A NETWORK ANALYSIS OF FIRE STATIONS

PREPARED BY: GIRAY AKINCITURK
SPATIAL REFERENCE: NAD83 UTM ZONE 17N
MAY 2023 - LONDON,ONTARIO, CANADA

INTRODUCTION

Network analysis is a fundamental component of GIS that focuses on the study and representation of spatial relationships within networks. These networks can include transportation systems, utilities, communication lines, or any other interconnected elements in a geographical space. Network analysis allows for the modeling, analysis, and visualization of complex spatial relationships, enabling users to solve real-world problems such as route optimization, service area analysis, and facility location.

The study area, London, is a vibrant city in southwestern Ontario, known for its strong sense of community, educational institutions, and rich culture. With a population of approximately 450,000 people, it is the 11th largest city in Canada. The city boasts a diverse population, representing various ethnic backgrounds, and is home to a significant student population attracted by its renowned educational institutions.

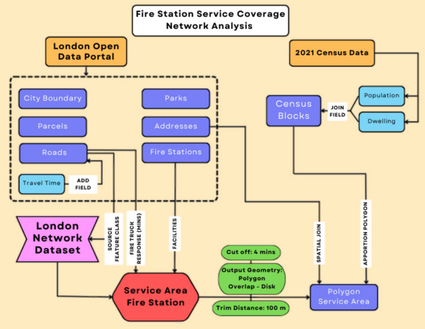
The city's fire protection and emergency response are handled by the London Fire Department (LFD). London City is well-equipped with 14 strategically located fire stations throughout its jurisdiction. These stations are staffed by highly trained firefighters and equipped with modern facilities to ensure effective fire protection and emergency services. The dedication of the LFD ensures the safety and well-being of the community they serve.

This study primarily focuses on examining the service areas coverage of the 14 currently existing fire stations in London City, as well as the proposed Fire Station #15, based on the "**Fire Master Plan**" published in May 2022 by the Municipality and London Fire Department.

METHODOLOGY

To examine the service area coverage of the 14 existing fire stations in London City and the proposed Fire Station #15, this study relies on a combination of data sources. Population and dwelling statistics, crucial for the analysis, were obtained from the **2021 Census Data**, providing a comprehensive understanding of the demographic characteristics in the area. Additionally, spatial data, essential for the network analysis, was acquired from the **London Open Data Portal**, which serves as a valuable resource for geospatial information.

In order to conduct the network analysis and effectively manage the data, ArcGIS Pro GIS software was utilized. This powerful software provides the necessary tools and functionalities to model, analyze, and visualize complex spatial relationships within networks.

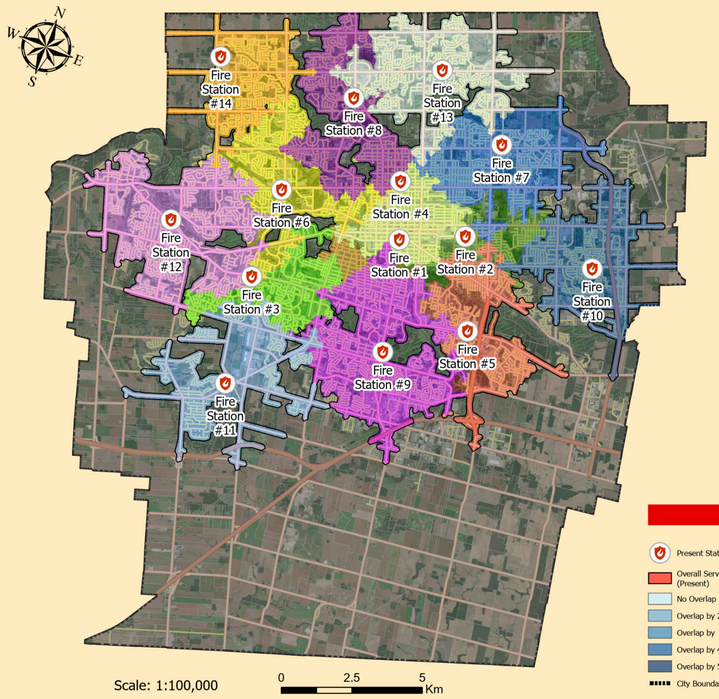


Prior to create the network, the travel time in minutes unit attributes were calculated using the attribute data of shape lengths for each individual line road and the speed limit based on road type. The network was created using a road line feature class, followed by conducting a service area network analysis using the fire station point feature class as facilities. Additionally, travel settings were configured based on the travel time attribute data derived in road line feature class, generating drive-time polygons with a cutoff of 4 minutes away from the facilities, within a 100-m buffer from the road centerline.

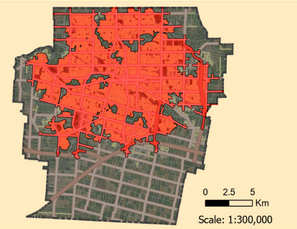
After creating the service areas, the "Spatial Join" geo-tool was utilized to incorporate the number of addresses data. Furthermore, the "Apportion Polygon" geo-tool was used to integrate the 2021 census data of population and dwelling statistics.

Additionally, the overlapping portions of the service areas were generated using the "Count Overlapping Features" geo-tool in order to observe the relationship between each fire stations.

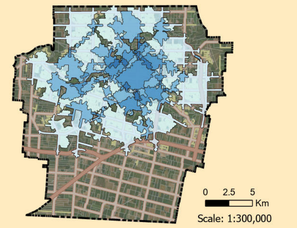
PRESENT FIRE STATION SERVICE COVERAGE MAP



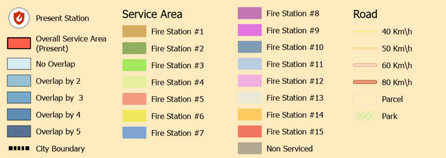
OVERALL SERVICE COVERAGE MAP



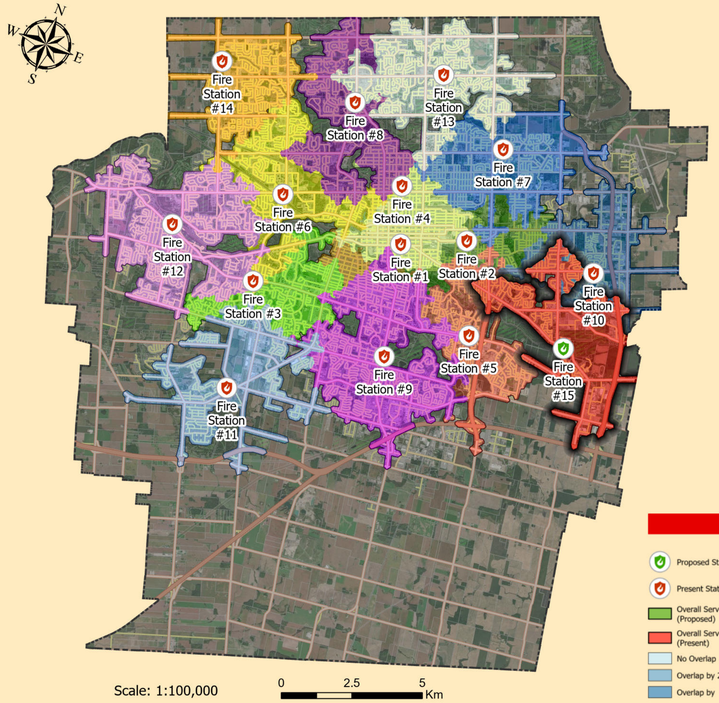
OVERLAPPED SERVICE COVERAGE MAP



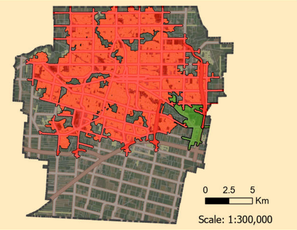
LEGEND



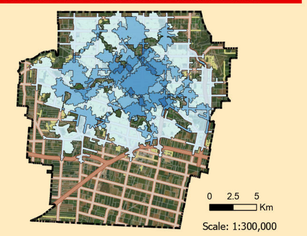
PROPOSED FIRE STATION SERVICE COVERAGE MAP



OVERALL SERVICE COVERAGE MAP



OVERLAPPED SERVICE COVERAGE MAP



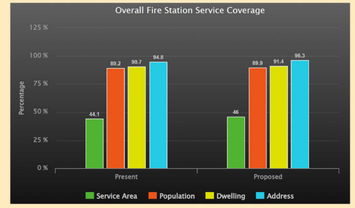
LEGEND

RESULTS

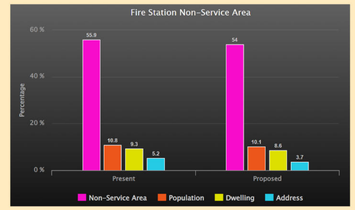
Based on spatial and statistical data, the City of London has a population of 422,324, 186,409 dwellings, and 138,926 addresses within a 42,300-hectare area. The fire station service areas were created using a 4-minute travel time criterion based on the **Fire Protection and Prevention Act, 1997**.

City	Total Area (Ha)	Population	Dwelling	Address
London, ON	42302.28	422324	186409	138926

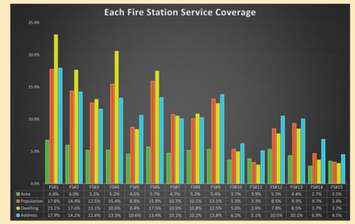
The existing fire stations cover 44.6% of the city's land area, serving 89.2% of the population, 90.7% of the dwellings, and 94.8% of the addresses. Unserved areas constitute 55.9% of the land area, representing 10.8% of the population, 9.3% of the dwellings, and 5.2% of the addresses.



In line with the Fire Master Plan, proposed Fire Station #15 is planned for the southeast of the city. When included in the network analysis, the proposed fire stations will cover 46.0% of the land area, serving 89.9% of the population, 91.4% of the dwellings, and 96.3% of the addresses. Unserved areas will constitute 54.0% of the land area, representing 10.1% of the population, 8.6% of the dwellings, and 3.7% of the addresses.

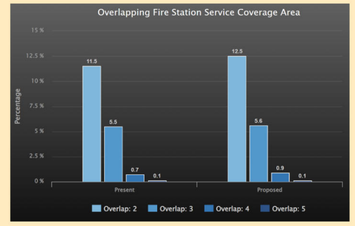


On average, each fire station covers 4.9% of the service area, serving 10.7% of the population, 11.6% of the dwellings, and 11.0% of the addresses. Fire Station #1 has the highest coverage with 6.8%, serving 17.8% of the population, 23.1% of the dwellings, and 17.9% of the addresses. Conversely, Fire Station #11 has the lowest coverage with 3.9%, serving 3.3% of the population, 2.9% of the dwellings, and 5.1% of the addresses.



Upon adding Fire Station #15, it will cover 3.5% of the service area, serving 3.4% of the population, 3.2% of the dwellings, and 4.5% of the addresses.

Overlapping service areas among existing fire stations range from 11.5% for 2 stations to 0.1% for 5 stations. With the addition of Fire Station #15, the overlapping service areas will range from 12.5% for 2 stations to 0.1% for 5 stations.



DISCUSSION

The analysis revealed that existing fire stations in the City of London cover a significant portion, serving a large proportion of the population, dwellings, and addresses. However, some areas remain unserved, highlighting the need for improved placement and coverage. The proposed Fire Station #15 slightly increased overall coverage, enhancing access to fire protection. Variations in individual station performance were observed, with Fire Station #1 being the most effective and Fire Station #11 the least. Overlapping service areas indicate potential redundancy or collaboration opportunities. Continuous evaluation and strategic planning are crucial for comprehensive coverage and efficient emergency response capabilities in the City of London.

REFERENCE

» **City of London Open Data Portal:** https://opendata.london.ca/
» **Census Profile:** https://www12.statcan.gc.ca/census-recensement/2021/dp-pd/prof/index.cfm?Lang=E
» **Census Blocks:** https://www12.statcan.gc.ca/census-recensement/2021/geo/sip-pis/boundary-limites/index-eng.cfm
» **London Fire Master Plan:** https://globalnews.ca/wp-content/uploads/2022/06/2022-London-Fire-Master-Plan.pdf
» **Firefighting Wiki:** https://fire.fandom.com/wiki/London_Fire_Department_(Ontario)
» **Fire Protection and Prevention Act, 1997:** https://www.canlii.org/en/on/laws/regu/o-reg-377-18/latest/o-reg-377-18.html