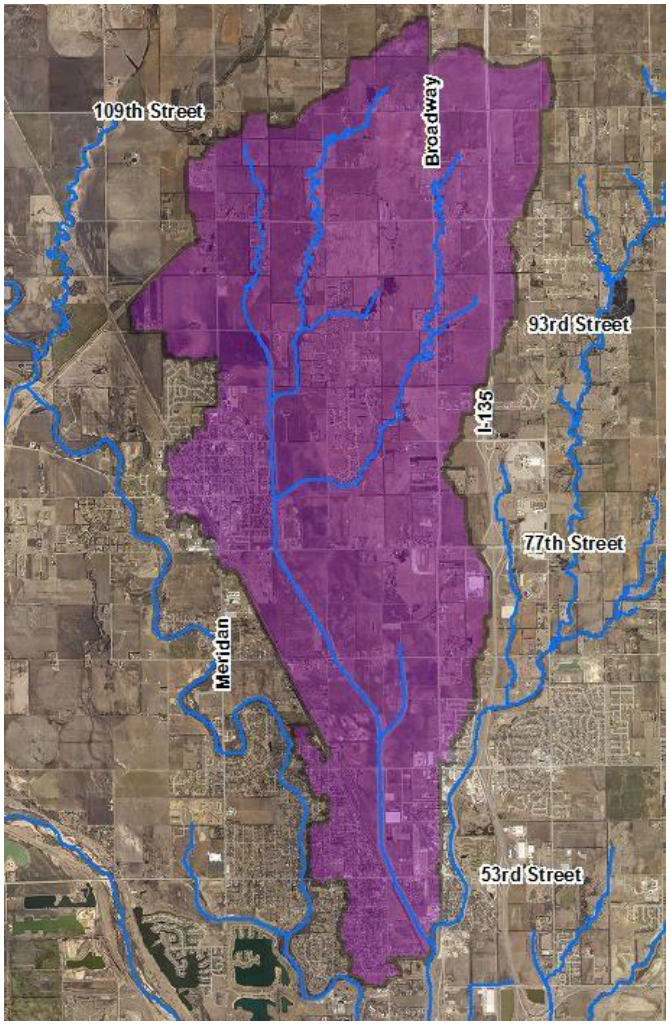
West Branch Chisholm Creek Watershed Study
Sedgwick County, Kansas



Prepared For:
Sedgwick County, Kansas
Contract: RFP#12-0111 Proposal

Prepared By:
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Environment & Infrastructure, Inc
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Wichita, KS 67218

April 2016

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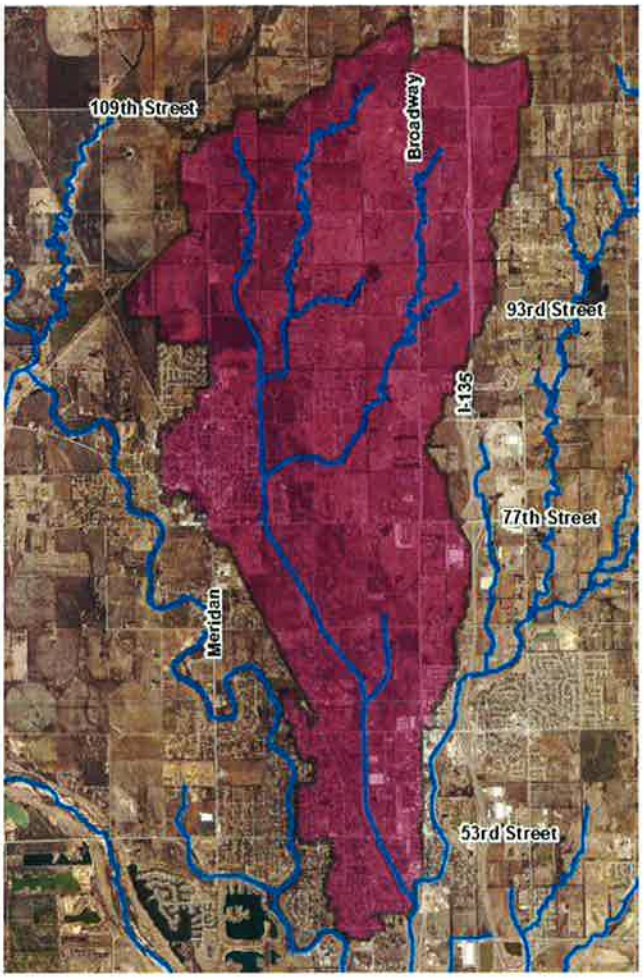

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Table of Contents

TABLES

FIGURES

APPENDICIES

EXECUTIVE SUMMARY

Sedgwick County contracted with Amec Foster Wheeler Environment & Infrastructure, Inc. (Amec) to perform a study for the West Branch Chisholm Creek watershed, which includes portions of Sedgwick County, Park City, Valley Center and Wichita. The purpose of the study was to evaluate flood risk along with water quality issues such as channel erosion and sedimentation throughout the watershed. This study was intended to identify areas highly susceptible to flooding as well as water quality issues, and to identify potential improvements that can be made to mitigate these issues. Numerous alternatives were evaluated to address the identified issues, and recommendations for improvements along with planning level cost estimates were developed as part of this study and are presented in this report.

Flood potential of the West Branch Chisholm Creek watershed is primarily a function of the storage that is available within the watershed prior to a storm event. Flood potential in developed areas could be significantly increased should available storage areas be removed as a result of future development. Field investigations of the watershed to evaluate water quality indicate that there are some minor channel erosion areas that if not addressed, could increase sedimentation rates due to increased channel erosion and instability. In addition, it was noted during the field investigations that some sedimentation has occurred around culvert structures which may reduce the capacity of flow at these locations, potentially increasing flooding.

Amec evaluated the watershed for a variety of flood risk concerns, and developed a suite of recommendations to mitigate these concerns. Amec recommends maintaining existing storage throughout the watershed through enforcement of the compensatory storage policy requirements in the Wichita and Sedgwick County Stormwater Manual. In order to address existing flooding issues, Amec recommends that two regional detention facilities be constructed; one at the confluence of Trailsview Slough & West Branch Chisholm Creek and the other along Trailsview Slough approximately 0.5 miles upstream of 85th Road. Originally, we evaluated whether the entire training levee system (non-accredited levee system north of 61sth Street) could be modified to provide 100-year flood protection. However, the levee currently has trapezoidal weirs at multiple locations, allowing surcharge flows to be stored in low lying areas on the dry sides of the levees. These low lying areas provide substantial storage, which if removed from the system by closing the weirs, would significantly increase flows within West Branch Chisholm Creek. Based on our analysis it does not appear feasible to close all weirs due to the amount of upstream detention that would need to be constructed; therefore, we focused on closing those that protect the majority of existing residential structures. Amec recommends that improvements be made to portions of the "training levee" system from 61st Street up to 93rd Street, so that the levee at these specified locations will provide 100-yr event level protection and can be certified per FEMA 44CFR 65.10. Additionally, independent recommendations have been made downstream of 61st Street to reduce flooding associated with two low lying areas adjacent to the levees. Total order of magnitude costs for these improvements are approximately $25.2 Million and could be completed in up to six phases over several years.

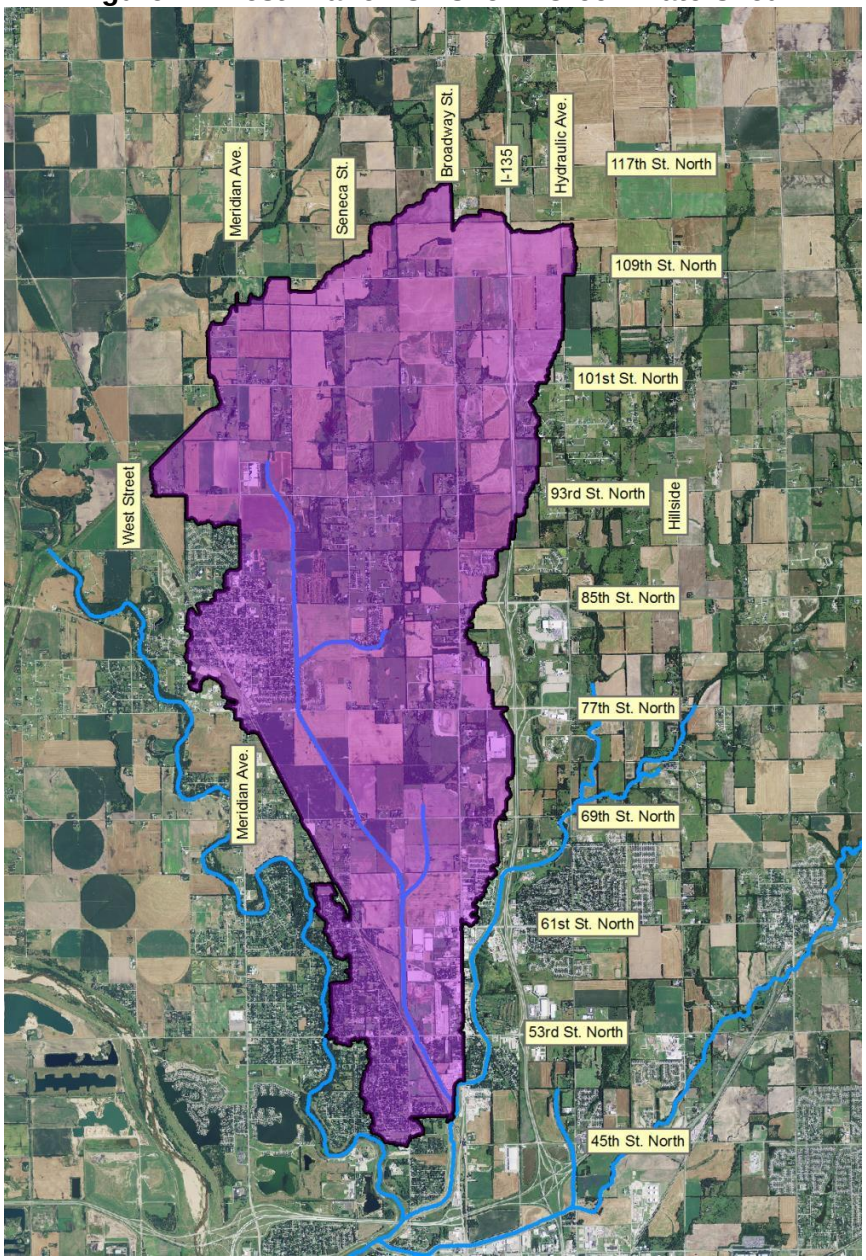
Amec performed water quality field investigations in which minimal stream bank erosion and sedimentation was noted around structures. There are no TMDL's identified within the watershed and sediment is the only identified widespread pollutant. Amec recommends that these areas are monitored and mitigated through a stream maintenance program. Minor stream bank erosion areas and downstream sedimentation could be mitigated using a combination of buffer strips and stream stabilization alternatives. In addition, existing sediment around structures should be removed so that the original conveyance capacity is maintained.

The following report summarizes our analyses, findings, recommendations and cost estimates developed for this watershed study.

INTRODUCTION

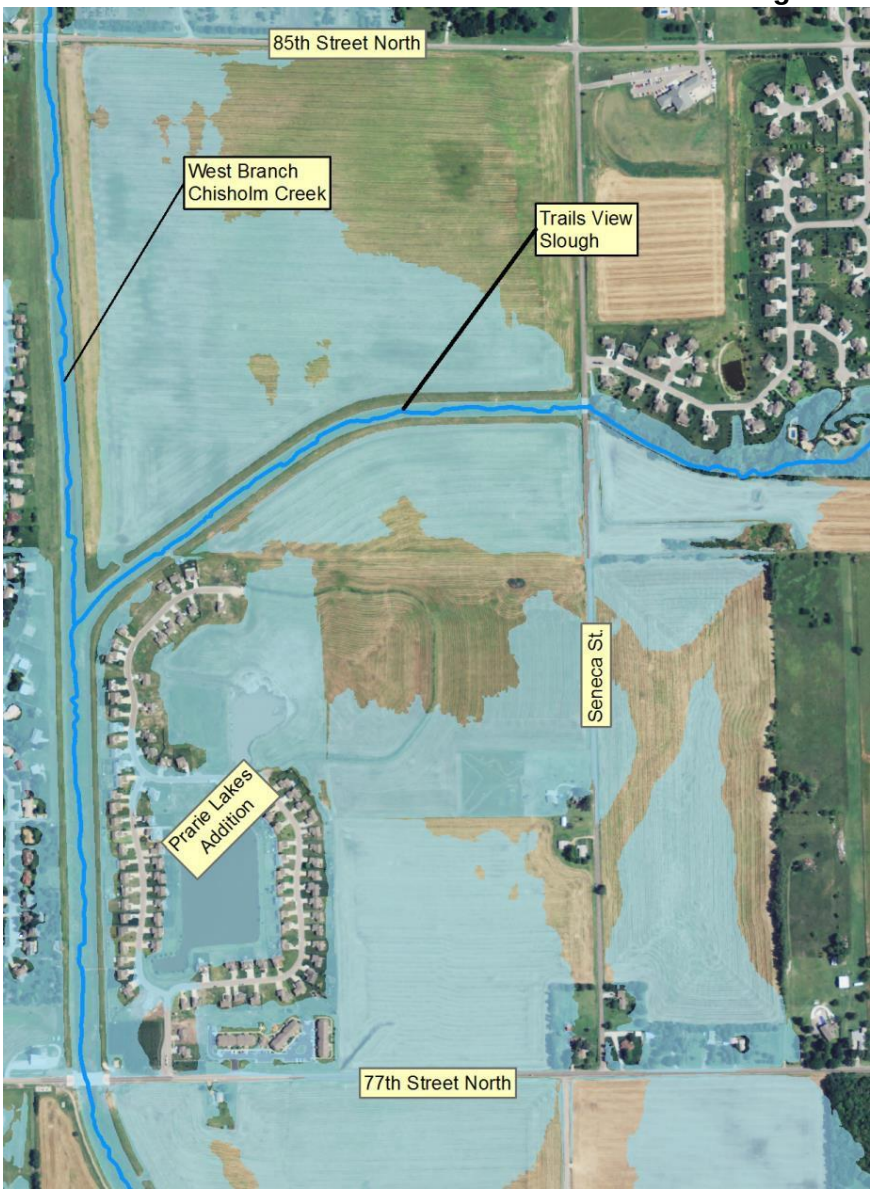
Sedgwick County contracted with Amec to perform a watershed study on the West Branch Chisholm Creek Watershed. This watershed consists of approximately 17.5 square miles that collects runoff from Park City, Valley Center, Wichita, and unincorporated areas of Sedgwick County. The overall drainage basin extends from the confluence with Chisholm Creek northerly to a location near 117th Street North as shown in Figure 1 below. There are several creeks that contribute to the West Branch Chisholm Creek which includes the Trailsview Slough and multiple unnamed tributaries. Amec's previous work in the area includes the Wichita – Valley Center Floodway Levee Certification project along with countywide floodplain mapping for Sedgwick County under contract with the Kansas Department of Agriculture. As part of these previous projects, Amec developed extensive hydrologic and hydraulic models of the flooding sources within the watershed that were enhanced to evaluate flood risk and served as a basis to evaluate potential mitigation alternatives.

Figure 1: West Branch Chisholm Creek Watershed



In the past, portions of the watershed have experienced severe flooding during heavy rainfall events. One such location is the Prairie Lakes Addition located on the north side of 77th Street North immediately adjacent to the east bank of West Branch Chisholm Creek as shown in Figure 2. This residential development flooded previously due to runoff exceeding the capacity of Trailsview Slough and bypassing the training levee, entering the development from the east. Other areas of Valley Center experience street flooding primarily directly to the west of the West Branch Chisholm Creek.

Figure 2: Prairie Lakes Addition – 1% Annual Chance Existing Floodplain

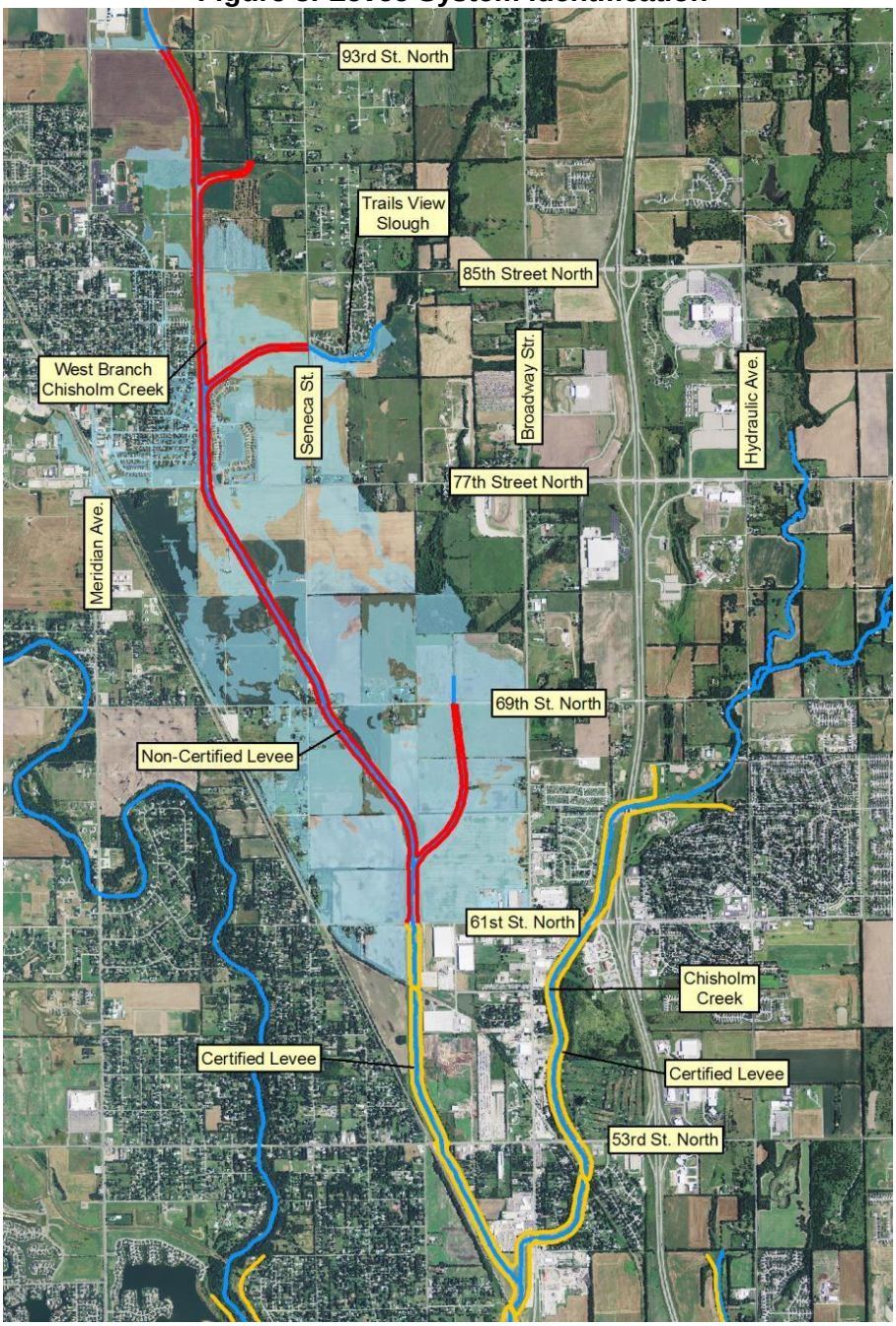


HYDROLOGIC & HYDRAULICS ANALYSIS

Existing Conditions:

The West Branch Chisholm Creek watershed was analyzed using HEC-HMS and HEC-RAS (unsteady flow) software for the areas within the certified levees and for the areas upstream of 61st St North, for West Branch Chisholm Creek as well as within the dry side storage areas. Interior drainage analyses for the area adjacent to the certified levee (61st Street North downstream to the confluence with Chisholm Creek) were performed using PCSWMM software. Figure 3 below identifies the levee segments. Those depicted in red represent current non-certified segments, whereas those shown in yellow represent current certified segments.

Figure 3: Levee System Identification



Hydrologic and hydraulic models previously developed during the Sedgwick County DFIRM project and Wichita Levee Certification project were used as the basis for this assessment. The hydrologic analysis was performed using detailed inputs into the HEC-HMS software for multiple events. Specifically, the events analyzed were the 50-, 20-, 10-, 4-, 2-, 1-, and 0.2-percent chance exceedance events. The hydrologic analysis was performed for three scenarios:

1. Existing conditions "geometry" with existing conditions land uses
2. Existing conditions "geometry" with future conditions land uses
3. Future conditions "geometry" with future conditions land uses

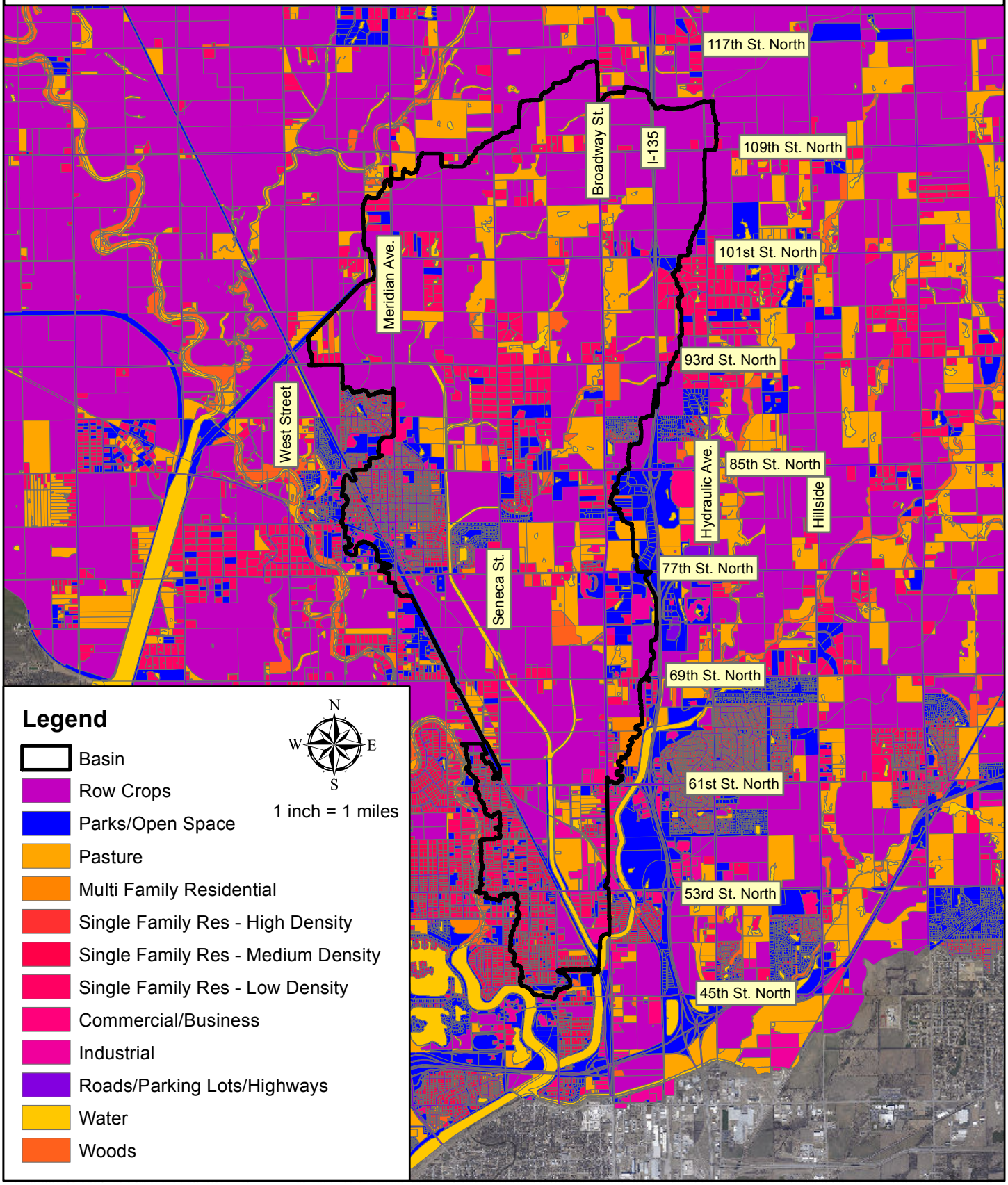
By using the three scenarios, we were able to compare the impact of runoff as the region continues to develop, as well as the impacts of the runoff impacted by any proposed improvements as development occurs.

The existing conditions land use was developed for the previous levee certification and floodplain mapping projects. Additional data was obtained from the Wichita Area Planning Commission (MPAC), City of Valley Center, City of Park City, City of Bel Aire, and the City of Kechi. This data was primarily projected land use data taken from the comprehensive plans that each entity had prepared. This became the basis for adjusting the existing land uses from current use to projected future uses.

West Branch Chisholm Creek is highly sensitive to Chisholm Creek backwater. Therefore, the hydrologic and hydraulic models were networked with the entire Chisholm Creek watershed. When evaluating future conditions hydrology, future conditions hydrology was applied to the entire Chisholm Creek watershed in order to apply the appropriate backwater conditions and timing to the West Branch Chisholm Creek assessment.

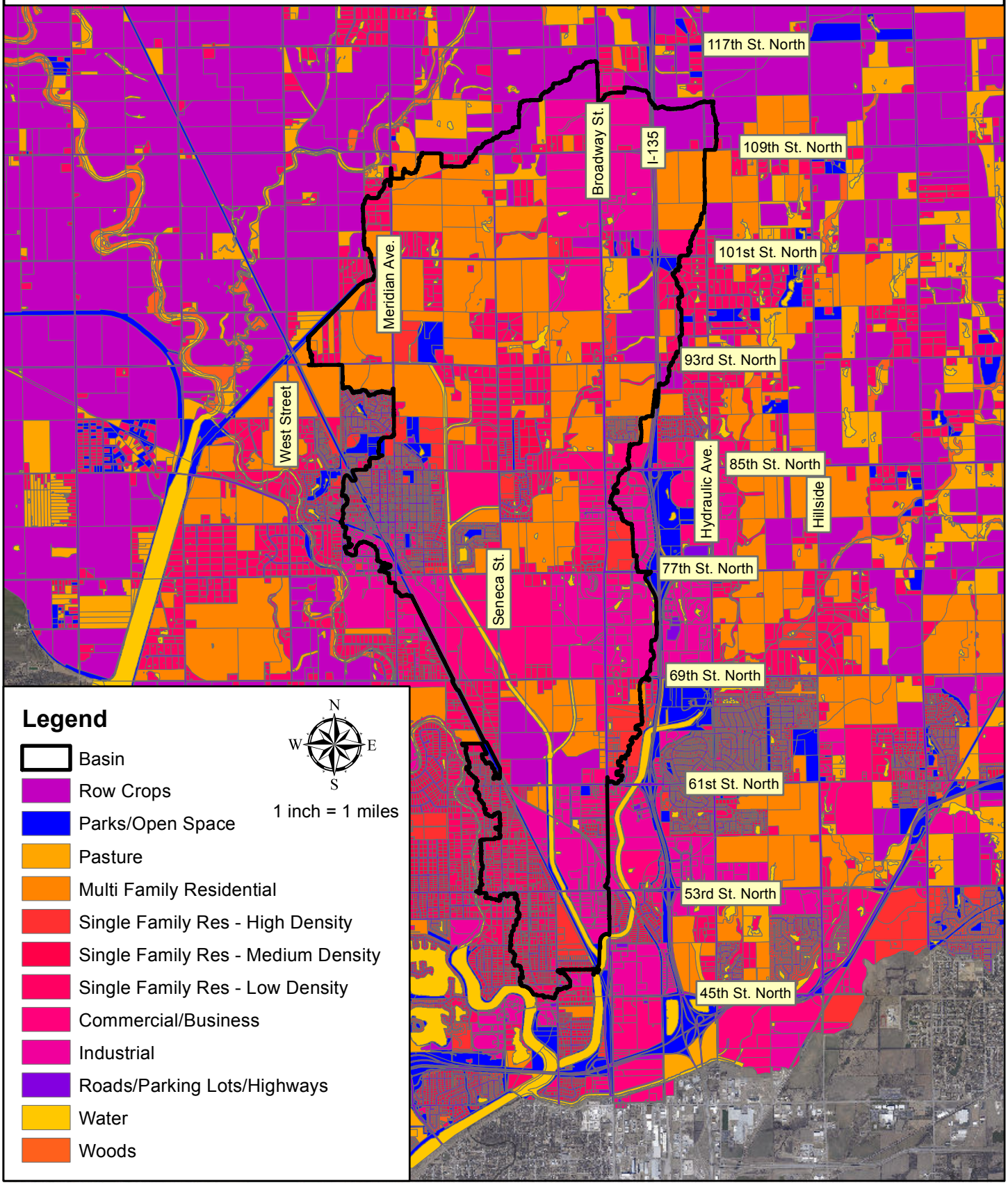
The following maps represent the existing conditions land use and the projected future conditions land use. Note that the transition of areas from purple and blue to red and orange indicate an increase in impervious area. Transitions in the opposite direction indicate a decrease in imperviousness.

West Branch Chisholm Creek
Existing Conditions Landuse



Map A

West Branch Chisholm Creek
Future Conditions Landuse



Map B

Hydraulic analysis methods were chosen dependent on the location of the point of interest. In areas where free flow into and out of the levee system are allowed, HEC-RAS was used to determine the ponding elevations of water on the "dry" side of the levee and to calculate the water surface profile of the channel which is confined by the training levees.

In areas that are farther downstream and adjacent to the certified levees, PCSWMM was used to analyze dry side improvements. PCSWMM is the same software that was used to model the interior drainage areas during the original Wichita Valley Center Levee System certification project. The choice of PCSWMM for this analysis is to utilize the existing data and have a baseline for comparison without having to develop an entirely new hydraulic model.

Future Conditions:
With the baseline hydrology and hydraulics models completed, the future conditions hydrology was applied to the existing conditions geometry hydraulic model to determine the impacts of future development on the watershed, with the assumption that no conveyance or storage improvements are made. The primary assumption is that site specific detention and/or compensatory storage volumes would not be provided. The future conditions hydrology was assumed to be unregulated, with the understanding that possible improvements that were proposed with this study could be designed to accommodate increased runoff from future development potentially reducing the necessity of on-site stormwater detention for future development.

The results of applying future condition hydrology to the existing conditions hydraulics indicated that without controlling future runoff, flooding potential and frequency would be increased in the future. Allowing uncontrolled discharge from new developments increases the water surface elevations calculated for the 100-yr event within the downstream certified levee segments to a point in which the freeboard would not pass the requirements as set forth in 44 CFR 65.10. Thus, if rainfall runoff from new developments is not controlled, not only would localized flooding issues increase, but negative consequences would result to Sedgwick County and the City of Wichita downstream potentially calling into question their levee certification and potentially leading to increased flood insurance premiums and reducing the overall levee factor of safety.

WATER QUALITY ASSESSMENT

The majority of the watershed is agricultural with a mix of tilled and no-till crop land as well as some rangeland. In addition to agricultural land use, portions of the Cities of Valley Center, Park City and Wichita are located within the watershed, therefore urban water quality issues are also a consideration.

AMEC evaluated the watershed for potential water quality issues including stream stability, sedimentation, and urban water quality concerns. AMEC performed two site visits documenting concerns, and took site photos of potential water quality issues. Exhibit A contains a summary of these findings. AMEC only noted minor water quality issues based on our assessment. In general, the majority of the watershed has adequate stream bank protection in the form of a mix between grass, heavy shrubs and trees. One area was noted where the stream bank is eroding towards the roadway embankment. A couple of additional areas were noted as potential contributors to sedimentation as a result of agriculture fields with inadequate ground cover during certain parts of the year AMEC consulted with KDHE and TMDL publications about the watershed. There are no TMDL's identified for this watershed. Based on our observations and discussions with the steering committee, sedimentation appears to be the only wide spread pollutant in the watershed. All other issues appear localized and are not easily dealt with as part of a comprehensive watershed plan.

In general AMEC recommends that a maintenance program be considered to monitor and mitigate against any current or future water quality concerns. As part of an on-going maintenance program the watershed could be continually monitored and locations for grass buffer strips could be considered to prevent sedimentation of agricultural fields adjacent to water conveyance systems. Figures 4 and 5 provide example locations in which buffer strips may help reduce the risk of future water quality issues as a result of sedimentation from agricultural activities. In addition, existing sedimentation around structures could be excavated to re-establish designed culvert capacities.

In addition to surface water quality issues, there are 8 Kansas Department of Health and Environment (KDHE) identified remediation sites located within the watershed. Table 1 summarizes the remediation sites that were located using the KDHE online remediation site identification tool. While each of these sites have their own specific remediation plan, the County and Cities should be aware of these locations. If sedimentation occurs or contamination is observed from one of these sites, coordination should immediately occur with KDHE to discuss specific clean up procedures to protect water quality. In general the cause of these remedial sites is primarily due to oil and gas activities which affect subsurface soils and groundwater quality. These remedial sites are currently under KDHE regulatory authority and are thus subject to their requirements including monitoring and remedial actions. As it pertains to this study, remedial sites such as these should be considered should future development include subsurface improvement activities and are located within these remedial site areas.

Table 1: KDHE Identified Remediation Sites

Facility ID	Site Name	Status
C208700055	57TH & NORTH BROADWAY, WICHITA	Active
C208700057	PARK CITY PWS WELLS	Active
C208772841	PARK CITY PROPERTIES	Active
C208770582	COASTAL PIPELINE - 53RD & BROADWAY	Resolved
C208773108	PARK CITY DRO	Active
C208772193	B & D INSTRUMENTS, INC (FORMER)	Active
C208771622	VALLEY CENTER SITE	Active

Figure 4: Potential Buffer Strip Area – Upstream of 93rd Street

Figure 5: Potential Buffer Strip Areas – Downstream of 77th Street

DEVELOPMENT OF FLOOD REDUCTION ALTERNATIVES

Based on the findings of the future conditions hydrology applied to the existing conditions geometry, it is apparent that for the levee system freeboard downstream of 61st St North to not be jeopardized, upstream storage in the watershed must be conserved so that flows and water surface elevations are not increased in the downstream levee reach. Numerous alternatives were evaluated in determining the final recommendations that are presented in this report. Preliminary modeling attempted to provide several smaller storage areas at various locations throughout the watershed to reduce the peak flow rates and reduce flooding in key locations. This approach was unsuccessful in providing sufficient attenuation of the peak flows and flooding concerns were only minimally impacted. Based on these results, the approach of isolated smaller detention facilities was abandoned and focus was shifted to providing regionalized detention.

For purposes of this report, the iterations are referenced numerically beginning with the regionalized detention focus. The first trial was developed using significant storage in various locations while maintaining the target flows within the West Branch Chisholm Creek. The target flow rates were set to be those flows in which freeboard requirements of 44 CFR 65.10 are met, along with providing enough storage to provide sufficient freeboard for the levee system from 61st Street North to 93rd Street North to be certified. Scenario #1 consisted of the following modifications to the baseline model:

1. Added regional off-line detention south of 85th street, and northeast of the confluence of Trailsview Slough and West Branch Chisholm Creek
2. Added regional off-line detention north of 85th street
3. Added inline detention in the Hydrology model north of 85th street on Trailsview Slough
4. Added inline detention to the Hydrology model just north of 93rd street on the Tributary of West Branch Chisholm Creek
5. Narrow Levee along Trailsview Slough
6. Added Storage designed by Professional Engineering Consultants (PEC) of 77th Street west of West Branch Chisholm Creek
7. Added additional storage to the east of the storage designed by PEC
8. Added flap gates to structures along levee and closed gaps in levee
9. Replace Seneca Street Bridge with a larger structure

In general, the results of our first scenario were not sufficient to meet the target condition of obtaining adequate freeboard at the 77th Street North and 85th Street North bridges. Existing conditions hydrology shows a lack of up to 0.5 feet of freeboard at the 85th Street North Bridge. Therefore, levee raising would still be required.

The second scenario eliminated any additional storage except that which was naturally occurring in the watershed and that which was recently designed for the area at the southwest end of Valley Center. The intent of this iteration was to determine how much the levee top would need to be raised in order to meet certification requirements. Key alterations to the model for this analysis are:

1. Added flap gates to structures along levee and closed gaps in levee
2. Construct new levee along Trailsview Slough east of Seneca
3. Added Storage Area South of 77th Street
4. No additional changes made to the existing conditions

The results of this trial indicated that the average increase in the levee height would need to be approximately one foot. In addition, to increasing the height of the levee, five bridge structures would need to be replaced or modified to obtain the necessary freeboard in order to bring the levee system up to certifiable condition. These bridge structures are located at 61st Street North, 69th Street North, Seneca Street, the newly constructed 77th Street North bridge, and the newly constructed 85th Street North bridge. More importantly, without providing compensating storage for all of the storage removed behind the levees, the certified levee system would no longer meet freeboard requirements and the certified levee system would have to undergo significant modifications to remain compliant with FEMA requirements. Therefore, this Scenario was not considered feasible

Scenario #3 expanded on the findings from the previous two scenarios. Since raising the levee alone did not yield feasible results, a scenario that incorporates regional detention combined with raising the levee was developed. The significant modeling modifications are:

1. Maximized regional off-line detention south of 85th Street North, northeast of the confluence of Trailsview Slough and West Branch Chisholm Creek
2. Provided inline detention within the hydrology model north of 85th street on Trailsview Slough to reduce peak discharges
3. New levee construction to the east of Seneca Street along Trailsview Slough
4. Added Storage Area South of 77th Street

By using the combined approach of raising the existing training levees, rehabilitating the existing levee east of Seneca Street, and providing two regional detention facilities, the overall impact is beneficial and appears to be the most cost effective. The existing training levee would need to be raised, on average, less than one-foot with the modification of the bridges at 77th Street North and 85th Street North and a full replacement of the Seneca Street Bridge.

Scenario #3 was further modified in attempt to minimize the impact and optimize the results. Targeted areas during the optimization were:

1. Narrowing the corridor of the proposed levee construction along Trailsview Slough
2. Minimize inline detention requirement along Trailsview Slough
3. Address instability of model by adding cross sections within Trailsview Slough

Including these optimization adjustments to Trailsview Slough, we developed our recommended improvements to aid in the reduction of flooding impacts.

RECOMMENDED IMPROVEMENTS

Based on our findings from multiple iterations, the West Branch Chisholm Creek Watershed is less sensitive to conveyance improvements and relies greatly on storage. As a result of these findings AMEC has has developed recommendations for several improvements, which combined will assist in mitigating flood risk for existing and future conditions within the watershed. The recommended improvements include obtaining levee certification through levee improvements upstream of 61st Street North, construction of two (2) regional detention facilities, and increasing storage capacity in two locations adjacent to the certified levee system downstream of 61st Street North.

The proposed improvements, discussed in more detail below, could be completed in several phases over many years. In general it is recommended that the two proposed detention facilities be completed prior to the levee improvements in order to prevent adverse impacts downstream. The proposed storage capacity improvements adjacent to the certified levee

system could be completed independently of the other proposed improvements without causing adverse impacts.

AMEC has developed budget level cost estimates associated with these improvements in this report, but these costs may vary based on additional analyses performed during the design phase.

DRY DETENTION FACILITY #1

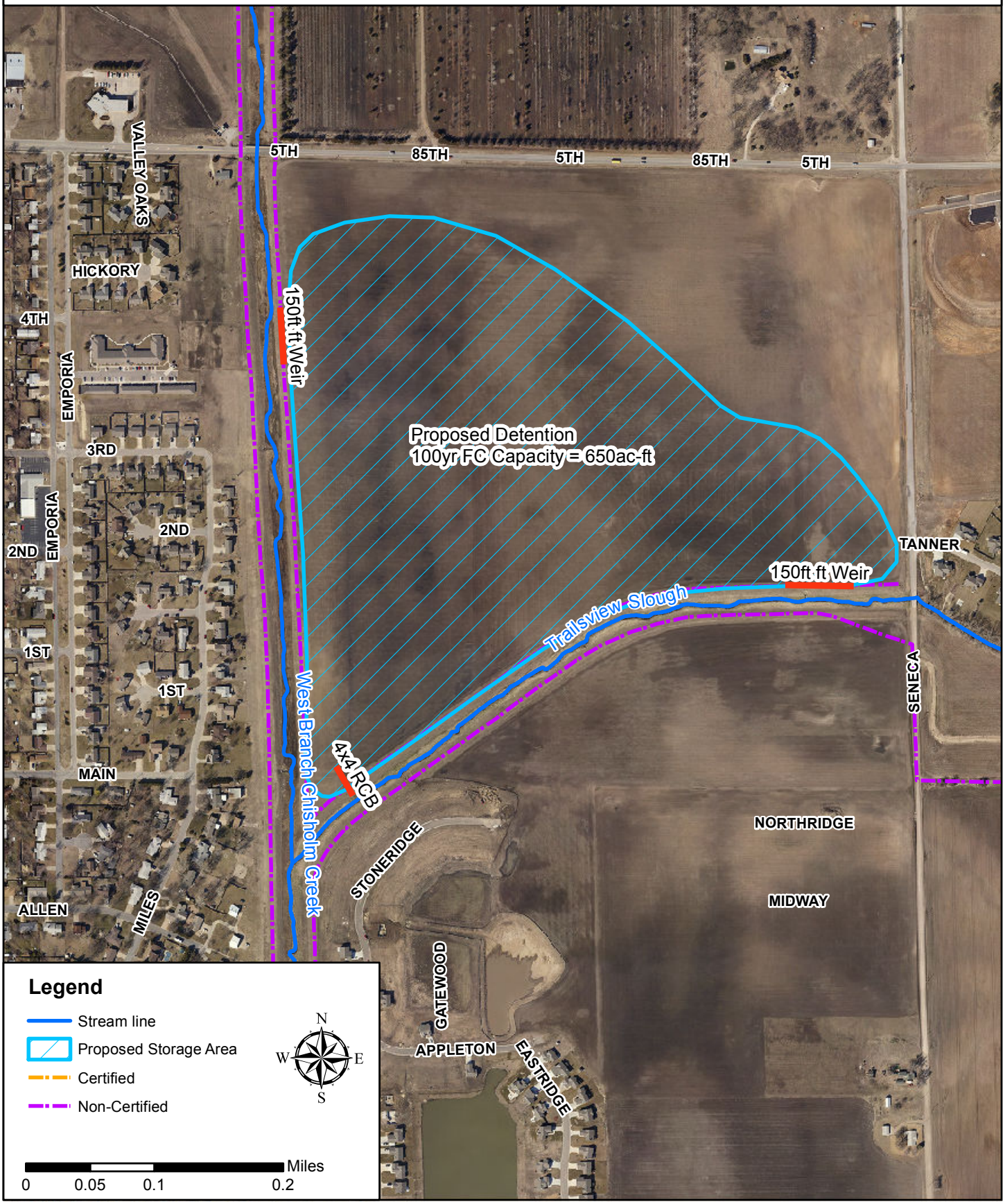
A large detention facility is recommended to be designed and constructed immediately adjacent to the confluence of the West Branch Chisholm Creek and Trailsview Slough as shown in the following map. This proposed storage area would encompass approximately 75 acres of land which is currently undeveloped and has sufficient volume to detain approximately 610 ac-ft of water. Table 2 provides a summary of Dry Detention Facility #1.

Table 2: Dry Detention Facility #1 Summary

Detention Area	Outlet Structure	Proposed Capacity (ac-ft)	Total Proposed Area (ac)	Estimated Cut Volume (ft3)
Dry Detention Facility #1	1 – 4'X4' RCB & 2 Lateral Weirs	650	75	880,000

West Branch Chisholm Creek

Proposed Detention #1



Map C

Each of the streams would have side-discharge weirs installed to allow excess water to flow into the facility. The configuration of this facility allows for water from either channel to be stored in the same location. Depending on the timing of the runoff, either stream or both may be contributing to the detention area. The first weir is 165 feet in length located along the east bank of the West Branch Chisholm Creek roughly 500 feet downstream of 85th St North. The second inflow weir is located along the north bank of Trailsview Slough approximately 250 feet downstream of Seneca Street with a constructed with a weir length of 150 feet. The outfall from the detention facility consists of a 4'X4' RCB that allows uncontrolled flow.

The effects of this proposed detention facility #1 combined with the secondary proposed dry detention facility #2, described on the following page, results in a reduction of the 1% annual chance peak discharge by as much as 14%. In addition, the combined effect of the two proposed detention facilities also separates the coincidence of the peaks between West Branch Chisholm Creek and Trailsview Slough by approximately 4 hours. Figure 6 shows the hydrographs for the existing conditions and recommended alternatives for a location just downstream of the confluence of West Branch Chisholm Creek and Trailsview Slough. Figure 7 shows the Stage vs Time curves for the two conditions at the same location.

Figure 6: Flow Hydrograph Comparison - Existing vs Proposed Improvements

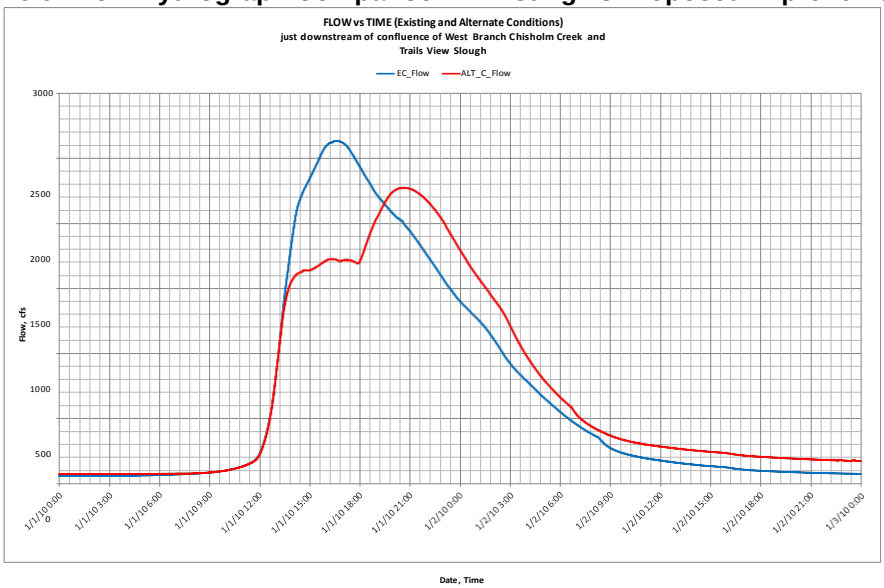


Figure 7: Stage Hydrograph Comparison - Existing vs Proposed Improvements

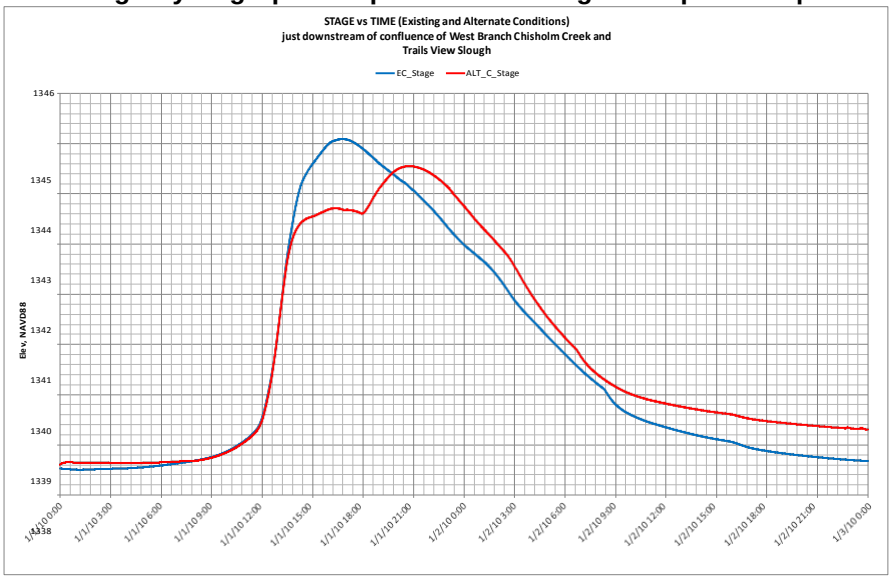
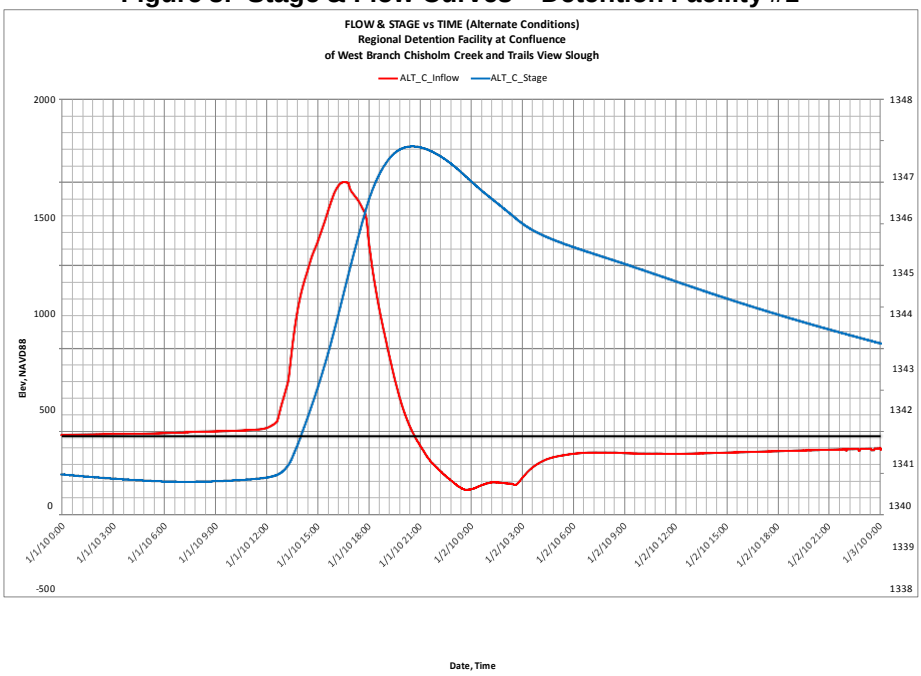


Figure 8 below shows the resulting Stage & Flow curves within the proposed detention facility #1.

Figure 8: Stage & Flow Curves – Detention Facility #1



DRY DETENTION FACILITY #2

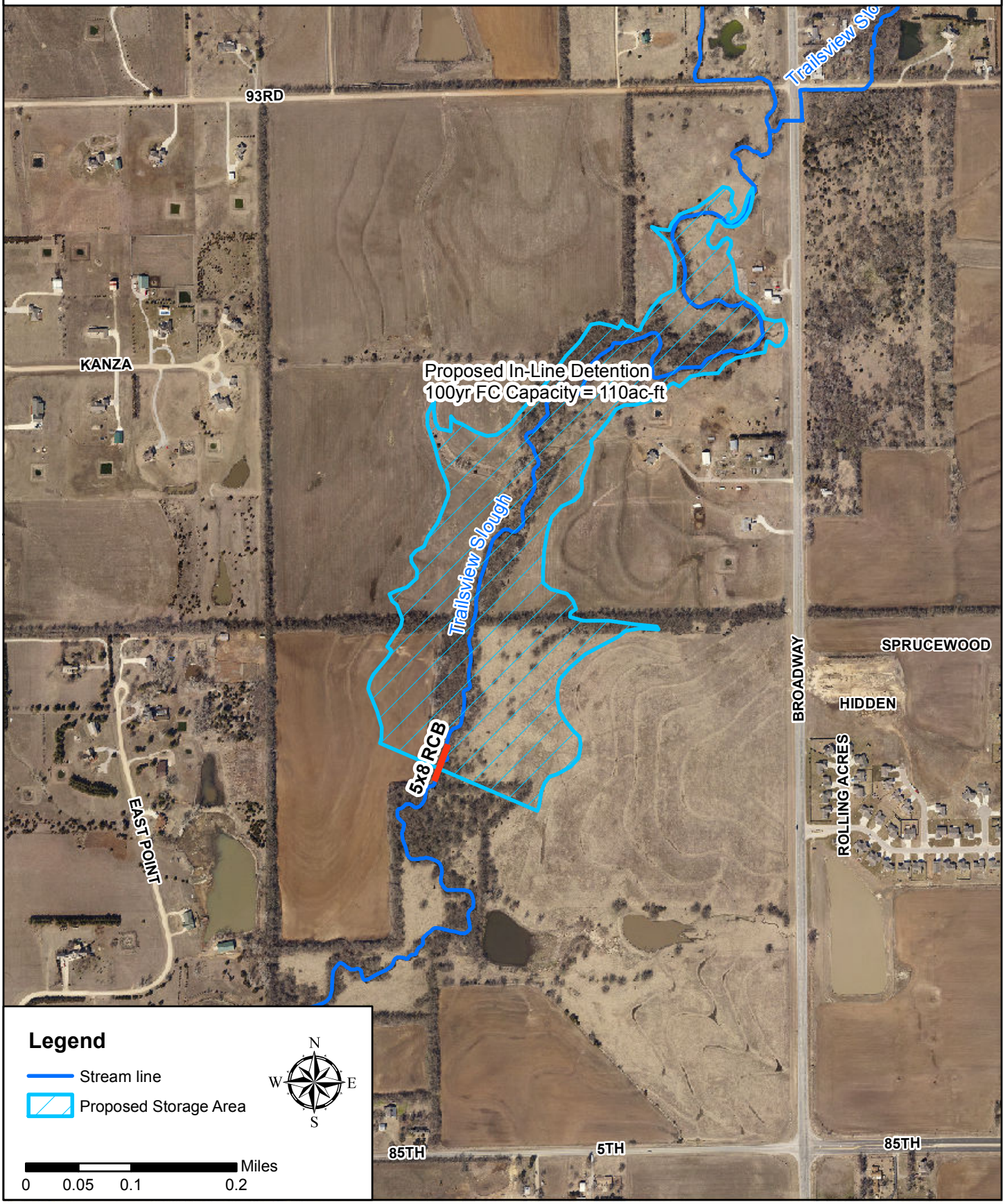
A second detention facility is proposed upstream of 85th Street North on Trailsview Slough as shown in the following map. In lieu of excavating to obtain the necessary detention volumes, a dry dam structure would be constructed to create a restriction in the stream that would serve as the detention pond, leaving the nature riparian corridor in place for environmental permitting purposes. The dam would be constructed to meet current local, state, and federal regulations and provide detention storage for 110 acre-feet of water. The outlet works would consist of an 8'X5' reinforced concrete box culvert with an earthen auxiliary spillway. At the maximum 100-yr water surface elevation of 1373.8, approximately 21 acres would be temporarily inundated. Table 3 provides details regarding Dry Detention Facility #2.

Table 3: Dry Detention Facility #2 Summary

Detention Area	Outlet Structure	Minimum Capacity (ac-ft)	Total Proposed Area (ac)	Estimated Cut Volume (ft3)
Dry Detention Facility #2	1 – 8'X5' RCB ***Aux spillway if necessary	110	21	7,500

West Branch Chisholm Creek

Proposed Detention #2



Map D

The proposed detention facility would reduce flows under existing land use conditions from 1,606 cfs to 1,300 cfs and delay the peak flow by approximately 80 minutes. By both reducing and lagging the calculated peak flow, the downstream effect at the confluence of Trailsview Slough and West Branch Chisholm Creek is even more beneficial than if only one of the two results was obtained. Figure 9 shows the Flow vs. Time curve for existing conditions for a segment along Trailsview Slough upstream of Seneca Street. Figure 10 shows the Stage vs Time curve with the inclusion of the recommended improvements.

Figure 9: Flow Hydrograph Comparison - Existing vs Proposed Improvements

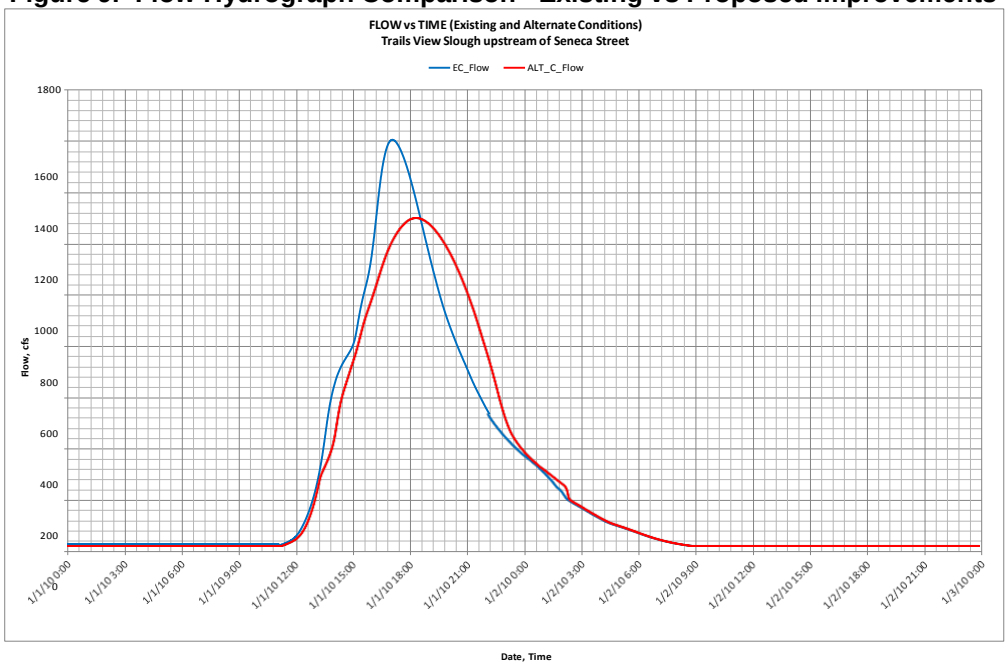
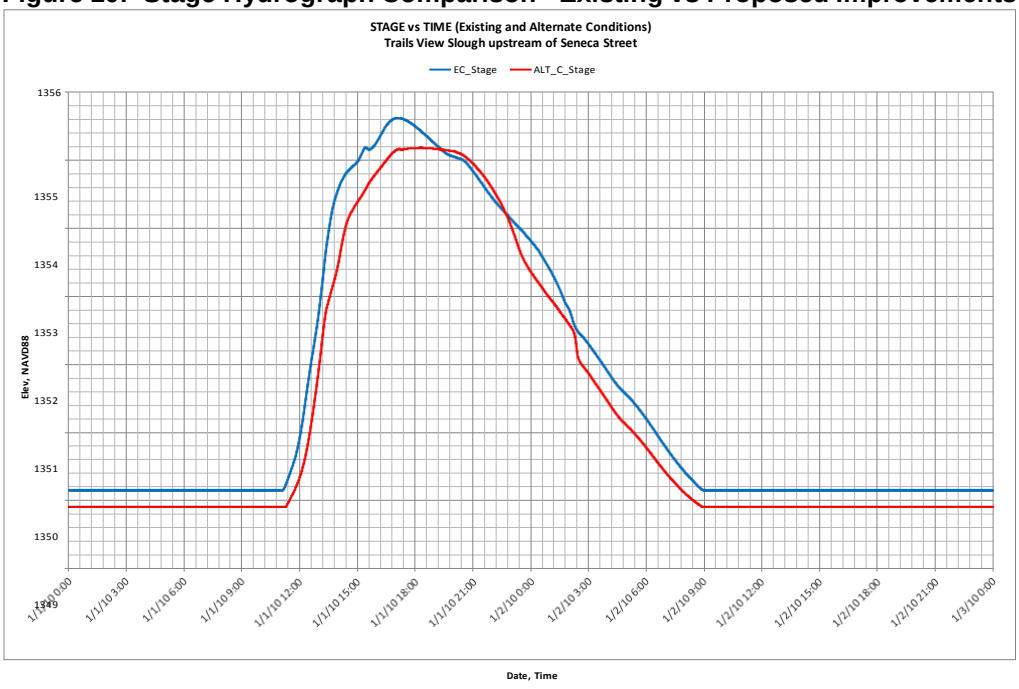


Figure 10: Stage Hydrograph Comparison - Existing vs Proposed Improvements



NON-CERTIFIED LEVEE REACH (UPSTREAM OF 61ST ST NORTH) - LEVEE IMPROVEMENTS

Exhibit E and F show the proposed levee improvements upstream of 61st. Street North. These improvements are intended to provide 100-yr flood protection, and to be compliant with FEMA 65.10 criteria for a certified levee. This criterion establishes specific requirements for various items such as required freeboard, geotechnical stability, and embankment protection. All existing structures that penetrate the proposed certified levee will be required to have flap-gates installed to prevent flow from leaving the channel once it has been introduced into the system. The exception is the interconnectivity with one of the two proposed regional detention facilities discussed later in this report.

In addition to flap gates, AMEC recommends that 10 new conveyance structures are installed as part of these levee improvements to fill open conveyances (weirs) in the existing system. In order to satisfy levee freeboard requirements the 77th and 5th Street bridges would need to be retrofitted to include upstream and downstream floodwalls which would tie into the earthen levee system to provide the required 4 feet of freeboard for the 1% event. Table 4 lists those improvements that are required to meet levee certification guidelines and maximize flood reduction benefits.

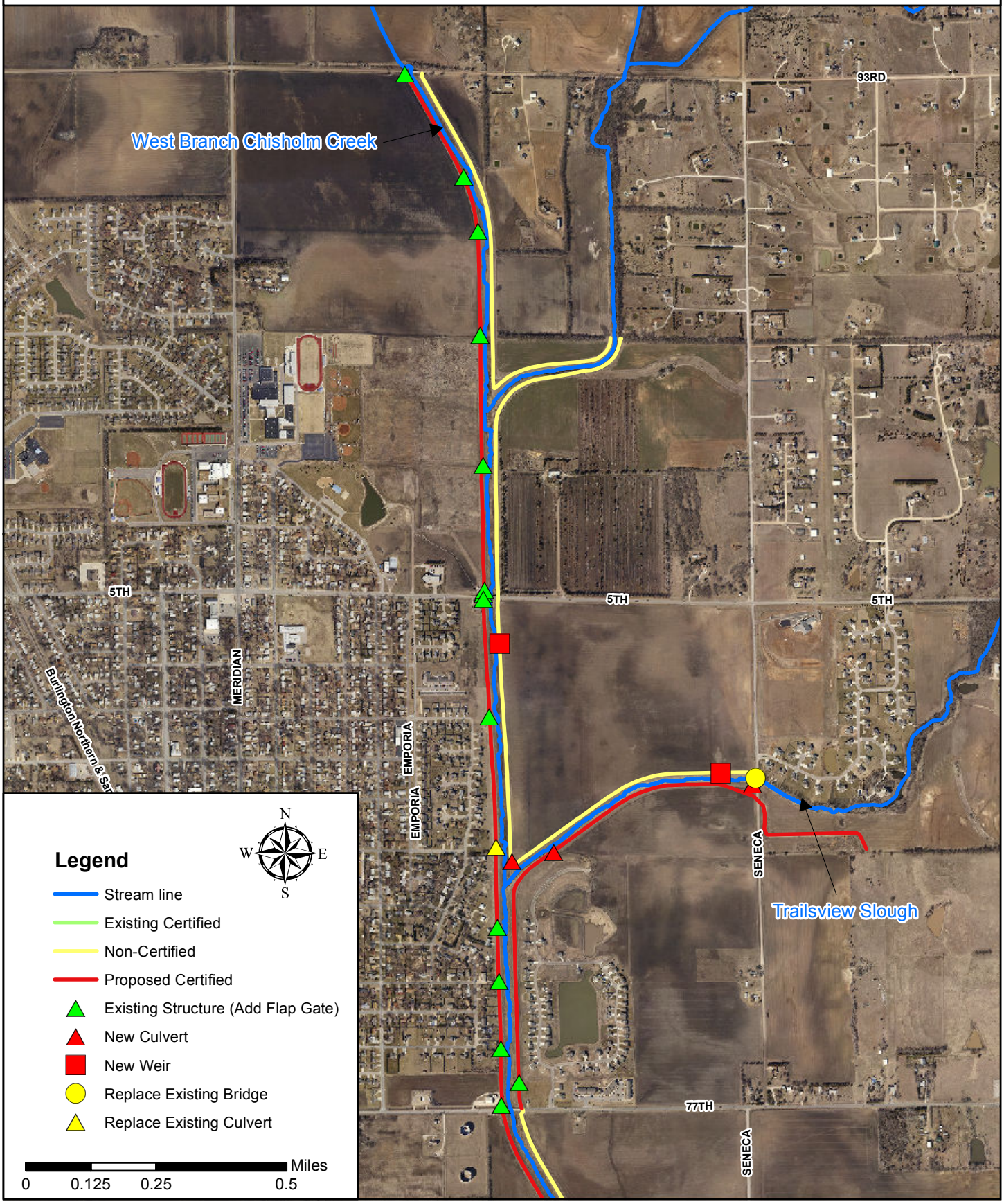
Table 4: Levee Improvements Conveyance Structures

Location of Improvement	Existing Structure	Recommended Improvement	Length (ft)
Left levee between 93rd and 85th Street	1 - 2' dia. CMP	Check / Add Flap Gate	34
Left levee between 93rd and 85th Street	1 - 2' dia. CMP	Check / Add Flap Gate	53
Left levee between 93rd and 85th Street	1 - 2' dia. CMP	Check / Add Flap Gate	34
Left levee between 93rd and 85th Street	1 - 2' dia. CMP	Check / Add Flap Gate	34
Left levee between 93rd and 85th Street	1 - 2' dia. CMP	Check / Add Flap Gate	36
Left levee between 93rd and 85th Street	1 - 3' dia. RCP	Check / Add Flap Gate	36
Left levee between 85th and 77th Street	1 - 4' dia. CMP	Check / Add Flap Gate	35
Left levee between 85th and 77th Street	2 - 4' dia. CMP	Check / Add Flap Gate	187
Left levee between 85th and 77th Street	1 - 3'X14' RCB	Check / Add Flap Gate	107
Left levee between 85th and 77th Street	1 - 3' dia. RCP	Check / Add Flap Gate	120
Left levee between 85th and 77th Street	1 - 2'X45' RCB	Check / Add Flap Gate	180
Left levee between 85th and 77th Street	1 - 8'X8' RCB	Check / Add Flap Gate	134
Left levee between 77th and 61st Street	1 - 3' dia. CMP	Check / Add Flap Gate	43
Left levee between 77th and 61st Street	1 - 35' dia. CMP	Check / Add Flap Gate	110
Right levee just upstream of 61st Street	1 - 4'X2' RCB	Check / Add Flap Gate	392
Left levee between 93rd and 85th Street	1 - 4' dia. RCP	Check / Add Flap Gate	115

Table 4: Levee Improvements Conveyance Structures (continued)			
Location of Improvement	Existing Structure	Recommended Improvement	Length (ft)
Left levee between 77th and 61st Street	N/a	Close Levee Gap - 1 - 4' dia. CMP (50' length)	50
Left levee between 77th and 61st Street	N/a	Close Levee Gap - 1 - 4' dia. CMP (50' length)	50
Left levee between 77th and 61st Street	N/a	Close Levee Gap - 1 - 4' dia. CMP (50' length)	50
Left levee between 77th and 61st Street	N/a	Close Levee Gap - 1 - 4' dia. CMP (50' length)	50
Left levee between 77th and 61st Street	N/a	Close Levee Gap - 1 - 4' dia. CMP (50' length)	50
Left levee between 77th and 61st Street	N/a	Close Levee Gap - 1 - 4' dia. CMP (50' length)	50
Right levee between 77th and 61st Street	N/a	Close Levee Gap - 1 - 4' dia. CMP (50' length)	50
Right levee along Trailsview Slough upstream of 77th Street	N/a	Close Levee Gap - 1 - 4' dia. CMP (50' length)	50
Right levee upstream of 61st Street	N/a	Close Levee Gap - 1 - 4' dia. CMP (50' length)	50
Right levee along Trailsview Slough just downstream of Seneca Street	N/a	Close Levee Gap - 1 - 4' dia. CMP (50' length)	50
Just upstream of right levee tie-back upstream of 61st Street	20' bottom width 1:3 side slopes	Remove Culvert and create channel	60
77th Street Bridge over West Branch Chisholm Creek	77th Street Bridge	Retrofit existing structure for levee certification freeboard compliance Add upstream and downstream floodwalls and tie into levees	n/a
85th Street Bridge over West Branch Chisholm Creek	85th Street Bridge	Retrofit existing structure for levee certification freeboard compliance Add upstream and downstream floodwalls and tie into levees	n/a

West Branch Chisholm Creek

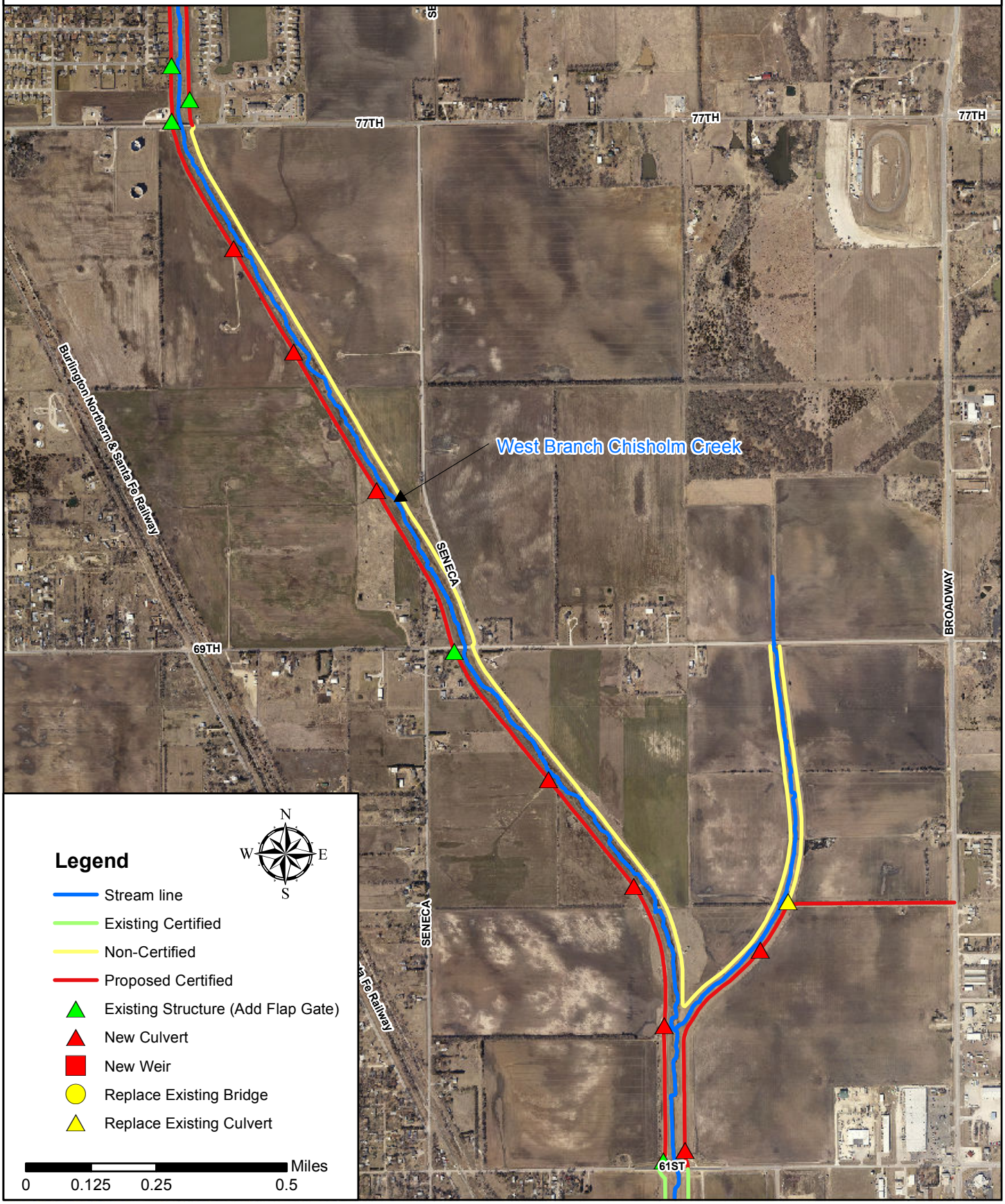
Proposed Levee Improvements (Upper Reach)



Map E

West Branch Chisholm Creek

Proposed Levee Improvements (Lower Reach)



Map F

Ponding areas would exist adjacent to the levee system on the existing ground. The configuration of these ponding areas would need to be identified as part of the design process. If future development were then to occur in or around these ponding areas, compensating storage would be extremely important.

SENECA BRIDGE REPLACEMENT

In addition to the conveyance structures along the levee system it is also recommended that the Seneca Bridge along Trailsview Slough be replaced in order to provide sufficient conveyance capacity to minimize levee improvements while ensuring that there are not adverse impacts to properties directly adjacent to the channel. The proposed structure would span Trailsview Slough and be elevated to ensure that FEMA 65.10 levee requirements are met. In addition to the new bridge, minor adjustments to the channel would be made to stabilize stream banks and improve conveyance through the new structure.

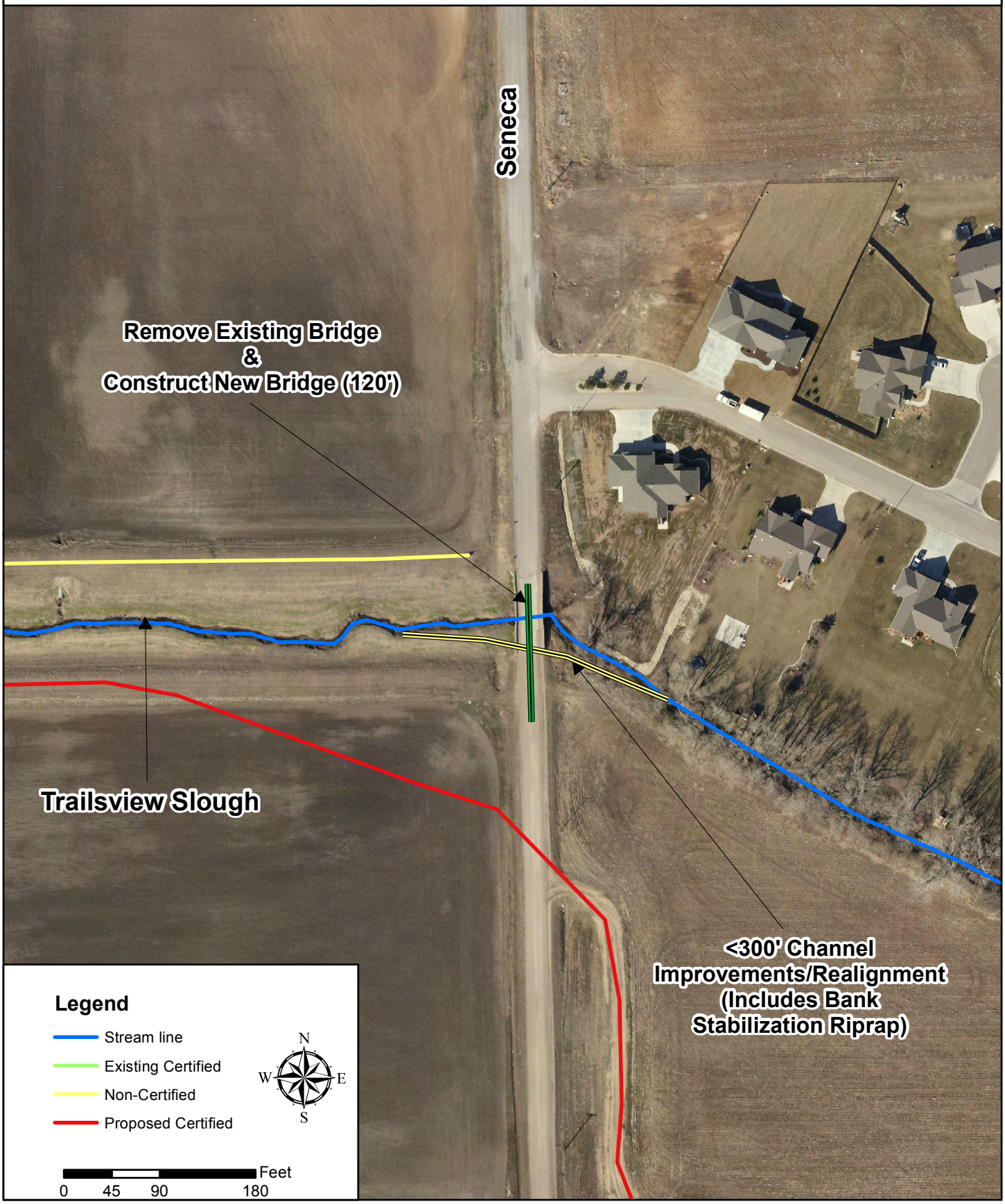
Table 5: Seneca Bridge Improvements

Location of Improvement	Existing Structure	Recommended Improvement	Approx Length
Seneca and Trailsview Slough	Seneca Bridge	New Bridge 57' x 120'	n/a
Seneca and Trailsview Slough	Existing Channel	Channel improvements including realignment and embankment stabilization	300 feet

The following figure provides a representation of the Seneca Bridge Replacement improvements.

West Branch Chisholm Creek

Seneca Bridge Replacement



Map G

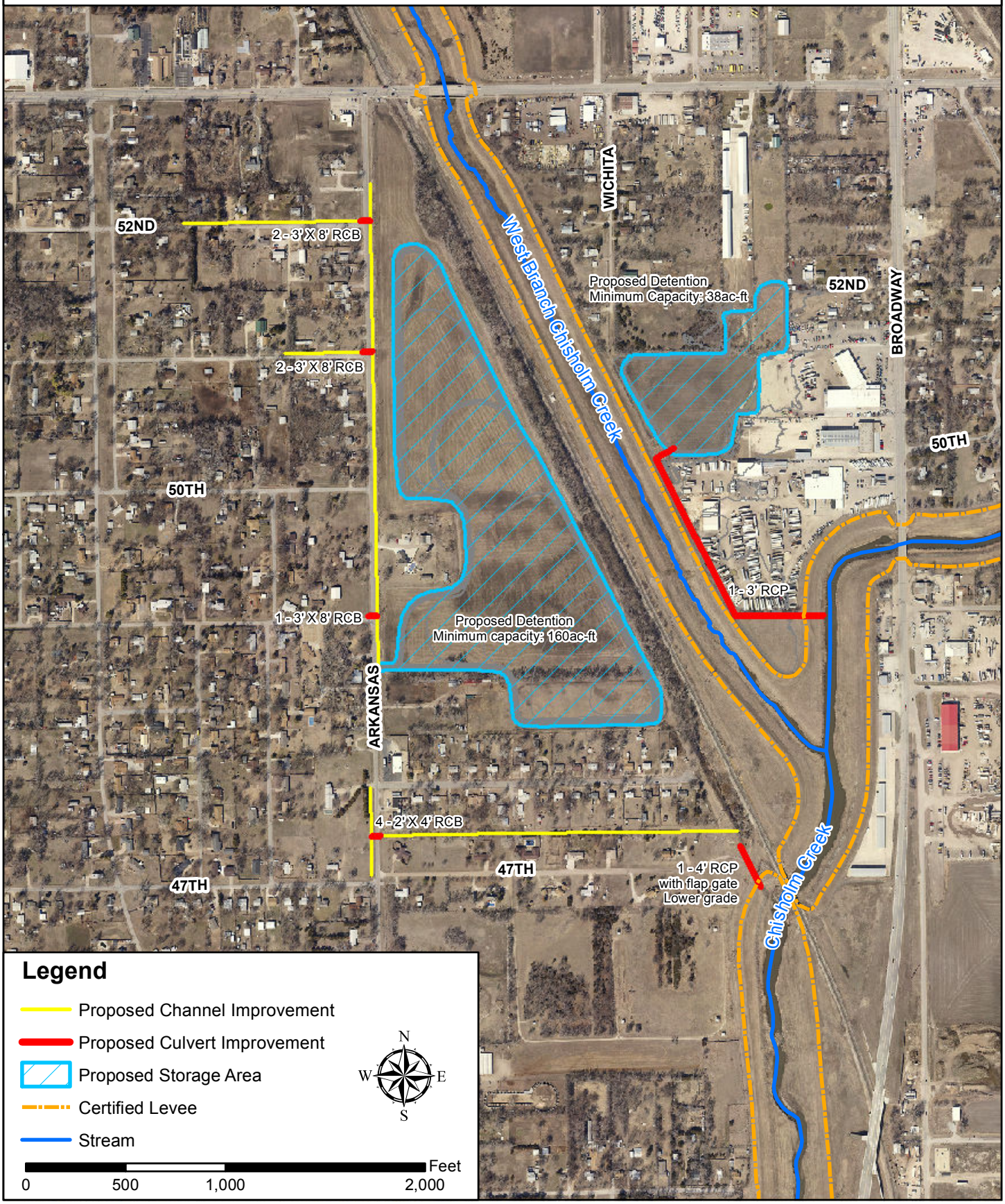
Special Levee Conveyance Structure Considerations

Several existing conveyance structures are associated with interior stormwater systems of the City of Valley Center. In some instances these systems may not carry the 100-year design storm causing water to pond in urban interior areas. At this time AMEC recommends that flap gates and control measures are implemented to prevent backwater affects in the urban areas as a result of floods along West Branch Chisholm Creek. Once completed, an urban drainage study should be completed geared specifically toward further reducing localized flooding issues, which could then be implemented to address localized issues.

The following figure provides a comparison of the 1% annual chance floodplain without and with the proposed improvements along and adjacent to the levee system upstream of 61st Street.

West Branch Chisholm Creek

Interior Drainage Proposed Improvement



Map H

CERTIFIED LEVEE REACH (DOWNSTREAM OF 61ST ST NORTH) – INTERIOR STORAGE IMPROVEMENTS

The approach for developing improvements in this location was to provide additional storage behind the levee and allow for controlled discharge without increasing flows or water surface elevations. Two primary areas were identified to have significant flooding effects during major flooding events in which improvements are recommended.

IDA WEST IMPROVEMENTS

This proposed improvement is located west of West Branch Chisholm Creek between 45th Street North and 53rd Street North. In this location, several houses are subject to flooding conditions during the 1% chance exceedance event, as well as a significant street flooding.

The recommended improvements include the excavation of a dry bottom detention facility just west of the existing right bank levee of West Branch Chisholm Creek. This detention facility would encompass approximately 364 acres providing a minimum of approximately 160 acre feet of storage.

Due to the elevations necessary to provide sufficient benefit, a new conveyance structure is recommended adjacent to the existing double 48-inch penetration through the right levee of Chisholm Creek, approximately 800 feet downstream of the confluence of West Branch Chisholm Creek, but placed at a lower grade to support positive existing flow.

AMEC also recommends that additional conveyance improvements are made at various locations that contribute to the detention area. As shown in Table 6, 7, and 8; AMEC proposes to add 3 new structures, modify 2 additional structures, perform open channel improvements, and construction of a detention area.

Table 6: West Interior Drainage Structure Improvements*

Structure Location	Structure Description	Length (ft)	Previous Structure
Levee Control Structure 1171+75M	1 - 4' RCP with flap gate; Lower grade than existing control structure	235	Adjacent 2 - 4' RCP
Arkansas Ave & W 52nd St N	2 - 3' X 8' RCB	50	None
Arkansas Ave & W 51st St N	2 - 3' X 8' RCB	50	None
Arkansas Ave & W 49th St N	1 - 3' X 8' RCB	45	None
North of Arkansas Ave & W 47th St N	4 - 2' X 4' RCB	50	2 - 2' X 7' RCB

*Improved channels throughout site, totaling approximately 6,000 feet in length, are not represented in this table

Table 7: West Interior Drainage Channel Improvements

Channel Location	Improvement Description	Length (ft)
Along east side of Arkansas Ave, north section	Regraded trapezoidal channel - top width of 28ft and 3:1 side slopes	1,217
Along east side of Arkansas Ave, middle section	Regraded trapezoidal channel - top width of 28ft and 3:1 side slopes	548

Table 7: West Interior Drainage Channel Improvements (continued)		
Channel Location	**Improvement Description**	**Length (ft)**
Along east side of Arkansas Ave, south section	Regraded trapezoidal channel - top width of 28ft and 3:1 side slopes	903
Along channel north of W 47th St N, west section	Regraded trapezoidal channel - top width of 30ft and 3:1 side slopes	634
Along channel north of W 47th St N, middle section	Regraded trapezoidal channel - top width of 30ft and 3:1 side slopes	167
Along channel north of W 47th St N, middle section	Regraded trapezoidal channel - top width of 30ft and 3:1 side slopes	804
Along channel north of W 47th St N, east section	Regraded trapezoidal channel - top width of 30ft and 3:1 side slopes	188
Along north side of W 52nd St N, to Arkansas Ave	Regraded trapezoidal channel - top width of 15ft and 3:1 side slopes	890
Along north side of W 51st St N, to Arkansas Ave	Regraded trapezoidal channel - top width of 25ft and 2:1 side slopes	390
Along west side of Arkansas Ave, to W 47th St N	Regraded trapezoidal channel - top width of 20ft and 25:1 side slopes	440

Table 8: West Interior Drainage Proposed Detention Area				
Detention Area	**Outlet Structure**	**Minimum Capacity (ac-ft)**	**Total Proposed Area (ac)**	**Estimated Cut Volume (ac-ft)**
West Detention	Open Channel	160	364	205

The benefits from this installation can be realized by the reduction of flooding that occurs within the immediate vicinity of the detention pond, primarily in the areas around 47th St North and 48th St North (Northern Acres and Riverview Gardens). Another significant benefit of the construction of this detention facility is that there is sufficient storage provided to limit the overflow of runoff from the north into the low lying residential area bound by 45th Street North, Arkansas Ave, and Chisholm Creek (Ark Valley Park Add, Suburban Acres, and JB Muller Add). Under existing conditions, a significant portion of this area would be impacted by the 1% chance exceedance event. However, with the proposed improvements, virtually all the interior ponding would be mitigated.

IDA EAST IMPROVEMENTS

This proposed improvement is located immediately north of the confluence of West Branch Chisholm Creek with Chisholm Creek. The calculated existing 100-yr floodplain primarily affects Northcutt Trailer Sales, Cummings Central Power, Wichita Kenworth to the west of Broadway (US 81 Highway), Broadway Heights Addition along the east side of Broadway, as well as Arcadian Acres to the northwest.

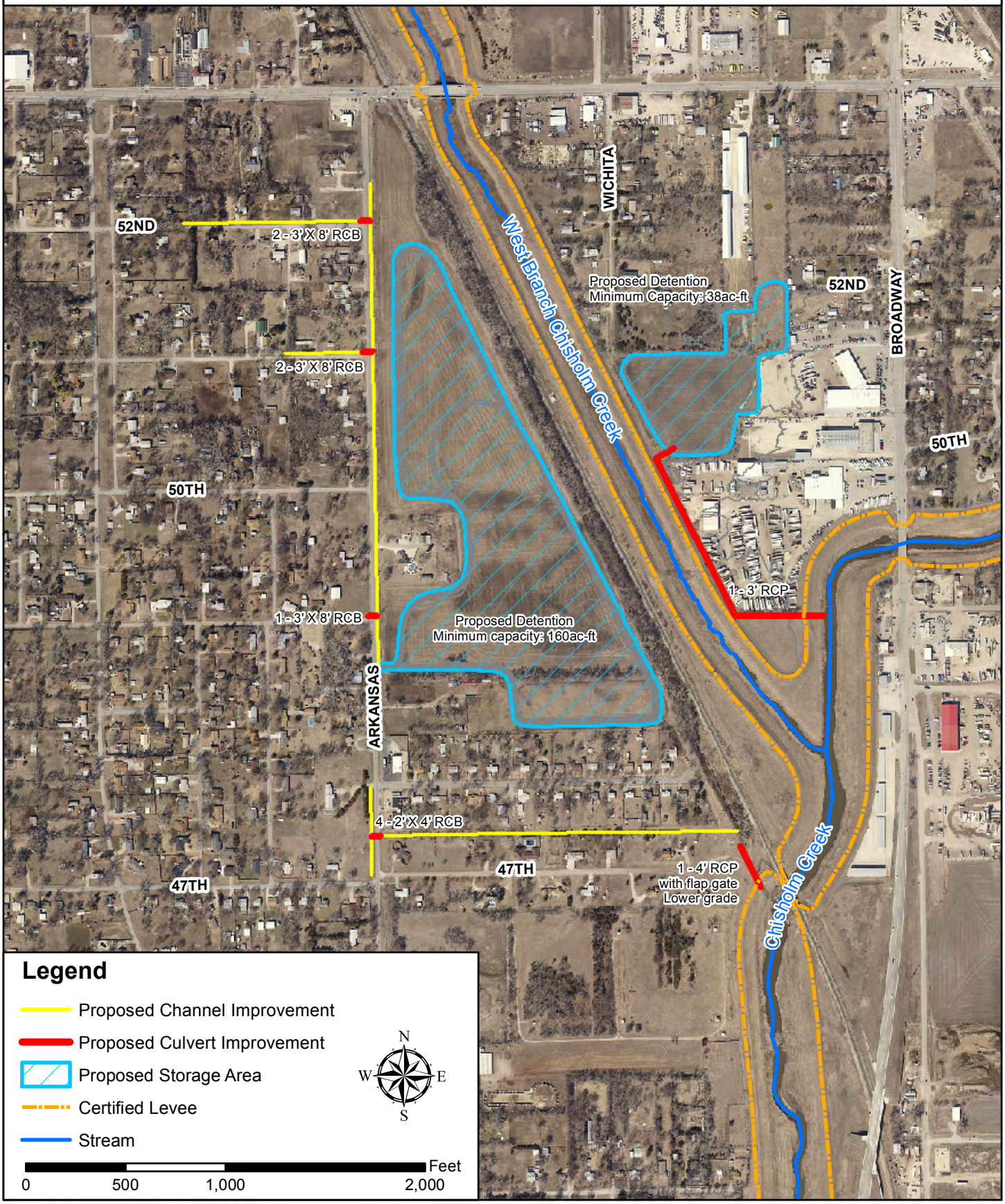
The proposed improvements are to increase the available storage in the basin to allow for relief to the affected properties. The recommendation in this vicinity is to excavate a dry bottom detention facility covering approximately 85 acres and providing nearly 43 ac-ft of storage in the open space behind the three industrial properties west of Broadway. In order to provide sufficient storage without introducing a pumping system, a 36-inch pipe would need to be installed from the pond southeasterly paralleling the left levee of the West Branch Chisholm Creek and then easterly where a new penetration through the right levee of the Chisholm Creek would be constructed. This alignment utilizes the grade differential between the two creeks and allows for the pond to be constructed deeper than if the discharge point was made directly into the West Branch Chisholm Creek.

By providing the detention facility the storage volume is provided in a controlled location and alleviates the flooding from the residential areas within Arcadian Acres as well as reclaims the majority of the currently utilized portions of the industrial businesses along Broadway. Although there is an indication that flooding could be reduced in the Broadway Heights Addition, it appears that it will not provide sufficient reduction to remove any of the structures from the 100-year floodplain.

The following figures depict the proposed improvements to both IDA areas as well as the estimated 100-year floodplain benefits should the proposed improvements be constructed.

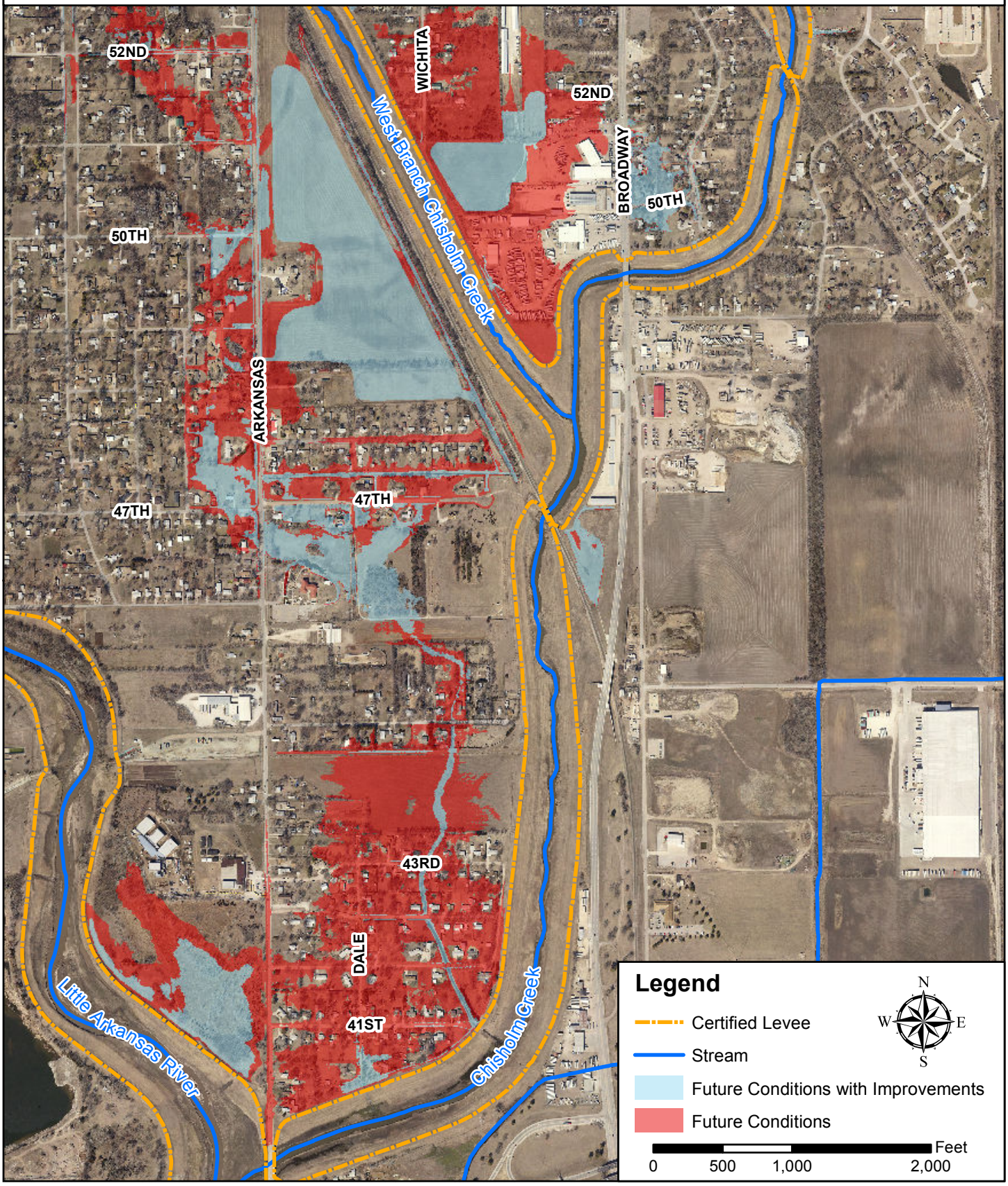
West Branch Chisholm Creek

Interior Drainage Proposed Improvement



Map I

West Branch Chisholm Creek
Interior Drainage100-year Floodplains
Future Conditions, with and without Improvements



Map J

Operation & Maintenance Considerations

There are operation and maintenance needs associated with existing and future systems. Although primarily mitigated through automatic operation measures, existing and recommended detention facilities will require operational and maintenance plans, and periodic maintenance. The recommended detention facilities are proposed to be dry and therefore mowing and growth maintenance will be necessary. Monitoring and excavation of sedimentation may be necessary after large events in dry detention areas should significant sedimentation affect the effective storage capacity. Operation and maintenance plans will also be a requirement of the improved levee system. The O&M plans and requirements will be similar to the Wichita-Valley Center levee system O&M requirements. Operations and Maintenance cost for these improvements have not been developed as part of this plan.

Planning Level Improvement Costs

AMEC has developed planning level cost estimates for the recommended improvements. In general, unit costs were derived from recent KDOT bid tabs for various structure, excavation, and fill activities. The costs assume a 20% contingency and a 15% design and project cost fee on top of the estimated construction costs. These costs may vary during the design phase but will provide a financial planning tool should it be determined to proceed with the improvements. Table 9 below summarizes the costs of the recommended improvements. Exhibit K provides a more detailed summary of the cost estimates and how they were developed. These improvements can be completed in several phases while avoiding adverse downstream impacts Prerequisite projects are listed below in the Table.

Table 9: Order of Magnitude Improvement Cost Summary

Activity ID	Improvement	Prerequisite Activities	Order of Magnitude Cost
1	Dry Detention Facility #1 (At confluence of West Branch Chisholm Creek & Trailsview Slough)	None	$12,843,886
2	Dry Detention Facility #2 (Inline along Trailsview Slough)	None	$915,273
3	Levee Improvements (Upstream of 61st Street)	1 & 2	$2,234,029
4	Seneca Road Bridge Replacement	3	$2,410,813
5	IDA West Improvements	None	$5,414,156
6	IDA East Improvements	None	$1,349,077
		Total	**$25,167,235**

SUMMARY

On May 19, 2015, an Open House was held in Valley Center Kansas to discuss the proposed projects and get feedback from the communities on the projects and project needs. The open house was promoted by several forms of public outreach both from Sedgwick County and Valley Center. One week prior, an Open House was held in Valley Center to show the new preliminary FEMA maps and the areas that would be impacted by the new floodplains. The FEMA Map Open House was well attended with approximately 150 people in attendance, and the Open House for the West Branch Chisholm Creek watershed was promoted at that FEMA Map Open House, as potential solutions to the 1% chance flooding mapped as part of the FEMA mapping update project.

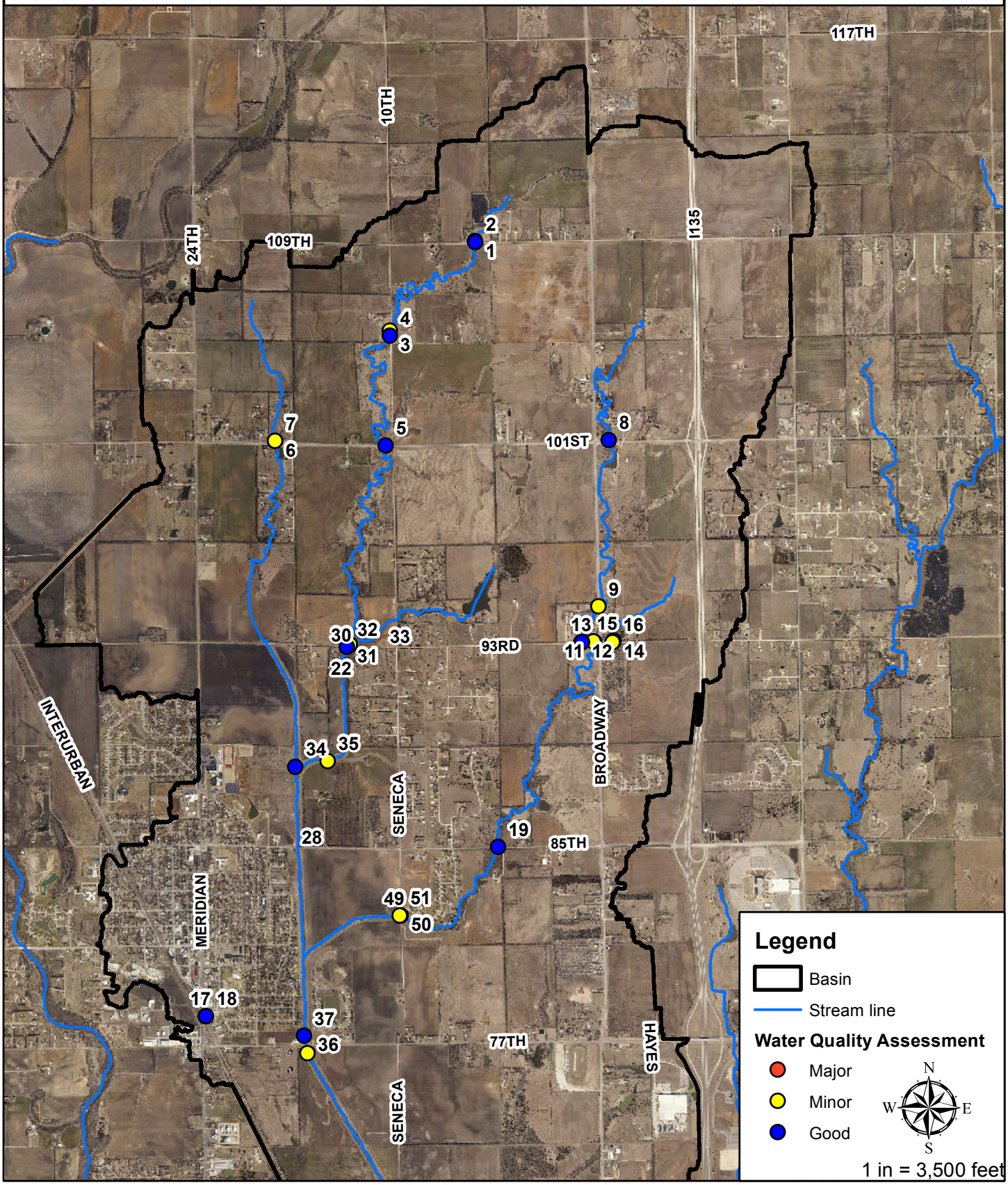
The West Branch Chisholm Creek attendance was 11 people, along with staff from Sedgwick County, Valley Center, and Amec Foster Wheeler. The majority of the people there were land owners near the proposed projects, mostly interested in how the projects would impact their land. A simple survey was also developed and submitted to the public, and there were only three responses to the survey. Therefore, not much was learned from the open house or from the survey, other than the project did not generate a significant amount of public interest.

Upon completion of this watershed assessment it is apparent that flood risks to residential structures and property are primary concern for this watershed, especially as expansion continues into floodplain storage areas reducing the overall storage of the watershed. However, at this time there does not appear to be a significant amount of community or public interest in the project. AMEC has provided several recommended improvements for consideration including continuing compensatory storage requirements, and proposing key dry detention areas and levee improvement activities. Design and construction of these improvements will help to reduce flood risk to life and property throughout the watershed. To support planning activities, AMEC has developed budget level cost estimates for the recommended improvements.

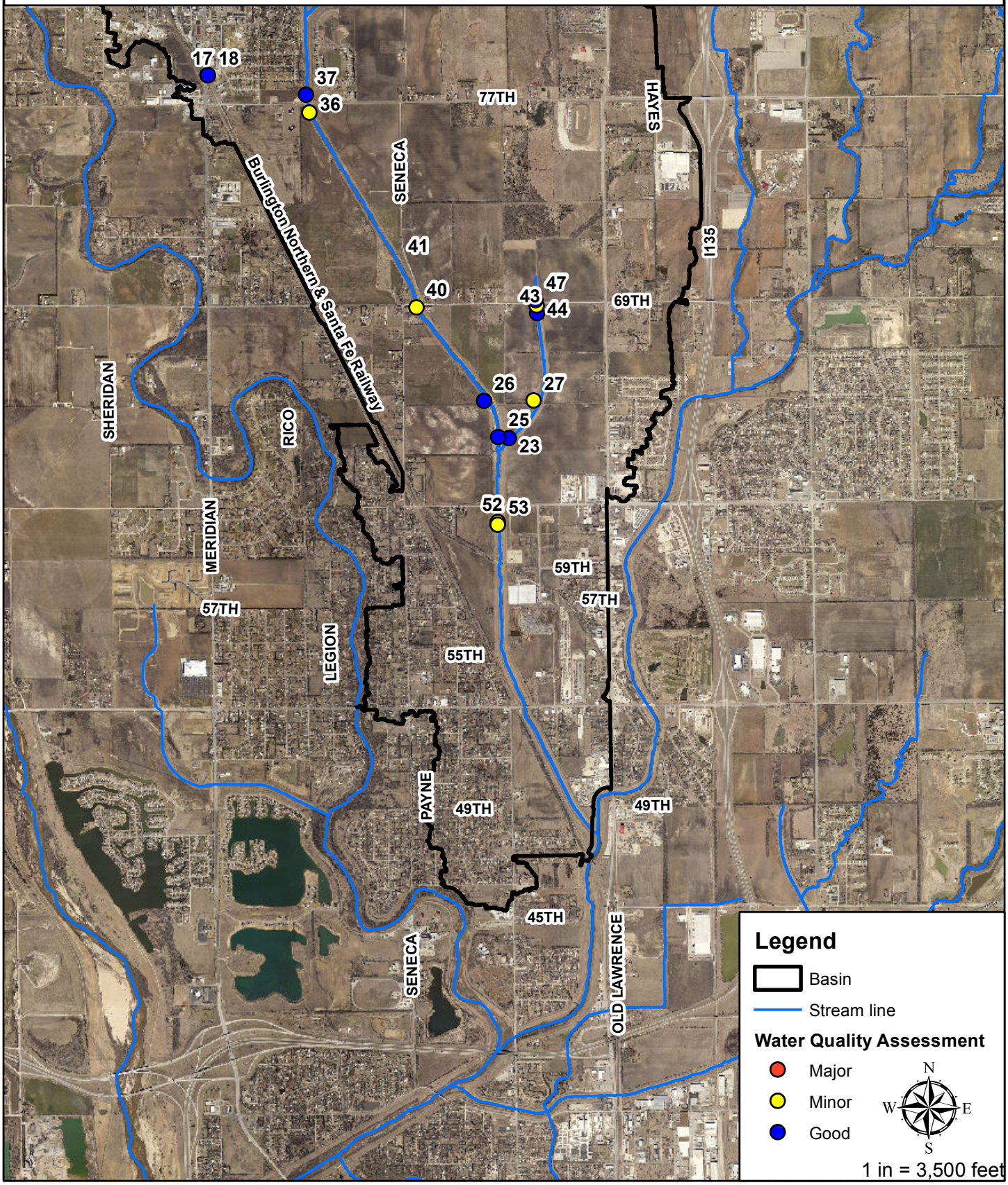
While water quality is always a concern for urban and rural watersheds in Kansas, only minor sedimentation issues were noted in AMEC's assessment of the West Branch Chisholm, and no major capital improvement type projects are recommended at this time. We recommend that the county continue to implement their BMP's under their Phase 2 Stormwater Permit.

Appendix A
Water Quality Assessment Points & Photos

West Branch Chisholm Creek
Water Quality Assessment



West Branch Chisholm Creek
Water Quality Assessment



Water Quality Assessment – Points/Notes/Photos			
Point ID	Photo ID	Notes	Assessment Grade
1	IMG_0001	US Picture - stable with minor debris	Good
2	IMG_0002	DS Picture - stable	Good
3	IMG_0003	Stream along embankment - emb protection applied	Minor
4	IMG_0004	US & DS stable and clean	Good
5	IMG_0005	US & DS stable and clean	Good
6	IMG_0006	US & DS stable and minor rock debris	Minor
7	IMG_0007	Asphalt in US channel	Minor
8	IMG_0008	US & DS stable - some debris in fence	Good
9	IMG_0009	US & DS stable - some debris and exposed banks	Minor
10	IMG_0010	Sediment in US opening - stable	Minor
11	IMG_0011	Culverts have sediment/veg in opening	Minor
12	IMG_0012	Sediment in opening of culvert	Minor
13	IMG_0013	Channel next to road - stable	Good
14	IMG_0014	Erosion, debris, and sedimentation US	Minor
15	IMG_0015	Debris in opening	Minor
16	IMG_0016	DS of opening is clean - minimal cover	Minor
17	IMG_0017	Urban channel - stable and clean	Good
18	IMG_0018	Urban channel - stable and clean	Good
19	IMG_0019	US and Ds is stable	Good
20	IMG_0020	Buffer strip in field - minimal cover	Minor
21	IMG_0021	Highly erodible field - no terraces	Minor
22	IMG_0022	Highly erodible field - no terraces	Minor
23	DSC00014	Typical of channel segment	Good
25	DSC00015	Typical of West Branch Chisholm Creek Segment	Good
26	DSC00016	Possible wetland adjacent to levee	Good
27	DSC00013	Control Headcutting	Minor
28	DSC00024	85th Street Bridge	n/a
30	DSC00029	Upstream from 93rd St North	n/a
31	DSC00030	Downstream view from 93rd St North	Good
33	DSC00028	Viewing NW from 93rd St North	n/a
34	DSC00027	Viewing upstream in West Branch Chisholm Creek Typical conditions	Good
35	DSC00026	View of armored bend on West Branch Chisholm Creek Tributary No 2	Minor
36	DSC00019	Looking downstream Channel incised at this location	Minor
37	DSC00020	Looking upstream representative of typical conditions	Good
40	DSC00017	Minor scour at 69th St North Bridge	Minor
41	DSC00018	Two culvert crossing from east to west under Seneca Street	n/a
43	DSC00011	No erosion - Typical conditions	Good
44	DSC00010	Sediment accumulation at bridge	Minor
47	DSC00009	Upstream from 69th St North	Good
49	DSC00021	Looking upstream into Trails View Slough from Seneca Street Bridge	Good
51	DSC00023	Looking downstream into Trails View Slough from Seneca Street Bridge	Minor
52	DSC00032	View of channel just downstream of 53rd St North - minor bank erosion	Minor
53	DSC00033	Downstream view from just south of 53rd St North typical conditions	Minor

Point ID #1:

Point ID #2:

Point ID #3:

Point ID #4:

Point ID #5:

Point ID #6:

Point ID #7:

Point ID #8:

Point ID #9:

Point 10 #10:

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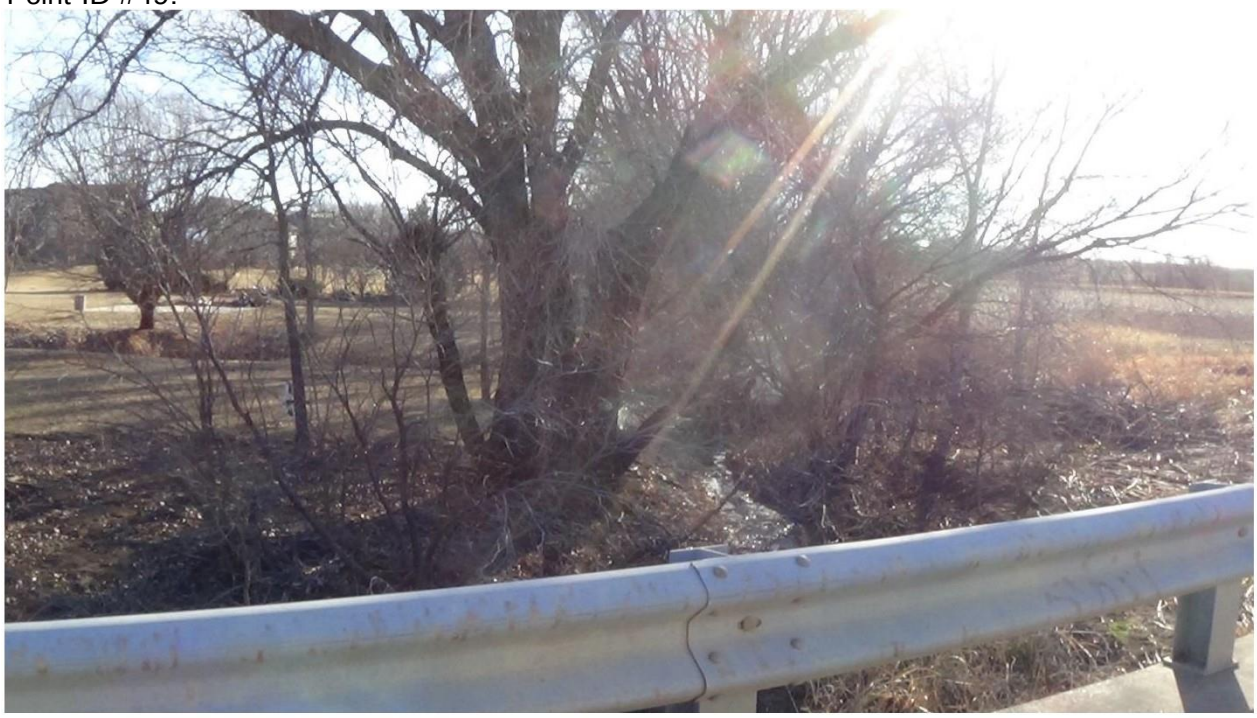

Point ID #51:

Point ID #52:

Point ID #53

Appendix B
Budget Level Cost Estimates

Regional Detention Facility #1				
Type	**Units**	**Unit Type**	**Unit Cost**	**Cost**
*New Structure 4'X4' RCB (100' length)	1	Per Structure	$41,550	$41,550
**New Weir Structure SE Weir 150' length 1:15 side slopes	1	Per Structure	$162,000	$162,000
**New Weir Structure NW Weir 160' length 1:15 side slopes	1	Per Structure	$178,880	$178,880
Earthen Fill	11000	cubic yards	$10	$110,000
Excavation	883945	cubic yards	$8	$7,071,560
Seeding	60	acres	$1,500	$90,000
Erosion Sediment Control	60	acres	$3,000	$180,000
Acquisition Estimate				$1,680,000
		Construction Cost		$9,513,990
		Contingency (20%)		$1,902,798
		Project Cost (15%)		$1,427,099
		Total		$12,843,887

*New structure improvement include cost of conduit and headwalls

**New weir structure includes cost of concrete, rebar, and bedding material

Inline Detention Facility #2				
Type	**Units**	**Unit Type**	**Unit Cost**	**Cost**
*New Structure 5'X8' RCB (120' length)	1	Per Structure	$85,940	$85,940
Earthen Fill	20054	cubic yards	$10	$200,540
Excavation	7500	cubic yards	$8	$60,000
Seeding	7	acres	$1,500	$10,500
Erosion Sediment Control	7	acres	$3,000	$21,000
Acquisition Estimate				$300,000
		Construction Cost		$677,980
		Contingency (20%)		$135,596
		Project Cost (15%)		$101,697
		Total		$915,273
*New structure improvement include cost of conduit and headwalls				

Levee Improvements				
Type	**Units**	**Unit Type**	**Unit Cost**	**Cost**
*Existing Structure 2' dia. CMP	1	Per Structure	$7,152	$7,152
*Existing Structure 2' dia. CMP	1	Per Structure	$7,152	$7,152
*Existing Structure 2' dia. CMP	1	Per Structure	$7,152	$7,152
*Existing Structure 2' dia. CMP	1	Per Structure	$7,152	$7,152
*Existing Structure 2' dia. CMP	1	Per Structure	$7,152	$7,152
*Existing Structure 3' dia. RCP	1	Per Structure	$9,724	$9,724
**New Structure 4' dia. CMP	1	Per Structure	$20,369	$20,369
*Existing Structure Double 4' dia. CMP	1	Per Structure	$23,539	$23,539
*Existing Structure 3'X14' RCB	1	Per Structure	$44,180	$44,180
*Existing Structure 3' dia. RCP	1	Per Structure	$10,342	$10,342
*Existing Structure 2'X45' RCB	1	Per Structure	$16,690	$16,690
*Existing Structure 8'X8' RCB	1	Per Structure	$45,846	$45,846
*Existing Structure 3' dia. CMP	1	Per Structure	$10,342	$10,342
*Existing Structure 35' dia. CMP	1	Per Structure	$11,677	$11,677
*Existing Structure 4'X2' RCB	1	Per Structure	$12,530	$12,530
**New Structure 4' dia. CMP	1	Per Structure	$43,513	$43,513
**New Structure 4' dia. CMP	1	Per Structure	$45,413	$45,413
**New Structure 4' dia. CMP	1	Per Structure	$47,313	$47,313
**New Structure 4' dia. CMP	1	Per Structure	$43,513	$43,513
**New Structure 4' dia. CMP	1	Per Structure	$43,513	$43,513
**New Structure 4' dia. CMP	1	Per Structure	$48,263	$48,263
**New Structure 4' dia. CMP	1	Per Structure	$46,363	$46,363
**New Structure 4' dia. CMP	1	Per Structure	$45,413	$45,413
**New Structure 4' dia. CMP	1	Per Structure	$43,513	$43,513
**New Structure 4' dia. CMP	1	Per Structure	$43,513	$43,513
Remove Culvert - Create Open Channel	1	Per Structure	$13,832	$13,832
Earthen Fill - Existing Levee Raise	32792	cubic yards	$10	$327,920
Earthen Fill - New Levee	19250	cubic yards	$10	$192,500
Seeding - New and Raised Levee	43	acres	$1,500	$64,500
Erosion Sediment Control	43	acres	$3,000	$129,000
Acquisition Estimate				$135,758
***77th and 5th Street Bridge Modifications	1	Both Bridges	$100,000	$100,000
		Construction Cost		$1,654,836
		Contingency (20%)		$330,967
		Project Cost (15%)		$248,225
		Total		$2,234,029
*Improvements to existing structures include extending conduit for levee modifications, flap gates, headwalls, and seeding				
**New structure improvement include cost of conduit, headwalls, flap gates, sluice, gates, fill, seeding, and erosion control				
***Cost estimated include some concrete work, earthen fill, and seeding to tie existing structure to modified levees				

Seneca Bridge Replacement				
Type	**Units**	**Unit Type**	**Unit Cost**	**Cost**
*New Bridge 57' x 120'	1	Per Structure	$1,573,200	$1,573,200
Earthen Fill	10000	cubic yards	$10	$100,000
Excavation - Channel Modification	400	cubic yards	$15	$6,000
Seeding	3	acres	$1,500	$4,500
Erosion Sediment Control	3	acres	$3,000	$9,000
Acquisition Estimate				$5,000
Rip-Rap - Along Channel & Embankment (300' at 27 ft3/ft)	5873	tons	$150	$88,088
		Construction Cost		$1,785,788
		Contingency (20%)		$357,158
		Project Cost (15%)		$267,868
		Total		$2,410,813
*$230 per square foot cost estimate to remove and construct new taken from DOT sources				

IDA West Improvements				
Type	**Units**	**Unit Type**	**Unit Cost**	**Cost**
New Levee CS 1171+75M 4' RCP with flap gate; Lower grade than existing control structure (235')	1	Per Structure	$88,585	$88,585
*Replace Structure - Arkansas Ave & W 52nd St N - Double 3' X 8' RCB (50')	1	Per Structure	$70,700	$70,700
*Replace Structure - Arkansas Ave & W51st St N - Double 3' X 8' RCB (50')	1	Per Structure	$70,700	$70,700
*Replace Structure - Arkansas Ave & W 49th St N - Single 3' X 8' RCB (45')	1	Per Structure	$63,570	$63,570
*New Structure - North of Arkansas Ave & W 47th St N - Quadruple 2' X 4' RCB (50')	1	Per Structure	$76,340	$76,340
**Ditch Modification (1217') - Along east side of Arkansas Ave, north section	1	Per Ditch Segment	$46,604	$46,604
**Ditch Modification (548') - Along east side of Arkansas Ave, middle section	1	Per Ditch Segment	$12,938	$12,938
**Ditch Modification (903') - Along east side of Arkansas Ave, south section	1	Per Ditch Segment	$31,904	$31,904
**Ditch Modification (634') - Along channel north of W 47th St N, west section	1	Per Ditch Segment	$18,068	$18,068
**Ditch Modification (167') - Along channel north of W 47th St N, middle section	1	Per Ditch Segment	$4,254	$4,254
**Ditch Modification (804') - Along channel north of W 47th St N, middle section	1	Per Ditch Segment	$24,542	$24,542
**Ditch Modification (188') - Along channel north of W 47th St N, east section	1	Per Ditch Segment	$8,556	$8,556
**Ditch Modification (890') - Along north side of W 52nd St N, to Arkansas Ave	1	Per Ditch Segment	$14,092	$14,092
**Ditch Modification (390') - Along north side of W 51st St N, to Arkansas Ave	1	Per Ditch Segment	$7,772	$7,772
**Ditch Modification (440') - Along west side of Arkansas Ave, to W 47th St N	1	Per Ditch Segment	$6,993	$6,993
Earthen Fill		cubic yards	$10	$0
Excavation - Detention	3307333	cubic yards	$8	$2,645,866
Seeding - Detention	364	acres	$1,500	$54,600
Erosion Sediment Control	364	acres	$1,000	$36,400
Acquisition Estimate				$728,000
		Construction Cost		$4,010,486
		Contingency (20%)		$802,097
		Project Cost (15%)		$601,573
		Total		$5,414,156
*New structure improvement include cost of conduit and headwalls				
**Ditch improvement includes excavation, seeding, and erosion control				

IDA East Improvements				
Type	**Units**	**Unit Type**	**Unit Cost**	**Cost**
*New Levee CS 3' RCP with flap gate (1440')	1	Per Structure	$234,348	$234,348
Earthen Fill		cubic yards	$10	$000
Excavation - Detention	722773	cubic yards	$8	$578,218
Seeding	83	acres	$1,500	$12,450
Erosion Sediment Control	83	acres	$1,000	$8,300
Acquisition Estimate				$166,000
		Construction Cost		$999,316
		Contingency (20%)		$199,863
		Project Cost (15%)		$149,897
		Total		$1,349,077

*New structure improvement include cost of conduit, headwalls, flap gates, sluice gate, fill, seeding, and erosion control