Exploration Report

Streets & Safety: Pavement Condition and Fire Hydrant Coverage in Syracuse (2022–2024)

1. Introduction

This exploration report documents Phase 2 of the *Streets & Safety* civic data project, which examines street pavement conditions and fire hydrant coverage across the City of Syracuse. The goal of this phase is to understand the structure, quality, and limitations of the available datasets and to identify meaningful patterns that warrant deeper neighborhood-level analysis in subsequent phases.

The analysis focuses on three years of pavement condition data (2022–2024) and a citywide inventory of fire hydrants. Together, these datasets provide a foundation for assessing infrastructure quality and public safety readiness at a granular level.

2. Data Sources and Scope

The following datasets were used in this phase:

- Syracuse Pavement Ratings (2022, 2023, 2024)
  Street segment–level inspection data with numeric condition ratings and categorical condition labels.

- Syracuse Fire Hydrants
  Point locations of fire hydrants maintained by the city, including ownership and pressure zone attributes.

All datasets were acquired directly from the City of Syracuse Open Data portal and represent the most current publicly available versions at the time of analysis.

3. Data Quality Assessment

3.1 Pavement Ratings Data

Completeness

- All three pavement datasets include a consistent number of street segments, indicating stable inspection coverage across years.

- Pavement condition ratings are fully populated.

- A very small number of records have missing inspection dates, affecting less than one percent of observations.

Consistency

- Core fields such as street identifiers, ward, and condition ratings are present in all years.

- Minor naming differences exist across years but do not affect interpretability.

- Condition ratings fall within a consistent numeric range, supporting year-to-year comparison.

Temporal Coverage

- Each dataset represents a single inspection cycle rather than continuous monitoring.

- The three-year span enables trend analysis but cannot capture short-term condition changes.

Geographic Coverage

- Pavement data is reported at the street-segment level.

- No neighborhood identifiers are included; neighborhood analysis requires spatial assignment in later phases.

Limitations

- Pavement ratings reflect inspection snapshots, not real-time conditions.

- The data does not capture traffic volume, winter maintenance, or construction timing.

3.2 Fire Hydrant Data

Completeness

- Location coordinates are present for nearly all hydrants, supporting spatial analysis.

- Asset identifiers and ownership fields are consistently populated.

Missing Values

- Several operational fields (e.g., nozzle type, riser details, installation date) contain substantial missing values.

- These fields are not required for presence or density analysis and do not affect the core objectives of this project.

Consistency

- Hydrant ownership and pressure zone categories are generally consistent.

- No evidence of large-scale duplication or invalid coordinates was found.

Geographic Coverage

- Hydrant locations form a coherent citywide spatial pattern.

- The dataset supports aggregation to neighborhood boundaries once spatial assignment is performed.

Limitations

- Hydrant presence does not measure fire response capacity, water pressure reliability, or staffing levels.

- Density is used strictly as a proxy for infrastructure coverage.

4. Key Statistical Summaries

Pavement Condition Overview

Across all three years:

- The median pavement rating remains stable, indicating that the typical street is in fair-to-good condition.

- The average rating declined in 2023 and partially rebounded in 2024.

- The percentage of street segments rated "poor" increased between 2022 and 2023 and remained elevated in 2024.

These statistics suggest that while overall conditions appear relatively stable, a subset of streets continues to experience poor conditions.

5. Exploratory Visual Analysis

The following exploratory visualizations were produced and interpreted:

1. Pavement rating distributions (2022–2024)
   Ratings cluster strongly in the mid-to-high range, with a persistent low-rating tail across all years.

2. Average pavement rating trend
   A noticeable decline occurs in 2023, followed by partial recovery in 2024.

3. Percentage of poor-rated segments over time
   The share of poorly rated segments increases and does not return to 2022 levels.

4. Lowest-rated streets by average condition
   A small group of streets consistently appears among the lowest performers, suggesting persistent maintenance challenges.

5. Hydrant coordinate distribution
   Spatial patterns indicate comprehensive citywide coverage with no obvious geographic gaps.

6. Hydrant ownership distribution
   Ownership is concentrated among a small number of entities, simplifying aggregation and interpretation.

Together, these visuals reveal patterns that are not visible through summary statistics alone, particularly the persistence of low-condition street segments.

6. Findings and Hypotheses

Key Findings

1. Inspection coverage is stable across years
   The same number of street segments appears in all three pavement datasets, supporting valid year-to-year comparison.

2. Average condition masks localized issues
   Despite stable median ratings, the increase in poorly rated segments indicates localized deterioration.

3. Low-condition streets persist over time
   Streets in poor condition tend to remain poor across multiple years rather than rotating randomly.

Hypotheses for Further Investigation

1. Spatial concentration hypothesis
   Poor pavement conditions are clustered within specific neighborhoods rather than evenly distributed across the city.

2. Infrastructure mismatch hypothesis
   Neighborhoods with worse pavement conditions may not have correspondingly higher fire hydrant density, indicating potential infrastructure imbalances.

3. Persistence hypothesis
   The same street segments consistently experience poor conditions, suggesting maintenance backlogs or structural issues.

These hypotheses will be tested in subsequent phases using neighborhood-level aggregation and spatial analysis.

7. Summary and Next Steps

Phase 2 confirms that Syracuse's open infrastructure data is sufficiently complete and consistent for meaningful neighborhood-level analysis. While citywide averages suggest stability, deeper exploration reveals persistent pockets of poor pavement condition that merit targeted attention.

The next phase will:

- Assign pavement segments and hydrants to neighborhood boundaries

- Aggregate metrics at the neighborhood level

- Integrate findings into an interactive public-facing dashboard

This progression ensures that technical analysis translates into actionable insight for residents, community organizations, and city officials.