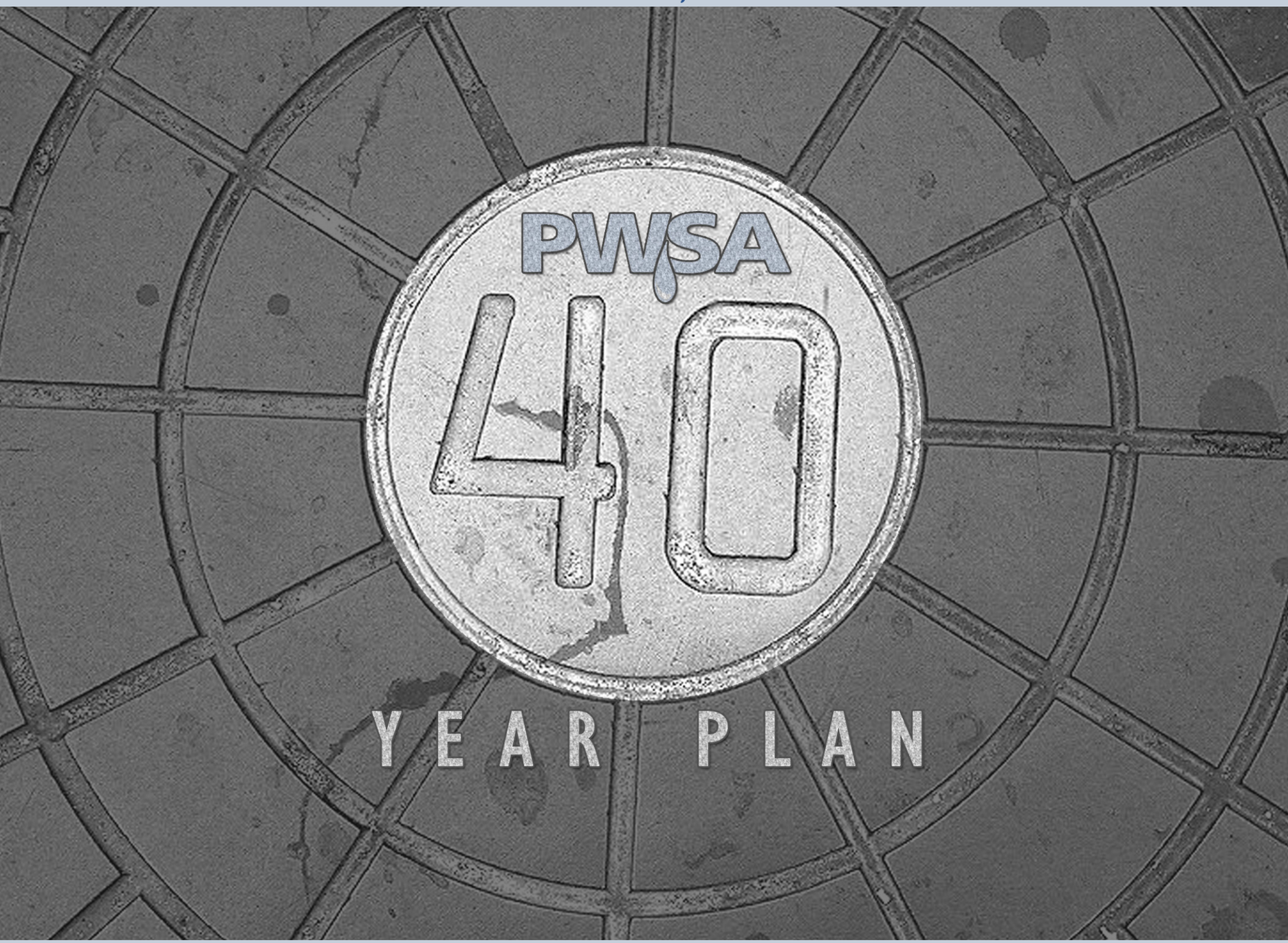
THE PITTSBURGH WATER & SEWER AUTHORITY

ALLEGHENY COUNTY, PENNSYLVANIA



YEAR PLAN

SEPTEMBER 2012

CHESTER ENGINEERS, INC.

The Pittsburgh Water and Sewer Authority
Allegheny County, Pennsylvania

40-Year Plan

May 2011
Revised September 2012

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Project No.: 10-3549-40 Year

PWSA Project No. R-D1.10015-11

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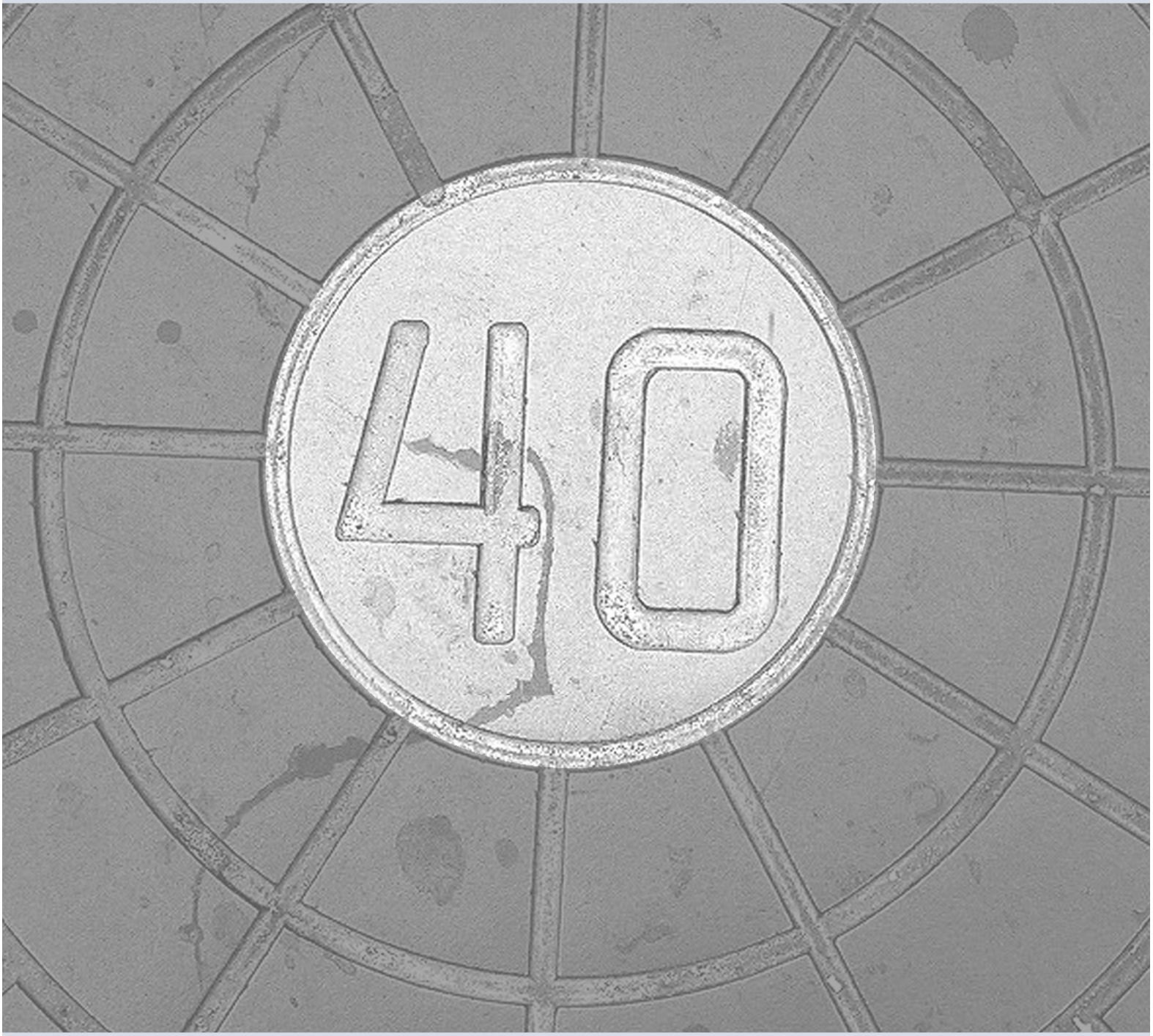

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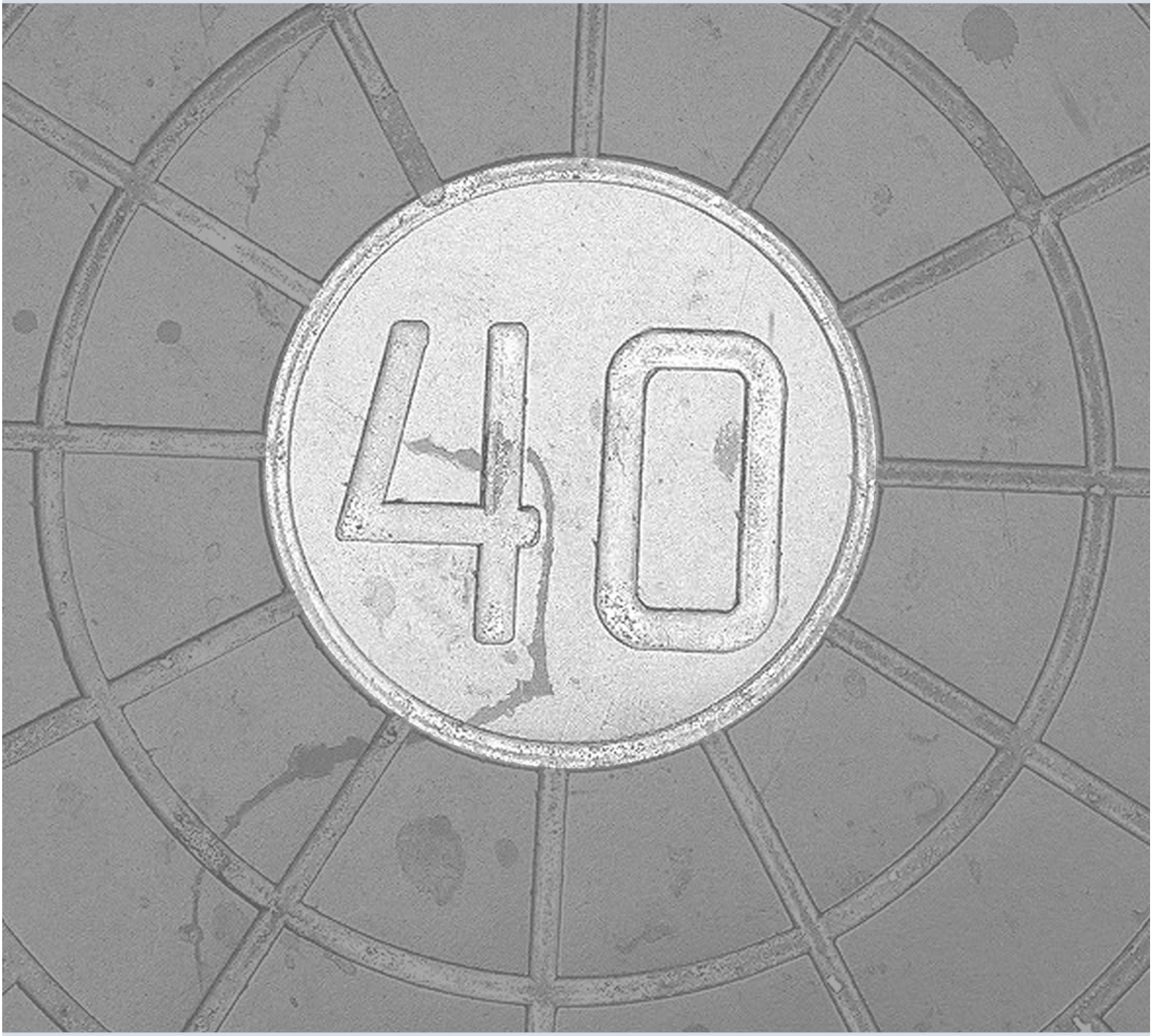
EXECUTIVE SUMMARY



CHESTER ENGINEERS, INC.

PITTSBURGH WATER AND SEWER AUTHORITY
40-YEAR PLAN
EXECUTIVE SUMMARY

In June 2010, PWSA issued an RFP for the preparation of a 40-Year Capital Plan and Water and Sewer Master Plan. The PWSA Board, upon recommendation of the PWSA staff, awarded the project to Chester Engineers.

The 40-Year Plan is a road map for the future that estimates the financial resources needed for capital improvements to the PWSA system. The Plan identifies upgrades to maintain and enhance the performance of the PWSA water and sewer systems. The Capital Improvement Program (CIP) is a series of eight 5-year plans that address repair and replacement needs. The capital plans provide PWSA with the tools to tackle the issues and to meet business objectives, maintain regulatory compliance, and address operational needs within the framework of practical capital funding capabilities. The plan will enable the PWSA Staff and Board to plan future rate adjustments and develop capital borrowing needs. Findings and recommendations are summarized below.

Potential Acquisitions

An analysis of the 40 public water suppliers in Allegheny County concluded that potential expansion of the PWSA water system through acquisition or water sales is limited to Etna Borough, Sharpsburg Borough, and the portion of the City that is currently served by Pennsylvania American Water Company. Etna and Sharpsburg could be served via existing PWSA interconnects but significant capital expenditures would be required to serve the South Hills portion of the City of Pittsburgh.

There are 23 neighboring communities whose wastewater passes through the PWSA system on the way to ALCOSAN for treatment. Because of the unknown costs of upgrading sewer systems to meet COA requirements, assuming ownership of a sewer system would have to be considered a liability. Excluding these concerns, the best candidates for regionalization would have sewer systems in good condition with considerable customer populations and no significant COA issues. The sewer systems in Green Tree Borough and Brentwood Borough meet these criteria.

System Inventory

System inventories were prepared in Excel spreadsheet format for all identified water and sewer system components. The collected information summarizes the age, type, and general condition of PWSA facilities. Treatment facilities include the 117 mgd capacity water filtration plant at Aspinwall and the 26 mgd capacity membrane filtration plant at the Highland No. 1 reservoir. There are 12 water pumping stations in the PWSA system,

excluding the Ross pump station which supplies raw water to the Aspinwall treatment plant. Water storage facilities include 4 in-ground reservoirs and 12 above-ground storage tanks. Above-ground storage facilities include 10 ground level tanks or standpipes and two elevated tanks. Three of the four reservoirs have floating covers. Highland No. 1 reservoir is not covered, so all the water that passes through this reservoir must be re-treated by the membrane filtration plant before it is distributed to customers. Summary statistics for the PWSA water distribution system are listed below:

- 5,341,000 linear feet or 1,012 miles of waterlines, 1-inch to 120-inch diameter.
- 25,330 valves.
- 7,558 hydrants.
- 3/4 of pipelines in system are 6, 8, and 12-inches in diameter.
- Oldest pipes and valves date back to 1887.

Statistics for the PWSA sewer system are summarized below:

- 6,395,000 linear feet or 1,211 miles of sewers, 3-inch to 168-inch diameter
- 29,084 manholes
- 24,143 catch basins/inlets
- 99 diversion structures
- 4 sewage pump stations
- Oldest sewers date back to 1900

System Valuations

A Replacement Cost New Less Depreciation analysis was conducted to determine system valuations. This type of analysis estimates how much it would cost to construct new facilities today and then adjusts replacement costs for individual facilities to account for their age via straight line depreciation. Estimated replacement costs and depreciated values for PWSA facilities are summarized below:

Category	Replacement Cost	Depreciated Value
Distribution	$708.05 million	$169.70 million
Treatment	262.26 million	129.15 million
Pumping	49.83 million	20.46 million
Storage	226.97 million	167.35 million
Water System Subtotal	1.25 billion	486.66 million
Sewer System	1.26 billion	287.27 million
Total	$2.51 billion	$777.93 million

Future Water Needs

Future treatment, pumping, storage, and distribution needs were determined using the PWSA water distribution system model. These evaluations were performed using 2051 water demands, which are expected to be about 8 percent higher than current levels.

Results of the distribution system capacity analysis indicate that no major new water main transmission projects are required to meet anticipated future demands.

The nominal capacities of the pump stations exceed projected future maximum day demands, indicating sufficient pumping capacity. However, additional pumping capacity is recommended at the Lincoln pump station in order to reduce demands in the Herron Hill District.

The PWSA system has an overall surplus of water storage capacity but deficits in storage capacities under future demand conditions were identified in several areas. It is recommended that the capacities of the Herron Hill and Garfield tanks be increased, and that the Squirrel Hill tank be replaced with an elevated tank. Additional storage capacity is also needed in the Lincoln District to lower demands in the Herron Hill District.

Based on current and projected future water demands, no additional treatment capacity is required but it is recommended that PWSA apply for an increase in the permitted water allocation from 100 to 117 mgd.

Sewer System Needs

The PWSA Feasibility Study provides preliminary recommendations relative to projects needed to control CSO discharges from PWSA facilities. PWSA customers will share in the costs for improvements to the jointly permitted outfalls but PWSA will only have to finance capital costs for improvements related to its own CSO outfalls.

The improvements described in the Draft Feasibility Study were reviewed with PWSA staff to identify and refine the improvements needed to control overflows from CSO outfalls that are permitted to PWSA only. PWSA's share of costs for all the CSO improvement projects is estimated to be $195.16 million. This is a very preliminary estimate that is subject to change pending finalization of the PWSA Draft Feasibility Study and regional wet weather planning efforts. Remaining costs are to be covered by contributions from tributary communities that make use of PWSA sewers to convey their wastewater contributions to the ALCOSAN system.

Pumping and Treatment Inventory

An inventory of major PWSA pumps and equipment was developed that includes pumps and equipment at water pumping stations, the Highland membrane filtration plant, the Aspinwall water treatment plant, and at the four sewage pumping stations. The inventory presents information about the pumps and equipment located at each PWSA facility. Information on the list includes equipment name or brief description, equipment

manufacturer, model / serial number, capacity, number of units, date installed, age of unit, and general condition based on appearance and input from PWSA staff.

Waterline Risk Based Analysis

A significant percentage of the water mains in the PWSA system are more than 70-years of age, a generally accepted estimate of the useful life of cast iron mains. Aging pipes become increasingly vulnerable to structural failures and are plagued by water main breaks of increasing frequency and severity, excessive leaks, and catastrophic failure resulting in large water losses, flooding, property damage, and community disruption. These issues can be addressed through the implementation of an ongoing water main repair and replacement program. Water main replacements have been a part of capital improvements programs in the past. However, to be effective, the 40-Year capital plan must include a substantially more aggressive water main replacement program that is supported by a decision support system that can better target mains for replacement and provide a tool for CIP planning.

As part of the development of the 40-year plan, the CapPlan software was used to develop a risk based water main replacement/rehabilitation program. The basic concept is that investments in water main replacement/rehabilitations should be targeted to most effectively minimize risk to the system. The software was used to calculate the risk associated with each pipe segment as the consequences of failure score multiplied by the probability of failure score. The computed risk provided the measure used to prioritize specific water main segments for replacement/rehabilitation.

The CapPlan program was used to develop a budget for replacing/rehabilitating all pipe segments that the program identified as having medium to high risk of failure. Pipe segments identified as having a low to negligible relative risk were not scheduled for replacement/rehabilitation during the 40-year planning period. In order to rehabilitate/replace the medium to high risk mains, the program determined that approximately $14.8 million per year (project cost in current dollars) will have to be spent over the next 40 years.

Leak Detection and Repair

The following activities are recommended for PWSA to institute a comprehensive and efficient leak detection program:

- Calibrate venturi meters at the treatment plant and pump stations to provide accurate figures for the amount of water produced and entering the distribution system.
- Break down the water system into subareas based on the locations of the venturi meters.

- Determine the total metered consumption in individual subareas.
- Compare the amount of water delivered to each subarea versus the amount of water consumed to determine apparent water losses.
- Rank the subareas from worst to best in terms of apparent water losses.
- Use leak detection contractors to find leaks in larger lines and PWSA crews to survey leaks in smaller lines.

Leak detection and repair efforts should focus on subareas identified as having the highest rates of apparent water losses to maximize results. The PWSA GIS can also be used to compare flow rates and metered usage to quantify non-revenue water losses on a near real-time basis. Most customer meters are equipped with an automatic meter reading feature that can be used to determine water use in 15 minute increments. If the water system subareas are broken down into smaller sections for further analysis, zonal system metering can be used in conjunction with automatic meter reading of customer usage to help determine leaks in the distribution system.

Cost Estimates

Concept level cost estimates were developed for recommended capital improvements. The improvement projects are broken down into eight- five year plans to provide the PWSA with a plan of action to meet business objectives, maintain regulatory compliance, and address operational needs within the framework of practical capital funding capabilities. Each capital improvement project is grouped according to business area.

Distribution

Distribution system improvements include the following components:

- Replacement of pipe segments with medium to high risk of failure.
- Leak detection on larger lines by outside contractors.
- Water meter replacement program.
- Millvale water system improvements to increase pressure.
- Facilities to transfer water from Highland No. 2 District to Highland No.1 District.
- Bloomfield-Penn Avenue distribution system improvements.
- Reducing the size of the Herron Hill service district.
- Joint venture projects.

The cost for the recommended distribution system improvements is estimated to be $1.405 billion over the 40-year planning period.

Pumping and Storage

Pumping improvements include replacement of pumps, roofs, motor control centers, and HVAC systems. Storage improvements include repair and replacement of floating reservoir covers, reservoir cleaning, tank painting, concrete tank repairs, tank replacement, and installation of systems to reduce TTHMs in water storage tanks. The estimated cost for improvements over the 40-year planning period is $35.018 million for pumping upgrades and $150.652 million for storage related projects.

Treatment

Treatment improvements include rehabilitation of sedimentation basins, clarifiers, filters, the clearwell, and chemical feed systems. Other improvements include SCADA upgrades, replacement of motor control centers, pumps and motors, and the boiler at the Ross pump station. The estimated cost for recommended treatment improvements is projected to be $401.607 million over the planning period.

Sewers

Sewer improvements include COA projects, sewage pump station upgrades, and joint venture projects with the URA and other agencies. Expenditures include $1.00 million per year for COA compliance and a $2 million annual allowance for other sewer system improvements. The cost for recommended capital improvements to the sewer system over the 40-year planning period is estimated to be $604.995 million.

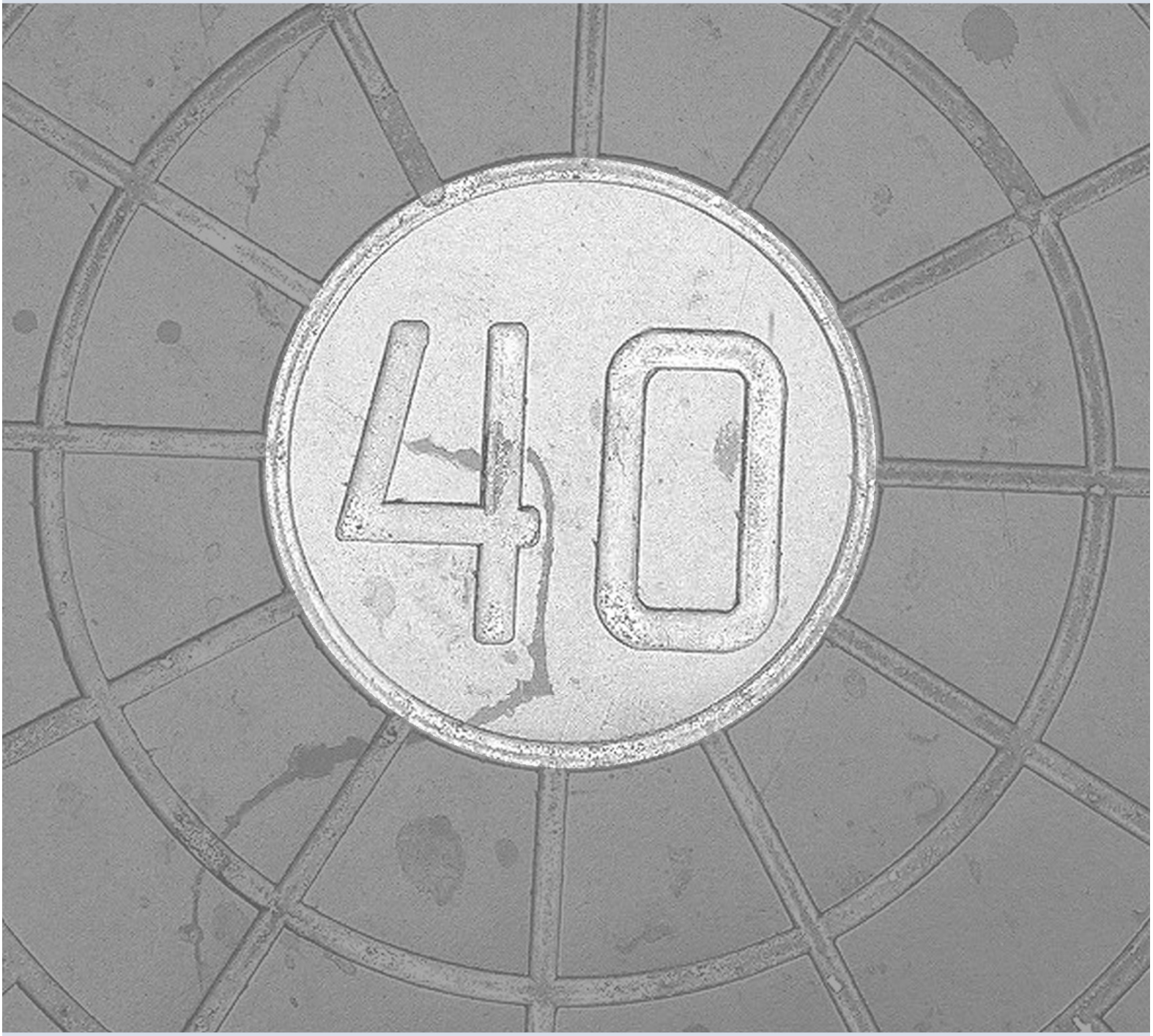
GIS

The estimated cost for GIS capital improvements is estimated at $2.10 million over the planning period. Items under this category include GPS units, laptops for field crews, software upgrades, and server upgrades.

Total Costs

The total cost for system improvements over the 40-year planning period is estimated to be $2.60 billion. Distribution system improvements account for about 54 percent of the total. Expenditures for recommended capital improvements during the eight, five-year plans range from $242 to $408 million and average $325 million or $65 million per year.

TASK 1



CHESTER ENGINEERS, INC.

PITTSBURGH WATER AND SEWER AUTHORITY
40-YEAR PLAN
TASK 1 - PROJECT COORDINATION/REVIEW MEETINGS

1.1 PROJECT KICKOFF MEETING

A project kickoff meeting was held on October 5, 2010 with key PWSA personnel. Items discussed at the meeting included project organization, communications, project tasks, project schedule, and project objectives. The roles of Chester Engineers team members and PWSA staff were identified and communication protocols were established. The work tasks described in Chester's proposal were reviewed to ensure that the proposed work scope and schedule were in alignment with the PWSA's goals and objectives. Specific project objectives were also discussed during the kick-off meeting.

More detailed information about the kick-off meeting is available in the meeting minutes. Minutes for the kick-off meeting are included in Appendix 1-1.

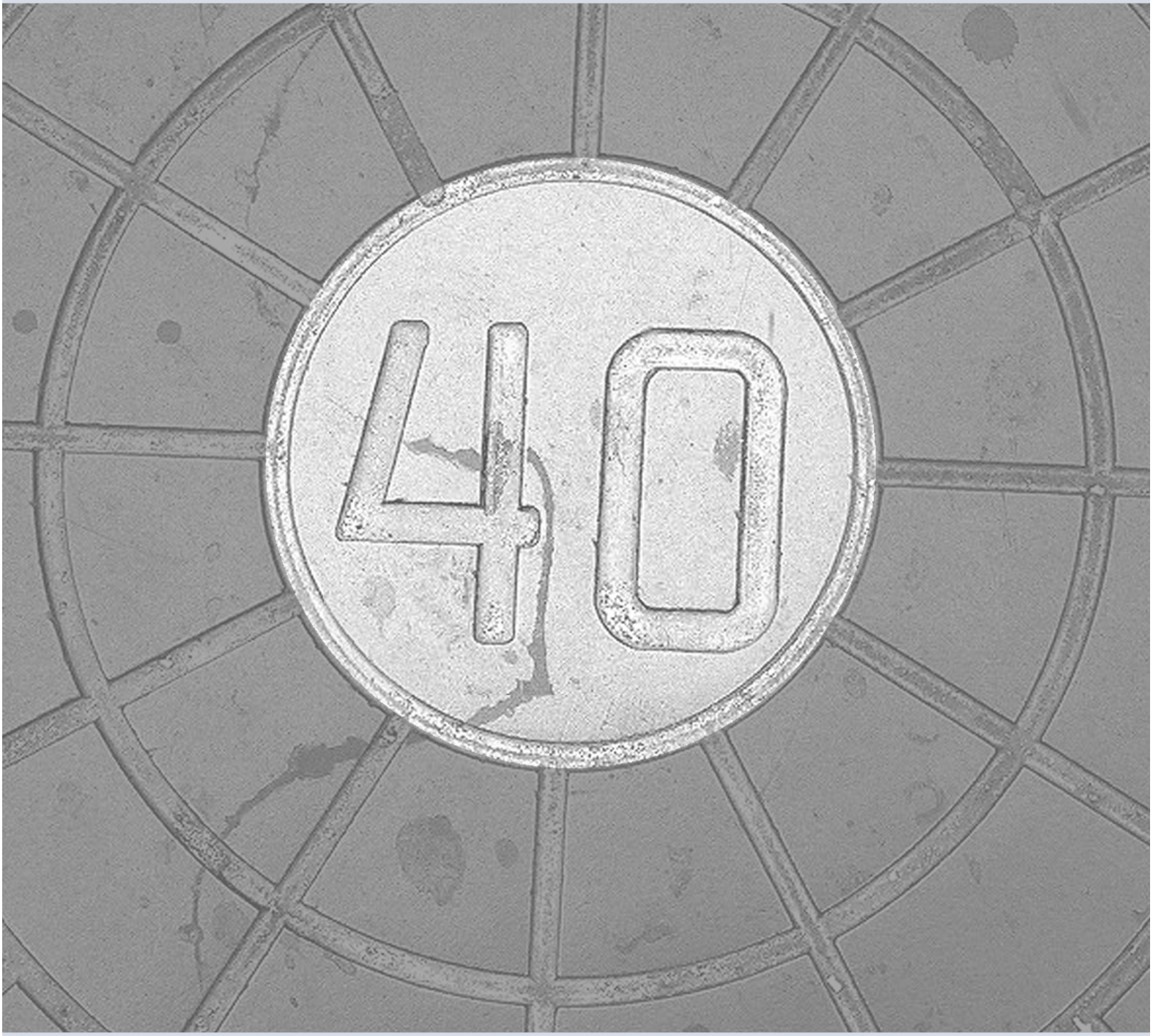
1.2 MONTHLY PROJECT MEETINGS

Progress meetings were held at approximately one-month intervals. Agendas were developed prior to the meetings and minutes were produced afterwards to document the subjects covered at the meetings. General discussion topics for the meetings included preliminary findings, updates of progress versus schedule, and identification of potential alternatives. The meetings were also used to solicit input from PWSA staff regarding sources of available information, evaluation of alternatives, and prioritization of improvements.

More detailed information about the monthly progress meetings can be found in the meeting agendas and meeting minutes. Meeting agendas are included as Appendix 1-2 and meeting minutes are contained in Appendix 1-3.

An internal questionnaire was also developed and distributed to PWSA. The purpose of this questionnaire was to obtain input from PWSA department heads and other key staff members on items that needed to be addressed in the 40-Year Capital Plan. A meeting to discuss the internal questionnaire was held on October 29, 2010. A meeting agenda and completed questionnaires are included in Appendix 1-4.

TASK 2



CHESTER ENGINEERS, INC.

THE PITTSBURGH WATER AND SEWER AUTHORITY
40-YEAR PLAN
TASK 2 - IDENTIFY OPPORTUNITIES FOR REGIONALIZATION

2.1 GROWTH INITIATIVES AND REGIONALIZATION

Meetings were held with representatives of the City of Pittsburgh Department of City Planning, the Allegheny County Department of Economic Development, the Allegheny County Health Department (ACHD), and the Pennsylvania Department of Environmental Protection (DEP). Summaries of the items discussed at each individual meeting can be found in Appendix 2-1.

The meeting with the Department of City Planning was held on May 4, 2011. Most of the meeting was spent discussing what City Planning has observed regarding historic development trends and where future land use changes are expected within the City. Projections indicate that the City's 2035 population is expected to stabilize between 330,000 and 335,000 persons.

A meeting was held on May 5, 2011 with the Allegheny County Department of Economic Development. Information was provided on two new hotel developments, one Downtown and one in Oakland, that are expected to be completed in 2013. The remainder of the meeting was spent reviewing activities that the Department has been involved with, specifically related to development trends and the City. These activities and studies include Allegheny Places, Connect, Allegheny Together, ARTEZ, and comprehensive water and sewer plans for Allegheny County.

The meeting with ACHD was held on May 10, 2011. The majority of the meeting was spent discussing conditions that the ACHD sees in the field and the type of complaints that are received. ACHD receives very few complaints about the PWSA water system but the age of the existing infrastructure is a concern. On the sewer side, combined sewer overflows are a concern and the ACHD estimates that approximately 500 homes in the City of Pittsburgh are served by private septic systems and are not connected to the public sewer system.

The meeting with the DEP was also held on May 10, 2011. Discussions primarily focused on expected future trends in Pennsylvania air and water regulations but Marcellus shale issues and Brownfields redevelopment were also discussed. DEP representatives noted that regionalization opportunities exist with surrounding communities including Reserve, Aspinwall, Fox Chapel, Blawnox, and Millvale.

2.2 REGIONALIZATION REVIEW

Introduction

Definition: Regionalization

- Expanded service areas that take in a larger geographic area or multiple systems.
- Multi-jurisdictional utility commissions, special districts, authorities or corporations.
- Consolidated operation or management of multiple systems or onsite systems.
- Merging, consolidating, or combining infrastructure assets of two or more existing facilities or systems.

Primary drivers for regionalization (not in any order of importance or priority):

- Changing water and wastewater rules and regulations.
- Reliability and capacity.
- Economies of scale.
- Financing.
- Shortage of qualified leadership, management or supervisorial talent and/or an adequate skilled trade labor force (e.g., retirement of "baby boomers").
- Consolidation of redundant administrative and governance functions.

Annually, the American Water Works Association (AWWA) reissues its Statement of Policy on Public Water Supply Matters with little if any modification since release of the 1996 Safe Drinking Water Act Amendments. In 2009, the reaffirmation of its policy read as follows:

> The American Water Works Association (AWWA) encourages water utilities to support regional solutions to resource management, water supply, and utility services needs (emphasis added). AWWA values the protection and efficient use of natural resources. Regional water supply planning may increase water use efficiency, promote water conservation, minimize capital investment, and enhance source protection. Where a regional program is necessary or desirable, water utilities should work with the appropriate governmental and other entities to develop regional solutions to promote effective water resource and water supply management practices coupled with sound provision of utility services (emphasis added). Furthermore, AWWA encourages state, provincial, territorial, and federal agencies to support local efforts to develop appropriate regional programs and to ensure equitable benefits to all participating water utilities.

> Regionalization of water source management and utility services, either through physical connection and/or common management structures, may provide enhanced source water protection and management practices and economies of scale (emphasis added). AWWA defines a regional water system as a management or contractual administrative organization, or a coordinated physical system plan of two or more community water systems using common resources and facilities to their optimum advantage, to provide sustainable water resource and supply management and high quality water service to customers in a fiscally responsible manner.
>
> The economic effect of regulatory reform, such as the 1996 Safe Drinking Water Act Amendments is significant. Utilities face additional monitoring and capital costs, and smaller water systems may struggle to cover costs associated with water resource and supply management requirements in their effort to provide high-quality water utility services. AWWA recognizes the importance of regional solutions that support local (community) needs and are consistent with effective resource management programs and practices. At the same time, AWWA emphasizes the need for utilities to operate as self-sustaining organizations whose management practices and structures are defined by local requirements (emphasis added). Accordingly, regional water resource and supply management and utility service programs and policies need to recognize and address the individual needs and requirements of local, state, provincial, and federal stakeholders.

In summary, the AWWA Statement of Policy:

- Encourages water utilities to support regional solutions to resource management, water supply, and utility services needs.
- Suggests where a regional approach is necessary or desirable; that water utilities should work with appropriate governmental and other entities to develop regional solutions to promote effective water resource and water supply management practices coupled with sound provision of utility services.
- Advises that regionalization of water source management and utility services, either through physical connection and/or common management structures, may provide enhanced source water protection and management practices and economies of scale.

With little modification, this policy can readily be applied as a policy statement for accomplishing regional solutions for water quality protection and wastewater management. However, relative to water systems, regionalization of wastewater systems has been particularly emphasized in the last 40 years under provisions of the Clean Water Act Amendments of 1972 ("the Act" [PL 92-500]) starting with grants for regional wastewater facility planning required by Section 201 of the Act. This planning preceded

tens of billions of dollars for design and construction grants for water pollution control facilities obligated into the 1980's and ultimately morphing into a sustained federal capitalized grant program under which states administer low interest capital loan programs, commonly know as State Revolving Funds. The wastewater industry has reaped the benefits of grant funding, which accelerated and expanded regional approaches to water quality and wastewater management across the nation.

Pennsylvania Statutes on Water Utility Restructuring and Consolidation Efforts

This section summarizes Pennsylvania statutes, regulations, or policies that encourage or require consolidation or restructuring (aka regionalization) of drinking water systems.

Overview of State Restructuring and Consolidation Efforts

State agencies directly involved with restructuring and consolidation efforts are primarily the Pennsylvania Public Utility Commission and the Pennsylvania Department of Environmental Protection.

Title 52 Pennsylvania Code (PC) Chapter § 69.701 addresses the viability of small water systems and presents objectives of the Public Utility Commission (PUC) and the Department of Environmental Protection (DEP) as "substantially restricting the number of nonviable drinking water systems by discouraging the creation of new nonviable small systems, and at the same time, encouraging the restructuring of existing nonviable small systems".

To meet these goals the PUC provides acquisition incentives, among other things, and facilitates the rate process to aid in the provision of financial assistance from PENNVEST, the state's finance authority, to projects that incorporate or encourage comprehensive planning and restructuring. The PUC has statutory authority to order, under appropriate circumstances, the acquisition of small, noncompliant water systems by larger systems that are capable of providing safe and adequate service to all ratepayers.

To be eligible for the incentives, an acquisition must: serve the general public interest; be conducted through arms-length negotiations; leave the acquiring system with adequate technical, managerial and financial capabilities; and provide the acquired system's rate payers with improved service within a reasonable period of time. In addition, the acquired system must be non-viable: in violation of a PUC statute or regulation; have failed to comply with a DEP order; and serve fewer than 3,300 customers. The purchase price of the acquisition must be fair and reasonable.

Acquisition incentives include additional rate of return basis points, the inclusion of reasonable excess acquisition costs in the rate base of the acquiring entity and amortization over 10 years, with a phased-in rate recovery for improvement costs. Additional surcharges are allowed to offset various operating costs (state tax adjustment, distribution system improvement, purchase power, and purchase water). The PUC encourages Single Tariff Pricing (STP) as an appropriate tool to facilitate regionalization.

Benefits of Regionalization

In general, benefits of regionalization are derived from the following:

- Economies of scale – larger pool of ratepayers to spread operating and capitalization costs.
- Consolidation of services – billing services, certified operators, and other administrative functions.
- Fewer numbers of treatment installations - leads to overall cost-savings to ratepayers (e.g., one centralized treatment plant to cover all demands).
- Access to capital and lower cost of capital – better loan terms and bond rates
- Natural resources management and watershed protection – better opportunity to manage a watershed holistically to accommodate multiple uses and interests.

System Operational Benefits

- Operation and Management – facilitate improvement of management by providing more comprehensive supervision and better day-to-day direction of operations. More effective and extensive monitoring of water quality on the basis of economies of scale; 1) assure optimum reaction to emergencies by unified service organizations, and 2) standardization of construction materials.
- Planning and Design – allow for optimum planning of water supply
- Financing – uniform water rate structure resulting from the cost of services being distributed over a larger geographic area and facilitating coordination and combination of fiscal and physical resources; assist in better short- and long-term financing terms because of the stability of the revenue base and better bond/credit ratings.
- Government – will assist the Pennsylvania Department of Environmental Protection (DEP) by reducing the number of management organizations needed to monitor water quality, and possibly the reduction in political entities involved in water system management. Well managed systems will reduce

the incidence of government interceding in the operation and control of water utilities.

Potential Problems/Drawbacks

- Public Attitude and Government – communities may be opposed to loss of control of its water system's income diverted to a regional general fund. May be indifferent to water needs and the risk posed by inaction. Municipalities cannot readily be compelled to join a regional agency.
- Inequities and financing – concern for loss of water sales revenue used for other general purpose needs; may be difficult to purchase a private system or acquire properties of another utility by condemnation. Concern that water revenues from a well serviced area will be used to finance improved supply to a poorly serviced area.
- Reorganization – reduction in staff; may shift highly qualified personnel into incompatible positions for their skills; organized labor issues.

Regionalization "Lite"

Drinking water and water quality rules and regulations have historically, at least in part, driven regionalization or other cooperative efforts among agencies. While these rules undoubtedly have raised the cost of doing business, funding agencies tend to look more favorably toward projects that have some characteristics of a regional approach. Implementation of existing rules through voluntary and enforcement actions, and the advent of new rules and regulations on the horizon and beyond will dictate the need for continuing and expanded cooperation. Such relatively recent or emerging areas of regulation include:

- Surface Water Treatment.
- Disinfectants and Disinfection Byproducts.
- Personal Hygiene Products.
- Endocrine blockers and other pharmaceuticals.
- Other micro contaminants.

However, there are alternatives to complete consolidation and regionalization of service providers such as interconnection for purposes of supplying wholesale treated and untreated bulk water; providing emergency backup capacity; providing mutual aid; and sharing other resources/assets including offices, and management and operational personnel, while maintaining separate governing bodies. These alternatives should be carefully considered in the overall scheme of regionalization concepts and approaches.

Barriers to Regionalization

A series of listening sessions were held in the state of Idaho to document perspectives on regional approaches to providing drinking water and sanitary sewer services. One consistent theme emerged from these discussions - the desire to maintain jurisdictional autonomy regularly outweighs the potential benefits of participating in regional approaches involving shared capacity and governance. Participants felt that decisions on how best to manage water and wastewater provisions are most effectively carried out on a local, case-by case basis. Further, individual communities were reluctant to give up their ability to control the pattern and pace of development within their jurisdictions.

Potential barriers to the adoption of regional approaches to water and sewer provision are listed below:

- History of disagreements / political posturing by neighboring communities.
- Differing priorities and opinions on appropriate service levels.
- Differing public financing philosophies - pay as you go versus bonds.
- Potential loss of control over how resources will be deployed - one community will be required to pay for the needs of another community.
- Concern about unequal allocation of shared resources between jurisdictions - smaller community won't benefit from the shared arrangement.
- Concern about a lack of access to the capacity needed to support growth opportunities.
- Potential loss of control regarding the nature and rate of development within the community.
- Regional approach adds bureaucracy and costs to an already complicated system.
- Concern about the loss of community identity if resources are shared.
- No compelling reasons to change – inertia, no significant problems with current system.

Use of Eminent Domain to Purchase Water Utilities

The use of eminent domain to provide for public utilities such as light, heat, water, and power is widely recognized. However, the governing statutory provisions in most states usually do not expressly provide that eminent domain can be used to acquire an existing utility. The practice of public condemnation of private utilities dates back to the mid-19th century. The practice is generally accepted historically, with courts uniformly finding that obtaining public ownership of utilities is a sufficient public purpose to support the exercise of eminent domain. In the past half-century, there is more division on the issue,

with some states encouraging condemnation by statute and other states limiting it. A few states require a finding of "necessity" as a pre-condition for exercising eminent domain. In the condemnation of an existing utility, it is possible to argue a lack of necessity since the public already is being served by the private utility.

The cities of Pekin and Peoria, Illinois have been separately engaged in legal struggles with Illinois American Water, an investor-owned utility, over purchasing the utility assets. Peoria's right to purchase private assets was established under an old contract through which they sold public assets to American Water's predecessor. The courts upheld the repurchase clause in the contract, although American Water disputed it. Ultimately, Peoria chose not to re-purchase the American Water assets because they were deemed too expensive.

Unlike Peoria, the City of Pekin has no such contractual history with American Water. Pekin has attempted to use eminent domain to purchase the private assets and this action is currently being litigated. Illinois is among those states that limit local authority, although not over a finding of necessity. Instead, the Illinois Commerce Commission has established a standard that the condemnation must be in the public interest. Pekin has floundered on this standard and in particular has not addressed the issue of rate protection for water system customers outside Pekin City limits.

Privately owned utility companies fear such government ownership and have resisted selling their assets to cities, arguing that public ownership will not provide the promised reliability, adequate customer service, or reduced prices. This is precisely the argument made successfully so far by Illinois-American Water versus the City of Pekin.

Advancing Regionalization and the Human Factor.
Blockers, Dos and Don'ts

Potential adverse human reaction to the suggestion of regionalization should be anticipated in order to preserve the integrity of the option and ultimately manage its implementation successfully. Several of the more common reactions include the following:

- Concerns about losing autonomy, loss of control or power by one group or another, or not being able to control their own destiny.
- If the people involved believe that something is being forced upon them and they cannot see a direct benefit to the community, opposition is generally the outcome.
- It is important that local elected officials do not allow their own personal agendas to influence their decisions. It is essential for those who are involved in the process to be involved for the right reason -- the overall good of the community.

Advancing Regionalization

- Good communication – participants must not feel threatened or forced into hasty decisions; well designed and executed public participation is strongly advised.
- Strong leadership – need to keep moving the dialog forward; supply the diplomacy and communications needed to garner the support required to advance the project.
- Customer confidence – merger has to resolve problems obvious to the ratepayers and undeniably improve efficiencies of operations while meeting a represented level of service.
- Common agendas – differences have to be minimized if not eliminated in order to achieve unity and a spirit of cooperation

Responsibility of the Community in Considering Regionalization

Regionalization is linked to capacity development and helping drinking water and sewer systems improve their finances, management, infrastructure, and operations so they can provide safe drinking water and water quality protection consistently, reliably and cost effectively. In that context, communities should answer the following before proceeding with long-term regionalization efforts:

- Will the community or public be better served by the new system?
- What are the added benefits that the community will receive from this new entity?

2.3 EVALUATE WATER SYSTEM EXPANSION OPTIONS

Public water service in Allegheny County is provided by the 40 water suppliers listed in Table 2-1. Public water suppliers include 23 authorities, 16 municipalities, and 1 investor owned utility. Areas of Allegheny County served by these water suppliers are illustrated in Figure 2-1. PWSA acquired the Millvale water system in 2009.

Table 2-1
Allegheny County Public Water Suppliers

Supplier	Type of Ownership	Primary Source of Water
Aleppo Township Authority	Authority	Purchased
Aspinwall Borough Water Department	Municipal	Ground
Brackenridge Borough Water	Municipal	Surface

Table 2-1
Allegheny County Public Water Suppliers (Continued)

Supplier	Type of Ownership	Primary Source of Water
Blawnox Municipal Waterworks	Municipal	Purchased
Braddock Borough Water Authority	Authority	Purchased
Cheswick Borough Water Department	Municipal	Ground
Coraopolis Water & Sewer Authority	Municipal	Ground
Creswell Heights Joint Authority	Authority	Ground
City of Duquesne	Municipal	Purchased
East Deer Township Waterworks	Municipal	Purchased
Edgeworth Borough Municipal Authority	Authority	Purchased
Etna Borough	Municipal	Purchased
Fawn Frazier Joint Water Authority	Authority	Purchased
Findlay Twp Water Authority	Authority	Purchased
Fox Chapel Authority	Authority	Purchased
Glenfield Water Company	Municipal	Purchased
Hampton Shaler Water Authority	Authority	Ground
Harmar Township Municipal Authority	Authority	Ground
Harrison Township Water Authority	Authority	Surface
Monroeville Municipal Authority	Authority	Purchased
Moon Township Water Authority	Authority	Surface
Neville Township	Municipal	Purchased
Oakdale Borough	Municipal	Purchased
Oakmont Borough Municipal Authority	Authority	Surface
Pennsylvania American Water Company	Investor PUC	Surface
Pittsburgh Water & Sewer Authority	Authority	Surface
Plum Borough Municipal Authority	Authority	Purchased
Richland Township Municipal Authority	Authority	Purchased
Reserve Township	Municipal	Purchased
Robinson Township Municipal Authority	Authority	Surface
Sewickley Borough Water Authority	Authority	Ground
Borough of Sharpsburg	Municipal	Ground
Springdale Township	Municipal	Purchased
Springdale Borough Water Department	Municipal	Ground
Tarentum Borough	Municipal	Surface
Western Allegheny County Municipal Authority	Authority	Purchased
Westmoreland County Municipal Authority	Authority	Surface
West View Borough Municipal Authority	Authority	Surface
Wilkinsburg -Penn Joint Water Authority	Authority	Surface

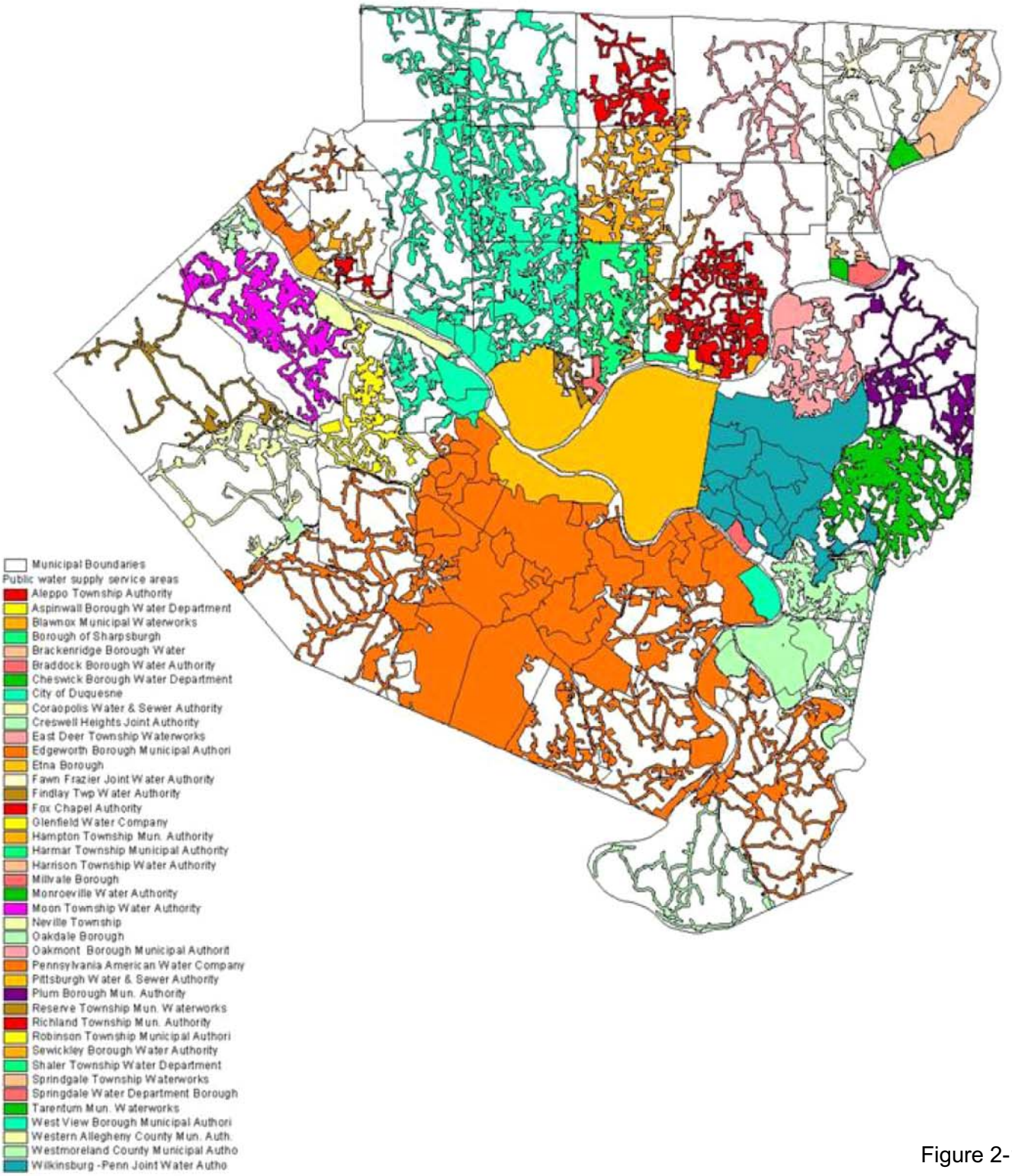

Municipal Boundaries
Public water supply service areas
Aleppo Township Authority
Aspinwall Borough Water Department
Blawnox Municipal Waterworks
Borough of Sharpsburgh
Brackenridge Borough Water
Braddock Borough Water Authority
Cheswick Borough Water Department
City of Duquesne
Coraopolis Water & Sewer Authority
Creswell Heights Joint Authority
East Deer Township Waterworks
Edgeworth Borough Municipal Authori
Etna Borough
Fawn Frazier Joint Water Authority
Findlay Twp Water Authority
Fox Chapel Authority
Glenfield Water Company
Hampton Township Mun. Authority
Harmar Township Municipal Authority
Harrison Township Water Authority
Millvale Borough
Monroeville Water Authority
Moon Township Water Authority
Neville Township
Oakdale Borough
Oakmont Borough Municipal Authorit
Pennsylvania American Water Company
Pittsburgh Water & Sewer Authority
Plum Borough Mun. Authority
Reserve Township Mun. Waterworks
Richland Township Mun. Authority
Robinson Township Municipal Authori
Sewickley Borough Water Authority
Shaler Township Water Department
Springdale Township Waterworks
Springdale Water Department Borough
Tarentum Mun. Waterworks
West View Borough Municipal Authori
Western Allegheny County Mun. Auth.
Westmoreland County Municipal Autho
Wilkinsburg -Penn Joint Water Autho

Figure 2-1

Water Requirements

Table 2-2 presents information about existing Allegheny County water suppliers. Numbers of customers and current water demands associated with each of the water service suppliers were obtained from annual water supply reports that are submitted to the Pennsylvania Department of Environmental Protection (DEP). Average day demands are most relevant to the assessment of the impact upon treatment system capacity and water sales revenue potential. Maximum day demands are the primary determining factor in sizing water system extensions and evaluating the impact of those extensions on the PWSA distribution system.

Existing Rate Information

Table 2-2 also presents existing rate structure information for each water supplier, including the base rate and the volumetric rate for water service. Rate information for four of the suppliers came from Internet web sites but the majority of the information was obtained via a telephone survey. Base rate information was only provided by about 50 percent of the suppliers contacted during the telephone survey. The Glenfield Water Company did not provide any information. Some water providers bill their customers on a quarterly basis while others send bills each month. Similarly, some providers send bills based on the number of gallons used while other bills are based on cubic feet of water consumed. To be consistent and allow comparisons to be made, all base rates were converted to a cost per month and all volumetric rates were converted to a cost per 1,000 gallons.

Potentially Feasible Candidates for Regionalization

Regionalization with many of the 39 other public water suppliers that operate in Allegheny County is not feasible for various reasons including the size of the County, distances from PWSA facilities, small service populations for some suppliers, and political considerations. Allegheny County has a total area of about 745 square miles. At its widest points, the County measures approximately 33 miles in a north-south direction and 34 miles from east to west. The PWSA service area is located in the geographical center of the County, making it impractical to extend service from the PWSA system to distant water suppliers. The following 15 public water suppliers are situated at the outer edges of Allegheny County and are adjacent to neighboring counties:

- Brackenridge Borough Water
- Creswell Heights Joint Authority
- East Deer Township Waterworks

Table 2-2

Public Water Supplier Information

	Supplier	Ownership	Water Source	No. of Customers	Avg. Day Demand	Max Day Demand	Base Rate $/Month	Water Cost $/1,000 gal
1	Aleppo Township Authority (2)	Authority	Purchased	647	184,193	N.A.	$7.72	$6.00
2	Aspinwall Borough Water Department (1)	Municipal	Purchased	1,201	232,164	257,500	N.P.	6.61
3	Brackenridge Borough Water (1)	Municipal	Surface	1,403	1,304,411	1,987,000	8.89	5.87
4	Blawnox Municipal Waterworks (4)	Municipal	Purchased	726	124,458	N.A.	N.P.	5.43
5	Braddock Borough Water Authority (1)	Authority	Purchased	711	282,246	595,408	14.23	5.78
6	Cheswick Borough Water Department (4)	Municipal	Ground	911	189,247	N.A.	N.P.	5.75
7	Coraopolis Water & Sewer Authority (1)	Municipal	Ground	2,658	553,990	642,035	8.82	5.29
8	Creswell Heights Joint Authority (1)	Authority	Ground	5,659	906,077	1,222,000	12.99	5.10
9	City of Duquesne (1)	Municipal	Purchased	2,050	550,822	992,000	N.P.	6.75
10	East Deer Township Waterworks (2)	Municipal	Purchased	624	260,202	402,742	N.P.	6.00
11	Edgeworth Borough Municipal Authority (1)	Authority	Purchased	2,311	645,506	1,100,100	N.P.	7.68
12	Etna Borough (1)	Municipal	Purchased	1,664	105,204	2,630,000	N.P.	5.75
13	Fawn Frazier Joint Water Authority (1)	Authority	Purchased	1,874	432,715	N.A.	N.P.	5.42
14	Findlay Township Water Authority (1)	Authority	Purchased	1,889	493,849	1,093,000	N.P.	7.39
15	Fox Chapel Authority (1)	Authority	Purchased	5,390	1,848,219	2,720,000	7.41	6.22
16	Glenfield Water Company (2)	Municipal	Purchased	84	18,472	N.A.	N.P.	N.P.
17	Hampton Township Municipal Authority (1)	Authority	Purchased	9,790	1,848,101	2,503,000	5.51	4.24
18	Harmar Township Municipal Authority (3)	Authority	Ground	1,100	512,460	793,000	12.00	6.42
19	Harrison Township Water Authority (1)	Authority	Surface	4,859	1,416,430	1,866,000	N.P.	6.26
20	Monroeville Municipal Authority (1)	Authority	Purchased	10,713	2,994,409	6,029,000	N.P.	5.00
21	Moon Township Water Authority (1)	Authority	Surface	7,957	2,514,283	4,099,000	N.P.	3.50
22	Neville Township (2)	Municipal	Purchased	654	551,586	N.A.	N.P.	6.00
23	Oakdale Borough (2)	Municipal	Purchased	684	134,706	N.A.	N.P.	6.20
24	Oakmont Borough Municipal Authority (1)	Authority	Surface	16,584	4,676,345	6,379,000	N.P.	3.73
25	Pennsylvania American Water Company (1)	Investor PUC	Surface	207,087	76,240,214	91,150,000	13.00	7.89
26	Pittsburgh Water and Sewer Authority (1)	Authority	Surface	80,435	70,493,158	91,048,000	15.80	5.39
27	Plum Borough Municipal Authority (1)	Authority	Purchased	10,028	2,124,251	2,756,720	12.83	3.06
28	Richland Township Municipal Authority (1)	Authority	Purchased	3,466	807,561	1,105,000	9.00	5.30
29	Reserve Township (1)	Municipal	Purchased	1,495	257,701	315,142	8.07	5.50
30	Robinson Township Municipal Authority (1)	Authority	Surface	4,619	2,789,050	4,059,360	N.P.	4.95
31	Sewickley Borough Water Authority (2)	Authority	Ground	2,211	990,569	2,208,160	12.07	8.75
32	Shaler Township Water Department (1)	Municipal	Ground	12,663	4,568,957	6,078,000	7.50	3.77
33	Borough of Sharpsburg (1)	Municipal	Ground	1,454	464,085	636,000	6.67	5.00
34	Springdale Township (1)	Municipal	Purchased	819	118,697	N.A.	7.50	3.50
35	Springdale Borough Water Department (1)	Municipal	Ground	1,737	505,773	1,059,000	N.P.	6.00
36	Tarentum Borough (1)	Municipal	Surface	2,056	893,197	1,178,000	8.25	5.30
37	Western Allegheny County Municipal Authority (1)	Authority	Purchased	6,263	389,356,510	1,736,665	15.59	5.55
38	Westmoreland County Municipal Authority (1)	Authority	Surface	119,959	46,611,196	53,965,000	11.51	4.79
39	West View Borough Municipal Authority (1)	Authority	Surface	52,721	25,334,107	31,728,000	5.00	3.36
40	Wilkinsburg-Penn Joint Water Authority (1)	Authority	Surface	40,634	21,020,603	25,642,000	N.P.	4.82

(1) 2009 Public Water Supply Report
(2) 2008 Public Water Supply Report
(3) 2006 Public Water Supply Report
(4) 2005 Public Water Supply Report

N.P. = Not Provided

- Fawn Frazier Joint Water Authority
- Findlay Township Water Authority
- Harrison Township Water Authority
- Monroeville Municipal Authority
- Moon Township Water Authority
- Oakdale Borough
- Plum Borough Municipal Authority
- Richland Township Municipal Authority
- Springdale Township
- Tarentum Borough
- Western Allegheny County Municipal Authority
- Westmoreland County Municipal Authority

Of the remaining 24 public water suppliers, the following 7 are located in the Ohio River valley at a considerable distance from the PWSA system:

- Aleppo Township Authority
- Coraopolis Water & Sewer Authority
- Edgeworth Borough Municipal Authority
- Glenfield Water Company
- Neville Township
- Robinson Township Municipal Authority
- Sewickley Borough Water Authority

A further impediment to extending service to suppliers in the Ohio River valley is that any pipeline extension would have to pass through the existing West View Borough Municipal Authority service area. The West View Authority serves customers in 24 municipalities located north and west of the PWSA system.

Of the remaining 17 Allegheny County public water suppliers, the following 4 are located in the Allegheny River valley and are also situated a considerable distance from the PWSA system:

- Cheswick Borough Water Department
- Harmar Township Municipal Authority
- Oakmont Borough Municipal Authority
- Springdale Borough Water Department

In the Monongahela River valley, two small water suppliers with limited customer bases are located within a few miles of the PWSA system. The City of Duquesne serves 2,050 customers and the Braddock Borough Water Authority serves 711 customers. However, water lines to extend service to these areas would have to be constructed through existing service areas for the Wilkinsburg-Penn Joint Water Authority and/or the Pennsylvania American Water Company.

Based on the analysis presented above, PWSA could potentially provide water to the following 11 water suppliers:

- Aspinwall Borough Water Department
- Blawnox Municipal Waterworks
- Etna Borough
- Fox Chapel Authority
- Hampton Township Municipal Authority
- Reserve Township
- Shaler Township Water Department
- Borough of Sharpsburg
- Pennsylvania American Water Company
- West View Borough Municipal Authority
- Wilkinsburg-Penn Joint Water Authority

PWSA has system interconnects with all of the above suppliers except for the Wilkinsburg-Penn Joint Water Authority. An interconnect with Etna Borough has been closed. Table 2-3 lists information regarding water supplied by PWSA via system interconnects from 2006 to 2008 based on information contained in Annual Water Supply Reports.

PWSA currently provides water for resale to Aspinwall, Fox Chapel, and Reserve Township. PWSA also acquired the Millvale water system in 2009 and now provides full managed water service to the residents of Millvale Borough. Fox Chapel provides water for resale to Blawnox.

In March 2011, municipal officials in Hampton and Shaler Townships gave approval to merge water systems and form a new Hampton-Shaler water authority. The new authority will take over operations on January 1, 2012. As a result, the probability of future water sales to Hampton and Shaler is extremely low.

Table 2-3

Water Provided by PWSA to Neighboring Systems Through Interconnects

Water Supplier	2006			2007			2008		
	Total Usage (gallons)	Number of Days	Average Usage (gpd)	Total Usage (gallons)	Number of Days	Average Usage (gpd)	Total Usage (gallons)	Number of Days	Average Usage (gpd)
Aspinwall Borough	783,000	150	5,220	35,299,000	215	164,181	65,402,000	366	178,694
Etna Borough	0	0	0	0	0	0	0	0	0
Fox Chapel No. 1 *	597,943,000	303	1,973,409	746,747,000	365	2,045,882	675,322,000	366	1,845,142
Fox Chapel No. 2 *	10,450,000	181	57,735	5,450,000	215	25,349	661,000	183	3,612
Hampton	7,124,000	365	19,518	7,961,000	265	30,042	5,883,000	366	16,074
Millvale	12,556,500	365	34,401	130,550,000	265	492,642	125,870,000	366	343,907
PA American - Esplen	0	0	0	0	0	0	0	0	0
PA American - Mt. Wash.	1,105,000	213	5,188	25,000,000	306	81,699	12,800,000	215	59,535
Reserve Township	107,016,000	365	293,195	119,256,000	365	326,729	121,641,000	366	332,352
Shaler	95,000	62	1,532	25,000	30	833	185,000	62	2,984
Sharpsburg	0	0	0	84,940,000	123	690,569	80,000	62	1,290
West View No.1	0	0	0	0	0	0	0	0	0
West View No.2	0	0	0	0	0	0	0	0	0
West View No.3	30,000	31	968	0	0	0	0	0	0
Totals			2,391,166			3,857,926			2,783,590

* Blawnox is included in the Fox Chapel Usage

The Wilkinsburg-Penn Joint Water Authority and the West View Borough Municipal Authority are large water authorities with surface water treatment plants and significant infrastructure investments. As such, these two water providers are not good candidates for regionalization.

Excluding the suppliers discussed above, potential expansion of the PWSA water system through acquisition or water sales is limited to the following:

- Etna Borough
- Borough of Sharpsburg
- Pennsylvania American Water Company

The Shaler Township Water Department currently provides all the water used in Etna Borough. PWSA had an emergency interconnect with the Etna water system at one time but the interconnect has been closed. The Borough of Sharpsburg has its own treatment plant and water system. However, PWSA has supplied significant amounts of water to Sharpsburg during six years in the 1996 to 2008 time period. The amount of water supplied to Sharpsburg in these years ranged from 47 to 99 million gallons and averaged 73 million gallons per year.

PWSA is most interested in extending service to the portion of the City (South Hills) that is currently served by Pennsylvania American Water Company. PWSA bills all City customers for water and sewer services based on PWSA rates. However, Pennsylvania American water rates are higher than those charged by PWSA. In order to maintain uniform rates for all City residents, PWSA must subsidize the costs for customers that reside in areas served by Pennsylvania American Water. This requires PWSA to make periodic payments to Pennsylvania American to make up the difference. PWSA has paid an average of $1.43 million in subsidy to Pennsylvania American Water Company over the past 5 years.

The PWSA water system could potentially be expanded through acquisition or water sales to three adjacent water supply systems. Table 2-4 lists the suppliers along with their average day and maximum day water demands. Water demands for City of Pittsburgh residents served by Pennsylvania American Water Company were estimated based on PWSA billing records. The water suppliers listed in Table 2-4 serve almost 28,000 customers. The service areas have a combined average day demand of approximately 4.50 mgd and a maximum day demand of 7.20 mgd.

Concept Level Cost Estimates for Extending Water Service

Available information indicates that service to Etna and Sharpsburg could be provided through existing PWSA interconnects. A conceptual level estimate was developed for the cost of extending service to the portion of the City that is currently served by Pennsylvania American Water Company.

Table 2-4

Potential PWSA Water Service Expansion Areas

Supplier	Number of Customers	Average Day Demand	Maximum Day Demand	Base Rate ($/Month)	Water Cost ($/1,000 gal.)
Etna Borough	1,664	105,204	263,000	N.P	5.75
Pennsylvania American Water Company (1)	20,304	4,106,861	6,570,978	13.00	7.89
Borough of Sharpsburg	1,454	464,085	636,000	6.67	5.00
Totals	23,422	4,676,150	7,469,978		

(1) PA American Water Rate is Shown. City of Pittsburgh Residents Pay PWSA Rate

N.P. = Not Provided

Chester Engineers previously estimated the amount of water that would be needed to serve the South Hills area in May 2008. After review of metered water use that was completed as part of the 40-Year Plan, it was determined that the original analysis overestimated the demand. An updated conceptual analysis of the cost of providing water service to City of Pittsburgh customers that are currently served by Pennsylvania American Water Company is included as Appendix 2-2. The total estimated project cost to provide service to this area is $68.60 million.

Potential for Purchasing Systems from Existing Bulk Water Customers

This section examines the potential cost-benefit to PWSA of purchasing water systems from existing bulk water customers Aspinwall, Fox Chapel and Reserve. Customer and average day demand information from Table 2-2 was used to estimate the revenues that PWSA currently receives from bulk water sales based on 2012 rates. Bulk sales revenues were then compared to the estimated revenue that would be generated if the individual customers in these communities were paying 2012 PWSA water rates. The results of these analyses are summarized in Table 2-5.

Table 2-5 indicates that estimated revenues to PWSA from Aspinwall and Reserve would more than double relative to bulk sales revenues if the residents in these communities were PWSA customers. Estimated revenues would almost quadruple from Fox Chapel if the residents were PWSA customers. In total, water revenues from these communities would be an estimated $4.1 million per year higher if the residents were PWSA customers rather than the communities being bulk rate customers.

In order for the purchase of a water system to make economic sense, the increase in water revenues has to exceed the sum of the annualized purchase price for the system plus any annual capital, operation and maintenance costs associated with ownership of the system. As noted earlier in this section, PWSA acquired the Millvale water system and now provides full managed water service to the residents of Millvale Borough. Prior to 2009, Millvale was a bulk water customer. The cost history for the Millvale water system can be used to estimate capital, operation, and maintenance costs for other systems and allow development of prices for potential water system purchases. If the initial economic evaluation is positive, discussions can be initiated with the system owner regarding system acquisition by PWSA.

2.4 EVALUATE SEWER SYSTEM EXPANSION OPTIONS

Wastewater from 23 neighboring communities flows into and through the PWSA sewer system to ALCOSAN. Figure 2-2 identifies the tributary municipalities and highlights the portion of each borough or township that contributes flow to the PWSA.

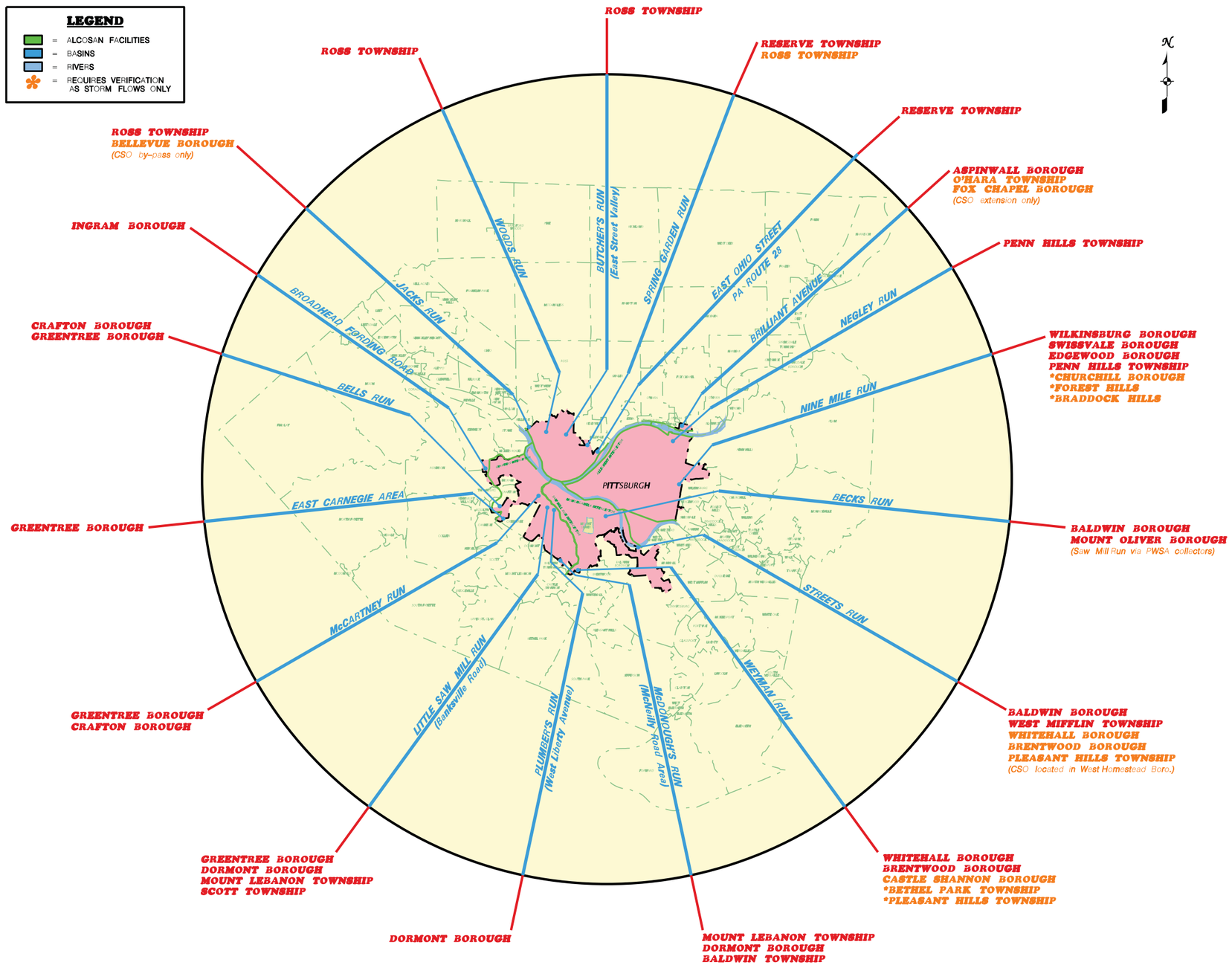


Figure 2-2

DRAFT

September 29, 2010

NOTE:
INFORMATION SHOWN IS PLOTTED FROM RECORD INFORMATION ONLY. EXACT LOCATIONS MUST BE FIELD VERIFIED. THERE MAY ALSO BE UNRECORDED SEWER LINE TIES UNKNOWN TO THE PITTSBURGH WATER AND SEWER AUTHORITY AND THE CITY OF PITTSBURGH.

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DIRECT FLOW CONNECTIONS TO PWSA SYSTEMS = 19

FLOWS CONVEYED BY PWSA VIA OTHER INTER-MUNICIPAL CONNECTIONS = 9

City of Pittsburgh

INTER-URBAN SEWERAGE / BASIN CONNECTIONS

PWSA
THE PITTSBURGH WATER & SEWER AUTHORITY
Quality Water Quality Service

Table 2-5

Estimated Revenues From Bulk Water Rates Versus PWSA Rates

Bulk Water Customer	Number of Customers	Average Month Demand (gpd)	2012 Estimated Annual Bulk Revenue	2012 Estimated Revenue as PWSA Customers	Estimated Revenue Difference
Borough of Aspinwall	1,201	7,061,655	$267,778	$637,151	$369,373
Fox Chapel Water Authority	5,390	56,216,661	1,191,308	4,525,188	3,333,880
Reserve Water Department	1,495	7,838,405	318,633	728,469	409,836
Totals	8,086	71,116,722	$1,777,719	$5,890,807	$4,113,088

Tributary Sewer System Information

Table 2-6 presents information about neighboring sewer systems that are tributary to PWSA. One sewer system is owned by a sewer authority but the remaining systems are municipally owned. The number of customers in each system was estimated through a GIS analysis of the number of buildings in each sewershed area. The general condition of each system and significant Consent Order and Agreement (COA) issues were determined based on review and assessment of the information contained in system inventory and characterization reports (Existing Conditions Reports) developed by ALCOSAN. Base rate information was obtained from an October 2010 sewer rate survey conducted by the 3 Rivers Wet Weather Demonstration Project. The 23 tributary systems contain an estimated 42,405 customers that contribute flow to PWSA.

Existing Rate Information

Table 2-6 also presents base rate information for each sewer system. Base rates range from a low of $0.63 per 1,000 gallons in Bellevue to a high of $7.85 per 1,000 gallons in Mt. Oliver. The base rate represents the sewer charge imposed by the municipality and does not include ALCOSAN charges.

Potentially Feasible Candidates for Regionalization

General conditions of sewer systems and the existence of significant COA issues were used to evaluate systems relative to their need for capital improvement projects to address system deficiencies. Table 2-7 presents a ranking of the tributary sewer systems. Systems at the top of the list, which are in good condition and have no COA issues, are anticipated to have the lowest capital improvement costs. Systems with combined sewers are ranked lower because they are expected to encounter higher costs of achieving COA compliance. Systems for which the general system condition is unknown were placed at the bottom of the list. Although this is a somewhat subjective evaluation, systems at the top of the list are considered to be better candidates for regionalization than systems lower on the list.

Because of the unknown costs of upgrading sewer systems to meet COA requirements, assuming ownership of a sewer system by itself would have to be considered a liability. Nevertheless, it could be advantageous for PWSA to take over a sewer system if the service agreement also included providing water to a new community. Owners of three sewer systems listed in Table 2-6 also own the public water systems in their communities. However, PWSA already sells bulk water to Fox Chapel Borough, Aspinwall Borough, and Reserve Township. As a result, there appears to be little incentive for PWSA to take over the sewer systems in these communities.

Table 2-6

Tributary Sewer System Information

	System	Ownership	Dual Water and Sewer Ownership	Number of Customers (1)	General Condition of System (2)	Significant COA Issues (2)	Base Rate (3) ($/1,000 gal)
1	Aspinwall Borough	Municipal	X	355	Fair to Good	88% Combined	$1.73
2	Baldwin Borough	Municipal		5,279	Unknown	None	4.21
3	Baldwin Township	Municipal		638	Good	Portions Combined	4.50
4	Bellevue Borough	Municipal		413	Good	Portions Combined	0.63
5	Braddock Hills	Municipal		41	Unknown	None	1.50
6	Brentwood Borough	Municipal		4,235	Good	None	4.40
7	Castle Shannon	Municipal		61	Fair	None	4.80
8	Churchill Borough	Municipal		277	Good	None	2.50
9	Crafton Borough	Municipal		421	Fair	CSO Permittee	6.50
10	Dormont Borough	Municipal		3,476	Fair	None	3.50
11	Edgewood Borough	Municipal		1,330	Unknown	None	3.70
12	Forest Hills	Municipal		15	Fair	None	3.00
13	Fox Chapel Borough	Municipal	X	253	Good	None	1.65
14	Green Tree Borough	Municipal		2,087	Good	None	3.00
15	Ingram Borough	Municipal		100	Good	Combined Sewers	3.75
16	Mount Lebanon	Municipal		1,371	Fair	None	4.05
17	Mount Oliver	Municipal		1,553	Unknown	None	7.85
18	Penn Hills, Municipality of	Municipal		910	Good	None	6.95
19	Pleasant Hills Borough	Municipal		32	Good	None	2.16
20	Reserve Township	Municipal	X	1,178	Unknown	Unknown	1.17
21	Ross Township	Municipal		1,440	Unknown	Unknown	2.25
22	Scott Township	Municipal		780	Fair	None	1.50
23	Swissvale Borough	Municipal		1,858	Fair to Good	Combined Sewers	1.50
24	West Mifflin Borough	Authority		581	Fair	None	4.82
25	Whitehall Borough	Municipal		4,996	Unknown	None	5.53
26	Wilkinsburg Borough	Municipal		7,032	Fair to Good	Illegal Storm Connections	1.19

(1) Customer Information From Figure 2-2
(2) General System Condition and Significant COA Issues Were Determined From Review of Individual Basin Reports for the ALCOSAN Service Area
(3) Base Rate Information is From an October 2010 Sewer Rate Survey by The 3 Rivers Wet Weather Demonstation Project

Table 2-7

Sewer System Rankings

	System	Ownership	Dual Water and Sewer Ownership	Number of Customers (1)	General Condition of System (2)	Significant COA Issues (2)	Base Rate (3) ($/1,000 gal)
1	Fox Chapel Borough	Municipal	X	253	Good	None	$1.65
2	Pleasant Hills Borough	Municipal		32	Good	None	2.16
3	Churchill Borough	Municipal		277	Good	None	2.50
4	Green Tree Borough	Municipal		2,609	Good	None	3.00
5	Brentwood Borough	Municipal		4,235	Good	None	4.40
6	Penn Hills, Municipality of	Municipal		873	Good	None	6.95
7	West Mifflin Borough	Authority		581	Fair	None	4.82
8	Scott Township	Municipal		780	Fair	None	1.50
9	Dormont Borough	Municipal		3,476	Fair	None	3.50
10	Mount Lebanon	Municipal		2,750	Fair	None	4.05
11	Wilkinsburg Borough	Municipal		7,029	Fair to Good	Illegal Storm Connections	1.19
12	Bellevue Borough	Municipal		413	Good	Portions Combined	0.63
13	Baldwin Township	Municipal		638	Good	Portions Combined	4.50
14	Aspinwall Borough	Municipal	X	355	Fair to Good	88% Combined	1.73
15	Ingram Borough	Municipal		100	Good	Combined Sewers	3.75
16	Swissvale Borough	Municipal		1,830	Fair to Good	Combined Sewers	1.50
17	Crafton Borough	Municipal		421	Fair	CSO Permittee	6.50
18	Edgewood Borough	Municipal		1,330	Unknown	None	3.70
19	Baldwin Borough	Municipal		5,279	Unknown	None	4.21
20	Whitehall Borough	Municipal		4,973	Unknown	None	5.53
21	Mount Oliver	Municipal		1,553	Unknown	None	7.85
22	Reserve Township	Municipal	X	1,178	Unknown	Unknown	1.17
23	Ross Township	Municipal		1,440	Unknown	Unknown	2.25

(1) Customer Information From Figure 2-2
(2) General System Condition and Significant COA Issues Were Determined From Review of Individual Basin Reports for the ALCOSAN Service Area
(3) Base Rate Information is From an October 2010 Sewer Rate Survey by The 3 Rivers Wet Weather Demonstation Project

Excluding concerns regarding unknown costs for COA compliance, the best candidates for regionalization would be sewer systems in good condition that have significant customer populations and no significant COA issues. The sewer systems in Green Tree Borough and Brentwood Borough meet these criteria.

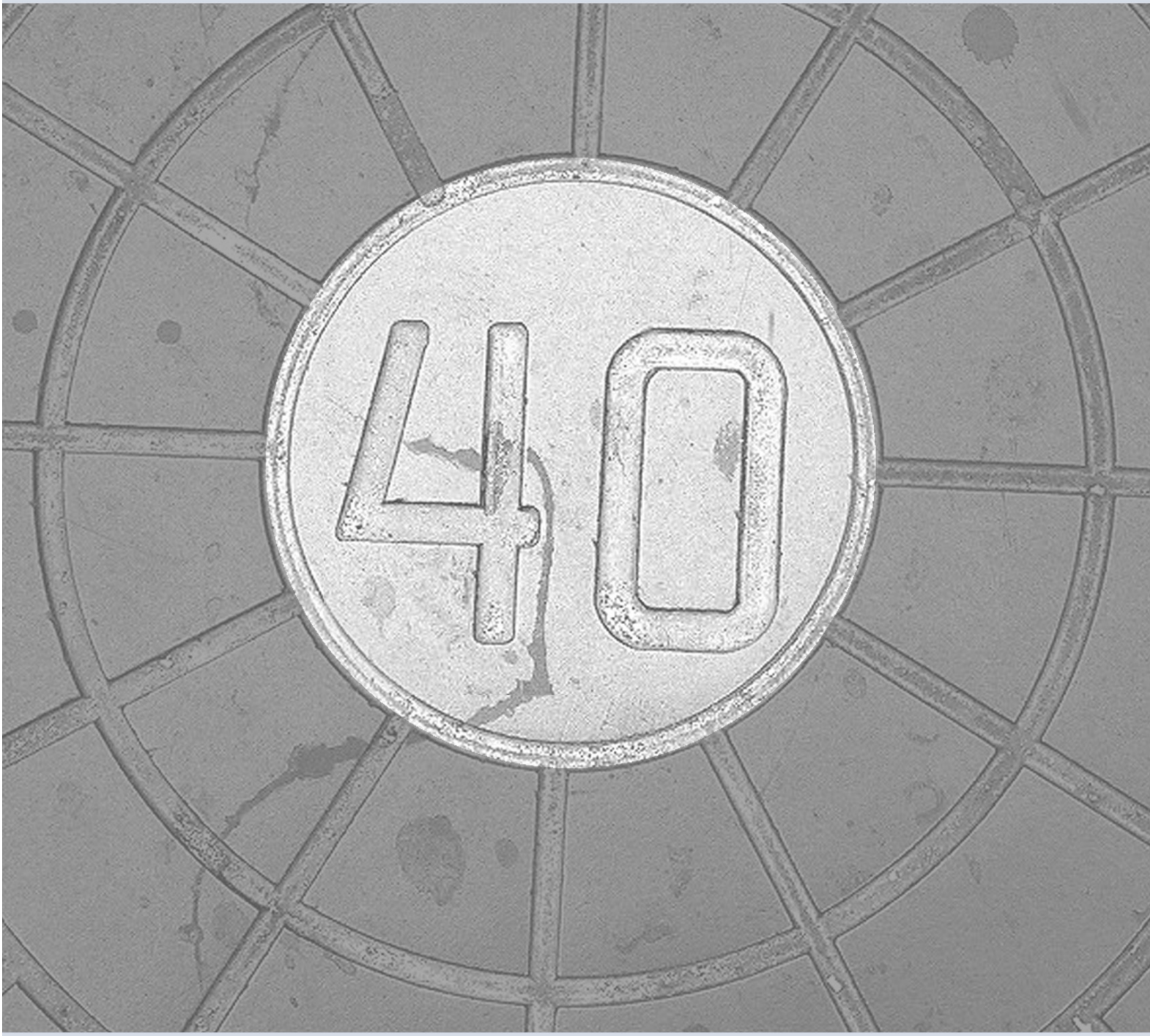
2.5 ASSESS POTENTIONAL ACQUISITIONS

Based on the information collected under Task 2, the potential for acquisition of individual water or sewer systems is limited to systems in communities that are adjacent to the PWSA service area. At the meetings conducted under Task 2.1, DEP representatives noted that water system regionalization opportunities exist with surrounding communities including Reserve, Aspinwall, Fox Chapel, Blawnox, and Millvale. However, PWSA already provides water for resale to the first three communities and has provided full managed water services to Millvale since 2009. Fox Chapel provides water for resale to Blawnox.

The analysis of Allegheny County public water providers under Task 2.3 concluded that potential expansion of the PWSA water system through acquisition or water sales is limited to Etna Borough, Sharpsburg Borough, and the portion of the City that is currently served by Pennsylvania American Water Company. Etna and Sharpsburg could be served via existing PWSA interconnects but significant capital expenditures would be required to serve the South Hills portion of the City of Pittsburgh.

Sewer system expansion options were evaluated under Task 2.4. There are 23 neighboring communities with wastewater flows that pass through the PWSA system on their way to ALCOSAN for treatment. Unfortunately, insufficient information is available to estimate costs for COA compliance in neighboring municipalities. Excluding the unknown costs for COA compliance, the best candidates for regionalization would be sewer systems in good condition that have significant customer populations and no significant COA issues. The sewer systems in Green Tree Borough and Brentwood Borough meet these general criteria.

TASK 3



CHESTER ENGINEERS, INC.

THE PITTSBURGH WATER AND SEWER AUTHORITY
40-YEAR PLAN
TASK 3 - COMPLETE AN ASSESSMENT OF NEEDS

3.1 SYSTEM INVENTORY AND SYSTEM VALUATIONS

An inventory of the PWSA water and sewer systems was developed by examining available information to identify the various components that make up the systems. Information of interest for water and sewer lines (pipe lengths and diameters, numbers of valves and hydrants, numbers of manholes and structures, materials of construction) was determined from information contained in the PWSA GIS. Site visits to pump stations, water storage tanks, and treatment facilities were also conducted to assess the general condition of above-ground facilities. System valuations were then completed for the water and sewer systems based on the age and condition of the facilities.

System Inventory

Separate inventories were prepared in Excel spreadsheet format for all identified water and sewer system components. The collected information summarizes the age, type, and general condition of PWSA facilities. Detailed information regarding the process equipment, pumps, and other items housed in buildings were cataloged separately as part of Task 3.7.

Table 3-1 presents an inventory of PWSA water treatment, pumping, and storage facilities. Information is also provided for chlorine booster stations at water storage facilities. Table 3-1 provides a name, location, and description for all above-ground water facilities and lists the year in which a facility was constructed and/or last rehabilitated.

Treatment facilities include the 117 mgd capacity water filtration plant at Aspinwall and the 26 mgd capacity membrane filtration plant at the Highland No. 1 reservoir. There are 12 water pumping stations in the PWSA system. This total does not include the Ross pump station, which supplies raw water to the Aspinwall treatment plant. The Millvale pump station was constructed before PWSA took over the Millvale water system but was never placed into service.

Water storage facilities include 4 in-ground reservoirs and 12 above-ground storage tanks. Above-ground storage facilities include 10 ground level tanks or standpipes and two elevated tanks. Three of the four reservoirs have floating covers. Highland No. 1

Table 3-1

Water Treatment, Pumping, Storage, and Chlorine Booster Facilities

Type of Facility	Facility Name	Location	Description	Year Constructed	Last Rehabilitation	
					Structural	Mechanical
Rapid Sand Filtration Plant	Raw Water Intakes	Aspinwall	2 Intakes With Auto Backwash Moving Screens, Permitted for 100 mgd	1908		
	Ross Pump Station	Aspinwall	Raw Water PS, 5 Pumps, 400 mgd max., to Clarifiers or Sed. Basins	1907		
	Clarifiers	Aspinwall	4 units, 220' x 60' x 20' deep	1962		
	Sedimentation Basins	Aspinwall	2 Basins, 15 Hour Detention Time @ Design Flow	1908		
	Rapid Sand Filters	Aspinwall	18 Filters, 2,280 sq. ft. each, sand and anthrafilt	1969		
	Clearwell	Aspinwall	22.5 feet deep, 44.5 MG, supplies 3 high lift pump stations	1908		
	Access Tunnel at Treatment Plant	Aspinwall	Asphalt road surface, concrete walls, 350 feet long by 12 feet wide	1908	1908	1908
Membrane Filtration Plant	Highland Membrane Filtration Plant	Highland Park	13,889 gpm or 20 mgd capacity / 18,056 gpm or 26 mgd capacity	2002		
Pumping	Aspinwall Pump Station	Aspinwall	4 Pumps, 34 mgd max., pump to Lanpher Reservoir	1914		
	Bruecken Pump Station	Highland Park	3 Pumps (2-4), 84 mgd max., pump to Highland #13 Pumps (5-7), 72 mgd max., pump to Highland #2	1931		
	Fox Chapel Pump Station		4 Pumps, 6 mgd max., pump to Fox Chapel Borough	2003		
	Herron Hill Pump Station	Herron Hill	4 Pumps (1-4), 23 mgd max., pump to Herron Hill 1 Pump (5), 10.0 mgd, pump to Herron Hill or Squirrel Hill 1 Pump (6), 2 mgd max., pump to Bedford	1931		
	Herron Hill Tank Pump Station	Herron Hill	2 Pumps, 3.4 mgd max, pump to Herron Hill tank	1963		
	Highland Pump Station	Highland Park	3 Pumps, 7.8 mgd max., pump to Garfield Tank	1960		
	Howard Pump Station	North Side	4 Pumps (1-4), 22 mgd max., pump to Spring Hill/McNaugher 3 Pumps (5-7), 9.5 mgd max., pump to Brashear	1904		
	Inline Pump Station at Pacific & Coral	Friendship District	1 Pump, 0.14 mgd, 1 Pump, 0.29 mgd, pump to Distribution in Friendship	1981		
	Lincoln Pump Station	Lincoln-Lemington	3 Pumps, 6 mgd max. (combined capacity), pumps to Lincoln	1952		
	Millvale Pump Station	Millvale	2 pumps, 1.4 mgd, pumps to Millvale Tank	1996		
	Mission Pump Station	South Side	3 Pumps (1-3), 18 mgd max., + 1 Pump (4), 12 mgd + 1 Pump (5), 8 mgd, pump to Allentown	1912		
	Saline Pump Station	Greenfield	3 Pumps, 9 mgd max.(combined capacity), pump to Squirrel Hill	1935		
Storage	Herron Hill Reservoir	Herron Hill	12.8 MG capacity in-ground reservoir, floating cover	1880		
	Highland No. 1 Reservoir	Highland Park	130.5 MG capacity in-ground reservoir, UNCOVERED	1879		
	Highland No. 2 Reservoir	Highland Park	125 MG capacity in-ground reservoir, floating cover	1903		
	Lanpher Reservoir	Shaler Township	133 MG capacity in-ground reservor, floating cover	1914		
	McNaugher Reservoir	North Side	2 Concrete Tanks, 5 MG (185' dia. x 25' h) and 0.40 MG (50' dia. X 25' h)	1998		
	Allentown Tanks	Allentown	2 riveted steel tanks, 2.88 MG each (100' dia x 51' h)	1939		
	Bedford Tank	Hill District	1 welded steel tank, 2.1 MG capacity	1993		
	Brashear Tanks	North Side	2 welded steel tanks, 5.5 MG capacity each	2010		
	Herron Hill Tank	Herron Hill	1 elevated welded steel tank, 0.40 MG capacity	1967		
	Garfield Tank	Garfield	1 elevated welded steel tank, 1.9 MG capacity	1959		
	Lincoln Tank	Lincoln-Lemington	1 welded steel tank, 3 MG capacity (93' dia x 62' h)	1939		
	Spring Hill Tanks	Spring Hill	2 riveted steel tanks, 0.47 MG capacity each (50' dia x 34' h)	1928		
	Squirrel Hill Tank	Squirrel Hill	1 welded steel tank, 3.0 MG capacity (80' dia x 82' h)	1939		
Chlorine Booster Stations	Chlorine Booster Station	Brashear Tank	2 - 100 gal Tanks, 2 Feed Pumps - 0.37 GPH	1952		
	Chlorine Booster Station	Bedford Tank	2 - 100 gal Tanks, 2 Feed Pumps - 0.37 GPH	2004		
	Chlorine Booster Station	Garfield Tank	Taken out of Service	2004		
	Chlorine Booster Station	Herron Hill Reservoir	3 - 100 gal Tanks, 3 Feed Pumps - 0.55 GPH	1952		
	Chlorine Booster Station	Highland No. 2	6 - 160 gal Tanks, 2 Feed Pumps - 13.0 GPH	1952		
	Chlorine Booster Station	Lanpher Reservoir	5 - 160 gal Tanks, 2 Feed Pumps - 13.0 GPH	1952		
	Chlorine Booster Station	McNaugher Res.	2 - 100 gal Tanks, 2 Feed Pumps - 0.37 GPH	1952		
	Chlorine Booster Station	Allentown Tanks	2 - 100 gal Tanks, 3 Feed Pumps - GPH	2009		
	Chlorine Booster Station	Lincoln Tank	2 - 100 gal Tanks, 2 Feed Pumps - GPH	2009		
	Chlorine Booster Station	Squirrel Hill Tank	2 - 100 gal Tanks, 2 Feed Pumps - GPH	2009		

reservoir is not covered, so all the water that passes through this reservoir must be re-treated by the membrane filtration plant before it is distributed to customers. PWSA currently has 9 chlorine booster stations. The chlorine booster station at the Garfield tank has been taken out of service.

Table 3-2 presents information about the four PWSA sewage pumping stations including name, location, description, and the approximate year when the stations were last rehabilitated. The Rogers Street pump station has 1,000 gpm capacity pumps and is the largest sewage pumping facility. The Evergreen Road facility is the smallest of the four stations and has a capacity of 150 gpm.

Water distribution system and sewer system data was taken from the PWSA GIS. Summary statistics for the PWSA water distribution system are listed below:

- 5,341,000 linear feet or 1,012 miles of waterlines, 1-inch to 120-inch diameter.
- 25,330 valves.
- 7,558 hydrants.
- 2/3 of pipelines in system are 6 and 8-inches in diameter.
- 3/4 of pipelines in system are 6, 8, and 12-inches in diameter.
- Oldest pipes and valves date back to 1887.

Statistics for the PWSA sewer system are summarized below:

- 6,395,000 linear feet or 1,211 miles of sewers, 3-inch to 168-inch diameter.
- 29,084 manholes.
- 24,143 catch basins/inlets.
- 99 diversion structures.
- Oldest sewers date back to 1900.

Detailed inventory information for the water distribution and sewer systems can be found in Appendices 3-1 and 3-2.

System Valuations

A Replacement Cost New Less Depreciation analysis was conducted to determine system valuations. This type of analysis estimates how much it would cost to construct new facilities today and then adjusts replacement costs for individual facilities to account for their age via straight line depreciation. System valuations for the water and sewer systems were developed based upon established service lives for different types of facilities and estimated remaining service lives for individual components based on age.

Table 3-2

Sewage Pumping Stations

Facility Name	Location	Description	Year Last Rehabilitated
Evergreen Road Pump Station	Summer Hill	2 pumps, 150 gpm capacity, 15 HP	1983
Mifflin Road Pump Station	Lincoln Place	2 pumps, 500 gpm capacity, 20 HP	2008
Rogers Street Pump Station	Lincoln Place	2 pumps, 1,000 gpm capacity, 40 HP	2008
Browns Hill Road Pump Station	Hazelwood	2 pumps, 250 gpm capacity, 10 HP	1983

Cost Estimating Approach

The first step in the process was to estimate how much it would cost to construct new water and sewer facilities today. Costs estimates for new water distribution and sewer system components were based on information from the publication *RS Means Heavy Construction Cost Data 2011*. This information was supplemented with actual bid prices from recent PWSA contracts. Costs for new water storage tanks were also determined using information from RS Means. Foundation costs were added to the tank costs to arrive at an estimated cost for each storage facility.

A replacement cost for the Lanpher reservoir was estimated by trending the original reservoir cost to April 2011 price levels using the Engineering New-Record Construction Cost Index (ENRCCI). The article in Appendix 3-3 describes design and construction of the Lanpher Reservoir. The project was awarded in July 1912 at a cost of $681,976. Costs for the other in-ground reservoirs and the sedimentation basins at the Aspinwall plant were estimated based on the calculated unit cost for the Lanpher facility and the storage volume for the basin. Costs for floating covers on the Lanpher, Herron Hill and Highland No. 1 reservoirs were estimated based on unit prices for the Highland No. 2 Floating Cover Replacement Project.

Costs for new booster pump stations were estimated using information from the March 2011 low bid price received for a booster pump station that Chester Engineers designed for a western Pennsylvania client. A unit cost per square foot was developed to cover building costs. The cost for new pumps was added to the building cost along with an allowance for piping, valves, and accessories. These components typically account for about 80 percent of the cost for pumping facilities. Electrical work makes up another 12 percent of the total, while general requirements and site work round out the total.

Replacement costs for treatment facilities were estimated as follows:

- Cost for Highland membrane filtration plant was based on the original and expansion costs for the facility trended to April 2011 price levels using the ENRCCI.
- Cost for the raw water intakes were estimated based on the cost for the traveling screens and size of the intake facilities.
- Cost for the Ross Pump Station was estimated using the procedure described above for the other pump stations.
- Cost for the clarifiers, filters, and chemical feed systems was based on the trended construction cost for a 30 mgd water treatment plant expansion project in Nashville, Tennessee that was designed by Chester Engineers in the 1990's.

The estimated cost for the clearwell was based on a trended cost for clearwell rehabilitation from a December 2008 report by Malcolm Pirnie, Inc. titled "Clearwell Improvements Phase 1 – Study". This report contained an estimated construction cost of $52,817,000 for the clear water basin at the Aspinwall plant. The clearwell cost was trended from December 2008 to April 2011 price levels using the ENRCCI.

Table 3-3 presents estimated replacement costs for existing waterlines in the PWSA system. Unit installation costs for pipeline include excavation, backfill, paving, pipe, and a 10 percent allowance for fittings. Water distribution system cost estimating information can be found in Appendix 3-4. Cost estimates are based on a 4-foot depth of cover over the installed pipe and the piping materials listed. Only about 8 percent of the waterlines in the GIS have material designations. Since almost 98 percent of these pipelines are designated as ductile iron, this material was assumed for the majority of the lines. Pipes smaller than 4-inch diameter were assumed to be copper and lines larger than 48-inches were assumed to be pre-stressed concrete cylinder pipe (PCCP). The replacement cost for the 1,011 miles of waterlines in the PWSA system is estimated to be $627.04 million.

Estimated replacement costs for the fire hydrants and valves in the water distribution system are listed in Table 3-4. The unit costs in the table are for gate valves since over 98 percent of the valves in the GIS are designated as this type of valve. Unit cost information for 4-inch to 36-inch valves is from R.S. Means Heavy Construction Cost Data 2011 and includes material, labor, equipment, overhead, and profit. Costs for larger valve sizes are estimated based on linear regression of unit costs for valves in the 24 to 36-inch range. Excavation, backfill, and paving costs are covered in the pipeline cost estimate. The replacement cost for the hydrants in the PWSA water system is estimated at $18.90 million and the valve replacement cost is estimated to be $62.47illion. The total estimated replacement cost for valves and hydrants is $84.37 million.

Table 3-5 presents estimated replacement costs for water treatment, pumping, and storage facilities in the PWSA system. The total replacement cost for these facilities is estimated to be $539.06 million. Details regarding treatment, pumping, and storage cost estimating information can be found in Appendix 3-5.

Estimated replacement costs for the sewer system are presented in Table 3-6. Sewer system components include sewers, manholes, catch basins, diversions structures, and four sewage pumping stations. Unit costs for sewers, manholes, and catch basins are from *RS Means Heavy Construction Data 2011*. Unit costs for diversion structures and sewage pump stations are trended costs from a 2005 Tapping Fee Study for PWSA. Installation costs for sewers include excavation, backfill, paving, pipe, and a 2 percent allowance for fittings. Cost estimates are based on a 10-foot depth of cover over the installed sewers. Sewer system cost estimating information can be found in Appendix 3-6. The majority of the sewer segments in the GIS have material designations. The most

Table 3-3

Estimated Replacement Cost for Existing Waterlines
Based on 2011 Construction Costs *

Pipe Diameter (inches)	Pipe Material	Estimated Length (feet)	Installed Unit Cost (1)	Total Cost
1	Copper	3,542	$31	$109,802
2	Copper	18,670	50	933,500
4	Ductile Iron	175,022	63	11,026,386
6	Ductile Iron	2,469,029	78	192,584,262
8	Ductile Iron	1,099,859	94	103,386,746
10	Ductile Iron	92,308	109	10,061,572
12	Ductile Iron	566,140	125	70,767,500
15	Ductile Iron	18,166	148	2,688,568
16	Ductile Iron	253,550	156	39,553,800
18	Ductile Iron	1,058	172	181,976
20	Ductile Iron	209,148	188	39,319,824
24	Ductile Iron	85,857	219	18,802,683
30	Ductile Iron	117,803	267	31,453,401
36	Ductile Iron	82,812	315	26,085,780
42	Ductile Iron	24,481	364	8,911,084
48	Ductile Iron	16,150	413	6,669,950
50	PCCP	36,300	453	16,443,900
60	PCCP	56,167	596	33,475,532
66	PCCP	2,170	655	1,421,350
72	PCCP	3,715	719	2,671,085
84	PCCP	3,873	931	3,605,763
90	PCCP	50	1,101	55,050
96	PCCP	4,361	1,272	5,547,192
120	PCCP	524	2,453	1,285,372
Total		5,340,755		$627,042,000

* Cost Information From R.S. Means Heavy Construction Data 2011
(1) Includes Pipe Material, Excavation, Installation, Backfill, and Paving
PCCP = Prestressed Concrete Cylinder Pipe

Table 3-4

Estimated Replacement Cost for Fire Hydrants and Valves
Based on 2011 Construction Costs *

Component	Diameter (inches)	Estimated Quantity	Installed Unit Cost (1)	Total Cost
Hydrants		7,558	2,500	$18,895,000
Valves	< 4	120	400	48,000
	4	609	785	478,065
	6	14,722	1,050	15,458,100
	8	5,703	1,275	7,271,325
	10	364	1,690	615,160
	12	2,363	2,100	4,962,300
	15	38	4,040	153,520
	16	545	5,975	3,256,375
	18	4	9,190	36,760
	20	321	12,400	3,980,400
	24	189	18,400	3,477,600
	30	154	45,000	6,930,000
	36	93	67,500	6,277,500
	42	32	92,700	2,966,400
	48	51	117,300	5,982,300
	50	8	125,500	1,004,000
	60	11	166,400	1,830,400
	72	2	215,500	431,000
	96	1	313,700	313,700
Subtotal Valves				65,473,000
Total Estimated Replacement Cost for Hydrants and Valves				$84,368,000

* Unit Cost Information From R.S. Means Heavy Construction Cost Data 2011
(1) Includes Material, Labor, Equipment, Overhead and Profit

Table 3-5

Estimated Replacement Costs for Water Treatment, Pumping, and Storage Facilities

Category	Facility Name	Estimated Cost
Treatment	Raw Water Intakes	$3,500,000
	Ross Pump Station	18,853,000
	Clarifiers, Filters, and Chem. Feed	131,100,000
	Sedimentation Basins	37,255,000
	Clearwell	55,756,000
	Highland Membrane Filtration Plant	15,791,000
	Treatment Subtotal	262,255,000
Pumping	Aspinwall Pump Station (1)	14,149,000
	Bruecken Pump Station	11,726,000
	Herron Hill Pump Station	4,598,000
	Herron Hill Tank Pump Station (2)	77,000
	Highland Pump Station	1,495,000
	Howard Pump Station	8,043,000
	Inline Pump Station (3)	219,000
	Lincoln Pump Station	1,206,000
	Mission Pump Station	6,626,000
	Saline Pump Station	1,693,000
	Pumping Subtotal	49,832,000
Storage	Herron Hill Reservoir	6,233,000
	Highland No. 1 Reservoir	62,594,000
	Highland No. 2 Reservoir	65,210,000
	Lanpher Reservoir	69,147,000
	McNaugher Tank No. 1	2,280,000
	McNaugher Tank No. 2	400,000
	Allentown Tank No. 1	1,510,000
	Allentown Tank No. 2	1,510,000
	Bedford Tank	1,190,000
	Brashear Tank No. 1	2,890,000
	Brashear Tank No. 2	2,890,000
	Herron Hill Tank	1,360,000
	Garfield Tank	5,850,000
	Lincoln Tank	1,590,000
	Spring Hill Tank No. 1	390,000
	Spring Hill Tank No. 2	390,000
	Squirrel Hill Tank	1,540,000
	Storage Subtotal	226,974,000
Total Estimated Cost for Treament, Pumping, and Storage Facilities		$539,061,000

(1) Includes Fox Chapel Pumps
(2) Represents Pump Replacement Cost (Pumps Are In Base of Elevated Tank)
(3) Packaged Pump Station, Buried in Street

Table 3-6

Estimated Replacement Cost for Sewer System
Based on 2011 Construction Costs *

Description	Diameter (inches)	Pipe Material	Length (feet)	Installed Unit Cost (1)	Total Cost
Sewers	4	PVC	1,892	$63	$119,196
	6	PVC	3,035	74	224,590
	8	PVC	776,734	84	65,245,656
	10	PVC	142,493	95	13,536,835
	12	PVC	650,695	102	66,370,890
	15	PVC	2,771,834	113	313,217,242
	18	RCP	570,348	142	80,989,416
	21	RCP	274,971	157	43,170,447
	24	RCP	337,942	175	59,139,850
	27	RCP	14,213	211	2,998,943
	30	RCP	138,192	230	31,784,160
	33	RCP	24,999	249	6,224,751
	36	RCP	186,113	268	49,878,284
	39	RCP	15,688	291	4,565,208
	42	RCP	79,174	314	24,860,636
	45	RCP	6,319	338	2,135,822
	48	RCP	92,183	361	33,278,063
	54	RCP	55,723	406	22,623,538
	60	RCP	52,652	452	23,798,704
	66	RCP	38,486	522	20,089,692
	72	RCP	54,351	593	32,230,143
	78	RCP	25,654	676	17,342,104
	84	RCP	16,849	760	12,805,240
	90	RCP	11,001	839	9,229,839
	96	RCP	20,958	919	19,260,402
	102	PCCP	10,371	1,300	13,482,300
	108	PCCP	9,410	1,681	15,818,210
	120	PCCP	2,832	2,414	6,836,448
	132	PCCP	3,062	2,651	8,117,362
	144	PCCP	6,125	2,890	17,701,250
	168	PCCP	1,028	3,373	3,467,444
Subtotal Sewers			6,395,327		1,020,543,000
Description			Quantity	Unit Cost	Total Cost
Manholes (2)			29,084	5,650	164,325,000
Catch Basins (2)			24,143	2,825	68,204,000
Diversion Structures (3)			99	95,000	9,405,000
Pump Stations (3)			4	600,000	2,400,000
Subtotal Other Items					244,334,000
Total Estimated Replacement Cost for Sewer System					$1,264,877,000

* Cost Information From R.S. Means Heavy Construction Cost Data 2011
(1) Includes Material, Excavation, Installation, Backfill, and Paving
(2) Includes Material, Labor, Equipment, Overhead and Profit
(3) Trended Cost From 2005 Tapping Fee Study

common sewer materials are vitrified clay pipe (VCP), reinforced concrete pipe (RCP), brick, and polyvinyl chloride (PVC). PWSA allows PVC to be used for sewers up to 15-inches in diameter. For larger lines, VCP is used for sanitary sewers and RCP is used for storm sewers. Since brick is no longer used for sewer and manhole construction, replacement cost estimates were based on PVC for the smaller sewers and concrete pipe for the larger lines. The replacement cost for the PWSA sewer system is estimated to be $1.265 billion.

Replacement Cost New Less Depreciation Analysis

The second step in the process involves depreciating the calculated replacement cost for the water and sewer facilities to account for the ages of individual components. This analysis was complicated by the fact that limited digital information is available regarding the age of water and sewer lines. The PWSA GIS includes installation date information for the facilities listed below:

- 6.0 percent of waterlines.
- 7.1 percent of valves.
- 0.0 percent of hydrants.
- 7.4 percent of sewers.
- 9.9 percent of manholes.
- 5.2 percent of catch basins.
- 46.5 percent of diversion structures.

As part of the main break analysis, estimated ages for waterlines and valves were determined by cross referencing GIS data with information from record books and calc books. PWSA provided Chester with geodatabase information for pipes as GIS features. The database included annotations with references to the office record books and calculation books associated with individual pipe segments. The record books and calculation books provide construction drawings for specific pipe segments and the dates of these books indicate the age of the pipes. The following procedure was used to assign an installation year to pipe segments and valves that did not have an age designation:

- PWSA provided a cross reference table between the record and calculation books and the data of the books
- The cross reference table was matched to the GIS annotations.
- The average installation year from the cross reference table was assigned to each annotation that was matched.
- The annotations were separated into record book entries and calculation book entries

- The calculation books were further filtered to include only water main replacements
- A workbook year was assigned for each water line by finding the nearest workbook label for each water line and extracting the year and distance to the line.
- A calculation book year was assigned for each water line by finding the nearest calc book label and extracting the year and distance to the line
- For each waterline and valve, the estimated installation year was set by the priority scheme listed below
  - GIS installation year if one was included in the GIS.
  - Calc book year if calc book distance was less than 200 feet from main.
  - Record book installation year if distance was less than 900 feet from main.

The above procedure produced estimated ages for 89 percent of the waterlines and 68 percent of the valves. For the remaining water lines and valves with no GIS age information, the average age for pipes or valves of the same size was assigned. Since no information on hydrant ages is available in the GIS, hydrant ages were assigned using the age distribution for valves. For sewers, manholes, and diversions structures that do not have GIS age information, ages were estimated based on weighted average values for the facilities that do have assigned ages. Catch basin ages were assigned using the age distribution for manholes.

Table 3-7 presents depreciated values for water treatment, pumping, and storage facilities. The estimated replacement cost was copied from Table 3-5 and the year installed is based on the date of the most recent upgrade to the facility per Table 3-1. The remaining life was calculated based on the age of a facility relative to its useful life. PWSA uses a 40 year useful life for plant facilities. The depreciated value for the treatment, pumping, and storage facilities is $316.96 million based on the estimated remaining lives of individual facilities. The clearwell is assumed to be fully depreciated due to its age.

Depreciation analyses similar to the one presented in Table 3-7 were conducted for the water distribution and sewer system components. However, the results cannot be easily presented in tabular form due to the large number of lines in the database files. As examples, the spreadsheet with waterline information from the GIS contains about 64,000 lines of data and there are 43,000 lines of sewer line data. As a result, information from the water and sewer line depreciations will be presented in summary form. PWSA uses a

Table 3-7

Water Treatment, Pumping, and Storage Depreciation

Facility	Estimated Replacement Cost	Year Installed *	Remaining Life (percent)	Depreciated Value
Raw Water Intakes	$3,500,000	2009	95.00%	$3,325,000
Ross Pump Station	18,853,000	1986	37.50%	7,069,875
Clarifiers, Filters, and Chem. Feed	131,100,000	1996	62.50%	81,937,500
Sedimentation Basins	37,255,000	1994	57.50%	21,421,625
Clearwell	55,756,000	1908	0.00%	0
Highland Membrane Filtration Plant	15,791,000	2010	97.50%	15,396,225
Subtotal Treatment	262,255,000			129,150,225
Aspinwall Pump Station	14,149,000	1989	45.00%	6,367,050
Bruecken Pump Station	11,726,000	1987	40.00%	4,690,400
Herron Hill Pump Station	4,598,000	1987	40.00%	1,839,200
Herron Hill Tank Pump Station	77,000	1988	42.50%	32,725
Highland Pump Station	1,495,000	1986	37.50%	560,625
Howard Pump Station	8,043,000	1986	37.50%	3,016,125
Inline Pump Station	219,000	1981	25.00%	54,750
Lincoln Pump Station	1,206,000	1986	37.50%	452,250
Mission Pump Station	6,626,000	1988	42.50%	2,816,050
Saline Pump Station	1,693,000	1986	37.50%	634,875
Subtotal Pumping	49,832,000			20,464,050
Herron Hill Reservoir	6,233,000	2007	90.00%	5,609,700
Highland No. 1 Reservoir	62,594,000	1983	30.00%	18,778,200
Highland No. 2 Reservoir	65,210,000	2011	100.00%	65,210,000
Lanpher Reservoir	69,147,000	2007	90.00%	62,232,300
McNaugher Tank No. 1	2,280,000	1998	67.50%	1,539,000
McNaugher Tank No. 2	400,000	1998	67.50%	270,000
Allentown Tank No. 1	1,510,000	1982	27.50%	415,250
Allentown Tank No. 2	1,510,000	1982	27.50%	415,250
Bedford Tank	1,190,000	1993	55.00%	654,500
Brashear Tank No. 1	2,890,000	2010	97.50%	2,817,750
Brashear Tank No. 2	2,890,000	2010	97.50%	2,817,750
Herron Hill Tank	1,360,000	2010	97.50%	1,326,000
Garfield Tank	5,850,000	1992	52.50%	3,071,250
Lincoln Tank	1,590,000	1982	27.50%	437,250
Spring Hill Tank No. 1	390,000	1982	27.50%	107,250
Spring Hill Tank No. 2	390,000	1982	27.50%	107,250
Squirrel Hill Tank	1,540,000	2011	100.00%	1,540,000
Subtotal Storage	226,974,000			167,348,700
Totals	$539,061,000			$316,962,975

* Based on Year of Most Recent Upgrade

Remaining Life is Based on a Total Asset Life of 40 years

Table 3-8

PWSA System Valuation Summary

Category	Estimated Replacement Cost	Depreciated Value
Waterlines	$627,059,000	$150,494,160
Valves	62,277,000	15,818,046
Hydrants	18,715,000	3,390,639
Distribution Subtotal	708,051,000	169,702,845
Treatment	262,255,000	129,150,225
Pumping	49,832,000	20,464,050
Storage	226,974,000	167,348,700
Subtotal Water System	1,247,112,000	486,665,820
Sewers	1,020,543,000	203,808,252
Manholes	164,325,000	57,657,604
Catch Basins	68,204,000	23,897,886
Diversion Structures	9,405,000	1,491,500
Pump Stations	2,400,000	411,429
Subtotal Sewer System	1,264,877,000	287,266,671
Total Water and Sewer Systems	$2,511,989,000	$773,932,491

useful life of 70 years for water and sewer lines. A 70-year useful life for pipelines means that waterlines installed before 1942 will be fully depreciated. Based on the actual and estimated ages for water system components, more than 50 percent of the waterlines and valves fall into this category. The useful lives of waterlines can be extended by applying cement or epoxy coatings to the pipe interior. The United States Environmental Protection Agency (EPA) estimates that cement lining extends the life of a waterline by 50 years and that epoxy linings last for 75 years. The PWSA GIS system does not contain information on pipes that have been relined, so the depreciation analysis was carried out using age information for the pipelines.

Table 3-8 presents a valuation summary for the PWSA water and sewer systems. The table lists estimated replacement costs and depreciated values for PWSA facilities. The water system has an estimated replacement cost of $1.247 billion and a depreciated value of $486.67 million. The sewer system has an estimated replacement cost of $1.265 billion and a depreciated value of $287.27 million. The total estimated replacement cost for the PWSA water and sewer systems is $2.51 billion and the depreciated value of the systems is estimated at $773.93 million.

3.2 WATER SYSTEM NEEDS ASSESSMENT

The performance of the PWSA water distribution was assessed using the PWSA water distribution system model in conjunction with Chester Engineers' experience with PWSA system operations. The PWSA water distribution system model, data collected during the Authority's on-going hydrant testing program, recent Insurance Services Organization (ISO) testing, and evaluations of available system storage versus demand were used to evaluate the ability of the existing water distribution system to meet current water demands and recommended fire flow requirements.

Existing average and maximum day demands by service district are presented in Table 3-9.

Table 3-9
Existing Average and Maximum Day Water Demands

Service District	Average Day Demands (mgd)	Maximum Day Demands (mgd)
Highland 1	14.0	25.1
Inline Pump District	0.2	0.2
Bedford	0.8	2.1
Herron Hill Tank	0.5	0.7
Herron Hill Reservoir	15.8	18.5
Bloomfield Regulator	0.8	0.7

Table 3-9
Existing Average and Maximum Day Water Demands (continued)

Service District	Average Day Demands (mgd)	Maximum Day Demands (mgd)
Lincoln	1.1	2.0
Garfield	3.0	3.5
Highland Park/Garfield Regulator	0.3	0.4
Zoo Regulator	0.1	0.2
Highland 1 Subtotal	*36.6*	*50.0*
Highland 2	9.2	22.2
Allentown	4.8	6.1
Squirrel Hill	2.5	3.1
Highland 2 Subtotal	*16.5*	*28.0*
Lanpher	8.2	21.2
Brashear	3.4	4.2
McNaugher/Spring Hill	5.7	7.5
Lanpher Subtotal	*17.2*	*28.0*
Total Production	70.2	107.0
Note: Maximum day values are not additive to total because service district maximum day events do not coincide.		

Evaluation of Distribution Pumping Capacity

The projected maximum day demands for the service districts were compared to the nominal pumping capacities of the associated pumping stations in order to evaluate the adequacy of the existing pumping facilities under the existing demand conditions. The nominal pump station capacity represents the sum of the rated capacities with one of the largest pumps out of service. This comparison is summarized in Table 3-10.

Table 3-10
Comparison of Existing Demands to Existing Pumping Capacity

Service District	Pump Station	Year 2011 Max Day Demand (mgd)	Pump Station Nominal Capacity (mgd)
Highland 1	n/a	25.10	n/a
Inline Pump District	Inline Pump Station	0.22	0.14
Bedford	Herron Hill Reservoir Pump Station	18.50	24.0
Herron Hill Reservoir			
Herron Hill Tank	Herron Hill Tank Pump Station	0.65	2.0

Table 3-10
Comparison of Existing Demands to Existing Pumping Capacity (continued)

Service District	Pump Station	Year 2011 Max Day Demand (mgd)	Pump Station Nominal Capacity (mgd)
Bloomfield Regulator	n/a	0.74	n/a
Lincoln	Lincoln Pump Station	1.98	4.0
Garfield	New Highland Pump Station	3.45	4.8
Highland Park/Garfield Regulator	n/a	3.45	n/a
Zoo Regulator	n/a	0.18	n/a
Highland 1 Subtotal	*Bruecken Pump Station*	*50.0*	56.0
Highland 2	n/a	22.20	
Allentown	Mission Pump Station	6.10	26.0
Squirrel Hill	Saline Pump Station	3.10	5.0
Highland 2 Subtotal	*Bruecken Pump Station*	*28.0*	48.0
Lanpher	n/a	21.20	n/a
Brashear	Howard Pump Station	4.20	7.5
McNaugher/Spring Hill	Howard Pump Station	7.50	13.5
Lanpher Subtotal	*Aspinwall Pump Station*	*28.0*	49.0
Nominal Capacity=Rated capacity with largest pump out of service			

As is indicated in Table 3-10, with the exception of the Inline Pump Station, the nominal capacities the pump stations exceed the existing maximum day demand, indicating sufficient pumping capacity. The Inline Pump Station contains two pumps; a 0.14-mgd capacity unit and a 0.29-mgd capacity unit. Consideration should be given to increasing the capacity of the smaller unit to improve system reliability under maximum day demand conditions.

Evaluation of Distribution System Storage Capacity

An evaluation of the adequacy of the distribution system storage capacity was performed under existing demand conditions. The required storage volumes for the storage facilities were determined using two methods. The first method computed the required volume as equivalent to one day of storage under average day demand conditions. The second method computed the required volume based upon the following formula.

The required effective storage is the sum of the following:

- Equalization storage = the volume that equates to the difference between the peak hour system demand and the firm pumping capacity of the supplying station for a 6-hour duration.

- Fire flow volume = the volume equal to a 3,000-gpm flow rate supplied for a 3-hour duration.
- Emergency storage volume = the volume equal to the maximum day demand rate for a 4-hour duration.

The effective storage is set to be available within the upper one-half of the storage facility. Therefore, total storage requirement equals twice the effective storage capacity.

The larger of volumes computed using these two methods was determined to be the required storage volume.

Table 3-11 presents a comparison of the computed storage capacity requirements for each of the distribution system storage facilities. As is indicated in Table 3-11, overall, the PWSA water distribution system has a surplus of capacity. However, deficits in storage capacities under the current demand conditions are identified for the Herron Hill Tank, the Garfield Tank and the Herron Hill Reservoir. The capacity of the Squirrel Hill Tank only marginally satisfies the computed storage requirement and concerns related to the amount and elevations of stored water available in the Squirrel Hill system and the impacts upon system operations and levels of service have existed for some time.

Table 3-11
Evaluation of Distribution System Storage Capacity – Existing Conditions

	Existing Storage (Mgal)	Required Storage Mgal	Surplus/Deficit (Mgal)
Highland 1 Reservoir	130.5	Included in subtotal	
Bedford Tank	2.1	1.8	0.3
Herron Hill Reservoir	14.0	15.8	-1.8
Herron Hill Tank	0.4	1.7	-1.3
Lincoln Tank	3.0	1.8	1.2
Garfield Tanks	2.0	3.0	-1.0
Highland 1 Reservoir Subtotal	152.0	36.6	115.4
Highland 2 Reservoir	125.0	Included in subtotal	
Allentown Tanks	6.0	4.8	1.2
Squirrel Hill Tank	3.0	2.5	0.5
Highland 2 Reservoir Subtotal	134.0	16.5	117.5
Lanpher Reservoir	133.0	Included in subtotal	
Brashear Tanks	11.0	3.4	7.6
McNaugher/Spring Hill Tanks	6.4	5.7	0.7
Lanpher Reservoir Subtotal	150.4	11.7	138.7
Note: Water stored in the Highland 1 Reservoir cannot be used unless the Membrane Filter Plant is operational and can only be used at a rate within the treatment capacity of the MFP.			

Assessment of Overall Distribution System Performance Under Current Conditions

The PWSA water distribution system model was used to evaluate system performance under current conditions. This analysis was completed by simulating system operation under the current average day and maximum day demand conditions. The average day and maximum day model simulations were performed and the results of the modeling were reviewed in order to evaluate system performance.

General system performance was evaluated based upon the ability of the distribution system to maintain operating pressures in the distribution grid at or above 35-psi under the average day demand conditions and above 20-psi under the extreme maximum day demand conditions. The results of this evaluation are illustrated in Figures 3-1 and 3-2. Figure 3-1 and Figure 3-2 present the results for the average day and maximum demand conditions, respectively. The working pressure performance targets are met at 99-percent of the 20,000+ model nodes. Exceptions to this predominantly occur at high elevations adjacent to storage facility locations and do not impact the levels of service experienced by the customers.

Other isolated instances of excursions occur at the highest elevations in service areas that are typically served by smaller diameter, older mains. These situations likely can be addressed by making minor adjustments to pressure district boundaries that entail minimal capital costs and/or through the replacement of small/old mains as part of an ongoing water main replacement program. These results indicate that no major new water main transmission projects are required to meet current demands.

Although the working pressure performance targets are generally met and no major new transmission main construction is required, there are two specific areas within the distribution system in which service pressures have been an issue. The first low pressure area of concern is in the Borough of Millvale. Properties in Millvale at higher elevations report pressures as low as 30-psi. Millvale is currently supplied from the PWSA 60-inch main on East Ohio Street and the volume of supply is more than adequate. However, pressures in the 60-inch main are insufficient to adequately reach the higher elevations in the Borough. It is currently proposed that the problematic higher elevation areas in Millvale be supplied by constructing a booster pump station. The associated necessary improvements are described in Section 4.

The second area consists of an area in Bloomfield along Penn Avenue roughly between 44th Street and Fairmount Street, along Friendship Avenue between Atlantic Avenue and Emory Way and along Harriet Street between Gross Street and Graham Street. This is an active redevelopment area in which existing customers report persistent low pressure problems. The area is served by the Highland 1 Reservoir District, but is immediately adjacent to the Bloomfield Regulator District. Expanding the Bloomfield Regulator

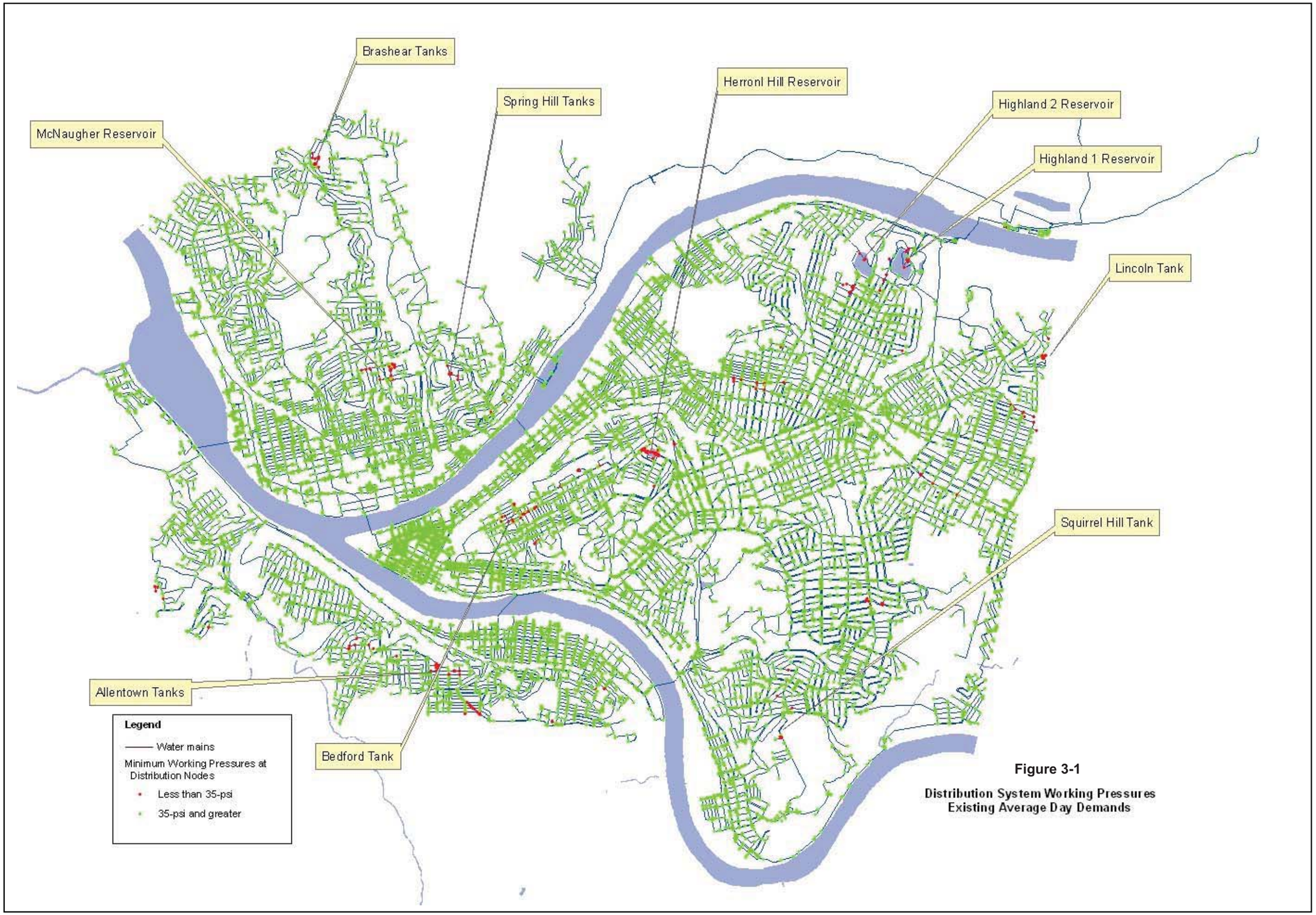


Figure 3-1

Distribution System Working Pressures
Existing Average Day Demands

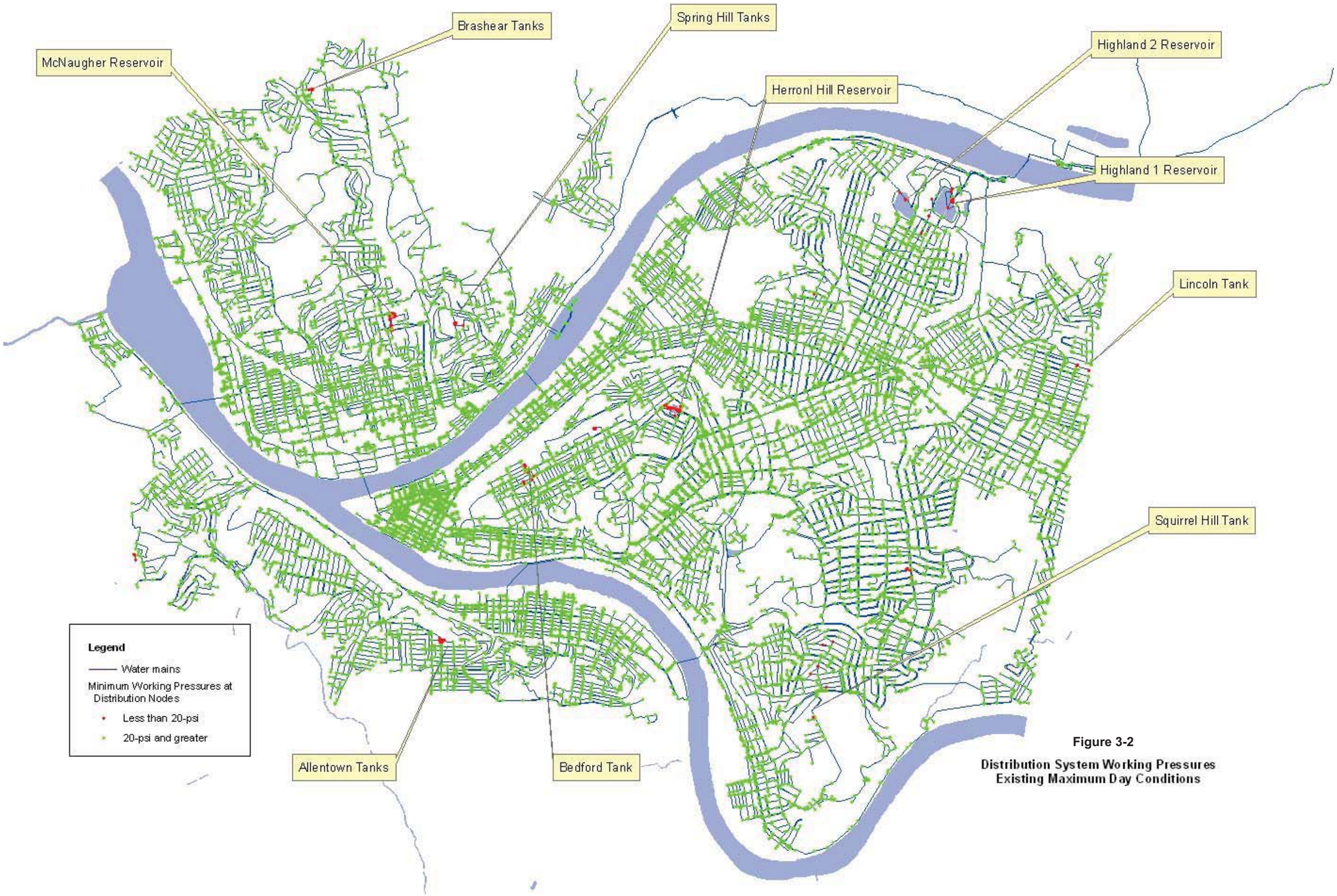


Figure 3-2

Distribution System Working Pressures
Existing Maximum Day Conditions

District has been identified as a feasible means of sufficiently increasing service pressures in this area. The associated necessary improvements are described in Section 4.

Expanding the Bloomfield Regulator district would shift approximately 0.75-mgd of water demand from the Highland 1 Reservoir District to the Herron Hill Reservoir District under maximum day demand conditions. The Herron Hill District is currently taxed and there is a concern that shifting this amount of demand to the Herron Hill Reservoir District will place too great a demand on the facilities. As was presented previously in Table 3-11, the projected year 2011 demand on the Herron Hill Reservoir Pump Station under the service area current configuration is approximately 21.7-mgd. Adding the Bloomfield demand would increase the total demand to 90-percent of the nominal rated capacity of the station. A concept that has been advanced for addressing this situation consists of expanding the Lincoln Service District into a portion of the Herron Hill Reservoir District. This modification to the configuration of the PWSA water distribution system would reduce the demand on the Herron Hill Reservoir Pump Station and Herron Hill Reservoir by reducing the size of the district served. It would also offer the benefits of expanding the Lincoln Tank District into higher elevation areas of the Herron Hill Reservoir District and improve working pressures and creating an emergency secondary feed to the Squirrel Hill District from the Lincoln District. Expansion of the Lincoln District as envisioned would shift approximately 4.5-mgd of demand under maximum day conditions from the Herron Hill Reservoir District to the Lincoln District. As is described in Section 4, this expansion would require the construction of a transmission main from the Lincoln District into the expanded service area, upsizing the Lincoln Pump Station, and adding storage to the Lincoln District.

Assessment of Fire Flow Delivery Capacity

An assessment of the fire flow delivery capacity of the distribution system was performed using a combination of computer modeling and the results of the PWSA's on-going field hydrant flow testing program. Fire flow delivery capacity is defined as the rate of flow (usually expressed in terms of gallons per minute (gpm) that can be delivered by the distribution system to specific hydrant locations at a 20-psi residual pressure in the mains. Estimates of the fire flow delivery capacities at the approximate locations of hydrants throughout the system under average day demand conditions were produced by computer modeling. The modeled hydrant flow capacities are illustrated in Figure 3-3. Field measured hydrant flow capacities at locations tested by either the PWSA or the Pittsburgh Bureau of Fire are illustrated in Figure 3-4. The general patterns of variations in hydrant flow capacities are generally similar for the modeled and field test results. However, the field tests are more precise measurements that more accurately reflect local pipe conditions that have significant impacts on flow capacity and typically result in lower than modeled capacities in older, smaller diameter areas of the water distribution system. Table 3-12 summarizes the results of the field testing program.

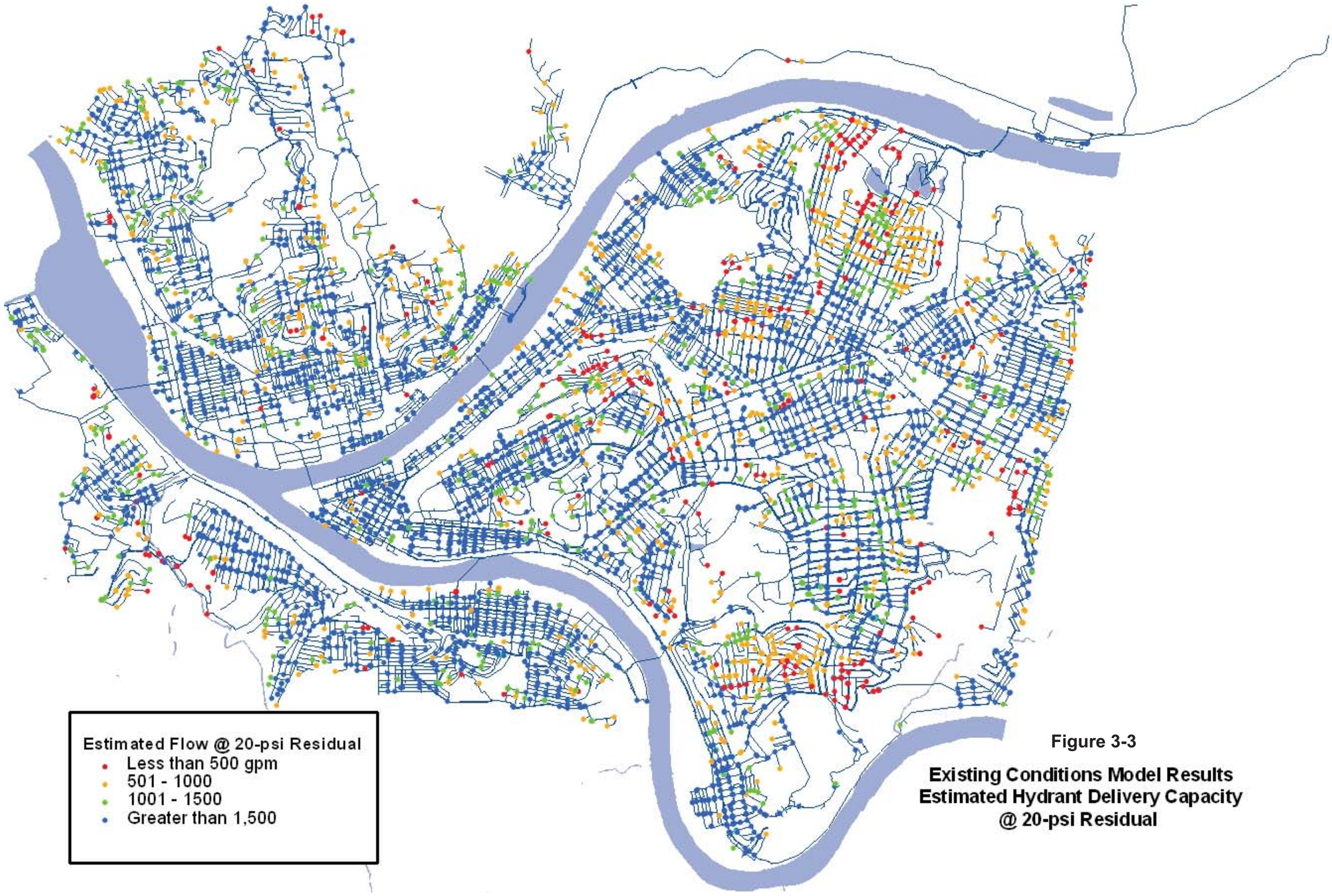


Figure 3-3

Existing Conditions Model Results
Estimated Hydrant Delivery Capacity
@ 20-psi Residual

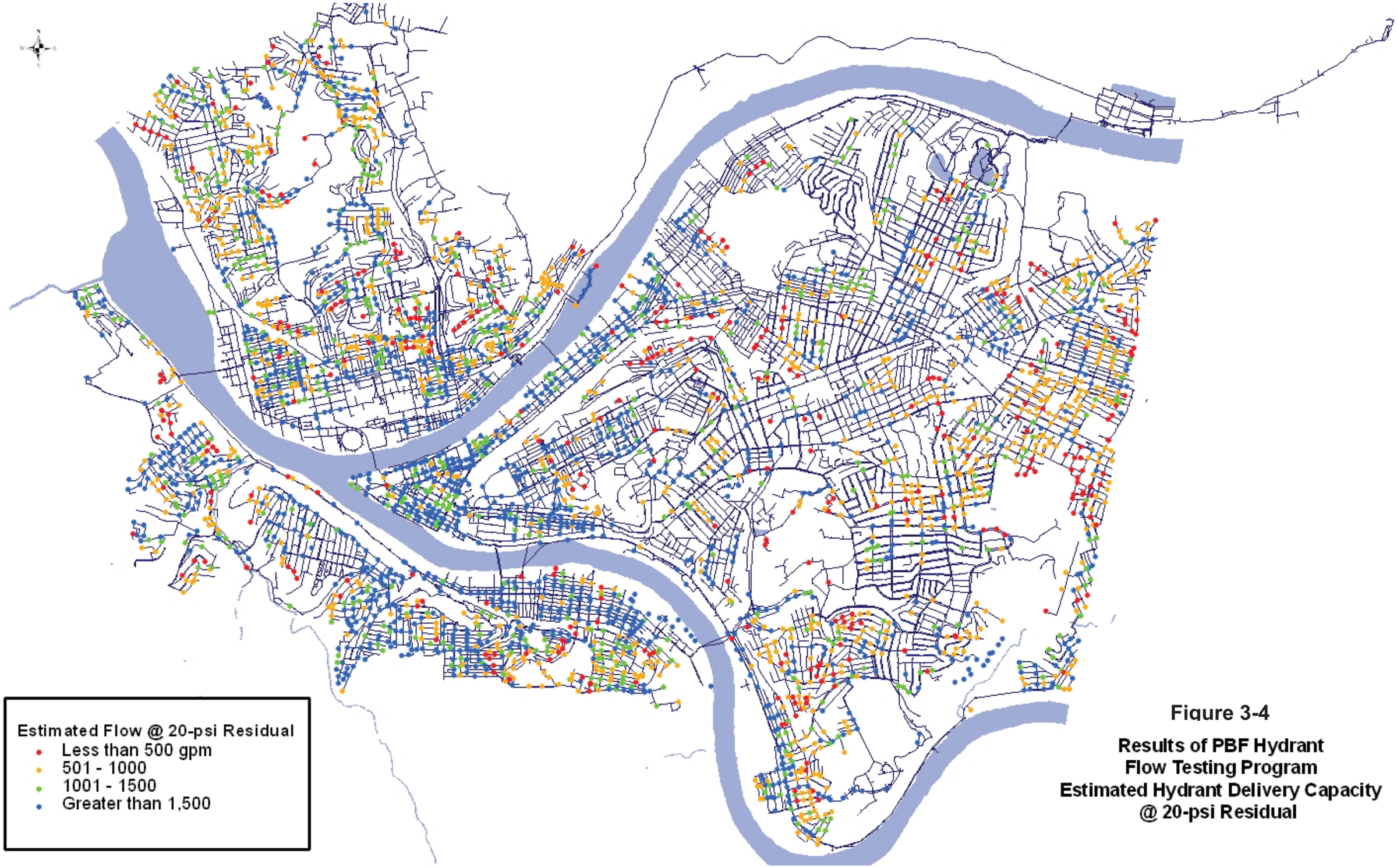


Figure 3-4

Results of PBF Hydrant Flow Testing Program Estimated Hydrant Delivery Capacity @ 20-psi Residual

Table 3-12
Summary of Field Test Hydrant Flow Capacities

Flow Capacity at 20-psi Residual Pressure (gpm)	Percent of Hydrants Tested
500 and less	9.4%
500 to 1,000	28.5%
1,000 to 1,500	18.1%
more than 1,500	44.0%

During 2011, the Insurance Services Organization (ISO) completed an analysis of the City of Pittsburgh's fire suppression delivery system. This included assigning recommended available fire flows for selected structures throughout the city, completing hydrant flow tests at 153 locations to determine the fire flow capabilities of the system and determining whether the system fire flow delivery capacity meets the recommended fire flows. The ISO measured fire flow capacities are illustrated in Figure 3-5. The ISO analysis concluded that the fire flow capacities of the distribution equaled or exceeded the recommended fire flows at 79-percent of the tested locations.

The target minimum performance level for available fire flow capacity is 500-gpm. Fewer than 10-percent of the Pittsburgh Bureau of Fire's field tested hydrants in the system exhibit flow capacities less than 500-gpm. Investigations performed pursuant to receipt of hydrant flow test results have determined that nearly all of the low fire flow capacity hydrants are located on dead end mains and/or in areas served by small diameter, usually older pipes. These investigations have demonstrated that the replacement of local, old, small diameter pipes will be effective in significantly increasing fire flow capacities. The instances of low fire flow capacities can be addressed as aging water mains are replaced. As is discussed later in this report, the water main replacement program considers the proximity to low capacity hydrants in prioritizing mains for replacement.

3.3 ADDITIONAL CONCERNS

Additional areas of concern regarding the water system were discussed with PWSA staff at the February 22, 2011 progress meeting. Based on discussions at Progress Meeting No. 5, the following items are to be addressed in the 40-Year Plan:

- WTP clearwell rehabilitation/replacement.
- Transfer pump station - Highland 2 reservoir to Highland 1 district.
- Second storage tank for Squirrel Hill pressure district.
- Low water pressure in the Penn Avenue area of Bloomfield/Garfield.

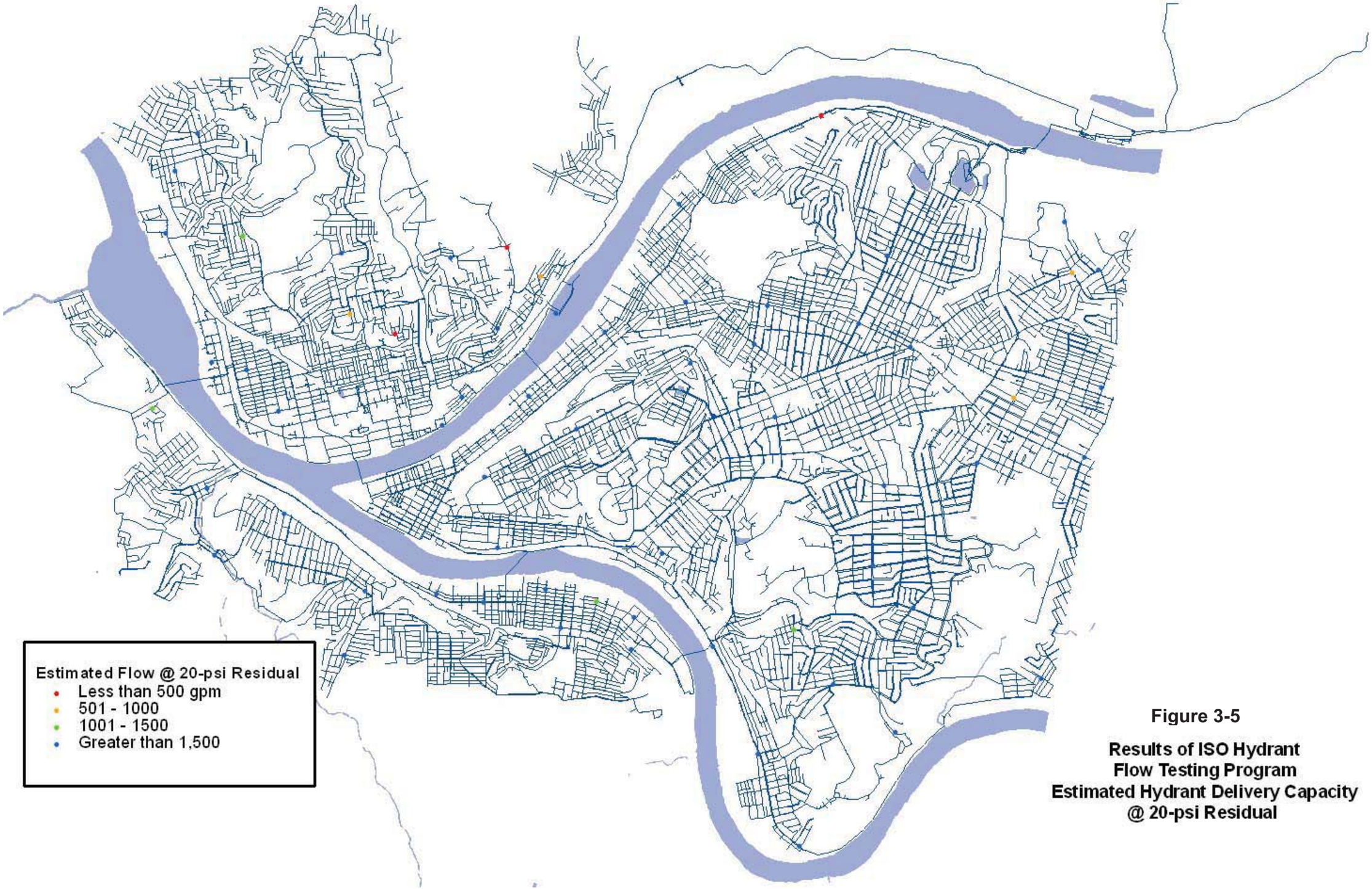


Figure 3-5

Results of ISO Hydrant Flow Testing Program Estimated Hydrant Delivery Capacity @ 20-psi Residual

- Increasing water demands in Herron Hill pressure district.
- Safe Drinking Water Act Compliance and TTHM reduction.
- Reducing non-revenue water through leak detection and repair.
- Prioritized water main replacement program.
- Service to PA American portion of City.
- Access tunnel at water treatment plant.
- License to pursue hydropower.

Much of the mechanical equipment, electrical equipment, and instrumentation at PWSA facilities is advanced in age. There is also a need for rehabilitation and improvements to the water treatment plant facilities and equipment. Recommended improvements to the water treatment plant are discussed in Task 4.3. Task 4.11 describes and provides concept level cost estimates for improvements to PWSA distribution, pumping, storage, and treatment facilities.

With regards to the need for backup power supplies or sources, PWSA authorized CDM to develop construction documents for a standby power project at the Bruecken Pump Station. The primary improvements included the addition of a 21 mgd capacity constant speed "trim" pump and two standby emergency generators with sufficient capacity to start and operate any two pumps during a complete power outage. A 90% Design Report prepared by CMD and dated June 2008 presented a $6.98 million construction cost estimate for the project. Facilities are currently being installed at Bruecken to accommodate the temporary hook-up of emergency generators.

PWSA has two portable generators to provide back-up power to the booster chlorination systems at water storage sites. Emergency power is primarily needed at locations where a higher amount of disinfection product is used. This would include Highland 2 Reservoir, Lanpher Reservoir, and Herron Hill Reservoir. PWSA operating staff would like to see automatically controlled (start and stop) generators permanently installed at these three sites.

Information on each of the bulleted items above is presented in the following sections.

WTP Clearwell Rehabilitation / Replacement

The 44 million gallon capacity clearwell was constructed around 1908 and is used to disinfect the filtered water produced at the Aspinwall water treatment plant. Water from the clearwell feeds the Aspinwall and Bruecken finished water pump stations. The clearwell is a weak link in the water treatment and distribution system because there is no practical way to take any portion of the clearwell out of service for maintenance or repair. If the clearwell became non-functional for any reason, the main source of potable water for PWSA customers would be interrupted.

Two parallel studies were prepared for clearwell improvements at the Aspinwall water treatment plant. HDR Engineering, Inc. prepared one report in November 2008 and Malcolm Pirnie, Inc. prepared a second report in December 2008. The HDR report evaluated the three alternatives listed below:

- Alternative 1 – Construct Permanent Clearwell in Existing Sedimentation Basin.
- Alternative 2 – Construct Permanent Clearwell on Aspinwall Pump Station Site.
- Alternative 3 – Install UV as Primary Disinfection Method.

Based on an evaluation of both cost and non-economic factors, HDR recommended that PWSA proceed with Alternative 1. Alternative 1 has a total estimated project cost of $68.574 million and includes the following components:

- Conversion of the central receiving basin to a finished water clearwell.
- Installation of a pump station and transmission main to convey filtered water to the new clearwell.
- Construction of a gravity line from the new clearwell back to the Aspinwall and Bruecken pump stations (will also serve as a bypass for the existing clearwell).
- Installation of variable speed drives on the Aspinwall and Bruecken pumps.
- Rehabilitation of the existing clearwell.
- Increased utilization of existing system storage at the Highland Reservoirs.

The Malcolm Pirnie report identified the top three most desirable alternatives as follows:

- Alternative 3a(1) – Convert the West Sedimentation Basin to a Temporary Clearwell and Rehabilitate the Existing Clearwell.
- Alternative 3b – Obtain CT in Sedimentation Basins and Rehabilitate the Existing Clearwell (CT = product of free chlorine residual and contact time).
- Alternative 3c – Combined Filter Effluent (CFE) Ultraviolet (UV) System and Rehabilitate the Existing Clearwell.

Based on pairwise and cost evaluations, Malcolm Pirnie identified Alternative 3c as the preferred alternative. Alternative 3c has a total estimated project cost of $68.664 million and includes the following major items:

- Clearwell Sediment Removal and Structural Inspection
- CFE UV Facility and Equalization Basin Construction
- Finished Water Pump Station VFD and Motor Upgrades

- Clearwell By-Pass Piping Modifications
- Clearwell Rehabilitation

PWSA staff suggested at the February 22, 2011 progress meeting that the 40-Year Plan should include costs for the most reasonable option for clearwell improvements. Estimated project costs for the HDR and Malcolm Pirnie recommended alternatives are virtually identical. Therefore, the estimated $52,817,000 construction cost associated with the Malcolm Pirnie alternative will be included in the 40-Year Plan for improvements to the clearwell.

Transfer Pump Station – Highland 2 to Highland 1 District

PWSA is investigating a transfer pump station to send water from Highland 2 reservoir to the Highland 1 district. This pump station would primarily be used to supplement the supply to the Highland 1 district during periods when demands exceed the capacity of the membrane filtration plant. The transfer pump station is discussed under Task 4.1.

Second Storage Tank for the Squirrel Hill Pressure District

The Squirrel Hill tank is scheduled to be painted this year but will be difficult to take out of service. It was suggested that the tank should be isolated so the tank condition can be evaluated prior to painting. If the inspection reveals that the tank is nearing the end of its useful life, the tank should be replaced.

The Squirrel Hill tank is a standpipe but should really be an elevated tank because the water in the bottom of the tank is of no use. If the water level drops below a certain level, part of the service area loses pressure. A second Squirrel Hill tank would take a load off the Herron Hill reservoir. Options for Squirrel Hill would be to add a second tank or replace the existing standpipe with an elevated tank. The 40-Year Plan recommends construction of an elevated tank to replace the existing Squirrel Hill tank.

The need for a second water storage tank in the other pressure districts that have a single tank (Lincoln, Garfield, and Herron Hill) was also discussed. It is recommended that redundant tanks be provided wherever possible to improve service.

Low Water Pressure in the Penn Avenue Area of Bloomfield/Garfield

Low water pressure in the Bloomfield/Garfield area could be addressed by changing the boundary of the Bloomfield regulator district. The recommended method of addressing this problem is described under Task 4.1.

Increasing Water Demands in the Herron Hill Pressure District

There is concern that demands in the Herron Hill District are growing and stressing the PWSA system. This district serves a large area including Oakland and all of the university and hospital facilities located there. The main water storage facility in the district, the Herron Hill Reservoir, is supplied by the Herron Hill Pump Station. The Herron Hill Pump Station is supplied from Highland 1 Reservoir. Since Highland 1 Reservoir is currently uncovered, all water coming from the reservoir must be re-treated in the membrane filtration plant before it can be pumped to the distribution system. The capacity of the membrane plant was recently increased from 20 to 26 mgd but the plant is still the biggest bottleneck in the PWSA system. Operational and reliability issues with the membrane plant equipment can also cause the output from the facility to be less than its rated capacity.

One way to improve supply to this area would be to carve out a portion of the Herron Hill Service District and move it to the Lincoln District. This alternative is discussed in more detail under Task 4.1.

Safe Drinking Water Act Compliance and TTHM Reduction

Alternative methods to reduce total trihalomethanes (TTHMs) in the PWSA system were discussed at the January 4th and March 29th progress meetings. Disinfection byproduct (DBP) control strategies include the three general approaches shown below. Alternative methods of control are listed beneath each general approach:

a. Removal of Organic DBP Precursors
    1. Enhanced coagulation
    2. Peroxide / Biological Activated Carbon
    3. Granular Activated Carbon in Existing Filters
    4. Granular Activated Carbon in New Filters
    5. Granular Activated Carbon Absorbers
    6. Nanofiltration
    7. Ozone / Biological Active Filtration
    8. Ozone / Biological Activated Carbon
    9. MIEX Ion Exchange
b. Alternative disinfectants and / or conditions
    1. Chlorine dioxide

2. Ozone
3. Chloramines

c. Remove after Formation
1. Granular Activated Carbon
2. Reverse Osmosis
3. Biologically Active Carbon
4. Air Stripping

PWSA has undertaken numerous steps to reduce TTHM concentrations in finished water. These steps include eliminating pre-chlorination of the raw water entering the treatment plant, lowering turbidity to reduce total organic carbon (TOC), practicing enhanced coagulation, decreasing the amount of stored water to reduce water age, and optimizing the system. A small amount of chlorine is added just before the filters to remove manganese.

The maximum contaminant level (MCL) for TTHMs is 80 micrograms per liter (ug/L). TTHM concentrations in the PWSA system are generally in the high 60s but concentrations in Reserve Township are close to the 80 ug/L limit. PWSA is currently meeting Stage 1 requirements for TTHMs but Stage 2 will require sampling at 12 sites instead of 4. Mandatory testing began in April 2012. It is believed that 20 percent TTHM removal would allow PWSA to meet the requirements for Stage 2 but there will be violations if TTHM levels can't be reduced at the storage tanks.

A flushing program can be used to reduce TTHMs. Automatic flushers can be installed on fire hydrants to bleed water from dead end lines. PWSA doesn't have a flushing program at the present time. Another way to reduce TTHMs would be to install a UV disinfection system at the treatment plant and use less chlorine.

PWSA can't use an alternative disinfectant such as chloramines because a corrosion inhibitor can't be added to the water due to the open Highland Park No. 1 reservoir. Without a corrosion inhibitor, the use of chloramines would cause lead violations.

Air stripping appears to be the most promising method of reducing TTHM concentrations from water in storage facilities. A literature review indicates that aeration can remove 70 to 90 percent of TTHMs. PWSA is working with PAX Technologies and Dr. Casson at the University of Pittsburgh to install a demonstration system at the Brashear tanks. The Brashear tanks are located near the sampling point that has the highest measured TTHMs. One of the two tanks was painted recently and is still off-line. The demonstration system will be installed in this tank. PWSA plans to sample the water entering and exiting the tank at two week intervals to determine what kind of TTHM reductions are possible with the PAX system. Additional vents may have to be added on the top of the tank to provide the required amount of air exchanges for the system. Both Brashear tanks are currently

equipped with Red Valve systems to prevent stratification. The PAX system will add a mixer.

Reducing Non-Revenue Water Through Leak Detection and Repair

This subject is discussed under Task 4.7.

Prioritized Water Main Replacement Program

The Cap Plan software program was used to develop a risk based water main replacement/rehabilitation program. The main replacement program is described in detail under Task 4.2.

Service to Portion of City Served by PA American Water

The 40-Year Plan needs to address the potential for serving the portion of the City currently serviced by PA American. The facilities needed to provide service will have to be in place in order for PWSA to take over service to the South Hills.

Monthly water billing records for City customers served by PA American water were analyzed from 2005 through 2010 to determine water demands in this potential service expansion area. Results for the analysis are contained in Appendix 3.7. Metered usage during this period averaged 4.11 mgd. There were approximately 20,304 customers in this service area during the period of review. Adjusting for "unaccounted for" and "other" water uses (40 percent) results in an average water demand of 6.84 mgd for this service area. The maximum day demand for the PA American service area of the City would be about 10.95 mgd based on the 1.60 peaking factor that is experienced in the Allentown service district.

Task 2.3 discussed the cost of extending service to serve the South Hills area. A conceptual analysis of the cost of providing water service to City of Pittsburgh customers that are currently served by PA American Water Company is included as Appendix 2.2. An assessment of the viability of extending PWSA service to the South Hills area is contained in Task 4.4.

Access Tunnel at Water Treatment Plant

The Aspinwall water treatment plant has a tunnel that passes under old Route 28 and the railroad tracks and provides emergency access to and from the plant site. The tunnel is approximately 350 feet long by 12 feet wide and extends from the parking lot of the Waterworks Mall to the eastern edge of the water treatment plant property. Locked gates are present on both ends of the tunnel to prevent unauthorized access to the plant. The tunnel includes a paved road surface and vertical concrete retaining walls along its entire

length. The walls vary in height and are tallest adjacent to the bridges. The structure is truly a tunnel in the two locations where bridges span the retaining walls. The larger of the two bridges carries vehicles on Freeport Road and train traffic for the railroad. The smaller bridge is for the road in front of the water treatment plant. Outside of the bridge areas, the tunnel resembles an open top box culvert.

The tunnel walls have cracks and spalling concrete in different locations but otherwise appear to be in good condition. The bridges seem to be in fair condition, with the smaller bridge looking to be in better shape than the larger one. There is some concrete spalling and cracking on both bridges and support beams for the bridge decks are rusted, particularly on the larger bridge. A leaking water line that discharges into the tunnel area also needs to be fixed.

Based on a cursory inspection, the access tunnel outside of the bridge areas could be rehabilitated by removing accumulated sediment from the road surface and making spot repairs to damaged concrete on the vertical walls. It is anticipated that PWSA will only be responsible for a portion of the cost to rehabilitate the tunnel. PennDOT and the railroad likely own the larger bridge. The City of Pittsburgh or PWSA may own the smaller bridge closest to the water treatment plant property.

License to Pursue Hydropower

PWSA authorized Tetra Tech to conduct a feasibility review for a hydroelectric plant at the Allegheny Lock and Dam 2 (Highland Park Dam). A preliminary review that was prepared in April 2012 indicates that a hydroelectric power plant is feasible at this location. The Tetra Tech technical memorandum stated that the project could be developed for an estimated capital cost of $25 million. Operating costs for a facility of this size are projected to be $900,000 per year and the amount of time needed to permit and construct the facility is estimated at 7 to 9 years.

An installation with two 4 MW turbines would generate approximately 53 GWh/year. This is close to the amount of electricity used by PWSA on an annual basis. The cost analysis contained in the feasibility review projected that annual revenues from power sales would exceed the annual debt service and O&M costs for the hydroelectric facility. Power produced by the facility could be used by PWSA to offset purchased power from the local utility by use of net metering. A less attractive alternative would be to develop a power purchase agreement (PPA) with the local utility.

The feasibility review was based on the premise that PWSA could proceed with a hydropower project at the Highland Park Dam. However, a permit is needed in order to develop a project. Free Flow Power (FFP) Missouri 12, LLC is the holder of the Preliminary Permit to investigate the development of a hydroelectric project at this location. A preliminary permit was issued to FFP Missouri 12, LLC, for the Allegheny Lock and Dam 2 Hydroelectric Project No. 13755-000. The permit is effective April 1,

2011 and ends on April 1, 2014 or on the date that a development application submitted by FFP has been accepted for filing, whichever occurs first.

A hydropower project could be developed in conjunction with FFP or PWSA could purchase the rights to the permit from FFP and develop its own project. If a joint project were developed with FFP, project related costs and revenues would be shared by the two parties. If rights to the permit were purchased, PWSA would have to make a monetary payment to FFP. Either of these arrangements would affect the cost projections contained in the feasibility review. Therefore, PWSA will need to re-evaluate the financial feasibility of the project based on the results of any future discussions with FFP.

3.4 MODEL FUTURE NEEDS

Future pumping and distribution needs were determined using the PWSA water distribution system model in conjunction with Chester Engineers' experience with PWSA system operations. The PWSA water distribution system model, data collected during the Authority's on-going hydrant testing program, and evaluations of available system storage versus demand were used to evaluate the ability of the water distribution system to meet projected future demands and acceptable fire flows at acceptable operating pressures.

Projected Water Demands

These evaluations were performed using 2051 water demands. The projection of future water demands was based upon population projections developed by the Southwestern Pennsylvania Commission (SPC). The SPC "Cycle 8" forecast (adopted by SPC in June, 2007) was used. This data provides population estimates for 36 Pittsburgh "neighborhood clusters" through the year 2035. These estimates were extrapolated to the year 2051 using the trends presented in the projections. Table 3-13 presents the estimated changes in population for City of Pittsburgh neighborhood clusters (as defined by SPC) and the municipalities of Reserve and Millvale.

These population projections were used as the basis for estimating future water demands. This was accomplished by apportioning the projected changes in population between the years 2010 to 2051 within each of the municipalities/neighborhood clusters to the appropriate PWSA water service districts. The resulting net change in service population was multiplied by 140 gallons per capita per day (gpcd) factor to produce estimates of the associated net change in average daily water consumption. The 140 gpcd factor was determined from analyses of billing and pumping records and includes domestic consumption plus allowances for associated increases in commercial, industrial and institutional consumption. The projected changes in future demands were added to the existing average day demands in each of the PWSA service districts to produce projected year 2051 average daily demands. In order to project future maximum day demands, the projected changes in average day demands for each service district were multiplied by an

average day to maximum day peaking factor that was determined from pumping data for the period 2007 through 2009.

Table 3-13
SPC Cycle 8 Population Projections by Municipality or Pittsburgh Neighborhood Cluster *

Municipality (or Pittsburgh neighborhood cluster)	Population Estimates by Year						
	SPC Cycle 8 Estimates						Extrapolated
	2005	2010	2020	2025	2030	2035	2051
01:Golden Triangle/Civic Arena	2,637	2,769	2,934	3,059	3,134	3,129	3,337
02:Central Oakland	4,891	4,904	4,980	4,859	4,728	4,593	4,180
03:North Oakland	9,717	9,765	10,139	10,468	10,875	11,395	12,735
04:West Oakland/South Oakland	5,028	4,956	5,029	5,207	5,424	5,705	6,426
05:Bluff	6,303	6,275	6,305	6,348	6,413	6,501	6,710
06:Strip District	259	262	286	305	329	359	437
07:Bedf Dw/Craw/Middle Hill/Terr Vill	10,475	9,896	9,560	9,648	9,821	9,547	9,533
08:Lawrenceville/Polish Hill	11,189	10,851	10,761	10,950	10,662	10,200	9,602
09:Bloomfield/Garfield/Friendship	15,129	14,755	14,978	15,472	15,620	15,211	15,460
10:Shadyside	13,390	13,525	14,485	14,497	14,507	14,505	14,526
11:East Liberty/Larimer	8,605	8,365	8,676	9,113	9,682	10,425	12,291
12:Stanton Hgts/Morningside/Hghlnd Pk	14,283	14,021	14,467	14,548	14,055	13,552	12,576
13:Lincoln/Lemington/Belmar	5,163	5,032	5,062	5,188	5,361	5,604	6,182
14:Homewood/East Hills	12,119	11,811	12,197	12,761	13,499	14,470	16,895
15:Point Breeze	7,540	7,429	7,733	7,889	7,644	7,393	7,030
16:Squirrel Hill North	11,228	11,348	12,021	12,250	12,171	12,084	12,151
17:Sq Hill South/Regent Sq/Swissh Prk	16,347	16,286	17,280	18,276	19,500	21,054	25,080
18:Greenfield/Hazelwood/Glen Hazel	12,967	12,619	12,663	12,980	13,426	14,157	15,751
19:North Shore	285	305	365	388	396	404	446
20:Chateau	69	65	62	62	61	61	60
21:Manchestr/Cent North Sid/Allegheny	9,798	9,514	9,698	10,064	10,552	10,388	11,124
22:Marshall-Shadeland/Brighton Hgts	14,320	14,194	14,653	15,199	15,467	15,231	15,848
23:Perry South/Northview Hgts	7,294	7,232	7,731	8,230	8,857	9,660	11,718
24:Finev/Sp Hll/Troy Hl/Spring Grdn	7,958	7,751	7,811	8,030	8,332	8,768	9,789
25:Perry North/Summer Hill	5,423	5,348	5,505	5,717	6,003	6,452	7,462
26:South Shore	59	58	57	56	55	55	53
27:South Side Flats/South Side Slopes	10,014	9,747	9,699	9,886	10,246	10,788	11,950
28:Fairywood/Sheraden/Windgap/Esplen	8,639	8,236	8,123	8,297	8,557	8,934	9,799
29:W End/Ellt/Wstwood/Crf Hghts/Oakwd	11,975	11,734	11,872	12,211	12,718	13,551	15,342
30:Duquesne Hgts/Mt Washington	11,808	11,547	11,635	12,086	12,148	11,667	11,701
31:Allentown/Beltzhoovr/Knoxv/Bon Air	10,528	10,320	10,630	11,075	11,311	11,115	11,632
32:Arlin/Arlin Hgts/St Clair/Mt Olivr	3,674	3,442	3,382	3,472	3,607	3,800	4,246
33:Banksville/Beechview	12,549	12,304	12,496	12,992	13,615	13,057	13,655
34:Brookline	13,440	13,147	13,221	13,602	14,269	13,668	14,145
35:Carrick/Overbrook	13,732	13,391	13,438	13,763	14,254	14,039	14,680
36:Hays/Lincoln Place/New Homestead	4,773	4,686	4,752	4,912	5,179	5,522	6,343
Millvale Borough	3,831	3,805	3,981	4,172	4,417	4,783	5,638

Table 3-13
SPC Cycle 8 Population Projections by Municipality or Pittsburgh Neighborhood Cluster (continued) *

Municipality (or Pittsburgh neighborhood cluster)	Population Estimates by Year						
	SPC Cycle 8 Estimates						Extrapolated
	2005	2010	2020	2025	2030	2035	2051
Reserve Township	3,751	3,748	3,871	4,000	3,895	3,747	3,615
Fox Chapel Borough	5,371	5,481	5,990	6,082	6,032	5,977	5,963
Totals	326,561	320,924	328,528	338,114	346,822	351,551	376,109
Percent Change 2010 to 2051	17.20%						

* Per 2000 US Census Data, Pittsburgh ranks fourth among large US cities for the highest increase in population during the workday. The City's population of 334,563 increases by 41.3 percent to 472,754 persons in the daytime as a result of the large number of commuters that work in the City.

Existing and estimated water demands by service district are listed in Table 3-14.

Table 3-14
Existing and Projected Average and Maximum Day Water Demands

Service District	Average Day Demands			Maximum Day Demands		
	Existing (mgd)	Year 2051 (mgd)	Percent Change	Existing (mgd)	Year 2051 (mgd)	Percent Change
Highland 1	14.0	15.7	11.6%	25.1	28.01	11.6%
Inline Pump District	0.2	0.2	1.4%	0.2	0.22	1.4%
Bedford	0.8	0.8	0.1%	2.1	2.10	0.1%
Herron Hill Tank	0.5	0.5	-0.6%	0.7	0.65	-0.6%
Herron Hill Reservoir	15.8	16.7	6.0%	18.5	19.61	6.0%
Bloomfield Regulator	0.8	0.8	0.9%	0.7	0.75	1.2%
Lincoln	1.1	1.1	7.1%	2.0	2.12	7.1%
Garfield	3.0	2.9	-2.1%	3.5	3.38	-2.1%
Highland Park/Garfield Regulator	0.3	0.3	-4.6%	0.4	0.36	-4.6%
Zoo Regulator	0.1	0.1	-4.4%	0.2	0.18	4.4%
Highland 1 Subtotal	*36.6*	*39.1*	*7.0%*	*50.0*	*54.0*	*8.0%*
Highland 2	9.2	9.5	3.9%	22.2	23.06	3.9%
Allentown	4.8	5.0	4.9%	6.1	6.40	4.9%
Squirrel Hill	2.5	2.8	14.1%	3.1	3.54	14.1%
Highland 2 Subtotal	*16.5*	*17.4*	*5.7%*	*28.0*	*29.8*	*6.3%*
Lanpher	8.2	9.2	12.5%	21.2	21.90	3.3%
Brashear	3.4	3.9	17.2%	4.2	4.92	17.2%
McNaugher/Spring Hill	5.7	6.3	10.5%	7.5	8.28	10.5%
Lanpher Subtotal	*17.2*	*19.4*	*12.8%*	*28.0*	*32.0*	*14.3%*
Total Production	70.2	75.9	8.1%	107.0	116.0	8.4%

Note: Maximum day values are not additive to total because service district maximum day events do not coincide.

Evaluation of Distribution Pumping Capacity

The projected maximum day demands for the service districts were compared to the nominal pumping capacities of the associated pumping stations in order to evaluate the

adequacy of the existing pumping facilities under the projected future demand conditions. The nominal pump station capacity represents the sum of the rated capacities with one of the largest pumps out of service. This comparison is summarized in Table 3-15.

Table 3-15
Comparison of Future Demands to Existing Pumping Capacity

Service District	Pump Station	Year 2051 Max Day Demand (mgd)	Pump Station Nominal Capacity (mgd)
Highland 1	n/a	28.01	n/a
Inline Pump District	Inline Pump Station	0.22	0.14
Bedford	Herron Hill Reservoir Pump Station	21.70	24.0
Herron Hill Reservoir			
Herron Hill Tank	Herron Hill Tank Pump Station	0.65	2.0
Bloomfield Regulator	n/a	0.75	n/a
Lincoln	Lincoln Pump Station	2.12	4.0
Garfield	New Highland Pump Station	3.38	4.8
Highland Park/Garfield Regulator	n/a	0.36	n/a
Zoo Regulator	n/a	0.18	n/a
Highland 1 Subtotal	*Bruecken Pump Station*	*54.0*	56.0
Highland 2	n/a	23.06	
Allentown	Mission Pump Station	6.40	26.0
Squirrel Hill	Saline Pump Station	3.54	5.0
Highland 2 Subtotal	*Bruecken Pump Station*	*29.8*	48.0
Lanpher	n/a	21.90	n/a
Brashear	Howard Pump Station	4.92	7.5
McNaugher/Spring Hill	Howard Pump Station	8.28	13.5
Lanpher Subtotal	*Aspinwall Pump Station*	*32.0*	49.0
Nominal Capacity=Rated capacity with largest pump out of service			

As is indicated in Table 3-15, with the exception of the Inline Pump Station, the nominal capacities of the pump stations exceed the projected future maximum day demand, indicating sufficient pumping capacity. The deficiency of the Inline Pump Station was noted under the evaluation under existing demand conditions (Section 3.2). As was stated in Section 3.2, the Inline Pump Station contains two pumps; a 0.14-mgd capacity unit and a 0.29-mgd capacity unit. Consideration should be given to increasing the capacity of the smaller unit to improve system reliability under maximum day demand conditions. It is also noted that the projected maximum day demand approaches, although does not exceed, the nominal pumping capacity of the Herron Hill Reservoir Pump Station and the Bruecken Pump Station Highland 1 set of pumps.

Evaluation of Distribution System Storage Capacity

An evaluation of the adequacy of the distribution system storage capacity was performed under projected year 2051 demand conditions. The basis for evaluating storage capacity under future demand conditions is the same as was used for the existing conditions and was previously discussed in Section 3.2.

Table 3-16 presents a comparison of the computed storage capacity requirements for each of the distribution system storage facilities. As is indicated in Table 3-16, overall the PWSA water distribution system has a surplus of capacity. However, deficits in storage capacities under the future demand conditions are identified for the Herron Hill Tank and the Garfield Tank. The capacity of the Squirrel Hill Tank only marginally satisfies the computed storage requirement and concerns related to the amount and elevations of stored water available in the Squirrel Hill system and the impacts upon system operations and levels of service have existed for some time. In consideration of these factors, there is a need for increasing the storage capacities provided by the Herron Hill Tank and Garfield systems and replacing the Squirrel Hill Tank. A storage deficit is indicated for the Herron Hill Reservoir. However, as is discussed subsequently, it is proposed that a portion of the Herron Hill Reservoir District be moved into the Lincoln District. This would reduce the demands in the Herron Hill Reservoir District, thereby reducing the required storage capacity of the reservoir.

Table 3-16
Evaluation of Distribution System Storage Capacity

	Existing Storage (Mgal)	Required Storage (Mgal)	Surplus/Deficit (Mgal)
Highland 1 Reservoir *	130.5	Included in subtotal	
Bedford Tank	2.1	1.8	0.3
Herron Hill Reservoir	14.0	16.7	-2.7
Herron Hill Tank	0.4	1.3	-0.9
Lincoln Tank	3.0	1.8	1.2
Garfield Tanks	2.0	2.9	-0.9
Highland 1 Reservoir Subtotal	152.0	39.1	112.9
Highland 2 Reservoir	125.0	Included in subtotal	
Allentown Tanks	6.0	5.0	1.0
Squirrel Hill Tank	3.0	2.8	0.2
Highland 2 Reservoir Subtotal	134.0	17.4	116.6

Table 3-16
Evaluation of Distribution System Storage Capacity (continued)

	Existing Storage (Mgal)	Required Storage (Mgal)	Surplus/Deficit (Mgal)
Lanpher Reservoir	133.0	Included in subtotal	
Brashear Tanks	11.0	3.9	7.1
McNaugher/Spring Hill Tanks	6.4	6.3	0.1
Lanpher Reservoir Subtotal	150.4	19.4	131.0
Note: Water stored in the Highland 1 Reservoir cannot be used unless the Membrane Filter Plant is operational and can only be used at a rate within the treatment capacity of the MFP.			

Assessment of Overall Distribution System Performance Under Future Conditions

The PWSA water distribution system model was used to evaluate system performance under future conditions. This analysis was completed by simulating system operation under the projected year 2051 average day and maximum day demand conditions. In order to accomplish this, the existing PWSA water distribution system model was modified to reflect the projected demand rates. The average day and maximum day model simulations were performed and the results of the modeling were reviewed in order to evaluate system performance.

General system performance was evaluated based upon the ability of the distribution system to maintain operating pressures in the distribution grid at or above 35-psi under the average day demand conditions and above 20-psi under the extreme maximum day demand conditions. The results of this evaluation are illustrated in Figures 3-6 and 3-7. Figure 3-6 and Figure 3-7 present the results for the average day and maximum demand conditions, respectively. Because the projected increases in future demands are relatively modest and dispersed throughout the system, there is not a significant difference between current and future system performance. However, existing issues of concern will worsen if remedial actions are not taken. The system improvements identified under the discussion of the existing system under the Task 3.2 section of this report will designed to be effective under future demand conditions.

Assessment of Fire Flow Delivery Capacity

The fire flow capacity of the water distribution system under future demand conditions was evaluated using the computer model. Figure 3-8 presents the computed hydrant flow capacities under future conditions. These results are essentially that same as under existing demand conditions. The remedial measures discussed in Section 3.2 and Section 4.1 will be effective in improving fire flow delivery capabilities.

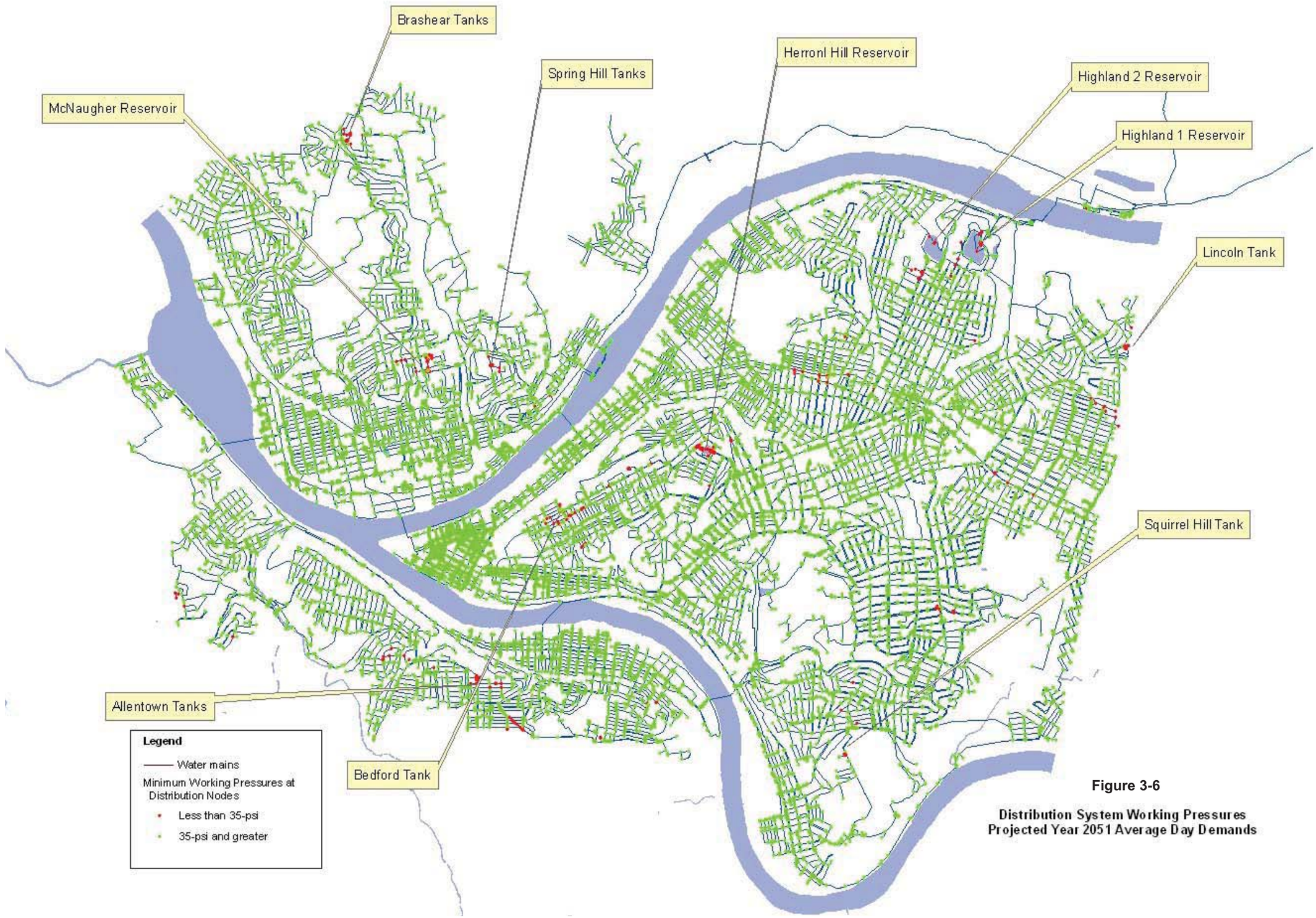


Figure 3-6

Distribution System Working Pressures
Projected Year 2051 Average Day Demands

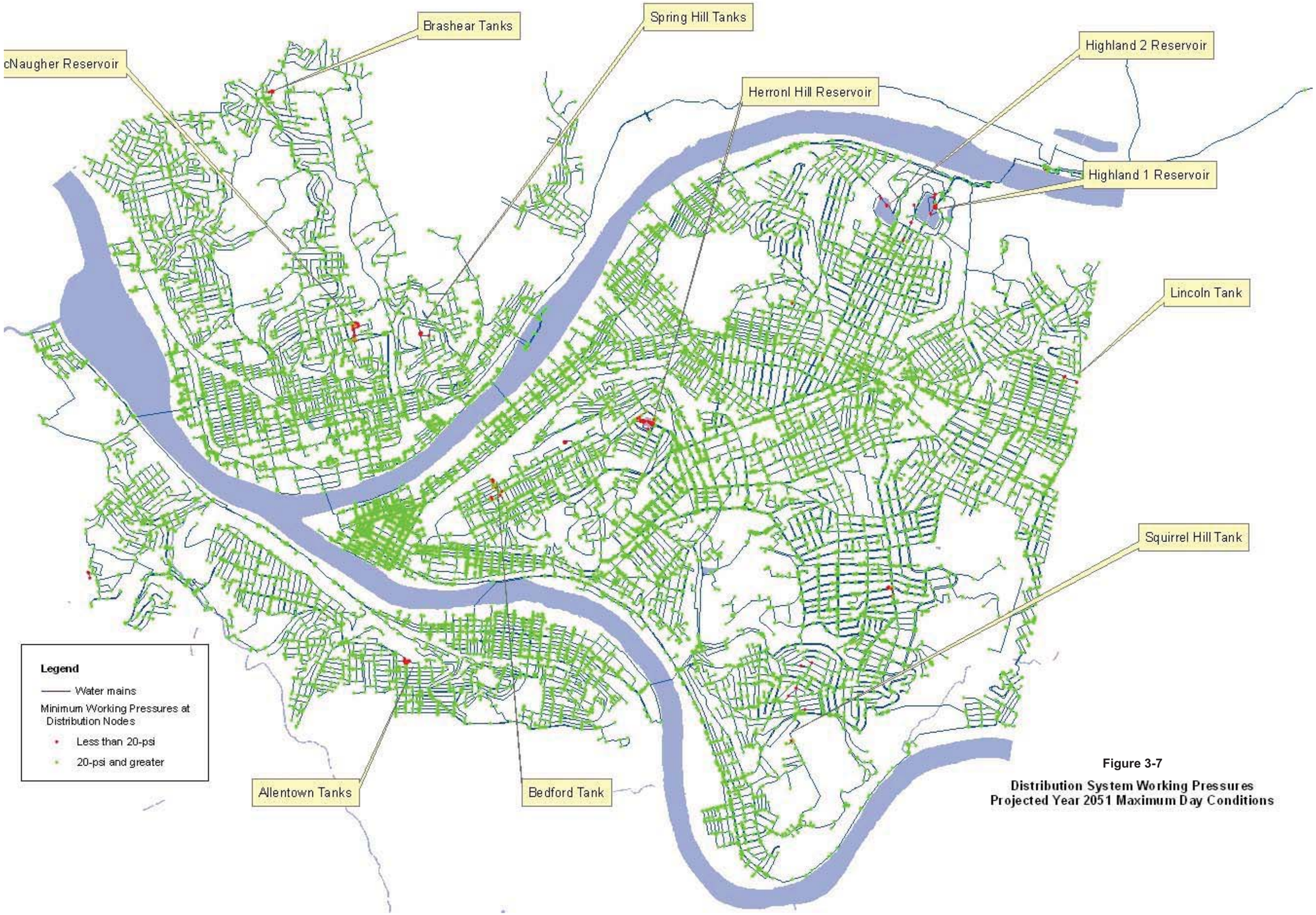


Figure 3-7

Distribution System Working Pressures
Projected Year 2051 Maximum Day Conditions

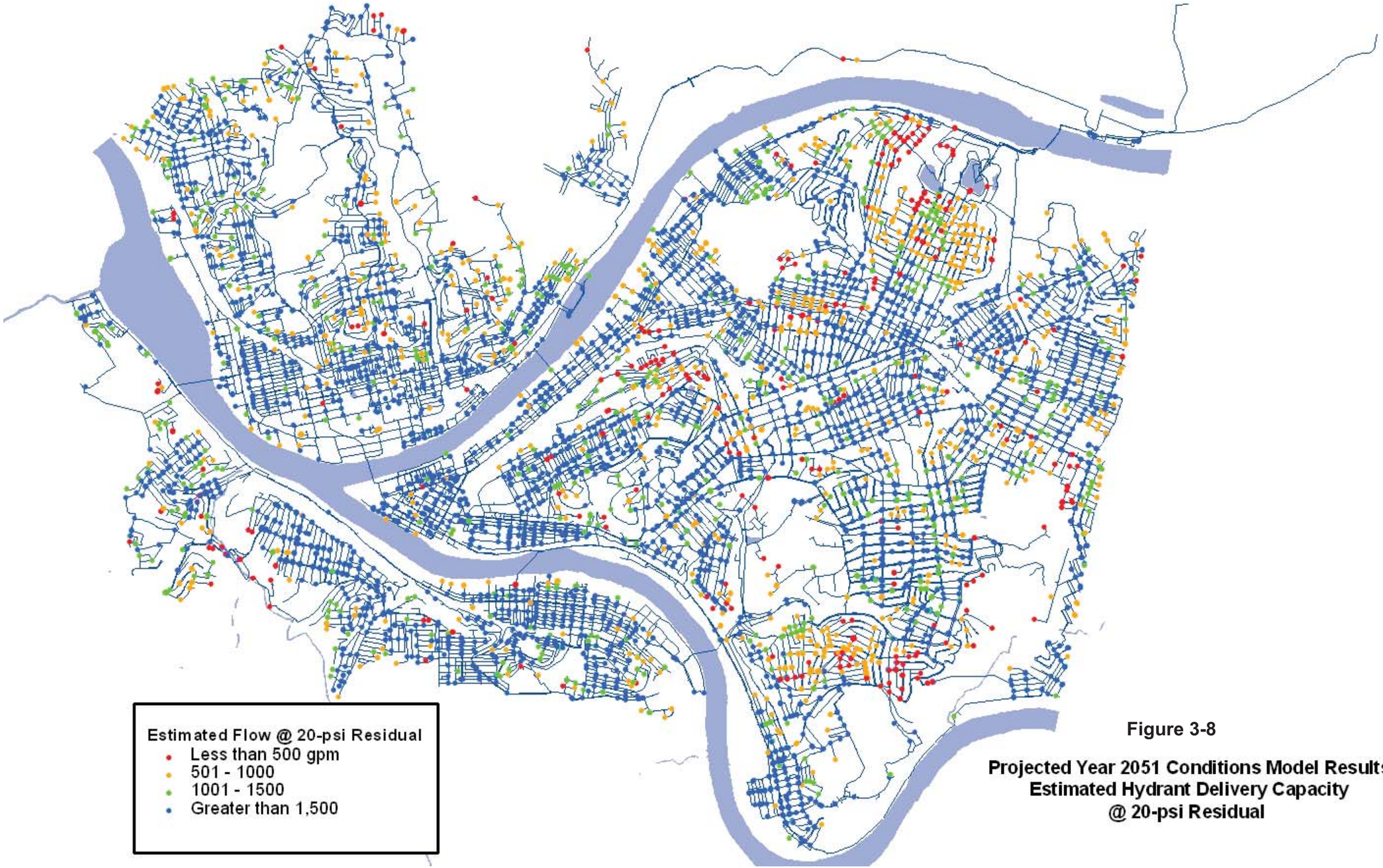


Figure 3-8

Projected Year 2051 Conditions Model Results
Estimated Hydrant Delivery Capacity
@ 20-psi Residual

Improving System Operability/Reliability

Other sections of this report address improvements/updates to the mechanical, electrical and instrumentation systems at the water distribution system pumping facilities. These improvements/updates will improve system operability and reliability. The addition of system storage in the Garfield, Herron Hill Tank, and Squirrel Hill Districts will also improve system reliability. The expansion of the Lincoln District into a portion of the Herron Hill Reservoir District will reduce the load placed upon the Herron Hill Reservoir District and provide a possible emergency service connection to the Squirrel Hill District, both of which will improve system reliability.

An additional improvement that is proposed to significantly improve system reliability is a pump station to transfer water from the Highland 2 Reservoir to the Highland 1 District. The Highland 1 District is supplied by the Bruecken Pump Station and any water that passes through Highland Reservoir 1 must be processed by the Membrane Filtration Plant. Both of these facilities can be affected by power outages and mechanical failures. The proposed transfer pump station will provide the ability to supplement the supply of water into the Highland 1 District in the event that the normal supplies of water to the Highland 1 District are reduced or curtailed. These facilities are described in Section 4.

Addressing the Aging Piping Infrastructure

An on-going water main replacement/rehabilitation program is recommended to address the issue of aging pipes. A risk-based water main repair/replacement capital improvements program has been developed as the basis for prioritizing specific water main replacements in consideration of the likelihood of main failure and the consequences should a failure occur. This program is described in Section 4.

Summary

The following major performance based capital expenditure needs associated with the PWSA water distribution system have been identified:

- Increase the capacity of the Inline Pump Station to provide a nominal firm pumping capacity at least equal to the projected future demand to improve system reliability under maximum day demand conditions.
- Provide at least 2.9 million gallons of storage in the Garfield District.
- Provide at least 1.3 million gallons of storage in the Herron Hill Tank District.
- Replace the Squirrel Hill Tank with two elevated tanks sized to provide at least 2.8 million gallons of storage (1.40 million gallons per tank).
- Supply the higher elevation areas in Millvale that currently experience water pressure problems through a connection with the Reserve Township system.

Another option would be to add an in-line pump station to pump water directly from the 60-inch supply line without the need to flow through Reserve Township.

- Expand the Bloomfield Regulator District in order to increase service pressures in this area in the Penn Avenue/Friendship Avenue/Harriet Street area in Bloomfield.
- Expand the Lincoln Service District into a portion of the Herron Hill Reservoir District to reduce demands on the Herron Hill Reservoir system, improve working pressures in some of the higher elevation areas currently in the Herron Hill Reservoir District and create an emergency secondary feed to the Squirrel Hill District.
- Construct a pump station to transfer water from the Highland 2 Reservoir to the Highland 1 System to increase the reliability of supply to the Highland 1 District.
- Implement an on-going, long range water main replacement/rehabilitation program to address the general issues associated with aging facilities and improve system fire flow capacities.

3.5 SEWER SYSTEM NEEDS

Combined Sewer Overflows (CSOs)

The PWSA Feasibility Study provides preliminary recommendations relative to projects needed to control CSO discharges from PWSA facilities. The October 2008 document is in draft form but still provides the best available indication of the CSO related improvements that will be required by the 2026 Consent Order and Agreement (COA) deadline.

The recommended plan was selected based on a multiple step process. The process included screening technologies to arrive at a short list of applicable CSO controls, prioritizing evaluation factors, generating model results, selecting the CSO control levels to be evaluated, and developing estimated costs for alternative control technologies. A system-wide evaluation was used to identify a highest rated set of improvements, which is based on the 1994 United States Environmental Protection Agency CSO Policy presumptive remedy approach. Under the presumptive approach, compliance with water quality standards is presumed if one of several performance criteria is met. CSO control alternatives in the Feasibility Study were sized for several control levels, including allowing only four overflows per year. Basin planning efforts by ALCOSAN are expected to clarify the ultimate control levels that are needed to meet water quality standards.

The highest ranked alternative for each of the five subsystems evaluated generally includes the conveyance of flows from the PWSA system to the existing points of connection to the ALCOSAN system. The method for managing the flows once they reach the ALCOSAN system is ALCOSAN's responsibility and will be determined by ALCOSAN during its CSO Feasibility Study. In some locations within the PWSA system, it is currently anticipated that flows will be controlled by sewer separation or subsurface storage. Work will also include improvements to CSO outfalls that are jointly permitted to both ALCOSAN and PWSA. It is important to note that ALCOSAN will be responsible for improvements to the jointly permitted outfalls. PWSA customers will share in the costs for improvements to the jointly permitted outfalls through payment of ALCOSAN sewer charges but PWSA will only have to finance capital costs for improvements related to its own CSO outfalls.

Chester Engineers worked with PWSA staff to identify and refine the improvements needed to control overflows from the CSO outfalls that are permitted to PWSA only. The identified improvements are sized to limit CSO discharge to four or fewer times during a typical year and, where necessary, provide sewers that are adequate to convey the peak flow from a 2-year design storm event to the ALCOSAN interceptor system. In cases where improvements are needed to sewers that receive flows from upstream communities, costs for the improvements will be shared between PWSA and the upstream communities. This subject is discussed in greater detail under Task 4.8.

Manhole surcharging and flooding that occur at locations within the PWSA system under extreme conditions are not addressed to any significant extent in the Draft Feasibility Study. This issue is discussed under Task 4.9.

Sewage Pumping Stations

The need for improvements to the four sewage pumping stations owned by PWSA has to be considered during the capital planning process. The Evergreen Road Pump Station is located in the Summer Hill section of the City near the border with Ross Township. The Browns Hill Road Pump Station is situated near the Homestead Grays Bridge in Hazelwood. Both the Rodgers Street and Mifflin Road Pump Stations are located in Lincoln Place, adjacent to the Borough of West Mifflin.

Available information indicates that the sewage pump stations last underwent significant upgrades in the mid-1980's. December 2010 evaluations of the facilities indicate that all the stations are in need of general rehabilitation and upgrades. The sewage and priming pumps at all stations are in good working condition but the priming systems that are needed to accommodate suction lift pumping conditions at the stations require a high degree of maintenance. Replacement of the existing pumps with dry pit submersible grinder-type pumps is currently being evaluated at the four pump stations. Also, the need for installation of emergency backup power generation systems is being reviewed.

Sewage generated in the Lincoln Place portion of the City is currently pumped into the ALCOSAN conveyance system by the Rodgers Street and Mifflin Road sewage pump stations. The area served by these two pump station includes approximately 900 residences. The natural topography of the area would allow gravity conveyance to the sewer system owned by the West Mifflin Sanitary Sewer Municipal Authority (WMSSMA). Transfer of the Lincoln Place service area to WMSSMA via a gravity sewer extension would allow the Rodgers Street and Mifflin Road pump stations to be abandoned, which would save PWSA the cost of upgrading the stations. PWSA and WMSSMA have discussed this situation and have reportedly agreed on terms for a transfer. Since ALCOSAN approval is needed for the transfer to go forward, the 40-Year Plan will include costs for upgrading all four of the PWSA sewage pump stations. However, it is recommended that PWSA pursue transfer of the Lincoln Place service area.

3.6 GREEN TECHNOLOGY ELEMENTS

This section reviews and evaluates green technology elements that could contribute to reduction of CSO problems if implemented in the PWSA service area. Methodologies discussed include installation of plumbing fixtures to reduce wastewater generation rates and green technology-based stormwater controls.

Interior Plumbing Fittings and Fixtures Replacement

Wastewater flows in a combined sewer system might be affected by reducing the amount of sanitary wastewater discharged into the collection system, or by reducing the amount of rainwater that reaches the collection system. Predicting the amount of reduction in wastewater flow by either of these measures will entail a significant degree of uncertainty. The following analysis will offer a broad comparison of the two approaches, as well as information that will offer a general view of potential implementation costs.

The federal Energy Policy Act of 1992 (EPAct 1992) included the following standards for water use by toilets, urinals, faucets, and showerheads:

- Toilets 1.6 gallons per flush (gpf)
- Urinals 1.0 gpf
- Faucets 2.5 gallons per minute (gpm)
- Showerheads 2.5 gpm

Prior to EPAct 1992 limits, which became effective in 1994, toilets flushing at the rate of five gallons or more were not uncommon. In the time since these limits were first promulgated, potable water purveyors in many parts of the U.S. organized programs to replace older sanitary fixtures, particularly toilets, in order to conserve water. These

conservation programs resulted in decreased wastewater flows as well as potable water use reduction.

A typical household with pre-1994 interior plumbing fixtures were predicted to use about 69.3 gallons per capita per day (gpcd), according to data derived from the American Water Works Association Research Foundation's *Residential End Uses of Water* (Vickers 2001). Post-1994 households were predicted to use 45.2 gpcd. These estimates of total residential water use were broken down as shown below:

Water use	Pre-1994 gpcd	Post-1994 gpcd
Toilets	18.5	8.2
Showers	11.6	8.8
Faucets	10.9	10.8
Other uses	28.3	17.4
Total use	69.3	45.2

'Other uses' includes clothes washers and dishwashers, as well as leaks.

These estimates imply that a residence that was built before 1994 and has not been remodeled might present the opportunity to decrease wastewater flow by 10.3 gpcd from toilets and by 2.8 gpcd from showerheads. Faucet use does not appear to offer appreciable opportunity for decreasing wastewater flow and achieving flow reductions from 'other uses' would entail extensive and expensive programs to replace clothes washers and dishwashers.

Data compiled by the US Census indicates that 95 percent of occupied housing units in the City of Pittsburgh were constructed prior to 1990. This proportion offers a reasonable estimate of pre-1994 housing units. Post-1994 housing stock probably constitutes a larger proportion of total units outside the city limits. Census data do not indicate whether bathroom upgrades were made to houses within the PWSA wastewater service area. Regardless of the uncertainty entailed in the data, it is instructive to consider housing units within the city limits as not having been upgraded since their original construction, and to calculate the potential wastewater flow reduction that would result from retrofitting all of those housing units with post-1994 toilets and showerheads. The result of this analysis might be considered an upper estimate for the possible extent of wastewater flow reduction that might be achieved by a comprehensive program of residential toilet and showerhead upgrades in the PWSA sewer service area is:

> City of Pittsburgh 2010 Census population (305,700) x (30.1 – 17.0) gpcd = 4 million gallons per day (mgd).

If half of the residential units in the combined sewer service area have been upgraded to post-1994 sanitary fixtures, the reduction of daily wastewater volume that might be achieved by upgrading the remaining residential units would be about 2 mgd. For the

purposes of this analysis, two toilets and one showerhead per dwelling unit are assumed to be upgraded in each residential unit. Such a program would entail 260,000 toilets and 130,000 showerheads if all of the pre-1994 residential units within the City of Pittsburgh were to be upgraded, or 130,000 toilets and 65,000 showerheads if half of the pre-1994 residential units were to be upgraded.

Water use for EPAct 1992 fittings and fixtures in commercial, institutional, and industrial (CII) sector is very difficult to estimate. CII establishments vary widely in occupancy, functions, and schedule. A very rough approximation of water use in toilets might be derived by comparing per capita residential use to workday use in CII establishments. The post-1994 per capita daily use of 8.2 gallons implies about five uses by each resident (8.2 divided by 1.6 gpf). Workplace use of toilets would likely average less than five times daily. Three uses per day by each workplace occupant would seem to be a plausible estimate. Distinguishing between toilet and urinal use would not be practical at this planning level. These assumptions lead to an estimated wastewater flow reduction of 6.2 gallons per day per CII occupant.

8.2 gpcd x 3/5 = 6.2 gallons per day per CII occupant

Potential wastewater flow reduction in the CII sector might be estimated by considering only toilets. Differentiating between toilets and urinals would not enhance a model at this planning level, and showerhead use cannot be defined without detailed building occupant data. Deriving this information would not be cost-effective, considering the scale of other unknowns and assumptions.

The 2000 Census provided an estimate of about 472,800 daytime occupants in City of Pittsburgh workplaces. Although an estimate of the number of workplaces with pre-1994 toilets is not available, assuming that all of the workplaces within the City are equipped with pre-1994 fixtures might provide a reasonable estimate of the maximum potential effect of a program to upgrade old toilets in the CII sector.

City of Pittsburgh workplace population (472,800) x (18.5 – 8.2) x 3/5 = 2.9 mgd

The number of toilets that would need to be replaced to achieve this level of wastewater flow reduction might be estimated by assuming workplaces conform to typical requirements of current plumbing codes, which call for between one toilet per 10 occupants to one toilet per 500 occupants, depending on building use. One toilet per 100 occupants seems to be a reasonable assumption to derive a general idea of the number of fixtures that a comprehensive fixture upgrade program might entail.

This analysis can be summarized as follows:

- Residential fitting and fixture upgrade program
  - Higher estimate
    - 260,000 toilets

    - 130,000 showerheads
  - Lower estimate
    - 130,000 toilets
    - 65,000 showerheads
- CII fixture upgrade program
  - 4700 toilets

Program costs to replace these fittings and fixtures might be estimated as:

- Residential toilets and showerheads– higher estimate
  - (260,000 x $200) + (130,000 x $20) = $57 million
  - Cost per mgd decrease, residential higher estimate - about $14 million
- Residential toilets and showerheads – Lower estimate
  - (130,000 x $200) + (65,000 x $20) = $27 million
  - Cost per mgd decrease, residential lower estimate - about $14 million
- CII toilets upgrades, represented by toilets
  - 4700 x $200 = $1 million
  - Cost per mgd decrease, CII – about $300,000 per mgd

Although there is a great deal of uncertainty in these estimates, it seems likely that the cost per unit wastewater flow reduction in the CII sector would be at least an order of magnitude less than the unit cost in the residential sector. Of course, the value of potable water saved by retrofitting interior residential fittings and fixtures might make such a program more attractive when combined with wastewater flow reduction.

Fittings and Fixture Replacement Programs

These programs have generally been focused on decreasing potable water demand; only a few reports offer observations regarding wastewater flow reduction. Many of the water use reduction programs involved rebates for customer purchase of efficient sanitary fixtures. Some of these rebates were reported to have covered the entire cost of fixture replacement, others probably defrayed only a portion of the cost to the water customer. The costs per mgd wastewater flow reduction reported or derived below should be considered in light of these uncertainties.

New York City NY

The New York City Department of Environmental Protection (NYC DEP) launched what the department calls the world's largest toilet rebate program in

1994. Between 1994 and 1997 NYC DEP provided rebates to building owners for replacement of 1.3 million toilets. The program estimated 90 mgd reduction in potable water usage for this program. During this period, total potable water consumption in New York City was about 1300 mgd. Program costs were reported to be $150 to $240 per toilet replaced. If wastewater flow reduction is assumed to correspond to potable water use reduction on a gallon-to-gallon basis, the cost per mgd decrease in wastewater flow achieved by the New York City program would be estimated as about $3 million.

NYC DEP is developing plans to offer a limited voucher-based plan for additional toilet replacements for 2014 and 2015.

Ashland OR

This municipality of about 20,000 population initiated a water conservation program in 1991 that included leak detection and repair, conservation-based water rates, showerhead replacement, and toilet replacement. The program was credited with a reduction of 16 percent of daily water usage and an estimated 58 million gallons per year of wastewater flow (160,000 gallons per day). The conservation program was estimated to cost about $800,000. Based on these figures, the cost per mgd reduction for the Ashland program was about $5 million. Ashland is now offering rebates of $45 to property owners who replace 1.6 gpf toilets with ultra-low flow toilets (1.28 gpf).

Goleta CA

The Goleta Water District carried out a water conservation program that focused on high-efficiency toilets and low-flow showerheads between 1987 and 1991, several years prior to promulgation of fitting and fixture standards under EPAct 1992. Combined with a water rationing program and changes to the water rate structure, the program resulted in a decrease in per capita water use from 125 to 90 gpcd. The water conservation program was also credited with a decrease in wastewater flow from 6.7 mgd to 4 mgd. The program was reported to have cost $1.5 million. The cost per mgd reduction was about $600,000.

Houston TX

This large system purveys potable water to a population of 1.7 million, as well as 553,000 CII customers. The Houston conservation program included changing water rates to an increasing block structure, and an extensive public education program. A pilot program carried out in cooperation with the housing authority to replace pre-1994 toilets with 1.6 gpf fixtures indicated that water savings and wastewater flow reduction could quickly offset the cost of installing the new

fixtures. The Houston department of Public Works and Engineering projected a benefit to cost ratio of more than 3 to 1 for expansion of the conservation program.

Massachusetts Water Resources Authority

MWRA is the wholesale water provider for 2.2 million people in 46 cities, towns, and water districts in the Boston area. The authority embarked on a ten-year program to decrease water demand in 1987, responding to predictions that population growth would result in overdrawing the safe yield of water sources. The program included changes to water rate structures, aggressive leak detection and repair, and retrofitting 370,000 homes to reduce potable water use by showerheads, faucets, and toilets. Retrofitting was done by MWRA crews, which replaced showerheads, installed restricting faucet aerators, and installed toilet dams in the tanks of existing toilets. The efforts resulted in reduction of average daily demand from 336 mgd in 1987 to 256 mgd in 1997. MWRA estimated that the 1990 cost per mgd water demand reduction was about $1.8 million.

Santa Monica CA

The Metropolitan Water District of Southern California initiated a program to reduce water use by 20 percent and wastewater flow by 15 percent between 1990 and 2000. The program had many elements, including changes to water rates, technical assistance, particularly for outdoor water conservation, rebates for toilet retrofits, and enhanced enforcement authority. Under the toilet rebate program, 41,000 residential fixtures and 1600 fixtures in private CII buildings were replaced, along with 1200 toilets in city-owned buildings. Potable water usage was reported to have decreased by 2 mgd and wastewater flow reduction was reported to be 2.2 mgd. The toilet rebate program offered $75 per fixture replaced, an amount that would not cover the full cost of a retrofit. Based on an estimated $200 cost to replace a toilet, the cost per mgd of wastewater reduced would be estimated to be about $4 million.

Seattle WA

Seattle Public Utilities (SPU) provides potable water to about 1.3 million people in Seattle and surrounding municipalities. SPU also collects wastewater within the City of Seattle, for treatment at one of several wastewater treatment plants operated by King County. The agency has two programs: one for residential customers (Home Water Savers Program) and one for CII customers (Water Smart Technology). Established in 1990, the programs have emphasized replacement of indoor fittings and fixtures, block rate structure for peak water use

periods, and water leak detection and repair. The program has been cited by many sources as exemplary, and it continues in effect today.

SPU has reported on the results of a toilet replacement program aimed at the CII sector, citing 0.8 mgd water usage reduction brought about by 600 businesses replacing 10,000 toilets. If this reduction of water usage resulted in an equal amount of wastewater flow reduction, the cost per mgd would be estimated at about $2.5 million.

Barrie ON (Canada)

This city near Toronto developed a fixture replacement program to decrease wastewater flows, in order to defer expansion of the community's wastewater treatment plant. Between 1995 and 1997, 10,500 households replaced 15,000 toilets with 1.6-gpf units, and a similar number of showerheads, receiving rebates of $145 (Canadian Dollars) for toilets and $8 for showerheads. Flow analysis indicated that water use in participating households was reduced by 16.4 gpcd, and that flow to the wastewater treatment plant was reduced by about 0.35 mgd. Cost per mgd wastewater flow reduced for this program would be about $9 million, based on $200 for toilet replacement and $20 for showerhead replacement.

Summary Observations

1. A residential toilet replacement program would be a great deal more costly than a CII program, on a cost per mgd of wastewater flow reduction basis.
2. A CII toilet replacement program might cost about $1 million per mgd reduction of wastewater flow.
3. A CII program in the PWSA service area might result in one or two mgd wastewater flow reduction.

Green Stormwater Infrastructure

In the combined sewer portions of the PWSA system, wastewater flow rate and volume may be decreased by diverting stormwater runoff from the sewer system. Wastewater flow rate may be decreased by delaying runoff as it travels toward the sewer system. Green stormwater infrastructure (GSI) may offer a cost-effective alternative to traditional wet weather storage facilities constructed in the wastewater collection system.

The GSI concept distributes stormwater runoff diversion or delaying facilities throughout the sewer service area, to deal with runoff as 'early' as possible. This approach avoids concentrating flows, allowing relatively small facilities to contribute significantly in

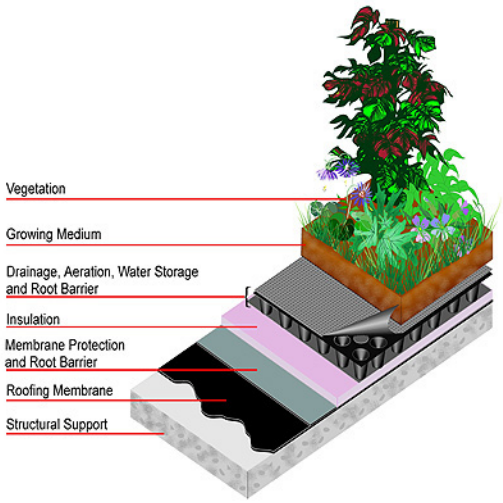
aggregate to controlling stormwater runoff entry into the sewer system. In an urban setting, GSI facilities may be constructed on roof tops, at the roof drain discharge, or in paved areas.

Rooftop GSI

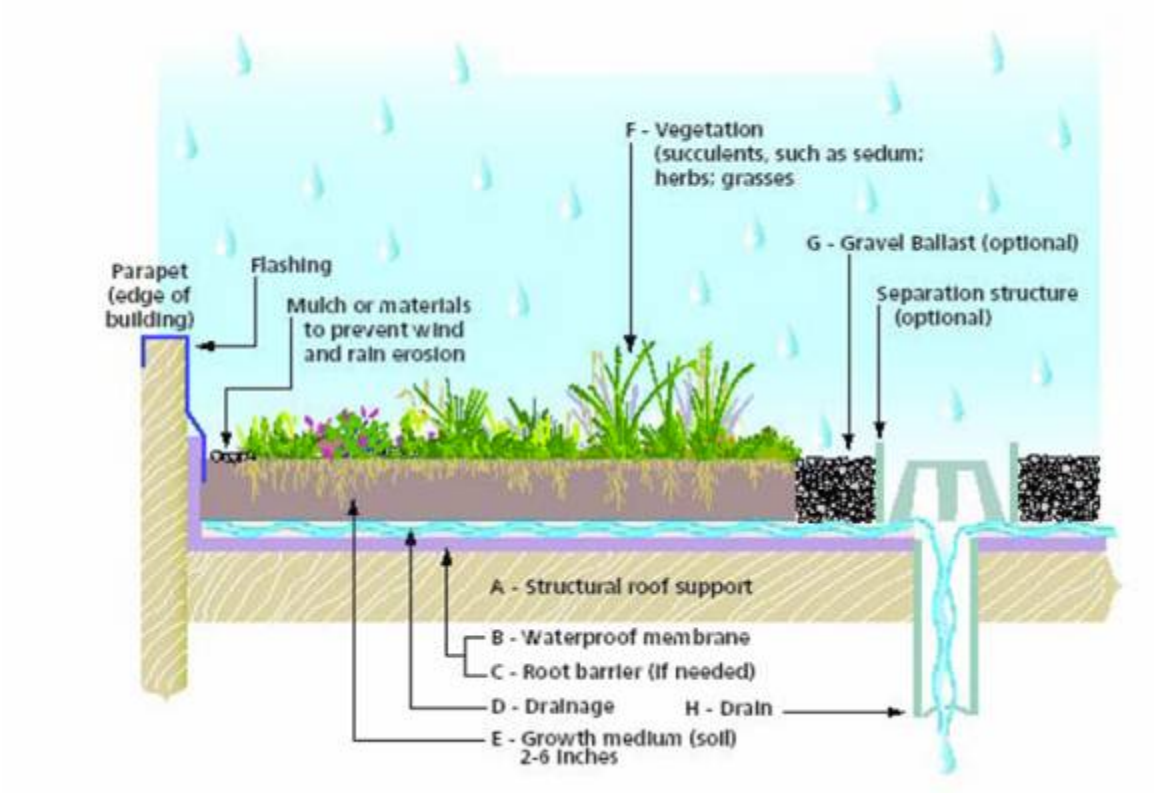
A vegetated roof can be designed to hold a portion of the rainfall that falls on the roof. Some of the rainfall will be diverted: held by the growth media and transpired by the vegetation. The amount of rainfall thus diverted will depend on a number of factors, such as the depth of the media and the type of vegetation planted on the roof. In general, vegetated roofs are classified as 'extensive' or 'intensive'. Vegetated roofs consist of several layers, starting at the bottom:

- Waterproof membrane installed over the roof structure
- Drainage layer that will collect and convey rainwater that infiltrates through the growth media
- Filter fabric to separate the drainage layer from the growth media, thus preventing downward migration of media particles and clogging of the drainage layer
- Growth media, generally consisting of light weight granular material
- Plant materials

Vegetated roofs can be installed in place, layer-by-layer, or they may be installed as modules that incorporate all of the layers, including vegetation.



Source: Low Impact Development Center



Source: City of Sandy OR

An extensive vegetated roof consists of a relatively shallow layer (3 or 4 inches) of growth media placed on a drainage layer, above a waterproof roof membrane. Typical vegetation used on an extensive vegetated roof is drought-resistant species such as sedum. These roofs are typically not irrigated. An intensive vegetated roof would typically have greater depth of growth media (from 4 inches to more than a foot) over the drainage layer. These roofs may be planted with a wider variety of vegetation, including small trees, and irrigation is generally required. Intensive roofs are often intended for use by building occupants; extensive roofs are generally not intended for use by occupants.

The vegetated roof may decrease rainfall runoff volume by absorbing a portion of the rainfall in the growth media. This retention reduces the rate of runoff from the roof to essentially zero until the media become saturated. As the media are saturated by rainfall, the roof begins to drain at about the rate of continuing rainfall. Water held in the media is released to the atmosphere through evapotranspiration after the rainfall event ends.

Research performed at Penn State University and Michigan State University indicates that media depth between 3 and 4 inches is optimal for holding rainfall. Deeper media were not observed to increase the volume retained. Other research findings included:

- Vegetated roofs retained about half of the annual rainfall volume. This finding is probably strongly related to the location of the research. The precipitation patterns in both locations are similar enough to Pittsburgh to adopt this general finding for this preliminary stage evaluation.
- Runoff from the roofs was delayed until growth media were saturated. Following saturation, runoff occurred at about the same rate as rainfall.
- High-intensity, short duration rainfall was attenuated more than lower intensity, longer duration rainfall.
- Roof slope had a small effect on runoff. More steeply sloped roofs produced slightly higher runoff volumes and rates, compared to less steeply sloped roofs.

It should be noted that the roof slopes studied by both Penn State and Michigan State were relatively shallow: between 2 percent and about 8 percent. Vegetated roofs have been installed on roofs as steep as 33 percent, but a slope of 25 percent is often cited as a practical maximum for vegetated roofs. The Penn State research indicated that nearly 95 percent of precipitation from summer rainfall events was retained by the vegetated roofs.

Based on these research findings, it appears extensive vegetated roofs would offer the more cost-effective approach to rooftop GSI control of wet weather flows to a combined sewer system, rather than intensive roofs. Extensive roofs are less costly to construct, since they require smaller volumes of media and impose less weight on the roof structure. Extensive roofs are also designed to function without irrigation, leading to lower operation and maintenance costs.

The potential effectiveness of rooftop GSI may be projected by considering the volume of rainfall that would be retained by a unit area of vegetated roof. Over the course of a year in Pittsburgh, where average annual precipitation is about 38 inches, a square foot of vegetated roof might be expected to retain half of the 24 gallons of rainfall it receives. During the summer months of June, July, and August, a square foot of vegetated roof might be expected to retain about 6 gallons of rainfall (95% of the 10.8 inches of rainfall striking the roof).

Residential Vegetated Roofs

The residential sector in the combined sewer area consists of many relatively small roofs, some flat and others sloped. If 800 square feet is considered as a typical residence footprint in the combined sewer service area, each vegetated roof might be expected to retain 9600 gallons of rainfall runoff in an average year and 4800 gallons of runoff during an average summer. Each residential installation would have to be preceded by a structural inspection to confirm that the existing roof would be able to support the additional load of an extensive

vegetated roof. If a residential roof were determined to be unable to support the additional load, it would logically be removed from consideration, as structural modifications to allow for the vegetated roof installation would almost certainly prove to be not cost-effective.

The installation cost of vegetated roofs has been estimated to be between $10 and $25 per square foot, with the higher side of the range relating to intensive roofs. Modular vegetated roof systems, which would probably be most plausible for residential use, are estimated to cost about $15 per square foot. The direct costs involved to install a vegetated roof on a typical 800-square foot residence might be:

- Structural assessment $ 1,000
- Roof installation $12,000
- Total cost $13,000

The cost per unit of runoff retained would thus be about $1.40 per gallon of annual runoff retained.

In addition to these direct costs, a public agency sponsoring a vegetated roof program for stormwater runoff control would have to consider administrative costs. Such costs would be fairly high on a unit runoff removed basis, due to the relatively small amount of flow attenuation that could be realized from each residence.

Commercial / Industrial / Institutional (CII) Vegetated Roofs

The CII sector will offer roofs that are generally much larger than residential roofs for GSI installations. The number of roofs in the combined sewer service area, and their typical size, are not known. A few assumptions can be made to estimate a cost per unit of runoff retained from CII buildings:

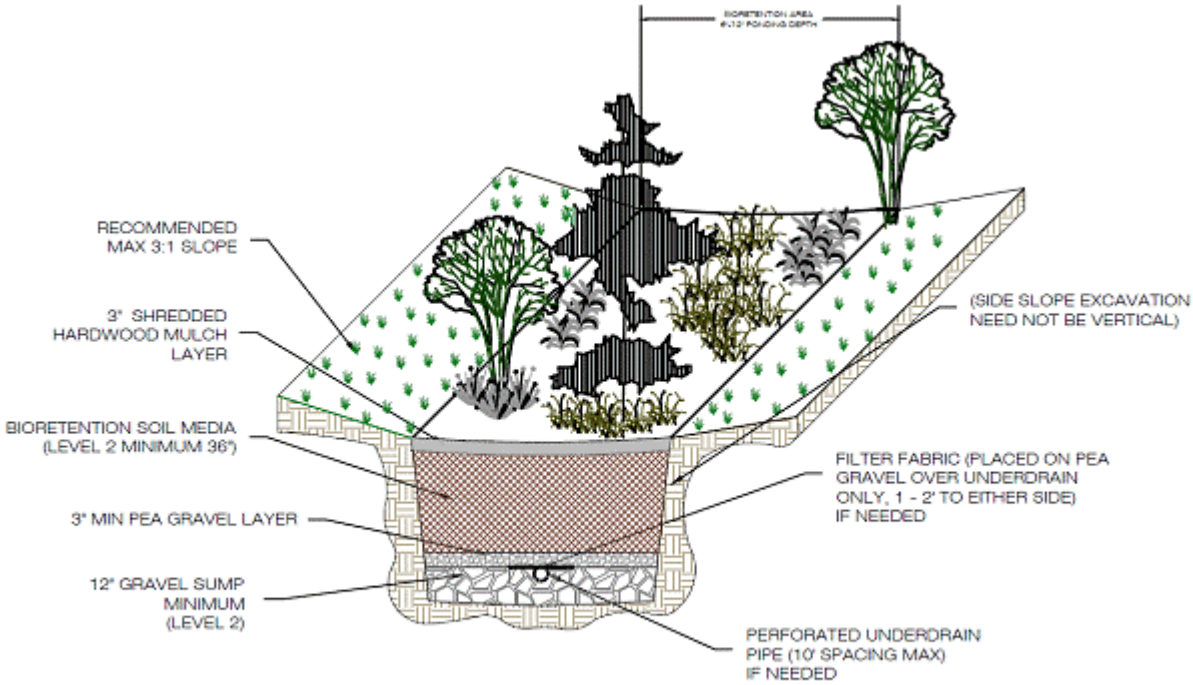
- Extensive CII vegetated roof would have a lower unit cost than residential roof.
  - Assume unit cost of $12 per square foot for roof installation.
- Structural assessment would be more complex, but potential to attenuate rainfall might make strengthening of existing roof structure cost-effective.
  - Assume $2 per square foot for structural evaluation and strengthening.

Using these assumptions, the direct unit cost of runoff retained in extensive vegetated roofs installed on CII buildings in the combined sewer service area might be about $1.20 per gallon of annual runoff retained.

The administrative effort and cost to recruit CII rooftops and manage the program for runoff attenuation would be significantly less than a program in the residential sector.

Roof Drainage GSI

Roof drainage may be intercepted as it reaches the ground, and conveyed to best management practices (BMPs) that might retain or delay the runoff as it travels toward the combined sewer system. A wide variety of BMPs exists, and the particular circumstances of a site will determine which approach would be most feasible. For the purposes of this preliminary analysis, a bioretention facility similar to the sketch below will offer a reasonable estimate of the potential runoff retention that could be achieved by this kind of GSI distributed in the CSO area.



TYPICAL BIORETENTION - LEVEL 2 WITH UNDERDRAIN

NTS

Source: Virginia Department of Conservation and Recreation

Sizing criteria for bioretention facilities range from about 2 percent to 7 percent of tributary area. For this analysis, a 5 percent criterion will be used. Thus, an impervious area of 100 square feet would be served by 5 square feet of bioretention surface area. If bioretention designed to this size criterion would

retain all of the rainwater it receives, a square foot of such a facility constructed in the PWSA combined sewer service area might be able to reduce stormwater runoff flow volume to the combined sewers by as much as 470 gallons annually.

In the residential sector, the typical 800 square foot roof envisioned for the vegetated roof analysis would require about 40 square feet of bioretention area at the ground surface. Bioretention designed according to this criterion will be considered to retain all of the runoff from the roof surface that it serves.

The cost of bioretention facilities has been reported from $5 per square foot to $40 per square foot, with the lower end of the range pertaining to simple residential installations and the higher end to complex CII facilities. For the purposes of this analysis, $20 per square foot of bioretention surface will be used to planning level cost comparisons. At this unit cost, diversion of a gallon of stormwater from the combined sewers might be accomplished for about $0.04.

This analysis illustrates the large difference in unit cost to retain or delay stormwater runoff between rooftop and ground level GSI practices.

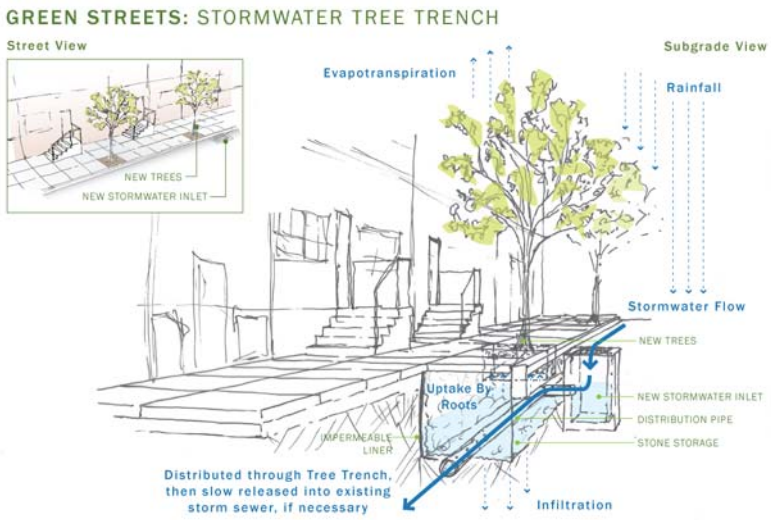
Paved Areas GSI

Rainwater runoff from ground surface impervious areas, such as parking lots, streets, and other urban hardscape, could be retained by bioretention facilities in the same manner as rooftop runoff. Bioretention could be installed at the edges and within parking lots and other large paved areas, to intercept runoff and either retain or delay its entry into the combined sewer system. The concept and unit cost for bioretention control of ground level runoff would be similar to control of roof drainage.

Paved areas may also be modified to provide infiltration and short-term storage of runoff beneath the paved areas. If soils drain sufficiently well, these facilities may result in some retention of runoff, as well as delayed entry of runoff into the combined sewer system. In parking lots, edge spaces might be retrofitted with subsurface storage/infiltration systems and overlain by pervious paving. Infiltration or bioretention beds may also be installed in the interior portions of paved areas, on a 1:20 basis (5 percent of tributary area) to intercept runoff within the paved areas and prevent its reaching storm drains, or to delay its entry into the combined sewer system. This approach would obviously decrease the number of spaces available for parking.

The cost of installing storage/infiltration/bioretention facilities in existing paved areas, such as parking lots, would be higher than the costs cited above for rooftop drainage bioretention. If unit costs were $40 per square foot of storage/infiltration/bioretention facilities, the diversion of a gallon of rainwater runoff from combined sewers might be about $0.08.

GSI can be adapted to many configurations of urban hardscape. For instance, the City of Philadelphia has developed a Tree Trench concept, which is a long, relatively narrow bioretention BMP that collects and retains or delays runoff from contiguous sidewalks. Storage/infiltration/bioretention can be incorporated into many construction activities, with little additional cost incurred.



Source: City of Philadelphia

GSI measures, applied even as small elements, can have a significant positive effect on wet weather flows in combined sewers. Their relatively small size makes them less daunting than large, bottom of basin storage facilities.

GSI Use in Other Cities

A number of wastewater agencies serving large urban areas have incorporated GSI into programs to control wastewater discharges from combined sewer areas.

Philadelphia PA

The Philadelphia Water Department (PWD) updated its Long Term Control Plan to reduce combined sewer overflows (CSOs) in 2007 to consider the potential benefits of GSI to supplement more traditional engineered infrastructure approaches to CSO reduction. Philadelphia entered into a consent order with PA DEP in 2011 that includes the concept of a 'Greened Acre' as a CSO control measure. A Greened Acre is one that is determined to have sufficient GSI measures in place to retain one inch of rainfall, thus diverting about 27,000 gallons of flow from the city's combined sewer system. PWD will test the concept over the next five years by developing and monitoring 744 Greened Acres. If the concept is proven, PWD will proceed to develop a total of nearly 10,000 Greened Acres in place at the end of a 25-year planning horizon.

The current PWD capital program budget illustrates the intended emphasis on GSI. Funding for GSI projects is about five times the projected funding for more traditional wastewater treatment solutions to CSOs in Philadelphia.

Portland OR

Portland entered a Stipulation and Final Order (SFO) in 1991 to reduce CSOs during a twenty year period, and succeeded in meeting the requirements of the agreement in 2011. Green infrastructure was adopted early in the city's response to the SFO through a program known as the Cornerstone Project. As it became evident that the SFO goal would be met, the city considered how continuing development could be allowed without losing some of the progress that had been made. Portland promulgated land development requirements that called for GSI measures and rehabilitation of conventional wastewater infrastructure that would achieve further CSO reductions to accompany land development.

A broadly based project known as Tabor to the River illustrates the comprehensive approach taken by Portland to build on the improvements made under the SFO. The project, which involves 2.3 square miles of the downtown, includes:

- 500 green street facilities, such as vegetated curb extensions and streetside planters,
- Rehabilitation or replacement of 81,000 lineal feet of sewer,
- 4000 street trees, and
- Working with private property owners to construct facilities to manage roof and parking lot runoff.

Portland has also established a 1% For Green Fund, which assesses a fee of one percent of the construction budget of any project in the public right of way that is not subject to stormwater regulations, such as projects smaller than the threshold area defined in the stormwater management manual. Funds are used to support other projects that either exceed the requirements of the stormwater manual or that are not subject to stormwater regulations.

Toronto ON Canada

Interest in vegetated roofs in Toronto was motivated first by concerns for biodiversity. A 2004 study suggested that a considerable portion of the city's footprint would be suitable for greening. A 2005 study identified the potential positive effect of GSI on Toronto's CSO program. The study included modeling of the extent to which GSI could offset conventional wet weather flow storage.

Modeling results suggested that if 5 percent of impervious cover within the 9100-hectare combined sewer area were replaced by GSI facilities, wastewater storage volume could be reduced by about 5 percent. Replacing 15 percent of impervious cover with GSI facilities was projected to allow storage volume to be reduced by about 13 percent.

In 2006 Toronto established a Green Roof Strategy intended to:

- Encourage the installation of vegetated roofs on city-owned buildings,
- Set up a pilot incentive program to encourage private owners to install vegetated roofs,
- Modify the land development review process to encourage vegetated roofs on new or renovated buildings, and
- Provide publicity and education to residents and businesses.

The Green Roof Strategy resulted in three city buildings being retrofitted with vegetated roofs and 7000 square meters of vegetated roof installed under the incentive program. A follow-on program called Eco-Roof was launched in 2009 with fourteen projects and 8100 square meters of vegetated roof.

In 2009, Toronto became the first city in North America to require vegetated roofs for new buildings. Buildings larger than 2000 square meters gross floor area permitted after January 31, 2010 are required to have vegetated cover for between 20 percent and 60 percent of roof area. Building developers may opt out of the requirement for a payment in lieu of $200 per square meter.

Seattle WA

Seattle Public Utilities developed a stormwater code to support the metropolitan area's Phase I NPDES and MS4 permit compliance program. This code establishes stormwater volume and peak rate controls for various types of urban land, including land within the combined sewer area of the City of Seattle. New development or redevelopment projects are required to use GSI to 'the maximum extent possible'. Relatively smaller projects – less than 10,000 square feet of new or replaced impervious surface – the code offers an option to employ 'pre-sized' flow control devices, to relieve smaller projects of the need to perform hydrologic modeling.

San Francisco CA

Stormwater guidelines specifically address control of wet weather flows in the city's combined sewer area. GSI is recognized along with conventional engineered measures to control volume and peak flows. The guidelines invoke

green building rating systems, such as Leadership in Energy and Environmental Design (LEED®) to establish requirements. For instance, in combined sewer areas under jurisdiction of the San Francisco Public Utilities Commission applicants for building permits are required to reduce volume and flow rate of runoff from rain events in accordance with Sustainable Sites Credit 6.1 – Stormwater Design: Quantity Control from the LEED for New Construction rating system.

Chicago IL

The Metropolitan Water Reclamation District of Greater Chicago (MWRD) developed one of the first wet weather storage systems, starting in the 1970s. The Chicago Tunnel and Reservoir Plan (TARP), which will consist of more than 100 miles of deep rock tunnels and 2.3 billion gallons of storage capacity, was the first project of its kind in the U.S. Construction of TARP commenced in the early 1970s and is planned for completion in 2015.

In December 2011 MWRD and U.S. EPA executed a consent decree that established an enforceable schedule for completion of TARP facilities. The consent decree also required a Green Infrastructure program that will entail spending of $25 million to $50 million on facilities that would:

- Reduce basement flooding,
- Readily become permanent stormwater control measures,
- Convert vacant parcels into 'stormwater parks', and
- Improve socio-economic conditions in areas impacted by environmental justice concerns.

The consent order sets goals for MWRD to build GSI stormwater retention capacity and offers such retention capacity to offset conventional storage capacity under certain circumstances, subject to EPA approval. The Green Infrastructure program also requires the distribution of 15,000 rain barrels to residential owners within the first five years, and an incentive program for GSI facilities on land leased by private entities from MWRD.

Summary Observations

Reduction of wastewater volume and flow rate by reducing potable water usage and by reducing rainwater runoff cannot be compared directly. Reduction of water usage constitutes reduction of base flow to the wastewater collection system. The positive effect of such reduction is limited, as removing base flow may simply 'make room' for rainwater runoff to enter the combined sewer system. This factor, along with the extremely high cost to reduce wastewater flow by reducing

water usage, recommend against using water use reduction measures to address the wet weather combined sewer overflow issue.

Small, distributed stormwater runoff storage facilities built with GSI practices in the sewer service area could reduce a portion of the excessive wet weather flows to the combined sewer system. Estimated costs to store a gallon of rainwater runoff are summarized below. It should be noted that some portion - perhaps a significant portion - of the stored runoff volume would not have to be pumped into the sewer system after the wet weather event has passed, as a portion of the stored runoff will infiltrate into the ground. This infiltration volume will, of course, depend on underlying soil characteristics and other site conditions.

1. Rooftop storage of rainwater runoff is estimated to cost between $1.20 and $1.40 per gallon.
2. Ground level storage of roof runoff is estimated to cost about $0.04 per gallon.
3. Storage of runoff from paved areas is estimated to cost about $0.08 per gallon.

3.7 PUMPING AND TREATMENT INVENTORY

An inventory of major PWSA pumps and equipment can be found in Appendix 3-8. The inventory includes pumps and equipment at water pumping stations, the Highland membrane filtration plant, the Aspinwall water treatment plant, and at the four sewage pumping stations. The inventory also lists information about chlorine booster stations that are located at water storage facilities.

The inventory presents information about the pumps and equipment located at each PWSA facility. Information on the list includes equipment name or brief description, equipment manufacturer, model / serial number, capacity, number of units, date installed, age of unit, and general condition based on appearance and input from PWSA staff. The equipment inventory primarily focused on pumps and treatment plant process equipment but also include major electrical components such as motor control centers and emergency generators. The collected information in the Excel spreadsheet was used in Task 4 to facilitate the development of capital budgets.

3.8 ASSET MANAGEMENT VIA GIS SYSTEM

Review of System

The PWSA currently manages its water and sewer infrastructure information on a GIS-based platform using the ESRI ArcGIS suite of software products. Utility GIS data is stored in an ESRI GIS database (Geodatabase) running on SQL Server. This data

management scheme supports a GIS-enabled intranet site which provides users throughout the organization with access to water and sewer mapping via a web-browser interface.

Utility GIS information is also provided to field inspection crews on ruggedized, tablet PCs, which are used to support on-going manhole and inlet inspection programs and other PM activities. The field inspection application works off of a local set of the mapping data stored on each individual tablet. Inspector field notes and edits are transmitted by redlining of comments, which are reviewed by the GIS staff and used to support mapping edits.

The PWSA currently uses Innovyze InfoNet asset management software to manage and maintain the sewer system network mapping and inspection information. Sewer utility data is periodically exported from InfoNet to a Geodatabase to support the intranet mapping site. The water distribution system mapping is maintained in a Geodatabase and MWHSoft's InfoWater software application is used to hydraulically model the water network.

PWSA Goals

The PWSA has made significant strides toward integrating GIS and related technologies into its operational structure. Moving forward, it would be beneficial to enhance the organization's capabilities and capacity to perform GIS work and field data acquisition with in-house staffing, equipment, hardware and software. To meet these goals, creation of a new, full-time position to facilitate interaction between the construction services group and GIS analysts working in the Engineering Division is recommended. This position would be tasked with performing conformational GPS surveys of infrastructure, verifying as-built conditions, and integrating survey data and as-built information into the GIS databases as required. This position would serve as a foundation for the formation of a survey services group within the Engineering Division whose mission would be to ensure that the water and sewer mapping datasets remain current and up to date. Acquisition of a real-time kinematic (RTK) GPS unit would support the field survey efforts.

As the PWSA deploys its mapping data to field personnel, it will be increasingly important to provide staff with the latest hardware and GIS software applications, enhanced connectivity and targeted training. Wireless connectivity to the PWSA's mobile devices can be achieve via the 4G, high speed cellular network now established in this region. High bandwidth, wireless connections would enable a broader range of data, including CCTV information, to be pushed to field crews. Currently CCTV data can be viewed through InfoNet software, which is not accessible to field laptops. The CCTV data files are very large and it is not feasible to store them on the laptop at this time.

Short-Term Recommendations

It is recommended that the PWSA continue to develop and deploy ArcServer mapping applications to support operations and enhance responsiveness in critical situations such as those requiring access to valve and hydrant data.

It is also recommended that the PWSA upgrade its GIS data server capacity to support the future needs of the organization. The PWSA currently maintains its GIS and CCTV data on two (2) servers with a combined capacity of 5.5 TBytes (consisting of a 2 TB and 3.5 TB drive). The 3.5 TB drive is currently at capacity and the 2 TB drive is at 90% of capacity currently and contains only CCTV data associated with the Consent Agreement video inspection program.

Long-Term Goals

As the PWSA continues to develop a robust GIS dataset of its water and utility infrastructure, it will become increasingly important to leverage this information as an integral component of the capital improvement planning process using analytical tools such as MWH Soft's CapPlan. GIS information can be used to support, manage, and document on-going PM programs such as valve exercising, hydrant testing and flushing programs. Integrating the existing water system mapping into MWHSoft's InfoNet asset management software would enable the Authority to more effectively manage its water assets and inspection programs.

GIS can also support work-order and asset management programs through applications such as the Cogsdale ERP suite of software products, which the Authority is currently implementing. An integrated ERP/GIS solution would enable the organization to utilize utility information maintained in the GIS to manage work order tracking, preventative maintenance programs, historical repair data, asset inventories, and associated repair and replacement costs. Programs such as the on-going CSO work could also benefit from the implementation of an integrated resource planning system strategy.

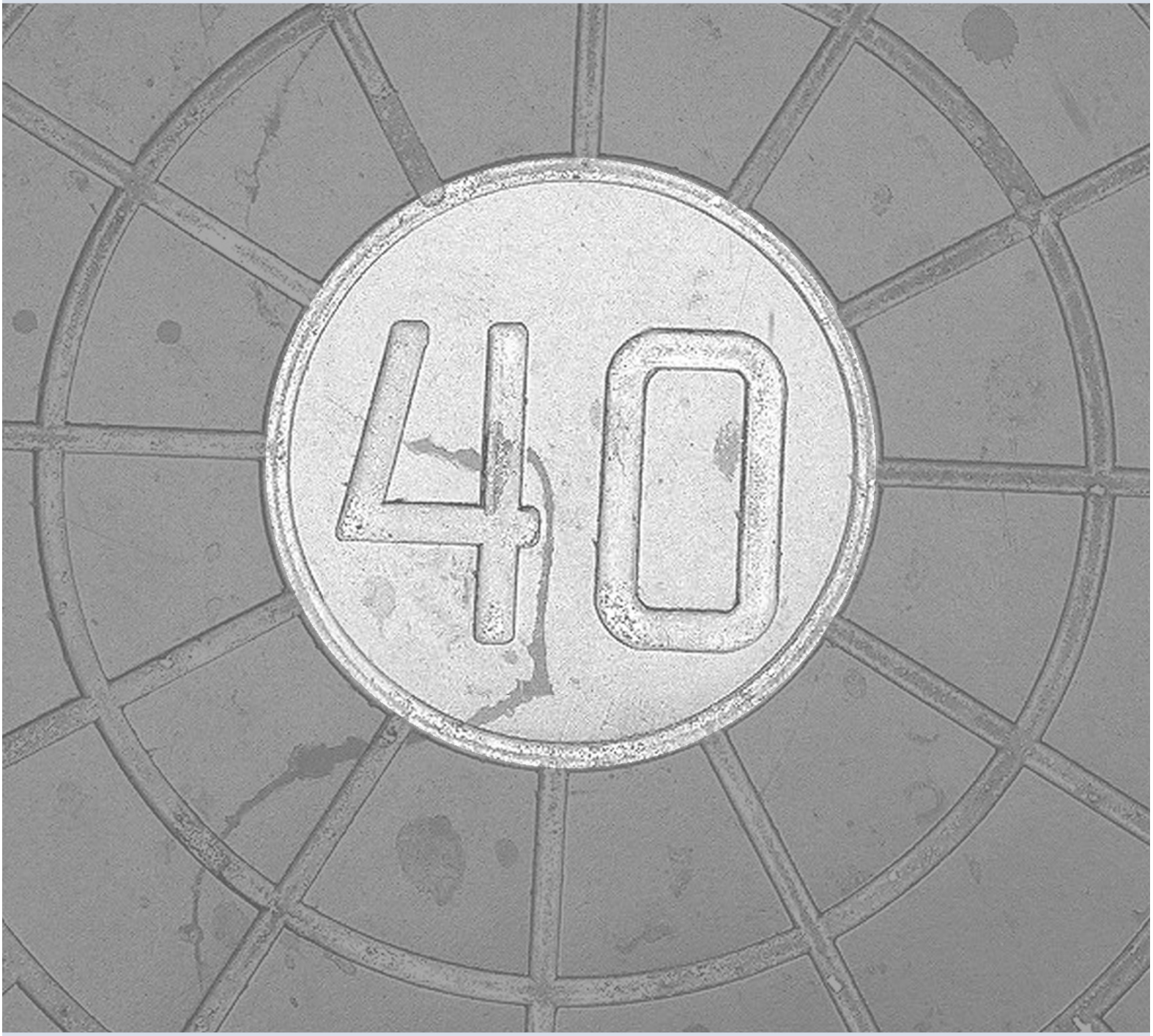
As the Authority becomes increasingly reliant on the utility information maintained in its GIS to support its operations, it will be imperative to ensure the accuracy of the water system mapping dataset. It is recommended that the PWSA undertake a comprehensive survey of its entire water distribution network using survey-grade GPS techniques to ensure the accuracy of its water network mapping. This effort would augment the on-going effort to map all large system valves as part of the valve exercising program managed by Wachs.

Estimated Capital Equipment Costs

The estimated capital costs for those items that have fixed costs are given in the table below. It is recommended that the training budget should be allocated for 3 staff members.

RTK GPS	$30,000
Additional laptops for field crews	$2,500 / laptop
3 days of training / year / person	$4,500 / year
ArcGIS Software Upgrade	$5,000
Wireless Connectivity to Mobile Users	$10,000 / year
GIS Server Upgrades	$5,000

TASK 4



CHESTER ENGINEERS, INC.

THE PITTSBURGH WATER AND SEWER AUTHORITY
40-YEAR PLAN
TASK 4 - RECOMMENDED CAPITAL IMPROVEMENTS

4.1 FUTURE WATER DISTRIBUTION NEEDS

Sections 3.2, 3.3 and 3.4 presented a water system needs assessment that determined that, overall, the PWSA water distribution system is capable of adequately meeting the water demands of the service area through the next 40 years. However, the need for several sets of improvements was identified to address specific localized issues and improve system operability and reliability. This section identifies specific recommendations regarding those improvements. It is noted that the recommendations provided herein are conceptual in nature and are subject to additional feasibility and pre-design studies.

Increasing Service Pressures in Identified Problematic Areas

The water distribution system is capable of satisfying the identified target minimum service pressures throughout the system. However, there are two areas where lower than desired pressures are a concern. One area consists of locations at higher elevations in Millvale that report pressures as low as 30-psi. Millvale is currently supplied from the PWSA 60-inch main on East Ohio Street and the volume of supply is more than adequate. However, pressures in the 60-inch main are insufficient to adequately reach the higher elevations in the Borough. This situation was confirmed by modeling.

Based upon feasibility studies performed by the PWSA, it is proposed that the problematic higher elevation areas in Millvale be supplied by constructing an in-line booster pump station to supply water to Millvale. This station would take water from the 60-inch transmission line and send it to the existing Millvale tank. The currently estimated construction cost for this work is approximately $500,000.

The second area consists of an area in Bloomfield along Penn Avenue roughly between 44th Street and Fairmount Street, along Friendship Avenue between Atlantic Avenue and Emory Way and along Harriet Street between Gross Street and Graham Street. This is an active redevelopment area in which existing customers report persistent low pressure problems. The area is served by the Highland 1 Reservoir District, but is immediately adjacent to the Bloomfield Regulator District. Expanding the Bloomfield Regulator District has been identified as a feasible means of sufficiently increasing service pressures in this area. The following recommended improvements to increase pressures have been identified. A general layout of these improvements is presented in Figure 4-1.

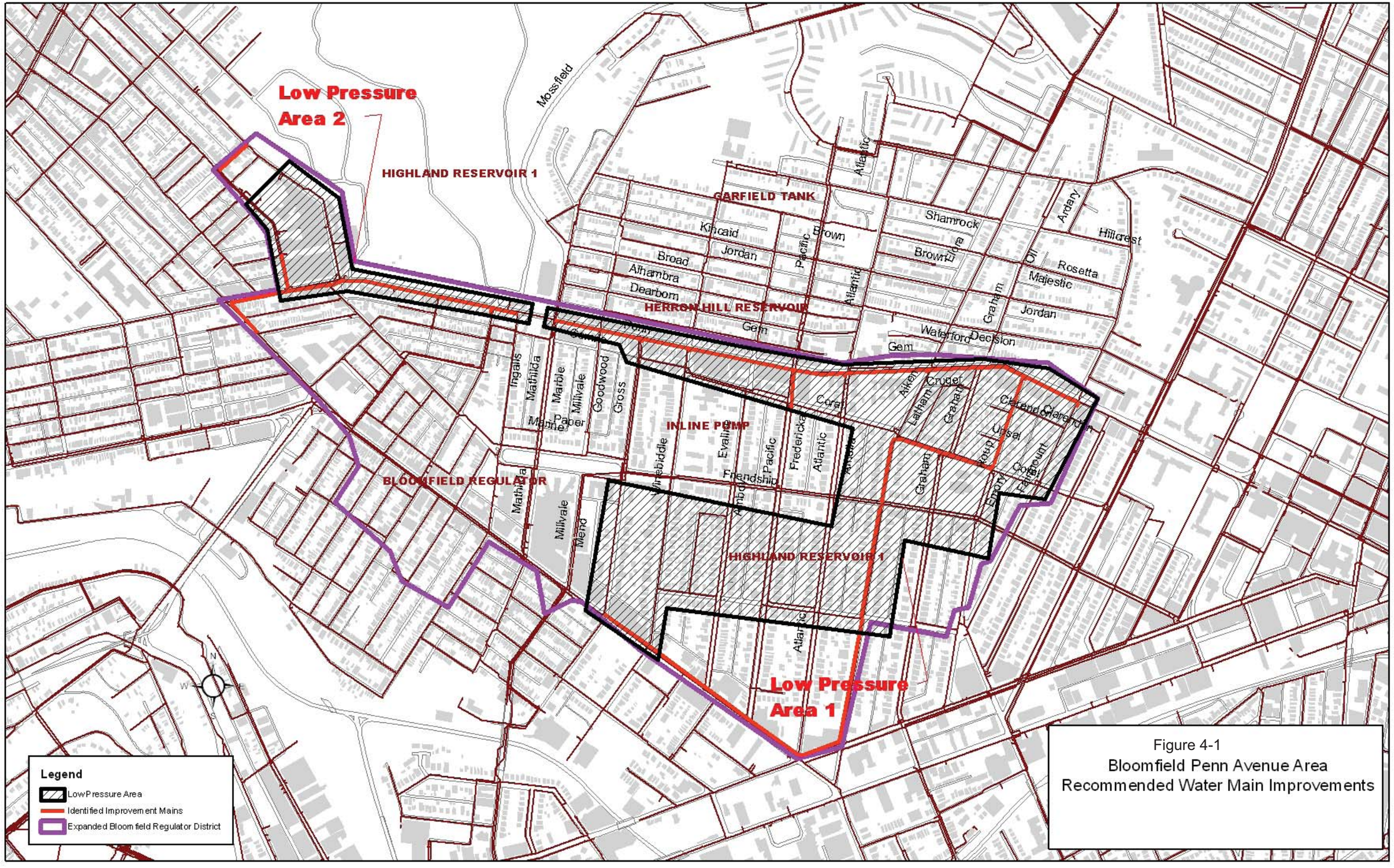


Figure 4-1
Bloomfield Penn Avenue Area
Recommended Water Main Improvements

- Make a connection to the discharge side piping from the existing Mathilda PRV at Penn and Mathilda to the following new mains: 3,980-feet of 12-inch main on Penn Avenue; 690-feet of 12-inch main on Roup Street; 760-feet of 12-inch main on Coral Street; 1,800-feet of 12-inch main on Aiken Street; 310-feet of 12-inch main on Baum Boulevard; and 1,800-feet of 12-inch main on Liberty Avenue. Install 1,430-feet of 8-inch main on Penn Avenue; 300-feet of 8-inch main on Main Street, 280-feet of 8-inch main on 44th Street, and 280-feet of 8-inch main on Sherrod Street.
- Position dividing pressure gates to expand the Bloomfield Regulator District as illustrated Figure 4-1, including the current Inline Pump District. This will enable the inline pump station to be eliminated.

The estimated construction cost for these improvements is $3,800,000.

Reducing the Size of the Herron Hill Reservoir District

Expanding the Bloomfield Regulator district would shift approximately 0.75-mgd of water demand from the Highland 1 Reservoir District to the Herron Hill Reservoir District under maximum day demand conditions. The Herron Hill District is currently taxed and there is a concern that shifting this amount of demand to the Herron Hill Reservoir District will place too great a demand on the facilities. The projected year 2051 demand on the Herron Hill Reservoir Pump Station under the service area current configuration is approximately 21.4-mgd. Adding the Bloomfield demand would increase the total demand to 90-percent of the nominal rated capacity of the station. A concept that has been advanced for addressing this situation consists of expanding the Lincoln Service District into a portion of the Herron Hill Reservoir District. This modification to the configuration of the PWSA water distribution system would reduce the demand on the Herron Hill Reservoir Pump Station and Herron Hill Reservoir by reducing the size of the district served. It would also offer the benefits of expanding the Lincoln Tank District into higher elevation areas of the Herron Hill Reservoir District and improve working pressures and creating an emergency secondary feed to the Squirrel Hill District from the Lincoln District. Expansion of the Lincoln District as envisioned would shift approximately 4.5-mgd of demand under maximum day conditions from the Herron Hill Reservoir District to the Lincoln District. This expansion would require upsizing the Lincoln Pump Station to a capacity of 6.7-mgd, increasing the storage volume in the Lincoln District to 5.2 million gallons, the construction of 11,300-feet of 20-inch and 12-inch diameter transmission main from the Lincoln District into the expanded service area and the construction of a point of emergency connection to the Squirrel Hill District.

A preliminary general layout of the modified service district boundaries and the facilities required to accomplish those modifications is presented in Figure 4-2. The estimated construction cost for these improvements is $9,500,000.

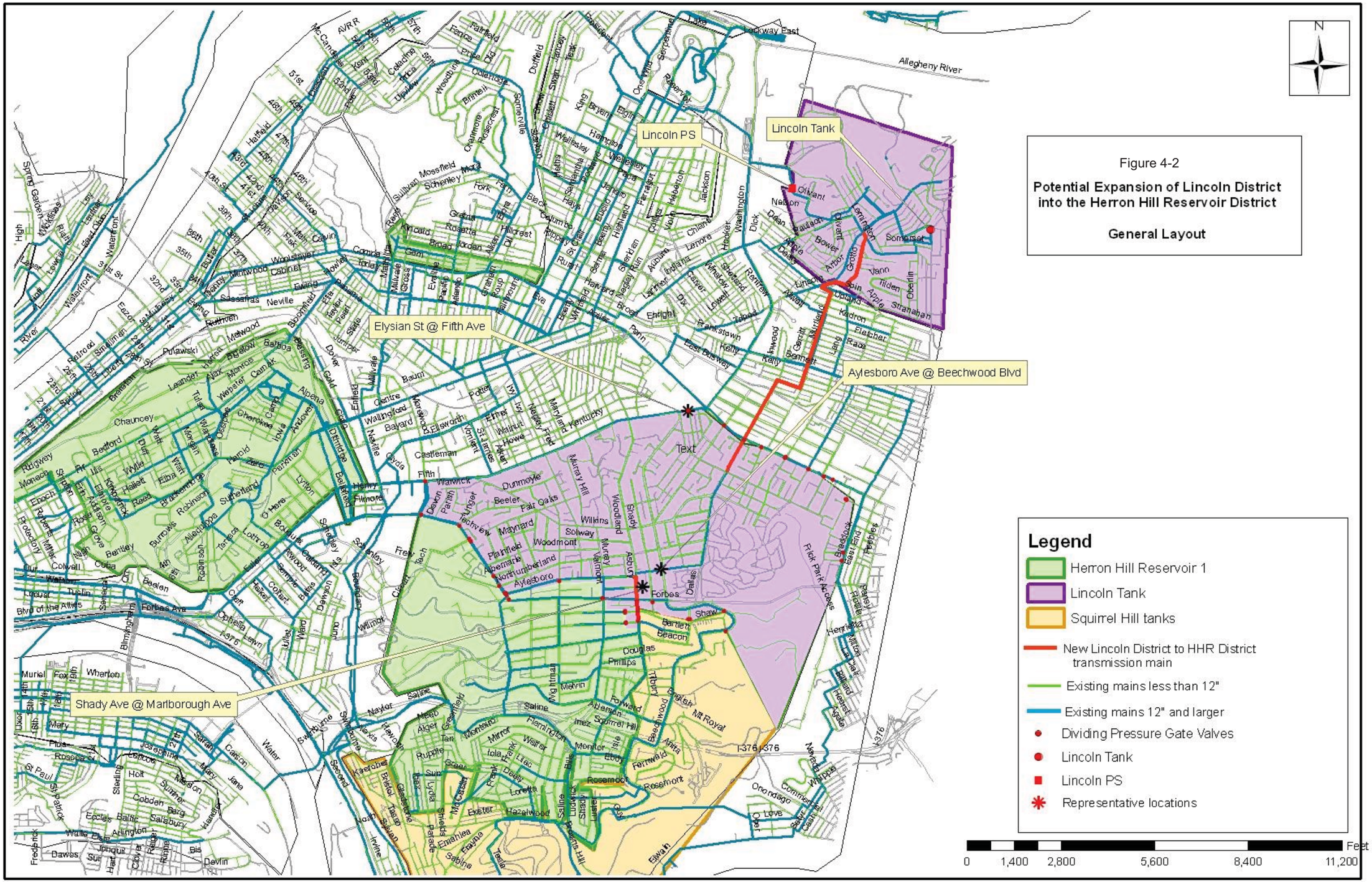


Figure 4-2

Potential Expansion of Lincoln District into the Herron Hill Reservoir District

General Layout

Providing Additional Pumping and Storage Capacity

The needs analysis presented in Section 3.2 evaluated existing pumping and distribution storage capacities under projected 2051 demand conditions. That analysis determined that the nominal rated capacity of the Inline Booster Station is less than the projected maximum day demand for the area served by the station. However, as discussed above, the recommended expansion of the Bloomfield Pressure Regulator District could eliminate the need for operating the Inline Pump Station. This would avoid the need for providing additional pumping capacity at that pump station. The proposed expansion of the Lincoln District into the Herron Hill Reservoir District will require increasing the capacity of the Lincoln District pump station to 6.7-mgd.

The needs analysis determined that the existing storage capacity does not satisfy the sizing criteria under maximum day conditions for the following service districts: Herron Hill Reservoir District, Herron Hill Tank District, and the Garfield Tank District. The needs analysis also identified the advisability of replacing/supplementing the storage in the Squirrel Hill District. The proposed expansion of the Lincoln District into the Herron Hill Reservoir District will require increasing the storage volume in the Lincoln District to 5.2-MG. However, this would avoid the need for increasing storage in the Herron Hill Reservoir District.

The actions required to address the identified distribution pumping and storage needs are as follows:

- Upsize the Lincoln Pump Station to a nominal rate capacity to 6.7-mgd.
- Increase the storage volume in the Herron Hill Tank District to 1.3-MG.
- Increase the storage volume in the Garfield Tank District to 2.9-MG.
- Provide a total of 2.8-MG of usable storage in the Squirrel Hill District.
- Increase the storage volume in the Lincoln District to 5.2-MG.

Where possible, two tanks will be used instead of one to improve storage redundancy. The estimated costs for these improvements are presented in Task 4.11.

Constructing a Highland 2 Reservoir District to Highland 1 Reservoir District Pump Station

The construction of a pump station capable of transferring water from the Highland 2 Reservoir to the Highland 1 District has been proposed. The proposed transfer pump station will provide that ability to supplement the supply of water into the Highland 1 District in the event that the normal supplies of water to the Highland 1 District are reduced or curtailed, significantly improving the reliability of the distribution system. A 32-mgd capacity transfer pumping station with a diesel powered generator and 12,500 feet of 42-inch pipe have been proposed. A second, separate electrical feed to the

Membrane Filter Plant has also been recommended as a part of these improvements. The estimated construction cost of these facilities is $4,600,000.

Improving Hydrant Flow Capacities and Addressing the Aging Piping Infrastructure

Hydrant flow testing and computer modeling have identified specific areas in the water distribution system that are in need of improved fire flow delivery capabilities. Investigations into these situations have determined that, in most cases, reduced fire flow capacity is attributable to small diameter, old pipes. A significant percentage of the water mains in the PWSA system are more than 70-years of age (a generally accepted estimated of the useful life of cast iron mains). In addition to losing capacity aging pipes become increasingly vulnerable to structural failures and are plagued by water main breaks of increasing frequency and severity, excessive leaks, and catastrophic failure resulting in large water losses, flooding, property damage, and community disruption. Addressing these issues can be accomplished through the implementation of an ongoing water main repair and replacement program. The PWSA's capital improvements programs (CIP) have included water main replacement elements. However, to be effective, the 40-year capital plan must include a substantially more aggressive water main replacement program that is supported by a decision support system that can better target mains for replacement and provide a tool for CIP planning.

4.2 WATERLINE RISK BASED ANALYSIS

As part of the development of the 40-year plan, the CapPlan software was used to develop a risk based water main replacement/rehabilitation program. The basic concept is that investments in water main replacement/rehabilitations should be targeted to most effectively minimize risk to the system. A complete understanding of risk requires the simultaneous consideration of the **probability of failure** of pipe components (i.e., how likely is it that a pipe will fail?) and the **consequences of failure** (i.e., if a pipe does fail, how will it impact the system and community?). Quantifying the relative risk of failure of pipes in the distribution system can provide a rational and defensible basis for developing a fully prioritized water main replacement/rehabilitation program that can be incorporated into an overall long-range plan and CIP and tailored to available capital budgets. Once individual pipe segments have been prioritized based upon risk, costs for replacement/rehabilitation have been estimated and capital budgets have been defined, specific main replacements can be assembled into an on-going program. This process is illustrated in Figure 4-3.

The PWSA's InfoWorks WS based hydraulic model of the distribution system was imported into the InfoWater/CapPlan modeling platform in order to permit the use of the CapPlan software.

Figure 4-3: Risk Based Water Main Replacement/Rehabilitation Development Process

Measures of the **probability of failure** of pipes were developed empirically using historical water main break records and specific pipe characteristics. A detailed, GIS based analysis of water main break records spanning the period 1989 to mid-2010 was performed in order to assign individual main break occurrences to specific pipe segments. A total of 5,100 individual main breaks were mapped to specific pipe segments. Relevant characteristics of specific pipe segments were determined using information contained in the PWSA's geographic information system (GIS), computer modeling results and other sources. The following pipe characteristics were defined: 1) estimated pipe age, 2) pipe diameter, 3) normal working pressures and 4) the natural corrosiveness of the soils in which the pipe is located. Each of these factors is thought to affect the probability of failure of pipes.

Figures 4-4 through 4-7 illustrate the empirical relationships between main break frequency and the four pipe characteristics listed above.

Pipe segments with similar characteristics were combined into bins of pipes with common characteristics. The historical frequency of water main breaks of pipes within each bin were computed in terms of the number of breaks that occurred per year per mile of pipe for all of the pipes within each characteristics bin. This served as the empirically derived measure of the probability of failure. Figure 4-8 presents the break frequency of PWSA pipes by pipe characteristics bin.

Figure 4-4
Empirical Relationship: Main Break Frequency vs. Pipe Age

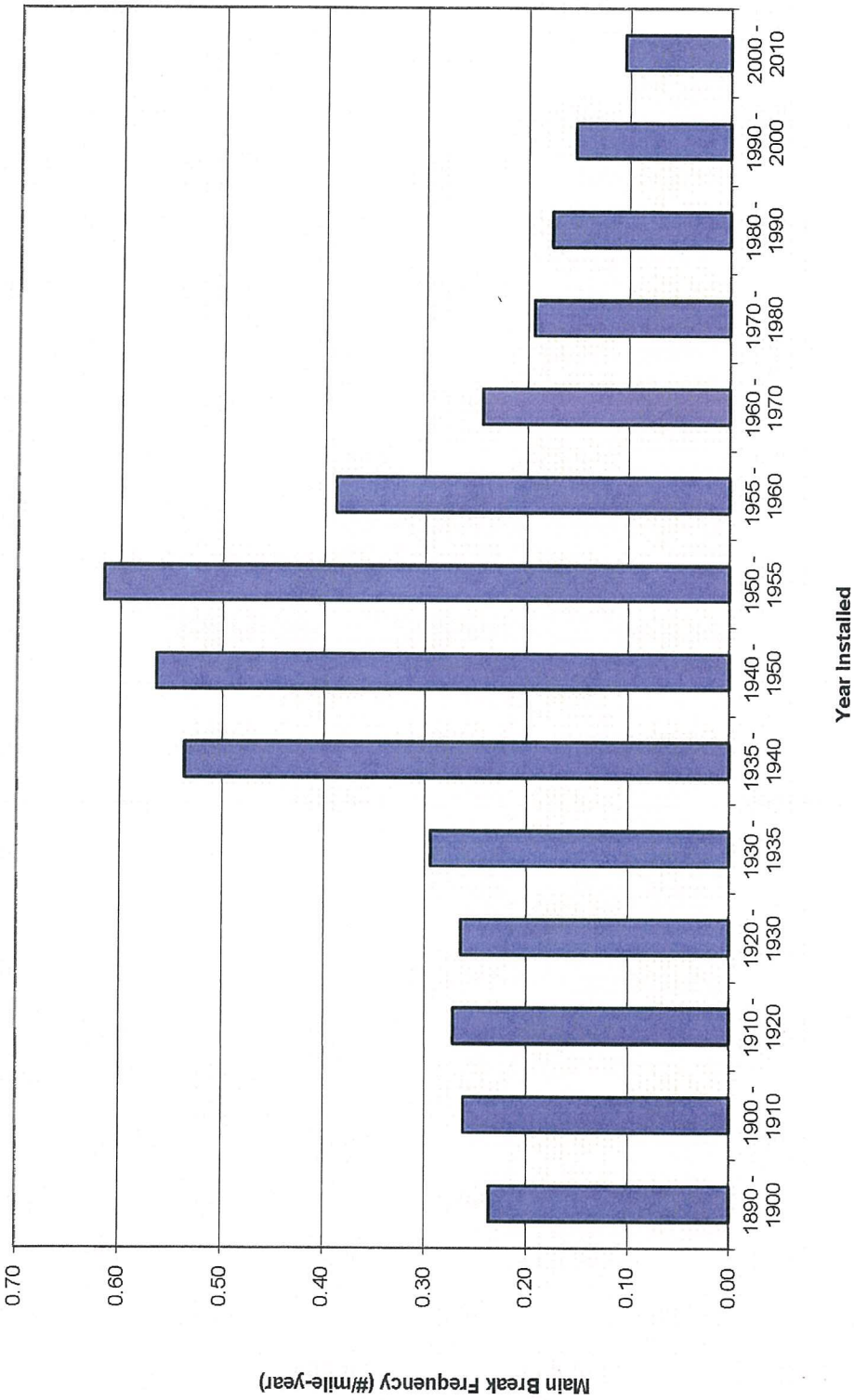


Figure 4-5
Empirical Relationship: Main Break Frequency vs. Pipe Diameter

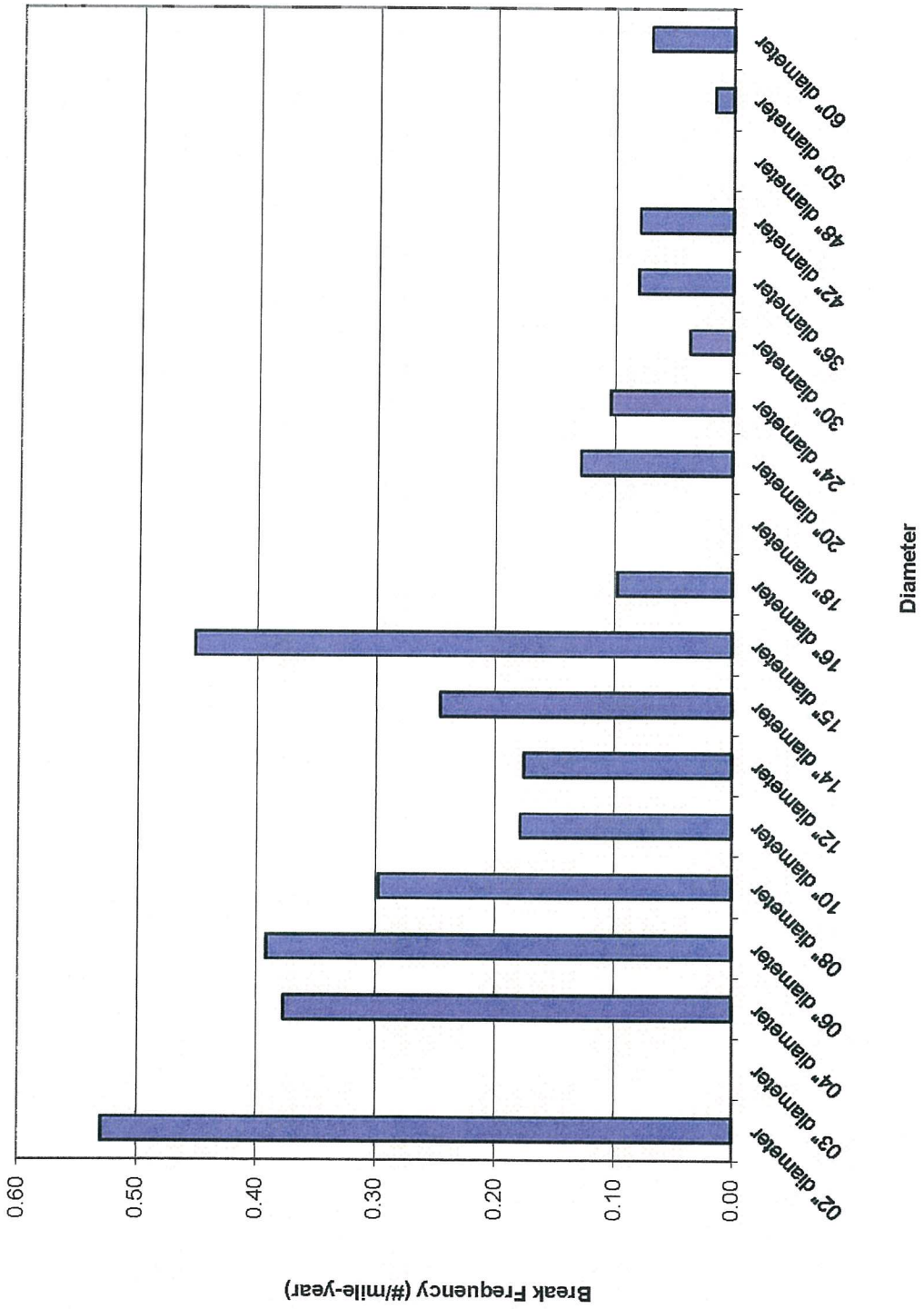


Figure 4-6
Empirical Relationship: Main Break Frequency vs. Soil Corrosivity

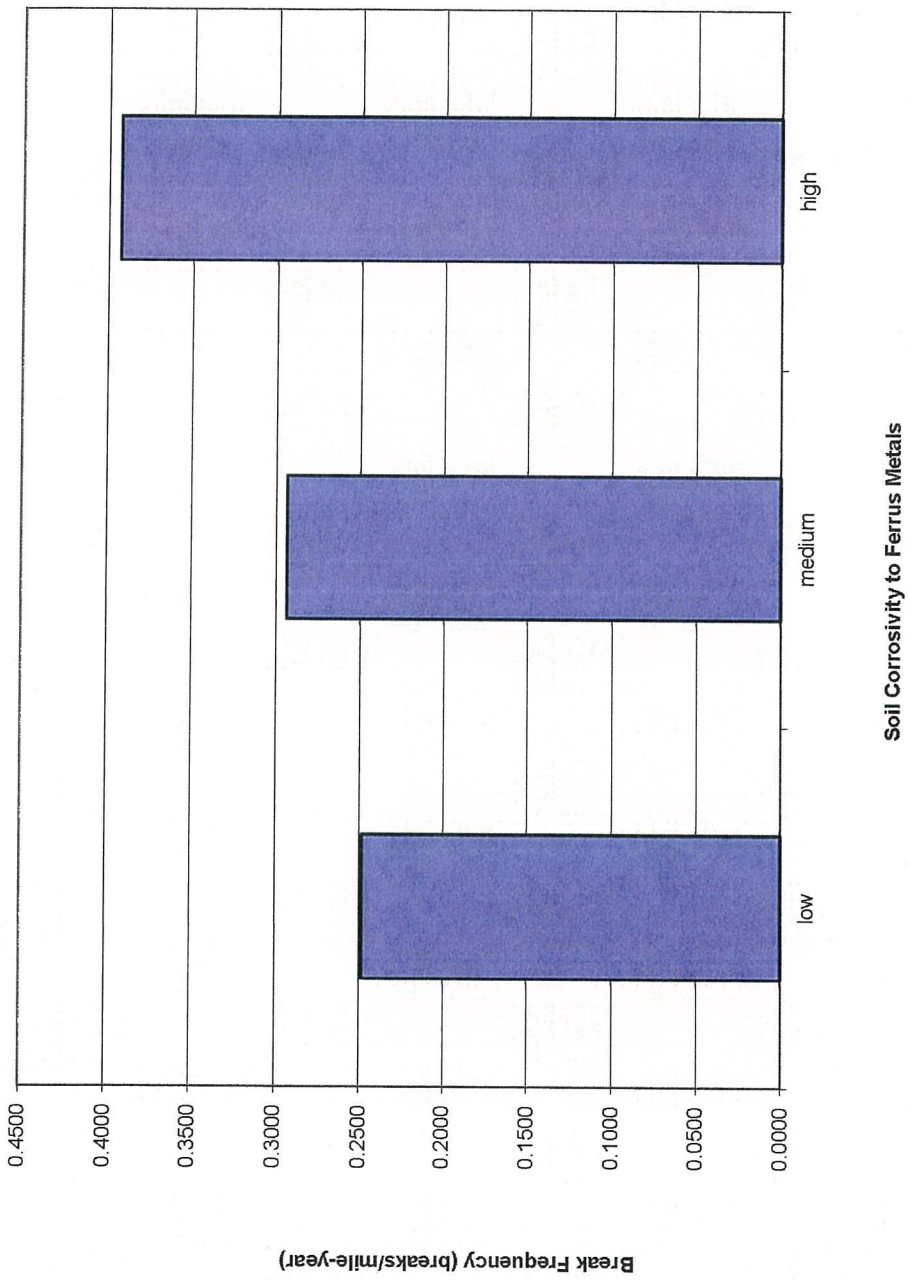


Figure 4-7
Empirical Relationship: Main Break Frequency vs. Normal Working Pressure

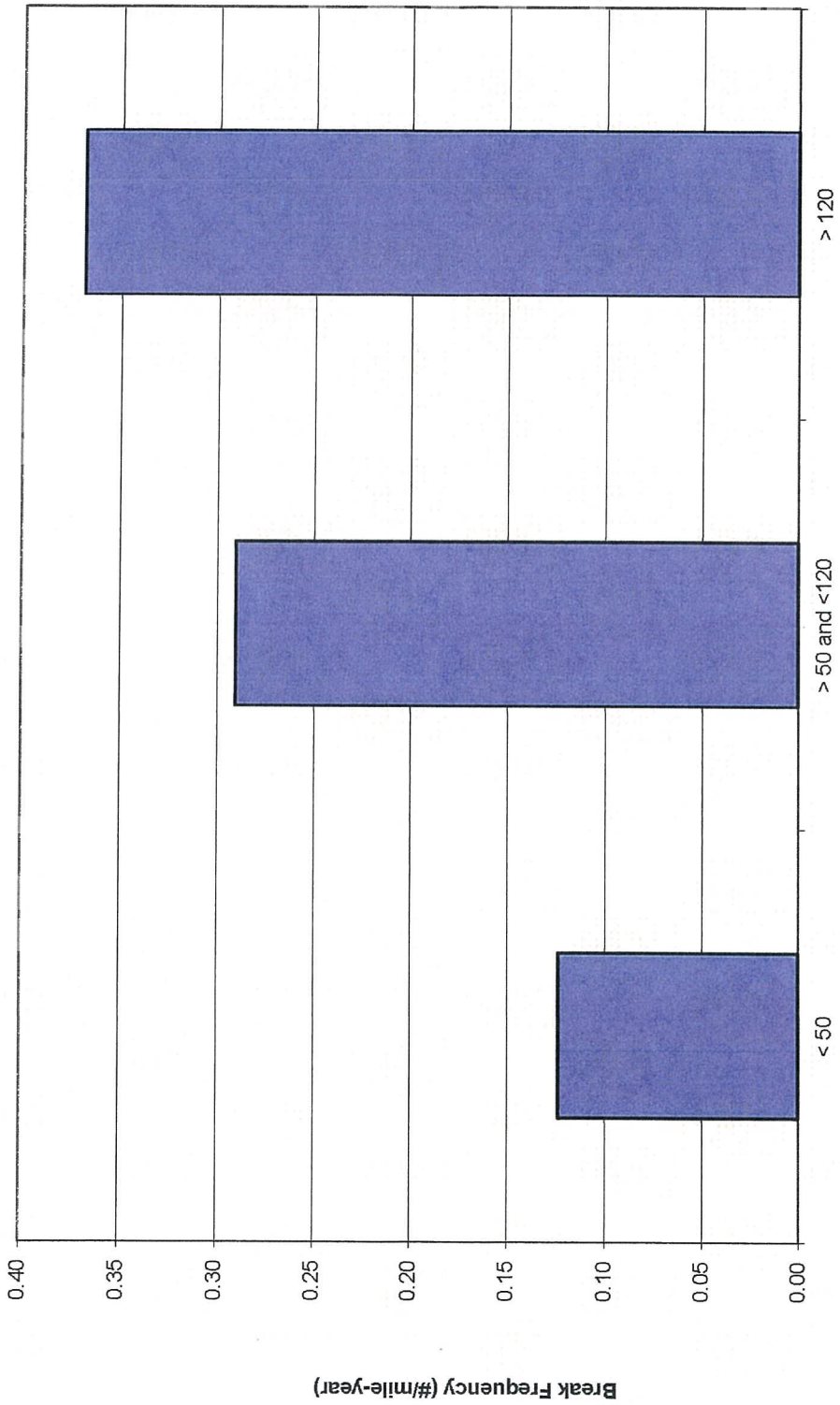
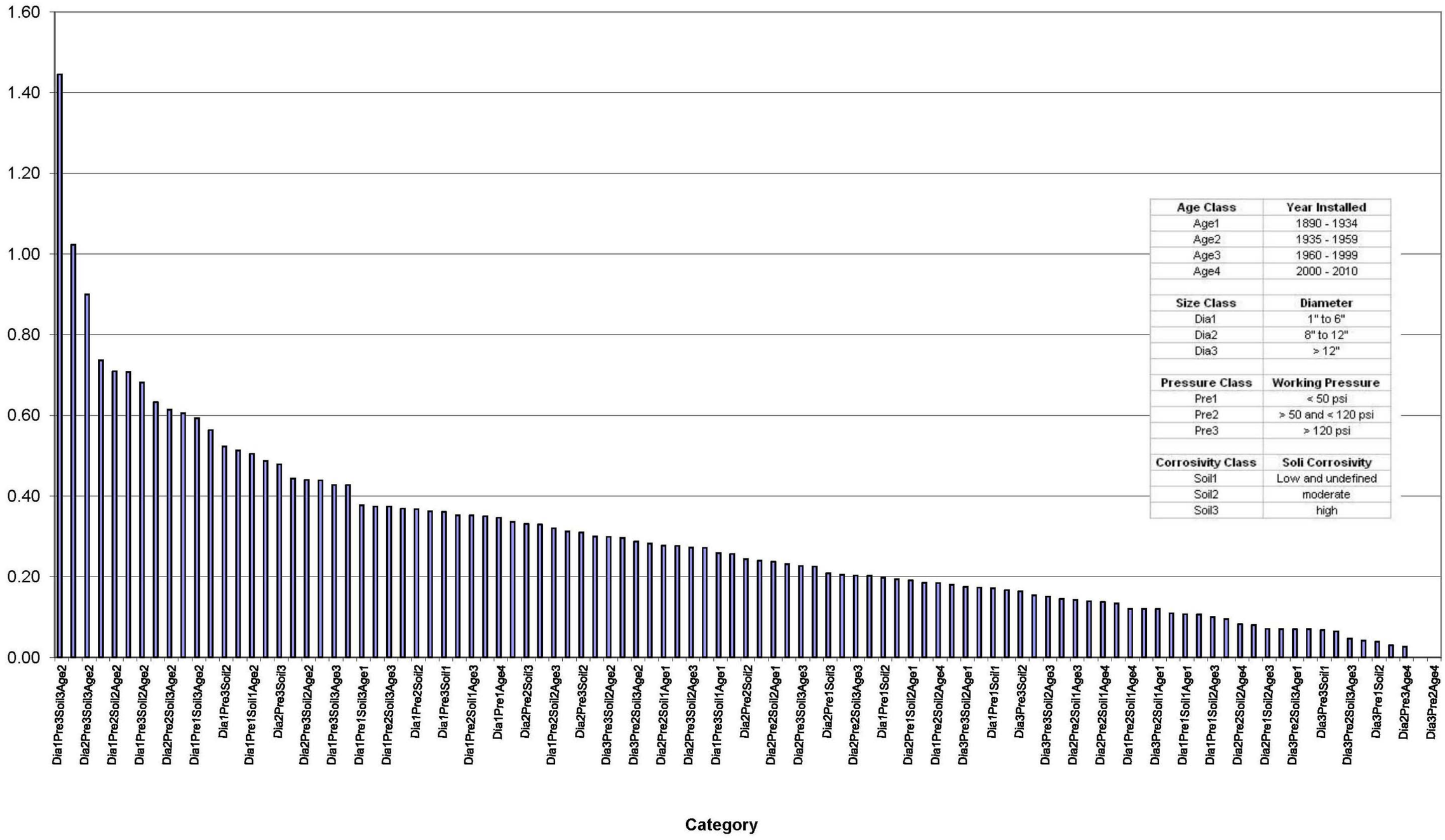


Figure 4-8
Likelihood of Failure Main Break Frequency Analysis



Age Class	Year Installed
Age1	1890 - 1934
Age2	1935 - 1959
Age3	1960 - 1999
Age4	2000 - 2010
Size Class	**Diameter**
Dia1	1" to 6"
Dia2	8" to 12"
Dia3	> 12"
Pressure Class	**Working Pressure**
Pre1	< 50 psi
Pre2	> 50 and < 120 psi
Pre3	> 120 psi
Corrosivity Class	**Soli Corrosivity**
Soil1	Low and undefined
Soil2	moderate
Soil3	high

The following measures of the **consequences of failure** were developed: criticality to overall system operation (identified major transmission mains), effects on critical customers (measures of the extent to which a failure of each main segment would affect service to hospitals), locations in high impact areas (identified water mains within major commercial/institutional/high traffic areas where failures would potentially produce highest property damage and community disruption), size of area affected by required repair shut down (InfoWater/CapPlan estimates of the number/length of mains affected by main break repair shut downs), rate of flow disrupted (InfoWater/CapPlan computations of the typical rates of flow through main segments), and proximity to low hydrant flow capacity locations (locations determined through an analysis of hydrant flow test results data).

The software was used to calculate the risk associated with each pipe segment as the consequences of failure score multiplied by the probability of failure score. The computed risk provided the measure used to prioritize specific water main segments for replacement/rehabilitation.

Cost estimates for the replacement/rehabilitation were developed based upon experience with PWSA projects and recent materials pricing information. It is anticipated that pipes to be replaced will be replaced with pipes of the same size except that pipes 6-inches and smaller in diameter will be replaced with 8-inch mains. It is also anticipated that mains 24-inches in diameter and larger will be rehabilitated via pipe lining.

The CapPlan program was used to develop a budget for replacing/rehabilitating all pipe segments that the program identified as having medium to high risk of failure. Pipe segments identified as having a low to negligible relative risk were not scheduled for replacement/rehabilitation during the 40-year capital planning period. In order to rehabilitate/replace the medium to high risk mains, the program determined that approximately $14.8 million per year (project cost in current dollars) will have to be spent over the next 40 years. Figure 4-9 illustrates the water mains identified for prioritized replacement/rehabilitation during the 40-year planning period. Figures 4-10 through 4-17 illustrate the mains identified for replacement/rehabilitation during each five year phase of the capital plan. An ArcMap shapefile containing data that identifies the pipes scheduled for replacement by 5-year phase intervals, the size and length of the pipe segments and the estimated cost for replacement/rehabilitation has been provided separately in digital form. The approximate lengths of main identified for replacement/rehabilitation during each phase of the capital plan are presented in Table 4-1. According to this schedule, approximately 945,000 feet of pipe would be replaced/rehabilitated over the 40 period, equating to 19-percent of the total length of pipe in the system. This equates to an annual replacement/rehabilitation rate of approximately 0.5-percent per year. The USEPA's 2006 Community Water System

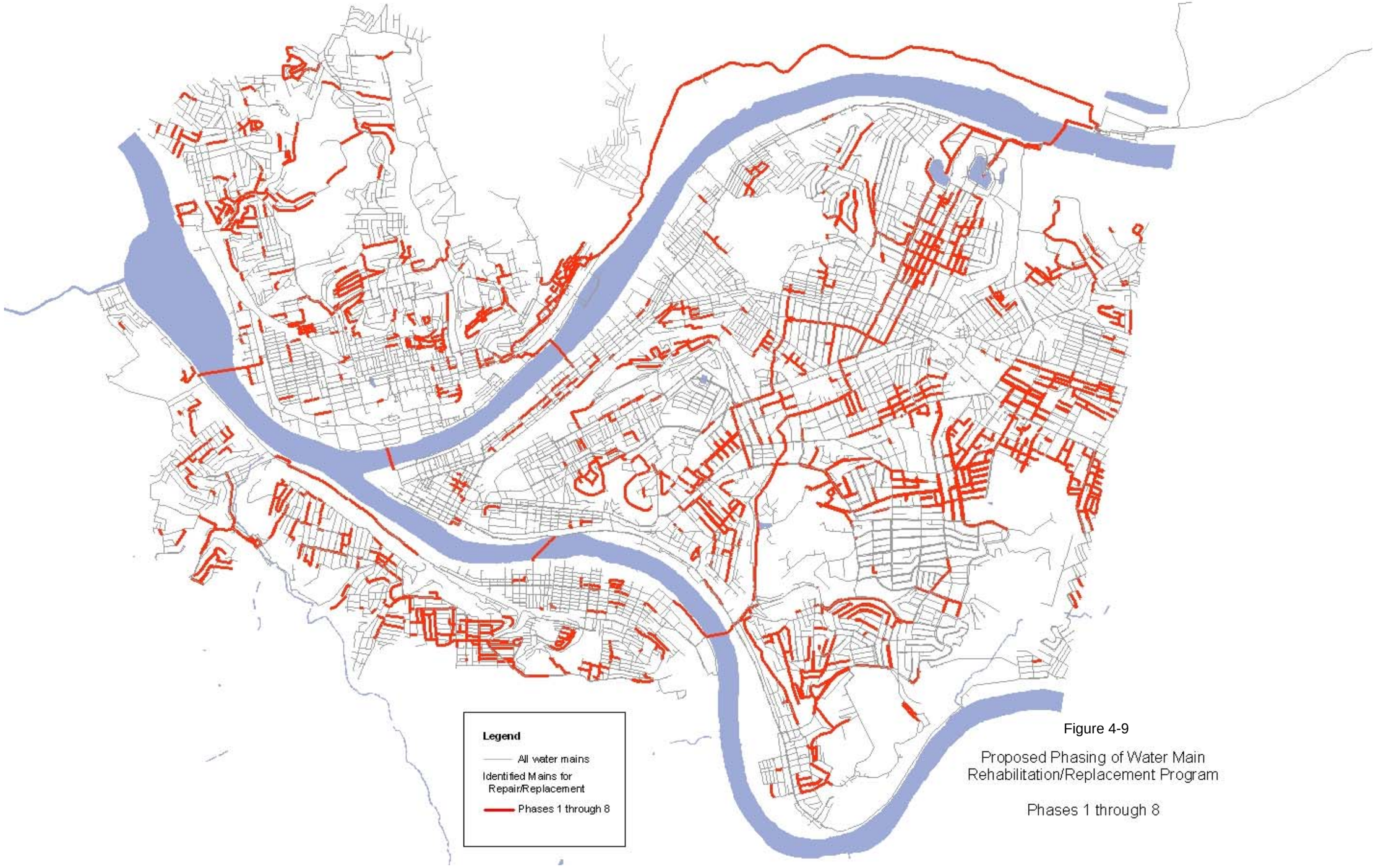


Figure 4-9

Proposed Phasing of Water Main Rehabilitation/Replacement Program

Phases 1 through 8

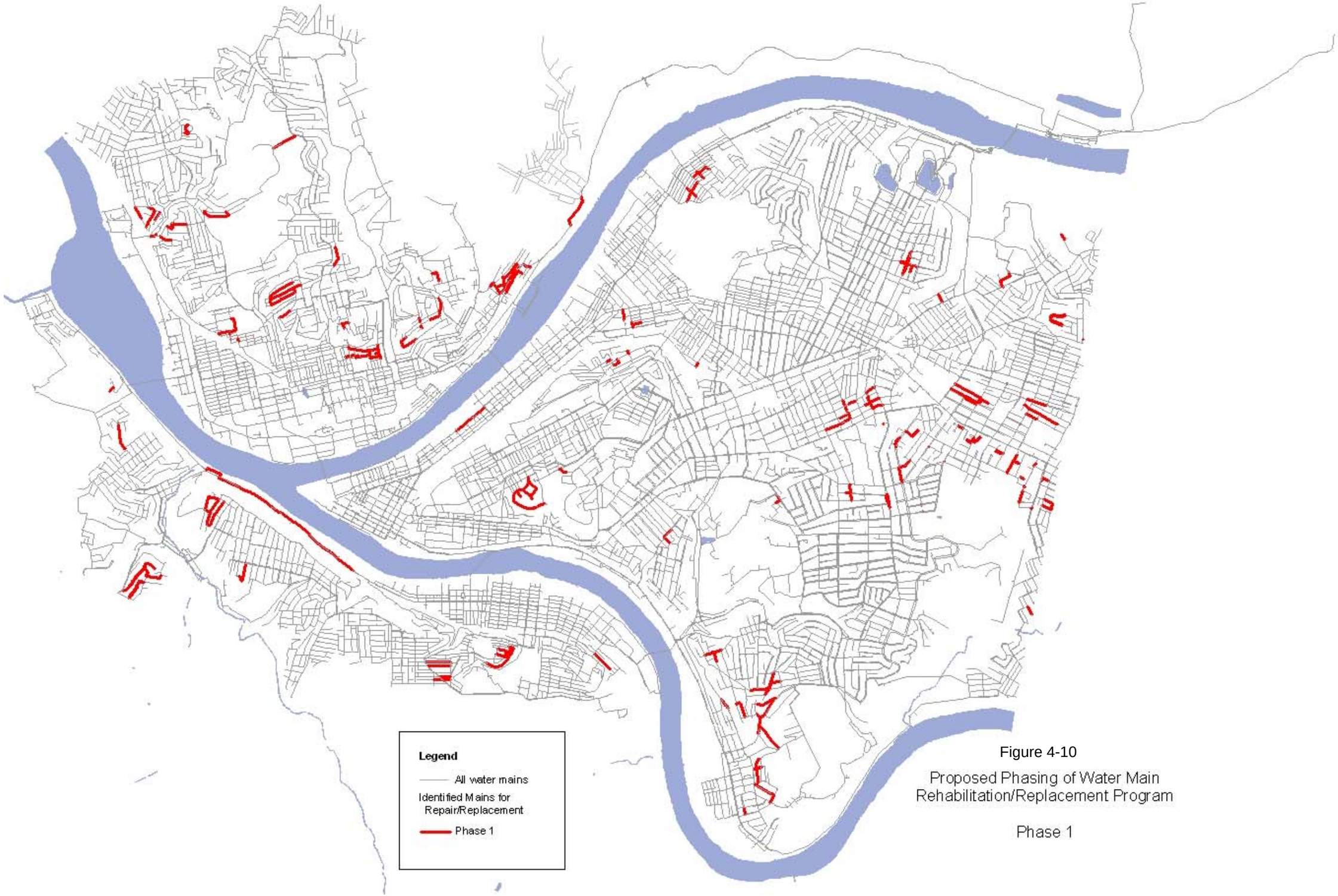


Figure 4-10

Proposed Phasing of Water Main Rehabilitation/Replacement Program

Phase 1

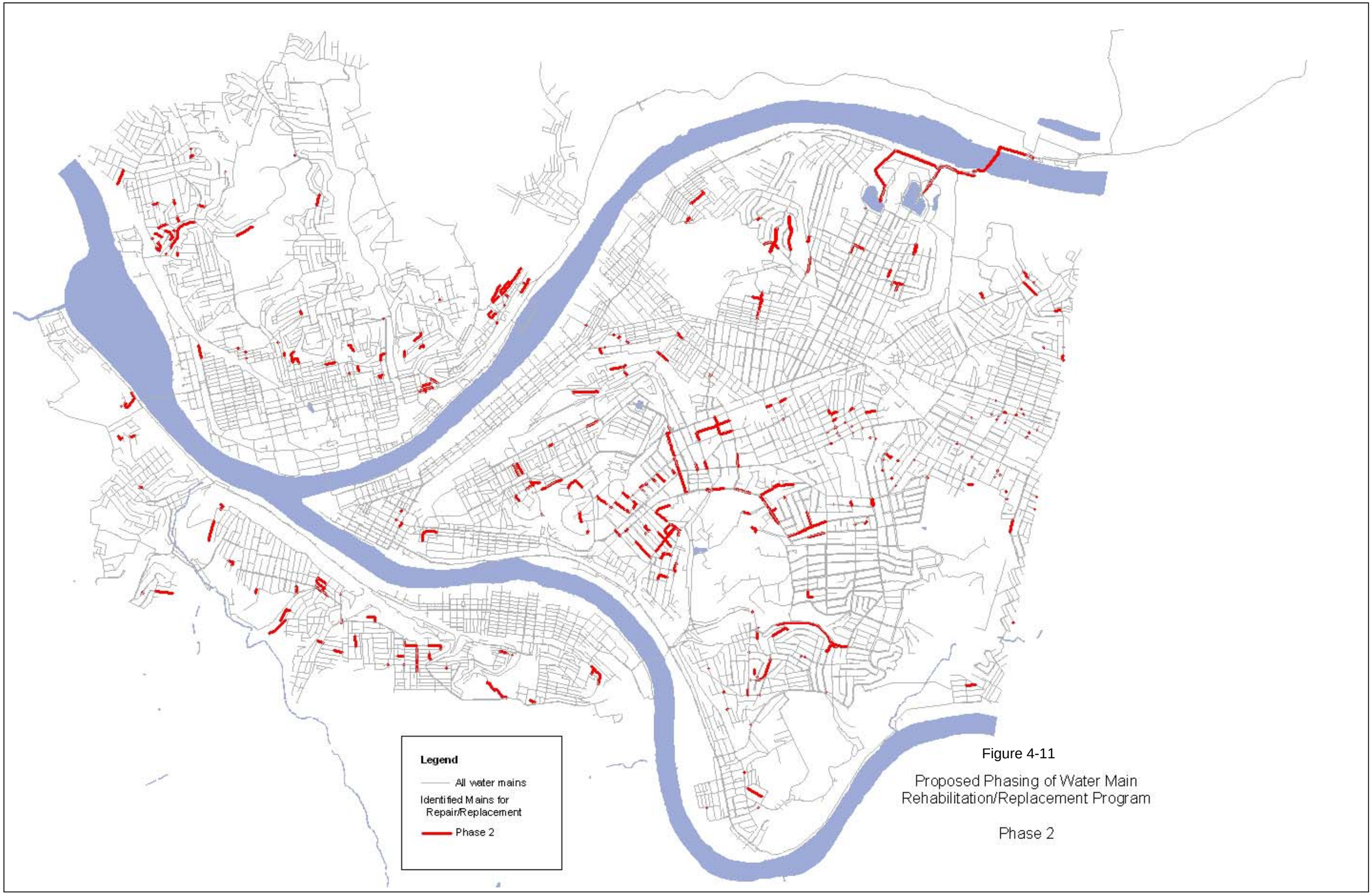


Figure 4-11

Proposed Phasing of Water Main Rehabilitation/Replacement Program

Phase 2

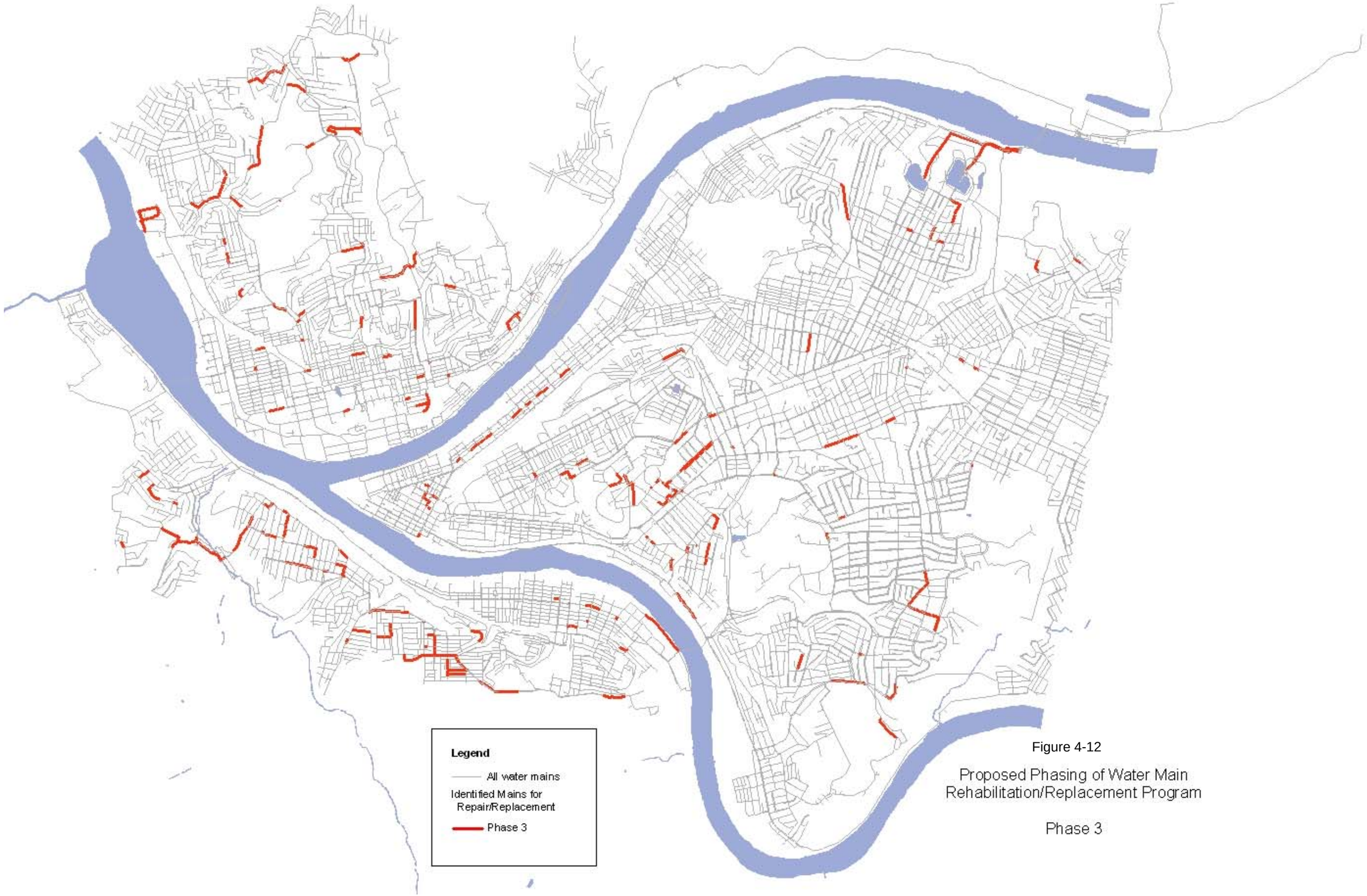


Figure 4-12

Proposed Phasing of Water Main Rehabilitation/Replacement Program

Phase 3

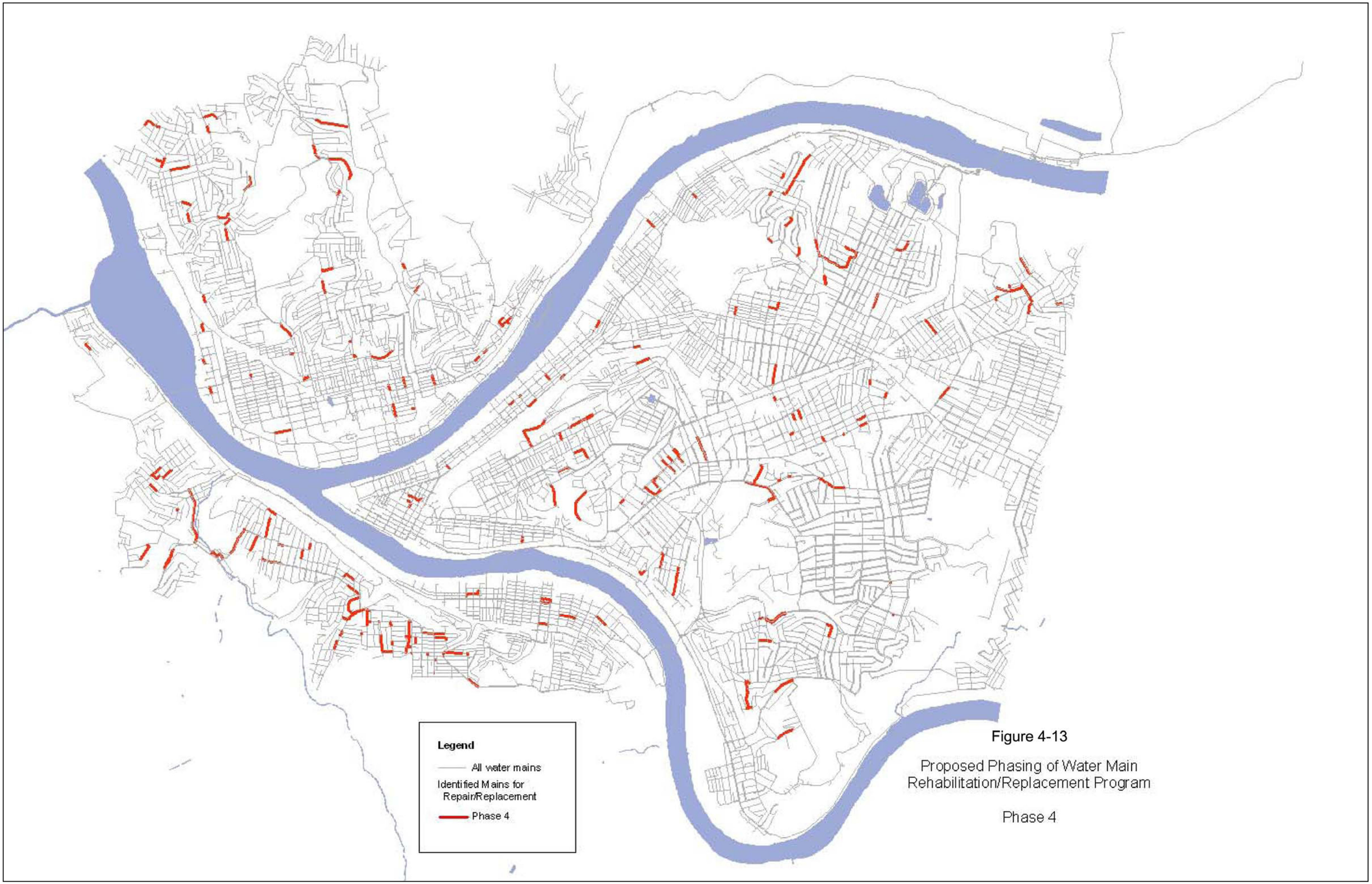


Figure 4-13

Proposed Phasing of Water Main Rehabilitation/Replacement Program

Phase 4

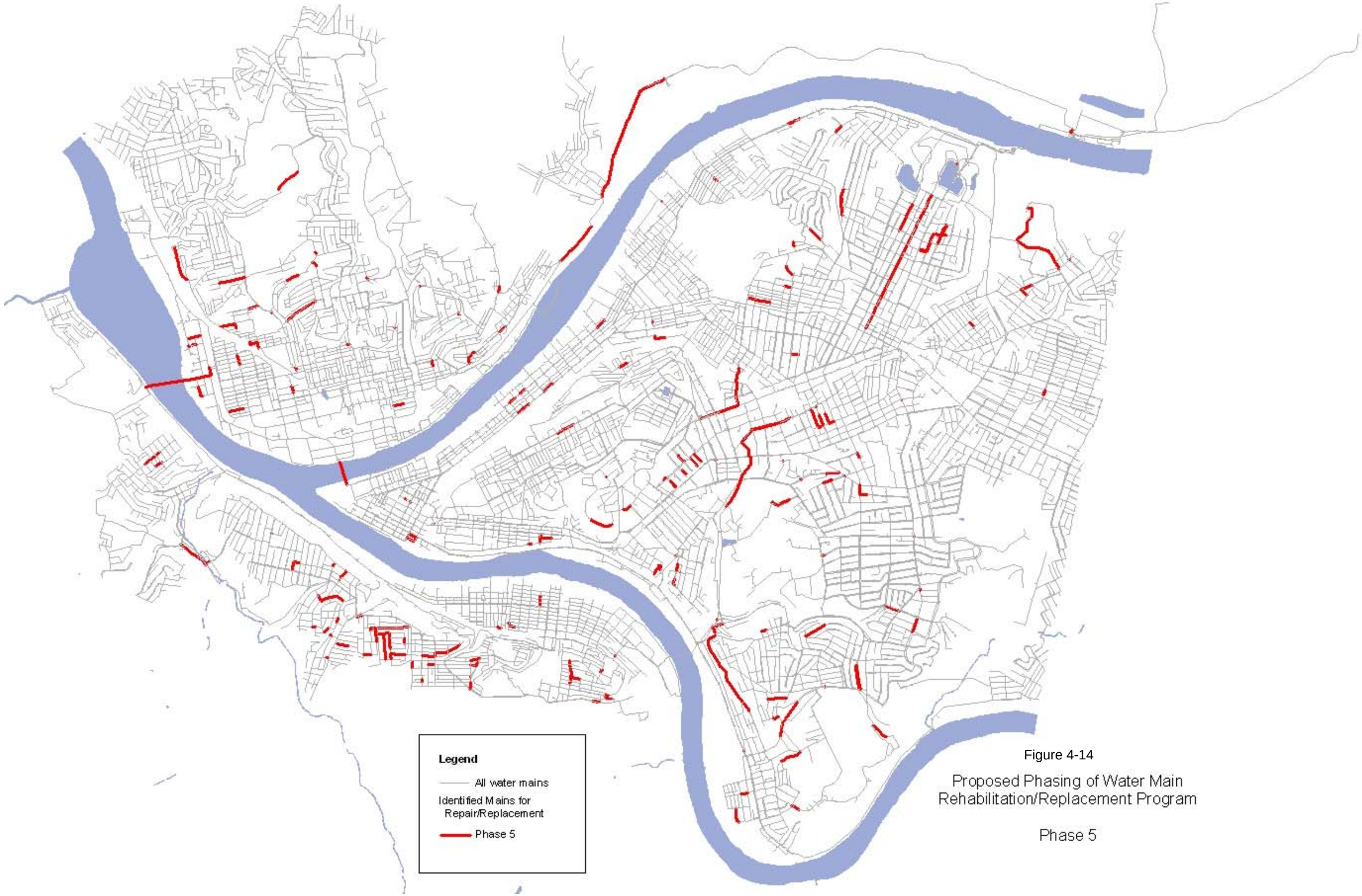


Figure 4-14

Proposed Phasing of Water Main Rehabilitation/Replacement Program

Phase 5

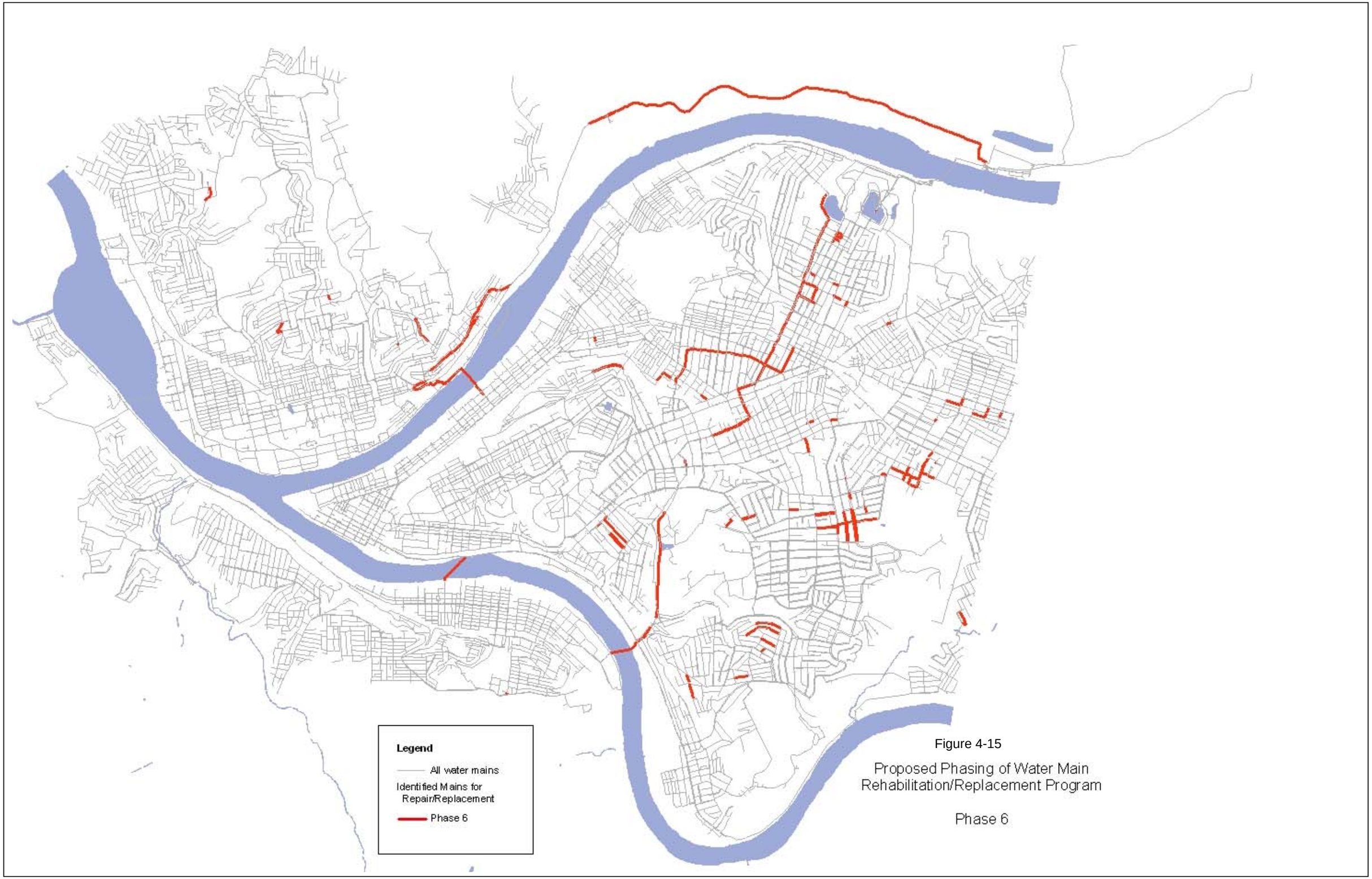


Figure 4-15

Proposed Phasing of Water Main Rehabilitation/Replacement Program

Phase 6

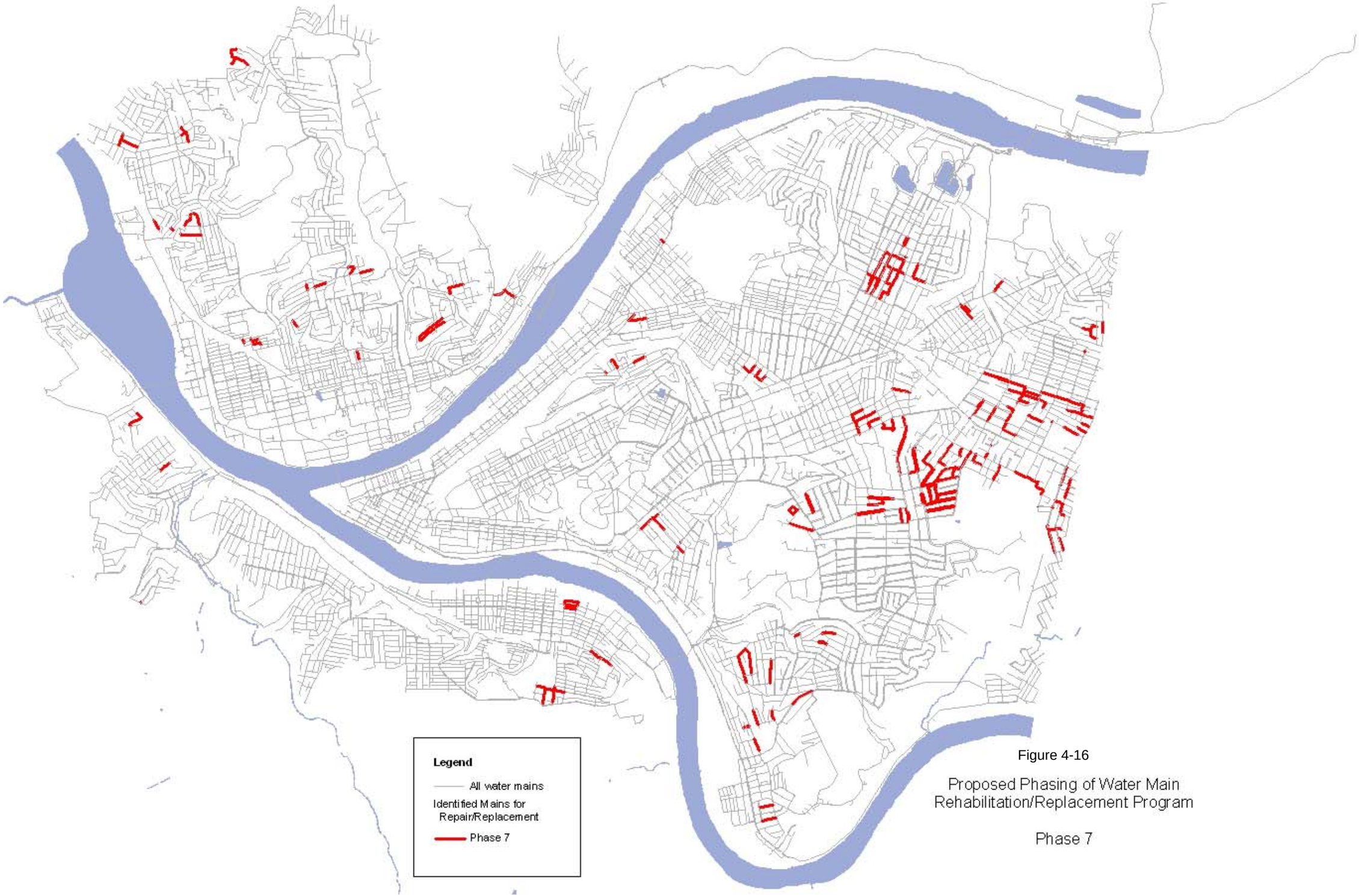


Figure 4-16

Proposed Phasing of Water Main Rehabilitation/Replacement Program

Phase 7

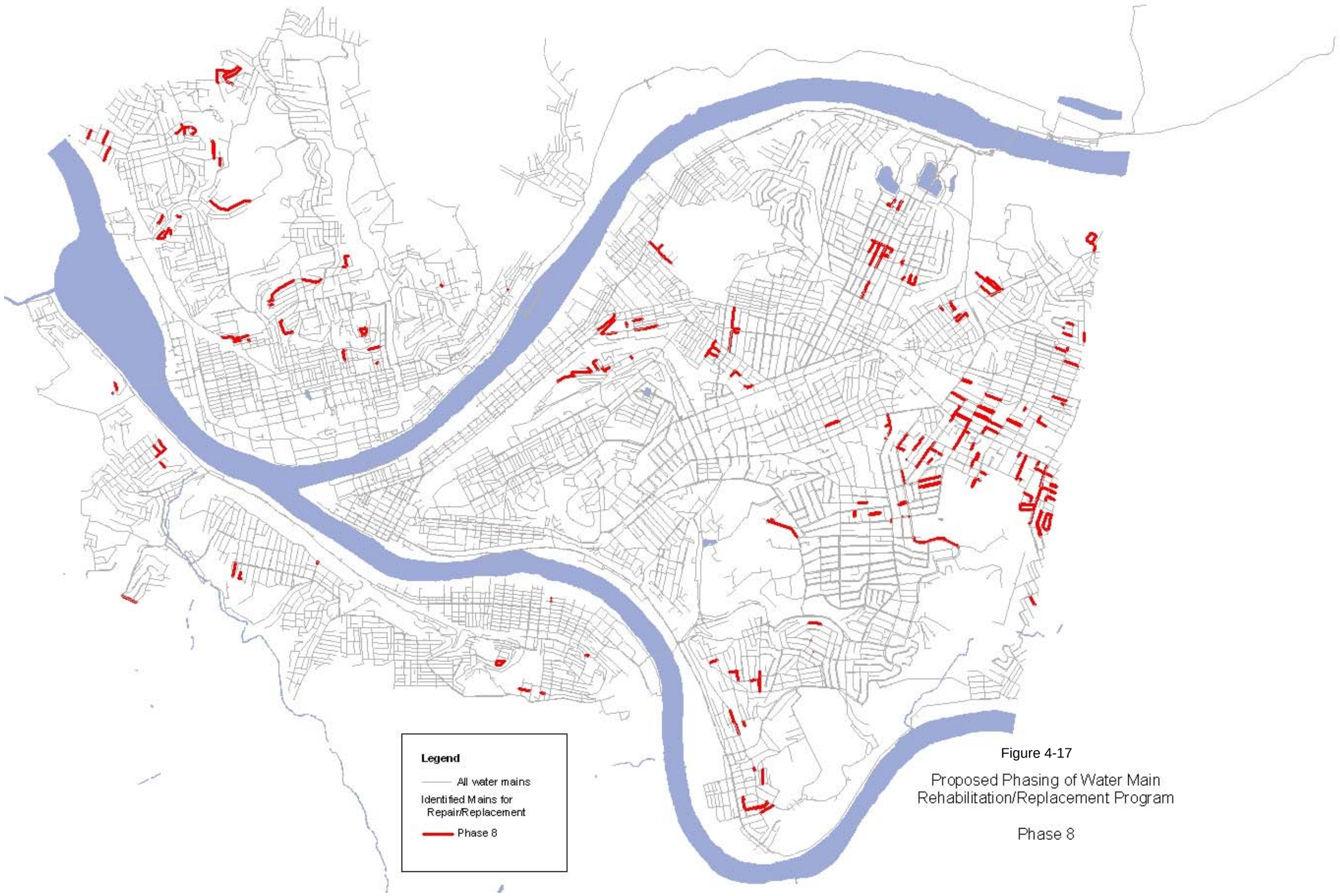


Figure 4-17

Proposed Phasing of Water Main Rehabilitation/Replacement Program

Phase 8

Survey reports that the median annual water main replacement rate during the previous five years for systems serving 100,001 to 500,000 persons was 0.2-percent per year. The mean replacement rate reported for this size range of systems was 0.4-percent.

Table 4-1
Proposed Water Main Replacement/Rehabilitation Program

Phase	Total Project Cost (Dollars)	Total Length (feet)	Percent of Total System Length (%)
1	72,300,000	117,000	2.3
2	78,200,000	125,000	2.5
3	76,200,000	117,000	2.3
4	72,200,000	116,000	2.3
5	71,000,000	114,000	2.3
6	73,600,000	116,000	2.3
7	74,800,000	122,000	2.4
8	71,900,000	118,000	2.4
Totals	590,200,000	945,000	18.9

4.3 WATER TREATMENT PLANT ASSESSMENT

Concept Level Improvements to the Water Treatment Plant

Based on the projected future water demands developed under Task 3.4 and the discussions in Task 4.4, no additional treatment capacity will be needed during the 40-year planning period. Projections indicate that the current 117 mgd of water treatment capacity will be adequate to meet future needs. However, periodic upgrades and enhancements to existing facilities will be required to maintain efficient and effective treatment.

When PWSA was created in 1984, its primary function was to oversee a capital improvement program to refurbish the water system infrastructure, including the water treatment plant. In the 1980's, the following projects were undertaken to upgrade facilities at the Aspinwall site:

- Clarifier sludge collector replacement.
- Clarifier joint repairs.
- Roof replacements.

- General, HVAC, and electrical improvements to Ross pump station.
- Traveling water screen rehabilitation.
- General, HVAC, and electrical improvements to water treatment plant.
- General, mechanical, and electrical improvements to filters.
- General, mechanical, and electrical work to cover clarifiers.

In the early 1990's, projects were completed to remove accumulated solids from the sedimentation basins, rehabilitate the sedimentation basins, and upgrade the chemical feed systems.

In the past few years, the useful lives for projects that were completed in the 1980's have been reached and the replacement cycle for facilities and equipment has begun again. Recent projects include switchgear upgrades at the Ross pump station, clarifier joint repairs, replacement of clarifier sludge collectors, replacement of traveling water screens, and rebuilding pumps at the Ross pump station. In the near future, the filters will need to be rehabilitated again and the solids build up in the sedimentation basins will have to be removed.

A filter rehabilitation project has been designed for the Aspinwall treatment plant. The general construction portion of the project will replace the existing filter media and underdrains, install new air scour piping, re-level existing washwater troughs and install new washwater troughs, replace valves and hydraulic operators, rehabilitate existing valves, and repair the backwash pump. The electrical construction component of the project will install new instruments, controls, and include related electrical work. A permit application for the project was submitted to the PADEP in September 2010. Drawings and specifications for the project were submitted for PWSA review in April 2011. Per an April 2009 cost estimate by CDM, the total construction cost for the project is projected to be $22.20 million.

It is anticipated that the filter rehabilitation project will get started in 2012 or 2013. The last filter rehabilitation project was initiated about 25 years ago, so another upgrade to the filtration system will be needed during the 40-year planning period. Rather than including costs for another rehabilitation of the sand filters, order of magnitude costs for membrane filtration will be used in the CIP. Membrane filtration is becoming a common technology to treat potable drinking water due to development of lower cost membranes with improved performance characteristics. The use of membrane filtration technology is expected to increase in the future and replace traditional water treatment technologies. Membranes offer numerous benefits for potable water production when compared to conventional treatment methods. Membrane filtration systems are reliable and can consistently produce very high quality filtered water due to the small pore size of the membrane media. Membrane filters can remove microorganisms such as protozoa, bacteria and viruses because the pore size of the membrane is much smaller than these

microorganisms. Membranes can completely remove chlorine-resistant pathogenic protozoan cysts and oocysts of Cryptosporidium and Giardia. The effective removal of these microorganisms makes the water very safe for consumption. Finally, membrane filtration systems have lower chemical requirements than conventional water treatment technologies. Membranes can remove suspended solids without the need for chemicals and chemical consumption required for disinfection (especially chlorine) will be substantially reduced since most microorganisms will be removed at the filtration stage.

Two studies on rehabilitation of the clearwell were completed in 2008. As discussed under Task 3.3, the clearwell has not been rehabilitated since it was constructed in 1908. Estimated project costs for the HDR and Malcolm Pirnie recommended alternatives are virtually identical, so an estimated construction cost of $52.817 million will be used for improvements to the clearwell. The clearwell alternative recommended by Malcolm Pirnie includes construction of a UV disinfection facility.

A prioritized set of water filtration plant improvements can be found in Task 4.11. The information presented under this task includes concept level cost estimates and schedules for future recommended capital improvements. .

Anticipated Future Changes to Safe Drinking Water Act Regulations

Ongoing PWSA efforts to reduce TTHMs are discussed under Task 3.3. PWSA has optimized performance of the water treatment plant to reduce TTHM formation and is taking additional steps at storage tank locations to reduce TTHMs in the distribution system. Anticipated future changes to Safe Drinking Water Act regulations are summarized below.

Revisions to the Total Coliform Rule

Coliforms are naturally occurring bacteria that are used as an indicator that other, potentially dangerous bacteria may also be present. The presence of E. coli may indicate potential contamination by harmful bacteria that can cause symptoms such as nausea, headaches, cramps, and diarrhea.

Proposed revisions to the Total Coliform Rule were published in July 2010. The proposed revision document identified monitoring requirements for systems with greater than 1,000 customers and defined what constitutes a violation of the E. Coli maximum contaminant level (MCL). It also identified the trigger points for Level 1 and Level 2 assessments of E. coli MCL violations. A Final Revised Total Coliform Rule is scheduled to be released in 2012.

Hexavalent Chromium

Chromium is a metallic element that is found in rocks, plants, and soil. The most common forms of chromium in the environment are trivalent (chromium-3), hexavalent (chromium-6) and the metal form (chromium-0). Chromium-3 is an essential human dietary nutrient that is found naturally at low concentrations in foods such as vegetables, grains, fruits, and meats. Chromium-6 is a more-toxic form that is generally produced by industrial processes. National primary drinking water regulations require community and non-transient, non-community water systems to test for chromium at the entry point to the distribution system.

The United States Environmental Protection Agency (EPA) regulates chromium-6 or hexavalent chromium as part of the total chromium drinking water standard. Chromium-6 and chromium-3 can convert back and forth, depending on environmental conditions, and measuring just one form may not capture all the chromium that is present. In order to ensure that the greatest potential risk is addressed, EPA's regulation assumes that the sample is 100% chromium-6, the more toxic form. The current maximum contaminant level for total chromium in drinking water is 100 parts per billion.

New health effects information has become available since the original drinking water standard was set in 1992. Based on a September 2010 draft human health assessment, EPA is proposing to classify hexavalent chromium as likely to cause cancer in humans. The draft health assessment addresses both non-cancer and cancer health effects associated with the ingestion of chromium-6 over a lifetime. This is the first EPA cancer assessment for hexavalent chromium by ingestion. The EPA classified hexavalent chromium as a known human carcinogen via inhalation in 1998 but did not have the science at that time to be able to classify it as a carcinogen via ingestion. When the review is complete, the EPA will consider this and other information to decide whether the drinking water standard for total chromium needs to be updated.

Perchlorate

Ammonium perchlorate is the oxidant in solid rocket fuel and is an essential component of military explosives, bottle rockets, fireworks, highway flares, and black powder. Much of the perchlorate contamination is believed to have seeped into ground waters around missile test sites and chemical manufacturing or storage facilities. However, recent research indicates that perchlorate may be formed naturally, most likely by photochemical reactions in the atmosphere. Perchlorate inhibits iodine uptake by preventing the thyroid gland from absorbing iodine from the bloodstream.

A 2008 determination not to regulate perchlorate was reopened after the EPA found there was a significant likelihood that perchlorate will occur in public water systems with a frequency and at levels of public health concern. The EPA's final regulatory determination is expected in 2011. The likely range for the proposed perchlorate MCL is 2 to 23 parts per billion (ppb).

Lead and Copper

The presence of lead and copper in drinking water is mostly due to corrosion of plumbing materials in potable water piping systems. The goal of the lead and copper rule is to minimize levels of these metals in drinking water, primarily by reducing water corrosivity. The rule establishes action levels of 0.015 milligram per liter (mg/l) for lead and 1.30 mg/l for copper based on 90th percentile levels of tap water samples. An action level exceedance is not a violation but can trigger other requirements that include water quality parameter monitoring, corrosion control treatment, source water monitoring/treatment, public education, and lead service line replacement. All community water systems and non-transient, non-community water systems are subject to the lead and copper rule requirements.

Exposure to lead can cause damage to the brain, red blood cells, and the kidneys, especially in young children and pregnant women. Lead can cause high blood pressure and delays in physical/mental development in children. Copper exposure can cause stomach and intestinal distress, liver or kidney damage, and complications of Wilson's disease in genetically predisposed people.

Changes to the lead and copper rule are expected to include changes to flushing guidance and sample collection after service line replacement, guidelines for lead service line replacement programs, changes to sample site collection criteria, guidance on new corrosion control strategies, and discussion of issues related to tap sampling. Revisions to the lead and copper rule are planned for 2012.

Groups of Contaminants

In March 2010, the EPA Administrator released a new drinking water strategy that includes regulating contaminants as groups rather than individually as has been done in the past. This approach will promote the use of new technologies for monitoring and treatment while leveraging the use of existing statutes to protect water sources. The new strategy will also promote easy access to utility monitoring data.

A total of nine contaminant groups have been identified by the EPA. The three contaminant groups that are ready for initial consideration include nitrosamines, carcinogenic volatile organic chemicals, and disinfection by-products from chlorination. One group is expected to be selected for regulation in 2011.

The EPA believes it has enough information to make a decision for the three categories listed above but needs more data for the other six groups, which are listed below:

- Perfluorinated compounds (PCFs).
- Organophosphates.
- Carbamates.
- Triazines.
- Chloracetanilides.
- Cyanotoxins.

4.4 CAPACITY IMPROVEMENTS

Current and Future Water Demands

Current and projected future water demands were presented under Task 3.4. Future water demands were based upon SPC Cycle 8 population projections for the existing PWSA water service area, including current water for resale customers. Existing and estimated future water requirements from Task 3.4 are summarized below.

Description	Average Day (mgd)	Maximum Day (mgd)
Existing Water Demand	70.2	107.0
2051 Water Demand	75.9	116.0

Water Supply and Treatment Capacities

A web site hosted by the Pennsylvania Department of Environmental Protection (http://www.drinkingwater.state.pa.us/default.html) provides information on drinking water systems in Pennsylvania. Information from this site shows that PWSA has a 100 mgd water allocation and the Aspinwall water treatment plant has a 117 mgd design capacity.

The existing 70.2 mgd average day water demand represents 60 percent of the 117 mgd design capacity and 70 percent of the 100 mgd water allocation. Future water demands in 2051 are expected to increase to 65 percent of the design capacity and 76 percent of the water allocation. Current and projected maximum day demands are less than the 117 mgd plant design capacity but exceed the current 100 mgd water allocation.

Task 2.3 analyzed Allegheny County public water providers to identify potential expansion areas for the PWSA water system. This review indicated that future expansion of the PWSA service area is limited by practical considerations to a pair of neighboring

communities (Etna and Sharpsburg) and to the portion of the City that is currently served by Pennsylvania American Water Company.

If Etna and Sharpsburg were to become PWSA customers in the future, water could be provided to these communities through existing interconnects with the PWSA system. The total average day demand is about 0.60 mgd and the combined maximum day demand is estimated at 0.90 mgd. Providing service to these municipalities would have little to no effect on average day or maximum day system demands.

An estimated 20,304 water customers in the City are currently served by Pennsylvania American Water. These customers have a 6.84 mgd average day water demand and an estimated 10.95 mgd maximum day demand when "unaccounted for" and "other" water demands are added to the average metered usage. Providing water to this area would increase the average day PWSA system demand to about 77 mgd and could at times cause maximum day demands to exceed the permitted 117 mgd permitted capacity of the Aspinwall water treatment plant. However, PWSA has over 400 million gallons of storage capacity in the distribution system. Therefore, any maximum day demands in excess of the treatment plant capacity could be provided by stored water.

As discussed under Task 2.3, an estimated $68.60 million in system improvements would be required in order for PWSA to provide water service to customers in the portion of the City currently served by Pennsylvania American Water. The feasibility of extending service to this area was evaluated by comparing potential revenues from water sales to the debt service payments that would be needed to finance the estimated $68.60 million in system improvements. To simplify the analysis, the 4.11 mgd average daily metered water demand was divided evenly between the 20,304 customers and estimated revenue from water sales was based on the 2012 rate schedule for residential service.

The table below compares annual payments for a $68.60 million, 20-year loan to annual revenue from water sales. Revenue from water sales in this area would total about $9.80 million per year while annual loan payments to finance the system improvements would vary from $4.97 to $5.87 million, depending on the interest rate. Average municipal bond interest rates for 2012 are in the four percent range. The current PENNVEST interest rate for Allegheny County is 1.751 percent for the first period and 2.276 percent for the second period. However, PENNVEST loans are limited to $11 million for a single project.

Interest Rate (percent)	**Annual Loan Payment**	**Revenue From Water Sales**	**Difference**
3.00%	4,565,447	9,803,241	5,237,794
4.00%	4,988,430	9,803,241	4,814,811
5.00%	5,432,756	9,803,241	4,370,485

In order for the purchase of the PA American system within the City to make economic sense, the increase in water revenues has to exceed the sum of the annualized purchase price for the system plus any capital, operation and maintenance costs associated with ownership of the system. The cost history for the Millvale water system can be used to estimate capital, operation, and maintenance costs and allow development of a price for potential purchase of the system. If the initial economic evaluation is positive, discussions can be initiated with PA American regarding system acquisition by PWSA.

Recommended Water Allocation Permit Change

The table below presents information from recent PWSA Annual Water Supply Reports. This information shows that maximum daily water use averaged 95.25 mgd from 1996 to 2009 and exceeded the 100 mgd water allocation in four years.

Year	Average Daily Water Use (GPD)	Maximum Daily Water Use (GPD)	Minimum Daily Water Use (GPD)
1996	61,268,473	93,917,000	46,217,000
1997	58,465,233	84,136,000	13,375,000
1998	54,494,931	76,265,000	27,561,000
1999	63,164,164	**101,166,000**	25,708,000
2000	68,111,361	91,000,000	15,197,000
2001	69,580,934	**102,000,000**	18,542,000
2002	73,231,000	97,000,000	44,541,000
2003	74,110,000	**106,417,000**	38,583,000
2004	70,487,787	98,958,000	50,166,000
2005	72,449,789	99,170,000	25,633,000
2006	70,780,447	89,687,000	37,458,000
2007	75,763,177	**107,850,000**	14,856,000
2008	71,553,396	94,850,000	41,810,000
2009	70,068,158	91,048,000	26,715,000
Averages	68,109,204	95,247,429	30,454,429

Based on current and projected future water demands, it is recommended that PWSA apply for an increase in the permitted water allocation from 100 to 117 mgd.

4.5 BACK-UP POWER SUPPLY AND CLEARWELL CONCERNS

Backup Power Supplies to Critical Facilities

Net pumpage data provided by PWSA was reviewed and evaluated to rank in order of importance the critical facilities requiring backup power. The ranking was based upon the amount of water provided to each reservoir and water storage tank by the various

pump stations. The table below presents average net pumpage data for the three year period from 2007 to 2009.

Pump Station	Reservoir/Tank	Average Pumpage (mgd)	Percent of Total
Bruecken PS (Pumps 2 – 4)	Net Highland 1 Reservoir	12.89	19.7
Bruecken PS (Pumps 5 – 7)	Net Highland 2 Reservoir	8.43	12.9
Herron Hill PS (Pumps 1 – 5)	Net Herron Hill Reservoir	14.46	22.1
Aspinwall PS	Net Lanpher Reservoir	8.16	12.5
Howard PS (Pumps 1 – 4)	McNaugher Reservoir *	5.21	8.0
Mission PS	Allentown Tank	4.38	6.7
Howard PS (Pumps 5 – 7)	Brashear Tanks	3.08	4.7
Highland PS	Garfield Tank	2.74	4.2
Saline PS	Squirrel Hill Tank	2.29	3.5
Fox Chapel Pump Station	N/A	1.58	2.4
Lincoln PS	Lincoln Tank	0.98	1.5
Herron Hill PS (Pump 6)	Bedford Tank	0.70	1.1
Herron Hill Tank PS	Herron Hill Tank	0.43	0.7
Total Average Pumpage 2007 to 2009		65.34	100.0

* Includes Spring Hill Tank

The Bruecken pump station provides water to Highland 1 and 2 reservoirs and pumped 21.32 mgd or almost one third of the total water produced by PWSA. The Herron Hill pump station delivered 14.46 mgd to the Herron Hill reservoir on average, equivalent to about 22 percent of the total water produced by PWSA. The Aspinwall station pumped 8.16 mgd or 12.5 percent of the water in the PWSA system. These three stations pump more than two-thirds of the water in the PWSA system and qualify as critical facilities that require backup power.

A 90 percent design for standby power facilities at the Bruecken Pump Station was completed in June 2008. The estimated cost for the improvements was $6.98 million. Facilities are currently being installed at Bruecken to accommodate temporary hook-up of emergency generators while Highland No. 2 reservoir is out of service for installation of a replacement liner and floating cover. The electrical connections for emergency generators at Bruecken will remain in place after the Highland No. 2 reservoir cover project is completed.

Due to the high cost for permanent standby power facilities at the Bruecken pump station, PWSA issued an advertisement in March 2012 for bids for a portable emergency generator to provide backup power at the water pump stations. The purchase contract is for a two megawatt (MW) power generator set consisting of two – 1,000 kW diesel generator sets in parallel. The 1,000 kW generator sets are housed in a 48-foot ISO container that is supported on a 48-foot air ride chassis. The unit has a 1,250 gallon double walled fuel tank and is rated for 2,000 kW at 0.80 PF. Bids were opened on April 17, 2012. Cummins Bridgeway, LLC submitted a bid price of $1,450,000 for the 2 MW Power Generator Set.

It is recommended that facilities be installed at the Aspinwall and Herron Hill pump stations to allow the portable generator to be hooked up to provide emergency power. The 2 MW generator for which PWSA recently received bids has sufficient capacity to provide emergency power at either the Bruecken, Aspinwall, or Herron Hill pump stations. The portable generator is sized to power the largest pump in the PWSA system and can provide emergency power for one of the four 2,250 HP pumps at Bruecken. Alternatively, the generator could power one of the two 1,500 HP pumps or both of the 1,000 HP pumps at Aspinwall. The generator is large enough to power all of the pumps at the Herron Hill pump station.

Clearwell Rehabilitation/Replacement

The findings of the Clearwell Improvements Studies prepared by HDR and Malcolm Pirnie are presented under Task 3.3 and are summarized below.

The HDR study recommended that PWSA proceed with Alternative 1, construction of a permanent clearwell in an existing sedimentation basin. This option has a total estimated project cost of $68.574 million and includes the following components:

- Conversion of the central receiving basin to a finished water clearwell.
- Installation of a pump station and transmission main to convey filtered water to the new clearwell.
- Construction of a gravity line from the new clearwell back to the Aspinwall and Bruecken pump stations (will also serve as a bypass for the existing clearwell).
- Installation of variable speed drives on the Aspinwall and Bruecken pumps.
- Rehabilitation of the existing clearwell.
- Increased utilization of existing system storage at the Highland Reservoirs

The Malcolm Pirnie report identified Alternative 3c as the preferred option. This option includes rehabilitating the existing clearwell and installing a combined filter effluent

(CFE) UV system. This alternative has a total estimated project cost of $68.664 million and includes the following major items:

- Construction of a CFE UV Facility.
- Construction of a temporary equalization basin.
- Construction of finished water pump station VFDs and electrical modifications.
- Rehabilitation of the existing clearwell or demolition and construction of a new clearwell.
- Modifications to site piping at the water treatment plant

Estimated project costs for the recommended alternatives are within $90,000 of one another, so an estimated construction cost of $52.817 million will be included in the 40-Year Plan for improvements to the clearwell.

License to Pursue Hydropower

PWSA authorized Tetra Tech to conduct a feasibility review for a hydroelectric plant at the Allegheny Lock and Dam 2 (Highland Park). A preliminary review prepared in April 2012 indicates that a hydroelectric plant is feasible at this location. An installation with two 4 MW turbines would generate approximately 53 GWh/year, which is close to the amount of electricity used by PWSA on an annual basis. The cost analysis contained in the feasibility review projected that annual revenues from power sales would exceed the annual debt service and O&M costs for the hydroelectric facility.

Per Federal Energy Regulatory Commission (FERC) regulations, a permit is needed to develop a hydroelectric project. Free Flow Power (FFP) Missouri 12, LLC is the holder of the Preliminary Permit to investigate the development of a hydroelectric project at the Allegheny Lock and Dam 2. A hydropower project could be developed in conjunction with FFP or PWSA could purchase the rights to the permit from FFP and develop its own project. If a joint project were developed with FFP, project related costs and revenues would be shared by the two parties. PWSA would have to make a monetary payment to FFP to purchase the rights to the permit. Either of these arrangements would affect the cost projections contained in the feasibility review. Therefore, PWSA will need to re-evaluate the financial feasibility of the project based on the results of any future discussions with FFP.

Capital Improvements

Recommended capital improvements are presented under Task 4.11.

4.6 RISK BASED MODEL

It is recommended that CapPlan be used by the PWSA to update the CIP as water main replacement projects are completed.

When the GIS is updated to reflect changes to the system, old high-risk pipes will be eliminated and replaced with new, low-risk pipes. Prior to finalizing specific elements for each year's capital program, the results of the CapPlan analysis should be reviewed and adjusted as necessary to consider anticipated redevelopment projects that will result in the replacement of mains as part of the redevelopment activities and to incorporate special needs and input provided by the operations and engineering staff. Periodically, the CapPlan analysis should be repeated to update the CIP project list. Similarly, the analysis can be repeated to reselect prioritized CIP projects if there are changes in the available capital budget.

4.7 LEAK DETECTION AND REPAIR

Non-Revenue Water Analysis

An analysis of historic water usage and population was conducted to assess the level of non-revenue water in the PWSA system. Figure 4-18 compares the population of the City of Pittsburgh to the amount of water delivered to the system between 1950 and 2009. Reduced water deliveries generally paralleled population decreases from 1950 through the early 1980's. The city's population continued to decline since that time but the amount of water delivered to the system has increased. Average water demands rose from 56 mgd in 1982 to 70 mgd in 2009, an increase of about 25 percent, while the city's population decreased by an equal percentage. The divergence of population and water demand indicates that the amount of non-revenue water in the PWSA system has increased over the past 30 years.

Table 4-2 presents average daily water usage information from PWSA Annual Water Supply Reports for the period from 1996 to 2009. Data is presented for individual customer classes and usage categories. Average daily water use includes domestic, commercial, industrial, institutional, and bulk sales to other public water suppliers. It also includes the unaccounted for and other water categories. Other is defined as water for public and municipal uses, hydrant inspections, hydrant flushing, street flushing, government usage, plant processing, etc. The information from Table 4-2 is presented graphically in Figure 4-19.

Information from the Annual Water Supply Reports shows that bulk water sales and usage by commercial and institutional customers remained relatively constant from 1996 to 2009, while estimated domestic unmetered sales doubled. Industrial usage declined slightly and domestic metered sales dropped by almost two thirds, decreasing from 31 mgd to 11 mgd. Overall water use went up by about 15 percent as compared to the 1996

Figure 4-18
City Population Versus Water Delivered to System, 1950 to 2009

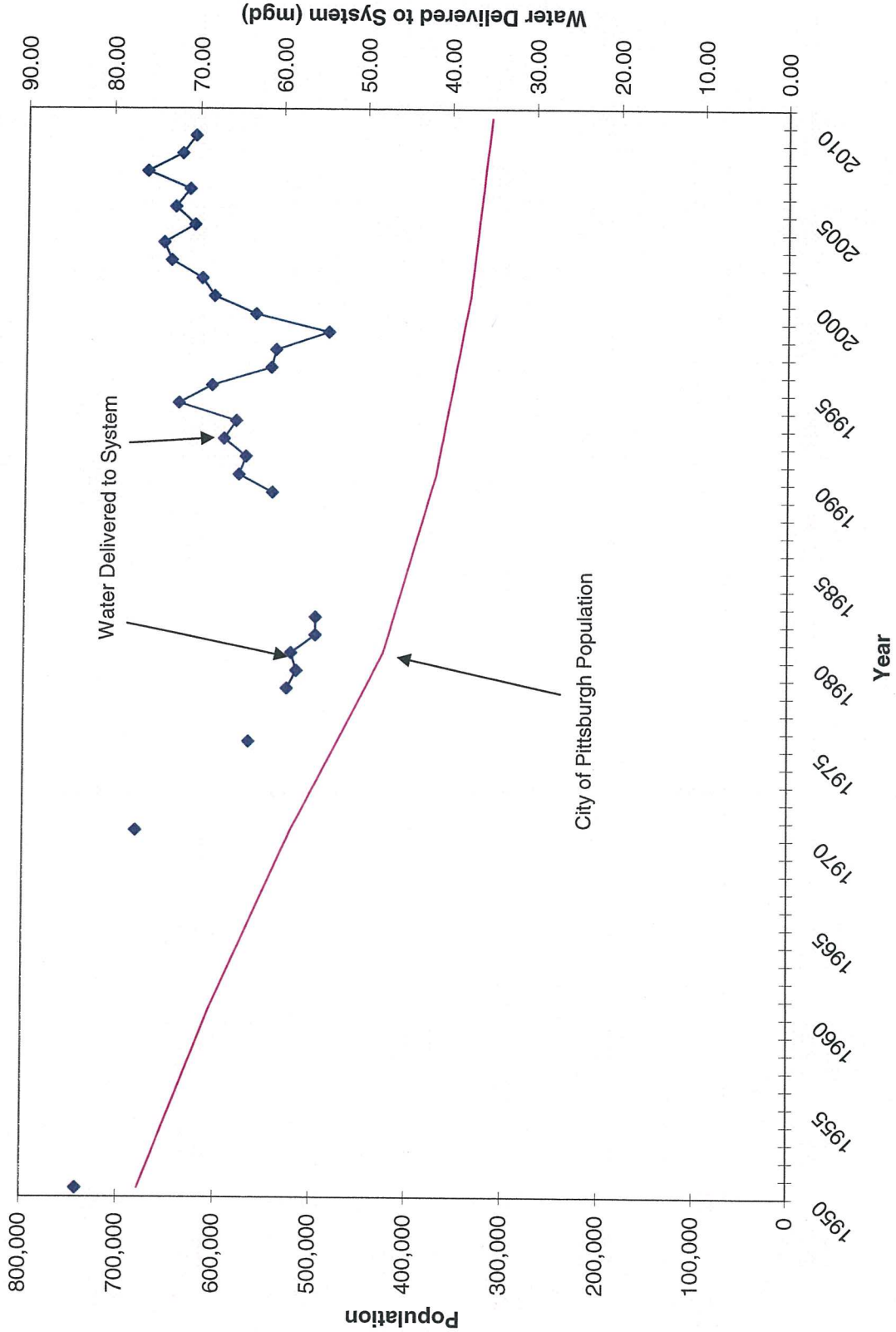
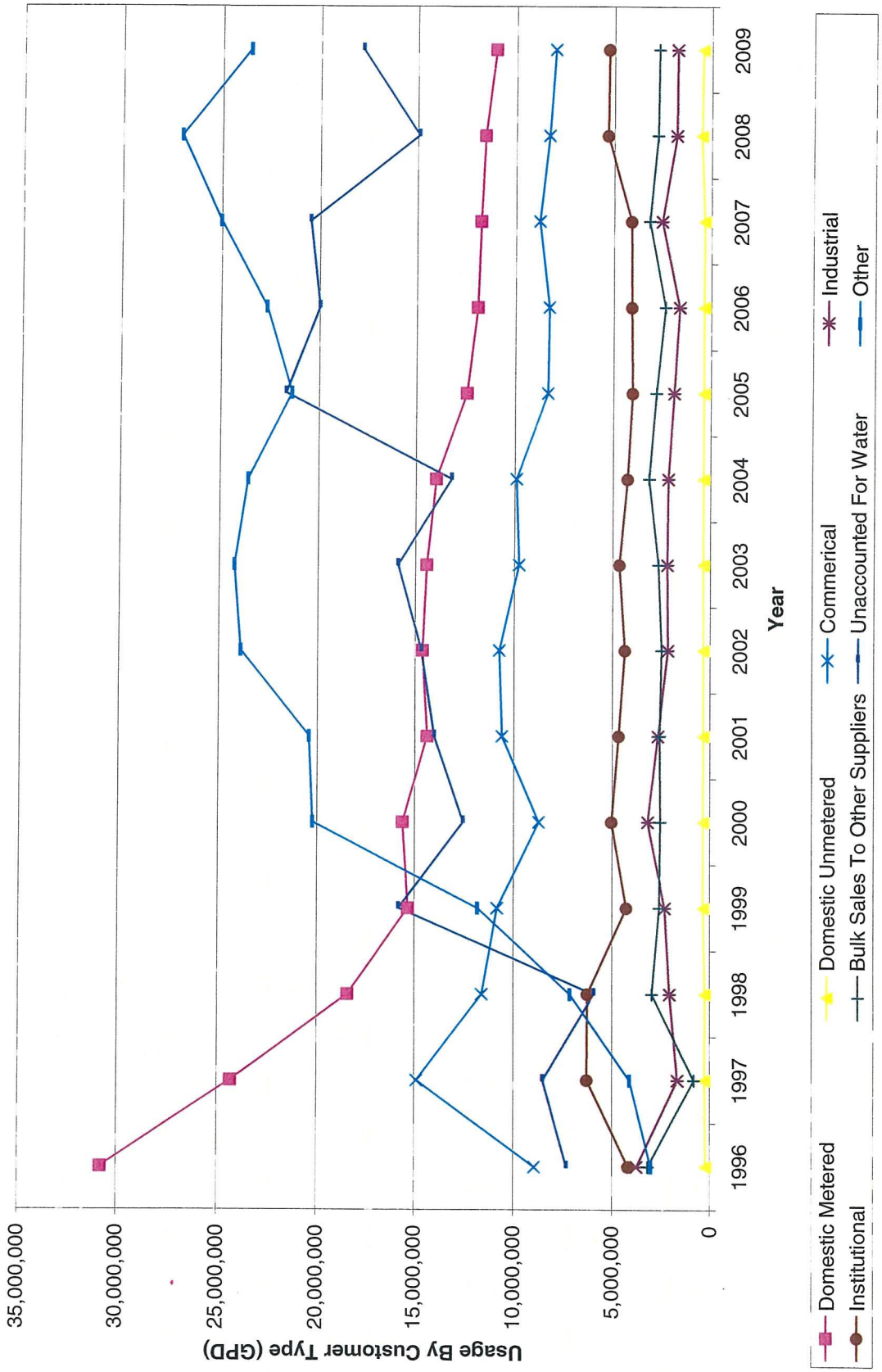


Table 4-2

PWSA Average Daily Water Usage by Customer Type (Gallons per Day)

Year	Domestic Metered	Domestic Unmetered	Commercial	Industrial	Institutional	Bulk Sales	Unaccounted For Water	Other	Total
1996	30,749,945	207,860	8,948,052	3,722,036	4,151,210	3,183,977	7,294,649	3,010,744	61,268,473
1997	24,286,221	252,790	14,879,784	1,619,731	6,255,665	808,120	8,505,712	4,105,870	60,713,893
1998	18,391,257	236,500	11,603,795	2,028,591	6,225,791	2,967,641	5,911,358	7,129,998	54,494,931
1999	15,295,000	331,700	10,832,000	2,274,000	4,245,000	2,586,000	15,791,000	11,810,000	63,164,700
2000	15,586,021	330,000	8,725,859	3,163,070	5,017,664	2,539,008	12,532,602	20,217,137	68,111,361
2001	14,347,775	336,640	10,605,041	2,646,986	4,649,126	2,579,049	14,012,127	20,404,190	69,580,934
2002	14,605,805	336,640	10,752,762	2,129,252	4,341,403	2,479,863	14,687,325	23,897,950	73,231,000
2003	14,407,194	353,200	9,773,890	2,173,753	4,635,630	2,656,252	15,880,081	24,230,000	74,110,000
2004	13,945,259	350,400	9,923,035	2,130,666	4,235,532	3,152,000	13,175,895	23,575,000	70,487,787
2005	12,423,912	347,600	8,344,151	1,855,244	3,992,559	2,788,762	21,675,158	21,370,000	72,797,386
2006	11,889,132	352,000	8,294,030	1,576,236	4,048,288	2,329,071	19,961,690	22,682,000	71,132,447
2007	11,748,967	339,200	8,795,466	2,495,419	4,077,397	3,165,008	20,465,920	25,015,000	76,102,377
2008	11,539,609	490,000	8,313,612	1,754,855	5,299,522	2,753,672	14,913,672	26,978,454	72,043,396
2009	11,015,712	425,000	8,006,317	1,732,279	5,258,852	2,700,849	17,812,591	23,541,558	70,493,158

Figure 4-19
Average Daily Water Use by Customer Type



total. The increase in total usage was accompanied by increases in the unaccounted for and other usage categories. Metered water usage represented about 83 percent of the total water produced in 1996. By 2001, metered usage was comparable to the sum of the unaccounted for and other usage categories. In 2009, metered usage was about 41 percent of the total water produced and unaccounted for / other usage was 59 percent.

Part of the increase in the unaccounted for and other water usage categories can be attributed to metering inaccuracies. A draft water audit was prepared to examine the accuracy of the primary meters that measure the amount of water produced and pumped through the PWSA system. The findings of the water audit are summarized in the following section.

Water meters are installed at individual customer locations to measure the amount of water consumed for billing purposes. However, water meters are mechanical devices that slow down and under-report the actual amount of water flow as they age. As the meter accuracy drops, the utility receives less revenue from water sales. In the past, AWWA recommended a replacement interval of 7-10 years for water meters, with some allowance depending on environmental factors. With recent advances in water meter technology and construction, the recommended replacement interval has been increased to 15-20 years for new meters.

PWSA provided the following age summary information for customer water meters 1-inch and smaller.

Meter Age In Years	Number of Meters	Percent of Total
1 to 8	17,709	22.8%
15 to 19	32,446	41.7%
20 to 25	27,286	35.1
> 26	339	0.4%
Total	77,780	100.0%

Based on the information above, a third of the existing customer water meters are more than 20 years old and three quarters are more than 15 years old.

It is recommended that a meter replacement program be instituted to replace all customer water meters that are more than 20 years old. The purpose of the replacement program is to increase revenues from domestic water sales. A nine-year program would be needed to replace the 60,071 meters that are currently 15 years or older. Approximately 6,900 meter replacements per year would be needed in years 1 through 4 to address the oldest meters in the system. Another 6,500 meters would have to be replaced annually in years 5 through 9 to replace meters that are currently in the 15 to 19 year age range. By the end of year 9, all of the domestic meters in the PWSA system would be less than 20 years old. Approximately 2,200 meters per year would then have to be replaced in years 13 to 20 to replace the meters that are currently in the 1 to 8 year age range. In year 21, the meter

replacement cycle would start again. About 5,000 meter replacements would be needed in years 21 through 32, followed by 2,200 meter replacements in years 33 to 40.

Review of Draft Water Audit

A draft water audit study was prepared by HDR Engineering, Inc. The intent of the audit was to check the accuracy of the primary meters in the PWSA system and to quantify system-wide non-revenue water. The water audit was reviewed as the starting point for development of a comprehensive leak detection and repair program.

Table 4-3 summarizes the results of the draft water audit. The raw water meter at the Ross pump station and the meters on rising mains 1 and 2 at the Bruecken pump station were not tested. However, 17 venturi meters in the PWSA water system were tested using pitot tube measurements. Pitot tube readings were recorded over a 24-hour period, and then the results were compared to venturi meter readings for the same time period. Field measured flow is the average flow measured during the pitot tube tests while the SCADA metered flow represents the meter output produced by the existing metering equipment during the pitot test. Meter accuracy is the ratio of metered flow to measured flow. If meter accuracy is less than 100%, the existing metering equipment is under recording the amount of flow. Meters with accuracies greater than 100% are over recording the amount of flow. Table 4-3 lists meters from most accurate at the top to least accurate at the bottom. Meter accuracies vary from a high of 99.8 percent to a low of 166.7 percent.

The American Water Works Association (AWWA) Manual M6 (Water Meters - Selection, Installation, Testing, and Maintenance) has established that a venturi meter must have a minimum accuracy of 98 percent to be considered accurate. The status column in Table 4-3 identifies the venturi meters that meet this standard. Only 2 of the 17 meters tested meet the AWWA accuracy requirement. The most accurate meter is located at the Herron Hill pump station and the second most accurate meter is situated at the Mission pump station. Six other meters register flows that are within 5 to 10 percent of the pitot measured values, but more than half of the meters have recording inaccuracies greater than 10 percent.

It is recommended that testing and maintenance procedures be established to assure meter accuracy. Accurate measurement is needed so that the amount of water pumped to the distribution system can be compared to metered water usage by PWSA customers. Meters at the treatment plant, and elsewhere in the system that measure the largest water volumes should be the highest priority in the meter testing and maintenance program. These meters determine how much water is produced and should be tested at least once a year. Industrial and commercial meters are the second testing and maintenance priority in the system because large volume users provide considerably more revenue per meter. For residential customers, a meter change-out program should be instituted so that PWSA maintains a 20 year meter replacement cycle.

Table 4-3

Summary of Draft Water Audit Results

Task	Venturi Meter Name	Meter Size (inches)	Venturi Meter Number	Test Date	Field Measured Flow (mgd)	SCADA Metered Flow (mgd)	Meter Accuracy	Status
A	Ross (Raw Water)	48	499	N/A	N/A	N/A	N/A	N/A
A	Bruecken - Riser Main 1	48	15960	N/A	N/A	N/A	N/A	N/A
A	Bruecken - Riser Main 2	48	15961	N/A	N/A	N/A	N/A	N/A
B	Herron Hill Pump 5	20	F17	12/12/2007	0.628	0.627	**99.8%**	Pass
B	Mission Pumps 4 & 5	24	N/A	12/14/2007	12.790	12.630	**98.7%**	Pass
B	Howard Pumps 1 - 4	20	F12	12/13/2007	7.890	8.260	104.7%	Fail
B	Saline Pumps 1 - 3	20	16880	12/12/2007	0.184	0.175	95.1%	Fail
A	Aspinwall - Riser 1 & 4	36	33525	6/27/2006	14.140	14.900	105.4%	Fail
B	Howard Pumps 5 - 7	24	F14	12/13/2007	4.480	4.730	105.6%	Fail
A	Aspinwall - Riser 2 & 3	36	33526	12/10/2007	17.060	18.190	106.6%	Fail
A	Bruecken - Riser Main 3	48	15962	12/13/2007	15.430	14.030	90.9%	Fail
B	Mission Pumps 1 - 3	24	33119	1/22/2009	12.220	10.760	88.1%	Fail
B	Herron Hill Pump 6	12	F18	12/12/2007	3.010	2.630	87.4%	Fail
B	Herron Hill Pumps 2 & 4	20	F19	12/12/2007	5.110	4.370	85.5%	Fail
B	Herron Hill Tank	12	F21	12/14/2007	1.260	0.960	76.2%	Fail
B	Lincoln	20	F15	12/14/2007	1.890	2.420	128.0%	Fail
A	WTP - Filter Composite	96	N/A	1/20/2009	78.960	56.580	71.7%	Fail
A	Bruecken - Riser Main 4	48	18284	12/13/2007	21.220	13.610	64.1%	Fail
B	Herron Hill Pumps 1 & 3	20	F20	12/11/2007	5.430	3.860	71.1%	Fail
B	New Highland Pumps 1 - 3	20	F16	12/10/2007	1.680	2.800	166.7%	Fail

Required Meter Accuary per AWWA is + / - 2 %

PWSA SCADA System Upgrade Project

PWSA issued an RFP for a SCADA system upgrade project in January 2010. The scope of work covered detailed design for upgrades to the SCADA systems at the Water Treatment Plant, pumping stations and water storage sites including the chlorine booster stations and flow meter vaults. The primary goals of the project are to upgrade the SCADA technology utilizing non-proprietary components, standardize equipment and establish an open-architecture SCADA network. The project also includes an instrumentation survey and instrument replacement, if required. Details of the upgrade project are summarized below.

Water Treatment Plant

Work at the Water Treatment Plant will include design of a redundant fiber-optic ring to act as the communication backbone. The ring will be installed throughout the Water Treatment Plant and will connect the two operation centers located at the Operations Center Building (Main OC) and the Chemical Center (Chemical OC) so all information is available at both areas. The Main OC will be designed with a UPS back-up system to allow monitoring and control of treatment processes and pumping to continue for 60 minutes during power outages. The Chemical OC will be designed to be connected to the stand-by generator located in the Ross Pump Station. The project will also automate the lime process for pH control. Alarm systems will be designed to be shown on an Operators cell phone and the Operator will be notified of an event by a text message and/or ringing the cell phone.

Pump Stations

The Transmitton Remote Terminal Units (RTUs) that control the pump stations and monitor the storage sites will be replaced with RTU's of modern design. The project will integrate the SCADA system with PWSA CMMS to capture information including pump and motor hours, bearing temperature and vibration data and power outages. The tone telemetry equipment at each sewage pump station will be replaced with new RTUs. In addition to the parameters already monitored at the sewage pump stations, the new SCADA system will include wet well level, influent and effluent flow.

Reservoir and Tank Sites

Information from water storage locations is currently sent back to the respective pumping station and conveyed from there to the plant. A redundant communication link will be established for each storage facility site to the plant. Design will include replacement of all PLCs with more modern equipment. The

scope will include the design for transmitting the chlorine residual signal generated at each chlorine booster station to the SCADA System for monitoring at the Main OC. Chlorine analyzers are currently present at the Allentown, Squirrel Hill and Lincoln Stations, so the project will include installation of chlorine analyzers at the remaining stations. Work will also include the revival of the flow monitoring vaults located at various reservoirs and tanks. Different flow metering technology will be proposed and tested to assure accuracy before this activity proceeds. All flow data will be sent to the Main OC.

Membrane Filtration Plant

The membrane plant is currently isolated from the existing SCADA system network. A reliable and redundant communications link back to the Aspinwall WTP will be established so that the system can be monitored. A more reliable communications system will be designed to replace the existing radio connection.

Security

Design of the new SCADA system will include the following security measures:

- Door limit switches at pump stations to signal an intruder alert at the Main OC
- Security cameras at the Water Treatment Plant and water storage sites
- Automatic gate and camera set-up at the Water Treatment Plant
- Security video monitor located in the Main OC
- Consultant to develop separate costs for a security system to be added onto the overall project.

The SCADA system upgrade project will give PWSA the tools needed to investigate and reduce non-revenue water losses. Revival of the flow metering vaults at the reservoir and tank locations, along with improved flow metering and data collection abilities, will allow water use in individual service districts to be monitored and compared to metered customer usage. This will facilitate identification of the service districts with the highest levels of non-revenue water and allow further water loss investigations to be undertaken.

Non-Revenue Water Loss Ranking by District

As part of the 40-Year Plan, we intended to review available SCADA data and water billing records to initially rank service districts in terms of non-revenue and apparent water losses. Pumpage data by district for the period from 2007 to 2009 was obtained from PWSA for this analysis. However, it became apparent after reviewing the results of

the draft water audit that such an investigation would have little value due to metering inaccuracies on the supply side. The venturi meters on rising mains 1 and 2 from the Bruecken pump station were not tested, so the accuracies of these meters are not known. The meter on rising main 3, which conveys flow to Highland No. 1 reservoir, has an accuracy of about 91 percent. The meter on rising main 4, which carries water to Highland No. 2 reservoir, is only 64 percent accurate. Wide variations in meter accuracies at the secondary pump stations would make it impossible to draw any meaningful conclusions from comparisons of metered supply and demand.

The two meters that record flows from the Aspinwall pump station to the Lanpher reservoir have accuracies of 105.4 percent and 106.6 percent. Meters at the Howard pump station, which measure flows to McNaugher reservoir and the Brashear tanks, also have accuracies in the 105 to 106 percent range. Based on the similarity between meter accuracies, a reasonable analysis could be conducted for this portion of the distribution system by dividing the system into smaller subareas and comparing the amount of water supplied versus the metered customer demand. Areas with the largest supply to demand differential would have the highest apparent water loss. Unfortunately, water demand in this portion of the service area only represents 25 percent of total usage based on 2007 to 2009 pumpage records.

Leak Detection and Repair Strategies

When accurate metering data is available, a standard approach to a non-revenue water leak detection and repair program generally begins with a desktop review of the available water consumption and loss data. Comparisons of flow measurements and billed water consumption rates are used to rank subareas in the system from highest to lowest in terms of water losses. This work is followed by field activities in the areas determined to have the highest water losses. Field activities include active leakage control strategies such as leak detection surveys and taking flow measurements in designated system subareas.

Various methods are available for detecting water distribution system leaks. Most methods use sonic equipment that identifies the location of a leak based on the sound of water escaping from a pipe. These devices include pinpoint listening devices that make contact with valves and hydrants, as well as geophones that can be used directly on the ground. Correlator devices can also be used to pinpoint the location of a leak by listening simultaneously at two points. Leaks on river crossing pipelines are the most difficult to detect, so initial leak detection efforts should focus on river crossings.

Water from large volume leaks often reaches the ground surface. This allows large leaks to be found and repaired quickly. As a result, large leaks do not necessarily result in the greatest volume of lost water. Small leaks can result in larger quantities of lost water if they exist for a long time without being detected. In many situations, small leaks are easier to detect because they are noisier and easier to hear using hydrophones. Leak detection and repair activities generally produce an immediate reduction in water losses.

Pipeline replacement projects have longer-lasting impacts, to the extent that they eliminate the root cause of leaks. A decision to emphasize detection and repair over pipe replacement will depend upon site-specific leakage rates and costs.

Active leak detection is crucial in identifying unreported water leakage and losses in the distribution system. Without a leak detection program, leaks may only be found when they become visible at the surface or when major infrastructure collapses. Active leak control will reduce emergency overtime repair expenses, associated liability costs, the impact on customers, and possible impacts on roads, sewers, and other utilities. Leak detection must be immediately followed by leak repair, the more costly step in the process. However, the savings from reduced water losses outweighs the costs for leak detection and repair activities.

The most important part of a leak detection and repair program is maintaining accurate and detailed records. The information should be easy to analyze and the data format should remain consistent over time. Water systems should keep and maintain the following three sets of records:

- Monthly reports on unaccounted-for water
- Leak repair report forms
- Updated system maps showing the location, type, and class of each leak.

Wachs Water Services Contract

PWSA contracted with Wachs Water Services (WWS) to undertake a Large Diameter Valve Condition Assessment, Improvement and Information Management Program. The program began in November 2010 and focused on mapping the exact location of water main valves; inspecting, operating, and assessing the mechanical condition and operational reliability of the valves; and making necessary repairs to non-functional valves. WWS field crews inspected and operated or attempted to operate 3,336 selected valves in the PWSA service area. The valves ranged from 3 to 60-inches, with two-thirds of the valves being 12-inch in size. Each of the selected valves was exercised either fully or partially. After taking corrective actions that included minor repairs, the results of the program are summarized below:

Total Valves Visited:	3,336	
Overall Valve Condition:		
Good:	2,197	66%
Fair:	126	4%
Poor:	48	1%
Inoperable:	678	20%
Unknown:	259	8%
Not Applicable:	28	1%

Summary Information:

Cannot Locate	453	Main Valve Position Corrected	43
Covered Over	27	Vacuumed/pumped	525
Frozen	18	Not on Map	35
Sheared Stem	10	Conflict turn/size	88
Spins Free	46	Leaks when exercised	64
Op Nut Problem	83	Other Discrepancy	57
Structure Misaligned	6	Structure Damaged	19
Lid Replacements	324	Bypass Inoperable	61
Broken Gears	3		

It should be noted that 453 of the valves in the "inoperable" category could not be located.

The operational improvements resulting from this program will allow faster water pipeline shut-downs during water main breaks, which will limit damages to buried infrastructure and reduce the number of residents affected by water main breaks. The program will also minimize treated water losses associated with main breaks and reduce insurance and legal claims. This project ties directly into the Authority's commitment to reduce losses of unaccounted for water and proactively maintain vital fixed assets.

In-House Leak Detection Resources

PWSA has been operating a leak detection and repair program for approximately 25 years. Two crews and two trucks are normally engaged in leak detection activities on a full-time basis. One PWSA leak detection crew can survey between 1,500 and 2,000 feet of waterline per day.

Available leak detection equipment includes geophones, electronic leak detectors, electronic leak correlators, software, and computers. Correlating loggers are also used to identify leaks. Loggers are placed on valves or pipe fittings during the day and are left in place to perform surveillance overnight. After the loggers are retrieved the next day, signal processing software is used to pinpoint leak locations.

PWSA leak detection staff checks for leaks when problems are reported by residents or PWSA work crews. While investigating reported problems, the leak detection crews also check other waterlines in the vicinity for leaks. Much of their work is focused in areas like Garfield and Herron Hill that experience a high incidence of water leaks. As would be expected, many of the leaks occur in portions of the system with higher operating pressures. Leak information is currently not recorded in the PWSA GIS but a water leak database is maintained and monthly reports of leak detection activities are prepared. Report information includes the length of pipeline surveyed, street address, number of leaks detected, estimated leak rate, leak size, and neighborhood. Information on

identified leaks is forwarded to another PWSA department that is responsible for repairing the leaks.

PWSA leak detection staff has determined from testing activities that the discharge lines from pump stations are in good shape. This is likely due to the relatively constant pressures to which these pipelines are exposed. Lines that are subject to larger pressure variations tend to experience more leaks. They have also found that it's difficult to find leaks in water lines that are greater than 16-inches in diameter. Large pipelines tend to have fewer valves and hydrants, which are typically used as contact points for leak testing purposes. As a result, it is often necessary to drill down through the ground to establish contact points on larger lines. The other problem is that differences in acoustics make it harder to identify leaks on large lines. It is much easier to hear leaks on smaller lines.

Estimated Levels of Effort for Leak Detection Program

As noted earlier in this section, the experience of PWSA leak detection staff is that it is difficult to find leaks in pipelines larger than 16-inches in diameter. Therefore, this would appear to be a logical cut-off point for dividing responsibilities between in-house resources and outside contractor leak detection specialists.

Data from the PWSA GIS shows that the water system contains 5.34 million feet or 1,012 miles of waterlines ranging from 1 to 120 inches in diameter. Approximately 88 percent or 4.69 million feet of waterlines in the PWSA system are 16-inches in diameter or smaller. Based on the metric that one PWSA leak detection crew can survey between 1,500 and 2,000 feet of waterline in a day, two crews could survey all the 16-inch and smaller diameter pipe in the system within a 5 to 7 year period. This analysis assumes that 45 weeks per year are spent on leak detection activities. If the estimated 537,000 feet of pipelines that have been installed or replaced within the last 20 years are excluded from the total, the time required for a full survey would drop to between 4.6 and 6 years.

State regulatory agencies in the United States recommend that water systems should conduct complete system-wide leak detection surveys every 3 to 5 years unless leakage constitutes a small portion of unaccounted for water. The estimated time for PWSA forces to conduct a complete system survey is slightly above this range but Pennsylvania does not make any specific recommendations regarding leak detection efforts. The DEP recommends the AWWA standard of 10-15 percent for unaccounted for water but also notes the relevance of factors that can cause the percentage of unaccounted for water to increase such as system age, system condition, system pressure, customer density, and meter accuracy. The DEP also recommends that water systems calculate the cost of producing water and then determine the amount of money that is being "lost" due to unaccounted for water. If the loss from unaccounted for water is more than the cost of fixing the problem, then capital expenditures to reduce leakage can be justified.

Pure Technologies, Ltd. was contacted to obtain budget cost estimates for completing leak detection surveys on PWSA waterlines larger than 16-inches in size. This company offers two systems that allow live inspections of large diameter water mains. Both systems are capable of detecting leaks as small as ¼ gallon per hour at a pressure of 90 psi.

The Sahara Pipeline Inspection System is used to check for leaks while a pipe remains in service. A sensor is inserted into the main through a 2-inch diameter or larger tap. A small parachute uses the flow of water to move the sensor through the pipeline. The sensor can handle pressures up to 200 psi and is tethered to the surface via a cable. A surface tracking device allows the position of leaks to be located to within 18-inches. Two insertions can typically be completed in a day, which translates to a survey rate of 2,000 to 3,000 feet of pipeline per day. Over 1,000 miles of pipeline inspections have been completed using this system.

SmartBall is a foam ball with an instrument-filled aluminum alloy core. The ball can be inserted and retrieved from a pipeline under normal operation and travels with the water flow. Only two access points are needed into the pipeline, one at the insertion point and the second at the extraction location. Long battery life and large memory capacity allow the SmartBall to operate for up to fifteen hours, which permits long lengths of pipelines to be surveyed. At a flow velocity of 2 feet per second, the ball can travel about 18 miles in a single deployment. SmartBall's acoustic sensor can clearly discern the acoustic activity associated with leaks. Acoustic pulses emitted by the ball are picked up by receivers that are attached to pipe appurtenances. The locations of leaks relative to the receiver positions are determined by processing the recorded data and analyzing arrival times of the pulses. SmartBall can be used in transmission mains 10-inches and larger in size.

Pure Technologies, Ltd. provided cost estimates for provision of leak detection services. Estimates for both systems include a mobilization cost and a unit survey cost. The mobilization cost covers getting equipment and personnel to and from the survey location, as well as up-front costs for planning and engineering. Budget costs are as follows:

- Sahara $22,000 mobilization charge and $16,000 per day survey cost
- SmartBall $25,000 mobilization charge and $12,000 per mile survey cost

Mobilization charges are slightly less for Sahara but the SmartBall system is much less costly on a unit cost basis. The $16,000 per day survey cost for the Sahara system translates to a unit cost of about $33,800 per mile based on an average survey rate of 2,500 feet per day.

The PWSA system contains approximately 122 miles of pipelines that are larger than 16-inches in diameter. Excluding mobilization charges, leak detection with the SmartBall

system would cost an estimated $1.46 million and costs for the Sahara system are estimated at $4.12 million. Under Task 4.11, leak detection costs will include mobilization and will be spread over a multiple year period.

Recommendations for Instituting a Non-Revenue Water Leak Detection Program

The following activities are recommended for PWSA to institute a comprehensive and efficient leak detection program:

- Calibrate venturi meters at the treatment plant and pump stations to provide accurate figures for the amount of water produced and entering the distribution system.
- Break down the water system into subareas based on the locations of the venturi meters.
- Determine the total metered consumption in individual subareas.
- Compare the amount of water delivered to each subarea versus the amount of water consumed to determine apparent water losses.
- Rank the subareas from worst to best in terms of apparent water losses.
- Use leak detection contractors to find leaks in larger lines and PWSA crews to survey leaks in smaller lines.

Leak detection and repair efforts should focus on subareas identified as having the highest rates of apparent water losses to maximize results. The SCADA system upgrade will facilitate investigators by providing improved flow metering and data collection abilities.

The PWSA GIS can also be used to compare flow rates and metered usage to quantify non-revenue water losses on a near real-time basis. Most customer meters are equipped with an automatic meter reading feature that can be used to determine water use in 15 minute increments. If the water system subareas are broken down into smaller sections for further analysis, zonal system metering can be used in conjunction with automatic meter reading of customer usage to help determine leaks in the distribution system.

4.8 SEWER SYSTEM IMPROVEMENTS

The Draft Feasibility Study provides preliminary recommendations relative to projects designed to control CSO discharges from PWSA facilities. Although the recommendations are subject to change as the region's wet weather feasibility planning moves toward completion in 2012, the Draft Feasibility Study provides the best available indication of the improvements that will be required by the current COA deadline in 2026.

As discussed under Task 3.5, the improvements described in the Draft Feasibility Study were reviewed with PWSA staff to identify and refine the improvements needed to control overflows from CSO outfalls that are permitted to PWSA only. The improvements are sized to limit CSO discharge to four or fewer times during a typical year and, where necessary, provide sewers that are adequate to convey the peak flow from a 2-year design storm event to the ALCOSAN interceptor system. In cases where improvements are needed to sewers that receive flows from upstream communities, costs for the improvements will be shared between PWSA and the upstream communities.

Table 4-4 presents estimated project costs by sewershed for improvements needed to control overflows from PWSA permitted CSO outfalls. The figures shown in Table 4-4 represent preliminary estimates of PWSA's share of the overall project costs. Remaining costs are to be covered by capital contributions from tributary communities that use PWSA sewers to convey wastewater to the ALCOSAN system. PWSA's portion of the costs for individual projects range from $1.46 million in the Becks Run sewershed to more than $40 million in the Negley Run sewershed. Anticipated costs for half of the CSO projects are less than $10 million per job. Four other projects have estimated project costs in the range of $20 million to $30 million. PWSA's share of the total project cost for the CSO improvement projects is estimated to be $195.16 million.

The estimates in Table 4-4 are very preliminary estimates that are subject to change pending finalization of the PWSA Draft Feasibility Study and regional wet weather planning efforts. The estimates represent 2011 project costs that will be used under Task 4.11. Capital costs for CSO improvements will be distributed over a portion of the 40-year planning period based on the current 2026 deadline for COA related activities. Costs for projects scheduled for implementation in future years will be increased to account for inflation.

4.9 SEWER SYSTEM SURCHARGING

Sewer surcharging areas were identified by analyzing sewer backup data for the period from 2004 to 2010. Sewer complaint information from SAP records (Complaint Code 150 – investigate customer sewer backup and Complaint Code 180 – clear surcharging manhole) was tabulated and addresses were geolocated to determine the distribution of problem areas in the sewer system. Review of the data did not identify any discernable pattern of backups, so the reported causes and repair actions associated with the backups were also examined.

Review of available information showed that there was no specific cause for the backup and no repair noted for approximately 30% of the sewer complaints. For about 45% of the problems, repairs included cleaning, inspection, and miscellaneous repairs. In the remaining 25% of the cases, problems were reported to be associated with the customers' facilities. Based upon this analysis, the majority of reported problems seem to be localized and associated with the customer facilities. Although there may be some cases where a lack of downstream capacity is a problem, it is not possible to make specific

Table 4-4

Estimated Project Costs for PWSA CSO Improvements Required to Convey the Peak Flow From a 2-Year Design Storm (4 Overflows per Year)

Sewershed	Estimated PWSA Project Cost
Becks Run	$1,460,000
Bells Run	$21,310,000
East Street	$5,800,000
Little Saw Mill Run (Banksville Road)	$26,860,000
Lower Nine Mile Run	$25,480,000
McCartney Run	$6,100,000
McDonoughs Run (McNeily)	$17,100,000
Negley Run (Upper Nine Mile Run)	$40,100,000
Plummers Run	$29,150,000
Streets Run	$9,900,000
Weymans Run	$2,070,000
Brook Street, Englert Street, Brookline Blvd.	$9,830,000
TOTALS	$195,160,000

Costs represent the estimated PWSA share of sewer improvement project costs. The cost estimates are based upon a 0-overflow/typical year, 2-year design storm level of control. The costs assume an allocation of costs between affected municipalities computed based upon relative peak wet weather flow contributions.

determinations based upon the available information. It appears that sporadic surcharging occurs at various locations throughout the sewer system, primarily in response to high intensity storms and temporary obstructions.

In October 2011, the City of Pittsburgh issued a request for Stormwater Hydrologic / Hydraulic Modeling and Drainage Studies. The City requested professional services proposals from qualified engineering firms with experience in stormwater hydrologic/hydraulic modeling and drainage studies. The consultant's services will include conducting stormwater drainage analyses in areas of the City with identified flooding problems, starting with the Washington Boulevard area. The general scope of work for the project will be to analyze watersheds with identified flooding problems and model 2, 10, 25 and 100-year design storms to determine runoff rates and volumes, water surface profiles, channel velocities and inundated/affected areas. Detailed scopes of services will be developed for individual projects that the City elects to undertake. The contract for these services was subsequently transferred from the City to PWSA. In April 2012, PWSA awarded a contract to MS Consultants.

The analyses will describe the nature, extent and estimated cost of damages associated with potential flooding problems indicated by the modeling. Viable options for addressing existing flooding problems will be developed and issues associated with those options will be identified. Concept plans and cost estimates will be prepared for the identified alternatives. Written reports will also be prepared that detail the findings of the investigations, identify flood prone areas, and estimate the cost of flood damages versus estimated costs for alternative solutions. The reports will also provide analyses of the risk and the reduction of risk due to implementation of flood mitigation projects.

4.10 GREEN STORMWATER CONTROLS

Green stormwater infrastructure (GSI) may be a cost-effective element of a comprehensive wet weather flow management strategy in the PWSA service area. GSI measures can intercept stormwater runoff at or near its source, often at a lower cost per volume detained by storage facilities constructed farther downstream in the sewer shed. Further, some portion of the runoff intercepted by GSI facilities will never reach the combined sewer system; it will infiltrate into the ground. This aspect of GSI will avoid the cost of treating that portion of the captured runoff.

GSI measures may be installed on rooftops or at ground level. Rooftop GSI would be significantly more costly than ground level facilities, perhaps by more than a factor of ten. The following recommendations are based on ground level GSI.

Program administration cost estimates presented below are necessarily very general. They are offered more as comparisons among programs directed at the three sectors (residential, commercial / industrial / institutional, and public) than as absolute estimates. Personnel costs, which would dominate program administration, are based on $60,000

per work year, to include direct wages, payroll-related charges, and PWSA overhead. Financing costs are not included in these estimates.

Residential Sector

GSI in the residential sector would consist of small facilities aimed at controlling runoff discharges from individual residential rooftops. A rain garden of about 40 square feet would control the discharge from the roof of a typical urban residence. Small systems such as these should be standardized to a large extent as much as possible, to keep the residential program simple and cost-effective. However, the hilly nature of the PWSA service area terrain may require a significant amount of site adaptation.

Implementation Issues

PWSA could recruit homeowners through means already available for contacting customers, such as water and sewer bill enclosures, or separate mailings. Public service announcements on public and commercial television and radio stations could be used to raise awareness. Motivation could be provided by offering financing, either outright or through water and sewer charge abatement over a period of time.

Design and construction of residential GSI facilities should be overseen by PWSA or another public body formed for the purpose. This oversight is particularly important if public financing is involved, but should be considered for any residential program, to provide reasonable assurance that the facilities would function properly. Bad publicity caused by malfunctioning rain gardens would have a serious negative impact on a residential GSI program.

Funds for public financing of residential GSI projects would have to be recognized in utility accounting. These funds might be handled in a manner similar to the Act 129 program for electric power demand reduction: a surcharge on water and sewer service bills that is allocated to implementation of GSI projects. Another possible funding mechanism for residential GSI projects might be based on a property assessed clean energy (PACE) model. This approach provides funding to homeowners and places an obligation on the property owner to pay back the utility over a period of time, generally through a charge on the utility bill. A PACE-like obligation would remain in place with an ownership change.

Administrative Issues

PWSA would need to commit employee work effort to recruit and enroll homeowners and to set up and administer the approved designer and contractor program. The initial effort could probably be handled by one or two utility

employees, along with periodic assistance from other PWSA employees; ongoing administrative effort would depend on response from the residential sector.

Ongoing maintenance and long term functioning of residential GSI would present some difficult issues. A homeowner might decide to replace the rain garden with another kind of landscaping, or to neglect maintenance. Such actions – or inactions – would be difficult for the utility to detect. A program of periodic inspection would require the commitment of several employees, and identifying ineffective residential GSI facilities could be very difficult, as many malfunctions might occur beneath the ground surface or under the vegetative cover.

Responsibility for maintaining residential GSI facilities upon property transfer would present another difficult administrative issue. New authority may be required for a utility to extend maintenance responsibility to a new homeowner, or to implement a PACE-like funding mechanism. Further, the cost and problems of an ongoing inspection program would probably increase as residential properties change ownership.

Potential Program Costs

- Set up and initial recruiting effort – 3 work years $180,000
- Reviews, permits, inspections – 2 work years annually $120,000

Commercial/Industrial/Institutional Sector

GSI facilities in the commercial / industrial / institutional (CII) sector would generally be larger than residential facilities. They could be designed to intercept the runoff from building roofs and from paved areas such as parking lots, sidewalks, storage areas, and other hardscape. Design of these facilities would be site-specific, rather than standardized, to account for the many site variables involved.

Implementation Issues

PWSA might recruit CII owners using publicity programs similar to a residential program, but the effectiveness of such an approach might be limited, compared to the residential sector. Identifying CII owners willing to commit to building GSI facilities would probably require an approach that focuses attention on individual properties, with more up-front development work by PWSA to present possible GSI concepts to interest the property owner.

CII owners might be motivated to participate by public financing assistance or by abatement of water and sewer charges, or a combination of the two. Another approach might be offered by the formation of a public entity to regulate stormwater runoff flows based on impervious area. GSI might be offered as a means for a CII owner to reduce runoff volume or rate.

Decisions on designing and building GSI facilities should reside with CII owners. Many of these owners would be likely to have existing relationships with engineering and construction firms. PWSA should provide technical guidance and designs should be subject to approval prior to construction. Further, finished facilities should be inspected by PWSA to confirm their adherence to approved designs. Some CII owners may not have existing relationships with engineering and construction firms. PWSA might assist these owners by developing lists of such firms with demonstrated competence and providing these lists to CII owners.

Financing of GSI facilities in the CII sector might be provided by mechanisms borrowed from electric power demand reduction programs: Act 129 and PACE financing. Financing could also be left to CII owners, with water and sewer charge abatement offered to pay off capital costs over a period of time.

Administrative Issues

The administrative effort for a GSI program focused on the CII community would be significantly more demanding than a residential program. Recruiting participants would require more effort, due to the need to address site-specific factors and the need to establish a useful working relationship between PWSA and individual CII owners. Design and construction review and inspection would require individuals with more extensive training and experience, compared to a residential program. Further, since CII facilities would be larger than residential installations, they would merit more frequent and detailed inspection during their operational lives. The number of individuals required to administer a CII program would depend on the number of CII owners that decide to participate. Although it is not possible to compare work efforts for the residential and CII sectors explicitly, it is probably reasonable to estimate that the administrative cost related to each GSI installation would be three or four times greater in the CII sector, compared to the residential sector. However, facilities at CII properties would result in greater reduction of runoff than installations at residences.

The transfer of responsibility for operating the GSI facility, and for paying any financial obligation upon sale of a CII property would need to be assured.

Potential Program Costs

- Set up and initial recruiting effort – 4 work years $240,000
- Reviews, permits, inspections – 4 work years annually $240,000

Governmental Sector

The governmental sector, including public authorities, controls significant land area within the PWSA service area:

- City of Pittsburgh facilities, including streets, parks, public works shops.
- Allegheny County facilities.
- Port Authority of Allegheny County.
- Pittsburgh Public Schools.
- Pittsburgh Zoo.
- Sports and Exhibition Authority of Pittsburgh and Allegheny County.
- Pittsburgh Parking Authority.
- Urban Redevelopment Authority of Pittsburgh.
- Housing Authority of the City of Pittsburgh.

Of course, PWSA also owns land within the sewered area. PWSA and other public landowners control large areas of impervious surfaces that could be modified with GSI to decrease stormwater runoff and demonstrate to private sector property owners the benefits that could accrue by installing these stormwater management practices.

Implementation Issues

Government agencies and public authorities could be recruited by direct outreach from PWSA. A relatively small number of entities control a large amount of impervious area. Employees and governing board members of public authorities are probably fairly familiar with one another. Motivation might be financial – water and sewer fee abatements, for instance – and this motivation might be enhanced by the public service of providing a positive example to private sector property owners in the PWSA service area. GSI projects constructed on public sector land could also provide valuable opportunities for PWSA to monitor performance, yielding useful data to enhance understanding of how GSI facilities function in the Pittsburgh climate and topographic setting.

Design and construction of GSI facilities would best be left to the existing capital project practices of the government agencies and public authorities. Technical guidelines would be useful, and PWSA should be involved, particularly if a facility were to be identified for detailed performance monitoring.

Financing GSI projects at public sector sites could be provided through a centralized funding mechanism, or it could be left to each of the government agencies and public authorities to achieve through their respective funding processes.

Administrative Issues

Work tasks needed to administer a GSI program aimed at public sector owners would be similar to those needed for either the residential or CII sectors, but work effort would probably be significantly less for the public sector, compared to the other two types of owners. A relatively small group of owners, significant familiarity that already exists between PWSA and other public sector owners, and a generally positive disposition among public agencies and authorities toward actions that advance the public good would all work to decrease the effort needed to identify and implement GSI projects. PWSA or another designated public agency should provide technical guidance and oversight to the program.

A GSI program aimed at the public sector would offer good opportunities for PWSA to collaborate with higher education institutions. Carnegie Mellon University and the University of Pittsburgh both have engineering programs that would offer competent and relatively low cost teams to monitor and analyze GSI installations. Other higher education institutions with environmental programs might also be included.

Potential Program Costs

- Set up and initial recruiting effort – 1 work years $60,000
- Reviews, permits, inspections – 1 work years annually $60,000

Summary Recommendations

1. Do not expect a potable water conservation program to result in more than trivial reduction of wet weather flows to the PWSA sewer system.
2. Implement a GSI program that is focused on ground level facilities, considering rooftop measures for special cases.
3. Begin a GSI program on land owned by public sector agencies and authorities.
4. Monitor and analyze the public sector GSI installations to build a technical record to support further implementation.
5. Study administrative and financial structures to advance a GSI program into the private sector.
6. Consider the CII sector. Do not launch a program in the residential sector, but publicize the public sector experience to encourage homeowners to install GSI facilities voluntarily.
7. Develop site-adaptable plans for use by voluntary participants.
8. Consider developing a prequalification program for design and construction firms, which could be used by voluntary participants.

4.11 COST ESTIMATING - FIVE YEAR PLANS

This section presents concept level cost estimates and schedules for recommended capital improvements. Specific capital projects and anticipated capital expenditure levels throughout the 40-year planning period are identified. The improvement projects are broken down into eight- five year plans to provide the PWSA with a plan of action to meet business objectives, maintain regulatory compliance, and address operational needs within the framework of practical capital funding capabilities. The capital improvement projects are grouped according to business area: Distribution, Pumping and Storage, Treatment, and Sewers. In addition, costs for recommended capital improvements to the GIS system are presented.

Distribution

Table 4-5 presents concept level cost estimates for recommended capital improvements to the distribution system. Cost estimates were developed for the following projects:

- Replacement of pipe segments with medium to high risk of failure
- Leak detection on larger lines by outside contractor
- Water meter replacement program
- Millvale water system improvements to increase pressure
- Facilities to transfer water from Highland No. 2 District to Highland No. 1 District
- Bloomfield – Penn Avenue distribution system improvements
- Reduce size of Herron Hill Reservoir District
- Joint venture projects with the URA and other agencies

Replacement of pipe segments based on risk of failure was discussed under Task 4.2. Leak detection activities and meter replacement were presented under Task 4.7. The other projects were discussed under Task 4.1. An allowance of $1.50 million per year was included for joint venture water projects with the URA, PennDot, and other agencies.

Project cost estimates for the various activities include estimated construction costs plus a 25 percent construction contingency and a 15 percent allowance for project costs. The project cost estimates listed in Table 4-5 are based on 2011 price levels. For activities scheduled in future years, 2011 project cost estimates were increased by 3 percent per year. Both the Engineering News Record Construction Cost Index and the Consumer Price Index had average annual increases of about 3 percent for the 25-year period between 1985 and 2010. Over the 40-year planning period, the cost for recommended distribution system improvements is estimated to be $1.405 billion.

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Table 4-5

Concept Level Cost Estimates for Recommended Capital Improvements - Distribution

Year	Replace Pipe Segments With Medium to High Risk of Failure	Leak Detection on Larger Lines by Outside Contractor	Water Meter Replacement Program	Millvale Water System Improvements to Increase Pressure	Highland 2 to Highland 1 Pump Station - Pipelines	Bloomfield - Penn Avenue Distribution System Improvements	Reduce Size of Herron Hill Reservoir District - Pipelines	Joint Venture Projects	Total
2012	$14,894,000	$388,000	$2,141,000	$721,000				1,545,000	$19,689,000
2013	15,341,000	400,000	2,205,000					1,591,000	19,537,000
2014	15,801,000	412,000	2,271,000		7,037,000			1,639,000	27,160,000
2015	16,275,000	424,000	2,340,000					1,688,000	20,727,000
2016	16,763,000	437,000	2,264,000					1,739,000	21,203,000
2017	18,675,000	450,000	2,332,000					1,791,000	23,248,000
2018	19,235,000	463,000	2,402,000					1,845,000	23,945,000
2019	19,812,000	477,000	2,474,000			6,739,000		1,900,000	31,402,000
2020	20,407,000	491,000	2,549,000					1,957,000	25,404,000
2021	21,019,000	506,000	0				17,874,000	2,016,000	41,415,000
2022	21,096,000	521,000	0					2,076,000	23,693,000
2023	21,729,000	537,000	0					2,139,000	24,405,000
2024	22,380,000	553,000	979,000					2,203,000	26,115,000
2025	23,052,000	570,000	1,008,000					2,269,000	26,899,000
2026	23,743,000	587,000	1,038,000					2,337,000	27,705,000
2027	23,172,000	604,000	1,069,000					2,407,000	27,252,000
2028	23,867,000	622,000	1,101,000					2,479,000	28,069,000
2029	24,583,000	641,000	1,134,000					2,554,000	28,912,000
2030	25,321,000	660,000	1,168,000					2,630,000	29,779,000
2031	26,080,000	680,000	1,203,000					2,709,000	30,672,000
2032	26,416,000	701,000	2,803,000					2,790,000	32,710,000
2033	27,209,000	722,000	2,887,000					2,874,000	33,692,000
2034	28,025,000	743,000	2,974,000					2,960,000	34,702,000
2035	28,866,000	766,000	3,063,000					3,049,000	35,744,000
2036	29,732,000	789,000	3,155,000					3,141,000	36,817,000
2037	31,745,000	812,000	3,250,000					3,235,000	39,042,000
2038	32,697,000	837,000	3,347,000					3,332,000	40,213,000
2039	33,678,000	862,000	3,447,000					3,432,000	41,419,000
2040	34,689,000	887,000	3,551,000					3,535,000	42,662,000
2041	35,729,000	914,000	3,657,000					3,641,000	43,941,000
2042	37,401,000	942,000	3,767,000					3,750,000	45,860,000
2043	38,523,000	970,000	3,880,000					3,863,000	47,236,000
2044	39,679,000	999,000	1,768,000					3,979,000	46,425,000
2045	40,869,000	1,029,000	1,821,000					4,098,000	47,817,000
2046	42,095,000	1,060,000	1,875,000					4,221,000	49,251,000
2047	41,677,000	1,091,000	1,931,000					4,347,000	49,046,000
2048	42,928,000	1,124,000	1,989,000					4,478,000	50,519,000
2049	44,215,000	1,158,000	2,048,000					4,612,000	52,033,000
2050	45,542,000	1,193,000	2,110,000					4,751,000	53,596,000
2051	46,908,000	1,228,000	2,173,000					4,893,000	55,202,000
Total	$1,141,868,000	$29,250,000	$85,174,000	$721,000	$7,037,000	$6,739,000	$17,874,000	$116,495,000	$1,405,158,000

Pumping and Storage

Information regarding recommended pumping and storage capital improvements is presented in Tables 4-6 through 4-9. Due to the large number of facilities and the need for periodic upgrades, schedules and estimated costs for improvements are presented separately.

Table 4-6 presents a schedule for recommended pumping improvements. Upgrade categories include replacement of motor control centers (MCCs), pumps, HVAC equipment, and flat roofs. Roof recoating rather than replacement was included for sloped metal roofs. Costs are also included for the pumping improvements required to meet future demands that were discussed under Task 4.1. The schedule in Table 4-6 is based on replacement intervals of 20 years for roof work, 25 years for HVAC, and 40 years for pumps and MCCs. These replacement intervals are consistent with historic scheduling of PWSA capital improvement projects.

Table 4-7 presents concept level cost estimates for recommended capital improvements to PWSA pumping facilities. Project cost estimates for the various activities include estimated construction costs plus a 25 percent construction contingency and a 15 percent allowance for project costs. For activities scheduled in future years, 2011 project cost estimates were increased by 3 percent per year. The cost for recommended pumping improvements is estimated to be $35.018 million over the 40-year planning period.

Table 4-8 is a schedule for recommended storage improvements. Upgrades include installation of floating reservoir covers, repairs to floating covers, sandblasting and painting of steel tanks, repair of concrete tanks, replacement of steel tanks, installation of systems to reduce TTHM concentrations in water storage tanks, and reservoir cleaning. Upgrades to certain storage facilities are also scheduled based on future requirements discussed under Task 4.1. These upgrades include the following:

- Replace the existing Garfield 1.90 MG elevated tank with two 1.45 MG tanks.
- Replace the existing Herron Hill 0.40 MG elevated tank with two 0.65 MG elevated tanks.
- Replace the existing Lincoln 3.00 MG standpipe with two 2.60 MG standpipes.
- Replace the existing Squirrel Hill 3.00 MG standpipe with two 1.40 MG elevated tanks.

The schedule in Table 4-8 is based on repairs to floating covers every 10 years, floating cover replacement every 20 years, tank painting every 20 years and concrete tank repairs every 20 years. Tank replacements were scheduled at the end of a painting cycle when the tank age exceeded 70 years. The schedule also includes cleaning and installation of a floating cover on the Highland No. 1 Reservoir.

Table 4-6
Schedule for Recommended Capital Improvements - Pumping

Year	Aspinwall Pump Station	Bruecken Pump Station	Fox Chapel Pump Station	Herron Hill Pump Station	Her. Hill Tank Pump Station	Highland Pump Station	Howard Pump Station	Lincoln Pump Station	Mission Pump Station	Saline Pump Station
2012						Replace MCC				Replace Roof
2013		Recoat Roof				Replace HVAC	Replace HVAC			
2014										
2015				Recoat Roof					Interior Bldg. Rehab.	
2016	Replace Roof						Replace MCC	Replace MCC	Recoat Roof	
2017									Exterior Bldg. Rehab.	
2018									Replace 3 Pumps	
2019										
2020								Replace Pumps		
2021	Recoat Roof	Replace MCC			Replace HVAC	Replace Roof			Replace MCC	
2022					Replace MCC				Replace Roof	
2023						Replace Pumps				
2024							Recoat Roof			
2025										
2026	Replace MCC									
2027		Replace HVAC		Replace HVAC						
2028				Replace Pumps	Replace Pumps					
2029	Replace Pumps	Replace Roof								
2030										Replace MCC
2031				Replace MCC				Replace Roof		Replace HVAC
2032									Replace 2 Pumps	Replace Roof
2033		Recoat Roof							Replace HVAC	
2034								Replace HVAC		
2035				Recoat Roof						
2036	Replace Roof								Recoat Roof	
2037										
2038						Replace HVAC	Replace HVAC			
2039										
2040										
2041	Recoat Roof					Replace Roof				
2042									Replace Roof	
2043			Replace Pumps							
2044			Replace MCC				Recoat Roof			
2045										
2046										
2047										
2048										
2049		Replace Pumps								
2050										Replace Pumps
2051							Replace Pumps	Replace Roof		

Replace MCC = replace motor control center
Replace Pumps = replace pumps and motors
Replace HVAC = replace boiler or unit heaters

Replace Roof = replace flat rubber roof
Recoat Roof = recoat sloped metal roof
Interior Bldg. Rehab. - Rehabilitate Pump Station Interior

Exterior Bldg. Rehab. - Rehabilitate Pump Station Exterior

Table 4-7
Concept Level Cost Estimates for Recommended Capital Improvements - Pumping

Year	Aspinwall Pump Station	Bruecken Pump Station	Fox Chapel Pump Station	Herron Hill Pump Station	Her. Hill Tank Pump Station	Highland Pump Station	Howard Pump Station	Lincoln Pump Station	Mission Pump Station	Saline Pump Station	Total
2012						123,000				7,000	$130,000
2013		32,000				105,000	502,000				639,000
2014											0
2015				32,000					791,000		823,000
2016	41,000						224,000	81,000	45,000		391,000
2017									536,000		536,000
2018									899,000		899,000
2019											0
2020								536,000			536,000
2021	49,000	328,000			6,000	14,000			159,000		556,000
2022					121,000				28,000		149,000
2023						309,000					309,000
2024							70,000				70,000
2025											0
2026	382,000										382,000
2027		499,000		442,000							941,000
2028				1,327,000	83,000						1,410,000
2029	3,570,000	15,000									3,585,000
2030										338,000	338,000
2031				337,000				15,000		8,000	360,000
2032									906,000	12,000	918,000
2033		58,000							743,000		801,000
2034								156,000			156,000
2035				57,000							57,000
2036	74,000								81,000		155,000
2037											0
2038						220,000	1,052,000				1,272,000
2039											0
2040											0
2041	88,000					26,000					114,000
2042									50,000		50,000
2043			1,460,000								1,460,000
2044			186,000				126,000				312,000
2045											0
2046											0
2047											0
2048											0
2049		11,476,000									11,476,000
2050										1,667,000	1,667,000
2051							4,499,000	27,000			4,526,000
Total	$4,204,000	$12,408,000	$1,646,000	$2,195,000	$210,000	$797,000	$6,473,000	$815,000	$4,238,000	$2,032,000	$35,018,000

Table 4-8
Schedule for Recommended Capital Improvements - Storage

Year	Herron Hill Reservoir	Highland 1 Reservoir	Highland 2 Reservoir	Lanpher Reservoir	Allentown No. 1 Tank	Allentown No. 2 Tank	Bedford Tank	Brashear No. 1 Tank	Brashear No. 2 Tank	Garfield Tank	Herron Hill Tank	Lincoln Tank	McNaugher No. 1 Tank	McNaugher No. 2 Tank	Spring Hill No. 1 Tank	Spring Hill No. 2 Tank	Squirrel Hill Tank
2012					Paint	Paint											
2013					TTHM	TTHM	TTHM	TTHM	TTHM	TTHM	TTHM	TTHM	TTHM	TTHM	TTHM	TTHM	TTHM
2014																	
2015																	
2016							Paint										
2017	Install FC			Install FC													
2018													Repair	Repair			
2019		Clean															
2020		Install FC															
2021			Repair FC							Replace +					Replace	Replace	
2022												Replace ++					
2023																	
2024																	
2025																	
2026																	
2027	Repair FC			Repair FC													
2028																	
2029								Paint	Paint								
2030		Repair FC															
2031			Install FC								Replace x						Replace *
2032					Replace	Replace											
2033																	
2034																	
2035																	
2036							Paint										
2037	Install FC			Install FC													
2038													Repair	Repair			
2039																	
2040		Install FC															
2041			Repair FC							Paint					Paint	Paint	
2042												Paint					
2043																	
2044																	
2045																	
2046																	
2047	Repair FC			Repair FC													
2048																	
2049								Paint	Paint								
2050		Repair FC															
2051			Install FC								Paint						Paint

Install FC = install floating cover
Repair FC = repair floating cover
Paint = sandblast and paint steel tank
Replace = replace steel tank
Repair = repair concrete tank
TTHM = install TTHM reduction system
Clean = clean reservoir

+ Replace Garfield 1.90 MG elevated tank with two 1.45 MG elevated tanks
x Replace Herron Hill 0.40 MG elevated tank with two 0.65 MG elevated tanks
++ Replace Lincoln 3.00 MG standpipe with two 2.60 MG standpipes
* Replace Squirrel Hill 3.00 MG standpipe with two 1.40 MG elevated tanks

Table 4-9

Concept Level Cost Estimates for Recommended Capital Improvements - Storage

Year	Herron Hill Reservoir	Highland 1 Reservoir	Highland 2 Reservoir	Lanpher Reservoir	Allentown No. 1 Tank	Allentown No. 2 Tank	Bedford Tank	Brashear No. 1 Tank	Brashear No. 2 Tank	Garfield Tank	Herron Hill Tank	Lincoln Tank	McNaugher No. 1 Tank	McNaugher No. 2 Tank	Spring Hill No. 1 Tank	Spring Hill No. 2 Tank	Squirrel Hill Tank	Total
2012					$519,000	$519,000												$1,038,000
2013					111,000	111,000	95,000	159,000	159,000	111,000	80,000	111,000	159,000	80,000	80,000	80,000	111,000	1,447,000
2014																		0
2015																		0
2016							560,000											560,000
2017	530,000			3,224,000														3,754,000
2018													550,000	96,000				646,000
2019		1,089,000																1,089,000
2020		5,538,000																5,538,000
2021			800,000							15,654,000					735,000	735,000		17,924,000
2022												5,235,000						5,235,000
2023																		0
2024																		0
2025																		0
2026																		0
2027	810,000			857,000														1,667,000
2028																		0
2029								1,874,000	1,874,000									3,748,000
2030		1,472,000																1,472,000
2031			5,436,000								9,663,000						20,330,000	35,429,000
2032					3,935,000	3,935,000												7,870,000
2033																		0
2034																		0
2035																		0
2036							1,012,000											1,012,000
2037	957,000			5,823,000														6,780,000
2038													993,000	174,000				1,167,000
2039																		0
2040		10,002,000																10,002,000
2041			1,445,000							5,007,000					368,000	368,000		7,188,000
2042												2,297,000						2,297,000
2043																		0
2044																		0
2045																		0
2046																		0
2047	1,464,000			1,548,000														3,012,000
2048																		0
2049								3,385,000	3,385,000									6,770,000
2050		2,658,000																2,658,000
2051			9,819,000								6,033,000						6,497,000	22,349,000
Total	$3,761,000	$20,759,000	$17,500,000	$11,452,000	$4,565,000	$4,565,000	$1,667,000	$5,418,000	$5,418,000	$20,772,000	$15,776,000	$7,643,000	$1,702,000	$350,000	$1,183,000	$1,183,000	$26,938,000	$150,652,000

Table 4-9 presents concept level cost estimates for recommended capital improvements to PWSA storage facilities. Project cost estimates include estimated construction costs plus a 25 percent construction contingency and a 15 percent allowance for project costs. For activities scheduled in future years, 2011 project cost estimates were increased by 3 percent per year. The cost for recommended storage improvements over the 40-year planning period is estimated to be $150.652 million.

Treatment

Table 4-10 presents concept level cost estimates for recommended capital improvements to PWSA treatment facilities. Project cost estimates include estimated construction costs plus a 25 percent construction contingency and a 15 percent allowance for project costs. The 2011 project cost estimates were increased by 3 percent per year for projects scheduled in the future. A $250,000 construction cost allowance is allocated for repairs to the access tunnel at the Aspinwall water treatment plant. Filter rehabilitation and clearwell renovation costs are based on the construction cost estimates discussed under Task 4.3. The cost for recommended treatment improvements over the 40-year planning period is estimated to be $401.607 million.

Sewers

Table 4-11 presents concept level cost estimates for recommended capital improvements to PWSA sewers. Costs for these items are based on the project costs discussed under Task 4.8 and presented in Table 4-4. Project cost estimates for activities scheduled in future years were increased by 3 percent per year. Sewer improvement costs also include $1.00 million per year expenditure for COA compliance, $1.50 million for joint venture projects with URA, PennDot, and other agencies, and a $2 million annual allowance for other sewer system improvements. The cost for recommended capital improvements to the sewer system over the 40-year planning period is estimated to be $604.995 million.

GIS

Table 4-12 presents concept level cost estimates for recommended capital improvements for GIS activities. Improvements include upgrades to GPS equipment, purchase of laptop computers for field crews, software upgrades, and server upgrades. Costs for these items are based on the information presented under Task 3.8. The estimated cost for GIS capital improvements is estimated at $2.101 million over the planning period.

Table 4-10
Concept Level Cost Estimates for Recommended Capital Improvements - Treatment

Year	Description	Total
2012	Access Tunnel Rehabilitation	$361,000
2013	Filter Rehabilitation	17,452,000
2014	Filter Rehabilitation, SCADA Upgrade	24,094,000
2015	Drain, Clean, and Inspect Sedimentation Basins	20,084,000
2016	Chemical Feed Upgrades	6,587,000
2017	Clearwell Renovation	23,302,000
2018	Clearwell Renovation	24,001,000
2019	Clearwell Renovation	24,721,000
2020	Clearwell Renovation	25,462,000
2021	Water Treatment Plant - Replace Motor Control Centers	329,000
2022	SCADA Upgrade	7,752,000
2023		0
2024		0
2025		0
2026	Ross Pump Station - Boiler Replacement	1,688,000
2027		0
2028		0
2029		0
2030	SCADA Upgrade	9,820,000
2031		0
2032		0
2033		0
2034	Clarifier Rehabilitation - New Sludge Collectors and Joint Repairs	10,359,000
2035	Replace Sand Filters With Membrane Filters	25,613,000
2036	Replace Sand Filters With Membrane Filters	26,382,000
2037	Replace Sand Filters With Membrane Filters	27,173,000
2038	Replace Sand Filters With Membrane Filters, SCADA Upgrade	40,427,000
2039		0
2040	Chemical Feed Upgrades	13,390,000
2041	Drain, Clean, and Inspect Sedimentation Basins	21,656,000
2042	Drain, Clean, and Inspect Sedimentation Basins	22,306,000
2043		0
2044		0
2045		0
2046	SCADA Upgrade	15,758,000
2047		0
2048		0
2049	Ross Pump Station - Replace Motor Control Centers	753,000
2050	Ross Pump Station - Replace Pumps and Motors	8,602,000
2051	Ross Pump Station - Boiler Replacement	3,535,000
Total		$401,607,000

Table 4-11

Concept Level Cost Estimates for Recommended Capital Improvements - Sewers *

Year	Sewage Pump Station Upgrades	Becks Run CSO Improvements	Bells Run CSO Improvements	East Street CSO Improvements	Little Saw Mill Run CSO Improvements	Lower Nine Mile Run Improvements	McCartney Run CSO Improvements	McDonough's Run CSO Improvements	Negley Run CSO Improvements	Plummers Run CSO Improvements	Streets Run CSO Improvements	Weymans Run CSO Improvements	Brook, Englert Brookline CSO Improvements	COA Compliance	Joint Venture Projects	General Sewer System Improvements	Total
2012	$3,090,000													1,030,000	1,545,000	2,060,000	$7,725,000
2013														1,061,000	1,591,000	2,122,000	4,774,000
2014		1,595,000		6,338,000			6,666,000					2,262,000		1,093,000	1,639,000	2,185,000	21,778,000
2015			7,995,000		10,077,000									1,126,000	1,688,000	2,251,000	23,137,000
2016			8,235,000		10,379,000									1,159,000	1,739,000	2,319,000	23,831,000
2017			8,482,000		10,691,000									1,194,000	1,791,000	2,388,000	24,546,000
2018						10,446,000		7,010,000						1,230,000	1,845,000	2,460,000	22,991,000
2019						10,759,000		7,221,000						1,267,000	1,900,000	2,534,000	23,681,000
2020						11,082,000		7,437,000						1,305,000	1,957,000	2,610,000	24,391,000
2021									17,964,000	13,058,000				1,344,000	2,016,000	2,688,000	37,070,000
2022									18,503,000	13,450,000				1,384,000	2,076,000	2,768,000	38,181,000
2023									19,058,000	13,854,000				1,426,000	2,139,000	2,852,000	39,329,000
2024											4,846,000		4,812,000	1,469,000	2,203,000	2,937,000	16,267,000
2025											4,992,000		4,956,000	1,513,000	2,269,000	3,025,000	16,755,000
2026											5,141,000		5,105,000	1,558,000	2,337,000	3,116,000	17,257,000
2027														1,605,000	2,407,000	3,209,000	7,221,000
2028														1,653,000	2,479,000	3,306,000	7,438,000
2029														1,702,000	2,554,000	3,405,000	7,661,000
2030														1,754,000	2,630,000	3,507,000	7,891,000
2031														1,806,000	2,709,000	3,612,000	8,127,000
2032														1,860,000	2,790,000	3,721,000	8,371,000
2033														1,916,000	2,874,000	3,832,000	8,622,000
2034														1,974,000	2,960,000	3,947,000	8,881,000
2035														2,033,000	3,049,000	4,066,000	9,148,000
2036														2,094,000	3,141,000	4,188,000	9,423,000
2037														2,157,000	3,235,000	4,313,000	9,705,000
2038														2,221,000	3,332,000	4,443,000	9,996,000
2039														2,288,000	3,432,000	4,576,000	10,296,000
2040														2,357,000	3,535,000	4,713,000	10,605,000
2041														2,427,000	3,641,000	4,855,000	10,923,000
2042														2,500,000	3,750,000	5,000,000	11,250,000
2043														2,575,000	3,863,000	5,150,000	11,588,000
2044														2,652,000	3,979,000	5,305,000	11,936,000
2045														2,732,000	4,098,000	5,464,000	12,294,000
2046														2,814,000	4,221,000	5,628,000	12,663,000
2047														2,898,000	4,347,000	5,797,000	13,042,000
2048														2,985,000	4,478,000	5,970,000	13,433,000
2049														3,075,000	4,612,000	6,150,000	13,837,000
2050														3,167,000	4,751,000	6,334,000	14,252,000
2051														3,262,000	4,893,000	6,524,000	14,679,000
Total	$3,090,000	$1,595,000	$24,712,000	$6,338,000	$31,147,000	$32,287,000	$6,666,000	$21,668,000	$55,525,000	$40,362,000	$14,979,000	$2,262,000	$14,873,000	$77,666,000	$116,495,000	$155,330,000	$604,995,000

* Estimated PWSA Share of Sewer Improvement Costs Based on Zero Overflows in a Typical Year and a 2-year Design Storm Level of Control. Costs Are Allocated Between PWSA and Municipalities Based Upon Peak Flow Contributions.

Table 4-12
Concept Level Cost Estimates for Recommended Capital Improvements - GIS

Year	RTK GPS	Laptops For Field Crews	ArcGIS Software Upgrades	GIS Server Upgrades	Total
2012	$31,000	$26,000	$5,000	$5,000	$67,000
2013					0
2014		14,000			14,000
2015		14,000		6,000	20,000
2016		20,000	6,000		26,000
2017	36,000	24,000			60,000
2018		22,000		6,000	28,000
2019		25,000			25,000
2020		23,000	7,000		30,000
2021		27,000		7,000	34,000
2022	42,000	24,000			66,000
2023		29,000			29,000
2024		26,000	7,000	7,000	40,000
2025		30,000			30,000
2026		27,000			27,000
2027	48,000	32,000		8,000	88,000
2028		29,000	8,000		37,000
2029		34,000			34,000
2030		31,000		9,000	40,000
2031		36,000			36,000
2032	56,000	33,000	9,000		98,000
2033		38,000		10,000	48,000
2034		35,000			35,000
2035		41,000			41,000
2036		37,000	10,000	10,000	57,000
2037	65,000	43,000			108,000
2038		39,000			39,000
2039		46,000		11,000	57,000
2040		41,000	12,000		53,000
2041		49,000			49,000
2042	75,000	44,000		13,000	132,000
2043		52,000			52,000
2044		46,000	13,000		59,000
2045		55,000		14,000	69,000
2046		49,000			49,000
2047	87,000	58,000			145,000
2048		52,000	15,000	15,000	82,000
2049		61,000			61,000
2050		55,000			55,000
2051		65,000		16,000	81,000
Total	$440,000	$1,432,000	$92,000	$137,000	$2,101,000

Total Costs

Table 4-13 summarizes total costs for recommended capital improvements to the PWSA system. The total cost for improvements over the 40-year planning period is estimated to be $2.60 billion. Distribution system improvements account for about 54 percent of the total.

Expenditures for recommended capital improvements during the eight, five-year plans are summarized below:

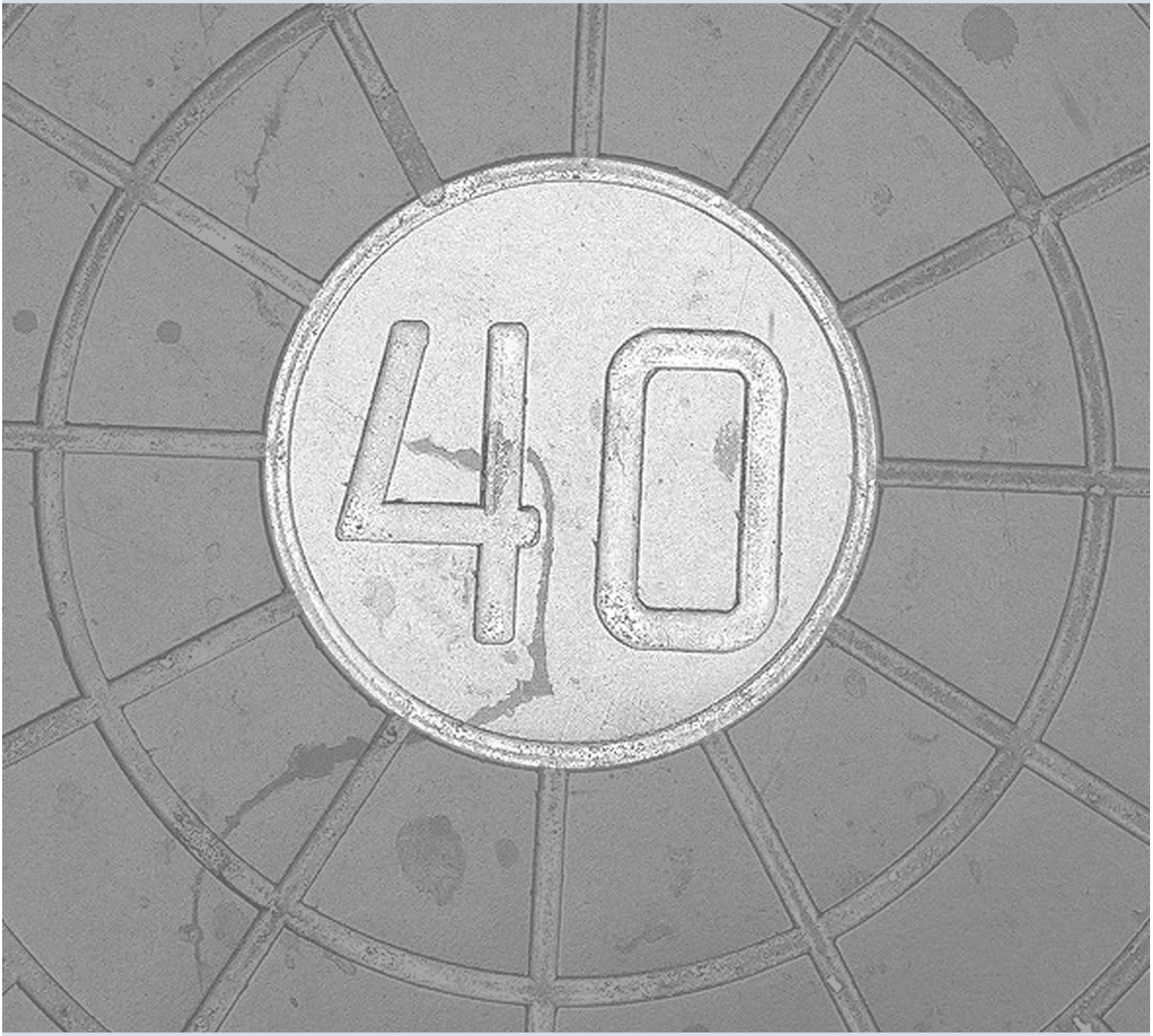
Capital Plan	**Total Expenditure**
First Five-Year Plan	$263,294,000
Second Five-Year Plan	407,563,000
Third Five-Year Plan	272,383,000
Fourth Five-Year Plan	242,027,000
Fifth Five-Year Plan	291,712,000
Sixth Five-Year Plan	388,277,000
Seventh Five-Year Plan	338,864,000
Eighth Five-Year Plan	395,411,000
Total	$2,559,531,000

Recommended capital expenditures for the five-year planning periods range from a high of $408 million to a low of $242 million and average $325 million per 5-year planning period or $65 million per year.

Table 4-13
Summary of Recommended Capital Improvement Costs

Year	Distribution	Pumping and Storage	Treatment	Sewers	GIS	Annual Total	Five-Year Capital Plan Total
2012	$19,689,000	$1,168,000	$361,000	$7,725,000	$67,000	$29,010,000	
2013	19,537,000	2,086,000	17,452,000	4,774,000	0	43,849,000	
2014	27,160,000	0	24,094,000	21,778,000	14,000	73,046,000	
2015	20,727,000	823,000	20,084,000	23,137,000	20,000	64,791,000	
2016	21,203,000	951,000	6,587,000	23,831,000	26,000	52,598,000	263,294,000
2017	23,248,000	4,290,000	23,302,000	24,546,000	60,000	75,446,000	
2018	23,945,000	1,545,000	24,001,000	22,991,000	28,000	72,510,000	
2019	31,402,000	1,089,000	24,721,000	23,681,000	25,000	80,918,000	
2020	25,404,000	6,074,000	25,462,000	24,391,000	30,000	81,361,000	
2021	41,415,000	18,480,000	329,000	37,070,000	34,000	97,328,000	407,563,000
2022	23,693,000	5,384,000	7,752,000	38,181,000	66,000	75,076,000	
2023	24,405,000	309,000	0	39,329,000	29,000	64,072,000	
2024	26,115,000	70,000	0	16,267,000	40,000	42,492,000	
2025	26,899,000	0	0	16,755,000	30,000	43,684,000	
2026	27,705,000	382,000	1,688,000	17,257,000	27,000	47,059,000	272,383,000
2027	27,252,000	2,608,000	0	7,221,000	88,000	37,169,000	
2028	28,069,000	1,410,000	0	7,438,000	37,000	36,954,000	
2029	28,912,000	7,333,000	0	7,661,000	34,000	43,940,000	
2030	29,779,000	1,810,000	9,820,000	7,891,000	40,000	49,340,000	
2031	30,672,000	35,789,000	0	8,127,000	36,000	74,624,000	242,027,000
2032	32,710,000	8,788,000	0	8,371,000	98,000	49,967,000	
2033	33,692,000	801,000	0	8,622,000	48,000	43,163,000	
2034	34,702,000	156,000	10,359,000	8,881,000	35,000	54,133,000	
2035	35,744,000	57,000	25,613,000	9,148,000	41,000	70,603,000	
2036	36,817,000	1,167,000	26,382,000	9,423,000	57,000	73,846,000	291,712,000
2037	39,042,000	6,780,000	27,173,000	9,705,000	108,000	82,808,000	
2038	40,213,000	2,439,000	40,427,000	9,996,000	39,000	93,114,000	
2039	41,419,000	0	0	10,296,000	57,000	51,772,000	
2040	42,662,000	10,002,000	13,390,000	10,605,000	53,000	76,712,000	
2041	43,941,000	7,302,000	21,656,000	10,923,000	49,000	83,871,000	388,277,000
2042	45,860,000	2,347,000	22,306,000	11,250,000	132,000	81,895,000	
2043	47,236,000	1,460,000	0	11,588,000	52,000	60,336,000	
2044	46,425,000	312,000	0	11,936,000	59,000	58,732,000	
2045	47,817,000	0	0	12,294,000	69,000	60,180,000	
2046	49,251,000	0	15,758,000	12,663,000	49,000	77,721,000	338,864,000
2047	49,046,000	3,012,000	0	13,042,000	145,000	65,245,000	
2048	50,519,000	0	0	13,433,000	82,000	64,034,000	
2049	52,033,000	18,246,000	753,000	13,837,000	61,000	84,930,000	
2050	53,596,000	4,325,000	8,602,000	14,252,000	55,000	80,830,000	
2051	55,202,000	26,875,000	3,535,000	14,679,000	81,000	100,372,000	395,411,000
Total	$1,405,158,000	$185,670,000	$401,607,000	$604,995,000	$2,101,000	$2,599,531,000	$2,599,531,000

APPENDIX 1-1



CHESTER ENGINEERS, INC.

APPENDIX 1-1
KICK-OFF MEETING MINUTES

The Pittsburgh Water and Sewer Authority
40 – Year Capital Plan, PWSA Project R-D1.10015-11
Project Kickoff Meeting
Tuesday, October 5, 2010, PWSA Training Room
Meeting Minutes

Attendees: PWSA – Tom Gigliotti, Bob Hutton, Michael Kenney, Jeff Lenner, Rick Obermeier, Tom Palmosina, Steve Simcic, Stanley States, Don Waldorf.
Chester Engineers – Chuck Brence, Ralph Eyerman, Charlie Jordan, John Maslanik, Michael McKee, Bill Sukenik
Collective Efforts – Kathy Chavara

Meeting Handouts / Attachments

1. Agenda
2. Project Organization Chart
3. Project Schedule

Items Discussed

1. Introductions
   a) All attendees introduced themselves to the group.

2. Project Organization
   a) See attached Organization Chart
   b) Jeff Lenner is the PWSA Project Manager.
   c) Charlie Jordan is the Chester Project Manager.
   d) Bill Sukenik is the Chester Principal in Charge.
   e) Mike McKee is the Lead Studies Engineer.
   f) John Maslanik will lead the effort in facilities Planning and Computer Modeling.
   g) Ralph Eyerman will provide expertise in the area of Water and Sewer Distribution.
   h) Chuck Brence and Mark Mellott will focus on improvements to the Water Treatment plant and Storage and Pumping Facilities.
   i) Kathy Chavara of Collective Efforts will provide expertise in the area of Stormwater management and Inter-governmental Coordination.
   j) David Sheridan of Aqua Cura will focus on Green technologies.

3. Communications
   a) Jeff Lenner should be the recipient or be copied on all project correspondence. Charlie Jordan should be the recipient or be copied on all project correspondence.

4. Project Tasks

a) Mike McKee reviewed the scope of work for each of the following project tasks:
   - Task 1 – Project Coordination / Review Meetings
   - Task 2 – Identify Opportunities for Regionalization
   - Task 3 – Complete an Assessment of Needs
   - Task 4 – Develop Recommended Capital Improvements and Actions
   - Task 5 – Prepare a Summary Report.

5. Project Schedule
   a) The project schedule was revised from the RFP. The start date is October 6, 2010. The contract length is 270 days. The completion date is July 3, 2010.
   b) A copy of the revised schedule will be included in the Kickoff Meeting Minutes.

6. Development of Project Objectives
   a) Throughout the meeting, project objectives were discussed. The following lists these objectives and the initials of the speaker:
      - The 40-year Capital Plan should focus on asset management. (M.K.)
      - PWSA's 2005 value assessment is coming along; it focuses on the primary mains. Discussions included the desire for "sort-able" presentation so that items like Leak Detection, Reoccurring Breaks, etc can be easily searched and defined. The PWSA SAP includes some of this information from work completed over the last 3 years. Whatever is determined to be the best means to gather, compile and ultimately search data should be used and compatible with current PWSA reports, work notifications. This will roll into more of a Management Asset Planning document. Key items tossed out included street address, pressure districts, replacement lines/valves, zone, GIS data fields, City Wards, etc. (D.W. , B.H.)
      - The sewer system improvements required under the COA will be a big part of the 40-Year Plan. (M.K.)
      - The 40-Year Capital Plan should identify what needs to be done in the next 40 years, as well as determine the impact that the recommended improvements will have on user rates (what needs to be done versus what you can afford to do with respect to rates). (M.K.)
      - Requirements related to the Consent Decree/Feasibility Study being conducted will need documented proof of the cost implications. This costing should be prepared so the cost implications can be presented to the PWSA Board. Costing is needed for Board, Bonding Agencies, Public, etc. to fully understand maintenance/improvement costs. Costing information will need to be fed into the Cogsdale environment, which is the PWSA platform that will be financed in 3rd quarter of 2011 and operational about the 1st quarter of 2012.(M.K.).
      - Cogsdale (PWSA's future Financial Management software package) has a long-term planning component. (S.S.)
      - The ultimate goal is to link PWSA's GIS to SAP/Cogsdale. (S.S.)

- Cogsdale has an 18-month implementation schedule and is expected to be operational in the 1st quarter of 2012. (S.S.)
- The stormwater management approach for Pittsburgh needs to be coordinated between PWSA, the City and its agencies / authorities, PENNDOT, and County Agencies. Jeff Lenner to be kept abreast of all meetings. (M.K.)
- Meetings should be scheduled with City Planning, the Sports and Exhibition Authority (SEA), the Urban Redevelopment Authority (URA) and County Planning to get their input. Directors will need to provide Chester with their valuable input. (M.K.)
- The 40-Year Plan is the template for the future and input from PWSA staff will be invaluable. (M.K.)
- The 40-Year Plan has to factor in green energy. Harnessing hydroelectric power at the Highland Dam, Emsworth Dam, and Braddock Dam could be a huge savings for PWSA. (D.W.)
- The Emsworth Dam is already set up for hydroelectric power generation. (D.W.)
- By 2013, PWSA is committed to break out water and sewer costs for PENNVEST. (S.S.)
- Need to look at rates and determine the breakdown of water and sewer costs. Can't supplement sewer with revenue from water rates and vice-versa. (M.K.)
- Of the 5 major problems facing PWSA, CSOs are #1. Suggestion was to look at what Washington Suburban is doing as they have had multiple year rate increases planned and media highlights needs of the system. (T.G.)
- Monthly progress meetings for the project should be scheduled now. Each meeting should last a maximum of 1 hour. The progress meetings should focus on action items, not completed tasks. (M.K.)
- Progress meetings as tentatively scheduled for the last Monday of the month. (C.J.)
- The PWSA system has been neglected for years. PWSA needs to institute multiple year rate increases to finance system improvements, similar to what the Washington Suburban Sanitary Commission has done. (M.K.)
- Target levels of service for the 40-Year Plan are as follows: (M.K.)

  40 psi minimum water pressure
  500 gpm minimum fire flow
  No sewer backups (at the end of 40 years)
- New storm sewers are designed for a 25-year storm. Existing storm sewers may be designed for 1, 2, 5, or 10-year storms. (D.W.)
- New development is required to install separate storm and sanitary sewers; therefore, storm sewer separation will occur over time. (D.W.)
- The 40-Year Plan should list the criteria needed to meet future requirements for stormwater CSOs. (M.K.)
- Capital improvements should build in redundancy for critical areas, such as the Herron Hill Reservoir which feeds hospitals but turns over once a day. (M.K.)

- Also address redundancy problems with Highland Reservoirs – pump from Highland #2 to Highland #1 or cover reservoir. (M.K.)
- Develop internal questionnaire for PWSA department heads to get input on the items that need to be addressed in the 40-Year Capital Plan. (M.K.)

7. Development of Key Topics for Progress Meetings
   - Monthly progress meetings for the project should be scheduled now. Each meeting should last a maximum of 1 hour. The progress meetings should focus on action items, not completed tasks. (M.K.)
   - Progress meetings are tentatively scheduled for the last Monday of the month. (C.J.)

8. Action Items
   a) Chester to develop internal questionnaire for PWSA department heads to get input on the items that need to be addressed in the 40-Year Capital Plan.
   b) Jeff Lenner and Charlie Jordan to arrange schedule for monthly progress meetings.

9. Next Meeting
   a) Tuesday, October 26, 2010 at 9:30 AM.

Please submit any corrections or additional comments to these meeting minutes to me at cjordan@chesterengineers.com. Comments must be submitted by October 22, 2010.

Respectfully submitted,

Charles J. Jordan, P.E.
Project Manager

The Pittsburgh Water and Sewer Authority

40-Year Capital Plan

PWSA Project R-D1.10015

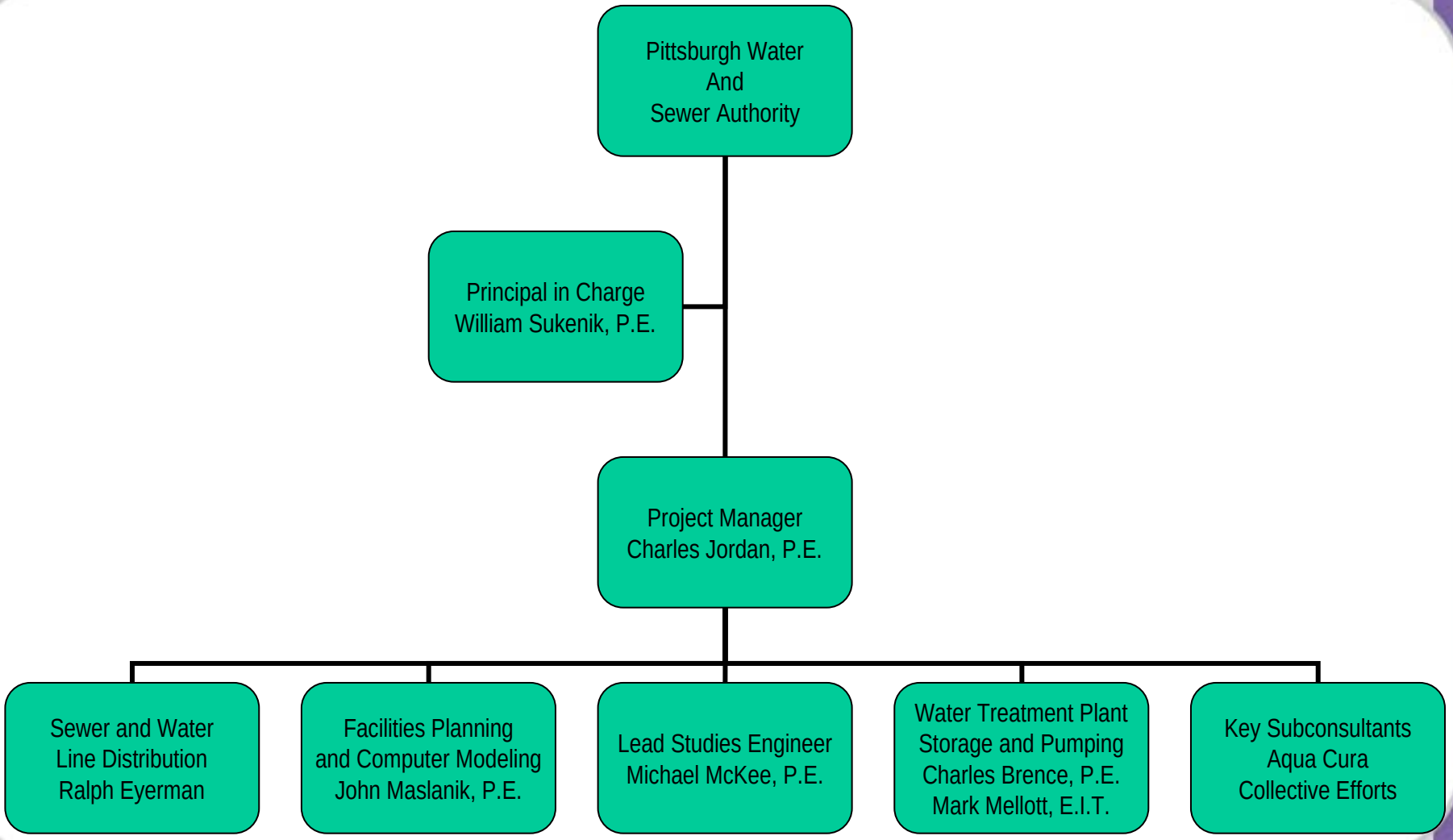
Project Kickoff Meeting

Tuesday, October 5, 2010

Meeting Agenda

- Introductions
- Project Organization
  - Define Roles of PWSA Staff and Chester Team Members
- Communications
- Project Tasks
- Project Schedule
- Development of Project Objectives
- Development of Key Topics for Progress Meetings

Organization Chart



Project Tasks

- Task 1: Project Coordination/Review Meetings
- Task 2: Identify Opportunities for Regionalization
- Task 3: Complete an Assessment of Needs
- Task 4: Develop Recommended Capital Improvements and Actions
- Task 5: Prepare a Summary Report

Project Schedule

- Discuss Schedule

Communications

- Open Discussion

Development of Project Objectives

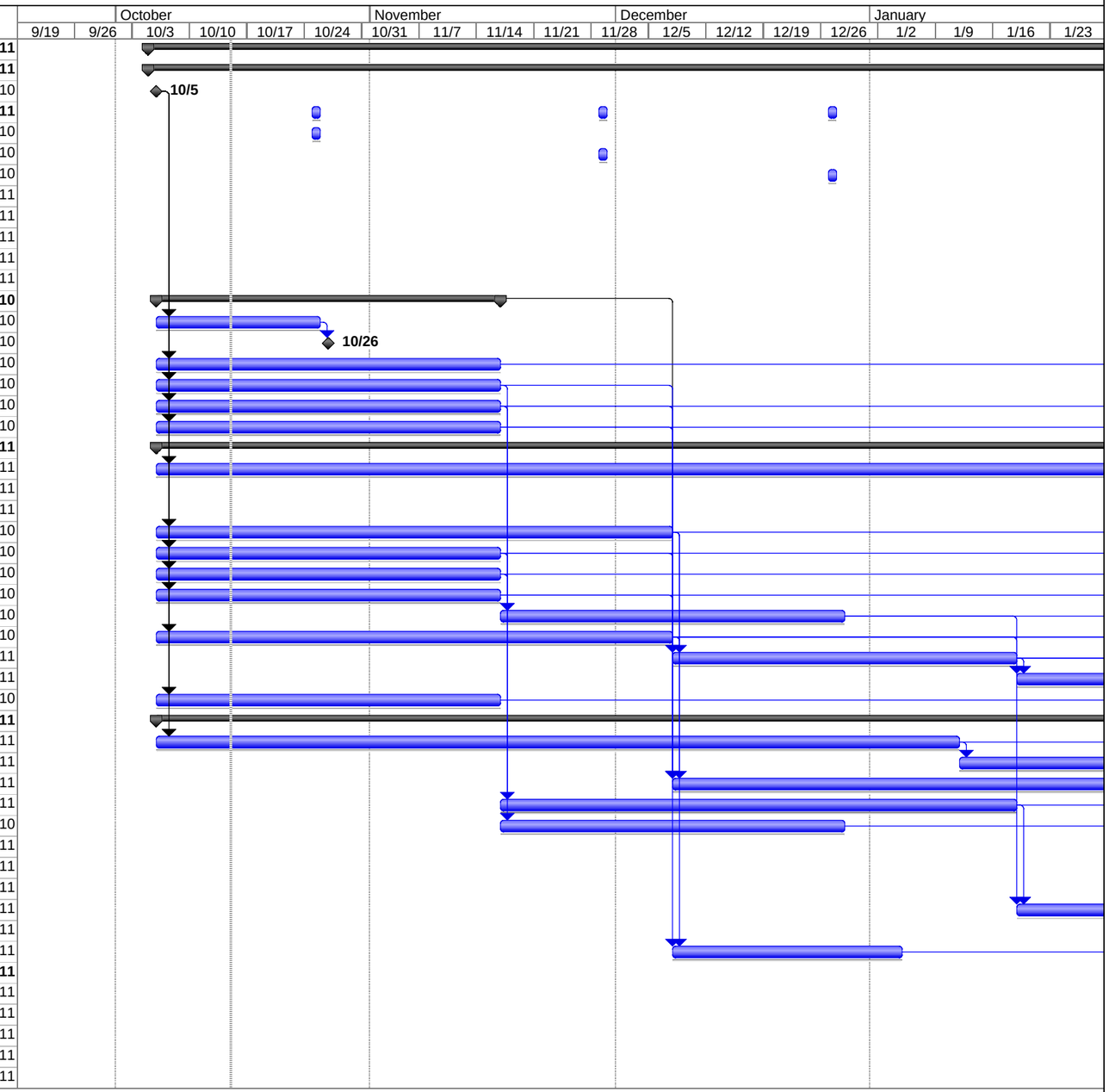
- Open Discussion

Development of Key Topics for Progress Meetings

- Open Discussion

THE PITTSBURGH WATER AND SEWER AUTHORITY
40-YEAR CAPITAL PLAN PROJECT
PWSA PROJECT R-D1.10015
PROJECT SCHEDULE

ID	WBS	Task Name	Duration	Start	Finish
1	**1**	**PWSA - 40 YEAR CAPITAL PLAN**	**193 days**	**Tue 10/5/10**	**Thu 6/30/11**
2	**1.1**	**Project Coordination**	**170 days**	**Tue 10/5/10**	**Mon 5/30/11**
3	1.1.1	Kickoff Meeting	1 day	Tue 10/5/10	Tue 10/5/10
4	**1.1.2**	**Progress Meetings**	**156 days**	**Mon 10/25/10**	**Mon 5/30/11**
5	1.1.2.1	Progress Meeting 1	1 day	Mon 10/25/10	Mon 10/25/10
6	1.1.2.2	Progress Meeting 2	1 day	Mon 11/29/10	Mon 11/29/10
7	1.1.2.3	Progress Meeting 3	1 day	Mon 12/27/10	Mon 12/27/10
8	1.1.2.4	Progress Meeting 4	1 day	Mon 1/31/11	Mon 1/31/11
9	1.1.2.5	Progress Meeting 5	1 day	Mon 2/28/11	Mon 2/28/11
10	1.1.2.6	Progress Meeting 6	1 day	Mon 3/28/11	Mon 3/28/11
11	1.1.2.7	Progress Meeting 7	1 day	Mon 4/25/11	Mon 4/25/11
12	1.1.2.8	Progress Meeting 8	1 day	Mon 5/30/11	Mon 5/30/11
13	**1.2**	**Identify Opportunities for Regionalization**	**30 days**	**Wed 10/6/10**	**Tue 11/16/10**
14	1.2.1	Coordinate Growth Initiative Meeting	14 days	Wed 10/6/10	Mon 10/25/10
15	1.2.2	Conduct Growth Initiative Meeting	1 day	Tue 10/26/10	Tue 10/26/10
16	1.2.3	Review Water and System Regionalization in Other Locals	30 days	Wed 10/6/10	Tue 11/16/10
17	1.2.4	Investigate Potential Areas of Water System Expansion	30 days	Wed 10/6/10	Tue 11/16/10
18	1.2.5	Investigate Water System Expansion Into City PAWC Service Area	30 days	Wed 10/6/10	Tue 11/16/10
19	1.2.6	Investigate Potential Areas of Sewer System Expansion	30 days	Wed 10/6/10	Tue 11/16/10
20	**1.3**	**Complete an Assessment of Needs**	**120 days**	**Wed 10/6/10**	**Tue 3/22/11**
21	1.3.1	Conduct System Inventory	90 days	Wed 10/6/10	Tue 2/8/11
22	1.3.2	Develop Valuations for Water and Sewer System	30 days	Wed 2/9/11	Tue 3/22/11
23	1.3.3	Identify Water System Improvements Based on Fire Demand	30 days	Wed 2/9/11	Tue 3/22/11
24	1.3.4	Inventory Major Pumping and Treatment Equipment	45 days	Wed 10/6/10	Tue 12/7/10
25	1.3.5	Review Backup Power Needs	30 days	Wed 10/6/10	Tue 11/16/10
26	1.3.6	Determine Strategy for Reduction of Non-Revenue Water	30 days	Wed 10/6/10	Tue 11/16/10
27	1.3.7	Conduct Needs Assessment Based on Safe Drinking Water Regulations	30 days	Wed 10/6/10	Tue 11/16/10
28	1.3.8	Determine Future Pumping and Distribution Needs	30 days	Wed 11/17/10	Tue 12/28/10
29	1.3.9	Review and Expand on Draft CSO Study	45 days	Wed 10/6/10	Tue 12/7/10
30	1.3.10	Determine Future Sewer Needs	30 days	Wed 12/8/10	Tue 1/18/11
31	1.3.11	Evaluate Green Technology	45 days	Wed 1/19/11	Tue 3/22/11
32	1.3.12	Review and Evaluate GIS System	30 days	Wed 10/6/10	Tue 11/16/10
33	**1.4**	**Develop Recommended Capital Improvements and Actions**	**180 days**	**Wed 10/6/10**	**Tue 6/14/11**
34	1.4.1	Develop Risk Based Analysis Model for Waterline Replacement	70 days	Wed 10/6/10	Tue 1/11/11
35	1.4.2	Prioritize Water Main Replacement	30 days	Wed 1/12/11	Tue 2/22/11
36	1.4.3	Identify Improvements and Upgrades to WTP, Incl Clearwell	40 days	Wed 12/8/10	Tue 2/1/11
37	1.4.4	Identify Areas Requiring Backup Power	45 days	Wed 11/17/10	Tue 1/18/11
38	1.4.5	Develop Plan for Non-Revenue Water & Leak Detection	30 days	Wed 11/17/10	Tue 12/28/10
39	1.4.6	Recommend Solutions to Sewer System	60 days	Wed 3/23/11	Tue 6/14/11
40	1.4.7	Recommend and estimate Cost of Green Technologies	20 days	Wed 3/23/11	Tue 4/19/11
41	1.4.8	Develop Eight Five Year Capital Plans for Water Distribution	20 days	Wed 2/23/11	Tue 3/22/11
42	1.4.9	Develop Eight Five Year Capital Plans for Pumping and Storage	20 days	Wed 1/19/11	Tue 2/15/11
43	1.4.10	Develop Eight Five Year Capital Plans for WTP	20 days	Wed 2/2/11	Tue 3/1/11
44	1.4.11	Develop Eight Five Year Capital Plans for Sewers	20 days	Wed 12/8/10	Tue 1/4/11
45	**1.5**	**Prepare a Summary Report**	**67 days**	**Wed 3/30/11**	**Thu 6/30/11**
46	1.5.1	Prepare Draft Report	30 days	Wed 3/30/11	Tue 5/10/11
47	1.5.2	Submit Draft Report	1 day	Wed 5/11/11	Wed 5/11/11
48	1.5.3	PWSA Review and Comment	21 days	Thu 5/12/11	Thu 6/9/11
49	1.5.4	Prepare Final Report	14 days	Fri 6/10/11	Wed 6/29/11
50	1.5.5	Submit 25 Copies of Summary report	1 day	Thu 6/30/11	Thu 6/30/11



Project: PWSA 40-YEAR Capital Plan

Task | Split | Progress | Milestone | Summary | Project Summary | External Tasks | External Milestone | Deadline

THE PITTSBURGH WATER AND SEWER AUTHORITY
40-YEAR CAPITAL PLAN PROJECT
PWSA PROJECT R-D1.10015
PROJECT SCHEDULE

ID	WBS	Task Name
1	**1**	**PWSA - 40 YEAR CAPITAL PLAN**
2	**1.1**	**Project Coordination**
3	1.1.1	Kickoff Meeting
4	**1.1.2**	**Progress Meetings**
5	1.1.2.1	Progress Meeting 1
6	1.1.2.2	Progress Meeting 2
7	1.1.2.3	Progress Meeting 3
8	1.1.2.4	Progress Meeting 4
9	1.1.2.5	Progress Meeting 5
10	1.1.2.6	Progress Meeting 6
11	1.1.2.7	Progress Meeting 7
12	1.1.2.8	Progress Meeting 8
13	**1.2**	**Identify Opportunities for Regionalization**
14	1.2.1	Coordinate Growth Initiative Meeting
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17	1.2.4	Investigate Potential Areas of Water System Expansion
18	1.2.5	Investigate Water System Expansion Into City PAWC Service Area
19	1.2.6	Investigate Potential Areas of Sewer System Expansion
20	**1.3**	**Complete an Assessment of Needs**
21	1.3.1	Conduct System Inventory
22	1.3.2	Develop Valuations for Water and Sewer System
23	1.3.3	Identify Water System Improvements Based on Fire Demand
24	1.3.4	Inventory Major Pumping and Treatment Equipment
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27	1.3.7	Conduct Needs Assessment Based on Safe Drinking Water Regulations
28	1.3.8	Determine Future Pumping and Distribution Needs
29	1.3.9	Review and Expand on Draft CSO Study
30	1.3.10	Determine Future Sewer Needs
31	1.3.11	Evaluate Green Technology
32	1.3.12	Review and Evaluate GIS System
33	**1.4**	**Develop Recommended Capital Improvements and Actions**
34	1.4.1	Develop Risk Based Analysis Model for Waterline Replacement
35	1.4.2	Prioritize Water Main Replacement
36	1.4.3	Identify Improvements and Upgrades to WTP, Incl Clearwell
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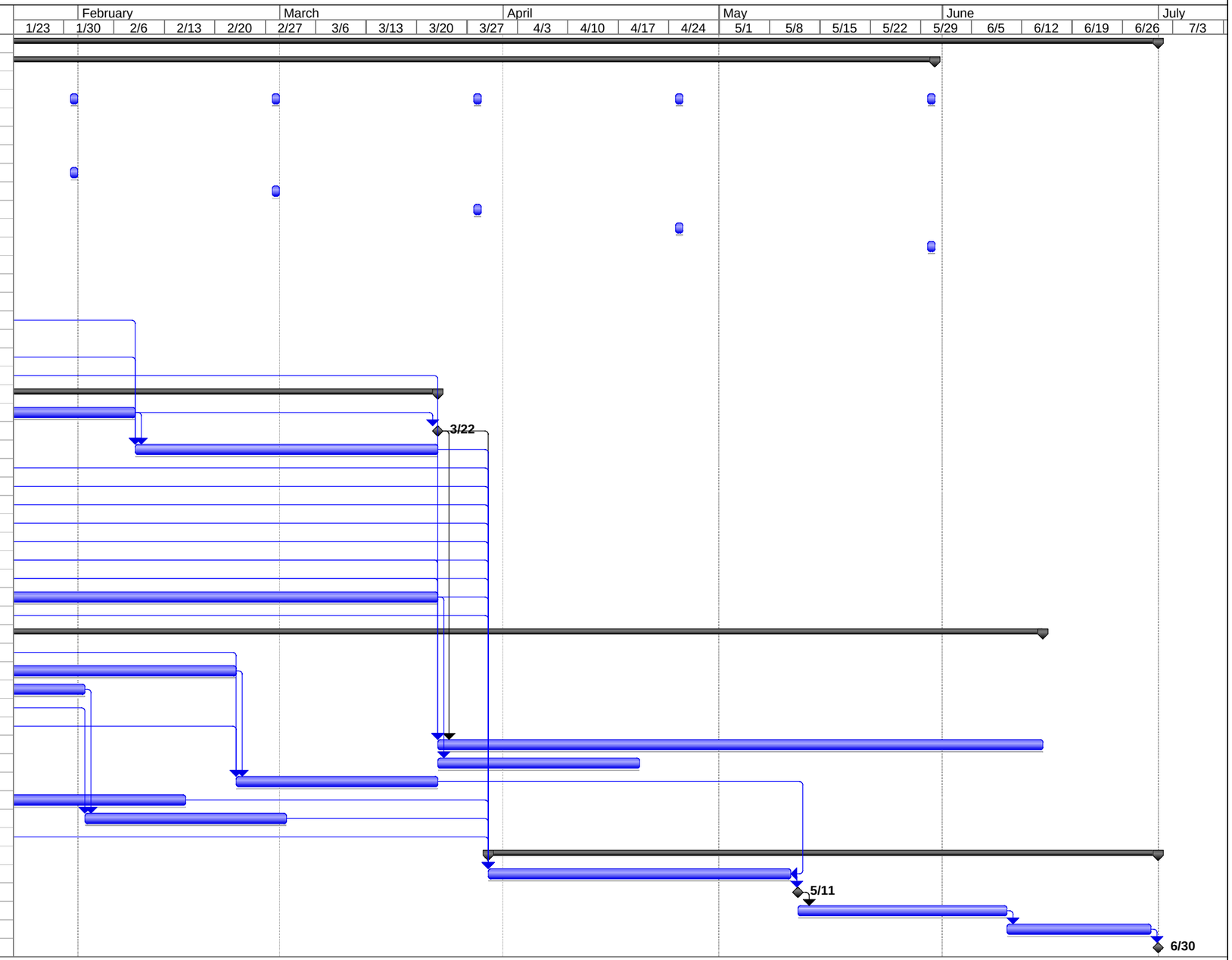
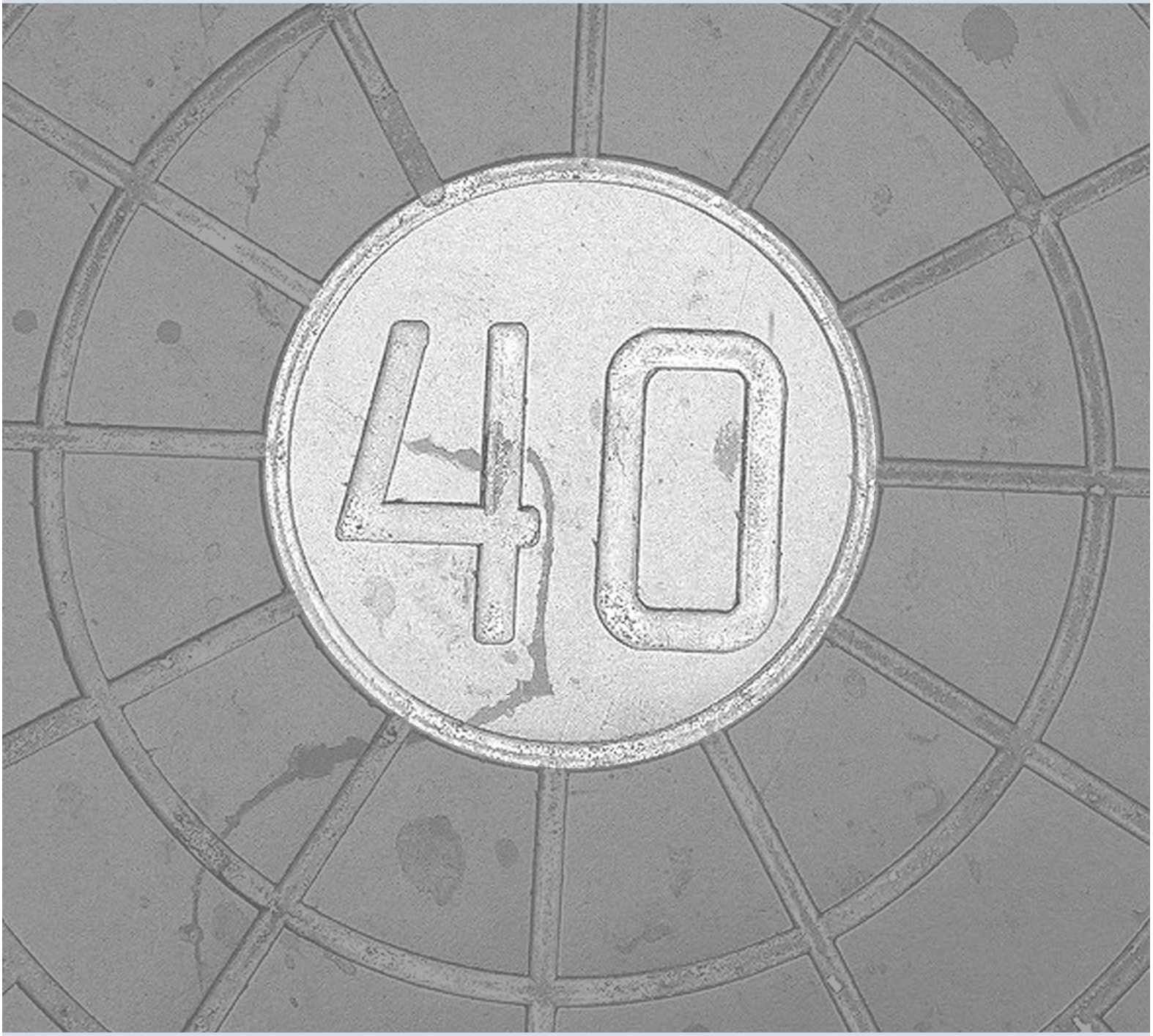
38	1.4.5	Develop Plan for Non-Revenue Water & Leak Detection
39	1.4.6	Recommend Solutions to Sewer System
40	1.4.7	Recommend and estimate Cost of Green Technologies
41	1.4.8	Develop Eight Five Year Capital Plans for Water Distribution
42	1.4.9	Develop Eight Five Year Capital Plans for Pumping and Storage
43	1.4.10	Develop Eight Five Year Capital Plans for WTP
44	1.4.11	Develop Eight Five Year Capital Plans for Sewers
45	**1.5**	**Prepare a Summary Report**
46	1.5.1	Prepare Draft Report
47	1.5.2	Submit Draft Report
48	1.5.3	PWSA Review and Comment
49	1.5.4	Prepare Final Report
50	1.5.5	Submit 25 Copies of Summary report



Project: PWSA 40-YEAR Capital Plan

Task | Progress | Summary | External Tasks | Deadline
Split | Milestone | Project Summary | External Milestone

APPENDIX 1-2



CHESTER ENGINEERS, INC.

APPENDIX 1-2
PROGRESS MEETING AGENDAS

THE PITTSBURGH WATER AND SEWER AUTHORITY
40-YEAR CAPITAL PLAN
PWSA PROJECT NO. R-D1.10015
PROGRESS MEETING NO. 1
FRIDAY OCTOBER 29, 2010 @ 10:00 AM

AGENDA

1. Progress Report

   a. Work has been initiated on all tasks having a 10/6/10 start date per the project schedule. Analysis of sewer surcharging areas has begun (Task 3.5) but work related to specific CSO recommendations is being held off until PWSA review of the Draft CSO Feasibility Study is complete.

   b. Scheduled deliverables before the November 2010 progress meeting include a discussion paper on system regionalization in other areas and interim reports on potential water and sewer system expansion, additional areas of concern, and the GIS system.

2. Action Items

   a. Meeting on internal PWSA questionnaire is scheduled for 11:00 AM today.

   b. Schedule meeting to discuss additional areas of concern (Task 3.3) if not adequately addressed at the internal questionnaire meeting.

   c. Schedule site visits to PWSA water and sewer facilities to complete system inventory (Task 3.1) and inventory of all major pumping and treatment equipment items (Task 3.7).

   d. Schedule meeting to discuss how GIS system can be enhanced to improve O&M activities (Task 3.8).

THE PITTSBURGH WATER AND SEWER AUTHORITY
40-YEAR CAPITAL PLAN
PWSA PROJECT NO. R-D1.10015
PROGRESS MEETING NO. 2
TUESDAY NOVEMBER 30, 2010 @ 9:30 AM

AGENDA

1. Progress Report

    a. Arranging meetings with local planning agencies (Task 2.1).

    b. Information regarding Allegheny County water and sewer service providers has been compiled (Tasks 2.3 and 2.4) for screening and further discussion about potential system expansion / acquisitions / water sales.

    c. System Inventory (Task 3.1) and Pumping and Treatment Inventory (Task 3.7) spreadsheets have been compiled based on available information. Mark Mellott has been updating the information prior to the site visits, which will be carried out in December.

    d. The water distribution system model (Task 4.2) has been converted to the InfoWater platform format to facilitate the analysis of distribution system improvements in conjunction with the application of the CapPlan risk based model.

    e. The license for the CapPlan risk based model (Task 4.6) has been obtained. Twenty years of water main break data has been obtained from the PWSA MIS and the cal books. This data has been geolocated in preparation for assignment to specific main segments and the generation of likelihood of failure statistics. Working with the PWSA GIS group to estimate pipe segment ages.

    f. Sewer surcharging (Task 4.9) complaint data has been obtained from the PWSA MIS and has been tabulated and geolocated. This information will be reviewed with PWSA staff to identify chronic – capacity related surcharging problem areas for investigation and development of solutions.

2. Action Items

    a. Need internal questionnaires that have not yet been returned.

    b. Need a copy of the “Water Audit Study” as a starting point for development of a comprehensive leak detection and repair program.

THE PITTSBURGH WATER AND SEWER AUTHORITY
40-YEAR CAPITAL PLAN
PWSA PROJECT NO. R-D1.10015
PROGRESS MEETING NO. 3
TUESDAY JANUARY 4, 2011 @ 9:00 AM

AGENDA

1. Progress Report

   a. Meetings with local agencies (City and County Planning Departments, Allegheny County Health Department, PA Department of Environmental Protection) are scheduled to be held in January 2011 (Task 2.1).

   b. System Inventory (Task 3.1) and Pumping and Treatment Inventory (Task 3.7) spreadsheets are being finalized this week based on site visits in December 2010 to the treatment plant, water pumping stations, water storage facilities, and sewage pumping stations. Draft spreadsheets are attached for review.

   c. Methods to reduce total trihalomethanes (TTHMs) in the PWSA system (Task 3.3) have been investigated. Stripping TTHMs from water in storage facilities appears to be the most promising alternative for reducing TTHMs produced as disinfection by-products. The literature review indicates that aeration can remove 70 to 90 percent of TTHMs while having little to no effect on chlorine residuals. Several articles on this subject are attached.

   d. Work continued on the analysis of water main break data (Task 4.2). Individual water main breaks data points are being assigned to the associated water main segment for the purpose of generating main break frequency statistics to be used to generate the water main replacement program.

   e. Population projections from the Southwestern Pennsylvania Commission have been obtained and processed to determine the population change that is projected to occur within each of the service districts. Draft figures illustrating projected population changes are attached. This information is being used to increase water demands in the water model to reflect future demand conditions (Task 3.4).

2. Action Items

   a. Need PWSA internal questionnaires that have not yet been returned.

THE PITTSBURGH WATER AND SEWER AUTHORITY
40-YEAR CAPITAL PLAN
PWSA PROJECT NO. R-D1.10015
PROGRESS MEETING NO. 4
TUESDAY JANUARY 25, 2011 @ 9:30 AM

AGENDA

1. Progress Report

   a. A list of local agencies and contacts for meetings regarding potential expansion of the PWSA service area (Task 2.1) is attached.

   b. A draft discussion paper on water and sewer system regionalization (Task 2.2) is attached. The paper discusses primary drivers for regionalization, Pennsylvania statutes on utility consolidation, benefits, and potential problems with regionalization. It also presents barriers to regionalization, discusses the use of eminent domain to purchase water utilities, and discusses methods to advance regionalization efforts.

   c. System Inventory (Task 3.1) and Pumping and Treatment Inventory (Task 3.7) spreadsheets were finalized based on site visits in December 2010 to the treatment plant, water pumping stations, water storage facilities, and sewage pumping stations. Final spreadsheets are attached.

   d. The draft water audit study was reviewed as the first step in developing a leak detection and repair program (Task 4.7). Results of the draft water audit are summarized in the attached file. A graph that compares service population to the amount of water delivered to the system between 1950 and 2010 is also attached. Reduced water use generally paralleled the population decrease through the 1980's, when unaccounted for water was reportedly in the 30% range. Since the 1980's, service population continued to decline but the amount of water delivered to the system appears to have increased.

      A summary of annual water supply report data for 2005 to 2009 is attached. Average daily water use includes domestic, commercial, industrial, institutional, and bulk sales to other public water suppliers. It also includes unaccounted for water and other connections. Other is defined as water for public and municipal uses, hydrant inspections, hydrant flushing, street flushing, government usage, plant processing, etc.

THE PITTSBURGH WATER AND SEWER AUTHORITY
40-YEAR CAPITAL PLAN
PWSA PROJECT NO. R-D1.10015
PROGRESS MEETING NO. 5
TUESDAY FEBRUARY 22, 2011 @ 9:00 AM

AGENDA

1. Progress Report

   a. Development of valuations for the PWSA water and sewer systems (Task 3.1) has been initiated. System inventory information from facility site visits plus water and sewer line data extracted from the PWSA GIS system will be used to complete this task. A Replacement Cost New Less Depreciation analysis will be developed to determine system valuations. This type of analysis estimates how much it would cost to construct new facilities, and then adjusts replacement costs for individual facilities to account for their age via straight line depreciation.

   b. Additional areas of concern relative to the water system (Task 3.3) to be addressed in the 40-Year Plan will include the following:

      - WTP clearwell rehabilitation / replacement
      - Transfer pump station - Highland 2 reservoir to Highland 1 district
      - Second storage tank for Squirrel Hill pressure district
      - Low water pressure in the Penn Avenue area of Bloomfield/Garfield
      - Increasing water demands in Herron Hill pressure district
      - Safe Drinking Water Act Compliance and TTHM reduction
      - Reducing non-revenue water through leak detection and repair
      - Prioritized water main replacement program

      The need for a second water storage tank in the other pressure districts that have a single tank (Lincoln, Garfield, Herron Hill) is an item for discussion.

   c. A meeting is scheduled for Friday February 25th to discuss the existing PWSA GIS system and determine how it can be enhanced to improve system O&M activities (Task 3.8).

   d. Development of concept level cost estimates for future capital improvements in the distribution, pumping and storage, and treatment categories (Task 4.11) is also getting underway. Cost estimates will be broken down into eight five-year capital plans for use by PWSA for planning and budgeting purposes.

e. Capital improvements for the sewer category will be based on information contained in the draft CSO Feasibility Study. Activity on this item has been delayed pending PWSA approval of the draft study.

f. Review of the development of the risk-based water main replacement capital program (Task 4.2).

THE PITTSBURGH WATER AND SEWER AUTHORITY
40-YEAR CAPITAL PLAN
PWSA PROJECT NO. R-D1.10015
PROGRESS MEETING NO. 6
TUESDAY MARCH 29, 2011 @ 9:00 AM

AGENDA

1. Progress Report

   a. The Pittsburgh office of the US Army Corps of Engineers was contacted to determine if any entity holds a license to pursue hydropower at the Highland Park Lock and Dam or the Emsworth Lock and Dam (Task 3.3). Neither is currently permitted or licensed for hydropower but four firms have submitted applications at each location. A summary of the discussions, general information on the permitting process, and a table that identifies the hydropower applicants is included in Attachment A. Applicants must follow Federal Energy Regulatory Commission procedures. Available information suggests that permitting and licensing of a hydropower facility is an involved and lengthy process.

   b. During a discussion about historic water use and unaccounted for water at the January 25th Progress Meeting, it was noted that PWSA bills City of Pittsburgh customers that are served by Pennsylvania American Water Company. Monthly water billing records for the 2005 to 2010 time period were analyzed to determine water demands in this potential service expansion area. Results for the analysis are contained in Attachment B. Metered usage from 2005 to 2010 averaged 3.94 mgd. Adjusting for "unaccounted for" and "other" water uses (40 percent) results in an average water demand of 6.57 mgd for this service area. Based on measured maximum day to average day pumping rates of 1.6 for the Allentown service district, maximum day demands in the PA American service area of the City would be about 10.60 mgd.

   c. Alternative methods to reduce total trihalomethanes (TTMHs) in the PWSA system were discussed briefly at the January 4th Progress Meeting. Disinfection byproduct (DBP) control strategies include the three general approaches shown below. Alternative methods of control are listed beneath each general approach:

      1. Removal of Organic DBP Precursors
         - Enhanced coagulation
         - Peroxide / Biological Activated Carbon
         - Granular Activated Carbon in Existing Filters
         - Granular Activated Carbon in New Filters

- Granular Activated Carbon Adsorbers
- Nanofiltration
- Ozone / Biological Active Filtration
- Ozone / Biological Activated Carbon
- MIEX Ion Exchange

2. Alternative disinfectants and / or conditions
    - Chlorine dioxide
    - Ozone
    - Chloramines

3. Remove after Formation

    - Granular Activated Carbon
    - Reverse Osmosis
    - Biologically Active Carbon
    - Air Stripping

Air stripping appears to be a low cost method of reducing TTHM concentrations from water in storage facilities. A literature review indicates that aeration can remove 70 to 90 percent of TTHMs.

An Ohio water provider installed a 50 gpm recirculation pump in an elevated tank at a remote location. The pump draws water from the tank inlet/outlet and discharges it above the water surface through a spray nozzle. Operating results since the system was installed show a 70 to 80 percent TTHM reduction. Aeration also appears to have little to no effect on chlorine residuals. The cost for the pump, piping, and accessories was reported to be $2,500 and it costs about $800 per year to run the 2 HP pump continuously from April to November. Equipment installation was done by water department staff.

Attachment C contains information about the Air-Max Oxygen Injector System. This system is specifically designed to be placed into potable water tanks for the purpose of mixing, circulating, and injecting oxygen into the drinking water to reduce DBPs. The self contained unit consists of a stainless steel pump motor and intake screen, flexible PVC tubing, underwater power cord, and a fiberglass float / air intake that supports the motor and suspends the discharge nozzles just below the water surface. The oxygenated plumes of water exiting the discharge nozzles remove DBPs from the water through volatilization. The system can be installed in water tank through a 30-inch opening and costs about $3,000. Information on the system is available at the following web site:

http://drinkingwateraerator.com/

d. Work on system valuations (Task 3.1) began this month. Information about PWSA treatment, pumping, and storage facilities was collected as part of the system inventory / pumping and treatment inventory tasks. Water distribution system and sewer system data was taken from the PWSA GIS. The GIS contained information on installation dates for some water and sewer system components. Estimated ages for waterlines and valves were determined by cross referencing GIS data with information from record books and calc books. Summary water and sewer system information from this analysis is included in Attachment D. Water and sewer summary statistics are listed below:

- 1,012 miles of 1 to 120-inch waterlines
- 25,375 valves
- 7,558 hydrants
- Oldest pipes and valves date back to 1887
- 1,211 miles of 3 to 168-inch sewers
- 29,084 manholes
- 24,143 inlets / catch basins
- 99 diversion structures

PWSA uses the following for the useful lives of facilities:

- 70 years for water and sewer lines
- 40 years for plant facilities
- 25 years for boilers, floating reservoir covers, tank painting

Useful live figures will be used to depreciate assets during preparation of the system valuations. A 70-year useful life for pipelines means that waterlines installed before 1941 will have zero value. Based on the actual and estimated ages for water system components, more than 50 percent of the waterlines and valves fall into this category.

e. Development of concept level cost estimates for recommended capital improvements (Task 4.11) continued this month. Historic records are being reviewed to determine typical time intervals between facility upgrades for use in projecting dates for future projects. The table in Attachment E lists ages for PWSA treatment, pumping, and storage facilities. Although the facilities have been rehabilitated and upgraded over time, a quarter of the items on the list are more than 100 years old and ages for 80 percent of the items exceed the 40 year useful life for plant facilities. DeLaval and Allis Chalmers pumps at the Ross, Bruecken, Mission, and Lincoln pump stations are original units that have been rebuilt numerous times.

THE PITTSBURGH WATER AND SEWER AUTHORITY
40-YEAR CAPITAL PLAN
PWSA PROJECT NO. R-D1.10015
PROGRESS MEETING NO. 7
TUESDAY APRIL 26, 2011 @ 9:00 AM

AGENDA

1. Progress Report

   a. Work on system valuations (Task 3.1) continued in April. Water distribution system and sewer system information was taken from the PWSA GIS. Costs for these components will be estimated using information from the 2011 edition of R.S. Means Heavy Construction Cost Data.

      Costs for new water storage tanks were estimated using information from the 2011 edition of R.S. Means Heavy Construction Cost Data. Estimated foundation costs were added to the tank costs and the total estimated project cost for each storage facility included a construction contingency and an allowance for engineering and other project costs. New tank cost estimates are included as Attachment A.

      Costs for in-ground reservoirs are being estimated based on the original cost for the Lanpher reservoir. The article in Attachment B describes design and construction of the Lanpher Reservoir. The project was awarded in July 1912 at a cost of $681,976. The original construction cost was trended to April 2011 price levels using the Engineering New-Record Construction Cost Index (ENRCCI). The cost for a floating cover is being estimated based on bid prices for the Highland No. 2 Floating Cover Replacement Project.

      Development of system valuations for pumping and treatment facilities is underway. Costs for new booster pump stations are being estimated using information from the March 2011 low bid price received for a booster pump station that Chester Engineers designed for a western Pennsylvania client. A unit cost per square foot has been developed to cover building costs. The cost for new pumps will be added to the building cost along with an allowance for piping, valves, and accessories. These components typically account for about 80 percent of the cost for pumping facilities. Electrical work makes up another 12 percent of the total, while general requirements and site work round out the total. Total estimated costs for new pump stations will also include a construction contingency and a project cost allowance.

   b. Development of concept level cost estimates for recommended capital improvements (Task 4.11) continued this month. Historic records were reviewed to determine typical time intervals between facility upgrades for use

in projecting dates for future projects. Attachment C contains a schedule for recommended capital improvements to storage facilities, as well as concept level cost estimates for recommended capital improvements.

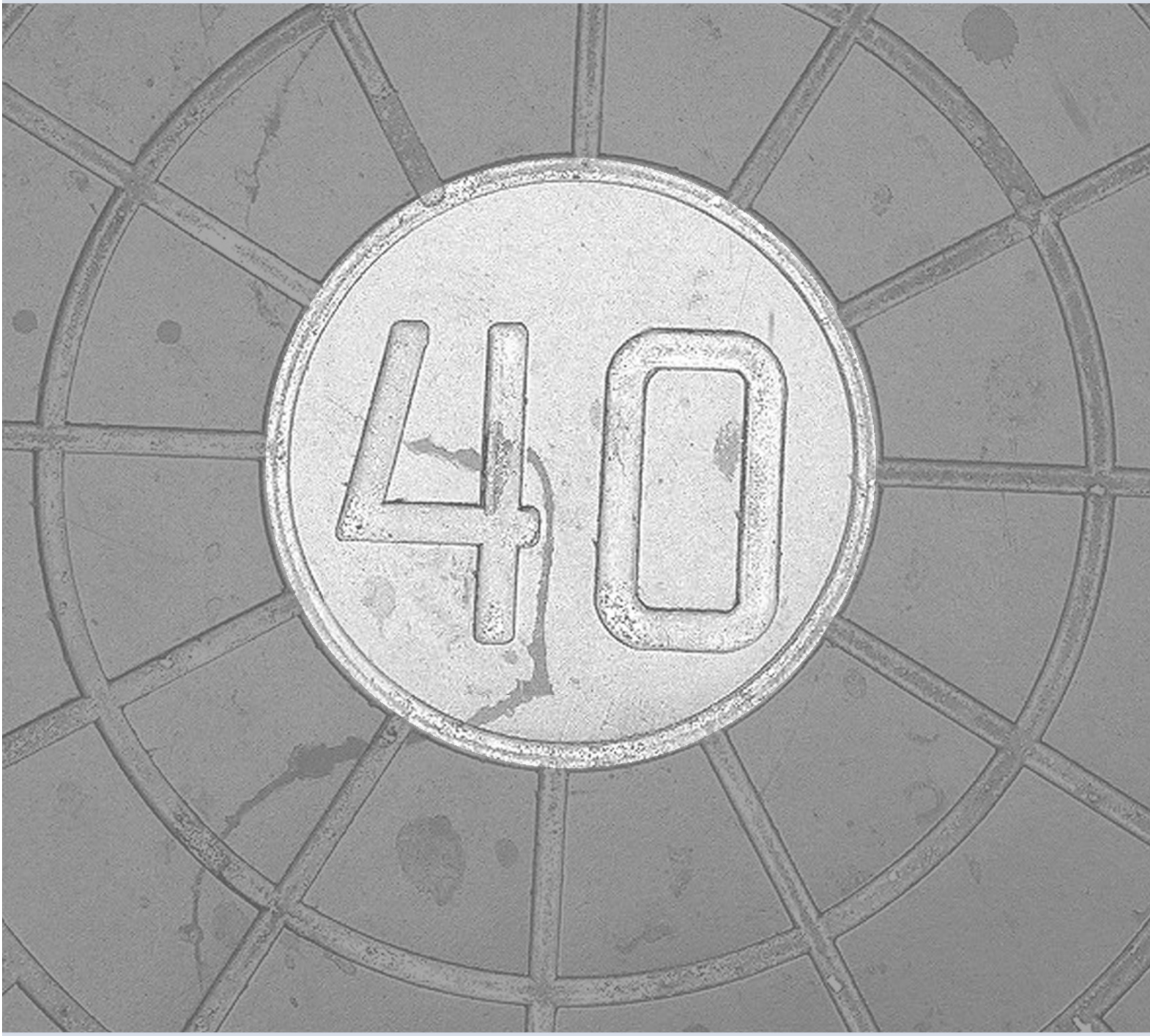
Similar schedules and cost estimates are being developed for distribution, pumping and treatment improvements.

On the sewer side, Chester has been working with PWSA staff to go through the Draft Feasibility Study and identify recommended improvements needed for PWSA to control overflows from the CSO outfalls that are permitted to PWSA only. Improvements are sized so that CSOs discharge 4 times or fewer during a typical year and so that conveyance facilities have capacity to carry peak flows from a 2-year design storm. Construction cost estimates are being developed using the ALCOSAN ACT cost estimating tool.

A much larger set of CSOs are jointly permitted to both ALCOSAN and PWSA. ALCOSAN will be responsible for controlling flows from the jointly permitted outfalls. PWSA will not absorb any direct capital costs for these improvements but will share in these costs with other ALCOSAN customers.

Improvements to PWSA sewage pump stations will be based on upgrades being made to all four pump stations. The Mifflin Road and Rodgers Street pump stations in Lincoln Place could be eliminated by constructing short gravity sewer extensions and allowing the wastewater to be treated by the West Mifflin Sanitary Sewer Municipal Authority. Discussions have been held between PWSA and West Mifflin to work out the details but this change cannot happen without ALCOSAN approval.

APPENDIX 1-3



CHESTER ENGINEERS, INC.

APPENDIX 1-3
PROGRESS MEETING MINUTES

The Pittsburgh Water and Sewer Authority
40 – Year Capital Plan, PWSA Project R-D1.10015-11
Progress Meeting No. 3
Tuesday, January 4, 2011, PWSA Training Room
Meeting Minutes

Attendees: PWSA – Bob Hutton, Jeff Lenner, Tom Palmosina, Steve Simcic, Stanley States, Thomas Gigliotti
Chester Engineers – Charlie Jordan, John Maslanik, Michael McKee

Meeting Handouts and Attachments

1. Agenda
2. Draft System Inventory Spreadsheet
3. Draft Pumping and Treatment Inventory Spreadsheet
4. Examples of TTHM Removal via Air Stripping – City of Surprise, Arizona; Las Vegas, Nevada; and Sandusky, Ohio
5. Figure Showing Total Projected Population Change Through 2046
6. Figure Showing Projected Population Change by Acre Through 2046

Items Discussed

1. Progress Report
   a) Meetings with City and County Planning Department, Allegheny County Health Department, and Pennsylvania Department of Environmental Protection to be held in January 2011. Charlie Jordan will forward the schedule so that interested PWSA staff can attend meetings. Stanley States indicated that he would like to attend the meetings with ACHD and DEP.

   b) System Inventory and Pumping and Treatment Inventory spreadsheets are being finalized during the week of January 3rd based on information collected during site visits in December 2010 to the treatment plant, water pump stations, water storage facilities, and sewage pump stations. The draft spreadsheets that were attached to the agenda will be updated with information from the site visits.

   c) Removal of total trihalomethanes (TTHMs) from water storage facilities via air stripping appears to be a promising alternative to reduce TTHMs produced as disinfection by-products. Stanley States indicated that PWSA has taken steps through the years to minimize TTHM formation by trying alternative disinfectants (chlorine dioxide), optimizing the treatment process, and changing chlorine application points. He also mentioned problems that other water systems (West View Water, Washington D.C.) have had with lead violations after changing disinfectants. PWSA is currently working with a vendor to get bubbler systems installed in a few water storage tanks to

evaluate the effectiveness of air stripping in TTHM removal. This program is being undertaken with Dr. Casson at the University of Pittsburgh.

d) Work continued on the analysis of water main break data for the purpose of generating main break frequency statistics for the water main replacement program. John Maslanik stated that main break data from 1990 has been assembled from SAP and calc books, so 20 years of break information will be available for the analysis. Bob Hutton stated that PWSA has developed a rating or scoring system used to determine which pipes to replace. Chester will assess the feasibility of incorporating the rating system into the main replacement program if PWSA provides information on this subject. Bob Hutton also mentioned that leadite was used in the PWSA system for about 15 years – from the mid-1940's to the 1960's. Known problem areas that correspond to the leadite years are good candidates for pipe replacement. There is limited information available regarding the Millvale system but any main break data for Millvale can be included in the model.

e) Population changes in the PWSA system have been developed using population projections from the Southwest Pennsylvania Commission. This information will be used in the water model to reflect future water demand conditions.

f) There are two action items. Chester Engineers needs any PWSA internal questionnaires that have not yet been returned. Chester also has to complete a discussion paper regarding how water and sewer system regionalization has been accomplished in other parts of the United States.

2. <u>Reserve Township and Millvale Systems</u>

a) A waterline agreement is currently being negotiated with Reserve Township to construct a link to the Millvale system. Most of the pipelines in the Reserve Township water system are dead ends and the connection with Millvale will improve flow characteristics in the Township.

b) A sewer agreement is also being discussed with Reserve Township.

c) PWSA needs to inspect the Millvale tank. This elevated tank was built by Millvale but was never placed into service. The tank couldn't be filled because the pipelines in the system couldn't handle the pressure.

3. <u>2010 PWSA Inspection Reports</u>

a) Mark Mellott has completed his annual inspection reports for PWSA facilities. Charlie Jordan will forward this information to PWSA.

4. Next Meeting
   a) Tuesday, January 25, 2011 at 9:00 AM.

Please submit any corrections or additional comments to these meeting minutes to me at cjordan@chesterengineers.com. Comments must be submitted by January 22, 2011.

Respectfully submitted,

Charles J. Jordan, P.E.
Project Manager

The Pittsburgh Water and Sewer Authority
40 – Year Capital Plan, PWSA Project R-D1.10015-11
Progress Meeting No. 4
Tuesday, January 25, 2011, PWSA Training Room
Meeting Minutes

Attendees: PWSA – Tom Gigliotti, Bob Hutton, Jeff Lenner, Rick Obermeier, Stanley States, Don Waldorf
Chester Engineers – Charlie Jordan, John Maslanik, Michael McKee

Meeting Handouts and Attachments

1. Agenda
2. List of Local Agencies and Contacts for Meetings Regarding Potential Expansion of the PWSA Service Area
3. Draft Discussion Paper on Water and Sewer System Regionalization
4. System Inventory Final Spreadsheet
5. Pumping and Treatment Inventory Final Spreadsheet
6. Summary of Water Audit Results
7. Analysis of Water Use and Service Population Trends From 1950 to 2010
8. Summary of Annual Water Supply Report Data From 2005 to 2009
9. Chart Showing Main Break Frequency (1989 to 2010) Versus Age of Pipe

Items Discussed

1. Progress Report
   a) The list of local agencies and contacts for meetings about potential expansion of the PWSA service area was presented. Don Waldorf commented that other private developers, such as Walnut Capital, could be included on the contact list in addition to The Buncher Group.

   b) The draft discussion paper on water and sewer system regionalization was summarized, including two cases where cities in Illinois attempted to use eminent domain to purchase the assets of an adjacent investor-owned utility.

   c) Final System Inventory and Pumping/Treatment Inventory spreadsheets were presented. Tom Gigliotti suggested that the information in the Pumping and Treatment Inventory should be broken down into major equipment categories rather than being ordered by facility. It was also suggested that the sewage pumping stations be separated from the water facilities.

   d) The results of the draft water audit study by HDR Engineering were summarized. The main finding of the study is that the majority of the venturi meters in the PWSA system do not meet AWWA accuracy standards. Tom Gigliotti discussed some of the meter problems. Venturi meters need to be installed properly and then calibrated and maintained to provide accurate readings. The flow signal for a venturi meter is based on a differential

pressure reading. Tom Gigliotti is trying to get HDR to finish up the water audit, which was started in 2005/2006.

e) An analysis of water usage and service population trends from 1950 to 2010 was presented. Reduced water use generally paralleled population decreases through the 1980's, when unaccounted for water was reportedly in the 30% range. Since the 1980's, service population continued to decline but the amount of water delivered to the system appears to have increased. Unaccounted for water and "other" uses are the two largest components of PWSA water use. Based on the apparent historic relationship between water use and service population, it is not clear how much water is available for future expansion of the service area. PWSA staff feels that the system has plenty of treatment and storage capacity but that additional pipelines and some additional pumping capacity would be needed to serve the South Hills. PWSA bills the customers in portions of the City that are currently served by Pennsylvania American Water Company.

f) A chart showing main break frequency versus age of pipe was presented and discussed. The chart was based on main break data from 1989 to 2010. This analysis shows that pipelines with the highest incidence of breaks were installed in the 1940's and 1950's when leadite was used as a construction material. Leadite was used during World War II due to a shortage of lead and was phased out in the mid 1950's. Other factors that impact main breaks are the pipe size, material of construction, and soil corrosivity.

2. Action Items

a) Chester Engineers requests billing data for City water customers that are served by PA American to assist in determining water demands for this potential expansion area.

b) Chester Engineers requests copies of annual water supply reports for 2010 and for the period from 1991 to 2004 for use in analyzing historic water usage and unaccounted for water.

3. Next Meeting
   a) Tuesday, February 22, 2011 at 9:00 AM.

Please submit any corrections or additional comments to these meeting minutes to me at cjordan@chesterengineers.com. Comments must be submitted by February 12, 2011.

Respectfully submitted,

Charles J. Jordan, P.E.
Project Manager

The Pittsburgh Water and Sewer Authority
40 – Year Capital Plan, PWSA Project R-D1.10015-11
Progress Meeting No. 5
Tuesday, February 22, 2011, PWSA Training Room
Meeting Minutes

Attendees: PWSA – Tom Gigliotti, Bob Hutton, Jeff Lenner, Rick Obermeier, Tom Palmosina, Stanley States, Don Waldorf
Chester Engineers – Charlie Jordan, John Maslanik, Michael McKee

Meeting Handouts and Information

1. Agenda
2. Powerpoint Presentation on the Risk-Based Water Main Replacement Capital Program

Items Discussed

1. Progress Report

   a) Valuations for the PWSA water and sewer systems (Task 3.1) have been initiated and will be developed using a Replacement Cost New Less Depreciation analysis. System inventory information from the facility site visits plus water and sewer line data extracted from the PWSA GIS system will be used to complete this task.

   b) Additional areas of water system concerns (Task 3.3) to be addressed in the 40-Year Plan will include the following:

      - WTP clearwell rehabilitation / replacement
      - Transfer pump station - Highland 2 reservoir to Highland 1 district
      - Second storage tank for Squirrel Hill pressure district
      - Low water pressure in the Penn Avenue area of Bloomfield/Garfield
      - Increasing water demands in Herron Hill pressure district
      - Safe Drinking Water Act Compliance and TTHM reduction
      - Reducing non-revenue water through leak detection and repair
      - Prioritized water main replacement program

      Two parallel studies were prepared for the WTP clearwell and Dennis Graham was involved with both studies. The 40-Year Plan should include costs for the most reasonable option. The estimated cost for clearwell rehabilitation is $100 million.

      The clearwell is over 100 years old. PWSA is working with Dennis Graham on an emergency operation plan to address potential problems with the

clearwell. The purpose of the operation plan is to identify how water would get from the treatment plant to the system if the clearwell collapsed.

PWSA is investigating a transfer pump station to send water from Highland 2 reservoir to the Highland 1 district. A potential location for the pump station is at the toe of the slope of Highland 2 reservoir, near the 50-inch main.

The Squirrel Hill tank is scheduled to be painted this year but will be difficult to take out of service. Stanley States suggested that the tank should be isolated so that KTA can assess the tank condition prior to painting. If the inspection reveals that the tank is nearing the end of its useful life, the tank should be replaced. The Squirrel Hill tank is a standpipe but should really be an elevated tank because the water in the bottom of the tank is of no use. If the water level drops below a certain level, part of the service area loses pressure. A second Squirrel Hill tank would take a load off the Herron Hill reservoir. Options for Squirrel Hill would be to add a second tank or replace the existing standpipe with an elevated tank. The 40-Year Plan should recommend the best alternative.

Low water pressure in the Bloomfield/Garfield area could be addressed by changing the boundary of the Bloomfield regulator. However, this action would increase demand in the Herron Hill pressure district. The Garfield Tank already experiences a lot of use and turns over two times a day.

Increasing water demands in the Herron Hill district could be eased by construction of a second Herron Hill pump station near Boundary Street. The station could take water from a 50-inch transmission main and the pump discharge could tie into distribution mains nearby. This station would add flexibility and capacity to the system, would serve as a backup for the existing Herron Hill pump station, and could provide service from Highland 1 or Highland 2.

An experimental aeration system is being installed in the Brashear Tank to address TTHM issues. The Squirrel Hill tank also has problems with TTHMs and will need a similar system.

The 40-Year Plan needs to address the potential for serving the portion of the City currently serviced by PA American. The facilities needed to provide service will have to be in place if PWSA takes over service to the South Hills. PWSA currently has the 40 Acres area in the South Hills but the area is more like 100 acres in size. There will need to be a lot of re-adjustment if PWSA takes over service to the South Hills. The major problem in evaluating service to this area is that we don't know anything about the PA American distribution system in the South Hills except that PA American has storage tanks in Greenfield and Lincoln Place. Chester Engineers previously estimated the amount of water that would be needed to serve the South Hills

area. Upon further review, this analysis overestimated the demand. Lower demand will have less impact on the PWSA system than the original analysis.

Another item to be added to the 40-Year Plan is rehabilitation of the access tunnel at the water treatment plant. This tunnel passes under old Route 28 and the railroad tracks and provides emergency access to the plant site. The tunnel is over 100 years old and will need to be rehabilitated in the next 40 years.

c) A meeting is scheduled for Friday February 25 to discuss the existing PWSA GIS system and determine how it can be enhanced to improve system O&M activities. Chester GIS personnel will confirm the meeting date and time with Bob Hutton.

d) Development of concept level cost estimates for future capital improvements in the distribution, pumping and storage, and treatment categories (Task 4.11) is also getting underway. Dennis Graham and Mark Mellott will be involved with this activity since they are the Chester employees who are most knowledgeable about past and planned future capital improvements.

e) Capital improvements for the sewer category will be based on information contained in the draft CSO Feasibility Study.

The draft Feasibility Study recommends taking more water to the ALCOSAN interceptors in order to limit discharges from the PWSA system to 4 overflows per year at each CSO. This approach will involve building larger pipes to transport the flows to ALCOSAN. There are 40 PWSA CSOs and 145 ALCOSAN diversion chambers.

Don Waldorf feels that separating sewers would be a lower cost alternative and recommended that costs for sewer separation should be developed and compared to the costs for installing larger pipes.

The 4 overflow per year criteria has been established for 25 years. If the system repairs needed to meet this standard are determined to be unaffordable, then the regulatory agencies can be lobbied to allow more overflows per year.

Chester has modeled the PWSA system to develop pipeline quantities needed to address the CSO issues. Costs for the feasibility study recommendations have been estimated using the ALCOSAN cost estimation tool. Chester is in the process of costing out sewer separation in 9 or 10 drainage areas where this is an issue. PWSA and Chester are working to get this situation resolved by April. The cost estimate information from this analysis will be used in the 40-Year Plan.

f) Powerpoint Presentation on Risk-Based Water Main Replacement Program

The water main replacement program uses the likelihood of failure and consequences of failure to calculate the risk of pipeline breaks. The likelihood of failure is based on historic water main break records, approximately 5,200 breaks since 1989. Street addresses for main breaks were available in SAP. GIS was used to geolocate and assign each break to a water main segment. Findings from the main break analysis include the following:

- Break frequency is highest for pipes installed between 1940 to 1950, when leadite was used as a construction material because of a lead shortage during World War II.

- 15-inch pipe has a high break frequency. This may be due to a combination of two factors, a small quantity of 15-inch lines in the system and very old pipe.

- Smaller pipes are more prone to breaks. Tom Gigliotti suggested that the higher incidence of breaks in small lines may be influenced by water hammer.

Don Waldorf asked why the incidence of main breaks was also elevated during the period from 1930 to 1940 since leadite was not used until some time in the 1940's. Chester will review the data and try to determine a reason for this finding.

Consequences of failure are evaluated by identifying factors such as critical mains and critical users. Critical mains are those in which a break would curtail service to large numbers of customers and/or would cause major traffic disruptions. The software program identifies valves that would need to be closed to isolate pipe segments in the event of a break. Critical users would include hospitals and other PWSA identified users.

PWSA staff suggested that critical facilities should include hospitals, the downtown central business district, schools/universities, the north shore area between the stadiums and the state prison (just south of the ALCOSAN treatment plant), and rising mains.

Potential fire flow improvements can be made in areas that exhibit poor hydrant flow results. In these areas, pressures and fire flows could be significantly improved by replacing existing 6-inch lines with 8-inch diameter pipes.

Don Waldorf suggested that the main break replacement program be expanded to include the Millvale water system since PWSA is now responsible for operation and maintenance of the system.

Chester Engineers will investigate how the rate of water main breaks has varied over time. Chester will also identify the total length of line by pipe diameter for the three identified categories with the highest incidence of breaks.

2. Action Items

   a) Chester Engineers has requested sewer system information from the PWSA GIS system for use in the system valuation analysis.

3. Next Meeting
   a) Tuesday, March 29, 2011 at 9:00 AM.

Please submit any corrections or additional comments to these meeting minutes to me at cjordan@chesterengineers.com. Comments must be submitted by March 11, 2011.

Respectfully submitted,

Charles J. Jordan, P.E.
Project Manager

The Pittsburgh Water and Sewer Authority
40 – Year Capital Plan, PWSA Project R-D1.10015-11
Progress Meeting No. 6
Tuesday, March 29, 2011, PWSA Training Room
Meeting Minutes –REVISION (4/25/11)

Attendees: PWSA – Tom Gigliotti, Bob Hutton, Jeff Lenner, Rick Obermeier, Stanley States, Don Waldorf
Chester Engineers – Chuck Brence, Charlie Jordan, John Maslanik, Michael McKee

Meeting Handouts and Information

1. Agenda
2. Attachment A – Hydropower Information
3. Attachment B – Metered Water Use for City Customers Served by PA American
4. Attachment C – Information on Air-Max Oxygen Injector System
5. Attachment D – Summary Water and Sewer System Information
6. Attachment E – Ages for PWSA Treatment, Pumping, and Storage Facilities

Items Discussed

1. Progress Report

   a) The Pittsburgh office of the US Army Corps of Engineers was contacted to determine if any entity holds a license to pursue hydropower at the Highland Park Lock and Dam or the Emsworth Lock and Dam. Neither dam is currently permitted or licensed for hydropower but four firms have submitted applications at each location. Applications for Highland Park range from 10 to 16 megawatt (MW) capacity while the Emsworth applications range from 31 to 36 MW.

   PWSA had a license for hydropower in the past but it expired. Reports on generating hydropower were prepared for PWSA in the early 1990s. The current annual electric bill for PWSA is approximately $5.5 million. PWSA staff feels that an application should be submitted to generate hydropower at the Highland Park dam. Wind power should also be investigated as a potential source of power for PWSA. There is a restaurant across the street that has a cylinder-type windmill to generate power. Cylinder-type units reportedly do not harm birds and bats. The area by the clearwell would be a good location for wind power.

   b) Water billing records for City customers served by PA American water were analyzed from 2005 through 2010 to determine water demands in this potential service expansion area. Metered usage during this period averaged about 4.00 mgd. There were approximately 24,600 customers in this service

area during 2010. Adjusting for "unaccounted for" and "other" water uses results in an average water demand of 6.60 mgd for this area. The maximum day demand for the PA American service area of the City would be about 10.60 mgd based on the 1.60 peaking factor that is experienced in the Allentown service district.

Several PWSA staff members felt that the number of customers and metered water demand seemed low in the portion of the City served by PA American. However, this information was determined from PWSA billing records. PWSA provides sewer service to all City residents and water service to approximately 75 percent of the residents. There are currently about 80,000 metered water connections in the PWSA service area. Adding the 24,600 customers served by PA American results in about 105,000 total metered connections in the City. The 80,000 water customers served by PWSA is consistent with the 75 percent estimate above, representing about 76 percent of total customers in the City.

c) Control strategies and alternative methods to reduce total trihalomethanes (TTHMs) in the PWSA system were discussed. Air stripping appears to be a low cost method of reducing TTHM concentrations from water in storage facilities. The maximum contaminant level (MCL) for TTHMs is 80 micrograms per liter (ug/L). TTHM concentrations in the PWSA system are generally in the high 60s but concentrations in Reserve Township are close to the 80 ug/L limit. PWSA is currently meeting Stage 1 requirements for TTHMs but Stage 2 will require sampling at 12 sites instead of 4 and a running average will no longer be used to determine the TTHMS. Each site must be below the MCL of 80 ppb. Mandatory testing will begin in April 2012. Stanley States feels that 20 percent TTHM removal would probably allow PWSA to meet the requirements for Stage 2 but there will be violations if TTHM levels can't be reduced at the storage tanks.

PWSA has undertaken numerous steps to reduce TTHM concentrations in finished water. These steps include eliminating pre-chlorination of the raw water entering the treatment plant, lowering turbidity to reduce total organic carbon (TOC), practicing enhanced coagulation, decreasing the amount of stored water to reduce water age, and optimizing the system. A small amount of chlorine is added just before the filters to remove manganese.

A flushing program is another method that can be used to reduce TTHMs. Automatic flushers can be installed on fire hydrants to bleed water from dead end lines. PWSA doesn't have a flushing program at the present time. Another way to reduce TTHMs would be to install a UV disinfection system at the treatment plant and use less chlorine. PWSA can't use an alternative disinfectant such as chloramines because a corrosion inhibitor can't be added to the water due to the open Highland Park No. 1 reservoir. Without a corrosion inhibitor, the use of chloramines would cause lead violations.

PWSA is working with PAX Technologies and Dr. Casson at the University of Pittsburgh to install a demonstration system at the Brashear tanks. The Brashear tanks are located near the sampling point that has the highest measured TTHMs. One of the two tanks was painted recently and is still off-line. The demonstration system will be installed in this tank. PWSA plans to sample the water entering and exiting the tank at two week intervals to determine what kind of TTHM reductions are possible with the PAX system. The collected data will be published in a paper at the end of the study. Stan States said that other than the PAX process, no other major changes will be made to the system and that PWSA must now optimize the system to reduce the growth the TTHMs.

The PAX demonstration systems need to be put into place ASAP. Additional vents may have to be added on the top of the tank to provide the required amount of air exchanges for the system. Both Brashear tanks are currently equipped with Red Valve systems to prevent stratification. The PAX system will add a mixer.

d) Work on system valuations began in March. Information from the GIS indicates that more than 50 percent of the water lines in the PWSA system are older than 70 years, which is the figure that PWSA uses for the useful life of a water or sewer line. Useful life figures will be used to depreciate assets during the preparation of the system valuations, which means that water lines older than 70 years will have zero value. From a system management standpoint, assets that have exceeded their useful lives need to be replaced.

PWSA staff noted that a very small percentage of PWSA water lines have been replaced in recent years. The URA installs a lot of new water lines as part of their projects. Stanley States noted that Cincinnati completed a program to reline or replace all of the water lines in their system over a 30-year period. Tom Gigliotti requested that Chester review data for other cities to see how many waterlines are being replaced in other areas of the country and to determine a typical replacement rate (percent per year).

PWSA staff recommended that a lead service line replacement program be included in the 40-year plan. There are no statistics on the number of lead service lines in the PWSA system. Any program needs to include replacement of the entire service line from the main to the house because replacing part of a lead line sometimes makes things worse (higher lead levels than if nothing is done). PWSA could replace the lead service line from the main to the property line if the property owner agrees to replace the service line from the property line to the house. There is also no point in replacing a lead service line if there is still lead pipe within a home.

e) Development of concept level cost estimates for future capital improvements continued in March. Although PWSA facilities have been rehabilitated and upgraded over time, ages for 80 percent of PWSA treatment, pumping, and storage items exceed the 40 year useful life for plant facilities. DeLaval and Allis Chalmers pumps at four of the pump stations are original units that have been rebuilt or rehabilitated numerous times. Tom Gigliotti commented that is difficult to find people to repair and rebuild these pumps. Bearings and spare parts are not readily available and there are few companies left that can fabricate parts. The 40-Year Plan should include replacement costs for the older pumps.

f) The 40-Year Plan will include a recommendation that a floating cover be installed on the Highland No. 1 reservoir. Although the reservoir has a capacity of 130 million gallons, the amount of useable water is limited to the capacity of the membrane filtration plant plus the water stored in tanks within the service district. As a result, the Highland No. 1 reservoir is a bottleneck in the PWSA system. It is also a potential target for a terrorist attack on the City's water supply. PWSA staff indicated that it was a political issue to leave the reservoir uncovered. This subject was discussed back in the 1990's and the decision was made to leave the reservoir uncovered. Local residents walk around the reservoir and like the appearance of the open water. The membrane treatment plant went into operation in 2002 and was rehabilitated in 2010. Tom Gigliotti indicated that it costs $40,000 per month to run the membrane plant.

g) Tom Gigliotti and Jeff Lenner indicated that they would be interested in attending the meeting with the local agencies (DEP, ACHD, City and County Planning departments).

2. <u>Next Meeting</u>

a) Tuesday, April 26, 2011 at 9:00 AM.

Respectfully submitted,

Charles J. Jordan, P.E.
Project Manager

The Pittsburgh Water and Sewer Authority
40 – Year Capital Plan, PWSA Project R-D1.10015-11
Progress Meeting No. 7
Tuesday, April 26, 2011, PWSA Training Room
Meeting Minutes

Attendees: PWSA – Tom Gigliotti, Bob Hutton, Jeff Lenner, Tom Palmosina, Stanley States, Don Waldorf
Chester Engineers – Charlie Jordan, John Maslanik, Michael McKee

Meeting Handouts and Information

1. Agenda
2. Attachment A – Cost Estimates for New Water Storage Tanks
3. Attachment B – Article on Lanpher Reservoir, Floating Cover Cost Estimates
4. Attachment C – Schedule and Cost Estimates for Storage Improvements

Items Discussed

1. Progress Report

   a. Work on system valuations (Task 3.1) continued in April. Water distribution system and sewer system information was taken from the PWSA GIS. Costs for these components will be estimated using unit cost data from the 2011 edition of R.S. Means Heavy Construction Cost Data.

   Costs for new water storage tanks were estimated using information from the 2011 edition of R.S. Means Heavy Construction Cost Data. The total estimated project cost for each storage facility includes a construction contingency and an allowance for engineering and other project costs. Tom Gigliotti said that PWSA (Anthony Teti) has recent budget quotes for the Herron Hill tank.

   Costs for in-ground reservoirs are being estimated based on the original cost for the Lanpher reservoir, trended to 2011 price levels. The cost for a floating cover is being estimated based on bid prices for the Highland No. 2 Floating Cover Replacement Project.

   Development of system valuations for pumping and treatment facilities is underway. Costs for new booster pump stations are being estimated using information from the March 2011 bid price received for a booster pump station that Chester Engineers designed for a western Pennsylvania client. The estimated cost for each station will be adjusted based on the area of the building and the cost for new pumps and piping. Total costs for pump stations will include a construction contingency and a project cost allowance.

b. Development of concept level cost estimates for recommended capital improvements (Task 4.11) continued this month. Historic records were reviewed to determine typical time intervals between facility upgrades for use in projecting dates for future projects. Stanley States noted that the Highland No. 1 reservoir needs to be cleaned and a new liner should be installed. The reservoir was last cleaned in 1982 and the liner was installed at that time. A dividing wall is also needed to provide redundancy. Tom Gigliotti suggested that $4 to $5 million be allocated to fix the parapet wall, install a new liner, and re-install the railing around the reservoir.

Similar schedules and cost estimates are being developed for distribution, pumping and treatment improvements. Tom Gigliotti indicated that the Aspinwall treatment plant needs a polishing step to remove substances such as medical wastes and bromides. Costs for future treatment improvements should be included as a placeholder in the 40-Year Plan. Stanley States felt that future treatment plant improvements should include membrane filtration and UV disinfection, in addition to the required clearwell improvements. Don Waldorf pointed out that the access tunnel to the Aspinwall plant, which passes under old Route 28, needs to be rehabilitated.

John Maslanik stated that costs for a solution to low pressure in the Bloomfield area (changing the boundary of the Bloomfield regulator) will be included in the 40-Year Plan.

Chester has been working with PWSA staff to go through the Draft Feasibility Study and identify recommended improvements needed for PWSA to control overflows from the CSO outfalls that are permitted to PWSA only. Construction cost estimates are being developed using the ALCOSAN ACT cost estimating tool. A larger set of CSOs are jointly permitted to both ALCOSAN and PWSA. PWSA will not absorb any direct capital costs for these improvements but will share in these costs with other ALCOSAN customers.

Improvements to PWSA sewage pump stations will be based on upgrades being made to all four pump stations. The Mifflin Road and Rodgers Street pump stations in Lincoln Place could be eliminated by constructing short gravity sewer extensions and allowing the wastewater to be treated by the West Mifflin Sanitary Sewer Municipal Authority. However, ALCOSAN will not approve this change because it does not want to lose the sewer customers. Tom Gigliotti suggested that $3 million be allocated for station upgrades.

Dye testing identified 163 PWSA catch basins that are connected to sanitary sewers and need to be disconnected per COA requirements. Most of these catch basins were constructed to eliminate puddles in the street that people complained about. Some of the catch basins may be able to be daylighted but others will require storm sewer construction to handle the flows.

Don Waldorf said that PWSA should not build any storm sewers to disconnect catch basins unless Public Works is already re-paving the road. Tom Gigliotti will send a letter to Public Works to get the paving schedule for this year.

John Maslanik asked how much money should be allocated to disconnect catch basins since the cost to disconnect a storm inlet will be site specific. Don Waldorf stated that PWSA should not spend more than $5,000 to $10,000 to disconnect a catch basin from the sanitary sewer system. Bob Hutton said PWSA has a map of the 31st Ward that identifies catch basins that failed a dye test and are connected to sanitary sewers. The map will be analyzed to develop a unit cost for catch basin disconnections that can be used in the 40-Year Plan. Don Waldorf feels that a storm water authority is needed to fund these types of improvements.

The end date for CSO related work is 2026. The PWSA CSO plan must be finalized next year. The 40-Year Plan will assume sewer design and planning activities starting in 2013 and a 10-year construction period beginning in 2017.

Tom Gigliotti feels that PWSA needs to accelerate efforts to reduce water losses as part of the 40-Year Plan.

c. Chester Engineers requested an extension for completion of the draft report from May 11 to May 31.

2. Next Meeting

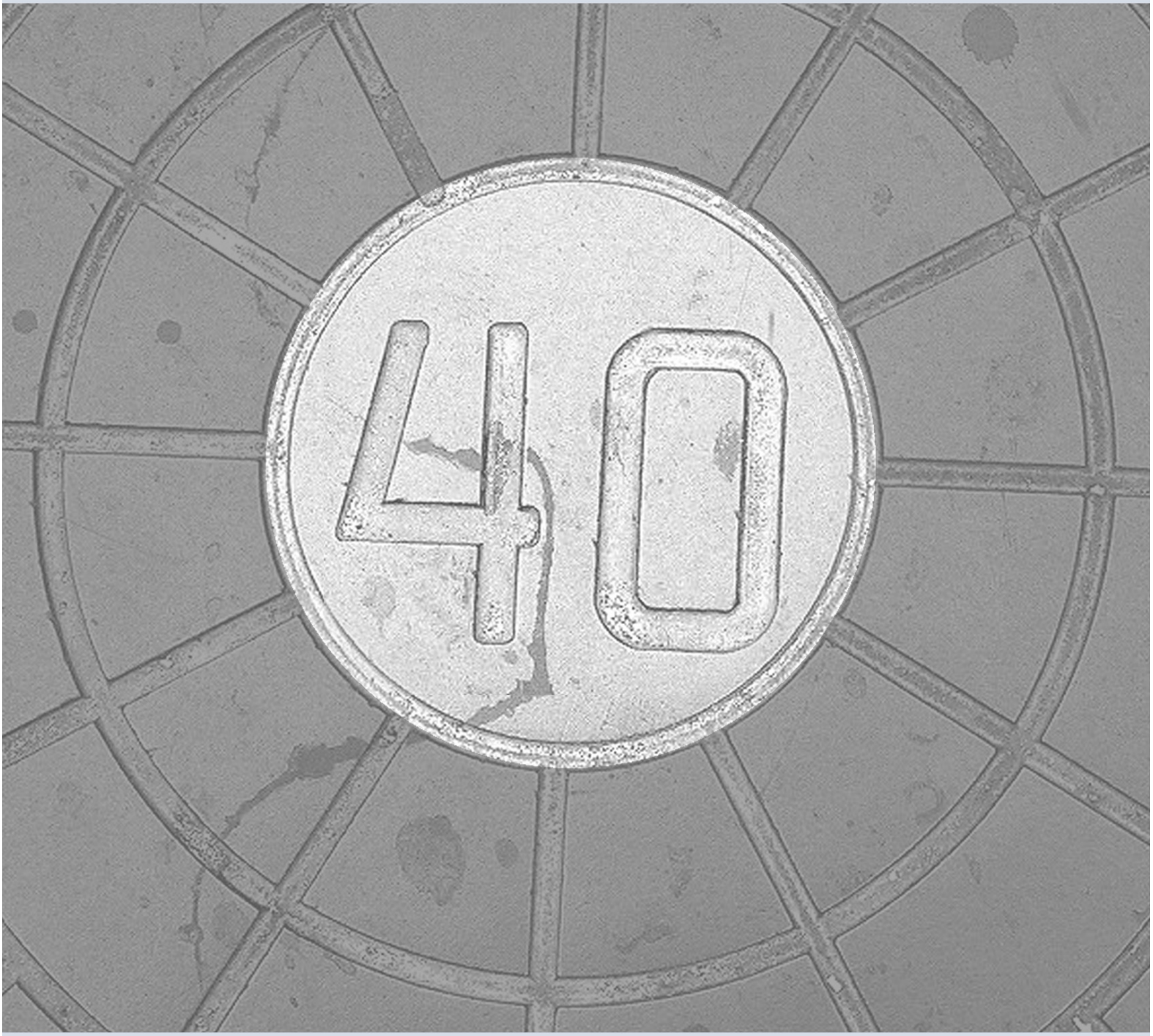
a) To be scheduled after PWSA review of the draft 40-Year Plan.

Please submit any corrections or additional comments to these meeting minutes to me at cjordan@chesterengineers.com. Comments must be submitted by May 16, 2011.

Respectfully submitted,

Charles J. Jordan, P.E.
Project Manager

APPENDIX 1-4



CHESTER ENGINEERS, INC.

APPENDIX 1-4
INTERNAL QUESTIONAIRE MEETING AGENDA AND COMPLETED QUESTIONAIRES

THE PITTSBURGH WATER AND SEWER AUTHORITY
40-YEAR CAPITAL PLAN
PWSA PROJECT NO. R-D1.10015
INTERNAL QUESTIONNAIRE MEETING
FRIDAY OCTOBER 29, 2010 @ 11:00 AM

AGENDA

1. Introductions
2. Purpose of Internal Questionnaire
3. Water System Critical Problems and Needs
4. Sewer System Critical Problems and Needs
5. Target Levels of Service for Acceptable System Performance
6. Other Problems and Needs
7. Discussions

PWSA 40-Year Capital Plan
Internal Questionnaire

PWSA is beginning the preparation of a 40-Year Capital Plan. The plan will include needs assessments to identify the future improvements required to maintain and enhance the performance of the existing water and sewer systems. The plan will also investigate opportunities for system expansion through regionalization or PWSA acquisitions.

The purpose of this questionnaire is to obtain input from PWSA department heads and other key staff members on items that need to be addressed in the 40-Year Capital Plan. Your participation in the planning process is vital component in charting the future direction of the Authority. Therefore, we ask that you fill out the following questionnaire. We plan to use the results of your initial input through this questionnaire as an initial starting point and basis for future discussions to insure that we capture and consider your specific concerns. If you have any questions or comments regarding this questionnaire, please contact Mike McKee of Chester Engineers at 412-809-6623 or mmckee@chesterengineers.com.

Name of Person Completing Questionnaire Tom Palmosina
Telephone Number _____
e-mail address _____

1. Please list and provide below or on separate sheets brief descriptions of what you consider to be the most critical problems/most pressing needs facing the PWSA water system? Please rank by importance. As a point of reference, we identified the following major water system issues in our proposal. They are presented in no particular order of perceived importance. We encourage you to add or delete items as you see fit.

   - The age of the clearwell, difficulties in accessing the clearwell for inspection, repair/rehabilitation and the lack of redundancy.
   - The need for various improvements/rehabilitations of the water treatment plant facilities to address capacity, water quality standards, and age and condition of the facilities.
   - The need for compliance with water quality standards for disinfection byproducts.
   - The advanced age of much of the mechanical, electrical and instrumentation equipment.
   - The need for standby power generation or alternative power feeds to booster pump stations and the Membrane Filter Plant.

- The need for greater reliability of supply into the Highland 1 District and the advisability of constructing a pump station capable of transferring water from the Highland 2 District to the Highland 1 District.

- Increasing demands being exerted on the Herron Hill Reservoir District and the reliance of the Herron Hill Reservoir District on the Highland 1 District for supply.

- Persistent pressure problems in the Bloomfield/Garfield neighborhoods in the vicinity of Penn Avenue.

- Issues related to removing distribution system storage tanks from service for periodic painting, particularly concerns related to work in the Squirrel Hill district and other districts having only a single tank.

- The need to reduce/control the amount of non-revenue water in the system.

- The need to provide sufficient fire flow capacity throughout the distribution system.

- The need to institute an increasingly aggressive water main replacement program as the pipes continue to age.

Listing and Description of Identified Water System Problems/Needs

Identify 4” Water Mains

Dead End Mains

Old Ludlow Hydt / 4” Branches

Lead Service Lines

Leadite Joints (area’s)

Leak Detection Surveys

Valve Exercising / Hydt Flushing

Partyline Seperations

Inter-connection (other Water Utilities).

River Crossing Survey

Hazelwood Area (source / circulation issues)

Facilities (Pump Stations / Tanks)

River crossing inspection/evaluation including including new signage on river banks

2. Please list and provide below or on separate sheets brief descriptions of what you consider to be the most critical problems/most pressing needs facing the PWSA sewer system? Please rank by importance. As a point of reference, we identified the following major water system issues in our proposal. They are presented in no particular order of perceived importance. We encourage you to add or delete items as you see fit.

- Compliance with the Consent Order and Agreement for the control of combined sewer overflows.
- Addressing existing flooding problem areas
- Replacing/repairing deteriorating sewers and manholes.
- Incorporating green technologies for stormwater source controls

Listing and Description of Identified Sewer System Problems/Needs

Please provide your thoughts relative to the target levels of service or system performance that should be used to define acceptable system performance. The primary measures of system performance to be considered in the evaluation of the systems will include the following. We have provided values for these measures that are typically used. However, these values are subject to change and local preference and will be finalized based upon the PWSA's preferences.

- Water treatment plant capacity (permitted treatment capacity in excess of the maximum day water demand)

- Distribution system operating pressures (in excess of 20-psi at all times, normal operating pressure 35-psi minimum)

- Distribution system fire flow capacity (500-gpm to 3,000-gpm at 20-psi residual pressure depending on local fire protection requirements) As a point of reference, based upon hydrant flow testing performed on PWSA's hydrants during the past 3 years, Roughly 11% of PWSA's hydrants have a capacity of 500-gpm or less, 28% have a capacity between 500-gpm and 1,000-gpm, 18% have a capacity between 1,000-gpm and 1,500 gpm, and 43% have a capacity greater than 1,5000-gpm). The attached map illustrates the distribution of these hydrant test results.

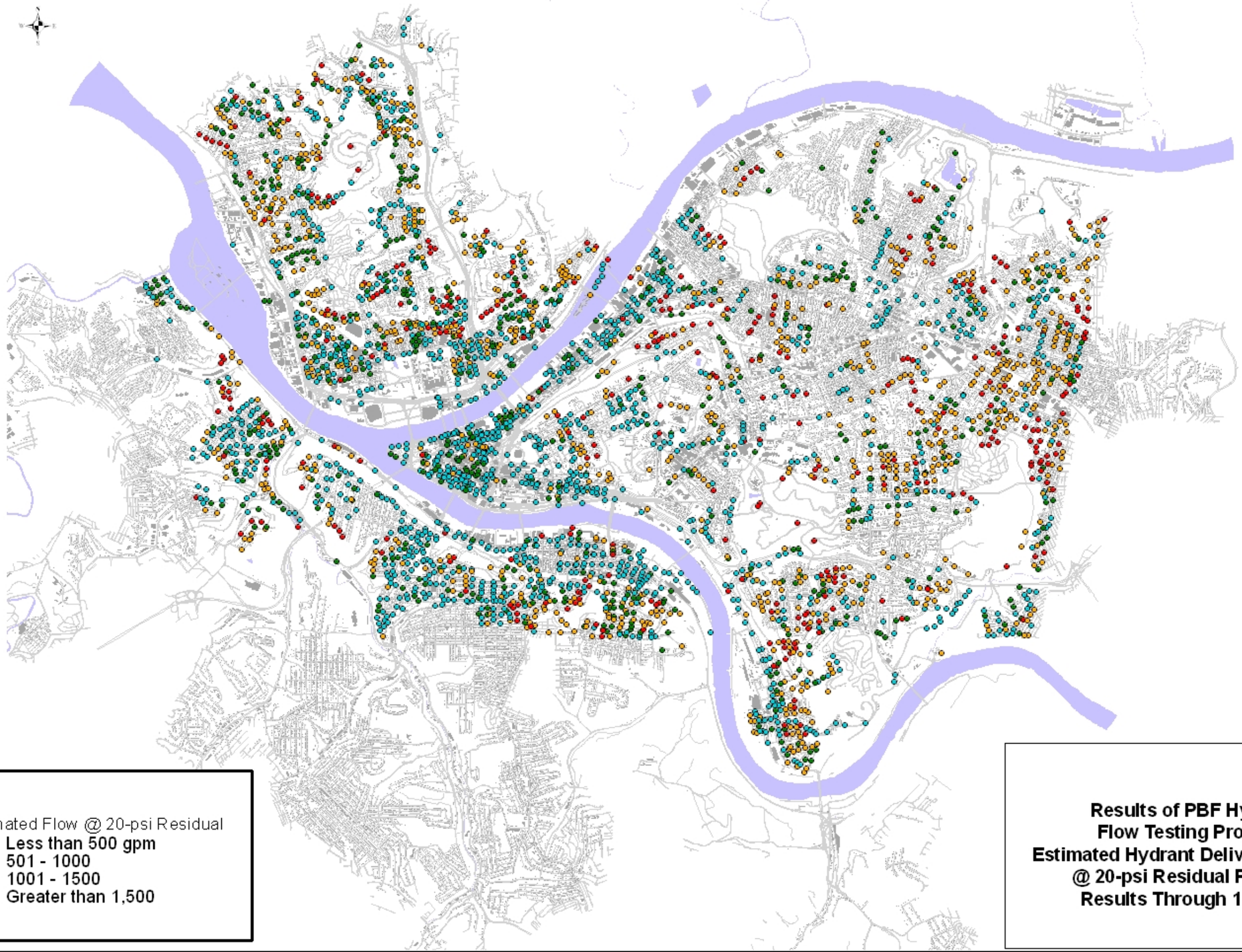
- Pump Station firm pumping capacity (greater than or equal to the maximum day demand within the area supplied)

- Distribution system storage (Total storage requirement is the sum equalization volume plus the larger of a fire flow volume or an emergency storage volume. Equalization volume equals the difference between the peak hour system demand and the firm pumping capacity of the supplying station for a 6-hour period. Fire flow volume equals the targeted fire flow rate capacity for a duration of 3-hours.

Emergency storage volume equals the maximum day demand rate for a period of 4-hours)

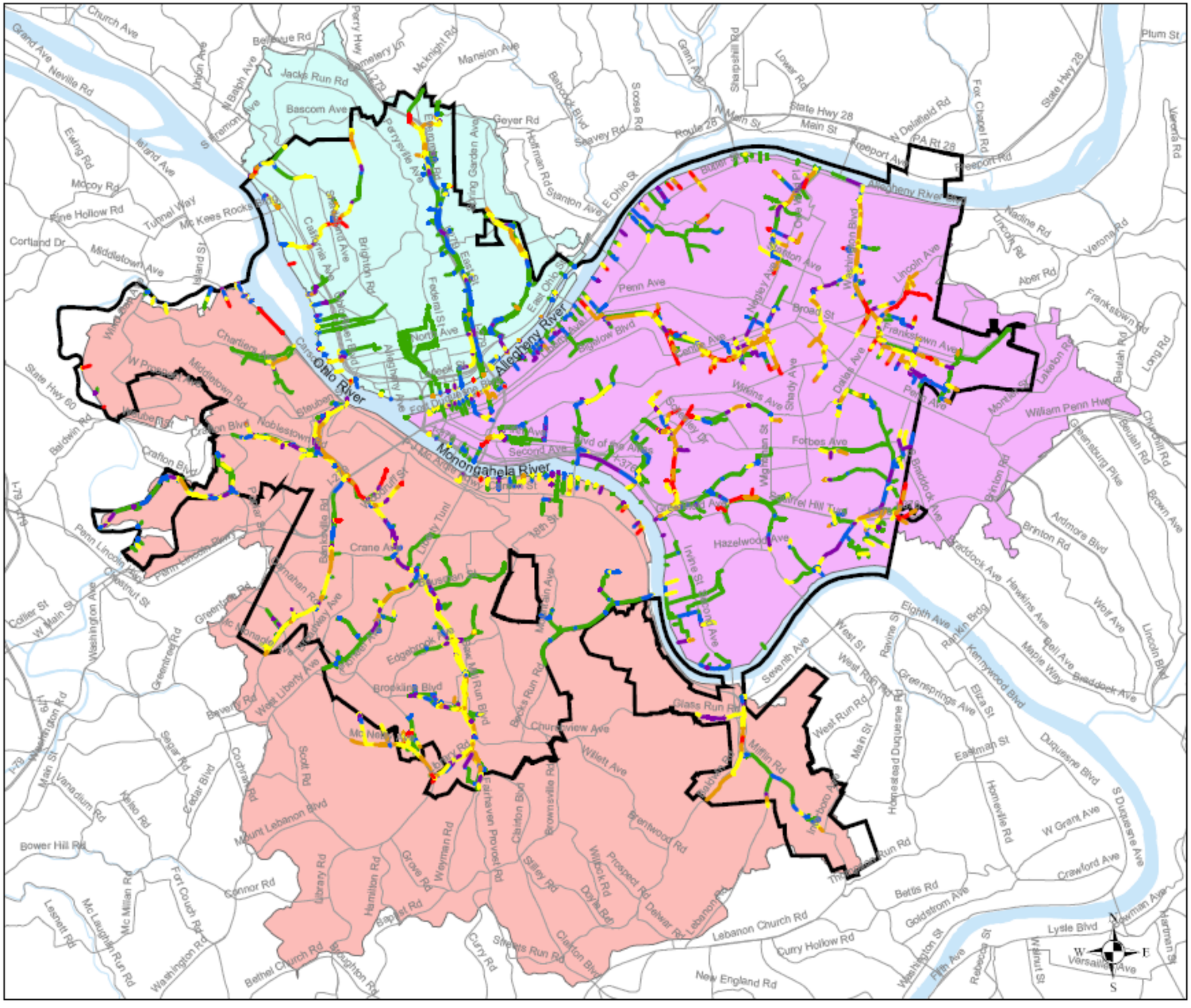
- Sewer system conveyance capacity without flooding/basement flooding (most commonly 10-year to 25-year design storm capacity). The attached mapping that was produced as part of PWSA Hydraulic and Hydraulic Characterization Report presents computed surcharge depths in trunk sewers that were modeled for the study for 5-year, 10-year and 25-year design storm conditions. This provides an indication of the levels of service currently provided by the system.

3. Please provide any other comments below or on a separate page.



Estimated Flow @ 20-psi Residual
- Less than 500 gpm
- 501 - 1000
- 1001 - 1500
- Greater than 1,500

Results of PBF Hydrant Flow Testing Program
Estimated Hydrant Delivery Capacity @ 20-psi Residual Pressure
Results Through 10-07-10



Partnering to achieve long term benefits

PWSA CSO Team

Metcalf & Eddy Baker/Wade-Trim

Legend

Pipe Surcharge Level

- No Surcharge
- 0 - 3 ft
- 3 - 5 ft
- 5 - 10 ft
- 10 - 15 ft
- >15 ft

PWSA Sewersheds

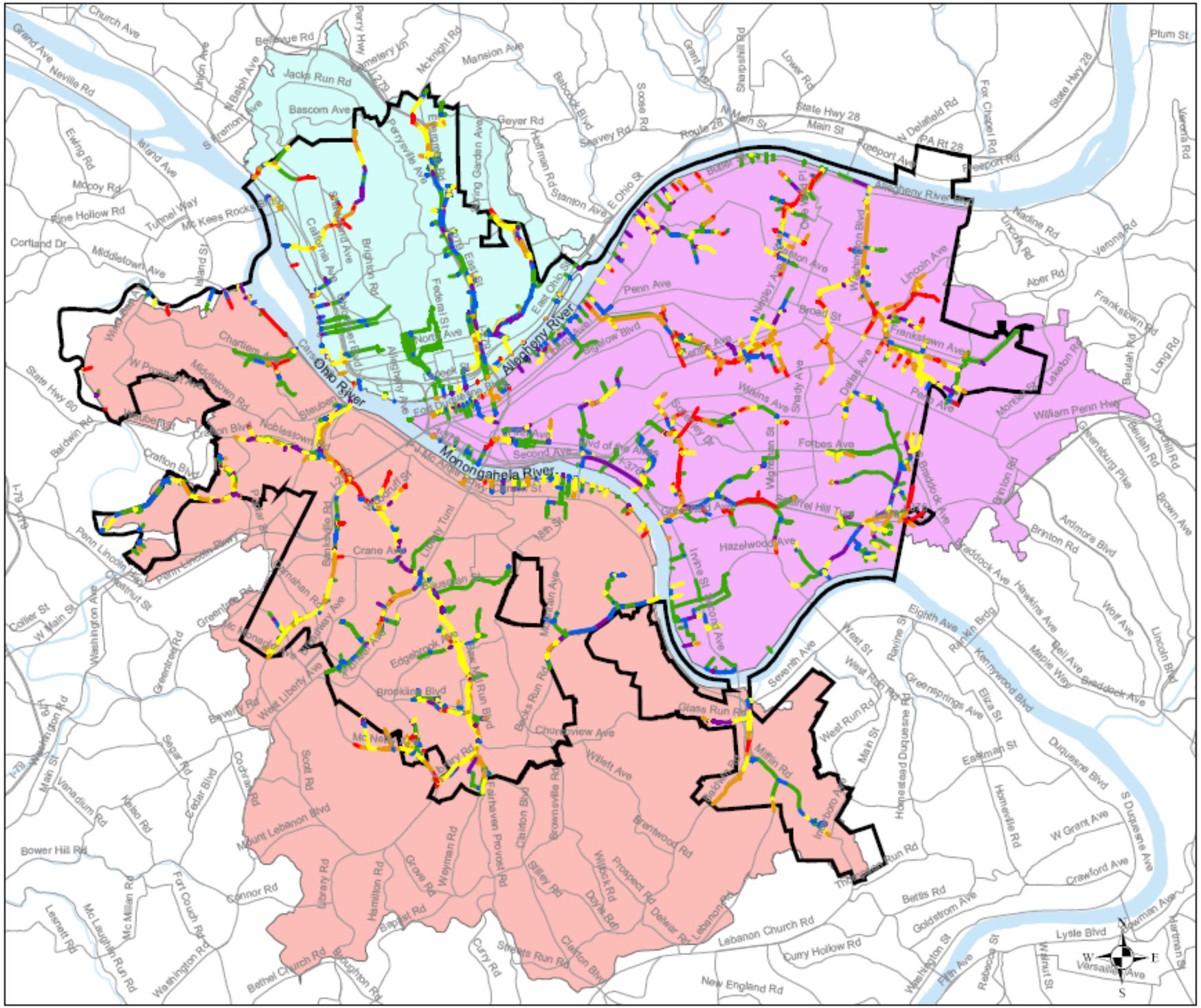
- East Sewersheds
- North Sewersheds
- South Sewersheds
- City of Pittsburgh

0 1 2 Miles

Figure 8-4
All Sewersheds
5 Year-24 Hour Design Storm
Level of Service
(Base Line Conditions)

PWSA Collection System Hydraulic & Hydrologic Characterization Report

PWSA THE PITTSBURGH WATER & SEWER AUTHORITY Quality Water Quality Service



Partnering to achieve long term benefits
PWSA CSO Team
Metcalf & Eddy Baker/Wade-Trim

Legend

Pipe Surcharge Level
- No Surcharge
- 0 - 3 ft
- 3 - 5 ft
- 5 - 10 ft
- 10 - 15 ft
- >15 ft

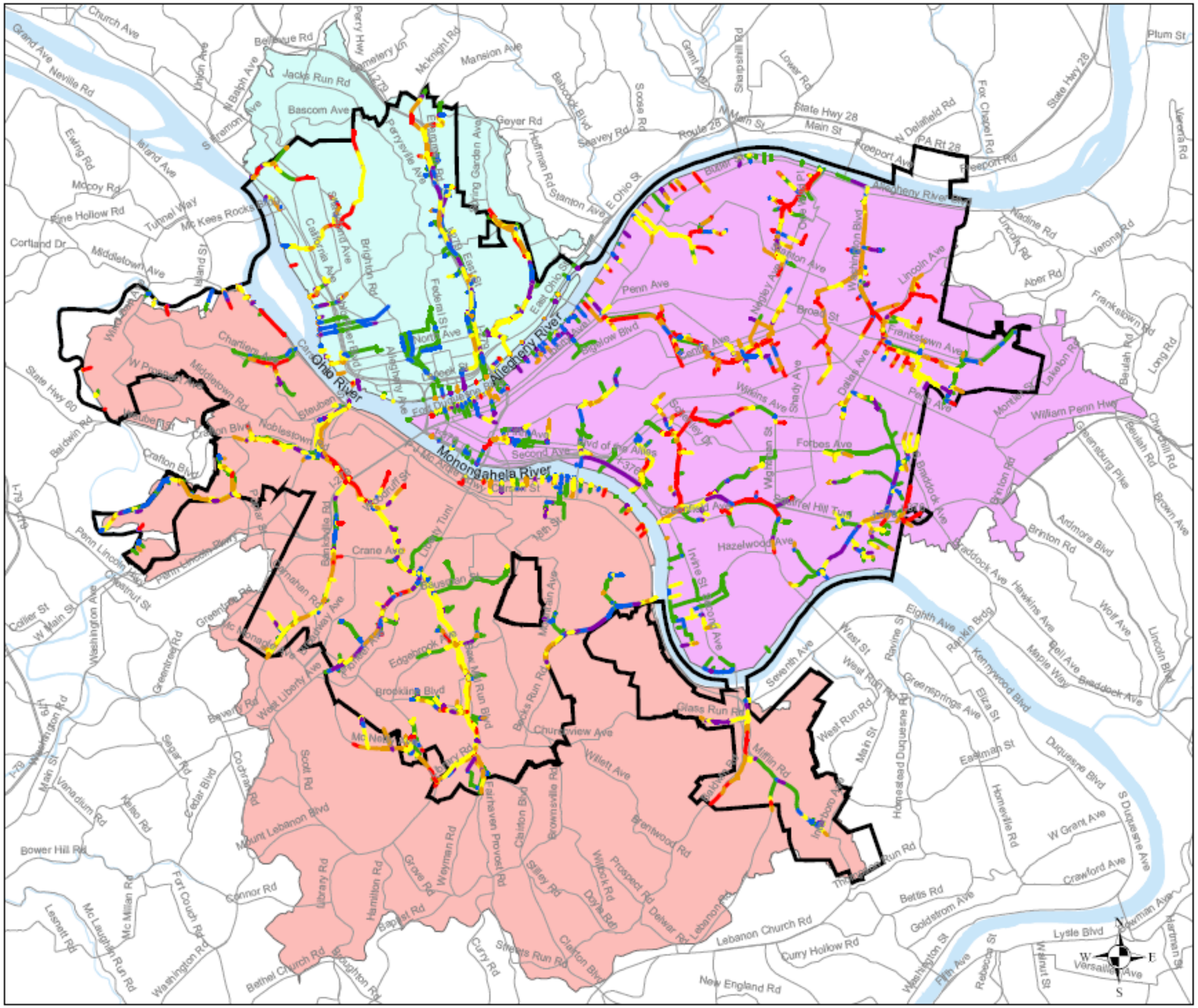
PWSA Sewersheds
- East Sewersheds
- North Sewersheds
- South Sewersheds
- City of Pittsburgh

0 1 2 Miles

Figure 8-5
All Sewersheds
10 Year-24 Hour Design Storm
Level of Service
(Base Line Conditions)

PWSA Collection System Hydraulic & Hydrologic Characterization Report

PWSA
THE PITTSBURGH WATER & SEWER AUTHORITY
Quality Water Quality Service



Partnering to achieve long term benefits
PWSA CSO Team
Metcalf & Eddy Baker/Wade-Trim

Legend

Pipe Surcharge Level

- No Surcharge
- 0 - 3 ft
- 3 - 5 ft
- 5 - 10 ft
- 10 - 15 ft
- >15 ft

PWSA Sewersheds

- East Sewersheds
- North Sewersheds
- South Sewersheds
- City of Pittsburgh

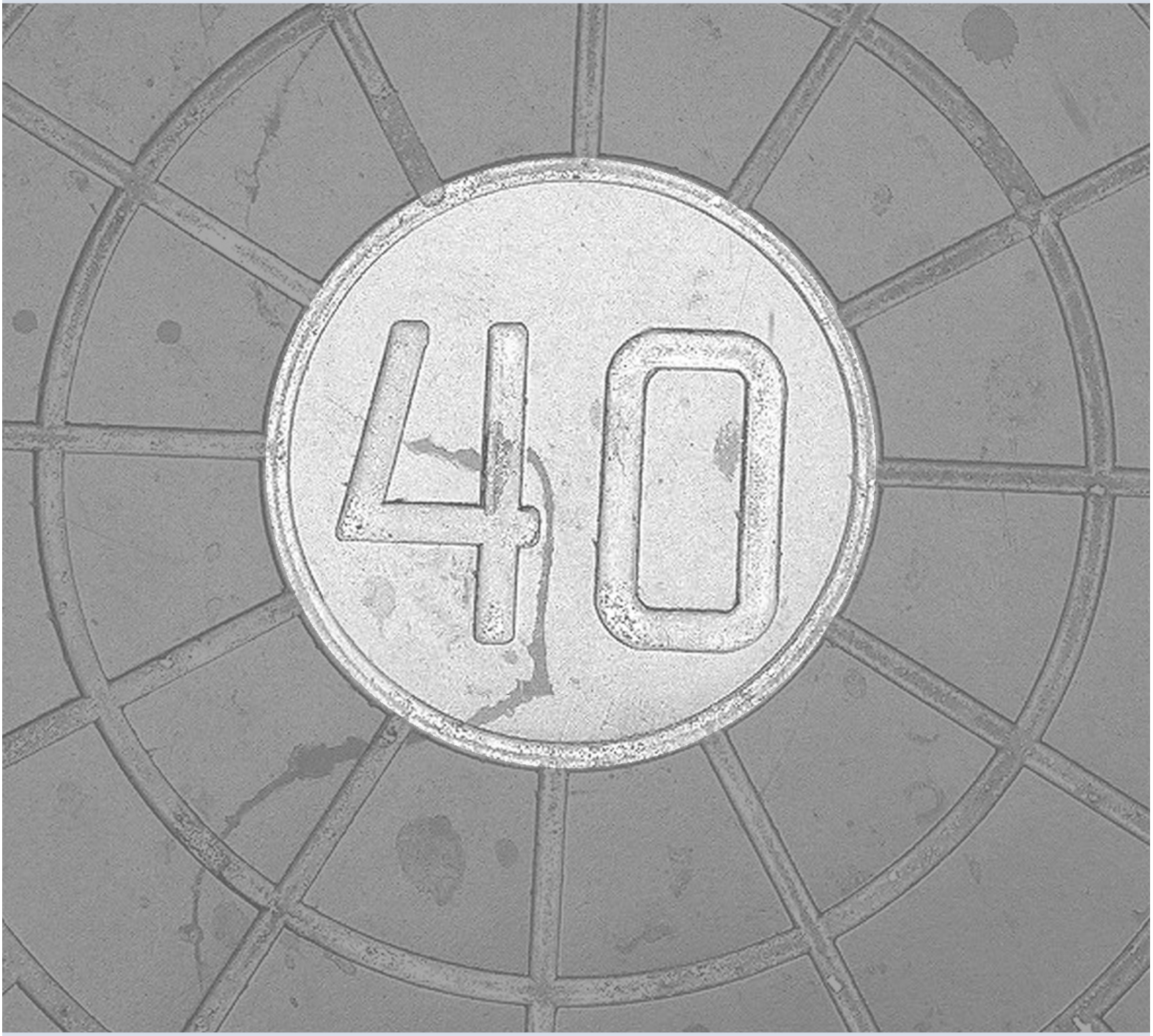
0 1 2 Miles

Figure 8-6
All Sewersheds
25 Year-24 Hour Design Storm
Level of Service
(Base Line Conditions)

PWSA Collection System Hydraulic & Hydrologic Characterization Report

PWSA
THE PITTSBURGH WATER & SEWER AUTHORITY
Quality Water Quality Service

APPENDIX 2-1



CHESTER ENGINEERS, INC.

APPENDIX 2-1
INFORMATION FROM MEETINGS WITH AGENCIES

Collective Efforts, LLC
Civil and Environmental Engineers

May 20, 2011

Charles J. Jordan, P.E.
Senior Project Manager
Chester Engineers
1250 Penn Avenue
Pittsburgh, PA 15222-2219

Subject: Regulatory and Local Planning Department Meeting Summaries
Pittsburgh Water and Sewer Authority - 40-Year Capital Plan
Allegheny County, Pennsylvania
CE Project No. 10-10427

Dear Mr. Jordan:

Collective Efforts, LLC (Collective Efforts) thanks you for the opportunity to assist Chester Engineers with the local meetings/discussions in which we gathered information about the opportunities for regionalization as this relates to the Pittsburgh Water and Sewer Authority (PWSA), 40-Year Capital Plan. In summary, Collective Efforts attended four meetings, one each with the following organizations/dates:

- City of Pittsburgh, Department of City Planning – May 4, 2011
- Allegheny County Department of Economic Development – May 5, 2011
- Allegheny County Health Department – May 10, 2011
- Pennsylvania Department of Environmental Protection – May 10, 2011

For ease of incorporation of this data into you overall report, Collective Efforts has provided meeting summaries of the events that were completed for Task 2 of the Scope of Work as individual attachments to this letter. We will provide you with both a hard copy of this submittal, as well as forward the electronic Word™ documents.

At the conclusion of our meeting with the Allegheny County Health Department, Mr. David Troianos noted that it may be beneficial to meet with PWSA to review the meetings/information provided and to get PWSA feedback as to what data they want to be incorporated into the 40-Year Capital Plan. Please note that we would be happy to meet with PWSA representatives as necessary to present some or all of the findings.

We thank you again for this work and look forward to any questions that Chester Engineers may have on this submittal.

Sincerely,
Collective Efforts, LLC

Kathy Chavara, P.E.
Principal

Attachments

462 Perry Highway, 2nd Floor Pittsburgh, Pennsylvania 15229 412-459-0114 412-459-0117(fax)
E-mail: info@collectiveefforts.com

ATTACHMENT A
City of Pittsburgh
Department of City Planning

Department of City Planning

This meeting was held at the City of Pittsburgh, Department of City Planning located at 200 Ross Street in Pittsburgh, Pennsylvania. The meeting was held on Wednesday, May 4, 2011 at 1 PM.

Meeting attendees included:

- Mr. Dan Sentz, Environmental Planner
- Mr. Andrew Dash, AICP, Senior Planner
- Mr. Justin Miller, Senior Planner
- Mr. David Troianos, PE, Chester Engineers
- Ms. Kathy Chavara, PE, Collective Efforts, LLC

A brief *Existing Conditions and Projected Development Survey* (included in Attachment E) was forwarded to Mr. Dan Sentz just before the meeting with the City Planners. Although the survey was not returned, we did spend most of the meeting time in discussions about what the City of Pittsburgh, Department of City Planning has witnessed in relation to development trends and where they anticipate specific land uses within the City in the longer term.

The Planners talked about a neighborhood analysis web tool identified as SNAP; accessible at www.pghsnap.com . This tool is being developed to provide a free assessment of the existing conditions of a property in the City of Pittsburgh, with consideration of sixteen planning sectors. Several of the noted planning sectors include transportation, demographics, land use, and existing buildings. Andrew Dash is working on the development of a SNAP component as it relates to the use/reuse of open space and the potential connection to address stormwater management. Over the next few years, City Planners will be looking toward completion of planning sectors such as overall infrastructure assessments and a land use component as part of the overall tool. The web site supports static links to current City mapping as well.

In addition, "Action Planning" is taking place to specifically look at interventions in particular parts of the City. This work is being completed in conjunction with the Urban Redevelopment Authority of Pittsburgh (URA).

When discussing anticipated projects that may significantly modify land use or zoning, a few areas around the City of Pittsburgh were discussed, including:

- *Lower Hill District* – This area is located around the Civic Arena and will most likely see redevelopment/reuse over the next 20 years. There are just shy of 30 acres in this vicinity that have not been updated (infrastructure-wise) since the 1950s and 1960s.
- *Fifth and Forbes Avenues* – This area will most likely see moderate growth over the next 10 years. The mixed use in this location will most likely continue and will most likely include the expansion of the campus living area for Duquesne University along Forbes Avenue.
- *North Shore* – New street grids are anticipated for the areas around the existing North Shore developments. Specially Planned (SP) areas/development will most likely follow the street grid work and may include a mixture of commercial, entertainment, restaurants and retail. Development in this area is anticipated within the next 10 years.
- *Top Hill District* – This area may see lower cost residential development.
- *Lower Washington Place* – This area may see heavier densities.
- *Strip District* – Several projects were noted as current, including work that the Buncher Company is doing to renovate two existing buildings, and the Allegheny Riverfront Vision Plan. Partners for the Allegheny Riverfront Vision Plan include the Department of City Planning, the

URA, Riverlife and Perkins Eastman. Details of the Allegheny Riverfront Vision Plan that focus on areas along the southern shores of the Allegheny River from 11th Street to Washington Boulevard in Highland Park can be found on the web at http://alleghenyriverfront.pittsburghpa.gov. Anticipated redevelopment focus specified in the Allegheny Riverfront Vision Plan includes a mixture of residential, office and retail uses.

- *South Side Works* – This area has recently experienced redevelopment and additional development is anticipated along Sydney and 26th Streets. Both residential and parking are uses being considered longer term; with a new hotel, restaurants and offices anticipated in the next few years.
- *Mount Washington* – Plans for a substantial investment at the western end of Grandview Avenue is anticipated within the next 5 years.
- *Former LTV Steel Site, Hazelwood* – Almono, LP has developed a few Master Plans related to the redevelopment of this former steel facility.
- *UPMC* – UPMC is looking to eventually expand UPMC Mercy. This expansion is anticipated in a 10-year time period.

Additional, but more general trends were discussed, including anticipation for higher densities in locations around the bus way and light rail systems; for example, Homewood and East Liberty.

Open space and the redevelopment/renewal of existing recreational facilities are being addressed for some of the facilities constructed in the late 1930s and 1940s. A community and recreation center is being designed currently for Riverview Park.

The City Planners identified that there is a modest retention of population in the City of Pittsburgh. Population numbers discussed, and as presented in the Comprehensive Plan, projects population by 2035 between 330,000 and 335,000 people. However, the City Planners noted that the trend is to rent, not own property.

At the conclusion of the meeting, we briefly discussed the following areas of the City that the Planers were aware of either water service, sanitary or stormwater concerns or repetitive issues. The areas noted included the 31st Ward (numerous water main breaks), and within greenways of Perry South, Arlington, Mt. Oliver and other southern hilltop communities.

ATTACHMENT B
Allegheny County
Department of Economic Development

This meeting was held at the Allegheny County Department of Economic Development (ACDED) located at 425 Sixth Avenue, Suite 800 in Pittsburgh, Pennsylvania. The meeting was held on Thursday, May 5, 2011 at 3 PM.

Meeting attendees included:

- Ms. Kay Pierce, Manager, Planning
- Ms. Christine Goswick, Planner II
- Ms. Kathy Chavara, PE, Collective Efforts, LLC

A brief *Existing Conditions and Projected Development Survey* (included in Attachment E) was forwarded to Ms. Kay Pierce just before the meeting with the County Planners. One survey, completed by Mr. Patrick Earley, Manager, Development, is included with this Attachment. Mr. Earley noted the planned improvements were being considered for a new hotel development on 4th and Ross Streets. This development is estimated to be completed in 2013; another hotel development is also scheduled for completion in 2013 on 5th Avenue in Oakland.

The remainder of the meeting was spent in review of current activities that the ACDED is involved with, specifically related to development trends and the City. The County Planners introduced a number of activities and studies that they have been involved with that may help to provide overall guidance and insight related to future development, population, infrastructure needs, etc. These resources include:

- *Allegheny Places* – The Allegheny County Comprehensive Plan, dated December 2008, provides much information about all of Allegheny County, including the City of Pittsburgh. Chapter 4 of Plan includes a section on utilities. The Allegheny County Comprehensive Plan can be accessed via the web at http://www.alleghenyplaces.com/default.aspx . As of January 2011, a map viewer has been activated to provide a link to local GIS data. Unfortunately, the map link was not readily available.
- *Connect* – Connect's mission is to coordinate the activities of the City of Pittsburgh and the 35 municipalities that share its border through: advocating for and voicing the collective interests of the urban core and its 680,745 residents; developing and enhancing ways the 36 municipalities work together to deliver important public services; and maintaining a forum for the discussion, deliberation and implementation of new ways to maximize economic prosperity for Western Pennsylvania. Members noted include: the City of Pittsburgh, Aspinwall, Baldwin Borough, Baldwin Township, Bellevue, Brentwood, Castle Shannon, Crafton, Dormont, Edgewood, Etna, Fox Chapel, Green Tree, Homestead, Ingram, Kennedy, McKees Rocks, Millvale, Mt. Lebanon, Mount Oliver, Munhall, O'Hara, Penn Hills, Reserve, Robinson, Ross, Rosslyn Farms, Scott, Shaler, Sharpsburg, Stowe, Swissvale, West Homestead, West Mifflin, Whitehall, and Wilkinsburg. Connect is accessed via the web at http://connectpittsburgh.wordpress.com . The current municipal agreements are noted at http://connectpittsburgh.wordpress.com/municipal-agreements-2 .
- *Allegheny Together* – Allegheny Together is a program that was launched in 2007 by County Executive Dan Onorato in four pilot communities. Allegheny Together was developed to assist traditional pedestrian-based business districts throughout the County and was structured to stress community organization and data-driven planning as a way to direct public investment, spur private investment and revitalize communities. The current program communities include Bellevue, Bridgeville, Carnegie, Coraopolis, Dormont, Elizabeth, Stowe, Tarentum and Verona. Allegheny Together's Mission, "to encourage well-planned, well-designed and geographically-focused investment in the established, urban commercial districts of Allegheny County while respecting the unique history, character, and built environment of each," can be found at the web address: http://towncenter.info/downtown/allegheny_together/index.aspx .

- *ARTEZ* - In 2003, Allegheny River Towns Enterprise Zone (ARTEZ), an economic development agency was formed to collaborate with seven communities along the Allegheny River. These communities include Millvale, Etna, Shaler, Sharpsburg, O'Hara, Aspinwall, and Blawnox. The following web address, http://www/artez.org , can be used to view a database of properties for sale or lease within these communities as of July 2009.

In addition to the above provided resources, ACDED provided copies of the April 1996 *Comprehensive Water Supply Plan* and the November 1999 *Comprehensive Sanitary Sewage Management Plan*, each prepared for Allegheny County.

Based on our understanding that the PWSA 40-Year Capital Plan highlights current water service to Aspinwall, Blawnox, Fox Chapel and Reserve Township, the County Planners offered that the former Boy Scout Camp has the potential for future development in Aspinwall, while the land available in Reserve Township must deal with landslide prone soils and regulations that are under modification.

One trend that County Planning has recently witnessed is the desire of residents to walk to work.

Their population data and demographics for the County are based on PA Data Center information. This data can be accessed at the Pennsylvania Spatial Data Access (PASDA), which is the official public access geospatial information clearinghouse for Pennsylvania. PASDA provides information in both GIS and PDF formats, and links to Allegheny County GIS mapping (via the map viewer) and Google maps. Population data is noted by County only and contains data from the 2000 census. The County Planners noted that they anticipate an update soon that will supply similar data based on the 2010 census.

The Pittsburgh Water & Sewer Authority (PWSA)
40-Year Capital Plan

PWSA is in the process of preparing a 40-Year Capital Plan. The plan will include needs assessments to identify the future improvements required to maintain and enhance the performance of the existing water and sewer systems. The plan will also investigate opportunities for system expansion through regionalization or PWSA acquisitions.

The purpose of this questionnaire is to obtain input from your organization regarding current problem areas and projected future development that could impact current loading within the PWSA water and sewer systems. Your participation in the planning process is a vital component in charting the future direction of PWSA. Therefore, we ask that you fill out the following questionnaire so that your input can be utilized as a basis for future discussions to ensure that your specific concerns are captured and considered. If you have any questions or comments regarding this questionnaire, please contact Kathy Chavara of Collective Efforts at 412-459-0114 or kchavara@collectiveefforts.com .

Thank you in advance for your prompt attention to this survey!

Name of Person Completing Questionnaire	PATRICK Earley
Title	MANAGER, DEVELOPMENT
Organization Represented	ACED
Telephone Number	412-350-1061
e-mail Address	john.earley@alleghenycounty.us

1. Are there any anticipated projects that would significantly modify existing land use and/or zoning? Please list any projects along with their estimated completion dates.

   No

2. Are there planned improvements for additional hotels, hospitals, college campus expansions, etc. in the near or distant future? Please list any improvements along with their estimated completion dates.

   Planned Hotel development on 4th Street + Ross Street
   est. Completion: 2013
   Planned Hotel development on 5th Ave in Oakland
   est. Completion: 2013

3. Are there any known or anticipated major roadway or city block redevelopment projects? Please list any projects along with their estimated completion dates.

N/A

4. Are there any other groups, developers, or investors that might be good to speak with about general expansion plans in the City? Please provide the group's name as well as a contact person and phone number or email address, if known.

N/A

5. Are there any industrial areas that are planned for redevelopment, e.g. Green Boulevard Project? Please list any areas along with their estimated completion dates.

N/A

6. Please comment on your experience with green infrastructure and any desire to incorporate it to a greater extent within City-owned properties.

N/A

7. Are there any areas within the City known to have inadequate water, sanitary, or storm sewer services? Please be specific as to location and service issue, i.e., Sanitary – 500 block Jones Street – manhole surcharging whenever it rains.

N/A

8. Are there any areas within the City known to have concerns with water pressure or fire flow? Please be specific.

N/A

9. Are there any areas within the City known to experience numerous or repetitive water main breaks? Please be specific.

N/A

10. Please provide information regarding the population changes your organization is projecting within the City and surrounding region over the next five, 15, and 40 years.

N/A

ATTACHMENT C
Allegheny County Health Department

This meeting was held at the Allegheny County Health Department (ACHD) offices located at 3901 Penn Avenue in Pittsburgh, Pennsylvania. The meeting was held on Tuesday, May 10, 2011 at 9 AM.

Meeting attendees included:
Ms. Michelle Buys, ACHD Project Engineer
Ms. Lisa Sorg, ACHD
Mr. John Jeffries, ACHD Supervisor Public Drinking Water and Waste Management Program
Ms. Barbara Grosch, ACHD Environmental Health Specialist II
Mr. Michael Moskorisin, ACHD Environmental Health Administrator
Dr. Stanley States, PWSA Director of Water Quality and Production
Mr. David Troianos, PE, Chester Engineers
Ms. Kathy Chavara, PE, Collective Efforts, LLC

A brief *Existing Conditions and Projected Development Survey* (included in Attachment E) was forwarded to Ms. Michelle Buys prior to the meeting with the ACHD. Although completed surveys were not returned, we spent the majority of the meeting in discussions about what conditions the ACHD sees both in the field as well as based on complaints received. Mr. Jeffries noted that there were very few common complaints related to the water supply. He noted that the Millvale experiences a low water pressure; Dr States indicated that PWSA has been working with Millvale on this issue. Mr. Jeffries noted that there are no chronic "dirty" water calls; and if the ACHD does receive a call of this nature, it generally has been caused by recent construction activities. At this point in the meeting, Ms. Buys provided a two page spreadsheet containing a summary of the complaints recorded by the ACHD. A copy of this document is included within Attachment E of this document.

Overall, the ACHD staff attending the meeting commended PWSA on the quality of water provided by PWSA. The age of the existing infrastructure is of concern to the ACHD; as was the potential to replace existing water line infrastructure at many of the existing brownsfield sites in Pittsburgh.

We briefly discussed the current/formal Fire Flow Testing that PWSA performs and the Fluoride Tracer Study that PWSA prepared. ACHD was happy with each and asked that PWSA maintains current testing and tracer studies.

Dr. States noted that PWSA is managing a current water plant capital improvement project and that PWSA continues to inspect/repair/replace the larger (12" and greater) valves within the PWSA system. Valve locations and conditions are maintained by PWSA within their GIS mapping coverage of the system. The ACHD stressed the importance of 100% compliance related to turning the valves every 3 years (or at maximum, every 4 years for a system the size of Pittsburgh).

It was noted that PWSA continues to maintain their lines, isolate breaks when necessary, and maintain valves, lines and the appurtenances when paved-over. Dr. States noted that PWSA categorizes the age of their system in the approach that PWSA will look to replace those lines installed in the 1940's and 1950s, when material was scarce. Water lines installed during this time period tend to have more failures; however, there are a tremendous number of miles of water lines in this category and current budgets that allow for the replacement of minimal mile(s) per year.

While addressing the future, the ACHD requested that PWSA optimize the flushing program. Ms. Grosch voiced that ACHD looks for system modeling to indicate areas where PWSA should flush prior to "reactive flushing" that may occur following a water main break.

Current regulations include sampling/evaluation of trihalomethanes (THM) and source water protection monitoring within the rivers (intake) for bromide. Currently, there are no Unregulated Contaminant Monitoring Regulation (UCMR) hits yet. Chromium has been detected in low levels; however, this constituent is a natural contaminant. Following a brief discussion related to the studies being conducted in 25 cities across the United States, the group agreed that future sampling and possibly treatment may be considered to address trace pharmaceuticals, i.e.; estrogen. PWSA and the ACHD look for this directive under the UCMR3 expected in the next three years (2014). Recently, radioactive Iodine 131 was found in the drinking water supplies in Philadelphia, Pennsylvania. The ACHD conducts weekly sampling at the open water reservoirs; all three sampling locations show no indications of radioactive iodine.

At this point in the discussion, Ms. Buys provided a copy of the *Semi-Annual Progress Re*port *(Reference COA, Appendix E)* for the reporting period of July 1, 2010 to December 31, 2010. This document is included for reference within Attachment E of this document and was noted as a document that must be provided to the ACHD every 6 months. A brief discussion followed and highlighted consideration of concerns about the disinfection of combined sewer overflows (CSOs) potentially causing other concerns for water treatment/intake locations. The comments specifically addressed concerns that as more chemicals are added to sanitary treatment processes, these same chemicals have the potential to enter source waters; (i.e.; dechlorination).

The ACHD noted that they do understand that stormwater plays a role in meeting the CSO objectives for our area, and that bacteria loadings (from the stormwater) cause public health and recreation issues. Ms. Buys provided a *PWSA CSO Volume* record (see Attachment E) for 2006 that shows that PWSA is not meeting the 1994 CSO Policy, nor Water Quality Standards. She indicated that the Pennsylvania Department of Environmental Protection (PADEP) will be looking at the 21 dry weather overflows noted in 2008.

Ms. Buys also noted that the ACHD would like to see aging/failing pump stations rebuilt. Service requests between 2004 and 2011 could be improved.

Mr. Moskorisin identified that the ACHD had calls from the following locations with respect to on-lot sanitary systems in the City of Pittsburgh: 31st Ward (expects that the waste is disposed directly into the mines), 28th Ward, 26th Ward (Mount Pleasant), and the 27th Ward (Jack's Run and Ross Township boarder). He estimated that approximately 500 homes in the City of Pittsburgh are private septic. An *On-lot* handout was provided, see Attachment E.

In closing, there was a brief discussion that Federal emphasis may be headed to area supporting 10,000 to 20,000 populations; and that PADEP is looking toward distribution optimization.

ATTACHMENT D
Pennsylvania
Department of Environmental Protection

The final of four local meetings was held at the Pennsylvania Department of Environmental Protection offices located at 3901 Penn Avenue in Pittsburgh, Pennsylvania. The meeting was held on Tuesday, May 10, 2011 at 10:30 AM.

Meeting attendees included:
Mr. Ronald Schwartz, PE, BCEE, Assistant Regional Director
Mr. Sam Harper, PE, Water Quality Management Program
Dr. Stanley States, PWSA Director of Water Quality and Production
Mr. David Troianos, PE, Chester Engineers
Ms. Kathy Chavara, PE, Collective Efforts, LLC

Similar to the previous meetings, a brief *Existing Conditions and Projected Development Survey* (included in Attachment E) was forwarded to Mr. Ronald Schwartz prior to the meeting. The survey was used as an outline of meeting topics and focus; however, no surveys were returned.

Mr. Schwartz noted that the policies are written and directed out of Harrisburg, even those related to the current Marcellus shale industry. The approach for this particular industry, related to drinking water intake as well as discharges will be to control bromide and to control total dissolved solids (TDS). The DEP representatives noted that the power, steel and shale industries are looking at treatments that consider zero liquid discharge. DEP noted that the larger issues include: CSO containment, MS4 issues, and bacteriological issues.

Larger developments that DEP is familiar with include the expansion of the Allegheny Coke Works (which has not moved forward lately) and Allegheny Ludlum Brackenridge project. On the sanitary side of things, DEP is focused on ALCOSAN and PWSA commitments within the Consent Orders.

Within the Allegheny Watershed area, DEP foresee the use of scrubbers to clean the smoke stacks more efficiently, folks will be burning PA coal, and there will be a focus on the previously mined areas.

Historically, Mr. Schwartz and Mr. Harper noted that the redevelopment of the numerous brownsfield sites was very strong in the 1990s, following the enactment of Act 2 which risked away site liabilities.

The National Pollutant Discharge Elimination System (NPDES) program will continue to strengthen; with focus on suspended solids, infrastructure, urban runoff, etc. DEP envisions that this will be phased in as over the next 5 years. Enactment of NPDES sampling for discharges may be sometime yet. Future regulations will likely address pharmaceuticals and will necessitate the discussion of treatment (i.e.; water pretreatment or sanitary treatment prior to discharge).

They noted that Carnegie Mellon University is looking at many water-focused topics, including H2O Opportunities which looks at marketing the Pittsburgh water wealth to high-volume water industries. DEP also believes that the public will demand higher water quality. From a geographically low hanging fruit perspective, the communities which are located for regionalization opportunities surrounding Pittsburgh include: Reserve, Aspinwall, Fox Chapel, Blawnox and Millvale.

In closing, Mr. Schwartz noted that we may want to investigate the compliance and/or new projects as recorded within the state's eFacts system. In the longer term, the state's eNotice can be accessed and the public can use this system to receive e-mails about violations, trends for particular industries, general environmental data.

ATTACHMENT E
Items Provided by Meeting Hosts

Log No.	E-Facts No.	Complainant	Complainant's Address	Complainant's Phone No.	Complaint Location: Street No.	Complaint Location: Street	Complaint Location: City,	Complaint	Type of Problem	Date Received	Assign To	
04-010		Bob Maffeo	4740 Lougean Avenue, 31st Ward	412-462-3239		rear garage drains to Kinley Way sewer	Pittsburgh, PA	Pittsburgh	sewage backup, sewage in street	01/07/04	MM	01/07/04
04-015		Ida Daseul?	153 Kilimer Street, Pittsburgh		153	Kilmer Street	Pittsburgh	Pittsburgh	sewage overflow in street	01/21/04	EBW	
04-016		Tina Arginopowas?	539 Southcrest Drive, Brookline		539	Southcrest Drive	Pittsburgh	Pittsburgh	backups, blocked lateral	01/21/04	EBW	
04-017		Lee Robbins	5400 Keefe Street (CC)		5404	Keefe Street	Pittsburgh	Pittsburgh	sewage backup, surcharge MH	01/24/04	MM	
04-018		Anonymous				Banksville Road		Pittsburgh	surcharging manhole at Eat N Park	01/23/04	PB	
04-022		Fred Henzel	1527 Amanda, Carrick	412-882-7455	1529	Brownsville Road	Pittsburgh, PA	Pittsburgh	dumping oil in catch basins; commercial property owned by Jan Hall	02/06/04	ED	02/06/04
04-041		Greg Tolbert (HCE)		412-350-4046	1121	Amanda Street	Pittsburgh	Pittsburgh	4 homes on common lateral, sewage on street	02/24/04	RP	
04-043		Fred Henzel	1527 Amanda, Carrick	412-882-7455	1529	Brownsville Road		Pittsburgh	DUPLICATE		ED	
04-046		Ann Kesten	720 Parkwood Road, Pittsburgh		720	Parkwood Road	Pittsburgh, PA	Pittsburgh	raw sewage	03/01/04	PB	
04-048		Dave Namey (HCE)		412-350-4046	190-192	Kearns Avenue	Pittsburgh, PA	Pittsburgh	house not connected to city sewer		MM	
04-052		Karen Bishop	2806 Louisiana, Pittsburgh			city steps from Wenzell	Pittsburgh, PA	Pittsburgh	sewage running down city steps	03/19/04	MM	03/19/04
04-055	1326265	ACHD			DC 016A001	Banksville Road		Pittsburgh	DWOs, inaccessible, bad construction	02/16/04	MM	02/16/04
04-060	1344335	Judith Little	Castlegate Avenue, Pittsburgh			Castlegate and Norwich		Pittsburgh	collapsed sewer and cracked sewer	03/29/04	MM	03/29/04
04-061	1326265	ACHD			DC 062K002	W. Liberty Avenue		Pittsburgh	DWO rags	03/11/04	MM	03/11/04
04-062	1326265	ACHD			DC 039M001	Poplar and Kearns		Pittsburgh	DWO rocks and bricks	03/11/04	MM	03/11/04
04-085		Helen Blackwell	1352 Point View Street, Pittsburgh	412-363-0522		Point View Street		Pittsburgh	unknown water flowing in street, rats	04/23/04	EBW	05/12/04
04-089		William Schwartz		412-281-4777		Beck's Run Road	Pittsburgh	Pittsburgh	sewage by Wayne Road and odors in stream	04/30/04	EBW	
04-093		Gail Lucas (via Plumbing)	418 Laughlin Avenue, Pittsburgh	412-884-3251	417, 418, 420	Laughlin Ave. Extension		Pittsburgh	sewage discharges	04/28/04	PB	05/06/04
04-101		Charles Taylor		412-441-8691		Wiltsie and Highland	Pittsburgh	Pittsburgh	sewage discharge	05/13/04	EBW	
04-102		Fred Capuccio (ACHD)		412-578-8391		Rosetta and N. Atlantic	Pittsburgh	Pittsburgh	Unknown water	05/17/04	MM	05/17/04
04-106		Denise Jackson	707 Norwich Avenue, Pittsburgh	412-561-8452	707	Norwich Avenue	Pittsburgh	Pittsburgh	water in basement, wants us to test it	05/21/04	MM	05/21/04
04-107		Roberta Kostyak	1551 Methyl Street, Pittsburgh		1551	Methyl Street Rear yard	Pittsburgh	Pittsburgh	back yard saturated with water	05/21/04	PB	05/21/04
04-108		Marge Healy for sister			1533	Rutherford	Pittsburgh	Pittsburgh	broken sewer on Methyl, poured onto her property	05/21/04	PB	05/21/04
04-109		Vicky Berry, Larry York, Marlene Branson, Rachael Piccolino	308, 406, 412, 414 Kathleen Street	Rachael: 412-381-7311	308, 406, 412, 414	Kathleen Street	Pittsburgh	Pittsburgh	chronic basment backups	05/21/04	PB	05/24/04
04-110		Ed Rakowski	1321 Kinmount Street, Pittsburgh	412-922-1754	1321	Kinmount Street	Pittsburgh	Pittsburgh	sewage backups		PB	
04-112		Jane Conner	1331 Kinmount Street, Pittsburgh	412-563-6261	1331	Kinmount Street	Pittsburgh PA 15205	Pittsburgh	sewage backup	05/21/04	PB	05/21/04
04-120	1343712	Carmen Pirain (landlord)		412-292-6991	226-228	Maple Terrace	Pittsburgh	Pittsburgh	sewage backups	05/24/04	MM	05/24/04
04-121	1343712	Al Garnetta	209 West Sycamore Street	412-481-2128	209	W. Sycamore Street, South Hills Tailoring and Cleaning	Pittsburgh	Pittsburgh	backups after heavy rains	05/24/04	MM	05/24/04
04-123	1343712	Robert Scorzafave	126 Maple Terrace, Pgh	412-760-1888	126	Maple Terrace	Pittsburgh	Pittsburgh	backups after heavy rains	05/21/04	MM	05/21/04
04-142		Tony Amodeo	2411 Bazore Street, Pittsburgh	412-377-6672	2411	Bazore Street	Pittsburgh	Pittsburgh	main sewer backed up	05/26/04		
04-144B		Tommy Hess	4412 Woolslayer Way, Pittsburgh		4412	Woolslayer Way	Pittsburgh, PA	Pittsburgh	sewer odors in bsmt from hospital construction?	03/27/04		

04-147		Homer Ramsey	2310 W. Liberty Avenue, Pittsburgh	412-343-1200		West Liberty Chrysler	hillside behind car sales lot	Pittsburgh	Pittsburgh	waterfall, drainage	05/28/04	MM	05/28/04
04-159		Bill Hamilton (Food)	ACHD	412-578-8044		Noblestown and Obay Strs.	Pittsburgh	Pittsburgh	sewage discharge	06/08/04	NR	
04-160		Marilyn Zrust		412-922-8884		Kearns Avenue	Pittsburgh	28th Ward	stream is white	06/11/04	MM	06/15/04
04-161		Leanne Onorato via Mike Como and Dr. Dixon			3004, 3008, 3012	Perrysville Avenue	Pittsburgh	Pittsburgh	buried manholes	06/08/04	PB	
04-162		John Jeffries	ACHD	412-578-8040		East Myers and Amanda	Pittsburgh	Pittsburgh	dumping oil in catch basins	04/08/04	ED	
04-192		Roberta Kostyak	1551 Methyl Street, Pittsburgh	412-341-9259	1551	Methyl Street Rear yard	Pittsburgh, PA	Pittsburgh	drainage, wants us to test	06/28/04	PB	
04-197		David Gazdik		412-802-7812		Allegheny River between 40th & 42nd Streets		Pittsburgh	brown foam	07/02/04	PMB	
04-202		Mike Fieldhammer	6419 Bartlett Street, Pittsburgh, PA 15217	412-422-1341	6419	Bartlett Street	Pittsburgh, PA	Pittsburgh	lateral crushed by PWSA, sewage backing up in basement	07/07/04	EBW	07/07/04

SEMI-ANNUAL PROGRESS REPORT

(Ref: CQA, Appendix E)

Authority: Pittsburgh Water and Sewer Authority

Watershed:

Revision Date:

CSO Municipalities

Reporting Period From: July 1, 2010 To: December 31, 2010

Task Description	Proposed Start Date	Actual Start Date	Required Completion Date	Actual Completion Date	Required % of Project Completed	Actual % of Project Completed	Comments
PHASE I: System Inventory / O & M							
(A) Physical survey (Year 1) Critical/SSS	Jun 1, 2004	Jun 1, 2004	May 31, 2005	Dec 31, 2004	33%	34%	3301 MHs inspected to date, 10% of total, 1560 Critical/ SSS MHs inspected out of 4581, 34% of Crit/SSS
Physical survey (Year 2) Critical/SSS	Jun 1, 2005	Jan 1, 2005	May 31, 2006	Mar 31, 2009	66%	67%	4,786 inspected out of 7,180 total Critical/SSS manholes based on current GIS mapping. 1,544 (22% of total) of those not inspected were inaccessible or not located.
Physical survey (Year 3) Critical/SSS	Jun 1, 2006	Apr 1, 2009	May 31, 2007		100%	99.4%	Out of 7,035 total Critical/SSS manholes based on current GIS mapping, 5,136 (73.0% of total) were inspected & 1,856 (26.4% of total) of those not inspected were inaccessible, buried, or not located.
Physical survey (Year 4) Non-Critical	Jun 1, 2007	Jan 1, 2008	May 31, 2008	May 31, 2008		55%	10,062 inspected out of 18,161 total Non-Critical manholes based on current GIS mapping. 2,832 (16% of total) of those not inspected were inaccessible or not located.
Physical survey (Year 5) Non-Critical	Jun 1, 2008	Jun 1, 2008	May 31, 2009	May 31, 2009		69%	12,618 inspected out of 18,414 total Non-Critical manholes based on current GIS mapping. 3,831 (21% of total) of those not inspected were inaccessible or not located.
Physical survey (Year 6) Non-Critical	Jun 1, 2009	Jun 1, 2009	May 31, 2010	May 31, 2010		92%	Out of 18,379 total Non-Critical manholes based on current GIS mapping, 12,639 (69% of total) were inspected & 4,259 (23% of total) of those not inspected were inaccessible, buried, or not located.
Physical survey (Year 7) Non-Critical	Jun 1, 2010	Jun 1, 2010	May 31, 2011			98.1%	Out of 18,345 total Non-Critical manholes based on current GIS mapping, 13,200 (72.0% of total) were inspected & 4,799 (26.2% of total) of those not inspected were inaccessible, buried, or not located.
Physical survey (Year 8) Non-Critical	Jun 1, 2011		May 31, 2012				
Physical survey (Year 9) Non-Critical	Jun 1, 2012		May 31, 2013				
Physical survey (Year 10) Non-Critical	Jun 1, 2013		May 31, 2014				
(B) Cleaning/CCTV (Year 1) Critical/SSS	Jun 1, 2004	Jun 1, 2004	May 31, 2005	Dec 31, 2004	16.7%	47%	417,299 feet televised (including credit for past work) out of 887,870 estimated total feet of Critical/SSS sewers.
Cleaning/CCTV (Year 2) Critical/SSS	Jun 1, 2005	Jan 1, 2005	May 31, 2006	Dec 31, 2005	33.3%	45%	551,798 feet televised out of 1,220,950 estimated total feet of Critical/SSS sewers.
Cleaning/CCTV (Year 3) Critical/SSS	Jun 1, 2006	Jan 1, 2006	May 31, 2007	May 31, 2007	50%	51%	864,337 feet televised out of 1,680,913 total feet of Critical/SSS sewers based on current GIS mapping.
Cleaning/CCTV (Year 4) Critical/SSS	Jun 1, 2007	Jun 1, 2007	May 31, 2008	May 7, 2009	66.7%	66.7%	1,114,000 feet televised out of 1,670,510 total feet of Critical/SSS sewers based on current GIS mapping.
Cleaning/CCTV (Year 5) Critical/SSS	Jun 1, 2008	May 8, 2008	May 31, 2009	Jul 7, 2009	83.3%	83.3%	1,355,250 feet televised out of 1,626,955 total feet of Critical/SSS sewers based on current GIS mapping.
Cleaning/CCTV (Year 6) Critical/SSS	Jun 1, 2009	Jul 8, 2009	May 31, 2010		100%	99.97%	1,544,269 feet televised out of 1,580,265 total feet (97.7%) of Critical/SSS sewers based on current GIS mapping. 35,568 feet (2.3%) was attempted, but sewer was inaccessible.
Cleaning/CCTV (Year 1) Non-Critical	Jun 1, 2004	Jun 1, 2004	May 31, 2005	May 31, 2005		0%	
Cleaning/CCTV (Year 2) Non-Critical	Jun 1, 2005	Jun 1, 2005	May 31, 2006	May 31, 2006		7%	383,396 ft of non-critical sewers out of 5,605,270 ft total non-critical sewers have been televised
Cleaning/CCTV (Year 3) Non-Critical	Jun 1, 2006	Jun 1, 2006	May 31, 2007	May 31, 2007		5%	228,199 feet televised out of 4,246,074 total feet of Non-Critical sewers based on current GIS mapping.
Cleaning/CCTV (Year 4) Non-Critical	Jun 1, 2007	Jun 1, 2007	May 31, 2008	May 31, 2008		6.6%	279,257 feet televised out of 4,253,740 total feet of Non-Critical sewers based on current GIS mapping.
Cleaning/CCTV (Year 5) Non-Critical	Jun 1, 2008	Jun 1, 2008	May 31, 2009	May 31, 2009		7.9%	336,294 feet televised out of 4,255,959 total feet of Non-Critical sewers based on current GIS mapping.
Cleaning/CCTV (Year 6) Non-Critical	Jun 1, 2009	Jun 1, 2009	May 31, 2010	May 31, 2010		9.1%	385,336 feet televised out of 4,235,080 total feet of Non-Critical sewers based on current GIS mapping.
Cleaning/CCTV (Year 7) Non-Critical	Jun 1, 2010	Jun 1, 2010	May 31, 2011			18.4%	763,823 feet televised out of 4,212,389 total feet of Non-Critical sewers based on current GIS mapping. 11,013 feet (0.3%) was attempted, but sewer was inaccessible.
Cleaning/CCTV (Year 8) Non-Critical	Jun 1, 2011		May 31, 2012				
(C) GIS Mapping (Year 1)	Jun 1, 2004	Jun 1, 2004	May 31, 2005	Jun 30, 2005	33%	33%	Entire collection system now established on protocol-compliant GIS platform. Pipe and MH properties need to be assessed. GPS data integrated as field programs develop this information.
GIS Mapping (Year 2)	Jun 1, 2005	Jul 1, 2005	May 31, 2006	May 31, 2006	66%	66%	3RWW info is yet to be added to this total
GIS Mapping (Year 3)	Jun 1, 2006	Jun 1, 2006	May 31, 2007	Dec 31, 2006	100%	100%	GPS surveys from 3RWW linked to sewer system mapping. Manhole location adjustments made when necessary.
(D) Dye Testing (Year 1)	Jun 1, 2004	Jun 1, 2004	May 31, 2005	Oct 30, 2007	33%	33%	Approximately 170 buildings/residences were tested out of about 16,746 total within a 100-foot buffer from a sanitary sewer. Operations to expedite dye testing of storm and private inlets within 100-foot buffer began the summer of 2007.
Dye Testing (Year 2)	Jun 1, 2005	Oct 31, 2007	May 31, 2006	Mar 4, 2008	66%	66%	40,600 private drains & public storm inlets analyzed out of 61,526.
Dye Testing (Year 3)	Jun 1, 2006	Mar 5, 2008	May 31, 2007		100%	98.4%	Out of about 61,505 private drains, 56,322 were analyzed by PWSA and about 4,724 were analyzed by private firms for property-sales. Out of 2,741 public storm inlets, 2,146 were analyzed by PWSA. Total drains & inlets analyzed is estimated to be 63,192 out of 64,246.
(E) Enforcement - illegal connections	Jun 1, 2004	Jun 1, 2004	Nov 30, 2007		95%		Continual enforcement of point-of-sale requirements. 1,514 parcels were privately analyzed by separate sanitary sewer area property owners and were granted certifications by PWSA approving the sales if they passed their dye test results. About 4,724 drains were analyzed by private property owners due to the City of Pittsburgh property-sales ordinance requirements. Utility Line Security service corrected over 140 customer parcels with external downspouts and storm drains connected to separated sanitary sewers.

SEMI-ANNUAL PROGRESS REPORT

(Ref: COA, Appendix E)

Authority: Pittsburgh Water and Sewer Authority
Watershed:
Revision Date:

CSO Municipalities

Reporting Period From: July 1, 2010 To: December 31, 2010

Task Description	Proposed Start Date	Actual Start Date	Required Completion Date	Actual Completion Date	Required % of Project Completed	Actual % of Project Completed	Comments
(F) Ordinance Development							
(i) Prohibit Storm Water	Jun 1, 2004	Jun 1, 2004	Nov 1, 2004	Apr 12, 2006	100%	100%	Pittsburgh City Council passed ordinance on 3/28/06, approved by Mayor on 4/5/06. Effective date 7/5/06.
(ii) Point of Sale Ordinance	Jun 1, 2004	Jun 1, 2004	Nov 1, 2004	Apr 12, 2006	100%	100%	Pittsburgh City Council passed ordinance on 3/28/06, approved by Mayor on 4/5/06. Effective date 7/5/06.
(G) Deficiency corrections (Year 1) Critical/SSS	Jun 1, 2005	Jun 1, 2004	Nov 30, 2006	Nov 30, 2006	20%	20% +	Lined, gunited and point repaired or replaced several sewers -- the most severe defects were addressed first.
Deficiency corrections (Year 2) Critical/SSS	Dec 1, 2006	Dec 1, 2006	Nov 30, 2007	Nov 30, 2007	40%	40% +	Lined, gunited and point repaired or replaced several sewers -- the most severe defects were addressed first.
Deficiency corrections (Year 3) Critical/SSS	Dec 1, 2007	Dec 1, 2007	Nov 30, 2008	Nov 30, 2008	60%	50% +	Lined, gunited and point repaired or replaced several sewers -- the most severe defects were addressed first.
Deficiency corrections (Year 4) Critical/SSS	Dec 1, 2008	Dec 1, 2008	Nov 30, 2009	Nov 19, 2010	80%	80%	Responding to significant structural defects, emphasizing the correction of structural failures and those areas determined by project engineers to be imminent structural failures through point repair and line replacement as they are discovered by CCTV inspection. Other less serious problems are rectified by lining, gunite, point repair, as well as line replacement. 184 out of 231 severe deficiencies have been corrected.
Deficiency corrections (Year 5) Critical/SSS	Dec 1, 2009	Nov 20, 2010	Nov 30, 2010		100%	88%	Responding to significant structural defects, emphasizing the correction of structural failures and those areas determined by project engineers to be imminent structural failures through point repair and line replacement as they are discovered by CCTV inspection. Other less serious problems are rectified by lining, gunite, point repair, as well as line replacement. As of November 24 2010, 196 out of 222 severe deficiencies have been corrected.
Deficiency corrections (Year 1) Non-Critical	Dec 1, 2005	Dec 1, 2005	Nov 30, 2006	Nov 30, 2006			Lined, gunited and point repaired or replaced several sewers -- the most severe defects were addressed first.
Deficiency corrections (Year 2) Non-Critical	Dec 1, 2006	Dec 1, 2006	Nov 30, 2007	Nov 30, 2007			Lined, gunited and point repaired or replaced several sewers -- the most severe defects were addressed first.
Deficiency corrections (Year 3) Non-Critical	Dec 1, 2007	Dec 1, 2007	Nov 30, 2008	Nov 30, 2008			Lined, gunited and point repaired or replaced several sewers -- the most severe defects were addressed first.
Deficiency corrections (Year 4) Non-Critical	Dec 1, 2008	Dec 1, 2008	Nov 30, 2009	Nov 30, 2009			Lined, gunited and point repaired or replaced several sewers -- the most severe defects were addressed first.
Deficiency corrections (Year 5) Non-Critical	Dec 1, 2009	Dec 1, 2009	Nov 30, 2010	Nov 30, 2010			Responding to significant structural defects, emphasizing the correction of structural failures and those areas determined by project engineers to be imminent structural failures through point repair and line replacement as they are discovered by CCTV inspection. Other less serious problems are rectified by lining, gunite, point repair, as well as line replacement.
Deficiency corrections (Year 6) Non-Critical	Dec 1, 2010	Dec 1, 2010	Nov 30, 2011				Responding to significant structural defects, emphasizing the correction of structural failures and those areas determined by project engineers to be imminent structural failures through point repair and line replacement as they are discovered by CCTV inspection. Other less serious problems are rectified by lining, gunite, point repair, as well as line replacement.
Deficiency corrections (Year 7) Non-Critical	Dec 1, 2011		May 31, 2012				
(H) Complete system hydraulic characterization (Year 1)	Jun 1, 2004	Jun 1, 2004	May 31, 2005	Dec 31, 2004	25%	25%	Hydraulic models under construction.
Complete system hydraulic characterization (Year 2)	Jun 1, 2005	Jan 1, 2005	May 31, 2006	Dec 31, 2005	50%	50%	Hydraulic model construction is continuing. Dry weather calibration complete, wet weather calibration started.
Complete system hydraulic characterization (Year 3)	Jun 1, 2006	Jan 1, 2006	May 31, 2007	Dec 31, 2006	75%	75%	Hydraulic model construction is continuing. Dry weather calibration complete, wet weather calibration near complete.
Complete system hydraulic characterization (Year 4)	Jun 1, 2007	Jan 1, 2007	May 31, 2008	Jun 30, 2007	100%	100%	Hydraulic model completed, incorporating both dry and wet weather calibration.
(I) Submit report of implementation of nine minimum controls		Jun 1, 2004	Dec 1, 2005	Nov 30, 2005		100%	
Submit supplemental report of implementation of nine minimum controls		Jul 1, 2010	Dec 1, 2010				
PHASE II: Planning							
Flow Monitoring	Jun 1, 2007	January 2004	May 31, 2008	May 31, 2008		100%	PWSA Monitoring Plan submitted January 2004, Flow Monitoring Report submitted February 2007, & Flow Monitoring Extension Report submitted July 2007. PWSA participated in the Regional Flow Monitoring group led by 3RWW. Regional Flow Monitoring Plan submitted June 2006 & Flow Monitoring Report submitted June 2009.

* Attach documentation of work completed during the reporting period.

Based on the above information, are the Municipality and Authority in compliance with the approved schedule? Yes, except as noted (Yes/No) If no, please include an explanation.

The Authority has been prohibited from seeking additional funds (bonds), which would have enabled the Authority to carry out this work, by the Intergovernmental Oversight Board (Oversight Board) for the City of Pittsburgh, established under the Intergovernmental Cooperation Authority Act for Cities of the Second Class, Act of February 12, 2004, P.L. 73, No. 11, 53 P.S. Section 28102, et seq. In addition, the City's capital budget was essentially eliminated for FY 2005 by the Act 47 Plan Coordinator, empowered under the Municipalities Financial Recovery Act of July 10, 1987, P.L. 246, No. 47, 53 P.S. Section 11701.11 et seq. As a result of the fiscal matters referenced above, the Authority/Municipality was behind schedule on the adoption of an ordinance.

Authority Official: Environmental Compliance Coordinator
Signature/Title

January 28, 2011
Date

PWSA CSO volume

2006

not meeting

→ 1994 CSO ~~Policy~~ Policy

→ ~~Dry~~ Dry Weather Discharges

→ Not Meeting WQS.

Allegheny River	Total CSO Volume (Mgal)	
Downtown Allegheny	66.4	
Strip District	117.12	
Two Mile Run	648.16	
Lawrenceville	428.24	
Heth's Run	309.32	
Negley Run	857.63	
TOTAL ALLEGHENY RIVER (Region 1)	**2426.87**	2426.87
Spring Garden	548.89	
East Street	235.45	
Dasher Street	65.15	
TOTAL ALLEGHENY RIVER (Region 2)	**849.49**	**849.49**

Monongahela River		
Downtown Momongahela	94.89	
Second Avenue	148.17	
Boundary street	571.22	
Hazelwood St.	124.96	
Nine Mile Run	275.49	
TOTAL Monongahela River Region 1	**1214.73**	1214.73
Nine Mile Run	3.79	
Arlington through 25th Street	306.9	
Becks Run	160.08	
Streets Run	164.45	
TOTAL Monongahela River Region 2	**631.43**	631.43

Ohio River		
Adams Street	101.85	
Dasher Street	0.74	
Doerr, Superior, Island Ave.	17.84	
Jacks Run	62.55	
Pennsylvania Avenue	56.83	
Woods Run	75.31	
Glen Mawr	155.96	
Saw Mill Run inteceptor	529.47	
TOTAL Ohio River (Region 2)	**1000.55**	1000.55

Saw Mill Run		
Bausman Brook and Warrington	70.6	
Brook-line Blvd	7.24	
Edge-brook Ave	7.73	
Englert and Weyman	0.31	
Little Saw Mill Run	33.6	
McCartney Run	18.69	
McDonoughs Run	36.63	
Olympia Shaler and Woodruff Streets	17.57	
Plummers Run	229.98	
TOTAL Saw Mill Run (Region 2)	**422.35**	422.35

Chartiers Creek		
Chartiers Creek and Bells Run	137.27	
Glen Mawr	163.31	
TOTAL Chartiers Creek (Region 2)	**300.58**	300.58

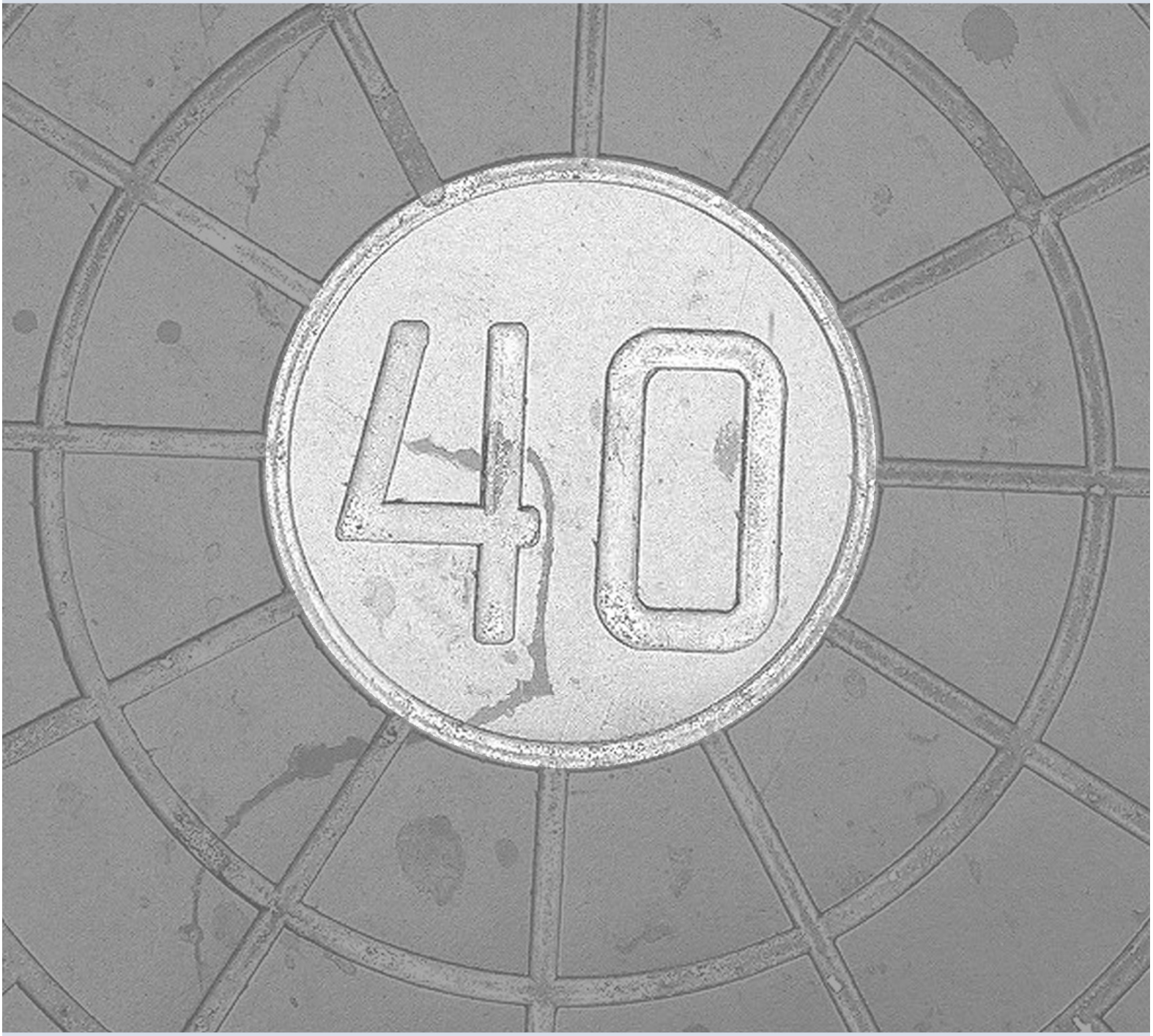
TOTAL PWSA CSO VOLUME **6846 Million Gallons**

6.846 Billion Gallons

on-lot

APPLICATION NO	SENT TO	DATE SENT	SEO ASSIGNED	DATE RETURNE	APPLICANT NAME	APPLICANT ADDRESS	PHONE NUMBER	SITE ADDRESS	MUNICIPALITY	TYPE	STATUS	ACTION
Q-38027	LINDA GRABOWSKI	7/15/99	INKS	9/9/1999	STEPHEN GRABOWSKI	4002 BAKERSTOWN ROAD, GIBSONIA, PA 15044		MCELHINNY ROAD	PITTSBURGH	NEW / SUBDIVISION	INACTIVE	INITIAL APPL INVOICE, READY FOR PITS; 2/7/00 INACTIVE LETTER;
S-51732	JOHN MORGAN	7/12/00	INKS	7/25/2000	JOHN MORGAN	1313 17TH STREET E, PALMETTO, FL 34221		STATION SQUARE	PITTSBURGH	HOLDING TANK	PENDING	INITIAL APPL INVOICE;
T-099855	ARTHUR BAHL		INKS	7/10/2003	ARTHUR BAHL	3854 HARPEN ROAD PITTSBURGH, PA 15214	412-931-2057	3854 HARPEN ROAD	PITTSBURGH	REPAIR	INACTIVE	07/14/03 INITIAL APPL INVOICE; 10/28/04 REFUND REQUESTED -- CONNECTED TO SEWERS
V-008281	MARK TAYLOR	11/15/04	INKS	12/23/2004	OHIO CENTRAL RAILROAD SYSTEM	208 ISLAND AVENUE MCKEES ROCKS, PA 15138	412-331-8200	1529 CHARTIERS VALLEY LANE	PITTSBURGH	HOLDING TANK	INCOMPLETE	12/28/04 INITIAL APPL INVOICE & INC LETTER;

APPENDIX 2-2



CHESTER ENGINEERS, INC.

APPENDIX 2-2
COST TO EXTEND SERVICE TO PA AMERICAN WATER CUSTOMERS IN THE CITY OF PITTSBURGH

TO: M. Mckee

FROM: J. Maslanik cc: C. Jordan

DATE: March 23, 2011

SUBJECT: Conceptual Analysis of the Cost of Providing Water Service to City of Pittsburgh Customers Currently Served by PA American Water Company – Revised Per Refined Estimate of PA American Demand Rates

This memo is an update/revision of a May 5, 2008 memo that I prepared to provide a conceptual analysis of the cost of providing water service to City of Pittsburgh customers who are presently served by the pA Amercian Water Company. The initial memo was based upon a estimated 21-mgd average daily demand rate developed by extrapolating from demands in other PWSA pressure districts. Recent estimates were developed by M. McKee based upon actual metered consumption data. These estimates are more accurate and are significantly lower than the 2008 memo estimates. Therefore, the conclusions of the earlier memo were revised to reflect the lower demands.

The conceptual analysis estimated of the cost of providing the improvements to the PWSA water system required to provide water service to City of Pittsburgh customers who are currently served by the PA American Water Company. In general, this would be accomplished by taking ownership of the PA American Water Company distribution facilities within the City of Pittsburgh. Supplying these distribution facilities could also require improvements to existing PWSA facilities. This memo conceptually identifies the required improvements to the PWSA system.

OVERVIEW

A map of the PWSA water service area, the PA American Water service area in western Pennsylvania, and the portion of the PA American Water service area that lies within the City of Pittsburgh are illustrated in Figure 1. The information regarding the PA American Water service area was drawn from previous work that I had done for Allegheny County. However, I do not have any information relative to the PA American Water distribution facilities themselves.

It appears that most of the PA American Water service area within the City would be served from the Allentown District. This district is supplied by the Mission Pump Station that draws its supply from the Highland 2 Reservoir District.

ESTIMATED WATER USE BY THE PA AMERICAN CITY OF PITTSBURGH CUSTOMERS

M. McKee's procedure for estimating average daily water demands associated with the City of Pittsburgh PA American customers is summarized as follows:

- The number of PA American customers in the City ranged from 20,300 in 2005 to 24,600 in 2010.
- In 2007, metered water usage was recorded for 100% of PA American customers. In other years, only 30% to 78% of customers had recorded water use.
- the average daily metered usage in 2007 was ***4.01*** mgd for 20,305 customers or **197** gpd/customer
- Adjusted average metered usage was calculated for years other than 2007 by taking (total accounts / accounts with usage) x averaged metered usage

- Adjusted average metered usage was **3.94** mgd for the 2005 to 2010 time period. Flow contributions per customer varied from 205 gpd in 2005 to 160 gpd in 2010.

- After metered water usage is adjusted to include "unaccounted for" and "other" water uses, average water demand increases to **6.57** mgd (**3.94**/.6). This amount is significantly less that the 21 mgd average daily demand listed in the May 5, 2008 memo.

I performed an analysis of maximum day to average day pumping rates in the PWSA's Allentown Service District and determined that the ratio of maximum to average day pump rates is 1.6. Applying this factor to the 6.6-mgd average daily rate produces a maximum day rate of 10.6-mgd.

ESTIMATED IMPACTS UPON FACILITIES

Based upon the estimates presented above, providing service to the City of Pittsburgh customers who are presently being served by the PA American Water Company would increase total daily demands by approximately 6.6-mgd on an annual average basis and approximately 10.6-mgd during the maximum month. The resulting effects on the various components of the PWSA system are discussed below.

Water Supply and Treatment

During 2004 through 2007, daily water production by PWSA averaged 73-mgd. The peak day production rate averaged 99-mgd during that time period. Adding the estimated daily demand from the PA American customers would increase the average daily water production to approximately 80-mgd. Adding the estimated maximum monthly average daily demand associated with the PA American customers increases the required average daily production to 99-mgd. Including the PA American demand would increase the required the peak day production rate to approximately 110-mgd.

The current water supply allocation for PWSA is 100-mgd. **Serving the PA American customers would require an increase in the current water allocation to approximately 110-mgd.** One would not expect obtaining an increase in the water allocation to be a major cost item.

The current permitted capacity of the water treatment plant is 117-mgd. **The estimated maximum day demand rate is less than the rated plant capacity.**

Breucken Pump Station Highland 2 Pumping Equipment

Pumping rates by the Breucken Pump Station Highland 2 pumps averaged 16-mgd on an annual average basis during 2004 and 2005. The maximum month daily pumping rate for that time period averaged 19-mgd. Adding the 10.6 maximum daily demand rate for the PA American Water Pittsburgh distribution system increases the pumping rate to 30-mgd. The nominal total pumping capacity of all of the Breucken Highland 2 pumps is 72-mgd. The capacity with one pump out of service is 48-mgd.

The capacity of the Breucken Pump Station Highland 2 Pumping equipment is adequate to supply the estimated PA American customer demands.

Highland 2 Reservoir

The nominal storage capacity of the Highland 2 Reservoir is 125-mg. At the estimated 45-mgd maximum month daily pumping rate into the Highland 2 District (including the PA American demands), the reservoir provides more than 3.75 days of storage. This more than satisfies the general 1-day storage requirement.

The capacity of the Highland 2 Reservoir is sufficient to provide for the estimated PA American customer demands. Moreover, the added demand may improve system performance relative to disinfection byproducts production by reducing residence time in the storage facility.

Highland 2 Transmission Mains

No detailed hydraulic analysis was performed regarding the Highland 2 transmission mains. However, it is not anticipated that improvements to the system of transmission mains would be required. The Highland 2 Reservoir is supplied by two 48-inch rising mains. Under the 45-mgd pumping rate, velocities in the mains will approximate 2.8-fps, an acceptable operating condition. **Therefore, the capacity of the rising mains is expected to be adequate.**

The Mission Pump Station is fed by a network of transmission mains, ranging in size from 16- to 50-inches in diameter. The main feed north of the Monongahela River is a 50-inch transmission main. The maximum month daily demand rate for the combined Allentown plus PA American Pittsburgh service areas is 19-mgd (10.6-mgd PA American Water service area + 8-mgd Allentown District). Even assuming that all of this demand is provided through the 50-inch main, flow velocities will remain below 3-fps. **Considering this and the fact that other mains supply this area, it is anticipated that the capacity of the transmission mains north of the Monongahela River will be adequate**.

The primary feeds to the Mission Pump Station in the South Side are through two 36-inch crossings of the Monongahela River and two 30-inch suction mains. There is the potential for some supply through a connection with the Lanpher District via a crossing of the Ohio River. However, this is considered a secondary feed in this analysis. At the 19-mgd Allentown and PA American Pittsburgh systems demand rate, the velocity in the 36-inch mains will approximate 2.0-fps and roughly 3.0-fps in the 30-inch suction mains. These flow velocities are well within typical design standards, indicating that the river crossings have sufficient capacity.

Mission Pump Station

The Mission Pump Station contains five pumps with a total nominal pumping capacity of 38-mgd. The nominal pumping capacity with the largest pump out of service is 26-mgd. The 19-mgd Allentown and PA American Pittsburgh service areas demand is within the total nominal pumping capacity.

Mission Pump Station Rising Mains

The Allentown Tanks are fed by the Mission Street Pump Station through two 30-inch rising mains. At the 19-mgd demand rate, flow velocities will approximate 3.0-fps. These flow velocities are well within typical design standards.

PA American Pittsburgh System Distribution

We do not have any information relative to the PA American water distribution facilities. Therefore, it is not possible at this point to identify specific improvements that will be required in order to incorporate that system into the PWSA system. However, for the purposes of this analysis, the following assumptions have been made. Clearly, a detailed hydraulic analysis of the PWSA and PA American distribution systems will be required in order to identify specific recommended improvements.

1. A pump station will be required in order to serve the entire system. Figure 3 illustrates the service area and identifies elevations that lie above the service elevation of the Allentown District (1,215-feet). This service elevation represents the elevation above which static pressures would fall below approximately 35-psi with the Allentown Tanks at approximately the 80% full level. As is indicated in Figure 3, there area substantial areas of the PA American Pittsburgh service district that lie above elevation 1,215-feet. Therefore, a pumping station will be required in order to serve the entire service district. The approximate location of the pump station is indicated in Figure 3.

2. A set of transmission mains will be required to supply the existing distribution system. A likely arrangement of such mains would consist of a transmission main creating a loop from the point of

supply in the eastern portion of the Allentown district, traversing the PA American Pittsburgh service district and connecting to the western end of the Allentown district. Separate transmission main legs would be extended to reach other areas of the PA American Pittsburgh service district. The existing PA American Pittsburgh service district distribution mains would be fed from connections to be made to the transmission mains. A conceptual layout of transmission mains through the PA American service district is provided in Figure 2. Available information is insufficient to size the mains at this time.

3. Additional system storage will be required. The total annual average daily demand for the combined Allentown and Pa American Pittsburgh service districts is estimated to be 11.5-mgd (4.9-mgd Allentown + 6.6-mgd PA American) . Using the 1-day of storage guideline, the total system storage requirement is 11.5-mg. The existing Allentown Tanks provide 6-mg of storage volume. Therefore, by this measure, an additional 5.5-mg of system storage is required. It is not known how much storage tank volume currently exists in the PA American. For the purpose of this analysis it is assumed that all of this storage volume will have to be provided. It is also anticipated that the storage would be provided within the PA American Pittsburgh service district upstream of the pump station. Conceptual potential locations for such storage facilities are indicated in Figure 2. The locations were identified solely based upon elevation and existing development factors drawn from the Allegheny County GIS topographic and building footprint databases.

The identified general required improvements associated with the PA American Pittsburgh service are distribution system are a new pump station, a network of transmission mains with connections to the existing distribution system, and approximately 5.5-mg of storage facilities.

The following two additional issues will also need to be addressed, evaluated and resolved. However, we do not have sufficient information to address them at this time.

1. Unless PWSA also serves Mt. Oliver at the time it acquires the PA American Pittsburgh system, provisions will have to be made to maintain connectivity between Mt. Oliver and the remaining PA American system. It is not clear from the limited information available how that can practically be accomplished.

2. Consideration must be given to how the rest of the PA American Water system will operate if the Pittsburgh portion of the system is assumed by PWSA. It is probable that connectivity of the overall system is currently maintained at least to some degree with piping contained within the City portion of the PA American system. The ultimate configuration of the piping must be able to accommodate the continued operation of the rest of the PA American system.

SUMMARY OF IDENTIFIED REQUIRED IMPROVEMENTS AND CONCEPTUAL COST ESTIMATES

Table 2 contains preliminary, conceptual cost estimates for the identified improvements required to facilitate service to the PA American Pittsburgh service area. These costs are very preliminary estimates based upon PWSA experience with generally similar projects, including allowances for the uncertainties inherent in this analysis.

Table 2
Preliminary Conceptual Cost Estimates for Improvements Required to Facilitate Service to the PA American Pittsburgh Service Area

Item	Quantity	Unit Cost	Estimated Construction Cost	Estimated Total Project Cost
Increase water allocation	increase to approximately 130-mgd	n/a	n/a	n/a
Upsize/improve Mission Pump Station	Nominal capacity approximately 34-mgd	lump sum	$10,000,000	$12,500,000
Construct PA American Pittsburgh service area pump station	Nominal capacity approximately 26-mgd	lump sum	$10,000,000	$12,500,000
Construct PA American Pittsburgh service area transmission mains and connections to distribution grid	103,000-feet	$350/foot	$36,100,000	$45,100,000
Construct distribution system storage facilities	5.5-million gallons	$1.5/gallon	$8,500,000	$11,000,000
Total			**$54,600,000**	**$68,600,000**
* unit cost for Mission Pump Station suction piping includes allowance for river crossing				

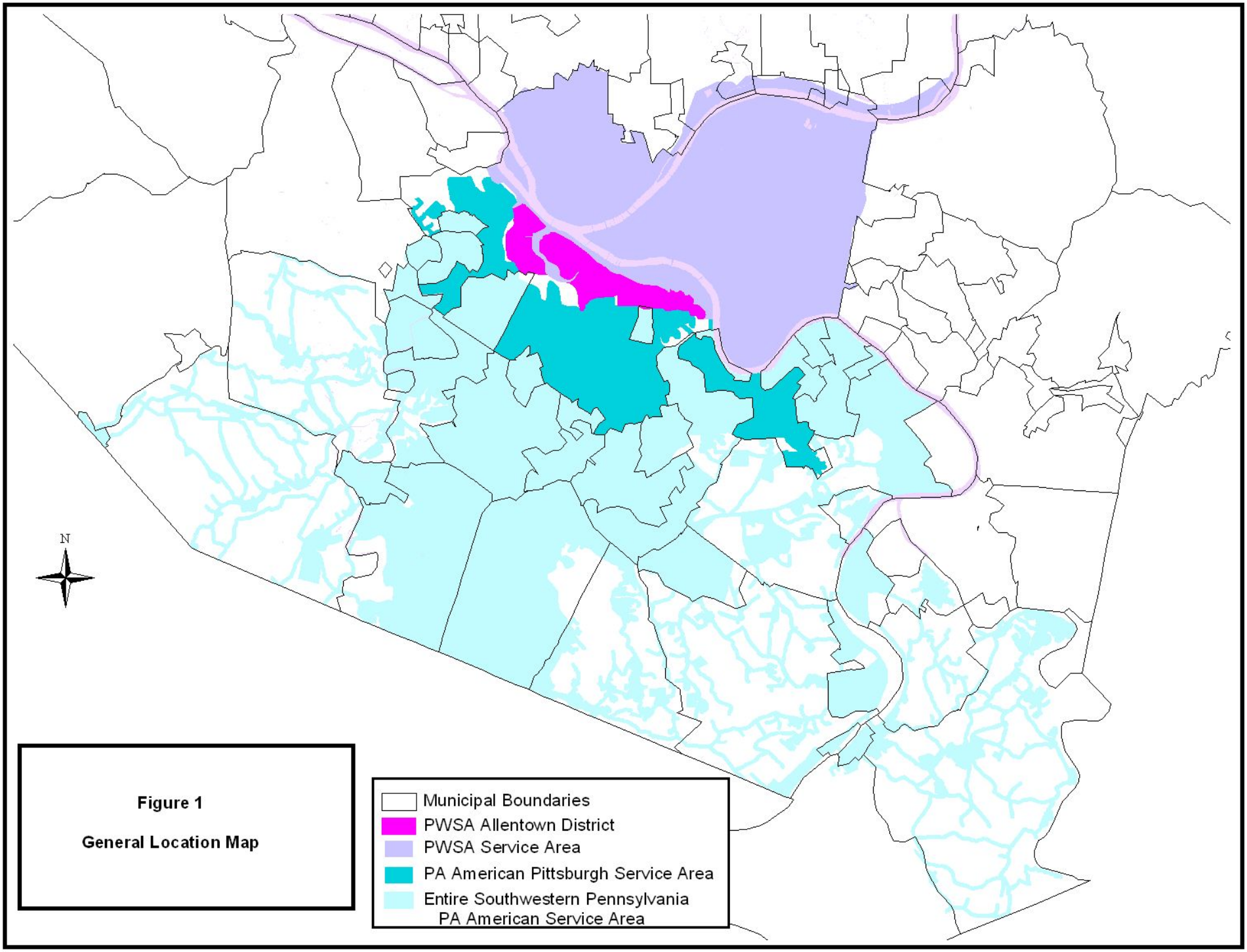


Figure 1

General Location Map

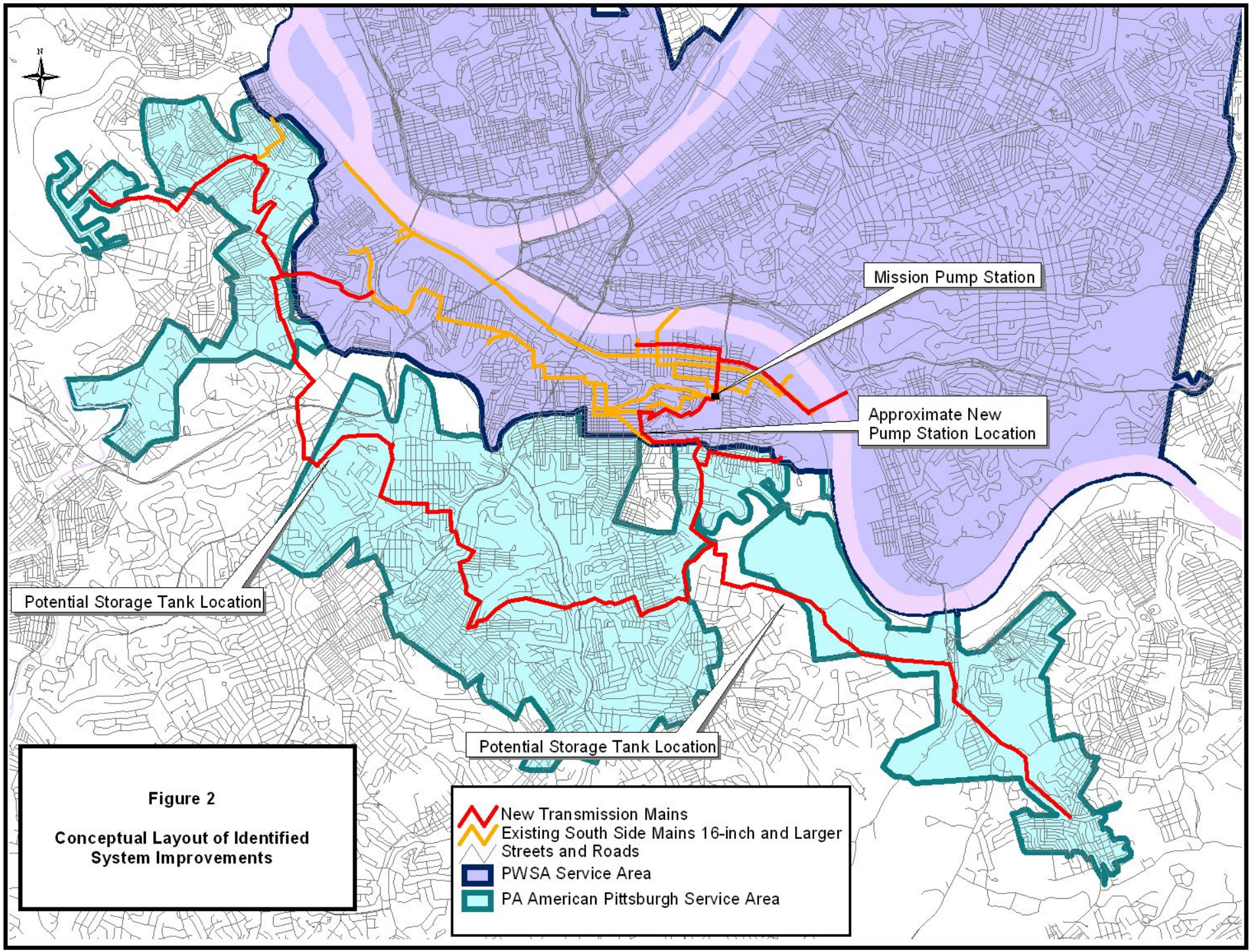


Figure 2

Conceptual Layout of Identified System Improvements

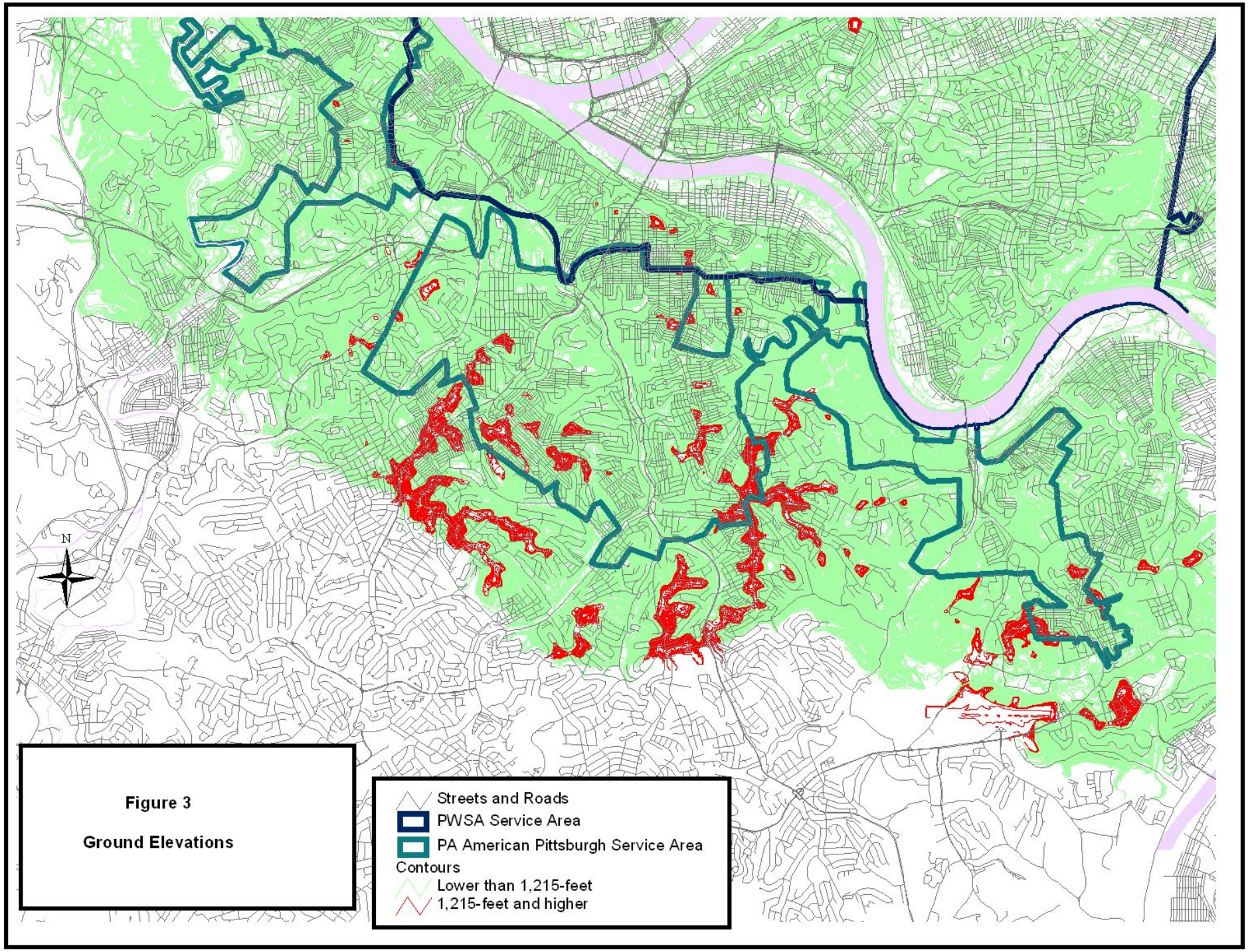
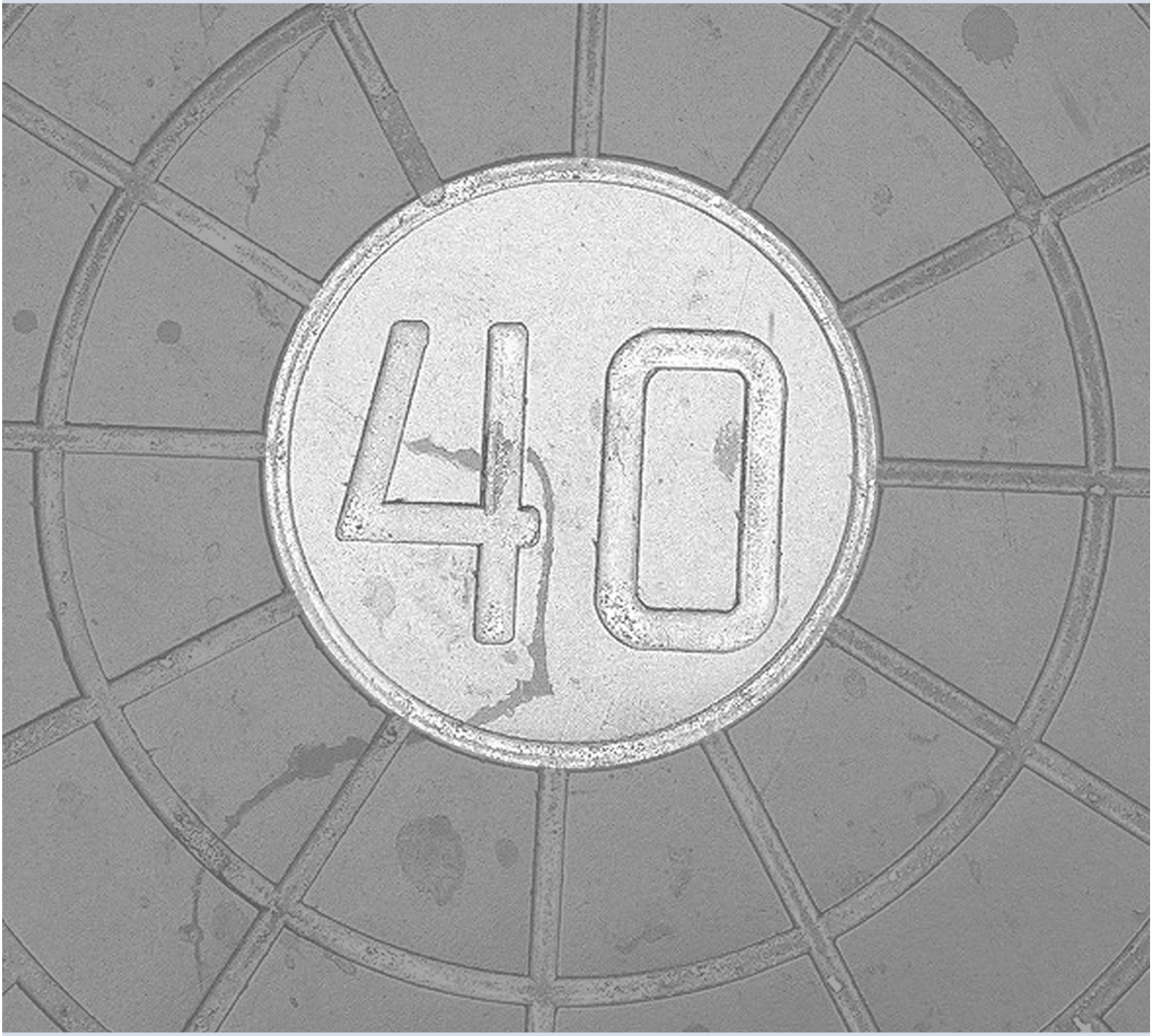


Figure 3

Ground Elevations

APPENDIX 3-1



CHESTER ENGINEERS, INC.

APPENDIX 3-1
WATER SYSTEM INFORMATION FROM GIS

Appendix 3-1

Water System Information

Waterline Information From GIS

Pipe Diameter (Inches)	Pipe Length (Feet)	Percent	Cumulat. Percent
1	3,542	0.07%	0.07%
2	18,670	0.35%	0.42%
4	175,022	3.28%	3.69%
6	2,469,029	46.23%	49.92%
8	1,099,859	20.59%	70.52%
10	92,308	1.73%	72.25%
12	566,140	10.60%	82.85%
15	18,166	0.34%	83.19%
16	253,550	4.75%	87.93%
18	1,058	0.02%	87.95%
20	209,148	3.92%	91.87%
24	85,857	1.61%	93.48%
30	117,803	2.21%	95.68%
36	82,812	1.55%	97.23%
42	24,481	0.46%	97.69%
48	16,150	0.30%	97.99%
50	36,300	0.68%	98.67%
60	56,167	1.05%	99.72%
66	2,170	0.04%	99.77%
72	3,715	0.07%	99.84%
84	3,873	0.07%	99.91%
90	50	0.00%	99.91%
96	4,361	0.08%	99.99%
120	524	0.01%	100.00%

Total * 5,340,755
Miles 1,011.51

* Excludes Abandoned Lines

Pipe Age Distribution

From Year	To Year	Length (feet)	Percent	Cumulat. Percent
1887	1890	28,725	0.56%	0.56%
1891	1900	218,763	4.30%	4.86%
1901	1910	633,419	12.45%	17.31%
1911	1920	334,711	6.58%	23.89%
1921	1930	765,743	15.05%	38.94%
1931	1940	648,178	12.74%	51.68%
1941	1950	300,709	5.91%	57.59%
1951	1960	219,157	4.31%	61.90%
1961	1970	616,592	12.12%	74.02%
1971	1980	641,219	12.60%	86.62%
1981	1990	143,998	2.83%	89.45%
1991	2000	214,129	4.21%	93.66%
2001	2010	323,345	6.35%	100.00%

Total 5,088,689

6.00% of waterlines (by length) have age in GIS
Oldest Pipe 1887 124 years old
Useful life for pipe 70 years
Pipe installed before 1941 will have no value in system valuation

2,629,539 LF waterlines installed before 1941
51.67% of pipes in system

Appendix 3-1 (continued)

Water System Information

Valve Information From GIS

Valve Size (inches)	Quantity	Percent	Cumulat. Percent
1	11	0.04%	0.04%
2	109	0.43%	0.47%
4	609	2.40%	2.88%
6	14,722	58.12%	61.00%
8	5,703	22.51%	83.51%
10	364	1.44%	84.95%
12	2,363	9.33%	94.28%
15	38	0.15%	94.43%
16	545	2.15%	96.58%
18	4	0.02%	96.60%
20	321	1.27%	97.86%
24	189	0.75%	98.61%
30	154	0.61%	99.22%
36	93	0.37%	99.59%
42	32	0.13%	99.71%
48	51	0.20%	99.91%
50	8	0.03%	99.94%
60	11	0.04%	99.99%
72	2	0.01%	100.00%
96	1	0.00%	100.00%

Total 25,330

Total Excludes 1,539 Abandoned and 3,307 Active Private Valves

Valve Types From GIS

Description	Number	Percent
Ball Valve	3	0.01%
Butterfly valve	145	0.57%
Cone Valve	7	0.03%
Gate Valve	19,236	75.94%
Hydrant Valve	5,709	22.54%
Air Gap	1	0.00%
Air Control	139	0.55%
Unknown	27	0.11%
Atmospheric Vacuum	2	0.01%
Altitude	2	0.01%
Double Check	3	0.01%
Pressure Vacuum	3	0.01%
Red. Press. Vacuum	2	0.01%
Simple Check	20	0.08%
Vacuum Release	9	0.04%
Regular	22	0.09%
Total	25,330	100.00%

Valves with ages in GIS 7.1%

Oldest Valve Install Date	1887
Useful Life for Valve (years)	70
Cut-Off Date for Useful Life	1941
Valves Installed Before 1941	50.3%

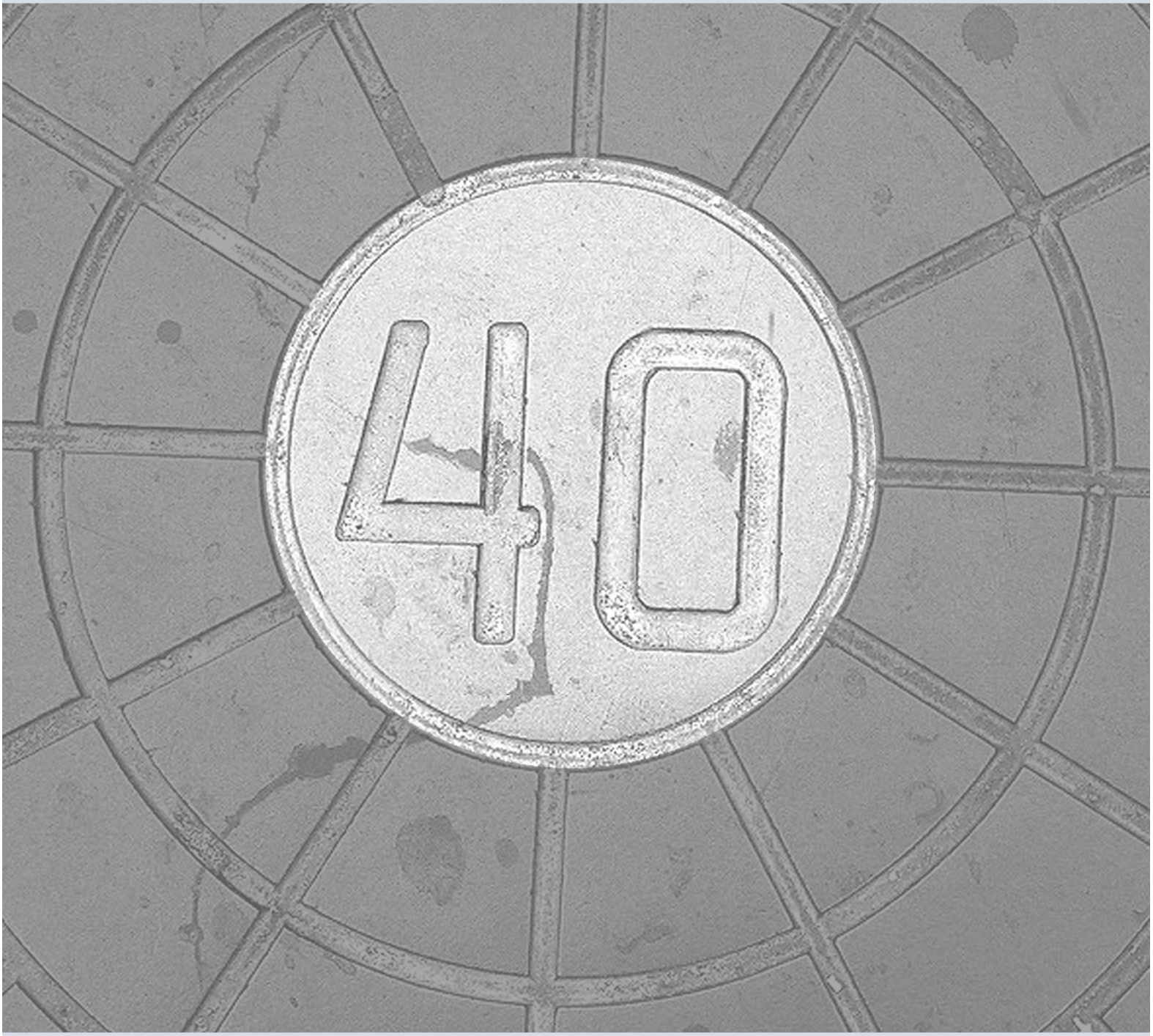
Fire Hydrant Information From GIS

Size	Quantity	Percent
4	85	1.12%
6	7,458	98.68%
8	10	0.13%
12	5	0.07%

Total 7,558 100.00%

No age information for hydrants in GIS

APPENDIX 3-2



CHESTER ENGINEERS, INC.

APPENDIX 3-2
SEWER SYSTEM INFORMATION FROM GIS

Appendix 3-2

Sewer System Information

Sewer Line Information From GIS

Pipe Diameter	Pipe Length	Percent
3	84	0.00%
4	1,807	0.03%
4.8	24	0.00%
5	27	0.00%
6	2,984	0.05%
7.2	34	0.00%
7.8	17	0.00%
8	776,684	12.14%
9	43,494	0.68%
9.6	24	0.00%
10	98,975	1.55%
11	18	0.00%
12	650,606	10.17%
13	71	0.00%
14	417	0.01%
14.4	39	0.00%
15	2,770,241	43.32%
15.6	16	0.00%
16	1,121	0.02%
16.8	261	0.00%
18	570,076	8.91%
19.2	11	0.00%
20	249,204	3.90%
20.4	25	0.00%
21	24,376	0.38%
22	1,366	0.02%
24	337,942	5.28%
27	14,213	0.22%
29	354	0.01%
30	136,386	2.13%
31	1,452	0.02%
33	24,082	0.38%
34	917	0.01%
35	841	0.01%
36	184,933	2.89%
37	339	0.01%
38	1,880	0.03%
39	9,595	0.15%
39.5	1,334	0.02%
40	2,879	0.05%
42	79,174	1.24%
44	725	0.01%
45	5,549	0.09%
46	45	0.00%
48	87,391	1.37%
50	2,169	0.03%
51	2,623	0.04%

Pipe Diameter	Pipe Length	Percent
52	526	0.01%
53	2,498	0.04%
54	51,472	0.80%
56	1,227	0.02%
57	7,887	0.12%
58	493	0.01%
60	44,271	0.69%
64	948	0.01%
66	24,926	0.39%
68	8,555	0.13%
69	4,057	0.06%
70	1,486	0.02%
72	52,708	0.82%
74	157	0.00%
75	3,868	0.06%
78	19,011	0.30%
81	2,775	0.04%
81.5	1,991	0.03%
82	1,032	0.02%
84	9,551	0.15%
85.5	1,948	0.03%
86	1,669	0.03%
87	658	0.01%
88	629	0.01%
89	1,149	0.02%
90	3,584	0.06%
91	3,933	0.06%
93	1,706	0.03%
94	623	0.01%
96	17,038	0.27%
97	511	0.01%
97.5	2,204	0.03%
98	582	0.01%
99.6	617	0.01%
101	1,231	0.02%
102	7,675	0.12%
105	848	0.01%
106	600	0.01%
108	6,117	0.10%
114	2,693	0.04%
120	2,832	0.04%
129	1,416	0.02%
132	1,150	0.02%
135	495	0.01%
141.3	5,111	0.08%
144	1,015	0.02%
168	1,028	0.02%

7.4% of sewers with installation date
1900 oldest sewer

Total 6,395,326 100.00%
1,211.24 miles

Appendix 3-2 (continued)

Sewer System Information

Manhole Information From GIS

Type	Number	Percent
Lamphole	353	1.2%
Manhole Equalizing Chamber	17	0.1%
Manhole Flow Divider	12	0.0%
Manhole	28,702	98.7%

Total 29,084 100.0%

9.90% MHs with install date in GIS
1900 oldest MH

Inlet Information From GIS

Type	Subtype	Number	Percent
Catch Basin	Type 1	8,590	35.6%
	Type 5	166	0.7%
	Type 9	1,851	7.7%
	Type 10	15	0.1%
	Type 11	2,713	11.2%
	Other	792	3.3%
	None	560	2.3%
Headwall	Other	1	0.0%
	None	4	0.0%
Inlet	Type 1	295	1.2%
	Type 5	8	0.0%
	Type 9	41	0.2%
	Type 11	112	0.5%
	Other	31	0.1%
	None	3,201	13.3%
Storm Inlet	Type 1	1,224	5.1%
	Type 5	173	0.7%
	Type 9	1,622	6.7%
	Type 10	5	0.0%
	Type 11	1,903	7.9%
	Other	769	3.2%
	None	67	0.3%

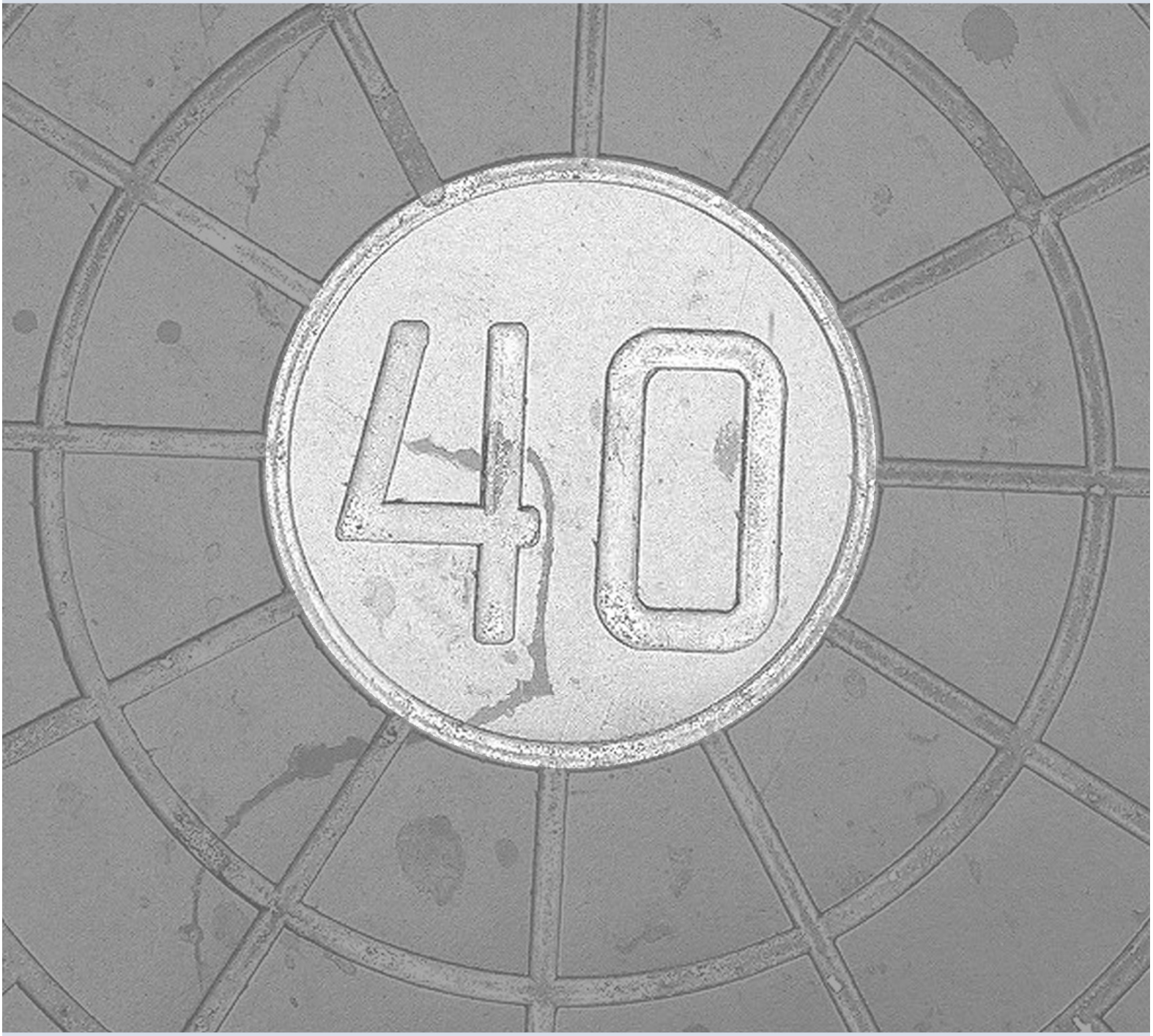
Total 24,143 100.0%

5.2% inlets with install date in GIS
1919 oldest inlet

Diversion Structure Information From GIS

99 diversion structures
46.5% with install date in GIS
1922 oldest diversion structure

APPENDIX 3-3



CHESTER ENGINEERS, INC.

APPENDIX 3-3
1914 ARTICLE ON LANPHER RESERVOIR

WATER WORKS

Design and Construction of the North Side Reservoir of the Pittsburgh Water Works.

The new North Side (Cabbage Hill) reservoir of the Pittsburgh water works is located about six miles from the point section of the city. The flow line elevation is 275 ft., Pittsburgh datum, and is the same as that of the lower Highland Park reservoir which supplies that portion of the central city along both rivers, and the entire South Side.

The reservoir is of 160,000,000 gals. capacity with a water area of 17 acres and a water depth of 38 ft. It has been built by the cut and fill method, three sides being built of rolled embankment, the remaining side being entirely in cuts, surrounded by a reinforced concrete retaining wall along a public roadway. The reservoir is divided into east and west basins by a reinforced concrete dividing wall 18 ft. high, containing the inlet conduit which connects the main, or inlet and outlet gate house in the northerly embankment, with the distribution or secondary gate house in the southerly slope.

The objects of the reservoir are: (1) To replace the old, small and unsafe Troy Hill reservoir in the supply system of the North Side (formerly Allegheny); and (2) to act as an equalizer in conjunction with Highland No. 2 Reservoir. The main distribution feeder mains from both reservoirs are to be cross-connected by a 48-in. steel main under the Allegheny River. The design and construction of the reservoir are here described from information taken from a paper by E. E. Lanpher and J. S. Cole before the Engineers' Society of Western Pennsylvania. The full paper and discussion are in the October, 1914. Proceedings.

In 1896 the former city of Allegheny laid a 60-in. steel water main from its pumping station on the Allegheny River, a distance of about 8.6 miles, to the Troy Hill reservoir. At Etna this main deviated north from the river over a divide and thence back to the river bank near Millvale.

The new North Side reservoir is constructed on this divide, so that the toe of the northerly embankment is bounded by the water main. Allegheny had intended to construct such a reservoir about one-third mile north, and about 100 ft. higher than the present reservoir, and installed two Y's and valves on this main about one-half mile apart and looking toward the higher elevation. These Y's and valves were of great value in the connecting of the new reservoir to the supply main, without interfering with the water supply, inasmuch as the 60-in. main was the sole source of water supply of the North Side.

The reservoir is constructed from designs and specifications prepared in the Division of Engineering and Construction of the Bureau of Water, and contract was awarded upon the unit price basis, July 6, 1912, to the John F. Casey Co. The contract price was $681,976.

EXCAVATION AND EMBANKMENTS.

Work of clearing the site was started July 20, 1912. Preparatory to embankment work, the entire site of 24 acres was cleared of all vegetable growth and the top soil removed to storage piles. Good foundation for embankment was found in most places at a depth of about 18 ins. All embankment material was obtained from excavation in the basin and consisted mainly of first class clay of several shades, and of easily broken stone of shale formation, although in some cases low grade dynamite was used to facilitate digging. Most of this shale disintegrated rapidly when exposed to the atmosphere. A mixture of the clay and shale spread in layers of 6 ins. or less, and rolled with grooved rollers of two tons per foot produced a very hard, impervious embankment, but it was necessary to pass the roller over each layer at least six times to thoroughly compact the soil, and to further break the small stones. (There are no stones in the embankment larger than 4 ins. in diameter.)

Three steam shovels with 3, 1½, and ½ cu. yd. dippers respectively and a McMyler crane were used in excavating, the larger shovels working efficiently in the shale. Four contractor's engines and 50 dump cars, of 4 cu. yds. capacity, were used in conveying the material to the embankments. An engine operated spreader, two road graders and four 16-ton rollers were used in spreading and rolling the embankments. The maximum yardage excavated and rolled in embankment in one day of 11½ hours, was 3,500 cu. yds.

The embankments have a slope on the outside of 2 to 1 for a height of about 20 ft., where there is a 5-ft. berm. Above this berm the slope is 1¾ to 1 for a height of 20 ft. On the inside, the slope is uniform at 2 to 1 from the bottom to the top, the height being about 42 ft. above the floor of the basins. The outside of the embankment was scored and covered with 6 ins. (measured vertically) of top soil, which is seeded and sodded. This top soil was dumped from the top of the embankment, graded and rolled, a horse operated roller being used.

The top of the embankment is 15 ft. wide, while the maximum width of the foot of the embankment is 185 ft.

STEEL PIPE AND CONNECTIONS.

In order to maintain the supply through the single 60-in. main and make the difficult connections to the main gate house, about one-half mile of 60-in. riveted steel main of ⅜-in. plate was laid parallel to, and connected to the Y's left in the old main. From these two mains two 60-in. steel inlet pipes and two 60-in. steel outlet pipes were installed to the main gate house in the northerly embankment. Both 60-in. mains are equipped with Venturi meters (30-in. diameter of throat) consisting of cast iron up-stream ends, bronze throat pieces and reinforced concrete tail pieces. These tail pieces were built in place and at ten days were subjected to a 90-lb. pressure test, showing no signs of leakage.

The 70-ton traveling crane was used in connection with all of the steel pipe work, no tripods being used. Even the excavation was done by this crane with an orange peel bucket. A 300-ft. length of 60-in. pipe was laid in one day, the major portion of it being riveted. At one time it became necessary to shut off the water in the old main, cut out the rivets of three joints, remove 125 ft. of the pipe, replace a portion of this pipe with one section containing a bulkhead and rivet this section to the pipe in place; all of which was done in four hours.

Riveted steel Y's and Tees of ½-in. plate were used in place of the usual cast iron specials.

MAIN AND SECONDARY GATE HOUSES.

The main gate house foundation is a reinforced concrete structure, 42 x 38 ft. in plan, extending from bed rock to the top of the northerly embankment. Water enters through the two inlet pipes at elevation 242.5, and rises in the inlet wells and flows over weirs at elevation 271 into two inlet chambers controlled by stop planks, thence through the main inlet chamber again controlled by stop planks to a 7-ft. reinforced concrete conduit through the embankment and directly across the reservoir to the secondary gate house in the southerly slope. The secondary gate house is a well 24 ft. 6 ins. x 11 ft. 3 ins. in plan, into which the water enters at reservoir floor elevation, rises to elevation 263.90, where it is passed through 5-ft. circular sluice gates to distributing conduits in both basins. The water again re-enters the main house through two 5-ft. reinforced concrete conduits, passing directly through the gate house to the two outlet pipes. Both outlet channels through the gate house are controlled by 6-ft. x 3½-ft. sluice gates in addition to stop planks on both sides of each sluice gate.

The main gate house is so arranged that water may be passed from the inlet pipes to the inlet chambers, to the outlet chambers and outlet pipes, without entering the reservoir. Water may be drained from either basin to the main drain through 3-ft. x 2½-ft. sluice gates in the outlet chambers.

The main gate house was poured in two horizontal sections and five vertical sections, and contains approximately 800 cu. yds. of concrete mixed in a 1-cu. yd. batch mixer, electrically operated, all material being handled by the traveling crane.

The superstructures of these gate houses are not included in the present contract.

DRAINAGE SYSTEM.

In the main gate house a waste weir at elevation 275 is provided against overflowing, the water being carried to the main drain which is a 36-in. circular conduit approximately 2,300 ft. long, running parallel to the main pipe lines to a small stream discharging into the Allegheny River. Into this drain also discharges surface water from a 3 x 2-ft. egg shaped concrete drain, extending along the roadways on the southerly and easterly sides and a 12-in. and 18-in. tile drain extending along the westerly and northerly sides of the reservoir. Along the southerly, or hillside, portion of the reservoir, between the Friday avenue wall and the roadway, a ground water cut-off drain was installed consisting of a 6-in. open joint tile pipe in a 30-in. trench, the trench being filled with gravel to the surface. This tile pipe is at elevation approximately 255, or about 18 ft. above the floor of the basins, and failed to cut off all ground water as was shown when excavation proceeded to grade. This condition caused the construction of shallow diagonal drains under the floor system along the easterly and southerly slopes as nearly perpendicular as possible to the direction of ground water flow as determined by observations from a system of test wells. These diagonal or herring-bone drains carry the water to main collector drains along the toe of the southerly slope, and thence to two 8-in. main drains under the dividing wall and through the embankment to the waste drain in the gate house. All of the collecting drains consist of 4-in. and 6-in. open joint tile surrounded by gravel, all covered by a 12-in. concrete cap which forms a foundation for the floors. The 8-in. drains are surrounded by concrete to prevent upward pressure on the base of the dividing wall.

Steel forms were used for the 36-in. main drain and part of the egg drain, and both drains were poured in two sections, except where the main drain was reinforced near the gate house. In the deep trench of the cut-off drain an A-frame movable crane with hoisting drums was used to remove excavated materials. Concrete in drains was mainly hand mixed. These drains were constructed mainly in cold weather, making it necessary to heat the sand and gravel, and to maintain fires in the trenches.

FRIDAY AVENUE RETAINING WALL.

The reinforced concrete retaining wall, extending for 875 ft. along the southerly side of the reservoir and holding in place a public roadway, is built at the top of the 2 to 1 slope and varies in height from 2 to 21¾ ft. The heel of the wall is tied into a 2x3-ft. egg shaped drain for stability. The vertical section of this wall is 18 ins. thick. The foundation extends 2 ft. in front and in the higher sections 9 ft. back of the face of the wall.

The vertical reinforcing of the higher sections of the wall consists of ⅝-in. rods on 16-in. centers from the top to the base, ⅝-in. rods on 8-in. centers from a point 10 ft. below the top of the base, ⅝-in. rods on 4-in. centers from a point 12 ft. below the top to the base,

and in addition, ¾-in. rods on 10-in. centers through the base and the top of the egg drain, and ⅞-in. rods on 12-in. centers extending from the base both sides of the egg drain, with additional short rods at construction joints.

The base of this wall was constructed in 8-ft. sections because of interference of the bracing that held the roadway in place, while the wall proper was built in 48-ft. sections, or from one galvanized plate expansion joint to another.

After this wall had been practically completed and the slope trimmed, a slippery clay was exposed, showing that a general movement of the wall would probably follow the back-filling. A large toe pier or buttress was therefore constructed below and in front of the base of the retaining wall and extending to the rock, increasing the stability of the wall against sliding from 0.98 to 1.50 as computed from Baker's formula with a coefficient of 0.25 for the sliding of clay on clay. By working the concrete dry a close joint was made between the toe pier and the base of the wall, no sulphur, lead or wedges being used.

Concrete for the wall and toe pier was mixed along Friday avenue in a ½-cu. yd. batch mixer; the A-frame traveling crane being used in the handling of the forms and in the backfilling.

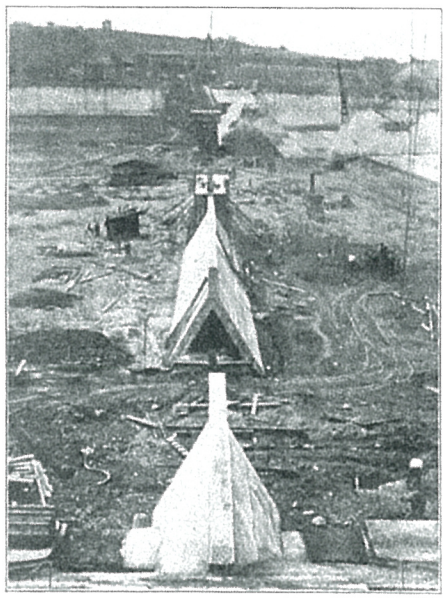


Fig. 1. View of Combined Dividing Wall and Inlet Conduit of North Side Reservoir, of Pittsburgh, Under Construction.

DIVIDING WALL AND CONDUIT.

The original design of the reservoir provided for an earth dividing embankment surmounted by a 7-ft. reinforced concrete inlet conduit extending between the two gate houses. Inability to obtain sufficient clay to mix with the shale for outside embankment purposes caused the substitution of a combined dividing wall and conduit for the dividing embankment and circular conduit. A view of the dividing wall and conduit is shown in Fig. 1.

The conduit wall is a triangular conduit of an area equivalent to a 7-ft. circle, supported on two legs or cut-off walls extending from 5 to 9 ft. below the floor to bed rock, all surmounted by an 18-in. wall about 5 ft. high, making the height of the conduit wall 16 ft. above one basin floor and 18 ft. above the other basin floor. The sides of the triangular conduit are 20 ins. thick, reinforced with ⅞-in. diamond bars on 9-in. centers, extending from the legs to the surmounting walls and ½-in. diamond bars on 12-in. centers at both surfaces. The base of the triangle is designed as a beam with the same reinforcement as the sides. The surmounting wall is designed as a cantilever. Copper expansion joints are used in the legs and floors.

This conduit wall was built in 58½-ft. sections; the legs, the conduit floor and the sides with the surmounting wall being built at separate pourings. It being practically impossible to work the concrete in the conduit forms, two air hammers were kept constantly but gently hammering the forms during the pouring, resulting in a thoroughly compacted concrete of smooth finish. All forms and material for the dividing wall and conduit were handled by the cableway.

That portion of the inlet conduit from the main gate house to the conduit wall is a 7-ft. circular, reinforced, concrete conduit for a distance of 40 ft. to a vertical well, which forms the junction of the circular section and the triangular section of the inlet conduit.

The reinforcement of the circular conduit consisted of ½-in. rods on 6-in. centers running longitudinally, and ½-in. rods on 4-in. centers running transversely, except in the outside layer of the reinforcement in the bottom where ½-in. rods on 24-in. centers running transversely, and ½-in. rods on 4-in. centers running longitudinally, were used.

The concrete for the circular conduit was mixed in a ½-cu. yd. batch mixer, while the concrete for the vertical well was mixed in the central mixing plant, and placed by means of the cableway.

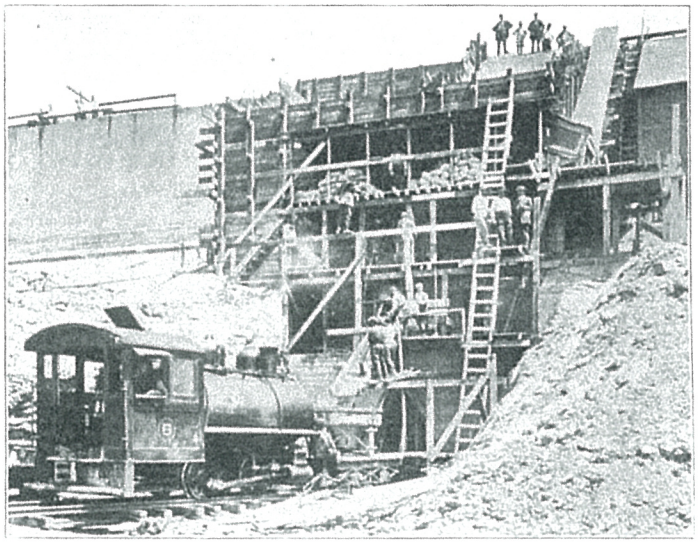


Fig. 2. View of Central Concrete Mixing Plant, North Side Reservoir Construction, Pittsburgh, Pa.

CENTRAL CONCRETE MIXING PLANT AND ITS SUPPLY AND DISTRIBUTION PLANT.

All the sand and gravel used in the construction of the reservoir was dug from the Allegheny River in the vicinity of Hoboken, from which point it was transported in barges to Millvade, where the contractor installed a hoisting plant. The material was taken from the barge in a clam shell bucket and dumped into an elevated storage bin containing compartments for coarse gravel, fine gravel and sand. From this bin it was taken to the reservoir, a distance of 1¾ miles by a group of six 5-ton auto trucks, each truck making from 18 to 20 trips per day of 11 hours. The cement was received at a siding adjacent to the Millvale storage bin, and transported to the reservoir in a 5-ton flat-bed truck. During the summer of 1914 these trucks were operated double shift, or 22 hours per day, in order to maintain a supply of materials at the reservoir site. From the fleet of seven trucks it was found necessary to hold one truck each day in the shop for overhauling.

At the reservoir the supply bins and the cement house were built on the southerly slope between the foundation of the secondary gate house and the Friday Ave. wall. These bins held approximately 400 cu. yds. of concrete gravel, 200 cu. yds. of sand and 200 cu. yds. of coarse gravel. Storage was provided for two cars of cement in the cement house and one car on the platform. Sand and gravel were dumped from the trucks directly into the bins. The cement was dumped on the Friday Ave. platform and hand handled to the chute leading to the cement house.

An electrically operated 1½ cu. yd. batch mixer was installed on the secondary gate house foundation directly in front of the storage bins. The sand and gravel from the bins were controlled by shear gates directly above the mixer hopper, while the cement was placed in a vertical chute directly over the hopper, and controlled by a slide gate. The hopper was standardized for 1 cu. yd. of concrete. During the busy season 1 cu. yd. of concrete could be turned out of the mixer every minute, although the average time of mixing was about 1½ minutes; this, of course, was for wet concrete used in walls and all flat work. The dry concrete used on slopes required about 2¼ minutes for mixing each batch.

The mixer discharged directly into shear gate buckets on flat cars, or to cradle cars. Three contractors' locomotives were required, during the time of the laying of the floor and slope blocks, to transport the concrete from the mixer to the crane. A view of the central mixing plant is shown in Fig. 2.

A stationary cableway was used in the construction of the dividing wall and conduit, and the well in the northerly embankment, also for general transportation purposes from Friday Ave., including the transporting of the steel reinforcement and concrete forms. The head tower is 50 ft. high, located on the southerly side of Friday Ave., and the tail tower is 45 ft. high, located on the gate house in the northerly embankment. The distance between towers is approximately 850 ft.

RESERVOIR LINING.

The lining of the reservoir floor and of the slopes up to the revetment consists of two 4-in. layers of concrete, the joints overlapping 8 ins. instead of the usual method of overlapping from center to center of blocks. The lining of the slopes above the revetment drain consists of a 4-in. layer of concrete covered to a depth of 12 ins. with large gravel, upon which rests a 6-in. layer of reinforced concrete, the waterproofing and a 4-in. surface layer of concrete. The floor blocks are 10 ft. square, while the blocks on the slopes vary from 8 × 10 ft. to 16 × 38 ft., the larger blocks being in the 6-in. reinforced layer.

Waterproofing of the slopes consists of

four 1/16-in. layers of asphalt and three layers of 8-oz. saturated burlap laid alternately, between the layers of concrete, while in the floors three layers of asphalt and two layers of burlap in 18-in. strips were used at the floor joints only in such a manner that the waterproofing overlaps the joints of both layers by 5 ins. All joints were treated with asphalt either by mopping or by pouring the spaces left by the ¼-in. steel plates used as forms. The three-ply waterproofing is about ⅜-in. thick, while the two-ply waterproofing is about ¼-in. thick.

All concrete used below the revetment was mixed at the central mixing plant, transported in 1-cu. yd. batches in shear gate buckets on flat cars, lifted from the flat cars by the 70-ton crane and dumped into the forms. A few of the blocks above the revetment were placed in this same manner; a few such blocks were also built from concrete mixed in a ½ cu. yd. mixed on top of the embankment, dumping directly into the forms; but the major portion of these blocks were built from concrete mixed at the central plant, conveyed in yard cradle cars along the top of the embankment and dumped into the forms. The concrete for the floor blocks was of a wet mix, while the concrete for the slope blocks was much dryer.

On the slopes the usual system of pouring alternate blocks was followed. On the floors the concrete was laid in rows extending from one side of the basin to the opposite side, the longitudinal forms consisting of 4-in. × 6-in. stringers, while the transverse forms were ¼-in. × 4-in. steel plates set in the stringers and the points of the preceding row of blocks. The concrete was finished with straight edge and wooden trowels. In a day of 11 hours 488 cu. yds. of concrete were placed in floor blocks and finished.

The distributing conduits, which extend along the southerly slopes of both basins, were built from concrete mixed in the ½ cu. yd. mixer working along Friday Ave. A section of this conduit is in the form of a trapezoid, the top of which is horizontal, the bottom of which is the upper layer of the floor system on the 2 to 1 slope, and the sides of which are vertical. Circular openings are provided in the top of the conduit, to provide for circulation of water near the secondary gate house.

The asphalt was heated to 400° F. and applied with ordinary cotton mops. In three-ply waterproofing the burlap was lapped 13 ins., the width of burlap being 39 ins.

All concrete used in the construction of the reservoir was of 1:2:4 mix, except in negligible cases, such as manholes, catch basins and gate vaults.

The responsibility of the reservoir lies with Mr. Joseph G. Armstrong and Mr. Robert Swan, former and present directors of the Department of Public Works; Mr. Charles A. Finley, superintendent of the Bureau of Water; Mr. C. O. Daughaday and Mr. John M. Rice, Division Superintendent and Assistant Engineer, respectively, of the division of engineering in charge during the design and first four months of construction work; Mr. E. E. Lanpher and Mr. John S. Cole, Division Superintendent and Assistant Engineer, respectively, of the distribution division, in charge since November, 1912.

DISCUSSION.

The following interesting points were brought out in the discussion. Mr. J. M. Rice explained the advantage of lapping the two layers of concrete only 8 ins. instead of lapping them half their length, as is usually done, as follows:

We adopted this design from experience gained in the construction of the Pittsburgh Filtration Works. During the first season of construction the floor which was of two layers, each 4 ins. thick, was put in with the upper blocks breaking joints at the center of the lower layer blocks, and after the winter had passed we found that the upper blocks had broken just over the joints in the lower layer. In the endeavor to avoid this next season we brought out the construction used here, i. e., offsetting the vertical joints in the upper and lower layers from 6 to 8 ins., and this proved effective.

The explanation for the cause of the cracks offered is that the contraction in the lower blocks during the cold weather had been sufficient to break the upper blocks and by lapping the joints a small amount we did not get that effect, as the adhesion of the surface in contact was less than the strength of the upper layer of concrete, and thus sliding instead of cracking occurred.

In spite of the precaution taken to secure watertightness and the adoption of a waterproofing membrane, this reservoir compares very favorably in cost per million gallons with reservoirs of similar size, as shown in Table I, which gives some costs of large basins constructed in the United States.

One of the most interesting points discovered in the course of the construction work was in connection with the waterproofing. This consisted of three plies of saturated burlap mopped on with hot asphalt. Mr. S. L. Fuller discussed that feature as follows:

The specifications said "all surfaces receiving waterproofing shall be clean, dry and smooth." The word "dry" in relation to setting concrete was subject to the decision of the inspectors and naturally was an open point for argument, as in order to keep the work moving we desired to lay the waterproofing as soon as possible, while the inspectors held out for strictly dry surfaces. We had occasion to remove one of the top blocks and much to our surprise and gratification we found that while the layer of waterproofing which had been mopped on to the 24-hour old concrete had no adhesion to it at all, yet the top block which had been poured wet on to the asphalt could not be separated from it. We then made several experiments and we found that the best bond between the asphalt and concrete was obtained when the asphalt was mopped on as soon as the concrete had set, so that it could be walked on without injury. The theory we advance is that as soon as concrete starts to set it starts to "dust," and by applying the asphalt practically before this starts we avoid the thin layer of dust, which it is impossible to remove and which prevents the close adhesion of asphalt to concrete.

Probably the most remarkable thing about the job was the speed obtained in laying the 4-in. floor slabs. Through a carefully designed concrete plant with one Ransome 40 cu. ft. mixer, motor driven, we were able to average 375 cu. yds. per day for a period of four weeks, the maximum day's output being 489 cu. yds. All of the material for this was hauled by five, 5-ton Pierce Arrow motor trucks, which we found most economical in operation. These we worked 24 hours a day and they hauled over a distance of 1¾ miles, the last ¾ mile being all up a 4 to 6 per cent grade. The economy of the motor truck was marked. We cut down the haul by probably half over what we could have accomplished with teams, and it would have been impossible to complete the reservoir in one season had it not been for the truck proposition, because we could not have worked 150 teams in and out. As it was, with the team making six trips a day from the hoist to the job, we had to snap them all up the hill. We put on three teams and had four teams to bring up the three wagons. That was before we procured the trucks. Of course the upkeep of trucks is heavy on that hill, but there is no question that the truck proposition was the life saver of the job.

TABLE I.—COST OF SIX LARGE AMERICAN WATER WORKS RESERVOIRS.

Reservoir.	Location.	Capacity in million gals.	Cost.	Cost per million gals.
Queen Lane	Philadelphia, Pa.	383	$1,188,000	$3,100
New Roxborough	Philadelphia, Pa.	147	524,000	3,600
Settling Basins	Cincinnati, Ohio	330	1,276,000	3,900
Service Reservoir	Minneapolis, Minn.	93	442,000	4,750
Prospect	Rochester, N. Y.	110	554,000	5,000
Northside	Pittsburgh, Pa.	150	676,000	4,100

Time Studies in Connection With the Cleaning of Filter Sand at Philadelphia.

Efficiency in municipal government will only come about as the work in the various departments is put on a basis which gives each man, from the common laborer up to the skilled artisan and clerk, a well-defined task to do in a given time, with a definite reward for its accomplishment. Under the ordinary methods of handling city work it is cheaper where there is fair competition to let work by contract than to handle it by day labor. With an effective system that eliminates not merely favoritism but also presents a definite incentive for each man to do a fair day's work, the day labor plan becomes more attractive from an economic standpoint. The construction and maintenance work in the department of public works is a field that offers the largest opportunities from an engineering standpoint. It includes such operations as trenching, pipe-laying, sewer construction, aqueduct construction, filter cleaning, street cleaning, road building, grading, concrete work and building construction. Under ordinary municipal management it is out of the question, as above indicated, to handle work of this kind economically. However, practically every one of the classes of work mentioned has been handled at large reduction of cost by means of systematic planning of the work in advance and layout of tasks or establishment of piece rates.

The present article describes one accomplishment of Philadelphia along the line of improved methods. The particular operation studied is the cleaning of filter sand. Our information is from a paper before the American Society of Mechanical Engineers by Mr. Sanford E. Thompson.

Philadelphia has five large filtration plants consisting of covered reservoirs operated by slow sand filtration. The water pumped into the reservoir from the Schuylkill and the Delaware Rivers, after passing through the pre-filters, percolates through about 4 ft. of sand and gravel and is thus purified. The impurities are caught largely in the upper few inches of sand, so that if this upper portion is washed the filtration area is practically renewed. Several methods of cleaning filter sands are in use, all of them involving considerable manual labor. Further details of the methods followed in the case under observation are referred to below.

RESULTS.

The object of the plan has been to lay out the work of each gang of men so as to increase the effectiveness of the plant and provide a definite task to be accomplished in a day. The results of the plan which is being put into operation are as follows:

Rotation of cleaning the filters is planned in advance by well-defined rule.

A definite area of sand to clean is assigned to each gang, this area depending upon the depth of cleaning necessary.

This setting of tasks has increased output of each gang 15 per cent and this should be further increased to at least 25 per cent.

Accurate records are kept, showing the time consumed by each gang.

Cost accounts, as well as pay-roll, are made up from the time tickets furnished to the men.

Gang leaders are required to pay closer attention to their duties.

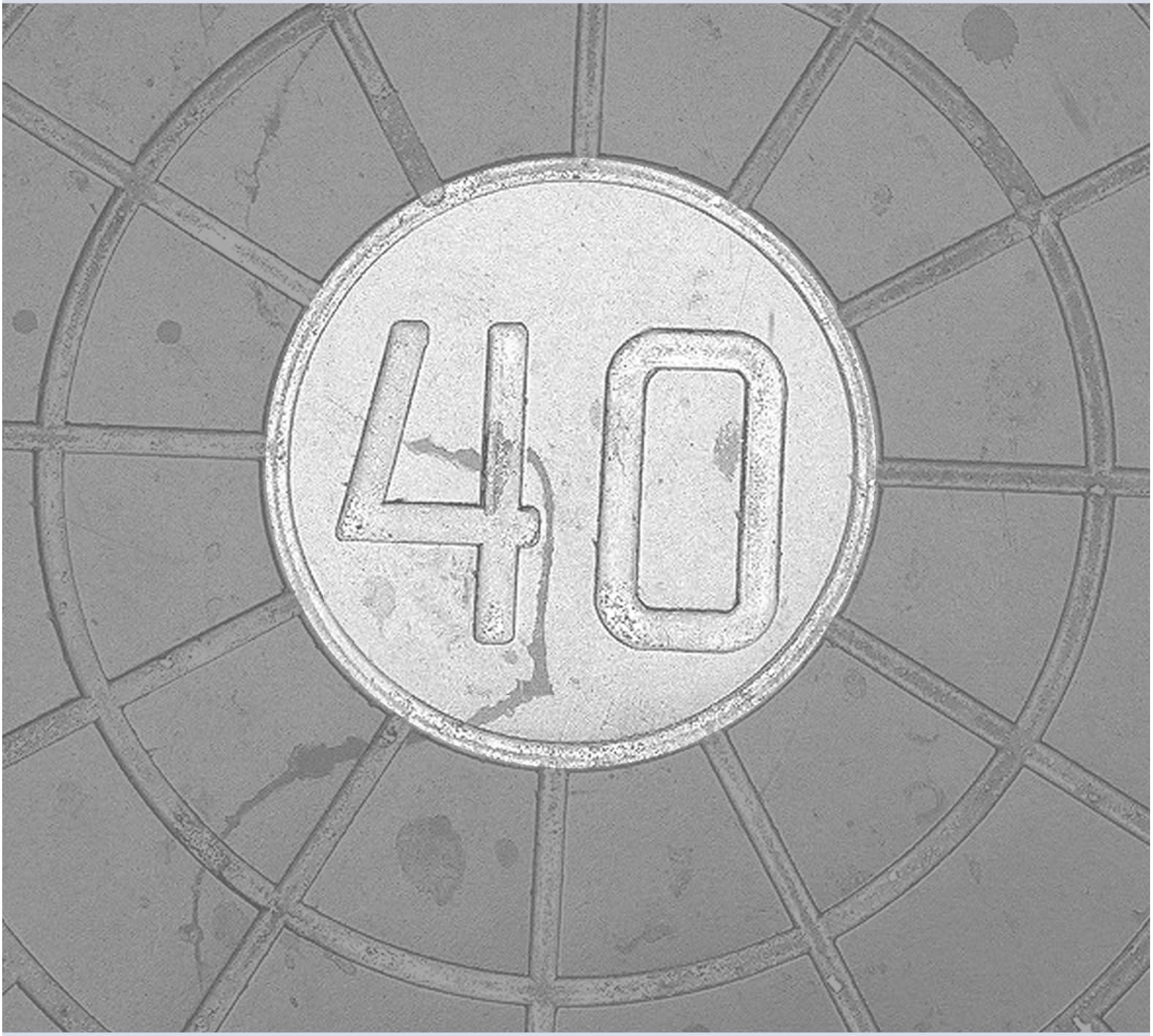
Improved apparatus and machinery are under consideration.

Methods of determining depths of sand to clean are being standardized.

OBSTACLES.

The greatest obstacle encountered has been the city ordinance fixing the rate of pay of unskilled laborers on a level wage per day

APPENDIX 3-4



CHESTER ENGINEERS, INC.

APPENDIX 3-4
WATER DISTRIBUTION SYSTEM COST ESTIMATE INFORMATION

PWSA 40-Year Plan
Estimated Costs for Waterline Excavation, Backfill, and Paving
From RS Means Heavy Construction Cost Data 2011

Excavation - assumes no slope for trench walls

Depth of cover over pipe (C) =	48	inches =	4.00	feet
Trench width on each side of pipe =	12	inches =	1.00	feet
Trench depth below bottom of pipe =	6	inches =	0.50	feet

Pipe Diameter (inches)	Pipe Diameter (feet)	Pipe Area (sq. ft.)	Trench Width "W " (feet)	Trench Depth "D" (feet)	Excav. Trench Volume (Cu. Ft.)	Excav. Cost per LF @ $0.52 per Cu. Ft.
1	0.08	0.01	1.00	4.58	4.58	2.40
1.5	0.13	0.01	1.00	4.63	4.63	2.42
2	0.17	0.02	1.00	4.67	4.67	2.44
3	0.25	0.05	1.00	4.75	4.75	2.49
4	0.33	0.09	2.33	4.83	11.28	5.91
6	0.50	0.20	2.50	5.00	12.50	6.55
8	0.67	0.35	2.67	5.17	13.78	7.22
10	0.83	0.55	2.83	5.33	15.11	7.91
12	1.00	0.79	3.00	5.50	16.50	8.64
14	1.17	1.07	3.17	5.67	17.94	9.40
15	1.25	1.23	3.25	5.75	18.69	9.79
16	1.33	1.40	3.33	5.83	19.44	10.18
18	1.50	1.77	3.50	6.00	21.00	11.00
20	1.67	2.18	3.67	6.17	22.61	11.84
24	2.00	3.14	4.00	6.50	26.00	13.62
30	2.50	4.91	4.50	7.00	31.50	16.50
36	3.00	7.07	5.00	7.50	37.50	19.64
42	3.50	9.62	5.50	8.00	44.00	23.05
48	4.00	12.57	6.00	8.50	51.00	26.71
50	4.17	13.64	6.17	8.67	53.44	27.99
60	5.00	19.63	7.00	9.50	66.50	34.83
66	5.50	23.76	7.50	10.00	75.00	39.28
72	6.00	28.27	8.00	10.50	84.00	44.00
84	7.00	38.48	9.00	11.50	103.50	54.21
90	7.50	44.18	9.50	12.00	114.00	59.71
96	8.00	50.27	10.00	12.50	125.00	65.47
120	10.00	78.54	12.00	14.50	174.00	91.13

PWSA 40-Year Plan
Estimated Costs for Waterline Excavation, Backfill, and Paving
From RS Means Heavy Construction Cost Data 2011

Backfill - assumes $40.00 per cubic yard cost for trench backfill material

Depth of cover over pipe (C) =	42	inches =	3.50	feet
Trench width on each side of pipe =	12	inches =	1.00	feet
Trench depth below bottom of pipe =	6	inches =	0.50	feet

Pipe Diameter (inches)	Pipe Diameter (feet)	Pipe Area (sq. ft.)	Trench Width "W" (feet)	Trench Depth "D" (feet)	Backfill Trench Volume (Cu. Ft.)	Backfill Cost per LF @ $1.48 per Cu. Ft.
1	0.08	0.01	1.00	4.08	4.08	6.04
1.5	0.13	0.01	1.00	4.13	4.11	6.09
2	0.17	0.02	1.00	4.17	4.14	6.14
3	0.25	0.05	1.00	4.25	4.20	6.22
4	0.33	0.09	2.33	4.33	10.02	14.85
6	0.50	0.20	2.50	4.50	11.05	16.38
8	0.67	0.35	2.67	4.67	12.10	17.92
10	0.83	0.55	2.83	4.83	13.15	19.48
12	1.00	0.79	3.00	5.00	14.21	21.06
14	1.17	1.07	3.17	5.17	15.29	22.65
15	1.25	1.23	3.25	5.25	15.84	23.46
16	1.33	1.40	3.33	5.33	16.38	24.27
18	1.50	1.77	3.50	5.50	17.48	25.90
20	1.67	2.18	3.67	5.67	18.60	27.55
24	2.00	3.14	4.00	6.00	20.86	30.90
30	2.50	4.91	4.50	6.50	24.34	36.06
36	3.00	7.07	5.00	7.00	27.93	41.38
42	3.50	9.62	5.50	7.50	31.63	46.86
48	4.00	12.57	6.00	8.00	35.43	52.49
50	4.17	13.64	6.17	8.17	36.73	54.41
60	5.00	19.63	7.00	9.00	43.37	64.24
66	5.50	23.76	7.50	9.50	47.49	70.36
72	6.00	28.27	8.00	10.00	51.73	76.63
84	7.00	38.48	9.00	11.00	60.52	89.65
90	7.50	44.18	9.50	11.50	65.07	96.40
96	8.00	50.27	10.00	12.00	69.73	103.31
120	10.00	78.54	12.00	14.00	89.46	132.53

PWSA 40-Year Plan
Estimated Costs for Waterline Excavation, Backfill, and Paving
From RS Means Heavy Construction Cost Data 2011

$125 per ton for asphalt paving
680 pounds of asphalt per square yard
42.5 per sqare yard

Paving - assumes $42.50 per square yard cost for 6 inch thick asphalt paving

Trench width on each side of pipe = 12 inches = 1.00 feet

Pipe Diameter (inches)	Pipe Diameter (feet)	Pipe Area (sq. ft.)	Paving Area (sq. ft.)	Paving Cost per LF @ $4.72 per sq. ft.
1	0.08	0.01	1.00	4.72
1.5	0.13	0.01	1.00	4.72
2	0.17	0.02	1.00	4.72
3	0.25	0.05	1.00	4.72
4	0.33	0.09	2.33	11.02
6	0.50	0.20	2.50	11.81
8	0.67	0.35	2.67	12.59
10	0.83	0.55	2.83	13.38
12	1.00	0.79	3.00	14.17
14	1.17	1.07	3.17	14.95
15	1.25	1.23	3.25	15.35
16	1.33	1.40	3.33	15.74
18	1.50	1.77	3.50	16.53
20	1.67	2.18	3.67	17.31
24	2.00	3.14	4.00	18.89
30	2.50	4.91	4.50	21.25
36	3.00	7.07	5.00	23.61
42	3.50	9.62	5.50	25.97
48	4.00	12.57	6.00	28.33
50	4.17	13.64	6.17	29.12
60	5.00	19.63	7.00	33.06
66	5.50	23.76	7.50	35.42
72	6.00	28.27	8.00	37.78
84	7.00	38.48	9.00	42.50
90	7.50	44.18	9.50	44.86
96	8.00	50.27	10.00	47.22
120	10.00	78.54	12.00	56.67

Pipe Installation Costs
From RS Means Heavy Construction Cost Data 2011
Mechanical Joint Class 50 DI pipe

Pipe Diameter (inches)	Material	Labor	Equipment	Total	Total Incl. O&P	O&P Multiplier
4	12.50	8.55	2.17	23.22	29.00	1.25
6	14.60	10.70	2.72	28.02	35.00	1.25
8	21.00	12.80	3.26	37.06	46.00	1.24
10	26.50	14.95	3.80	45.25	55.50	1.23
12	32.00	16.25	4.13	52.38	64.00	1.22
14	48.50	17.10	4.34	69.94	84.50	1.21
16	50.00	23.50	5.95	79.45	97.00	1.22
18	53.00	25.00	6.30	84.30	103.00	1.22
20	56.00	30.00	7.60	93.60	115.00	1.23
24	61.00	36.50	9.25	106.75	132.00	1.24
						1.23 ave. multiplier

Calculated Values for Ductile Iron Pipe Based on Best Fit Lines
Excluding Excavation, Backfill, Paving

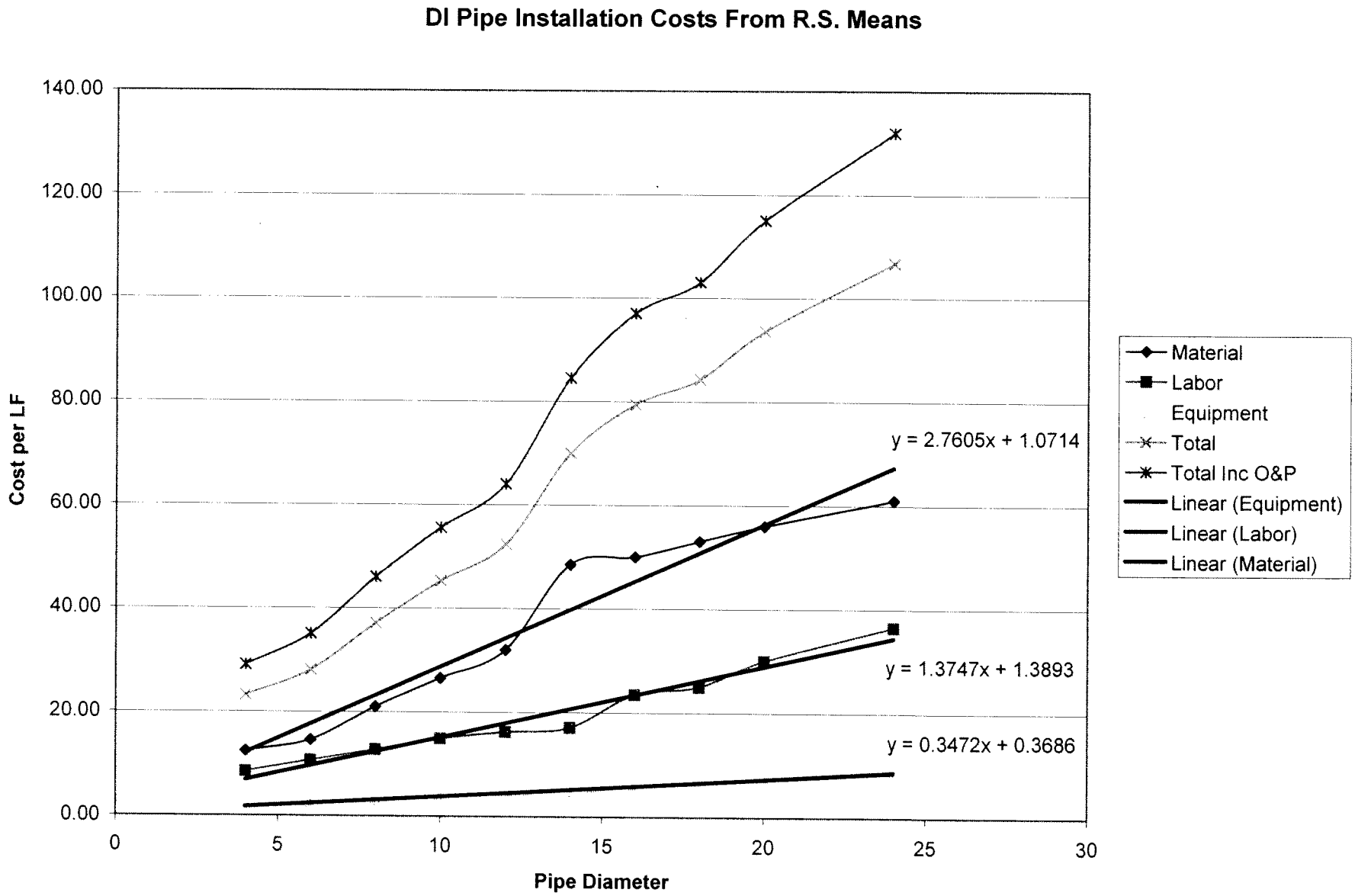
Pipe Diameter (feet)	Material	Labor	Equipment	Total	Total Incl. O&P
4	12.11	6.89	1.76	20.76	25.54
6	17.63	9.64	2.45	29.72	36.57
8	23.16	12.39	3.15	38.69	47.60
10	28.68	15.14	3.84	47.65	58.63
12	34.20	17.89	4.54	56.62	69.66
14	39.72	20.64	5.23	65.58	80.69
15	42.48	22.01	5.58	70.07	86.21
16	45.24	23.38	5.92	74.55	91.72
18	50.76	26.13	6.62	83.51	102.75
20	56.28	28.88	7.31	92.48	113.78
24	67.32	34.38	8.70	110.41	135.84
30	83.89	42.63	10.78	137.30	168.93
36	100.45	50.88	12.87	164.20	202.02
42	117.01	59.13	14.95	191.09	235.11
48	133.58	67.37	17.03	217.98	268.20
50	139.10	70.12	17.73	226.95	279.23
60	166.70	83.87	21.20	271.77	334.38

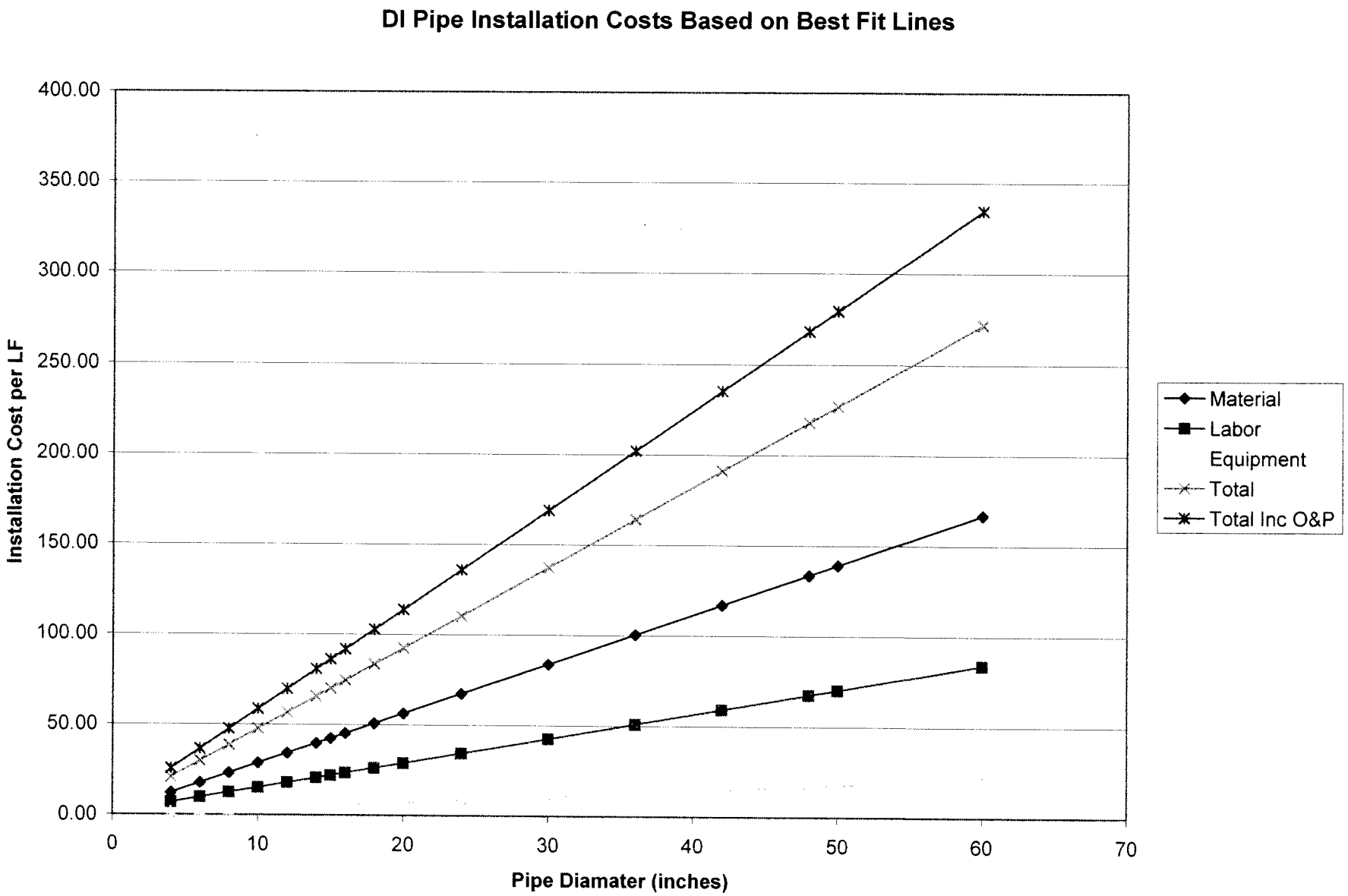
Costs for Copper Pipe, Type K
Excluding Excavation, Backfill, Paving

Pipe Diameter (feet)	Material	Labor	Equipment	Total	Total Incl. O&P
1					14.65
1.5					22.50
2					32.50
3					65.00

Costs for Prestressed Concrete Cylinder Pipe (PCCP)
Excluding Excavation, Backfill, Paving

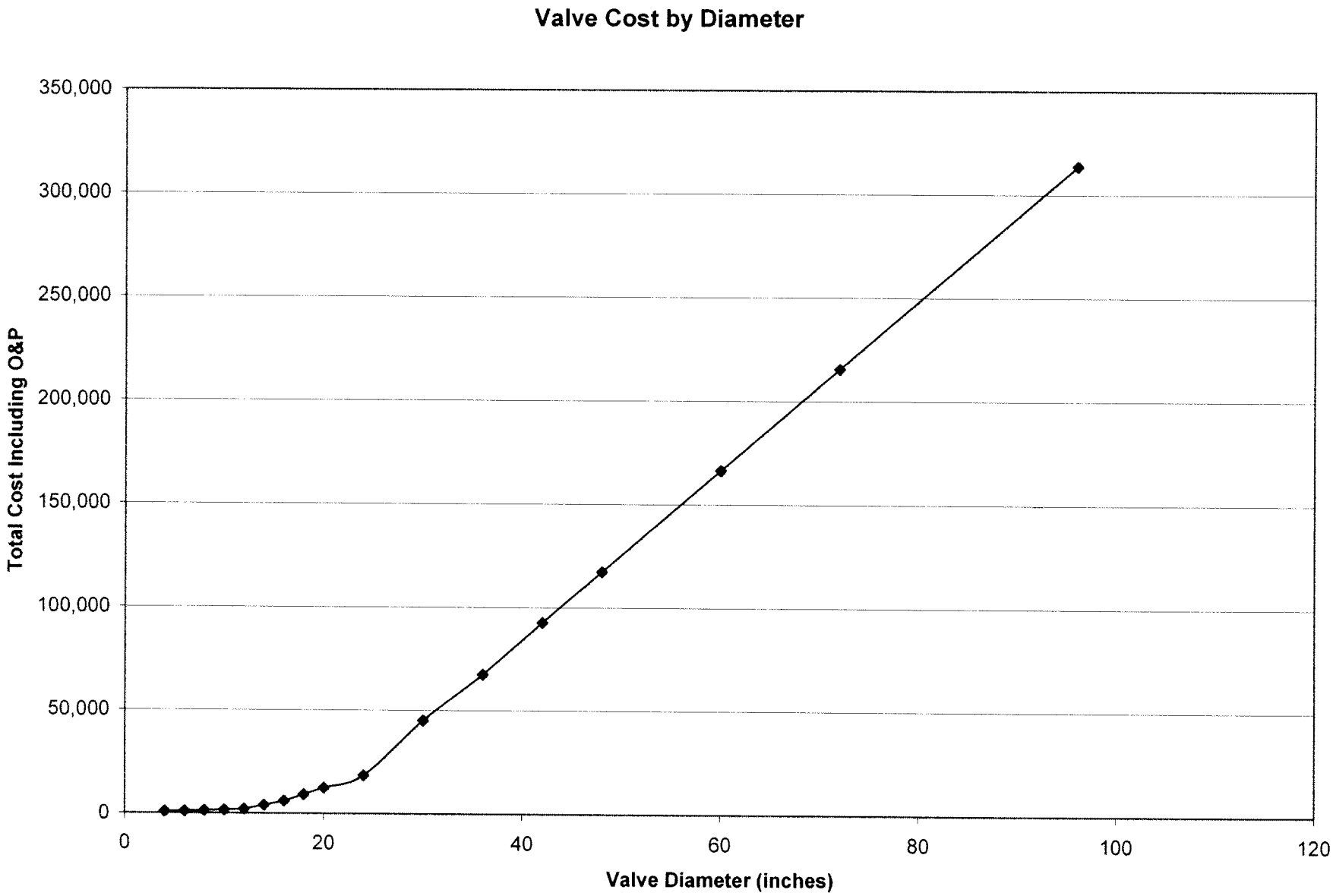
Pipe Diameter (feet)	Material	Labor	Equipment	Total	Total Incl. O&P
66					450.00
72					495.00
84					660.00
90					800.00
96					940.00
120					1,950.00


DI Pipe Installation Costs From R.S. Means
140.00
120.00
100.00
80.00
60.00
40.00
20.00
0.00
Cost per LF
0
5
10
15
20
25
30
Pipe Diameter
y = 2.7605x + 1.0714
y = 1.3747x + 1.3893
y = 0.3472x + 0.3686
Material
Labor
Equipment
Total
Total Inc O&P
Linear (Equipment)
Linear (Labor)
Linear (Material)

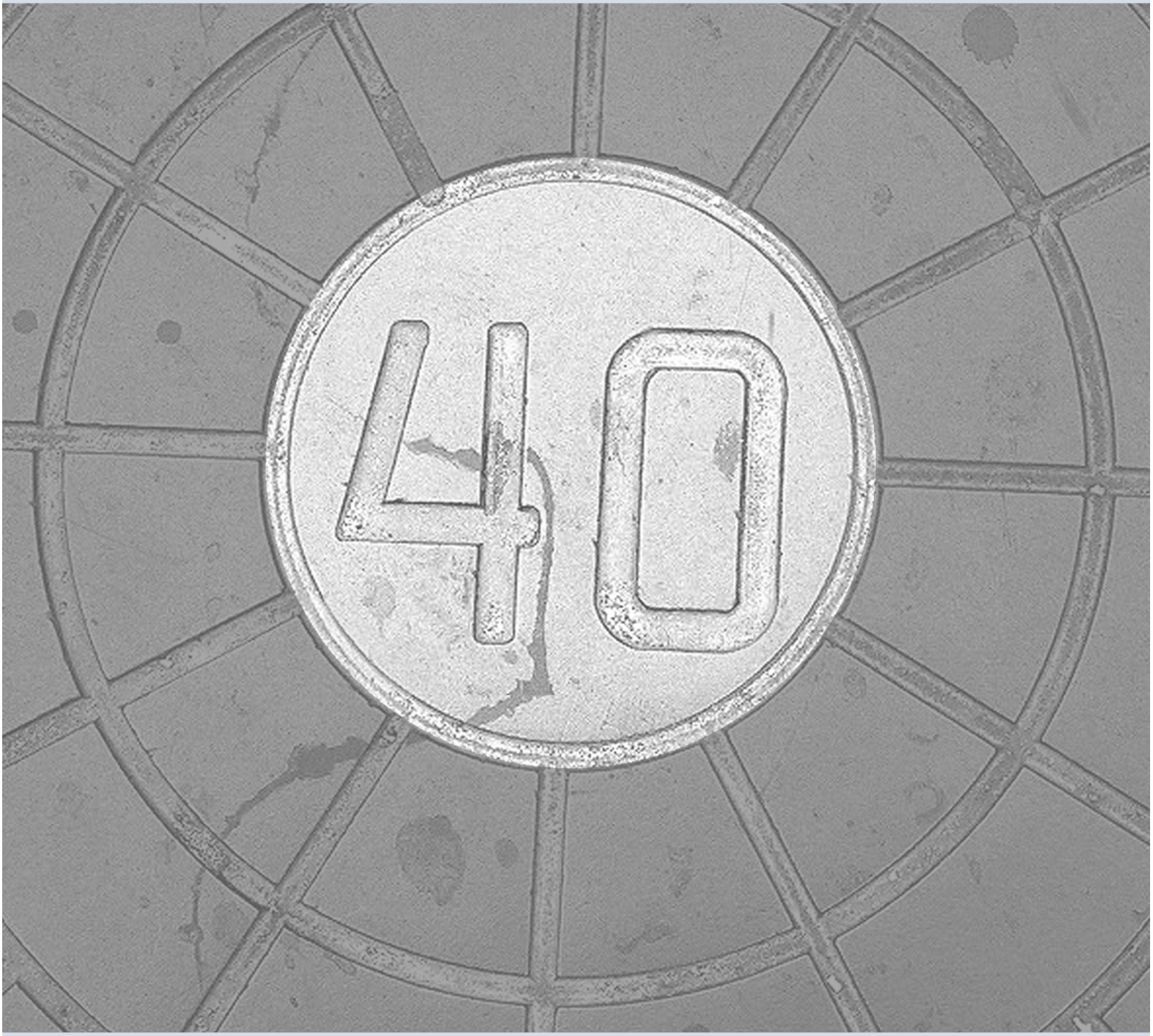

DI Pipe Installation Costs Based on Best Fit Lines
Installation Cost per LF
400.00
350.00
300.00
250.00
200.00
150.00
100.00
50.00
0.00
0
10
20
30
40
50
60
70
Pipe Diamater (inches)
Material
Labor
Equipment
Total
Total Inc O&P

Total Estimated Cost for Water Piping Installation per LF

Pipe Diameter (inches)	Excavation	Backfill	Paving	Pipe Material	Piping Subtotal	Allowance for Fittings 10.00% percent	Rounded Cost per LF
1	2.40	6.04	4.72	14.65	27.81	2.78	31.00
1.5	2.42	6.09	4.72	22.50	35.74	3.57	39.00
2	2.44	6.14	4.72	32.50	45.81	4.58	50.00
3	2.49	6.22	4.72	65.00	78.43	7.84	86.00
4	5.91	14.85	11.02	25.54	57.32	5.73	63.00
6	6.55	16.38	11.81	36.57	71.30	7.13	78.00
8	7.22	17.92	12.59	47.60	85.33	8.53	94.00
10	7.91	19.48	13.38	58.63	99.41	9.94	109.00
12	8.64	21.06	14.17	69.66	113.53	11.35	125.00
14	9.40	22.65	14.95	80.69	127.70	12.77	140.00
15	9.79	23.46	15.35	86.21	134.80	13.48	148.00
16	10.18	24.27	15.74	91.72	141.91	14.19	156.00
18	11.00	25.90	16.53	102.75	156.18	15.62	172.00
20	11.84	27.55	17.31	113.78	170.49	17.05	188.00
24	13.62	30.90	18.89	135.84	199.25	19.92	219.00
30	16.50	36.06	21.25	168.93	242.74	24.27	267.00
36	19.64	41.38	23.61	202.02	286.65	28.67	315.00
42	23.05	46.86	25.97	235.11	330.99	33.10	364.00
48	26.71	52.49	28.33	268.20	375.74	37.57	413.00
50	27.99	54.41	29.12	279.23	390.75	39.08	430.00
60	34.83	64.24	33.06	334.38	466.51	46.65	513.00
66	39.28	70.36	35.42	450.00	595.06	59.51	655.00
72	44.00	76.63	37.78	495.00	653.40	65.34	719.00
84	54.21	89.65	42.50	660.00	846.36	84.64	931.00
90	59.71	96.40	44.86	800.00	1,000.97	100.10	1,101.00
96	65.47	103.31	47.22	940.00	1,156.00	115.60	1,272.00
120	91.13	132.53	56.67	1,950.00	2,230.33	223.03	2,453.00


Valve Cost by Diameter
350,000
300,000
250,000
200,000
150,000
100,000
50,000
0
Total Cost Including O&P
0
20
40
60
80
100
120
Valve Diameter (inches)

APPENDIX 3-5



CHESTER ENGINEERS, INC.

APPENDIX 3-5
TREATMENT, PUMPING, AND STORAGE COST ESTIMATE INFORMATION

Highland Membrane Filtration Plant
Cost for Original Facility Based on PWSA Records

Cost in 2002	8,573,257
2002 ENR CCI Index	6468.01
April 2011 ENR CCI Index	9027.23
Trended Cost for Original Plant	11,965,467
Est. Exp. Cost from 20 to 26 mgd	3,825,500
Total Est. Replacement Cost	15,790,967
Rounded Replacement Cost	15,791,000

Nashville, TN - 30 mgd expansion - clarifiers, filters, and chemical feed

Capacity Expansion (mgd)	30
1991 Construction Cost	$18,600,000
ENR CCI in 1991	4835.20
ENR CCI in April 2011	9027.23
Trended Cost for 30 mgd Capacity	$34,725,860
PWSA WTP Capacity (mgd)	117
Estimated Cost for PWSA	131,062,117
Rounded Cost	131,100,000

Estimated Costs for In-Ground Reservoirs

Lanpher Reservoir Contract Price	681,976
ENR CCI in 1912	90.7
ENR CCI in April 2011	9027.23
Trended Cost for Lanpher	67,876,000

Highland No. 2 Floating Cover Price

Bid Price for Cover	1,346,750
ENR CCI in Sept. 2009	8578.71
ENR CCI in April 2011	9027.23
Trended Cost for Lanpher	1,417,000

Reservoir	Capacity (MG)	Estimated Reservoir Cost	Surface Area (sq. ft.)	Estimated Cover Cost	Total Est. Replacement Cost
Herron Hill	12.8	6,024,000	96,000	209,000	6,233,000
Highland No. 1	130.5	62,594,000	918,000	NO COVER	62,594,000
Highland No. 2	125.0	63,793,000	651,000	1,417,000	65,210,000
Lanpher	133.0	67,876,000	584,000	1,271,000	69,147,000
Sed. Basins.	73.0	37,255,000			

Estimated Cost for Clearwell
From December 2008 Report by Malcolm Pirnie, Inc. "Clearwell Improvements Phase 1 - Study"

December 2008 Cost	52,817,000
ENR CCI in December 2008	8551.32
ENR CCI in April 2011	9027.23
Trended Cost	55,756,000

Estimated Cost for Raw Water Intakes

2010 - Traveling Water Screens	1,183,339
Est. Cost for Intake Structure	2,320,000
Total Estimated Cost	3,500,000

PWSA 40-Year Capital Plan - Estimated Pump Station Replacement Costs

Pump Station	Building Area (sq. ft.)	Building Cost @ $350 per Sq. ft.	Mechanical & Piping	Subtotal Building, Mechanical, & Piping	General Req, Site Work, Electrical	Total Estimated Construction Cost
Ross	31,175	10,911,000	4,171,000	15,082,000	3,771,000	18,853,000
Aspinwall	23,125	8,094,000	3,225,000	11,319,000	2,830,000	14,149,000
Bruecken (1)	7,920	2,772,000	6,609,000	9,381,000	2,345,000	11,726,000
Herron Hill	6,984	2,444,000	1,234,000	3,678,000	920,000	4,598,000
Highland	2,470	865,000	331,000	1,196,000	299,000	1,495,000
Howard	12,325	4,314,000	2,120,000	6,434,000	1,609,000	8,043,000
Lincoln	1,984	694,000	271,000	965,000	241,000	1,206,000
Mission	9,800	3,430,000	1,871,000	5,301,000	1,325,000	6,626,000
Saline	1,560	546,000	808,000	1,354,000	339,000	1,693,000
Herron Hill Tank (2)			77,000			
Inline (3)			73,000			
Millvale (4)			103,000			

(1) Pumps for Fox Chapel PS are located inside Bruecken PS
(2) Pumps are located in the base of the Herron Hill tank
(3) Packaged station buried in the street

PWSA 40-Year Capital Plan
Estimated 2011 Costs for Steel Water Storage Tanks

Tank	Diameter (feet)	Height (feet)	H / D	Capacity (MG)	Estimated Tank Cost	Estimated Foundation Concrete (CY)	Foundation Cost @ $600 per CY	Total Estimated Construction Cost
Allentown 1	100	50	0.50	2.94	1,416,443	151	90,792	1,510,000
Allentown 2	100	50	0.50	2.94	1,416,443	151	90,792	1,510,000
Bedford	120	25	0.21	2.11	1,062,453	216	129,887	1,190,000
Brashear 1	195	25	0.13	5.58	2,555,850	564	338,672	2,890,000
Brashear 2	195	25	0.13	5.58	2,555,850	564	338,672	2,890,000
Lincoln	93	62	0.67	3.15	1,508,071	131	78,758	1,590,000
Spring Hill 1	50	34	0.68	0.50	367,115	39	23,597	390,000
Spring Hill 2	50	34	0.68	0.50	367,115	39	23,597	390,000
Squirrel Hill	80	82	1.03	3.08	1,479,150	98	58,678	1,540,000

RS Means Heavy Construction Cost Data 2011 - Water Storage Tanks
Steel, Ground Level, Not Including Foundation

Tank Capacity (gallons)	Cost
100,000	196,000
250,000	260,000
500,000	368,000
750,000	475,000
1,000,000	583,000
2,000,000	1,013,000
4,000,000	1,873,000
6,000,000	2,733,000
8,000,000	3,593,000
10,000,000	4,460,000

$y = 0.4304\,x + 152{,}192$

PWSA 40-Year Capital Plan
Estimated 2011 Costs for Elevated Steel Water Storage Tanks

Tank	Floor Elevation (feet)	Ground Elevation (feet)	Height to Bottom Capacity (feet)	Tank Capacity (MG)	Estimated Tank Cost	Estimated Foundation Concrete (CY)	Foundation Cost @ $600 per CY	Total Estimated Construction Cost
Herron Hill (existing)	1,322	1,220	102	0.40	1,237,600	196	117,600	1,360,000
Garfield (existing)	1,275	1,180	95	2.00	5,190,000	1,100	660,000	5,850,000

RS Means Heavy Construction Cost Data 2011 - Elevated Water Storage Tanks
Not Including Pipe, Pumps, or Foundation
Elevated Water Tanks, 100' to Bottom Capacity Line, Includes Painting

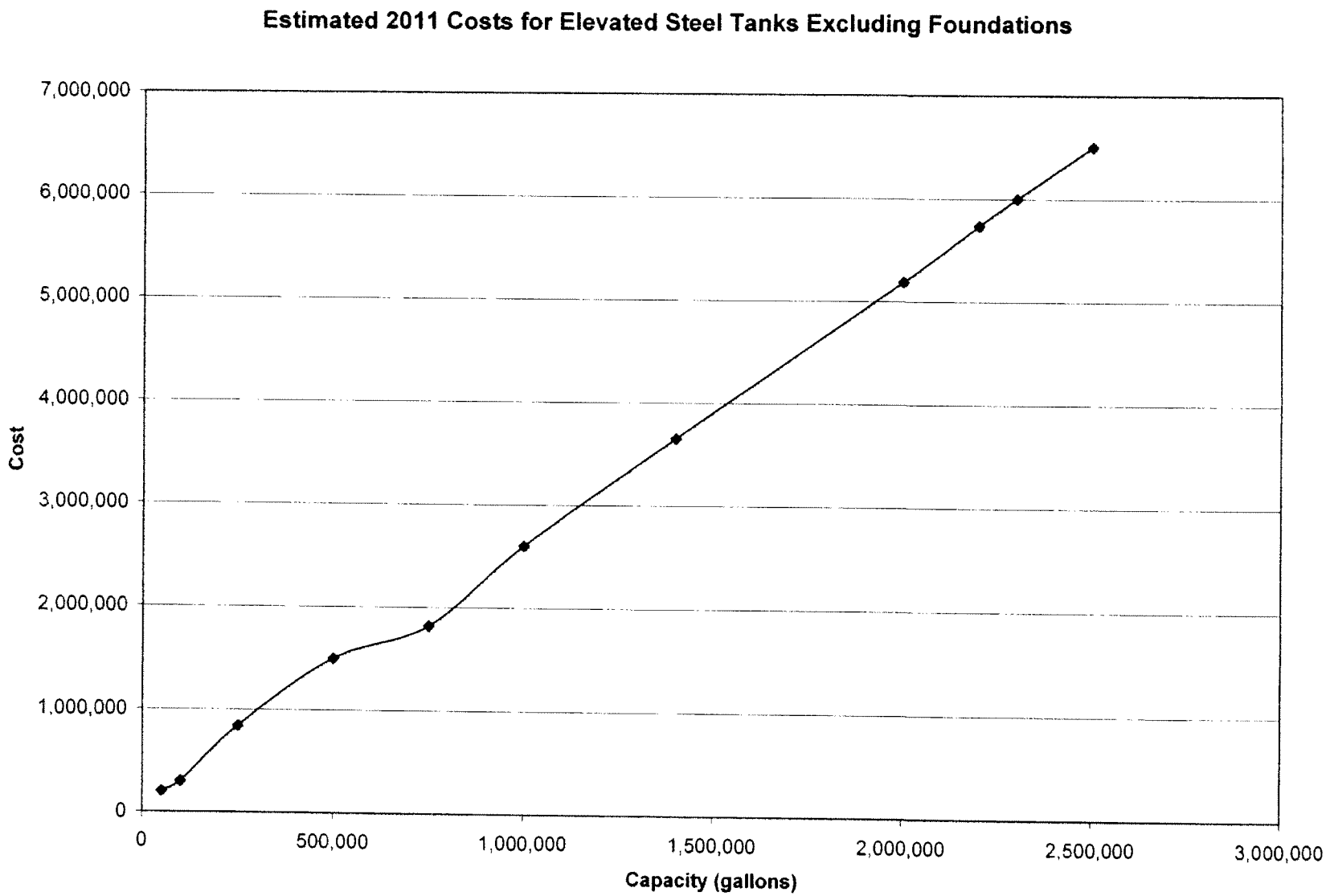
Tank Capacity (gallons)	Cost		
50,000	200,000		
100,000	300,000		
250,000	844,000		
500,000	1,500,000	400,000	1,237,600
750,000	1,820,000		
1,000,000	2,600,000		
1,400,000	3,650,000		
2,000,000	5,190,000		
2,200,000	5,740,000		
2,300,000	6,000,000		
2,500,000	6,500,000		

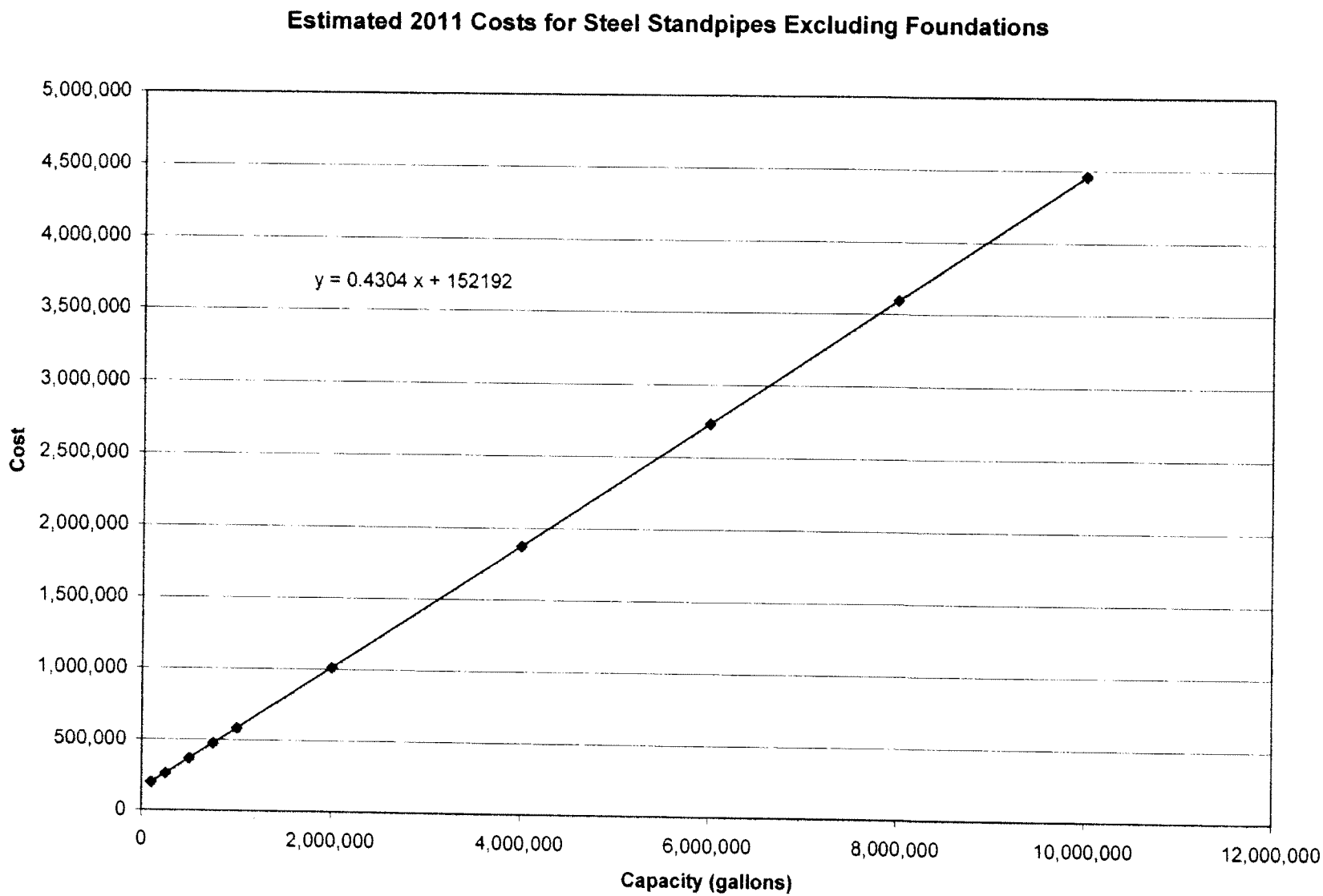
PWSA 40-Year Capital Plan
Estimated 2011 Costs for Concrete Water Storage Tanks

Tank	Diameter (feet)	Height (feet)	Capacity (MG)	Estimated Tank Cost	Estimated Foundation Concrete (CY)	Foundation Cost @ $600 per CY	Total Estimated Construction Cost
McNaugher 1	185	25	5.00	1,976,000	509	305,162	2,280,000
McNaugher 2	50	25	0.40	375,000	39	23,597	400,000

RS Means Heavy Construction Cost Data 2011 - Water Storage Tanks
Prestressed Concrete Above Ground Water Utility Storage Tanks
Not Including Foundation, Piping, or Pumps

Tank Capacity (gallons)	Cost		
250,000	297,000		
500,000	485,000	400,000	375,000
1,000,000	703,000		
2,000,000	1,067,000		
4,000,000	1,697,000		
6,000,000	2,255,000	5,000,000	1,976,000
8,000,000	2,909,000		
10,000,000	3,519,000		


Estimated 2011 Costs for Elevated Steel Tanks Excluding Foundations
7,000,000
6,000,000
5,000,000
4,000,000
3,000,000
2,000,000
1,000,000
0
Cost
0
500,000
1,000,000
1,500,000
2,000,000
2,500,000
3,000,000
Capacity (gallons)


Estimated 2011 Costs for Steel Standpipes Excluding Foundations
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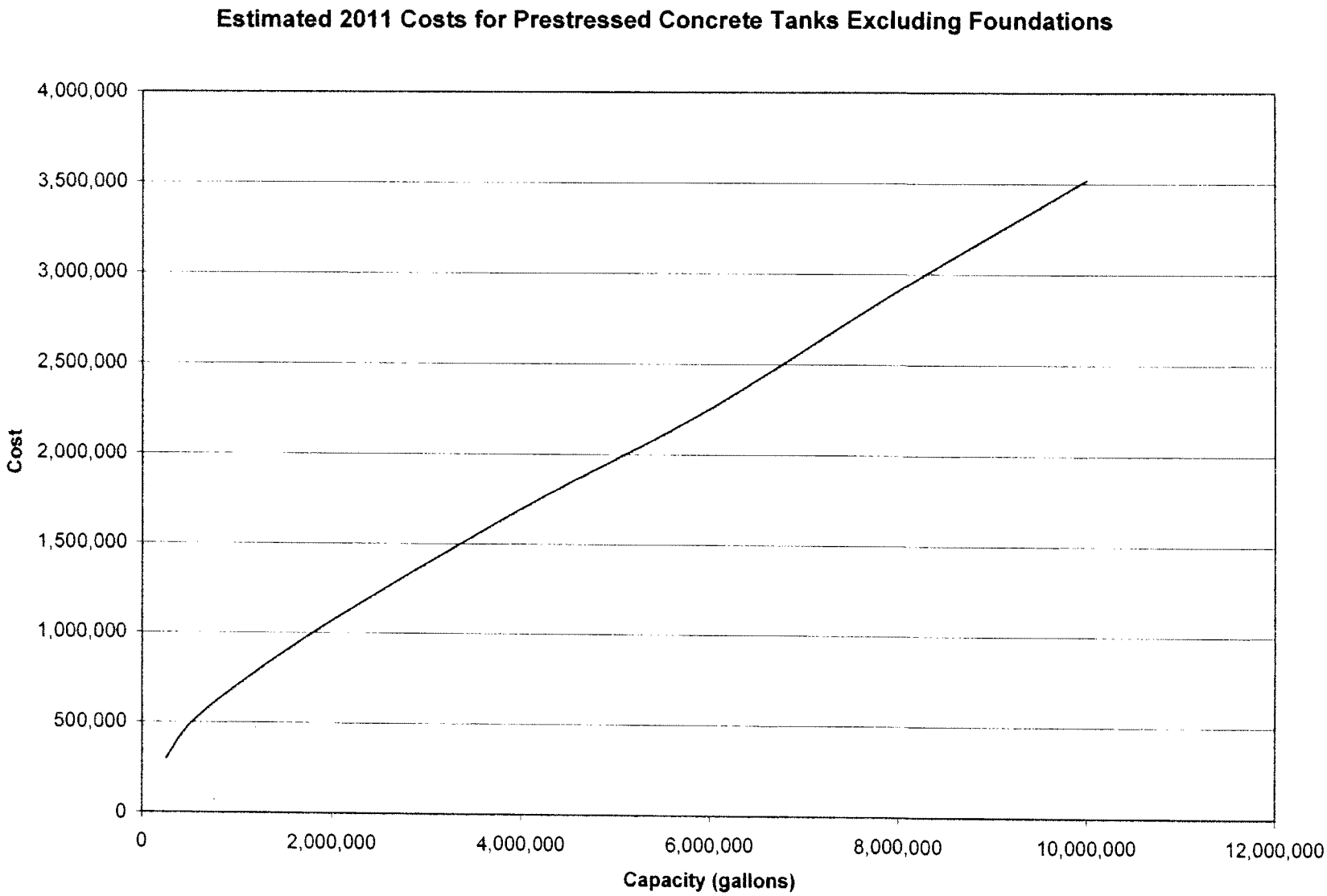
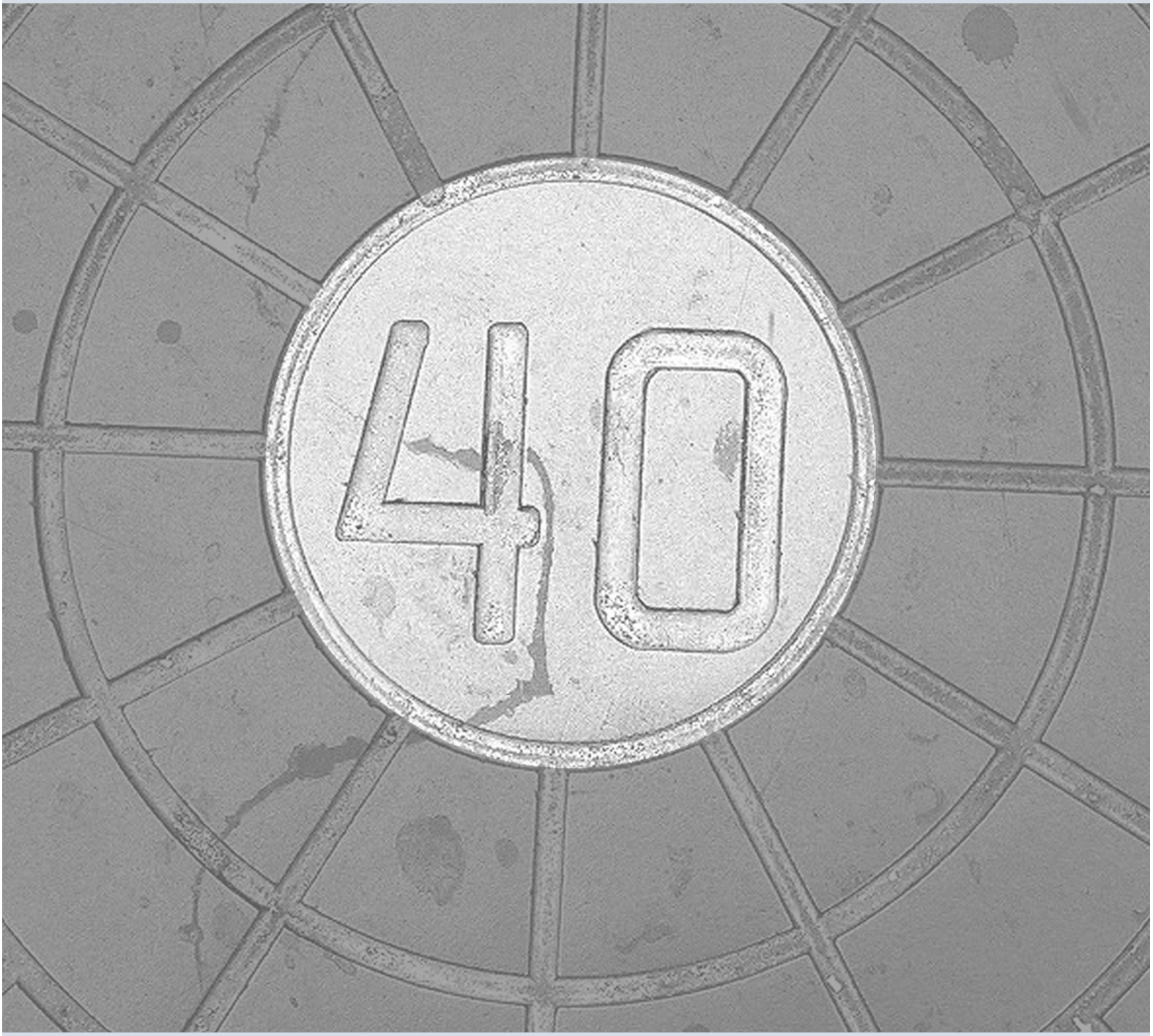
Cost
5,000,000
4,500,000
4,000,000
3,500,000
3,000,000
2,500,000
2,000,000
1,500,000
1,000,000
500,000
0
0
2,000,000
4,000,000
6,000,000
8,000,000
10,000,000
12,000,000
Capacity (gallons)


Estimated 2011 Costs for Prestressed Concrete Tanks Excluding Foundations
Cost
4,000,000
3,500,000
3,000,000
2,500,000
2,000,000
1,500,000
1,000,000
500,000
0
0
2,000,000
4,000,000
6,000,000
8,000,000
10,000,000
12,000,000
Capacity (gallons)

APPENDIX 3-6



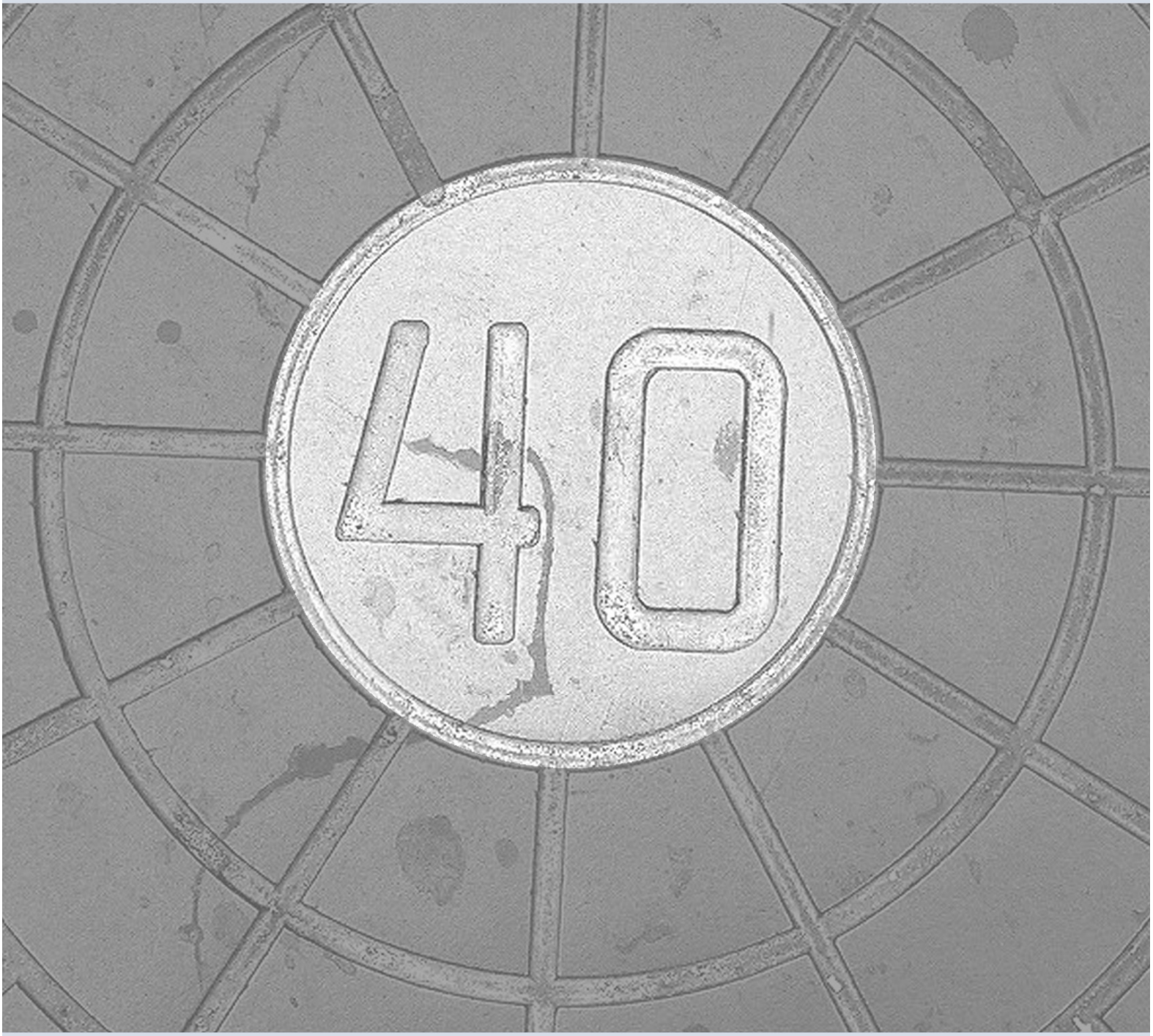
CHESTER ENGINEERS, INC.

APPENDIX 3-6
SEWER SYSTEM COST ESTIMATE INFORMATION

Total Estimated Cost for Sewer Piping Installation per LF

Pipe Diameter (inches)	Excavation	Backfill	Paving	Pipe Material	Piping Subtotal	Allowance for Fittings 2.00% percent	Rounded Cost per LF	Pipe Material
4	11.49	37.32	7.43	5.80	62.04	1.24	63	PVC
6	12.50	40.45	11.81	8.10	72.85	1.46	74	PVC
8	13.53	43.60	12.59	12.55	82.27	1.65	84	PVC
10	14.59	46.76	13.38	18.00	92.74	1.85	95	PVC
12	15.68	49.95	14.17	20.00	99.79	2.00	102	PVC
15	17.36	54.76	15.35	23.50	110.96	2.22	113	PVC
18	19.09	59.60	16.53	26.00	121.22	2.42	124	PVC
21	20.88	64.49	17.71	33.00	136.08	2.72	139	PVC
24	22.72	69.42	18.89	40.50	151.53	3.03	155	PVC
27	24.63	74.39	20.07	87.50	206.58	4.13	211	RCP
30	26.59	79.39	21.25	98.50	225.73	4.51	230	RCP
33	28.60	84.44	22.43	108.75	244.23	4.88	249	RCP
36	30.68	89.53	23.61	119.00	262.82	5.26	268	RCP
39	32.81	94.65	24.79	133.00	285.25	5.71	291	RCP
42	34.99	99.82	25.97	147.00	307.79	6.16	314	RCP
45	37.24	105.03	27.15	161.50	330.92	6.62	338	RCP
48	39.54	110.27	28.33	176.00	354.14	7.08	361	RCP
54	44.31	120.88	30.69	202.50	398.39	7.97	406	RCP
60	49.31	131.65	33.06	229.00	443.02	8.86	452	RCP
66	54.54	142.58	35.42	279.50	512.03	10.24	522	RCP
72	59.99	153.67	37.78	330.00	581.44	11.63	593	RCP
78	65.67	164.91	40.14	392.50	663.22	13.26	676	RCP
84	71.58	176.32	42.50	455.00	745.40	14.91	760	RCP
90	77.72	187.88	44.86	512.50	822.96	16.46	839	RCP
96	84.08	199.61	47.22	570.00	900.91	18.02	919	RCP
102	90.67	211.49	49.58	922.50	1,274.24	25.48	1,300	PCCP
108	97.48	223.53	51.94	1,275.00	1,647.96	32.96	1,681	PCCP
120	111.80	248.09	56.67	1,950.00	2,366.56	47.33	2,414	PCCP
132	127.03	273.28	61.39	2,137.50	2,599.20	51.98	2,651	PCCP
144	143.16	299.12	66.11	2,325.00	2,833.39	56.67	2,890	PCCP
168	178.15	352.68	75.56	2,700.00	3,306.39	66.13	3,373	PCCP

APPENDIX 3-7



CHESTER ENGINEERS, INC.

APPENDIX 3-7
WATER DEMANDS IN PA AMERICAN PORTION OF THE CITY

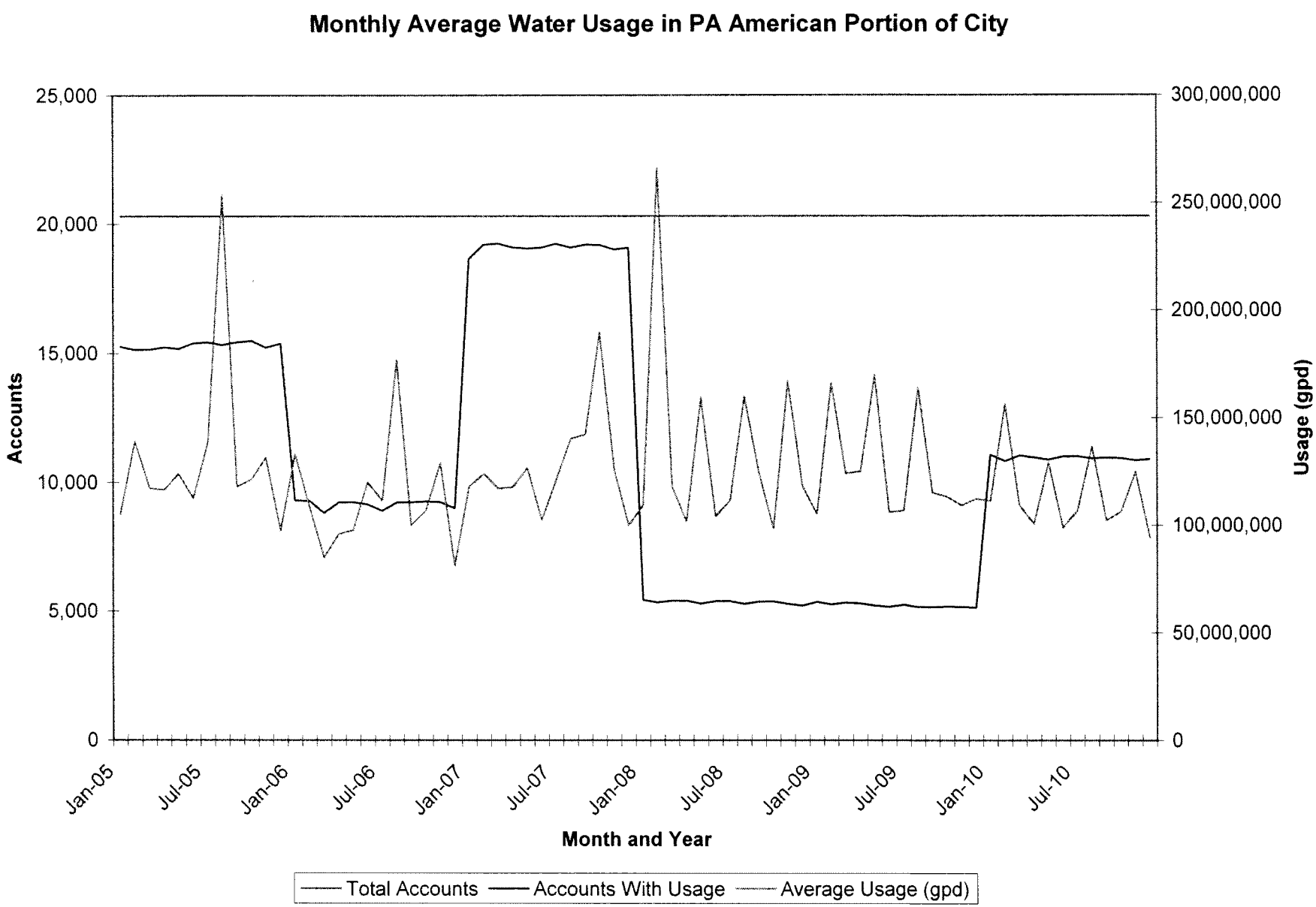
PWSA 40-Year Plan
Metered Water Usage in Portion of City Served By PA American Water Company

Month	All Accounts	Accounts With Usage	Average Usage per Account (gal/month)	Estimated Total Usage for All Accounts (gal/month)	Average Usage (gpd)
Jan-05	20,304	15,258	5,162	104,804,933	3,380,804
Feb-05	20,304	15,135	6,866	139,410,481	4,978,946
Mar-05	20,304	15,145	5,779	117,332,944	3,784,934
Apr-05	20,304	15,236	5,739	116,518,639	3,883,955
May-05	20,304	15,178	6,110	124,055,979	4,001,806
Jun-05	20,304	15,389	5,545	112,586,536	3,752,885
Jul-05	20,304	15,433	6,828	138,640,235	4,472,266
Aug-05	20,304	15,330	12,502	253,837,388	8,188,303
Sep-05	20,304	15,427	5,810	117,969,354	3,932,312
Oct-05	20,304	15,482	5,975	121,323,804	3,913,671
Nov-05	20,304	15,223	6,484	131,652,490	4,388,416
Dec-05	20,304	15,371	4,791	97,284,000	3,138,194
Jan-06	20,304	9,293	6,567	133,336,860	4,301,189
Feb-06	20,304	9,284	5,354	108,697,873	3,882,067
Mar-06	20,304	8,799	4,185	84,976,267	2,741,170
Apr-06	20,304	9,216	4,718	95,791,122	3,193,037
May-06	20,304	9,222	4,808	97,620,014	3,149,033
Jun-06	20,304	9,136	5,919	120,176,033	4,005,868
Jul-06	20,304	8,886	5,482	111,313,241	3,590,750
Aug-06	20,304	9,212	8,728	177,212,190	5,716,522
Sep-06	20,304	9,228	4,923	99,948,238	3,331,608
Oct-06	20,304	9,255	5,257	106,747,467	3,443,467
Nov-06	20,304	9,229	6,359	129,108,760	4,303,625
Dec-06	20,304	8,987	3,997	81,153,412	2,617,852
Jan-07	20,304	18,658	5,822	118,204,710	3,813,055
Feb-07	20,304	19,198	6,107	123,997,531	4,428,483
Mar-07	20,304	19,240	5,771	117,171,126	3,779,714
Apr-07	20,304	19,099	5,804	117,836,607	3,927,887
May-07	20,304	19,049	6,246	126,823,431	4,091,078
Jun-07	20,304	19,083	5,042	102,372,255	3,412,409
Jul-07	20,304	19,233	5,971	121,243,103	3,911,068
Aug-07	20,304	19,084	6,921	140,530,625	4,533,246
Sep-07	20,304	19,199	7,011	142,350,334	4,745,011
Oct-07	20,304	19,186	9,349	189,816,438	6,123,111
Nov-07	20,304	19,008	6,203	125,948,920	4,198,297
Dec-07	20,304	19,076	4,921	99,907,966	3,222,838
Jan-08	20,304	5,429	5,385	109,341,412	3,527,142
Feb-08	20,304	5,332	13,108	266,145,906	9,177,445
Mar-08	20,304	5,401	5,809	117,952,466	3,804,918
Apr-08	20,304	5,396	5,006	101,637,719	3,387,924
May-08	20,304	5,283	7,855	159,483,370	5,144,625
Jun-08	20,304	5,376	5,128	104,115,131	3,470,504
Jul-08	20,304	5,381	5,490	111,477,389	3,596,045
Aug-08	20,304	5,277	7,881	160,022,865	5,162,028

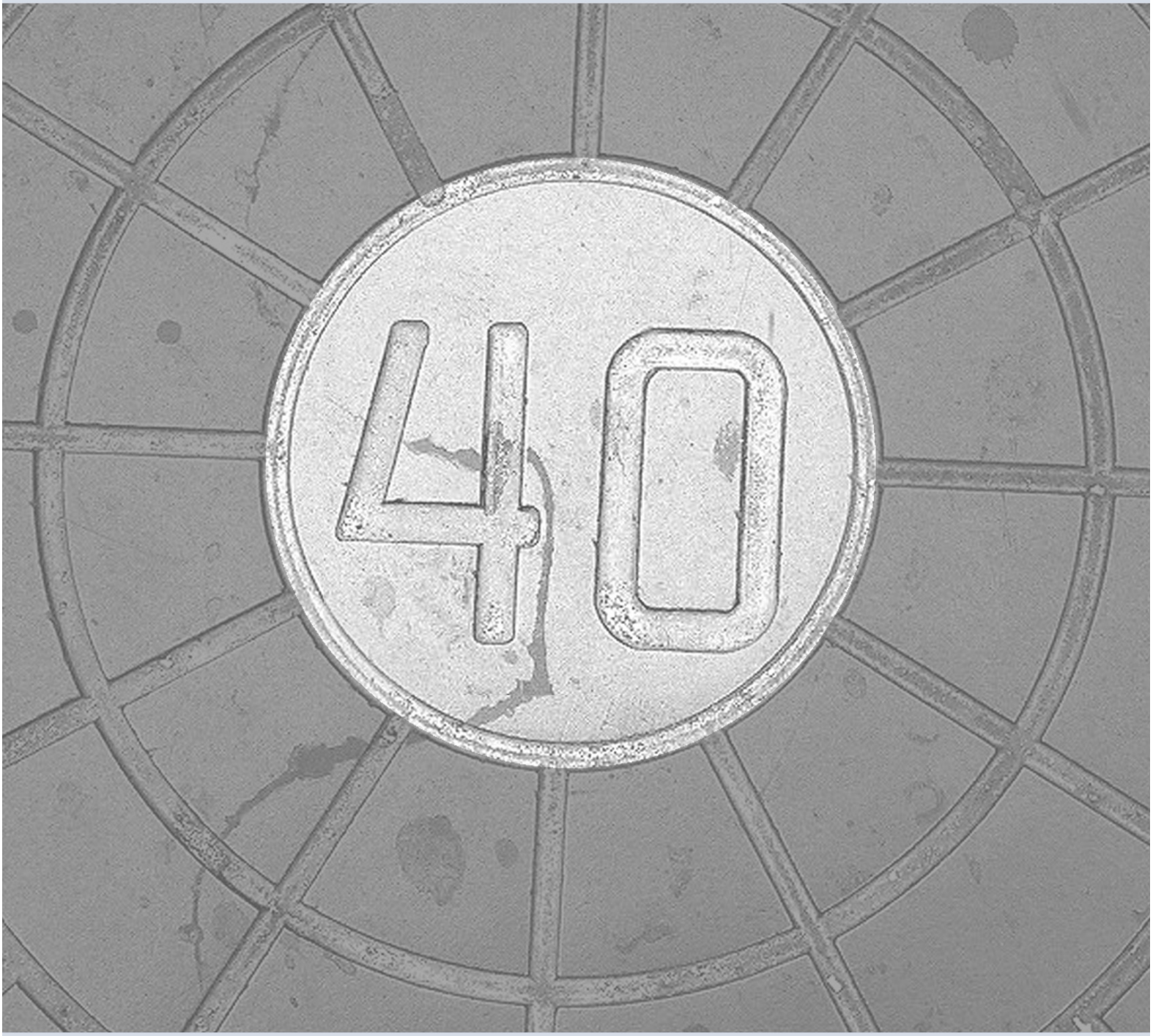
Sep-08	20,304	5,362	6,127	124,404,789	4,146,826
Oct-08	20,304	5,372	4,849	98,446,544	3,175,695
Nov-08	20,304	5,275	8,238	167,263,713	5,575,457
Dec-08	20,304	5,211	5,823	118,231,178	3,813,909
Jan-09	20,304	5,349	5,181	105,200,930	3,393,578
Feb-09	20,304	5,258	8,196	166,405,058	5,943,038
Mar-09	20,304	5,323	6,114	124,140,182	4,004,522
Apr-09	20,304	5,299	6,163	125,126,387	4,170,880
May-09	20,304	5,208	8,369	169,928,675	5,481,570
Jun-09	20,304	5,165	5,225	106,091,545	3,536,385
Jul-09	20,304	5,243	5,256	106,723,830	3,442,704
Aug-09	20,304	5,162	8,081	164,083,409	5,293,013
Sep-09	20,304	5,160	5,676	115,235,734	3,841,191
Oct-09	20,304	5,179	5,579	113,280,258	3,654,202
Nov-09	20,304	5,165	5,378	109,189,357	3,639,645
Dec-09	20,304	5,137	5,527	112,229,828	3,620,317
Jan-10	20,304	11,068	5,484	111,340,679	3,591,635
Feb-10	20,304	10,830	7,700	156,335,584	5,583,414
Mar-10	20,304	11,039	5,383	109,304,751	3,525,960
Apr-10	20,304	10,967	4,952	100,549,277	3,351,643
May-10	20,304	10,880	6,364	129,215,895	4,168,255
Jun-10	20,304	11,009	4,873	98,950,789	3,298,360
Jul-10	20,304	11,011	5,255	106,703,386	3,442,045
Aug-11	20,304	10,929	6,735	136,744,807	4,411,123
Sep-10	20,304	10,957	5,028	102,094,766	3,403,159
Oct-10	20,304	10,941	5,236	106,301,886	3,429,093
Nov-10	20,304	10,858	6,149	124,854,708	4,161,824
Dec-10	20,304	10,901	4,649	94,396,997	3,045,064
Average Month (gpd)					4,106,861
Maximum Month (gpd)					9,177,445

Year	No. of Customers	Average Usage (gpd)	GPD per Customer
2005	20,304	4,318,041	213
2006	20,304	3,689,682	182
2007	20,304	4,182,183	206
2008	20,304	4,498,543	222
2009	20,304	4,168,420	205
2010	20,304	3,784,298	186
Average metered usage (gpd)		4,106,861	202
Average water demand (gpd) *		6,844,769	

* Includes "unaccounted for" and "other" water


Monthly Average Water Usage in PA American Portion of City
25,000
20,000
15,000
10,000
5,000
0
Accounts
300,000,000
250,000,000
200,000,000
150,000,000
100,000,000
50,000,000
0
Usage (gpd)
Jan-05
Jul-05
Jan-06
Jul-06
Jan-07
Jul-07
Jan-08
Jul-08
Jan-09
Jul-09
Jan-10
Jul-10
Month and Year
Total Accounts
Accounts With Usage
Average Usage (gpd)

APPENDIX 3-8



CHESTER ENGINEERS, INC.

APPENDIX 3-8
MAJOR PUMP AND EQUIPMENT INVENTORY

Pittsburgh Water and Sewer Authority 40-Year Capital Plan
Major Pump and Equipment Inventory

Facility Name	Equipment Name - Brief Description	Equipment Manufacturer	Model No. / Serial No.	Capacity	Number of Units	Date Installed	Age of Unit	General Condition
Aspinwall P.S.	Pump 1 - Centrifugal, 2 Stage	Worthington	18-LCS-3 / 1521127	8,500 gpm @ 265 ' TDH	1	1958	52	Good
	Pump 2 - Centrifugal, 2 Stage	Worthington	18-LCS-3 / 1521126	10,420 gpm @ 265 ' TDH	1	1958	52	Good
	Pump 3 - Centrifugal, 2 Stage	Worthington	20-LCS-4 / 1521125	15,278 gpm @ 265 ' TDH	1	1958	52	Good
	Pump 4 - Centrifugal, 2 Stage	Worthington	20-LCS-4 / 1521124	19,500 gpm @ 265 ' TDH	1	1958	52	Good
	Motor 1 - Synchronous, 2300 V	Westinghouse	N.A.	1,000 HP 1,200 RPM	1	1958	52	Good
	Motor 2 - Synchronous, 2300 V	Westinghouse	2557 / P621	1,000 HP 1,200 RPM	1	1958	52	Good
	Motor 3 - Synchronous, 2300 V	Westinghouse	1557 / P623	1,500 HP 720 RPM	1	1958	52	Good
	Motor 4 - Synchronous, 2300 V	Westinghouse	2557 / P623	1,500 HP 720 RPM	1	1958	52	Good
	Motor Control Center							Upgrade - Replace Electronic Protection Modules (GE- multilins) Switchgear Contactor DC Batteries - Good
	RTU / SCADA							Being Replaced
	Emergency Power Backup							
	- RTU / SCADA							Backup Batteries & Charger needs replaced with a UPS and replace RTU Inverter
	- Emergency Generator							Non-functional - Replace with Emergency Light Units
Bruecken P.S.	Pump 2 - Centrifugal, 2 Stage	Allis Chalmers	SG30/24 22640; 22641	19,450 gpm @ 365 ' TDH	1	1932	78	Rebuilt in 2010
	Pump 3 - Centrifugal, 2 Stage	Allis Chalmers	SG30/24 22639; 22642	19,450 gpm @ 365 ' TDH	1	1932	78	Rebuilt in 2010
	Pump 4 - Centrifugal, 2 Stage	Allis Chalmers	SG30/24 22643; 22644	19,450 gpm @ 365 ' TDH	1	1932	78	Seal bearing housings to keep water out of bearings
	Pump 5 - Centrifugal, 2 Stage	Allis Chalmers	SG30/24 22645; 22646	16,700 gpm @ 272 ' TDH	1	1932	78	Good
	Pump 6 - Centrifugal, 2 Stage	Allis Chalmers	SG30/24 22648; 22647	16,700 gpm @ 272 ' TDH	1	1932	78	Rebuilt in 2009
	Pump 7 - Centrifugal, 2 Stage	Allis Chalmers	SG30/24 22650; 22649	16,700 gpm @ 272 ' TDH	1	1932	78	Good
	Motor 2 - Synchronous, 2300 V	Allis Chalmers	128569	2,250 HP 720 RPM	1	1932	78	Rebuilt in 2007
	Motor 3 - Synchronous, 2300 V	Allis Chalmers	128226	2,250 HP 720 RPM	1	1932	78	Rebuilt in 2010
	Motor 4 - Synchronous, 2300 V	Allis Chalmers	128573	2,250 HP 720 RPM	1	1932	78	Good
	Motor 5 - Synchronous, 2300 V	Allis Chalmers	128494	2,250 HP 720 RPM	1	1932	78	Rebuilt in 2008
	Motor 6 - Synchronous, 2300 V	Allis Chalmers	128219	1,500 HP 720 RPM	1	1932	78	Rebuilt in 2009
	Motor 7 - Synchronous, 2300 V	Allis Chalmers	128557	1,500 HP 720 RPM	1	1932	78	Good

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Facility Name	Equipment Name - Brief Description	Equipment Manufacturer	Model No. / Serial No.	Capacity	Number of Units	Date Installed	Age of Unit	General Condition
	Motor Control Center							Upgraded in 1992. Needs serviced / cleaned. Replace Agastat & Priming Relays
	RTU / SCADA							Being Replaced
	Emergency Power Backup							
	- RTU / SCADA							Backup Batteries & Charger needs replaced with a UPS and replace RTU Inverter
	-Back-up Power - Dual Power Supply from Utility Co.							
	- Emergency Generator - Serves Flood Pumps							Good
Fox Chapel P.S.	Pump 1 - Centrifugal, 1 Stage	Ingersoll Dresser	SC/LG/ 0698-8852A	2,400 gpm @ 375'	1	1999	11	Good
	Pump 2 - Centrifugal, 1 Stage	Ingersoll Dresser	SC/LG/ 0698-8853	2,400 gpm @ 375'	1	1999	11	Good
	Pump 3 - Centrifugal, 1 Stage	Ingersoll Dresser	SC/LG/ 0698-8852B	2,400 gpm @ 375'	1	1999	11	Good
	Pump 4 - Centrifugal, 2 Stage	Ingersoll Dresser	8GT/ 0698-8854	1,800 gpm @ 588'	1	1999	11	Good
	Motor 1 - Induction, 460 V	Marathon	MV204/ 890-7/3-01	400 HP 1,785 RPM	1	1999	11	Good
	Motor 2 - Induction, 460 V	Marathon	MV204/ 890-7/7-02	400 HP 1,785 RPM	1	1999	11	Good
	Motor 3 - Induction, 460 V	Marathon	MV204/ 890-7/7-03	400 HP 1,785 RPM	1	1999	11	Good
	Motor 4 - Induction, 460 V	Marathon	MV204/ 900-7/7	500 HP 1,785 RPM	1	1999	11	Good
	Motor Control Center							Good
	Emergency Power Backup							None
Herron Hill P.S.	Pump 1 - Centrifugal, 2 Stage	Worthington	IDLR-178/763368	5,000 gpm @ 234 ' TDH	1	1988	22	Good
	Pump 2 - Centrifugal, 2 Stage	Worthington	IDLR-178/763367	5,000 gpm @ 234 ' TDH	1	1988	22	Good
	Pump 3 - Centrifugal, 2 Stage	Worthington	8LR-20A/763369	3,500 gpm @ 222 ' TDH	1	1988	22	Good
	Pump 4 - Centrifugal, 1 Stage	Worthington	6LR-18/763370	2,083 gpm @ 254 ' TDH	1	1988	22	Good
	Pump 5 - Centrifugal, 2 Stage	Worthington	10LR-18A/763371	6,944 gpm @ 370 ' TDH	1	1988	22	Good
	Pump 6 - Centrifugal, 1 Stage	Worthington	ALR-123/763372	1,389 gpm @ 97 ' TDH	1	1988	22	Good
	Motor 1 - Induction, 4000 V	US Motor	R02P085010,7R-1	350 HP 1,780 RPM	1	1988	22	Good
	Motor 2 - Induction, 4000 V	US Motor	R02P085011,4R-1	350 HP 1,780 RPM	1	1988	22	Good
	Motor 3 - Induction, 4000 V	US Motor	R02P085012,2R-1	300 HP 1,775 RPM	1	1988	22	Good
	Motor 4 - Induction, 4000 V	US Motor	R02P085013,9R-1	200 HP 1,780 RPM	1	1988	22	Good

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Facility Name	Equipment Name - Brief Description	Equipment Manufacturer	Model No. / Serial No.	Capacity	Number of Units	Date Installed	Age of Unit	General Condition
	Motor 5 - Induction, 4000 V	US Motor	R02P085014,9R-1	500 HP 1,775 RPM	1	1988	22	Good
	Motor 6 - Induction, 440 V	US Motor	R02P085022,4R-1	75 HP 1,785 RPM	1	1988	22	Good
	Motor Control Center							Fair Condition, Evaluate Pump #6 Switchgear
	RTU / SCADA							Being Replaced
	Emergency Power Backup							
	- RTU / SCADA							Backup Batteries & Charger needs replaced with a UPS and replace RTU Inverter
	-Back-up Power - Dual Power Supply from Utility Co.							Recommend Auto Transfer Switch
Herron Hill Tank P.S.	Pump 1 - Centrifugal, 1 Stage	Peerless	00806614R?	1,181 gpm @ 130 ' TDH	1	1963	47	Good
	Pump 2 - Centrifugal, 1 Stage	Peerless	N.A.	1,181 gpm @ 130 ' TDH	1	1963	47	Suction Valves are Bad. Will Be Replaced.
	Motor 1 - Induction, 460 V	U.S. Electric Motor	3525298	50 HP 1,800 RPM	1	1963	47	Good
	Motor 2 - Induction, 460 V	U.S. Electric Motor	N.A.	50 HP 1,800 RPM	1	1963	47	Good
	Motor Control Center							Needs to be evaluated
	RTU/SCADA							Will be replaced
	Emergency Generator - Owned by EOC - Serves Scada and Lighting							Owned by "Emergency Operations Center"
Highland P.S.	Pump 1 - Centrifugal, 1 Stage	Aurora	411-BF / 82-10074-1	1,650 gpm @ 270 ' TDH	1	1983	27	Sized wrong, 3600 RPM; Frequent Failure
	Pump 2 - Centrifugal, 1 Stage	Aurora	411-BF / 82-10074-2	1,650 gpm @ 270 ' TDH	1	1983	27	Sized wrong, 3600 RPM; Impeller was cut
	Pump 3 - Centrifugal, 2 Stage	Aurora	82-10075	2,100 gpm @ 280 ' TDH	1	1983	27	Good
	Motor 1 - Induction, 460 V	Marathon	MH-405-TS/TDS700-1GNW	150 HP 3,500 RPM	1	1983/2009	27	Replaced 2009
	Motor 2 - Induction, 460 V	Marathon	MH-405STTD/5701GNW	150 HP 3,500 RPM	1	1983/2008	27	Rebuilt 2009
	Motor 3 - Induction, 460 V	Marathon	LD44FTS/TD57026ECW	200 HP 1,780 RPM	1	1983	27	
	Motor Control Center							Needs Evaluated; Unreliable
	RTU / SCADA							Being Replaced
	Emergency Power Backup							
	- RTU / SCADA							Backup Batteries & Charger and RTU Inverter - Good Condition

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Facility Name	Equipment Name - Brief Description	Equipment Manufacturer	Model No. / Serial No.	Capacity	Number of Units	Date Installed	Age of Unit	General Condition
Highland	Membrane Filtration Plant							
Membrane Filtration								
Plant	Rotating Strainers	Kinney	20AP	10 MGD	2	2002		Good
	Feed Pump No. 1	Peerless	Type AE	8.78 MGD @ 120 '	1	2002		Good - Rebuilt & Upgraded 2009
	Feed Pump No. 2	Peerless	Type AE	8.78 MGD @ 120 '	1	2002		Good - Rebuilt & Upgraded 2009
	Feed Pump No. 3	Peerless	Type AE	8.78 MGD @ 120 '	1	2002		Good - Rebuilt & Upgraded 2009
	Feed Pump No. 4	Peerless	Type AE	8.78 MGD @ 120 '	1	2002		Good - Rebuilt & Upgraded 2009
	Feed Pump No. 1 Motor							
	Feed Pump No. 2 Motor							
	Feed Pump No. 3 Motor							
	Feed Pump No. 4 Motor							
	Filtering Module Racks; A through J 80 Modules Each X 10 = 800 Total	Pall Corp.		2.6 MGD	10	2009		Good - Rebuilt & Upgraded 2009
	Filter Valve Racks; A through J	Pall Corp.				2002 / 09		Good - Rebuilt & Upgraded 2009
	Brush Filters, Filter Gallery	Amiad	2.08312E+12		10	2009		Poor Design - Modifications Needed
	Backwash Recovery Tank, Pump Rm	Edwards	4693/ 03017101	5,000 Gal	1	2002		Good
	Backwash Feed Pump #1	Peerless	F11030AP-BF/ 992700004293	600 GPM @ 150 PSI	1	2009		Good
	Backwash Feed Pump #2	Peerless	F11030AP-BF/ 992700004293	600 GPM @ 150 PSI	1	2009		Uninstalled
	Backwash Pump Motor #1	General Electric	5K5254/ 92081405	15 HP @ 1,760 RPM	1	2009		Good
	Backwash Pump Motor #2	General Electric	5K5254/ 92081405	15 HP @ 1,760 RPM	1	2009		Uninstalled
	Basket Strainer, Caustic Room	Hayward	BS204001/16		1	2009		Good
	Backwash Water Filter Module Rack, 56 modules	Pall Corp.			1	2005		Good
	Backwash Water Filter Module Valve Rack	Pall Corp.				2005		Good
	Backwash Brush Filter, Pump Room	Amiad	6202ZC01/ VP4X		1	2007		Good
	Hypochlorite Storage Tank #1	Edwards	4695/ 03017101	2,800 Gal	1	2002		Good
	Hypochlorite Storage Tank #2	Edwards	4694/ 03017101	2,800 Gal	1	2002		Good
	Hypochlorite Transfer Pump	Goulds	GBI0M	30 GPM @ 20 PSI	1	2009		Good
	Hypochlorite Day Tank, Chlorine Rm	Edwards	4696/ 03017101	150 Gal	1	2002		Good
	Hypochlorite Dosing Pumps	Prominent Sigma	C1M34D18F28B	11 GPM	2	2006		Good

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Facility Name	Equipment Name - Brief Description	Equipment Manufacturer	Model No. / Serial No.	Capacity	Number of Units	Date Installed	Age of Unit	General Condition
	Chlorine Flow Meter	Krohne	IFC020/ A0218233		1	2002		Good
	CCM Tank w/ Heater, Caustic Rm	Edwards	4689/ 03017101	1,500 Gal	1	2002		Good
	Acid CIP Tank w/ Heater, Acid Rm	Edwards	4690/ 03017101	1,500 Gal	1	2002		Good
	CIP Circulation Pump, Caustic Rm	Grundfoss	CRN-4	300 GPM	1	2002		Good
	Castic Transfer Pump, Caustic Rm	Vanton		19 GPM 3/4 HP	1	2002		
	Neutralization Tank, Chlorine Rm	Edwards	4692/ 03017101	4,000 Gal	1	2002		Good
	Neutralization Tank Mixer, Chlorine Rm	Chemineer	5JTC	1 HP 1,200 RPM	1	2002		Good
	4" Vertical Pump, Acid Rm	Grundfos	CR-1	20 GPM @ 145 PSI	1	2010		Good
	Acid Dosing Pump, Acid Rm	Chem-Tainer	7B42	140 GPM @ 42 PSI	1	2004		Good
	Air Compressor, 2nd Floor	Atlas Copco	APCE3055C98/38/972		2	2009		Good
	Acid Dosing Pump, Acid Rm	Chem-Tainer	7B42	140 GPM @ 42 PSI	1	2004		Good
	Air Compressor, 2nd Floor	Atlas Copco	APCE3055C98/38/972		2	2009		Good
	Hypochlorite Transfer Pump	Goulds	GBI0M	30 GPM @ PSI	1	2009		Good
	Day Tank, Chlorine Rm	Edwards	4696/ 03017101	Gal	1	2002		Good
	Chemical Mixer, Chlorine Rm	Chemineer	5JTD	HP RPM	1	2002		Good
	Hypochlorite Pumps	Prominent Sigma	C1M34D18F28B	11 GPM @	2	2006		Good
	Chlorine Flow Meter	Krohne	IFC020/ A0218233		1	2002		Good
	CCM Tank, Caustic Rm	Edwards	4689/ 03017101	Gal	1	2002		Good
	Caustic CIP Tank	Edwards	4690/ 03017101	1,500 Gal	1	2002		Good
	Acid CIP Tank	Edwards	4690/ 03017101	1,500 Gal	1	2002		Good
	CIP Circulation Pump	Vanton	CC	300 GPM @ PSI	1	2002		Good
	Neutralization Tank, Chlorine Rm	Edwards	4692/ 03017101	4,000 Gal	1	2002		Good
	Chemical Mixer, Chlorine Rm	Chemineer	5JTC	HP RPM	1	2002		Good
	4" Vertical Pump, Acid Room	Grundfos	CR-1	GPM @ PSI	1	2010		Good
	Dosing Pump	Chem-Tainer	7B42	GPM @ PSI	1	2004		Good
	Air Compressor, 2nd Floor	Atlas Copco	APCE3055C98/38/972		2	2009		Good

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Facility Name	Equipment Name - Brief Description	Equipment Manufacturer	Model No. / Serial No.	Capacity	Number of Units	Date Installed	Age of Unit	General Condition
Howard P.S.	Pump 1 - Centrifugal, 2 Stage	Aurora	87-21321	5,200 gpm @ 270 ' TDH	1	1998	22	Good
	Pump 2 - Centrifugal, 2 Stage	Aurora	87-21322	5,200 gpm @ 270 ' TDH	1	1998	22	Good
	Pump 3 - Centrifugal, 2 Stage	Peerless	444867	2,100 gpm @ 270 ' TDH	1	1998	22	Good
	Pump 4 - Centrifugal, 2 Stage	Peerless	444868	2,100 gpm @ 270 ' TDH	1	1998	22	Good
	Pump 5 - Centrifugal, 2 Stage	Peerless	444153	1,750 gpm @ 480 ' TDH	1	1998	22	Planning to rebuild
	Pump 6 - Centrifugal, 2 Stage	Peerless	AE817Q	3,500 gpm @ 440 ' TDH	1	2010	1	Excellent
	Pump 7 - Centrifugal, 2 Stage	Peerless	AE817Q	3,500 gpm @ 440 ' TDH	1	2010	1	Excellent
	Motor 1 - Induction, 2300 V	General Electric	TB242003	500 HP 1,785 RPM	1	1998	22	Good
	Motor 2 - Induction, 2300 V	General Electric	TB241001	500 HP 1,785 RPM	1	1998	22	Good
	Motor 3 - Induction, 2300 V	US Motor	N.A.	200 HP 1,780 RPM	1	1998	22	Good
	Motor 4 - Induction, 2300 V	US Motor	N.A.	200 HP 1,780 RPM	1	1998	22	Good
	Motor 5 - Induction, 2300 V	US Motor	108P0440391C-01	300 HP 1,775 RPM	1	1998	22	Clean & replace bearings
	Motor 6 - Induction, 2300 V	Emerson	N.A.	500 HP 1,770 RPM	1	2010	1	Excellent
	Motor 7 - Induction, 2300 V	Emerson	N.A.	500 HP 1,770 RPM	1	2010	1	Excellent
	Motor Control Center							Needs Replaced, including DC power supply
	RTU / SCADA							Being Replaced
	Emergency Power Backup							
	- RTU / SCADA							Backup Batteries & Charger needs replaced with a UPS and replace RTU Inverter
	-Back-up Power - Dual Power Supply from Utility Co.							
Lincoln P.S.	Pump 1 - Centrifugal, 1 Stage	DeLaval	K 8/6 / 254857	1,400 gpm @ 310 ' TDH	1	1952	58	Fair
	Pump 2 - Centrifugal, 1 Stage	DeLaval	K 8/6 / 254855	1,400 gpm @ 310 ' TDH	1	1952	58	Out of Service, being replaced
	Pump 3 - Centrifugal, 2 Stage	DeLaval	K 8/6 / 254856	1,400 gpm @ 310 ' TDH	1	1952	58	Fair
	Motor 1 - Induction, 440 V	Elliot	121459	150 HP 1,760 RPM	1	1952	58	Fair
	Motor 2 - Induction, 440 V	Elliot	121461	150 HP 1,760 RPM	1	1952	58	Fair
	Motor 3 - Induction, 440 V	Elliot	121463	150 HP 1,760 RPM	1	1952	58	Fair
	Motor Control Center							Needs evaluated to determine deficiencies
	RTU / SCADA							Being Replaced
	Emergency Power Backup							
	- RTU / SCADA							Backup Batteries & Charger and RTU Inverter - Working Condition, But Old
Millvale	Pump 1 - Centrifugal	Cornell	4RB/94227	1,000 gpm @ 145' TDH	1	1996	14	Out of Service & never put on-line

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Facility Name	Equipment Name - Brief Description	Equipment Manufacturer	Model No. / Serial No.	Capacity	Number of Units	Date Installed	Age of Unit	General Condition
Millvale	Pump 2 - Centrifugal	Cornell	4RB/94226	1,000 gpm @ 145' TDH	1	1996	14	Out of Service & never put on-line
Millvale	Motor 1 - Induction	Baldor	596C	50 HP 1,775 RPM	1	1996	14	Out of Service & never put on-line
Millvale	Motor 2 - Induction	Baldor	596C	50 HP 1,775 RPM	1	1996	14	Out of Service & never put on-line
Mission P.S.	Pump 1 - Centrifugal, 2 Stage	DeLaval	2 / 260689	4,170 gpm @ 388 ' TDH	1	1958	52	Good
	Pump 2 - Centrifugal, 2 Stage	DeLaval	2 / 260690	4,170 gpm @ 388 ' TDH	1	1958	52	Good
	Pump 3 - Centrifugal, 2 Stage	DeLaval	2 / 260691	4,170 gpm @ 388 ' TDH	1	1958	52	Good
	Pump 4 - Centrifugal	Worthington	12LNH32/70032361	8,400 gpm @ 388 ' TDH	1	1992	18	Good
	Pump 5 - Centrifugal	Worthington	10LNH22/7003237	5,600 gpm @ 388 ' TDH	1	1992	18	Good
	Motor 1 - Synchronous, 2300 V	Elliot	25-10424	500 HP 1,200 RPM	1	1958	52	Good
	Motor 2 - Synchronous, 2300 V	Elliot	IS-10424	500 HP 1,200 RPM	1	1958	52	Good
	Motor 3 - Synchronous, 2300 V	Elliot	SS-10424	500 HP 1,200 RPM	1	1958	52	Good
	Motor 4 - Synchronous, 2300 V	Westinghouse	5299AA1	1,250 HP 1,250 RPM	1	1992	18	Good
	Motor 5 - Synchronous, 2300 V	Westinghouse	5299BA1	700 HP 1,280 RPM	1	1992	18	Good
	Motor Control Center - Pumps 1-3							Fair Condition - Need\s to be Evaluated
	Motor Control Center - Pumps 4 & 5					1992		Excellent
	RTU / SCADA							Being Replaced
	Emergency Power Backup							
	- RTU / SCADA							Backup Batteries & Charger and RTU Inverter - Good Condition
	-Back-up Power - Dual Power Supply from Utility Co.							
Inline Pump Station Coral & Pacific	Pump 1 - Centrifugal In-line	PACO	1595-5/KRM01061A	100 gpm @ 70 'TDH	1	1981	29	Good
(In Ground Package)	Pump 2 - Centrifugal In-line	PACO	2095-1/JTF12132	200 gpm @ 70 'TDH	1	1981	29	Needs Replaced
	Motor 1 - Induction	Reliance		5 HP 1,750 RPM	1	1981	29	Good
	Motor 2 - Induction	Reliance		8 HP 1,750 RPM	1	1981	29	Needs Replaced
Saline P.S	Pump 1 - Centrifugal, 2 Stage	Allis Chalmers	A1/8AE17Q	2,800 gpm @ 376 ' TDH	1	2010	1	Rebuilt Stg 1 & Replaced Stg 2 in 2010
Saline P.S	Pump 2 - Centrifugal, 2 Stage	Allis Chalmers	01-2/87139673	2,800 gpm @ 376 ' TDH	1	1988	22	Rebuilt in 2010
Saline P.S	Pump 2 - Centrifugal, 2 Stage	Allis Chalmers	02-2/87139673	2,800 gpm @ 376 ' TDH		1988	22	
Saline P.S	Pump 3 - Centrifugal, 2 Stage	Allis Chalmers	A-1/871-39673-05-1	1,200 gpm @ 400 ' TDH	1	1987	23	
Saline P.S	Motor 1 - Induction, 4160 V	General Electric	5KS511A,N2002HB	400 HP 1,790 RPM	1	1987	23	

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Saline P.S	Motor 2 - Induction, 4160 V	General Electric	R8184005	400 HP 1,790 RPM	1	1988	22	
Saline P.S	Motor 3 - Induction, 4160 V	General Electric	58202002	200 HP 1,790 RPM	1	1987	22	
Saline P.S	Motor Control Center							Operates reliability, but should be evaluated and tested
Saline P.S	RTU / SCADA							Being Replaced
Saline P.S	Emergency Power Backup							
Saline P.S	- RTU / SCADA							Backup Batteries & Charger needs replaced with a UPS and replace RTU Invertor
Water Filtration Plant East Raw Water Intakes	East Raw Water Intakes - Bar Screen				2	1928		Poor Condition
	East Sluice Gate Valve	Rodney Hunt		84 inch	1	1928		Fair
	West Sluice Gate Valve	Rodney Hunt		84 inch	1	1928		Fair
	East Valve Actuator Control System	Dean			1	1928		Fair
	West Valve Actuator Control System	Dean			1	1928		Fair
	Sample Pump, 3 x 2	STA-RITE	DHF3-51	HP RPM	1			Good
	Sample Pump Motor	STA-RITE	P48L2EB7	2 HP 3,450 RPM	1			Good
Water Filtration Plant West Raw Water Intakes	East Sluice Gate Valve	Copfinrail Bearing Stand			1	1906		Fair, in Open position
	West Sluice Gate Valve	Copfinrail Bearing Stand			1	1906		Poor Dismantled; In Closed position: Needs Gear Assembly Rebuilt
	Sluice Gate Valves - River Side of Chamber				8	1906		Not Used; All in Open Position
	BW Retention Basin Mixer	Lightnin	204H1		1			Good
	BW Retention Basin Mixer Motor	Allis Chalmer	51-447-270-4461	3 HP 1,740 RPM	1			Good
Water Filtration Plant - Ross PS - Raw Water Pumps and Equipment	Pump 1 - Centrifugal, 1 Stage	DeLaval	X-48 / 79387	60,417 gpm @ 57 ' TDH	1	1928	82	Rebuilt 2008
	Pump #1 Oiling Hydraulic Unit	Weinman Pump & Supply	60-1K5-14D-66/ A2851-2		1			Good
	Pump #1 Hydraulic Unit Motor #1	Master	Style 200456/ CZ-15601	0.5 HP @ 1,725 RPM	1			Good
	Pump #1 Hydraulic Unit Motor #2	Master	Style 200456/ DP3679	0.5 HP @ 1,725 RPM	1			Good
	Pump 2 - Centrifugal, 1 Stage	DeLaval	W 42/36 / 79388	34,750 gpm @ 57 ' TDH	1	1928	82	Rebuilt 2009

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	Pump #2 Oiling Hydraulic Unit	Weinman Pump & Supply	60-1K5-14D-66/ A2851-1		1			Good
	Pump #2 Hydraulic Unit Motor #1	Master	Style 200456/ CZ-15596	0.5 HP @ 1,725 RPM	1			Good
	Pump #2 Hydraulic Unit Motor #2	Master	Style 200456/ CZ15597	0.5 HP @ 1,725 RPM	1			Good
	Pump 3 - Centrifugal, 1 Stage, two 25 mgd pumps in parallel	DeLaval	P 30/24 / 280396 & 280398	17,360 gpm @ 57 ' TDH	1	1956	54	Rebuilt 2010
	Pump 4 - Centrifugal, 1 Stage	DeLaval	X54/48 / 251298	81,250 gpm @ 58 ' TDH	1	1956	62	Being Rebuilt for 2011
	Pump #4 Oil / Water Separator	DeLaval	54-11/ 3517783		1			Out of Service; To Be Eliminated
	Pump 5 - Centrifugal, 1 Stage	DeLaval	X-48 / 15919	76,289 gpm @ 56 ' TDH	1	1913	97	Good
	Motor 1 - Synchronous, 2300 V	Westinghouse	1667D936	1,000 HP 340 RPM	1	1960	50	Will be inspected / tested in 2011
	Motor 2 - Wound Rotor, 2300 V	Westinghouse	18-57P938	600 HP 410 RPM	1	1960	50	Rebuilt 2004
	Motor 3 - Synchronous, 2300 V	Elliot	4044-MO6018	700 HP 600 RPM	1	1956	54	Reconditioned 2010
	Motor 4 - Synchronous, 2300 V	Elliot	4257-MO6259	1,250 HP 327 RPM	1	1948	62	Being Rebuilt for 2011
	Motor 5 - Synchronous, 2300 V	Elliot	8006-MO6708	1,500 HP 320 RPM	1	1949	61	Will be inspected/tested in 2011
	Pump #5 Hydraulic Unit	Weinman Pump & Supply	60-1K5-14D-F5C/ A4231		1			Good
	Pump #5 Hydraulic Unit Motor	Reliance		0.5 HP @ 1,725 RPM	1			Good
	Priming Pumps							
	East Priming Pump	SIHI Pump Limited	C07632075-01	GPM @ TDH	1			Good
	West Priming Pump	SIHI Pump Limited	5K5184SE205D8/ PJK44011814	GPM @ TDH	1			Good
	East Priming Pump Motor	GE	STK911093/ ID #P56E1302N-GP	5 HP @ 1,755 RPM	1			Good
	West Priming Pump Motor	Reliance	ID # P18F12V.Q	5 HP @ 1,710 RPM	1			Good
	Electrical Equipment							
	Motor Control Center					1956		Being Replaced in 2011
	AC Generator (Serving Chemical Bldg, Pump Room Lights & Valves, EDP-1 &	Stamford	PH13008590/ 463Ho4	313 KVA / 250 KW	1	2005	5	Good
	Emergency Power Backup - AC Generator Motor	Cummins	GTA855G3/ 25297627	HP 1,800 RPM	1	2005	5	Good
	E-Power Transfer Switch	Cummins	1040692543			2005	5	Good

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	Emergency Power Distribution Panelboard	Eaton / Cutler Hammer	PRL4		1	2005	5	Good
	Boiler System E-Power Transformer	Manufacturing Transformer Group	MK150KB/ PK150KBAH3	150 KVA	1	2005	5	Good
	Emergency Power Backup - AC Generator Motor	Cummins	GTA855G3/ 25297627	HP 1,800 RPM	1	2005	5	Good
	E-Power Transfer Switch	Cummins	DTPCD1000/ 1040692543			2005	5	Good
	Emergency Power Distribution Panelboard	Eaton / Cutler Hammer	PRL4		1	2005	5	Good
	Boiler System E-Power Transformer	Hammond Manufacturing Transformer Group	MK150KB/ PK150KBAH3	150 KVA	1	2005	5	Good
Water Treatment Plant Boiler System at Ross Pump Station	Boilers							
	Package Boiler #1 - NG / Oil	Clever Brooks	CB-LE 200.600.150	24.494 MBTUH @ 150 Psi	1	2002		Good
	Package Boiler #2 - NG / Oil	Clever Brooks	CB-LE 200.600.150	24.494 MBTUH @ 150 Psi	1	2002		Good
	Boiler #1 Blower Motor	Clever Brooks		30 HP RPM	1	2002		Good
	Boiler #2 Blower Motor	Clever Brooks		30 HP RPM	1	2002		Good
	Boiler #1 Compressor Motor	Marathon Elec	Series E	8 HP @ 1,760 RPM	1	2002		Good
	Boiler #2 Compressor Motor	Marathon Elec	8VF213TTDW4059/ Series E	8 HP @ 1,760 RPM	1	2002		Good
	Boiler #1 Reduction Equipment	Clever Brooks	AP153028		1	2002		Good
	Boiler #2 Reduction Equipment	Clever Brooks	AP153028		1	2002		Good
	Deaerator System - Third Floor							
	Deaerator Tank, Steel (5' dia x 10' SS)	Clever Brooks		1,460 Gal	1	2002		Good
	Boiler Feedwater Pump #1	Grundfos	B42296263P10349US939/ Type CR8-100/9 U-G-A Aude	42 GPM @ 404 'TDH	1	2002		Good
	Boiler Feedwater Pump #2	Grundfos	B42296263P10349US939/ Type CR8-100/9 U-G-A Aude	42 GPM @ 404 'TDH	1	2002		Good
	Boiler Feedwater Pump #1Motor	Baldor	Cat # 85600017/ Spec #36H302W385G1	8 HP @ 3,450 RPM	1	2002		Good

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	Boiler Feedwater Pump #2 Motor	WEG	Grundfos Part #85Z81974	10 HP @ 3,450 RPM	1	2002		Good- uninstalled spare also present
	Chemical Solution Tank, PE flat bottom with removable lid			100 Gal	1	2002		Good
	Chemical Solution Tank Mixer #1 with 3-blade impeller on 4' long shaft	GE	5KH36PNB050T	1/4 HP @ 1,750 RPM	1	2002		Good
	Chemical Solution Tank Level Indicator		Probe Type		1	2002		Good
	Chemical Solution Piston Type Feed Pump	Von Weise		HP @ RPM	1	2002		Good
	Chemical Solution Feed Pump Motor	GE		1/4 HP @ 1,725 RPM	1	2002		Good
	Economizer - Third Floor							
	Economizer # 1	Cannon Boiler Works, Inc.	S/O 5124-5100/ FS12SC523	450 PSI @ 650 F	1	2002		Good
	Economizer # 1	Cannon Boiler Works, Inc.	S/O 5124-5100/ FS12SC523	450 PSI @ 650 F	1	2002		Good
	Condensate System - Pump Area							
	Surge Tank, 8' dia x 12' high	Cleaver Brooks	SRG2000/ RG8876	2,000 Gal	1	2001		Good
	Condensate Return Pump #1, 2 x 2.5 x 6	Cleaver Brooks	Type 321-BF/ AS01-50254	100 GPM @ 90' TDH	1			Good
	Condensate Return Pump #2 2 x 2.5 x 6	Cleaver Brooks	Type 321-BF/ AS01-50255	100 GPM @ 90' TDH	1			Good
	Condensate Return Pump Motor #1	Marathon	8VJ182DDTR7602DT/ Part # 950-3641-940	5 HP @ 3,450 RPM	1			Good
	Condensate Return Pump Motor #2	Marathon	8VJ182DDTR7602DT/ Part # 950-3641-940	5 HP @ 3,450 RPM	1			Good
	Condensate Return Pump #1, 2 x 2.5 x 6	Cleaver Brooks	Type 321-BF/ AS01-50254	100 GPM @ 90' TDH	1			Good
	Condensate Return Pump #2 2 x 2.5 x 6	Cleaver Brooks	Type 321-BF/ AS01-50255	100 GPM @ 90' TDH	1			Good
	Condensate Return Pump Motor #1	Marathon	8VJ182DDTR7602DT/ Part # 950-3641-940	5 HP @ 3,450 RPM	1			Good
	Condensate Return Pump Motor #2	Marathon	8VJ182DDTR7602DT/ Part # 950-3641-940	5 HP @ 3,450 RPM	1			Good
	Boiler Chemical Treatment for Feedwater - Boiler Room							
	Chemical Solution Tank #1, PE flat bottom with removable lid			100 Gal	1	2002		Good

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	Chemical Solution Tank #2, PE flat bottom with removable lid			100 Gal	1	2002		Good
	Chemical Solution Tank Mixer #1 with 3-blade impeller on 4' long shaft	GE	5KH36PNB050T	1/4 HP @ 1,725 RPM	1	2002		Good
	Chemical Solution Tank Mixer #2 with 3-blade impeller on 4' long shaft	GE	5KH36PNB050T	1/4 HP @ 1,725 RPM	1	2002		Good
	Chemical Solution Tank #1 Level Indicator		Probe Type		1	2002		Good
	Chemical Solution Tank #2 Level Indicator		Probe Type		1	2002		Good
	Chemical Solution Tanks #1 & #2 Metering Pump	LMI / Milton Roy	C101-94S/ 08022514744-1	1 GPH @ 300 PSI	1	2002		Concern - Pump has high failure rate due to high boiler pressure reqdmt
	Control Panel - Boiler Room	Swindell Dresser				2		
	PLC	Eaton / Cuttler-Hammer	Panelmate Power Pro/					
	Steam Meter Gauge #1 Boiler	Thermal Instrmt Co., Inc	SN 2010262	SCFM	1	2010		Good - Mounted onto SD Panel
	Steam Meter Gauge #2 Boiler	Thermal Instrmt Co., Inc	SN 2010263	SCFM	1	2010		Good - Mounted onto SD Panel
	Generator Meter Gauge	Thermal Instrmt Co., Inc	SN 2010264	SCFM	1	2010		Good - Mounted onto SD Panel
	Conductivity Controller #1	Advance Controls Inc	2B-7M/ G1-146		1	2010		Good - Mounted onto SD Panel
	Conductivity Controller #2	Advance Controls Inc	2B-7M/ G1-145		1	2010		Good - Mounted onto SD Panel
	Boiler Feedwater Water Softener (Located in Chem Room)			100 PSI @ 650 F				
	Resin Tank #1 (3' dia x 6' SS)	Metro MFG. CO.		300 Gal	1	1990		Good But Being Replaced with a Larger Capacity System
	Resin Tank #2 (3' dia x 6' SS)	Metro MFG. CO.		300 Gal	1	1990		Good But Being Replaced with a Larger Capacity System
	Brine Solution Tank, FRP, flat bottom, open removable lid top				1	1990		Good But Being Replaced with a Larger Capacity System
	1.5" Flowmeter #1	Badger	SR/ SN19669-1/ Part # 9823486	0 to 300 GPM	1	1990		Good
	1.5" Flowmeter #2	Badger	SR/ SN19669-1/ Part # 9823486	0 to 300 GPM	1	1990		Good

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Facility Name	Equipment Name - Brief Description	Equipment Manufacturer	Model No. / Serial No.	Capacity	Number of Units	Date Installed	Age of Unit	General Condition
Water Treatment Plant Ross Pump Station Compressed Air Systems	Instrument Air Compressor Basement							
	Instrument Air Compressor	Ingersol Rand	Type ESH-1/ IDC-15	scfm @ psig	1	1959		Fair
	Air Compressor Motor	GE	5K4286A21A5	20 HP @ 1,760 RPM	1			Good
	Air Receiver, bolted Stl tank, 5' dia x 6' high		117,589XR	950 GAL	1	1959		Fair
	Instrument Air Compressor Boiler Room							
	Reciprocating Type Twin Unit with common Receiver tank	Moeller	HPL3D-8/ PL15A02387		1			Good
	Compressor #1	Moeller	PL15A 02387	140 scfm @ 175 psig	1			Good
	Compressor #2	Moeller	PL15A 02415	130 scfm @ 165 psig	1			Good
	Compressor Motor #1	Baldor	Cat #M3111-CH/ Spec #35L101787862	3 HP @ 1,725 RPM	1			Good
	Compressor Motor #2	Baldor	Cat #M3111-CH/ Spec #35L101787862	3 HP @ 1,725 RPM	1			Good
	Instrument Air Compressor Basement							
	Reciprocating Type mounted on Receiver tank	Kruman Equipment Co.	HR 7-8/ R30028798	scfm @ 1,745 RPM	1			Some surface deterioration
	Compressor Receiver Tank (1.5' dia x 5')	Champion	SN R3028798	60 Gal	1			Some surface deterioration
	Compressor Motor	Magnetic Century Electric		7.5 HP @ 1,745 RPM	1			Some surface deterioration
	Instrument Air Compressor Third Floor							
	Backup Reciprocating Air Compression	Brunner Manufacturing Co.	A212/ 147720	scfm @ 1,760 RPM	1	1941	69	Poor
	Compressor Receiver Tank (2' dia x 3' high)	Pressure Steel Co.		Gal	1	1941	69	Poor
	Compressor Motor	Westinghouse		8 HP @ 1,760 RPM	1	1941	69	Poor
	Instrument Air Compressor First Floor							
	Plant Air Compressor, Single Reciprocating type	Ingersol Rand			1			Disconnected

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	Instrument Air Compressor First Floor							
	Plant Air Compressor, Single Reciprocating type	Ingersol Rand	T30251204/ 30T719795	200 psi @ 460 F	1			
	Air Compressor Motor	Baldor	NA		1			External deterioration
	AC Receiver, 2' dia x 5' Lg	Brunner Engineering & Manufacturing, Inc.		110 Gal	1			
Water Filtration Plant Sodium Hypochlorite Building	Pretreatment Sodium Hypochlorite							
	Storage Tanks #1 - #4 Fiberglass 12.5% Solution	Augusta Fiberglass Inc.		11,750 Gal 10' dia 22' high	4	2004		Good
	Feed Pump 1 - Metering	US Filter	Encore 700 / 86-45704	160 GPH @ 100 PSIG	1	2004		Fair with external rust - Not Used
	Feed Pump 2 - Metering	US Filter	Encore 700 / 86-45701	160 GPH @ 100 PSIG	1	2004		Fair with external rust - Not Used
	Feed Pump 3 - Metering	US Filter	Encore 700 / 86-45702	160 GPH @ 100 PSIG	1	2004		Fair with external rust - To Be Replaced
	Feed Pump 4 - Metering	Prominent Sigma	WDL 100C /	130 GPH @ 100 PSIG	1	2004		Good
	Feed Pump Motor 1	Baldor	N0204120791	1 HP 1,750 RPM	1	2004		Fair with external rust - Not Used
	Feed Pump Motor 2	Baldor	N0204120800	1 HP 1,750 RPM	1	2004		Fair with external rust - Not Used
	Feed Pump Motor 3	Baldor	N0204120740	1 HP 1,750 RPM	1	2004		Fair with external rust - To Be Replaced
	Feed Pump Motor 4	ATB	215741401H0238 10307	0.37 KW 1,750 RPM	1	2004		Good
	Transfer Pump #1	Goulds	3298 / 756E644.1	105 gpm @ 25' TDH	1	2004		Good
	Transfer Pump #2	Finish Thompson Inc.	DB110.2 / 75391G09	gpm @ TDH	1	2004		Good
	Transfer Pump Motor #1	US Motors	001 F	2 HP 1,740 RPM	1	2004		Good
	Transfer Pump Motor #2	Emerson	69689E / NA	2 HP 3,450 RPM	1	2004		Good
Water Treatment Plant Chemical Feed Center at Ross Pump Station	Chemical Spill Holding Tanks							
	Storage Tank #1	Sii		4,000 Gal	1	2002		Good
	Storage Tank #2	Sii		4,000 Gal	1	2002		Good
	Storage Tank #3	Sii		4,000 Gal	1	2002		Good
	Phosphate Feed System							

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	Phosphate Solution Tank, PE flat bottom with removable lid			100 Gal	1	2002		Good
	Phosphate Solution Feed Pump	Wallace Tiernan	A116146	Gph @ 60 Psig	1			Good
	Phosphatel Solution Feed Pump Motor	GE	Model 5KHC39QN9581GT	1/3 HP @ 1,725 RPM	1			Good - Feeding Phosphate to Soda Ash System
	Phosphate Solution Tank Mixer	GE	Cat # C365	1/4 HP @ 1,725 RPM	1	2002		Out of Service, no shaft or blade
	Phosphate Solution Tank Level Indicator		Probe Type		1	2002		Good
	Chemical Solution Tank Level Indicator		Probe Type		1	2002		Good
	Ferric Chloride Feed System							
	Storage Bin #3	NA	NA	16000 Gal	1	1960		Good
	Storage Bin #5	NA	NA	16,000 Gal	1	1960		Good
	Storage Bin #6	NA	NA	16,000 Gal	1	1960		Good
	Feed Pump 1 - Dual head Metering	USFilter	R-100-7746/ 013GLH20430	gpm @ ' TDH	1	2004		Fair with external corrosion, newer pump head - Needs Replaced
	Feed Pump 2 - Dual head Metering	USFilter		gpm @ ' TDH	1	2004		Poor w/ external corrosion -Needs Replaced
	Feed Pump 3 - Dual head Metering	USFilter		gpm @ ' TDH	1	2004		Poor w/ external corrosion -Needs Replaced
	Feed Pump Motor 1	Baldor	SN - W0304120795	1 HP 1,750 RPM	1	2004		Poor w/ external corrosion -Needs Replaced
	Feed Pump Motor 2	Baldor	SN - W0344160750	1 HP 1,750 RPM	1	2004		Poor w/ external corrosion -Needs Replaced
	Feed Pump Motor 3	Baldor	SN - W0208160745	1 HP 1,750 RPM	1	2004		Poor w/ external corrosion -Needs Replaced
	#3 Level Indicator, cont. analog output	Bindicator Silomaster	NA		1	1994	16	Nonfunctional
	#5 Level Indicator, cont. analog output	Bindicator Silomaster	NA		1	1994	16	Nonfunctional
	#6 Level Indicator, cont. analog output	Bindicator Silomaster	NA		1	1994	16	Nonfunctional - Replaced
	#6 Level Indicator, LED Readout	Siemens	NA		1	2010	0	Excellent; Replaced above unit
	Lime Feed System							
	Storage Bin #1	NA	NA	150,000 LBs	1	1960		Good
	Storage Bin #2	NA	NA	150,000 LBs	1	1960		Good
	#1 Level Indicator, cont. analog output	Bindicator Silomaster	SN-CL3G1E204-30		1	1994	16	Nonfunctional
	#2 Level Indicator, cont. analog output	Bindicator Silomaster	SN-CL3G1E204-30		1	1994	16	Nonfunctional
	#1 Pressure Relief Valve	Groth Equip. Corp	10-1		1	1994		Good
	#2 Pressure Relief Valve	Groth Equip. Corp	10-2		1	1994		Good
	Dust Collector Unit #1	DCE Dalamatic			1	1994		Inspect & Evaluate
	Dust Collector Unit #2	DCE Dalamatic			1	1994		Inspect & Evaluate

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	Dust Collector Motor #1	Baldor		7.5 HP RPM	1	1994		Good
	Dust Collector Motor #2	Baldor		7.5 HP RPM	1	1994		Good
	Dust Collector #1 Pres Dif Gauge	NA	NA		1	1994		Inspect & Evaluate
	Dust Collector #2 Pres Dif Gauge	NA	NA		1	1994		Inspect & Evaluate
	Volumetric Feeder #1 w/ gear reducer	US Filter	Series 32-300		1	2009		Good
	Volumetric Feeder #2 w/ gear reducer	US Filter	Series 32-300		1	2009		Good
	Motor - Volumetric Feeder #1	Baldor		1 HP 1,725 RPM	1	2009		Good
	Motor - Volumetric Feeder #2	Inverter		1 HP 1,725 RPM	1	2009		Good
	Lime Slaker #1	Siemens	BN19763/ 126438-SA1			2009		Good
	Lime Slaker #2	Siemens	BN19763/ 126438-SA1			2009		Good
	Vibrator Gauge	SWECO				2009		Good
	Vibrator Gauge	SWECO				2009		Good
	Potassium Permanganate Feed System							
	Storage Bin #9	NA	NA	150,000 LBs	1	1960		Good
	Level Indicator, cont. analog output	Bindicator Silomaster	SN-CL3G1E204-30		1	1994	16	Good
	Pressure Release Valve	Groth Equip. Corp	3		1			Good
	Dust Collector Unit	DCE Dalamatic			1	1994		Inspect & Evaluate
	Dust Collector Motor	Baldor		7.5 HP RPM	1	1994		Good
	Dust Collector Pres Dif Gauge	NA	NA		1	1994		Inspect & Evaluate
	Magnetic Vibrator	Bindicator Silomaster			1	1994		Good
	Solution Tank	Wallace Tiernan			1	2010		Good
	Solution Tank Mixer	Wallace Tiernan			1	1994		Good
	Solution Tank Mixer Motor	Wallace Tiernan		1/3 HP RPM	1	1994		Good
	Solution Tank Control Panel	Syntron	V-9 / W-7488	115 VAC		1994		Good
	Solution Feed Pump, Centrifugal			GPM @ 'TDH		2004		Fair
	Solution Feed Pump Motor, 480 V			3 HP RPM		2004		
	Polyelectrolyte Feed System							
	Storage Bin #8	NA	NA	16,000 GAL	1	1960		Good
	Level Indicator, cont. analog output	Bindacator Silomaster	SN-CL3G1E204-30		1	1994	16	Nonfuntional - Replaced
	Level Indicator, LED Readout	Siemens	NA			2010	0	Excellent - Replaced Above

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	Solution Feed Pump #1, Contrifugal	Pulsafeeder	1	6 GPH		1	2004		Good
	Solution Feed Pump #2, Contrifugal	Pulsafeeder	2	6 GPH		1	2004		Good
	Solution Feed Pump Motor #1, 480 V	Baldor	40C AMB Cont	0.17 HP	1,725 RPM	1	2004		Good
	Solution Feed Pump Motor #2, 480 V	Baldor	40C AMB Cont	0.17 HP	1,725 RPM	1	2004		Good
	Caustic Feed System								
	Storage Tank - Fiberglass	Augusta Fiberglass Inc.		5,250 Gal	8' dia 16' high	1	2004		Good
	Feed Pump No. 1 Metering	US Filter	Encore 700 / BF 45743	160 GPH	100 PSIG	1	2004		Poor with much external rust
	Feed Pump No. 2 Metering	US Filter	Encore 700 / BF 45742	160 GPH	100 PSIG	1	2004		Fair with external rust
	Feed Pump No. 1 Motor	Baldor	35G719T634 / F898	0.75 HP	1,725 RPM	1	2004		Fair with external rust
	Feed Pump No. 2 Motor	Baldor	35G719T634 / F396	0.75 HP	1,725 RPM	1	2004		Fair with external rust
	Soda Ash Feed System								
	Storage Bin #4	NA	NA	150,000	LBs	1	1960		Good
	Storage Bin #7	NA	NA	150,000	LBs	1	1960		Good
	#1 Level Indicator, cont. analog output	Bindicator Silomaster	SN-CL3G1E204-30			1	1994	16	Nonfunctional
	#2 Level Indicator, cont. analog output	Bindicator Silomaster	SN-CL3G1E204-30			1	1994	16	Nonfunctional
	#1 Pressure Release Valve	Groth Equip. Corp	10-1			1	1994		Good
	#2 Pressure Release Valve	Groth Equip. Corp	10-2			1	1994		Good
	Dust Collector Unit #1	DCE Dalamatic				1	1994		Inspect & Evaluate
	Dust Collector Unit #2	DCE Dalamatic				1	1994		Inspect & Evaluate
	Dust Collector Motor #1	Baldor		7.5 HP	RPM	1	1994		Good
	Dust Collector Motor #2	Baldor		7.5 HP	RPM	1	1994		Good
	Dust Collector #1 Pres Dif Gauge	NA	NA			1	1994		Inspect & Evaluate
	Dust Collector #2 Pres Dif Gauge	NA	NA			1	1994		Inspect & Evaluate
	Screw Feeder #1					1	1994		Good
	Screw Feeder #2					1	1994		Good
	Solution Tank #1					1	1994		Good
	Solution Tank #2					1	1994		Good
	Solution Tank #1 Mixer					1	1994		Good
	Solution Tank #2 Mixer					1	1994		Good
	Solution Tank #1 Mixer Motor	Century		1/3 HP	1,725 RPM	1	1994		Good

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	Solution Tank #2 Mixer Motor	Century		1/3 HP	1,725 RPM	1	1994		Good
	Control Panel EDP-1	Siemens				1	1994		Good
	Control Panel EDP-2	Siemens				1	1994		Good
	Solution Feed Pump @ Bin 4, 1x2-10	Peerless	10-A	30 GPM @	70 'TDH	1	2010		Good
	Solution Feed Pump At Bin 7, 1x2-10	Peerless	8196MTP/ 079158A	30 GPM @	70 'TDH	1	2011		Good
	Solution Feed Pump Motor @ Bin #4	Line	A	3 HP	1,740 RPM	1	2010		Good
	Solution Feed Pump Motor @ Bin #7	US Motor	W01V329R084M	3 HP	1,750 RPM	1	2011		Good
Water Filtration Plant Screen Room	Traveling Screens								
	Intake Screen 1 East - Auto Backwash	Siemens	45A TWS			1	2009		Excellent
	Intake Screen 2 West - Auto Backwash	Siemens	45A TWS			1	2009		Excellent
	Conveyor Discharge Screw	Jim Meyers & Sons	NA / 0840-SC10			1	2009		Excellent
	Discharge Screw Motor	SEW Eurodrive	DRE80H4DH-102	1 HP	1,740 RPM	1	2009		Excellent
	Rapid Flash Mixers								
	1 - Mixer	Lightnin	85C20/1000000058240	20 HP	55.5 RPM		2010		Excellent
	2 - Mixer	Lightnin	85C20/1000000058241	20 HP	55.5 RPM		2010		Excellent
	3 - Mixer	Lightnin	85C20/1000000058239	20 HP	55.5 RPM		2010		Excellent
	4 - Mixer	Lightnin	85C20/1000000058238	20 HP	55.5 RPM		2010		Excellent - Not Installed Yet
	4 - Mixer	Philadelphia	3809-S PTS	20 HP	56 RPM		1994		To Be Replaced with Above Unit
	1 - Mixer Motor	Baldor Reliance	S9018419-001 002 GL	20 HP	1,760 RPM		2010		Excellent
	2 - Mixer Motor	Baldor Reliance	S9018419-001 007 GL	20 HP	1,760 RPM		2010		Excellent
	3 - Mixer Motor	Baldor Reliance	S9000352-001 001 AL	20 HP	1,760 RPM		2010		Excellent
	4 - Mixer Motor	Baldor Reliance	S9018419-001 023 GL	20 HP	1,760 RPM		2010		Excellent - Not Installed Yet
	4 - Mixer Motor	Reliance	1XAF62220	20 HP	1,755 RPM		1994		To Be Replaced with Above Unit
	Carbon Feed System								
	Precarbon Transfer Pump #1	Peerless Pump Co.	8196 MTP / 079155B	100 gpm	50' TDH		1993		Poor - Needs Replaced
	Precarbon Transfer Pump #2	Peerless Pump Co.	8196 MTP / 079155A	100 gpm	50' TDH		1993		Poor - Needs Replaced
	Precarbon Pump Motor #1	US Motors	V09V203R018M	5 HP	1,740 RPM		1993		Poor - Needs Replaced
	Precarbon Pump Motor #2	US Motors	V09V203R018M	5 HP	1,740 RPM		1993		Poor - Needs Replaced

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Facility Name	Equipment Name - Brief Description	Equipment Manufacturer	Model No. / Serial No.	Capacity		Number of Units	Date Installed	Age of Unit	General Condition
	Carbon Slurry Recirculation Pump # 1	Goulds	3196 / A745F022-1	2 HP	1,800 RPM		2009		Good
	Carbon Slurry Recirculation Pump # 2	Sterling Pump Co.	8196-S / 07806B	2 HP	1,735 RPM				Out of Service - Replacement Purchased; Needs installed
	Carbon Slurry Recirculation Pump # 3	Sterling Fluid Systems	8196-S / 671405	2 HP	1,750 RPM		2008		Good
	Carbon Slurry Reciculation Pump Motor #1	Emerson	S425 / L08-S425-M	2 HP	1,735 RPM		2009		Good
	Carbon Slurry Recirculation Pump Motor #2	US Motors	NA / C0789U08U168R101F	2 HP	1,735 RPM				Out of Service - Replacement Purchased; Needs installed
	Carbon Slurry Recirculation Pump Motor #3	Emerson	S425 / H01-S425-M	2 HP	1,735 RPM		2008		Good
	Rotodip Carbon Feeder #1						1994		Poor; Not in Use
	Rotodip Carbon Feeder #2						1994		Poor; Not in Use
	Rotodip Carbon Feeder #3						1994		Poor
	Carbon Rotodip Premixer #1			HP @	RPM		1994		Not Operational
	Carbon Rotodip Premixer #2			HP @	RPM		1994		Not Operational
	Carbon Rotodip Premixer #3			HP @	RPM		1994		Not Operational
	Carbon Tank No. 1 Mixer	Philadelphia	91DGK0183	20 HP	56 RPM	1	1994		Good
	Carbon Tank No. 2 Mixer	Philadelphia	91DGK0182	20 HP	56 RPM	1	1994		Good
	Carbon Tank No. 3 Mixer	Philadelphia	84DEJ0326	20 HP	56 RPM	1	1994		Out of service with fallen impeller
	Carbon Tank No. 1 Mixer Motor	Reliance	3MAF62220	20 HP	1,740 RPM	1	1994		Good
	Carbon Tank No. 2 Mixer Motor	Reliance	C0901210117	20 HP	1,760 RPM	1	1994		Good
	Carbon Tank No. 3 Mixer Motor	Reliance	Y145109A3	20 HP	1,725 RPM	1	1994		Good
	Cabon Sump Pump								Fair
	Carbon Sump Pump Motor								Fair
Water Filtration Plant Clarifiers	Clarifier Basins					4	1960		Good
	1 - Sludge Collector A	Siemens					2011		Excellent
	1 - Sludge Collector B	Siemens					2011		Excellent
	1 - Sludge Collector C	Siemens					2011		Excellent
	1 - Sludge Collector D	Siemens					2011		Excellent
	1 - Sludge Collector Gear Reducer A/B	SEW Eurodrive					2011		Excellent
	1 - Sludge Collector Motor A/B	Baldor Reliance					2011		Excellent
	1 - Sludge Collector Gear Reducer C/D	SEW Eurodrive					2011		Excellent

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Facility Name	Equipment Name - Brief Description	Equipment Manufacturer	Model No. / Serial No.	Capacity	Number of Units	Date Installed	Age of Unit	General Condition
	1 - Sludge Collector Motor C/D	Baldor Reliance				2011		Excellent
	1 - Screw Auger	Siemens				2011		Excellent
	1 - Sludge Screw Auger Gear Reducer	SEW Eurodrive				2011		Excellent
	1 - Sludge Screw Auger Motor	Baldor Reliance				2011		Excellent
	1 - Flocculator Primary A	Envirex				1989		Poor - Needs Replaced
	1 - Flocculator Gear Reducer Primary A	SEW Eurodrive	R10707100L4-KS / 890106670.05.05.003			2005		Good
	1 - Flocculator Motor Primary A	SEW Eurodrive	DFT100L4-KS / 890106670.05.05.003	5 HP 1,800 RPM		2005		Good
	1 - Flocculator Secondary B	Envirex				1989		Poor - Needs Replaced
	1 - Flocculator Gear Reducer Secondary B	SEW Eurodrive	R87DT90L4-KS / 890106667.05.05.002			2005		Good
	1 - Flocculator Motor Secondary B	SEW Eurodrive	DFT90L4-KS / 89010667.05.05.002	2 HP 1,800 RPM		2005		Good
	1 - Flocculator Primary C	Envirex				1989		Poor - Needs Replaced
	1 - Flocculator Gear Reducer Primary C	SEW Eurodrive	R10707100L4-KS / 890106670.05.05.008			2005		Good
	1 - Flocculator Motor Primary C	SEW Eurodrive	DFT100L4-KS / 890106670.05.05.008	5 HP 1,800 RPM		2005		Good
	1 - Flocculator Secondary D	Envirex				1989		Poor - Needs Replaced
	1 - Flocculator Gear Reducer Secondary D	SEW Eurodrive	R87DT90L4-KS / 890106667.05.05.001			2005		Good
	1 - Flocculator Motor Secondary D	SEW Eurodrive	DFT90L4-KS / 89010667.05.05.001	2 HP 1,800 RPM		2005		Good
	2 - Sludge Collector A	Siemens				2011		Excellent
	2 - Sludge Collector B	Siemens				2011		Excellent
	2 - Sludge Collector C	Siemens				2011		Excellent
	2 - Sludge Collector D	Siemens				2011		Excellent
	2 - Sludge Collector Gear Reducer A/B	SEW Eurodrive				2011		Excellent
	2 - Sludge Collector Motor A/B	Baldor Reliance				2011		Excellent
	2 - Sludge Collector Gear Reducer C/D	SEW Eurodrive				2011		Excellent
	2 - Sludge Collector Motor C/D	Baldor Reliance				2011		Excellent
	2 - Screw Auger	Siemens				2011		Excellent
	2 - Sludge Screw Auger Gear Reducer	SEW Eurodrive				2011		Excellent
	2 - Sludge Screw Auger Motor	Baldor Reliance				2011		Excellent
	2 - Flocculator Primary A	Envirex				1989		Poor - Needs Replaced

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Major Pump and Equipment Inventory

Facility Name	Equipment Name - Brief Description	Equipment Manufacturer	Model No. / Serial No.	Capacity	Number of Units	Date Installed	Age of Unit	General Condition
	2 - Flocculator Gear Reducer Primary A	SEW Eurodrive	R10707100L4-KS / 890106670.05.05.005			2005		Good
	2 - Flocculator Motor Primary A	SEW Eurodrive	DFT100L4-KS / 890106670.05.05.005	5 HP 1,800 RPM		2005		Good
	2 - Flocculator Secondary B	Envirex				1989		Poor - Needs Replaced
	2 - Flocculator Gear Reducer Secondary B	SEW Eurodrive	R87DT90L4-KS / 890106667.05.05.005			2005		Good
	2 - Flocculator Motor Secondary B	SEW Eurodrive	DFT90L4-KS / 89010667.05.05.005	2 HP 1,800 RPM		2005		Good
	2 - Flocculator Primary C	Envirex				1989		Poor - Needs Replaced
	2 - Flocculator Gear Reducer Primary C	SEW Eurodrive	R10707100L4-KS / 890106670.05.05.002			2005		Good
	2 - Flocculator Motor Primary C	SEW Eurodrive	DFT100L4-KS / 890106670.05.05.002	5 HP 1,800 RPM		2005		Good
	2 - Flocculator Secondary D	Envirex				1989		Poor - Needs Replaced
	2 - Flocculator Gear Reducer Secondary D	SEW Eurodrive	R87DT90L4-KS / 890106667.05.05.001			2005		Good
	2 - Flocculator Motor Secondary D	SEW Eurodrive	DFT90L4-KS / 89010667.05.05.001	2 HP 1,800 RPM		2005		Good
	3 - Sludge Collector A	Siemens				2010		Excellent
	3 - Sludge Collector B	Siemens				2010		Excellent
	3 - Sludge Collector C	Siemens				2010		Excellent
	3 - Sludge Collector D	Siemens				2010		Excellent
	3 - Sludge Collector Gear Reducer A/B	SEW Eurodrive	K77R37AM56-KS / 850269141.10.10.006			2010		Excellent
	3 - Sludge Collector Motor A/B	Baldor Reliance	34K066-081261	0.5 HP 1,800 RPM		2010		Excellent
	3 - Sludge Collector Gear Reducer C/D	SEW Eurodrive	K77R37AM56-KS / 850269141.10.10.005			2010		Excellent
	3 - Sludge Collector Motor C/D	Baldor Reliance	34K066-081261	0.5 HP 1,800 RPM		2010		Excellent
	3 - Screw Auger	Siemens				2010		Excellent
	3 - Sludge Screw Auger Gear Reducer	SEW Eurodrive	K97AM184-KS / 850269144.10.10.007			2010		Excellent
	3 - Sludge Screw Auger Motor	Baldor Reliance	CEM3165T / F1002111059	5 HP 1,750 RPM		2010		Excellent
	3 - Flocculator Primary A	Envirex				1989		Poor - Needs Replaced
	3 - Flocculator Gear Reducer Primary A	SEW Eurodrive	R10707100L4-KS / 890106670.05.05.004			2005		Good
	3 - Flocculator Motor Primary A	SEW Eurodrive	DFT100L4-KS / 890106670.05.05.004	5 HP 1,800 RPM		2005		Good

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Facility Name	Equipment Name - Brief Description	Equipment Manufacturer	Model No. / Serial No.	Capacity	Number of Units	Date Installed	Age of Unit	General Condition
	3 - Flocculator Secondary B	Envirex				1989		Poor - Needs Replaced
	3 - Flocculator Gear Reducer Secondary B	SEW Eurodrive	R87DT90L4-KS / 890106667.05.05.008			2005		Good
	3 - Flocculator Motor Secondary B	SEW Eurodrive	DFT90L4-KS / 89010667.05.05.008	2 HP 1,800 RPM		2005		Good
	3 - Flocculator Drive Primary C	Envirex				1989		Poor - Needs Replaced
	3 - Flocculator Gear Reducer Primary C	SEW Eurodrive	R10707100L4-KS / 890106670.05.05.001			2005		Good
	3 - Flocculator Motor Primary C	SEW Eurodrive	DFT100L4-KS / 890106670.05.05.001	5 HP 1,800 RPM		2005		Good
	3 - Flocculator Secondary D	Envirex				1989		Poor - Needs Replaced
	3 - Flocculator Gear Reducer Secondary D	SEW Eurodrive	R87DT90L4-KS / 890106667.05.05.007			2005		Good
	3 - Flocculator Motor Secondary D	SEW Eurodrive	DFT90L4-KS / 89010667.05.05.007	2 HP 1,800 RPM		2005		Good
	4 - Sludge Collector A	Siemens				2009		Excellent
	4 - Sludge Collector B	Siemens				2009		Excellent
	4 - Sludge Collector C	Siemens				2009		Excellent
	4 - Sludge Collector D	Siemens				2009		Excellent
	4 - Sludge Collector Gear Reducer A/B	SEW Eurodrive	K77R37AM56-KS / 850147789.09.08.002			2009		Excellent
	4 - Sludge Collector Motor A/B	Baldor Reliance	05E03W16	0.5 HP 1,800 RPM		2009		Excellent
	4 - Sludge Collector Gear Reducer C/D	SEW Eurodrive	K77R37AM56-KS / 850147789.09.08.001			2009		Excellent
	4 - Sludge Collector Motor C/D	Baldor Reliance	05E03W16	0.5 HP 1,800 RPM		2009		Excellent
	4 - Screw Auger	Siemens				2009		Excellent
	4 - Sludge Screw Auger Gear Drive	SEW Eurodrive	K97AM184-KS / 850204822.09.09.001			2009		Excellent
	4 - Sludge Screw Auger Motor	Baldor Reliance	CEM3165T/ 06F057W352	5 HP 1,750 RPM		2009		Excellent
	4 - Flocculator Primary A	Envirex				1989		Poor - Needs Replaced
	4 - Flocculator Gear Reducer Primary A	SEW Eurodrive	R10707100L4-KS / 890106670.05.05.006			2005		Good
	4 - Flocculator Motor Primary A	SEW Eurodrive	DFT100L4-KS / 890106670.05.05.006	5 HP 1,800 RPM		2005		Good
	4 - Flocculator Secondary B	Envirex				1989		Poor - Needs Replaced
	4 - Flocculator Gear Reducer Secondary B	SEW Eurodrive	R87DT90L4-KS / 890106667.05.05.003			2005		Good

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Facility Name	Equipment Name - Brief Description	Equipment Manufacturer	Model No. / Serial No.	Capacity	Number of Units	Date Installed	Age of Unit	General Condition
	4 - Flocculator Motor Secondary B	SEW Eurodrive	DFT90L4-KS / 89010667.05.05.003	2 HP 1,800 RPM		2005		Good
	4 - Flocculator Drive Primary C	Envirex				1989		Poor - Needs Replaced
	4 - Flocculator Gear Reducer Primary C	SEW Eurodrive	R10707100L4-KS / 890106670.05.05.007			2005		Good
	4 - Flocculator Motor Primary C	SEW Eurodrive	DFT100L4-KS / 890106670.05.05.007	5 HP 1,800 RPM		2005		Good
	4 - Flocculator Secondary D	Envirex				1989		Poor - Needs Replaced
	4 - Flocculator Gear Reducer Secondary D	SEW Eurodrive	R87DT90L4-KS / 890106667.05.05.004			2005		Good
	4 - Flocculator Motor Secondary D	SEW Eurodrive	DFT90L4-KS / 89010667.05.05.004	2 HP 1,800 RPM		2005		Good
Water Filtration Plant Sedimentation Basins	Sedimentation Basins				3	1906		
Water Filtration Plant	OPS Building							
Water Filtration Plant Filter Building	Rapid Sand Filters - Filter Building				18	1964		To Be Rehabilitated
	Control Panels	Leopold	SY/MAX		18	1990		Good
	Turbidity Sample Pump, Horiz Cent	Crane-Deming	Type A-1/ SN 186		1			Some external deterioration
	Turbidity Sample Pump Motor	Baldor		1/3 HP @ 3,450 RPM	1			Some external deterioration
	Backwash Vertical Pump	Johnson	Repair #-95JK8311/ JZ2732	GPM @ TDH	1	1995		To Be Rebuilt
	Backwash Vertical Pump Motor	Gen'l Dynamics	SN-80100771A1	300 HP @ 590 RPM	1	1995		Good
	Spare Backwash Pump	Johnson			1			Good
	Air Scour Blower No. 1	Hoffman			1	1990		To Be Replaced
	Air Scour Blower No. 1 Motor				1	1990		To Be Replaced
	Air Scour Blower No. 2	Hoffman			1	1990		To Be Replaced
	Air Scour Blower No. 2 Motor				1	1990		To Be Replaced
	Valves and Sluice Gates							

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Facility Name	Equipment Name - Brief Description	Equipment Manufacturer	Model No. / Serial No.	Capacity	Number of Units	Date Installed	Age of Unit	General Condition
	36" Influent Butterfly				18	1990		To Be Replaced or Rebuilt
	24" Effluent Butterfly				18	1964		To Be Replaced or Rebuilt
	30" Main Backwash Butterfly				18	1964		To Be Replaced or Rebuilt
	42" Filter Drain Butterfly				18	1990		To Be Replaced or Rebuilt
	12" Filter Air Inlet Butterfly				36	1990		To Be Replaced or Rebuilt
	12" Air Scour Flow Control				1	1990		To Be Replaced or Rebuilt
	30" Backwash Control Valve with double action Actuator	Pratt	Mod XR/ S034874-1		1	1998		To Be Replaced or Rebuilt
	30" Left or Right Backwash				36	1964		To Be Replaced or Rebuilt
	12" Motorized Inlet Control				2	1990		To Be Replaced or Rebuilt
	8" Rewash Butterfly				18	1990		To Be Replaced or Rebuilt
	Pre-Filter Chlorination Sodium Hypochlorite - North Garage of Filter Building							
	Hypochlorite Storage Tank #1	Nalgene	51309-1100 / 3A970038	1100 Gal	1			Good
	Hypochlorite Storage Tank #2	Nalgene	51309-1100 / 3A970039	1100 Gal	1			Good
	Hypochlorite Storage Tank #3		170708812	1000 Gal	1			Good
	Hypochlorite Storage Tank #4		170708840	1000 Gal	1			Good
	Hypochlorite Storage Tank #5	Ace Roto-Mold	VT00210SWSX	210 Gal	1			Good
	Pre-Chlorine Feed Pump #1	Prominent Sigma	OUD000C / 2706014201	28.5 GPH @ 145 PSI	1			Good
	Pre-Chlorine Feed Pump #2	Prominent Sigma	OUD000C / 2706003380	28.5 GPH @ 145 PSI	1			Good
	Pre-Filter Chlorination - Injection System Second Floor Filter Gallery							
	Day Tank, 4' dia x 4' high, PE			200 Gal	1			Good
	Pre-Chlorine Application Pump Peristaltic type	Cole-Palmer	Mod 7518-00		1			Good
	ORP Probe	Drexelbrook	800		1			Some external deterioration
	48" Air Circulation Fan - Portable	Dayton	3C673A	3/4 HP 2 Speed	1			Good
	Post-Filter Chlorination - North Garage of Filter Builing							
	Hypochlorite Storage Tank #1		170708826	1000 Gal	1			Good

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Facility Name	Equipment Name - Brief Description	Equipment Manufacturer	Model No. / Serial No.	Capacity	Number of Units	Date Installed	Age of Unit	General Condition
	Hypochlorite Storage Tank #2		170708819	1000 Gal	1			Good
	Hypochlorite Storage Tank #3		170708801	1000 Gal	1			Good
	Hypochlorite Storage Tank #4		170708808	1000 Gal	1			Good
	Hypochlorite Storage Tank #5		170708794	1000 Gal	1			Good
	Hypochlorite Storage Tank #6		170708833	1000 Gal	1			Good
	Post-Chlorine Feed Pump	Prominent Sigma	OUDC000C /	96.5 GPH @ 58 PSI	1			Good
Water Filtration Plant Clearwell	Clearwell, Concrete UG Structure			44.50 MG	1	1912		Needs Renovated
	Inlet Gate House					1912		
	Sluice Gate Valve #1	Coffin Valve Co.			1	1912		Fair
	Sluice Gate Valve #1 Motor					1912		Fair
	Sluice Gate Valve #2	Coffin Valve Co.			1	1912		Fair
	Sluice Gate Valve #2 Motor					1912		Fair
	Sluice Gate Valve #3	Hydrogate			1	1912		Good
	Sluice Gate Valve #3 Motor		EIM Controls	2 HP @ 1,725 RPM	1	1912		Good
	Outlet Gate House					1912		
	Sluice Gate Valve #1	Coffin Valve Co.			1	1912		Fair
	Sluice Gate Valve #1 Motor					1912		Fair
	Sluice Gate Valve #2	Coffin Valve Co.			1	1912		Fair
	Sluice Gate Valve #2 Motor					1912		Fair
	Sluice Gate Valve #3	Coffin Valve Co.			1	1912		Fair
	Sluice Gate Valve #3 Motor					1912		Fair
	Sluice Gate Valve #4	Coffin Valve Co.			1	1912		Fair
	Sluice Gate Valve #4 Motor					1912		Fair
Water Filtration Plant Fluoride Feed System	Hydrofluorosilicic Acid Storage Tank #1	Edwards Fiberglass, Inc		7760 GAL	1	1991		Good
	Hydrofluorosilicic Acid Storage Tank #2	Edwards Fiberglass, Inc		7760 GAL	1	1991		Good
	HFA Feed Pump #1	Prominent Sigma			1			Uninstalled
	HFA Feed Pump #2	Prominent Sigma	SN 270708812	28.5 GPH @ 145 PSI	1	2009		Good

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Facility Name	Equipment Name - Brief Description	Equipment Manufacturer	Model No. / Serial No.	Capacity	Number of Units	Date Installed	Age of Unit	General Condition
	Air Compressor Motor	Speedaire	4B247B	3 HP 2900 3,500 RPM	1			Good
	Air Compressor Receiver	Speedaire	4B237C	30 Gal	1			Good
Chlorine Booster Stations (CBS)							6	
Brashear CBS	2 - 100 gal tanks, 2 - feed pumps			0.37 GPH	2	2004	6	Good
Bedford CBS	2 - 100 gal tanks, 2 - feed pumps			0.37 GPH	2	2004	6	Good
Garfield CBS	Deleted							Eliminated
Herron Hill CBS	3 - 100 gal tanks, 3 - feed pumps			0.55 GPH	3	2004	6	Good
Highland No. 2 CBS	6 - 160 gal tanks, 2 - feed pumps			13 GPH	2	2004	6	Good
Lanpher CBS	5 - 160 gal tanks, 2 - feed pumps			13 GPH	2	2004	6	Good
McNaugher CBS	2 - 100 gal tanks, 2 - feed pumps			0.37 GPH	2	2004	6	Good
Lincoln CBS	2 - 100 gal tanks, 2 - feed pumps			GPH	2	2009	1	Pump Being Replaced
Squirrel Hill CBS	2 - 100 gal tanks, 2 - feed pumps			GPH	22	2009	1	Good
Allentown CBS	2 - 100 gal tanks, 2 - feed pumps			GPH	2	2009	1	Pump Being Replaced
Rogers Sewage Pump Station	Pump #1 - Vacuum Primed Centrifugal	Smith & Loveless	14132-XX2983/ 841306A-1	1,000 gpm @ 95 'TDH	1	1983	27	Pump and Motor Being Replaced
	Pump #2 - Vacuum Primed Centrifugal	Smith & Loveless	146561-2XX3103/ 833801B-1	1,000 gpm @ 95 'TDH	1	1983	27	Pump and Motor Being Replaced
	Motor #1		66-1040	40 HP 1,800 RPM	1	1983	27	
	Motor #2		66-1040	40 HP 1,800 RPM		1983	27	
Lincoln Place (Mifflin Road) Sewage PS	Pump #1 - Vacuum Primed Centrifugal	Smith & Loveless	14656-XX3103/ 834442B-5	500 gpm @ 88 'TDH	1	1983	27	Pump and Motor Being Replaced

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Facility Name	Equipment Name - Brief Description	Equipment Manufacturer	Model No. / Serial No.	Capacity		Number of Units	Date Installed	Age of Unit	General Condition
	Pump #2 - Vacuum Primed Centrifugal	Smith & Loveless	146561-2-XX3103/ 834787B-8	500 gpm @	88 'TDH	1	1983	27	Pump and Motor Being Replaced
	Motor #1		66-1039	20 HP	1,800 RPM	1	1983	27	
	Motor #2		66-1039	20 HP	1,800 RPM		1983	27	
Browns Hill Sewage PS	Pump #1 - Vacuum Primed Centrifugal	Smith & Loveless	13861-XX2979/ 832787B-5	250 gpm @	'TDH	1	1983	27	Pump and Motor Being Replaced
	Pump #2 - Vacuum Primed Centrifugal	Smith & Loveless	13861-XX2978/ 8322955B-4	250 gpm @	'TDH	1	1983	27	Pump and Motor Being Replaced
	Motor #1			10 HP	1,800 RPM	1	1983	27	
	Motor #2			10 HP	1,800 RPM		1983	27	
Evergreen Road Sewage PS	Pump #1 - Vacuum Primed Centrifugal	Smith & Loveless	16055-XX2980/ 63596C-1	150 gpm @	90 'TDH	1	1983	27	Pump and Motor Being Replaced
	Pump #2 - Vacuum Primed Centrifugal	Smith & Loveless	16055-XX2980/ 835986C-26	150 gpm @	90 'TDH	1	1983	27	Pump and Motor Being Replaced
	Motor #1		66-1041	15 HP	RPM	1	1983	27	
	Motor #2		66-1041	15 HP	RPM		1983	27	