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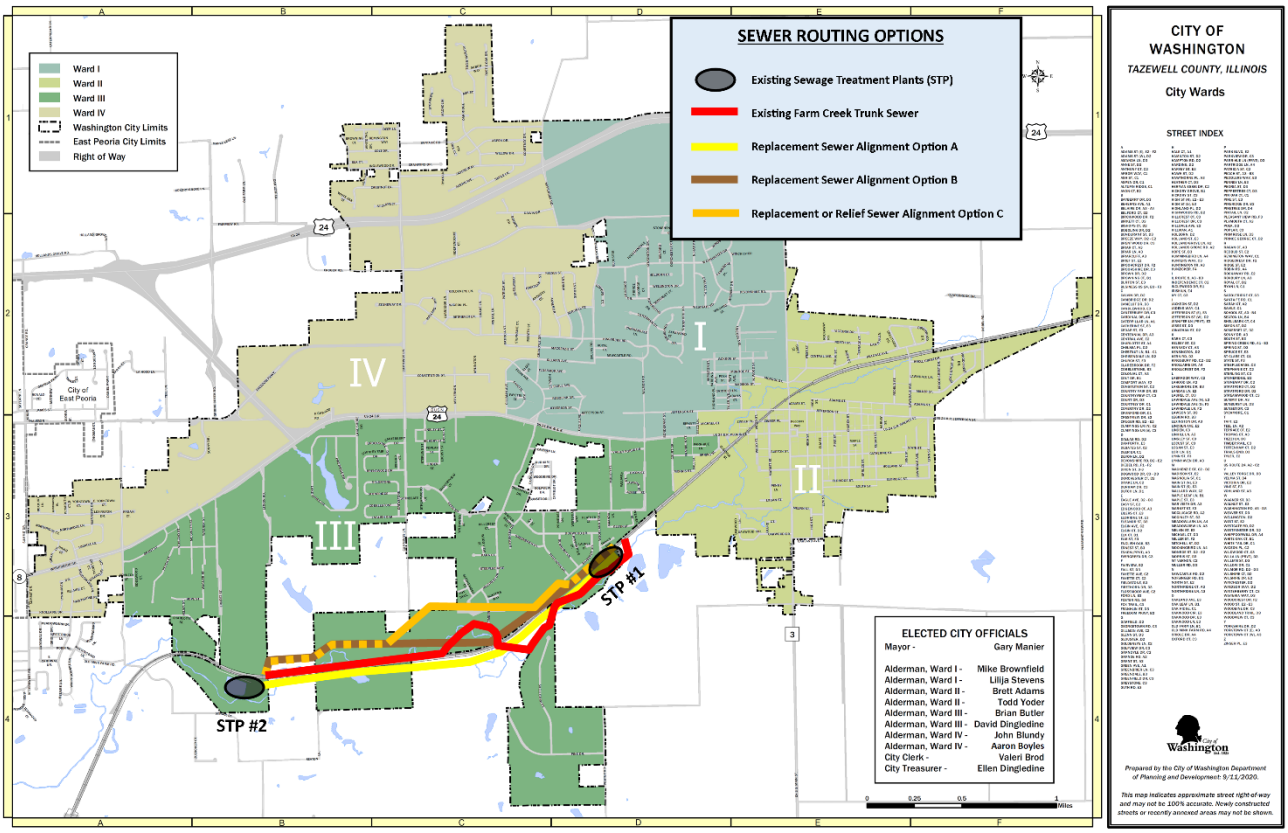
City of Washington, Illinois
Farm Creek Trunk Sewer
3rd Party Alignment Analysis
HCE Job# 21911

February 15, 2022



Prepared By: Howard J. Hamilton, P.E., CFM, CPESC
Hamilton Consulting Engineers, Inc.

Prepared For:
City of Washington, Illinois

HAMILTON CONSULTING ENGINEERS, INC.: IL LICENSE NO. 184-003205

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2.0 Executive Summary

Project Origin

The existing Farm Creek Trunk Sewer (FCTS) connects STP#1 and STP#2, but it does not have capacity for the peak flows that are generated in the east and northeast portions of the City due to excessive infiltration and inflow (I/I) from those areas. As a result, wastewater overflows manholes in two locations on the FCTS and there is no room for growth as the sewer lacks capacity. To resolve these issues, the City hired a consultant to design a new trunk sewer to allow abandonment of STP#1 and to move all raw wastewater to STP#2.

Progress to Date

The approach to date has been to abandon the existing trunk sewer and build a new sewer with the capacity to transport the peak flows to STP#2 with room in the sewer to allow build-out of limited portions of the City's Comprehensive Planning Area. Strand Associates, Inc. evaluated several alternatives and completed their design, Strand Alignment B, to the 90% level.

A separate design report was completed by Pudik Architecture, PC, which follows the same intent via many different routes. In August 2021, the City sought a qualified third party to review the project, evaluate the alternatives presented, and make recommendation to the City.

Altogether, dozens of alternatives have been put forward by Strand Associates and Pudik Architecture combined, and each alignment was thoroughly reviewed by HCE in the development of this report. While the original Request for Qualifications called for analysis of five (5) previously recognized alignments, the three following have been deemed the most cost-effective and feasible options already under consideration.

To these three alternatives, HCE added three options that are new and also analyzed a "No Build" option.

Analysis - Previously Recognized Options:

Each previously recognized option selected for additional analysis prioritizes different aspects of the project, whether cost, environmental impact, feasibility, or shovel-readiness.

For all previously recognized options:

- New easements are necessary for construction and maintenance.
- The existing Farm Creek Sewer would be decommissioned, requiring access and work along the sewer for proper abandonment, resulting in environmental impacts and restoration requirements.

The cost estimates for abandoning the existing FCTS exceeds the scope of this report.

- Each length of Sewer and each manhole must be evaluated individually to determine if:
  - it can be filled and abandoned in place or if it must be physically removed.
  - if there is existing adequate access for the recommended action or if easements must be obtained and access routes constructed for heavy equipment.
- For this report, the estimated cost for alternatives that require abandonment of the existing FCTS are noted with Footnote 1 to explain that there is an additional cost that has not been explored in detail.

Alternative A. Strand Alignment B:

- With plans at 90% completion and manhole locations staked for construction in the field, this project is the most shovel-ready. Pending easement acquisition, construction could begin in 2022.
- At approximately $8 million[1] construction cost, this option is the lowest in cost among the previously recognized options.
- The sewer alignment largely follows the south property line of the railroad.
- Immediate growth potential is the greatest for this alternative.
- This alignment limits accessibility.
- This alignment makes the greatest impact to existing wetlands and trees of all previously recognized alternatives, though mitigation and restoration will be completed and were included in the project plans and EOPCC.

Alternative B. Pudik Alignment L-1:

- Alignment L-1 is in the concept phase, though depths and locations have been further developed during this study. Surveys and design plans have not been initiated. Construction is unlikely to begin until 2023.
- At approximately $11 million[1] construction cost, this option is more costly than the selected Strand alternative.
- This sewer alignment largely follows the north property line of the railroad.
- This alignment to the north reduces growth potential south of Farm Creek.
- This alignment reduces the impact to existing wetlands and trees by staying north of the railroad. However, while in lesser degree, both trees and wetlands are still present along this alignment and the existing Farm Creek Trunk sewer will need to be accessed for proper abandonment, thereby reducing the environmental benefit.

[1] Exclusive of costs for abandoning the existing FCTS

Alternative C. Pudik Alignment E-3:

- Similar to Alternative B. Pudik Alignment L-1, this alignment is in the concept phase and construction is unlikely to begin until 2023.
- At approximately $12.6 million[1] construction cost, this option is the costliest of both previously recognized AND new alternatives. This high cost is due to the depth of construction and need for significant lengths of directional boring.
- The sewer alignment largely follows property lines further north of the railroad than Alternative B. Pudik Alignment L-1.
- This alignment restricts growth potential more than any other option, previously recognized or new.
- The alignment is in more upland areas, which increases depth and therefore cost, but further reduces the impact to existing wetlands and trees. However, the impact is not entirely removed, and the existing Farm Creek Trunk sewer will need to be accessed for proper abandonment.
- As the northernmost route, the sewer alignment runs through the Timber Rail development, including between houses, adding an impact to residences absent in other alternatives.

Preliminary Findings

Preliminary findings based on review of these three previously recognized options led HCE to further investigation.

In keeping the purpose of this project central to the engineering analysis, HCE considered other methods to allow the Farm Creek Trunk sewer to safely convey wastewater during peak flows and rain events.

This led to a review and analysis of the basic assumption made by both Strand and Pudik Architecture:

The key assumption made by Strand Associates and Pudik Architecture has been that the FCTS must be decommissioned, and a larger trunk sewer built because the initial assumption was that water from Farm Creek was infiltrating the sewer, resulting in the higher peak flows, supporting the decision to decommission and build a new sewer.

However:

- Review of flow monitoring and conclusions from the Strand report indicate that significant Infiltration and Inflow (I/I) is **not occurring along the FCTS, but upstream**
- Visual inspection of exposed sections of the FCTS and manholes indicates that it is in acceptable condition to remain in use.

The findings in this report suggest that a more thoughtful, long-term, and cost-effective approach is to reduce the excess I/I flows from upstream, thereby delaying construction of a new trunk sewer until growth and expansion creates the need for sewer service expansion.

By removing I/I:

- The sewer would no longer overflow.
- STP#2 would have lower operating costs.
- The existing trunk line would have capacity for additional growth.

Essentially, removing the I/I would remove the need for the project. This is the "No Build" option, or Alternative G. below.

That said:

- it is likely that a significant portion of I/I is generated on private property.
  - The identification and removal of these private sources takes time and resources.
  - An estimate of cost for the reduction in private source I/I cannot be determined until a Sanitary Sewer Evaluation Survey (SSES) is completed.
- During this process, overflows of the Farm Creek Trunk Sewer would continue.

Therefore, as further analyzed by HCE below, **Alternative G. No Build is not optimal and cannot be recommended due to continued overflows of the existing system.**

In addition to the three previously recognized alternatives and the "No Build" scenario, HCE identified three alternatives, D, E, and F that:

- Retain the Farm Creek Trunk Sewer with televising and repair as needed.
- Reduce environmental impacts by avoiding extensive new construction and decommission of the FCTS.
- Avoid lessening the growth potential associated with the new sewer alignments,
- Reduce overall project costs.
- Remove overflows from the FCTS, allowing time and resources to be spent developing an SSES and removing I/I from the system, aiding in long term costs and growth potential.

The three new options proposed by HCE are described below, and Option G, No Build option, is also included with the same review format for consistency.

Alternative D. Pump Station and Relief Sewer

- Inspect and make repairs to the FCTS as needed.[2]

[2] Exclusive of inspection and repair of the existing FCTS

- Construct a pump station and flow meter at STP#1 to bypass peak flows that would otherwise surcharge the system.
- Construct a 30" gravity sewer to STP#2 to receive flow from the new pump station via a new 12" forcemain.
- Environmental impacts are less as the 12" forcemain can be constructed at a shallow depth in a narrower trench and routed to avoid environmental resources, plus the FCTS does not need to be decommissioned.
- Estimated cost of $7.6 Million is less than any of the original options.
- Potential for growth is increased incrementally over time, as opposed to increased immediately or decreased in other options.
- Route is similar to Alternative C. Pudik Alignment E-3, and impacts residences.
- Pump station requires maintenance and associated costs to operate.

Alternative E. Relief Sewers

- Inspect and make repairs to the FCTS as needed. [2]
- Construct two 30" bypass sewers to remove flow from sewers and manholes where overflows occur.
- Removes all overflows from the FCTS.
- Estimated cost of $1.2 Million is lower than all other alternatives.
- Does not increase or decrease potential for growth.
- Has impact to residential properties, but less than Pudik Alignment E-3 or the Pump Station Relief Sewer.
- Does impact environmental resources, but the **least of all evaluated options**.

Alternative F. Sanitary Sewer Evaluation Surveys (SSES):

- Inspect and make repairs to the FCTS as needed. [2]
- Undertake a City-wide approach toward voluntary removal of private illicit connections.
- Identify and eliminate public illicit connections in a Basin-by-Basin approach.
- Identify and repair public sewer defects in a Basin-by-Basin approach.
- Provides for incremental growth as capacity is made available in both the sewers and STP#2.

Alternative G. No Build Option – summarized from the discussion above:

Note – this Alternative G is not recommended but is included as a baseline.

- Inspect and make repairs to the FCTS as needed. [2]

Recommendation

Should the City require a more immediate increase is sewage collection capacity and an immediate solution to periodic overflows of the Farm Creek Trunk Sewer, Strand's design, Alternative A. Strand Alignment B, is cost effective and ready-to-build as soon as easements and permits are acquired.

However, for the reasons outlined above and throughout this report, it is our opinion that the long-term and short-term interests of the City are best served by:

1. Completing Alternative E. Relief Sewers, which will eliminate overflows of the FCTS at the least cost, allowing time and resources to be devoted to solving the City's I/I flows.

2. Inspecting, repairing (if needed) and maintaining the existing FCTS to provide opportunity for future growth.

3. As funding allows, completing Alternative F. SSES, and removing sources of I/I into the system, thereby reducing excessive flows.

   Note that communication to the City's residents of required compliance with City Ordinances is critical to this work.

4. Regularly monitor flows at STP#2 to monitor changes in flow patterns.

The following Matrix of Alternatives is presented in Summary form here, but in detail in Appendix A.

Exhibit 2.1 Matrix of Alternatives (1=Best, 7=Worst)

ALTERNATIVE	DESCRIPTION		LOCATION	INCREASE IN AREAS SERVED?	DEPTH OF SEWER	EOPCC + ENGINEERING (NOT INCLUDING EASEMENT COSTS)	FUTURE COSTS - MAINTENANCE & OPERATION, ETC.	ENVIRONMENTAL IMPACTS	ANY RESIDENCES/RESIDENTS AFFECTED?	ACCESSIBILITY	CONSTRUCTABILITY	OVERALL RANKING OF ALTERNATIVES (NO WEIGHTING OF FACTORS)
A	STRAND ALIGNMENT B	BUILD NEW 42" GRAVITY REPLACEMENT SEWER AND ABANDON EXISTING FCTS	FOLLOWS SOUTH SIDE OF THE RR FROM MH 101/STP#1 TO NEW INFLUENT PUMP STATION AT STP#2	1	5	5	3	6	1	6	5	3.8
B	PUDIK ALIGNMENT L-1	BUILD NEW 42" GRAVITY REPLACEMENT SEWER AND ABANDON EXISTING FCTS	FOLLOWS NORTH SIDE OF RR FROM MH 101/STP#1 TO MH240/STP#2 - HCE MODIFIED TO MORE CLOSELY FOLLOW TOPOGRAPHY AND PROPERTY LINES	5	6	6	3	4	2	1	6	3.8
C	PUDIK ALIGNMENT E-3	BUILD NEW 42" GRAVITY REPLACEMENT SEWER AND ABANDON EXISTING FCTS	FOLLOWS EXISTING ROW LINES NORTH OF THE RR FROM MH 101/STP#1 TO MH 240/STP#2 - HCE MODIFIED TO MORE CLOSELY FOLLOW TOPOGRAPHY AND PROPERTY LINES	6	7	7	3	5	5	2	7	4.6
D	REFIEF SEWER/PUMP STATION	EVALUATION & REPAIR OF EXISTING FCTS AND PROVIDES A 16,200 GPM PUMP STATION AT STP#1 TO OFFLOAD FLOWS IN EXCESS OF THE CAPACITY OF THE EXISITNG SEWER, PUMPING THEM STO STP#2 WITH A NEW 12" FORCEMAIN AND A NEW 30" GRAVITY SEWER	EXISTING FCTS AND NEW ROUTE IS SIMILAR TO ALTERNATIVE C. PUDIK ALIGNMENT E-3	2	3	4	4	3	4	5	4	3.1
E	RELIEF SEWERS	EVALUATION & REPAIR OF EXISTING FCTS AND PROVIDE 30" RELIEF SEWERS BETWEEN MANHOLES 229/218 AND MANHOLES 244/237	EXISTING FCTS AND NEW STP#1 RELIEF SEWER IS ON STP#1 PROPERTY, NEW TIMBER RAILS RELIEF SEWER IS NORTH OF THE RR AND SOUTH OF FARM CREEK	4	4	3	3	2	3	4	3	2.7
F	SSES	EVALUATION & REPAIR OF EXISTING FCTS AND PERFORM A CITY-WIDE SANITARY SEWER EVALUATION SURVEY (SSES)	EXISTING FCTS AND SSES IS CITY-WIDE	3	2	2	1	1	6	3	2	2
G	NO BUILD	EVALUATION & REPAIR OF EXISTING FCTS	EXISTING FCTS	7	1	1	2	7	7	7	1	3.6

3.0 Background and Purpose

The City of Washington has been required by the Illinois Environmental Protection Agency (IEPA) to abandon STP#1 and divert all flow to STP#2. In October 2019, Strand Associates completed a report, entitled *Preliminary Engineering for the Farm Creek Trunk Sewer,* to:

1. *"Characterize the City's existing sanitary collection and conveyance system.*
2. *Perform flow monitoring to quantify dry weather and wet weather flows conditions from the collection system and in the trunk sewer.*
3. *Assess potential future development in the City that would be tributary to the trunk sewer.*
4. *Determine design flow capacity requirements for a new trunk sewer based on existing and projected future flow conditions.*
5. *Identify potential trunk sewer routes and improvements at STP#2 influent pumping station to meet the design flow requirements.*
6. *Develop a concept level opinion of probable construction cost (OPCC) for the identified alternatives.*[3]

The report concluded that the existing trunk sewer had inadequate capacity to handle the excess flows that were found to exist during wet weather events. Two replacement sewer routes were proposed. Alignment B was selected, and design was begun.

There is no direct route between STP#1 and STP#2 without passing through private properties and one of the advantages of Alignment B is that easements from only three property owners are required.[4] However, at least one of the property owners is unwilling to provide an easement and commissioned their own analysis to recommend an alternate route. The City wished to obtain an independent opinion to evaluate both Strand and the private owner's recommendations. Also, review of draft easement documents, including access easements, reveals that six separate property owners will be affected.

On November 4, 2021, Hamilton Consulting Engineers, Inc. entered into contract with the City of Washington to review Strand's recommendations, consider concepts developed by the property owners, and to determine if other alternative(s) were worthy of consideration. This report presents the results of that review and analysis.

[3] Strand Associates, *Report for City of Washington, Illinois-Preliminary Engineering Study for the Farm Creek Trunk Sewer* (October 2019), 1-1 to 1-2.

[4] Ibid, 3-9.

4.0 Prior Work

The City of Washington constructed STP#1 in 1950.[5] It was designed by Warren and Van Praag, Inc. of Decatur. In the ensuing 70 years there have been many expansions, improvements, sewer extensions, and the construction of and improvements to STP#2. However, for the purposes of this report only select projects and information that involve the Farm Creek Trunk Sewer and provide critical technical data are presented.

1971 *USEPA Water Pollution Control Grant WPC-ILL-980*
There were three divisions of work designed by Daily and Associates Engineers, Inc. in 1971 under the grant.

Division A, Revisions and Additions to Existing Treatment Plant and Interceptor System included STP#1 improvements and extension of the existing 21" VCP (vitrified clay pipe) via a flow division structure to allow a portion of the flow to bypass to the new STP#2. This project included 21" and 27" RCP (reinforced concrete pipe) and the construction of Manholes 238-244 (current City of Washington GIS identifiers) of the Farm Creek Trunk Sewer.

Division B, Interceptor Sewer 1F, Interceptor Sewer 2F, Interceptor Sewer 4F included the 30" and 36" RCP portions of the Farm Creek Trunk Sewer from MH 238 to STP#2 as projects 1F and 4F. This project included crossings of Farm Creek and manholes in the steep banks of the creek. However, a rigorous pipe design, concrete encasement of the sewer at creek crossings, concrete encasement of manholes when near the creek, and waterproof manhole lids were included in the design to mitigate and limit infiltration and inflow from the creek.

Division C was work at STP#2 and was not reviewed for this report.

1971-1972 Property and easements were acquired for the construction of the sewers.
Copies of the recorded documents are included in Appendix B. The recorded easements are metes and bounds descriptions and do not reference the final location of the constructed sewers or manholes.

2015? Austin Engineering, Co., Inc. prepares an unsigned, unsealed, undated plan.
view exhibit of the existing Farm Creek Trunk Sewer and recorded easements. The exhibit shows that much of the existing trunk sewer is located outside of the easements. Although not noted as copywritten, the document is not reproduced herein.

2015? Austin Engineering, Co., Inc. prepares an unsigned, unsealed, undated plan.
and profile design of a 36" Sanitite™ sewer and easements from MH 245 (current City of Washington GIS identifier) to STP#2 immediately adjacent the existing Farm Creek Trunk Sewer. Although not noted as copywritten, the document is not reproduced herein.

[5] History of Washington, Illinois Sesquicentennial 1825-1975, pages 8 and 66.

2016	Strand Associates is retained by the City of Washington for Phase I, II and III engineering services for the Farm Creek Trunk Sewer Replacement Project (Appendix C).
April 2020?	Property owners affected by the proposed project provide comments to the City and Strand reevaluates their prior recommendations.
6/3/2020	Strand prepares a *Draft Preliminary Engineering Design Supplement* (Appendix D) in response to the above referenced comments. They propose a route similar to Route B, but closer to the railroad than previous.
1/26/2021	The Pudik family submits a report entitled *Practicable Alternatives Analysis* by Pudik Architecture, PC (Appendix E). The report presents 23 different sewer alignments and discusses multiple concerns, many of which will be addressed by this report.
7/7/2021	Strand prepares *City of Washington Farm Creek Trunk Sewer Summary of Alternative Route Analyses July 7, 2021* (Appendix F) wherein the pros and cons of five separate sewer replacement routes are presented.
7/12/2021	Property owners present to the City of Washington Committee of the Whole a PowerPoint entitled *Farm Creek Trunk Sewer Replacement Project: Landowners' Concerns & Recommendations* (Appendix G).
8/12/2021	Washington issues "*City of Washington Notice of Request for Statements of Interest And Qualifications: Professional Engineering Services for the Completion of a 3rd Party Alternative Analysis for Farmdale Creek Trunk Sewer in Washington, Illinois, Tazewell County"* followed by Addendum 1 (Appendix H).
11/4/2021	The City of Washington enters into contract with Hamilton Consulting Engineers, Inc. (HCE) to "*perform a highly transparent 3rd party alternative analysis for the Farm Creek Trunkline Sanitary Sewer in Washington, Illinois, providing assistance in analyzing five alternative alignments and giving a recommendation presentation to the City Council*."
12/14/2021	HCE presents initial findings to City Staff, conducts an introductory meeting with a group of residents, and leads two groups of residents, staff and an elected official along the northern route (Alternative B. Pudik Alignment L-1 and Alternative C. Pudik Alignment E-3) and southern route (Alternative A. Strand Alignment B) alignments.
1/18/2022	Website and Community Questionnaire go live at www.farmcreeksewerproject.com.
2/28/2022	Community Questionnaire is scheduled to close.

5.0 Process - Hamilton Consulting Engineers, Inc. (HCE) is following a 10-step process to develop this report.

1. Data Collection - completed
    a. Obtain and review Strand Data
    b. Develop Routes using County GIS/LIDAR mapping
    c. Calculate I/I contribution from FCTS
2. Interview City Staff, completed 12/14/2020
    a. Site meeting
    b. Memo
3. Interview property owners, completed 12/14/2020
    a. Meeting
    b. Walk Route
    c. Memo

3a. Community Survey and Website
    a. Question development, 1/18/2022
    b. Survey Development and Posting, 1/18/2022
    c. Capture Results – Questionnaire will close 2/28/2022
    d. Report to City
    e. Website Development and Monthly Updates

4. Existing Sewer Evaluation
    a. Bid documents for TV Inspection
    b. Review videos
    c. Recommendation Memo
    d. Bid documents for telegrouting (or sliplining), MH Repair
5. Draft Report, completed 2/15/2022
    a. Report
    b. Exhibits
6. Report Revisions
7. Public Hearing
    a. Exhibits
    b. Stenographer
    c. Hearing
    d. Disposition of Comments
    e. PW meeting to discuss comments
8. Final Draft
9. Presentation to Council
    a. PowerPoint
    b. Council Meeting
10. Final Report

6.0 Existing Conditions

The existing Farm Creek Trunk Sewer was designed in 1971 as detailed in Section 4.0 of this report. Review of Strand's flow data[6] reveals that the FTC sewer is subjected to wet weather peak flows above its capacity, but that these excess flows originate not from I/I into the FCTS itself (from Farm Creek), but from upstream sewers tributary to the Trunk Sewer. Hamilton has reviewed this conclusion and agrees with Strand's finding.

6.1 Flow Conditions

The first recommendation of the Strand report is:

> "*A. Excess Flow Removal Program*
> *The City currently experiences excess wet weather flow conditions in its sewer system that potentially exceed the capacity of the local sewers, the Farm Creek Trunk Sewer, and the influent pumping station at STP# 2. The City should perform a sanitary sewer evaluation study (SSES) to identify the sources I/I contributing excess flow to the system. Common sources of I/I include manhole defects, manhole flooding, pipe defects, and storm sewer cross connections. However, I/I can also come from private sources such as connected downspouts, foundation drains, and sump pumps from homes and businesses.*
>
> *An SSES study would prioritize areas of the City exhibiting the highest levels of excess flow and endeavor to identify potential sources through manhole inspections, smoke testing, dye testing, and sewer televising. The SSES study should also consider a private source investigation, which may include home inspections. The results of the SSES would define potential rehabilitation and removal methods to reduce excess flows in the system.*"[7]

We concur with this recommendation and point-out that Strand's flow monitoring data reveals that the existing trunk sewer is not a significant source of infiltration and inflow. The table on the following page has been adapted from Strand's report[6] and reveals that excess flow is generated predominantly from Basins 7, 8 and 9 in the eastern and northern sections of the City of Washington. In fact, these three basins generate more peak flow than was received at STP#2, which indicates sewage overflows are occurring.

Utilizing pipe diameters and inverts from Strand's survey data[8] HCE was able to calculate that the sewage overflows occur at MH 240 and MH 245 of the Farm Creek Trunk Sewer. During our site visit of December 1, 2021, evidence of a recent overflow at MH 245 was noted (see Exhibit 6.1 for manhole locations).

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[6] Strand Associates, *Report for City of Washington, Illinois-Preliminary Engineering Study for the Farm Creek Trunk Sewer* (October 2019), Table 2.02-3, 2-7.
[7] Ibid, 6-2
[8] Strand Associates, *Farm Creek Trunk Sewer Replacement for the City of Washington Tazewell County, Illinois January 2021(Rev. 2 Prefinal Engineering for Permitting 1/2/2021)*, 8.

Table 6.1
Flow Monitoring Results[6]

Information Adapted from
Table 2.02-3 Wet Weather Flow Metering Data

Flowmeter	Location	Average Dry Flow (gpm)	Peak Day Recorded (gpm)	Excess Flow (gpm)	Excess Flow (%)	Peaking Factor	Typical Peaking Factor
FM 1	Basin 1	179	2,290	2,111	1179%	12.79	3.50
FM 3	Basin 3	17	139	122	718%	8.18	4.11
FM 4	Basin 4	349	909	560	160%	2.60	3.24
FM 7	Basin 7	56	3,142	3,086	5511%	56.11	3.86
FM 8	Basin 8	636	9,584	8,948	1407%	15.07	2.99
FM 9	Basin 9	78	3,391	3,313	4247%	43.47	3.77
Total Input Flows to STP 2 from FCTS		1,136	17,165	16,029	1411%	15.11	2.74
Total Input Flows to STP 2		1,315	19,455	18,140	1379%	14.79	2.68

As shown, the inflow to the FCTS from the upstream Basins greatly exceeds what is expected for peak flow events. Basin 7 has approximately 14.5 times more flow during rain events than a typical peak flow time, indicating significant I/I. Basins 3, 7, and 9 also flow into the FCTS with above normal peak flows.

Flowmeter	Location	Average Dry Flow (gpm)	Peak Day Recorded (gpm)	Excess Flow (gpm)	Excess Flow (%)	Peaking Factor	Typical Peaking Factor
FM 2	FCTS U/S of STP 2	1,024	12,114	11,090	1083%	11.83	2.79
FM 3	Basin 3	17	139	122	718%	8.18	4.11
FM 4	Basin 4	349	909	560	160%	2.60	3.24
FM 5	FCTS U/S of Basin 4	981	11,470	10,489	1069%	11.69	2.80

Flowmeter 2, located upstream of STP#2, is expected to have equal flow from the combination of Flowmeters 3, 4 and 5. This is close to accurate, with the combined flow of Basin 3 and 4 and the upstream FCTS (FM 5) being 11,171 gpm and flows at STP#2 being 11,090 gpm. This is a difference of only 81 gpm (0.7%). This result shows that inflow is not occurring to the Farm Creek Trunk Sewer in this region, which begins near Timber Rail and extends to STP#2. Neither are overflows occurring as significant flow is not lost.

Flowmeter	Location	Average Dry Flow (gpm)	Peak Day Recorded (gpm)	Excess Flow (gpm)	Excess Flow (%)	Peaking Factor	Typical Peaking Factor
FM 5	FCTS U/S of Basin 4	981	11,470	10,489	1069%	11.69	2.80
FM 6	FCTS U/S of STP 1	633	11,671	11,038	1744%	18.44	2.99

Finally, FM 5, located upstream of Basin 4, is further downstream along the Farm Creek Trunk Sewer than FM 6, which is located upstream of STP#1, and FM 5 has a predictably greater average dry flow. However, the peak flow at FM 5 is less than that at FM 6. This indicates overflows to the FCTS between these metering locations. From further analysis, evidence shows these overflows at MH 240 and MH 245.

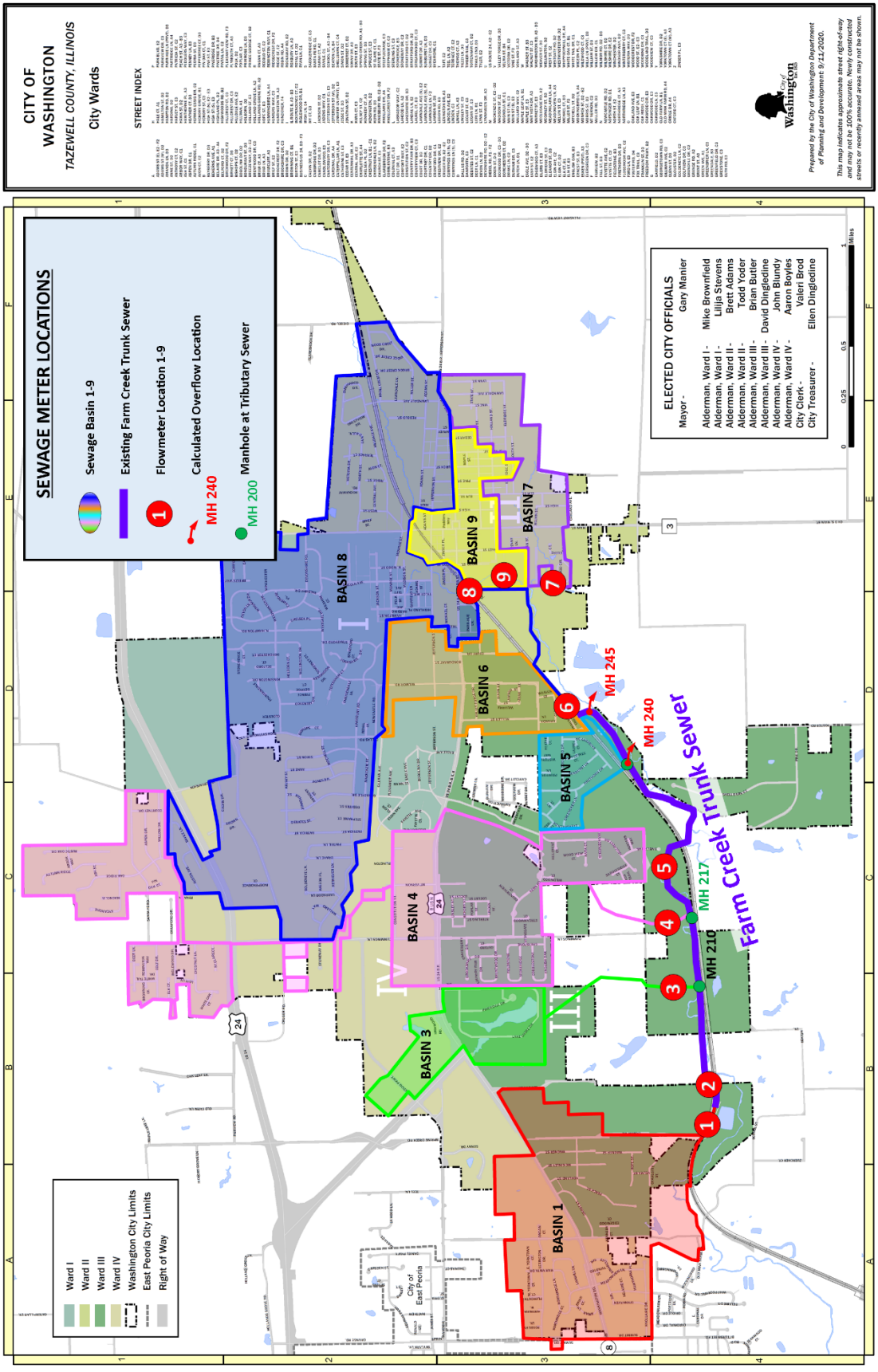
A further discussion of the mathematical relationships that lead to the conclusions in this table is included in Appendix I.

To amend Strand's recommendation for an SSES, we suggest that a targeted approach toward elimination of public sources of infiltration and inflow begin, and that a City-wide program be started for private sources. More details are provided in Section 17 of this report.

The flowmeter locations and drainage basins from Strand's report[9] are presented in Exhibit 6.1 for reference.

[9] Strand Associates, *Report for City of Washington, Illinois-Preliminary Engineering Study for the Farm Creek Trunk Sewer* (October 2019), untitled exhibit following page 3-1.

Exhibit 6.1
Flow Meter and Sewage Collection Basins[8]



6.2 Sewer Conditions

As discussed in the previous section, the 50-year-old Farm Creek Trunk Sewer between STP#1 and STP#2 does not appear to be a significant source of infiltration and inflow. This is likely the direct result of the design including measures specific to preventing the creek from flowing into the pipe and manholes. During our site visit of December 14, 2021, we witnessed a stream crossing that was within the flow line of the channel, with the pipe visible to the surface, and some manholes that were within eroded banks. However, we saw no open pipe joints, or displaced manhole sections. This corroborates Strand's finding that the FCTS is not a source of infiltration. That said, due to the critical location of this sewer, it should have an aggressive evaluation as discussed in Section 17 of this report.

The City has five separate sources of information for the Farm Creek Trunk Sewer which have been provided. In the order received they are:

Strand Associates, *Report for City of Washington, Illinois-Preliminary Engineering Study for the Farm Creek Trunk Sewer* (October 2019) (**Strand Report**)

Austin Engineering Co., Inc., untitled plan and profile exhibit of a replacement sewer with much of the existing sewer shown (2015?)

City of Washington GIS Utilities Map (**GIS**)

Daily and Associates Engineers, Inc., *Division A, Revisions and Additions to Existing Treatment Plant and Interceptor System* and *Division B, Interceptor Sewer 1F, Interceptor Sewer 2F, Interceptor Sewer 4F* (1971) (**D&A Plans**)

Strand Associates, *Farm Creek Trunk Sewer Replacement for the City of Washington, Tazewell County, Illinois, January 2021*, Sheet 8 – *Control Point, Benchmark and Existing Manhole Information* (**Strand Prelim. Plans**)

As can be expected with documents spanning 50 years, there are discrepancies between them. However, all are important for understanding both the intent of the original design and the current conditions. Table 6.2 on the following page combines the data from these sources and calculates the current capacity of the sewer. For all references in the report, the rim elevations, invert elevations and pipe sizes are from the Strand Prelim. Plans, pipe material is from the D&A Plans, and manhole designations are from GIS.

Review of the data reveals that the existing sewer is back-pitched for 217 feet between MH 246 and the Control Chamber at STP#1 and is back-pitched for 97 feet between MH 214 and MH 213. However, approach and exit velocities from these short reaches have likely prevented serious debris accumulation.

Table 6.2
Analysis of the Existing Farm Creek Trunk Sewer
Data as Available

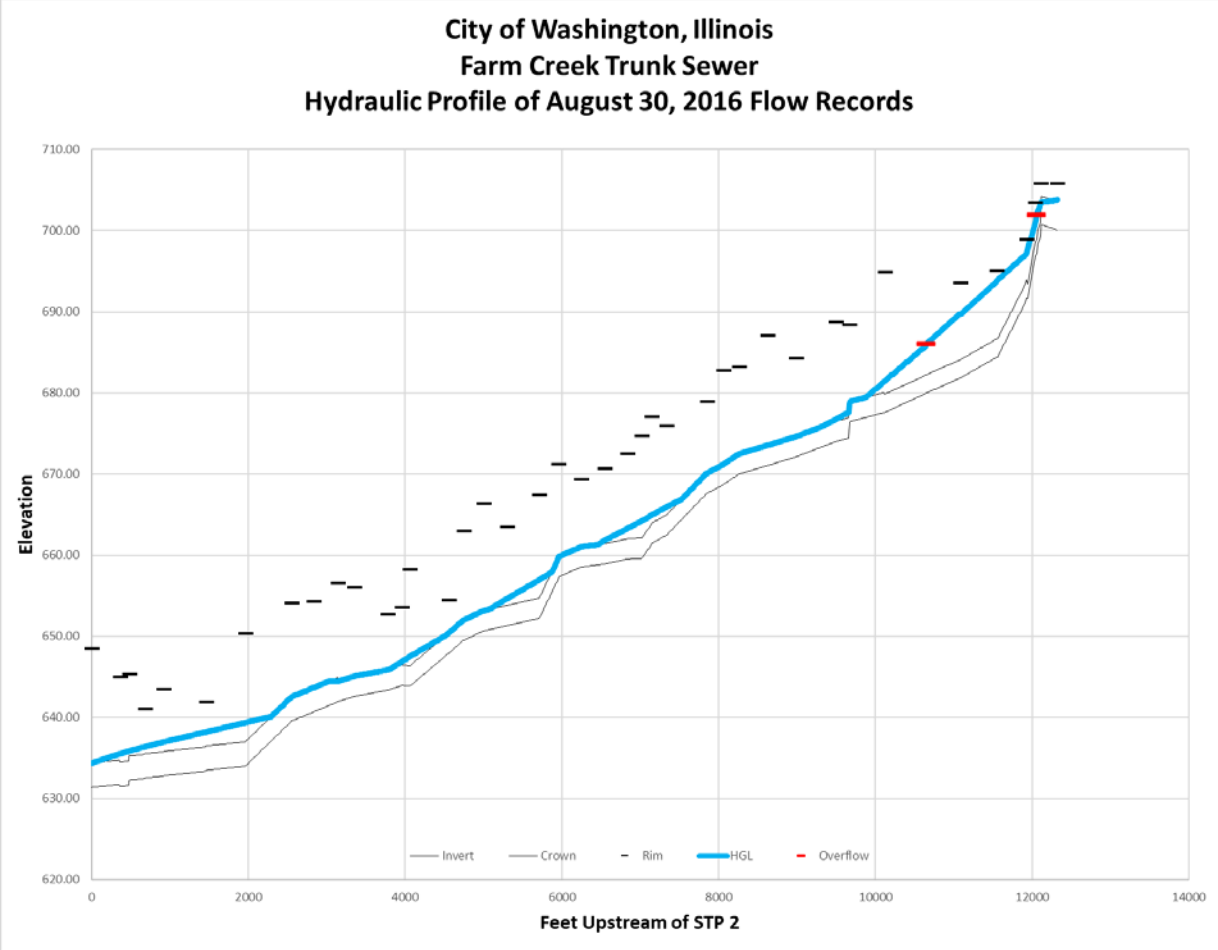
Washington GIS Structure Number	Austin MH	Strand Information: Structure Number	FM Point	Rim	Inv.	Length	Dia	Slope	Calculations: Vel (fps)	Cap. (MGD)	Daily & Associates Design: MH	Rim	Inv.	Length	Slope	Dia	Calculations: Vel (fps)	Cap. (MGD)
246	101	unk	STP-1a	705.824	700.024													
						217	42	-0.32%	#NUM!	#NUM!								
245.1		unk		705.830	700.720						Ctrl Chamber	703.5	700.32			21		
					699.330								699.80					
						45	21	2.40%	10.20	15.86				58	4.88%	21	14.55	22.62
245	239	unk		701.874	698.251													
					697.171													
						25	21	0.68%	5.45	8.47								
244	238A	239		703.455	697.000						6C	703.5	696.97					
					696.905								696.87					
						107	21	4.93%	14.62	22.73				105	4.67%	21	14.23	22.12
243	LL	238	STP-1b	698.883	691.633						5C	699.0	691.97					
					691.700								691.88					
						384	27	1.89%	10.72	27.55				350	2.12%	21	9.59	14.91
242	KK	237		695.076	684.426						4C	695.5	684.46					
					684.376								683.95					
						456	27	0.55%	5.79	14.87				500	0.20%	27	3.48	8.95
241	JJ	236		693.51	681.86						3C	693.5	682.95					
													682.85					
						439	27	0.43%	5.11	13.13				500	0.28%	27	4.12	10.59
240	II	235	D	686	679.97						2C	692.5	681.45					
													679.85					
						534	27	0.45%	5.21	13.39				500	0.28%	27	4.12	10.59
239	HH	234		694.91	677.58						1C	694.5	678.45					
													678.44					
						446	27	0.26%	3.94	10.12				438	0.28%	27	4.13	10.61
238	GG	233		688.34	676.44						29	689.5	677.21					
													675.86					
						170	30	1.43%	9.99	31.70				172	0.26%	30	4.23	13.41
237	FF	232		688.75	674.01						28		675.42					
													675.32					
						511	30	0.37%	5.07	16.08				514	0.25%	30	4.17	13.23
236	EE			684.28	672.13						27		674.04					
													672.14					
						361	30	0.30%	4.59	14.57				364	0.25%	30	4.18	13.26
235	DD			687.09	671.04						26		671.23					
													671.13					
						364	30	0.29%	4.49	14.24				371	0.25%	30	4.18	13.27
234	CC			683.23	669.99						25		670.20					
													670.10					
						201	30	0.64%	6.69	21.24				213	0.25%	30	4.17	13.22
233	BB			682.81	668.70						24		669.57					
													669.47					
						214	30	0.52%	6.02	19.09				226	0.25%	30	4.20	13.31
232	AA			678.89	667.59						23		668.90					
													668.80					
						506	30	1.01%	8.38	26.59				509	1.00%	30	8.36	26.51
231	Z	226		675.94	662.50						22		663.71					
													662.51					
						192	30	0.54%	6.12	19.42				215	0.08%	30	2.35	7.45
230	Y	225		677.05	661.47						21-2		662.34					
													662.30					
						136	30	1.36%	9.75	30.92				151	0.80%	30	7.48	23.73
229	X	224		674.70	659.62						21-1		661.09					
													660.09					
						173	30	0.06%	2.11	6.69				175	0.08%	30	2.36	7.50
228	W	223		672.48	659.51						21		659.95					
													659.75					
						289	30	0.21%	3.81	12.08				299	0.08%	30	2.37	7.51
222	V	222		670.70	658.91						20		659.51					
													659.41					
						305	30	0.12%	2.95	9.36				288	0.52%	30	6.01	19.07
221	U	221		669.36	658.53						19		657.92					
													657.82					
						285	30	0.42%	5.42	17.20				290	0.52%	30	6.03	19.13
220	T	220		671.18	657.33						18		656.31					
													656.21					
						257	30	2.00%	11.81	37.46				275	0.87%	30	7.81	24.77
219	S	219		667.44	652.20						17		653.81					
													652.44					
						407	30	0.22%	3.91	12.40				363	0.20%	30	3.75	11.89
218	R	218		663.50	651.31						16		651.71					
													651.61					
						302	30	0.22%	3.91	12.39				390	0.20%	30	3.74	11.86
217	Q	217	E	666.39	650.65						15		650.83					
													650.73					
						250	30	0.45%	5.62	17.82				253	0.20%	30	3.75	11.90
216	P	216		662.97	649.52						14		650.22					
													650.12					
						186	30	0.84%	7.65	24.28				186	0.20%	30	3.73	11.82
215	O	215		654.46	647.96						13		649.75					
													649.65					
						501	30	0.82%	7.57	24.01				510	0.20%	30	3.74	11.86
214	N	214		658.23	643.85						12		648.63					
													646.66					
						97	30	-0.09%	#NUM!	#NUM!				100	0.21%	30	3.83	12.15
213	M	213		653.54	643.94						11		646.45					
													646.35					
						183	30	0.32%	4.74	15.05				203	0.20%	30	3.76	11.91
212	L	212		652.65	643.35						10		645.94					
													645.84					
						426	30	0.18%	3.55	11.27				425	0.20%	30	3.74	11.86
211	K	211		656.04	642.58						9		644.99					
													644.89					
						212	30	0.30%	4.59	14.57				418	0.48%	30	5.81	18.43
210	J	210	F	656.54	641.94						8		642.87					
													642.77					
						315	36	0.41%	6.01	27.48								
209	I	209		654.25	640.66									500	0.48%	30	5.79	18.37
						280	36	0.40%	5.94	27.14								
208	H	208		654.10	639.55						7		640.37					
						591	36	0.94%	9.15	41.82				495	0.48%	30	5.79	18.38
207	G	207	G	650.29	633.99						6		637.99					
													634.99					
						501	36	0.10%	3.01	13.75				504	0.06%	36	2.30	10.52
206	F	206		641.90	633.48						5		634.69					
					633.35	536	36	0.10%	2.98	13.63				408	0.06%	36	2.29	10.46
205	E	205		643.50	632.81						4		634.45					
					632.76	236	36	0.10%	2.98	13.63			632.65	288	0.06%	36	2.29	10.47
204	D	204		641.00	632.52						3		632.48					
					632.45	201	36	0.10%	2.98	13.63				287	0.11%	36	3.18	14.51
203	C			645.35	632.25						2							
					631.62	119	36	0.10%	2.98	13.63				128	0.11%	36	3.18	14.51
202	B		H1	644.94	631.50						1.1		632.01					
													631.81					
					631.74	364	36	0.10%	2.98	13.63				337	0.05%	36	2.06	9.39
200	A		STP-2	648.50	631.38						1		631.65					
													631.45					

LEGEND

XX	Data point of concern
XX	Calculation of concern
	Overflow location, Rim

HCE created a Hydraulic Grade Line analysis of the existing sewer system using the August 30, 2016 flows from the Strand Report (Exhibit 6.2 below). This analysis reveals that this flow event would have created full-pipe flow for the entire length of the sewer from STP#1 to STP#2 with surcharging of most manholes and overflow of MH240 and MH 245.

Exhibit 6.2



Excluding the two back-pitches pipes, the existing Farm Creek Trunk Sewer is limited to carrying 6.69 million gallons per day in the 173 lineal feet of 30-inch RCP between manholes MH 229 and MH 228 upstream south of Timber Rail Drive.

Utilizing a standard peaking factor of 2.53, this sewer has capacity for a population equivalent (PE) of 26,443 persons. Strand's report[10] reveals a current average flow of 1,281 gpm in this reach which equates to the flow from 18,446 PE. Therefore, this pipe has capacity for an additional 7,997 PE growth in Basins 5-9 combined should those Basins have adequate sewerage capacity, and if excess flows were eliminated to standard levels.

[10] Ibid, Table 2.03-5, Junction D, 2-18.

However, the August 30, 2016 flow at this location was recorded as 19,285 gpm, which is 4.15 times the capacity of the sewer.

The next limiting point is 11.27 million gallons per day in the 173 lineal feet of 30-inch RCP between manholes MH 212 and MH 211 downstream (southwest) of the location of Flowmeter 3. Utilizing a standard peaking factor of 2.27, this sewer has capacity for a population equivalent (PE) of 49,648 persons. Strand's report[10] reveals a current average flow of 1,647 gpm in this reach which equates to the flow from 23,717 PE. Therefore, this pipe has capacity for an additional 25,931 PE growth in Basins 3-9 combined if excess flows in their Basins were eliminated to standard levels.

However, the August 30, 2016 flow at this location was recorded as 20,333 gpm, which is 2.60 times the capacity of the sewer.

6.3 GIS Mapping Inconsistencies

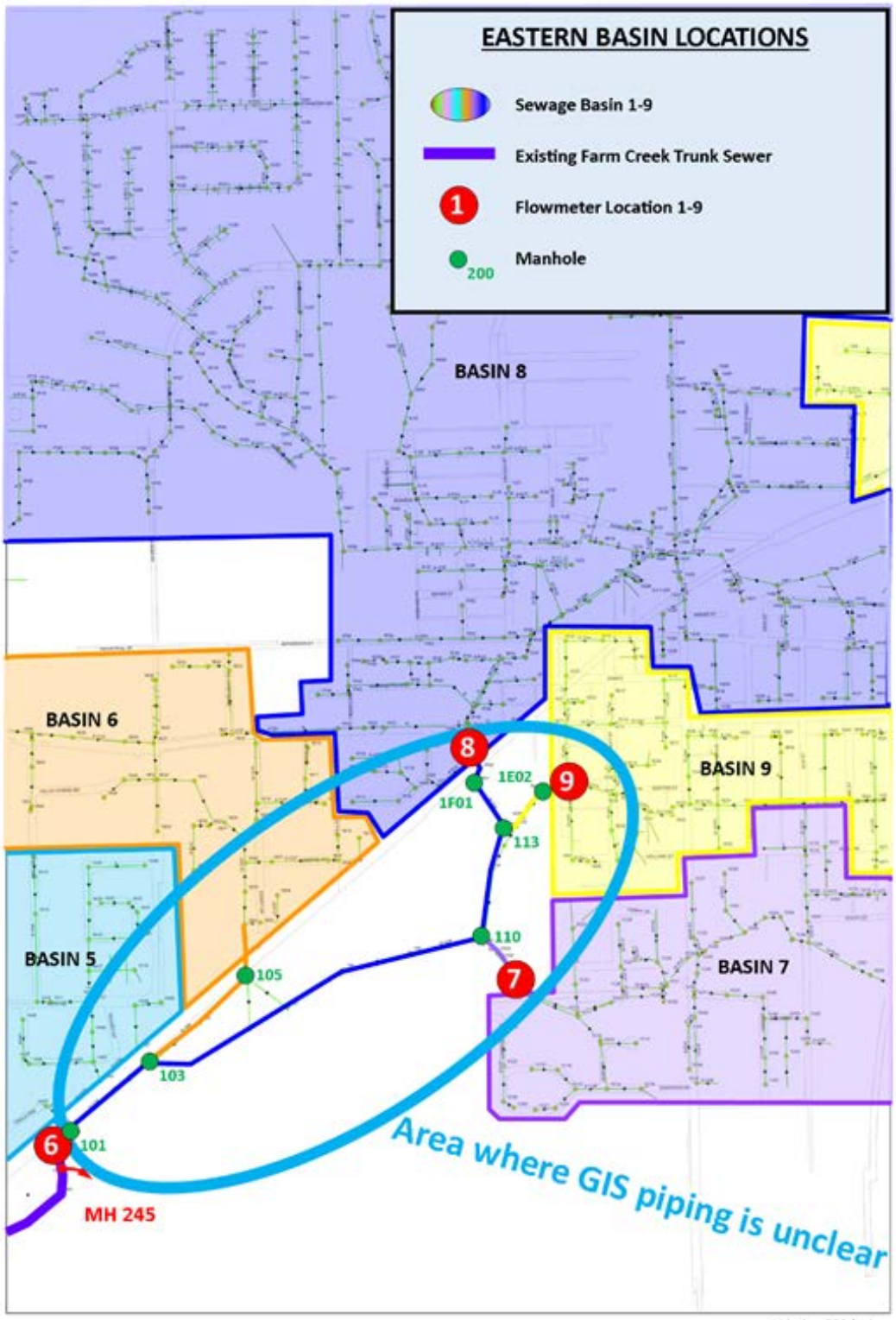
While attempting to clarify which data is accurate from those sources referenced in Section 6.2 of this report, several discrepancies were found between Strand's survey data[11] and the City's GIS map. Review of the GIS database finds that much of the data has been obtained from previous utility maps and design plans which is very typical for GIS maps when they are first created. However, when those maps become the source for studies and maintenance schedule, detailed and correct information regarding manhole locations and pipe sizes is critical; and data regarding pipe material, manhole rim elevations, and pipe invert elevations is very helpful.

One area where more detailed information is needed is that portion of the sewage collection system immediately upstream (east) of STP#1 (see Exhibit 6.3). The GIS map indicates many clay sewers (VCP) which may be from the City's original collection system. In addition, the GIS shows duplicate pipes, duplicate manholes, and pipes that do not connect to any structure. Basins 7, 8 and 9 flow into collector sewers in this area. These Basins exhibited the most severe peak flows recorded[12]. Confirmation that the sewers have adequate capacity to transport those flows is critical to the long-term growth of the City and the future performance of the FCTS project. Accurate data will also be instrumental in the development of an SSES and targeted removal of I/I sources.

[11] Strand Associates, *Farm Creek Trunk Sewer Replacement for the City of Washington Tazewell County, Illinois January 2021(Rev. 2 Prefinal Engineering for Permitting 1/2/2021)*, 8.

[12] Strand Associates, *Report for City of Washington, Illinois-Preliminary Engineering Study for the Farm Creek Trunk Sewer* (October 2019), Table 2.03-5, 2-18.

Exhibit 6.3
Eastern Sewage Collection Basin Trunk Sewers



6.4 City of Washington Concerns

The Strand Report lists four concerns expressed by the City regarding the existing Farm Creek Tunk Sewer[13]:

1. *"Operational problems because of its proximity to Farm Creek.*
2. *Instability and erosion of Farm Creek leading to exposed sewer pipe in several locations.*
3. *Excess flow conditions in the sewer during wet weather and high creek flow conditions.*
4. *Anticipated continued growth and development potentially exceeding trunk sewer capacity."*

HCE has evaluated each of these concerns as they relate to the various alignments and improvement options put forth for consideration.

6.1.1 "*Operational problems*" is not defined. However, the current sewer manholes are difficult to locate due to undergrowth and they cross onto both sides of the railroad and both sides of Farm Creek and its tributaries making searching for manholes difficult, and manhole-to-manhole maintenance such as jetting or televising cumbersome. These issues can be mitigated without abandoning the sewer.

Regular clearing of the brush over manholes will aid in their location as will obtaining GPS locations of all manholes. Manholes should be inspected every 5 years[14] and regular brush clearing on this interval would be an improvement over the current condition.

Because of the high velocities in the sewers, regular jetting is not a requirement, although a typical sewer should be cleaned every 3 years[14.] It would be reasonable in the high velocity sewer to combine the work with every 5-year manhole inspection.

Televising companies utilizing crawler cameras do not need to access every manhole and splitting teams between the north side and the south side of the creek should only result in a nominal cost surcharge. This process should be undertaken on average once every 15 years[14].

6.1.2 "*Instability and erosion*" though observed in several locations, erosion has not appeared to compromise either the manholes or the pipes. A rigorous inspection of the sewer and manholes should be performed to determine the current condition. Should erosion imperil a length of sewer, or a manhole; replacement or encasement of that structure can occur without abandonment of the entire sewer line.

6.1.3 "*Excess flow conditions*" from upstream areas should be addressed as discussed in Section 17 of this report. These high flows not only result in overflows of the sewers, but they also result in additional pumping, treatment and capacity costs at the sewage treatment plant. Replacing the Farm Creek Trunk Sewer solves one of the symptoms of infiltration and inflow without addressing the cause and without reducing flows at STP#2.

[13] Ibid, 6-1.

[14] USEPA, *EPA 832-F-99-031, Collection Systems O&M Fact Sheet Sewer Cleaning and Inspection* (September 1999), 5.

All sewers in town should be evaluated and repaired, and illicit connections removed. The existing Farm Creek Trunk Sewer needs to be evaluated and cost-effectively repaired if needed. As stated earlier in this report, Strand's flow monitoring data does not show significant infiltration or inflow in the Farm Creek Trunk Sewer between STP#1 and STP#2, so significant repairs are not anticipated.

6.1.4 "*Growth potentially exceeding trunk sewer capacity*" The key word is "potentially." There exists available capacity within the Farm Creek Trunk Sewer to accommodate growth city-wide should excess flows from I/I be reduced to standard levels. However, additional sewerage capacity will eventually be required for ultimate build-out of the City's Comprehensive Planning area.

7.0 Alternative Solutions

Although Strand proposed multiple solutions in their reports and the Pudik's have proposed dozens, the three most cost-effective alternative solutions from those two sources are evaluated in this report. In addition, as a result of our thorough review, HCE has identified two additional options and also included the SSES Only and "No Build" options.

Alternative A. Strand Alignment B. This project is a 42" Hobas™ gravity replacement sewer that follows the south side of the railroad tracks from MH 246 at STP#1 to STP#2, completely replacing the FCTS. The alignment generally seeks retain the existing service area of the FCTS.

Alternative B. Pudik Alignment L-1. This project is a 42" gravity replacement sewer that generally follows the north side of the railroad tracks from MH 246 at STP#1 to MH 240 STP#2, completely replacing the FCTS. As an alternative to the Strand design, the alignment seeks to avoid trees and environmental resources south of the railroad.

Alternative C. Pudik Alignment E-3. Similar to Pudik Alignment L-1, this project is a 42" gravity replacement sewer that completely replaces the FCTS. However, this alignment is further north from the railroad tracks along property lines. The alignment seeks to further avoid creek crossings and environmental resources and crosses through the Timber Rail development.

Alternative D. Pump Station and Relief Sewer. This project retains the FCTS, while providing safe routing of excess wet weather flow by way of a pump station. The existing Farm Creek Trunk Sewer will be evaluated and repaired as needed, and a 16,200-gpm pump station provided at STP#1 to pump excess flows to STP#2 via a 12" forcemain and new 30" gravity sewer that can also serve unsewered areas south of Basins 3 and 4. The route generally follows that of Alternative C. Pudik Alignment E-3.

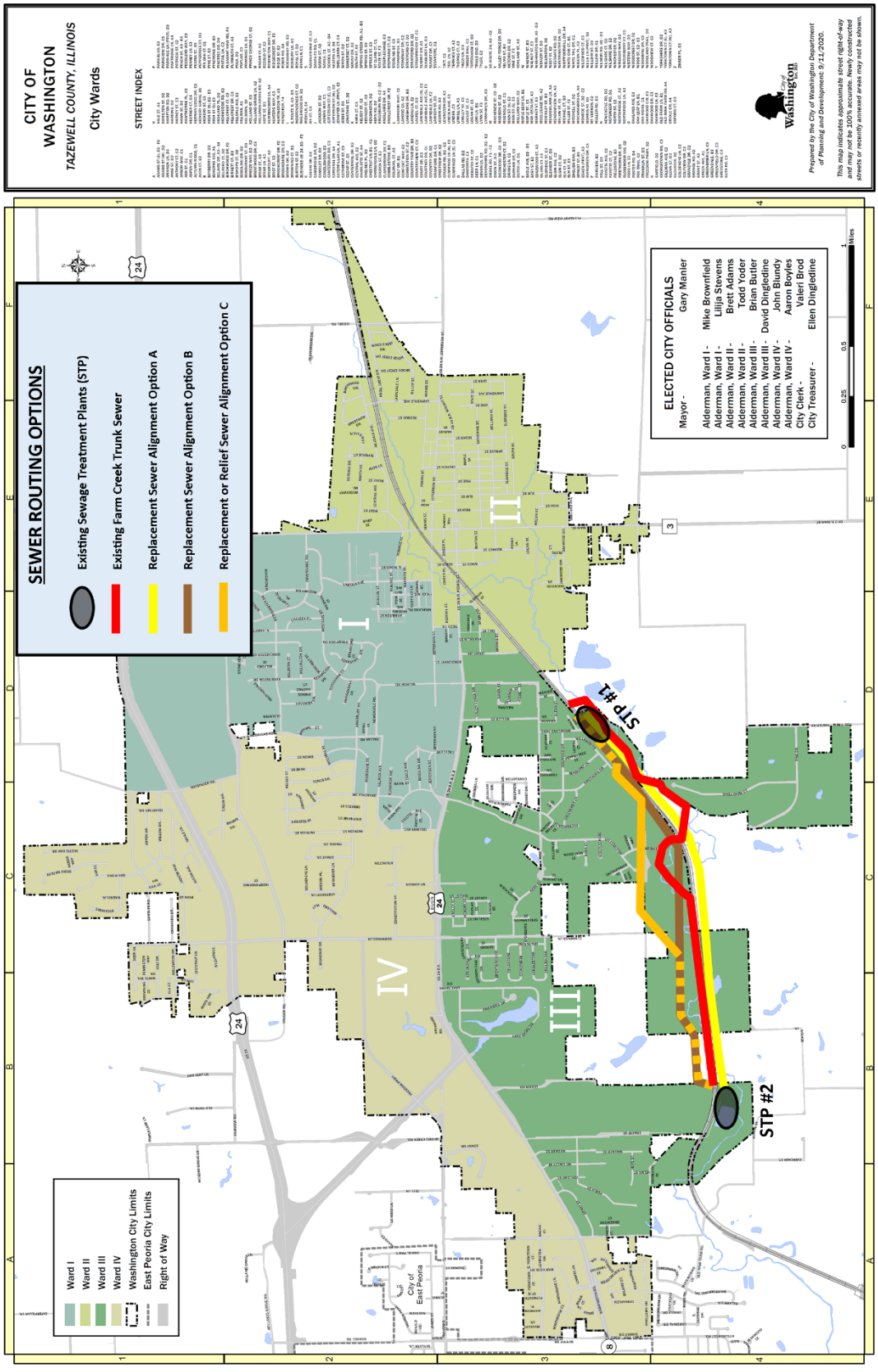
Alternative E. Relief Sewers. From review of the Strand Report, and our own research evaluating alternatives, the existing Farm Creek Trunk sewer appears to be in acceptable condition and have acceptable capacity for growth, except for two overflow locations. This alternative retains the FCTS, with evaluation and repair as needed, and seeks to remove the overflow locations, thereby eliminating the excess flows, allowing for continued use while completing a SSES and addressing I/I.

Alternative F. SSES. This alternative also retains the existing FCTS, with evaluation and repair as needed. A Sanitary Sewer System Evaluation Survey (SSES) will be performed to determine the extent of infiltration and inflow (I/I) on a Basin-by-Basin basis, then repair of sewers/manholes and removal of illicit connections from the sanitary sewers will be carried out.

Alternative G. No Build. In this alternative, the existing FCTS is inspected and repaired as needed.

A general location map of these alternatives is provided in Exhibits 7.1 - 7.3 and a more thorough discussion of these alternatives follows.

Exhibit 7.1
Sewer Alignment Options



7.1 Alternative A, Strand Alignment B.
This 42" diameter sewer at 0.30% slope has 35.62 million gallons per day capacity to serve a population equivalent of 201,243 persons using a peaking factor of 1.77. Strand Associates, Inc. has completed 90% plans for this alignment and has produced easement plats to construct and maintain the completed sewer.

Their Engineer's Opinion of Probable Construction Cost (EOPCC) for the project is $7,926,705 excluding easement acquisition costs. However, their plans do not include casing for the shallow (less than 5 feet cover) stream crossings, or for the deep (greater than 35 feet cover) lengths of sewer. Casings are recommended in each of the locations and adding those to the cost brings the EOPCC to $8,000,000. The estimate is detailed in Appendix J-1.

Note – the unit prices used by Strand appear reasonable, but they have not been reviewed in detail. And these unit prices have been used for each alternative to provide a uniform basis of comparison.

Strand has completed plans for influent pump station improvements at STP#2. We have visited STP#2 and agree that the upgrades are warranted regardless of which sewer option is chosen.

However, none of the options, including Strand Alignment B require the new pump station.

All alignments can work with the existing invert elevation at STP#2 by providing cased, bored casings under the stream crossings.

The STP#2 influent pumping station requires upgrades due to age and capacity not related to the Trunk Sewer. Therefore, the estimated costs for this work are not included in this, or any of the alternatives, although the work is necessary.

7.2 Alternative B, Pudik Alignment L-1.
This sewer is the same size, diameter and slope as Alternative A. HCE has modified the original alignment to more closely follow topography using Tazewell County LIDAR data, and to follow property lines (when possible) to minimize the impact on the remainder of the property by an easement acquisition. The alignment follows the north ROW of the railroad and seeks to preserve trees and wetlands south of the railroad. The EOPCC of this alternative, exclusive of easement acquisition is $10,980,642. The estimate and alignment are detailed in Appendix J-2.

7.3 Alternative C, Pudik Alignment E-3.
This sewer is the same size, diameter and slope as Alternatives A and B. HCE has modified the original alignment to more closely follow topography using Tazewell County LIDAR data, and to follow property lines (when possible) to minimize the impact on the remainder of the property by an easement acquisition. The EOPCC of this alternative, exclusive of easement acquisition is $12,581,197. The estimate and alignment are detailed in Appendix J-3.

The greatest challenge, and greatest cost factor, of this alignment is excessive depths of up to 75 feet and lengthy directional bore lengths of up to 1,000 feet.

Introduction to Alternative D, Pump Station and Relief Sewers, Alternative E. Relief Sewers, Alternative F. SSES and Alternative G. No Build.

For each of the Hamilton-suggested alternatives, consideration should be given toward keeping the existing Farm Creek Trunk Sewer in service.

There is an advantage to the FCTS being both north and south of Farm Creek and the railroad in that it aids in future sewage service expansions north and south respectively. The existing alignment achieves this advantage while the other options do not. However, the sewer is prone to surcharges and overflows due to excess flows from upstream areas.

Also, the existing sewer requires inspection and potential repair.

The existing sewer is reinforced concrete pipe and therefore is unlikely to have any serious cracking. However, 50-year-old mastic joints have likely experienced contraction and/or intrusion by roots.

These joints can be made watertight by:

- lining the entire pipe with a Cast-In-Place-Plastic (CIPP) liner,
  or
- testing each joint individually and forcing grout into the joint in a process named Telegrouting.

Telegrouting is paid on a per-joint-tested, and per-gallon of grout used, quantity and is often one-half to three-quarters of the cost of CIPP, although the costs are extremely variable.

CIPP cost is more predictable, and the City of Washington has a March 24, 2021 proposal from Pipe Vision for CIPP lining of the pipe sizes needed for the existing Farm Creek Trunk Sewer. Applying those costs to the recorded lengths and sizes of the existing sewer results in the estimate in Table 7.1.

Table 7.1
Engineer's Opinion of Probable Construction Cost
For CIPP Sliplining of the Existing Farm Creek Trunk Sewer

Estimated Length	Diameter	Pipe Vision $/LF	Estimated Cost
2,259 LF	27"	$ 117.50	$ 265,432.50
6,528 LF	30"	$ 125.00	$ 816,000.00
3,143 LF	36"	$ 175.00	$ 550,025.00
TOTAL			**$1,631,457.50***

* The estimate is a worst-case scenario wherein the ***entire*** sewer would need to be lined. It is likely that much (if not most) of the sewer will not require lining, thereby reducing the cost significantly.

7.4 Alternative D, Pump Station and Relief Sewers.
In addition to evaluation and repair of the existing FCTS as needed per the discussion above, the next component of this alternative is to construct a pump station and flow meter at STP#1 to intercept flows from Basins 7, 8 and 9 and bypass any flows that exceed the capacity of the downstream sewers directly to STP#2.

The alignment of the forcemain and gravity sewer extension from STP#2 follows that of Alternative C. The EOPCC of this alternative, exclusive of easement acquisition is $7,618,040. The estimate and alignment are detailed in Appendix J-4.

The combined capacity of this alternative is 82,929 PE, or 19.23 million gallons per day.

- The capacity of the gravity portion of the relief sewer is 12.54 million gallons per day for a population equivalent of 56,486 with a peaking factor of 2.22.
- Adding the current capacity of the Farm Creek Trunk Sewer, which is limited to 6.69 gallons per day for a population equivalent of 26,443 with a peaking factor of 2.53.

7.5 Alternative E, Relief Sewers.
Section 6.2 of this report discussed reaches of the FCTS that limit capacity. This Alternative E. Relief Sewers, in addition to evaluation and repair of the FCTS as needed and discussed above, encompasses two projects that can remove restrictions and increase the sewer's capacity.

7.5.1 Timber Rail Relief Sewer
This project bypasses the 6.69 MGD flow restriction between MH 228 and MH 229 as shown in Exhibit 7.2. This project will involve work in a residential backyard near a fire pit surrounded by a bluestone patio. An allowance has been added to the estimate to address premium landscaping restoration bringing the total estimate for this project to $561,556. This can be handled either by the contractor or as a paid allowance to the property owner as part of an easement agreement.

7.5.2 STP#1 Relief Sewer
This project bypasses the 8.47 MGD flow restriction between MH 244 and MH 245 and eliminates the overflows at MH 240 and MH245 as shown in Exhibit 7.3. The entire project is at the STP#1 site, so no easements are required. The Engineer's opinion of probable construction cost for this project is $654,091.

The total estimate for these two projects is $1,475,200 and upon their completion the next remaining flow restriction is 11.27 million gallons per day between MH 211 and MH 210.

- Using a standard peaking factor of 2.27 for this flow reveals that there is capacity of 49,648 PE.
- Although this flow value is still less than the recorded peak flows, there will be no more system overflows allowing the City time to make progress with a SSES as discussed in the next Section of this report.

Exhibit 7.2
Timber Rail Relief Sewer

TIMBER RAIL RELIEF SEWER					
Structure Number	Rim	Inv.	Length	Dia	Slope
229a	674.7	659.50	460	30	0.73%
218b	674.0	656.14 656.04	460	30	0.73%
218a	667.4	652.68 652.18			
222	670.7	660.00	350	8	0.40%
222a	672.5	658.60 658.50	250	8	0.40%
218b	674.0	657.50 652.18			

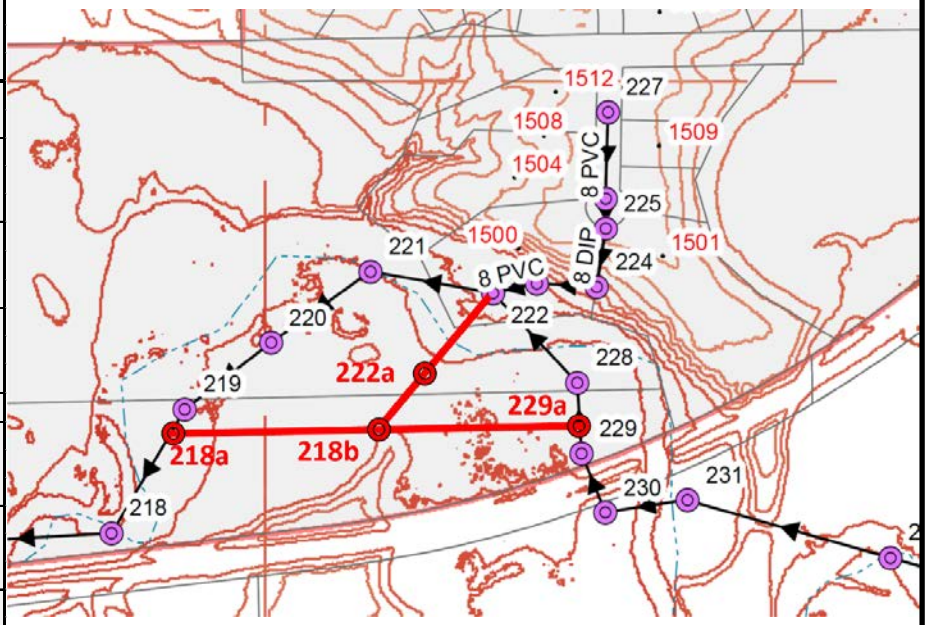
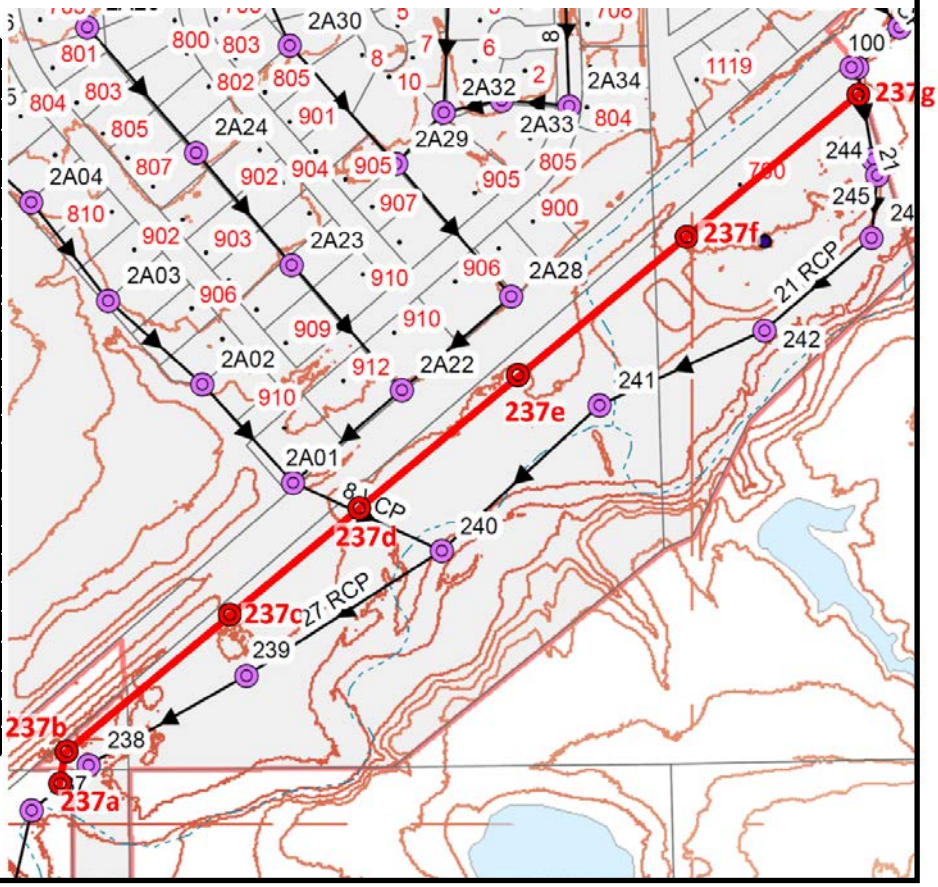


Exhibit 7.3
STP#1 Bypass Sewer

STP 1 BYPASS SEWER					
Structure Number	Rim	Inv.	Length	Dia	Slope
237g	706.0	699.00	420	30	1.12%
237f	700.0	694.30 694.20	420	30	1.12%
237e	695.5	689.49 689.39	420	30	1.12%
237d	694.0	684.69 684.59	415	30	1.12%
237c	696.0	679.94 679.84	415	30	0.65%
237b	688.5	677.14 677.04	30	30	0.65%
237a	688.5	676.85 676.30			



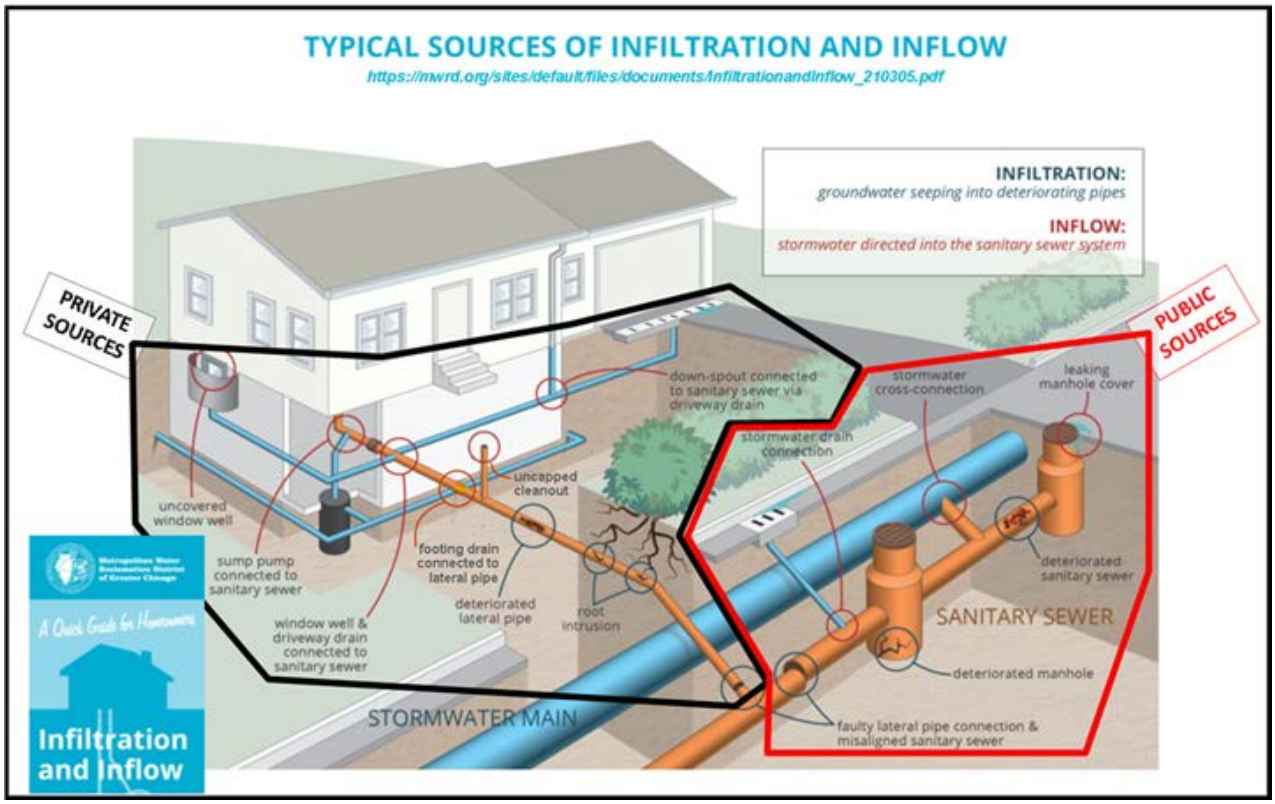
7.6 Alternative F, Sewer System Evaluation Survey (SSES).
This alternative starts with evaluation and repair, as needed, of the existing FCTS per above.

Infiltration and Inflow (I/I) monitoring is an important part of the operation and maintenance of a sewage collection system. The following definitions are offered:

> *Infiltration – Water other than wastewater that enters a sewer system (including sewer service connections and foundations drains) from the ground through such means as defective pipes, pipe joints, connections, or manholes.*
>
> *Inflow – Water other than wastewater that enters a sewer system (including sewer service connections) from sources such as, but not limited to, roof leaders, cellar drains, yard drains, area drains, drains from springs and swampy areas, manhole covers, cross connections between storm sewers and sanitary sewers, catch basins, cooling towers, stormwaters, surface runoff, street wash water or drainage.*[15]

An important clarification to these definitions is the difference between public and private sources of I/I. Public sources enter the public sewers through defects in the collection system (manholes and sewer mains), or interconnection with public storm sewer systems. Private sources enter the public sewers through defects in the private service pipe, footing tile connections, sump pump connections, yard drains or downspouts. The following exhibit for the Chicago Metropolitan Water Reclamation District shows this graphically[16]:

Exhibit 7.4[16]



[15] Illinois EPA Bureau of Water Infrastructure Financial Assistance Section, *Water Pollution Control Loan Program 2021 Intended Use Plan Illinois EPA Water Pollution Control Loan Program 2021 Intended Use Plan FINAL - August 2020*, 15.
[16] https://mwrd.org/sites/default/files/documents/infiltrationand inflow_210305.pdf

Sanitary Sewer Evaluation Surveys (SSES) have been conducted by most communities over the past 50 years due to requirements of the USEPA Water Pollution Control Grants. Appendix K includes sections 2.1 and 2.2 of *EPA/625/6-91/030, Sewer System Infrastructure Analysis and Rehabilitation*[17] with bold, highlights and underlines added. A brief summary of the critical elements of this document follows:

> *"**2.1 Historical Background***
> *The Water Pollution Control Act Amendments, **require** that the U.S. EPA construction grant applicants investigate the condition of their sewer systems.* *** The grant cannot be approved unless it is documented that each sewer system discharging into such treatment works is not subject to "excessive infiltration and inflow."***
>
> *In addition, **I/I analysis and Sewer System Evaluation Surveys (SSES) were required to be conducted on a routine basis** to document I/I, and also to indicate the most cost-effective method of rehabilitation required to correct the sewer pipe and manhole structure damage.*
>
> *The SSES should include a systematic examination of the sewer system to determine the specific locations, estimated flow rates, method of rehabilitation and cost of rehabilitation versus the cost of transportation and treatment for each defined source of infiltration and each defined source of inflow. The results of the SSES should be summarized in a report…*
>
> ***2.2 Summary of Applicable U.S. EPA and State Regulations****
> *The following is a Summary of Federal and State Regulations and Guidelines for I/I analysis and SSES applicable under the U.S. EPA construction grant program.*
> *The grant applicant must determine the I/I conditions in the sewer system by analyzing the preceding year's flow records from existing treatment plant and pump stations.*
>
> ***No further I/I analysis will be necessary if domestic wastewater plus non-excessive infiltration does not exceed 120 gallons per capita per day (gpcd) during periods of high groundwater.***
>
> ***The total daily flow during a storm should not exceed 275 gpcd,** and there should be no operational problems such as **surcharges, bypasses** or poor treatment performance resulting from hydraulic overloading of the treatment works during storm events.*
>
> *The flow rate of 120 gpcd for infiltration analysis contains two flow components:*
> *80 gpcd of domestic base flow and*
> ***40 gpcd of non-excessive infiltration**."*

[17] EPA/625/6-91/030, *Sewer System Infrastructure Analysis and Rehabilitation*, 7.

* With the expiration of the US EPA Pollution Control Grants Program the enforcement of these requirements fell to the States. For the Illinois Water Pollution Control Loan Program, applicants must certify that they do not have excessive I/I and that they have an ongoing I/I elimination program.

An estimate of the peak flows recorded by Strand for the City of Washington is as follows:

Table 7.2
Recorded Excess Flows[18]

Sewage Collection Basin and Ward	**Total Flow Recorded on August 30, 2016** (gallons per capita per day)	**Excess Flow Recorded on August 30, 2016** (gallons per minute)
Basin 7, Ward 2	5,611 gpcd	3,086 gpm
Basin 9, Ward 2	4,347 gpcd	3,313 gpm
Basin 8; Wards 1, 2 and 4	1,507 gpcd	8,948 gpm
Basin 1; Wards 3 and 4	1,279 gpcd	2,111 gpm
Basin 3; Wards 3 and 4	818 gpcd	122 gpm
Basin 4; Wards 3 and 4	260 gpcd	flow is not excessive
Total Excess Flow = the peak flow from a population of 133,238		**17,580 gpm**

These numbers exceed the above-referenced regulations by up to 2,040%. It is likely that a SSES would find a high degree of cost-effective I/I removal from this system.

We recommend a two-pronged approach toward correcting the City's excessive I/I issues.

1. We recommend that the City undertake a city-wide program to eliminate private I/I sources by enforcement of current ordinances:

> ***52.051 SOURCES OF SURFACE RUNOFF OR GROUNDWATER***
> *No person shall make connection of roof downspouts, exterior foundation drains, areaway drains, or other sources of surface runoff or groundwater to a building sewer or building drain which in turn is connected directly or indirectly to a public sanitary sewer.*
> *(Ord. 987, passed **3-16-70**) Penalty, see § 52.999*
>
> ***USE OF PUBLIC SEWERS***
> ***52.065 DISCHARGE OF STORMWATER AND OTHER UNPOLLUTED DRAINAGE***
> *(A) No person shall discharge or cause to be discharged any stormwater, surface water, groundwater, roof run-off, subsurface drainage, uncontaminated cooling water, or unpolluted industrial process waters to any sanitary sewer… (Ord. 987, passed **3-16-70**) Penalty, see § 52.999*

[18] Strand Associates, Report for City of Washington, Illinois-Preliminary Engineering Study for the Farm Creek Trunk Sewer (October 2019), Table 2.03-5, 2-18.

52.999 PENALTY

*(A) Whoever violates any provision of this chapter, for which another penalty is not already provided, shall be fined not more than one hundred dollars ($100.00) for each violation. Each day's violation shall constitute a separate offense. (Ord. 987, passed **3-16-70**)*

This section of the City Code of Ordinances was updated and amended on December 6, 2021 as Ordinance 3442 (Appendix L) to provide further limits and controls, including the following excerpts and explanations.

§ 52.056 CONNECTION AND REPAIR OF PRIVATE SANITARY SEWER LATERALS

Explanation: This ordinance clarifies that the property owner is responsible for the maintenance of the sewage service pipe.

DISCHARGING OF SUMP PUMPS AND PERIMETER TILES INTO SANITARY SEWERS

§ 52.081 PURPOSE

… No person shall discharge or cause to be discharged any stormwater, surface water, groundwater, roof run-off, subsurface drainage, uncontaminated cooling water, or unpolluted industrial process waters to any sanitary sewer.

§ 52.082 INSPECTION AUTHORIZATION

The City Administrator, or one or more of his designees, are authorized and directed to cause an inspection of the plumbing fixtures and facilities, downspouts, sump pumps, building drains, building sewers, yard drains, area drains, and building or lot storm water, surface water, or ground water drainage devices located on or used by premises located in the City, in an effort to locate conditions which would permit storm water, surface water, or ground water to enter directly or indirectly the public sanitary sewer. In certain cases, an inspection may require more than one entry to the premises.

The City Administrator shall develop a plan to inspect premises in those areas that have experienced surcharging and those areas that may contribute to surcharging and shall implement said plan as soon as reasonably practical.

§ 52.083 TESTING PROCEDURES

*The City Administrator, or one or more of his designees, are authorized and directed to cause **"smoke tests", "dye tests", "TV monitor tests", or any combination of such tests to be conducted within any "area subject to surcharging and any area that may contribute to surcharging"** in order to locate conditions which would permit storm water, surface water, or ground water to enter a building sanitary drain, private sanitary sewer, or public*

sanitary sewer, or if the exact location of such conditions cannot be determined, to at least determine if, during such tests, water or dye placed in or on any such premises or in any storm water collection or diversion device located on such premises, reaches the public sanitary sewer or if smoke pumped into the public sanitary sewer emerges from locations on private property.

The aforesaid testing shall be paid for by the City, provided the owner and occupant of the premises have provided access for and consented to the inspection of the premises *as provided in Section 52.085…*

In the event the owner and occupant of a premises do not consent to the inspection as provided in Section 52.085, or provide access as defined in this Section, then ***the owner shall reimburse the City for the cost of testing****. The cost of said testing is determined to be* ***five hundred dollars ($500.00)****…*

§ 52.086 NOTIFICATION OF ACTION REQUIRED

After the City has inspected the premises, either by voluntary consent or pursuant to authorization received by court, the City shall notify the owner by written notice sent by first class mail if there is any violation of Section 52.065(A) of this Code.

The owner shall have the following periods to correct any violation:

(A) If a sump pump is hooked into the sanitary sewer, it shall be unhooked within one (1) month of such notice.

(B) If a perimeter tile (or more than one) is hooked into the sanitary sewer, then all of such tiles shall be disconnected within six (6) months of the date of such notice*. If the disconnect date falls in the months of March, April, or May, the effective date shall be May 31 of the same year.*

§ 52.088 GRANT INCENTIVE

The owner of a premises shall be eligible to receive a ***grant of the lesser of five hundred dollars ($500.00) or the reasonable costs of unhooking the perimeter tile from the sanitary sewer****, if all of the following conditions are met:*

(A) An owner and the occupant (in those cases where an owner does not reside in the premises) have provided access as defined in Section 52.083.
(B) An owner and the occupant (in those cases where an owner does not reside in the premises) have voluntarily consented to and allowed an inspection of the premises within the time frame set forth in Section 52.085.
(C) The owner has disconnected the perimeter tile within the time limits prescribed in Section 52.086 (There is no grant incentive for disconnecting a sump pump.)

With respect to the requirement of disconnecting perimeter tiles, all such work shall be done in accordance with all other ordinances of the City. The owner and occupant (in those cases where an owner does not reside in the premises) shall allow the City to inspect all work to ensure that it has been done in conformity with all ordinances.

§ 52.089 GRANT INCENTIVE - REPAIRS ONLY

The owner shall also be eligible for ***a grant of the lesser of five hundred dollars ($500.00) or the costs of repairing a sewer lateral*** *provided the following conditions have been met:*

(A) The owner and occupant (in those cases where an owner does not reside in the premises) have complied with all provisions of this Chapter.
(B) The problem with the sewer lateral was discovered pursuant to one of the testing procedures set forth in this Chapter.
(C) The owner repairs the sewer lateral in a manner satisfactory to the City with the repair to be accomplished within one (1) year of the date of the test.
(D) The owner shall provide satisfactory proof to the City of the costs of the repair.

The grant shall be paid only to the owner of the property at the time of the repair. The owner shall provide satisfactory proof to the City within ninety (90) days of notification of same by the City of their eligibility.

§ 52.092 PENALTIES

Any person who violates, neglects, or refuses to comply with, or who resists or opposes the enforcement of any provision of this ordinance shall be punished by a fine of One Hundred Dollars ($100.00) per month that such violation, neglect, or refusal continues...

2. We recommend that the City begin a targeted Basin-by-Basin approach toward removing public I/I following the ordered list in Table 7.2.
   - Smoke testing will find both public and private illicit connections.
   - Televising the sewers will find defects in the pipes and manholes can be visually inspected.

During the manhole inspection GIS information can be collected, including location coordinates of the structure, rim elevation, invert elevations, pipe diameters and pipe material. The current GIS model has the ability to maintain a database of all of this information and more (such as construction date, repair history, inspection dates, etc.)

Once the defects are recorded, a repair program can be developed for the basin. Repairs may include:

- Sewer lining
- Telegrouting
- Manhole lid replacement
- Manhole rim adjustment
- Chimney seal installation
- Manhole grouting and/or lining
- Surface connection removal – sometimes involves building a stormwater collection system
- Illicit connection removal
- Abandoned service removal

Unfortunately, an estimate for the total cost of repairs cannot be provided until inspections have been completed.

In addition to the Basin-by-Basin work, the existing Farm Creek Trunk Sewer also needs to be inspected and repaired. Estimates for the sewer repair portion of that work are including in Table 7.1.

7.7 Alternative G, No Build.

At its most restricted point, the existing Farm Creek Trunk Sewer has capacity to serve a population equivalent 26,443 persons without overflowing or surcharges. This utilizes a standard peaking factor of 2.53, which would be used for a new design, and indicates that the sewer should have capacity for the current City population and future growth. However, the actual peaking factor for the FCTS is 18.44 due to excessive Inflow/Infiltration (I/I), meaning that water other than wastewater is entering the system and bringing the total flow rate up several orders of magnitude greater than it was designed to handle. In effect, just the excess flow is equal to a population equivalent of 133238 persons.

Under the No Build alternative, the Farm Creek Trunk Sewer will be inspected and repaired (estimates are included in Table 7.1), but no other work will be completed. In lieu of construction of new trunk sewers (Alternatives A-C), relief sewers and pump station (Alternative D), or relief sewers (Alternative E), effort will be spent to eliminate the excess I/I. With excess flows removed, the existing Farm Creek Trunk Sewer will no longer overflow or surcharge, and the existing capacity will be freed up for future growth.

8.0 Environmental Impacts

Each of the construction options will still short-term consequences that must be addressed as part of the IEPA permitting process through consultation with the US Army Corps of Engineers and the Illinois Department of Natural Resources (IDNR).

IDNR records three separate actions in the area:

1. 1610133, 4/29/2016, WASHINGTON SEWAGE TREATMENT PLANT NO.2 - PHASE 2A IMPROVEMENTS which resulted in Consultation Termination
2. 2004071, 11/7/2019 Farm Creek Trunk Sewer Replacement and Influent Pumping Station which resulted in No T&E species or natural areas in vicinity of the project
3. 2101905 8/24/2020 which resulted in Consultation Termination

Any work subject to IEPA permitting requires the same consultation.

A concern that has been voiced is removal of trees. The northern routes have smaller trees (less than 18" diameter) that may be impacted. However, much of the sewer routing is within or adjacent to clearings to minimize impacts. Alternative A, Strand Alignment B comes near to some mature oak and hickory trees that should be shown on the plans and called out for protections.

Small adjustments in alignment can be made to avoid trees, or short tunnels under mature trees can be made. A detailed tree survey is recommended for any route and field consultation with affected property owners is recommended. Specific environmental impact discussions for each option follows.

8.1. Alternative A, Strand Alignment B

This alternative is entirely south of the railroad and primarily runs through existing forested land. Several wetlands will be impacted through placement of manholes and sewers and from construction access. While any impact will include restoration and mitigation as part of the required IEPA permits, there will be short term consequences, including to mature trees. The alignment comes near some mature oak and hickory trees that should be shown on the plans and called for protection to reduce the impact. Additional use of trenchless technology could also be employed.

As a replacement of the Farm Creek Trunk Sewer, the existing sewer will need to be properly decommissioned. This will entail construction access to the existing line and disturbance of wetlands and trees to properly abandon the sewer. This alternative also has the most creek crossings; however, creek crossings will be completed with directional boring techniques to negate most environmental impacts.

8.2. Alternative B, Pudik Alignment L-1

While located north of the railroad tracks, this new sewer will still have impacts similar to Strand Alignment B; however, portions of the sewer will be placed in open land, reducing the environmental impacts. This northern route has smaller trees (less than 18" diameter) that may be impacted. The alignment also includes fewer creek crossing, though the benefits of this are less significant due to trenchless installation methods used in Alternative A. Strand Alignment B.

As in the case of Alternative A. Strand Alignment B, the existing Farm Creek Trunk Sewer will require abandonment. Construction access, wetland impacts, and tree removals south of the railroad will still be necessary. This diminishes the environmental benefits of this alignment.

8.3. Alternative C, Pudik Alignment E-3

By being located even further north than Alternative B, this alignment is clear of creek crossings and further removed from forested areas and wetlands. While these impacts will still be present, this alignment represents a clear improvement to the environmental impact of the project. As in Alternative B. Pudik Alignment L-1, trees are typically smaller. However, the impacts south of the railroad to the existing FCTS will be identical to both Alternative A. Strand Alignment B and Alternative B. Pudik Alignment L-1.

8.4. Alternative D, Pump Station and Relief Sewer.

The forcemain and sewer constructed in this alternative closely follow the alignment of Alternative C. Pudik Alignment E-3. As such, the environmental impact is similar. However, this alternative has several advantages. The forcemain is constructed at a much shallower depth than the gravity sewer, which reduces the width of excavations and construction access, therefore reducing impacts. In addition, the existing Farm Creek Trunk Sewer is retained, and while maintenance and repairs are needed, it is unlikely that the entire sewer system would need to be accessed, which would reduce the impact south of the railroad tracks compared to Pudik alignment.

8.5. Alternative E, Relief Sewers

The total construction length of this option is only 3,640 feet, which is significantly less than all other construction options. The first bypass sewer is located north of the railroad. The second bypass sewer is located entirely on the STP#1 property, and while environmental impacts will be present, they will not affect private property. By reducing the total construction length, this option is anticipated to result in the smallest environmental impact. In addition, the existing FCTS is kept in use, so the impact south of the railroad tracks will be the same as in Alternative D.

8.6. Alternative F, SSES

Although there may be minor localized environmental impacts caused by the locating and excavation of any buried manholes and excavation to correct any illicit connections, theses would temporary. The net benefit of eliminating system overflows outweighs these negligible, temporary effects.

8.6. Alternative G, No Build

This option has the most severe environmental consequences. During completion of the SSES and I/I reduction projects, the sewer will continue to operate in its current condition, with overflows into Farm Creek and systemwide.

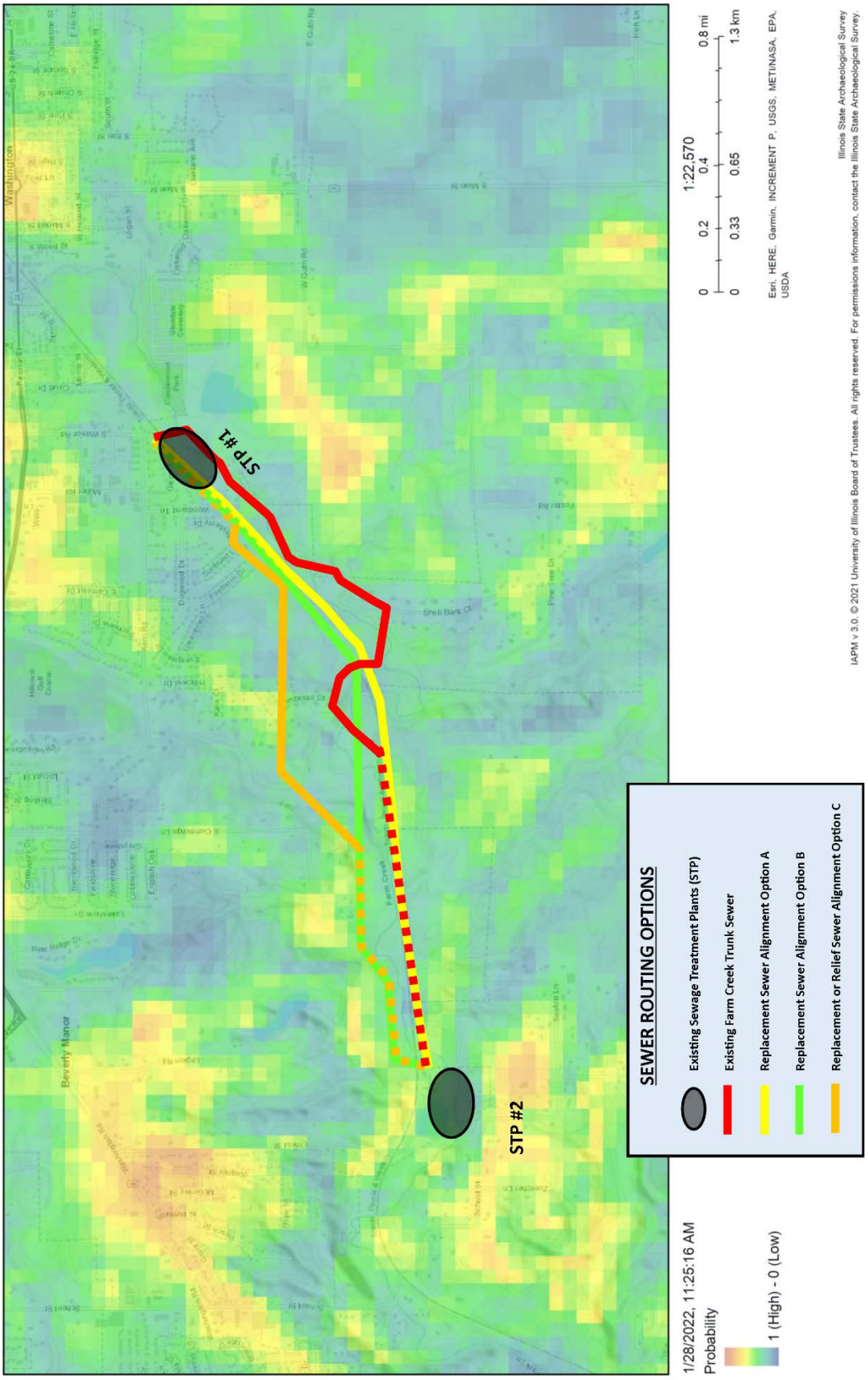
9.0 Cultural Resource Impacts

Review of the Illinois Archaeological Predictive Model shows that the Farm Creek corridor is an area of low archaeological resource probability as shown in Exhibit 9.1. However, the upland areas around the corridor have a moderate probability of containing archaeological resources. Consultation with the State Historic Preservation Office (SHPO) is required by IEPA as part of the permitting process, and a Phase I Archaeological Survey of any chosen route may be required by them.

While Alternative C may have a greater chance of encountering cultural resources or requiring an archaeological survey, there is not a significant benefit or detriment to any specific option.

Exhibit 9.1

Illinois Archaeological Predictive Model (IAPM)



10.0 Landowner Impacts (Easement Locations)

Even the existing sewer has easement issues that should be addressed.

A summary of the easement requirements for each alternative follows:

Existing Farm Creek Trunk Sewer - If Option D, E, F, or G is chosen, and the existing FCTS is kept in use:

- It should be mapped by an Illinois Licensed Professional Land Surveyor.
- The existing 20' easements should be renegotiated to be placed over the actual location of the existing sewer.
- Access easements should be identified, negotiated and obtained to allow access for future maintenance.

Alternative A. Strand Alignment B:

- Strand has already completed Easement documents for this alignment.
- Easements will be required from 6 property owners
- 12.30 acres of permanent easements are required*
- 10.51 acres of temporary construction easements are required*

* There is a "double-counting" of easement requirements because the permanent and construction easements overlap

Alternative B. Pudik Alignment L-1:

- Easements will be required from 7 property owners
- 7.73 acres of permanent easements are required
- 6.19 acres of temporary construction easements are required

Alternative C. Pudik Alignment E-3:

- Easements will be required from 7 property owners
- 7.13 acres of permanent easements are required
- 4.90 acres of temporary construction easements are required

Alternative D. Pump Station and Relief Sewer:

- Easements will be required from 7 property owners
- 4.20 acres of permanent easements are required
- 5.74 acres of temporary construction easements are required

Alternative E. Relief Sewers:

- Easements will be required from 2 property owners
- 1.67 acres of permanent easements are required
- 0.94 acres of temporary construction easements are required

Alternative F. Sanitary Sewer Evaluation Surveys (SSES):

- Access easements should be negotiated to allow access of any sewer with restricted access (rear yards, side yards, etc.)
- Access for remote portions of the Farm Creek Trunk Sewer should be further identified, negotiated, and obtained.

Alternative G. No Build Option:

- Access easements for remote portions of the existing FCTS should be further identified, negotiated, and obtained.

A comparison table of the easement requirements for each alignment alternative follows.

Table 10.1
Easements Required for Each Construction Alternative

Force Main Alignment — **WASHINGTON SEWER MAIN EASEMENTS** — Date: 2/11/2022

SUMMARY TABLE		Alternative A *Strand B*		Alternative B *Pudik L-1*		Alternative C *Pudik E-3*		Alternative D *Pump Station*		Alternative E *Relief Sewers*	
Property Owner	PIN	Permanent Easements (Acre)	Temporary Easements (Acre)	Permanent Easements (Acre)	Temporary Easements (Acre)	Permanent Easements (Acre)	Temporary Easements (Acre)	Permanent Easements (Acre)	Temporary Easements (Acre)	Permanent Easements (Acre)	Temporary Easements (Acre)
City of Washington	02-02-22-400-012	-	-	-	-	-	-	-	-	-	-
	02-02-22-400-015	-	-	-	-	-	-	-	-	-	-
	02-02-23-302-007	-	-	-	-	-	-	-	-	-	-
	02-02-28-100-003	-	-	-	-	-	-	-	-	-	-
	02-02-22-400-012	-	-	-	-	-	-	-	-	-	
	02-02-23-302-007	-	-	-	-	-	-	-	-	-	
	02-02-28-100-003	-	-	-	-	-	-	-	-	-	
Ehrsam, Scott	02-02-27-101-004	-	-	-	-	-	-	-	-	0.05	-
Feeney, William	02-02-28-200-009	-	-	-	-	0.16	-	0.12	0.24	-	-
Firethorn, LLC	02-02-22-400-014	-	-	1.28	0.85	1.12	0.73	0.47	0.73	-	-
Franzen, Katherine	02-02-27-100-008	0.31	-	-	-	0.42	0.30	0.17	0.33	-	-
	02-02-27-100-009	-	-	0.35	0.35	-	-	-	-	-	-
Kara Steeplechase Estates, Inc. (Lisa Hines)	02-02-27-100-010	-	-	0.95	0.71	1.61	1.24	0.62	1.24	0.38	0.11
	02-02-27-100-011	0.06	-	2.02	1.34	-	-	-	-	0.95	0.63
	02-02-27-101-005	-	-	0.19	-	-	-	-	-	0.29	0.20
Meadow Valley, LLC (Gary Deiters) - N/o TP&W	02-02-28-100-006	-	0.17	0.92	0.92	0.96	0.96	0.96	0.96	-	-
Meadow Valley, LLC (Gary Deiters) - S/o TP&W	02-02-28-100-006	2.07	2.43	0.08	0.08	0.08	0.08	0.08	0.08	-	-
Miller, Sam & Carol - N/o TP&W	02-02-28-200-003	0.06	-	0.12	0.12			-	-	-	-
Miller, Sam & Carol - S/o TP&W	02-02-28-200-003	3.59	4.94	-	-			-	-	-	-
Plattner, Sally	02-02-28-200-006	1.07	-	1.13	1.13	2.63	1.59	1.67	1.93	-	-
Goat Springs, LLC	02-02-27-100-005	1.57	0.94	-	-	-	-	-	-	-	-
Pudik, Jack S.	02-02-27-100-006	3.57	2.03	-	-	-	-	-	-	-	-
Wiegand, Kenneth & Susan	02-02-28-200-007	-	-	0.69	0.69	-	-	-	-	-	-
	02-02-28-200-011	-	-	-	-	0.15	-	0.11	0.23	-	-
Affected Property Owners		6		7		7		7		2	
Total Acres		12.30	10.51	7.73	6.19	7.13	4.90	4.20	5.74	1.67	0.94
		22.81		13.92		12.03		9.94		2.61	

Notes on Alternative A, Strand Alignment B

[1]Permanent Easements includes Ingress/Egress Easements

[2]Temporary Easements include Permenant Easement Acreage as provided in Strand documents

[3]Easements for Franzen, Katherine and Plattner, Sally are for Ingress/Egress only

[4]Easement documents were not provided for Goat Springs, LLC or Pudik, Jack S. and were calculated by HCE.

11.0 Accessibility

The existing sewer is the least easily accessible route since it crosses the creek, tributaries, and the railroad. As stated in Section 10 of this report, access routes should be obtained.

Alternative A, Strand Alignment B has the same issues with access needed to the existing sewer to decommission and to the proposed sewer alignment for construction and future maintenance. However, after proper abandonment of the existing sewer, long term access will not be necessary to the existing Farm Creek Trunk Sewer. Strand has already included access routes in their required easements.

Alternatives B and C (Pudik Alignments L-1 and E-3) are readily accessible, and entail fewer creek crossings, but will require access easements to reach the sewers from different locations. In addition, the existing FCTS will need to be accessed to be properly abandoned, but, like Alternative A, access routes to the existing sewer are only temporary. Being further north and located through the Timber Rail neighborhood, Alternative D (Alignment E-3) will impact the greatest number of properties and owners with access needed between residential homes.

Alternative D, Relief Sewers is largely identical to Alternative C, with the route closely following that alignment. While the FCTS is being kept in use, access routes are still required for maintenance and should be obtained in perpetuity.

Alternative E, Bypass Sewers has a similar long-term impact to the existing Farm Creek Trunk Sewer in that access is needed in the short-term for inspection and repairs, but also the long-term for future maintenance. However, since construction of new sewers is reduced, and one bypass sewer is located entirely on City property (STP#1), the overall impact of sewer access is less.

Alternative F, SSES. For sewers, including the FCTS, that are within difficult-to-access easements, access routes should be acquired and maintained. Televising and telegrouting can be performed using small trucks and sliplining can also be performed in 15-20-foot-wide access easements.

Alternative G, No Build. Accessibility for this alternative will require access routes for the existing FCTS manholes that currently do not have them, but for no other areas. Access will be required in the short-term and long-term. With no construction, this option has the least impact with regard to access.

When the City selects a preferred option, detailed easements can be researched and prepared.

12.0 Future Service Area Expansion Opportunities

The City has a defined Comprehensive Planning Area. A suggested planning strategy for developing Comprehensive Plans includes plans for extension of utilities so that properly sized expansions can be made when annexation requests are being considered. This section of the report is offered to provide the City our professional opinion as to which considered options further, hinder or do not limit future growth opportunities.

12.1 Alternative A, Strand Alignment B

Strand's report presents a detailed Basin-by-Basin flow analysis that shows the ultimate tributary area to the Farm Creek Trunk Sewer will serve a population equivalent (PE) of 98,925 (see Table 2.02-3 in Appendix M). The area is shown graphically in their untitled Exhibit following page 3-1. For this report HCE has reviewed the City's GIS Utilities map, and Tazewell County LIDAR and found that there is additional area that can receive gravity service from the existing Farm Creek Trunk Sewer or from Alternative A (Strand Alignment B). This area represents 6,600 acres with an ultimately developed PE of 66,000. It is shown on Exhibit 12.1.

The Alternative A 42" sewer, at 0.30%, has a capacity of 35.62 MGD. In order to serve the entire potential future service area and the current excess flows in the system from I/I, the required capacity of the sewer is 61.61 MGD. Therefore, additional trunk sewers will be required in the future to realize all possible growth. However, with flow reductions from a SSES and I/I removal project, the required capacity is only 26.17 MGD thus leaving capacity in the sewer for 9.45 MGD from the Additional Area.

This alternative maximizes future service area upon completion of the project.

12.2 Alternative B, Pudik Alignment L-1

Much of Alternative B sits above the bed of Farm Creek, therefore it cannot serve the Additional Service Area without pump stations. While the capacity of the sewer is the same as Alternative A, significant future cost is needed to accommodate growth with the Comprehensive Planning Area.

12.3 Alternative C, Pudik Alignment E-3

This alternative has the same capacity as Alternatives A and B. Similar to Alternative B, Alternative C cannot serve the Additional Area without pump stations. However, this alignment is further north and along higher ground, and has deeper sewers, which further limits growth accessible with gravity sewers and will increase the cost and length of future pump stations and forcemains.

12.4 Alternative D, Pump Station and Relief Sewer

The pump station and relief sewer have the ability to offload all or a portion of the flow from Basins 7, 8 and 9. The 36", 0.25% gravity portion of the sewer has capacity of 21.55 MGD which exceeds ultimate required capacity of 14.97 MGD however, the SSES will be required to meet this flow requirement. Since the existing Farm Creek Trunk sewer will remain in service, this option has the same service area as Alternatives A, B and C, but with

the same need for pump stations and forcemains. Additional relief sewers will be necessary to achieve ultimate build-out of the service areas.

12.5 Alternative E, Relief Sewers

The construction of relief sewers to eliminate sewer overflows does not in itself provide for capacity for expansion. However, by continuing to utilize the existing Farm Creek Trunk Sewer, the same service area is accessible as all prior alternatives. In addition, removing sources of I/I with an SSES increases the available capacity of the FCTS to 11.27 MGD (49,648 PE).

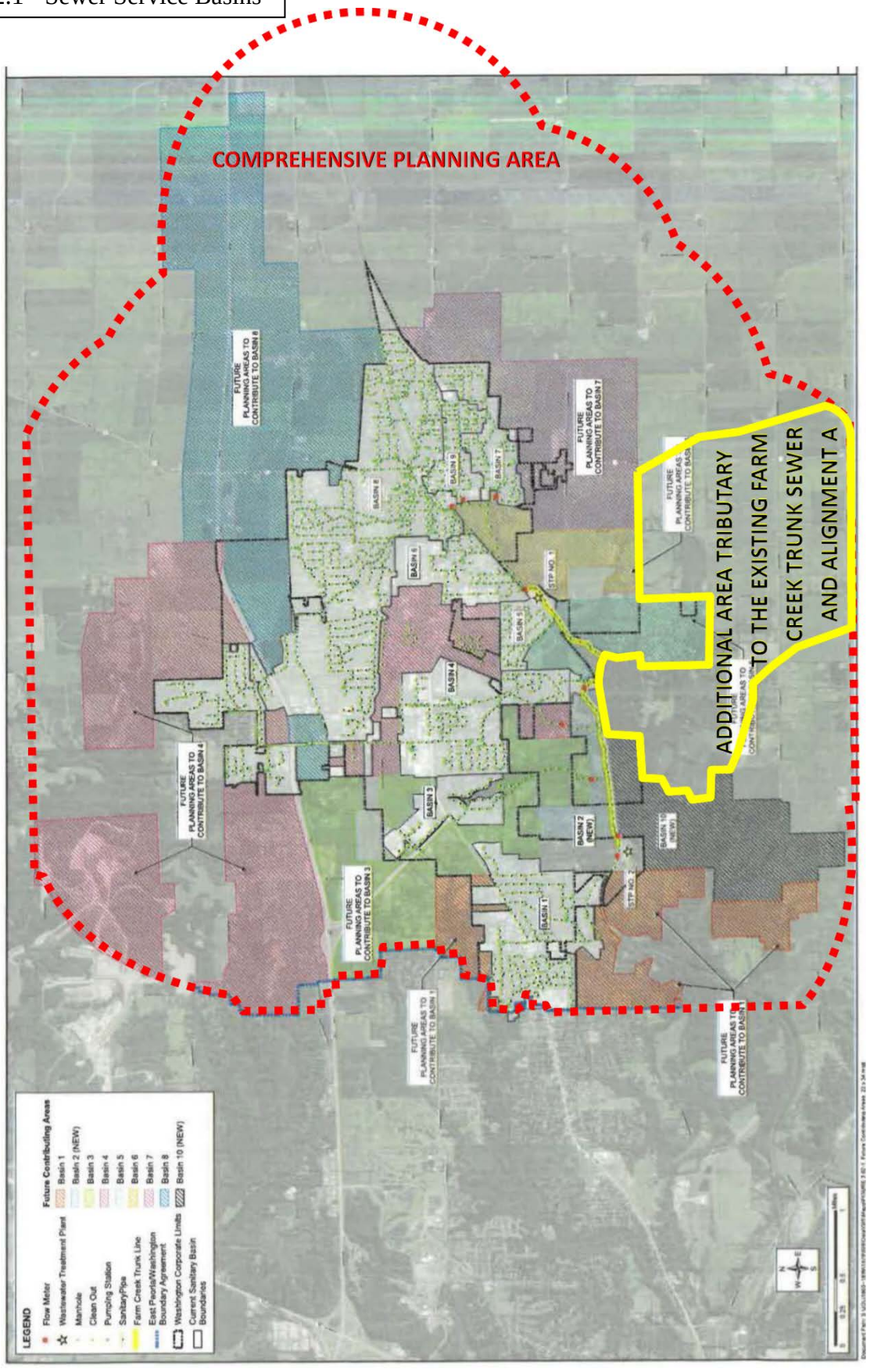
12.6 Alternative F, SSES

The SSES alone will not allow the Service Area to fully develop. If successful, it will open-up capacity for 6.69 MGD (26,443 PE) capacity in the Farm Creek Trunk Sewer.

12.7 Alternative G, No Build

For this alternative, the existing FCTS is left over capacity. Therefore, Service Area expansion is not possible.

Exhibit 12.1 - Sewer Service Basins



13.0 Permitting Issues (IDNR, USACOE, IEPA)

All alternatives are equally permittable.

Although permitting requirements vary for each option, only the No Build option shows an advantage in this category.

IEPA permits:

- Will be required for any of the new construction projects (Alternatives A-E),
- Will be required for abandonment of the existing sewer (Alternatives A-C),
- Will not be required for maintenance of the existing FCTS (Alternatives D-F).

The No-Build option (Alternative G) has no immediate permitting need. While Alternatives D, E and F have fewer permitting needs by keeping the existing FCTS, there is not a distinct advantage since IEPA permits are required for construction.

IDNR permits will not be required for any stream crossing IF the crossings are designed to conform to the State-wide permit program.

- Projects that are designed to conform with State-wide permit requirements can be constructed without submittal and review by IDNR.
- It is strongly recommended that all projects be designed and constructed in this manner, making all Alternatives equal in this regard.

The U.S. Army Corps of Engineers will need to review any wetland impacts to confirm that work is covered under the Nation-wide permit program.

As all Alternatives involve probable wetland impacts – whether from new construction, abandonment of the existing Farm Creek Trunk Sewer, or maintenance work to the existing FCTS – all Alternatives are equal in this regard.

14.0 Impact on Residents of the City (immediate and long-term)

Allowing excessive I/I to persist will have a negative impact on the residents of the City of Washington in both the immediate and long-term case. The excess flow will require more engineering studies to plan relief sewers and sewage treatment plant expansions to treat the excess flows. Operation costs will remain high as pumps will need to pump the higher flows and plants will need to treat a greater amount of wastewater.

The sewer routing proposed in Alternative A. Strand Alignment B and Alternative B. Pudik Alignment L-1 minimizes impact on current and future properties by following existing property lines and by staying clear of residences and residential properties.

Alternative C. Pudik Alignment E-3 and Alternative D. Pump Station and Relief Sewer also following existing property lines but include work in residential areas and between residential lots. However, impact is reduced due to work in open spaces, which lessens the impact.

Alternative E. Relief Sewer has a direct impact on the rear yard of one residential property. As previously noted, a patio and fire pit will be disturbed by construction and will need to be rebuilt upon project completion. The improvements can be fully restored after project completion, so there is no long-term impact on the property.

Alternative F. SSES has the greatest short-term impact upon individual residents, but the greatest long-term benefit with reduced costs at the STP and reduced damages due to basement sewer backups. It is very likely that most homes that were built prior to the mid 1980's have foundation drains tied directly to the sanitary sewer. Ordinance 52.051 prohibits these to remain, but most residents avoid complying due to cost which can be as high as $6,000 per home to disconnect and construct an outdoor sump pump. However, since a single 4" diameter foundation drain from one home can contribute 100 gpm to a sewer it takes only a few connected homes to cause sewer backups into their neighbors', and the homeowner's own basements during a rainstorm. These are also a significant factor in the Farm Creek Trunk Sewer overflows.

Sump pumps are usually simple to disconnect. A single sump pump typically produces 50 gpm of flow, and it can be disconnected from the sanitary sewer service with just a few dollars' worth of PVC pipe and fittings. However, once a homeowner tires of a puddle in their yard, it is just as easy to reconnect the pump to the sanitary sewer. This is why private sources of I/I are a nearly constant headache for public works personnel and frustrating for homeowners as well.

15.0 Constructability

Constructability analysis is part of the design process of any large-scale project. Strand has addressed this issue with access routes included in their design and reflected in their preliminary opinions of construction cost, although further attention to the protection and preservation of mature trees is warranted. For the alternatives that we have prepared we have provided allowances for tree preservation and construction access in the estimates as well for construction in steep slopes and wooded areas.

Each of the alternatives has a need for trenchless construction. Railroad crossings will require auger boring with a casing pipe. Stream crossings, especially those with less than 4 feet of cover should also be constructed by auger boring with a casing pipe. The casing is a preferred alternative because it allows for good control of pipe slope, the casing protects the sewer from trench settlement, infiltration, or damage should the stream bed erode to below pipe elevation.

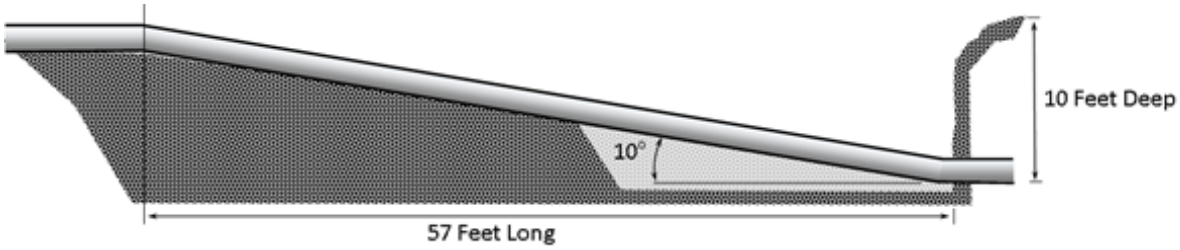
For this type of work a trench of about 25'-25' length is constructed on one side of the bore (the jacking pit) and a trench of about 10-15' is constructed at the other end (the receiving pit). An auger drills from the jacking pit to the receiving pit and a steel casing pipe is jacked behind the auger. Each length of casing pipe is welded to the next. Once the casing pipe is installed, the sewer (carrier pipe) is pushed into the pipe with spacers to keep it on the required slope. Once it is in-place gravel is jetted into the annular space around the pipe and the ends of the casing are sealed in concrete. Maximum length for this type of work is about 600'.[19]

For horizontal directional drilling there is no casing pipe, and the sewer is assembled above ground and pulled into the bore hole behind the horizontal drill head. Different sewer pipe materials have varying maximum angles that each joint may be deflected before failure, but the common value on 10^{o} is provided as an example herein. For a typical depth of 10 feet, a 10^{o} slope behind the face of the trench requires a slope length of 57 feet with no horizontal deflection. Also, the pipe typically needs to be assembled on a level surface before it can be "bent" into the trench, so there needs to be a cleared, level surface behind the trench on which to assemble the pipe.

The geometrics of Alternative A, Strand Alignment B. can accommodate this type of construction. The other gravity sewer alignments will be more difficult due to depth and horizontal alignment challenges.

[19] Vermeer Corporation, *HORIZONTAL DIRECTIONAL DRILLING VS. AUGER BORING,* https://protips.vermeer.com/underground/2021/11/22/horizontal-directional-drilling-vs-auger-boring/

Exhibit 15.1
Directional Boring
Approach Slope Requirements



16.0 Conclusions

As part of this project, HCE has reviewed seven project alternatives against nine design and planning criteria. Below are our conclusions:

16.1. Environmental Impacts

Alternative G. No Build has the highest degree of impact due to the continuance of overflow events of the Farm Creek Trunk Sewer.

Of the construction options:

Alternative A. Strand Alignment B has the most impact due to its location south of the railroad tracks.

Alternative B. Pudik Alignment L-1 and Alternative C. Pudik Alignment E-3 have less impact the Alternative A and are similar to one another.

Alternative D. Pump Station and Relief Sewers has further reduced impact due to the shallow excavations for the forcemain.

Alternative E. Relief Sewers has the least negative impact since it involves the least construction.

Alternative F. SSES has only positive environmental impacts.

16.2. Cultural Resource Impacts

There is not a significant benefit nor detriment to any one alternative over another.

16.3. Landowner Impacts

Alternative F, the Sanitary Sewer Evaluation Survey (SSES) will impact the greatest number of landowners. Typically, a door-to-door survey is required to confirm if sump pumps are connected to the sanitary sewer, and this will directly impact a significant portion of the City residents. Smoke testing of the public sewers often results in smoke appearing next to foundations due to illicit footing tile connections, and smoke will collect in yards over leaky sewer services. Dry floor drains and sinks will allow smoke to collect inside of homes. These are all direct impacts. Repair of the discovered defects will also be a direct impact.

Of the five construction options, those on the north side of the railroad, Alternatives B, C, and D impact the most properties (7). Alternative E, Relief Sewers affects only 2 properties.

16.4. Accessibility

Alternatives located south of the railroad are the least accessible. This includes Alternative A and Alternatives D-F, which involve keeping the existing Farm Creek Trunk Sewer.

However, all construction alternatives require at least temporary access to the existing sewer.

Of the options that retain the FCTS, Alternative G requires no other access, and Alternative E requires the least after that.

Alternatives B-D are more accessible, but C and D require access across residential neighborhoods.

16.5. Future Service Area Expansions

The issue for comparing Service Area opportunities is strongly related to timing.

Alternative A serves the greatest Service Area by building an oversized sewer today.

Alternatives D, E and F allow future expansion potential when needed by increasing capacity in the existing sewers today.

Alternatives B and C actually decrease Service Area expansion opportunities.

16.6. Permitting Issues

All alternatives will require permitting, whether that's temporary impacts related to access, or construction permitting. As such, no alternative is more desirable, and all alternatives are equally permittable.

16.7. Impact on Residents

Alternatives A and B follow existing property lines and avoid residential properties.

Alternatives C and D follow existing property lines but include work in residential areas.

Alternative E has a direct, but temporary impact to one residential patio and fire pit.

Alternative F may impact most residents city-wide.

Alternative G has no land acquisition impact beyond access and easements for the existing FCTS, which all Alternatives share. However, there are many residents who have reported sewer backups, which will remain in the No Build Alternative G.

16.8. Constructability

For alternatives to construct a new trunk sewer, Alternative A best accommodates trenchless technology, while Alternatives B and C will be more difficult due to alignment and increased depth.

Alternative D improves on constructability by utilizing a shallow forcemain.

Alternative G includes no new construction, while Alternative E includes the least new construction, making either option preferable.

Alternative F SSES may have construction on private property or within paved roadways.

16.9. Cost Effectiveness

The Engineer's Opinion of Probable Construction Costs for each alternative follows. Easement costs are within 25% contingency for each of the construction options:

Alternative A, Strand Alignment B $8,000,000
Alternative B, Pudik Alignment L-1 ..... $10,980,642
Alternative C, Pudik Alignment E-3 ..... $12,581,197

Note: Alternatives A, B and C must have the cost of FCTS abandonment added.

Alternative D, Pump Station and Relief Sewer $7,618,040
Alternative E, Relief Sewers $1,475,200
Alternative F, SSES..... Unknown

Note: Alternative D, E and F must have the cost of FCTS evaluation and repair added as needed per Alternative G below.

Alternative G, No Build ..... </=$1,631,458

Alternative E has the most benefit for the least cost.

Alternative D is next, followed by Alternative A.

However, Alternative A has already been designed to 90% completion, making it the most desirable option after Alternative E.

Alternative F involves development of an SSES and I/I removal project, which cannot be estimated without further work and analysis.

17.0 Recommendations

In Alternative A, Strand Alignment B, the City has a nearly complete set of design documents for a new trunk sewer. Due to the investment of time and resources, there is good cause to continue with the process. Plus, with a design capacity of 201,243 PE, this alternative provides the City with the most sewer capacity for future growth if excess flows are reduced in the near future.

While the new construction associated with Alternatives C and D (Pudik Alignments L-1 and E-3) results in less environmental impacts, the work necessary to properly abandon the existing Farm Creek Trunk sewer lessens the advantage of either alignment. Advantages in accessibility are also offset by more difficult constructability, higher costs, and reduction or additional costs needed to reach the desired service area. As such, Alternative A is recommended over these options.

However, in our professional opinion, there is good reason to reconsider the assumption that the Farm Creek Trunk Sewer should be decommissioned, and a new trunk sewer constructed.

Without addressing the inflow and infiltration problems presented in the Strand Report, any new sewer will need to transport and treat extremely high peak flows. The decision to allow this to continue should be reevaluated.

Furthermore, should these flows be reduced, the existing Farm Creek Trunk Sewer has capacity to accommodate growth and reach the largest service area.

From our own investigations, we do not find the existing sewer to be in disrepair to the point of abandonment.

Applying the same construction dollars that a new sewer would cost to development of an SSES, to repairing defects in the FCTS, and to resolving surcharges and overflows would save the City the immediate costs associated with a new trunk sewer, and the long-term costs for transporting, pumping, and treating the high peak flows experienced by the City.

In addition, without removing these flows, future growth will require improvements to the treatment capacity of STP#2. These improvements could be delayed if the excess flow is removed from the system.

We recommend the following approach.

1. Design, permit, bid and construct Alternative E, Relief Sewers.

2. Perform a video analysis and repair as needed of the Farm Creek Trunk Sewer and manholes.

3. Remind the public of required compliance with Ordinance 52.051.

4. As funding allows, begin an SSES and repairs to I/I on a Basin-by-Basin approach in the following order:
    1) Basin 7
    2) Basin 9
    3) Basin 6
    4) Basin 8
    5) Remainder of the City

5. Regularly monitor flows with improved SCADA at STP#2 to observe changes in flow patterns.

    With steps 1 and 2 construction cost of just over $3.1 Million, the City could budget for I/I work and still be at a lower project cost than any other construction alternative.

    Plus, this recommended approach has the added benefit of reduced Maintenance and Operation costs at STP#2 due to reduced flows.

    Either approach – Alternative A. Strand Alignment B or the HCE-recommended Alternative E - or another combined approach of alternatives reviewed above will serve the residents of the City of Washington well.