Project Process and Development Workflow

1. Initial Project Planning

The project began with the development of a proposal outlining the primary goals of examining pedestrian safety and walkability in Ames, Iowa through spatial analysis and interactive web visualization. Early project planning focused on identifying appropriate datasets, selecting analysis methods, and designing a narrative structure for the final Tableau story dashboard.

Abstract

This project presents a series of maps and dashboards to analyze pedestrian safety and walkability in Ames, Iowa, which is a college town with high pedestrian activity. Using open-source spatial data, including pedestrian crash records (2021–2025), road networks, sidewalks, crossings, and points of interest from OpenStreetMap such as shops and parks, the study explores how infrastructure and activity patterns relate to pedestrian risk. Spatial indicators such as intersection density, sidewalk and path coverage, and accessibility to key destinations will be developed and compared with crash patterns. A composite pedestrian safety index will be created to highlight spatial variations across the city. The final product will show multiple map layers and visualizations about pedestrians' safety.

Technology

For this project, R studio, QGIS or ArcGIS Pro, Tableau proposed to be used.

Data

There are three main types of data sources that will be used.

1. Pedestrian crash data (2021-2025) [3]
2. Sidewalks, roads, crossing roads, bus stops etc. from Open Street Map [4]
3. Population data [2], from United States Census Bureau.

Process

1. Data collection and cleaning.
2. Spatial joins
3. Calculations for different indicators such as intersection density, sidewalk coverage, crash density.
4. Aggregations and producing the pedestrian safety index.
5. Creating maps and dashboards.

Timeline

This project is designed to be finished within six weeks, and scheduled as below:

	3.30-4.6	4.6-4.13	4.13-4.20	4.20-4.27		4.27-5.4	5.4-5.10
Data collection, cleaning							
Spatial joins							
Indicators Calculation							
Pedestrian safety index							
Maps and Dashboards							

2. Pedestrian Crash Data Collection and Filtering

Pedestrian crash data was obtained from the Iowa Open Data Portal. Initial crash datasets contained multiple crash types and locations across Iowa, so additional filtering was required to isolate only pedestrian-related crashes occurring within Ames between 2021 and 2025.

Crash records outside the Ames municipal boundary or unrelated to pedestrian incidents were removed during preprocessing. Severity categories including fatal, serious injury, minor injury, and possible injury crashes were retained for later visualization and spatial analysis.

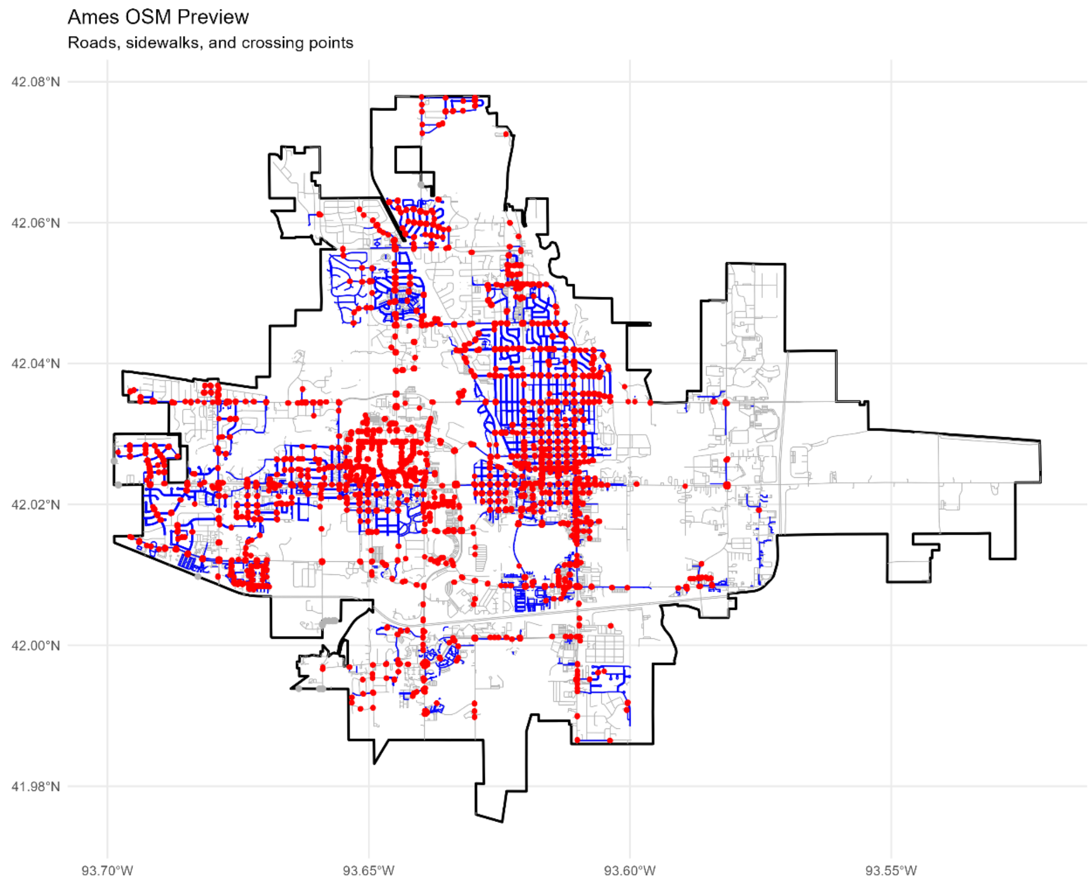
3. OpenStreetMap Data Export and Processing

OpenStreetMap (OSM) data were exported to represent pedestrian infrastructure and accessibility conditions across Ames. Multiple OSM layers were collected, including:

- Footways and sidewalks
- Crossing-point features
- Bus stops
- Parks
- Shops and commercial destinations

Some OSM layers required additional cleaning because several features contained inconsistent attribute structures, overlapping geometries, or incomplete records.

During early development, both sidewalks and footways were evaluated separately. Later revisions simplified the analysis by emphasizing mapped pedestrian footway accessibility while still acknowledging sidewalk infrastructure within the study area.



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- ames_cycleways.geojson
- ames_footways.geojson
- ames_parks.geojson
- ames_roads.geojson
- ames_shops.geojson
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4. Crossing Point Development

Pedestrian crossing accessibility was represented by using crossing-point features extracted from OpenStreetMap pedestrian infrastructure data. Crossing-point density was calculated by spatially aggregating crossing locations within census tracts and grid cells.

Several visualization approaches were tested for representing crossing accessibility. Early versions attempted to use larger crossing polygons and detailed intersection features, but these approaches created excessive visual clutter in Tableau dashboards. A simplified crossing-point representation was ultimately selected to improve readability and spatial consistency.

5. Spatial Processing and Analysis in R

Spatial analysis and index generation were performed in R using spatial analysis workflows and open-source GIS libraries including sf, dplyr, and tidyverse.

Multiple spatial layers were transformed into a common coordinate system and spatially intersected with:

- Census tracts
- 250m grids
- 100m grids

Indicator calculations included:

- Pedestrian crash density
- Footway density
- Crossing-point density
- POI density
- Population density

Spatial joins and aggregation workflows were used to calculate pedestrian-related indicators for each spatial analysis unit.

6. Index Construction and Weight Testing

Several iterations of the Pedestrian Safety & Walkability Index were tested throughout the project. Different weighting structures were explored to evaluate how pedestrian infrastructure and crash-related safety conditions influenced the final spatial patterns.

Early versions placed stronger emphasis on walkability indicators such as pedestrian infrastructure and POI accessibility. Additional iterations increased the influence of crash-related safety conditions. Multiple weighting structures were compared visually to evaluate how sensitive the resulting index patterns were to weighting changes.

After testing several combinations, the final index adopted a balanced weighting structure consisting of:

- 50% walkability conditions
- 50% pedestrian safety conditions

All variables were normalized to a 0–1 scale prior to weighted aggregation to reduce differences in units and variable ranges.

7. Multi-Scale Spatial Analysis

The project evaluated pedestrian safety and walkability patterns using multiple spatial aggregation units:

- Census tracts
- 250m grids
- 100m grids

Larger spatial units produced smoother generalized patterns, while smaller grids revealed more localized pedestrian activity and safety variation near intersections, commercial corridors, and Iowa State University.

Several grid sizes were tested during development to determine which spatial resolutions produced the clearest visualization and interpretation.

8. Tableau Dashboard and Story Development

Final spatial layers and analytical outputs were exported into Tableau for interactive visualization and story-map development.

During dashboard design, multiple layout revisions were required to improve:

- Narrative flow
- Visual consistency
- Text readability
- Dashboard organization

Early dashboard versions contained excessive map layers and overlapping legends, which reduced readability. Later revisions simplified the dashboard structure by separating:

- Crash density
- Crash severity
- Methodology
- Multi-scale analysis

into dedicated story dashboards.

Additional revisions were made to:

- Standardize dashboard titles
- Improve map hierarchy
- Reduce visual clutter
- Enhance user interaction

9. Challenges and Lessons Learned

Several challenges were encountered throughout the project:

- OSM pedestrian infrastructure data contained incomplete or inconsistent attributes in some areas.
- Different spatial aggregation scales produced different interpretations of pedestrian accessibility and safety conditions.
- Balancing crash-related safety conditions with walkability indicators required multiple rounds of weighting evaluation.
- Dashboard readability and story organization required several iterations to reduce clutter and improve narrative flow.

The final Tableau story demonstrates how open spatial data, R-based GIS analysis, and interactive visualization tools can be combined to explore pedestrian-oriented urban environments and spatial safety patterns in Ames, Iowa.