



CITY OF DALLAS

Dallas City Council

Mayor

Michael S. Rawlings

Mayor Pro Tem

Monica R. Alonzo

Deputy Mayor Pro Tem

Erik Wilson

Council Members

Carolyn King Arnold

Rickey D. Callahan

Mark Clayton

Jennifer S. Gates

Sandy Greyson

Scott Griggs

Philip T. Kingston

Lee M. Kleinman

B. Adam McGough

Adam Medrano

Casey Thomas, II

Tiffinni A. Young

Office of the City Auditor

Audit Report

**AUDIT OF
DEPARTMENT OF DALLAS WATER UTILITIES'
MAINTENANCE OF INFRASTRUCTURE
(Report No. A16-003)**

December 4, 2015

City Auditor

Craig D. Kinton

Table of Contents

	Page
Executive Summary	1
Audit Results	
Three Different Pipeline Target Replacement Rates Do Not Readily Indicate the Sufficiency of DWU's Actual Water Pipeline Replacement	5
Water Pipeline Replacement Performance Measures Are Not Precise and Clear	8
Water Pipeline Software Applications Do Not Have Adequate Functionality	11
Recommended Asset Management Business Plan Was Not Fully Implemented and Sufficiently Monitored	13
Water Pipeline Replacement Prioritization Procedures Are Not Current or Fully Documented	15
Appendices	
Appendix I – Background, Objective, Scope and Methodology	16
Appendix II – Changes to DWU's Water Pipeline System, 2004 to 2014	19
Appendix III – Major Contributors to This Report	23
Appendix IV – Management's Response	24

Executive Summary

The Department of Dallas Water Utilities’ (DWU) water pipeline replacement program is intended to prevent degrading water service, service disruptions, costly emergency repairs, and water loss. The DWU estimates it has invested \$444 million in the last eight years (2007 to 2014) to replace about 60 miles of water pipeline each year. The replacement efforts have: (1) decreased the percentage of water pipeline miles made of cast iron from 51 percent to 41 percent; (2) decreased the percentage of water pipelines with smaller diameters from 33 percent to 24 percent; and, (3) maintained the average water pipeline age at 42 years. The DWU plans to replace another 500 water pipeline miles at a cost of about \$500 million over the next ten years.

Despite this progress, better information is needed to evaluate if DWU’s annual water pipeline replacement efforts are sufficient to meet the City of Dallas’ (City) long-term infrastructure needs. Specifically:

- The DWU uses three different annual target replacement rates ranging from 0.75 percent to 1.5 percent, a difference of up to 59 water pipeline miles per year. In addition, two of the three target replacement rates combine water and wastewater pipelines into one target replacement rate. As a result, there is a lack of clarity about the true target replacement rate and whether DWU is making sufficient progress as intended to continue providing quality water delivery services, limit service disruptions, manage costly emergency repairs effectively, and minimize water loss.

Background Summary

The Department of Dallas Water Utilities (DWU) is responsible for delivering drinking water to about 2.4 million customers in the City of Dallas (City) and surrounding communities. The DWU maintains more than 4,900 miles of water pipeline and another 4,000 miles of wastewater pipeline. The DWU had an annual adopted budget of \$614.5 million in Fiscal Year (FY) 2015, including \$296.1 million in capital funding.

Water pipeline replacement is a major component of DWU’s capital infrastructure spending, representing an estimated average of \$55.5 million each year over the last eight years (2007 to 2014). The DWU plans to replace another 500 miles of its 4,900 miles of water pipelines at a cost of about \$500 million over the next ten years. Previous reports, including two released in 2002, urged the City to replace its aging, cast iron water pipelines with newer materials.

Sources: Office of Financial Services (OFS) FY 2015 Adopted Annual Budget and DWU management

- The DWU does not use precise and clear performance measures that are focused on monitoring current and proposed water pipeline replacement efforts. As a result, DWU cannot determine whether its water pipeline replacement efforts meets its planned goals or objectives. The performance measures are a combination of water and wastewater activity and are based

**An Audit Report on –
Department of Dallas Water Utilities' Maintenance of Infrastructure**

on miles awarded for contract not actual completion. In addition, the performance measures do not fully incorporate probability of failure assessments and other measures recommended in the 2007 Water Distribution Capital Infrastructure Master Plan (2007 Master Plan).

- The current DWU software applications do not have the functionality necessary to ensure that the operational data used by DWU management to make water pipeline replacement decisions is complete, accurate, or secured (data reliability). Although DWU management has implemented additional manual procedures to verify the operational data is generally reliable, the manual procedures do not provide the same degree of data reliability that other software applications could provide.

In addition, DWU operational changes are needed to address the following:

- The DWU has not fully implemented an Asset Management Business Plan (Business Plan), a key recommendation of the 2007 Master Plan, or sufficiently monitored progress against the Business Plan. As a result, DWU's operational decisions may not match the overall strategic goal for water pipeline replacement.
- The DWU does not have water pipeline replacement prioritization procedures that are current or sufficiently documented for another individual to follow. As a result, water pipeline replacement decisions could be incorrect or inconsistent.

We recommend the Director of DWU improves how the department plans, performs, and monitors its water pipeline replacement efforts by implementing the recommendations made throughout this report.

The audit objective was to determine whether DWU adequately maintains and renovates infrastructure to ensure current and future service delivery. The objective was further refined to focus on water pipelines. The audit scope covered Fiscal Year (FY) 2001 to FY 2015. We also reviewed certain related transactions and records before and after that period.

Although auditors identified concerns with the software applications' functionality, since the water pipeline data is consistently used by management to report to City Council and is the only available data, auditors used certain data elements to provide an analysis of the infrastructure.

Management's response to this report is included as Appendix IV.

Audit Results

Overall Conclusions

The City of Dallas (City) estimates it is investing more than \$55 million each year to replace its water pipelines. This effort is changing the composition of the water pipelines, including a reduction in water pipelines that are made of aging cast iron material and an increase in water pipelines that are at least eight inches in diameter. Replacing older water pipelines with new ones has kept the average water pipeline age steady at 42 years (see Appendix II).

Despite this progress, better information is needed to evaluate if the Department of Dallas Water Utilities' (DWU) annual water pipeline replacement efforts are sufficient to meet the City's long-term infrastructure needs. Specifically, DWU:

- Uses three different annual target replacement rates ranging from 0.75 percent to 1.5 percent, a difference of up to 59 water pipeline miles per year, and two of the three target replacement rates combine water and wastewater pipeline into one target replacement rate
- Does not use precise and clear performance measures that are focused on monitoring current and proposed water pipeline replacement efforts
- Uses software applications that do not have the functionality necessary to ensure that the operational data used by DWU management to make water pipeline replacement decisions is complete, accurate, or secured (data reliability)

In addition, DWU operational changes are needed to address the following:

- The DWU has not fully implemented an Asset Management Business Plan (Business Plan), a key recommendation of the 2007 Water Distribution Capital Infrastructure Master Plan (2007 Master Plan), or sufficiently monitored progress against the Business Plan.
- The DWU's formal internal procedures for prioritizing water pipelines for replacement are not current or fully documented. As a result, DWU cannot determine if it is replacing enough water pipelines.

Three Different Pipeline Target Replacement Rates Do Not Readily Indicate the Sufficiency of DWU's Actual Water Pipeline Replacement

The DWU uses three different annual target replacement rates ranging from 0.75 percent to 1.5 percent, a difference of up to 59 water pipeline miles per year. In addition, two of the three target replacement rates combine water and wastewater pipeline into one target replacement rate. As a result, there is a lack of clarity about the true target replacement rate and whether DWU is making sufficient progress as intended to continue providing quality water delivery services, limit service disruptions, manage costly emergency repairs effectively, and minimize water loss.

Water Pipeline Replacement Effort

The DWU replaces its water pipelines to adequately deliver water to its customers. The water pipeline replacement effort is a response to the City's large network of older water pipelines, its corrosive soils, and its history of water pipeline breaks and leaks. In addition to replacing water pipelines in its own construction projects, DWU coordinates with other government and business construction to replace aging water pipelines during street repairs or private development.

Source: DWU Management

The DWU states that it combines these target replacement rates with other DWU performance measures, such as unaccounted for water, main breaks per mile, and service disruptions, to obtain a more complete assessment of sufficiency. Although using other performance measures can provide DWU with valuable information, the different target replacement rates make it more difficult to assess if DWU is meeting its goals.

The target replacement rates are cited in the City's 2015-2017 Strategic Plan, the 2007 Master Plan, and the City's Fiscal Year (FY) 2014 and FY 2015 Adopted Annual Budgets. When the three different pipeline target replacement rates are evaluated, the following is noted:

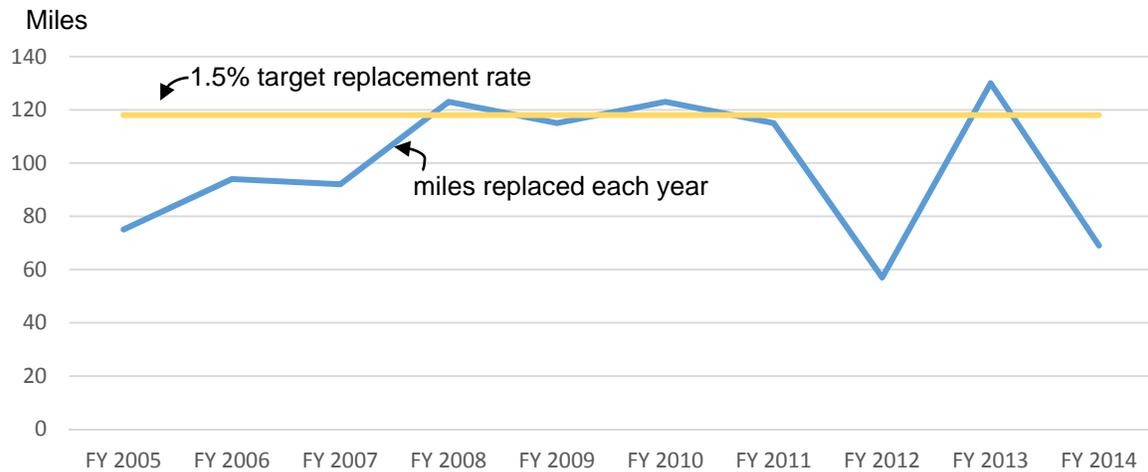
Target Replacement Rate of 1.5 Percent Was Not Consistently Met

The DWU's 1.5 percent pipeline replacement rate includes both **water and wastewater pipeline** miles and has not been met consistently over the past four fiscal years. When this target replacement rate is evaluated over a period of ten years from FY 2005 to FY 2014 (see Chart 1 on the following page), DWU awarded a replacement rate of 1.26 percent of its water and wastewater pipeline miles. The DWU informally adopted this 1.5 percent pipeline replacement rate in the mid-2000s and referenced it repeatedly in responses to national surveys and audit interviews. The 1.5 percent replacement rate is also currently reflected in the City's 2015-2017 Strategic Plan.

According to DWU management, the 1.5 percent target replacement rate is a goal to provide flexibility as needed to make operational decisions based on budgetary limitations and competing needs within the utility. For example, if DWU determines a state or local entity has a planned transportation project, it may be more efficient to simultaneously replace the water pipelines, even though DWU did not originally include those specific water pipelines in its upcoming capital construction plans.

Chart I

Miles of Water and Wastewater Pipelines Replaced Over 10 Years
Comparison to 1.5 Percent Target Replacement Rate



Source: Auditor analysis using the City’s adopted annual budgets of the number of water and wastewater pipelines replaced the prior year, from FY 2005 to FY 2014.

The 2007 Master Plan Water Pipeline Target Replacement Rate of 0.87 Percent Was Met

In June 2015, DWU self-reported that for the calendar years between 2007 and 2014, it exceeded the 0.87 percent water pipeline target replacement rate and has replaced an average of 1.44 percent of its water pipelines each year. The 2007 Master Plan recommended the 0.87 percent as an annual water pipeline target replacement rate. The DWU has not formally adopted this rate; however, after this audit began, DWU did evaluate its water pipeline replacement progress using this target replacement rate.

The Adopted Annual Budget Target Replacement Rates Were Met

The DWU met the target replacement rate for water and wastewater pipeline of 0.75 percent in the FY 2014 Adopted Budget and the target replacement rate of

0.89 percent in the FY 2015 Adopted Annual Budget. Starting in FY 2014, DWU reported an expected water and wastewater pipeline target replacement rate each year in its annual adopted budget. Although the target replacement rates included in the annual adopted budgets have the same parameters as the Strategic Plan rate of 1.5 percent, the target replacement rates are significantly lower.

Research shows that there is no formal state or national standard for water pipeline replacement rates, as replacement rates vary based on the condition of each water utility’s infrastructure and needs. An informal standard, however, for water pipeline replacement is that municipalities replace water pipelines every 100 years, or a one percent rate. National guidance from the American Water Works Association (AWWA) also encourages municipalities to take a proactive approach rather than a reactive approach to long-term infrastructure planning.

Recommendation I

We recommend the Director of DWU reviews water pipeline replacement needs and develops and regularly reports on one water pipeline target replacement rate.

Please see Appendix IV for management’s response to the recommendation.

Water Pipeline Replacement Performance Measures Are Not Precise and Clear

The DWU does not use precise and clear performance measures that are focused on monitoring current and proposed water pipeline replacement efforts. As a result, DWU cannot determine whether its water pipeline replacement efforts meet its planned goals or objectives. The following issues were identified with DWU's performance measures:

A Separate Performance Measure for Water Pipelines Is Not Used

The DWU primarily measures water pipeline replacement as a combined performance measure of water and wastewater pipelines. The combined performance measure makes it difficult to determine:

- a) Annual planned water pipeline replacement
- b) Actual miles of water pipeline replaced
- c) Variance between planned and actual water pipeline replacement
- d) Contributing factors to any variances

For years, many utilities have reported on water and wastewater pipeline replacements in a combined measure. While DWU separates its water and wastewater pipeline replacement financial information in several detailed documents, including its City Council agenda documents, funding resolutions, and capital budget tables, it does not provide separate pipeline performance measures and expectations.

In FY 2012, DWU awarded 57 water and wastewater pipeline miles for replacement. The following year, DWU reported awarding 130 water and wastewater pipeline miles for replacement. Over the last five years, 62 percent of the miles awarded for replacement have been water pipeline miles. Whether these different replacement efforts are sufficiently meeting DWU's planned progress for water pipeline replacement cannot be determined since there is no consistent method to track planned, actual, variance, and contributing factors for water pipelines only.

The auditor conducted an independent survey of peer cities in which three of the four responding cities said they reported on water and wastewater pipeline replacement separately. According to DWU management, some of these peer cities are under consent decree to report separate numbers. Although the City is

currently not under a consent decree, the separate performance measures appear to be a valid method to measure progress.

Water Pipeline Efforts Are Not Measured on Completed Annual Replacements

The DWU primarily measures water pipeline replacement based on water pipeline miles awarded for construction. The performance measure of water pipeline miles awarded indicates only that the City has contracted with a vendor to have a certain number of water pipeline miles replaced. The actual installation could be completed two years or more after the contract was awarded. For example, in FY 2015, the DWU reported awarding 65 miles of water and wastewater pipeline for replacement yet many of those pipeline miles will be replaced in a later fiscal year. By primarily measuring water pipeline efforts based on water pipeline miles awarded and not on water pipeline miles completed, DWU does not focus on how many water pipeline miles are actually replaced annually.

Water Pipelines Are Replaced Without System-wide Probability of Failure Ratings

The DWU has not completed a probability of failure rating assessment for the entire water pipeline system. Currently, DWU uses a water pipeline segment’s past history of main breaks, material, age, size, soil features, and other factors to determine its probability of failure rating and only in response to repairs or construction projects.

Elements of Risk

Probability – A measure of the likelihood a water pipeline will fail.

Consequence – A measure of the impact of that failure on the water system and the community it serves.

Source: DWU Management

In the last two years, DWU began using consequences of failure as criteria for water pipeline replacement decisions. That criteria is only one of the two elements necessary for a complete assessment to ensure that high risk water pipelines are replaced first and timely. The DWU stated it is working to further refine its risk-based assessments for all water pipelines by addressing probability of failure, but needs better integrated software applications that may take years to implement.

Master Plan Recommended Performance Measures Are Not Used

The DWU does not fully use certain performance measures recommended in the 2007 Master Plan to evaluate progress of water pipeline replacement efforts. For instance, the DWU has not developed the detailed and specific performance measures that could be used to pinpoint water loss and water pipeline breaks by region of the City, water pipeline breaks by material type, and the unit cost of water pipeline replacement efforts. The 2007 Master Plan stated these performance

measures could be used to demonstrate that DWU's water pipeline replacement efforts were adequate.

According to DWU, it does not have the software application functionality needed to provide some of the recommended performance measures. The DWU has identified ways to upgrade and integrate its software applications to provide more detailed and precise information about its water pipeline condition and operations. The DWU anticipates the plan will be completed in April 2016, and its implementation will be complete in about two years from then.

The 2007 Master Plan and the National Performance Management Advisory Commission suggest performance measures should be developed to measure the effectiveness of the strategy. Performance measures allow for continual assessment to understand whether the activities are producing expected results.

Recommendation II

We recommend the Director of DWU further develops precise and clear performance measures to evaluate its water pipeline replacement efforts.

Please see Appendix IV for management's response to the recommendation.

Water Pipeline Software Applications Do Not Have Adequate Functionality

The current DWU software applications do not have the functionality necessary to ensure that the operational data used by DWU management to make water pipeline replacement decisions is complete, accurate, or secured (data reliability). Although DWU management has implemented additional manual procedures to verify the operational data is generally reliable, the manual procedures do not provide the same degree of data reliability that other software applications could provide. As a result, there is a risk DWU management could make decisions about water pipeline replacement using incomplete and inaccurate data.

The DWU uses Microsoft (MS) Access database, MS Excel spreadsheets, and a customized off-the-shelf Geographic Information System (GIS) application, to track water pipeline breaks, prioritize water pipeline replacement, and document water pipeline conditions, such as age, history, and material (e.g. cast iron). Some limitations of the software applications include missing functionality that could:

- Identify errors in manually entered data, such as missing information and transposed information to ensure data completeness. For the spreadsheet and database, management does not have a consistent process to review data and check for errors. For example, the individual who completes programming changes is often the same individual who reviews the changes for completeness and accuracy.
- Verify accuracy of the manually entered data. The MS Excel spreadsheet and MS Access database do not inherently have the sophistication to verify accuracy, such as duplicate data entries. The GIS does not have reasonableness checks, such as confirming street address accuracy.
- Secure the data from unauthorized internal use. The three software applications either do not have password security or the passwords do not follow the Department of Communication and Information Services (CIS) standards for password expirations. The MS Access database is stored on a shared drive that can be accessed by unauthorized

Data Integrity Definitions

The United States Government Accountability Office (GAO) says system controls should provide reasonable assurance of the following:

Completeness – All transactions that occurred are entered into the system, processed only once, and properly included in outputs.

Accuracy – Activity is properly recorded, data elements are accurate, and outputs are accurate.

Security – Application data and reports and other output are protected against unauthorized access.

Source: GAO 2014 Standards for Internal Control in the Federal Government

personnel. According to DWU management, the MS Access database was moved to a secure server and password protected shortly after this issue was communicated.

The DWU management has identified completeness, accuracy, and security issues as part of its 2014 Business Technology Master Plan. The DWU is working towards implementing a solution that will include developing a work order system to consolidate water pipeline information.

The Standards for Internal Control in the Federal Government by the Comptroller General of the United States says data systems (software applications) should have sufficient completeness, accuracy, and security controls.

Recommendation III

We recommend the Director of DWU:

- Ensures completeness of data entry by assigning reviews of the entered information by individuals who did not enter the data and using accuracy checks, such as control totals, for the MS Excel spreadsheet and MS Access database
- Identifies and implements other available reasonableness checks in GIS to verify accuracy
- Secures the MS Access database on a shared drive with restricted access
- Applies password controls over the three software applications consistent with the CIS Enterprise Security Standard. If password standards cannot be applied in totality, then DWU should, at a minimum, change passwords consistent with CIS policy.
- Continues to develop an integrated work order system and regularly monitors its progress

Please see Appendix IV for management’s response to the recommendation.

Recommended Asset Management Business Plan Was Not Fully Implemented and Sufficiently Monitored

The DWU has not fully implemented a Business Plan, a key recommendation of the 2007 Master Plan, or sufficiently monitored progress against the Business Plan. As a result, DWU's operational decisions may not match the overall strategic goal for water pipeline replacement.

The Business Plan elements that were not fully implemented includes the following:

- a) Implement a computerized maintenance management system or work order system throughout the utility to capture more detailed and accurate data on buried infrastructure
- b) Utilize the facilities' assessment database and Water Distribution Management System water pipeline prioritization program to improve the reinvestment and prioritization process
- c) Review and update the prioritization criteria every two to three years to ensure that the appropriate factors are considered in water pipeline prioritization
- d) Modify and develop business process changes to effectively combine the GIS application, hydraulic model, facilities database, and Water Distribution Management System into an integrated system

Additionally, since the Business Plan was not monitored for progress, the following were not addressed:

- The DWU has not reviewed all water pipeline main breaks that could be used for water pipeline replacement decisions
- The DWU has not met the recommended goal of inspecting all water pipelines that are at least 36 inches in diameter at least once every ten years

During the course of this audit, in June 2015, DWU provided a status report self-reporting that a number of recommendations are in progress or completed. For example, DWU stated that the Business Plan is being developed and that DWU now uses consequences of failure ratings in making water pipeline prioritization decisions. The status report, however, did not clearly identify which of the recommendations were current and applicable to DWU's strategy, the timeline to complete all the applicable components, and the mechanisms used to monitor the progress of the Business Plan.

The Standards for Internal Control in the Federal Government by the Comptroller General of the United States says by linking objectives throughout the entity to the mission, management improves the effectiveness and efficiency of program operations in achieving the mission.

Recommendation IV

We recommend the Director of DWU:

- Identifies and formally documents the elements of the Business Plan that are current and applicable to the DWU overall strategy for water pipeline replacement
- Develops a timeline for implementing the Business Plan
- Develops processes to monitor the implementation of the Business Plan over a period of time

Please see Appendix IV for management’s response to the recommendation.

Water Pipeline Replacement Prioritization Procedures Are Not Current or Fully Documented

Procedures for prioritizing water pipeline replacement projects are either not current or not documented completely for another individual to follow. As a result, water pipeline replacement decisions could be incorrect or inconsistent.

The DWU uses two processes to prioritize water pipelines for replacement and both have not been updated in at least three years (see textbox).

One procedure used to recommend water pipelines for replacement is not clearly documented so that another individual with no prior knowledge could follow the procedure and replicate the decisions.

A second procedure used to prioritize water pipelines is out of date and no longer applies. While a new draft procedure has been developed, it has not been approved and released.

According to DWU management, water pipeline replacement project prioritization decisions happen infrequently and, therefore, the updated internal process to support management decisions has not been formalized.

Prioritization Procedures Description

Recommend Water Main Replacement (DWU-PRO-006-DIST) – This procedure shows the steps for the distribution division to recommend a water pipeline for replacement and rate it on a one to five priority scale. Last updated in June 2010.

Prioritize Projects (DWU-WKI-010-CIOPS) – This procedure directs the water pipeline project management division to use the ratings received from the distribution division. Last updated in February 2012.

Assignment of Pipeline Projects to Engineering Contracts (DRAFT) – When released, this procedure will direct the water pipeline project management division to prioritize projects, taking into equal consideration the ratings from the distribution division and the ratings of each water pipeline's consequences of failure.

Source: DWU Management

The 2007 Master Plan and best practices recommend that DWU review the water pipeline prioritization procedures every two to three years and update procedures when changes occur in the internal process.

Recommendation V

We recommend the Director of DWU reviews, develops, and/or updates the procedures related to water pipeline replacement prioritization.

Please see Appendix IV for management's response to the recommendation.

Appendix I

Background, Objective, Scope and Methodology

Background

The City of Dallas (City) Charter grants the Department of Dallas Water Utilities (DWU) the authority to operate and maintain the waterworks system. The City Charter directs DWU to be self-sustaining by paying for all expenses using the payments it receives from water and wastewater customers.

The DWU is responsible for delivering drinking water to approximately 2.4 million customers in the City and surrounding communities. The DWU maintains more than 4,900 miles of water pipeline to transport water to its customers and approximately 4,000 miles of wastewater pipeline. The DWU's Fiscal Year (FY) 2015 Adopted Annual Budget of \$614.5 million includes \$296.1 million in capital funding.

Replacing water pipelines is a major component of DWU's capital infrastructure expenditures. The DWU estimates it has replaced about 480 miles of its water pipelines during the past eight years (2007 to 2014) at a cost of \$444 million. The DWU projects it needs to replace 500 more water pipeline miles over the next ten years, at a cost of about \$500 million.

Replacing water pipelines has been a local and national priority for more than a decade. The American Water Works Association (AWWA) noted in a 2001 report, that the nation's water pipelines needed a significant replacement effort. In a follow-up report in 2012, AWWA said the need to replace water pipelines was only growing and still necessary to prevent major problems, including service disruptions, degrading water service, and significant water loss. The report estimated the cost of replacing the country's replacement-ready water pipelines at more than \$1 trillion over the next 25 years.

The DWU's water pipeline replacement efforts increased following two reports issued in 2002 – a consultant's report and an audit by the Office of the City Auditor. Both reports raised concerns that DWU's aging water pipelines were vulnerable to breaks and leaks and that DWU's water target pipeline replacement rate was inadequate. As a result, DWU increased its water pipeline replacement efforts and commissioned the 2007 Water Distribution Capital Infrastructure Master Plan (2007 Master Plan) which is DWU's current water distribution capital infrastructure master plan. The DWU anticipates it will begin procuring its next master plan in FY 2016.

The DWU's stated 1.5 percent target replacement efforts have been considered high for large water systems. Only two other water providers with at least one

million customers reported higher replacement rates to an independent 2012 survey by the Association of Metropolitan Water Agencies for either the past five years or the next five years.

The age of water pipelines can vary by region and by city. For example, 40 percent of DWU’s water pipelines are at least 50 years old, while only 16 percent of San Antonio’s water pipelines are of the same age.

Objective, Scope and Methodology

This audit was conducted under the authority of the City Charter, Chapter IX, Section 3 and in accordance with the FY 2013 Audit Plan approved by the City Council. This performance audit was conducted in accordance with generally accepted government auditing standards. Those standards require that we plan and perform the audit to obtain sufficient, appropriate evidence to provide a reasonable basis for our findings and conclusions based on our audit objective. We believe that the evidence obtained provides a reasonable basis for our findings and conclusions based on our audit objective.

The audit objective was to determine whether DWU adequately maintains and renovates infrastructure to ensure current and future service delivery. The objective was further refined to focus on water pipelines. The audit period covered FY 2001 to FY 2015. We also reviewed certain related transactions and records before and after that period.

To achieve the audit objective, we performed the following procedures:

- Conducted interviews with DWU personnel
- Researched applicable state and local statutes that impact water infrastructure requirements
- Reviewed City and DWU policies and procedures, specifically those policies and procedures related to water infrastructure and water pipeline prioritization
- Compared DWU responses to those of other water utilities to the 2012 Association of Metropolitan Water Agencies’ Utility Financial Information Survey
- Surveyed a judgmental selection of seven peer city water utilities about their water pipeline replacement goals and reporting criteria, receiving responses from four, including three in Texas

**An Audit Report on –
Department of Dallas Water Utilities' Maintenance of Infrastructure**

- Reviewed the implementation of the 2007 Master Plan recommendations, including DWU's June 2015 report on its implementation
- Reviewed the data reliability controls for software applications for completeness, accuracy, validity, and security
- Determined the change in water pipeline system composition for material, water pipeline age, and diameter size between the 2004 data used in the 2007 Master Plan report and recent data as of December 3, 2014
- Assessed DWU's water pipeline replacement rates based on available information in its budget documents and its Pipeline Project Management spreadsheet
- Reviewed DWU's performance measures included in the City's FY 2015 Adopted Annual Budget and the FY 2016 Proposed Annual Budget

Appendix II

Changes to DWU's Water Pipeline System, 2004 to 2014

To determine the changes to the Department of Dallas Water Utility's (DWU) water pipeline system over the last decade, auditors compared the condition in December 2014 to the 2004 data reported in the 2007 Water Distribution Capital Infrastructure Master Plan (2007 Master Plan). Auditors reviewed water pipeline material, diameter, and age, then re-produced graphics to illustrate the changes and noted the following:

Maintaining Average Water Pipeline Age Below 50 Years

The average weighted age of water pipelines was 42.4 years in December 2014. The DWU reports the average age, weighted by water pipeline segment length, has stayed relatively steady at about 42 years since 2007. The DWU says it is difficult to maintain a steady average age as the water pipelines installed when the City grew rapidly after World War II continue to grow older. There is great variety in the infrastructure's water pipeline age – some water pipelines are newly installed and others have been used for a century. As of December 2014, of DWU's water pipelines, 40 percent were 50 or more years old.

Installing Modern Materials

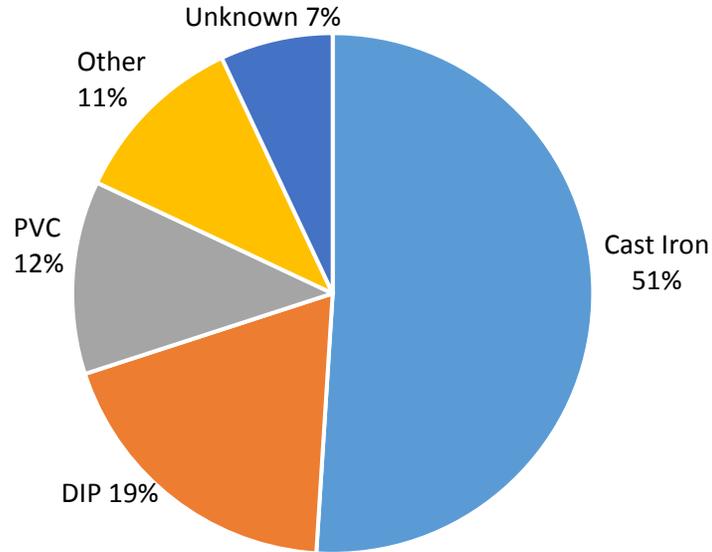
The DWU's efforts to replace its water pipelines have been increasing the use of polyvinyl chloride (PVC) materials over the past decade. PVC began to be used in the late 1980s and had become the most frequently used water pipeline material by 2007. The share of DWU's water pipelines made of PVC has doubled since 2004. As of December 2014, PVC water pipelines represented 24 percent of the infrastructure, up from 12 percent in 2004 (see Charts II and III on the following page).

Most of the corresponding reduction was seen in cast iron water pipelines, which previous studies have urged the City to replace. For example, a 2002 Water Efficiency Study stated that cast iron water pipelines have shorter life cycles in the City than in other regions due to corrosive soils and high temperatures. Cast iron water pipelines now represent 41 percent of the infrastructure, down from 51 percent in 2004 (see Charts II and III on the following page).

The percentage of water pipelines with unknown materials also declined from seven percent of the infrastructure to four percent, as DWU has either replaced or identified water pipelines of unknown material (see Charts II and III on the following page).

Chart II

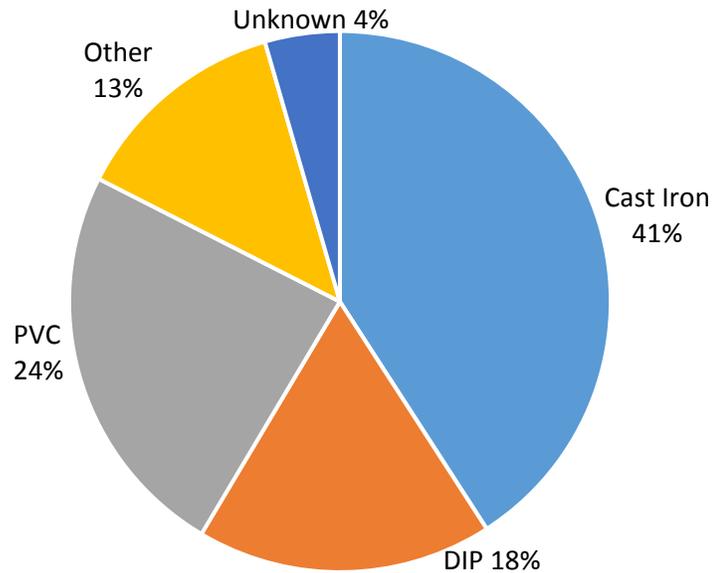
DWU Water Pipeline Inventory Composition by Material as of 2004



Source: Pie chart recreated from the 2007 Master Plan, Volume 1, Figure 2-3, by Black & Veatch

Chart III

DWU Water Pipeline Inventory Composition by Material as of 2014



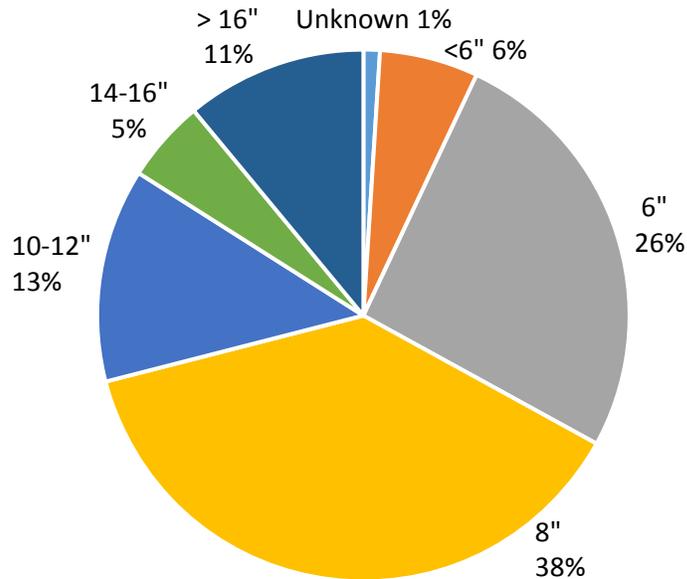
Source: Auditors analyzed 2014 data DWU provided from its GIS database on December 3, 2014

Replacing Undersized Water Pipelines

The DWU has replaced some water pipelines that were six inches or less in diameter with larger water pipelines. The 2007 Master Plan recommended replacing water pipelines with diameters six inches or less with eight inch diameters, when practical. The percentage of the infrastructure with water pipelines six inches in diameter or smaller has declined from 33 percent in 2004 to 24 percent as of December 2014. The greatest increase has been in the percentage of water pipelines that are eight inches in diameter, which account for 44 percent of the infrastructure, up from 38 percent (see Charts IV and V below and on the following page).

Chart IV

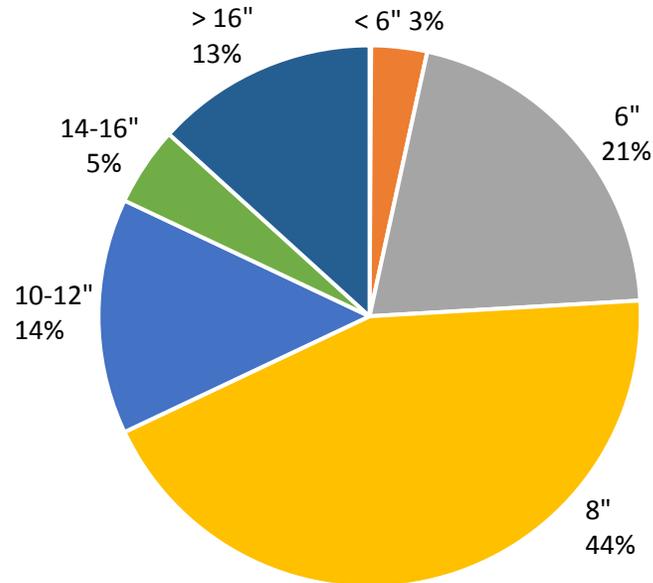
DWU Water Pipeline Inventory Composition by Diameter as of 2004



Source: Pie chart recreated from the 2007 Master Plan, Volume 1, Figure 2-2, by Black & Veatch

Chart V

DWU Water Pipeline Inventory Composition by Diameter as of 2014



Source: Auditors analyzed 2014 data DWU provided from its GIS database on December 3, 2014

Appendix III

Major Contributors to This Report

Lee Chiang, CIA – Auditor

Daniel Genz – Project Manager

Mamatha Sparks, CIA, CISA, – Audit Manager

Carol A. Smith, CPA, CIA, CFE, CFF – First Assistant City Auditor

Theresa Hampden, CPA, – Quality Control Manager

Management's Response

Memorandum

RECEIVED

NOV 23 2015

City Auditor's
Office



CITY OF DALLAS

DATE: November 23, 2015

TO: Craig D. Kinton, City Auditor

SUBJECT: Response to Audit Report:
Audit of Department of Dallas Water Utilities' Maintenance of Infrastructure

Our responses to the audit report recommendations are as follows:

Recommendation I

We recommend the Director of DWU reviews water pipeline replacement needs and develops and regularly reports on one water pipeline target replacement rate.

Management Response / Corrective Action Plan

Agree Disagree

Over the past decade, DWU has adopted and reported a combined annual main replacement goal of 1.5%. Annual replacement rates vary year-to-year due to budgetary priorities within the utility.

The replacement rate alone does not readily provide the success of any replacement program. When the replacement rate is combined with the additional DWU performance measures such as main breaks per mile and service disruptions, a clear indication of system improvement is readily apparent.

DWU will continue to report a combined replacement goal with additional details on individual target rates for its water and wastewater systems.

Implementation Date

October 2016

Responsible Manager

Richard V. Wagner, Assistant Director of Capital Services
Terry S. Lowery, Assistant Director of Business Operations
Randall L. Payton, Assistant Director of Water Delivery

Recommendation II

We recommend the Director of DWU further develops precise and clear performance measures to evaluate its water pipeline replacement efforts.

Management Response / Corrective Action Plan

Agree Disagree

DWU currently maintains performance measures for 1) water main replacement rate, 2) water main breaks per mile and 3) service disruptions related to repairs. Reviewing these measures over time, provide a clear indication of system improvements resulting from water replacement efforts. In addition to management's response to recommendation one, DWU will review development of additional measures as needed in an effort to provide precise and clear performance measures.

Implementation Date

October 2016

Responsible Manager

Richard V. Wagner, Assistant Director of Capital Services
Terry S. Lowery, Assistant Director of Business Operations
Randall L. Payton, Assistant Director of Water Delivery

Recommendation III

We recommend the Director of DWU:

- Ensures completeness of data entry by assigning reviews of the entered information by individuals who did not enter the data and using accuracy checks, such as control totals, for the MS Excel spreadsheet and MS Access database
- Identifies and implements other available reasonableness checks in GIS to verify accuracy
- Secures the MS Access database on a shared drive with restricted access
- Applies password controls over the three software applications consistent with the CIS Enterprise Security Standard. If password standards cannot be applied in totality, then DWU should, at a minimum, change passwords consistent with CIS policy.
- Continues to develop an integrated work order system and regularly monitors its progress

Management Response / Corrective Action Plan

Agree Disagree

While the individual MS spreadsheet and database were not password protected, they are located within the City's firewall. DWU understands this recommendation is related to internal data security. DWU will continue to review and implement control and security

"Dallas, the City that Works: Diverse, Vibrant and Progressive."

measures recommended above. Furthermore, DWU is in the process of procuring and implementing an integrated work order and asset management system.

Implementation Date

Security Measures Partially Implemented – October 2015

Control and Security Measures – October 2016

Integrated Work Order and Asset Management System – Beginning September 2017

Responsible Manager

Richard V. Wagner, Assistant Director of Capital Services

Ade Williams, Assistant Director of Utility Operations

Randall L. Payton, Assistant Director of Water Delivery

Recommendation IV

We recommend the Director of DWU:

- Identifies and formally documents the elements of the Asset Management Business Plan (from DWU 2007 Master Plan) that are current and applicable to the DWU overall strategy for pipeline replacement
- Develops a timeline for implementing the Asset Management Business Plan
- Develops processes to monitor the implementation of the Asset Management Business Plan over a period of time

Management Response / Corrective Action Plan

Agree Disagree

DWU agrees that not all Business Plan elements listed within 2007 Distribution Master Plan were fully implemented at the time of audit. However, DWU provided a status report self-reporting that a number of recommendations are in progress or completed. DWU agrees to identify and formally document elements of the business plan that are current and applicable.

Implementation Date

October 2016

Responsible Manager

Richard V. Wagner, Assistant Director of Capital Services

Terry S. Lowery, Assistant Director of Business Operations

Randall L. Payton, Assistant Director of Water Delivery

Ade Williams, Assistant Director of Utility Operations

Recommendation V

We recommend the Director of DWU reviews, develops, and/or updates the procedures related to pipeline replacement prioritization.

Management Response / Corrective Action Plan

Agree Disagree

In order to improve business continuity for pipeline replacement procedures, DWU agrees to continue reviewing, developing and updating its pipeline replacement prioritization procedures.

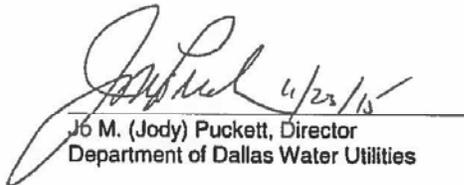
Implementation Date

Partially Implemented - August 2015
October 2016

Responsible Manager

Richard V. Wagner, Assistant Director of Capital Services
Randall L. Payton, Assistant Director of Water Delivery

Sincerely,


Jo M. (Jody) Puckett, Director
Department of Dallas Water Utilities


Mark McDaniel
Assistant City Manager

C: A.C. Gonzalez, City Manager