Date: January 4, 2023

To: Sheryl M.M. Long, City Manager

From: Lauren Sundararajan, CFE, Internal Audit Manager

Copies to: Internal Audit Committee
William Weber, Assistant City Manager
Michael A. Washington, Sr., Fire Chief
Verna Arnette, Interim Executive Director, Greater Cincinnati Water Works

Subject: **Fire Hydrant Inspection, Flow Testing and Maintenance Audit**

Attached is the Fire Hydrant Inspection, Flow Testing and Maintenance Audit. The primary objective of this performance audit was to evaluate the internal controls and processes the City of Cincinnati uses to inspect, flow test and maintain fire hydrants. The audit was conducted in accordance with the current audit agenda.

We would like to thank the management and staff of the Cincinnati Fire Department and Greater Cincinnati Water Works for their assistance and cooperation during this audit.

If you need any further information, please contact me.

Attachment

Fire Hydrant Inspection, Flow Testing and Maintenance Audit

January 2023

Lauren Sundararajan, CFE
Internal Audit Manager

Pamela King
Senior Internal Auditor

Tawana Keels
Internal Auditor

Table of Contents

Executive Summary

Internal Audit (IA) conducted a performance audit of fire hydrant inspection, flow testing and maintenance. The primary objective of this performance audit was to evaluate the internal controls and processes the City of Cincinnati (City) uses to inspect, flow test and maintain fire hydrants.

The Cincinnati Fire Department (CFD) works closely with Greater Cincinnati Water Works (GCWW) to inspect, flow test and maintain City-owned public fire hydrants. City fire companies conduct operational inspections of fire hydrants, servicing the fire hydrants in the spring and fall. GCWW takes a more quantitative approach, flow testing fire hydrants, adjusting and recording flow rates based on overall operations of the water system.

The audit revealed several opportunities for CFD and GCWW to strengthen their internal control structure. IA found that both departments are working independently due to their separate responsibilities, and interdepartmental communication and coordination needs to be improved. A lack of coordination and sharing of fire hydrant flow rates, work order status, fire hydrant location, and main information can impact the ability of CFD to quickly extinguish a fire, affecting the safety of the firefighters, residents, and the business community. Further, there is no memorandum of understanding (MOU) between the two departments. A formalized agreement will help to define responsibilities, information sharing, reporting and establish performance metrics for fire hydrant repairs.

Fire hydrant flow tests are conducted to measure real world pressure and flow in the water system. Routine checks of City fire hydrants will ensure each fire hydrant can provide the required water pressure and flow rate to extinguish a fire. IA found flow testing of the City's approximately 14,000 fire hydrants is not complete and the procurement process for obtaining contractors to conduct the flow testing is not cost effective. Additionally, GCWW conducts flow testing on a reactionary basis and not in accordance with the National Fire Protection Association standards.

Furthermore, the Cincinnati Fire Prevention Code requires owners of private fire hydrants to maintain them in proper working order. IA found oversight of private fire hydrants needs to be improved. Since fire companies rely on private fire hydrants as a source of water to extinguish fires, it is imperative that CFD ensures the code is adhered to. IA was unable to obtain evidence that all private fire hydrants are inspected, flow tested and maintained. Additionally, fire hydrant maps in the fire engine do not provide reliable location, service status and flow data.

To strengthen the internal controls over fire hydrant inspection, flow testing and maintenance, IA recommends CFD and GCWW collaborate to share critical fire hydrant information, develop a MOU to formalize responsibilities, adhere to fire flow testing standards, create policies and procedures to monitor and maintain inspection and service records for private fire hydrants, and develop reliable mapping solutions for CFD. Implementing these internal controls will ensure proper oversight of fire hydrant inspection, flow testing and maintenance.

I. Introduction

Background

Fire hydrants are a connection point by which firefighters can tap into a water supply and are components of active fire protection. Before the City had piped water supplies, wooden main water systems were installed. Firefighters would dig down to the pipes and drill a hole for water to fill a “wet well” for the buckets or pumps. This had to be filled and plugged afterwards, hence the common US term for a fire hydrant, 'fireplug'. A marker would be left to indicate where a 'plug' had already been drilled to enable firefighters to find ready-drilled holes. Later wooden systems had pre-drilled holes and plugs. When cast-iron pipes replaced the wood, permanent underground access points were included for the firefighters.[1]

Today, public fire hydrants are considered part of the water distribution main, connecting to the main underground. To use the fire hydrant, the firefighter releases the fire hydrant nozzle to attach the hose, then twists a valve to get pressurized water. Fire hydrants are installed near a water main and almost always by pavement or a curb. Public fire hydrants are most prevalent as they are located on public property along City streets. GCWW provides all necessary public fire hydrants on dedicated streets. Private fire hydrants are located on private property and are owned and maintained by the property owner. Fire hydrants installed outside City limits are furnished and maintained by the political subdivision.

CFD works closely with GCWW to inspect, flow test and maintain City-owned public fire hydrants. City fire companies conduct operational inspections of fire hydrants, servicing the fire hydrants in the spring and fall. GCWW takes a more quantitative approach, flow testing fire hydrants, adjusting and recording flow rates based on overall operations of the water system. GCWW also is responsible for the maintenance of public fire hydrants, using Maximo[2] to receive, track and manage fire hydrant service requests. There are approximately 14,000 fire hydrants in the City; 10,468 public fire hydrants owned and maintained by GCWW, and an estimated 3,532 private fire hydrants owned and maintained by the property owner.[3]

Exhibit 1: Fire hydrants ready to be repaired, painted, and tested at GCWW.

Exhibit 2: Fire hydrants stored at GCWW following reconditioning.

[1] https://En.Wikiipedia.org/wiki/Fire_hydrant.
[2] Maximo is the work order system used at Greater Cincinnati Water Works.
[3] Memo from Cathy B. Bailey, Executive Director, Greater Cincinnati Works to John P. Curp, Interim City Manager dated May 27, 2022. Subject: GCWW Hydrant Painting.

Audit Selection
IA conducted this audit in accordance with the current work plan.

Audit Objective
The primary objective of this performance audit was to evaluate the internal controls and processes the City of Cincinnati uses to inspect, flow test and maintain fire hydrants.

Audit Scope and Methodology
To achieve the audit objective, IA compared current practices to national standards, reviewed internal policies and procedures, interviewed appropriate staff, observed the inspection and maintenance process, and examined relevant contracts and agreements. Records reviewed included documentation generated during calendar year 2019 through the present.

Statement of Auditing Standards
As required by the Cincinnati Administrative Code Article II §15, this audit was conducted in accordance with the Generally Accepted Government Auditing Standards (GAGAS), except for standard 5.60 pertaining to external peer review requirements. This exception did not have a material effect on the audit.

IA continues to conduct internal quality reviews to assure conformance with applicable GAGAS. IA performed the fieldwork between June 2022 and October 2022.

Commendations
IA commends the management and staff of CFD and GCWW for their assistance and cooperation throughout the audit.

II. Audit Findings and Recommendations

Interdepartmental coordination efforts need to be improved.

CFD and GCWW share responsibilities to inspect, flow test and maintain City-owned fire hydrants. The co-dependent nature of the relationship requires coordination and communication by both departments. While CFD is responsible for visual inspections and bi-annual servicing of fire hydrants, GCWW is responsible for the overall water system for the City, repairing and replacing aging water mains and fire hydrants. GCWW determines what the system can provide based on flow requirements as provided by CFD. Coordination of information between CFD and GCWW is essential to ensure compliance.

IA found that both departments work independently regarding fire hydrant operations due to their separate responsibilities. Through interviews, IA was informed that the sharing of valuable fire hydrant data is not always communicated effectively between departments, which can lead to operational inefficiencies.

A lack of coordination and sharing of fire hydrant flow rates, work order status, fire hydrant location, and main information can impact the ability of CFD to quickly extinguish a fire, affecting the safety of the firefighters, residents, and the business community.

Recommendation 1: IA recommends CFD and GCWW collaborate to share critical fire hydrant information.

Department Response (CFD): Agree. The CFD office of Apparatus and Water (Captain Pigman) will work with CWW to develop a system to share critical hydrant information between the two departments and a mechanism to disseminate the information to the operation's division fire companies in real time. (January 2024)

Department Response (GCWW): Agree, however, GCWW currently collaborates with CFD to share information including results of hydrant flow testing, water system maintenance that impacts fire hydrants and watermain information. Please note that in addition to sharing information, training users of the data in understanding its limitations and proper use is equally important.

There is no memorandum of understanding (MOU) between CFD and GCWW for fire hydrant inspection, flow testing and maintenance.

CFD and GCWW share responsibilities for fire hydrant inspection, flow testing and maintenance without a written agreement of roles, expectations, and performance metrics between the departments. CFD and GCWW are co-dependent participants in providing operational fire hydrants capable of delivering water to extinguish fires in the City. Working collaboratively to establish written procedures and expectations for fire hydrant inspection, flow testing and maintenance will assist CFD and GCWW in working together to achieve shared goals and objectives.

Recommendation 2: CFD and GCWW should develop a MOU to formalize responsibilities, information sharing, reporting, and performance metrics for fire hydrant inspection, flow testing and maintenance.

Department Response (CFD): Agree. The CFD office of Apparatus and Water (Captain Pigman) will work with CWW to develop, write and publish an MOU that establishes the policies and procedures for hydrant inspection, flow testing and maintenance. (January 2024)

Department Response (GCWW): Agree. The establishment of an MOU between CFD and GCWW is important and will lead to a better understanding of the roles and responsibilities of each organization.

Please note there is an important distinction between a water system and connected fire hydrants. An MOU needs to reflect this distinction. While public fire hydrants are connected to the water distribution system via underground mains, they are not to be considered as part of the water distribution system

Flow testing of the City's 14,000 fire hydrants is not complete.

Fire hydrant flow tests are conducted to measure real world pressure and flow in the water system. Routine checks of City fire hydrants will ensure each fire hydrant can provide the required water pressure and flow rate to extinguish a fire.

In August 2020, in response to concerns expressed by the Law and Public Safety Committee regarding the flow of water available in Cincinnati neighborhoods, CFD and GCWW developed a plan to flow test 14,000 fire hydrants. As part of this effort, IA found that GCWW contracted with Hydromax USA, LLC in 2020 to conduct flow testing on approximately 2,400 fire hydrants, with the remainder of the City's 14,000 fire hydrants to be tested in the fall of 2020 and in 2021.[4] IA found that a second contractor began flow testing approximately 2,500 fire hydrants in September 2022. Based on the current project schedule, all City fire hydrants will not be flow tested prior to fiscal year (FY) 2026. This indicates that the original completion date was not met and that approximately 65% of City fire hydrants have yet to be flow tested.

Recommendation 3: CFD and GCWW should reassess the project schedule to complete flow testing of City fire hydrants.

Department Response (CFD): Agree, however this recommendation is under the direction of CWW. The CFD wants this information as soon as possible. (Not a CFD project)

Department Response (GCWW): Agree. The project schedule should be reassessed based on our experience with the first phases of the flow testing project, current and future funding availability, and as noted below.

GCWW is responsible for the maintenance and replacement of public fire hydrants, and funding is provided to support these activities. There are 10,774 public fire hydrants (as of 6/30/22) owned by the City of Cincinnati. This number differs from the 14,000 originally cited in August of 2020 due to the subsequent distinction between private and public fire hydrants. Privately owned fire hydrants are the responsibility of the property owner and are outside the jurisdiction of GCWW's authorized fire hydrant maintenance and replacement.

[4] Memo from Cathy B. Bailey, Executive Director, Greater Cincinnati Water Works to Paula Boggs Muething, Interim City Manager dated August 13, 2020. Subject: GCWW/CFD Hydrant Flow Testing Notification.

As directed by the City Administration in 2019-2020, the initial rounds of flow testing were performed by GCWW to set the baseline for testing and data quality review and was meant to eventually be transitioned to CFD. The original schedule was proposed before the COVID19 pandemic and without prior experience in executing a flow testing project of this magnitude. Since then, the cost of testing has increased and as a result, the testing phases have slowed. Performing hydrant flow testing must be balanced against available staffing and financial resources, considering increasing costs and the seasonal limitations of flow testing (generally April through October). Future flow testing phases need to be discussed with CFD, GCWW and the Administration.

It should be noted that it may not be feasible or necessary to conduct a flow test on all hydrants. Hydrants on larger watermains and in high traffic locations are difficult to test due to the large volume of water which would be required to obtain the necessary data points to calculate the available fire flow, potentially causing safety concerns and property damage. Often just by flowing the hydrant and obtaining flow and pressure measurements it can be concluded that the system exhibits strong characteristics to deliver normal fire flow requirements.

The procurement process for obtaining contractors to flow test is not cost effective.

During IA interviews, GCWW stated the procurement process to contract with a vendor for flow testing can take nine months to complete. Based on the current project schedule, it will take four to six years to complete flow testing of all City fire hydrants. The segmented bidding process has resulted in a gap in flow testing, extending the target completion to flow test all City fire hydrants from 2021 to FY 2026.

As the cost of goods and services continue to rise with stresses on the U.S. Economy, delaying the bidding process for the remaining City fire hydrants could result in higher costs to the City both in materials and labor.

Recommendation 4: IA recommends GCWW reassess the bidding process for the remaining City fire hydrants to reduce costs and accelerate the flow testing process.

Department Response (GCWW): Disagree. GCWW does not specify the bidding process. The bidding process must be in alignment with legal requirements specified by State and City laws and codes and as implemented by the City's Office of Procurement.

City fire hydrant flow testing is not regularly conducted in compliance with National Fire Protection Association (NFPA 291) standards.

NFPA 291 Section 4.13.1 recommends public fire hydrants be flow tested every five years to verify capacity and marking of the fire hydrant, considering if there is a pressing need for testing and if test data is available that is less than five years old from an adjacent fire hydrant on the same grid.[5]

Through interviews, IA found that GCWW does not conduct flow testing on a regular basis as part of an annual fire hydrant maintenance plan. Instead, GCWW conducts flow testing on a

[5] National Fire Protection Association (NFPA) 291, Recommended Practice for Fire Flow Testing and Marking of Hydrants, 2019 Edition, 4.13 Public Hydrant Testing and Flushing, page 291-17.

reactionary basis when requested for repair or to determine available water capacity for a development. Regular fire hydrant flow testing ensures each fire hydrant can provide the required water pressure and flow rate to extinguish a fire and keep the community and firefighters safe.

Recommendation 5: GCWW should develop an internal policy for ongoing flow testing that aligns with NFPA 291, Section 4.13.1.

Department Response (GCWW): Disagree. As directed by the City Administration in 2019-2020, the initial rounds of flow testing were performed by GCWW to set the baseline for testing and data quality review and was meant to eventually be transitioned to CFD. While the results of fire flow testing assist with identifying watermains in need of replacement, performing flow testing of all hydrants on a routine basis (e.g., every 5 years) is not necessary or of significant benefit for daily water system operations. Additionally, GCWW performs flow tests in conformance to National Fire Protection (NFPA) and American Water Works Association (AWWA) M17 standards on an as needed basis. We also have developed strict criteria for accepting flow test results.

As a point of clarification, the statement above, "*Regular fire hydrant flow testing ensures each fire hydrant can provide the required water pressure and flow rate to extinguish a fire and keep the community and firefighters safe,*" is inaccurate. The testing does not ensure the required pressure is met; the testing provides data indicating the flow the water system may provide at a specified residual pressure under a specific set of operating conditions.

Oversight of private fire hydrants needs to be improved.

Cincinnati Fire Prevention Code, Section 1229-9 Private Fire Hydrants (b) states, "All private fire hydrants shall be maintained in proper working order by the owner;" and (c) states, "An inspection and flow test shall be conducted annually as prescribed by the fire chief."[6]

Since fire companies rely on private fire hydrants as a source of water to extinguish fires, it is imperative that CFD ensures the code is adhered to. However, IA was unable to obtain evidence that all private fire hydrants are inspected, flow tested and maintained.

Further, IA tested out of service fire hydrants using an Out of Service (OOS) report provided by CFD, dated September 29, 2022, and found a large disparity in the number of days private fire hydrants remain out of service. While public fire hydrants were out of service an average of 34 days, private fire hydrants remain out of service an average of 325 days. Of the out of service private fire hydrants, 53% were located within the inspection district of one fire company, and there is a private fire hydrant repair request dating back two years to October 28, 2020.

Recommendation 6: CFD and GCWW should develop policies and procedures to monitor and maintain inspection and service records for private fire hydrants. Additionally, management should review out of service reports on a regular basis to ensure service is restored timely.

Department Response (CFD): Agree. The CFD Operations Division and the CFD Fire Prevention Division shall collaborate to facilitate the expeditious repair of the private hydrants. CFD Operations Division fire companies shall issue a fire code violation when a private fire

[6] Cincinnati Fire Prevention Code, Section 1229-9 Private Fire Hydrants (b) and (c).

hydrant is found to be defective and specify that the violation shall be corrected immediately. The fire company shall reinspect the hydrant weekly to determine the status of the repair. The Fire Prevention Division shall assist the fire company with obtaining compliance from the owner up to and including issuing citations. (July 2023)

Department Response (GCWW): GCWW defers this recommendation to CFD. Private fire hydrants are located on private property and are owned and maintained by the property owner per the Cincinnati Fire Prevention Code and CMC 1229-9. GCWW provides all necessary public fire hydrants on dedicated streets within the City of Cincinnati pursuant to CMC 401-112 and as funded by the fire hydrant repair and replacement charge (CMC 401-89). Fire hydrants installed outside City limits and connected to the GCWW Water System are furnished and maintained by the political subdivision. GCWW does not track or maintain private fire hydrants but if it is helpful, we can provide examples of how we operate similar compliance programs within GCWW (e.g., backflow prevention program).

There are no documented metrics for fire hydrant repairs.

Establishing goals, expectations, and metrics that align with internal processes can assist management in decision making and process improvement. Through IA interviews, GCWW management discussed the process of repairing City-owned public fire hydrants from when a fire hydrant is reported for service until the time it is repaired; however, management could not provide documented standards or metrics for completion times.

IA sought to independently analyze fire hydrant repair trends for City-owned fire hydrants but was unable to complete the analysis due to data inconsistencies.

Recommendation 7: GCWW should establish metrics to analyze data for decision making and process improvements.

Department Response (GCWW): Agree. GCWW in consultation with CFD, will develop and establish metrics for hydrant repair. The metrics can be discussed during the MOU development.

Fire hydrant maps in the fire engine do not provide reliable location, service status and flow data.

City fire companies rely on Computer Aided Dispatch (CAD) maps viewed on Premier Mobile Data Computers (PMDC's) in the fire engine to identify the best route to the fire and location of a fire hydrant with adequate water supply. IA found GCWW mapping of fire hydrants to be robust and interactive, while mapping in the fire engines lacked reliable fire hydrant status, flow data or location information. As a result, fire companies maintain printed fire hydrant map books and utilize various fire hydrant mapping applications to locate available fire hydrants. While fire companies are responsible for knowing the location of public and private fire hydrants in their fire district, fire hydrants may have been moved, placed out of service, and flow test data may be missing.

Recommendation 8: IA recommends CFD, GCWW, Cincinnati Area Geographic Information System (CAGIS) and the Emergency Communications Center (ECC) meet to develop mapping solutions for CFD.

Department Response (CFD): Agree. The CFD Administrative Division District Chief (DC John Davis) will lead a committee comprised of CFD Operations (DC Goodman), CFD EMD – Dispatch (Capt. Neiheisel) along with representatives from ECC and CAGIS to develop a reliable and real time hydrant mapping solution for the CFD fire companies. This solution should consider utilizing the ESRI Suite of Applications (Quick Capture, Survey 1-2-3, Field Maps). (July 2024)

Department Response (GCWW): Agree, however, GCWW already provides mapping data and will continue to provide data to support solutions as recommended and developed by CFD.

City fire hydrant information is not available on the Hamilton County Operational Fire Hydrant Portal.

The Hamilton County Operational Fire Hydrant Portal provides geographical information system (GIS) mapping of fire hydrant locations within Hamilton County, outside the City. The portal allows the user to identify fire hydrants by entering a street address or clicking on a fire hydrant icon located on the GIS map. The application identifies fire hydrant locations, providing asset number, flow rate, main number, main size, and repair status. The portal is available to fire departments in Hamilton County and is used to submit fire hydrant repair requests directly to the Hamilton County Storm Water District.

IA found CAGIS maintains data on fire hydrants located within the City. Updating CAGIS based applications to include City fire hydrant data will align CFD access with other fire departments in Hamilton County and provide the platform for City fire companies to submit repair requests directly to GCWW.

Recommendation 9: CFD should work with CAGIS to add fire hydrants located within the City to mapping applications, providing access to fire hydrant location data, flow rate, main number, main size, service status and other relevant data fields.

Recommendation 10: CFD should work with CAGIS to provide direct entry of fire hydrant repair requests from fire companies to GCWW and receive email notifications when service is complete.

Department Response 9 and 10 (CFD): Agree. The CFD Administrative Division District Chief (DC John Davis) will lead a committee comprised of CFD Operations (DC Goodman), CFD EMD – Dispatch (Capt. Neiheisel) along with representatives from ECC and CAGIS to develop a reliable and real time hydrant mapping solution and reporting system for the CFD fire companies. This solution should consider utilizing the ESRI Suite of Applications (Quick Capture, Survey 1-2-3, Field Maps). (July 2024)

Fire companies are not notified when fire hydrants or water mains are moved or relocated.

IA obtained GCWW Valve Manual Section 16, Fire Department Notification that states, “When shutting down any part of the Greater Cincinnati Water Works system, which affects the fire protection in the area, the fire company responsible for the area shall be directly notified. This procedure shall be followed for both emergency and non-emergency runs. The term “fire

protection" shall be construed as meaning all of the fire hydrants, fire branches, automatic sprinkler systems, standpipe connections and/or volume of water available to an area."[7]

GCWW is responsible for maintaining the water system for the City, replacing aging water mains, and repairing City-owned fire hydrants. IA found that fire companies are not directly notified when fire hydrants or mains are moved or relocated.

Recommendation 11: GCWW should directly notify City fire companies when fire hydrants or water mains are moved or relocated.

Department Response (GCWW): Agree. GCWW already notifies CFD of proposed fire hydrant location changes through the normal plan approval process and has informal dialogue with fire stations when hydrant locations change. Within the plan review process, CFD approves the location of each fire hydrant. GCWW water main construction inspectors notify the corresponding fire station when new hydrants are in service. CFD is best positioned to ensure comprehensive communication within each fire station for day-to-day changes in hydrant status. GCWW proposes to discuss with CFD a formal notification process of hydrant location change when changes are completed.

Residents and businesses are not consistently notified of plans to service or flow test fire hydrants.

The process of servicing and flow testing fire hydrants can stir up dirt, rust, and sediment in the water, seeping into the waterline of homeowners and businesses. Water can become discolored (reddish) from rust and other materials dislodged from the cast iron mains during the testing process. Rust itself is not a health concern but can react with and eliminate chlorine that is in the water as a disinfectant to prevent the growth of bacteria. GCWW recommends customers do not drink tap water if it is discolored due to contaminants.[8] Notifying the public prior to servicing or flow testing fire hydrants can assist in alleviating public health concerns.

In August 2020, as part of the phase 1 flow testing plan, GCWW notified the public of scheduled flow testing with announcements and door hangers. Also, the GCWW/CFD Hydrant Flow Testing Notification was posted on the GCWW website identifying affected communities of the flow testing schedule. However, IA has not observed the same level of notification to affected residents and businesses for phase 2 of flow testing.

Recommendation 12: CFD and GCWW should consistently notify the public of scheduled fire hydrant service and flow testing.

Department Response (CFD): Agree. The CFD Public Information Officer will post repeated messaging on all social media platforms announcing the annual flowing of fire hydrants in April of every year. The messaging will begin the last week of March and continue through April. All local news outlets shall also continually receive a media release requesting their assistance in spreading the message. All messaging shall include recommendations for residents to follow in the event the water is discolored. (March 2023)

[7] GCWW Valve Manual Section 16, page 41.
[8] GCWW/CFD Hydrant Flow Testing Notification, April 17, 2020.

Department Response (GCWW): Agree. GCWW notified residents and businesses before the 2022 fire hydrant flow testing project by handing out our standard flow testing door hangers before the tests were conducted.

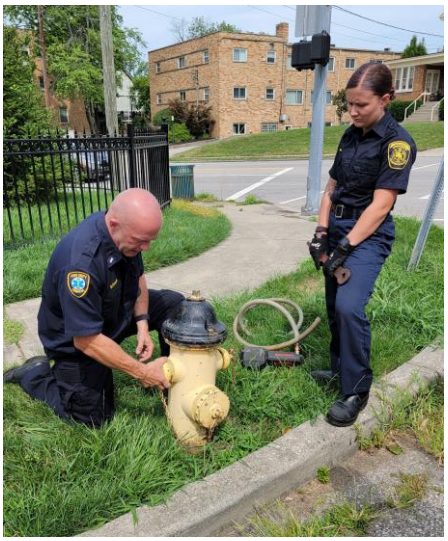

Exhibit 3: CFD Firefighters servicing a fire hydrant in Hyde Park.

Exhibit 4: CFD Firefighter flowing a fire hydrant. Company Engine 46 also pictured.

The workflow process for fire hydrant service requests is not documented.

Work order requests for fire hydrant repairs originate from dispatch, residents, GCWW employees and the Hydrant and Apparatus Technician (HAAT) Desk located within CFD. IA was unable to obtain written policies and procedures for processing work order requests for fire hydrants. The lack of internal policies and procedures can affect operational effectiveness and create inconsistencies in the execution of program functions.

Recommendation 13: GCWW should document the workflow process for fire hydrant service requests.

Department Response (GCWW): Agree. GCWW will document the workflow process for fire hydrant service requests. This process will be documented and made available during the MOU development meetings.

There are no written policies and procedures that require fire companies to maintain records of fire hydrant inspections.

Fire companies are required to inspect all fire hydrants a minimum of at least every two weeks. Firefighters conduct a “visual inspection” of fire hydrants, looking for weeds, tall grass, obstructions, missing fire hydrants or fire hydrants that are leaking or knocked over. IA was informed by firefighters that fire hydrants located off the main roads are not inspected every two weeks. Further, there is no written policy that requires fire companies to maintain records of fire hydrant inspections. Standard operational procedures and record keeping will allow CFD management to monitor, verify, and enforce department policies and procedures for fire hydrant inspections.

Recommendation 14: CFD should develop standard policies and procedures for documenting fire hydrant inspections. Additionally, ensure all fire hydrants are inspected every two weeks.

Department Response (CFD): Agree. The CFD Office of Apparatus and Water (Capt. Pigman), CFD IT, and the CFD Operations Division shall develop an electronic platform to document and track all fire hydrants and fire hydrant maintenance. Fire officers shall be responsible to maintain the electronic database. (January 2024)

Fire hydrant capacity color painting guidelines should be developed and standardized.

GCWW developed a program to paint all City fire hydrants over a 10-year period to improve their appearance and help beautify neighborhoods.[9] Through IA interviews, it was revealed GCWW is painting all fire hydrants yellow. The American Waters Works Association (AWWA) and the National Fire Protection Association (NFPA) recommend capacity color standards to classify fire hydrant flow capacity in gallons per minute (gpm). Capacity color standards are; light blue to designate fire hydrant flow capacity of 1,500 gpm or more; green to designate fire hydrant flow capacity of 1,000 to 1,499 gpm; orange to designate a flow capacity of 500 to 999 gpm; and red to designate the lowest flow capacity of less than 500 gpm.[10] Flow capacity indicators would further assist firefighters with the data needed to quickly extinguish a fire, saving lives and property in City neighborhoods.

Recommendation 15: CFD and GCWW should establish fire hydrant capacity color guidelines that align with AWWA and NFPA standards.

Department Response (CFD): Agree. The CFD recommends following the NFPA hydrant coloring system. The CFD recommends the 5” hydrant cap be painted the corresponding flow color and the remainder of the hydrant remain yellow. (Dependent on flow testing dta)

Department Response (GCWW): GCWW defers to CFD on this recommendation. This has been discussed with CFD in the past. GCWW cautions that flow availability at any one hydrant varies based on system conditions at the time of use, number of hydrants in service at one time, etc. Color coding alone is not an absolute indicator of system performance and requires understanding of system hydraulics and flow data interpretation for proper use. Additionally, watermain replacements and other system changes made over time can have an impact/improvement to the fire flow conditions in the surrounding area because they act as an improved water source.

Fire hydrant repair requests are misrouted.

Citizen service requests are recorded and tracked by the Citywide Customer Service Call Center. The system is maintained as a part of the Call Center and requests are recorded and forwarded to City departments.

IA found instances where fire hydrant repair requests are routed from the Call Center to CFD instead of GCWW. IA found that CFD has received approximately 40 repair requests from the

[9] Memo from Cathy B. Bailey, Executive Director, Greater Cincinnati Works to John P. Curp, Interim City Manager dated May 27, 2022. Subject: GCWW Hydrant Painting.
[10] NFPA 291 Recommended Practice for Fire Flow Testing and Marking of Hydrants, 2019 Edition, Annex B, Section 5.1 Classification of Hydrants, page 291-17.

Call Center in the past 12 months. Submitting requests directly to GCWW reduces the public safety risk associated with out of service fire hydrants.

Recommendation 16: GCWW should work with the Call Center to ensure all fire hydrant work order requests are properly routed.

Department Response (GCWW): Agree. GCWW will work with the City Call Center to find improvements in the workflow identification process.

III. Conclusion

CFD and GCWW share responsibilities to inspect, flow test and maintain City-owned fire hydrants. The co-dependent nature of the relationship requires coordination and communication by both departments. If not done effectively, it can impact the ability of CFD to quickly extinguish a fire, affecting the safety of the firefighters, residents, and the business community.

The audit revealed several opportunities for CFD and GCWW to strengthen the internal controls over fire hydrant inspection, flow testing and maintenance. IA recommends CFD and GCWW collaborate to share critical fire hydrant information, develop a MOU to formalize responsibilities, adhere to fire flow testing standards, create policies and procedures to monitor and maintain inspection and service records for private fire hydrants, and develop reliable mapping solutions for CFD. Implementing these internal controls will ensure proper oversight of fire hydrant inspection, flow testing and maintenance.

IV. Cincinnati Fire Department Response

city of CINCINNATI
Interdepartment Correspondence Sheet

Date: November 22, 2022

To: Internal Audit

From: Assistant Fire Chief Thomas Lakamp

Subject: CFD Response to Fire Inspection, Flow Testing and Maintenance Audit

Recommendation 1: IA recommends CFD and GCWW collaborate to share critical fire hydrant information.

Department Response: Agree. The CFD office of Apparatus and Water (Captain Pigman) will work with CWW to develop a system to share critical hydrant information between the two departments and a mechanism to disseminate the information to the operation's division fire companies in real time. (January 2024)

Recommendation 2: CFD and GCWW should develop a MOU to formalize responsibilities, information sharing, reporting, and performance metrics for fire hydrant inspection, flow testing and maintenance.

Department Response: Agree. The CFD office of Apparatus and Water (Captain Pigman) will work with CWW to develop, write and publish an MOU that establishes the policies and procedures for hydrant inspection, flow testing and maintenance. (January 2024)

Recommendation 3: CFD and GCWW should reassess the project schedule to complete flow testing of City fire hydrants.

Department Response: Agree, however this recommendation is under the direction of CWW. The CFD wants this information as soon as possible. (Not a CFD project)

Recommendation 6: CFD and GCWW should develop policies and procedures to monitor and maintain inspection and service records for private fire hydrants. Additionally, management should review out of service reports on a regular basis to ensure service is restored timely.

Department Response: Agree. The CFD Operations Division and the CFD Fire Prevention Division shall collaborate to facilitate the expeditious repair of the private hydrants. CFD Operations Division fire companies shall issue a fire code violation when a private fire hydrant is found to be defective and specify that the violation shall be corrected immediately. The fire company shall reinspect the hydrant weekly to determine the status of the repair. The Fire Prevention Division shall assist the fire company with obtaining compliance from the owner up to and including issuing citations. (July 2023)

Recommendation 8: IA recommends CFD, GCWW, Cincinnati Area Geographic Information System (CAGIS) and the Emergency Communications Center (ECC) meet to develop mapping solutions for CFD.

Departmental Response: Agree. The CFD Administrative Division District Chief (DC John Davis) will lead a committee comprised of CFD Operations (DC Goodman), CFD EMD – Dispatch (Capt. Neiheisel) along with representatives from ECC and CAGIS to develop a reliable and real time hydrant mapping solution for the CFD fire companies. This solution should consider utilizing the ESRI Suite of Applications (Quick Capture, Survey 1-2-3, Field Maps). (July 2024)

Recommendation 9: CFD should work with CAGIS to add fire hydrants located within the City to mapping applications, providing access to fire hydrant location data, flow rate, main number, main size, service status and other relevant data fields.

Recommendation 10: CFD should work with CAGIS to provide direct entry of fire hydrant repair requests from fire companies to GCWW and receive email notifications when service is complete.

Departmental Response: Agree. The CFD Administrative Division District Chief (DC John Davis) will lead a committee comprised of CFD Operations (DC Goodman), CFD EMD – Dispatch (Capt. Neiheisel) along with representatives from ECC and CAGIS to develop a reliable and real time hydrant mapping solution and reporting system for the CFD fire companies. This solution should consider utilizing the ESRI Suite of Applications (Quick Capture, Survey 1-2-3, Field Maps). (July 2024)

Recommendation 12: CFD and GCWW should consistently notify the public of scheduled fire hydrant service and flow testing.

Departmental Response: Agree. The CFD Public Information Officer will post repeated messaging on all social media platforms announcing the annual flowing of fire hydrants in April of every year. The messaging will begin the last week of March and continue through April. All local news outlets shall also continually receive a media release requesting their assistance in spreading the message. All messaging shall include recommendations for residents to follow in the event the water is discolored. (March 2023)

Recommendation 14: CFD should develop standard policies and procedures for documenting fire hydrant inspections. Additionally, ensure all fire hydrants are inspected every two weeks.

Departmental Response: Agree. The CFD Office of Apparatus and Water (Capt. Pigman), CFD IT, and the CFD Operations Division shall develop an electronic platform to document and track all fire hydrants and fire hydrant maintenance. Fire officers shall be responsible to maintain the electronic database. (January 2024)

Recommendation 15: CFD and GCWW should establish fire hydrant capacity color guidelines that align with AWWA and NFPA standards.

Departmental Response: Agree. The CFD recommends following the NFPA hydrant coloring system. The CFD recommends the 5" hydrant cap be painted the corresponding flow color and the remainder of the hydrant remain yellow. (Dependent on flow testing dta)

Note:
The CFD Office of Apparatus and Water is only staffed by a fire captain. The Administrative Technician that was once assigned was eliminated in order to facilitate an HR analyst for the department. The elimination of this position has, and will continue to negatively affect the operation of the Apparatus and Water office and will negatively affect the implementation of the audit recommendations.

V. Greater Cincinnati Water Works Response

Greater Cincinnati Water Works Response

Recommendation 1: IA recommends CFD and GCWW collaborate to share critical fire hydrant information.

Department Response: Agree, however, GCWW currently collaborates with CFD to share information including results of hydrant flow testing, water system maintenance that impacts fire hydrants and watermain information. Please note that in addition to sharing information, training users of the data in understanding its limitations and proper use is equally important.

Recommendation 2: CFD and GCWW should develop a MOU to formalize responsibilities, information sharing, reporting, and performance metrics for fire hydrant inspection, flow testing and maintenance.

Department Response: Agree. The establishment of an MOU between CFD and GCWW is important and will lead to a better understanding of the roles and responsibilities of each organization.

Please note there is an important distinction between a water system and connected fire hydrants. An MOU needs to reflect this distinction. While public fire hydrants are connected to the water distribution system via underground mains, they are not to be considered as part of the water distribution system.

Recommendation 3: CFD and GCWW should reassess the project schedule to complete flow testing of City fire hydrants.

Department Response: Agree. The project schedule should be reassessed based on our experience with the first phases of the flow testing project, current and future funding availability, and as noted below.

GCWW is responsible for the maintenance and replacement of public fire hydrants, and funding is provided to support these activities. There are 10,774 public fire hydrants (as of 6/30/22) owned by the City of Cincinnati. This number differs from the 14,000 originally cited in August of 2020 due to the subsequent distinction between private and public fire hydrants. Privately owned fire hydrants are the responsibility of the property owner and are outside the jurisdiction of GCWW's authorized fire hydrant maintenance and replacement.

As directed by the City Administration in 2019-2020, the initial rounds of flow testing were performed by GCWW to set the baseline for testing and data quality review, and was meant to eventually be transitioned to CFD. The original schedule was proposed before the COVID19 pandemic and without prior experience in executing a flow testing project of this magnitude. Since then, the cost of testing has increased and as a result, the testing phases have slowed. Performing hydrant flow testing must be balanced against available staffing and financial resources, considering increasing costs and the seasonal limitations of flow testing (generally April through October). Future flow testing phases need to be discussed with CFD, GCWW and the Administration.

It should be noted that it may not be feasible or necessary to conduct a flow test on all hydrants. Hydrants on larger watermains and in high traffic locations are difficult to test due to the large volume of water which would be required to obtain the necessary data points to calculate the available fire flow, potentially causing safety concerns and property damage. Often just by

flowing the hydrant and obtaining flow and pressure measurements it can be concluded that the system exhibits strong characteristics to deliver normal fire flow requirements.

Recommendation 4: IA recommends GCWW reassess the bidding process for the remaining City fire hydrants to reduce costs and accelerate the flow testing process.

Department Response: Disagree. GCWW does not specify the bidding process. The bidding process must be in alignment with legal requirements specified by State and City laws and codes and as implemented by the City's Office of Procurement.

Recommendation 5: GCWW should develop an internal policy for ongoing flow testing that aligns with NFPA 291, Section 4.13.1.

Department Response: Disagree. As directed by the City Administration in 2019-2020, the initial rounds of flow testing were performed by GCWW to set the baseline for testing and data quality review and was meant to eventually be transitioned to CFD. While the results of fire flow testing assist with identifying watermains in need of replacement, performing flow testing of all hydrants on a routine basis (e.g., every 5 years) is not necessary or of significant benefit for daily water system operations. Additionally, GCWW performs flow tests in conformance to National Fire Protection (NFPA) and American Water Works Association (AWWA) M17 standards on an as needed basis. We also have developed strict criteria for accepting flow test results.

As a point of clarification, the statement above, "*Regular fire hydrant flow testing ensures each fire hydrant can provide the required water pressure and flow rate to extinguish a fire and keep the community and firefighters safe,*" is inaccurate. The testing does not ensure the required pressure is met; the testing provides data indicating the flow the water system may provide at a specified residual pressure under a specific set of operating conditions.

Recommendation 6: CFD and GCWW should develop policies and procedures to monitor and maintain inspection and service records for private fire hydrants. Additionally, management should review out of service reports on a regular basis to ensure service is restored timely.

Department Response: GCWW defers this recommendation to CFD. Private fire hydrants are located on private property and are owned and maintained by the property owner per the Cincinnati Fire Prevention Code and CMC 1229-9. GCWW provides all necessary public fire hydrants on dedicated streets within the City of Cincinnati pursuant to CMC 401-112 and as funded by the fire hydrant repair and replacement charge (CMC 401-89). Fire hydrants installed outside City limits and connected to the GCWW Water System are furnished and maintained by the political subdivision. GCWW does not track or maintain private fire hydrants but if it is helpful, we can provide examples of how we operate similar compliance programs within GCWW (e.g., backflow prevention program).

Recommendation 7: GCWW should establish metrics to analyze data for decision making and process improvements.

Department Response: Agree. GCWW, in consultation with CFD, will develop and establish metrics for hydrant repair. The metrics can be discussed during the MOU development.

Recommendation 8: IA recommends CFD, GCWW, Cincinnati Area Geographic Information System (CAGIS) and the Emergency Communications Center (ECC) meet to develop mapping solutions for CFD.

Department Response: Agree, however, GCWW already provides mapping data and will continue to provide data to support solutions as recommended and developed by CFD.

Recommendation 11: GCWW should directly notify City fire companies when fire hydrants or water mains are moved or relocated.

Department Response: Agree. GCWW already notifies CFD of proposed fire hydrant location changes through the normal plan approval process and has informal dialogue with fire stations when hydrant locations change. Within the plan review process, CFD approves the location of each fire hydrant. GCWW water main construction inspectors notify the corresponding fire station when new hydrants are in service. CFD is best positioned to ensure comprehensive communication within each fire station for day-to-day changes in hydrant status. GCWW proposes to discuss with CFD a formal notification process of hydrant location change when changes are completed.

Recommendation 12: CFD and GCWW should consistently notify the public of scheduled fire hydrant service and flow testing.

Department Response: Agree. GCWW notified residents and businesses before the 2022 fire hydrant flow testing project by handing out our standard flow testing door hangers before the tests were conducted.

Recommendation 13: GCWW should document the workflow process for fire hydrant service requests.

Department Response: Agree. GCWW will document the workflow process for fire hydrant service requests. This process will be documented and made available during the MOU development meetings.

Recommendation 15: CFD and GCWW should establish fire hydrant capacity color guidelines that align with AWWA and NFPA standards.

Department Response: GCWW defers to CFD on this recommendation. This has been discussed with CFD in the past. GCWW cautions that flow availability at any one hydrant varies based on system conditions at the time of use, number of hydrants in service at one time, etc. Color coding alone is not an absolute indicator of system performance and requires understanding of system hydraulics and flow data interpretation for proper use. Additionally, watermain replacements and other system changes made over time can have an impact/improvement to the fire flow conditions in the surrounding area because they act as an improved water source.

Recommendation 16: GCWW should work with the Call Center to ensure all fire hydrant work order requests are properly routed.

Department Response: Agree. GCWW will work with the City Call Center to find improvements in the workflow identification process.