

Modeling Transit Accessibility Gaps for the Mobility Impaired

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A Project of the Spokane LIFTS Program

Overview

- **Project Background**
- **Data Model Description**
- **Data Preparation for Modeling**
- **Modeling Results**

Spokane LIFTS Project

- **LIFTS: Lifeplan Improvement through Feasible Transportation Services**
- A project designed and implemented by a local consortium with Spokane Transit as lead agency, having evolved from ACCT in 2001.
- Spokane's implementation of the JARC (Job Access and Reverse Commute) Program, which began under TEA-21 and was continued under SAFE-TEA.
- The JARC program assists states and localities in developing new or expanded transportation services that connect welfare recipients and other low income persons to jobs and other employment related services.
- The JARC program establishes a coordinated regional approach to job access challenges. Projects must be the result of collaborative planning.
- Funding requires 50% State/Local Match.

LIFTS Components

- **Web-based GIS tool for public use with layers of data that will assist people in locating necessary services such as Spokane Transit fixed bus routes, job training sites, affordable housing options, child care, and employment sites. Also provides training for case workers and clients.**
- **GIS mapping of physical barriers between fixed routes and origins and destinations in order to improve transportation access for people with mobility impairments.**

Mobility Mapping Project

- **Accessibility: ADA and Barriers**
- **Project Goals and Objectives**
- **Project Development:**
 - **Data Model and Mapping Methods and Workshop for People with Mobility Impairments**
 - **Pilot Mapping 2006**
 - **Lessons and Refinements**
 - **Production 2007**

Accessibility

- **Accessibility to public buildings and facilities for people with disabilities was mandated by the passage of the Americans with Disabilities Act in 1990.**
- **Appendix A to Part 1191 - Americans with Disabilities Act (ADA) Accessibility Guidelines for Buildings and Facilities, Section 4.3.2 Location:**
 - **(1) At least one accessible route within the boundary of the site shall be provided from public transportation stops, accessible parking, and accessible passenger loading zones, and public streets or sidewalks to the accessible building entrance they serve. The accessible route shall, to the maximum extent feasible, coincide with the route for the general public.**
 - **(2) At least one accessible route shall connect accessible buildings, facilities, elements, and spaces that are on the same site.**

Barriers

- **Absence of sidewalk, curb cuts (curb ramps) or bus stop apron**
- **Non-ADA compliant variations in:**
 - **Surface condition**
 - **Height**
 - **Width**
 - **Slope**

In the transit world, buses and stops are usually ADA accessible, but are destinations?



Spokane: 2nd Avenue Near Hamilton



Increasing Accessibility

- **Increasing accessibility means:**
 - **Reducing barriers to access fixed route buses and destinations to & from them.**
 - **Barrier identification is one of the first steps in the reduction process.**
 - **Potential alternate pedestrian routing.**
- **Documenting lack of access to/from fixed routes allows use of demand response vans.**

Absolute and Relative Access

- **ADA accessibility is a standards-based system that uses presence or absence to test for compliance.**
- **Relative access compares distances or difficulty of access between individuals of differing capabilities.**
- **We represent and model both these conditions.**

Project Goals

- **Map Spokane's Pedestrian Network**
 - Include facilitators of and barriers to access.
 - Project Area is Spokane Transit Service Area (PTBA).
- **Analyze and Model that Network**
 - Identify and prioritize sections of the network in need of repair or maintenance.
 - Identify gaps in absolute and relative accessibility to the transit system.
 - Support development of a routing system for individuals of varying levels of mobility that helps them move conveniently and independently from home to work or services and back using fixed route buses.

Project Objectives

- **Develop a digital network map of the pedestrian paths of Spokane as well as associated data models and mapping protocols.**
- **Identify and map features that are barriers or aids for people using the path network to access Spokane Transit fixed route buses.**
- **Model access and conduct accessibility gap analysis. FOCUS OF THIS TALK.**

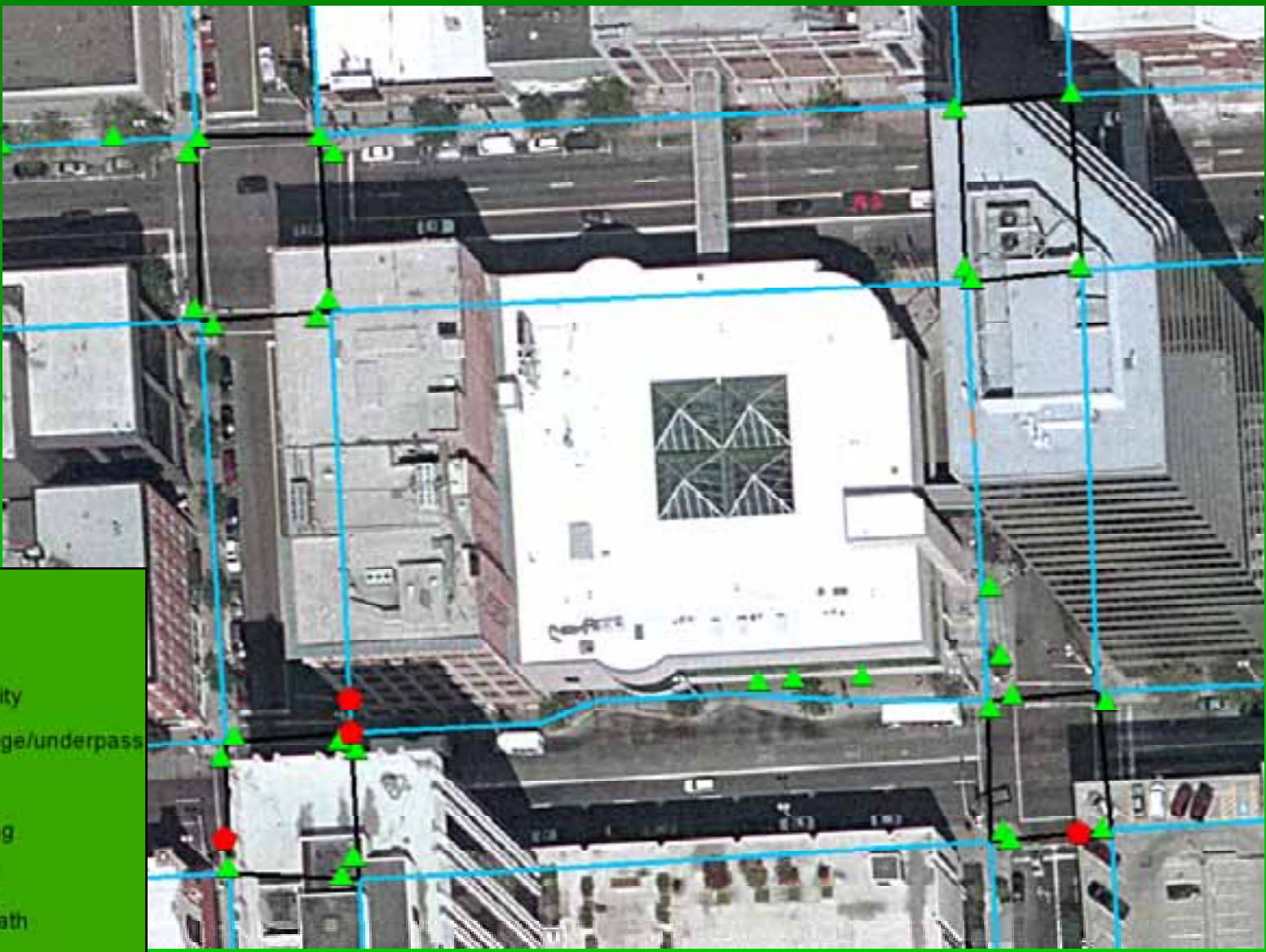
Project Development

- **Preliminary Data Model.**
 - **Based on:**
 - ADA Standards.
 - Transportation Data Models.
 - Conference Sessions (2005, 2005).
 - Research Literature.
- **Refinement Team and Focus Group Workshop.**
 - **Pilot Mapping (Summer 2006).**
 - **Final Data Model.**
 - **Implement Mapping 2007.**

Data Model

- **Two Components**
 - **Linear Features (Pedestrian ROWs)**
 - **Point Features (Aids and Barriers)**

Data Model



Legend

- Barriers
- ▲ Aids to Mobility
- Pathway bridge/underpass
- Alley Xing
- Driveway Xing
- Formal Path
- No Formal Path
- Road Xing

Linear Network Attributes

- **Retain information for identification and addresses from road centerlines.**
- **Determine basic network from existing layers and aerial photographs.**
 - **Apply attributes and edit network geometry.**
 - **Use aerial photography from Avista Utilities.**
- **Verify basic network and add condition information by direct observation.**

Linear Network Attributes

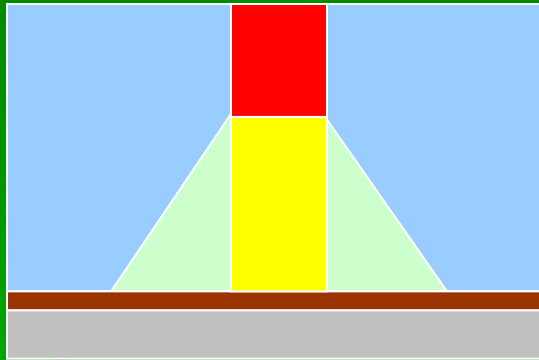
- **Examples**
 - **Surface Type**
 - **Feature Type (i.e. Formal Path, Road Crossing, etc)**
 - **Presence of Traffic Control Devices**
 - **Presence of Crosswalk Markings**
 - **Number of Traffic Lanes to Cross**
 - **Accessible Characteristics**

Point Feature Attributes

- **Created from Field Observations**
- **Examples**
 - **Subtypes: Aids to Mobility or Barriers to Mobility**
 - **Width: < 32" or < 32"**
 - **Accessible Characteristics**

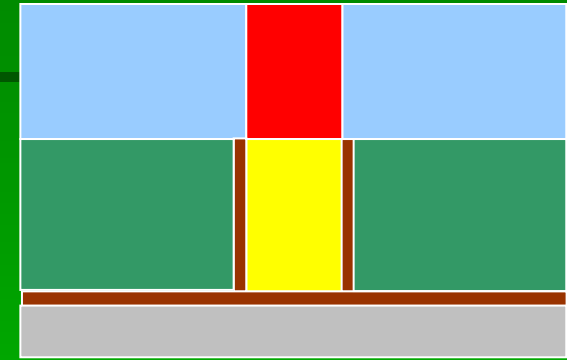
Curb Ramp Classifications

1) Winged



- Approach
- Curb
- Flare
- Gutter
- Landing
- Ramp
- Vegetation

2) Curbed

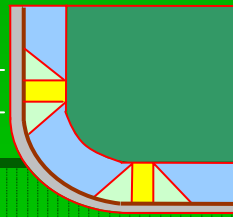
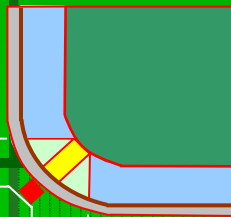


Diagonal

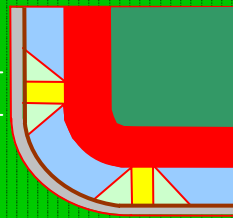
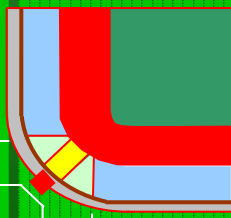
Perpendicular

Diagonal

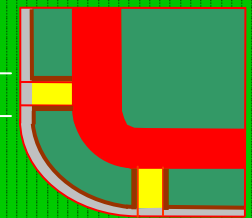
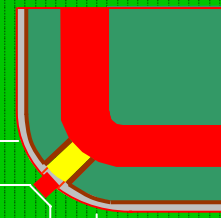
Perpendicular



Without Landing

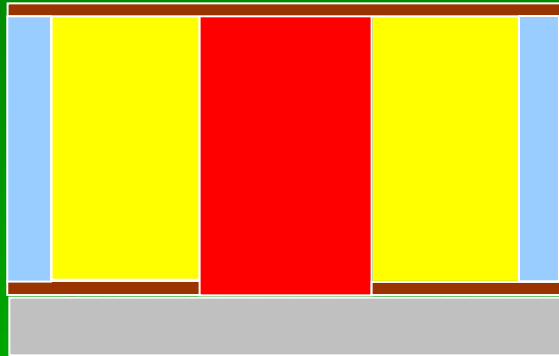


With Landing in
Adjacent Walk



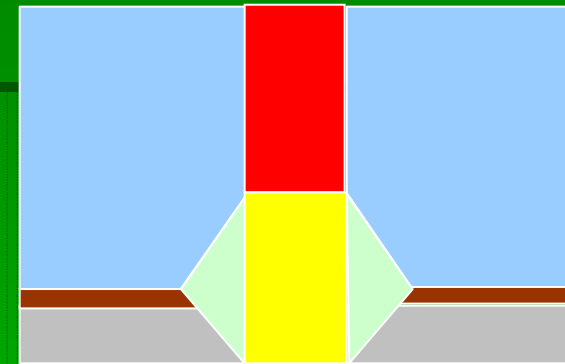
Curb Ramp Classifications

3) Parallel



- Approach
- Curb
- Flare
- Gutter
- Landing
- Ramp
- Vegetation

4) Built-up



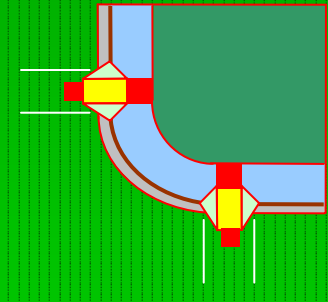
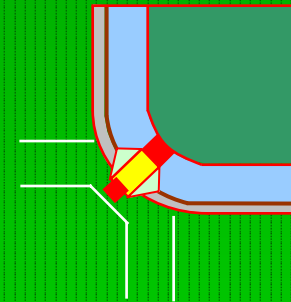
Diagonal

Perpendicular

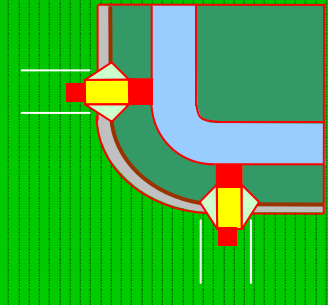
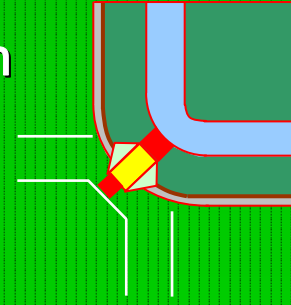
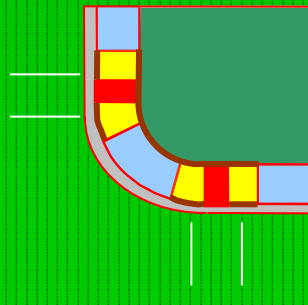
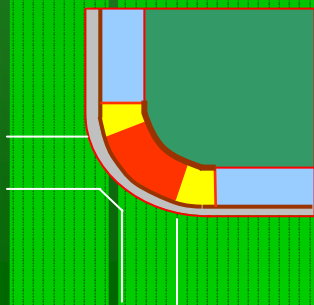
Diagonal

Perpendicular

Without
Landing



With Landing in
Adjacent Walk



Ramp Slope Measurement



Slope Conversion

1.5° or less	1:50
2°	1:30
3°	1:20
4°	1:15
5°	1:12
6°	1:10
7°	1:8
8°	1:7
9°	1:6
10°	1:5

Accuracy 1/2 of 1°

Pedestrian Modeling

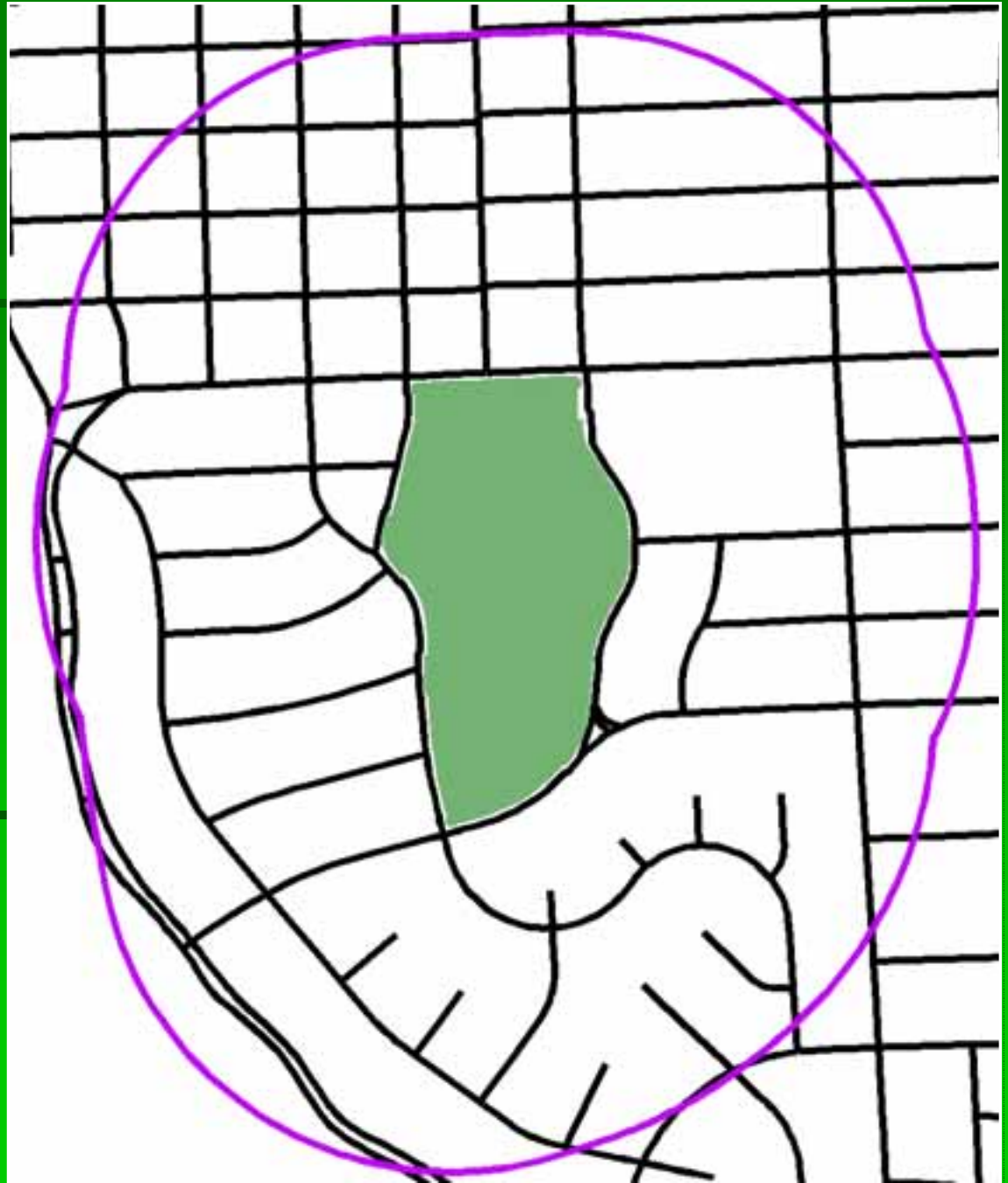
- **Test Site Selection**
- **Network Creation and Impedance Assignments.**
- **Service Area Creation and Analysis**
- **Route Creation and Analysis**

Site Reference Map



Third Site

- **Comstock Park**
 - **Grid Street Pattern**
 - **Curvilinear Streets**
 - **Cul-de-Sacs**



Network Creation

- **Impedance (Cost of Travel)**
 - **Relative Barriers**
 - Values from MAGUS project (Beale 2001)
 - **Absolute Barriers**
 - Examples: Gravel Surface, Prohibited Crossing at Intersections, Narrow Sidewalk

Network Creation

- Impedance Categories
 - Two Groups
 - Turn Table

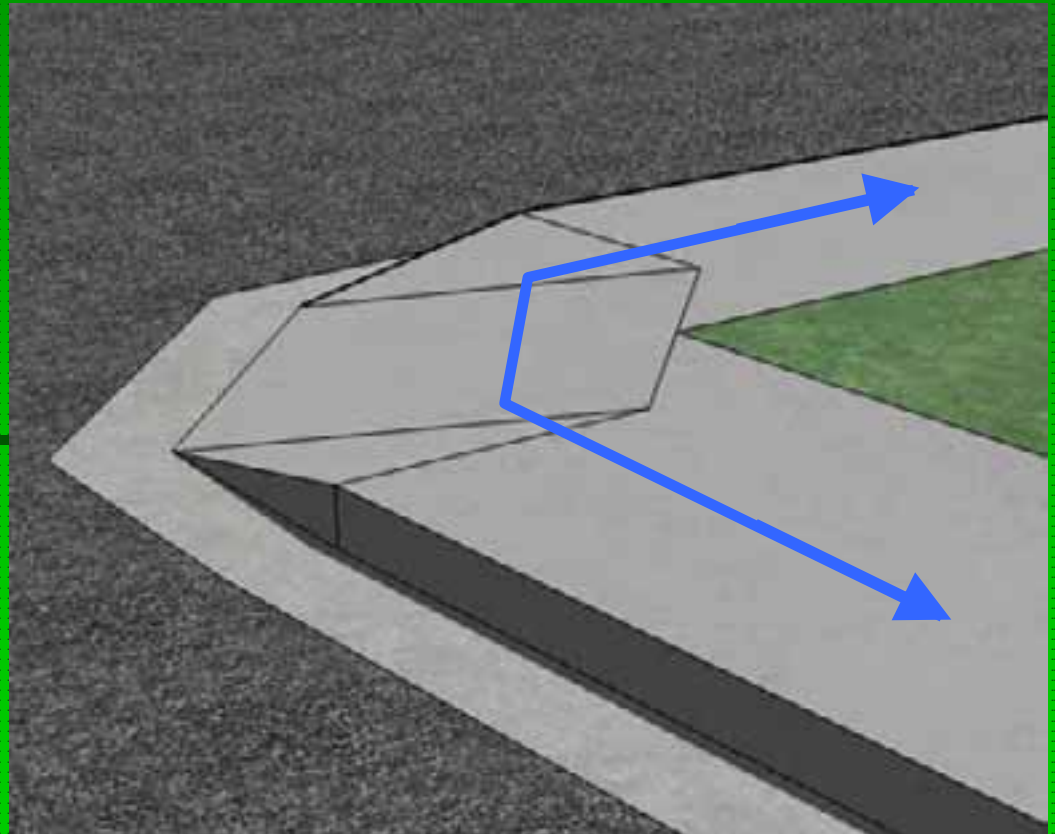


Image Source: Author

Network Creation

- **Impedance Value Assignment**
 - Values Assigned Based on Attribute (i.e. Concrete, Grass) and Group
 - Formula Used to Assign Total Impedance to Linear Feature
 - Example

$$I_{om} = \left(0.5 \times \frac{1}{[MI _ LinBar]} \right) + \left(0.5 \times \frac{1}{[MI _ Surface]} \right)$$

- **Total Impedance Value Determines Rate of Travel**

Service Area Creation

- **Service Areas**

3 Mobility Groups x

3 Parks =

9 Different Service Areas

Service Area Creation

- **Origins/Access Points**



Image Source: Author; Aerial Imagery Courtesy of Avista Utilities

Service Area Analysis

- Relative Accessibility (RA)

$$RA = a_1 / a_2$$

Case 1

Case 2

Origin

Service Area Analysis

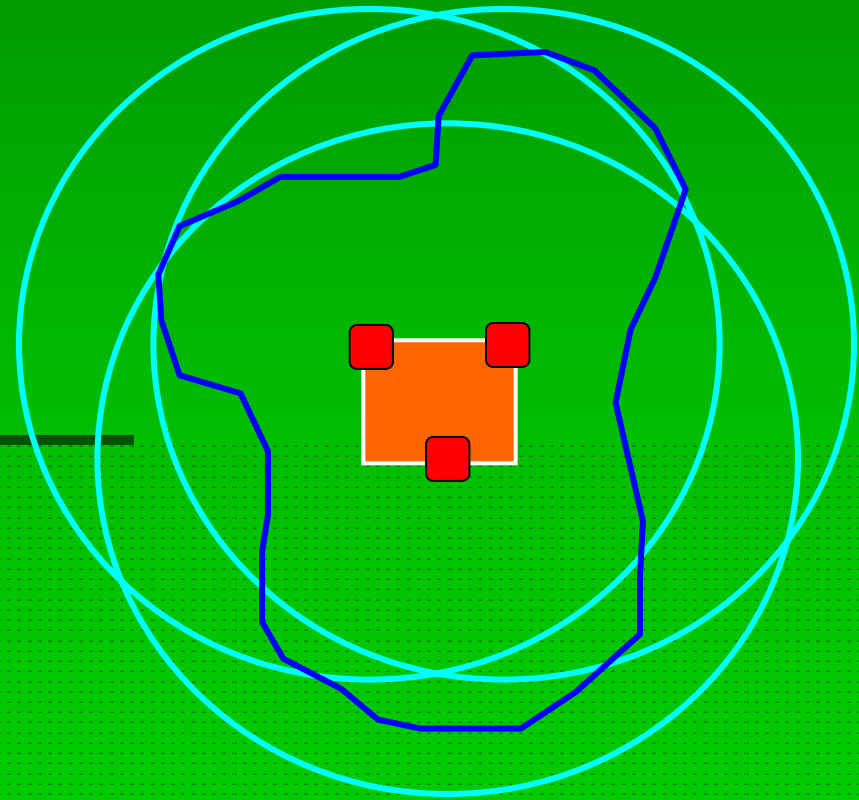
- Normalized Patch Shape Index (NPSI)

$$NPSI = \frac{\frac{P_1}{2\sqrt{a_1\pi}}}{\frac{P_2}{2\sqrt{a_2\pi}}}$$

Buffer

Origin

Facilities



Service Area Analysis

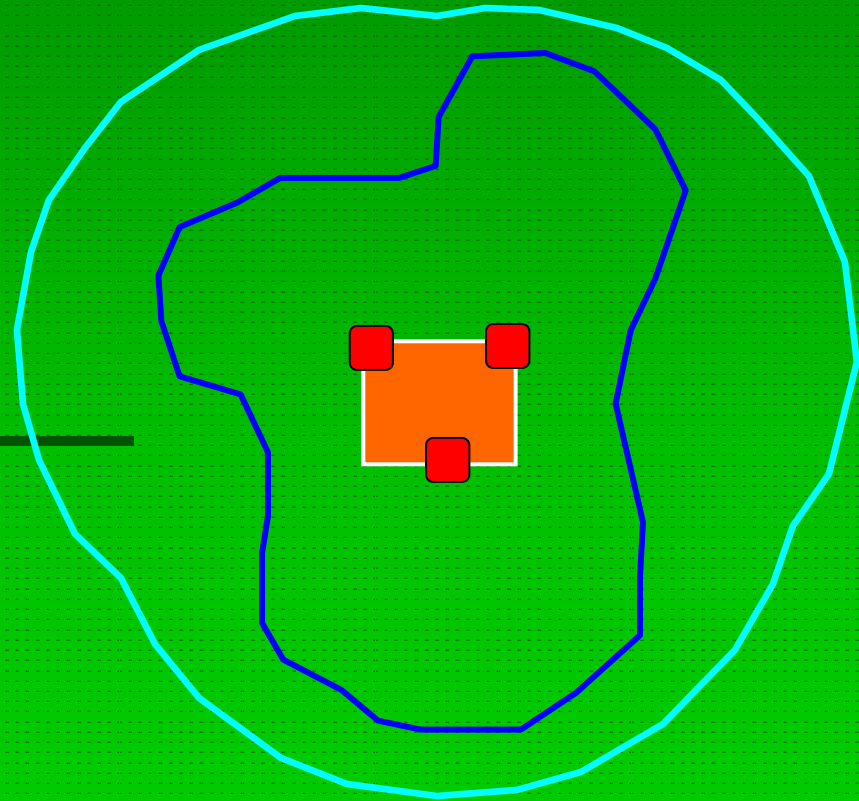
- Normalized Patch Shape Index (NPSI)

$$NPSI = \frac{\frac{p_1}{2\sqrt{a_1}\pi}}{\frac{p_2}{2\sqrt{a_2}\pi}}$$

Ideal Shape

Facility

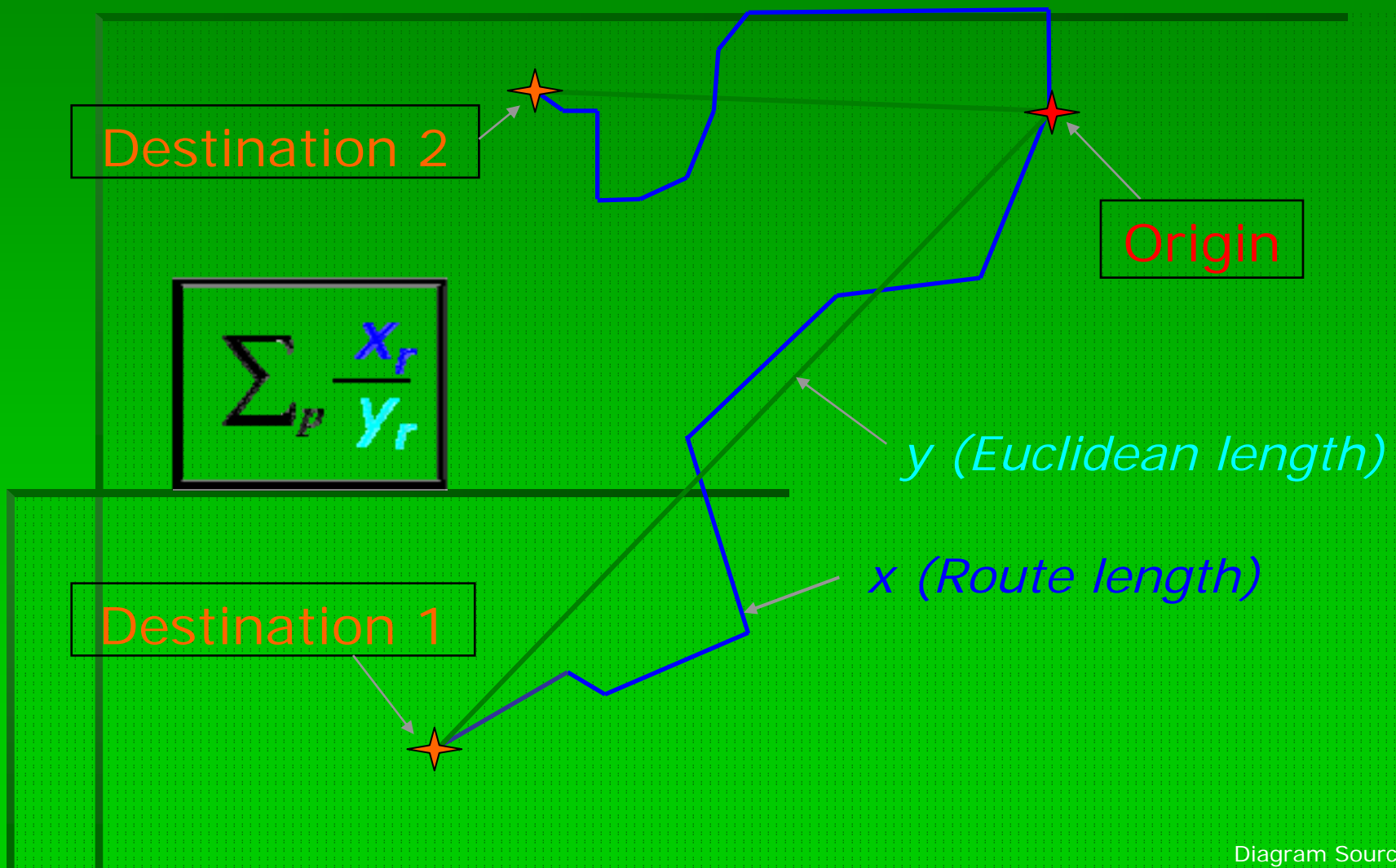
Origin



Route Creation

- **One Origin/Park**
- **Destinations**
- **Least Resistance (Lowest Impedance)**

Route Analysis



Analysis

- **Service Areas**
 - **Display**
 - **Analysis**
- **PRD**
 - **Display**
 - **Analysis**
- **Summary**

Service Areas: Comstock

- Pedestrian ROWs
- Ambulatory Service Area (Linear)
- Baseline Service Area (Linear)
- Mobility-Impaired Service Area (Linear)
- 1/4 Mile Park Buffer
- Park
- Baseline Service Area
- Ambulatory Service Area
- Mobility-Impaired Service Area

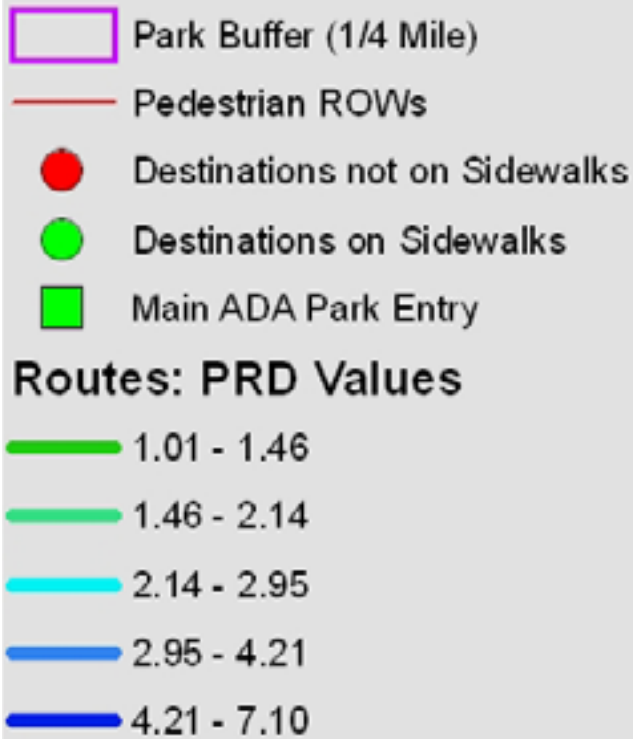


Service Areas Analysis

	Friendship Park	Comstock Park	Audubon Park
RA: Ambulatory/Baseline	<i>0.584</i>	0.711	0.650
RA: Mobility-Impaired /Baseline	<i>0</i>	<i>0</i>	0.002
RA: Mobility Impaired /Ambulatory	<i>0</i>	<i>0</i>	0.003
NPSI: Baseline	1.447	1.439	<i>1.196</i>
NPSI: Ambulatory	<i>1.482</i>	1.402	1.412
NPSI: Mobility-Impaired	<i>0</i>	<i>0</i>	1.936

Bold = Best; Italics = Worst

Comstock PRD

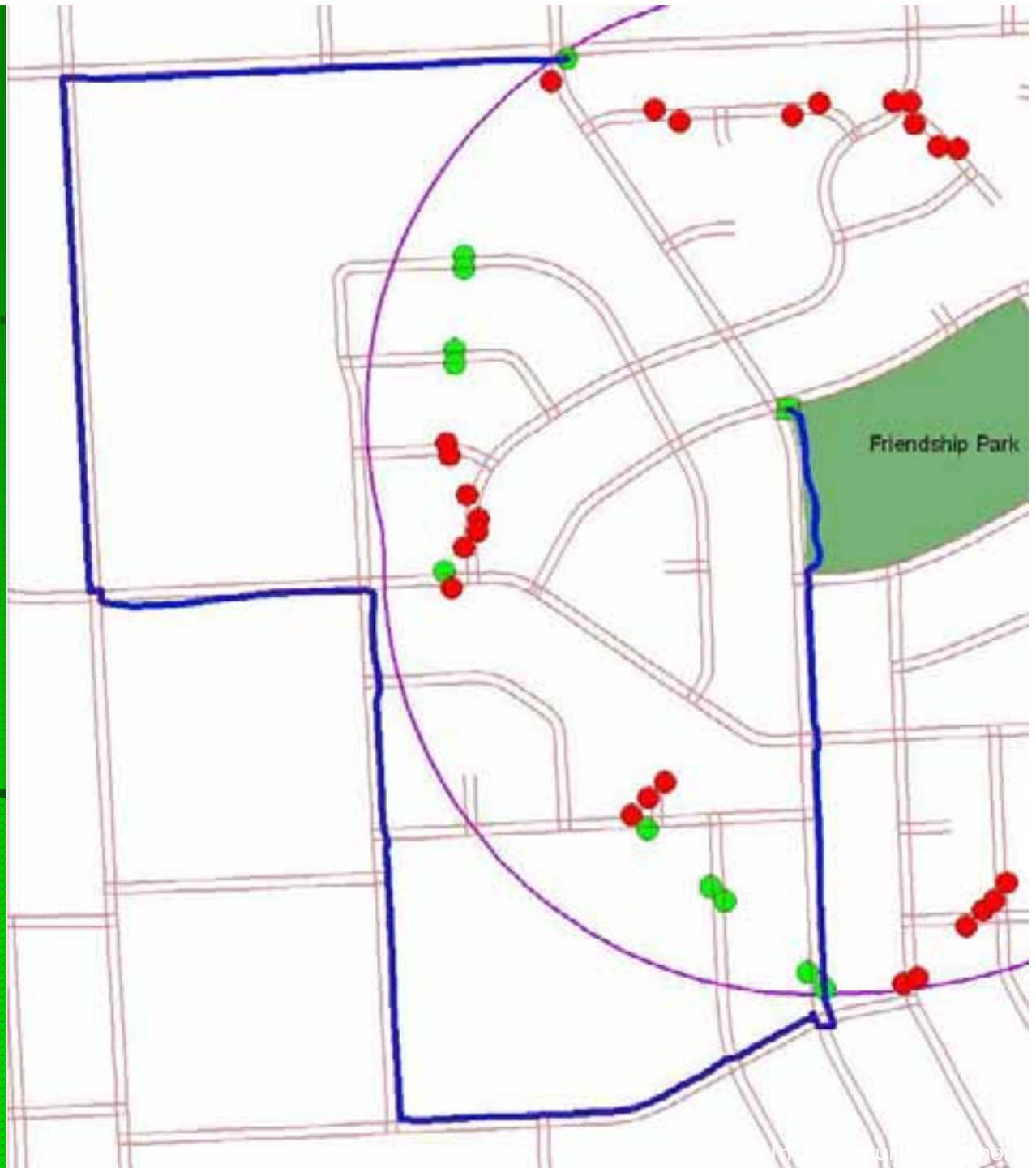
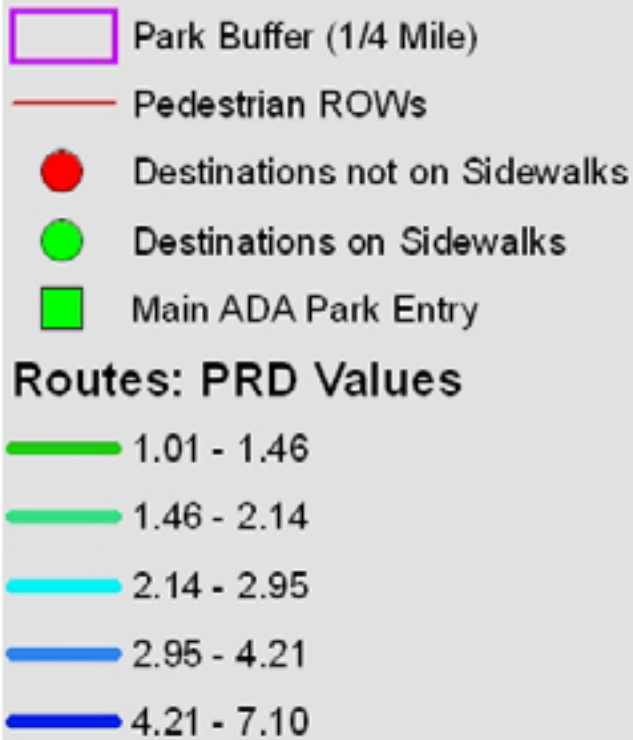


PRD Analysis

PRD Value	<u>Audubon</u>	<u>Friendship</u>	<u>Comstock</u>
Mean	1.490	2.582	3.329
Minimum	1.032	1.027	1.018
Maximum	2.138	7.096	5.26

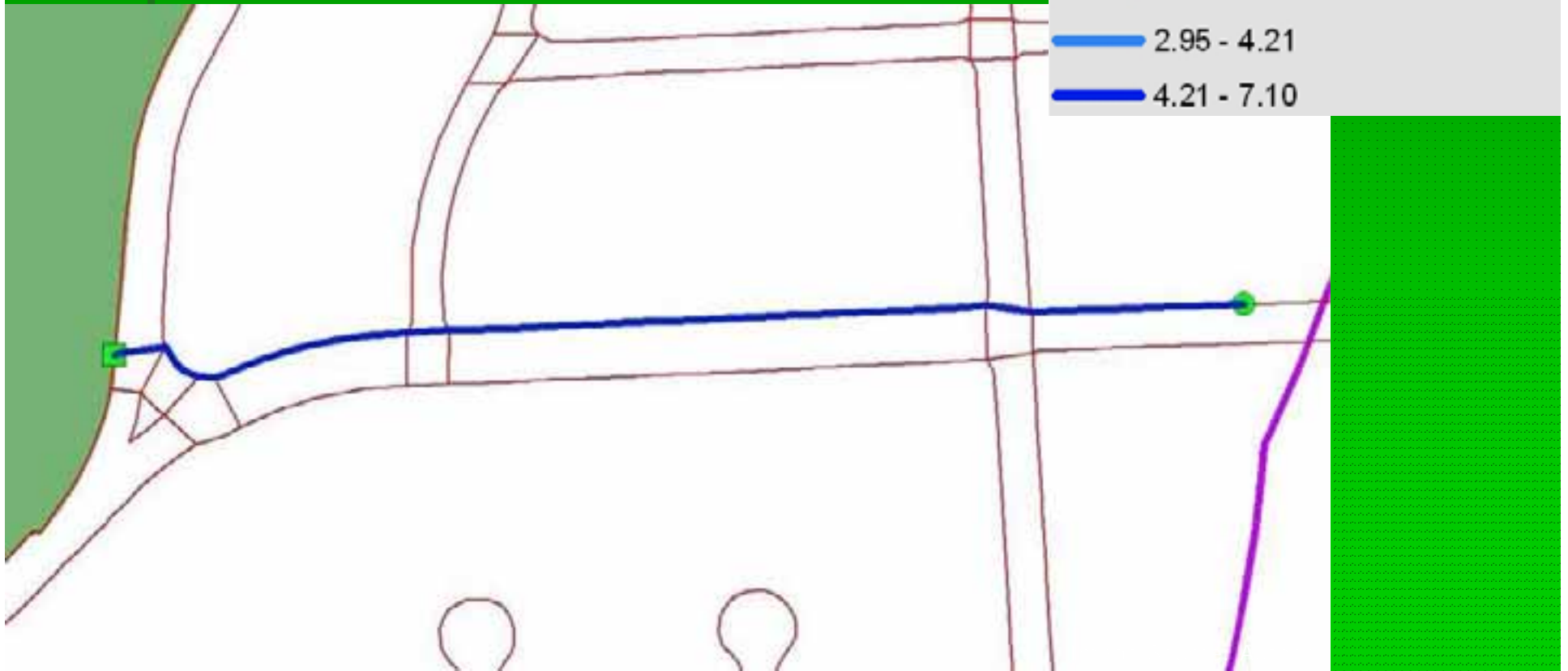
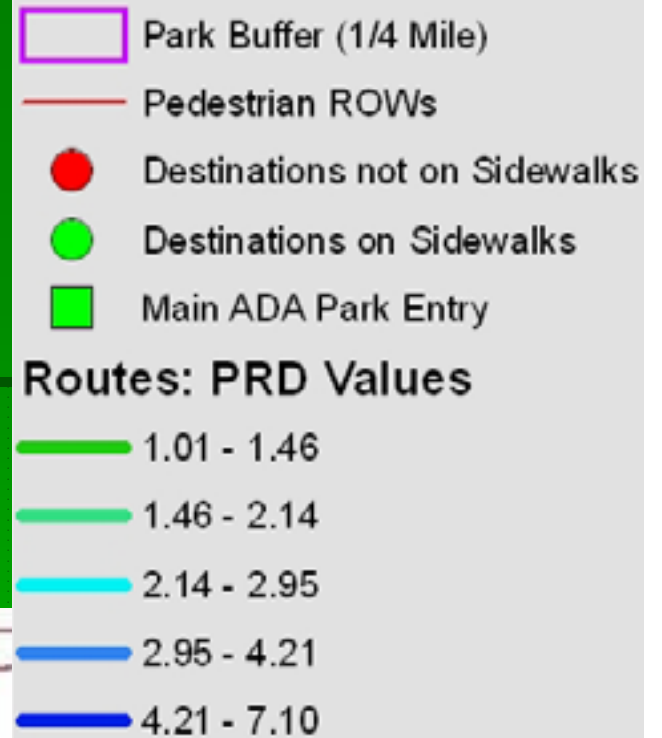
PRD Analysis

- Highest PRD Value (7.10)



PRD Analysis

■ Lowest PRD Value



Analysis Summary

- **Audubon Park**
 - **Larger Service Areas**
 - **Most Ideal Mean PRD**
- **Friendship Park**
 - **Most Ideal Relative Accessibility for Ambulatory Group**
- **Comstock Park**
 - **Most Spatially Equitable Access for Ambulatory Group**

Conclusion

- RA
- NPSI
- PRD
- Spokane's Marks

Recommendations

- **Walkability Equation**
- **Sliding Scale for Ability**
- **Better Input Data**

Acknowledgments

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- **Regional Orthophoto Consortium**
- **VP Network**
- **Avista Utilities**
- **More Information:**
kerrybrooks@wsu.edu

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