VILLAGE OF TOLONO, IL

# Sanitary Sewer System Flow Study

## Technical Report

**September 2019**

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Donohue Project No.: 13523

# TECHNICAL REPORT

## VILLAGE OF TOLONO, IL

## SANITARY SEWER SYSTEM FLOW STUDY

## CHAMPAIGN, IL

## PROJECT NO. 13523

## CERTIFICATION

I hereby certify that this technical report was prepared by me and that I am a duly Licensed Professional Engineer under the laws of the State of Illinois.


License Expires: November 30, 2019

Dated Signed: September 24, 2019

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**Donohue & Associates, Inc.**

**Illinois-registered Professional Design Firm No. 184.001924**

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# EXECUTIVE SUMMARY

This report is primarily intended to identify capacity concerns within the Village of Tolono's existing sanitary sewer collection system. This report will also provide general condition assessments of the Village's lift stations and the WWTP. Ultimately, this report should provide assistance with long-term planning for the Village's sanitary sewer collection system. The following phases of this study were completed previously:

Phase 1 – Existing collection system analysis and lift station evaluation

Phase 2 – Flow monitoring and data analysis

The following sanitary sewer system improvements are recommended and will be discussed further in this report:

1) East St. Lift Station Replacement
2) WWTP Capital Improvements
3) Elizabeth Street Lift Station Improvements
4) Watson Street Lift Station Improvements
5) Sewer Cleaning & Inspection Program
6) Sewer Repair/Rehabilitation/Replacement

## BACKGROUND

The Village's wastewater system serves approximately 673 acres, including 1,158 single-family residential properties, 30 commercial properties, and 14 multi-family properties. There are no special waste generators within the Village's existing service area.

The Village's collection system is comprised of approximately 80,100 feet of gravity sanitary sewer and six (6) municipal lift stations (not including the WWTP influent lift station or Unity High School & Jr. High Lift Station) and force mains. The majority of the collection system and WWTP were built with the original system constructed in the early 1970's. Collection system additions since the original construction include the extension to serve the Linshar Fields subdivision in the 1990's and the Deerpath, Windstone, Kinderwood, and Southview subdivisions in the 2000's. The WWTP is an activated sludge WWTP that has had some upgrades including the construction of a primary clarifier, filter building, sludge storage lagoon in the 1980's and the addition of a roughing filter in 2011.

General steps to evaluate an existing sanitary sewer collection system and wastewater treatment plant (WWTP) are as follows:

1) Review existing maps, plans, and data about the existing infrastructure
2) Meet with operations and maintenance staff to discuss existing concerns
3) Inspect condition and operation of existing WWTP and lift stations within the collection system
4) Evaluate treatment process and identify improvement needs
5) Delineate drainage basins based on existing infrastructure that flows to individual lift stations
6) Identify any special waste generators
7) Estimate theoretical flows to WWTP and lift station drainage basins based on State recommended design standards
8) Develop flow monitoring plan to determine actual flows to the WWTP and within the collection system at reasonable intervals to divide the system into somewhat equal parts based on total length of sewers within the collection system
9) Install flow monitors to determine actual flows during dry weather and wet weather
10) Analyze data collected during flow monitoring to identify capacity concerns at the WWTP and within the collection system
11) Prioritize areas requiring improvement or additional physical investigation including cleaning, manhole inspections, sewer televising, dye testing, and smoke testing based on existing condition, operation, and capacity concerns.

With the exception of treatment process evaluation (Step 4) which is being completed as part of the WWTP Capital Improvement Planning study, steps 1 – 7 were completed during Phase 1 and are summarized in the Phase 1 Summary attached in **Appendix 1**. The Phase 1 Summary monitoring locations map has been marked up to indicate actual locations where monitors were installed.

Step 7 was completed during Phase 2 using six (6) Teledyne ISCO Model 2150 Area Velocity Flow Meters and one (1) Teledyne ISCO Model 676 Rain Logging System installed at the locations shown on the Flow Monitor Location Map in Appendix A.

Steps 8 – 9 were completed as part of Phase 3 and will be discussed in this report.

## FLOW MONITORING DATA & ANALYSIS

As previously mentioned, area-velocity flow meters were installed at strategic locations in the Village to determine average daily flows and peak hourly flows from different areas of the Village to help pinpoint capacity concerns within the sanitary sewer collection system. In addition, this data can be used to efficiently plan for future investigation and rehabilitation efforts to minimize inflow and infiltration and reduce the overall load on the existing WWTP.

DEVICE LIMITATIONS, DATA IRREGULARITIES, AND DATA EXCLUDED FROM FURTHER ANALYSIS

Although submerged area-velocity sensors are one of the primary recommended methods for measuring flow in this application, they are not flawless; interpretation of data is a key component of the process. Based on discussions with the flow monitoring equipment representatives, ideal flow measurement parameters for these devices in this application have a consistent depth of 1" or greater and a consistent velocity of 1 foot per second or greater. Data irregularities resulting from obscure velocity and level readings may occur during turbulent flows, low flows, or possibly when debris is blocking the sensor. Invalid data should not be used for analysis.

The six (6) flow monitors and rain gauge were originally installed on March 14, 2019.

Data was collected during the first two weeks and monitors on the east side of the system required adjustment/relocation. Final monitor adjustments and relocations were performed on March 29th, 2019. No east side flow monitoring data prior to March 30th, 2019 was used for further analysis.

There were some perceived velocity measurement issues at the Elizabeth St. Monitor, potentially due to sensor blockage, between April 6th and May 8th. Attempts to clear the blockage from the surface were made at the beginning of May but did not appear to be effective until the rain event on May 9th dislodged the blockage. There was also questionable flow data from the east side monitors beyond June 7th, where downstream monitors were consistently indicating less flow than upstream monitors. All data from the specific monitors and monitoring periods above was deemed invalid and was not user in further analysis.

Both the West Side monitor and the Cory Street monitor consistently measured velocities less than 1 ft/sec, however based on visual observation, this appeared accurate. The West Side monitor was frequently surcharged due to restrictions at the influent lift station to the WWTP. Low velocities observed at Cory Street may have been due to a flattened downstream sewer run or possibly solids buildup in the sewer run immediately downstream. Based on visual observations, this data was considered to be accurate and was used for further analysis.

A summary of the flow data identifying invalid data and other flow analysis is included in **Appendix 2.**

## DATA ANALYSIS AND SUMMARY

EPA criteria for excess dry and wet weather flows are 120 Gallons per Capita per Day (GPCD) and 275 GPCD respectively. Based on estimated census data, the Village of Tolono currently serves 3,449 people; thus indicating excessive dry weather daily flows at and above 413,880 GPD and excessive wet weather daily flows at and above 948,475 GPD.

A summary of the observed data analysis is shown in the table below:

| | PEAK HOURLY FLOW (3/30/19) | PEAK DAILY FLOW (3/30/19) | AVERAGE DRY WEATHER FLOW (6/2/19 TO 6/6/19) | PEAKING FACTOR | IEPA THEORETICAL PEAKING FACTOR[2] |
|---|---|---|---|---|---|
| | GPD | GPD | GPD | UNITLESS | UNITLESS |
| WWTP[1] | 1,120,167 | 767,354 | 225,546 | 4.97 | 3.54 |
| EAST | 476,667 | 337,846 | 92,786 | 5.14 | 3.82 |
| ELIZABETH | 409,667 | 284,465 | 86,044 | 4.76 | 3.84 |
| WASHINGTON | 221,667 | 166,182 | 31,742 | 6.98 | 4.07 |
| WEST | 643,500 | 429,508 | 132,760 | 4.85 | 3.72 |
| WATSON | 312,250 | 222,921 | 58,857 | 5.31 | 3.94 |
| CORY | 133,083 | 85,094 | 38,278 | 3.48 | 4.03 |

1) WWTP Totals were calculated by combining East and West flows.
2) Illinois' design recommendation for new collection systems varies based on population served; IEPA Theoretical Peaking Factor was calculated using average dry weather flow and 100 GPDC to determine equivalent population served.

Flow charts for WWTP Total Flow, East Side Flow, and West Side Flow are included in **Appendix 3.**

In order to determine Average Dry Weather (ADW) flow, we utilized data between the dates of June 2nd, 2019 to June 6th, 2019 when there was no recorded rainfall. There was little, to no, rainfall in the three (3) days leading up to June 2nd, 2019 which allowed the effects from previous rain events to subside. The total system ADW flow from this period was approximately 225,000 Gallons Per Day (GPD) which compares very closely (within 10%) to the Village's average daily water usage during the study period, of approximately 244,000 GPD, indicating the data's validity.

According to EPA's guide to estimating infiltration and inflow, groundwater infiltration (GWI) can be estimated by averaging the flows from midnight to 6:00 a.m. during the same period used to determine the ADW. However, based on the data collected, it appeared that water usage flows dropped more significantly from 1:00 a.m. to 6:00 a.m., so this time period was used to estimate GWI. Based on this criteria, the follow groundwater infiltration estimates were generated:

| | ESTIMATED GROUNDWATER INFILTRATION (6/2/19 TO 6/6/19)[3] | AVERAGE DRY WEATHER FLOW (6/2/19 TO 6/6/19) | % INFILTRATION | INCH-DIAMETER-MILE[4] | GPD/IDM[5] |
|---|---|---|---|---|---|
| | GPD | GPD | % | IDM | |
| WWTP[1,2] | 99,624 | 225,546 | 44% | 130 | 764 |
| EAST[2] | 33,581 | 92,786 | 36% | 70 | 478 |
| ELIZABETH[2] | 34,432 | 86,044 | 40% | 60 | 572 |
| WASHINGTON[2] | 10,664 | 31,742 | 34% | 53 | 202 |
| WEST | 66,042 | 132,760 | 50% | 43 | 1,521 |
| WATSON | 25,113 | 58,857 | 43% | 30 | 833 |
| CORY | 7,294 | 38,278 | 19% | 16 | 460 |

1) WWTP Totals were calculated by combining East and West flows.
2) Average Dry Weather Flow is likely ~5,760 GPD higher during school year, which would reduce % infiltration
3) Based on average of minimum observed flows from 1 a.m. to 6 a.m. during Average Dry Weather period
4) Based on the estimated lengths/sizes of existing Village-owned sanitary sewers upstream of monitoring location.
5) Generally, anything equal to or greater than 3,000 GPD/IDM is considered excessive infiltration.

Another general measure of infiltration and inflow is the capture coefficient of storm events. Capture coefficient is a measure of the percentage of total rainfall volume from a storm event that inflows or infiltrates the collection system. Collection systems exceeding 5% capture capacity may be considered to be in poor condition but capture capacity is highly subjective since it depends on preexisting moisture conditions.

| | SERVICE AREA | TOTAL AVERAGE SEWER FLOW VOLUME[2] | TOTAL SEWER FLOW VOLUME DURING STORM EVENT[2] | NET SEWER FLOW VOLUME DURING STORM EVENT | TOTAL RAINFALL VOLUME DURING STORM EVENT[3] | CAPTURE COEFFICIENT |
|---|---|---|---|---|---|---|
| | ACRES | GAL | GAL | GAL | GAL | % |
| WWTP[1] | 689 | 694,235 | 1,447,010 | 752,776 | 20,765,884 | 3.63% |
| EAST | 405 | 303,356 | 629,205 | 325,849 | 12,206,361 | 2.67% |
| ELIZABETH | 331 | 241,015 | 536,118 | 295,103 | 9,976,063 | 2.96% |
| WASHINGTON | 128 | 171,740 | 326,885 | 155,146 | 3,857,813 | 4.02% |
| WEST | 284 | 375,016 | 817,806 | 442,790 | 8,559,523 | 5.17% |
| WATSON | 225 | 180,117 | 430,615 | 250,498 | 6,781,312 | 3.69% |
| CORY | 66 | 82,290 | 170,458 | 88,169 | 1,989,185 | 4.43% |

1) WWTP Totals were calculated by combining East and West flows.
2) Sewer flow volume is based on flows from 3/29/19 @10:00 p.m. to 4/1/2019 @ 12:00 a.m. when flows returned to average conditions.
3) Rainfall volume is based on service area and total rainfall from 3/29/19 @10:00 p.m. to 3/30/19 @ 5:30 p.m.

Although there were an abundance of rain events during the monitoring period, no single event resulted in a storm that exceed a 2-month recurrence interval based on ISWS Bulletin 70 which contains the current standards for stormwater design in Illinois. That being said, the impacts of stormwater discussed in this report may not account for larger events that inevitably will occur. During the study period, peak flows occurred on March 30th, 2019 following multiple rain events during that day and the days prior. The peak hourly flows from the monitors varied between 3.48 up to 6.98 times the normal ADW.

In Illinois, new collection systems are recommended to be designed to convey peak hourly flows which are approximately 4 times the average daily flows (varies based on population served). Although some of the areas peaking factors exceed 4, the observed peak flows are not an immediate concern in regards to sewer capacity assuming that sewers were constructed at minimum grade in accordance with current standards. If any area posed minor concerns for sewer capacity, it would be the sewers at the downstream end of the Elizabeth St. area since the peak hourly flow observed during the study period was 83% of the full flow capacity of an 8-inch sewer at minimum grade which is the largest diameter sewer in the area. Aside from a single incident that occurred due to pump failure, the director of public works indicated that there have been no sanitary sewer overflow events reported since he started there in January of 2016.

The lift stations downstream of the monitored locations do not present an immediate capacity concern either except for the influent lift station at the WWTP. A draw down test could not be performed at the WWTP due to frequent operation under surcharged conditions so its performance cannot be verified. However, the following information suggests the WWTP influent lift station is likely a hydraulic limitation:

1) The contract operator expressed concern that it could not keep up during storm events,
2) The total daily flow on March 30th exceeded the facility's NPDES permitted daily maximum flow of 0.588 MGD by approximately 30%,
3) And the sewer at the closest upstream monitor to the influent lift station, the West Side monitor, was consistently at a level above 90% of the total pipe height.

With no significant capacity concerns in the system, other than at the plant, further analysis should be performed to determine the financial impacts of conveying and treating this extraneous flow.

The overall average daily flows compared to the dry weather flows observed during the study period and net value was extrapolated over a year's time to estimate the total infiltration and inflow pumped and treated in a year.

| | AVERAGE DAILY FLOW[3] | AVERAGE DRY WEATHER FLOW (6/2/19 TO 6/7/19) | ESTIMATED TOTAL ANNUAL FLOW | ESTIMATED ANNUAL INFLOW & INFILTRATION |
|---|---|---|---|---|
| | GPD | GPD | GALLONS | GALLONS |
| WWTP[1,2] | 333,233 | 225,546 | 121,629,921 | 39,305,742 |
| EAST[2] | 145,611 | 92,786 | 53,147,891 | 19,281,069 |
| ELIZABETH[2] | 115,687 | 86,044 | 42,225,792 | 10,819,740 |
| WASHINGTON[2] | 82,435 | 31,742 | 30,088,777 | 18,503,000 |
| WEST | 180,008 | 132,760 | 65,702,751 | 17,245,394 |
| WATSON | 86,456 | 58,857 | 31,556,497 | 10,073,669 |
| CORY | 39,499 | 38,278 | 14,417,175 | 445,873 |

1) WWTP Totals were calculated by combining East and West flows.
2) Average Dry Weather Flow is likely ~5,760 GPD higher during school year, which would reduce % infiltration
3) Estimated annual inflow & infiltration calculated by subtracting ADW flow from Average Daily Flow and multiplying 365 days

Based on information provided by the Village from the past few years, annual costs to power and operate the lift stations and WWTP are approximately $60,000. With a total estimated annual flow of 122 million gallons, and assuming electrical costs are directly proportional to flow, we can estimate that it costs approximately $492 per 1 million gallons to pump and treat wastewater. Based on these estimates, the

Village is spending nearly $20,000 annually to treat extraneous flow. Mechanical and electrical equipment will likely require replacement more frequently due to the added wear and tear from conveying and treating this extraneous flow. An exact dollar figure cannot be associated with this but it should be noted as a negative financial impact from this extraneous flow. The costs and benefits of reducing this extraneous flow are discussed later in this report.

## IDENTIFIED CONCERNS

Lift Stations

During Phase 1 of this study the Village's lift stations were inspected visually, draw down tests were performed (if feasible), and theoretical flows from service areas upstream of the lift stations were calculated. The majority of the Village's lift stations are in fair condition and aside from the WWTP influent lift station, none of them appeared to have capacity concerns. However, the age and condition of the East St. Lift Station (also referred to as Walnut Street Lift Station) warrants immediate replacement. The lift station is capable of keeping up with flows but the brackets, lifting chains, force main in the wet well, and the wet well structure are all extremely corroded and could fail at any time. This is a critical lift station being that it is immediately downstream from the Unity High School & Junior High. The Village was made aware and has already engaged Donohue and Associates to begin redesign of the lift station.

Other lift station concerns to note would be:

- WWTP Influent Station – Appears to be under capacity based on frequent surcharging upstream of WWTP and comments by the on-site operator. This will be analyzed further as part of a WWTP Capital Improvement Plan that is underway.
- Larmon St. Lift Station – Normally operated surcharging upstream sewers. Operation should be discussed with contract operator to see if float switch levels can be adjusted to prevent surcharging upstream sewers.
- Elizabeth Street & Watson Street Lift Stations – Both are in fair/good condition, aside from somewhat frequent clogging in the Elizabeth Street Station, but both are can-type lift stations which require confined space entry to service and operate the station. At some point the Village should consider retrofitting or replacing these stations to allow for servicing and operation to be done without requiring confined space entry.

Collection System

Aside from reviewing as-built drawings and opening a few key manholes during flow monitoring, the collection system was not visually inspected as part of this study. Based on the flow monitoring completed during Phase 2 of this study, it appears that nearly 1/3 of the total water pumped and treated by the Village is groundwater infiltration or stormwater inflow. Although 1/3 of the total flow may seem significant, there are no signficant capacity concerns within the collection system. Realistically, a significant portion, assume one-half, of the extraneous flow is likely being contributed via service laterals/connections, so performing improvements to eliminate inflow and infiltration from the Village's sewer mains and manholes would not be expected to remove all of the extraneous flows. Sanitary sewer rehabilitation projects consisting of sewer inspection, spot repairs, and CIPP liners typically cost $40 to $60 per lineal foot depending on the scale of the project, degree of failure, and level of rehabilitation selected. The financial impacts are not necessarily significant enough at this point to justify a rehabilitation or replacement plan but it may be worthwhile to begin allocating funds towards an annual cleaning and televising program to begin identifying any major structural defects within the gravity sewers. Cleaning and televising sewers is one of the most important, low-cost maintenance tasks that can be performed. Typically, cleaning and televising services will cost between $2 to $5 per lineal foot, dependent on the total length and size of sewers to be inspected.

If future inspection funds were to be priortized based on observed groundwater infiltration percentages, funds would be spent as follows:

| | | |
|---|---|---|
| 1) | West Side Interceptor Service Area | ~7,209 feet of gravity sewer |
| 2) | Watson Street Service Area | ~18,423 feet of gravity sewer |
| 3) | Elizabeth Street Service Area | ~15,219 feet of gravity sewer |
| 4) | East Side Interceptor Service Area | ~9,612 feet of gravity sewer |
| 5) | Washington Street Service Area | ~20,025 feet of gravity sewer |
| 6) | Cory Street Service Area | ~10,413 feet of gravity sewer |

If future inspection funds were to be priortized based on observed peaking factors, potentially indicating extraneous flow contributions from stormwater inflow, funds would be spent as follows:

| | | |
|---|---|---|
| 1) | Washington St. Service Area | ~20,025 feet of gravity sewer |
| 2) | Watson Street Service Area | ~18,423 feet of gravity sewer |
| 3) | East Side Interceptor Service Area | ~9,612 feet of gravity sewer |
| 4) | West Side Interceptor Service Area | ~7,209 feet of gravity sewer |
| 5) | Elizabeth Street Service Area | ~15,219 feet of gravity sewer |
| 6) | Cory Street Service Area | ~10,413 feet of gravity sewer |

In addition to the prioritizing future inspection funds based on infiltration and inflow, we would recommend also priortizing based on age of the infrastructure. Older sewers have a higher potential for deficiencies, as well as potentially being built to lesser standards than today. Sewers downstream of proposed expansion areas or development may also take priority to identify any concerns before adding flow to the downstream collection system. A reasonable goal may be to clean and televise all of the Village's sewers over the next 10 years. At $3.50/foot, with 80,100 feet of gravity sewer, spread over 1,300 users, this would equate to approximately $1.80/user/month. Upon completion of cleaning and televising, sewers found to have signficant structural damage, root infiltration, solids build up, or other deficiencies may require further maintenance, repair, rehabiliation, or replacement.

WWTP

The WWTP was visually inspected during Phase 1 of this study along with review of past as-built plans of the plant. Based on the visual inspection, the plant has significant signs of age and detrioration including spalling concrete and corroded mechanical components and piping. The plant's ability to treat the wastewater was not analyzed as part of this study. Based on the flow monitoring during Phase 2 of this study, the plant's capacity is a concern but it is currently operational. During average dry weather, the WWTP is operated at it's NPDES rated daily average flow. However, it is more regurlarly operating about 40% over it's NPDES rated daily average flow, and peak flows during our study exceeded it's NPDES rated daily maximum flow. The Village recently engaged Donohue & Associates to develop a WWTP Capital Improvement Plan (CIP) due to existing capacity concerns and increasing interest from existing and proposed adjacent developments to expand and connect to the Village's system. The CIP will further evaluate the existing plant's condition and ability to convey and treat existing and anticipated future flows. The final report for the CIP will identify existing treatment deficiencies and will provide recommended improvements with planning level cost estimates to ensure the plant is capable of conveying and treating the anticipated flows and loadings while remaining in compliance.

## RECOMMENDED IMPROVEMENTS, BUDGETARY COSTS, AND SCHEDULE

Based on the concerns identified in this report, the most critical sanitary sewer system improvements, along with their associated budgetary costs and estimated schedule for completion, are as follows:

| | | | |
|---|---|---|---|
| 1) | East St. Lift Station Replacement | $300,000 | 2020 |
| 2) | WWTP Capital Improvements | TBD | TBD |
| 3) | Elizabeth Street Lift Station Improvements | $100,000 - 300,000 | 2020-2025 |
| 4) | Watson Street Lift Station Improvements | $100,000 - 300,000 | 2025-2030 |
| 5) | Sewer Cleaning & Inspection Program | $28,000/yr. | 2020 to 2030 |
| 6) | Sewer Repair/Rehabilitation/Replacement | TBD | TBD |

Budgetary costs and estimated schedule for completion for the WWTP Capital Improvements will be identified in the WWTP CIP. Sewer repair/rehabilitation/replacement costs and schedule will be dependent on concerns identified during sewer cleaning and inspection.

# APPENDIX 1

# Phase 1 Summary

# VILLAGE OF TOLONO

# CHAMPAIGN COUNTY, ILLINOIS

## Sanitary Sewer Flow Study

**PHASE I SUMMARY**

**August 2018**

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**Wastewater Treatment Plant**

Service Area and Theoretical Flow Calculations

Tolono's WWTP is located on the southeast edge of the Village limits and accessed from Bourne Street. The lift station at the WWTP serves the entire Village, with an area of approximately 673 acres, including 1,158 single-family residential properties, 30 commercial properties, and 14 multi-family properties. The theoretical average design flow for the WWTP was calculated to be 0.467 MGD (325 GPM) with a peaking factor of 3.27 and a theoretical peak hourly design flow of 1.529 MGD (1,062 GPM). Theoretical flow was calculated based on typical sewage flows from residential and commercial properties in accordance with Part 370 - Illinois Recommended Standards for Sewage Works.

WWTP Details & History

The WWTP utilizes a dry-pit lift station to dose the treatment process. The WWTP, constructed along with the collection system in the early 1970's, has had some upgrades including the construction of a primary clarifier, filter building, sludge storage lagoon (1980's) and the addition of a roughing filter (2011). The lift station at the WWTP is equipped with three (3) vertical solids-handling pumps as well as a high-water level bypass pump which discharges to an equalization lagoon and is dosed back through the treatment process when flows return to normal. The influent structure is a 10' x 10' concrete box, located on the north side of the control building, and is equipped with a sewage grinder positioned in the front of the influent sewer from the north. Each discharge line is equipped with a check valve and plug valve which are located in the basement of the control building along with the pumps and the control panels. The pumps are controlled by float switches. The pump pit in the basement of the control building is equipped with a sump pump. The three discharge force mains come together into a common force main which discharges to the first cell of the primary clarifier (1984). The flow schematic through the rest of the treatment plant can be seen in the 2011 roughing filter addition. Currently, the WWTP operator does not operate the tertiary filters.

Operation Observations

A drawdown test was not performed at the influent lift station to the WWTP. Defining an accurate cross-sectional area of the influent lift station, which is imperative for draw down test calculations, was not feasible based on the wet well's construction. The downstream treatment process and its flow restrictions may control the pump station's operation. More detailed pump information was requested from the contract operator but is yet to be provided.

Initial Analysis:

The lift station at the WWTP is in fair overall condition. The pumps, piping, and valves in the basement of the control building all appear to be in fair and operable condition.

The influent lift station at the WWTP serves the entire community and is critical to the function of both the collection system and the WWTP. **Phase 2 of the study will include the installation of permanent flow monitor at the WWTP influent to better quantify the total flow**; this information will be extremely useful when evaluating the actual average and peak hourly flows of the current collection system and will help analyze the feasibility of future service area expansion and its potential effects on the existing plant.

**Elizabeth St. Lift Station**

Service Area and Theoretical Flow Calculations

The Elizabeth St. Lift Station is located at the northwest corner of Elizabeth St. and Marshall on the southeast side of Tolono. This lift station serves an area of approximately 351 acres, including 582 single-family residential properties, 15 commercial properties, and 6 multi-family properties. This includes the area and properties served from two (2) upstream sub-basins described as Walnut St. Basin (which also serves Unity High School) and Larmon St. Basin. The theoretical average design flow for this area was calculated to be 0.230 MGD (160 GPM) with a peaking factor of 3.54 and a theoretical peak hourly design flow of 0.815 MGD (566 GPM). The theoretical flow was calculated based on typical sewage flows from residential and commercial properties in accordance with Part 370 - Illinois Recommended Standards for Sewage Works.

Station Details & History

The Elizabeth St. Lift Station is a dry-pit lift station that was constructed with the original sanitary sewer system in the early 1970's. It utilizes a 6-ft. diameter, precast concrete manhole, directly east of the lift station, as a wet well, which has two influent sewers; one from the north and one from the south. The buried, dry pit, metal lift station is equipped with electrical controls, air compressor, dehumidifier, two (2) vertical solids-handling pumps, check valves, plug valves, and a sump pit with a pump that discharges back to the wet well. The pumps are controlled using a bubbler system which requires a bubbler tube installed in the wet well, mechanical air supply, and a pressure switch. Although inexpensive initially, these systems are uncommon in new construction due to higher operation and maintenance costs. The station is equipped with an above-ground, force main bypass connection. The force main currently discharges to a sanitary manhole approximately 13 feet west of the existing pump station where the old force main is capped (to the west) and a gravity sanitary sewer runs south along Elizabeth St. to the East Side Interreceptor Sewer running along the south side of Benham St.

Operation Observations

During the drawdown test performed on 7/9/2018, the observed average inflow rate was 61 GPM and the effluent pumping rates were 300 GPM (south pump) and 455 GPM (north pump). Using the average, observed inflow rate and calculated effective capacity of 269 gallons between the lead pump on level and the pump off level, the average detention time is 4 minutes 26 seconds. With an average pump cycle time of 57 seconds, the average total cycle time was 5 minutes 23 seconds. With two (2) pumps alternating, each pump operates between 5-6 times every hour under these flow conditions. This many starts per hour is not an immediate cause for concern but too many starts per hour can negatively impact the life of the motor. Pump manufacturer recommendations for pump starts per hour should be reviewed and compared to the operation observed during the drawn down test.

Initial Analysis:

The Elizabeth St. Lift Station is in fair overall condition. All of the components in the buried can station appear to be functional and free of corrosion or major wear. According to conversations with the contract operator's on-site representative (Doug, ERH Enterprises), the primary concerns with this station are related to the bubbler system level control and system capacity; although it wasn't clear whether it is the pumps, force main, or downstream sewer capacity that causes the capacity concern. The buried can lift station is not an ideal setup for safety of maintenance personnel. Since confined space entry is required to record daily pump hours and perform regular maintenance, maintenance personnel must take precautions on a daily basis to comply with OSHA requirements.

The actual flow observed is significantly lower than the theoretical flow at this station. Based on the observed average flow during the draw down test and the theoretical peaking factor, the current pumps appear to be capable of meeting peak hourly flow rates aside from potential, upstream inflow and infiltration.

This station serves the largest collection area in the community besides the WWTP and should be considered as one of the highest priorities in the sanitary sewer collection system. **At least one flow monitor should be dedicated to the Elizabeth St. area during Phase 2 of this study, if not two.** Dependent upon the flow monitoring results collected during Phase 2 of this study, this station may need minor improvements or it may be a good candidate for full replacement of the lift station and force main.

**Watson St. Lift Station**

Service Area and Theoretical Flow Calculations

The Watson St. Lift Station is located south of Illini FS on the east side of Route 45. This lift station serves an area of approximately 224 acres, including 392 single-family residential properties, 15 commercial properties, and 8 multi-family properties. This includes the area and properties served from another upstream sub-basin described as the Deer Path Basin. The theoretical average design flow for this area was calculated to be 0.173 MGD (120 GPM) with a peaking factor of 3.63 and a theoretical peak hourly design flow of 0.627 MGD (436 GPM). The theoretical flow was calculated based on typical sewage flows from residential and commercial properties in accordance with Part 370 - Illinois Recommended Standards for Sewage Works.

Station Details & History

The Watson St. Lift Station is a dry-pit lift station that was constructed with the original sanitary sewer system in the early 1970's. It utilizes a 6-ft. diameter, precast concrete manhole, directly north of the lift station, as a wet well which has one influent sewer from the north. The buried, dry pit, metal lift station is equipped with electrical controls, air compressor, dehumidifier, two vertical solids-handling pumps, check valves, plug valves, and a sump pit with a pump that discharges to the wet well. The pumps are controlled using a bubbler system which requires a bubbler tube installed in the wet well, mechanical air supply, and a pressure switch. Although inexpensive initially, these systems are uncommon in new construction due to higher operation and maintenance costs. The station is equipped with an above-ground, force main bypass connection. The force main currently discharges to a sanitary manhole located approximately 698 feet south of the existing pump station. This gravity sanitary sewer, which runs south and west, eventually reaches the WWTP through the West Side Interceptor Sewer running down Bourne St.

Operation Observations

During the drawdown test performed on 7/10/2018, the observed average inflow rate was 49 GPM and the effluent pumping rates were 309 GPM and 345 GPM. Using the average inflow rate and calculated effective capacity of 209 gallons between the lead pump on level and the pump off level, the average detention time was 4 minutes 14 seconds. With an average pump cycle time of 45 seconds, the total average cycle time was 4 minutes 59 seconds. With two pumps alternating, each pump operates around 6 times every hour under these flow conditions. This many starts per hour is not an immediate cause for concern but too many starts per hour can negatively impact the life of the motor. Pump manufacturer recommendations for pump starts per hour should be reviewed and compared to the operation observed during the drawn down test.

Initial Analysis:

The Watson St. Lift Station is in fair overall condition. All of the components in the buried can station appear to be functional and free of corrosion or major wear. According to conversations with the contract operator's on-site representative (Doug, ERH Enterprises), the primary concerns with this station are related to the bubbler system level control. The buried can lift station is not an ideal setup for safety of maintenance personnel. Since confined space entry is required to record daily pump hours and perform regular maintenance, maintenance personnel must take precautions on a daily basis to comply with OSHA requirements.

The actual flow observed is significantly lower than the theoretical flow at this station. Based on the observed average flow during the draw down test and the theoretical peaking factor, the current pumps appear to be capable of meeting peak hourly flow rates aside from potential, upstream inflow and infiltration.

This station serves the third largest collection area in the community and should be considered as one of the highest priorities in the sanitary sewer collection system. **At least one flow monitor should be dedicated to the Watson St. area during Phase 2 of this study, if not two.** Dependent upon the flow monitoring results collected during Phase 2 of this study, this station may need minor improvements or it may be a good candidate for full replacement of the lift station and force main.

**Third St. Lift Station**

Service Area and Theoretical Flow Calculations

The Third St. Lift Station is located on the west side of Third St. between Benham and Marshall on the southeast side of Tolono. This lift station serves an area of approximately 39 acres, including 93 single-family residential properties, with no commercial or multi-family properties. There are no separate sub-basins contributing to this area. The theoretical average design flow for this area was calculated to be 0.033 MGD (23 GPM) with a peaking factor of 4.06 and a theoretical peak hourly design flow of 0.132 MGD (92 GPM). The theoretical flow was calculated based on typical sewage flows from residential and commercial properties in accordance with Part 370 - Illinois Recommended Standards for Sewage Works.

Station Details & History

The Third St. Lift Station is a submersible lift station that was constructed with the original sanitary sewer system in the early 1970's. It has a 5-ft. diameter, precast concrete manhole as the wet well with one influent sewer from the north and a precast concrete valve vault directly south of the wet well. The control panel is located north of the lift station in an electrical cabinet mounted to a concrete pad. The pumps are controlled by float switches and the 3-inch diameter force main discharge lines are each equipped with pressure gauges, check valves, and plug valves in the valve vault. The station can be bypassed by connecting a temporary pump and force main to a vertical gate valve located on the common force main in the valve vault. The valve vault is not equipped with a drain line or sump pump to dewater it. The force main originally discharged approximately 30 feet north of the station to an 8" sanitary sewer that flowed west down the alley between Benham and Marshall. The force main was rerouted approximately 163 feet south to the East Side Interceptor Sewer, located on the south side of Benham St. Rerouting the force main eliminated pumping the wastewater a second time through the Elizabeth St. Lift Station.

Operation Observations

During the drawdown test performed on 7/10/2018, the observed average inflow rate was 9 GPM and the effluent pumping rates were 49 GPM (east pump) and 71 GPM (west pump). Using the average inflow rate and calculated effective capacity of 130 gallons between the lead pump on level and the pump off level, the average detention time was 14 minutes 46 seconds. With an average pump cycle time of 2 minutes 41 seconds, the total average cycle time was 17 minutes 27 seconds. With two pumps alternating, each pump operates around 2 times every hour under these flow conditions. Detention time is not an immediate concern but should be monitored to prevent septicity and H2S corrosion. IEPA recommends to avoid detention times longer than 30 minutes.

Initial Analysis:

The Third St. Lift Station is in fair overall condition. The brackets, guiderails, and lifting chains are all in fair condition with minor signs of corrosion. The force main in the wet well does have significant signs of corrosion and may be worth replacing in the near future. The piping and valves in valve vault all appear to have been replaced recently and are in good condition. The Village has experienced a couple of recent sanitary sewer surcharges during rain events at this station. Based on reports from the contract operator and the public works director, they were both related to pump malfunctions, the second of which occurred while one pump was removed for repair and no temporary bypass plan was in place.

The actual flow observed is significantly lower than the theoretical flow at this station. Based on the observed average flow during the draw down test and the theoretical peaking factor, the current pumps appear to be capable of meeting peak hourly flow rates aside from potential, upstream inflow and infiltration.

This station serves both new and older developed properties in the Village. With the recent surcharge events it will be imperative to identify whether or not the electrical feed and pumps are designed properly or if the failures are solely due to extreme inflow and infiltration in the collection system. **Flow monitoring during Phase 2 of this study is not likely going to be performed to directly isolate the Third St. area because it only accounts for about 7% of the theoretical average design flow and 7% of the total gravity sanitary sewer collection system. Analysis of flow data collected from other monitors should indicate if there are inflow and infiltration concerns in the East Side Interceptor Sewer and Third St.**

**Larmon St. Lift Station**

Service Area and Theoretical Flow Calculations

The Larmon St. Lift Station is located on the east edge of the Village limits between Larmon St. and Boone St. This lift station serves an area of approximately 16 acres, including 36 single-family residential properties and no commercial or multi-family properties. There are no separate sub-basins contributing to this area. The theoretical average design flow for this area was calculated to be 0.013 MGD (9 GPM) with a peaking factor of 4.21 and a theoretical peak hourly design flow of 0.053 MGD (37 GPM). The theoretical flow was calculated based on typical sewage flows from residential and commercial properties in accordance with Part 370 - Illinois Recommended Standards for Sewage Works.

Station Details & History

The Larmon St. Lift Station is a submersible lift station that was constructed to serve the Linshar Fields development in the 1990's. It has a 5-ft. diameter, precast concrete manhole as the wet well with one influent sewer from the north. The precast concrete valve vault is located directly west of the wet well and has been landscaped around by the adjacent homeowner. The control panel is located southwest of the lift station in an electrical cabinet mounted to a concrete pad within the same landscaped area as the valve vault. The pumps are controlled by float switches and the 3-inch diameter force main discharge lines are each equipped with pressure gauges, check valves, and plug valves in the valve vault. The station can be bypassed by connecting a temporary pump and force main to a vertical gate valve located on the common force main in the valve vault. The valve vault is not equipped with a drain line or sump pump to dewater it and was full of water when we first opened it. The force main runs approximately 1,637 feet to the northwest and discharge to a sanitary manhole located on Broadway, east of Third St.

Operation Observations

A drawdown test could not be performed with any accuracy due to current operating conditions. The lift station's floats were set at levels that operated the lift station with upstream sanitary sewers in constant surcharge. Without having a reasonable estimate of effective capacity between pumping cycles, it was not possible to perform a draw down test. The pumps were operated in hand just to confirm our understanding of flow schematics into and out of the station. Since there are no serious concerns at this station reported by the Village or contract operator we opted not to spend time adjusting operations to perform a draw down test. We intend to discuss its operation with the contract operator to see if there is justification for the operation settings at this station.

Initial Analysis:

The Larmon St. Lift Station is in fair overall condition. The brackets for the guiderails are the only component with significant signs of corrosion. The guiderails, lifting chains, and force all appear to be in fair condition with minor signs of corrosion. The piping and valves in valve vault all appear to be in good condition.

This station serves one of the newest developments in Tolono. This station has little need for immediate action other than possibly adjusting the pump operating levels. **Flow monitoring during Phase 2 of this study is not going to be performed to isolate the Larmon St. area unless data collected warrants further investigation.**

**Walnut St. Lift Station**

Service Area and Theoretical Flow Calculations

The Walnut St. Lift Station is located at the southwest corner of Walnut St. and East St. near the ball diamond at East Side Park in Tolono. This lift station serves an area of approximately 84 acres, including 77 single-family residential properties, Unity High School & Junior High, and no other commercial or multi-family properties. There are no separate sub-basins contributing to this area. The theoretical average design flow for this area was calculated to be 0.038 MGD (27 GPM) with a peaking factor of 4.03 and a theoretical peak hourly design flow of 0.155 MGD (107 GPM).The theoretical flow was calculated based on typical sewage flows from residential and commercial properties in accordance with Part 370 - Illinois Recommended Standards for Sewage Works.

Station Details & History


The Walnut St. Lift Station is a submersible lift station that was retrofitted into a sewage ejector station that was constructed as part of the original sanitary sewer system in the early 1970's. It has a 7-ft. diameter, steel manhole as the wet well with one influent sewer from the east and a precast concrete valve vault directly west of the wet well. The control panel is located north of the lift station in an electrical cabinet mounted on two 4"x4" timber posts. The pumps are controlled by float switches and the 4-inch diameter force main discharge lines are each equipped with pressure gauges, check valves, and plug valves in the valve vault. The station can be bypassed by connecting a temporary pump and force main to a vertical gate valve located on the common force main in the valve vault. The valve vault is not equipped with a drain line or sump pump to dewater it and was full of water (above ground level). The 4-inch cast-iron force main discharges approximately 392 feet to the west of the station to a sanitary manhole at the intersection of Walnut and Lincoln. The flow from the Walnut St. service area is pumped into the Elizabeth St. service area.

Operation Observations

During the drawdown test performed on 7/10/2018, the observed average inflow rate was 13 GPM and the effluent pumping rates were 266 GPM (south pump) and 285 GPM (north pump). Using the average inflow rate and calculated effective capacity of 70 gallons between the lead pump on level and the pump off level, the average detention time was 5 minutes 17 seconds. With an average pump cycle time of 16 seconds, the total average cycle time was 5 minutes 33 seconds. With two pumps alternating, each pump operates around 5-6 times every hour under these flow conditions. This many starts per hour is not an immediate cause for concern but too many starts per hour can negatively impact the life of the motor. Pump manufacturer recommendations for pump starts per hour should be reviewed and compared to the operation observed during the drawn down test.

Initial Analysis:

The Walnut St. Lift Station is a critical lift station due to the fact that it serves Unity High School and Junior High. The existing station is in extremely poor condition overall. The brackets, lifting chains, force main in the wet well, and the wet well are all extremely corroded and could fail at any time. The guide rails appear to be in good condition. The piping and valves in the valve vault all appear to have been replaced recently and are in good condition.

The actual flow observed is significantly lower than the theoretical flow at this station. Based on the observed average flow and the theoretical peaking factor, the current pumps appear to be sized larger than necessary to meet hourly peak flow rates; of course, this is without regard to any potential, upstream stormwater inflow and infiltration.

Based on the condition of the existing station components and Unity High School and Junior High's dependency on it, this station should be considered for replacement immediately. **This service area may be a good candidate for flow monitoring in Phase 2 of this study to help identify stormwater inflow and infiltration upstream of this lift station, as well as help accurately size a replacement lift station.**

**Deer Path Lift Station**

Service Area and Theoretical Flow Calculations

The Deer Path Lift Station (also referred to as Condit St. Lift Station) is located on the east side of Condit St. just south of Walnut St. and the Deer Path Subdivision on the northwest side of Tolono. This lift station serves an area of approximately 38 acres, including 90 single-family residential properties and no commercial or multi-family properties. There are separate no sub-basins contributing to this area. The theoretical average design flow for this area was calculated to be 0.032 MGD (22 GPM) with a peaking factor of 4.07 and a theoretical peak design flow of 0.128 MGD (89 GPM). The theoretical flow was calculated based on typical sewage flows from residential and commercial properties in accordance with Part 370 - Illinois Recommended Standards for Sewage Works.

Station Details & History

The Deer Path Lift Station is a submersible lift station that was constructed during Phase 2 of the Deer Path Subdivision in 2002-2003. It has a 6-ft. diameter, precast concrete manhole as the wet well with one influent sewer from the north and a precast concrete valve vault directly south of the wet well. The control panel is located northeast of the lift station in an electrical cabinet mounted to two 6”x6” timber posts. The pumps are controlled by float switches and the 3-inch diameter force main discharge lines are each equipped with pressure gauges, check valves, and plug valves in the valve vault. There was no visible sign of a connection to the common force main for bypass pumping. The valve vault is not equipped with a drain line or sump pump to dewater it and had approximately 1 foot of standing water in the bottom of the vault. The force main discharges approximately 53 feet west of the lift station to a sanitary manhole on the west side of Condit St.

Operation Observations

During the drawdown test performed on 7/9/2018 and 7/10/2018, the observed average inflow rate was 9 GPM and the effluent pumping rates were 350 GPM (west pump) and 329 GPM (east pump). Using the average inflow rate and calculated effective capacity of 217 gallons between the lead pump on level and the pump off level, the average detention time was 23 minutes 43 seconds. With an average pump cycle time of 39 seconds, the total average cycle time was 24 minutes 22 seconds. With two pumps alternating, each pump operates around 1-2 times every hour under these flow conditions. The detention time causes some concern and should be monitored closely to prevent septicity and H2S corrosion. IEPA recommends to avoid detention times longer than 30 minutes.

Initial Analysis:

The Deer Path Lift Station is in good overall condition. The brackets, guiderails, lifting chains, and force main are all in fair condition with minor signs of corrosion. The piping and valves in valve vault all appear to be in good condition. It should be noted that on a separate trip, during wet weather, there were significant signs of infiltration into the wet well through the manhole joints.

The actual flow observed was significantly lower than the theoretical flow at this station. Based on the observed average flow and the theoretical peaking factor, the current pumps appear to be sized larger than necessary to meet peak hourly flow rates; of course, this is without regard to any potential, upstream stormwater inflow and infiltration.

This station serves one of the newest developments in Tolono. This station has little cause for concern immediately but it may be a good candidate for some minor improvements to prevent infiltration at the wet well. **Flow monitoring during Phase 2 of this study is not going to be performed to isolate the Deer Path area unless data collected warrants further investigation.**

**Phase 1 Final Recommendations**

Upon completion of Phase 1 investigation along with input from Tolono's Public Works Director, we have developed a flow monitoring plan which includes the installation of six flow monitors at the following locations:

**1 – East Side Interceptor** *Monitors 55% of total sewer system (12% net)*

*The monitor is proposed to be installed in the North invert of the sanitary manhole directly north of WWTP influent wet well.*

**2 –West Side Interceptor** *Monitors 45% of total sewer system (9% net)*

*The monitor is proposed to be installed in the West invert of the sanitary manhole directly north of WWTP influent wet well.*

**3 – Elizabeth Street Area** *Monitors 43% of total sewer system (19% net)*

*The monitor is proposed to be installed in the South invert of the sanitary manhole directly north of the Elizabeth St. Lift Station wet well.*

**4 – Watson Street Area** *Monitors 36% of total sewer system (23% net)*

*The monitor is proposed to be installed in the South invert of the sanitary manhole directly north of the Watson St. Lift Station wet well.*

**5 – Elizabeth/Reynolds** *Monitors 25% of total sewer system (25% net)*

*The monitor is proposed to be installed in the North invert of the sanitary manhole located at the intersection of Elizbeth St. and Reynolds St.*

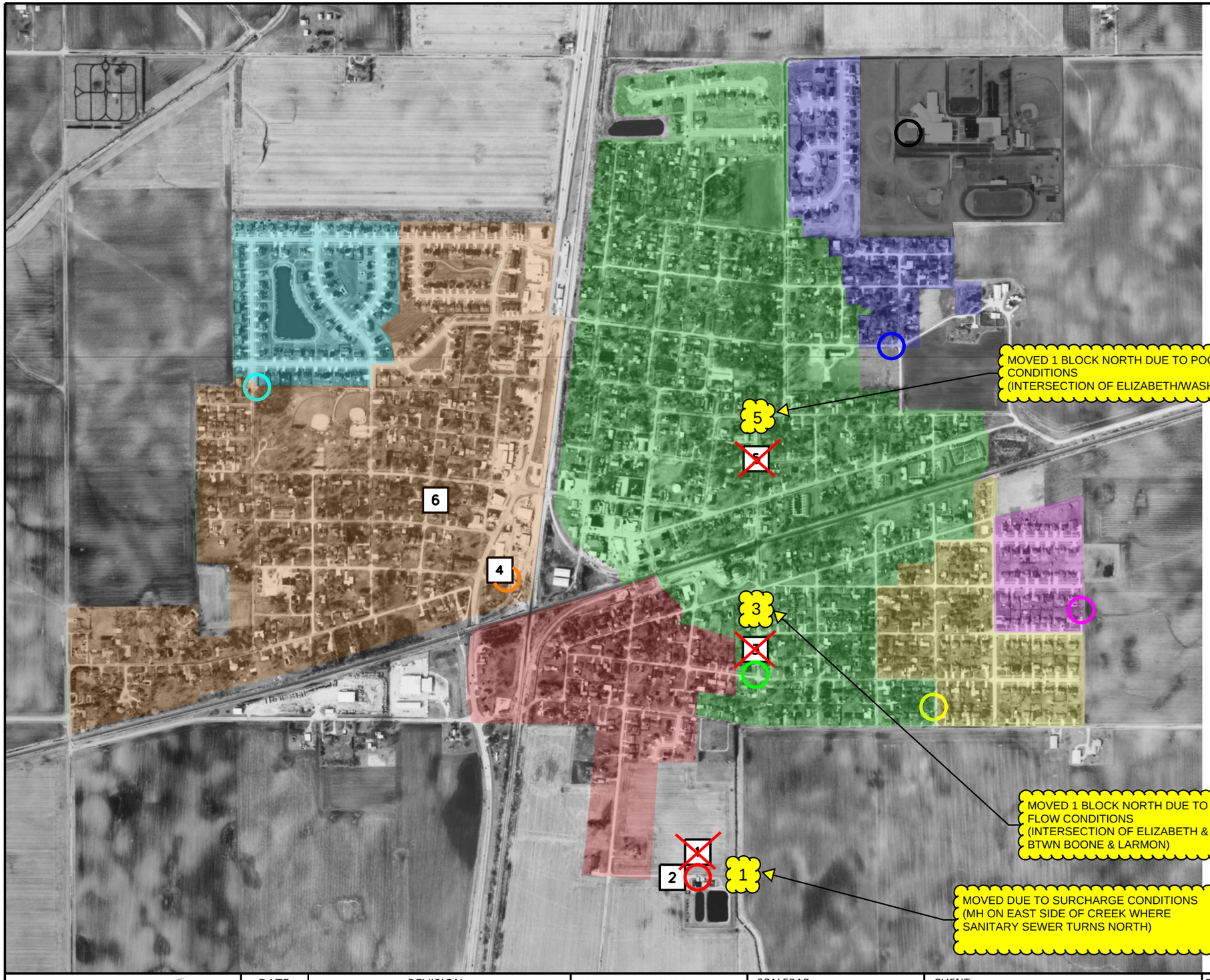
**6 – Cory Street** *Monitors 13% of total sewer system (13% net)*

*The monitor is proposed to be installed in the East invert of the sanitary manhole located at the Cory St. and the alley between Linden and Holden.*

All flow monitor locations are subject to change upon further investigation with Gasvoda and Associates to ensure good flow characteristics are present for monitoring at the proposed locations. The percentages listed above are based on total length of gravity sanitary sewers which is estimated to be 80,100 feet. The net percentages are the percentage of the system which is solely monitored through the proposed location and is not monitored at any upstream locations. Please see attached location map for proposed locations.

The original estimate for Phase 2 services was based on using five monitors, not six, so there will be some additional costs for equipment rental/install. We do plan to meet with Gasvoda and Associates to consider options for a permanent installation but it will likely be more cost effective to plan for more adequate permanent influent flow monitoring as part of more significant WWTP upgrades in the future.

We originally planned to begin monitoring in early Spring of 2019 and divide the costs of Phase 2 between the Village's 2018 and 2019 fiscal years. If the Village is interested in beginning monitoring sooner, we could begin Phase 2 within 30 days of authorized notice to proceed with Phase 2.




**MONITOR LOCATIONS & NAMES**

1) WEST SIDE INTERCEPTOR
2) EAST SIDE INTERCEPTOR
3) ELIZABETH STREET
4) WATSON STREET
5) WASHINGTON STREET
6) CORY STREET

C2 Engineers — Designing Higher Standards

| DATE | REVISION |
|---|---|
| | |

SOURCE OF ORTHOIMAGERY:
Illinois Natural Resources Geospatial Data Clearinghouse, Illinois State Geological Survey
http://www.isgs.uiuc.edu/nsdihome/webdocs/idot2011/
(2011 Illinois Department of Transportation Orthophotos; accessed July 11, 2014)

| | |
|---|---|
| SCALE: | 1:800 |
| DATE: | 8/23/2018 |
| CHECKED BY: | TAC |
| DESIGNED BY: | TAC |

SCALEBAR: 0' 200' 400' 800'

CLIENT:
VILLAGE OF TOLONO
TOLONO, ILLINOIS

PROJECT NAME: SANITARY SEWER SYSTEM FLOW STUDY

SHEET TITLE: PROPOSED MONITORING LOCATIONS

SHEET NO. 1 OF 1 SHEETS

FILE NAME: C:\C2 Engineers\Box Sync\C2 Engineers, LLP\Clients\Tolono\2018-2019 Sanitary Sewer System Flow Study\5-CAD\2-BASE FILES\Proposed Monitoring Locations.dgn

# APPENDIX 2

# Summary of Flow Data

# VILLAGE OF TOLONO
# SANITARY SEWER SYSTEM FLOW STUDY
# SUMMARY OF FLOW DATA

| Date | Average Water Usage (Gal) | Rainfall (in) | Total WWTP | Total Flow (Gallons) | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | East Interceptor | Elizabeth St. | Washington St. | West Interceptor | Watson St. | Cory St. |
| 03/14/19 | 220,925 | 0.00 | PARTIAL DAY | PARTIAL DAY | PARTIAL DAY | PARTIAL DAY | PARTIAL DAY | PARTIAL DAY | PARTIAL DAY |
| 03/15/19 | 220,925 | 0.00 | 390,953 | 145,611 | 115,687 | 82,435 | 245,342 | 117,434 | 73,283 |
| 03/16/19 | 220,925 | 0.00 | 372,898 | 145,611 | 115,687 | 82,435 | 227,287 | 108,579 | 66,796 |
| 03/17/19 | 220,925 | 0.00 | 359,286 | 145,611 | 115,687 | 82,435 | 213,675 | 106,126 | 60,084 |
| 03/18/19 | 220,925 | 0.00 | 337,737 | 145,611 | 115,687 | 82,435 | 192,126 | 88,330 | 48,898 |
| 03/19/19 | 220,925 | 0.00 | 322,728 | 145,611 | 115,687 | 82,435 | 177,117 | 78,450 | 45,953 |
| 03/20/19 | 220,925 | 0.11 | 320,295 | 145,611 | 115,687 | 82,435 | 174,684 | 80,588 | 44,238 |
| 03/21/19 | 220,925 | 0.01 | 311,045 | 145,611 | 115,687 | 82,435 | 165,434 | 79,474 | 43,506 |
| 03/22/19 | 220,925 | 0.00 | 310,598 | 145,611 | 115,687 | 82,435 | 164,987 | 77,922 | 43,754 |
| 03/23/19 | 220,925 | 0.00 | 309,693 | 145,611 | 115,687 | 82,435 | 164,082 | 73,293 | 41,886 |
| 03/24/19 | 220,925 | 0.22 | 319,498 | 145,611 | 115,687 | 82,435 | 173,887 | 78,572 | 42,812 |
| 03/25/19 | 220,925 | 0.08 | 305,591 | 145,611 | 115,687 | 82,435 | 159,980 | 69,527 | 36,886 |
| 03/26/19 | 220,925 | 0.00 | 294,817 | 145,611 | 115,687 | 82,435 | 149,206 | 66,762 | 32,077 |
| 03/27/19 | 220,925 | 0.00 | 293,731 | 145,611 | 115,687 | 82,435 | 148,120 | 65,452 | 31,816 |
| 03/28/19 | 220,925 | 0.66 | 313,701 | 145,611 | 115,687 | 82,435 | 168,090 | 73,948 | 32,237 |
| 03/29/19 | 220,925 | 0.19 | 342,448 | 145,611 | 115,687 | 82,435 | 196,837 | 94,292 | 38,029 |
| **03/30/19** | **220,925** | **0.99** | **767,354** | **337,846** | **284,465** | **166,182** | **429,508** | **222,921** | **85,094** |
| 03/31/19 | 220,925 | 0.00 | 645,731 | 276,683 | 239,774 | 151,567 | 369,048 | 198,467 | 81,818 |
| 04/01/19 | 238,462 | 0.00 | 470,607 | 212,870 | 169,998 | 130,779 | 257,737 | 129,770 | 57,920 |
| 04/02/19 | 238,462 | 0.00 | 398,017 | 184,547 | 143,214 | 111,738 | 213,470 | 108,357 | 51,910 |
| 04/03/19 | 238,462 | 0.00 | 344,337 | 155,759 | 133,892 | 109,620 | 188,578 | 105,639 | 46,513 |
| 04/04/19 | 238,462 | 0.08 | 324,004 | 147,921 | 115,924 | 101,244 | 176,083 | 84,833 | 45,623 |
| 04/05/19 | 238,462 | 0.01 | 299,813 | 135,788 | ~~96,215~~ | 96,008 | 164,025 | 79,911 | 40,245 |
| 04/06/19 | 238,462 | 0.00 | 295,021 | 131,261 | ~~87,730~~ | 93,093 | 163,760 | 84,740 | 42,826 |
| 04/07/19 | 238,462 | 0.22 | 304,627 | 134,573 | ~~94,677~~ | 97,921 | 170,054 | 87,034 | 40,430 |
| 04/08/19 | 238,462 | 0.16 | 323,258 | 150,121 | ~~103,756~~ | 105,519 | 173,137 | 88,443 | 39,852 |
| 04/09/19 | 238,462 | 0.00 | 284,988 | 133,974 | ~~98,256~~ | 96,167 | 151,014 | 81,401 | 37,233 |
| 04/10/19 | 238,462 | 0.31 | 319,022 | 146,417 | ~~103,984~~ | 103,531 | 172,605 | 87,243 | 35,887 |
| 04/11/19 | 238,462 | 0.12 | 295,799 | 135,912 | ~~88,159~~ | 92,961 | 159,887 | 82,348 | 35,020 |
| 04/12/19 | 238,462 | 0.35 | 397,208 | 175,068 | ~~111,385~~ | 108,178 | 222,140 | 103,636 | 42,379 |
| 04/13/19 | 238,462 | 0.00 | 346,938 | 152,468 | ~~88,644~~ | 92,425 | 194,470 | 95,437 | 40,987 |
| 04/14/19 | 238,462 | 0.65 | 514,829 | 230,074 | ~~146,902~~ | 124,442 | 284,755 | 147,664 | 55,178 |
| 04/15/19 | 238,462 | 0.00 | 454,401 | 204,889 | ~~117,501~~ | 116,430 | 249,512 | 122,131 | 50,374 |
| 04/16/19 | 238,462 | 0.00 | 398,762 | 175,513 | ~~93,494~~ | 97,476 | 223,249 | 100,817 | 43,406 |
| 04/17/19 | 238,462 | 0.00 | 334,102 | 150,026 | ~~96,013~~ | 92,531 | 184,076 | 90,173 | 43,873 |
| 04/18/19 | 238,462 | 0.67 | 439,721 | 198,458 | ~~120,499~~ | 107,971 | 241,263 | 124,967 | 50,477 |
| 04/19/19 | 238,462 | 0.11 | 463,388 | 210,375 | ~~111,943~~ | 110,711 | 253,013 | 128,321 | 53,172 |
| 04/20/19 | 238,462 | 0.00 | 405,354 | 181,329 | ~~90,263~~ | 100,145 | 224,025 | 108,892 | 40,960 |
| 04/21/19 | 238,462 | 0.00 | 350,092 | 155,544 | ~~84,906~~ | 94,387 | 194,548 | 99,683 | 39,975 |
| 04/22/19 | 238,462 | 0.00 | 316,437 | 140,729 | ~~82,915~~ | 91,232 | 175,708 | 89,897 | 38,347 |
| 04/23/19 | 238,462 | 0.00 | 285,997 | 125,416 | ~~81,802~~ | 90,513 | 160,581 | 80,041 | 33,038 |
| 04/24/19 | 238,462 | 0.00 | 275,864 | 120,543 | ~~87,120~~ | 92,684 | 155,321 | 77,408 | 37,588 |
| 04/25/19 | 238,462 | 0.43 | 295,576 | 136,287 | ~~91,545~~ | 97,778 | 159,289 | 79,902 | 32,558 |
| 04/26/19 | 238,462 | 0.05 | 300,073 | 129,145 | ~~94,529~~ | 92,629 | 170,928 | 77,555 | 33,562 |
| 04/27/19 | 238,462 | 0.23 | 286,647 | 123,409 | ~~81,076~~ | 90,146 | 163,238 | 79,772 | 31,872 |
| 04/28/19 | 238,462 | 0.04 | 293,401 | 127,748 | ~~91,512~~ | 93,308 | 165,653 | 83,867 | 32,929 |
| 04/29/19 | 238,462 | 0.06 | 274,000 | 119,742 | ~~87,551~~ | 97,492 | 154,258 | 74,557 | 33,978 |
| 04/30/19 | 238,462 | 0.49 | 254,647 | 109,751 | ~~84,085~~ | 93,516 | 144,896 | 70,753 | 34,452 |
| 05/01/19 | 241,097 | 0.05 | 300,969 | 135,812 | ~~100,255~~ | 95,636 | 165,157 | 76,044 | 31,074 |
| 05/02/19 | 241,097 | 0.28 | 315,985 | 143,212 | ~~103,038~~ | 95,313 | 172,773 | 78,345 | 31,927 |
| 05/03/19 | 241,097 | 0.00 | 328,868 | 146,496 | ~~94,893~~ | 95,442 | 182,372 | 78,147 | 31,589 |
| 05/04/19 | 241,097 | 0.04 | 370,194 | 143,500 | ~~86,108~~ | 90,965 | 226,694 | 80,776 | 33,239 |
| 05/05/19 | 241,097 | 0.00 | 341,267 | 136,106 | ~~84,086~~ | 93,985 | 205,161 | 88,895 | 35,922 |
| 05/06/19 | 241,097 | 0.00 | 273,951 | 118,773 | ~~77,438~~ | 83,622 | 155,178 | 77,265 | 33,769 |
| 05/07/19 | 241,097 | 0.00 | 253,779 | 113,683 | ~~75,945~~ | 70,645 | 140,096 | 71,941 | 32,353 |
| 05/08/19 | 241,097 | 0.00 | 293,136 | 117,488 | 79,766 | 69,572 | 175,648 | 74,990 | 27,237 |
| 05/09/19 | 241,097 | 1.00 | 474,893 | 223,536 | 178,247 | 92,053 | 251,357 | 137,749 | 44,696 |
| 05/10/19 | 241,097 | 0.00 | 406,788 | 163,352 | 127,524 | 75,257 | 243,436 | 103,317 | 37,240 |
| 05/11/19 | 241,097 | 0.16 | 359,188 | 149,767 | 102,081 | 66,936 | 209,421 | 95,949 | 39,523 |
| 05/12/19 | 241,097 | 0.02 | 338,129 | 145,169 | 101,060 | 62,330 | 192,960 | 95,543 | 42,867 |
| 05/13/19 | 241,097 | 0.00 | 302,024 | 130,704 | 107,764 | 59,707 | 171,320 | 80,760 | 37,341 |
| 05/14/19 | 241,097 | 0.00 | 272,206 | 121,497 | 108,011 | 57,816 | 150,709 | 77,109 | 38,819 |
| 05/15/19 | 241,097 | 0.03 | 274,411 | 113,857 | 100,553 | 55,859 | 160,554 | 73,260 | 40,635 |
| 05/16/19 | 241,097 | 0.00 | 259,979 | 112,090 | 75,551 | 57,102 | 147,889 | 71,813 | 36,512 |
| 05/17/19 | 241,097 | 0.00 | 247,200 | 104,482 | 64,855 | 53,224 | 142,718 | 66,577 | 32,816 |
| 05/18/19 | 241,097 | 0.00 | 235,260 | 99,770 | 68,471 | 48,726 | 135,490 | 65,439 | 33,970 |
| 05/19/19 | 241,097 | 0.30 | 278,283 | 117,797 | 59,927 | 55,478 | 160,486 | 74,393 | 35,996 |
| 05/20/19 | 241,097 | 0.00 | 260,013 | 105,993 | 65,495 | 55,223 | 154,020 | 65,942 | 32,515 |
| 05/21/19 | 241,097 | 0.63 | 242,457 | 104,965 | 97,572 | 56,937 | 137,492 | 63,327 | 28,569 |
| 05/22/19 | 241,097 | 0.43 | 490,974 | 214,868 | 173,334 | 81,039 | 276,106 | 132,910 | 41,973 |
| 05/23/19 | 241,097 | 0.30 | 427,743 | 178,852 | 143,720 | 74,961 | 248,891 | 118,967 | 36,765 |
| 05/24/19 | 241,097 | 0.00 | 345,071 | 143,608 | 116,676 | 69,598 | 201,463 | 97,908 | 34,470 |
| 05/25/19 | 241,097 | 0.00 | 306,864 | 130,115 | 96,887 | 63,245 | 176,749 | 89,503 | 32,359 |
| 05/26/19 | 241,097 | 0.38 | 385,540 | 164,535 | 148,791 | 76,145 | 221,005 | 113,242 | 37,874 |
| 05/27/19 | 241,097 | 0.00 | 346,527 | 149,251 | 118,753 | 71,088 | 197,276 | 100,242 | 35,742 |
| 05/28/19 | 241,097 | 0.00 | 294,916 | 128,759 | 119,532 | 64,170 | 166,157 | 83,445 | 33,310 |
| 05/29/19 | 241,097 | 0.24 | 300,303 | 131,077 | 108,769 | 60,895 | 169,226 | 82,014 | 28,960 |
| 05/30/19 | 241,097 | 0.06 | 271,624 | 122,569 | 101,261 | 54,697 | 149,055 | 72,582 | 30,136 |
| 05/31/19 | 241,097 | 0.00 | 263,785 | 113,351 | 94,032 | 46,558 | 150,434 | 67,927 | 28,238 |
| 06/01/19 | 282,236 | 0.00 | 242,969 | 107,973 | 88,578 | 34,693 | 134,996 | 66,793 | 32,338 |
| **06/02/19** | **282,236** | **0.00** | **238,876** | **103,431** | **100,669** | **32,435** | **135,445** | **63,379** | **39,984** |
| **06/03/19** | **282,236** | **0.00** | **231,505** | **94,971** | **79,328** | **25,927** | **136,534** | **59,064** | **37,873** |
| **06/04/19** | **282,236** | **0.00** | **225,099** | **95,227** | **74,907** | **34,146** | **129,872** | **57,677** | **36,319** |
| **06/05/19** | **282,236** | **0.00** | **210,698** | **85,054** | **85,880** | **31,293** | **125,644** | **52,763** | **37,809** |
| **06/06/19** | **282,236** | **0.00** | **221,564** | **85,259** | **89,475** | **34,979** | **136,305** | **61,450** | **39,429** |
| 06/07/19 | 282,236 | 0.00 | ~~191,900~~ | ~~69,471~~ | ~~88,732~~ | ~~32,816~~ | 122,429 | 51,813 | 33,282 |
| 06/08/19 | 282,236 | 0.11 | ~~198,205~~ | ~~70,257~~ | ~~90,168~~ | ~~30,409~~ | 127,948 | 54,671 | 33,592 |
| 06/09/19 | 282,236 | 0.00 | ~~217,399~~ | ~~90,248~~ | ~~101,642~~ | ~~43,669~~ | 127,151 | 56,680 | 33,400 |
| 06/10/19 | 282,236 | 0.00 | ~~192,117~~ | ~~74,301~~ | ~~63,474~~ | ~~74,455~~ | 117,816 | 49,894 | 30,414 |
| 06/11/19 | 282,236 | 0.00 | ~~179,982~~ | ~~62,805~~ | ~~85,598~~ | ~~80,754~~ | 117,177 | 51,326 | 30,588 |
| 06/12/19 | 282,236 | 0.49 | ~~196,291~~ | ~~71,727~~ | ~~76,884~~ | ~~82,490~~ | 124,564 | 53,953 | 29,346 |
| 06/13/19 | 282,236 | 0.00 | ~~214,306~~ | ~~84,598~~ | ~~55,790~~ | ~~85,724~~ | 129,708 | 60,248 | 32,853 |
| 06/14/19 | 282,236 | 0.04 | ~~191,782~~ | ~~76,193~~ | ~~48,470~~ | ~~80,258~~ | 115,589 | 58,841 | 31,833 |
| 06/15/19 | 282,236 | 0.81 | ~~257,950~~ | ~~105,021~~ | ~~61,046~~ | ~~97,907~~ | 152,929 | 78,047 | 36,557 |
| 06/16/19 | 282,236 | 0.09 | ~~265,620~~ | ~~108,267~~ | ~~69,544~~ | ~~98,664~~ | 157,353 | 76,973 | 33,906 |
| 06/17/19 | 282,236 | 0.00 | ~~230,902~~ | ~~89,622~~ | ~~51,493~~ | ~~87,042~~ | 141,280 | 68,111 | 32,729 |

~~INVALID DATA~~

DRY WEATHER DATA

PEAK FLOW DATA

AVERAGE DAILY DATA SUBSTITUTED FOR INVALID DATA

# APPENDIX 3

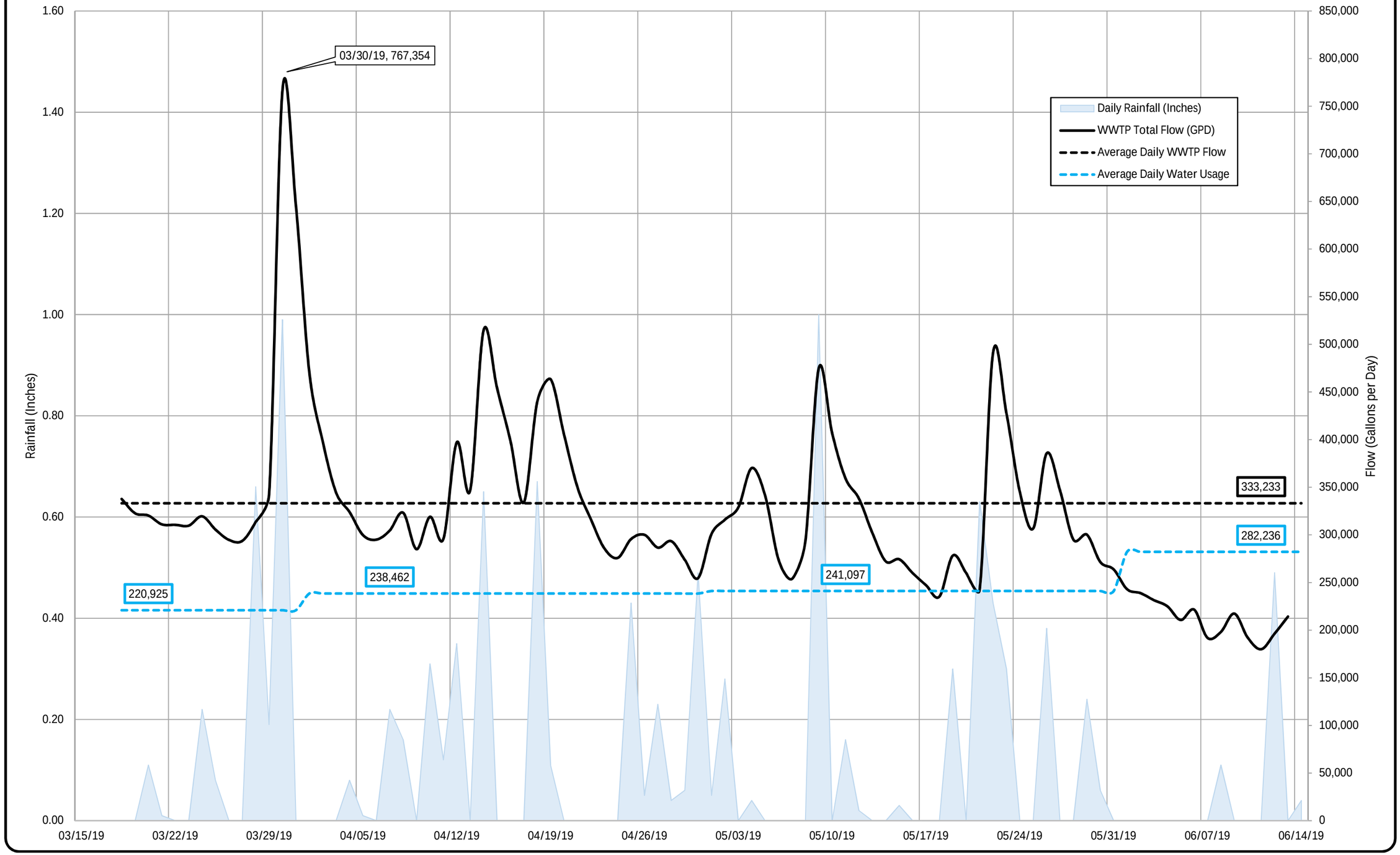
# Flow Charts

*WWTP Total Flow Chart*

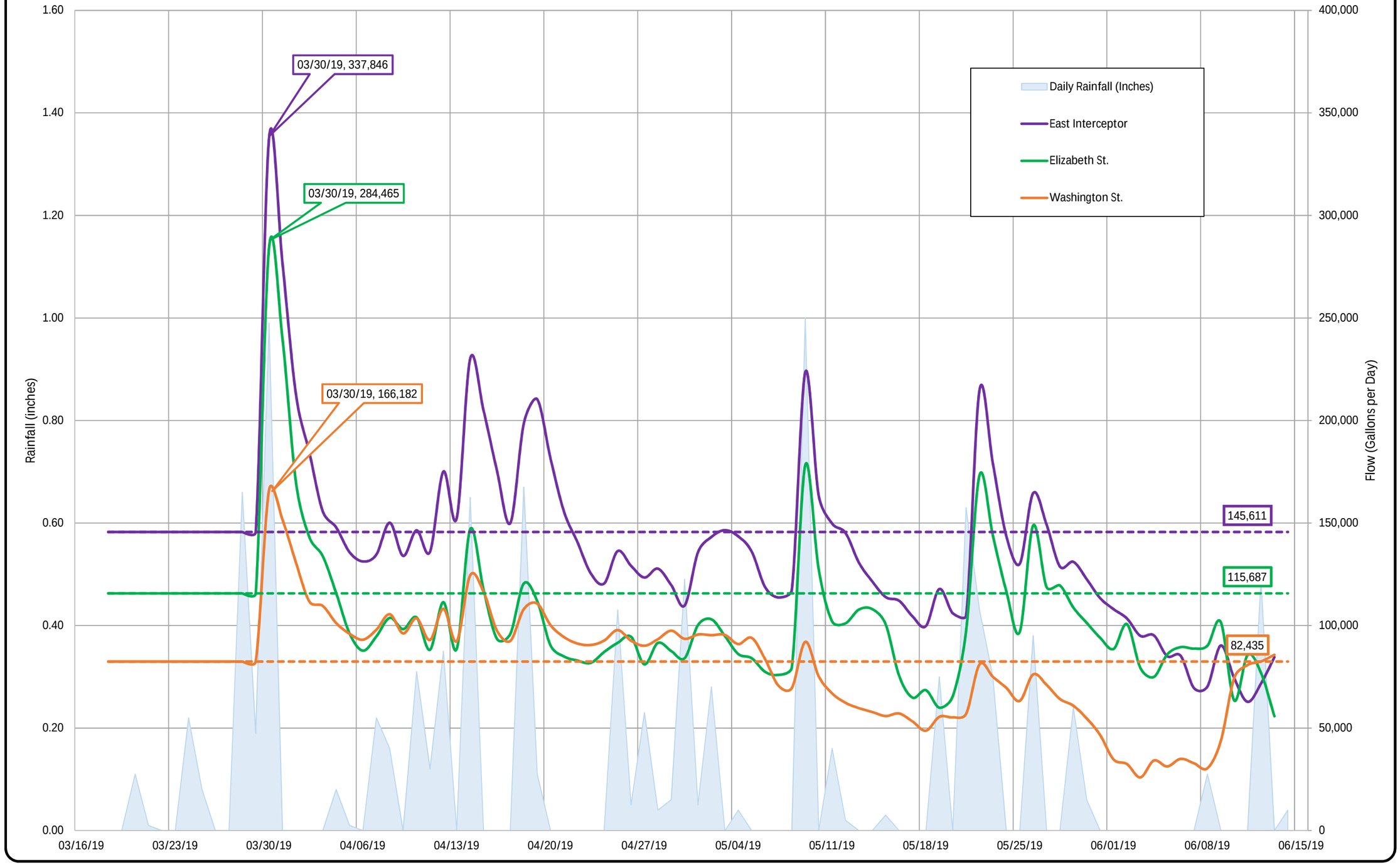
*East Side Flow Chart*

*West Side Flow Chart*

# WWTP TOTAL FLOW CHART



# EAST SIDE FLOW CHART



# WEST SIDE FLOW CHART