

4.5 SACSIM Land Use Spatial Association

4.5.1 Circuity Buffer Introduction

The Parcel-Point DAYSIM file not only includes the parcel level variables described above, but also requires relative distance information to calculate attractiveness between land use data. Previous versions of SACSIM utilized a Euclidean distance parcel point to parcel point approach which is common in buffering analysis. SACSIM19 parcel point files uses a hybrid approach between shortest orthogonal path, and node to node path distances call “circuity-based measures for each parcel”. This method creates a “circuity surface” using 24 radially distributed points to represent the path distances from a walkable streets network based on XY coordinates; 8 directions at 3 distinct distance bands (0.5 mile, 1 mile and 1.5 mile) and the parcel-point location. Each point is then mapped to the closest network node. For a parcel, a circuity factor or ratio is calculated based on the shortest path distance and straight line distance for all 24 radial points. To measure the distance from a parcel to another parcel, the distance is interpolated based on the circuity factors surrounding the destination parcel. Figure 4-2 illustrates the circuity path distance calculation conceptually. Figure 4-3 shows how the decay function adjusts the radial point distances per parcel. Figure 4-4 compares the relationship of parcels distance to employment centers using the “Circuity buffering” process compared to a Euclidean distance.

Figure 4-2 Parcel Circuity Ratio Diagram

Circuity Ratio Concept

Compute circuity ratio for 24 predefined points
Interpolate any other parcels

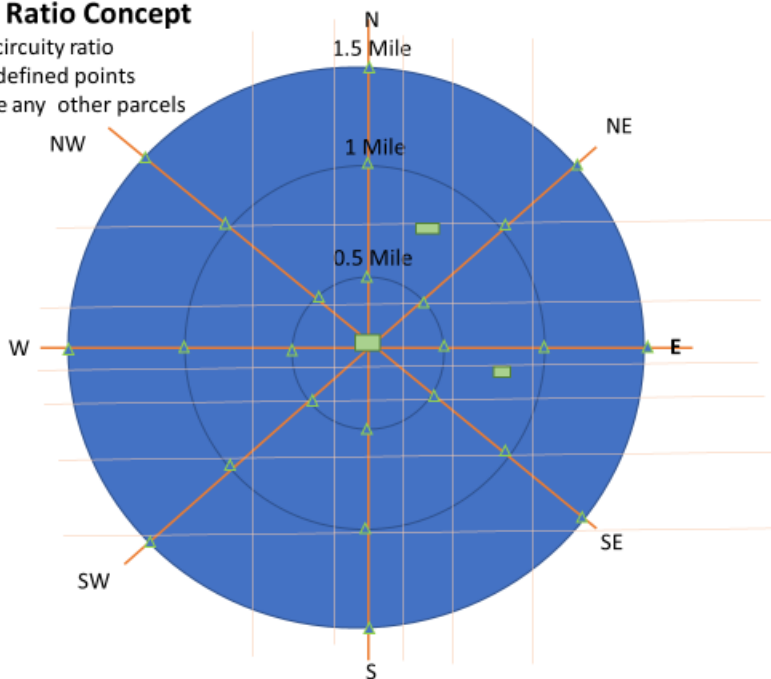
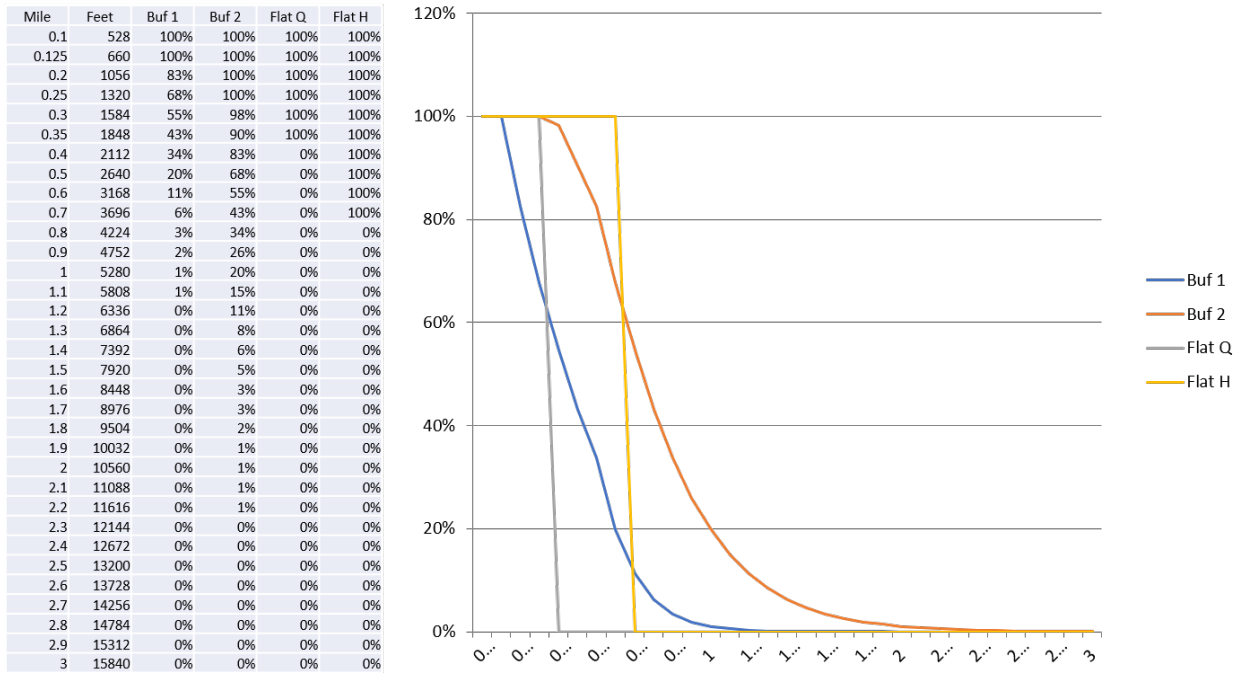
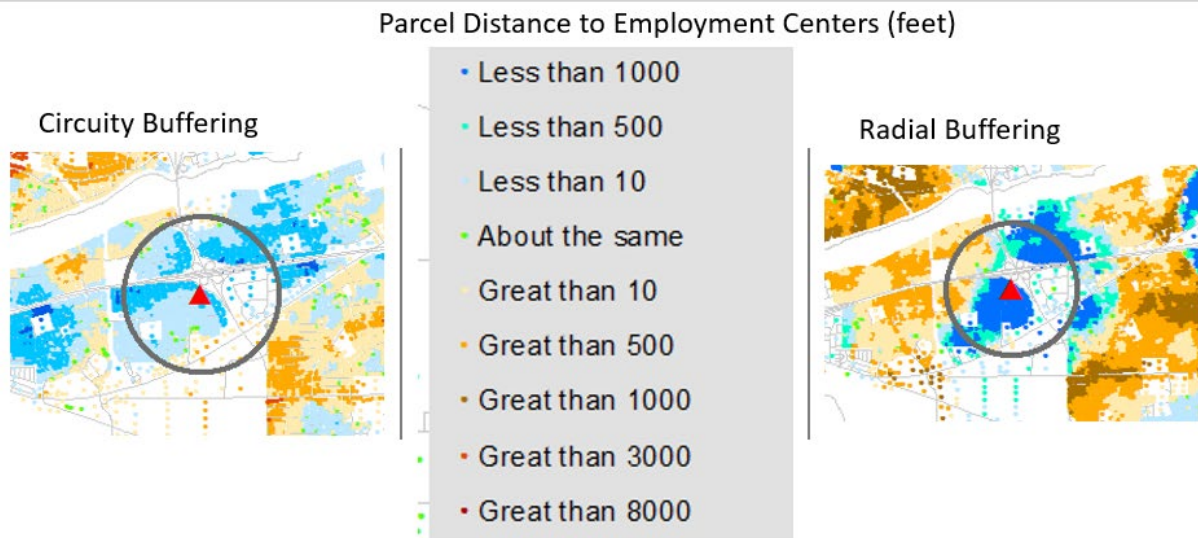


Figure 4-3 Decay Function Compared to Flat Buffering Relationship



Source: SACOG 2020.

Figure 4-4 Circuitry vs Radial Buffering Comparison



Source: SACOG 2020.

4.5.2 Files Required for Circuitry Buffer Process

Circuitry Factor File: a parcel list with circuitry factors or ratios of 24 points describe above.

Parcel Base: a parcel list with all variables is specified in Table 4-5.

Intersections: A list of intersections, with node ID, XY coordinates, and number of links terminating at the node. (This can be the same file as the node list used above, but it should contain all intersections, regardless of whether or not it is a nearest node to any parcel, and it contains the extra information on number of links ending at the node.)

Transit stops: A list of transit stops, with stop ID, XY coordinates, and the type of transit serving the stop. SACSIM19 currently uses local bus and LRT stops are used for parcel to parcel buffering.

Open space areas: A list of parks, sports fields and other public recreational areas, with an ID and the size, in square feet. If this file is not provided, the buffered variables for open space will be 0.

4.5.3 Development of Circuity Buffering Inputs

This section describes the process of how to create the necessary input variables to calculate the parcel circuity buffering process.

4.5.3.1 Circuity Factor File Creation

Parcel and network information are read in and 24 fictitious points around the parcel are created (from the X and Y coordinates of the parcels). The 24 points correspond to 8 directions (East, Northeast, North, Northwest, West, Southwest, South, and Southeast) and 3 distance bands (0.5, 1.0, and 1.5 miles) around each parcel. Each of the 25 points (including the parcel itself) is then mapped to its closest node on the network. The process and tools needed are described in Appendix F, Circuity Surface Data Preparation Memo.

Regional circuity factor regional averages by base year land use type inventories were used to forecast scenario parcels in new development areas.

Further process, description and tools needed are described in Appendix F Circuity Surface Data Preparation Memo.

Intersection File Process

Each parcel record in the SACSIM table must have information about the surrounding walkable street network pattern. This information is stored in the following fields: NODES1Q, NODES1H, NODES3Q, NODES3H, NODES4Q and NODES4H. NODES1 indicates the number of nearby cul-de-sacs and dead-ends. NODES3 indicates the number of nearby “T” or three-way intersections and NODES4 indicates the number of nearby 4-way (or more) intersections. These fields affect the walkability of the street network surrounding a parcel.

4.5.3.1.1 Street Intersection Base Layer

To populate the node fields, spatial buffer operations must be performed against a layer of street intersections. Generally, this layer can be created from a street centerline layer use a line to point style node_builder script. These street intersections do not include nodes along freeways and other facilities that are closed-off to pedestrians.

The node_builder script will identify the number of links attached to the nodes (valence) so that they can be separated into 1-link, 3-link and 4+-link layers.

Figure 4-5 Street Intersection (NODE) Layer



Source: SACOG 2020.

Figure 4-6 Node Typology



Source: SACOG 2020.

4.5.3.1.2 Intersections for Future Streets

Street centerline data do not exist for future development areas. SACOG implemented an estimation of 1-link, 3-link and 4+-link nodes per acre based on the place type of a future-

development area. These estimations were applied to a grid of synthetic nodes of fixed area, and nodes/acre values to them. For example, for a newly developed greenfield area typical rates of 1-link, 3-link and 4+-link intersections were applied to each grid point, based on the development type. These node densities are listed below in Table 4-4 for each place type.

Table 4-4 Node Density by Place Type

Place Type	1-Leg Intersections per acre	3-Leg Intersections per acre	4-Leg Intersections per acre
1. Rural Residential	0.026	0.020	0.039
2. Very Low Density Residential	0.026	0.065	0.052
3. Low Density Residential	0.065	0.260	0.104
4. Medium Density Residential	0.130	0.390	0.260
5. Medium-High Density Residential	0.130	0.390	0.260
6. High Density Residential	0.013	0.390	0.455
7. Urban Residential	0.013	0.390	0.455
8. High-Intensity Office	0.013	0.390	0.455
9. Moderate-Intensity Office	0.130	0.195	0.390
10. Community/Neighborhood Retail	0.000	0.104	0.039
11. Regional Retail	0.013	0.104	0.013
12. Light Industrial - Office	0.013	0.104	0.013
13. Light Industrial	0.013	0.104	0.013
14. Heavy Industrial	0.013	0.104	0.013
15. Public/Quasi-Public	0.013	0.026	0.013
16. Community/Neighborhood Commercial/Office	0.000	0.104	0.039
17. Regional Commercial/Office	0.013	0.104	0.013
18. Mixed Use Employment Focus	0.130	0.390	0.260
19. Mixed Use Residential Focus	0.130	0.390	0.260
24. Low Density Mixed Residential	0.065	0.260	0.104
25. Medium Density Mixed Residential	0.130	0.390	0.260
26. High Density Mixed Residential	0.013	0.390	0.455
27. Low Density Mixed Use Center or Corridor	0.065	0.260	0.130
28. Medium Density Mixed Use Center or Corridor	0.130	0.325	0.195
29. High Density Mixed Use Center or Corridor	0.013	0.325	0.390
31. Suburban Center/Corridor	0.065	0.260	0.130
40. Sac CBD High Intensity Mixed Use Office	0.020	0.260	0.590
45. Intense Urban Residential	0.100	0.260	0.260
47. Agricultural Residential	0.020	0.010	0.050
47. Medical Facility	0.010	0.070	0.010
48. Airport	0.010	0.010	0.010
50. K-12 Schools	0.010	0.030	0.010
51. Colleges and Universities	0.050	0.070	0.130
52. Civic/Institution	0.100	0.260	0.130

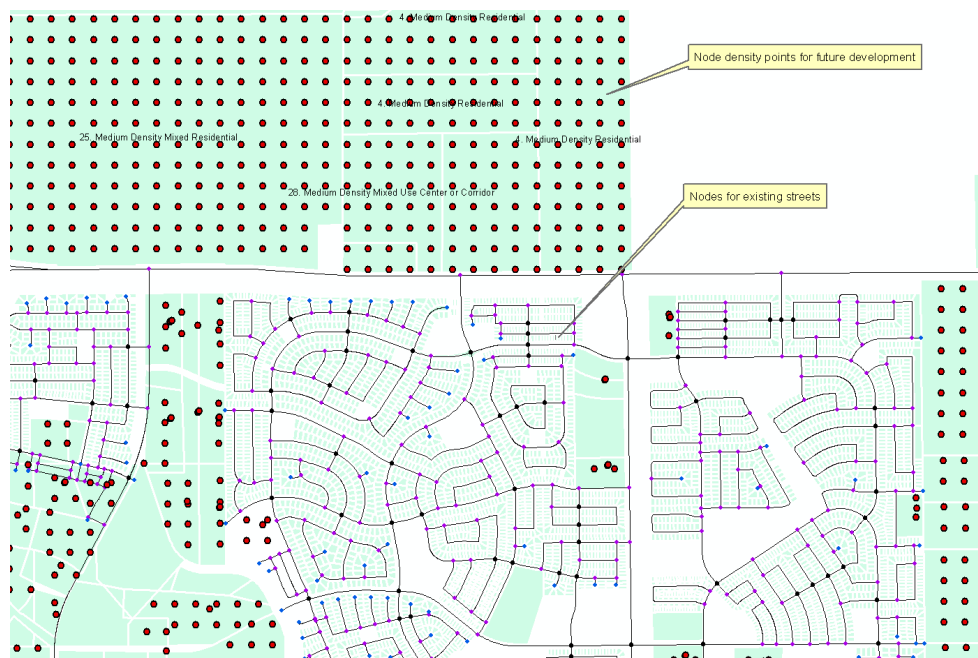
Source: SACOG 2020.

The first step in determining where to generate the grids of synthetic nodes is to identify those areas where future greenfield development will occur. Figure 4-7 shows a portion of the region where development exists with streets and areas slated for future development. In these areas of future development are synthetic nodes to represent a street pattern based on development type.

Once node rates have been set, the synthetic nodes may be combined with real nodes so that the node proximity variables (NODES1Q, NODES1H, NODES3Q, NODES3H, NODES4Q and NODES4H) can be computed. An example is shown below of combining the node sets to create a point layer of 1-link nodes.

A final forecasting step takes into consideration new development areas within SACOG designated Complete Street project areas. Within 500 feet of the complete street identified segments, a 20 percent increase in unit value was added to 3- or 4-way intersections and a 20 percent decrease for one-way (cul-de-sac) intersections. These factors are applied as a factor to better represent complete street design infrastructure and safety characteristics.

Figure 4-7 Synthetic Nodes for Future Development Street Pattern



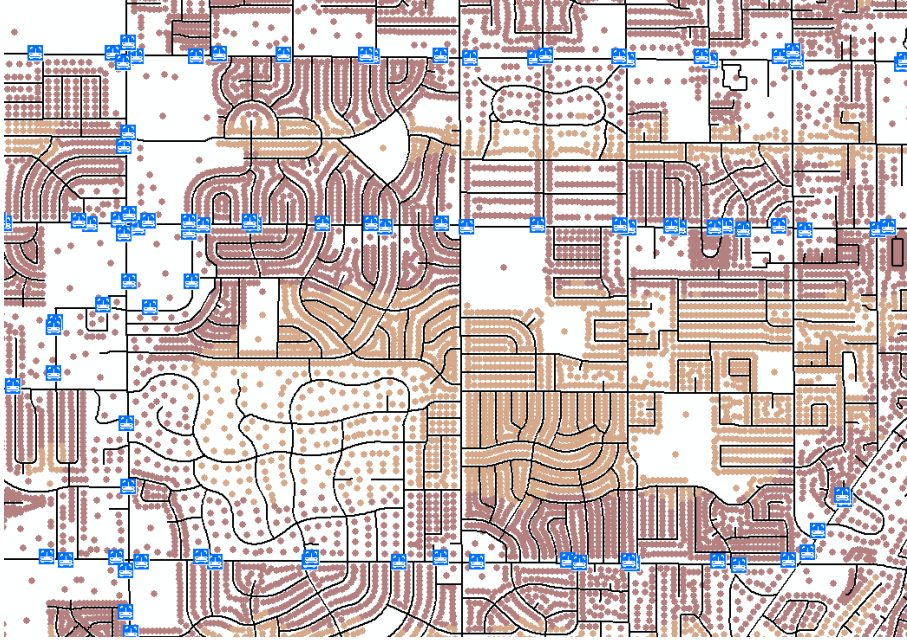
Source: SACOG 2020.

4.5.3.2 Transit Stops File Process

Transit proximity is represented at parcel level as the distance to the nearest transit station or stop. Two variables are computed for each parcel: the distance to the nearest LRT (or more generally, rail) station (DIST_LRT), and distance to the nearest bus (or more generally, rubber-tired) stop. The distance is computed as the straight-line distance from the parcel point and the nearest station or

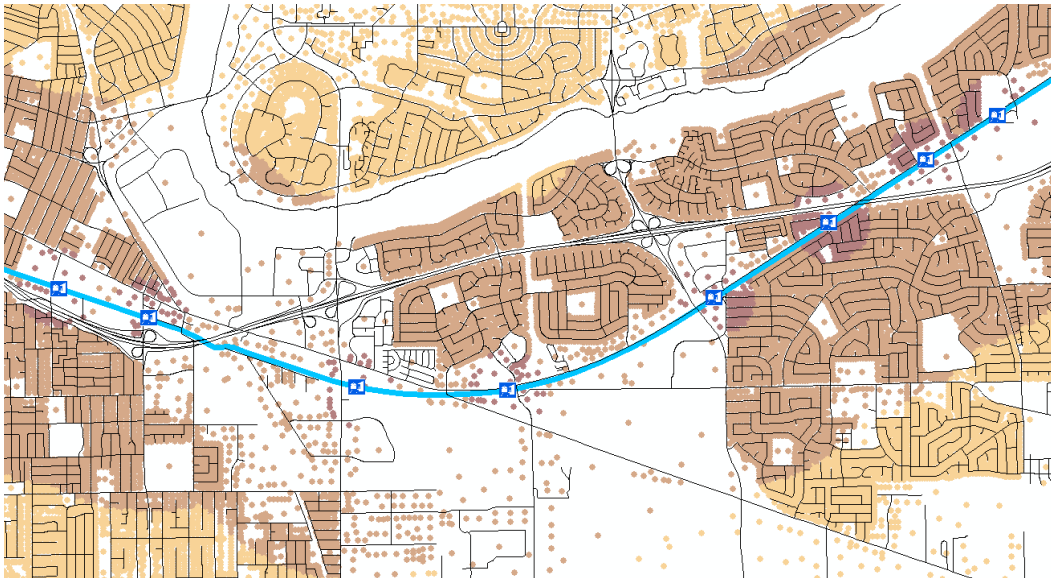
stop. Figure 4-8 and Figure 4-9 show the relationship between Bus and Light Rail Stops to parcel-points.

Figure 4-8 Bus Stops and Parcel Centroids



Source: SACOG 2020.

Figure 4-9 LRT Stations and Parcel Centroids



Source: SACOG 2020.

4.5.3.3 Open Space File Process

Open space file includes open space areas with public recreation access. This includes parks and sporting fields. Large open spaces with restricted access were removed from file. Open spaces are represented by a centroid location and area.