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Memo

Project: Village of St. Joseph – North Sanitary Sewer Study
(CDI Project No. S0010070)
To: Joe Hackney, Village Administrator
From: Nicholas Rademacher and Andrea Bretl
Date: January 9, 2023
Subject: North Sanitary Expansion Study

The Village of St Joseph (St Joe) is exploring the feasibility of development possibilities that would allow for residential and commercial growth. Clark Dietz (CD) is currently working with the Village on several wastewater and stormwater capital improvement projects including wastewater treatment plant upgrades, sanitary sewer interceptor replacement, and a new large diameter storm sewer. Once these projects are complete, existing sewer system capacity issues will be resolved and the Village will be positioned for substantial developments.

The goal of this study is to evaluate the feasibility of adding sanitary sewer infrastructure north of I-74 and determine design requirements for a north expansion of the sanitary utility. This memo includes discussion of:

- Development Study Area: *Approximately 1,330 acres of developable land north of I-74.*
- Downstream Connection: *Sanitary forcemain would need to connect near Rte 150/Monroe St.*
- Preliminary Gravity Sewer Network: *Two preferred lift station options and gravity sewer layout.*
- Lift Station and Forcemain: *Lift station and forcemain sized for phased development of Study Area.*
- Preliminary Cost Estimate: *Lift station and forcemain total project cost estimated at $2,839,000.*

Development Study Area

One area of interest for development is north of Interstate-74 (see Figure 1 below). This area is currently not part of the Village, nor does it contain any Village-owned public infrastructure.

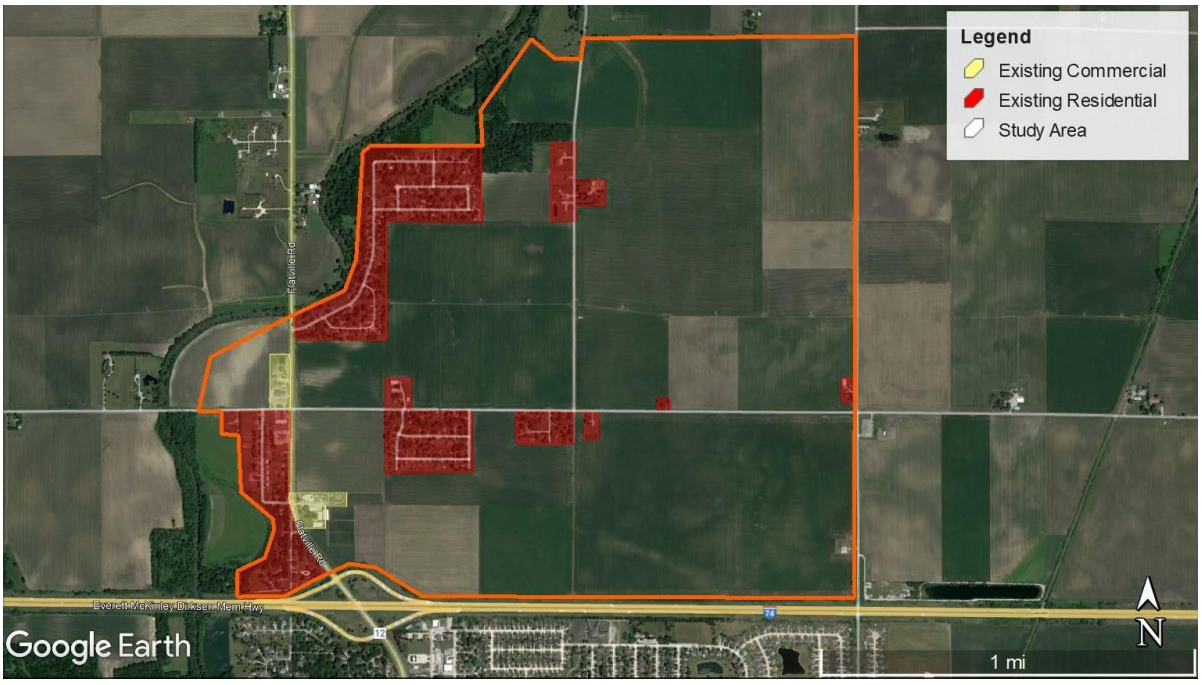


Figure 1. North Development Study Area

The Study Area contains approximately 1,330 acres of developable land. Existing land uses and corresponding acreage are summarized below in Table 1.

Table 1. Study Area Existing Land Use

Land Use	Area (Acres)
Undeveloped Land	1,150
Existing Residential	165
Existing Business/Commercial	15
Total Study Area	1,330

Development Phase Assumptions

The identified Study Area is a combination of undeveloped area and existing developed area. This creates a wide range of possibilities for development types, development timeframe, and flow contributions. The Wastewater Treatment Plant Upgrades Facility Plan prepared in 2019 by Clark Dietz for the Village was used as a reference for development scenarios. Flow assumptions from that document are summarized in Table 2 below.

Table 2. Wastewater Treatment Plant Design Values from Facility Plan

Parameter	Unit	Value
Existing Treatment Plant Flow	mgd	0.51
Expanded Capacity	mgd	0.95
Remaining Treatment Plant Capacity	mgd	0.44
Assumed # of Future Development Households	--	1,200
Development Area	acres	525
Flow Per Household	gpd	360
Households per acre	--	2.26

Unit Abbreviations
mgd: million gallons per day
gpd: gallons per day

Flow rates from industrial areas can be highly variable based on the number of employees in the building, building use, and the manufacturing or industrial process. For example, warehouses fall in the low water usage category due to minimal employees and no additional processes contributing to the sanitary sewer system while food processing facilities are in the high usage category.

For the purposes of quantifying development phase limits, only residential development was assumed. The sanitary system is capable of adding other connection types such as commercial, industrial, or multifamily residential. Anticipated flows from those developments can be compared to the available system capacity when the Village evaluates development opportunities.

Development Phases

The Study Area was divided into 3 phases of development. Design criteria from each phase of development are used in determining the immediate and future infrastructure needs. A summary of each Phase is shown in Table 3 below.

Table 3. Development Phase Summary

		Phase 1	Phase 2	Phase 3
Treatment Plant Capacity	%	75%	100%	117%
Average Daily Flow	mgd	0.19	0.44	1.11
Peak Design Flow	mgd	0.60	1.36	3.46
Assumed # of Households	--	525	1,200	3,040
Study Area Developed	%	17%	39%	100%
Development Area	acres	230	525	1,330

Figure 2 provides a visual representation to quantify the assumed level of development for each phase. These are based on all residential development at the stated household density. Actual location, quantity, and flow contribution may differ from the assumed values, but the conclusions should be similar.

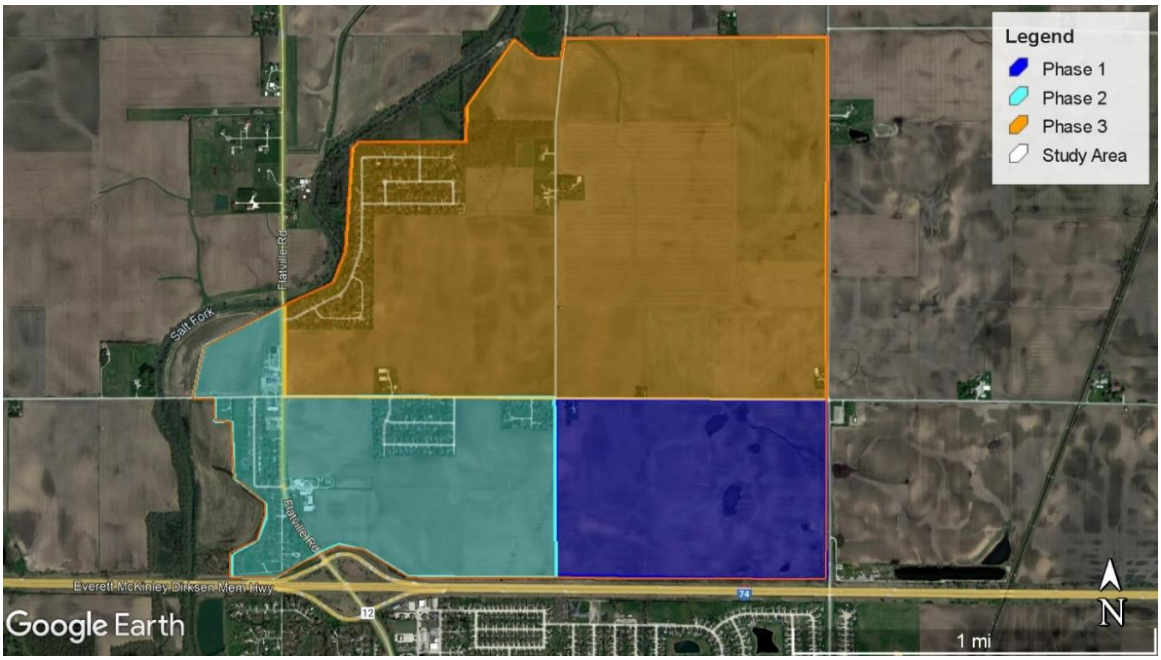


Figure 2. Assumed Development Phase Land Acreage

Phase 3 would require modifications at the wastewater treatment plant to treat and discharge additional sanitary sewer flow. While this is not anticipated to occur for some time, these values were used as a reference when considering the design criteria for the longer design life infrastructure (gravity sewers, lift station wet well substructure, etc.).

Downstream Connection

Development north of Interstate 74 requires a lift station and forcemain to transfer sanitary sewer flow to the existing sanitary network. A gravity sewer from this part of town to the existing treatment plant would be too deep to connect at the plant influent wetwell. A new treatment plant that serves only north of the interstate is not recommended due to additional construction and operational costs and permitting requirements. Two treatment plants are not feasible for communities of this population size. Therefore, a lift station and forcemain is the preferred option for conveying sanitary sewer flow.

The following downstream connection locations were evaluated to determine their capacity of conveying additional flow. These locations are shown in the following figure.

- Northeast Sanitary Basin
- Northwest Sanitary Basin
- Sanitary Sewer Interceptor

Northeast and Northwest Sanitary Basins

The existing sanitary basins adjacent to the interstate (northeast and northwest basins) are shown in Figure 3. Figure 3 also shows the new large interceptor sanitary sewer which is currently being designed and construction is anticipated in 2024-2025.

Figure 3. Existing Sanitary Sewer Basins (Northeast, Northwest)

The northeast sanitary sewer basin is approximately bounded by I-74, Main Street, Route 150, and the east Village limits. Most of this basin is served by 8-inch sanitary sewer with the downstream end connecting to a 10-inch sanitary sewer. The northwest sanitary basin is located in the existing northwest quadrant of the Village bounded by the interstate, wetland, and high school property. The basin is served by entirely 8-inch sanitary sewer.

Theoretical capacity of each sewer diameter was compared to the observed peak from the 2017 flow monitoring study. As shown in Table 4 below, the existing sewer in this area is at or above the theoretical available capacity during peak flow periods. ***Therefore, it is not recommended that sanitary sewer flow from north of the interstate connect within the northeast or northwest sanitary basins.***

Table 4. Northeast and Northwest Sanitary Basin Capacity

		Northeast		Northwest
Sewer Diameter	in	8	10	8
Service Area	acres	270	395	80
Existing Peak	gpm	365	535	320
Existing Peak	gpm/acre	1.35	1.35	4.0
Slope	%	0.40%	0.28%	0.40%
Theoretical Capacity	gpm	345	520	345
Remaining Capacity	gpm	none	none	25

Replaced Sanitary Interceptor

The Village's sanitary sewer interceptor from the wastewater treatment plant to Route 150 is anticipated to be replaced in 2024/2025. This sewer will be sized to handle future connections and increased sanitary sewer flow.

The forcemain conveying sanitary sewer flow associated with developments north of the interstate will need to connect at the upstream end of this interceptor sewer near the intersection of Monroe St and Route 150 (Warren St).

Preliminary Gravity Sewer Network

To properly size the lift station and forcemain, a preliminary gravity sewer network for north of the interstate was developed. Two options for lift station location were evaluated since exact development locations are unknown. Both locations are expected to have similar design components and construction cost.

Maps showing the two potential lift station locations and associated forcemain and gravity sewer network are attached in Appendix A. Proposed lift station Location 1 is near the north limit of Shore Drive. Proposed lift station Location 2 is directly north of the intersection of Northgate Drive and Balsam Drive on the opposite side of Interstate 74. Also included in Appendix A are approximate ground profile drawings for the proposed interceptor sewer alignments. These profiles were used in determining required wetwell depth for the proposed lift station.

Varying sewer diameters were used based on the assumed sewer shed that would contribute flow to the pipe. Immediately upstream of the lift station would require a 21" interceptor sewer with sizes expected to decrease to 15" and 10" for tributary and connector sewers. Actual sewer sizes would be determined during final design in coordination with the Village and developers.

Lift Station and Force Main

The lift station and force main are recommended to be designed for Phase 1 and 2 flows. This determines wetwell size, pump size, and forcemain size as summarized in Table 5 below. We recommend that the lift station only be designed for the Phase 1 and 2 flows because designing for Phase 3 flows would lead to oversized infrastructure that would not operate efficiently at the flow anticipated in the short to medium term. When developing beyond 1,200 additional residences (in addition to the current number of Village residences) a lift station expansion and parallel forcemain will be required. Wastewater treatment plant capacity expansion will also be required when more than 1,200 residences are added.

Table 5. Lift Station and Forcemain Design Criteria

Parameter	Unit	Value
Wet Well Diameter	ft	10
Incoming Sewer Depth	ft	27
Wet Well Depth	ft	35
Wet Well Depth (Usable)	ft	8
Usable Volume	gal	4,700
Pump Flow Rate, each*	gpm	500
Pump Quantity (Duty/Standby)	ea	2
Pump TDH*	ft	60
Pump HP*	hp	10
Forcemain Diameter	in	8

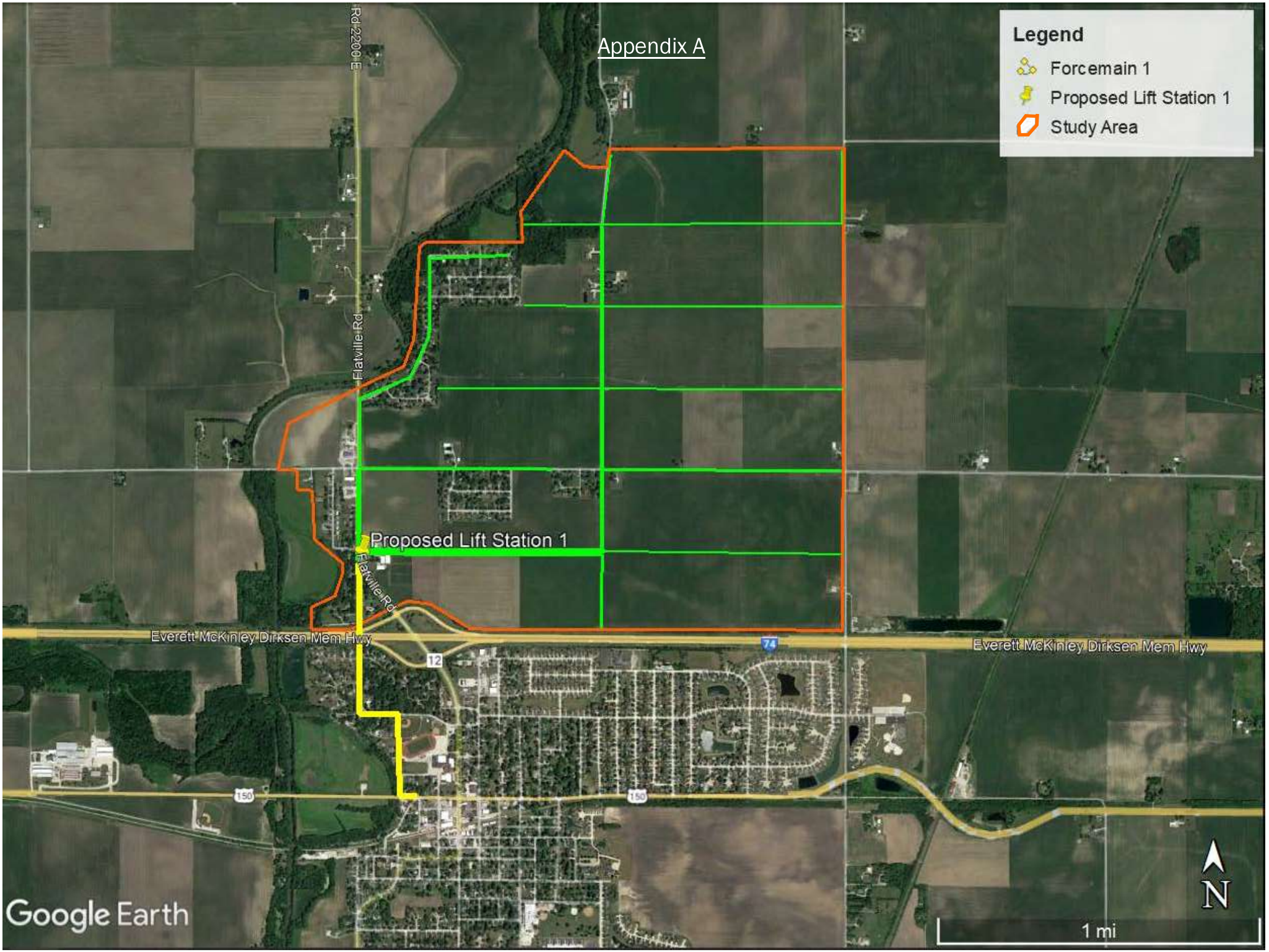
*Pump parameters based on Phase 1. Larger pumps are required for Phase 2 flows.

Preliminary Cost Estimate

The preliminary total project cost estimate for a lift station and forcemain is shown below in Table 6. This cost does not include the installation of a gravity sewer network but provides an approximate cost per foot for reference. The forcemain length is based on Location 1, with Location 2 having approximately 1,150 less feet of forcemain.

Table 6. Preliminary Total Project Cost Estimate (2023 Dollars)

Item	Quantity	Unit	Unit Price	Total
Lift Station				
Wetwell (10 ft Diameter, 35 ft Deep)	1	LS	$250,000	$250,000
Pumps (500gpm, 55ft, 10hp)	2	EA	$37,500	$75,000
Wetwell Piping, Valves, Flow Meter, Valve Box	1	LS	$100,000	$100,000
Site Work (Access, Enclosure, Grading)	1	LS	$100,000	$100,000
Site Land Acquisition/Easements	1	LS	$25,000	$25,000
Electrical/Controls	1	LS	$150,000	$150,000
			Subtotal	$700,000
Forcemain				
Forcemain (8”)	5425	LF	$150	$813,750
Bore and Jack I-74 and Rte 150	400	LF	$500	$200,000
Downstream Connection	1	LS	$15,000	$15,000
Forcemain Land Acquisition/Easements	1	LS	$25,000	$25,000
			Subtotal	$1,053,750
General				
Contractor Mobilization & Demobilization	5%			$88,000
Contractor Bonds & Insurance	2%			$35,000
Contingency	25%			$614,000
			Total Construction Cost	$2,491,000
Final Design Engineering	8%			$199,000
Construction Engineering	6%			$149,000
			Total Project Cost	**$2,839,000**
Additional Costs (for reference only)				
10” Sanitary Sewer, Open Cut, BFM2, 9-12 ft	1	LF	$200	
15” Sanitary Sewer, Open Cut, BFM2, 12-15 ft	1	LF	$250	
21” Sanitary Sewer, Open Cut, BFM2, 15-18 ft	1	LF	$350	


Appendix A
Legend
Forcemain 1
Proposed Lift Station 1
Study Area
Rd 2200E
Flatville Rd
Proposed Lift Station 1
Flatville Rd
Everett McKinley Dirksen Mem Hwy
Everett McKinley Dirksen Mem Hwy
74
12
150
150
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N
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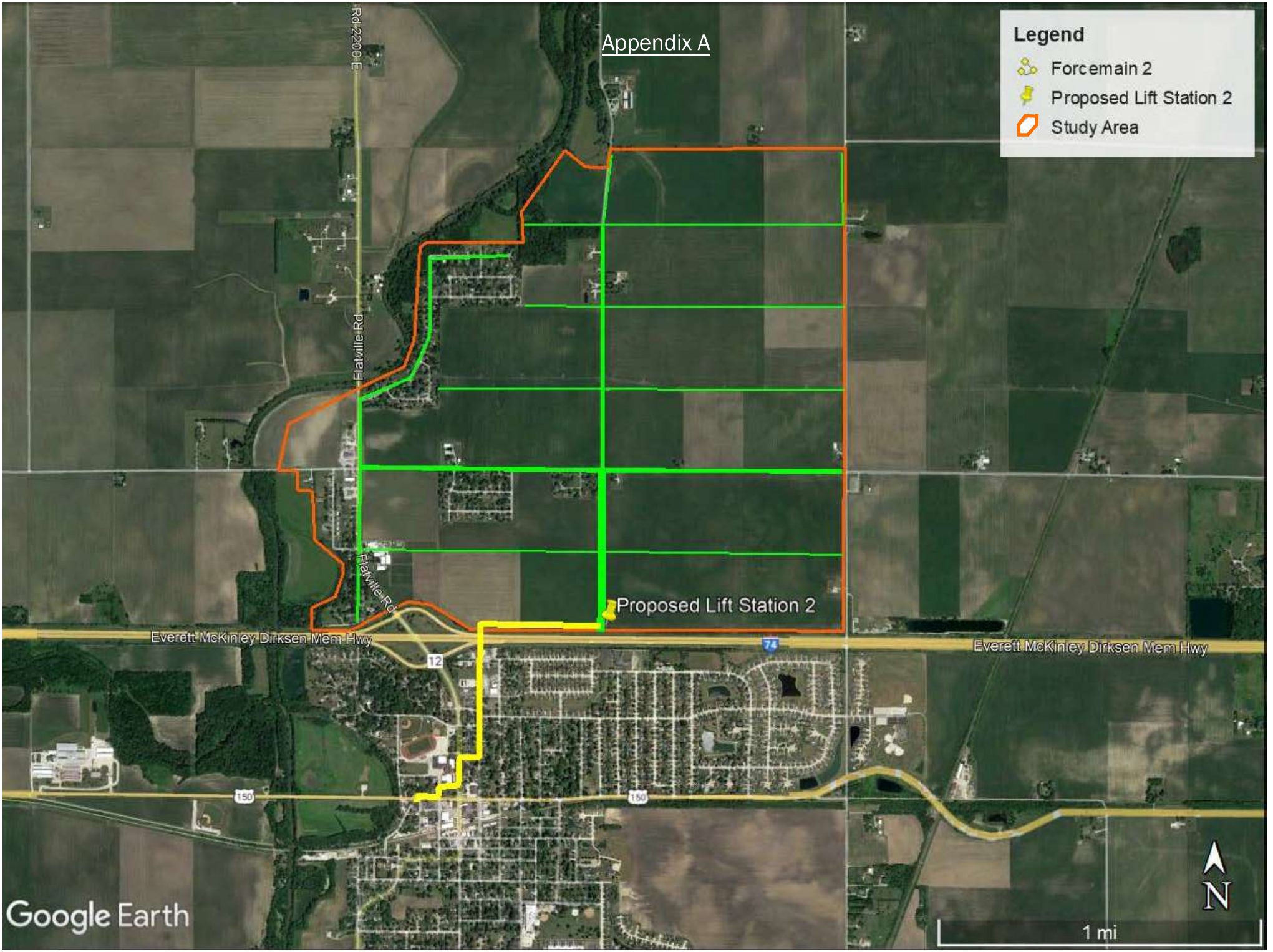
Appendix A
Legend
Forcemain 2
Proposed Lift Station 2
Study Area
Rd 2200 E
Flatville Rd
Flatville Rd
Proposed Lift Station 2
Everett McKinley Dirksen Mem Hwy
Everett McKinley Dirksen Mem Hwy
12
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Google Earth
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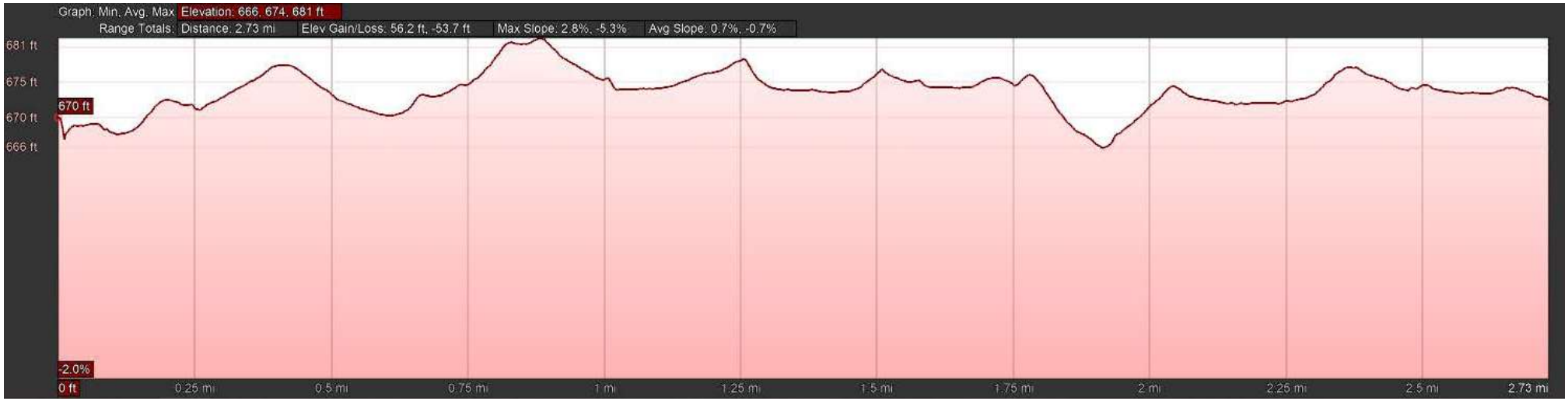
Appendix A

Approximate Ground Profile along North Sewer Interceptor from Lift Station Location 1.



Approximate Ground Profile along North Sewer Interceptor from Lift Station Location 2.