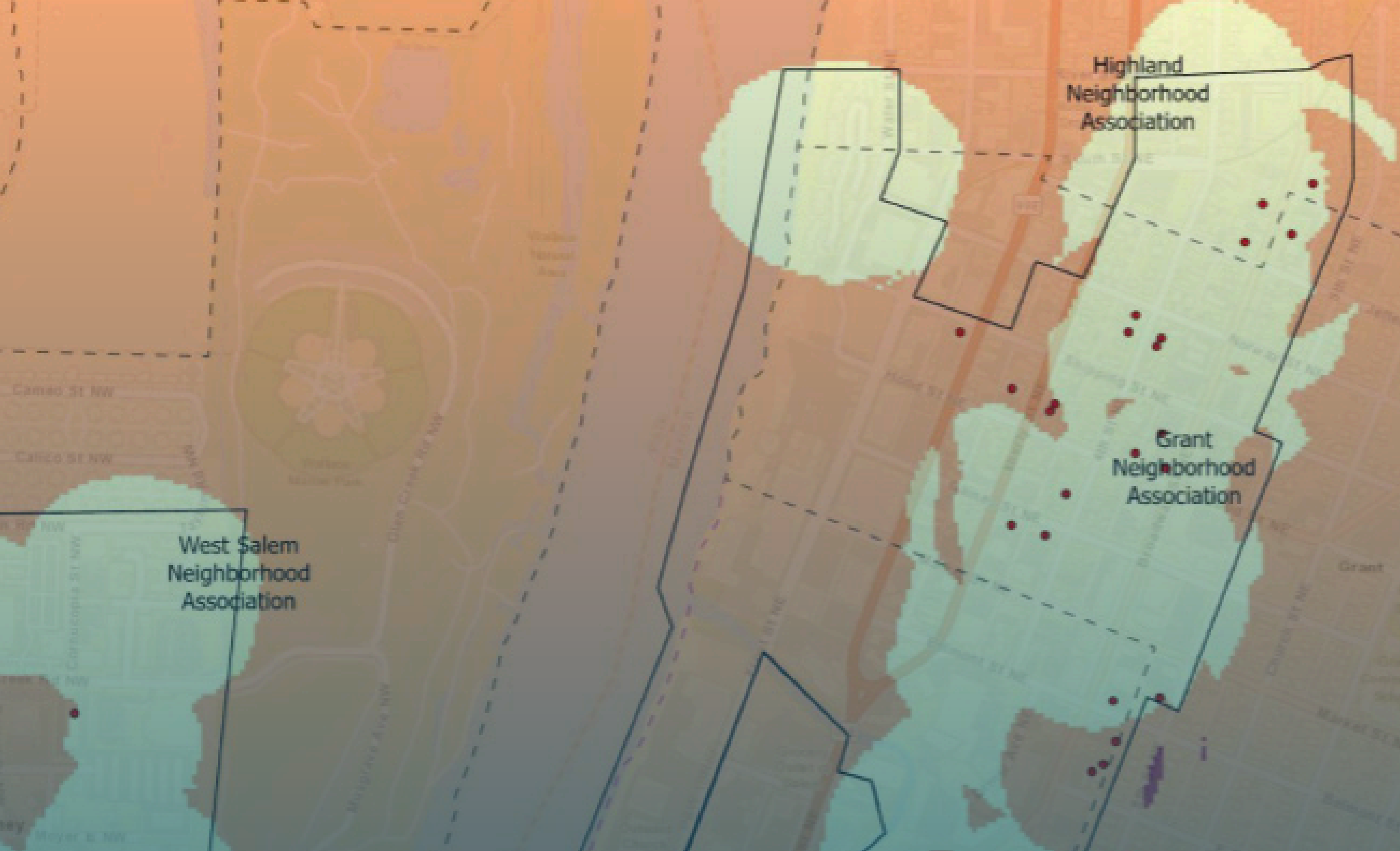

GIS Analyses of Walkability in Salem, Oregon

VOLUME 2

Appendix: Student Final Projects

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WINTER 2024
SALEM

GEOG 482/582: GISCIENCE II | COLLEGE OF ARTS AND SCIENCES

UNIVERSITY OF OREGON
CITY OF Salem AT YOUR SERVICE
SCI Sustainable Cities Institute
SCYP Sustainable City Year Program

Acknowledgments

This report was made possible by the collaborative efforts of many individuals from the University of Oregon and the City of Salem. We wish to acknowledge and thank the following staff for their assistance and contributions instrumental in completing the report.

Maddie Huelbig, Department of Geography Graduate Employee

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Julie Hanson, Transportation Planning Manager

Contents

About SCI

The Sustainable Cities Institute (SCI) is an applied think tank focusing on sustainability and cities through applied research, teaching, and community partnerships. We work across disciplines that match the complexity of cities to address sustainability challenges, from regional planning to building design and from enhancing engagement of diverse communities to understanding the impacts on municipal budgets from disruptive technologies and many issues in between.

SCI focuses on sustainability-based research and teaching opportunities through two primary efforts:

1. Our Sustainable City Year Program (SCYP), a massively scaled university-community partnership program that matches the resources of the University with one Oregon community each year to help advance that community's sustainability goals; and

2. Our Urbanism Next Center, which focuses on how autonomous vehicles, e-commerce, and the sharing economy will impact the form and function of cities.

In all cases, we share our expertise and experiences with scholars, policymakers, community leaders, and project partners. We further extend our impact via an annual Expert-in-Residence Program, SCI China visiting scholars program, study abroad course on redesigning cities for people on bicycle, and through our co-leadership of the Educational Partnerships for Innovation in Communities Network (EPIC-N), which is transferring SCYP to universities and communities across the globe. Our work connects student passion, faculty experience, and community needs to produce innovative, tangible solutions for the creation of a sustainable society.

About SCYP

The Sustainable City Year Program (SCYP) is a yearlong partnership between SCI and a partner in Oregon, in which students and faculty in courses from across the university collaborate with a public entity on sustainability and livability projects. SCYP faculty and students work in collaboration with staff from the partner agency through a variety of studio projects and service- learning courses to provide students with real-world projects to investigate. Students bring energy, enthusiasm, and innovative approaches to difficult, persistent problems. SCYP's primary value derives from collaborations that result in on-the-ground impact and expanded conversations for a community ready to transition to a more sustainable and livable future.

About City of Salem

The City of Salem is Oregon's second largest city (179,605; 2022) and the State's capital. A diverse community, Salem has well-established neighborhoods, a family-friendly ambiance, and a small town feel, with easy access to the Willamette riverfront and nearby outdoor recreation, and a variety of cultural opportunities.

The City is known for having one of Oregon's healthiest historic downtowns, hosts an airport with passenger air service, and is centrally located in the heart of the Willamette Valley, 47 miles south of Portland and an hour from the Cascade Mountains to the east and the ocean beaches to the west.

State government is Salem's largest employer, followed by the Salem-Keizer School District and Salem Health. The City also serves as a hub for area farming communities and is a major agricultural food processing center. A plethora of higher education institutions are located in Salem, ranging from public Western Oregon University, private Willamette and Corban universities, and Chemeketa Community College.

Salem is in the midst of sustained, steady growth. As a "full-service" city, it provides residents with services such as police and fire protection, emergency services, sewage collection and treatment, and safe drinking water. Salem also provides planning and permitting to help manage growth, as well as economic development to support job creation and downtown development. The City also provides 2,338 acres of parks, libraries and educational programs, housing and social services, public spaces, streetscaping, and public art.

Salem's vision is a safe, livable, and sustainable capital city, with a thriving economy and a vibrant community that is welcoming to all. The City's mission is to provide fiscally sustainable and quality services to enrich the lives of present and future residents, protect and enhance the quality of the environment and neighborhoods, and support the vitality of the economy. The City is in the midst of a variety of planning efforts that will shape its future, ranging from climate action planning and implementation, a transportation system plan update, as well as parks master planning.

This SCYP and City of Salem partnership is possible in part due to support from U.S. Senators Ron Wyden and Jeff Merkley, as well as former Congressman Peter DeFazio, who secured federal funding for SCYP through Congressionally Directed Spending. With additional funding from the city, the partnership will allow UO students and faculty to study and make recommendations on city-identified projects and issues.

Course Participants

UNDERGRADUATE

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Course Description

GEOG 482/582: GISCIENCE II

This course focused on spatial data collection, spatial data models, database design, data editing, geographic information system (GIS) project management, and advanced topics in geographic information science.

Introduction

Driven by a shared commitment to improve environmental health, community well-being, and accessibility, students in the Advanced GIS class collaborated with the City of Salem to develop data-driven strategies for urban improvement. Walkability, a concept that refers to the safety and comfort of pedestrian infrastructure, serves as a link between both social considerations and urban design principles. Improvements in walkability can be associated with decreasing traffic congestion and carbon emissions, while improving pedestrians' overall quality of life. In winter 2024, students created recommendations based on spatial patterns gathered from the City of Salem's geodatabase. Using datasets ranging from transportation networks, demographic makeup, and public facilities, students addressed three specific aspects of walkability in Salem:

1. **Public Transportation Core Networks** analyzed datasets with the intent to improve the accessibility and effectiveness of Salem's public transportation.

2. **Equity Focus Areas** analyzed pedestrian infrastructure trends to increase accessibility in a lower-income area of Salem.

3. **Climate-Friendly Areas** created recommendations to improve pedestrian safety within Salem's expanding mixed-use infrastructure downtown.

Student recommendations aimed to elevate Salem's walkability score and foster community livability, sustainability, and social cohesion. By prioritizing public transportation and pedestrian infrastructure, the City of Salem can encourage a reduction in carbon emissions and an increase in walking and cycling. The shift towards sustainable transportation can help tackle urban design challenges such as traffic congestion and design effectiveness. Volume 2 of the report serves as the appendix and includes 26 individual final reports from each student in the class.

Public Transportation Core Networks Group

Final Proj Submission

Project Summary

Project Goals:

The goal of this project was to assess and improve the walkability and busability of Salem, focusing on areas with low walk scores and inadequate lighting around bus stops. By analyzing the distribution of street lights, bus stops, and pedestrian infrastructure, the aim was to identify areas for targeted improvements to enhance pedestrian safety and accessibility, ultimately improving the overall urban environment and quality of life for residents. Effective lighting boosts urban safety, reduces crime, and improves residents' quality of life. Its benefits include enhanced hazard management, fewer driver-pedestrian accidents, reduced violent crimes, and increased walkability and busability.

Hazard Management:
Proper lighting identifies hazards like uneven pavement, making signs more visible and reducing accidents.

Decreased Accidents:
Well-lit streets reduce the risk of driver-pedestrian accidents, especially in high traffic areas.

Reduced Crime:
Well-lit public spaces can deter crime by increasing the perceived risk of detection, making communities safer.

Improved Walkability and Busability:
Good lighting encourages walking and public transport use, fostering a more active community.

Summary of Recommendations:

Based on the analysis, several key recommendations are proposed to improve walkability in Salem:

1. **Increase Street Lighting:** Install additional street lights, particularly in areas with high pedestrian traffic, low walk scores, and low-income areas more likely to use public transit to improve visibility and enhance safety, especially around bus stops and non-signalized crosswalks.
2. **Enhance Pedestrian Infrastructure:** Improve sidewalks, crosswalks, and pedestrian pathways to make them more accessible and safer for pedestrians, especially in areas with high walk scores but inadequate lighting.
3. **Improve Bus Stop Amenities:** Upgrade bus stops with shelters, seating, and lighting to make them more comfortable and safer for waiting passengers, particularly in underserved areas with low walk scores.

Methods:
My analysis utilized GIS tools and spatial analysis techniques to assess walkability and busability in Salem. The following input data and methods were employed.

Input Data:

1. Street lights
2. Bus stops
3. Sidewalks
4. Cherriot route
5. Cherriot Core network

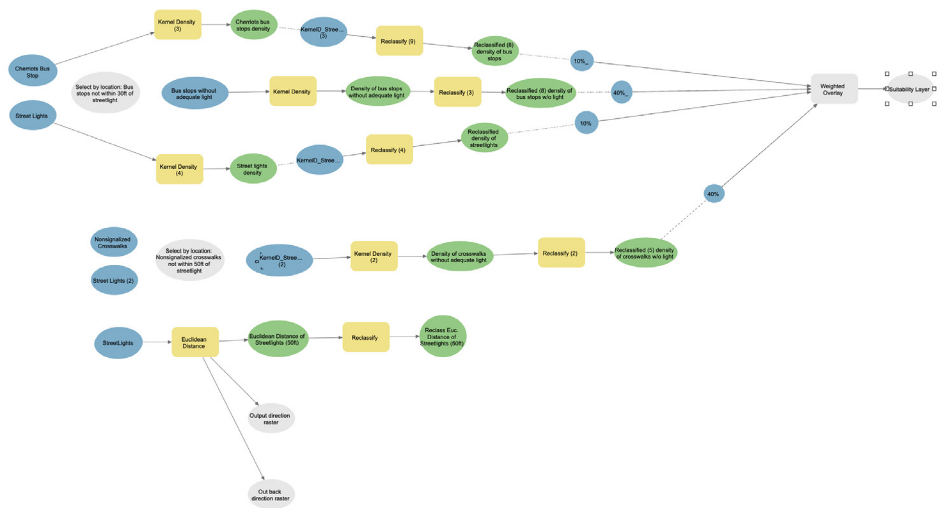
Analysis Methods:

1. **Kernel Density of Street Lights:** Used to visualize the distribution of street lights across Salem.
2. **Kernel Density of Bus Stops:** Used to visualize the distribution of bus stops across Salem.
3. **Euclidean Buffer Zones of Street Lights:** Created to show the area illuminated by each street light, assuming a typical 50-foot radius.
4. **Select by Location, KDE of Non-Signalized Crosswalks without Adequate Lighting:** Identified areas where non-signalized crosswalks do not have a street light within 50 feet, indicating a safety concern.

5. **Select by Location, KDE of Bus Stops without Adequate Lighting:** Identified areas where bus stops do not have a street light within 30 feet, indicating a safety concern.
6. **Transformation of Kernel Densities:** Transformed the kernel densities of street lights, bus stops without lighting, and non-signalized crosswalks without lighting to highlight areas with lower density of lighting.
7. **Weighted Sum Overlay:** Combined the transformed kernel densities and the density of bus stops to calculate a walkability score. Used a weight of 40% each for bus stops without lighting and non-signalized crosswalks without lighting, and 10% for the density of bus stops and the transformed kernel density of lighting. These weights were chosen to prioritize safety concerns related to lighting and pedestrian infrastructure while also considering the overall density of bus stops and lighting as a factor in walkability.

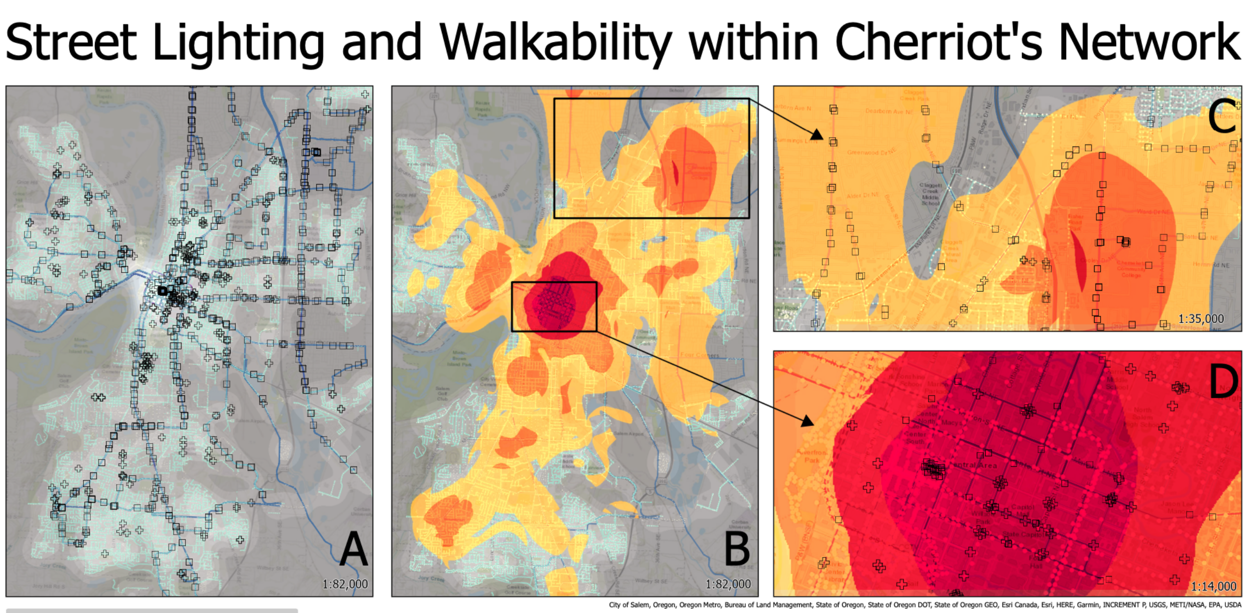
ModelBuilder Model

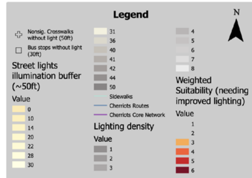
The geospatial analysis was conducted using ModelBuilder in ArcGIS Pro. The model, named "WalkabilityAnalysis", is available here for reference.



Results

Supporting Maps and Graphics:





The analysis revealed patterns of walkability in Salem, highlighting areas where there is insufficient lighting for bus stops and non-signalized crosswalks (A+B). The hotspots can help prioritize areas for improvements to enhance pedestrian safety and accessibility.

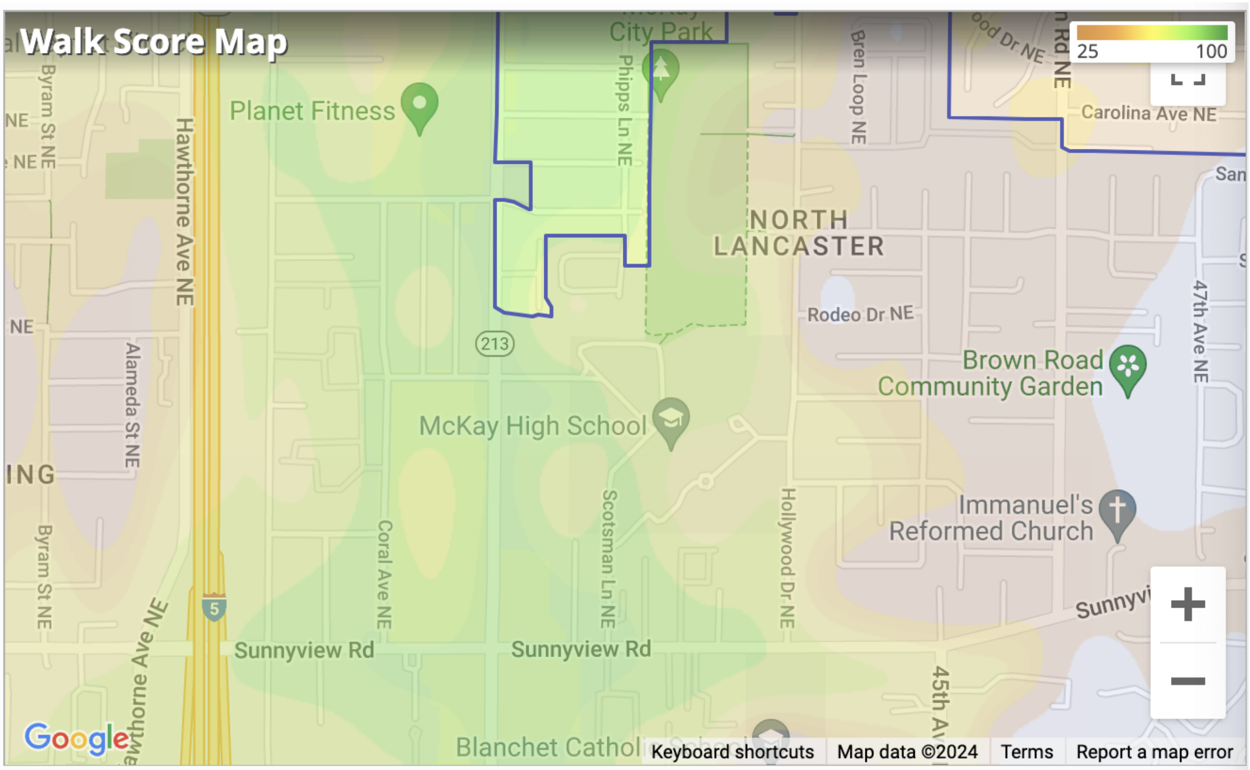
Details of Specific Areas in Salem:
The analysis showed that there are several areas with low walkability scores, indicating a need for improved lighting and safety features (C+D). These areas coincide with high-density bus stop locations and non-signalized crosswalks without adequate lighting, suggesting potential safety concerns for pedestrians.

StreetView Images: Specific Areas of Interest

- Street view images allowed a visual comparison of conditions around bus stops in high and low walk score areas. High walk score areas, despite having positives like dense tree cover, good sidewalks, and close amenities, often had poor lighting. Low walk score areas also had bad lighting and fewer amenities.

figure 1

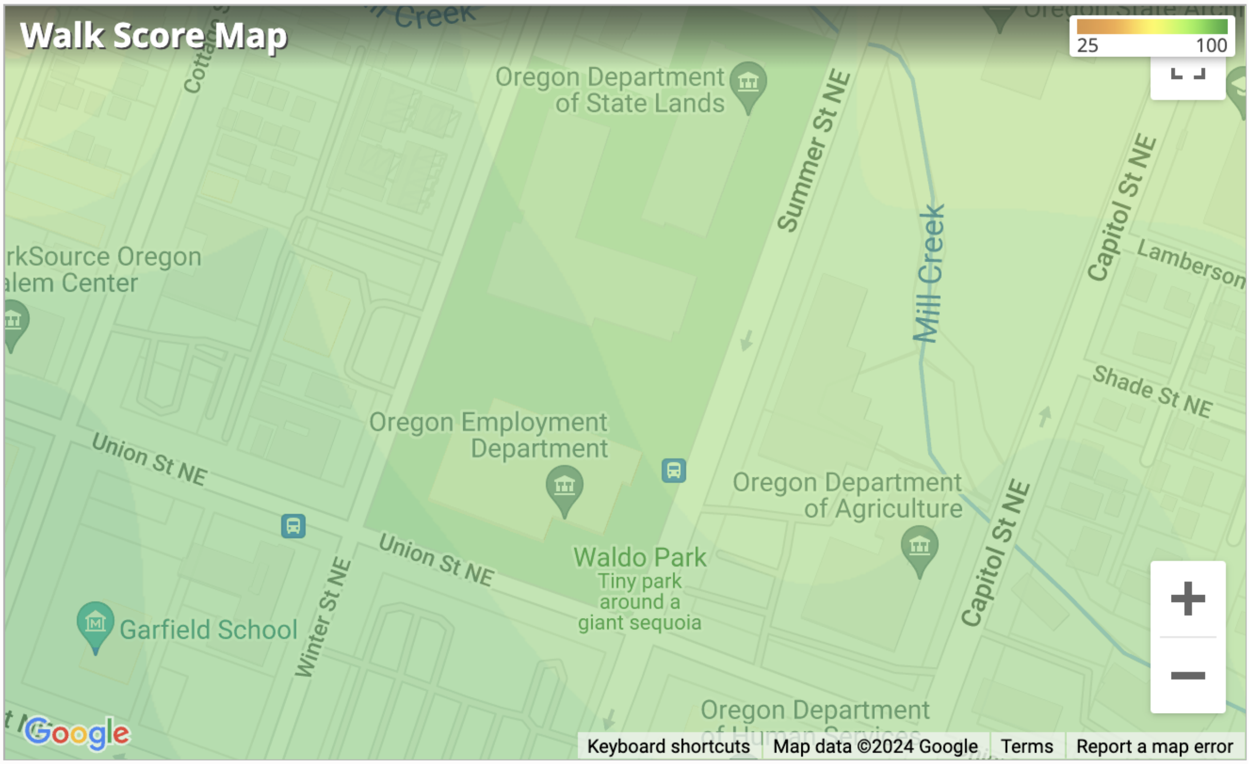
https://www.google.com/maps/place/2475+OR-213,+Salem,+OR+97305/@44.9585777,-122.9835403,3a,75y,282.09h,80.26t/data=!3m6!1e1!3m4!1swOpWxNl_ihvQM1o8fiZk0g!2e0!7i16384!213,+Salem,+OR+97305!3b1!8m2!3d44.9587115!4d-122.984167!16s%2Fg%2F11ggsn841n!3m5!1s0x54bffe8d9565b999:0x40f2a6cd69c610ba!8m2!3d44.9587115!4d-122.984167!16s%2Fg%2F11ggsn841n?entry=ttu



While neither figure 1 or 2 has a streetlight near the bus stop, they have well-maintained sidewalks, pleasant tree canopy, and bus shelters (which may have some lighting in them).

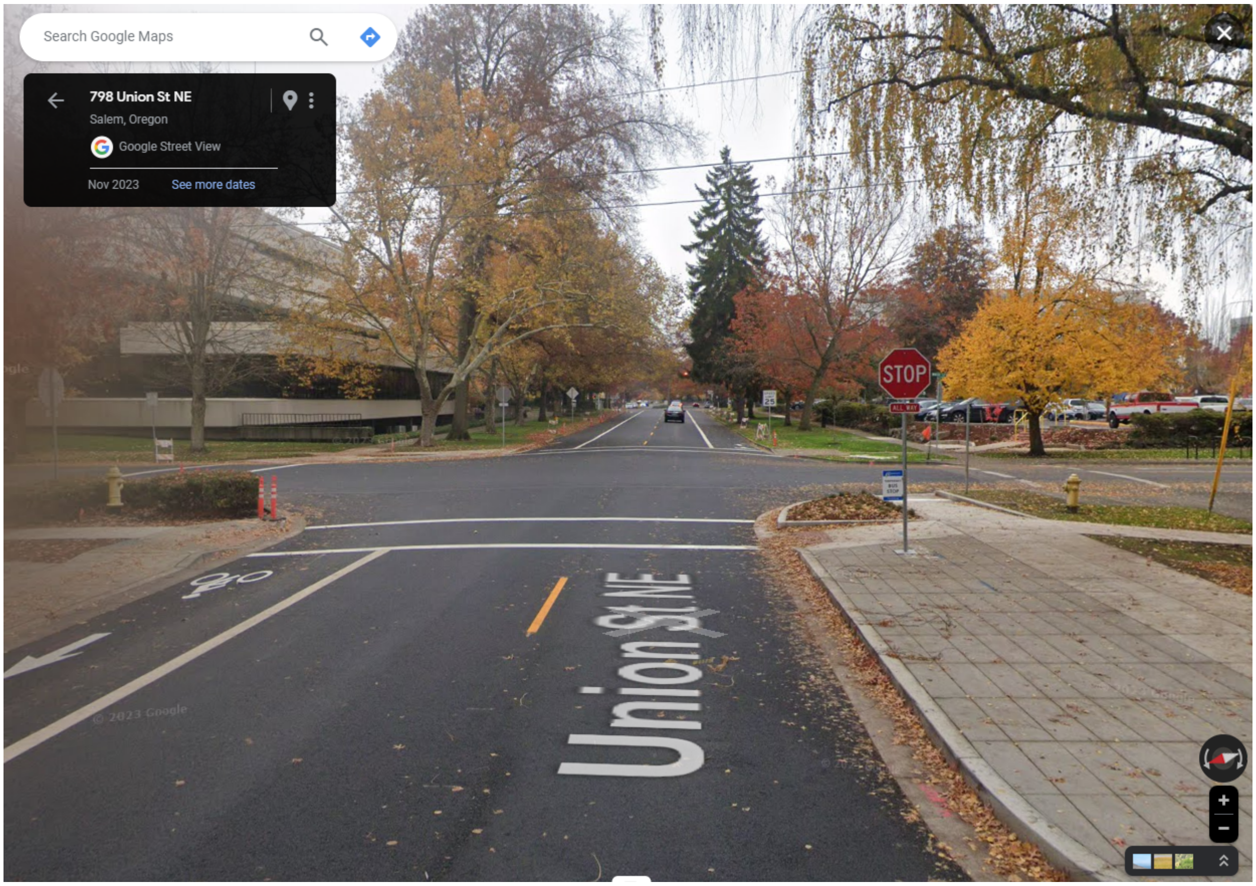
figure 2

https://www.google.com/maps/place/639+Summer+St+NE,+Salem,+OR+97301/@44.9440374,-123.0276523,3a,75y,340.03h,74.25t/data=!3m7!1
pa.googleapis.com%2Fv1%2Fthumbnail%3Fpanoid%3DwF1EIou0C8yNAdsvYkYfGA%26cb_client%3Dsearch.gws-
prod.gps%26w%3D360%26h%3D120%26yaw%3D199.56781%26pitch%3D0%26thumbfov%3D100!7i16384!8i8192!4m13!1m7!3m6!1s0x54bf
123.0276419!3m4!1s0x54bfff0ff33e5641:0x2afa199fa48f4b3a!8m2!3d44.9439817!4d-123.0276419?entry=ttu



In contrast, figure 3 has a bus stop with no shelter and no light, but again has tree canopy, is on a single-lane two-way road with a four-way stop, and is in close proximity to amenities.

figure 3



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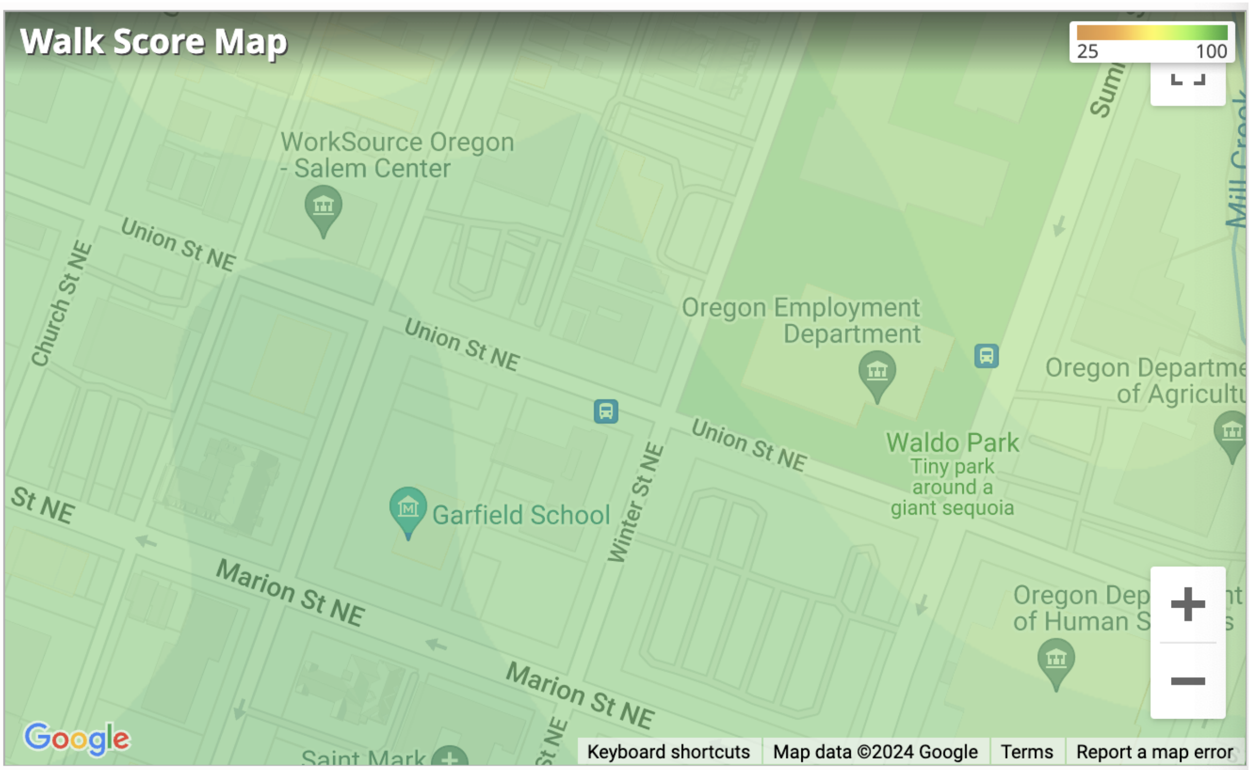
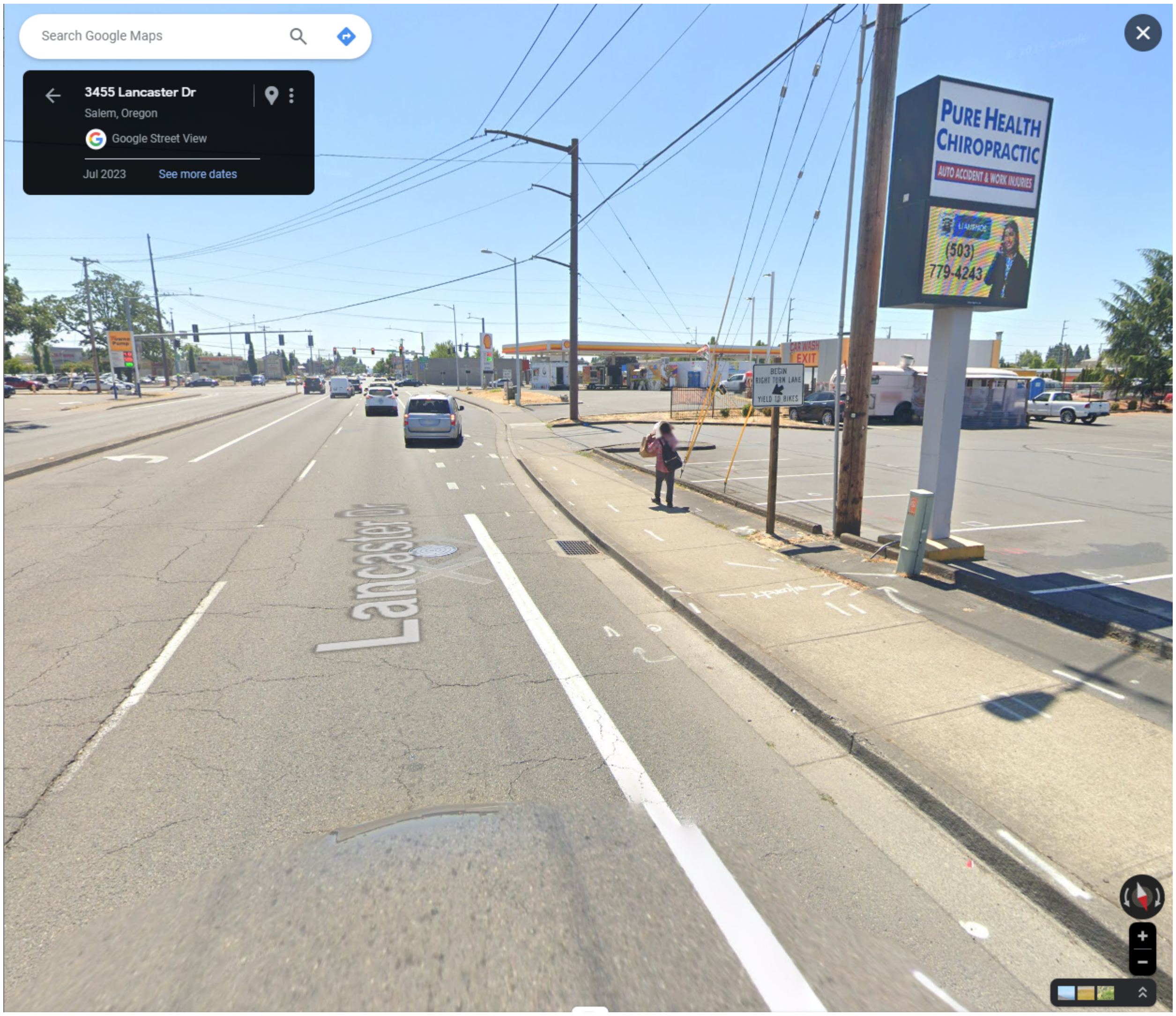

Walk Score Map
25
100
WorkSource Oregon
- Salem Center
Union St NE
Church St NE
Union St NE
Oregon Employment
Department
Oregon Departme
of Agricultu
Union St NE
Waldo Park
Tiny park
around a
giant sequoia
St NE
Garfield School
Winter St NE
Marion St NE
Marion St NE
Oregon Dep
of Human S
Saint Mark
Google
Keyboard shortcuts
Map data ©2024 Google
Terms
Report a map error

figure 4



https://www.google.com/maps/@44.9702067,-122.9835674,3a,75y,269.05h,76.13t/data=!3m6!1e1!3m4!1sxbFDwbZfSSV-avWCHZZs3A!2e0!7i16384!8i8192?entry=ttu

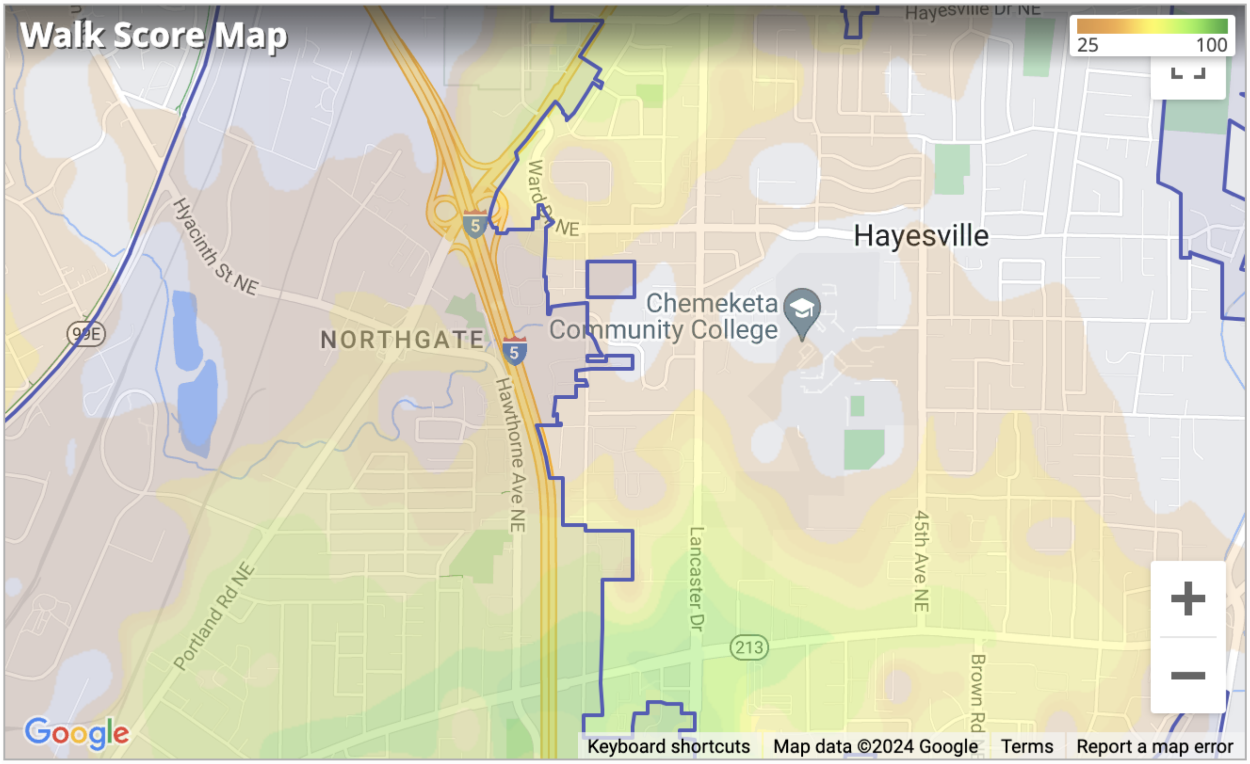


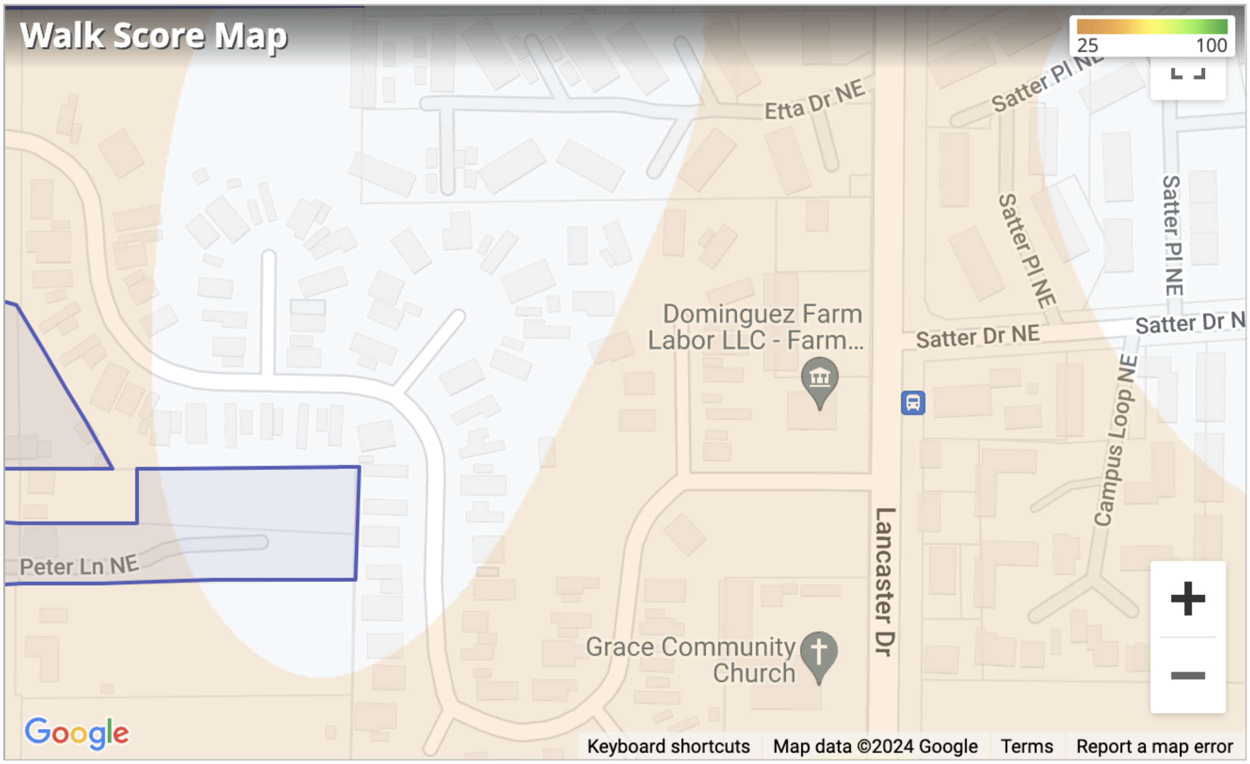
Figure 4 and 5 show a very different story. Figure 4, in particular, has no shelter/shade, is along a busy road, and is generally less walkable to amenities. The angle of the image shows a pedestrian walking and using a paper to shade their face/head, with the bus stop being behind the perspective of the camera.

FIgure 4, while having canopy and a signalized crosswalk, does not have a bus shelter and is along a busy road, with less walkable access to amenities.

This area is residential, and has a community college, increasing the need for safe bus access to reach ammenities for individuals without cars.

figure 5

https://www.google.com/maps/@44.9791585,-122.9834099,3a,75y,39.32h,82.73t/data=!3m6!1e1!3m4!1sIiLe2dwMmpjGRIhhkkcc2w!2e0!7i163
entry=ttu



The study revealed that both affluent regions with high walk scores and underserved areas with low walk scores suffer from poor lighting around bus stops. The impact, however, is more significant in low walk score regions where poor lighting aggravates safety concerns and issues of urban blight. Thus, addressing these lighting issues is paramount to improving busability and walkability, especially in low walk score areas. Enhancing lighting in these areas can aid revitalization efforts, improve the quality of life, and foster more sustainable and inclusive urban spaces by making bus stops safer and more accessible.

Citations

https://www.masstransitmag.com/technology/facilities/shelters-stations-fixtures-parking-lighting/article/21093924/creating-a-sense-of-place-at-bus-stops-improves-the-customer-experience

https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6171860/

https://crimelab.uchicago.edu/resources/reducing-crime-through-environmental-design-evidence-from-a-randomized-experiment-of-street-lighting-in-new-york-city/

Data Layes

PC > files\courses (R:) > GEOG482_582_22260_Winter2024 > Student_Data > ncleland > FinalProject

Name	Date modified	Type	Size
BusStopsWithoutLight.lyrx	3/12/2024 11:45 PM	ArcGIS Pro Layer File	16 KB
Cherriots_Bus_Stop selection.lyrx	3/12/2024 11:46 PM	ArcGIS Pro Layer File	18 KB
Cherriots_Bus_Stop.lyrx	3/12/2024 11:46 PM	ArcGIS Pro Layer File	15 KB
CityofSalem_Nonsignalized_Crosswalks selectio...	3/12/2024 11:46 PM	ArcGIS Pro Layer File	16 KB
CityofSalem_Nonsignalized_Crosswalks.lyrx	3/12/2024 11:46 PM	ArcGIS Pro Layer File	15 KB
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StreetLights.lyrx	3/12/2024 11:46 PM	ArcGIS Pro Layer File	15 KB
Weighte_Recl2.lyrx	3/12/2024 11:46 PM	ArcGIS Pro Layer File	14 KB

Project:

GEOG482_582_22260_Winter2024 > Student_Data > ncleland > Lab3_SalemWalkability > Restart_SalemWalkability >

Restart_SalemWalkability.aprx

Naomi Gates
GEOG 482
03/20/2024

Goals

My project focuses on transportation, land use, and community design to improve walkability. My focus group for this term is the Cherriots Core Network group, in which I looked to improve walkability and connectedness within and around the already existing public transit network.

“Transportation, land use, and community design planners have the power to increase opportunities for walking and improve the pedestrian experience by designing and maintaining communities and streets to make them safe and accessible for people of all ages and abilities” (Surgeon General). The transportation, land use, and community design sector can promote walking and walkable communities through some of the following strategies I incorporated in my project:

- Design streets, sidewalks, and crosswalks that encourage walking for people of all ages and abilities.
- Improve traffic safety on streets and sidewalks.
- Locate, worksites, businesses, and other places that people regularly use within walkable distance of each other.
- Support safe, efficient, and easy-to-use public transit systems and transit-oriented development.

I combined this transportation focus with the business and industry realm, using worksites and residential areas to promote walking and walkable communities. Since most working adults spend the majority of their time at their worksite or home, it is important for worksites, especially those that employ a large percentage of the surrounding population, to provide access to “opportunities and support for physical activity, including walking, making it easier for them to integrate it into their daily lives” (Surgeon General). Some of the strategies that worksites can use to promote walking and walkable communities include:

- Provide access to facilities and locations to support walking.
- Engage in community planning efforts to make the communities around worksites more walkable.

My project uses residential and working areas, combined with walking distance from bus stops to support safe, efficient, walkable areas and connection between walking and public transportation.

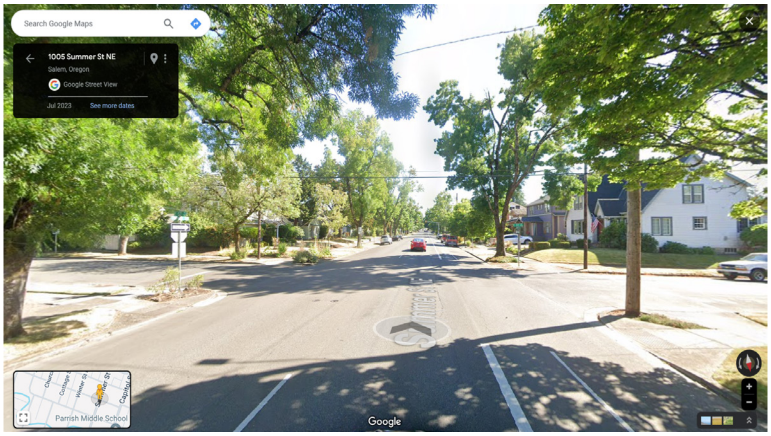
Recommendations

My focus group is the Cherriots Core Network. Bus systems inherently influence walk score due to the tendency to walk to and from bus stations, and therefore the need for proper walking infrastructure around bus lines, or at least stations. The bus network is also influenced by population, given that you want stations and bus lines to reach the most people most efficiently. Therefore, the walk scores around bus lines are influenced by both population and the amenities that public transit brings (bus stations, signage, and walking infrastructure). All of the Google images are along the main Core Network in Salem.

The Central Downtown area has the highest walk score, due to its population density and distance to amenities. The area also has the greatest intersections and routes of bus lines coming to and from. As the core network disperses, the routes become less connected and eventually end, in the same areas where the walk scores decrease, farther away from the areas people tend to work and live.

While I didn't choose any areas to present that had specific bus stop locations, all of these pictures are from a spot along the Cherriot Core Network area. It is important not only to provide good conditions for public transit but to provide good walking and cycling connections to public transport stops and stations as well.

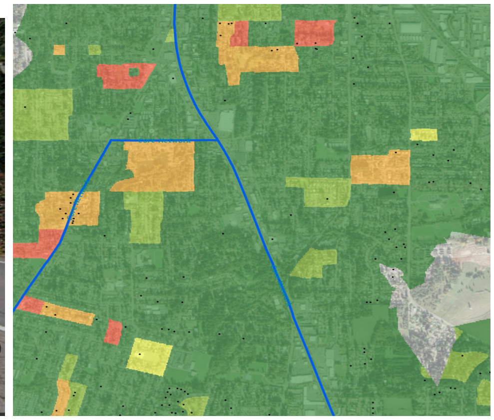
Walk Score: 80 (Central Area)
This image is from the Central Area of Salem where the walkability score is the highest at 80. This is also the neighborhood with the greatest amount of residents at 2,716, shown by the red and orange blocks in the suitability clip above. Being the most walkable area in Salem, this image understandably shows some amazing pedestrian infrastructure including a pedestrian bridge and marked/signed crosswalks. It's hard to tell if the bridge above is for bikes as well, but regardless it provides a safe way of getting across what looks to be a busy, 4-lane arterial. The vegetation buffers and bike lanes provide a safe distance between pedestrians and cars, and the marked crosswalk with signage provides a safe way for pedestrians to cross. Since the road most likely sees medium to high volumes of vehicles and pedestrians every day, I would increase walkability here by creating a raised crosswalk to slow down cars traveling on the road and increase pedestrian safety and visibility when crossing.
Link: https://maps.app.goo.gl/S8t1pqRWMdUpVzMJ9



Walk Score: 77 (Grant Neighborhood)
This image shows an intersection along a one-way road, in a neighborhood with a good walk score, just above the Central Area. This area is the intersection just below the red block in the suitability model above. In terms of walkability, this is a good example, with sidewalks along each block and vegetation buffers between the sidewalks and the roadway as well as parking which creates a buffer. However, being a one-way, cars tend to drive faster, and with parking on both sides, I'm sure it is difficult to see pedestrians trying to cross. To increase the walkability in this area I think pinched crosswalks or bulb-outs should be placed to increase pedestrian safety and decrease high speeds.
Link: https://maps.app.goo.gl/WeTraDkLRxFq8Gtv9

Walk Score: 66 (Southeast Salem)
This image shows an intersection in Southeast Salem, just East of the Central Area. This clip in particular does not look very welcoming to the pedestrian. There are no areas to cross the main road, and the areas to cross the side street are not marked for pedestrians. There is no sort of buffer between the sidewalk and the roadway, making the area feel less welcoming to people walking there. To increase walkability here there are a lot of things I would change. I would continue the tree line buffer in the top-right along the block to increase pedestrian safety and comfort. I would also add a bike lane to act as a buffer and increase connectivity between modes. Lastly, I would add a marked crosswalk to at least the sidestreet so pedestrians can cross more efficiently and safely, and crosswalks across the main arterial and are marked

with proper signage or through proper infrastructure such as raised cross-walks, to prevent high speeds from cars.
Link: https://maps.app.goo.gl/sFuQwmsgGq1KQ2Tt7

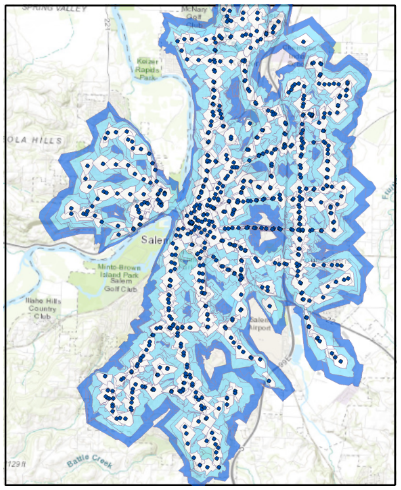


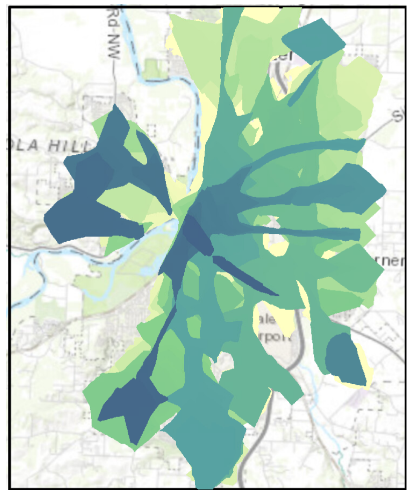
Walk Score: 50 (Morningside)
This image shows a terrible intersection for pedestrians. This area understandably has a walk score of 50. This road looks very busy and has high speeds, with no areas to cross or walk along except for the block in the bottom left. This is not an area I would enjoy walking as a pedestrian, and it is catered towards cars and lacks proper infrastructure for pedestrians and other modes. The bike lane provides a buffer between the road and the sidewalk, but it is only present on one side of the street, going only in one direction, and has no buffer itself, so I can't imagine most cyclists feel comfortable biking along it. If I were to change walkability and connectivity overall for this area, I would add both a sidewalk and bike lane along the other side of the road, with plastic bollards or some other form of bike-lane buffer to provide a safer area for cyclists and pedestrians. I would also add marked crosswalks to each area where the road would need to be crossed and/or bulb-outs to slow down traffic if high speeds are a problem here, allowing pedestrians the ability to cross traffic safely.
Link: https://maps.app.goo.gl/heLPB3WtP8Rqxyyf7

Methods

To create my suitability layer for deciding which areas Salem should focus on walkability improvements, I began with the core bus network. I used Pairwise Clip to clip all of the routes and bus stops into the Salem study area. I then created a network analysis service area layer that shows 5, 10, and 15-minute walking distance from each bus stop within the study area.

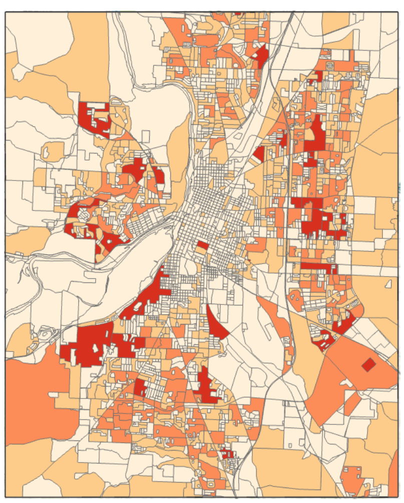
I used the equal interval classification method and then used the polygon to raster tool to change the data into raster where the darkest areas represent the shortest and most consistent walkability around bus stops. The areas have been reclassified on a 1 to 5 scale, with 5 being the most favorable area to walk in terms of the shortest distances to the greatest amount of bus stops.

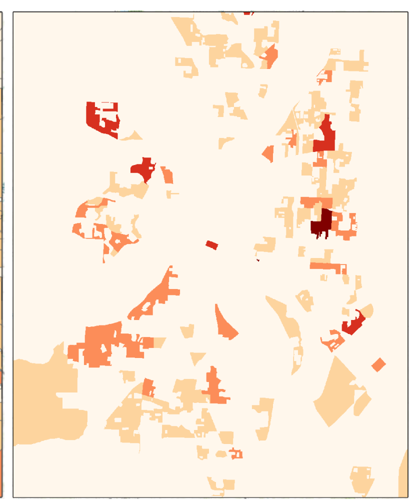




I took the Salem blocks data and clipped it into the study area. Using the equal interval classification method, I then changed the symbology to graduated colors by population to know the residence demand/where most people live and will need transport to and from.

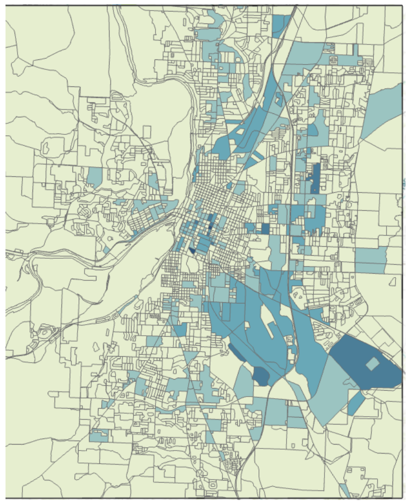
I then used the feature to raster tool to change the data into raster where the darkest areas represent the housing units with the largest population living there. The areas have been reclassified on a 1 to 5 scale, with 5 being the most populated housing areas, and therefore the greatest focus for infrastructure improvements.

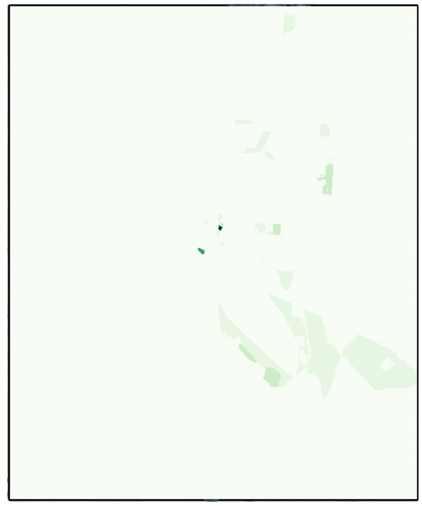


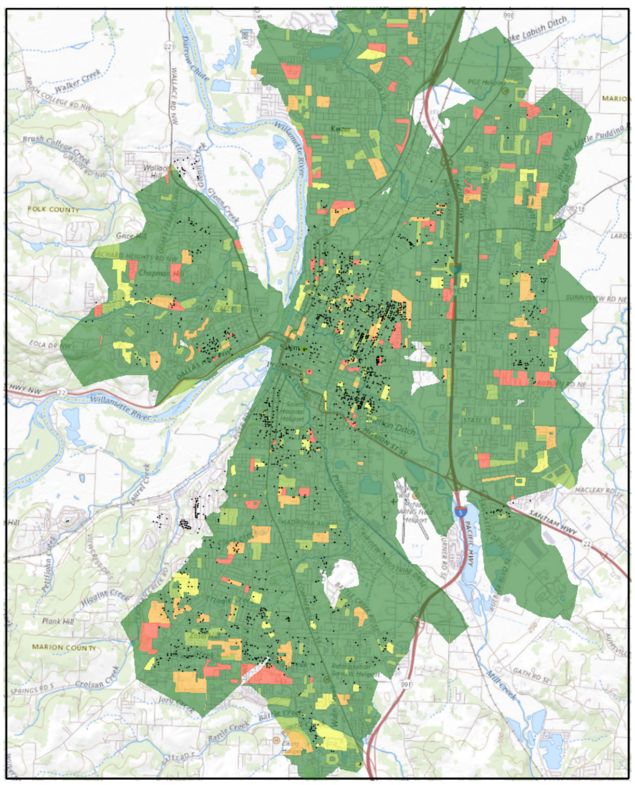


I then took the Salem workplace area data and clipped it into the study area. Using the equal interval classification method I then changed the symbology to graduated colors by field C000, which represents the total number of jobs in each workplace area, to know the demand for transport from Salem workplaces.

I then used the feature to raster tool to change the data into a raster where the darkest areas represent where the greatest population of people work. The areas have been reclassified on a 1 to 5 scale, with 5 being the most populated in terms of working areas, and therefore the greatest focus for infrastructure improvements. While this classification is less substantial than the last two, the Central Area has small blocks of high workforce numbers and Southeast Salem.

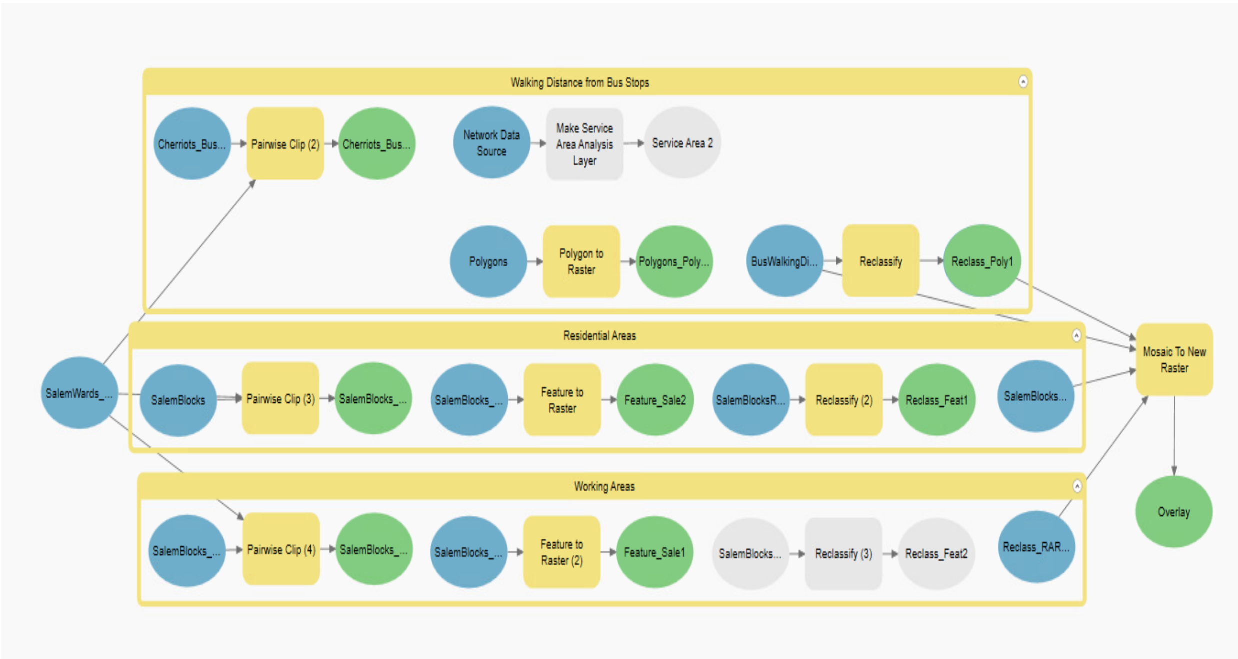






I used an overlay analysis since each input layer had different ranges of numbers. To combine them in a single analysis, I reclassified each into a common scale of 1 to 5, with 5 being the most favorable. These three layers show the areas that should be favored for walkability developments due to the working population, living population, and access to bus routes/public transit stations.

I then used the mosaic to new raster tool to merge all three raster datasets. Using their scale/ranking, the raster above shows a suitability model for walkability, with red being the areas where the (5/5) greatest amount of people might walk, considering the access/location related to workplaces, housing, and bus stops.



Future Directions and Improvements

After creating this raster dataset I layered "sidewalk concerns" over that, not to show what specific concerns should be focused on first, but to provide an idea of the areas where the most sidewalk concerns are seen and how that overlaps with the areas favored for walkability and transit-oriented developments. This model is intended to show where walkability concerns and transit connection issues should be addressed, in terms of 'least important' to 'most important' when looking at the ranking of 1-5. Concerns in the red areas should be looked at first, followed by orange, yellow, and green, with concerns in the non-colored areas to be 'least important' due to the lack of access and use of these areas.

Continuing this project, I think it would be important to look at the walking infrastructure concerning bus stops. I created a layer that shows where infrastructure updates should be given the highest priority due to accessibility and use from the surrounding population, but the bus stops themselves, and their surrounding areas within a 15-minute walk should be the initial improvement when looking at proper connection between the transit network and walking. Adding the sidewalk concerns layer along with data regarding safe crosswalks and proper lighting, if clipped into the 15-minute walking distance from bus stops, would show necessary improvements in areas already being used by walkers and commuters, who deserve proper infrastructure and safe trips.

Citations

Office of the Surgeon General. 2015. "Surgeon General Strategies for Making Communities More Walkable." HHS.gov. US Department of Health and Human Services. September 1, 2015. https://www.hhs.gov/surgeongeneral/reports-and-publications/physical-activity-nutrition/walking-sectors/index.html

Novak, M. (2021, May 18). *Infrastructural Changes for Pedestrians: What to Consider*. City Changers. https://citychangers.org/pedestrianisation-what-to-consider/

"Modeling Walkability." n.d. Accessed March 10th, 2024. https://www.esri.com/news/arcuser/0112/modeling-walkability.html

Final Project Memo

To: Nick Kohler and Maddie
From: Matthew Healy
Date: March 11th, 2024
Subject: Cherriot Core Focus Group Final Project

Overview

This memo outlines my recommendations for improving walkability and connectivity in Salem, focusing on implementing strategies to promote walking as a safe and accessible mode of transportation for residents of all ages and abilities. Drawing on principles outlined by the US Department of Health and Human Services, my recommendations aim to design streets, sidewalks, and crosswalks that encourage walking and enhance community livability. This memo summarizes specific recommendations for infrastructure improvements, describes the data and methodology used to develop these suggestions, shows the different observations I made while doing research, and includes citations of major sources consulted in the process. Additionally, I will provide PowerPoint graphics to visually illustrate the geographic areas of focus and the data analysis that I used to inform my recommendations.

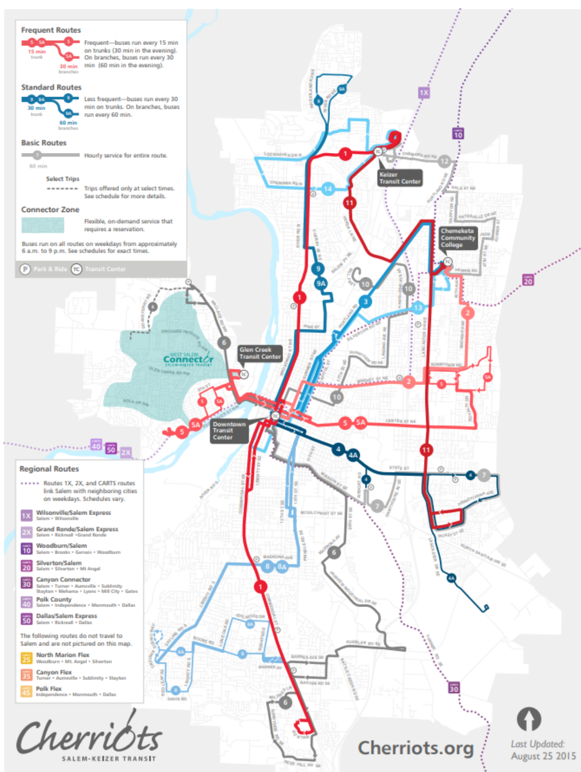


Figure 1: Cherriot Core Network (1)

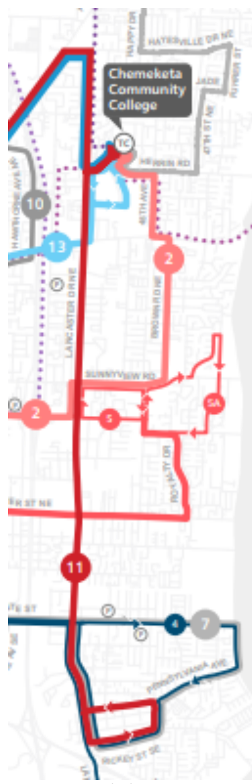


Figure 2: Route 11 (1)

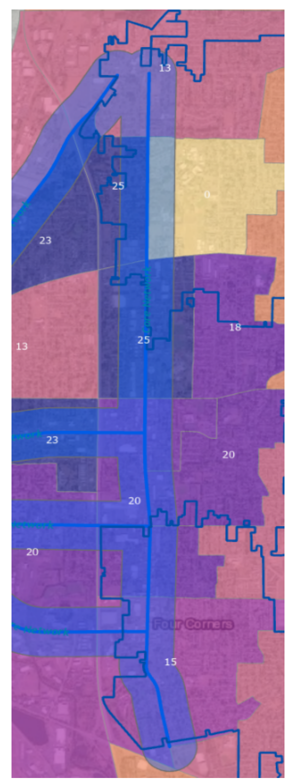


Figure 3: Equity Scores

Background

The city of Salem recognizes the importance of creating pedestrian-friendly environments that promote health, sustainability, and community well-being. In response to this goal, city officials reached out to our GEOG 482 class to request assistance in conducting a walkability suitability analysis. This collaboration reflects the city's commitment to engaging with local academic institutions and harnessing their expertise to address urban challenges.

The project aims to identify areas within Salem where walkability can be improved through targeted infrastructure enhancements and policy interventions. By leveraging the knowledge and skills of our class, the city aims to gain valuable insights into the current state of walkability and identify priority areas for intervention.

Through my analysis in Lab 3 and Lab 4 I identified route 11 on the Cherriot core network as an ideal area for increasing pedestrian safety and overall walkability. I believe that this selection of intersections is optimal for critical analysis due to several key factors. This section of the Cherriot network offers several modes of transit, is within the equity area of focus (as seen in figure 3 on the page above), sees a high amount of traffic, and is positioned within a major corridor of the Salem metropolitan area (see figure 1 and 2). The route follows along Lancaster Dr for several miles, this road is bordered by several commercial centers and pedestrian destinations.

Observations

In this section I intend to share the observations of the different intersections, road conditions, and walk scores along route 11 of the Cherriot Core Network in an attempt to address potential safety hazards to pedestrians traveling along the route.

Walk Score

Salem Neighborhoods

Rank ▲	Name	Walk Score	Transit Score	Bike Score	Population
1	Central Area	80	56	85	2,716
2	Grant	77	47	91	2,648
3	South Central	69	34	72	6,427
4	Southeast Salem	66	38	79	5,853
5	Highland	62	38	85	5,598
6	Northeast Salem	61	39	78	7,140
7	Northeast Neighbors	61	43	82	7,240
8	Lansing	53	37	68	4,420
9	Morningside	50	32	65	9,963
10	Faye Wright	49	30	65	7,487
11	South Salem	46	25	57	6,658
12	North Lancaster	45	38	57	6,416
13	East Lancaster	40	37	61	8,367
14	Northgate	40	33	65	11,300
15	South Gateway	30	29	46	16,457
16	Sunnyslope	28	25	52	6,993
17	Southeast Mill Creek	16	24	42	7,806

Figure 4: Salem walk score provided by Lab 4 PDF (4)

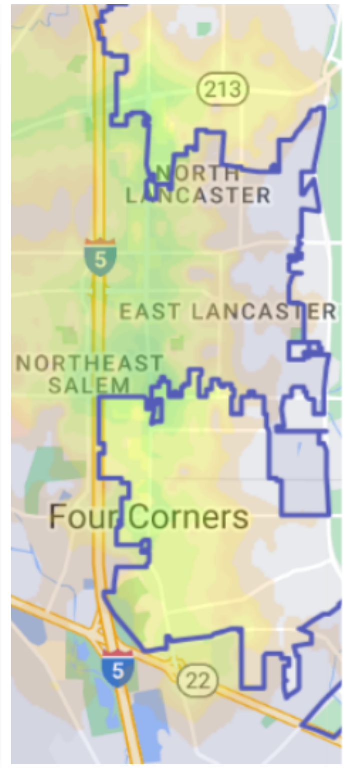


Figure 5: Walk Score Map (4)

Route 11 traverses across several major neighborhoods within the Salem Metro area. Analysis of walk scores reveals a clear correlation between proximity to Route 11 and higher walkability ratings. Neighborhoods closer to the route tend to have higher scores, indicating greater accessibility and pedestrian-friendliness.

For example when you look at both North and East Lancaster in figure 5 you can see that their walkability scores are heavily skewed towards their west boundaries which is where route 11 intersects with both neighborhoods. This is a common theme seen through out Salem where the further you get from the core network the 'less walkable' the city becomes, showing the impact that access to the transit system plays when calculating walk scores.

Intersections

Several safety concerns exist at Route 11 intersections, including a lack of pedestrian crossings and long crossing distances.

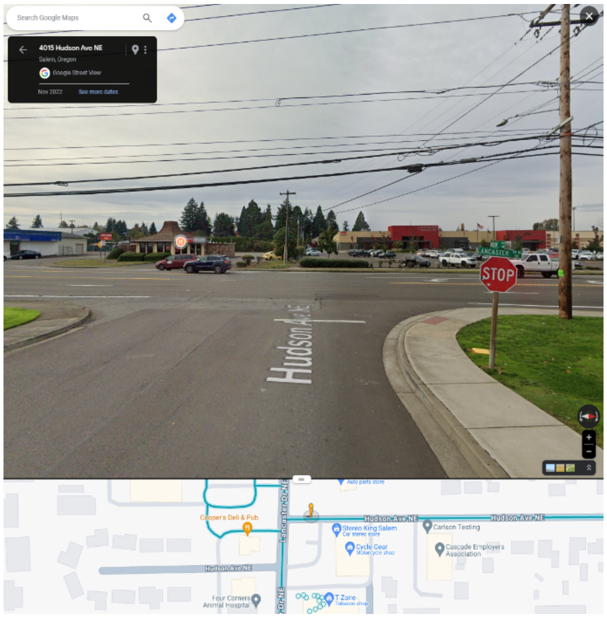


Figure 6: Hudson and Lancaster Drive Intersection (3)

Example: if you wanted to walk from the Cycle gear Motor shop to the Dicks sporting goods across the street, you would need to walk a third of a mile up or down the road before you could attempt to cross safely. By adding a crossing that utilizes some of the recommended proven safety countermeasures provided by the Federal Highway Administration Salem could easily improve the walkability along this major commercial corridor.

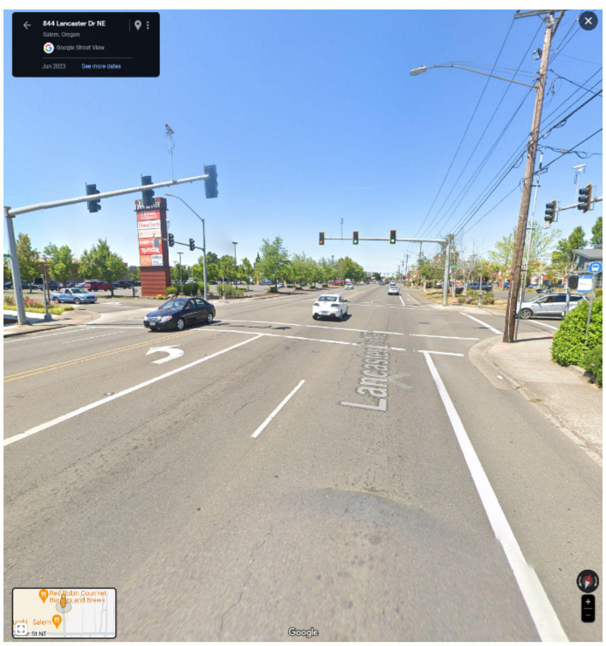


Figure 7: Denver and Lancaster Drive Intersection (3)

Example: The Intersection at Lancaster Drive and Denver Avenue connects two commercial areas. At this intersection, you can see that the pedestrian has to cross 5 lanes to reach the other side of the intersection. This distance can make this intersection potentially dangerous for pedestrians who may be visually impaired or those who can't cover said distance within the allotted time frame of the crosswalk. A curb extension would help shorten the distance that the pedestrian has to walk to reach the other side of the intersection.

Bike Infrastructure

While the corridor features dedicated bike lanes, these lanes are not physically separated from the normal flow of traffic. Cyclists navigating Route 11 share the road with motor vehicles, leading to safety concerns and a deterrent effect on cycling as a mode of transportation. There is also a Lack of dedicated bike turn lanes and signals at intersections along Route 11 which complicates cyclists' ability to navigate safely, increasing the risk of conflicts with turning vehicles and impeding the flow of bicycle traffic.

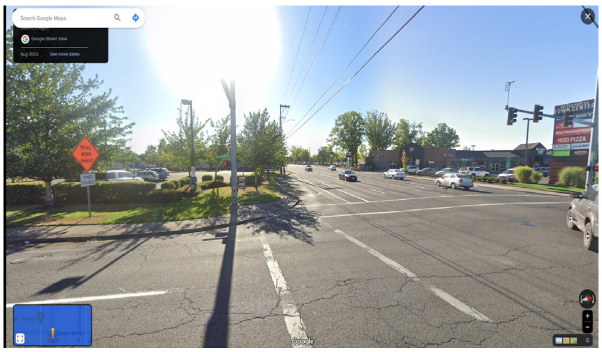


Figure 8: Lancaster Drive and Center Street Bike Lane (3)

Example: The intersection of Lancaster Drive and Center Street has dedicated bike lanes that lead up to it from all sides but as you can see on the approach the right-hand turn lane intersects with the dedicated bike lane. This creates an unnecessary interaction between cyclists and motor vehicles.

Recommendations

My project focuses on the first design strategy outlined by the US Department of Health and Human Services, which is to "Design streets, sidewalks, and crosswalks that encourage walking for people of all ages and abilities." This strategy emphasizes creating infrastructure that promotes walking as a safe and accessible mode of transportation for everyone, regardless of age or ability. With this in mind, my recommendations for improving walkability and connectivity in the city of Salem are:

Figure 9: FHWA (2)

- Implementing sidewalk maintenance and expansion projects to address gaps and obstacles, particularly along major corridors like Route 11.
- Installing pedestrian amenities such as benches, shelters, and lighting to enhance comfort and safety for pedestrians, especially in areas with high foot traffic and at each bus stop along Route 11.
- Introducing dedicated pedestrian crossings with high-visibility markings and pedestrian-activated signals at key intersections to improve safety and accessibility for pedestrians.
- Introducing traffic calming measures such as raised crosswalks and curb extensions to reduce vehicle speeds and improve pedestrian safety at intersections.
- Upgrading existing bike lanes to physically separated or protected bike lanes to enhance cyclist safety and encourage cycling as a mode of transportation.

Strategies

Here I intend to delve deeper into each recommendation.

Walk Score

Improvement of Sidewalks: Invest in sidewalk maintenance and expansion projects to ensure continuous and accessible pedestrian pathways along Route 11 and its adjacent neighborhoods. Addressing sidewalk gaps and obstacles enhances walkability and promotes pedestrian safety.

Pedestrian Amenities: Install benches, shelters, and pedestrian-scale lighting along the corridor to improve comfort and convenience for pedestrians. These amenities encourage walking as a mode of transportation and enhance the overall pedestrian experience.

Intersections

Pedestrian Crossings: Implement dedicated pedestrian crossings with high-visibility markings and pedestrian-activated signals, as recommended by FHWA's proven safety countermeasures. These measures enhance pedestrian safety at intersections and reduce the risk of pedestrian-vehicle conflicts.

Traffic Calming Measures: Introduce traffic calming measures such as raised crosswalks and curb extensions, consistent with FHWA's recommendations for intersection safety improvements. These measures help mitigate vehicle speeds and improve pedestrian safety at intersections, aligning with FHWA's objectives for enhancing intersection design.

Bike Infrastructure

Protected Bike Lanes: Upgrade existing bike lanes to physically separated or protected bike lanes, in accordance with FHWA's proven safety countermeasures for bicycle infrastructure improvements. Separating bike lanes from vehicular traffic enhances cyclist safety and aligns with FHWA's objectives for improving bike facilities.

Bike Route Signage: Install clear and consistent signage indicating designated bike routes, bike lanes, and shared roadways along the corridor. Proper signage enhances wayfinding for cyclists and motorists, promoting safer interactions between different road users.

If Salem were to Implement these suggestions, they could address the identified shortcomings and improve walkability, pedestrian safety, and cycling infrastructure along Route 11 and its surrounding areas.

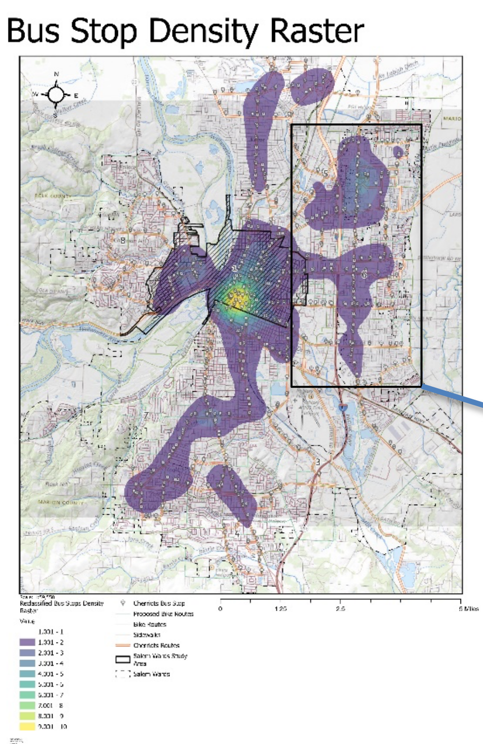
Data and Methodology

My recommendations are based on a comprehensive analysis of walkability and transportation data, including walk scores, geolocations, existing GIS data provided by the city of Salem, Google Street View images of the target areas, and information from the Federal Highway Administration about Proven Safety Countermeasures.

Geospatial analysis played a crucial role in assessing and quantifying various factors that influence pedestrian activity and walkability. One of the key techniques used was the creation of a raster weighted sum overlay, which combined four submodels to evaluate different aspects of walkability within Salem.

The Figure to the left is a complete Model Builder model of all the different submodels that I created during the spatial analysis phase of this project. The model shows the different transformations that each submodel underwent in order to create the final overlay.

Figure 10: Model Builder Lab 3 (6)



1. The first submodel examined the density of bus stops, a vital component of public transit infrastructure. Using GIS software, I geocoded the locations of bus stops provided by the city of Salem and calculated the density of bus stops within each raster cell. This submodel identified areas with high accessibility to public transit, enhancing walkability by providing alternative transportation options.

In the Bus stop density map it becomes apparent that route 11 has a good frequency of bus stops.

Figure 11: Bus Stop Density Raster (6)

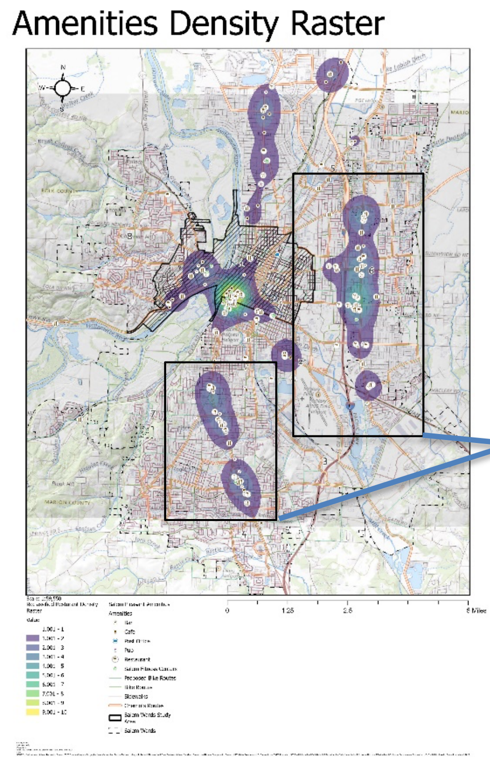


Figure 12: Amenities Density Raster (6)

2. The second submodel focuses on the density of pleasant amenities, including restaurants, bars, fitness centers, and other destinations that contribute to the attractiveness of walking routes. By aggregating point data representing these amenities, we created a raster layer depicting the density of pleasant amenities across Salem. Areas with higher densities of pleasant amenities were considered more walkable and desirable for pedestrians.

This submodel identifies several areas with high concentration of pleasant amenities, most of which are along major corridors.

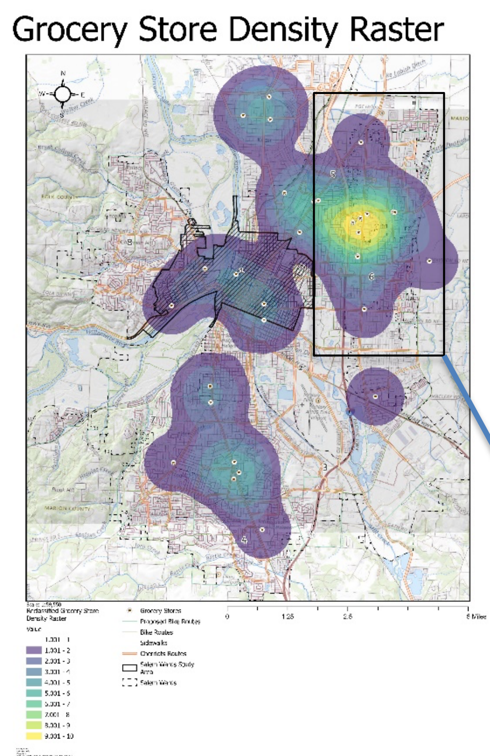


Figure 13: Grocery Store Density Raster (6)

3. The third submodel assessed the density of grocery stores, recognizing their importance in promoting walkability by providing convenient access to essential goods. Similar to the previous submodel, we aggregated point data representing grocery store locations to create a raster layer depicting the density of grocery stores. Areas with higher densities of grocery stores were considered more walkable due to their ability to meet residents' daily needs within walking distance.

You can see that there seems to be a high concentration of grocery store locations along route 11.

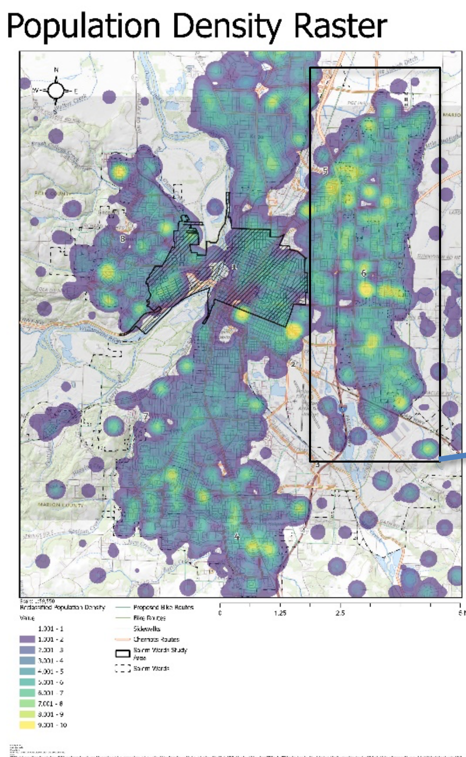


Figure 14: Population Density Raster (6)

4. Lastly, the fourth submodel examined population density as a key determinant of walkability. Leveraging census data on population distribution, we transformed census block data into points and applied kernel density analysis to generate a population density raster layer. This layer was reclassified to highlight areas with higher residential density, indicating potential pedestrian activity hubs where walkability improvements may have the greatest impact.

Route 11 also passes through a more densly populated area of salem as seen in the population density raster on the left here.

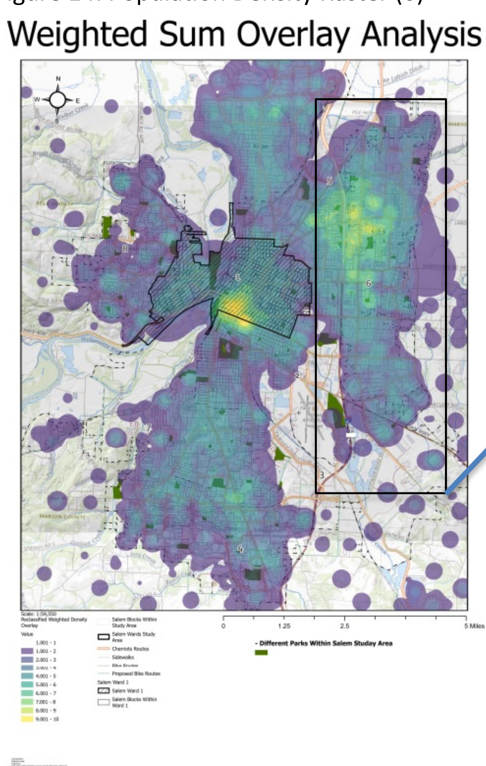


Figure 15: Weighted Sum Overlay (6)

By combining these four submodels into a raster weighted sum overlay, I generated a comprehensive walkability index that identified areas of Salem with the highest potential for pedestrian activity and identified priority areas for walkability improvements. In tandem with this, I identified Cherriot Core Route 11 as a primary candidate for improvement due to its proximity to Salem's identified target equity area.

This map shows the combination of all 4 submodels and the outlined area shows the location of Cherriot Core Route 11 in relation to the overall Salem Metro Area.

Future Directions and Improvements

If I was to redo this project, I would adjust the weights that I assigned to each submodel. Originally I had applied an equal weight to each submodel, after performing the my analysis I've come to the understanding that this may not accurately represent the importance of each factor. Adjusting the weights in the final overlay could better reflect the relative importance of different factors influencing walkability in Salem. For instance, assigning a higher weight to the density of pleasant amenities may better capture the influence of attractive destinations on pedestrian activity. Similarly increasing the weight of population density in the overlay could more accurately prioritize the areas with higher concentrations of potential pedestrian activity hubs.

Another aspect that I would delve further into in the future would be implementing more refined suggestions based upon proven safety countermeasures that increase safety for pedestrians interacting with the urban interface. In this document I provide some links to the FHWA's website where the administration goes into detail on some of the different countermeasures they recommend, but I think it would be wise to research other strategies in order to find different countermeasures that may be out there.

Sources

1 *City of Salem.* 01/13/2020. Salem Transportation System Plan. Salem, OR.
https://www.cityofsalem.net/home/showpublisheddocument/5158/637798388452130000

2 *Federal Highway Administration.* 05/18/2015.
A. Bicycle Lanes.
https://highways.dot.gov/safety/proven-safety-countermeasures/bicycle-lanes
B. Crosswalk Visibility Enhancements.
https://highways.dot.gov/safety/proven-safety-countermeasures/crosswalk-visibility-enhancements
C. Pedestrian Hybrid Beacons (PHB).
https://highways.dot.gov/safety/proven-safety-countermeasures/pedestrian-hybrid-beacons
D. Rectangular Rapid Flashing Beacons (RRFB).
https://highways.dot.gov/safety/proven-safety-countermeasures/rectangular-rapid-flashing-beacons-rrfb

3 *Google Street View.* Google. Google.com.

4 *Walk Score.* Living in Salem. Walkscore.com.
https://www.walkscore.com/OR/Salem

5 *Surgeon General strategies for making communities more walkable.* US Department of Health and Human Services. 10/13/2015. hhs.gov.
https://www.hhs.gov/surgeongeneral/reports-and-publications/physical-activity-nutrition/walking-sectors/index.html

6 *GEOG 482 Lab 3 and Lab 4.* Matthew Healy. March 2024.

7 *GEOG 482.* Matthew Healy. Data Layers and Symbology can be found under R:\GEOG482_582_22260_Winter2024\Student_Data\mhealy3\Final_Project. In the Student R:\ Drive.
These Layers Include:

- Reclassified Bus Stop Density Raster
- Reclassified Grocery Density Raster
- Reclassified Pleasant Amenities Density Raster
- Reclassified Population Density Raster
- Reclassified Weighted Density Overlay


Cherriots Bus Stop
Kernel Density
Kernel_Bus_Stops
Reclassify
Reclass_Bus_Stop
Salem Pleasant Amenities
Kernel Density (2)
Kernel_Resturants
Reclassify (2)
Reclass_Resturant
Grocery_Within_Salem_Wards
Kernel Density (3)
Kernel_Grocery
Reclassify (3)
Reclass_Grocery
Blocks_Within ...
Feature To Point
Population_Density
Kernel Density (4)
KernelD_Popu1
Reclassified Bus Stops Density Raster
Reclassified Grocery Store Density Raster
Reclassified Resturant Density Raster
Reclassified_P ...
Weighted Sum
Weighte_Reclassified_Densit_Overlay
Cherriots_Bus ...
Select Layer By Location
Cherriots_Bus ... (2)
Output Layer Names
Count
SalemWards_...
geopoints
Select Layer By Location (2)
geopoints (2)
Output Layer Names (2)
Count (2)

GEOG 482 Walkability Final Project

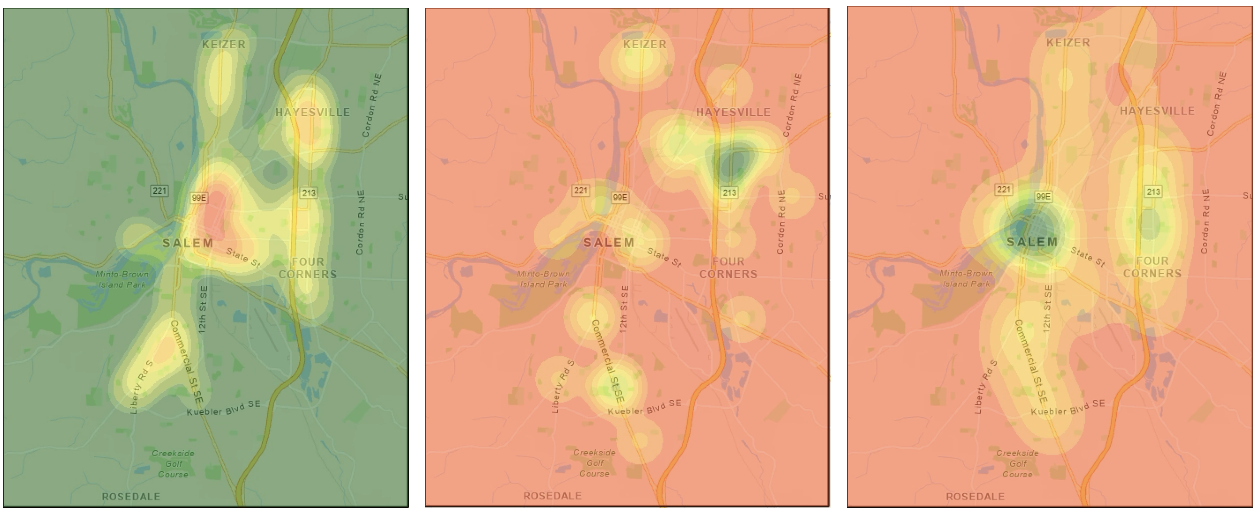
Project Goals

The overarching goal of this project was to provide the city of Salem with recommendations on how to improve walkability. These recommendations were to be, at least in some capacity, driven by GIS analyses of Salem. With students split up into three focus areas, I found myself in the Cherriots group, performing analyses centered around the bus network of the same name. The main goals within this scope included but were not limited to suggesting improvements to core network service, assessing current walkability concerns along the core network, and identifying sites for walkable transit-oriented development. Ensuing recommendations were to be presented to representatives from the city of Salem incorporating both GIS analyses and walkability theory.

Recommendations

My major recommendation for improving walkability in Salem is to invest in mixed-use, transit-oriented development in what I have deemed downtown fringe areas (right, roughly outlined in red)—in other words, the area around the edge of downtown just outside of the most dense, currently walkable blocks. In this section, I will outline my reasons behind this recommendation.

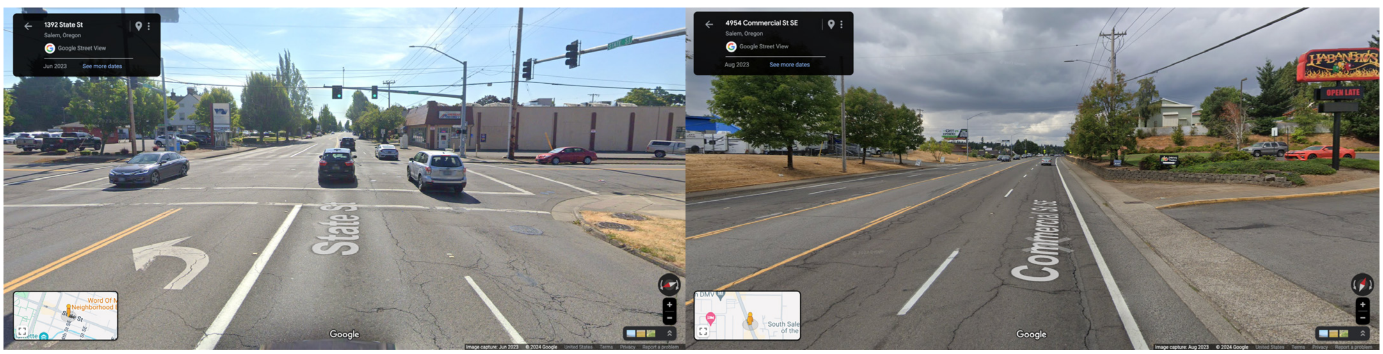
These downtown fringe areas have good urban fabric, but there is currently too much surface parking and lack of density to make it truly walkable. What I mean by this is that it has a solid urban framework for walkability, but in this case, its potential has not been realized. Some of the main factors that affect walkability are sidewalk aesthetics, population density, proximity of amenities, and street network (Al Shammas & Escobar, 2021). Out of any of these, street network is by far the hardest to incorporate in an urban retrofitting, yet this area of Salem already has a dense grid system. In addition to this, the area is already served by numerous routes and stops on the core bus network and the spread of amenities is adequate, albeit far from optimal.



Left to right: density of core network bus stops (red=denser), density of grocery stores (green=denser), density of restaurants/bars (green=denser)

The best way to transform the downtown fringe into the walkable area it is destined to be is to invest in mixed-used development. This will allow for more efficient use of the core network bus stops in the area as they will foster future residents' movement throughout the city in addition to accommodating incoming business traffic. Within these future communities themselves, residents will be able to access amenities within their own buildings or others nearby without requiring access to a personal vehicle. If population density and amenity density are improved upon in this area, its walkability will begin to rival that of downtown, taking full advantage of the existing core bus network and dense street grid.

Despite having a similar Walk Score to other areas of the city, the downtown fringe is by far the best area for investment in mixed-use, transit-oriented development, which will in turn promote walkability. For starters, Walk Score can be quite unreliable at times, prioritizing amenity density over intersection frequency, though the latter is taken into account as well (Telega et al., 2021). A simple eye test on Google Street View can serve as further evidence for the argument that investment is best placed in the downtown fringe. The Commercial St SE corridor may have plenty of amenities, but they are all along a major stroad with infrequent intersections, which can pose significant safety concerns and create an unpleasant environment in general.



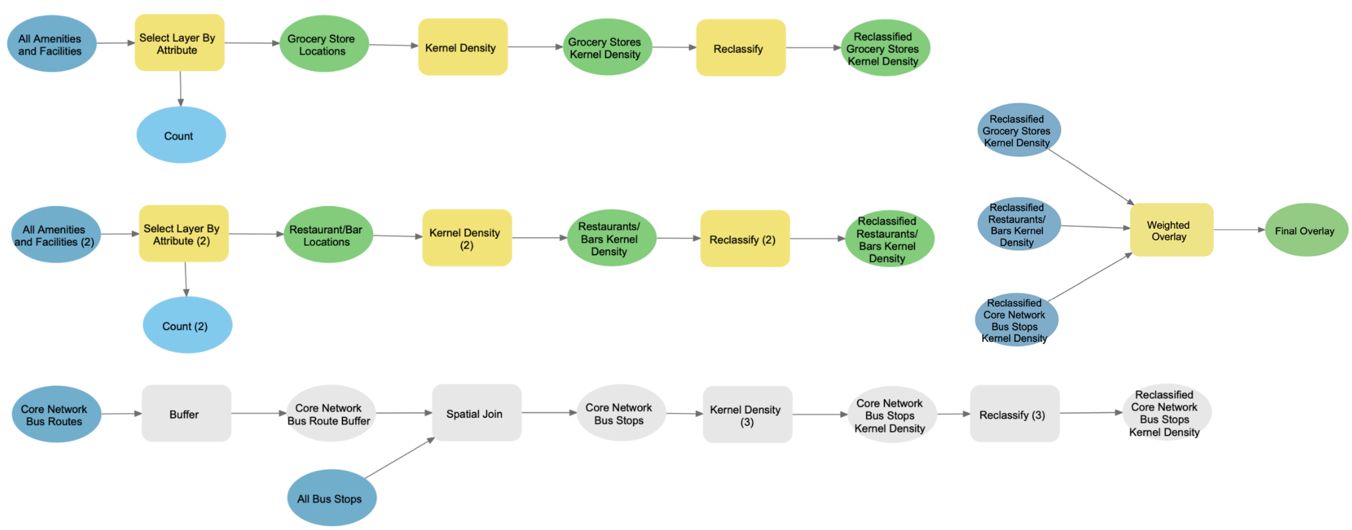
Left to right: downtown fringe (June 2023), Commercial St SE (August 2023)

Methods

My primary GIS analyses for this project were three different kernel density maps, pictured in the previous section, that would be put into a final overlay. These were focused on the densities of core network bus stops, grocery stores, and restaurants and bars.

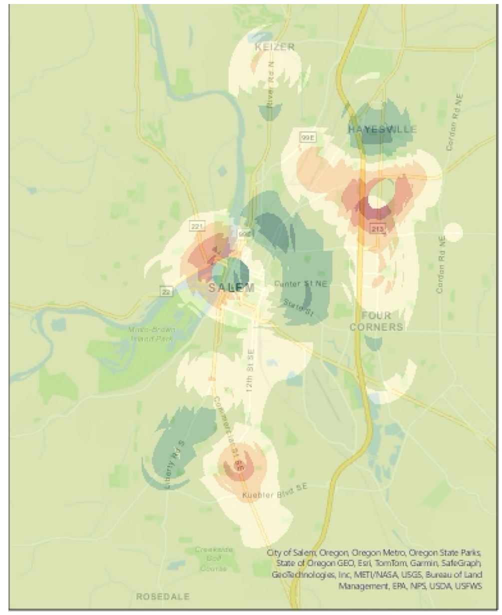
To create the kernel density map for the core network bus stops, I first created a small buffer around the provided core network routes layer. Next, I performed a spatial join between the buffer and the provided data layer containing all bus stops, leaving me with only those along the core network. After this, I created a kernel density of the core network bus stops, playing around with search radii until I found one that I believed best illustrated the spread. Finally, I performed a reclassification to prepare it for input into my final overlay.

To create the two kernel density maps for the relevant amenities, I first used select layer by attribute on the provided layer containing every amenity. For one, I selected grocery stores, and for the other, I selected both restaurants and bars since the two go hand in hand. I then created a kernel density map for each resulting layer, once again playing around with search radii until finding an adequate representation of the spread. Both of these were then reclassified for input into my final overlay, where all layers were weighted equally.



Future Directions and Improvements

My main regret with this project is that I was not able to incorporate all of the submodels I originally planned to. Instead of incorporating a kernel density of core network bus stops, I hoped to include a submodel of walking service areas for core network bus stops, but there were complications with converting this to raster while preserving the symbology necessary to display the data. If I were able to make this happen, I believe I would be more satisfied with my final overlay, which I have chosen not to include in previous sections of this report. Another regret with the final overlay is my choice of symbology. I used red to represent lower densities and green to represent higher densities for both amenity kernel density maps, but I reversed this for the bus stop kernel density map. I did this in hopes of highlighting areas with a high concentration of amenities without core network service (darkest green) as well as areas with core network service but a low concentration of amenities (darkest red). However, my final overlay (right) does not reflect this as well as I intended, and the colors have a tendency to be quite misleading. That being said, it did provide me with the information I needed with regards to which parts of the city to analyze for my recommendations.



While my recommendations ended up being less GIS-based than intended, there is plenty of opportunity for further development of these ideas within the scope of GIS. To refine my recommendation area a bit more, I could perform an analysis to figure out what portion of each block in Salem is either undeveloped or occupied by surface parking. From there, I could highlight blocks above a certain threshold that are within a certain distance of the city center, roughly coinciding with the hand-drawn outline of the downtown fringe in the recommendations section. This would theoretically produce a map of which downtown fringe areas are best for future mixed-use development.

Notes:

The ArcPro project used to work on this can be found at R:\GEOG482_582_22260_Winter2024\Student_Data\bhk\Lab3\Lab3_SalemWalkability\Keller_Lab3_SalemWalkability

All maps and models included in this report can be found at R:\GEOG482_582_22260_Winter2024\Student_Data\bhk\FinalProject

- Layer Packages
    - Final overlay: WeightedOverlay.lpkx
    - Core network bus stops kernel density: CoreStopsKernelDensity.lpkx
    - Grocery stores kernel density: GroceryStoresKernelDensity.lpkx
    - Restaurants and bars kernel density: RestaurantsBarsKernelDensity.lpkx
- Models
    - Individual submodels: Model_IndividualSubmodels.pdf
    - Final overlay: Model_Overlay.pdf

References

Al Shammas T, Escobar F. Comfort and Time-Based Walkability Index Design: A GIS-Based Proposal. *International Journal of Environmental Research and Public Health*. 2019; 16(16):2850. https://doi.org/10.3390/ijerph16162850

Telega A, Telega I, Bieda A. Measuring Walkability with GIS—Methods Overview and New Approach Proposal. *Sustainability*. 2021; 13(4):1883. https://doi.org/10.3390/su13041883

Ethan Moser
GEO 482: GIS II
Salem Walkability Project: Part II
21 March, 2024

Goals

My area of concentration was the Cherriot Core network. Within this, I chose to look at sidewalk Within 2,000 feet of bus stops along the Core network. Based on my overlay analysis from lab 3, I identified the Northeast Neighbors and South Central neighborhoods as two areas of high concern for sidewalk walkability. For lab 4, I will be looking at these neighborhoods.

My goal here is to create an analysis of sidewalk concerns within a 0.5 mile radius of bus stops. The idea is that making bus stops easier to access with better walkability (i.e. improved sidewalks) will create more incentive for people to walk and take public transportation. This has been shown to increase people's perceptions for walkability (D'orso et al.). The idea of this map is to show Salem officials where to best utilize funds for improving walking infrastructure (i.e. near bus stops). I chose 'within 0.5 miles' from bus stops because I read several sources that indicated that investment should be made for pedestrian walkability within a 0.75 mile radius around public transportation to induce a modal shift towards public transport (D'Orso et al.).

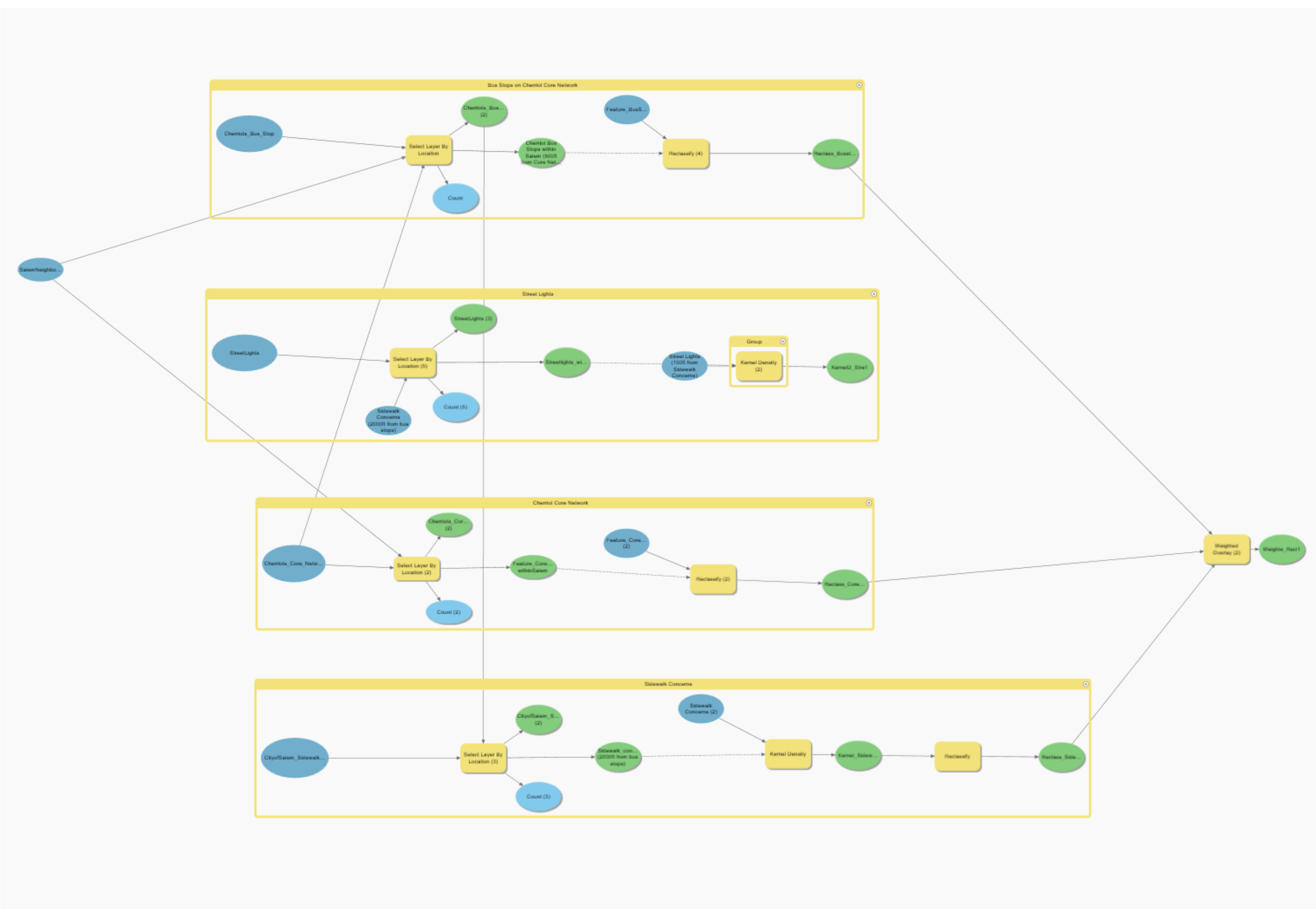
Methods

A step by step analysis of the submodels (input layers) I put on the map, as well as the geoprocessing tools I ran.

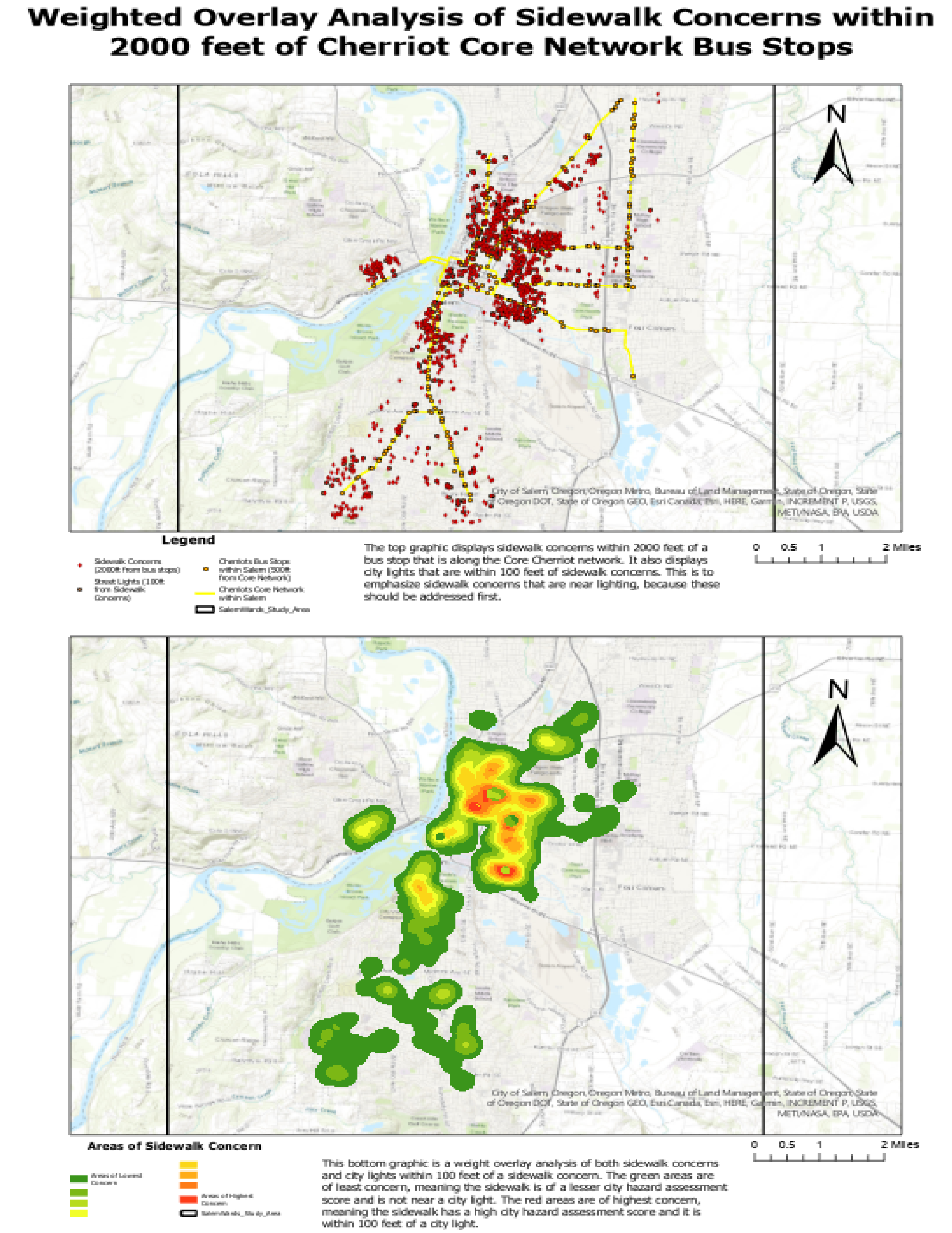
1. Cherriot Core Network route
    a. Selected by location for lines that INTERSECT Salem neighborhoods.
    b. I then ran a feature to raster tool and gave it a cell size of 50, which I believed to be big enough to see the results on a map, but not big enough to be a nuisance.
2. Cherriot bus stops
    a. Selected by location for bus stops that were WITHIN A DISTANCE of 500 feet of the Cherriot Core Network and WITHIN Salem neighborhoods. I chose 500 feet because that was the appropriate distance to cover those bus stops that were also one block away from the core network.
    b. I then ran a feature to raster tool and gave it a cell size of 50, which I believed to be big enough to see the results on a map, but not big enough to be of a nuisance
3. Sidewalk concerns
    a. Selected by location for concerns that were WITHIN A DISTANCE of 2500 feet from the selected layer of bus stops along the core network. I chose 2500 feet because I read several sources that indicated that investment should be made for pedestrian walkability within a 0.75 mile radius around public transportation to induce a modal shift towards public transport (D'Orso et al.).
    b. I then made a Kernel density of this selected layer, and made the population field 'city hazard assessment value' to indicate where the highest densities of

sidewalks with the highest assessment value were. I chose this population field value because it made the most sense when analyzing where the city should start if allocating resources to fixing sidewalks for walkability.
   c. I then RECLASSIFIED this kernel layer via lowest to highest on assessment value.
   d. I did not need to run a feature to raster tool because the kernel density tool turned these features to rasters.
4. Street lights
   a. Selected by location for street lights that were WITHIN A DISTANCE of 100 feet from the selected layer of sidewalk concerns. I chose 100 feet because
   b. I then made a kernel density of this selected layer to indicate where the highest densities of lights within the given distance of sidewalk concerns were. I chose a population field of NONE because there was not a specific value that needed to be picked out.
   c. I then reclassified this field.
   d. I did not need to run a feature to raster tool because the kernel density tool turned these features to rasters.

Model Builder of Methods



Supporting Maps and Graphics



Northwest Neighbors

1.) Walk score: 61 (rank of 7th in Salem)
    a.) Northeast Neighbors is most walkable on the southeast corner of the neighborhood. This also happens to be where the majority of the amenities like restaurants. People can walk to an average of 0.8 amenities within 5 minutes. This is obviously less than 1.0, so on average you have to walk a little ways to get to an amenity. This poor score is probably due to this concentration of amenities, and the fact that the neighborhood blocks are uneven and unequal, with some areas having longer blocks than others, which makes walking for certain areas harder and longer. It is also the 7th most populous neighborhood (out of 17). Another impact on the walkability score of this Neighborhood might be that it has four major roads going through it (Center St NE, Market St NE, 17th St NE, and Sunnyview Rd). These roads are more difficult to cross with required wait times at crosswalks, let alone travel to crosswalks.
    b.) The neighborhood also has a low transit score (43) which means that if you need to leave the neighborhood for other destinations, or perhaps travel from one end to the other, its a lot more difficult to.
2.) Challenges to this walkability with relation to my focus of sidewalk concerns impacting walkability.

https://maps.app.goo.gl/dRGzFdx8TnaKrqMP7: In the above picture, you can see the sidewalk square is sticking up, creating a walking and tripping hazard. This image was taken July 2023.

https://maps.app.goo.gl/hMy2uumWJTStye2bA
In this image above, the vegetation next to the sidewalk has overgrown, creating a harder route for people to walk through, thus requiring them to walk around on unstable ground, which can be hard for older individuals. This image was taken June 2023.

https://maps.app.goo.gl/x7rVVjXoeVfoyjKL6
In this photo, you can see that the tree root has pushed up and cracked the cement sidewalk block, causing a tripping hazard. Photo taken June 2023.

To improve walkability in this specific neighborhood, and within the scope of my project, I would first focus on improving the sidewalk conditions on the main through streets in this neighborhood. In D'orso et al. 2019, a suggestion they made was to identify which major thorough roads of a neighborhood funneled the most people in and out of a neighborhood, and had the most bus stops, because that is where most people will be walking to and on. I would also include improving infrastructure on main 'secondary' streets that run through neighborhoods on a straight line and intersect the thorough roads. This will encourage people to walk the neighborhood to transit or amenities.

Speaking of amenities, it would also be important to establish routes to the southeast corner of the neighborhood where the major concentration of amenities are. I notice that there is a large section where Mill Creek winds through that is larger neighborhood blocks and is not easily walked around. One aspect of sidewalks could also be the creation of more sidewalks and walking paths through large blocks like that, which would facilitate easier and quicker access to restaurants, bars, cafes, and shopping.

Works Cited

D'Orso, Macro Migliore. "A GIS-based Method for Evaluating the Walkability of a Pedestrian Environment and Prioritised Investments". Journal of Transport Geography. Volume 82; 102555. January 2020. Accessed 14 February, 2024.

Office of the Surgeon General. 2015. "Surgeon General Strategies for Making Communities More Walkable." HHS.gov. US Department of Health and Human Services. September 1, 2015. https://www.hhs.gov/surgeongeneral/reports-and-publications/physical-activity-nutrition/walking-sectors/index.html .

Alexander Segal
GIS II
Final Project

Goals

The primary goal of this project is to identify ways in which walkability in Salem can be improved through the design of well-connected communities. Enhancing the Cherriots Core Network and making sure there are established routes between residential and commercial locations are ways to achieve this goal.

Summary of Recommendations

My suggestions for improving connectivity in Salem mainly relate to their public transportation, the Cherriots Core Network. Though the existing bus routes do cover a decent amount of the city, especially central Salem, it is lacking in other areas. One area of interest for potentially developing better public transportation would be the more suburban neighborhoods, such as the Northgate neighborhood. This location has a relatively high population and is already connected to the Cherriots Core Network, but it lacks high density of businesses or public facilities. Improving the bus network in highly populated neighborhoods like this could make a significant decrease in car-dependency of people living in those areas. More frequent bus schedules and strategically located stops in walkable areas with high business and public facility density would increase overall walkability.

For Salem as a whole, the bus stops themselves could also be improved in several ways. When looking at Google StreetViews of several locations along the bus network, many bus stops were only marked by a single signpost. Without cover from the rain or seating, it makes using public transit difficult or impossible for people, especially those with mobility issues who may not be able to stand for 30 minutes to wait for a bus to come. Adding shelter and seating to more bus stops could help. Also, it seemed that many stops did not have adequate lighting, so adding that to the stops (or by locating the stops closer to already implemented streetlamps) could improve feelings of safety at the stops.

Understandably, it would cost a lot of money to build even small, covered seating areas for all bus stops, so certain areas may be prioritized over others. Prioritizing the implementation of these improvements to bus stops located in areas with higher average population age could be beneficial. People above retirement age are more likely to have mobility issues and may not be able to drive. By making the public transit network more accessible, it can help people get from residential areas to more highly walkable areas with high density of both necessary and recreational facilities. This would help improve both the residents' health and also likely help stimulate the economy by making it easier for people to get to those more commercial and business-dense places.

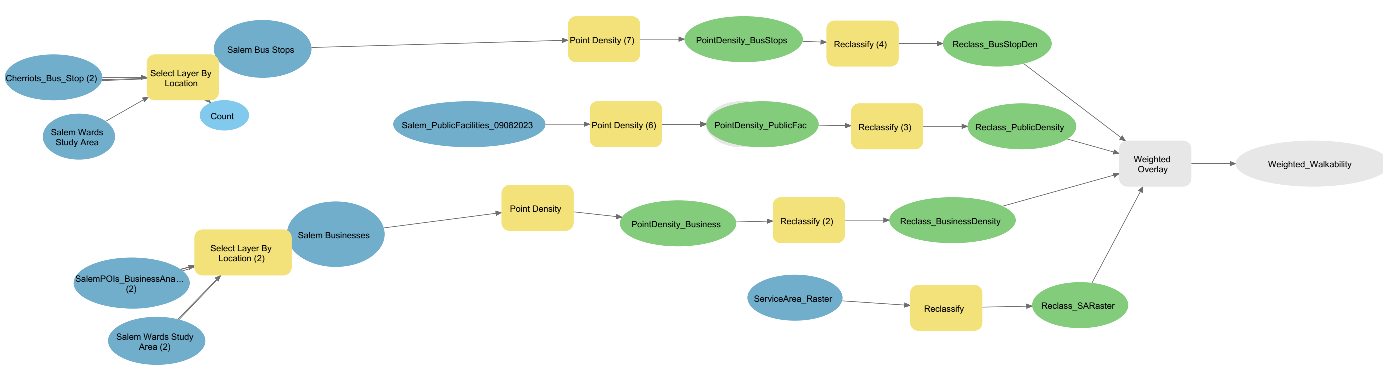
Methods

In ArcGIS, most of the data used came from the US Census or from the City of Salem. I used density analysis to identify regions with higher and lower density for public facilities, businesses, and bus stops. Creating a service area layer also helped visualize which areas of Salem were actually within reasonable walking distance to bus stops and which were not. The

Cherriots Core Network route was included in the final map so that a clear pattern between increased bus access and walkable areas could be seen. The final map was created by using a weighted overlay and took the above data into consideration for judging walkability.

Looking at many locations in Google StreetView also helped get more specific information about what these places look like in real life. While in ArcGIS it looks like there are lots of bus stops throughout the city, not all were made equal, which can be seen from actual photos in Google. Many bus stops were bare, only marked by a sign, with no cover, no seating, and sometimes even no nearby lighting. Some places had overgrown or cracked sidewalks. So, using both a combination of the analysis in ArcGIS and the images from Google were helpful in guiding the above recommendations.

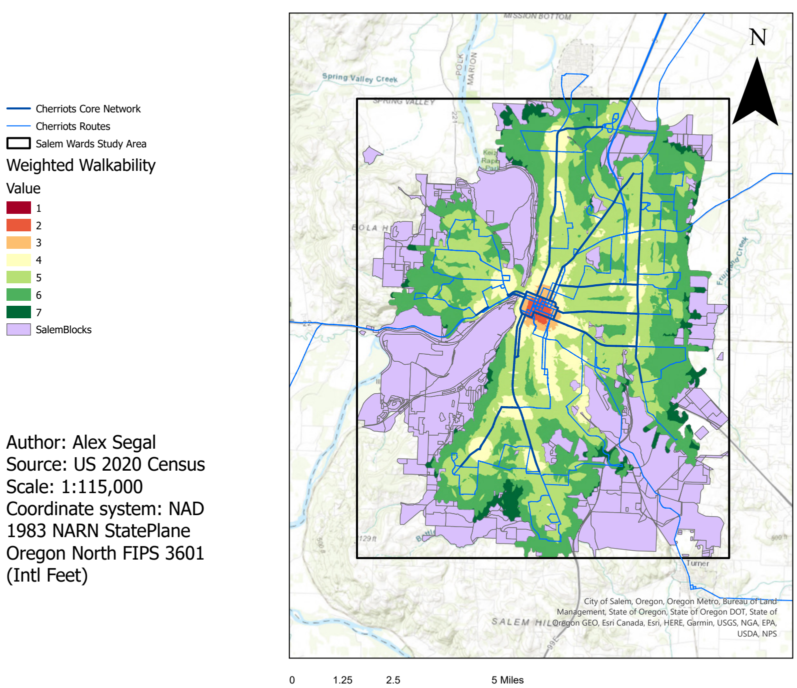
Below is a ModelBuilder which shows an overview of the analyses involved in creating the walkability map. The creation of the service area was not able to be shown in the model builder, but a service area was also created with cutoffs at 5-, 10-, and 15-minutes walking distance from the bus stops in Salem. Areas that take longer than that to walk to are not included in the final map.



Supporting Maps and Graphics

The final Salem Walkability Map (see below) considered density of bus stops, density of public facilities, density of businesses, and distance from bus stops (service area). The weighting for the walkability overlay was 20% service area, 25% business density, 25% public facility density, and 30% bus stop density. The general trend of walkability is that areas in the city center and along the bus network are more walkable, and the further out you go, the less walkable it is. Areas in western Salem and in southeast Salem were the least walkable, with limited access to bus routes and lack of high-density amenities.

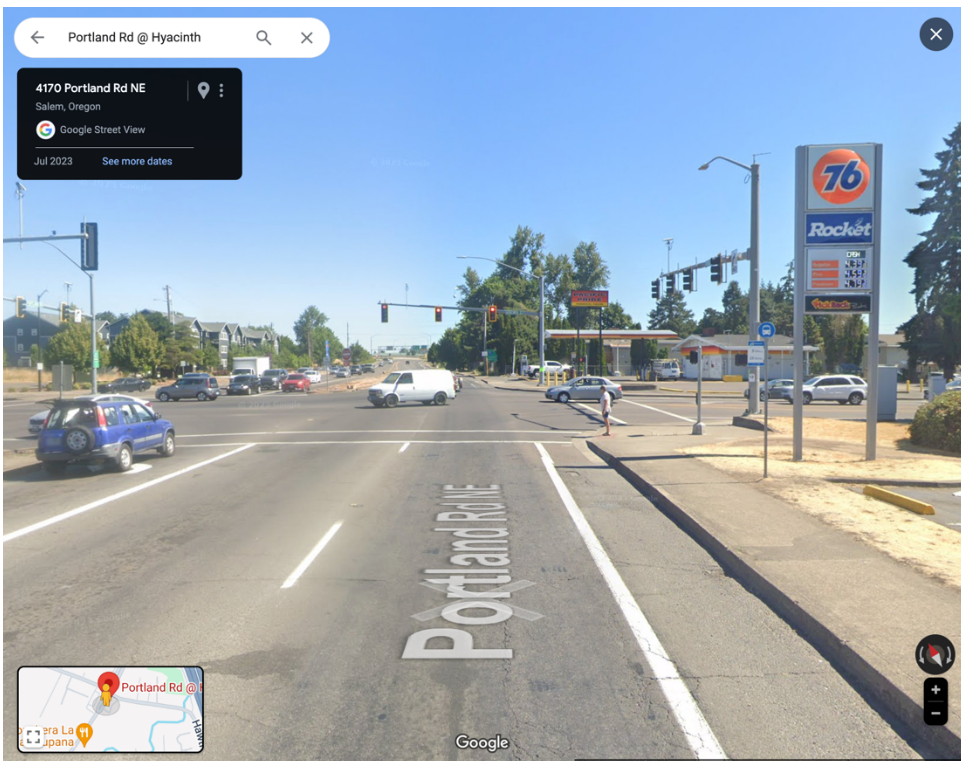
Salem Walkability Map



Author: Alex Segal
Source: US 2020 Census
Scale: 1:115,000
Coordinate system: NAD 1983 NARN StatePlane Oregon North FIPS 3601 (Intl Feet)

The map shows walkability and bus routes in Salem, Oregon. Areas of higher walkability are in red and areas of lower walkability are in dark green. Factors that contributed to the weighted overlay included service areas of the bus routes, business density, public facility density, and bus stop density. The blocks shown are only those which are entirely within the Salem Wards Study Area. Locations which are not colored by the weighted walkability were outside the parameters (either not entirely within the Study Area, or not deemed walkable).

The Google StreetView below (https://maps.app.goo.gl/XzQcst6wu881PVbG8) shows a bus stop along the Cherriots Core Network in the Northgate neighborhood. It demonstrates how, though there is a bus stop, this area is clearly made for cars. This is the type of location that the suggestions listed earlier would apply to. The bus stop could be improved by adding a small, covered seating area.



Future Directions and Improvements

Though the suggestions outlined above recommend focusing on areas with higher average population for places to improve bus stops, the analysis done for this project and the resulting map did not include data relating to demographics like age. This data should be added to a future map, so that regions with a high density of older residents can be clearly seen. Once that information is added, Salem can figure out where to direct funding to improve the bus stops in places where it will make the biggest difference in helping improve connectivity.

Citations

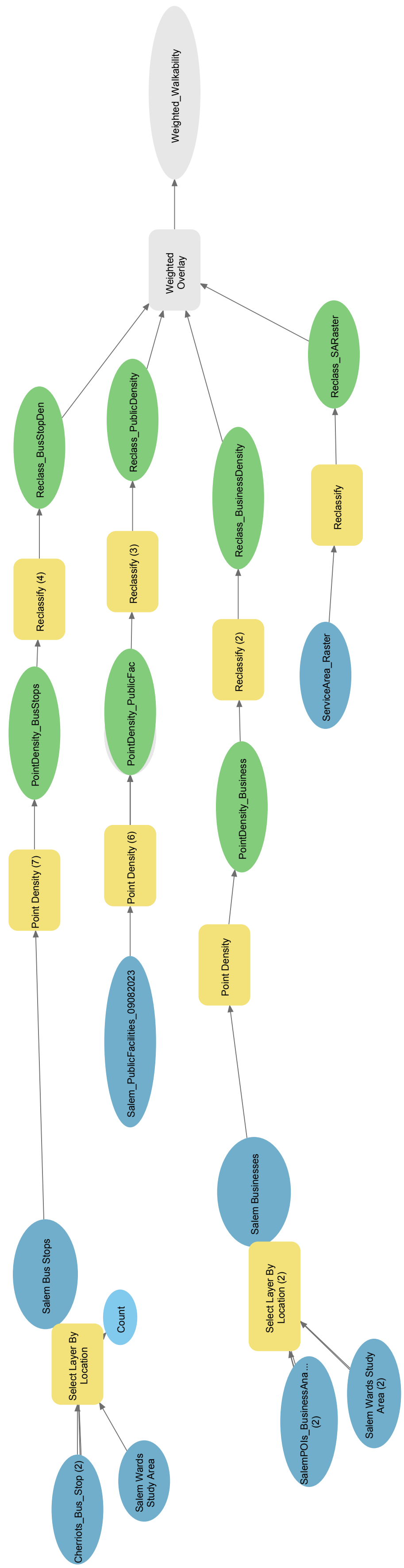
D'Orso, Gabriele, and Marco Migliore. 2020. "A GIS-Based Method for Evaluating the Walkability of a Pedestrian Environment and Prioritised Investments." Journal of Transport Geography 82 (January): 102555. https://doi.org/10.1016/j.jtrangeo.2019.102555

Kerski, Joseph. "Walkability." ArcGIS StoryMaps, Esri, 29 Aug. 2022, storymaps.arcgis.com/stories/1e4847f78ec94fd89e960adfabb5ac5c

Office of the Surgeon General. "Surgeon General Strategies for Making Communities More Walkable." *HHS.Gov*, 12 Mar. 2021, www.hhs.gov/surgeongeneral/reports-and-publications/physical-activity-nutrition/walking-sectors/index.html

Data Layers and Symbology

The data layers associated with this project are saved in my R:drive. The layer package includes the Cherriots Core Network, Salem study area, weighted walkability, public facility point density, bus stop point density, and business point density layers. To find them, go to the Student_Data folder, asegal2 folder, then FinalProject folder. The layer folder is named SegalWalkability_Layer.lpkx. The ArcPro project is also in the FinalProject folder, and is named walkabilitytryagain.aprx. I was getting a “failed to open map view” error on my original ArcPro file, so I had to add the shapefiles/rasters to a new project, so that is why it is named that way and has slightly different layers than the map I added to the graphics above.



Weighted_Walkability
Weighted Overlay
Reclass_BusStopDen
Reclass_PublicDensity
Reclass_BusinessDensity
Reclass_SARaster
Reclassify (4)
Reclassify (3)
Reclassify (2)
Reclassify
PointDensity_BusStops
PointDensity_PublicFac
PointDensity_Business
ServiceArea_Raster
Point Density (7)
Point Density (6)
Point Density
Salem_PublicFacilities_09082023
Salem Businesses
Salem Bus Stops
Count
Select Layer By Location
Select Layer By Location (2)
Cherriots_Bus_Stop (2)
Salem Wards Study Area
SalemPOIs_BusinessAna... (2)
Salem Wards Study Area (2)

Chris Sterner
3/20/24
Geography 482
Final Project

Introduction:

My project is focused on designing and maintaining sidewalks and crosswalks for the use of transportation. I was in the equity focus group and seeked to focus on walkability within census tracts that had a median income below the median for the city as a whole. My goal is to focus on the walkability, and use of public transit to get from areas of lower income housing to grocery stores and parks. I hoped to access the challenges that residents who do not have access to a personal vehicle face in accessing groceries and public parks.

My primary motivation for the target of this project was drawn from personal experience. I have lived in places where I could easily walk to a grocery store, bus stop to get to and from work, and access public lands for recreation. At one point my vehicle broke down, and I could not afford to fix it. It was only a minor inconvenience, I was still able to carry on with life and slowly save enough to get it fixed. In another situation with less walkability, and no public transit access, getting groceries was the hardest and most physically taxing part of my week despite being only a mile from the nearest store, and being in peak physical fitness. Grocery shopping so at night was a high risk activity due to traffic and lighting. I recognized if I got injured or sick while in this living situation I would become reliant upon assistance from others.

Lower income neighborhoods often face higher rates of obesity and other health issues as well as more limited walkability and park access (Melillo, 2022). By encouraging and enabling walkability, and improved access to parks and sources of healthy food, we have the potential to make a huge difference in quality of life for marginalized groups. Obesity and diabetes are the number one driver of healthcare costs. Improving walkability in vulnerable populations should be viewed as an investment, rather than a cost.

Recommendations:

At the intersection of Silverton ave and Lansing ave an example of great walkability exists. Multi- Family housing units, complete sidewalk network, greenspace, bus stops, a metered crosswalk, and close proximity to a major grocery store. To me this is a depiction of the level of walkability that would make a major difference in quality of life for someone with limited income, or mobility.

Just across the street from this location on 30th Ave is an example of poor walkability: the sidewalk is fragmented, and side of street parking would force those walking into the roadway. This would be an impactful area for sidewalk improvement as it would be the primary walking route to the grocery store for a dense area of housing. Connecting existing sidewalks along this street could go a long way in providing easy access to groceries especially for those with impaired mobility.

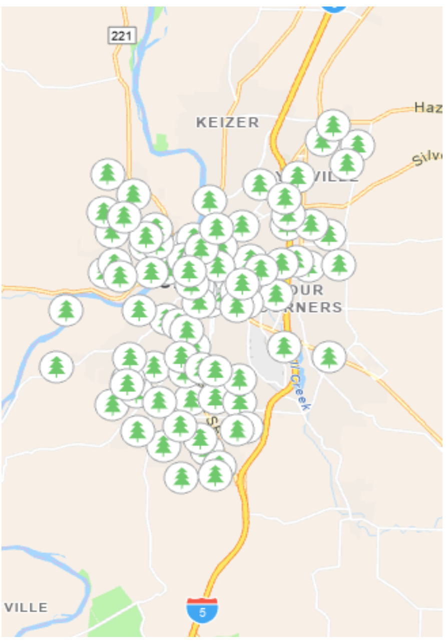
Another area of recommendation is the improvement of walking access to city parks. The vehicle routes and parking areas are well developed for both cars and pedestrians.

However many of the alternative access points are less than inviting and do not encourage park walkability for nearby residences. Many access points have abundant signage and barricades to keep vehicles out at these locations, but no signage or basic infrastructure to invite pedestrians in. Improving these access points could be a low cost solution that would increase pedestrian access to parks, and contribute to the neighborhood community atmosphere.

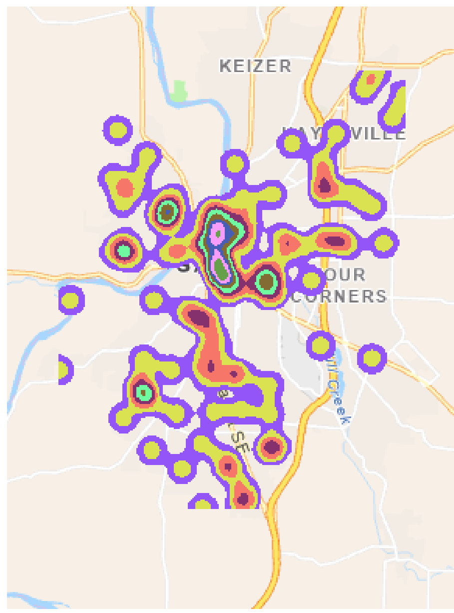
Methods:

A majority of the data that went into my weighted overlay analysis was drawn directly from the provided data sets. I used the park boundaries from lab 2 with a feature to point, to get park points. I used a point density analysis to rasterize both the park points, and the cherriots core bus stops with the settings of a 100ft output cell and a 3000ft search radius. The resulting submodels were reclassified to 10 classes using natural breaks.

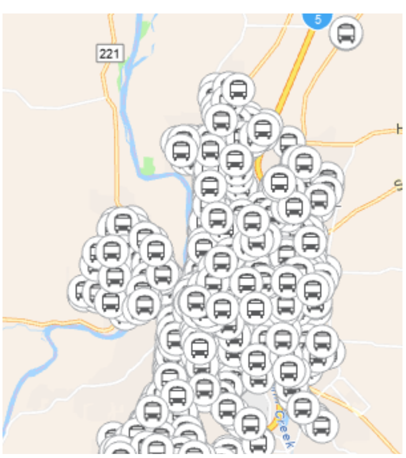
Park Point Input



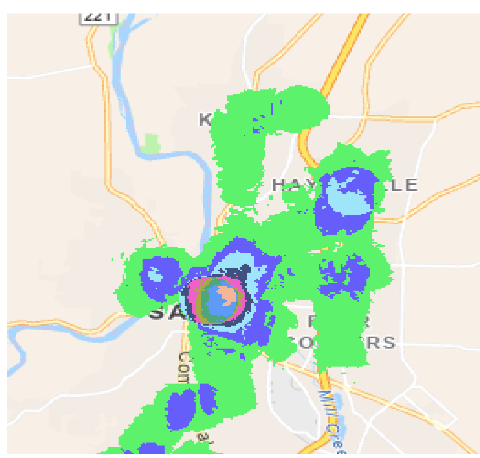
Parks Submodel



Cherriots Core Bus Stop Points

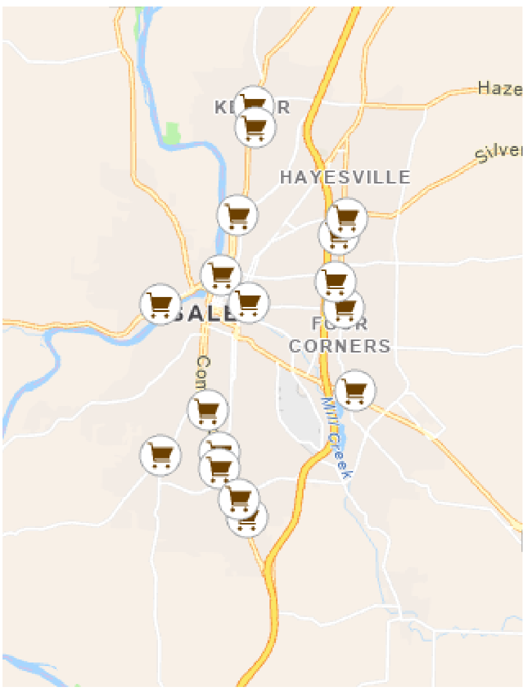


Bus Stop Submodel

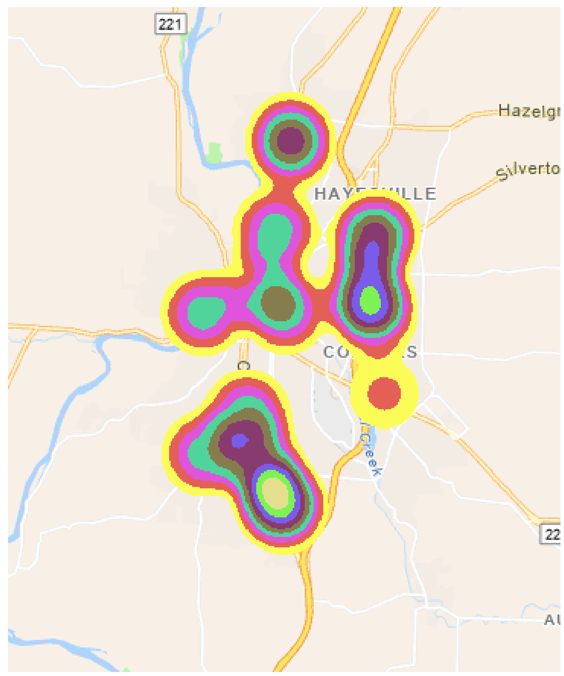


To find grocery stores I used the Business POI data set and selected by attribute "contains the text" with the names of all major grocery store locations in Salem that I identified with a quick google search. I excluded high end grocery stores like whole foods due to the equity focus area of my project. I then rasterized the resulting grocery store point locations with a kernel density with the 100ft output cell and a 3000ft search radius settings. I chose to use a kernel density in order to "smooth out" the results in this relatively small data set of 28 objects. The resulting submodel was reclassified to 10 classes using natural breaks.

Grocery Point Input Layer

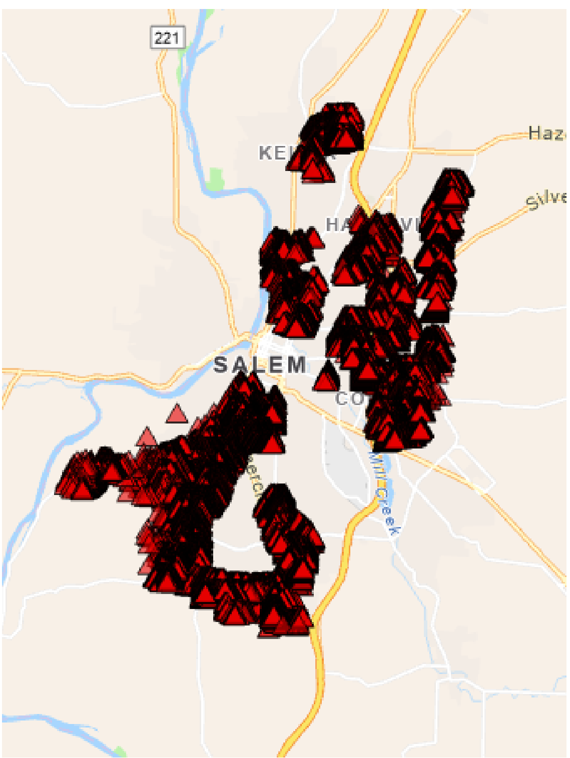


Grocery Store Submodel

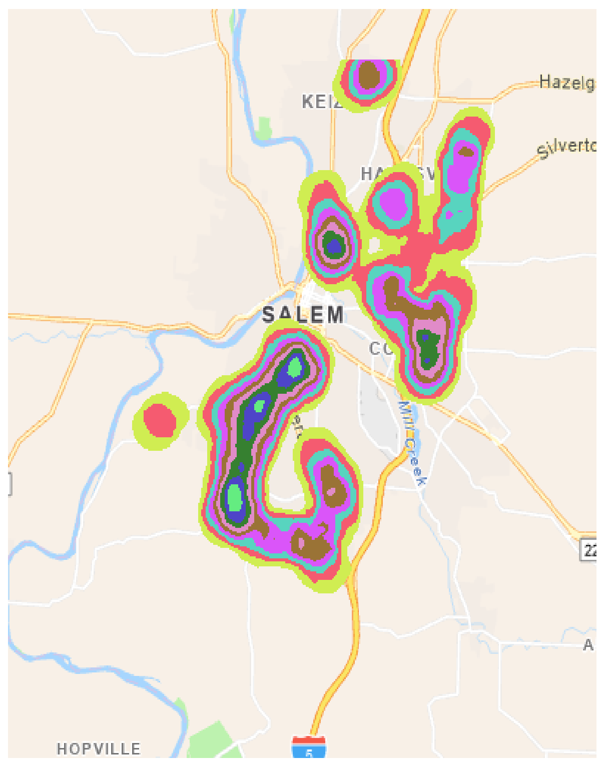


The final submodel of residential unit density was the most complex. I began with the parcel tax lot dataset from lab 2 selecting out all of the objects that had a zoning classification that included the text “RF” residential single family, “RM” residential multi family, and “RA” residential agricultural. There were many instances where there were multiple classifications for the same parcel so any address that could be residential was included. One discrepancy with this data was that the entire area west of the Willamette River had null values for zoning classification, which meant they were excluded from the data set. My focus was on the eastern areas of the city that contained neighborhoods with lower equity scores so I ignored this and proceeded. I then used a spatial join with ACS census tract level data to associate housing units with a tract resolution generalized income level. I then selected by attribute all of the residential units that were within census tracts that had a lower than median income of $67,540 for the whole of Salem (U.S. Census, 2022). I then performed a point density analysis from the resulting points with the settings 100ft output cell and a 3000ft search radius. The resulting submodel was reclassified to 10 classes using natural breaks.

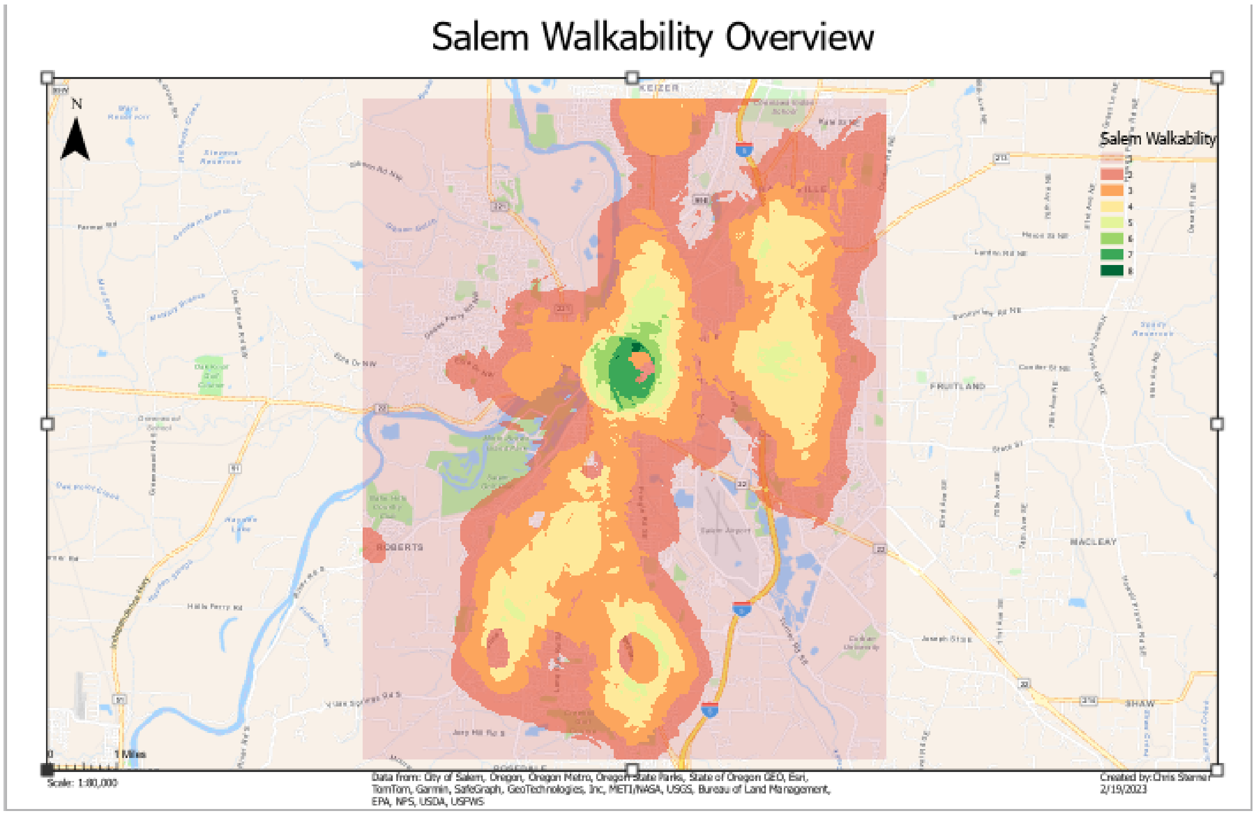
Residential Point Input Layer



Residential Submodel

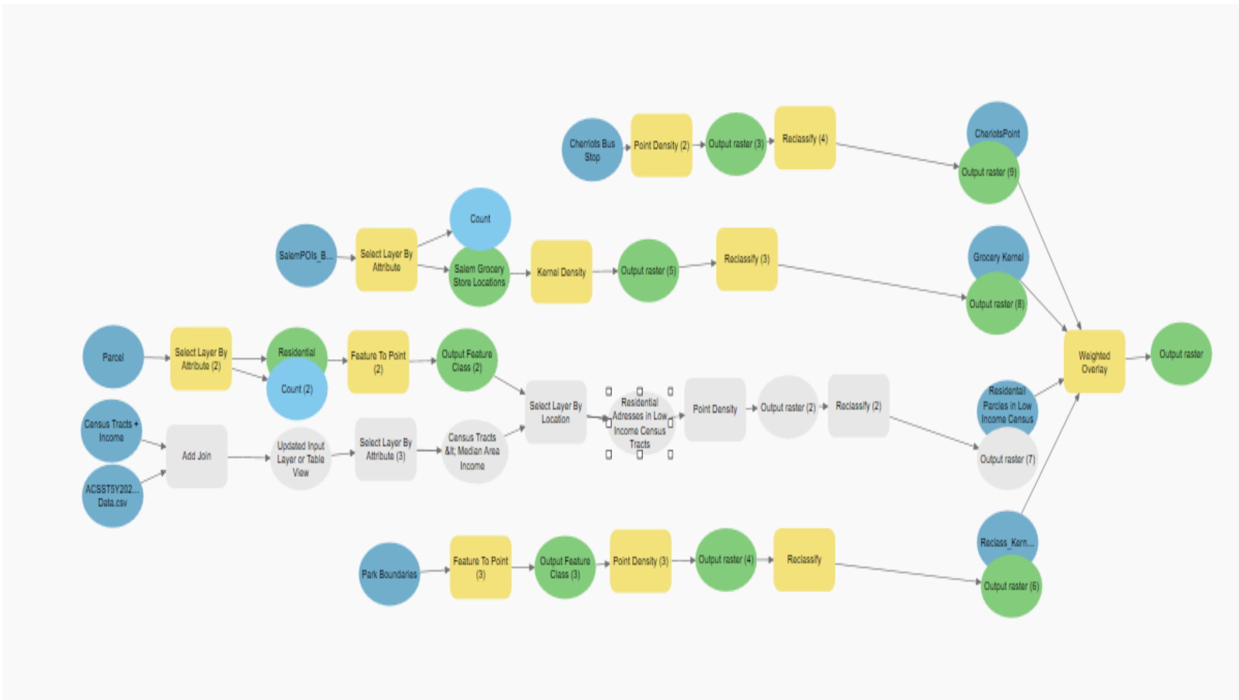


My weighted overlay was created by assigning Cherriots Bus Stop Submodel (50%), Parks Point Submodel (10%), Grocery Locations Submodel (20%), and the Residential Parcels in below median income Census Tracts Origin Submodel (20%). I placed an extremely high weight upon bus stops due to the expanded walkable access that public transit can provide to those without personal vehicles. I did not find the resulting model especially helpful in providing suggestions but rather used it, the submodels, and point data to identify areas to take a deeper look at on google street view which is where my recommendations are drawn from.



Green areas represent areas of high walkability within my model, while the transparent pink and red represent areas of low walkability, yellow represents areas of moderate walkability. .

Model Builder Workflow Overview:



Future Developments:

I went into the project thinking that a continuous raster surface was the goal, while in hindsight continuity was much less important than detail for walkability GIS analysis. In order to improve this aspect of the project and make the model outputs more useful I would firstly use a higher resolution of the output cell, as well as a smaller search radius (ESRI, n.d.).

Another issue that came up while taking a deeper look at the residential and grocery store point data inputs was incompleteness of the data sets. For the residential data it would probably be more useful to have used LODES data rather than the complicated multi step process I used for the parcels, the primary issue was parcels that had multiple zoning classifications, and a large area of West Salem had null values for zoning. For the grocery stores I overlooked several of the smaller full service community grocery stores while selecting them out by name which certainly skewed the output results. Acquiring straightforward point datasets from trusted sources like the City of Salem would have been a better approach than the multi-step processes I used for the residential and grocery store input points. This would leave less margin of error and more conclusive and trustworthy model results.

A final component that would have been useful to include in my analysis would have been employment accessibility. I overlooked this important aspect in developing my model however I recognize that this is a significant factor in walkability. In summary this quote sums up walkability design best, “Well-communicated streets are those whose network is connected with the so-called “key attractors”, such as working place, home, recreation area or public transport” (Telega .et al, 2021).

A full list of data and layers used for this project is located at:

R:\GEOG482_582_22260_Winter2024\Student_Data\csterner\Final Project

Bibliography:

ESRI. (n.d.). *Differences between point, line, and kernel density*. Differences between point, line, and kernel density-ArcGIS Pro | Documentation. https://pro.arcgis.com/en/pro-app/latest/tool-reference/spatial-analyst/differences-between-point-line-and-kernel-density.htm

Melillo, G. (2022, March 22). *Walkability and redlining: How built environments impact health and perpetuate disparities*. AJMC. https://www.ajmc.com/view/walkability-redlining-how-built-environments-impact-health-and-perpetuate-disparities

U.S. Census Bureau quickfacts: Salem City, Oregon. U.S. Census Bureau. (2022). https://www.census.gov/quickfacts/fact/table/salemcityoregon/PST045222

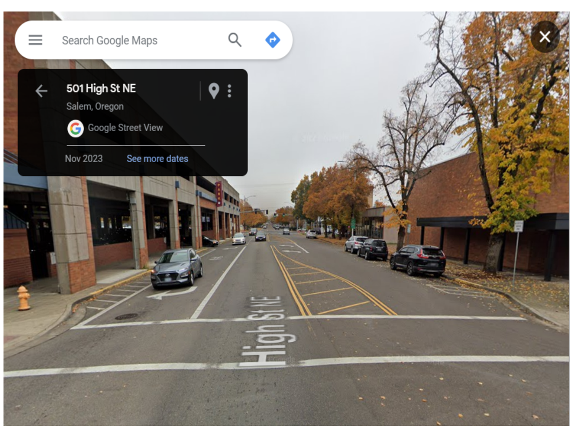
Telega, A., Telega, I., & Bieda, A. (2021, February 9). *Measuring walkability with GIS-methods overview and new approach proposal*. MDPI. https://www.mdpi.com/2071-1050/13/4/1883

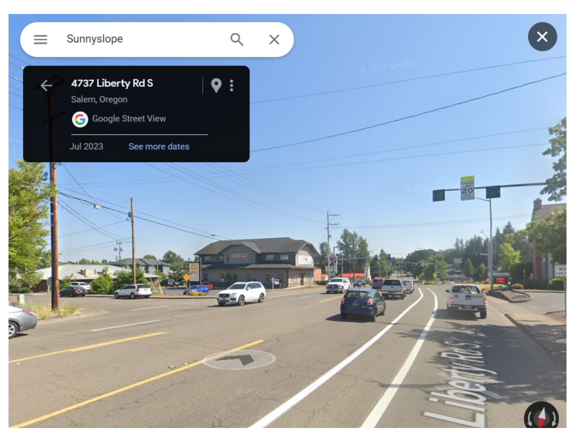
The goal of this project was to try and look at places in Salem, Oregon, that could potentially be improved upon to increase the city's walkability. This was done by using Salem city data in ArcGIS to do analysis on the area to find what spots needed the most improvement. I then came up with some recommendations to give the workers in the city offices on ways to potentially increase walkability in the city of salem.

My first recommendation to improve walkability would be to add crosswalks to the more residential neighborhoods, such as Sunnyslope, to try and get the same level of walkability as we see in more dense neighborhoods, such as the Central Area. As you can see in the images the central area has more crosswalks and sidewalks, whereas in the Sunny slope image we see a complete lack of crosswalks and very small sidewalks. One of the articles given as a class resource that was written by Aateka Shashank and Nadine Schuurman talks about how allocating resources to these less developed areas can address many disparities in infrastructure provision. There's also a lack of traffic-calming measures seen in the images. Implementing things like speed bumps and roundabouts are another good way to promote and enhance pedestrian safety, which in turn would encourage walking.

Another recommendation I would make is to try and implement more commercial amenities in the less dense neighborhoods to promote walking. When communities are integrated residentially, commercially, and recreationally, it allows for the residents to access these amenities by foot, which then reduces the reliance on cars. We also see this highlighted in the Shashank and Schuurman article when they mention the importance of land use diversity in enhancing walkability

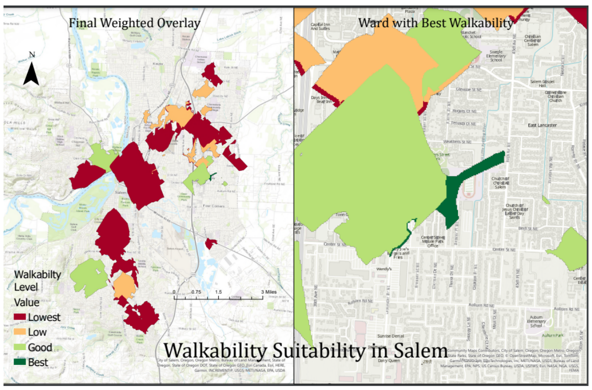
To get these recommendations I looked at a section of the Cherriots Core network that runs through the Central Area, South Central, Morningside, Faye Wright, and Sunnyslope neighborhoods in Southwest Salem. Based on the walk score table we were given, as well as my results from Lab 3, we know that the Central and South Central neighborhoods, seen on the right, have some of the highest walkability in the city , so to improve the other neighborhoods we can look to them to see what improvements could be made. The Morningside and Faye Wright

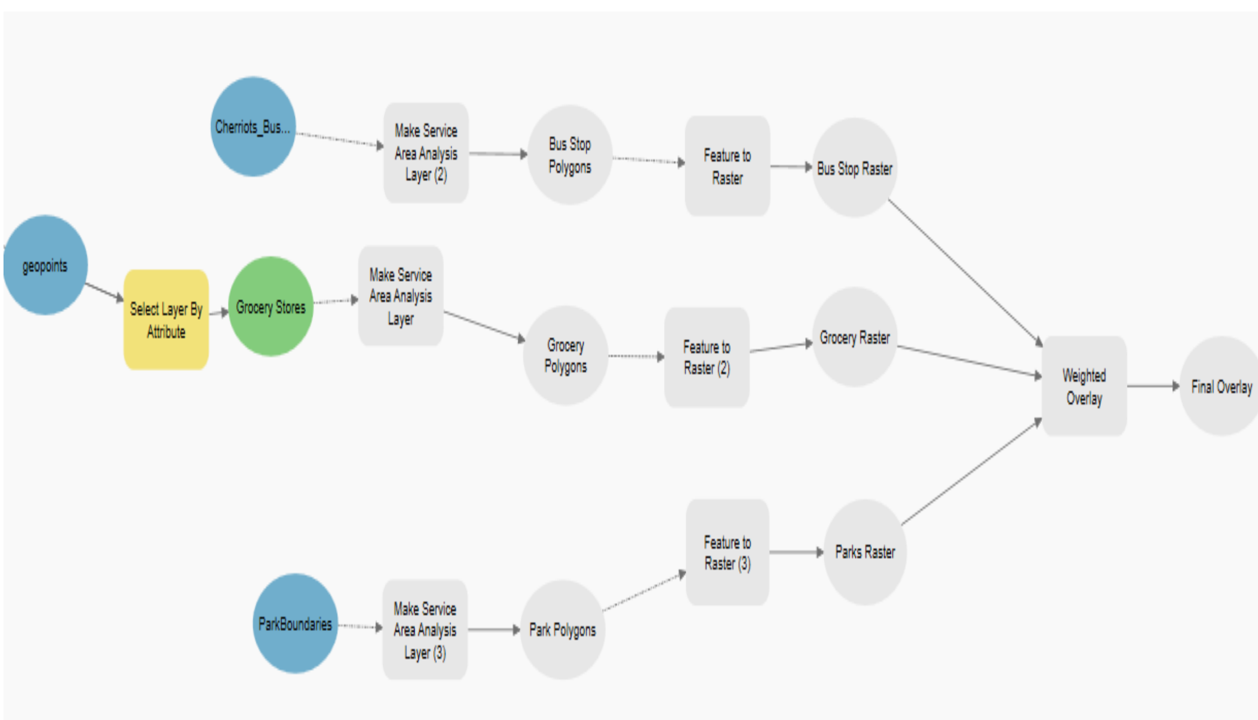




neighborhoods are more central in the table so they have a more average walk score, however the Sunnyslope neighborhood mentioned before, to the left, is at the bottom of the list so that's where walkability needs to improve the most. When looking at the chart, it seems as though the walk scores go up as you get more central into Salem which could be due to more infrastructure being put into the downtown area, making it easier to commute and travel by foot around there. Then as you move away from the center of town we see walk scores start to decrease, due to less infrastructure being put into these more residential neighborhoods. We also see more condensed amenities, such as restaurants and retail shops in the central area, which leads to a higher walk-score as well.

I also used my work in Lab 3 to try and find the areas that needed the most improvements. After creating sub-models to measure walking distance to and from bus stops, parks, and grocery stores, I compiled them all together in order to get a final weighted overlay, seen on the right. There are four levels to the walkability in this overlay ranging from Lowest to Best. The dark green area, which is shown in the overlay, has the best walkability that corresponds to bus stops, parks, and grocery stores in the study area. The lighter green areas represent good walkability, the orange represents low walkability, and the red shows the areas that have the lowest walkability. I focused on these red areas as they are in the most need of improvements. It looks as though the areas with the worst level of walkability are also the least developed areas, with the areas with high walkability being more central close to downtown and some schools. Blow is a model builder showing the exact steps I took in making my final overlay.





If I were to make any future improvements upon my project I would definitely use more data sets looking at how amenities are for bus routes/stations, things like crosswalks or street lights for pedestrian safety. I'd probably also try and make different submodels that are a little more coherent to try and have a better looking overlay that also details the information I want it to.

Citations:

- Shashank, Aateka, and Nadine Schuurman. 2019. "Unpacking Walkability Indices and Their Inherent Assumptions." *Health & Place* 55 (January): 145-54. https://doi.org/10.1016/j.healthplace.2018.12.005
- Google Street View
- ArcGIS Pro
- Class Salem Data

My data layer packages are located in my student folder in another folder titled FinalProject. It contains all my final layers. The title of the projects I was using were Lab3_Sterner and Sterner_Lab4.

Walkability in Salem Oregon

Report Written by University of Oregon Student Sam Tyler for City of Salem Planners

March 2024

Salem Won't be Truly Walkable, Until All Components of Walkability are Addressed

The purpose of this project is to address walkability in Salem with a focus on the Cherriot Bus Network. The frequency of Bus Network arriving at bus stops would drastically increase the ridership across Salem. However, if the area around the stop isn't easily accessible to pedestrians, then the increased investment in the Cherriot Network will significantly impact Walkability in Salem.[1]

Goals & how they will be accomplished

The main goal of this project will be to bridge the gap between the Salem Cherriot Bus System and true walkability in Salem. This can be done through a variety of ways, the ones I will be focusing on in this project are:

- Looking directly at areas surrounding Cherriot Bus Stops to identify specific challenges
- Working to increase walkability in areas directly surrounding Cherriot Bus Stops
- Adding additional stops or increasing frequency of bus per route in low coverage areas

A secondary goal of this project is too increase access to schools. Not only is this a population that mostly doesn't have access to cars, but giving young students access to a robust bus routes and pleasant walkable streets will train them to covet this in the future which will help further transition Salem into a walkable city.

A tertiary goal of this project is to connect Salem to it's parks, similarly to the dilemma of increasing Bus Route frequency without increasing walkability, the parks aren't going to be frequented without increasing walkability surrounding the parks.

[1] Walker, Jarrett. "The Transit Ridership Recipe — Human Transit." *Human Transit*, https://humantransit.org/basics/the-transit-ridership-recipe#ridershipcoveragetradeoff. Accessed 21 March 2024.

Summary of Recommendations

I will make recommendations for 3 areas of Salem, the first is Lancaster Drive, the second is Sprague High School, and lastly, I will be looking at Wendy Kroger Park. For Lancaster Drive, I will be specifically focusing on increasing walkability emanating out from a Bus Stop located in front of a Fred Meyers. That is one of the only grocery stores in the area, so improving walkability by decreasing lane width and adding signalized crosswalks, protected bike lanes, and shading and separating the sidewalk and Bus Stop with trees are the main focuses.

Moving onto Sprague High School is an area of focus due to the vulnerable population of students it serves. Given that a lot of these kids can't drive, connectivity needs to be improved. In addition to adding a two-way bike lane going into the school and widening the sidewalk on Kuebler Blvd. Bus routes should be expanded to cover more of the student neighborhood, as well as increasing the frequency of the route that is already servicing the school.

Lastly, Wendy Kroger Park is a stand-in for parks across Salem, in addition to the walkability-increasing measures I have already mentioned, many of Salem's parks could be turned into greenways. A lot of them occur in residential areas, and making the walk up to them pedestrian-oriented would do wonders to increase their walkability, where this isn't applicable the traditional walkability increase that I've already mentioned should be implemented.

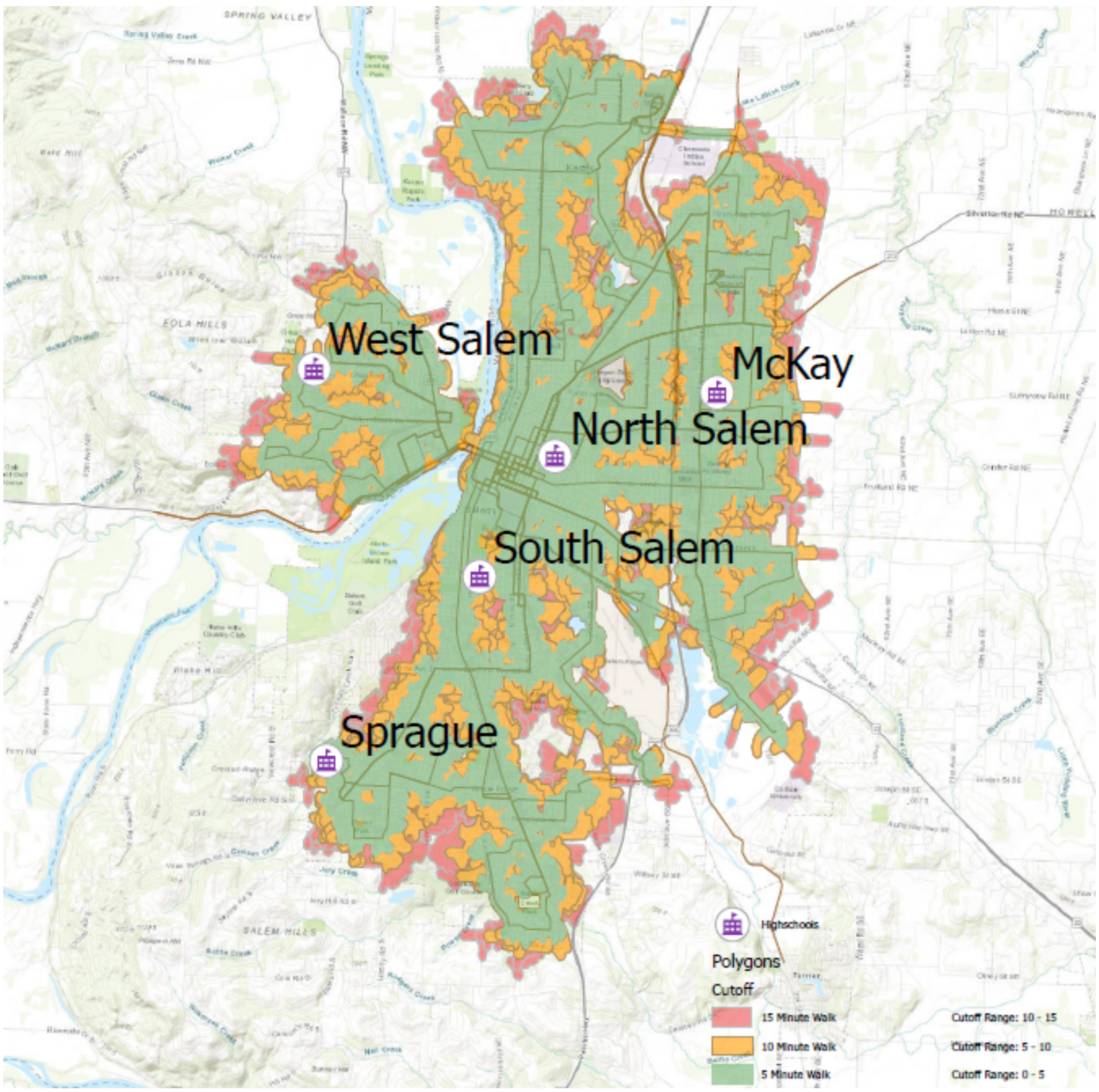
Looking at 3 Areas and Aspects of Walkability

When looking at a service area analysis of bus stop coverage in Salem, you might get the idea that a majority of the city is covered by the Bus Network. Looking at Figure 1, you can see that in the areas of Salem specifically targeted by the Bus Network, there is pretty good coverage. Green is the dominant color of the Service Area with mostly the outskirts of the Bus Network having a 15-minute walking distance to a stop. On the surface, Salem appears to have a robust network. However, as discussed in the introduction, you could have the most robust Bus Network in the world, and if the area surrounding the Bus Stops isn't walkable people won't use the Bus Network.

Methods for Figure 1

I created this Serivce Area by selecting for a 5,10,15 walk away from each bus stop across Salem. Meaning all you need is the bus stops to replicate this figure

Figure 1: Basic Service Area Analysis of the Stops



I included the schools in this image both as a grounding factor to make the map location more identifiable, and because schools are going to be the focus of my analysis later in this section. A lot of the parks were also left without analysis in part because they don't have stops inside of their boundaries, but also because I'm going to talk about access to parks throughout this paper.

Lancaster Dr Bus Stop & the lack of Connectivity Surrounding it

Figure 2: Lancaster Drive NE: Taken in June of 2023: https://maps.app.goo.gl/H9Pf4Dh26aNJCNby5

Taking in Figure 2 it is important to note that there is a Bus Stop down the street on the right side of the road. Some additional context is that Fred Meyers is one of the lone big grocery stores in the surrounding area, so pedestrians and Bus users will congregate at this grocery store specifically. Additionally, this road resides in the green zone of Figure 1, and as we can see, this place is not very walkable.[2]

My first In this area, I would like to improve the connectivity through several steps: First I would continue the sidewalk across the extremely wide entrances to stores, they appear to be designed to make drivers wait in the area for the sidewalk. Adding a raised sidewalk across the gap would signify to drivers that they shouldn't wait to turn in that area, and will offer a little more protection to pedestrians. Next, I would shrink the size of the lanes, this will calm the speed of the drivers on the road making it safer to walk along. While also providing room for an expanded bike lane on either side of the road with room for raised protective buffers between the bike lane and the car lanes. These buffers could be flower beds or areas for trees to go which would improve the beauty and air quality of the area. This combined with the increase in safety will make people more likely to choose to walk on the street instead of driving. Lastly, I would add signalized crosswalks with islands located in the center turn lane. The islands could be placed away from the entrances to various businesses, allowing people to safely cross the 5 lanes of traffic without disrupting the center turn lane. The changes recommended for this specific area could be modified to work for locations across all of Salem. I intend to look further into areas near the high schools as well as public parks. These changes prioritize walk and bike-ability over car-centric thinking by increasing the safety and comfort of pedestrians, which will pave the way for a more connected Salem.

Future Directions and Improvements

Another possibility would be to implement an EMX-style bus lane in the middle of the street which decreases the street space but could be integrated into our crosswalk islands in the middle of the street. This would also allow for the protected bike lane to be less interrupted since it wouldn't have to make breaks for the bus stops. I recognize how unfeasible this suggestion is, but I thought it would be important to strive for even more investment. I think the future Salem could have EMX-style routes across all of Salem, and advocating for it right now would be a good step to get the ball rolling.

Here is a look at what this newly imagined street would look like, minus the crosswalks as the simulation doesn't have that capability.

[2] Kerski, Joseph. "Walkability." *ArcGIS StoryMaps*, 29 August 2022, https://storymaps.arcgis.com/stories/1e4847f78ec94fd89e960adfabb5ac5c. Accessed 14 February 2024.

Figure 3: Streetview of Lancaster Dr.[3]

Just from comparing Figures 2 and 3, we can see that Figure 3 looks a lot more pleasant for the non-cargoers. The protective flower beds provide a great barrier for cyclists, and the trees not only separate the sidewalk and bus stop from the street even further but also make it more pleasant to walk on.

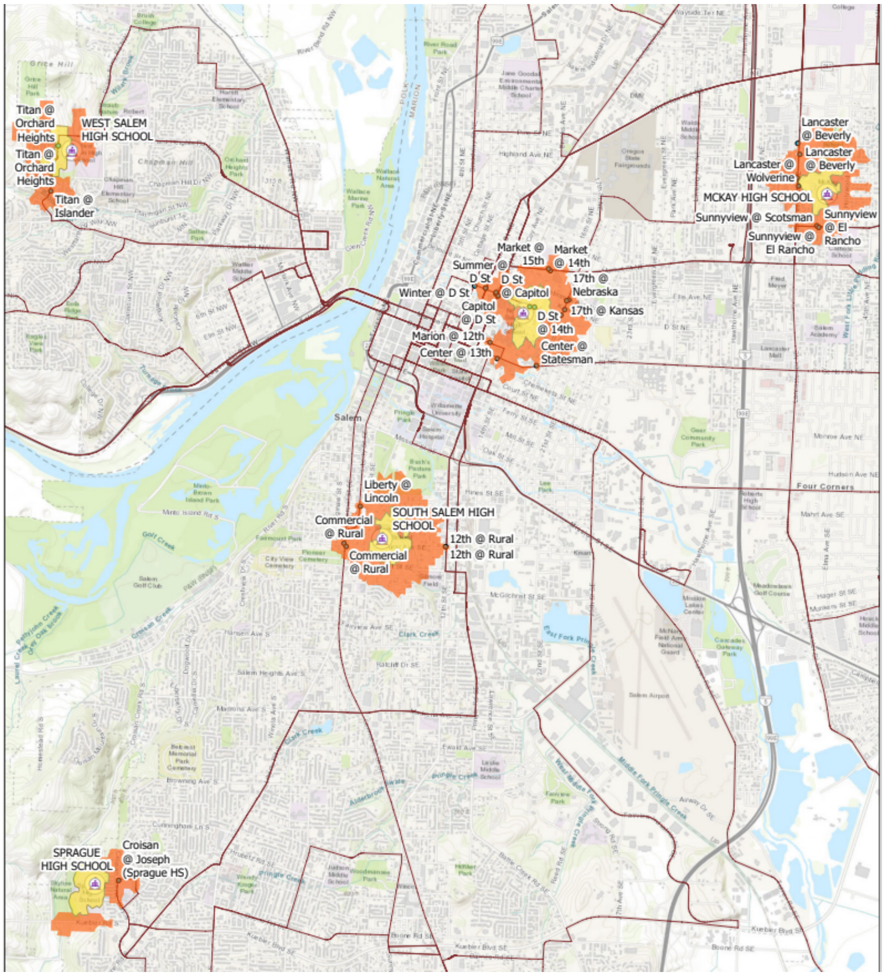
Sprague High School's Lack of Bus Access

Method of Figure 4:

In order to replicate Figure 4 you'll need to have a Bus Lines, Bus Stops, and Highschool data layer. Then do a Service Area Analysis of the High schools, those are your facilities. Make sure to ask to do a 5, and 10-minute service area.

[3] Streetmix, https://streetmix.net/-/2473886. Accessed 12 March 2024.

Figure 4



As you can see Sprague High School has some of the worst op-----tions for using the bus of all the High Schools in Salem. All the other schools have many options for riding the bus, meanwhile, Sprague has a single option within a 10-minute walk of the schools. Additionally, that bus only comes once an hour[4] I recommend increasing the frequency of this single stop to come every 15 minutes from 6-10am & from 2-5. To catch any students with non-traditional schedules. Further coordination could be done with Sprague high school to see if they have an A-B schedule style. Based off the single bus route I would assume that Spraque is super walkable or open to bikes, however this is not the case.

[4] https://www.cherriots.org/route/8/

Figure 5: Sprague High School on Kuebler Blvd
https://maps.app.goo.gl/qtX8JGNU6zYp4bYe8

Analyzing this image there are some glaring issues with Walkabilty to Sprague, the school is behind the sign and the entrance is that right turn at the light. The first danger to cyclists I see is the right turn into the school and pushes the bike lane in between the turn lane and the other lanes of the road. This is a danger to cyclists as drivers might attempt to get into the turn lane without looking to see if a cyclist is occupying the bike lane. Additionally, the bike lane disappears when turning into the school, forcing cyclists to contend with morning drop-off which can't be productive, or onto the small and presumably crowded morning sidewalk. Speaking of the sidewalk, they're very small especially when compared to this extremely wide 3-4 lane road.

I recommend decreasing the size of the roads, firstly to calm traffic and secondly to make room for further pedestrian oriented development. I would increase the width of the sidewalk dramatically, the current one are incredibly small and doesn't look very inviting especially when paired with the large roads, I want to protect and move the bike lane. First of all, I want to get rid of the bike lane on the left side of the image in favor of having a double lane on the right side. However, that turn lane into the school has got to be moved so as to not have it cross the bike lane until the actual turn itself, otherwise, the Bike Lane won't be truly safe. Next, I want to protect the bike lane with raised tree beds, not only will this make riders safer, but they will have a more pleasant ride to school in the morning which will make them more likely to ride in the future.[5]

[5] Kerski, Joseph. "Walkability." *ArcGIS StoryMaps*, 29 August 2022, https://storymaps.arcgis.com/stories/1e4847f78ec94fd89e960adfabb5ac5c. Accessed 14 February 2024.

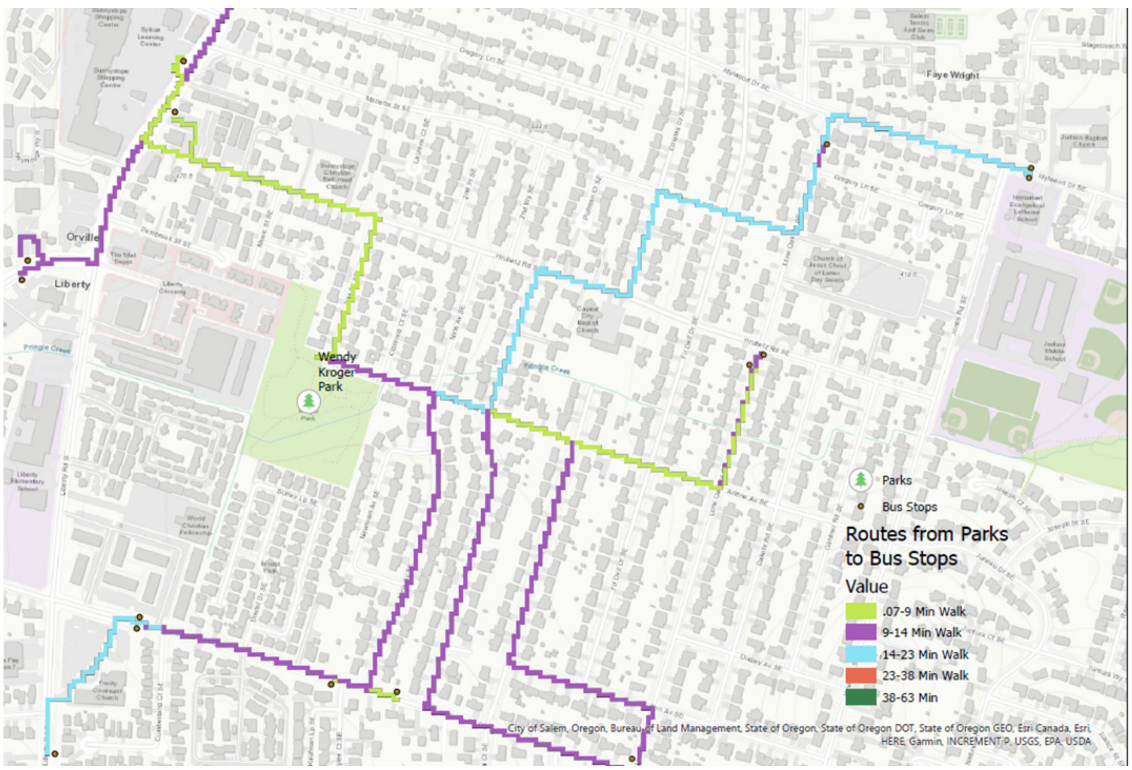
Future Directions and Improvements

Another step that could be taken would be adding more Bus lines connecting to Sprague High School. One of the limitations of this project is that I'm not super familiar with Salem's make-up, but I'm sure Salem Planners have access to where a majority of Sprague students live. Having robust bus routes close to where students live will condition them to expect this type of connectivity across the city and will make the future implementation of this goal easier.

Wendy Kroger Park

Is also located several blocks away from Sprague High School, meaning any improvements done for the park will also positively impact the high school.

Figure 6: Wendy Kroger proximity to Bus Stops



Method for Figure 6

First, you need to get all the park locations in Salem and convert them into point data, then choose the point parks as your facilities choose a destination/route service area, and have it route to the bus stops. This resulted in the figure above, notice that each line is color coded showing the different walk times to each stop from Wendy Kroger Park.

Figure 7: Wendy Kroger Park: https://maps.app.goo.gl/Enmq8CgUfmwgXn9b7

While this does appear to be located on a residential street, this is a route that bus riders would walk along to get to the park as it's the only street connecting it to the rest of Salem. My first change would be to eliminate the privilege of parking near the entrance to the park. This will make entering the park much more pleasant for pedestrians. Speaking of pedestrian comfortability, I want to increase the size of the sidewalk, Arlene Ave is much too wide for a simple residential road anyway. I also want to add a bike lane, this task is difficult due to this being a residential road, and homeowners will be accustomed to being able to park on the street. Although I'm not a fan of using parking spots as protection for bike lanes, on this residential street it seems to be called for to avoid massive pushback from the residents of this area.

Future Directions and Improvements

In an ideal world, I would turn this road into a greenway, perhaps making its way to Sprague High School as well. The greenway could transform the street into being more oriented for pedestrian travel, while only allowing local residents to be through traffic. By increasing greenery and designing the street with pedestrians & cyclists in mind, combined with the connectivity of the bus stops would make this park more popular as it is such a pleasant walking destination.[6]

Conclusion

My recommendations were left intentionally open, so they could be applied where applicable across Eugene. For example, my Lancaster recommendations could realistically apply to any busy street across Salem, as walkability is typically the worst in those areas. Schools across Salem should be made as walkable and connected as possible, and while I didn't look at them specifically I'm sure the other schools suffer similar issues across Salem. Salem has a ton of parks and working to make them easier to walk, cycle, and bus to would drastically increase their popularity. Allowing Salem residents to truly enjoy the park amenities across the city. The focus on city-wide improvement ties back to the thesis of this report, which is that true walkability can only be achieved by improving all aspects of walkability.[7] Focusing on one aspect of walkability won't have the intended effect unless you bring along the other components of walkability.

[6] Walker, Jarrett. "The Transit Ridership Recipe — Human Transit." *Human Transit*, https://humantransit.org/basics/the-transit-ridership-recipe#ridershipcoveragetradeoff. Accessed 21 March 2024.

[7] Walker, Jarrett. "The Transit Ridership Recipe — Human Transit." *Human Transit*, https://humantransit.org/basics/the-transit-ridership-recipe#ridershipcoveragetradeoff. Accessed 21 March 2024.

Sam Whitfield
GEOG482

Goals: a text narrative describing the project goals

My project focuses on transportation, land use, and community design. I noticed that pleasant walking connections are lacking between neighborhoods, so I wanted to consider how to make walking along busy roads safer and more enjoyable. My goals were to improve connectivity between neighborhoods, especially those separated by the industrial area between i5 and ~18 St.

Summary of Recommendations: A two to four paragraph summary of recommendations for improving walkability in Salem or a specific part of Salem. This should describe the specific geographic areas, types of infrastructure, or populations involved

Salem has its highest walkscores around downtown and just to the east of i5. The lower walkscores are along roads that connect neighborhoods, specifically those connecting the Central Area with Four Corners (not in Salem? Then let's say Northeast Salem). Geer Community Park lies between these two areas and has a remarkably low walkscore. This is because it is directly next to i5, it is not near any amenities, and is not well connected with other roads. Walkscores decrease dramatically as you move southeast from the city center toward the airport (no one walks to the airport so there's no infrastructure for it). Also, the area east of Southeast Salem is quite industrial and understandably has few walking visitors. Areas along the core bus routes appear to be fairly well built-out with high walkscores along most of the routes. In short, Salem has walkable neighborhood areas, but those areas are not well connected for walking (they are by bus or car). Most of Salem's amenities are focused in the downtown area or to the east of i5.

Slowing down cars is probably the most feasible opportunity to improve walkability. To achieve this, Salem could rectangular rapid flashing beacons (RRFB) with retroreflective coatings near potential pedestrian crossings (example below). RRFBs would not impede the flow of traffic but would greatly increase pedestrian safety. RRFBs are also beneficial because they are relatively low cost and can be installed at pre-existing intersections, reducing the need for additional infrastructure. RRFBs have been proven to increase driver yield rates by up to 98%, reducing pedestrian crashes by 47% (source)

Similar to RRFBs, pedestrian hybrid beacons (PHBs) result in a 55% reduction in pedestrian crashes and should be easily installed at important crossings. Additional car slowing measures could be implemented such as speed bumps and curb extensions. Speed bumps are a low impact, relatively low budget but highly effective way to slow drivers. Speed bumps should be constructed on roads where people speed (usually in industrial districts, so Center St and State St), especially near major entrances/exits to amenities.

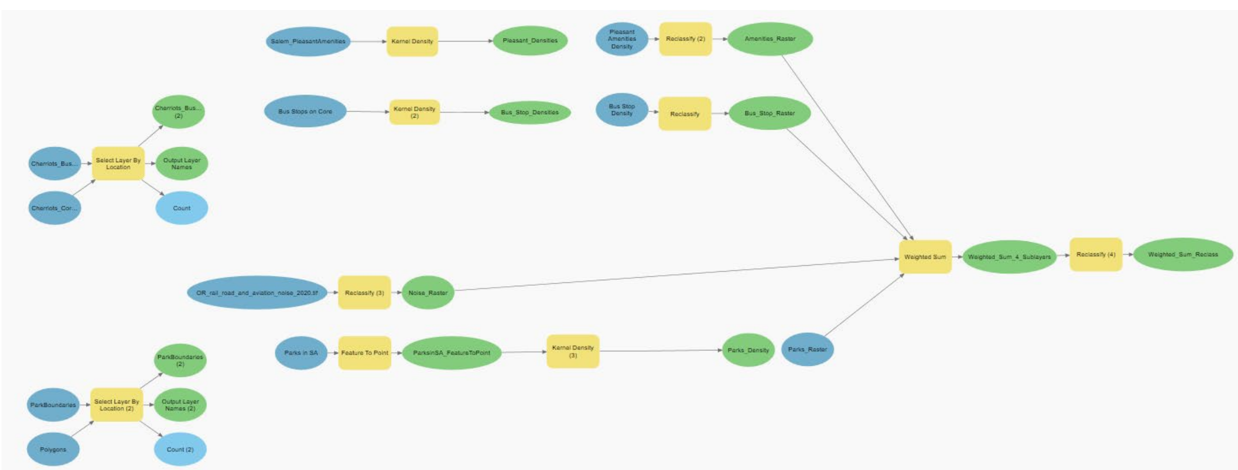
Generally, bus stops east of downtown in the industrial district are not well shaded and not easily accessible. While it would be beneficial to create more pedestrian crossings or reduce road widths, it is not monetarily feasible. Adding signage and signals should be more feasible and will similarly result in more awareness of pedestrian crossings and slower driving speeds along the core bus routes.

A description of the data and geospatial analysis methods used to create these recommendations. This should be complete enough so that your methods could be recreated by another person.

To analyze walkability in Salem, especially around the core Cherriot bus routes, I performed a weighted sum overlay of densities and locations of pleasant amenities, parks, and bus stops, in combination with road noise. Data on pleasant amenities (point data), bus routes (vector data) and stops (point data), and parks (polygons) was sourced from the city of Salem. Road noise was sourced as a raster layer directly from the US Department of Transportation.

Amenities and bus stops were first converted to a kernel density to better visualize possibly underserved areas. These density maps were then reclassified to a scale of 1-10, with 1 representing areas with none of the facilities in question, and 10 representing areas with a high density of a given facility. The same was done with parks, but first a "select by location" was used to limit the parks to those within the study area, then the polygons were converted to centroid points. Similarly, the road noise raster layer was reclassified to the same scale and rating system but inversed, with 1 representing the most noise and 10 representing no noise.

Once all 4 layers were raster layers with a rating system of 1 to 10, a weighted sum overlay was performed. Amenities and bus stops were given a weight of 30% because they represent more used services (compared to parks). Parks, like amenities, are highly visited, but they are given a weight of only 25% because many residents are likely to visit their neighborhood park, not get on a bus to go to a park. Road noise was given a weight of 15% because road noise alone is not a good indicator for walkability needs; the noisiest roads are generally not walkable (e.g. highways or airport runways).



This model is not functional and is provided only to show workflow. + graphics later

Further Suggestions based on feedback that we received from neither the instructor nor the city of Salem which is worth 1/5 of this whole assignment (get real)

Noise was not a necessary consideration unless they can get a grant to reduce noise pollution (they won't). A zoning layer would have been helpful in my analysis – I indirectly found the industrial zones by mapping densities of amenities. I'd combine my data with data about streetlights and pedestrian crossings because it is currently difficult to get to the bus stops and or the bus stops are poorly lit and feel unsafe. Having data about who commutes to where would also be helpful here.

Citations:

"Living in Salem." *Walk Score*, www.walkscore.com/OR/Salem. Accessed 11 Mar. 2024.

"National Transportation Noise Map." *Bureau of Transportation Statistics*, www.bts.gov/geospatial/national-transportation-noise-map. Accessed 11 Mar. 2024.

"Proven Safety Countermeasures." *Proven Safety Countermeasures | Federal Highway Administration*, USDOT | Federal Highway Administration, highways.dot.gov/safety/proven-safety-countermeasures. Accessed 11 Mar. 2024.

"Rectangular Rapid Flashing Beacons (RRFB)." *Proven Safety Countermeasures* , USDOT, highways.dot.gov/safety/proven-safety-countermeasures/rectangular-rapid-flashing-beacons-rrfb. Accessed 11 Mar. 2024.

Data:

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Contains

Amenities_density_raster.lpkx

Bus_stop_density_raster.lpkx

Parks_density_raster.lpkx

Noise_Raster.lpkx

Project:

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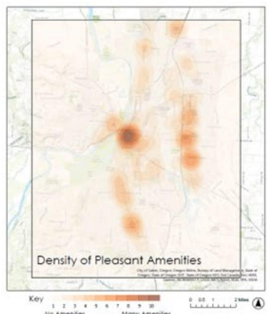
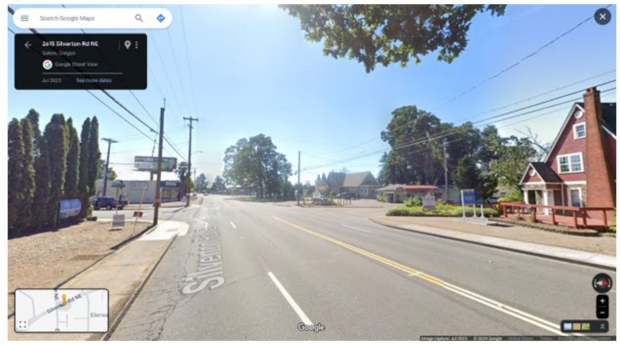
Lab3_Whitfield.aprx

Supporting Maps and Graphics

Salem Walkability
Geog 482 – Winter 2024

This data layer illustrates the density of amenities along the core Cherriot bus routes. This map specifically highlights the lack of connections between neighborhoods.

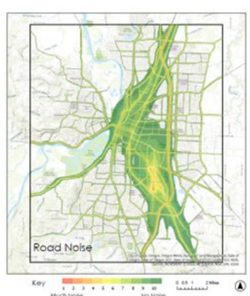




a. https://maps.app.goo.gl/9WG8AYxZxt7GUq16A
Shows sidewalks with little protection from cars along a main road. Sidewalks lack shade which could dissuade walkers. There is no pedestrian intersection at this cross-roads nor any speed limits or yield signs. This is on a core bus route.
Date: July 2023

Salem Walkability
Geog 482 – Winter 2024

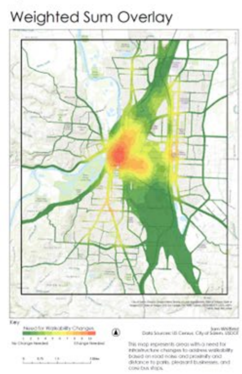
This data layer illustrates road noise in Salem. This map specifically highlights noisiness associated with i5 and major downtown intersections. It wasn't super helpful to inform walkability suggestions because noise is complicated and expensive to mitigate.



a. https://maps.app.goo.gl/4fzb1fNzZSx2mvvG8
Shows that amenities may exist but they are not easily walkable. Skinny sidewalks so close to a busy road may be a walking deterrent. Not a crosswalk in sight.
Date: August 2023

Salem Walkability
Geog 482 – Winter 2024

This map represents areas with a need for infrastructure changes to address walkability based on road noise and proximity and distance to parks, pleasant businesses, and core bus stops.



a. https://maps.app.goo.gl/MAkioLUgPtJTDWmNA
   Shows that many amenities are designed specifically for cars. Again, no crosswalks in sight. Not really anywhere to go on foot. Bus stop not pictured but in very similar setting. Date: June 2023

Equity Focus Areas Group

Ben Adams
3/20/2024

Final Project Submission

Goals:

I first sought to assess existing walkability in the City of Salem using geospatial analysis and publicly available tools like WalkScore.com and Google Street View. I focused my analysis on sections highlighted by the city as "Equity Focus Areas," neighborhoods where certain demographic groups most dependent on walkability were abundant. Then, using this analysis along with walkability research conducted by others, I sought to provide recommendations to the City of Salem that could help improve the walkability of these Equity Areas.

Summary of Recommendations:

My geospatial analysis of Wards 5 and 6 produced a distribution of walkability scores fairly similar to the online WalkScore tool (Figure 1). I realized that while these analyses were good at describing proximity to certain amenities, both lacked the ability to capture what it would actually look and feel like to be walking in these spaces. Looking at images in Google Street View, I found that even the most "walkable" spaces were not all that different from the least walkable in terms of how it would feel to be a pedestrian on those streets (Figure 2). While big shopping centers and malls may provide good access to retail and places of employment, they are often surrounded by busy, high-speed, and high-traffic arterial roads. A signalized crosswalk here is a nice addition but won't do all that much to improve the experience of walking there.

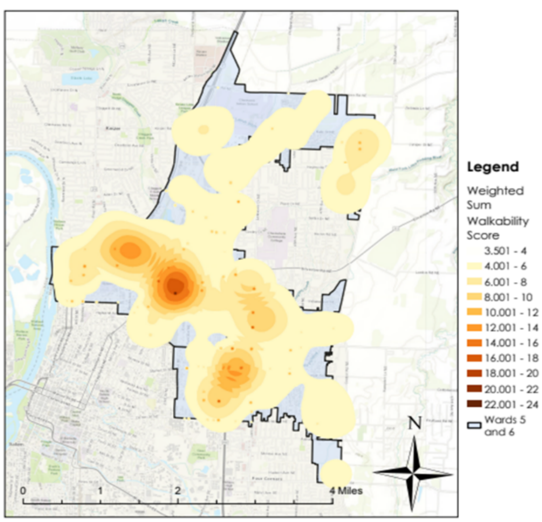


Figure 1: Weighted Sum Overlay of walkability scores in Salem Wards 5 and 6

Figure 2: Intersection of Lansing Ave. NE and Silverton Rd. NE. Despite the relatively high score of 21, this area does not look visually appealing or accessible to a pedestrian.

Instead, I would suggest planting trees and other vegetation between pedestrians and cars to help establish a sense of separation and protection from the busy roads. These strips of vegetation have different names worldwide but are often called sidewalk buffers or road verges. A lot of research has been done (though mostly in Europe, Asia, and Australia) about how these areas can provide important ecosystem services and habitats for pollinators. Phillips et al., (2020) provide a good review of these ecosystem services, and Marshall et al., (2019) found that these sidewalk buffers actually make up a significant amount of urban green space, and that planting these areas with trees and shrubs improves walkability.

Additionally, I believe the city should encourage the division of large tax lots zoned for commercial and retail into smaller parcels of land. Hopefully, this will encourage the presence of smaller, street-front businesses that are more accessible to pedestrians (Telega et al, 2021). That being said, I believe my recommendations are meaningless without consulting the community first. Though I can approximate locations that lack crosswalks or tree cover, I have never walked in these spaces. Though it may be more costly than GIS analysis, I believe the city's main priority should be to consult with the community. The people who regularly walk in these spaces know where a crosswalk would be most beneficial and know where they are most worried about fast-moving cars being so close to pedestrians.

My analysis as well as the online WalkScore both failed to accurately portray patterns of large-scale connectivity between sections of the city. I believe this to be very important, as certain neighborhoods, like those in the equity areas, are essentially cut off from the rest of the city by major infrastructure like I-5 and other arteries. During my Street View analysis, I found the Orchard Park Apartments, in a section of the Northgate Neighborhood, nestled between I-5 and a large interchange with Portland Rd. NE. Despite this section's relative proximity to the city center, the rest of Salem is essentially inaccessible on foot. The closest elementary school, for example, requires a 30+ minute walk, in which pedestrians walk along Portland Rd NE as it passes over the interstate. To combat this, I recommend the construction of pedestrian and bike–specific bridges across this major infrastructure. Ideally, these new bridges could include some degree of continuity between green spaces, such as small buffers, or could even connect larger parks and greenways. In a review article about urban green space planning, Semenzato et al., (2011) describe how bike and pedestrian bridges can be built to repurpose old industrial areas while improving the safety of commuters.

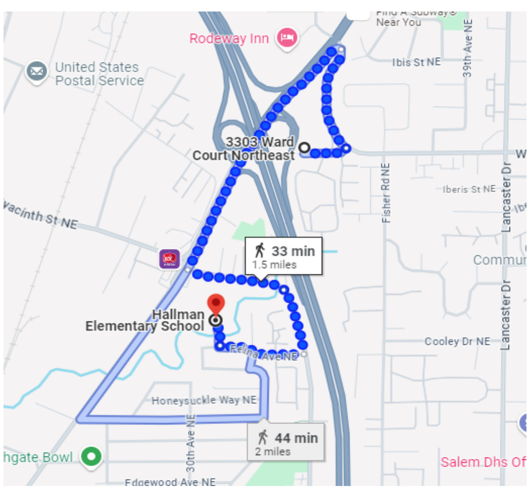


Figure 3: Google Maps walking route from the Orchard Park Apartments to Hallman Elementary School. This walk takes over 30 minutes.

Figure 4: Bridge 'Erzbahnschwinge' in Emscher Park Radweg cycle track (Photo: Harald Spiering, RVR) (Semenzato et al., 2011)

Methods:

For my analysis, I chose to focus on the entirety of Wards 5 and 6, with school-aged children and teens as my main target demographic. I then based my data layer selection on work done by Telega et al. in 2021 as well as methods used by WalkScore.

I started by selecting out all parcels of land zoned for commercial retail, reasoning that these areas could be used as amenities as well as places of employment for my target populations, particularly high school-aged teens. I calculated a centroid for each of these zones, and their shapes were regular enough that geometric centroids did a good job of capturing their locations. I then calculated a kernel density for these points with a search radius of 800 meters, or 2625 feet. I reclassified density values to a scale of 1-10. I performed the same kernel density and reclassifications on all public amenities in the area. These amenities included things like schools, parks, natural areas, and hospitals.

Next, I calculated the kernel density for both signalized and nonsignalized crosswalks in the area. Here, I only used a search radius of 50 meters (165 feet), assuming that pedestrians are less likely to go very far out of their way to traverse the street at a crosswalk. Density values for both types of crosswalks were again reclassified to a scale from 1-10.

Lastly, I constructed a weighted sum overlay. I left scores for retail zones, amenities, and signalized crosswalks at 100% of their reclassified values, while reducing nonsignalized crosswalks to 50% under the assumption that this infrastructure is less safe and usable for pedestrians. This allowed for a maximum walkability score of 35. A model builder is included within my ArcGIS Project File and as a PDF in my FinalProject Folder on the R: Drive.

Lastly, I used Google Street View to assess the results and accuracy of my analysis in order to provide better recommendations.

Future Directions and Improvements:

As I have mentioned, a crucial first step to take before implementing any of these recommendations is to survey the needs of the community. The people who walk in these areas every day have a much better understanding of the space and what is needed to improve it.

In terms of my own analysis, I think it potentially would have been helpful to include tree canopy data. Though this would still fail to paint the whole picture of what it's like to walk on these streets, it could certainly improve my analysis. Additionally, I think I could have refined my analysis of Commercial Retail Zones to be a bit more specific to my target demographics. The type and size of these retail tax lots is something that needs to be taken into consideration if we want to assess how useful and accessible they are for pedestrians.

Data Layers:

My ArcGIS Project File, Model Builder PDF, and Layer Packages can be found in the FinalProject Folder in my R: Drive:
R:\GEOG482_582_22260_Winter2024\Student_Data\badams10\FinalProject
Layer Packages include the input data, the kernel density layers, and the final overlay.

Citations:

Kerski, Joseph. n.d. "Walkability." Accessed March 20, 2024. https://storymaps.arcgis.com/stories/1e4847f78ec94fd89e960adfabb5ac5c

Marshall, A. J., Grose, M. J., & Williams, N. S. G. (2019). From little things: More than a third of public green space is road verge. *Urban Forestry & Urban Greening*, *44*, 126423. https://doi.org/10.1016/j.ufug.2019.126423

Phillips, B. B., Bullock, J. M., Osborne, J. L., & Gaston, K. J. (2020). Ecosystem service provision by road verges. *Journal of Applied Ecology*, *57*(3), 488–501. https://doi.org/10.1111/1365-2664.13556

Semenzato, P., Sievänen, T., de Oliveira, E. S., Soares, A. L., & Spaeth, R. (2011). Natural Elements and Physical Activity in Urban Green Space Planning and Design. In K. Nilsson, M. Sangster, C. Gallis, T. Hartig, S. de Vries, K. Seeland, & J. Schipperijn (Eds.), *Forests, Trees and Human Health* (pp. 245–282). Springer Netherlands. https://doi.org/10.1007/978-90-481-9806-1_9

Telega, Agnieszka, Ivan Telega, and Agnieszka Bieda. (2021). "Measuring Walkability with GIS—Methods Overview and New Approach Proposal." Sustainability: Science Practice and Policy 13 (4): 1883. https://doi.org/10.3390/su13041883

Salem Final Project

Goals

The goal of this project was to analyze walkability near public schools for students living in the Equity Priority Area (EPA) and identify areas of improvement. Improving walkability near schools will improve walkability to education, helping students build a habit of regular walking (Dept of Health and Human Services), and lessen accessibility barriers to education.

Summary of Recommendations

With the goal of improving walkability around public schools for students living in the Equity Priority Area, I'm focusing on sidewalk crosswalk condition near schools. The schools included are all public schools within 0.5 miles of the EPA, to allow for schools that are located outside the EPA, but still serve students living there. Specifically I'm focusing on nonsignalized crosswalk conditions close to schools (within 100 yards), and sidewalk conditions- missing sidewalk- near schools (within 0.25 miles).

I recommend improving safety at nonsignalized crossings by implementing at least one safety measure (median, curb extension, rectangular rapid flare beacons, raised crossing), or a signalized crosswalk on busy streets (*Crosswalks and crossings*). Nonsignalized crossings are best used in low traffic or for short crossings, but should be used with alternative crossing treatments (median, raised crossing, RRFB, etc). Signalizing the crosswalk is important for busy streets because it increases the visibility of the crosswalk. Students will continue to cross at the same time and place during the school year, regardless of drivers visibility, so signalizing school crossings or implementing alternative treatments will make it safer and more walkable. For example, the crosswalk in Fig 2 is nonsignalized with one traffic light, in the dark this crosswalk would be hard to see and potentially unsafe. Additionally ensuring there are curb cuts for each crosswalk will make it more accessible to all pedestrians. Replacing missing sidewalk sections and cracked or misshapen sidewalk (ex: Fig. 5) will also improve walkability.

Methods

I used data on the school locations, signalized and nonsignalized crosswalks, sidewalks from the Salem SCYP, sidewalk concerns data from the Salem SCYP Nov 23, equity tracts data, and population data from block data from the Census. I used the equity tracts data to define the Equity Priority Area (areas where the equity rank is greater than or equal to 15), and then selected schools and sidewalks within 0.5 miles of it and made them separate layers. Then I selected relevant features of each layer to make new relevant layers, notably the signalized crosswalks, and nonsignalized crosswalks, within 0.25 miles of the schools, sidewalk concerns within the EPA and sidewalk concerns within 0.25 miles of a school. To get the population density I clipped the Salem Blocks layer to fit the EPA, and then used the feature to point tool to create a point layer of the population data, from this layer I used the kernel density tool to create a density layer of the population data. Then I made another kernel density layer of sidewalk concerns, and converted the nonsignalized crosswalks points to raster. Then I used the Network Analysis tool to find the walking service area (20 minutes) of the schools.

To analyze and display the overall walkability near schools in the EPA, I converted the school service area polygons to raster, and reclassified it, as well as the population density, sidewalk concern density near schools, and nonsignalized crosswalk raster so that NODATA=0. Then I put these layers into a weighted sum overlay,with the service area weighted as a 10, population density as a 5, nonsignalized crosswalks as an 8, and sidewalk concerns as a 7. The overlay is meant to give an idea of general areas of walkability concern around education in the EPA, not to show any specific locations of problems.

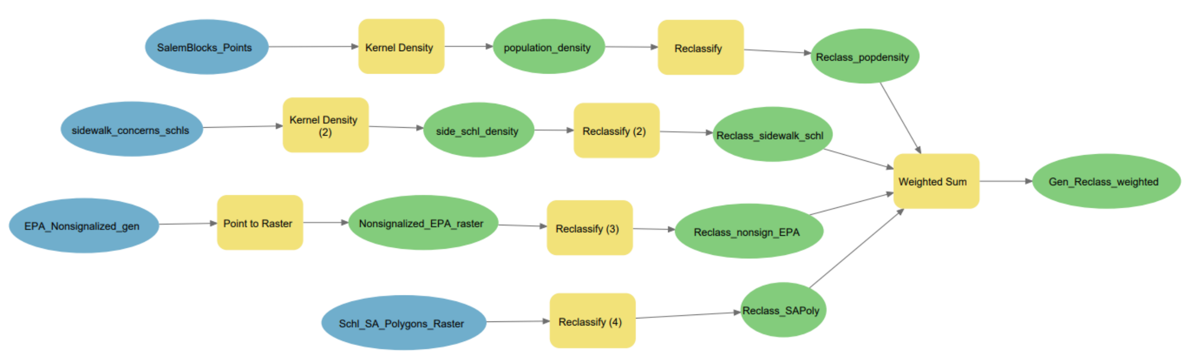


Fig 1. ModelBuilder display of "FinalOverlay_Model1.pdf" showing the steps reclassifying data and inputting them to the weighted overlay. Model can be found in the winter 2024 class folder under Student_Data\lhahn2\SalemFinal\Lab3_SalemWalkability.

To identify specific problems I selected and made new layers from the sidewalk concerns near schools layer and the nonsignalized crosswalks near schools layer. From those sidewalk concerns I selected and made a layer out of the points where the "missing section value" is not null, and then reviewed the points using streetview on Google Maps to identify problem areas. I found that most of these spots did not have a missing section, but some had other problems, most of the footage is from July 2023, so it is possible sidewalks were improved after the data was collected but before this project. From the nonsignalized crosswalk layer I selected points within 100 yards of the schools to identify which were possible school crossings. Then I reviewed these points using streetview on Google Maps to identify if they were school crossings, and if they had any alternative safety measures (medians, curb extensions, rectangular rapid flare beacons).

Supporting Maps and Graphics

Fig 2. 19th & Nebraska Ave NE across from Englewood Elementary (https://maps.app.goo.gl/cR82XVg55W4gXHm3A)
The curb cuts and sidewalk setback are good for walkability, but the nonsignalized crosswalk lacks pedestrian friendly design

Fig 3. Lansing Ave NE & Hammel St NE (https://maps.app.goo.gl/5BEj3SvStGMW9XAq7)

Nonsignalized crosswalk across from Waldo Middle School, could be made more visible and pedestrian friendly with a curb extension or rectangular rapid flare beacons

Fig 4. Richmond Ave & Mill St (https://maps.app.goo.gl/UqZfMoMJ27Hju9qZ8)
Set of nonsignalized crosswalks at corner of Richmond School- only one crosswalk has a curb cut

Fig 5. 1345 19th St NE (https://maps.app.goo.gl/z4jTqmS1pijZp78TA)
Sidewalk is very uneven, panel has been significantly cracked

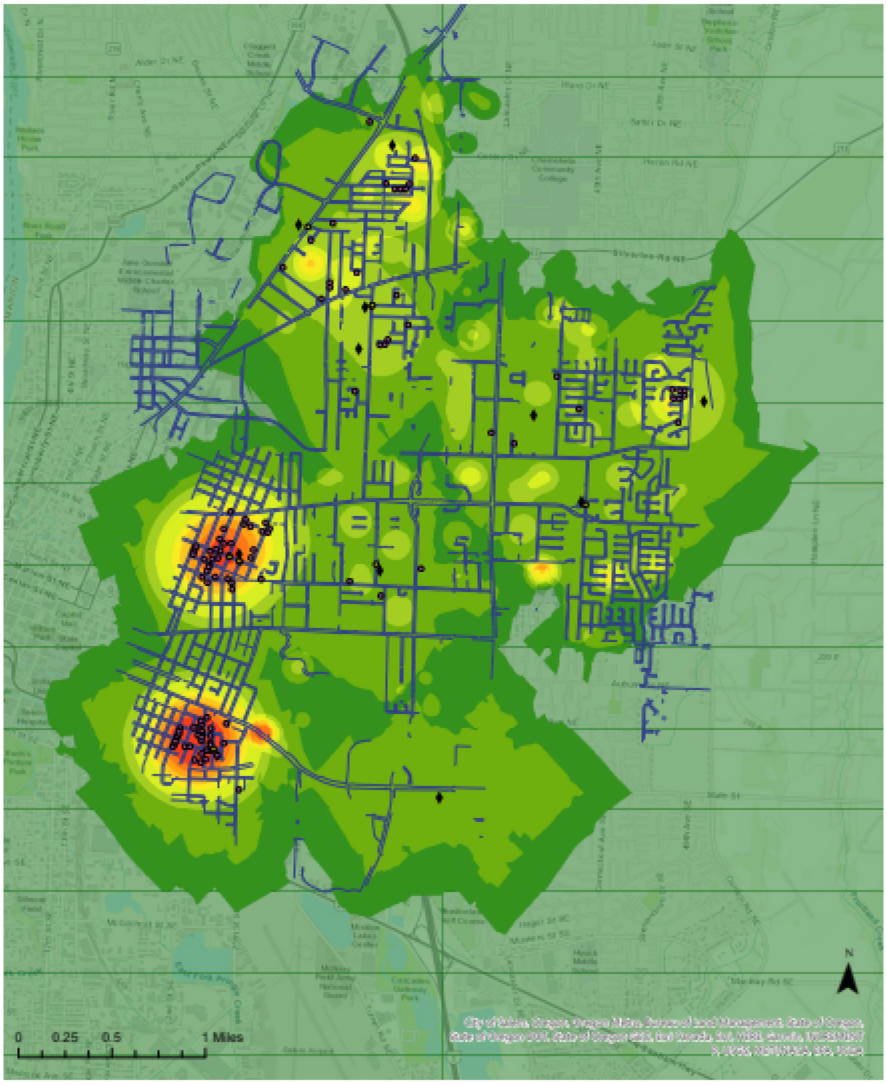


Fig 6. Weighted Sum Overlay, with sidewalks, schools, sidewalk concerns, and nonsignalized crosswalks near schools shown. Green areas have low walkability concern, red areas have high walkability concern.

Future Directions and Improvements

Improvements

Filling in and updating the details of the "nonsignalized crosswalk" dataset would allow for a more thorough analysis on the crosswalk's safety; currently the median, curb extension, rectangular rapid flare beacons, and school crossing categories are often left null. Also, focusing on a sidewalk concern other than "missing section" (such as "spalling") would help identify more sidewalk concerns, especially because many of the spots identified as "missing section" did not appear to have a missing section on GoogleMaps streetview.

Future Directions

This project focused on walkability directly around schools, so it could be expanded further into neighborhoods to improve walkability to and from schools by analyzing which walking routes are most convenient for students and if they need improvement. Asking students that already walk to/from school about their experience and what they see as a need for improvement, as well as more direct questions on walkability (sidewalk condition, crosswalk safety, etc), or asking students who don't walk to/from school why they prefer other methods of transportation could be a good way to acquire additional data. Alternatively, setting up walk-to-school programs would encourage students to walk to school.

Citations

Crosswalks and crossings. National Association of City Transportation Officials. (2015, July 24). https://nacto.org/publication/urban-street-design-guide/intersection-design-elements/crosswalks-and-crossings/#:~:text=As%20traffic%20speeds%20and%20volumes,preserve%20a%20safe%20walking%20environment

Dept of Health and Human Services. (2021, March 12). *Surgeon general strategies for making communities more walkable*. HHS.gov. https://www.hhs.gov/surgeongeneral/reports-and-publications/physical-activity-nutrition/walking-sectors/index.html

Salem-Keizer Public Schools. (NK). *School attendance areas*. Salem-Keizer District 24J. https://salkeiz.k12.or.us/schools/attendance-areas

Data Layers and Symbology

Layer package

- Name: "SalemEPA_school_walkability.lpkx"
    - Contains
        - Gen_Reclass_weighted: the weighted sum overlay
        - Schools_near_EPA: public schools within 0.5 miles of the equity priority area (close enough that their attendance boundary may intersect it)
        - Sidewalks: sidewalks clipped to the EPA
        - sidewalk_concerns_schls: sidewalk concerns within 0.25 miles of schools
        - Schools_Nonsisgnalized: nonsignalized crosswalks within 0.25 miles of schools
        - population_density: population kernel density within EPA
- Location: R:\GEOG482_582_22260_Winter2024\Student_Data\lhahn2\Salemfinal\FinalProjectLayers

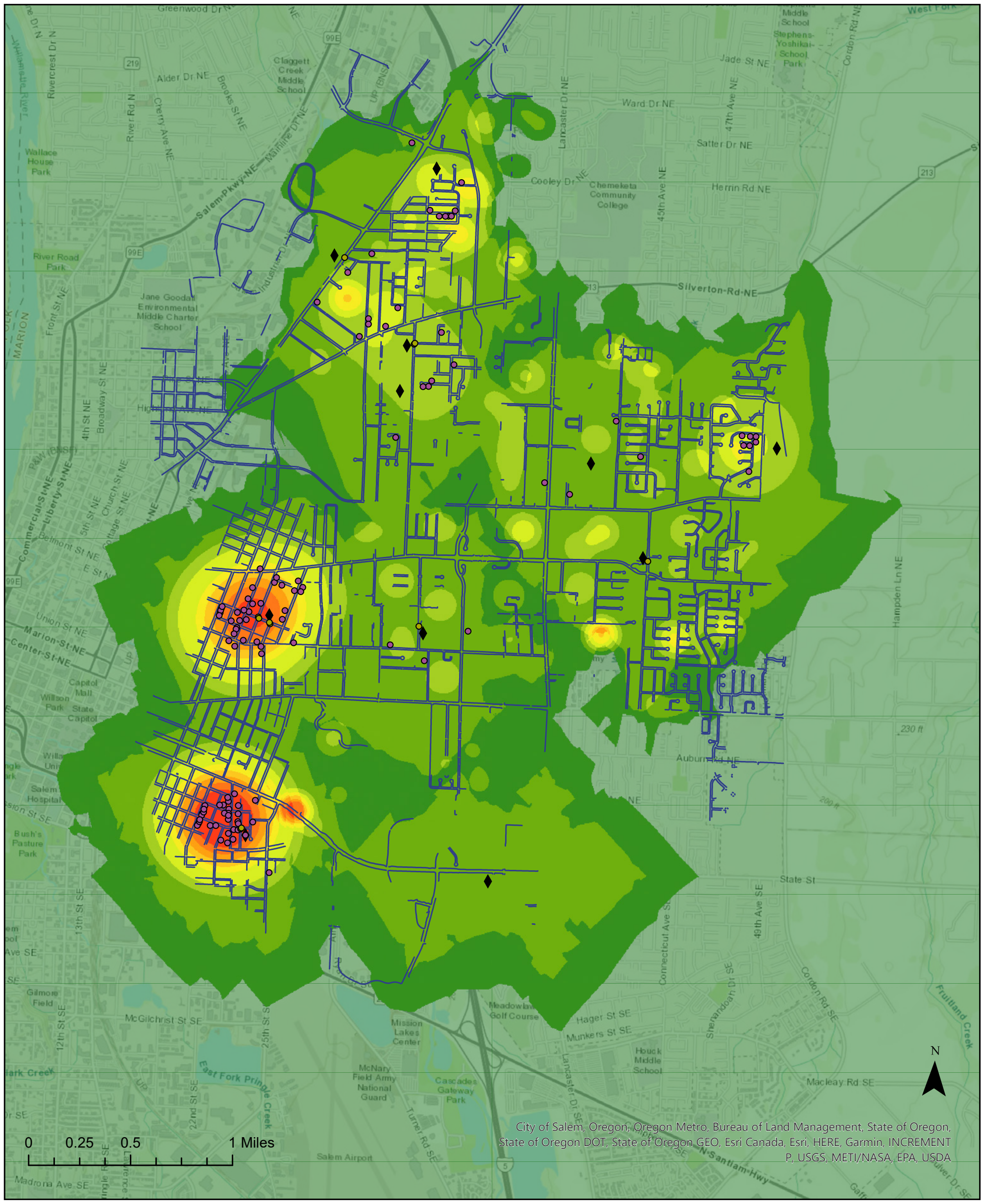
ArcPro Project

- Name: "SalemProject.aprx"
- Location: R:\GEOG482_582_22260_Winter2024\Student_Data\lhahn2\Salemfinal\Lab3_SalemWalkability

Walkability Around Public Schools in Equity Priority Area

using weighted sum overlay

By: Louisa Hahn



1 : 32,461

Legend

- Nonsignalized crosswalk (within 100y of a school)
- Sidewalk concerns (within 0.25 mi of a school)
- Public School
- Sidewalk

Value of Overlay: walkability concern

- not applicable
- low concern
- high concern

The weighted sum overlay gives a general visualization of walkability concern near schools. It uses data on population density, sidewalk concern density, nonsignalized crosswalks within the Equity Priority Area, and the service area layer of the schools (20 min walking). On top of this is a map of the sidewalks in the EPA, as well as possible points of concern near schools.

Data from the Census and SCYP in conjunction with the city of Salem

Goals: a text narrative describing the project goals,

My strategy for improving walkability is to improve community design to create a more welcoming space for pedestrians. My goal is to provide a small scale recommendation for improving walkability on a road that I identified as lacking many features of what makes a street walkable. I focused on how industrial buildings correlate with low-equity areas and how vegetation is lacking on roads which provide alternative routes away from industrial zoned areas.

Summary of Recommendations: A two to four paragraph summary of recommendations for improving walkability in Salem or a specific part of Salem. This should describe the specific geographic areas, types of infrastructure, or populations involved.

I am focusing primarily on Portland Road NE. This is a major throughway within the equity priority area which is an important connecting artery between amenities and residences. This road also borders the large industrial zone which will serve to funnel people onto Portland Road as a better option for walking than within the industrial zone. Portland Road is a 5 lane road with sidewalks on both sides. It has various businesses on it, many of which serve the prominent hispanic/latino population which is concentrated in North east Salem, and makes up approximately 20% of Salem's population.

To improve walkability on this road, I recommend improving greenery. My map, which illustrates the conjunction of industrial zoning with the lack of greenery shows why this area may be a high priority throughway for walkability improvement. Other main arterial avenues of this type in the higher scoring equity areas clearly have more vegetation which has many positive effects on walkability. It has been proven that improving access to green spaces promote walkability, physical exercise (Juul & Nordbø, 2023) , improve mental health (Cohen-Cline et al., 2015), and physical health (Tsai et al., 2019).

Methods: A description of the data and geospatial analysis methods used to create these recommendations. This should be complete enough so that your methods could be recreated by another person.

ModelBuilder models can be used for this portion - please give the name and location of the model in addition to a graphic of the model for the write-up!

In my third and fourth labs, I examined the relationship between industrial zoning and walkability. The combination of the North Gate industrial sector, which borders the equity priority, and the lack of alternative green space for walkways in the area have strong adverse effects on walkability in the area. My lab 3 overlay showed considerable correlation between the presence of industrial sectors and low equity areas.

The data being used in my analysis is the parcel zoning data, from which I have selected and clipped zones designated for general industrial and commercial industrial purposes (IC and IG zoning codes). Additionally, I am utilizing the vegetation data set for the city of Salem, as well as point data for signalized and unsignalized crosswalks. My final map did not involve much analysis involving these layers. I was relying on the visual features of these layers, and decided to keep it simple to easily convey my point.

In my research of greenspaces, I have found a strong set of benefits which are provided by access to greenspaces for walkability. I used this knowledge in conjunction with my data sets to zero in on an area which correlates with the low equity area and could be improved by adding greenery.

Supporting Maps and Graphics: Maps and graphics should be included in the write-up to illustrate the main aspects of your analysis. These can be included in the text narrative as figures, or as separate maps.
***Note:** Salem City staff appreciated the StreetView images to show places discussed in your recommendations - please include the links to the images (use the 'share' option) in addition to screenshots of the StreetViews.

Future Directions and Improvements: Describe recommendations to refine, improve upon, or develop your project further: these can be additional datasets, types of geospatial analysis, or other suggestions.

I think that my analysis could have been improved upon using demographic data. Since I was focusing on the equity priority area, I think that including what populations of people would actually be affected by my proposed solutions would help demonstrate why my changes are relevant to a population, or if the resources would be better used elsewhere. Many other datasets would fit in well with my analysis, for example, the heat index of streets, traffic data, and air pollution. Vegetation has been proven to have a positive effect on cooling a city because it breaks up and absorbs sunlight. I think that this could be a relevant fact for my analysis because the heat and shade cover could be an important consideration for people when deciding to walk and what routes they may take. Traffic data could also be helpful to determine if this has any effect on the walk score. Higher traffic areas are less walkable, and if a street has a high concentration of automobile traffic, it may be more useful to designate a different road as one where walkability is being emphasized and improved. Air pollution data would be relevant to my focus area because I am focusing on a street which borders an industrial zone. It is possible that these industrial facilities have a negative impact on air quality, which would be important to note when considering if we want to encourage people to walk in these areas due to possible health implications.

- **Citations:** Provide citations to support your recommendations and methods

Cohen-Cline, H., Turkheimer, E., & Duncan, G. E. (2015). Access to green space, physical activity and Mental Health: A twin study. *Journal of Epidemiology and Community Health*, *69*(6), 523–529. https://doi.org/10.1136/jech-2014-204667

Juul, V., & Nordbø;, E. C. A. (2023, February 6). *Examining activity-friendly neighborhoods in the Norwegian context: Green space and walkability in relation to physical activity and the moderating role of perceived safety - BMC public* *health*. BioMed Central. https://bmcpublichealth.biomedcentral.com/articles/10.1186/s12889-023-15170-4#:~:text=Neighborhood%20green%20spaces%20are%20considered,in%20less%20green%20environments%20%5B22

- **Data layers and symbology:** Save your ArcPro project work and any key results layers in a “FinalProject” folder in your userspace on the R: drive.
    - Save key results layers as ‘layer packages’ that have both the data and the symbology included - see the following help page for information: Share a layer package—ArcGIS Pro
    - Links to an external site.
    -
    - Provide a list of the layer packages and the location of the folder.
    - Provide the name of the ArcPro project(s) used for work on your final project and its location on the R: drive

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LayerPakage.lpkx

Layers:

- Vegetation
- Industrial parcels
- Signalized crosswalks
- Non Signalized Crosswalks
- Equity priority area

R:\GEOG482_582_22260_Winter2024\Student_Data\mlannin2\Final

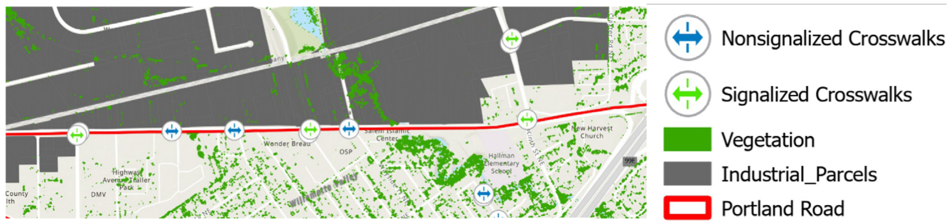
Final.aprx

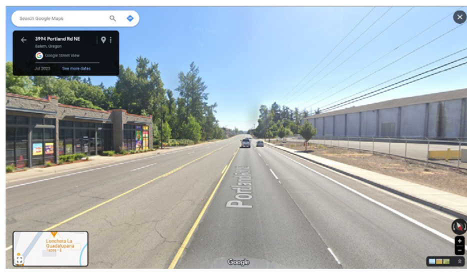
Salem Walkability

Geog 482 – Winter 2024

Max Lanning

To improve walkability on this road, I recommend improving greenery. My map, which illustrates the conjunction of industrial zoning with the lack of greenery shows why this area may be a high priority throughway for walkability improvement. Other main arterial avenues of this type in the higher scoring equity areas clearly have more vegetation which has many positive effects on walkability. It has been proven that improving access to green spaces promote walkability, physical exercise (Juul & Nordbø, 2023) , improve mental health (Cohen-Cline et al., 2015), and physical health (Tsai et al., 2019).



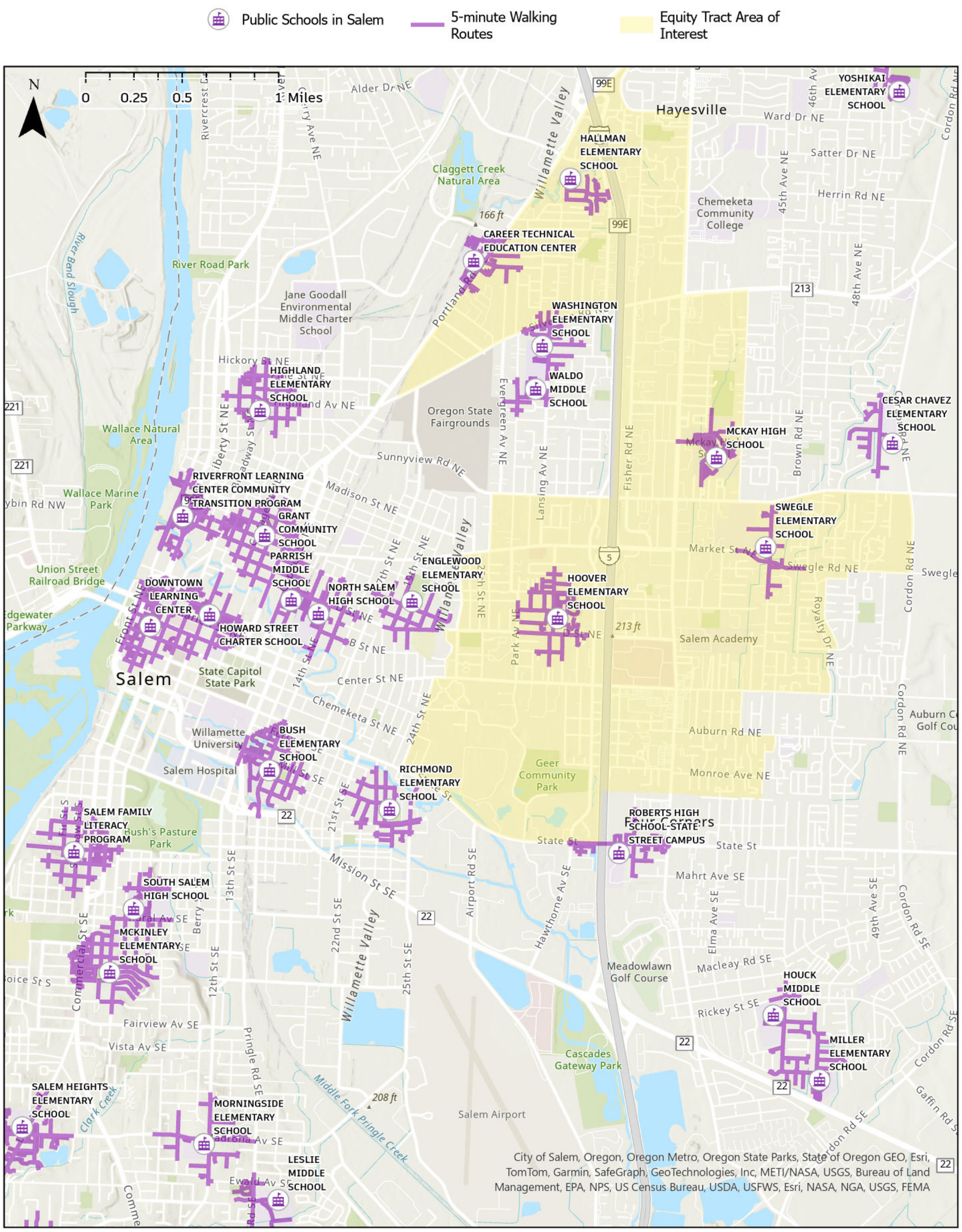


Good amount of vegetation

Needs more vegetation

Service Areas Around Salem Public Schools

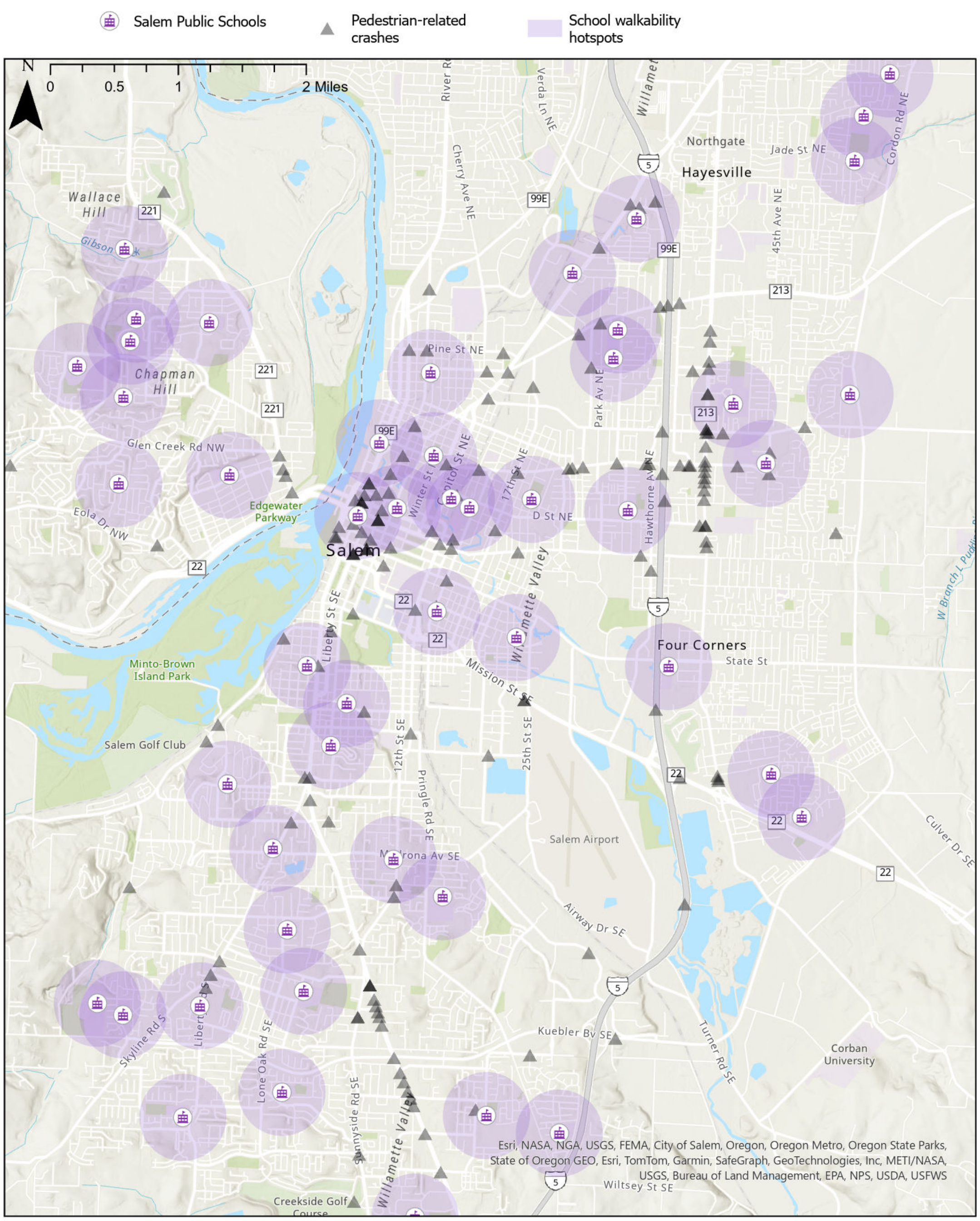
Of the 49 public school sites in Salem, 8 facilities are within or directly adjacent to the equity tract area of interest provided by the City of Salem, including five elementary schools, one middle school, one high school, and the Salem Career Technical Education Center. There is a variety of residential, business, and mixed-use area surrounding each school, making assessing walkability a challenge. Five-minute network analyses of walking distances show that depending on the surrounding area, each school has a different service area of reasonable walking distance, and highlight which schools may most benefit from walk- or bike-to-school programming.



Pedestrian-involved Accidents in Salem

A small percentage of the overall traffic accident data from 2019 to 2021 includes pedestrian involvement, injury, or death. These incidents tend to occur at or near major intersections. Many incidents are caused by right-of-way issues, suggesting that signalized crosswalks, traffic lights, and other safety measures are crucial to promoting pedestrian safety.

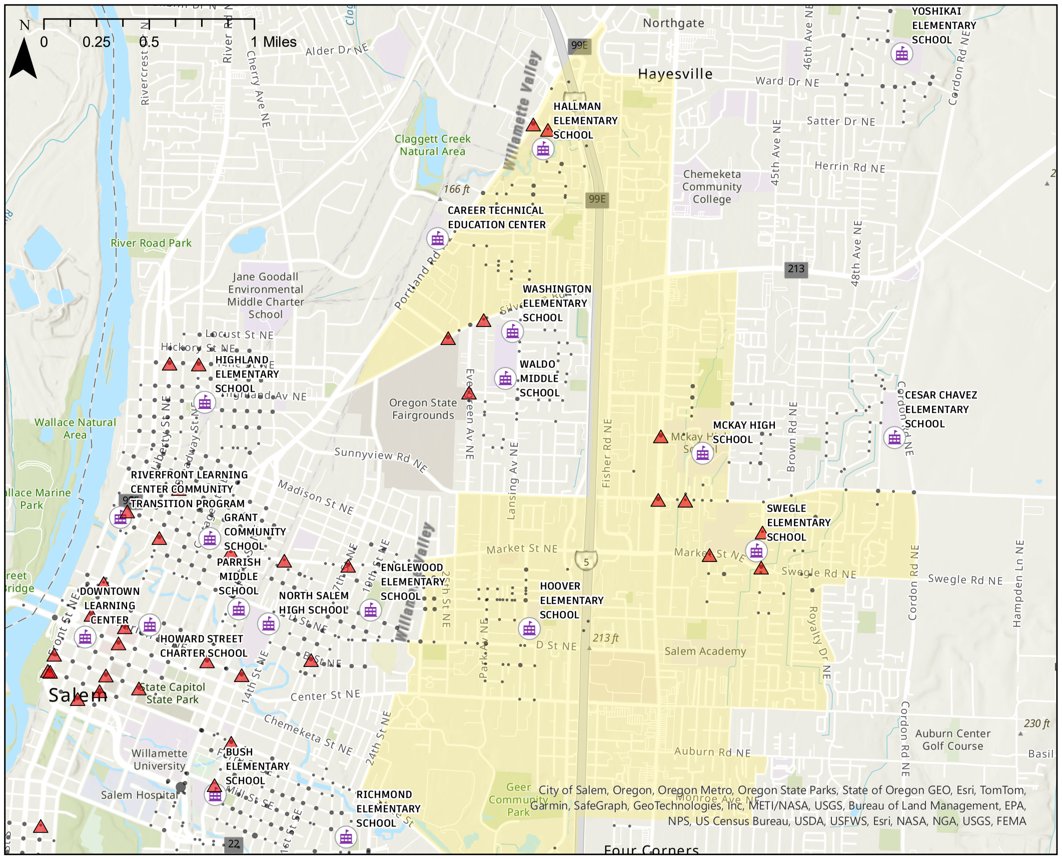
Several major intersections overlap with quarter-mile Euclidian buffers around public schools, prompting a review of safety measures around these areas.



Intersections Recommended for Crossing Guards in Salem

Dangerous Intersections of Interest
Public Schools in Salem
3.000 - 3.800
3.801 - 4.600
4.601 - 5.400
5.401 - 6.200
6.201 - 7.000
Equity Tract Area of Interest

Several major intersections (defined as intersections with a high likelihood of foot traffic, or intersections that connect multiple major roads) within walking distance of public schools have a history of pedestrian-related incidents. While some of these intersections may benefit from improvements such as signalization, many already have these features or are not suitable for them. In this case, crossing guards offer a solution to keep children safe and avoid right-of-way related traffic incidents.



Intersections Recommended for Improvement near Equity Tract Area

Qualitative Rating (1-5)	School	In "Equity tract"	Intersection	Direct route	School Xing Sign	Marked Crosswalk	Signalized
3	Hallman Elementary	Yes	Hyainth Sct NW and Fir Rest Wy NE	No	No	No	No
2	Hallman Elementary	Yes	Porland Rd NE and Hyacinth St NW	No	No	Yes	Yes
3	Washington Elementary	Yes	Park Av NE and Silverton Rd NE	No	No	Yes	No
2	Waldo Middle	No	Chester Av NE and Evergreen Av NE	Yes	No	No	No
4	Mckay High	Yes	Wolverine St NE and Lancaster Dr NE	Yes	No	Yes	Yes
4	Mckay High	Yes	Sunnyview Rd and Scotsman Ln NE	Yes	Yes	Yes	No
5	Swegle Elementary	Yes	45th Ave NE and Country Ln NE	Yes	No	No	No
4	Swegle Elementary	Yes	Swegle Rd NE and 45th Ave NE	Yes	Yes	Yes	Yes
3	Blanchet Catholic School	Yes	Market St NE and Tierra Dr NE	Yes	Yes	Yes	No

OBJECTID	Google Maps Link	Qualitative Rating (1-5)	School	In "Equity tract"	Intersection	Direct route	School Xing Sign	Marked Crosswalk	Signalized
37	https://maps.app.goo.gl/ZZuuhwpYTkvrx8si8	3	Hallman Elementary	Yes	Hyainth Sct NW and Fir Rest Wy NE	No	No	No	No
36	https://maps.app.goo.gl/wXMwXmVYyNKAaLwy6	2	Hallman Elementary	Yes	Porland Rd NE and Hyacinth St NW	No	No	Yes	Yes
35	https://maps.app.goo.gl/iaTebZSdVPWNRiKKA	3	Washington Elementary	Yes	Park Av NE and Silverton Rd NE	No	No	Yes	No
34	https://maps.app.goo.gl/ndWAo7CCkL7gLjar5	2	Waldo Middle	No	Chester Av NE and Evergreen Av NE	Yes	No	No	No
39	https://maps.app.goo.gl/T81aM6VPX9ApuVko8	4	Mckay High	Yes	Wolverine St NE and Lancaster Dr NE	Yes	No	Yes	Yes
38	https://maps.app.goo.gl/WsE6bYzJGwFR1kLz6	4	Mckay High	Yes	Sunnyview Rd and Scotsman Ln NE	Yes	Yes	Yes	No
43	https://maps.app.goo.gl/jnnCEA29PS9Erfry7	5	Swegle Elementary	Yes	45th Ave NE and Country Ln NE	Yes	No	No	No
42	https://maps.app.goo.gl/aDGePP3xWeLYS23S9	4	Swegle Elementary	Yes	Swegle Rd NE and 45th Ave NE	Yes	Yes	Yes	Yes
41	https://maps.app.goo.gl/89NPY53qsxpvB3D97	3	Blanchet Catholic School	Yes	Market St NE and Tierra Dr NE	Yes	Yes	Yes	No

Recommendations for Placement of Crossing Guards Near Public Schools

Project Goals

My analysis focuses on the goal of "Promote community programs and policies that make it safe and easy for residents to walk". Infrastructure and physical environment changes can often be expensive to implement and time-consuming to put into practice. My suggestion of adding crossing guards is a policy that can be implemented almost immediately (given school district cooperation) near schools to increase walkability while also promoting safety for children and ease of mind for parents. The project focuses on real-life dangers (based on history of pedestrian injuries) in intersections and qualitative and quantitative criteria for improvement of these intersections.

Summary of Recommendations

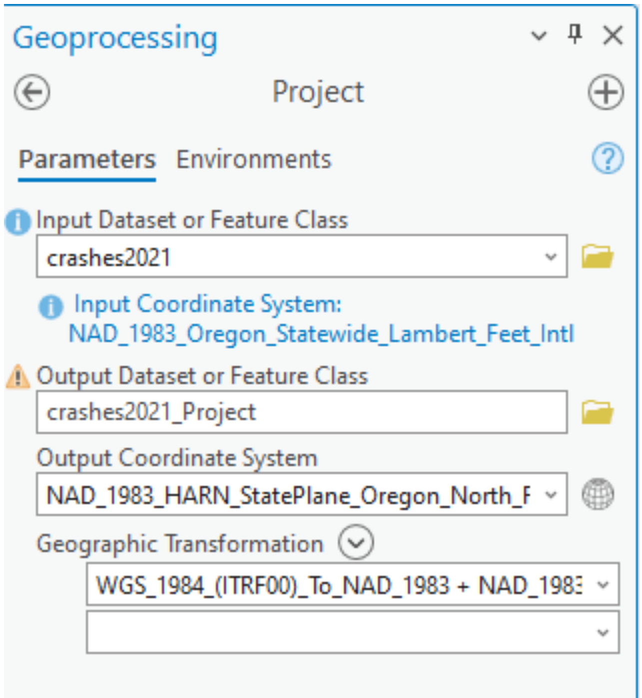
I recommend nine intersections with a history of pedestrian-involved traffic incidents to place crossing guards before and after school hours. Some of these intersections have signage, marked crosswalks, or even signalized crosswalks; yet traffic incidents related to pedestrians still occur. These intersections were qualitatively assessed to be poor candidates for signalization improvements. For example, 45th Ave and Country Ln NE (an intersection near Swegle Elementary School) is a T-shaped intersection that would not benefit from a four-way stop sign or light system. Furthermore, children are a safety risk both due to being lower visibility than taller pedestrians and may still be learning proper right-of-way communication, making crosswalks less beneficial as safety features on the road.

Crossing guards are an ideal “middle ground” for both improving safety and promoting walkability. Studies have shown that even when a walking route is perceived as unpleasant or unsafe in general, the mere presence of a crossing guard greatly increases a pedestrian’s perception of safety and comfort (Rothman et al. 2013). Furthermore, crossing guards are an effective incentive for parents to choose to send their children walking to school (Omura et al. 2018). Crossing guards are also an effective safety measure for children walking to school (Perry et al. 2015).

Methods

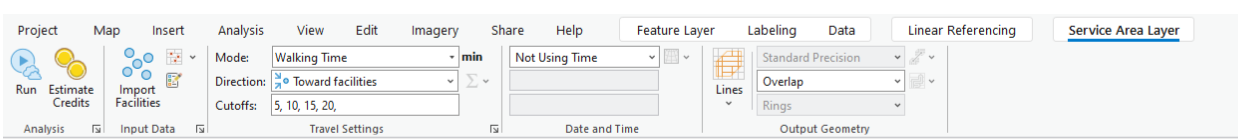
1. Data layer: Public schools in Salem
    a. To find every public school in Salem, export all public facilities point in Salem_PublicFacilities_09082023 that contains the text School in the Place Type field into a new layer called AllSchools.
2. Data layer: Crash or vehicle incidents in Salem involving pedestrians

a. Downloaded 2021traffic incidents from https://www.oregon.gov/odot/Data/Pages/CrashDataProducts.aspx?wp8625=f%3a%7bc%3a38877%2co%3a%7bt%3a2%2co%3a%5b%22Geodatabase%22%5d%7d%7d
b. Changed coordinate system to match default Salem data and saved as <u>CrashesinSalem2021</u>



c. Definition query: CITY_SECT_NM = 'Salem'
d. Repeated this process for 2020 and 2019 data
e. Merged all three layers into one using the Merge tool, renamed <u>CrashesinSalemThreeYearMerge</u>
f. Looked specifically for pedestrians by selecting TOT_PED_CNT > 0 and exporting to a new layer, <u>PedCrashes</u>

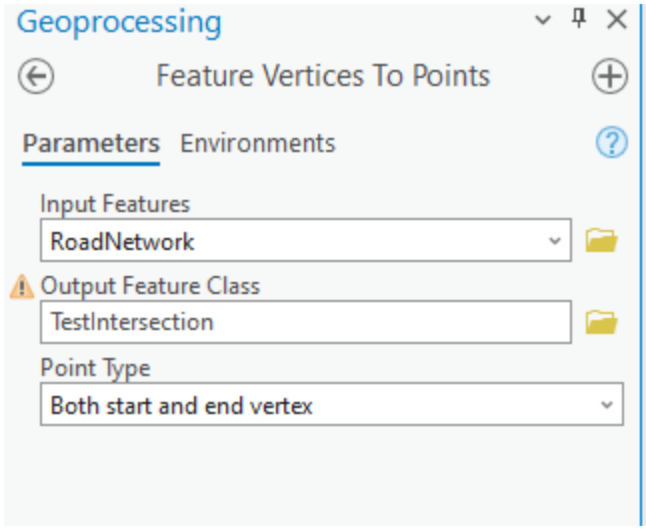
3. Analysis layer: roads within a 5min walking distance to each school



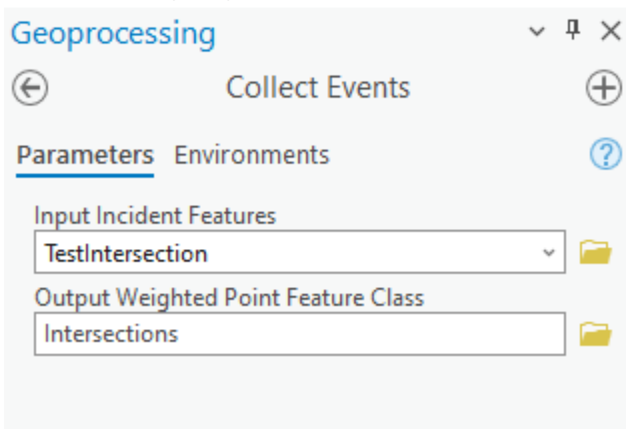
a. Imported AllSchools as the point layer with this configuration

4. Data layer: Downloaded Oregon Transportation Network from https://www.oregon.gov/odot/data/pages/gis-data.aspx#transportationNetwork
a. Did a pairwise clip to use only the lines within Salem study area, called <u>RoadNetwork</u>

b. Searched for vertices with Vertices to Points



c. **Collected points at the same place to not miscount vertices at the same location (very important!)**



d.

e. **Ran a definition query on the final <u>intersections</u> layer ICOUNT > 2 to get rid of col de sacs and dead ends (very important!)**

5. Created buffers 600 yards around each school
    a. Selected all intersections within school buffers, called IntersectionsNearSchools
6. Selected intersections within 25 feet of IntersectionsNearSchools and exported to a new layer, DangerousIntersections

Future Directions and Improvements

Unfortunately, I did not have access to where crossing guards are currently stationed. An ideal next step for this project would be to contact local school districts and ask where crossing guards currently are in order to best plan out which of the dangerous intersections highlighted could benefit from another guard. Crossing guards can, to some extent, “direct” the flow of foot traffic, as a pedestrian is more likely to cross near a crossing guard than an unguarded intersection along their route. It is therefore worth investigating real-time foot traffic from children's homes to their school to qualitatively assess which intersections require crossing guards.

Several kinds of community policies can promote walkability. For example, a "bike parade" led by local children and parents is an effective way to provide safety in numbers for children. These kinds of policies are best implemented at the citizen level and are often started by enthusiastic parent volunteers, meaning no money from the city is necessary.

File locations

Original Arcpro project saved under FinalProjectMessy (R:\GEOG482_582_22260_Winter2024\Student_Data\llindros\FinalProject\FinalProjectMessy).

Tables and charts stored under FinalProject.

Please refer to "Process.docx" for information about layers, as well as metadata on most finalized layers of the map.

Jack Madigan

Winter 2024

GEOG 482

Salem Walkability Final Project

Goals

With this project, I aim to indicate which areas of Salem, Oregon are in the greatest need of focus on walkability improvement. To do this, I have created a raster overlay using three sub-models in ArcGIS Pro. This overlay intends to indicate where walkability improvements are likely to be in the highest demand. I have also highlighted several areas using Google Street View imagery, along with specific suggestions on how these areas could improve.

Summary of Recommendations

My analysis layer focused on the entirety of Salem's city limits; however, in practice I will be homing in on the area of Lancaster Drive NE and its surrounding communities. This area has a large proportion of ethnic/racial minority residents, with several census tracts containing majority Hispanic/Latino populations. This is the only part of Salem where minority populations outnumber whites.

In general, I find that the Equity Focus Area is poorly designed for walkability. While errands are technically possible on foot, the walking distance can be very long for those who live in proximity to the Lancaster Drive commercial area. In some areas, infrastructure is harmed by inconsistencies in city limits, leading to fragmented sidewalk coverage and variable quality. Additionally, I find that walking in such a car-centric infrastructure offers pedestrians a certain indignity not found in better suited areas. Walking in the beating-hot sun, surrounded by speeding cars in between parking lots simply makes for an unpleasant, alienating experience.

My first suggestion would be to rezone some of the residentially zoned areas along Sunnyview Road and similar streets into various types of mixed-use zone. This will incentivize the creation of amenities such as shopping to these areas, which are presently very car dependent. I would also encourage collaboration between the city of Salem and the adjacent Hayesville and Four Corners CDP to improve continuity of sidewalk infrastructure in areas straddling the city limits. In general, I find that the city of Salem does a better job in connecting its streets via sidewalk than the neighboring CDPs. Since many in Salem spend great amounts of time commuting to and through these CDPs, I think it is important to seek collaboration for the community's well-being.

In the adjacent image, you can see an aerial view of a predominantly residential area near Trenton, New Jersey. Within the neighborhood, you can find a small mixed-use node containing convenience stores, a pharmacy, and a Dunkin' location. For the surrounding neighborhoods, proximity to amenities is increased without the need for a main thoroughfare. (Link: https://www.google.com/maps/@40.2773479,-74.7804704,587m/data=!3m1!1e3?entry=ttu)

On Lancaster Drive NE itself, I have one primary suggestion. Firstly, I would opt to revamp the sidewalk to have a sizable median between it and the road, which would improve pedestrian safety. There currently is no area along Lancaster Drive NE that has this type of buffer area. To supplement the comfort of pedestrians, I would support the creation of assets such as benches and improved tree cover and landscaping in close proximity to this new sidewalk layout.

At this similar mixed-use thoroughfare in a suburb of Albany, New York, we can see an example of the type of layout and landscaping I believe would improve Lancaster Drive NE in Salem for pedestrians. The sidewalk's position here offers ample shade from trees and a much safer distance from the road, improving both pedestrian safety and comfort. (Link: https://www.google.com/maps/@42.7145191,-73.8129692,3a,90y,235.48h,90.73t/data=!3m6!1e1!3m4!1sFZeo9vw1y1fJR8uKTsJ2Fg!2e0!7i16384!8i8192?entry=ttu)

Methods

In creating my raster overlay of Salem's Walkability Demand, I used three sub-models as weights. My first highlighted sub-model is large parcel density. I used this metric because areas with larger parcels are more likely to have properties and buildings widely spaced apart, signifying an area that may be difficult to access for pedestrians. To create this, I first started with parcel data sourced from Marion and Polk counties. I selected from this data by attribute, taking out the top 5% of parcels by area (Area > 81643). To set up my kernel analysis of density, I first transformed the top 5% of parcels into points using the Centroid feature, placing a point in the center of each polygon. Using these points, I performed a kernel density analysis with a cell size of 20, outputting a density raster. To use this new layer in a weighted overlay, I was required to transform the values in this layer to integers using the Raster Calculator tool. This outputted the final raster, called 'LargeParcelDensity.'

My commercial zone density sub-model underwent a very similar process. I began with the zoning data from the city of Salem. I then Selected by Attribute the parcels with commercially viable zones where people are likely to be employed – in this case Commercial, Industrial, and Mixed-Use. Like for my previous sub-model, I turned the selected polygons into points using the Centroid feature, before performing a kernel density analysis. Finally, I converted the values in this new density analysis to integers using the Raster Calculator tool. This output the final 'CommercialZoneDensity' raster to be used in my final overlay.

My final layer that I used is the Equity Score calculated by the city of Salem and provided to us. Given that my group's focus is on equity, I felt it necessary to include this metric in my analysis. According to the city of Salem, this score is calculated using the following eight categories of data from the American Community Survey:

1. Persons aged 65 or older
2. Persons between the ages of 15 and 17
3. Persons identifying as Hispanic and/or non-white
4. Households with no vehicles
5. Households with limited English
6. Persons at or below the poverty level
7. Persons aged between 18 and 64 with a disability
8. Persons aged 65 older with a disability

"Each category is measured as a percentage of the total population in each of Salem's census tracts. Each percentage is then converted to a score between 0 (lowest percentage) and 100 (highest percentage) in 10-point intervals. Our Beta version Equity Scoring Tool sums the scores across all eight categories for each of Salem's 42 census tracts, giving every census tract a Total Equity Score. Where a project touches two or more census tracts, it is proposed that the project receive the higher (or highest in the case of 3 or more census tracts) Total Equity Score" (City of Salem).

To get this data, I used the provided Salem Census Tract data containing each's equity score. Using the Polygon to Raster tool, I was able to output a raster layer of these equity scores. Since these were already integer values, I did not need to convert them for the final overlay.

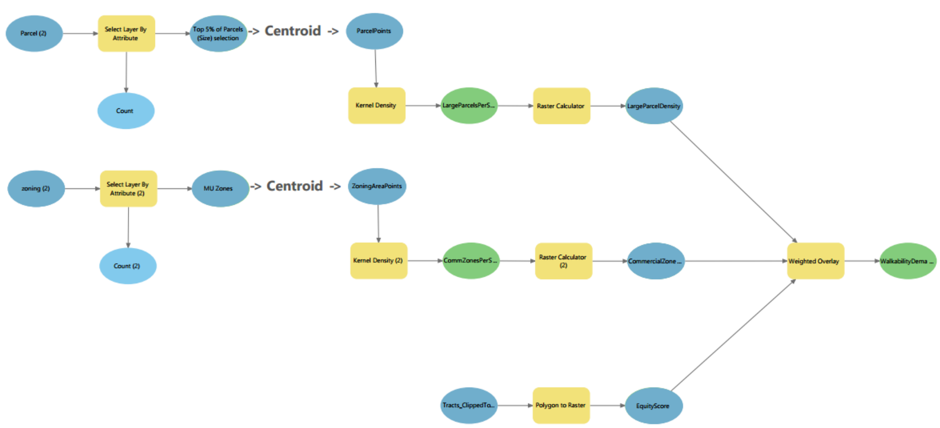
For the final overlay, I input each aforementioned layer into the Weighted Overlay tool. I used the following weights:

- LargeParcelDensity: 30%
- CommercialZoneDensity: 30%
- EquityScore: 40%

I felt that Equity Score deserved the highest weight, as it serves as a composite of several factors that impact walkability. Additionally, given my assigned focus on equity, I felt that this was the best approach for this project. Large parcel density and commercial zone density are also predictors of walkability. For these, I gave each a weight of 30%.

My final overlay, 'WalkabilityDemand,' is an expression of walkability demand in Salem rather than a measure of walkability itself. Demand is measured on a scale of 1-9, with 1 being the highest demand and 9 being the lowest. In my chosen ward of Salem (the area surrounding Lancaster Drive NE), this score nearly uniformly fell within the highest level of demand. This is an area with a very high equity score, large parcels, and high levels of zones where you are likely to find employed people and commuters.

ModelBuilder Graphic:



<u>Supporting Maps and Graphics</u>

Raster Overlays:

Walkability Demand in Salem, Oregon

The city of Salem, Oregon's state capital, is requesting GIS research on the issue of walkability in its city limits. This overlay measures demand for walkability in the city using three measures - the city of Salem's 'Equity Score' data, density of commercially active zones where people are likely to be employed, and density of large parcels, which are likely to experience issues with pedestrian connectivity.

Legend

WalkabilityDemand

Value

- 1.001 - 1
- 1.001 - 2
- 2.001 - 3
- 3.001 - 4
- 4.001 - 5
- 5.001 - 6
- 6.001 - 7
- 7.001 - 8
- 8.001 - 9

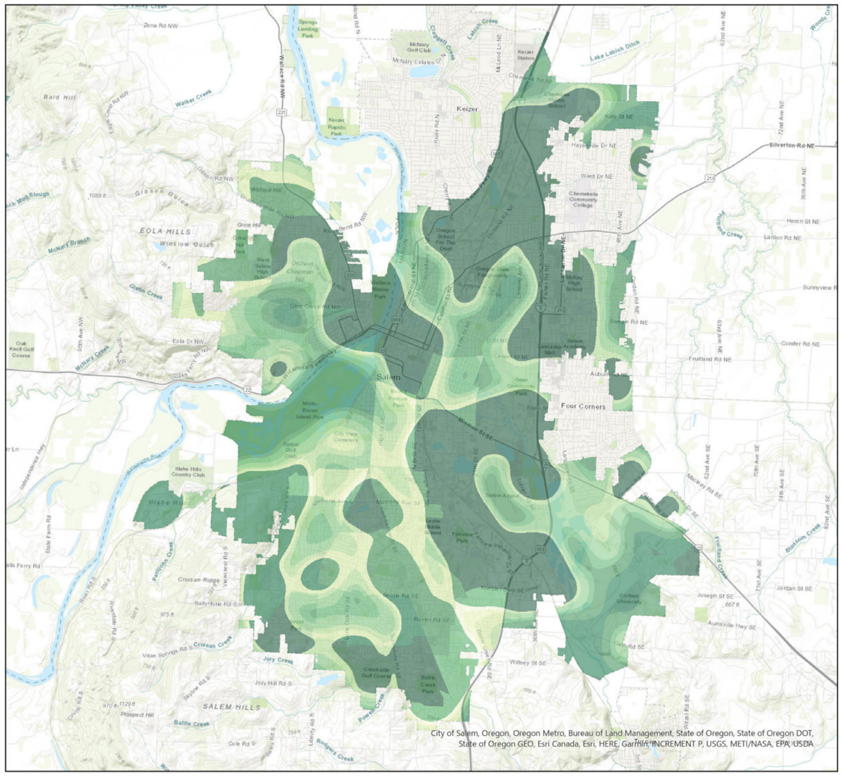
In this legend, '1' indicates the highest demand and '9' indicates the lowest. This demand is calculated through a weighted overlay of the city of Salem's Equity Score data, commercial zoning density, and density of large parcels.

N

0 1 2 4 Miles

Author: Jack Madigan
Data Sources: U.S. Census Bureau, City of Salem

Scale: 1:75000



Walkability Demand in Salem, Oregon

Lancaster Drive NE Ward

The city of Salem, Oregon's state capital, is requesting GIS research on the issue of walkability in its city limits. In this view, we see walkability as it pertains to the four census tracts in the ward closest to Lancaster Drive NE. This ward is in the northeastern part of the city. The area has some of Salem's highest equity scores, large numbers of commercially active zones, and a high density of large parcels.

Legend

Selected Census Tracts in Ward

WalkabilityDemand

Value

- 1.001 - 1
- 1.001 - 2
- 2.001 - 3
- 3.001 - 4
- 4.001 - 5
- 5.001 - 6
- 6.001 - 7
- 7.001 - 8
- 8.001 - 9

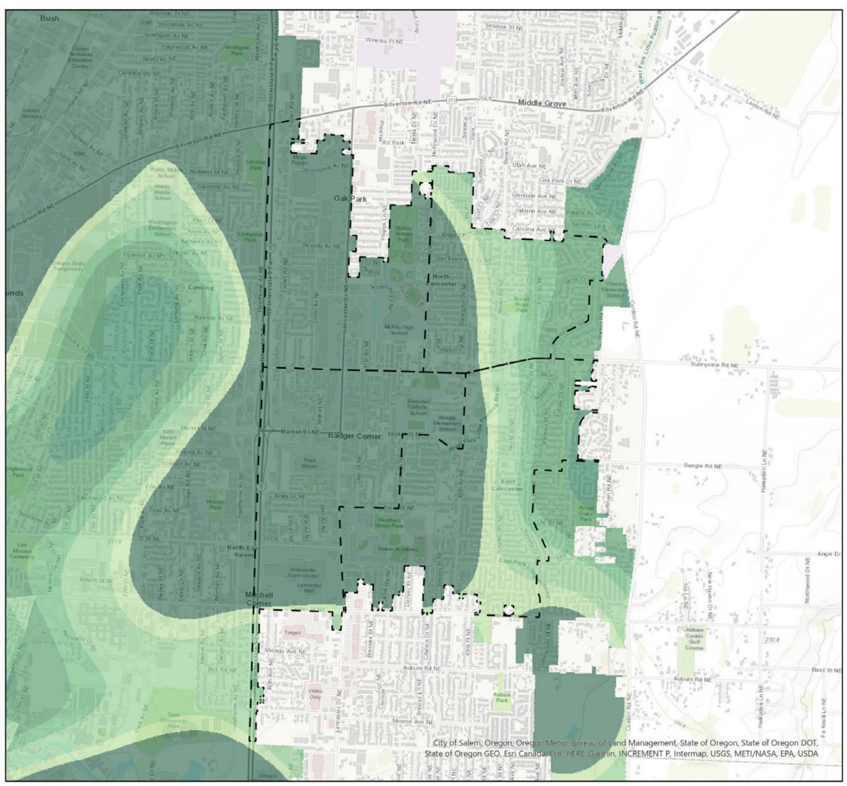
In this legend, '1' indicates the highest demand and '9' indicates the lowest. This demand is calculated through a weighted overlay of the city of Salem's Equity Score data, commercial zoning density, and density of large parcels.

N

0 0.25 0.5 1 Miles

Author: Jack Madigan
Data Sources: U.S. Census Bureau, City of Salem

Scale: 1:10000



Street View Images and Context:

In this image, we can see the extent of the car-centric infrastructure on Lancaster Drive NE. We see a roadway with 6 wide lanes. The sidewalk, while present, is scattered between entrances into various shopping or otherwise commercial complexes We see a lack of trees and natural shading. It is obvious that when this layout was constructed, pedestrian comfort was an afterthought.

Date: Jun 2023

Link: https://www.google.com/maps/@44.949047,-122.9836292,3a,75y,351.01h,90.52t/data=!3m7!1e1!3m5!1s8Si3AcTKxJd9hjyEhQgq2w!2e0!6https:%2F%2Fstreetviewpixels-pa.googleapis.com%2Fv1%2Fthumbnail%3Fpanoid%3D8Si3AcTKxJd9hjyEhQgq2w%26cb_cli ent%3Dmaps_sv.tactile.gps%26w%3D203%26h%3D100%26yaw%3D57.860836%26pitch%3D0%26thumbfov%3D100!7i16384!8i8192?entry=ttu

At the intersection of Lancaster Drive NE and Center Street NE, we can see a sidewalk end as we enter a residential area. The sidewalk does not resume until over 1,000 feet later for a short time at the front of a bowling alley. After this brief interlude, the sidewalk ends again for another 1,500 feet. Worth noting is that only part of this street is located in Salem; the southern half of the street is within the Four Corners CDP.

Date: Jun 2023

Link: https://www.google.com/maps/@44.9397446,-122.9815968,3a,48.5y,77.18h,87.63t/data=!3m6!1e1!3m4!1sWv93B3oSLwtnQHDBw9lw7w!2e0!7i16384!8i8192?entry=ttu

In the residentially zoned areas of the Equity Focus Area, one of the main access roads is Sunnyview Rd NE. For many neighborhoods, Sunnyview along with similarly designed streets are the main routes to access amenities. For such important access roads, these streets feel fairly sparse. We don't see amenities such as corner stores that are of easier access to these neighborhoods – we only see single-family homes and churches. For many in these areas, the walking distance to an amenity such as a grocery store is usually over one mile. In areas with high equity scores such as these, this can pose an issue.

Date: Jun 2023

Link: https://www.google.com/maps/@44.9543867,-122.9709603,3a,90y,266.32h,84.62t/data=!3m7!1e1!3m5!1skXvOoaB3b5lY_PYrXHi07A!2e0!6shttps:%2F%2Fstreetviewpixels-pa.googleapis.com%2Fv1%2Fthumbnail%3Fpanoid%3DkXvOoaB3b5lY_PYrXHi07A%26cb_client%3Dmaps_sv.tactile.gps%26w%3D203%26h%3D100%26yaw%3D186.61487%26pitch%3D0%26thumbfov%3D100!7i16384!8i8192?entry=ttu

Future Directions or Improvements

In the future, I would like to better relate my raster overlay to my overall findings in the Equity Score area. While my raster overlay did do a decent job selecting areas where demand for walkability improvements may be high, it does not necessarily indicate what should or should not be improved without further context. One idea I had for a dataset that could surely improve the map could be a point-based dataset indicating where sidewalk connections are broken or interrupted. I experimented with creating this myself during my research process – however, I ultimately abandoned it due to the difficulty of evaluating this throughout all of Salem with the resources I currently have.

Another factor I would change relates directly to my overlay itself. In hindsight, I would likely have chosen a different sub-model rather than Parcel Size. While this does indicate areas where implementing walkability infrastructure may be difficult, it does not necessarily indicate the presence of demand for this infrastructure. For example, while walkability may be in demand in areas with large parking lots and strip malls, walkability is not at the same level of demand in the middle of an industrial park. Despite this, my sub-model gives equal weight to both of these examples.

Citations - The following works informed this report in some shape or form.

City of Salem. (n.d.). Equity Scoring Explanation. Salem, OR.

City of Salem. (n.d.). Equity Scoring Map. Salem, OR.

Rattan, A., Campese, A., & Eden, C. (2012, Winter). Modeling Walkability. https://www.esri.com/news/arcuser/0112/modeling-walkability.html

Data Layers and Symbology

Since all of my files are located on my own PC and cannot be added to the R: Drive, I will be sharing these using the following ArcGIS Online link: https://uo-online.maps.arcgis.com/home/item.html?id=6fad0bc79fbb468a848122f3b58c54ee

Upon downloading, the layers along with their symbology can be accessed easily in ArcGIS Pro.

If there is any other way I can get this layer package over, let me know via email (jmadigan@uoregon,edu). However, given my current circumstances this is the best I could figure out.

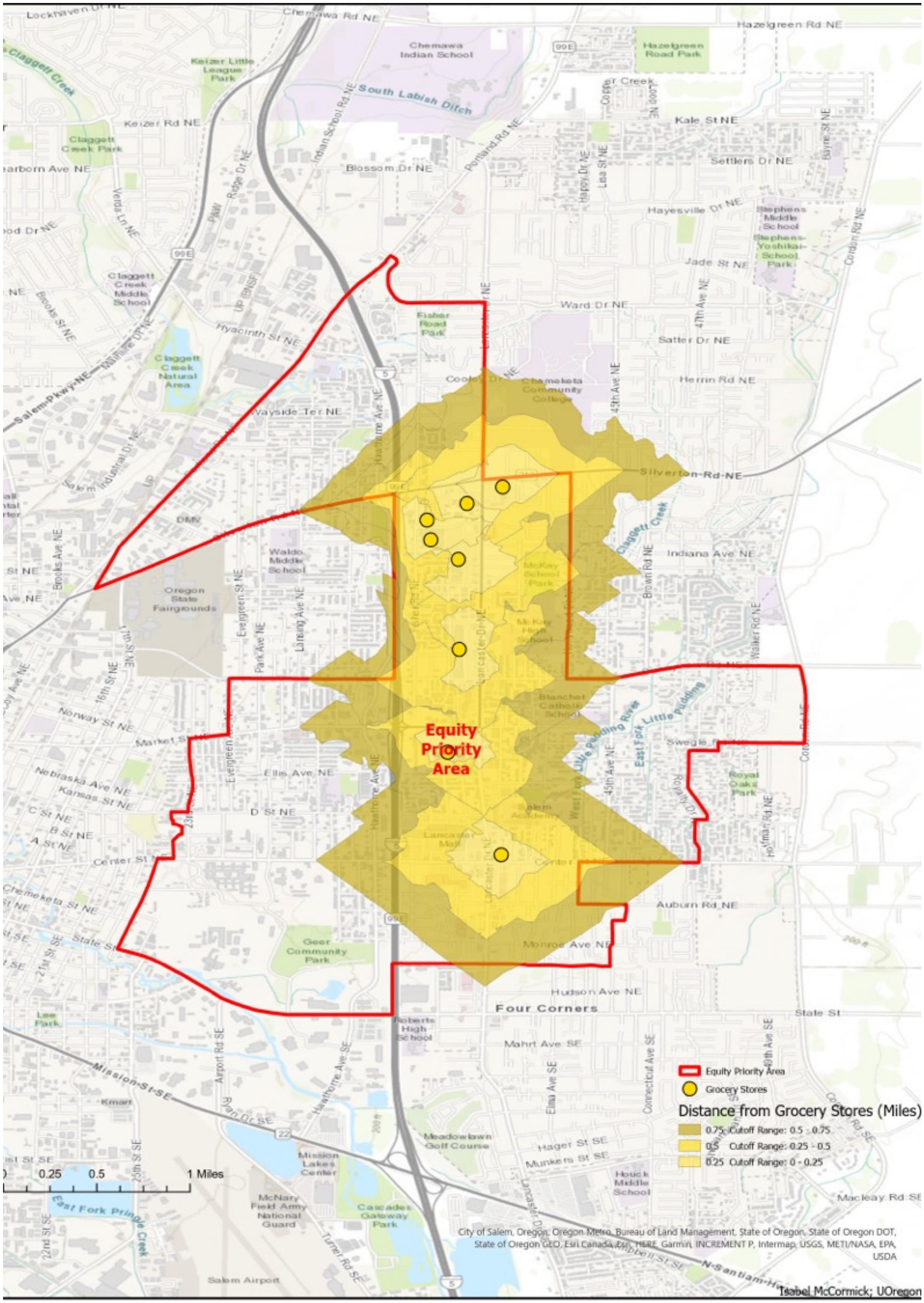
Final Project
Isabel McCormick
19 March 2024

Goals:
The area I am focusing on in this project resides in the neighborhood of Northeast Salem (Equity focus group area). With the neighborhood being of low equity, there is a high possibility that when choosing between walking or driving, individuals will choose the faster option. This is due to the convince that cars provide. By constructing more clusters and accessible stores in the given area, more people will be able to complete their daily errands. I think that we should remove the gas stations in the area, replacing them with daily errand stores. This will create a negative connotation towards getting gas, alluring more walkers (it will be more work to get gas then to walk to the store). It will also give people living in residential zones an alternative option to walk, rather than drive.
I do think there is a larger scale problem here. It has become socially normal to buy a property in a secluded area (suburbanization). Therefore, companies are regulating their business in 'busier' areas. Their business' will strive more in an area that is surrounded by partnering shops, rather than an area that most residents reside in. People's subconscious notion is to use a car to complete an errand, rather than walk. It is how they grew up; it is normalized. I think that we should be using our resources to disband from car dependency. We should be merging the commercial and residential zones.

Methods:
I think the best way of describing this data is by doing two separate things; demonstrating the current walkability of the given area and analyzing the given gas stations which can potentially be constructed into daily errand buildings or complexes.
In the first graphic I want to use Salem's features data set (found in our Class Data folder). I would have to find the features located within the equity barriers (select by location). I then would use 'select by attribute' and condense the layer to the grocery store features. I am choosing this variable because it is one of the most common "daily errand" tasks. Then, I would use network analysis to demonstrate the walkability outreach. Keep in mind this does not consider the safety of said walk, but rather demonstrates the distance one could travel from the given feature. This would be my first graphic. From lab 4, I hypothesize that most grocery stores will be situated on the west side of the zone. This is due to the neighborhood's relation to the freeway. Stores are usually located near a transport system because it saves them time, resources, and, most importantly, money. It also increases their revenue due to the idea of clustering (Hoteling's Model of Spatial Competition). Business' want to be present in an area that is highly attractable to customers. The issue with this is that there is a decrease in demand to build stores in residential areas.
So, to solve this problem we should blend the residential and commercial zones. As stated above, I think that we should locate the gas stations and analyze their walkability outreach. Because there is no gas station attribute in the feature class data layer, I would need to attain the data through an outside recourse. For this project, I used Google Maps. Through Google Maps, I can convert the point features of Salem's gas stations into a KML file. I then can add this file into my data folder and use the 'KML to Layer' tool to convert this data into editable points. From here, I can essentially do the same process. I would use 'select by location' on the point layer and export the features within the equity focus layer. Then, I would use network analysis to determine its

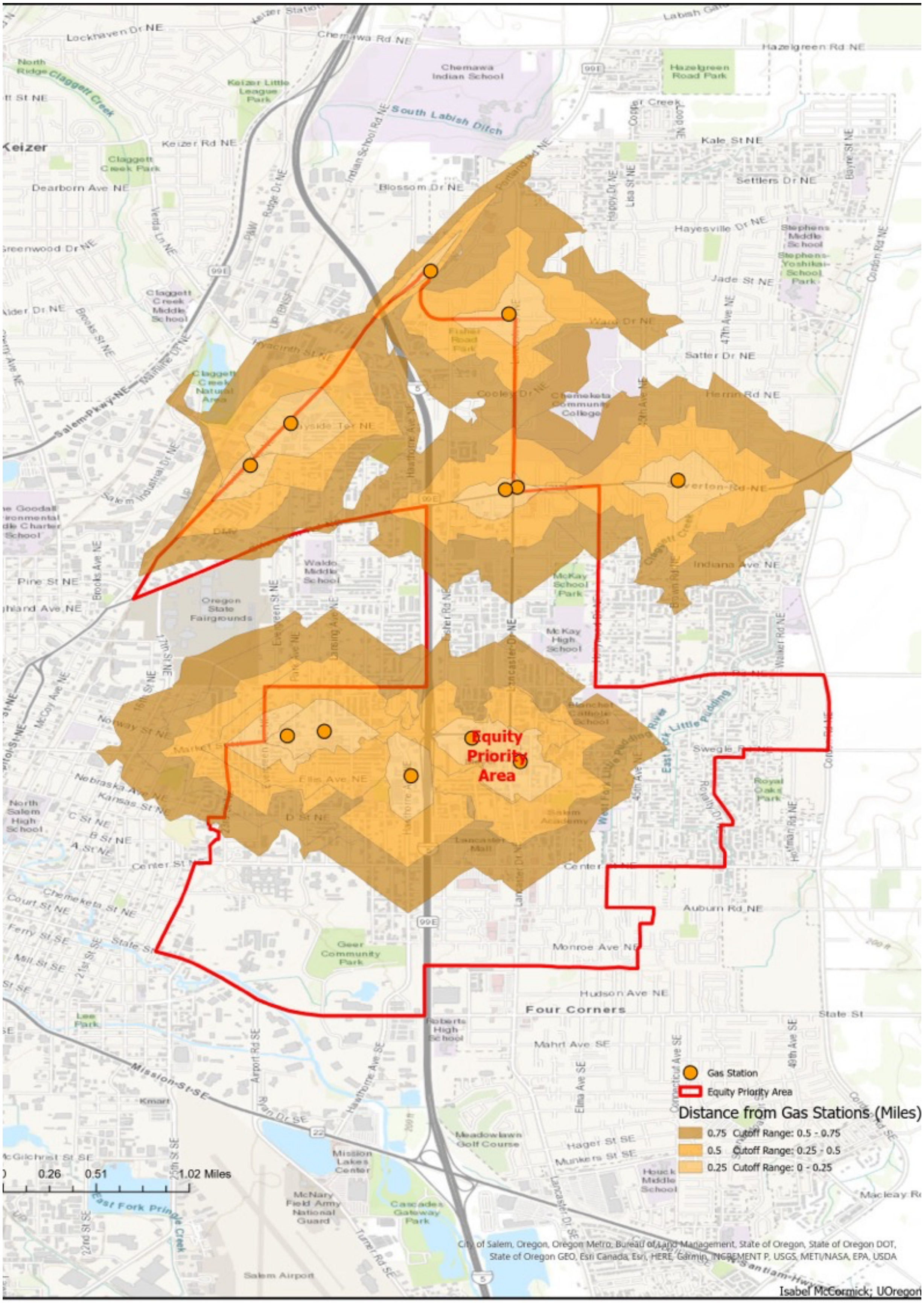
walkability outreach. Gas stations are one of the few commercial properties built near or inside residential areas. By building daily errand stores in a residential area, there should be an increase of walkability to that store.

Supporting Maps and Graphics:



The Walking Distance from Salem's Grocery Stores

Location: Equity Priority Area (North and East Lancaster Neighborhoods)



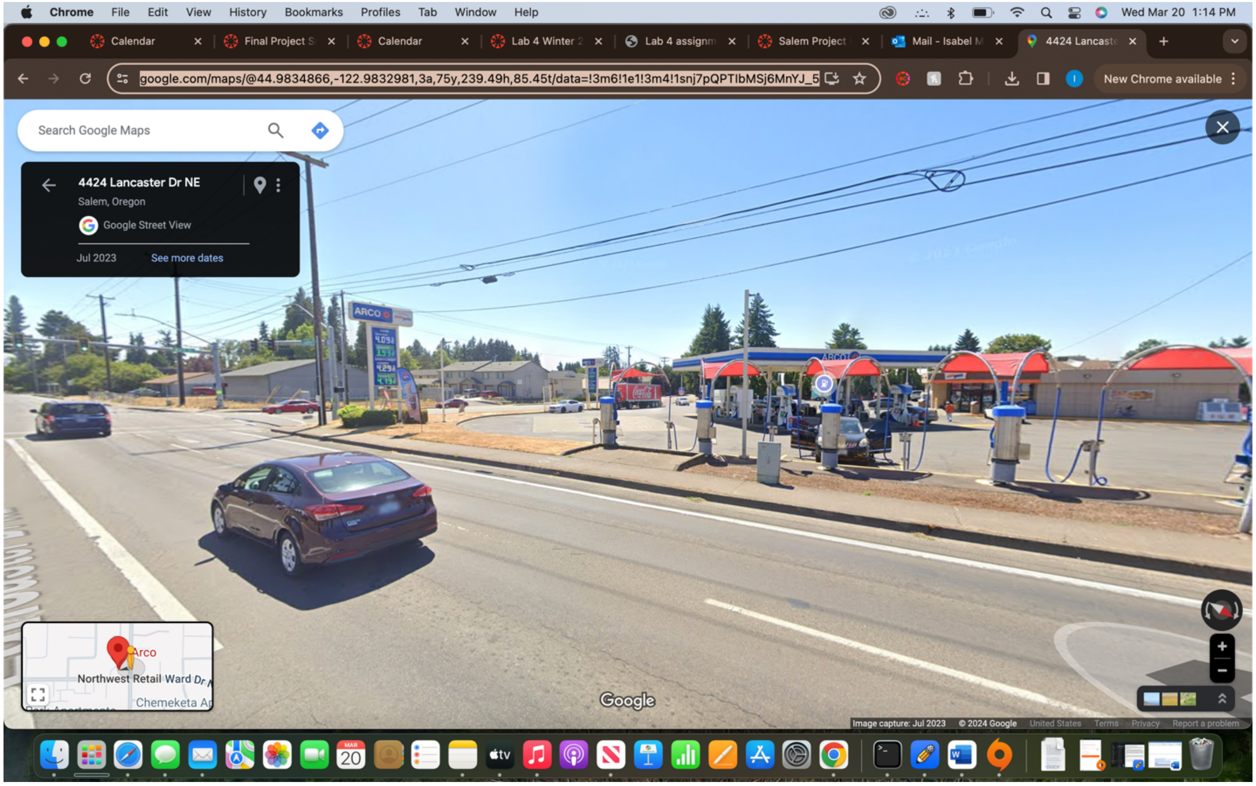
The Walking Distance from Salem's Gas Stations

Location: Equity Priority Area (North and East Lancaster Neighborhoods)

N

https://www.google.com/maps/@44.9494445,122.985501,3a,75y,254.71h,94.82t/data=!3m6!1e1!3m4!1sAQL-azFRlBRt2DcW3yNfFA!2e0!7i16384!8i8192?entry=ttu+

This is one of the several shopping centers located on the western half of the neighborhood. A shopping center provides convenience to residents because they can complete multiple of their errands at one stop. Although, in the future I would like the US to disband from shopping centers because they do not encourage walkability from outside neighborhoods, building them in residential areas will be a good starting point.



https://www.google.com/maps/@44.9834866,-122.9832981,3a,75y,239.49h,85.45t/data=!3m6!1e1!3m4!1snj7pQPTIbMSj6MnYJ_5scw!2e0!7i16384!8i8192?entry=ttu

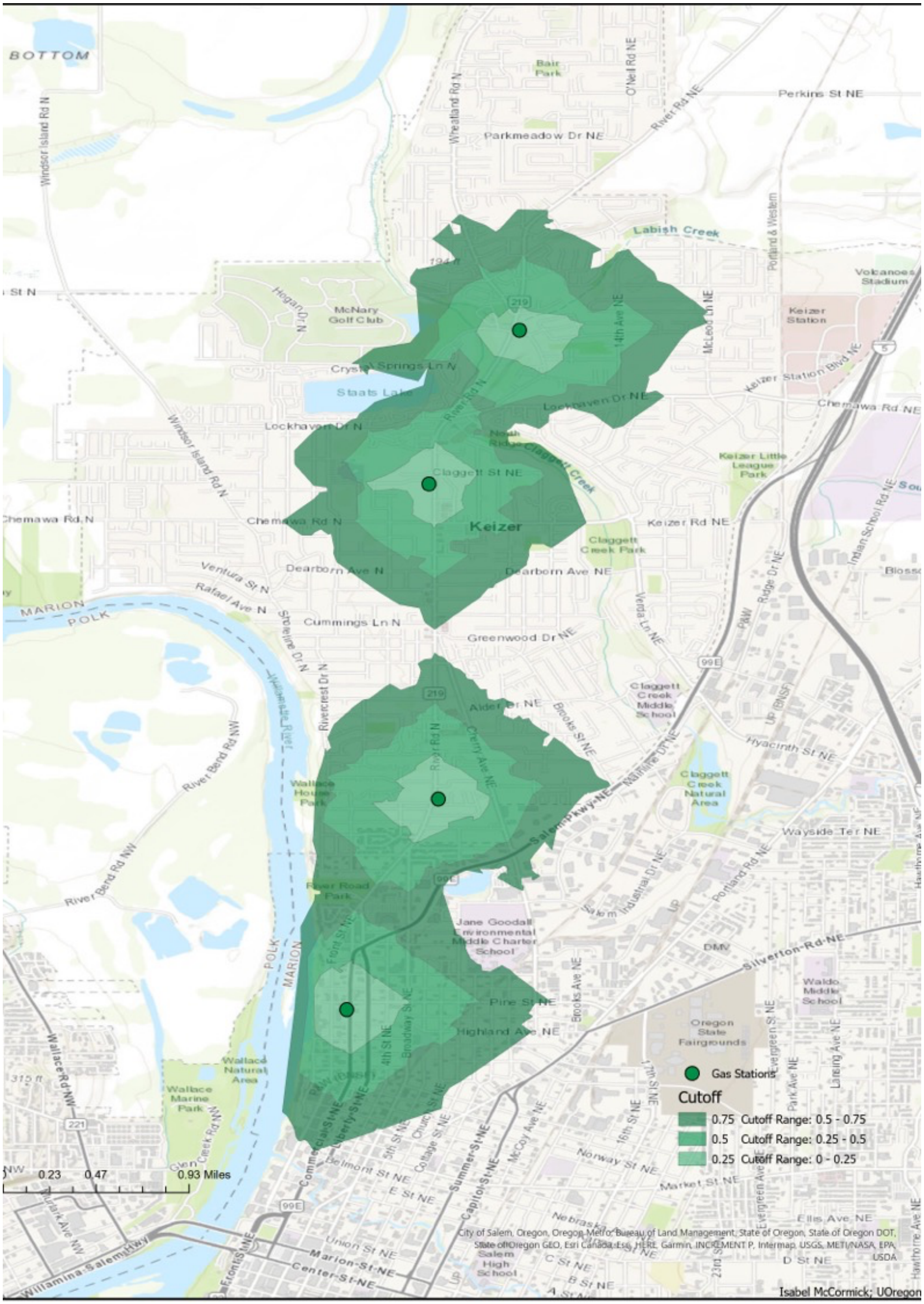
This is a screenshot of a potential gas station that can be reconstructed to a more versatile store. Notice the residential areas in the background, supplying easy access to a future development.

Future Directions and Improvements:

The biggest issue with this plan would be the social drawback of removing gas stations in a low equity area. I choose this area due to the likely possibility that lower income individuals would essentially be more burdened to get gas, increasing the likelihood of walks as a transportation mechanism. This area also already has a public transportation system engraved in its infostructure.

However, some may see this removal as an act of limiting the poor from potential opportunities. In that regard, I thought about deconstructing gas stations in a high-income neighborhood. However, with the wealthy generally having more time and finical means, I am not satisfied that the drawing factor will be significant enough, that being individuals won't feel upset enough to start walking to stores. People can also take the social standpoint that the city is only improving higher income areas.

For these reasons, I believe that the future directions of this plan should incorporate both low and high equity areas. Start the process from either side of the spectrum to limit the reactions of both social drawbacks. There is a figure below that demonstrates the possible gas stations located in Keizer Neighborhood that could be deconstructed to daily errand stores.



The Walking Distance from Salem's Gas Stations

Location: Inequity Area (Keizer Neighborhood)

N

Citations Page:

Google Maps: Salem's Gas Stations (Equity Focus Area)
https://www.google.com/maps/d/u/0/edit?mid=1yIM3Z-5n29ZL2m5x3z4r5_muxPEu1PI&usp=sharing

Google Maps: Salem's Gas Stations (Keizer Neighborhood)
https://www.google.com/maps/d/u/0/edit?mid=1ecxQS29-bPuQrRm02kpOZ4tXVGtMmnE&usp=sharing

Miranda Mell
March 21, 2024

Walkability Recommendations for Salem, OR – Final

Goals:

This project aims to provide recommendations to improve the walkability of Salem based on the results of a geospatial analysis assessing comfortability factors throughout the city. The recommendations are specifically focused on Ward 6 of the city, a high-priority equity area.

Summary of Recommendations:

The walkability of a city is an essential factor in fostering a connected and healthy community. Similar to many cities in the United States, Salem has many opportunities to improve the walkability of its street network and foster a more positive walking experience for residents. To accomplish this, planning staff must consider street features that create a comfortable environment for pedestrians to travel at ease on sidewalks. There are many contributors to the comfortability of a walking experience, some of which include shade and rain cover, noise, connectivity, perceived safety, lighting, aesthetic interest, and more (Maghelal & Capp, 2011). I will address the noise and connectivity components in my recommendations.

Figure 3 shows a comfortability of walking analysis of Ward 6 based on key data layers: traffic counts, sidewalks above 500 feet in length, and reported sidewalk concerns. Areas in red, orange, and yellow model highly concentrated comfortability detracts and therefore areas for planning staff to focus on in future projects.

High noise levels are identified as a source of discomfort for pedestrians (Shammas & Escobar, 2019). As modeled in Figure 1, many sidewalks in Salem are directly adjacent to busy, noisy streets. This creates an uncomfortable walking environment for pedestrians and can lead to feelings of danger. Widening sidewalks or adding new vegetation like bushes or trees can create a perceived buffer between the sidewalk and the street. Similar strategies like urban parks can also reduce noise levels in cities. Creating a protected bike lane is another way to address this concern as pedestrians feel more comfortable walking near bikes than cars.

Creating a more connected street network, designed for pedestrian mobility rather than vehicle mobility increases the comfort of walking because it is easier to navigate safely (Telega et al., 2021). Lancaster Dr, depicted in Figure 2, is an example of a streetscape that lacks connectivity as there are long blocks with minimal explicit, protected pedestrian crossings. Creating more pedestrian crossings and bridges would address this issue. These should be focused on areas with parks, schools, restaurants, and other amenities that people walk to.

Methods:

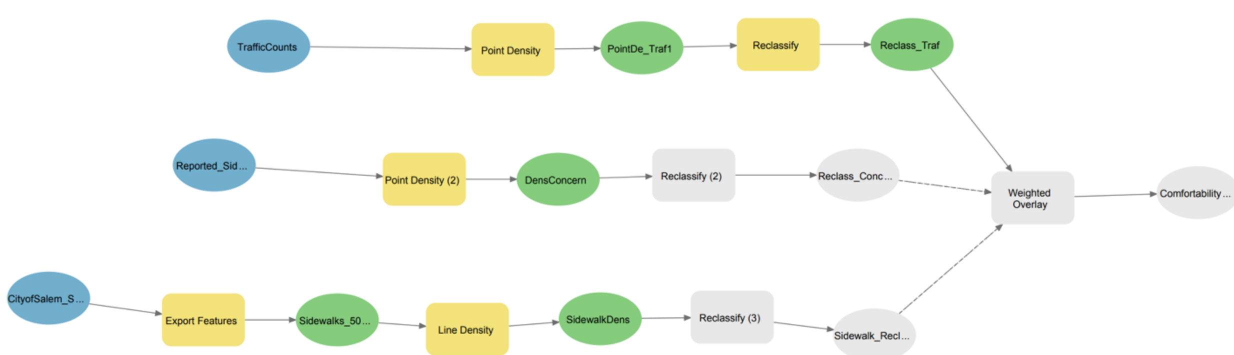
To assess the comfortability of walking, I used the following data layers: traffic counts (correlates to street noise), reported sidewalk concerns, and sidewalk lengths above 500 feet. I used 500 feet as the maximum because longer streets are difficult to navigate efficiently and safely for pedestrians and generate faster street traffic.

My first step in the analysis was exporting the sidewalks above 500 feet in length from the City of Salem Sidewalk layer to create a new data layer. I then ran a line density analysis to determine the areas where sidewalks above 500 feet are concentrated and convert the vector data of sidewalks into a raster density surface. I followed a similar process for traffic count and reported sidewalk concerns, but I used the point density tool. Once all the sub-models were raster layers, I reclassified them on a scale of 1 to 10. 10 correlates to the least comfortable areas to walk in. This reclassification allowed me to conduct a weighted overlay of the layers. I assigned equal weights to the sub-models as they have equal importance in curating a comfortable walking experience.

The final overlay reveals patterns in the comfortability of walking throughout Salem. This overlay is most applicable to times throughout the day when traffic counts occurred. I found that there are areas of concern dispersed throughout the center of the city while the outskirts of Salem enjoy the most favorable comfortability factors. The most concerning areas are in Ward 6, Ward 5, Ward 7, and Ward 3. As a member of the equity group, I will focus on Ward 6 which has a high concentration of disadvantaged demographic groups.

This overlay highlights areas that need improvements in walking comfortability. This can be achieved through additional landscaping which would minimize some street noise and provide more aesthetically pleasing things to look at which would improve a walking experience. This could also be improved by adding mid-block crossings and connected pass-throughs to address lengthy sidewalks.

This workflow process is shown in this model:



Supporting Maps and Graphics:

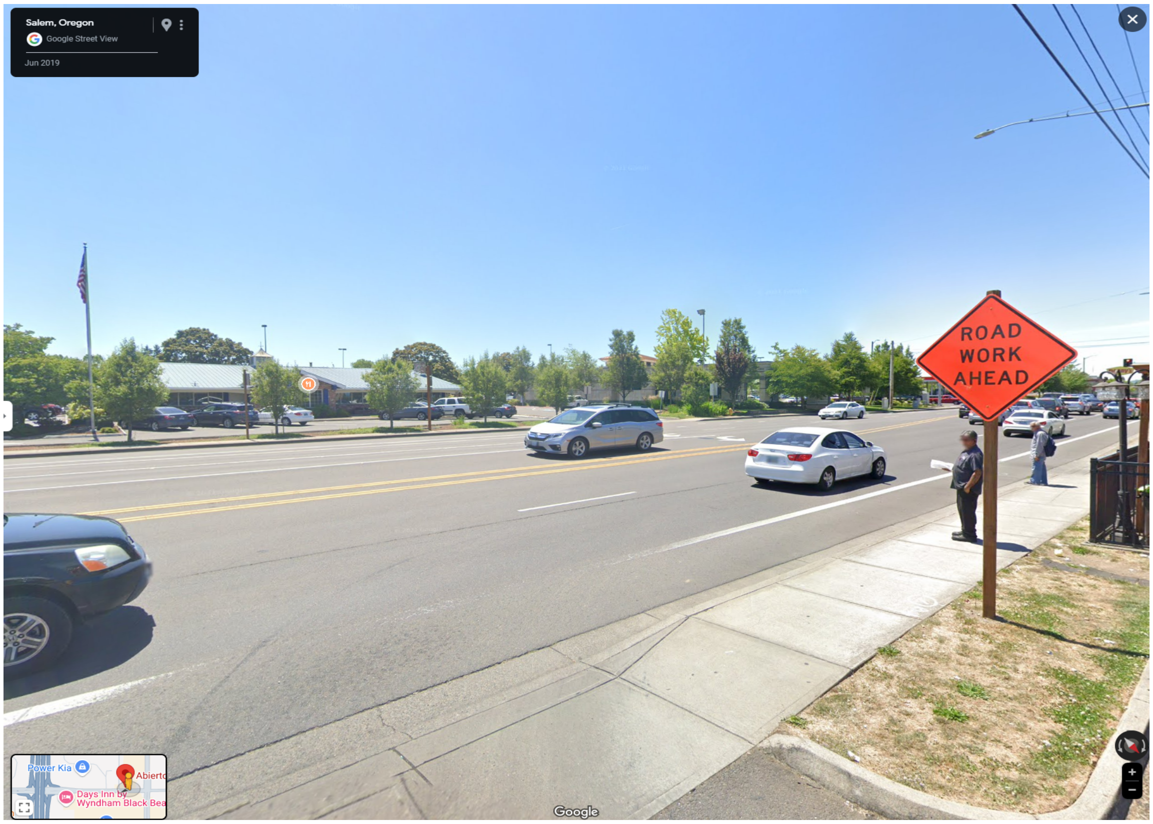


Figure 1: https://maps.app.goo.gl/1pRoikqQ7ewH8GL69

Figure 2: https://maps.app.goo.gl/Fc9V5JddTxKKvF957

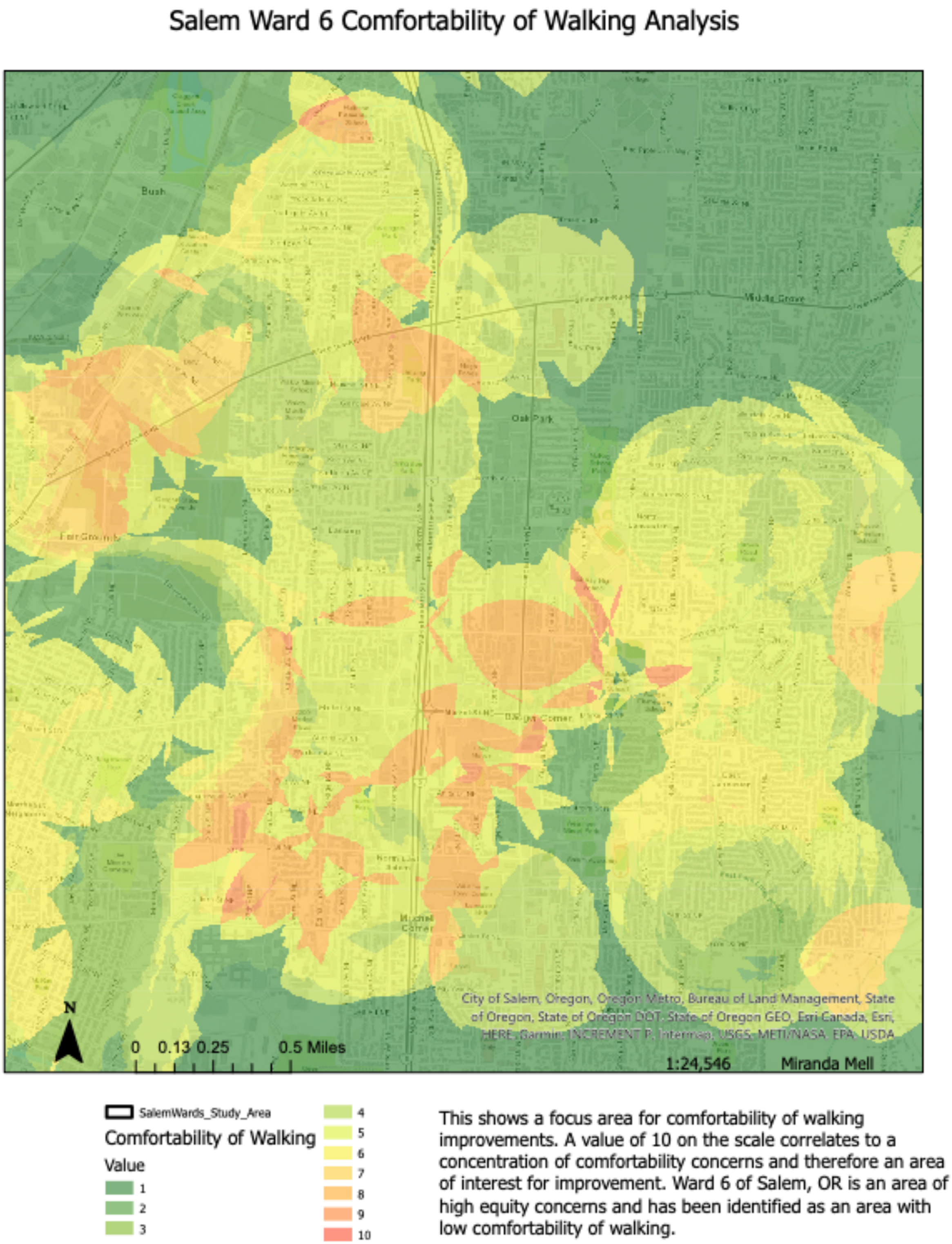


Figure 3

Future Directions and Improvements:

The comfortability analysis can be improved in many different areas. Refining the layer of sidewalks above 500 feet in length to exclude blocks with existing pedestrian crossings would create a more representative dataset of concerning factors. Additional datasets would also help to create a more refined representation of comfortability concerns. This could include a dataset of the canopy cover throughout the city which would provide information on the shade and rain cover present throughout different times of the year. A noise map of the city would also be a helpful dataset as it would capture specific noise levels rather than a more generalized representation of traffic-related noise.

Data Layers and Symbology:

Model location:
R:\GEOG482_582_22260_Winter2024\Student_Data\mmell\FinalProject\Model.pdf

Layer Package location:
R:\GEOG482_582_22260_Winter2024\Student_Data\mmell\FinalProject\ComfortabilityAnalysis.lpkx

ArcProProject location:
R:\GEOG482_582_22260_Winter2024\Student_Data\mmell\FinalProject\Lab3_SalemWalkability_Mell.aprx

Citations:

Al Shammas, T., & Escobar, F. (2019). Comfort and time-based Walkability Index Design: A GIS-based proposal. *International Journal of Environmental Research and Public Health*, *16*(16), 2850. https://doi.org/10.3390/ijerph16162850

Maghelal, P., & Capp, C. (2011). Walkability: A Review of Existing Pedestrian Indices. *Urban and Regional Information Association Journal, 23(2). https://www.researchgate.net/profile/Praveen-Maghelal/publication/279588344_'Walkability_A_Review_of_Existing_Pedestrian_Indices'/links/597ee5c00f7e9b8802eaf8d4/Walkability-A-Review-of-Existing-Pedestrian-Indices.pdf*

Telega, A., Telega, I., & Bieda, A. (2021). Measuring walkability with GIS—methods overview and new approach proposal. *Sustainability*, *13*(4), 1883. https://doi.org/10.3390/su13041883

Tessa Wright

GEOG 482

March 21st, 2024

Salem Final Project

The goal of this project was to conduct a raster overlay analysis that constructed a suitability index showing walkability in Salem, Oregon. This was done by integrating factors like bus stops, streetlights, and grocery stores to generate a walkability index map. The overall objective was to identify areas within Salem that need walkability improvements. My focus area was the Equity Tract, especially the Lansing and Lancaster zones; through analysis, I will seek to provide valuable insights about this area to city partners.

To enhance walkability in the Salem area, specifically the Lansing/Lancaster zone, I located street lighting, grocery stores, and bus stops within walking distance of underprivileged residential areas. When locating grocery stores, I saw only eight stores in the area, which were far from core residential neighborhoods. This was similar to bus stops; these stops were only located on main roads. While there was a high amount, there were far to walk if you lived in the neighborhood. Additionally, when examining street lighting, there were mixed results, with some areas having a large amount and others having little to none. Extensive areas with none usually surrounded the areas with a large amount.

Several things can be done to improve the limitations listed above. Firstly, the placement of grocery stores and bus stops should be evaluated to ensure access for all neighborhood residents. More stores and bus stops should be integrated into core neighborhoods instead of just along the main roads. By establishing new grocery stores or expanding existing ones closer to core residential neighborhoods and augmenting bus stops to include more stops within residential areas, the reliance on vehicular transportation can be reduced, encouraging more walking as a mode of transit. Community engagement in these processes should also be implemented in the decision-making process regarding the placement and design of new amenities. By doing this, the city can gather valuable insights into the specific needs and or preferences of the neighborhoods. That will also promote ownership and empowerment among residents.

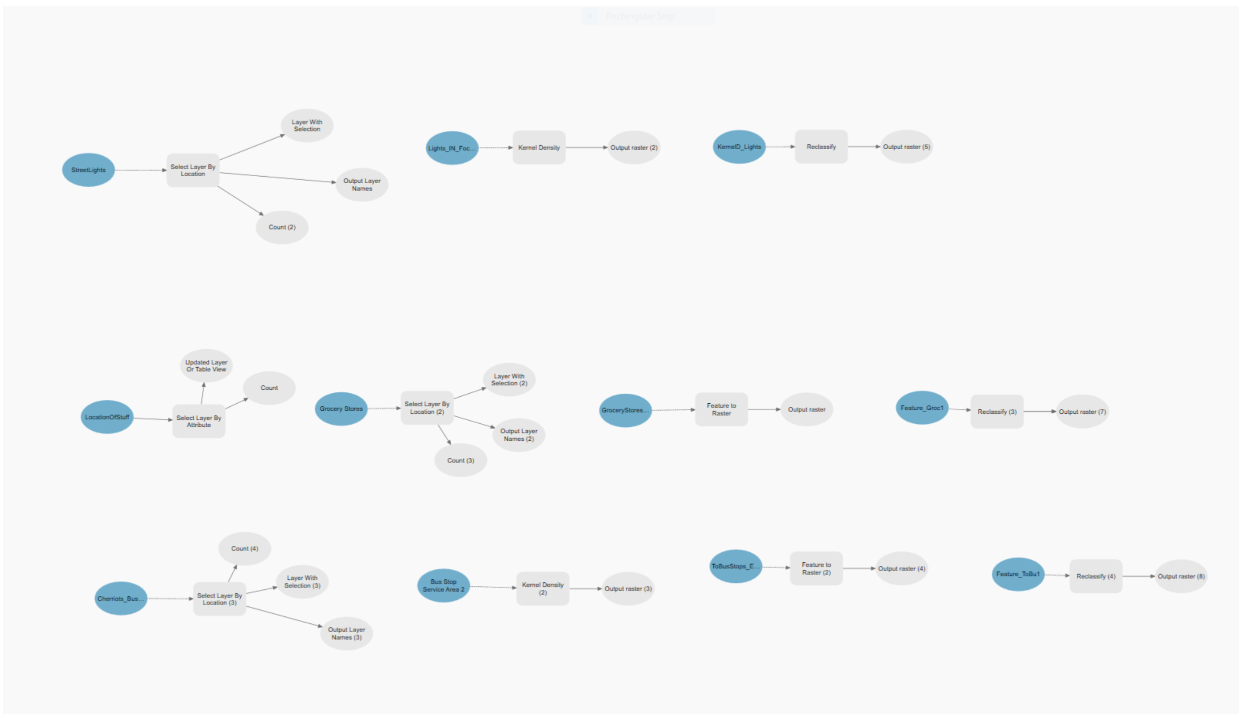
https://maps.app.goo.gl/iPVvCcY9kPj9cKYh6

Additionally, addressing the lack of streetlights is crucial; implementing lights where they are lacking will enhance driver safety and pedestrian visibility. The absence of adequate lighting in this neighborhood presents a safety concern for pedestrians walking at night and discourages walking. By adding more streetlights, the city can create a safer and more inviting walking environment for pedestrians. In the photo above, a notable section of a neighborhood only features one streetlight. This problem enhances the risk of pedestrian travel at night, not only compromising safety but also leaving residents with a feeling of uncertainty when traveling on foot at night. Worries can be eased by addressing this problem and ensuring that residential areas are properly illuminated. By addressing the disparities in the Lansing/Lancaster area and implementing new infrastructure, the city can create a more walkable and equitable environment benefiting all Salem residents.

In developing a comprehensive understanding of walkability patterns in Salem, I focused on three key factors: street lighting, grocery store locations, and bus stops. Understanding how vital these components are to providing accessible pedestrian infrastructure allowed me to conduct a detailed analysis of the allocated equity area. Street lighting is crucial in enhancing pedestrian safety, such as preventing crime and pedestrian visibility for drivers. At the same time, the availability of grocery stores ensures residents have access to essential goods within walking distance. Strategically placed bus stops enhance accessibility and connectivity by allowing residents to move around the city effectively without requiring their vehicles.

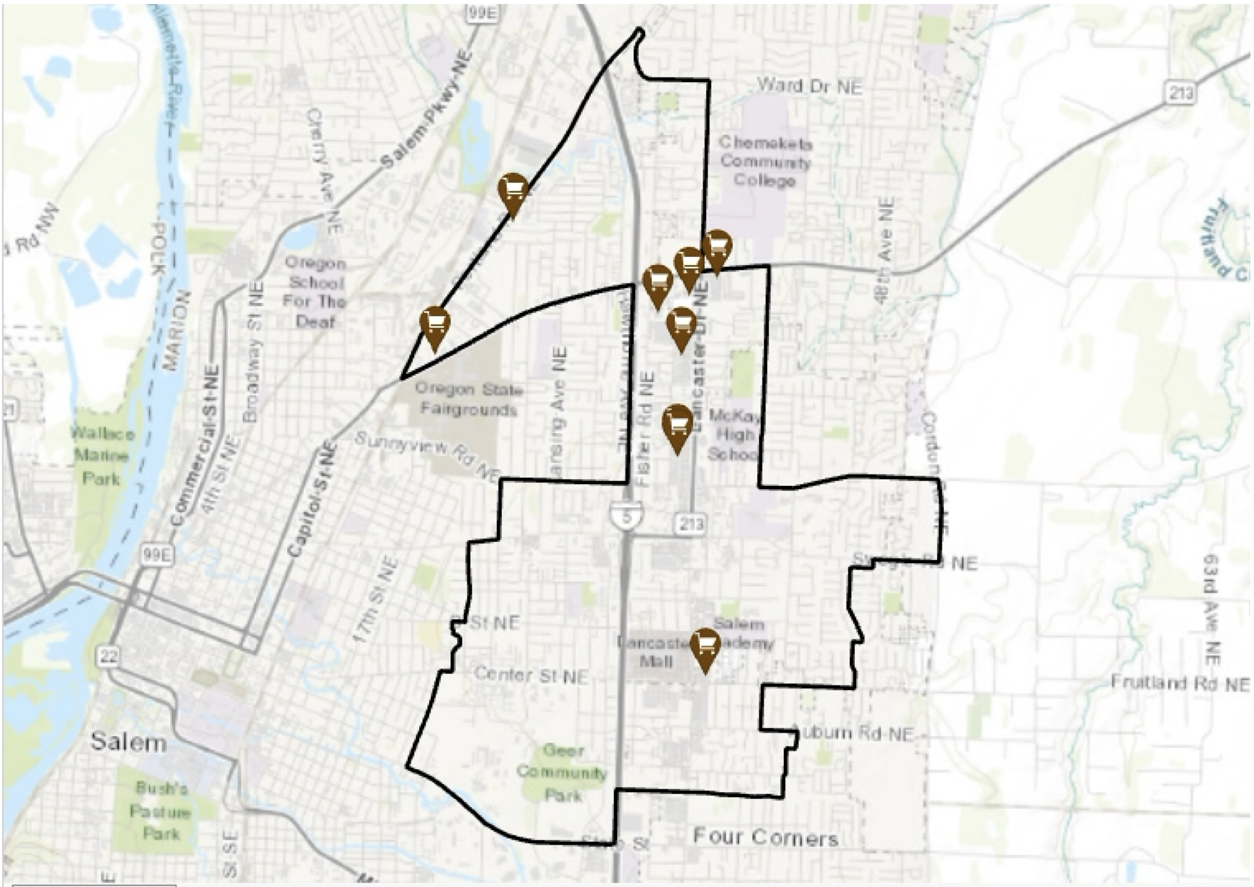
Using spatial analysis techniques such as kernel density and selection by location tools, I identified areas within the Lansing area that lacked adequate street lighting, grocery stores, and bus stops. I began by narrowing down the input data to be only in this specific zone of Salem by performing a selection by location on all data. I began by analyzing the street light data, starting with the data layer " StreetLigthts," which included all the street lights in Salem. I performed a select by location and then got the later 'Lights_IN_FocueArea." This led me to perform kernel density, which gave me the outpost rater of "KernleID_Lights." Once that was done, I reclassified it and made it Kernel Street Lights.

I also found where grocery stores are located in the area similarly using the data layer "LocationOfStuff" and then executing select layer by location, which led me to the layer "Grocery Stores," which I then narrowed down to "GroceryStoresFocus" by performing select by location, and then a feature to raster leaving me with "Feature_Grocery1". With that last layer, I reclassified it, leaving me with "Grocery Store Locations." For bus stops, I performed the same sequence as I did for the street lights, including a feature to raster. Starting with "Cherriots_Bus," select a layer by locations into "Bus Stops Service Areas 2" kernel density to "ToBusStops_Export" feature to raster "feature-ToBus1" reclassify finally to "Bus stop service areas. When choosing each layer weight, I thought none was more important than the other; thus, I made them all equal.



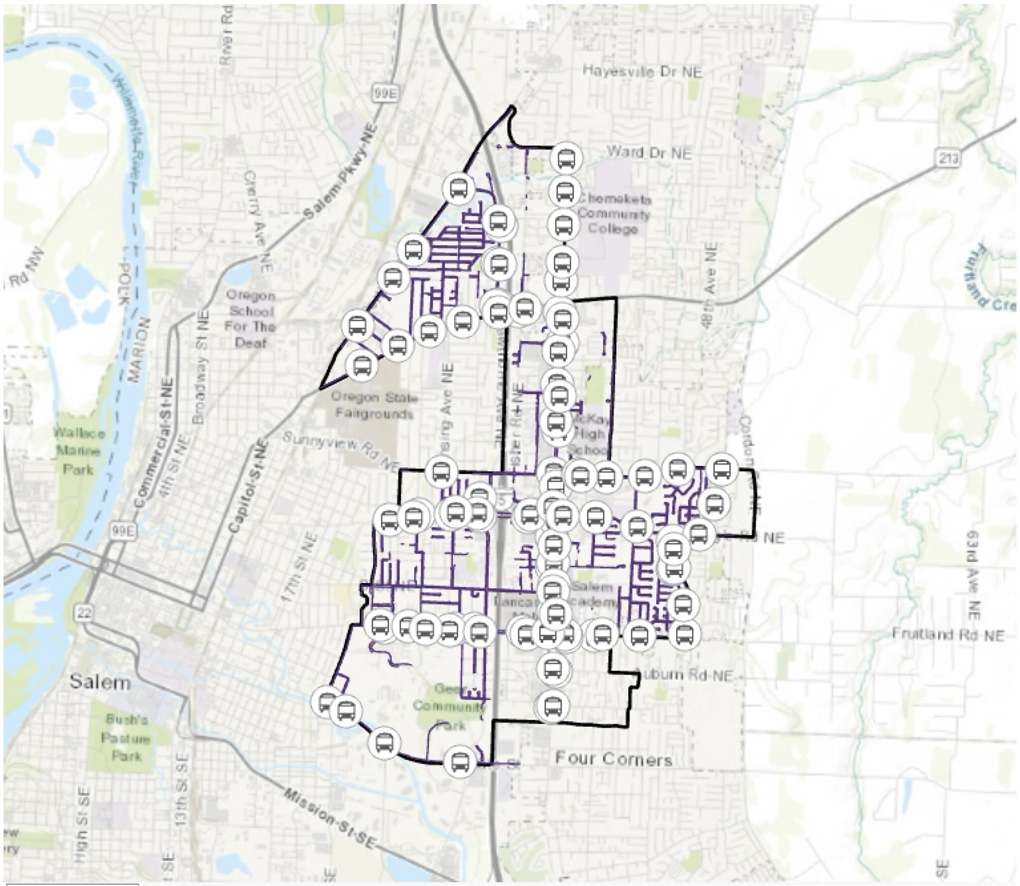
Here is the map to better show the tools and methods used in this project. My ModelBuilder can be found at twright2 > Lab3 > SalemWalkability.atbx > toolboxes > FINALmodel

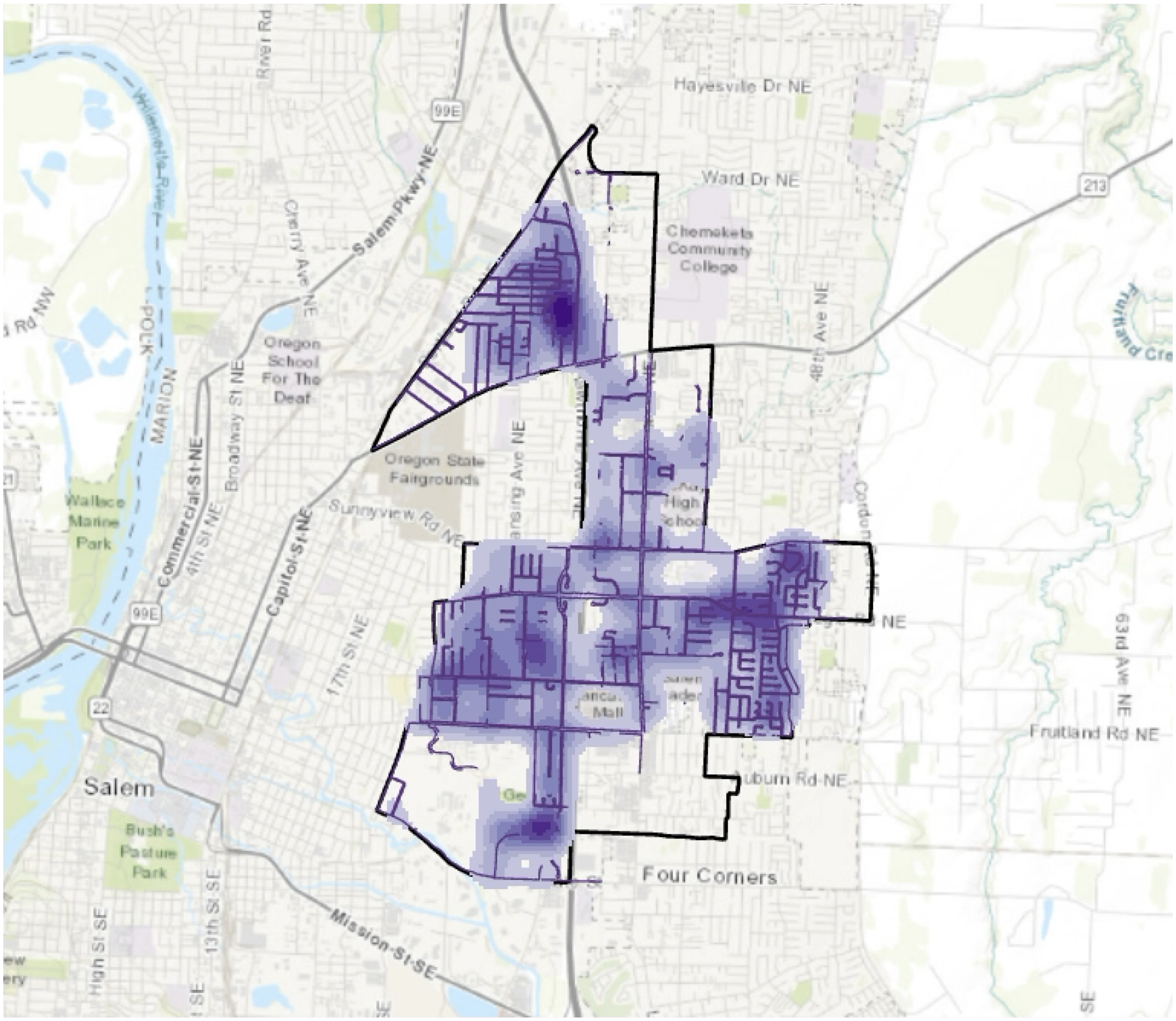
Supporting Maps



Locations of Grocery stores across the Equity tract.

Bus stops in the tract.





Kernel density map of street lights in the area.

Moving forward, the city can take several different directions for improvement. Firstly, it can introduce and integrate more datasets that focus on pedestrian infrastructure, such as sidewalks, conditions of sidewalks, crosswalks, streetlight count, grocery store scones, and bike lanes. This will offer a better understanding of walkability in the city and help easily identify areas lacking walkability. Additionally, investigating new GIS techniques could help yield new models of neighborhoods that give deeper insights into the factors of walkability. Using methods not used before, the city can see new spatial patterns and relationships that might not have been seen before. By applying these recommendations, the city can refine the streets and provide ease of walking for all of Salem's residents.

Citations:

How Kernel Density works. Pro.arcgis. (n.d.). https://pro.arcgis.com/en/pro-app/latest/tool-reference/spatial-analyst/how-kernel-density-works.htm

Salem neighborhoods on Walk Score. Walk Score. (n.d.). https://www.walkscore.com/OR/Salem

Select layer by location (data management). Select Layer By Location (Data Management)-ArcGIS Pro | Documentation. (n.d.). https://pro.arcgis.com/en/pro-app/3.1/tool-reference/data-management/select-layer-by-location.htm

Use modelbuilder. Use ModelBuilder-ArcGIS Pro | Documentation. (n.d.). https://pro.arcgis.com/en/pro-app/3.1/help/analysis/geoprocessing/modelbuilder/modelbuilder-quick-tour.htm

Data layers and symbology: Save your ArcPro project work and any key results layers in a "FinalProject" folder in your userspace on the R: drive.

- Provide a list of the layer packages and the location of the folder.
  - Located in twright2 > FinalProject
  - GroceryStores
  - BusStops
  - Streetlights
- Provide the name of the ArcPro project(s) used for work on your final project and its location on the R: drive
  - Lab3v2 > Lab3_SalemWalkability

* I was unable to do the final weighted overlay; Mady said that it was fine to turn it in without *

Climate-Friendly Areas Group

Aidan Austin
GEOG 482,
Final Project
1/19/2024

SCYP - Salem Walkability Final Project

Introduction

The City of Salem has partnered with the University of Oregon through the Sustainable City Year Program (SCYP). The SCYP has partnered with the GEOG 4/582 class to explore ways that can improve walkability by looking at GIS maps and analysis.

Goals

While students were given flexibility regarding their data and variables, my project was primarily based on one of the surgeon general's recommendations for "Design communities that support safe and easy places for people to walk." (General, 2015). My recommendations specifically focus on the outcome of "Design[ing] streets, sidewalks, and crosswalks that encourage walking for people of all ages and abilities." I focused on this aspect because it was something that I was familiar with. I took a study abroad course over the prior summer and now deeply understand how European cities design streets that are both safe and encourage walking. I hope to take this insight into this class and to help form recommendations for the City of Salem to find ways to improve walkability in the future.

*Note that my analysis will be focused on walkability improvements inside of Climate Friendly Areas (CFAs), specifically the Central Downtown, North Downtown, and West Salem CFAs (Climate-Friendly and Equitable Communities Overview, 2022).

Summary of Recommendations

My analysis and recommendations to improve walkability has two parts to it.

1) With maps: I showcase the proximity of amenities in CFAs discourage walkability in them, and how to improve.
2) With Google Street View: I go in depth and showcase 'the little things' that make walkability much better. This was necessary for this project as it is arguably equally important to make the physical infrastructure attractive to use as it is to densify amenities and bring them closer together. This is especially important because the CFAs are already relatively small areas to begin with.

Part 1: Map-based recommendations:
Map 1 shows my final walkability scores based on the scores of the four input layers (see 'methods' section for more explanation behind the process).

Analyzing this map, scores were anywhere between 6 and 10, with the most common score being a 7. Note that scores (for the most part) were relatively high amongst all districts. This is because almost all the areas in the CFAs are in proximity to a park and grocery store (which were half of the layers used to input for the final score).

Out of all the individual data layers, the population density scored the least, so I decided to take a closer look at that. **Map 2** showcases population density. The highest score was 6, however the most common scores were a 2 or 3. This leads me to **recommendation 1: densify housing options**. I quickly learned that many of the housing options inside of the CFAs are low-density and single-family lots. Fortunately, CFAs will eliminate some of this, as the core goal of a CFA is to "Zone areas to allow walkable cities with a mix of residential, office, retail, services, and public uses" (Climate-Friendly and Equitable Communities Overview, 2022). This means higher density (such as multifamily) lots will likely emerge over the coming years. Improving the density of housing options is a great first step towards improving walkability, and making these changes would "increase" the scores seen on maps 1 and 2.

Part 2: Street View-based recommendations:

Google Street View can show aspects of walkability beyond what can be analyzed with maps and geospatial data. Because the CFA areas are relatively small, I was able to "drive around" their areas virtually, finding two key recommendations for improving walkability.

Specifically, I recommend **repairing sidewalk quality** and **added tree cover** as ways "minor improvements" can improve walkability.

- **Recommendation 2: repairing damaged sidewalks** (Figures 2 and 3): Repairing sidewalk quality is something the city should seriously consider. Sidewalks decaying over time is perfectly normal. The natural forces of the earth (such as trees growing) lead to sidewalks cracking, uplifting, etc. However, this decaying of sidewalks causes them to fall into a shape that is not suitable to ADA standards. By spending equal effort into repairing sidewalks as the city does to repair roads, it would show how the city prioritizes pedestrians. In order to fund this endeavor, the City of Eugene has passed a bond measure that will partially cover the repairs of city sidewalks (*Bond Measures to Fix Streets | Eugene, OR Website*, n.d.), and the City of Salem could potentially follow similar footsteps.
    - Note that this improvement is already highlighted in the City of Salem comprehensive plan, but in smaller capacity, on page 95 (Salem Area Comprehensive Plan, 2022).
- **Recommendation 3: adding more tree cover** (Figures 4 and 5)**:** Lastly, adding more tree cover is something that would encourage walking for all ages and abilities. While not required in all areas, lacking tree cover certainly discourages walking during summer months. This is because during these months, the temperatures are high, and the sun is shining down at walkers with little protection. This not only causes the pedestrian to heat up quickly, it also causes the sidewalk pavement itself to collect heat and be extremely hot. While this does not pose a health risk to humans, it does make it just that much more unbearable. Thus, adding a healthy mix of tree cover (to provide shade) is a relatively easy solution that can help mitigate these issues. Trees can also be placed between cars and the sidewalk, which gives pedestrians a sense of safety (that they don't have to walk

directly next to cars). Literature shows that greenery in urban areas promotes physical activity (such as walking) as well as promotes contact between residents (Mullaney et al., 2015).

- Note that this improvement is already highlighted in the City of Salem comprehensive plan, but in smaller capacity, on page 81 (Salem Area Comprehensive Plan, 2022).

Methods

Part 1: Maps

The methods for creating my maps started with researching what layers I wanted to use. My walkability analysis is based off the website called "WalkScore" that shows how walkable an area is based on its location. I chose four of the key data layers that WalkScore uses, those being the locations of Parks, Grocery Stores, and Residence/Employer density data.

More superficially, my GIS map data was based on a model of

1. Park Proximity (Park data provided by City of Salem/SCYP portal)
2. Employment Density (Employment by census block provided by LODES WAC data)
3. Residence Density (Population per census block provided by U.S. Census Bureau)
4. Grocery Store Proximity (Locations provided by ArcGIS "Business Analyst")

Figure 1 shows a model of the various tools I used to create the sub-layer and final layer. After classifying my data (on an equal interval), output scores ranged on a scale of 1 through 10. 1 being "least desirable" and 10 being "most desirable" in terms of walkability. Taking this data, I was able to combine the highest scores from each category. This was done using a "weighted sum" tool, which combines the scores from each of the input layers into one comprehensive layer (Al Shammas & Escobar, 2019). Figure 1 shows a flowchart of the various functions I used to create my final layer.

The "weighted sum" tool also allows a user to prioritize certain scores over others. In my case, I set the grocery store layer to receive twice the weight as other layers. In this process, I also gave priority to areas near grocery stores. This is because a grocery store can be a popular destination to walk to in areas that promote walking (Willberg et al., 2023).

Analyzing these scores (in Map 1), the central downtown CFA received the highest scores, with the north downtown receiving the second highest, and the West CFA receiving the lowest. As noted in the "walkability improvement" section, this quantitative data suggested that relatively complex methods (like adding dense clusters of housing) were the only way to improve scores.

However, knowing that was not the case, and because my analysis area was relatively small, I also did some qualitative analysis (by Google Street view). By "driving around" the various areas within the CFAs, I was able to draw some conclusions on smaller (but potentially more budget friendly) improvements that could be made. This was how I ended up with recommendations 2 and 3, as listed in my "walkability improvements" section.

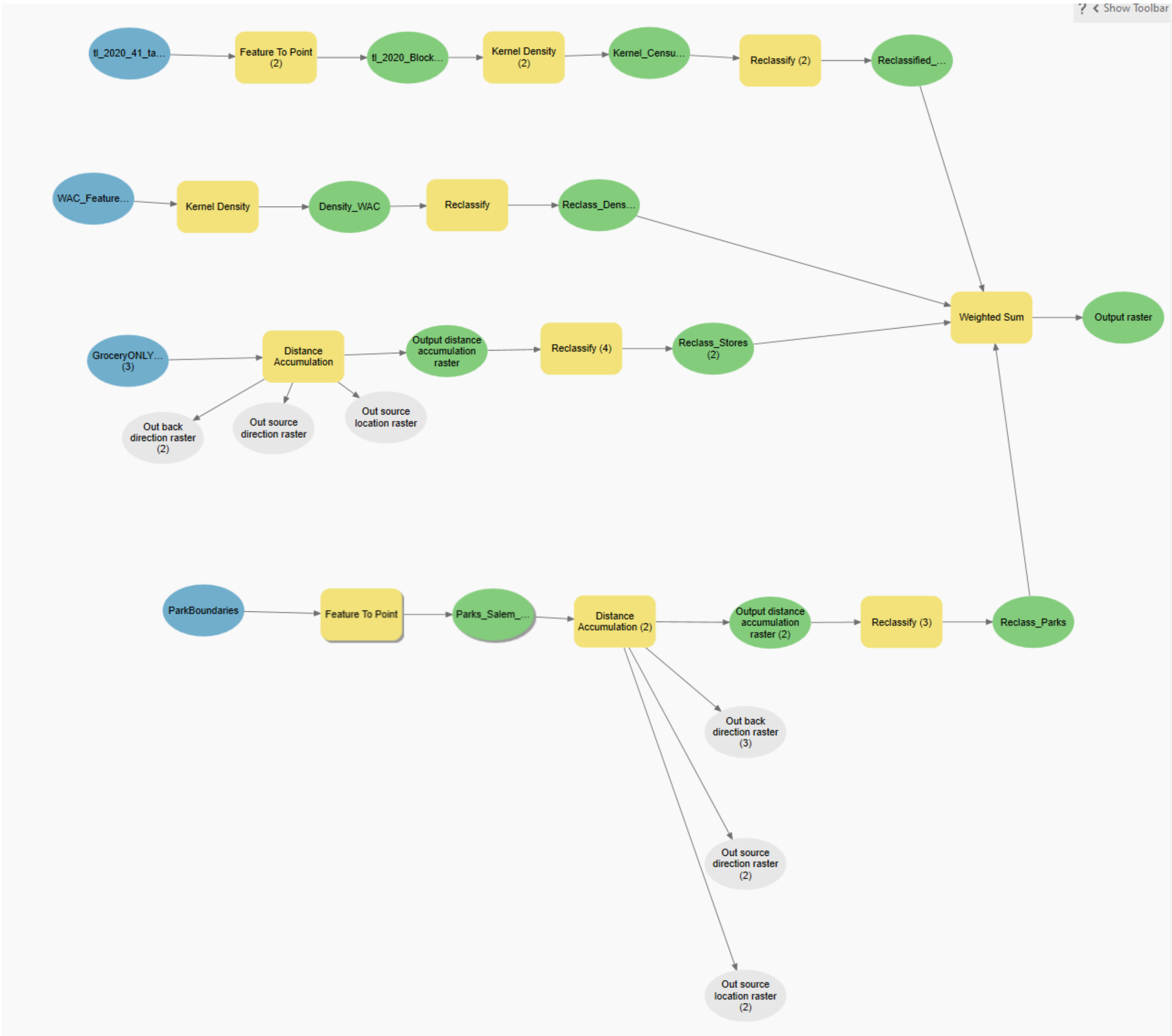


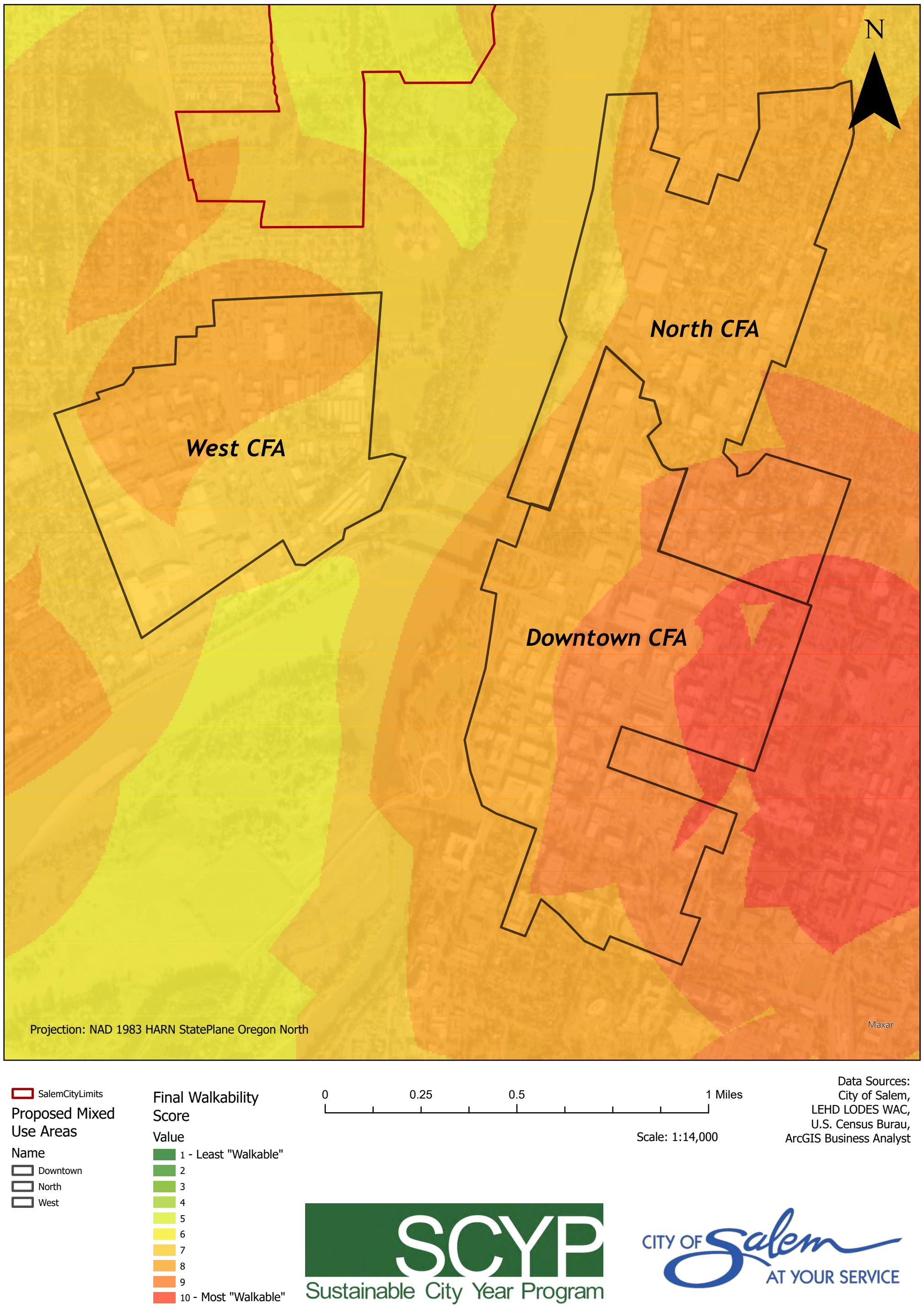
Figure 1: Density Model (from ArcGIS Pro ModelBuilder). Note that yellow boxes are 'functions' while green boxes are outputs

Maps and Graphics

Maps are enlarged to maximize viewability. Please advance to the next page to see maps and graphics.

Map 1. Note that values of 1 are 'least walkable' and values of 10 are the most.

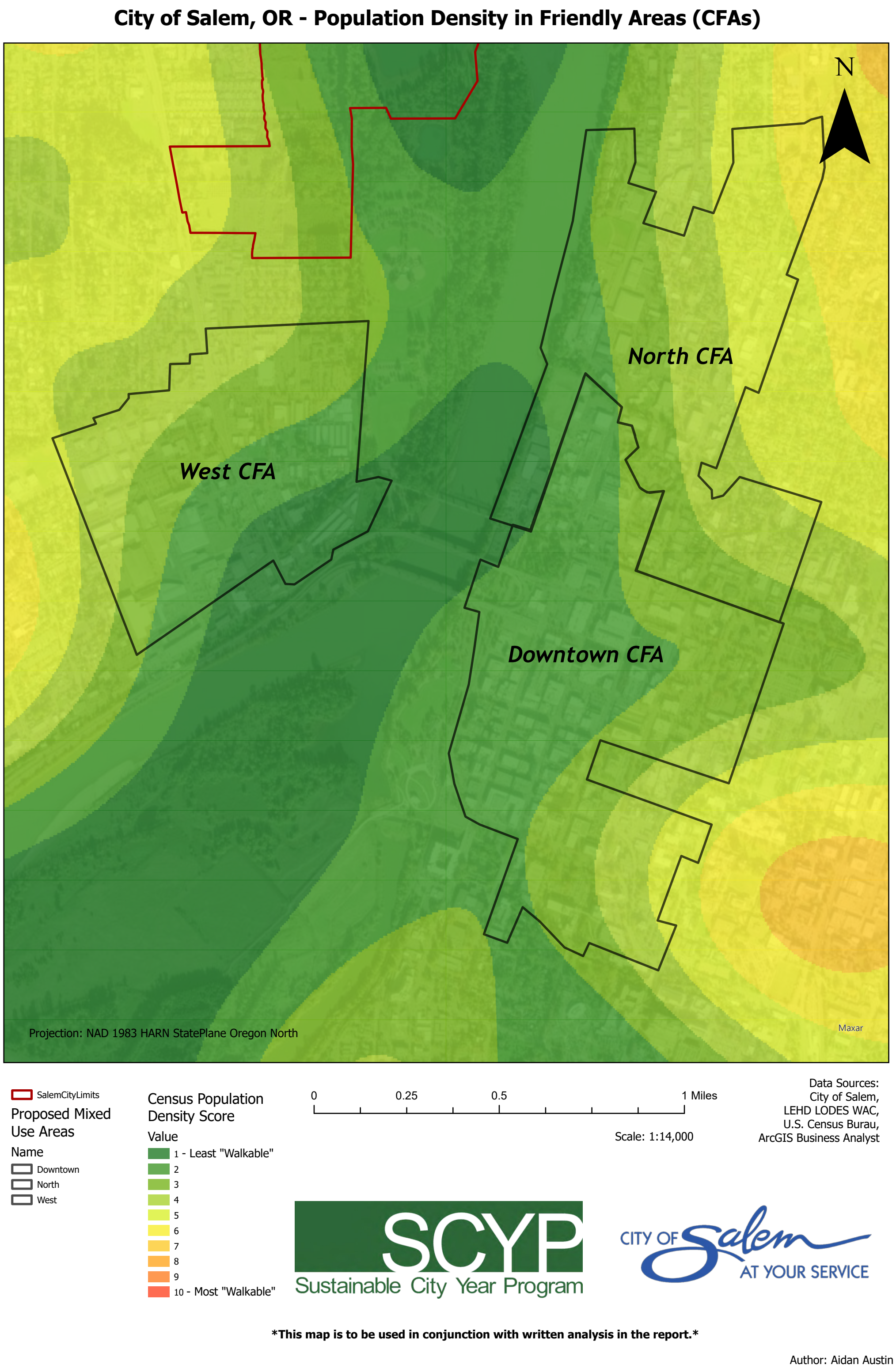
City of Salem, OR - Final Walkability Scores in Friendly Areas (CFAs)



This map is to be used in conjunction with written analysis in the report.

Author: Aidan Austin

Map 2. Note that values of 1 are 'least walkable' and values of 10 are the most.



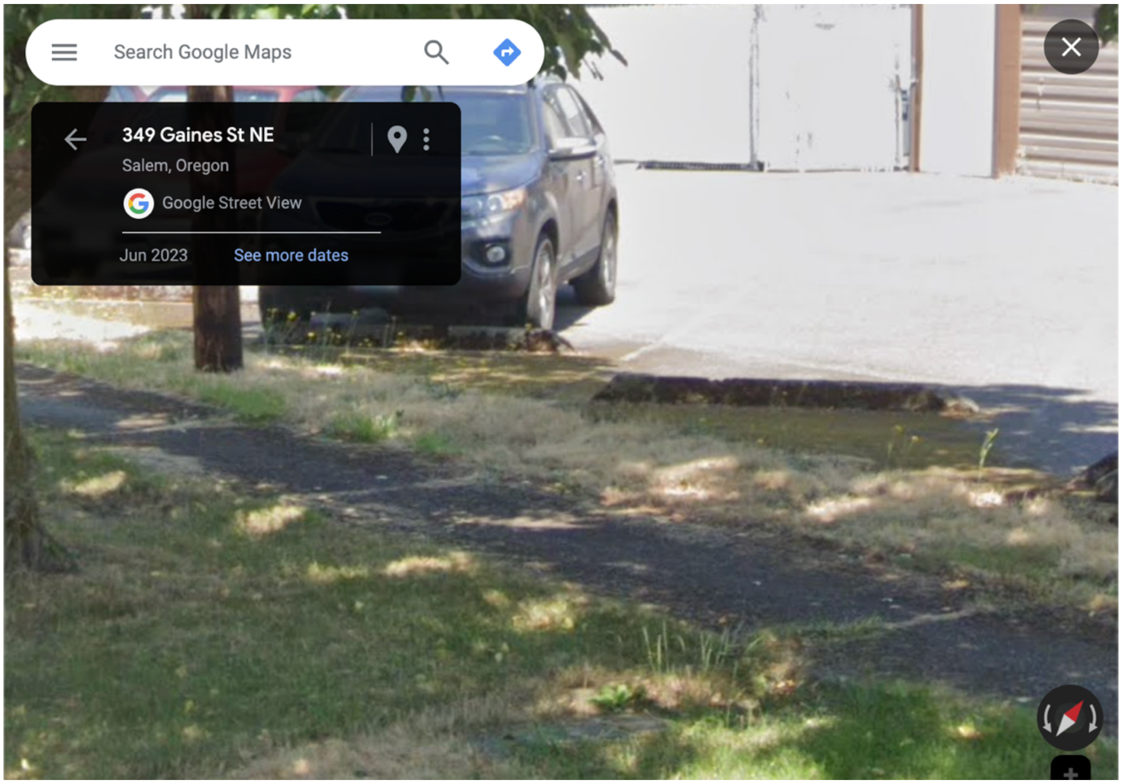


Figure 2: Sidewalk quality of Gaines Street NE (just West of the intersection of Liberty Street). This is in North CFA. This figure supports recommendation 2 – improving sidewalk quality. ([Click here for link to interactive view](#))

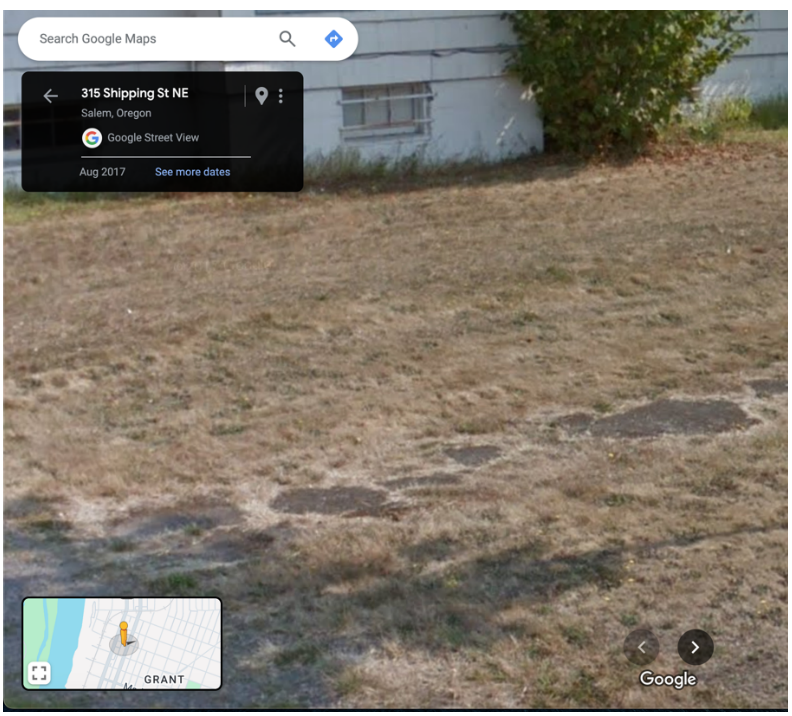


Figure 3: Sidewalk quality of Shipping Street NE, located near Commercial Street in North CFA. Figure supports recommendation 2 – improving sidewalk quality ([Click here for link to interactive view](#))

Figure 4: Note the lack of tree cover on Patterson Street NW near Ruge Street NW, in West Salem CFA. Figure supports recommendation 3 – need for increased tree cover. ([Click here for link to interactive view]())

Figure 5: Note the lack of tree cover on Wallace Road (near Taggart Dr), in West Salem CFA. Figure supports recommendation 3 – need for increased tree cover. ([Click here for link to interactive view]())

Future Directions and Improvements

Moving forward, the City of Salem has several ways they could go about implementing my recommendations.

To support recommendation 1: more GIS analysis could be done on neighborhoods in CFAs to determine their walkability. For example, looking at the proximity to bus stops and bus routes would be another layer that could potentially be useful. Also determining the commuting patterns of the residents that live in the CFAs could bring more perspectives on how to improve walkability.

To support recommendation 2 (on improving sidewalk quality) I have three recommendations.

1. See if there is any data on existing sidewalk quality. This would allow the city to prioritize sidewalk improvements on certain streets over others.
2. They could also see if there is any data on 'pedestrian counts' to see if certain streets are more higher trafficked than others.
3. Explore potential funding options to improve sidewalk quality. My recommendation is to look at efforts made by the City of Eugene – a similar sized city compared to Salem.

To support recommendation 3 (on improving tree cover) I recommend looking into existing data on tree canopies to prioritize areas that could use additional tree cover. While the data of existing tree cover is something that I did not have access to for this project, I've been told that the city does have this data.

Works Cited

Al Shammas, T., & Escobar, F. (2019). Comfort and Time-Based Walkability Index Design: A GIS-Based Proposal. *International Journal of Environmental Research and Public Health*, *16*(16). https://doi.org/10.3390/ijerph16162850

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General, O. of the S. (2015, September 1). *Surgeon General strategies for making communities more walkable* [Text]. https://www.hhs.gov/surgeongeneral/reports-and-publications/physical-activity-nutrition/walking-sectors/index.html

Mullaney, J., Lucke, T., & Trueman, S. J. (2015). A review of benefits and challenges in growing street trees in paved urban environments. *Landscape and Urban Planning*, *134*, 157–166. https://doi.org/10.1016/j.landurbplan.2014.10.013

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Willberg, E., Fink, C., & Toivonen, T. (2023). The 15-minute city for all? – Measuring individual and temporal variations in walking accessibility. *Journal of Transport Geography*, *106*, 103521. https://doi.org/10.1016/j.jtrangeo.2022.103521

Appendix: Data layers and symbology

Layer Files can be found in:

R:\GEOG482_582_22260_Winter2024\Student_Data\aaustin3**Lab3_SalemWalkability\Layer Files**

- FinalLayver_Reclass_Walkability_Reclass_Walkability
- Reclass_Density_WAC – WAC Density Layer
- Reclass_Parks – Parks Layer
- Reclass_Stores – Proximity to Stores Layer
- Reclassified_CensusPop_Density – Population Density Layer

ArcProjects used to work on final project can be found in:

- R:\GEOG482_582_22260_Winter2024\Student_Data\aaustin3\Lab3_SalemWalkability\ **Lab3_SalemWalkability_NPK.aprx**
- R:\GEOG482_582_22260_Winter2024\Student_Data\aaustin3\Lab4\ **Lab4_Final.aprx**

Model builder: **"**Model 3" from

R:\GEOG482_582_22260_Winter2024\Student_Data\aaustin3**Lab3_SalemWalkability\Lab3_SalemWalkability.atbx**

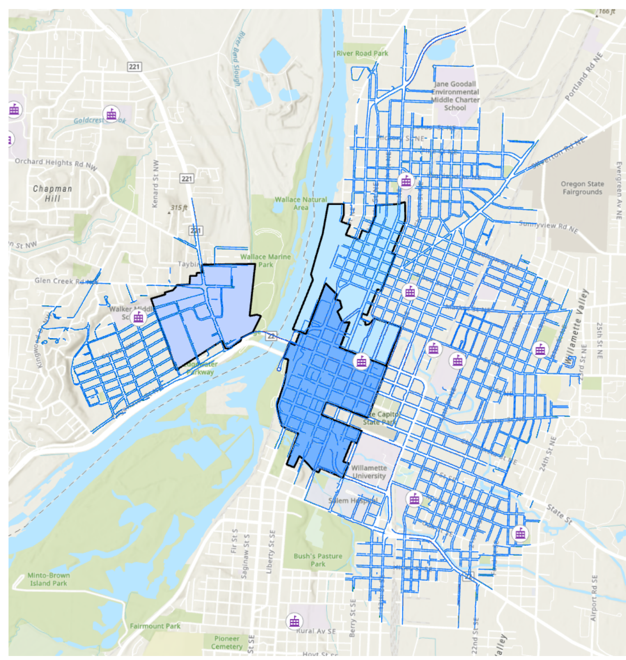
Screenshots to supplement my Google Street View findings can be found in:

R:\GEOG482_582_22260_Winter2024\Student_Data\aaustin3**Lab4\Lab4_final_Images**

Deanna Jacobs
GEOG 482 GIS 2
Final Project: Salem Walkability

Goals:

The project's goal is to ensure that school kids feel safe walking through town. Walking, biking, and taking public transport are some of the most environmentally friendly ways to get around town. With Salem wanting to be carbon neutral by 2050 (*Climate Action Plan for Salem* | *Salem, Oregon*, n.d.) it is important to start the idea of carbon neutral methods with kids in school for it to be easy for them to implement in their everyday lives. I've added many citations of helpful links to add to the ideas provided on how to encourage kids to walk in cities and to school safely with the community's support.



Summary of Recommendations:

Salem's downtown area is full of many stores, restaurants, and parks that are very accessible via walking, hiking, or bus. There are many schools in the area or around the area where kids can access these accommodations. There are many homes in the area and apartments where many families live. For a high walkability score, they need to get to areas like shops, grocery stores, doctors, schools, and work via walking. With a walkability score in the 80's the downtown area is fairly walkable but can be improved. Walking is environmentally friendly and is a good form of exercise. As shown in the image to the right many schools in the area are close enough to the downtown area for kids to walk to after school.

Many of the roads in the downtown area of Salem are multiple-lane traffic areas. As shown below in the images taken from Google Maps. Even with lights signaling when to cross many kids do not know how to safely cross intersections like this one. Many people also ignore the lights or go when it's too late and interfere with traffic. There should be signs that are better adapted for kids to read to know when or when not to cross these busy intersections. Areas like the West FCA Intersections are not as busy to pedestrians as they would have to cross the bridge to access this area and there are not as many amenities over there. Some additional suggestions would be to add areas dedicated to people walking or biking and limit driving in that area to keep those people safe.

[Salem Downtown Intersection- August 2023]

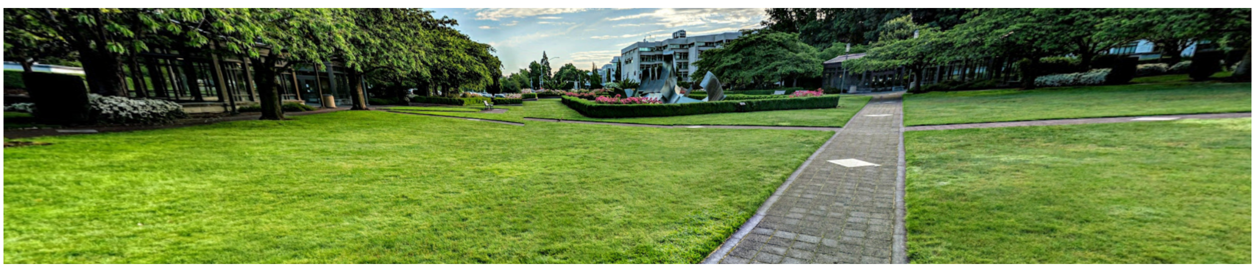
[West FCA Intersection- June 2023]

[200 Commercial St NE, Salem, OR- June 2018]

One main reason the walkability score in the area is low is that there are not enough grocery stores within walking distance of the downtown area. As you can see in the map clip below there are only snack stores in the area with the bigger grocery stores for everyday needs that are further away and may require a car to get to. As the area is already fairly occupied with many businesses and apartments the city could plan to add grocery stores on the ground floor of apartment buildings (as shown in the map clip below) that anyone in the area can access. This will help to fill abandoned storefronts along with accommodating the residents of Salem who live in this area. This will help the families in the area to get food efficiently if they don't have access to cars and allow for kids to get healthy snacks after school. This can also be implemented in future apartment designs.

[206 OR-99E BUS Salem, Oregon- November 2023]

There are a few parks within walking distance from the schools. Such as Oregon State Capital City Park which is a nice open field and Riverfront City Park which has a playground, amphitheater, and other amenities.



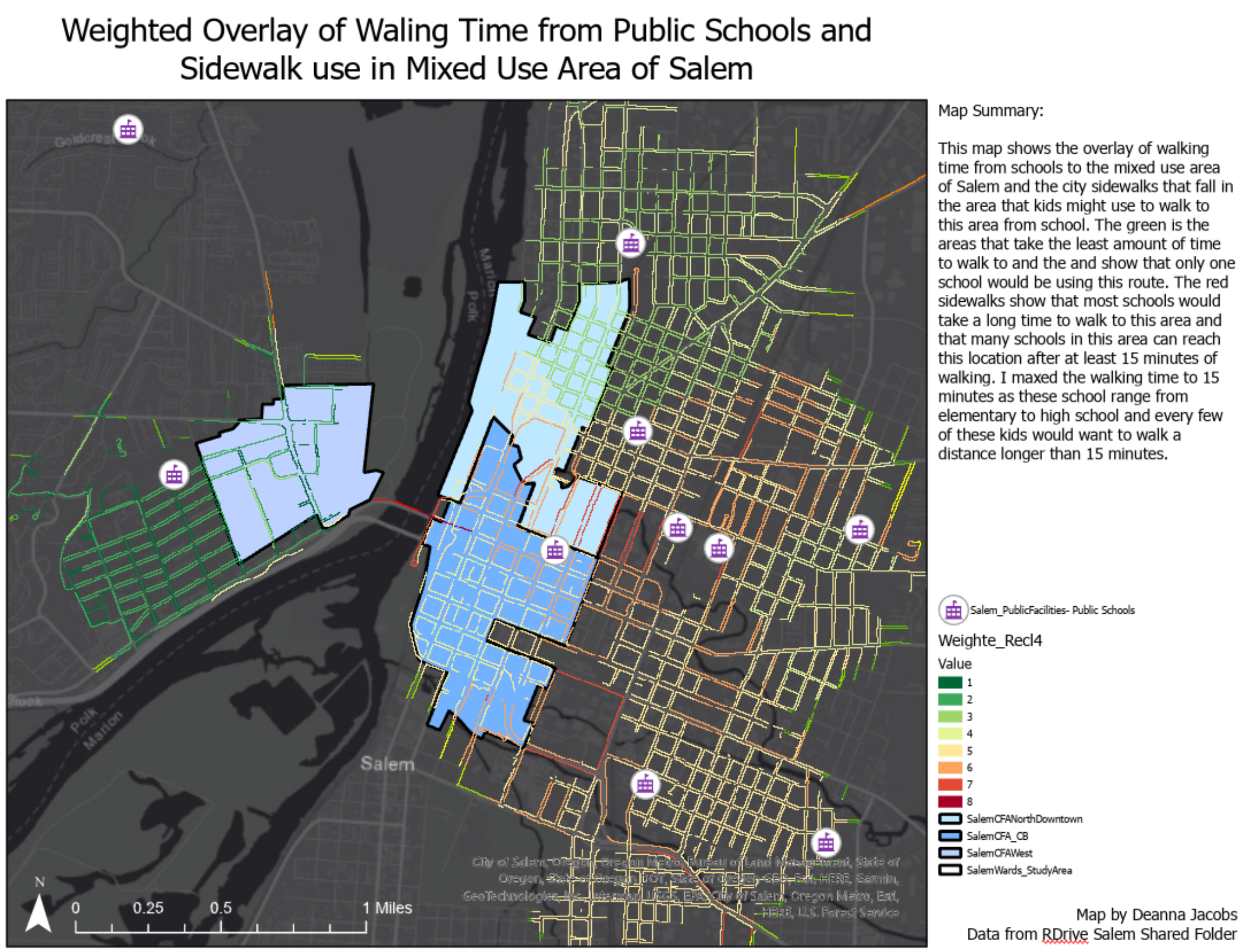
Oregon State Capital City Park- June 2018

Riverfront City Park- June 2018

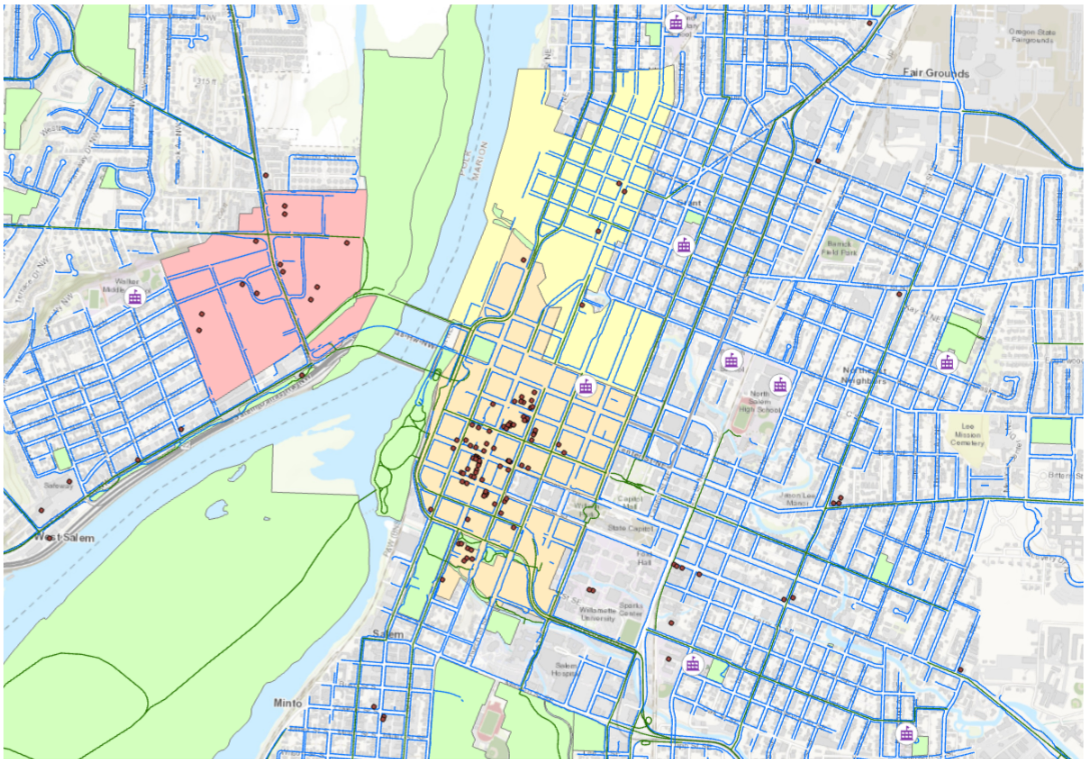
Methods:

To find these suggestions I used a weighted overlay of schools' walking distance within 15 service area minutes of the Mixed-use area and the sidewalks they can use to find what schools can get to certain areas within a short time as kids don't want to walk far. It was found that many schools in the area can access most of the area in that amount of walking time. The data was also compared with the Pleasant Amenities data to find what was in the area that would interest kids. Using the data shown from the weighted overlay gives them access to many shops, restaurants, and parks in the area.

To create the weighted overlay I first created a service area polygons layer of 5, 10, and 15-minute walking times from public schools. I then added the sidewalk layer turned that and the service areas into raster data and reclassified the rasters into simple numbers from 1 to 9 to find what areas had the most school access. I then inputted both raster files into the weighted overlay analysis to find the areas that are easiest to get to for most schools within 15 minutes using the sidewalks. The outcome of this method is found in the map I created below for Lab 3.



I then compared this information with the Pleasant Amenities to see what areas have the most kids can do after school and if they can get there. An important location for them to get to that is not a part of the Pleasant Amenities is the RiverFront City Park which most schools being used can get to.



Future Directions and Improvements:

Schools with students in the area with many students in close distance should encourage their students to walk or bike to school. They should create programs that get groups of kids together that either all walk or bike to school together to encourage this behavior of walking or biking places around town.

The city can create bike paths that are separate from the sidewalks to protect walkers but also separate lanes from the cars to protect the bikers. They can also create streets that do not allow cars on them to encourage walking through the Mixed-use area. They work on creating spaces that are enjoyable and that people want to walk to. Such as green spaces that add in public art or interactive spaces.

The local businesses, schools, and county libraries should create programs that encourage walking places. Such as promoting scavenger hunts for kids around the Mixed-use area. They can host outdoor events such as Saturday markets, music/film festivals, food truck fairs, or even carnivals during the summer that take place outside and encourage walking around town.

While encouraging people to walk is important it is also important for drivers to be aware of walkers and know to drive safely and understand pedestrians' right of way.

Citations:

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Richardblambert. (2020, July 5). *How to create walking friendly cities -*. https://naturalwalkingcities.com/how-to-make-cities-walking-friendly/

Gardner, S. (2023, September 6). *Strength Test #6: Can children safely walk and bike in your town?* Strong Towns. https://www.strongtowns.org/journal/2017/4/4/strength-test-6-can-children-safely-walk-and-bike-in-your-town

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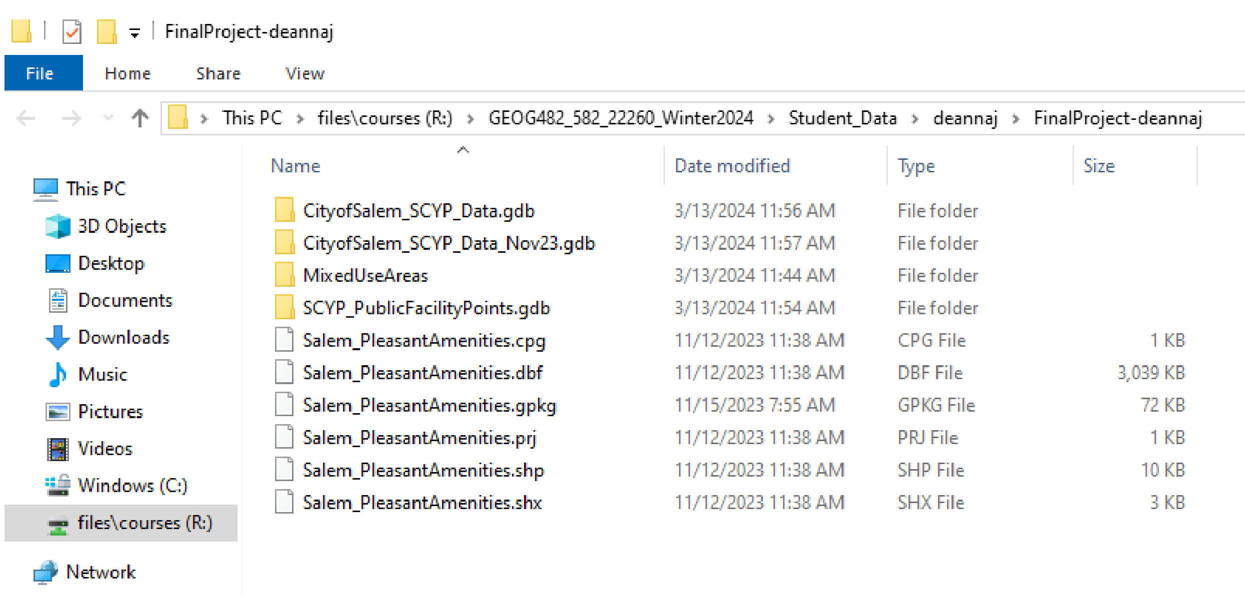
Llc, K. F. (2022, June 9). Walking Infrastructure is Key in Building Child-Friendly Communities | K&E Flatwork. *Commercial Concrete Contractor in Kansas City | K&E Flatwork.* https://www.keflatwork.com/blog/designing-walking-infrastructure-for-healthy-and-independent-children/

Data layers and symbology:



Yasmine Lones
3.15.2024
GEOG 482
Nick Kohler

Final Project

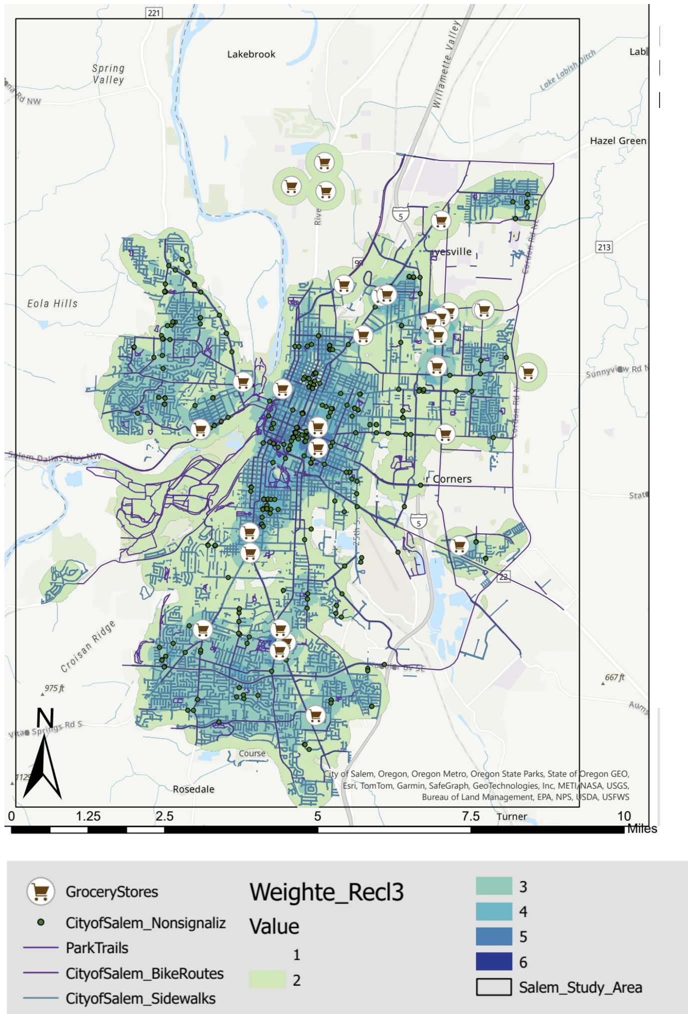
Project Goals

When I initially saw this project, my goal was to become more comfortable working with the geoprocessing tab to create a weighted overlay independently. Walkability wise, my goal was aimed at finding walkability in the mixed use areas in relation to the grocery stores and how accessible it was from the outer areas.

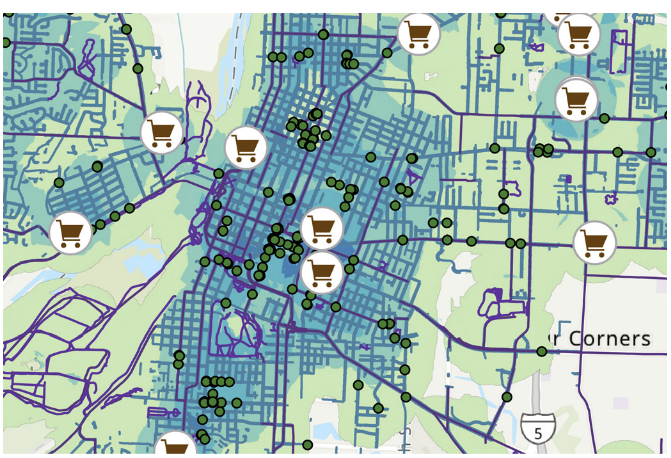
Recommendation

After finalizing my map, my main recommendation was to build walking bridges. When the Salem city staff listened to our presentations, they mentioned that some data was not updated, including the data that showed an already existing walking bridge. My more recent recommendation is to create more biking trails going into the city. In the Netherlands, people are notoriously known for biking so I was interested to see how they achieved this. The Dutch approach to bicycle mobility was to redesign the streets with the intention of putting pedestrians and cyclists first. This is known as retrofitting.

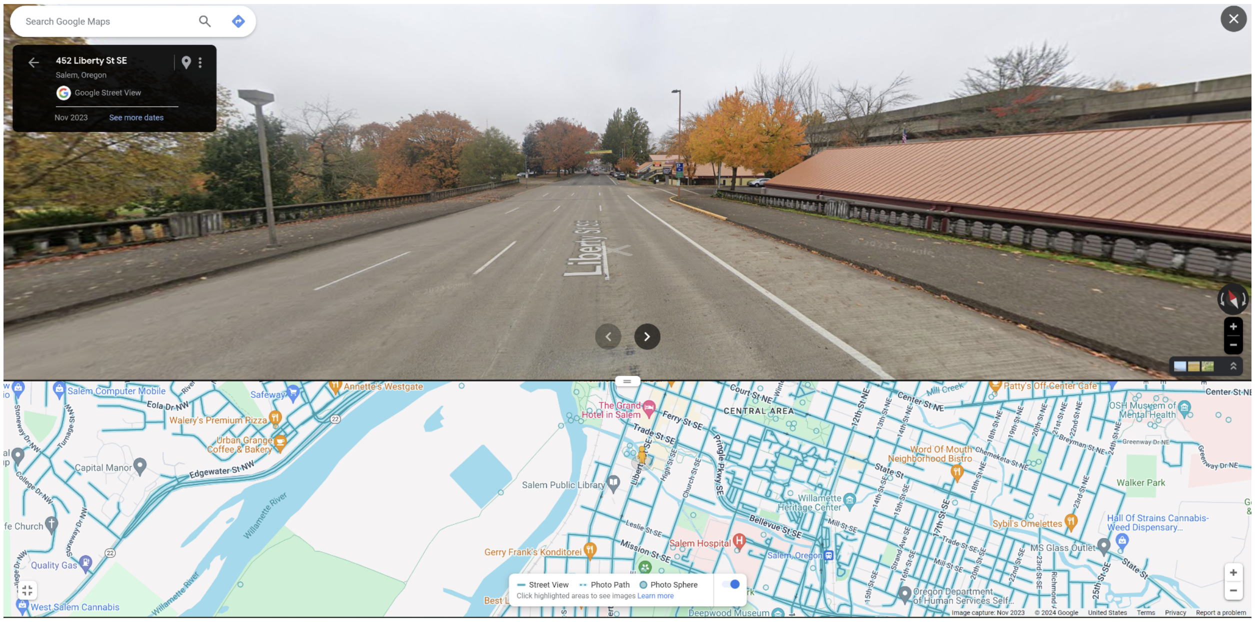
Redesigning streets is an expensive task, especially for a city that has had a somewhat similar structure in the streets for so long. In the Netherlands, their approach was to get sponsors from the Federal highway administration. This could be applied here, receiving help from outside-Salem administrations could be beneficial. The Dutch streets where cars drive are in a completely separate place from bike routes and walking routes. By making a clear split between where people are and where cars are, the safety of walking rises and it also makes walking more pleasurable (nobody wants to walk next to a busy road). Creating more paths into the city that are accessible for bikes and pedestrians would give people more incentive to walk in central Salem instead of just driving into the city.



These images portray the zoomed out scale of my finished map after performing a weighted overlay.



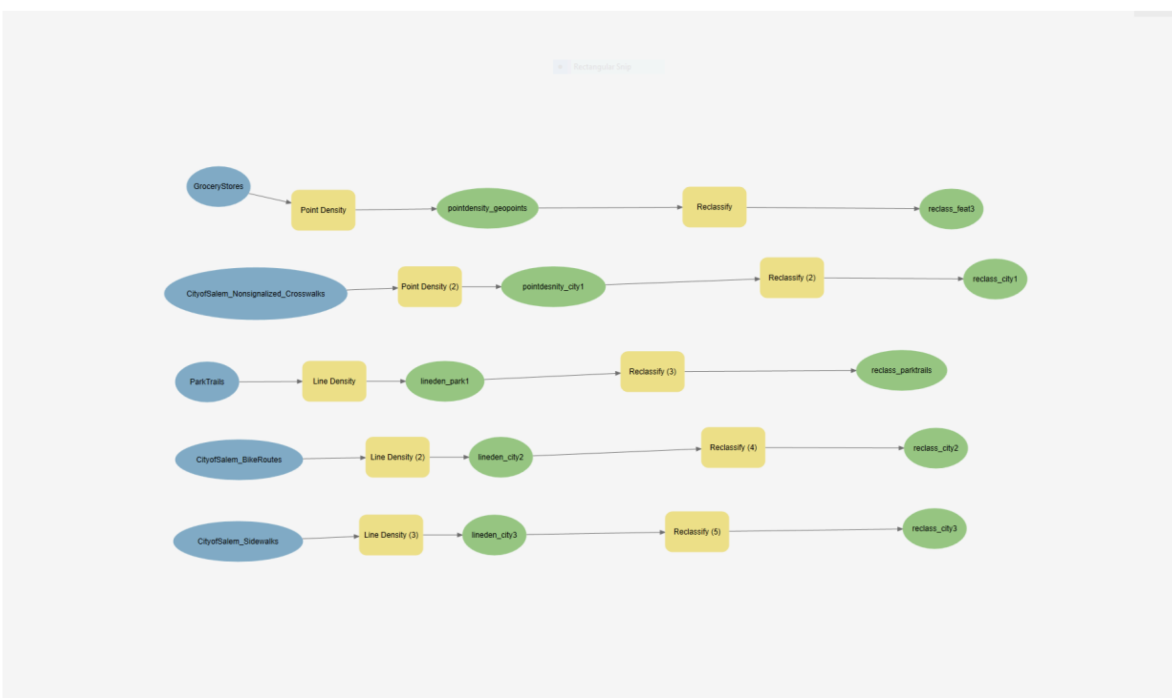
This image more closely shows what trails are in accordance with the legend above.



This is a screencap of liberty st in central Salem. This is a good example of a street where the sidewalk and street where cars drive have barley and differentiation between each other. This is both unenjoyable to walk on and unsafe, especially with there being three driving lanes.

Method

Below is my model builder. This is located in my (ylones) lab 3 folder of the R-drive, named modelbuilderlab3.



Future Directions and Improvements

To further this project, I would like to have access to the data in the Netherlands, specifically the central part to relate that with the city of Salem, OR. I would have also been more broad when choosing which geopoints to highlight. I only chose grocery stores, which were helpful, but a broader scope might have also been helpful.

Sources Used

- Google Maps
- US Department of Transportation report on The Dutch Approach to Bicycle Mobility:
- https://international.fhwa.dot.gov/pubs/pl18004/fhwapl18004.pdf
- Elevating Urban Connectivity: The Spirit of Pedestrian Bridges in Cities:
- https://www.archdaily.com/1011926/elevating-urban-connectivity-the-spirit-of-pedestrian-bridges-in-cities

Charles Petrik

GEOG 482/582

Dr. Kohler

March 19th, 2024

Final Salem Walkability Project

Strategy, Focus and Goals

The design strategy that was considered in my analysis of mixed-use areas most directly correlates with "Transportation, Land Use, and Community Design," which encourages walkability for people of all ages and abilities by improving street aesthetics, the safety of sidewalks and communities that are connected within short distances by main amenities. Specifically, I chose to focus on how to visualize the impact of design and safety on walkability (sidewalks, streetlights and population) while highlighting key amenities in the proposed Climate Friendly Mixed-Use Areas (CFA'S/MU) downtown in relation to population demand.

My goal for this project was to analyze the walkability of populations within the proposed Salem mixed-use areas in relation to key amenities while considering street composition. Ideally, I could identify issues with connectivity within these areas using layers that detailed population dynamics, accessibility to equitable food resources, and base layers of sidewalk accessibility and safety.

Data and Methods

In this project, the analysis process ranged from density analysis to service area creation, eventual reclassification and input into a weighted overlay. Primarily, I utilized kernel density analysis for the streetlight, sidewalk and population data, intending to show generalized access patterns within the smaller service areas which required a density analysis, but using the kernel aspect, allowed it to avoid over-generalization and overlap and further specify the areas of highest population, streetlight and sidewalk density consistently. For the streetlight and sidewalk density analysis, the respective point and lines features input directly into the kernel density function, but I had to undergo a feature-to-point conversion within the population data to then output a density feature. Before conducting the density analysis, all features were selected by location and cropped if their center was within the mixed-use areas outlined by Salem. Below in Figure 1 is a full "model builder" flow chart depicting the following steps in my analysis.

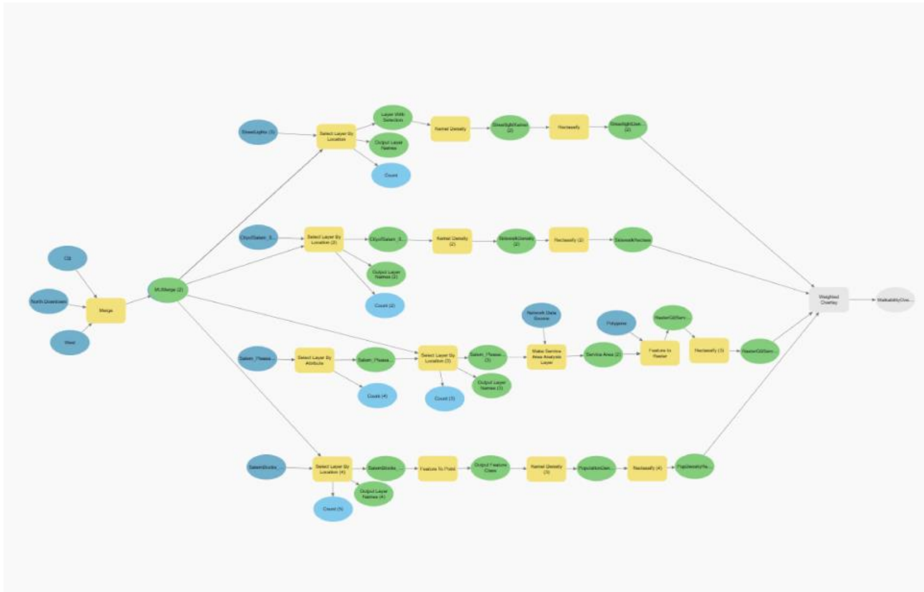


Figure 1: “Model builder” model of full analysis

The outlier in this analysis was the grocery store and bakeries data which was pulled from LODES RAC data taken in 2020. I utilized this data to isolate the POP20 field into points, using a feature to point conversion and conducted a kernel density analysis on these points to outline where most people were living within the mixed-use areas.

Finally, I wanted to depict how easy it was for individuals to reach amenities, specifically grocery stores and bakeries. I excluded convenience stores from my selection of attributes to avoid false representations of access to adequate and more holistic food options, which could influence which areas were in proximity to amenities. The same argument could be applied to bakeries as well and is a point of consideration for me as I move forward in this project. After narrowing down the data to just grocery stores and bakeries that had their center within the mixed-use areas, I conducted a high-precision service area analysis on the order of walking time at intervals of 5, 10 and 15 minutes and chose to dissolve the boundaries into a single feature. After this I converted this data to raster utilizing a feature to raster conversion tool.

After these functions were finished, I then had to reclassify the data to conduct a weighted overlay analysis. Utilizing the “reclassify” tool I directly input the population, streetlight and sidewalk densities and reclassified them on the order of 1-10, expressed as 1-9 in the final overlay analysis. For the grocery store data, I had to manually reclassify the data by flipping those areas represented by faster walk times to higher numbers that, in the final output, represented higher walkability. The output scale for this service area was reclassified into orders correlating the 5-, 10- and 15-minute walk time to the numbers of 9, 3, and 1 which highly favored the 5-minute accessibility walk time to the grocery stores or bakeries.

Finally, I was working with integers, so I chose to do a weighted overlay. Population was among the most important layers in choosing how to weigh each variable because it was not only a layer of residence demand but also one that influenced the desire to go out and walk to amenities when surrounded by other individuals. The grocery stores and bakeries were to depict destination demand, which also added to their importance, making the population analysis and grocery store-bakery layer the most important to weigh heavily. However, I didn't want to discount the importance of the aesthetic features of the streets represented by the sidewalk and streetlight density layers so my final choice for weights in this analysis was 30 for population and amenity raster layers and 20 for the streetlight and sidewalk raster layers (added up to 100), resulting in my final product represented using a diverging color scheme. This weighting could be played with to visualize different aspects of walkability, specifically surrounding the impact of streetlight presence and population density.

Recommendations for Improving Walkability/Connectivity

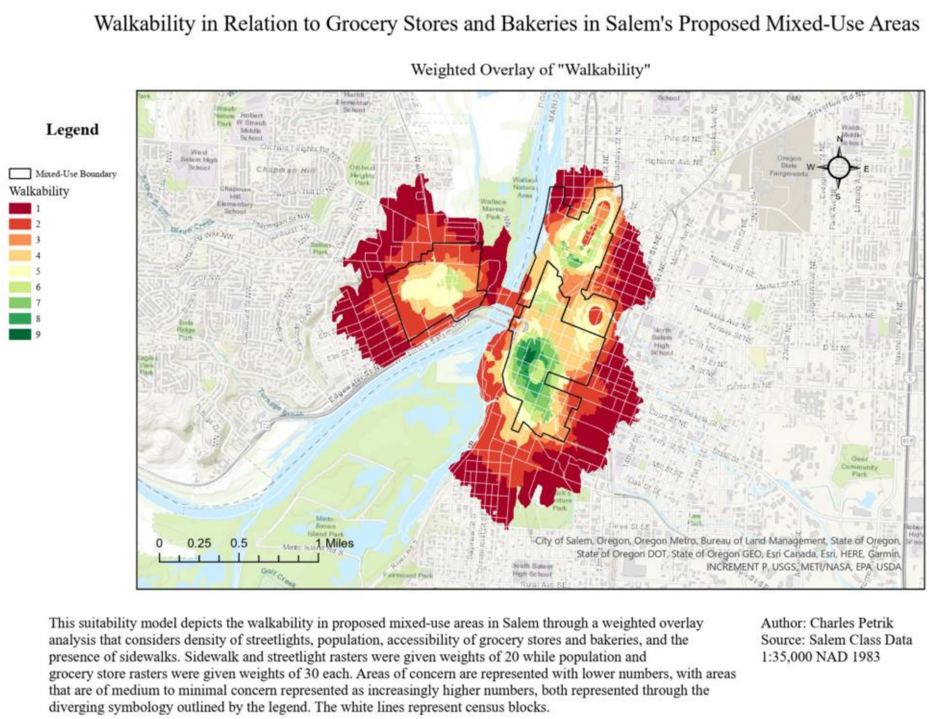


Figure 2: Final "walkability" deliverable, R:\GEOG482_582_22260_Winter2024\Student_Data\cpetrik\Layer Files\SalemWalkability_CharlesPetrik.aprx

As seen in Figure 2, with less walkability between neighborhoods, despite their closeness, those in mixed-use areas are fragmented, disadvantaging the walkability of those living near major conjunction points. It would be interesting to add an overlay that depicts major roads in these areas, as we might see a correlation between their presence and a lack of walkability in relation to grocery stores and bakeries. This could be amended through the greater implementation of streetlights, specifically in the North Downtown and West neighborhoods and another analysis that identifies sidewalk concerns in these areas. Another solution could be increasing amenities in zones such as North Downtown that have high population densities but relatively less access to bakeries and grocery stores, suggesting new developments of these amenities in these areas. That assertion could be validated through an allocation-demand model applied with this data.

One recommendation to improve the overall “walkability” or access within the Central Area would be to improve the connectivity, via. increasing bike ability and walkability of the proposed mixed-use areas in order to promote a greater introduction of population demand and access to amenities. Currently, as depicted in Figure 3, Commercial Business areas (CB) are segregated by designated mixed-use areas (MU), and are characterized by high usage and accommodation of cars in their spaces. Although the streets are kept, there is minimal population density within these spaces, and it is rare to see a pedestrian in these zones outside of their immediate destination, in part, due to the high usage of cars.

Figure 3: *Salem Area Comprehensive Plan (SACP),* (n.d.)

The connectivity of these areas could be increased through a variety of measures, with the more realistic being increasing bike lane prevalence in the Downtown area, which could be complimented by an analysis of bike lane availability, or by providing greater infrastructure for streetlights, and safe intersections that acknowledge bikers through signs or stop lights. The same can be done for pedestrians who are traveling from mixed-use zones into the commercial business district to access amenities, as their walk through CB zones could be made more enjoyable and enticing through the increased prevalence of trees, safe intersections that have flashing lights for cars, and streetlights that ensure a safe walking commute back home at night. Currently, the car-centricity of the downtown area and the lack of connectivity between West Salem and Downtown presents significant barriers to the desire to walk outside of the public parks to alternative destinations which is depicted in the street view below.

Figure 4: StreetView, November, 2023, https://maps.app.goo.gl/dA42iDh1n4vuDrS9A

Another recommendation I would have would be to effectively allocate resources based on the needs expressed by community members within these mixed-use areas. Some zones are more business and commercially oriented, and there is little demand for populations to visit these industrial areas to access key amenities such as grocery stores (see Figure 5) suggesting significant reforms such as the addition of sidewalks and streetlights to improve connectivity that takes into account the demand of populations. That demand could be considered by increasing vegetation and sidewalk safety in highly trafficked areas, such as around OR-22, where the MU areas are disconnected from each other, and considering the least cost routes that populations within each area would take on their way to the key amenity hotspots in the CFAs.

Figure 5: StreetView, November, 2022 https://maps.app.goo.gl/k2MsJhaAWXTqzLBeA

With an increase in connectivity comes an increase in the perceived population density of the area, as it is utilized for daily access and errands. Despite a higher walk score for this area of 80, “Walk Score also measures pedestrian friendliness by analyzing population density” which is lacking in the CB districts and could be offset through a bridge or lane that connects West Salem to the downtown area ("Walk Score,” n.d.). Currently, the built environment does not enable the complete mobility of pedestrians due to the high emphasis of cars in these areas (Kerski, 2022), but the potential for greater walkability will rely on removing barriers to accessing and fulfilling demand from residential areas to the blocks designated as CB. Bike and bus networks connecting these zones will need to be complemented by biking infrastructure downtown, and room for pedestrians to cross town safely, which will create a more pedestrian friendly space outside of the demand for cars.

Improvements and Future Directions

Taking into account the feedback that was received from the Salem partners, it became evident that some of the analysis could be improved through updated data layers and further collaboration between groups. For instance, connecting the West Salem CFA to the Downtown CFA's through increased sidewalks or an expansion of a bike lane was one of my main project recommendations, however, we became aware through the meeting that there is a new pedestrian bridge that connects these two areas. This could have affected the outcomes of my analysis by providing those on the outskirts of the CFA's more access to resources in either zone through the bridge, expressed via my service area analysis.

To further refine my data and analysis, I could also add in a vegetation density raster clipped to sidewalk buffers that would give me a true, aesthetic visualization not only of the walkability in the street network, but also improve our understanding of visual appeal of the streets outside of population, streetlights and sidewalk factors.

Finally, in hindsight, I also could have further contributed to my equitable goals by removing the bakery aspect of my analysis, as these locations may not be within the price points of many residents, negatively affecting our understanding of service areas or true, equitable amenity locations. Further recommendations by me concerning a lack of amenities could be analyzed using a location-allocation analysis in the CFA/MU areas and

Saved Layer Packages

R:\GEOG482_582_22260_Winter2024\Student_Data\cpetrik\Layer Files

- SalemWalkability_CharlesPetrik.aprx
- Block Markers
- Grocery_Bakery
- Mixed-Use Boundary
- Population
- Sidewalks
- Streetlights
- Weighted Overlay

ARCPro Projects Utilized

R:\GEOG482_582_22260_Winter2024\Class_Data\Data\Salem\SalemData\MixedUseAreas

R:\GEOG482_582_22260_Winter2024\Class_Data\Data\Salem\LODES_Data\
SalemBlocks_RAC2020.shp

R:\GEOG482_582_22260_Winter2024\Class_Data\Data\Salem\SalemData\StreetLights.gdb\Streetlights

R:\GEOG482_582_22260_Winter2024\Class_Data\Data\Salem\SalemData\CityofSalem_SCYP_Data.gdb\CityofSalem_Sidewalks

R:\GEOG482_582_22260_Winter2024\Class_Data\Data\Salem\OSMNX\Salem_PleasantAmenities.shp

Citations

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Kerski, J. (2022, August 29). *Walkability*. ArcGIS StoryMaps. https://storymaps.arcgis.com/stories/1e4847f78ec94fd89e960adfabb5ac5c

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Telega, Agnieszka, Ivan Telega, and Agnieszka Bieda. 2021. "Measuring Walkability with GIS—Methods Overview and New Approach Proposal" *Sustainability* 13, no. 4: 1883. https://doi.org/10.3390/su13041883

Al Shammas, Tarek, and Francisco Escobar. 2019. "Comfort and Time-Based Walkability Index Design: A GIS-Based Proposal" *International Journal of Environmental Research and Public Health* 16, no. 16: 2850. https://doi.org/10.3390/ijerph16162850

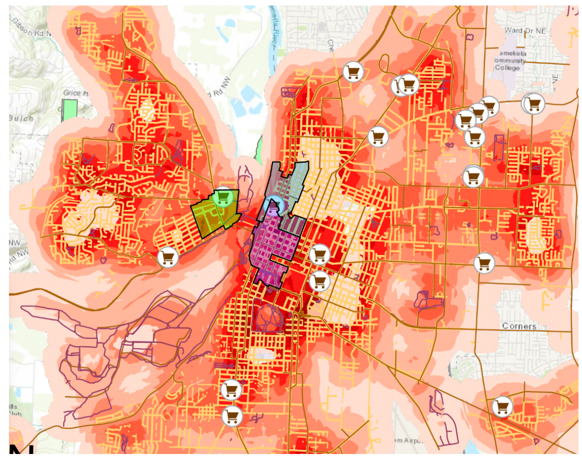
Gorrini, Andrea, et al. “Assessing the Level of Walkability for Women Using GIS and Location-Based Open Data: The Case of New York City: Published in Findings.” *Findings*, Findings Press, 21 Dec. 2021, findingspress.org/article/30794-assessing-the-level-of-walkability-for-women-using-gis-and-location-based-open-data-the-case-of-new-york-city. Accessed 14 Feb. 2024.

Morgan Potts
March 21, 2023
GEOG 482
Dr. Kohler

Final Project Submission

Goals:

The goal of my project was to identify the proximity of grocery stores in relation to sidewalks, bike routes, and park trails, within the CFAs. This is important because to truly understand how the mixed use areas are climate friendly, it helps to understand the proximity to a location, in this case grocery stores. As seen in the graphic to the right, there are only two grocery stores located directly within a CFA. In contrast, the walkability in these areas is much higher because of the amount of businesses and shops available in the CFAs.



Summary:

The mixed use areas have an overall high walk score, mainly due to these areas being more of a shopping, eating, and business areas. Looking more specifically at the neighborhoods within the CFAs they do have the highest walk score of any others. Central Area located within the Downtown CFA has a walk score of 80 and Grant located in the North CFA has a score of 77 (*Salem Neighborhoods on Walk Score*, 2024). While the populations of these neighborhoods are actually the lowest, it shows those who live in these neighborhoods do walk more than those who do not. The overall city of Salem in contrast has a walk score of 42, being a very car dependent city. This plays an effect on how the mixed use areas can improve walkability. Many of Salem's residents live in more suburban neighborhoods and drive down to the CFAs for business or shopping. During my presentation, the city of Salem representatives mentioned that there is a foot bridge residents can walk across. In the image to the right (*Google Maps*, 2017), it appears that the bridge is more for leisure purposes, and would not provide enough room for bikes. The Willamette River separates the West CFA from the North and Downtown CFAs,

which causes more residents to drive or use motor transport to get across. Making a larger effort to highlight that to the residents would increase the usage as well. If the city showed pictures of the pedestrian bridge compared to the highway bridge it may draw more attention. Increasing the width of the bridge as well would allow for more usages.

The other way to make the city of Salem more walkable is to look specifically at the sidewalks within the CFAs. Since many residents do not live within the CFAs it will be very important to ensure that in order to get to these areas it is safe. The image to the left (*Google Maps*, 2023) is located in the Downtown CFA,and there is not a safe way across to the grocery store. There is not a light or crosswalk near the store, unless one was driving it would be difficult to access the store. Installing proper sidewalks for people to easily and calmly get across would help instill more confidence in the community and the walkability. Within this image, there could be a light installed with a signalized crosswalk to ensure safety.

The last recommendation for the city of Salem is to increase the locations of proximity of grocery stores, convenience stores, and other essential stores where it is plausible for one to walk to. As seen in the map I created on the first page, and the screenshot I provided to the right you can clearly see that there are only two grocery stores directly within a CFA, and they are not necessarily the most sought after stores. Many of the suburban population within Salem may tend to go to Trader Joes and Whole Foods, while the lower income has to choose between Safeway, Grocery Outlet, and WinCo. Dispensing the grocery stores to all parts of Salem would allow for

more of the population to walk or bike to the store they desire to go. Within the mixed-use especially because there is already a high level of walkability. Increasing the amount of businesses that are deemed a need, like grocery stores, within certain neighborhoods of Salem would allow for more of the population to access it by walking.

Methods:

The methods to be used in order to consider my recommendations starts with compiling different data sets. For the pedestrian bridge, while it did not show up in the Salem data for roads, park trails, or bike paths, the city did mention they do have it within a data layer, potentially bridges. Along with the bridge data, adding in signalized crosswalks along with potential signalized crosswalks. This is important to ensure the mixed use areas have the safety measures to account for more walkability. The last data layer could be potential grocery stores fixed on dispersion throughout neighborhoods. The layers will have to be converted into raster data in order to be used for further analysis. This is done so by doing some form of a density analysis, in this case point to raster analysis and line density analysis. Once it is all in raster data, you can reclassify all of the layers. This is important for the weighted analysis because all the layers need to have the same number of classes. I like 10 for all the layers when reclassifying. To do so, you use the reclassify tool for each raster data layer, and then within the tool change it to Jenks Natural and change the class size to 10. The last step to perform is a weighted overlay, which includes weighing the layers individually to equal 100%. For example, you could do the pedestrian bridge weighted 25%, grocery stores weighted 25%, and signalized crosswalks weighted 50%.

Future Directions and Improvements:

To further refine this project other recommendations to implement could be gathering real time data. Focusing on traffic, pedestrian, and public transport schedules could enhance the analysis further to identify the primary locations and times of traffic and times of walking and driving. This data could help enable better accountability for outcomes (Jain & Espey, 2022), especially if Salem does choose to include more crosswalks and signalized crosswalks. The city of Salem could also implement a city wide survey for households, asking specific questions regarding walkability, biking, and public transportation. This survey could indicate the areas and types of families that need better access for walkability compared to others. In lower income areas the families are more likely to walk or bus to gather groceries and within these areas more stores could be accessible.

Data Layers and Symbology:

R: Drive > Geog482 > Student_Data > mpotts > Lab3_MP > NewLab3 > Lab3info

- Map:
    - Lab3_SalemWalkability_new.aprx
- Other info:
    - Layoutfinal.pdf
    - Map2final.pdf
    - realmodelbuilder.png
- Layer Packages:
    - DowntownCFA
    - NorthCFA
    - WestCFA
    - GroceryStorePoints
    - Bike Routes
    - ParkTrails
    - Sidewalks
    - Weighted_sidewalkstrails
    - Wesighted_Stores

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Kate Ryan

Final Project

Goals

The goal of this project is to provide suggestions on how to improve walkability in the city of Salem, focusing on the proposed mixed-use area in the downtown area. The suggestions are supported by analysis, literature, and feedback from the city.

Recommendations

The existing walkability infrastructure within the proposed mixed-use areas of Salem is already pretty good. However, there are some areas where the sidewalks are not completely connected, there are some unsignalized crosswalks, and reported sidewalk concerns. The West CFA and North CFA have fewer sidewalks than the Downtown CFA, but they have fewer amenities than the Downtown CFA. While I think improving walkability in all three CFA's is important, I would recommend focusing more on the Downtown CFA as it possesses more existing amenities like restaurants and retail stores.

Figure 1. Amenities in Proposed Mixed-Use Areas

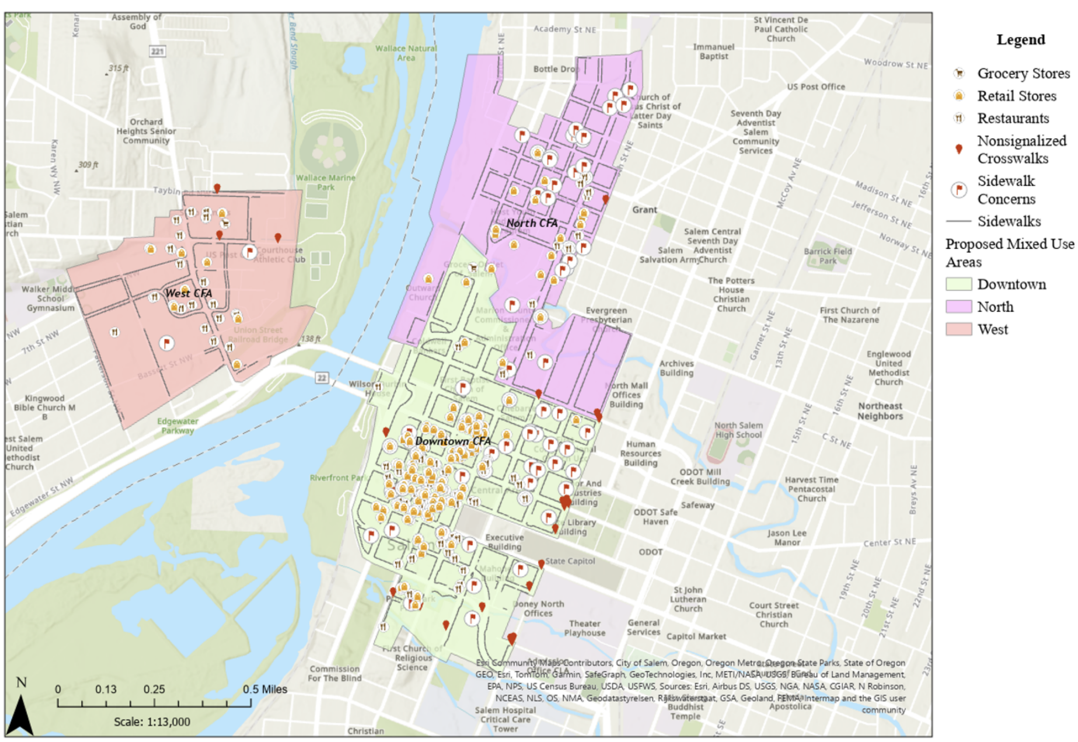


Fig. 1. This figure shows the amenities (grocery stores, restaurants, and retail stores) in the mixed-use areas as well as the sidewalks, non signalized crosswalks, and sidewalk concerns.

Figure 2. Amenities in Downtown CFA

Fig. 2. This figure shows the amenities (grocery stores, restaurants, and retail stores) in the downtown CFA as well as the sidewalks, non signalized crosswalks, and sidewalk concerns.

For general walkability improvements, the sidewalk concerns should be addressed and signals should be added to non signalized crosswalks to improve pedestrian safety, especially in areas with a high density of amenities. For example, in the Downtown CFA, areas like the intersection of Court ST and Liberty ST have a lot of restaurants and retail stores, but there are a few sidewalk concerns. Additionally, there are some rather large stretches of Liberty ST and some on the surrounding streets where there are no sidewalks, so by adding sidewalks and connecting them to the existing sidewalks, walkability would be improved.

Figure 3. Street View of a Nonsignalized Crosswalk

Fig. 3. This figure shows a nonsignalized crosswalk on Court ST where a signal for pedestrians might be useful and improve pedestrian safety. https://maps.app.goo.gl/oqS4L4hNEzdVFzsg6

For new infrastructure recommendations, in areas with high pedestrian traffic or a high density of amenities, traffic calming infrastructure like speed humps, raised crosswalks, or smart crossing signals could be installed to adapt signal timings based on pedestrian flow. A more extreme approach could involve severely limiting or eliminating vehicle traffic to create a pedestrian-only 'mainstreet' with restaurants, shops, and other amenities.

For the overall appeal of the city and for the joy of pedestrians, adding more trees or greenery along the streets could enhance the aesthetic of the city and provide shade for pedestrians, especially during the hotter months. Additionally, small pocket parks or rest areas could be created in areas in between and near amenities to encourage people to walk around and enjoy their surroundings.

Figure 4. Street View of Tree Coverage

Fig. 4. This figure is an example of tree coverage in the north CFA. On the right there is good tree coverage, whereas on the left there is none and could use improvement. https://maps.app.goo.gl/GP5ZnuZVihbsFbon9

Methods

The data used to create these suggestions included population data from census data, place type data which came from the salem addresses layer, sidewalk locations, sidewalks concerns, and non signalized crosswalks. Initially a suitability analysis was conducted for the study area of Salem using population density, euclidean distance from restaurants, and euclidean distance from grocery stores to determine which areas were most suitable to make walkability improvements.

For the suitability analysis, all data layers were selected for what was within the study area using select by location. Restaurant and grocery store locations were then selected from the Salem addresses by using select by attribute, which then created those two layers. They were then converted to raster by calculating their euclidean distance with a cell size of 10, then reclassified using natural breaks to a scale of 1-10. The population data (from the census data) was turned into point using the feature to point tool, then converted to raster by using a kernel density calculation with a cell size of 10. Which was then reclassified using natural breaks to a scale of 1-10. The final suitability model was created by combining those three layers using a weighted overlay. In the overlay, the reclassified population density and grocery store distance were weighted at 35 and the reclassified restaurant distance was weighted at 30 to get a sum of 100. The scale used was 1-10. The model showed which areas in Salem were most suitable for walkability improvements based on those layers. Within the mixed-use areas, almost all of the area was determined to have the highest suitability for these improvements.

To further determine what areas within the proposed mixed-use areas would be best for walkability improvements, additional layers were added. The layers added were from Salem data and includes sidewalks, sidewalk concerns, and non signalized crosswalks along with restaurants, retail stores, and grocery stores which were selected from the Salem addresses data. All of these layers initially provided data for the entire city, but by using select by attribute or select by location, the layers only show the data for the mixed-use areas. Adding these layers helped to show where existing problems are, what type of improvements could be made for those existing problems, and where most of these amenities are located within the mixed-use areas.

Figure 5. Suitability Analysis Model

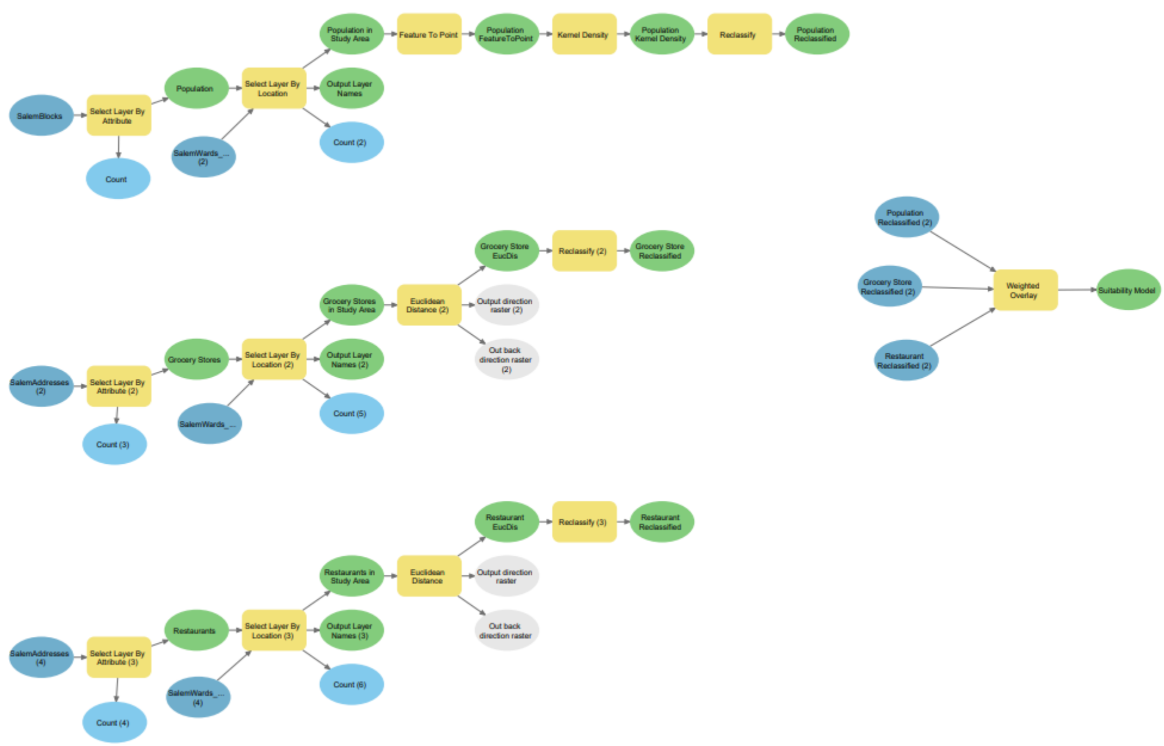
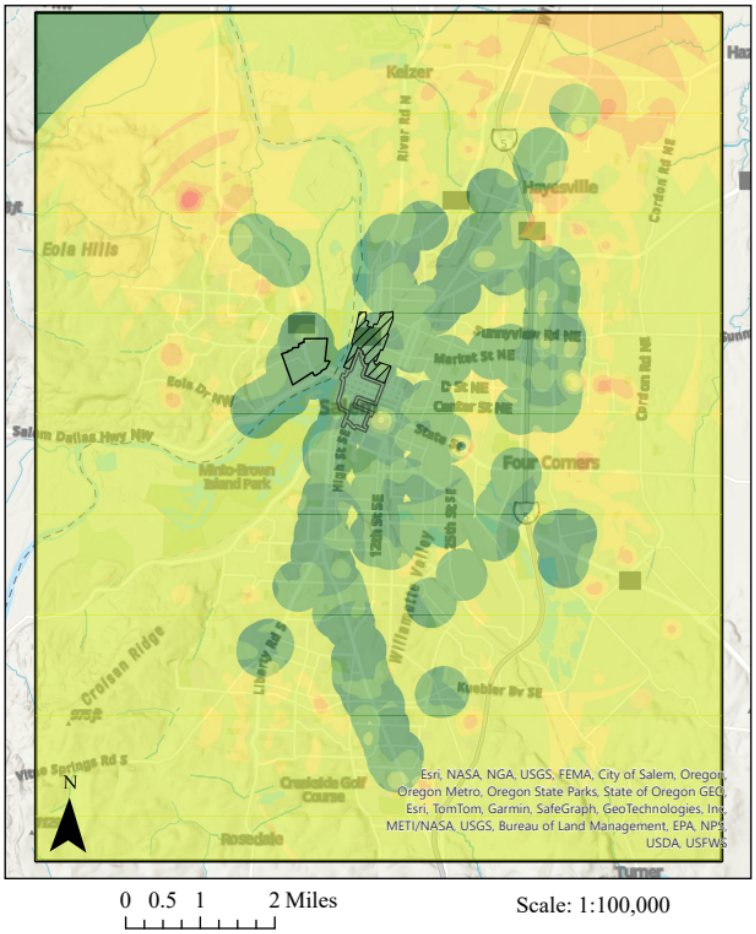


Fig. 5. This figure is the model for the suitability analysis conducted in lab three. The graphic is located in R: drive > geog482 > student_data > kryan > Lab_3 > model.pdf

The actual model is located in R: drive > geog482 > student_data > kryan > Lab_3 > Kryan_Lab3 > kryan_lab3.aprx

Figure 6. Resulting Map form the Suitability Analysis



This map shows the most suitable areas within Salem to improve walkability. The analysis was conducted using population density within the study area as well as Euclidean distance from restaurant and grocery store locations. The suitability model was created by using a weighted overlay, with the input being those three raster submodels. The green areas with a lower value are the most suitable while the red and yellow areas with a higher value are less suitable.

Future Directions & Improvements

To more accurately determine where these recommendations should be implemented, a suitability analysis using the proposed mixed use areas could be run. The layers for this analysis could be either distance to or density of restaurants, grocery stores, and retail stores. For the recommendations involving traffic calming infrastructure, data for vehicle traffic and which areas experience a higher volume of traffic would be useful in determining where to implement these traffic calming measures. To determine where to put pocket parks, a distance analysis could be run using any of the layers mentioned above to strategically place the parks near and in between the amenities. Additionally, data about the tree coverage within the mixed use areas would be helpful in determining which areas already have sufficient tree coverage and which areas could use improvement. .

Citations

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Walk score Methodology. n.d. Walk Score. Accessed March 8, 2024. https://www.walkscore.com/methodology.shtml

Data Layers & Symbology

Key result layers were saved to my userspace in the R: drive in the final project folder as layer packages. There should be 8 total layer packages titled:

Grocery Stores, Nonsignalized Crosswalks, Proposed mixed use areas, Restaurants, Retail Stores, Sidewalk Concerns, Sidewalks, and Suitability Model

Location: R:drive > geog482 > student_data > kryan > Final Project

There were 2 ArcPro projects used for this final project.

1. Title: Kryan_Lab3.aprx

   Location: R: drive > geog482 > student_data > kryan > Lab_3 > Kryan_Lab3 > Kryan_Lab3.aprx

2. Title: Final Project.aprx

   Location: R: drive > geog482 > student_data > kryan > Final Project > Final Project.aprx

Hannah Siegel

GEOG 481

Final Project Writeup & Recommendations: Salem Walkability

PROJECT GOALS:

Overall, the goal of the Salem walkability project was to examine the existing layout, pedestrian infrastructure, and distribution of the city of Salem, using geospatial analysis to determine which areas could be deemed highly "walkable" and which areas needed improvement. "Walkability" in a certain area refers to that area's safety, comfortability, ease, and convenience for pedestrian travel. Per the Salem WalkScore website, one of the most important criteria for walkability is the accessibility (on foot) to amenities like stores, parks, businesses, and restaurants, which requires both reasonable proximity to these amenities and well-maintained pedestrian infrastructure for people to use.

My walkability project covers the Climate Friendly Mixed-Use areas in downtown Salem (shown in figure 1, below), which is a small subset of the larger Salem study area. Because of the walkability factors discussed above, I chose to focus on the strategy of designing and maintaining sidewalks so that walking is safe and easy, identifying and prioritizing sidewalk hazards in areas with high walking demand between amenities.

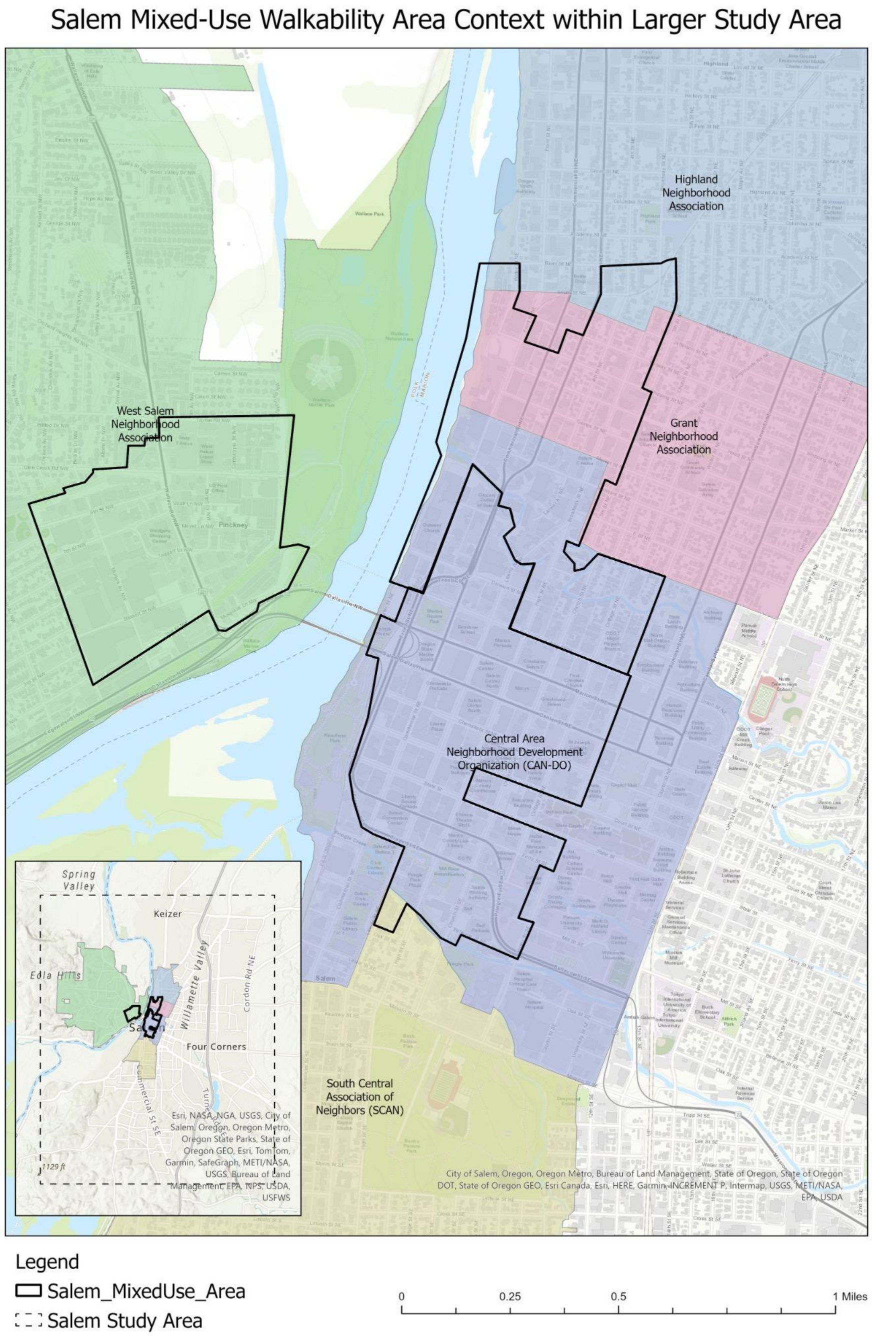

Fig. 1: Salem CFAs Focus Area outlined in black, neighborhoods color coded

RECOMMENDATIONS, ANALYSIS METHODS, & OVERALL FINDINGS:

My main goals to improve mixed-use walkability in downtown Salem are to focus on fixing the highest-priority areas of sidewalk concern. Multiple sources identify pedestrian-friendly infrastructure (such as sidewalks and crosswalks) and closeness to amenities as the two most important factors for determining walkability. From this description, we can determine that while poor pedestrian infrastructure is always an issue, it is even more problematic when these sidewalk issues arise on main pedestrian routes to and from amenity-dense areas. For example, a small, exposed sidewalk on the edge of a busy road with no crosswalks is a problem and indicates low walkability, but it is a much more pressing issue if that sidewalk were one of the main pedestrian routes between a residential neighborhood and a town center with shops, restaurants, and grocery stores. In summary, my recommendations are to focus on sidewalk concerns *near areas of high walkability demand*, or lots of amenities.

To begin my analysis, I created a polygon layer for the smaller Salem CFAs area that I would be focusing on. To do this I ran a spatial join to combine the downtown mixed-use polygons of SalemCFAWest, SalemCFANorthDowntown, and SalemCFA_CB (shown in figure 1 above).

Since my walkability analysis centers around pedestrian infrastructure in between points of interest (like houses or stores), the main sub-models I used in my analysis were a residence density layer, an amenity density layer, a combination overlay of the two to determine "walkability demand", and sidewalk concern data to determine sidewalk concern density as well as specific points of hazards. My final weighted overlay uses inputs of residence density, amenity density, and sidewalk concern density.

1) <u>To create my residence density raster layer:</u> I used the geopoints.shp dataset of "business locations, groceries, etc." selected by attribute to contain the text "residences" and clipped to show only points within the joined downtown mixed-use polygon layer. I calculated a density raster surface (figure 2) using a radius of 600 feet from this points layer, and then reclassified it using 5 classes (1 to 5, with 1 being least housing-dense and 5 being most housing-dense).
2) <u>To create my amenity density raster layer:</u> I used the same geopoints.shp dataset filtered to the attribute of restaurants/fast food businesses, grocery stores, convenience stores, offices, and retail

stores (to include all relevant amenities that people might walk to). I clipped these points within the mixed-use polygon layer, calculated a density raster surface (figure 2) using a radius of 600 feet, and reclassified it using 5 classes (1 is least amenity-dense, 5 is most amenity-dense).

3) <u>To create a combination map of both 1 & 2:</u> I calculated a weighted overlay of both amenity density and residence density, using an equal 50% weight on each raster layer, to create a map representing walkability *demand*, or all areas that people would likely be walking to and from. I combined this map layer with the Salem sidewalk concern location points dataset, in order to visualize the areas of interest that require good pedestrian infrastructure for people to access, as well as which sidewalk concerns are in "high-demand" routes/areas and therefore should be of highest priority (Figure 2). Again, I reclassified this overlay layer into 5 classes, with 1 indicating the least walkability demand and 5 indicating the most.

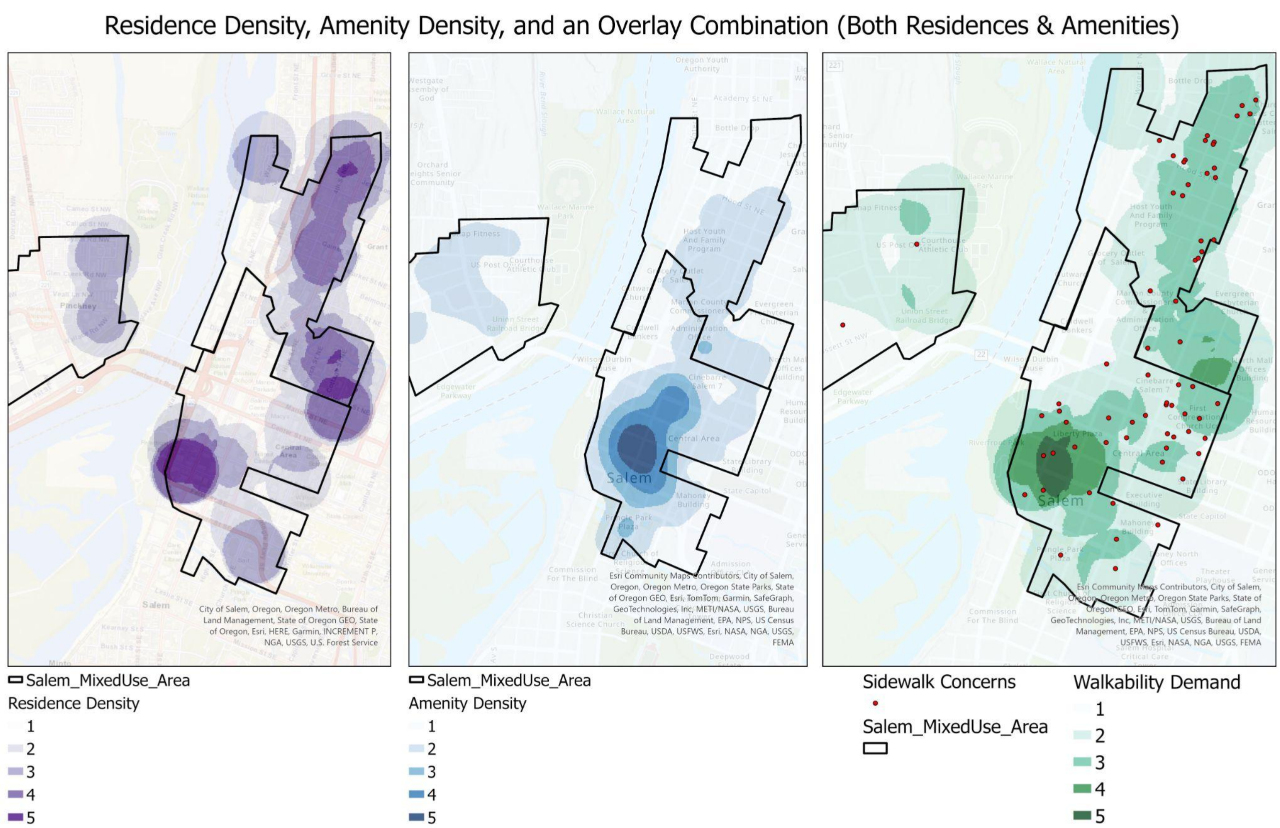

Figure 2: Residence density layer (left), amenity density layer (middle), overlay combination walkability "demand" with sidewalk concern points (right)

4) <u>To create my sidewalk concern density layer</u> (for use in my final weighted overlay which includes residence density, amenity density, and sidewalk concern density): I used the Salem sidewalk concern location points dataset to calculate a density raster surface using a radius of 600 feet within the downtown mixed-use polygon layer. I reclassified the density raster layer using 5 classes and reversing the symbology to indicate that denser areas are less walkable and vice versa (a scale of 1 to 5, where 1 represents least walkable/highest sidewalk concern density, and 5 represents most walkable/lowest sidewalk concern density).

Lastly, I created a final weighted overlay layer to represent overall walkability, using the residence density raster, the amenity density raster, and the sidewalk concern density raster (figure 3). I used a 40% weight on both the residence and amenity layers, due to the idea that areas with more points of interest are more "pedestrian-friendly" in the first place, and I used a 20% weight on the sidewalk concerns layer. I also included the sidewalk concerns data points layer for a more specific visualization of where the main sidewalk hazards are located.

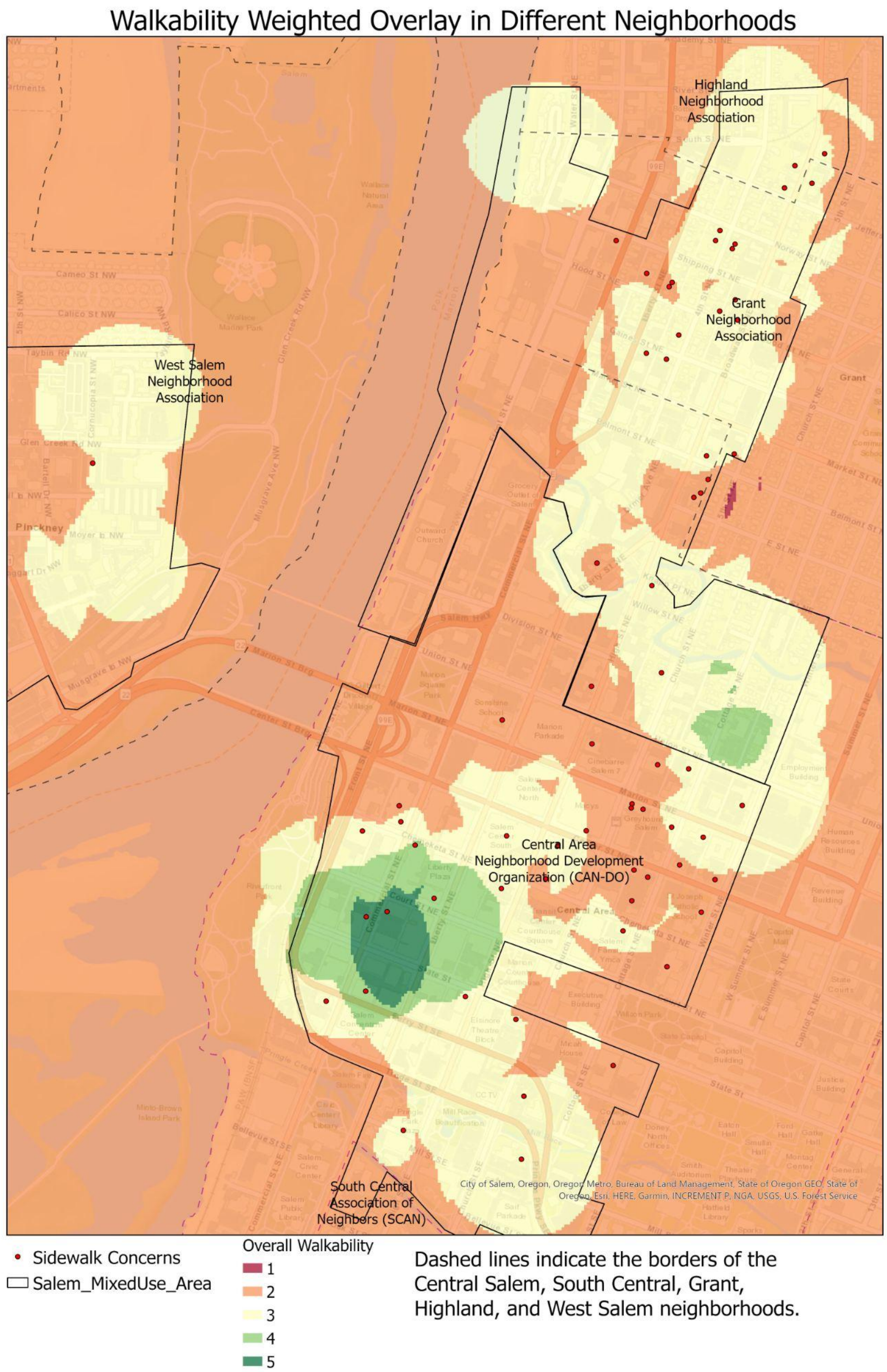

Figure 3: Final walkability weighted overlay on a scale of 1-5, with red/orange areas indicating low walkability (1) and green areas indicating high walkability (5). Sidewalk concern data points are included in red.

After analyzing the weighted overlays illustrating walkability demand and overall walkability, as well as the sidewalk concern data points and their specific locations, I have determined that the the locations with the most pressing sidewalk concerns affecting walkability are:

1) Central Salem: in the eastern areas of Center Street and Marion Street,
2) Along Belmont Street: on the border of the Central Salem and Grant neighborhood districts (in the North CFA),
3) as well as the general waterfront area of the western Grant district and northwestern Central district (indicated by orange areas nearer to the waterfront in figure 3).

Looking on Google Street View to find some visual examples of low-walkability sidewalk areas, we can see that some of the main issues are a lack of crosswalks, sidewalks positioned very close to the edge of busy streets, and a lack of cover for pedestrians (such as spatial buffers away from cars, tree canopy covering the sidewalks, etc.). Some sidewalks and crosswalks have been closed, as well, limiting the routes people can walk.

Figure 4: An unsignalized crosswalk next to a main road, close to residences and stores in the Grant neighborhood near the waterfront (a lot of the areas near Belmont Street are similar to this, with sidewalks right next to busy roads and places to cross that are not signalized).

https://maps.app.goo.gl/ctb8Wci3dGpWxDt56

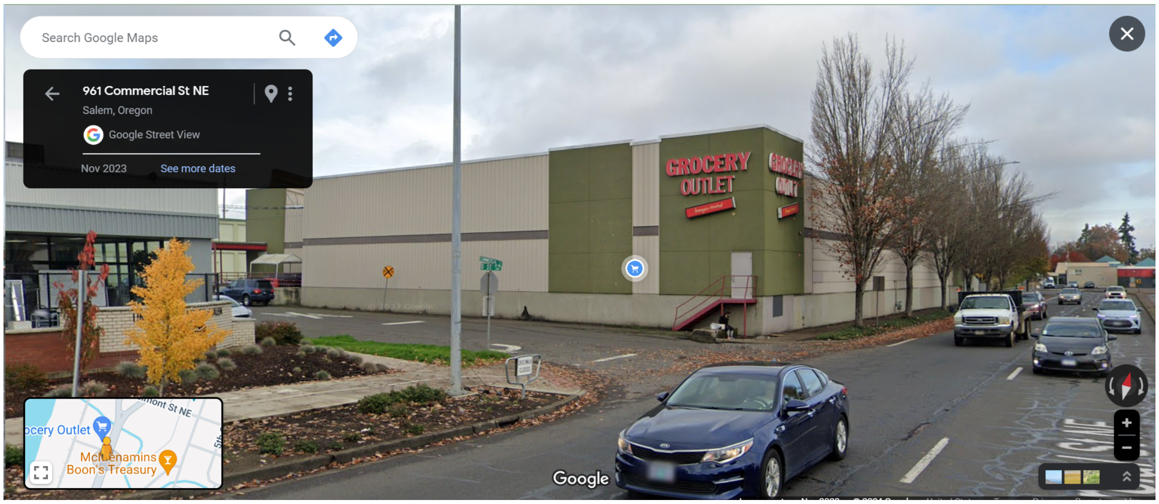

Figure 5: Exposed sidewalks next to a busy road and closed/unusable crosswalks next to stores in north Central Salem, near the waterfront. Many areas near the waterfront (near Commercial Street & D Street NE, in the northwestern part of Central Salem) are similar to this in terms of walkability and exposed sidewalks.

https://maps.app.goo.gl/fp7W45fCzNa8p9DF9

These particular areas should be of the highest priority and focus when it comes to increasing walkability, because we see frequent and high-hazard sidewalk issues occurring on routes *between* residence-dense and/or amenity-dense areas. In other words, the main pedestrian paths from people's homes to amenities like shops and restaurants are compromised, and walkability of the overall area would be greatly increased if the sidewalk infrastructure were improved.

SUMMARY:

The main issue when trying to improve pedestrian infrastructure is ensuring that walking is safe, convenient, easy, and pleasant for pedestrians trying to get to points of interest (houses, amenities). The most important points of high sidewalk concern highlighted above are places where walking is not safe, easy, or pleasant, usually due to sidewalk quality, number and safety of crosswalks, as well as sidewalk proximity to busy roads which can be noisy, dangerous, and overall unpleasant to walk next to (thus deterring people from walking those routes).

My main recommendation is that the city of Salem focuses on improving walkability in those highlighted locations *first*, due to their higher importance from being on high-demand walking routes. In these locations, I recommend the implementation of more signalized crosswalks if the sidewalks are near busy streets, making sure pedestrians have alternate routes if sidewalks or crosswalks are closed, as well as repairing any sidewalk breakage or potholes. Another recommendation I have is creating more cover for pedestrians, both from things like tree canopy cover and separation from busy roads (perhaps using buffers like curbs, bike lanes, or trees/plants). All of these solutions will improve walkability for pedestrians by making their walk safer, easier, more convenient, and more pleasant.

It is unreasonable to expect the city to work on fixing sidewalks, implementing crosswalks, etc. at *every single point of sidewalk concern* in the downtown area. This is why my main recommendation is to focus on those of highest priority and location, as this smaller focus makes the problem a bit more manageable. It will also yield better results in the long run, since good pedestrian infrastructure near concentrated neighborhoods will positively affect all of those populations living there.

FUTURE DIRECTIONS AND IMPROVEMENTS FOR THIS PROJECT:

For future analysis, it would be interesting to have data that shows which amenities are actually most frequently accessed by the surrounding populations. Since I did not have that data for my project, I chose to indicate “walkability demand” by just the *density* of these amenities (like stores, restaurants, etc.), but this may not be accurate to what people are actually interested in walking to all the time.

In addition, during the Salem project presentations it came to light that some of the sidewalk and concern data was not fully accurate and all-encompassing: for example, the footbridge across the river from East to West was not included. I would have liked to incorporate that into my analysis.

CITATIONS:

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- "Using GIS to Analyze Pedestrian Accessibility." Geography Realm, 24 Jan. 2019, www.geographyrealm.com/using-gis-to-analyze-pedestrian-accessibility/. Accessed 11 Mar. 2024.
- Kohler, Nicholas. "Walkability in Salem, Oregon." ArcGIS Online, storymaps.arcgis.com/stories/a9b18e06dfaa473cbe736212118034c9. Accessed 19 Mar. 2024.

DATA LAYERS AND SYMBOLOGY:

Folder location: R:\GEOG482_582_22260_Winter2024\Student_Data\hsiegel\FinalFinal

Files:

- OverallWalkabilityOverlay
- ResidenceDensity
- Salem_MixedUseArea
- SidewalkConcernDensity
- SidewalkConcernPoints
- WalkabilityDemand
- AmenityDensity
- AmenityPoints

Allegra Weil

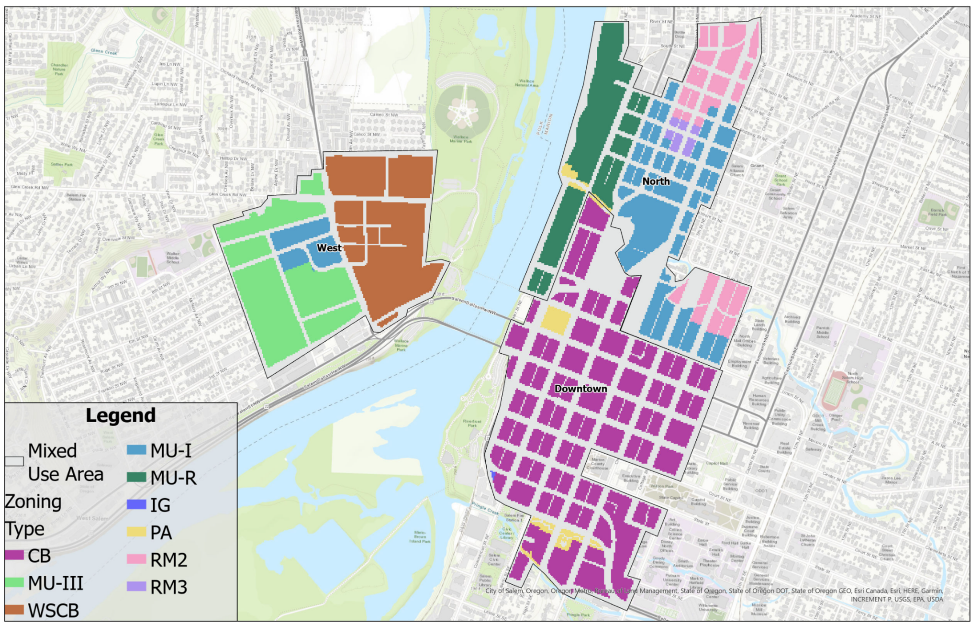
GEOG 482

Walkability of Salem

The primary goal of this lab project is to conduct a raster overlay analysis to establish a suitability index for 'walkability' within Salem, Oregon. This index will serve to highlight areas within the city that either excel in terms of walkability or require improvements to enhance pedestrian access. By integrating data on the existing transportation infrastructure, local amenities and services, as well as proximity to key destinations like places of employment or housing, the analysis aims to generate a comprehensive understanding of walkability patterns throughout Salem. The ultimate outcome will be a raster layer delineating areas that are most conducive to pedestrian activity alongside those that are less accommodating, thereby facilitating targeted discussions and interventions to enhance walkability within the city.

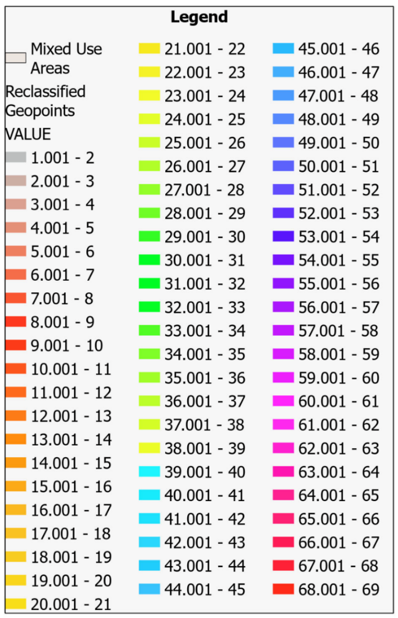
Improving walkability in Salem, Oregon, particularly in areas with lower walk scores, necessitates a multi-faceted approach tailored to the specific needs and characteristics of each neighborhood. West Salem, with its notably low walk score of 13, stands out as an area requiring focused attention. To address this, initiatives should prioritize enhancing pedestrian infrastructure such as sidewalks and crosswalks, particularly along key routes connecting residential areas to amenities like grocery stores and schools. By investing in well-lit pathways and accessible pedestrian crossings, West Salem can foster a safer and more inviting environment for walking, reducing reliance on cars and promoting community engagement. In addition to infrastructure enhancements, fostering mixed-use development in areas like West

Salem can significantly improve walkability. By encouraging the integration of residential, commercial, and recreational spaces, the neighborhood can create vibrant hubs where residents have easy access to daily necessities and leisure activities within walking distance. Mixed-use zoning not only promotes convenience but also cultivates a sense of community by fostering social interaction and supporting local businesses. Through strategic zoning policies and incentives, Salem can incentivize developers to incorporate mixed-use elements into new projects while revitalizing existing areas to better meet the diverse needs of residents.

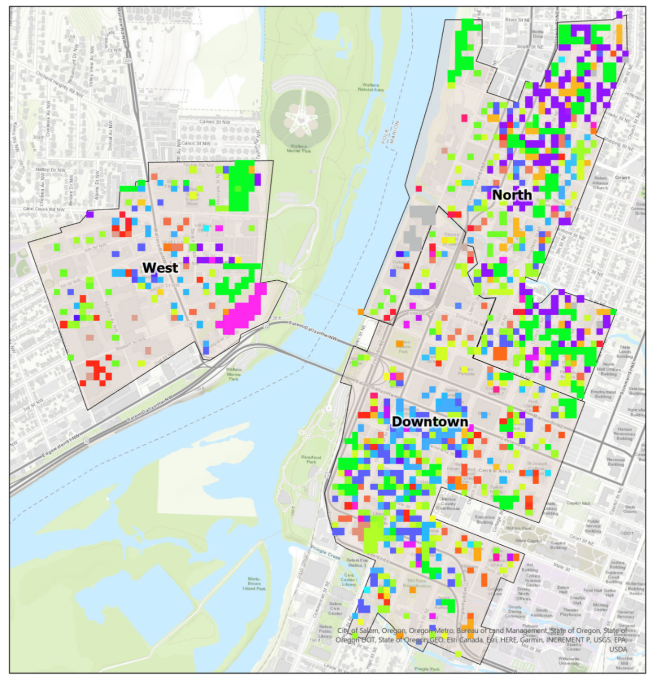


Moreover, community engagement plays a pivotal role in enhancing walkability and fostering inclusivity within Salem's neighborhoods. By actively involving residents in the planning process, city officials can gain valuable insights into local needs and preferences, ensuring that proposed improvements align with community priorities. Initiatives such as neighborhood walkability assessments, community workshops, and participatory budgeting empower residents to voice their concerns and collaborate with stakeholders to implement solutions. By fostering a sense of ownership and pride in their neighborhoods, Salem can cultivate stronger social ties and a collective commitment to creating walkable, inclusive spaces that reflect the diverse needs and aspirations of its residents. Ultimately, improving walkability in Salem is not just about upgrading infrastructure—it's about building a city where everyone feels connected, safe, and valued. By integrating infrastructure enhancements, mixed-use development, and community engagement initiatives, Salem can create vibrant, pedestrian-friendly neighborhoods that enhance quality of life and promote social cohesion. Each step taken toward improving walkability brings Salem closer to its vision of a more accessible, equitable, and enjoyable urban environment for all residents to cherish and thrive in.

To begin the geospatial analysis aimed at improving walkability in Salem, Oregon, several datasets were utilized

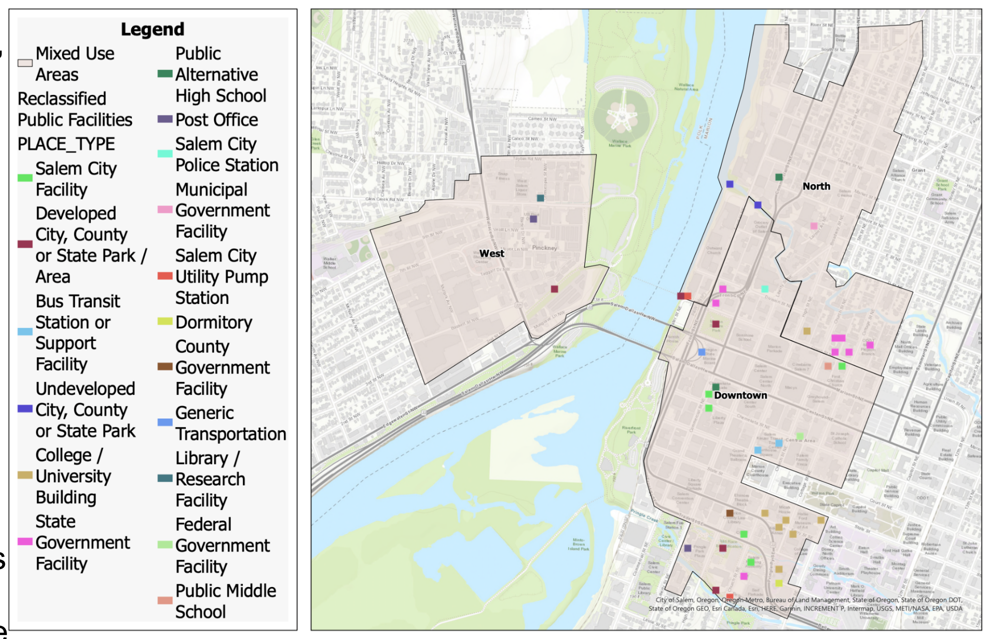


figuring out hoe to change the numbers to the names of the types of building. each number corresponds to a type of building.



within ArcGIS Pro. These datasets included SalemCFANorth, SalemCFA_CB, SalemCFAWEST, geopoints, zoning districts, and Salem public facilities. Initially, the CFA datasets were merged into a single layer to create a comprehensive representation of mixed-use areas across Salem. This merge operation facilitated the identification and analysis of areas characterized by diverse land uses, including residential, commercial, and recreational. Next, the zoning districts, public facilities, and geopoints datasets were selected by location within the newly merged mixed-use layer. This step ensured that only relevant data within the mixed-use areas were considered for further analysis.

By focusing on these areas, the analysis could prioritize improvements where they would have the most significant impact on walkability and community accessibility. The geopoints dataset underwent a dissolve geospatial analysis to aggregate points within close proximity, resulting in a more generalized representation of amenities and services available within the mixed-use areas. The dissolved geopoints layer was then reclassified to assign values indicative of their contribution to walkability, such as proximity to grocery stores, schools, parks, and other essential services. Similarly, the output layers generated from the selection by location operation for zoning districts and public facilities were converted into feature layers. These feature layers represented specific attributes of interest within the mixed-use areas, such as zoning designations and the location of public amenities. Each feature layer was then converted into raster format and reclassified to assign suitability values based on their impact on walkability. By employing these geospatial analysis methods, the study was able to integrate diverse datasets and assess their collective influence on walkability within Salem's mixed-use areas. The resulting raster

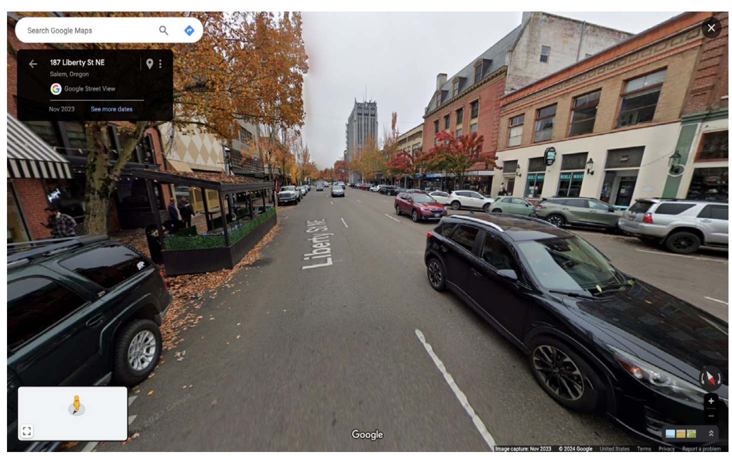


layers provided a spatially explicit representation of walkability factors, allowing for informed decision-making and targeted interventions aimed at enhancing pedestrian access and community well-being.

For future directions and improvements, I would incorporate additional datasets such as pedestrian traffic data, land use intensity metrics, and demographic information to further refine the walkability analysis. Additionally, exploring advanced geospatial analysis techniques such as network analysis for evaluating pedestrian connectivity and spatial regression modeling for assessing the impact of various factors on walkability could enhance the accuracy and robustness of the recommendations. Furthermore, engaging with community stakeholders and conducting surveys or participatory mapping exercises to gather qualitative insights on pedestrian experiences and preferences would enrich the analysis and ensure that recommendations align with the needs and aspirations of Salem's residents.

Downtown Salem/Central Area (Nov 2023):

This image captures the bustling streets of downtown Salem, characterized by a mix of shops, restaurants, and pedestrians. Sidewalks are well-maintained, and the vibrant atmosphere encourages walking. However, potential improvements could include adding more pedestrian amenities like benches, street trees, and public art to enhance the overall walking experience.(https://maps.app.goo.gl/bmmYmLRhDFLLzRW46)



West Salem (Jul 2023):

This residential area lacks the vibrancy and amenities found in downtown Salem. While sidewalks are present, the absence of shops and restaurants discourages walking for errands or leisure activities. Improving walkability in this area could involve diversifying land use by incorporating mixed-use

developments and enhancing pedestrian infrastructure such as adding crosswalks, pedestrian-friendly lighting, and green spaces to create a more inviting environment for walking. (https://maps.app.goo.gl/gU6yK5uiePnFh3Pp6)

South Central Salem (Aug 2023):

This stretch of road features decent sidewalks, but the lack of amenities and perceived safety concerns, especially at night, may deter pedestrians, particularly women, from walking in the area. Strategies to improve walkability here could include increasing street lighting, enhancing visibility, and implementing crime prevention measures to create a safer environment for pedestrians, thus

promoting equity in access to walkable spaces. (https://maps.app.goo.gl/qgsjC74JGTcCoLRj9)

Works Cited:

Iskalo Development Corp. "Explore the Benefits of Mixed-Use Development." Iskalo Development Corp., https://iskalo.com/insights/explore-the-benefits-of-mixed-use-development/#:~:text=Mixed%2Duse%20development%20encourages%20public,pollution%20and%20promote%20energy%20conservation.

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Final Project - Ava Wessel

Goal

The main design strategy for my recommendations are to focus on transportation, land use, and community design. Specifically making suggestions for more crosswalks to increase safety.

Summary of the Recommendations

To improve the walkability in Salem, my main proposition is the addition of crosswalks, specifically signalized crosswalks. Being a part of the mixed-use group, I focused these recommendations on all crosswalks within a quarter of a mile from each mixed use zone. According to NACTO (National Association of City Transportation Officials), if it takes a person more than three minutes to walk to a crosswalk and wait to cross the street, they may choose to cross directly, making this much more dangerous. This poses a significant risk to pedestrians and highlights a need for signalized crosswalks to avoid this risk. Another study found that an increase in signalized crosswalks resulted in an increase in safe street crossings and calmed traffic volume and speed (Schultz et al. 2015). Redesigning pedestrian crossings, taking in account the current network and traffic networks can greatly increase safety, foster a sense of community, and encourage more sustainable modes of transportation.

Looking at a three minute walking service area around each crosswalk will provide specific examples around and in the mixed-use zones that should have an increase in crosswalks and/or increase in signalized crosswalks. Most of these recommendations can be shown outside of the CB CFA zone and along the west CFA zone. In addition to this recommendation, using a similar method, showing the geographical location of bus stops in comparison to crosswalks will also help provide some helpful insight into the placement of crosswalks around the mixed-use areas. As bus stops are bringing in pedestrians from other areas, improving the availability of safe street crossings nearby will further enhance the accessibility and functionality of the mixed-use areas (DOT 2013). If pedestrians are able to reach their destination even quicker by increasing the amount of crosswalks and reducing walking time, this will encourage more public transport usage (DOT 2013). Creating more safe access to and from public transportation will allow higher connectivity to these mixed-use areas.

Overall both of these recommendations will help create a safe walkable community, focusing specifically on and around the mixed-use zones. Along with this idea, it is important that these crosswalks have adequate markings, allow an efficient amount of time during and in between cycles to further ensure safe crossing. These recommendations involve all populations of people, especially if specific populations live close or within these mixed-use zones and frequently use public transportation.

Data and Methods

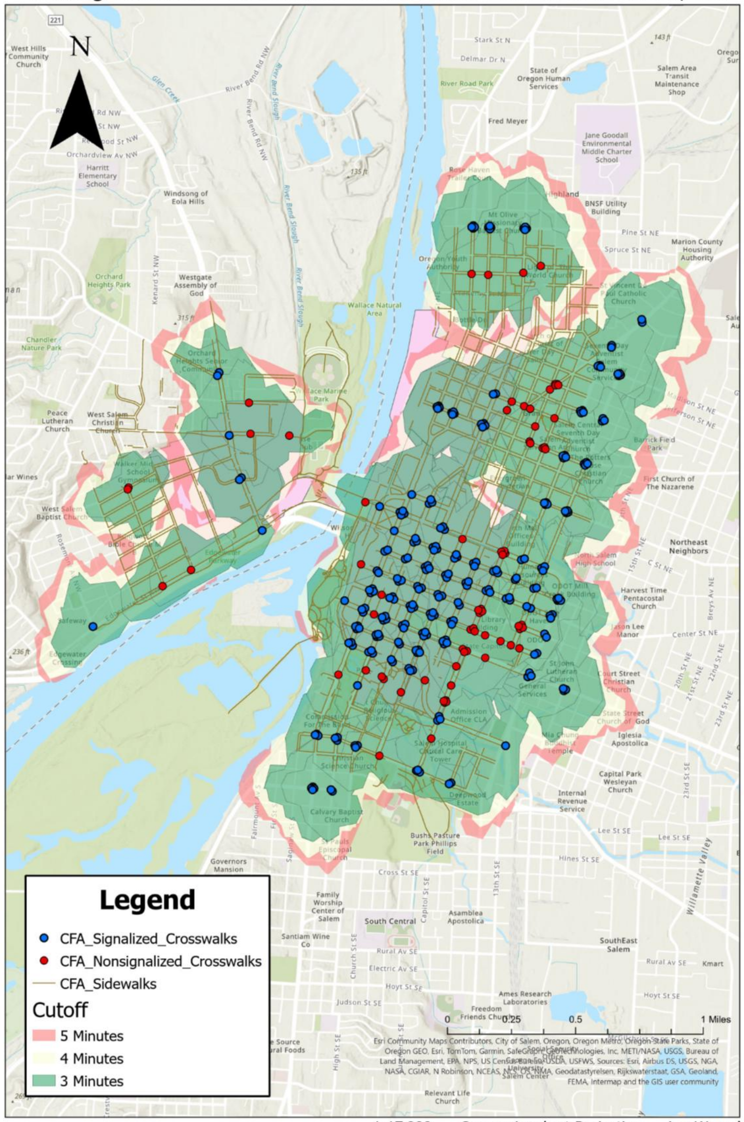
To complete this analysis, for my first recommendation I completed a three minute service area around each signalized and unsignalized crosswalk within a quarter mile of the mixed-use areas. To begin using the three mixed-use polygons and the merge tool, I combined these into one layer with the three polygons, SalemCFA_Merge. After completing this I was now able to select the filtered data from each data layer. Using the Salem_UnsignalizedCrosswalks layer and using select by location, I selected all data points that intersect within a 0.25 US survey miles of the SalemCFA_merge layer. I did this same strategy with the Salem_SignalizedCrosswalks layer as well. All of these selections were turned into a new layer entitled CFA_Unsignalized_Crosswalks and CFA_Signalized_Crosswalks. In addition to this, in order to visibly see the connection with sidewalks and crosswalks, I selected the sidewalk lines from Salem_Sidewalks and ParkTrails to intersect within 0.25 US survey miles from the mixed-use polygons. I chose to use both the sidewalks and park trails as they involve many connections within and around the mixed-use zones. For example, a pedestrian bridge connecting the west CFA area and the north downtown CFA area was only in the ParkTrails dataset. After selecting by location for both these line layers, I used the merge tools to combine both of these into one comprehensive layer entitled SalemCFASidewalks_Merge. Finally I created a network analysis and completed a three, four, and five minute walking time, away from facilities, service area around the CFA_Signalized_Crosswalks and CFA_Unsignalized_Crosswalks. This service area was exported to a new layer entitled CFA_REVISEDCross_Walking (some minor tweaks were needed throughout, this is the final layer name located in the layer package).

Next for the second recommendation, I created 0.1 US Survey miles buffers around each bus stop within a quarter of a mile of the mixed-use zones. To begin, similar to the first recommendation, I used the select by location tool to intersect the Cherriots_Bus_stop data with the SalemCFA_Merge layer within a 0.25 US Survey Mile. This selection was turned into a new layer entitled CFABus_Stop. Using this new layer of points and the Pairwise Buffer geoprocessing tool, 0.1 Survey Mile buffers were created around each bus stop point. The new output layer containing this was titled Bus_stops_PairwiseBuffer. Finally the CFA_Signalized_Crosswalks and CFA_Unsignalized_Crosswalks point layers were made visible to show how many total crosswalks were within each bus stop buffer.

Supporting Maps and Graphics

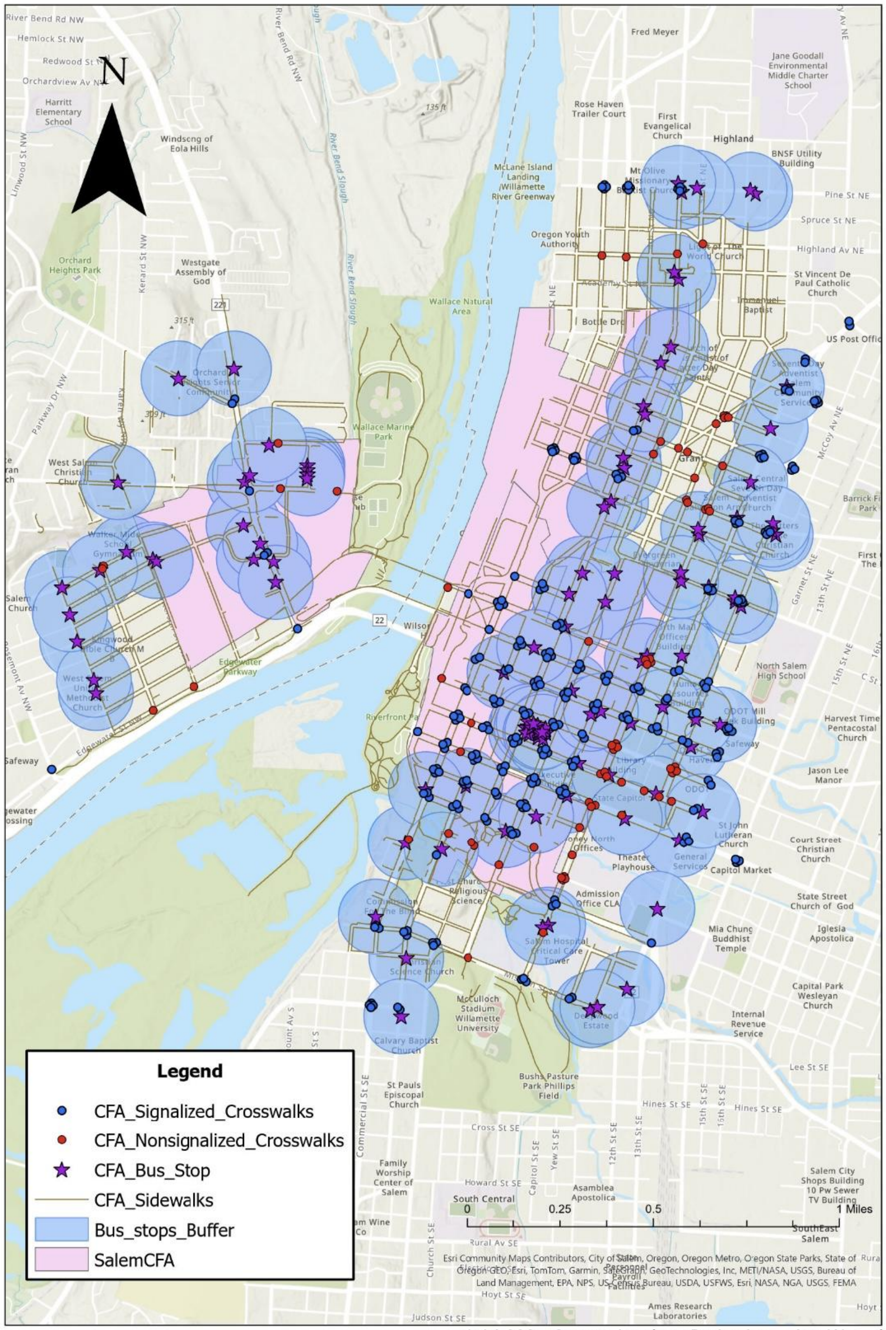
Graphic 1:

Walking Time from Crosswalks around Mixed-Use Areas in Salem, OR



1:17,000 Oregon Lambert Projection Ava Wessel

Bus Stops Blend with Crosswalks around Mixed-Use Areas in Salem, OR



1:14,000 Oregon Lambert Projection Ava Wessel

Graphic 2:

Future Directions and Improvements

To continue this on with this recommendation there are many possible directions that could be a beneficial expansion to this.

1. Pedestrian and Car Traffic: The incorporation of the density of pedestrian or car traffic data could offer further insight into the areas that are the busiest and are in more need of crosswalks. This could also provide the information to create the most efficient crosswalk-traffic transit plans. If each crosswalk was more strategically placed based on how many cars and pedestrians are in that area, it would not inhibit the ability of people driving to get to their destination quickly as well as pedestrians.
2. Types of Crosswalks: There are many different types of crosswalks that stretch from unsignalized to signalized. If there was more utilization of mid-block crosswalks that allow cars to pass through if there are no actively walking pedestrians will further increase traffic efficiency.
3. Public Engagement: In order for the increase in crosswalks and the connectivity with bus stops to be more utilized, conducting community surveys or workshops could help gather feedback on pedestrian experiences and preferences for these. Though some areas may seem to be in need based on GIS analysis, there may be areas that actually are of more concern but don't reflect accurately in the analysis. Engaging with the community can help make more informed decisions to align with local priorities.

Citations

Crosswalks and Crossings | National Association of City Transportation Officials. *National Association of City Transportation Officials*, 24 (2015), nacto.org/publication/urban-street-design-guide/intersection-design-elements/crosswalks-and-crossings.

Schultz, C.L., Sayers, S.P., Wilhelm Stanis, S.A. *et al.* The Impact of a Signalized Crosswalk on Traffic Speed and Street-Crossing Behaviors of Residents in an Underserved Neighborhood. *J Urban Health* 92, 910–922 (2015). https://doi.org/10.1007/s11524-015-9979-7

Pedestrians and Transit - Safety | Federal Highway Administration. safety.fhwa.dot.gov/ped_bike/ped_transit/ped_transguide/ch3.cfm. (2013).

Provide a list of the layers and the location of the folder.

R:\GEOG482_582_22260_Winter2024\Student_Data\awessel\Final_Project\Layer_Packages**CFA_REVISEDCross_Walking.lpkx**

R:\GEOG482_582_22260_Winter2024\Student_Data\awessel\Final_Project\Layer_Packages**Rec1_CrossWalks.lpkx**

R:\GEOG482_582_22260_Winter2024\Student_Data\awessel\Final_Project\Layer_Packages**Rec2_BusStopAddition.lpkx**

Provide the name of the ArcPro project(s) used for work on your final project and its location on the R: drive

R:\GEOG482_582_22260_Winter2024\Student_Data\awessel\Final_Project\Final_awessel**Final_awessel.aprx**

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