Performance Audit

Department of Public Works
Snow and Ice Control and
Street Pothole Maintenance Programs

Report by the
Office of City Controller

MICHAEL E. LAMB
CITY CONTROLLER

Douglas W. Anderson, Deputy Controller

Gloria Novak, Performance Audit Manager

Bette Ann Puharic, Performance Audit Assistant Manager

Bill Vanselow, Performance Auditor

Emily Ferri, Performance Auditor

June 2020

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CITY OF PITTSBURGH

OFFICE OF THE CITY CONTROLLER

Controller Michael E. Lamb

June 23, 2020

The Honorable William Peduto, Mayor of Pittsburgh
and Members of Pittsburgh City Council

Dear Mayor Peduto and Members of City Council:

The Office of the City Controller is pleased to present this performance audit of the **Department of Public Works' Snow and Ice Control and Street Pothole Maintenance Programs** conducted pursuant to the Controller's powers under Section 404(b) of the Pittsburgh Home Rule Charter. Our procedures were conducted in accordance with applicable government auditing standards and are limited to our objectives, scope, and methodology sections of this report.

EXECUTIVE SUMMARY

The Department of Public Works' (DPW) Bureau of Operation's Street Maintenance and Park Maintenance Divisions are responsible for the Snow and Ice Control and Street Pothole Maintenance Programs. During the winter weather season, DPW applies deicing materials to City streets, tertiaries, steps, bridges, public roadways, park roads, park sidewalks, and facility parking lots. According to the Director of Public Works, all DPW employees (641) are available for snow and ice operations in case of an emergency. The Streets Maintenance Division also completes pothole patching year round. Temporary cold patching is used in the winter months, while more permanent hot patching is used during warmer months.

Snow and Ice Control Vehicles and Equipment

During winter weather seasons, DPW uses dump trucks, pick-up trucks, and tractors to control snow and ice from streets with plows and spreaders. DPW had a total of 144 vehicles available for snow and ice control operations during the 2018-2019 snow season. These consisted of 71 dump trucks, 37 pick-up trucks, and six (6) tractors with both plows and spreaders; twenty-two (22) pick-up trucks and eight (8) tractors had plows only.

The number of vehicles that DPW had for snow and ice control increased between 2008 and 2018, with 130 dump and pick-up trucks available in 2018 compared to 112 in 2008. A

frequent concern expressed by workers is the age and availability of fleet vehicles needed for snow and ice control. Almost half of the fleet (47.95%) is less than ten (10) years old; however, 17.81% of Street Division dump trucks are between 15 and 18 years old. Some fleet inspections are being scheduled during the winter months making them unavailable during a winter storm.

Deicing Materials

All rock salt purchased by DPW during the audit scope was from American Rock Salt. During the 2016-2017 and 2017-2018 snow season, DPW used regular rock salt (sodium chloride) to treat streets.

Beginning in the 2018-2019 snow season, DPW began to purchase a new formula of rock salt to treat streets, sodium chloride treated with magnesium + an Organic Based Performance Enhancer that is tinted blue. While regular sodium chloride rock salt can only melt snow and ice at 15-20 degrees Fahrenheit, the new formula has a melting point of -25 to -30 degrees. Although the new formula is more costly per ton than the regular rock salt, less of the new formula is needed to treat the same area. During interviews with auditors, DPW drivers and laborers said that they were impressed with the new formula and said the product was more effective in treating roads.

DPW continues to purchase a small amount of the regular rock salt as a backup in case of a shortage. Of the audit years, the most salt used was in the 2017-2018 winter weather season, which was also the year when the City had the most snow accumulation.

New Snow Plow Tracker, Spreader Controls, and Routing

Beginning in the 2018-2019 snow season, the City entered into an agreement with Quetica to install a more detailed snow plow tracker system with better salt spreader controls and optimized route directions for snow and ice control vehicles. A number of subcontractors worked on the contract. Skyhawk Telematics created the new snow plow tracker with more details including where salt had been spread or if a vehicle had its plow up or down. A&H Equipment installed this new technology into the vehicles, including a salt spreader system that was designed to dispense an even coating of salt treatment per mile based on the speed of the vehicle. Magellan created a new set of optimized routes for vehicles and designed the system devices used to feed the directions to drivers. The total cost of the contract was not to exceed $1,731,832.00. As of January 2020, the total amount paid for the work done on the contract was $1,400,581.40.

The new systems required a transition period that had implementation issues. New routes were tested by drivers for efficiency and safety. Some of the salt spreader technology had previously been designed for different types of vehicle parts, requiring additional trouble shooting and fixes in order to use. As of the writing of this audit, additional system repairs were still being designed and installed.

The auditors interviewed supervisors, foreman, truck drivers, and laborers at all five (5) DPW Street Divisions to see if the new systems made snow and ice control more efficient. The auditors received both positive and negative feedback about the systems.

Pothole patching is completed throughout the year by the Streets Maintenance Division. Depending on the season, DPW uses two (2) types of patching materials. Cold patch is typically used between December and February, while the more durable hot patch is used the rest of the year. Aquaphalt, which DPW began to use in 2017-2018 winter season, is another product that can be used all year even while it is raining, unlike other materials. The City increased spending on patching materials during each year of this audit's scope. A majority (81.98%) of the spending on patching materials went towards purchasing hot patch mix.

Requests from 311

Residents can call the 311 Call Center to report street issues to the City, including the need for snow and ice removal and potholes. Overall, the 3rd division, which contains many of the hilly southern neighborhoods, had the most snow and ice 311 requests. The highest number of 311 calls in this audit was during the 2017-2018 winter weather season, which was also the year with the greatest amount of snowfall.

The 3rd Division also had the most 311 calls for potholes. The year with the most pothole requests was 2018, following the harsh 2017-2018 winter weather season. Tracking 311 pothole requests showed that a majority of these requests are fulfilled within one month, while usually 10% of requests take more than 100 days to close. Carrick and Brookline were the only two (2) neighborhoods for the entire audit scope period that were in the top ten for the most 311 snow and ice and pothole repair requests. Both of these neighborhoods are located in the southern hilly areas of the City.

Our findings and recommendations are discussed in detail beginning on page 7. We believe our recommendations will provide more accountability and improve operation efficiency.

We would like to thank the Department of Public Works' staff for their cooperation and assistance.

Sincerely,

Michael E. Lamb
City Controller

INTRODUCTION

This performance audit of the Department of Public Works (DPW) Snow and Ice Control and Street Pothole Maintenance Programs was conducted pursuant to section 404(c) of Pittsburgh's Home Rule Charter. This audit assesses the process, procedures and policies for the City's snow and ice control and examines the effectiveness of pothole repair.

Three past performance audits of the Department's Snow & Ice Control program were conducted in 1996, 1999, and 2009. The 2009 audit focused on the programs for street resurfacing, street repair and snow and ice control.

OVERVIEW

DPW is separated into four bureaus: Administration, Operations, Environmental Services and Facilities. See Organization Chart on page 4.

The Snow and Ice Control Program and Street Pothole Maintenance Program is handled by the Bureau of Operation's Streets Maintenance and Parks Maintenance Divisions. The DPW Street and Parks Maintenance Divisions maintain responsibilities for 1,200 linear miles of city streets, 23 miles of steps, 276 miles of public sidewalks and 7 miles of bridge sidewalks.

During the winter season the DPW Streets Maintenance Division applies deicing materials to eliminate snow and ice from all City streets, tertiaries, steps, bridges, public roadways and park roads in the 5 regional parks. The 5 Regional Parks are Highland, Schenley, Riverview, Frick and Emerald View.

The Parks Maintenance Division duties are to apply deicing materials to eliminate snow and ice from all city park sidewalks, steps, facility parking lots as well as assisting the Streets Maintenance Division in their snow and ice control job duties.

All street repair and pothole patching is done year round by the Streets Maintenance Division. Temporary pothole patching (cold patch) is applied in the winter. Then in the spring, all Street Maintenance Divisions provide permanent pothole patching (hot patch).

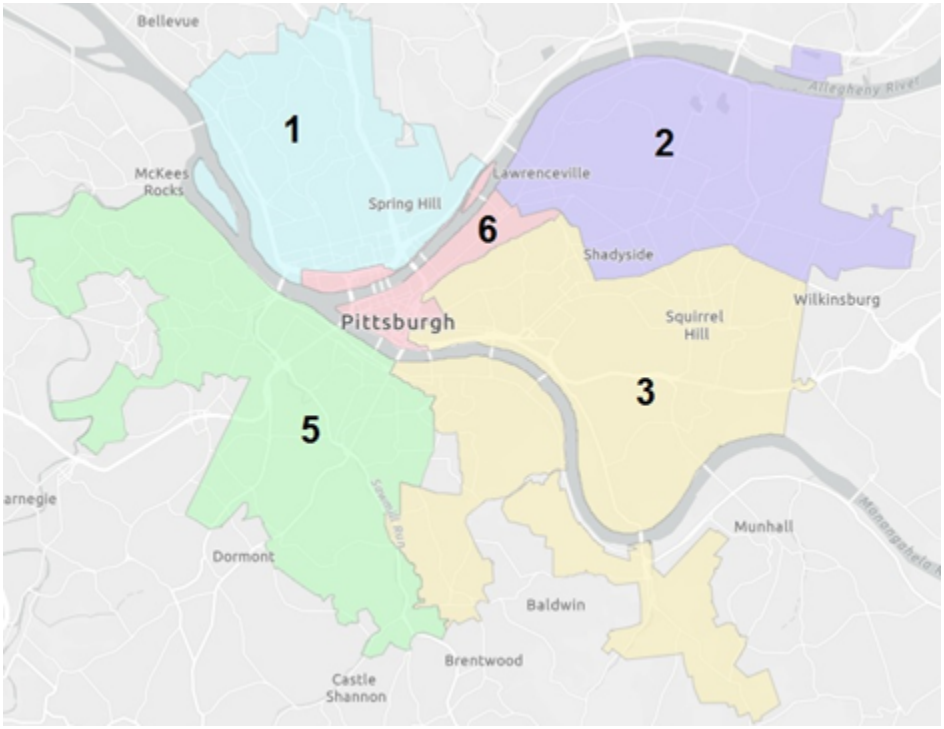
Other duties of the DPW's Street and Parks Maintenance division include cutting grass, emptying trash cans, removing graffiti, collecting litter, weed control, leaf removal, and providing park clean-ups, in addition to many other tasks and duties.

Divisions

DPW Street Maintenance divides the City into five (5) areas or divisions to ensure public roadways and streets are functional, safe, and attractive. The bulk of the DPW street maintenance program is handled by DPW Street Maintenance Divisions. DPW's superintendent of streets

oversees the five (5) divisions. Divisional supervisors and foremen provide day to day oversight. The five (5) divisions are also staffed with full and seasonal truck drivers, full time and seasonal laborers, sweeper operators, tractor operators, general laborers, skilled laborers and clerks. A list of the five (5) divisions and their locations can be found in Figure 1.

FIGURE 1
CURRENT FIVE DPW DIVISIONS

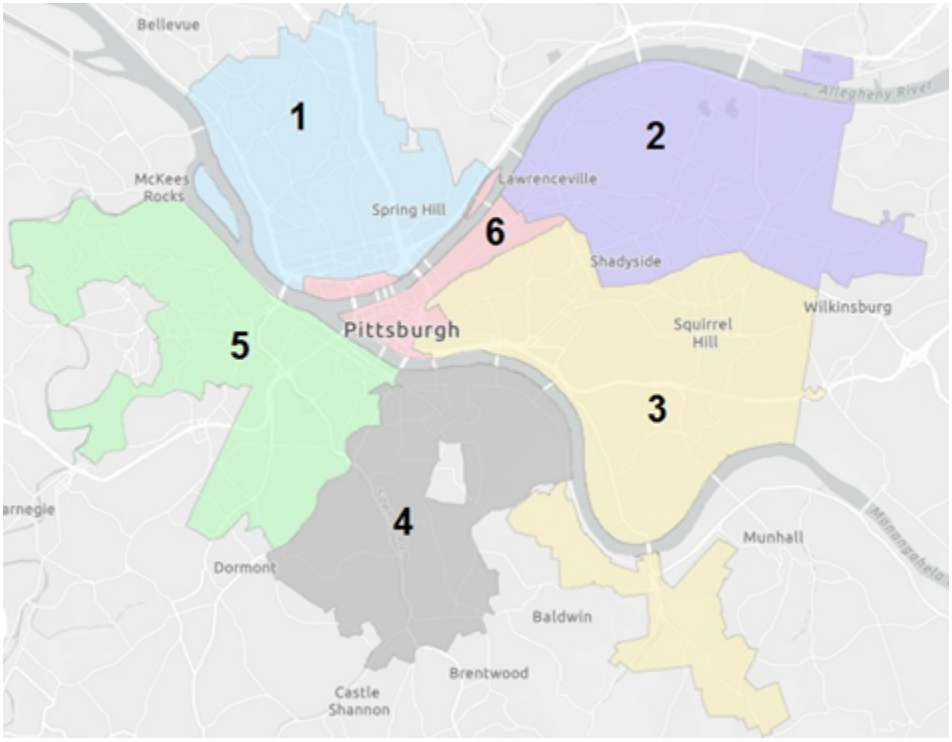


Source: Western PA Regional Data Center, ESRI

Up until October 2017, DPW also had a 4th division located on Bausman St. in the neighborhood of Knoxville. This division was temporarily dissolved due to decline and deterioration of the maintenance facility structure. The building was demolished in January 2018. All employees and equipment from the division were temporarily split between the 3rd and 5th divisions until a new structure/campus is built nearby on Mathews Avenue.

According to the Director of Public Works, the new 4th division building will be relocated to nearby Mathews Avenue and is currently under design. The completion date is expected to be fall 2020 and operational in December 2020/January 2021. The area covered by the 4th Division prior to its demolition can be found in Figure 2 below. Once the new structure/campus is constructed DPW will be staying at five (5) divisions via a reorganization bid and redeployment of resource.

FIGURE 2
SIX DPW DIVISIONS PRIOR TO OCTOBER 2017



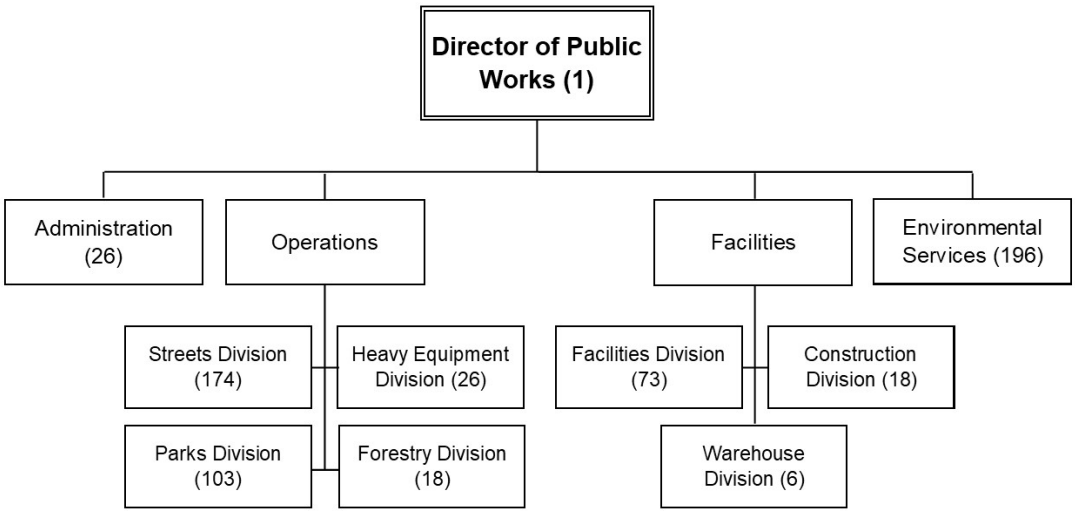
Source: Western PA Regional Data Center, ESRI

Staffing and Work Hours

In 2019, the five (5) DPW street divisions were staffed as the following: 1st Division (29 employees), 2nd Division (34 employees), 3rd Division (45 employees), 5th Division (41 employees), and 6th Division (25 employees).

According to the Director of Public Works, all DPW personnel (641 employees) are available for snow and ice operations in-case of an emergency storm or lack of available staff from Street divisions. Figure 3 shows the organizational chart that lists all DPW divisions and the number of employees from each division available for snow and ice control duties.

FIGURE 3
2019 DEPARTMENT OF PUBLIC WORKS
ORGANIZATIONAL CHART



Snow Control Work Shifts

All DPW employees that provide snow and ice control are full-time year round except twelve (12) seasonal employees, ten (10) of these are truck drivers, that are added in the winter months.

DPW covers the City 24/7, 12 months a year. During the winter season, certain shifts are augmented. The normal DPW Street Division work shift is 6:00 a.m. to 2:30 p.m. During the winter weather season, shifts are adjusted to augment twenty-four (24) hour, seven (7) day a week coverage. From December to March, DPW employees bid to work the 10:00 p.m. to 6:00 a.m. shift which adds about 40 to 50 employees to that shift.

In 2019, the overnight shift did not begin until the 3rd week of January because of the mild weather, forecasts and the lack of repetitive winter weather which activates the 10:00 p.m. to 6:00 a.m. shift. Overtime is offered by seniority to employees if drivers are needed. All DPW staff are allowed to work up to sixteen (16) hours shifts.

Changes in City's Street Maintenance Program

The last DPW streets maintenance audit focused on all street paving and resurfacing of city streets. As of January 2018, all street paving and resurfacing is handled by the Department of Mobility and Infrastructure (DOMI). Evaluation of services are outside the scope of this audit.

OBJECTIVES

1. To assess the effectiveness of current snow and ice control protocols.

2. To evaluate the scope of work performed in the DPW contract with Quetica, LLC. For fleet telematics and snow route optimization.

3. To determine the total cost of salt and pothole patching materials purchased by DPW from 2016-2018.

4. To analyze the DPW's snow and ice control fleet and equipment.

5. To assess DPW's pothole patching program.

6. To make recommendations for improvement

SCOPE

The scope of this performance audit for the snow and ice control program are the winter weather seasons in 2016-2017, 2017-2018 and 2018-2019. DPW defines the winter weather season as the months running from October-April. The scope was expanded to include the status of new GPS tracking, routing and salt spreader control equipment was reported as of January 2020. The scope for the street pothole maintenance program are the years 2016-2018.

METHODOLOGY

The auditors met with the DPW Director, Parks Superintendent, Streets Superintendent, Manager of Personnel & Finance, and the Department of Innovation and Performance's (I&P) Project Manager to discuss audit objectives, and to get an overview of the DPW streets maintenance job functions and duties.

Auditors met with I&P's Project Manager to discuss the City's online snow plow tracker updates, and all new equipment enhancements installed in snow control vehicles in 2018-2019.

A meeting was held with I&P's Business Analyst to discuss all public and administrative features that were installed on the City's online snow plow tracker system prior to 2018.

The DPW Director answered a series of questions and supplied the auditors with the following documents that were reviewed: maps of each division showing their streets and neighborhood coverage, vehicles and equipment per division, foreman contact information for

each division, # of employees and job title per each DPW division, all rock salt locations, amount of snow fall and salt deliveries for 2016-2017, 2017-18 and 2018-19 winter seasons.

Auditors reviewed 2019 DPW Bureau of Operations Operating Budget and DPW Organizational Chart listed in the budget.

All resident snow and ice control 311 calls was obtained from the Western Pennsylvania Regional Data Center. Pothole complaint information was obtained from 311 phone call center, once known as the Mayor's Service Center. All maps of 311 requests were created using Esri ArcGIS.

The 4-18-08 equipment inventory spreadsheet found in the 2009 DPW Street Maintenance Program audit file was used for comparison to the 2019 equipment inventory list supplied by the DPW director.

The auditors received a fleet inventory list from the Office of Management and Budget's Fleet Services Manager that included all dump and pick-up trucks with make, model, and year manufactured to calculate the age of the DPW snow control fleet.

The auditors visited all five (5) Street Maintenance divisions and talked to supervisors, foreman, drivers and laborers regarding their job duties. Some of the issues discussed were the pro and cons of the GPS and spreader controls installed on all vehicles and improvements that could be provided to the divisions to make their job easier.

The auditors used the City's Onbase database system to research all City contracts for snow control and pothole patching products. The Onbase database and JDE software system was used to look up the fleet telematics and snow route optimization and payments with Allied Communications and Quetica.

The auditors interviewed DPW Heavy Equipment Division employees about their experience in trouble shooting spreader controls installed in the snow control vehicles.

FINDINGS AND RECOMMENDATIONS

Winter Street Maintenance

City streets are designated as either primary, secondary or tertiary for purposes of snow control priority. Primary routes are main business arteries that provide access to hospitals, schools, police and fire stations. Secondary routes are in residential areas that branch off of the primary routes. Primary and secondary routes are treated at the same time with priority given to primary routes. Tertiary routes, treated lastly, are those streets and alleyways that have little traffic on a regular basis.

DPW Snow and Ice Control Vehicles and Equipment

Total Number of Snow and Ice Control Vehicles by Division

During the winter weather season, DPW uses dump trucks, pick-up trucks, and tractors to remove snow and ice from streets. Dump trucks are the main vehicle used by the street maintenance divisions to treat roadways. They have larger plows, can carry more salt, and cover more ground. Pick-up trucks are used in neighborhoods with narrow streets, roads with tight bends, and alleys. The steepness of a specific street may also determine whether a dump or pick-up truck is used. Tractors are primarily used to remove snow and ice in city park's parking lots but have assisted in street operations with salting and plowing primarily addressing tertiary streets.

Snow control vehicles use plows and spreaders attachments to eliminate all snow and ice from streets. Some vehicles have both a plow and spreader attachments while some vehicles just have a plow. All DPW snow control vehicles have plow attachments readily available all year round except dump trucks that need plows installed right before winter season. This is because the plows are very large, making it extremely challenging for drivers to make turns on tight city streets. It must be done before the season so the trucks can be readily utilized when there is a snow-storm.

Preparation of plows happens when three inches (3") or more of snow is forecast. When inclement weather strikes, DPW uses extra vehicles and equipment from all its divisions such as parks, construction, forestry etc. DPW had 144 vehicles available for 2018-2019 winter season. Table 1 shows the number of vehicles by division and other areas of DPW.

TABLE 1

Total Number of Snow and Ice Control Vehicles and Equipment by Division for Winter 2018-2019						
Division	**Plows and Spreaders**			**Just Plows**		
	Dump Trucks	**Pick - Ups**	**Tractors**	**Pick-Ups**	**Tractors**	**Total # of Vehicles**
1st Division	11	4	0	1	0	16
2nd Division	12	6	0	1	1	20
3rd Division	19	12	0	1	1	33
5th Division	17	9	0	2	1	29
6th Division	6	2	0	2	0	10
Northern	0	1	1	3	2	7
North East	1	0	1	2	1	5
Eastern	1	1	1	2	1	6
Southern	0	0	0	1	1	2
Western	0	1	1	0	0	2
Schenley	0	0	2	1	0	3
Construction	3	1	0	0	0	4
Forestry	1	0	0	2	0	3
Environmental Services	0	0	0	4	0	4
TOTALS	**71**	**37**	**6**	**22**	**8**	**144**

Source: Department of Public Works

DPW had 71 dump trucks, 37 pick-up trucks, and six (6) tractors with both plows and spreaders in 2018 to 2019. Twenty-two (22) pick-ups trucks and eight (8) tractors had plows only.

The Street Maintenance divisions that had the most snow control vehicles were the following: 3rd division (33), 5th division (29), 2nd division (20), 1st division (16), and the 6th Division (10).

DPW Snow and Ice Control Vehicle and Equipment Comparison

Having enough vehicles, equipment, and staff is vital for a city's snow and ice control program. If more of these resources are available, more streets should get treated and/or plowed at a faster rate of time. The auditors wanted to see if more snow control vehicles and equipment were allocated to DPW since the DPW Street Maintenance Program Performance audit released in 2009. The 2018 to 2019 inventory list was compared to the unpublished 4-18-08 DPW equipment inventory list found in the old 2009 DPW Street Maintenance Program audit file.

The auditors only included dump trucks and pickup trucks for the analysis that had a plow, spreader, or both attachments. Tractors were not compared because the auditors did not know which of the 31 tractors listed on the 2008 inventory list were used for snow and ice control.

TABLE 2

Comparison of the Number of DPW Snow and Ice Control Dump and Pick-Up Trucks between 2018 and 2008			
Attachment	**Type of DPW Vehicle**	**# of Vehicles in 2018**	**# of Vehicles in 2008**
Plows and Spreaders	20 ton dump trucks	2	0
	10 ton dump trucks	17	24
	8 ton dump trucks	15	11
	6 ton dump trucks	0	5
	5 ton dump trucks	11	11
	4 ton dump trucks	0	3
	1 ton dump trucks	26	15
	Pickup trucks	37	19
TOTALS		**108**	**88**
Plows Only	1 ton dump trucks	0	1
	Pickup trucks	22	22
Spreaders Only	10 ton dump trucks	0	1
TOTALS		**130**	**112**

Source: Department of Public Works

Finding: The total number of DPW dump and pick-up trucks available for snow and ice control increased from 112 to 130 (16.07%) from the years 2008 to 2018.

Finding: The total number of DPW dump and pick-up trucks with both plow and salt capabilities increased from 88 to 108 (22.72%) from the years 2008 to 2018.

Age of Fleet

While visiting the five (5) Street Maintenance divisions, the auditors received numerous complaints from DPW crew members about their snow control vehicles. A common complaint was how old the fleet was and the amount of mechanical breakdowns the dump and pick-up trucks had on a yearly basis. After a breakdown, many of the vehicles become "out of service." This was a concern among crew members because when a couple snow control vehicles are "out of service" during the winter season, the job becomes much harder. When there are not enough vehicles on hand, streets do not get plowed or treated in a timely fashion.

In order to determine the age of the current fleet, the auditors requested a fleet inventory list for all snow control vehicles from the Office of Management and Budget's (OMB) Fleet Services Manager. This list included the vehicle's 3 digit DPW identification number, make, model, and year manufactured. The vehicle spec list requested from the Director of Public Works in February 2019, did not have the information needed to calculate the age of the fleet.

The fleet inventory list from OMB included all DPW dump or pick-up trucks for the five (5) street divisions, parks, forestry, and construction divisions. Tractors were not included in the inventory list and thus were eliminated from the analysis.

The fleet inventory list from OMB had a total of 128 vehicles. Seventy-three (73) were dump trucks and 55 were pick-up trucks. These numbers conflicted with the February 2019 fleet inventory list. The original list had 130 vehicles. Seventy-one (71) were dump trucks and 59 were pick-up trucks. (The 14 tractors were not included in this analysis). A possible explanation is that some vehicles may have been added or decommissioned during the course of 2019. Also the current list does not seem to show the four (4) Bureau of Environmental Services pick-up trucks. The Fleet Services Manager was not entirely sure if his list was accurate.

Table 3 lists the DPW fleet age as of September 2019.

TABLE 3

2019 Department of Public Works Snow and Ice Control Vehicles Age of Fleet							
YEAR	**Dump Trucks**	**(%)**	**(c%)**		**Pick-up Trucks**	**(%)**	**(c%)**
2019	9	12.33%	12.33%		0	0.00%	0.00%
2018	2	2.74%	15.07%		1	1.82%	1.82%
2017	0	0.00%	15.07%		0	0.00%	1.82%
2016	5	6.85%	21.92%		4	7.27%	9.09%
2015	**6**	**8.22%**	**30.14%**	**5 Years Old**	4	7.27%	**16.36%**
2014	2	2.74%	32.88%		3	5.45%	21.82%
2013	5	6.85%	39.73%		6	10.91%	32.73%
2012	0	0.00%	39.73%		15	27.27%	60.00%
2011	6	8.22%	47.95%		0	0.00%	60.00%
2010	0	0.00%	**47.95%**	**10 Years Old**	**0**	**0.00%**	**60.00%**
2009	0	0.00%	47.95%		7	12.73%	72.73%
2008	8	10.96%	58.90%		15	27.27%	100.00%
2007	5	6.85%	65.75%		0	0.00%	100.00%
2006	12	16.44%	82.19%		0	0.00%	100.00%
2005	7	9.59%	91.78%	**15 Years Old**	0	0.00%	100.00%
2004	0	0.00%	91.78%		0	0.00%	100.00%
2003	0	0.00%	91.78%		0	0.00%	100.00%
2002	2	2.74%	94.52%		0	0.00%	100.00%
2001	4	5.48%	100.00%	**18 Years Old**	0	0.00%	100.00%
TOTAL	**73**	100.00%			**55**	100.00%	

Source: Office of Management and Budget

Finding: Almost half (47.95%) of the street division dump trucks are less than or equal to ten (10) years old.

Finding: There were a total of 11 (15.07%) street division dump trucks purchased within the last two (2) years. However 13 (17.81%) street division dump trucks are between 15 and 18 years old.

Finding: All pick-up trucks are less than or equal to 12 years old. 60% of the pick-up trucks are less than or equal to eight (8) years old.

Vehicle Concerns

The auditors conducted on site interviews of DPW laborers and truck drivers. One problem that was pointed out, was the need for inter departmental/contractor communication. This has to do with the scheduling of snow control vehicles for inspection in January and February.

The winter months when the City gets the most snow are January, February and March. Vehicles needed for snow control cannot be utilized if they are in the garage for servicing and inspection. The lack of vehicles delays the treating of streets in a timely fashion. Trained snow control drivers do not have trucks to operate and instead become passengers for other snow control operators.

RECOMMENDATION NO. 1

DPW administration needs to work with the City's contractor for fleet repair and maintenance in order to coordinate an inspection plan that allows dump trucks to be available for snow season. OMB should amend the fleet repair and maintenance contract to allow for earlier inspections of dump trucks if necessary.

Department of Public Works Deicing Material (Salt) Storage

Storage Locations

Since 2009, DPW has added additional salt depots to make loading salt easier during inclement weather. Some of these new locations include parks, salt sheds, and the closed city asphalt plant. There is an additional reserve salt location in Blawnox that is used by both the City and Allegheny County.

The Director of Public Works explained that there has not yet been funding in the capital budget to permanently cover all salt piles. A list of salt locations can be found in Table 4 and a

map of these locations can be found in Figure 4. Not included in this list is the former 4th Division, which previously had a storage capacity of 1,200 tons.

TABLE 4

Department of Public Works Rock Salt Locations in 2019		
	Capacity in tons	**Containment**
1st Division	5,000	Dome
2nd Division	5,000	Dome
3rd Division	1,500	Clear Span
5th Division Main Station	5,000	Dome
5th Division Sub Station	5,000	Dome
6th Division	900	Clear Span
Asphalt Plant	700	Shed
Moore Park	800	Open
South Side Park	700	Open
Blawnox (shared with Allegheny County)	2,500 (city) 2,500 (county)	Dome
TOTAL	**27,100**	

Source: Department of Public Works

Clear Span is a company that makes heavy duty fabric buildings that can be used for a variety of needs. One side of the building is left open, in whole or in part, with no structural supports or barrier. The rest of the building is covered by a heavy duty fabric fastened around steel. According to DPW these structures protect the salt at minimal cost because these buildings are light weight, sturdy and easy to install.

Table 4 lists the 10 locations where salt is stored and shows that 50% of the city's salt storage facilities are 10% of the salt is stored in a Shed; 20% is Clear Span and 20% is Open to the elements. Due to the difference in facility capacity, 83% of salt is stored under a dome, 8.9% is under Clear Span, 2.6% is stored in a shed, and 5.5% of salt is open to the elements.

Finding: A large percentage of salt, 94.5%, is in some type of covered storage facility.

In 2008, the controller's audit showed that DPW had a total of seven (7) salt storage facilities with two (2) not covered; the 3rd Division and the 6th Division. A recommendation was made in that audit, to provide cover for the salt storage facilities or eliminate them.

Finding: DPW administration followed the controller's 2008 audit recommendation and covered two (2) uncovered salt storage facilities.

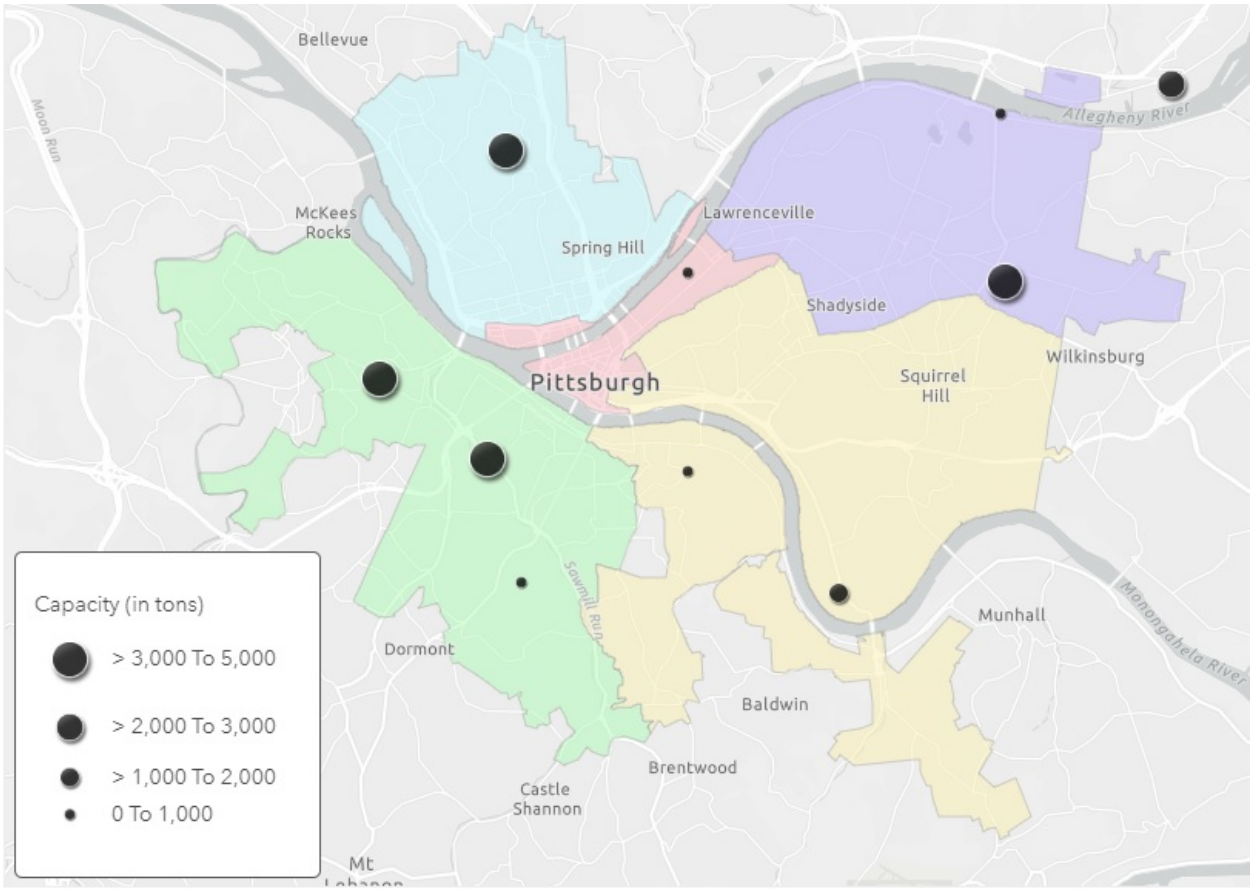
Since 2009, the 4th Division salt storage facility closed. By 2019 the DPW administration had increased the number of salt storage facilities to ten (10). The new locations are Moore Park,

South Side Park, the former Asphalt Plant site and the shared facility at Blawnox. The Moore Park and South Side Park locations are temporary until the 4th Division facility is rebuilt.

RECOMMENDATION NO. 2

The DPW administration should cover any newly constructed salt storage facility. This should be included with the plans to reconstruct the 4th Division. City administration and council should budget an increase in funds, if needed, to get this accomplished. The Clear Span buildings have provided an effective solution.

FIGURE 4
MAP OF 2019 SALT DOME AND PILE LOCATIONS



Source: DPW, Esri

Use of New Melting Materials

DPW treats all streets, bike lanes, trails and steps with rock salt (sodium chloride) and sometimes are treated with liquid calcium chloride. Sidewalks are treated with granular calcium chloride. DPW only treats sidewalks in city parks, at bridges, and city-owned facilities.

Beginning in the 2018-2019 snow season, DPW purchased a new formula of rock salt for the streets. This new formula is sodium chloride tinted blue and treated with Magnesium + an Organic Based Performance Enhancers (OBPE), which in this case was Corn Syrup. This new tinted blue formula allows the public to more easily see when the streets have been initially treated.

According to the Director of Public Works, the benefit of the new formula is that it can be used in much lower temperatures. The new formula has a melting point of -25 to -30 degrees Fahrenheit, where the former rock salt only melted at 15-20 degrees Fahrenheit. Another advantage of using the blue tinted rock salt is that it is a stronger formula so less of the product is needed to produce the same results as the former rock salt. In the long run, this will lower the amount of rock salt needed to be purchased each year and save the City money.

The Director of Public Works also stated that the divisions will not start using the new rock salt formula until the old rock salt reserves have been exhausted.

Tinted Blue Rock Salt Results

The auditors visited all the DPW divisions to interview employees. DPW truck drivers and laborers at all divisions told the auditors that they "have been really impressed with the new salt formula." The division members said that they liked the product because less product can be used to produce the same results.

The city workmen stated that the new salt formula is more effective on steep roads and old cobblestone streets because in the past these streets usually needed more treatment to melt snow and ice. Drivers also confirmed that the product was more effective in colder temperatures; that some of the wider roads that needed to be treated two (2) to three (3) times in the past, now only needed one (1) pass with the new deicing formula.

Vendors

The City purchased rock salt from American Rock Salt the last couple of years since they had the lowest qualified bid. The rock salt purchased for the snow season of 2016-2017 and 2017-2018 were from a PA COSTARS state contract that the City piggy-backed on. That

contract ran from 8/1/16 to 7/31/19. The average cost of rock salt for both snow seasons was $62.50 per ton.

The City entered into its own contract with American Rock Salt for purchasing the new blue tinted rock salt coated with magnesium+OBPE. This contract is currently in effect from 8/1/18-7/31/19 with a one (1) year option to renew. The purchase price in the contract is $85.50 per ton.

It should be noted that the City still purchases a small amount of rock salt (sodium chloride) through the PA COSTARS contract. This allows the City to keep a good ongoing relationship with PA COSTARS in case they have to buy additional rock salt if there is a shortage of the blue tinted salt.

Amount of Rock Salt Purchased

All rock salt purchased during the snow seasons of 2016-2017 and 2017-2018 were for the normal rock salt (sodium chloride) that the City always used. DPW purchased both regular rock salt and blue tinted rock salt during the snow season of 2018-2019. Regular rock salt was phased out that season.

The amount of rock salt purchased by each division for the 2016-2017, 2017-2018, and 2018-2019 snow seasons can be found in Tables 5, 6, and 7. Table 7 shows a combined purchase amount of both regular and blue tinted rock salt. The auditors did not receive a breakdown of both types of rock salt purchased by each division.

TABLE 5

Department of Public Works Rock Salt Deliveries for the Snow Season of 2016-2017		
	Capacity in Tons	**Total Cost**
1st Division	3,746.09	$234,130.61
2nd Division	4,937.65	$308,603.25
2nd Division Lock	796.85	$49,803.16
3rd Division	2,080.74	$130,046.30
3rd Division Sub Station	1,930.64	$120,665.03
4th Division	1,879.67	$117,479.33
5th Division Main Station	981.36	$61,335.06
5th Division Sub Station	7,382.88	$461,430.07
6th Division	1,191.82	$74,488.81
TOTALS	**24,927.70**	**$1,557,981.62**

Source: Department of Public Works

The City purchased 24,927.70 tons of regular rock salt for a total cost of $1,557,981.62 during the snow season of 2016-2017.

TABLE 6

Department of Public Works Rock Salt Deliveries for the Snow Season of 2017-2018		
	Capacity in Tons	**Total Cost**
1st Division	9,759.54	$609,971.30
2nd Division	10,786.00	$674,125.11
2nd Division Lock	599.71	$374,481.88
3rd Division	4,777.58	$298,598.71
3rd Division Sub Station	4,921.51	$307,594.44
Moore Park	808.94	$50,558.76
4th Division	592.69	$37,043.12
5th Division Main Station	1,990.78	$124,423.74
5th Division Sub Station	13,671.52	$854,468.18
6th Division	3,210.02	$200,626.24
TOTALS	**51,118.29**	**$3,194,891.48**

Source: Department of Public Works

During the winter of 2017-2018 the City purchased 51,118.29 tons of regular rock salt for a total cost of $3,194,891.48.

TABLE 7

Department of Public Works Rock Salt Deliveries for the Snow Season of 2018-2019		
	Capacity in Tons	**Total Cost**
1st Division	3,206.26	$244,230.06
2nd Division	4,476.54	$353,006.95
2nd Division Lock	1,708.34	$146,063.12
3rd Division Sub Station	7,033.01	$598,757.40
5th Division Sub Station	11,045.27	$944,369.73
6th Division	2,572.26	$219,928.20
TOTALS	**30,011.68**	**$2,506,355.46**

Source: Department of Public Works

Of the three (3) snow seasons examined, the 2017-2018 season had the most snow. The City purchased 30,011.68 tons of rock salt for a total cost of $2,506,355.46 during the snow season of 2018-2019.

The blue tinted rock salt accounted for 27,010.05 tons and the regular rock salt accounted for 3,001.63 tons out of the 30,011.68 tons of rock salt DPW purchased during that season.

The total amount of money the City spent on each type of rock salt for the 2018-2019 winter season is listed below:

Blue Tinted Rock Salt	27,010.05 tons x 85.50 =	$2,309,359.28
Regular Rock Salt	3,001.63 tons x 65.63 =	$196,996.18
		$2,506,355.46

Estimated Salt Used by the City

The DPW Manager of Personnel and Finance keeps track of the estimated amounts of salt available at each DPW division at the beginning and end of each snow season. The auditors calculated the amount of salt used for three (3) different snow seasons by looking at the difference in the estimated salt amounts available at the beginning and the end of each season. Not included in the calculations were the 2,500 tons of salt on reserve at the Blawnox facility that is shared with the county.

TABLE 8

The Estimated Amount of Salt Used by the City for 3 Snow Seasons

Snow Season	Total Snow Accumulation for Season	Estimated Tons of Salt on Hand to Start Season	Tons of Salt Bought During the Year	Estimated Tons of Salt on Hand to End Season	Estimated Amount of Salt used	% Increase or Decrease the Following Year
2016-2017	32.0"	20,000	24,927.7	17,500	27,427.7	N/A
2017-2018	59.8"	17,500	51,118.29	14,000	54,618.29	+99.13%
2018-2019	36.6"	14,000	30,011.68	9,550	34,461.68	-36.90%

Source: Department of Public Works

During the past three (3) snow seasons, it was estimated that DPW used the most rock salt during the 2017-2018 snow season. This was also the year the City had the most snow accumulation (59.8 inches of snow).

That year it was estimated that DPW used 54,618.29 tons of rock salt. This was 27,190.58 (99.13%) more tons of rock salt than what was used during the 2016-2017 snow season and 20,156.61 (58.49%) more tons that what was used during 2018-2019 snow season.

The table shows there is a direct correlation between the snow fall amount and the amount of salt purchased and used by DPW during a snow season. In other words the more it snows the more salt is used.

The amount of estimated tinted salt left at the end of the 2019-2020 winter season will be a good indication whether the new blue tinted salt coated with magnesium+OBPE was effective in snow control.

RECOMMENDATION NO. 3

After a snow season when only the new salt formula is used, the DPW administration should conduct a comparison analysis of the amount and cost of the new salt formula to previous years when only regular rock salt was used. This analysis should solidify the premise that the new formula saves the City money.

Snow Plow Tracker and Vehicle Upgrades

The City receives an abundance of calls each winter season from residents who are concerned as to when their street will get plowed and treated. To deal with this situation, the current administration decided to develop a snow plow tracker on the city website that can be viewed by the public.

Snow Plow Tracker and GPS System Contract with Allied Communications

All work on the snow plow tracker was originally done through an Allegheny County contract with Allied Communications from 9/1/2012-6/30/18 and a professional service contract from 7/01/18- 12/31/19. TeMeDa was the subcontractor in the contract who developed the snow plow tracker with collaboration from Department of Innovation and Performance (I&P). The contract also called for TeMeDa to install GPS sensors in DPW vehicles. The GPS sensors are small devices in the vehicle used by DPW to track a vehicle's location, travel, speed, and engine/idle times. The GPS sensors would be used to feed information into the snow plow tracker map to tell the location of the vehicle. Originally the GPS sensors were used for DPW internal tracking but were expanded to be used for the snow plow tracker and online viewing of the public during a snow storm.

Over 300 DPW vehicles currently have GPS sensors except vehicles in the Department of Environmental Services. Each vehicle had a $22.95 per month air time cost fee from 2015-2017 and a $21.95 air time cost fee from 2018 to present. This monthly fee is paid to Allied Communications and will be discussed later in this audit.

In January 2015, the City of Pittsburgh launched a pilot version of the Snow Plow Tracker Website. The website gave city residents a live view as to where all city snow plow vehicles are located on their route while treating roads during a snow storm.

The website also shows the travel history of the vehicle. The location of the vehicle on the website is represented by a vehicle icon on the screen and the vehicle travel history is shown by highlighting roads on the map. If you click on the highlighted road, the snow plow tracker would show when the vehicle was last there. The tracker becomes deactivated on the website when a storm level is zero (0). Residents can also download the snow plow application on their cellphone.

The first snow plow tracker and GPS system developed by TeMeDa was used during the snow seasons of 2016-2017 and 2017-2018.

Limitations of the System

While the public snowplow tracker provided residents with a previously unavailable history as to when a City vehicle had driven down their road, there were certain limitations to this initial system.

For instance, users could not see on the tracker if a truck was currently treating their road with salt or if the truck had its snowplow up or down. This caused confusion as sometimes a route would have a record of a truck passing, but the truck may have been out of salt and therefore did not treat that road. Furthermore, if a truck had returned to its division and had not been idle for a certain period of time, it would be still visible as not moving on the tracker. Finally, private, state, and county roads were not differentiated on the previous tracker, even though the City may not have an agreement or obligation to treat those roads.

The original snow plow tracking system was capable of producing reports of vehicle use, though it did not have the easy capability of seeing what roads may have been missed during a snow event. In the case of accidents, it was possible to run a report tracking what vehicles may have passed through a certain area during a certain point of time to determine if a City vehicle may have caused damage to private property.

Cost of Snow Plow Tracker and GPS Sensors Contract with Allied Communications

The auditors were unable to find the total cost of the contract with Allied Communications. The auditors used the City's Onbase and JDE software system to research for any Allied Communication invoices related to the development of the snow plow tracker or the installation costs of GPS sensors. No invoices were found. The software systems only had invoices the City pays relating to the vehicle GPS air time fees.

The City pays Allied Communication a monthly vehicle GPS sensor air time invoice each month. The invoices vary depending on the amount of vehicles in service that month. For

example, if the department runs 280 vehicles in December, 280 x $21.95 fee= $6,146. That is what the city would be billed for the month. This can become very costly over the course of the year. The auditors found 42 DPW vehicle air time invoices to Allied Communications from 2/11/16 to 7/23/19 for a total cost of $275,632.52.

Current Snow Plow Tracker and GPS System Developed by Quetica

The City did not renew their contract with Allied Communications. Instead the City entered into a contract with Quetica in beginning of the 2018-2019 snow season with goals of cutting back on road salt and making snow control more efficient. According to the scope of the contract, Quetica was to install GPS routing and spreader controls systems in all DPW snow control vehicles. Quetica was also to take over TeMeDa job duties of assisting I&P in running the snow plow tracker.

Work to complete the contract was done by various subcontractors. Skyhawk Telematics developed the snow plow tracker program called ConnectAnywhere. The route optimization and the interface for the routing tablets inside of the vehicles was developed by the subcontractor Magellan. A&H Equipment Company was responsible for the installation of the new technology into DPW vehicles. Installation of the new system began in November 2018 and has continued through October of 2019.

Unlike the previous system, the new system developed by Quetica can provide much more detailed information about the plowing and salt spreading of trucks during snow events, as well as providing precise routing information in the vehicle. In addition to providing vehicle location on the public snowplow tracker, this agreement included new controls for salt spreader distribution as well as route optimization with route direction to be provided in-vehicle for plow and truck drivers.

The contract is for three (3) years dated 3/18/2019 with an option of two (2) one-year renewals. The total cost of the contract was not to exceed $1,731,832.00. As of January 2020, the total amount paid for the work done on the contract was $1,400,581.40.

Vehicle Spreader Control System

Salt spreaders were installed in every DPW snow control vehicle. The new salt spreading system allows for a more standard application across the vehicle fleet. While previously some vehicles had manual controls for salting levels, all vehicles are now retrofitted to have the same control system. A control for liquid treatment has also been installed to future-proof the vehicles, although DPW does not use liquid treatment at this time.

Based on best practices used by other cities, the dial control for the salt spreaders are calibrated at 50 pounds per mile increments, with a maximum of 400 pounds per mile. Furthermore, the salt spreader is connected to the GPS and speed of the vehicle to distribute an even amount of salt per mile.

For example, if a vehicle slows down, the spreader will release less salt, but when speed increases, more salt will be released to ensure an even coating on each mile. The system will provide recommendations to drivers for what level of salt to spread. It is the responsibility of the truck driver to change the salt spreading controls. There are no remote or central controls to increase or decrease the amount of salt a vehicle is distributing. Eventually, the new system will provide audits of salt use by each driver. The practice of checking salt use by the drivers began by the 2018-2019 snow season. This helps to determine if some drivers are over or undertreating certain routes.

GPS Routing System

Each DPW snow control vehicle has a tablet with a GPS routing system developed by the subcontractor Magellan. The new system has the capacity to provide turn-by-turn directions for drivers. These directions are based on the optimization of routes by Quetica. In addition to providing the best route to treat the streets for which the City is responsible, the optimizations will also consider vehicle size as well as slope information.

On each driver's tablet screen, the route will change colors based on action. If the route is green, the vehicle should spread salt. If the route is in blue, the driver should follow the route but turn off their salt spreader. If the route is red, the driver is off their assigned route. While drivers will operate within their assigned DPW division, some routes may blur the line between divisions if the system provides a more efficient distribution of routes.

For the 2018-2019 snow season, the internal GPS did not provide optimized route directions to vehicles. In the meantime, the former paper map routes were digitized as a baseline for the creation of the new routes. The original paper routes were also used due to the drivers' familiarity during the transition period. In July 2019, several rounds of testing were conducted to identify issues with the digitized routes. Feedback forms, from the truck drivers, were to be completed and sent to I&P, where the request status was tracked after the issues were reported to Magellan.

The use of the optimized snow routes was set to begin during the 2019-2020 snow season. According to the administration, once the new routes are used, they will be analyzed to determine what improvement can be made.

Snow Plow Tracker Updates

Skyhawk Telematics, a subcontractor in the Quetica contract, created the interface for the public snow plow tracker through their program ConnectAnywhere. Now residents will be able to see if a vehicle is currently plowing or spreading salt, in addition to seeing vehicle location. Additionally, roads that are not the responsibility of the City will be marked in a different color.

DPW Snow and Ice Control Vehicle Installation Updates

Not all DPW snow control vehicles received the GPS upgrades and salt spreader controls installation during the snow season 2018-2019. This caused the snow plow tracker to show some of the treated roads as not complete

Finding: Some DPW snow control vehicles did not have the GPS upgrades and salt spreader controls installation upgrades during the 2018-2019 winter season.

DPW's goal is to have GPS routing system and salt spreader controls installed on all snow control vehicles with plow and spreader capabilities within all DPW divisions for the upcoming 2019-2020 snow season.

According to the Director of Public Works, only seven (7) out of 98 (7.1%) snow control vehicles at the five (5) DPW divisions still need GPS routing system and salt spreader controls as of August 7th 2019. Three (3) of the vehicles were in the shop for GPS routing system installation, three (3) were in route to the shop for GPS installation, and one (1) vehicle was down for long term repair.

Finding: As of August 2019, the GPS routing system and salt spreader controls were installed in 97% of snow control vehicles at the five (5) DPW divisions.

Finding: All snow control vehicles will have GPS routing systems, salt spreader controls, and will be featured on the snow plow tracker for the 2019-2020 winter season.

DPW Driver and Laborer Training

As of October 1st 2019, all DPW drivers and laborers have not been trained on the GPS and spreader control system yet. I&P's Project Manager has been actively scheduling small group training sessions with drivers and laborers within all five (5) divisions throughout the course of the year. Training involves learning all the controls and running test routes to get familiar with the new GPS directions. The division supervisors seemed confident all drivers and laborers would be trained before the 2019-2020 winter season.

RECOMMENDATION NO. 4

DPW administration should have all drivers and laborers trained on using the spreader control system before the next snow season starts.

Division Staff GPS and Spreader Control System Feedback

The auditors wanted to find out if the DPW Street Division staff felt the GPS route and spreaders controls vehicle upgrades made controlling snow and ice easier and more efficient than the old manual control system.

All five (5) DPW Street Divisions were visited and various supervisors, foreman, drivers, and labors were interviewed by the auditors regarding the new system during the fall of 2019. During this period, drivers were still testing the routes. The testing conducted during this period helped to provide feedback that was used to create the routing that was developed to treat streets during a winter weather event.

The auditors received both positive and negative feedback from truck drivers and laborers who received training and who were able to use the equipment in the 2018-2019 snow season. Listed in Table 9 and 10 are a list of comments and complaints made by the DPW staff about the GPS, Routing, and Salt Spreader improvements as told to the auditors.

TABLE 9

Positive and Negative DPW Staff Comments GPS and Routing System		
	Positives	**Negatives**
GPS and Routing System	• Many drivers felt that the system could be effective once the issues were resolved. • Several drivers said that is easier to read that screen at night time rather than trying to read the paper routes while using the globe light. • One foreman said he saw the new system as the upgraded version of the previous technology. • If a driver is unable to finish their route, the remainder of that route can be sent to another truck. • When following the GPS route, it is easier to see what streets may have been missed. • GPS routes help new drivers that are unfamiliar with City streets.	• Most drivers were wary of implementing new system. • Several drivers said that they felt the system would eventually be effective, but that during the coming snow season it would take longer to treat all routes. • System does not acknowledge a street has been treated if it is not part of that driver's assigned route. For instance, drivers are occasionally called to treat the street around an accident. Because it did not follow the set route, the street would not be marked as completed in the system, resulting in another driver spreading salt even though the street was already treated. • If a truck must return to pick up more salt, the truck must return to its exact last spot from the GPS routing. Any streets that may be treated in between picking up salt and the designated GPS point will not be marked as treated in the system. • There is no flexibility to treat streets that previously would be given priority in certain situations (such as schools in the morning or steep hills). • Some routes required drivers to plow hills in a way that could be dangerous during a snowstorm. • Although some routes have been tested multiple times and feedback has been provided, certain obstacles remain, such as dead-end roads or unpaved streets. • Tunnels and tall buildings have caused temporary loss of GPS signal.

TABLE 10

Positive and Negative DPW Staff Comments About Salt Spreaders		
	Positives	**Negatives**
Salt Spreader	• Salt augers are already installed into the trucks, which will result in less time to be prepared for snow season. • Issues spreading salt while going backwards have been resolved at some divisions	• Some trucks experienced calibration issues during last snow season, though these are being addressed. • The spreader is often delayed after stopping, resulting in partially treated intersections. • For wider roads, the spreader is not able to always spread the width of the road while going a slower speed. • Some drivers felt the blast period was still not long enough to go up certain hills.

Drivers at the divisions stressed driver vehicle safety as very important to them in the snow and ice control program. Staff members at the 1st, 3rd, and 5th divisions felt that some of the new routes installed of the GPS system did not provide safety for them during routing test runs. These three (3) divisions cover neighborhoods that have a lot of steep or narrow streets such as Southside Slopes, Carrick and Northside. Drivers said some steep streets can only be treated by going up the hill or sometimes in reverse up a hill. The routes installed in the GPS system has the drivers going down these hills which they said is too dangerous. The dump or pick-up truck will slide down the hill, jeopardizing the driver's safety, and could cause property damage to houses or parked cars.

They felt the system was designed for cities that were flat and had streets that were more in line with a grid system. Furthermore, some staff mentioned the fear that if they did not follow the routes exactly during the first season to account for changes that may need to be made during a snow event, they may be punished for not following the new system. One foreman stressed the importance of encouraging positivity while implementing and training for a new system, particularly among the leadership within each division.

RECOMMENDATION NO. 5

The DPW administration should have drivers document all safety hazards while testing their routes and submit their suggestions to their supervisor who will then submit the suggestion to the Department of Innovation and Performance's Project Manager.

RECOMMENDATION NO. 6

The DPW administration should have Quetica collaborate with the City's Department of I&P to examine all GPS routes that DPW drivers considered safety hazards and make changes if deemed necessary.

RECOMMENDATION NO. 7

The DPW administration should ensure drivers that their jobs are not in danger while the issues with the new system are being addressed, particularly during the first snow season in use. Leadership at each division should address drivers' concerns but be aware of negativity internally that may prolong the adoption of new technology.

Some drivers said their new GPS routes were one (1) or two (2) hours longer than the routing system used during previous winters. They felt the longer run times would increase the number of complaints to the city's 311 call center.

RECOMMENDATION NO. 8

The DPW administration should evaluate the routes that take longer than usual during the upcoming snow season and reroute if necessary.

Snow Plow Tracker Records

The auditors requested records of the three (3) largest snow events for the three (3) snow seasons included in the scope of this audit. Over the course of six (6) months, I&P staff attempted to get these records from the TeMeDa and Skyhawk Telematics but they were never sent. The auditors were therefore unable to examine the actual coverage of City vehicles during a snow event using vehicle location data.

RECOMMENDATION NO. 9

In future contracts, the City administration and DPW administration should ensure that they have continued access to snow plow tracker data to allow for future analysis of route coverage and efficiency.

311 Requests for Snow Routes and Snow Control

During all three (3) snow seasons, Division 3 had the most 311 requests. A large portion of Division 4, which contains many hilly neighborhoods that had the highest number of 311

requests both during this audit and the previous audit, are located in this division. A list of 311 calls per division can be found in Table 11 below.

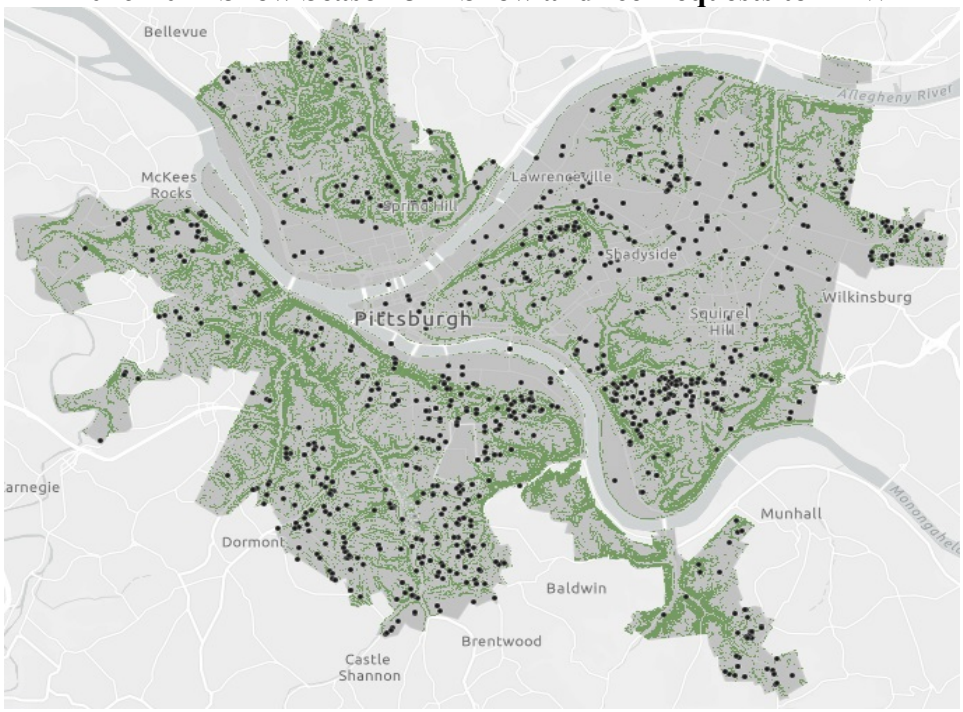
TABLE 11

311 Calls for Snow and Ice Control			
Division	**2016-2017 Snow Season Requests**	**2017-2018 Snow Season Requests**	**2018-2019 Snow Season Requests**
1	126	524	468
2	195	709	571
3	562	2,260	1,304
5	267	1,876	1,043
6	14	68	37
No Location	35	61	12
TOTAL	**1,199**	**5,500**	**3,436**

Source: Western Pennsylvania Regional Data Center

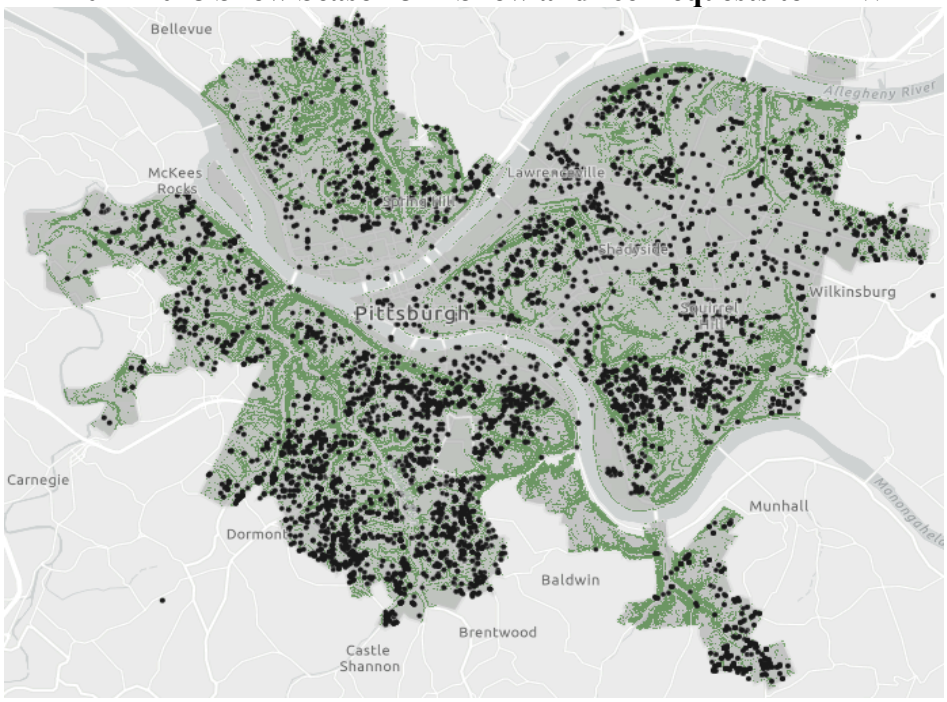
Figures 5, 6, and 7 show locations of 311 calls for snow and ice control. Areas shaded in green indicate a 25% or greater slope. As seen on the maps, areas without steep slope generally tend to have fewer nearby 311 requests for snow and ice compared to the more hilly areas of the City. This is particularly visible in the hilltop neighborhoods to the south.

FIGURE 5
2016-2017 Snow Season 311 Snow and Ice Requests to DPW



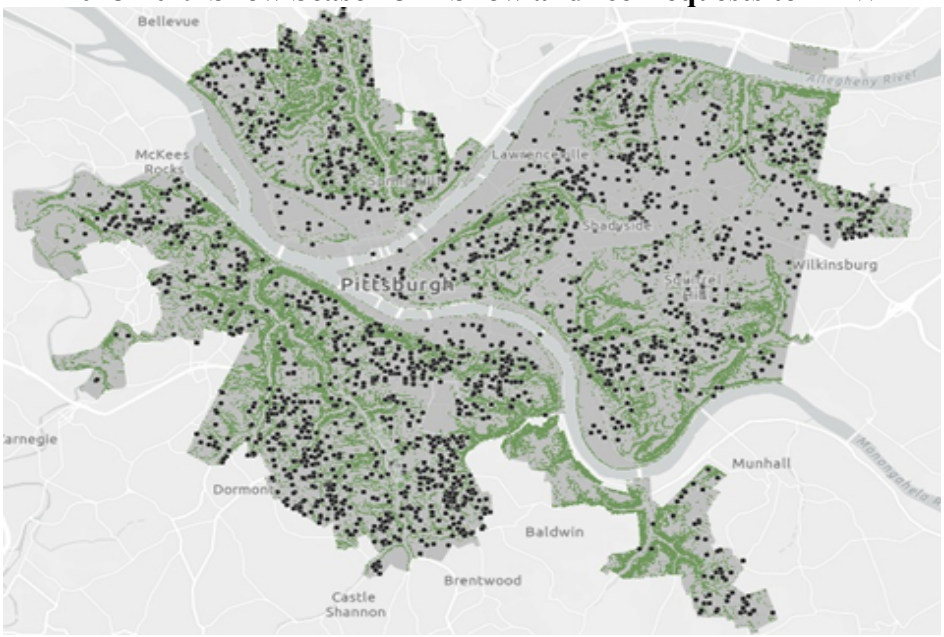
Source: Western PA Regional Data Center, Esri

FIGURE 6
2017-2018 Snow Season 311 Snow and Ice Requests to DPW



Source: Western PA Regional Data Center, Esri

FIGURE 7
2018-2019 Snow Season 311 Snow and Ice Requests to DPW



Source: Western PA Regional Data Center, Esri

The top ten neighborhoods for 311 snow and ice requests for DPW for the 2016-2017, 2017-2018, and 2018-2019 snow seasons were as follows:

- 2016-2017: Carrick (85), Greenfield (85), Brookline (77), South Side Slopes (76), Squirrel Hill South (56), Hazelwood (34), Lincoln Place (33), Overbrook (32), Beechview (28), and Stanton Heights (26)

- 2017-2018: Brookline (525), Carrick (458), Greenfield (278), Beechview (268), South Side Slopes (214), Squirrel Hill South (199), Lincoln Place (194), Hazelwood (175), Mount Washington (174), and Overbrook (159)

- 2018-2019: Carrick (342), Brookline (239), Beechview (158), Squirrel Hill South (129), Stanton Heights (128), South Side Slopes (122), Greenfield (106), Mount Washington (104), Overbrook (88), and Lincoln-Lemington-Belmar (87).

Carrick, Brookline, Beechview, Squirrel Hill South, South Side Slopes, and Overbrook were in the top 10 for snow and ice 311 requests during all three snow seasons in this audit.

During the 2017-2018 snow season, 311 requests for snow and ice control were much greater than the other two (2) years of the audit. A likely explanation for this increase is the harsher weather experience during this snow season. Total accumulation and largest single accumulation were both greatest during the 2017-2018 snow season, with nearly twice as much total snowfall during this season as the other two snow seasons in this audit (Table 12, below).

TABLE 12

Snowfall Information for Pittsburgh			
	2016-2017 Snow Season	2017-2018 Snow Season	2018-2019 Snow Season
Total snowfall	32.0”	59.8”	36.6”
First snowfall	November 19	December 16	November 15
Last snowfall	March 17	April 19	March 22
Most snow on one day	3.8”	8.7”	4.2”
Day of accumulation	29	47	33

Source: DPW and the National Weather Service

Pothole Maintenance

Potholes are a major problem come early spring in Pittsburgh. Potholes are caused by the winter’s freeze-thaw cycles, the age of the surface, poor drainage, and high traffic volume. During the winter when it rains or snows, water seeps into cracks and lays on the ground underneath the pavement. The pavement surface cracks, creating a pothole.

Leaving potholes unattended is a safety hazard. Potholes cause car accidents and costly vehicle repairs. It is the duty of the DPW Streets Maintenance Division to repair all potholes throughout the City as soon as possible.

DPW Pothole Repair Program

Pothole patching is done year round and is performed by the Streets Maintenance Divisions. Each of the area divisions are responsible for handling all the pothole patching in their designated area as shown in Figure 1 on page 2.

The majority of pothole patching is driven by complaints that residents request through the City's 311 center. This is discussed later in the audit. Other times supervisors/foreman will identify potholes that need filled while driving around their respective division.

DPW crews will also perform "pothole blitzes" during weekends with sunny weather and no rain in the forecast. During a pothole blitz, crews will work extended hours and weekends. According to the press release history on the City website, DPW crews worked 12 hour shifts on Thursday on January 25th 2018 through Saturday January 27th 2018 filling 300 potholes. The auditors requested the number of pothole blitzes during their audit scope period but did not receive any information from DPW.

Pothole Maintenance Process

Each Division sends out one (1) or two (2) crews at a time to patch potholes. Crews are maned with three (3) or four (4) laborers who do the patching work or flag the worksite for safe car passage and a truck driver. The pothole maintenance schedule is done in the most efficient manner with respect to travel from the place they are dispatched from.

Once potholes are identified, the laborers will either sweep or blow out all water, loose rocks, and debris from the hole. Then cold patch or hot patch (depending on season) is shoveled into the hole. Lastly, the patching material is smoothed over with a handheld/mechanical tamper or a small roller.

Cold Patch vs Hot Patch

DPW crews use two (2) different types of patching materials depending on what season it is. Cold patch used from December through February and hot patch is used March through November. Hot patch is stronger/more durable product but is unavailable during the winter months because asphalt plants are closed.

It is not cost effective for asphalt plants to be open during the winter months because hot patch asphalt needs to manufactured at temperatures between 270°F and 325°F and there is low demand for the product. The air and ground temperatures need to be above freezing for the hot mix to cure properly. This is usually when the pavement temperature or surface temperature is at about 40 degrees.

DPW uses cold patch as a band aid to patch poles until the asphalt plants open. Quite a few pot holes that are filled with cold patch need to be cleaned out and refilled with hot patch later in the year.

All cold patch is stored at the DPW divisions while hot patch is picked up right from an asphalt plant on the day the job is being done.

Other Patching Products

In 2017 and 2018, DPW also started using a product called Aquaphalt to fill in potholes. Aquaphalt is an effective product that can be used when it is raining. Aquaphalt mix is shoveled into the pothole, tampered, and the binder hardens when water is applied or it can just be placed into a pothole filled with water because water activates the product. DPW used this product to fill potholes in 2017-2018 because of the substantial amount of rain the City received. According to the Director of Public Works, this product is as effective as hot patch.

Contracts, Costs, and Vendors

The City purchases bituminous hot patch paving materials from Lindy Paving Inc. which is manufactured at two (2) locations: 2nd Ave and Neville Island. The current contract with Lindy Paving Inc. expires on 3/31/20. The City has been extending the contract with Lindy Paving Inc. since the last DPW Streets Maintenance performance audit released in January 2009.

Premix bituminous cold patch materials is purchased from two (2) vendors: Hei-Way LLC and Russell Standard. The Hei-Way LLC contract is piggybacked on a state contract that started on 9/1/14 and has been renewed twice. The last contract listed in City's On Base database shows the contract expired 8/31/18. The current contract with Russell Standard runs from 1/1/18 to 12/31/20. Aquaphalt is purchased from Sealmaster under a p-card purchase as needed. The following table shows the amount the City spent on hot patch, cold patch, and Aquaphalt from 2016-2018.

TABLE 13

The Total Amount Spent on Pothole Patching Mixes for the Years 2016-2018				
Pot Hole Patching Mix	**2016**	**2017**	**2018**	**TOTAL $ AMOUNT**
Hot Patch	$226,686.40	$245,815.98	$261,815.43	$734,317.81
Cold Patch	$35,409.83	$54,990.15	$63,200.73	$153,600.71
Aquaphalt	$0	$2,664.00	$5,154.80	$7,818.80
TOTAL $ AMOUNT	$262,096.23	$303,470.13	$330,170.96	**$895,737.32**

Source: Department of Public Works

The City spent $895,737.32 on pot hole patching mixes from 2016-2018. The majority of the spending (81.98%) went towards the purchase of hot patch mix. The City spends more money on hot patch than either cold patch or Aquaphalt.

The City's overall spending on pothole patching mixes increased 15.78% ($41,373.90) from 2016-2107 and 8.80% ($26,700.83) from 2017-2018. There was a larger increase in spending from 2016-2017 than 2017-2018 because cold patch spending increased 55.30% ($19,580.32).

311 Requests for Potholes

Resident can submit a request to 311 to fill potholes. These requests are then passed onto DPW. Occasionally DPW can then forward that request to DOMI if they find that it is not feasible to patch the road and that it needs to instead be completely resurfaced. The total of 311 pothole requests for each division during 2016, 2017, and 2018 can be found in Table 14 below. There were far more 311 pothole requests in 2018 than in 2016 and 2017 (15,647 in 2018 compared to 6,016 and 7,779 in 2016 and 2017).

TABLE 14

311 Requests for Pothole Patching 2016-2018			
Division	**2016 Requests**	**2017 Requests**	**2018 Requests**
1	502	704	1,359
2	1,996	2,593	4,299
3	1,684	2,359	6,252
4	1	1	2
5	1,633	1,834	3,082
6	195	287	650
No Division	5	1	3
TOTAL	**6,016**	**7,779**	**15,647**

Source: Department of Public Works

The top ten neighborhoods for 311 pothole requests for DPW for the years 2016, 2017, and 2018 were as follows:

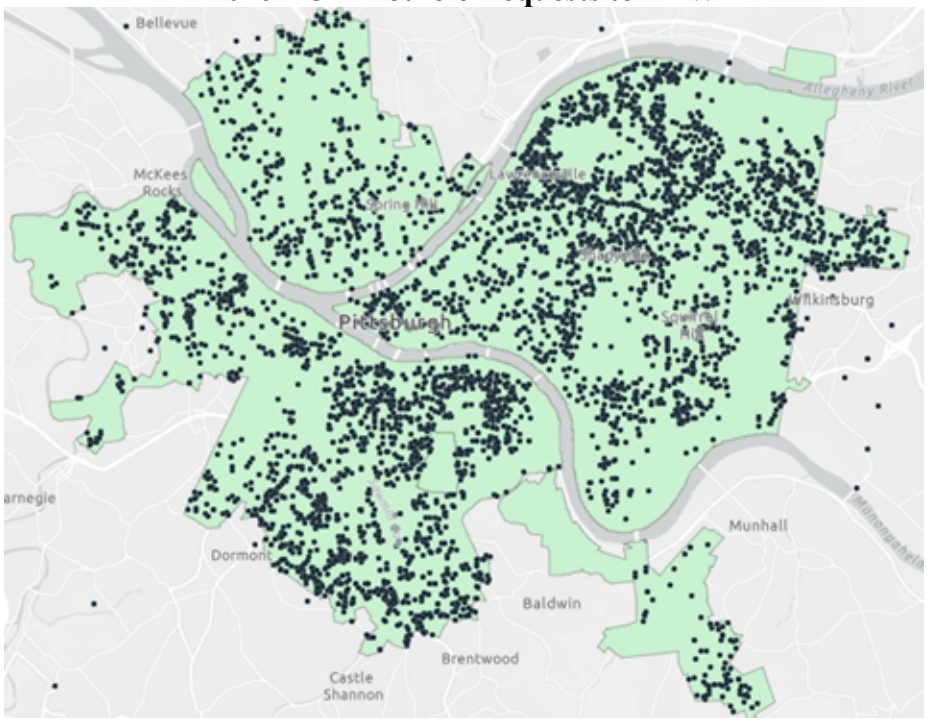
- 2016: Brookline (390), Bloomfield (224), Carrick (216), Lincoln-Lemington-Belmar (203), Squirrel Hill North (193), Central Lawrenceville (189), Mount Washington (181), St. Clair (169), Shadyside (159), South Side Flats (158);

- 2017: Brookline (463), Carrick (327), Bloomfield (300), Central Lawrenceville (274), Squirrel Hill North (271), Lincoln-Lemington-Belmar (231), Shadyside (201), Highland Park (196), St. Clair (193), Overbrook (187);

- 2018: Squirrel Hill North (855), Bloomfield (755), Carrick (686), Brookline (550), Spring Hill-City View (506), Central Lawrenceville (429), Greenfield (417), Shadyside (380), Lincoln Place (364), North Oakland (357).

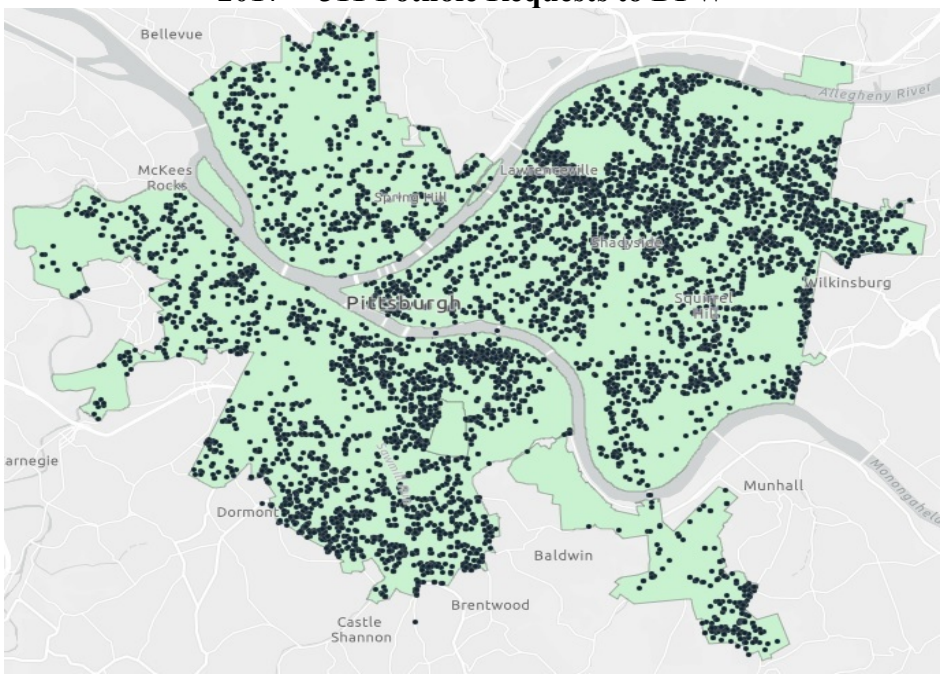
Brookline, Carrick, Bloomfield, Central Lawrenceville, and Squirrel Hill North were in the top ten neighborhoods for all three years of this audit.

FIGURE 8
2016 -- 311 Pothole Requests to DPW



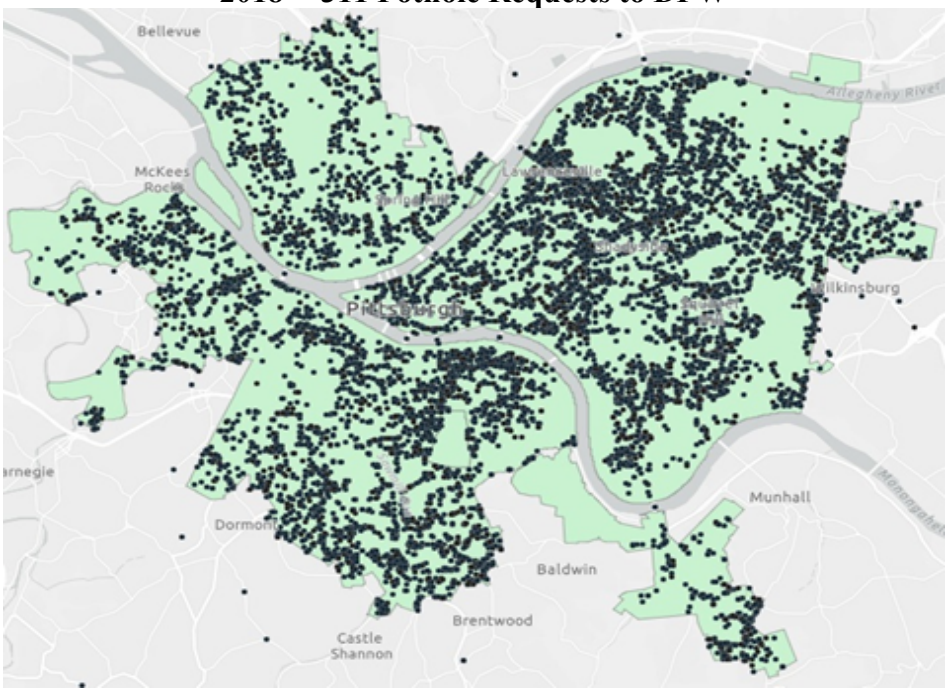
Source: 311, Esri

FIGURE 9
2017 -- 311 Pothole Requests to DPW



Source: 311, Esri

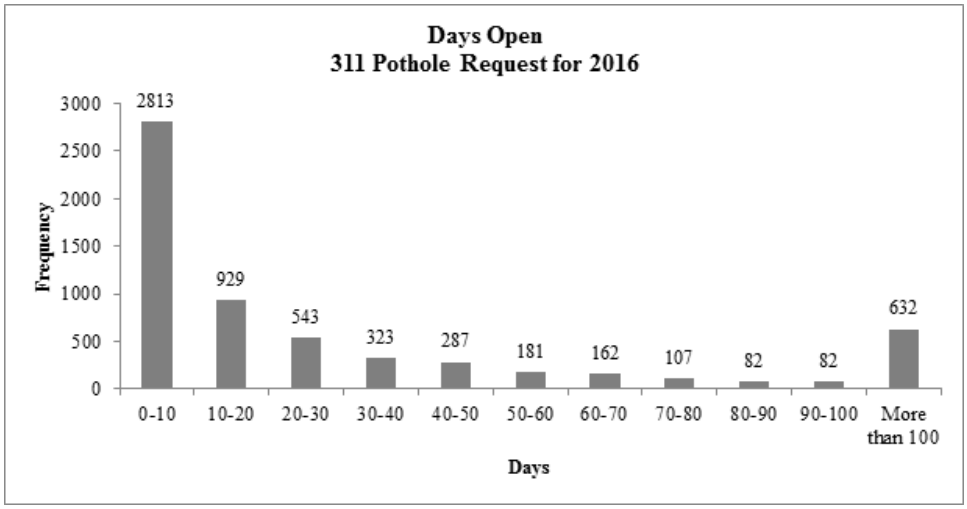
FIGURE 10
2018 -- 311 Pothole Requests to DPW



Source: 311, Esri

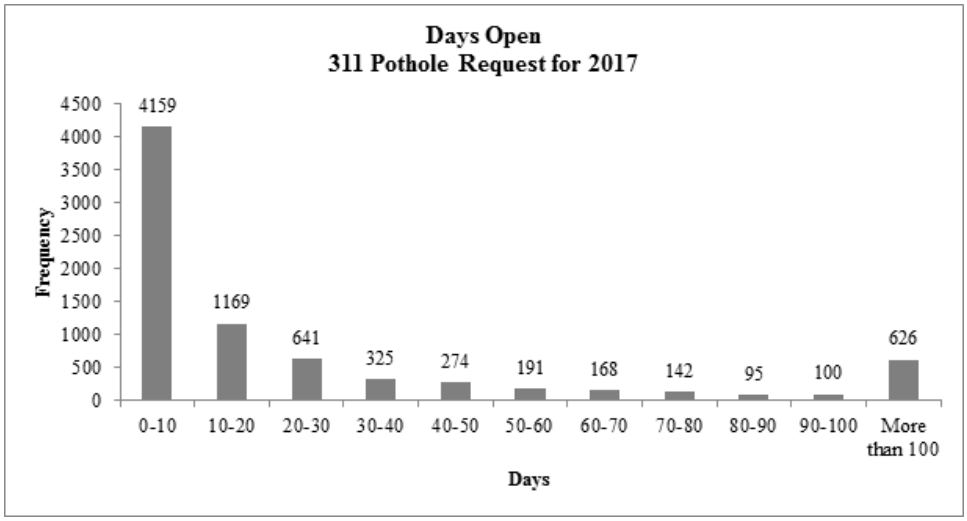
Figure 11, 12 and 13 indicate the time between when a 311 pothole request was opened and its final closing date. For 2016, 2017, and 2018, there are several hundred requests that seem to have taken more than 100 days for the request to be addressed. However, occasionally a request will accidentally reopen when a staff member interacts with it, such as printing the record. This can make it look like a 311 request was open for a greater number of days, even if the request had previously been addressed and had been closed.

FIGURE 11



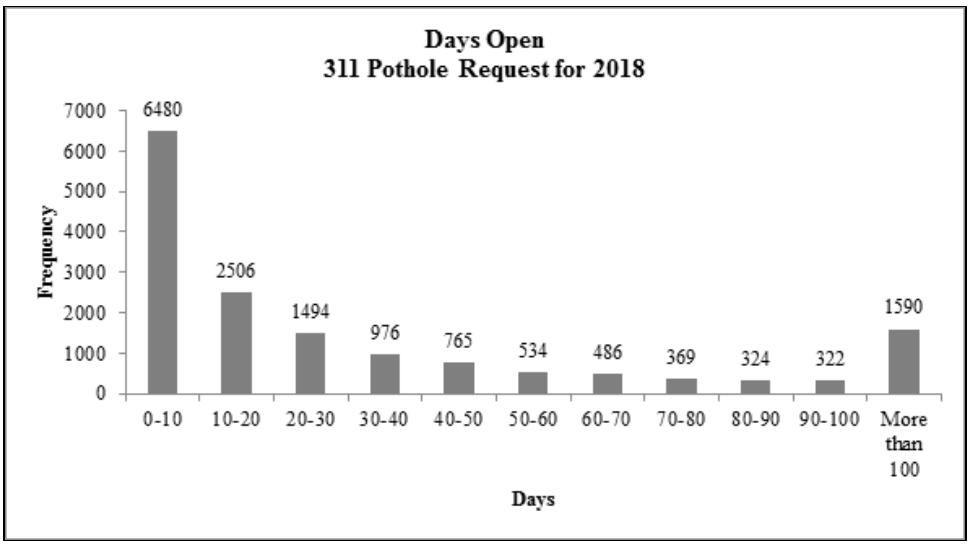
Source: 311

FIGURE 12



Source: 311

FIGURE 13



Source: 311

For all three (3) years, a majority of pothole requests were fulfilled within one (1) month, or 30 days (69.78% in 2016, 75.65% in 2017, and 66.14% in 2018). Potholes that took more than 100 days to be closed in the system tended to stay around 10% for all three (3) years (10.29% in 2016, 7.93% in 2017, and 10.03% in 2018), although this number may be inflated by cases where a requests was reopened in the system and not immediately properly re-closed.

Table 15 breaks down the number of days that a pothole requests was open by each division for the years 2016 to 2018. While the 1st, 5th, and 6th divisions had a greater than 50% close rate for pothole requests within ten (10) days of the request, the 2nd and 3rd divisions had a 42.14% and 38.58% rate within the first ten (10) days, respectively. However, the 2nd and 3rd divisions also had the most number of 311 pothole requests compared to the other divisions during this time, which may have contributed to the backlog in requests.

TABLE 15

Days Open by Division 311 Pothole Requests 2016-2018										
Days Open	**Division 1**	**Cumulative %**	**Division 2**	**Cumulative %**	**Division 3**	**Cumulative %**	**Division 5**	**Cumulative %**	**Division 6**	**Cumulative %**
0-10	1,375	53.61%	3,745	42.14%	3,972	38.58%	3,476	53.08%	593	52.39%
10-20	410	69.59%	1,366	57.50%	1,781	55.88%	901	66.83%	136	64.40%
20-30	221	78.21%	851	67.08%	994	65.54%	535	75.00%	65	70.14%
30-40	95	81.91%	558	73.36%	602	71.38%	332	80.07%	29	72.70%
40-50	47	83.74%	481	78.77%	501	76.25%	259	84.03%	33	75.62%
50-60	26	84.76%	304	82.19%	361	79.76%	186	86.87%	24	77.74%
60-70	16	85.38%	292	85.47%	350	83.16%	131	88.87%	22	79.68%
70-80	19	86.12%	204	87.77%	258	85.66%	105	90.47%	27	82.07%
80-90	20	86.90%	183	89.83%	214	87.74%	64	91.45%	16	83.48%
90-100	8	87.21%	185	91.91%	209	89.77%	83	92.72%	15	84.81%
More than 100	328	100.00%	719	100.00%	1,053	100.00%	477	100.00%	172	100.00%
TOTALS	2,565	100.00%	8,888	100.00%	10,295	100.00%	6,549	100.00%	1,132	100.00%

Source: 311

Pothole Prevention

Sealing cracks in city streets helps in preventing potholes. The easiest way to accomplish this is to completely mill and pave the street. This work performance is based on the availability of funds to. The City uses asphalt to resurface streets and all work is contracted out. An analysis of this work is outside the scope of the audit.

According to the Director of Public Works, the City has a number of potholes because the City has not met the street resurfacing schedule in the past. Some streets have not been resurfaced in over 30 years. But the current administration has made the right steps to eliminate potholes by increasing the resurfacing budget each year. If the budget allowed for resurfacing of around 80-100 miles of City streets each year, potholes would be significantly reduced, maybe even eliminated. The 2019 city budget said that DOMI paved 60 miles of City streets in 2018.

Spreader Control Updates as of January 2020

During the month of January 2020, the auditors were told by the City Controller's Office inspectors that they were receiving complaints from DPW's Heavy Equipment Division mechanics. The complaints were about the spreader controls that were installed in all DPW snow control vehicles by A&H Equipment Company. A&H was the subcontractor in the fleet telematics and snow route optimization contract the City has with Quetica.

The DPW Heavy Equipment Division and First Vehicle Services (FVS) are responsible for trouble shooting any errors within the snow vehicle control system. Heavy Equipment does quick turnaround time repairs during winter weather events but took on the added responsibilities of FVS during the snow season of 2019-2020. This added work load caused problems at the Heavy Equipment Division. According to division mechanics, the majority of their labor hours the last couple months have been spent trying to fix these problems leaving other equipment repairs unattended to.

Finding: The City's Heavy Equipment Division mechanics are assigned to repair problems associated with the snow control system and the salt spreaders in addition to their regular job duties.

Spreader Control Installation Problems

The majority of the spreader control installation problems are with 18 pick-up trucks with warranty issues that use the electric spreader system. This installation was a custom request by the City and A&H had little experience installing this type of equipment. Some of the problems happened during installation or immediately after.

During installation, A&H initially hardwired three (3) spreaders into the pick-up trucks. Because these trucks are used year-round to haul equipment in addition to plowing snow and spreading salt, the wires needed to be cut to remove the salt spreaders. A&H returned to add plugs to the cut wires to allow the salt spreaders to be removed and reinstalled for the future, but the initial plugs were too small, continually breaking until they were replaced. Eventually this problem was solved by A&H Equipment Company.

Spreader Control Problems after Installation

Other problems didn't become apparent until after the equipment was installed and used during the 2019-2020 snow season. Most of the problems happened with the 18 pick-ups with electric hog spreaders. The auditors were told by division mechanics that a representative from A&H stated that the company had never installed this type of spreader system on a truck outfitted with an electric hog before.

Some DPW pick-up trucks have electric hogs while others have hydraulic hogs. The system installed by A&H was designed for hydraulic hogs. While the control for hydraulic hogs can communicate directly with the spreader in the back of the truck, electric hogs need additional equipment in the back of the truck to change the spreader strength. As a result, some trucks outfitted with electric hogs will cease spreading salt, sometimes in the middle of a route. A specific reason for this error has not yet been identified as of January 29, 2020.

Currently, trucks need to be taken to the Heavy Equipment Division mechanics to have the spreader switched to manual operation in order to guarantee that they will be usable in a snow event. Because the hydraulic hogs have not yet experienced this issue, DPW may be able to keep these trucks on the new system, while reverting all trucks with electric hogs back to manual until they can be replaced with hydraulic hogs.

Initially City laborers were trained to fix the problems with the electric spreader control calibration but were unsuccessful due to the technical nature of the system. DPW Heavy Equipment took over this responsibility during the 2019-2020 snow season. Some DPW workers staffed at the Heavy Equipment Division have spent numerous man-hours trouble shooting these issues in search of a solution. The City, by having the Heavy Equipment Division mechanics trouble shoot the spreader control system, have taken them away from performing their regular jobs tasks of fixing hilifts, tractors etc. Since A&H installed the system they should be responsible for repairs.

A&H has visited the division to troubleshoot the system from time to time. They also have been completing identified repairs that are covered under the warranty. However, a permanent solution to the electric hogs and the signal loss has not yet been identified.

Finding: The new fleet telematics and snow route optimization system is costing the City more money than the initial contract because City mechanics are taken from their regular job assignments to fix problems associated with the system.

Signal Problems

Finally, all dump and pick-up trucks are experiencing signal outages, which results in breaks or delays for the salt spreader. In certain patches and dead zone around the City, the system loses the speed readings which allows the spreader to know how quickly to dispense the salt. When this signal is lost, the truck will not spread any salt, resulting in poorly salted roads. These issues have been experienced across the snow control fleet. The auditors were told Grant Street in the Central Business District is a dead zone.

Finding: There are glitches in the snow control vehicle spreader control system provided by A&H that will not allow DPW trucks to treat roads properly.

Finding: All dump and pick-up trucks installed with salt spreaders are experiencing signal outages, which results in breaks or delays for the salt spreader.

RECOMMENDATION NO. 10

DPW administration should make fixing the signal issues a top priority. A possible way the City could fix signal issues would be to tie the system into trucks that have digital dash boards for speed readings. This would remove the need to communicate with outside towers in order to spread salt. All repairs and equipment checks should be completed before the next snow season.

RECOMMENDATION NO. 11

City and DPW administration should hold the A&H Company responsible for fixing all aspects of their snow control system technology and the City should receive a rebate for having Heavy Equipment Division mechanics do their job.

WILLIAM PEDUTO
MAYOR

MICHAEL GABLE
DIRECTOR

CITY OF PITTSBURGH
DEPARTMENT OF PUBLIC WORKS
CITY-COUNTY BUILDING

May 28, 2020

Mr. Michael Lamb
City Controller
Office of the City Controller
City-County Building
414 Grant Street
Pittsburgh, PA 15219

Dear Controller Lamb:

We have reviewed the Snow and Ice Control Street Maintenance Performance Audit performed by your audit team. We previously had the opportunity to review the initial draft version of the audit and discussed it via a virtual exit conference with Gloria Novak and her team and my DPW senior staff in addition to a representative from the Department of Innovation and Performance. DPW provided a number of comments and suggested corrections and your staff was receptive to those and most but not all made it into this final version.

With regard to the eleven (11) recommendations within the document please refer to the attachment for our responses.

We found the content of the audit to be favorable and captured the essence of the programs managed here in DPW. It was also a pleasure working with your staff. If there are any questions related to our responses please do not hesitate to call me at x2726 or email (mike.gable@pittsburghpa.gov). Thank you.

Sincerely,

Michael Gable, CPRP
Director

MG:kah

Attachment

Cc: Gloria Novak, Performance Audit Manager-Office of the City Controller/Bill Crean, Superintendent-DPW/
Tom Paulin, Superintendent-DPW/Dave Osterman, Manager-Personnel & Finance-DPW/
Chris Belasco, Project Manager-I&P/Dan Gilman, Chief of Staff-Office of the Mayor/
Kinsey Casey, Chief of Operations-Office of the Mayor

RECOMMENDATION NO. 1

DPW Administration needs to work with the City's contractor for fleet repair and maintenance in order to coordinate an inspection plan that allows Dump Trucks to be available for snow season. OMB should amend the fleet repair and maintenance contract to allow for earlier inspections of Dump Trucks if necessary.

RESPONSE:

There are regular meetings with First Vehicle Services (FVS) representatives, the City of Pittsburgh employee (OMB) overseeing FVS operations, and multiple DPW senior staff (Operations Coordinator, Superintendents). Discussions revolve around what vehicles come down for service, what vehicles will be purchased, and what vehicles get decommissioned. We will forward the suggestion to OMB regarding the contract amendment.

RECOMMENDATION NO. 2

The DPW Administration should cover any newly constructed salt storage facility. This should be included with the plans to reconstruct the 4th Division. City Administration and Council should budget an increase in funds, if needed, to get this accomplished. The Clear Span Buildings have provided an effective solution.

RESPONSE:

We agree any permanent salt storage facility should be covered and Clear Span is one effective solution however, it is unlikely a salt storage facility will be included on the 4th Division campus because of how close it exists to the residential neighborhood.

RECOMMENDATION NO. 3

After a snow season when only the new salt formula is used, the DPW Administration should conduct a comparison analysis of the amount and cost of the new salt formula to previous years when only regular rock salt was used. This analysis should solidify the premise that the new formula saves the city money.

RESPONSE:

We did an analysis of the 2019-2020 Winter Weather Season with respect to salt usage and cost and the result was outstanding. For the most recently completed season we used an average of 376 tons of Blue Tinted Magnesium Chloride + OBPE Salt for every inch of snow at a cost of $88.00 per ton which equates to $33,088 per treated inch. For the seasons 2016-2017, 2017-2018, and 2018-2019 we used an average of 917 tons of regular rock salt for every inch of snow at an average cost over those three (3) seasons of $69.50 per ton which equates to $63,732 per treated inch. Based on this information we are using less salt per inch of snow and that is resulting in a 48% reduction in cost.

RECOMMENDATION NO. 4

DPW Administration should have all Drivers and Laborers trained on using the spreader control system before the next snow season starts.

RESPONSE:

This has already happened. Employees were trained before October 19, 2019.

RECOMMENDATION NO. 5

The DPW Administration should have Drivers document all safety hazards while testing their routes and submit their suggestions to their Supervisor who will then submit the suggestion to the Department of Innovation and Performance's Project Manager.

RESPONSE:

This has been done in all five (5) Street Maintenance Divisions and continues to be done as we work on route optimizations. The employees drove the routes, made notes and suggestions, and they were provided to the I&P Project Manager. Once the changes are made any employee given a route to drive will be able to do it safely.

RECOMMENDATION NO. 6

The DPW Administration should have Quetica collaborate with the City's Department of I&P to examine all GPS routes that DPW Drivers considered safety hazards and make changes if deemed necessary.

RESPONSE:

This response is similar to our response to Recommendation No. 5. As of April, 2020 the comments/changes/communications with Quetica and I&P is about 60% complete and expect it to be 100% complete well before the 2020-2021 Winter Weather Season begins.

RECOMMENDATION NO. 7

The DPW Administration should ensure Drivers that their jobs are not in danger while the issues with the new systems are being addressed, particularly during the first snow season in use. Leadership at each Division should address Driver's concerns but be aware of negativity internally that may prolong the adoption of new technology. Some Drivers said their new GPS routes were one (1) or two (2) hours longer than the routing system used during previous winters. They felt the longer run times would increase the number of complaints to the City's 311 Call Center.

RESPONSE:

No one's job is in danger. We have addressed the Driver's concerns adapting to the new technology. As to the length of routes what is commented here is opinion and not necessarily based on fact. Routes are being optimized with input from the Drivers, we need to make sure they have enough salt in the vehicle and/or access to other reloading depots regardless of the actual length of time it takes to complete the route.

RECOMMENDATION NO. 8

The DPW Administration should evaluate the routes that take longer than usual during the upcoming snow season and reroute if necessary.

RESPONSE:

This will be accomplished via the ongoing route optimization process.

RECOMMENDATION NO. 9

In future contracts, the City Administration and DPW Administration should ensure that they have continued access to Snow Plow Tracker data to allow for future analysis of route coverage and efficiency.

RESPONSE:

It was disappointing that the previous vendor (TeMeDa) was unable to fulfill the Audit Team's request for previous historical winter weather events, but the team in I&P is working with the Western PA Regional Data Center (WPRDC) using an Application Program Interface (API). This tracker data can be warehoused and stored for future use.

RECOMMENDATION NO. 10

DPW Administration should make fixing the signal issues a top priority. A possible way the City could fix signal issues would be to tie the system into trucks that have digital dash boards for speed readings. This would remove the need to communicate with outside towers in order to spread salt. All repairs and equipment checks should be completed before the next snow season.

RESPONSE:

It is a priority as are some other technical issues. Your suggestion may be a possible solution that we can explore along with other options. We hope to have this corrected before the 2020-2021 Winter Weather Season.

RECOMMENDATION NO. 11

City and DPW Administration should hold the A&H Company responsible for fixing all aspects of their Snow Control Systems technology and the City should receive a rebate for having Heavy Equipment Division Mechanics do their job.

RESPONSE:

We do not concur entirely with this recommendation, however A&H is honoring their warranty and repairing the technology on the vehicles. Additionally five (5) of the eighteen (18) vehicles have been completed as of May 20, 2020, and the remaining thirteen (13) are expected to be done relatively soon.