MUNICIPAL ASSET CONDITION ASSESSMENT IN CHATHAM-KENT

A GIS CASE STUDY

GEOS 540: APPLIED GIS DIRECTED FIELD STUDIES

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Assignment 2: Case Study (15 Pages)

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Executive Summary

In summer 2025, as an intern working for the Chatham-Kent municipality, Department of Asset Management, we set out to the field to conduct a project of identifying, collecting, and assessing conditions of municipal assets. These assets include trees, fire hydrants, parking spaces, parking lots, parking meters, traffic lights, bus stops, and bus shelters. A project of more than 20,000 assets within the municipality. We used standardized IPWEA conditions to rate our assessment. I collected more than 5,500 assets in less than 4 months. My methodology focuses on fire hydrants, combining statistics, mapping conditions, spatial queries, and conclusions and recommendations. The results of fire hydrant analysis can be used for planning, decision making, or even presented to the council for further actions.

Introduction

Chatham is a ward in Chatham-Kent Municipality in Southwestern Ontario, with a population of over 45,000 residents from diverse backgrounds. The municipality is responsible for maintaining public infrastructure that affects the livelihood, safety, and quality of life of Chatham's residents. As urban infrastructure expands and budgets remain limited, there is a growing need for efficient, data-driven decision-making. Modern asset management practices supported by Geographic Information Systems (GIS) play a vital role in this context. Asset Management offers a better way to oversee public infrastructure, but where should you start? Many towns and cities face similar challenges in how to begin collecting data on their infrastructure and developing asset management plans along with integrated policies and procedures (Canadian Network of Asset Managers, 2021).

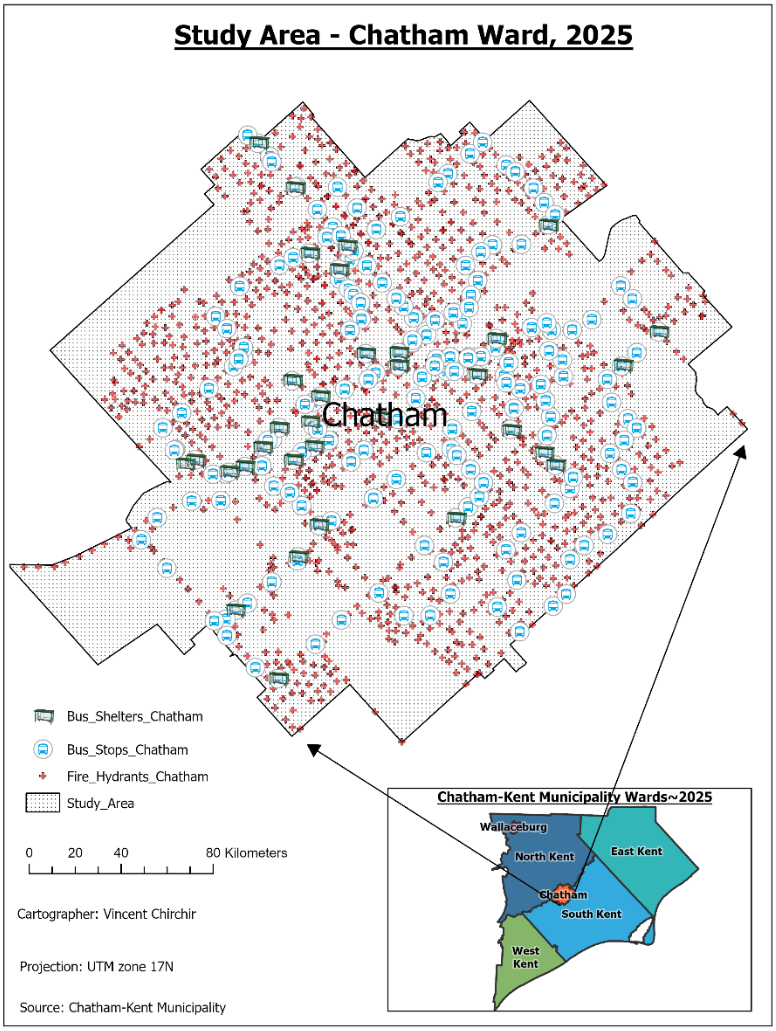


Figure: Chatham Ward, Study Area

The department of Asset Management in the Municipality of Chatham-Kent has likely found where to start. In 2024, the Asset and Management Department started data collection using ArcGIS Field Maps to assess the condition of various municipality assets such as fire hydrants, parking spaces, parking meters, bus shelters, bus route stops, and trees. Assets were rated on a scale of 5, from New Install, good condition, fair condition, poor condition, and critical condition, and trees were based on health ratings on crown, trunk, and root defects on the same 5 scale.

This case study shows how I contributed to this project, focusing on the data collected. This project will enable the identification of assets that need attention from the municipality and support the development of spatially informed solutions using GIS analysis tools. As a result, the city will be better positioned to make timely, evidence-based decisions that enhance both public safety and service delivery.

Background Research

According to the Federation of Canadian Municipalities, Good asset management practices are fundamental to achieving sustainable communities (Canadian Network of Asset Managers, 2021, p. 4). In the context of the Federation of Canadian municipalities, good data and regularly updated asset data help in determining which infrastructure requires maintenance, repair, or replacement, and when. The accurate field collected data supports informed decision-making around service-level delivery while enabling municipalities to prioritize critical safety-related assets, such as fire hydrants. It all starts by collecting data, validating and analyzing data to set a good foundation for decision making.

As cities continue to grow, neighborhoods are faced with aging and deteriorating assets; thus, the demand for new infrastructure and the replacement of aging assets is increasing. Residents and businesses are calling for high-quality public services—yet many are reluctant to support the increased taxes that such improvements need. This creates a challenge for local governments: how to deliver essential services and maintain critical infrastructure without overextending taxes to their residents. These balance demands careful planning. But with reliable information, cities can evaluate the condition and priority of each asset and make smarter, more transparent decisions that reflect both realities and community needs.

GIS has become a useful tool in overcoming this challenge. Local authorities need to know where the assets are in the public, and the condition in which they are developed, ways on how they can be continually monitored to register and plan on how they can trace them at any moment they want to use. According to Tang and Waters (2005), GIS enables local authorities to see, understand, interpret, and visualize assets in different forms, where they can find various spatial correlations, patterns, and conditions of assets in the public. It therefore becomes an important decision-making tool. GIS can design possible alternatives and future development of a municipality with a growing population, economy, and development

Mobile GIS solutions, such as ArcGIS Field Maps, allow field crews to collect, verify, attach photographs, and update asset data on-site using mobile devices. ArcGIS Field Map syncs with ArcGIS Online systems, ensuring accuracy and accessibility of data across departments (ESRI, 2022).

The value of mobile GIS in asset management is well demonstrated in the City of Las Vegas' ParkPAD initiative, which replaced a legacy maintenance system with a mobile data collection solution based on ArcPad. This approach enabled crews to digitally assess parks and facilities in real time, resulting in improved maintenance efficiency, cost savings, and better coordination between city departments (City of Las Vegas, 2012).

Research by Crompton (2007) and Bowes and Ihlanfeldt (2001) argues that deteriorating public infrastructure—such as unsafe trees, damaged sidewalks, or poorly marked roads—can compromise public safety and reduce the quality of urban life, particularly in underserved communities and therefore integrating GIS with asset management enables better stewardship of infrastructure, helps meet regulatory expectations, and ensures that critical services—such as fire protection, transit access, and urban forestry—are delivered safely and efficiently (InfraGuide, 2005; Government of Canada, 2021).

Problem Definition

Existing assets are aging, while the demand for enhanced, higher-quality, and safer assets is rising throughout the city. The Chatham-Kent municipality bears responsibility for maintaining this diverse range of infrastructural assets, including urban green spaces, fire hydrants, bus shelters, bus stops, parking meters, and parking spaces across Chatham. However, until recently, the Municipality started assessing the conditions and safety risks associated with these assets. Some of these assets are deteriorated or missing important safety measurements.

Without accurate data from the field, the municipality faced challenges in

- Knowing which assets to prioritize in replacing
- Which assets to justify in resource allocation.

According to the Federation of Canadian Municipalities (2021), data collection and availability are the most frequently identified challenges faced by communities at the beginning of their asset management journey. And thus, municipalities are unable to make responsible asset decisions if they are unaware of their conditions in the field, and what level of service is expected from those assets to provide when needed. The lack of this foundational data can make it difficult for Chatham-Kent to meet public expectations for safety, especially as aging infrastructure coincides with limited municipal budgets and increased regulatory oversight.

Public assets such as fire hydrants and bus shelters/stops are very important, especially during emergencies. A fire hydrant that is hidden, for example, can affect its functionality when needed.

Figure 1: Hidden Fire Hydrant

And if there is no centralized mapping to monitor, coordination becomes slow or even inactive, leading to a dependence on residents' complaints.

Figure 2: A Fire Hydrant Out of Service

Through my internship in the Asset and Management department, I have directly involved myself in addressing this problem. We are implementing the use of ArcGIS Field Map to assess the conditions of these assets in the field. Our goal was not just to collect data but to build a sustainable, repeatable workflow that would support spatial risk analysis and proactive maintenance planning in the Municipality for the next generations.

My case study focuses on addressing the asset challenges and answering the question of 'How can field-collected data help the municipality identify, map, and respond to assets that pose potential risks to the public?'

Methodology

Everything starts with having the right information organized in the right way. To address up-to-date data in the municipality, the Assets and Management Department started a mobile-based data collection using ArcGIS Field Maps. The goal is to assess the conditions in real time of specific assets that can help make timely decisions and mitigate the risks associated with service delivery.

Data Collection

I actively participated in the data collection process, and we were able to inspect more than 1,400 fire hydrants across Chatham, 14,381 trees, 199 bus stops, 100 bus shelters,

Trees – trees were collected based on the crown health, trunk health, and root health, all using a scale of no defects, minor defects, moderate defects, significant defects, and critical defects. We also included cavity presence in a value of (YES/NO), circumference of the tree in (cm), species of the tree, and geotag a photo of the tree.

Fire hydrants – we verified if the fire hydrant is present, checked the condition (using IPWEA standards) on a scale of good condition, Fair condition, Poor condition, and critical condition. We also checked the color of the bands (Blue, Red, Green), and the hydrant color (Yellow, Yellow/Red, Yellow/Back).

Transit – for bus shelters and bus stops, we recorded whether they are available and their conditions, which range from (New install, good condition, fair condition, poor condition, and critical condition). We also noted the presence of a solar panel (YES/NO), a bench (YES/NO), and the condition of the bench if present. Additionally, we recorded if there is a pad (YES/NO), the condition of the pad if available, whether it is a transfer point (YES/NO), and if it is on request (YES/NO).

Each feature was supported with photographic evidence.

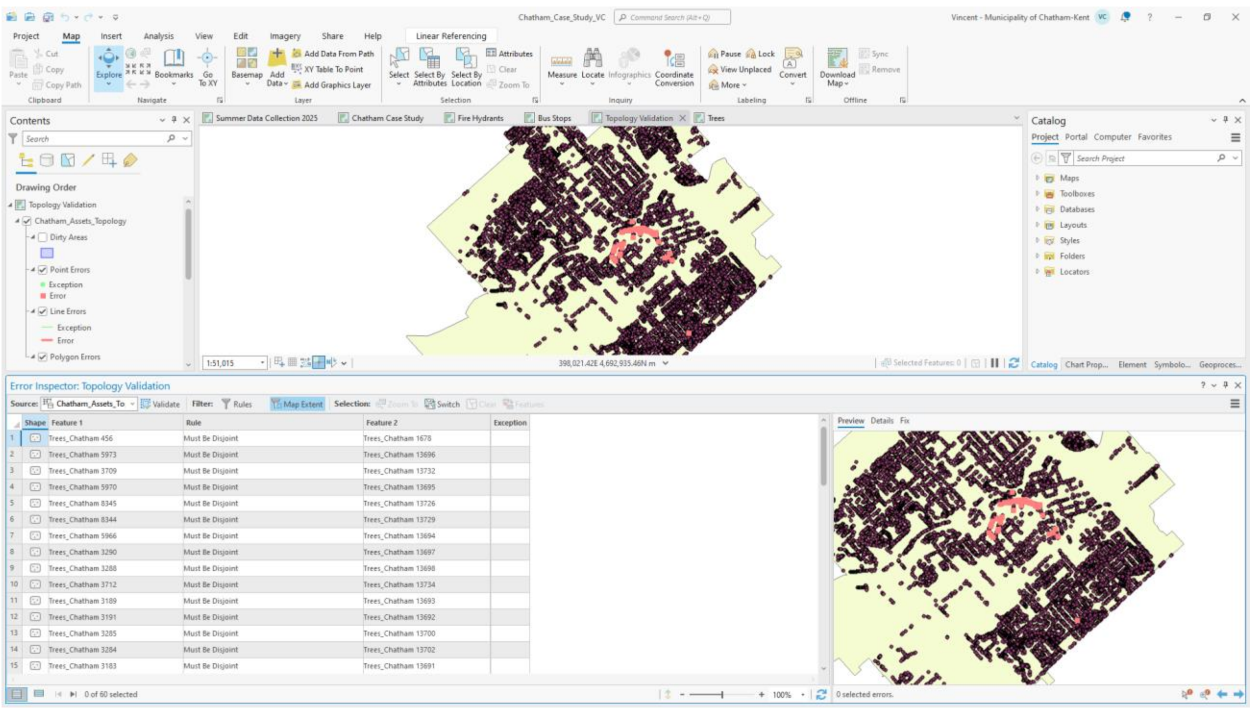
Data Normalizing

For analysis, future integrations, clustering, and aggregations, there is a need to normalize data for consistency.

The ratings were scaled to a 1-5 numeric range, and YES/NO were standardized to 1=YES and 0=NO.

Topology Rules

We then created a topology under the dataset of Chatham Assets and set rules on points and polygons. The point rules covered trees, fire hydrants, bus stops, and parking meters. The polygon rules covered parking spaces and parking lots.



We ran the validated topology rule in ArcGIS Pro to validate our features. We then used the error inspector to review and correct any duplicate points and any other errors in the polygons.

We then re-validated to confirm zero errors. This ensured that we were working with logically consistent data.

Assessment and Analysis

Once the data was collected and translated into formats suitable for spatial analysis, we then started to identify and quantify the overall conditions of the assets.

Descriptive statistics

For each asset, we calculated the condition score and the proportion of assets in the IPWEA Conditions category. We computed summary statistics using the summary tool in ArcGIS to get the total percentage, mean, and standard deviation of asset quality across Chatham. Those summaries would provide a basis for asset comparisons.

Results and Discussion

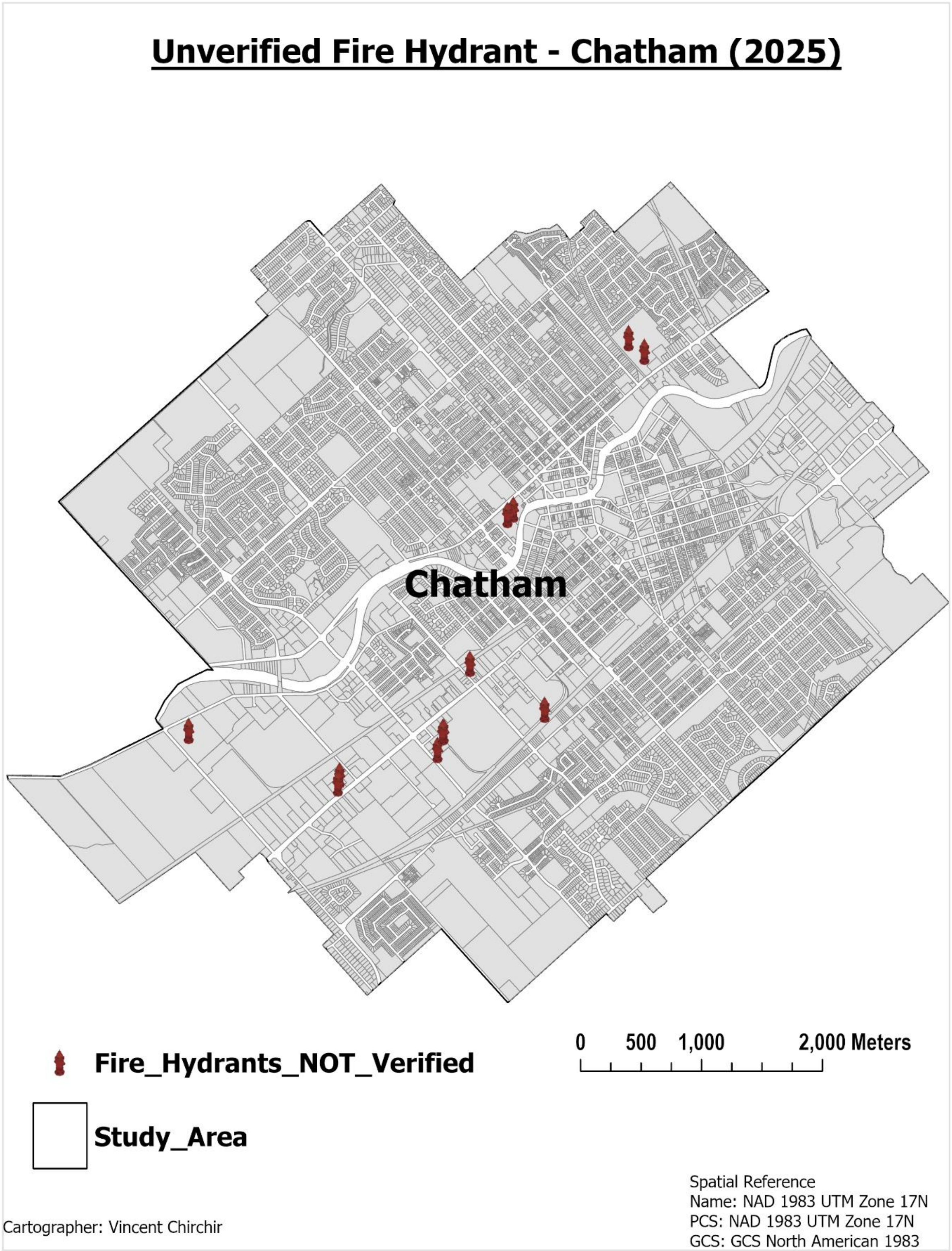
Fire Hydrants

Out of 1446 fire hydrants in Chatham, we verified 99.17%. The remaining 0.83% weren't reachable because they were too hidden or deep inside a property.

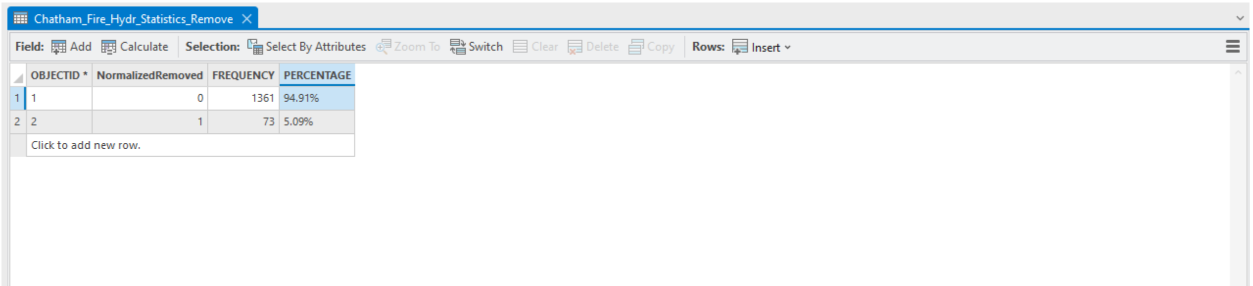
	OBJECTID *	NormalizedVerified	FREQUENCY	PERCENTAGE
1	1	0	12	0.83%
2	2	1	1434	99.17%

Figure 3; Summary statistics table showing the percentage of fire hydrants verified

The map below shows a small number of hydrants that are part of the distribution of unverified fire hydrants in Chatham. The unverified are slightly more in the southern Chatham. To ensure complete field assets coverage, follow-up with property owners may be necessary to close the gap


Unverified Fire Hydrant - Chatham (2025)
Chatham
Fire_Hydrants_NOT_Verified
Study_Area
0 500 1,000 2,000 Meters
Spatial Reference
Name: NAD 1983 UTM Zone 17N
PCS: NAD 1983 UTM Zone 17N
GCS: GCS North American 1983
Cartographer: Vincent Chirchir

Out of 1434 verified fire hydrants, 5.09% have been removed, while the remaining 94.91% are still present.



Chatham_Fire_Hydr_Statistics_Remove

Field: Add Calculate Selection: Select By Attributes Zoom To Switch Clear Delete Copy Rows: Insert

	OBJECTID *	NormalizedRemoved	FREQUENCY	PERCENTAGE
1	1	0	1361	94.91%
2	2	1	73	5.09%
	Click to add new row.			

Figure 4; Summary statistics table showing percentage of removed fire hydrants

The map below displays the locations of removed fire hydrants in Chatham. Several are spread throughout the city, with a higher concentration in northern Chatham.

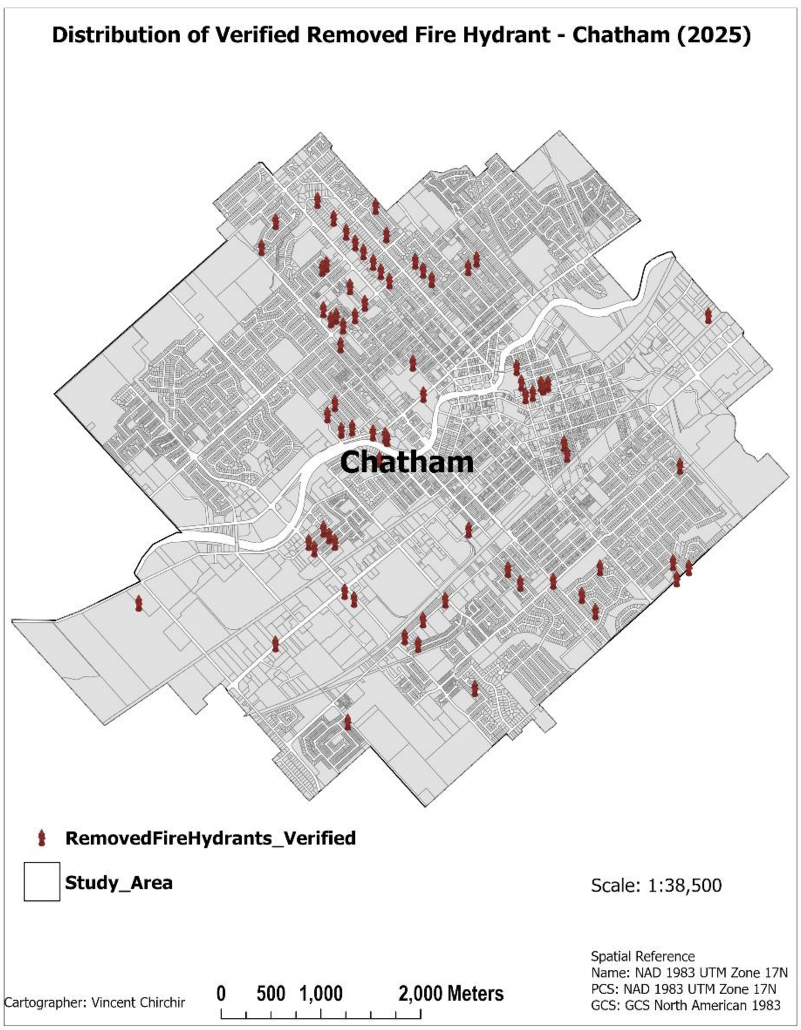


Figure 5: Distribution of verified removed fire hydrants in Chatham (2025)

Out of 1446 total fire hydrants in Chatham, 1,361 were NOT removed, reached, and verified according to IPWEA conditions.

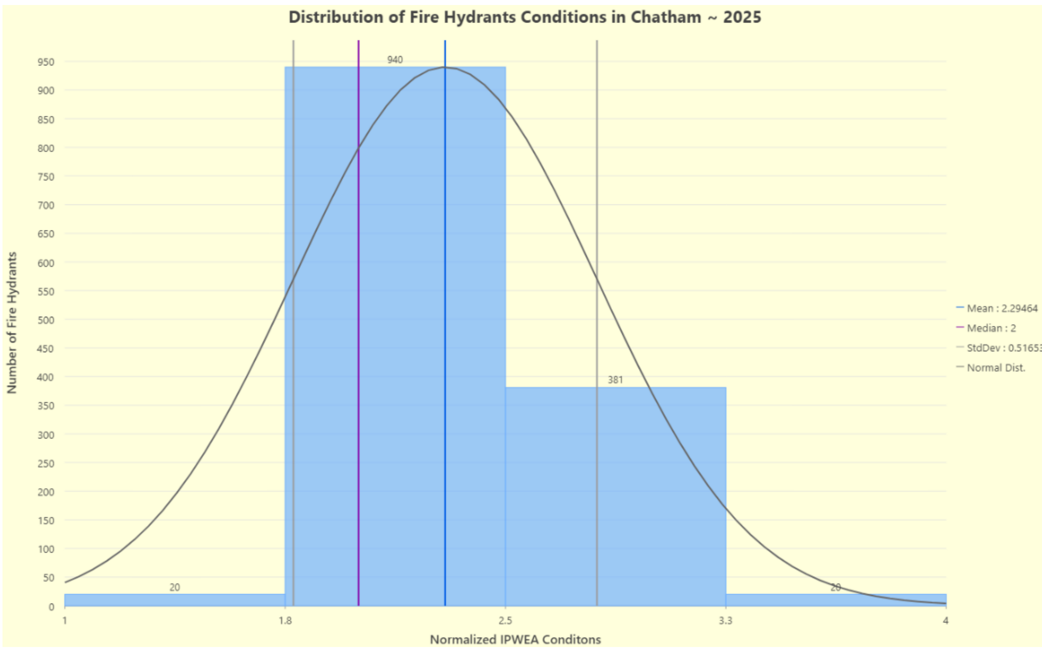


Figure 6: Fire Hydrant Statistics in Chatham - 2025

The figure above shows the distribution of normalized IPWEA condition scores for the 1361 verified fire hydrants in Chatham. From the graph, we can see the statistics:

Mean: 2.29

Median: 2.00

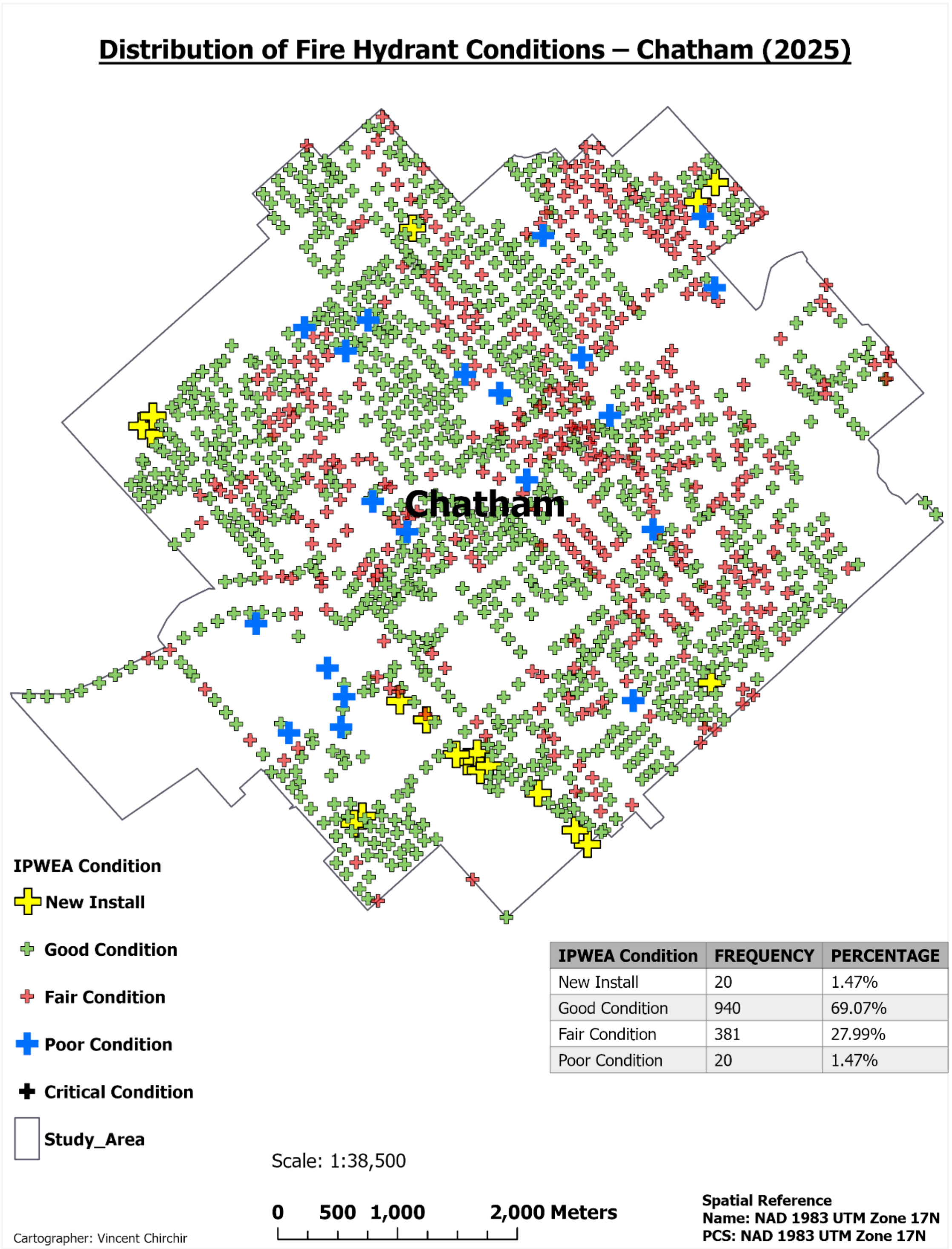
STDEV: 0.52

More of the fire hydrants are clustered around a score of 2 'Good condition' and 3 'Fair Condition'. Notice how most of the scores are clustered at the lower end and middle of the distribution, and fewer scores create a tail toward the higher end. This shows that a few hydrants in a poorer state are pulling the average upwards.

Also, a few fire hydrants scored at 1 'New Install' and 5 'Critical Condition', showing that most of the fire hydrants are neither brand new nor are in critical condition.

A standard deviation of 0.52 shows low dispersion. 68 % of fire hydrant scores fall between 1.777 and 2.81. This spread shows that the overall health condition is consistent, with only a few requiring attention.

From the map below, we can see the geographic spatial pattern of fire hydrant conditions. It shows that the few poor fire hydrants are scattered across different neighborhoods and not concentrated in one neighborhood



IPWEA Condition	FREQUENCY	PERCENTAGE
New Install	20	1.47%
Good Condition	940	69.07%
Fair Condition	381	27.99%
Poor Condition	20	1.47%

Figure 7: Geographic Distribution of Fire Hydrant Conditions in Chatham (2025)

Conclusion

A fundamental goal of asset management is to predict the future (ESRI, 2017, p.10). By applying a structured, GIS–driven asset management process to Chatham Kent's fire hydrants, we turned data into important information that can be used for various decisions. By leveraging ArcGIS Field Maps, normalizing IPWEA Conditions, and quantifying both individuals to reveal their degradation for further actions

This case study has demonstrated a full life cycle of GIS from data collection to visualization, and we were able to confirm that 99.17 % of hydrants were successfully located and scored, creating a near-complete inventory, existing hydrants also confirmed that 69.07% of hydrants are in good condition, 27.99% Fair, 1.47 % Poor, with only new installations at 1.47 %. No hydrants fell into a Critical category. From the maps, we saw that poorly conditioned and removed hydrants are scattered rather than clustered, indicating system-wide wear rather than localized problem areas. And finally, the mapping of unverified hydrants (0.83 %) requires follow-up to prevent problems during emergencies.

Recommendations

1. The municipality is to act on 1.47% fire hydrants that are in poor condition to be repaired to avoid risks associated with poor assets
2. The municipality undertakes targeted site visits or conducts high-resolution imagery to resolve the status of the 0.83% unverified fire hydrants
3. The municipality can remove the confirmed 1.47% fire hydrants from the municipal database and do network analysis to determine if they can add or if the nearby hydrants can serve the neighborhoods
4. Deploy an ArcGIS Dashboard to publish live condition summaries—distribution maps, removal statistics, and pending verifications—for supervisors and executives, enabling real-time performance monitoring as advocated by Esri’s seven-step asset management framework
5. Apply the same normalized-rating, data-collection, and mapping methodology to other asset categories (trees, bus shelters, parking meters, traffic poles), prioritizing high-risk groups—such as failing trees near roads or signal poles with non-functional push buttons—for maximum public safety impact

References

1. Green Municipal Fund. (n.d.). *How Lethbridge County doubled down its asset management*. Retrieved July 30, 2025, from https://greenmunicipalfund.ca/case-studies/how-lethbridge-county-doubled-down-its-asset-management
2. Federation of Canadian Municipalities. (2021). *Asset management insights: Data and information*. Retrieved from https://fcm.ca/en/resources/mamp/asset-management-insights-data-and-information
3. Tang, L., & Waters, N. (2005). The impact of GIS on the efficiency of municipal infrastructure maintenance planning. *Journal of Urban Planning and Development, 131*(2), 92–100.
4. City of Las Vegas. (2012). City of Las Vegas implements ParkPAD for mobile asset management. *ArcNews*, Spring 2012. Retrieved from https://www.esri.com/news/arcnews/spring12articles/city-of-las-vegas-implements-parkpad-for-mobile-asset-management.html
5. Federation of Canadian Municipalities, & National Research Council Canada. (2005). *Managing infrastructure assets*. In *National guide to sustainable municipal infrastructure (InfraGuide)*. Retrieved from https://www.infraguide.ca
6. Bowes, D. R., & Ihlanfeldt, K. R. (2001). Identification of the effects of greenbelts on residential property values. *Land Economics, 77*(1), 1–14. https://doi.org/10.2307/3146925
7. Crompton, J. L. (2007). The role of maintenance in ensuring the safety and value of public parks and assets. *Parks and Recreation Magazine, 42*(7), 20–29.
8. PSD Citywide. (n.d.). *Using GIS for municipal asset mapping*. Retrieved July 30, 2025, from https://www.psdcitywide.com/using-gis-for-municipal-asset-mapping/
9. Esri. (n.d.). *Charlottesville Fire Department: ArcGIS Field Maps improves hydrant inspections*. Retrieved July 17, 2025, from https://www.esri.com/en-us/lg/product/charlottesville-fd-case-study