City of Troy

# Industrial Mega Site Feasibility Study

## Final Report

May 2024

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# Contents

Acronyms and Abbreviations ..... v
Executive Summary ..... 1
1 Project Background ..... 1-1
1.1 Projected Water Demands and Sanitary Flows ..... 1-2
2 Water System Evaluation ..... 2-1
2.1 Hydraulic Model Update and Validation ..... 2-1
2.2 Water System Level of Service Benchmarks ..... 2-2
2.3 Existing System Baseline ..... 2-2
2.4 Existing System Available Capacity ..... 2-6
2.5 Alternative Analysis ..... 2-6
2.5.1 Alternative 1 – Dedicated Extra High Zone Transmission Pipeline ..... 2-8
2.5.2 Alternative 2 – Integrated High Zone Transmission Pipeline ..... 2-12
2.5.3 Alternative 3 – Partial Integrated High Zone Transmission Pipeline ..... 2-17
2.5.4 Alternative Comparison ..... 2-22
2.6 Preliminary Cost Estimates ..... 2-23
2.7 Other Considerations ..... 2-26
2.7.1 Carbon Dioxide Storage: ..... 2-26
2.7.2 Well Capacity: ..... 2-26
2.7.3 Well Backup Power: ..... 2-26
3 Sanitary System Evaluation ..... 3-1
3.1 Hydraulic Model Update and Validation ..... 3-1
3.2 Sanitary System Level of Service Benchmarks ..... 3-4
3.3 Existing System Baseline Capacity ..... 3-5
3.4 Alternative Analysis ..... 3-8
3.4.1 Alternatives 1A and 1B - Increase Sewer Capacity ..... 3-10
3.4.2 Alternatives 2A and 2B - New Sewer Route Along Dorset Road ..... 3-15
3.4.3 Alternatives 3A and 3B - Storage Tank to Facilitate Wet Weather Flows ..... 3-20
3.4.4 Alternative Comparison ..... 3-23
3.5 Preliminary Cost Estimates for Sanitary Improvements ..... 3-24
4 Conclusions ..... 4-1

# Tables

**Table ES-1 Water System Improvement Alternatives Comparison ........ 2**
**Table ES-2. Water System Improvement Cost Estimates ........ 3**
**Table ES-3. Sanitary Sewer System Improvement Alternatives Comparison ........ 5**
**Table ES-4. Sanitary System Improvement Cost Estimates ........ 6**
**Table 2-1. Water System Improvement Alternatives Comparison ........ 2-22**
**Table 2-2. Water System Improvement Cost Estimates ........ 2-24**
**Table 3-1. Sanitary Sewer System Improvement Alternatives Comparison. ........ 3-23**
**Table 3-2. Sanitary System Improvement Cost Estimates ........ 3-25**

# Figures

**Figure ES-1. Water System Capital Improvement Projects ........ 4**
**Figure ES-2. Sewer System Capital Improvement Projects ........ 8**
**Figure 1-1. Industrial Mega Site Location ........ 1-1**
**Figure 2-1. Baseline MDD Minimum Pressures ........ 2-3**
**Figure 2-2. Baseline MDD Maximum Pressures ........ 2-4**
**Figure 2-3. Baseline MDD Maximum Velocities ........ 2-5**
**Figure 2-4. Capacity of Existing System to Serve Industrial Mega Site ........ 2-7**
**Figure 2-5. Alternative 1 Infrastructure ........ 2-9**
**Figure 2-6. Alternative 1 Minimum Pressures ........ 2-10**
**Figure 2-7. Alternative 1 Maximum Velocities ........ 2-11**
**Figure 2-8. Alternative 2 Infrastructure ........ 2-13**
**Figure 2-9. Alternative 2 Minimum Pressures ........ 2-14**
**Figure 2-10. Alternative 2 Maximum Velocities ........ 2-15**
**Figure 2-11. Alternative 2 Tank Levels ........ 2-16**
**Figure 2-12. Alternative 2 Pump Station Flow ........ 2-16**
**Figure 2-13. Alternative 3 Infrastructure ........ 2-18**
**Figure 2-14. Alternative 3 Minimum Pressures ........ 2-19**
**Figure 2-15. Alternative 3 Maximum Velocities ........ 2-20**
**Figure 2-16. Alternative 3 Tank Levels ........ 2-21**
**Figure 2-17. Alternative 3 Pump Station Flow ........ 2-21**
**Figure 2-18. Water System Capital Improvement Projects ........ 2-25**

**Figure 3-1. Focused Sewers Studied for the Feasibility Study ........ 3-2**
**Figure 3-2. Sewer Model Update: Parallel Sewers Replaced with Continuous Single Sewer ........ 3-3**
**Figure 3-3. Sewer Model Update: Siphon Representation Revised ........ 3-3**
**Figure 3-4. Comparison of Monitored and Modeled Hydrographs at FM9 (Manhole 1205) ........ 3-4**
**Figure 3-5. Existing Condition Model Results for Manhole Freeboard During a 10-year, 6-hour Design Storm ........ 3-6**
**Figure 3-6. Existing Condition Model Results for Pipe Capacity During Peak Dry Weather Flow ........ 3-7**
**Figure 3-7. Industrial Mega Site Possible Tie in Locations ........ 3-8**
**Figure 3-8. Gravity Sewer Routes Required to Convey Flows to the Connection Points ........ 3-9**
**Figure 3-9. Alternative 1A - Profile of the Proposed Construction Area During Peak Flow Conditions ... 3-11**
**Figure 3-10. Alternative 1A - Manhole Freeboard During Peak Flow Conditions ........ 3-12**
**Figure 3-11. Alternative 1B - Profile of the Proposed Construction Area During Peak Flow Conditions . 3-13**
**Figure 3-12. Alternative 1B - Manhole Freeboard During Peak Flow Conditions ........ 3-14**
**Figure 3-13. Alternative 2A - Profile of the Proposed Construction Area During Peak Flow Conditions . 3-16**
**Figure 3-14. Alternative 2A - Manhole Freeboard During Peak Flow Conditions ........ 3-17**
**Figure 3-15. Alternative 2B - Profile of the Proposed Construction Area During Peak Flow Conditions . 3-18**
**Figure 3-16. Alternative 2B - Manhole Freeboard During Peak Flow Conditions ........ 3-19**
**Figure 3-17. Alternatives 3A and 3B - Profile of the Existing Area During Peak Flow Conditions ........ 3-21**
**Figure 3-18. Alternatives 3A and 3B - Manhole Freeboard During Peak Flow Conditions ........ 3-22**
**Figure 3-19. Sewer System Capital Improvement Projects ........ 3-27**

# Acronyms and Abbreviations

| | |
|---|---|
| AACE | Advancement of Cost Engineering |
| BPS | Booster Pump Station |
| GIS | Geographic Information System |
| gpm | gallons per minute |
| LOS | Level of Service |
| MG | Million Gallons |
| MGD | Million Gallons per Day |
| SCADA | Supervisory Control and Data Acquisition |
| USD | United States Dollar |
| VSP | Variable Speed Drive |
| WIB | Water in Basement |
| WTP | Water Treatment Plant |
| WWTP | Wastewater Treatment Plant |
| XHZ | Extra High Zone |

# Executive Summary

Arcadis U.S. Inc. was hired to evaluate infrastructure improvements required to support a 1,000 acre industrial mega site northwest of the City of Troy's current corporation limits between Washington Road on the west and Experiment Farm Road on the east. The purpose of this study is to determine the available capacity of existing water and sewer infrastructure to serve the industrial site, and to explore infrastructure improvements that would be needed to accommodate an additional two (2) million gallons per day (MGD) peak water demand and an additional one (1) MGD of peak sanitary flow.

Prior to beginning the evaluation, Arcadis reviewed the City's existing water and sewer system models, compared them to the City's GIS to identify infrastructure not represented, and made updates to hydraulically significant infrastructure that would impact the model results for evaluating the industrial mega site. Model demands and sewer flows were also reviewed against recent plant production and flow data to determine if adjustments were needed. The model controls were reviewed and updated, and then model results were validated against SCADA information to determine if the model predictions were within acceptable industry standards.

Initial model simulations were run to determine the available capacity of the existing water and sewer systems to serve the industrial mega site without constructing significant new water system infrastructure. Various alternatives were then considered for new system infrastructure to support the industrial mega site under buildout demands and flows. A summary of the water system alternatives and costs is provided in Table ES-1 and Table ES-2. Figure ES-1 shows the location of the water system improvement alternatives. A summary of the sewer system alternatives and costs are provided in Table ES-3 and Table ES-4. Figure ES-2 shows the location of the sanitary system improvement alternatives.

*Table ES-1 Water System Improvement Alternatives Comparison*

| Alternative/Cost | Benefits | Concerns |
|---|---|---|
| **Alternative 1** - Dedicated Transmission Pipeline<br><br>***Cost: $49,913,000*** | • No disruption to existing infrastructure or operations<br>• Easier construction of transmission mains (less populated areas) and reduced traffic impacts | • Limited number of new future customers anticipated along this transmission main route<br>• Transmission line provides no benefit until fully constructed<br>• Ability to provide system redundancy is limited |
| **Alternative 2** - Integrated High Zone Transmission Pipeline<br><br>***Cost: $43,559,000*** | • Transmission improvements can be constructed in phases as industrial area develops<br>• Increases High Zone system resilience to a transmission main outage<br>• Increases supply capacity to High Zone (in addition to the Extra High Zone)<br>• Utilizes existing excess capacity at High Zone Pump Station | • Constructability is much more challenging (new mains through highly populated areas) and will cause greater impacts to traffic<br>• Requires changes to operations of High Zone Pump Station<br>• May be difficult to achieve turnover in Barnhart Tank while maintaining minimum tank levels in Stanford Tank under some demand conditions |
| **Alternative 3** – Partial Integrated High Zone Transmission Pipeline<br><br>***Cost: $34,145,000*** | • Less costly<br>• Transmission improvements can be constructed in phases as industrial area develops<br>• Increases High Zone system resilience to a transmission main outage (Alt 2 provides more benefit)<br>• Increases supply capacity to High Zone (in addition to the Extra High Zone) (Alt 2 provides more benefit)<br>• Utilizes existing excess capacity at High Zone Pump Station | • Constructability is much more challenging (new mains through highly populated areas) and will cause greater impacts to traffic<br>• Requires changes to operations of High Zone Pump Station<br>• May be difficult to achieve turnover in Barnhart Tank while maintaining minimum tank levels in Stanford Tank. (This issue is less extreme in Alt 2)<br>• Does not consider other future demands within the system (recommended to be re-evaluated under a master planning effort) |

*Table ES-2. Water System Improvement Cost Estimates*

| Project ID | Project Description | Length (LF) or Quantity | Size | Construction Cost | Engineering, Legal, Administration Costs (30%) | Contingency (30%) | Total Project Cost |
|---|---|---|---|---|---|---|---|
| **On-Site Backbone Water Pipelines (All Alternatives)** | | | | | | | |
| W-3 | New 16-inch mains within the Industrial Area | 20,783 | 16-inch | $9,319,000 | $2,796,000 | $3,635,000 | $15,750,000 |
| **Alternative 1 Water Projects- Dedicated Extra High Zone Transmission Pipeline** | | | | | | | |
| W-1 | New 24-inch transmission main from the WTP to Industrial Site | 27,122 | 24 inch | $14,717,000 | $4,415,000 | $5,740,000 | $24,872,000 |
| W-2 | New 16-inch parallel main in Experiment Farm Road | 723 | 16 inch | $317,000 | $95,000 | $124,000 | $536,000 |
| W-4 | Additional Storage in Extra High Pressure Zone | 1 | 2.5 MG | $10,000,000 | $3,000,000 | $3,900,000 | $16,900,000 |
| W-5 | New Pump Station at WTP | 1 | 4.75 MGD | $4,500,000 | $1,350,000 | $1,755,000 | $7,605,000 |
| | | | | | | ***Alternative 1 Total Cost*** | ***$49,913,000*** |
| **Alternative 2 Water Projects - Integrated High Zone Transmission Pipeline** | | | | | | | |
| W-6 | New 20-inch parallel transmission main from the WTP to Industrial Site | 22,179 | 24 inch | $10,314,000 | $3,094,000 | $4,022,000 | $17,430,000 |
| W-7 | New 16-inch main downstream from the New XHZ BPS | 2,308 | 16 inch | $1,011,000 | $303,000 | $394,000 | $1,708,000 |
| W-4 | Additional Storage in Extra High Pressure Zone | 1 | 2.5 MG | $10,000,000 | $3,000,000 | $3,900,000 | $16,900,000 |
| W-8 | New Extra High Zone Pump Station | 1 | 4.75 MGD | $4,450,000 | $1,335,000 | $1,736,000 | $7,521,000 |
| | | | | | | ***Alternative 2 Total Cost*** | ***$43,559,000*** |
| **Alternative 3 Water Projects - Partial Integrated High Zone Transmission Pipeline** | | | | | | | |
| W-9 | New 20-inch optimized transmission main (based on current demands) | 10,383 | 20 inch | $4,743,000 | $1,423,000 | $1,850,000 | $8,016,000 |
| W-7 | New 16-inch main downstream from the New XHZ BPS | 2,308 | 16 inch | $1,011,000 | $303,000 | $394,000 | $1,708,000 |
| W-4 | Additional Storage in Extra High Pressure Zone | 1 | 2.5 MG | $10,000,000 | $3,000,000 | $3,900,000 | $16,900,000 |
| W-8 | New Extra High Zone Pump Station | 1 | 4.75 MGD | $4,450,000 | $1,335,000 | $1,736,000 | $7,521,000 |
| | | | | | | ***Alternative 3 Total Cost*** | ***$34,145,000*** |

***Note: All estimates are in 2023 dollars***

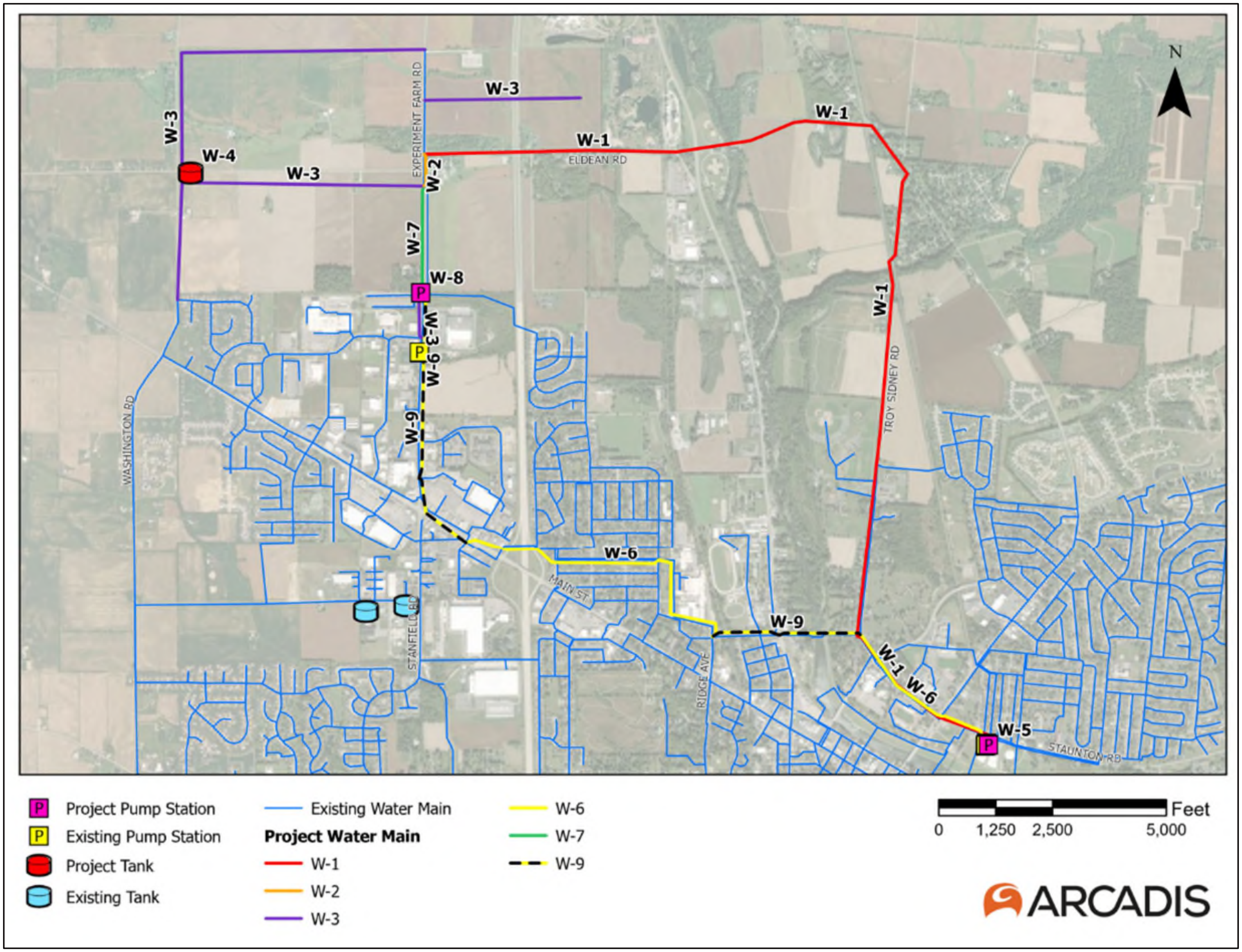


*Figure ES-1. Water System Capital Improvement Projects*

*Table ES-3. Sanitary Sewer System Improvement Alternatives Comparison*

| Alternative | Benefits | Concerns |
|---|---|---|
| **Alternative 1A and 1B** – Increase Sewer Capacity<br>***Cost: $1.56M - $1.65*** | • Meets LOS goals<br>• Construction is primary along hiking trail<br>• New piping reduces I/I risks in the near term<br>• Least length pipe for construction | • Railroad crossing coordination<br>• Siphon can become capacity concern for additional growth<br>• Shallow pipes in project area; any surcharging is within 4 feet of the surface |
| **Alternative 2A and 2B** – New Sewer Route Along Dorset Road<br>***Cost: $6.9M*** | • Meets LOS goals<br>• Avoids siphon<br>• Could add capacity for future growth<br>• Provides the most additional capacity of all alternatives | • Residential areas<br>• Crossing Main St<br>• Model was not validated by Arcadis at the south tie in location<br>• Large amount of new construction |
| **Alternative 3A and 3B** – Storage Tank to Facilitate Wet Weather Flows<br>***Cost: $5.1M - $7.0M*** | • Meets LOS goals<br>• Construction is isolated to a single area<br>• Could be used in tandem with another alternative | • Buried vs. above ground costs vary, especially dependent on subsurface<br>• Potential for odor<br>• Dewatering timing concerns<br>• Consecutive wet weather events can be problematic |

*Table ES-4. Sanitary System Improvement Cost Estimates*

| Project ID | Project Description | Length (LF) or Quantity | Size | Construction Cost | Engineering, Legal, Administration Costs (30%) | Contingency (30%) | Total Project Cost |
|---|---|---|---|---|---|---|---|
| **New Piping to Growth Areas (Applies to All Alternatives)** | | | | | | | |
| New-1 | New 12-inch pipes to growth areas | 18,520 | 12 inch | $5,185,600 | $1,556,000 | $2,022,000 | $8,763,600 |
| New-2 | Manholes affected or added | 62 | -- | $744,000 | $223,000 | $290,000 | $1,257,000 |
| ***New Piping Cost*** | | | | | | | ***$10,020,600*** |
| **Alternative 1A Upsizing pipes upstream of siphon** | | | | | | | |
| 1A-1 | 18-inch pipes increased to 24-inch near siphon | 2,646 | 24 inch | $846,720 | $254,000 | $330,000 | $1,430,720 |
| 1A-2 | Manholes affected or added | 11 | -- | $132,000 | $40,000 | $52,000 | $224,000 |
| ***Alternative 1A Total Cost*** | | | | | | | ***$1,654,720*** |
| **Alternative 1B Parallel pipes upstream of siphon** | | | | | | | |
| 1B-1 | New 18-inch parallel pipe near siphon | 2,646 | 18 inch | $793,800 | $238,000 | $310,000 | $1,341,800 |
| 1B-2 | Manholes affected or added | 11 | -- | $132,000 | $40,000 | $52,000 | $224,000 |
| ***Alternative 1B Total Cost*** | | | | | | | ***$1,565,800*** |
| **Alternative 2A New Dorset Road flow route with upsizing** | | | | | | | |
| 2A-1 | New 15-inch gravity main from Cornish Rd to Arlington Ave | 9,000 | 15 inch | $2,610,000 | $783,000 | $1,018,000 | $4,411,000 |
| 2A-2 | 12-inch pipes increase to 18-inch from ArlingtonAve to State Route 718 | 3,144 | 18 inch | $943,200 | $283,000 | $368,000 | $1,594,200 |
| 2A-3 | Manholes affected or added | 45 | -- | $540,000 | $162,000 | $211,000 | $913,000 |
| ***Alternative 2A Total Cost*** | | | | | | | ***$6,918,200*** |
| **Alternative 2B New Dorset Road flow route with parallel pipes** | | | | | | | |
| 2B-1 | New 15-inch gravity main from Cornish Rd to State Route 718 | 12,144 | 15 inch | $3,521,760 | $1,057,000 | $1,374,000 | $5,952,760 |
| 2B-2 | Manholes affected or added | 45 | -- | $540,000 | $162,000 | $211,000 | $913,000 |
| ***Alternative 2B Total Cost*** | | | | | | | ***$6,865,760*** |
| **Alternative 3A Wet Weather Storage pump in option** | | | | | | | |
| 3A-1 | Storage Tank in open lot West of Fairgrounds | 1 | 1.1 MG | $2,200,000 | $660,000 | $858,000 | $3,718,000 |
| 3A-2 | Influent Pump | 1 | 1175 GPM | $1,690,000 | $507,000 | $659,000 | $2,856,000 |
| 3A-3 | New 15-inch gravity main from diversion to storage tank | 400 | 15 inch | $116,000 | $35,000 | $45,000 | $196,000 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 3A-4 | New 12-inch gravity main connecting storage tank to existing system | 400 | 12 inch | $112,000 | $34,000 | $44,000 | $190,000 |
| 3A-5 | Manholes affected or added | 4 | -- | $48,000 | $14,000 | $19,000 | $81,000 |
| ***Alternative 3A Total Cost*** | | | | | | | ***$7,041,000*** |
| **Alternative 3B Wet Weather Storage pump out option** | | | | | | | |
| 3B-1 | Storage Tank in open lot West of Fairgrounds | 1 | 1.1 MG | $2,200,000 | $660,000 | $858,000 | $3,718,000 |
| 3B-2 | Dewatering Pump | 1 | 380 GPM | $550,000 | $165,000 | $215,000 | $930,000 |
| 3B-3 | New 15-inch gravity main from diversion to storage tank | 400 | 15 inch | $116,000 | $35,000 | $45,000 | $196,000 |
| 3B-4 | New 12-inch gravity main connecting storage tank to existing system | 400 | 12 inch | $112,000 | $34,000 | $44,000 | $190,000 |
| 3B-5 | Manholes affected or added | 4 | -- | $48,000 | $14,000 | $19,000 | $81,000 |
| ***Alternative 3B Total Cost*** | | | | | | | ***$5,115,000*** |

***Note: All estimates are in 2023 dollars***

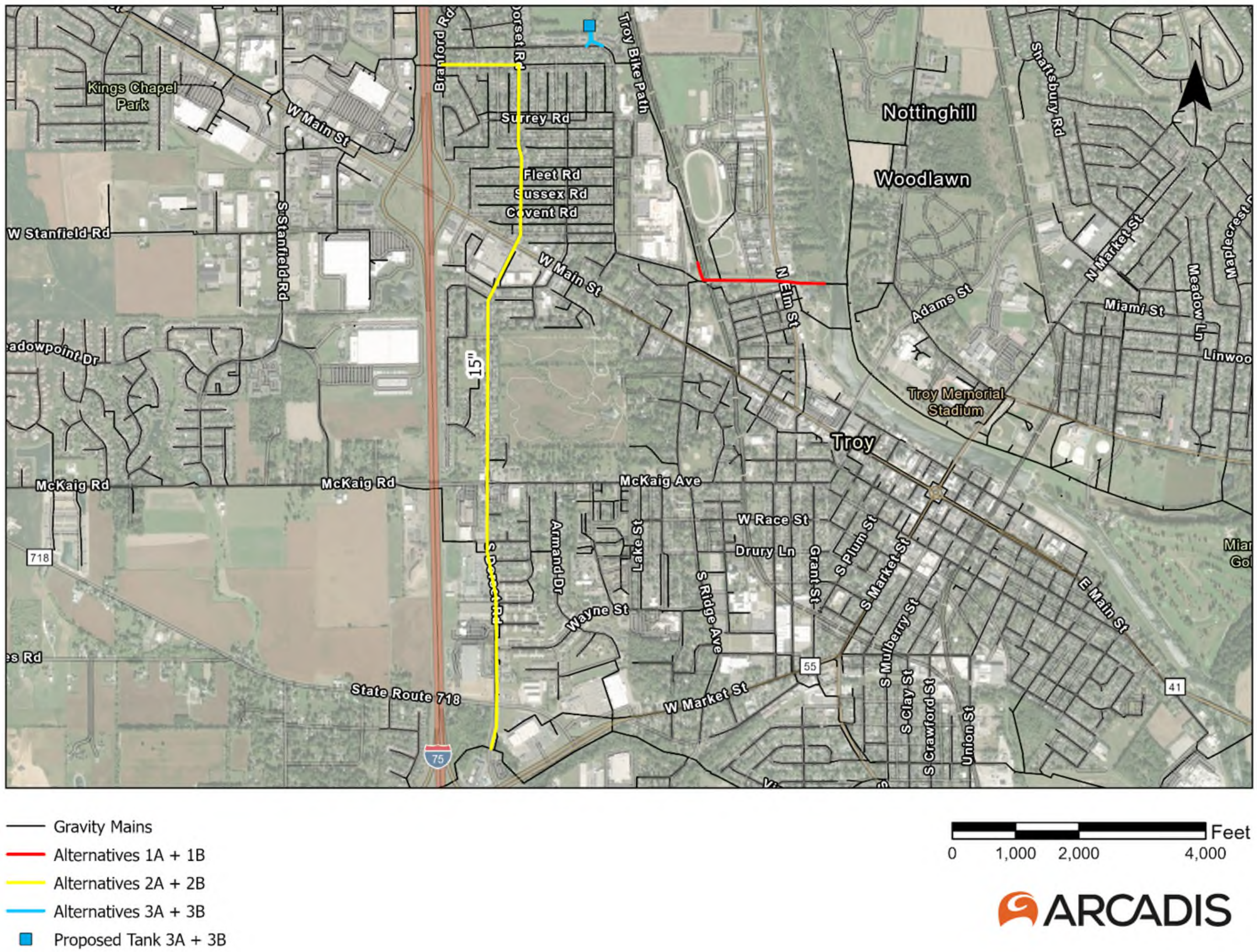


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*Figure ES-2. Sewer System Capital Improvement Projects*

# 1 Project Background

The City of Troy (City) is evaluating the infrastructure improvements required to support a 1,000 acre industrial mega site northwest of the City in the general vicinity north of Corporate Drive and between Washington Road on the west and Experiment Farm Road on the east, northwest of the City's current corporation limits. The location of the industrial mega site is shown on Figure 1-1. The purpose of this study is to determine the available capacity of existing water and sewer infrastructure to serve the industrial site, and to explore infrastructure improvements that would be needed to accommodate an additional two (2) million gallons per day (MGD) peak water demand and an additional one (1) MGD of peak sanitary flow. This report serves as a high-level feasibility study to provide budgetary and planning guidance as the City explores the possibility of an industrial mega site for food producers, Intel spinoffs or other large industrial developments.

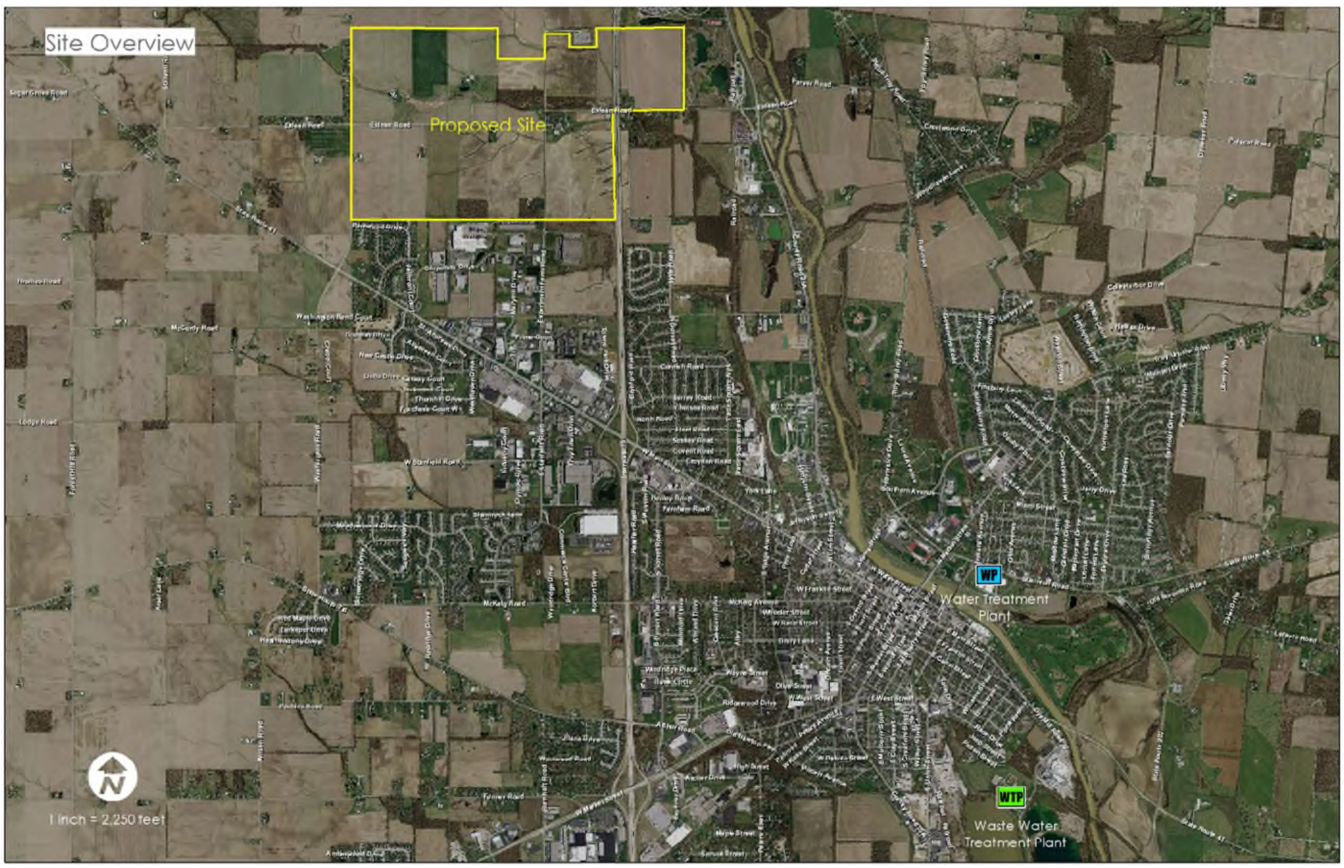


*Figure 1-1. Industrial Mega Site Location*

## 1.1 Projected Water Demands and Sanitary Flows

Peak water demand at buildout of the industrial mega site is projected to be 2 MGD. For the purpose of this study, it was assumed that the 2 MGD is a constant demand and does not vary seasonally or with time of day. The actual demand pattern and seasonal variability of industrial mega site water demand will be highly dependent on the industry(s) that develop the site. Actual industrial water use may be nearly constant or highly variable.

Peak sanitary flow at buildout of the industrial mega site is projected to be 1 MGD. As with the water demands, it was assumed that the 1 MGD is a constant flow and does not vary seasonally or with time of day. Sanitary flow was assumed to be half of the water demand because it is assumed that a large proportion of industrial user demand will be consumptive use.

# 2 Water System Evaluation

The City of Troy obtains its public drinking water supplies from buried valley sand and gravel aquifers associated with the Great Miami River. The City currently utilizes 10 production wells with a total production capacity of 10.5 MGD to draw water from the buried aquifer for treatment at the Water Treatment Plant (WTP). The WTP is designed to treat a maximum flow of 16 MGD, although the existing system average flow rate is only 3.85 MGD, with a maximum daily production of 5.68 MGD. Troy maintains 8.25 million gallons of treated water storage in the system between 4 water towers and the clearwell at the WTP. Two pump stations at the WTP supply treated water to two main pressure zones: the Low Zone and the High Zone. A third pressure zone, the Extra High Zone, is supplied via a booster pump station on Experiment Farm Road that draws water from the High Zone.

## 2.1 Hydraulic Model Update and Validation

Arcadis reviewed the City's existing water distribution system model and compared it to the City's GIS to identify existing infrastructure not represented in the water distribution system model. Updates were made to hydraulically significant infrastructure that impacts the model results for providing supply to the project site. Significant updates made to hydraulic model infrastructure include:

- Added large diameter (12-inch and greater) pipelines constructed since the last model update.
- Updated diameters, alignment, and connectivity of pipelines in the vicinity of the WTP to better align with City GIS.
- Updated internal piping of the High Zone Pump Station and Low Zone Pump Station based on record drawings. Updated model pump curves based on manufacturer information for greater accuracy when operating at high flows.
- Adjusted the location of the Stanfield High Tank and added the Stanfield Extra High Tank to the model. Updated tank elevations and storage curves based on record drawings.
- Updated the pressure zone boundary between the High Zone and Extra High Zone.
- Updated the configuration of the Extra High Zone Booster Pump Station based on record drawings.

In addition, the model was updated to InfoWater Pro (the latest version of InfoWater, which is compatible with ArcGIS Pro).

Model demands were reviewed against recent production data to determine if adjustments were needed to better match model demands with current production under both average and maximum day demand conditions. Average daily production from January 2022 through October 2023 was 3.85 MGD; the maximum daily production during this period was 5.68 MGD. Existing model demands are 4.22 MGD average day demand and 6.53 MGD maximum day demand, which are 10 percent and 15 percent higher than the recent production data, respectively. In addition to comparing production totals, the distribution of model demands by pressure zone was compared with recent operations data and found to be nearly identical to the observed demand distribution. Therefore, existing model demand totals were not adjusted, as they are similar to, but slightly more conservative than, recent production data.

The existing pump controls in the model used time-based controls to determine when pumps run. Pump controls were updated to turn on and off based on the tank level setpoints currently used by the SCADA system. The use of level-based controls is more accurate and allows the model to adjust pump operations dynamically in response to different scenarios and demand conditions.

The model was set up to simulate a 72-hour extended period simulation under average day and maximum day demands. Model results were compared with SCADA information from a period of one week in August 2023 to confirm that the simulated tank levels and pump flows are within typical ranges. Simulated tank levels were within +/- 1 foot of typical ranges. Pump flow data was not available and had to be calculated indirectly using pressure zone production totals and pump hours. Simulated High Zone Pump Station flows were within one percent of the calculated average, however simulated flows for the Low Zone Pump Station and Extra High Zone Booster Pump Station were 25 to 40 percent higher than the calculated average. This may be due to the inaccuracies inherent in the calculation methodology used or could represent an aspect of the system not currently captured in the model, such as deterioration of pump impellers, a partially closed valve, or variable speed pump (VSP) controls. However, for the purposes of this evaluation, the Low Zone Pump Station and Extra High Zone Booster Pump Station are not critical facilities because the Low Zone is hydraulically isolated from the rest of the system, and the Extra High Zone Booster Pump Station is assumed to be offline in all but the baseline capacity scenario. It is recommended that the discrepancies between operational data and model results at these facilities be further investigated during a comprehensive water model update and calibration process.

## 2.2 Water System Level of Service Benchmarks

The following Level of Service (LOS) goals were applied during the model evaluations to determine available capacity and the feasibility of various alternatives. Level of service benchmarks include:

- Minimum water system pressure at service locations of 40 psi.
- Maximum water system pressure at service locations of 100 psi.
- Maximum water pipeline velocity of 5 fps.
- Minimum available fire flow of 2,500 gpm for 3 hours at proposed industrial site while maintaining a minimum residual pressure of 20 psi in the water system.

## 2.3 Existing System Baseline

Model simulations were run to determine existing system baseline results under a maximum day demand (MDD) condition without additional demands or new infrastructure associated with the industrial mega site. Results from these baseline scenarios were then compared against model simulations that include the proposed development to determine the impact of the industrial mega user demands on the water system.

Figure 2-1 shows the minimum pressure under an existing MDD condition. Minimum pressures are above 40 psi throughout the system, although minimum pressures in the northwest quadrant of the High Zone along Experiment Farm Road are near the 40 psi threshold.

Figure 2-2 shows the maximum pressure under an existing MDD condition. Maximum pressures in the northeastern portion of the High Zone are above 90 psi but do not exceed 100 psi, with the exception of a couple of locations in the immediate vicinity of the WTP.

Figure 2-3 shows the maximum velocities under an existing maximum day demand condition. Velocities in the transmission main from the WTP to the northwest quadrant of the High Zone and in the water mains near the Extra High Zone Booster Pump Station exceed 2 fps but are well below 5 fps.

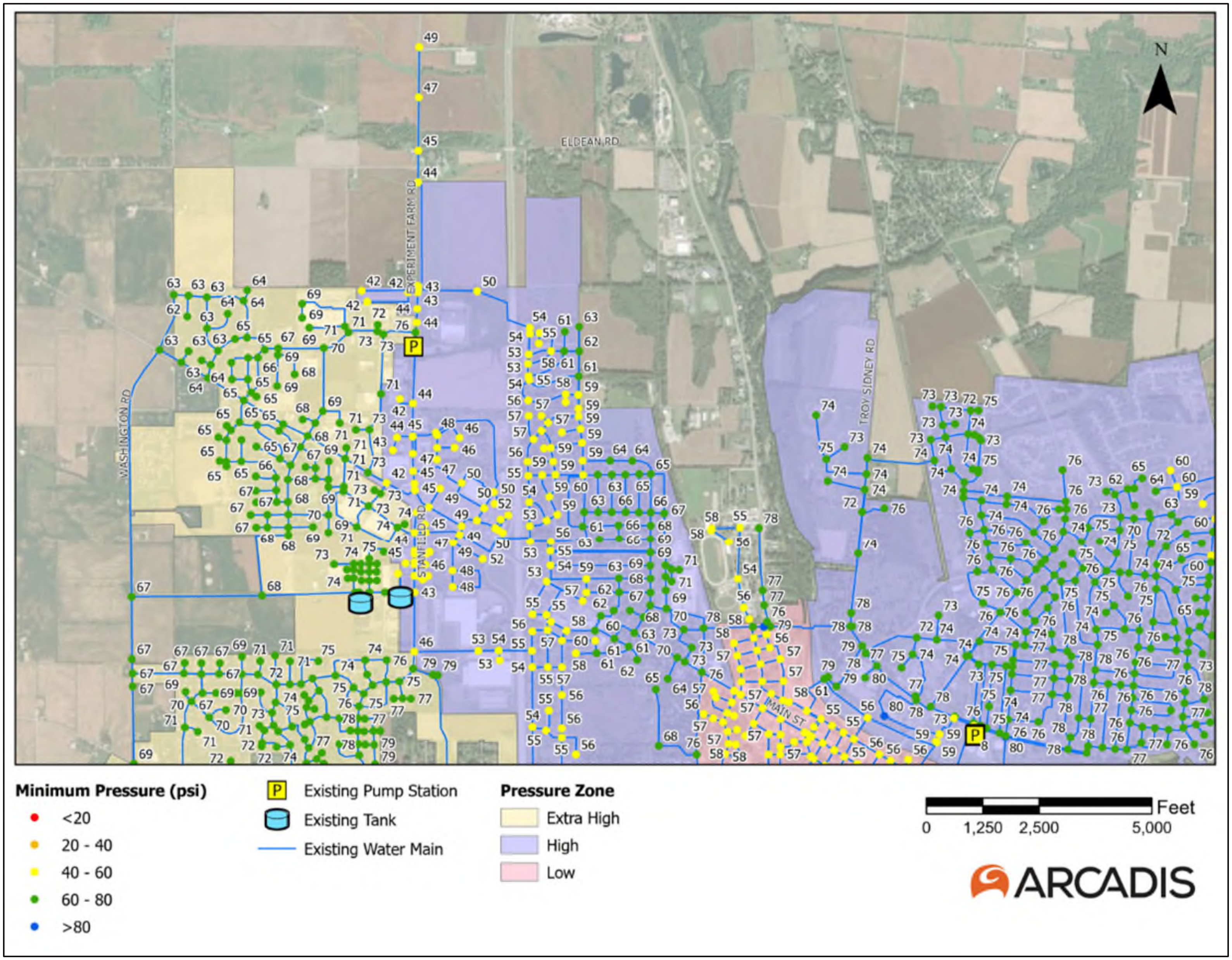


*Figure 2-1. Baseline MDD Minimum Pressures*

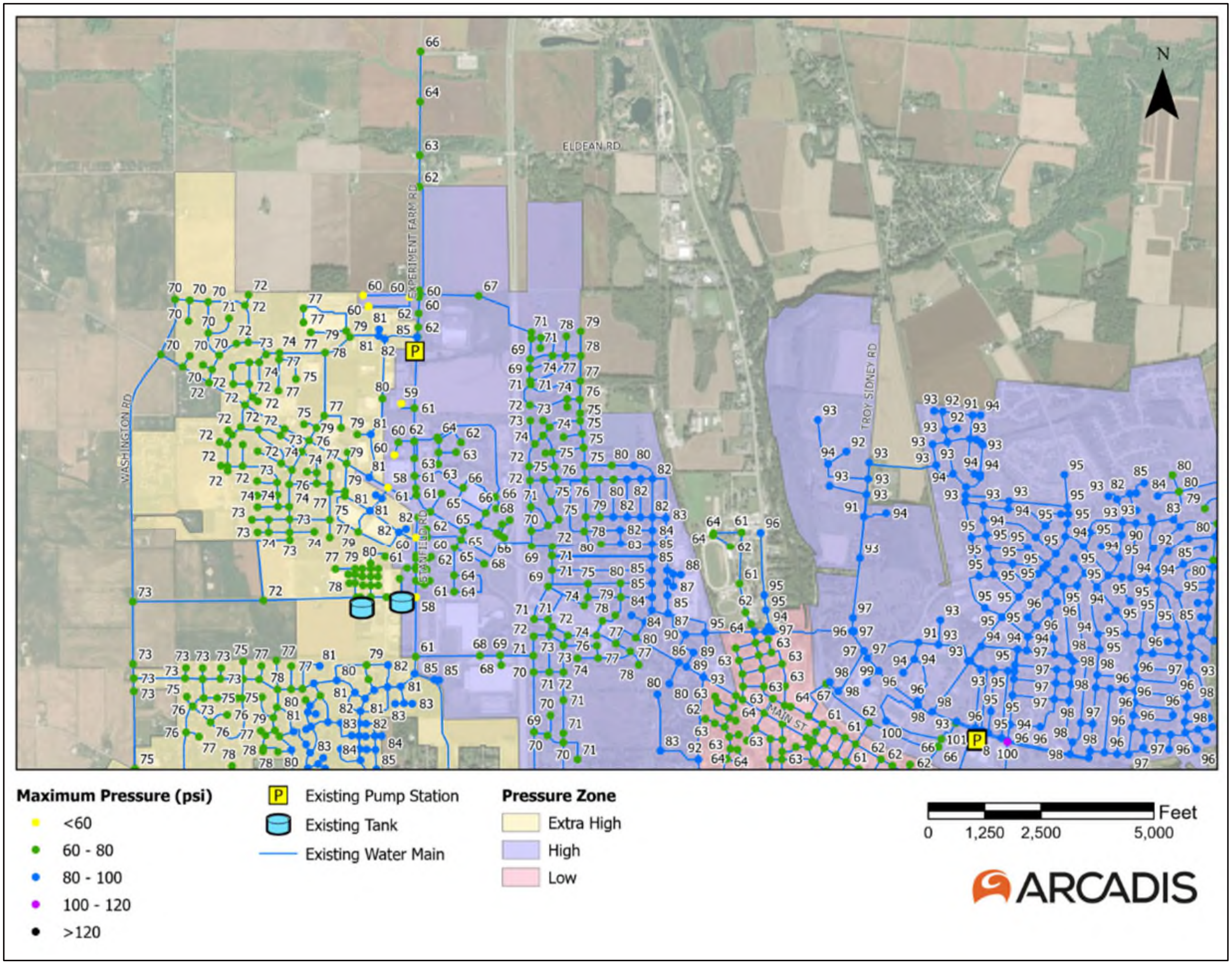


*Figure 2-2. Baseline MDD Maximum Pressures*

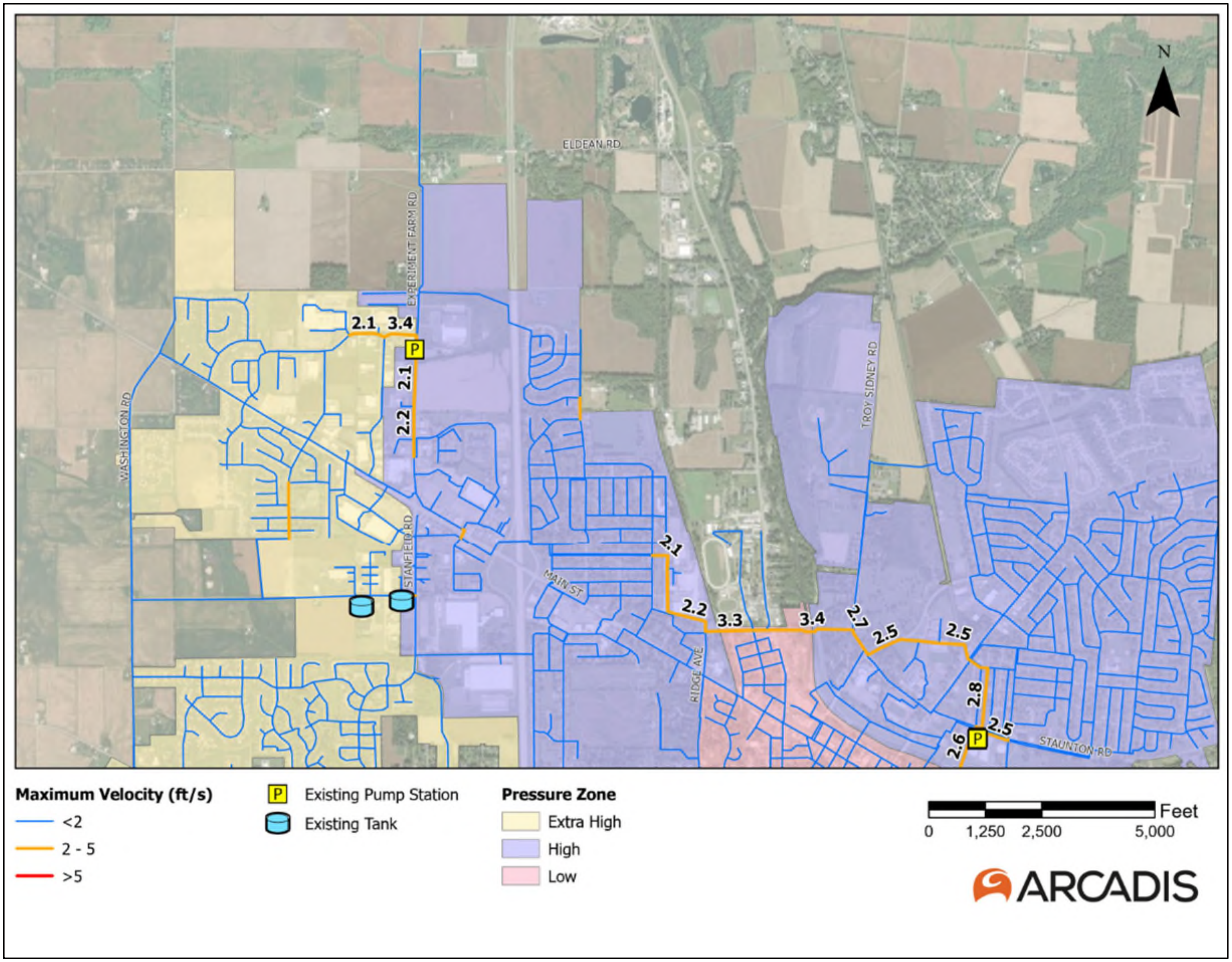


*Figure 2-3. Baseline MDD Maximum Velocities*

## 2.4 Existing System Available Capacity

Model simulations were run to determine the available capacity of the existing water system to serve the industrial mega site without constructing significant new water system infrastructure. Currently, the eastern portion of the site could be served from the existing 12-inch diameter High Zone pipeline on Experiment Farms Road and the western portion of the site could be served from the existing 16-inch diameter Extra High Zone pipeline along Washington Road. Figure 2-4 shows the existing locations that can serve the industrial mega site and the available supply capacity at each location.

If serving the eastern portion of the site only, up to 0.57 MGD can be supplied without causing pressures in the High Zone to fall below 40 psi during an MDD condition. However, because of the range of elevations in the industrial mega site, pressures in areas west of Experiment Farm Road within the industrial site would fall below 40 psi if served from the High Zone.

If serving the western portion of the site only, up to 1.1 MGD can be supplied without causing pressures in the High Zone to fall below 40 psi during an MDD condition. Pressures within the High Zone remain the limiting factor in this scenario because high flow through the Extra High Zone BPS lowers pressures on its suction side. Supplying 1.1 MGD to the industrial site utilizing the Extra High Zone BPS would require the Extra High Zone BPS to run at firm capacity nearly constantly under a maximum day demand condition.

If serving the site from both pressure zones simultaneously, 0.57 MGD can be supplied to the industrial site via the Extra High Zone and 0.29 MGD can be supplied via the High Zone, for a total supply of 0.86 MGD.

## 2.5 Alternative Analysis

Due to the elevations in the industrial mega site, it is recommended that the site ultimately be served by the Extra High Zone at buildout. Additional infrastructure required to support the industrial mega site at buildout under all alternatives is:

- Approximately 3.9 miles of 16-inch diameter backbone transmission pipelines within the industrial mega site. This length is based on an assumed simple grid layout. Actual length of transmission pipelines will be dependent on the site layout and roadways.
- A new 2.5 MG water tower on the western side of the industrial site. A significant increase in Extra High Zone storage capacity would be required to provide sufficient operational, fire flow, and emergency storage at the industrial mega site at buildout. The western side of the industrial site has the highest ground level elevations and so would be the preferred site for a new water tower. It was assumed that the additional 2.5 MG of storage capacity will be constructed as a single tank for modeling and cost estimating purposes. However, the required storage capacity could be split between two tanks if desired for phased development of the site, improved water quality, and ease of maintenance, although this would increase the total cost of the additional storage facilities.

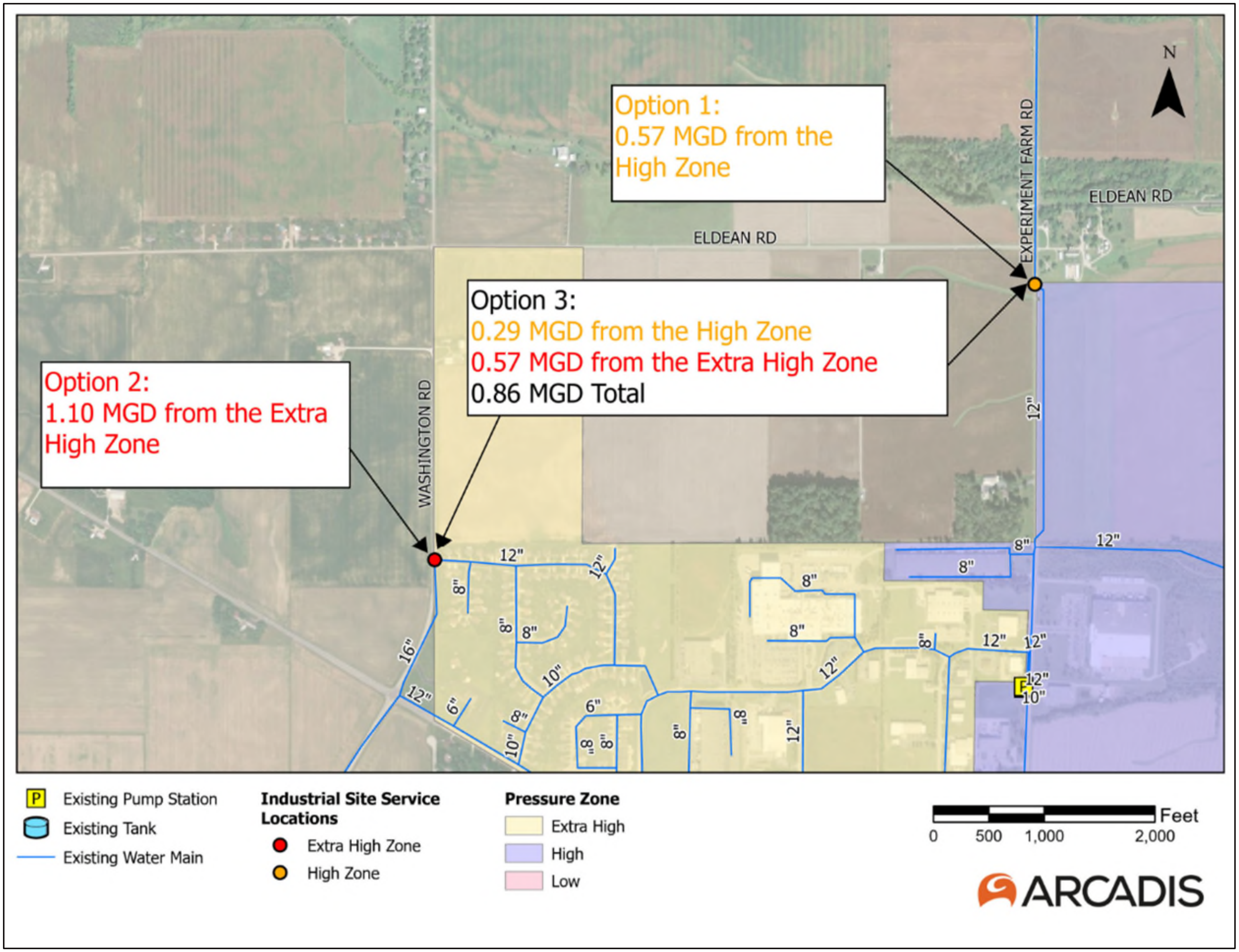


*Figure 2-4. Capacity of Existing System to Serve Industrial Mega Site*

### 2.5.1 Alternative 1 – Dedicated Extra High Zone Transmission Pipeline

Alternative 1 would construct 5 miles of dedicated transmission pipeline from the WTP to the eastern edge of the industrial mega site along Troy Sidney Road and Eldeen Road. A new 4.75 MGD firm capacity Extra High Zone Pump Station would be constructed at the WTP and would become the main source of supply for the Extra High Zone. The existing Extra High Zone BPS would be placed on standby to provide a partially redundant source of supply to the Extra High Zone in an emergency. Figure 2-5 shows the water system infrastructure required for Alternative 1.

Model simulations found that both 20-inch and 24-inch diameter are feasible sizes for the Alternative 1 transmission pipeline. If this alternative is selected, a detailed cost-benefit analysis should be conducted to compare the increased capital costs of a 24-inch diameter pipeline with the increased energy costs and larger pumps required to pump water through a 20-inch diameter pipeline. For the purposes of this evaluation, it was assumed that a 24-inch diameter pipeline would be selected.

Figure 2-6 shows the simulated minimum pressures during a MDD condition under Alternative 1. Minimum pressures within the industrial area are 60 psi or greater. Minimum pressures within the northwestern quadrant of the High Zone increase compared to existing system conditions because the existing Extra High Zone demand is no longer transmitted through the High Zone to the existing Extra High Zone BPS.

Maximum pressures along the dedicated transmission main exceed 110 psi in some locations. Although it is not anticipated that the City will expand its service area to the northeast, if future customers or developments east of the Great Miami River were to be served from this transmission main pressure reducing valves (PRVs) would be required at the connections. Maximum pressures in the High Zone are similar to those under baseline conditions (See Figure 3) and are all less than 100 psi.

Figure 2-7 shows the simulated maximum velocities during a MDD condition under Alternative 1 with a 24-inch diameter pipeline. Maximum velocities in all pipelines are less than 5 fps. If a 20-inch diameter pipeline were selected instead, velocities would increase but remain below 5 fps.

Alternative 1 is capable of providing 2,500 gpm fire flow for a duration of 3 hours to all locations within the industrial mega site, and does not negatively impact available fire flow in other areas of the system.

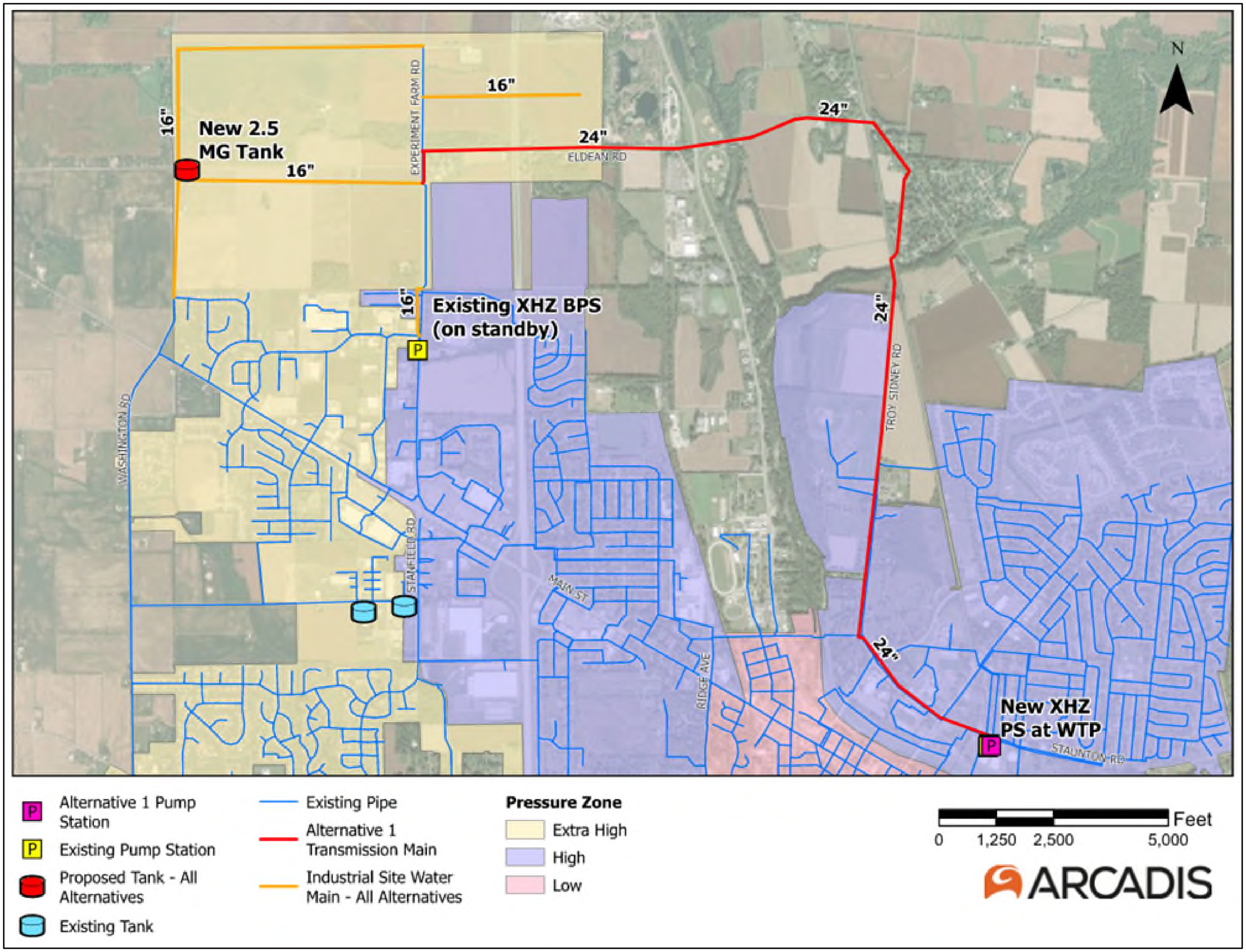


*Figure 2-5. Alternative 1 Infrastructure*

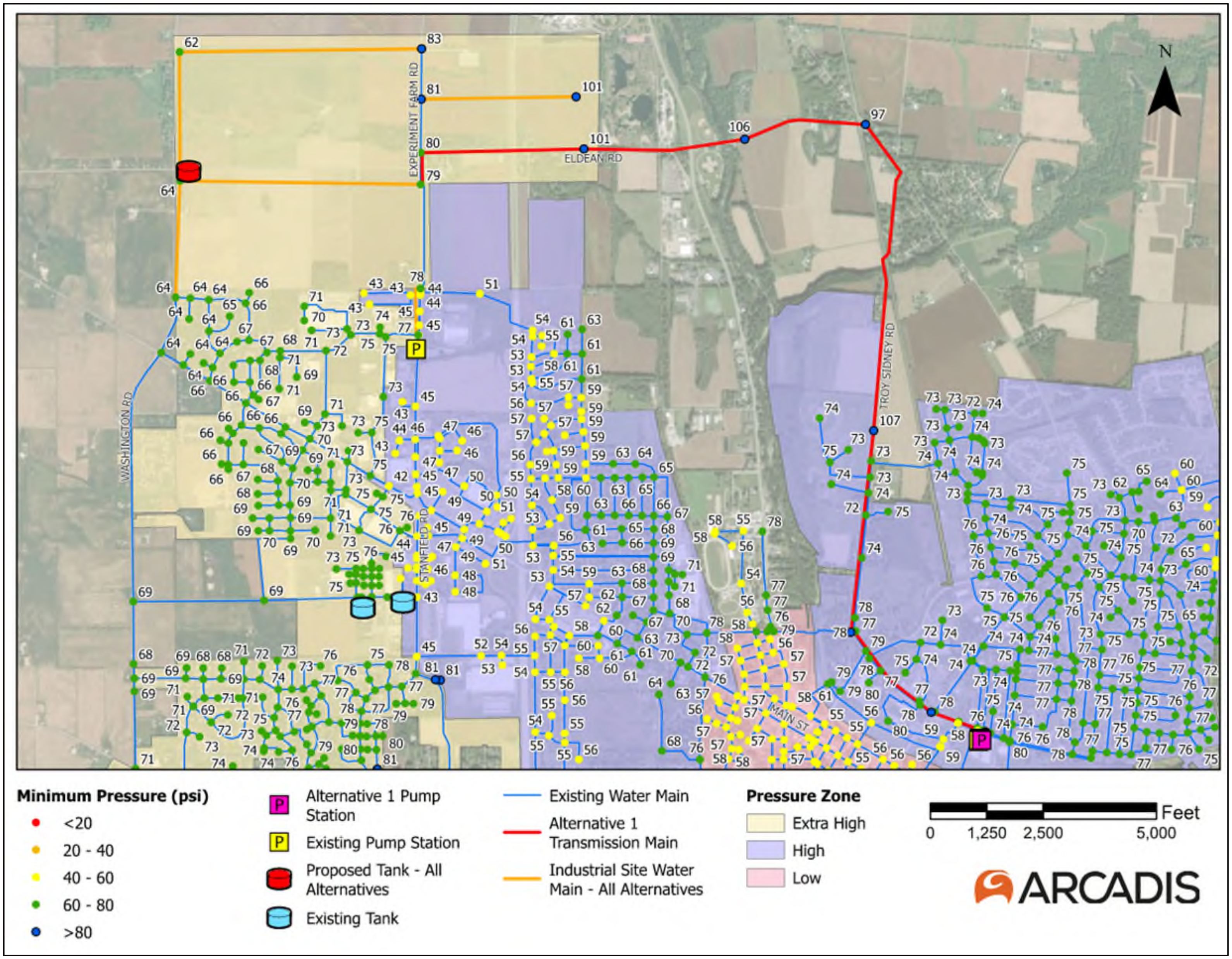


*Figure 2-6. Alternative 1 Minimum Pressures*

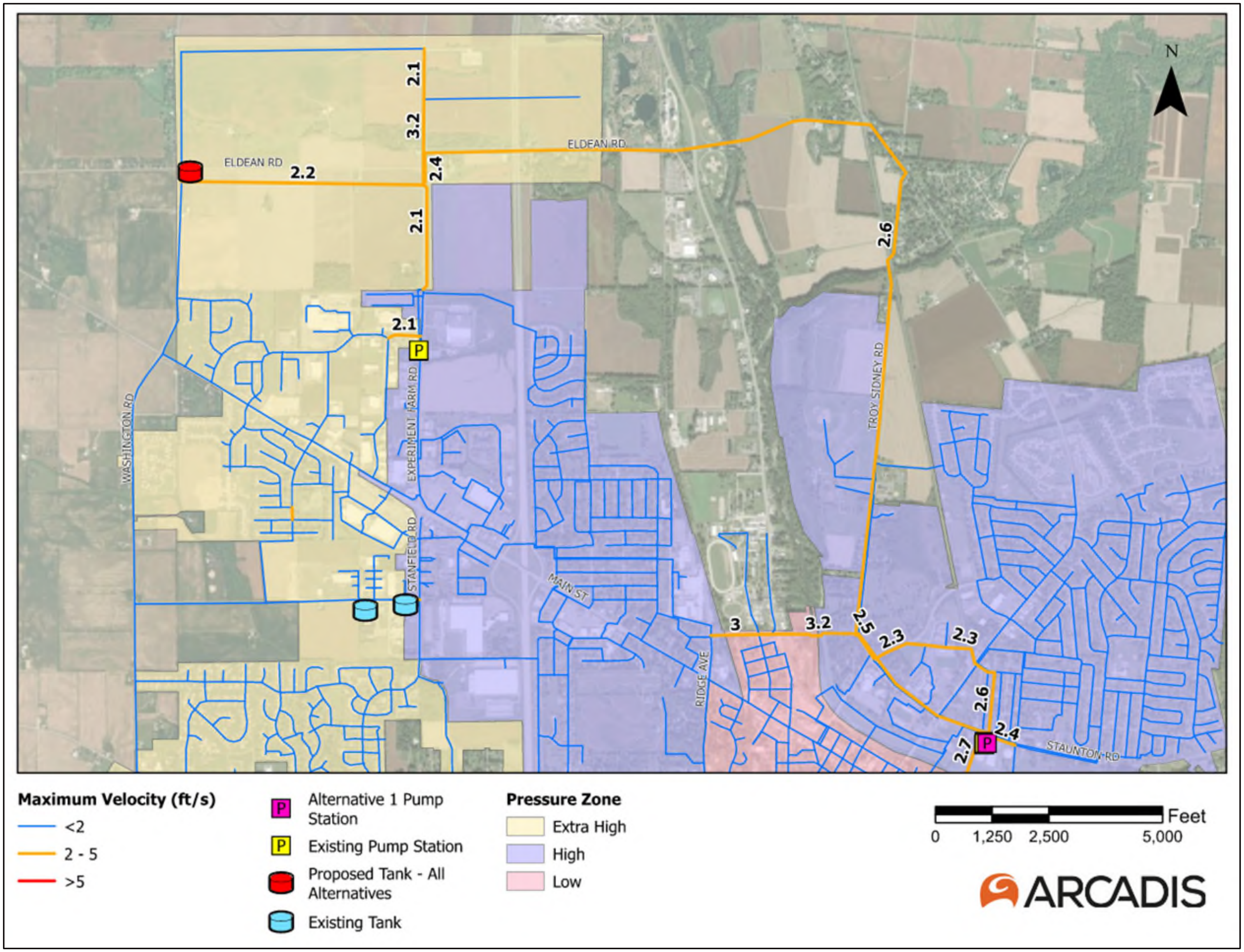


*Figure 2-7. Alternative 1 Maximum Velocities*

### 2.5.2 Alternative 2 – Integrated High Zone Transmission Pipeline

Alternative 2 would construct 4.2 miles of additional High Zone transmission pipeline from the WTP to a new 4.75 MGD Extra High Zone BPS constructed north of Marybill Drive along Experiment Farm Road. This 20-inch diameter High Zone transmission pipeline would be constructed parallel to the existing High Zone transmission pipeline and would tie into existing High Zone pipelines at regular intervals along its length. This alternative would utilize available excess pumping capacity at the High Zone Pump Station and would not require the construction of additional pumping capacity at the WTP. Figure 2-8 shows the water system infrastructure required for Alternative 2.

A new Extra High Zone BPS would be necessary because site space limitations make expanding the existing Extra High Zone BPS infeasible. Because the existing Extra High Zone BPS is located near the proposed location of the new BPS, it is anticipated that the existing BPS would be decommissioned rather than placed on standby.

Figure 2-9 shows the simulated minimum pressures during a MDD condition under Alternative 2. Minimum pressures within the industrial area are 60 psi or greater. Minimum pressures within the northwest quadrant of the High Zone are slightly lower than under existing conditions, and some locations fall just below 40 psi.

Maximum pressures in the High Zone under Alternative 2 are generally a few psi lower in comparison to baseline conditions (see Figure 3) and are all less than 100 psi. This is due to the additional transmission capacity in the High Zone.

Figure 2-10 shows the simulated maximum velocities during a MDD condition under Alternative 2. Maximum velocities in all pipelines are less than 5 fps.

Alternative 2 is capable of providing 2,500 gpm fire flow for a duration of 3 hours to all locations within the industrial mega site and does not negatively impact available fire flow in other areas of the system.

Figure 2-11 and Figure 2-12 shows the simulated tank levels and pump flow, respectively, during a MDD condition under Alternative 2. To meet demands and maintain High Zone tank levels, one pump at the High Zone Pump Station must run constantly, and four additional pumps must turn on in response to low tank levels in the High Zone. Therefore, this alternative utilizes the firm capacity of the High Zone Pump Station during peak pump flow.

Although Figure 2-11 shows that tank turnover in both the Barnhart and Stanfield High Tanks can be maintained in this alternative, it was noted during scenario development that the Stanfield High Tank is very sensitive to the additional Extra High Zone demands from the industrial area. Due to the high capacity of the new Extra High Zone Booster Pump Station, the Stanfield Tank can be quickly drained if not properly supported by a sufficient capacity of High Zone pumps. In addition, because the 0.5 MG Stanfield Tank is much smaller than the 2.0 MG Barnhart Tank, it may be difficult to achieve turnover in the Barnhart Tank while maintaining acceptable minimum levels in the Stanfield High Tank under certain conditions, such as when demands near the Barnhart Tank are low but industrial mega area demands remain high. This concern could potentially be alleviated by constructing additional storage in the northern portion of the High Zone or by constructing additional transmission capacity between the Barnhart Tank and the Stanfield High Tank, although these possibilities were not evaluated as part of this study. It is recommended that High Zone storage deficiencies and imbalances be further explored in a Water System Master Plan that accounts for all anticipated future development areas.

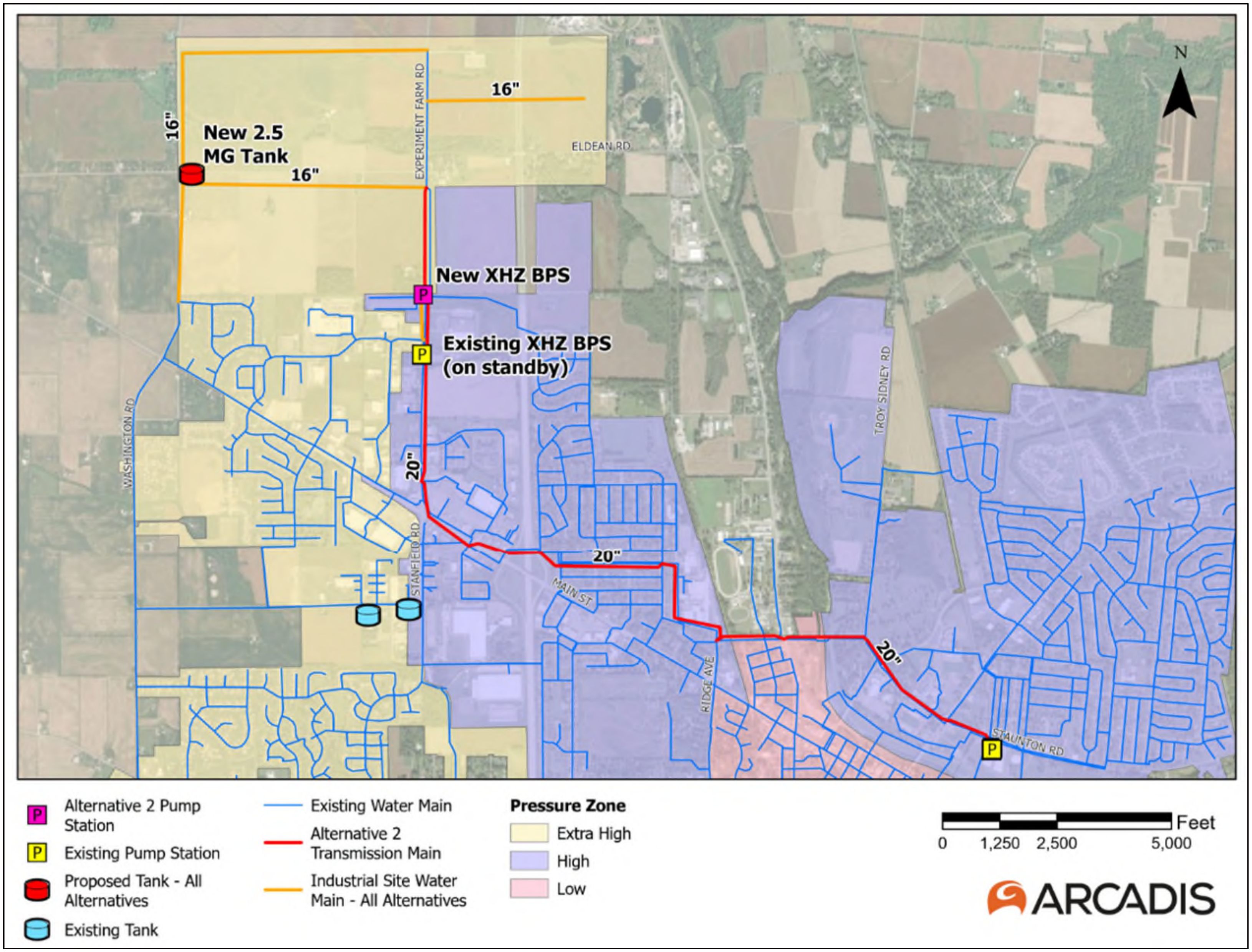


*Figure 2-8. Alternative 2 Infrastructure*

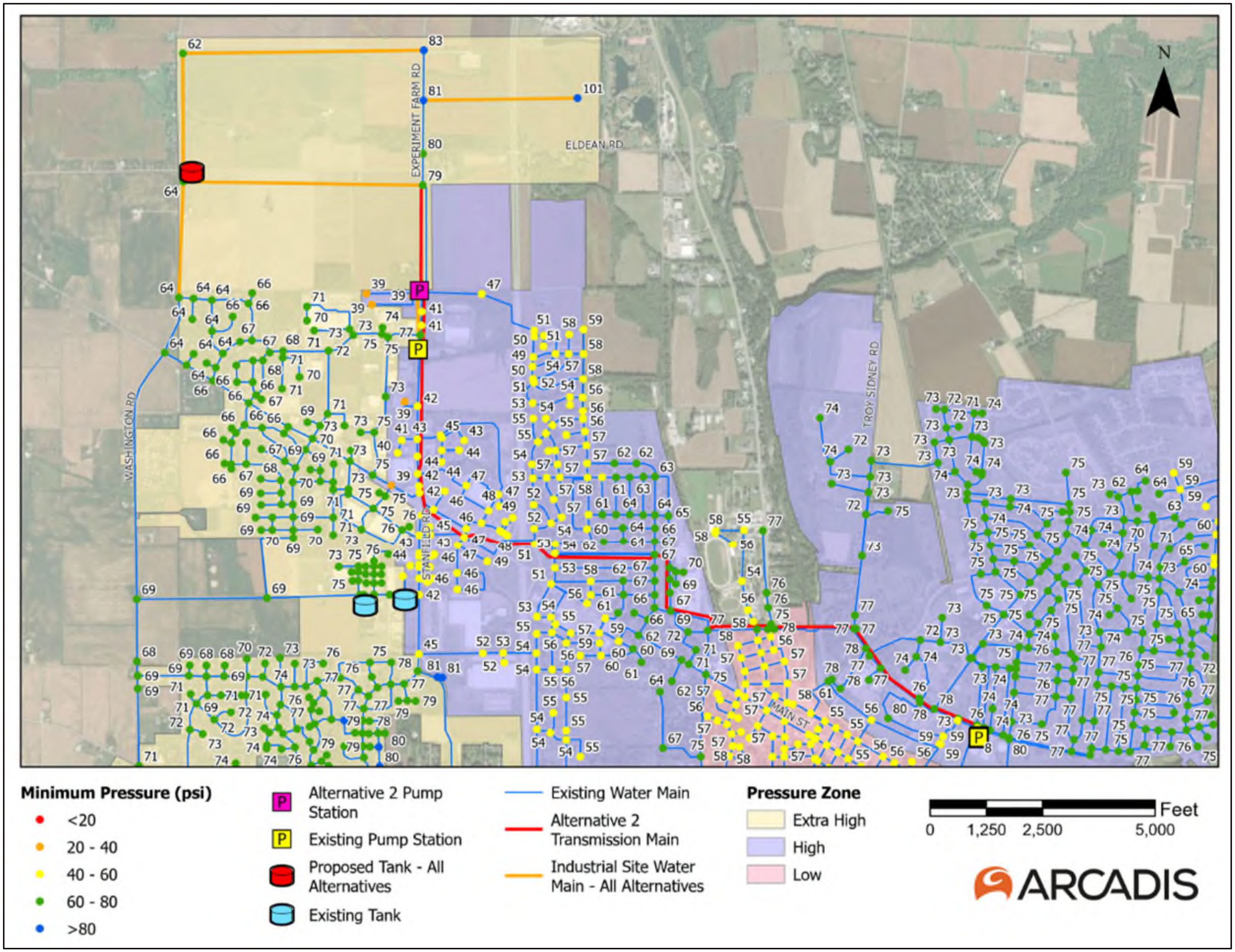


*Figure 2-9. Alternative 2 Minimum Pressures*

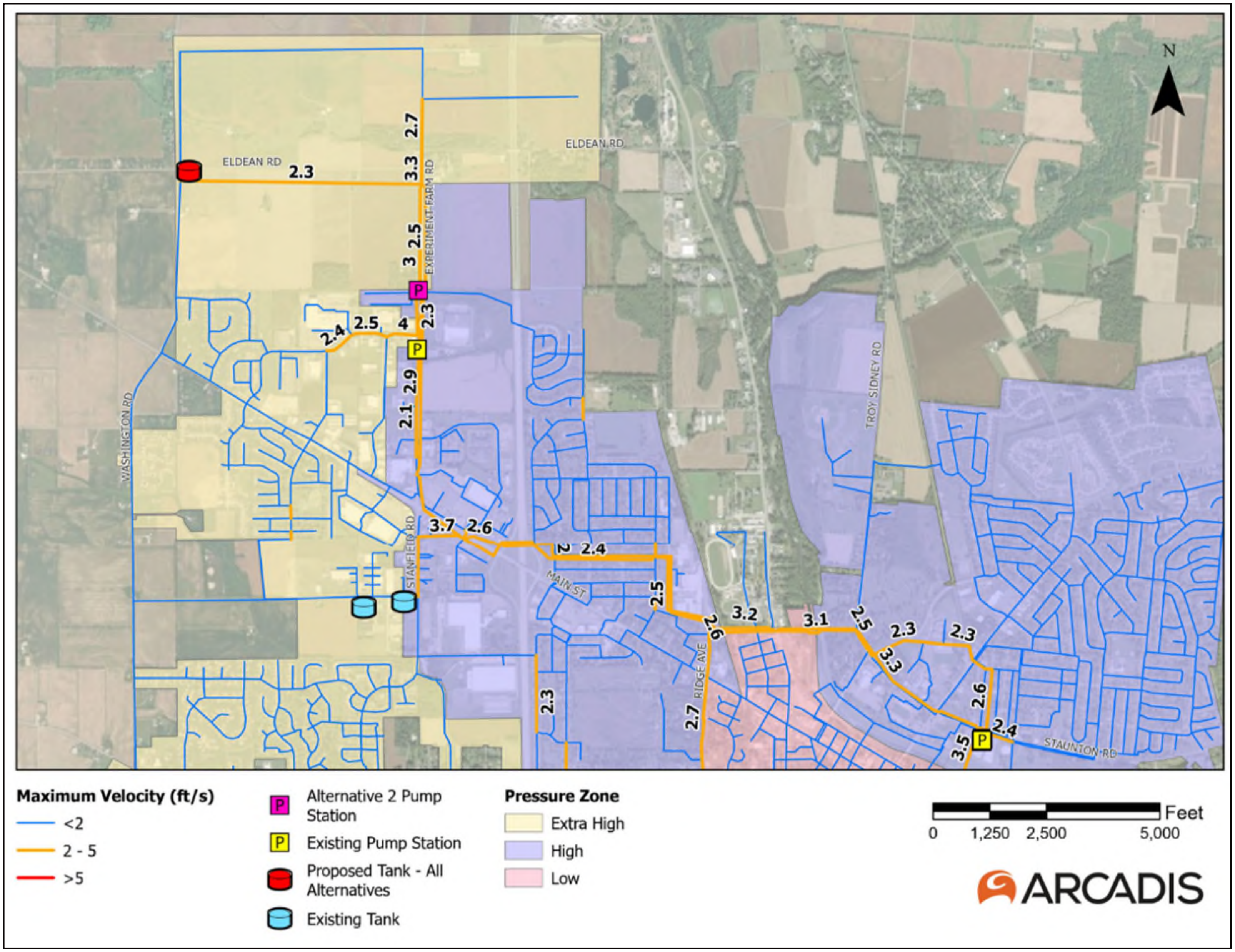


*Figure 2-10. Alternative 2 Maximum Velocities*

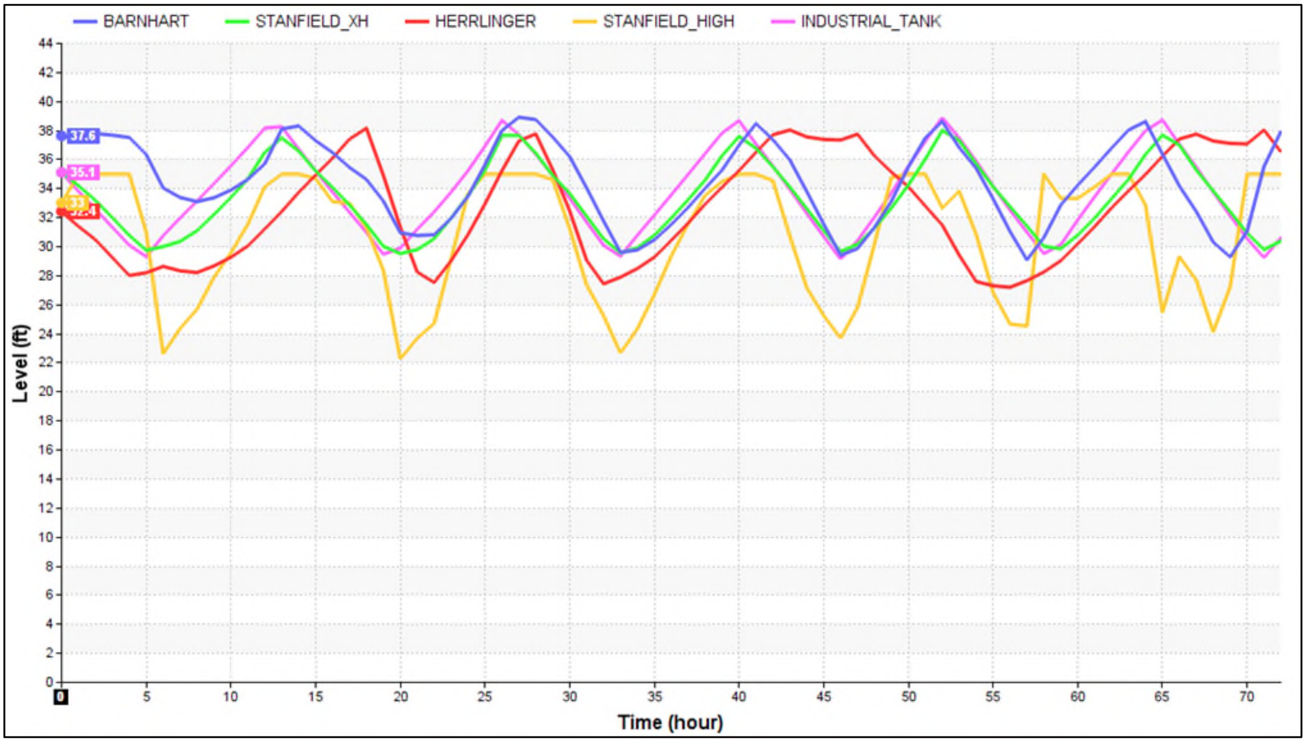


*Figure 2-11. Alternative 2 Tank Levels*

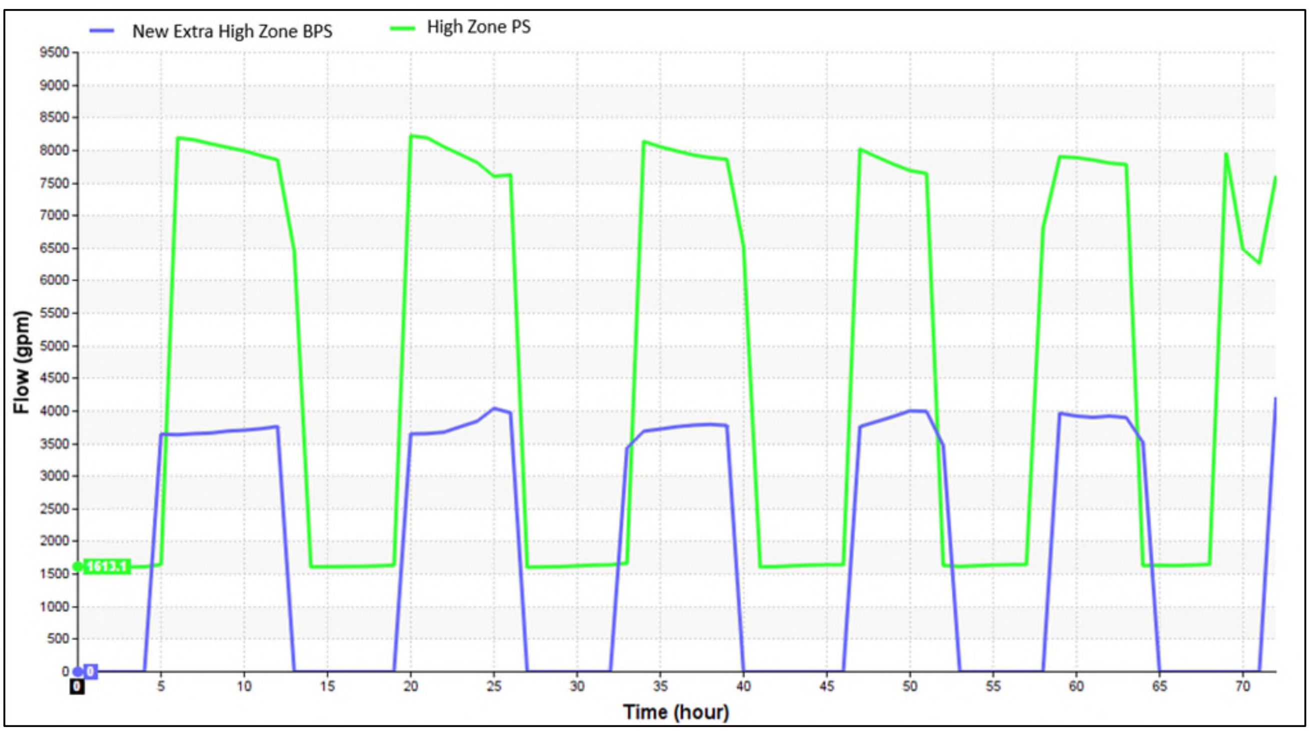


*Figure 2-12. Alternative 2 Pump Station Flow*

### 2.5.3 Alternative 3 – Partial Integrated High Zone Transmission Pipeline

As in Alternative 2, Alternative 3 would construct a new 4.75 MGD Extra High Zone BPS and additional High Zone transmission pipeline parallel to the existing High Zone transmission pipeline. However, instead of extending the entire length between the WTP and the new Extra High Zone BPS, Alternative 3 would construct only 2.2 miles of parallel 20-inch diameter transmission pipelines at the locations where additional transmission capacity would have the most impact. These targeted locations are along Experiment Farm Drive and West Main Street, parallel to an existing 12-inch diameter pipeline, and at the river crossing between Riverside Drive and North Ridge Avenue, parallel to an existing 16-inch diameter pipeline. Figure 2-13 shows the water system infrastructure required for Alternative 3.

Figure 2-14 shows the simulated minimum pressures during a MDD condition under Alternative 3. Minimum pressures within the industrial area are 60 psi or greater. Minimum pressures within the northwest quadrant of the High Zone are slightly lower than under existing conditions, and some locations fall just below 40 psi.

Maximum pressures in the High Zone under Alternative 3 are generally 4 to 5 psi lower in comparison to baseline conditions (see Figure 3) and are all less than 100 psi. This is due to the additional transmission capacity in the High Zone and because Stanfield Tank levels are on average lower than under baseline conditions.

Figure 2-15 shows the simulated maximum velocities during a MDD condition under Alternative 3. Maximum velocities in all pipelines are less than 5 fps.

Alternative 3 is capable of providing 2,500 gpm fire flow for a duration of 3 hours to all locations within the industrial mega site and does not negatively impact available fire flow in other areas of the system.

Figure 2-16 and Figure 2-17 shows the simulated tank levels and pump flow, respectively, during a MDD condition under Alternative 3. To meet demands and maintain High Zone tank levels, one pump at the High Zone Pump Station must run constantly, and four additional pumps must turn on in response to low tank levels in the High Zone. Therefore, this alternative utilizes the firm capacity of the High Zone Pump Station during peak pump flow.

Figure 2-16 shows that Stanfield Tank levels are less stable and much lower in this alternative than under Alternative 2. Due to the additional headloss in the portions of the High Zone that do not have a parallel transmission main installed, the Stanfield Tank cannot be filled to its existing maximum level. This illustrates how the concerns with High Zone tank operations and turnover discussed under Alternative 2 would be exacerbated under Alternative 3.

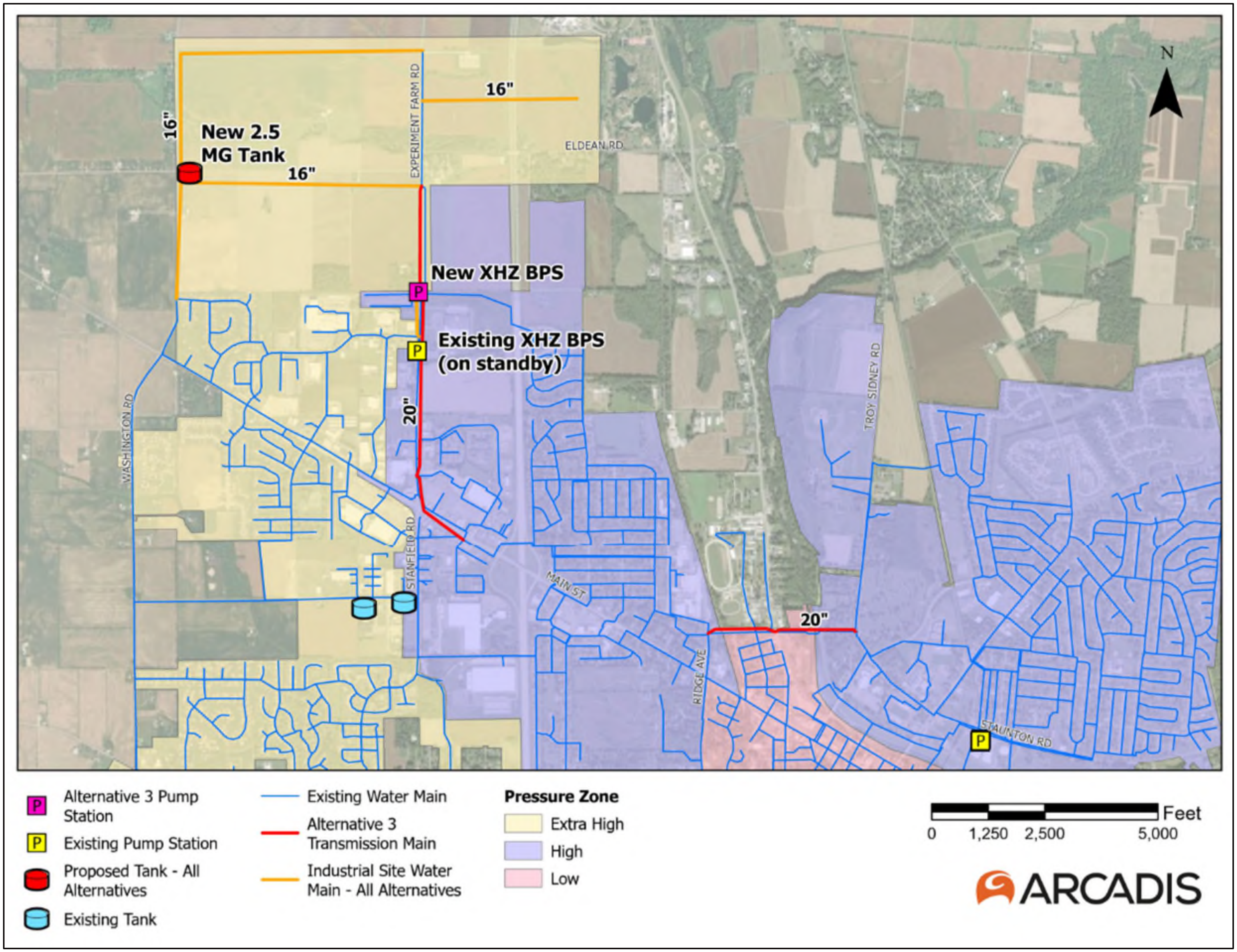


*Figure 2-13. Alternative 3 Infrastructure*

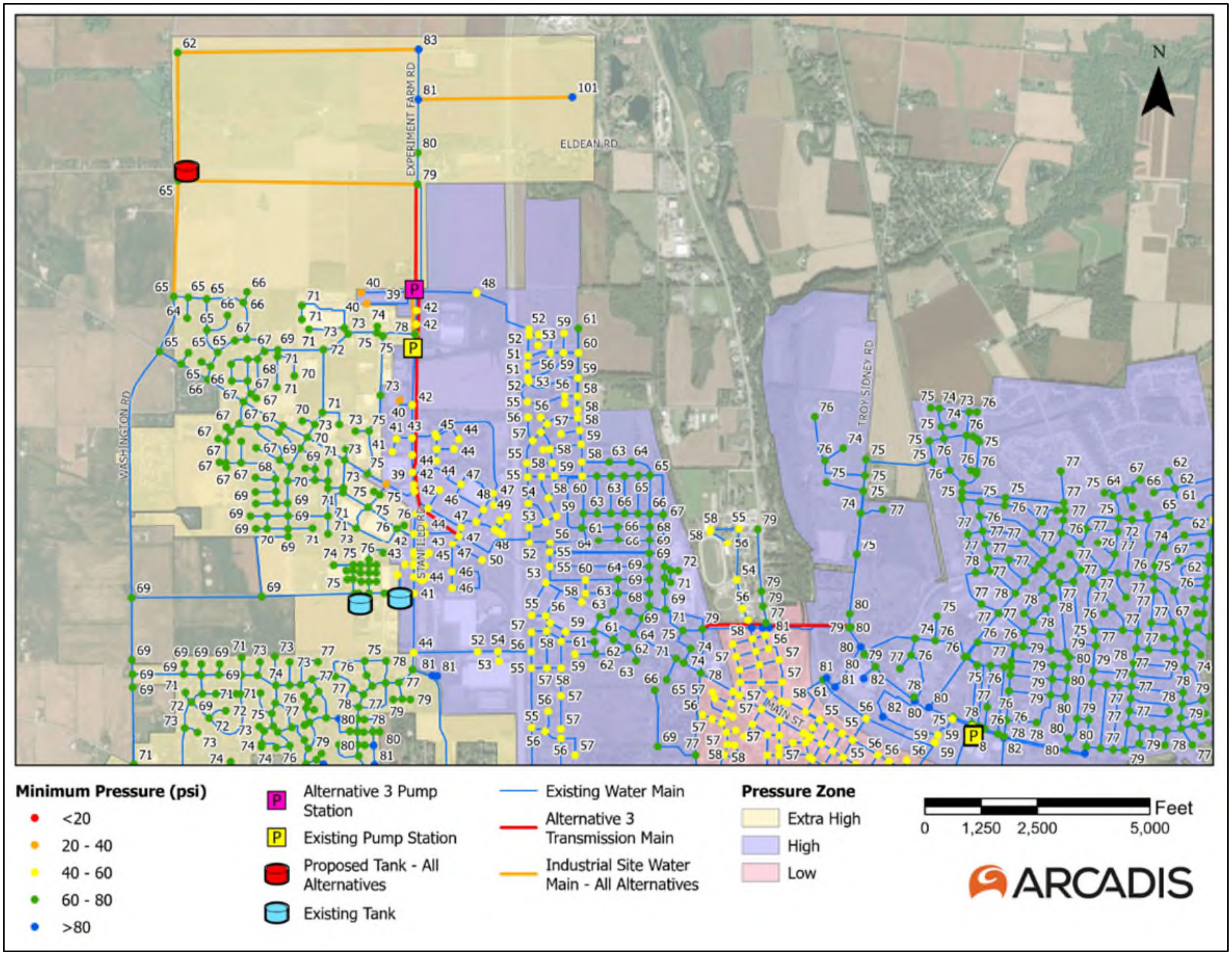


*Figure 2-14. Alternative 3 Minimum Pressures*

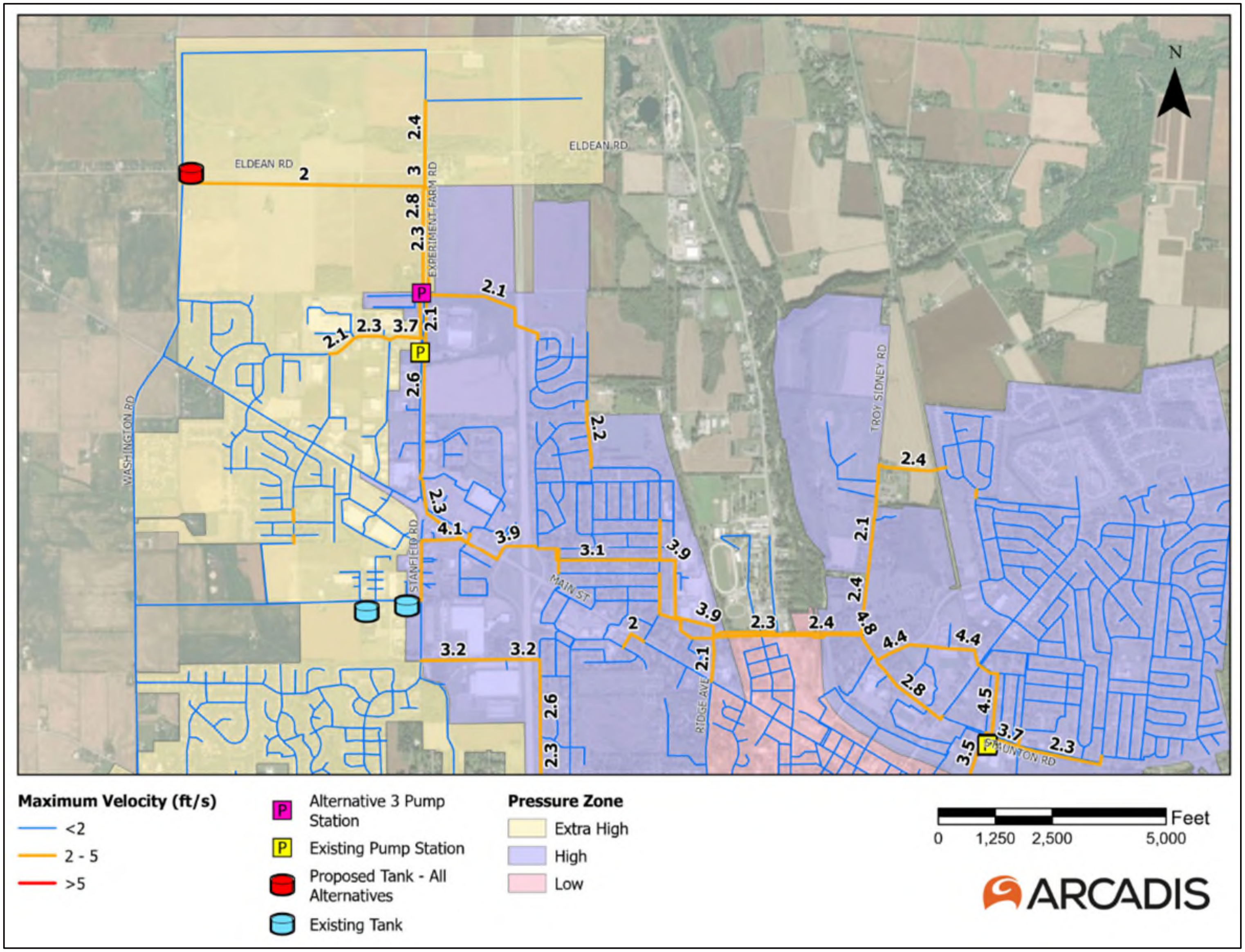


*Figure 2-15. Alternative 3 Maximum Velocities*

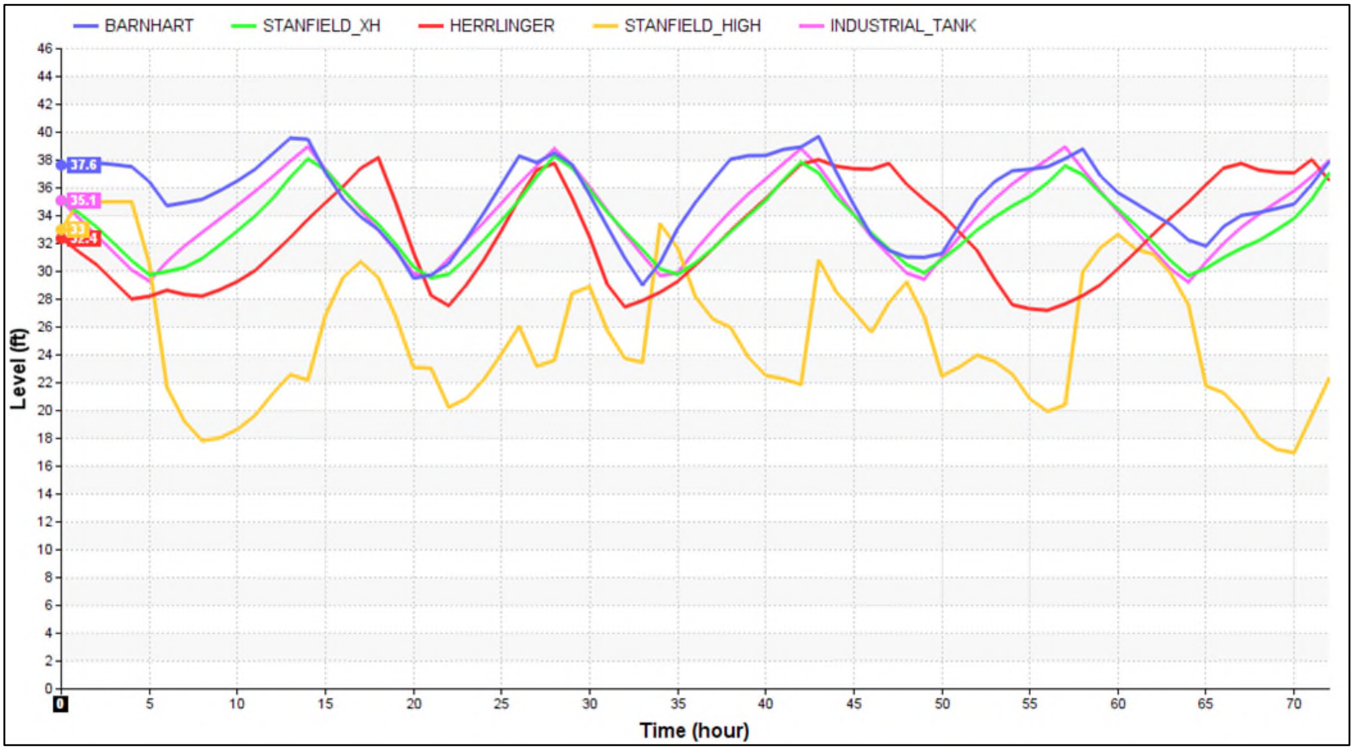


*Figure 2-16. Alternative 3 Tank Levels*

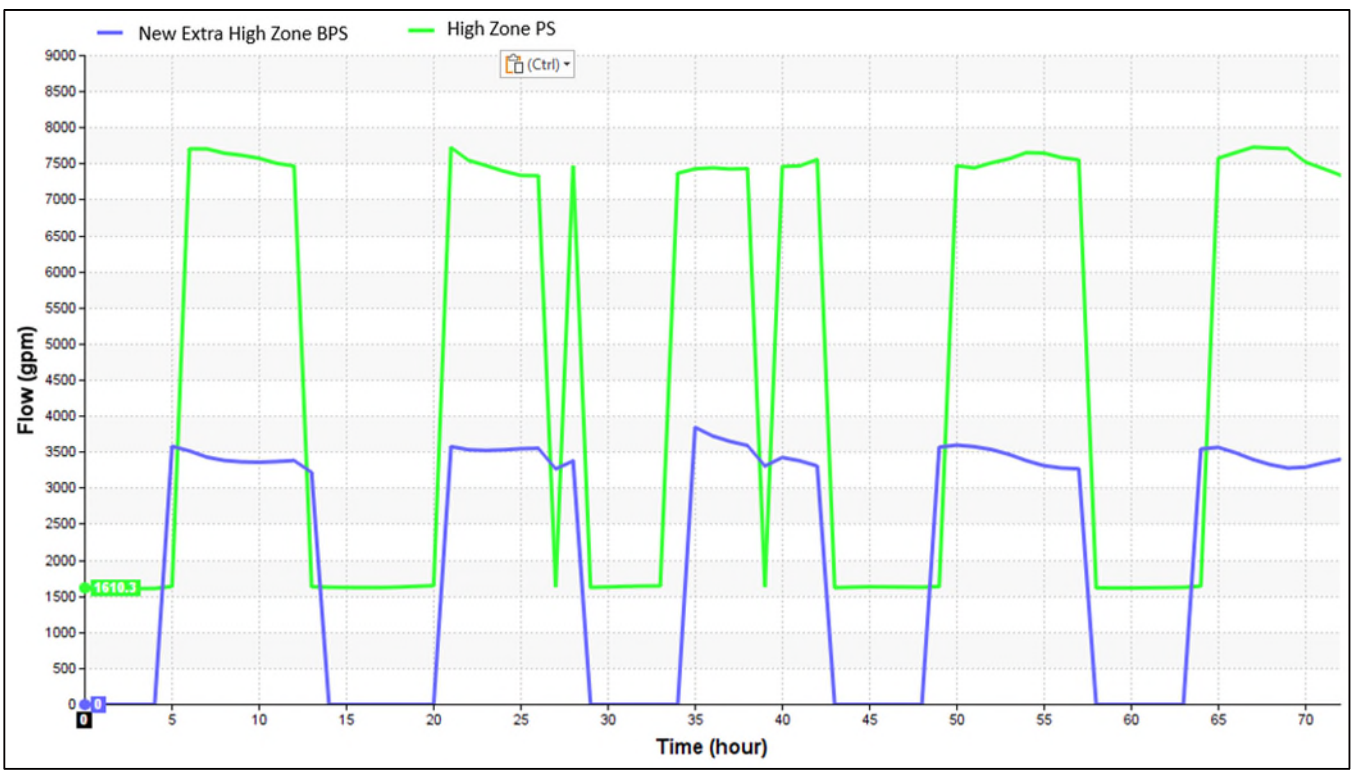


*Figure 2-17. Alternative 3 Pump Station Flow*

### 2.5.4 Alternative Comparison

Table 2-1 summarizes the benefits and concerns associated with each of the water system improvement alternatives.

*Table 2-1. Water System Improvement Alternatives Comparison*

| Alternative | Benefits | Concerns |
|---|---|---|
| Alternative 1 - Dedicated Transmission Pipeline | • No disruption to existing infrastructure or operations<br>• Easier construction of transmission mains (less populated areas) and reduced traffic impacts | • Limited number of new future customers anticipated along this transmission main route<br>• Transmission line provides no benefit until fully constructed<br>• Ability to provide system redundancy is limited |
| Alternative 2 - Integrated High Zone Transmission Pipeline | • Transmission improvements can be constructed in phases as industrial area develops<br>• Increases High Zone system resilience to a transmission main outage<br>• Increases supply capacity to High Zone (in addition to the Extra High Zone)<br>• Utilizes existing excess capacity at High Zone Pump Station | • Constructability is much more challenging (new mains through highly populated areas) and will cause greater impacts to traffic<br>• Requires changes to operations of High Zone Pump Station<br>• May be difficult to achieve turnover in Barnhart Tank while maintaining minimum tank levels in Stanford Tank under some demand conditions |
| Alternative 3 – Partial Integrated High Zone Transmission Pipeline | • Less costly<br>• Transmission improvements can be constructed in phases as industrial area develops<br>• Increases High Zone system resilience to a transmission main outage (Alt 2 provides more benefit)<br>• Increases supply capacity to High Zone (in addition to the Extra High Zone) (Alt 2 provides more benefit)<br>• Utilizes existing excess capacity at High Zone Pump Station | • Constructability is much more challenging (new mains through highly populated areas) and will cause greater impacts to traffic<br>• Requires changes to operations of High Zone Pump Station<br>• May be difficult to achieve turnover in Barnhart Tank while maintaining minimum tank levels in Stanford Tank. (This issue is less extreme in Alt 2)<br>• Does not consider other future demands within the system (recommended to be re-evaluated under a master planning effort) |

## 2.6 Preliminary Cost Estimates

Preliminary project cost estimates for the water system improvement alternatives were developed as part of this evaluation. The costs presented herein are considered a preliminary estimate for long-term planning and feasibility studies only. The cost estimates are consistent with a Class 5 estimate as defined by the Association for the Advancement of Cost Engineering (AACE) International. The guidelines for Class 5 estimates per AACE indicate the estimate is typically -30% to +50%, with approximately 0% to 2% project definition.

For the associated project costs, a fixed percentage of 30% was added to the estimated construction cost to account for design engineering, construction administration, administrative, legal, and other costs associated with project implementation. An additional 30% contingency factor was then added to the construction cost and associated project costs to obtain the total project cost estimate.

Water system project costs are shown in Table 2-2, and a map of the improvement projects is shown on Figure 2-18. Costs for the modeled backbone water pipelines (Project W-3) common to all alternatives within the industrial mega site are shown separately from the costs for the other improvement projects, as it is assumed that the cost for constructing these pipelines would be solely the responsibility of the site developers. Costs for the three Alternatives are presented separately. Some projects, such as the construction of additional storage in the Extra High Pressure Zone (Project W-4) are common to multiple alternatives. Unit costs used to estimate the water project costs are based on recent representative water system construction projects in Ohio and scaled to the recommended project size. All estimates are in 2023 US Dollars (USD) and inflation may need to be considered based timing of anticipated construction.

*Table 2-2. Water System Improvement Cost Estimates*

| Project ID | Project Description | Length (LF) or Quantity | Size | Construction Cost | Engineering, Legal, Administration Costs (30%) | Contingency (30%) | Total Project Cost |
|---|---|---|---|---|---|---|---|
| **On-Site Backbone Water Pipelines (All Alternatives)** | | | | | | | |
| W-3 | New 16-inch mains within the Industrial Area | 20,783 | 16-inch | $9,319,000 | $2,796,000 | $3,635,000 | $15,750,000 |
| **Alternative 1 Water Projects- Dedicated Extra High Zone Transmission Pipeline** | | | | | | | |
| W-1 | New 24-inch transmission main from the WTP to Industrial Site | 27,122 | 24 inch | $14,717,000 | $4,415,000 | $5,740,000 | $24,872,000 |
| W-2 | New 16-inch parallel main in Experiment Farm Road | 723 | 16 inch | $317,000 | $95,000 | $124,000 | $536,000 |
| W-4 | Additional Storage in Extra High Pressure Zone | 1 | 2.5 MG | $10,000,000 | $3,000,000 | $3,900,000 | $16,900,000 |
| W-5 | New Pump Station at WTP | 1 | 4.75 MGD | $4,500,000 | $1,350,000 | $1,755,000 | $7,605,000 |
| | | | | | | ***Alternative 1 Total Cost*** | ***$49,913,000*** |
| **Alternative 2 Water Projects - Integrated High Zone Transmission Pipeline** | | | | | | | |
| W-6 | New 20-inch parallel transmission main from the WTP to Industrial Site | 22,179 | 24 inch | $10,314,000 | $3,094,000 | $4,022,000 | $17,430,000 |
| W-7 | New 16-inch main downstream from the New XHZ BPS | 2,308 | 16 inch | $1,011,000 | $303,000 | $394,000 | $1,708,000 |
| W-4 | Additional Storage in Extra High Pressure Zone | 1 | 2.5 MG | $10,000,000 | $3,000,000 | $3,900,000 | $16,900,000 |
| W-8 | New Extra High Zone Pump Station | 1 | 4.75 MGD | $4,450,000 | $1,335,000 | $1,736,000 | $7,521,000 |
| | | | | | | ***Alternative 2 Total Cost*** | ***$43,559,000*** |
| **Alternative 3 Water Projects - Partial Integrated High Zone Transmission Pipeline** | | | | | | | |
| W-9 | New 20-inch optimized transmission main (based on current demands) | 10,383 | 20 inch | $4,743,000 | $1,423,000 | $1,850,000 | $8,016,000 |
| W-7 | New 16-inch main downstream from the New XHZ BPS | 2,308 | 16 inch | $1,011,000 | $303,000 | $394,000 | $1,708,000 |
| W-4 | Additional Storage in Extra High Pressure Zone | 1 | 2.5 MG | $10,000,000 | $3,000,000 | $3,900,000 | $16,900,000 |
| W-8 | New Extra High Zone Pump Station | 1 | 4.75 MGD | $4,450,000 | $1,335,000 | $1,736,000 | $7,521,000 |
| | | | | | | ***Alternative 3 Total Cost*** | ***$34,145,000*** |

***Note: All estimates are in 2023 dollars***

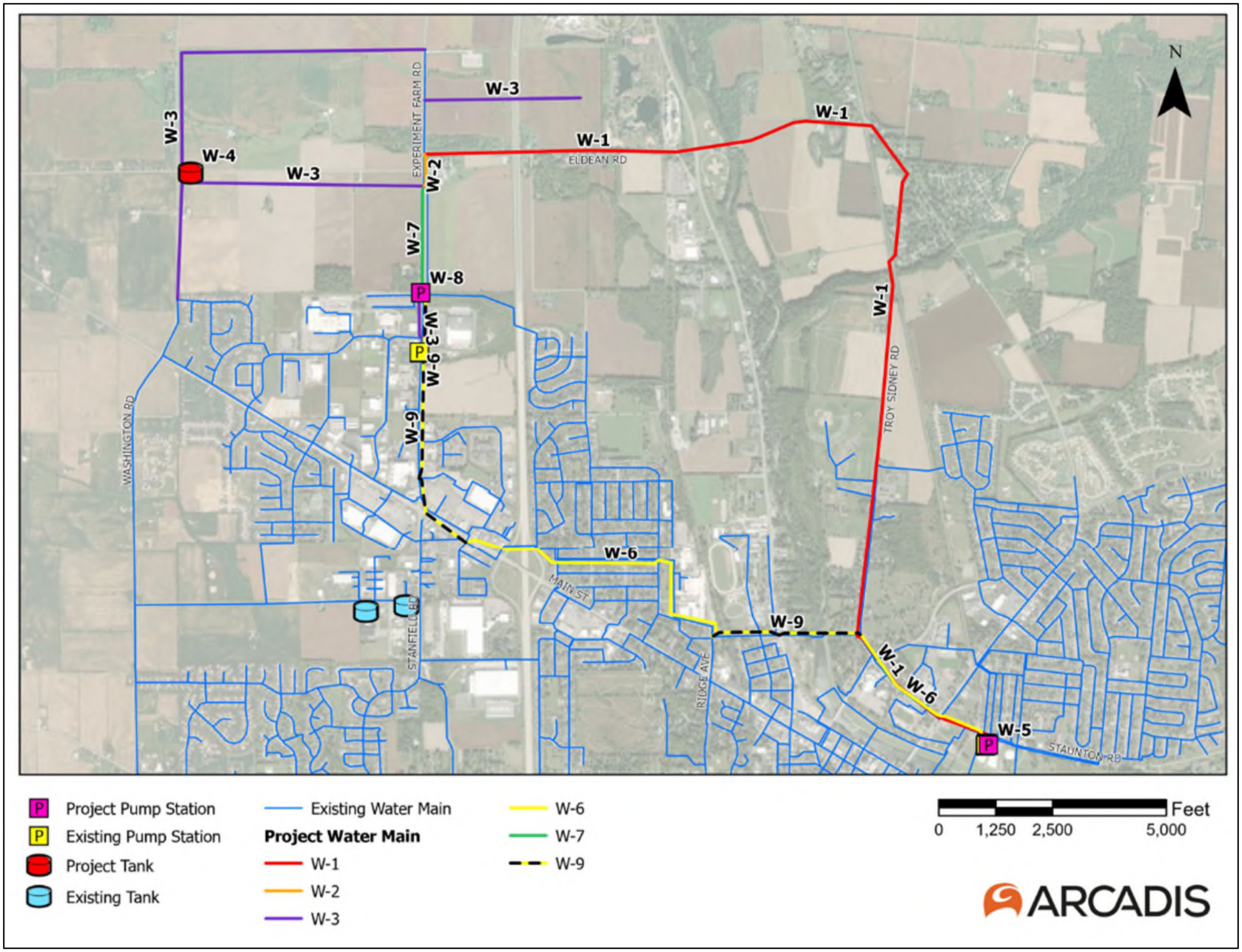


*Figure 2-18. Water System Capital Improvement Projects*

# 2.7 Other Considerations

Additional considerations that were outside the scope of this study but should be investigated in future planning for the industrial mega site are discussed below.

## 2.7.1 Carbon Dioxide Storage:

The WTP stabilizes well production water using carbon dioxide. The Ohio Environmental Protection Agency (OEPA) requires that a 30-day supply of chemicals be stored on site. Assuming that carbon dioxide consumption will increase proportionally to the increased well production, the additional flow of 2 MGD would result in a usage rate of just over 26 tons. The WTP's current carbon dioxide storage vessel holds 26 tons and is scheduled for replacement in 2026. The City should consider expanding the carbon dioxide storage capacity, either by increasing the size of the replacement tank, or by installing a second 26-ton tank to provide additional storage and redundancy.

## 2.7.2 Well Capacity:

The City's current total well capacity is 10.5 MGD. Maximum day production from the wells was 6.68 MGD in 2023. The addition of the 2 MGD industrial mega site would increase maximum day production to 8.68 MGD. While this is below the existing total well capacity, an analysis on firm well capacity and redundancy should be performed to determine if additional wells would need to be drilled to accommodate for the additional usage and to allow for wells to be out of service for repair and rehabilitation.

## 2.7.3 Well Backup Power:

The east wellfield has existing backup power for two wells and the west wellfield has existing backup power for three wells. The existing available well production capacity on backup power is 6.14 MGD. Two additional wells can be attached to a portable generator for backup power, assuming the portable generator is not needed at the Extra High Zone Booster Pump Station. Backup power for the wells would need to be expanded to accommodate the additional demands from the industrial mega site.

# 3 Sanitary System Evaluation

The City's sanitary sewer system collects wastewater flows from the City's service area and conveys flows to the Wastewater Treatment Plant (WWTP). The WWTP is designed to treat an average flow of 7 MGD, with a current monthly average flow of 5.46 MGD. The City is currently constructing a plant expansion that modifies the treatment technology and adds an additional aeration tank, increasing capacity to 9 MGD. The project is scheduled to be complete in Fall 2024.

## 3.1 Hydraulic Model Update and Validation

Arcadis reviewed the City's existing sanitary sewer model for completeness and continuity along the project focused sewer pipes between the proposed industrial mega site and the WWTP. The "project focused sewer pipes" are shown in Figure 3-1. A cursory review of the entire model to check for reversed pipes, flow routing, connectivity issues, and incorrect pipe slopes, sizes, and offsets was completed. Arcadis referenced the City's sewer GIS and available as-builts to make updates to improve the sewer model representation including the following:

- Per the City, replaced the two parallel pipes with the correct 27-inch pipe near N. Market St. bridge, between Manholes 2018 and 2285. See Figure 3-2
- Reconstructed the siphon between Manholes 1137 and 1201, downstream of the Fairgrounds pump station tie-in, based on the as-built drawings. See Figure 3-3.

The County Fairgrounds pump station representation in the model was compared to provided as-builts, pump curves and operating conditions. Arcadis found the pump was set up and operating correctly in the model; therefore, no changes were made.

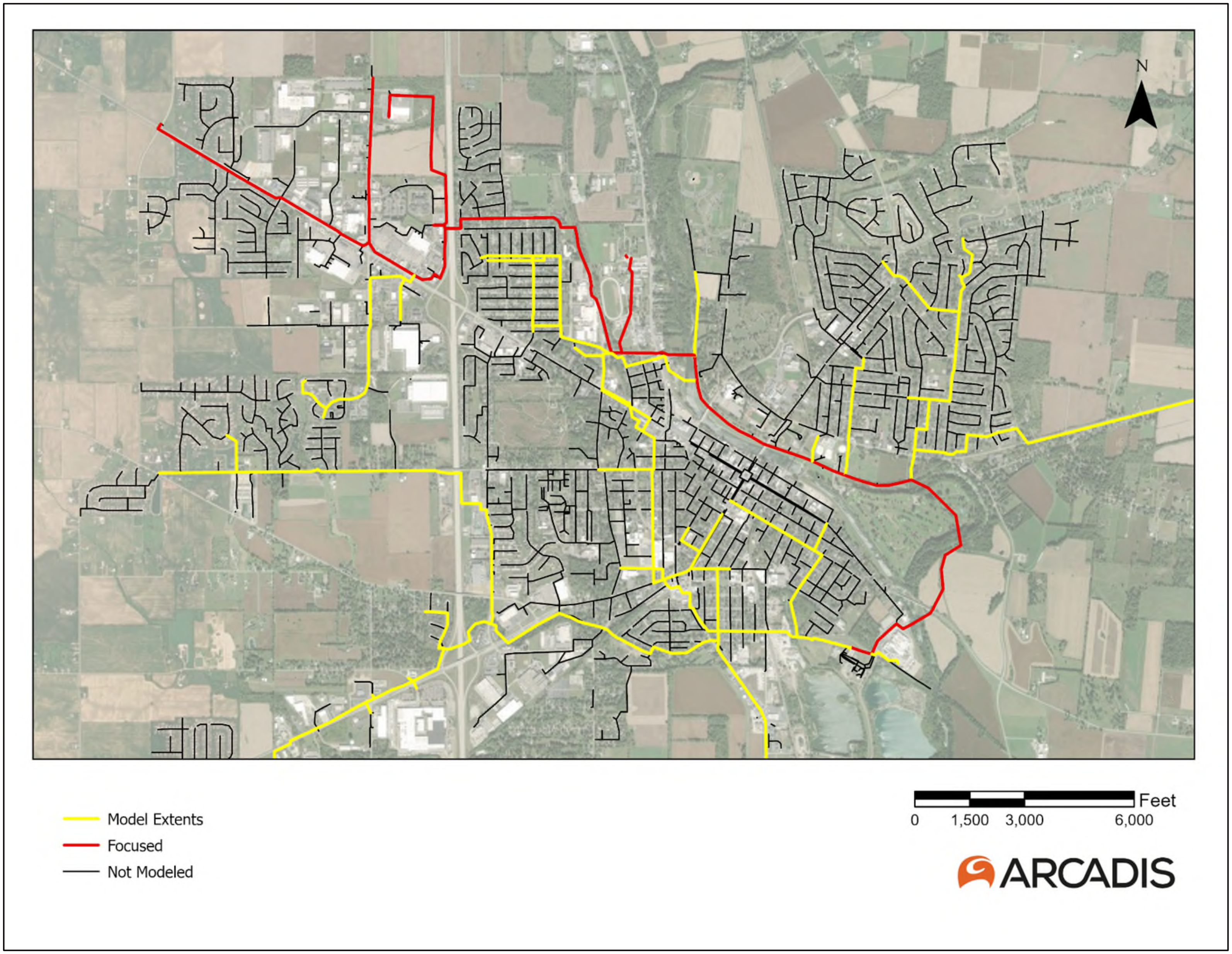


*Figure 3-1. Focused Sewers Studied for the Feasibility Study*

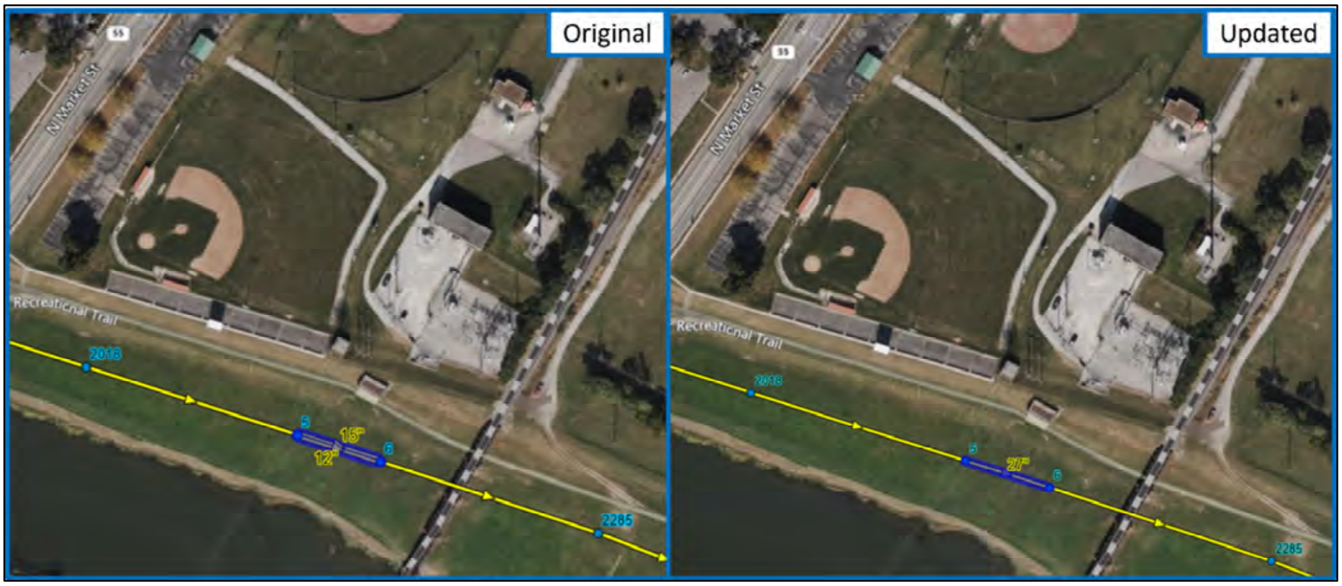


*Figure 3-2. Sewer Model Update: Parallel Sewers Replaced with Continuous Single Sewer*

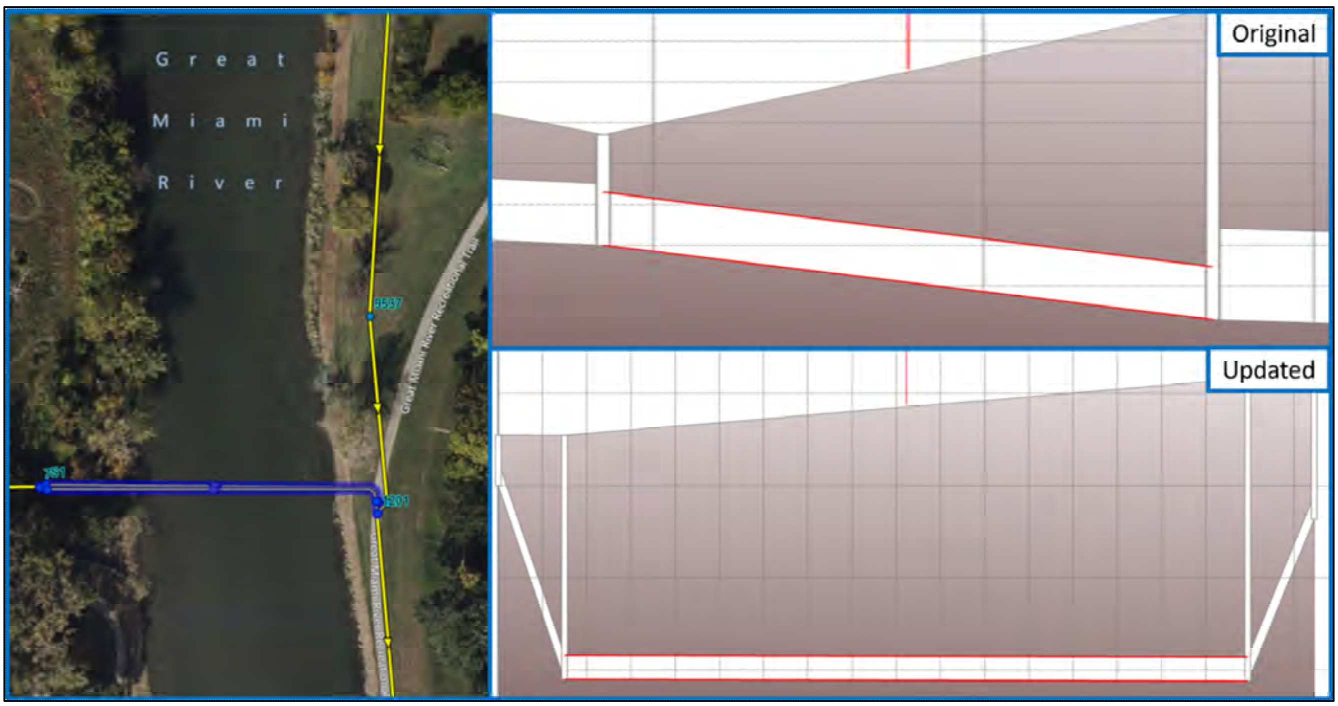


*Figure 3-3. Sewer Model Update: Siphon Representation Revised*

The sanitary sewer model was checked for reasonable calibration. Again, the effort focused on the extent of the model that is hydraulically significant to the proposed industrial mega site per the scope. Rainfall data from March 5 through August 14, 2023, was used in the model to compare results to flow monitoring data provided by the City. Flow data from the WWTP from 2020 was also used for validation. The model calibration was confirmed using one dry weather flow period (consisting of seven days with no precipitation) and two wet weather events from this period. The diurnal patterns and magnitude of flow were compared between model results and provided flow data. Wet weather events were compared visually for matching storm peak responses and post event inflow and infiltration responses. The model calibration was found to be sufficient for this project, and the findings of existing hydraulic flow constraints reasonably match the 2014 sewer modeling efforts. Figure 3-4 presents a wet weather response in the model compared to the flow data provided.  Figure 3-4Figure 3-3 also shows the dry weather before the storm and the return to dry weather conditions afterwards. It should be noted that the infiltration response observed in the model is extremely long (i.e., several days) causing an extended period of high flows. In future model calibration efforts, the hydrologic responses should be carefully calibrated to reflect system performance during large, wet weather events. For the current evaluations for the industrial mega site, the peak flows were the primary driving concern and are discussed in Section 3.4.

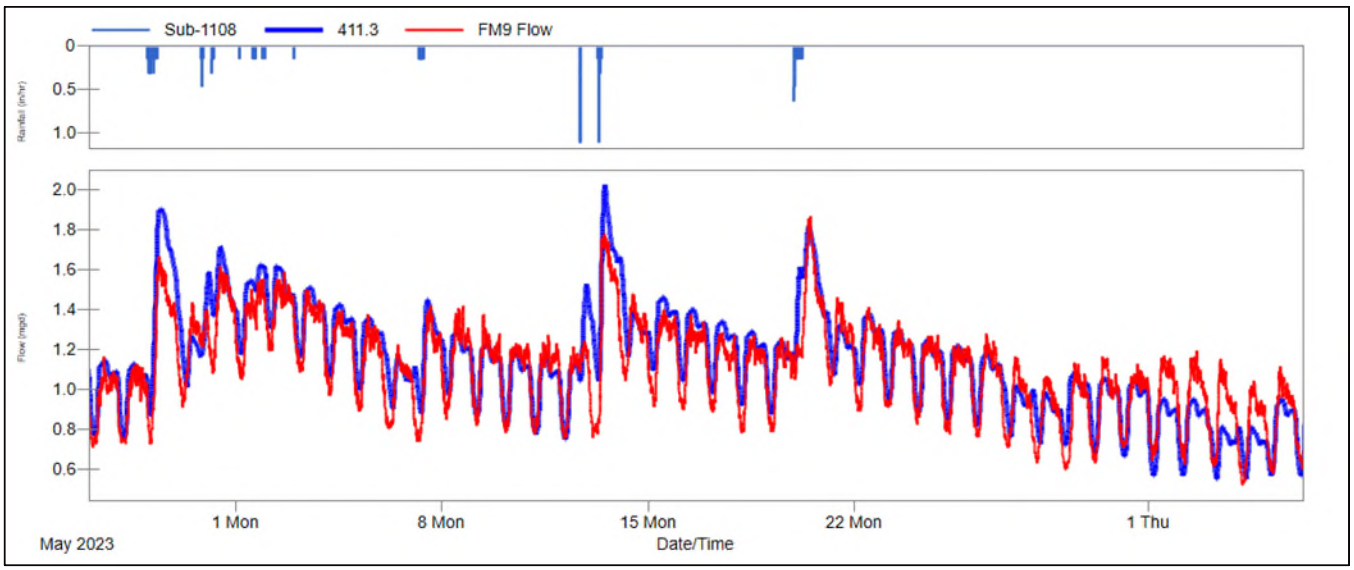


*Figure 3-4. Comparison of Monitored and Modeled Hydrographs at FM9 (Manhole 1205)*

## 3.2 Sanitary System Level of Service Benchmarks

As the City is providing sewer service to its customers, the desired level of service (LOS) goals were discussed and identified to help the City understand the existing conditions evaluation results. LOS goals were defined in an attempt to protect customers and the environment against water in basement (WIB) and manhole flooding up to a certain sized rainfall event. Usually, utilities strive to maintain at least eight feet of freeboard, the distance between the manhole rim and the maximum water surface elevation, with the understanding that basement floors are usually eight feet below grade.  Although specific guidance is not defined, utilities typically identify a maximum level of service rainfall as a 10-year storm. The City also selected a 10-year, 6-hour event with the following LOS goals:

- Gravity pipes maintain a depth of flow to diameter ratio < 0.8 during dry weather and depth of 8-feet below the rim in manholes during wet weather events.
- Pump stations experience a peak flow less than or equal to the firm capacity, and the pump stations and upstream gravity sewers do not experience overflows during wet weather.
- Force mains should not have a velocity exceeding 10 feet per second (fps).

These level of service goals were applied during the model evaluations to identify system capacity, velocity, surcharge, and flooding issues during existing system baseline conditions.

## 3.3 Existing System Baseline Capacity

Arcadis reviewed, validated, and updated the existing collection system model, as detailed in Section 3.1. Model simulations were then run for a 10-year, 6-hour design storm to determine capacity constraints. The model was also run for a dry weather period to check depth to diameter ratios during dry weather periods do not exceed 0.8 as stated in the LOS goals. There is currently a capacity concern at the shallow 18-inch gravity mains near the County Fairgrounds pump station connection point (from manhole 2404 and 1137) causing possible flooding during wet weather events, and this concern was also noted in previous reports. The model does not predict any gravity sewer mains with a depth to diameter ratio exceeding 0.8, aside from siphons, during dry weather periods. Model results for the existing sanitary system in wet and dry weather conditions are shown in Figure 3-5Figure 3-4 and Figure 3-6.

Figure 3-5 presents the available freeboard during the 10-year, 6-hour design storm. The figure shows the degree of surcharging at each modeled manhole. The red manholes are the locations where the model predicts manhole flooding is expected to occur, and the orange manholes are where surcharging is expected to be within two feet of the rim elevation. The yellow, green, and blue manholes represent surcharging within 2-4 feet, 4-6 feet and 6-8 feet of the manhole rim, respectively. These locations represent the possibility of basement flooding. The gray manholes are locations where no surcharging is expected, and all flow stays within the pipe. It is possible for available freeboard to be less than 8 feet without any surcharging where the pipes have shallow cover; these manholes are also shown in gray. As shown in the figure, the potential freeboard concerns are limited to the area near the Fairgrounds, as expected, and a few manholes along Dorset Road that surcharge slightly above the crown of the pipe. There was no surcharging shown by the model outside the area shown in Figure 3-5.

Figure 3-6 shows the depth to diameter ratio during dry weather flow for each sewer pipe. Red pipes represent sewers with a depth ratio greater than 0.8; these pipes are undersized for dry weather flow with possible downstream constraints driving capacity issues. The yellow pipes have a calculated depth ratio between 0.71 and 0.8 of the diameter. The blue sewers have a depth ratio of less than 0.7; these sewers have available capacity during dry weather. The only depths exceeding the 0.8 depth/diameter ratio are along a siphon which functions in a surcharged state and therefore is not imposing a flow constraint during dry weather conditions.

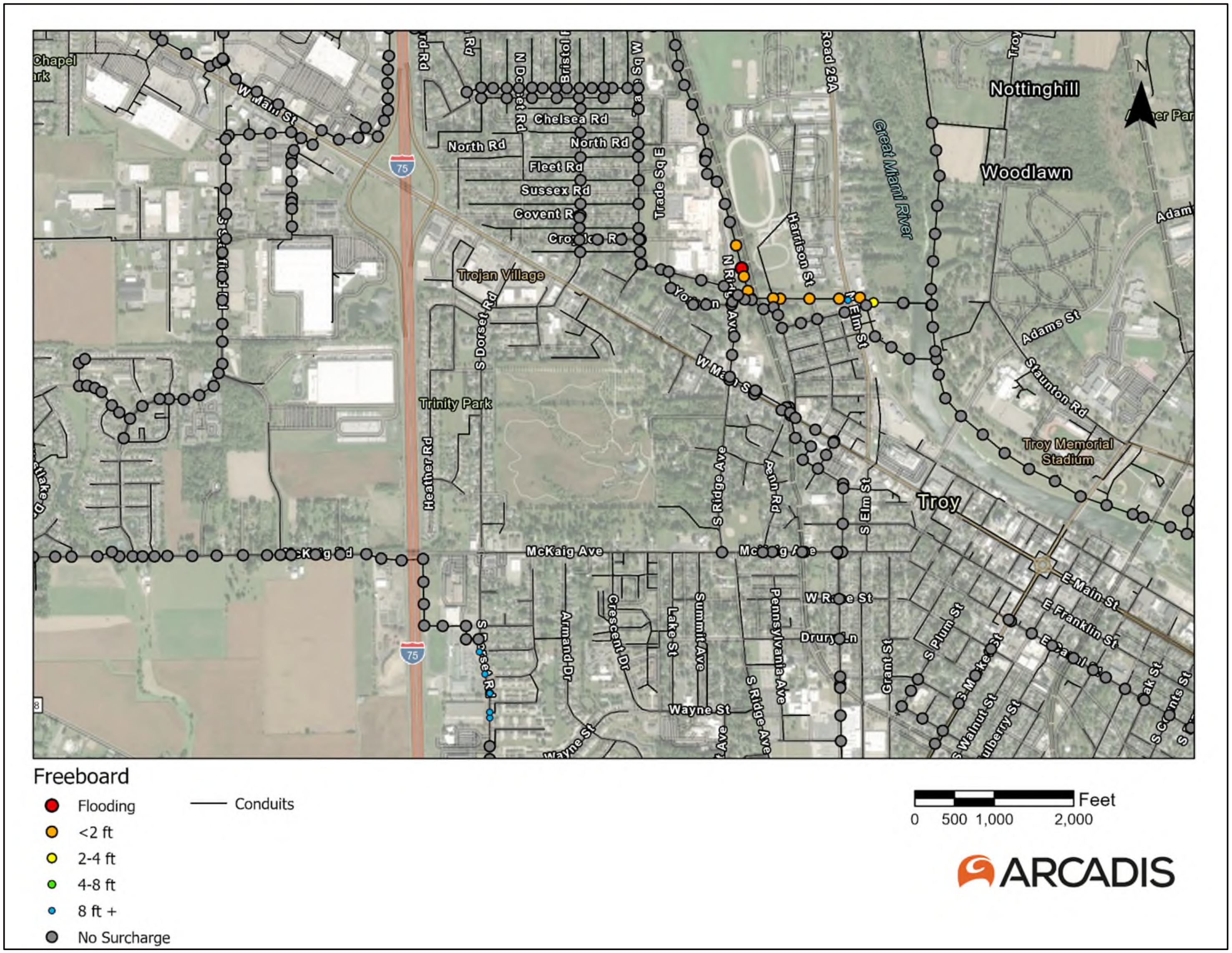


*Figure 3-5. Existing Condition Model Results for Manhole Freeboard During a 10-year, 6-hour Design Storm*

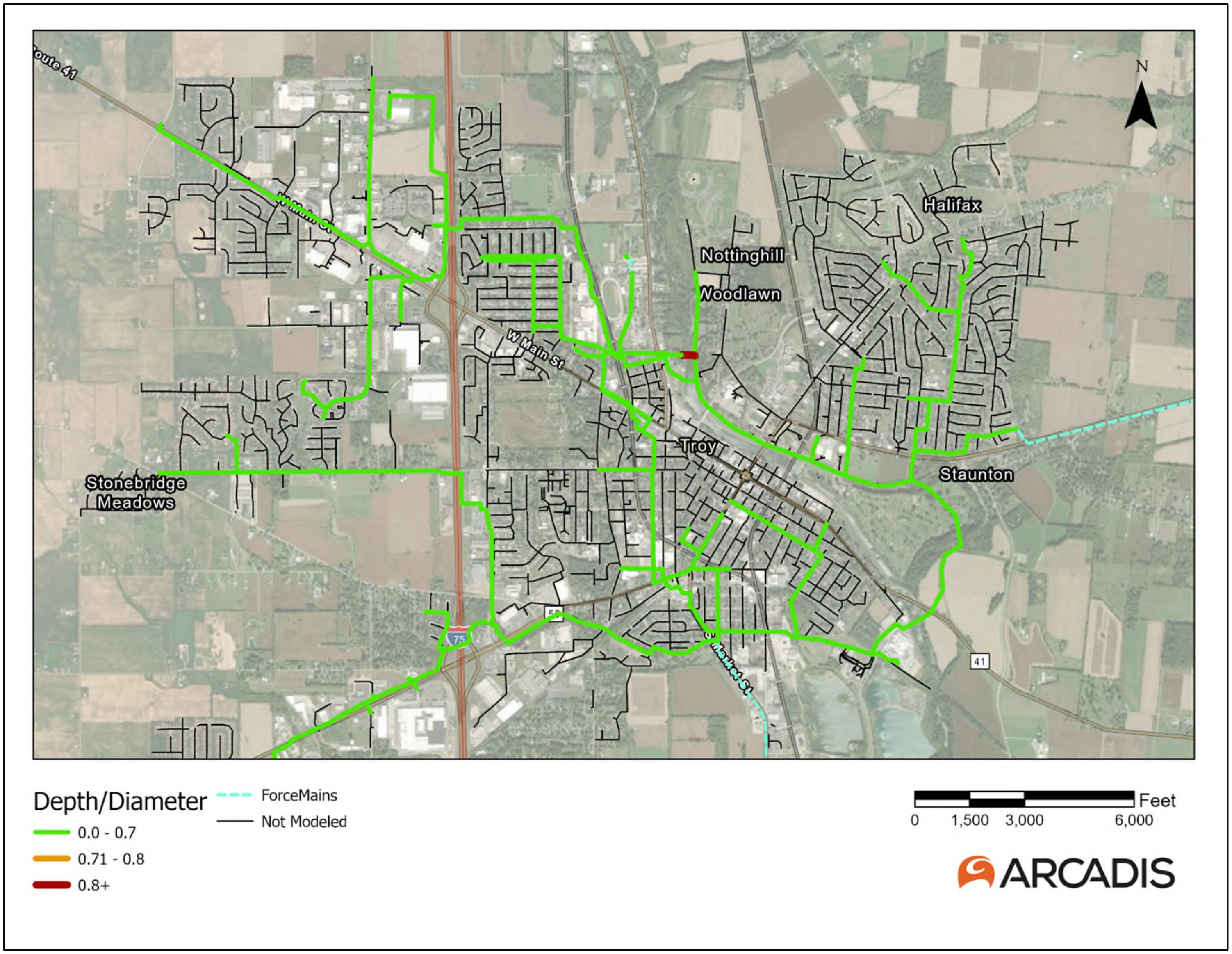


*Figure 3-6. Existing Condition Model Results for Pipe Capacity During Peak Dry Weather Flow*

## 3.4 Alternative Analysis

The alternative analysis began by identifying three possible connection points where the industrial mega site(s) may tie in as shown as red points in Figure 3-7. The approximate available capacities, based on downstream pipe capacities for each connection points are 1.3 MGD at the west connection point, 0.67 MGD at the central connection point, and 0.85 MGD at the east connection point. The flow from these connection points converges at the point where the system crosses Interstate I-75. At this point, the sewers are near capacity under existing conditions during the 10-year, 6-hour design storm. Sewer capacity is not the only factor considered as the LOS goals can be met with pipes being slightly over capacity during wet weather events if there is 8-feet of freeboard remaining. Proposed alternatives focus on conveying the flow downstream of these points, but future demands over 1 MGD at the facility may require capacity improvements in this area.

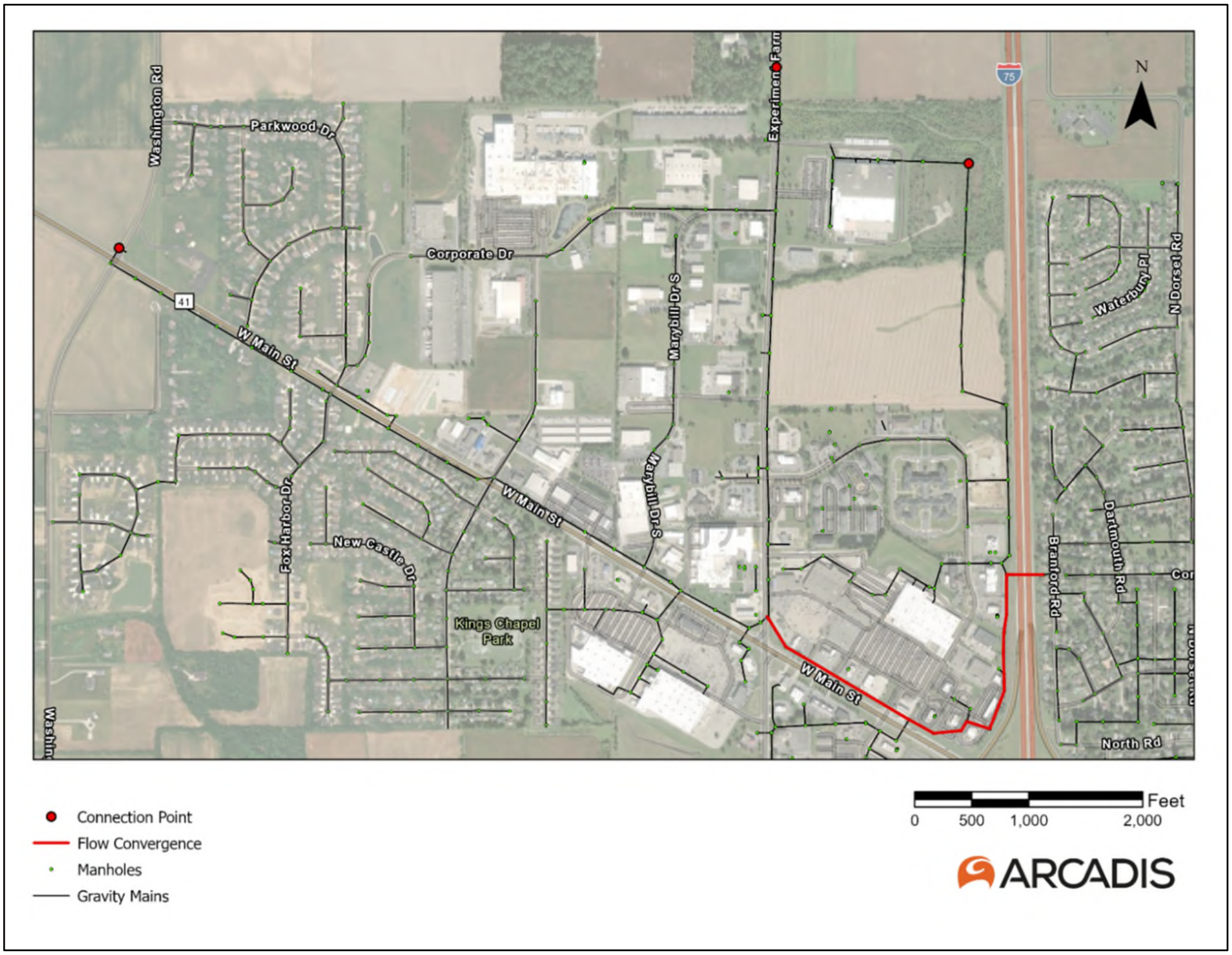


*Figure 3-7. Industrial Mega Site Possible Tie in Locations*

To convey sewage from the industrial mega site(s), all alternatives will require approximately 18,500 ft of 12-inch gravity mains to connect to one or more of the proposed tie-in locations from Figure 3-7. Arcadis assumed using the central and eastern connection points for modeling and costing purposes in the presented alternatives. It was also assumed that gravity mains would need to be connected to the furthest points inside the industrial mega site; this is a conservative assumption for cost purposes. The proposed sewer pipes and routing are shown in Figure 3-8.

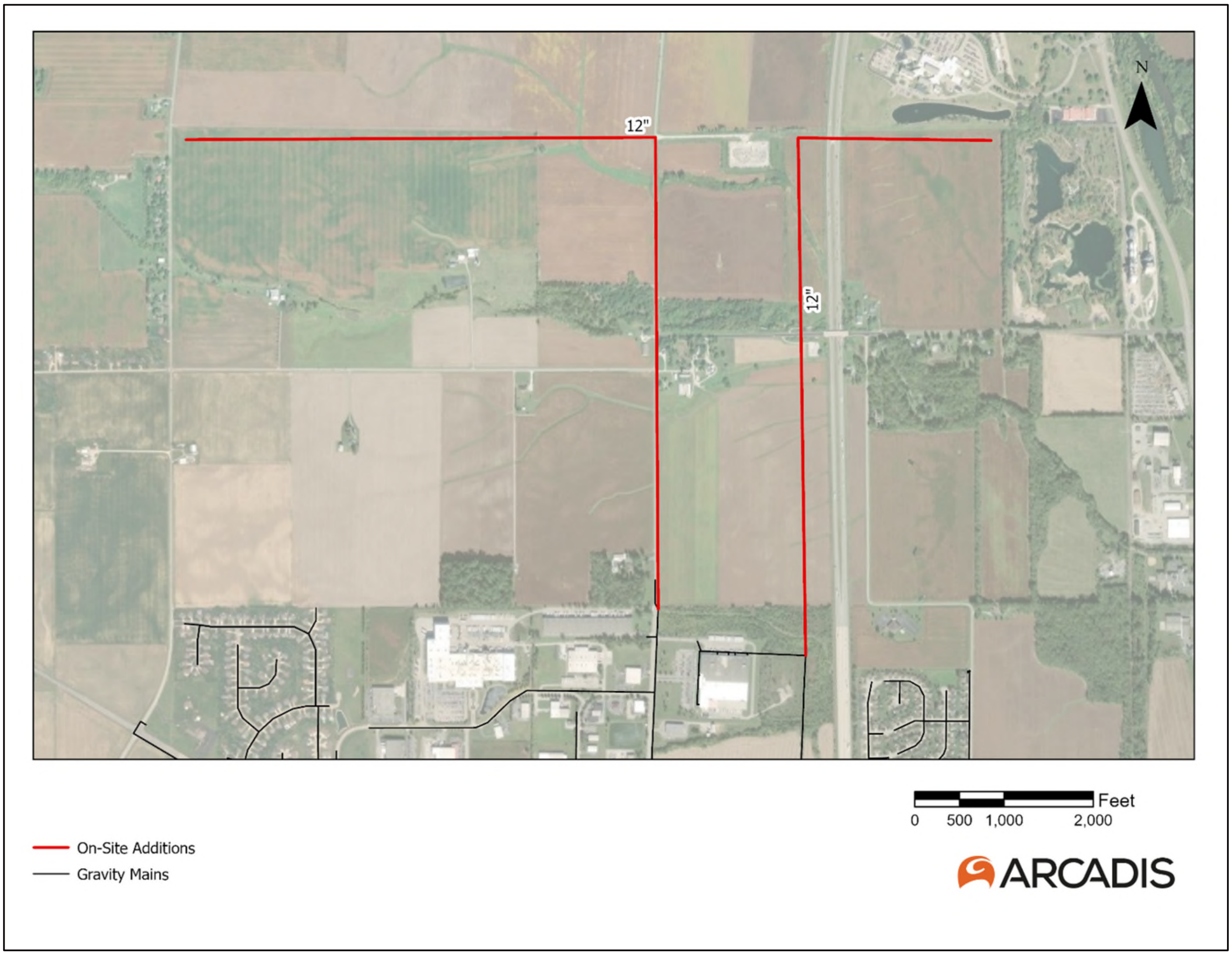


*Figure 3-8. Gravity Sewer Routes Required to Convey Flows to the Connection Points*

Arcadis developed six alternatives to improve the City's sanitary sewer system for the additional 1 MGD flow from the industrial mega site. Alternatives were designed to meet the LOS benchmarks detailed in Section 3.2. These alternatives are grouped into Alternatives 1A and 1B (increasing sewer capacity), Alternatives 2A and 2B (new sewer route), and Alternatives 3A and 3B (storage tank).

### 3.4.1 Alternatives 1A and 1B - Increase Sewer Capacity

Alternatives 1A and 1B both require approximately 2,700 feet of new sewers and replacement of 11 manholes. Alternative 1A replaces the existing 18-inch sewers with 24-inch sewers. Alternative 1B adds a new, parallel 18-inch sewer along the same route from Manhole 2404 to Manhole 1137. **Error! Reference source not found.** through **Error! Reference source not found.** show peak wet weather response for both Alternative 1A and Alternative 1B. These alternatives attenuate the existing flow constrains in the area by increasing flow capacity locally. The additional 1 MGD flow from the industrial mega site can also be conveyed with these proposed improvements. The siphon downstream of the Fairgrounds connection may also be a flow restricting point in these alternatives if additional future demands are added since improvements are proposed upstream to increase capacity. Constructability and the City's preference are large deciding factors between these alternatives as the cost and hydraulic performance are similar.

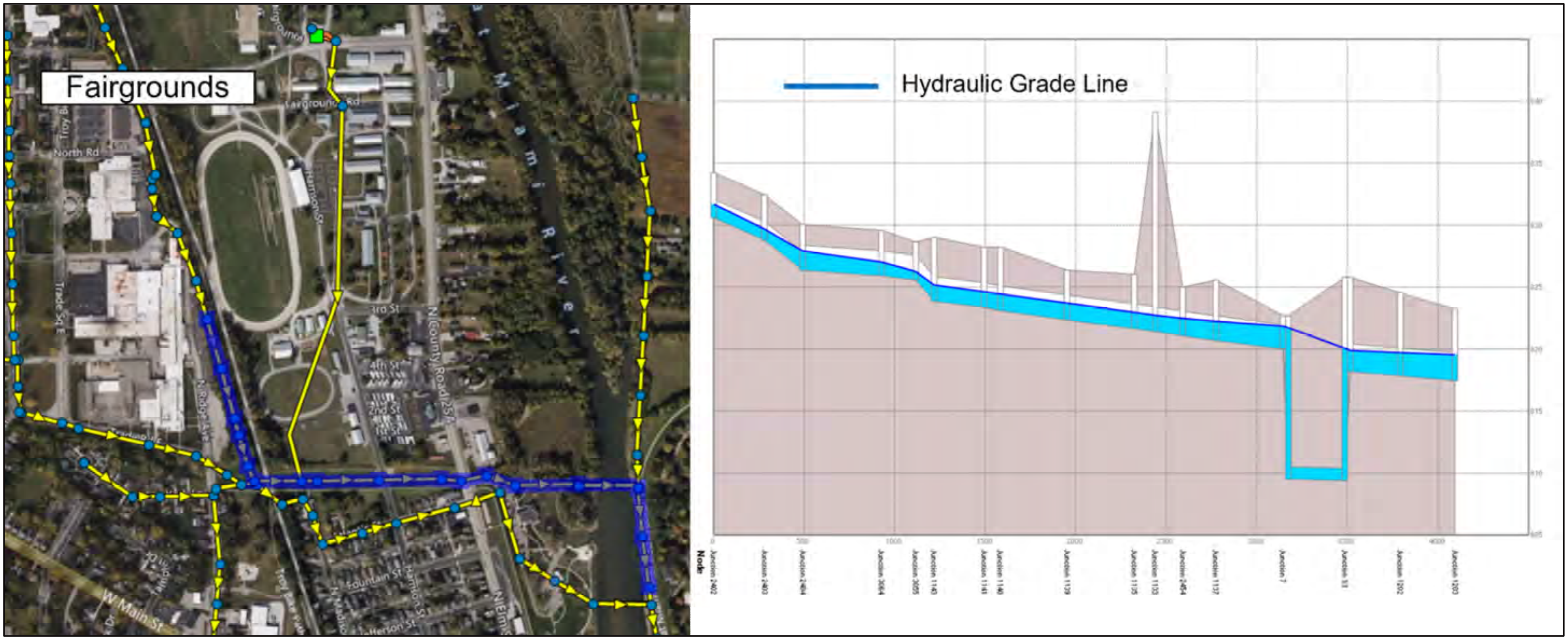


*Figure 3-9. Alternative 1A - Profile of the Proposed Construction Area During Peak Flow Conditions*

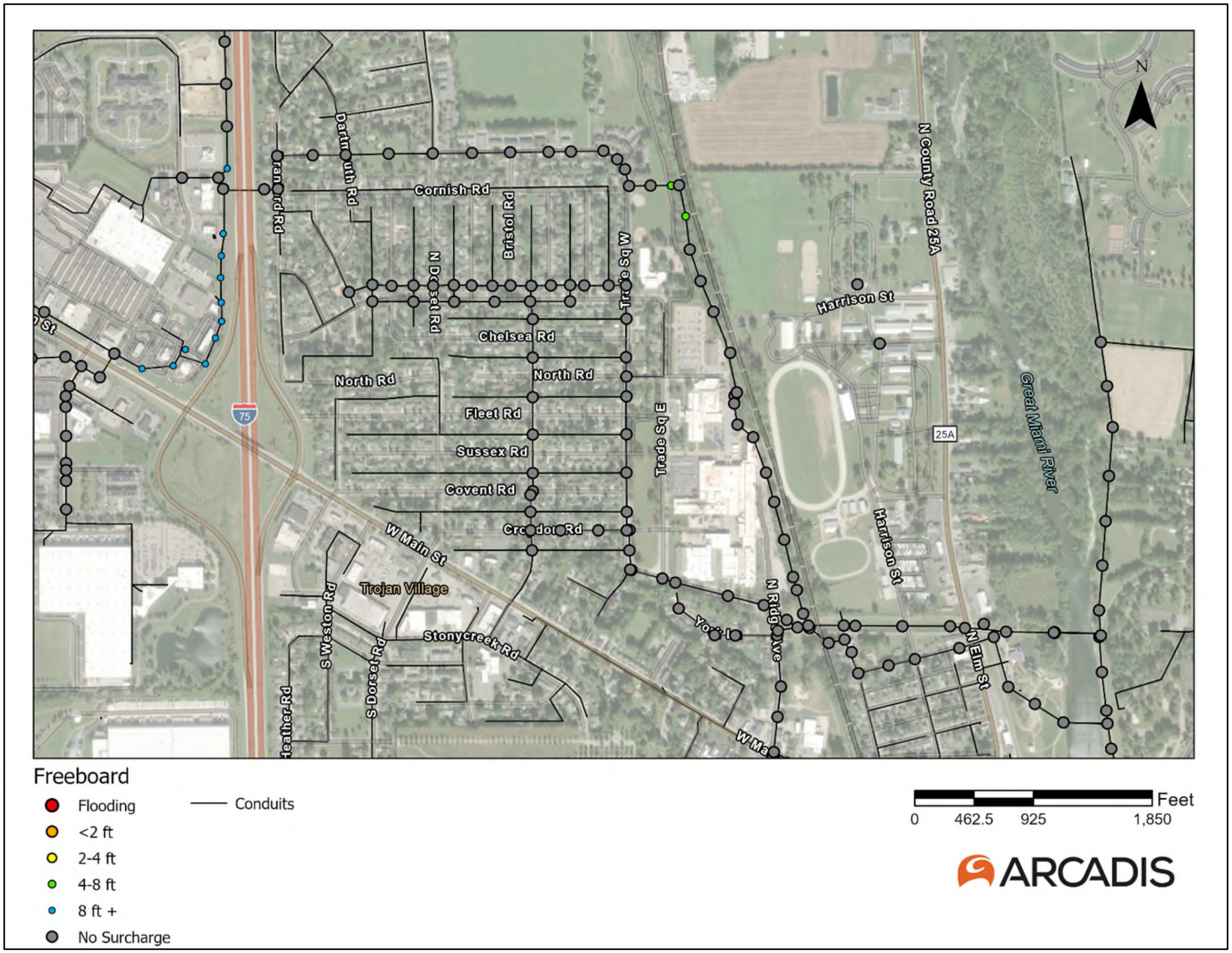


*Figure 3-10. Alternative 1A - Manhole Freeboard During Peak Flow Conditions*

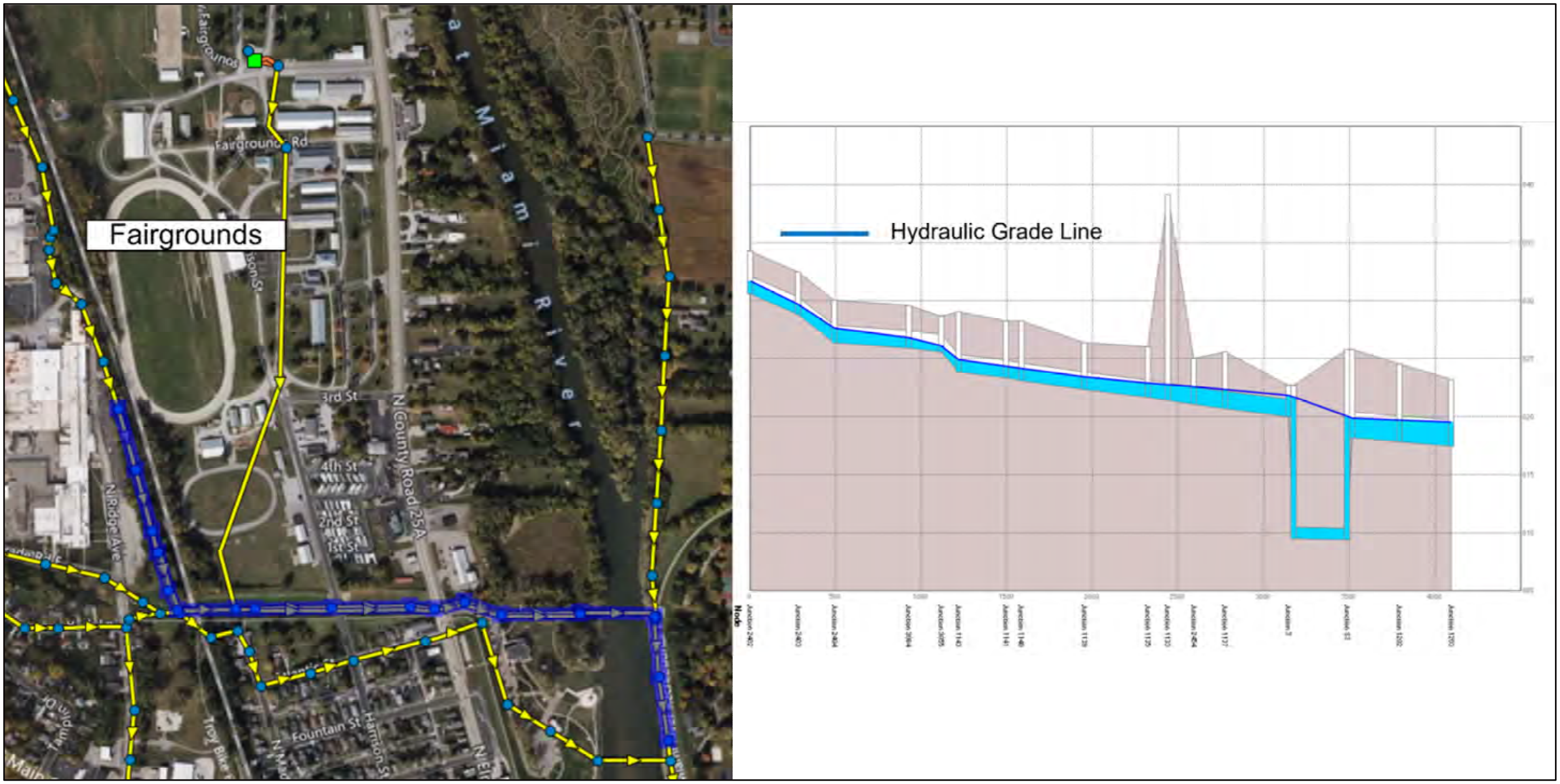


*Figure 3-11. Alternative 1B - Profile of the Proposed Construction Area During Peak Flow Conditions*


*Figure 3-12. Alternative 1B - Manhole Freeboard During Peak Flow Conditions*

### 3.4.2 Alternatives 2A and 2B - New Sewer Route Along Dorset Road

Alternatives 2A and 2B include routing dry weather flow and most wet weather flows coming from the serviced area west of I-75 along N. Dorset Road through a new sewer to connect with the existing sewer on S. Dorset Road. The idea behind this alternative was to route flows south to avoid the siphon at the river and to take advantage of available capacity in the sewer along Cornish Road. To divert flows to the new sewer, a diversion structure at Manhole 1004 on Cornish Rd to direct all dry weather flow and most wet weather flow. Alternative 2A requires 9,000 feet of 15-inch gravity sewers to connect to Manhole 659 on S. Dorset Road. After the connection, 3,200 ft of 12-inch sewers will be replaced with to 18-inch sewers to accommodate the additional flow. Alternative 2B requires 12,200 feet of 15-inch sewers as the proposed route ties in further south at Manhole 569. These alternatives redirects a majority of the flow that would have gone through the existing capacity concern area near the Fairgrounds, allowing for conveyance of the 10-year, 6-hour design storm in addition to the 1MGD flows from the industrial mega site. These results are shown in freeboard and profile in Figure 3-14 through

Figure 3-. Constructability and the City’s preference are large deciding factors between these two alternatives as the cost and hydraulic performance are similar.

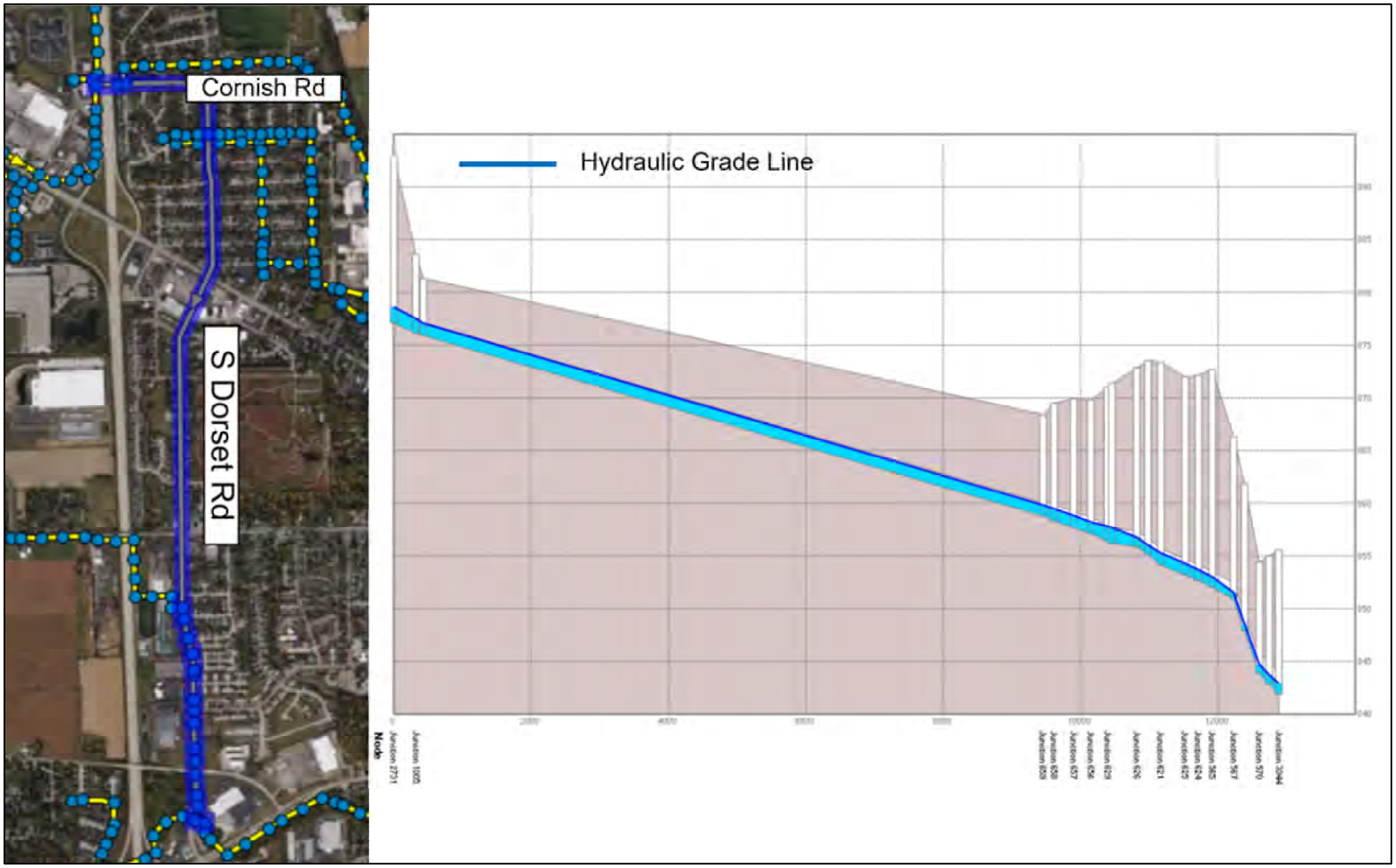


*Figure 3-13. Alternative 2A - Profile of the Proposed Construction Area During Peak Flow Conditions*


*Figure 3-14. Alternative 2A - Manhole Freeboard During Peak Flow Conditions*

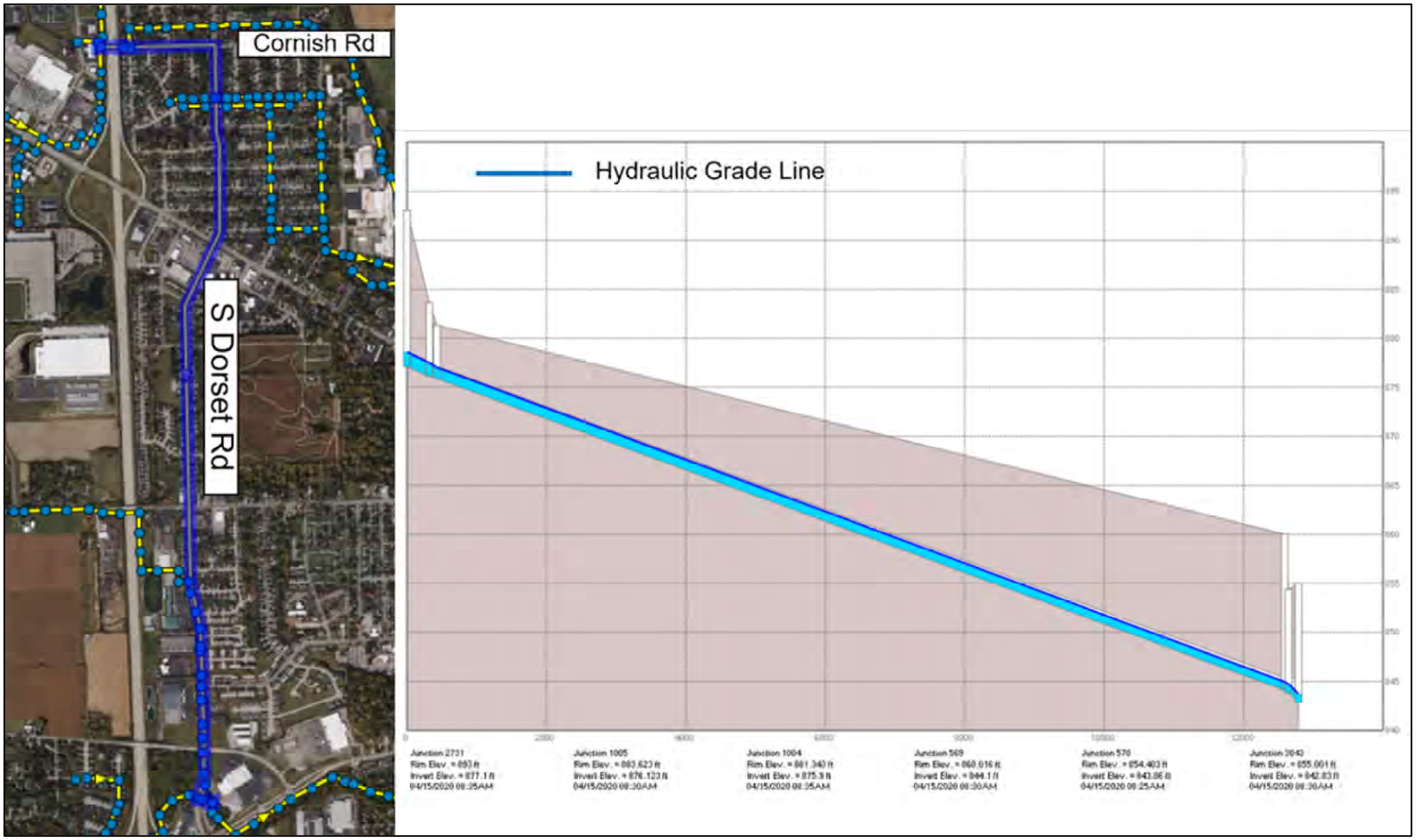


*Figure 3-15. Alternative 2B - Profile of the Proposed Construction Area During Peak Flow Conditions*


*Figure 3-16. Alternative 2B - Manhole Freeboard During Peak Flow Conditions*

### 3.4.3 Alternatives 3A and 3B - Storage Tank to Facilitate Wet Weather Flows

Alternatives 3A and 3B include adding a storage tank to capture wet weather flow and meet the LOS goals in the downstream sewers. Neither alternative requires downstream sewer improvements. Alternative 3A proposes an above ground storage tank which will require flows to be pumped in, whereas Alternative 3B proposes a buried storage tank which will require the flow to be pumped out. Both alternatives require a 1.1 MG volume tank, 400+ feet of 15-inch gravity sewers (inflow to tank), and 400+ feet of 12-inch gravity sewers (outflow from tank). The length of these gravity mains depends on the final location of the storage tank on the proposed site. Alternative 3A requires a 1,175 gpm pump to convey peak wet weather flows to the storage tank. Alternative 3B utilizes a buried storage tank that would allow a gravity flow into the tank and a 380 gpm pump to dewater after the wet weather event has passed. In both alternatives, the storage tanks are designed to dewater within 48 hours of the end of the wet weather event. It should be noted that the model currently predicts a very extended infiltration response to wet weather events, and flow rates do not return to typical dry weather flow levels for several days. It is recommended to perform additional flow monitoring and/or observations prior to construction to verify the storage tanks can successfully dewater within 48 hours without increasing the risk of downstream flooding.

The model results for Alternatives 3A and 3B are similar as both alternatives redirect the same flows during wet weather and dewater at the same rate; only results from Alternative 3B are shown in **Error! Reference source not found.** and Figure 3-17 for clarity. The necessary operation and maintenance of storage tanks needs to be considered, including the flushing system to clean the tank after use (such as a tipping bucket or gate flushing system or high pressure hoses).

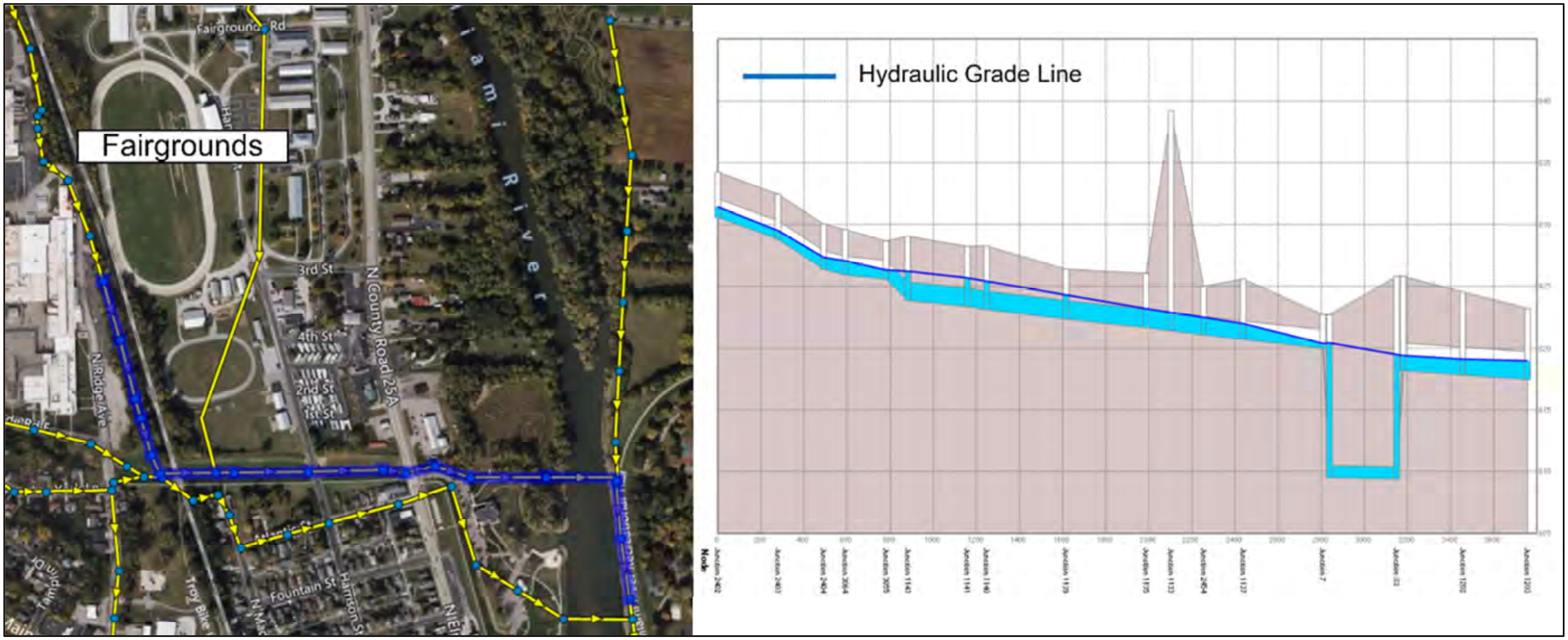


*Figure 3-17. Alternatives 3A and 3B - Profile of the Existing Area During Peak Flow Conditions*

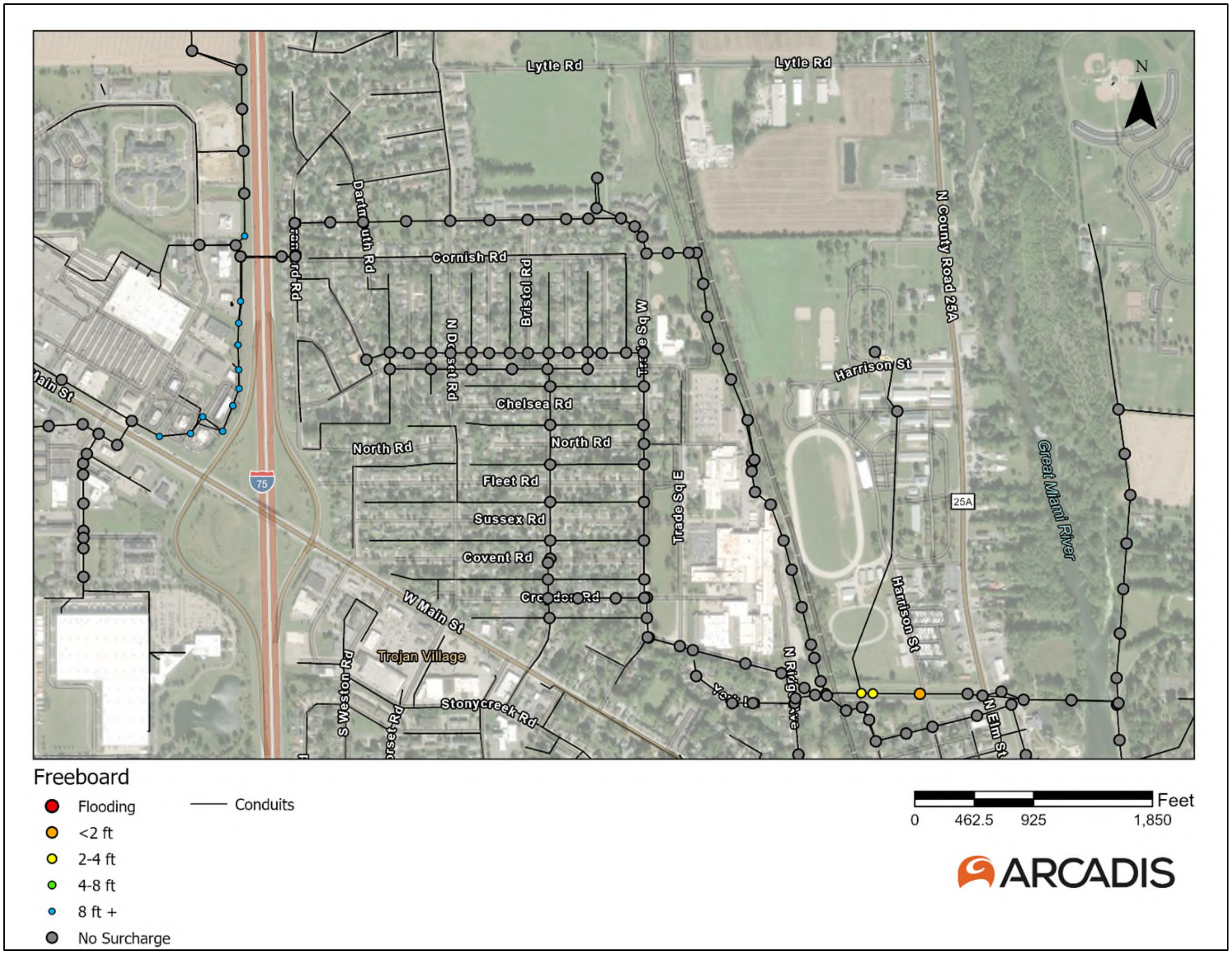


*Figure 3-18. Alternatives 3A and 3B - Manhole Freeboard During Peak Flow Conditions*

### 3.4.4 Alternative Comparison

Table 3-1 summarizes the benefits and concerns for the sanitary sewer alternative to serve a 1MGD industrial mega site. The A and B alternatives are combined in this table.

*Table 3-1. Sanitary Sewer System Improvement Alternatives Comparison.*

| Alternative | Benefits | Concerns |
|---|---|---|
| Alternative 1A and 1B – Increase Sewer Capacity | • Meets LOS goals<br>• Construction is primary along hiking trail<br>• New piping reduces I/I risks in the near term<br>• Least length pipe for construction | • Railroad crossing coordination<br>• Siphon can become capacity concern for additional growth<br>• Shallow pipes in project area; any surcharging is within 4 feet of the surface |
| Alternative 2A and 2B – New Sewer Route Along Dorset Road | • Meets LOS goals<br>• Avoids siphon<br>• Could add capacity for future growth<br>• Provides the most additional capacity of all alternatives | • Residential areas<br>• Crossing Main St<br>• Model was not validated by Arcadis at the south tie in location<br>• Large amount of new construction |
| Alternative 3A and 3B – Storage Tank to Facilitate Wet Weather Flows | • Meets LOS goals<br>• Construction is isolated to a single area<br>• Could be used in tandem with another alternative | • Buried vs. above ground costs vary, especially dependent on subsurface<br>• Potential for odor<br>• Dewatering timing concerns<br>• Consecutive wet weather events can be problematic |

## 3.5 Preliminary Cost Estimates for Sanitary Improvements

Preliminary project cost estimates for the sanitary system improvement alternatives were developed as part of this evaluation. The costs presented herein are considered a preliminary estimate for long-term planning and feasibility studies only. The cost estimates are consistent with a Class 5 estimate as defined by the Association for the Advancement of Cost Engineering (AACE) International. The guidelines for Class 5 estimates per AACE indicate the estimate is typically -30% to +50%, with approximately 0% to 2% project definition.

For the associated project costs, a fixed percentage of 30% was added to the estimated construction cost to account for design engineering, construction administration, administrative, legal, and other costs associated with project implementation. An additional 30% contingency factor was then added to the construction cost and associated project costs to obtain the total project cost estimate.

Table 3-2 shows the sanitary system alternative cost estimates, and a map of the improvement projects is shown on Figure 2-18. Costs for the three Alternatives are presented separately. Costs for the modeled backbone sanitary sewers (Projects NEW-1 and NEW-2) common to all alternatives within the industrial mega site are shown separately from the costs for the other improvement projects, as it is assumed that the cost for constructing these sewers would be solely the responsibility of the site developers. Unit costs used to estimate the sewer project costs are based on recent representative sewer system construction projects in Ohio and scaled to the recommended project size. All estimates are in 2023 USD and inflation may need to be considered based timing of anticipated construction.

*Table 3-2. Sanitary System Improvement Cost Estimates*

| Project ID | Project Description | Length (LF) or Quantity | Size | Construction Cost | Engineering, Legal, Administration Costs (30%) | Contingency (30%) | Total Project Cost |
|---|---|---|---|---|---|---|---|
| **New Piping to Growth Areas (Applies to All Alternatives)** | | | | | | | |
| New-1 | New 12-inch pipes to growth areas | 18,520 | 12 inch | $5,185,600 | $1,556,000 | $2,022,000 | $8,763,600 |
| New-2 | Manholes affected or added | 62 | -- | $744,000 | $223,000 | $290,000 | $1,257,000 |
| ***New Piping Cost*** | | | | | | | ***$10,020,600*** |
| **Alternative 1A Upsizing pipes upstream of siphon** | | | | | | | |
| 1A-1 | 18-inch pipes increased to 24-inch near siphon | 2,646 | 24 inch | $846,720 | $254,000 | $330,000 | $1,430,720 |
| 1A-2 | Manholes affected or added | 11 | -- | $132,000 | $40,000 | $52,000 | $224,000 |
| ***Alternative 1A Total Cost*** | | | | | | | ***$1,654,720*** |
| **Alternative 1B Parallel pipes upstream of siphon** | | | | | | | |
| 1B-1 | New 18-inch parallel pipe near siphon | 2,646 | 18 inch | $793,800 | $238,000 | $310,000 | $1,341,800 |
| 1B-2 | Manholes affected or added | 11 | -- | $132,000 | $40,000 | $52,000 | $224,000 |
| ***Alternative 1B Total Cost*** | | | | | | | ***$1,565,800*** |
| **Alternative 2A New Dorset Road flow route with upsizing** | | | | | | | |
| 2A-1 | New 15-inch gravity main from Cornish Rd to Arlington Ave | 9,000 | 15 inch | $2,610,000 | $783,000 | $1,018,000 | $4,411,000 |
| 2A-2 | 12-inch pipes increase to 18-inch from ArlingtonAve to State Route 718 | 3,144 | 18 inch | $943,200 | $283,000 | $368,000 | $1,594,200 |
| 2A-3 | Manholes affected or added | 45 | -- | $540,000 | $162,000 | $211,000 | $913,000 |
| ***Alternative 2A Total Cost*** | | | | | | | ***$6,918,200*** |
| **Alternative 2B New Dorset Road flow route with parallel pipes** | | | | | | | |
| 2B-1 | New 15-inch gravity main from Cornish Rd to State Route 718 | 12,144 | 15 inch | $3,521,760 | $1,057,000 | $1,374,000 | $5,952,760 |
| 2B-2 | Manholes affected or added | 45 | -- | $540,000 | $162,000 | $211,000 | $913,000 |
| ***Alternative 2B Total Cost*** | | | | | | | ***$6,865,760*** |
| **Alternative 3A Wet Weather Storage pump in option** | | | | | | | |
| 3A-1 | Storage Tank in open lot West of Fairgrounds | 1 | 1.1 MG | $2,200,000 | $660,000 | $858,000 | $3,718,000 |
| 3A-2 | Influent Pump | 1 | 1175 GPM | $1,690,000 | $507,000 | $659,000 | $2,856,000 |
| 3A-3 | New 15-inch gravity main from diversion to storage tank | 400 | 15 inch | $116,000 | $35,000 | $45,000 | $196,000 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 3A-4 | New 12-inch gravity main connecting storage tank to existing system | 400 | 12 inch | $112,000 | $34,000 | $44,000 | $190,000 |
| 3A-5 | Manholes affected or added | 4 | -- | $48,000 | $14,000 | $19,000 | $81,000 |
| ***Alternative 3A Total Cost*** | | | | | | | ***$7,041,000*** |
| **Alternative 3B Wet Weather Storage pump out option** | | | | | | | |
| 3B-1 | Storage Tank in open lot West of Fairgrounds | 1 | 1.1 MG | $2,200,000 | $660,000 | $858,000 | $3,718,000 |
| 3B-2 | Dewatering Pump | 1 | 380 GPM | $550,000 | $165,000 | $215,000 | $930,000 |
| 3B-3 | New 15-inch gravity main from diversion to storage tank | 400 | 15 inch | $116,000 | $35,000 | $45,000 | $196,000 |
| 3B-4 | New 12-inch gravity main connecting storage tank to existing system | 400 | 12 inch | $112,000 | $34,000 | $44,000 | $190,000 |
| 3B-5 | Manholes affected or added | 4 | -- | $48,000 | $14,000 | $19,000 | $81,000 |
| ***Alternative 3B Total Cost*** | | | | | | | ***$5,115,000*** |

***Note: All estimates are in 2023 dollars***

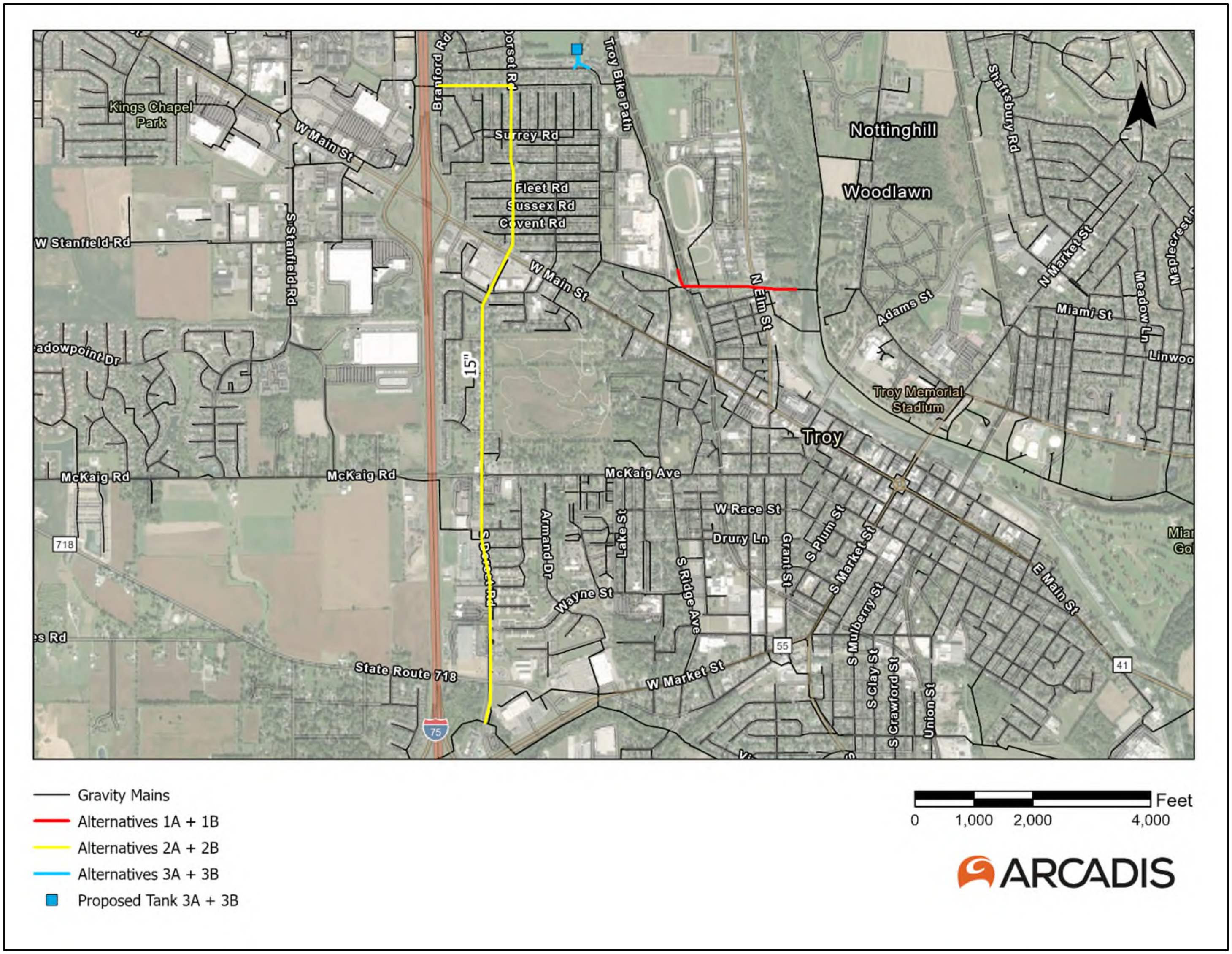


*Figure 3-19. Sewer System Capital Improvement Projects*

# 4 Conclusions

This report presents feasible recommendations for accommodating the anticipated growth at the industrial mega site based on preliminary information and the existing water and sewer models available at this time. The recommendations should be revisited as the potential development and/or growth materializes and the specific site location(s), consumption rates and wastewater flows are defined. In addition, the use of on-site water storage and pretreatment facilities can impact the improvements recommended in this report.

The following next steps and recommendations are suggested:

- Update the water and sewer master plans, including the hydraulic models. As noted in this report, the models used were only validated for the specific areas of interest. It is recommended to recalibrate the water and sewer models for the entire service area to maintain a current tool for evaluating the impact of growth, development and water/sewer issues. In particular, it is recommended that the Water System Master Plan investigate potential future turnover issues in the Stanfield High and Barnhart Tanks that may develop as the system expands and demands in the northwestern portion of the High Zone increase.
- As noted in Section 3.4.3, the sanitary sewer model predicts extended, high infiltration flows after a wet weather event. As such, estimating the necessary storage tank size to capture a wet weather event carries a large uncertainty. Also, with extended peak flows, dewatering the storage tank becomes a challenge. It is strongly recommended to perform additional flow monitoring and to refine the model calibration to refine the infiltration component in the model.
- The cost estimates will need to be refined based on:
  - The timing of the construction. The costs included in this report are in 2023 dollars.
  - Costing to a higher degree of certainty. The costs included in this report are considered Class 5 estimates as defined by AACE.
  - Opportunities for the industry(s) to fund the necessary improvements.

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