Winnipeg | Audit

Intersection Signal Infrastructure Investigation

September 2022

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Investigation Services

The Audit Department provides investigation services based on information identified in reports submitted through the Fraud and Waste Hotline, audit projects, Council, Public Service or resident's requests.

The Fraud and Waste Hotline is a confidential and anonymous service accessible to everyone to make reports 24/7/365. We review every report that is received and will investigate when appropriate supporting information is provided.

A strong anonymous fraud and waste reporting system is one of the best mechanisms available for uncovering wrongdoing. There are many benefits to the City in having an effective reporting system, most importantly being the early detection and/or prevention of harmful misconduct. Other non-quantifiable benefits are strengthened internal controls, improved policies and procedures and increased operational efficiencies.

The City Auditor takes all fraud and waste reports seriously. Comprehensive investigations help to maintain public confidence; the public needs to feel confident that the City is committed to taking appropriate steps to address the fraud and waste allegations.

This is not an audit as defined by Generally Accepted Government Auditing Standards, but does conform to Audit Department standards for independence, objectivity and quality. The Audit Department performed the engagement following the Department's internal Audit Manual and Hotline Report Handling Procedures.

Investigation Background

On February 24, 2022, Council adopted a motion directing the City Auditor to initiate an investigation into the allegations of potential waste and mismanagement surrounding intersection signal infrastructure. The City Auditor was to report back to Council in 120 days, but was granted an extension of an additional 90 days to report back to Council through the Audit Committee at the September 14, 2022 meeting.

The Audit Department engaged an external contractor to provide supplemental resources with expertise in engineering, capital project works and forensics.

Conclusions

Conclusion 1

- The Traffic Signals Branch (the Branch) has not developed asset management plans for the intersection signal infrastructure. The intent of an asset management plan is to outline how infrastructure investment can be directed to minimize lifecycle costs, at an acceptable level of risk, while delivering an expected level of service.
    - A Branch specific asset management plan is in the process of being developed. An asset management plan for LED components of intersection signals has been drafted.
    - The Branch appears to employ an opportunistic approach to modernization. If/when an opportunity is available to update infrastructure, the decision to revise will be in isolation of a proper asset management plan to identify when is the most appropriate time to update the infrastructure based on a lifecycle decision making approach.
    - As an example, when the decision was made to shift from a 10' to 15' shaft pole, there was no guidance on how or when to implement the conversion through the rest of the City's infrastructure inventory. Based on the Branch's documentation, we cannot determine if the current approach has returned the best value for the City.
    - Additionally, in 2014, the Branch initiated a shift to install cantilever poles rather than davit poles, this was noted as a shift in design philosophy. There are no internal guidelines indicating the contexts where cantilever poles are intended to be installed nor any documentation to indicate the Branch's plan for replacing the poles throughout the City.
    - The Branch must also reactively respond to work plans from other branches, specifically major road rehabilitation or renewal projects. The coordination and communication between branches is outside the scope of this review; however, the City should ensure the communication channels are effective and support the efficient operation of all branches. Current processes may lead to upgrades to infrastructure components prior to end of service life.

Conclusion 2

- The Branch lacks full documentation to support decisions on changes to existing intersection signal infrastructure.
    - The Branch was able to provide adequate support for infrastructure changes or movements but that often included a verbal rationale from current staff based on professional judgement due to the lack of documented guidance.
    - In 2018 the Branch re-evaluated their internal practice regarding vehicle signal configuration. The Branch identified that a portion of intersections were not meeting TAC guidelines related to lateral cones of vision (i.e., areas of visibility). The Branch is now

working to clarify the City's guidelines on signal placement for different intersection configurations.

- In 2013 an internal memorandum set out that any 10' shaft poles holding vehicle signals that are knocked down and structurally damaged should be replaced with 15' shaft poles. The guidance does not provide any contextual consideration to the decision which would be important since both the 10' or the 15' poles satisfy Transportation Association of Canada (TAC) guidance.
- While there is no guidance from TAC or from the City of Winnipeg's Accessibility Standards that indicates the preferred direction of Accessible Pedestrian Signal (APS) units, the Branch did receive feedback from community advocates which resulted in changes to the placement of APS units at intersections. We were informed that these lessons learned and the Branch's preferred positioning of the APS units is not formally captured in any internal guidance.
- Similarly, new pole bases were designed to accommodate the use of larger and heavier cantilever poles. This is because the existing, smaller pole base most commonly used in the City cannot accommodate cantilever poles. When a new pole base is deemed to be required as part of a project, the Branch advised that larger bases are installed, including under the smaller davit poles. This is to save potential future costs in the event a cantilever pole would need to be installed. No documentation of this decision or practice was available.

Independence

The Audit Department and external consultant team members selected for the investigation did not have any conflict of interest related to the investigation's subject matter.

Acknowledgement

The Audit Department wants to extend its appreciation to management and staff within the Public Works Department who assisted with this investigation.



September 2022

Bryan Mansky — Date

City Auditor

1.1 Overview of the Traffic Signals Branch

- The Traffic Signals Branch's (the Branch) main service areas are the design, operations, procurement, timings of intersection signals and the Transportation Management Centre (TMC). This covers all 671 signalized intersections, 186 pedestrian corridors and 7 rectangular rapid flashing beacon (RRFB) crosswalks in the City. The Branch is situated within the Transportation Division, which also includes the planning elements of the City's transportation network. The Transportation Division is situated within the Public Works Department.
- Projects related to intersection signal infrastructure can be both proactive and reactive in nature.
    - Proactive projects consist of street upgrades or planned rehabilitations.
    - Reactive work responds to issues such as signal malfunctions or damage.
    - Additionally, some planned projects may be completed by the Branch in isolation or with the coordination of other branches within the Public Works Department.
- The design of intersection signal infrastructure is conducted internally, as well as, all above-ground work on intersection signals. The only work related to intersection signals that is currently contracted is underground conduit, concrete bases and related works.
- The Branch produces work orders to track and document work performed on each component of intersection signal infrastructure. Approximately a year and a half ago the City switched from a paper-based work order system to a digital form.
- All new intersection signals, half signals, pedestrian corridors and RRFB crosswalks installed in the City must first be approved by the Standing Policy Committee on Infrastructure Renewal and Public Works. To get this approval, the intersection needs to have undergone a warrant analysis that justifies additional intersection signals and the types of signal infrastructure to be installed.
- Additionally, where necessary, the Transportation Division conducts additional studies to ensure the safety of specific planned or existing intersections.
    - Road Safety Audits are formal safety performance checks performed independently at the planning and design stage.
    - An In-Service Road Safety Review (ISRSR) occurs for existing intersections to identify safety improvements. An ISRSR may suggest cost-effective countermeasures that result in changes to existing intersection signal infrastructure through additional or upgraded signal components.

1.2 Overview of Factors Influencing Intersection Signal Infrastructure

- A high-level chronological timeline has been developed to understand the factors that influence the design and construction of intersection signal infrastructure. The elements included in the Timeline represent guidance available to the City that may come from relevant external sources (External Influences), which are positioned alongside internal written direction (Internal Influences).

1.2.1 External Influences

- Provincial Regulation
    - *The Provincial Highway Traffic Act* establishes the approved traffic control devices through the Traffic Control Devices Regulation. This regulation approves for use the traffic control devices set out in TAC's Manual of Uniform Traffic Control Devices for

Canada (MUTCDC), 5th Edition. The regulation also provides additional guidance for two signal devices.

- Transportation Association of Canada (TAC)
    - TAC is the principal source of external technical guidance applicable to intersection signal infrastructure. TAC guidelines are updated periodically as the technical guidance evolves.
    - TAC publications are not mandatory standards that must be strictly adhered to by jurisdictions, but rather a set of best practices to be administered locally. This leaves room for municipalities to interpret their application to meet local conditions.
    - The primary TAC publication is the MUTCDC. This provides guidance related to signal installation, display, configuration and operational requirements, among other items. Individual design practitioners interpret design principles of the MUTCDC when applying professional judgment in their local context.
    - Various additional TAC publications provide guidance on specific components of intersection signal infrastructure, these include: the Pedestrian Crossing Control Guide; the Guidelines for Understanding, Use and Implementation of Accessible Pedestrian Signals; the Advanced Warning Flashers: Guidelines for Applications and Installation; and the Traffic Signal Guidelines for Bicycles. These additional publications expand upon provisions of the MUTCDC or provide guidelines where no set practice had previously been established.
    - Additionally, TAC's Geometric Design Guide for Canadian Roads does not focus on intersection signals infrastructure; however, it is used by the Transportation Facilities Planning Branch for geometric road design.
- Other External Influences
    - American Public Works Association (APWA) - The APWA accreditation program seeks, among other objectives, to improve public works performance and the provision of services. Although APWA does not prescribe certain policies for accreditation, it requires that the municipality has an established set of policies for municipal asset types, including traffic signals. The Public Works Department is an accredited agency of APWA.
    - Principles of Universal Design - The Principles of Universal Design, as developed and promoted by the Center for Universal Design at North Carolina State University, provide a standard for designing usable products and environments for people of all ability levels. This standard has been adopted by asset owners of various types, including intersection signal infrastructure. The City has integrated the principles of Universal Design into the planning and design processes of intersection signal infrastructure through the 2015 Accessibility Design Standards.
    - Human Rights Code of Manitoba - The Manitoba Human Rights Commission (Commission) administers the complaint process of the Human Rights Code of Manitoba. The Memorandum of Agreement seen in the Timeline provided a settlement of complaints filed against the City before the Commission. The terms of the agreement require specific accessibility improvements be made to intersection signal infrastructure in a given area and timeframe. This is the only directive from the Commission related to intersection signal infrastructure provided by the City.
- Technological Factors
    - Technological improvements can enhance the functionality of intersection signal infrastructure, improve operational efficiency and boost the level of service for road

users. The investigation and testing of new signal technology may result in physical changes to existing signal infrastructure.
    - Advanced traffic intersection controllers connect to a cellular network that is controlled by the Transportation Management Centre is an example of improved functionality that improves the City's ability to remotely respond to signal malfunctions. The City conducted intersection upgrades for cellular connectivity throughout the review period as an adoption of new technology to enhance the performance of the system.
    - Installation of wireless vehicle detection technology has also been an initiative of the Branch. This is a non-intrusive detection method where traditional vehicle detection loop technology is no longer required.
    - Upgrades to wired connections in signal poles have also occurred to prevent malfunctions.

1.2.2 Internal Influences

- The City will document its own internal design guidance based on the available external design guidance from technical resources. The City will then implement infrastructure designs and manage the portfolio of intersection signal assets using the existing processes and management approach. As such, Internal Influences can be categorized into design and organizational factors.
- Internal Design Influences
    - Design practices influence the physical changes seen in intersection signal infrastructure. In the case of the City, design practices may take the form of localized design guides or standards manuals that apply to different facets of intersection signal infrastructure. Internal guidelines generated by the City build upon and are informed by available external guidelines and regulations, as well as other internally-generated guidelines. TAC guidance related to intersection signals is adopted by the City through the Traffic Signal Design Guide (2012) and the Traffic Signals Design, Operation, Maintenance and Timing Practices (2010).
    - Additionally, the City's internal design guidelines take into account the lessons learned by the City from previous projects, pilot programs, or citizen feedback. Some elements of intersection signal design may be left to the discretion of the design engineer.
- Internal Organizational Influences
    - The Branch implemented a preventative maintenance program in 2020. This impacts both planned projects and reactive work conducted on signal assets.
    - The Branch may be tasked with proactive projects that consist of street upgrades or planned rehabilitations.
    - The Branch also performs reactive work to respond to issues such as signal malfunctions or damage.
    - A Branch specific asset management plan is in the process of being developed. An asset management plan for LED components of intersection signals has been drafted. No other asset management plans for other intersection signal components have been supplied by the Branch. The intent of an asset management plan is to outline how infrastructure investment can be directed to minimize lifecycle costs, at an acceptable level of risk, while delivering an expected level of service.

1.2.3 Timeline

External Influences		Internal Influences
TAC – Manual of Uniform Traffic Control Devices 4th Edition TAC - Pedestrian Crossing Control Manual, 1st Edition	1998	
TAC - Geometric Design Guide for Canadian Roads, 2nd Edition	1999	
TAC - Advance Warning Flashers: Guidelines for Applications and Installation, 1st Edition - Consolidates the best available knowledge for the application and installation of Advanced Warning Flashers, including the placement, size and timing.	2005	
	2006	City of Winnipeg - Accessibility Design Standards, 1st Edition
	2007	Traffic Signals Branch - Inter-Office Memo- Direction provided to only use 12”-12”-12” displays on vehicle signal heads, discontinuing all further installations of 8”-8”-12” vehicle signal heads.
TAC - Guidelines for Understanding, Use and Implementation of Accessible Pedestrian Signals, 1st Edition – Also expands upon the APS provisions within the MUTCDC. Manitoba Human Rights Commission - Memorandum of Agreement: Bridgeman/Martin v. City of Winnipeg - The agreement commits to the deactivation of pushbuttons for visible pedestrian signals that do not have audible traffic signals and to the installation of audible pedestrian signals at all signalized intersections that have visual pedestrian signals.	2008	
	2010	Traffic Signals Branch - Traffic Signals Design, Operation, Maintenance and Timing Practices – Cursory design and installation guidance is provided on various signal components, including shaft poles, joint-use poles, pedestrian push buttons, detection loops, left and right turn indications and pedestrian corridors. City of Winnipeg - Accessibility Design Standards, 2nd Edition - Access issues regarding traffic signal poles are addressed with a focus on the provision of appropriate space beside pedestrian push buttons, pedestrian push button configuration and mounting height.
TAC - Pedestrian Crossing Control Guide, 2nd Edition	2012	Traffic Signals Branch - Traffic Signal Design Guide – A set of design guidelines is provided for vehicle head and pedestrian display visibility and placement, pole placement, pedestrian corridors, placement of traffic controller cabinets, typical vehicle head configurations, and to account for vehicle detection, power supply, service boxes and wiring methods.

External Influences		Internal Influences
	2013	Public Works Department - Transportation Standards Manual (draft 2012 Update; adopted as final) - Vertical poles placed in certain locations relative to the street shall be placed on breakaway pole bases with some potential exceptions. Traffic Signals Branch - Project Business Case: Pedestrian Countdown Signals – Upon completion of a Pedestrian Countdown Signal (PCS) pilot project, additional PCS units were requested to be installed in key sensitive locations chosen by the Transportation Division. 40 PCS units were intended to be installed per year for a period of 10 years.
TAC - Manual of Uniform Traffic Control Devices for Canada, 5th Edition TAC – Traffic Signal Guidelines for Bicycles, 1st Edition – Intent is to help practitioners plan, design and implement traffic signals for bicycles in Canada.	2014	
	2015	City of Winnipeg - Accessibility Design Standards, 3rd Edition – Elements of the design standards relevant to traffic signal infrastructure remain unchanged from the 2010 Accessibility Design Standards, 2nd Edition.
TAC - Geometric Design Guide for Canadian Roads, 3rd Edition - Fundamental reference document for roadway design practitioners, which includes the design of freeways, arterial, collector, and local roads in both urban and rural contexts.	2017	
TAC - Pedestrian Crossing Control Guide, 3rd Edition - Augments the MUTCDC's guidance with both quantitative criteria and qualitative engineering judgment to support a systematic approach that can flexibly address unique local conditions.	2018	
Traffic Control Devices Regulation - Part of the Highway Traffic Act, this regulation approves for use the Traffic Control Devices set out in the MUTCDC, 5th Edition.	2019	
TAC - Manual of Uniform Traffic Control Devices for Canada, 6th Edition The MUTCDC provides guidance related to signal installation, display, configuration and operational requirements, among other items. Individual design practitioners interpret design principles of the MUTCDC when applying professional judgment in their local context.	2021	Traffic Signals Branch – LED Infrastructure Asset Management Plan – Direction provided to replace the full vehicle or pedestrian head when an individual LED needs replacing, with each out of service component to be inspected and later reused.

1.3 Risk Methodology[1]

- The risk identification and selection methodology have been based on industry and other publicly available information, the Department's internal guidance and discussions with management.
- Timing and resources did not allow for an assessment of every intersection and every potential issue.
- The City has a vast network of intersection signal infrastructure and our assessment does not necessarily reflect all intersections and/or potential issues within the City, or all changes made to signal infrastructure over time.
- The following is a brief overview of the risk assessment process:
    - The project team identified approximately 80 unique issues related to the infrastructure of a single signal intersection.
    - Those 80 issues were categorized into seven (7) broad topics (Potential Issues) for review.
    - Preliminary information available for the intersections was reviewed to determine the number of intersections affected by each Potential Issue (category of issue).
    - Risk factors were developed to assess the Potential Issues for their risk and identify which intersections are the highest risk. The following is a brief overview of the risk factors:
        - Work Relates to Public Safety - Work conducted that relates to public safety would be assessed a lower risk ranking. Safety provides a clear impetus for signal infrastructure changes to occur, and the decision to conduct such work is less likely to be the result of management discretion.
        - Level of Guidance – Work that is governed by documented guidance, in the form of standards, policies or guidelines from external or internal sources, would be assessed a lower risk ranking. Guidance provides direction on the nature of work which reduces the range of management discretion and would have a lower risk ranking.
        - Expected Relative Cost - Higher cost projects have a greater impact on the public and therefore would have a higher risk ranking.
        - Prevalence of Issue – An issue that appears more prevalent contributes to the risk of any potential misuse of public funds and would have a higher risk ranking.
        - Multiple Intersections - A potential issue that is identified for multiple intersections would be assessed a higher risk ranking.
    - The intersections selected for review were among those evaluated with the highest risk while ensuring a wide coverage of Potential Issue types and applicable signal components (e.g. poles, vehicle heads, pedestrian infrastructure).
    - The risk methodology was presented and discussed with the Traffic Signals Branch management.

[1] The risk methodology/assessment was based on the information received up to May 31, 2022.

2.1 Machray and Salter Intersection

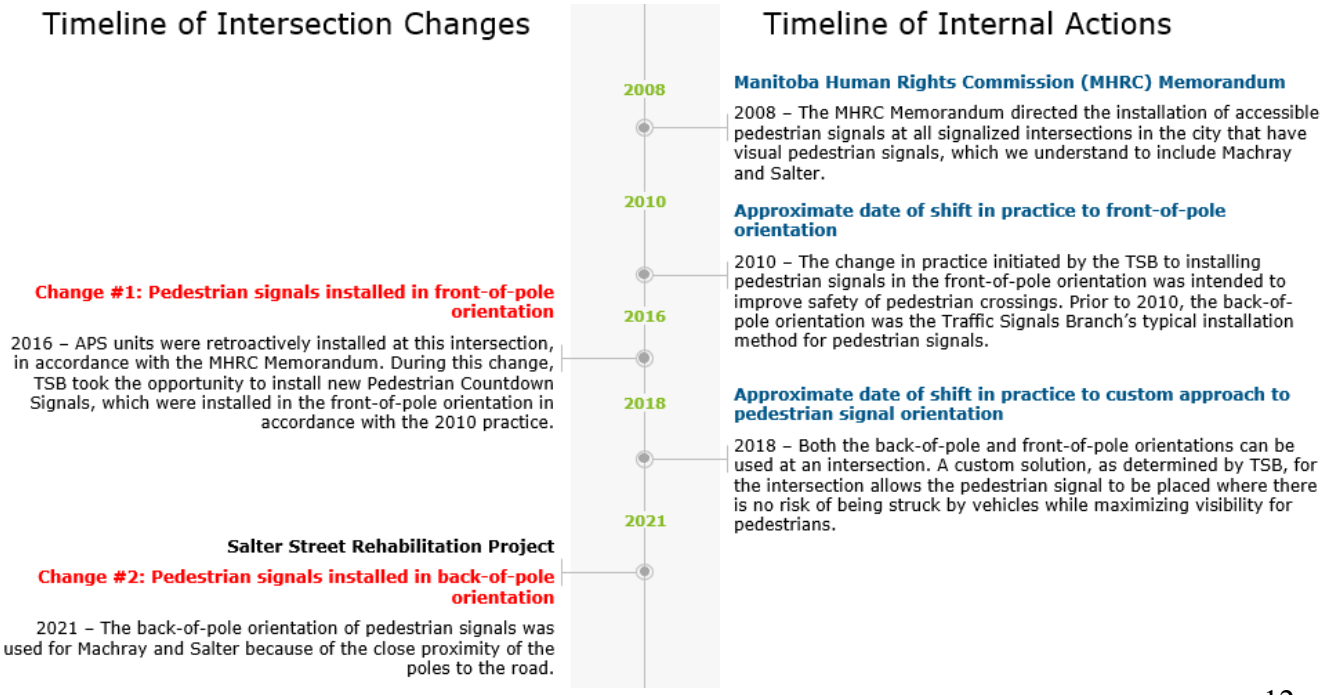
Observations

- The Machray and Salter intersection is a large, four-lane collector road intersecting with a two-lane local road in the centre of the City. This intersection was involved in a large-scale intersection rehabilitation project along Salter Street starting in 2021 requiring signals upgrades (Salter Street Rehabilitation Project – SSRP).
- The review of the intersection involved three signal components: pedestrian infrastructure, poles, and vehicles signal displays.
- Each change made at the intersection had their own rationale that was described as an incremental improvement to the intersection signal infrastructure.
- Based on discussions and documents reviewed, professional judgement of individuals within the Branch appears to have been applied to improve public safety, minimize lifecycle costs, and/or become compliant with applicable guidelines.
- Documentation was available to describe the nature of changes that occurred; however, the rationale for the practices that the Branch follows were generally not documented.
- A design consultant was engaged to identify pole bases at the intersection that required a change in elevation, due to grade changes associated with the project's sidewalk work.
- Once the SSRP project had been initiated, the Branch conducted further work opportunistically to incrementally improve the intersection to bring in line with the Branch's practices at that point in time.

Analysis

2.1.1 Flipping Pedestrian Heads Perpendicular and Then Reversing Back

- The timeline below shows the changes which occurred at the intersection as well as actions undertaken by the City.



Infrastructure Changes

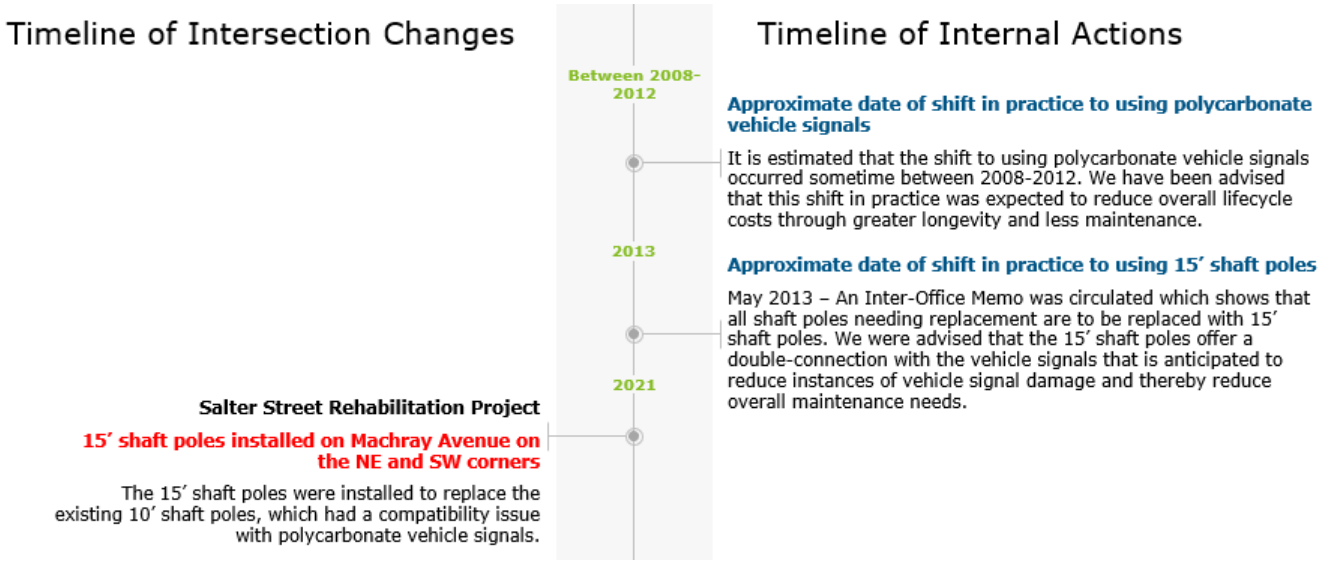
- Change #1 – Pedestrian Signals installed in front-of-pole orientation: The installation of new APS units, as directed by the MHRC Memorandum, necessitated an upgrade to the pedestrian signal, whereby a soundboard was added. We understand that this necessitated the removal of the pedestrian signal from the pole, which in turn provided the opportunity to reinstall a pedestrian countdown signal in the front-of-pole orientation.
- Change #2 – Pedestrian Signals installed in back-of-pole orientation: With the Branch decision to replace several poles as part of the SSRP, the Branch had the opportunity to reinstall pedestrian signals using the current orientation practice.

Guidelines and Consistency

- Based on discussions with the Branch, we understand that the changes made were based on internal lessons learned specifically related to the orientation of the pedestrian signals, which were not documented at the time of installation.
- The shift in practice to install pedestrian heads in the front-of-pole orientation that started around 2010, was thought to make pedestrian crossings safer because the pedestrian signals were closer to the pedestrian waiting on the departing ramp.
- As part of the practice change of 2018, we understand based on discussions, that new pedestrian signals may be installed in either the back-of-pole or front-of-pole orientations, based on what the Branch determines to be most appropriate for the intersection. The intent is to provide the best visibility for pedestrians while maintaining sufficient separation between the pedestrian signal and the road.
- While the TAC guidance was not a driver for these pedestrian signal orientation changes, both orientations of pedestrian signals are in compliance with the external TAC guidelines for pedestrian signal head location.

2.1.2 Changing Small Shaft Poles to Medium

- The timeline below shows the changes which occurred at the intersection as well as actions undertaken by the City.



Infrastructure Changes

- Prior to 2021, four of the eight poles at this intersection were 10' shaft poles with a single point of connection between the top of the shaft pole and the bottom of a vehicle signal. The other four poles in place were davits.
- As part of the SSRP, two of the 10' shaft poles on Machray Avenue (poles 1 and 5, at the Northeast and Southwest corners) were replaced with 15' shaft poles, while the other two 10' shaft poles became davit poles[2].
- The two 10' shaft poles at this intersection that were replaced with 15' shaft poles were not among those recommended by the City's consultant for adjustment. The Branch decided to opportunistically replace them during the SSRP to get the intersection as close as possible to current practices and eliminate a known signal connection issue with the 10' shaft pole.

Guidelines and Consistency

- An internal memorandum to Branch staff from May 2013 sets out that any 10' shaft poles holding vehicle signals that are knocked down and damaged (with regard to the pole's structural integrity) should be replaced with 15' shaft poles.
- Applicable TAC guidance specifies the required clearance of the vehicle signal above the sidewalk, which either the 10' or the 15' shaft poles may satisfy.
- The Branch advised that the specific change from 10' to 15' shaft poles was guided by engineering judgment based on operational considerations of other signal infrastructure components, namely a shift to using polycarbonate vehicle signals. Management asserts the polycarbonate vehicle signals have certain advantages, such as lower component cost and greater longevity with less maintenance.
- The 10' shaft poles provide a single point of connection for vehicle signals, which the Branch

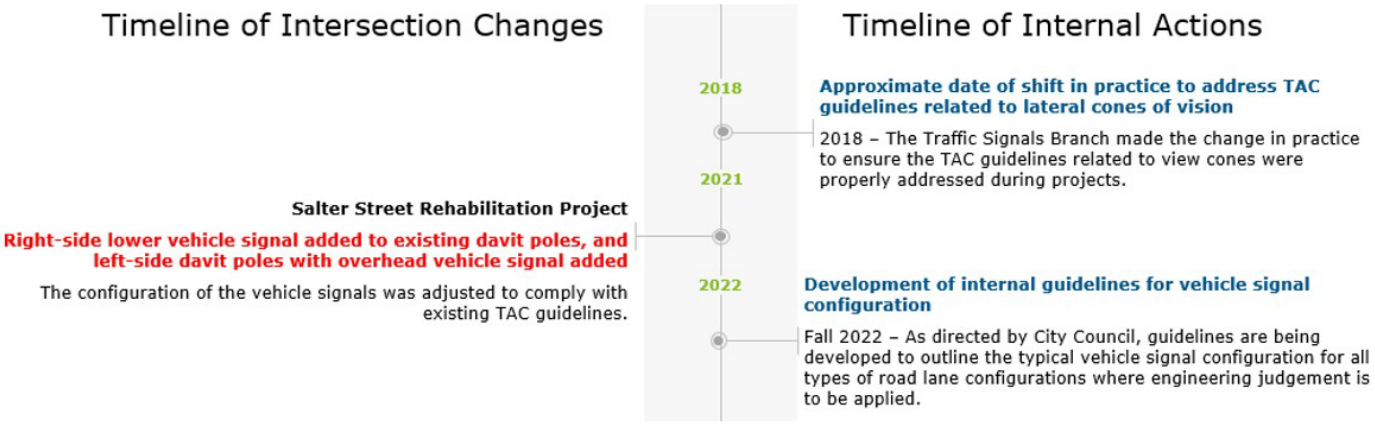
[2] A davit pole is a tall, curved pole used to hang vehicle signals or other components over a road. The shaft pole is a straight, relatively shorter pole that does not hang over the road.

advises leaves the polycarbonate vehicle signal vulnerable to damage (e.g. high winds), and potentially being non-operational.

- The Branch's current practice for new and rehabilitated intersections is to replace 10' shaft poles with 15' shaft poles, which offer two points of connection for vehicle signals. The two points of connection to the vehicle signal minimizes the potential for damage by high winds.
- Salvaged 10' shaft poles in inventory are still used for purposes other than holding vehicle signals such as to support rectangular rapid flashing beacons at crosswalks and to support pedestrian signals where no vehicle signal is attached and thus were installed in other locations in the City at the same time.
- The internal guidance does not provide the contextual considerations set out above with regard to polycarbonate vehicle signals or any other rationale for this approach.

2.1.3 Use of Right Side Vehicle Displays

- The timeline below shows the changes which occurred at the intersection as well as actions undertaken by the City.



Infrastructure Changes

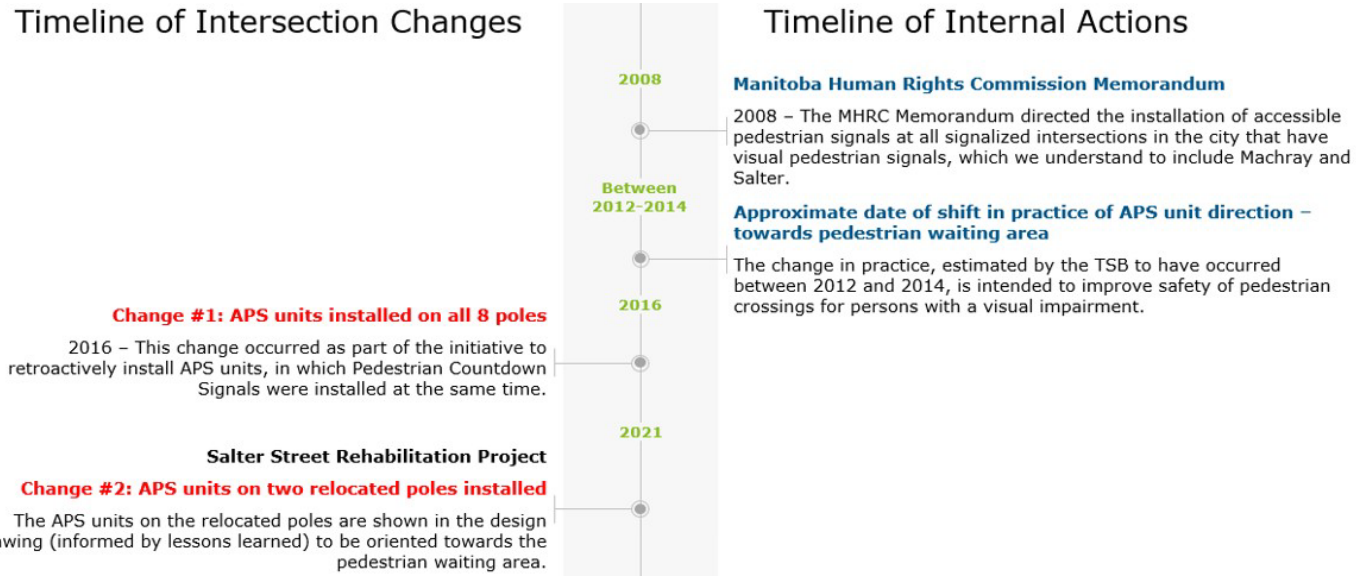
- The Branch determined that the existing vehicle signal configuration was not meeting TAC guidelines.
- The vehicle signals had previously been constructed using a high right-side primary signal on a davit pole and a lower left-side signal on a shaft pole.
- As part of the SSRP, new left-side davit poles from the perspective of drivers on Salter Street entering the intersection were installed holding vehicle signals overhanging the intersection and lower right-side signals were installed on the existing right-side davit poles.
- The Branch's decision to relocate pole bases provided an opportunity (based on engineering judgment) to adjust the configuration of the vehicle signals on Salter Street to achieve the desired separation of vehicle signals as recommended by TAC guidelines.

Guidelines and Consistency

- Beginning in 2018, the Branch re-evaluated their internal practice regarding vehicle signal configuration once it was determined that a portion of intersections in the City were not meeting TAC guidelines related to lateral cones of vision (i.e., areas of visibility) for approaching drivers. The Branch advised they are working towards clarifying the City's guidelines on signal placement for different intersection configurations.
- The use of low mounted vehicle displays on the right-side is not a standard component used across all intersections.
- Older intersections may not have been built to follow the vertical and horizontal spacing guidelines of TAC.
- For new or reconstructed intersections where the low mounted vehicle display may be used to satisfy TAC guidelines related to vertical spacing of vehicle displays a low mounted vehicle display on the right side may not be used due to intersection-specific considerations.
- The Branch does apply their professional judgement as to the inclusion of low mounted vehicle displays on the right-side within the intersection.
- The Branch is currently undertaking an internal initiative, as directed by City Council, to develop a set of guidelines related to vehicle signal configuration.

2.1.4 Accessible Pedestrian Signal ("APS")

- The timeline below shows the changes which occurred at the intersection as well as actions undertaken by the City.



Infrastructure Changes

- Design documentation shows two poles being relocated further away from Salter Street as they have moved to the back of sidewalk from the original location at the back of curb.
- Relocation of the poles necessitated adjustment in the direction of each APS unit.
- The APS units on the two poles are now designed to face Salter Street[3], while the direction of all other APS units at this intersection remain unchanged.

Guidelines and Consistency

- There is no guidance from TAC or from the City of Winnipeg's Accessibility Standards guidance that indicates the preferred direction of APS units relative to the crosswalk.
- The Branch advised that they received feedback from community advocates that individuals will use the sound from the APS unit to indicate when to leave the corner, and not as a directional cue to find their way across the crosswalk. As a result, the APS units are intended to be directed to the back of the curb ramp or the back of the detectable warning tile if present where the pedestrian would wait to cross the road.
- APS units installed as part of new construction or rehabilitations are intended to be installed to meet the practice, where feasible, of being directed towards the pedestrian waiting area.
- We were informed that these lessons learned from community stakeholder or the Branch's preferred positioning of the APS units is not formally documented in any internal guidance.

[3] Our understanding of this Potential Issue is predicated on the APS units on these two poles changing direction as indicated on the design drawings available. However, the APS unit on one pole appears to have been installed differently than the most recent design drawing indicates.

2.2 Corydon and Elm Intersection

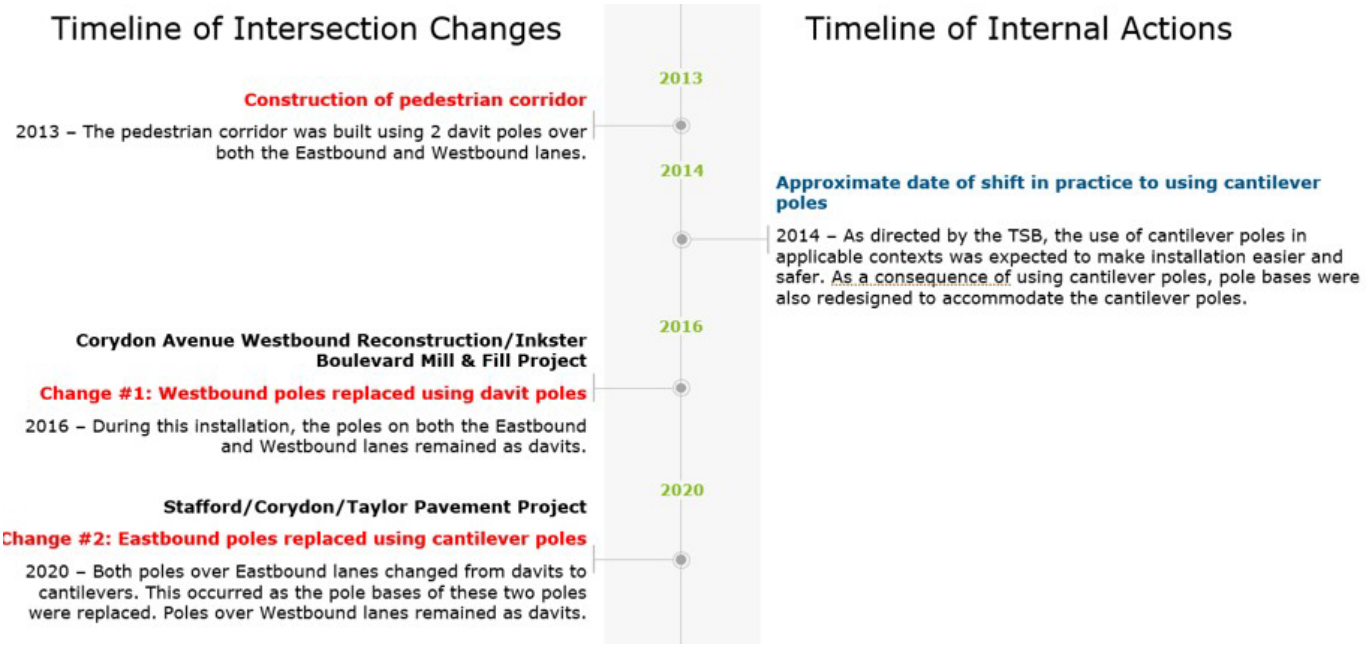
Observations

- Corydon Avenue, a divided four-lane street through the segment under review, forms a T-intersection with Elm Street to the South in the River Heights neighbourhood.
- In 2013, a signalized pedestrian corridor was built across Corydon at Elm using davit poles on both the Eastbound and the Westbound portions of the street (with the Eastbound and Westbound portions of the street each surrounded by two davit poles).
- In the course of subsequent street work at the intersection in 2016, two of the four poles in place were replaced with new davits, while the other two were replaced with cantilevers in 2020.
- Additionally, the davit poles installed in 2016 on the North half of the intersection may not have followed the branch practice of installing cantilever poles. There is an absence of documentation or other information supporting the decision. The Branch advised that the shift to installing cantilever poles from davit poles was a shift in design philosophy, and one that was slow to be adopted.
- There are also no internal guidelines indicating the contexts where cantilever poles are intended to be installed nor any documentation to indicate the Branch's plan for replacing the poles throughout the City with cantilever poles.

Analysis

2.2.1 Changes to poles

- The timeline below shows the changes which occurred at the intersection as well as actions undertaken by the City.



Infrastructure Changes

- Change #1 – Replacement of poles on Westbound half of corridor with davits.
    - As part of the Corydon Avenue Westbound Reconstruction and Inkster Boulevard Mill and Fill Project, a street renewal program that included work on several blocks of Corydon Avenue, in approximately late 2016, the davit poles on the Westbound half of the pedestrian corridor were replaced using davit poles.
    - Documentation reviewed for this intersection does not provide a rationale for the choice of poles used.
- Change #2 – Replacement of poles on Eastbound half of corridor with cantilevers.
    - In approximately late 2020, as part of the Stafford/Corydon/Taylor Pavement Renewals Project involving the Eastbound side of Corydon, further updates to the intersection included the replacement of the davit poles on the South half of the corridor with cantilever poles.
    - The Project Manager for the Engineering Division requested from the Branch that signals infrastructure at the Eastbound half of the pedestrian corridor be replaced to avoid additional site constraints for the street reconstruction project. The Branch acted on this request to replace the pole bases on the Eastbound half of the pedestrian corridor.
    - Documentation for this intersection work also does not provide a rationale for the poles used.
    - Poles that are taken down in the course of pavement and pole base work cannot be stored on-site during this work, so as not to impede the work of other contractors. This removal presents an opportunity to replace the poles according to current practice. Current management believe this appears to be the reason that the poles on the Eastbound Portion of the pedestrian corridor were replaced with cantilever poles.
- While the rationale for the pole choice is not documented, the decision-making process as described was based on professional judgment that took into account the operational challenges of assembling cantilever rather than davit arms, as well as logistical and cost-efficiency considerations that prevented simply restoring the pole as it was prior to this work.

Guidelines and Consistency

- TAC and internal Branch guidance does not speak to specific pole types and therefore decisions on pole types are left to the discretion of the implementing jurisdiction.
- We were advised that cantilever and davit styles of poles both allow for the placement of vehicle signals, pedestrian signals and pedestrian corridor boxes to meet their respective requirements within TAC guidelines.
- While maintaining visual consistency at intersections is one element that may be considered in design choices, cantilever poles have advantages separate from aesthetic considerations. The Branch indicated that one advantage was a better style of connection with the base.
- Cantilever arms are bolted in place, whereas crews must use sledgehammers to connect and disconnect davit arms from poles. Cantilever components represent a slight cost increase, the Branch considers this offset by the improved ease and safety of assembly.
- The Branch advised that they still prefer to install davits in certain situations, such as where low power lines might come into contact with cantilever arms. Further, the Branch stated that they have not conducted a retroactive replacement of existing davits with cantilevers, but makes such replacements where the scope of a project already includes base replacement. Wewere

advised that this approach is taken because a cantilever pole cannot be installed on the smaller base used for older davit poles and would require a new base to be installed in such locations.

- The Branch speculated that the slow adoption of installing cantilever poles may have been why the 2016 project on the North half of Corydon/Elm was installed as davits instead of cantilevers despite the change in practice starting around 2014. No documentation specific to this intersection indicates this to be the case.

2.3 Langside and Portage Intersection

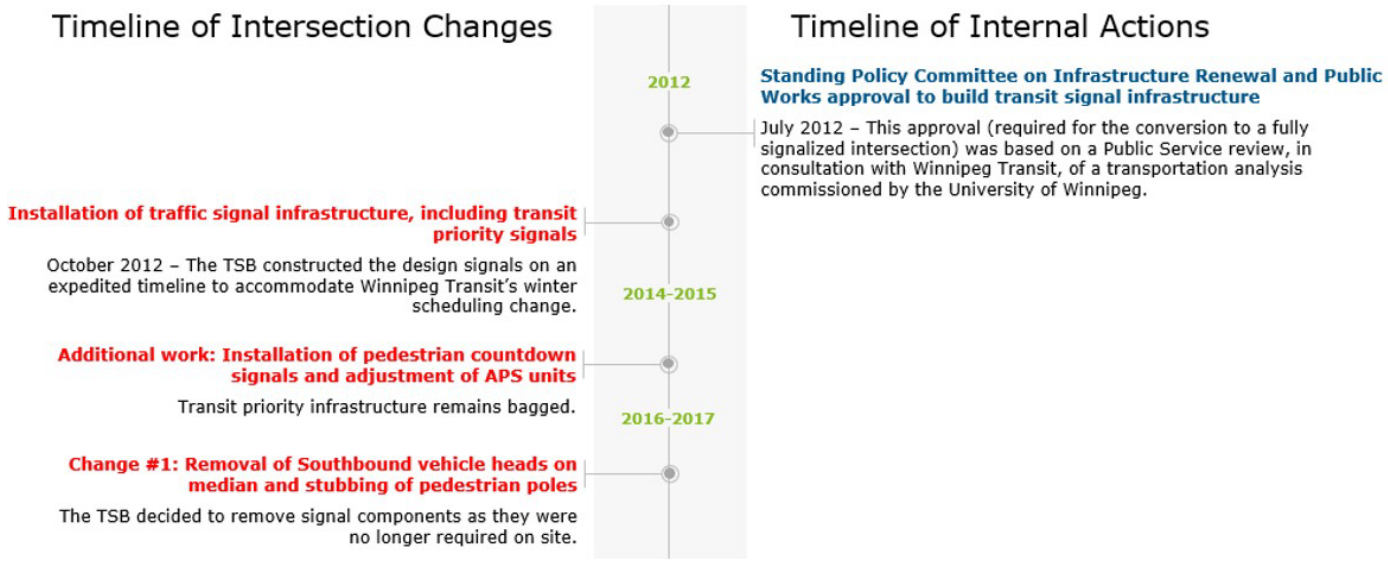
Observations

- Portage Avenue runs Southwest from downtown and intersects with Langside Street South of the University of Winnipeg (UW) campus.
- In 2012, signals infrastructure was installed by the Branch to permit left turns for Southbound transit vehicles onto Portage from Langside.
- These new signals were not used, covered to motorists and partially uninstalled in 2016/2017, leaving two covered transit heads in place.
- The rationale for this work, that received Standing Policy Committee on Infrastructure Renewal and Public Works (SPCIRPW) approval, arose from the organizational priorities of Winnipeg Transit and the UW, rather than professional judgment on the part of the Branch or any formal guidance.
- Our review could not confirm why Winnipeg Transit did not ultimately use the Langside & Portage intersection, they did note various contextual factors that could have affected the decision-making in subsequent years. These factors included the relocation of a private bus service that had operated beside the UW campus, which created more room for Winnipeg Transit buses to operate on nearby streets, as well as the receipt of federal funding in approximately 2015 or 2016 to support development of a Transit Master Plan for Winnipeg.

Analysis

2.3.1 Changes to signals

- The timeline below shows the changes which occurred at the intersection as well as actions undertaken by the City.



Infrastructure Changes

- Installation of traffic signal infrastructure, including transit priority signals.
    - Prior to the work under discussion in 2012, this was a half-signalized intersection with pedestrian-activated signals controlling traffic on Portage and stop signs controlling right turns onto Portage from Langside. The intersection did not allow for left turns onto Portage from Northbound or Southbound Langside or through traffic crossing Portage along Langside.
    - In July 2012, in response to planned UW construction work that would require relocation of a Winnipeg Transit terminal, SPCIRPW approved a Public Service proposal, in consultation with Winnipeg Transit, that the Branch configure this intersection (including signals and median work) to re-route bus traffic such that left turns would be permitted from Southbound Langside onto Portage for buses only. This re-routing was recommended by a transportation consultant engaged by UW.
    - In October 2012, the Branch installed the new infrastructure, including transit priority signals for Southbound Langside traffic.
    - Subsequently, Winnipeg Transit advised the Branch that, while the terminal relocation would not be proceeding as planned, Winnipeg Transit would seek to negotiate an alternative arrangement that would eventually, and on an undefined timeframe, use the redesigned Langside & Portage intersection as contemplated for buses turning onto Portage.
    - Winnipeg Transit ultimately pursued another routing option that did not use this intersection as intended. Our review did not identify a point at which this decision was formally reached and/or communicated to the Branch.
- Change #1 – Partial removal of transit infrastructure.
    - The removal of part of this transit infrastructure in late 2016 or early 2017 appears to have been the result of an ad-hoc, informal, and undocumented enquiry from the Branch to Winnipeg Transit rather than a documented decision-making process and was not precipitated by specific management initiatives or operational needs.
    - We understand that the bagged transit priority signal heads that remained in place at the intersection at the time of our review were meant to be removed at the same time but appeared to have been overlooked due to a misunderstanding of the relevant construction design. The Branch intends to remove the remaining traffic signals initially intended for removal.

Guidelines and Consistency

- The work at this intersection appears to have been driven by organizational decision-making outside the Branch rather than by any design guidance or engineering judgment.
- SPC IRPW's approval was based on a Public Works report indicating that all costs associated with modifying these signals would be borne by the University of Winnipeg and that there would be no anticipated increase in annual maintenance costs as a result of the modification. The City invoiced UW for work at this intersection in June 2014 and received payment in full.

2.4 Breakaway Pole Bases

Background

- Historically, all traffic signal poles in the City are required to be mounted on a pole base with a breakaway base. A pole base refers to the concrete unit that sits in the ground, above which the breakaway base sits. A traffic signal pole sits on top of the breakaway base, all of which is anchored to the pole base through embedded anchor bolts.
- The breakaway base is used with the intention of being the first point of failure in a vehicle collision, increasing the likelihood that a pole will not be damaged and still be reusable. The breakaway base consists of a reaction plate that sits above the concrete base, and a set of couplings that then attach to a cantilever pole base. In the case of davit poles, a transition plate is also used above the breakaway base to connect to the bottom of the davit pole. A unique breakaway base is designed for each pole base type. Depending on the pole type, the breakaway base can appear as a 'small' or 'large' variety, as referred to in this report. Davit poles typically use the small breakaway bases.
- Additionally, a non-standard 'fixed' breakaway base type is available for the Branch design engineer to include in certain situations (e.g. poles with extra long arms). The fixed breakaway bases appear to be the same dimension as the small breakaway bases used.

Analysis

Infrastructure Changes

- As part of the Branch's introduction of cantilever poles into the City, new pole bases were designed to accommodate the larger and heavier cantilever poles. This is because the existing, smaller pole base most commonly used in the City cannot accommodate cantilever and davit poles.
- In parallel, the design of new breakaway bases occurred to accommodate cantilever poles on the new pole base types. The breakaway base design for the cantilever and davit poles are larger than the breakaway bases used throughout the City before cantilevers were introduced.
- We understand from the Branch that the design of cantilever poles and the associated pole bases and breakaway bases were designed around 2013-2014, and revisions to the design were made in subsequent years. The design of the breakaway bases occurred according to the pole designs.
- The breakaway bases used between davit poles and the older type of pole base shifted from a small to a large type. This occurred prior to 2018 as a result of a manufacturer of the breakaway bases reviewing their designs and updating the recommended breakaway base products for each type of pole base.
- When a new pole base is deemed to be required as part of a project involving signal poles, the new pole bases and breakaway bases are used. This can accommodate both davits and cantilevers. The Branch advised that pole bases and breakaway bases are replaced if specified during a reconstruction or rehabilitation project.
- The introduction of cantilever poles necessitated the use of larger pole bases and breakaway bases, which were then subsequently used when pole bases needed replacement. The use of larger pole bases to accommodate any type of pole in the future allows for the Branch to remain versatile in pole selection and potentially minimize future work.
- The Branch advised that the intent of moving towards using the larger pole base and breakaway bases is to occur opportunistically as pole base replacements occur and not retroactively as

standalone projects; therefore, the cost for the shift in practice may only be the difference in material cost of the pole base types.

Guidelines and Consistency

- TAC and internal Branch guidance does not speak to when to use a specific pole type and therefore decisions on pole types are left to the discretion of the implementing jurisdiction.
- Davit poles do not inherently require the large pole base and large breakaway base.
- The Branch advised that larger bases are installed under davit poles to accommodate cantilever poles if one would need to be installed in the future. This situation may arise in the event that the davit pole gets knocked down and needs replacement. As a result, some older davit poles in the City may be observed on the older, smaller breakaway bases, while some recently installed davit poles in the City may be seen on newer, larger breakaway bases.
- Additionally, if a pole base replacement is not warranted during a project, the City may exercise the option to install davit poles on the existing, smaller pole bases as a cost-saving measure instead of replacing the pole base and installing a cantilever pole.

2.5 Recommendations

<table>
<tr><td colspan="4">RECOMMENDATION 1</td></tr>
<tr><td colspan="4">An Asset Management Plan is created and effectively implemented. It is our understanding that the Branch is currently in the process of creating an Asset Management Plan specific to traffic signals infrastructure. It is recommended the Asset Management Plan being developed include what the Branch's overall asset strategy plan is and ensure that it is updated when necessary for changes in guidance and internal procedures. Elements of the plan should include procedures for the following:

• When updates should occur,
• Replacement of assets before the end of asset life, including when a cost-benefit assessment should occur, and
• Required levels of documentation.

The Asset Management Plan should be effectively communicated with other branches of the City that impact traffic signals infrastructure.</td></tr>
<tr><td>RISK AREA</td><td>Business Process</td><td>ASSESSMENT</td><td>High</td></tr>
<tr><td>BASIS OF ASSESSMENT</td><td colspan="3">Asset management plans outline how infrastructure investment can be directed to minimize lifecycle costs, at an acceptable level of risk, while delivering an expected level of service.</td></tr>
<tr><td colspan="4">MANAGEMENT RESPONSE</td></tr>
<tr><td colspan="4">Agree.
Traffic Signals asset management will be developed in accordance with the City of Winnipeg's Asset Management Policy F1-011 which will lead to a full cycle cost of maintenance and replacements.</td></tr>
<tr><td>IMPLEMENTATION DATE</td><td colspan="3">End of second quarter 2024</td></tr>
</table>

RECOMMENDATION 2			
Guidance on internal practices related to traffic signals infrastructure should be updated and regularly reviewed to ensure alignment with external guidance. The practices/guidelines should include a review period to ensure they reflect current practice and are aligned with all external guidance. Once the practice/guidelines are documented they should be effectively communicated internally and with other branches of the City that impact traffic signals infrastructure. It is our understanding that the Branch is currently undertaking an internal initiative, as directed by City Council, to develop a set of guidelines related to vehicle signal configuration.			
RISK AREA	Business Process	**ASSESSMENT**	High
BASIS OF ASSESSMENT	Formal guidance helps ensure a consistent approach to signals work and compliance with external guidance.		
MANAGEMENT RESPONSE			
Agree. Work has previously commenced on the Traffic Control Signals Design Guidelines which will formulate the framework for signal configuration. This guideline is planned for completions in 2023 and will be reviewed annually in conjunction with Transportation Association of Canada's (TAC) Manual of Uniform Traffic Control Devices of Canada (MUTCDC).			
IMPLEMENTATION DATE	End of first quarter 2023		

RECOMMENDATION 3			
Decisions are documented: The Branch should review the internal documentation practices to determine an optimal level of documentation to support signals project work. The guidance should define the minimum standard of documentation to support signals project work. The guidance must balance between the documentation of decisions and the creation of extraneous paperwork. Ultimately, the Branch should be able to demonstrate accountability to decision-makers for the works performed and monies expended.			
RISK AREA	Business Process	**ASSESSMENT**	Moderate
BASIS OF ASSESSMENT	Documenting signal work decisions supports transparency and accountability.		
MANAGEMENT RESPONSE			
Agree. Traffic Signals currently follows the City of Winnipeg's Asset Management Policy F1-011 and is in the process of implementing the framework from the City of Winnipeg's Project Management Manual 4.0.			
IMPLEMENTATION DATE	End of third quarter 2023		

APPENDIX 1 – Methodology

Mandate of City Auditor

The City Auditor is a statutory officer appointed by City Council under *The City of Winnipeg Charter*. The City Auditor is independent of the Public Service and reports directly to Executive Policy Committee, which serves as the City's Audit Committee.

The City Auditor conducts examinations of the operations of the City and its affiliated bodies to assist Council in its governance role of ensuring the Public Service's accountability for the quality of stewardship over public funds and for the achievement of value for money in City operations.

Once the report has been communicated to Council, it becomes a public document.

Scope

The work included developing an understanding of the industry and technological factors that influence the design and construction of intersection signal infrastructure. The scope of the work also included testing a sample of work performed at identified intersections. The scope did not entail a detailed costing of signals work undertaken by the Branch.

Approach and Criteria

The work performed in relation to this project does not constitute an audit conducted in accordance with Generally Accepted Government Auditing Standards (GAGAS). The work performed does conform to Audit Department standards for independence, objectivity and quality. We believe we have performed sufficient work in satisfaction that the evidence obtained provides a reasonable basis for our findings and conclusions.

An external contractor was engaged to provide supplemental resources with expertise in engineering, capital project works and forensics. We conducted research to understand the applicable governing laws, information systems, policies, procedures and practices undertaken in the Traffic Signals Branch related to intersection signal infrastructure change work. We also reviewed relevant industry guidance related to intersection signal infrastructure.

The background information was used to assess a sample of work performed at selected intersections. A set of risk criteria were used to select the intersection work to be tested.

The samples selected for testing were non-statistical, the results should not be used to draw any further conclusions. For tested intersections, we obtained and reviewed all available documentation from the Traffic Signals Branch including, but not limited to, project drawings, Traffic Signal request forms, cost estimates, work orders, damage reports, email correspondence and other miscellaneous documentation.