E10th-006	4.87	43.371	0.082	0.013	0.982	0.187	0	8.9057	0.0168	0.0027	0.2016	0.0384	0.0000
E10th-007	5.11	51.057	0.093	0.015	1.502	0.229	0.001	9.9916	0.0182	0.0029	0.2939	0.0448	0.0002
E10th-008	6.76	67.859	0.123	0.02	2.138	0.306	0.001	10.0383	0.0182	0.0030	0.3163	0.0453	0.0001
E10th-009	7.55	70.841	0.125	0.021	1.878	0.315	0.001	9.3829	0.0166	0.0028	0.2487	0.0417	0.0001
E10th-010	20.78	242.088	0.397	0.072	6.358	0.932	0.004	11.6500	0.0191	0.0035	0.3060	0.0449	0.0002
E10th-011	30.93	416.782	0.598	0.116	8.682	1.348	0.007	13.4750	0.0193	0.0038	0.2807	0.0436	0.0002
E10th-012	25.67	321.819	0.473	0.089	6.803	1.083	0.005	12.5368	0.0184	0.0035	0.2650	0.0422	0.0002
E10th-013	20.71	153.265	0.281	0.042	4.464	0.749	0.002	7.4005	0.0136	0.0020	0.2155	0.0362	0.0001
E10th-014	10.13	79.049	0.149	0.023	1.844	0.35	0.001	7.8035	0.0147	0.0023	0.1820	0.0346	0.0001
E13th-001	3.41	26.441	0.042	0.007	1.523	0.162	0.001	7.7540	0.0123	0.0021	0.4466	0.0475	0.0003
E13th-002	9.71	81.903	0.15	0.023	2.45	0.395	0.001	8.4349	0.0154	0.0024	0.2523	0.0407	0.0001
E13th-003	5.68	32.535	0.058	0.008	1.107	0.181	0	5.7280	0.0102	0.0014	0.1949	0.0319	0.0000
E13th-004	5.04	40.267	0.076	0.012	0.953	0.18	0	7.9895	0.0151	0.0024	0.1891	0.0357	0.0000
E13th-005	18.09	126.793	0.215	0.034	3.428	0.61	0.002	7.0090	0.0119	0.0019	0.1895	0.0337	0.0001
E13th-006	5.75	63.984	0.119	0.02	1.694	0.266	0.001	11.1277	0.0207	0.0035	0.2946	0.0463	0.0002
E13th-007	6.08	45.868	0.084	0.012	1.386	0.23	0.001	7.5441	0.0138	0.0020	0.2280	0.0378	0.0002
E13th-008	4.76	35.384	0.066	0.01	0.889	0.164	0	7.4336	0.0139	0.0021	0.1868	0.0345	0.0000
E13th-009	3.3	24.296	0.045	0.007	0.568	0.11	0	7.3624	0.0136	0.0021	0.1721	0.0333	0.0000
E13th-010	5.18	44.463	0.083	0.013	1.167	0.203	0.001	8.5836	0.0160	0.0025	0.2253	0.0392	0.0002
E13th-011	3.4	28.453	0.053	0.008	0.704	0.127	0	8.3685	0.0156	0.0024	0.2071	0.0374	0.0000
E13th-012	6.85	51.792	0.097	0.015	1.311	0.241	0.001	7.5609	0.0142	0.0022	0.1914	0.0352	0.0001
E13th-013	5.49	50.72	0.092	0.015	1.191	0.217	0.001	9.2386	0.0168	0.0027	0.2169	0.0395	0.0002
E13th-014	16.9	145.797	0.266	0.042	4.479	0.697	0.002	8.6270	0.0157	0.0025	0.2650	0.0412	0.0001
E13th-015	4.86	38.644	0.072	0.011	1.022	0.18	0	7.9514	0.0148	0.0023	0.2103	0.0370	0.0000
E13th-016	7.52	65.118	0.12	0.019	1.636	0.288	0.001	8.6593	0.0160	0.0025	0.2176	0.0383	0.0001
E13th-017	5.37	45.99	0.08	0.013	1.223	0.203	0.001	8.5642	0.0149	0.0024	0.2277	0.0378	0.0002
E13th-018	1.73	19.282	0.036	0.006	0.437	0.076	0	11.1457	0.0208	0.0035	0.2526	0.0439	0.0000
E13th-019	5.55	54.813	0.1	0.016	1.625	0.25	0.001	9.8762	0.0180	0.0029	0.2928	0.0450	0.0002
E13th-020	8.89	70.269	0.131	0.02	1.838	0.326	0.001	7.9043	0.0147	0.0022	0.2067	0.0367	0.0001
E13th-021	12.95	98.924	0.184	0.028	2.525	0.461	0.001	7.6389	0.0142	0.0022	0.1950	0.0356	0.0001
E13th-022	11.58	105.497	0.183	0.03	2.432	0.433	0.001	9.1103	0.0158	0.0026	0.2100	0.0374	0.0001
E13th-023	12.16	78.546	0.133	0.021	2.342	0.412	0.001	6.4594	0.0109	0.0017	0.1926	0.0339	0.0001
E13th-024	2.41	28.807	0.049	0.009	0.738	0.109	0	11.9531	0.0203	0.0037	0.3062	0.0452	0.0000
E13th-025	7	55.607	0.097	0.015	1.678	0.269	0.001	7.9439	0.0139	0.0021	0.2397	0.0384	0.0001
E13th-026	6.51	50.25	0.093	0.014	1.248	0.232	0.001	7.7189	0.0143	0.0022	0.1917	0.0356	0.0002
E13th-027	5.25	38.209	0.071	0.011	1.033	0.182	0	7.2779	0.0135	0.0021	0.1968	0.0347	0.0000
E13th-028	6.82	83.672	0.13	0.024	1.597	0.278	0.001	12.2686	0.0191	0.0035	0.2342	0.0408	0.0001
E13th-029	16.7	281.188	0.398	0.081	4.442	0.755	0.005	16.8376	0.0238	0.0049	0.2660	0.0452	0.0003
E13th-030	7.09	117.975	0.158	0.033	2.09	0.325	0.002	16.6396	0.0223	0.0047	0.2948	0.0458	0.0003

E13th-031	5.97	96.429	0.129	0.027	1.823	0.275	0.002	16.1523	0.0216	0.0045	0.3054	0.0461	0.0003
E13th-032	5.95	57.996	0.081	0.016	1.009	0.208	0.001	9.7472	0.0136	0.0027	0.1696	0.0350	0.0002
E13th-033	7.12	18.38	0.02	0.004	0.368	0.101	0	2.5815	0.0028	0.0006	0.0517	0.0142	0.0000
E13th-034	9.44	115.307	0.224	0.038	1.537	0.377	0.001	12.2147	0.0237	0.0040	0.1628	0.0399	0.0001
E15th-001	5.85	37.712	0.069	0.01	1.136	0.195	0	6.4465	0.0118	0.0017	0.1942	0.0333	0.0000
E15th-002	8.79	54.952	0.099	0.014	1.806	0.298	0.001	6.2516	0.0113	0.0016	0.2055	0.0339	0.0001
E15th-003	8.82	63.026	0.116	0.017	1.831	0.311	0.001	7.1458	0.0132	0.0019	0.2076	0.0353	0.0001
E15th-004	7.27	59.388	0.109	0.016	1.78	0.29	0.001	8.1689	0.0150	0.0022	0.2448	0.0399	0.0001
E15th-005	5.98	46.732	0.079	0.013	1.501	0.234	0.001	7.8147	0.0132	0.0022	0.2510	0.0391	0.0002
E15th-006	5.97	45.246	0.082	0.013	1.158	0.208	0.001	7.5789	0.0137	0.0022	0.1940	0.0348	0.0002
E15th-007	7.83	68.272	0.121	0.019	1.546	0.284	0.001	8.7193	0.0155	0.0024	0.1974	0.0363	0.0001
E15th-008	17.28	286.771	0.388	0.081	5.047	0.791	0.005	16.5955	0.0225	0.0047	0.2921	0.0458	0.0003
E15th-009	13.71	177.253	0.242	0.049	3.484	0.574	0.003	12.9287	0.0177	0.0036	0.2541	0.0419	0.0002
E15th-010	6.12	11.666	0.011	0.003	0.261	0.07	0	1.9062	0.0018	0.0005	0.0426	0.0114	0.0000
E16th-001	3.23	26.386	0.05	0.008	0.573	0.113	0	8.1690	0.0155	0.0025	0.1774	0.0350	0.0000
E16th-002	3.26	26.41	0.05	0.008	0.579	0.113	0	8.1012	0.0153	0.0025	0.1776	0.0347	0.0000
E16th-003	7.52	56.892	0.105	0.016	1.477	0.267	0.001	7.5654	0.0140	0.0021	0.1964	0.0355	0.0001
E16th-004	5.53	38.711	0.071	0.011	1.104	0.192	0	7.0002	0.0128	0.0020	0.1996	0.0347	0.0000
E16th-005	4.83	37.867	0.07	0.011	1.007	0.179	0	7.8400	0.0145	0.0023	0.2085	0.0371	0.0000
E16th-006	6.54	44.355	0.082	0.012	1.218	0.217	0	6.7821	0.0125	0.0018	0.1862	0.0332	0.0000
E16th-007	3.16	26.629	0.047	0.007	0.999	0.136	0	8.4269	0.0149	0.0022	0.3161	0.0430	0.0000
E16th-008	8.65	107.171	0.158	0.03	2.53	0.379	0.002	12.3897	0.0183	0.0035	0.2925	0.0438	0.0002
E16th-009	1.7	19.939	0.032	0.006	0.597	0.081	0	11.7288	0.0188	0.0035	0.3512	0.0476	0.0000
E16th-010	2.45	27.351	0.044	0.008	0.893	0.114	0.001	11.1637	0.0180	0.0033	0.3645	0.0465	0.0004
E16th-011	2.62	24.353	0.04	0.007	0.5	0.097	0	9.2950	0.0153	0.0027	0.1908	0.0370	0.0000
E16th-012	5.6	89.916	0.12	0.025	1.727	0.258	0.002	16.0564	0.0214	0.0045	0.3084	0.0461	0.0004
E16th-013	8.88	73.595	0.124	0.02	1.713	0.315	0.001	8.2877	0.0140	0.0023	0.1929	0.0355	0.0001
E16th-014	11.01	186.259	0.243	0.052	3.292	0.505	0.003	16.9173	0.0221	0.0047	0.2990	0.0459	0.0003
E16th-015	7.42	62.292	0.105	0.017	1.544	0.267	0.001	8.3951	0.0142	0.0023	0.2081	0.0360	0.0001
E16th-016	3.4	46.675	0.07	0.013	0.824	0.144	0.001	13.7279	0.0206	0.0038	0.2424	0.0424	0.0003
E16th-017	11.03	186.814	0.234	0.051	3.465	0.51	0.003	16.9369	0.0212	0.0046	0.3141	0.0462	0.0003
E16th-018	6.13	103.374	0.142	0.029	1.713	0.279	0.002	16.8636	0.0232	0.0047	0.2794	0.0455	0.0003
E16th-019	3.6	60.284	0.084	0.017	0.98	0.163	0.001	16.7456	0.0233	0.0047	0.2722	0.0453	0.0003
E16th-020	11.95	35.723	0.042	0.009	0.673	0.188	0	2.9894	0.0035	0.0008	0.0563	0.0157	0.0000
EMurdock-001	5.47	60.428	0.111	0.019	1.679	0.253	0.001	11.0472	0.0203	0.0035	0.3069	0.0463	0.0002
EMurdock-002	12.51	104.17	0.172	0.029	5.317	0.59	0.002	8.3269	0.0137	0.0023	0.4250	0.0472	0.0002
EMurdock-003	6.65	48.44	0.075	0.013	3.081	0.316	0.001	7.2842	0.0113	0.0020	0.4633	0.0475	0.0002
EMurdock-004	11.63	115.498	0.204	0.035	4.248	0.54	0.002	9.9310	0.0175	0.0030	0.3653	0.0464	0.0002
EMurdock-005	43.81	701.533	0.969	0.198	12.273	1.974	0.012	16.0131	0.0221	0.0045	0.2801	0.0451	0.0003
EMurdock-006	19.64	275.439	0.401	0.078	5.214	0.852	0.005	14.0244	0.0204	0.0040	0.2655	0.0434	0.0003
EMurdock-007	22.29	206.892	0.379	0.061	5.22	0.886	0.003	9.2818	0.0170	0.0027	0.2342	0.0397	0.0001
EMurdock-008	20.43	241.039	0.363	0.067	5.584	0.865	0.004	11.7983	0.0178	0.0033	0.2733	0.0423	0.0002
EMurdock-009	10.3	86.429	0.156	0.025	2.086	0.376	0.001	8.3912	0.0151	0.0024	0.2025	0.0365	0.0001
EMurdock-010	12.28	193.797	0.256	0.053	3.698	0.558	0.003	15.7815	0.0208	0.0043	0.3011	0.0454	0.0002
W10-001	5.68	45.528	0.084	0.013	1.122	0.203	0.001	8.0155	0.0148	0.0023	0.1975	0.0357	0.0002

W10-002	4.99	38.51	0.071	0.011	0.933	0.172	0	7.7174	0.0142	0.0022	0.1870	0.0345	0.0000
W10-003	4.42	35.177	0.065	0.01	0.968	0.164	0	7.9586	0.0147	0.0023	0.2190	0.0371	0.0000
W10-004	5.32	41.046	0.077	0.012	1.031	0.188	0	7.7154	0.0145	0.0023	0.1938	0.0353	0.0000
W10-005	3.47	29.694	0.056	0.009	0.622	0.124	0	8.5573	0.0161	0.0026	0.1793	0.0357	0.0000
W10-006	3.42	30.287	0.058	0.009	0.614	0.124	0	8.8558	0.0170	0.0026	0.1795	0.0363	0.0000
W10-007	3.77	29.582	0.056	0.009	0.681	0.131	0	7.8467	0.0149	0.0024	0.1806	0.0347	0.0000
W10-008	11.18	43.238	0.058	0.011	0.984	0.23	0	3.8674	0.0052	0.0010	0.0880	0.0206	0.0000
W13-001	2	17.405	0.029	0.005	0.823	0.094	0	8.7025	0.0145	0.0025	0.4115	0.0470	0.0000
W13-002	7.23	64.566	0.114	0.019	2.431	0.322	0.001	8.9303	0.0158	0.0026	0.3362	0.0445	0.0001
W13-003	1.46	15.484	0.028	0.005	0.496	0.067	0	10.6055	0.0192	0.0034	0.3397	0.0459	0.0000
W13-004	1.54	10.648	0.016	0.003	0.735	0.073	0	6.9143	0.0104	0.0019	0.4773	0.0474	0.0000
W13-005	0.5	3.457	0.005	0.001	0.239	0.024	0	6.9140	0.0100	0.0020	0.4780	0.0480	0.0000
W13-006	1.48	10.233	0.015	0.003	0.706	0.071	0	6.9142	0.0101	0.0020	0.4770	0.0480	0.0000
W13-007	0.4	2.766	0.004	0.001	0.191	0.019	0	6.9150	0.0100	0.0025	0.4775	0.0475	0.0000
W15-001	10.78	85.131	0.145	0.023	3.895	0.48	0.002	7.8971	0.0135	0.0021	0.3613	0.0445	0.0002
W15-002	4.93	31.056	0.041	0.008	1.398	0.193	0.001	6.2994	0.0083	0.0016	0.2836	0.0391	0.0002
W16-001	30.04	205.525	0.38	0.056	5.643	1.005	0.002	6.8417	0.0126	0.0019	0.1878	0.0335	0.0001
W16-002	2.58	16.235	0.029	0.004	0.423	0.08	0	6.2926	0.0112	0.0016	0.1640	0.0310	0.0000
W16-003	1.58	6.655	0.011	0.001	0.306	0.046	0	4.2120	0.0070	0.0006	0.1937	0.0291	0.0000
W17-001	8.42	58.958	0.105	0.017	1.29	0.265	0.001	7.0021	0.0125	0.0020	0.1532	0.0315	0.0001
W18-001	4.37	32	0.059	0.009	0.861	0.153	0	7.3227	0.0135	0.0021	0.1970	0.0350	0.0000
W18-002	8.63	54.145	0.098	0.014	1.736	0.288	0.001	6.2740	0.0114	0.0016	0.2012	0.0334	0.0001
W18-003	3.42	24.389	0.045	0.007	0.646	0.116	0	7.1313	0.0132	0.0020	0.1889	0.0339	0.0000
W18-004	1.15	10.301	0.02	0.003	0.197	0.041	0	8.9574	0.0174	0.0026	0.1713	0.0357	0.0000
W18-005	7.25	49.104	0.09	0.013	1.412	0.245	0.001	6.7730	0.0124	0.0018	0.1948	0.0338	0.0001
W18-006	5.85	43.704	0.081	0.012	1.14	0.204	0	7.4708	0.0138	0.0021	0.1949	0.0349	0.0000
W18-007	5.79	41.013	0.076	0.011	1.092	0.196	0	7.0834	0.0131	0.0019	0.1886	0.0339	0.0000
W18-008	4.83	32.872	0.059	0.009	0.829	0.157	0	6.8058	0.0122	0.0019	0.1716	0.0325	0.0000
W19th-001	7.9	59.284	0.102	0.016	2.166	0.315	0.001	7.5043	0.0129	0.0020	0.2742	0.0399	0.0001
W19th-002	8.1	56.644	0.105	0.016	1.496	0.271	0.001	6.9931	0.0130	0.0020	0.1847	0.0335	0.0001
W19th-003	3.61	29.086	0.055	0.008	0.642	0.125	0	8.0571	0.0152	0.0022	0.1778	0.0346	0.0000
W19th-004	7.66	44.272	0.08	0.011	1.46	0.243	0	5.7796	0.0104	0.0014	0.1906	0.0317	0.0000
W19th-005	4.07	36.125	0.066	0.011	1.045	0.165	0	8.8759	0.0162	0.0027	0.2568	0.0405	0.0000
W19th-006	3.36	22.885	0.042	0.006	0.636	0.113	0	6.8110	0.0125	0.0018	0.1893	0.0336	0.0000
W19th-007	6.82	54.007	0.099	0.015	1.459	0.253	0.001	7.9189	0.0145	0.0022	0.2139	0.0371	0.0001
W19th-008	5.75	71.947	0.112	0.021	1.946	0.266	0.001	12.5125	0.0195	0.0037	0.3384	0.0463	0.0002
W19th-009	4.33	54.563	0.085	0.016	1.461	0.201	0.001	12.6012	0.0196	0.0037	0.3374	0.0464	0.0002
W19th-010	5.21	42.558	0.079	0.012	1.082	0.192	0.001	8.1685	0.0152	0.0023	0.2077	0.0369	0.0002
W19th-011	5.84	69.626	0.113	0.02	1.693	0.259	0.001	11.9223	0.0193	0.0034	0.2899	0.0443	0.0002
W19th-012	10.2	70.012	0.127	0.019	1.97	0.345	0.001	6.8639	0.0125	0.0019	0.1931	0.0338	0.0001
W19th-013	5.32	40.555	0.074	0.011	1.228	0.199	0.001	7.6231	0.0139	0.0021	0.2308	0.0374	0.0002
W19th-014	7.57	59.436	0.109	0.016	1.753	0.29	0.001	7.8515	0.0144	0.0021	0.2316	0.0383	0.0001
W19th-015	11.97	91.275	0.168	0.026	2.549	0.435	0.001	7.6253	0.0140	0.0022	0.2129	0.0363	0.0001
W19th-016	12.4	93.713	0.173	0.026	2.617	0.45	0.001	7.5575	0.0140	0.0021	0.2110	0.0363	0.0001
W19th-017	8.78	82.363	0.148	0.024	2.04	0.347	0.001	9.3808	0.0169	0.0027	0.2323	0.0395	0.0001

WBACKBAY-001	4.33	36.823	0.07	0.011	0.745	0.152	0	8.5042	0.0162	0.0025	0.1721	0.0351	0.0000
WBACKBAY-002	1.22	8.059	0.014	0.002	0.202	0.039	0	6.6057	0.0115	0.0016	0.1656	0.0320	0.0000
WForest-001	30.82	109.878	0.142	0.027	2.548	0.599	0.001	3.5652	0.0046	0.0009	0.0827	0.0194	0.0000
WForest-002	2.03	11.385	0.018	0.003	0.263	0.056	0	5.6084	0.0089	0.0015	0.1296	0.0276	0.0000
WMurdock-001	5.05	36.686	0.068	0.01	0.925	0.17	0	7.2646	0.0135	0.0020	0.1832	0.0337	0.0000
WMurdock-002	6.1	45.675	0.085	0.013	1.131	0.21	0	7.4877	0.0139	0.0021	0.1854	0.0344	0.0000
WMurdock-003	6.07	45.083	0.084	0.013	1.121	0.208	0	7.4272	0.0138	0.0021	0.1847	0.0343	0.0000
WMurdock-004	11.14	79.507	0.148	0.022	2.069	0.376	0.001	7.1371	0.0133	0.0020	0.1857	0.0338	0.0001
WMurdock-005	13.29	87.293	0.16	0.023	2.631	0.45	0.001	6.5683	0.0120	0.0017	0.1980	0.0339	0.0001
WMurdock-006	9.34	139.554	0.216	0.041	2.492	0.422	0.002	14.9415	0.0231	0.0044	0.2668	0.0452	0.0002
WMurdock-007	6.59	50.482	0.078	0.014	1.6	0.264	0.001	7.6604	0.0118	0.0021	0.2428	0.0401	0.0002
WMurdock-008	8.81	93.905	0.166	0.028	2.717	0.405	0.001	10.6589	0.0188	0.0032	0.3084	0.0460	0.0001
WMurdock-009	5.62	51.935	0.098	0.015	1.226	0.227	0.001	9.2411	0.0174	0.0027	0.2181	0.0404	0.0002
WMurdock-010	9.09	89.504	0.161	0.027	2.974	0.415	0.001	9.8464	0.0177	0.0030	0.3272	0.0457	0.0001
WMurdock-011	11.09	112.213	0.201	0.034	3.882	0.515	0.002	10.1184	0.0181	0.0031	0.3500	0.0464	0.0002
WMurdock-012	5.3	37.649	0.058	0.01	2.504	0.253	0.001	7.1036	0.0109	0.0019	0.4725	0.0477	0.0002
WMurdock-013	7.88	84.23	0.156	0.025	2.006	0.351	0.001	10.6891	0.0198	0.0032	0.2546	0.0445	0.0001
WMurdock-014	3.08	38.944	0.065	0.011	0.773	0.137	0.001	12.6442	0.0211	0.0036	0.2510	0.0445	0.0003
WMurdock-015	5.01	62.315	0.111	0.019	1.56	0.237	0.001	12.4381	0.0222	0.0038	0.3114	0.0473	0.0002
WMurdock-016	6.4	67.54	0.124	0.02	1.769	0.301	0.001	10.5531	0.0194	0.0031	0.2764	0.0470	0.0002
WMurdock-017	5.32	58.525	0.108	0.018	1.553	0.245	0.001	11.0009	0.0203	0.0034	0.2919	0.0461	0.0002
WMurdock-018	6.55	73.072	0.133	0.022	1.973	0.303	0.001	11.1560	0.0203	0.0034	0.3012	0.0463	0.0002
WMurdock-019	3.64	49.646	0.086	0.015	1.079	0.173	0.001	13.6390	0.0236	0.0041	0.2964	0.0475	0.0003
WMurdock-020	5.54	72.354	0.126	0.022	1.704	0.271	0.001	13.0603	0.0227	0.0040	0.3076	0.0489	0.0002
WMurdock-021	2.63	41.783	0.068	0.013	0.664	0.121	0.001	15.8871	0.0259	0.0049	0.2525	0.0460	0.0004
WMurdock-022	3.44	43.844	0.08	0.014	0.938	0.156	0.001	12.7453	0.0233	0.0041	0.2727	0.0453	0.0003
WPEARCE-001	5.06	37.398	0.07	0.011	0.923	0.172	0	7.3909	0.0138	0.0022	0.1824	0.0340	0.0000
WPEARCE-002	8.01	41.832	0.066	0.011	1.037	0.214	0	5.2225	0.0082	0.0014	0.1295	0.0267	0.0000
WPEARCE-003	1.76	4.615	0.005	0.001	0.092	0.025	0	2.6222	0.0028	0.0006	0.0523	0.0142	0.0000



MIDTOWN NEIGHBORHOOD

STORMWATER MASTER PLAN

MODELED - TOTAL SUSPENDED SOLIDS (TSS)

NORTH

CITY OF WICHITA

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APPENDIX K – Cost Estimates

Midtown Neighborhood Stormwater Master Plan
CIP Concept Discovery Cost Estimates
Summary of Unit Costs

ITEM	DESCRIPTION	ESTIMATED UNIT PRICE	
1	12" SWS	$	25.00
2	15" SWS	$	35.00
3	18" SWS	$	40.00
4	24" SWS	$	50.00
5	30" SWS	$	70.00
6	36" SWS	$	85.00
7	42" SWS	$	100.00
8	48" SWS	$	115.00
9	54" SWS	$	140.00
10	3' X 2' RCBC	$	225.00
11	3' X 3' RCBC	$	250.00
12	5' X 2' RCBC	$	260.00
13	5' X 2.5' RCBC	$	270.00
14	5' X 3' RCBC	$	275.00
15	6' X 2' RCBC	$	275.00
16	6' X 3' RCBC	$	300.00
17	6' X 4' RCBC	$	310.00
18	8' X 2' RCBC	$	310.00
19	8' X 3' RCBC	$	330.00
20	8' X 4' RCBC	$	340.00
21	9' X 3' RCBC	$	350.00
22	9' X 4' RCBC	$	360.00
23	10' X 2' RCBC	$	375.00
24	10' X 3' RCBC	$	380.00
25	10' X 4' RCBC	$	420.00
26	12' X 3' RCBC	$	440.00
27	12' X 4' RCBC	$	500.00
28	12' X 5' RCBC	$	510.00
29	Curb Inlet	$	3,500.00
30	Reinforced Concrete Manhole	$	10,000.00
31	Manhole	$	4,000.00
32	Manhole	$	3,300.00

Midtown Neighborhood Stormwater Master Plan
CIP Concept Discovery Cost Estimates
Overall Summary

Alternative 1				
CORRIDOR IMPROVEMENT		**Estimate of Probable Construction Cost**		
18th Street to 15th Street				
East 17th Street	$	2,964,312.50		
West 16th Street (Arkansas)	$	734,956.25		Group total
East 15th Street	$	8,294,450.00	***$***	***11,993,718.75***
15th Street to Murdock				
East 13th Street	$	11,828,487.50		
East Murdock	$	10,743,344.25		
Lewellen Disconnect	$	1,508,443.75		Group total
West Murdock	$	1,651,731.25	$	25,732,006.75
Oxbow Area				
West 10th Street + Forrest	$	2,280,962.50	$	2,280,962.50
GRAND TOTAL ALT 1	**$**	**40,006,688.00**		

Alternative 2				
CORRIDOR IMPROVEMENT		**Estimate of Probable Construction Cost**		
18th Street to 15th Street				
East 17th Street	$	2,964,312.50		
West 16th Street (Arkansas)	$	4,912,312.50		Group total
Detention Ponds	$	5,554,062.50	$	13,430,687.50
15th Street to Murdock				
East 13th Street	$	8,907,625.00		
12th Street Diversion	$	803,437.50		
East 10th Street	$	7,084,737.50		
Lewellen Disconnect	$	1,508,443.75		
8th Street Diversion	$	5,033,487.50		
Murdock West	$	-		Group total
Murdock East	$	-	***$***	***23,337,731.25***
Oxbow Area				
West 10th Street + Forrest	$	2,280,962.50	***$***	***2,280,962.50***
GRAND TOTAL ALT 2	**$**	**39,049,381.25**		

RECOMMENDED PLAN			
18th Street to 15th Street (Alternative #1)		$	11,993,718.75
15th Street to Murdock (Alternative #2)		$	23,337,731.25
	Southwest Area	$	2,280,962.50
	Recommended Plan Total	***$***	***37,612,412.50***

Midtown Neighborhood Stormwater Master Plan
CIP Concept Discovery Cost Estimates
Detail - 18th Street to 15th Street Basins
Alternate #1

Basin	IMPROVEMENT	Estimate of Probable Construction Cost	Basin Total
East 17th Street	17th Street, Wellington to Wichita Drainage Canal	$ 2,964,312.50	$ 2,964,312.50
West 16th Street	16th Street, Waco to Little Arkansas River	$ 734,956.25	$ 734,956.25
East 15th Street	St. Francis, 17th Street to 16th Street	$ 352,425.00	
	Broadway, 17th Street to 16th Street	$ 623,575.00	
	16th Street & Santa Fe	$ 2,528,937.50	
	15th Street, Waco to Wichita Drainage Canal	$ 4,789,512.50	$ 8,294,450.00
	TOTAL	**$ 11,993,718.75**	

Project Name: Midtown Neighborhood Stormwater Master Plan | **Estimate by:** G. Rath

Phase and/or Portion: | **Date Prepared:** 10/18/2011

Item No.	Description	Quantity	Unit	Std Unit Price	Custom Unit Price	Extension	Special Conditions
4	24" SWS	165	LF	$ 50.00		$ 8,250.00	
9	3' X 2' RCBC	365	LF	$ 225.00		$ 82,125.00	
11	5' X 2' RCBC	285	LF	$ 260.00		$ 74,100.00	
13	5' X 3' RCBC	3925	LF	$ 275.00		$ 1,079,375.00	
31	BMP's	1	LS	$ 3,200.00	$ 2,000.00	$ 2,000.00	
36	Flowable Fill	4740	LF	$ 50.00		$ 237,000.00	
37	Reinforced Concrete Manhole	10	EA	$ 3,300.00	$ 10,000.00	$ 100,000.00	
38	Pavement Remove and Replace	4740	LF	$ 140.00		$ 663,600.00	
42	Bore under RR Tracks	170	LF	$ 650.00		$ 110,500.00	
43	Rip Rap	50	SY	$ 50.00		$ 2,500.00	
45	Site Clearing & Restoration	1	LS	$ 10,000.00	$ 2,000.00	$ 2,000.00	
48	Railroad Permit	1	LS	$ 2,500.00	$ 10,000.00	$ 10,000.00	
					Subtotal	$ 2,371,450.00	
					Contingencies @ 25% +/-	$ 592,862.50	
					TOTAL	$ 2,964,312.50	

Assumptions:

MKEC ENGINEERING CONSULTANTS, INC.

Project Name: Midtown Neighborhood Stormwater Master Plan | **Estimate by:** GR

Phase and/or Portion: West 16th (Arkansas) | **Date Prepared:** 20-May

Item No.	Description	Quantity	Unit	Std Unit Price	Custom Unit Price	Extension	Special Conditions
1	5' x 3' RCBC	345	LF	$ 25.00	$ 275.00	$ 94,875.00	
2	15" SWS	425	LF	$ 35.00		$ 14,875.00	
3	18" SWS		LF	$ 40.00		$ -	
4	24" SWS		LF	$ 50.00		$ -	
5	30" SWS		LF	$ 70.00		$ -	
6	36" SWS	885	LF	$ 85.00		$ 75,225.00	
7	42" SWS		LF	$ 100.00		$ -	
8	48" SWS		LF	$ 115.00		$ -	
9	Remove 12" SWS		LF	$ 20.00		$ -	
10	Remove 18" SWS		LF	$ 35.00		$ -	
11	Abandon Existing Pipe and Structures	620	LF	$ 70.00	$ 25.00	$ 15,500.00	
12	Special Area Inlet		EA	$ 10,000.00		$ -	
13	Inlet Adjustment		EA	$ 5,000.00		$ -	
14	BMP's	1	LS	$ 3,200.00	$ 1,500.00	$ 1,500.00	
15	Compacted Fill		CY	$ 2.00		$ -	
16	Inlet	21	EA	$ 3,500.00		$ 73,500.00	
17	Ditch		LF	$ 5.00		$ -	
18	Exc.		CY	$ 2.00		$ -	
19	Manhole	3	EA	$ 3,300.00		$ 9,900.00	
20	Sand Backfill &/or Flowable Fill	1511	LF	$ 50.00		$ 75,550.00	
21	Reinforced Concrete Manhole	1	EA	$ 3,300.00	$ 10,000.00	$ 10,000.00	
22	Pavement Remove and Replace	1511	LF	$ 1.00	$ 140.00	$ 211,540.00	
23	Rip Rap	50	SY	$ 50.00		$ 2,500.00	
24	Moisture Control Soils		CY	$ 8.00		$ -	
25	Site Clearing & Restoration	1	LS	$ 10,000.00	$ 2,000.00	$ 2,000.00	
26	Traffic Control	1	LS	$ 1.30	$ 1,000.00	$ 1,000.00	
27	Compact AB-3 Base		CY	$ 12.00		$ -	
28	Excavation		CY	$ 8.00		$ -	
29						$ -	
30						$ -	

Assumptions:

Contingencies @ 25% +/-	$ 146,991.25
Construction Total	$ 734,956.25
TOTAL	$ 734,956.25

MKEC ENGINEERING CONSULTANTS, INC.

Project Name: Midtown Neighborhood Stormwater Master Plan | **Estimate by:** GR

Phase and/or Portion: St. Francis, 16th to 17th | **Date Prepared:** 16-May

Item No.	Description	Quantity	Unit	Std Unit Price	Custom Unit Price	Extension	Special Conditions
1	12" SWS		LF	$ 25.00		$ -	
2	15" SWS	100	LF	$ 35.00		$ 3,500.00	
3	18" SWS		LF	$ 40.00		$ -	
4	24" SWS	856	LF	$ 50.00		$ 42,800.00	
5	30" SWS		LF	$ 70.00		$ -	
6	36" SWS		LF	$ 85.00		$ -	
7	42" SWS		LF	$ 100.00		$ -	
8	48" SWS		LF	$ 115.00		$ -	
9	Remove 12" SWS		LF	$ 20.00		$ -	
10	Remove 18" SWS		LF	$ 35.00		$ -	
11	Abandon Existing Pipe and Structures	956	LF	$ 70.00	$ 25.00	$ 23,900.00	
12	Special Area Inlet		EA	$ 10,000.00		$ -	
13	Inlet Adjustment		EA	$ 5,000.00		$ -	
14	BMP's	1	LS	$ 3,200.00	$ 1,500.00	$ 1,500.00	
15	Compacted Fill		CY	$ 2.00		$ -	
16	Inlet	6	EA	$ 3,500.00		$ 21,000.00	
17	Ditch		LF	$ 5.00		$ -	
18	Exc.		CY	$ 2.00		$ -	
19	Extend RCBC		LS			$ -	
20	Sand Backfill &/or Flowable Fill	956	LF	$ 50.00		$ 47,800.00	
21	Manholes	2	EA	$ 3,300.00		$ 6,600.00	
22	Pavement Remove and Replace	956	LF	$ 1.00	$ 140.00	$ 133,840.00	
23	Rip Rap		SY	$ 50.00		$ -	
24	Moisture Control Soils		CY	$ 8.00		$ -	
25	Site Clearing & Restoration	1	LS	$ 10,000.00	$ 500.00	$ 500.00	
26	Traffic Control	1	LS	$ 1.30	$ 500.00	$ 500.00	
27	Compact AB-3 Base		CY	$ 12.00		$ -	
28	Excavation		CY	$ 8.00		$ -	
29						$ -	
30						$ -	

Assumptions:

Contingencies @ 25% +/-	$ 70,485.00
Construction Total	$ 352,425.00
TOTAL	$ 352,425.00

MKEC ENGINEERING CONSULTANTS, INC.

Project Name: Midtown Neighborhood Stormwater Master Plan | **Estimate by:** GR

Phase and/or Portion: Broadway, 17th to 16th | **Date Prepared:** 16-May

Item No.	Description	Quantity	Unit	Std Unit Price	Custom Unit Price	Extension	Special Conditions
1	5' X 2' RCBC	658	LF	$ 25.00	$ 260.00	$ 171,080.00	
2	15" SWS	150	LF	$ 35.00		$ 5,250.00	
3	18" SWS		LF	$ 40.00		$ -	
4	24" SWS	354	LF	$ 50.00		$ 17,700.00	
5	30" SWS		LF	$ 70.00		$ -	
6	36" SWS		LF	$ 85.00		$ -	
7	42" SWS		LF	$ 100.00		$ -	
8	48" SWS		LF	$ 115.00		$ -	
9	Remove 12" SWS		LF	$ 20.00		$ -	
10	Remove 18" SWS		LF	$ 35.00		$ -	
11	Abandon Existing Pipe and Structures	1162	LF	$ 70.00	$ 25.00	$ 29,050.00	
12	Special Area Inlet		EA	$ 10,000.00		$ -	
13	Inlet Adjustment		EA	$ 5,000.00		$ -	
14	BMP's	1	LS	$ 3,200.00	$ 2,000.00	$ 2,000.00	
15	Compacted Fill		CY	$ 2.00		$ -	
16	Inlet	8	EA	$ 3,500.00		$ 28,000.00	
17	Ditch		LF	$ 5.00		$ -	
18	Exc.		CY	$ 2.00		$ -	
19	Extend RCBC		LS			$ -	
20	Sand Backfill &/or Flowable Fill	1162	LF	$ 50.00		$ 58,100.00	
21	Reinforced Concrete Manhole	2	EA	$ 3,300.00	$ 10,000.00	$ 20,000.00	
22	Pavement Remove and Replace	1162	LF	$ 1.00	$ 140.00	$ 162,680.00	
23	Rip Rap		SY	$ 50.00		$ -	
24	Moisture Control Soils		CY	$ 8.00		$ -	
25	Site Clearing & Restoration	1	LS	$ 10,000.00	$ 2,500.00	$ 2,500.00	
26	Traffic Control	1	LS	$ 1.30	$ 2,500.00	$ 2,500.00	
27	Compact AB-3 Base		CY	$ 12.00		$ -	
28	Excavation		CY	$ 8.00		$ -	
29						$ -	
30						$ -	

Assumptions:

Contingencies @ 25% +/-	$ 124,715.00
Construction Total	$ 623,575.00
TOTAL	$ 623,575.00

MKEC ENGINEERING CONSULTANTS, INC.

Project Name: Midtown Neighborhood Stormwater Master Plan | **Estimate by:** GR

Phase and/or Portion: 16th & Santa Fe | **Date Prepared:** 14-May

Item No.	Description	Quantity	Unit	Std Unit Price	Custom Unit Price	Extension	Special Conditions
1	5' X 2' RCBC	675	LF	$ 25.00	$ 260.00	$ 175,500.00	
2	8' X 2' RCBC	1043	LF	$ 35.00	$ 310.00	$ 323,330.00	
3	8' X 3' RCBC	1124	LF	$ 40.00	$ 330.00	$ 370,920.00	
4	8' X 4' RCBC	514	LF	$ 50.00	$ 340.00	$ 174,760.00	
5	15" SWS	800	LF	$ 35.00		$ 28,000.00	
6	36" SWS		LF	$ 85.00		$ -	
7	42" SWS		LF	$ 100.00		$ -	
8	48" SWS		LF	$ 115.00		$ -	
9	Remove 12" SWS		LF	$ 20.00		$ -	
10	Remove 18" SWS		LF	$ 35.00		$ -	
11	Abandon Existing Pipe and Structures	4156	LF	$ 70.00	$ 25.00	$ 103,900.00	
12	Special Area Inlet		EA	$ 10,000.00		$ -	
13	Inlet Adjustment		EA	$ 5,000.00		$ -	
14	BMP's	1	LS	$ 3,200.00	$ 2,500.00	$ 2,500.00	
15	Compacted Fill		CY	$ 2.00		$ -	
16	Inlet	32	EA	$ 3,500.00		$ 112,000.00	
17	Ditch		LF	$ 5.00		$ -	
18	Exc.		CY	$ 2.00		$ -	
19	Extend RCBC		LS			$ -	
20	Sand Backfill &/or Flowable Fill	3296	LF	$ 50.00		$ 164,800.00	
21	Reinforced Concrete Manhole	10	EA	$ 3,300.00	$ 10,000.00	$ 100,000.00	
22	Pavement Remove and Replace	3296	LF	$ 1.00	$ 140.00	$ 461,440.00	
23	Rip Rap		SY	$ 50.00		$ -	
24	Moisture Control Soils		CY	$ 8.00		$ -	
25	Site Clearing & Restoration	1	LS	$ 10,000.00	$ 5,000.00	$ 5,000.00	
26	Traffic Control	1	LS	$ 1.30	$ 1,000.00	$ 1,000.00	
27	Compact AB-3 Base		CY	$ 12.00		$ -	
28	Excavation		CY	$ 8.00		$ -	
29						$ -	
30						$ -	

Assumptions:

Contingencies @ 25% +/-	$ 505,787.50
Construction Total	$ 2,528,937.50
TOTAL	$ 2,528,937.50

MKEC ENGINEERING CONSULTANTS, INC.

Project Name: Midtown Neighborhood Stormwater Master Plan | **Estimate by:** GR

Phase and/or Portion: 15th Street | **Date Prepared:** 14-May

Item No.	Description	Quantity	Unit	Std Unit Price	Custom Unit Price	Extension	Special Conditions
1	6' X 2' RCBC	2389	LF	$ 25.00	$ 275.00	$ 656,975.00	
2	6' X 3' RCBC	515	LF	$ 35.00	$ 300.00	$ 154,500.00	
3	9' X 4' RCBC	3071	LF	$ 40.00	$ 360.00	$ 1,105,560.00	
4	15" SWS	1500	LF	$ 35.00		$ 52,500.00	
5	30" SWS		LF	$ 70.00		$ -	
6	36" SWS		LF	$ 85.00		$ -	
7	42" SWS		LF	$ 100.00		$ -	
8	48" SWS		LF	$ 115.00		$ -	
9	Remove 12" SWS		LF	$ 20.00		$ -	
10	Remove 18" SWS		LF	$ 35.00		$ -	
11	Abandon Existing Pipe and Structures	7475	LF	$ 70.00	$ 25.00	$ 186,875.00	
12	Special Area Inlet		EA	$ 10,000.00		$ -	
13	Inlet Adjustment		EA	$ 5,000.00		$ -	
14	BMP's	1	LS	$ 3,200.00	$ 5,000.00	$ 5,000.00	
15	Compacted Fill		CY	$ 2.00		$ -	
16	Inlet	60	EA	$ 3,500.00		$ 210,000.00	
17	Ditch		LF	$ 5.00		$ -	
18	Exc.		CY	$ 2.00		$ -	
19	Extend RCBC		LS			$ -	
20	Sand Backfill &/or Flowable Fill	5430	LF	$ 50.00		$ 271,500.00	
21	Reinforced Concrete Manhole	21	EA	$ 3,300.00	$ 10,000.00	$ 210,000.00	
22	Pavement Remove and Replace	5430	LF	$ 1.00	$ 140.00	$ 760,200.00	
23	Rip Rap	50	SY	$ 50.00		$ 2,500.00	
24	Bore Under Railroad Tracks	290	LF	$ 8.00	$ 650.00	$ 188,500.00	
25	Site Clearing & Restoration	1	LS	$ 10,000.00		$ 10,000.00	
26	Traffic Control	1	LS	$ 1.30	$ 7,500.00	$ 7,500.00	
27	Railroad Permits	1	LS	$ 12.00	$ 10,000.00	$ 10,000.00	
28	Excavation		CY	$ 8.00		$ -	
29						$ -	
30						$ -	

Assumptions:

Contingencies @ 25% +/-	$ 957,902.50
Construction Total	$ 4,789,512.50
TOTAL	$ 4,789,512.50

MKEC ENGINEERING CONSULTANTS, INC.

Midtown Neighborhood Stormwater Master Plan
CIP Concept Discovery Cost Estimates
Recommended Plan Detail - 15th Street to Murdock

Basin	IMPROVEMENT	Estimate of Probable Construction Cost	Basin Total
East 13th Street	13th Street - Waco to Outfall	$ 5,755,437.50	
	14th Street - Rochester to Park Pl., south to 13th Street	$ 1,597,625.00	
	14th Street - Broadway to Market, south to 13th Street	$ 519,250.00	
	14th Street - Broadway to Santa Fe, south to 13th Street	$ 781,687.50	
	Wellington, 12th Street to 13th Street	$ 253,625.00	**$ 8,907,625.00**
12th Street Diversion	12th Street Diversion, Wellington to LAR	$ 803,437.50	**$ 803,437.50**
East 10th Street	10th Street and Main to Outfall	$ 4,885,356.25	
	12th Street and Market - 10th Street	$ 1,865,506.25	
	12th Street and St. Francis - Emporia	$ 333,875.00	**$ 7,084,737.50**
Lewellen Disconnect	9th Street & Jackson to LAR Outfall	$ 503,225.00	
	Lewellen - 9th Street to 11th Street	$ 1,005,218.75	**$ 1,508,443.75**
8th Street Diversion	9th Street & Main to 8th Street LAR outfall	$ 1,793,956.25	
	Main St. - 11th Street to 9th Street	$ 1,345,531.25	
	9th Street & Waco east to Main	$ 663,500.00	
	10th Street - Wichita east to Main	$ 404,000.00	
	11th Street - Waco to Main	$ 826,500.00	**$ 5,033,487.50**
Murdock West	No Projects	$ -	
Murdock East	No Projects	$ -	
	TOTAL	**$ 23,337,731.25**	

Project Name: Midtown Neighborhood Stormwater Master Plan | **Estimate by:** G. Rath

Phase and/or Portion: 13th, Waco to Wichita Drainage Canal | **Date Prepared:** 4/23/2012

Item No.	Description	Quantity	Unit	Std Unit Price	Custom Unit Price	Extension	Special Conditions
2	15" SWS	2250	LF	$ 35.00		$ 78,750.00	
6	36" SWS	930	LF	$ 85.00		$ 79,050.00	
18	8' X 4' RCBC	720	LF	$ 340.00		$ 244,800.00	
23	10' x 4' RCBC	4680	LF	$ 420.00		$ 1,965,600.00	
29	Abandon Existing Pipe and Structures	4330	LF	$ 70.00	25	$ 108,250.00	
32	BMP's	1	LS	$ 3,200.00	5000	$ 5,000.00	
34	Curb Inlet	90	EA	$ 3,500.00		$ 315,000.00	
36	Manhole	4	EA	$ 3,300.00		$ 13,200.00	
37	Flowable Fill	8580	LF	$ 50.00		$ 429,000.00	
38	Reinforced Concrete Manhole	12	EA	$ 3,300.00	$ 10,000.00	$ 120,000.00	
39	Pavement Remove and Replace	8580	LF	$ 140.00		$ 1,201,200.00	
43	Bore under RR Tracks	30	LF	$ 650.00		$ 19,500.00	
44	Rip Rap	50	SY	$ 50.00		$ 2,500.00	
46	Site Clearing & Restoration	1	LS	$ 10,000.00		$ 10,000.00	
48	Traffic Control	1	LS	$ 10,000.00		$ 10,000.00	
49	Railroad Permit	1	LS	$ 2,500.00		$ 2,500.00	
					Subtotal	$ 4,604,350.00	
					Contingencies @ 25% +/-	$ 1,151,087.50	
					TOTAL	$ 5,755,437.50	

Assumptions:

MKEC ENGINEERING CONSULTANTS, INC.

Project Name: Midtown Neighborhood Stormwater Master Plan | **Estimate by:** G. Rath

Phase and/or Portion: | **Date Prepared:** 4/23/2012

Item No.	Description	Quantity	Unit	Std Unit Price	Custom Unit Price	Extension	Special Conditions
2	15" SWS	500	LF	$ 35.00		$ 17,500.00	
11	5' X 2' RCBC	280	LF	$ 260.00		$ 72,800.00	
13	5' X 3' RCBC	1840	LF	$ 275.00		$ 506,000.00	
28	Abandon Existing Pipe and Structures	2620	LF	$ 70.00	$ 25.00	$ 65,500.00	
31	BMP's	1	LS	$ 3,200.00	$ 1,500.00	$ 1,500.00	
33	Curb Inlet	20	EA	$ 3,500.00		$ 70,000.00	
36	Flowable Fill	2620	LF	$ 50.00		$ 131,000.00	
37	Reinforced Concrete Manhole	3	EA	$ 3,300.00	$ 10,000.00	$ 30,000.00	
38	Pavement Remove and Replace	2620	LF	$ 140.00		$ 366,800.00	
42	Manhole	5	EA	$ 3,300.00		$ 16,500.00	
47	Traffic Control	1	LS	$ 10,000.00	$ 500.00	$ 500.00	
					Subtotal	$ 1,278,100.00	
					Contingencies @ 25% +/-	$ 319,525.00	
					TOTAL	$ 1,597,625.00	

Assumptions:

MKEC ENGINEERING CONSULTANTS, INC.

Project Name: Midtown Neighborhood Stormwater Master Plan | **Estimate by:** G. Rath

Phase and/or Portion: 14th, Broadway to Market, South to 13th | **Date Prepared:** 4/23/2012

Item No.	Description	Quantity	Unit	Std Unit Price	Custom Unit Price	Extension	Special Conditions
2	15" SWS	225	LF	$ 35.00		$ 7,875.00	
6	36" SWS	213	LF	$ 85.00		$ 18,105.00	
8	48" SWS	840	LF	$ 115.00		$ 96,600.00	
28	Abandon Existing Pipe and Structures	600	LF	$ 70.00	$ 25.00	$ 15,000.00	
31	BMP's	1	LS	$ 3,200.00	$ 1,000.00	$ 1,000.00	
33	Curb Inlet	9	EA	$ 3,500.00		$ 31,500.00	
36	Flowable Fill	1278	LF	$ 50.00		$ 63,900.00	
38	Pavement Remove and Replace	1278	LF	$ 140.00		$ 178,920.00	
45	Site Clearing & Restoration	1	LS	$ 10,000.00	$ 1,000.00	$ 1,000.00	
47	Traffic Control	1	LS	$ 10,000.00	$ 1,500.00	$ 1,500.00	
					Subtotal	$ 415,400.00	
					Contingencies @ 25% +/-	$ 103,850.00	
					TOTAL	$ 519,250.00	

Assumptions:

Model will be modified to extend link C5 west to Market, adding ~150 ft of 48" RCP (included in the 840 ft above)

MKEC ENGINEERING CONSULTANTS, INC.

Project Name: Midtown Neighborhood Stormwater Master Plan | **Estimate by:** G. Rath

Phase and/or Portion: 14th, Broadway to Santa Fe, South to 13th | **Date Prepared:** 4/23/2012

Item No.	Description	Quantity	Unit	Std Unit Price	Custom Unit Price	Extension	Special Conditions
2	15" SWS	400	LF	$ 35.00		$ 14,000.00	
6	36" SWS	450	LF	$ 85.00		$ 38,250.00	
7	42" SWS	1640	LF	$ 100.00		$ 164,000.00	
28	Abandon Existing Pipe and Structures	2490	LF	$ 70.00	$ 25.00	$ 62,250.00	
31	BMP's	1	LS	$ 3,200.00	$ 1,500.00	$ 1,500.00	
33	Curb Inlet	16	EA	$ 3,500.00		$ 56,000.00	
36	Flowable Fill	1515	LF	$ 50.00		$ 75,750.00	
38	Pavement Remove and Replace	1515	LF	$ 140.00		$ 212,100.00	
45	Site Clearing & Restoration	1	LS	$ 10,000.00	$ 1,000.00	$ 1,000.00	
48	Railroad Permit	1	LS	$ 2,500.00	$ 500.00	$ 500.00	
					Subtotal	$ 625,350.00	
					Contingencies @ 25% +/-	$ 156,337.50	
					TOTAL	$ 781,687.50	

Assumptions:

MKEC ENGINEERING CONSULTANTS, INC.

Project Name: Midtown Neighborhood Stormwater Master Plan | **Estimate by:** G. Rath

Phase and/or Portion: Wellington, 12th to 13th | **Date Prepared:** 4/23/2012

Item No.	Description	Quantity	Unit	Std Unit Price	Custom Unit Price	Extension	Special Conditions
2	15" SWS	100	LF	$ 35.00		$ 3,500.00	
3	18" SWS	620	LF	$ 40.00		$ 24,800.00	
28	Abandon Existing Pipe and Structures	720	LF	$ 70.00	$ 25.00	$ 18,000.00	
31	BMP's	1	LS	$ 3,200.00	$ 1,500.00	$ 1,500.00	
33	Curb Inlet	4	EA	$ 3,500.00		$ 14,000.00	
36	Flowable Fill	720	LF	$ 50.00		$ 36,000.00	
38	Pavement Remove and Replace	720	LF	$ 140.00		$ 100,800.00	
42	Manhole	1	EA	$ 650.00	$ 3,300.00	$ 3,300.00	
45	Site Clearing & Restoration	1	LS	$ 10,000.00	$ 500.00	$ 500.00	
47	Traffic Control	1	LS	$ 10,000.00	$ 500.00	$ 500.00	
Assumptions:					**Subtotal**	$ 202,900.00	
					Contingencies @ 25% +/-	$ 50,725.00	
					TOTAL	$ 253,625.00	

MKEC ENGINEERING CONSULTANTS, INC.

Project Name: Midtown Neighborhood Stormwater Master Plan | **Estimate by:** G. Rath

Phase and/or Portion: | **Date Prepared:** 4/23/2012

Item No.	Description	Quantity	Unit	Std Unit Price	Custom Unit Price	Extension	Special Conditions
2	15" SWS	500	LF	$ 35.00		$ 17,500.00	
6	36" SWS	1290	LF	$ 85.00		$ 109,650.00	
7	42" SWS	500	LF	$ 100.00		$ 50,000.00	
28	Abandon Existing Pipe and Structures	1100	LF	$ 70.00	$ 25.00	$ 27,500.00	
33	Curb Inlet	20	EA	$ 3,500.00		$ 70,000.00	
36	Flowable Fill	1700	LF	$ 50.00		$ 85,000.00	
38	Pavement Remove and Replace	1700	LF	$ 140.00		$ 238,000.00	
42	Manhole	12	EA	$ 650.00	$ 3,300.00	$ 39,600.00	
43	Rip Rap	50	SY	$ 50.00		$ 2,500.00	
45	Site Clearing & Restoration	1	LS	$ 10,000.00	$ 1,500.00	$ 1,500.00	
47	Traffic Control	1	LS	$ 10,000.00	$ 1,500.00	$ 1,500.00	
					Subtotal	$ 642,750.00	
					Contingencies @ 25% +/-	$ 160,687.50	
					TOTAL	$ 803,437.50	

Assumptions:

MKEC ENGINEERING CONSULTANTS, INC.

Project Name: Midtown Neighborhood Stormwater Master Plan | **Estimate by:** G. Rath

Phase and/or Portion: 10th, Main to Canal | **Date Prepared:** 4/23/2012

Item No.	Description	Quantity	Unit	Std Unit Price	Custom Unit Price	Extension	Special Conditions
2	15" SWS	1350	LF	$ 35.00		$ 47,250.00	
4	24" SWS	437	LF	$ 50.00		$ 21,850.00	
6	36" SWS	742	LF	$ 85.00		$ 63,070.00	
13	5' X 3' RCBC	380	LF	$ 275.00		$ 104,500.00	
24	10' x 4' RCBC	4118	LF	$ 420.00		$ 1,729,560.00	
30	Abandon Existing Pipe and Structures	7027	LF	$ 70.00	$ 25.00	$ 175,675.00	
33	BMP's	1	LS	$ 3,200.00	$ 5,000.00	$ 5,000.00	
35	Curb Inlet	54	EA	$ 3,500.00		$ 189,000.00	
38	Flowable Fill	7027	LF	$ 50.00		$ 351,350.00	
39	Reinforced Concrete Manhole	4	EA	$ 3,300.00	$ 10,000.00	$ 40,000.00	
40	Pavement Remove and Replace	7027	LF	$ 140.00		$ 983,780.00	
41	Manhole	30	EA	$ 3,300.00		$ 99,000.00	
44	Bore under RR Tracks	125	LF	$ 650.00		$ 81,250.00	
45	Rip Rap	50	SY	$ 50.00		$ 2,500.00	
47	Site Clearing & Restoration	1	LS	$ 10,000.00		$ 10,000.00	
49	Traffic Control	1	LS	$ 10,000.00	$ 2,000.00	$ 2,000.00	
50	Railroad Permit	1	LS	$ 2,500.00		$ 2,500.00	
					Subtotal	$ 3,908,285.00	
					Contingencies @ 25% +/-	$ 977,071.25	
					TOTAL	$ 4,885,356.25	

Assumptions:

MKEC ENGINEERING CONSULTANTS, INC.

Project Name: Midtown Neighborhood Stormwater Master Plan | **Estimate by:** G. Rath

Phase and/or Portion: 12th and Market - 10th St | **Date Prepared:** 4/23/2012

Item No.	Description	Quantity	Unit	Std Unit Price	Custom Unit Price	Extension	Special Conditions
2	15" SWS	400	LF	$ 35.00		$ 14,000.00	
4	24" SWS	237	LF	$ 50.00		$ 11,850.00	
11	5' X 2' RCBC	829	LF	$ 260.00		$ 215,540.00	
23	10' X 4' RCBC	1315	LF	$ 420.00		$ 552,300.00	
29	Abandon Existing Pipe and Structures	2781	LF	$ 70.00	$ 25.00	$ 69,525.00	
32	BMP's	1	LS	$ 3,200.00	$ 1,000.00	$ 1,000.00	
34	Curb Inlet	16	EA	$ 3,500.00		$ 56,000.00	
37	Flowable Fill	2781	LF	$ 50.00		$ 139,050.00	
38	Reinforced Concrete Manhole	2	EA	$ 3,300.00	$ 10,000.00	$ 20,000.00	
39	Pavement Remove and Replace	2781	LF	$ 140.00		$ 389,340.00	
40	Manhole	6	EA	$ 3,300.00		$ 19,800.00	
46	Site Clearing & Restoration	1	LS	$ 10,000.00	$ 2,500.00	$ 2,500.00	
48	Traffic Control	1	LS	$ 10,000.00	$ 1,500.00	$ 1,500.00	
					Subtotal	$ 1,492,405.00	
					Contingencies @ 25% +/-	$ 373,101.25	
					TOTAL	$ 1,865,506.25	

Assumptions:

MKEC ENGINEERING CONSULTANTS, INC.

Project Name: Midtown Neighborhood Stormwater Master Plan | **Estimate by:** G. Rath

Phase and/or Portion: 12th and St. Francis - Emporia | **Date Prepared:** 4/23/2012

Item No.	Description	Quantity	Unit	Std Unit Price	Custom Unit Price	Extension	Special Conditions
2	15" SWS	200	LF	$ 35.00		$ 7,000.00	
11	5' X 2' RCBC	360	LF	$ 260.00		$ 93,600.00	
28	Abandon Existing Pipe and Structures	560	LF	$ 70.00	$ 25.00	$ 14,000.00	
31	BMP's	1	LS	$ 3,200.00	$ 500.00	$ 500.00	
33	Curb Inlet	8	EA	$ 3,500.00		$ 28,000.00	
36	Flowable Fill	560	LF	$ 50.00		$ 28,000.00	
37	Reinforced Concrete Manhole	1	EA	$ 3,300.00	$ 10,000.00	$ 10,000.00	
38	Pavement Remove and Replace	560	LF	$ 140.00		$ 78,400.00	
39	Manhole	2	EA	$ 3,300.00		$ 6,600.00	
45	Site Clearing & Restoration	1	LS	$ 10,000.00	$ 500.00	$ 500.00	
47	Traffic Control	1	LS	$ 10,000.00	$ 500.00	$ 500.00	
					Subtotal	$ 267,100.00	
					Contingencies @ 25% +/-	$ 66,775.00	
					TOTAL	$ 333,875.00	

Assumptions:

MKEC ENGINEERING CONSULTANTS, INC.

Project Name: Midtown Neighborhood Stormwater Master Plan | **Estimate by:** G. Rath

Phase and/or Portion: 9th & Jackson to LAR Outfall | **Date Prepared:** 4/23/2012

Item No.	Description	Quantity	Unit	Std Unit Price	Custom Unit Price	Extension	Special Conditions
2	15" SWS	200	LF	$ 35.00		$ 7,000.00	
6	36" SWS	1681	LF	$ 85.00		$ 142,885.00	
28	Abandon Existing Pipe and Structures	1	LS	$ 70.00	$ 2,000.00	$ 2,000.00	
31	BMP's	1	LS	$ 3,200.00	$ 500.00	$ 500.00	
33	Curb Inlet	8	EA	$ 3,500.00		$ 28,000.00	
36	Flowable Fill	1040.5	LF	$ 50.00		$ 52,025.00	
37	Reinforced Concrete Manhole	2	EA	$ 3,300.00	$ 10,000.00	$ 20,000.00	
38	Pavement Remove and Replace	1040.5	LF	$ 140.00		$ 145,670.00	
43	Rip Rap	50	SY	$ 50.00		$ 2,500.00	
45	Site Clearing & Restoration	1	LS	$ 10,000.00	$ 1,500.00	$ 1,500.00	
47	Traffic Control	1	LS	$ 10,000.00	$ 500.00	$ 500.00	
					Subtotal	$ 402,580.00	
					Contingencies @ 25% +/-	$ 100,645.00	
					TOTAL	$ 503,225.00	

Assumptions:

MKEC ENGINEERING CONSULTANTS, INC.

Project Name: Midtown Neighborhood Stormwater Master Plan | **Estimate by:** G. Rath

Phase and/or Portion: Lewellen - 9th to 11th | **Date Prepared:** 4/23/2012

Item No.	Description	Quantity	Unit	Std Unit Price	Custom Unit Price	Extension	Special Conditions
2	15" SWS	450	LF	$ 35.00		$ 15,750.00	
5	30" SWS	690	LF	$ 70.00		$ 48,300.00	
6	36" SWS	2130	LF	$ 85.00		$ 181,050.00	
28	Abandon Existing Pipe and Structures	2205	LF	$ 70.00	$ 25.00	$ 55,125.00	
31	BMP's	1	LS	$ 3,200.00	$ 500.00	$ 500.00	
33	Curb Inlet	18	EA	$ 3,500.00		$ 63,000.00	
36	Flowable Fill	2205	LF	$ 50.00		$ 110,250.00	
37	Reinforced Concrete Manhole	2	EA	$ 3,300.00	$ 10,000.00	$ 20,000.00	
38	Pavement Remove and Replace	2205	LF	$ 140.00		$ 308,700.00	
45	Site Clearing & Restoration	1	LS	$ 10,000.00	$ 1,000.00	$ 1,000.00	
47	Traffic Control	1	LS	$ 10,000.00	$ 500.00	$ 500.00	
					Subtotal	$ 804,175.00	
					Contingencies @ 25% +/-	$ 201,043.75	
					TOTAL	$ 1,005,218.75	

Assumptions:

MKEC ENGINEERING CONSULTANTS, INC.

Project Name: Midtown Neighborhood Stormwater Master Plan | **Estimate by:** G. Rath

Phase and/or Portion: 9th & Main to 8th LAR outfall | **Date Prepared:** 4/23/2012

Item No.	Description	Quantity	Unit	Std Unit Price	Custom Unit Price	Extension	Special Conditions
2	15" SWS	400	LF	$ 35.00		$ 14,000.00	
23	12' X 3' RCBC	1883	LF	$ 440.00		$ 828,520.00	
29	Abandon Existing Pipe and Structures	1383	LF	$ 70.00	$ 25.00	$ 34,575.00	
32	BMP's	1	LS	$ 3,200.00	$ 1,500.00	$ 1,500.00	
34	Curb Inlet	16	EA	$ 3,500.00		$ 56,000.00	
37	Flowable Fill	2283	LF	$ 50.00		$ 114,150.00	
38	Reinforced Concrete Manhole	4	EA	$ 3,300.00	$ 10,000.00	$ 40,000.00	
39	Pavement Remove and Replace	2283	LF	$ 140.00		$ 319,620.00	
40	Manhole	6	EA	$ 3,300.00		$ 19,800.00	
44	Rip Rap	50	SY	$ 50.00		$ 2,500.00	
46	Site Clearing & Restoration	1	LS	$ 10,000.00	$ 3,000.00	$ 3,000.00	
48	Traffic Control	1	LS	$ 10,000.00	$ 1,500.00	$ 1,500.00	
					Subtotal	$ 1,435,165.00	
					Contingencies @ 25% +/-	$ 358,791.25	
					TOTAL	$ 1,793,956.25	

Assumptions:

MKEC ENGINEERING CONSULTANTS, INC.

Project Name: Midtown Neighborhood Stormwater Master Plan | **Estimate by:** G. Rath

Phase and/or Portion: | **Date Prepared:** 4/23/2012

Item No.	Description	Quantity	Unit	Std Unit Price	Custom Unit Price	Extension	Special Conditions
2	15" SWS	300	LF	$ 35.00		$ 10,500.00	
22	10' X 3' RCBC	675	LF	$ 380.00		$ 256,500.00	
23	12 X 3' RCBC	840	LF	$ 440.00		$ 369,600.00	
29	Abandon Existing Pipe and Structures	975	LF	$ 70.00	$ 25.00	$ 24,375.00	
32	BMP's	1	LS	$ 3,200.00	$ 500.00	$ 500.00	
34	Curb Inlet	12	EA	$ 3,500.00		$ 42,000.00	
37	Flowable Fill	1815	LF	$ 50.00		$ 90,750.00	
38	Reinforced Concrete Manhole	2	EA	$ 3,300.00	$ 10,000.00	$ 20,000.00	
39	Pavement Remove and Replace	1815	LF	$ 140.00		$ 254,100.00	
40	Manhole	2	EA	$ 3,300.00		$ 6,600.00	
46	Site Clearing & Restoration	1	LS	$ 10,000.00	$ 500.00	$ 500.00	
48	Traffic Control	1	LS	$ 10,000.00	$ 1,000.00	$ 1,000.00	
					Subtotal	$ 1,076,425.00	
					Contingencies @ 25% +/-	$ 269,106.25	
					TOTAL	$ 1,345,531.25	

Assumptions:

MKEC ENGINEERING CONSULTANTS, INC.

Project Name: Midtown Neighborhood Stormwater Master Plan | **Estimate by:** G. Rath

Phase and/or Portion: 9th - Waco East to Main | **Date Prepared:** 4/23/2012

Item No.	Description	Quantity	Unit	Std Unit Price	Custom Unit Price	Extension	Special Conditions
2	15" SWS	350	LF	$ 35.00		$ 12,250.00	
7	42" SWS	869	LF	$ 100.00		$ 86,900.00	
15	6' X 3' RCBC	256	LF	$ 300.00		$ 76,800.00	
28	Abandon Existing Pipe and Structures		LF	$ 70.00	$ 25.00	$ -	
31	BMP's	1	LS	$ 3,200.00	$ 500.00	$ 500.00	
33	Curb Inlet	14	EA	$ 3,500.00		$ 49,000.00	
36	Flowable Fill	1475	LF	$ 50.00		$ 73,750.00	
38	Pavement Remove and Replace	1475	LF	$ 140.00		$ 206,500.00	
39	Manhole	7	EA	$ 3,300.00		$ 23,100.00	
45	Site Clearing & Restoration	1	LS	$ 10,000.00	$ 1,000.00	$ 1,000.00	
47	Traffic Control	1	LS	$ 10,000.00	$ 1,000.00	$ 1,000.00	
					Subtotal	$ 530,800.00	
					Contingencies @ 25% +/-	$ 132,700.00	
					TOTAL	$ 663,500.00	

Assumptions:

MKEC ENGINEERING CONSULTANTS, INC.

Project Name: Midtown Neighborhood Stormwater Master Plan | **Estimate by:** G. Rath

Phase and/or Portion: | **Date Prepared:** 4/23/2012

Item No.	Description	Quantity	Unit	Std Unit Price	Custom Unit Price	Extension	Special Conditions
2	15" SWS	250	LF	$ 35.00		$ 8,750.00	
6	36" SWS	700	LF	$ 85.00		$ 59,500.00	
28	Abandon Existing Pipe and Structures	950	LF	$ 70.00	$ 25.00	$ 23,750.00	
31	BMP's	1	LS	$ 3,200.00	$ 500.00	$ 500.00	
33	Curb Inlet	10	EA	$ 3,500.00		$ 35,000.00	
36	Flowable Fill	950	LF	$ 50.00		$ 47,500.00	
38	Pavement Remove and Replace	950	LF	$ 140.00		$ 133,000.00	
39	Manhole	4	EA	$ 3,300.00		$ 13,200.00	
45	Site Clearing & Restoration	1	LS	$ 10,000.00	$ 1,000.00	$ 1,000.00	
47	Traffic Control	1	LS	$ 10,000.00	$ 1,000.00	$ 1,000.00	
					Subtotal	$ 323,200.00	
					Contingencies @ 25% +/-	$ 80,800.00	
					TOTAL	$ 404,000.00	

Assumptions:

MKEC ENGINEERING CONSULTANTS, INC.

Project Name: Midtown Neighborhood Stormwater Master Plan | **Estimate by:** G. Rath

Phase and/or Portion: | **Date Prepared:** 4/23/2012

Item No.	Description	Quantity	Unit	Std Unit Price	Custom Unit Price	Extension	Special Conditions
2	15" SWS	400	LF	$ 35.00		$ 14,000.00	
6	36" SWS	1608	LF	$ 85.00		$ 136,680.00	
28	Abandon Existing Pipe and Structures	2008	LF	$ 70.00	$ 25.00	$ 50,200.00	
31	BMP's	1	LS	$ 3,200.00	$ 1,000.00	$ 1,000.00	
33	Curb Inlet	16	EA	$ 3,500.00		$ 56,000.00	
36	Flowable Fill	2008	LF	$ 50.00		$ 100,400.00	
38	Pavement Remove and Replace	2008	LF	$ 140.00		$ 281,120.00	
39	Manhole	6	EA	$ 3,300.00		$ 19,800.00	
45	Site Clearing & Restoration	1	LS	$ 10,000.00	$ 1,000.00	$ 1,000.00	
47	Traffic Control	1	LS	$ 10,000.00	$ 1,000.00	$ 1,000.00	
					Subtotal	$ 661,200.00	
					Contingencies @ 25% +/-	$ 165,300.00	
					TOTAL	$ 826,500.00	

Assumptions:

MKEC ENGINEERING CONSULTANTS, INC.

Midtown Neighborhood Stormwater Master Plan
CIP Concept Discovery Cost Estimates
Detail - Little Arkansas River Watershed
Both Alternates

Basin	IMPROVEMENT	Estimate of Probable Construction Cost	Basin Total
West 10th Street + Forrest	West 10th Street + Forrest	$ 2,280,962.50	$ 2,280,962.50
	GRAND TOTAL	**$ 2,280,962.50**	

Project Name: Midtown Neighborhood Stormwater Master Plan | **Estimate by:** GR

Phase and/or Portion: West 10th Corridor (incl. Forrest) | **Date Prepared:** 20-May

Item No.	Description	Quantity	Unit	Std Unit Price	Custom Unit Price	Extension	Special Conditions
1	12" SWS		LF	$ 25.00		$ -	
2	15" SWS	800	LF	$ 35.00		$ 28,000.00	
3	18" SWS		LF	$ 40.00		$ -	
4	24" SWS	1015	LF	$ 50.00		$ 50,750.00	
5	30" SWS	1427	LF	$ 70.00		$ 99,890.00	
6	36" SWS	2126	LF	$ 85.00		$ 180,710.00	
7	42" SWS		LF	$ 100.00		$ -	
8	8' X 2' RCBC	410	LF	$ 310.00		$ 127,100.00	
9	Remove 12" SWS		LF	$ 20.00		$ -	
10	Remove 18" SWS		LF	$ 35.00		$ -	
11	Abandon Existing Pipe and Structures	5368	LF	$ 70.00	$ 25.00	$ 134,200.00	
12	Special Area Inlet		EA	$ 10,000.00		$ -	
13	Inlet Adjustment		EA	$ 5,000.00		$ -	
14	BMP's	1	LS	$ 3,200.00	$ 2,000.00	$ 2,000.00	
15	Compacted Fill		CY	$ 2.00		$ -	
16	Inlet	32	EA	$ 3,500.00		$ 112,000.00	
17	Ditch		LF	$ 5.00		$ -	
18	Exc.		CY	$ 2.00		$ -	
19	Extend RCBC		LS			$ -	
20	Sand Backfill &/or Flowable Fill	5368	LF	$ 50.00		$ 268,400.00	
21	Manholes	19	EA	$ 3,300.00		$ 62,700.00	
22	Pavement Remove and Replace	5368	LF	$ 1.00	$ 140.00	$ 751,520.00	
23	Rip Rap	80	SY	$ 50.00		$ 4,000.00	
24	Moisture Control Soils		CY	$ 8.00		$ -	
25	Site Clearing & Restoration	1	LS	$ 10,000.00	$ 2,500.00	$ 2,500.00	
26	Traffic Control	1	LS	$ 1.30	$ 1,000.00	$ 1,000.00	
27	Compact AB-3 Base		CY	$ 12.00		$ -	
28	Excavation		CY	$ 8.00		$ -	
29						$ -	
30						$ -	

Assumptions:

Contingencies @ 25% +/-	$ 456,192.50
Construction Total	$ 2,280,962.50
TOTAL	$ 2,280,962.50

MKEC ENGINEERING CONSULTANTS, INC.

APPENDIX L – Vendor Supplied Layouts

Johnson, Estell/WIC

From: Tim Ritchie [Tim.Ritchie@ads-pipe.com]
Sent: Tuesday, May 17, 2011 8:31 PM
To: Johnson, Estell/WIC
Subject: RE: Hydrodynamic Separators - Hydro International
Attachments: Water Quality Flow Calculator - Example.xls

Estell,

The cost of the two units, including the manholes they are in, would be approximately $87,000. That would not include the diversion structure. Also, I did want to quote an alternative with the BaySeparator XK unit. I will provide you information on that once I have received it.

I have also included a calculator that has been helpful in determining first flush, flow based vs. volume. It comes from the Georgia Stormwater manual. From what the city has told me, they have developed their manual after the iSWM manual (Dallas/Fort Worth area). That manual is based off of the Georgia manual.

I will provide you another quote and information on the XK BaySeparator shortly.

Best Regards,

Tim Ritchie
Storm Water Product Manager
StormTech/ADS/Nyloplast
937-631-0477

From: Estell.Johnson@CH2M.com [mailto:Estell.Johnson@CH2M.com]
Sent: Monday, May 16, 2011 11:19 AM
To: Tim Ritchie
Subject: RE: Hydrodynamic Separators - Hydro International

Tim,

Yes, a cost estimate would be great.

Thanks,
Estell

From: Tim Ritchie [mailto:Tim.Ritchie@ads-pipe.com]
Sent: Friday, May 13, 2011 06:23 AM
To: Johnson, Estell/WIC
Subject: FW: Hydrodynamic Separators - Hydro International

Estell,

I am sorry for such a delay in this endeavor. Here is a conceptual layout of a system to treat the 23.1 cfs. Please let me know if this layout will work for your design and I can then provide you with a cost estimate for the appropriate units. I appreciate the opportunity.

Downstream Defender®

Advanced Vortex Separator

Proven to be more efficient for removing pollutants and preventing washout

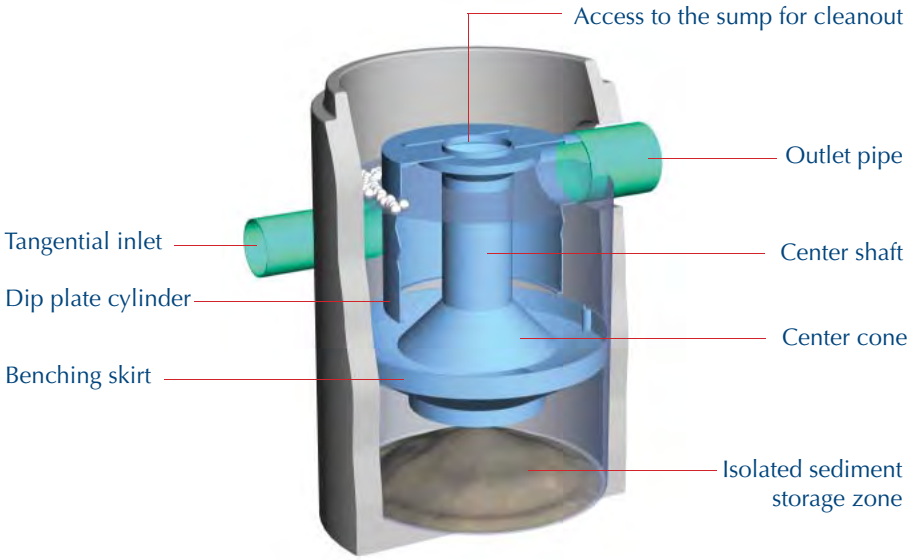
APPLICATIONS

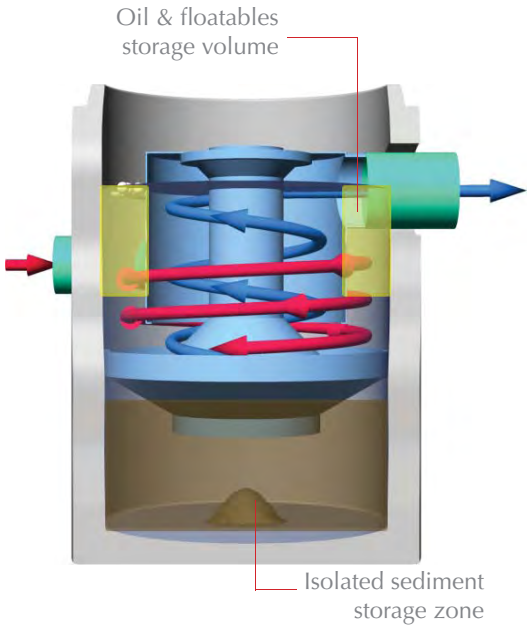
- Control of sediment, floatable trash and petroleum products
- New developments
- Redevelopment projects
- Streets, roadways and parking lots
- Pretreatment for filters, infiltration or storage
- LEED® development projects

ADVANTAGES

- Most efficient separator available
- Smaller footprint
- Lower capital cost than other devices
- Proven to prevent washout
- Verified through nationally recognized programs
- Low system headloss

The **Downstream Defender** is the most advanced vortex separator available for the removal of sediment, oil and floatables from stormwater runoff. The **Downstream Defender** is proven to be more efficient than other structural treatment devices in as little as ½ the footprint and is the only separator with internal components proven to prevent pollutant washout.





HOW IT WORKS

The **Downstream Defender** has internal components designed to advance vortex separation by minimizing turbulence and headloss, increasing efficiency and preventing washout of stored pollutants.

Stormwater is introduced tangentially into the side of the vessel, generating a rotating flow that spirals around the outside of the dip plate (red arrow).

Oils, trash and floatable debris rise to the water surface and are trapped in the oil and floatables storage volume (yellow zone).

As flow continues to spiral down around the dip plate cylinder, low energy vortex motion directs sediment inward along the benching skirt and into the protected sediment storage zone (brown zone).

The benching skirt and center cone redirect the rotating flow up and inward between the center shaft and dip plate cylinder away from the stored sediment. The outlet pipe discharges treated effluent from within the dip plate cylinder ensuring the longest possible residence time (blue arrow).

Advanced vortex separation is provided by extending and stabilizing the flow path while protecting trapped pollutants for a wide range of flow rates.

Hydro International stormwater

Ph: 207.756.6200 • Fax: 207.756.6212 • Email: stormwaterinquiry@hil-tech.com
www.hydro-international.biz

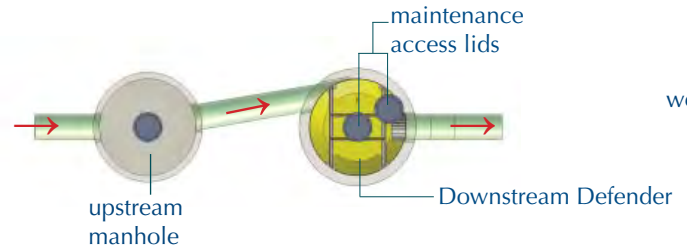
Maintenance

The **Downstream Defender** is easy to maintain using a sump-vac to remove captured sediment and floatables. Cleanout ports are located in the top of the manhole and provide access to pollutant storage areas. Maintenance is generally conducted every 12 to 18 months, although individual maintenance schedules are site specific. Hydro International works with owners and municipalities through networks of certified maintenance contractors to ensure proper maintenance practices.

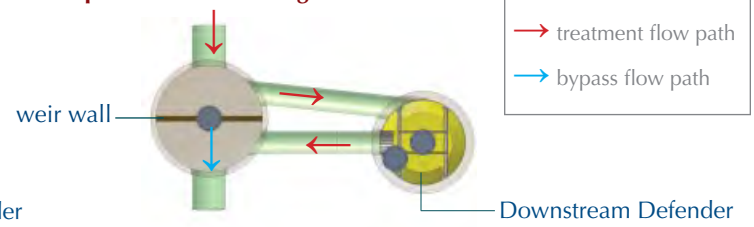
Sizing and Design

The **Downstream Defender** is sized and designed to accommodate site parameters. The device is commonly installed in an on-line configuration (figure A). In an off-line configuration an upstream diversion structure with an integral weir diverts treatment flows to the **Downstream Defender**. Excess storm flows spill over the weir directly to the outlet (figure B).

A. Example of On-line Configuration

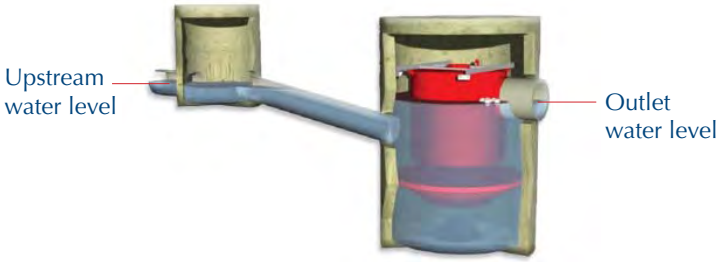


B. Example of Off-line Configuration



Low Headloss

The **Downstream Defender** has clear openings and no internal restrictions in order to minimize hydraulic losses, blockages and the risk of upstream flooding.



Downstream Defender Design Chart

Model Number and Diameter (ft)	Peak Treatment Flow (cfs)	Maximum Pipe Diameter (in)	Headloss at Peak Treatment Flow (in)	Oil Storage Capacity (gallons)	Sediment Storage Capacity (cubic yards)	Minimum Distance from Outlet Invert to Top of Rim (ft)	Standard Distance Outlet Invert to Sump Floor (ft)
4	3.0	12	6	70	0.70	3.2	4.0
6	8.0	18	8	230	2.10	3.6	5.9
8	15.0	24	9	525	4.65	4.1	7.7
10	25.0	30	10	1,050	8.70	4.9	9.4

For more information please call our office toll free at 800-848-2706 or inquire at www.hydro-international.biz.

Hydro International stormwater

This information is subject to change without notice.

Certificate No. 961366

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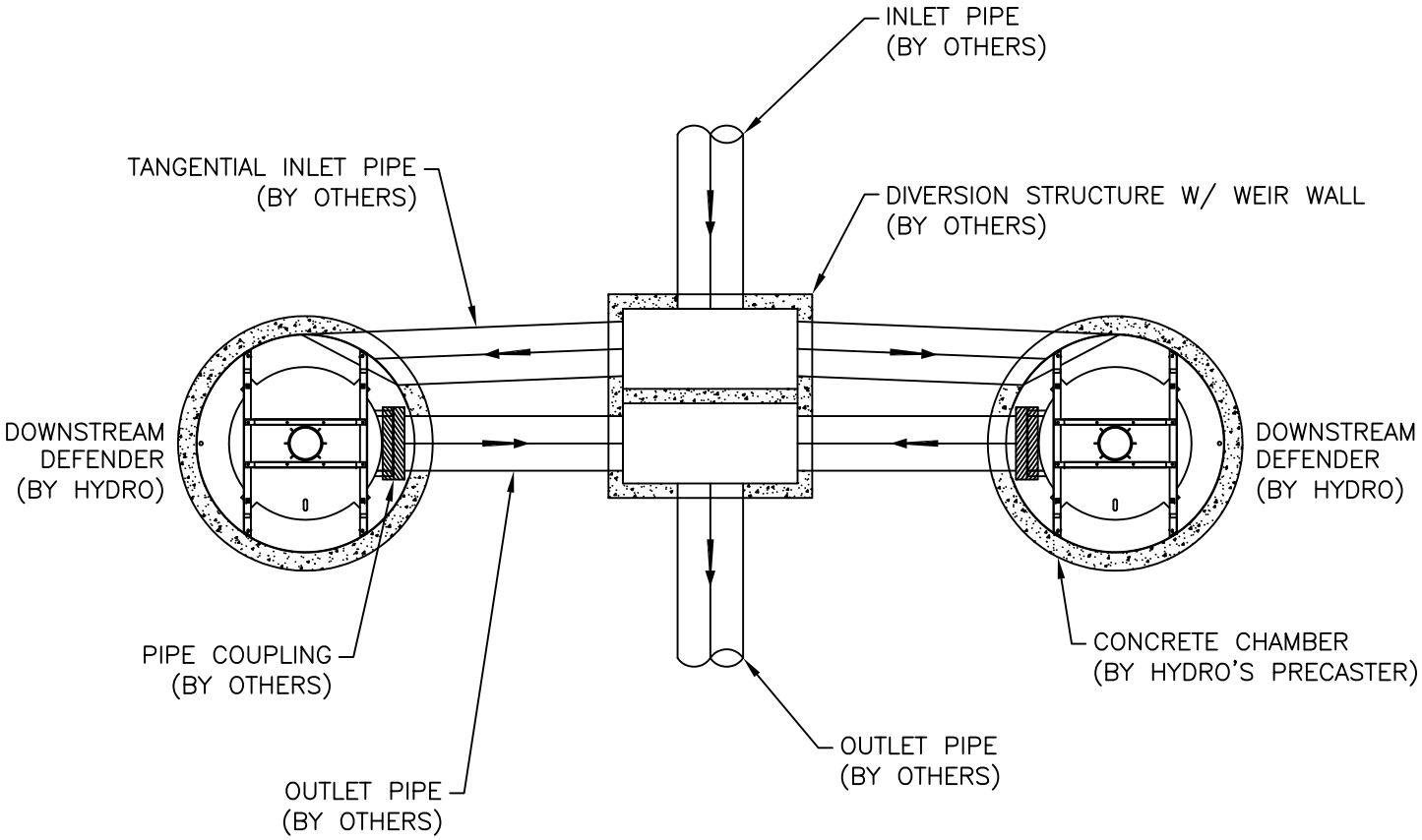

PARALLEL OFFLINE ARRANGEMENT

NOTES:

REVISION HISTORY			
REV	BY	DATE	DESCRIPTION
	RC	02/19/09	FIRST ISSUE

DATE:	SCALE:
02/19/09	NTS

DRAWN:	CHECKED:	APPROVED:
RC		

TITLE

DOWNSTREAM DEFENDER®

GENERAL PARALLEL
OFFLINE ARRANGEMENT

Hydro International stormwater

94 Hutchins Drive
Portland, Maine 04102
Tel: (207) 756-6200
Fax: (207) 756-6212
Email:
stormwaterinquiry@hil-tech.com

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Hydro International

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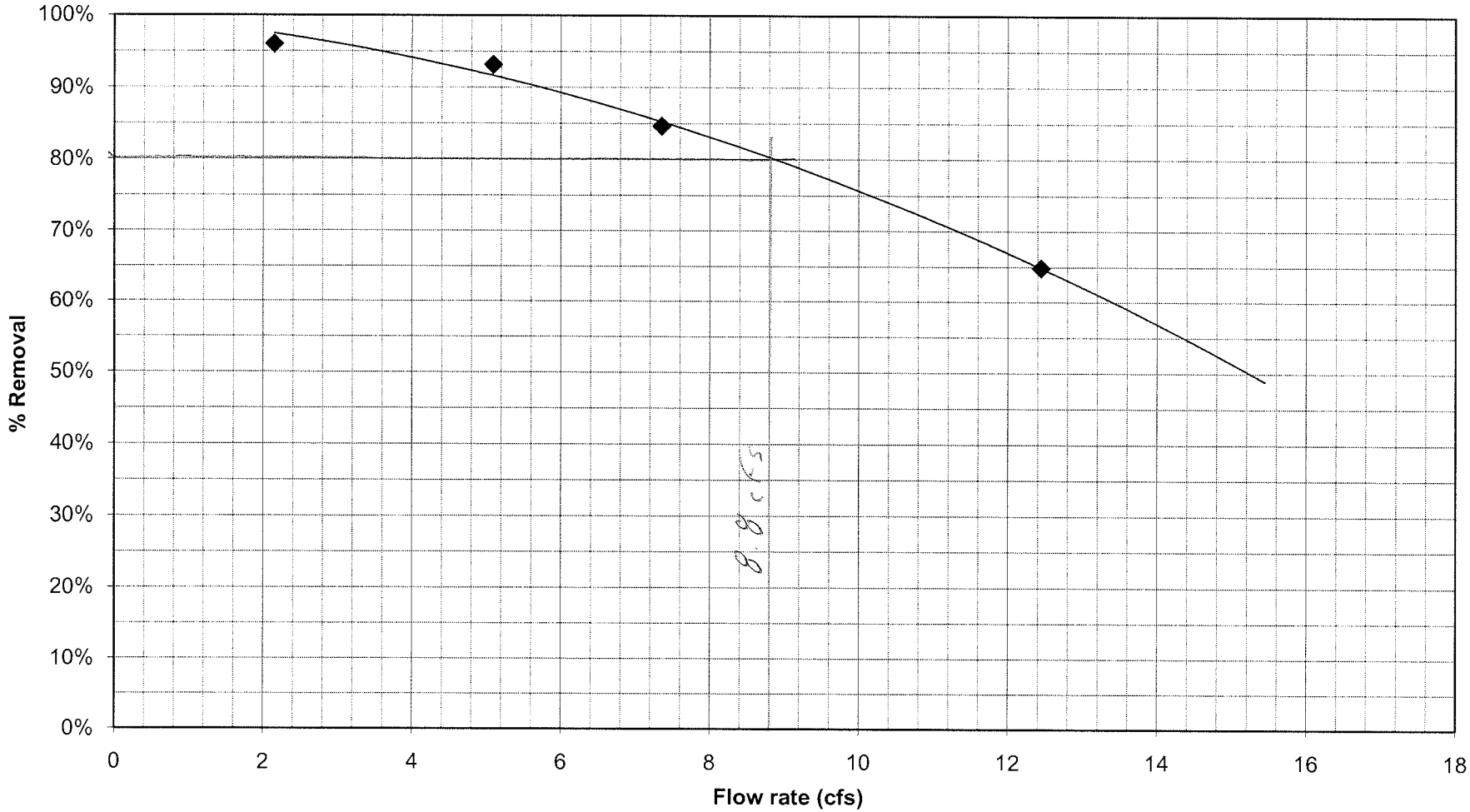
CAD Ref.: DD-GOA2-P
Project No.:
Drawing No.: DD-GOA2-P

Downstream Defender Performance

Test Material = OK110 (D50: Approx.=106 microns)

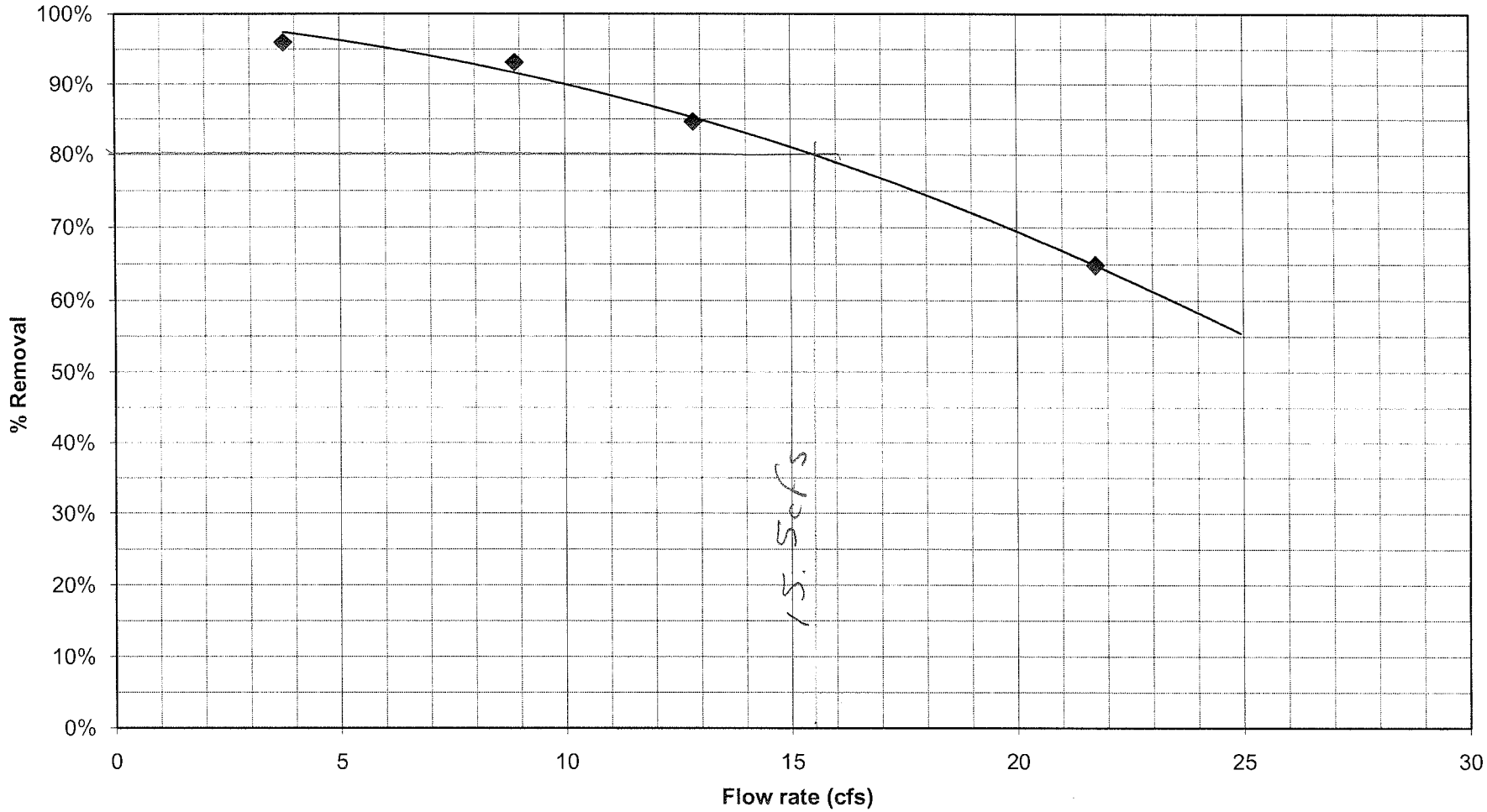
Model: 8-ft Diameter



Downstream Defender Performance

Test Material = OK110 (D50: Approx.=106 microns)

Model: 10-ft Diameter



8.3
15.5
24.3