Transect Code Manual

A Step-by-Step Guide

Emily Talen

Contents

Introduction

This Manual is for anyone who believes that zoning in the U.S. is in desperate need of reform. It is intended to help communities write a new kind of zoning ordinance, one that will help build communities that function well, accommodate different types of people, promote a sense of caring about place, and ultimately provide a more supportive and inspiring public realm.

The Manual offers step-by-step instructions on the "how to" of zoning change. It will help planners, students, community activists – anyone with an interest in changing our current system of rules – develop a whole new system of coding.

This new type of code is based on the principle of an urban-to-rural transect – an organization of the built environment that varies in intensity.

The Manual shows in detail the main steps in involved in writing a new code: how to observe, analyze, and code places that are civically minded, well-functioning, and pedestrian-oriented.

The Manual is intended for urban planners, architects, landscape architects, geographers, and community activists working in the field, but the Guide could also serve as a text for students in any course that touches on issues of neighborhood, place, and community.

Our method is adapted from SmartCode version 9.2 and Manual, which is available here: http://www.transect.org/codes.html. The SmartCode is an open source model zoning code based on the transect. It is continually updated, including a number of "modules" on a variety of topics that use the transect as an organizing device. See SmartCode Central for all the details: http://www.smartcodecentral.org/

Further information about the transect and the Center for Applied Transect Studies is available here: http://www.transect.org/

A brief history of how we got into this predicament

Duany and Plater-Zyberk's 1982 master-planned community of Seaside, FL initiated the first wave of form-based codes, specifying building height, setback, permitted encroachments, and parking. There were initially five types of standards: a regulating plan, urban regulations, architectural regulations, street sections, and landscape regulations. Subsequently, the Congress for the New Urbanism advocated that codes focus on the visual harmony of the public realm by requiring continuous urban frontage. By the late 1990s, the goal of radically transforming development regulations in favor of form-based coding was in full swing. The Governor of Maryland, Parris Glendening, held a conference in 1999 on the theme of rehabilitating codes, proposing a "smart growth model ordinance" as well as a new building code. Since then, FBCs have taken on their own complexity, where cities now merge FBCs with priority areas or overlay zones, or hybrid zones that have some form-based emphasis mixed in with conventional use-based coding. The result may be a mixture, as in New York City, where two types of rules are enforced: contextual, where buildings define space, or non-contextual, where buildings simply exist within it.

Transect-based codes such as the SmartCode – which this manual is based on – are a subset of FBCs. Petaluma, California, which had earlier experimented with code innovation in the 1960s, and the first U.S. city to have a plan for controlling growth in the 1970s, was the first city to adopt a SmartCode, in 2003. Miami, Florida approved a transect-based code in 2010, the first form-based code adopted for a large American city. Denver, Colorado became the second. Other large cities like Baltimore, Dallas, Houston and Orlando are in the process of adopting form-based codes. As of 2011, there were 200 adopted form-based codes in the U.S., and an additional 126 codes currently in the developmental stage. Of the 200 adopted, not all are yet effective, and less than 20% can point to projects that have been built or approved under the code. Of those adopted, nearly half are of the transect-based, "SmartCode" variety.

Part I: The Basics

A new approach to zoning: the transect

The zoning reform we advocate in this Manual is based on the idea of an urban-to-rural transect. The transect is an analytical method that organizes the elements of urbanism—building, lot, land use, street, and all of the other physical aspects of the human habitat—in ways that preserve the integrity of different types of urban and rural environments. These environments vary along a continuum that ranges from less intensity (rural) to high intensity (urban).

This transect-based approach is a kind of form-based code (FBC). FBCs emerged in recent decades as the best option for implementing a three dimensional vision of desired urban pattern and form in a transparent, predictable way – an approach that doesn't hide behind arcane text that no one can understand, or that results in forms and patterns no one particularly wants. FBCs are the antidote to conventional zoning, subdivision regulations, and the myriad of "flexible" techniques instituted from a previous generation of code reformers. FBCs control form explicitly.

Like all FBCs, a transect-based code tries to reinstate a meaningful spatial pattern of zones by varying regulations based on locational intensity, ranging from more rural to more urban qualities. An example is shown below. Higher intensity zones typically line commercial streets, while less intense zones transition, sequentially, away from the commercial areas. Typically, smaller unit sizes, street widths, and lot area requirements are associated with zones "closer in" – i.e., in more urbanized locations.

Source: Opticos Design

Transect-based codes, like all FBCs, address homogeneity by aiming for a much greater diversity of land uses within a smaller number of zones. Each zone has a significantly more inclusive interpretation of allowable uses. They permit a greater variety of housing unit types, applying frontage, setback, and other form related rules to help successfully integrate townhomes, duplexes and single-family residences in relatively close proximity.

Transect-based codes seek to promote connectivity – and therefore mitigate separation – in a number of ways, for example by limiting parking requirements, limiting curb cuts, allowing shared driveways, and requiring that streets, paths, and routes intersect rather than dead-end.

Transect zones

Adhering to this system of organization, each type of environment—whether urban, rural, or somewhere in between—can be zoned accordingly. The rules of each transect zone – or "T-zone" – are designed to strengthen and support the character of an area.

Transect zones are meant to be balanced within a neighborhood structure. A walkable neighborhood or "pedestrian shed" consists of a

combination of transect zones. Transect zones do not stand on their own.

In this Manual, we will suggest a new zoning code based on the following zones:

1. Rural preserve (T1)
2. Rural reserve (T2)
3. Sub-urban (T3)
4. Urban general (T4)
5. Urban center (T5)
6. Urban core (T6)

Again it is VERY IMPORTANT to understand that T-zones are to be combined to form complete neighborhoods. Thus, a T-3 zone is often in close proximity to T-4 or even T-5 zones. If it weren't, it would be in danger of being a single-family low-density development (sprawl), not a good example of transect-based urbanism.
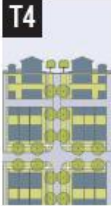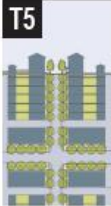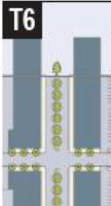
A very useful table describing the transect zones is Table 1 from the SmartCode:

TABLE 1. TRANSECT ZONE DESCRIPTIONS

TABLE 1: Transect Zone Descriptions. This table provides descriptions of the character of each T-zone.

T1

T-1 NATURAL
T-1 Natural Zone consists of lands approximating or reverting to a wilderness condition, including lands unsuitable for settlement due to topography, hydrology or vegetation.

General Character:	Natural landscape with some agricultural use
Building Placement:	Not applicable
Frontage Types:	Not applicable
Typical Building Height:	Not applicable
Type of Civic Space:	Parks, Greenways

T2

T-2 RURAL
T-2 Rural Zone consists of sparsely settled lands in open or cultivated states. These include woodland, agricultural land, grassland, and irrigable desert. Typical buildings are farmhouses, agricultural buildings, cabins, and villas.

General Character:	Primarily agricultural with woodland & wetland and scattered buildings
Building Placement:	Variable Setbacks
Frontage Types:	Not applicable
Typical Building Height:	1- to 2-Story
Type of Civic Space:	Parks, Greenways

T3

T-3 SUB-URBAN
T-3 Sub-Urban Zone consists of low density residential areas, adjacent to higher zones that some mixed use. Home occupations and outbuildings are allowed. Planting is naturalistic and setbacks are relatively deep. Blocks may be large and the roads irregular to accommodate natural conditions.

General Character:	Lawns, and landscaped yards surrounding detached single-family houses; pedestrians occasionally
Building Placement:	Large and variable front and side yard Setbacks
Frontage Types:	Porches, fences, naturalistic tree planting
Typical Building Height:	1- to 2-Story with some 3-Story
Type of Civic Space:	Parks, Greenways

T4

T-4 GENERAL URBAN
T-4 General Urban Zone consists of a mixed use but primarily residential urban fabric. It may have a wide range of building types: single, sideyard, and rowhouses. Setbacks and landscaping are variable. Streets with curbs and sidewalks define medium-sized blocks.

General Character:	Mix of Houses, Townhouses & small Apartment buildings, with scattered Commercial activity; balance between landscape and buildings; presence of pedestrians
Building Placement:	Shallow to medium front and side yard Setbacks
Frontage Types:	Porches, fences, Dooryards
Typical Building Height:	2- to 3-Story with a few taller Mixed Use buildings
Type of Civic Space:	Squares, Greens

T5

T-5 URBAN CENTER
T-5 Urban Center Zone consists of higher density mixed use building that accommodate etail, offices, rowhouses and apartments. It has a tight network of streets, with wide sidewalks, steady street tree planting and buildings set close to the sidewalks.

General Character:	Shops mixed with Townhouses, larger Apartment houses, Offices, workplace, and Civic buildings; predominantly attached buildings; trees within the public right-of-way; substantial pedestrian activit
Building Placement:	Shallow Setbacks or none; buildings oriented to street defining a street wall
Frontage Types:	Stoops, Shopfronts, Galleries
Typical Building Height:	3- to 5-Story with some variation
Type of Civic Space:	Parks, Plazas and Squares, median landscaping

T6

T-6 URBAN CORE
T-6 Urban Core Zone consists of the highest density and height, with the greatest variety of uses, and civic buildings of regional importance. It may have larger blocks; streets have steady street tree planting and buildings are set close to wide sidewalks. Typically only large towns and cities have an Urban Core Zone.

General Character:	Medium to high-Density Mixed Use buildings, entertainment, Civic and cultural uses. Attached buildings forming a continuous street wall; trees within the public right-of-way; highest pedestrian and transit activity
Building Placement:	Shallow Setbacks or none; buildings oriented to street, defining a street wall
Frontage Types:	Stoops, Dooryards, Forecourts, Shopfronts, Galleries, and Arcades
Typical Building Height:	4-plus Story with a few shorter buildings
Type of Civic Space:	Parks, Plazas and Squares; median landscaping

SmartCode Version 9.2

Note there is also a category called "special district" that applies to large facilities like airports and college campuses; in addition, there is the designation of "civic space".

What do transect zones look like?

The website http://transect-collection.org, using photographs by Sandy Sorlien, has been developed to show examples of what different T-zones in different places look like.

Generally, this is what a T-3 zone looks like (Oak Park, Illinois):

Here is an example of T-4 (Longmont, Colorado):

Here is an example of T-5 (Hibbing, Minnesota):

And finally, an example of T-6 (Chicago, IL):

Part II: Using GIS to Delineate Transect Zones

In this section we demonstrate a GIS-based method for delineating a transect zoning map. We will demonstrate this method for a section of Phoenix, AZ (a 1-mile area around the Phoenix Light Rail).

Step 1. Compile your GIS data. To generate the transect zoning map demonstrated here, you will need the following data layers:

- Parcels – represented as polygons, and containing a variable for land use. You will also need number of dwelling units.
- Environmental sensitivity – usually a polygon layer. Join the attributes to the parcels layer.
- Streets – represented as lines, and containing information on street segment width, if possible.
- Blocks – you can use a shapefile of census blocks, if you don't have a separate blocks file.

    Note: We used Esri's ArcMap for this exercise. Some commands are specific to Esri software.

Step 2. Designate T-1 and T-2 zones.

The T-1 zone is land that is already protected - agricultural land, natural areas, wildlife habitat, sites of cultural and/or natural significance, steep slopes. Use your land use variable in the parcels layer (or data appended from your environmental layers) to make this determination.

The T-2 zone is land that should or is planned to be protected – unprotected agricultural land, woodlands, sites of cultural and/or natural significance, future park lands, steep slopes. Use your land use variable in the parcels layer (or data appended from your environmental layers) to make this determination.

Remove T-1 and T-2 areas from the remaining steps.

(Note: our Phoenix example does not have any T-1 or T-2 zones).

Step 3. Get a baseline understanding of the transect qualities of your buildable areas (the T-3 to T-6 zones) by doing a visual inspection.

You are looking for how different blocks seem to have different transect qualities. Your goal is to start to delineate the specific dimensions of transect zones for your area. For example, in your city, what are the basic sizes of blocks and lots in a typical T-3 zone?

Google Earth inspection is one way to arrive at this understanding. The Synpotic Survey – described in detail in Part III of this Manual – is another way.

Using either method, the idea is to find the main dimensions and elements in each of four transect zones, T-3, T-4, T-5, T-6, for example as shown in the table below. The table shows generic characteristics of transect zones for a neighborhood in Chicago. The descriptions only pertain to areas where development occurs – T-3 to T-6. In the T-1 and T-2 zones, land is either preserved (T-1), or reserved for future preservation (T-2).

Transect Zone Descriptions for a neighborhood in Chicago				
	T3	T4	T5	T6
Land uses and buildings	Houses	Houses, town houses, limited commercial	Town houses, apartments, hotels, office buildings	High- and medium-rise apartments, office buildings, hotels
Private frontage	Lawns, porches, fences	Porches, fences	Stoops, shopfronts	Stoops, forecourts, shopfronts
Public frontage	Open swales, naturalistic tree planting	Raised curbs, narrow sidewalks	Raised curbs, wide sidewalks	Raised curbs, wide sidewalks
Thoroughfares	Roads	Streets, rear lanes	Boulevards, avenues, streets	Boulevards, avenues, streets
Open spaces	Parks, greens	Squares, playgrounds	Squares, plazas, playgrounds	Squares, plazas, playgrounds

This preliminary visual inspection is important because we will be assigning transect zones based on some assumptions about the existing character of zones in the community.

In the steps that remain, your goal is to designate each block as a transect zone. In our Phoenix example, we are using the following factors: proximity to thoroughfares and transit, mix of land uses, density, environmental sensitivity, and block perimeter.

**Note: Many areas will not conform to one transect zone or another. Thus, transect zone delineation also involves a process of identifying areas that are in nonconformance with the new transect zones (for example, blocks that exceed the maximum targeted perimeter, densities that are too low, or lot widths that are too wide). Those areas can be identified as "transitional," constituting places where the new transect zoning rules will allow them to evolve.

****Note****

‣

· In **Steps 4, 5 and 6** we assign a transect zone to each block.

‣

· In **Step 7** we adjust these assignments to make sure there aren't large areas assigned to only one T-zone. To reiterate: T-zones have to be combined to form complete neighborhoods – that's the tricky part!

Step 4. Determine distribution of basic morphologies. These will be used to determine Step 5 categorization.

1. Thoroughfare types (to be used to determine proximity to major thoroughfares and light rail line for Step 5)
   - 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 5). 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

Step 5. Assign categories to blocks, based on findings from Step 4.

Create 5 GIS layers (unit = urban block; exclude T-1 and T-2 zones)

1. Proximity to main thoroughfares: 3 categories, as follows:

    A. adjacent (to major thoroughfares or within 1/8 mile from light rail line);
    B. within ¼ mi buffer;
    C. 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

Proximity to Main Thoroughfares

Adjacent
Within 1/4 mile
Not in 1/4 mile
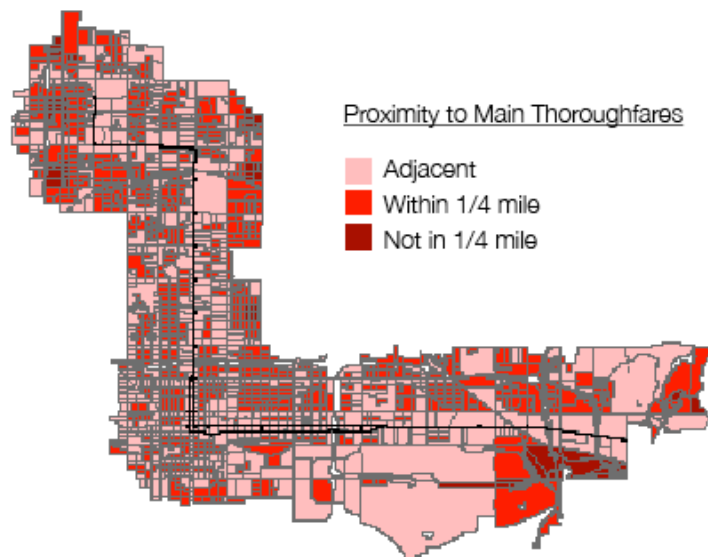
2. Residential Density:

- Find the number of dwelling units for residential properties, available in the parcel data layer (label the field 'NUM_DU')

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

- Create new field to calculate density using the formula 'NUM_DU' / 'ACRES'   (calculated only for residential property types)

- Since the above calculation is by parcel, do a spatial join with blocks layer – i.e., 'join data from another layer based on spatial location'. Assign a density level.

Residential Density

- 0 - 3 dwelling units per acre (du/ ac)
- 4 - 5 du/ ac
- 6 - 11 du/ ac
- 12+ du/ ac
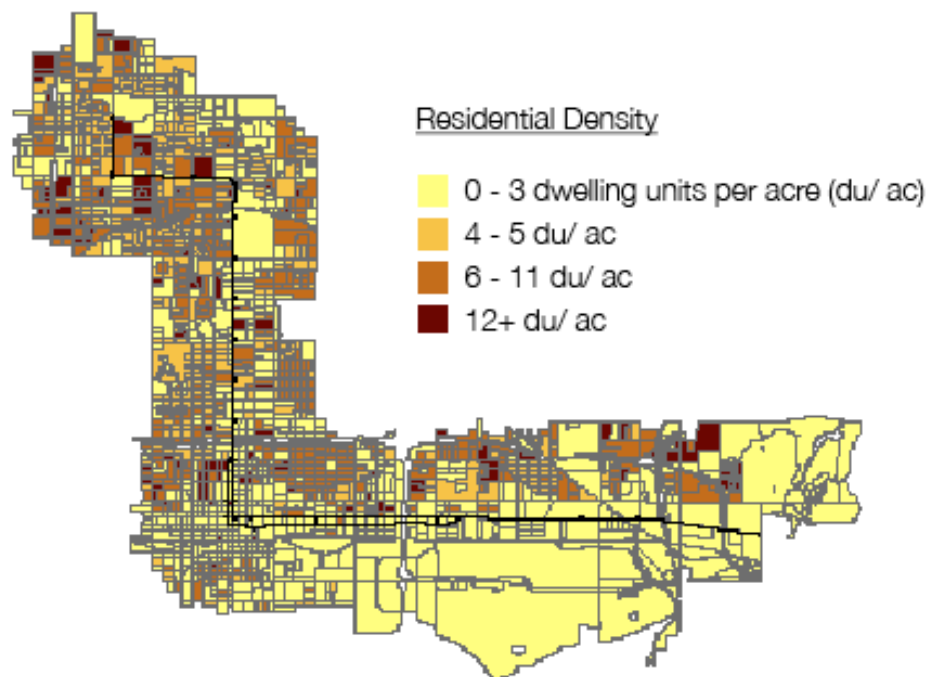
3. Land Use Mix:

- 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.

  Note: land use designations, which usually originate from a tax assessor, usually have to be combined to form more useful categories. Here is how we combined land use parcel descriptions for the Phoenix data:

    o Single-Family: 'RES-SINGLE FAMILY' 'MOBILE HOME'
    o Multi-Family: 'RES-APARTMENT' 'RES-CONDOMINIUM' 'RES-DU/TRI/FOURPLEX' 'RES-ASST LIVING'
    o Commercial: 'COMM-HOTEL/MOTEL' 'COMM-OFFICE' 'COMM-RESTAURANT/BAR' 'COMM-RETAIL'
    o Industrial: 'INDUSTRIAL' 'WAREHOUSE'
    o Parking: 'VEHICLE PARKING'
    o Mixed Use: 'MIXED-OFF/RETAIL/RESTAU' 'MIXED-RES/COMM' 'SOCIAL SERVICE' 'RELIGIOUS' 'DAYCARE' 'GOVERNMENT' 'MEDICAL' 'MUSEUM'
    o Civic Spaces: 'OPEN SPACE' 'SCHOOL'
    o Special District 1: 'AIRPORT'
    o Special District 2: 'RAILROAD' 'UTILITY'
    o Under-utilized Land: 'VACANT' 'SALVAGE' 'VEHICLE PARKING'

- Remove Special Districts layers from the next 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

- Join data from parcels to blocks using the command 'join data from another layer based on spatial location' and select the option 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.

- Classify each block into one of five categories (levels 1-5 are 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)).
- According to your percentages, assign each block to a level of

mix. There is some trial and error involved here, as you obviously don't want the whole city to be classified at one level. Degree of mix is partly a relative concept. Relative to Phoenix, the following levels made sense:

- Level 0: When a block had all zero values (in our case, vacant, salvage yard, or parking lot); we classified these blocks as "under-utilized"
- 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.

Also in our case, about 20 blocks did not fall into any category, so we assigned a level to these "outliers" as follows:

- 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
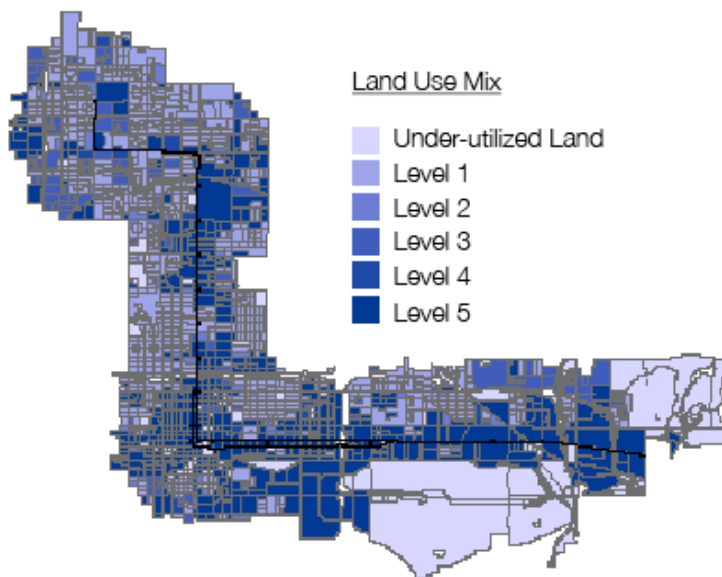
4. Environmental Sensitivity (for areas not T-1 or T-2):

- Delineate sensitive resources and determine appropriate buffers (e.g. water resources, soil types, slopes, other environmentally or culturally significant areas).

- Weight significance of resources within each watershed.

- Create 3 categories:
  - Low Sensitivity
  - Moderate Sensitivity
  - High Sensitivity (high sensitivity is designated T2)

Note: In our case, the entire area had low environmental sensitivity.

5. Block perimeter:

- Create a new field in attribute table ('PERIMETER')

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

- 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 found in the SmartCode, given the very large block sizes in Phoenix.

Block Perimeter

- 0 - 2,400 feet
- 2,400 - 3,000 feet
- 3,000 + feet
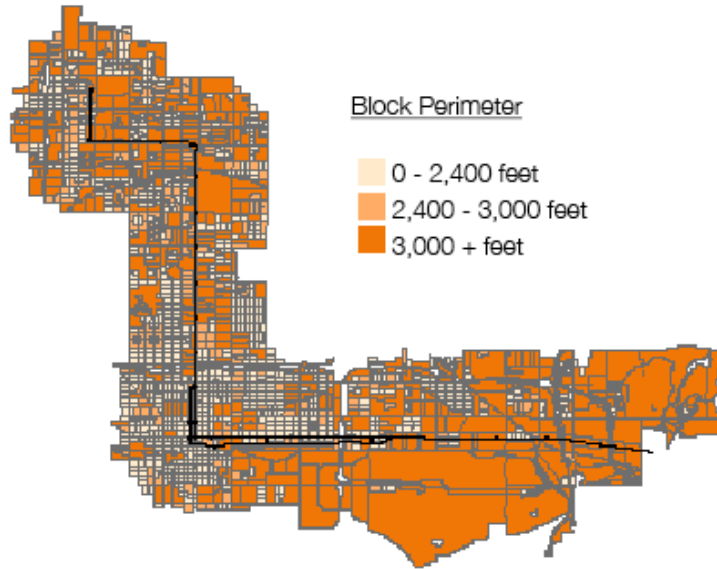
Step 6. Assign each block a preliminary transect zone.

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:

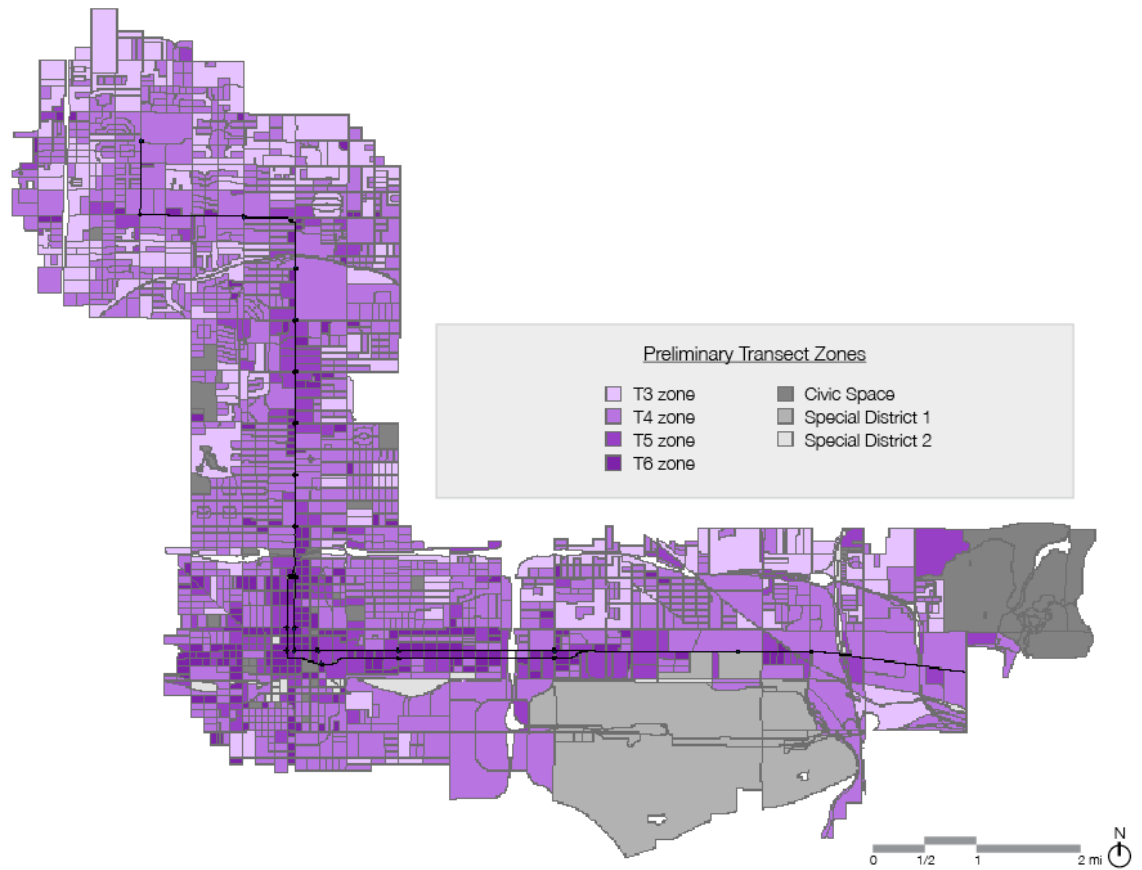|	PROXIMITY	LAND USE MIX	BLOCK PERIMETER
T3	not in buffer	level 1	> 3,000 ft
T4	within buffer	level 1, 2, or 3	< 3,000 ft
T5	adjacent	level 3, 4, or 5	2,400 - 3,000 ft
T6	adjacent	level 4 or 5	< 2,400 ft

3. For the blocks that did not match the above criteria, we came up with a set of rules to make T-zone assignments. Again, there was some trial and error here. Our goal was to find a reasonable set of parameters that could be applied in a transparent way. Ultimately these rules are

negotiated through a community-driven process.

Our rules were as follows:

- 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   ■ Civic Space
- ■ T4 zone   ■ Special District 1
- ■ T5 zone   ☐ Special District 2
- ■ T6 zone

Step 7. Assign Community Unit Types and then Adjust T-zones.

As noted above, you now have to adjust your block assignments to make sure there aren't large areas assigned to only one T-zone. T-zones have to be combined to form complete neighborhoods – that's the tricky part!

Because we are dealing with an existing urban area, there are two community types that we will use:

1. TND or Traditional Neighborhood Development: a Community Type based upon a Standard Pedestrian Shed oriented toward a Common Destination consisting of a mixed-use center or corridor, and having a minimum developable area of 80 acres.

2. RCD or Regional Center Development : a Community Type based upon a partial or entire Long Pedestrian Shed, oriented toward a strong Town Center. With transit existing or proposed, it is called TOD (Transit-Oriented Development). The minimum developable area of an RCD/TOD is 160 acres.

Also per the SmartCode, our aim is to get to the following allocation of zones within each pedestrian shed:

- TND:

    10-30% T3
    30-60% T4
    10-30% T5

- RCD:

    10-30% T4
    10-30% T5
    40-80% T6

Step 7.1: Create a network-based pedestrian shed

- Enable Network Analyst extension in both ArcCatalog and ArcMap

- Create a 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.

- 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

  o Select 'Solve' on Network Analyst toolbar. This creates 1/4 mile service areas.

- Calculate service areas around major intersections

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

Step 7.2: Define Community Unit Types

- 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.

- Defining Community Units around light rail stops and major intersections:
  o 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.

- Defining remaining blocks to Community Units:
  o 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 7.3: 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 7.4: 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.

- In the attribute table of 'TZones' shapefile add a new field ('BL_ACRES') and calculate the acres per block using the geometry calculator.

- 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 160 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

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

    TND:

    10-30% T3
    30-60% T4
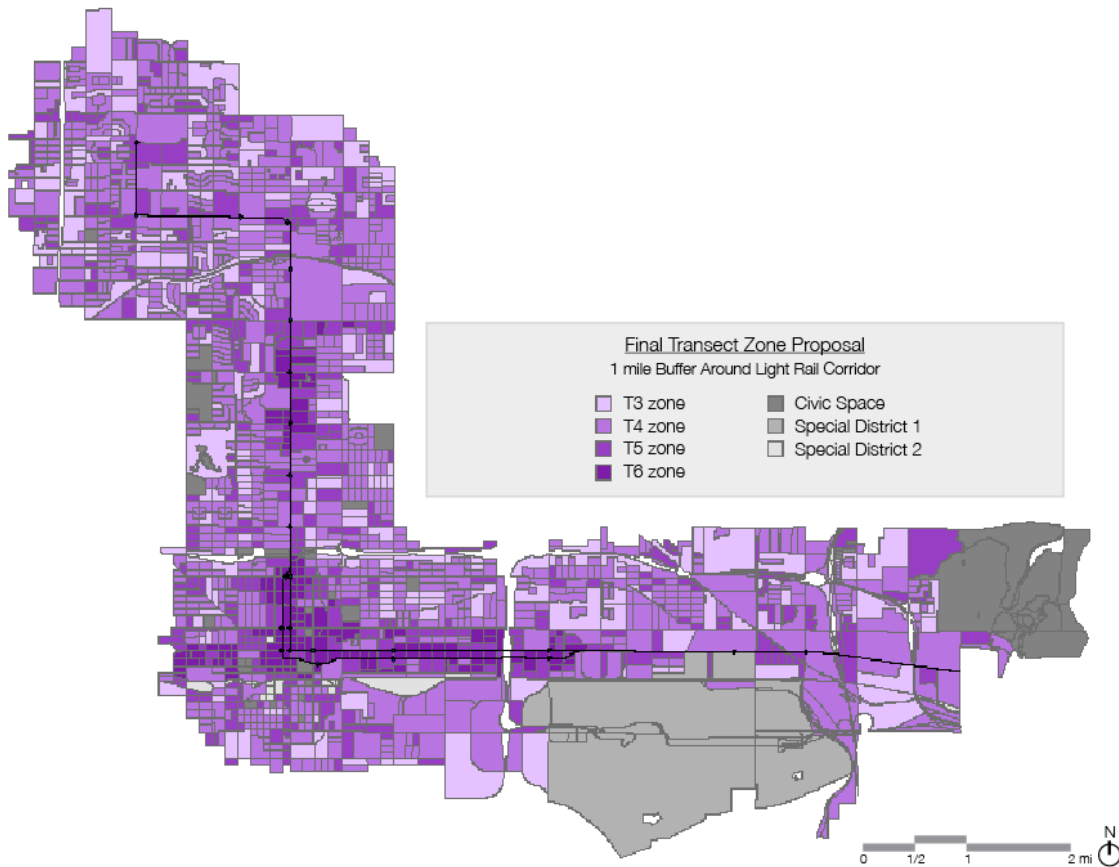   10-30% T5

    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 what could be adjusted. For adjusting the T-Zones first consider how closely the criteria were met to begin with (i.e. 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).

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

Our final transect zone delineation looked like this:

Final Transect Zone Proposal
1 mile Buffer Around Light Rail Corridor

☐ T3 zone   ■ Civic Space
■ T4 zone   ☐ Special District 1
■ T5 zone   ☐ Special District 2
■ T6 zone

Part III: Code Calibration

Code calibration involves specifying more exact rules for each zone based on the DNA of a particular place. The Synoptic Survey is used to extract that DNA.