transect zone and community unit projections for the phoenix light rail corridor

GIS-based guide to creating transect zones // phoenix urban research lab // fall 2011

Revised: January 2012

1 Step 1: Define regional sector boundaries (O1 & O2)

1. (O1) Preserved open space sector: already protected lands (e.g. ag land, natural areas, wildlife habitat, sites of cultural and/or natural significance, steep slopes). Designate all land in O1 as T1

2. (O2) Reserved open space sector: land that should or is planned to be protected (e.g. unprotected ag land, woodlands, sites of cultural and/or natural significance, future park lands, steep slopes). Designate all land in O2 as T2

3. Remove O1 and O2 areas from remaining steps.

**It was assumed that the LRC did not have O1 or O2 areas.*

2 Step 2: Determine distribution of basic morphologies

(These will be used to determine Step 3 categorization)

1. Thoroughfare types (to be used to determine proximity to major thoroughfares and light rail line for Step 3)
    - create new field in attribute table for street type, using numeric system:
    - arterials = 1
    - all others = 0

2. Residential Density (determined from SmartCode, base residential density, by right)
    - 2 – 3 dwelling units/ acre
    - 4 – 5 dwelling units/ acre
    - 6 - 11 dwelling units/ acre
    - 12+ dwelling units/ acre

3. Land Use Mix
    - Level 1: 50% or more single-family homes
    - Level 2: 50% or more single-family homes, and > 30.5% mixed use
    - Level 3: 50% or more multi-family homes
    - Level 4: 50% or more multi-family homes, and > 30.5% mixed use
    - Level 5: greater than 30.5% mixed residential, commercial, and industrial land uses.

4. Environmental Sensitivity
    - Low sensitivity
    - Moderate sensitivity
    - High sensitivity

5. Block sizes (to be used to determine block perimeter for Step 3). Block sizes were originally determined from the SmartCode, but slight adjustments were made to account for the large block sizes of Phoenix:
    - < 2,400 ft
    - 2,400 ft – 3,000 ft
    - > 3,000 ft

image credit: SmartCode, DPZ

3 Step 3: Assign categories to blocks
(Based on findings from Step 2)

Create 5 GIS layers (unit = urban block; exclude O1 and O2 land)

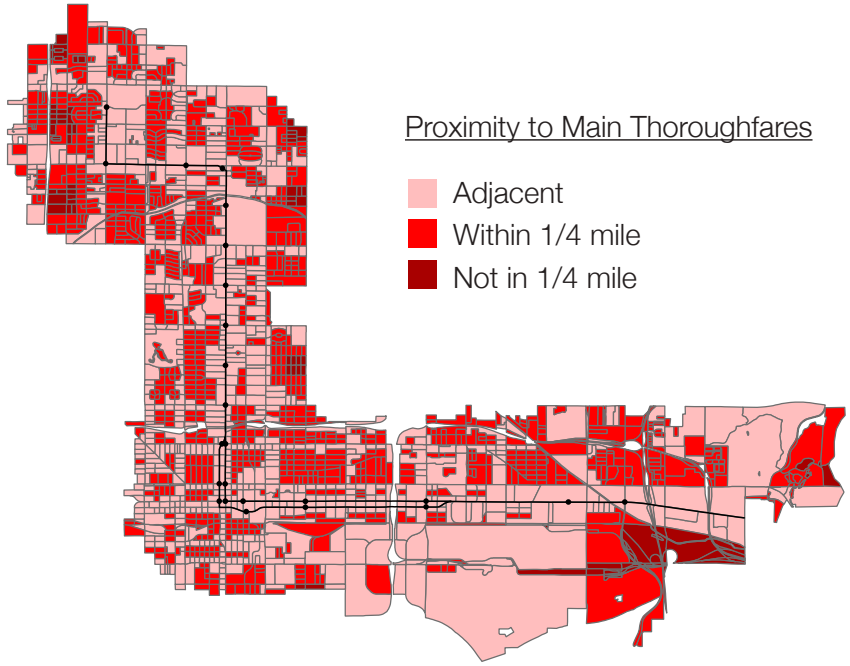
1. Proximity to main thoroughfares: 3 categories, as follows: adjacent (to major thoroughfares or within 1/8 mile from light rail line); within ¼ mi buffer; all remaining land
    - create new field in attribute table for proximity, using numeric code:
    - 0 = adjacent
    - 1 = within ¼ mi buffer
    - 2 = not in ¼ mi buffer

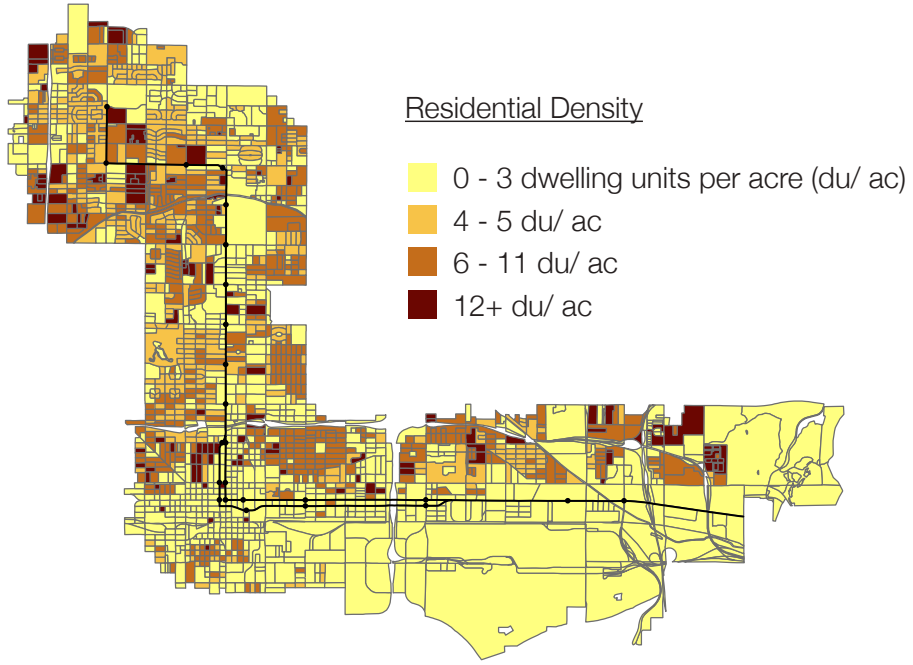
2. Residential Density:
A. Number of dwelling units for residential properties available in parcel data layer, labeled 'NUM_DU' (note: some parcels did not have any data on dwelling units)

B. Create new field ('ACRES') to calculate the area in acres for each parcel (using the geometry calculator tool)

C. Create new field to calculate density using the formula 'NUM_DU' / 'ACRES' (calculated only for residential property types and ignored other property types such as comm-hotel, comm-motel, etc)

D. This is by parcel, so do a spatial join with blocks layer, 'join data from another layer based on spatial location'

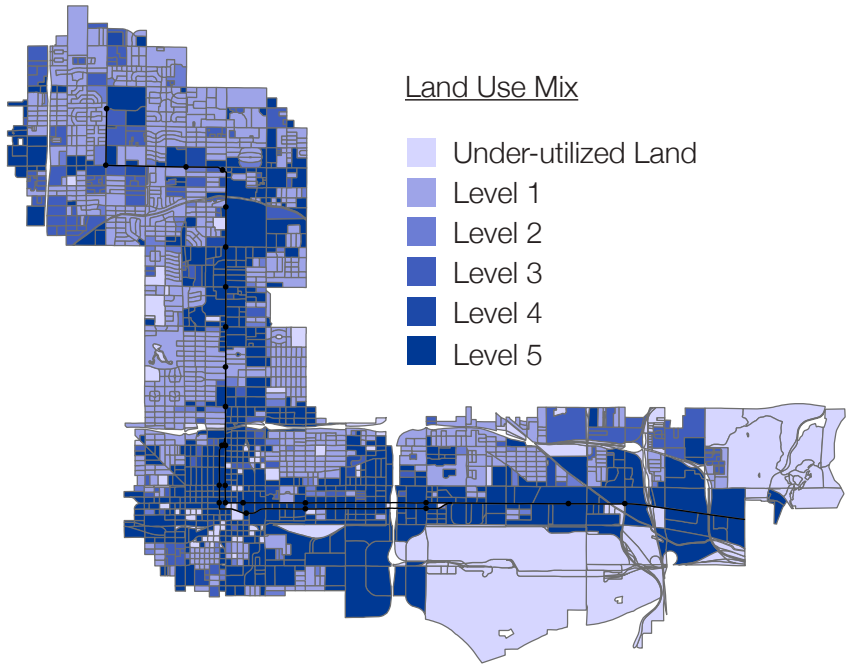




3. Land Use Mix:
A. Classify all parcel data into the following categories based on the allowable land use: Single-Family, Multi-Family, Commercial, Industrial, Parking, Mixed-Use (i.e. residential and commercial), and Special Districts.
• How the given property descriptions were used to make the categories (using 'PROP_ DESC3')
• Single-Family: 'RES-SINGLE FAMILY' 'MOBILE HOME'
• Multi-Family: 'RES-APARTMENT' 'RES-CONDOMINIUM' 'RES-DU/TRI/FOURPLEX' 'RES-ASST LIVING'
• Commercial: 'COMM-HOTEL/MOTEL' 'COMM-OFFICE' 'COMM-RESTAURANT/ BAR' 'COMM-RETAIL'
• Industrial: 'INDUSTRIAL' 'WAREHOUSE'
• Parking: 'VEHICLE PARKING'
• Mixed Use: 'MIXED-OFF/RETAIL/RESTAU' 'MIXED-RES/COMM' 'SOCIAL SERVICE' 'RELIGIOUS' 'DAYCARE' 'GOVERNMENT' 'MEDICAL' 'MUSEUM'
• Civic Spaces: 'OPEN SPACE' 'SCHOOL'
• Special District 1: 'AIRPORT'
• Special District 2: 'RAILROAD' 'UTILITY'
• Under-utilized Land: 'VACANT' 'SALVAGE' 'VEHICLE PARKING'

B. Remove Special Districts layers from the following steps. Create a new data layer with three categories (on parcels layer): 1) Mixed use (Commercial, Industrial, + Mixed-Use), 2) Single-Family, and 3) Multi-Family

C. Join data from parcels to blocks by 'join data from another layer based on spatial location' and choose to sum attributes. The results will show the total number of parcels in each category (ie. mixed use, single-family, multi-family) for each block.



D. Then classify each block into one of five categories (levels 1-5 listed below) based on their mix of land uses. Create new fields and use the field calculator with the formula: percent = sum_mixed / (sum mixed + single family + multifamily))

E. According to the percentages, assign each block to one of the following categories:
• Level 1: 50% or more single-family homes
• Level 2: 50% or more single-family homes, and > 30.5% mixed use
• Level 3: 50% or more multi-family homes (e.g. apartments, row houses, and townhouses)
• Level 4: 50% or more multi-family homes, and > 30.5% mixed use
• Level 5: greater than 30.5% mixed residential, commercial, and industrial land uses.

• Level 0 when all 0 values (these will be classified as under-utilized land)
• About 20 parcels left that did not fall into any category, so assigned:
    • Level 1, if 40% - 50% single-family homes
    • Level 3, if 40% - 50% multi-family homes
    • Level 5, if percent of single family homes equals percent of multi family homes

4. Environmental Sensitivity (ES; for areas not O1/O2)
A. Delineate sensitive resources and determine appropriate buffers (e.g. water resources, soil types, slopes, other environmentally or culturally significant areas)

B. Weight significance of resources within each watershed

C. Create 3 categories:

- Low Sensitivity
- Moderate Sensitivity
- High Sensitivity (high sensitivity is designated T2)

**It was assumed the entire LRC has low environmental sensitivity.*

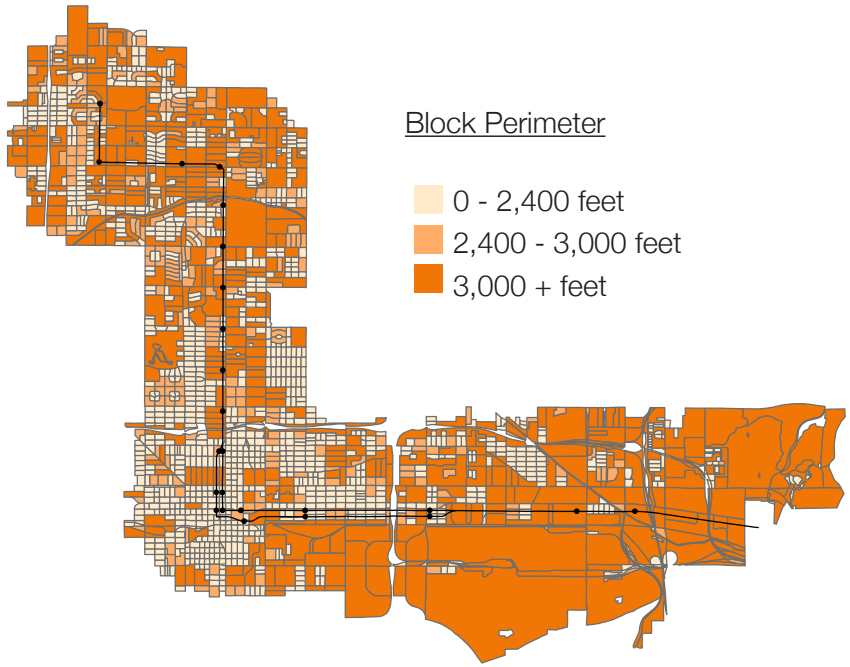
5. Block perimeter:
A. Create a new field in attribute table ('PERIMETER')

B. Calculate the block perimeter by using the calculate geometry tool (select perimeter, then select U.S. feet)

C. Create 3 categories:

- < 2,400 ft
- 2,400 ft – 3,000 ft
- > 3,000 ft

(Note: this is a slight adjustment from the original values from the SmartCode)



4 Step 4: Assign each block a preliminary transect zone

1. First assign those blocks that are either civic or special districts.
C = Civic Space
SD1 = Special District 1: Airport
SD2 = Special District 2: Railroad and Utility

2. For the remaining blocks, begin by using these criteria:

	PROXIMITY	LAND USE MIX	BLOCK PERIMETER
T3	not in buffer	level 1	> 3,000 ft
T4	within buffer	level 1, 2, or 3	< 3,000 ft
T5	adjacent	level 3, 4, or 5	2,400 - 3,000 ft
T6	adjacent	level 4 or 5	< 2,400 ft

3. For the blocks that did not match all of these criteria, use these rules:

*If underutilized lands (vacant parcels, parking, and salvage yards) front a major thoroughfare/ light rail, then T5

*If underutilized lands do not front a major thoroughfare/ light rail, then T4

*If light rail adjacent and mix of 4 or 5 and block perimeter less than 4000 ft, then T5

*If light rail adjacent and mix of 4 or 5 and block perimeter greater than 4000 ft, then T4

*If light rail adjacent and mix of 1, 2, or 3, then T4 (regardless of block perimeter)

*If downtown (and within 1/4 mi buffer of light rail) and mix of 4 or 5 and block perimeter less than 2400 ft, then T5

*If proximity is adjacent and land use mix of 1, 2, or 3 and block perimeter less than 3000 ft, then T4

*If proximity is adjacent and land use mix of 1, 2, or 3 and block perimeter greater than 3000 ft, then T3

*If proximity is adjacent and land use mix of 4 or 5 and block perimeter greater than 3000 ft, then T4

*If proximity is within 1/4mi buffer and land use mix of 2 or 3 and block perimeter greater than 3000 ft, then T3

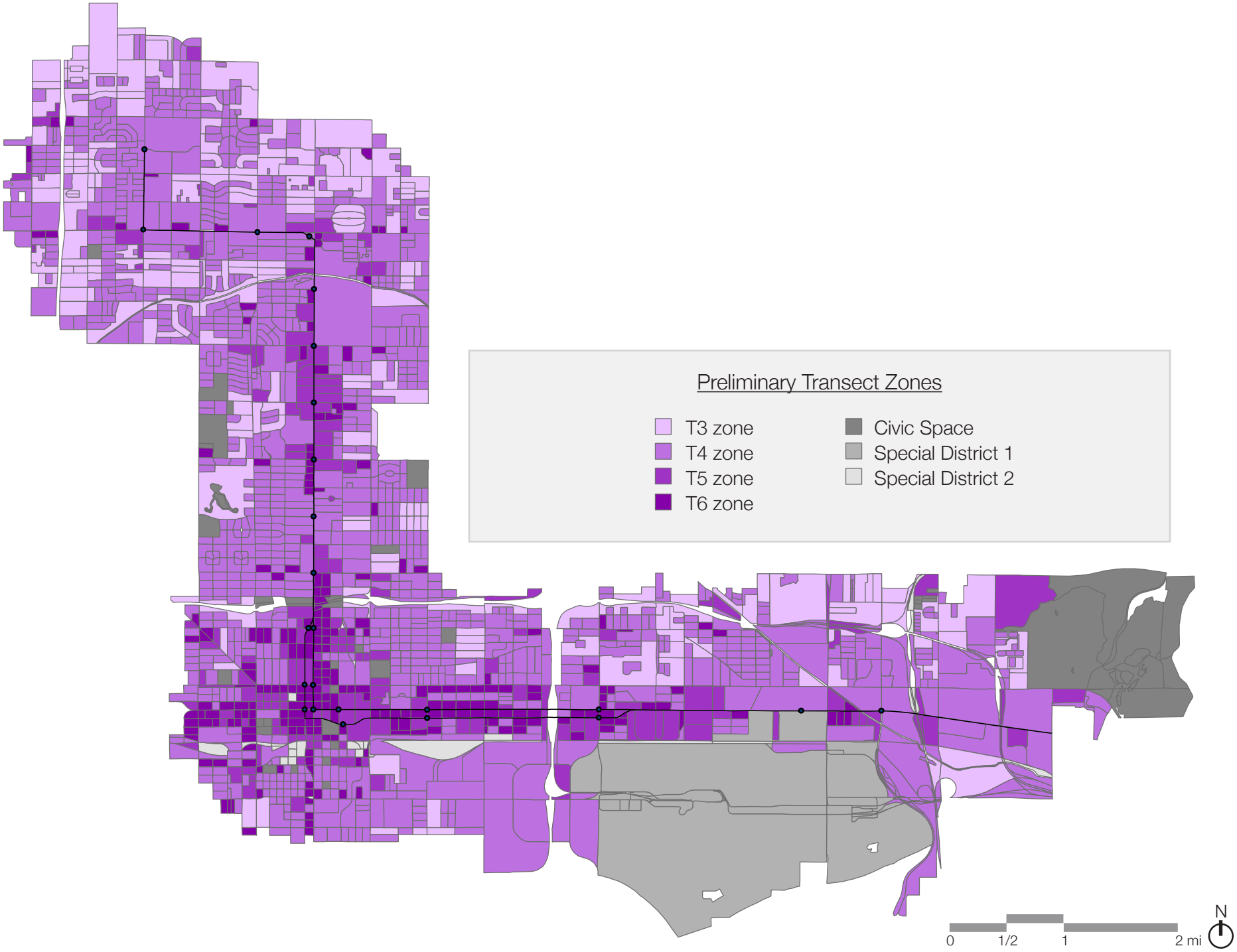
*If proximity is within 1/4mi buffer and land use mix of 1 and block perimeter greater than 3000 ft, then T3

*If proximity is within 1/4mi buffer and land use mix of 4 or 5, then T4

*If proximity is not in 1/4mi buffer of major thoroughfares and land use mix of 1, then T3 (regardless of block perimeter)

*If proximity is not in 1/4mi buffer and land use mix of 2, 3, 4, or 5 and block perimeter is less than 3000 ft, then T4

*If proximity is not in 1/4mi buffer and land use mix of 2, 3, 4, or 5 and block perimeter is greater than 3000 ft, then T3


Preliminary Transect Zones
T3 zone
T4 zone
T5 zone
T6 zone
Civic Space
Special District 1
Special District 2
0
1/2
1
2 mi
N

5 Step 5: Assign Community Unit Types

Community Unit Types for G-3 Intended Growth and G-4 Infill Growth Sectors (according to SmartCode)

- Allocation of Zones per Pedestrian Shed:
- TND:
  - 10-30% T3
  - 30-60% T4
  - 10-30% T5
- RCD:
  - 10-30% T4
  - 10-30% T5
  - 40-80% T6

Step 5.1: To create Network Pedestrian Shed

A. Enable Network Analyst extension in both ArcCatalog and ArcMap

B. Create new dataset in Network Analyst

- In ArcCatalog, right click on streets layer, then create new network dataset
- Check the Streets feature class to use it as a source for the network dataset
- Select 'No' to model turns in the network (because calculating walking distance, not driving time speed)
- Connectivity: In the connectivity dialog box, set up the connectivity model for the network. Change policy of streets from 'end point' to 'any vertex' so it will read the vertex as the street intersections (so person walking could be calculated to turn at intersections)
- Using Elevation Fields: option not selected
- Add New Attribute dialog box: required to have one, so use default of length as cost
- The new network dataset, Streets_ND, is added to ArcCatalog along with the system junctions feature class, Streets_ND_Junctions.

C. Calculate service areas around light rail stops

- Create a series of polygons that represent the distance that can be reached from a light rail station within a specified distance (1/4 mile in this case). These polygons are known as service area polygons in Network Analyst.
- In ArcMap, add Network Data set created in ArcCatalog
- Select Network Analyst on the Network Analyst toolbar and select New Service Area
- On the Network Analyst window, right-click 'Facilities (0)' and choose Load Locations
- Load locations from 'lightrail_stops_PHX.' Sort field by station and leave other settings as default.
- Select the Analysis Layer Properties button on the Network Analyst window. Then select the Analysis Settings tab. Settings as follows:
  - Impedance: Length (feet)
  - Default break: 1320 (because 1320 ft = 1/4 mile)
  - Direction: Away from facility
  - U-Turns at Junctions: Allowed
  - Ignore Invalid Locations: Checked
- Select 'Solve' on Network Analyst toolbar. This creates 1/4 mile service areas.

D. Calculate service areas around major intersections

- Select major thoroughfares from the Streets shapefile and export them to a new shapefile.
- Repeat previous steps B (Create new dataset in Network Analyst) and C (Calculate service areas).

Step 5.2: Define Community Unit Types

A. In 'TZones' shapefile, add new field: 'RCD_TND' to specify location of the community unit. Name according to road intersection (ie. East-West Road & North-South Road) and designate light rail stations with 'LRT' after the street. If desired, a numeric code could be used instead of naming according to the road intersection.

B. Defining Community Units around light rail stops and major intersections:
Select by Location, those preliminary T-Zone blocks that intersect with the polygon service area. Deselect Special District blocks (Sky Harbor Airport, railroad, utility, and Papago Park). In the 'RCD_TND' field specify location, as outlined in the previous step.

C. Defining remaining blocks to Community Units:
First, assign those blocks that are directly adjacent to previously defined community units to those particular community units. Second, create new community units around the intersections of non-major thoroughfares (based upon remaining blocks).

Step 5.3: Define each Community Unit as either RCD or TND

Define each Community Unit as either RCD or TND based upon location. RCD units are reserved for those areas in the downtown. TNDs range from 80 acres to 160 acres. RCDs range from 80 acres to 640 acres.

Step 5.4: Calculate Allocation of Zones per Community Unit

Once blocks per community unit are defined, then calculate the percentages of T3, T4, T5, and T6 within each community unit.

A. In the attribute table of 'TZones' shapefile add a new field ('BL_ACRES') and calculate

the acres per block using the geometry calculator.

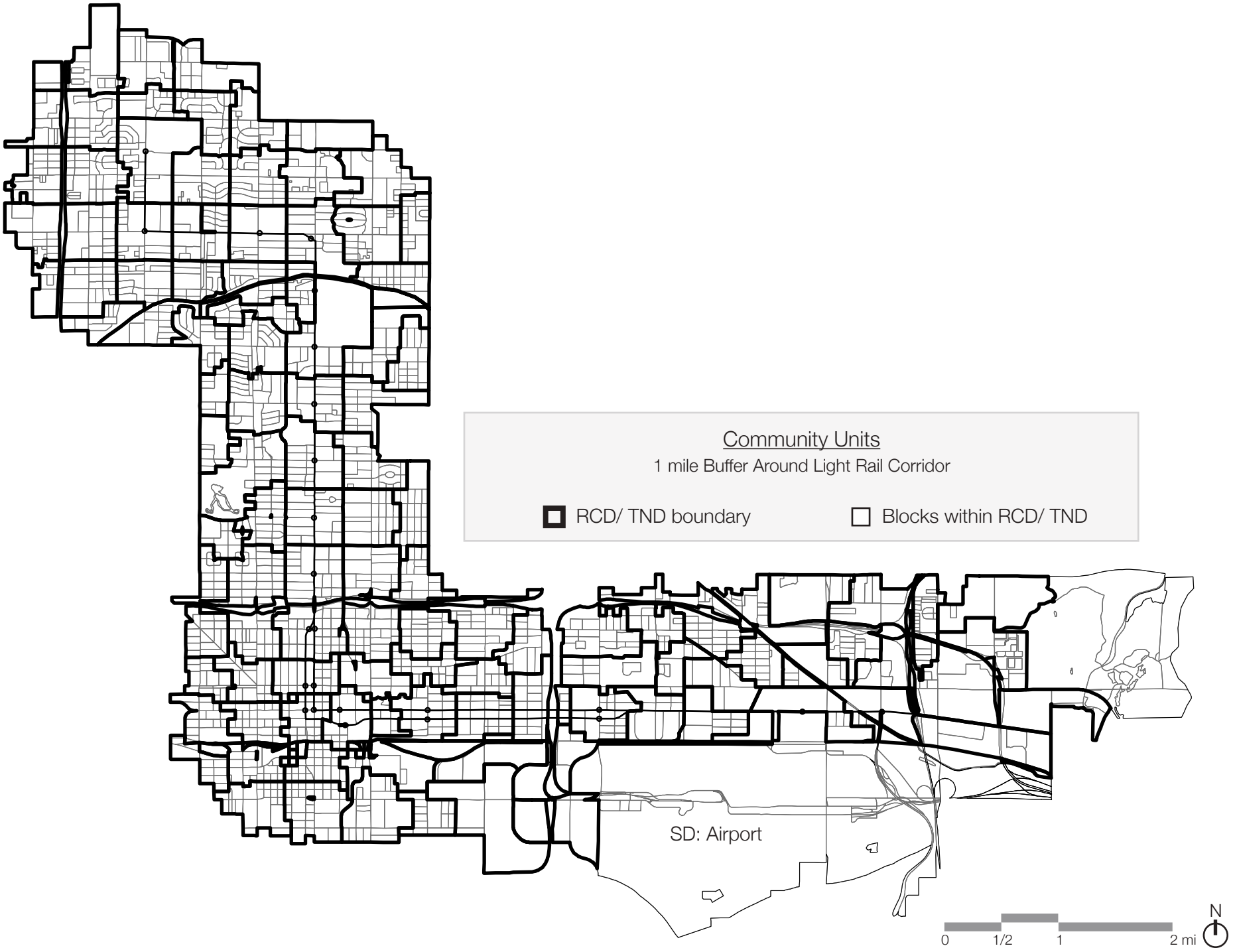
B. Export the attribute table into Excel. Then, calculate the following per community unit:
• Sum the total number of acres per community unit. TND units range from 80 to 160 acres, and RCD units range from 80 to 640 acres.
• Calculate the percentage of T-Zone that contributes to the total number of acres within the community unit by using the formula: (Number of Acres per Block) divided by (Total Number of Acres). This will help take into account the size of one block compared to the sizes of the other blocks within the same community unit.
• Sum the percentages of T3, T4, T5, and T6 within each community unit

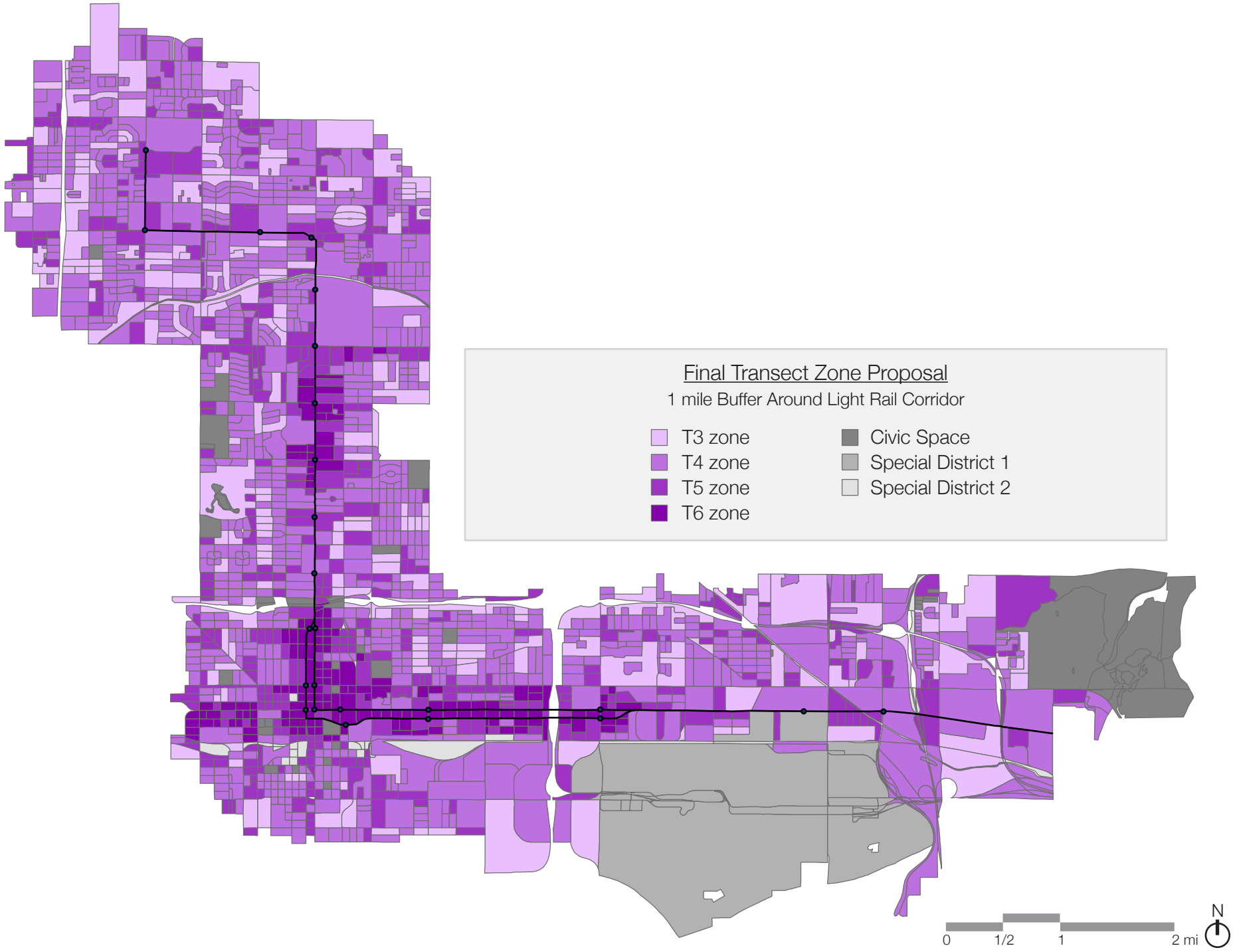
C. Compare these percentages with the valid ranges for TND or RCD.

• TND:
    10-30% T3
    30-60% T4
    10-30% T5
• RCD:
    10-30% T4
    10-30% T5
    40-80% T6

If the percentages are not within the valid ranges, then analyze the criteria (proximity, land use mix, and perimeter) of each block to see which could be adjusted. For adjusting the T-Zones first consider how closely the criteria were meet to begin with (ie. if a block was originally assigned as T4 because the block perimeter was slightly too large to be considered T5 block, then the block can be changed to T5 in order to accommodate the ranges of T-Zones needed per community unit type).

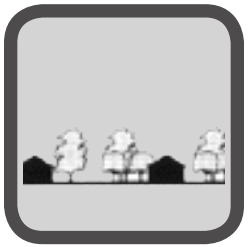
D. Adjust any changed T-Zones in the attribute table accordingly (based upon previous steps) to ensure proper allocation of zones per community unit.


Community Units
1 mile Buffer Around Light Rail Corridor
RCD/ TND boundary
Blocks within RCD/ TND
SD: Airport
0
1/2
1
2 mi
N


Final Transect Zone Proposal
1 mile Buffer Around Light Rail Corridor
T3 zone
T4 zone
T5 zone
T6 zone
Civic Space
Special District 1
Special District 2
0
1/2
1
2 mi
N

DISTRIBUTION OF PARCEL SIZE PER TRANSECT ZONE

T-ZONE	PARCEL SIZE RANGE					
	0 – 1/8 ACRE (0 – 5,445 SQ FT)	1/8 – 1/4 ACRE (5,446 – 10,890 SQ FT)	1/4 – 1/2 ACRE (10,891 – 21,780 SQ FT)	1/2 – 3/4 ACRE (21,781 – 32,670 SQ FT)	3/4 -1 ACRE (32,671 – 43,560 SQ FT)	1+ ACRE (43,561+ SQ FT)

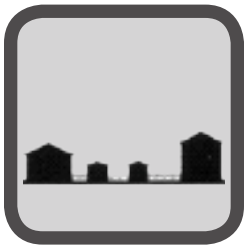


11% | 89% | 13% | 3% | 1% | 5%

T3 SUB-URBAN ZONE // 5,487 Total Number of Parcels // 7,733 Median Parcel Size (SQ FT) // 26,187 Mean Parcel Size (SQ FT)

8% | 73% | 11% | 2% | 1% | 5%

T4 GENERAL URBAN ZONE // 16,246 Total Number of Parcels // 7,618 Median Parcel Size (SQ FT) // 20,026 Mean Parcel Size (SQ FT)



13% | 60% | 15% | 4% | 2% | 7%

T5 URBAN CENTER ZONE // 5,015 Total Number of Parcels // 7,582 Median Parcel Size (SQ FT) // 20,443 Mean Parcel Size (SQ FT)

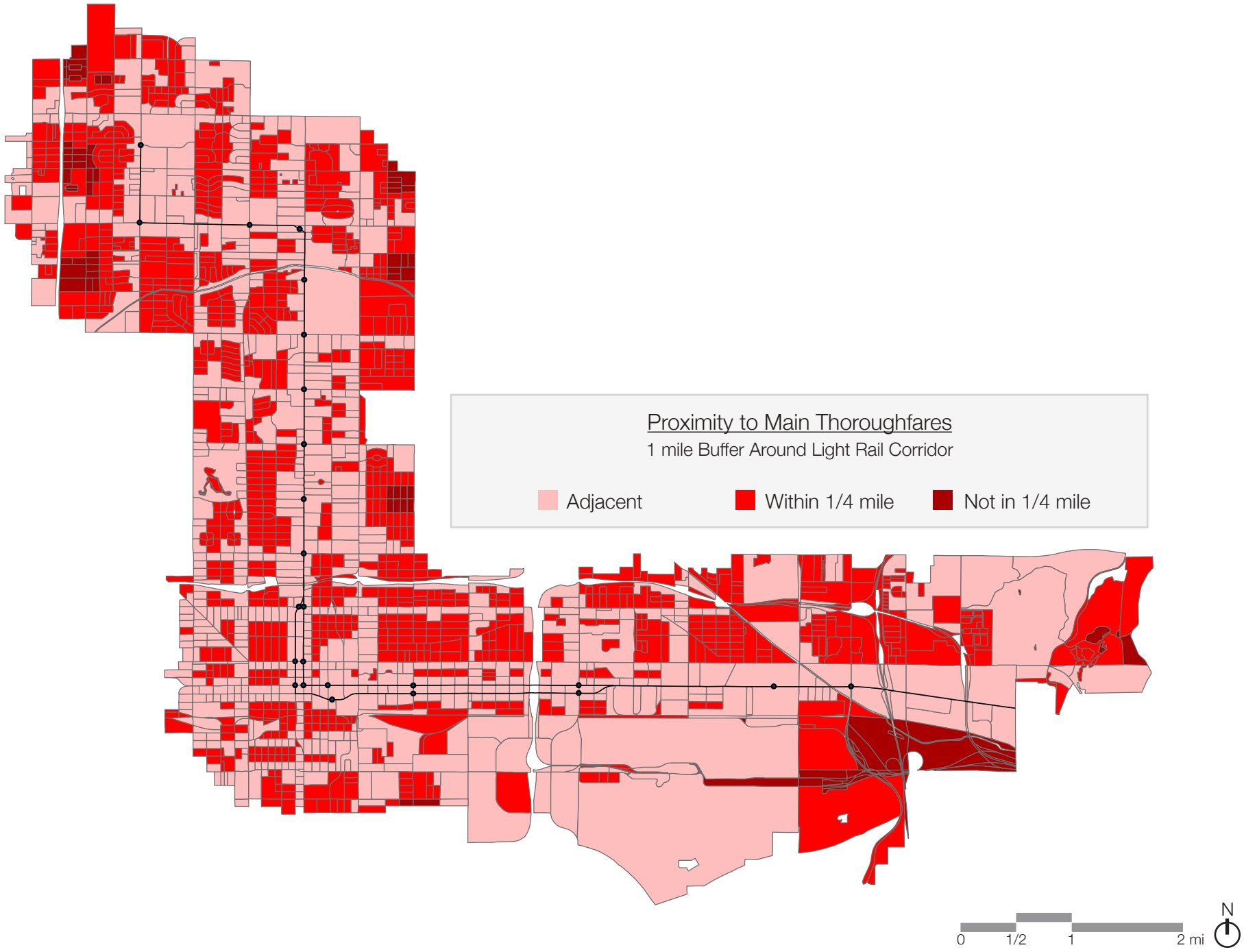
13% | 62% | 12% | 3% | 2% | 8%

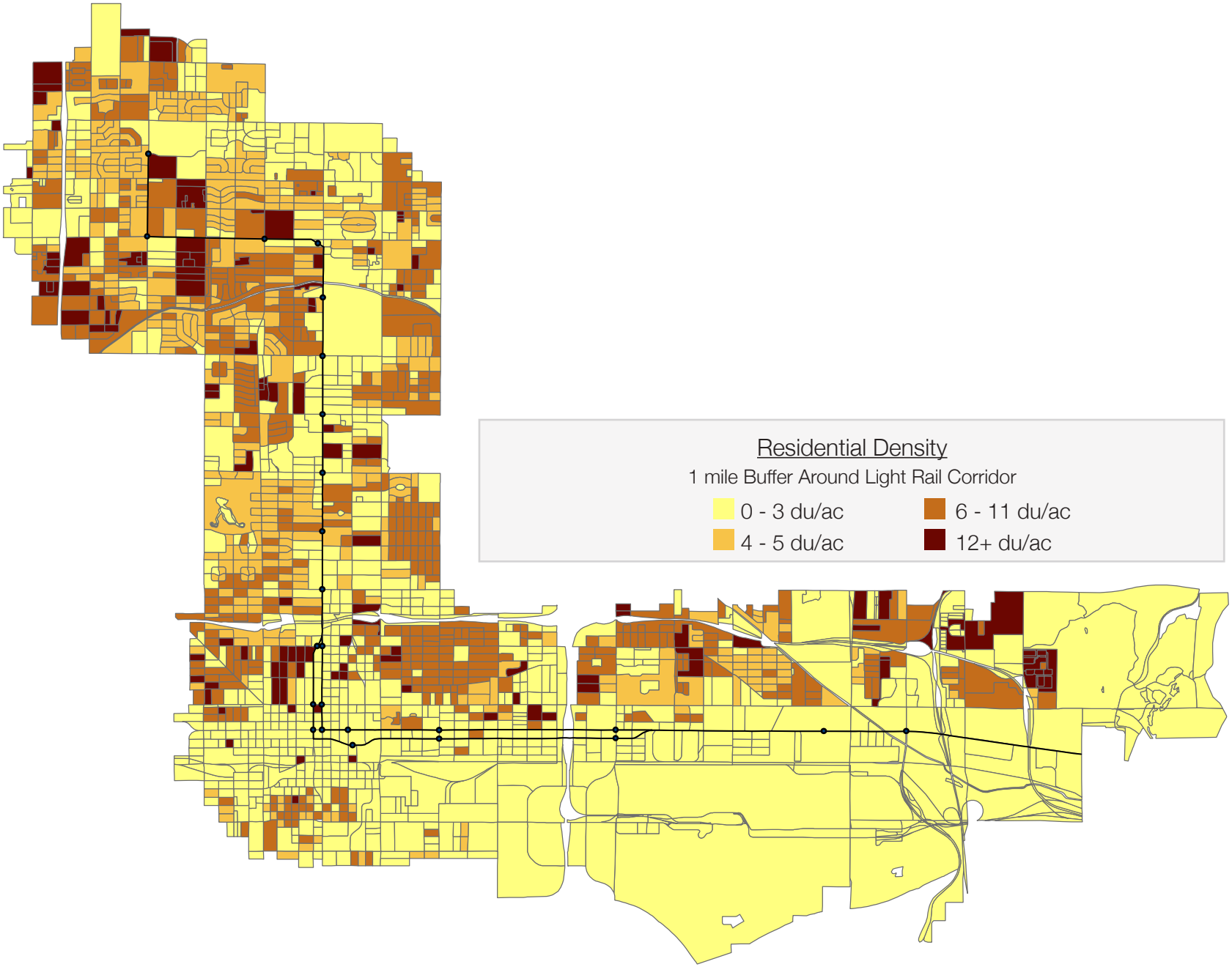
T6 URBAN CORE ZONE // 1,590 Total Number of Parcels // 7,138 Median Parcel Size (SQ FT) // 17,722 Mean Parcel Size (SQ FT)

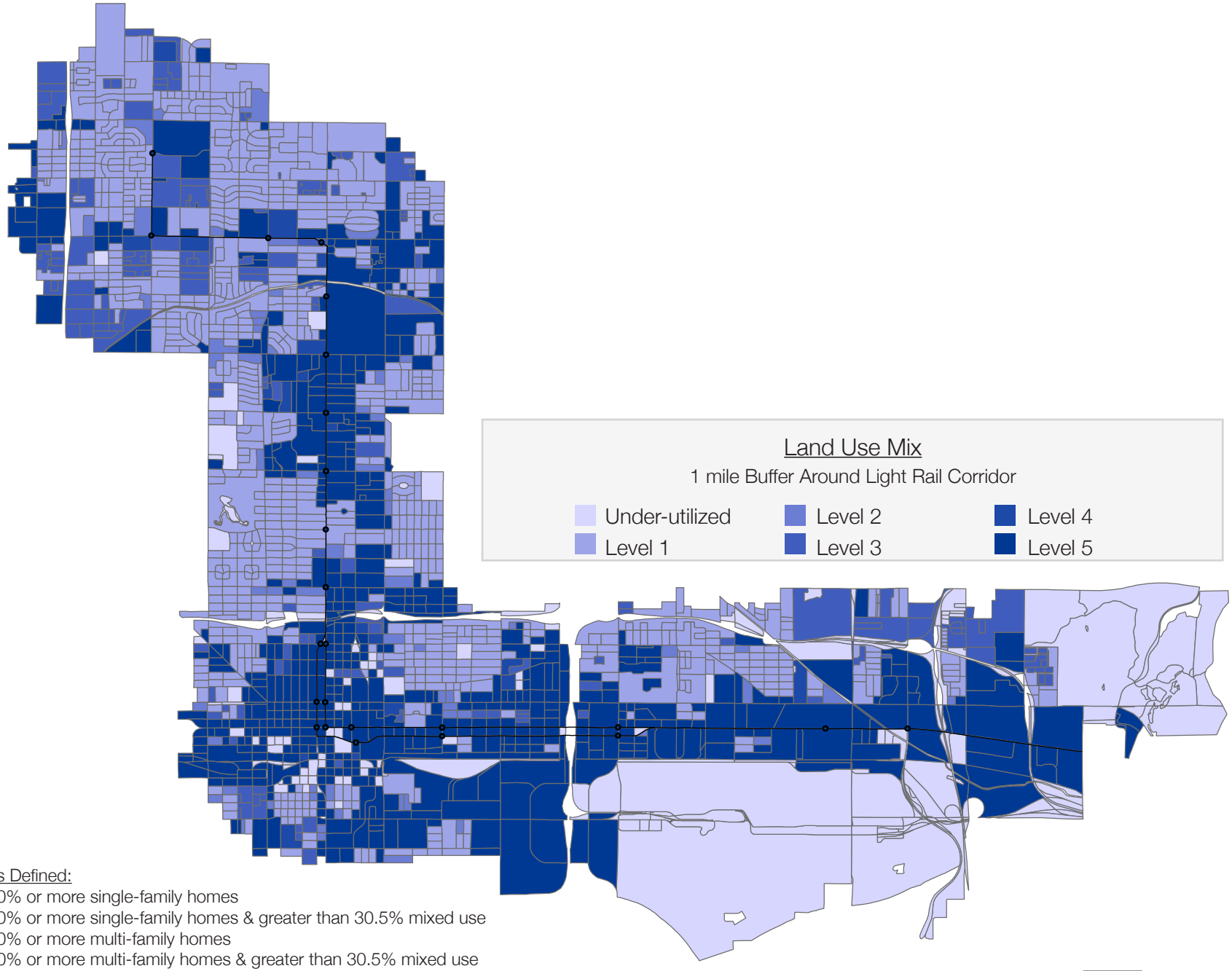
Appendix

The appendix contains enlargements of the maps from Step 3:

- Proximity to Main Thoroughfares
- Residential Density
- Land Use Mix
- Block Perimeter

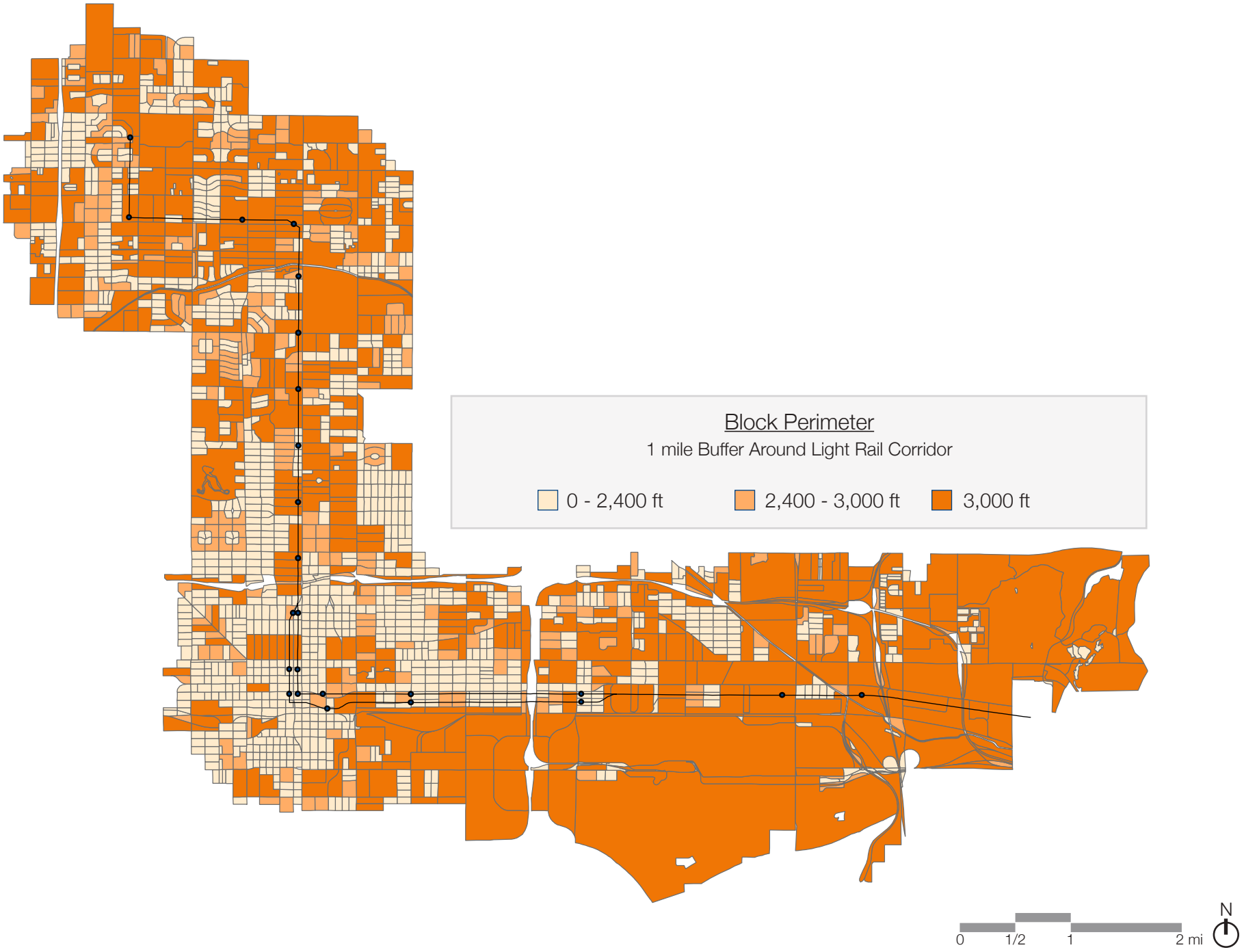

Proximity to Main Thoroughfares
1 mile Buffer Around Light Rail Corridor
Adjacent
Within 1/4 mile
Not in 1/4 mile
0
1/2
1
2 mi
N


Residential Density
1 mile Buffer Around Light Rail Corridor
0 - 3 du/ac
4 - 5 du/ac
6 - 11 du/ac
12+ du/ac
0
1/2
1
2 mi
N



Categories Defined:

Level 1: 50% or more single-family homes
Level 2: 50% or more single-family homes & greater than 30.5% mixed use
Level 3: 50% or more multi-family homes
Level 4: 50% or more multi-family homes & greater than 30.5% mixed use
Level 5: greater than 30.5% mixed residential, commercial & industrial land uses


Block Perimeter
1 mile Buffer Around Light Rail Corridor
0 - 2,400 ft
2,400 - 3,000 ft
3,000 ft
0
1/2
1
2 mi
N