# Measuring Transit Stop Accessibility by using the Street Network in the Salem-Keizer Region of Oregon

INTRODUCTION

One-quarter mile has become the accepted distance for gauging a transit station's catchment area in the U.S. This distance is loosely based on the amount people that are willing to walk to transit. Bus Stop locations are generally determined by transit authorities based on goals for ridership, traffic operations and passenger accessibility (Foda and Osman 2010). In this research, transit stop access coverage is estimated based on the actual street network surrounding the stops. Using the indices created by Foda and Osman in their 2010 research "Using GIS for Measuring Transit Stop Accessibility Considering Actual Pedestrian Road Network" this project looks at the spatial accessibility to bus stops by creating a ratio between the actual coverage and the ideal access coverage of stops. The three indices used from the Foda omen paper include:

- The Ideal Stop-Accessibility Index (ISAI) evaluates the accessibility of bus stops through the surrounding street network and can be used to assess and compare different stop locations from a spatial perspective.
- The Actual Stop-Accessibility Index (ASAI) gives a more accurate measurement of the street network density around a bus stop based on Network Analyst.
- The Stop Coverage Ratio Index (SCRI) evaluates the percentage of actual access coverage of a bus stop with respect to its ideal access coverage.

Legend

- Study bus routes
- Bus stops
- Cherriots bus routes
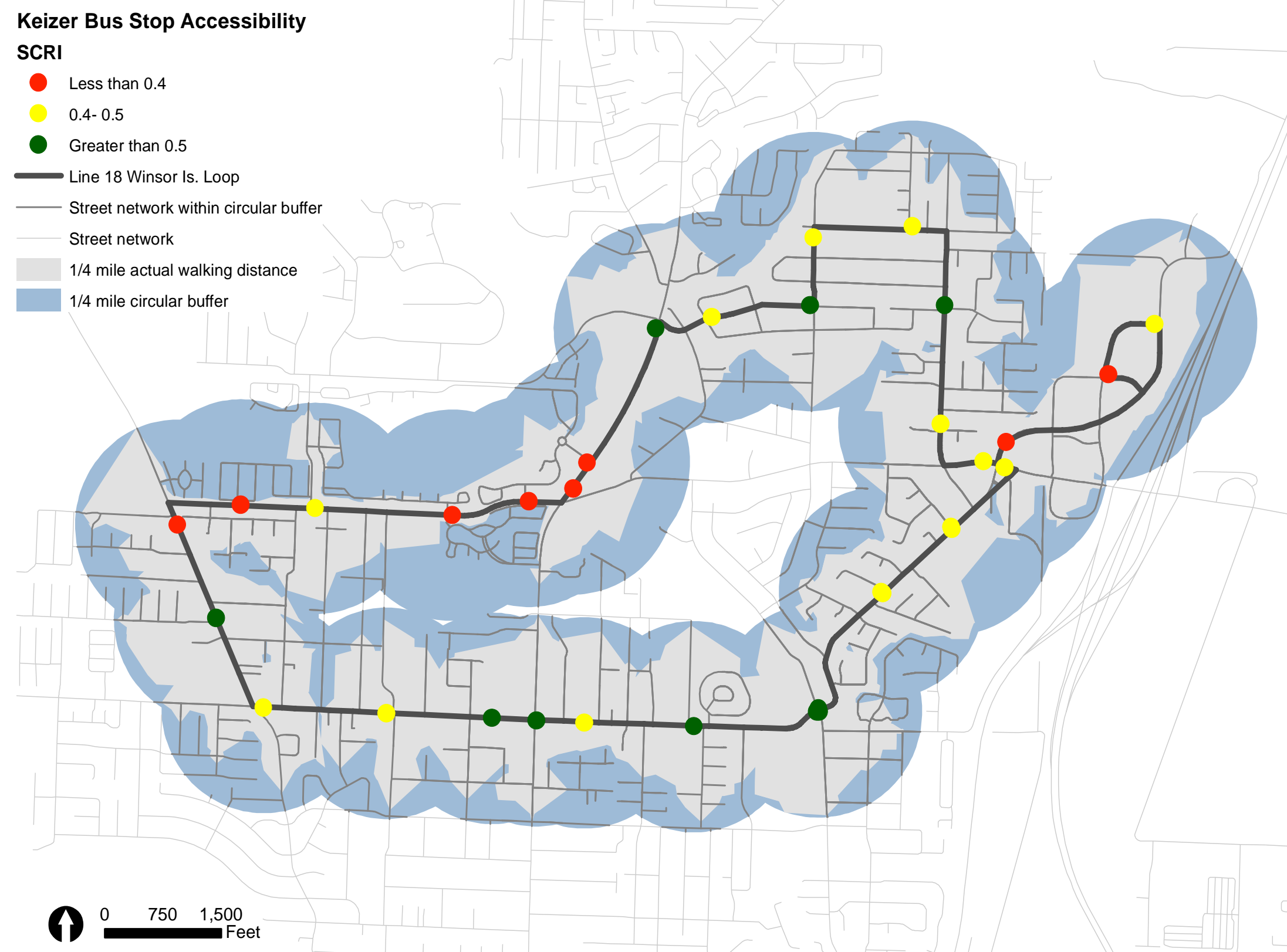- Street network
- Salem-Keizer UGB
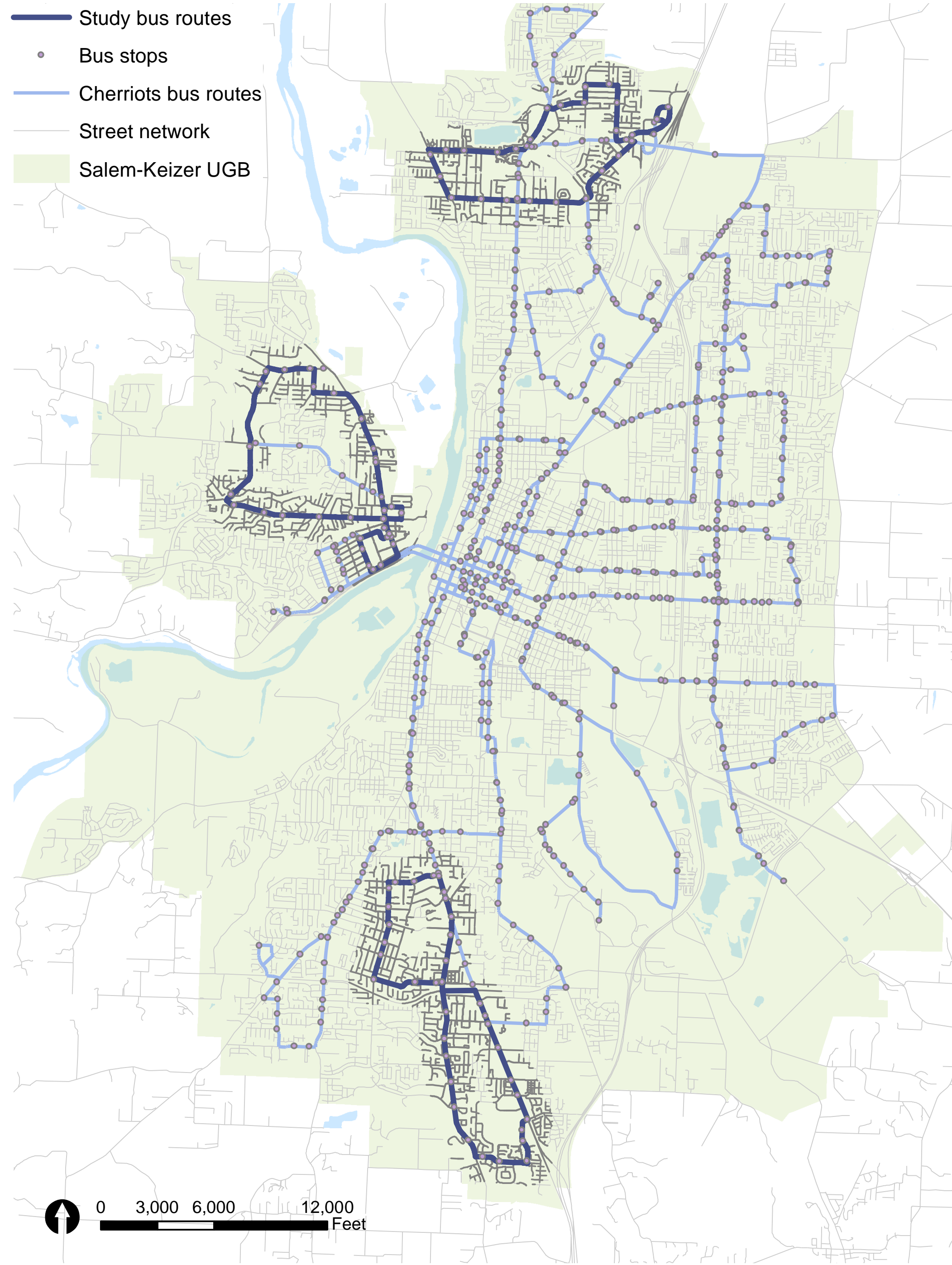
STUDY AREA

The indices will be used to measure the accessibility of three bus lines and their respective bus stops in West Salem, South Salem, and Keizer in the Salem-Keizer region in the state of Oregon. These three areas lack non-gridded circuitous streets and have large single-family residential lots. These physical traits tend to prevent traditional fixed-route transit from capturing enough riders to be cost-effective. This research will analyze the accessibility coverage of the Line 22 Brush College Loop in West Salem, the Line 21 Rees Hill Loop in South Salem, and the Line 18 Windsor Island Loop in Keizer. Within the Salem-Keizer Transit Agency, loops, also known as "circulators", are used in low-density neighborhoods. They are one-way loops that usually travel from transit centers, through residential neighborhoods and back to the same point. Untimately, this project hopes to uncover how accesible current bus stops on these routes are to the residents within the residential areas.

BRIEF METHODOLOGY

Data obtained from Salem-Keizer Transit Agency (Cherriots) included the Salem street network, Cherriots bus routes, and Cherriots bus stop locations. The street network was used to create a network dataset. Once the network was created, bus stops along the three chosen lines were used as facilities to perform a service area analysis. Using network analyst, overlapping polygons were created for each bus stop with a distance of a quarter-mile. Any street segment within the polygons is within a quarter-mile walking distance of a bus stop. The length of all street segments within the polygon was then calculated. This was accomplished through using geoprocessing to intersect the polygons with the street network. A spatial join was then used to determine the length of street segments within the polygon. Finally, quarter-mile buffers were also created around each bus stop. The process described above was then repeated to calculate the length of street segments within each buffer. These methods were used to calculate the ISAI, ASAI, and SCRI for each study route.
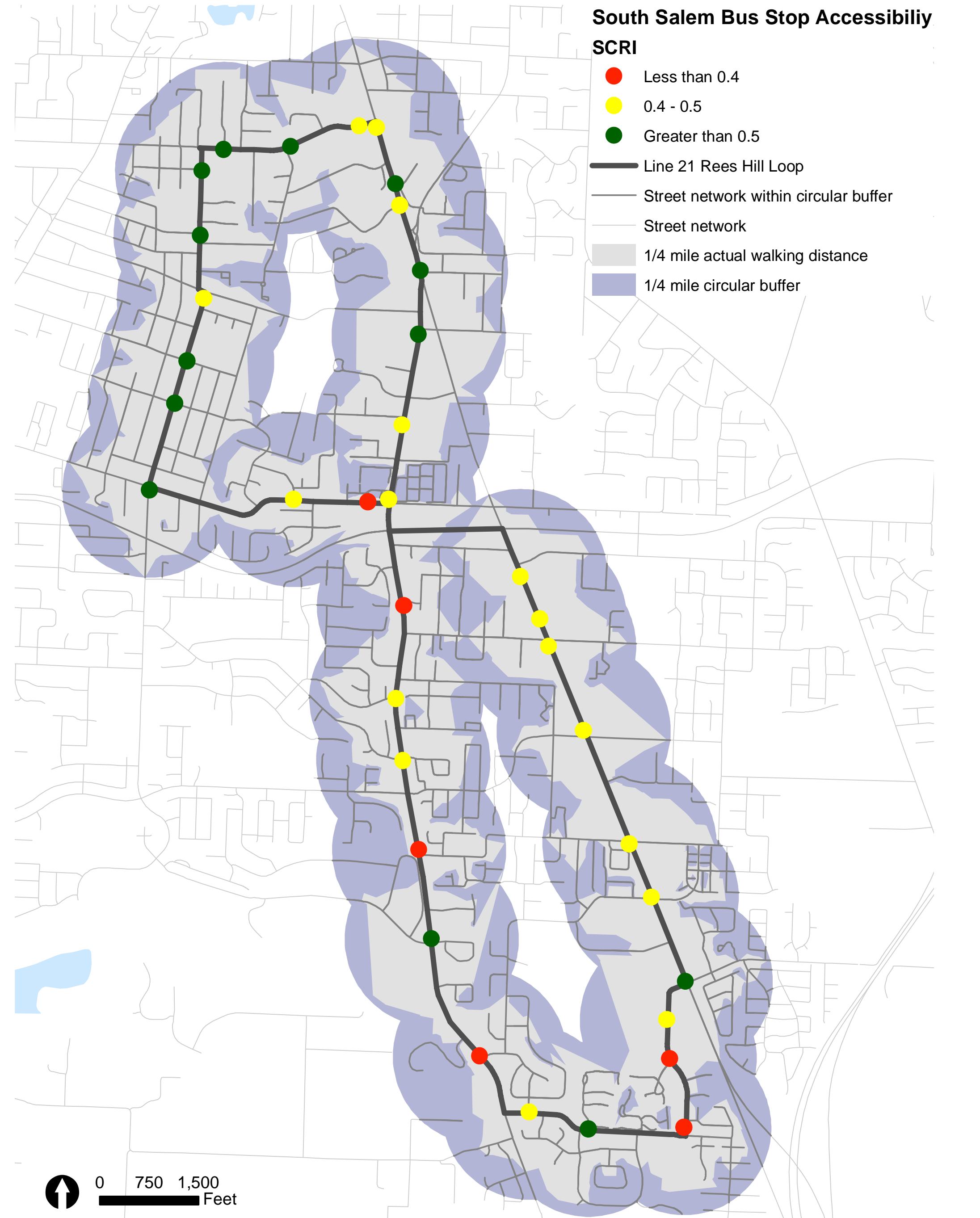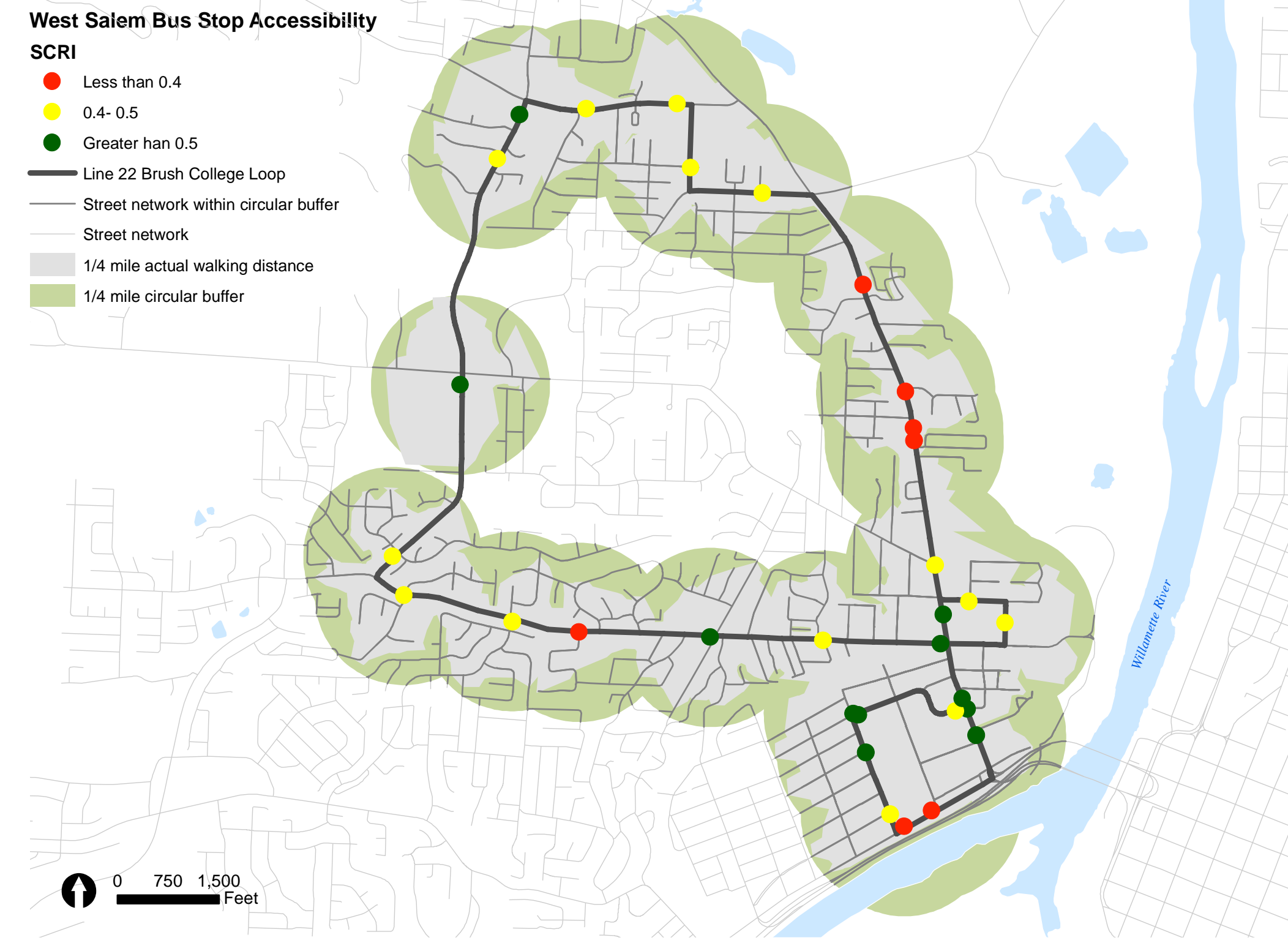
KEIZER LINE 18

Keizer Bus Stop Accessibility
SCRI
- Less than 0.4
- 0.4- 0.5
- Greater than 0.5
- Line 18 Winsor Is. Loop
- Street network within circular buffer
- Street network
- 1/4 mile actual walking distance
- 1/4 mile circular buffer

Bus Stop Name	Area of Polygon (sq feet)	Buffer Area (sq feet)	Street Length (In Buffer)	Street Length (In Polygon)	ISAI (ft/ft^2)	ASAI (ft/ft^2)	SCRI
River Rd @ Chemawa SE	2,937,199	5,473,911	54117	25754	0.010	0.018	0.537
Chemawa @ Safeway	2,589,428	5,473,911	47118	21861	0.009	0.018	0.473
Verda @ Chemawa	3,326,859	5,473,911	72555	35763	0.013	0.022	0.608
Chemawa @ Modoc	2,393,537	5,473,911	94265	41459	0.017	0.039	0.437
Chemawa @ Springtime	2,600,587	5,473,911	83303	32930	0.015	0.032	0.475
Chemawa @ Verda	3,264,421	5,473,911	74915	35229	0.014	0.023	0.596
Manzanita @ 14th	3,289,025	5,473,911	53071	26269	0.010	0.016	0.601
Chemawa @ Rickman	3,421,747	5,473,911	40504	24221	0.007	0.012	0.625
Chemawa @ Verda	3,293,652	5,473,911	73431	35798	0.013	0.022	0.602
River Rd @ Lockhaven	2,117,481	5,473,911	57689	23642	0.011	0.027	0.387
River Rd @ Promenade Way	1,996,717	5,473,911	53959	20654	0.010	0.027	0.365
River Rd @ McNary Estates	3,458,816	5,473,911	38836	18122	0.007	0.011	0.632
Lockhaven @ Chemawa	2,399,860	5,473,911	107351	42842	0.020	0.045	0.438
Lockhaven @ Keizer Station Blvd	2,380,590	5,473,911	112799	42583	0.021	0.047	0.435
Ulali @ Keizer Station Blvd.	2,649,111	5,473,911	28507	9800	0.005	0.011	0.484
Chemawa @ Elizabeth	2,800,031	5,473,911	49867	24511	0.009	0.018	0.512
Chemawa @ Delight	2,493,390	5,473,911	40905	16146	0.007	0.016	0.456
Chemawa @ Shoreline	2,419,506	5,473,911	40162	15428	0.007	0.017	0.442
Windsor Island @ Willow Lake	3,113,347	5,473,911	51647	18123	0.009	0.017	0.569
Locations @ Inland Shores	1,888,699	5,473,911	57317	23628	0.010	0.030	0.345
Lockhaven @ Lakefair Pl	950,546	5,473,911	51418	14740	0.009	0.054	0.174
Lockhaven @ McClure	2,235,149	5,473,911	52266	18020	0.010	0.023	0.408
Lockhaven @ Wildwood Ct	1,217,915	5,473,911	62997	17089	0.012	0.052	0.222
Windsor Island @ Trent AV	2,102,374	5,473,911	54661	18139	0.010	0.026	0.384
Chemawa @ Springtime Ct.	2,600,573	5,473,911	87507	32018	0.016	0.034	0.475
Chemawa @ Modoc Dr.	2,466,697	5,473,911	93464	48613	0.017	0.038	0.451
Keizer Transit Center	2,074,863	5,473,911	108880	38718	0.020	0.052	0.379
Stadium @ Ulali	2,147,711	5,473,911	49505	16437	0.009	0.023	0.392
McLeod @ Tepper	2,564,981	5,473,911	47745	17974	0.009	0.019	0.469
McLeod @ Dennis Ray	2,657,286	5,473,911	95102	32635	0.017	0.036	0.485
Mcleod @ Manzanita	2,811,385	5,473,911	70472	25163	0.013	0.025	0.514
14th @ Stone Hedge	2,603,831	5,473,911	51819	18972	0.009	0.020	0.476
Manzanita @ trail	2,394,583	5,473,911	43260	20133	0.008	0.018	0.437

SOUTH SALEM LINE 21

Bus Stop Name	Area of Polygon (sq feet)	Buffer Area (sq feet)	Street Length (In Buffer)	Street Length (In Polygon)	ISAI (ft/ft^2)	ASAI (ft/ft^2)	SCRI
Commercial @ Wiltsey	2,731,983	5,473,911	39274	15255	0.007	0.014	0.499
Sunnyside @ Neahkahnie	2,047,861	5,473,911	32576	14144	0.006	0.016	0.374
Sunnyside @ Boone	2,274,452	5,473,911	81660	27016	0.015	0.036	0.416
Commercial @ Baxter (Walmart)	2,462,347	5,473,911	48732	18546	0.009	0.020	0.450
Commercial @ Browning	2,682,936	5,473,911	56071	27286	0.010	0.021	0.490
Commercial @ Welcome	2,725,687	5,473,911	61582	32692	0.011	0.023	0.498
Commercial @ Barnes	2,521,453	5,473,911	43751	15951	0.008	0.017	0.461
Commercial @ Baxter	2,580,881	5,473,911	41182	15396	0.008	0.016	0.471
Commercial @ Fabry	2,425,548	5,473,911	25695	10144	0.005	0.011	0.443
Commercial @ Madras	2,437,507	5,473,911	44862	16456	0.008	0.018	0.445
Commercial @ Fairway	3,104,238	5,473,911	50145	17520	0.009	0.016	0.567
Fairway @ Lexington	1,871,715	5,473,911	61807	13743	0.011	0.033	0.342
Fairway @ Rees Hill	2,147,210	5,473,911	59148	20440	0.011	0.028	0.392
Rees Hill @ Huntington	2,757,265	5,473,911	58847	23054	0.011	0.021	0.504
Rees Hill @ 14th	2,495,309	5,473,911	46499	22731	0.008	0.019	0.456
Sunnyside @ Cayuse	3,049,794	5,473,911	28169	11661	0.005	0.009	0.557
Sunnyside @ Wiltsey	1,530,749	5,473,911	43243	13384	0.008	0.028	0.280
Sunnyside @ Valleywood	2,426,689	5,473,911	51536	19675	0.009	0.021	0.443
Sunnyside @ Ironwood	2,718,660	5,473,911	49679	21266	0.009	0.018	0.497
Commercial @ Lansford	2,874,798	5,473,911	56136	31921	0.010	0.020	0.525
Commercial @ Promontory	2,873,385	5,473,911	59005	31643	0.011	0.021	0.525
Browning @ Dakota	3,096,149	5,473,911	54577	27416	0.010	0.018	0.566
Browning @ Alderbrook	2,873,623	5,473,911	46690	18859	0.009	0.016	0.525
Browning @ Commercial	2,287,247	5,473,911	51620	23197	0.009	0.023	0.418
Sunnyside @ Hilfiker	3,190,927	5,473,911	36476	21791	0.007	0.011	0.583
Sunnyside @ Boxwood	2,432,879	5,473,911	63196	20320	0.012	0.026	0.444
Boone @ Sunnyside	1,565,524	5,473,911	82891	27200	0.015	0.053	0.286
Boone @ Pam	2,352,277	5,473,911	47750	13778	0.009	0.020	0.430
Lone Oak @ Friendship	2,854,997	5,473,911	59716	27537	0.011	0.021	0.522
Lone Oak @ Moonlight	2,917,820	5,473,911	57913	30286	0.011	0.020	0.533
Lone Oak @ Boone	3,055,253	5,473,911	36485	20604	0.007	0.012	0.558
Lone Oak @ Arlene	3,347,671	5,473,911	57648	32124	0.011	0.017	0.612
Lone Oak @ Hrubetz	3,037,696	5,473,911	59878	33351	0.011	0.020	0.555
Fairway @ South Salem Senior Cntr	2,601,969	5,473,911	52097	17351	0.010	0.020	0.475
Sunnyside @ Alina	2,099,376	5,473,911	58716	19628	0.011	0.028	0.384
Lone Oak @ Idylwood	2,641,914	5,473,911	63507	35002	0.012	0.024	0.483

South Salem Bus Stop Accessibiliy
SCRI
- Less than 0.4
- 0.4 - 0.5
- Greater than 0.5
- Line 21 Rees Hill Loop
- Street network within circular buffer
- Street network
- 1/4 mile actual walking distance
- 1/4 mile circular buffer

WEST SALEM LINE 22

West Salem Bus Stop Accessibility
SCRI
- Less than 0.4
- 0.4- 0.5
- Greater han 0.5
- Line 22 Brush College Loop
- Street network within circular buffer
- Street network
- 1/4 mile actual walking distance
- 1/4 mile circular buffer

Bus Stop Name	Area of Polygon (sq feet)	Buffer Area (sq feet)	Street Length (In Buffer)	Street Length (In Polygon)	ISAI (ft/ft^2)	ASAI (ft/ft^2)	SCRI
Glen Creek @ Burley Hill	2,457,886	5,473,911	47173	15909	0.009	0.019	0.449
Glen Creek @ Wallace Rd.	3,055,611	5,473,911	133120	70482	0.024	0.044	0.558
Glen Creek Transit Station	2,642,166	5,473,911	88684	37294	0.016	0.034	0.483
Patterson @ 2nd St	2,219,649	5,473,911	83849	31662	0.015	0.038	0.405
Brush College @ Wilark	2,474,696	5,473,911	44875	16273	0.008	0.018	0.452
Doaks Ferry @ Gibson Woods	2,495,568	5,473,911	31703	15293	0.006	0.013	0.456
Wallace @ Taybin (Burger King)	3,104,497	5,473,911	121308	58964	0.022	0.039	0.567
Wallace @ Orchard Hts	2,671,870	5,473,911	71005	32840	0.013	0.027	0.488
Wallace @ Hope	1,975,450	5,473,911	5717	26206	0.010	0.029	0.361
Wallace @ Empire	2,116,036	5,473,911	53864	24122	0.010	0.025	0.387
Wallace @ Harritt	1,977,130	5,473,911	28820	12753	0.005	0.015	0.361
Wallace @ Hope	1,679,386	5,473,911	53710	24457	0.010	0.032	0.307
Taybin @ 5th	2,717,823	5,473,911	93784	34643	0.017	0.035	0.497
Wintergreen @ Winchester	2,394,872	5,473,911	45523	15974	0.008	0.019	0.438
Wallace @ Bassett	2,761,447	5,473,911	138257	58506	0.025	0.050	0.504
7th @ Patterson	3,119,791	5,473,911	100104	41252	0.018	0.032	0.570
Patterson @ Ruge	2,765,487	5,473,911	73276	40209	0.019	0.037	0.505
7th @ Patterson	3,097,543	5,473,911	111051	40251	0.020	0.036	0.566
Doaks Ferry @ Brush College	3,163,764	5,473,911	36763	19246	0.007	0.012	0.578
Glen Creek @ Westfarthing	2,495,830	5,473,911	45448	17356	0.008	0.018	0.456
Glen Creek @ Windemere	2,014,129	5,473,911	41245	13973	0.008	0.020	0.368
Glen Creek @ Patterson	2,568,803	5,473,911	69725	16988	0.013	0.027	0.469
Wallace @ Taggart	2,803,621	5,473,911	66805	32872	0.012	0.023	0.512
Taggert @ Wallace	2,418,284	5,473,911	149328	56201	0.027	0.062	0.442
River Bend @ Morning Dove	2,404,234	5,473,911	32726	11516	0.006	0.014	0.439
Brush College @ Wintergreen	2,429,782	5,473,911	33235	12124	0.006	0.014	0.444
Wallace @ Taggart	2,778,156	5,473,911	138004	60782	0.025	0.050	0.508
Doaks Fy @ Orchard Hts. (West Sa	3,582,354	5,473,911	10608	5838	0.002	0.003	0.654
Edgewater @ Patterson	1,787,411	5,473,911	84599	26978	0.015	0.047	0.327
Glen Creek Rd @ Parkway	3,241,156	5,473,911	34705	19726	0.006	0.011	0.592
Edgewater @ Murlark	1,901,087	5,473,911	96447	36644	0.018	0.052	0.347
Doaks Fy @ Ptarmigan	2,351,387	5,473,911	42222	17767	0.008	0.018	0.430

NEXT STEPS

After conducting our SCRI study, this research has identified steps that could use accessibility improvements. Other information and data that could potentially help strengthen the findings are as follows:

- Pedestrian infrastructure conditions: Data on sidewalk infrastructure, pedestrian crossings, and human-made paths could help better improve this analysis.
- This analysis could be combined with demographic information such as the locations of transit dependent populations, density in neighborhoods, and auto-dependency.
- Ridership figures could also be analyzed to see if the accessibility of bus stops affects the demand needs of riders for different areas throughout Salem and Keizer.

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