This Technical Memorandum presents information regarding the historic and planned improvements to the sanitary sewer collection system. Discussion will include constructed improvements dating back to the most recent sanitary sewer master plan prepared by CDM, Camp Dresser McKee. Discussion will also include planned improvements to the collection system identifying problem areas.

The intent is to recognize and credit improvements made while thinking forward to what needs will be addressed in the future.

It is organized as follows.

- Objective
- Summary
- Previous Master Plans
- Improvements Since 1998 Master Plan
- Future Collection and Conveyance Improvements

**Objective**

The objective of this TM 2.0, Historic and Planned Improvements is to identify changes in the collection system and planning that has occurred since the 1998 Master Plan. Based on narrative and information furnished by the City, it compile a list of significant sanitary sewer system improvements implemented since the 1998 Master Plan and documents a list of future improvements and associated capital needs based on previously identified problem areas.

**Summary**

This TM 2.0 Historic and Planned Improvements can be summarized as follows.

Relevant recent planning documents for the sanitary sewer collection system include a 1984 Sewer System Evaluation and the 1998 Sanitary Sewer Master Plan. The 1984 system evaluation included capacity evaluations with inflow and infiltration investigation. Minimal action was taken on the recommendation from 1984 through 1989.

The 1998 Sanitary Sewer Master plan was a comprehensive study of the conveyance system and the Water Pollution Control Facility. A number of recommendations were developed by the
Completed improvements since the 1998 master plan include:

- Southeast Interceptor River Crossing
- Sanitary Sewer Overflow Pump removal
- Ellis Road NW Force Main
- Morgan Creek Lift station capacity upgrades
- Indian Creek Trunk Sewer Replacement
- Prairie Creek planning
- Ongoing capital improvement projects
- 2008 Flood Repair projects

Planned future improvements include:

- Inflow and Infiltration reduction
  - Lennox Neighborhood
  - Grande and Park neighborhood
- Private Source Inflow and Infiltration Reduction
- Rehabilitation of the East Side Interceptor
- Main sewer capacity improvements
  - Indian Creek
  - Prairie Creek
- Lift stations capacity analysis
  - Hoosier Creek
  - Hoosier Creek South
- Lift station policy development and implementation
- CMOM Plan update

**Previous Master Plans**

**1984 Sewer System Evaluation**

A sewer system evaluation survey was performed in 1984. The survey included:

- Night visual inspections of flow
- Televising
- Capacity calculation
- Smoke testing
- Inflow/infiltration (I/I) investigation

Much of the capacity data has minimal value because the system has grown significantly since that time. Based on reviews of records, minimal work was completed on the recommendations during the period of 1984 to 1998.
Relevant recommendations are summarized in Table 1:

<table>
<thead>
<tr>
<th>TOPIC</th>
<th>CONCERN</th>
<th>CURRENT STATUS</th>
</tr>
</thead>
<tbody>
<tr>
<td>I/I</td>
<td>• Wet weather flows exceed the capacity of the system at main lift.</td>
<td>• Pumps at main lift were increased in capacity</td>
</tr>
<tr>
<td></td>
<td>• Wet Weather Flows are increasing treatment costs.</td>
<td>• System repairs and lining have been targeted to reduce the impact of Public Site I/I.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Repairs to interceptor planned or have been done</td>
</tr>
<tr>
<td>CCTV program</td>
<td>• No consistent program of inspection was being performed.</td>
<td>• Even though the City owned CCTV equipment, it did less than 20% of the system in the period of 1980-2003. It averaged under 10 miles/yr. The average since 2004 has been over 100 miles/yr.</td>
</tr>
<tr>
<td>CIPP program</td>
<td>• Cracked pipes were causing collapses, I/I source and SSOs</td>
<td>• Starting in 1999, the City increased the annual CIPP program and has installed over 60 miles of liner.</td>
</tr>
<tr>
<td>Flow problem in the areas of Lennox Ave NE and Grande Ave/Blake Blvd SE</td>
<td>• I/I exceeds the capacity of the system resulting in basement backups</td>
<td>• City Initiated I/I study of Lennox area in 2014.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• City rehab portion of area</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• City Initiated I/I study of Grande Ave/Blake Blvd in 2015</td>
</tr>
<tr>
<td>Brick manhole rehab program is necessary</td>
<td>• I/I source</td>
<td>• Some manhole rehab done in the 2000s. All structures in the flood plain investigated after 2008 Flood and are being repaired as needed.</td>
</tr>
<tr>
<td></td>
<td>• Collapsing streets and sewers</td>
<td></td>
</tr>
<tr>
<td>Grease was a source Sanitary Sewer Overflows (SSO)</td>
<td>• SSOs</td>
<td>• Pre 1994 There was minimal action. In 1994 the City enacted a grease trap ordinance which decreased backups by over 150 per year.</td>
</tr>
<tr>
<td>Systematic maintenance program for roots and cleaning</td>
<td>• Roots are a major source of backups.</td>
<td>• CIPP targeted lines with roots starting in 2000</td>
</tr>
<tr>
<td></td>
<td>• Sediment buildup has caused loss of capacity</td>
<td>• A targeted preventive maintenance program was established in 2004</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• CCTV program used to identify/validate the maintenance requirements</td>
</tr>
</tbody>
</table>

**1998 Master Plan**

In 1998 through the Metropolitan Planning Organization (MPO), a comprehensive study was performed of the regional conveyance system and waste treatment facility on Bertram Road SE. The study found dry weather flows were within the capacity of the conveyance and treatment. Wet weather flows exceeded the system capacity. To reduce the amount and numbers of Sanitary Sewer Overflows, the wet weather flow had to be reduced, the capacity expanded or some combination of both were needed. The recommendation was a combination of both expansion of conveyance and treatment capacity and reduced flows. Other results are summarized in Table 2. The study provides discussion on the following topics.

**Improvements since 1998 Master Plan**

The City last prepared a Sanitary Sewer System Master Plan in 1998 (1998 Master Plan). That document, prepared by CDM Camp Dresser McKee, gathered available information from prior studies to complete modeling of the collection system. The modeling effort was then used to evaluate the systems performance and consider alternatives for improvements along with a recommended plan. The recommended plan focused on several action items related to policy making and expenditure of capital intended to reduce peak flows.
<table>
<thead>
<tr>
<th>TOPIC</th>
<th>CONCERN</th>
<th>CURRENT STATUS</th>
</tr>
</thead>
<tbody>
<tr>
<td>24 constructed Sanitary Sewer Overflow point pumps</td>
<td>• An estimated 130 million gallons of untreated wastewater was released to the environment in 1996</td>
<td>• All bypass pumps have been decommissioned and system upgrades have reduced their need.</td>
</tr>
<tr>
<td>I/I reduction - general system</td>
<td>• Wet weather flows exceed the capacity of the system at main lift • Flow is increasing treatment costs</td>
<td>• Pumps at main lift were increased in capacity • System repairs and lining have been targeted to reduce the impact of I/I • Repairs to interceptor planned or have been done</td>
</tr>
<tr>
<td>I/I reduction - houses</td>
<td>• Wet weather flows result in neighborhood basement back ups • Extreme wet weather result in temporary pumping and increased costs</td>
<td>• Program started in 2014 to investigate areas with this • Council discussions to begin regarding how to address private sources of I/I</td>
</tr>
<tr>
<td>Increase capacity to Morgan Creek lift station</td>
<td>• Flow exceeds capacity</td>
<td>• Upgrade complete</td>
</tr>
<tr>
<td>McCloud Run interceptor needs increased capacity</td>
<td>• Flow exceeds capacity • 1993 damage/debris has not been addressed</td>
<td>• Monitoring has not shown major issues. Line still needs additional modeling, inspection and cleaning</td>
</tr>
<tr>
<td>Indian Creek/Dry Creek Interceptor needs increased capacity</td>
<td>• Flow exceeds capacity and does not meet the needs of growth</td>
<td>• Multi-year CIP has been started</td>
</tr>
<tr>
<td>NW force main needs to be replaced</td>
<td>• Line is old and is breaking • Line has insufficient capacity</td>
<td>• Upgrade complete</td>
</tr>
<tr>
<td>Cost allocation</td>
<td>• Rate structure allocates cost on volume and not peak rates which require additional capacity</td>
<td>• No action</td>
</tr>
<tr>
<td>Establish rain gage network</td>
<td>• Provide data for analysis</td>
<td>• Seven rain gauges are installed. Planning is underway to increase number of gauges and data quality • Planning for real time data is underway</td>
</tr>
<tr>
<td>Flow monitoring</td>
<td>• Provide data for analysis</td>
<td>• Program has been in place for over 10 years</td>
</tr>
<tr>
<td>Sewer inspections</td>
<td>• Need to televise on 10 year basis</td>
<td>• System is on 8 year basis but is now being reduced to a 12 to 15 year basis based on Performance Review</td>
</tr>
<tr>
<td>Foundation drain survey</td>
<td>• Need data for basis of policy decisions</td>
<td>• Program started in 2014</td>
</tr>
<tr>
<td>Evaluation of foundation drain disconnection program</td>
<td>• Need budget. Cost can be $2,000 to 10,000 each. Potentially 10,000+ properties</td>
<td>• Discussion regarding policy is taking place. • A pilot study was completed in 2014 of the Lennox Avenue Neighborhood. Results are being used to establish policy</td>
</tr>
<tr>
<td>Sewer rehabilitation program</td>
<td>• Age of system requires replacement or rehabilitation</td>
<td>• Over 60 miles of cured in place liner installed since 98 • Over 10% of current system has been rehabbed or replaced in last 17 years</td>
</tr>
<tr>
<td>Main lift and storage facilities at Waste Treatment Plant needs expansion</td>
<td>• Flow exceeds capacity</td>
<td>• Total pumping capacity has been upgraded to just over 100 mgd firm and about 132 mgd total</td>
</tr>
<tr>
<td>Modeling of wet weather needed</td>
<td>• System flow is not understood so future capacity expansion can be planned</td>
<td>• Monitoring and modeling of flows have been performed by HDR</td>
</tr>
<tr>
<td>Disconnect foundation drains and sump pumps</td>
<td>• I/I source</td>
<td>• Still in investigation phase</td>
</tr>
<tr>
<td>Storage facilities should be built far upstream of treatment plant</td>
<td>• Reduce volume rates so interceptors can handle the flows</td>
<td>• Morgan Creek line was built with storage capacity</td>
</tr>
</tbody>
</table>
The narrative that follows identifies improvements completed subsequent to the 1998 Master Plan reflective of the City’s program to assess, maintain, replace, and rehabilitate the sanitary sewer collection system. Expenditures since the 1998 Master Plan to date is approximately $45 million with an additional $25 million planned over the next five years which includes maintenance, capacity improvements, and 2008 Flood recovery projects. Since the 1998 Master Plan 60.7 miles of pipe have been lined and 16.6 miles replaced.

**South East Interceptor River crossing**
In December 2010, the City received a Community Development Block Grant (CDBG) of over $7 million to replace the Cedar River siphon built in 1953 (a twin 30 inch cast iron pipe river crossing south of the Sinclair property that crossed to the landfill site). Completed in 2014, the City installed a siphon headbox and tailbox, constructed all-weather access roads, and installed 800 linear feet of two 36” inverted siphon pipes. (CIP 655080)

**Sanitary Sewer Overflow Pumps**
A major recommendation of the 1998 Master Plan was to eliminate the 24 in-ground transfer pumps that relieved the sanitary system during high-flow events to the City’s storm sewer system. The pumps would automatically pump based on the level indications. In 1996, it was reported to the Iowa Department of Natural Resources (IDNR) that 130 million gallons of untreated waste water had been released by these pumps. Starting in 2004, a number of pumps were decommissioned and removed based on lack of usage. The number of pumps was further reduced by I&I reduction achieved by the pipe lining program. To date, these pumps have all been removed and the automatic discharge of wastewater to the waters of the United States through the storm sewer system is disallowed per the City’s Municipal Separate Storm Sewer (MS-4) National Pollutant Discharge Elimination System (NPDES) Permit issued by the IDNR. (CIP 655147)

**Ellis Rd NW Force Main**
Based on the 1998 Sewer Master Plan, the City in 1999 selected HR Green to complete a study to evaluate the capacity of the of the Morgan Creek lift station, force main, and receiving sanitary sewers serving the Usher Ferry and Ellis Rd mains. A design for 17.3 mgd was recommended including a major upgrade to the lift station and construction of a multiple force main system in lieu of one larger force main to achieve the following:

- Provide long term capacity for the Morgan Creek lift station and service area
- Provide operational efficiency and flexibility in regards to a long force main and a wide range of anticipated flows (current average dry weather flow of 1.0 mgd versus ultimate peak wet weather flow of 17.3 mgd)
- Increased system reliability

The City started construction in 2001 of the multiple force main system which included abandoning the existing 12-inch force main and constructing two new force mains (18-inch and 24-inch) parallel to the existing force main. The work was completed in 2011.
**Morgan Creek Lift Station**
The Morgan Creek lift station was constructed in the early 1970’s and is located west of Edgewood Rd NW and north of Ellis Rd. The potential service area to the lift station is approximately 20,000 acres, including approximately 2,700 acres north of the Cedar River (Usher’s Ferry main service area) and approximately 17,300 acres on the south side of the Cedar River, west of the lift station (Ellis Rd main service area) and also serves the City of Palo. The lift station currently serves about 10,000 persons and is expected to serve about 27,000 persons in 20 years and ultimately will serve up to 85,000 persons.

Starting in 2010 and completed in 2012, the lift station has been upgraded to include:
- A 500 year flood plus one foot elevation protection
- Upgraded the electrical systems to current code
- A new emergency generator
- New SCADA equipment to enable remote monitoring from the Water Pollution Control (WPC) facility.
- Pump upgrades that support the 18 inch force main and ultimately 24 inch line. (CIP 655823 and 615169.)

**Indian Creek Main**
The City of Cedar Rapids (City) has collaborated with Marion, Hiawatha, Robins, and Linn County to replace the existing Indian and Dry Run Creek sewer with larger diameter pipe. The project extends for roughly 16 miles from the Cedar River to Robins. This project will be completed over the next 10-20 years with multiple construction phases. Each phase will replace a selected segment of the sewer.

Construction started in 2011 and completed in 2012 on the first phase. The second phase was completed in 2013. The initial two phases were managed by the City of Cedar Rapids. The next phase will be managed by the City of Marion. The full project will encumber approximately $20 million of Cedar Rapids CIP funding. (CIP 655625)

**Main Interceptor Repair**
In 2007 and 2008, City staff and a consultant conducted surveys of portions of the 96 inch interceptor through the use of a pole camera. Indications were found of possible crown corrosion in the last mile of the interceptor prior to the plant. In 2009 and 2010, a contractor that specializes in large diameter pipe televising (Red Zone) was hired to assess the downstream
end of the interceptor (approximately 5 miles) up to the mains to verify the extent of damage. The inspection revealed the last mile of the main interceptor had corrosion down to the rebar and required replacement or rehab. It also highlighted other damages, and I&I within the Prairie Creek Main and some I&I within the lower part of Indian Creek Main. A lining option was chosen with a cost of $9.6 million which was completed in 2011-2012. The location can be seen in Figure 2.

(CIP 655028 – investigation/consultants, CIP 615121 – rehab of Main Interceptor)

Figure 2 Main Interceptor Lining Project

**Prairie Creek Main**
Investigation shows the main was damaged during the 2008 flood, has areas of crown corrosion, and needs greater capacity for future growth. The project design has been completed with the finalization of funding pending. Bidding and start of construction is scheduled for 2015. Current pipe diameter ranges from 42 inch to 60 inch as can be seen in Figure 3 below.
The pipe is scheduled to be replaced with 66 inch diameter pipe. The work is divided into a series of three phases.

The first two phases consist of construction of the sanitary sewer line from J Street SW to the Cedar River then connecting to the interceptor sewer. These two phases address damage from the 2008 Flood, some crown corrosion, and I&I sources. It will be partially funded by FEMA with a total cost estimate of $14+ million. (CIP 655028)

The final phase is from J Street SW to Hawkeye Downs. This phase is being constructed to expand capacity and correct I&I issues. The cost estimate is $6.8 million. (CIP 655257)

Ongoing Capital Improvement Projects
Annually the Sanitary Sewer Utility spends roughly $4 million on CIP. $1.5 to 2 million is spent on renewal (maintenance or known problems). The other half is spent on capacity and development related projects. In the period of 1999 to 2008, over $10.3 million was spent on renewal projects for the six to eighteen inch lines. This included reconstruction of 5.6 miles and 42.2 miles of lining. After the 2008 flood, the renewal program became a lower priority during the period of 2009 – 2012 because of staff and contractor constraints. As the FEMA related work was investigated and started construction, renewal work started again. As of 2014, over 60 miles of the system have lined with CIPP.

2008 Flood Repairs
The City received historic flood water levels during the National disaster period of 25 May 2008 to 13 August 2008. The river peaked on 13 June 2008 at the 31.12 feet stage which was over 11 feet above the previous historic level. Over 1,300 blocks or 9.2 square miles of the City’s roughly 72 square mile incorporated area was flooded. The sanitary sewer collection system
inundation map can be viewed below in Figure 4. The high flood water inundated the sanitary sewer system and exerted great pressure on the lines. When the water receded, it pulled saturated soils with it leaving numerous voids around the collection system pipes and under several roadways. The collection system sustained over $40 million in damages and an increase in average daily flow of about 48% from non-industrial contributions.

The flood waters inundated two lift stations (Morgan Creek and Indian Creek) and the treatment plant. The damage at the treatment plant included the areas of the incinerator, main lift, and clarifier. The cost of the repairs for these exceeded $30 million.

Immediately following the 2008 Flood, the effected portions of the collection system were cleaned and televised. The asset condition assessment resulted in a quantification of damages. The repair and rehabilitation of the damages utilizing funds awarded to the City by FEMA began in 2010 and is planned to complete in 2016.

IMMEDIATE REPAIRS
Immediately following the receding floodwater, a number of streets and alleys showed failed and collapsing sanitary lines and manholes. They were repaired at a cost of $72,000. There were over 20 contractor repair sites, including the following.

- 11th Ave SE between 6th St and 7th St. – collapsed 18 inch pipe
- 9th Ave SE between 7th and 8th St – collapsed manhole
- 9th Ave SE between 6th and 7th St – line blockage
- Alley between E and F Ave NW east of Ellis Blvd – collapsed manhole
- Cottage Glen SE – washout by pipe
- 18th Ave SW east of Mallory St – collapsed manhole
- 11th Ave SE between 6th and 7th St – street failure and line required patching
- 625 C Ave NW – collapsed line under a building
- 811 1st Ave W - collapsed line under a building

(Project SSD 001,003 and 004)
City staff did street repairs, manhole repairs, cleaning, televising. Costs totaled over $9 million. (Project # SSD 006, 007, 008, 013)

**QUADRANT AND 27-36 INCH PIPELINE REPAIRS**

The cleaning and televising of the sewers took over a year to accomplish. It was started in July 2008 after the removal of temporary flood protection and before the completion of the bypass pumping to mitigate the effects of the loss of the treatment plant. During this period, a number of Sanitary Sewer Overflows did occur in the flooded areas because of debris in the lines and the initial asset failures. The televising data was analyzed by Anderson Bogert and an improved FEMA project was authorized for the repairs. The work started in 2010 and is expected to complete in 2016. The cost of the work is over $28 million. (Project SSD 101, 102, 103, 104, 011)

**SW MAIN**

The SW Main that runs from the 2400 block A St SW around the site 1 landfill down to the river crossing just downstream of the Police firing range on Old River Rd SW sustained damage. It is an 84 inch diameter pipe. The treatment plant noted a significant increase in dry and wet flow rates following the flood. Televising inspection showed the joints were leaking in numerous locations. A project repaired 33 internal joint seals, in 16 pipe segment in 2012-2013. (Project SSD 010)

**HISTORIC SEWERS**

In the period of the 1920 and 30’s, a series of sewers were built in NE and SE that were deemed historic under the FEMA criteria. The sizes ranged from 18 to 48 inches with building
material consisting of clay, brick and concrete pipe. A map of the historic sewers can be viewed in Figure 5.

Historic documentation of the system was performed by the Louis Berger Group to preserve the context and survey of the historic sections. Most of the lines could be rehabilitated by use of liners. This included the east side interceptor that runs from near the Cargill plant to the cross river siphon. It required temporary night time road closures of the major Avenues on the SE near the river.

![Figure 5 Historic Sewers (From the Louis Berger Group Inc.)](image)

The historic brick sewer under 2nd St SE required replacement. It ran from 5th Ave at the Ground Transportation Center to the 1400 block at the edge of the Sinclair property. Because of the depth and substantial street damage, 2nd street was reconstructed from 8th to the end of pavement south of 14th Ave SE.

The total cost of work on the historic sewers exceeds $5 million. (Project SSD 013)

**RIVER CROSSING REPAIR**

The 2008 flood created higher than normal scouring of the river bottom which could have destabilized the cross river sanitary pipe. A dive inspection showed this did happen. A $210,000 project in early 2012/2013 re-ballasted the pipe. (Project SSD 009)

**Future Collection and Conveyance Improvements**

The City of Cedar Rapids has an ongoing program to improve the sanitary sewer system. Generally the Capital Improvement Project (CIP) funds are generally split into two areas
replacement and rehabilitation, and capacity improvements and development. This section discusses the major initiatives that are ongoing or planned for the next five years.

**Ongoing Rehabilitation**

As noted in TM 1.0 Existing System, the City has spent an average of $1.6 million annually to replace or line an average of 24,332 feet of sanitary sewer per year over the past 16 years. This equates to approximately 0.7 percent of the total sanitary sewer system per year. Given an estimated life expectancy of 80 years, the City should, in theory, be replacing or lining 1.25 percent of the total sanitary sewer system per year.

While targeted at extending the useful life of the sanitary sewer system, the ongoing rehabilitation effort had a positive effect in reducing infiltration and inflow as well. Pre 2008 flood, the long term wet weather flow trend was downward at WPC.

**Inflow and Infiltration (I&I) Reduction**

Wet weather events and/or high river levels cause high flows in the sanitary sewer system. These high flows are the result of extraneous flow commonly referred to as I&I. I&I is relatively clear surface and ground water that enters the sanitary sewer system through defects. It effectively reduces the capacity of the sanitary sewer system to carry wastewater and can lead to sanitary sewer overflows and basement backups.

The City completed I&I studies in the 1980’s and 1990’s. No significant municipal actions were taken as a result of these studies. The 1998 Sanitary Sewer Master Plan stated the issue more plainly - I&I is a significant capacity issue for the City and must be addressed. As discussed above, ongoing rehabilitation efforts have begun to address the I&I issue through sanitary sewer lining and replacement.

However, in recent years, particularly post 2008 flood, the sanitary sewer system and waste treatment facility have again been challenged with peak wet weather flows approaching and exceeding existing capacity. TM 600 of the Collection System I&I and Main Lift Capacity study identified historic and projected future flows to the Water Pollution Control Facility. The TM showed river and collection system I/I can result in an estimated 70 to 80 million gallons per day of additional flow to WPC.

The extraneous flows tax the capacity of the Main Interceptor trunk sewer, the Main Lift Station and WPC. Left unchecked, these peak flows will require significant capital investment for capacity expansion, prompting recommendations to consider alternatives to reduce collection system I/I, provide flow equalization storage, and/or some combination of all.

TN 700 identified several alternatives to provide the additional capacity in the event that I&I can not be reduced. Those alternatives are presented in the Main Interceptor and Main Lift Station Capacity Improvements section. Based on the options considered and the comparative costs developed, the study recommended, among other things, that the City continue, even accelerate, efforts to identify and eliminate I/I, particularly if significant river related and/or other inflow sources can be identified.
Starting in 2014, I/I studies in the upstream collection system were started. The first study was in the Lennox Ave and 38th St NE area. The second study is in 2015 for the Grande and Park Ave SE. The first study focused on area of study in the Lennox and 39th St NE neighborhood. Figure 6 below shows the study area.

![Lennox Ave Metershed](image)

**Figure 6  Lennox Neighborhood**

The study reviewed flow monitoring data and field observations to better quantify wet weather I&I contributions from public and private sources. It identified a total of $5.3 million of improvements to address public and private sources of I&I, but recommended a pilot project consisting of $3.6 million of improvements to address a mix of both public and private sources in a manner to assess the relative effectiveness of both. The desired outcome of the pilot program is a true cost comparison between increasing system capacity versus a robust public and/or private source I&I reduction program.

A second city-led effort was started in early 2015 to find obvious inflow sources within the Grande and Park Ave SE neighborhood. Figure 7 below shows the sewersheds for the Grande and Park neighborhoods. The impetus for this effort was in response to a large number of residents in the area expressing concerns over the frequency of backups being experienced.
Public asset data revealed limited major I&I sources, therefore smoke testing to determine private I&I sources was conducted. The smoke testing was completed for about 250 homes. Of this sample set only one home was found to have a roof drain connection. Other homes did have smoke enter their basements, but city crews were unable to enter these homes to verify illegal connections.

The initial study identified additional information needs and recommended both capital repairs to the public sewer system and private source infiltration and inflow reduction. Costs have not yet been identified.

A significant portion of the I&I in the sanitary sewer system is from areas outside of Cedar Rapids. The I/I from neighboring cities should be further defined and the associated documentation and cost impacts should be shared with those cities.

**Private Source I&I Reduction**

Homes built in the 1950’s and 1960’s have anecdotally been targeted as most likely to have sump pumps, foundation drains, or other such cross connections discharging I&I to the sanitary sewer system. Auditor’s data indicates that there are 14,874 structures in Cedar Rapids built between 1950 and 1970, roughly one-fourth of the total number of structures.
TM 852 of the Collection System I&I and Main Lift Capacity Study targeted I&I in the Lennox Ave and 38th St NE area. It found that 25 to 30 percent of the houses have cross connections primarily sump pumps (nearly 2/3) and foundation drains (nearly 1/3) connected to the sanitary sewer. Based on this range, maybe 2600 homes in Cedar Rapids have sump pumps and 1300 have foundation drains connected to the sanitary sewer.

A typical 1/3 horsepower sump pump has a capacity of over 2,700 gallons per hour based on comparison of multiple brands at a home improvement store. Many homes in high groundwater areas have 1/2 or 3/4 horse power pumps with capacities of over 3,200 gallons per hour. Assuming just one hour total operation per event, 3,900 homes with sump pump connections, or foundation drains, could result in nearly 13 million gallons of extraneous flow to the sanitary sewer system. While it varies significantly, reports from some residents indicate sump pumps run continuously for extended periods during some events and intermittently for extended periods of time thereafter.

TM 852 also estimated the cost to address sump pump and foundation drain cross connections at $750 and $4500 each, respectively. There is currently an incentive program in place for disconnecting foundation drains from the sanitary system. The program provides a $500 incentive to disconnect a foundation drain from the sanitary sewer system, but has seen very limited use. Future Ordinance measures may need to provide additional incentives and disincentives. As of early 2015, there is no official policy for reimbursement for disconnecting structures.

An initial policy for disconnects is under consideration and will be brought to the City council for consideration. The policy proposes that the City pay for inspections and the costs for disconnecting either foundation drains or sump pumps. It includes locations in targeted I&I neighborhoods and locations along street reconstruction projects as triggers for inspections. It estimates an average $3400 per home and an annual cost of $1.1 million.

TM 852 also cautions that cost of building equalization basins, noting that addressing one defect could simply result in a migration of groundwater to the next defect. In this case, the primary concern would be defective service laterals. In the Lennox study area, approximately 70 percent of the private service laterals are leaking, and approximately 50 percent of the private service lateral connections to the sanitary sewer are leaking. As such, it makes sense to also address leaking private service laterals as well.

The cost to line a service lateral was estimated at $4,200 and the cost to line just the connection and the public portion of the lateral was estimated at $1200. The aforementioned policy currently under consideration anticipates that the cost for defective service lateral repair or replacement will be borne by the Owner.

**Main Interceptor and Main Lift Station Capacity Improvements**

As mentioned in the Infiltration and Inflow Reduction section, TM 700 of the Collection System I&I and Main Lift Capacity study included an alternative analysis for future capacity needs for the Main Interceptor, Main Lift Station and Water Pollution Control. For comparative purposes a baseline for simply expanding existing facilities to accommodate the extraneous flow was
developed. The comparative baseline estimate is projected at $333 million, to expand the existing main interceptor, main lift station, and WPC treatment processes to accommodate the future flows.

Other alternatives incorporating equalization basin storage or high rate treatment for the peak flows were also explored. These solutions ranged in cost from $104 million to $130 million for either equalization or high rate treatment, prompting recommendations to focus efforts on I/I reduction. Other recommendations included the following.

- Proceed with planning to expand main lift capacity; at a minimum to match main lift firm pumping capacity to upstream main interceptor and downstream primary clarifier capacity. In the interim, any modifications to the Parshall flume structure to increase metering capacity should anticipate such a main lift capacity expansion.
- Proceed with planning to identify a suitable site(s) and construct a large, open, earthen equalization basin(s) in the areas along the main interceptor sewer between Cole Street and Indian Creek, or along the Indian Creek interceptor north of the Nature Center and south of Marion.

Flow equalization is the process of mitigating changes in flow rate through a portion of a system by providing storage to hold water when it is arriving too rapidly, and to supply additional water when it is arriving less rapidly than desired. Equalization basins provide the storage capacity in a collection system. They can be earthen or concrete structures that hold the peak flows.

The study recommended $104 million to provide 156 million gallons of equalization basin storage and expand main lift capacity by 32 mgd as the most attractive option, assuming a site(s) conducive to large, open, earthen basins is practical upstream of the treatment plant near Cole St SE or near that area on existing City owned property. The basins should be sized and constructed after the combined reductions of I/I and the repairs to the Indian Creek and Prairie Creek trunk lines are completed so that the impacts would be known and incorporated into the design size of the basins which is the most costly portion.

**Flow Monitoring**

The City of Cedar Rapids is maintaining a flow monitoring system consisting of seven regular rain gauges (plus one back-up rain gauge) and 60 flow meters of varying types and ages throughout the collection system. The current system has proved beneficial for billing regional customers and to provide historic information to troubleshoot specific problem areas, to assist with new and rehabilitation sewer design, and for analysis of the relative magnitude of infiltration and inflow (I/I). However, the sheer volume of the data and field logistics involved are very difficult to manage, data accuracy suffers as a result, and data is not readily available in real time for ongoing operations and maintenance.

A study was conducted in 2014 by HDR. Per Technical Memo of March 2014, the system should be upgraded and expanded to reduce staff time, present real time data and provide additional information for I/I analysis. The cost recommendation is $426,000. The system would then need replacement in 6 to 8 years.
Cured In Place Pipe Liner
Cured-in-place pipe (CIPP) is one of several trenchless rehabilitation methods used to repair existing pipelines. CIPP is a jointless, seamless, pipe-within-a-pipe with the capability to rehabilitate pipes ranging in diameter from (4”–110”). As one of the most widely used rehabilitation methods CIPP has application in water, sewer, gas, and chemical pipelines. (Trenchless Technology (New York: McGraw Hill, 2004)

The City started using CIPP extensively as a rehab method in the late 1990s. During the period of 2000 – 2009, the targeted pipes had the following conditions:

- Beneath structures
- Hard to access for maintenance (wooded areas or other locations with roots or infiltration)
- Roots at joints but not from private laterals
- Structural defects of cracking, egg shaping, crown corrosion, or holes

From 2010 – 2014, most of the CIPP work has been associated with damages from the 2008 Flood. The work has included 14.8 miles of pipe.

The program has been successful and sufficiently reduced public I&I that the primary issue is now roots and private source I&I. This will require new more expensive techniques and policy decision where the work is no longer just in public but private lines. Cost shares for the work and line access will have to be determined. The City is hesitant to begin too robust a program for work on private lines. Stringent conditions and agreements will need to be drafted and adhered to for private owners to qualify for public dollar assistance. The City should remain without liabilities or ownership of any portion of a private line.

Main Interceptor Structure Rehabilitation
During the June 2014 Cedar River flooding, the waste treatment plant lost power for a short period which allowed for a hydraulic water hammer of the manhole structures in the lower section. This same section has the highest levels of hydrogen sulfide in the collection system which results in concrete corrosion. The combination of the two impacts resulted in damages to the manholes. 12 of the structures were repaired in 2014. There are 40 structures on the line. They should be inspected and analyzed for possible rehabilitation or replacement. The cost of a study will cost $10,000 to 50,000 depending on the level of consultant support. Repairs or replacement could range from $1,000 to 15,000. If one considers that 25 percent might require replacement and 25% some for an interior lining, this may cost over $170,000. ($10,000 in FY 16 would come from existing operations and not CIP)
Rehabilitation of East Side Interceptor
The 2008 Flood caused damaged to the flood effected areas of the east side interceptor shown in Figure 8. Joint leaks have resulted in street failures and potential pipe collapses. A CIPP lining of the pipe is in progress to address this issue starting at Cedar Lake in the NE to the river siphon in the SE.

Furfural in the waste stream from Quaker Oats was a contributing factor to rehabilitation needs in the East Side Interceptor. Furfural is an organic compound derived from a variety of agricultural byproducts, including corncobs, oat, wheat bran, and sawdust. In the 1920’s Quaker Oats Company began mass-producing furfural from oat hulls. The process includes sulfuric acid. While furfural production has been discontinued, the process by-products contributed to crown corrosion. Additional future CIPP or reconstruction may need to be performed on the affected lines.

Trunk Sewer Capacity Improvements
In 2009 the City contracted large diameter sanitary inspection. The results of the inspection revealed a number of I&I sources, crown corrosion, and joint failures. This work combined with the ongoing capacity improvement program identified sections of Prairie Creek and Indian Creek lines in need of reconstruction.

The Prairie Creek main line from C St to 6th St SW is scheduled for reconstruction. The first phase of the project will be funded by FEMA funding to address damages from the 2008 Flood. This phase is from C St SW to J St SW. The second section will continue west to the Hawkeye Downs complex. The reconstruction will increase the line from a 42 to 66 inch diameter.

As identified in the 1998 Master Plan, the Indian Creek trunk sewer requires expansion to convey the peak flows from I&I and continued growth in Robins, Hiawatha, Marion and Cedar Rapids. The City of Cedar Rapids has completed work on the first three phases of this capacity improvement. The City of Marion will now continue with the next three phases. This 10 to 20 year capacity expansion was estimated at a total cost of $36.6 million in 2007 dollars. Based on the proportional capacity the sewer provides for Cedar Rapids, the City will be responsible for an estimated 30 percent of the cost.

Lift Station Capacity Analysis
The Morgan Creek, Hoosier Creek, and South Hoosier Creek Lift Stations are all located downstream of growth areas targeted by EnvisionCR. Additionally, portions of the growth areas targeted by EnvisionCR will or may require lift stations.
Additional study will be required to identify specific needs and associated costs. For example, additional capacity improvements were anticipated at the Morgan Creek Lift Station when the 2012 improvements were implemented. With additional growth to the south, the Hoosier and South Hoosier lift stations may also require expansion. These and other lift station related improvements need to be identified.

**Private Lift Stations**

Sewage lift stations are used to pump wastewater from a lower to higher elevation. These stations are used if the elevation of the source is not sufficient for gravity flow and/or when the use of gravity conveyance will result in excessive excavation and higher construction costs. (Pollution Control Systems Inc.) Cedar Rapids topology has required few lift stations. Additional lift stations will be required for expansion of residential areas as discussed in the EnvisionCR comprehensive plan.

Starting in 2014, Cedar Rapids started to investigate the possible future conversion of private lift stations to public. Results of the evaluation are documented in the Cedar Rapids Lift Station Evaluations Final Report dated March 2015 prepared by Watersmith Engineering. For each of the following private lift stations, the City has identified a list of improvements to meet current City design guidelines or a concept to replace the lift station with a gravity sewer. The estimated total capital cost is $1,913,000, the increased annual operations and maintenance cost is $288,600, and the associated annual revenue generation is $70,200. Of the total capital cost $1,088,800 is for Phase 1 minimum requirements and the balance is for Phase 2 to incorporate remaining features from City design guidelines.

- Beaver Hollow located north of Mount Vernon Road SE and east of East Post Road SE
- College Farms located on the north side of US Highway 30 at Ivanhoe Road SW and Union Drive SW
- Hoover Trail located south of US Highway 30 on the west side of Ely Road SW just south of Roosevelt Road SW
- Old Orchard Knolls 5 located on Carby Court NE at Rimrock Drive NE
- Old Orchard Knolls 8 located on Rimrock Court NE south of Old Orchard Road NE
- Prairie located on the east side of Kirkwood Boulevard SW south of 76th Ave Drive SW
- Spirit Hollow located on Q Avenue NW west of 20th Street NW

**Capacity Management Operation and Maintenance (CMOM)**

The City of Cedar Rapids last updated their capacity, management, operation and maintenance (CMOM) program in 2010. Upon completion of the sanitary sewer master planning effort the CMOM Plan should be updated to include the information obtained during creation of the Sanitary Sewer Master Plan. This will ensure that the long term goals identified in the CMOM Plan are congruent with information presented in the Sanitary Sewer Master Plan. In coordination with updating CMOM Plan this would be the ideal opportunity to update and incorporate benchmark data into the CMOM Plan.