Subject: Inspection Programs and Condition of Niagara Region Trunk Sanitary Sewer Infrastructure

Report to: Public Works Committee

Report date: Tuesday, April 5, 2022

Recommendations

1. That this Report **BE RECEIVED** for information; and
2. That this Report **BE CIRCULATED** to the Local Area Municipalities.

Key Facts

- The purpose of this report is to outline current inspections programs for linear sanitary sewer assets and report known structural or inflow and infiltration (I/I) issues, as directed by Public Works Committee on January 11, 2022.
- Niagara Region owns and maintains 145 kilometers of trunk sanitary gravity sewers, 161 kilometers of sanitary force mains, and 2,093 sanitary access chambers across 11 municipalities.
- Niagara Region inspects approximately 85 per cent of its conventional trunk sanitary gravity system once every three years. The remaining 15 per cent is large diameter trunk sewers which are inspected once every 10 to 15 years.
- Niagara Region monitors sewer flows at 147 permanent locations and 57 temporary locations. Flow monitoring information is used for municipal Pollution Prevention and Control Plans (PPCPs), Master Servicing Plans (MSPs), Inflow and Infiltration (I&I) studies, billing, development planning, and capital project design.

Financial Considerations

The total replacement cost of Regional trunk sanitary gravity mains and sanitary force mains is over 1.1 billion dollars based on the 2016 Asset Management Plan, inflated to 2022 dollars. Sanitary gravity main and force main assets are designed for a useful service life that ranges between 60 and 100 years and sanitary access chambers are designed for a useful service life of 50 to 100 years. Asset service life and condition are influenced by various factors such as material, sewage characteristics, location, use, and the environment that it is installed in. The Region has several inspection and maintenance programs included in the approved operating budget to maximize useful life and maintain asset performance. These programs are detailed in Table 1.

Table 1: Sanitary Gravity Main Inspection and Maintenance Programs

Program Name	Frequency	Cost
Conventional Trunk Sanitary Gravity Sewer CCTV Inspections (up to 1350mm)	Annual Program	$175,000
Sanitary Gravity Sewer Flushing	Annual Program	$100,000
Large Diameter Trunk Sanitary Gravity Sewer CCTV Inspection (1350mm and larger)	Once every 10 to 15 years	$210,000
Sanitary Access Chamber Inspection	Once every 10 to 15 years	$210,000
Suspended Pipe Inspection (These are elevated pipes that cross highways or water bodies)	Once every 10 to 15 years	$30,000

Analysis

Niagara Region owns and maintains 145 kilometers of trunk sanitary gravity mains, 161 kilometers of sanitary force mains, and 2,093 sanitary access chambers across 11 municipalities. Appendix 1 contains a summary of linear assets by municipality. Existing programs for these assets can be grouped into five categories; inspection, flow monitoring, combined sewer overflow (CSO) control and wet weather management, maintenance, and rehabilitation and replacement.

Inspection

Trunk sanitary gravity sewers are large pipes that receive wastewater flows from smaller sewers and convey wastewater using the force of gravity. Niagara Region assesses the condition and performance of trunk sanitary gravity sewers using Closed Circuit Television (CCTV) camera equipment. Key observations are encoded into CTSpec which is a sewer inspection system that is built on National Association of Sewer Service Companies (NASSCO) industry standards.

Sanitary gravity mains with a diameter of 1350mm or less are inspected once every three years. These mains account for 85 per cent of all Regional trunk gravity mains. Trunk sanitary gravity mains that have a diameter greater than or equal to 1350mm are inspected once every 10 to 15 years. These large diameter sewers account for 15 per cent of all Regional trunk sanitary gravity mains. The difference in inspection frequency

is due to the specialized equipment necessary to access and inspect sewers that have continuous high flow levels. Table 2 details the total length of sewers inspected over the past four years.

Table 2: CCTV Program Summary

Measurement in Meters	2018	2019	2020	2021
Inspection Length (M)	54,151	49,621	37,905	18,500*

*2021 marked the end of one inspection contract and the start of a new contract. Delays in the procurement process due to competing priorities resulted in a gap in inspection contracts. As a result, the length of sewers inspected in 2021 was less than in prior years.

Sanitary gravity sewer condition reporting is split into two groups, structural defects and service defects. Structural defects include collapses, cracks, pipe offsets, and other defects that impact the integrity of the pipe. Structural condition ratings range from 1 to 5, with 1 representing a new pipe with no defects, and 5 being a pipe that has one or more of the most severe defects. Appendix 2 provides a graphic overview of the current structural condition of Regional trunk sanitary gravity mains.

Service or operational defects are defects that affect the performance of the pipe. These defects include debris, roots, and other blockages. Service condition ratings range from 1 to 5, with 1 representing a new pipe with no defects, and 5 is a pipe that has one or more of the most severe blockages. Appendix 3 provides a graphic overview of the current service condition for Regional trunk sanitary gravity mains.

Fourteen per cent of sanitary trunk gravity mains have no data because these pipes were inspected fifteen years ago as part of a large diameter inspection contract and data was not imported into the sewer inspection system. Large diameter sewers can be extremely deep and have high and fast flows. Performing assessments of these sewers requires specialized equipment. A contract will be released later this year to re-inspect large diameter sanitary gravity sewers.

Sanitary force mains are pressurized sewer pipes that convey pumped wastewater from a lower elevation to a higher elevation or across areas where deep excavation is not feasible. The cost of inspecting sanitary force mains is high because temporary flow bypass is required and gaining access to the pipe often exceed the costs of physical

inspection. As a result, sanitary force main condition is calculated based on age and break history. Appendix 4 provides a graphic overview of sanitary force main condition.

Sanitary access chambers are access shafts that provide access to sanitary gravity sewer pipes. Sanitary access chambers are inspected every 10 to 15 years. The last time the Region completed a system-wide access chamber inspection program was in 2009. Condition information grades from the 2009 system-wide inspection are shown in Appendix 5.

Thirty-eight per cent of sanitary access chambers have not been inspected because of accessibility issues but the condition of many of these chambers are observed during CCTV pipe inspections. Service condition for another six per cent could not be obtained because of chamber size or configuration. A graphic breakdown is shown in Appendix 6. Deeper chambers may have stairs and landings that restrict inspection equipment.

Flow Monitoring

Since 2013, Niagara Region has continued to support Local Area Municipalities by offering remote access to customized SCADA screens offering both real-time status and historical data for wastewater collection system infrastructure servicing their municipality. Nine of the eleven serviced municipalities currently utilize this tool to assist them in making informed decisions during wet weather events. Niagara has since expanded the functionality of this tool by offering municipalities the option of creating automated alarming to notify of alarm events impacting critical collection system locations in their area.

Niagara Region monitors sewer flows at 147 permanent locations and 57 temporary locations. Flow monitoring information is used for municipal Pollution Prevention and Control Plans (PPCPs), Master Servicing Plans (MSPs) including the 2021 Water and Wastewater MSP, Inflow and Infiltration (I&I) studies, billing, development planning, and capital project design. Over the past four years, Niagara Region has participated in the following plans:

- 2018 Niagara Falls PPCP
- 2019 Fort Erie PPCP
- 2019 Grimsby Lincoln West Lincoln PPCP
- 2019 St. Catharines PPCP
- 2019 Welland PPCP
- 2021 Niagara Region MSP

CSO Control Program & Wet Weather Management

The Regional Combined Sewer Overflow (CSO) Control Program is a collaborative initiative between the Region and Municipal Partners and is managed by the Infrastructure Planning & Development Engineering group in Planning & Development Services. The CSO Program is part of the Wet Weather Management (WWM) Group, which has local municipal representation for all serviced areas. This group meets to review the CSO Program and cost-sharing funding for projects that deal with I&I issues on the municipal sanitary systems and includes funding as well Regional participation in projects like the PPCPs listed above. PPCPs will consider flow monitoring for the entire sanitary collection system including local municipal sewers as well as Regional sanitary trunk sewers and Regional sewage pumping stations to determine specific areas of greater I&I and direction for further study and remediation.

The widely accepted CSO Control Program goal is to work on targeted I&I reduction to lower the risk of basement flooding and reduce overflows to the environment as well as gaining back existing capacity, postponing upgrades/expansions of wastewater infrastructure, and providing capacity for growth.

The CSO Funding Program has been in place since 2007 and is intended to facilitate shared funding with the local Municipal partners to help mitigate the impacts of wet weather events on the Region-wide sanitary system and the environment. A total of approximately $68 million dollars of funding has been awarded from 2007- 2021 for 388 projects with LAMs.

Maintenance

When Regional asset defects are identified, it is triaged and resolved according to the level of risk. Major structural defects such as collapses or holes are repaired using annual maintenance budgets. Service defects such as roots, debris, grease deposits, or calcite are removed through the annual sewer flushing program. Table 3 details the total length of sewers cleaned over the past four years.

Table 3: Sewer Flushing Program Summary

Measurement in Meters	2018	2019	2020	2021
Flushing Length (M)	20,950	12,613	11,010	6,400*

*2021 marked the end of one flushing contract and the start of a new contract. Delays in the procurement process due to competing priorities resulted in a gap in sewer flushing contracts. As a result, the total length of sewer flushing in 2021 was less than in prior years.

Rehabilitation or Replacement

Defects requiring sewer replacement or rehabilitation such as sewer relining are prioritized using the Corporate Asset Management Risk Assessment (CAMRA) model and added to the capital program. Over the past four years, over 17 million dollars has been spent relining the Stamford Interceptor Trunk Sewer in Niagara Falls and Oaks Park Trunk Sewer in Fort Erie. Table 4 details the total length of sewers that have been relined or replaced over the past four years.

Table 4: Sewer Relining and Replacement Summary

Measurement in Meters	2018	2019	2020	2021
Sanitary Gravity Main Relining Length (M)	1,278	1,563	690	1,558
Sanitary Gravity Main Replacement Length (M)	867	1,008	6	7
Sanitary Force Main Replacement Length (M)	1,128	3,184	1,597	1,673

Alternatives Reviewed

Since the late 1990's, Niagara Region has relied on camera-based technologies such as CCTV camera inspections for gravity pipe condition assessments. Camera-based technologies are well-established and cost-effective condition assessment methods that can be used on gravity pipes of various sizes and materials. The drawbacks of this technology are that it cannot inspect pipes that are submerged and it can only inspect internal pipe surface conditions.

Alternative technologies such as acoustic and free-swimming leak detection equipment have been used to inspect sanitary force mains and sewers that are continuously submerged but success has been limited. Acoustic technology was used in 2012 to inspect a portion of the River Road Trunk Sanitary Sewer but this inspection was unsuccessful. In 2015, free-swimming technologies were used successfully to inspect the condition of 2,000 meters of the St Davids #1 (Cannery) Sewage Pumping Station force main. This technology was also used to inspect the Victoria Avenue Sewage Pumping Station force main however this inspection was unsuccessful.

Due to sewer size, flow and access, it is not always economically feasible to conduct complete inspections of the entire wastewater system. A balance must be struck between the collection of condition information and the cost and risk of inspection.

Relationship to Council Strategic Priorities

Information presented in this report relates directly to Council's Strategic Priority 4.1 of committing to "high quality, efficient and coordinated core services"

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Appendices

Appendix 1	Sanitary Sewer Network Statistics
Appendix 2	Sanitary Trunk Gravity Main Structural Condition
Appendix 3	Sanitary Trunk Gravity Main Service Condition
Appendix 4	Sanitary Force Main Structural Condition
Appendix 5	Sanitary Access Chamber Structural Condition
Appendix 6	Sanitary Access Chamber Service Condition

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Sanitary Sewer Network Statistics

Wastewater Network	Fort Erie	NOTL	Grimsby	Niagara Falls	St. Catharines	Port Colborne
Number of Local Area Municipal Connections to Niagara Region Sewers	66	23	42	70	137	31
Niagara Region Average Sanitary Gravity Main Age (Years)	40.43	35.14	36.32	43.59	49.74	45.34
Niagara Region Average Sanitary Force Main Age Average (Years)	12.28	15.22	24.58	15.79	18.66	21.51
Approximate Local Area Municipal Sanitary Gravity Main Length (Km)	199.26	93.47	112.00	432.16	560.76	90.20
Niagara Region Sanitary Gravity Main Length (Km)	16.27	8.96	11.11	21.32	35.64	0.97
Approximate Local Area Municipal Sanitary Force Main Length (Km)	0.00	3.45	1.34	1.08	3.95	0.84
Niagara Region Sanitary Force Main Length (Km)	20.05	15.46	13.80	29.45	6.32	19.09
Number of Niagara Regional Access Chambers (Maintenance Holes & Underground Enclosures)	284	152	198	332	435	75
Number of Local Area Municipal Access Chambers (Maintenance Holes & Underground Enclosures)	2743	1678	2058	6065	8216	1135

Wastewater Network	Welland	Thorold	Lincoln	West Lincoln	Pelham
Number of Local Area Municipal Connections to Niagara Region Sewers	83	36	20	5	31
Niagara Region Average Sanitary Gravity Main Age (Years)	36.18	41.35	41.89	18.67	32.66
Niagara Region Average Sanitary Force Main Age Average (Years)	23.11	23.29	26.77	12.81	13.07
Approximate Local Area Municipal Sanitary Gravity Main Length (Km)	235.79	102.22	85.57	33.15	66.51
Niagara Region Sanitary Gravity Main Length (Km)	28.02	5.76	7.56	0.34	5.27
Approximate Local Area Municipal Sanitary Force Main Length (Km)	1.59	0.00	3.64	0.18	0.48
Niagara Region Sanitary Force Main Length (Km)	13.54	8.90	13.90	14.01	6.91
Number of Niagara Regional Access Chambers (Maintenance Holes & Underground Enclosures)	275	118	127	31	79
Number of Local Area Municipal Access Chambers (Maintenance Holes & Underground Enclosures)	3913	1448	1255	501	989

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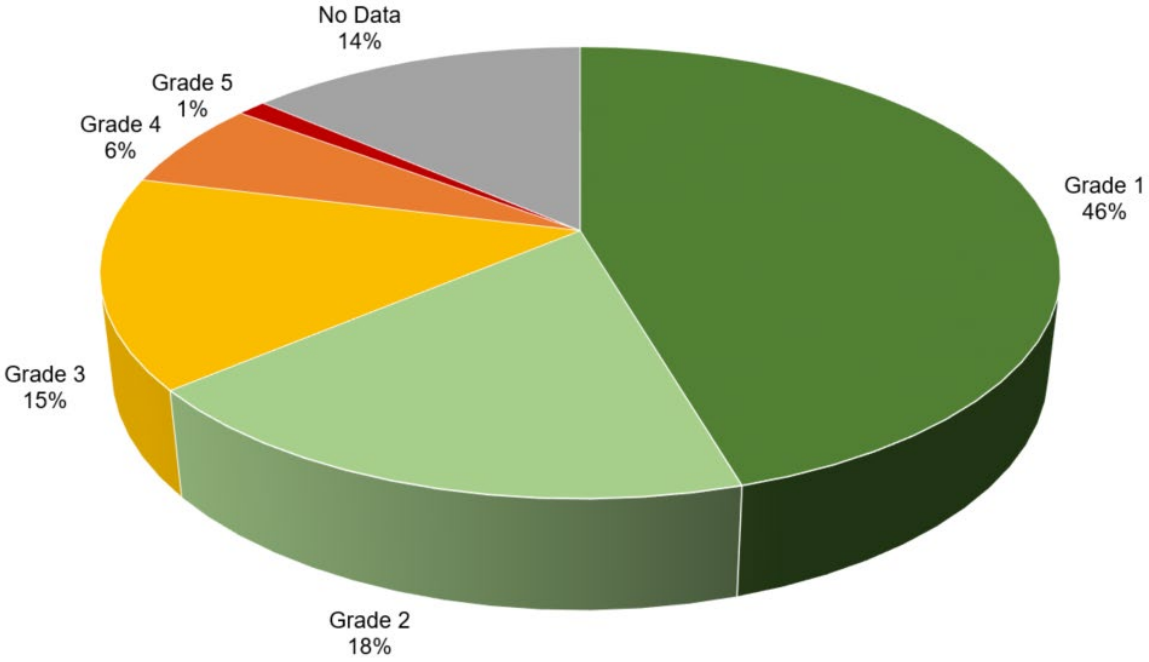
Sanitary Trunk Gravity Main Structural Condition



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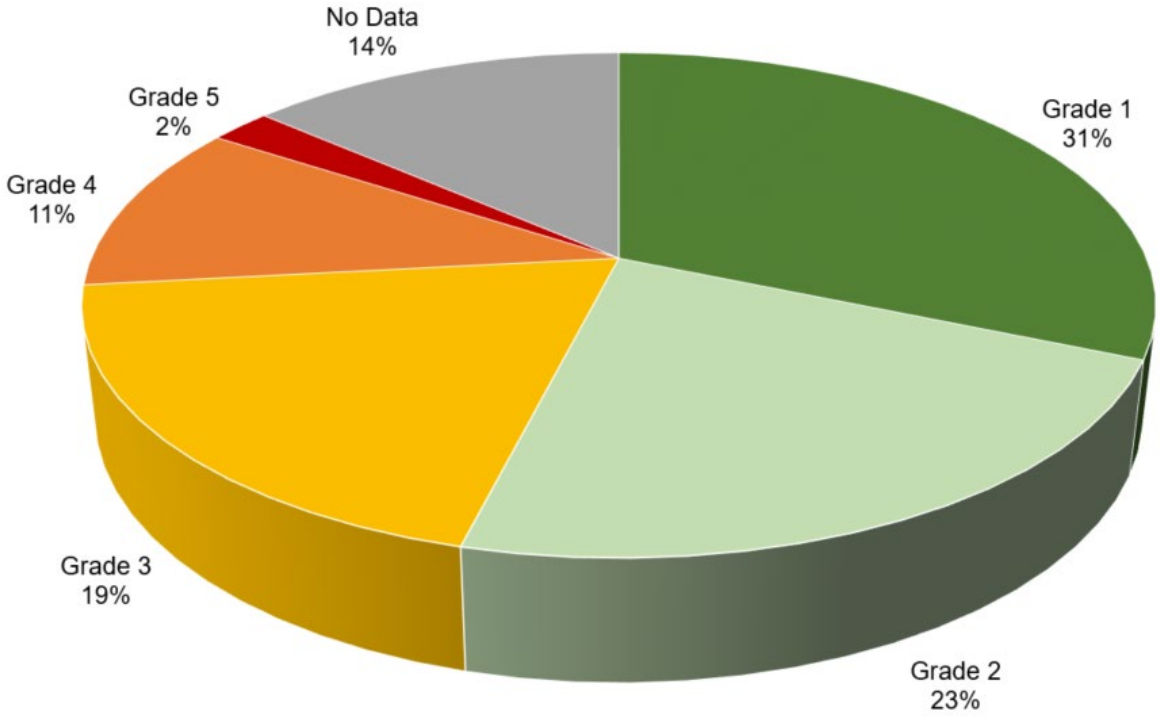
Sanitary Trunk Gravity Main Service Condition



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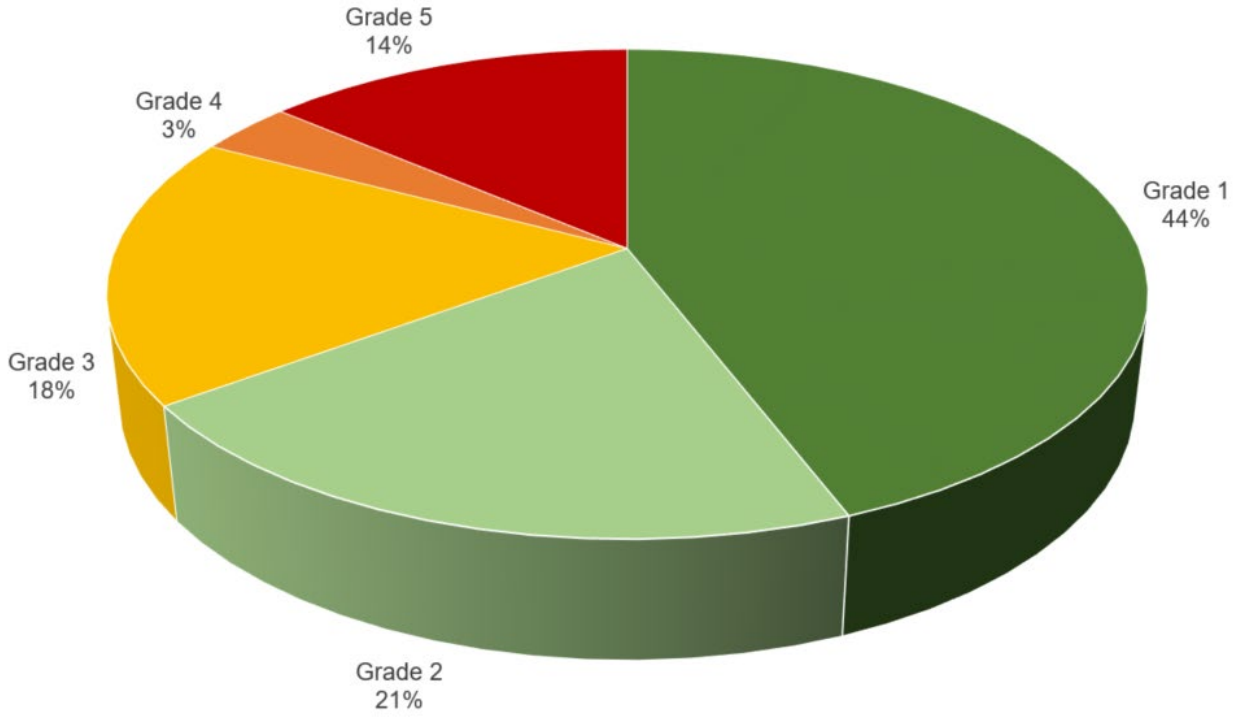
Sanitary Force Main Structural Condition



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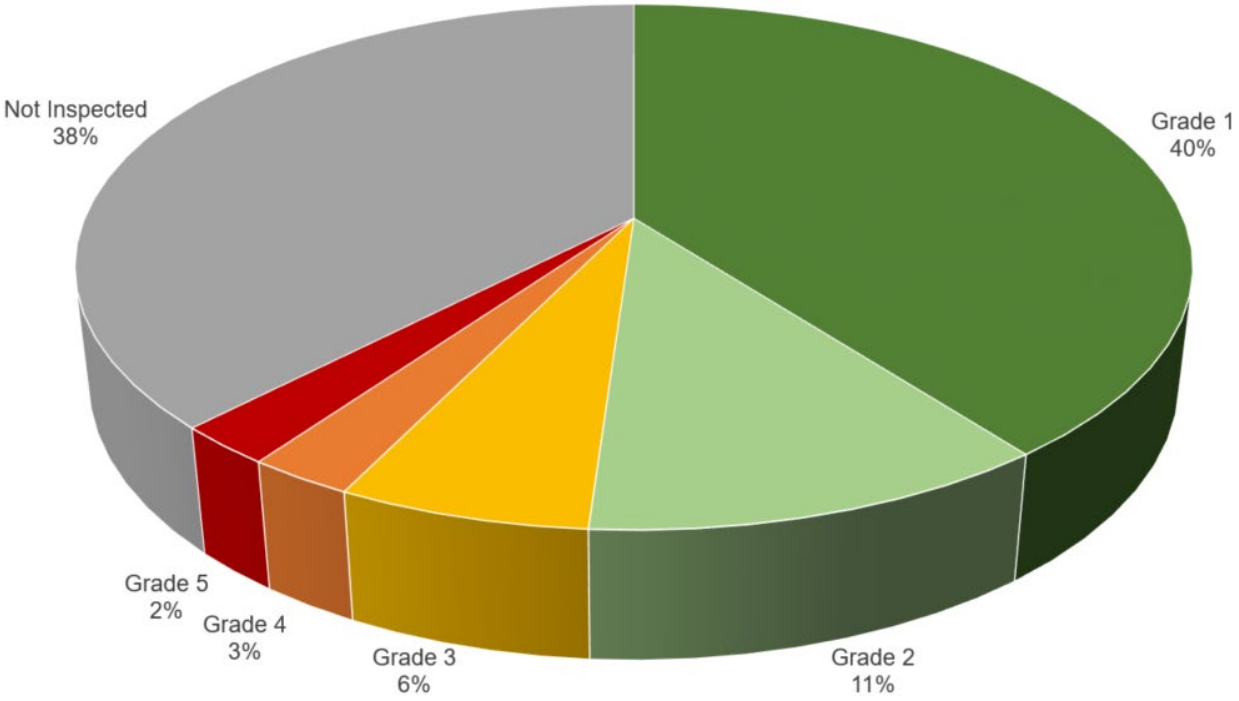
Sanitary Access Chamber Structural Condition



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Sanitary Access Chamber Service Condition