DISTRICT OF OAK BAY

PREPARED FOR: Committee of the Whole
FROM: Ed Robertson, Director Engineering and Public Works and Pierce Mimura, Manager of Engineering, Infrastructure, Maintenance, Analysis & Planning
MEETING DATE: May 21, 2024
SUBJECT: State of the Infrastructure (Report 1 of 2)

RECOMMENDATION(S)

THAT the report titled "State of the Infrastructure (Report 1 of 2)", co-authored by Pierce Mimura, Manager of Engineering, Infrastructure, Analysis, and Planning and Ed Robertson, Director of Engineering and Public Works dated May 21, 2024 be received.

EXECUTIVE SUMMARY OF REPORT

The State of the Infrastructure Report attached to this staff report is the initial presentation of a two-part series to Council. This first part outlines findings, issues, and recommendations regarding water, sanitary sewer, stormwater, roads, sidewalks, and streetlighting infrastructure based on engineering assessments and master plans. It also covers the application of engineering standards, specifications, and best practices related to identification of risks to municipal infrastructure, decision-making, methodologies used for prioritizing infrastructure projects, and overall scoring of each infrastructure type.

In Q3/Q4 2024, Staff will bring will forward the second part of the State of the Infrastructure Report to identify proposed solutions, financial analysis results from condition assessments, budgetary recommendations, staffing and operational considerations, and other pertinent information aimed at mitigating risks to the District's infrastructure and the impact on surrounding properties.

COUNCIL PRIORITY SUPPORTED

Livability

FINANCIAL IMPACT

N/A

IAP2 FRAMEWORK ENGAGEMENT

☒ **INFORM** ☐ **CONSULT** ☐ **INVOLVE** ☐ **COLLABORATE**

Respectfully submitted,

Ed Robertson, Director Engineering and Public Works
Pierce Mimura, Manager of Engineering, Infrastructure, Maintenance, Analysis & Planning

Reviewed and approved by the Director of Corporate Services.

Dianna Plouffe

Dianna Plouffe, Director of Corporate Services

I have read and consider staff's recommendation to be supportable for Council's consideration.

Selina Williams

Selina Williams, Chief Administrative Officer

ATTACHMENTS(S):
State of the Infrastructure Report (1 of 2)
PowerPoint_State of the Infrastructure_Report 1 of 2

State of the Infrastructure Report
Report 1 of 2

District of Oak Bay
May 2024

Glossary

The intention is to use standard terms that are recognized across the Engineering discipline. These definitions have been provided, courtesy of the Federation of Canadian Municipalities (FCM) and definitions commonly used by Staff:

Closed-Circuit Television Inspection (CCTV) - An inspection method utilizing a closed-circuit television camera system with appropriate transport mechanism to view the interior of storm and sanitary sewer mains.

Concern: Refers to something that is perceived as important or potentially problematic. It may indicate an area that requires attention, investigation, or action.

Fire Flow – The flow rate of a water supply system, measured at 20 psi residual pressure, that is available at the surrounding fire hydrants.

Hazard – The source of potential damage (an event, condition, action, or inaction)

Hydraulic Capacity (at Design) – Hydraulic capacity (at design) refers to the ability for a pipe to pass or maintain a given design flow rate. Flow is the actual amount of water, sewage, stormwater that is being moved through the pipe. Typically measured in Liters per Second (L/s). Hydraulic capacity is a function of pipe diameter, material, slope, and/or pressure (where in a pressurized system). Reduced hydraulic capacity can occur when constrictions occur in a pipe, such as a water pipe that has significant tuberculation (rust formation in a pipe).

Risk - The effect of uncertainty on objectives that is the combination of the likelihood that a hazard will occur and the consequence of the hazard

Risk Management - A structured and disciplined approach to identify and mitigate risk and reduce uncertainty in the achievement of organizational goals and objectives

Trenchless Technology - Techniques for utility line installation, replacement, rehabilitation with minimum excavation from the ground surface. These include processes such as Cement Mortar Lining, Epoxy Lining, Pipe Bursting, Horizontal Drilling, Cured-in-Place Pipe, and Micro-Tunneling.

Tables and Figures

The following Tables and Figures can be found within this State of the Infrastructure Report.

Tables

Figures

Introduction

The focus of this report is to provide an update on the state of the infrastructure within the District of Oak Bay. This report complements the District's 2021 *Sustainable Infrastructure Replacement Plan* and expands on the groundwork laid by the previous Council and the diligent efforts of Staff. It emphasizes the necessity of long-term financial planning for sustainable infrastructure renewal and its implications on surrounding properties and infrastructure.

This report is the initial presentation of a two-part series to Council. This first part will outline the findings, issues, and recommendations regarding water, sanitary sewer, stormwater, roads, sidewalks, and streetlighting infrastructure based on engineering assessments and master plans. It also covers the application of engineering standards, specifications, and best practices related to identification of risks to municipal infrastructure, decision-making, methodologies used for prioritizing infrastructure projects, and overall scoring of each infrastructure type. In Q3/Q4 2024, Staff will bring will forward the second part of the State of the Infrastructure Report to identify proposed solutions, financial analysis results from condition assessments, budgetary recommendations, staffing and operational considerations, and other pertinent information aimed at mitigating risks to the District's infrastructure and the impact on surrounding properties based on a full risk analysis. Staff are actively assessing and reviewing other items such as the beach access stairs, Bowker Creek walkway railings, and foreshore erosion protection, however, these infrastructure projects are out of scope of this report.

In the past, assessments of infrastructure were often incomplete or lacking detail. This gap in evaluation meant that crucial factors such as main material, size, age, and maintenance history may not have been adequately considered in decision-making processes, resulting in a reactive approach to capital planning and maintenance management. Without comprehensive assessments, there are indications that past Staff struggled to identify and prioritize infrastructure in need of replacement that would be part of a comprehensive planning process.

Staff's current approach is to employ a systematic and rigorous process to assess and identify deficiencies in the infrastructure that need to be addressed though the completion of condition assessments and master plans in addition to Staff observations, which includes routine inspections, maintenance, and analysis. This process allows Staff to identify deficiencies, hazards, and risks to municipal infrastructure in a manner that is comprehensive, estimates the investment required, and can help identify interdependencies, such as physical overlap, shared physical deterioration, and/or long-term planning to accommodate future land-use planning changes. Once the process is complete, infrastructure maintenance, monitoring, rehabilitation, or replacement strategies can be implemented in an integrated manner.

The District has aging infrastructure across its core asset classes, much of which is nearing, or beyond, the end of their useful life or in poor condition. However, the District is not alone in facing the challenge that the services it provides continues to meet the community's expectations. In 2019, the Canadian government published a report titled "Canadian Infrastructure Report Card" which provided an objective look at the state of core public infrastructure assets across Canada. The report concluded that "a concerning amount of municipal infrastructure across the country is in poor or very poor condition". To address infrastructure planning challenges, guidance on complex decision-making and best practices related to infrastructure planning and analysis for this report utilizes key recommendations from the following documents:

1) Planning and Defining Municipal Infrastructure Needs (FCM 2003) published by the Federation of the Canadian Municipalities.
2) A Framework for Municipal Infrastructure Management for Canadian Municipalities (NRC 2006) published by the National Research Council of Canada.

The approach to infrastructure management is well documented and established by the Federation of Canadian Municipalities (FCM) and they have built a framework for municipalities to follow to begin to understand what is needed to spend the correct amount of resources to manage their core asset classes.

This report has been broken down into five parts, as follows:

Part 1: Findings and Recommendations to Council

Present findings and recommendations for water, storm, sewer, roads, sidewalks, and streetlighting infrastructure based on Staff observations and condition assessments and master plans, that have been completed by licensed engineering consultants.

Part 2: Application of Engineering Standards, Specifications, and Best Practices

Communicate the application of engineering standards, specifications, best practices, and regulatory requirements used to inform decision-making processes regarding infrastructure planning and analysis.

Part 3: Overview of Risks to Municipal Infrastructure

Provide an overview of the risks to municipal infrastructure by utilizing data from recent condition assessments and master plans to identify vulnerabilities and hazards within the District's infrastructure.

Part 4: Staff's Infrastructure Prioritization Methodology

Describe the general approach used to prioritize infrastructure projects that outlines the criteria and methodology used to prioritize underground and surface infrastructure based on best practices and recommendations from condition assessments and master plans.

Part 5: State of the Infrastructure Results and Next Steps

Provide a final score using a five-star rating scale for each infrastructure category to summarize the number and severity of infrastructure issues and challenges. Summarize the top concerns in this report and describe the steps that will be taken in the next report.

Part 1: Findings and Recommendations to Council

Infrastructure Overview and Reports

Water Infrastructure

The District's water distribution system is comprised of 115 km of mains, 6,013 service connections, 1,098 valves, 497 hydrants, 2 pressure reducing valve stations, and 4 pump stations and is supplied by potable water from Sooke Lake Reservoir via the Regional Water Supply System operated by the Capital Regional District (CRD.) In 2019, the District retained Kerr Wood Leidal Associates Ltd. (KWL) to prepare a Water Supply Master Plan. This report was completed and provided to the District in 2021.

Sanitary Sewer Infrastructure

The District's sanitary sewer system is comprised of 97 km of gravity mains, 2 km of force mains, 8 lift stations, 1,600 manholes, and 5,800 laterals/services. The District has 13 catchment areas where sewage is directed to the Capital Regional District's major trunk sewers, which is further directed to the CRD Clover Point Pump Station and ultimately the McLoughlin Point Wastewater Treatment Plant. In 2020, the District retained GeoAdvice Engineering Inc. (GeoAdvice) to prepare a Sanitary Sewer Master Plan. This report was completed and provided to the District in 2022.

Stormwater Infrastructure

The District's stormwater system is comprised of 141 km of gravity mains, 5,438 laterals/services, 1,306 manholes, 37 outfalls, and 2 lift stations. In 2022, the District retained GeoAdvice Engineering Inc. (GeoAdvice) to prepare a Storm Drain Master Plan. This report is still in progress and is expected to be completed by Q3 of 2024.

Road Infrastructure

The District's road network is comprised of approximately 100 km of paved roads, comprising of arterial, special, collector, and local roads. In 2023, the District retained Tetra Tech Canada Inc. (Tetra Tech) to conduct a full network pavement condition assessment and prepare a Pavement Management Plan. This report was completed and provided to the District in 2024.

Sidewalk and Curb Infrastructure

The District's sidewalk and curb network is comprised of approximately 112 km of sidewalk and 162 km of curb. In 2024, the District retained MPE a division of Englobe (MPE) to undertake a comprehensive sidewalk and curb rehabilitation program to assess the condition of the network and to prepare a Sidewalk and Curb Assessment Report. This report was completed and provided to the District in 2024, and will be presented to Council in Q2 of 2024.

Streetlight and Traffic Signal Infrastructure

The District's lighting infrastructure is comprised of approximately 2,800 street light and traffic signal assets, including 9 signalized intersections. In 2023, The District retained PBX Engineering Ltd. (PBX) to perform structural assessments of its streetlight and traffic signal inventory and to prepare a Condition Assessment Report. This report was completed and provided to the District in 2024.

Useful Life of Municipal Infrastructure

The age of the water, sanitary sewer, and storm system reflects the development history intrinsic to the District.

The expected useful life of components within the municipal system varies and are dependent on many factors, including soil conditions, design and construction practices of the day, and maintenance history of the component. There is no accepted standard for the average age of these systems, however, when lifespans are known, insights into the condition of the infrastructure can be inferred.

Typical expected useful life of infrastructure within the District's system can be found in Table 1.

Table 1: Typical Expected Useful-Life of Municipal Infrastructure

Component	Useful Life Range (Years)	Source/Citation*
Asbestos Cement Main	40 to 70	IPWEA
Cast Iron Main	50 to 100	IPWEA
Ductile Iron Main	50 to 100	IPWEA
Polyvinyl Chloride (PVC) Main	50 to 100	IPWEA
Steel Main	80 to 100	City of Toronto
Concrete Main	40 to 100	IPWEA
Vitrified Clay Main	50 to 100	IPWEA
Pumps	15 to 30	IPWEA
Valves	30 to 50	IPWEA
Concrete Vaults	40 to 80	IPWEA
Local Roads (Pavement Surface)	50 to 100	IPWEA
Collector Roads (Pavement Surface)	40 to 60	IPWEA
Arterial Roads (Pavement Surface)	30 to 50	IPWEA
Sidewalks and Curbs	50 to 80	IPWEA
Streetlights	75	City of Edmonton

*IPWEA (Institute of Public Works Engineering Australasia)
*City of Toronto: Toronto's Water's Infrastructure Renewal Backlog Staff Report
*City of Edmonton: Streetlighting FAQ and Neighbourhood Renewal

Mains can fail in a multitude of ways, for example, ductile iron pipe can fail via corrosion through holes, asbestos cement mains can fail through circumferential cracking and/or longitudinal splits. As shown in the photos below, mains within the District's system can have different issues associated with them, all of which reduce the useful life of the main.

Photo 1: Tuberculation (rust) inside 150 mm (6”) water main, evidence of reduced hydraulic capacity.

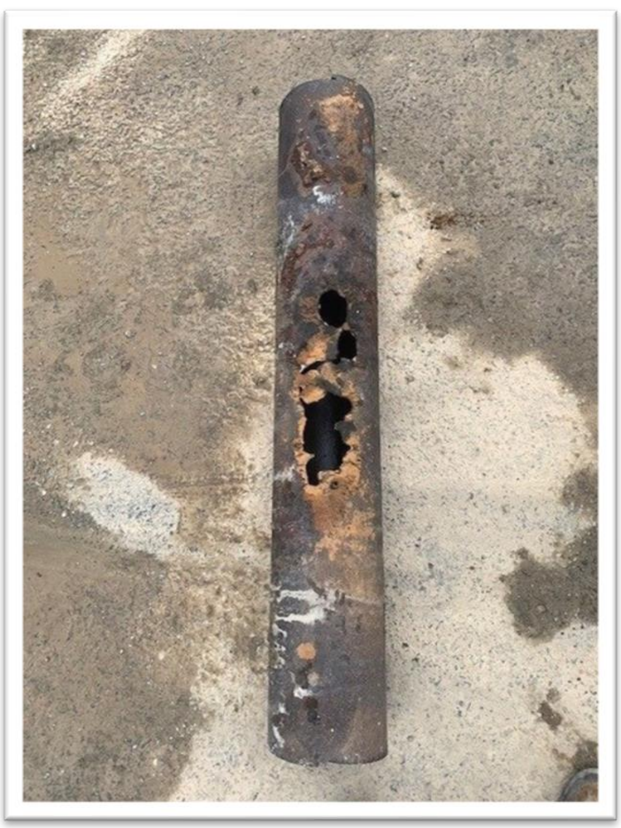


Photo 2: 1980’s ductile iron main showing signs of severe corrosion, resulting in holes in the water main.

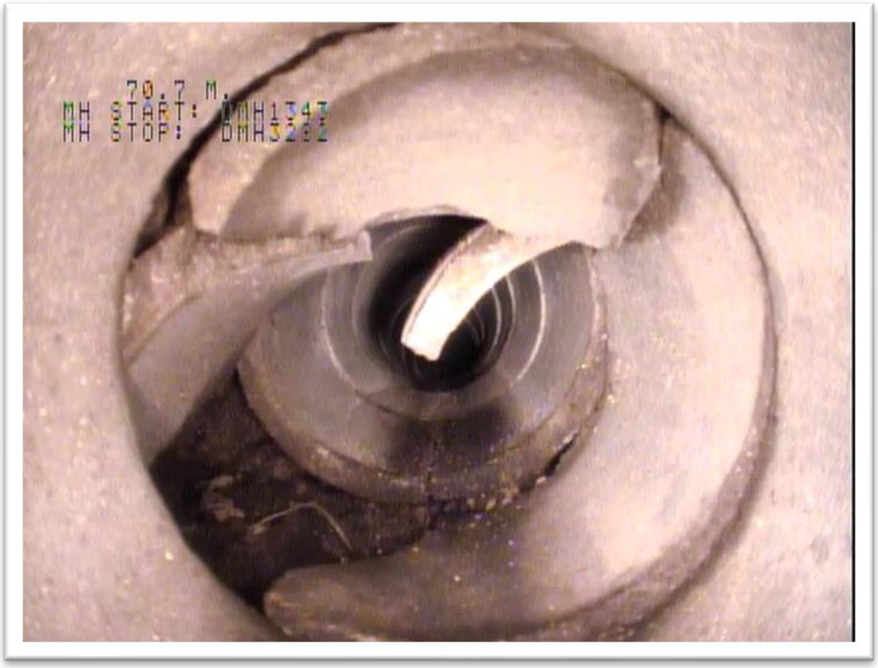


Photo 3: Broken main, evidence of severe fractures and circumferential cracking. Found in sanitary sewer and stormwater mains.

Photo 4: Root mass within the main that is creating a severe blockage. Roots can cause further cracking and reduce the overall structural integrity of the main. Found in sanitary sewer and stormwater mains.

Concern Level Matrix: Assessing Findings, Issues, and Recommendations

Findings, Issues, and Recommendations within this report are presented based on the condition assessments, master plans, and Staff observations. The following, five-point colour-coded Likert scale as shown on Table 2 is used to illustrate the level of concern. The Likert scale terms presented below have been adopted from Sorrel Brown, Iowa State University to provide clarity.

Table 2: Concern Level Matrix for Findings and Recommendations

Very High Concern
Very important for operations of infrastructure system, and/or extremely costly to repair/rehabilitate, and/or very important to meet long-term strategic objectives.
High Concern
Important for operations of infrastructure system, and/or very costly to repair/rehabilitate, and/or important to meet long-term strategic objectives.
Medium Concern
Fairly important for operations of infrastructure system, and/or moderately costly to repair/rehabilitate, and/or fairly important to meet long-term strategic objectives.
Low Concern
Slightly important for operations of infrastructure system, and/or slightly costly to repair/rehabilitate, and/or slightly important to meet long-term strategic objectives.
Very Low Concern
Not important for operations of infrastructure system, and/or little cost to repair/rehabilitate, and/or not important to meet long-term strategic objectives.

It's important to note the distinction of "concern" and "risk" used within this report. While they are related concepts, they differ:

- **Concern**: Concern refers to something that is perceived as important or potentially problematic. It may indicate an area that requires attention, investigation, or action. Concerns can range from very low to very high and may be based on factors such as observations, analysis, or assessments.
- **Risk**: Risk refers to the potential for harm, loss, or negative consequences associated with a particular action, decision, event, or condition. It involves the likelihood of an undesirable outcome occurring and the severity of its impact if it does happen. Risks are typically evaluated based on factors such as probability, consequence, and potential mitigation measures.

Water Infrastructure

The Water Supply Master Plan and Staff observations indicated several crucial findings regarding the condition and capacity of the District's water infrastructure. Key findings, issues, and recommendations for the water system are provided in Table 3.

The findings presented below include various insights, such as the identification of 16% (19 km) of the water system consisting of mains 100 mm or smaller, or the percentage of mains that are a certain material type (such as asbestos cement or cast iron). While there isn't a universally applicable benchmarking figure for this type of data, engineering guidelines and standards from organizations like the American Water Works Association (AWWA) and Master Municipal Construction Documents (MMCD) provide recommendations for new water main sizing, installation methods, and material selection. For example: new water main installations are typically installed with PVC or ductile iron main material and are recommended to be a minimum size of 200 mm, with minor exceptions in cul-de-sacs.

Guidelines and best practices consider factors such as anticipated flow rates, pressure requirements, and service area characteristics/topographies to ensure that water mains are appropriately sized for performance and reliability for domestic use, such as washing dishes and to provide enough flow for hydrants during the event of a fire. Other benchmarks, such as best practices around replacing pumps in pump stations are more established (typically replacement of pumps every 15 to 30 years).

Table 3: Findings and Recommendations for Water System

Very High Concern		
Key Finding	**Issue**	**Recommendation**
The water system is supplied from one source: the CRD Transmission Main #3 connection at Foul Bay Road and Lansdowne Road.	There are two emergency, backup historical water supply connections to neighbouring municipalities, however, these need to be re-established and need to be properly designed.	Work with District of Saanich and City of Victoria to establish connections for redundant water supply.
Most of the supply to the Oak Bay water system flows through the Lansdowne Pressure Reducing Valve (PRV) station and through an aging 1950's large diameter (500 mm) steel main on Lansdowne Road.	The PRV station is in poor condition due to its age. Structural and mechanical concerns. Operational failure and widespread service disruption. Steel main is prone to corrosion, leaks, and breaks, due to its age.	Planning to replace PRV station in the next 5 years. Possible trenchless technologies to extend the life of the large diameter steel main.
Undersized mains • 16% (19 km) of the system is 100 mm or smaller	Tuberculation is reducing the capacity in 100 mm or smaller diameter mains for domestic use and hydrants are not able to be installed on these small diameter mains, which results in firefighters having to connect to hydrant infrastructure that is further away on adjacent streets.	Prioritize replacement of smaller diameter mains in the system

17% (19 km) of water mains are asbestos cement.	These mains have deterioration issues, are past their useful life, are prone to breakage, leakage, and can become damaged as they age due to their material composition. Expensive to replace due to additional regulatory requirements and can release fibers if they are damaged or disturbed during construction activities. See the **Important Note** below Table 1 for information from Health Canada.	Prioritize replacement of asbestos cement mains.
High Concern		
Key Finding	**Issue**	**Recommendation**
Modelling indicates that some larger mains may be undersized due to location/topographical considerations. (homes located at higher elevations may have low pressure or flow).	Existing mains may not be sized to accommodate new development/demand. Also modelling shows need for increased size for improved system redundancy of the overall network.	• Prioritize where the Water Supply Master Plan identifies upgrades to mains within the system. • For new water main upgrades, the minimum main size recommended is 200 mm diameter except where the main terminates in a short residential cul-de-sac and a 150 mm diameter main can provide the required fire flow protection.
There are structural and mechanical concerns related to the operation of the Pump Stations and Pressure Reducing Valve (PRV) stations.	Operational failure. Service disruptions and increased costs to maintain.	Replace and upgrade mechanical equipment that is past its useful life. Implement more aggressive maintenance program.
Medium Concern		
Key Finding	**Issue**	**Recommendation**
GIS data indicates that 14% (17 km) of the water mains in Oak Bay are 100 years or older.	As the water system ages the number of breaks is expected to increase and the mains are more susceptible to leakage, increased corrosion, and reduced hydraulic capacity due to tuberculation.	Prioritize replacement of older mains in the system or rehabilitate using trenchless technologies, where possible.
No pump stations have emergency power or a plug for a generator.	Service disruptions in the event of power loss.	Conduct a study to review the existing power supplies, and requirements for emergency power.

The age and condition of water mains and appurtenances continue to degrade at a faster rate than capital projects can keep pace with.	Increased capital, maintenance costs and more leaks/breaks, potential flooding, legal claims, and unscheduled repairs.	Increase maintenance activities and deploy trenchless technologies to extend the life of water mains, where possible. Determine when replacement should be done.
Ductile Iron mains have been experiencing more breaks than expected in the last few years.	Staff are required to perform emergency repair work and this pulls Staff from scheduled work and further delays projects and other planned maintenance activities.	Continue to monitor and respond to water main breaks as they occur. Document where the break is occurring, approximate, age, material, and size of main.
Low Concern		
Key Finding	**Issue**	**Recommendation**
53% (61 km) of the mains are cast iron in the system.	Cast iron mains are vulnerable to "graphitic corrosion" which results in a brittle/weaker main structure over time	Non-structural and semi-structural rehabilitation methods may be recommended using trenchless technologies such as epoxy lining, cement mortar lining, etc.
Very Low Concern		
Key Finding	**Issue**	**Recommendation**
Not applicable	Not applicable	Not applicable

Important Note from Health Canada

Health Canada maintains there are no health concerns associated with drinking asbestos fibers. "There is no consistent, convincing evidence that ingested asbestos is hazardous. There is, therefore, no need to establish a maximum acceptable concentration (MAC) for asbestos in drinking water," according to the Guidelines for Canadian Drinking Water Quality: Guideline Technical Document.

Figures 1 to 3 illustrate the main age, material composition, and size of mains within the District's water system. Percentages are approximate and are rounded.

Figure 1: Water System Age

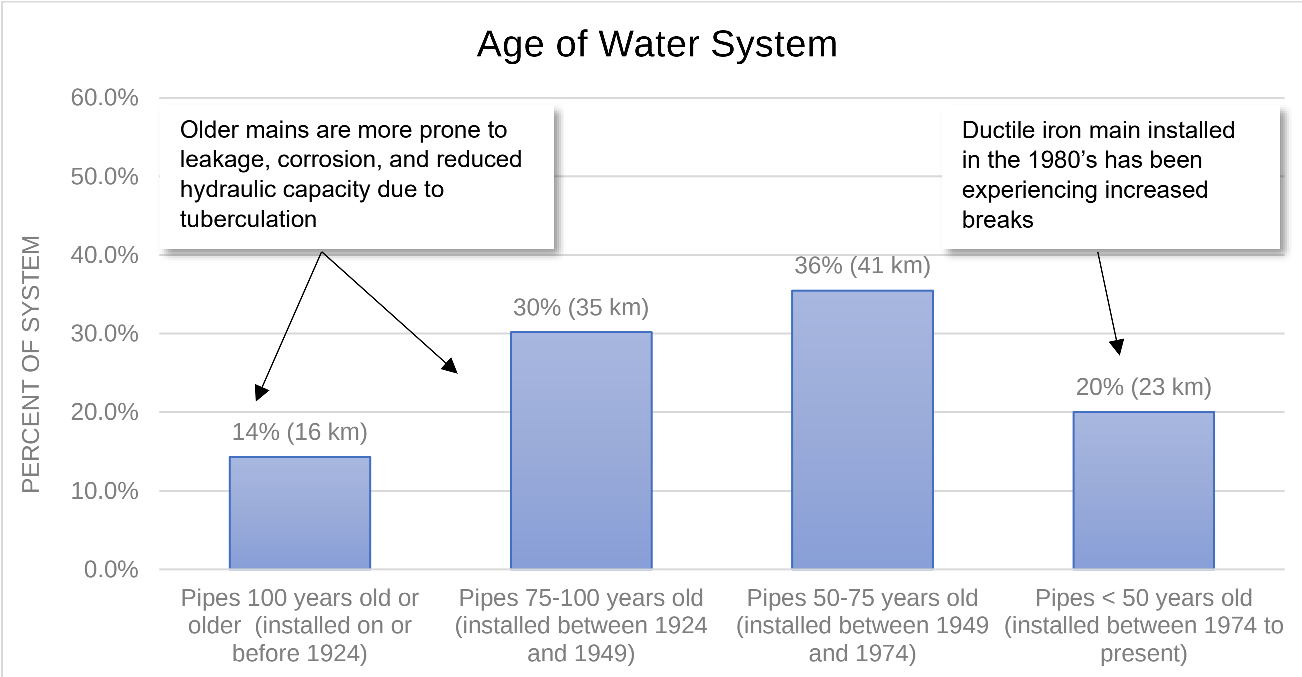


Figure 2: Water System Material

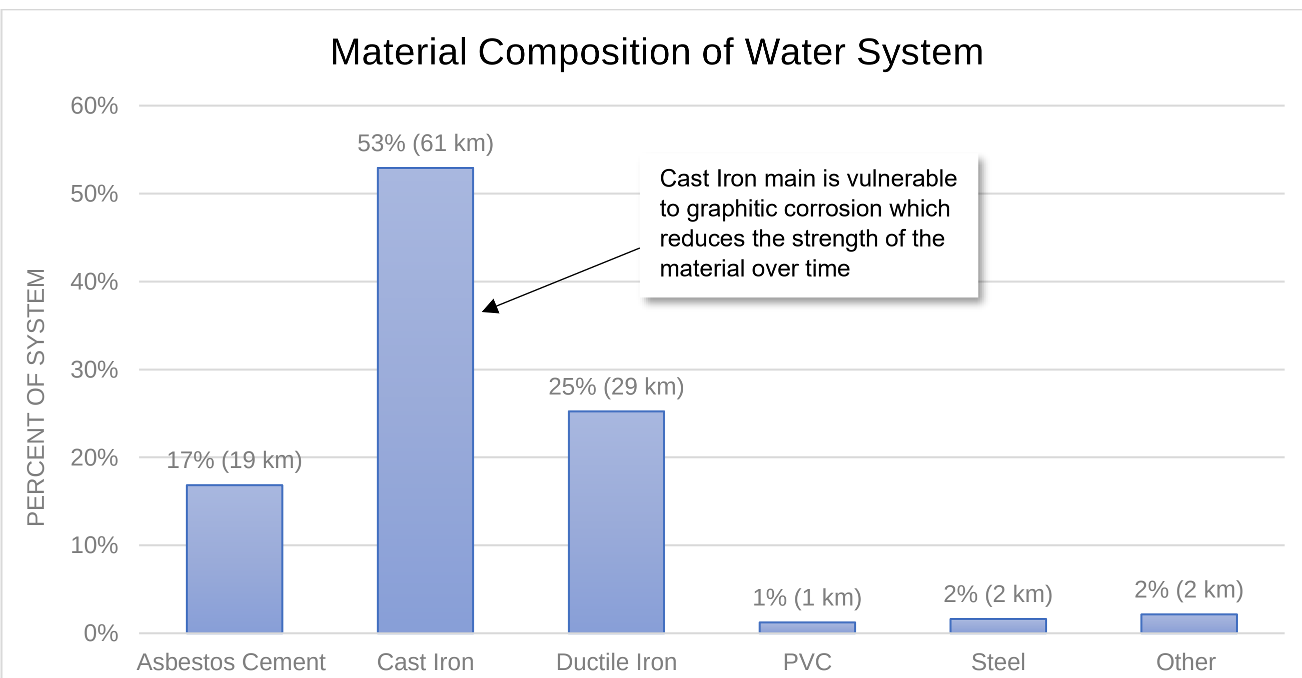
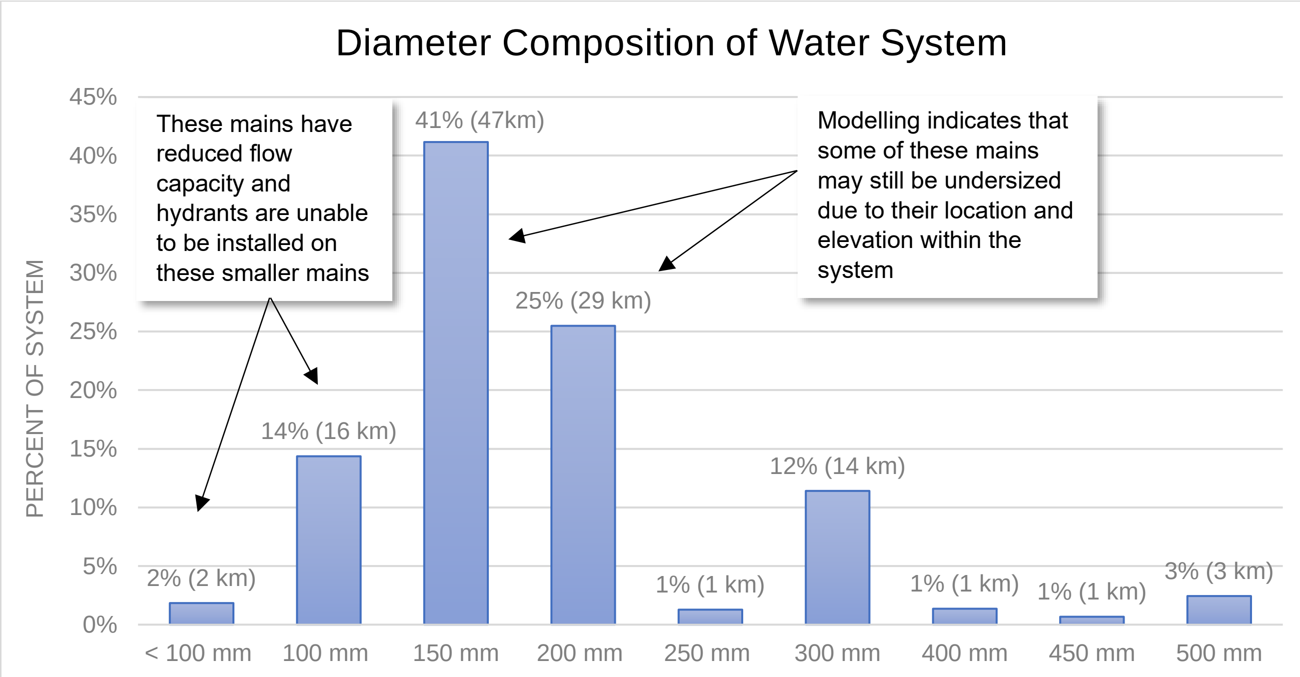


Figure 3: Water System Size



Sanitary Sewer Infrastructure

The Sanitary Sewer Master Plan and Staff observations indicated several crucial findings regarding the condition and capacity of the District's sanitary sewer infrastructure. Key findings, issues, and recommendations for the sanitary sewer system are provided in Table 4.

The findings presented below include various insights, such as the identification of 8% (8 km) of the sanitary sewer system consisting of mains 150 mm or smaller, or the percentage of mains that are a certain material type (such as asbestos cement or vitrified clay). While there isn't a universally applicable benchmarking figure for this type of data, engineering guidelines and standards from organizations such as Master Municipal Construction Documents (MMCD) provide recommendations for new sewer main sizing, installation methods, and material selection. For example: new sewer main installations are typically installed using PVC main material and are recommended to be a minimum size of 200 mm.

Table 4: Findings and Recommendations for Sanitary Sewer System

Very High Concern		
Key Finding	**Issue**	**Recommendation**
The majority of the sewer system is separated (sewer is separate from the storm main) with the exception of two catchments, Humber and Rutland that are still maintained as combined sanitary and storm sewers.	Combined sewer systems where both sewage and stormwater flow through the same main can become overwhelmed during heavy rain events and result in sewage overflowing into the ocean, which results in environmental damage and risks to public health. There is also increased costs borne by the District to treat stormwater at the Sanitary Sewer Wastewater treatment plant operated by CRD.	Separate combined sewer systems. *Ongoing work starting in May 2023 within the Humber catchment to separate the storm and sanitary system*
23% (23 km) of sewer mains are asbestos cement.	These mains have deterioration issues, are past their useful life, are prone to breakage, leakage, and can become damaged as they age due to their material composition. Expensive to replace due to additional regulatory requirements and can release fibers if they are damaged or disturbed during construction activities.	Prioritize replacement of asbestos cement mains.
High Concern		
Key Finding	**Issue**	**Recommendation**
Mechanical and/or electrical components of the lift stations (Radcliffe, Satellite, Bowker, King George Terrace) are in poor condition.	Operational failure, increased costs for Staff to maintain and service disruptions.	Replace mechanical and/or electrical components. Implement a more aggressive maintenance program.
Some mains are undersized: • 8% (8km) of the system are 150 mm or smaller • Modelling indicates that some mains that are larger may still be undersized due to elevation within the system or sewage inflow considerations.	Smaller diameter mains could not be inspected by CCTV due to their size and were not included in the risk assessment completed by GeoAdvice. Capacity issues within the system were identified, which could result in sewage overflows resulting in risk to property, environmental, and harm to public health.	Using acoustic sewer inspection (SL-RAT) to do a rapid assessment in absence of data and monitor problem areas. New main upgrades are recommended to be a minimum of 200 mm. Replace smaller mains.

Many mains are located in easements in back and side yards. Some mains are located under homes and some mains on properties are not in registered easements.	This creates an issue for Staff to maintain and they are more expensive to repair due to their location and proximity to homes. Access to some mains is an issue.	Implement trenchless technologies to line mains, if feasible, to extend the useful life of the main. Otherwise, use conventional open-cut excavations. Add access points/cleanouts.
33% (33 km) of the system is approximately 100 years old or older.	Older mains are vulnerable to failure and can become cracked, broken, or collapsed.	Prioritize replacement of older mains in the system. Rehabilitate using trenchless technologies, where possible.
Medium Concern		
Key Finding	**Issue**	**Recommendation**
The majority of the sewer system is separated (sewer is separate from the storm main) with the exception of two catchments, Humber and Rutland that are still maintained as combined sanitary and storm sewers.	Combined sewer systems where both sewage and stormwater flow through the same main can become overwhelmed during heavy rain events and result in sewage overflowing into the ocean, which results in environmental damage and risks to public health. There is also increased costs borne by the District to treat stormwater at the Sanitary Sewer Wastewater treatment plant operated by CRD.	Separate Rutland combined sewer system. Increase reserve funding and planning to undertake Phase 2 (final) of the Uplands Sewer Separation project.
51% (51 km) of the system is comprised of Vitrified Clay main, which is typical for the age of the system.	Camera inspections and maintenance activities on these mains indicate they are more prone to root infestation, increased blockages, which can result in collapsed mains.	Monitor and replace Vitrified Clay main with newer main materials such as PVC. Deploy root cutting maintenance activities and increase preventative maintenance programs.
Rain enters the sanitary system during rainfall events (this is called Inflow and Infiltration) and can be an indicator for where cross-connections from storm services exist and leakage in adjacent mains. Every monitored catchment within the District experiences significant and excessive levels of inflow and infiltration, generally 2.5 to 6.8 times the Capital Regional District target.	Probable sources include cross connections, cracked infrastructure, and combined sewers – inflow and infiltration is a problem because it reduces the downstream capacity of the CRD treatment plant to treat sewage and results in higher costs to the District to treat rainwater in sanitary sewer system.	Separate combined sewers. Conduct smoke testing program to confirm areas of cross connections, if found: action is necessary to eliminate it. This typically involves disconnecting the cross connected services to prevent unwanted stormwater (or sewage) entering into the wrong main (sewage into storm main or stormwater into sanitary main). Continue to monitor inflow and infiltration into the system

		and key monitoring points. Implement a long-term temporary flow monitoring program to assess Inflow and Infiltration within the system and continue to inspect sanitary sewer mains and monitor condition using CCTV and SL-RAT (acoustic sewer inspection) technologies. Line deteriorated mains, if feasible.
Low Concern		
Key Finding	**Issue**	**Recommendation**
Information provided to consultant to prepare the Sanitary Sewer Master Plan was taken from old record drawings and incomplete CCTV assessments.	Inaccuracies may exist as a significant amount of data was inferred or taken from old record drawings to complete the Master Plan Study.	Verification of physical characteristics should be considered before upgrades are undertaken at the project level.
Very Low Concern		
Key Finding	**Issue**	**Recommendation**
With the existing population base of Oak Bay, the sewage generated per capita is within a normal range for smaller sized municipalities in British Columbia.	No concern.	Continue monitoring sewage generation trends.

Figures 4 to 6 illustrate the main age, material composition, and size of mains within the District's sanitary sewer system. Percentages are approximate and are rounded.

Figure 4: Sanitary Sewer System Age

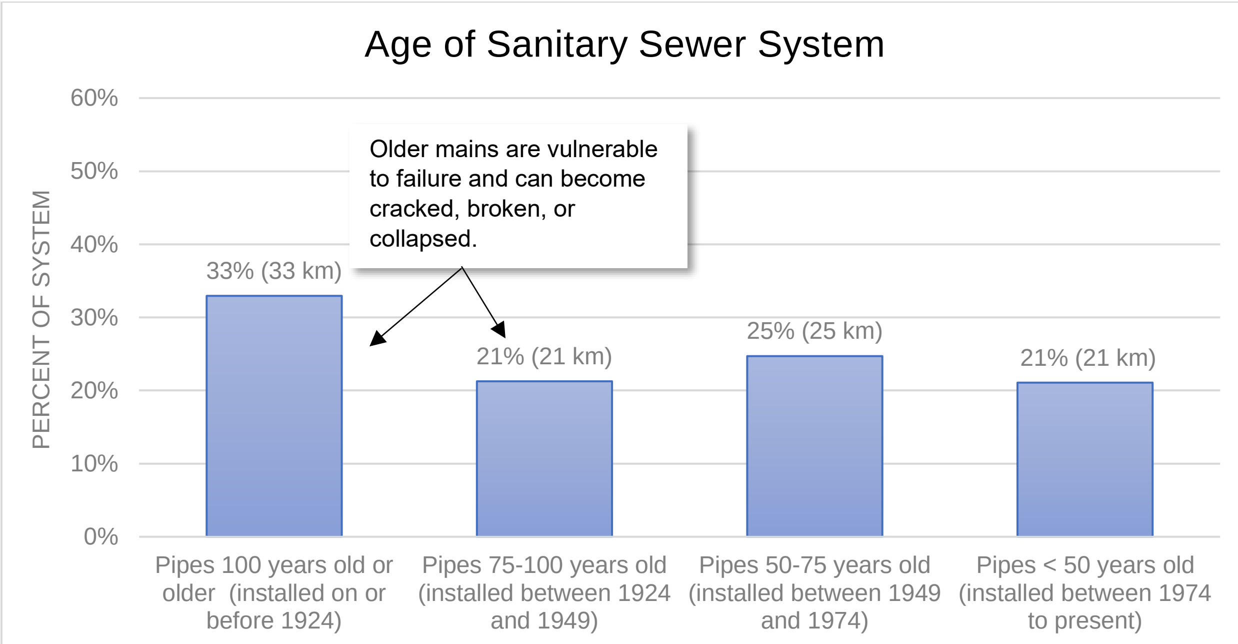


Figure 5: Sanitary Sewer System Material

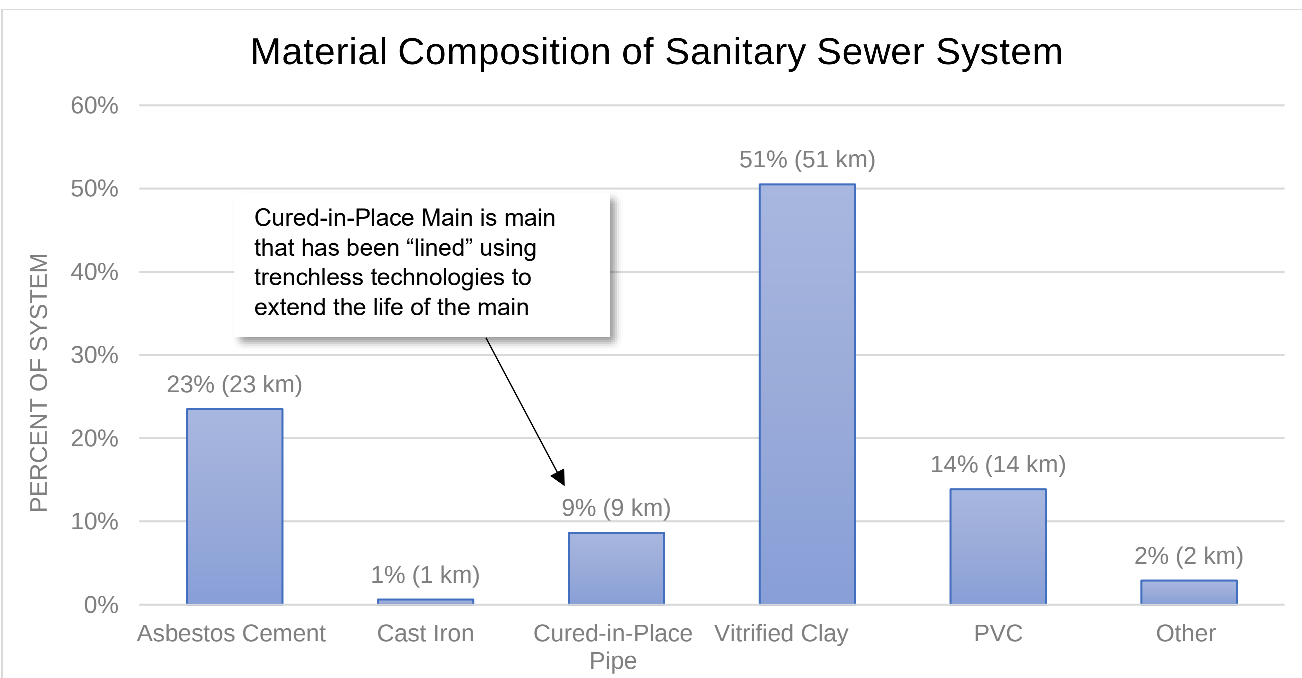
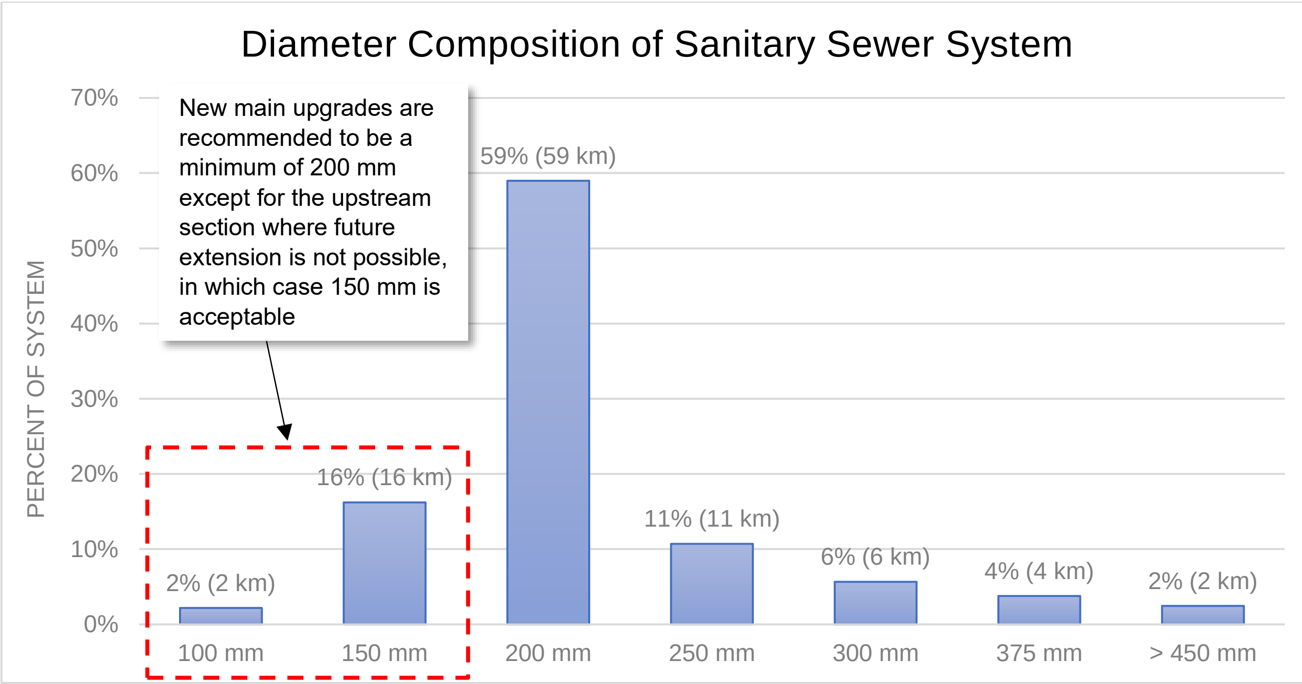


Figure 6: Sanitary Sewer System Size



Stormwater Infrastructure

The Storm Drain Master Plan is in progress, however, preliminary discussions with the consultant and Staff observations indicated several crucial findings regarding the condition and capacity of the District's stormwater infrastructure. Key findings, concerns, and recommendations for the stormwater system are provided in Table 5.

The findings presented below include various insights, such as the identification of 12% (16 km) of the stormwater system consisting of mains 150 mm or smaller, or the percentage of mains that are a certain material type (such as vitrified clay). While there isn't a universally applicable benchmarking figure for this type of data, engineering guidelines and standards from organizations such as Master Municipal Construction Documents (MMCD) provide recommendations for new storm main sizing, installation methods, and material selection. For example: new storm main installations are typically installed using PVC main material and are recommended to be a minimum size of 250 mm.

Table 5: Findings and Recommendations for the Stormwater System

Very High Concern		
Key Finding	**Issue**	**Recommendation**
Capacity issues exist within the system across the District due to inadequate depths and slopes of the mains.	Some stormwater outfalls are not deep enough. This creates an issue as replacement of storm mains "like for like" or one size larger is not the solution. Localized flooding issues cannot be easily solved as the impact is due to downstream flow conditions. Moreover, due to shallow depths of storm mains in the roadway, it is difficult for full height basements that are connected to the storm system via a lateral connection to flow by gravity.	Begin replacing storm mains at the most downstream end of the system first (i.e. where the main discharges at an outfall to the ocean) and work up from there. This will allow for replacement of "typical" two mains on each boulevard with one deeper one near the center of the road.
High Concern		
Key Finding	**Issue**	**Recommendation**
Some mains are undersized: • 12% (16 km) of the system are 150 mm or smaller • Modelling indicates that some mains that are larger may still be undersized due to elevation within the system or stormwater inflow considerations.	Small diameter mains have reduced hydraulic capacity, thus are more vulnerable to creating flooding issues.	New main upgrades are recommended to be a minimum of 250 mm.
Many mains are located in easements in back and side yards. Some mains are located under homes and some mains on properties are not in registered easements.	This creates an issue for Staff to maintain and they are more expensive to repair due to their location and proximity to homes. Access to some mains is an issue.	Implement trenchless technologies to line mains, if feasible, to extend the useful life of the main. Otherwise, use conventional open-cut excavations. Add access points/cleanouts. Register easements where possible.
27% (35 km) of stormwater mains are at least 100 years old.	Older stormwater mains are more vulnerable to failure due to deterioration over time, which can lead to increased risk of flooding.	Prioritize replacement of older stormwater mains or rehabilitate using trenchless technologies, where possible.
Medium Concern		
Key Finding	**Issue**	**Recommendation**
Storm mains are commonly located on both sides of the street.	Having multiple storm mains on one street is atypical for a residential street. This adds cost to the project to remove or decommission multiple mains before installing a new single main.	For new main upgrades, where possible, install a single storm main that conveys stormwater in the middle of the road.

Storm mains are commonly located under large boulevard trees.	Tree root infestation into storm mains is an issue across the District. Approximately 64% (84 km) of the system is Vitrified Clay, which is vulnerable to root intrusion at the joints of mains. This is a significant maintenance issue for Staff.	Enhance a root cutting program that targets the worst mains within the system on a regular basis. Replace mains that are past their useful life or have collapsed. Develop database to schedule and track progress and reduce backups and claims.
2% (3 km) of storm mains are asbestos cement.	These mains have deterioration issues, are past their useful life, are prone to breakage, leakage, and can become damaged as they age due to their material composition. Expensive to replace due to additional regulatory requirements and can release fibers if they are damaged or disturbed during construction activities.	Prioritize replacement of asbestos cement mains.
Low Concern		
Key Finding	**Issue**	**Recommendation**
The District has an estimated 37 storm drain outfalls that discharge stormwater into the ocean.	Stormwater outfalls need regular maintenance and monitoring. Due to their location and proximity to homes, they can impact private property if they fail (ex. rock slides, sink holes, etc.).	Review maintenance protocols, standards, and increase maintenance and monitoring at stormwater outfalls to assess performance.
Information provided to consultant to prepare the Strom Drain Master Plan was taken from old record drawings and incomplete CCTV assessments.	Inaccuracies may exist as a significant amount of data was inferred or taken from old record drawings to complete the Master Plan Study.	Verification of physical characteristics should be considered before upgrades are undertaken at the project level.
Very Low Concern		
Key Finding	**Issue**	**Recommendation**
Not applicable	Not applicable	Not applicable

Figures 7 to 9 illustrate the main age, material composition, and size of mains within the District's stormwater system. Percentages are approximate and are rounded.

Figure 7: Stormwater System Age

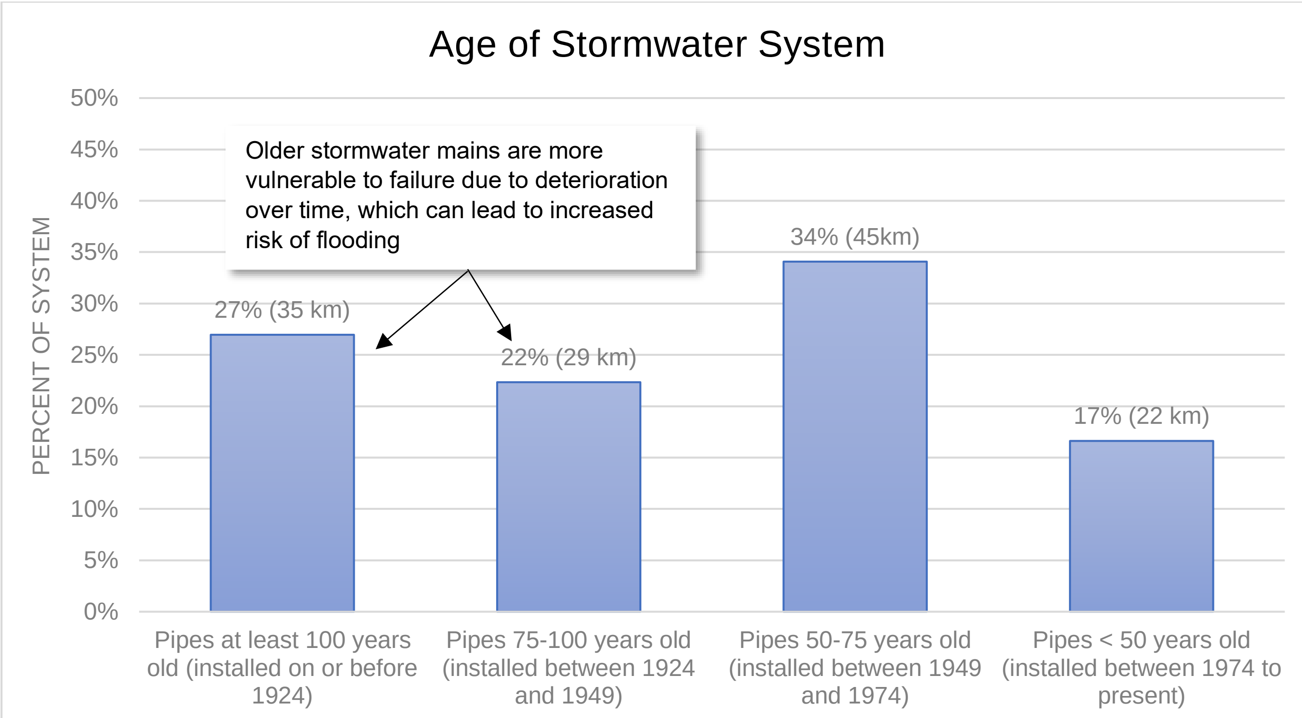


Figure 8: Stormwater System Material

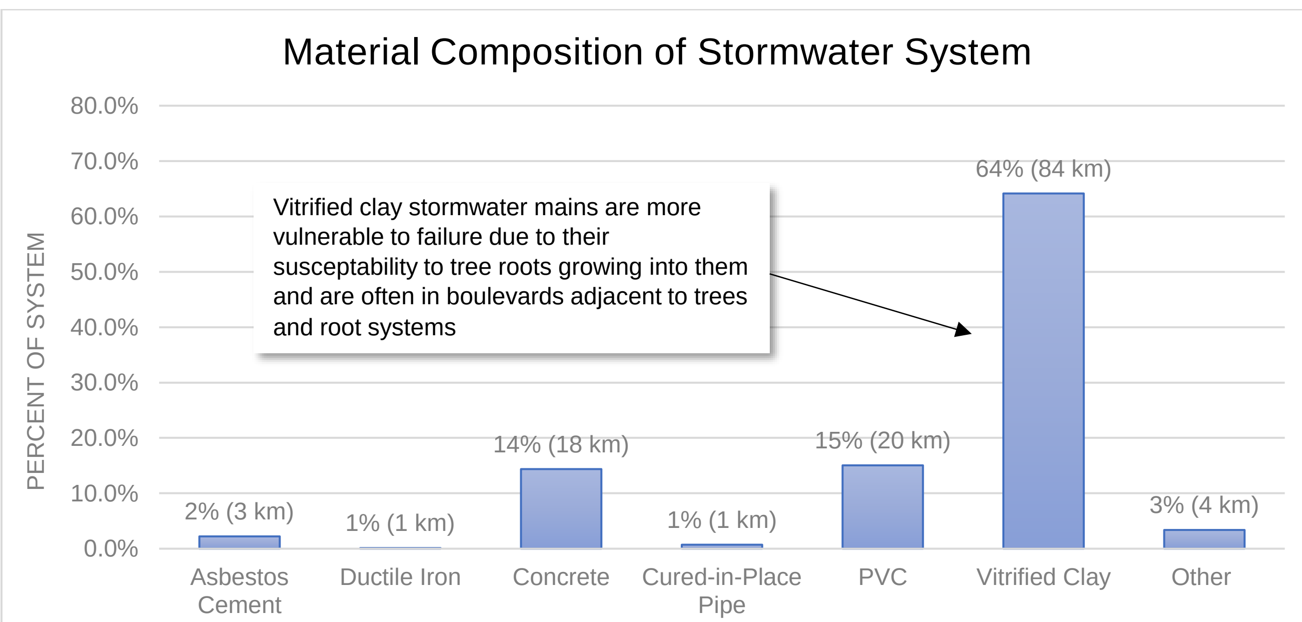
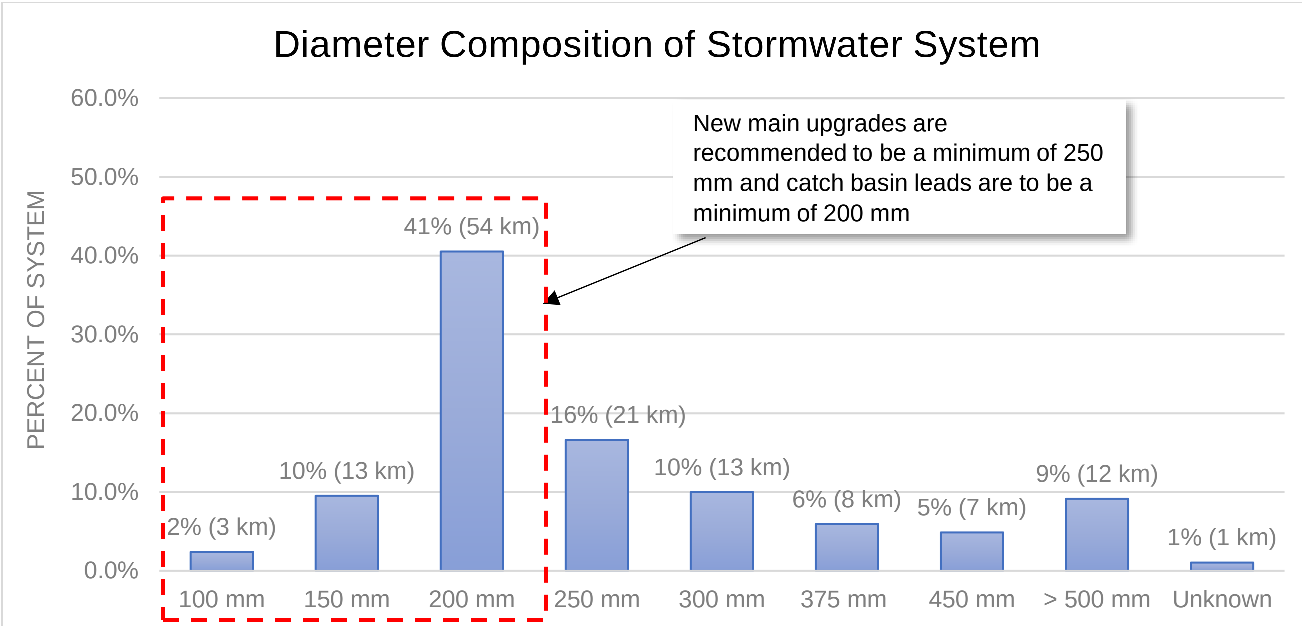


Figure 9: Stormwater System Size

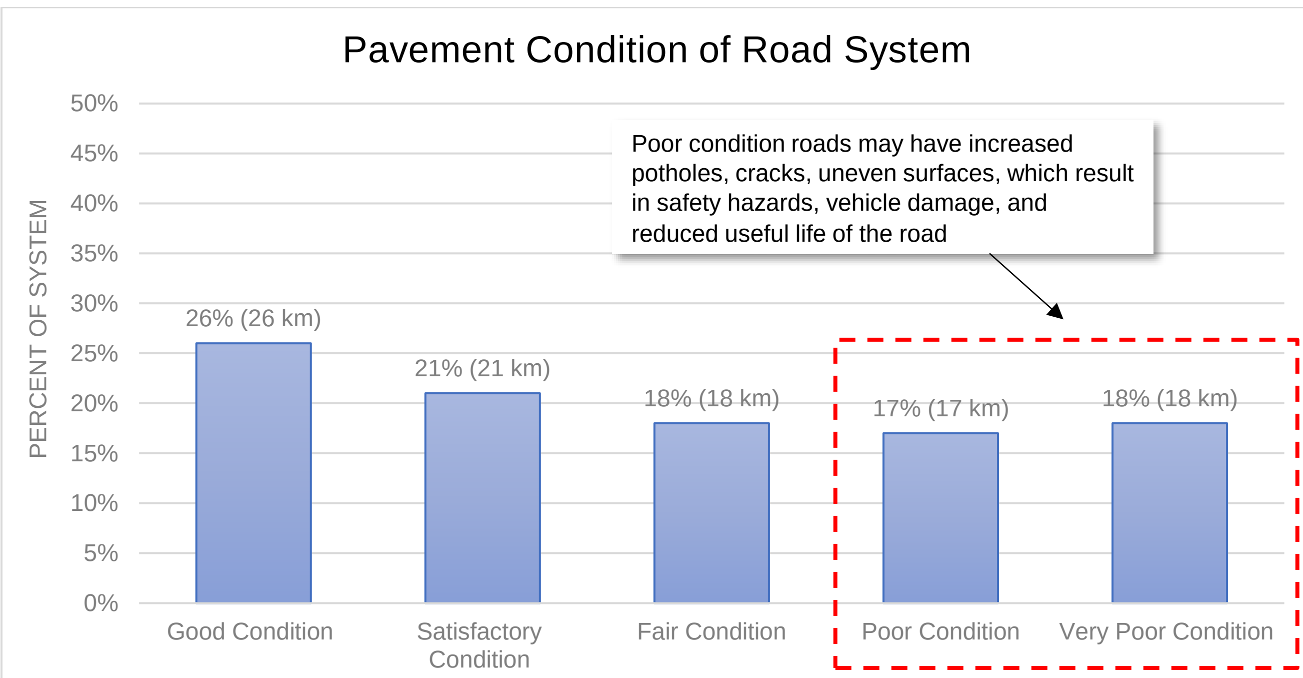


Road Infrastructure

The Pavement Condition Assessment indicated several crucial findings regarding the condition of the District's road infrastructure. Key findings include:

- The District has approximately 100 km of road infrastructure, comprised of:
    - 10 km of Arterial Roads
    - 16.7 km of Collector Roads
    - 64 km of Local Roads
    - 9.4 km of Special Roads
- Pavement surface distresses were measured for the entire road network to measure the severity and extent of cracks and other roadway distress types, these included rutting, alligator cracking, longitudinal cracking, potholes, etc.
- Based on Pavement Condition Index (PCI) which expresses the condition of the pavement surface as a function of the severity and extent of the visible surface distresses are described in Figure 10.

Figure 10: Pavement Condition Distribution in Terms of Pavement Condition Index (PCI)



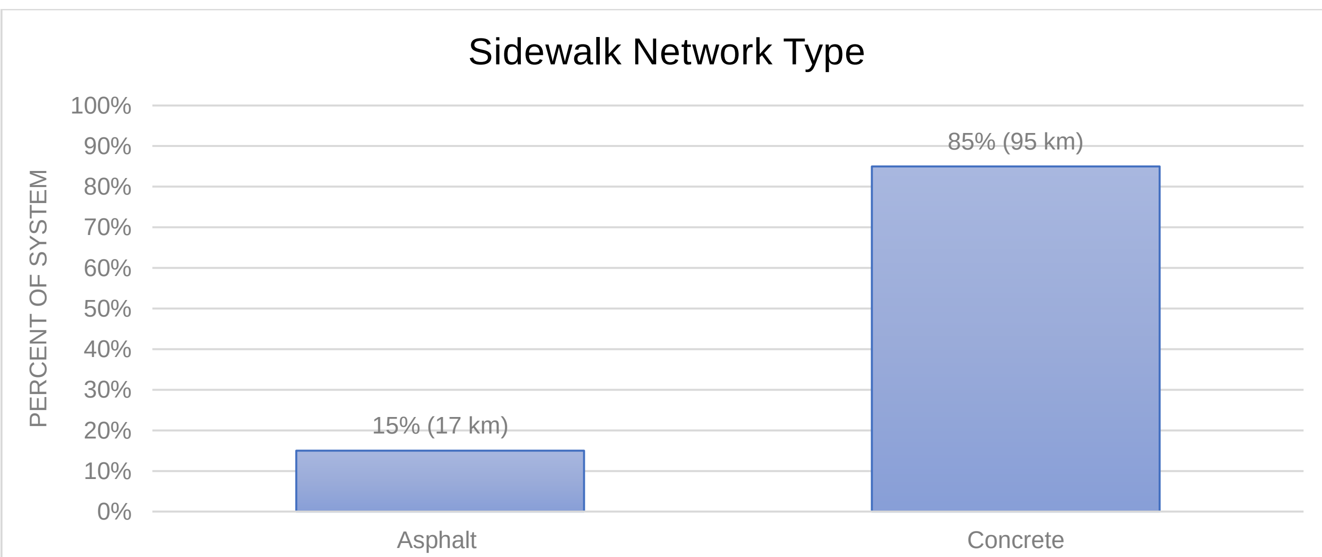
Sidewalk and Curb Infrastructure

The Sidewalk and Curb Condition Assessment indicated several crucial findings regarding the condition of the District's sidewalk and curb infrastructure. Key findings include:

Sidewalk Infrastructure

- The District has 112 km of sidewalk that are approximately 85% concrete and 15% asphalt.
- The assessment results indicate that scaling is the most common recorded distress, with 8,942 slabs affected throughout the network. This is a high concern to Staff.
- 74 trip hazards were identified at the moderate or high severity level. This is a very high concern to Staff. The assessment completed indicates that these severity levels are prescribed by ASTM standards and further information related to the actual scoring can be found in the detailed report.
- Slab replacement is recommended to maintain the sidewalk network. Patching, crack repair, and grinding are recommended maintenance activities to make safe until slab replacement can take place.
- No prioritization of asphalt vs concrete sidewalk type – replacement based on trip hazard, severity, accessibility concerns, etc.
- Based on the Sidewalk Condition Index (SCI) which expresses the condition of the sidewalk as a function of the severity and extent of the visible surface distresses, the sidewalk network <u>received an overall score of 76</u> (based on a score of 0-100) with 0 being the worst and 100 being the best.

Figure 11: Sidewalk Network Type



Curb Infrastructure

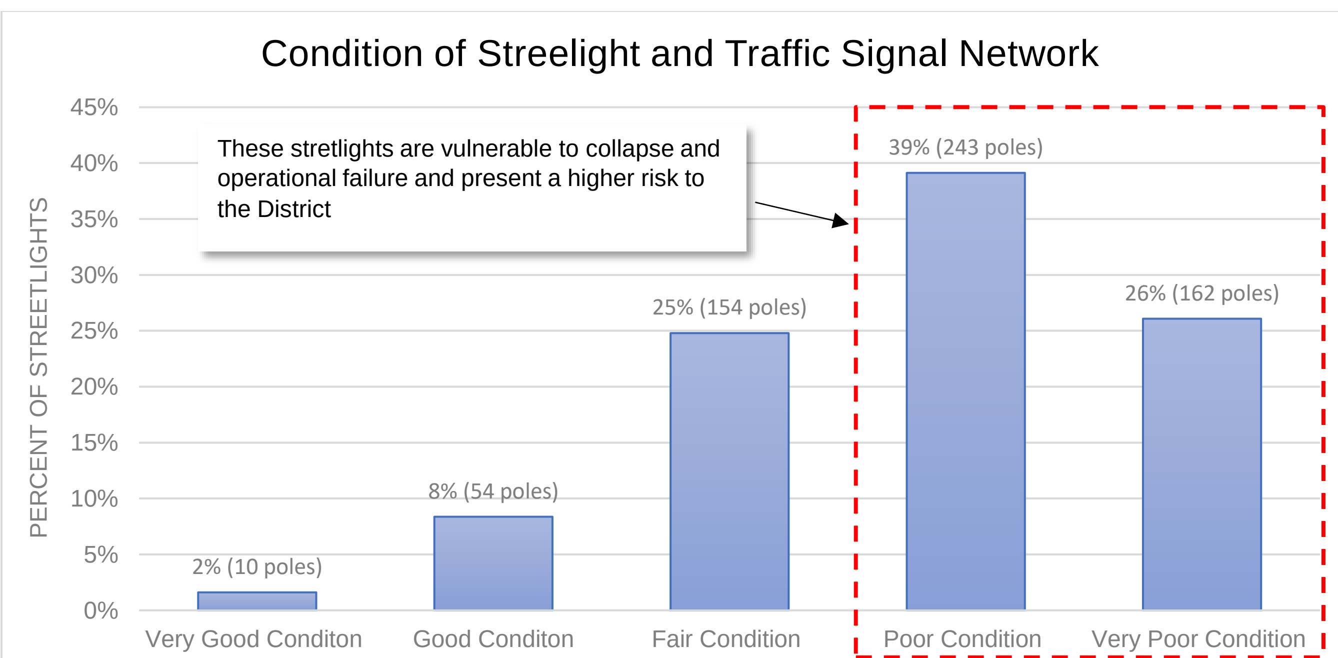
- The District has 162 km of curb that is in fair condition and a review of the distress results indicates that raveling and linear cracking are the most observed defects in the curb network. Most occurrences of these distresses are at the low severity level. This is a low concern to Staff.
- 15.5 km of curb require replacement largely due to adjacent sidewalk replacement needs and paved gutters causing poor curb height conditions. This will be dealt with when paving or sidewalk work is undertaken. This is a medium concern to Staff.

Streetlight and Traffic Signal Infrastructure

The District of Oak Bay owns and maintains approximately 2,800 street and traffic signal assets, including 9 signalized intersections. Excluding the Uplands region, 644 of the District's 850 davit, ornamental, and traffic signal assets were assessed. The Condition Assessment Report for the streetlights and traffic signal inventory indicated several crucial findings regarding the condition of the District's lighting infrastructure. Key findings and recommendations include:

- 644 ornamental/decorative, davit, and traffic signal poles were assessed by reviewing the paint finish, surface rust, thickness, baseplates, damage, overall condition, anchor bolts, and concrete base location and type. 318 ornamental streetlights within the Uplands were out of scope of the study.
- Replace all very poor condition structures and repair and treat the poor condition structures as described in the Condition Assessment Report
- Based on the condition assessment, the condition of the streetlights are described in Figure 12.

Figure 12: Condition Assessment Lighting Network



Key Takeaways and Conclusions

Water Infrastructure

Based on Figures 1 to 3, Staff have determined that the percentage of the system that is considered **high priority is in the range of 40%** when accounting for age, material, and size of mains and removing any overlapping characteristics (ex. asbestos cement mains greater than 100 mm). Replacement using conventional or trenchless technologies is recommended where possible.

Sanitary Sewer Infrastructure

Based on Figures 4 to 6, Staff have determined that the percentage of the system that is considered **high priority is in the range of 70%** when accounting for age, material, and size of mains and removing any overlapping characteristics (ex. asbestos cement mains greater than 150 mm). Replacement using conventional or trenchless technologies is recommended where possible.

Stormwater Infrastructure

Based on Figures 7 to 9, Staff have determined that the percentage of the system that is considered **high priority is in the range of 40%** when accounting for age, material, and size of mains and removing any overlapping characteristics. Replacement using conventional or trenchless technologies is recommended.

Road Infrastructure

Based on Figure 10, approximately **35% of the road infrastructure is in poor or very poor condition**. If left too long, the road base, rather than just the asphalt layer typically needs to be excavated to repair – this adds significant cost. Staff recommend that a proactive approach be taken and to perform preventative maintenance programs such as crack sealing, early pothole repair with larger patches, etc., where feasible.

Sidewalk and Curb Infrastructure

There are some trip hazards within the District's sidewalk network, ranging in severity. Slab replacement and curb replacement is recommended to improve the overall condition of the network. The condition assessment indicated that the **overall score for the sidewalk network is 76 out of 100** with 0 being the worst and 100 being the best. Pavement patching, crack repair, and grinding are recommended maintenance activities in advance of slab replacement. Staff have put forward a new capital program in 2024 to begin to address the deficiencies within the sidewalk and curb network.

Streetlight and Traffic Signal Infrastructure

Based on Figure 12, approximately **65% of the streetlight infrastructure is in poor or very poor condition**. Replacing streetlights also addresses liability and safety concerns and replacement/rehabilitation of streetlights is recommended in the Condition Assessment Report. Staff have put forward a new capital program in 2024 to begin to address the deficiencies within the streetlighting network.

Part 2: Application of Engineering Standards, Specifications, and Best Practices

Engineering standards, specifications, best practices, and regulatory requirements play a crucial role in informing Staff's decision-making processes regarding municipal infrastructure. The adherence to standards and best practices for municipal infrastructure can be a complex process, navigating legislative approval processes, selecting optimal designs that satisfy industry and regulatory standards, while also ensuring that projects are also cost-effective and scaled appropriately for the size of the District. Documents relevant to municipal infrastructure in British Columbia include (but are not limited to) those provided in Table 6.

Table 6: Engineering Standards, Specifications, and Best Practices used by Staff

Document	Description
BC Drinking Water Protection Act and Drinking Water Protection Regulation	Legislation ensuring safe drinking water in British Columbia, standards for potable water, permits, and response plans.
Municipal Wastewater Regulation	Legislation regarding wastewater discharges to water bodies, outfall requirements, and other types of discharges
Environmental Management Act	Legislation regarding prohibitions, authorizations, waste management, contaminated sites, remediation, and spill responses.
AWWA Standards	Standards published by the American Water Works Association for water distribution.
ASTM Standards	Standards published by the American Society for Testing and Materials for water testing methods, specifications, and practices for materials. • Example: ASTM-D6433 establishes the methodology for determining Pavement Condition Index (PCI)
CSA Standards	Standards published by the Canadian Standards Association for materials, fittings, and specifications.
MMCD Standards	Master Municipal Construction Documents providing standards for construction and maintenance.
MMCD Design Guidelines	Master Municipal Construction Documents providing design guidelines for municipalities. • Example: Minimum fire flow design requirements based on type of adjacent building to hydrant
IPWEA (Institute of Public Works Engineering Australasia)	Guidelines for asset management and financial management of municipal assets.
Transportation Association of Canada (TAC) Geometric Design Guide for Canadian Roads	Provides guidance and consistent implementation with regards to road design, including lane widths, drainage, geometric considerations, integrating bicycle facilities, and intersection design.
British Columbia Active Transportation Design Guide	Provides guidance and best practices to help municipalities build safe, effective active transportation infrastructure.
InfraGuide (Water)	Reports and best practices around developing a water system renewal plan, inspection of water systems, water quality, water loss, etc. for municipalities.

InfraGuide (Stormwater and Wastewater)	Reports and best practices around assessment and evaluation of storm and wastewater collection systems, stormwater management planning, and inflow and infiltration reduction control reduction or wastewater collection systems.
InfraGuide (Roads and Sidewalks)	Reports and best practices around road drainage design, sidewalk design construction and maintenance, and priority planning and budgeting for pavement maintenance and rehabilitation.
InfraGuide (Multidisciplinary)	Best practices and approaches to assess and evaluate municipal road, sewer, and water networks together and to develop levels of service, key indicators, and benchmarks for linear infrastructure.
Ministry of Health Design Guidelines for Drinking Water Systems in British Columbia	Provide guidance to municipalities for the approval process and issuance of permits under the Provincial Acts in BC for water systems.
Ministry of Health Sewerage System Standard Practice Manual	Provide standard practices for the planning, installation, and maintenance of sewerage systems.
Water Supply for Public Fire Protection – Fire Underwriters Survey	Guidelines and recommended practices for calculating fire flows for buildings in a community and size, type, and installation methods for hydrants. Example: Per the Fire Underwriters Survey, “lateral street connections should not be less than 150 mm in diameter”

For example, with regards to the water system, Staff adhere to legislated requirements under the Provincial Acts, and also adhere to industry-established standards and guidelines such as those published by the American Water Works Association (AWWA) and the Master Municipal Construction Documents (MMCD) for our water system. AWWA standards provide valuable guidance for water distribution systems which includes guidance on pipe materials, maintenance programs, construction techniques, and water pressure testing requirements. Similarly, the MMCD standards provide a framework for municipal infrastructure projects, general conditions, standard specifications, and standard detail drawings that are used across British Columbia.

Part 3: Overview of the Risks to Municipal Infrastructure

Staff are developing a risk register for water, sanitary sewer, stormwater, and surface infrastructure to identify and communicate the hazard type, its impact, and a description of the risk to illustrate how Staff typically evaluates the various types of hazards and the risks they present to the District's infrastructure. An in-depth risk analysis evaluating the consequence and probability of the District experiencing the identified risks is outside the scope of this report and will be addressed in the second part of the state of the infrastructure report. However, Staff have linked how each of the risks for each asset are related to Council Priorities to provide a greater level of insight into the state of the infrastructure and have identified risks inherent to the water, sanitary sewer, stormwater, roads, sidewalks, and street lighting infrastructure.

Further risk analysis is conducted at the project level to determine the types of risk management options that need to be employed and the risk they present.

Staff use the following terminology to communicate risk to infrastructure:

- **Hazard** is the source of potential damage (an event, condition, action, or inaction)
- **Risk** is the effect of uncertainty on objectives that is the combination of the likelihood that a hazard will occur and the consequence of the hazard
- **Risk Management** is a structured and disciplined approach to identify and mitigate risk and reduce uncertainty in the achievement of organizational goals and objectives

"The purpose of the risk analysis is to comprehend the nature of risk and its characteristics including, where appropriate, the level of risk. Risk analysis involves a detailed consideration of uncertainties, risk sources, consequences, likelihood, events, scenarios, controls and their effectiveness. An event can have multiple causes and consequences and can affect multiple objectives." (CSA ISO 31000, Section 6.4.3)

Table 7: Risk Register for Water Infrastructure

Hazard Category	Type of Hazard	Risks	Council Priorities
Natural Disasters	Flooding	Water infrastructure damage, power outages, increased erosion due to flooding. Risk of contamination of water sources in upstream reservoirs, groundwater, and reduction in water quality. Operational impacts resulting from pumping systems being out of service (low pressure, low water flow, limited fire fighting capabilities).	Livability and Climate
	Earthquakes	Structural damage to water facilities (e.g., pump stations, hydrants, meter vaults) and mains caused by seismic activity. Catastrophic failures across the entire water system are certain as a result of ground displacement, surface rupture, and damage to mains, connections, and structures.	Livability and Climate
Environmental	Climate Change	Changing weather patterns affecting water availability, demand, source water quality, and performance of water infrastructure (drought, use of water, water restrictions)	Climate
Design	Undersized Infrastructure	Reduced water pressure, flow, inability to fight fires effectively, limited capacity for water system to accommodate new development. Tuberculation is reducing the capacity in 100 mm or smaller diameter mains for domestic use and hydrants are not able to be installed on these small diameter mains, which results in firefighters having to connect to hydrant infrastructure that is further away on adjacent streets.	Livability
	Inadequate Data or Data Unknowns	Inability to properly plan, identify, analyze, or monitor water infrastructure resulting in increased costs, reactive maintenance, inaccurate modelling results, and inefficient use of resources. The ability to prioritize and make informed decisions is reliant on how accurate the data is. Due to the age of infrastructure installed the reliability of data for linear and non-linear infrastructure is essential.	Livability
Operational	Infrastructure Failure Due to Age and/or Material Type	Deterioration and failure to older water facilities and mains (e.g., asbestos cement main) resulting in loss of service or disruption in service. Depending on the material of the main, repairs and new service connections are difficult to construct and may require special handling for removal and disposal. Increased potential for contamination of the water supply system during a water main break due to loss of system pressure resulting in increased human health risks. Possible damage to roadways (e.g., sinkhole formation). Reduced overall system redundancy and fire fighting capability due to failure of the main, pump, or tuberculation.	Livability
	Lack of Redundant Infrastructure	In the event of an emergency, the water supply system is compromised due to only having a single connection to the Capital Regional District.	Livability
	Natural Landscape, Space, and Constructability Issues	Difficult to repair or replace infrastructure located within existing easements that are space constrained or located in easements that are in the back yard or side yards of properties.	Livability
Legal	Legal Action	Failing to comply with water regulations leading to legal action. Legal action from affected parties due to water-related issues, such as pollution or contamination.	Livability

Table 8: Risk Register for Sanitary Sewer Infrastructure

Hazard Category	Type of Hazard	Risks	Council Priorities
Natural Disasters	Flooding	Sewer infrastructure damage, power outages, increased erosion and sediment due to flooding, and increased inflow and infiltration at manholes and sewage overflows in combined systems. Pumping systems can become overwhelmed due to infiltration of water into the sewer system leading to operational failure (sewer backups, economic loss).	Livability and Climate
	Earthquakes	Structural damage to sewer facilities (e.g., lift stations, manholes) and mains caused by seismic activity. Catastrophic failures across the entire sewer system are certain as a result of ground displacement, surface rupture, and damage to mains, connections, and structures.	Livability and Climate
Environmental	Climate Change	Changing weather patterns impacting sewer management resulting in increased inflow and infiltration (increased loading on sewer infrastructure) and unnecessary downstream treatment of clean water at the sewage treatment plant.	Climate
	Sewage Overflows into Ocean	Combined sewer systems where both sewage and stormwater flow through the same main can become overwhelmed during heavy rain events and result in sewage overflowing into the ocean, which results in environmental damage and risks to public health. This risk remains for the District until Phase 2 of the Uplands Sewer Separation project is completed. Phase 1 is expected to be completed by 2025.	Climate
Design	Undersized Infrastructure	Undersized infrastructure increases the possibility of sewer infrastructure contributing to the exposure of the public to pathogens as the risk of sewage leaks and overflows causing damage to the environment and property is increased. Increased development/density will lead to further demand on the system.	Livability
	Inadequate Data or Data Unknowns	Inability to properly plan, identify, analyze, or monitor sewer infrastructure resulting in increased costs, reactive maintenance, inaccurate modelling results, and inefficient use of resources. The ability to prioritize and make informed decisions is reliant on how accurate the data is. Due to the age of infrastructure installed the reliability of data for linear and non-linear infrastructure is essential.	Livability
Operational	Infrastructure Failure Due to Age and/or Material Type	Deterioration and failure to older sewer facilities and mains as a result of main breaks, root intrusion, debris blockages. Service disruption, inability to utilize sewer system. Increased maintenance costs and monitoring (using CCTV).	Livability
	Natural Landscape, Space, and Constructability Issues	Difficult to repair or replace infrastructure located within existing easements that are space constrained or located in easements that are in the back yard or side yards of properties. Due to the large number of trees and proximity to sewer infrastructure – root intrusion is common and requires ongoing maintenance for Public Works.	Livability
Legal	Legal Action	Failing to comply with sewer regulations or discharge requirements leading to legal action. Legal action from affected parties due to sewer-related issues, such as pollution or contamination	Livability

Table 9: Risk Register for Stormwater Infrastructure

Hazard Category	Type of Hazard	Risks	Council Priorities
Natural Disasters	Flooding	Stormwater infrastructure damage, power outages, flash flooding, increased sediment loading, debris, and overflow resulting in overland flooding and property damage. Pumping systems over capacity leading to operational failure.	Livability and Climate
	Earthquakes	Structural damage to stormwater infrastructure (e.g., mains, pump stations) impacting stormwater conveyance caused by seismic activity. Catastrophic failures across the entire stormwater system are certain as a result of ground displacement, surface rupture, and damage to mains, connections, and structures.	Livability and Climate
Environmental	Climate Change	Changing weather patterns impacting stormwater management (increased flooding, more frequent and intense storms, conveyance structures overwhelmed).	Climate
	Sewage Overflows into Ocean	Combined sewer systems where both sewage and stormwater flow through the same main can become overwhelmed during heavy rain events and result in sewage overflowing into the ocean, which results in environmental damage and risks to public health. This risk remains for the District until Phase 2 of the Uplands Sewer Separation project is completed. Phase 1 is expected to be completed by 2025.	Climate
Design	Undersized Infrastructure	Undersized conveyance of stormwater infrastructure resulting in localized overland flooding, basement flooding, and pollution of the environment through polluted runoff.	Livability
	Inadequate Data or Data Unknowns	Inability to properly plan, identify, analyze, or monitor stormwater infrastructure resulting in increased costs, reactive maintenance, inaccurate modelling results, and inefficient use of resources. The ability to prioritize and make informed decisions is reliant on how accurate the data is. Due to the age of infrastructure installed the reliability of data for linear and non-linear infrastructure is essential.	Livability
Operational	Infrastructure Failure Due to Age and/or Material Type	Deterioration and failure to older stormwater facilities and mains as a result of main breaks, root intrusion, debris blockages. Service disruption, inability to utilize stormwater system	Livability
	Natural Landscape, Space, and Constructability Issues	Difficult to repair or replace infrastructure located within existing easements that are space constrained or located in easements that are in the back yard or side yards of properties. Due to the large number of trees and proximity to stormwater infrastructure – root intrusion is common and requires ongoing maintenance for Public Works.	Livability
Legal	Legal Action	Failing to comply with stormwater regulations or discharge requirements leading to legal action. Legal action from affected parties due to stormwater related issues, such as pollution, contamination, or property damage.	Livability

Table 10: Risk Register for Surface Infrastructure

Hazard Category	Type of Hazard	Risks	Council Priorities
Natural Disasters	Flooding	Transportation infrastructure damage, road structures at risk, drainage structures overwhelmed resulting in overland flooding, movement of people and goods adversely affected. Road closures and reduced connectivity are likely during a flooding event.	Livability and Climate
	Earthquakes	Structural damage to roads and sidewalks caused by seismic activity. Road washouts, closures. Inundation of low-lying areas, reduced service, and inability for emergency vehicles to travel safely and effectively. Catastrophic failures across the entire transportation network are certain as a result of damages to roads being destroyed and seismic activity turning loose soil into a liquid during an earthquake (liquefaction) undermining foundations for various transportation infrastructure.	Livability and Climate
Environmental	Climate Change	Changing weather patterns impacting transportation network (increased local flooding, road closures, increased cracking and degradation of pavement surfaces)	Climate
Design	Undersized Infrastructure	Longer travel times, traffic congestion, increased risk of traffic accidents, and delays for emergency vehicles.	Livability
	Inadequate Road Design and/or Active Transportation Measures	Longer travel times, traffic congestion, increased risk of traffic accidents, and delays for emergency vehicles. Conflicting uses for transportation infrastructure (e.g., collector road vs. cyclist commuter route) resulting in further design, traffic studies, traffic calming, costs associated with active transportation. Increased risks to cyclists and/or pedestrians due to existing road designs that do not accommodate cyclist infrastructure.	Livability
Operational	Infrastructure Failure	Deterioration of roads leading to reduced road quality and performance resulting in traffic congestion/disruption, delays, road closures, and detours. Deterioration of the sidewalks resulting in safety issues, ongoing maintenance, and mobility issues.	Livability
	Natural Landscape, Space, and Constructability Issues	Difficult to repair or replace paved surfaces that are space constrained (back alleys, side alleys). Due to the large number of trees and proximity to transportation infrastructure – roots create an ongoing maintenance issue for Public Works to address.	Livability
	Poor Lighting	Safety concerns, visibility, ongoing maintenance, and replacement.	Livability
Legal	Legal Action	Legal action claims arising from accidents involving transportation infrastructure	Livability

Part 4: Staff's Infrastructure Prioritization Methodology

Staff have begun to prioritize infrastructure projects based on the master plans, condition assessments and staff observations. These assessments highlight the condition, capacity, material, and other factors. Recent condition assessments provide valuable information to make informed decision-making.

Staff observations include reviewing camera inspections of mains, completing routine inspections, flushing mains, root cutting mains, acoustic testing mains, clearing blockages, exercising valves and hydrants, etc. Field data collected by Staff aids in consultants reports and analysis for the District.

In the past, it does not appear that all the available assessment tools were used to inform and prioritize infrastructure replacement.

However, even with all the condition assessments, master plans, and Staff observations, it is still difficult to navigate a straightforward path forward. Synthesizing all the data from various assessments into a coherent picture is challenging and complex, especially because it requires balancing a diverse set of considerations that are more than just physical condition and age. These include: Council priorities, budgets, public impact, legislation, and other external factors. All municipalities struggle with these same challenges.

Staff recognize that the process to prioritize infrastructure is not a perfect science, so we follow best practices around the replacement of municipal infrastructure established by the Federation of Canadian Municipalities (FCM), which include recommendations based on various aspects such as asset management and risk assessments for municipal infrastructure.

Underground Infrastructure

Underground infrastructure is typically hidden from public view, leading to lower levels of criticism compared to surface infrastructure. This is because its performance is primarily assessed based on its intended function or "end use" rather than its visibility.

- Example: The "end use" of the water system is clean, safe drinking water from the tap.

Examples of questions the Public may ask related to underground infrastructure:

- When I open my water tap, is my water safe to drink?
- Do I have adequate pressure at my tap for washing dishes or having a shower?
- Is sewage being adequately conveyed from my house when I flush the toilet?
- Is stormwater being adequately conveyed away from my house when it rains?

Staff use the following common criteria to evaluate underground infrastructure replacement, rehabilitation, or maintenance activities:

Pipe Material

Pipe material influences the decision to replace underground infrastructure because it directly affects factors such as durability, corrosion resistance, and overall maintenance requirements.

- Example: Asbestos cement mains in the water system are prioritized for replacement due to their known deterioration issues

Pipe Size

Pipe size influences underground infrastructure replacement since it directly affects the system's capacity to meet current and future demands.

- Example: 100 mm and smaller diameter mains in the water system are prioritized for replacement due to their inability to have hydrants connected to them and their small size results in lower flows flowing through the system.

Pipe Age

Older mains are typically at greater risk of failure and are more susceptible to leaks and additional maintenance. Pipe age can help aid to determine if a pipe has reached the end of its useful life.

- Example: Mains that are over 100 years old are prioritized for replacement

Maintenance History

Maintenance history influences the need for infrastructure replacement or rehabilitation. Staff review issues documented in the field.

- Example: A water pipe that has experienced multiple breaks in a short period.

Above Ground (Surface) Infrastructure

Surface infrastructure, such as roads, sidewalks, bike lanes, and streetlighting can be more complex, as it is visible to the Public. Performance of surface infrastructure is typically more heavily criticized and subject to a higher level of Public input as the Public interacts with it by walking, driving, biking, or using other modes of transportation.

Examples of questions the Public may ask related to surface infrastructure:

- Can I utilize multiple modes of transportation on a given road?
- Is the road bumpy or smooth? What level of comfort and safety does the surface provide?
- Can I use a wheelchair safely? Are there accessibility concerns?
- Can I safely walk down the sidewalk without encountering severe trip hazards?
- Are the streets adequately lit so that I can safely walk, cycle or drive on them at night?

As a result, Staff, in addition to the condition assessments completed for surface infrastructure, evaluate using the following criteria for surface infrastructure replacement, rehabilitation, or maintenance activities:

Customer Experience

Customer experience influences the need for infrastructure replacement or rehabilitation. Staff document issues and/or concerns relayed by the Public.

- Example: The need for traffic calming measures on a road is determined by assessing and recording speeds on a roadway before implementing potential design changes.

Maintenance History

Maintenance history influences the need for infrastructure replacement or rehabilitation. Staff review issues documented in the field.

- Example: A sidewalk that has trip hazards that need to be ground down multiple times due to roots uplifting panels may be considered as part of a sidewalk capital project.

Demand

Over time, the type and demand for a roadway facility may change and influences the need for infrastructure measures (ex. traffic calming measures, stop signs, etc.)

- Example: The addition of traffic calming (road bumps or curb extensions).

Integration of Condition Assessments and Master Plans

Staff incorporate the common infrastructure criteria (as shown above) with the Condition Assessments and Master Plans to develop annual and five-year infrastructure replacement and rehabilitation programs. Due to the number of infrastructure assessments and Master Plans to consider, there are often competing priorities with regards to the replacement of infrastructure. Staff aim to balance these priorities with the risks identified for each asset to determine which infrastructure project is selected.

Part 5: State of the Infrastructure Results and Next Steps

Based on Staff observations and condition assessments and master plans completed for the water, sanitary sewer, stormwater, roads, sidewalks, and streetlighting infrastructure, the District has significant current and future infrastructure challenges. Staff have done their best to consolidate the number and severity of infrastructure issues across the District into the following five-star Report Card (1 being the worst, 5 being the best) for each category of infrastructure presented in Table 11. It does not include a detailed risk analysis which will be undertaken in the second report. This analysis is primarily concerned about maintaining the District's existing infrastructure and does not include any infrastructure enhancements (i.e. adding bike lanes, adding a sidewalk that has been identified as a missing link, etc.)

Table 11: State of the Infrastructure Report Card

Infrastructure Category	Overall Score	Scoring Rationale
Water	★☆☆☆☆	Based on the assessment of the water system and Staff observations, the criticality of the infrastructure, including the age, material, and size of water mains and the condition of critical pump stations and pressure reducing stations, and our single water supply connection with the CRD.
Sanitary Sewer	★★☆☆☆	Based on the assessment to the sanitary sewer system and Staff observations, the criticality of the infrastructure, including the age, material, and size of sewer mains and the condition of critical lift stations.
Stormwater	★★☆☆☆	Based on the assessment of the stormwater system and Staff observations, the criticality of the infrastructure, including the age, material, and size of stormwater mains and the condition of critical pump stations.
Roads	★★★☆☆	Based on the assessment of the roads system and Staff observations, the criticality of the infrastructure, the types and severity of defects the roads system.
Sidewalk and Curbs	★★★☆☆	Based on the assessment of the sidewalks and curbs and Staff observations, the criticality of the infrastructure, the types and severity of defects in the sidewalks and curbs system.
Streetlights and Traffic Signal Network	★☆☆☆☆	Based on the assessment of the streetlights and traffic signals and Staff observations, the criticality of the infrastructure, the types and severity of defects in the lighting infrastructure system.

In addition to the state of the infrastructure scoring, Staff have summarized the top concerns in this report as shown in Table 12 to highlight areas within the District that need the most attention.

Table 12: Top Concerns for the District's Infrastructure

Service	Key Finding	Concern Level	Description
Water	Single water supply connection and no emergency water supply to the CRD Transmission main	Very High	Widespread water service disruption if CRD Transmission #3 fails as it is the District's only water source.
	Poor condition water Pressure Reducing Valve (PRV) station and aging water steel transmission main	Very High	Widespread water service disruption of the PRV station fails or if the aging transmission main fails.
	16% (19 km) of the water system is 100 mm or smaller	Very High	This is a very high concern to Staff for two reasons, first, tuberculation is reducing the capacity in 100 mm or smaller diameter mains for domestic use and second, hydrants are not able to be installed on these small diameter mains, which results in firefighters having to connect to hydrant infrastructure that is further away on adjacent streets.
	17% (19 km) of water mains are asbestos cement.	Very High	Localized damage if main breaks. Short service disruption if water main break occurs (<1 day).

Sanitary Sewer	Sanitary sewer lift stations are in poor condition	High	Critical components of the sanitary sewer system responsible for pumping sewage from lower elevations to higher elevations. If they fail, it could lead to sewage backups and result in risks to public health, property, and environment.
	Undersized sanitary sewer mains	High	Potential sewer backups and overflows. Property damage, health hazards, and environmental contamination, resulting in risks to public health, property, and environment.
Stormwater	Some stormwater outfalls and mains are not deep enough	Very High	Replacement of stormwater mains further up in the system is limited due to the inadequate depth of some of the stormwater outfalls. This can result in flooding and property damage.
Sidewalks	74 sidewalk tripping hazards were identified that were moderate or high severity	Very High	The number and presence of sidewalk tripping hazards poses a high level of concern because it increases the likelihood of injuries and liability claims.
Streetlights	26% (162 poles) Streetlights are in very poor condition	Very High	Very poor condition poles creates a risk to public safety and damage to surrounding vehicles.

Summary

Staff recognize that there are various concerns related to the District's infrastructure and have outlined many of these key findings in this report based on condition assessments, master plans, and Staff observations. This first part of the state of the infrastructure report presents infrastructure deficiencies within the District but does not provide Council the full picture in order to respond to all of the issues and recommendations identified. The second report will include a detailed risk analysis that will provide Council the necessary information to make funding decisions to maintain current service levels, allocation of resources, and to mitigate potential vulnerabilities within the District's infrastructure network.

By mitigating the most significant risks to infrastructure within the system, the District can manage their key assets effectively and ensure that the performance of their assets are reliable and sustainable for current and future residents of Oak Bay.

DISTRICT OF OAK BAY

State of the Infrastructure Report (Report 1 of 2)

Date: May 2024

DISTRICT OF OAK BAY

AGENDA

- Introduction
- Useful Life of Municipal Infrastructure and Pictures
- Findings and recommendations from assessments and Staff observations
- Overview of risks to municipal infrastructure
- Staff methodology to prioritize capital projects
- State of the Infrastructure Report Card
- Next Steps

INTRODUCTION

- **This presentation** is the **first part** of a two-part series to Council, which will focus on:
    - An outline of key findings and concerns for municipal infrastructure
    - Application of engineering standards, specifications, and best practices
    - Overview of risks, decision-making, prioritization methodologies, and overall infrastructure scoring
- In **Q3/Q4 2024,** Staff will present the **second part** of the State of the Infrastructure Report, identifying proposed solutions, financial analysis, budgetary recommendations, staffing, and operational considerations

INTRODUCTION

We are Here

Condition Assessments and Master Plans

Review of Information and Report Preparation

Present State of the Infrastructure Report (1 of 2)

Identify Solutions and Review Operational and Financial Considerations

Present State of the Infrastructure Report (2 of 2)

USEFUL LIFE OF MUNICIPAL INFRASTRUCTURE

Typical useful life range of infrastructure

Component	Useful Life Range (Years)	Source/Citation*
Asbestos Cement Main	40 to 70	IPWEA
Cast Iron Main	50 to 100	IPWEA
Ductile Iron Main	50 to 100	IPWEA
Polyvinyl Chloride (PVC) Main	50 to 100	IPWEA
Steel Main	80 to 100	City of Toronto
Concrete Main	40 to 100	IPWEA
Vitrified Clay Main	50 to 100	IPWEA
Pumps	15 to 30	IPWEA
Valves	30 to 50	IPWEA
Concrete Vaults	40 to 80	IPWEA
Local Roads (Pavement Surface)	50 to 100	IPWEA
Collector Roads (Pavement Surface)	40 to 60	IPWEA
Arterial Roads (Pavement Surface)	30 to 50	IPWEA
Sidewalks and Curbs	50 to 80	IPWEA
Streetlights	75	City of Edmonton

*IPWEA (Institute of Public Works Engineering Australasia)
*City of Toronto: Toronto's Water's Infrastructure Renewal Backlog Staff Report
*City of Edmonton: Streetlighting FAQ and Neighbourhood Renewal

Dependent on:

- Pipe Characteristics
- Design and Construction Practices
- Soil Conditions
- Maintenance History

PICTURES OF ISSUES

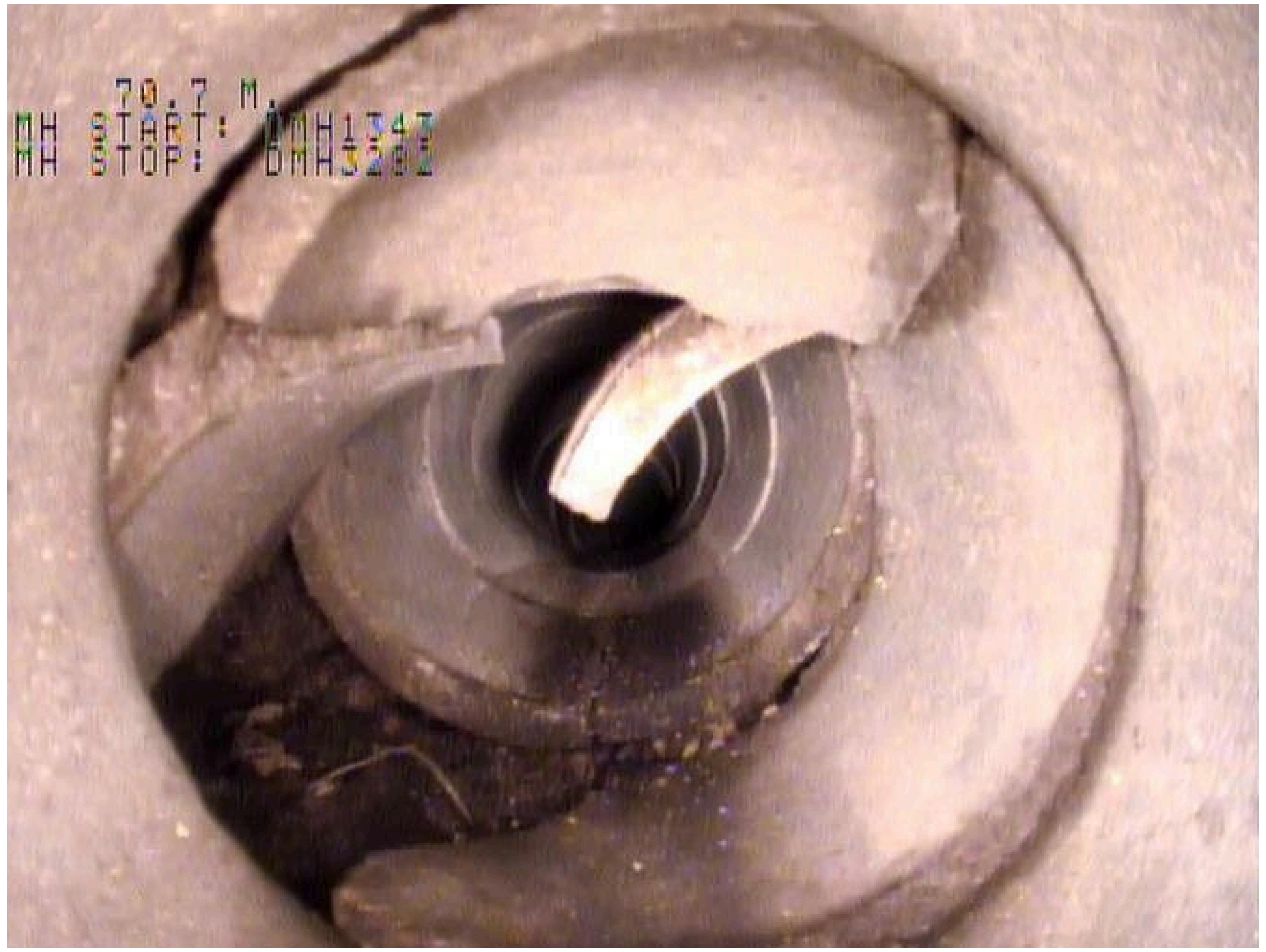
Tuberculation

- Rust inside of 150 mm (6") water main
- Reduces hydraulic capacity

Corrosion

- Evidence of severe corrosion from 1980's ductile iron main
- Holes/break in water main
- Disruption in water service

PICTURES OF ISSUES



Fractures and Cracking

- Evidence of severe fracturing and displacement within mains
- Can collapse - creating possible flooding or sewer backups

Root Intrusion

- Evidence of roots within the system
- Causes blockage and further fractures
- Can create flooding or sewer backups

CONCERN LEVEL MATRIX

Very High Concern
Very important for operations of infrastructure system, and/or extremely costly to repair/rehabilitate, and/or very important to meet long-term strategic objectives.
High Concern
Important for operations of infrastructure system, and/or very costly to repair/rehabilitate, and/or important to meet long-term strategic objectives.
Medium Concern
Fairly important for operations of infrastructure system, and/or moderately costly to repair/rehabilitate, and/or fairly important to meet long-term strategic objectives.
Low Concern
Slightly important for operations of infrastructure system, and/or slightly costly to repair/rehabilitate, and/or slightly important to meet long-term strategic objectives.
Very Low Concern
Not important for operations of infrastructure system, and/or little cost to repair/rehabilitate, and/or not important to meet long-term strategic objectives.

Used to categorize key findings and issues for infrastructure

WATER INFRASTRUCTURE

KEY TAKEAWAY

Staff have determined that approximately **40% of the system is considered high priority** when accounting for age, material, and size of mains and removing any overlapping characteristics (ex. asbestos cement mains less than 100 mm).

REPORT CARD

WATER INFRASTRUCTURE

VERY HIGH CONCERN

- Lack of water supply redundancy
- Poor condition of critical infrastructure
- 16% (19 km) of mains are 100 mm or smaller
  - Hydrants unable to be installed on these
- 17% (19 km) of mains are asbestos cement

MEDIUM CONCERN

- 14% (17 km) of mains are 100 years or older
- No pump stations have emergency power
- Ductile iron pipes in the 1980's have been breaking uncharacteristically

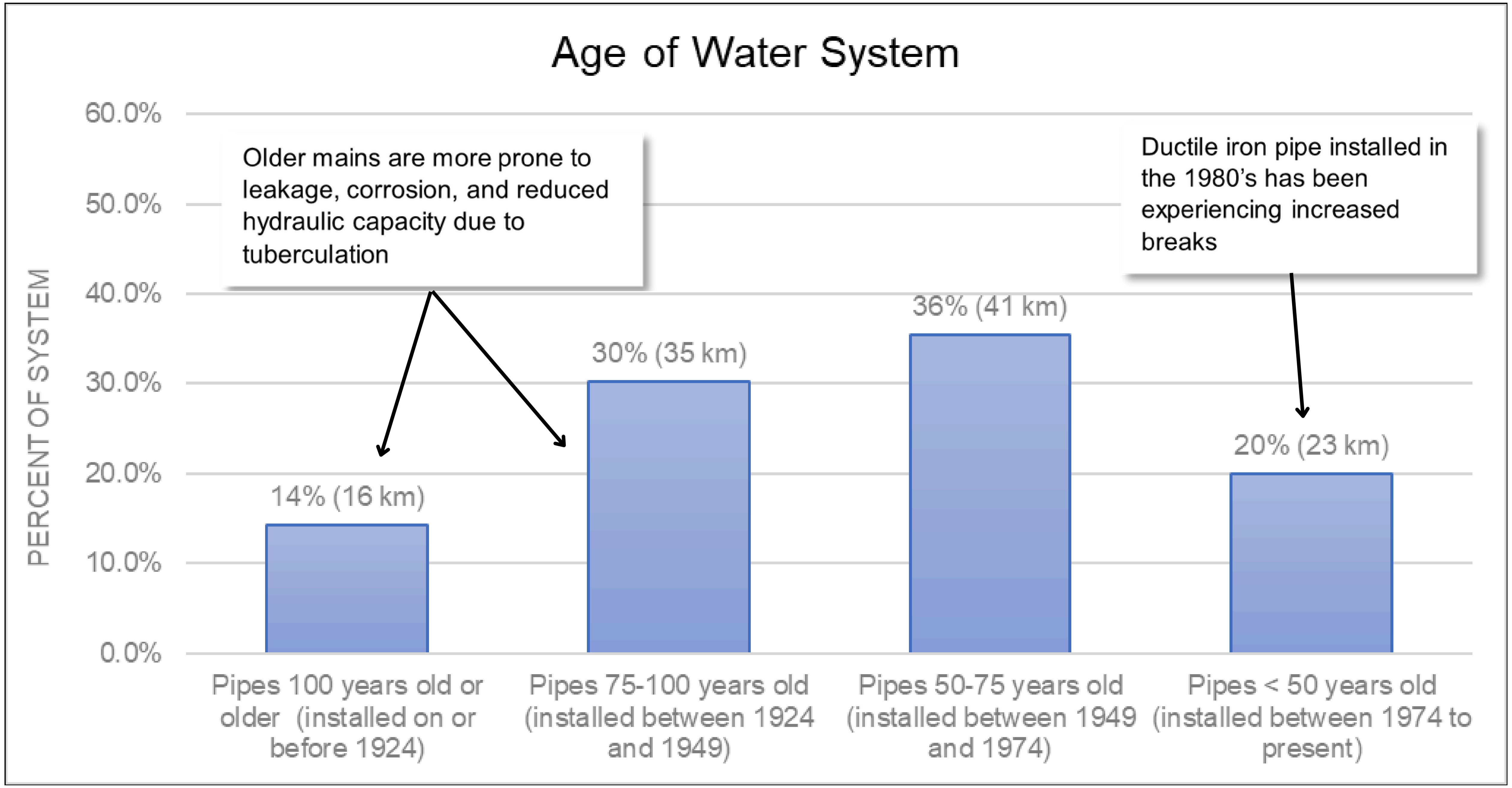
HIGH CONCERN

- Some mains are undersized
  - Impacts available fire flow at hydrants
  - May not be able to accommodate new development
- Mechanical components of critical infrastructure are in poor condition

LOW CONCERN

- 53% (61 km) of the mains are cast iron

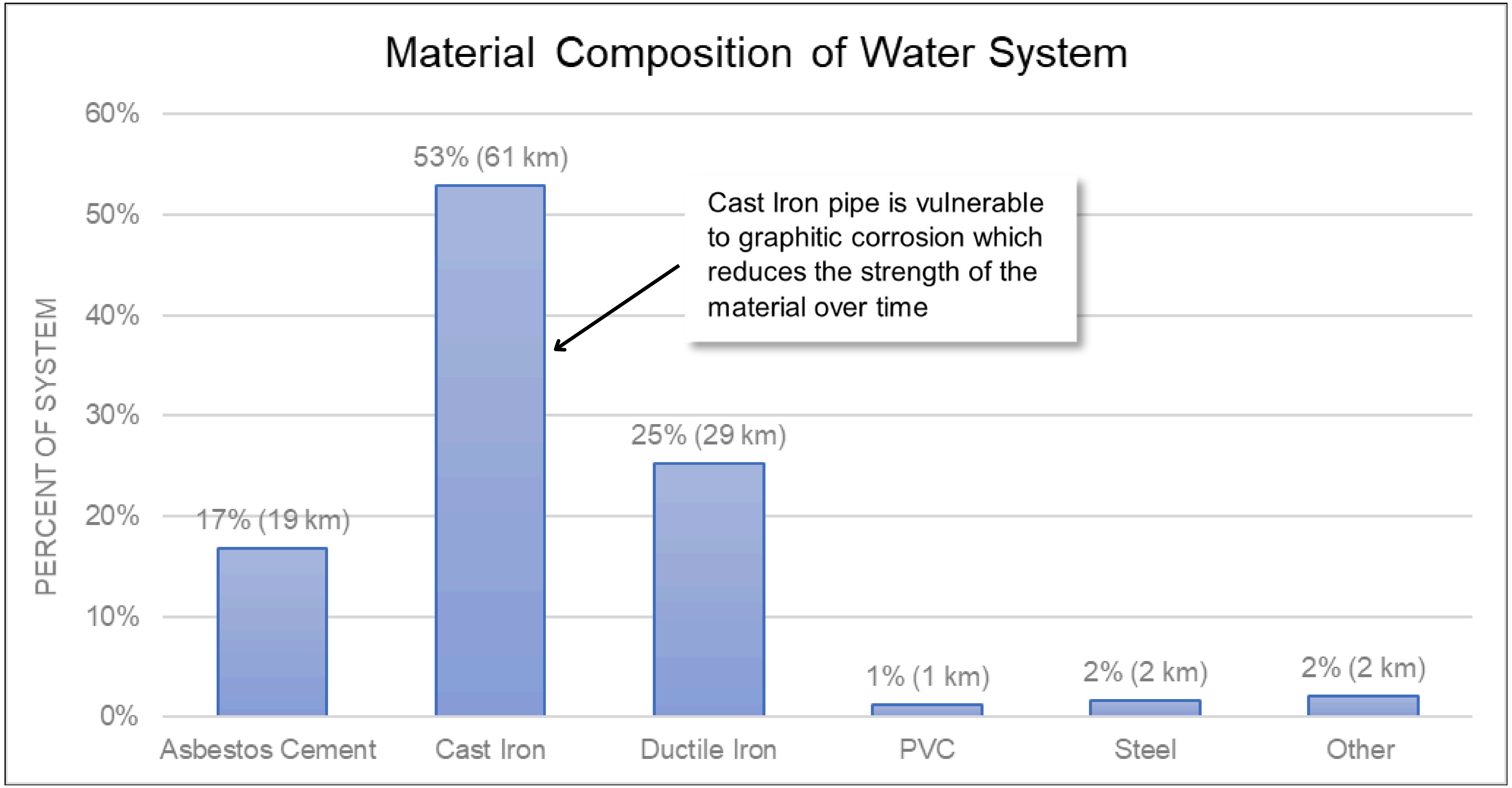
AGE OF THE WATER SYSTEM



The average age of the water system is **69 years old.**

Typical useful life of a water main is 40 to 100 years

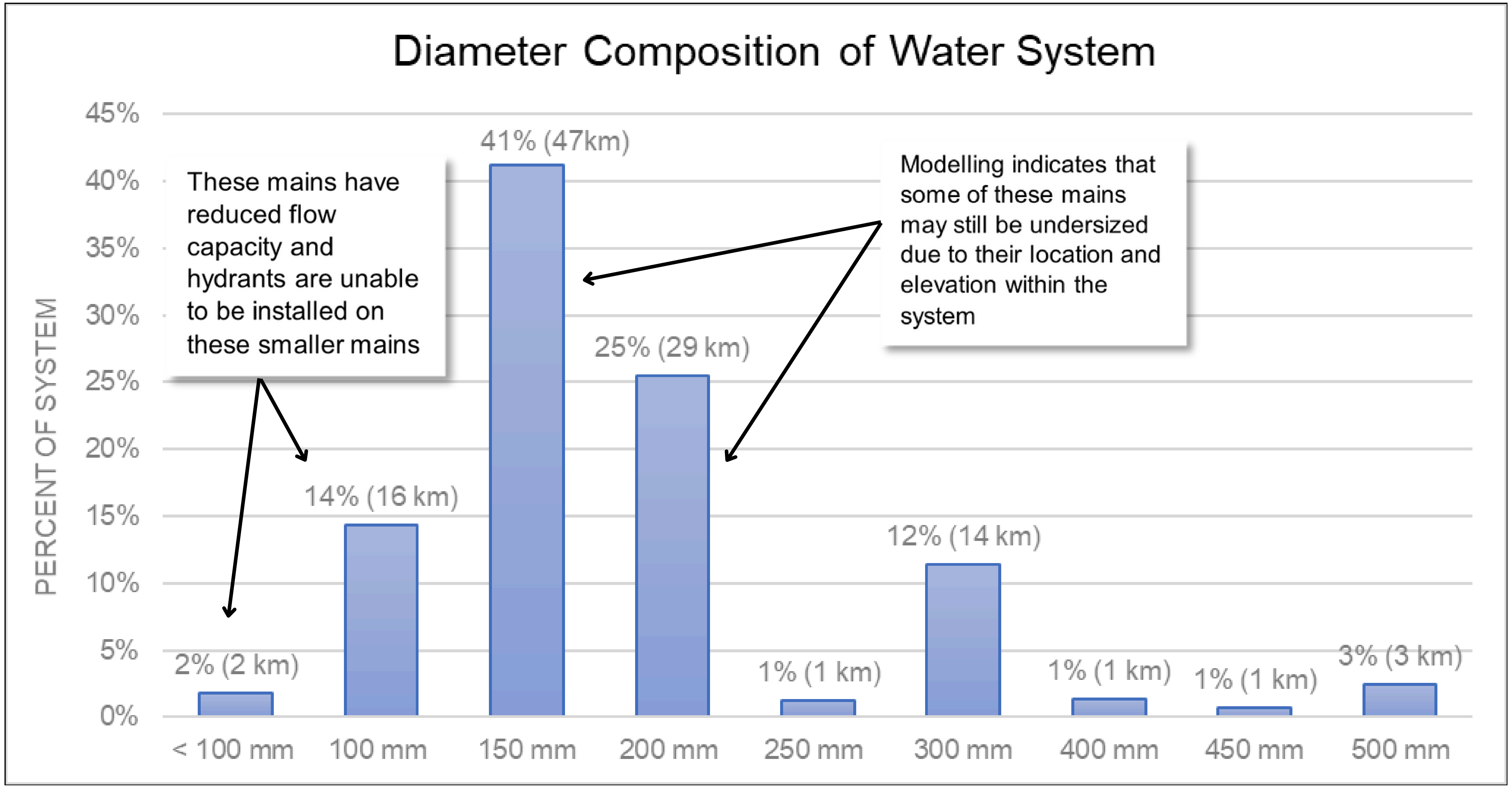
MATERIAL COMPOSITION OF THE WATER SYSTEM



The District's water system primarily consists of **cast iron, ductile iron, and asbestos cement mains.**

Differing materials can have different failure mechanisms

DIAMETER COMPOSITION OF THE WATER SYSTEM



New water mains are recommended to be a minimum size of 200 mm, with minor exceptions in cul-de-sac's.

The size of the pipe is correlated with its hydraulic capacity

SANITARY SEWER INFRASTRUCTURE

KEY TAKEAWAY

Staff have determined that approximately **70% of the system is considered high priority** when accounting for age, material, and size of mains and removing any overlapping characteristics (ex. asbestos cement mains less than 150 mm).

REPORT CARD

★★☆☆☆

SANITARY SEWER INFRASTRUCTURE

VERY HIGH CONCERN

- Combined sewer systems
- 23% (23 km) of sewer mains are asbestos cement

MEDIUM CONCERN

- 51% (51 km) of mains are Vitrified Clay
- Rain enters sanitary system during rainfall events (2.6 to 6.8 times the CRD target) via inflow and infiltration

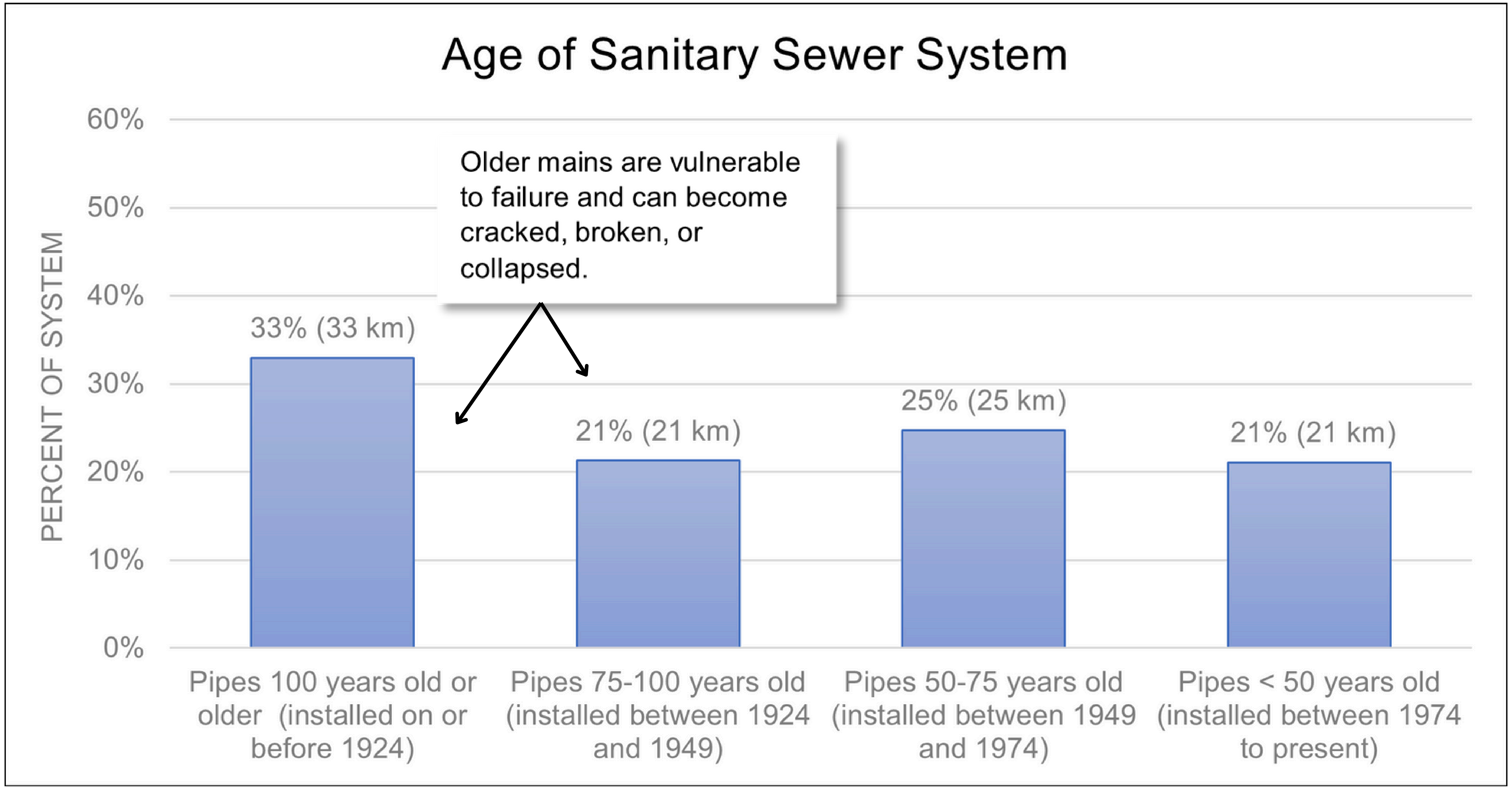
HIGH CONCERN

- Mechanical and electrical components of critical infrastructure are in poor condition
- Some mains are undersized
- Some mains are located in easements in back and side yards
- 33% (33 km) of mains are 100 years or older

LOW CONCERN

- Inaccuracies in modelling results to prepare Sanitary Sewer Master Plan may exist as data was taken from old record drawings and incomplete CCTV assessments

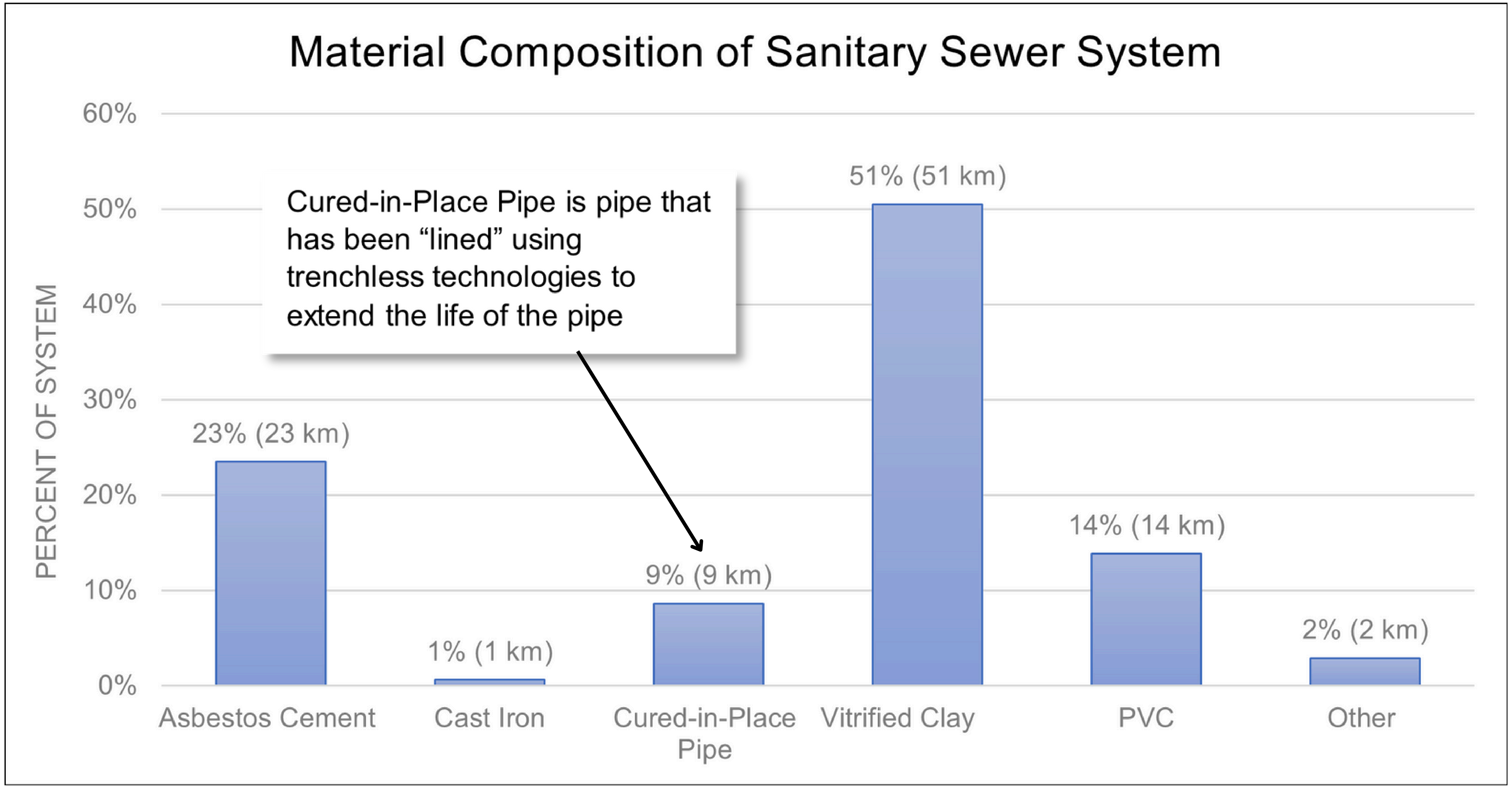
AGE OF THE SANITARY SEWER SYSTEM



The average age of the sanitary sewer system is **75 years old.**

Typical useful life of a sewer main is 40 to 100 years

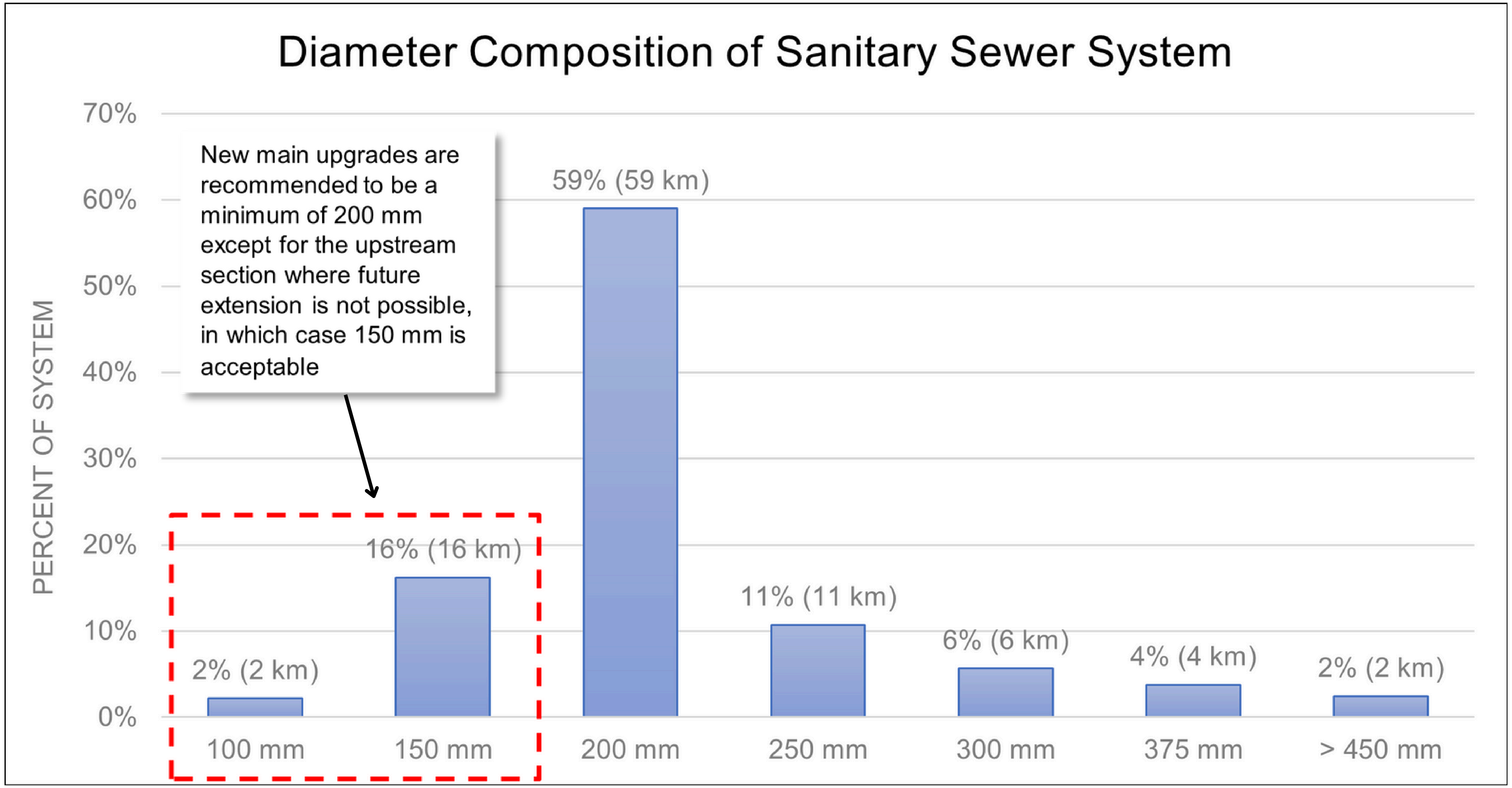
MATERIAL COMPOSITION OF THE SANITARY SEWER SYSTEM



The District's sanitary sewer system primarily consists of **vitrified clay, asbestos cement, and PVC.**

Differing materials can have different failure mechanisms

DIAMETER COMPOSITION OF THE SANITARY SEWER SYSTEM



New sanitary sewer mains are recommended to be a minimum of 200 mm.

The size of the pipe is correlated with its hydraulic capacity

STORMWATER INFRASTRUCTURE

KEY TAKEAWAY

Staff have determined that approximately **40% of the system is considered high priority** when accounting for age, material, and size of mains and removing any overlapping characteristics.

REPORT CARD

★★☆☆☆

STORMWATER INFRASTRUCTURE

VERY HIGH CONCERN

- Some stormwater outfalls are not deep enough
- Inadequate depth and slopes of some mains

MEDIUM CONCERN

- Storm mains are commonly located on both sides of the street
- Storm mains are commonly located under large boulevard trees
- 2% (3km) of mains are asbestos cement

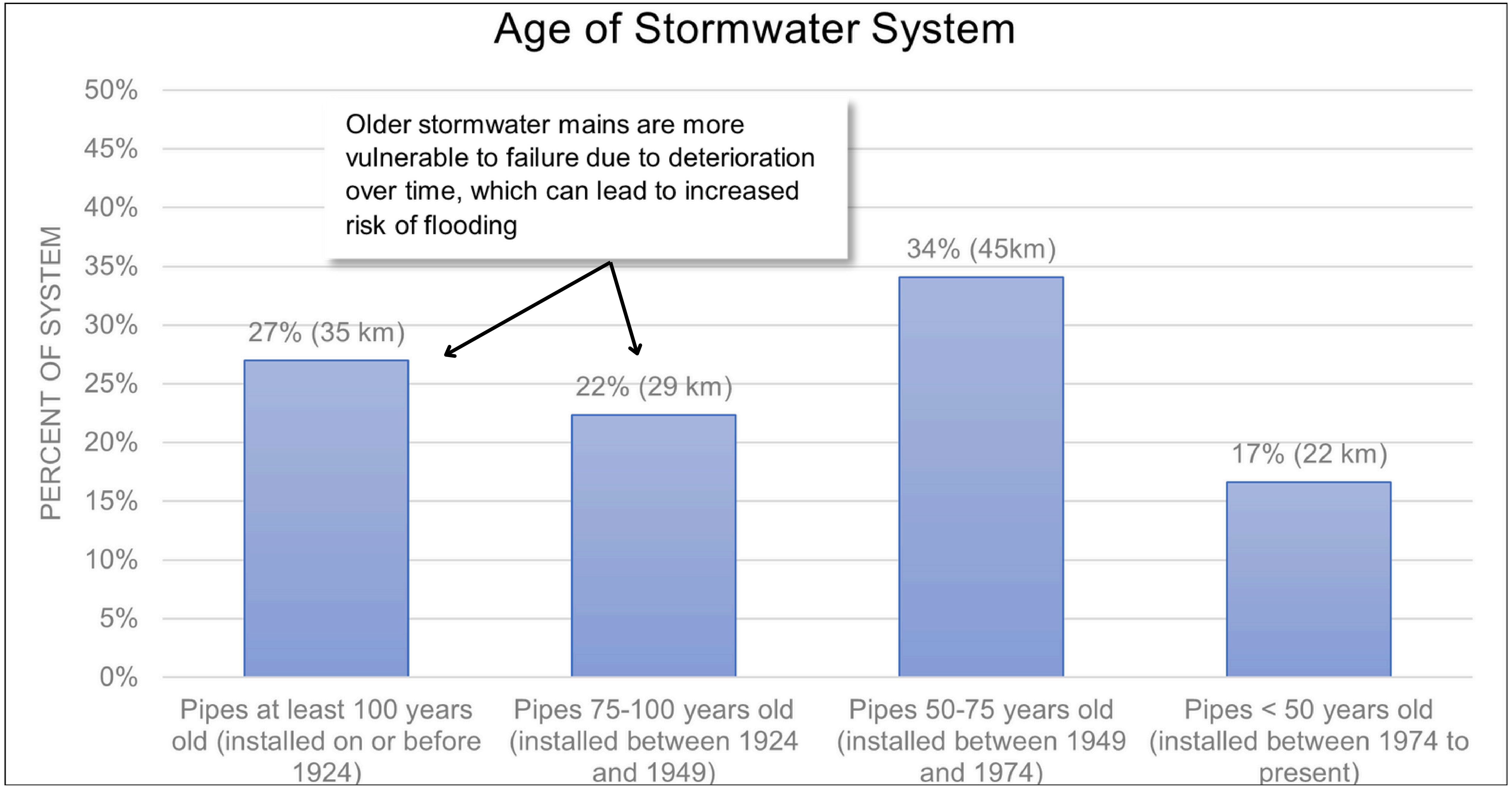
HIGH CONCERN

- Some mains are undersized
- Some mains are located in easements in back and side yards
- 27% (35 km) of mains are 100 years or older

LOW CONCERN

- Inaccuracies in modelling results to prepare Storm Drain Master Plan may exist as data was taken from old record drawings and incomplete CCTV assessments
- The District has 37 storm outfalls that discharge stormwater into the ocean that may need increased maintenance

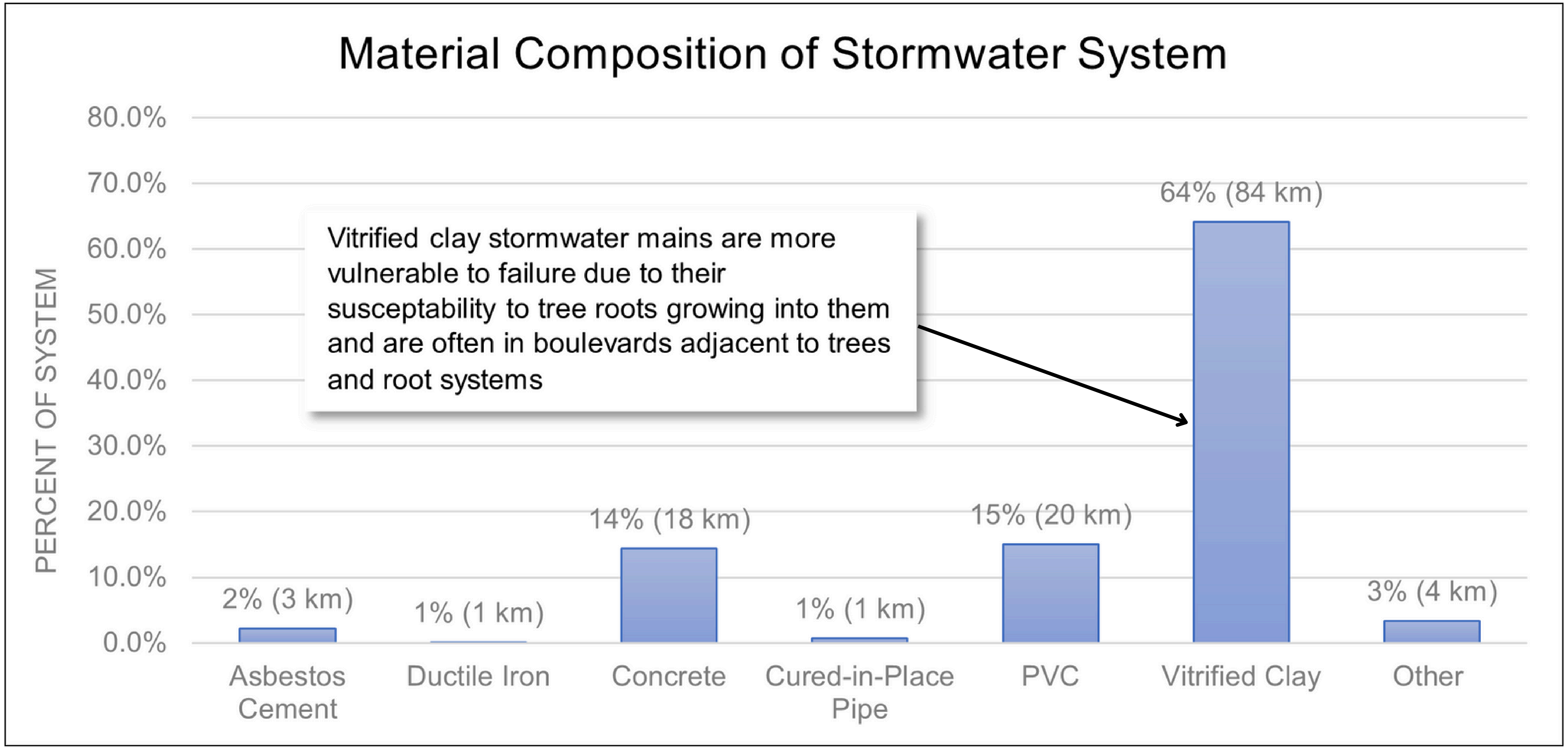
AGE OF THE STORMWATER SYSTEM



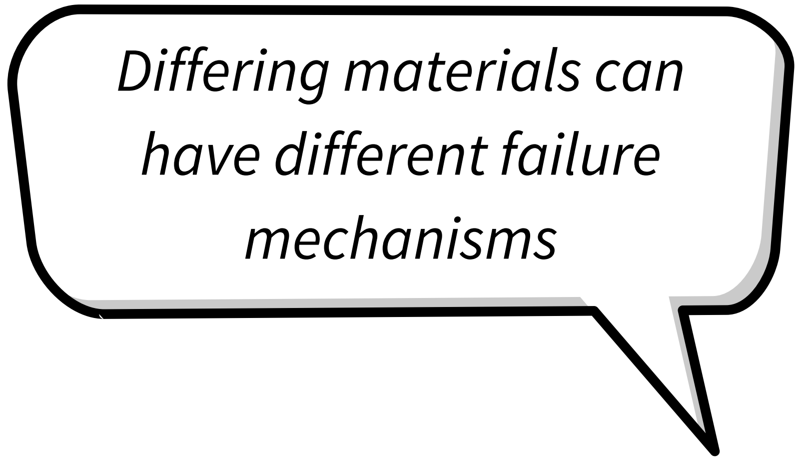
The average age of the stormwater system is **72 years old.**

Typical useful life of a stormwater main is 50 to 100 years

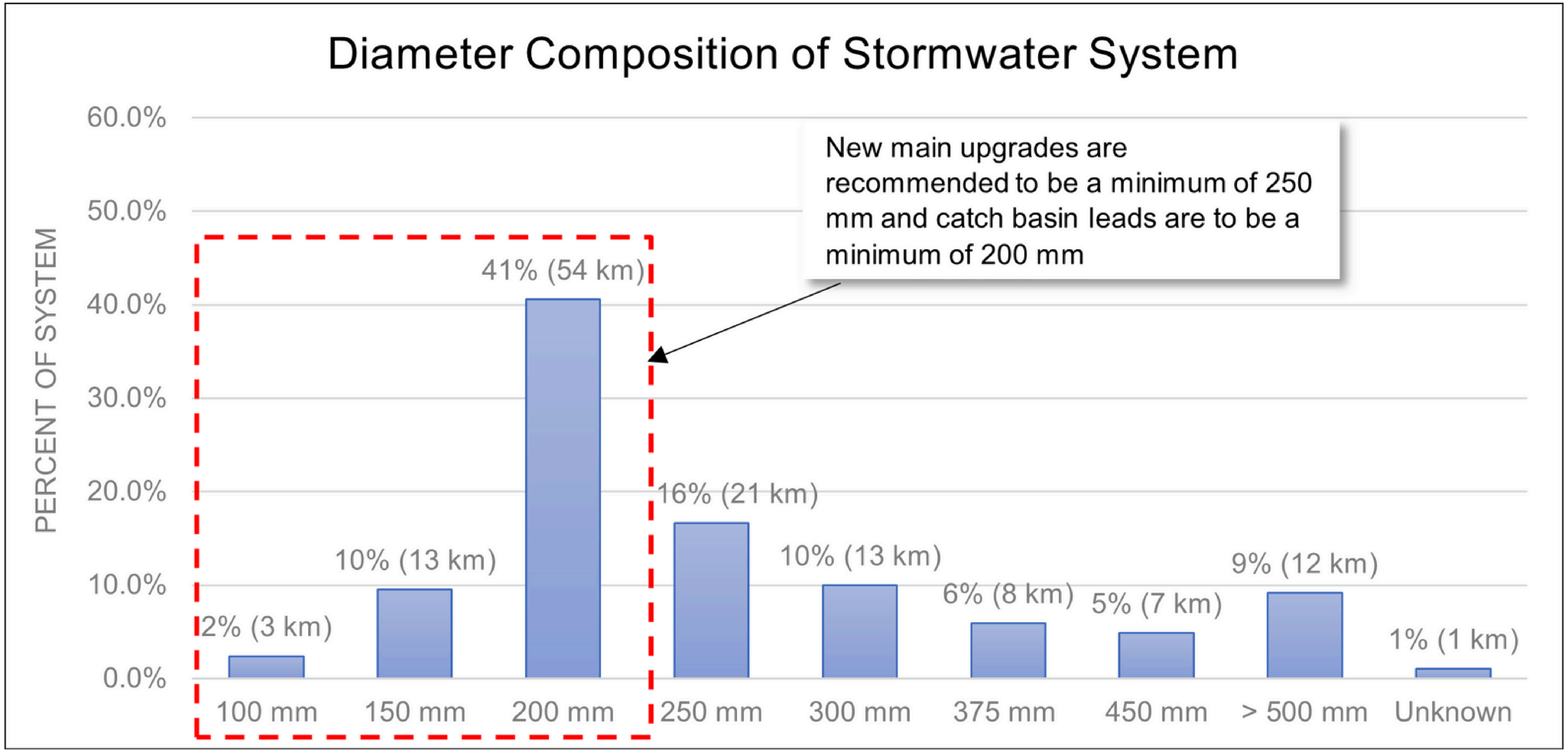
MATERIAL COMPOSITION OF THE STORMWATER SYSTEM



The District's stormwater system primarily consists of **vitrified clay, PVC, and concrete.**



DIAMETER COMPOSITION OF THE STORMWATER SYSTEM



The District's stormwater system consists of **12% (16 km)** mains that are 150 mm or smaller.

Smaller pipes are more vulnerable to flooding issues

SURFACE INFRASTRUCTURE (ROADS, SIDEWALKS, CURBS, STREETLIGHTING)

KEY TAKEAWAY	REPORT CARD
35% of the road infrastructure is in poor or very poor condition based on the most recent condition assessment.	★★★☆☆
The condition assessment indicated that the overall score for the **sidewalk network is 76 out of 100.**	★★★☆☆
65% of the streetlight infrastructure is in poor or very poor condition.	★☆☆☆☆

SURFACE INFRASTRUCTURE (ROADS, SIDEWALKS, CURBS, STREETLIGHTING)

VERY HIGH CONCERN

- 26% (162 poles) are in very poor condition
- 74 trip hazards within the sidewalk network were identified at the moderate or high severity level

MEDIUM CONCERN

- 35% (35 km) of roads are in very poor or poor condition
- 15.5 km of curb require replacement largely due to adjacent sidewalk replacement needs

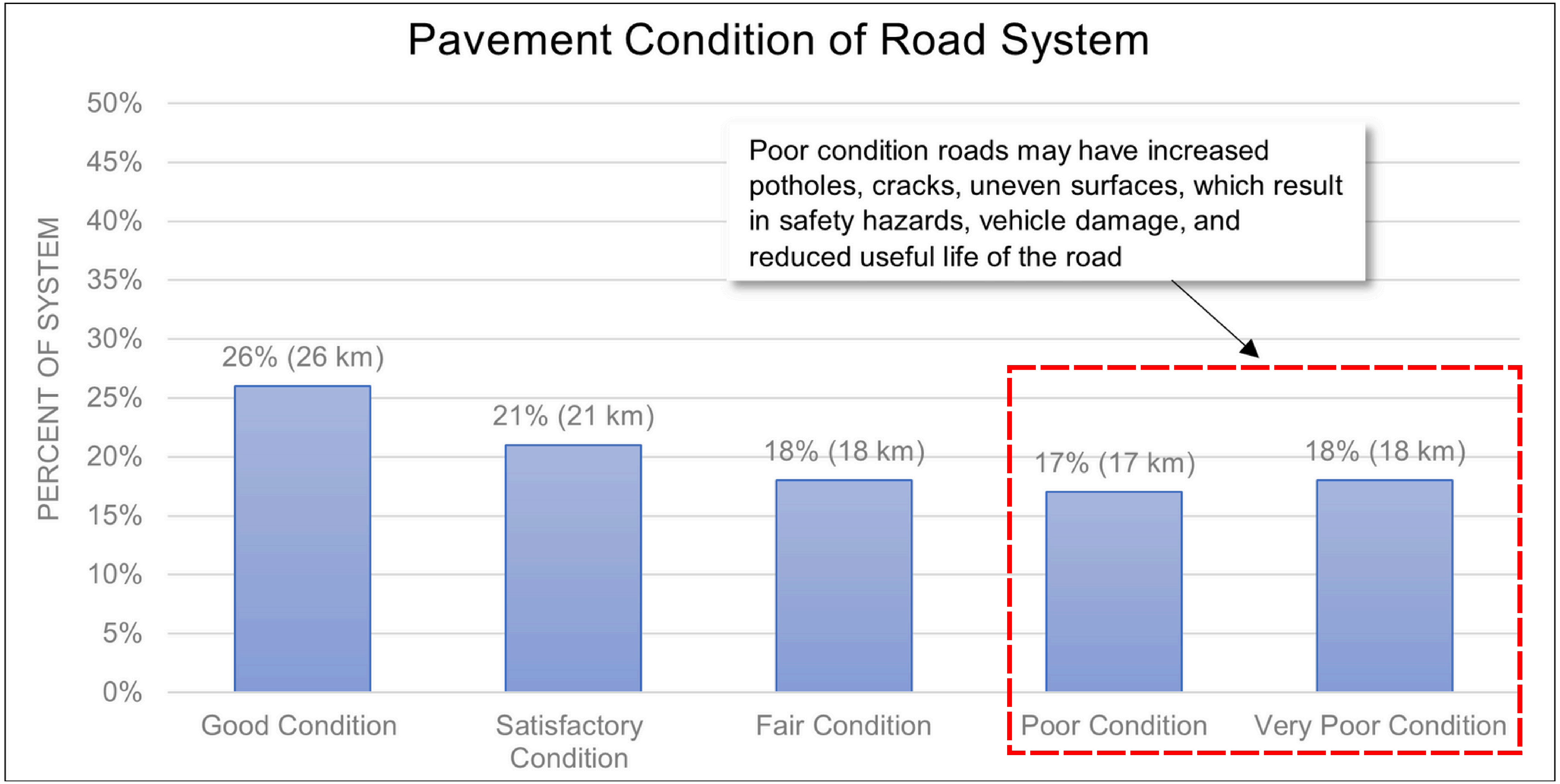
HIGH CONCERN

- 8,942 sidewalk slabs were affected by scaling
- 39% (243 poles) are in poor condition

LOW CONCERN

- 162 km of the curb infrastructure is in fair condition
- 25% (154 poles) are in fair condition

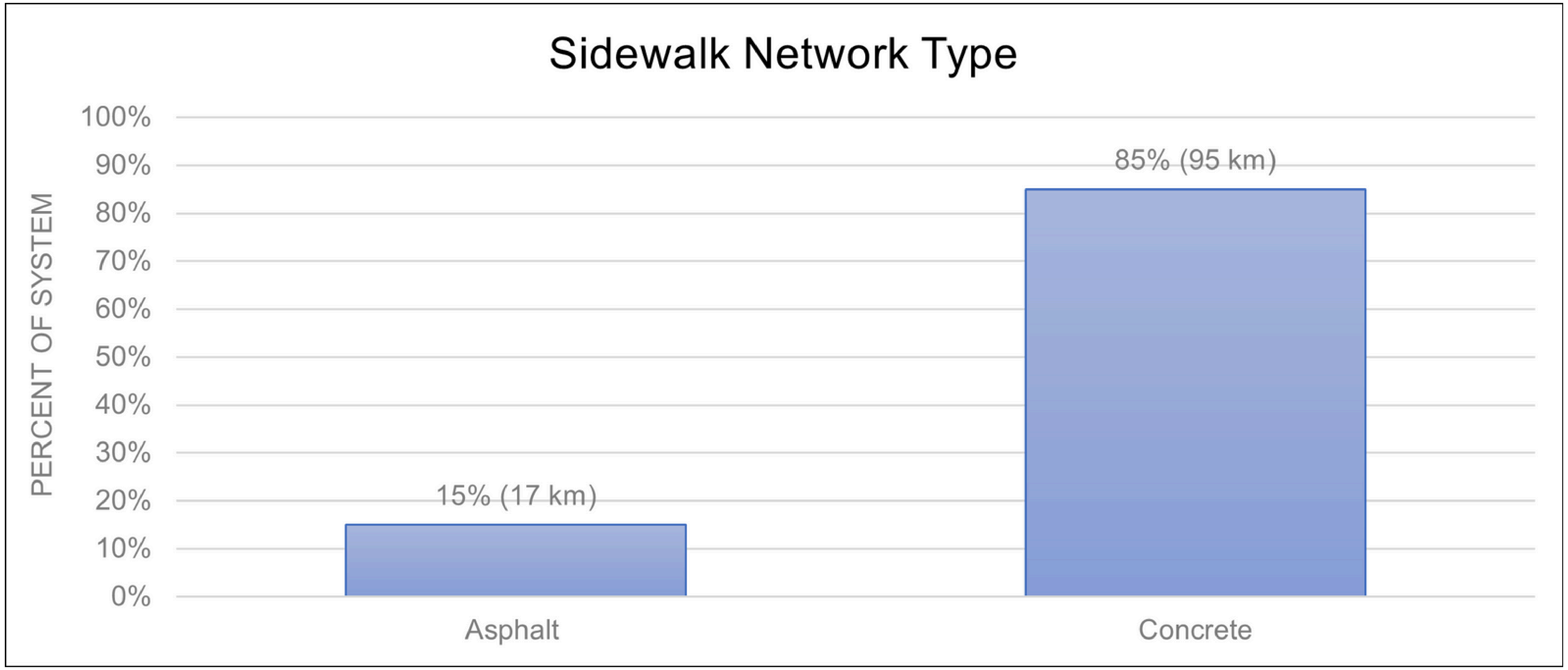
SURFACE INFRASTRUCTURE (ROAD INFRASTRUCTURE)



Pavement surface distresses are measured for the entire road network and measure the severity and extent of the defect.

Local roads (pavement surface) have an average useful life of 50 to 100 years

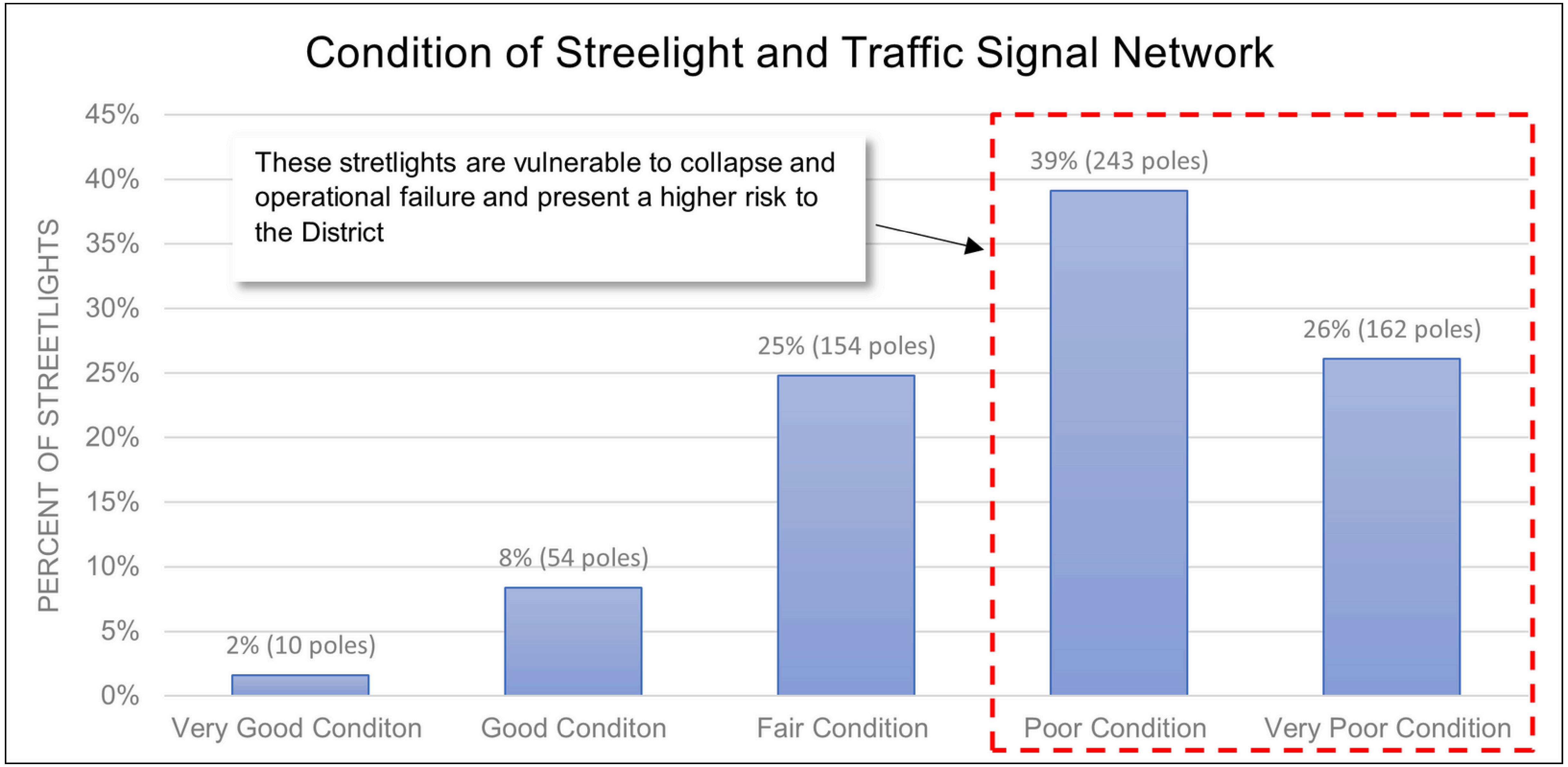
SURFACE INFRASTRUCTURE (SIDEWALKS)



The District has 112 km of sidewalk

Slab replacement is recommended to maintain network

SURFACE INFRASTRUCTURE (STREETLIGHTING)



Very poor and poor condition poles creates a risk to public safety and property

ENGINEERING STANDARDS, SPECIFICATIONS, AND BEST PRACTICES

- Staff use various design standards, specifications, best practices, and regulatory requirements to inform decision-making processes regarding municipal infrastructure

- Examples include:
    - AWWA Standards
    - MMCD Standards
    - Transportation Association of Canada (TAC) Geometric Design Guide
    - Ministry of Health Design Guidelines for Drinking Water

OVERVIEW OF RISKS TO MUNICIPAL INFRASTRUCTURE

Hazard Category

- Natural Disasters
- Environmental
- Design
- Operational
- Legal

Type of Hazard

- Flooding
- Earthquakes
- Climate Change
- Undersized Infrastructure
- Infrastructure Failure
- Inadequate Data
- Lack of Redundancy
- Natural Landscape
- Legal Action

Risks

- Power Outages
- Structural Damage
- Public Health Risks
- Environmental Damage
- Increased Costs
- Increased Maintenance
- Traffic Congestion
- Project Delivery Delays
- Safety Concerns

STAFF INFRASTRUCTURE PRIORITIZATION METHODOLOGY

Staff prioritize infrastructure projects based observations and on master plans and condition assessments. Other criteria (non exhaustive) that Staff use are found below

Underground Infrastructure Criteria

- Pipe Material
- Pipe Size
- Pipe Age
- Maintenance History
- Condition Assessments and Master Plans

Surface Infrastructure Criteria

- Customer Experience
- Maintenance History
- Demand
- Condition Assessments and Master Plans

SYNTHESIZATION OF INFORMATION

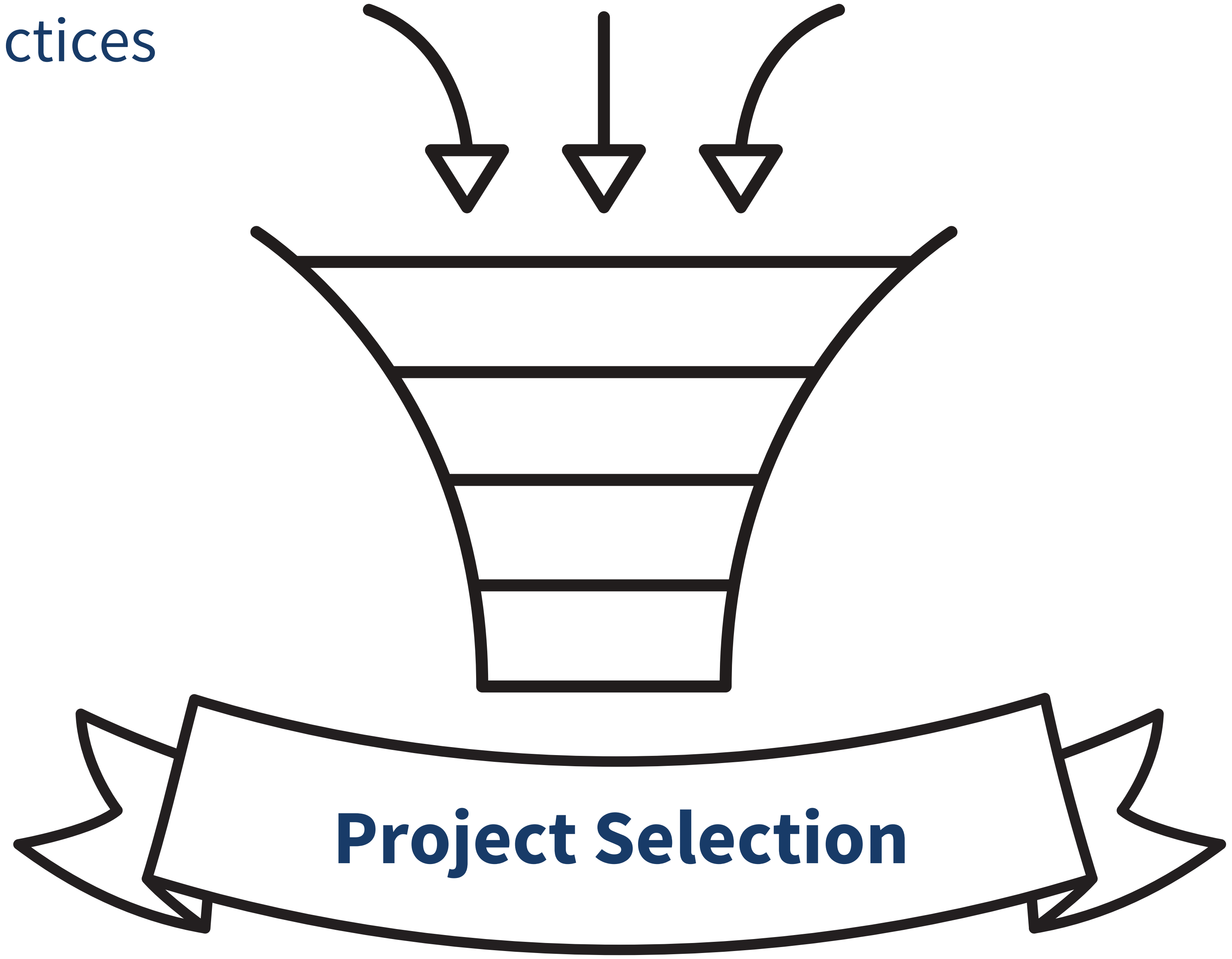
Risk to the District

Condition Assessments

Master Plans

Engineering Standards and Best Practices

Other Factors?



Not a perfect science

Many factors to consider...

STATE OF THE INFRASTUCTURE REPORT CARD

INFRASTRUCTURE CATEGORY	OVERALL SCORE
WATER	★☆☆☆☆
SANITARY SEWER	★★☆☆☆
STORMWATER	★★☆☆☆
ROADS	★★★☆☆
SIDEWALK AND CURBS	★★★☆☆
STREETLIGHTS AND TRAFFIC LIGHTS	★☆☆☆☆

The analysis presented today is primarily concerned about maintaining the District's existing infrastructure and **does not include** any infrastructure enhancements (i.e. adding bike lanes, adding a sidewalk that has been identified as a missing link, etc.)

STATE OF THE INFRASTUCTURE - NEXT STEPS

In the next presentation (Part 2), Staff will present a **detailed risk analysis** to address the infrastructure deficiencies in **Q3/Q4 of 2024**.

- Necessary to make funding decisions related to levels of service, allocation of resources, and to mitigate potential vulnerabilities within the District's network.

- Will provide Council with a full picture in order to respond to all the issues identified within Part 1 of the State of the Infrastructure Report.

QUESTIONS?