

# LEAN-GIS

## Protocols\*

(Local Environment for Activity and Nutrition--  
Geographic Information Systems)

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**T h i s   i s   a   w o r k   i n   p r o g r e s s**

# LEAN: GIS Protocols

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# 1. CONCEPTUAL ISSUES

## 1.1. Protocol Purposes and Audiences

This manual provides protocols for measuring environmental variables associated with food, youth and physical activity used in the Minnesota TREC-IDEA study (TREC = Transdisciplinary Research on Energetics and Cancer). It is a companion to an earlier manual NEAT-GIS Protocols (Neighborhood Environment for Active Transport) developed for the Twin Cities Walking Study (TCWS) (Forsyth 2005, 2006, 2007, 2010) and available at <http://www.designforhealth.net/GISprotocols.html>.

The manual has three purposes:

- To record the methods for environmental measurement used in the study.
- To document methods for replication.
- To make GIS research methods and data sources less opaque.

## 1.2 Organization of the Protocols Manual

The manual is organized into eight sections.

1. This introduction provides an overview of the study and data.
2. Fundamental protocols and procedures for measuring land area and various buffer areas, distances, and paths. These are used in all other measures.
3. Food service measurement protocols--measuring densities of and distances to various kinds of restaurants as a proxy for measuring food quality.
4. Food store measurement protocols--from convenience grocery to super centers, as another proxy for quality.
5. Measurement protocols related to utilitarian and recreational physical activity among youth. Many of these protocols simply refer the reader to *Environment and Physical Activity: GIS Protocols*, developed for the Twin Cities Walking Study (TCWS GIS Protocols): <http://www.designforhealth.net/GISprotocols.html>. This includes distances to parks, gyms, and trails.
6. Protocols related to census variables.
7. Protocols for data storage and data sharing.
8. Appendices, keyed to specific chapters, followed by references.

Protocols themselves take a specific format. Each one contains six main parts that are described in more depth in a related article (Forsyth et al 2006). These are: *Basic Concept; Basic Formula, Basic Definition, or Basic Procedure; Detailed Formula or Detailed Definition; Comments and Explanations; GIS Approach; and GIS Steps*. It should be noted that these steps often indicate one of several ways to do measurements.

### 1.3 The Context of the Manual: TREC-IDEA followed by EAT-III and ECHO

The manual was initially written in the context of a research project measuring the neighborhood built environment related to healthy (and otherwise) eating and physical activity of youth. This project was part of a larger project on Transdisciplinary Research on Energetics and Cancer, Examining the Obesity Epidemic through Youth, Family, and Young Adults led by PI Robert Jeffrey. This manual was written for a substudy, the Identifying Determinants of Eating and Activity (IDEA) project led by PI Leslie Lytle.

Overweight and obesity among adolescents is increasing across the globe, but the rise is particularly dramatic in the United States. This study looks at cancer and obesity risks by examining psychological, social, genetic, and environmental features. This manual focuses on one component, measuring the built environment at a community level including such factors as population density, street pattern, mixed use, pedestrian infrastructure, and access to different kinds of food stores and restaurants. For more information about the larger TREC program see:

<https://www.compass.fhcrc.org/trec/> and <http://www.ncbi.nlm.nih.gov/pmc/articles/PMC2819263/>.

The manual was subsequently updated for two other studies: Eating Among Teens, part three (EAT-III) and Etiology of Childhood Obesity (ECHO) see:

<http://www.sph.umn.edu/epi/research/eat/index.asp> for more detail.

### 1.4 Steps in Developing the Manual

This manual follows the approach of the *NEAT GIS Protocols Manual* but is based on further review of the literature on health and food. In addition, a number of changes in ArcGIS came about after the physical activity protocols manual had been developed, most notably a very significant change in the way network buffers were constructed. This manual reflects the results of investigations into the effects of those changes.

The manual has also gone through several versions:

- Version 1 was created for the TREC-IDEA study as a companion to the earlier *NEAT-GIS Protocols*, with LEAN-GIS adding measures on food and recreation physical activity with a focus on youth. These versions were created in October 2006 and June 2007.
- Version 2 was refined for the EAT-III and ECHO studies and was updated to Arc-GIS 9.3 where needed.

### 1.5 Data

The following lists data used in these specific studies. Analysts using different data may need to modify protocols. General problems with GIS data are described in Forsyth et al. (2006, 2010) and in the companion NEAT manual in section 1.5.

*US Census*

[www.census.gov](http://www.census.gov)

Description: SF1 files at the block and block-group level and SF3 at the block-group level for TREC-IDEA. Given changes to the US census, later versions have been converted for use with the new 2010 census and American Community Survey.

Metadata: Metadata for census variables are available in a number of parts of the census Web site. For details on downloading large SF# files see <http://www.census.gov/support/SF3ASCII.html>

### *MetroGIS*

[www.metrogis.org](http://www.metrogis.org)

[www.datafinder.org](http://www.datafinder.org)

Description: This is the GIS group supported by the Metropolitan Council of the Twin Cities, a state agency that does planning and analysis for seven counties at the core of the Twin Cities metropolitan area. Its data include a number of useful layers complete with metadata and accessible from <http://www.datafinder.org/catalog.asp>. Not all data are free and many require specific agreements to be made between the user and the data owner:

#### General data

- 2000 Digital Orthophotos (2 feet per pixel resolution)
- Generalized Land Use, 2000
- Counties, Cities and Townships
- MetroGIS Regional Parcel Dataset - Current (updated quarterly)
- Water Features from 2000 Land-Use Data (supplements Ramsey County water layer)
  
- NCompass Data (note name change of data from earlier versions)—Streets, Points of Interest, and Census
- Census Geography 2000 – NCompass Aligned; Blocks, Block Groups & Tracts. This is the MetroGIS-endorsed version of the census data and the one we used. It has the census geographies better aligned with the TLG roads layer
- NCompass Landmarks – Areas of Interest
- NCompass Landmarks – Lines of Interest
- NCompass Landmarks – Points of Interest
- NCompass Street Centerline Edits Table
- NCompass Street Centerlines and Address Ranges
  
- Bus Route Segments
- Bus Routes
- Bus Service
- Bus Shelters
- Bus Stops
- Transit Centers

## Other

- Regional Trails – Existing and Proposed
- Metadata: Most are available linked to the data finder Web site at <http://www.datafinder.org/catalog.asp>

### *Health and Agriculture Department Data*

Businesses selling food need to be licensed by various agencies. In broad terms, restaurants are licensed by departments of health and food stores by the department of agriculture. However, many businesses combine elements of each--such as a delicatessen selling sandwiches and packaged goods. Businesses selling only packaged goods have specific requirements. In some states such licensing is done at the state level, providing consistent data collection. Unfortunately this is not the case in Minnesota. Appendix 1A contains more detail about these data sources. In summary:

- Food stores including packaged goods are typically regulated by cities and counties—see Appendix 1A for sample data and Appendix 1B.
- Restaurants/food service: In Minnesota these are typically regulated by health departments. Some are regulated by the state health department but in the Twin Cities, a number of cities and counties have been delegated this role. The list of agencies is included in Appendix 1C.

Unfortunately, each jurisdiction collects different data with the only things in common being name and address (see Appendix 1A for a table showing examples of the different data).

### *Commercial Data*

There are several commercial databases available for business addresses (e.g. Dun and Bradstreet, InfoUSA/ESRI Business Analyst) as well as more specialized data for specific purposes such as stores with soda fountains (Forsyth et al. 2010)

Commercial data often includes industrial classification codes called SIC or NAICS codes (old Standard Industrial Classification codes used to 1997 and North American Industrial Classification System codes used since 1997 with refinement in 2002 and 2007). **Dun and Bradstreet data, see below, is an example of data using such codes and was the data source in version 1 of this manual; later versions use Business Analyst (see below).** These codes come in a variety of levels—from 2 to six digits, with longer codes being more specific. For example, the following NAICS 2002 codes relate to food and beverage stores:

#### 44-45 Retail Trade

#### 445 Food and Beverage Stores

##### 4451 Grocery Stores

##### 44511 Supermarkets and Other Grocery (except Convenience) Stores

##### 445110 Supermarkets and Other Grocery (except Convenience) Stores

##### 44512 Convenience Stores

##### 445120 Convenience Stores

##### 4452 Specialty Food Stores

##### 44521 Meat Markets

##### 445210 Meat Markets

##### 44522 Fish and Seafood Markets

- [445220](#) Fish and Seafood Markets
- [44523](#) Fruit and Vegetable Markets
- [445230](#) Fruit and Vegetable Markets
- [44529](#) Other Specialty Food Stores
- [445291](#) Baked Goods Stores
- [445292](#) Confectionery and Nut Stores
- [445299](#) All Other Specialty Food Stores
- [4453](#) Beer, Wine, and Liquor Stores
- [44531](#) Beer, Wine, and Liquor Stores
- [445310](#) Beer, Wine, and Liquor Stores

The following refer to restaurants

[72](#) Accommodation and Food Services

[722](#) Food Services and Drinking Places

[7221](#) Full-Service Restaurants

[72211](#) Full-Service Restaurants

[722110](#) Full-Service Restaurants

[7222](#) Limited-Service Eating Places

[72221](#) Limited-Service Eating Places

[722211](#) Limited-Service Restaurants

[722212](#) Cafeterias

[722213](#) Snack and Nonalcoholic Beverage Bars

[7224](#) Drinking Places (Alcoholic Beverages)

[72241](#) Drinking Places (Alcoholic Beverages)

[722410](#) Drinking Places (Alcoholic Beverages)

However it should be noted there are other places selling food such as dinner theaters.

In addition, in the food area, NAICS has typically fewer subtypes of businesses but is potentially more accurate. For example, the following are all coded 445299 in NAICS but have several different 4-digit SIC codes

2002 NAICS	1997 NAICS	1987 SIC
445299	445299	5499 Coffee and tea (i.e., packaged) stores
445299	445299	5451 Dairy product stores
445299	445299	5499 Gourmet food stores
445299	445299	5451 Ice cream (i.e., packaged) stores
445299	445299	5499 Soft drink stores, bottled
445299	445299	5499 Specialty food stores
445299	445299	5499 Spice stores
445299	445299	5499 Tea and coffee (i.e., packaged) stores
445299	445299	5499 Water stores, bottled

Source: <http://www.census.gov/epcd/naics02/def/ND445299.HTM>

A full list of codes is available at <http://www.census.gov/cgi-bin/sssd/naics/naicsrch?chart=2007> and a comparison between NAICS and SIC codes is at <http://www.census.gov/epcd/naics02/N02TOS87.HTM>

The problem faced by researchers is that the NAICS/SIC codes are not always accurately applied in commercial databases, particularly for beyond the two and three digit levels. However, using such databases and **names** of chains it is possible to classify, for example, fast food restaurants or major supermarket chains. **This was the approach taken in version 2.**

The following is a list of potential commercial data with sources and comments. More detail about coding is included in Appendix 1E):

- Dun and Bradstreet (**used in version 1 of this manual**): D&B is a business information provider. Companies apply for a D-U-N-S number (Dun and Bradstreet Universal Numbering System) for free. According to Wikipedia 100 million companies have done so, globally. A sample entry is included in Appendix 1D. Useful data include exact address, SIC/NAICS code, number of employees, sales volume, and square footage of buildings. Addresses can be matched to parcels. The main Dun and Bradstreet web site for the U.S. is at: <http://www.dnb.com/us/>. This is an excellent source of data but is quite expensive—one year of data for the Twin Cities is approximately \$13,000. Using 2005 data Krizek et al. (2007) counted 123,668 businesses in the Twin Cities metro area. We used these data for the TREC-IDEA study but after completing a comparison with Business Analyst decided to use it for the EAT-III and ECHO studies as more cost effective (Forsyth et al 2010).
- Business Analyst (InfoUSA/ESRI) (**used in version 2 of this manual**): ESRI (originally the Environmental Systems Research Institute) is the creator of the ArcGIS suite of GIS software, the most used GIS software in the U.S. Business Analyst is integrated with their software and uses InfoUSA as the business database—a listing of 11 million U.S. businesses by “business name, industry description or SIC/North American Industry Classification System, sales, employees, and location” (<http://www.esri.com/software/arcgis/extensions/businessanalyst/about/high-quality.html>). It also includes the Directory of Major Malls, a list of 4,000 larger shopping centers. InfoUSA data are compiled from phone books, business directories, public filings, and U.S. Postal Service National Change of Address files, checked by phoning businesses. However, addresses are not always exactly matched and coding is not always precise. For example, in one part of the Twin Cities only 90 percent of addresses were matched to streets; the rest to zip codes. Most restaurants were classified as limited service (akin to fast food). The main InfoUSA web site is <http://list.infousa.com/>. Using 2006 data Krizek et al. (2007) counted 93,840 businesses in the Twin Cities metro area. However, this is a less expensive data source. One year of data costs approximately \$3,500 for the Twin Cities. **For version 2 and later we used InfoUSA to locate restaurants in general and a set of chain names and key words to locate fast food.**

More details about the data are in Appendix 1D.

## 1.6 Measurement Units

This protocol manual uses metric measurement units.

## 1.7 Measurement Logistics

These protocols generally use existing data and do not involve fieldwork.

## 1.8 General Measurement Geographies: TREC-IDEA, EAT-III, and ECHO

The TREC-IDEA study examined two major youth environments—home and school. Other parts of the study looked at the environments within the home and school. In the TREC-IDEA study we used the geographies below. It should be noted that in early versions of the companion *NEAT GIS Protocols* we also examined 200m network buffers. Changes in network analyst made it problematic to use the 200m network buffers (there were many oddly shaped of zero size buffers, but of a different shape to previous versions). Further, ongoing research did not show any special association between these buffers and physical activity. For these reasons we dropped the 200m network buffer.

<b>School</b>	<b>Home</b>	<b>Home to School **</b>
<i>Straight line</i>	<i>Straight line</i>	<i>Straight line</i>
200m	200m	50 m either side
400m	400m	
<b>800m</b>	<b>800m</b>	
<b>1600m</b>	<b>1600m</b>	
<b>3000m</b>	<b>3000m</b>	
<b>Distance to nearest feature</b>	<b>Distance to nearest feature</b>	
<i>Network</i>	<i>Network</i>	<i>Network</i>
		50 m either side
400m	400m	
<b>800m</b>	<b>800m</b>	
<b>1600m</b>	<b>1600m</b>	
<b>3000m</b>	<b>3000m</b>	
<b>Distance to nearest feature</b>	<b>Distance to nearest feature</b>	

For EAT-III and ECHO we decided on fewer geographies and also decided to use a new network buffering technique that we call the “sausage buffer” less susceptible to unexplained changes in the GIS software. The specific geographies and protocols used in these studies are explained in Appendices 1F and 1G and are indicated in **bold above**.

## 2. FUNDAMENTAL PROTOCOLS AND PROCEDURES

*Note: these protocols draw on work previously done in the companion physical activity protocols but were updated and modified for this study by Ann Forsyth (selection of protocols) and Nishi Mishra and David Van Riper (GIS steps).*

### Background

This project includes buffers and distance measures for three areas: home, school, and the path between. The key issue that the first versions of these protocols had to deal with was that with the introduction of a new version of network analyst, the program that created street distance (network) buffers for ArcGIS 9. In 2006 the software programmers radically changed the way that buffers are made. However, they did not document this. The issues around these changes are described in more detail in the protocols for network buffers. We used the proprietary network buffers in the TREC-IDEA study but changed to what we call “sausage buffers” for the EAT-III and ECHO studies. These use a different approach to making buffers, one that is more easily reproduced and that we believe represents the neighborhood environment as accurately.

#### 2.1 Net Land Area (without water): See NEAT GIS Protocol 2.1 (2010 EAT-III & ECHO)

This uses the existing *NEAT GIS Protocol*. Be sure to use the latest version-- preferably 5.0 or later--as these versions correct errors, simplify some steps, or at least indicate where protocols are in need of revision.

#### 2.2 Gross Area (including water): See NEAT GIS Protocol 2.2

This uses the existing *NEAT GIS Protocol*. Be sure to use the latest version--4.0 or later and preferably 5.0 or later--as these versions correct errors, simplify some steps, or at least indicate where protocols are in need of revision.

#### 2.3 Measurement Geography Type 1: Straight Line or Airline Buffer: See NEAT GIS Protocol 2.5 (2010 EAT-III & ECHO)

This uses the existing *NEAT GIS Protocol*. Be sure to use the latest version--4.0 or later and preferably 5.0 or later--as these versions correct errors, simplify some steps, or at least indicate where protocols are in need of revision.

## 2.4 Measurement Geography Type 2: Network or Street Distance Buffer (2010 EAT-III & ECHO--New Sausage Version)

*Note: This version is new for version 2.0. Version 1 was adapted from the NEAT GIS Protocol 2.6 but dealt with updates to Arc GIS that fairly radically changed the method of creating network buffers and thus their area and shape. The GIS steps for that version are now in Appendix 2A. This new version uses a different approach, creating a sausage shaped area along each street.*

### 1. Basic Concept

A network buffer includes the area within x distance along a street network from the starting point (a school or home in this case). In ArcGIS9 a new version of network analyst fundamentally changed the way network buffers are created. In version 2.0 we decided to avoid using this kind of buffer and substitute a buffer along routes—the “sausage” buffer that is easier to replicate in different programs. Our logic is described in Appendix 2B.

### 2. Basic Definition

A network buffer is an area within X-meters street distance of a point (or a polygon) measured by moving along the street network.

### 3. Detailed Definition

A sausage network buffer is an area within X-meters street distance of a point (or a polygon) moving along the street network and buffered at an amount of Y meters either side of the street--this amount is called the “radius” to distinguish it from the overall buffer “distance”.

### 4. Comments and Explanations

**The exact “radius” distance is being assessed and will be described in version 2.1 of these protocols. It will likely be 100-200 meters.** The protocol uses a rounded buffer and in order for the buffer to extend exactly X-meters, the radius of the sausage is deducted from X (so in order to have the buffer extend X meters, it is actually drawn out X-Y meters).

For the EAT-III and TREC studies the buffer distances are listed in appendix 1G. The street network distance may be from a home, work place, school, or other relevant spot. More specifically, it is the distance along the street network from the house or building’s street location. Note, it is possible to manually locate buildings using aerial photos and this may be more appropriate than centroids in smaller studies. This is a little trickier to do in GIS than the straight-line buffer. There is little guidance in the literature. Some work has been done on buffering routes between two places and comparing buffers of shortest distances with actual routes travelled and they often don’t coincide (Badland et al. 2010).

In addition, it would be preferable to add in pedestrian networks but in these studies with highly dispersed populations, large numbers of participants, and small GIS budgets, that was not possible.

### 5. GIS Approach

The GIS approach for creating the sausage buffers requires two steps. First, use the Service Area Solver in the Network Analyst extension for ArcGIS 9.3.1 to calculate service areas around the set

of point features, in this case the study participants. The Service Area Solver will create both polygons and lines that comprise the service area. These lines serve as the input for step 2. Second, buffer the lines using a particular distance to create the sausage buffers.




## 6. GIS Steps


The following procedure was completed using ArcInfo 9.3.1

Requirements for ArcGIS 9.3.1:

1. Road Layer polyline
2. Point feature to calculate the sausage network buffer around (Participant or School)

Generate the Network Buffer Lines

1. Start **ArcMap**
2. On the Main Menu, click Tools and click on Extensions
  - a. Check Network Analyst Extension
  - b. Click Close
3. Click the Add Data button  on the Standard Toolbar
  - a. Navigate to the Network Dataset location, created earlier
  - b. Click on the Network Dataset and click Add to add the Network Dataset to ArcMap
  - c. Click Yes to add all the feature classes that participate in the network dataset to the map
4. Click the Add Data button  on the Standard Toolbar
  - a. Navigate to the Point Layer to be used in the analysis, in this case the Participant layer
  - b. Click on the Point Layer and click Add to add it to the map
5. In the Table of Contents, right-click on the Participant layer and click Open Attribute Table
  - a. In the Attribute Table
    - i. Click the Options button
    - ii. Click Add Field...
    - iii. Add the Participant ID as a Text field
      1. Type Part\_ID\_T in the Name field
      2. Select Text (50) as Type
      3. Accept default as the Length
      4. Click OK
    - iv. Add the Participant ID as an Integer field
      1. Type Part\_ID in the Name field
      2. Select Long Integer as Type
      3. Accept default (0) as Precision
      4. Click OK
    - v. Enter the assigned ID for Part\_ID\_T and Part\_ID
6. On the Main Menu, click View
  - a. Click on Toolbars
  - b. In the side menu click Network Analyst to add the Network Analyst toolbar to ArcMap
  - c. Click the Network Analyst Window button  on the toolbar to open the window
7. On the Network Analyst toolbar, click Network Analyst Dropdown Menu
  - a. Click New Service Area
  - b. The Table of Contents and the Network Analyst window will contain an empty list of Facilities, Barriers, Lines, and Polygons
8. Right-click on Facilities in the Network Analyst window and click Load Locations
  - a. In the Load Locations window
    - i. Click Browse and navigate to the Participant/School Point Feature Layer
    - ii. Choose the Participant ID (Part\_ID) as the Sort field
    - iii. Choose the Participant ID text field (Part\_ID\_T) as the Name field and accept the defaults for the other Location Analysis Properties options

- iv. Use 50 meters for Location Position, Use Geometry
  - v. Click OK
- 9. Right-click on the Service Area in the Table of Contents and select Properties
  - a. In the Analysis Settings tab:
    - i. Choose Length (meters) for Impedance
    - ii. Type the Buffers distance for the Default Breaks
    - iii. Choose Away from Facility for Direction
    - iv. Choose Everywhere for Allow U-Turns
  - b. In the Line Generation tab:
    - i. Click the check-box next to Generate Lines
    - ii. In the Overlap Options section, click the radio-button next to Overlapping
  - c. Click OK to close the Properties dialog box
- 10. On the Network Analyst Toolbar, click the Solve button 
- 11. Right-click on the Lines layer in the Table of Contents and select Data -> Export Data...
  - a. Choose the Output Location and OK to export the lines to a shapefile
- 12. Dissolve the exported shapefile on FacilityID to merge all lines for a participant into one feature
  - a. Click on the ArcToolbox icon to open the ArcToolbox window
  - b. Open the Data Management Toolbox, then open the Generalization toolbox and double-click the Dissolve tool
    - i. For Input Features, select the line shapefile just exported
    - ii. Specify the Output Feature Class
    - iii. Click on the checkbox next to FacilityID in the Dissolve Field(s) box
    - iv. Click OK
- 13. Join the Participant attributes to the dissolved line shapefile
  - a. Right-click on the dissolved line shapefile
  - b. Click Joins and Relates and then Joins...
    - i. Choose Join attributes from a table for the "What do you want to join to this layer?"
    - ii. Choose Facility ID as the Field to base the join on
    - iii. Choose the Participant Layer as the Table to Join to this layer
    - iv. Choose the Participant ID as the field in the table to base the join on
    - v. Click OK to execute the join
- 14. Right click the dissolved line shapefile
- 15. Click on Data and then Export Data
  - a. Choose this layer's source data for the coordinate system
  - b. Specify the output location
  - c. Click OK to export the data
- 16. Buffer the exported shapefile by XX meters to create the sausage buffers
  - a. In ArcToolbox, open the Analysis Toolbox, then open the Proximity toolbox and double-click the Buffer tool
    - i. For Input Features, select the line shapefile with the joined participant attributes
    - ii. Specify the Output Feature Class
    - iii. Set the Linear Units to XX meters
    - iv. Choose Full for the Side Type
    - v. Choose Flat for the End Type
    - vi. Choose None for the Dissolve Type
    - vii. Click OK to execute the buffer

**The part of the protocol for undertaking the density calculation is not included.**

## 2.5 Measurement Geography Type 3: Straight Line or Airline Distance to Nearest Feature: See NEAT GIS Protocol 2.7. (2010 EAT-III & ECHO)

This uses the existing *NEAT GIS Protocol*. Be sure to use the latest version--4.0 or later and preferably 5.0 or later--as these versions correct errors, simplify some steps, or at least indicate where protocols are in need of revision.

## 2.6 Measurement Geography Type 4: Network or Street Distance to Nearest Feature (2010 EAT-III & ECHO)

*Note: this is similar to a protocol in the NEAT GIS Protocols manual but this one is most up to date. Updated in version 2.0.*

### 1. Basic Concept

The airline distance to a feature such as a restaurant may be important, but the street distance may well be closer to people's experiences. The street distance does not always match the distance via pedestrian paths, sidewalks, and short cuts. In the IDEA, EAT-III, and ECHO studies we were not able to do data collection of such paths but used the straight line distance as an approximation. In addition, the new ArcGIS created a new method for calculating such distances.

### 2. Basic Definition

The street distance between a youth's home or school and the feature of interest.

### 3. Detailed Definition

The street distance between a youth's home or school and the feature of interest calculated using the TLG roads layer for the Twin Cities (modified from the census) and ArcGIS 9.3.1 Network Analyst.

### 4. Comments and Explanations

This is done by using the OD Cost Matrix option in Network Analyst Extension of ArcGIS 9.3.1. The OD Cost Matrix calculates the network distance between all origin features (participant's home or school) to all features in the destination layer (feature of interest layer). For each origin-destination pair, the output of the OD Cost Matrix function contains the network distance and the rank of that distance in comparison to all other destinations for that origin. A rank of 1 represents the shortest network distance for a given origin.

### 5. GIS Approach

The approach for this measure is to load a set of origins and destinations, then use the OD Cost Matrix function in Network Analyst to calculate the network distance from each origin to the nearest destination.




### 6. GIS Steps


Requirements for ArcGIS 9.3.1:

1. Road Layer polyline
2. Point Features to calculate the nearest distance from (Participant layer/ school layer).
3. The feature of interest layer (Point features) to calculate the nearest distance to (Restaurants/Gym/Retail food outlet)
4. Network Analyst Extension for ArcGIS 9.3.1

Calculate the Network Distance to Nearest Feature of Interest

- 1. Start ArcMap**

2. On the Main Menu click **Tools** and Click on **Extensions**.
  - a. Check **Network Analyst** Extension.
  - b. Click Close
3. Click the **Add Data** button  on the **Standard Toolbar**
  - a. Navigate to the **Network Dataset** location, created earlier
  - b. Click on the **Network Dataset** and click **Add** to add the Network Dataset to ArcMap.
  - c. Click **Yes** to add all the feature classes that participate in the network to the map.
4. Click the **Add Data** button  on the **Standard Toolbar**
  - a. Navigate to the **Point Layers** to be used for analysis, in this case **Participant location and Feature of Interest Locations**
  - b. Click on the **Point Layers** and click **Add** to add it to ArcMap.
5. In the Table of Contents Right Click the **Point Layer** and click on **Open Attribute Table**
  - a. In the **Attribute Table**
    - i. Click **Options**
    - ii. Click **Add Field**
    - iii. Add the **Feature\_Of\_Interest\_Id)/Participant\_Id** as Text
      - Type **FOI\_Id\_T(Feature of interest)/Part\_Id\_T** in the **Name** field
      - Select **Text (50)** as **Type**
      - Accept default for **Length**
      - Click **OK**
    - iv. Add the **Feature\_Of\_Interest\_Id/Participant\_Id** as **Integer**
      - Type **FOI\_Id/Part\_Id** in the **Name** field
      - Select **Short Integer** as **Type**
      - Accept default (0) for **Precision**
      - Click **OK**
    - v. Enter the assigned Id for the participants and schools
6. On the main menu click **View**
  - a. Click on **Toolbars**
  - b. In the side menu click **Network Analyst** to add the Network Analyst toolbar to ArcMap
7. Click **Network Analysis Toolbar**
  - a. Click **Network Analyst Window** button  to add the Network Analyst Window to the map
8. On the **Network Analyst Toolbar** Click **Network Analyst Dropdown Menu**
  - a. Click **New OD Cost Matrix**
  - b. The Table of contents and the Network Analyst Window contains empty list of **Origins**, **Destinations**, **Barriers** and **Lines** Categories.
9. On the **Network Analyst Window** right-click **Origins** and click **Load Locations**
  - a. In **Load Locations Window**
    - i. Click **Browse** and navigate to the **Participant/School Point feature layer**
    - ii. Click on the **Participant/School layer** and click **Add**
    - iii. Choose the **Participant/School Id** as the **Sort** field
    - iv. Choose the **Participant/School Id Text** as the **Name** field. Accept the **default** for other **Location Analysis Properties**
    - v. Use **50 Meters** for **Location Position**, Use **Geometry** (increase the search tolerance if many locations are unlocated)
    - vi. Click **OK**
10. On the **Network Analyst Window** right Click **Destinations** and Click **Load Locations**
  - a. In **Load Locations Window**

- i. Click **Browse** and navigate to the **Feature of Interest Locations, Point feature layer**
  - ii. Click on the **Feature of Interest Locations layer** and click **Add**
  - iii. Choose the **Feature of Interest Id** as the **Sort** field
  - iv. Choose the **Feature of Interest Id Text** as the **Name** field. Accept the **default** for other **Location Analysis Properties**
  - v. Use 100 Meters for the **Location Position, Use Geometry**
  - vi. Click **OK**
- 11. To set the properties to be used in the Analysis, In the Table of Contents Right-Click the OD Cost Matrix and Click **Properties**
  - a. Click on **Analysis Settings** Tab
    - i. Choose **Length (Meters)** for **Impedance**
    - ii. Choose **None** for **Default Cutoff Values**
    - iii. Choose **<All>** for **Destinations to Find**
    - iv. Choose **Everywhere** for **Allow U-Turns**
    - v. Choose **None** as **Output Shape Type**
    - vi. Check the box to **Ignore Invalid Locations**
  - b. Click **Ok**
- 12. On the **Network Analyst Toolbar**, click **Solve** Button 
- 13. The output of the OD Cost Matrix is stored in the **Lines** layer. Right-click on Lines and choose **Open Attribute Table**.
  - a. Name is the Origin-Destination pair
  - b. OriginID is the Participant/School ID
  - c. DestinationID is the Feature of Interest ID
  - d. DestinationRank is the ranking of the distance for that OriginID
  - e. Total\_Length is the distance, in meters, between the origin and the destination
- 14. Joining the OD Cost Matrix attributes with Origin Point Layer to carry over the data
  - a. Right Click the **Lines Layer**
  - b. Click **Joins and Relates** and then **Join**
    - i. Choose **Origin Id** as the Field to base the join on
    - ii. Choose the **Participant/SchoolLayer** as the Table to Join to this layer
    - iii. Choose the **Participant/School ID** as the field in the table to base the join on
    - iv. Click **Ok**
  - c. Right Click the **Lines Layer**
  - d. Click on **Data** and then **Export Data**
    - i. Choose **this layer's source data** for the coordinate system
    - ii. Specify the Output location
- 15. To select the closest destination for each origin, right-click on the layer from the previous step and choose **Open Attribute Table**
  - a. Click on the **Options** button and select **Select by Attributes...**
  - b. In the Select by Attributes dialog box, form the following query:
    - i. DestinationRank = 1
  - c. Click **Apply** to execute the query
  - d. Click on the **Options** button and select **Export...**
  - e. Set the **Export** dropdown option to **Selected Records**
  - f. Specify the Output location and click **OK** to save data.

In ArcGIS 9.3.1 the name field of routes contains the Incident Id (Participant Id) to Facility ID (Feature of Interest ID). It indicates which Participant is connected to which Feature of Interest via the route.

The length of the nearest distance segment from a participant's location to the nearest feature of interest is stored in the Total Length attribute.

## 2.7 Measurement Geography Type 5: Home to School Route Buffer

*Note: this was updated slightly in Version 1.3 to take account of home-schooled children and change the buffer from 100m to 50 m on either side of the route (though as is discussed in the “GIS Approach” there may be reasons to change it back). It is not being updated in version 2.0 because it is not being used in ECHO or EAT-III.*

### 1. Basic Concept

The idea behind this measure is that the home to school route is important for youth, and the features (businesses, recreation opportunities, densities, etc) along the route may be an important part of the youth's daily environment. Complications occur because youth may take the bus or be driven and they may not take the shortest route. This measurement is exploratory.

### 2. Basic Definition

The shortest network path between home to school and an area 50m on either side of it.

### 3. Detailed Definition

The shortest network path between home to school and an area 50m on either side of it using the TLG street layer from Metro GIS.

### 4. Comments and Explanations

This is fairly easy to do in ArcGIS 9.3.1 compared to ArcGIS 9.1 due to the ability of ArcGIS 9.3.1 to calculate multiple routes. We initially proposed to exclude freeways and other limited access highways which would not be accessible to pedestrians, but because students going to school might well be in cars we decided that this would not be an appropriate exclusion. Also, we removed home-schooled students from the participant dataset before calculating the route. ArcGIS 9.3.1 will not calculate a route if the student's school and home are the same location.

### 5. GIS Approach

The GIS approach for this protocol is a two stage process. First, create the shortest network path between Home to School, and then buffer it for a distance of 50 meters. The route solver with multiple routes in Network Analyst 9.2 creates the route from each participant home location to the respective school. The route created by Network Analyst is then buffered using Buffer Tool in ArcToolbox, the buffer created represents the area of 50 meters around the route (reduced from an initial 100 meters). Round buffer type is used to be able to cover all the area accessible to the participant. Note that Badland et al. (2010) conducted pilot testing of adults and consider 100 meters to be better than 25 meters as an approximation of the environment on the actual route travelled (they did not test 50 meters). However, we did not use this after TREC-IDEA so we have not considered whether it is worth updating for children.




## 6. GIS Steps


Requirements:

1. Roads Layer Network dataset

2. Participant Home Location Point Feature Layer for origin
3. School Location Point Feature Layer for destination
4. Network Analyst Extension for ArcGIS 9.2

#### I. Create Home To School Route

1. Start **ArcMap**
2. On the Main Menu click **Tools** and Click on **Extensions**.
  - a. Check **Network Analyst** Extension.
  - b. Click Close
3. Click the **Add Data** button  on the **Standard Toolbar**
  - a. Navigate to the **Network Dataset** location.
  - b. Click on the **Network Dataset** and click **Add** to add the Network Dataset to ArcMap.
  - c. Click **No** to add all the feature classes, which participate in the network, to the map.
4. Click the **Add Data** button  on the **Standard Toolbar**
  - a. Navigate to the **Point Layers** to be used for analysis, in this case **Participant Home location and School Locations**
  - b. Click on the **Point Layers** and click **Add** to add it to ArcMap.
5. If the **School Id** and **Participant ID's** are already assigned go to next step else, In the Table of Contents Right Click the **Point Layer** and click on **Open Attribute Table**
  - a. In the **Attribute Table**
    - i. Click **Options**
    - ii. Click **Add Field**
    - iii. Add the **School\_Id/Participant\_Id** as Text
      - Type **School\_Id\_T/Participant\_Id\_T** in the **Name** field
      - Select **Text (50)** as **Type**
      - Accept default for **Length**
      - Click **OK**
    - iv. Add the **School\_Id/Participant\_Id** as **Integer**
      - Type **School\_Id/Participant\_Id** in the **Name** field
      - Select **Short Integer** as **Type**
      - Accept default (0) for **Precision**
      - Click **OK**
    - v. Enter the assigned Id for the participants and schools
6. On the main menu click **View**
  - a. Click on **Toolbars**
  - b. In the side menu click **Network Analyst** to add the Network Analyst toolbar to ArcMap
7. Click **Network Analysis Toolbar**
  - a. Click **Network Analyst Window** button  to add the Network Analyst Window to the map
8. In **ArcToolbox** Click on **Network Analyst Tools** and then Click on **Calculate Locations**
  - a. Add the **School Location Point** layer as the **Input Point Layer**
  - b. Add the **Road Network Dataset** as the **Input Analysis network**
  - c. Accept all other **defaults**
  - d. Click **Ok**
9. **Join** the School and Participant layer using School Id,
  - a. In the Table of contents Right Click **Participant Location layer**
  - b. Click **Join and Relates** and then **Join**
    - i. Choose **School Id** as the field to base the join on

- ii. Choose the **School Location layer** as the Table to Join to this layer
  - iii. Choose the **School Id** as the field in the table to base the join on
  - iv. Click **Ok**
- 10. On the **Network Analyst Toolbar** Click **Network Analyst Dropdown Menu**
  - a. Click **New Route**
  - b. The Table of contents and the Network Analyst Window contains empty list of **Stops, Barriers** and **Routes** Categories.
- 11. On the **Network Analyst Window** right click **Stops** and then click **Load Locations**, to add the origin locations
  - a. In **Load Locations Window**
    - i. Choose the **Participant Location layer** for Load from, these points would be the origin stops.
    - ii. Choose **Participant Id** as the **Sort Field**
    - iii. Choose the **Participant Id** as the **Name** and **RouteName**
    - iv. Choose **Search Tolerance** of **100 meters** for location position
    - v. Click **OK**
- 12. Again right click **Stops** and then click **Load Locations**, to add the destination locations
  - a. In **Load Locations Window**
    - i. Choose the **Participant Location layer** for Load from
    - ii. Choose **School.School Id** as the **Sort Field**
    - iii. Choose the **School.School Id** as the **Name**
    - iv. Choose the **Participant.Participant Id** as the **RouteName**
    - v. Choose Use **Network Location Fields**, calculated in Step 8 for location position
      - Choose **PosAlong** from School Point layer attributes for **PosAlong Property**
      - Choose **SideOfEdge** from School Point layer attributes for **SideOfEdge Property**
      - Choose **SourceID** from School Point layer attributes for **SourceID Property**
      - Choose **SourceOID** from School Point layer attributes for **SourceOID Property**
    - vi. Click on **Advance Tab**
      - Check **Snap to Position Along Network**
      - Check **Loading locations using locations fields**
    - vii. Click **OK**
- 13. Click **Solve Button**  to generate the routes
- 14. Join the route layer with Source Point layer to carry over the data
  - a. Right Click the **Routes Layer**
  - b. Click **Joins and Relates** and then **Join**
    - i. Choose **Name** as the Field to base the join on
    - ii. Choose the **Participant Location Layer** as the Table to Join to this layer
    - iii. Choose the **Participant ID Text** as the field in the table to base the join on
    - iv. Click **Ok**
  - e. Right Click the **Routes Layer**
  - f. Click on **Data** and then **Export Data**
    - iii. Choose **this layer's source data** for the coordinate system
    - iv. Specify the **Output location**
- II. Create 100 meters buffer around the route from Home to School
  - 1. Click **Analysis Tools**
  - 2. Click **Proximity**
  - 3. Click **Buffer**
    - a. Add the Route layer created in Step 14 as the **Input Layer**
    - b. Name the **output feature class** appropriately
    - c. Type **50 meters** as the Linear unit for **Distance**
    - d. Choose **Full** as **Side Type**

- e. Choose **Round** as the **End Type**
- f. Choose **None** as **Dissolve Type**
- g. Click **Ok**

You now have the route layer and the area of 50 meters around it.

### 3. RESTAURANTS A.K.A. FOOD SERVICES

*Note: these protocols were developed by Ann Forsyth (definitions and concepts), Nishi Mishra (GIS steps), and Dave Van Riper (GIS steps).*

Typically, in research to date, restaurants have been identified in four ways:

- Some municipalities have very detailed **land use data** allowing identification of restaurants as a group and of different types (Forsyth 2006). Such data are not consistently available across the seven counties of the Twin Cities Metropolitan area.
- Some areas have a consistent **food service licensing** process across the relevant study area meaning similar data are collected and stored. As is explained in chapter 1, this is not the case in the Twin Cities as there is a maze of licensing bodies in that region.
- Many researchers have used lists of **chain restaurant names** to identify major fast food restaurants in either GIS studies or for surveys (e.g. Pereira et al 2005; Block et al 2004). EAT-III and ECHO propose to take this approach to identify specific kinds of restaurants (e.g. fast food). A key issue is that fast food is a broad category including not only the prototypical burger joints but potentially also such limited service chains as Starbucks.
- Other researchers have used **SIC or NAICS codes** to classify types of stores. This was the approach we used in the TREC-IDEA study. EAT-III and ECHO use these codes for larger categories such as restaurants. As was noted in chapter 1, the accuracy of these classifications varies greatly across databases. In TREC-IDEA we used Dun and Bradstreet that seemed, in our initial assessment, to have more accurate and detailed classifications than other available sources. However, on balance for the EAT-III and ECHO studies we proposed that Business Analyst would be most cost effective and for subsets of restaurants we could use names.

There are three sorts of **measures that are included** in these protocols:

- Some measures repeat those **already used in the literature**.
- Other measures try to take advantage of improvements in data or GIS technologies to **develop new measures to more effectively measure food quality**. After all, it is not really important whether someone eats at a fast food restaurant or a restaurant with table service. What is most important is the quality and character of the food that they purchase and eat.
- Others try to measure using GIS what is also being measured via survey or checklist in other parts of the studies. In this way we can analyze **perceived vs. GIS or observed vs. GIS measures**.

A more detailed discussion about the pros and cons of differing approaches to measuring food access is in Forsyth et al. (2010a).

### 3.1 Distance to Nearest Restaurant (2010 EAT-III & ECHO)

*Updated in version 2.0.*

#### *1. Basic Concept*

The idea of this measure is that the street distance or straight line to any away from home restaurant will affect the number of away from home meals. This measure does not distinguish between types of restaurants.

#### *2. Basic Definition*

Distance to nearest restaurant = The shortest (a) network or (b) straight line path between home or school and the nearest restaurant.

#### *3. Detailed Definition*

Distance to nearest restaurant = The shortest network or straight line path between home or school and the nearest restaurant where restaurants are defined as the following NAICS codes:

[722110 Full-Service Restaurants](#)

[722211 Limited-Service Restaurants](#)

[722212 Cafeterias](#)

[722213 Snack and Nonalcoholic Beverage Bars](#) (part)

As these are studies of adolescents, we did not include alcoholic beverage drinking places or dinner theaters. The updated measure uses Business Analyst data that is already geocoded. The TREC-IDEA version used Dun and Bradstreet that had to be geocoded and was checked against phone books and internet databases (Forsyth et al. 2010).

#### *4. Comments and Explanations*

This is done by using the OD Cost Matrix option in Network Analyst Extension of or the Near Tool in ArcGIS 9.3.1. For network distance, a point layer, to which the shortest network distance is to be calculated, is specified as the “destination” layer and the point, from which the distance is to be calculated, serves as the origin.

For points that do not fall on the network, there is a dialog box when using this extension that allows the user to decide how far away from the network to search for points to use in the processing. Points outside that distance will not be used.

#### *5. GIS Approach*

The approach for this measure is to load a set of origins and destinations, then use the OD Cost Matrix solver in Network Analyst to calculate the network distance from each origin to each destination. The OD Cost Matrix solver ranks the network distance from each origin to all destinations with ranking #1 being the shortest distance. The straight-line distance is calculated using the Near Tool in ArcToolbox.


#### **6. GIS Steps**

Requirements:

1. Road Layer polyline
2. Point Features for origin and destinations

### 3. Network Analyst Extension for ArcGIS 9.3.1

Query and extract data for Restaurants according to specified NAICS codes from the Business Analyst InfoUSA data, if the restaurant layer is not already prepared.

1. Start **ArcMap**
2. Click the **Add Data** button  on the **Standard Toolbar**.
  - a. Navigate to the **Business Analyst data**
  - b. Click on the **Business Analyst data** and click **Add** to add the dataset to the Map
3. Right Click the Business Analyst data and click **Open Attribute Table**
  - a. Click on **Options**
  - b. Click **Select by Attributes**
    - i. Select **Create a new selection** as **Method**
    - ii. Click on "NAICS\_EXT" in the Attributes list and click on **Unique values** (since this can take substantial time, instead of this consider typing the codes as mentioned below)
    - iii. Click "=" operator
    - iv. Click or Type '72211001'
    - v. Click "OR" operator
    - vi. Repeat steps ii to v changing the values to '72211002', '72211003', '72211003', '72211004', '72211005', '72211006', '72211007', '72211008', '72211009', '72211010', '72211011', '72211012', '72211013', '72211015', '72211016', '72211020', '72221101', '72221102', '72221103', '72221104', '72221105', '72221201', '72221202', '72221301', '72221302', '72221303', '72221304', '72221305', '72221306', '72221307', '72221309', '72221310', '72221311', '72221313', '72221314', '72221315', '72221316', '72221317', '72221318', '72221319', '72221320'
    - vii. Click **Apply**
  - c. Right Click the **Business Analyst data** and Click **Data** and then **Export data**
    - i. Choose **Selected Features** for **Export**
    - ii. Choose **this layer's source data** for **Use the same coordinate system as:**
    - iii. Navigate to appropriate folder and give the output file an appropriate name for **Output shapefile or feature class**
    - iv. Click **OK**
    - v. Click **Yes** to add the data to current data frame

#### A. Calculate the Network Distance to Nearest Restaurant

1. Use LEAN Protocol 2.6 to determine the network distance to the nearest restaurant. The participant locations are the origins and the restaurant locations are the features of interest

The length of the nearest distance segment from a participant's location to the nearest restaurant is stored in the Total Length attribute.

#### B. Straightline distance

1. Open **ArcToolbox**, then click **Analysis Tools**
2. Click on **Proximity Tools**
3. Click on **Near** tool
  - a. Navigate and Choose **Participant Layer** as the **Input Features**
  - b. Navigate and Choose **Restaurant layer** as **Near Features**
  - c. Click **Ok**

The straightline distance to nearest restaurant is stored in the attribute table under field name Near\_Dist. The Near\_FID field has the FID of the Nearest Restaurant.

## 3.2 Restaurant Density (2010 EAT-III & ECHO)

*Note: The GIS Steps for calculating the network buffer were updated in Version 1.3. Updated in version 2.0.*

### 1. Basic Concept

The idea behind this measure is that the density of away-from-home restaurants within a certain radius or street distance will affect the number of away- from-home meals. This in turn will affect the amount and character of what people eat. This measure does not distinguish between types of restaurants.

### 2. Basic Definition

Restaurant density = Total restaurants per unit land area (excluding water).

### 3. Detailed Definition

Restaurant density = Total restaurants per unit land area (excluding water) where restaurants are defined as the following NAICS codes:

[722110 Full-Service Restaurants](#)

[722211 Limited-Service Restaurants](#)

[722212 Cafeterias](#)

[722213 Snack and Nonalcoholic Beverage Bars](#) (part)

As the focus of all three studies for these protocols (TREC-IDEA, EAT-III, and ECHO) was on adolescents, we did not include alcoholic beverage drinking places or dinner theaters. There is, however, a separate question dealing with alcohol.

### 4. Comments and Explanations

To calculate the density of restaurants, it is necessary to first demarcate the area within which the density will be calculated (e.g. a buffer) and then count the number of restaurants in the area. After the area is demarcated and the number of restaurants is counted, the density is simply calculated by dividing the number of restaurants by the area.

While NAICS codes in Business Analyst are not particularly effective at distinguishing between limited service (fast food) and full service restaurants, as this protocol looks at all restaurants that isn't a problem for this protocol.

### 5. GIS Approach


The GIS approach for calculating the density of restaurants is to count the number of restaurants that fall within the buffers created with Protocols 2.3 and 2.4, with the water area removed using Protocol 2.1. The count is generated using a spatial join. Then, the density is calculated by dividing the number of restaurants by the area of the buffer.

## 6. GIS Steps

Requirements:

1. Restaurant Layer (Point)
  2. Participant Network Buffers with Water Areas removed
  3. Participant Straightline Buffers with Water Areas removed
- II.** Use the steps in LEAN protocol 3.1 to create the Restaurant Point layer from the Business Analyst InfoUSA data if not already created

### III. Load the Participant buffers into ArcMap

- a. Click the **Add Data** button  on the **Standard Toolbar**
- b. Navigate to the location of the Participant buffers
- c. Select the buffers and click Open to add them to the ArcMap document

### IV. Spatially join the restaurants to the Participant buffers

- a. Right-click the Participant buffer layer and select Joins and Relates and then choose Join...
- b. For What do you want to join to this layer?, select “Join data from another layer based on spatial location”
- c. For 1. Choose the layer to join to this layer, or load spatial data from disk, select the Restaurant layer
- d. For 2. You are joining: Points to Polygons, select the radio button next to “Each polygon will be given a summary of the numeric attributes of the points that fall inside it, and a count field showing how many points fall inside it”
- e. For 3. The result of the join will be saved into a new layer, specify the output location and name
- f. Click OK to execute the spatial join

### V. Calculate the density of the restaurants in the buffer

- a. Right-click on the output from the previous step and select Open Attribute Table
- b. Click on the Options button and select Add Field...
  1. For the Name, type RestCXXXX where XXXX is the buffer distance
  2. Set the Type to Integer
  3. Accept the defaults for Scale and Precision
  4. Click OK to add the attribute
- c. Right-click on the RestCXXXX attribute and select Field Calculator...
  1. In the field calculator, construct the following query: [Count\_]
  2. Click OK to execute the query
- d. Click on the Options button and select Add Field...
  1. For the Name, type RestDXXXX where XXXX is the buffer distance
  2. Set the Type to Double
  3. Accept the defaults for Scale and Precision
  4. Click OK to add the attribute
- e. Right-click on the RestDXXXX attribute and select Field Calculator...
  1. In the field calculator, construct the following query: [RestCXXXX] / [Hectares]
  2. Click OK to execute the query

The RestDXXXX field contains the density of restaurants per hectare in the buffer around the participant location. Repeat these steps for all other network and straightline participant buffers.

## 3.3: Distance to Fast Food Restaurants (2010 EAT-III & ECHO)

*Note: this was significantly updated in Version 1.3 changing the method for selecting fast food restaurants from chain names to NAICS codes; it was changed back to restaurant names in version 2.0.*

### 1. Basic Concept

While fast food is a commonly understood term, it is actually quite difficult to define it in a meaningful way. It is also not particularly clear that fast food per se is less healthy than slower food as there are choices in both types. However, more research is needed in this area and definitional clarity will help such research.

The TREC-IDEA study used two types of questions about this restaurant type:, one asking a global question about fast food in general and the other breaking the restaurants into subcategories.

- PS63 In the past month, how many times did you buy food at a restaurant where food is ordered at a counter or at a drive-through window (there is no waiter/waitress)? (Based on Project EAST (10)) Fast Food
- SS163 During a normal school week, how many days per week do you get lunch off campus at a fast food restaurant? ( TACOS Student Survey (11))
- SS 173 About how long would it take to get from your home to the nearest fast food restaurant if you walked? (Adapted from NEWS B12 (14))
- PS 70 During the past 7 days, how many times was a family evening meal purchased from a fast food restaurant and eaten either at the fast food restaurant or at home? (Part 1, #4 Jayne's Family Meal Packet)

In the TREC-IDEA study we used NAICS codes and Dun and Bradstreet data to locate fast food restaurants, specifically:

[722211 Limited-Service Restaurants](#)

[722213 Snack and Nonalcoholic Beverage Bars](#)

Dun and Bradstreet classified 48% in this category and a visual review of the data indicated that the classifications seemed largely appropriate (see Appendix 1E). However, as Dun and Bradstreet data was not geocoded and thus expensive both to buy and process for analysis, we decided to shift to Business Analyst in ECHO and EAT-III (Forsyth et al. 2010).

That meant we had to move to the alternative of using chain names to classify fast food (e.g. Pereira et al 2005; Block et al. 2004; Bourdette and Whitacker 2003, 59).

We developed a logical process as follows:

1. Start with a list of all restaurants (from the previous protocol, and using NAICS codes)
2. Search for two kinds of restaurants:
  - a. Ones with key words indicating fast food e.g. “pizza”, “taco”, “burger”, “fried”, “ice cream,” “gelato,” “donut,” “burrito”, “coffee”, “sub”, “sandwich”, “espresso”, “custard”, “bagel”, “cookie”, “to go”, “take out”, “carry out”.
  - b. Ones from important chains e.g. “Wendy’s” from the list of chains in Appendix 3A updated with some local chains.

## 2. Basic Definition

Distance to Fast Food Restaurants = The shortest network or straight line distance between home or school and the nearest fast food restaurant.

## 3. Detailed Definition

Distance to Fast Food Restaurants = The shortest network or straight line distance between home or school and the nearest fast food restaurant defined in the following way and using Business Analyst:

1. Start with a list of all restaurants (from the previous protocol, and using NAICS codes)
  2. Search for two kinds of restaurants: (a) ones with key words and (b) ones from a list of chains. The two studies had different emphases.
    - The ECHO study (following on the IDEA approach) emphasized a comprehensive list of restaurants.
    - The EAT-III study wanted to match particular types of restaurants.
- ECHO list

- a. Key words e.g. “pizza”, “taco”, “burger”, “fried”, “ice cream,” “gelato,” “donut”, “burrito”, “coffee”, “sub”, “sandwich”, “espresso”, “custard”, “bagel”, “cookie”, “to go”, “take out”, “carry out.” .
- b. Chains: **the following list with alternative spellings added** “A & W All-American Food”, “Arby’s”, “Au Bon Pain”, “Baja Fresh Mexican Grill”, “Baja Sol Tortilla Grill”, “Baskin-Robbins”, “Ben & Jerry’s”, “Blimpie Subs & Salads”, “Bojangles”, “Boston Market”, “Bruegger’s Bagel Bakery”, “Buffalo Wild Wings”, “Burger King”, “Captain D’s”, “Carl’s Jr.”, “Checkers/Rally’s”, “Chick-fil-A”, “Chipotle Mexican Grill”, “Chuck E. Cheese’s”, “Church’s Chicken”, “CiCi’s Pizza”, “Cold Stone Creamery”, “Cosi”, “Cousins Subs”, “Culver’s”, “Dairy Queen”, “Del Taco”, “Domino’s Pizza”, “Drive-In/Rally’s”, “Dunkin’ Donuts”, “Dunn Bros Coffee”, “Einstein Bros Bagels”, “El Pollo Loco”, “Fazoli’s”, “Five Guys Burgers & Fries”, “Fuddruckers”, “Godfather’s Pizza”, “Great Steak and Potato Co”, “Hardee’s”, “Hot Stuff Pizza”, “In-N-Out Burger”, “Jack in the Box”, “Jamba Juice”, “Jason’s Deli”, “Jimmy John’s Gourmet Sandwich”, “KFC”, “Krispy Kreme Doughnuts”, “Krystal”, “Leann Chin Chinese Cuisine”, “Little Caesars Pizza”, “Long John Silver’s”, “McDonald’s”, “Milio’s Sandwiches”, “Noodles & Co”, “Orange Julius”, “Panda Express”, “Panera Bread”, “Papa John’s Pizza”, “Papa Murphy’s Take ‘N’ Bake”, “Pizza Hut”, “Pizza Ranch”, “Popeyes”, “Potbelly Sandwich Works”, “Qdoba Mexican Grill”, “Quiznos”, “Raising Cane’s Chicken Fingers”, “Sbarro”, “Schlotzsky’s Deli”, “Sonic Drive-In”, “Starbucks”, “Steak ‘n Shake”, “Subway”, “Taco Bell”, “Taco John’s”, “TCBY”, “Tim Hortons”, “Wendy’s”, “Whataburger”, “White Castle”, “Zaxby’s”.

#### EAT-III List

- A. Key words: e.g. “pizza”, “taco”, “burger”, “fried”, “burrito”, “sub”, “sandwich”, “cookie”, “to go”, “take out”, “carry out.” .
- b. Chains: **the following list with alternative spellings added:** “A & W All-American Food”, “Arby’s”, “Au Bon Pain”, “Baja Fresh Mexican Grill”, “Baja Sol Tortilla Grill”, “Blimpie Subs & Salads”, “Bojangles”, “Boston Market”, “Buffalo Wild Wings”, “Burger King”, “Captain D’s”, “Carl’s Jr.\*”, “Checkers/Rally’s”, “Chick-fil-A\*”, “Chipotle Mexican Grill”, “Chuck E. Cheese’s”, “Church’s Chicken\*”, “CiCi’s Pizza”, “Cosi”, “Cousins Subs”, “Culver’s”, “Dairy Queen”, “Del Taco”, “Domino’s Pizza”, “Drive-In/Rally’s”, “El Pollo Loco”, “Fazoli’s”, “Five Guys Burgers & Fries”, “Fuddruckers”, “Godfather’s Pizza”, “Great Steak and Potato Co”, “Hardee’s”, “Hot Stuff Pizza”, “In-N-Out Burger\*”, “Jack in the Box”, “Jason’s Deli”, “Jimmy John’s Gourmet Sandwich”, “KFC”, “Krystal”, “Little Caesars Pizza”, “Long John Silver’s”, “McDonald’s”, “Milio’s Sandwiches”, “Panera Bread”, “Papa John’s Pizza”, “Papa Murphy’s Take ‘N’ Bake”, “Pizza Hut”, “Pizza Ranch”, “Popeyes\*”, “Potbelly Sandwich Works”, “Qdoba Mexican Grill”, “Quiznos”, “Raising Cane’s Chicken Fingers”, “Sbarro”, “Schlotzsky’s Deli”, “Sonic Drive-In”, “Steak ‘n Shake\*”, “Subway”, “Taco Bell”, “Taco John’s”, “Wendy’s”, “Whataburger”, “White Castle”, “Zaxby’s”,

#### 4. Comments and Explanations

This is similar to the protocol 3.1, distance to nearest restaurant, and calculates the distance to nearest fast food restaurant by using the OD Cost Matrix option in Network Analyst Extension of ArcGIS 9.3.1. For detailed explanation see Protocol 3.1

#### 5. GIS Approach

First the Fast Food Restaurants are extracted from the master data and then the nearest distance to these locations is calculated. The basic idea is similar to the protocol 3.1, distance to nearest restaurant. Nearest network distance between a set of origin locations and destination locations is calculated using Network Analyst and straight line distance is calculated using the Near tool in ArcToolbox.


For detailed explanation see Protocol 3.1.

#### 6. GIS Steps

Requirements:

1. **Road Network** feature dataset
2. **Point Features (Fast Food Restaurants layer)** for finding the nearest distance to
3. **Point Features (Participants layer)** for finding the nearest distance from
4. **Network Analyst Extension** for ArcGIS 9.3.1

I. Query and extract data for Fast Food Restaurants from the Business Analyst InfoUSA data, according to names specified in the master list, if the restaurant layer is not already prepared

1. Start **ArcMap**
2. Click the **Add Data** button  on the **Standard Toolbar**.
  - a. Navigate to the **Business Analyst InfoUSA data**
  - b. Click on the **Business Analyst InfoUSA dataset** and click **Add** to add the dataset to the Map
3. Right Click the **Business Analyst InfoUSA data** and Click **Open Attribute Table**
  - a. Click on **Options**
  - b. Click on **Add Field...**
    - i. Type “FastFood” in the **Name** box
    - ii. Click OK to add the field to the table
  - c. Click on **Options** and then click **Select by Attributes**
    - i. Select **Create a new selection** as **Method**
    - ii. Click **CONAME** in the attributes list.
    - iii. Click the **“LIKE”** button
    - iv. Type in ‘%PIZZA%’
    - v. Click **“OR”** operator
    - vi. Click on **“CONAME”** again.
    - vii. Click the **“LIKE”** button
    - viii. Type in ‘%TACO%’
    - ix. Repeat these steps for each of the following terms: [SEE LISTS ABOVE]
    - x. Click **Apply** to execute the query. This query will select all companies with the terms in their names.
    - xi. Right-click on the FastFood attribute in the table and select **Field Calculator...**
    - xii. Type 1 into the box and click OK to set the selected records equal to 1
    - xiii.
  - d. Click on **Options** again and then click **Select by Attributes**
    - i. Select **Create a new selection** as **Method**

- ii. Click **CONAME** in the attributes list and then click on **Unique values**
- iii. Click the “=” operator
- iv. Click on one of the fast food chain names in the Unique Values
- v. Click “**OR**” operator
- vi. Repeat steps ii-iv for all other fast food chain names [above]
- vii. Click **Apply** to execute the query. This query will select all records with the specified names.
- viii. Right-click on the Fast Food attribute in the table and select Field Calculator...
- ix. Type 1 into the box and click OK to set the selected records equal to 1
- e. Right Click the **Business Analyst InfoUSA data** and Click **Data** and then **Export data**
  - i. Choose **Selected Features** for **Export**
  - ii. Choose **this layer’s source data** for **Use the same coordinate system as:**
  - iii. Navigate to appropriate folder and give the output file an appropriate name for **Output shapefile or feature class**
  - iv. Click **OK**
  - v. Click **Yes** to add the data to current data frame

## II. Calculate the Network to the Nearest Fast Food Restaurant

A. Use LEAN Protocol 2.6 to determine the network distance to the nearest restaurant. The participant locations are the origins and the fast food restaurants are the features of interest

### B. Straight line distance

- 1. Open **ArcToolbox**, then click **Analysis Tools**
- 2. Click on **Proximity Tools**
- 3. Click on **Near tool**
  - a. Navigate and Choose **Participant Layer** as the **Input Features**
  - b. Navigate and Choose **Fast Food Restaurants layer** as **Near Features**
  - c. Click **OK**

The straightline distance to nearest fast food restaurant is stored in the attribute table under field name Near\_Dist. The Near\_FID field has the FID of the Nearest Fast-Food Restaurant.

## 3.4 Fast Food Restaurant Density (2010 EAT-III & ECHO)

*Note: This protocol was updated in Version 1.3 to use NAICS codes to identify fast food restaurants. It was, however, changed in version 2.0 to use chain names.*

### 1. Basic Concept

The number of restaurants close to where someone lives or goes to school may be more important than the nearest one. After all in food, choices are often important. This measures the density of the comprehensive list of fast food restaurants in Protocol 3.3.

### 2. Basic Definition

Fast Food Restaurant Density = Total fast food restaurants per unit land area (excluding water).

### 3. Detailed Definition

Fast Food Restaurant Density = Total fast food restaurants per unit land area (excluding water) where fast food restaurants are defined in the following way and using Business Analyst:

- 1. Start with a list of all restaurants (from the previous protocol, and using NAICS codes)

3. Search for two kinds of restaurants: (a) ones with key words and (b) ones from a list of chains. The two studies had different emphases.
  - The ECHO study (following on the IDEA approach) emphasized a comprehensive list of restaurants.
  - The EAT-III study wanted to match particular types of restaurants.

**See protocol 3.3. for the exact lists.**

#### 4. Comments and Explanations

The protocol is similar to the Protocol 3.2, Density of Restaurants. However, only the fast food restaurants are used in this case. The area within which the density has to be calculated is demarcated, the number of fast food outlets in the area is counted and the number is divided by the area to get the density.

#### 5. GIS Approach

First, the fast food restaurants are extracted from the master data and then a buffer area is created using Network Analyst. Then, the water features are erased from the buffers using Erase tool, and then the area of the buffer layer with erased water features is calculated. The number of retail food outlets is counted with a spatial join between the buffer layer and the retail food outlet location layer. The number of retail food outlet locations is then divided by the area in hectares to get the density.

For a detailed explanation refer to GIS Approach in Protocol 3.2

#### 6. GIS Steps

Requirements:

1. Fast Food Restaurant Layer (Point)
2. Participant Network Buffers with Water Areas removed
3. Participant Straightline Buffers with Water Areas removed
- 4.

**I.** Use the Fast Food restaurant layer created for Protocol 3.3, or follow the GIS steps in Protocol 3.3 to create the Fast Food restaurant layer.

**II.** Load the Participant Buffers into ArcMap

- a. Click the Add Data button on the Standard Toolbar
- b. Navigate to the location of the Participant buffers
- c. Select the buffers and click Open to add them to the ArcMap document

**III.** Spatially join the fast food restaurants to the Participant buffers

- a. Right-click the Participant buffer layer and select Joins and Relates and then choose Join...
- b. For What do you want to join to this layer?, select "Join data from another layer based on spatial location"
- c. For 1. Choose the layer to join to this layer, or load spatial data from disk, select the Fast Food Restaurant layer
- d. For 2. You are joining: Points to Polygons, select the radio button next to "Each polygon will be given a summary of the numeric attributes of the points that fall inside it, and a count field showing how many points fall inside it"
- e. For 3. The result of the join will be saved into a new layer, specify the output location and name
- f. Click OK to execute the spatial join

**IV.** Calculate the density of the fast food restaurants in the buffer

- a. Right-click on the output from the previous step and select Open Attribute Table

- b. Click the Options button and select Add Field...
  - i. For the Name, type FFCXXXX where XXXX is the buffer distance
  - ii. Set the Type to Integer
  - iii. Accept the defaults for Scale and Precision
  - iv. Click OK to add the attribute
- c. Right-click on the FFCXXXX attribute and select Field Calculator...
  - i. In the field calculator, construct the following query: [Count\_]
  - ii. Click OK to execute the query
- d. Click on the Options button and select Add Field...
  - i. For the Name, type FFDXXXX where XXXX is the buffer distance
  - ii. Set the Type to Double
  - iii. Accept the defaults for Scale and Precision
  - iv. Click OK to add the attribute
- e. Right-click on the FFDXXXX attribute and select Field Calculator...
  - i. In the field calculator, construct the following query: [FFCXXXX] / [Hectares]
  - ii. Click OK to execute the query

The FFDXXXX field contains the density of fast food restaurants per hectare in the buffer around the participant location. Repeat these steps for all other network and straightline participants buffers.

### 3.5 Distance to Fast Food Restaurant Subtypes (EAT-III)

This is a variation on the fast food restaurant protocol (3.3). It uses the same steps but looks at four specific subtypes of fast food restaurant chosen because they were easiest to reliably identify: traditional burger and fries; pizza; subs and sandwiches; and all others.

### 3.6 Density Fast Food Restaurant Subtypes (EAT-III)

This is a variation on the fast food restaurant protocol (3.4). It uses the same steps but looks at four specific subtypes of fast food restaurant chosen because they were easiest to reliably identify: traditional burger and fries; pizza; subs and sandwiches; and all others.

### 3.7 Distance to Non Fast Food Restaurants.

*Note: This protocol was updated in Version 1.3 to reflect the use of NAICS codes. It was updated in version 2 for the New ArcGIS but is not being use in any study.*

#### 1. Concept

The TREC-IDEA survey asked students about their perceived distance to non fast food restaurants:

- SS 175 About how long would it take to get from your home to the nearest non-fast food restaurant if you walked? (Adapted from NEWS B15 (14))
- PS 71 During the past 7 days, how many times was a family meal purchased and eaten in other types of restaurants (i.e., full-service, sit down type)? (Part 1, #5 Jayne's Family Meal Packet).

To do this we will subtract the fast food restaurants identified in protocols 3.3 and 3.4, from the total restaurants identified in protocols 3.1 and 3.2. This is a really rough measure but is the best approximation we could make given available data.

## *2. Basic Definition*

Distance to Non Fast Food Restaurants = The shortest network or straight line distance between home or school and the nearest non-fast food restaurant.

## *3. Detailed Definition*

Distance to Non Fast Food Restaurants = The shortest network or straight line distance between home or school and the nearest non-fast food restaurant where this is defined as the universe of all restaurants using the following NAICS codes:

[722110 Full-Service Restaurants](#)

[722212 Cafeterias](#)

## *4. Comments and Explanations*

This is similar to the protocol 3.1, distance to nearest restaurant, however this protocol calculates the distance to nearest non-fast food restaurant by using the OD Cost Matrix option in Network Analyst Extension of ArcGIS 9.3.1.

For detailed explanation see Protocol 3.1.

## *5. GIS Approach*

First the Fast Food Restaurants are identified in the master restaurant list created in Protocols 3.1 and 3.2. All remaining restaurants in the master list are considered Non-Fast Food Restaurants. Then the nearest distance to these locations is calculated. The basic idea is similar to the protocol 3.1, distance to nearest restaurant. Nearest network distance between a set of origin locations and destination locations is calculated using Network Analyst and straight line distance is calculated using Near tool in ArcToolbox.


For detailed explanation see Protocol 3.1

## 6. GIS Steps

### Requirements:

1. Road Layer polyline
2. Point Features (Non-Fast Food Restaurants layer) for finding the nearest distance to
3. Point Features (Participants layer) for finding the nearest distance from
4. Network Analyst Extension for ArcGIS 9.1 or ArcGIS 9.2

### **I. Extract the Non-Fast Food Restaurants from the master restaurant dataset created in Protocols 3.1/3.2**

- 1. Start ArcMap**
- 2. Click the Add Data button  on the Standard Toolbar.**
  - a. Navigate to the Master Restaurant dataset
  - b. Click on the Master Restaurant dataset and click **Add** to add the dataset to the Map
- 3. Right Click the Master Restaurant dataset and Click Open Attribute Table**
  - a. Click on **Options**
  - b. Click **Select by Attributes**

- i. Select **Create a new selection** as **Method**
  - ii. Click on "**FastFood**" in the Attributes list
  - iii. Click "=" operator
  - iv. Click or Type 0
  - v. Click **Apply**
- c. **Right Click** the Master Restaurant dataset and Click **Data** and then **Export data**
  - i. Choose **Selected Features** for **Export**
  - ii. Choose **this layer's source data** for **Use the same coordinate system as:**
  - iii. Navigate to appropriate folder and give the output file an appropriate name for **Output shapefile or feature class**
  - iv. Click **OK**
  - v. Click **Yes** to add the data to current data frame

## II. Calculate the Network Distance to the Nearest Non-Fast Food Restaurant

A. Use LEAN Protocol 2.6 to determine the network distance to the nearest non-fast food restaurant. The participant locations are the origins and the non-fast food restaurant locations are the features of interest

### B. Straight line distance

- 1. Open **ArcToolbox**, then click **Analysis Tool**
- 2. Then click **Proximity Tools**
- 3. Click on **Near tool**
  - a. Navigate and Choose **Participant Layer** as the **Input Features**
  - b. Navigate and Choose **Non-Fast Food Restaurants layer** as **Near Features**
  - c. Click **OK**

The straight line distance to nearest non fast food restaurant is stored in the attribute table of Participant layer under field name Near\_Dist. The Near\_FID field has the FID of the Nearest Non-Fast Food Restaurant.

## 3.8 Density of Non Fast Food Restaurants

*Note: This protocol was updated in Version 1.3 to reflect the use of NAICS codes. It was updated in version 2 for the New ArcGIS but is not being use in any study.*

### 1. Basic Concept

This density measure is the companion to protocol 3.7.

### 2. Basic Definition

Density of Non Fast Food Restaurants = Total non fast food restaurants per unit land area (excluding water).

### 3. Detailed Definition

Density of Non Fast Food Restaurants = Total non fast food restaurants per unit land area (excluding water) where non fast food restaurants are defined as the universe of all restaurants using the following NAICS codes:

[722110 Full-Service Restaurants](#)

[722212 Cafeterias](#)

### 4. Comments and Explanations

The protocol is similar to the Protocol 3.2, Density of Restaurants, However only the non-fast food restaurants are used in this case. The area within which the density has to be calculated is

demarcated, the number of retail food outlets in the area is counted and the number is divided by the area to get the density.

For a detailed explanation refer to Protocol 3.2.

### 5. GIS Approach

First the Fast Food Restaurants are identified in the master restaurant list created in Protocols 3.1 and 3.2. All remaining restaurants in the master list are considered Non-Fast Food Restaurants. Then, the number of retail food outlets is counted with a spatial join between the buffer layer and the retail food outlet location layer. The number of retail food outlet locations is then divided by the area in hectares to get the density.


For a detailed explanation refer to GIS Approach in Protocol 3.2.

### 6. GIS Steps

#### Requirements:

1. **Road Network** feature dataset
2. **Point Features (Non-Fast Food Restaurants layer)** for finding the nearest distance to
3. **Point Features (Participants layer)** for finding the nearest distance from
4. **Network Analyst Extension** ArcGIS 9.2

#### I. Extract the Non-Fast Food Restaurants from the master restaurant dataset created in Protocols 3.1/3.2

1. Start **ArcMap**
2. Click the **Add Data** button  on the **Standard Toolbar**.
  - a. Navigate to the Master Restaurant dataset
  - b. Click on the Master Restaurant dataset and click **Add** to add the dataset to the Map
3. Right Click the Master Restaurant data and Click **Open Attribute Table**
  - a. Click on **Options**
  - b. Click **Select by Attributes**
    - i. Select **Create a new selection** as **Method**
    - ii. Click on "**FastFood**" in the Attributes list and click on **Unique values** (since this can take substantial time, instead of this consider typing the codes as mentioned below)
    - iii. Click "**=**" operator
    - iv. Click or Type 1
    - v. Click **Apply**
  - c. Right Click the **Dun & Bradstreet data** and Click **Data** and then **Export data**
    - i. Choose **Selected Features** for **Export**
    - ii. Choose **this layer's source data** for **Use the same coordinate system as:**
    - iii. Navigate to appropriate folder and give the output file an appropriate name for **Output shapefile or feature class**
    - iv. Click **OK**
    - v. Click **Yes** to add the data to current data frame

#### II. Load the Participant buffers into ArcMap

- a. Click the Add Data button on the Standard Toolbar
- b. Navigate to the location of the Participant buffers
- c. Select the buffer and click Open to add them to the ArcMap document

#### III. Spatially join the restaurants to the Participant buffers

- a. Right-click the Participant buffer layer and select Joins and Relates and then choose Join...
- b. For What do you want to join to this layer?, select "Join data from another layer based on spatial location"

- c. For 1. Choose the layer to join to this layer, or load spatial data from disk, select the Non-Fast Food Restaurants layer
- d. For 2. You are joining: Points to Polygons, select the radio button next to “Each polygon will be given a summary of the numeric attributes of the points that fall inside it, and a count field showing how many points fall inside it
- e. For 3. The result of the join will be saved into a new layer, specify the output location and name
- f. Click OK to execute the spatial join

**IV. Calculate the density of the non-fast food restaurants in the buffer**

- a. Right-click on the output from the previous step and select Open Attribute Table
- b. Click on the Options button and select Add Field...
  - i. For the Name, type NFFCXXXX where XXXX is the buffer distance
  - ii. Set the Type to Integer
  - iii. Accept the defaults for Scale and Precision
  - iv. Click OK to add the attribute
- c. Right-click on the NFFCXXXX attribute and select Field Calculator...
  - i. In the field calculator, construct the following query: [Count\_]
  - ii. Click OK to execute the query
- d. Click on the Options button and select Add Field...
  - i. For the Name, type NFFDXXXX where XXXX is the buffer distance
  - ii. Set the Type to Double
  - iii. Accept the defaults for Scale and Precision
  - iv. Click OK to add the attribute
- e. Right-click on the NFFDXXXX attribute and select Field Calculator...
  - i. In the field calculator, construct the following query: [NFFCXXXX] / [Hectares]
  - ii. Click OK to execute the query

The NFFCXXXX field contains the density of non-fast food restaurants per hectare in the buffer around the participant location. Repeat these steps for all other network and straightline participant buffers.

### 3.9 Restaurant Density Adjusted for Chain Duplicates (EAT-III)

*This is new in version 2.0.*

#### 1. Basic Concept

This is a companion to protocol 3.4. The number of restaurants close to where someone lives or goes to school may be more important than the nearest one. After all in food, choices are often important. This measures the density of the comprehensive list of fast food restaurants in Protocol 3.3 adjusted for duplicates, that is where there are two or more restaurants of the same chain within the same buffer, only one is counted.

#### 2. Basic Definition

Fast Food Restaurant Density = Total fast food restaurants per unit land area (excluding water) adjusted for chain duplicates.

#### 3. Detailed Definition

Fast Food Restaurant Density = Total fast food restaurants per unit land area (excluding water) where fast food restaurants are defined in the following way and using Business Analyst:

- 2. Start with a list of all restaurants (from the previous protocol, and using NAICS codes)
- 4. Search for two kinds of restaurants: (a) ones with key words and (b) ones from a list of chains. The two studies had different emphases.

- The ECHO study (following on the IDEA approach) emphasized a comprehensive list of restaurants.
- The EAT-III study wanted to match particular types of restaurants.

**See protocol 3.3. for the exact lists.**

Where there are two or more examples of the same chain, only one is counted.

#### *4. Comments and Explanations*

None.

#### *5. GIS Approach*

The protocol is similar to the Protocol 3.2, Density of Restaurants. However, only the fast food restaurants are used in this case and, in addition, only one example of each chain is counted. The area within which the density has to be calculated is demarcated, the number of fast food outlets in the area is counted and the number is divided by the area to get the density.

#### *6. GIS Steps*

Not provided.

## 4. FOOD STORES

*Note: these protocols were developed by Ann Forsyth (definitions and concepts) and Nishi Mishra and David Van Riper (GIS steps).*

Food stores come in many sizes and shapes. Typically larger stores have more variety and are more likely to contain fresh fruits and vegetables, although there are of course exceptions to this rule.

The studies that these protocols support asked specifically about several kinds of stores selling food including Supermarkets, convenience stores, gas stations, and hardware stores (selling drinks). They also ask about farm stands and farmers markets that are seasonal and difficult to capture in databases.

These measures include:

- All food stores--from pharmacies to gas stations
- All grocery stores, only omitting convenience stores
- Large supermarkets and super centers
- Convenience stores and gas stations

### 4.1 Distance to any Retail Food Outlet--All Stores Selling Food (not restaurants)

*Note: Version 1.3 added an additional NAICS code. This was updated for version 2.0 but is not being used in EAT-III or ECHO.*

#### 1. Basic Concept

The idea of this measure is to estimate how close participants are to food stores of any type, including those in other businesses such as gas stations. This measure will look at the distance to the nearest food store using the old SIC code 54—all food stores with the following sub-types.

1987SIC	1987 SIC Description	2002 NAICS	2002 NAICS US Description
54	<a href="#">Food stores</a>		
541	<a href="#">Grocery stores</a>		
5411	<a href="#">Grocery Stores</a>		
	Except convenience stores, freezer plans, and grocery stores with substantial general merchandise	<a href="#">445110</a>	<a href="#">Supermarkets and Other Grocery (except Convenience) Stores</a> (part)
	Convenience stores without gas	<a href="#">445120</a>	<a href="#">Convenience Stores</a>
	Convenience store with gas	<a href="#">447110</a>	<a href="#">Gasoline Stations with Convenience Stores</a> (part)
	Grocery stores and supermarkets selling substantial amounts of nonfood items	<a href="#">452910</a>	<a href="#">Warehouse Clubs and Supercenters</a> (part)
	Frozen food and freezer plan providers	<a href="#">454390</a>	<a href="#">Other Direct Selling Establishments</a> (part)
542	<a href="#">Meat and fish (seafood) markets, including freezer provisioners</a>		

5421	<a href="#">Meat and Fish (Seafood) Markets, Including Freezer Provisioners</a>			
	Meat except freezer provisioners		<a href="#">445210</a>	<a href="#">Meat Markets</a> (part)
	Seafood		<a href="#">445220</a>	<a href="#">Fish and Seafood Markets</a> (part)
	Freezer provisioners		<a href="#">454390</a>	<a href="#">Other Direct Selling Establishments</a> (part)
543	<a href="#">Fruit and vegetable markets</a>			
5431	<a href="#">Fruit and Vegetable Markets</a>			
	Except temporary fruit and vegetable stands		<a href="#">445230</a>	<a href="#">Fruit and Vegetable Markets</a> (part)
	Temporary fruit and vegetable stands		<a href="#">454390</a>	<a href="#">Other Direct Selling Establishments</a> (part)
544	<a href="#">Candy, nut, and confectionery stores</a>			
5441	<a href="#">Candy, Nut, and Confectionery Stores</a>			
	Chocolate candy stores, preparing on premises		<a href="#">311330</a>	<a href="#">Confectionery Manufacturing from Purchased Chocolate</a> (part)
	Nonchocolate candy stores, preparing on premises		<a href="#">311340</a>	<a href="#">Nonchocolate Confectionery Manufacturing</a> (part)
	Except stores preparing candy on premises		<a href="#">445292</a>	<a href="#">Confectionery and Nut Stores</a> (part)
545	<a href="#">Dairy products stores</a>			
5451	<a href="#">Dairy Products Stores</a>		<a href="#">445299</a>	<a href="#">All Other Specialty Food Stores</a> (part)
546	<a href="#">Retail bakeries</a>			
5461	<a href="#">Retail Bakeries</a>			
	Bread, cake and related products baked and sold on premise		<a href="#">311811</a>	<a href="#">Retail Bakeries</a>
	Selling only		<a href="#">445291</a>	<a href="#">Baked Goods Stores</a>
	Snacks		<a href="#">722213</a>	<a href="#">Snack and Nonalcoholic Beverage Bars</a> (part)
549	<a href="#">Miscellaneous food stores</a>			
5499	<a href="#">Miscellaneous Food Stores</a>			
	Poultry and poultry products		<a href="#">445210</a>	<a href="#">Meat Markets</a> (part)
	Except food supplement stores and poultry stores		<a href="#">445299</a>	<a href="#">All Other Specialty Food Stores</a> (part)
	Food supplements		<a href="#">446191</a>	<a href="#">Food (Health) Supplement Stores</a> (part)

Source: <http://www.census.gov/epcd/naics02/SICN02G.HTM#S54>

In addition we will use codes where appropriate including:

45291 [Warehouse Clubs and Supercenters](#)

45211 [Department Stores](#) (including discount and not),

44719 Other Gas Stations

And other food stores such as pharmacies etc. where they involve chains selling food. This is a very broad definition.

## 2. Basic Definition

Distance to any Retail Food Outlet (not restaurants) = The shortest network or straight line distance between home or school and the nearest retail food outlet.

### 3. Detailed Definition

Distance to any Retail Food Outlet (not restaurants) = The shortest network or straight line distance between home or school and the nearest retail food outlet defined with SIC/NAICS codes and using Dun and Bradstreet data

### 4. Comments and Explanations

This is similar to the protocol 3.1, distance to nearest restaurant, and is done by using the OD Cost Matrix option in Network Analyst Extension of ArcGIS 9.3.1. Though in this case, the nearest distance is calculated only for the Retail Food outlets and not restaurants.

See Protocol 3.1 for more explanation.

### 5. GIS Approach

First the Retail Food Outlets are extracted from the master data and then the nearest distance to these locations are calculated. The basic idea is similar to the protocol 3.1, distance to nearest restaurant. Nearest network distance between a set of origin locations and destination locations is calculated using Network Analyst and straight line distance is calculated using Near tool in ArcToolbox.


See Protocol 3.1 for more explanation.

## 6. GIS Steps

### Requirements:

1. Road Layer polyline
2. Point Features (Restaurant layer) for finding the nearest distance
3. Point Features (School or Participant layer) to find the distance from
4. Network Analyst Extension for ArcGIS 9.3.1

### I. Query and extract data for Retail Food Outlet according to specified NAICS codes from the Business Analyst InfoUSA data, if the restaurant layer is not already prepared

1. Start **ArcMap**
2. Click the **Add Data** button  on the **Standard Toolbar**.
  - a. Navigate to the **Business Analyst InfoUSA data**
  - b. Click on the **Business Analyst InfoUSA dataset** and click **Add** to add the dataset to the Map
3. Right Click the **Business Analyst InfoUSA data** and Click **Open Attribute Table**
  - a. Click on **Options**
  - b. Click **Select by Attributes**
    - i. Select **Create a new selection as Method**
    - ii. Click on **"PrimaryNai"** in the Attributes list and click on **Unique values** (since this can take substantial time, instead of this consider typing the codes as mentioned below)
    - iii. Click **"="** operator
    - iv. Click or Type **445110**
    - v. Click **"OR"** operator
    - vi. Repeat steps ii to v adding the values to **445120, 447110, 452910, 454390, 445210, 445220, 445390, 445230, 454390, 311330, 311340, 445292, 445299, 311811, 445291, 722213, 445210, 445299, 446191, 452190, 452111, 452112, 447190, 446110**
    - vii. The **SELECT \* FROM Business Analyst InfoUSA WHERE:** should look like  
**"PrimaryNai" = 445110 OR "PrimaryNai" = 445120 OR "PrimaryNai" = 447110 OR "PrimaryNai" = 452910 OR "PrimaryNai" = 454390 OR "PrimaryNai" = 445210 OR**

"PrimaryNai" = 445220 OR "PrimaryNai" = 454390 OR "PrimaryNai" = 311330 OR  
 "PrimaryNai" = 311340 OR "PrimaryNai" = 445292 OR "PrimaryNai" = 445299 OR  
 "PrimaryNai" = 311811 OR "PrimaryNai" = 445291 OR "PrimaryNai" = 722213 OR  
 "PrimaryNai" = 445210 OR "PrimaryNai" = 445299 OR "PrimaryNai" = 446191 OR  
 "PrimaryNai" = 452910 OR "PrimaryNai" = 452111 (If included) OR "PrimaryNai" =  
 447190 OR "PrimaryNai" = 446110 OR "PrimaryNai" = 452112

viii. Click **Apply**

c. Right Click the **Business Analyst InfoUS** and Click **Data** and then **Export data**

i. Choose **Selected Features** for **Export**

ii. Choose **this layer's source data** for **Use the same coordinate system as:**

iii. Navigate to appropriate folder and give the output file an appropriate name for **Output shapefile or feature class**

iv. Click **OK**

v. Click **Yes** to add the data to current data frame

**II.** Calculate the Network Distance to Nearest Retail Food Outlet:

- a. LEAN Protocol 2.6 to determine the network distance to the nearest Retail Food Outlet. The participant locations are the origins and the retail food outlet locations are the features of interest

The length of the nearest distance segment from a participant's location to the nearest retail food outlet is stored in the Total Length attribute.

**A.** Straight line distance

1. Open **ArcToolbox**, then click **Analysis Tools**

2. Click on **Proximity Tools**

3. Click on **Near tool**

- a. Navigate and Choose **Participant Layer** as the **Input Features**

- b. Navigate and Choose **Retail Food Outlets layer** as **Near Features**

- c. Click **OK**

The straightline distance to nearest retail food outlet is stored in the attribute table under field name Near\_Dist. The Near\_FID field has the FID of the Nearest Retail Food Outlet.

## 4.2 Density of all Retail Food Outlets (not restaurants)

*Note: This protocol was updated in Version 1.3 to add an additional NAICS code. This was updated for version 2.0 but is not being used in EAT-III or ECHO.*

### 1. Basic Concept

This is the density version of protocol 4.1.

### 2. Basic Definition

Density of all Retail Food Outlets (not restaurants) = Total retail food outlets per unit land area (excluding water).

### 3. Detailed Definition

Distance to any Retail Food Outlet (not restaurants) = The shortest network or straight line distance between home or school and the nearest retail food outlet with retail food outlets defined using SIC/NAICS codes and using Dun and Bradstreet data (see protocols 4.1).

#### 4. Comments and Explanations

The protocol is similar to the Protocol 3.2, Density of Restaurants. However, in this case the retail food outlets are used. The area within which the density has to be calculated is demarcated, the number of retail food outlets in the area are counted, and the number is divided by the area to get the density.

For a detailed explanation refer to Protocol 3.2.

#### 5. GIS Approach

First the retail food outlets are extracted from the master data and then the buffer area is created using Network Analyst. Then, the water features are erased from the buffers using Erase tool, then the area of the buffer layer with erased water features is calculated. The number of retail food outlets is counted with a spatial join between the buffer layer and the retail food outlet location layer. The number of retail food outlet locations are then divided by the area in hectares to get the density.

For a detailed explanation refer to GIS Approach in Protocol 3.2.

#### 6. GIS Steps

##### Requirements:

1. Retail Food Outlets layer (Point)
2. Participant Layer (Point)
3. Water feature layer (Polygon)
4. Roads Network dataset

##### I. Query and extract data for Restaurants according to specified NAICS codes from Dun & Bradstreet data, if the restaurant layer is not already prepared

###### 1. Start ArcMap

###### 2. Click the **Add Data** button on the **Standard Toolbar**.

###### a. Navigate to the **Dun & Bradstreet data**

###### b. Click on the **Dun & Bradstreet dataset** and click **Add** to add the dataset to the Map

###### 3. Right Click the **Dun & Bradstreet data** and Click **Open Attribute Table**

###### a. Click on **Options**

###### b. Click **Select by Attributes**

###### i. Select **Create a new selection** as **Method**

###### ii. Click on **"PrimaryNai"** in the Attributes list and click on **Unique values** (since this can take substantial time, instead of this consider typing the codes as mentioned below)

###### iii. Click **"="** operator

###### iv. Click or Type **445110**

###### v. Click **"OR"** operator

###### vi. Repeat steps ii to v adding the values to **445120, 447110, 452910, 454390, 445210, 445220, 454390, 445230, 454390, 311330, 311340, 445292, 445299, 311811, 445291, 722213, 445210, 445299, 446191, 452190, 452111, 452112, 447190, 446110**

###### vii. The **SELECT \* FROM Dun & Bradstreet WHERE** should: look like

```
"PrimaryNai" = 445110 OR "PrimaryNai" = 445120 OR "PrimaryNai" = 447110 OR  
"PrimaryNai" = 452910 OR "PrimaryNai" = 454390 OR "PrimaryNai" = 445210 OR  
"PrimaryNai" = 445220 OR "PrimaryNai" = 454390 OR "PrimaryNai" = 311330 OR  
"PrimaryNai" = 311340 OR "PrimaryNai" = 445292 OR "PrimaryNai" = 445299 OR  
"PrimaryNai" = 311811 OR "PrimaryNai" = 445291 OR "PrimaryNai" = 722213 OR  
"PrimaryNai" = 445210 OR "PrimaryNai" = 445299 OR "PrimaryNai" = 446191 OR
```

**"PrimaryNai" = 452910 OR "PrimaryNai" = 452111 (If included) OR "PrimaryNai" = 447190 OR "PrimaryNai" = 446110 OR "PrimaryNai" = 452112**

**viii. Click Apply**

**c. Right Click the Dun & Bradstreet data and Click Data and then Export data**

**ix. Choose Selected Features for Export**

**x. Choose this layer's source data for Use the same coordinate system as:**

**xi. Navigate to appropriate folder and give the output file an appropriate name for Output shapefile or feature class**

**xii. Click OK**

**xiii. Click Yes to add the data to current data frame**

**II. Load the Participants buffers into ArcMap :**

- a. Click the Add Data button on the Standard Toolbar
- b. Navigate to the location of the Participant buffers
- c. Select the buffer and click Open to add them to the ArcMap document

**III. Spatially join the retail food outlets to the Participant buffers**

- a. Right-click the Participant buffer layer and select Joins and Relates and then choose Join...
- b. For What do you want to join to this layer?, select "Join data from another layer based on spatial location"
- c. For 1. Choose the layer to join to this layer, or load spatial data from disk, select the Retail food outlets layer
- d. For 2. You are joining: Points to Polygons, select the radio button next to "Each polygon will be given a summary of the numeric attributes of the points that fall inside it, and a count field showing how many points fall inside it"
- e. For 3. The result of the join will be saved into a new layer, specify the output location and name
- f. Click OK to execute the spatial join

**IV. Calculate the density of the retail food outlets in the buffer**

- a. Right-click on the output from the previous step and select Open Attribute Table
- b. Click on the Options button and select Add Field...
  - i. For the Name, type NFFCXXXX where XXXX is the buffer distance
  - ii. Set the Type to Integer
  - iii. Accept the defaults for Scale and Precision
  - iv. Click OK to add the attribute
- c. Right-click on the NFFCXXXX attribute and select Field Calculator...
  - i. In the field calculator, construct the following query: [Count\_]
  - ii. Click OK to execute the query
- d. Click on the Options button and select Add Field...
  - i. For the Name, type NFFDXXXX where XXXX is the buffer distance
  - ii. Set the Type to Double
  - iii. Accept the defaults for Scale and Precision
  - iv. Click OK to add the attribute
- e. Right-click on the NFFDXXXX attribute and select Field Calculator...
  - i. In the field calculator, construct the following query: [NFFCXXXX] / [Hectares]
  - ii. Click OK to execute the query

The NFFCXXXX field contains the density of retail food outlets per hectare in the buffer around the participant location. Repeat these steps for all other network and straightline participant buffers.

## 4.3 Distance to Groceries, Supermarkets, or Super Centers (2010 EAT-III & ECHO)

*Updated in version 2.0.*

### 1. Basic Concept

The basic idea of this measure is to estimate access to a wide selection of food items. This is a broad category. While technically a supermarket (selling mainly food and other groceries) is different to a super center (a supermarket added on to a discount department store) they sell similar things. The TREC-IDEA and ECHO surveys asked about distance to supermarkets:

#### Supermarkets

- SS170 About how long would it take to get from your home to the nearest supermarket if you walked? (Adapted from NEWS B2 (14))

This measure uses SIC/NAICS codes --445110 for the list. In addition, major retailers like Super Target and Walmart Supercenter were included because they sell significant amounts of food. Again, because this is a large category, NAICS codes will capture the overall number. This protocol does **not** include membership sorts such as Sam's Club and Costco but they **are** included in the companion measure about the density of nearby grocery stores etc.

It uses the following codes.

2002 NAICS	1997 NAICS	1987 SIC	Corresponding Index Entries
445110	445110	5411	Commissaries, primarily groceries
445110	445110	5411	Delicatessens primarily retailing a range of grocery items and meats
445110	445110	5411	Food (i.e., groceries) stores
445110	445110	5411	Grocery stores
445110	445110	5411	Supermarkets

Source: <http://www.census.gov/epcd/naics02/def/NDEF445.HTM#N44511>

### 2. Basic Definition

Distance to Grocery, Supermarket, or Super Center = The shortest network or straight line distance between home or school and the nearest grocery, supermarket, or super center.

### 3. Detailed Definition

Distance to Grocery, Supermarket, or Super Center = The shortest network or straight line distance between home or school and the nearest grocery, supermarket, or super center where these are identified using NAICS codes and web searches for Super Targets, Super Walmarts, and Super K-Marts. In TREC-IDEA this protocol used Dun and Bradstreet data; in EAT-III and ECHO, Business Analyst InfoUSA.

#### 4. Comments and Explanations

This is similar to the protocol 3.1, distance to nearest restaurant, and is done by using the OD Cost Matrix option in Network Analyst Extension of ArcGIS 9.3.1. However in this case, the nearest distance is calculated only for the groceries, supermarkets, or super centers and not for restaurants.

See Protocol 3.1 for more explanation.

#### 5. GIS Approach

First the Groceries, Supermarkets, or super centers are extracted from the master data and then the nearest distance to these locations are calculated. The basic idea is similar to the protocol 3.1, distance to nearest restaurant. Nearest network distance between a set of origin locations and destination locations is calculated using Network Analyst and straight line distance is calculated using Near tool in ArcToolbox.

See Protocol 3.1 for more explanation.

#### 6. GIS Steps

Requirements:

1. Road Layer polyline
2. Food Outlets (Groceries, Supermarkets, or super centers) layer (Point Features) for finding the nearest distance to
3. Participants layer (Point Features) for finding the nearest distance from
4. Network Analyst Extension for ArcGIS 9.3.1

- I. Query and extract data for Groceries, Supermarkets, or super centers according to specified NAICS codes from Business Analyst InfoUSA data, if the layer is not already prepared

1. Start **ArcMap**

2. Click the **Add Data** button  on the **Standard Toolbar**.

- a. Navigate to the **Business Analyst InfoUSA data**

- b. Click on the **Business Analyst InfoUSA dataset** and click **Add** to add the dataset to the Map

3. Right Click the **Business Analyst InfoUSA data** and Click **Open Attribute Table**

- a. Click on **Options**

- b. Click **Select by Attributes**

- i. Select **Create a new selection** as **Method**

- Click on "NAICS\_EXT" in the Attributes list

- Click the "=" operator

- Type '44511001'

- Click the "OR" operator

- Click on "NAICS\_EXT" in the Attributes list

- Click the "=" operator

- Type '44511002'

- Repeat for '44511002', '44511003', '44511004', '44511005', '44511006', '44511007', '44511008'

- ii. Click the "OR" operator again and then click on "**CONAME**" in the attributes list

- Click "=" operator

- Type '**SUPER TARGET**'

- Click "**OR**" operator

- Repeat above steps adding the values to **SUPERTARGET, WALMART SUPERCENTER,**

- iii. The **SELECT \* FROM XXXX WHERE:** should look like

**'NAICS\_EXT' = '44511001' OR 'NAICS\_EXT' = '44511002' OR 'NAICS\_EXT' = '44511003' OR 'NAICS\_EXT' = '44511004' OR 'NAICS\_EXT' = '44511005' OR 'NAICS\_EXT' = '44511006' OR 'NAICS\_EXT' = '44511007' OR 'NAICS\_EXT' = '44511008' OR 'CONAME' = 'SUPER TARGET' OR 'CONAME' = 'SUPERTARGET' OR 'CONAME' = 'WALMART SUPERCENTER'**

iv. Click **Apply**

c. Right Click the **Business Analyst InfoUSA data layer** and Click **Data** and then **Export data**

i. Choose **Selected Features** for **Export**

ii. Choose **this layer's source data** for **Use the same coordinate system as:**

iii. Navigate to appropriate folder and give the output file an appropriate name for **Output shapefile or feature class**

iv. Click **OK**

v. Click **Yes** to add the data to current data frame

**II.** Calculate the Network and Straight line Distance to Nearest Grocery Store, Supermarket, or Super Center.

a. Use LEAN Protocol 2.6 to determine the network distance to the nearest Grocery Store, Supermarket, or Super Center. The participant locations are the origins and the restaurant locations are the features of interest

**A.** Network Distance

**B.** Straight line distance

1. Open **ArcToolbox**, then click **Proximity Tools**

2. Click on **Near tool**

a. Navigate and Choose **Participant Layer** as the **Input Features**

b. Navigate and Choose **Food Outlets (Groceries, Supermarkets, or super centers)** layer as **Near Features**

c. Click **OK**

The straight line distance to nearest Food Outlets (Groceries, Supermarkets, or super centers) is stored in the attribute table under field name Near\_Dist. The Near\_FID field has the FID of the Nearest Food Outlets (Groceries, Supermarkets, or super centers).

## 4.4 Density of Groceries, Supermarkets, or Super Centers (2010 EAT-III & ECHO)

*Note: The steps were updated in Version 1.3 to better measure super centers. They were updated again in version 2.0 to reflect new GIS tools.*

### 1. Basic Concept

This is the density version of protocol 4.3.

### 2. Basic Definition

Density of Groceries, Supermarkets, or Super Centers = Total groceries, supermarkets, or super centers per unit land area (excluding water).

### 3. Detailed Definition

Density of Groceries, Supermarkets, or Super Centers = Total groceries, supermarkets, or super centers per unit land area (excluding water) these are identified using NAICS codes (**445110**) and In addition, major retailers like Super Target, Walmart Supercenter, Costco, and Sam's Club were included because they sell significant amounts of food. (Super K-Marts would need to be added in

other regions.) In TREC-IDEA this used Dun and Bradstreet data; in EAT-III it is using Business Analyst.

#### 4. Comments and Explanations

The protocol is similar to the Protocol 3.2, Density of Restaurants. However, in this case the groceries, supermarkets, or super centers are used. The area within which the density has to be calculated is demarcated, the number of groceries, supermarkets, or super centers in the area is counted, and the number is divided by the area to get the density.

For a detailed explanation refer to Protocol 3.2.

#### 5. GIS Approach

First the Groceries, Supermarkets, or Super Centers are extracted from the master data and then the buffer area is created using Network Analyst. Then, the water features are erased from the buffers using Erase tool, then the area of the buffer layer with erased water features is calculated. The number of groceries, supermarkets, or super centers is counted with a spatial join between the buffer layer and the Groceries, Supermarkets, or super centers location layer. The number of groceries, supermarkets, or super centers locations is then divided by the area in hectares to get the density.


For a detailed explanation refer to GIS Approach in Protocol 3.2.

#### 6. GIS Steps

##### Requirements:

1. Road Layer polyline
2. Groceries, Supermarkets, or super centers layer (Point Features) for finding the nearest distance to
3. Participants layer (Point Features) for finding the nearest distance from
4. Network Analyst Extension for ArcGIS 9.1 or ArcGIS 9.2

##### I. Query and extract data for Groceries, Supermarkets, or super centers according to specified NAICS codes from Dun & Bradstreet data, if the layer is not already prepared

1. Start **ArcMap**
2. Click the **Add Data** button  on the **Standard Toolbar**.
  - a. Navigate to the **Business Analyst InfoUSA data**
  - b. Click on the **Business Analyst InfoUSA dataset** and click **Add** to add the dataset to the Map
3. Right Click the **Business Analyst InfoUSA data** and Click **Open Attribute Table**
  - a. Click on **Options**
  - b. Click **Select by Attributes**
    - i. Select **Create a new selection** as **Method**
    - ii. Click on **"NAICS\_EXT"** in the Attributes list
    - iii. Click **"="** operator
    - iv. Type **'44511001'**
    - v. Click the **"OR"** operator
    - vi. Click on **"NAICS\_EXT"** in the Attributes list
    - vii. Click the **"="** operator
    - viii. Type **'44511002'**
    - ix. Repeat for **'44511002', '44511003', '44511004', '44511005', '44511006', '44511007', '44511008'**
    - x. Click the **"OR"** operator again and then click on **"CONAME"** in the attributes list
    - xi. Click **"="** operator

- xii. Type 'SUPER TARGET'
  - xiii. Click "OR" operator
  - xiv. Repeat above steps adding the values for SUPERTARGET, WALMART SUPERCENTER, SAM'S CLUB, and COSTCO
  - xv. The **SELECT \* FROM XXXX WHERE:** should look like **NAICS\_EXT' = '44511001' OR 'NAICS\_EXT' = '44511002' OR 'NAICS\_EXT' = '44511003' OR 'NAICS\_EXT' = '44511004' OR 'NAICS\_EXT' = '44511005' OR 'NAICS\_EXT' = '44511006' OR 'NAICS\_EXT' = '44511007' OR 'NAICS\_EXT' = '44511008' OR 'CONAME' = 'SUPER TARGET' OR 'CONAME' = 'SUPERTARGET' OR 'CONAME' = 'WALMART SUPERCENTER' OR 'CONAME' = 'SAM'S CLUB' OR 'CONAME' = 'COSTCO'**
  - xvi. Click **Apply**
  - c. Right Click the **Business Analyst InfoUSA data layer** and Click **Data** and then **Export data**
    - i. Choose **Selected Features for Export**
    - ii. Choose **this layer's source data** for **Use the same coordinate system as:**
    - iii. Navigate to appropriate folder and give the output file an appropriate name for **Output shapefile or feature class**
    - iv. Click **OK**
    - v. Click **Yes** to add the data to current data frame
- II. Load the participant buffers into ArcMap**
- a. Click the Add Data button on the Standard Toolbar
  - b. Navigate to the location of the Participant buffers
  - c. Select the buffer and click Open to add them to the ArcMap document
- III. Spatially join the Groceries, Supermarkets, or super centers layer to the Participant buffers**
- a. Right-click the Participant buffer layer and select Joins and Relates and then choose Join...
  - b. For What do you want to join to this layer?, select "Join data from another layer based on spatial location"
  - c. For 1. Choose the layer to join to this layer, or load spatial data from disk, select the Groceries, Supermarkets, or super centers layer
  - d. For 2. You are joining: Points to Polygons, select the radio button next to "Each polygon will be given a summary of the numeric attributes of the points that fall inside it, and a count field showing how many points fall inside it"
  - e. For 3. The result of the join will be saved into a new layer, specify the output location and name
  - f. Click OK to execute the spatial join
- IV. Calculate the density of the Groceries, Supermarkets, or super centers layer in the buffer**
- a. Right-click on the output from the previous step and select Open Attribute Table
  - b. Click on the Options button and select Add Field...
    - i. For the Name, type NFFCXXXX where XXXX is the buffer distance
    - ii. Set the Type to Integer
    - iii. Accept the defaults for Scale and Precision
    - iv. Click OK to add the attribute
  - c. Right-click on the NFFCXXXX attribute and select Field Calculator...
    - i. In the field calculator, construct the following query: [Count\_]
    - ii. Click OK to execute the query
  - d. Click on the Options button and select Add Field...
    - i. For the Name, type NFFDXXXX where XXXX is the buffer distance
    - ii. Set the Type to Double
    - iii. Accept the defaults for Scale and Precision
    - iv. Click OK to add the attribute
  - e. Right-click on the NFFDXXXX attribute and select Field Calculator...
    - i. In the field calculator, construct the following query: [NFFCXXXX] / [Hectares]
    - ii. Click OK to execute the query

The NFFCXXXX field contains the density of Groceries, Supermarkets, or super centers per hectare in the buffer around the participant location. Repeat these steps for all other network and straightline participant buffers

## 4.5 Distance to Large Supermarkets or Super Center (2010 EAT-III)

*Note: This was updated in Version 1.3 to explain finalized coding. Updated in version 2.0.*

### 1. Basic Concept

The basic idea of this measure is to estimate access to high quality and inexpensive food and to test whether the largest stores are best.

Zenk et al. (2005) used store names rather than SIC codes for classification and omitted smaller chains: "Supermarkets were defined as super centers (e.g. Meijer, Super Kmart) and full-line grocery stores (e.g. Farmer Jack, Kroger) associated with a national or regional grocery chain, i.e. a chain with 11 or more retail stores" (p.).

There are two potential lists of chains. The web site [www.supermarketnews.com](http://www.supermarketnews.com) has a national supermarket list. Wikipedia has a list that includes specialty and natural food chains, retail cooperatives, regional and local chains, national chains, Hispanic/Latino chains, discount chains, and Asian chains (See Appendix 4A). Most of these would be seen as supermarkets but only some were actually in Minnesota.

In TREC we examined the various data and decided to use Dun and Bradstreet industrial classifications to locate supermarkets (NAICS **445110**) and to add Super Centers from lists on the web sites of major chains. In EAT-III we decided to use a list of chain names for major stores in the Twin Cities area. This does not include membership stores as households may not be members (such stores are included in "density" type measures). In a "distance to" measure one nearby store can make a great difference to the measure; in density measures this is not as significant.

### 2. Basic Definition

Distance to Supermarket or Super Center = The shortest network or straight line distance between home or school and the nearest supermarket or super center.

### 3. Detailed Definition

Distance to Supermarket or Super Center = The shortest network or straight line distance between home or school and the nearest supermarket or super center where supermarkets are defined using Business Analyst data the following list (based on the supermarket news list and local knowledge):

- Albertsons
- Byerly's
- Cub Foods
- Kowalski's
- Lunds Markets
- Rainbow Foods
- Walmart Supercenter
- Costco

- Sam's Club
- Super Target

#### 4. Comments and Explanations

The GIS method to find the nearest large supermarket or supercenter is similar to the protocol 3.1, distance to nearest restaurant, and is done by using the OD Cost Matrix option in Network Analyst Extension of ArcGIS 9.3.1. Though in this case, the nearest distance is calculated only for the large supermarket or supercenter and not restaurants. The large supermarket and supercenter's are selected on the basis of chain names. These supermarkets were selected because they sell food (fruits and vegetables etc) whereas their counterparts like Target or Walmart rarely have fresh food and would not be appropriate for the measures.

See Protocol 3.1 for more explanation on finding the nearest larger supermarket.

#### 5. GIS Approach

First of all the large supermarkets or super centers are extracted from the master data and then the nearest distance to these locations are calculated. The basic idea is similar to the protocol 3.1, distance to nearest restaurant. Nearest network distance between a set of origin locations and destination locations is calculated using Network Analyst and straight line distance is calculated using Near tool in ArcToolbox. However, while extracting the large supermarket or supercenter's from master data, the chain names are used.

See Protocol 3.1 for more explanation.

#### 6. GIS Steps

##### Requirements:

1. Road Layer polyline
2. Point Features (Large Supermarkets or Supercenter layer) for finding the nearest distance to
3. Point Features (Participants layer) for finding the nearest distance from
4. Network Analyst Extension for ArcGIS 9.1 or ArcGIS 9.2

##### I. Query and extract data for Large Supermarkets or Supercenters according to specified names of supermarkets from Business Analyst InfoUSA data, if the layer is not already prepared

##### 1. Start ArcMap

##### 2. Click the **Add Data** button on the **Standard Toolbar**.

##### a. Navigate to the **Business Analyst InfoUSA data**

##### b. Click on the **Business Analyst InfoUSA dataset** and click **Add** to add the dataset to the Map

##### 3. Right Click the **Business Analyst InfoUSA data** and Click **Open Attribute Table**

##### a. Click on **Options**

##### b. Click **Select by Attributes**

##### i. Select **Create a new selection** as **Method**

##### ▪ Click on **"CONAME"** in the Attributes

##### ▪ Click **"="** operator

##### ▪ Type **'BYERLY'S'**

##### ▪ Click **"OR"** operator

##### ▪ Repeat above steps adding the values to **ALBERTSON'S, CUB FOODS, RAINBOW FOODS, LUNDS MARKETS, KOWALSKI'S, KOWALSKI'S MARKET, KOWALSKI'S MARKETS, KOWALSKI'S YOUR NEIGHBORHOOD,**

KOWALSKI'S MARKET EDEN PRAIRIE, SUPERTARGET, SUPER TARGET, BYERLY'S INC, BYERLY'S GROCERY, BYERLY'S FINE FOODS, BYERLY'S ROSEVILLE, COSTCO

- ii. The **SELECT \* FROM Business Analyst InfoUSA WHERE:** should look like  
**CONAME" = 'BYERLY'S' OR "CONAME" = 'ALBERTSON'S' OR "CONAME" = 'CUB FOODS' OR "CONAME" = 'RAINBOW FOODS' OR "CONAME" = 'LUNDS MARKETS' OR "CONAME" = 'KOWALSKI'S' OR "CONAME" = 'KOWALSKI'S MARKET' OR "CONAME" = 'KOWALSKI'S MARKETS' OR "CONAME" = 'KOWALSKI'S YOUR NEIGHBORHOOD' OR "CONAME" = 'KOWALSKI'S EDEN PRAIRIE' OR "CONAME" = 'SUPERTARGET' OR "CONAME" = 'SUPER TARGET' OR "CONAME" = 'BYERLY'S INC' OR "CONAME" = 'BYERLY'S GROCERY' OR "CONAME" = 'BYERLY'S FINE FOODS' OR "CONAME" = 'BYERLY'S ROSEVILLE' OR "CONAME" = 'COSTCO' OR "CONAME" = 'SAM'S CLUB' OR "CONAME" = 'WALMART SUPERCENTER'**

- iii. Click **Apply**

- c. Right Click the **Business Analyst InfoUSA** data and Click **Data** and then **Export data**

- i. Choose **Selected Features** for **Export**

- ii. Choose **this layer's source data** for **Use the same coordinate system as:**

- iii. Navigate to appropriate folder and give the output file an appropriate name for **Output shapefile or feature class**

- iv. Click **OK**

- v. Click **Yes** to add the data to current data frame

- II. Calculate the Network and Straight line Distance to Nearest Large Supermarket or Super Center: Use LEAN Protocol 2.6 to determine the network distance to the nearest large supermarket or super center. The participant locations are the origins and the largest supermarkets or super centers locations are the features of interest

#### A. Straight line distance

1. Open **ArcToolbox**, then click **Proximity Tools**

2. Click on **Near tool**

- a. Navigate and Choose **Participant Layer** as the **Input Features**

- b. Navigate and Choose **Large Supermarkets or Supercenters layer** as **Near Features**

- c. Click **OK**

The straightline distance to nearest supermarket or super center is stored in the attribute table under field name Near\_Dist. The Near\_FID field has the FID of the Nearest Large Supermarkets or Supercenters.

## 4.6 Density of Large Supermarkets or Super Centers (2010 EAT-III)

*Updated in version 2.0.*

### 1. Basic Concept

This is the density version of protocol 4.5.

### 2. Basic Definition

Density of Supermarkets or Super Centers = Total supermarkets or super centers per unit land area (excluding water).

### 3. Detailed Definition

Density of Supermarkets or Super Centers = Total supermarkets or super centers per unit land area (excluding water) where supermarkets are defined using Business Analyst data and the following list (based on the supermarket news list and local knowledge):

- Albertsons
- Byerly's
- Cub Foods
- Kowalski's
- Lunds Markets
- Rainbow Foods
- Super Target
- Walmart Supercenter
- Sam's Club
- Costco

#### 4. Comments and Explanations

The protocol is similar to the Protocol 3.2, Density of Restaurants. However, in this case the large supermarkets and supercenters density is calculated. The area within which the density has to be calculated is demarcated, the number of large supermarkets and supercenters in the area are counted, and the number is divided by the area to get the density. The large supermarkets and supercenter's are selected on basis of chain names

For a detailed explanation for calculating the density refer to Protocol 3.2.

For a detailed explanation about selecting the large supermarkets and supercenters refer to Protocol 4.5.

#### 5. GIS Approach

First the large supermarkets and supercenters are extracted from the master data and then the buffer area is created using Network Analyst. Then, the water features are erased from the buffers using Erase tool, then the area of the buffer layer with erased water features is calculated. The number of large supermarkets and supercenters is counted with a spatial join between the buffer layer and the retail food outlet location layer. The number of large supermarkets and supercenters locations is then divided by the area in hectares to get the density.

For a detailed explanation refer to GIS Approach in Protocol 3.2.


#### 6. GIS Steps

##### Requirements:

1. Road Layer polyline
2. Large Supermarkets or Supercenters layer (Point Features) for finding the nearest distance to
3. Participants layer (Point Features) for finding the nearest distance from
4. Network Analyst Extension for ArcGIS 9.3.1

- I. Query and extract data for Large Supermarkets or Supercenters according to specified names of supermarkets, from Business Analyst InfoUSA data, if the layer is not already prepared

##### 1. Start ArcMap

2. Click the **Add Data** button  on the **Standard Toolbar**.
  - a. Navigate to the **Business Analyst InfoUSA data**
  - b. Click on the **Business Analyst InfoUSA dataset** and click **Add** to add the dataset to the Map
3. Right Click the **Business Analyst InfoUSA data** and Click **Open Attribute Table**
  - a. Click on **Options**

**b. Click Select by Attributes**

**i. Select Create a new selection as Method**

- Click on "CONAME" in the Attributes list
- Click "=" operator
- Type 'BYERLY'S'
- Click "OR" operator
- Repeat above steps adding the values to ALBERTSON'S, CUB FOODS, RAINBOW FOODS, LUNDS MARKETS, KOWALSKI'S, KOWALSKI'S MARKET, KOWALSKI'S MARKETS, KOWALSKI'S YOUR NEIGHBORHOOD, KOWALSKI'S MARKET EDEN PRAIRIE, SUPERTARGET, SUPER TARGET, BYERLY'S INC, BYERLY'S GROCERY, BYERLY'S FINE FOODS, BYERLY'S ROSEVILLE, COSTCO, SAM'S CLUB

**ii. The SELECT \* FROM Business Analyst InfoUSA WHERE: should look like**

"CONAME" = 'BYERLY'S' OR "CONAME" = 'ALBERTSON'S' OR "CONAME" = 'CUB FOODS' OR "CONAME" = 'RAINBOW FOODS' OR "CONAME" = 'LUNDS MARKETS' OR "CONAME" = 'KOWALSKI'S' OR "CONAME" = 'KOWALSKI'S MARKET' OR "CONAME" = 'KOWALSKI'S MARKETS' OR "CONAME" = 'KOWALSKI'S YOUR NEIGHBORHOOD' OR "CONAME" = 'KOWALSKI'S EDEN PRAIRIE' OR "CONAME" = 'SUPERTARGET' OR "CONAME" = 'SUPER TARGET' OR "CONAME" = 'BYERLY'S INC' OR "CONAME" = 'BYERLY'S GROCERY' OR "CONAME" = 'BYERLY'S FINE FOODS' OR "CONAME" = 'BYERLY'S ROSEVILLE' OR "CONAME" = 'COSTCO' OR "CONAME" = 'SAM'S CLUB' OR "CONAME" = 'WALMART SUPERCENTER'

**iii. Click Apply**

**c. Right Click the Business Analyst InfoUSA data and Click Data and then Export data**

- i. Choose Selected Features for Export**
- ii. Choose this layer's source data for Use the same coordinate system as:**
- iii. Navigate to appropriate folder and give the output file an appropriate name for Output shapefile or feature class**
- iv. Click OK**
- v. Click Yes to add the data to current data frame**

**II. Load the participants buffers into ArcMap**

- 2.3 Click the Add Data button on the Standard Toolbar
- 2.4 Navigate to the location of the Participant buffers
- 2.5 Select the buffer and click Open to add them to the ArcMap document

**III. Spatially join the Large Supermarkets or Supercenters layer to the Participant buffers**

- 3.3 Right-click the Participant buffer layer and select Joins and Relates and then choose Join...
- 3.4 For What do you want to join to this layer?, select "Join data from another layer based on spatial location"
- 3.5 For 1. Choose the layer to join to this layer, or load spatial data from disk, select the Large Supermarkets or Supercenters layer
- 3.6 For 2. You are joining: Points to Polygons, select the radio button next to "Each polygon will be given a summary of the numeric attributes of the points that fall inside it, and a count field showing how many points fall inside it"
- 3.7 For 3. The result of the join will be saved into a new layer, specify the output location and name
- 3.8 Click OK to execute the spatial join

**IV. Calculate the density of the Large Supermarkets or Supercenters in the buffer**

- 4.3 Right-click on the output from the previous step and select Open Attribute Table
- 4.4 Click on the Options button and select Add Field...
  - 4.4.1 For the Name, type NFFCXXXX where XXXX is the buffer distance
  - 4.4.2 Set the Type to Integer
  - 4.4.3 Accept the defaults for Scale and Precision
  - 4.4.4 Click OK to add the attribute
- 4.5 Right-click on the NFFCXXXX attribute and select Field Calculator...
  - 4.5.1 In the field calculator, construct the following query: [Count\_]

- 4.5.2 Click OK to execute the query
- 4.6 Click on the Options button and select Add Field...
- 4.6.1 For the Name, type NFFDXXXX where XXXX is the buffer distance
- 4.6.2 Set the Type to Double
- 4.6.3 Accept the defaults for Scale and Precision
- 4.6.4 Click OK to add the attribute
- 4.7 Right-click on the NFFDXXXX attribute and select Field Calculator...
- 4.7.1 In the field calculator, construct the following query: [NFFCXXXX] / [Hectares]
- 4.7.2 Click OK to execute the query

The NFFCXXXX field contains the density of Large Supermarkets or Supercenters per hectare in the buffer around the participant location. Repeat these steps for all other network and straightline participant buffers

## 4.7 Type of Nearest Retail Food Outlet

*Note: Updated in Version 1.3.*

### 1. Basic Concept

The closest store is likely to be the one frequented.

This will build on Moore and Diez Roux (2006) who used InfoUSA to classify stores into "the following categories using the SIC codes:

- grocery stores and supermarkets (541101, 541104-541106);
- convenience stores (541102, 541103);
- meat and fish markets (5421, 549907, 549911);
- fruit and vegetable markets (543101-543103, 549933);
- bakeries (541);
- natural food stores (549901, 549909, 549935);
- specialty food stores (549910, 549912, 549914, 549916-549921, 559923, 549926-549928, 549930, 549937);
- and liquor stores (5912)." (p 326, bulleting added).

However, as we have found much misclassification in this database in the Twin Cities, we will instead use Dun and Bradstreet and will use NAICS as appropriate to attempt to classify these better. While some may seem odd—such as confectionary manufacturing from purchased chocolate—that category includes handmade chocolate stores. These include:

- 311330 Confectionery Manufacturing from Purchased Chocolate
- 311340 Nonchocolate Confectionery Manufacturing
- 311811 Retail Bakeries
- 445120 Convenience Stores
- 445210 Meat Markets
- 445220 Fish and Seafood Markets
- 445230 Fruit and Vegetable Markets
- 445291 Baked Goods Stores
- 445292 Confectionery and Nut Stores
- 445299 All Other Specialty Food Stores

- 446110 Pharmacies and Drug Stores
- 446191 Food (Health) Supplement Stores,
- 447110 Gasoline Stations with Convenience Stores
- 447190 Other Gasoline Stations (our local knowledge indicated most of these sold food)
- 452111 Department Stores (except Discount Department Stores)
- 452112 Discount Department Stores
- 452190 [typo in steps, to fix]
- 452910 Warehouse Clubs and Supercenters
- 454390 Other Direct Selling Establishments
- 722213 Snack and Nonalcoholic Beverage Bars

## 2. Basic Definition

Type of Nearest Retail Food Outlet = industrial code of the type of food store that is the shortest network or straight line distance between home or school.

## 3. Detailed Definition

Type of Nearest Retail Food Outlet = industrial code of the type of food store that is the shortest network or straight line distance between home or school where type of store is identified using NAICS codes above.

## 4. Comments and Explanations

The methodology to find the nearest retail food outlet is similar to the protocol 3.1, distance to nearest restaurant, and is done by using the OD Cost Matrix option in Network Analyst Extension of ArcGIS 9.3.1. Though in this case, the type of nearest retail food outlet is the output. In case of Network distance, the type of nearest food outlet is extracted by joining the facility layer (the sub layer of closest facility) with the retail food outlet layer and then joining this combined data with the route layer. This ensures that all the routes carry over the original retail food outlet data.

See Protocol 3.1 for more explanation of finding the closest facility.

## 5. GIS Approach

First the Retail Food Outlets are extracted from the master data and then the nearest distance to these locations are calculated. The basic idea to find the nearest retail food outlet is similar to the protocol 3.1, distance to nearest restaurant. Nearest network distance between a set of origin locations and destination locations is calculated using Network Analyst and straight line distance is calculated using Near tool in ArcToolbox. In case of Network distance, the type of nearest food outlet is extracted by joining the attributes of facility layer (the sub layer of closest facility) using the Name field, with the retail food outlet layer, using the retail food outlet Id and exporting this data as new layer. Then this exported data is joined with the route layer using facility Id and object Id of exported data. This ensures that all the routes carry over the original retail food outlet data.

See Protocol 3.1 for more explanation.

## 6. GIS Steps

### Requirements:

1. Road Layer polyline

2. Point Features (Retail Food Outlets layer) for finding the nearest distance to
3. Point Features (Participants layer) for finding the nearest distance from
4. Network Analyst Extension for ArcGIS 9.1 or ArcGIS 9.2

**I. Query and extract data for Restaurants according to specified NAICS codes from Dun & Bradstreet data, if the restaurant layer is not already prepared**

**1. Start ArcMap**

**2. Click the Add Data button  on the Standard Toolbar.**

**a. Navigate to the Dun & Bradstreet data**

**b. Click on the Dun & Bradstreet dataset and click Add to add the dataset to the Map**

**3. Right Click the Dun & Bradstreet data and Click Open Attribute Table**

**a. Click on Options**

**b. Click Select by Attributes**

**i. Select Create a new selection as Method**

**ii. Click on "PrimaryNai" in the Attributes list and click on Unique values (since this can take substantial time, instead of this consider typing the codes as mentioned below)**

**iii. Click "=" operator**

**iv. Click or Type 445110**

**v. Click "OR" operator**

**vi. Repeat steps ii to v adding the values to 445120, 447110, 452910, 454390, 445210, 445220, 454390, 445230, 454390, 311330, 311340, 445292, 445299, 311811, 445291, 722213, 445210, 445299, 446191, 452190, 452111, 452112, 447190, 446110**

**vii. The SELECT \* FROM Dun & Bradstreet WHERE: should: look like**

"PrimaryNai" = 445110 OR "PrimaryNai" = 445120 OR "PrimaryNai" = 447110 OR  
 "PrimaryNai" = 452910 OR "PrimaryNai" = 454390 OR "PrimaryNai" = 445210 OR  
 "PrimaryNai" = 445220 OR "PrimaryNai" = 454390 OR "PrimaryNai" = 311330 OR  
 "PrimaryNai" = 311340 OR "PrimaryNai" = 445292 OR "PrimaryNai" = 445299 OR  
 "PrimaryNai" = 311811 OR "PrimaryNai" = 445291 OR "PrimaryNai" = 722213 OR  
 "PrimaryNai" = 445210 OR "PrimaryNai" = 445299 OR "PrimaryNai" = 446191 OR  
 "PrimaryNai" = 452910 OR "PrimaryNai" = 452111 (If included) OR "PrimaryNai" =  
 447190 OR "PrimaryNai" = 446110 OR "PrimaryNai" = 452112

**viii. Click Apply**

**c. Right Click the Dun & Bradstreet data and Click Data and then Export data**

**ix. Choose Selected Features for Export**

**x. Choose this layer's source data for Use the same coordinate system as:**

**xi. Navigate to appropriate folder and give the output file an appropriate name for Output shapefile or feature class**

**xii. Click OK**

**xiii. Click Yes to add the data to current data frame**

**II. Calculate the Network and Straight line Distance to Nearest Restaurant**

**A. Network Distance**

**1. Start ArcMap**

**2. On the Main Menu click Tools and Click on Extensions.**

**a. Check Network Analyst Extension.**

**b. Click Close**

**3. Click the Add Data button  on the Standard Toolbar**


**a. Navigate to the Network Dataset location, created earlier**


**b. Click on the Network Dataset and click Add to add the Network Dataset to ArcMap.**

**c. Click Yes to add all the feature classes, that participate in the network, to the map.**

**4. Click the Add Data button  on the Standard Toolbar**

**a. Navigate to the Point Layers to be used for analysis, in this case Participant location and Restaurant Locations**

- b. Click on the **Point Layers** and click **Add** to add it to ArcMap.
5. Assign Id's to the retail food outlets and the participant's if not done already. In the Table of Contents Right Click the **Point Layer** and click on **Open Attribute Table**
  - a. In the **Attribute Table**
    - i. Click **Options**
    - ii. Click **Add Field**
    - iii. Add the **RetailId\_T/Part\_Id\_T** as Text
      - Type **RetailId\_T/Part\_Id\_T** in the **Name** field
      - Select **Text (50)** as **Type**
      - Accept default for **Length**
      - Click **OK**
    - iv. Add the **Retail\_Id/Part\_Id** as **Integer**
      - Type **Retail\_Id/Part\_Id** in the **Name** field
      - Select **Short Integer** as **Type**
      - Accept default (0) for **Precision**
      - Click **OK**
    - v. Enter the assigned Id for the participants and schools
6. On the main menu click **View**
  - a. Click on **Toolbars**
  - b. In the side menu click **Network Analyst** to add the Network Analyst toolbar to ArcMap
7. Click **Network Analysis Toolbar**
  - a. Click **Network Analyst Window** button  to add the Network Analyst Window to the map
8. On the **Network Analyst Toolbar** Click **Network Analyst Dropdown Menu**
  - a. Click **New Closest Facility**
  - b. The Table of contents and the Network Analyst Window contains empty list of **Facilities, Incidents, Routes** and **Barriers** Categories.
9. On the **Network Analyst Window** right Click **Facilities** and Click **Load Locations**
  - a. In **Load Locations Window**
    - i. Click **Browse** and navigate to the **Retail Food Outlets Locations, Point** feature layer
    - ii. Click on the **Retail Food Outlets Locations layer** and click **Add**
    - iii. Choose the **Retail Food Outlets Id** as the **Sort** field
    - iv. Choose the **Retail Food Outlets Id Text** as the **Name** field. Accept the **default** for other **Location Analysis Properties**
    - v. Use **50 Meters** for **Location Position**, Use **Geometry** (increase the search tolerance if many locations are not located)
    - vi. Click **OK**
10. On the **Network Analyst Window** right click **Incidents** and Click **Load Locations**
  - a. In **Load Locations Window**
    - i. Click **Browse** and navigate to the **Participant Locations, Point** feature layer
    - ii. Click on the **Participant Locations layer** and click **Add**
    - iii. Choose the **Participant ID/School Id** as the **Sort** field
    - iv. Choose the **Participant ID/School Id Text** as the **Name** field. Accept the **default** for other **Location Analysis Properties**
    - v. Accept the **default Location Position**
    - vi. Click **OK**
11. To set the properties to be used in the Analysis, In the Table of Contents Right Click the **Closest Facility Layer** and Click **Properties**

- a. Click on **Analysis Settings** Tab
    - i. Choose **Length (Meters)** for **Impedance**
    - ii. Choose **None** for **Default Cutoff Values**
    - iii. Choose **Facilities To Find** as **1**
    - iv. Choose **Travel From** as **Incident To Facility**
    - v. Choose **Everywhere** for **Allow U-Turns**
    - vi. Choose **Output Shape Type** as **True Shape**
    - vii. Check the box to **Ignore Invalid Locations**
  - b. Click **Ok**
12. On the **Network Analyst** Toolbar, Click **Solve** Button 
13. Joining attributes with Source Point Layer to carry over the data
  - a. Right Click the **Facilities** layer
  - b. Click **Joins and Relates** and then **Join**
    - i. Choose **Name** as the Field to base the join on
    - ii. Choose the **Retail Food Outlets Layer** as the Table to Join to this layer
    - iii. Choose the **Retail Food Outlets ID Text** as the field in the table to base the join on
    - iv. Click **Ok**
  - c. Right Click the **Facilities** Layer
  - d. Click on **Data** and then **Export Data**
    - i. Choose **this layer's source data** for the coordinate system
  - e. Specify the **Output location**
  - f. Right Click the **Routes** Layer
  - g. Click **Joins and Relates** and then **Join**
    - v. Choose **Facility Id** as the Field to base the join on
    - vi. Choose the **Data join layer exported in above step** as the Table to Join to this layer
    - vii. Choose the **Object ID** as the field in the table to base the join on
    - viii. Click **Ok**
  - h. Right Click the **Routes** Layer
  - i. Click on **Data** and then **Export Data**
    - i. Choose **this layer's source data** for the coordinate system
    - ii. Specify the **Output location**

In ArcGIS 9.2 the name field of routes contains the Incident Id (Participant Id) to Facility ID (Retail Food Outlets ID) in the format Incident Id - Facility ID. It indicates the route connects a participant to the corresponding retail food outlets. To obtain the Type of Retail Food Outlet, the NAICS code corresponding to each facility can be found out from the attribute table.

- B. Straight line distance
  1. Open **ArcToolbox**, then click **Proximity Tools**
  2. Click on **Near tool**
    - a. Navigate and Choose **Participant Layer** as the **Input Features**
    - b. Navigate and Choose **Restaurant layer** as **Near Features**
    - c. Check **Location** and **angle**, if need to calculate them
    - d. Click **OK**

The straightline distance to nearest restaurant is stored in the attribute table under field name Near\_Dist. The Near\_FID field has the FID of the Nearest Restaurant. To obtain the Type of Retail Food Outlet, the NAICS code corresponding to each facility can be found out from the attribute table.

## 4.8 Distance to Nearest Convenience Store Including Gas Stations (2010 EAT-III & ECHO)

*Note: NAICS codes were slightly updated in Version 1.3. Updated in version 2.0.*

### *1. Basic Concept*

The TREC-IDEA study had several questions about convenience stores:

#### Convenience Stores

- SS164 During a normal school week, how many days per week do you get lunch off campus at a convenience store? (TACOS Student Survey (11))
- SS169 About how long would it take to get from your home to the nearest convenience store if you walked? (Adapted from NEWS B1 (14))
- Ps 65/66 In the past month, how many times did you buy food/sweetened beverage at a convenience store, gas station, hardware store, or a vending machine?

The TREC-IDEA study has one question about gas stations:

- Ps 65/66 In the past month, how many times did you buy food/sweetened beverage at a convenience store, gas station, hardware store, or a vending machine?

We use NAICS codes 44512 (convenience stores) , 44711 [Gasoline Stations with Convenience Stores](#), and 44719 [Other Gasoline Stations](#).

### *2. Basic Definition*

Distance to nearest convenience store = the shortest network or straight line distance between home or school and the nearest convenience store.

### *3. Detailed Definition*

Distance to nearest convenience store = The shortest network or straight line distance between home or school and the nearest convenience store defined with NAICS codes (44512, 44711, 44719) and Business Analyst data.

### *4. Comments and Explanations*

This is similar to the protocol 3.1, distance to nearest restaurant, and is done by using the OD Cost Matrix option in Network Analyst Extension of ArcGIS 9.3.1. Though in this case, the nearest distance is calculated only for the Convenience Stores (including Gas Stations) and not for restaurants.

See Protocol 3.1 for more explanation.

### *5. GIS Approach*

First the Convenience Stores (including Gas Stations) are extracted from the master data and then the nearest distance to these locations are calculated. The basic idea is similar to the protocol 3.1, distance to nearest restaurant. Nearest network distance between a set of origin locations and destination locations is calculated using Network Analyst and straight line distance is calculated using Near tool in ArcToolbox.

See Protocol 3.1 for more explanation.

### *6. GIS Steps*

Requirements:

1. Road Layer polyline
2. Convenience Stores (including Gas Stations) layer (Point Features) for finding the nearest distance to
3. Participants layer (Point Features) for finding the nearest distance from
4. Network Analyst Extension for ArcGIS 9.3.1

**I. Query and extract data for Convenience Stores (including Gas Stations) according to specified NAICS codes from Business Analyst InfoUSA data, if the layer is not already prepared**

**1. Start ArcMap**

**2. Click the Add Data button  on the Standard Toolbar.**

**a. Navigate to the Business Analyst InfoUSA data**

**b. Click on the Business Analyst InfoUSA dataset and click Add to add the dataset to the Map**

**3. Right Click the Business Analyst InfoUSA data and Click Open Attribute Table**

**a. Click on Options**

**b. Click Select by Attributes**

**i. Select Create a new selection as Method**

**ii. Click on "NAICS\_EXT" in the Attributes list and click on Unique values (since this can take substantial time, instead of this consider typing the codes as mentioned below)**

**iii. Click "=" operator**

**iv. Click or Type '44512001'**

**v. Click "OR" operator**

**vi. Click or Type '44719001'**

**vii. Repeat for '44719002', '44719003', '44719004', '44719005', '44719006', '44719007'**

**viii. The SELECT \* FROM Business Analyst InfoUSA WHERE: should: look like**

"NAICS\_EXT" = '44512001' OR "NAICS\_EXT" = '44719001' OR "NAICS\_EXT" = '44719001' OR "NAICS\_EXT" = '44719003' OR "NAICS\_EXT" = '44719004' OR "NAICS\_EXT" = '44719005' OR "NAICS\_EXT" = '44719006' OR "NAICS\_EXT" = '44719007'

**ix. Click Apply**

**c. Right Click the Business Analyst InfoUSA data layer and Click Data and then Export data**

**i. Choose Selected Features for Export**

**ii. Choose this layer's source data for Use the same coordinate system as:**

**iii. Navigate to appropriate folder and give the output file an appropriate name for Output shapefile or feature class**

**iv. Click OK**

**v. Click Yes to add the data to current data frame**

**II. Calculate the Network and Straight line Distance to the Nearest Convenience Store including Gas Stations**

**A. Network Distance: Use LEAN Protocol 2.6 to determine the network distance to the nearest convenience store including gas stations. The participant locations are the origins and the convenience stores including gas stations are the features of interest**

The length of the nearest distance segment from a participant's location to the nearest Convenience Stores (including Gas Stations) is stored in the Total Length attribute.

**B. Straight line distance**

**1. Open ArcToolbox, then click Proximity Tools**

**2. Click on Near tool**

**a. Navigate and Choose Participant Layer as the Input Features**

**b. Navigate and Choose Convenience Stores (including Gas Stations) layer as Near Features**

**c. Click OK**

The straight line distance to nearest Convenience Stores (including Gas Stations) is stored in the attribute table under field name Near\_Dist. The Near\_FID field has the FID of the Nearest Convenience Stores (including Gas Stations).

## 4.9. Density of Convenience Stores Including Gas Stations (2010 EAT-III & ECHO)

*Note: NAICS codes were slightly updated in Version 1.3. Updated in version 2.0.*

### 1. Basic Concept

This is the density version of protocol 4.6.

### 2. Basic Definition

Density of all Convenience Stores = Total convenience stores per unit land area (excluding water).

### 3. Detailed Definition

Density of all Convenience Stores = Total convenience stores per unit land area (excluding water) with convenience stores defined using NAICS codes (44512, 44711, 44719) and Business Analyst data.

### 4. Comments and Explanations

The protocol is similar to the Protocol 3.2, Density of Restaurants. However, in this case the Convenience Stores (including Gas Stations) are used. The area within which the density has to be calculated is demarcated, the number of Convenience Stores (including Gas Stations) in the area is counted, and the number is divided by the area to get the density.

For a detailed explanation refer to Protocol 3.2.

### 5. GIS Approach

First the Convenience Stores (including Gas Stations) are extracted from the master data and then the buffer area is created using Network Analyst. Then, the water features are erased from the buffers using Erase tool, then the area of the buffer layer with erased water features is calculated. The number of Convenience Stores (including Gas Stations) is counted with a spatial join between the buffer layer and the Convenience Stores (including Gas Stations) location layer. The number of Convenience Stores (including Gas Stations) locations is then divided by the area in hectares to get the density.

For a detailed explanation refer to GIS Approach in Protocol 3.2.

### 6. GIS Steps

Requirements:

1. Road Layer polyline
2. Convenience Stores (including Gas Stations) layer (Point Features) for finding the nearest distance to
3. Participants layer (Point Features) for finding the nearest distance from
4. Network Analyst Extension for ArcGIS 9.3.1

**I.** Query and extract data for Convenience Stores (including Gas Stations) according to specified NAICS codes from Business Analyst InfoUSA data, if the layer is not already prepared

**1.** Start **ArcMap**

**2.** Click the **Add Data** button  on the **Standard Toolbar**.

**a.** Navigate to the **InfoUSA Business Analyst data**

- b. Click on the **InfoUSA Business Analyst dataset** and click **Add** to add the dataset to the Map
    - 3. Right Click the **InfoUSA Business Analyst data** and Click **Open Attribute Table**
      - a. Click on **Options**
      - b. Click **Select by Attributes**
        - i. Select **Create a new selection** as **Method**
        - ii. Click on "NAICS\_EXT" in the Attributes list and click on **Unique values** (since this can take substantial time, instead of this consider typing the codes as mentioned below)
        - iii. Click "=" operator
        - iv. Click or Type '**44512001**'
        - v. Click "**OR**" operator
        - vi. Click or Type '**44719001**'
        - vii. Repeat for '44719002', '44719003', '44719004', '44719005', '44719006', '44719007'
        - viii. The **SELECT \* FROM Business Analyst InfoUSA WHERE:** should look like:  
"NAICS\_EXT" = '44512001' OR "NAICS\_EXT" = '44719001' OR "NAICS\_EXT" = '44719001' OR "NAICS\_EXT" = '44719003' OR "NAICS\_EXT" = '44719004' OR "NAICS\_EXT" = '44719005' OR "NAICS\_EXT" = '44719006' OR "NAICS\_EXT" = '44719007'
        - ix. Click **Apply**
    - c. Right Click the **Business Analyst InfoUSA data layer** and Click **Data** and then **Export data**
      - i. Choose **Selected Features** for **Export**
      - ii. Choose **this layer's source data** for **Use the same coordinate system as:**
      - iii. Navigate to appropriate folder and give the output file an appropriate name for **Output shapefile or feature class**
      - iv. Click **OK**
      - v. Click **Yes** to add the data to current data frame
- II. Load the Participant buffers into ArcMap
  - a. Click the Add Data button on the Standard Toolbar
  - b. Navigate to the location of the Participant buffers
  - c. Select the buffer and click Open to add them to the ArcMap document
- III. Spatially join the Convenience Stores (including Gas Stations) layer to the Participant buffers
  - a. Right-click the Participant buffer layer and select Joins and Relates and then choose Join...
  - b. For What do you want to join to this layer?, select "Join data from another layer based on spatial location"
  - c. For 1. Choose the layer to join to this layer, or load spatial data from disk, select the Convenience Stores (including Gas Stations) layer
  - d. For 2. You are joining: Points to Polygons, select the radio button next to "Each polygon will be given a summary of the numeric attributes of the points that fall inside it, and a count field showing how many points fall inside it"
  - e. For 3. The result of the join will be saved into a new layer, specify the output location and name
  - f. Click OK to execute the spatial join
- IV. Calculate the density of the Convenience Stores (including Gas Stations) layer in the buffer
  - a. Right-click on the output from the previous step and select Open Attribute Table
  - b. Click on the Options button and select Add Field...
    - i. For the Name, type NFFCXXXX where XXXX is the buffer distance
    - ii. Set the Type to Integer
    - iii. Accept the defaults for Scale and Precision
    - iv. Click OK to add the attribute
  - c. Right-click on the NFFCXXXX attribute and select Field Calculator...
    - i. In the field calculator, construct the following query: [Count\_]
    - ii. Click OK to execute the query
  - d. Click on the Options button and select Add Field...
    - i. For the Name, type NFFDXXXX where XXXX is the buffer distance
    - ii. Set the Type to Double

- iii. Accept the defaults for Scale and Precision
- iv. Click OK to add the attribute
- e. Right-click on the NFFDXXXX attribute and select Field Calculator...
  - i. In the field calculator, construct the following query: [NFFCXXXX] / [Hectares]
  - ii. Click OK to execute the query

The NFFCXXXX field contains the density of Convenience Stores (including Gas Stations) per hectare in the buffer around the participant location. Repeat these steps for all other network and straightline participant buffers

## 4.10 Distance to Farmers Market (2010 EAT-III)

*Note. New in version 1.2. Updated in version 2.0.*

### 1. Basic Concept

Farmers markets provide access to fresh local produce during the growing season. They are much promoted as providing a healthy option but do they make a real difference?

### 2. Basic Definition

Straight line or street network distance to the nearest farmers market.

### 3. Detailed Definition

Straight line or street network distance to the nearest farmers market as specified in the local web listing of farmers markets including those opening between twice a week and once a month.

### 4. Comments and Explanations

For the TREC study the farmer's markets in the Twin Cities were listed on the Minneapolis Star Tribune's website (<http://www.startribune.com/438/story/1187326.html>). By 2010 the markets were listed at <http://www3.mda.state.mn.us/mngrown/searchresults.aspx?location=&products=1>. The addresses for every market were extracted from the website and geocoded using ArcGIS 9.3.1.

### 5. GIS Approach

The GIS approach is to use the OD Cost Matrix option in Network Analyst Extension of ArcGIS 9.3.1 to find the closest farmer's market to a participant's home. The point layer containing the farmer's markets are the "facilities" in Network Analyst, and the participant locations are the "incidents" in Network Analyst. A street network is required for calculating the distance between farmer's markets and participant locations.

In the Network Analyst Extension, specify the "origins" and the "destinations" and solve for the OD Cost Matrix. .

The straight-line distance is calculated using the Near Tool in ArcToolbox.

## 6. GIS Steps

Requirements:

- 3. Road Network dataset
- 4. Participants' Locations Point Feature Layer for incidents (origins)
- 5. Farmer's Market Locations Point Feature Layer for facilities (destinations)
- 6. **Network Analyst Extension** for ArcGIS 9.3.1

Calculate the Network Distance to the nearest farmer's market

Use LEAN Protocol 2.6 to determine the network distance to the nearest farmer's market. The participant locations are the XXX and the farmer's market are the features of interest

Calculate the straight-line distance to the nearest farmer's market

- A. Straight line distance
  - a. Open ArcToolbox, then click Proximity Tools
  - b. Click on the Near tool
    - i. Navigate and Choose the Participant Layer as the Input Features
    - ii. Navigate and Choose the Farmer's Markets layer as Near Features
    - iii. Click OK.

The straight line distance to the nearest Farmer's Markets is stored in the attribute table under field name Near\_Dist. The Near\_FID field has the FID of the Nearest Farmer's Market.

Join the Participant Location layer to the Farmer's Market layer using the NEAR\_FID attribute.

1. **Right-click** on the participant location layer and select **Joins and Relates -> Join...**
2. Choose **NEAR\_FID** as the field to base the join on.
3. Choose the **Farmer's Market layer** as the **Table to Join** to this layer.
4. Choose the **FID** attribute as the field in the table to base the join on.
5. Click **OK**. The Farmer's Market attributes will be joined to the Participant locations.
6. **Right-click** on the **Participant Locations layer** and select **Data-> Export Data**.
  - a. Choose **this layer's source data for the coordinate system**.
  - b. Specify the **Output Location**.
  - c. Click **OK**.

A new shapefile will be created in the output location. This shapefile will contain the participant locations and the attributes of the nearest farmer's market to each participant location.

## 4.11 Distance to Alcohol Sales Places

*Note. New in version 1.2.*

### 1. Basic Concept

While the focus of these protocols is on youth, alcohol is still an issue. This protocol examines both bars and stores selling alcohol. It omits restaurants as these require significant additional purchases.

### 2. Basic Definition

Distance to alcohol sales = Straight line or street network distance to the nearest store or bar selling alcohol.

### 3. Detailed Definition

Distance to alcohol sales = Straight line or street network distance to the nearest store, bar, or restaurant selling alcohol using NAICS codes 7224: Drinking Places (Alcoholic Beverages) and 4453 Beer, Wine, and Liquor Stores.

### 4. Comments and Explanations

None.

## 5. GIS Approach

The GIS approach is to use the OD Cost Matrix option in Network Analyst Extension of ArcGIS 9.3.1 to find the closest Alcohol Sales Place to a participant's home. The point layer containing the alcohol sales places are the "facilities", and the participant locations are the "incidents" in Network Analyst. A street network is required for calculating the distance between alcohol sales places and participant locations.

In the Network Analyst Extension, specify the "facilities" and the "incidents" and solve for the closest facility to each incident. Attach the distance to the closest facility to each incident.

The straight-line distance is calculated using the Near Tool in ArcToolbox.

## 6. GIS Steps

The following procedures were completed in **ArcMap (ArcInfo) 9.2**.

To follow this protocol you will need:

1. **Road Network** dataset
2. **Alcohol Sales Places** point feature layer for facilities (destinations)
3. **Participants' Locations** for incidents (origins)
4. **Network Analyst Extension** for ArcGIS 9.2

Calculate the Network Distance to the nearest alcohol sales place

1. Start **ArcMap**.
2. On the Main Menu, click **Tools** and click on **Extensions**
  - a. Check **Network Analyst Extension**
  - b. Click **Close**
3. Click the **Add Data** button on the **Standard Toolbar**
  - a. Navigate to the **Network Dataset** location
  - b. Click on the **Network Dataset** and click **Add** to add the Network Dataset to ArcMap
  - c. Click **Yes** to add all the feature classes that participate in the network to the map
4. Click the **Add Data** button on the **Standard Toolbar**
  - a. Navigate to the **Points Layers** to be used for the analysis, in this case the **Participant locations** and the **Alcohol Sales places**
  - b. Select the **Point Layers** and click **Add** to add them to ArcMap
5. If the Alcohol Sales IDs and the Participant IDs are already assigned, go to the next steps. Otherwise, in the Table of Contents, right-click on the **Participant locations** point layer and select **Open Attribute Table**
  - a. In the **Attribute Table**
    - i. Click **Options**
    - ii. Click **Add Field...**
    - iii. Add **Par\_ID\_T** as **Text**
      1. Type **Par\_ID\_T** in the **Name** field
      2. Select **Text** as **Type**
      3. Set the **Length** to **20**
      4. Click **OK**
    - iv. Click **Options** and select **Add Field...**
    - v. Add **Par\_ID** as **Integer**
      1. Type **Par\_ID** in the **Name** field
      2. Select **Short Integer** as **Type**
      3. Accept **default (0)** for **Precision**
      4. Click **OK**
    - vi. Right-click on the **Par\_ID** field and select **Field Calculator...**
      1. Set the **Par\_ID** equal to **[FID] + 1**

2. Click **OK**
- vii. Right-click on the **Par\_ID\_T** field and select **Field Calculator...**
  1. Set the **Par\_ID\_T** equal to **Par\_ID**
  2. Click **OK**
- b. Right-click on the **Alcohol Sales point layer** and select **Open Attribute Table**
  - i. Click the **Options** button and select **Add Field**
  - ii. Add **Alc\_ID\_T** as **Text**
    1. Type **Alc\_ID\_T** in the **Name** field
    2. Select **Text** as **Type**
    3. Set the **Length** to **20**
    4. Click **OK**
  - iii. Click the **Options** button and select **Add Field**
  - iv. Add **Alc\_ID** as **Integer**
    1. Type **Alc\_ID** in the **Name** field
    2. Select **Short Integer** as **Type**
    3. Accept **default (0)** for **Precision**
    4. Click **OK**
  - v. Right-click on the **Alc\_ID** field and select **Field Calculator...**
    1. Set the **Alc\_ID** equal to **[FID] + 1**
    2. Click **OK**
  - vi. Right-click on the **Alc\_ID\_T** field and select **Field Calculator...**
    1. Set the **Alc\_ID\_T** equal to **Alc\_ID**
    2. Click **OK**
6. Load the Network Analyst toolbar
  - a. On the Main Menu, click on **View**
  - b. Click on **Toolbars**
  - c. In the side menu, click **Network Analyst** to add the Network Analyst toolbar to ArcMap
7. Load the Network Analyst Window
  - a. Click on the **Show/Hide Network Analyst Window** to open the window
8. Create a **New Closest Facility**
  - a. Click on the **Network Analyst** button on the Network Analyst toolbar
  - b. Select **New Closest Facility** from the dropdown menu
  - c. The Table of Contents and the Network Analyst Window will now contain a **Closest Facility** layer, which contains Facilities, Incidents, Barriers, and Routes categories
9. Load the Alcohol Places in the **Facilities** category in Network Analyst
  - a. In the Network Analyst window, right-click **Facilities** and click **Load Locations**. This will open the Load Locations Window
  - b. In the Load Locations Window
    - i. Select the point layer containing the **Facilities locations** from the dropdown box next to Load From. If the required point layer is not in the dropdown box, click on the **Browse for Point Features to Load** icon and navigate to the point layer.
    - ii. Choose the **Alc\_ID** as the **Sort** field
    - iii. Choose the **Alc\_ID\_T** for the **Name** property under **Locational Analysis** properties.
    - iv. Accept the defaults for the other **Locational Analysis** properties.
    - v. Choose a suitable **Search Tolerance** for the **Location Position**. If features cannot be located on the network dataset, this tolerance may need to be increased.
    - vi. Click **OK**
  - c. To verify all Alcohol Places were located on the network dataset, do one of the following. If any feature has a status of **Not Located**, the search tolerance in 9.b.v may need to be increased or the feature reviewed for its correct location.
    - i. For small datasets, scroll through the resulting lists of Facilities in the **Network Analyst Window**, looking for features with RED question marks.
    - ii. For large datasets, it may be easier to right-click on the **Facilities** in the **Network Analyst Window**, select **Open Attribute Table** and sort descending on the **STATUS** column. The **Not Located** features should be sorted to the top.

10. Load the Participant locations into the **Incidents** category in Network Analyst
  - a. In the Network Analyst window, right-click **Incidents** and click **Load Locations**. This will open the Load Locations Window.
  - b. In the Load Locations Window
    - i. Select the point layer containing the **Participant locations** from the dropdown box next to Load From. If the required point layer is not in the dropdown box, click on the **Browse for Point Features to Load** icon and navigate to the point layer.
    - ii. Choose the **Par\_ID** as the **Sort** field.
    - iii. Choose the **Par\_ID\_T** for the **Name** property under **Locational Analysis** properties.
    - iv. Accept the defaults for the other **Locational Analysis** properties.
    - v. Choose a suitable **Search Tolerance** for the **Location Position**. If features cannot be located on the network dataset, this tolerance may need to be increased.
    - vi. Click **OK**.
  - c. To verify all Participant locations were located on the network dataset, do one of the following. If any feature has a status of **Not Located**, the search tolerance in 10.b.v may need to be increased or the feature reviewed for correct location.
    - i. For small datasets, scroll through the resulting lists of **Incidents** in the **Network Analyst Window**, looking for features with RED question marks.
    - ii. For large datasets, it may be easier to right-click on the **Incidents** in the **Network Analyst Window**, select **Open Attribute Table** and sort descending on the **STATUS** column. The **Not Located** features should sort to the top.
11. Set the properties for the analysis
  - a. In the Table of Contents, right-click **Closest Facility** and click **Properties**. This will open the Closest Facility properties dialog box.
  - b. Click on the **Analysis Settings Tab**
    - i. Choose **length (meters)** for **Impedance**.
    - ii. Choose **None** for **Default Cutoff Values**.
    - iii. Set **Facilities to Find** to **1**.
    - iv. Set the **Travel From** option to **Incident to Facility**.
    - v. Set **Allow U-Turns** to **Everywhere**.
    - vi. Set **Output Shape Type** to **True Shape**.
    - vii. Check the box to **Ignore Invalid Locations**
  - c. Click **OK**
12. To calculate the closest Alcohol Sales place to a Participant location, click the **Solve Button** on the Network Analyst Toolbar.
  - a. When Network Analyst has solved the calculations, the **Routes** layer will be populated with line segments joining each participant location to its closest alcohol sales place. The Routes attribute table contains the unique IDs for the participant and the alcohol sales place along with the network length separating them and the route name (a concatenation of the participant ID and the facility ID).
13. Join the Alcohol Sales places and the Participants to the results of the Find Closest Facility analysis.
  - a. Right-click the **Routes** layer
  - b. Select **Joins and Relates** and then click **Join**
    - i. Choose **Facility ID** as the field to base the join on
    - ii. Choose the **Alcohol Sales layer** as the **Table to Join** to this layer
    - iii. Choose the **Alc\_ID** as the field in the table to base the join on
    - iv. Click **OK**
  - c. Right-click on the **Routes** layer
  - d. Select **Joins and Relates** and then click **Join**
    - i. Choose **Incident\_ID** as the field to base the join on
    - ii. Choose the **Participant layer** as the **Table to Join** to this layer
    - iii. Choose the **Par\_ID** as the field in the table to base the join on
    - iv. Click **OK**
  - e. Right-click on the **Routes** layer
  - f. Select **Data** and then click **Export Data**
    - i. Choose this **layer's source data for the coordinate system**

- ii. Specify the **Output location**
- iii. A new shapefile will be created in the output location. This shapefile will contain the routes from each participant location to the nearest alcohol sales place. Each route will contain the attributes of the participant and the nearest facility.

Calculate the straight-line distance to the nearest alcohol sales place

To follow this protocol, you will need:

1. Participant Locations Point Feature Layer for incidents (origins)
2. Alcohol Sales Places Point Feature Layer for facilities (destinations)

Calculate the straight-line distance to the nearest

1. Start **ArcMap**
2. Click the **Add Data** button on the **Standard Toolbar**
  - a. Navigate to the Point Layers to be used in the analysis, in this case the **Participant locations** and the **Alcohol Sales Places**.
  - b. Select the **Point Layers** and click **Add** to add them to ArcMap.
3. Open **ArcToolbox** by clicking on the icon.
4. Navigate to the **Near** tool (Analysis Tools -> Proximity) and double-click to open it.
5. Click the down-arrow in the Input Features box and select the **Participant Locations** feature layer.
6. Click the down-arrow in the Near Features box and select the **Alcohol Sales Places** feature layer.
7. Leave the **Search Radius (optional)** box empty. This will guarantee that every Participant Location will have its nearest alcohol sales place found.
8. Leave the **Location (optional)** and **Angle (optional)** check boxes unchecked.
9. Click **OK** to execute the tool.
10. The tool will find the nearest alcohol sales place to each participant location and measure the straight-line distance between those points. The tool will add two attributes to the participant location attribute table, NEAR\_DIST and NEAR\_FID. The NEAR\_DIST will contain the distance, in the units of the Layers (e.g., meters, feet). NEAR\_FID will contain the feature ID of the closest alcohol sales place. Use the NEAR\_FID attribute to join the Alcohol Sales Places layer to the Participant Location layer to determine the characteristics of the nearest Alcohol Sales Place.

Join the Alcohol Sales Places Layer to the Participant Locations layer using the NEAR\_FID attribute.

1. Right-click on the **Participant Location layer** and select **Joins and Relates -> Join...**
2. Choose **NEAR\_FID** as the field to base the join on.
3. Choose the **Alcohol Sales Place layer** as the **Table to Join** to this layer.
4. Choose the **FID** attribute as the field in the table to base the join on.
5. Click **OK**. The Alcohol Sales Place attributes will be joined to the Participant locations.
6. **Right-click** on the Participant Locations Layer and select **Data -> Export Data**.
  - a. Choose this **layer's source data for the coordinate system**.
  - b. Specify the **Output Location**.
  - c. Click **OK**.

A new shapefile will be created in the output location. This shapefile will contain the participant locations and the attributes of the nearest alcohol sales place to each participant location.

## 4.12 Density of Alcohol Sales Places

### 1. Basic Concept

Like the previous protocols his protocol examines both bars and stores selling alcohol. It omits restaurants as these require significant additional purchases.

## 2. Basic Definition

Density of alcohol sales = Total number of stores or bars selling alcohol divided by the land area (excluding water).

## 3. Detailed Definition

Density of alcohol sales = Total number of stores or bars selling alcohol divided by the land area (excluding water). Using NAICS codes 7224: Drinking Places (Alcoholic Beverages) and 4453 Beer, Wine, and Liquor Stores.

## 4. Comments and Explanations

None.

## 5. GIS Approach

The GIS approach is to perform a spatial join between the measurement geographies and the alcohol sales places. This will count the number of alcohol sales places in each measurement geography. Then divide this number by the net land area of each measurement geography.

## 6. GIS Steps

The following procedures were completed using **ArcMap (ArcInfo) 9.2**.

To complete this protocol you will need:

1. **Study-site Layer** (polygon)
2. **Alcohol Sales Places Layer** (point)

Refer to protocol 2.1 for the procedures to calculate net land area (land area with water features removed)

Add the **Alcohol Sales Places** and **Study-Site layer** to an **ArcMap Document**.

1. Right-click on the **Study-Site Layer** and choose **Joins and Relates -> Join**.
2. Under the dropdown box labeled **What do you want to join to this layer?**, choose **Join data from another layer based on spatial location**.
3. In **Step 1** of the dialog box, choose the **Alcohol Sales Places layer**.
4. In **Step 2**, click the button to choose **Each polygon will be given a summary of the numeric attributes...**
5. In **Step 3**, choose a name and location for the output layer.
6. Click **OK**.
7. The output layer now contains a **Count** field with the number of alcohol sales places found in each features of the Study-Site layer.

Calculate the alcohol sales places per net land area:

1. Right-click on the **output layer** of the **spatial join** and select **Open Attribute Table**.
2. Click **Options** and choose **Add Field**.
3. Name the field **AlcDens** and change the type to **Double**.
4. Click **OK** to add the field.
5. In the **Table of Contents**, right-click on the **output layer** from the **spatial join** performed above and choose **Joins and Relates -> Join**.
6. In the dropdown box, choose to **Join Attributes** from a table.
7. In **Step 1**, choose to base the join on the field containing the unique ID of the measurement geographies.
8. In **Step 2**, load the table from the result of following **protocol 2.1, Net Land Area**.
9. In **Step 3**, choose the field in the Net Land Area Layer's table containing the unique ID of the measurement geographies.
10. Click **OK**.

11. Open the **Attribute Table** of the output layer from the spatial join, which now has the net land area table joined to it.
12. Right-click on the **AlcDens** field and choose **Field Calculator...**
13. In the Field Calculator dialog box, click the **Count** field, then click the / button, and finally click the name of the field containing the net land area.
14. Click **OK**.

The AlcDens field now contains the density of alcohol sales places (number of alcohol sales places divided by the net land area in whichever units you used).

## 5. YOUTH AND UTILITARIAN OR RECREATIONAL PHYSICAL ACTIVITY

*Note: Many of these protocols draw on work previously done in the companion physical activity protocols but were updated and modified for this study by Ann Forsyth (selection of protocols, concepts, definitions) and David Van Riper (GIS steps).*

Research on adult physical activity has mixed results but focuses attention on a number of aspects of the environment including density, pedestrian infrastructure, land-use mix, street pattern, and recreational facilities. Research on youth focuses on many similar things.

### DENSITY

#### 5.1 Raw Population per Unit Land Area: See NEAT GIS Protocol 3.1

This uses the existing *NEAT GIS Protocol*. Be sure to use the latest version--4.0 or later and preferably 5.0 or later--as these versions correct errors, simplify some steps, or at least indicate where protocols are in need of revision.

#### 5.2 Population per Unit Land Area (without water): See NEAT GIS Protocol 3.2 (2010 EAT-III & ECHO)

This uses the existing *NEAT GIS Protocol*. Be sure to use the latest version--4.0 or later and preferably 5.0 or later--as these versions correct errors, simplify some steps, or at least indicate where protocols are in need of revision.

#### 5.3 Residential Population in Residential Parcels (Residential Density) (without water): based on NEAT GIS Protocol 3.4 but updated

*Note: This protocol was significantly revised for Version 1.3. Some earlier versions of this protocol used the Geoprocessing Wizard and Xtools. ArcGIS 9.2 has replaced the Geoprocessing Wizard with the Intersect Tool, and it offers a Calculate Geometry dialog box, negating a need for Xtools. The protocol detailed below has been tested in ArcGIS 9.2.*

##### *1. Basic Concept*

This density calculation reflects the kinds of densities that are talked about by developers, rather than the experience of place. That is, while people experience a whole environment – including roads and non-residential uses – developers build on parcels and density is often debated in those terms.

We propose to do some measurements using this definition of density to see if it has any relation at all to actual physical activity in a specific place.

## 2. Basic Formula

Residential Population in Residential Parcels = Persons in housing units per unit land area in residential parcels.

## 3. Detailed Formula

Residential Population in Residential Parcels = Persons in housing units as measured in the US Census at the block level per unit land area in residential parcels, excluding rights of ways, water bodies, and land not in parcels.

## 4. Comments and Explanations

This calculation requires that the parcels layer contain land-use information that can identify residential parcels. Also, where census blocks are cut by the end of the measurement geography, the population is apportioned according to the percentage of land area falling inside and outside the line.

## 5. GIS Approach

Use a definition query to display only residential parcel layer. Intersect these residential parcels with the measurement geographies. Summarize the resulting layer's attribute table by measurement geography and sum the area. Apportion the census population by intersecting the census blocks with the measurement geographies. Summarize the resulting layer's attribute table by measurement geography ID and sum the population. For each measurement geography, divide the sum of apportioned population by the sum of residential hectares.

## 6. GIS Steps

The following procedures were completed using **ArcMap (ArcInfo) 9.2**.

To follow this protocol you will need:

1. **Study-site layer (polygon)** with unique ID field
2. **Parcels Layer (polygon)**
3. **Census Block Layer (polygon)** with field containing population

Use a **Definition Query** to display only residential parcels

1. In the **Table of Contents** (the pane with the list of layers), right-click on the **Parcels Layer** and choose **Properties**.
2. Go to the **Definition Query** tab and click **Query Builder**.
3. Construct an SQL expression that applies to whichever field contains the land-use data of the parcels and selects the values that identify residential uses.
4. Click **Ok** to close the Query Editor and then **OK** again to close the Layer Properties window.
5. Ensure that only the residential parcels in your Parcels Layer are displayed.

Intersect residential parcels with the study-site layer:

1. Add the **Study-Site Layer** to your **Map Document**.
2. Open **ArcToolbox** and navigate to the **Intersect** tool (Analysis Tools -> Overlay -> Intersect). Double-click the Intersect tool to open it.
  - a. For the **Input Features**, click on the down-arrow and select the **Land-Use Parcels Layer** from the list of Layers.
  - b. Repeat step 2.a and select the **Study-Site Layer**.
  - c. Specify a name and location for the output layer in the **Output Feature Class** box.
  - d. Set the **JoinAttributes** drop-down box to **ALL**.

- i. The **ALL** option will transfer all the attributes from the input features to the output feature class.
- e. Leave the **XY tolerance** box empty.
- f. Set the **Output Type** to **INPUT**.
  - i. The **INPUT** option will return intersections with the same geometry type as the Input Feature with the lowest geometry dimension.
- g. Click **OK** to execute the Intersect. The output feature class will be added to the Map Document.
- h. The **Parcels** will now be clipped to the study-site boundaries and be assigned the ID associated with the study-site in which it is located. Note that parcels which exist in two or more overlapping study-sites will be represented by two or more identical (except for Study-Site ID number) rows in the Attribute Table.

Calculate the area of the residential parcels within each study-site:

1. Right-click on the layer created by the Intersect tool and select **Open Attribute Table**.
2. Click on the **Options** button and select **Add Field...**
3. Type **Hectares** in the **Name** field and set the **Type** to **Double**.
4. Click **OK**.
5. Right-click on the **Hectares** field and select **Calculate Geometry...**
6. Set the **Property:** box to **Area**.
7. Set the **Coordinate System** to “Use coordinate system of the data source:”.
8. Set the **Units** to **Hectares [ha]**.
9. Click **OK**. This will calculate the area, in hectares, of each land-use type within a given study-site.

Determine the total area of residential parcels within each study-site:

1. Open the attribute table of the layer created by the Intersect tool.
2. Right-click on the **study-site ID** and select **Summarize...**
3. In the **Summarize...** dialog box, click on the **plus** sign next to the **Hectares** field.
4. Click the **checkbox** next to **Sum**. This will add the hectares of residential parcels in each study-site.
5. Specify a name and location for the output file.
6. Click **OK**. The output table will be added to the Map Document.

Create the **Census Block Layer with water features** removed:

1. Add the **Census Block Layer** and **Water Features** layer to your Map Document.
2. Open **ArcToolbox** and navigate to the **Erase** tool (Analysis Tools -> Overlay). Open the **Erase** tool by double-clicking it.
3. In the **Input Features** drop-down box, select the **Census Block layer**.
4. In the **Erase Features** drop-down box, select the **Water Features layer**.
5. Specify the location and name of the output feature class.
6. Click **OK**.
7. The output feature class will be generated and added to the map document.

Determine the **apportioned census population figure** for each site:

1. Calculate the area for the census block layer with the water removed.
  - a. Right-click on the **census block layer with water removed** and select **Open Attribute Table...**
  - b. Click on the **Option** button and select **Add Field...**
  - c. Type **Hectares** in the **Name** field and set the **Type** to **Double**.
  - d. Click **OK**.
  - e. Right-click on the **Hectares** field and select **Calculate Geometry...**
  - f. Set the **Property:** box to **Area**.
  - g. Set the **Coordinate System** to “Use coordinate system of the data source:”
  - h. Set the **Units** to **Hectares [ha]**.
  - i. Click **OK**.
2. Intersect the census block layer with water removed with the Study-Site layer.
  - a. Open **ArcToolbox** and navigate to the **Intersect** tool (Analysis Tools -> Overlay -> Intersect). Double-click the Intersect tool to open it.

- b. For the **Input Features**, click on the down-arrow and select the **Census Block Layer with Water Features removed**.
  - c. Repeat 2.b and select the **Study-Site layer**.
  - d. Specify a name and location for the output layer in the **Output Feature Class** box.
  - e. Set the **JoinAttributes** drop-down box to **ALL**.
    - i. The **ALL** option will transfer all the attributes from the input features to the output feature class.
  - f. Leave the **XY Tolerance** box empty.
  - g. Set the **Output Type** to **INPUT**.
    - i. The **INPUT** option will return intersections with the same geometry type as the Input Feature with the lowest geometry dimension.
  - h. Click **OK** to execute the **Intersect**. The output feature class will be added to the Map Document.
3. Update the areas of the clipped census block layer with water features removed.
  - a. Open the **Attribute Table** of the **clipped Census Block Layer with water features removed** created in the previous step.
  - b. Click on **Options** and choose **Add Field...**
  - c. Type **OrigHect** in the **Name** field and set the **Type** to **Double**.
  - d. Right-click on the **OrigHect** field.
  - e. Choose **Field Calculator...**
  - f. In the **Field Calculator**, click **Hectares** and click **OK**.
  - g. You have now copied the values from **Hectares** to **OrigHect**.
  - h. Right-click on the **Hectares** field and select **Calculate Geometry...**
    - i. Set the **Property:** box to **Area**.
    - ii. Set the **Coordinate System** to “Use coordinate system of the data source:”
    - iii. Set the **Units** to **Hectares [ha]**.
    - iv. Click **OK**.
4. Perform the population apportionment.
  - a. Open the Attribute table of the clipped Census Block Layer with water features removed.
  - b. Click on the **Option** button and select **Add Field...**
  - c. Type **PopSplit** in the **Name** field and set the **Type** to **Double**.
  - d. Click **OK**.
  - e. Right-click on the **PopSplit** field and select **Field Calculator...**
  - f. In the Field Calculator, click **Hectares**, then click the “/” operator, then click **OrigHect**, then click the “\*” operator, and finally click the name of the **Population** field.
  - g. Click **OK**.
5. Calculate the total population of each study-site.
  - a. Open the Attribute table of the clipped Census Block Layer with water features removed.
  - b. Right-click on the attribute containing the **study-site ID** and choose **Summarize...**
    - i. In the box beneath **Choose one or more summary statistics**, click the **plus** sign next to **PopSplit**.
    - ii. Click the **checkbox** next to **Sum**.
    - iii. Choose a name and location for the **Output Summary Table**.
    - iv. Click **OK**.
  - c. The output summary table will contain the apportioned population sum for each study-site.

Perform the final calculation:

1. Open the output summary table created in the previous step.
  - a. Click the **Option** button and select **Add Field...**
  - b. Type **ResPop** in the **Name** field and set the **Type** to **Double**.
  - c. Click **OK**.
2. Join the table containing the area of residential parcels within each study-site to the table containing the apportioned population in each study-site.
  - a. Right-click on the **apportioned population table**, select **Joins and Relates...**, and then **Join...**
  - b. Under **1. Choose the field in this layer that the join will be based on:**, click the down-arrow and select the **Study-Site ID**.

- c. Under **2. Choose the table to join to this layer, or load the table from disk:**, click on the down-arrow and select the table containing the area of residential parcels within each study-site.
  - d. Under **3. Choose the field in the table to base the join on:**, click the down-arrow and select the **Study-Site ID**.
  - e. Click **OK** to execute the join.
3. Open the table containing the apportioned population in each study-site. It will now have the residential parcels area joined to it.
- a. **Right-click** on the **ResPop** attribute and select **Field Calculator...**
  - b. In the **Field Calculator**, click the **PopSplit** attribute, then click the “/” operator, and then click the attribute containing the sum of the residential parcels area in each study-site.

The ResPop field now contains the population per hectare of residential land in the study-site.

## 5.4 Employment Per Unit Land Area: Based on NEAT GIS Protocol 3.6 but updated

*Note: This was based on the existing NEAT GIS Protocol 3.6 from version 4.1 of the manual but steps were updated significantly in Version 1.3. GIS steps were updated in version 2.0 though this protocol is not being used*

### 1. Basic Concept

While residential population is the most often used density measure, and an overall activity density is likely important, a number of researchers have propose that employment density may be associated with walking. In downtown areas this is obvious as congestion makes automobiles less viable for transportation. In terms of the residential populations in the Twin Cities Walking Study, however, employment density in these neighborhoods is more likely a proxy of mixed use.

A later version of this manual will address prior studies using various employment density measures, although many were only of land in parcels, e.g., Cervero and Kockelman (1996, 8), Ewing (1995, 55), and Frank and Pivo (1994, 46-48).

### 2. Basic Formula

Employment per Unit Land Area = Total employees per unit land area (excluding water).

### 3. Detailed Formula

Employment Per Unit Area = Total employees per unit land area (excluding water).

### 4. Comments and Explanations

Area of water features is excluded in the calculation of area. The methods explained below are narrowly tailored to the nature of the employment data we purchased.

Employment is from Business Analyst InfoUSA with some checking of data.

### 5. GIS Approach

The approach to this measurement is to perform a spatial join between the employment data and the study sites for which employment density is needed. When doing the spatial join, calculate the sum of all employment. Finally, divide the total employment for each study site by its area.

## 6. GIS Steps

The following procedures were completed using **ArcMap (ArcInfo) 9.3.1**.

To follow this protocol you will need:

1. **Participant Buffers if already created or Study-Site Layer** (polygon) with unique ID field
2. **Employment Data Layer** (point)
3. **Water Features Layer** (polygon)

If the Participant Buffers have already been created, use those for this protocol. If not, use NEAT Protocol 2.1 Net Land Area (without water) to create the participant buffers.

Find the employment data points within the study-sites (without layer)

1. Add the **Participant buffers** and the **Employment Data layer** to an ArcMap Document.
2. Right-click on the **Participant buffer** and choose **Joins and Relates -> Join...**
3. Under the drop-down box labeled **What do you want to join to this layer?** choose **Join data from another layer based on spatial location**.
4. In **Step 1** of the dialog box, choose the **Employment Data layer**.
5. In **Step 2**, click the button to choose **Each polygon will be given a summary of the numeric attributes...** and also click the check-box next to **Sum**.
6. In **Step 3**, choose a name and location for the output layer.
7. Click **OK**.
8. The output layer now contains a **Count** field with the number of Businesses found within each Study Site. The **Sum\_NUMBER\_EMP** attribute contains the sum of employment for those businesses within each Study Site.

Calculate the employment per unit land area

1. Add an attribute to hold the **Employment per Unit Land Area** value to the Participant buffer.
  - a. Right-click on the Participant buffer and select **Open Attribute Table**.
  - b. Click the **Options** button and select **Add Field...**
  - c. Name the field **EmpPerHect** and change the **Type** to **Double**.
  - d. Click **OK**.
2. Join the output layer from the previous procedure to the Study-Site Layer (without water).
  - a. Right-click on the Participant buffer and choose **Joins and Relates -> Join**.
  - b. Under the dropdown box labeled **What do you want to join to this layer?** choose **Join attributes from a table**.
  - c. Choose the unique ID for each study site as the **field to base the join on**.
  - d. Choose the output layer from the previous procedure as the **Table to Join to this layer**.
  - e. Choose the unique ID for each study site as the **field to base the join on**.
  - f. Click **OK**.
3. Perform the final calculation
  - a. Right-click the **EmpPerHect** field in the **Participant buffer** and select **Field Calculator...**
  - b. In the **Field Calculator**, click the field **Sum\_Employment**, click the **/** button, and then click the **Hectares** field.
  - c. Click **OK**.

The **EmpPerHect** field now contains the number of employees per hectare (excluding the water of water features).

## PEDESTRIAN INFRASTRUCTURE

In these protocols we only deal with topics for which there is existing data.

## 5.5 Distance to Nearest Transit Stop: Based on NEAT GIS Protocol 4.10 but updated (2010 ECHO)

*Note: The steps were updated in Version 1.3. It was based on the existing NEAT GIS Protocol 4.10 in version 4.1 of the manual.*

### 1. Basic Concept

People walk to transit. The distance to the nearest transit stop may be associated with physical activity.

This relates to the TREC-IDEA survey question:

- SS178 About how long would it take to get from your home to the nearest bus stop if you walked? (Adapted from NEWS B20 (14))

### 2. Basic Definition

Distance to Nearest Facility = Straight line or network distance to the nearest transit stop.

### 3. Detailed Definition

Distance to Nearest Facility = Straight line or network distance to the centroid of the nearest transit stop using bus stop and light-rail stop data from the Metropolitan Council.

### 4. Comments and Explanations

This is done using Network Analyst in ArcMap (ArcInfo) 9.3.1 using a function called OD Cost Matrix. You can specify a point layer to use as your “origins” and another point layer to serve as your destinations. It will then take the road network and calculates the network distance from each origin to all destinations. The function then ranks the distances from 1 (shortest network distance) to N (longest network distance) (and it can do this using travel costs as well, if certain type of roads were considered more or less easy to use, for instance).

For points that do not fall on the network, there is an option in the Load Locations dialog box that allows the user to decide how far away from the network to search for points to use in the processing.

We used all transit stops—some may be more active than others.

### 5. GIS Approach

The approach for this measure is to load a set of origins (in this case, participant locations) and destinations (transit stops). Then use the OD Cost Matrix function in Network Analyst to calculate the network distance from each origin to the all transit stops.

### 6. GIS Steps

The following procedures were completed in **ArcMap (ArcInfo) 9.3.1**.

To follow this protocol you will need:

1. **Road Network** dataset

2. **Transit Stop Locations Point Feature Layer** for facilities
3. **Participants' Locations Point Feature Layer** for incidents
4. **Network Analyst Extension** for ArcGIS 9.3.1

Calculate the Network Distance to the nearest transit stop:

1. Use LEAN Protocol 2.6 to determine the network distance to the nearest transit stop. The participant locations are the XXX and the transit stop locations are the features of interest

Calculate straight-line distance to nearest transit stop

To follow this protocol, you will need:

1. **Participant Locations Point Feature Layer** for incidents (origins)
2. **Transit Stop Point Feature Layer** for facilities (destinations)

Calculate the straight-line distance to the nearest transit stop

1. Start **ArcMap**.
2. Click the **Add Data** button on the **Standard Toolbar**.
  - a. Navigate to the Point Layers to be used in the analysis, in this case the **Participant locations** and the **Transit Stops**.
  - b. Select the Point Layers and click **Add** to add them to ArcMap.
3. Open **ArcToolbox** by clicking on the icon.
4. Navigate to the **Near** tool (Analysis Tools -> Proximity) and double-click to open it.
5. Click the down-arrow in the Input Features box and select the **Participant Locations** feature layer.
6. Click the down-arrow in the Near Features box and select the **Transit Stops** feature layer.
7. Leave the **Search Radius (optional)** box empty. This will guarantee that every Participant Location will have its nearest transit stop found.
8. Leave the **Location (optional)** and **Angle (optional)** check boxes unchecked.
9. Click **OK** to execute the tool.
10. The tool will find the nearest transit stop to each Participant Location and measure the straight-line distance between those points. The tool will add two attributes to the participant location attribute table, NEAR\_DIST and NEAR\_FID. NEAR\_DIST will contain the distance, in the units of the Layers (e.g., meters, feet). NEAR\_FID will contain the feature ID of the closest transit stop. Use the NEAR\_FID attribute to join the Transit Stop Layer to the Participant Location layer to determine the characteristics of the nearest transit stop.

Join the Participant Location Layer to the Transit Stop Layer using the NEAR\_FID attribute.

1. **Right-click** on the Participant Location layer and select **Joins and Relates -> Join...**
2. Choose **NEAR\_FID** as the field to base the join on.
3. Choose the **Transit Stop** layer as the Table to Join to this layer.
4. Choose the **FID** attribute as the field in the table to base the join on.
5. Click **OK**. The Transit Stop attributes will be joined to the Participant locations.
6. **Right-click** on the Participant Locations Layer and select **Data -> Export Data**.
  - a. Choose this layer's source data for the coordinate system.
  - b. Specify the **Output Location**.
  - c. Click **OK**.

A new shapefile will be created in the output location. This shapefile will contain the participant locations and the attributes of the nearest transit stop to each participant location.

## 5.6 Transit Stop Density: See NEAT GIS Protocol 4.11 (2010 EAT-III)

*This uses the existing NEAT GIS Protocol. Be sure to use the latest version--4.0 or later and preferably 5.0 or later--as these versions correct errors, simplify some steps, or at least indicate where protocols are in need of revision.*

## LAND-USE MIX

### 5.7 Percentage of Total Parcel Area in Major Land Uses (residential, commercial, office, industrial, institutional, park and recreation, vacant): Based on NEAT GIS Protocol 5.1 (2010 EAT-III))

*This is based on the existing NEAT GIS Protocol 5.1 updated for version 4.1 of the protocols however as of version 1.1 we are debating how to exclude water most effectively given changes in GIS software. This protocol will be updated before actual measurement occurs. It was updated again in Version 1.3.*

#### 1. Basic Concept

A simple measure of land-use percentage in major uses, this is less a measure of mix per se than the relative amount of each land use: residential, commercial, office, industrial, institutional, park and recreation, vacant.

#### 2. Basic Formula

Percentage of Total Parcel Area in Major Land Uses = Total area in each of seven major land-use categories (residential, commercial, office, industrial, institutional, park and recreation, vacant) divided by total land area in parcels.

#### 3. Detailed Formula

Percentage of Total Parcel Area in Major Land Uses = Total area in parcels in each of the seven major land-use categories (residential, commercial, office, industrial, institutional, park and recreation, vacant) divided by total land area in parcels, with water area removed. Note that some land uses (agricultural, airport, non-roadbed right of way) are not included in our seven major land-use categories, but are included in the total land area figures.



Fig. 5.1. Parcels coded with the seven major land-use categories:

Residential – yellow  
Commercial – red  
Institutional – purple  
Office – blue  
Park and recreation – green  
Industrial – dark grey  
Vacant - not marked

#### 4. Comments and Explanations

Land uses were assigned at the parcel level and reflected the most detailed data available. These data were then generalized to our seven major land-use categories.

Complicating factors may, however, be unique to our data:

- a. Two different water layers were used for exclusions (see earlier discussion in chapter 1).
- b. We used two methods for assigning land uses, depending on whether the parcels were in our original Context Areas or fell within our extended buffer areas (see appendix 5C for details on how this was done).
- c. In general, we field-checked in the context areas, and where large buffers fell outside the context areas, we felt that the errors from using Metropolitan Council data would not be so large.

#### 5. GIS Approach

The parcel layer (with areas of water removed) was intersected with the measurement geographies and the areas of the parcels recalculated to account for those that were split by the study site boundaries. The land uses associated with each parcel were generalized into seven major land-use categories. For each study site, the total area of each land-use category was summarized. The percentages of the total parcel area for each study site were then calculated.

#### 6. GIS Steps [Note these steps are partially updated and should not be used!!!!]

The following procedures were completed using **ArcMap (ArcInfo) 9.2**.

To complete this protocol you will need:

1. **Study-Site Layer** (polygon)
2. **Land-Use Parcels Layer** (polygon)
3. **Water Features Layer** (polygon)
4. **Microsoft Excel** or other spreadsheet program

Determine Net Land Area (without water) for each Site: Follow the steps outlined in the protocol above

Convert land uses into seven categories:

1. Add the **Land-Use Parcel Layer** to an **ArcMap document**.
2. Right-click on the Land-Use Parcel layer and select **Open Attribute Table**.
3. Click on the **Options** button and select **Add Field**.
4. Name the field **LUC7**.
5. Select **Text** as **Type** and set the **Length** to 20.
6. Reclassify your parcels so that the land uses are generalized into the seven major land-use categories (residential, commercial, office, industrial, institutional, park and recreation, vacant). How this is done depends on the level of detail of your existing land-use categories – for example, if you have Small-scale Commercial, Strip Commercial, and Shopping Center land uses, these would all be generalized to a new land-use code of Commercial.
7. Enter the new land-use codes in the **LUC7** field.
  - a. Click **Options** and choose **Select by Attributes...**
    - i. Construct an SQL Query in the Dialog box as follows: “LUSE2005” = 100 OR “LUSE2005” = 201 OR “LUSE2005” = 203
    - ii. Click **Close** to execute the Query.

- iii. This will select all parcels classified as Agriculture, Major Highways, or Airports.
  - iv. Right-click on the LUC7 field and **select Field Calculator...**
  - v. Set **LUC7** equal to **OTHER**.
- b. Click **Options** and choose **Select by Attributes...**
  - i. Construct an SQL query in the Dialog box as follows: "LUSE2005" = 111 OR "LUSE2005" = 112 OR "LUSE2005" = 113 OR "LUSE2005" = 116 OR "LUSE2005" = 114 OR "LUSE2005" = 115
  - ii. Click **Close** to execute the Query.
  - iii. This will select all parcels classified as Farmsteads, Single-Family Residential, or Multifamily Residential.
  - iv. Right-click on the LUC7 field and select **Field Calculator...**
  - v. Set **LUC7** equal to **RESIDENTIAL**.
- c. Click **Options** and choose **Select by Attributes...**
  - i. Construct an SQL query in the Dialog box as follows: "LUSE2005" = 120 OR "LUSE2005" = 143
  - ii. Click **Close** to execute the Query.
  - iii. This will select all parcels classified as Commercial – Retail or Mixed-Use Commercial.
  - iv. Right-click on the LUC7 field and select **Field Calculator...**
  - v. Set **LUC7** equal to **COMMERCIAL**.
- d. Click **Options** and choose **Select by Attributes...**
  - i. Construct an SQL query in the Dialog box as follows: "LUSE2005" = 130 OR "LUSE2005" = 141
  - ii. Click **Close** to execute the Query.
  - iii. This will select all parcels classified as Commercial – Office or Mixed-Use Residential.
  - iv. Right-click on the LUC7 field and select **Field Calculator...**
  - v. Set **LUC7** equal to **OFFICE**.
- e. Click **Options** and choose **Select by Attributes...**
  - i. Construct an SQL query in the Dialog box as follows: "LUSE2005" = 142 OR "LUSE2005" = 151 OR "LUSE2005" = 153 OR "LUSE2005" = 202
  - ii. Click **Close** to execute the Query.
  - iii. This will select all parcels classified as Mixed-Use Industrial, Industrial and Utility, Extractive, or Railway.
  - iv. Right-click on the LUC7 field and select **Field Calculator...**
  - v. Set **LUC7** equal to **INDUSTRIAL**.
- f. Click **Options** and choose **Select by Attributes...**
  - i. Construct an SQL query in the Dialog box as follows: "LUSE2005" = 160.
  - ii. Click **Close** to execute the Query.
  - iii. This will select all parcels classified as Institutional.
  - iv. Right-click on the LUC7 field and select **Field Calculator...**
  - v. Set **LUC7** equal to **INSTITUTIONAL**.
- g. Click **Options** and choose **Select by Attributes...**
  - i. Construct an SQL query in the Dialog box as follows: "LUSE2005" = 170 OR "LUSE2005" = 173
  - ii. Click **Close** to execute the Query.
  - iii. This will select all parcels classified as Park, Rec, and Preserve or Golf Courses.
  - iv. Right-click on the LUC7 field and select **Field Calculator...**
  - v. Set **LUC7** equal to **PARK AND REC**.
- h. Click **Options** and choose **Select by Attributes...**
  - i. Construct an SQL query in the Dialog box as follows: "LUSE2005" = 210
  - ii. Click **Close** to execute the Query.
  - iii. This will select all parcels classified as Undeveloped.
  - iv. Right-click on the LUC7 field and select **Field Calculator...**
  - v. Set **LUC7** equal to **VACANT**.
- i. Click **Options** and choose **Select by Attributes...**
  - i. Construct an SQL query in the Dialog box as follows: "LUSE2005" = 220

- ii. Click **Close** to execute the Query.
- iii. This will select all parcels classified as Water.
- iv. Right-click on the LUC7 field and select **Field Calculator...**
- v. Set **LUC7** equal to **WATER**.

Remove water from the Land-use Parcels Layer.

1. Add the **Land-Use Parcel Layer** and the **Water Features Layer** to an ArcMap document.
2. Open **ArcToolbox** and navigate to the **Erase** tool (Analysis Tools -> Overlay). Open the Erase tool by double-clicking it.
3. In the **Input Features** drop-down box, select the **Land-Use Parcel layer**.
4. In the **Erase Features** drop-down box, select the **Water Features layer**.
5. Specify the location and name of the output feature class.
6. Click **OK**.
7. The output feature class will be generated and added to the Map Document.

Use a **Definition Query** to exclude **Land-use water areas** from the **Land-Use Parcels Layer**. This will eliminate water polygons that are in the land-use parcels layer but were missed during the previous step.

1. In the **Table of Contents**, right-click on **Land-use Parcels layer with water removed** and select **Properties**.
2. Go to the **Definition Query** tab and click **Query Builder**.
3. Construct an **SQL expression** that applies to whichever field contains the land-use code and exclude values that represent water.
4. Click **OK** to close the **Query Builder** and **OK** to close the **Layer Properties** window.
5. Ensure that water parcels in the Land-use Parcels layer with water removed are excluded.
6. Right-click on the **Land-use Parcels layer with water removed** and select **Data -> Export Data...**
7. Click the radio-button next to “**Use the same Coordinate System as this layer’s source data**” and specify a location and name for the output shapefile.
8. Click **OK**. This will create a shapefile with water features removed as well as water parcels removed.

Intersect parcels with study-site layer:

1. If the **Study-Site Layer** does not have unique IDs or names for each site, create them now.
  - a. Right-click on the **Study-Site Layer** and select **Open Attribute Table**.
  - b. Click on the **Options** button and select **Add Field**.
  - c. Name the field **Study\_ID**.
  - d. Select **Short Integer** as **Type** and accept **default (0)** for **Precision**.
  - e. Click **OK**.
  - f. Right-click on the **Study\_ID** field and select **Field Calculator...**
  - g. Set the **Study\_ID** equal to **[FID] +1**.
  - h. Click **OK**.
2. Open **ArcToolbox** by clicking on the icon and navigate to the **Intersect** tool (**Analysis Tools -> Overlay -> Intersect**). Double-click the **Intersect** tool to open it.
  - a. For the **Input Features**, click on the down-arrow and select the **Land-Use Parcels Layer with water features removed and water parcels excluded** from the list of Layers.
  - b. Repeat 2.a and select the **Study-Site Layer**.
  - c. Specify a name and location for the output layer in the **Output Feature Class** box.
  - d. Set the **JoinAttributes** drop-down box to **ALL**.
    - i. The **ALL** option will transfer all the attributes from the input features to the output feature class.
  - e. Leave the **XY Tolerance box** empty.
  - f. Set the **Output Type** to **INPUT**.
    - i. The **INPUT** option will return intersections with the same geometry type as the Input Feature with the lowest geometry dimension.
  - g. Click **OK** to execute the Intersect. The output feature class will be added to the Map Document.
  - h. The parcels will now be clipped to the study-site boundaries and be assigned the ID associated with the study-site in which it is located. Note that parcels which exist in two or more overlapping study

sites will be represented by two or more identical (except for Study-Site ID number) rows in the Attribute Table.

Dissolve the intersect results to create unique combinations of land use and study-site ID:

1. In ArcToolbox, find the **Dissolve** tool by navigating through **Data Management -> Generalization**
  - a. **Input Features** are the result of the Parcels – Study-site intersection.
  - b. Specify a name and location for the output layer.
  - c. Under **Dissolve\_Field(s)**, click the checkbox next to **LUC7** and the **Study-Site ID field**.
  - d. Ensure the **Multipart** option (at the bottom of the dialog box) is checked.
  - e. Click **OK**.
  - f. The output layer will contain the polygons for each land-use type within a study-site.

Calculate the area of each land-use class contained within each study-site:

1. Right-click on the layer created by the Dissolve tool and select **Open Attribute Table...**
2. Click the **Options** button and select **Add Field...**
3. Type **Hectares** in the **Name** field and set the **Type** to **Double**.
4. Click **OK**.
5. Right-click on the **Hectares** field and select **Calculate Geometry...**
6. Set the **Property:** box to **Area**.
7. Set the **Coordinate System** to “**Use coordinate system of the data source:**”.
8. Set the **Units** to **Hectares [ha]**.
9. Click **OK**. This will calculate the area, in hectares, of each land-use type within a given study-site.

Calculate land-use percentages for each site:

1. Open **ArcToolbox** and find the **Pivot Table** tool by navigating through **Data Management Tools -> Table**. Double-click on the Pivot Table tool to open.
2. Click on the down-arrow button by **Input Table** and select the **dissolved layer**.
3. The **Input Field** is the **unique ID for the study-site**.
4. The **Pivot Field** is the field containing the **land-use codes**.
5. The **Value Field** is the field containing the **Hectares** values.
6. Specify the name and location of the output pivot table.
7. Click **OK**. This function will create a table with one row for each study-site and a column for every land-use type. If a land-use type is found in a study-site, the area of that land-use type will be contained in the cell.
8. Right-click on the study-site layer and select **Open Attribute Table...**
9. Add an attribute that will contain land-use percentages for each Land Use type.
  - a. Click the **Option** button and select **Add Field...**
  - b. Change the name to **Perc\_<Land-Use\_Type>**, where **<Land-Use\_Type>** is one of the seven land-use type. Set the **Type** to **Double** and click **OK**.
  - c. Repeat steps 9a and 9b for the other six land-use type.
10. Join the table created by the Pivot Table tool to the study-site attribute table.
  - a. Right-click on the **study-site attribute table** and select **Joins and Relates -> Join...**
  - b. Under **What do you want to join to this layer?**, click the drop-down arrow and select **Join attributes from a table**.
  - c. Select the **unique study-site ID** for **1. Choose the field in this layer that the join will be based on:**
  - d. Under **2. Choose the table the join this layer, or load the table from disk:**, choose the table created by the Pivot Table tool.
  - e. Select the **unique study-site ID** for **3. Choose the field in the table to base the join on:**
  - f. Click **OK**.
11. Right-click on the study-site layer and select **Open Attribute Table...** The pivot table should be joined to the study-site layer.
12. Calculate the percentage of total parcel area in each land use.
  - a. For each land-use percentage attribute, right-click on the attribute and select **Field Calculator...**
  - b. Click on the **field holding the hectares of the particular land-use**, then click the **/** button, then click the **field holding the total hectares for the study-site**, then click the **\*** button, and finally type **100**.
  - c. Click **OK**. This will calculate the percentage of land parcel area in the particular land-use type.

- d. Repeat for all other land-use types.

## 5.8 Retail Employment Density: Updated from on NEAT GIS Protocol 5.11 (EAT-III)

*This uses the existing NEAT GIS Protocol 5.11 from Version 4.1 of the protocols. GIS steps were updated in version 2.0 though it is not being used in EAT-III or ECHO.*

### 1. Basic Concept

Retail uses are thought to promote walking.

### 2. Basic Formula

Retail Employment per Unit Area = Total retail employees per unit land area (excluding water).

### 3. Detailed Formula

Retail Employment per Unit Area = Total retail (NAICS 44-45) employees per unit land area (excluding water).

### 4. Comments and Explanations

We used SIC codes to correspond with earlier research. In later versions of these protocols we will provide the NAICS equivalent.

Retail data came from Business Analyst InfoUSA but were checked against other employment data.

In an earlier version of the protocols we proposed that the measure be made in increments of 100\*100-meter grid cells. We gained access to point data, however, and could then use standard buffers.

### 5. GIS Approach

Divide the total retail employment in each buffer by that buffer's area (excluding water).

### 6. GIS Steps

The following procedures were completed using ArcMap (ArcInfo) 9.3.1.

To follow this protocol you will need:

1. **Participant Buffer Layers** (polygon) with unique ID field
2. **Business Analyst InfoUSA Layer** (point)
3. **Water Features Layer** (polygon)

Query the employment data to show only retail businesses:

1. Add the Business Analyst InfoUSA **Layer** to your **Map Document**.
2. Right-click on the Business Analyst InfoUSA **Data Layer** in the **Table of Contents** and choose **Properties**.
3. Click the **Definition Query** tab.
4. Click on the **Query Builder** button.
5. Construct a query that will identify all retail employment businesses.
  - a. Click NAICS\_EXT from the list of variables.
  - b. Click the LIKE button.
  - c. Type in '44%'
  - d. Click the OR button

- e. Click NAICS\_EXT again from the list of variables
- f. Click the LIKE button
- g. Type in '45%'

6. Click **OK** to close the **Query Builder** and **OK** again.
7. The **Employment Data Layer** should be updated to show only retail businesses in the data view.

Use Protocol 2.1 to create a participant buffer layer with the water feature removed if it has not been created already.

Perform a spatial join between the study-site layer and employment layer:

1. Right-click the Participant Buffer **Layer** and choose **Joins and Relates**→**Join**.
2. In the top dropdown box, make sure it is set to **Join data from another layer based on spatial location**.
3. In the next item down, select the Business Analyst InfoUSA **Layer** to be the layer to join to the buffers.
4. Select **Each polygon will be given a summary of the numeric attributes** and check the box below next to **Sum**.
5. At the bottom, choose a name and location for the output file.
6. Click on **OK**.

The resulting file will have a field in its **Attribute Table** called **Sum\_NUMBER\_EMP** or similar (depending on the name of the field containing the number of employees in the original employment layer). The new layer should have the same number of features as the **Study-Site Layer**.

Perform the final calculation of the number of retail employees per hectare (excluding the area of water features).

1. Open the attribute table of the output file created in the previous step.
2. Click on the **Option** button and select **Add Field...**
3. Name the field **RetPerHect** and set the type to **Double**.
4. Right-click on the **RetPerHect** field and select **Field Calculator...**
5. In the **Field Calculator**, click on the field containing the sum of retail employees, click the / button, and then click the **Hectares** field.
6. Click **OK**.

The **RetPerHect** field now contains the number of employees per hectare (excluding the area of water features).

## 5.9 Distance to Nearest Facility (Mentioned in the Survey): Stores in Total, Hardware Stores

*Note this builds on the NEAT GIS Protocols 5.14 but has been modified to reflect the needs and interests of youth. It looks at to specific issues: total stores (including hardware stores) and hardware stores. Hardware stores are separated out because we were trying to match a question in the TREC-IDEA parent survey and were already measuring the other destinations mentioned in the survey. GIS steps were updated in version 2.0 though it is not being used in EAT-III or ECHO.*

### 1. Basic Concept

This related to survey questions will allow us to analyze perceived versus real distances.

- Ps 65/66 In the past month, how many times did you buy food/sweetened beverage at a convenience store, gas station, hardware store, or a vending machine?
- SS176 About how long would it take to get from your home to the nearest store (video, clothes, pharmacy) if you walked? (Adapted from NEWS B16 (14))

The nearest store will be classified as using the following NAICS codes explained at <http://www.census.gov/epcd/naics02/N2SIC44.HTM>:

441 Motor Vehicle and Parts Dealers  
 442 Furniture and Home Furnishings Stores  
 443 Electronics and Appliance Stores  
 444 Building Material and Garden Equipment and Supplies Dealers  
 445 Food and Beverage Stores  
 446 Health and Personal Care Stores  
 447 Gasoline Stations  
 448 Clothing and Clothing Accessories Stores  
 451 Sporting Goods, Hobby, Book, and Music Stores  
 452 General Merchandise Stores  
 453 Miscellaneous Store Retailers

Hardware stores are defined as 44413 [Hardware Stores](#) and 44411 [Home Centers](#).

## 2. Basic Definition

Distance to Nearest Facility = Straight line or network distance to the centroid of the nearest store (including hardware) or hardware store (alone).

## 3. Detailed Definition

Distance to Nearest Facility = Straight line or network distance to the centroid of the nearest store (including hardware) or hardware store (alone) defined using NAICS codes.

## 4. Comments and Explanations

None.

## 5. GIS Approach

This is done using Network Analyst in ArcMap (ArcInfo) 9.2 using a function called OD Cost Matrix. You can specify a point layer to use as your “origins” and another point layer to serve as your destinations. It will then take the road network and calculates the network distance from each origin to all destinations. The function then ranks the distances from 1 (shortest network distance) to N (longest network distance) (and it can do this using travel costs as well, if certain type of roads were considered more or less easy to use, for instance).

For points that do not fall on the network, there is an option in the Load Locations dialog box that allows the user to decide how far away from the network to search for points to use in the processing.

The straight-line distance is calculated using the Near Tool in ArcToolbox.

## 6. GIS Steps

The following procedures were completed in **ArcMap (ArcInfo) 9.3.1**.

To follow this protocol you will need:

1. **Road Network** dataset
2. **Facility Point Feature Layer** for facilities (destinations)
3. **Participants' Locations Point Feature Layer** for incidents (origins)
4. **Network Analyst Extension** for ArcGIS 9.2

Calculate the Network Distance to the nearest facility:

1. Use LEAN Protocol 2.6 to determine the network distance to the nearest facility. The participant locations are the XXX and the facilities are the features of interest

Calculate straight-line distance to nearest facility

To follow this protocol, you will need:

1. **Participant Locations Point Feature Layer** for incidents (origins)
2. **Facilities Point Feature Layer** for facilities (destinations)

Calculate the straight-line distance to the nearest facility

1. Start **ArcMap**.
2. Click the **Add Data** button on the **Standard Toolbar**.
  - a. Navigate to the Point Layers to be used in the analysis, in this case the **Participant locations** and the **Facilities**.
  - b. Select the Point Layers and click **Add** to add them to ArcMap.
3. Open **ArcToolbox** by clicking on the icon.
4. Navigate to the **Near** tool (Analysis Tools -> Proximity) and double-click to open it.
5. Click the down-arrow in the Input Features box and select the **Participant Locations** feature layer.
6. Click the down-arrow in the Near Features box and select the **Facilities** feature layer.
7. Leave the **Search Radius (optional)** box empty. This will guarantee that every Participant Location will have its nearest facility found.
8. Leave the **Location (optional)** and **Angle (optional)** check boxes unchecked.
9. Click **OK** to execute the tool.
10. The tool will find the nearest facility to each Participant Location and measure the straight-line distance between those points. The tool will add two attributes to the participant location attribute table, **NEAR\_DIST** and **NEAR\_FID**. **NEAR\_DIST** will contain the distance, in the units of the Layers (e.g., meters, feet). **NEAR\_FID** will contain the feature ID of the closest facility. Use the **NEAR\_FID** attribute to join the Facilities Layer to the Participant Location layer to determine the characteristics of the nearest Facility.

Join the Participant Location Layer to the Facility Layer using the **NEAR\_FID** attribute.

1. **Right-click** on the Participant Location layer and select **Joins and Relates -> Join...**
2. Choose **NEAR\_FID** as the field to base the join on.
3. Choose the **Facility** layer as the Table to Join to this layer.
4. Choose the **FID** attribute as the field in the table to base the join on.
5. Click **OK**. The Facility attributes will be joined to the Participant locations.
6. **Right-click** on the Participant Locations Layer and select **Data -> Export Data**.
  - a. Choose this **layer's source data for the coordinate system**.
  - b. Specify the **Output Location**.
  - c. Click **OK**.

A new shapefile will be created in the output location. This shapefile will contain the participant locations and the attributes of the nearest facility to each participant location.

## STREET PATTERN

### 5.10 Average Census Block Area: See NEAT GIS Protocol 6.1 (2010 EAT-III)

This uses the existing *NEAT GIS Protocol*. Be sure to use the latest version--4.0 or later and preferably 5.0 or later--as these versions correct errors, simplify some steps, or at least indicate where protocols are in need of revision.

### 5.11 Median Census Block Area: Based on NEAT GIS Protocol 6.2 but updated (2010 EAT-III)

*This protocol combines both versions available in the TCWS Protocol 6.2 in versions up to 4.0. It was updated slightly in Version 1.3. Updated in version 2.0.*

#### 1. Basic Concept

As with the average census block area, the median block area is an approximation for street pattern where bigger blocks have fewer streets and/or more culs-de sac and, unless they also have many additional pedestrian routes, they will be harder to get around.

This measure is not as easy to calculate as an average, because the calculation needs to be done partly in Excel.

#### 2. Basic Formula

Median Census Block Area = Median area for census blocks with a centroid falling within the measurement geography.

#### 3. Detailed Formula

Median Census Block Area = Median area for census blocks with a centroid falling within the measurement geography using census block data.

#### 4. Comments and Explanations

The centroid rule and the inconsistent centroid calculation issues in the previous protocol are the same for this one.

#### 5. GIS Approach

The GIS approach is to perform a spatial identity between the census block centroids and study sites. The attribute table of the resulting layer is imported into Microsoft Excel and summarized using the PivotTable feature. This creates a list of all the census blocks whose centroids are in a given study site. The median area can then be calculated automatically.

#### 6. GIS Steps

The following procedures were completed using **ArcMap (ArcInfo) 9.3.1**.

To complete this protocol you will need:

1. **Participant Buffer Layer** (polygon)
2. **Census Block Layer** (polygon)

### 3. Microsoft Excel

Calculate Census Block Areas:

1. Add the area fields to the **Census Block Layer**.
  - a. Right-click on the **Census Block Layer** and select **Open Attribute Table**.
  - b. Click on the **Option** button and select **Add Field...**
  - c. Name the field **Area** and change the Type to **Double**.
    - i. If a field named **Area** already exists, change the name in the **Add Field...** dialog box to something else.
  - d. Click **OK**.
  - e. Click on the **Option** button again and select **Add Field...**
  - f. Name the field **Hectares** and change the Type to **Double**.
    - i. If a field named **Hectares** already exists, change the name in the **Add Field...** dialog box to something else.
  - g. Click **OK**.
2. Calculate the values for Area and Hectares
  - a. For the **Area** field,
    - i. Right-click the **Area** field in the Census Block Layer attribute table and select **Calculate Geometry...**
    - ii. Set the **Property:** box to **Area**.
    - iii. Set the **Coordinate System** to “Use coordinate system of the data source:”
    - iv. Set the units to the desired type. For the **Area** attribute, **square meters, miles, or feet** is probably appropriate.
    - v. Click **OK**.
  - b. For the **Hectares** field,
    - i. Right-click the **Hectares** field in the Census Block Layer attribute table and select **Calculate Geometry...**
    - ii. Set the **Property:** box to **Area**.
    - iii. Set the **Coordinate System** to “Use coordinate system of the data source:”
    - iv. Set the **Units** to **Hectares [ha]**.
    - v. Click **OK**.

Create Census Block centroid layer:

1. Open **ArcToolbox** by clicking on the icon.
2. Navigate to the **Feature to Point** tool (**Data Management -> Features**). Double-click on the tool to open it.
3. Click on the down arrow in the **Input Features** box and select **Census Block Layer** from the list of layers.
4. Specify the name and location of the output feature class.
5. Do NOT click the check box next to **Inside**. By not clicking on the check box, ArcGIS will create the actual geometric centroid of each census block. The centroid may not fall within its census block, but it is not forced inside the block.
6. Click **OK**. The centroid layer will be created and added to the Map Document.

Intersect the Census Block centroids with the Participant buffer Layer:

1. Add the Participant buffer **Layer** to the **Map Document** if it is not there already.
2. Open **ArcToolbox** by clicking on the icon.
3. Navigate to the **Intersect** tool (**Analysis Tools -> Overlay**). Double-click on the tool to open it.
4. Click on the down arrow in the **Input Features** box and select the **Census Block centroid layer** from the list of layers.
5. Click on the down arrow in the **Identity Features** box and select the **Study-Site layer** from the list of layers.
6. Specify the name and location of the output feature class.
7. Set the **JoinAttributes** option to **ALL**.
8. Set the **XY Tolerance** to **0** and leave the **Keep Relationships check box** unchecked.
9. Click **OK**.
10. A feature class containing the census block centroids with the appropriate study-site attributes attached will be created and added to the Map Document. If a census block centroid intersects with two or more overlapping

study-sites, the output feature class will contain one record for each study-site with which the centroid intersected.

Import data into Microsoft Excel:

1. Right-click on the layer created in the previous **Identify** step and select **Open Attribute Table**.
2. Click on the **Option** button and select **Export**.
3. Set the **Export:** box to **All Records**. Then, specify a name and location for the output DBF file.
4. Click **OK**.
5. Open **Microsoft Excel** and then open the DBF file created in the previous step.
6. Open a blank Microsoft Excel workbook and copy and paste all the data from the DBF file into the workbook.
7. From the **Data** menu, select **PivotTable and PivotChart Report...**
8. Select all the data in the workbook for the **PivotTable** and click **Next**. Then click **Finish** to create the Pivot Table.
9. From the **PivotTable Field List**, drag and drop the field containing the **unique study-site ID** onto the large window where it says **Drop Column Fields Here**.
10. From the **PivotTable Field List**, drag and drop the field containing the **unique Census block centroid ID** onto the large window where it says **Drop Row Fields Here**.
11. From the **PivotTable Field List**, drag and drop the field containing the **Census Block Hectares values** onto the large window where it says **Drop Data Items Here**.
12. Find the row beneath the last row containing any values (each column will have a different number of values depending on how many census block centroids were found in each measurement geography).
13. Calculate the median of all cells in each column. This will provide the median census block size, in hectares, for the census blocks whose centroids fall within a study-site.

## 5.12 Number of Access Points (LEAN version) (2010 EAT-III)

*This simplifies the alternate access point calculation in NEAT GIS Protocol 6.4, which relies heavily on the hand-removal of parkway (at-grade divided roads) and interstate highways from the analysis. This is useful for smaller studies but very time intensive. Instead of examining each study-site and removing parkways and interstate highways, this protocol removes interstate highways from the Road Centerline Layer before creating the access points. Since identifying the parkways and at-grade divided roads for every study-site will be too time-consuming, they are left in the Road Centerline Layer. Updated in versions 2.0 and 2.1 (including substantial changes to the GIS steps)..*

### 1. Basic Concept

Access points are a measure of the amount of connection an area has to its surroundings.

At its most extreme, one can imagine a gated neighborhood, inside which the neighborhood had small blocks and a highly connected street pattern, but had only one way in and out. In this case, walking to destinations outside the development would be made far more complex. Access point measures create a measurement geography, generally a grid cell, and measure how porous its edges are (Southworth 1997, McNally and Kulkarni 1997, 109).

### 2. Basic Formula

Number of Access Points = Number of times a road crosses the edge of the measurement geography.

### 3. Detailed Formula

Number of Access Points = Number of times a road crosses the edge of the measurement geography with divided at-grade roads counted once and limited access highways excluded.



Fig. 6.2. Access points are points of intersection between road centerlines and site boundaries excluding points resulting from the intersections of site boundaries with Interstates, on- and off-ramps, and other limited access highways.

In the diagram to the left, the four green points are access points created by the intersection of the site boundary and an Interstate and its on- and off-ramps, and therefore are excluded from the analysis. The red point is a valid access point.



Fig. 6.3. Site boundary intersections with divided at-grade roads, such as parkways, are also counted once (as one access point) instead of twice. The green point in the diagram to the left is half of a set of paired access points created by the intersection of the site boundary and a divided parkway. Only the red access points are included in the analysis.

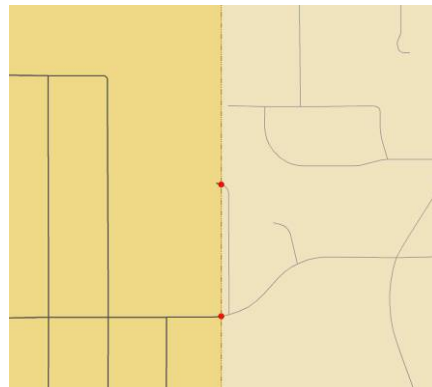


Fig. 6.4. Many access points, as measured, are somewhat marginal in their quality. That is, these points may exist but not provide significant access to the site, or may fall just inside the site boundary and therefore not be counted (see examples below). The red point in the middle of the image is technically an access point because the road centerline just crosses the site boundary, even though it provides no significant access to the site. However, it is extremely complex to develop rules to exclude such points—see next image for more examples.



g. 6.5. The three purple circles identify points that should be included in the analysis, since they provide significant access to the site, are not because the road centerlines lie just inside the site boundary and do not intersect it.

We experimented with methods of buffering these points and derived various rules for exclusion or inclusion but in the end, determined that this opened the door to many subjective decisions. It seemed that the number of access points included that probably should be excluded would roughly offset the number of access points excluded that probably should be included and, therefore, we decided to set aside the issue of marginal access points in our analysis.

#### 4. Comments and Explanations

None.

#### 5. GIS Approach

Interstates and access ramps were removed from the road centerline layer. Then a point file was created that contained all points where road centerlines intersected site boundaries. The total number of access points for each study site was summed.

#### 6. GIS Steps

The following procedures were completed using **ArcMap (ArcInfo) 9.3.1**.

To complete this protocol you will need:

1. **Participant buffer Layer** (polygon)
2. **Road Centerline Layer** (polyline)

Remove Interstate Highways and Access Ramps from the Road Centerline Layer:

1. Right-click on the **Road Centerline Layer** and select **Properties**.
2. Click on the **Definition Query** tab.
3. Construct an SQL query that eliminates the Interstate Highways and Access Ramps from the layer.
  - a. The SQL query should be: **[F\_CLASS] <> 'A10' AND [F\_CLASS] <> 'A15' AND [F\_CLASS] <> 'A63'**
  - b. Click **OK**.
4. The result of the SQL query will be a Road Centerline Layer without Interstate Highways or Access Ramps.

Create the Access Point Layer:

1. Click on the **Add Data** icon and load the **Road Centerline Layer** and **Study-Site Layer** to the **Map Document**.
2. Open **ArcToolbox** by clicking on the icon.
3. Navigate to the **Intersect** tool (**Analysis Tools -> Overlay**) and open the tool by double-clicking on it.
4. Click on the down-arrow by the **Input Features** box and select the **Study-Site Layer**.
5. Again, click on the down-arrow by the **Input Features** box and select the **Road Centerline Layer**.
6. Specify a name and location for the output layer.
7. Set the **JoinAttributes** option to **ALL**.
8. Accept the **XY Tolerance** default.
9. Set the **Output Type** to **POINT**. This will generate a point layer containing the intersections of the study-sites with the road centerlines.
10. Click **OK**.

Summarize Access Point Counts for Study-Sites:

1. If the Participant buffer **Layer** does not have unique IDs or names for each site, create them now.
2. Use the Summarize function to count the number of access points for each study-site
  - a. Right-click on the **Study-Site Layer** and select **Open Attribute Table**
  - b. In the attribute table, right-click on the column that contains the unique ID for each study site and select **Summarize...** from the context menu.
  - c. Accept the defaults for **1. Select a field to summarize:** and **2. Choose one or more summary statistics to be included in the output table:**.
  - d.
  - e. Specify the location and name of the output layer.
  - f. Click **OK**.
3. The output layer will contain one polygon for each study-site. One of the attributes of this layer will be the number of access points falling inside the study-site.

5.13 Road Length per Unit Area (LEAN Version) (2010 ECHO) *This simplifies the alternate NEAT GIS Protocol 6.5, which relies heavily on the hand-removal of parkways (at-grade divided roads) and interstate highways from the analysis. Instead of examining each study-site and removing parkways and interstate highways, this protocol removes interstate highways from the Road Centerline Layer before intersecting the roads with the study-sites. Since identifying the parkways and at-grade divided roads for every study-site will be too time-consuming, they are left in the Road Centerline Layer.*

#### 1. Basic Concept

Road length per hectare is related to both block size and connectivity.

The next version of these protocols will contain more detail about earlier uses of this measurement.

#### 2. Basic Formula

Road Length per Unit Area = Length of road with both interstates and ramps removed and divided roads averaged, per measurement area.

#### 3. Detailed Formula

Road Length per Unit Area = Length of road with both interstates and ramps removed and divided roads averaged, per measurement area with water removed from land area calculation. Road length uses the TLG/Metropolitan Council data.

#### 4. Comments and Explanations

Road lengths are simply the sums of the lengths of all road centerlines bounded by the study sites. Similar to the process used for access points, we ignored non-pedestrian lengths by removing Interstates and on- and off-ramps from our calculations. Also, we removed one of each pair of centerlines from all parkways and other divided at-grade roads in order to count their lengths once instead of twice.

Once this was done we used the area of each site to calculate the road length per hectare figures for each site.

## 5. GIS Approach

Delete all Interstates and on- and off-ramps. Intersect the roads layer with the measurement geographies. Recalculate the length of the road segments. Summarize the intersected layer by the measurement geography ID, calculating the sum of the Length field in the process. Divide the resulting sum of road lengths by the area in hectares of the associated measurement geography.

## 6. GIS Steps

The following procedures were completed using **ArcMap (ArcInfo) 9.2**.

To follow this protocol you will need:

1. **Participant buffer Layer** (polygon)
2. **Road Centerline Layer** (polyline)
3. The protocol for determining **Net Land Area (without water)**

Determine the Net Land Area (without water) for each Study-Site:

1. Complete protocol 2.1 (Net Land Area without water)

Remove Interstate Highways and Access Ramps from the Road Centerline Layer:

1. Right-click on the **Road Centerline Layer** and select **Properties**.
2. Click on the **Definition Query** tab.
3. Construct an SQL query that eliminates the Interstate Highways and Access Ramps from the layer.
  - a. The SQL query should be: **[F\_CLASS] <> 'A10' AND [F\_CLASS] <> 'A15' AND [F\_CLASS] <> 'A63'**
  - b. Click **OK**.
4. The result of the SQL query will be a Road Centerline Layer without Interstate Highways or Access Ramps.

Intersect Road Centerlines and Study-Sites and calculate road lengths:

1. Click on the **Add Data** icon and load the **Road Centerline Layer** and the **Study-Site Layer**.
2. Open **ArcToolbox** by clicking on the icon.
3. Navigate to the **Intersect** tool (**Analysis Tools -> Overlay**) and open the tool by double-clicking on it.
4. Click on the down-arrow by the **Input Features** box and select the **Study-Site Layer**.
5. Again, click on the down-arrow by the **Input Features** box and select the **Road Centerline Layer**.
6. Specify a name and location for the output layer.
7. Set the **JoinAttributes** option to **ALL**.
8. Accept the **XY Tolerance** default.
9. Set the **Output Type** to **LINE**. This will generate a line layer containing the intersections of the study-sites with the road centerlines.
10. Click **OK**. A new output layer containing only road segments intersecting with study-sites will be added to the Map Document. If a road segment falls in overlapping study-sites, the output layer will contain two records, one for each study-site, for the segment.
11. Recalculate the length of the road segments in the newly intersected layer.
  - a. Right-click on the new layer and select **Open Attribute Table**.
  - b. Click on the **Option** button and select **Add Field...**
  - c. Name the field **Length** and change the Type to **Double**.
    - i. If a field named **Length** already exists, change the name in the **Add Field...** dialog box to something else.
  - d. Click **OK**.
  - e. Right-click the **Length** field in the attribute layer and select **Calculate Geometry...**
  - f. Set the **Property:** to **Length**.
  - g. Set the **Coordinate System** to "Use coordinate system of the data source."
  - h. Set the units to the desired type.
  - i. Click **OK**. The lengths of the road segments will be calculated.

Summarize Road Lengths:

1. Right-click the **new Roads Layer** and select **Open Attribute Table**.

2. In the attribute table, right-click on the field containing the study-side unique ID and select **Summarize...**
3. In the Summarize dialog box, click on the **Length** field and check the box marked **Sum**.
4. Also, click on the **Area** field and check the box marked **Average**. This will guarantee that the study-site area value will be part of the output table and will help ease the road length per unit area calculation.
5. Specify a name and location for the output table.
6. Click **OK**.
7. A table containing one row per Study-Site will be created and added to the Map Document. Each row will contain the area of the study-site and the sum of the road lengths within the study-site.

Calculate Road Length per Hectare:

1. Open the table created in the previous step.
2. Click on the **Option** button and select **Add Field...**
3. Name the field **Len<Buffer Type><Distance>** and change the Type to **Double**.
4. Click **OK**.
5. Right-click on the **Len<Buffer Type><Distance>** field and select **Field Calculator...**
6. In the **Field Calculator**, click **Sum\_Length**, then click the **/** button, and finally click **Avg\_Area**.
7. Click **OK**.
8. The result is a field called **Len<Buffer Type><Distance>** that contains the road length per unit area in a study-site.

The Buffer types are N (network) or S (straightline) and Distance options **need to be added**.

## 5.14 Intersections per Unit Area (LEAN version) (2010 ECHO)

*Note: This is based on the TCWS protocol 6.6 but has of version 1.2 has been refined to limit the need for data cleaning. **However, please note that it is NOT yet complete. To use, the protocol needs to be revised to remove interstate highways.***

### 1. Basic Concept

The number of intersections per hectare is a measure of the connectivity of the street network (Cervero and Kockelman 1996, 8; McNally and Kulkarni 1997, 109). As can be seen from this and later protocols, however, judging an intersection can be complex, particularly in older areas, where intersections are not regularly spaced, road rights of way have varying sizes, and centerlines may be slightly offset within the right of way, creating false positives in terms of intersection counts (see below for more detail).

This is obviously an area where more research would help, to discover how much of a jog in an intersection is needed before it is perceived as two intersections. In the absence of such research, we spent some time observing difficult cases in the field.

**While we created many more complicated versions of intersection measures, the results from the Twin Cities Walking Study were substantially similar for each variant and so we recommend using this one as it is the simplest.**

### 2. Basic Definition

Intersections per Unit Area = Number of intersections per unit land area.

### 3. Detailed Definition

Intersections per Unit Area = Number of intersections per unit land area with interstate highways removed.

#### 4. Comments and Explanations

Early versions of NEAT GIS protocol 6.6, Intersections per Unit Area, removed Interstate highways from a roads dataset, then calculated all intersections using a custom ArcGIS script, and finally created single intersections in places where roads converge but do not perfectly align. The LEAN version of this protocol simplifies the TCWS protocol. It uses the intersections generated when the user creates the road network dataset and it does not create single intersections in places where roads converge but do not perfectly align.

#### 5. GIS Approach

The GIS approach uses a spatial join to count the number of intersections within a study-site. The intersections come from the Junctions feature class that is created when the road network dataset is created.

#### 6. GIS Steps

The following procedures were completed using ArcMap (ArcInfo) 9.2.

To follow this protocol you will need:

1. **Participant buffer Layer** (polygon)
2. **Road Network Dataset**, particularly the Junctions feature class
3. The protocol for determining **Net Land Area (without water)**

Summarize Intersection Counts for Study-Sites:

1. Start **ArcMap**.
2. Click the **Add Data** button on the **Standard Toolbar**.
  - a. Navigate to the **Road Network** dataset location.
  - b. Click on the **Network dataset** and click **Add** to add the Network dataset to ArcMap.
  - c. Click **Yes** to add all the feature class that participate in the network to the map.
3. Click the **Add Data** button on the **Standard Toolbar**.
  - a. Navigate to the **Participant buffer polygon layer** to be used for the analysis.
  - b. Click on the Study-Site layer and click **Add** to add it to ArcMap.
4. Right-click on the Participant buffer **layer** and choose **Joins and Relates -> Join...**
5. Under the dropdown box labeled **What do you want to join to this layer?** choose **Join data from another layer based on spatial location**.
6. In **Step 1** of the dialog box, choose the **Junctions** layer.
7. In **Step 2**, click the button to choose **Each polygon will be given a summary of the numeric attributes...**
8. In **Step 3**, choose a name and location for the output layer.
9. Click **OK**.
10. The output layer now contains a **Count** field with the number of intersections found in each feature of the Study-Site layer.

Calculate the intersections per net land area:

1. Determine the **Net Land Area for the Study-Site layer** if it hasn't already been calculated.
2. Right-click on the **output layer** from the **spatial join** and select **Open Attribute Table**.
3. Click **Options** and choose **Add Field**.
4. Name the field **IntDens** and change the type to **Double**.
5. Click **OK** to add the field.
6. In the **Table of Contents**, right-click on the **output layer** from the **spatial join** and choose **Joins and Relates -> Join**.
7. In the dropdown box, choose to **Join attributes from a table**.
8. In **Step 1**, choose to base the join on the field containing the unique ID of the study-sites.
9. In **Step 2**, load the table from the result of the Net Land Area protocol.

10. In **Step 3**, choose the field in the Net Land Area layer's table containing the unique ID of the study-sites.
11. Click **OK**.
12. Open the Attribute Table of the **output layer** from the **spatial join**, which now has the net land area table joined to it.
13. Right-click on the **IntDens** field and choose **Field Calculator...**
14. In the Field Calculator dialog box, click the **Count** field, then click the / button, and finally click the name of the field containing the net land area.
15. Click **OK**.

The field now contains the density of intersections (number of intersections divided by the net land area in whichever units you used).

## OTHER BUILT-ENVIRONMENT RELATED/SPATIAL VARIABLES

### 5.15 Proportion of High Functional Classifications [i.e. busy streets]: See NEAT GIS Protocol 7.1 (2010 EAT-III & ECHO)

This uses the existing *NEAT GIS Protocol*. Be sure to use the latest version--4.0 or later and preferably 5.0 or later--as these versions correct errors, simplify some steps, or at least indicate where protocols are in need of revision.

### 5.16 Distance to Nearest Park (2010 EAT-III & ECHO)

*Note: The GIS steps were updated in Version 1.3.*

#### 1. Basic Concept

This is related to one question in the TREC-IDEA study:

- SS179 About how long would it take to get from your home to the nearest park if you walked? (Adapted from NEWS B21 (14))

It is related to the TCWS Protocol 5.14 that calculates distance to the nearest facilities of various types.

#### 2. Basic Definition

Distance to Nearest Park = Straight line or network distance to the nearest part of the park border.

#### 3. Detailed Definition

Distance to Nearest Park = Straight line or network distance to the nearest part of the park border where that is operationalized as the nearest park vertex.

#### 4. Comments and Explanations

The tricky component of this measure is that a park is an area and so that until Version 9.1 or 9.2, the GIS program had difficulty finding the closest point as it slowed down trying to find the exact nearest boundary point of the park. In newer version of ArcGIS we can make this measure directly.

## 5. GIS Approach

The GIS approach is to use the Find Closest Facility option in the Network Analyst Extension of ArcGIS 9.2 to find the closest park to a participant's home or school. The point layer containing parks are the "facilities" in Network Analyst, and the participant locations are the "incidents" in Network Analyst. A street network is required for calculating the distance between parks and participant locations.

In the Network Analyst Extension, specify the "facilities" and the "incidents" and solve for the closest facility to each incident. Attach the distance to the closest facility to each incident.

The straight-line distance is calculated using the Near Tool in ArcToolbox.

## 6. GIS Steps

The following procedures were completed using **ArcMap (ArcInfo) 9.3.1**.

To complete this protocol you will need:

- o **Road Network** dataset
- o **Participant Locations** (point)
- o **Regional Parks** (polygon)
- o **Network Analyst Extension** for ArcGIS 9.2

Convert the Regional Parks (polygon) layer to a point layer

1. Add the **Regional Parks (polygon)** layer to an **ArcMap Document**.
2. Open the **ArcToolbox** by clicking on the icon and navigate to the **Feature Vertices to Points** tool (Data Management Tools -> Features -> Feature Vertices to Points). Open the tool by double-clicking it.
  - a. In the **Input Features** drop-down box, select the **Regional Parks (polygon)** layer.
  - b. Specify a name and location for the output feature class.
  - c. Set the **Point Type** (optional) to **ALL**.
  - d. Click **OK**.
  - e. This tool will create an output layer containing all vertices in the Regional Parks polygons. Each vertex will contain the attributes of the park from which it was derived. Please note that this output layer will contain many thousands of points.

Calculate the network distance to the nearest park

1. Start **ArcMap**
2. On the Main Menu, click **Tools** and click on **Extensions**
  - a. Check **Network Analyst** Extension
  - b. Click **Close**
3. Click the **Add Data** button on the **Standard Toolbar**
  - a. Navigate to the **Network Dataset** location
  - b. Click on the **Network Dataset** and click **Add** to add the Network Dataset to ArcMap.
  - c. Click **Yes** to add all the feature classes that participate in the network to the map.
4. Click the **Add Data** button on the **Standard Toolbar**
  - a. Navigate to the **Point Layers** to be used for the analysis, in this case the **Participant locations** and **Regional Parks points** (created in the previous step).
  - b. Select the **Point Layers** and click **Add** to add them to ArcMap.
5. If the Participant IDs and Regional Parks IDs are already assigned, go the next step. Otherwise, in the Table of Contents, right-click on the **Participant locations** point layer and select **Open Attribute Table**.
  - a. In the **Attribute Table**,
    - i. Click **Options** and select **Add Field...**
    - ii. Add **Par\_ID\_T** as **Text**
      1. Type **Par\_ID\_T** in the **Name** field
      2. Select **Text** as **Type**

3. Set the **Length** to 20
    4. Click **OK**
  - iii. Click **Options** and select **Add Field...**
  - iv. Add **Par\_ID** as Integer
    1. Type **Par\_ID** in the Name field
    2. Select **Short Integer** as **Type**
    3. Accept **default (0)** for **Precision**
    4. Click **OK**
  - v. Right-click on the **Par\_ID** field and select **Field Calculator...**
    1. Set the **Par\_ID** equal to **[FID] + 1**
    2. Click **OK**
  - vi. Right-click on the **Par\_ID\_T** field and select **Field Calculator...**
    1. Set the **Par\_ID\_T** equal to **Par\_ID**
    2. Click **OK**
- b. Right-click on the **Regional Parks** point layer and select **Open Attribute Table**.
  - i. In the **Attribute Table**,
    1. Click the **Options** button and select **Add field...**
    2. Add **Pk\_ID\_T** as **Text**
      - a. Type **Pk\_ID\_T** in the **Name** field
      - b. Select **Text** as **Type**
      - c. Set the **Length** to 20
      - d. Click **OK**
    3. Click the **Options** button and select **Add Field**
    4. Add **Pk\_ID** as **Integer**
      - a. Type **Pk\_ID** in the **Name** field
      - b. Select **Short Integer** as **Type**
      - c. Accept **default (0)** for **Precision**
      - d. Click **OK**
    5. Right-click on the **Pk\_ID** field and select **Field Calculator...**
      - a. Set the **Pk\_ID** equal to **[FID] + 1**
      - b. Click **OK**
    6. Right-click on the **Pk\_ID\_T** field and select **Field Calculator...**
      - a. Set the **Pk\_ID\_T** equal to **Pk\_ID**
      - b. Click **OK**
6. Load the Network Analyst toolbar
  - a. One the Main Menu, click on **View**
  - b. Click on **Toolbars**
  - c. In the side menu, click **Network Analyst** to add the Network Analyst toolbar to ArcMap
7. Load the Network Analyst Window
  - a. Click on the **Show/Hide Network Analyst Window** to open the window
8. Create a **New Closest Facility**
  - a. Click on the **Network Analyst** button on the Network Analyst toolbar
  - b. Select **New Closest Facility** from the dropdown window
  - c. The Table of Contents and the Network Analyst Window will now contain a **Closest Facility** layer, which contains Facilities, Incidents, Barriers, and Routes categories.
9. Load the Regional Parks points into the **Facilities** category in Network Analyst
  - a. In the Network Analyst window, right-click **Facilities** and click **Load Locations**. This will open the Load Locations Window
  - b. In the Load Locations Window
    - i. Select the point layer containing the **Regional Parks points** from the drop-down box next to Load From. If the required point layer is not in the drop-down box, click on the **Browse for Point Features to Load** icon and navigate to the point layer.
    - ii. Choose the **Pk\_ID** as the **Sort** field.
    - iii. Choose the **Pk\_ID\_T** for the **Name** property under **Locational Analysis** properties.
    - iv. Accept the default for the other **Locational Analysis** properties.

- v. Choose a suitable **Search Tolerance** for the **Location Position**. Since the Regional Parks point layer contains so many points, we recommend constraining the tolerance to approximately 200 meters. **[note this was reduced in version 2.0]**
    - vi. Click **OK**. This process will take two to three hours to finish.
  - c. To verify all Regional Parks points were located on the network dataset, do the following.
    - i. Right-click on the **Facilities** in the **Network Analyst Window, Open Attribute Table** and sort descending on the **STATUS** column. The **Not Located** features should be sorted to the top.
    - ii. It is likely that some Regional Parks points will be not be located because they fall outside of the tolerance. Those points usually fall along the interiors of parks and can safely be ignored for this analysis.
- 10. Load the Participant locations into the **Incidents** category in Network Analyst.
  - a. In the Network Analyst window, right-click **Incidents** and click **Load Locations**. This will open the Load Locations Window.
  - b. In the Load Locations Window
    - i. Select the point layer containing the **Participant locations** from the drop-down box next to Load From. If the required point layer is not in the drop-down box, click on the **Browse for Point Features to Load** icon and navigate to the point layer.
    - ii. Choose the **Par\_ID** as the **Sort** field.
    - iii. Choose the **Par\_ID\_T** for the **Name** property under **Locational Analysis** properties.
    - iv. Accept the default for the other **Locational Analysis** properties.
    - v. Choose a suitable **Search Tolerance** for the **Location Position**. If features cannot be located in the network dataset, this tolerance may need to be increased.
    - vi. Click **OK**.
  - c. To verify all Participant locations were located on the network dataset, do one of the following. If any feature has a status of **Not Located**, the search tolerance in 10.b.v may need to be increased or the feature reviewed for correct location.
    - i. For small datasets, scroll through the resulting list of Incidents in the **Network Analyst Window**, looking for features with RED question marks.
    - ii. For large datasets, it may be easier to right-click on the **Incidents** in the **Network Analyst Window, Open Attribute Table** and sort descending on the **STATUS** column. The **Not Located** features should sort to the top.
- 11. Set the properties for the analysis
  - a. In the Table of Contents, right-click **Closest Facility** and click **Properties**. This will open the Closest Facility properties dialog box.
  - b. Click on the **Analysis Settings Tab**
    - i. Choose **Length (meters)** for **Impedance**
    - ii. Choose **None** for **Default Cutoff Values**
    - iii. Set **Facilities to Find** to **1**
    - iv. Set **Travel From** option to **Incident to Facility**
    - v. Set **Allow U-Turns** to **Everywhere**
    - vi. Set **Output Shape Type** to **True Shape**
    - vii. Check the box to **Ignore Invalid Locations**
  - c. Click **OK**.
- 12. To calculate the closest Regional Park point to a Participant location, click the **Solve Button** on the Network Analyst Toolbar.
  - a. When Network Analyst has solved the calculations, the **Routes** layer will be populated with line segments joining each participant location to its closest Regional Park point. The Routes Attribute table contains the unique IDs for the participants and the regional parks along with the network length separating them and the route name (a concatenation of the participant ID and the regional park point ID).
- 13. Join the Regional Park points and the Participants to the results of Find Closest Facility analysis
  - a. Right-click the **Routes** layer.
  - b. Select **Joins and Relates** and then click **Join**.
    - i. Choose **Facility\_ID** as the field to base the join on

- ii. Choose the **Regional Parks point layer** as the **Table to Join** to this layer
  - iii. Choose the **Pk\_ID** as the field in the table to base the join on
  - iv. Click **OK**
- c. Right-click on the **Routes** layer.
- d. Select **Joins and Relates** and then click **Join**.
  - i. Choose **Incident\_ID** as the field to base the join on
  - ii. Choose the **Participant layer** as the **Table to Join** to this layer
  - iii. Choose the **Par\_ID** as the field in the table to base the join on
  - iv. Click **OK**
- e. Right-click the **Routes** layer
- f. Select **Data** and then click **Export Data**
  - i. Choose this **layer's source data for the coordinate system**
  - ii. Specify the **Output Location**
  - iii. A new shapefile will be created in the output location. This shapefile will contain the routes from each participant location to the nearest regional park. Each route will contain the attributes of the participant and the nearest regional park.

Calculate straight-line distance to nearest park

To follow this protocol, you will need:

1. Participant Locations Point Feature Layer for incidents (origins)
2. Regional Parks Point Feature Layer for facilities (destinations), created in previous steps

Calculate the straight-line distance to the nearest park

16. Start **ArcMap**.
17. Click the **Add Data** button on the **Standard Toolbar**.
  - a. Navigate to the Point Layers to be used in the analysis, in this case the **Participant locations** and the **Regional Parks** point feature layer.
  - b. Select the Point Layers and click **Add** to add them to ArcMap.
18. Open **ArcToolbox** by clicking on the icon.
19. Navigate to the **Near** tool (Analysis Tools -> Proximity) and double-click to open it.
20. Click the down-arrow in the **Input Features** box and select the **Participant Locations** feature layer.
21. Click the down-arrow in the **Near Features** box and select the **Regional Parks Point** feature layer.
22. Leave the **Search Radius (optional)** box empty. This will guarantee that every Participant Location will have it nearest regional park point found.
23. Leave the **Location (optional)** and **Angle (optional)** check boxes unchecked.
24. Click **OK** to execute the tool.
25. The tool will find the nearest regional park point to each Participant Location and measure the straight-line distance between those points. The tool will add two attributes to the participant location attribute table, **NEAR\_DIST** and **NEAR\_FID**. **NEAR\_DIST** will contain the distance, in the units of the Layers. **NEAR\_FID** will contain the feature ID of the closest regional park point. Use the **NEAR\_FID** attribute to join the Regional Park Point Layer to the participant location layer to determine the characteristics of the nearest regional park point.

Join the Participant Location Layer to the Regional Park Point Layer using the **NEAR\_FID** attribute.

1. Right-click on the Participant Location layer and select **Joins and Relates -> Join...**
2. Choose **NEAR\_FID** as the field to base the join on.
3. Choose the **Regional Park Point layer** as the Table to Join to this layer.
4. Choose the **FID** attribute as the field in the table to base the join on.
5. Click **OK**. The Regional Park Point attributes will be joined to the Participant locations.
6. Right-click on the Participant Locations Layer and select **Data -> Export Data...**
  - a. Choose this **layer's source data for the coordinate system**.
  - b. Specify the **Output Location**.
  - c. Click **OK**.

A new shapefile will be created in the output location. This shapefile will contain the participant locations and the attributes of the nearest regional park to each participant location.

## 5.17 Distance to Nearest Gym or Fitness Facility (2010 EAT-III & ECHO)

*Note: The steps were updated in Version 1.3 and 2.0.*

### 1. Basic Concept

This is a fairly simple distance to a nearest parcel (centroid) calculation. What is most important is defining a gym or fitness facility as these can be public or private. It is related to the following TREC-IDEA question:

- SS181 About how long would it take to get from your home to the nearest gym or fitness facility if you walked? (Adapted from NEWS B23 (14) )

The issue is defining a gym or fitness facility. Looking at the list below (which does not include dance studios) it can be seen there are a variety of definitions but the best fit is: 71394 [Fitness and Recreational Sports Centers](#).

### 713 Amusement, Gambling, and Recreation Industries

2002 NAICS	2002 NAICS U.S. Description (with link to definition)	Com- para- bility	1987 SIC	1987 U.S. SIC Description (with link to definition)
7139	<a href="#">Other Amusement and Recreation Industries</a>			
71391	<a href="#">Golf Courses and Country Clubs</a>			
713910	<a href="#">Golf Courses and Country Clubs</a>			
			<a href="#">7992</a>	<a href="#">Public Golf Courses</a>
			<a href="#">7997</a>	<a href="#">Membership Sports and Recreation Clubs</a> (Golf clubs)
71392	<a href="#">Skiing Facilities</a>			
713920	<a href="#">Skiing Facilities</a>		<a href="#">7999</a>	<a href="#">Amusement and Recreation Services, NEC</a> (Skiing facilities)
71393	<a href="#">Marinas</a>			
713930	<a href="#">Marinas</a>		<a href="#">4493</a>	<a href="#">Marinas</a>
71394	<a href="#">Fitness and Recreational Sports Centers</a>			
713940	<a href="#">Fitness and Recreational Sports Centers</a>			
			<a href="#">7991</a>	<a href="#">Physical Fitness Facilities</a>
			<a href="#">7997</a>	<a href="#">Membership Sports and Recreation Clubs</a> (Recreation clubs with facilities)
			<a href="#">7999</a>	<a href="#">Amusement and Recreation Services,</a>

71395 [Bowling Centers](#)

713950 [Bowling Centers](#)



[7933](#)

[NEC](#) (Nonmembership fitness and recreational sports centers)

[Bowling Centers](#)

Source: <http://www.census.gov/epcd/naics02/N2SIC71.HTM#N713>

## 2. Basic Definition

Distance to Nearest Gym or Fitness Facility = Straight line or network distance to the centroid of the nearest Gym or Fitness facility.

## 3. Detailed Definition

Distance to nearest gym or fitness facility = Shortest straight line or network path between home or school and the nearest gym or fitness facility where gyms or fitness facilities are defined as the following NAICS codes in Business Analyst:

71394 Fitness and Recreational Sports Centers  
71394001 through 71394028 in NAICS\_EXT code

## 4. Comments and Explanations

This is done by using the OD Cost Matrix option in Network Analyst Extension or the Near Tool in ArcGIS 9.3.1. For network distance, a point layer, to which the shortest network distance is to be calculated, is specified as the “destination” layer and the point, from which the distance is to be calculated, serves as the origin.

For points that do not fall on the network, there is a dialog box when using this extension that allows the user to decide how far away from the network to search for points to use in the processing. Points outside that distance will not be used.

## 5. GIS Approach

The GIS approach is to use the OD Cost Matrix option in the Network Analyst Extension of ArcGIS 9.3.1 to find the closest gym or fitness facility to a participant’s home or school. The point layer containing gyms or fitness facilities are the “destinations” in Network Analyst, and the participant locations are the “origins” in Network Analyst. A street network is required for calculating the distance between gyms/fitness facilities and participant locations.

The approach for this measure is to load a set of origins and destinations, then use the OD Cost Matrix function in Network Analyst to calculate the network distance from each origin to the nearest destination.

## 6. GIS Steps


The following procedures were completed in **ArcMap (ArcInfo) 9.3.1**.

To follow this protocol you will need:

1. **Road Network** dataset
2. **Gym and Fitness Facility Point Feature Layer** for destinations
3. **Participants’ Locations Point Feature Layer** for origins

#### 4. **Network Analyst Extension** for ArcGIS 9.3.1

Query and extract data for Restaurants according to specified NAICS codes from the Business Analyst InfoUSA data, if the restaurant layer is not already prepared.

1. Start ArcMap
2. Click the Add Data button  on the Standard Toolbar.
  - a. Navigate to the Business Analyst data
  - b. Click on the Business Analyst data and click Add to add the dataset to the Map document
3. Right-click the Business Analyst data and click Open Attribute Table
  - a. Click on Options
  - b. Click Select by Attributes
    - i. Select Create a new selection as Method
    - ii. Click on “NAICS\_EXT” in the Attributes list and click on Unique values (since this can take substantial time, instead consider typing the codes as mentioned below)
    - iii. Click the “=” operator
    - iv. Click or Type ‘71394001’
    - v. Click “OR” operator
    - vi. Repeat steps ii to v changing the values to ‘71394002’, ‘71394004’, ‘71394005’, ‘71394006’, ‘71394007’, ‘71394008’, ‘71394009’, ‘71394011’, ‘71394012’, ‘71394013’, ‘71394014’, ‘71394016’, ‘71394017’, ‘71394018’, ‘71394019’, ‘71394020’, ‘71394021’, ‘71394022’, ‘71394023’, ‘71394024’, ‘71394025’, ‘71394026’, ‘71394027’, ‘71394028’
    - vii. Click Apply
  - c. Right Click the Business Analyst data and click Data and then Export data
    - i. Choose Selected Features for Export
    - ii. Choose this layer’s source data for Use the same coordinate system as:
    - iii. Navigate to the appropriate folder and give the output file an appropriate name for Output shapefile or feature class
    - iv. Click OK
    - v. Click Yes to add the data to the current data frame

Calculate the Network Distance to the nearest gym or fitness facility: Use LEAN Protocol 2.6 to determine the network distance to the nearest restaurant. The participant locations are the XXX and the gym and fitness facilities are the features of interest

The length of the nearest distance segment from a participant’s location to the nearest gym or fitness facility is stored in the Total Length attribute.

#### **C.** Straightline distance

4. Open **ArcToolbox**, then click **Analysis Tools**
5. Click on **Proximity Tools**
6. Click on **Near** tool
  - a. Navigate and Choose **Participant Layer** as the **Input Features**
  - b. Navigate and Choose **Gym or Fitness Facility layer** as **Near Features**
  - c. Click **Ok**

The straightline distance to nearest restaurant is stored in the attribute table under field name Near\_Dist. The Near\_FID field has the FID of the Nearest Gym or Fitness Facility.

## 5.18 Distance to Nearest Recreation Center, Community Center, or School (2010 EAT-III & ECHO)

*Note: The steps were updated in Version 1.3. This protocol was updated in version 2.0.*

### 1. Basic Concept

This is a fairly simple distance to a nearest parcel (centroid) calculation. What is most important is finding data on such facilities. It is related to two questions in the TREC-IEAD and ECHO studies.

- SS180 About how long would it take to get from your home to the nearest recreation center (community center, school in your neighborhood) if you walked? (Adapted from NEWS B22 (14))

Again definitions are complex and might include:

- 71394 [Fitness and Recreational Sports Centers](#)
- 6111 [Elementary and Secondary Schools](#)

However, the Twin Cities school data were best obtained from a public source.

### 2. Basic Definition

Distance to Nearest Recreation Center, Community Center, or School = Straight line or network distance to the centroid of the nearest facility of that type.

### 3. Detailed Definition

Distance to Nearest Recreation Center, Community Center, or School = Straight line or network distance to the centroid of the nearest facility of that type with data from Business Analyst and from The Lawrence Group (TLG) Geospatial Landmark data for schools. **Note, this is being updated to ensure that it works with the Business Analyst NAICS coding.**

### 4. Comments and Explanations

The early versions used Dun and Bradstreet data that contained few elementary and secondary schools (369 total, but many of these addresses are for school district headquarters instead of actual schools); therefore, a new data source was required. NCompass Geospatial Landmark data, updated quarterly and available from the MetroGIS' datafinder ([http://www.datafinder.org/metadata/tlg\\_landmarks.htm](http://www.datafinder.org/metadata/tlg_landmarks.htm)), contain 808 public and private elementary, middle, and high schools in 2007. We continued to use this source when we converted to Business Analyst.

This is done by using the OD Cost Matrix option in Network Analyst Extension of or the Near Tool in ArcGIS 9.3.1. For network distance, a point layer, to which the shortest network distance is to be calculated, is specified as the "destination" layer and the point, from which the distance is to be calculated, serves as the origin.

For points that do not fall on the network, there is a dialog box when using this extension that allows the user to decide how far away from the network to search for points to use in the processing. Points outside that distance will not be used.

### 5. GIS Approach

The GIS approach is to use the OD Cost Matrix option in the Network Analyst Extension of ArcGIS 9.3.1 to find the closest gym or fitness facility to a participant's home or school. The point layer containing recreation centers, community centers, or schools are the "destinations" in Network Analyst, and the participant locations are the "origins" in Network Analyst. A street network is required for calculating the distance between recreation centers/community centers/schools and participant locations.

The approach for this measure is to load a set of origins and destinations, then use the OD Cost Matrix function in Network Analyst to calculate the network distance from each origin to the nearest destination.

The straight-line distance is calculated using the Near Tool in ArcToolbox.

### 6. GIS Steps

The following procedures were completed in **ArcMap (ArcInfo) 9.2**.

To follow this protocol you will need:

1. **Road Network** dataset
2. **Recreation Center, Community Center, or School Point Feature Layer** for facilities (destinations)
3. **Participants' Locations Point Feature Layer** for incidents (origins)
4. **Network Analyst Extension** for ArcGIS 9.2.

Merge the Recreation Center/Community Center points with the School points to create a single Recreation Center, Community Center, or School Point Feature Layer

1. Open **ArcToolbox**.
2. Navigate to the **Merge** tool (Data Management Tools -> General). Double-click on **Merge** to open the tool.
3. Click on the folder icon next to the **Input Datasets** box and navigate to the location of the School points. Click on the School points and click **OK** to add them to the tool.
4. Click on the folder icon again and navigate to the location of the Recreation Center/Community Center points. Click on the Recreation Center/Community Center points and click **OK** to add them to the tool.
5. Specify the name and location of the **Output Dataset**.
6. Click **OK** to execute the **Merge** tool.
7. When the Merge tool finished, the merged shapefile will be added to the Table of Contents. Use this merge dataset for all subsequent steps in this protocol.

Calculate the Network Distance to the nearest recreation center, community center, or school: Use LEAN Protocol 2.6 to determine the network distance to the nearest recreation center, community center, or school. The participant locations are the facilities and the recreation centers, community centers, and schools are the features of interest.

The length of the nearest distance segment from a participant's location to the nearest recreation center, community center, or school is stored in the Total Length attribute.

- D.** Straightline distance
  7. Open **ArcToolbox**, then click **Analysis Tools**
  8. Click on **Proximity Tools**
  9. Click on **Near** tool

- a. Navigate and Choose **Participant Layer** as the **Input Features**
- b. Navigate and Choose **Recreation Centers, Community Centers, or Schools layer** as **Near Features**
- c. Click **Ok**

The straightline distance to nearest restaurant is stored in the attribute table under field name Near\_Dist. The Near\_FID field has the FID of the Nearest Gym or Fitness Facility.

## 5.19 Density/Number of Recreation Centers, Community Centers, or Schools (2010 EAT-III & ECHO)

*This is new in version 2.1.*

This is the density version of Protocol 5.18.

### 6. GIS Steps

The following procedures were completed in **ArcGIS (ArcInfo) 9.3.1**.

To follow this protocol, you will need:

1. Recreation Center, Community Center, or Schools Point Feature Layer
2. Participant Location Buffer Feature Layer

Spatially join the rec center/community center/schools point feature layer to the Participant buffers

1. Right-click the Participant buffer layer and select Joins and Relates → Join...
2. For the question “What do you want to join to this layer?”, select “Join data from another layer based on spatial location”
3. For “1. Choose the layer to join to this layer, or load spatial data from disk”, select the rec center/community center/schools point layer
4. For “2. You are joining: Points to Polygons”, select the radio button next to “Each polygon will be given a summary of the numeric attributes of the points that fall inside it, and a count field showing how many points fall inside it”
5. Specify the output location and shapefile name
6. Click OK to execute the spatial join

Calculate the density of rec centers, community centers, or schools in the buffer

1. Right-click on the output from the previous step and select Open Attribute Table
2. Click the Options button and select Add Field...
  - a. For the Name, type RCCXXXX where XXXX is the buffer distance
  - b. Set the Type to Integer
  - c. Accept the defaults for Scale and Precision
  - d. Click OK to add the attribute
3. Right-click on the RCCXXXX attribute and select Field Calculator...
  - a. In the field calculator, construct the following query: [Count\_]
  - b. Click OK to execute the query
4. Click on the Options button and select Add Field...
  - a. For the Name, type RCDXXXX where XXXX is the buffer distance
  - b. Set the Type to Double
  - c. Accept the defaults for Scale and Precision
  - d. Click OK to add the attribute
5. Right-click on the RCDXXXX attribute and select Field Calculator...
  - a. In the field calculator, construct the following query: [RCCXXXX] / [Hectares]
  - b. Click OK to execute the query

The RRDXXXX field contains the density of recreation centers, community centers, or schools per hectare in the buffer around the participant location. Repeat these steps for all other network and straightline participant buffers.

## 5.20 Distance to Nearest Bicycle or Pedestrian Trail Access Point (2010 EAT-III)

*Note: This protocol was updated in Version 1.3. It was renumbered in version 2.0—previously it was 5.19. This protocol was updated in version 2.0.*

### 1. Basic Concept

Again, another distance to nearest feature, except in this case it is a distance to a line (a trail). It is related to the following question in the TREC-IDEA study:

- SS 183 There are bicycle or pedestrian trails in or near my neighborhood that are easy to get to (E3 NEWS (14))

### 2. Basic Definition

Distance to Nearest Bicycle or Pedestrian Trail = Straight line or network distance to the closest intersection with a facility of that type.

### 3. Detailed Definition

Distance to Nearest Bicycle or Pedestrian Trail = Straight line or network distance to the closest intersection with a facility of that type using trail data from the Metropolitan Council.

### 4. Comments and Explanations

Bicycle trails and pedestrian trails were obtained from the Metropolitan Council's DataFinder website. The bicycle trails metadata can be found at <http://www.datafinder.org/metadata/bikeways.htm> and the pedestrian trails metadata can be found at [http://www.datafinder.org/metadata/trails\\_regional.htm](http://www.datafinder.org/metadata/trails_regional.htm).

The pedestrian trail dataset contains trails that exist, under acquisition, planned, or proposed. This protocol only uses trails that exist.

The bicycle trail dataset contains trails, bike lanes, and paved shoulders. This protocol only uses trails.

### 5. GIS Approach

The GIS approach is to use the Find Closest Facility option in the Network Analyst Extension of ArcGIS 9.2 to find the closest bicycle or pedestrian trail to a participant's home or school. The point layer containing bicycle or pedestrian trails are the "facilities" in Network Analyst, and the participant locations are the "incidents" in Network Analyst. A street network is required for calculating the distance between bicycle or pedestrian trails and participant locations.

In the Network Analyst Extension, specify the "facilities" and the "incidents" and solve for the closest facility to each resident. Attach the distance to the closest facility to each incident.

The straight-line distance is calculated using the Near Tool in ArcToolbox.

## 6. GIS Steps

The following procedures were completed using **ArcMap (ArcInfo) 9.3.1**.

To complete this protocol you will need:

1. Road Network dataset
2. Participant Locations (point)
3. Bicycle or Pedestrian Trails (line)
4. Network Analyst Extension for ArcGIS 9.2

Select the existing pedestrian trails from the full pedestrian trails dataset

1. Start **ArcMap**.
2. Click the **Add Data** button on the **Standard Toolbar**
  - a. Navigate to the location of the pedestrian trails.
  - b. Click on the pedestrian trails dataset and click **Add** to add the dataset to ArcMap.
3. Use the **Select by Attributes...** dialog to select Existing pedestrian trails.
  - a. Click the **Selection** menu item and then click **Select by Attributes...**
  - b. Select the **Pedestrian Trails** from the dropdown box next to **Layer**:
  - c. From the **Fields:** box, double-click on “**Status**”.
  - d. Then, click the = button.
  - e. Click the **Get Unique Values** and then double click ‘**Existing**’.
  - f. Click **Apply** to execute the query and then click **Close**.
4. Right-click on the Pedestrian Trails layer in the Table of Contents and select **Data...-> Export Data**.
  - a. Choose this layer’s source data for the coordinate system.
  - b. Specify the **Output Location**.
  - c. Click **OK**.
  - d. If ArcMap prompts you to add the exported shapefile to the Table of Contents, click **Yes**.

Select the trails from the full bicycle trails dataset

6. Start ArcMap.
7. Click the Add Data button on the Standard Toolbar.
  - a. Navigate to the location of the bicycle trails.
  - b. Click on the bicycle trails dataset and click Add to add the dataset to ArcMap.
8. Use the Select by Attributes... dialog to select only trails.
  - a. Click the Selection menu item and then click Select by Attributes.
  - b. Select the Bicycle Trails from the dropdown box next to Layer:
  - c. From the Fields: box, double-click “TYPE”.
  - d. Then, click the = button.
  - e. Click the Get Unique Values button.
  - f. Double-click ‘Non-paved Trail’.
  - g. Click the OR button and then double-click “TYPE”.
  - h. Click the = button, and then double-click ‘One-way Paved Trail’.
  - i. Click the OR button and then double-click “TYPE”.
  - j. Click the = button, and then double-click ‘Paved Trail’.
  - k. Click Apply to execute the query and then click Close.
9. Right-click on the Bicycle Trials layer in the Table of Contents and select Data...-> Export Data.
  - a. Choose this layer’s source data for the coordinate system.
  - b. Specify the Output Location.
  - c. Click OK.
  - d. If ArcMap prompts you to add the exported shapefile to the Table of Contents, click Yes.

Merge the Bicycle Trails and Pedestrian Trails datasets together to create one dataset.

1. Open ArcToolbox.
2. Navigate to the Merge tool (Data Management Tools -> General). Double-click on Merge to open the tool.
  - a. Click on the down arrow by Input Datasets: and select the Pedestrian Trails dataset created above.
  - b. Again, click on the down arrow by Input Datasets: and select the Bicycle Trails dataset created above
  - c. Specify the Output Dataset.
  - d. Click OK to execute the Merge tool
3. When the Merge tool finishes, the merged shapefile will be added to the Table of Contents. Use this merged dataset for all subsequent steps in this protocol.

Convert the Bicycle or Pedestrian Trails layer to a point layer.

1. Open the **ArcToolbox** by clicking on the icon and navigate to the **Feature Vertices to Points** tool (Data Management Tools -> Features -> Feature Vertices to Points). Open the tool by double-clicking it.
  - a. In the **Input Features** drop-down box, select the **Bicycle or Pedestrian Trails (line)** layer.
  - b. Specify a name and location for the output feature class.
  - c. Set the **Point Type** (optional) to **ALL**.
  - d. Click **OK**.
  - e. This tool will create an output layer containing all vertices in the Bicycle or Pedestrian Trails lines. Each vertex will contain the attributes of the bicycle or pedestrian trail from which it was derived.

Calculate the network distance to the nearest bicycle or pedestrian trail.

1. Start **ArcMap**.
2. On the Main Menu, click **Tools** and click on **Extensions**.
  - a. Check **Network Analyst** Extension.
  - b. Click **Close**.
3. Click the **Add Data** button on the **Standard Toolbar**.
  - a. Navigate to the **Network Dataset** location.
  - b. Click on the **Network Dataset** and click **Add** to add the Network Dataset to ArcMap.
  - c. Click **Yes** to add all the feature classes that participate in the network to the map.
4. Click the **Add Data** button on the **Standard Toolbar**.
  - a. Navigate to the **Point Layers** to be used for the analysis, in this case the **Participant locations** and **Bicycle or Pedestrian Trail points** (created in the previous step).
  - b. Select the **Point Layers** and click **Add** to add them to ArcMap.
5. If the Participant IDs and Bicycle or Pedestrian Trail IDs are already assigned, go the next step. Otherwise, in the Table of Contents, right-click on the **Participant locations** point layer and select **Open Attribute Table**.
  - a. In the **Attribute Table**,
    - i. Click **Options** and select **Add Field...**
    - ii. Add **Par\_ID\_T** as **Text**.
      1. Type **Par\_ID\_T** in the **Name** field.
      2. Select **Text** as **Type**.
      3. Set the **Length** to 20.
      4. Click **OK**.
    - iii. Click **Options** and select **Add Field...**
    - iv. Add **Par\_ID** as **Integer**.
      1. Type **Par\_ID** in the **Name** field.
      2. Select **Short Integer** as **Type**.
      3. Accept **default (0)** for **Precision**.
      4. Click **OK**.
    - v. Right-click on the **Par\_ID** field and select **Field Calculator**.
      1. Set the **Par\_ID** equal to **[FID] + 1**.
      2. Click **OK**.
    - vi. Right-click on the **Par\_ID\_T** field and select **Field Calculator...**
      1. Set the **Par\_ID\_T** equal to **Par\_ID**.
      2. Click **OK**.
  - b. Right-click on the **Bicycle or Pedestrian Trail** point layer and select **Open Attribute Table**.

- i. Click the **Options** button and select **Add field...**
  - ii. Add **Bp\_ID\_T** as **Text**.
    1. Type **Bp\_ID\_T** in the **Name** field.
    2. Select **Text** as **Type**.
    3. Set the **Length** to 20.
    4. Click **OK**.
  - iii. Click the **Options** button and select **Add Field...**
  - iv. Add **Bp\_ID** as **Integer**.
    1. Type **Bp\_ID** in the **Name** field.
    2. Select **Short Integer** as **Type**.
    3. Accept **default (0)** for **Precision**.
    4. Click **OK**.
  - v. Right-click on the **Bp\_ID** field and select **Field Calculator...**
    1. Set the **Bp\_ID** equal to **[FID] + 1**.
    2. Click **OK**.
  - vi. Right-click on the **Bp\_ID\_T** field and select **Field Calculator...**
    1. Set the **Bp\_ID\_T** equal to **Bp\_ID**.
    2. Click **OK**.
6. Load the Network Analyst toolbar.
  - a. On the Main Menu, click on **View**.
  - b. Click on **Toolbars**.
  - c. In the side menu, click **Network Analyst** to add the Network Analyst toolbar to ArcMap.
7. Load the Network Analyst Window.
  - a. Click on the **Show/Hide Network Analyst Window** to open the window.
8. Create a **New Closest Facility**.
  - a. Click on the **Network Analyst** button on the Network Analyst toolbar.
  - b. Select **New Closest Facility** from the dropdown window.
  - c. The Table of Contents and the Network Analyst Window will now contain a **Closest Facility** layer, which contains Facilities, Incidents, Barriers, and Routes categories.
9. Load the Bicycle or Pedestrian Trail points into the **Facilities** category in Network Analyst.
  - a. In the Network Analyst window, right-click **Facilities** and click **Load Locations**. This will open the Load Locations Window.
  - b. In the Load Locations Window,
    - i. Select the point layer containing the **Bicycle or Pedestrian Trail points** from the drop-down box next to Load From. If the required point layer is not in the drop-down box, click on the **Browse for Point Features to Load** icon and navigate to the point layer.
    - ii. Choose the **Bp\_ID** as the **Sort** field.
    - iii. Choose the **Bp\_ID\_T** for the **Name** property under **Locational Analysis** properties.
    - iv. Accept the default for the other **Locational Analysis** properties.
    - v. Choose a suitable **Search Tolerance** for the **Location Position**. Since the Regional Parks point layer contains so many points, we recommend constraining the tolerance to approximately 200 meters.
    - vi. Click **OK**. This process will take two to three hours to finish.
  - c. To verify all Bicycle or Pedestrian Trail points were located on the network dataset, do the following:
    - i. Right-click on the **Facilities** in the **Network Analyst Window**, **Open Attribute Table** and sort descending on the **STATUS** column. The **Not Located** features should be sorted to the top.
    - ii. It is likely that some Bicycle or Pedestrian Trail points will be not be located because they fall outside of the tolerance. Those points usually fall along the interiors of parks and can safely be ignored for this analysis.
10. Load the Participant locations into the **Incidents** category in Network Analyst.
  - a. In the Network Analyst window, right-click **Incidents** and click **Load Locations**. This will open the Load Locations Window.
  - b. In the Load Locations Window,

- i. Select the point layer containing the **Participant locations** from the drop-down box next to Load From. If the required point layer is not in the drop-down box, click on the **Browse for Point Features to Load** icon and navigate to the point layer.
    - ii. Choose the **Par\_ID** as the **Sort** field.
    - iii. Choose the **Par\_ID\_T** for the **Name** property under **Locational Analysis** properties.
    - iv. Accept the default for the other **Locational Analysis** properties.
    - v. Choose a suitable **Search Tolerance** for the **Location Position**. If features cannot be located in the network dataset, this tolerance may need to be increased.
    - vi. Click **OK**.
  - c. To verify all Participant locations were located on the network dataset, do one of the following. If any feature has a status of **Not Located**, the search tolerance in 10.b.v may need to be increased or the feature reviewed for correct location.
    - i. For small datasets, scroll through the resulting list of Incidents in the **Network Analyst Window**, looking for features with RED question marks.
    - ii. For large datasets, it may be easier to right-click on the **Incidents** in the **Network Analyst Window**, **Open Attribute Table** and sort descending on the **STATUS** column. The **Not Located** features should sort to the top.
11. Set the properties for the analysis,
  - a. In the Table of Contents, right-click **Closest Facility** and click **Properties**. This will open the Closest Facility properties dialog box.
  - b. Click on the **Analysis Settings Tab**.
    - i. Choose **Length (meters)** for **Impedance**.
    - ii. Choose **None** for **Default Cutoff Values**.
    - iii. Set **Facilities to Find** to **1**.
    - iv. Set **Travel From** option to **Incident to Facility**.
    - v. Set **Allow U-Turns** to **Everywhere**.
    - vi. Set **Output Shape Type** to **True Shape**.
    - vii. Check the box to **Ignore Invalid Locations**.
    - viii. Click **OK**.
12. To calculate the closest Bicycle or Pedestrian Trail point to a Participant location, click the **Solve Button** on the Network Analyst Toolbar.
  - a. When Network Analyst has solved the calculations, the **Routes** layer will be populated with line segments joining each participant location to its closest Bicycle or Pedestrian Trail point. The Routes Attribute table contains the unique IDs for the participants and the bicycle or pedestrian trail along with the network length separating them and the route name (a concatenation of the participant ID and the bicycle or pedestrian trail point ID).
13. Join the Bicycle or Pedestrian Trail points and the Participants to the results of Find Closest Facility analysis.
  - a. Right-click the **Routes** layer.
  - b. Select **Joins and Relates** and then click **Join...**
    - i. Choose **Facility\_ID** as the field to base the join on.
    - ii. Choose the **Bicycle or Pedestrian Trail point layer** as the **Table to Join** to this layer.
    - iii. Choose the **Bp\_ID** as the field in the table to base the join on.
    - iv. Click **OK**.
  - c. Right-click on the **Routes** layer.
  - d. Select **Joins and Relates** and then click **Join...**
    - i. Choose **Incident\_ID** as the field to base the join on.
    - ii. Choose the **Participant layer** as the **Table to Join** to this layer.
    - iii. Choose the **Par\_ID** as the field in the table to base the join on.
    - iv. Click **OK**.
  - e. Right-click the **Routes** layer.
  - f. Select **Data** and then click **Export Data**.
    - i. Choose this **layer's source data for the coordinate system**.
    - ii. Specify the **Output Location**.

- iii. A new shapefile will be created in the output location. This shapefile will contain the routes from each participant location to the nearest bicycle or pedestrian trail. Each route will contain the attributes of the participant and the nearest bicycle or pedestrian.

Calculate straight-line distance to nearest bicycle or pedestrian trail access points

To follow this protocol, you will need:

1. **Participant Locations Point Feature Layer** for incidents (origins)
2. **Bicycle or Pedestrian Trail Point Feature Layer** for facilities (destinations)

Calculate the straight-line distance to the nearest bicycle or pedestrian trail access point

1. Start **ArcMap**.
2. Click the **Add Data** button on the **Standard Toolbar**.
  - a. Navigate to the Point Layers to be used in the analysis, in this case the **Participant locations** and the **Bicycle or Pedestrian Trail Access Point**.
  - b. Select the Point Layers and click **Add** to add them to ArcMap.
3. Open **ArcToolbox** by clicking on the icon.
4. Navigate to the **Near** tool (Analysis Tools -> Proximity) and double-click to open it.
  - a. Click the down-arrow in the Input Features box and select the **Participant Locations** feature layer.
  - b. Click the down-arrow in the Near Features box and select the **Bicycle or Pedestrian Trail Access Point** feature layer.
  - c. Leave the **Search Radius (optional)** box empty. This will guarantee that every Participant Location will have its nearest bicycle or pedestrian trail access point found.
  - d. Leave the **Location (optional)** and **Angle (optional)** check boxes unchecked.
  - e. Click **OK** to execute the tool.
5. The tool will find the nearest bicycle or pedestrian trail access point to each Participant Location and measure the straight-line distance between those points. The tool will add two attributes to the participant location attribute table, **NEAR\_DIST** and **NEAR\_FID**. **NEAR\_DIST** will contain the distance, in the units of the Layers (e.g., meters, feet). **NEAR\_FID** will contain the feature ID of the closest bicycle or pedestrian trail access point. Use the **NEAR\_FID** attribute to join the Bicycle or Pedestrian Trail Access Point Layer to the Participant Location layer to determine the characteristics of the nearest bicycle or pedestrian trail access point.

Join the Participant Location Layer to the Bicycle or Pedestrian Trail Access Point Layer using the **NEAR\_FID** attribute.

1. **Right-click** on the Participant Location layer and select **Joins and Relates -> Join...**
2. Choose **NEAR\_FID** as the field to base the join on.
3. Choose the **Bicycle or Pedestrian Trail Access Point** layer as the Table to Join to this layer.
4. Choose the **FID** attribute as the field in the table to base the join on.
5. Click **OK**. The Bicycle or Pedestrian Trail Access Point attributes will be joined to the Participant locations.
6. **Right-click** on the Participant Locations Layer and select **Data -> Export Data**.
  - a. Choose this layer's source data for the coordinate system.
  - b. Specify the **Output Location**.
  - c. Click **OK**.

A new shapefile will be created in the output location. This shapefile will contain the participant locations and the attributes of the nearest bicycle or pedestrian trail access point to each participant location.

## 5.21 Distance to School Attended (2010 EAT-III & ECHO)

*Note: This protocol was updated in Version 1.3. It was renumbered from 5.19 to 5.20 in version 2.0. This protocol was updated in version 2.0.*

### 1. Basic Concept

Again, another distance to nearest feature. It is related to the following question in the TREC-IDEA study:

- SS172 About how long would it take to get from your home to the school you attend if you walked? (Note: there is an option to mark they don't attend school) (Adapted from NEWS B9 (14))

### 2. Basic Definition

Distance to School Attended= Straight line or network distance to the centroid of the school attended.

### 3. Detailed Definition

Distance to School Attended= Straight line or network distance to the centroid of the school attended with school address obtained from the study survey.

### 4. Comments and Explanations

None.

### 5. GIS Approach

The GIS approach is to create a Route in the Network Analyst Extension connecting a participant's home with the school they attend. Join the participant's home location to their school location and then solve for the route connecting those locations. A street network is required for calculating the route between home and school.

The straight-line distance is calculated using the Near Tool in ArcToolbox.

### 6. GIS Steps

The following procedures were completed in **ArcMap (ArcInfo) 9.3.1**.

To follow this protocol you will need:

1. **Roads Layer Network** dataset
2. **Participant Home Location Point Feature Layer** for origins
3. **School Location Point Feature Layer** for destinations
4. **Network Analyst Extension** for ArcGIS 9.2

In order to successfully complete this protocol, features in the participants' location layer must have an attribute describing the school the participant attends. This attribute will be used to join the participant to the correct school features.

Create Home to School Routes: Use LEAN Protocol X.X to create the route from a participant location to the school the participant attends. Do not execute the steps to create the buffer.

Calculate the straight-line distance to the school attended

To follow this protocol, you will need:

1. **Participant Locations Point Feature** layer
2. **School Location Point Feature** layer

1. **Start ArcMap.**
2. Click the **Add Data** button on the **Standard Toolbar**.
  - a. Navigate to the Point Layers to be used in the analysis, in this case the Participant locations and the School locations.
  - b. Select the Point Layers and click Add to add them to ArcMap.
3. Add a field to the Participant Locations layer that will hold the straight-line distance to the school attended
  - a. Right-click on the Participant Locations layer and select **Open Attribute Table**.
  - b. Click **Options** and select **Add Field...**
  - c. Add **Sch\_Dist** as **Double**.
    - i. Type **Sch\_Dist** in the **Name** field.
    - ii. Select **Double** as the **Type**.
    - iii. Accept **default (0)** for **Precision**.
    - iv. Click **OK**.
4. Join the School Locations to the Participant Locations using School ID.
  - a. Right-click on the **Participant Locations** layer and select **Joins and Relates -> Join...**
  - b. Choose the School ID (the school that the participant attends) as the **field to base the join on**.
  - c. Choose the School Location layer as the **Table to Join to this layer**.
  - d. Choose the School ID as the **field in the table to base the join on**
  - e. Click **OK**.
5. Use the Pythagorean theorem to calculate the straight-line distance to the school attended.
  - a. Right-click on the Participant Locations layer and select **Open Attribute Table**.
  - b. Right click on the **Sch\_Dist** attribute and select **Field Calculator...**
  - c. In the Field Calculator box, click the check-box next to **Advanced**.
  - d. Build a short VBA script to calculate the distance between the participant location and the school attended.
    - v. Type the following three lines into the text box:

```
Dim xDiff as Double  
Dim yDiff as Double  
Dim Output as Double
```

- vi. Calculate the square of the difference between the Participant Location X coordinate and the School Location X coordinate.

```
xDiff = Abs([Participant Location.X] - [School Location.X]) * Abs([Participant Location.X] - [School Location.X])
```

- vii. Calculate the square of the difference between the Participant Location Y coordinate and the School Location Y coordinate.

```
yDiff = Abs([Participant Location.Y] - [School Location.Y]) * Abs([Participant Location.Y] - [School Location.Y])
```

- viii. You will probably need to change the terms "Participant Location" and "School Location" in the above two lines. Substitute the names of whatever the feature layers are.
- ix. Calculate the square root of the sum of xDiff and yDiff to get the distance.

```
Output = sqrt(xDiff + yDiff)
```

- x. Type **Output** into the small text box at the bottom of the Field Calculator and click **OK**. This will populate the **Sch\_Dist** attribute with the straight-line distance between the participant location and the school the participant attends.

xi. Here's what the actual VBA code will look like in the text box:

```
Dim xDiff as Double
```

```
Dim yDiff as Double
```

```
xDiff = Abs([Participant Location.X] - [School Location.X]) * Abs([Participant Location.X] - [School Location.X])
```

```
yDiff = Abs([Participant Location.Y] - [School Location.Y]) * Abs([Participant Location.Y] - [School Location.Y])
```

```
Output = sqrt(xDiff + yDiff)
```

The Sch\_Dist attribute will contain the straight-line distance between the participant location and the school they attend.

## 6. CENSUS AND CRIME DATA—GIS MEASURES

### Background

There are two forms used in the census up to 2000 and one after that. The short form (or the only form for Census 2010) goes to all households and collects:

- Numbers of residents
- Age
- Hispanic or Latino origin
- Household relationship
- Race
- Sex
- Housing tenure
- Vacancy status

These data are available at the block level, roughly a street block. Blocks of course vary in population and area. We use these data to create the population and housing density variables in the LEAN (and NEAT) protocols.

The long form is only asked of 1/6 of the population and was phased out with the 2000 census, being replaced by the American Community Survey that examines roughly similar questions using a smaller sample but asking questions each year. In 2010 it released 5 year pooled data for areas smaller than 20,000 people. Due to the small numbers we chose to use census tracts for ACS information as the errors were smaller..

### 6.1 Proportion Female Headed Households (2010 EAT-III)

*New in version 2.0.*

#### *1. Basic Concept*

Female headed households are an indicator of family structure in the vicinity of a participant.

#### *2. Basic Definition*

Proportion Female Headed Households = total number of female headed households in area divided by total number of households.

#### *3. Detailed Definition*

Proportion Female Headed Households = total number of female headed households divided by total number of households in that same area using census data from the American Community Survey at the tract level. The census block the participant resides within will be the “vicinity”.

#### *4. Comments and Explanations*

The tract level is used because confidence intervals are smaller than the block group level.

### 5. GIS Approach

The GIS approach is to perform a spatial identity between the participant locations and the census block polygon layer. This identity will assign the census block ID to the participant. That ID can be used to join tabular data from the US Census Bureau to the participant and the proportion of female headed households can be calculated.

### 6. GIS Steps

The following procedures were completed using ArcMap (ArcINFO) 9.3.1.

To complete this protocol, you will need:

1. Participant Location layer
2. Census block polygon layer with the total number of households and the number of female-headed households joined to it

Assign the census block IDs to the participant locations

1. Add the Participant Location layer and the Census block polygon layer to the Map Document
2. Open ArcToolbox and navigate to the Identity tool in the Analysis Tools -> Overlay toolbox.
3. Double-click the Identity tool
4. Specify the Participant locations as the Input Features
5. Specify the Census block polygon layer as the Identity Features
6. Specify the output name and location of the Output Feature Class
7. Set JoinAttributes to ALL
8. Click OK to execute the identity

Calculate the proportion of female-headed households

1. Right-click on the Identity layer and select Open Attribute Table...
2. Click the Options... button and select Add Field...
3. For the Name, type ProFFHH
4. For the Type, select Double
5. Accept the defaults for Precision and Scale
6. Right-click on ProFFHH and select Field Calculator...
  - a. Click the attribute containing the number of female-headed households
  - b. Click the "/" operator
  - c. Click the attribute containing the total number of households
  - d. Click OK to execute the calculation

## 6.2 Median Household Income (2010 EAT-III)

*New in version 2.0.*

### 1. Basic Concept

Median household income is an indicator of the economic context.

### 2. Basic Definition

Median Household Income = median household income in the census tract of residence.

### 3. Detailed Definition

Median Household Income = median household income in the census tract of residence using the American Community Survey. This protocol used tract level data (for smaller confidence intervals than block group).

#### *4. Comments and Explanations*

None.

#### *5. GIS Approach*

The GIS approach is to perform a spatial identity between the participant locations and the census tract polygon layer. This identity will assign the tract group ID to the participant. That ID can be used to join the median household income from the US Census Bureau to the participant.

#### *6. GIS Steps*

The following procedures were completed using ArcMap (ArcInfo) 9.3.1.

To complete this protocol, you will need:

3. Participant Location layer
4. Census tract polygon layer with the median household income joined to it

Assign the census tract IDs to the participant locations

1. Add the Participant Locations layer and the Census tract layer to the ArcMap document
2. Open ArcToolbox and navigate to the Identity tool in the Analysis Tools -> Overlay toolbox
3. Double-click the Identity tool
4. Specify the Participant locations as the Input Features
5. Specify the Census tract polygon layer as the Identity Features
6. Specify the output name and location of the Output Feature Class
7. Set JoinAttributes to ALL
8. Click OK to execute the Identity

The output feature class will have the Census tract IDs along with the median household income attached to the participant locations.

### **6.3 Proportion High School Graduates (2010 EAT-III)**

*New in version 2.0.*

#### *1. Basic Concept*

Proportion of high school graduates is an indicator of the socio-economic context.

#### *2. Basic Definition*

Proportion High School Graduates = number of high school graduates in the census tract of residence divided by the number of people aged 25 and over (up to census 2000).

#### *3. Detailed Definition*

Proportion High School Graduates = number of high school graduates in the census tract of residence divided by the number of people aged 25 and over (up to census 2000). After 2010 the American Community Survey will be available, and this protocol will use tract level data (for smaller confidence intervals than block group).

#### *4. Comments and Explanations*

None.

## 5. GIS Approach

The GIS approach is to perform a spatial identity between the participant locations and the census tract polygon layer. This identity will assign the census tract ID to the participant. That ID can be used to join the educational attainment data from the US Census Bureau to the participant location.

## 6. GIS Steps

The following procedures were completed using ArcMap (ArcInfo) 9.3.1

To complete this protocol, you will need:

1. Participant Location layer
2. Census tract layer with the Sex by Educational Attainment for the Population 25 Years and Over data attached to it

Assign the census tract IDs to the participant locations

1. Add the Participant Locations layer and the Census tract layer to the ArcMap document
2. Open ArcToolbox and navigate to the Identity tool in the Analysis Tools -> Overlay toolbox
3. Double-click the Identity tool
4. Specify the Participant locations as the Input Features
5. Specify the Census tract polygon layer as the Identity Features
6. Specify the output name and location of the Output Feature Class
7. Set JoinAttributes to ALL
8. Click OK to execute the Identity

Calculate the proportion of the population 25 years and over who are high school graduates

1. Right-click on the Identity layer and select Open Attribute Table...
2. Add three fields to the attribute table
  - a. Click the Options... button and select Add Field...
  - b. For the Name, type Pop25Over
  - c. For the Type, select Long Integer
  - d. Repeat steps a-c for the high school graduates (HSG)
  - e. Click the Options... button and select Add Field...
  - f. For the Name, type PropHSG
  - g. For the type, select Double
  - h. Accept the defaults for Precision and Scale
3. Right-click on Pop25Over attribute and select Field Calculator...
  - a. Sum all Sex by Educational Attainment categories to create the population 25 and over
4. Right-click on the HSG attribute and select Field Calculator...
  - a. Sum all the Educational Attainment categories for high school degree and higher
5. Right-click on PropHSG attribute and select Field Calculator...
  - a. Divide HSG by Pop25Over

## 6.4 Proportion in Poverty (2010 EAT-III)

*New in version 2.0. This will be completed once the 2010 census and ACS data are released.*

### 1. Basic Concept

Proportion of people in poverty is an indicator of the socio-economic context.

## 2. Basic Definition

Proportion in Poverty = number of households in poverty in the census tract of residence divided by the number of households.

## 3. Detailed Definition

Proportion in Poverty = number of households in poverty in the census tract of residence divided by the number of households using the American Community Survey.

## 4. Comments and Explanations

None.

## 5. GIS Approach

The GIS approach is to perform a spatial identity between the participant locations and the census tract polygon layer. This identity will assign the census tract ID to the participant. That ID can be used to join the educational attainment data from the US Census Bureau to the participant location.

## 6. GIS Steps

The following procedures were completed using ArcMap (ArcInfo) 9.3.1

To complete this protocol, you will need:

1. Participant Location layer
2. Census tract layer with the Poverty Status in the past 12 months By Household Type by Age of Householder attached to it

Assign the census tract IDs to the participant locations

1. Add the Participant Locations layer and the Census tract layer to the ArcMap document
2. Open ArcToolbox and navigate to the Identity tool in the Analysis Tools -> Overlay toolbox
3. Double-click the Identity tool
4. Specify the Participant locations as the Input Features
5. Specify the Census tract layer as the Identity Features
6. Specify the output name and location of the Output Feature Class
7. Set JoinAttributes to ALL
8. Click OK to execute the Identity

Calculate the proportion of households in poverty

1. Right-click on the Identity layer and select Open Attribute Table...
2. Add three fields to the attribute table
  - a. Click the Options... button and select Add Field...
  - b. For the Name, type PovHH
  - c. For the Type, select Long Integer
  - d. Repeat steps a-c for the total number of households (HH)
  - e. Click the Options... button and select Add Field...
  - f. For the Name, type PropPovH
  - g. For the type, select Double
  - h. Accept the defaults for Precision and Scale
3. Right-click the PovHH attribute and select Field Calculator...
  - a. Sum all the Categories with income below poverty level to create the number of households in poverty
4. Right-click the HH attribute and select Field Calculator...
  - a. Sum all the categories together to create the total number of households
5. Right-click the PropPovH attribute and select Field Calculator...

## 6.5 Median Assessed Home Value (2010 EAT-III)

*New in version 2.0.*

### 1. Basic Concept

Median assessed home value is an indicator of the economic context.

### 2. Basic Definition

Median Assessed Home Value = median value of residential dwellings in the buffer area.

### 3. Detailed Definition

Median Assessed Home Value = median value of residential dwellings in the area using local assessors data. This variable is available at the parcel level so buffers can be used.

### 4. Comments and Explanations

This omits rental properties but these are often in multiple unit properties and thus have high values even though individual units may be less expensive.

### 5. GIS Approach

See steps.

### 6. GIS Steps

The following procedures were completed using ArcGIS (ArcInfo) 9.3.1

To complete this protocol, you will need:

1. Participant Buffer layer
2. Parcel points layer

The parcel point layer will work significantly better than a parcel polygon layer for this protocol. The spatial join tool is used to determine which parcels fall within each buffer polygon. If the participant layer contains more than a few hundred polygons, the Intersect tool will fail to complete. The spatial join of the parcel polygons and the participant polygons is too large and complex for ArcGIS to calculate. Using the parcel point layer in the intersect tool creates a simpler overlay calculation and permits ArcGIS to finish.

If the participant polygon layer contains a very large number of features (greater than 1000), consider subdividing the layer into smaller parts, especially if the spatial join fails.

Create a parcel point layer that contains residential properties. Parcels data is difficult to deal with because counties use different classification schemes for parcel land use. WHY DIDN'T WE JUST USE HOMESTEADED POINTS?

Create the parcel points layer containing residential properties

1. Add the Parcel point layer to the ArcMap document
2. Click on Selection menu and choose Select By Attributes...
3. Construct a query using the following USE1\_DESC codes:

"USE1\_DESC" = '1/2 Double Dwelling' OR

"USE1\_DESC" = '100 Res 1 unit' OR

"USE1\_DESC" = '100 Res 1 unit/115 B & B' OR

"USE1\_DESC" = '100 Res 1 unit/200 Agricultural' OR  
 "USE1\_DESC" = '100 Res 1 unit/200 Agricultural/211 Rural Vacant Land' OR  
 "USE1\_DESC" = '100 Res 1 unit/200 Agricultural/211 Rural Vacant Land/300 Commercial' OR  
 "USE1\_DESC" = '100 Res 1 unit/200 Agricultural/211 Rural Vacant Land/940 Wetlands' OR  
 "USE1\_DESC" = '100 Res 1 unit/200 Agricultural/940 Wetlands' OR  
 "USE1\_DESC" = '100 Res 1 unit/200 Agricultural/940 Wetlands/211 Rural Vacant Land/300 Comm' OR  
 "USE1\_DESC" = '100 Res 1 unit/211 Rural Vacant Land' OR  
 "USE1\_DESC" = '100 Res 1 unit/211 Rural Vacant Land/200 Agricultural' OR  
 "USE1\_DESC" = '100 Res 1 unit/211 Rural Vacant Land/300 Commercial' OR  
 "USE1\_DESC" = '100 Res 1 unit/211 Rural Vacant Land/940 Wetlands' OR  
 "USE1\_DESC" = '100 Res 1 unit/252 Managed Forest Land' OR  
 "USE1\_DESC" = '100 Res 1 unit/300 Commercial' OR  
 "USE1\_DESC" = '100 Res 1 unit/350 MH Park' OR  
 "USE1\_DESC" = '100 Res 1 unit/931 Charit Inst' OR  
 "USE1\_DESC" = '100 Res 1 unit/940 Wetlands' OR  
 "USE1\_DESC" = '100 Res 1 unit/940 Wetlands/200 Agricultural' OR  
 "USE1\_DESC" = '100 Res 1 unit/940 Wetlands/200 Agricultural/211 Rural Vacant Land' OR  
 "USE1\_DESC" = '100 Res 1 unit/940 Wetlands/211 Rural Vacant Land' OR  
 "USE1\_DESC" = '100 Res 1 unit/979 T E Misc Co D 20' OR  
 "USE1\_DESC" = '105 Res 2-3 units' OR  
 "USE1\_DESC" = '105 Res 2-3 units/100 Res 1 unit/211 Rural Vacant Land/200 Agricultural' OR  
 "USE1\_DESC" = '105 Res 2-3 units/115 B & B/300 Commercial' OR  
 "USE1\_DESC" = '105 Res 2-3 units/125 SRR' OR  
 "USE1\_DESC" = '105 Res 2-3 units/200 Agricultural' OR  
 "USE1\_DESC" = '105 Res 2-3 units/200 Agricultural/100 Res 1 unit/211 Rural Vacant Land' OR  
 "USE1\_DESC" = '105 Res 2-3 units/200 Agricultural/210 Ag 2 - 3 Units' OR  
 "USE1\_DESC" = '105 Res 2-3 units/200 Agricultural/210 Ag 2 - 3 Units/211 Rural Vacant Land' OR  
 "USE1\_DESC" = '105 Res 2-3 units/200 Agricultural/211 Rural Vacant Land' OR  
 "USE1\_DESC" = '105 Res 2-3 units/211 Rural Vacant Land' OR  
 "USE1\_DESC" = '105 Res 2-3 units/211 Rural Vacant Land/940 Wetlands' OR  
 "USE1\_DESC" = '105 Res 2-3 units/300 Commercial' OR  
 "USE1\_DESC" = '105 Res 2-3 units/940 Wetlands' OR  
 "USE1\_DESC" = '105 Res 2-3 units/940 Wetlands/211 Rural Vacant Land' OR  
 "USE1\_DESC" = '125 SRR' OR  
 "USE1\_DESC" = '125 SRR/200 Agricultural/940 Wetlands' OR  
 "USE1\_DESC" = '125 SRR/940 Wetlands' OR  
 "USE1\_DESC" = 'AG HOUSE GARAGE 1 ACRE' OR  
 "USE1\_DESC" = 'AG HOUSE GARAGE 1 ACRE-AG PRESERVE' OR  
 "USE1\_DESC" = 'APARTMENTS / COOP' OR  
 "USE1\_DESC" = 'APARTMENTS / COOP, RESIDENTIAL SINGLE FAMILY,' OR  
 "USE1\_DESC" = 'Apartment Condominium' OR  
 "USE1\_DESC" = 'CONDOMINIUMS' OR

"USE1\_DESC" = 'Condo - Garage/Miscellaneous' OR  
 "USE1\_DESC" = 'Condo/co-op' OR  
 "USE1\_DESC" = 'Condo/co-op Garage Or Storage' OR  
 "USE1\_DESC" = 'Condo/co-ops Storage Unit' OR  
 "USE1\_DESC" = 'Condominium' OR  
 "USE1\_DESC" = 'Condominium Office Units' OR  
 "USE1\_DESC" = 'Double Bungalow' OR  
 "USE1\_DESC" = 'Double Dwelling' OR  
 "USE1\_DESC" = 'Double Dwelling Exempt' OR  
 "USE1\_DESC" = 'EXEMPT RESIDENCE - CHURCH PROPERTY' OR  
 "USE1\_DESC" = 'Exempt Other Residential' OR  
 "USE1\_DESC" = 'Farm-Hmstd (House & 1 Acre)' OR  
 "USE1\_DESC" = 'INDUSTRIAL, RESIDENTIAL SINGLE FAMILY,' OR  
 "USE1\_DESC" = 'Other Residential' OR  
 "USE1\_DESC" = 'RES 1-3 UNITS' OR  
 "USE1\_DESC" = 'RES 4 OR MORE UNITS' OR  
 "USE1\_DESC" = 'RES 4+ OWNERS VALUE' OR  
 "USE1\_DESC" = 'RES DUPLEX/TRIPLEX' OR  
 "USE1\_DESC" = 'RES/AG' OR  
 "USE1\_DESC" = 'RESIDENTIAL' OR  
 "USE1\_DESC" = 'RESIDENTIAL DUPLEXES, DOUBLE BUNGALOWS,' OR  
 "USE1\_DESC" = 'RESIDENTIAL SINGLE FAMILY' OR  
 "USE1\_DESC" = 'RESIDENTIAL SINGLE FAMILY, RESIDENTIAL SINGLE FAMILY,' OR  
 "USE1\_DESC" = 'RESIDENTIAL SINGLE FAMILY, SEASONAL RECREATIONAL,' OR  
 "USE1\_DESC" = 'RESIDENTIAL-CONDOMINIUM' OR  
 "USE1\_DESC" = 'RESIDENTIAL-TOWNHOUSE' OR  
 "USE1\_DESC" = 'Res 1 unit' OR  
 "USE1\_DESC" = 'Res 2-3 units' OR  
 "USE1\_DESC" = 'Res/exempt 1/2 Double Dwelling' OR  
 "USE1\_DESC" = 'Res/exempt Multi Family Dwelling' OR  
 "USE1\_DESC" = 'Res/exempt Single Family Dwelling' OR  
 "USE1\_DESC" = 'Residential' OR  
 "USE1\_DESC" = 'Residential - Miscellaneous' OR  
 "USE1\_DESC" = 'Residential - Zero Lot Line - DB' OR  
 "USE1\_DESC" = 'Residential Lake Shore' OR  
 "USE1\_DESC" = 'Residential, Condo/co-op Vacant' OR  
 "USE1\_DESC" = 'Residential, Townhome Vacant' OR  
 "USE1\_DESC" = 'Residential, Vacant Land, Lot' OR  
 "USE1\_DESC" = 'SEASONAL RECREATIONAL' OR  
 "USE1\_DESC" = 'SRR' OR  
 "USE1\_DESC" = 'Seasonal-Residential Rec.' OR  
 "USE1\_DESC" = 'Single Family Dwelling, Platted Lot' OR

"USE1\_DESC" = 'TAX FORFEIT' OR  
 "USE1\_DESC" = 'Three Family Dwelling - Exempt' OR  
 "USE1\_DESC" = 'Three Family Dwelling, Platted Lot' OR  
 "USE1\_DESC" = 'Townhome - Detached' OR  
 "USE1\_DESC" = 'Townhome Non-tax Outlot' OR  
 "USE1\_DESC" = 'Townhome-inner' OR  
 "USE1\_DESC" = 'Townhome-outer' OR  
 "USE1\_DESC" = 'Townhouse' OR  
 "USE1\_DESC" = 'Triplex' OR  
 "USE1\_DESC" = 'Two Family Dwelling, Platted Lot' OR  
 "USE1\_DESC" = 'Two Residences On One Parcel'

4. Click OK to execute the query.
5. Click on Selection → Select By Attributes... again
6. From the Method drop-down list, choose Remove from current selection
- 7.
8. Construct the following query to remove non-homesteaded properties from the selection: "HOMESTEAD" = 'N'
9. Click OK to execute the query
10. Click on Selection → Select By Attributes... again
11. From the Method drop-down list, choose Remove from current selection
12. Construct the following query to remove properties with a building value of \$0: "EMV\_BLDG" > 0
13. Click OK to execute the query
14. Right-click on the parcel points layer and select Data → Export Data... and save the selected points to a new shapefile. This new shapefile will be used in the part of the protocol.

Spatially join the participant polygons to the parcel points that fall within the polygons

1. Add the participant buffer polygons and reduced parcel points layer created in the last step to the ArcMap document.
2. In ArcToolbox, navigate to the Spatial Join tool in the Analysis Tools → Overlay toolbox. Double-click the Spatial Join tool to open it.
3. Set the Target Features to the reduced parcel points layer
4. Set the Join Features to the participant polygon layer
5. Set the location and name of the output feature class
6. Set the Join Operation to "JOIN\_ONE\_TO\_MANY"
7. Turn the "Keep All Target Features" option off by unchecking the box.
8. Set the Match Option to "INTERSECTS"
9. Click OK to execute the Spatial Join
10. The output feature class will contain the following:
  - a. A record for each parcel point – participant polygon intersection
  - b. If a parcel point falls within multiple participant polygons, the point will be duplicated for each polygon it falls within

ArcGIS does not have a function for calculating the median value of parcels within a participant polygon. Use a statistical package to find the median value.

## 6.6 Proportion in 14 and Under (2010 EAT-III)

*New in version 2.0. This will be completed once the 2010 census and ACS data are released.*

### 1. Basic Concept

Proportion of people 14 and under relates to those likely to be included in the study.

## *2. Basic Definition*

Proportion 14 and under = number of persons 14 and under in the census tract of residence divided by the number of persons.

## *3. Detailed Definition*

Proportion 14 and under = number of persons 14 and under in the census tract of residence divided by the number of persons using the American Community Survey.

## *4. Comments and Explanations*

None.

## *5. GIS Approach*

The GIS approach is to perform a spatial identity between the participant locations and the census tract polygon layer. This identity will assign the census tract ID to the participant. That ID can be used to join the age data from the US Census Bureau to the participant location.

## *6. GIS Steps*

The following procedures were completed using ArcMap (ArcInfo) 9.3.1.

To complete this protocol, you will need:

3. Participant Location layer
4. Census tract polygon layer with the age data joined to it

Assign the census tract IDs to the participant locations

1. Add the Participant Locations layer and the Census tract layer to the ArcMap document
2. Open ArcToolbox and navigate to the Identity tool in the Analysis Tools → Overlay toolbox
3. Double-click the Identity tool
4. Specify the Participant Locations as the Input Features
5. Specify the Census tract polygon layer as the Identity Features
6. Specify the output name and location of the Output Feature Class
7. Set JoinAttributes to ALL
8. Click OK to execute the Identity

The output feature class will have the Census tract IDs along with the age data attached to the Participant locations.

Calculate the proportion of people aged 14 and under in the participant's census tract

15. Right-click on the output layer from the previous step and select Open Attribute Table...
16. Click on the Options button and select Add Field... from the dialog box
17. Type in the name of the attribute (e.g., Tot14under) and set the Type to Long Integer
18. Click OK to add the attribute.
19. Click on the Options button again and select Add Field... from the dialog box
20. Type the name of the attribute (e.g., Prop14under) and set the Type to Double
21. Right-click on the Tot14under attribute and select Field Calculator from the context menu
22. Create a formula to sum the age categories that yield a value for the total number of people aged 14 and under in the census tract. Click OK to execute.
23. Right-click on the Prop14under attribute and select Field Calculator from the context menu
24. Create a formula that divides the Total population aged 14 and under by the total population in the census tract. Click OK to execute.

These same steps may be used to calculate the proportion of the population in a certain age group, depending on the study needs.

## 6.7 Local Street Crime (2010 EAT-III)

### *1. Basic Concept*

The idea is to map street crime for predefined neighborhoods.

### *2. Basic Definition*

Neighborhood Crime = Uniform Crime Report (UCR) crime counts by neighborhood for Minneapolis and by grid zones for Saint Paul.

### *3. Detailed Definition*

Neighborhood Crime = Uniform Crime Report (UCR) crime counts by neighborhood for Minneapolis and by grid zones for Saint Paul.

### *4. Comments and Explanations*

None.

### *5. GIS Approach*

We obtained Uniform Crime Report (UCR) crime counts by neighborhood for Minneapolis and by grid zones for Saint Paul. We joined the Minneapolis crime counts with the Minneapolis neighborhood shapefile, and we joined the Saint Paul crime counts with the Saint Paul grid zones. We then merged the two shapefiles together. We calculated the density of crimes against person and the density of property crimes for each neighborhood/grid zone. We spatially joined the participant points with the shapefile to assign the crime stats, including the percentages of personal and property crimes, to the participants.

### *6. GIS Steps*

Not provided.

## 7. DATA STORAGE AND SHARING

### Steps/Problems with Obtaining Data

#### *Accuracy of InfoUSA Data*

The InfoUSA business data for USA came along with the Business Analyst extension of ArcGIS 9.1. It has all the business listings for the USA classified according to the NAICS and SIC codes. Only 90 percent of the businesses are geocoded at the street address level and 99.8 percent are assigned to census block group. Initially we saw InfoUSA data as being less accurate. Thus, Dun and Bradstreet business listing data was used for the project. However this information required a great deal of geocoding meaning that the difference was much less than had been apparent. On balance we now recommend Business Analyst (Forsyth et al. 2010a).

#### *Dun & Bradstreet Data*

The Dun and Bradstreet data was obtained from where data was geocoded according to parcel centroid and had 86,677 geocoded business locations. This dataset was used for design and development of the protocols. However, sometimes very high tolerance of 500 meters had to be used to locate the business points while working with Network Analyst as the Network dataset was created using The Lawrence Group (TLG) road data and the business points were located at the parcel centroid. This increased the processing time as well as sometimes led to many business points remaining not-located, while working with network dataset. Thus to increase the efficiency of protocols using the TLG Network dataset the original Dun and Bradstreet address data was acquired and Geocoded.

Thanks to Dr. Kevin Krizek and his research group for assistance and advice in version 1.0 of these protocols.

#### *Food Beverage Licensing Data*

To check the accuracy of InfoUSA and Dun & Bradstreet data the licensing data for the Food Establishments was obtained for the seven county area. The various counties and cities classify the licensing categories on different criteria ranging from size of establishment, number of employees, type of food served and food risk categories. The only common attribute among all the counties and cities was the name of the establishment (Forsyth et al. 2010a).

### Storing/Sharing Data

#### *Tracking Changes*

Protocol Tracking Excel Sheet: An Excel spreadsheet was used to keep track of completion of Protocols within the team. The sheet was updated weekly about the progress of the Protocols.

Food Establishment Licensing data tracking sheet: In the TREC-IDEA study this sheet was used to keep a track of the contact person to acquire the data, the procedure to acquire the data, when was the concerned person last contacted, what was the response, and whether data was obtained or not.

Decision Logs: Logs were maintained about the daily progress of the protocols, key decisions were recorded, meeting conversations were documented, notes from conversations with government representatives along with their response, and the tasks that were performed.

#### *Other Issues*

Projections: The standard coordinate system for MetroGIS datasets is Universal Transverse Mercator (UTM) North American Datum 1983 (NAD83), Zone 15. Any working or final files created from MetroGIS data were kept in the same coordinates. The participant and school data were geocoded using the MetroGIS TLG road data, thus they automatically were projected in UTM NAD83 Zone 15 projection

## APPENDICES

### Appendix 1A: Food Data Comparison

Different jurisdictions classify their food services differently. The following lists demonstrate just a small amount of the diversity in the Twin Cities area.

#### *Food Establishment License Classes for **Anoka County**.*

The following license classes apply to food establishments:

Class I Beverage service only.

Class II Food establishments serving meals, sandwiches, snacks and similar foods only.

Class III Catering food service.

Class IV Food establishment serving meals, sandwiches, snacks and similar foods with bar-type beverage service.

Class V Schools or churches.

Class VI Temporary food establishment.

Class VII Catering food vehicle.

Class VIII Unopened, pre-prepared, pre-wrapped food service only.

Class IX Limited food service, including catered day care operations, catered satellite operations in industrial settings where the commissary is on the premises, continental breakfasts serving low hazard foods, and concession stands with menus limited to low hazard foods.

#### *Food Establishment License Classes for **St. Louis Park, City of***

([http://www.stlouispark.org/city\\_hall/permits.htm](http://www.stlouispark.org/city_hall/permits.htm))

[http://www.stlouispark.org/city\\_hall/permit\\_contact.htm#597](http://www.stlouispark.org/city_hall/permit_contact.htm#597)

#### Food and beverage licenses

- Class L (prepackaged food)
- Class M (coffee shop)
- Class H (establishment with on-site preparation of food and dining service)
- Class H+ (establishment with on-site preparation of food as well as dining service, bar and/or catering)
- Class V (vending)

#### *Food Establishment License Classes for **Hennepin County***

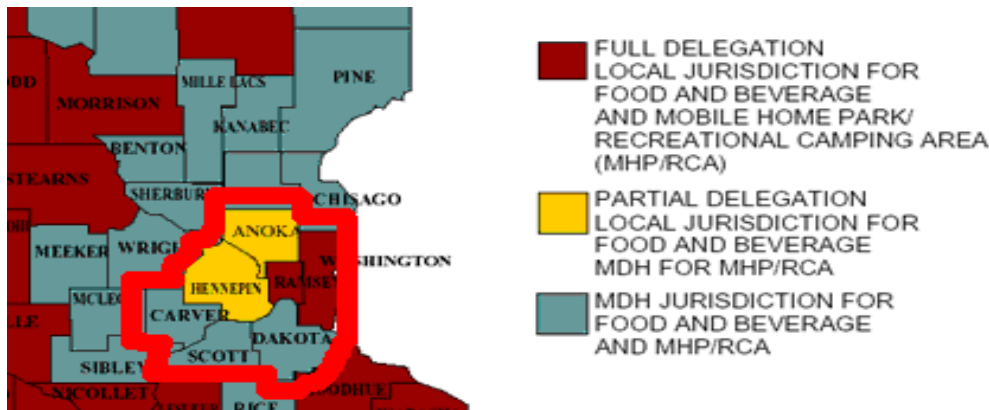
ABU: Bulk Food	FIS: Small Institution
ACS: C-Store	FLF: Limited
ADL: Deli Large	FLS: Food Low Small
ADM: Combo Meat/Deli	FOM: Commissary(L)
AHB: High Bakery	FOS: On Sale Bar
AHC: High Candy	FPZ: Pizza Carry,Order/Out
AHM: High Meat	FQU: Banquet Kitchen(S)
ALP: Lmt Produce	FRK: Rental Kitchen
AMG: Med Grocery	FSK: Snack Std(expanded)
AMM: Medium Meat	FSS: Snack Std(htd/prepkgd)
APP: Prepack	FTK: Test Kitchen
APR: Medium Produce	FWH: Warehouse
ASG: Small Grocery	FYT: Yacht(prepare)
AVE: Vending	SCF: School Sm Cafe
AVG: Small Produce	SLC: School Lg Cafe
FAS: Food Assembly With Sales	SLS: School Limited Snack
FAT: Caterer(L)	VNR: Veh/Cart/Port Bar No Refr
FBB: Bed and Breakfast	VWR: Vehicle/Cart w/Refrigerat
FBH: Boarding House	
FBQ: Banquet Kitchen(L)	
FBT: Boat Limited Operation	
FBV: Boat Small Menu	
FCC: Complex Cuisine(S)	
FCD: Cong Dining(prepare)	
FCF: Cafeteria(S)	
FCG: Cong Dining(no prepare)	
FCM: Commissary(S)	
FCT: Caterer(S)	
FCV: Catering Fd Veh(no prepare)	
FCX: Complex Cuisine(L)	
FDC: Day Care(meals provided)	
FDK: Domestic Kitchen	
FDL: Delicatessen	
FDS: Day Care(snacks only)	
FFE: Cafeteria(L)	
FFF: Fast Food(S)	
FFL: Full Menu(L)	
FFM: Manufacturer	
FFR: Full Menu(S)	
FFS: Fast Food(L)	
FFV: Catering Fd Veh(prepare)	
FHZ: Hazardous Vehicle	
FIL: Large Institution	

## Appendix 1B: Licensing Information for Food, Beverage, and Lodging in the Twin Cities

By Nishi Misha and Ed D'Sousa.

### Study Area Geography and Licensing Jurisdictions

The study area covers the following counties: Anoka, Ramsey, Hennepin, Carver, Scott, Dakota and Washington.



(<http://www.health.state.mn.us/divs/eh/food/license/delegation.htm>)

Below is a partial list of sources of licensing data.

*Minnesota Department of Health Food Code:*

(<http://www.health.state.mn.us/divs/eh/food/code/index.html>)

### Minnesota Department of Health

#### *Licensing: Food, Beverage and Lodging Establishment Definitions*

- Base Fee - an annual fee paid by each establishment except special event food stands.
- Limited Food Menu - prepackaged food that receives heat treatment and is served in the package, continental breakfast, soft drinks, coffee, nonalcoholic beverages.
- Small Establishment - food service with no salad bar, equipment not exceeding: one deep fat fryer; one grill; two hot holding containers; microwaves, or service of dipped ice cream/soft serve frozen desserts, or breakfast service in a bed and breakfast operation, or boarding establishments. Establishments which do not provide catering service and which meet “Medium Establishment” equipment criteria but have a total seating capacity of 50 or less are “Small Establishments.”
- Medium Establishment - food service using a range, oven, steam table, salad bar, or salad prep area, more than one deep fat fryer or grill, more than two hot holding containers, or involving catering.

- Large Establishment - food service that meets the full menu definition and seats more than 175 people, serves a full menu selection an average of five or more days per week or caters 500 or more meals per day.
- Beer or Wine Table Service - only beer or wine service to customers seated at tables.
- Alcohol Service From Bar - alcoholic mixed drinks are served or where beer or wine is served from a bar.
- Individual Water - a private water supply other than a community public water supply.
- Individual Sewer - a private sewage treatment system, which uses subsurface treatment and disposal.
- Lodging Per Unit - the number of guest rooms, cottages, or other rental units of a hotel, motel, lodging establishment, or resort, or the number of beds in a dormitory.
- Public Swimming Pool - any swimming pool other than a private residential swimming pool.
- Spa Pool - a public hot water pool intended for seated recreational use.
- Mobile Food Unit - a food and beverage service which is a vehicle mounted unit, either motorized or trailered, operating no more than 21 days annually at any one place or is operated in conjunction with a permanent business at the site of the permanent business by the same individual or company, and readily movable, without disassembling, for transport to another location.
- Seasonal Permanent Food Stand - a food and beverage service which is a permanent stand or building, but which operates no more than 21 days annually.
- Seasonal Temporary Food Stand - a food and beverage service stand which is disassembled and moved from location to location, but which operates no more than 21 days annually at any one location.
- Special Event Food Stand - a food and beverage service stand which is used in conjunction with celebrations and special events, and which operates at most three times annually for no more than ten total days.
- Food Cart - Means a food and beverage service, which is a non-motorized vehicle self-propelled by the operator.
- Late Penalty - additional charge added to the license fee when a person operates a business without first having made application and fee payment for the current year's license.

Counties and Cities--see Version 1.0

## Appendix 1C; Food, Beverage, and Lodging (FBL) Contacts

For the 7 County TREC study area a contact list is available from the January 2006 document “STATE AND LOCAL ENVIRONMENTAL HEALTH CONTACTS” **Compiled by:** Minnesota Department of Health (MDH), Division of Environmental Health, Environmental Health Services 651/201-4500, Well Management 651/201-4600 (Also available on the web at <http://www.health.state.mn.us/divs/eh/food/license/locals.pdf>)

## Appendix 1D: Dun and Bradstreet Data vs. Business Analyst

The 2006 data contained the following (Krizek et al. 2007):

- Records for 135,928 Metro area businesses (10 Counties)
- Detailed business data includes:
  - Location
  - Industry classification (NAICS and SICs)
  - Sales
  - Employees

### Sample Document

Source: <http://ds.datastarweb.com/ds/products/datastar/sheets/dbus.htm>

```
Duns Number & update
DUNS NO: 19-550-5177 D-S UPDATE: 199402.
Company name
American Biological Technologies, Inc.
Address
940 Crossroads Blvd.
Seguin.
Texas (TX) 78155-7801
USA.
Telecommunications
Telephone: 210-372-1391
County: Guadalupe
MSA: 7240 (San Antonio, TX).
Company history
Latest year organized:      1988
Date of incorporation:      27 October 1988 (19881027)
State of incorporation:      Texas (TX)
This is:
      A single location
      A Corporation
      A small business
      A Manufacturing location.
Management
President:
Michael Schrage              Pres
Line of business
Activities:
Mfg Serums.
US SIC codes
US SIC:
PRIMARY: 2835   Diagnostic substances, nsk

Employees
Employees here: 83
Employees total:
Latest year:      83
Trend year (1992): 83
Base year (1990): 60
Employment growth: 38 %.
```

#### Financial information

##### Sales:

Latest year:           USD       1,000,000  
                          ECU       889,570

Annual sales revision date: 13 January 1994 (940113).

#### Accommodation information

Square footage: 25,000       Occupancy type: Owned.

#### Professional advisors

Banking: Seguin State Bank & Trust Co (DUNS NO.: 00-895-3283).

## Business Analyst Attributes

CONAME – the legal, incorporated business location name

ADDR – physical address of business location

CITY16 – city where the business resides

STATE – two-letter abbreviation of the state where the business resides

STATE\_NAME – full name of state where the business resides

ZIP – five digit ZIP Code where the business resides

ZIP4 – four digit extension of the primary ZIP Code, if available

PHONE – telephone number with area code

SIC – primary Standard Industrial Code (up to six digits) of the business location

NAICS\_EXT – primary North American Industry Classification System code (up to eight digits) of the business location

SALES\_VOL – estimates sales or assets in thousands of dollars for the business location

HDBRCH – business status code of the business location

NUMBER\_EMP – number of employees for the business location

EMPSIZ – range describing the number of employees for the business location

FRNCOD – franchise code

SQFT – range describing the square footage of the business location

MATCH\_CODE – known qualities about the geocoded location for the business location

LOCNUM – unique internal code of the business location

## Appendix 1E: Notes on SIC and NAICS coding

*By Ed D'Sousa*

This appendix documented the SIC/NAICS codes that were used for the Twin Cities Walking study and highlighted some of the quality and usability issues of ESRI's Business Analyst infoUSA database. It is available in version 1.0 of these protocols. For further discussion see Forsyth et al. (2010a)

## Appendix 1F: Protocol/Geography/Data Matrix TREC-IDEA

Matrix complete as of version 1.0.

Draft TREC-IDEA Measures	Geographies					Data			
	straight line buffers	network buffers	home to school density	straight line distance	network distance	D&B/ Govt using NAICS	D&B/ Govt using names	Land use/ Met Council data	Census/ road data
5-Feb-07									
<b>2. FUNDAMENTAL PROTOCOLS AND PROCEDURES</b>									
2.1 Net Land Area (without water): See NEAT GIS Protocol 2.1.									
2.2 Gross Area (including water): See NEAT GIS Protocol 2.2.									
2.3 Measurement Geography Type 1: Straight Line or Airline Buffer; See NEAT GIS Protocol 2.5.	x								x
2.4 Measurement Geography Type 2: Network or Street Distance Buffer		x							x
2.5 Measurement Geography Type 3: Straight Line or Airline Distance to Nearest Feature; See NEAT GIS Protocol 2.7.				x					x
2.6 Measurement Geography Type 4: Network or Street Distance to Nearest Feature					x				x
2.7 Measurement Geography Type 5: Home to School Route Buffer			x						x
<b>3. FOOD SERVICES A.K.A. RESTAURANTS</b>									
3.1 Distance to Nearest Restaurant				x	x	x			x
3.2 Restaurant Density	x	x	x			x			
3.3: Distance to Limited Service or Fast Food Restaurants				x	x	x	x		x
3.4 Limited Service of Fast Food Restaurant Density	x	x	x			x	x		
3.5 Distance to Fast Food Restaurants Subtypes (See below for subtypes)				x	x	x	x		x
3.6 Density of Fast Food Restaurant Subtypes	x	x	x			x	x		
3.7 Distance to Non Fast Food Restaurants.				x	x	x			x
3.8 Density of Non Fast Food Restaurants	x	x	x			x			
<b>4. FOOD STORES</b>									
4.1 Distance to any Retail Food Outlet--All Stores Selling Food (not restaurants)				x	x	x			x
4.2 Density of all Retail Food	x	x	x			x			

Outlets-All Stores Selling Food (not restaurants)									
4.3 Distance to Groceries, Supermarkets, or Super Centers				x	x	x	x		x
4.4 Density of Groceries, Supermarkets, or Super Centers	x	x	x			x	x		
4.5 Distance to Large Supermarket or Super Center				x	x	x	x		x
4.6 Density of Large Supermarkets or Super Centers	x	x	x			x	x		
4.7 Type of Nearest Retail Food Outlet				x	x	x	x		x
4.8 Distance to Nearest Convenience Store Including Gas Stations				x	x	x			x
4.9. Density of Convenience Stores Including Gas Stations	x	x	x			x	x		
5. YOUTH AND UTILITARIAN OR RECREATIONAL PHYSICAL ACTIVITY									
DENSITY									
5.1 Raw Population per Unit Land Area: See NEAT GIS Protocol 3.1	x	x	x						x
5.2 Population per Unit Land Area (without water): See NEAT GIS Protocol 3.2	x	x	x						x
5.3 Residential Population in Residential Parcels (Residential Density) (without water): See NEAT GIS Protocol 3.3	x	x	x						x
5.4 Employment Per Unit Land Area: See NEAT GIS Protocol 3.6	x	x	x			x			
PEDESTRIAN INFRASTRUCTURE									
5.5 Distance to Nearest Transit Stop: See NEAT GIS Protocol 4.10				x	x			x	
5.6 Transit Stop Density: See NEAT GIS Protocol 4.11	x	x	x					x	
LAND-USE MIX									
5.7 Percentage of Total Parcel Area in Major Land Uses (residential, commercial, office, industrial, institutional, park and recreation, vacant): See NEAT GIS Protocol 5.1	x	x	x					x	
5.8 Percentage of Land Area in Retail Uses (a subset of the major land uses): See NEAT GIS Protocol 5.4	x	x	x					x	
5.9 Retail Employment Density: See NEAT GIS Protocol 5.11	x	x	x			x			
5.10 Distance to Nearest Facility (Mentioned in the Survey): Stores				x	x	x			

in Total, Hardware Stores									
<b>STREET PATTERN</b>									
5.11 Average Census Block Area: See NEAT GIS Protocol 6.1	x								x
5.12 Median Census Block Area: See NEAT GIS Protocol 6.2	x								x
5.13 Number of Access Points: See NEAT GIS Protocol 6.4*	x	x	x						x
5.14 Road Length per Unit Area: See NEAT GIS Protocol 6.5	x	x	x						x
5.15 Intersections per Unit Area: See NEAT GIS Protocol 6.6	x	x	x						x
<b>OTHER BUILT-ENVIRONMENT RELATED/SPATIAL VARIABLES</b>									
5.16 Proportion of High Functional Classifications [i.e. busy streets]: See NEAT GIS Protocol 7.1	x	x	x					x	
5.17 Distance to Nearest Park				x	x			x	
5.17 Distance to Nearest Gym or Fitness Facility				x	x	x	x	x	
5.18 Distance to Nearest Recreation Center, Community Center, or School				x	x	x	x	x	
5.19 Distance to Nearest Bicycle or Pedestrian Trail Access Point				x	x			x	
5.20 Distance to School Attended				x	x	data from survey			

Note: Buffers will be at 200m, 400m, 800m, and 1600m from home or school; other distances are possible.

## Appendix 1G: EAT-III and ECHO measures

The following measures are being used in the EAT-III and ECHO studies at 800, 1600, and 3000 meter buffers.

<b>Protocols:</b>	<b>EAT-III</b>			<b>ECHO</b>	
<b>Measures:</b>	density (3 network + 3 straight line)??	distance (network and straight line)	Census Geography	density (3 network + 3 straight line)	distance (network and straight line)
2.1 Net Land Area (without water): See NEAT GIS Protocol 2.1.	1			1	
2.2 Gross Area (including water): See NEAT GIS Protocol 2.2.					
2.3 Measurement Geography Type 1: Straight Line or Airline Buffer; See NEAT	3			3	

<b>Protocols:</b>	<b>EAT-III</b>			<b>ECHO</b>	
<b>Measures:</b>	density (3 network + 3 straight line)??	distance (network and straight line)	Census Geography	density (3 network + 3 straight line)	distance (network and straight line)
GIS					
2.4 Measurement Geography Type 2: Network or Street Distance Buffer	3			3	
2.5 Measurement Geography Type 3: Straight Line or Airline Distance to Nearest Feature; See NEAT GIS Protocol 2.7.		1			1
2.6 Measurement Geography Type 4: Network or Street Distance to Nearest Feature		1			1
2.7 Measurement Geography Type 5: Home to School Route Buffer	OMIT			OMIT	OMIT
3. RESTAURANTS A.K.A. FOOD SERVICES					
3.1 Distance to Nearest Restaurant		2			2
3.2 Restaurant Density	6			6	
3.3: Distance to Fast Food Restaurants (may use chain names rather than NAICS codes)		2			2
3.4 Fast Food Restaurant Density	6			6	
4. FOOD STORES					
4.3 Distance to Groceries, Supermarkets, or Super Centers		2			2
4.4 Density of Groceries, Supermarkets, or Super Centers	6			6	
4.5 Distance to Large Supermarkets or Super Center		2			
4.6 Density of Large Supermarkets or Super Centers	6				
4.8 Distance to Nearest Convenience Store Including Gas Stations		2			2
4.9. Density of Convenience Stores Including Gas Stations	6			6	
4.10 Distance to Farmers Market		2			
LAND USE, DENSITY, ETC					
5.2 Population per Unit Land Area excluding water: See NEAT GIS Protocol 3.2	6			6	
5.5 Distance to Nearest Transit Stop (NEAT GIS Protocol 4.10)					2
5.6 Transit Stop Density (NEAT GIS Protocol 4.11)	6				

Protocols:	EAT-III			ECHO	
Measures:	density (3 network + 3 straight line)??	distance (network and straight line)	Census Geography	density (3 network + 3 straight line)	distance (network and straight line)
5.7 Percentage of Total Parcel Area in Major Land Uses (residential, commercial, office, industrial, institutional, park and recreation, vacant):(NEAT GIS Protocol 5.1)	x				
STREET PATTERN					
5.10 Average Census Block Area (NEAT GIS Protocol 6.1)	6				
5.11 Median Census Block Area: See NEAT GIS Protocol 6.2	6				
5.12 Number of Access Points (TREC version)	6				
5.14 Road Length per Unit Area: See NEAT GIS Protocol 6.5				6	
5.15 Intersections per Unit Area: See NEAT GIS Protocol 6.6				6	
5.16 Proportion of High Functional Classifications [i.e. busy streets]: See NEAT GIS Protocol 7.1	6			6	
OTHER BUILT-ENVIRONMENT RELATED/SPATIAL VARIABLES					
5.17 Distance to Nearest Park		2			2
5.18 Distance to Nearest Gym or Fitness Facility		2			2
5.19 Distance to Nearest Recreation Center, Community Center, or School		2			2
5.20 Distance to Nearest Bicycle or Pedestrian Trail Access Point		check			
5.21 Distance to School Attended		check			2
NEW INFORMATION					
6.1 Proportion Female Headed Households	6				
6.2 Median Household Income			1		
6.3 Proportion High School Graduates			1		
6.4 Proportion in Poverty			1		
6.5 Median Assessed Home Value	6				
OTHER					

Protocols:	EAT-III			ECHO	
<b>Measures:</b>	density (3 network + 3 straight line)??	distance (network and straight line)	Census Geography	density (3 network + 3 straight line)	distance (network and straight line)
PARK ATTRIBUTES: We want to investigate, but not necessarily use, park attribute data, e.g. programming—that will mostly be the MPC folks but I could help (by the end of the meeting this seemed complicated).	INVEST-IGATE				
CRIME: Similarly, the MPC folks will look into crime data—if disaggregated data are not available, respondents could be allocated to neighborhoods or grid cells.	INVEST-IGATE				

## Appendix 2A: GIS Steps for Old Protocol 2.4: Network Buffer

### 5. GIS Approach

Use Network Analyst extension for ArcGIS 9.2 to determine the new service area around the set of point features, in this case participants or schools. Line features such as roads or trails are used to create the network, which is used to calculate all possible routes of a specified distance from the selected points.

### 6. GIS Steps

The following procedure was completed using ArcInfo 9.2

Requirements:




1. **Road Layer** polyline
2. **Point Features** for buffer
3. **Network Analyst Extension** for ArcGIS 9.2


#### II. Create a New Network Dataset

1. Start **ArcCatalog**.
2. On the Main Menu click **Tools** and Click on **Extensions**.
  - a. Check **Network Analyst** Extension.
  - b. Click Close.
3. In the catalog tree, navigate to the feature dataset if you are creating a geodatabase based network dataset. If you are creating a shapefile based network dataset navigate to the shapefile location in the catalog tree.
4. If you are creating a geodatabase based network dataset right click on the feature dataset and point to **New** and then click **Network Dataset**. If you are creating a shapefile based network dataset right click on the shapefile and click **New Network Dataset**.
5. In the **New Network Dataset Wizard**
  - a. Type a name for the network dataset and Click **Next**.
  - b. Check the **Road feature classes** that will be used as network source in the network and Click **Next**.
  - c. Accept the **default connectivity** settings and Click **Next**.
  - d. Accept the **default** option **NO** to modify the connectivity with **elevation** field data or elevation field settings and Click **Next**.
  - e. Accept the **default YES** to model **Turn** in the Network and Click **Next**.
  - f. Click **Add**
    - i. Type **Length** in the Name field.
    - ii. Select **Cost** as **Usage Type**, if it is not already selected.
    - iii. Select **Meters** as the **Units**.
    - iv. Select **Double** as the **Data type**, if it is not already selected.
    - v. Click **OK**.
    - vi. Click **Next**.
  - g. Accept the default **Yes** to use the **default directions** settings to establish driving directions for the network dataset and Click **Next**.
  - h. Review the network dataset summary to check the options are correctly selected and Click **Finish**.
6. Click **Yes** to build the Network Dataset.

#### III. Create the Network or Street Distance Buffer

1. Start **ArcMap**
2. On the Main Menu click **Tools** and Click on **Extensions**.
  - a. Check **Network Analyst** Extension.

- b. Click Close
3. Click the **Add Data** button  on the **Standard Toolbar**
  - a. Navigate to the **Network Dataset** location, created earlier in Step I
  - b. Click on the **Network Dataset** and click **Add** to add the Network Dataset to ArcMap.
  - c. Click **Yes** to add all the feature classes, that participate in the network, to the map.
4. Click the **Add Data** button  on the **Standard Toolbar**
  - a. Navigate to the **Point Layer** to be used for analysis, in this case **Participant location/School Locations**
  - b. Click on the **Point Layer** and click **Add** to add it to ArcMap.
5. In the Table of Contents Right Click the **Point Layer** and click on **Open Attribute Table**
  - b. In the **Attribute Table**
    - i. Click **Options**
    - ii. Click **Add Field**
    - iii. Add the **School\_Id/Participant\_Id** as **Text**
      - Type **School\_Id/Participant\_Id** in the **Name** field
      - Select **Text (50)** as **Type**
      - Accept **default** for **Length**
      - Click **OK**
    - iv. Add the **School\_Id/Participant\_Id** as **Integer**
      - Type **School\_Id/Participant\_Id** in the **Name** field
      - Select **Short Integer** as **Type**
      - Accept **default (0)** for **Precision**
      - Click **OK**
    - v. Enter the assigned Id for the participants and schools
6. On the main menu click **View**
  - a. Click on **Toolbars**
  - b. In the side menu click **Network Analyst** to add the Network Analyst toolbar to ArcMap
7. Click **Network Analysis Toolbar**
  - a. Click **Network Analyst Window** button  to add the Network Analyst Window to the map
8. On the **Network Analyst Toolbar** Click **Network Analyst Dropdown Menu**
  - a. Click **New Service Area**
  - b. The **Table of contents** and the **Network Analyst** Window contains empty list of **Facilities**, **Barriers** and **Polygon** Categories.
9. On the **Network Analyst Window** right Click **Facilities** and Click **Load Locations**
  - a. In **Load Locations Window**
    - i. Click **Browse** and Navigate to the **point feature layer**
    - ii. Click on the **Point feature layer** and click **Add**
    - iii. Choose the **Participant ID/School Id** as the **Name** field. Accept the **default** for other **Location Analysis Properties**
    - iv. Accept the **default Location Position**
    - v. Click **OK**
10. To set the properties to be used in the Analysis, In the Table of Contents Right Click the **Service Area Layer** and Click **Properties**
  - a. Click on **Analysis Settings Tab**
    - i. Choose **Length (Meters)** for **Impedance**.
    - ii. Type the **Buffer Distance** for **Default Breaks**
    - iii. Choose **Away From Facility** as **Direction**

- iv. Choose **Everywhere** for **Allow U-Turns**
    - v. **Uncheck the box next to Oneway Restrictions.**
  - b. Click on **Polygon Generation Tab**
    - i. Check **Polygon generation**
    - ii. Choose **Generalized** as the **Polygon Type**
    - iii. Uncheck **Trim Polygons**
    - iv. Choose **Overlapping** for **Multiple Facility Options**
    - v. Choose **Rings** as the **Overlap Type**
  - c. Click **Ok**
- 11. On the Network Analyst Toolbar, Click **Solve** Button 
- 12. Joining attributes with Source Point Layer to carry over the data.
  - a. Right Click the **Polygons Layer**
  - b. Click **Joins and Relates** and then **Join**
    - i. Choose **Facility Id** as the Field to base the join on
    - ii. Choose the **School/Participant Layer** as the Table to Join to this layer
    - iii. Choose the **School/Participant ID** as the field in the table to base the join on
  - e. Right Click the **Polygons Layer**
  - f. Click on **Data** and then **Export Data**
    - i. Choose **this layer's source data** for the coordinate system
    - ii. Specify the **Output location**

## Appendix 2B: Logic for Developing the “Sausage” Network Buffer

Street network buffers aim to measure the environment that can be reached by someone on foot along the street network and, if possible, the pedestrian network as well (though given a lack of GIS data on the pedestrian network, this can be time consuming because it requires fieldwork).

In addition, the way GIS programs calculate this buffer can lead to quite different shapes and areas. The images below illustrate some of the differences between how ArcView 3.3 calculated buffers (this was the version available up to about 2006) and the detailed and generalized buffers of version 9 of ArcGIS. They differ substantially. In the earlier version the network buffer merely joined the points furthest out X distance along the roads from the starting point. This was, or at least approximated, a shape known as a convex hull. This is not available in the new network analyst. Instead there are two shapes, one more complex (detailed) and one simpler (generalized). The following illustrations on the next page demonstrate some of these changes for a single case. This is the reason that for the versions of these protocols starting at 2.0 in 2010 we have developed a new “sausage” buffer. Our thoughts at arriving at this are below.

The following list illustrates the differences in area among the different standard buffers in Network Analysts and illustrating that in area, if not in shape and location, the newer generalized buffers are closest to the old network buffers. We used those in the TREC-IDEA study (version 1 and 1.1. of these protocols).

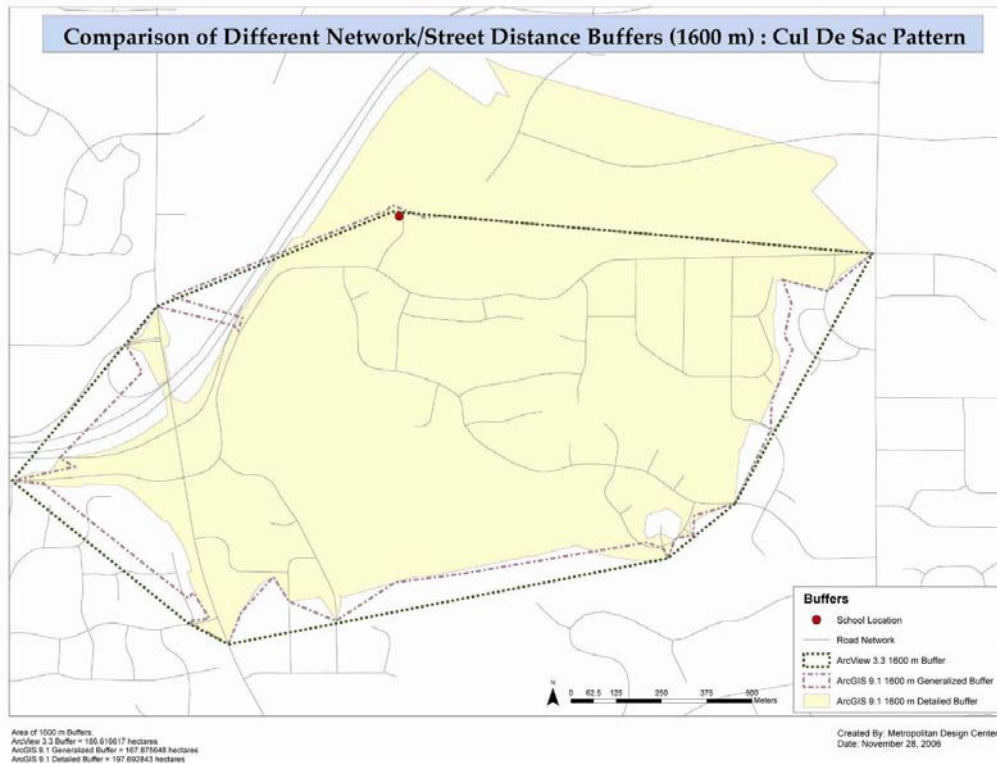
### Area of Buffers Around One Point:

1600 m ArcView 3.3 = 1866166.16725 sq m / **186.62** hectares  
1600 m generalized buffer = 1678756.48148 sq m / **167.88** hectares  
1600 m detailed buffer = 1976928.43402 sq m / **197.69** hectares

800 m ArcView 3.3 = 384657.620882 / **38.471** hectares  
800 m generalized buffer = 343218.353395 / **34.32** hectares  
800 m detailed buffer = 586742.068519 / **58.67** hectares

400 m ArcView 3.3 = 73484.750545 / **7.35** hectares  
400 m generalized buffer = 60505.556168 / **6.05** hectares  
400 m detailed buffer = 194117.956987 / **19.41** hectares

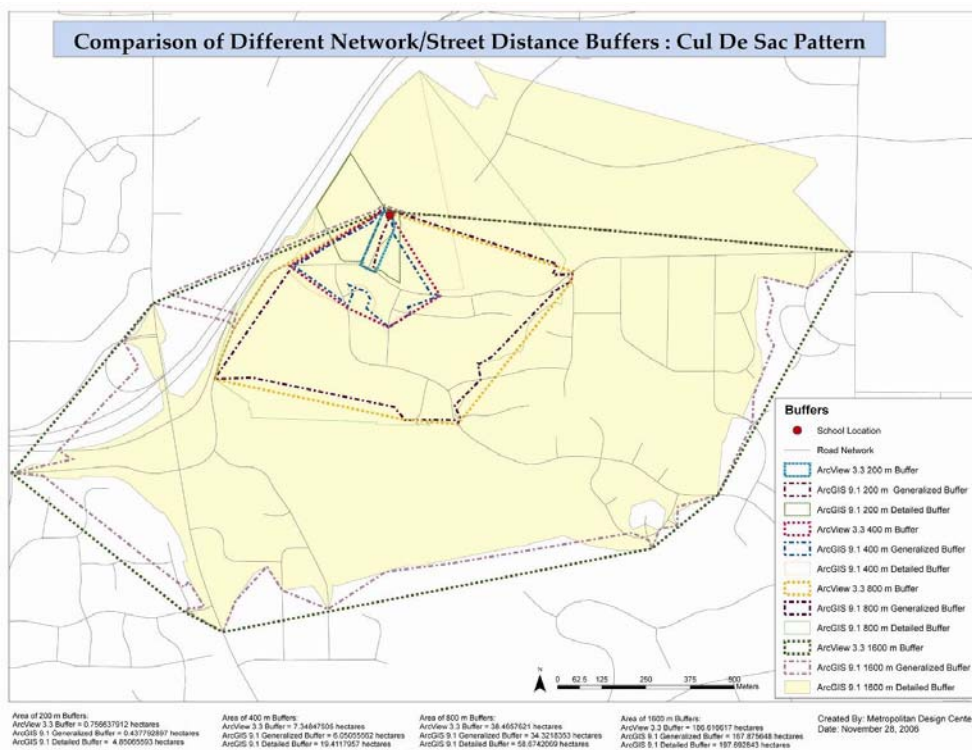
200 m ArcView 3.3 = 7566.379119 / **0.76** hectares  
200 m generalized buffer = 4377.928967 / **0.44** hectares  
200 m detailed buffer = 48506.559253 / **4.85** hectares



The outer greenish line is the traditional, ArcView 3.3 network buffer for 1 600 m distance.

The purple line is the “generalized” buffer from ArcGIS 9.1 for a 1600m distance.

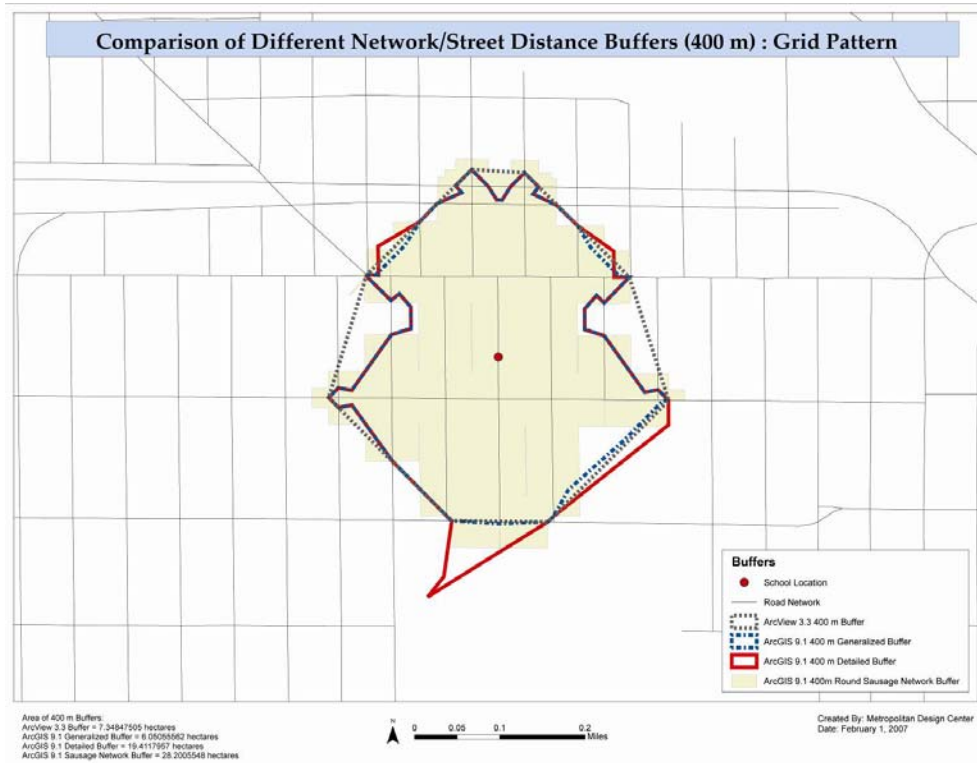
The yellow area is the “detailed” buffer from ArcGIS 9.1 for a 1600m distance.



Comparison of 200m, 400m, 800m and 1600m ArcView 3.3 network buffers, ArcGIS 9.1 generalized buffers, and ArcGIS 9.1 detailed buffers.

Notice that the detailed buffers are often in quite different locations to the generalized and ArcView buffers.

However, it is also possible to just buffer roads with a kind of network of sausages following the roads. This would be a more replicable method across program revisions and from program to program (given other GIS programs are more popular in Europe, for example). The sausage network buffer is a buffer constructed using a different function in ArcGIS and merely buffering x meters (we chose 50 for this test) on either side of all streets near the point out y meters (the buffer length). The following diagram illustrates how this buffer compares to the ArcView 3.3, generalized, and detailed buffer. This uses a buffer with flat ends--note that we eventually chose one with rounded ends.



The outer gray line is the traditional, ArcView 3.3 network buffer for 1 400 m distance.  
 The blue line is the “generalized” buffer from ArcGIS 9.1 for a 400m distance.  
 The red line is the “detailed” buffer from ArcGIS 9.1 for a 400m distance.  
 The yellow area is the “sausage” buffer with straight ends.

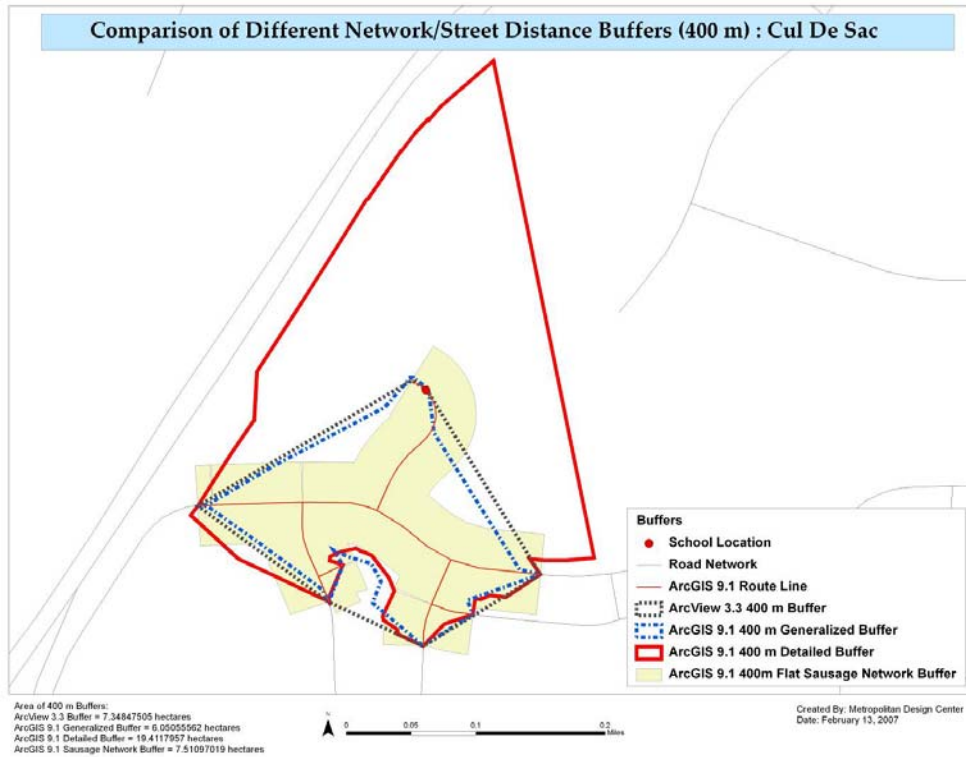
**Area of the Buffers:**

ArcView 3.3 Buffer = 28.5 hectares

ArcGIS 9.1 Generalized Buffer = 24.6 hectares

ArcGIS 9.1 Detailed Buffer = 26.9 hectares

ArcGIS 9.1 Sausage Network Buffer = 28.2 hectares



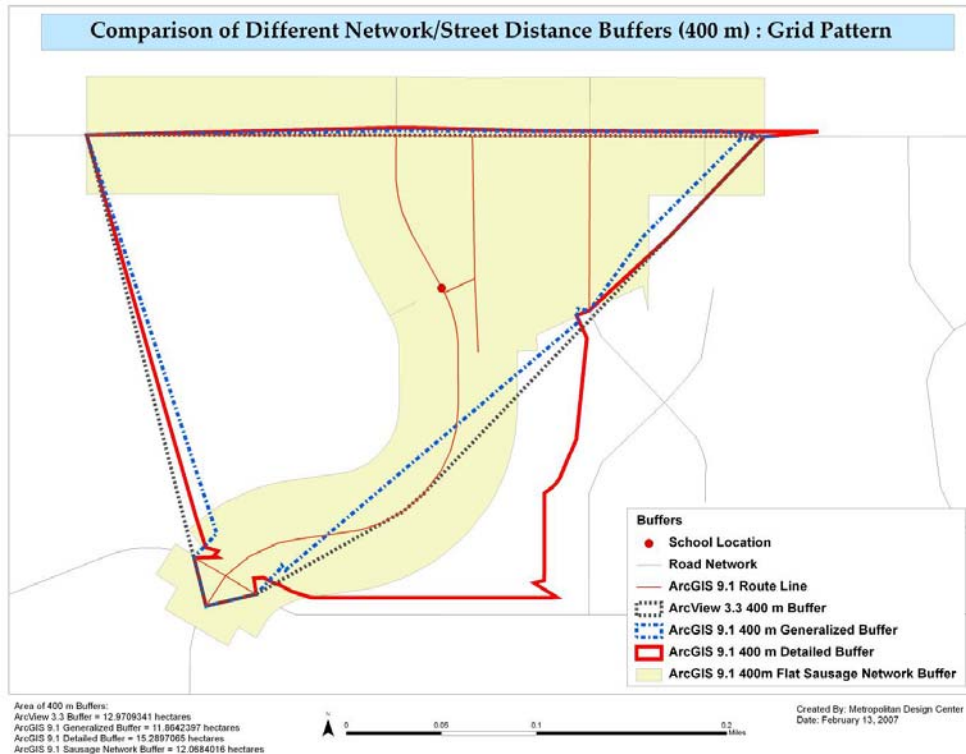
Area of the Buffers:

ArcView 3.3 Buffer =  
7.3 hectares

ArcGIS 9.1  
Generalized Buffer =  
6.01 hectares

ArcGIS 9.1 Detailed  
Buffer = 19.4  
hectares

ArcGIS 9.1 Sausage  
Network Buffer = 7.5  
hectares



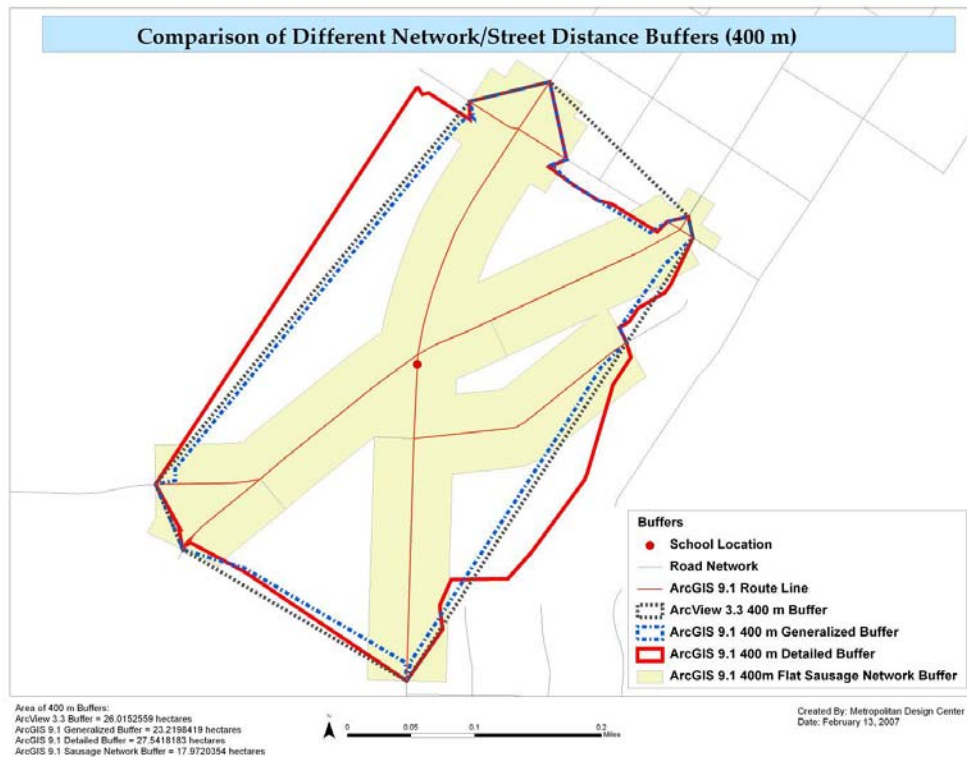
Area of the Buffers:

ArcView 3.3 Buffer =  
13.0 hectares

ArcGIS 9.1  
Generalized Buffer =  
11.9 hectares

ArcGIS 9.1 Detailed  
Buffer = 15.3  
hectares

ArcGIS 9.1 Sausage  
Network Buffer = 12.1  
hectares



Area of the Buffers:

ArcView 3.3 Buffer = 26.0 hectares

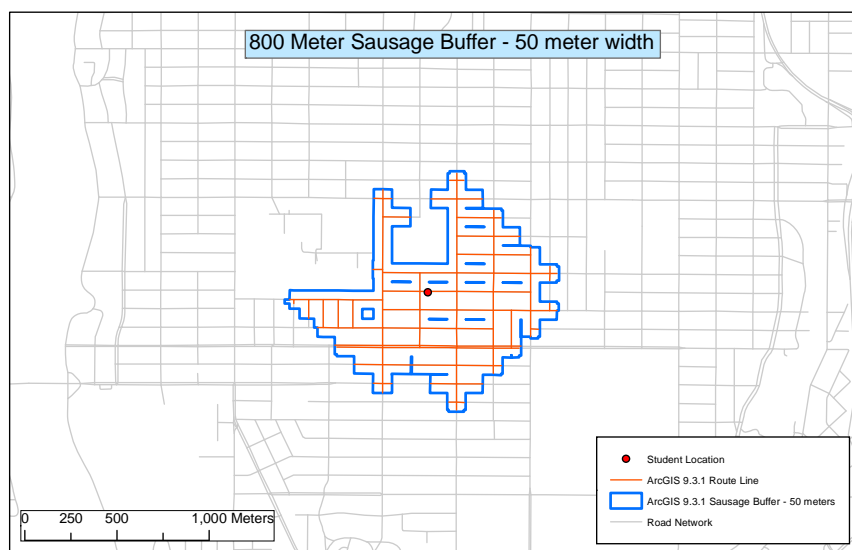
ArcGIS 9.1 Generalized Buffer = 23.2 hectares

ArcGIS 9.1 Detailed Buffer = 27.5 hectares

ArcGIS 9.1 Sausage Network Buffer = 18.0 hectares

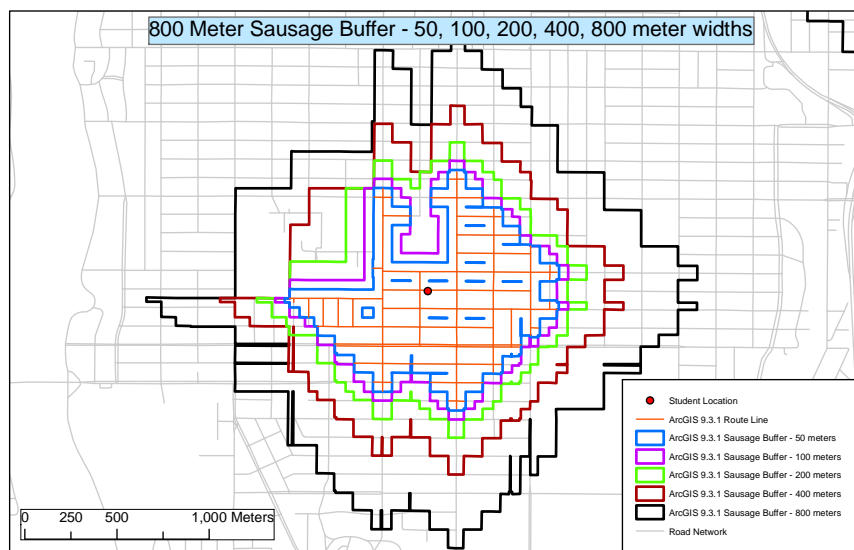
In 2010 we decided to really take on this challenge and develop viable sausage buffers that would be more stable in the sense they would not vary across programs and versions of programs. The following are some working tests we have performed.

As can be seen in gridded areas these buffers approximate the old-style network buffer shapes. **We are still testing cul-de-sac style patterns for optimal buffer radii (the amount buffered on either side of the street).** A final set of tests will more fully compare buffers.



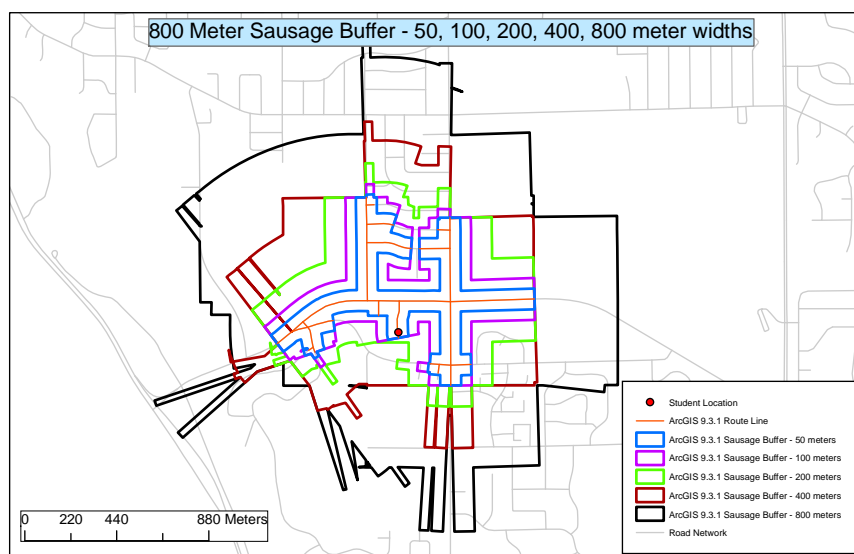
2010 Test 1: Sausage buffer X= 800 M and Y (radius) = 50 m.

This buffer radius covers most of the interiors of the standard sized blocks but extends 50m beyond the X distance. It represents a minimum buffer size for “grabbing” or measuring important contextual features in the environment such as nearby land use.



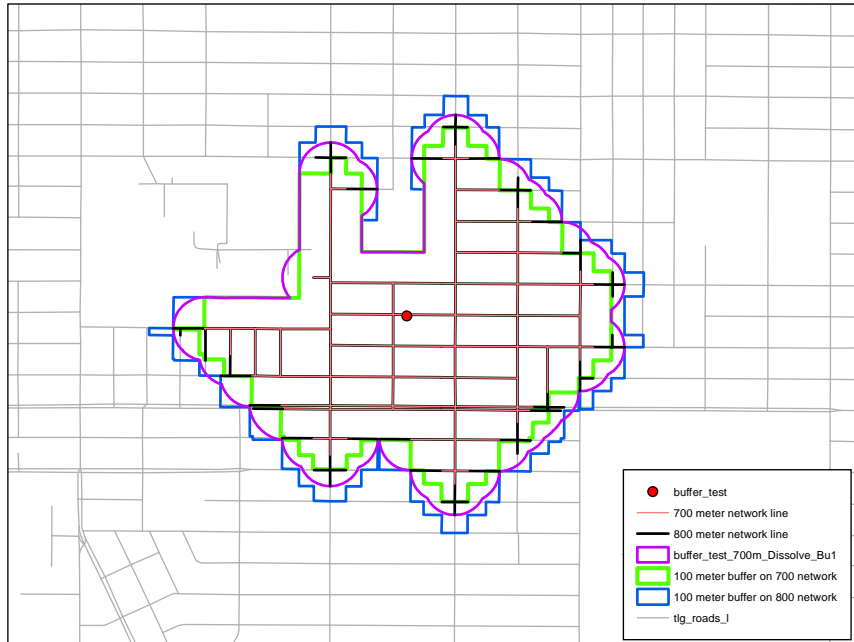
2010 Test 2: Sausage buffer  $X = 800$  M and  $Y$  (radius) = 50, 100, 200, 400, and 800 in a grid context.

The very large buffers extend out a great distance but if the radius were to be subtracted from the buffer distance to add up to  $X$  (800 m in this case), they would cover little of the road network (400m for a 400m buffer and 0m for an 800m one). This led us to look at smaller radius values.



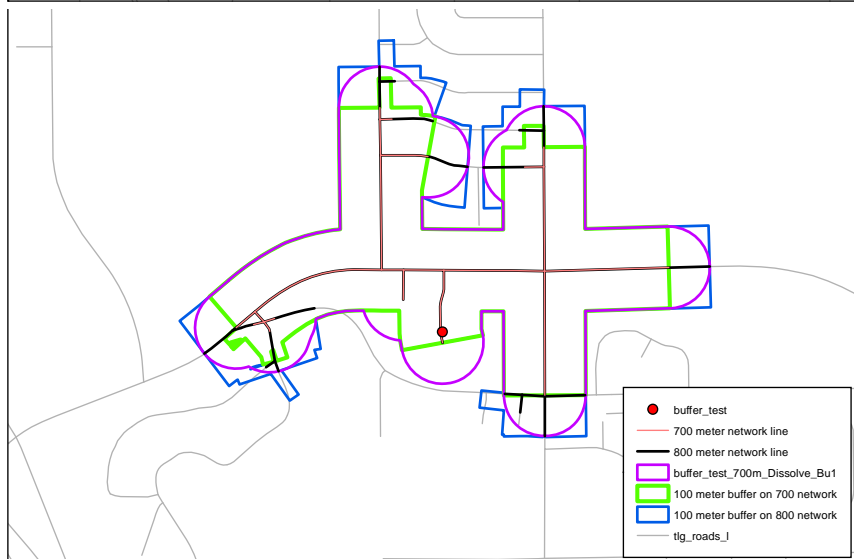
2010 Test 3: Sausage buffer  $X = 800$  M and  $Y$  (radius) = 50, 100, 200, 400, and 800 in a more curvilinear context.

The problems are similar to those in test 2.



2010 Test 3: Sausage buffer X= 800 M and Y (radius) = 100 m in a grid context, using different buffer end shapes.

This compares flat ended buffers with rounded buffers adjusted so they end at exactly X (in this case 800) meters from the starting point. The rounded buffer (purple line) is a close approximation of the earlier network buffers.



2010 Test 3: Sausage buffer X= 800 M and Y (radius) = 100 m in a grid context, using different buffer end shapes.

This compares flat ended buffers with rounded buffers adjusted so they end at exactly X (in this case 800) meters from the starting point. The rounded buffer (purple line) approximates the area experienced by those on the street network. **Further testing will resolve whether a slightly wider buffer might make sense.**

## Appendix 3A: Wikipedia and Quick Serve Restaurant Fast Food Lists 2007

### Wikipedia

A&W	Dunkin' Donuts	Papa Murphy's Pizza
Amigos/Kings Classic	Einstein Bros. Bagels	Take 'N Bake
Andy's	El Pollo Loco	Peter Piper Pizza
Arby's	Fatburger	Pioneer Chicken
Arctic Circle Restaurants	Fazoli's	Pizza Hut
Arthur Treacher's	Filiberto's	Pizza Ranch
Atlanta Bread Company	Five Guys	Popeyes Chicken & Biscuits
Au Bon Pain	Fosters Freeze	Portillo's
Back Yard Burgers	Fuddruckers	Potbelly Sandwich Works
Baja Fresh	Godfather's Pizza	Qdoba Mexican Grill
Baja Fresh Mexican Grill	Grandy's	Quiznos Subs
Baker's Drive-thru	Green Burrito	Raising Cane's Chicken Fingers
Baskin Robbins	Griff's Hamburgers	Rally's Hamburgers
Big Apple Bagels	Hamburger Stand with Der	Rax Restaurants
Big Boy	Wienerschnitzel	Red Burrito
Blake's Lotaburger	Happy Daz	Roy Rogers Family Restaurants
Blimpie	Hardee's	Rubio's
Bojangles'	Home Run Inn Pizza	Runza
Boston Market	Honey Dew Donuts	Sbarro
Boston's Gourmet	Hot Dog on a Stick	Schlotzsky's Deli
Braum's	Hot Stuff Pizza	Shakey's Pizza
Brown's Chicken & Pasta	In-N-Out Burger	Simple Simon's Pizza
Bruster's Ice Cream	Jack in the Box	Skipper's
Bud's Broiler	Jamba Juice	Sonic Drive-In
Buffalo Wild Wings	Jason's Deli	Sonny's Real Pit Bar-B-Q
Bun Boy	Jimmy John's	Starbucks
Burger King	Jim's Burger Haven	Starbucks
Captain D's Seafood	Kenny Rogers Roasters	Steak 'n Shake
Carl's Jr.	Kewpee	Stewart's Drive-In
Charley's Grilled Subs	KFC	Submarina
Checkers Drive-In (also called	Krispy Kreme	Subway
Rally's Drive-In)	Krystal	Taco Bell
Chester's	L&L Hawaiian Barbecue	Taco Bueno
Chick-fil-A	La Salsa	Taco Cabana
Chipotle Mexican Grill	Lenny's Sub Shop	Taco Del Mar
Chuck E. Cheese's	Little Caesars Pizza	Taco John's
Church's Chicken	Long John Silver's	Taco Mayo
CiCi's Pizza	Maid-Rite	Taco Tico
City Barbeque	McDonald's	Taco Time
Cold Stone Creamery	McDonald's	Tastee-Freez
Cosi	Milio's Sandwiches	Teriyaki Boy
Cousins Subs	Milo's Hamburgers	The Daily Bagel
Crown Burgers	Moe's Southwest Grill	The Great American Bagel
Culver's	Mr. Chicken	The Great Steak & Potato
Culver's	Mr. Sub	The Hat
Dairy Queen	Mrs. Winners Chicken	Tim Hortons
Del Rancho	Nathan's Famous	Togo's Eateries
Del Taco	Noah's Bagels	Tudor's Biscuit World
Denny's	Ollie's Trolley	Una Mas!
Dick's Drive-In	Orange Julius	Wendy's
Dog n Suds	Original Tommy's	Wetzel's Pretzels

Domino's Pizza  
Donatos Pizza  
Drive-In/Rally's  
Duchess Restaurants

Pal's Sudden Service  
Panda Express  
Panera Bread  
Papa John's Pizza

Whataburger  
White Castle  
Wienerschnitzel  
Winchell's Donuts  
Winsteads  
Yello Sub  
Yum-Yum Donuts  
Zaxby's

2007 Quick Serve Restaurant Magazine online's National Chain Restaurants--QSR 50 (ranked by system-wide sales). The list (with their rank) is as follows:

Arby's	11	Domino's Pizza	10	Panera Bread	18
Baja Fresh Mexican Grill	48	Drive-In/Rally's	32	Papa John's Pizza	16
Baskin-Robbins	34	Dunkin' Donuts	9	Papa Murphy's Pizza	Take 'N
Blimpie Subs	50	Einstein/Noah's Bagels	46	Bake	42
Bojangles'	41	El Pollo Loco	39	Pizza Hut	6
Boston Market	27	Fazoli's	47	Popeyes	19
Buffalo Wild Wings	29	Hardee's	17	Quiznos Classic Subs	20
Burger King	2	Hot Stuff Pizza	51	Sbarro	40
Captain D's Seafood	36	In-N-Out Burger	45	Sonic Drive-In	12
Carl's Jr.	21	Jack in the Box	13	Starbucks	7
Checkers	31	Jason's Deli	49	Steak n Shake	28
Chick-fil-A	15	KFC	8	Subway	4
Chipotle	30	Krystal	43	Taco Bell	5
Church's Chicken	24	Little Caesars Pizza	26	Wendy's	3
CiCi's Pizza	37	Long John Silver's	23	Whataburger	22
Cold Stone Creamery	44	McDonald's	1	White Castle	33
Culver's	38	Panda Express	25		
Dairy Queen	14				
Del Taco	35				

2010 Quick Serve Restaurant Magazine online's National Chain Restaurants--QSR 50 (ranked by system-wide sales). The list is as follows:

McDonald's	Quiznos Subs*	El Pollo Loco
Subway*	Hardee's*	Baskin-Robbins*
Burger King	Popeyes*	Del Taco
Wendy's*	Chipotle	CiCi's Pizza
Starbucks Coffee*	Carl's Jr.*	Boston Market*
Taco Bell	Panda Express	White Castle
Dunkin' Donuts*	Whataburger	Sbarro*
Pizza Hut	Little Caesars*	Five Guys Burgers & Fries
KFC	Church's Chicken*	Jason's Deli
Sonic	Steak 'n Shake*	Captain D's
Arby's*	Zaxby's	In-N-Out Burger*
Chick-fil-A*	Long John Silver's*2	Qdoba
Jack in the Box	Checkers/Rally's	Cold Stone Creamery
Domino's*	Bojangles'	Krystal
Panera Bread*	Culver's	Tim Hortons
Dairy Queen*	Papa Murphy's	Einstein Bros. Bagels*
Papa John's	Jimmy John's*	



## Appendix 4A: Wikipedia Supermarket List 2007

99 Ranch Market - The largest Asian American supermarket chain on the West Coast.	Asian	
Ai Hoa Supermarket - Formerly a large Chinese-Vietnamese American chain in southern California, now operates one store in Chinatown, Los Angeles	Asian	
Diho Supermarket - Chinese American	Asian	
Hong Kong Supermarket - Chinese American supermarket chain.	Asian	
Island Pacific Supermarket - Filipino American chain in California and Nevada	Asian	
Marukai - Japanese American supermarket.	Asian	
Mitsuwa - Japanese American supermarket chain of Southern California.	Asian	
Seafood City - Filipino American supermarket chain.	Asian	
Shun Fat Supermarket - Chinese American supermarket.	Asian	
Uwajimaya - Asian American supermarket chain in the Pacific Northwest.	Asian	
Aldi (the US operations of a German group)	discount chains	
Food 4 Less	discount chains	
Grocery Outlet (west)	discount chains	
Marc's	discount chains	
Price Chopper (New York and Pennsylvania)	discount chains	
PriceRite (Connecticut, New York, Massachusetts, Rhode Island and Pennsylvania--Owned by Wakefern)	discount chains	
Supervalu (midwest, mixed franchiser and directly-owned stores, uses banners: Cub Foods, Save-A-Lot and more )	discount chains	
WinCo Foods (west)	discount chains	
Fiesta Supermarket - Mexican-American, primarily in Texas	Hispanic/Latino	
Publix Sabor - Hispanic, operated by Publix.	Hispanic/Latino	
Superior Warehouse - Mexican American	Hispanic/Latino	
Supermercados Gigante - Mexico-based supermarket chain with locations in the US.	Hispanic/Latino	
Acme	National chains	supervalu
Albertsons	National chains	supervalu
Albertsons LLC	National chains	
Baker's	National chains	Kroger
bigg's	National chains	supervalu
Bloom	National chains	Delhaize Group (Belgian company's US subsidiaries)
Bristol Farms	National chains	supervalu
Carrs	National chains	safeway
Costco	National chains	
County Market	National chains	
Cub Foods	National chains	supervalu
Dillon's	National chains	Kroger
Dominick's	National chains	safeway
Farm Fresh	National chains	supervalu
Farmer Jack	National chains	A and P

Food 4 Less	National chains	Kroger
Food Emporium	National chains	A and P
		Delhaize Group (Belgian company's US subsidiaries)
Food Lion	National chains	Kroger
FoodsCo	National chains	Kroger
Fred Meyer	National chains	Kroger
Fry's Food	National chains	safeway
Genuardi's	National chains	Ahold (Dutch company's US subsidiaries)
		Ahold (Dutch company's US subsidiaries)
Giant Food (Maryland)	National chains	Delhaize Group (Belgian company's US subsidiaries)
Giant Food (Pennsylvania)	National chains	
Hannaford	National chains	Delhaize Group (Belgian company's US subsidiaries)
Harris Teeter	National chains	
		Delhaize Group (Belgian company's US subsidiaries)
Harvey's	National chains	
Henhouse	National chains	supervalu
Hornbacher's	National chains	Kroger
Jay C	National chains	supervalu
Jewel/Jewel-Osco	National chains	Delhaize Group (Belgian company's US subsidiaries)
		Kroger
Kash n' Karry	National chains	
King Soopers	National chains	
Kmart	National chains	
Kroger	National chains	Kroger
Lazy Acres	National chains	supervalu
Lucky Stores (used to be Max Foods) ( 3 locations Alhambra, El Centro, and Montebello, CA)	National chains	supervalu
Pavilions	National chains	safeway
		Ahold (Dutch company's US subsidiaries)
Peapod	National chains	
Piggly Wiggly	National chains	
QFC	National chains	Kroger
Ralphs	National chains	Kroger
Randalls	National chains	safeway
Safeway	National chains	safeway
Save-A-Lot	National chains	supervalu
Scott's Food & Pharmacy	National chains	supervalu
		Ahold (Dutch company's US subsidiaries)
see also: Giant-Stop & Shop	National chains	supervalu
Shaw's	National chains	supervalu
Shop 'n Save	National chains	Delhaize Group (Belgian company's US subsidiaries)
Shop 'n' Save (Singapore, not the Shop 'n Save owned by SuperValu)	National chains	supervalu
Shoppers Food & Pharmacy	National chains	Kroger
Smiths	National chains	supervalu
Star Market	National chains	Ahold (Dutch company's US subsidiaries)
		supervalu
Stop & Shop	National chains	supervalu
Sunflower Market	National chains	
Super Saver Foods	National chains	

SuperValu	National chains	supervalu
Target Stores	National chains	
Tom Thumb	National chains	safeway
Tops	National chains	Ahold (Dutch company's US subsidiaries)
Vons	National chains	safeway
Waldbaum's	National chains	A and P
Wal-Mart	National chains	
Whole Foods	National chains	
WinCo Foods	National chains	
Winn-Dixie	National chains	
Acme Fresh Market, operating in the Akron, Ohio area	Regional/local chains	
Andronico's (California)	Regional/local chains	
Bashas' (Arizona)	Regional/local chains	
Big Y Foods (New England)	Regional/local chains	
Bi-Lo Foods	Regional/local chains	Penn traffic
Brookshire Brothers (Texas) A brother of the Brookshires mentioned above.	Regional/local chains	
Brookshire's Also runs Super1 Foods in East Texas and Shreveport, LA (Texas & Louisiana)	Regional/local chains	
Buehler's Buy-Low (Indiana, Illinois, Kentucky)	Regional/local chains	
Byerly's	Regional/local chains	lunds
Cannata's Family Market (southern Louisiana)	Regional/local chains	
Clemens (PA)	Regional/local chains	
Copps Food Center	Regional/local chains	
Copps Food Center (Wisconsin)	Regional/local chains	Roundy's
County Market	Regional/local chains	
C-Town	Regional/local chains	
D&W Food Centers (Michigan)	Regional/local chains	
D'Agostino's (New York)	Regional/local chains	
DeMoulas' Market Basket (New England - Massachusetts/New Hampshire)	Regional/local chains	
Fareway (Iowa)	Regional/local chains	
FasChec (Charleston, West Virginia area)	Regional/local chains	
Felpausch (Michigan)	Regional/local chains	
Fiesta Food Stores (Houston, Dallas & Austin, Texas) Hispanic and International foods.	Regional/local chains	
Food Basket	Regional/local chains	
Food City (Kentucky, Virginia, Tennessee)	Regional/local chains	
Food Giant	Regional/local chains	
FoodFair (Southeast Ohio, Eastern Kentucky, and Western West Virginia)	Regional/local chains	
FoodLand (Hawaii)	Regional/local chains	
FoodLand Supermarkets(Western Pennsylvania)	Regional/local chains	
Foodtown (Northeast, mainly New Jersey) (a similarly named store, "Food Town", operates in the Houston, Texas area)	Regional/local chains	
Gerland's (Houston)	Regional/local chains	
Giant Eagle (eastern United States)	Regional/local chains	
Glen's (Northern Michigan)	Regional/local chains	

Grand Union (AKA GU Family Markets)	Regional/local chains	
Haggen Top Food & Drug (Washington, Oregon)	Regional/local chains	
Harding's Friendly Markets (Southwest Michigan)	Regional/local chains	
H-E-B (Texas) Has expanded in to Mexico and soon Louisiana. H-E-B Central Market is a competitor to Whole Foods (Health) Largest grocer in Texas.	Regional/local chains	
Heinen's Fine Foods (Greater Cleveland)	Regional/local chains	
Hugo's (North Dakota, Minnesota)	Regional/local chains	
Hy-Vee Food Stores (Hundreds of stores in 7 states)	Regional/local chains	
Ingles (south)	Regional/local chains	
Jons (Los Angeles inner-city)	Regional/local chains	
Karns Foods (Central Pennsylvania)	Regional/local chains	
Key Food	Regional/local chains	
King Kullen (Long Island)	Regional/local chains	
Kowalski's (Minnesota)	Regional/local chains	
Lowe's Foods (North Carolina)	Regional/local chains	
Lund's (Minnesota)	Regional/local chains	lunds
Magruder's (Washington, DC region)	Regional/local chains	
Market Basket (SE Texas and SW Louisiana)	Regional/local chains	
Mars (Greater Baltimore area)	Regional/local chains	
Marsh (Indiana and Ohio, includes O'Malia's and Lo-Bill chains)	Regional/local chains	
Martin's Super Food Stores (New York)	Regional/local chains	
Martin's Super Markets (Indiana)	Regional/local chains	
Mayfair	Regional/local chains	
Meijer (midwest)	Regional/local chains	
Minyard's (Dallas/Fort Worth Metroplex, operates also under the names "Carnival", an ethnic-oriented line, and "Sack and Save", a discount line)	Regional/local chains	
Nash Finch Company (Upper midwest)	Regional/local chains	
Nugget Markets (Northern California)	Regional/local chains	
Omni Foods (Massachusetts and New Hampshire)	Regional/local chains	
P&C Foods	Regional/local chains	Penn traffic
Pathmark (eastern United States)	Regional/local chains	
Penn Traffic (Pennsylvania, New York, Vermont, New Hampshire)	Regional/local chains	Penn traffic
Pick 'n Save (Wisconsin, Illinois)	Regional/local chains	Roundy's
Publix (southeast United States)	Regional/local chains	Penn traffic
Publix (southeastern US)	Regional/local chains	
Quality Markets	Regional/local chains	Penn traffic
Quality Markets (New York and Pennsylvania)	Regional/local chains	
Rainbow Foods (Minnesota)	Regional/local chains	Roundy's
Raley's (western U.S., own Nob Hill and Bel Air)	Regional/local chains	
Rice Supermarkets Also *Rice Epicurean Markets (Houston)	Regional/local chains	
Riverside Markets	Regional/local chains	Penn traffic
Robert's Fresh Market* (New Orleans, Louisiana Metro area)	Regional/local chains	
Roundy's	Regional/local chains	Roundy's
Rouse's Supermarket (Louisiana)	Regional/local chains	
Safeway (aka Preston-Safeway, unrelated to Safeway Inc.; Central Indiana)	Regional/local chains	
Save-Mart (California)	Regional/local chains	

Schnucks (Missouri, Illinois, Indiana)	Regional/local chains	
Scolari's Food and Drug (California, Nevada)	Regional/local chains	
Sears Grand (nationwide)	Regional/local chains	
Sendik's Food Market (Wisconsin)	Regional/local chains	
Sentry Foods (Wisconsin)	Regional/local chains	
Simon Delivers (Minneapolis/St. Paul, Minnesota/Wisconsin online grocery)	Regional/local chains	
Spartan Stores (Michigan)	Regional/local chains	
Stater Brothers (California)	Regional/local chains	
Stew Leonard's (New York City metropolitan area)	Regional/local chains	
Stewart's Shops (New York and Vermont)	Regional/local chains	
Strack and Van Til (Northwestern Indiana)	Regional/local chains	
Sullivan's Foods (Northern & Central Illinois)	Regional/local chains	
Sunshine Foods (Upper Mid-west)	Regional/local chains	
Turco's (New York)	Regional/local chains	
Ukrop's (central Virginia)	Regional/local chains	
United (West Texas)	Regional/local chains	
Victory (soon to be defunct, Massachusetts & New Hampshire)	Regional/local chains	
Wade's (Virginia)	Regional/local chains	
Wegmans (Northeast)	Regional/local chains	
Weis Markets - Mid-Atlantic (Pennsylvania, Maryland, New York, New Jersey, West Virginia)	Regional/local chains	
Westborn Market (Southeast Michigan)	Regional/local chains	
Whitefront - California (defunct)	Regional/local chains	
Wilson Farms (Upstate New York)	Regional/local chains	
Woodman's Food Market (Wisconsin, Northern Illinois)	Regional/local chains	
Affiliated Food Stores	Retailers cooperatives	
Affiliated Foods Midwest	Retailers cooperatives	
Apple Market	Retailers cooperatives	Associated Wholesale Grocers
Associated Food Stores	Retailers cooperatives	
Associated Grocers	Retailers cooperatives	
Associated Grocers of Florida	Retailers cooperatives	
Associated Grocers of the South	Retailers cooperatives	
Associated Wholesale Grocers	Retailers cooperatives	Associated Wholesale Grocers
Associated Wholesalers	Retailers cooperatives	
Cash Saver	Retailers cooperatives	Associated Wholesale Grocers
Central Grocers Cooperative	Retailers cooperatives	
Country Mart	Retailers cooperatives	Associated Wholesale Grocers
IGA	Retailers cooperatives	
Price Chopper / Price Mart	Retailers cooperatives	Associated Wholesale Grocers
Royal Blue (supermarket) (now defunct; founded in the 1930s)	Retailers cooperatives	
ShopRite/Wakefern Food Corporation	Retailers cooperatives	
Shurfine Markets	Retailers cooperatives	
SunFresh	Retailers cooperatives	Associated Wholesale Grocers
ThriftWay	Retailers cooperatives	Associated Wholesale

## Grocers

Unified Western Grocers	Retailers cooperatives
Western Family Foods (supermarket wholesaler)	Retailers cooperatives
Central Market (division of H-E-B)	Specialty/Natural
EarthFare - Specialty market in the Southeast	Specialty/Natural
Fairway (market) - New York City	Specialty/Natural
FreshDirect - online grocer in New York City	Specialty/Natural
Mollie Stone's	Specialty/Natural
Stew Leonard's - northern New York City suburbs	Specialty/Natural
Trader Joe's (owned by the German Aldi group)	Specialty/Natural
Whole Foods Market	Specialty/Natural
Wild Oats Markets (owns Capers Community Market, Henry's Farmers Market, and Sun Harvest)	Specialty/Natural

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