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Section ES

Executive Summary

ES.1 Project Overview

The Town of Montague, Massachusetts owns and operates wastewater pumping stations that convey raw sewage to the Water Pollution Control Facility. Eight pumping stations were reviewed in this study:

- Denton Street Pumping Station
- First Street Pumping Station
- G Street Pumping Station
- J Street Pumping Station
- Lake Pleasant Pumping Station
- Montague Center Pumping Station
- Poplar Street Pumping Station
- Technical School Pumping Station

The age of these eight stations varies, with original construction dates ranging from 1962 to 1982. A typical life expectancy for wastewater pumping equipment is 20 years, which speaks to the dedication of the Montague maintenance staff, and also the need to review (and potentially upgrade) all of these pumping stations in the near future.

ES.2 Project Goals

In many cases, pumping station upgrade or replacement is needed. To focus the evaluation of the stations, Town staff stated the following goals for this project:

1. Upgrade stations for reliable sustainable operations for the next 20 years
2. Meet projected capacity needs for the next 20 years
3. Improve overall reliability, including permanent bypass pumping provisions
4. Improve infrastructure security
5. Reduce maintenance and labor
6. Improve monitoring and alarm capability
7. Standardize equipment
8. Comply with applicable codes and standards and eliminate Confined Space Entry

ES.3 Systems Reviewed

An inspection of each station was performed. In each case, we reviewed hydraulic conditions and capacity, pipelines and site considerations, architectural, structural, process mechanical, plumbing, HVAC, electrical, standby power systems, and instrumentation and controls. Detailed findings from each discipline are discussed in the various Sections of this report.

ES.4 Key Findings

In general terms, the pumping stations have been well maintained and are functional. However, they are showing their considerable age and all of them have significant issues that warrant careful consideration by the Town.

- Five stations need increased capacity, and appear to keep up with peak flows only because both pumps (or ejector pots) are running simultaneously. This practice is not recommended and would cause a backup (or overflow) if either unit failed.
- Three stations raise significant structural integrity concerns. Two of these are metal can stations from 1962 that are badly deteriorated and leaking. Another has significant loss of concrete and exposed aggregate in the wet well.
- Four stations are dependent on a common air receiver tank and are thus susceptible to common mode equipment failure. Two of these are 50 years old, and all four ejector stations would not function at all in the event of a tank or valve failure.
- All stations have code issues that are currently "grandfathered", but that would dictate wholesale electrical and HVAC replacements in the event of an upgrade.
- All stations need minor concrete and other cosmetic and architectural repairs.
- All stations require confined space entry for maintenance and inspection. Confined space entry always presents a risk for injury, even when all safety precautions are taken and all documented procedures are followed.

ES.5 Recommendations

In all cases, the recommended alternative is complete replacement with a new precast concrete wet well structure with an integrated valve vault with bypass pumping provisions. For various reasons the existing structures are not suitable to remain in service, at least not in a manner consistent with the goals of this study. Submersible pumps are recommended, and would be installed similar to one of several layouts included in Appendix D. This is the only approach that satisfies all the goals of this study at any given station.

ES.6 Project Costs

Site specific opinions of probable cost have been developed for each station according to known and anticipated site conditions, the nature of improvements and depth of excavation at each site. Unit costs were estimated based on the Engineering News Record (ENR) 20 city average construction cost index. Project costs also include an allowance for contingency and engineering and implementation.

Contingencies were based on guidance from the Association for the Advancement of Cost Engineering and the US Environmental Protection Agency construction grant and loan program. Engineering and implementation costs can include permitting, finance bonding costs, engineering design, legal, construction oversight, administrative, geotechnical program (including borings), site survey, and public participation.

Depending on the final scope of work selected by the Town, the anticipated planning level project cost for all eight stations ranges from **$6.1 Million to $7.3 Million**. Scope inclusions and exclusions are described in Section 12.

ES.7 Impacts to Sewer Rates

Sewer user rates would increase as a result of the improvements recommended by this study. Assuming that all eight stations are constructed at once, Town staff have estimated that the approximate impact on residential rate payers the first year is anticipated to be $225 for a 20-year loan and $267 for a 15-year loan. The difference in total payments for a 20-year loan vs. a 15-year loan is approximately $100,000 over the life of the loan. More information on this analysis is described in Section 12.

ES.8 Prioritized Order of Improvements

It would be ideal to implement all recommended improvements at all stations as one large construction contract. Doing so would maximize the purchasing power of the Town and their contractor, attract bids from larger contractors, and allow an economy of scale at every step of the project from design through startup. This approach would also provide standardization of all equipment because the equipment would all be purchased at the same time, though the same contractor and chain of supply. We recommend that the Town make improvements to as many stations at one time as is practical to try to capture these benefits.

However, it is understood that the costs for the recommended improvements are substantial, and the Town may need to break this project up into pieces. If the project is broken into smaller pieces, there is a risk for less standardization, loss of the economy of scale effect, and the Town will continue to bear the risks associated with the existing stations (safety / confined space entry, structural integrity, capacity). Section 12 offers a potential order of priority for upgrading the stations.

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Section 1

Project Overview and Methodology

1.1 Project Background

The Town of Montague, Massachusetts owns and operates a number of wastewater pumping stations that convey raw sewage to the Water Pollution Control Facility. There are eight larger stations that service low lying and remote areas of the collection system, and several additional smaller grinder pumping stations that service single points of use (homes or businesses).

The eight larger stations are distributed across the town and include:

- Denton Street Pumping Station
- First Street Pumping Station
- G Street Pumping Station
- J Street Pumping Station
- Lake Pleasant Pumping Station
- Montague Center Pumping Station
- Poplar Street Pumping Station
- Technical School Pumping Station

The age of these eight stations varies, with original construction dates ranging from 1962 to 1982. While Town staff have continuously maintained these stations, the latest major overhaul at any station was at the Technical School Pumping Station circa 1990.

Aside from ongoing maintenance and repairs, this means that the "newest" station is approximately 22 years old, with the oldest elements of some stations now 50 years old. A typical life expectancy for wastewater pumping equipment is 20 years, which speaks to the dedication of the Montague maintenance staff, and also the need to review (and potentially upgrade) all of these pumping stations in the near future.

It is noted that the smaller grinder pumping stations have been recently upgraded (circa 2006). The grinder stations were not included in this project because of their newer vintage and reported good condition.

1.2 Project Purpose

The age and condition of the eight wastewater pumping stations warrant a thorough review. In many cases, upgrade or replacement is needed. To focus the evaluation of the stations, Town staff stated the following goals for this project:

1. Upgrade stations for reliable sustainable operations for the next 20 years

2. Meet projected capacity needs for the next 20 years
3. Improve overall reliability, including permanent bypass pumping provisions
4. Improve infrastructure security
5. Reduce maintenance and labor
6. Improve monitoring and alarm capability
7. Standardize equipment
8. Comply with applicable codes and standards and eliminate Confined Space Entry where possible.

1.3 Project Approach

This wastewater pumping station evaluation report identifies the major facility upgrades necessary to meet the future flow requirements and address the project goals identified by Town staff. To develop this report, the following steps were taken:

1.3.1 Project Workshop and Flow Assessment

Working collaboratively with Town staff, our engineers facilitated a workshop-style discussion to obtain stations history, problems, and complaints from the maintenance staff. Preferences on equipment, standardization requirements, design criteria, safety and security concerns were expressed and recorded.

CDM Smith staff also reviewed original designs, flow capacity, maintenance practices, operational issues, constraints, and station limitations. Design documents and pump information were reviewed to the extent they were available.

While expansion of the sewer service area to each station is not anticipated, we have reviewed data that include projections of population, commercial and industrial development within the sewered area from the Town Planning Department. Using this data, we have been able to estimate future average and peak flow rates to each of the pumping stations.

1.3.2 Overall Assessment and Information Gathering

Our engineers have reviewed the site layout and as-built drawings for each station. We have also visually inspected the condition of each station, including the overall structure and pumps, valves, piping, electrical power supply, standby power systems, instrumentation and controls. We have also reviewed available records to identify significant maintenance issues, and reviewed hydraulic conditions including wet well and force main capacity. Odor impacts and site security were also considered in the recommendations of this report.

1.3.3 Design Concepts

Recommendations for upgrading or replacement for each station are included in this report. Consideration has been given to simplicity of operation, ease of maintenance, reliability, accessibility, aesthetics, and standardization.

Other key concerns include health and safety issues including compliance with the OSHA Confined Space Requirements, NFPA Ventilation Requirements, NEC Electrical Code Requirements, and others as applicable.

Planning-level costs for improvements at each station are included, and we have worked with Town staff to identify which stations are most in need of improvements.

1.4 Systems Reviewed

The following systems were reviewed:

1. *Hydraulic and Capacity Analysis* – This review was based on available design drawings, operating records, and projections of population, commercial and industrial development from the Town Planning Department.

2. *Pipelines and Site Considerations* – This review assessed the conditions of the existing pipelines and sites, and modifications and new construction required to meet the new system performance criteria identified in the hydraulic analysis.

3. *Architectural/Structural* – The architectural/structural review assessed the structural building components and exterior shell systems such as walls, doors, windows, louvers, and vertical circulation. This review identified building modifications necessary to accommodate the recommended equipment upgrades, and meet the most recent building codes and design standards.

4. *Process/Mechanical* – The process mechanical evaluation included an inspection of the mechanical systems at the pumping stations.

5. *Plumbing/HVAC* – The plumbing and HVAC reviews assessed the water systems, fuel systems, unit heaters, ventilators, air handling units, exhausts, potable water supply and fire protection.

6. *Electrical* – The electrical review assessed the service available, location of service transformers, power transfer switches, building lighting, power distribution, fire alarm, and lightning protection.

7. *Standby Power Systems* – The standby power review assessed the age and condition of existing standby power systems and the impact of the recommended improvements relative to the existing standby power systems.

8. *Instrumentation and Controls* – The review of the existing instrumentation noted alarms present at each station and the mode of communication of any alarms.

1.5 Report Organization

This report is organized into Sections that cover each of the topics listed above. In each Section, applicable codes, standards, and references are cited to help put the condition of the existing stations in context with current design expectations. General observations are noted that may apply to all of the pumping stations, as well as focused site specific observations and recommendations. Recommendations are also summarized in Section 12.

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Section 2

Hydraulic and Capacity Analysis

Historically, the Town of Montague has not observed problems related to insufficient wastewater pumping station capacity. This section describes our evaluation of pumping station hydraulics and capacity as they are currently understood.

2.1 Codes, Standards, and References

The flow evaluation and capacity analysis complies with the following standards and references, which were utilized in the preparation of this section:

- GLUMRB Recommended Standards for Wastewater Facilities (Ten States Standards).
- NEIWPCC TR-16 Guides for the Design of Wastewater Treatment Works.

2.2 Operating Records

Town staff was able to compile and provide a complete year of operating records from 2011. For the ejector stations (Denton Street, G Street, J Street, and Lake Pleasant Pumping Stations), ejection count logs were provided along with the volume of each ejection. Using this relationship, it was possible to determine how many gallons each station pumped over the time periods of study. For the centrifugal stations (First Street, Montague Center, Poplar Street, and Technical School Pumping Stations), a similar methodology was used except that run hours were provided in lieu of ejection counts. Run hours were then multiplied by the rated capacity of the various pumps to determine flow rates at each station.

2.3 Planned Development

CDM Smith and WPCF staff reviewed growth areas and projections with the Town Planner and Conservation Agent (Walter Ramsey) to approximate the effects of anticipated grown on the wastewater pumping stations studied by this report. The planning office does not have a singular report that covers the time periods in question, so several data sources were referenced.

The Economic Plan was completed in 2004 and used MISER Projection through 2020 using 2003 data. This document projected a 5% growth rate through 2020. However, the Town Planner noted that in reality, this growth rate has been 0.61% increase from 2000 to 2010. Higher growth rates are not anticipated. The 2010 Open Space Plan is the most recent document available, and discusses population trends in Montague.

Extrapolating between the two data sources, the Planning office expects a slow to no growth scenario. Some the pieces at play over the 20 year horizon for a max growth are Strathmore Mill, RR salvage, Montague Center School, up to 5 small industrial lots on Turnpike Road. Residential growth would be mostly in the Montague Center area.

As a result of the planning data described above, we do not anticipate a decrease in pumping station flows, and suggest that future design efforts should plan on a modest increase in flows over time.

However, the very minor growth anticipated by the Planning office suggests that the operational data provided by Town staff is, generally, a good indication of the capacity needed at each station.

2.4 Capacity Evaluation

This review was based on available design drawings, operating records, and projections of population, commercial and industrial development from the Town Planning Department.

The stations were evaluated for annual average conditions, and peak flow (wet weather) conditions. The force mains of the respective pumping stations were also evaluated for hydraulic adequacy. Data contained in Appendix C summarizes the pump capacities, calculations and conclusions described below.

All of the pumping stations are duplex stations, meaning that they each have two pumps installed and available for service. However, the role of the second pump is intended as a standby or installed spare pump. TR-16 requires that we design around the "firm capacity" of a station, which is the available capacity with the largest pump (or ejector pot) out of service. In a duplex station where the pumps are the same size, this simply means we plan for running with only one pump.

2.4.1 Annual Average Conditions

Based on the 2011 data available, total annual run time (or ejection count) and resultant total annual flow were determined. This allowed the generation of a true average daily flow rate for the year. It has been assumed that all pumps are operating at their nameplate capacity. No flow measurement was performed and no flow data is available. All centrifugal pumps are understood to be constant speed with no VFD capacity. Based on published relationships between average flows and peak flows (included in Appendix C), a peaking factor was then determined for each station. This peaking factor was used to determine the required firm capacity for a given station in accordance with TR-16.

It is noted that flow values have been calculated for average daily flow. A more detailed analysis using flow metering could show that stations may be undersized based on daily diurnal patterns. Recommended TR-16 peaking factors were used because these factors account for this risk.

In this set of calculations, six of the eight pumping stations (all but the Denton Street and G Street stations) appear to have sufficient capacity. However, this evaluation does not reflect peak flow conditions. To better understand how the stations may behave under peak flows or during wet times of the year, the peak flow month was also evaluated as described below.

2.4.2 Peak Flow Month Conditions

The exercise described above for the 2011 annual average was repeated for the highest flow calendar month at each given pumping station. These months are noted in Appendix C. It should be noted that these calculations are based off the maximum calendar month in 2011, not a rolling average maximum month period. There is not sufficient data to generate a true maximum month rolling average, which can often produce higher values if the data set is of sufficient size.

Repeating the calculations above, we note that only three of the eight pumping stations appear to have sufficient capacity. These are First Street, Poplar Street, and Lake Pleasant. The other five stations (Denton Street, G Street, J Street, Montague Center and Technical School) are under sized for peak flow periods.

2.4.3 Force Main Capacity Calculations

Section 3 of this report discusses the size, material and condition of the force mains associated with each pumping station. Appendix C details the hydraulic calculations performed to determine the adequacy of each force main. Of note is the anticipated velocity in the pipeline when the pumping station is operating at its firm capacity. The highest force main velocity under this condition is 3.4 feet per second (First Street). This is a safe pipeline velocity, so this means that the size (capacity) of all the force mains is adequate.

However, TR-16 recommends a *minimum* force main velocity of 3 feet per second to re-suspend solid materials in the pipeline that may settle out in between pumping cycles and keep things moving to the wastewater treatment plant. Seven of the eight existing Town pumping station force mains to not achieve this recommended minimum velocity. This actually means that most of the force mains are oversized for their current firm capacity. If new stations are constructed, or if pump capacity is increased, force main size should be reviewed. Our understanding is that the Town has not had problems with clogged force mains, so this does not appear to be a problem under the current operational mode. If flow rates are increased, velocities would also increase and this would become less of a concern.

2.5 Conclusions and Recommendations

As noted at the beginning of this section, the Town has fortunately not observed problems related to insufficient wastewater pumping station capacity. The discrepancy between these observations and the calculations discussed above is the issue of "firm capacity". In many cases, both pumps at a given station have been operating to keep up with incoming sewage flows. This has been directly observed by Town staff, and is supported by operational records.

Due to the strong maintenance program upheld by Town staff, pump failures have been limited. However, the reality is that five of the eight pumping stations do not have adequate firm capacity, and if they were to lose a pump during elevated flow periods, sewer surcharge, basement backups and potential flooding would likely result. This problem is compounded at the ejector stations, which have a common air receiver tank that services both ejector pots. This is a form of common mode failure that would cripple the entire station in the event of an air receiver tank problem.

Given the age of the existing stations, the risk of a pump failure is significant (and increasing) in spite of the good maintenance program followed by the Town. Understanding the significant firm capacity shortfall at five of the eight stations, replacement with larger pumping units is recommended. Force main pipelines are currently over sized, and are not anticipated to need replacement due to a capacity restriction. Pipeline condition should be confirmed during design of improvements.

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Section 3

Pipelines and Site Considerations

This section presents the engineering criteria and technical approach used to evaluate the existing pipelines and sites. It also includes recommendations for necessary improvements.

3.1 Codes, Standards, and References

The design of recommended improvements should comply with Federal and State of Massachusetts laws or ordinances, as well as applicable codes, standards, regulations, and/or regulatory agency requirements including the partial listing below.

- GLUMRB Ten States Standards – Recommended Standards for Wastewater Facilities
- NEIWPCC TR-16 Guides for the Design of Wastewater Treatment Works
- American National Standards Institute (ANSI)
- AWWA M41 – Ductile Iron Pipe Design and Installation
- AWWA C105 – National Standard for Polyethylene Encasement for Ductile Iron Pipe Systems
- Handbook of Cathodic Corrosion Protection

3.2 Pipelines

Town staff noted that the various force mains from the pumping stations have been generally trouble free over the years. They have not documented specific problems, nor experienced surge conditions that can be problematic at some stations.

3.2.1 Force Main Size, Material, Age, and Condition

- Denton Street Pumping Station: 6-inch, PVC (record plans), 1984 (28 years), Reported as Good Condition.
- First Street Pumping Station: 6-inch, AC (record plans), 1962 (50 years), Reported as Good Condition.
- G Street Pumping Station: 6-inch, AC (record plans), 1962 (50 years), Reported as Good Condition.
- J Street Pumping Station: 6-inch, AC (record plans), 1962 (50 years), Reported as Good Condition.
- Lake Pleasant Pumping Station: 6-inch, PVC (record plans), 1984 (28 years), Reported as Good Condition.
- Montague Center Pumping Station: 8-inch, DI (record plans), 1982 (30 years), Reported as Good Condition.

- Poplar Street Pumping Station: 6-inch, AC (record plans), 1962 (50 years), Reported as Good Condition.

- Technical School Pumping Station: 6-inch, DI (assumed due to age), 1990 (22 years), Reported as Good Condition.

Most pipeline materials have a practical design life of 60 years. Some of the existing pipelines in question are currently 50 years old and will exceed 70 years old by the end of the next 20 year design cycle. However, the Town has not experienced problems with these force mains and thus there is no immediate motivation to incur the expense of force main replacement.

3.2.2 Bypass Pumping Provisions

None of the pumping stations have permanent provisions for bypass pumping. Such provisions are desirable per TR-16 and would allow use of a temporary pumping system (i.e. trailer mounted dry prime engine driven pump) in the event of pump failure at the station. Typical provisions include a DI suction pipe from the wetwell fitted with a quick connect fitting. A similar quick connection to the force main must also be provided, including an isolation valve and provisions to drain the pipe. A vault or manhole is typically a convenient means to house the discharge piping and valves needed to minimize freezing risks.

3.2.3 Pipeline Recommendations

1. **Install Bypass Provisions**: It is recommended that permanent bypass pumping provisions be added to each station. The Town may want to buy a trailer mounted dry prime engine driven pump and some flexible hose to use during bypass operations. Because all of the stations have 6-inch force main piping except for Montague Center, standardization is practical. A 6-inch x 8-inch increaser could be used at Montague Center. If the Town does not want to purchase its own engine driven bypass pump, an outside service such as Godwin Pump could be used as needed. However, such a pump could have multiple uses at the Water Pollution Control Facility as well.

2. **Test Force Main Condition**: During construction of bypass measures, it is recommended that the Town conduct a soil corrosion survey and metallurgical testing (on the force main coupon removed from the wet tap for bypass connection) to assess whether cathodic protection or a future pipeline replacement project is needed.

3.3 Site Conditions

Site conditions have generally been adequate for what has been needed in the past. Specific observations on each pumping station follow.

3.3.1 Land Area

Town parcels at each pumping station are small but have been adequate to date. Town staff have pulled parcel size records from the Town Assessor, and there appears to be adequate land area for improvements. However, plot plans (survey plans) that show the placement of existing features on the parcels are not available. As a result, it is not clear how proposed improvements could be arranged on the existing parcels, or if additional land area is required. These are questions that must be addressed during the design of improvements though a survey of existing conditions and a boundary survey of the property and easements.

3.3.2 Aesthetics and Odors

The existing pumping stations are typical for the date of their installation. They were not designed to be aesthetically pleasing, nor do they blend in their locations. The Town may want to consider aesthetic criteria for any future upgrades to the stations.

According to Town staff, odors have not been a historical problem. This assertion is supported by our direct observations from site visits performed in April 2011 and March 2012, and also from anecdotal commentary from a resident at the Poplar Street Pumping Station who stated that the Poplar Street station had never smelled.

3.3.3 Infrastructure Security

Site security is more important in modern times than ever before. The uninterrupted operation of wastewater pumping stations is critical for community health and general well being. As such, protection of the Town's wastewater infrastructure is a key consideration in the evaluation of these pumping stations.

Seven of the eight pumping stations have lockable chain link fencing in fair condition. The Montague Center station does not have fencing, and is potentially at risk for forced entry or damage to the external radiator for the station's standby generator.

While the Town has fortunately not had many issues, it is noted that security could be improved at all stations though the installation of new and higher fencing with barbed wire, better site lighting, and intrusion sensors within buildings, etc. The Poplar Street station may be at additional risk because of its location adjacent to a recreational area. Standby generators and controls should be housed within lockable structures or enclosures to minimize risk of sabotage and vandalism.

Use of external radiators is functional, but puts the station at risk because if the radiator is damaged, the engine on the generator will soon fail. Without reliable standby power, the station itself will not function during an outage.

3.3.4 Subsurface Considerations

Subsurface conditions are a consideration of this report because they will directly impact the potential cost of any improvements related to new structures and pipeline work. Since all of the stations are located in low laying areas, and many of them are in "fill" areas, the subsurface bearing capacity of the local soils will dictate foundation design of any new structures. In the worst cases, pile supported foundations will be required. However, all existing drawings show compacted gravel foundations, implying that pile supported foundations will not be needed for any proposed improvements.

In cases where existing stations have underground diesel fuel storage tanks for their standby generators, those tanks must be properly removed and documented. Soil and groundwater contamination is not anticipated based on input from Town staff.

3.3.5 100-Year Flood Elevation

Some of the areas of Montague serviced by pumping stations are low lying and / or adjacent to water. TR-16 recommends that all electrical and control equipment be located above the 100-year flood elevation.

3.3.5.1 Stations Vunerable to Flooding

The best available flood mapping at the writing of this report is from FEMA from 1982. Town staff have sought more recent information from the Town Planner and the Town's insurance agent, but it appears that better information is not available.

According to the available FEMA mapping from 1982, only two stations are prone to flood risk. These are Poplar Street (adjacent to the Connecticut River) and the Lake Pleasant station. Both of these stations are vulnerable to a 100-year flood.

The precise 100-year flood elevations for each of these stations are not critical at this stage, but should be determined prior to the design of improvements.

3.3.5.2 Stations Not Vunerable to Flooding

The First Street, G Street and J Street stations are adjacent to either the Connecticut River or the Power Canal, but these stations are protected by the dams and gates along these waters and thus are not flood prone. It is noted that four stations (First Street, G Street, J Street, and Poplar Street) have fiberglass generator enclosures that were designed to be crane lifted to a higher elevation in the event of a flood.

The Denton Street, Montague Center and Technical School stations are also not believed to be at risk from flooding.

3.3.6 Site Recommendations

Future design phases will involve the location of all existing utilities (above and below grade), a geotechnical investigation at each site, wetland delineation (where applicable) and a topographic and boundary survey to confirm or define the limits of the site and record all visible site features.

Electrical transformers, service connections and all critical electrical equipment must be located above the 100-year flood plain, though in some cases special provisions (such as a dike or berm) could be considered.

Parking should be provided for at least two service trucks. In locations where this does not exist, service vehicles are forced to park on the road or lawn, which is not ideal. Site security, snow removal and protection of future force main bypass features are also considerations for revised pumping station yard layouts.

Section 4
Architectural

The existing pumping stations were generally reviewed as described in Section 1. The following paragraphs include descriptions of the existing conditions and recommendations for improvements.

4.1 Codes, Standards, and References

Federal and State laws or ordinances, as well as applicable codes, standards, regulations, and/or regulatory agency requirements including the partial listing below, were considered to recommend improvements.

- International Building Code (IBC)
- International Plumbing Code (IPC)
- American with Disabilities Act (ADA)
- American National Standards Institute (ANSI)
- Underwriters Laboratory (UL)
- Department of Transportation (DOT)
- Occupational Safety and Health Administration (OSHA)
- American Society Of Plumbing Engineers Data Book
- National Fire Protection Association Standards (NFPA)

4.2 Denton Street Pumping Station

4.2.1 Description

The Denton Street station is a below grade structure with a hatch above grade. As such, most architectural categories do not apply to this station.

4.2.2 Existing Conditions of Concern

The existing station has no roof, windows, doors or louvers, or above grade exterior walls. The mechanical equipment, entry tube and lower level concrete walls have existing painted surface that show cracking and pealing. Miscellaneous metals are functional.

4.2.3 Recommendations

The existing painted surfaces should be re-coated, including removal of the old paint to allow proper adhesion of a new coating system. Any new structures constructed at this station (i.e. generator and control building) must be designed to current codes.

4.3 First Street Pumping Station

4.3.1 Description

The First Street station is a below grade metal “can” style pumping station. Standby power and electrical systems are located above grade in a fiberglass enclosure. This location has two generators, an older one in the fiberglass enclosure, and a newer one in a small metal enclosure outside.

4.3.2 Existing Conditions of Concern

Building Roof

The above grade fiberglass enclosure has a fiberglass roof that is reported not to leak.

Windows, Doors, and Louvers

The above grade fiberglass enclosure has no windows. The singular door is functional. The louvers are no longer used because this generator has been removed from service. The general condition of the above grade fiberglass enclosure is poor.

Finishes

The lower level walls are wet from condensation and most surfaces need to be repainted.

Miscellaneous Metals

While functional, ladders and rails are at the end of their life expectancy.

4.3.3 Recommendations

The above grade fiberglass enclosure should be replaced with a new building, structure, or enclosure. The existing unit does not meet current building codes and has reached the end of its useful life. If the below grade can station remains in service, it should be completely re-painted.

4.4 G Street Pumping Station

4.4.1 Description

The G Street station is a below grade concrete vault style pumping station. Standby power and electrical systems are located above grade in a fiberglass enclosure.

4.4.2 Existing Conditions of Concern

Building Roof

The above grade fiberglass enclosure has a fiberglass roof that is reported not to leak.

Windows, Doors, and Louvers

The above grade fiberglass enclosure has no windows. The singular door and louvers are functional. The general condition of the above grade fiberglass enclosure is poor.

Finishes

The lower level walls are damp from condensation and most painted surfaces need to be repainted.

Miscellaneous Metals

While functional, ladders and rails are at the end of their life expectancy.

4.4.3 Recommendations

The above grade fiberglass enclosure should be replaced with a new building, structure, or enclosure. The existing unit does not meet current building codes and has reached the end of its useful life. If the below grade vault station remains in service, painted materials and equipment therein should be completely re-painted and any ladders and rails should be reviewed during design.

4.5 J Street Pumping Station

4.5.1 Description

The J Street station is a below grade concrete vault style pumping station. Standby power and electrical systems are located above grade in a fiberglass enclosure.

4.5.2 Existing Conditions of Concern

Building Roof

The above grade fiberglass enclosure has a fiberglass roof that is reported not to leak.

Windows, Doors, and Louvers

The above grade fiberglass enclosure has no windows. The singular door and louvers are functional. The general condition of the above grade fiberglass enclosure is poor.

Finishes

The lower level walls are damp from condensation and most painted surfaces need to be repainted.

Miscellaneous Metals

While functional, ladders and rails are at the end of their life expectancy.

4.5.3 Recommendations

The above grade fiberglass enclosure should be replaced with a new building, structure, or enclosure. The existing unit does not meet current building codes and has reached the end of its useful life. If the below grade vault station remains in service, painted materials and equipment therein should be completely re-painted and any ladders and rails should be reviewed during design.

4.6 Lake Pleasant Pumping Station

4.6.1 Description

The Lake Pleasant Pumping Station is a below grade structure with a hatch above grade. As such, most architectural categories do not apply to this station.

4.6.2 Existing Conditions of Concern

The existing station has no roof, windows, doors or louvers, or above grade exterior walls. The station has a tile floor which is in serviceable condition. The mechanical equipment, entry tube and lower level concrete walls have existing painted surface that show cracking and pealing. Miscellaneous metals are functional.

4.6.3 Recommendations

The existing painted surfaces should be re-coated, including removal of the old paint to allow proper adhesion of a new coating system. Any new structures constructed at this station (i.e. generator and control building) must be designed to current codes.

4.7 Montague Center Pumping Station

4.7.1 Description

The Montague Center station is a multi-level structure with a very deep foundation, flat roof and red brick masonry façade on the above grade level. This station was constructed adjacent to a waterway (the Sawmill River).

4.7.2 Existing Conditions of Concern

Building Roof

The existing flat roofing on the building is reported not to leak and appears to be in adequate condition. However, the roofing system is nearing its normal life expectancy. The flashing is in fair condition.

Windows, Doors, and Louvers

The station has no windows. The doors to the wetwell and drywell are in adequate condition and the louvers are in good condition.

Exterior Walls

The exterior brick is in good condition except for minor mortar deterioration.

Finishes

The lower level concrete walls are painted surface that need to be repainted. Some interior walls in the lowest levels need to be repaired. Due to evidence of moisture in the lower levels, surface preparation and selection of a good coating system will be important.

Miscellaneous Metals

The ladders and handrails are in good condition, but access is difficult. Due to the compact nature of the station, stairs are not practical.

4.7.3 Recommendations

Roof

The existing flat roofing on the building has reached its life expectancy. It should be considered for replacement within the next 5 years.

Doors

The exterior doors are currently adequate but should be re-painted or replaced depending on the condition at the time of the next station upgrade.

Exterior Walls

The exterior brick and mortar should be re-pointed as needed at the time of the next station upgrade.

Finishes

The interior walls should be repaired and re-painted. To reduce the condensation on the lower level walls, continued use of a dehumidification system is recommended.

Miscellaneous Metals

Currently, ladders and handrails do not conform to the building code. These should be considered for alterations during the design phase. The local building official should review the existing conditions and determine if the existing handrail extensions need to be modified.

4.8 Poplar Street Pumping Station

4.8.1 Description

The Poplar Street station is a below grade metal “can” style pumping station. Standby power and electrical systems are located above grade in a fiberglass enclosure.

4.8.2 Existing Conditions of Concern

Building Roof

The above grade fiberglass enclosure has a fiberglass roof that is reported not to leak.

Windows, Doors, and Louvers

The above grade fiberglass enclosure has no windows. The singular door and louvers are functional. The general condition of the above grade fiberglass enclosure is poor.

Finishes

The lower level walls are wet from condensation and most surfaces need to be repainted.

Miscellaneous Metals

While functional, ladders and rails are at the end of their life expectancy.

4.8.3 Recommendations

The above grade fiberglass enclosure should be replaced with a new building, structure, or enclosure. The existing unit does not meet current building codes and has reached the end of its useful life. If the below grade can station remains in service, it should be completely re-painted.

4.9 Technical School Pumping Station

4.9.1 Description

The Technical School station consists of a below grade can style pump chamber, a below grade concrete wetwell structure, and an above grade brick generator and control building. There is also an abandoned (partially demolished) below grade pump chamber.

4.9.2 Existing Conditions of Concern

Building Roof

The generator and control building has a flat roof that is known to leak.

Windows, Doors, and Louvers

The generator and control building has no windows. The door and louver are functional but could be replaced at the time of the next station upgrade.

Exterior Walls

The exterior block of the generator and control building is in fair to good condition.

Finishes

Painted surfaces need to be re-painted.

Miscellaneous Metals

Entry and exit of the existing dry well structure is awkward and potentially unsafe due to the existing ladder and hatchway door arrangement. Currently, ladders and handrails do not conform to the building code. These should be considered for alterations or replacement during the design phase. The local building official should review the existing conditions and determine if the existing handrail extensions need to be modified or if the ladder needs to be replaced for better egress.

4.9.3 Recommendations

Roof

The existing flat roofing on the generator and control building needs to be replaced.

Doors

The exterior doors are currently adequate but should be re-painted or replaced depending on the condition at the time of the next station upgrade.

Exterior Walls

The exterior block and mortar should be evaluated and re-pointed as needed at the time of the next station upgrade.

Finishes

The interior walls and ceilings should be repaired and re-painted. To reduce the condensation on the lower level walls, continued use of a dehumidification system is recommended.

Miscellaneous Metals

Currently, ladders and handrails do not conform to the building code and egress is awkward and potentially unsafe. These should be considered for alterations or replacement during the design phase. The local building official should review the existing conditions and determine if the existing handrail extensions need to be modified, if the ladder should be replaced for better alignment with the entry hatchway door.

Section 5
Structural

The existing pumping stations were reviewed as described in Section 1. The following paragraphs include descriptions of the existing conditions and recommendations for improvements.

5.1 Denton Street Pumping Station

5.1.1 Description and Existing Conditions

The Denton Street pumping station is a concrete structure constructed circa 1984. This is an ejector station with no separate wet well. Structurally, it is in generally good condition with minor cracking around its entrance shaft.

Existing drawings show a compacted gravel foundation below the concrete structure, and make no reference to a pile supported foundation.

5.1.2 Recommendations

Structurally, the Denton Street pumping station is not in need of major repairs. The structure appears sound and could remain in service under its current function. If it remains in service under its current form, the cracking that exists around the entrance shaft should be repaired by removing loose and deteriorated concrete and replacing it with repair mortar to the original concrete dimensions.

Any new structures must have adequate foundation design. Based on the drawings for the existing structure, this is not anticipated to include a pile foundation. However, geotechnical exploration is recommended prior to the design of any new structures at this site.

5.2 First Street Pumping Station

5.2.1 Description and Existing Conditions

The First Street pumping station is a metal can style station that was constructed circa 1962 and upgraded in the 1980's. This station has a separate wet well structure, and a separate above grade fiberglass generator building.

Structurally, the metal can is badly deteriorated. A previous project added concrete fill to stabilize the interior floor of the station, but this effort sealed in several valves and flanges and will prevent work on or replacement of these items. Leakage and rust are evident inside the station.

Existing drawings show a compacted gravel foundation below the concrete structure, and make no reference to a pile supported foundation.

5.2.2 Recommendations

The First Street pumping station has exceeded its intended service life, is badly deteriorated, is not salvageable, and needs to be replaced.

The wet well may be re-usable depending on the configuration of the final design of the new station. This must be re-evaluated during a future phase of this project. It would be preferable to provide a new wet well to accompany the new pumping station, or to use a submersible station where the wet well and pumping station are the same structure.

The existing fiberglass generator enclosure dates from the 1980’s and will likely not survive for the intended life span of a new station. It is recommended that a new electrical and generator building be included with the new station.

Any new structures must have adequate foundation design. Based on the drawings for the existing structure, this is not anticipated to include a pile foundation. However, geotechnical exploration is recommended prior to the design of any new structures at this site.

5.3 G Street Pumping Station

5.3.1 Description and Existing Conditions

The G Street pumping station is a concrete structure constructed circa 1962 and upgraded in the 1980’s. This is an ejector station with no separate wet well. Structurally, it appears to be in generally good condition. This station has a separate above grade fiberglass generator building that was installed in the 1980’s.

Existing drawings show a compacted gravel foundation below the concrete structure, and make no reference to a pile supported foundation.

5.3.2 Recommendations

Structurally, the G Street pumping station is not in need of major repairs. If it remains in service under its current form, any cracking that exists should be repaired by removing loose and deteriorated concrete and replacing it with repair mortar to the original concrete dimensions.

It is noted that the current age of this structure (50 years) makes it less desirable for continued service in spite of its apparent good condition. At the end of the next 20 year design cycle, the structure will be more than 70+ years old. This far exceeds the typical service life for a structure of this type and application.

The existing fiberglass generator enclosure dates from the 1980’s and will likely not survive for the intended life span of another station upgrade. It is recommended that a new electrical and generator building (or outdoor weatherproof enclosures) be included with any potential upgrade or replacement of the station.

Any new structures must have adequate foundation design. Based on the drawings for the existing structure, this is not anticipated to include a pile foundation. However, geotechnical exploration is recommended prior to the design of any new structures at this site.

5.4 J Street Pumping Station

5.4.1 Description and Existing Conditions

The J Street pumping station is a concrete structure constructed circa 1962 and upgraded in the 1980’s. This is an ejector station with no separate wet well. Structurally, it appears to be in generally good condition. This station has a separate above grade fiberglass generator building that was installed in the 1980’s.

Existing drawings show a compacted gravel foundation below the concrete structure, and make no reference to a pile supported foundation.

5.4.2 Recommendations

Structurally, the J Street pumping station is not in need of major repairs. If it remains in service under its current form, any cracking that exists should be repaired by removing loose and deteriorated concrete and replacing it with repair mortar to the original concrete dimensions.

It is noted that the current age of this structure (50 years) makes it less desirable for continued service in spite of its apparent good condition. At the end of the next 20 year design cycle, the structure will be more than 70+ years old. This far exceeds the typical service life for a structure of this type and application.

The existing fiberglass generator enclosure dates from the 1980's and will likely not survive for the intended life span of another station upgrade. It is recommended that a new electrical and generator building (or outdoor weatherproof enclosures) be included with any potential upgrade or replacement of the station.

Any new structures must have adequate foundation design. Based on the drawings for the existing structure, this is not anticipated to include a pile foundation. However, geotechnical exploration is recommended prior to the design of any new structures at this site.

5.5 Lake Pleasant Pumping Station

5.5.1 Description and Existing Conditions

The Lake Pleasant pumping station is a concrete structure constructed circa 1984. This is an ejector station with no separate wet well. Structurally, it is in generally good condition with minor surface cracking in some locations.

Existing drawings show a compacted gravel foundation below the concrete structure, and make no reference to a pile supported foundation.

5.5.2 Recommendations

Structurally, the Lake Pleasant pumping station is not in need of major repairs. The structure appears sound and could remain in service under its current function. If it remains in service under its current form, the cracking that exists around the entrance shaft should be repaired by removing loose and deteriorated concrete and replacing it with repair mortar to the original concrete dimensions.

Any new structures must have adequate foundation design. Based on the drawings for the existing structure, this is not anticipated to include a pile foundation. However, geotechnical exploration is recommended prior to the design of any new structures at this site.

5.6 Montague Center Pumping Station

5.6.1 Description and Existing Conditions

The Montague Center pumping station is a multi level concrete structure constructed circa 1982. The structure is split into two major areas; wet well and dry well sides. The sides are divided by a concrete wall that extends from the base slab to the roof of the structure. The dry well is further divided into four levels. Generally, this pumping station is in fair to good condition with no substantial apparent structural defects.

Existing drawings show a compacted gravel foundation below the concrete structure, and make no reference to a pile supported foundation.

5.6.2 Recommendations

Structurally, the Montague Center pumping station is not in need of major repairs. The structure appears sound and could remain in service under its current function. However, this should be viewed as a short term alternative because continued use of the existing structure also means continued need for confined space entry to work on the below grade pumping equipment and other systems, which is not consistent with the goals of this project.

Any new structures must have adequate foundation design. Based on the drawings for the existing structure, this is not anticipated to include a pile foundation. However, geotechnical exploration is recommended prior to the design of any new structures at this site.

5.7 Poplar Street Pumping Station

5.7.1 Description and Existing Conditions

The Poplar Street pumping station is a metal can style station that was constructed circa 1962 and upgraded in the 1980's. This station has a separate wet well structure, and a separate above grade fiberglass generator building.

Structurally, the metal can is showing significant deterioration, especially on the floor of the pump room and approximately four inches up the walls from the floor.

Existing drawings show a compacted gravel foundation below the concrete structure, and make no reference to a pile supported foundation.

5.7.2 Recommendations

The Poplar Street pumping station has exceeded its intended service life, is showing significant signs of deterioration, is not salvageable, and needs to be replaced.

The wet well may be re-usable depending on the configuration of the final design of the new station. This must be re-evaluated during a future phase of this project. It would be preferable to provide a new wet well to accompany the new pumping station, or to use a submersible station where the wet well and pumping station are the same structure.

The existing fiberglass generator enclosure dates from the 1980's and will likely not survive for the intended life span of a new station. It is recommended that a new electrical and generator building be included with the new station.

Any new structures must have adequate foundation design. Based on the drawings for the existing structure, this is not anticipated to include a pile foundation. However, geotechnical exploration is recommended prior to the design of any new structures at this site.

5.8 Technical School Pumping Station

5.8.1 Description and Existing Conditions

The Technical School pumping station is a metal can style station that was constructed circa 1989. This station has a separate concrete wet well structure, and a separate above grade masonry generator building.

Structurally, the condition of the metal can appears acceptable. However, the concrete wet well walls have exposed aggregate and need to be addressed. The condition of the generator building is acceptable provided that the leaking roof is repaired.

Existing drawings show a compacted gravel foundation below the concrete structure, and make no reference to a pile supported foundation.

5.8.2 Recommendations

The metal can at the Technical School pumping station could remain in service if needed. However, this should be viewed as a short term alternative given the corrosion observed in the concrete wet well and the history of other similar metal cans in Montague. Continued use of the metal can also means continued need for confined space entry to work on the below grade pumping equipment and other systems, which is not consistent with the goals of this project.

The concrete wetwell should be repaired or replaced. Spalled concrete should be repaired by removing loose and deteriorated concrete and replacing it with repair mortar to the original concrete dimensions. However, it should be noted that repairs may ultimately prove more costly if confined space and bypass pumping provisions are considered.

Structurally, the generator building could remain in service with minor repairs. However, the existing structure is small and may not support the size of a modern generator and electrical gear which tend to be larger than older units due to emission control components.

Any new structures must have adequate foundation design. Based on the drawings for the existing structure, this is not anticipated to include a pile foundation. However, geotechnical exploration is recommended prior to the design of any new structures at this site.

5.9 Recommendations for Retrofit vs. Replacement

It is often desirable to make use of existing structures wherever possible in the design of upgrades. Montague has several existing concrete structures which have been evaluated for this purpose, specifically the pump chambers at Denton Street, Lake Pleasant, G Street, J Street and Montague Center.

At the four ejector stations (Denton Street, Lake Pleasant, G Street and J Street), conversion of the existing ejector chamber to a wet well will be problematic for several reasons:

- Structures range from approximately 30 years old (Denton Street, Lake Pleasant) to 50 years old (G, J) and were not designed to be used as wet wells. Their condition and suitability would need to be confirmed prior to design of modifications. A detailed structural inspection would be needed and would likely include some destructive testing such as core sampling.

- Structures currently have a layer of earth above their top slabs, which helps to resist upward movement due to buoyancy. Converting the structure to a wet well would involve prolonged bypass pumping during construction, gutting the equipment out of the existing station, excavating to expose the top of the structure, cutting off the top of the structure, constructing a new riser section to grade and adding a new top slab with access hatches. Looking beyond the expense of these modifications, this change leaves the modified structure vulnerable to upward movement during high groundwater periods.

- Structures were designed to contain mostly air. Converted to wet wells, they will now contain a large quantity of water. Thus the existing foundations may not be sufficient to support the additional weight and settlement may occur. Ironically, these modifications create a risk of settling during periods of low groundwater and floatation during periods of high groundwater. This alternation of settlement and buoyant uplift is likely to induce pipe stress over time and present a risk of pipe breakage for both the influent gravity sewer and the outgoing force main.

- The elevation of the influent sewer at each of these stations is approximately 4-ft above the existing chamber floor. This height does not leave sufficient space for a typical operating range for submersible pumps which may compromise the operation of the new pumps. Letting the wet well “flood” above the influent sewer would help the pumps, but may pose an unacceptable risk of sewer backups. Demolition of the existing chamber floor to create a deeper structure would be cost prohibitive and may potentially undermine the existing structure.

- Ultimately, the modifications described above would be asking a structure to play a role other than that it had originally been designed for, and this creates a level of risk that is not recommended.

At the Montague Center pumping station, we considered modification of the dry side (pump chamber and control rooms) into a new wet pit for submersible pumps. To achieve this conversion, the existing top building would need to be removed and sections of the intermediate floors would need to be removed to allow the travel of submersible pumps on rails. Rails would need to be stiffened at 10-ft intervals to traverse the moderate depth of this station. It is noted that removal of the Montague Center upper building needs to be studied further during design, but appears practical because it is assumed that groundwater levels are low due to the water level in the adjacent Sawmill River. Overall, the modifications required to achieve this adaptation of the aging structure represent a substantial effort in both design and construction. In contrast, a new precast structure offers a purpose built station with a longer service life. Cost comparisons for new vs. retrofit show a small “savings” associated with the retrofit, but this has to be weighed against the reduced life expectancy of the modified structure (vs. a new structure). On a per year basis, a new structure appears to be a far better value than a retrofit in this case.

At the existing metal can stations (First Street, Poplar Street, Technical School), retrofit is not recommended due to the nature and condition of the existing metal structures.

Section 6

Mechanical Equipment

An inspection and assessment of the existing pumps and other mechanical systems in the pumping stations has been carried out. The findings of this review and recommendations for improvements are described below.

6.1 Codes, Standards, and References

The evaluation and rehabilitation shall comply with Federal and State laws or ordinances, as well as applicable codes, standards, regulations, and/or regulatory agency requirements including the partial listing below.

- AISC American Institute of Steel Construction
- ASME American Society of Mechanical Engineers
- AWWA American Water Works Association
- GLUMRB Recommended Standards for Wastewater Facilities (Ten States Standards).
- NEIWPCC TR-16 Guides for the Design of Wastewater Treatment Works.

6.2 Denton Street Pumping Station

6.2.1 Description and Existing Conditions

The Denton Street pumping station is equipped with two 75-gallon ejector pots, two air compressors, and a common air receiver tank. Pot ejections are controlled via capacitance probes that detect a "full" level in the pot and call for a discharge from the air receiver tank. The mechanical equipment in this station is in good working order, though replacement parts for the ejector pots and ejector check valves are expensive, and will become more so as time goes on.

The common air receiver tank that services both ejector pots is a form of common mode failure that would cripple the entire station in the event of an air receiver tank problem. This risk is also present in some of the electrical and control equipment.

6.2.2 Recommendations

Given the age of the existing equipment, the risk of a pot failure is significant (and increasing) in spite of the good maintenance program followed by the Town. This station also has a significant firm capacity shortfall, indicating that replacement with larger pumping units is needed. Pump replacement with larger capacity submersible pumps is recommended.

6.3 First Street Pumping Station

6.3.1 Description and Existing Conditions

The First Street pumping station is equipped with two 300 gpm centrifugal pumps and a pressure transducer control system (Time Mark Controls). Pumps do not run on variable frequency drives, but are instead started across the line. Run hours are tracked via run clocks in the electrical panel. The pumping equipment in this station is in fair working order, but shows signs of its significant age (50 years). Future maintenance of this equipment will be hindered by the mass of concrete that was placed in the bottom of the can (needed to stabilize the failing metal structure) as this cemented a number valves and pipe fittings in place.

6.3.2 Recommendations

Given the significant age of the existing equipment (50 years), the risk of a failure is significant (and increasing) in spite of the good maintenance program followed by the Town. Although this station currently has adequate capacity, replacement with submersible pumps is recommended due to the age of the existing pumps, and because submersible pumps will facilitate the overall goals of this study (i.e. eliminate confined space entry, etc.).

6.4 G Street Pumping Station

6.4.1 Description and Existing Conditions

The G Street pumping station is equipped with two 100-gallon ejector pots, two air compressors, and a common air receiver tank. Pot ejections are controlled via mechanical floats that detect a “full” level in the pot and release a discharge from the air receiver tank via levers. Mechanical counters track the number of ejections. The mechanical equipment in this station is in fair to good working order, though replacement parts for the ejector pots and ejector check valves are expensive, and will become more so as time goes on. Also, the metal thickness of the air receiver tank was shown to be at the minimum tolerance at the last inspection.

The common air receiver tank that services both ejector pots is a form of common mode failure that would cripple the entire station in the event of an air receiver tank problem. This risk is also present in some of the electrical equipment.

6.4.2 Recommendations

Given the significant age of the existing equipment (50 years), the risk of a failure is significant (and increasing) in spite of the good maintenance program followed by the Town. This station also has a significant firm capacity shortfall, indicating that replacement with larger pumping units is needed. Pump replacement with larger capacity submersible pumps is recommended.

6.5 J Street Pumping Station

6.5.1 Description and Existing Conditions

The J Street pumping station is equipped with two 100-gallon ejector pots, two air compressors, and a common air receiver tank. Pot ejections are controlled via mechanical floats that detect a “full” level in the pot and release a discharge from the air receiver tank via levers. Mechanical counters track the number of ejections. The mechanical equipment in this station is in fair to good working order, though replacement parts for the ejector pots and ejector check valves are expensive, and will become more so as time goes on. Also, the metal thickness of the air receiver tank was shown to be at the minimum tolerance at the last inspection.

The common air receiver tank that services both ejector pots is a form of common mode failure that would cripple the entire station in the event of an air receiver tank problem. This risk is also present in some of the electrical equipment.

6.5.2 Recommendations

Given the significant age of the existing equipment (50 years), the risk of a failure is significant (and increasing) in spite of the good maintenance program followed by the Town. This station also has a firm capacity shortfall, indicating that replacement with larger pumping units is needed. Pump replacement with larger capacity submersible pumps is recommended.

6.6 Lake Pleasant Pumping Station

6.6.1 Description and Existing Conditions

The Lake Pleasant pumping station is equipped with two 75-gallon ejector pots, two air compressors, and a common air receiver tank. Pot ejections are controlled via capacitance probes that detect a “full” level in the pot and call for a discharge from the air receiver tank. The mechanical equipment in this station is in good working order, though replacement parts for the ejector pots and ejector check valves are expensive, and will become more so as time goes on.

The common air receiver tank that services both ejector pots is a form of common mode failure that would cripple the entire station in the event of an air receiver tank problem. This risk is also present in some of the electrical and control equipment.

6.6.2 Recommendations

Given the age of the existing equipment, the risk of a pot failure is significant (and increasing) in spite of the good maintenance program followed by the Town.

Although this station currently has adequate capacity, replacement with submersible pumps is recommended due to the age of the existing pots, and because submersible pumps will facilitate the overall goals of this study (i.e. eliminate confined space entry, eliminate common mode equipment failure, etc.).

6.7 Montague Center Pumping Station

6.7.1 Description and Existing Conditions

The Montague Center pumping station is the Town’s largest capacity station and is equipped with two 400 gpm centrifugal pumps and a bubbler control system. Pumps do not run on variable frequency drives, but are instead started across the line. Run hours are tracked via run clocks in the electrical panel. The pumping equipment in this station is in fair to good working order, but shows signs of its age. Maintenance activities are difficult at this station due to the depth of the pump vault, and the offset vertical ladders that have to be traversed. Confined space entry is a significant concern relating to operator safety at this station.

6.7.2 Recommendations

Given the age of the existing equipment, the risk of a failure is significant (and increasing) in spite of the good maintenance program followed by the Town. This station also has a firm capacity shortfall, indicating that replacement with larger pumping units is needed. Pump replacement with larger capacity submersible pumps is recommended and will also alleviate the confined space entry concerns associated with this very deep pump vault.

6.8 Poplar Street Pumping Station

6.8.1 Description and Existing Conditions

The Poplar Street pumping station is equipped with two 125 gpm centrifugal pumps and a pressure transducer control system (Time Mark Controls). Pumps do not run on variable frequency drives, but are instead started across the line. Run hours are tracked via run clocks in the electrical panel. The pumping equipment in this station is in fair working order, but shows signs of its significant age (50 years).

6.8.2 Recommendations

Given the significant age of the existing equipment (50 years), the risk of a failure is significant (and increasing) in spite of the good maintenance program followed by the Town. Although this station currently has adequate capacity, replacement with submersible pumps is recommended due to the age of the existing pumps, and because submersible pumps will facilitate the overall goals of this study (i.e. eliminate confined space entry, etc.).

6.9 Technical School Pumping Station

6.9.1 Description and Existing Conditions

The Technical School pumping station is equipped with two 200 gpm centrifugal pumps and a bubbler control system. Pumps do not run on variable frequency drives, but are instead started across the line. Run hours are tracked via run clocks in the electrical panel. The pumping equipment in this station is in fair to good working order, but the vacuum lift pumps have been problematic in their 23-year tenure.

6.9.2 Recommendations

Given the age of the existing equipment, the past history and future potential for vacuum priming problems, and the significant firm capacity shortfall at this station, pump replacement is recommended. Replacement with larger capacity submersible pumps is recommended and will meet the overall goals of this report, including elimination of confined space entry to service the pumps.

Section 7

Plumbing

The existing pumping stations were reviewed as described in Section 1. The following paragraphs include descriptions of the existing conditions and recommendations for improvements.

7.1 Codes, Standards, and References

This plumbing evaluation was performed to compare applicable laws or ordinances, as well as applicable codes, standards, regulations, and/or regulatory agency requirements including the partial listing below, to the existing plumbing conditions and recommend improvements.

- 2003 International Building Code (IBC)
- 2003 International Plumbing Code (IPC)
- American with Disabilities Act (ADA)
- American National Standards Institute (ANSI)
- Underwriters Laboratory (UL)
- Department of Transportation (DOT)
- Occupational Safety and Health Administration (OSHA)
- American Society Of Plumbing Engineers Data Book
- National Fire Protection Association Standards (NFPA)

7.2 Existing Plumbing Systems

Plumbing systems are limited at all of the stations. The following is a general description of the existing systems.

Water Supply

- Denton Street Pumping Station – City water w/BFP
- First Street Pumping Station – None
- G Street Pumping Station – None
- J Street Pumping Station – None
- Lake Pleasant Pumping Station – City water w/BFP
- Montague Center Pumping Station – City water @ 47 PSI w/BFP
- Poplar Street Pumping Station – None

- Technical School Pumping Station – City water w/BFP

Hot Water System

- None of the stations have hot water systems.

Sanitary Drainage System

- None of the stations have sanitary drainage systems.

Plumbing Fixtures

- None of the stations have plumbing fixtures.

Roof Drainage System

- Denton Street Pumping Station – None
- First Street Pumping Station – None
- G Street Pumping Station – None
- J Street Pumping Station – None
- Lake Pleasant Pumping Station – None
- Montague Center Pumping Station – Single roof drain routed to PVC drainage tile
- Poplar Street Pumping Station - None
- Technical School Pumping Station – Roof scuppers that drain over the rear edge of the generator building

Sump Pump

- Denton Street Pumping Station – Lower level floor pitched to float operated simplex pump (badly corroded)
- First Street Pumping Station – Dry pit (can) lower level has sump with float operated simplex pump (badly corroded)
- G Street Pumping Station – Lower level floor pitched to float operated simplex pump
- J Street Pumping Station – Lower level floor pitched to float operated simplex pump
- Lake Pleasant Pumping Station – Lower level floor pitched to float operated simplex pump (badly corroded)
- Montague Center Pumping Station – Lowest level perimeter trench drains routed to float operated simplex pump (badly corroded)
- Poplar Street Pumping Station – Dry pit (can) lower level has sump with float operated simplex pump (badly corroded)
- Technical School Pumping Station – Dry pit (can) lower level has sump with float operated simplex pump (badly corroded)

7.3 Recommendations

Plumbing system needs are limited at all of the stations. The following is a general description of recommendations for upgrade of the stations.

Water Supply

Having a water supply is helpful at pumping stations. Even if not required for mechanical seals, a water supply can still be helpful for periodic cleaning and other uses. A water service should be maintained at all stations that currently have it. If water can be extended to the remaining stations, the Town may want to consider doing so. It is noted that some pumping systems such as submersible pumps do not require seal flushing water.

Hot Water System

None of the stations have hot water systems. Hot water systems are not anticipated to be necessary.

Sanitary Drainage System

None of the stations have sanitary drainage systems. Sanitary drainage is not anticipated to be necessary because the stations do not have sinks or restrooms.

Plumbing Fixtures

None of the stations have plumbing fixtures. Plumbing fixtures are not anticipated to be necessary because the stations do not have sinks or restrooms.

Roof Drainage System

Roof drainage should be provided for all stations that have (or will have) generator / control buildings. Roof drainage can be simple and should be routed to surface runoff where practical.

Sump Pump

All stations should have sump pumps in the lowest level of their dry pit side. Existing pumps will predominantly need replacement in the near future.

Potable Water Supply

Water piping should be tested and covered with 1-inch-thick insulation to avoid sweating and corrosion in the future. The reduced pressure backflow preventer should be installed in an area that is accessible so that it can be tested on an annual basis as required.

A tepid water system is not required for this facility because there are no emergency shower/eyewash units located in either building.

A second backflow preventer should be installed on any potable water lines to avoid any cross connections.

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Section 8

Heating, Ventilation, and Air Conditioning (HVAC)

The existing pumping stations were reviewed as described in Section 1. The following paragraphs include descriptions of the existing conditions and recommendations for improvements.

8.1 Codes, Standards, and References

This HVAC evaluation was performed to compare applicable codes, standards, regulations, and/or regulatory agency requirements including the partial listing below, to the existing HVAC conditions and recommend improvements.

- 2003 International Building Code (IBC)
- 2003 International Mechanical Code (IMC)
- American National Standards Institute (ANSI)
- Underwriters Laboratory (UL)
- Department of Transportation (DOT)
- Occupational Safety and Health Administration (OSHA)
- National Fire Protection Association Standards (NFPA)
- NEIWPCC TR-16 Guides for the Design of Wastewater Treatment Works

8.2 Existing HVAC Systems

The HVAC systems in the existing pumping stations are comprised of a variety of heaters, thermostats dehumidifiers, exhaust fans, louvers and dampers. With the exception of the Montague Center station, the wetwells do not have ventilation. The electrical and control rooms (where applicable) do not have air conditioning. The pumping stations do not have restrooms, and as such, the ventilation requirements for these spaces do not apply.

The existing HVAC systems are functional and are doing what they were intended to do. However, the age of these systems ranges from 20 to 50 years old and as a general statement, we find that HVAC systems of this vintage simply do not meet modern code requirements for air exchanges in wastewater pumping stations as defined by NFPA 820 and TR-16.

8.3 Recommendations

Any significant upgrade of the pumping stations will trigger a need to update all existing HVAC systems. New ventilation fans, heaters and HVAC control systems should be designed per applicable standards as part of the station upgrade designs. After detailed review during design, any fans that are found to be adequately sized should still be replaced in kind due to their age.

Dehumidification is often recommended in below ground chambers with mechanical equipment. Air conditioning can be needed in electrical rooms with VFD loads, but this is more typical of larger pumping stations than those in Montague.

Section 9
Electrical

The following paragraphs describe the existing conditions and capital improvements necessary to implement planned mechanical upgrades, increase the capacity of the existing electrical system where needed, and provide more reliable performance.

9.1 Codes, Standards, and References

This electrical evaluation was performed to compare Federal and State laws or ordinances, as well as applicable codes, standards, regulations, and/or regulatory agency requirements including the partial listing below, to the existing electrical conditions and recommend improvements.

- 2005 National Electric Code (NFPA-70)
- National Fire Alarm Code (NFPA-72)
- State Building Code
- American National Standards Institute (ANSI)
- Occupational Safety and Health Administration (OSHA)
- National Electrical Safety Code (NESC)
- Underwriter Laboratories, Inc. (UL)
- Factory Mutual (FM)
- National Electrical Manufacturers Association (NEMA)
- American Society for Testing and Materials (ASTM)
- National Electrical Testing Association (NETA)
- Association of Edison Illuminating Companies (AEIC)
- Institute of Electrical and Electronic Engineers (IEEE)

9.2 Pumping Station Electrical Systems

9.2.1 Description and Existing Conditions

Most of the eight pumping stations covered under this report had been electrically updated in the 1980's. As discussed in Section 3, several of the stations are believed to be at risk from floodwaters. Four stations have generator and transfer switch buildings that are actually fiberglass enclosures intended to be portable, albeit a crane and electrical service disconnection is needed. Most stations have pole mounted electrical transformers to minimize risk of flood damage to their electrical infrastructure.

The newest electrical infrastructure is at the Technical School pumping station, upgraded circa 1989. Thus, in all cases, the electrical equipment is at least 23 years old at the writing of this report. Electrical gear at many stations is closer to 30 years old and is not in accordance with modern codes and standards. It is also noted that the electrical meter box at the Poplar Street station has loose door screws and that the door can not be shut evenly. As a result, there is a gap at the top of the box that exposes this sensitive equipment to damage from rain and snow.

9.2.2 Power Source and Capacity

Utility Source

Western Massachusetts Electric Company (WMECO).

Electric Services

- Denton Street Pumping Station: 208V, 3-phase, 60 Hz, 100A
  Three XFMR on local WMECO pole
  Service underground from pole
- First Street Pumping Station: 208V, 3-phase, 60 Hz, 100A
  Three XFMR on local WMECO pole
  Service underground from pole
- G Street Pumping Station: 208V, 3-phase, 60 Hz, 100A
  Two XFMR on adjacent WMECO pole
  One XFMR on distant WMECO pole
  Service underground from local pole
- J Street Pumping Station: 208V, 3-phase, 60 Hz, 100A
  Two XFMR on adjacent WMECO pole
  One XFMR on distant WMECO pole
  Service underground from local pole
- Lake Pleasant Pumping Station: 208V, 3-phase, 60 Hz, 100A
  Three XFMR on local WMECO pole
  Service underground from pole
- Montague Center Pumping Station: 208V, 3-phase, 60 Hz, 200A
  Three XFMR on local WMECO pole
  Service underground from pole
- Poplar Street Pumping Station: 110V, 1-phase, 60 Hz, 100A
  XFMR on adjacent WMECO pole
  Service underground from local pole
- Technical School Pumping Station: 208V, 3-phase, 60 Hz, 100A
  Pad Mounted WMECO XFMR
  Service underground

9.3 Assessment and Recommendation

In all cases, equipment has been well maintained, which has contributed to its longevity. However, since the existing equipment has been in service many years, maintenance requirements to keep the equipment in service are increasing which may result in increased the time required to restore power upon outages. Spare parts will become increasingly difficult to obtain and, in some cases, may not be available.

Additionally, the reliability of a system degrades with time and the mean time between failures decreases, meaning that failure of components within the system will occur more often as service life is extended. Continued reliable electrical supply to the pumping equipment, safety and the life expectancy issues alone justify the need to upgrade the electrical systems.

Thus, while the existing electrical systems appear adequate for current operations, they should be upgraded or replaced at the time of upgrade to each station. The modification of the pumping stations should include the following:

1. The installation of a new double-ended switch with automatic transfer control.
2. Individual station designs should consider the potential need for and benefit of VFDs.
3. All electrical and control equipment should be moved above the 100-year flood elevation.

9.4 Design Considerations

Electrical equipment installed in Class I, Division 1 or 2 areas shall be replaced with new, suitable for installation in these areas. Gas Detection and Fire Alarm Systems shall be installed where required by NFPA-820 and the local building code. The following are some additional considerations for design.

Standby Power

Standby power to the stations should be fed from new diesel engine generators installed within permanent Generator Buildings or sound attenuated weatherproof enclosures. The generators will provide power to all systems necessary to operate the stations during a utility power outage. The generators will also have a capacity to start the biggest motor and simultaneously operate the station electrical systems including lighting, heating and ventilation, instrumentation, and control. Section 10 provides additional detail of the stand-by generators.

Security Systems

A security detection and alarming system should be included in each station upgrade. The complexity of commercially available systems varies, and the design of improvements should evaluate Town needs at the time. Ideally, security systems for all pumping stations should be standardized. The security system master control panel may be combined with the Fire Alarm System.

Telephone or SCADA System

Pumping station communications should be discussed and addressed prior to the design of any station. Phone communications are often adequate for small remote pumping stations like those in Montague. However, as monitoring requirements increase, a radio based SCADA system will start to make more sense provided that radio service is available at all the stations. Cell phone communications may also be an option if service is reliable, but this option will likely not reduce operating costs.

Fire Alarm Systems

Complete electronically-operated, double-supervised, closed-circuit fire alarm systems should be installed. The fire alarm system will consist of a control panel, manual fire alarm boxes, automatic smoke and heat detectors, audible and visual alarm indicating appliances, standby batteries, and a charger. Local fire department notification could be carried out via phone dialer or the SCADA system. The fire alarm system master control panel may be combined with the security system.

Miscellaneous Equipment

The miscellaneous equipment in each station should include a panel board, transformer, lighting fixtures, receptacles, switches, clocks, emergency lighting battery units, exit signs, and all necessary accessories and appurtenances required for a complete and satisfactorily-operated systems.

Enclosures

The following enclosure guidelines are recommended:

a. NEMA 1 in dry, non-process indoor above grade locations (i.e. electrical rooms, storage rooms, lavatory).

b. NEMA 12 in damp locations, such as maintenance shops.

c. NEMA 4 in wet, outdoor locations, and rooms below grade (including basements and buried vaults).

d. NEMA 4X in corrosive locations (chemical areas) and areas of high humidity.

e. NEMA 7 in hazardous classified indoor locations.

Raceways

The following raceway guidelines are recommended:

a. Rigid steel conduit in all locations (underground and within structures) as raceways for shielded process instrumentation wiring, shielded control wiring, data highway wiring and I/O wiring.

b. Aluminum conduit for exposed conduit runs outdoors, in wet locations (process areas, shops, etc.) and hazardous location except PVC coated rigid steel conduit will be used in these areas for shielded process instrumentation wiring, shielded control wiring, data highway wiring, and I/O wiring.

c. Rigid nonmetallic conduit (PVC Schedule 40) for concrete encased underground ductbanks, except rigid steel conduit will be used in these areas for shielded process instrumentation wiring, shielded control wiring, data highway wiring and I/O wiring.

Wires and Cables

Wires and cables will be of annealed, 98 percent conductivity, soft drawn copper, size not smaller then No.12 AWG except for control, signal, and instrumentation circuits. 150 volts and below shall be type THHN/THWN-2, 150 volts and above shall be type XHHN/XHWN-2 up to size 4/0AWG and type RHW-2 for sizes 250kCMIL and above.

MOPO and Sequence of Construction

The pumping stations identified in this report are a critical part of the Town's sanitary sewage system. Therefore, the duration of the interrupting of the power or limiting of station capacity should be minimized as much as possible. A new utility power transformer should be provided to feed new loads while the existing loads are fed from the existing transformer. After the new systems are fully operational and tested, the old service and electrical equipment can be removed.

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Section 10

Standby Power Systems

The existing pumping stations all have standby generators of varying age and condition. This section describes the existing units and makes recommendations for future standby power systems for the Town pumping stations.

10.1 Codes, Standards, and References

New standby power systems shall comply with all Federal and State laws or ordinances, as well as all applicable codes, standards, regulations and or regulatory agency requirements including the partial listing below.

- NFPA 110 Standard for Emergency and Standby Power Systems, Level 2, Type 60
- NFPA 37 Standard for Installation and Use of Stationary Combustion Engines and Gas Turbines
- NEC 701, Legally Required Standby Systems
- UL 2200, Stationary Engine Generator Assemblies
- American National Standards Institute (ANSI)
- Occupational Safety and Health Administration (OSHA)
- NEIWPCC TR-16 Guides for the Design of Wastewater Treatment Works

10.2 Existing Engine-Driven Generators

The following summarizes the available information on the existing engine-driven generators:

Denton Street Pumping Station

Location: Trailer Mounted Portable
Fuel: Diesel
Fuel Location: Trailer Mounted Belly Tank
Date of Installation: 1984
Electrical Data: 208V, 3-ph, 60Hz, 104A
Note: The Denton Street generator is adjacent to a home. Area residents have complained about exhaust fumes in the past.

First Street Pumping Station

Location: Outdoor
Fuel: Diesel
Fuel Location: Belly Tank
Date of Installation: 2006 (+/-)
Manufacturer: Cummins / Onan
Model: Power Command 1300 Series

Capacity:	25-kW
Electrical Data:	208V, 3-ph, 60Hz, 104A

G Street Pumping Station

Location:	Fiberglass Generator Building
Fuel:	Diesel
Fuel Location:	Frame Mounted Belly Tank
Date of Installation:	1980’s
Manufacturer:	Empire
Capacity:	22-kW
Electrical Data:	208V, 3-ph, 60Hz, 100A

J Street Pumping Station

Location:	Fiberglass Generator Building
Fuel:	Diesel
Fuel Location:	Frame Mounted Belly Tank
Date of Installation:	1980’s
Manufacturer:	Empire
Capacity:	22-kW
Electrical Data:	208V, 3-ph, 60Hz, 100A

Lake Pleasant Pumping Station

Location:	Trailer Mounted Portable
Fuel:	Diesel
Fuel Location:	Trailer Mounted Belly Tank
Date of Installation:	1984
Electrical Data:	208V, 3-ph, 60Hz, 104A

Montague Center Pumping Station

Location:	Pump Station Drywell – Above Grade
Fuel:	Diesel
Fuel Location:	Buried 275 Gallon Tank
Date of Installation:	1982
Manufacturer:	Allis Chalmers / Onan
Electrical Data:	208V, 3-ph, 60Hz, 150A

Poplar Street Pumping Station

Location:	Fiberglass Generator Building
Fuel:	Diesel
Fuel Location:	Frame Mounted Belly Tank
Date of Installation:	1980’s
Manufacturer:	Empire
Capacity:	17.5-kW
Electrical Data:	110V, 1-ph, 60Hz, 100A

Technical School Pumping Station

Location:	Generator Building
Fuel:	Diesel
Fuel Location:	Frame Mounted Belly Tank
Date of Installation:	1989
Manufacturer:	Hercules /Superior
Model:	30R131
Capacity:	30-kW
Electrical Data:	208V, 3-ph, 60Hz, 104A

10.3 Existing Conditions

The in-service units are all functional, and the Town's service contractor has had good success finding spare parts to keep them running to date.

Most of the in-service units are of significant age, and do not appear to conform to modern codes and standards. Particularly, UL 2200 is a new standard that pertains to safety and guarding of hazardous components of generators. Also, the existing tanks do not appear to have secondary containment as would be required for current new construction.

10.4 General Recommendations

The existing generators do not power loads that would be considered directly related to life safety such as emergency egress lighting or a fire pump. Thus, their purpose is considered to be a legally required "stand-by" generator conforming to NEC 701 – not an emergency generator conforming to NEC 700.

The majority of units are already 25 to 30 years old. Even without considering the time required for funding, design and construction of improvements, the existing units will range from 50 to 55 years old at the end of the next 25 year planning period.

Despite their good service history, the age of these systems warrants their replacement. We recommend that they be replaced with new units of suitable rating to assure reliable service and availability of spare parts for the next 25 years. Experience has shown that equipment, even when supplied by major manufacturers such as Cummins, tends to not receive long term support for spare parts. Thus, the availability of critical spare parts in the future may become a problem.

Replacement offers reliability and a chance for standardization. The First Street generator is much newer and could be repurposed elsewhere in the Town.

The existing in-service generators will have limited salvage value because of EPA regulations currently coming into effect regulating exhaust emissions of new installations of stationary diesel engines. New diesel engines conform to the new regulations, but old engines do not, and cannot be economically modified to conform. Sale and re-installation of an existing engine by a new owner constitutes a "new" installation which must conform to the current regulations. If the Town has another location that could use this existing generator, regulations may allow the Town to relocate the existing unit to another Town-owned location.

Diesel fueled engines are recommended. The generator set should include its own automatic control panel, incorporating PLC driven control providing greater flexibility of operation and more information regarding operating parameters. The control panel will provide complete internal monitoring of engine/alternator operation. Alarm conditions will be detected, displayed, and transmitted; and serious operating problems will result in automatic shut-down of the generator unit. The control panel will be capable of transmitting all generator operating parameters and alarm conditions into a SCADA system for remote monitoring.

The generators will be intended for standby service only – to replace utility power when the utility power is not available (which can also be construed to mean when the utility is experiencing overload conditions that may lead to brown-out or complete failure, in which case the generator is operated to voluntarily remove the station load from the utility). The generator will not be intended for peak shaving to save utility power cost. Power supply to the facility will be from the utility or the generator. The automatic transfer switch(es) will assure that the generator cannot be interconnected to the utility.

Upon failure of the utility power, the generator will automatically start and come up to operating speed and voltage, at which time the automatic transfer switch(es) in the main switchgear will automatically switch over to the generator source of power. The pump control system should provide for time delays on the pump drives to start the pumps in a time delayed sequence to minimize the sudden motor starting load on the generator.

Upon restoration of utility power, the automatic transfer switch(es) will sense the availability of utility power, and switch the pumping station back to the utility power supply. Timers in the automatic transfer switches and/or the generator control panel will allow the generator to continue to operate for a few minutes without load to allow the unit to cool down before it automatically shuts down to standby condition.

The generator should be exercised on a regular basis to assure that it is in good condition, ready to operate whenever needed. Exercising consists of approximately one hour of operation under load approximately every two weeks. CDM Smith recommends manually initiating the exercising cycle so that personnel will observe operation of the generator to further confirm that all generator components are operating correctly, and there are no faults that may require service. Exercising is best done when there is a substantial electrical load to require the engine to come up to full operating temperature.

10.4.1 Additional Site Specific Generator Recommendations

- New standby generators should be provided at all eight stations. A precast generator and control building may be a cost effective way to achieve standardized reliable standby power systems. If buildings are not used, sound attenuated insulated enclosures would be a recommended alternative.
- The buried fuel tank at the Montague Center station should be removed. If buried tanks exist at any other stations, they should similarly be removed.
- The trailer mounted generators and manual transfer switches should no longer be used at the Lake Pleasant and Denton Street stations.

- Generators should be mounted above the 100-year flood elevation. This may require raised platforms with stairs for access.
- Generators should comply with the guidelines of TR-16, including provisions for fuel capacity for adequate run time.

10.5 Design Criteria

Specifications for new generators will need to be written to be generic to the standard products offered by the major standby diesel engine driven generator manufacturers such as Caterpillar, Cummins, and Kohler. The specifications should require a two year standby warranty for the generator and should require a one year service contract. The engine will be radiator cooled utilizing a unit mounted radiator and an engine driven fan. The engine will conform to all current regulations regarding emissions, and will be equipped as required by State regulation for proper dispersion of the exhaust gasses.

10.6 MOPO and Sequence of Construction

Maintenance of operation during construction will require providing at least the current level of standby power at all times.

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Section 11

Instrumentation and Controls

The goal of the instrumentation and control system is to provide reliable control of all pump station equipment with the ability to set control parameters, start and stop equipment, and monitor all pump station alarms and other conditions remotely through Supervisory Control and Data Acquisition (SCADA) communication infrastructure.

New equipment provided should use commercial, off-the-shelf (COTS) automation products that use industry standard communication protocols to allow the maximum flexibility in expansion and support options.

11.1 Codes, Standards, and References

The following codes and standards should be used in the detailed design of the control system:

- ISA S5.2 Binary Logic Diagrams for Process Operations
- ISA S5.3 Graphic Symbols for Distributed Control/Shared Display Instrumentation Logic and Computer Systems.
- ISA S20, Specification Forms for Process Measurement and Control Instruments, Primary Elements and Control Valves.
- ISA RP60.3, Human Engineering for Control Centers
- ISA RP60.6, Nameplates, Labels, and Tags for Control Centers
- National Electrical Manufacturers Association (NEMA)
- National Fire Protection Agency (NFPA)
- NFPA 70, National Electrical Code (NEC).
- American Society for Testing and Materials (ASTM)
- ASTM A269 Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service.
- Field wiring interconnection diagrams
- UL 508A Standards
- NEIWPCC TR-16 Guides for the Design of Wastewater Treatment Works

11.2 Existing System Description

Remote monitoring of the pumping stations has generally been satisfactory through the existing system. The existing control systems consist of very basic analog controls with hard wired status lights, run time meters, gauges, relays, contacts and selector switches. Most stations have local annunciator panels for the visual identification of alarm conditions. Alarms are communicated back to the Water Pollution Control Facility and staff cell phones via alarm dialers and phone lines.

Control panels are located in various locations at the different pumping stations. At the Denton Street and Lake Pleasant stations, control panels are located down in the ejector pit with the air compressors and other equipment. At the G Street and J Street stations, control and annunciator panels are split between the ejector pit and the generator enclosures. At the Montague Center station, controls are split among the upper level and first lower level of the station. At the three “can” style stations (First Street, Poplar Street and Technical School), controls and annunciator panels are split between the pump pit and the generator building / enclosure.

There is some alarm / annunciator variation from station to station depending on station age and type, but alarm conditions generally include the following:

- Wet Well High Level
- Wet Well Low Level
- Pump Chamber Flooding
- Air Bubbler System Low Air Pressure
- Compressor Failure
- Power Failure Utility
- Emergency Generator Failure
- Pump 1 Failure
- Pump 2 Failure
- Motor Overload
- High Invert Pressure
- Check Valve #1 Fail to Close
- Check Valve #1 Fail to Open
- Check Valve #2 Fail to Close
- Check Valve #2 Fail to Open

While consistent with the date of their installation (ranging from the 1960’s to 1980’s), the existing control systems are now obsolete by modern standards. Also, the location of many control features poses a liability from flooding and modern ventilation requirements. Communication back to the Water Pollution Control Facility through phone lines (while acceptable) is another area that may be improved depending on staff preferences. Currently, pumping station phone lines cost approximately $240 per month. Conversely, some radio technology does not require a monthly payment after an initial capital investment.

11.3 Recommendations

The control systems at the existing pumping stations should be replaced at the time of upgrade to each station. Though currently functional, the age and technology platform of the existing systems warrant their replacement. Modern PLC based controls will offer significant benefits including increased reliability and ease of troubleshooting and repair. New instrumentation and control systems can also offer more reliable and comprehensive communication to the water pollution control facility through SCADA. The plant SCADA should be updated to accept these signals.

Each pumping station should have new field instrumentation (i.e. level sensors, intrusion alarm, etc.), a new local pump station control panel (remote terminal unit or RTU) and a human machine interface (HMI) designed to make it easy to interrogate the system and confirm proper operation of the station. Minimum recommended alarms are contained in TR-16. Each station should have these minimum alarms and any additional alarms deemed necessary by the Town. This upgrade will allow the standardization of equipment and user interfaces across all pumping stations and the treatment plant.

New control panels and communications equipment should be mounted above the 100-year flood elevation. This may require raised platforms with stairs for access.

If desired by the Town, radio communications could be explored as an alternative to phone based communication. This should include a review of open systems and closed (proprietary) systems such as Motorola MOSCAD. A radio path study will likely be needed to confirm reception at the remote pumping station locations.

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Section 12

Recommended Alternatives and Opinion of Probable Cost

This section discusses the recommendations presented earlier in this report (Sections 1 through 11), makes an overall recommendation for the Town's pumping stations, and discusses the costs of that recommendation. Impacts on sewer rates as a result of those costs are also discussed and pumping stations are prioritized for implementation.

12.1 Recommendations Summary

Detailed recommendations from each discipline are discussed in earlier Sections. In general terms, the pumping stations have been well maintained and are functional. However, they are showing their age and all of them have significant issues that bear careful consideration by the Town. Brief recommendation highlights are listed below.

12.1.1 Denton Street Pumping Station

The Denton Street station needs increased capacity as well as minor structural repairs and other updates. Additionally, the configuration of this station makes it vulnerable to common mode failure of its aging equipment. Submersible pumps are recommended to eliminate confined space entry, and wholesale electrical, standby power and instrumentation replacements are required when the station is updated. HVAC improvements can be avoided by using submersible pumps. Site improvements would improve access and security.

12.1.2 First Street Pumping Station

The First Street station needs to be replaced because the existing 50 year old metal can pump chamber is not structurally sound. It has been temporarily stabilized with concrete, but continues to leak and deteriorate. Submersible pumps are recommended to eliminate confined space entry, and wholesale electrical, standby power and instrumentation replacements are required when the station is replaced. Site improvements would improve access and security.

12.1.3 G Street Pumping Station

The G Street station needs a significant increase in capacity as well as minor structural repairs and other updates. Additionally, the configuration of this station makes it vulnerable to common mode failure of its aging equipment. Submersible pumps are recommended to eliminate confined space entry, and wholesale electrical, standby power and instrumentation replacements are required when the station is updated. HVAC improvements can be avoided if submersible pumps are used. Site improvements would improve access and security.

12.1.4 J Street Pumping Station

The J Street station needs an increase in capacity as well as minor structural repairs and other updates. Additionally, the configuration of this station makes it vulnerable to common mode failure of its aging equipment. Submersible pumps are recommended to eliminate confined space entry, and wholesale electrical, standby power and instrumentation replacements are required when the station is updated. HVAC improvements can be avoided if submersible pumps are used. Site improvements would improve access and security.

12.1.5 Lake Pleasant Pumping Station

The Lake Pleasant station is generally in good condition and needs only minor structural repairs and other updates. However, the configuration of this station makes it vulnerable to common mode failure of its aging equipment. Submersible pumps are recommended to eliminate confined space entry, and wholesale electrical, standby power and instrumentation replacements are required when the station is updated. HVAC improvements can be avoided if submersible pumps are used. Site improvements would improve access and security.

12.1.6 Montague Center Pumping Station

The Montague Center station needs an increase in capacity as well as minor structural repairs and other updates. Submersible pumps are recommended to eliminate the particularly deep confined space entry currently needed at this station. Wholesale electrical, standby power and instrumentation replacements are required when the station is updated. HVAC improvements can be avoided if submersible pumps are used. Site improvements would improve access and security. Architectural repairs will be needed if the existing structure and generator building are kept in service.

12.1.7 Poplar Street Pumping Station

The Poplar Street station needs to be replaced because the existing 50 year old metal can pump chamber is not structurally sound. It is showing significant signs of metal deterioration and continues to leak. Submersible pumps are recommended to eliminate confined space entry, and wholesale electrical, standby power and instrumentation replacements are required when the station is replaced. Site improvements would improve access and security.

12.1.8 Technical School Pumping Station

The Technical School station (Industrial Boulevard) needs an increase in capacity as well as moderate structural wet well repair and other updates. Submersible pumps are recommended to eliminate confined space entry at this station, and also improve reliability compared to the existing problematic vacuum priming suction lift pumps. Use of a new structure would avoid bypass pumping to repair the existing wet well, avoid dependence on the aging metal can pump vault, and stream line construction. Wholesale electrical, standby power and instrumentation replacements are required when the station is updated. HVAC improvements can be avoided if submersible pumps are used. Site improvements would improve access and security. Architectural repairs are needed if the existing generator building remains in service.

12.2 Discussion on Alternatives

A variety of alternatives have been discussed with Town staff, but most have been discarded as impractical or not consistent with the goals of this study. This Section only presents those that are deemed worth reporting. The existing stations have been grouped for ease of presentation because there are similarities among all the ejector stations and all the metal can stations. The Montague Center station does not fit with either of these groups, and is discussed separately.

12.2.1 Ejector Stations

All four of the ejector stations (Denton Street, G Street, J Street, Lake Pleasant) present the same challenges and opportunities in terms of upgrade or replacement. Several alternatives were identified as described below:

Do Nothing

In these cases the "do nothing" alternative means that Town WPCF staff would continue to operate and maintain the stations as they always have. This alternative does have an annual maintenance and labor cost that will continue to increase as the equipment continues to age and needs more and more work to keep it going. This alternative does not achieve any of the goals of this study, and cannot address the significant capacity shortfalls at the Denton Street, G Street and J Street stations.

Convert Existing Pump Vault

One idea that we explored early on was the conversion of the existing concrete chamber into a new wet well for submersible pumps. However, we quickly realized that this alternative is not practical for many reasons. Significant structural and geotechnical problems were identified and are discussed in Section 5. Additionally, due to the elevation of the influent sewer (at each station) compared to the elevation of the floor of the existing vaults, new pumps would not have adequate storage or operational range without surcharging the incoming gravity sewer and risking flooding of upstream basements. Finally, it was noted that the significant work and bypass pumping needed to retrofit the existing structure and replace all electrical and control equipment would have costs approaching that of a new station.

Complete Replacement

This alternative proposes installation of a completely new precast concrete wet well with an integrated valve vault and built in bypass pumping provisions. The new structure would be suitable for new submersible pumps to be removed on rails. This alternative will achieve all goals of this study. Most importantly, the proposed new systems offer reliability and future capacity while eliminating confined space entry.

Complete replacement offers a new purpose built structure with a full service life ahead of it. This alternative also minimizes bypass pumping and streamlines construction while offering the opportunity to design exactly what is needed to meet current and future capacity needs. New electrical, standby power and control systems would be needed in any proposed upgrade, but complete replacement ensures that new systems will fit in the associated building, enclosures, etc. Appendix D contains drawings and literature on potential concrete structures and pumping systems. One way to control cost on this alternative would be to mount electrical, standby power and control systems in outdoor weatherproof enclosures rather than a new building.

Complete Replacement with a new Building

This alternative is another version of the "complete replacement" discussed above. This variant moves all electrical, standby power, fuel and control systems into a precast concrete building to be located adjacent to the new precast concrete wet well structure. The building can be configured as a common room or as a split structure with the generator on one side of a masonry partition and electrical and control equipment on the other. The addition of a building would add cost, but offers increased infrastructure security, improves working conditions during adverse weather, and would likely increase the longevity of the new equipment by protecting it better from the elements. A new building will have lights, heat and ventilation that will also increase utility costs at each station.

12.2.2 Metal Can Stations

All three of the metal can centrifugal stations (First Street, Poplar Street, Technical School) present similar challenges and opportunities in terms of upgrade or replacement. Several alternatives were identified as described below:

Do Nothing

In these cases the "do nothing" alternative means that Town WPCF staff would continue to operate and maintain the stations as they always have. This alternative does have an annual maintenance and labor cost that will continue to increase as the equipment continues to age and needs more and more work to keep it going. This alternative does not achieve any of the goals of this study, and cannot address the significant structural problems at the First Street, and Poplar Street stations. The only way to address the structural problems at those two stations is with a completely new structure as described below. This alternative also does not address the capacity shortfall or problematic equipment at the Technical School station.

Complete Replacement

This alternative proposes installation of a completely new precast concrete wet well with an integrated valve vault and built in bypass pumping provisions. The new structure would be suitable for new submersible pumps to be removed on rails. This alternative will achieve all goals of this study. Most importantly, the proposed new systems offer reliability and future capacity while eliminating confined space entry.

Complete replacement offers a new purpose built structure with a full service life ahead of it. This alternative also minimizes bypass pumping and streamlines construction while offering the opportunity to design exactly what is needed to meet current and future capacity needs. New electrical, standby power and control systems would be needed in any proposed upgrade, but complete replacement ensures that new systems will fit in the associated building, enclosures, etc. Appendix D contains drawings and literature on potential concrete structures and pumping systems. One way to control cost on this alternative would be to mount electrical, standby power and control systems in outdoor weatherproof enclosures rather than a new building.

It is noted that the Technical School station already has a generator building. However, this building needs significant repairs to remain in service, and is unlikely to be a convenient size for a new generator and electrical panels. Modern generators tend to have bulky emission control systems, and double ended electrical panels that comply with current EPA guidelines will be larger than the existing panels. Based on these facts, it is intended that the existing generator building would be removed.

Complete Replacement with a new Building

This alternative is another version of the "complete replacement" discussed above. This variant moves all electrical, standby power, fuel and control systems into a precast concrete building to be located adjacent to the new precast concrete wet well structure. The building can be configured as a common room or as a split structure with the generator on one side of a masonry partition and electrical and control equipment on the other. The addition of a building would add cost, but offers increased infrastructure security, improves working conditions during adverse weather, and would likely increase the longevity of the new equipment by protecting it better from the elements. A new building will have lights, heat and ventilation that will also increase utility costs at each station.

12.2.3 Montague Center Station

The Montague Center station presents a unique set of challenges and opportunities. It has a capacity shortfall, and needs larger pumping units. It is also a deep structure with significant confined space entry and safety concerns. However, the existing concrete investment is substantial. This structure, constructed circa 1984 is likely right in the middle of its potential life and currently needs only modest concrete repairs. After careful review with Town WPCF staff, we offer the following alternatives:

Do Nothing

In these cases the “do nothing” alternative means that Town WPCF staff would continue to operate and maintain this station as they always have. This alternative does have an annual maintenance and labor cost that will continue to increase as the equipment continues to age and needs more and more work to keep it going. This alternative does not achieve any of the goals of this study, and cannot address the significant confined space entry and safety related concerns present at this deep station. This alternative also does not address the capacity shortfall at the station.

Retrofit the Existing Station for New Submersible Pumps

This alternative proposes significant demolition and retrofit work in an attempt to take partial advantage of the capital structure already owned by the Town. This approach would also minimize new excavation along the Sawmill River. The concept involves complete demolition of the existing superstructure (building) and replacement with a new at-grade concrete slab with vents and access hatches.

The existing wet well side is too small to receive submersible pumps, and will remain as is. It may provide incremental storage in this role. The existing dry well side will be completely gutted and converted to a new wet well for submersible pumps. Large sections of the intermediate concrete slabs will need to be removed to create an open and clear pathway for the removal of new submersible pumps on rails that will need to be braced with stiffeners every ten feet. With the removal of so much of the existing concrete structure, additional wall bracing will be required.

Unfortunately, bypass pumping will be required throughout construction because the existing pumps and all of their support systems will need to be removed to facilitate this conversion. Also, there is a level of risk associated with changing the purpose and role of a deep structure, and significant structural re-design will be needed that will add cost to this alternative.

Finally, while this alternative makes use of the existing structure, additional work and excavation is still needed to provide a precast concrete valve vault and enclosures for the electrical gear, pump control system and generator. With these provisions, this alternative will achieve most of the goals of this study.

One potential down side of this alternative stems from the fact that the existing structure already needs some repair, and is already 28 (+/-) years old. The Town would be investing significant funds to retrofit a station that would have approximately half the life expectancy of a new structure.

Complete Replacement

This alternative proposes installation of a completely new precast concrete wet well with an integrated valve vault and built in bypass pumping provisions. The new structure would be suitable for new submersible pumps to be removed on rails. This alternative will achieve all goals of this study.

Most importantly, the proposed new systems offer reliability and future capacity while eliminating confined space entry.

Complete replacement offers a new purpose built structure with a full service life ahead of it. This alternative also minimizes bypass pumping and streamlines construction while offering the opportunity to design exactly what is needed to meet current and future capacity needs. New electrical, standby power and control systems would be needed in any proposed upgrade, but complete replacement ensures that new systems will fit in the associated building, enclosures, etc. Appendix D contains drawings and literature on potential concrete structures and pumping systems. One way to control cost on this alternative would be to mount electrical, standby power and control systems in outdoor weatherproof enclosures rather than a new building.

Complete Replacement with a new Building

This alternative is another version of the "complete replacement" discussed above. This variant moves all electrical, standby power, fuel and control systems into a precast concrete building to be located adjacent to the new precast concrete wet well structure. The building can be configured as a common room or as a split structure with the generator on one side of a masonry partition and electrical and control equipment on the other. The addition of a building would add cost, but offers increased infrastructure security, improves working conditions during adverse weather, and would likely increase the longevity of the new equipment by protecting it better from the elements. A new building will have lights, heat and ventilation that would likely be comparable to current non-pump utility costs at the station.

12.2.4 Options for Demolition

For all the stations, the Town will need to decide what level of demolition is appropriate. In many cases, we see that old structures are gutted of all piping and mechanical equipment, opened up, filled with sand, and backfilled to grade. As long as there have been no signs of settlement in the past, we would have every reason to believe the structure would remain stable in the future. This does leave a buried structure, but is a common cost effective approach. Any above grade structures and panels can be fully removed.

Another option for below grade structures is to fully remove the old structure. However, this is far more expensive and can expose adjacent roads and in-service structures to risk of settlement or collapse. Due to the expense and risk associated with full removal, this option is not often recommended unless the Town has a specific reason to want to remove the old structure(s).

Existing equipment is not anticipated to have significant salvage value. However, the Town may want to explore the sale of existing generators to a salvage wholesaler.

12.3 Recommended Alternative

In all cases, the recommended alternative is complete replacement with a new precast concrete wet well structure with an integrated valve vault with bypass pumping provisions. Submersible pumps are recommended, and would be installed similar to one of several layouts included in Appendix D. This is the only approach that satisfies all the goals of this study at any given station.

At the Montague Center station, the retrofit option was seriously considered and estimated for cost. However, the new components and ancillary structures that would be needed, and the considerable retrofit work and bypass pumping costs involved in the retrofit pushed the cost very close to that of a completely new station. Given that the retrofit would only have half the life expectancy (due to the age of the existing structure), we feel it makes sense to spend the small increment for a fully new station that would be standardized with the others.

12.4 Discussion on Environmental Permits

Proposed pumping station improvements are not anticipated to trigger a significant permitting activity. However, we anticipate reviews by the Planning Department and other Town agencies such as a Conservation Commission and Inland Wetlands and Water Courses Agency. None of the pumping stations appear to be in wetland areas, but this can be determined during the design phase when a survey is completed. It is unclear what level of permitting may be needed (if any) for the G Street and J Street stations due to their proximity to the power canal. A review by the U.S. Army Corps of Engineers may be needed.

12.5 Areas of Project Cost

When developing project costs, a number of contributing factors were considered as listed below:

1. Clearing and grubbing (Denton Street),
2. Site restoration (lawn repair and up to six arborvitaes),
3. Well point dewatering (assumed at four stations),
4. Bypass pumping,
5. Steel sheet shoring,
6. Compacted gravel base,
7. Selective concrete (or steel) demolition of old structure,
8. Mechanical demolition of old station,
9. Re-use of old fill from new structure,
10. Excavation and backfill,
11. Paving (new driveway),
12. Asphalt curbing (new driveway),
13. Chain link fencing,
14. Generator foundation (concrete pad),
15. Davit crane, lifting chain, rails & stiffeners,
16. Duplex pumping system w/ VFD controls,
17. Integrated precast concrete pumping station and valve vault,
18. Instrumentation and WPCF SCADA tie-in,

19. Modification of WPCF SCADA to receive pumping station signals,
20. Force main wet tap and tie in,
21. Gravity sewer tie in,
22. Electrical equipment and installation (MCC and panels),
23. Site lighting,
24. New electrical service and XFMR from WMECO,
25. New diesel generator w/ XFR switch and enclosure (30 kw to 50 kw),
26. New spilt electrical / control & generator building (where applicable)
27. Full removal of old station (where applicable)

Not all of these cost centers are needed at each station, and during the design phase, we propose to work with the Town to narrow the scope of each station to a cost effective or minimum required level.

It is also noted that proposed improvements would incorporate "green thinking" in terms of energy efficiency and reduced need for lights, heat, ventilation, etc. Pumps are proposed to run on variable frequency drives which allow precise control to match incoming flows, and which use dramatically less current to start the motors. All told, the proposed new stations are anticipated to have a dramatically smaller energy footprint than the existing stations, even in the stations where capacity is increased.

12.6 Opinions of Probable Cost

Site specific Opinions of Probable Construction Cost (OPCCs) have been developed for each station according to known and anticipated site conditions, the nature of improvements and depth of excavation at each site. These OPCCs reflect our opinion of the current bid costs for the sum of direct construction costs, such as labor and materials, and also factor in some typical contractor expenses such as building permits (0.4%), insurance (2.25%), bonds (1%), general conditions (10%), indirect costs and overhead and profit (10%), a planning level construction contingency (30%), and escalation to July 2013 (3%). Unit costs are estimated based on the *Engineering News Record* (ENR) 20 city average construction cost index. Contingencies used are based on guidance from the Association for the Advancement of Cost Engineering and the US Environmental Protection Agency construction grant and loan program. The OPCC for each station is shown on Line 1 of the Table 12-1.

From the OPCC, we can develop an anticipated project cost by adding in a 10% project contingency and a 20% allowance for engineering & implementation. Engineering and implementation costs can include permitting, finance bonding costs, engineering design, legal, construction oversight, administrative, geotechnical program (including borings), site survey, and public participation. This value for each station is shown on Line 2 of Table 12-1. Total anticipated costs are shown on Line 3 of the same table. It is noted that these costs are intended to be inclusive of the whole scope of work for each station, and that deductions could be made depending on the actual scope of work the Town wishes to move forward. As shown on Table 12-1, the anticipated planning level project cost for all eight stations ranges from $6.1 Million to $7.3 Million depending on these scope inclusions or exclusions.

Montague, Massachusetts
Wastewater Pumping Station Survey
Summary of Planning Level Project Costs
Table 12-1

Number	Cost Component	First Street	Poplar Street	Technical School	Lake Pleasant	Denton Street	G Street	J Street	Montague Center
1	Opinion of Probable Construction Cost	$ 750,000	$ 650,000	$ 650,000	$ 610,000	$ 650,000	$ 700,000	$ 700,000	$ 850,000
2	Engineering, Implementation & Contingency	$ 230,000	$ 200,000	$ 200,000	$ 180,000	$ 200,000	$ 210,000	$ 210,000	$ 260,000
3	**Anticipated Project Cost**	**$ 980,000**	**$ 850,000**	**$ 850,000**	**$ 790,000**	**$ 850,000**	**$ 910,000**	**$ 910,000**	**$ 1,110,000**

Table Notes:
1. All costs reflect Planning Level accuracy to be refined during design.
2. All values rounded to two significant digits.
3. Costs include a 10% Project Contingency and 20% Allowance for Engineering & Implementation.
4. Deduct $110,000 per station if outdoor control panels and generator are used in lieu of control building.
5. Deduct an average of $30,000 per site if the old station is not completely removed ($90k at Montague Center).
6. A new station is shown at Montague Center. Anticipate $20k savings by retrofitting old structure.

Sum of all Stations (All Improvements)	**$ 7,300,000**
Total w/o Generator & Control Bldg @ Each	**$ 6,400,000**
Total w/o Bldgs & w/o Full Demo of Old Station	**$ 6,100,000**

12.7 Impacts on Sewer Rates

Sewer user rates would increase as a result of the improvements recommended by this study. Town WPCF staff have estimated an approximate rate increase based on the following criteria:

- Assumed total project cost of $7.3 Million
- Assumed Interest Rate of 4%
- Historical rate increase per $10,000 = $0.045/1,000 gallons
- Rate changes assume current loading conditions, industrial fees, and surcharges
- Average residential sewer volume per fiscal year = 76,000 gallons

Using the above information, the total impact for debt service involving pumping station options (i.e. implement all improvements now or space them out over time) can be used as a decision guidance tool. For each $1 Million in debt, the first year of payments results in a rate increase of approximately $31 for a 20-year loan and $37 for a 15-year loan. The approximate impact on residential rate payers the first year is then $225 for a 20-year loan and $267 for a 15-year loan. The difference in total payments for a 20-year loan vs. a 15-year loan is approximately $100,000 over the life of the loan.

The question of 15-years vs. 20-years (or even 10-years, not shown here) is one of affordability and replacement cost of the proposed equipment. If equipment is being replaced outside of standard operational maintenance while debt service is still being paid on same equipment, then debt pyramiding occurs. This is a financial risk (or burden) in that incurring debt for other projects that will inevitably come along becomes more difficult and unsustainable for the Town in terms of both residential and industrial entities.

12.8 Prioritized Order of Improvements

It would be ideal to implement all recommended improvements at all stations as one large construction contract. Doing so would maximize the purchasing power of the Town and their contractor, attract bids from larger contractors, and allow an economy of scale at every step of the project from design through startup. This approach would also provide standardization of all equipment because the equipment would all be purchased at the same time, though the same contractor and chain of supply. We recommend that the Town make improvements to as many stations at one time as is practical to try to capture the benefits described above.

However, it is understood that the costs for the recommended improvements are substantial, and the Town may need to break this project up into pieces. If the project is broken into smaller pieces, there is a risk for less standardization, loss of the economy of scale effect, and the Town will continue to bear the risks associated with the existing stations (safety / confined space entry, structural integrity, capacity).

Working with Town WPCF staff, we have identified the following priority order for improvements to the existing stations (highest priority first):

1. First Street
2. Poplar Street

3. Montague Center
4. Technical School (Industrial Boulevard)
5. J Street
6. G Street
7. Denton Street
8. Lake Pleasant

It is noted that several natural groupings present themselves. For example, the four ejector stations are similar to each other, and the four centrifugal stations are similar to each other. We feel the stations should minimally be grouped in similar pairs.

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