Lab Exercise #11: Scenario Planning **Due Nov.22nd at 2:40 PM**

CRP 5080: Introduction to Geographic Information Systems
Fall 2021

San Francisco property prices have skyrocketed and only 13 percent of homebuyers are able to purchase a home. One way the city intends to ease the housing shortage is through infill development, which develops empty or underused land parcels within existing neighborhoods.

Where can the city of San Francisco build new housing through infill development? To answer this question, you'll use GeoPlanner, a web-based planning tool for regional and local scales. With GeoPlanner, you'll create scenarios, or plans, based on geographic data layers to explore solutions to complex problems, like the question of housing. Before you start designing scenarios, you'll create a new GeoPlanner project, customize the project's settings, and add relevant data layers. You'll also limit the data to a study area to reduce analysis time.

Part 1: Create a project from a template

To work in GeoPlanner, you must create a project. There are several default templates available for projects, each with default layers, settings, and symbols. You'll use a template specifically configured for this lesson, which you'll later customize to more precisely suit your project's needs.

1. Once, you have signed into ArcGIS Pro, open a new tab and sign in to ArcGIS GeoPlanner using your ArcGIS organizational account. After you sign in, a gallery of your recent projects is displayed. If this is your first time using GeoPlanner, you won't have any recent projects.
2. Click **Create New**. The **Create Project - Select a Template** window opens. Many of the available templates are named based on what they're designed to be used for, such as economic development planning or green infrastructure planning.
3. Select **GeoPlanner Template for Learn.arcgis.com**.
4. Give your project a title such as “San Francisco Infill Development”
5. Click **Create**.

   A new project is created. The template specifies the default extent of the project to focus on San Francisco, so you don't need to navigate the map to the study area. The template has a default active scenario called **Scenario A**.

Customize the project

We will adjust a few settings to add design types appropriate for urban planning. Design types contain symbols and labels and can be applied to features on the map.

1. On the ribbon, click the **Contents** button .

The **Contents** pane opens. The active scenario contains a layer named Potential Sites. (This layer was added by default as part of the template.) The layer currently doesn't have any features on the map. You'll add features later, but before you do, let us create design types that specify land-use types for each feature.

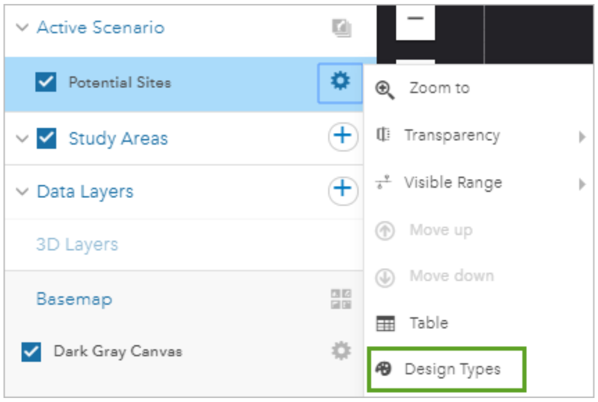


Figure 1: choosing Design Types

2. Click the gear next to **Potential Sites** and choose **Design Types**.

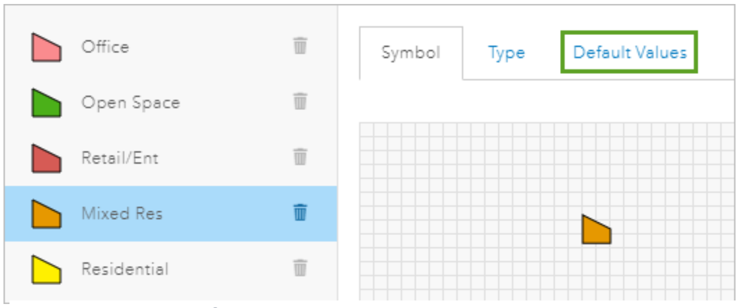
The template started with three design types for this layer: **Office**, **Open Space**, and **Retail/Ent** (entertainment). These are frequent land-use types suitable for infill development. However, if you added more design types for other land-use categories, your project could more accurately depict potential sites on the map. We will add three more design types: **Mixed Residential**, **Residential**, and **Vacant**.

3. Click **Add**. In the window, type MixedRes for **Polygon** (the field name) and Mixed Res for **Label** (the field alias).
4. Click **Add**. **Mixed Res** is added to the list of design types. You'll use this design type to display infill developments that can be used for residential and commercial purposes. Next, you'll change the design type's default color.
5. On the **Symbol** tab, select orange.
6. You'll create two more design types to represent residential and vacant parcels. Add another design type with the following parameters:
   - **Polygon**: Residential; **Label**: Residential; **Color**: Yellow

   Add another design type with the following parameters:
   - **Polygon**: Vacant; **Label**: Vacant; **Color**: Grey

   You now have six design types in total. Last, you'll add default dwelling unit density values for each design type. These values represent the number of dwelling units within a feature. For Mixed Res, which tends to have more dwelling units, you'll use 24 as the default value. For Residential, you'll use 18. Vacant parcels have no dwelling units, so you'll leave the default value of 0 unchanged.

7. In the list of design types, click **Mixed Res** to select it. Click the **Default Values** tab.



for **Dwelling Unit Density**, type 24. Select the **Residential** design type and give it a dwelling unit density of 18.

Figure 2: specifying the Dwelling Unit Density

8. Click **Save**.

Add Data

Next, you'll add data layers from ArcGIS Online that are relevant to your study area and project goals. In particular, you'll add data for public transportation, neighborhoods, and the boundary of current infill development in San Francisco, as well as some other layers. These data layers will later help you locate appropriate sites for new development.

1. On the ribbon, click **Explore**. Then, click **Add Data**. You want to search for feature layer data across ArcGIS Online.
2. On the ribbon of Search for Data box, click the **All** tab. Check the **Features** check box.
3. Type Vacant Land Use in the search bar. To limit the results to those owned by the Learn_ArcGIS account, add owner: Learn_ArcGIS. Press Enter.

4. **Add** the **Vacant Land Use** layer. A layer of all vacant parcels in San Francisco is added to the map.
5. Search for and add the following layers owned by Learn_ArcGIS:
    - Neighborhoods
    - Zoning Districts - Public Use
    - Parks and Open Space
    - Muni Rapid Network
    - Bay Area Rapid Transit (BART) Stations
    - Infill Development Boundary

6. Close the **Search for Data** window. The **Contents** pane is updated to list the added layers. The data also appears on the map. You added a lot of data. The Bay Area Rapid Transit (BART) Stations layer contains rail stations throughout San Francisco and surrounding cities, while the Muni Rapid Network layer shows San Francisco bus routes. Affordable housing should be within walking distance of public transportation, so these layers will be useful later in the project. The Parks and Open Space and Zoning Districts - Public Use layers show areas of the city set aside for public recreation or open space (the layers sometimes overlap one another). Lastly, Vacant Land Use shows vacant parcels that could potentially be used for infill development.

Figure 3: Infill Development Boundary and Neighborhoods

7. In the **Contents** pane, uncheck the boxes next to all data layers except **Infill Development Boundary** and **Neighborhoods**. The infill development boundary is the transparent blue polygon in the northeast corner of the city. Your study area comprises nine neighborhoods total.

8. When finished, turn off all data layers except the Infill Development Boundary layer.

Limit data to the study area

The data you added to the map covers San Francisco, but the infill development boundary only contains a few of the city's neighborhoods. You'll create a study area layer using the infill development boundary and mask features that occur outside the study area. Doing so will focus your analysis on the area of interest.

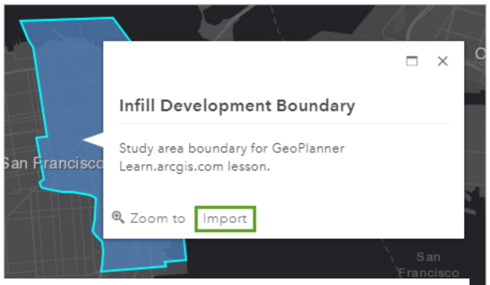


Figure 4: select the infill boundary

1. On the map, click the infill development boundary feature. The feature's pop-up opens.
2. Click **Import**. Confirm that **StudyArea** is chosen for the Layer tab, and type Infill Development Boundary Study Area.
3. Your layer will become the study area of your project. Click **Import**.

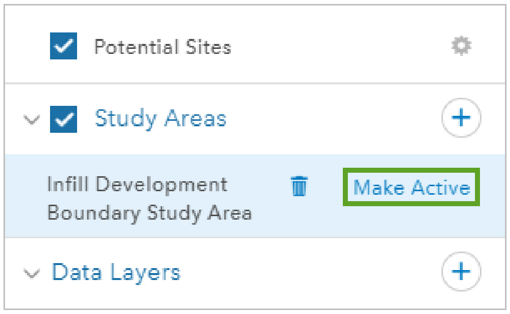


Figure 5: Make the Infill Development Boundary Study Area layer Active

The new layer is added to the **Contents** pane under **Study Areas**. The study area layer is not yet active on the map, however.

4. In the **Contents** pane, turn off the **Infill Development Boundary** layer. Under **Study Areas**, point to the **Infill Development Boundary Study Area** layer and click **Make Active**.

The map zooms to the study area. Everything outside the study area is covered with a mask (Figure 6).

Figure 6: Activating the Infill Development Boundary Study Area layer

Next, to save your project, click the **Open Menu** button on the top-left corner ☰ , Click **Save**.

You can change the title and other parameters of the web map that stores the project data. Click **Save**.

You've created a new project in GeoPlanner to determine appropriate places for infill development in San Francisco. You also created new design types for different types of land use and added San Francisco data relevant to your project. Next, you'll create a planning scenario for potential development based on your project's data.

Part 2: Create a scenario

For your scenario, you'll perform analysis to determine areas most appropriate for housing. In particular, you'll create a new layer that shows how long it takes to walk to public transportation from certain areas of the map. Then, you'll compare this layer to vacant parcels. You won't propose which parcels to develop into housing just yet, however. This scenario will instead demonstrate the current conditions in San Francisco.

Determine walking distance from public transportation

There are empty parcels all over the study area, but not all of those parcels would make good affordable housing. One of the ways you can evaluate vacant parcels is by their distance from public transportation. You'll perform analysis on the BART stations layer to determine the time it takes to walk to each station. But first, you'll rename the default scenario to a more meaningful name.

1. Make sure the **Infill Development Boundary Study Area** is active.
2. On the ribbon, click **Scenario A** and click the **Scenario Properties** button .
3. Click **Edit**. Replace the default title with “Current Conditions.”

   This name indicates that the scenario will show the infill development boundary as it currently exists, without proposing changes.

4. Click **Save**.

   The scenario's name changes. Next, you'll perform analysis on the BART stations. GeoPlanner includes several analytical tools. One of those tools is Create Travel-Time Areas, which takes an existing layer and creates a new layer that shows the areas that can travel to the original layer within a specified time. Good affordable housing should be within a few minutes' walk from public transportation, so you'll perform your analysis with that in mind.

5. In the **Contents** pane, turn on the **Bay Area Rapid Transit (BART) Stations** layer. BART is a railway system that travels throughout San Francisco and the nearby cities. There are four BART stations in your study area.
6. On the ribbon, click **Explore**. Click **Analysis**, click **Use Proximity**, and choose **Create Travel-Time Areas**.

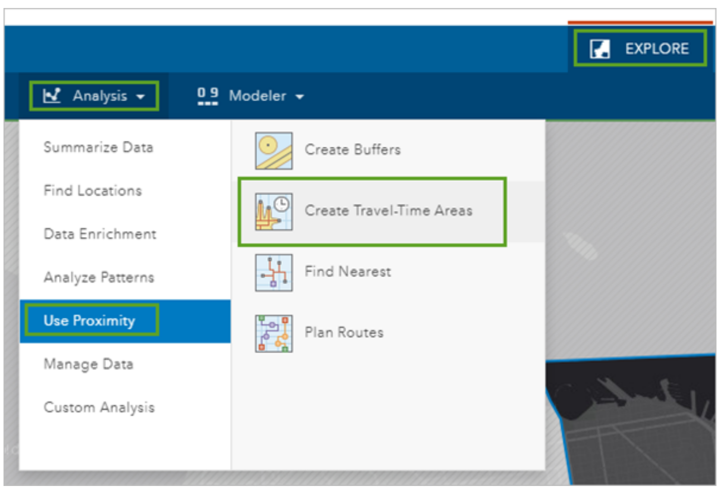


Figure 7: Creating Travel-Time Areas

The **Create Travel-Time Areas** pane opens.

7. For **Select Feature Layer**, choose **Bay Area Rapid Transit (BART) Stations**.

You can measure travel time by driving or walking. Because the key is for housing to be affordable, you'll measure by walking. For **Measure**, choose **Walking Time**.

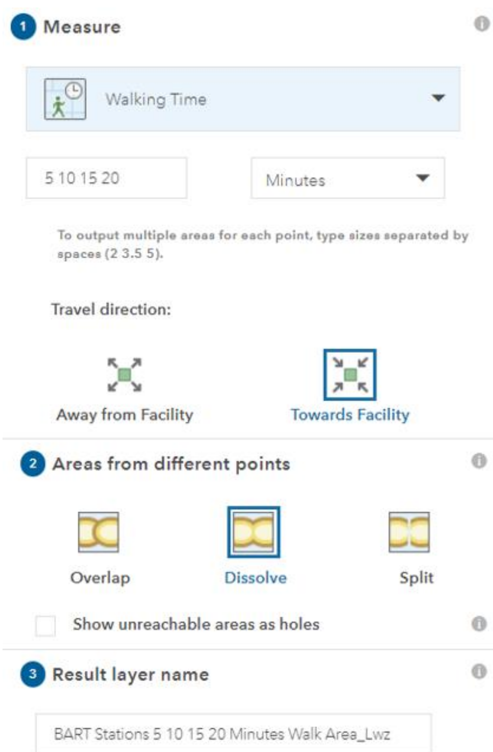


Figure 8: Parameters Setting for Creating Travel-time areas

Next, you will create walking time layers for 5-minute intervals up to 20 minutes, as most people would not want to walk longer than that to reach public transportation.

8. Below **Walking Time**, type 5 10 15 20 and make sure that **Minutes** is chosen.

Because there are multiple BART stations, you'll dissolve these areas into a single layer to streamline the results. For **Areas from different points**,

choose **Dissolve**. 

9. For **Result layer name**, replace the existing text with “BART Stations 5 10 15 20 Minutes Walk Area” and add your name or initials to the end to make it unique.

10. Click **Run Analysis**.

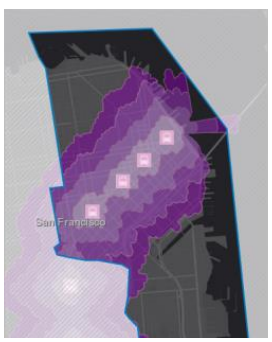


Figure 9: Travel-time intervals

11. The analysis pane closes. After a few **minutes**, the analysis layer is added to the map.

The walk-time layer has four shades of purple, from light to dark. Each shade represents a different time interval you specified when you ran the tool.

Classify the walk-time layer

The four walk-time zones in the layer are divided by the time it takes to walk to a station. It's better for housing to be 5 or 10 minutes from a station than 15 or 20. To indicate the higher suitability of these walk-time zones over the others, you'll classify the layer using a scale of 0 to 9, with 9 being most suitable.

1. Turn off the **Bay Area Rapid Transit (BART) Stations** layer.
2. In the **Contents** pane, click the settings button  next to the **BART Stations 5 10 15 20 Minutes Walk Area** layer and choose **Classify**.

The **Classify (0-9 scale)** window opens for the layer. You can classify with unique values in the layer or by numeric ranges. The walk-time zones are a numeric range of 5 to 20 minutes.

3. Click **Using numeric ranges**.
4. For **Field**, choose **Travel Time End (Minutes)**. For **Classes**, choose **4**.

The window displays four scales, one for each walk-time minute interval. For each scale, you'll choose a value that indicates how suitable that walk-time interval is for affordable housing. The exact values you choose are up to your judgment, and using different values can alter your decision-making process. For this classification, you'll indicate that walk times up to 10 minutes are highly suitable, while 10- to 20-minute walk-times have low suitability.

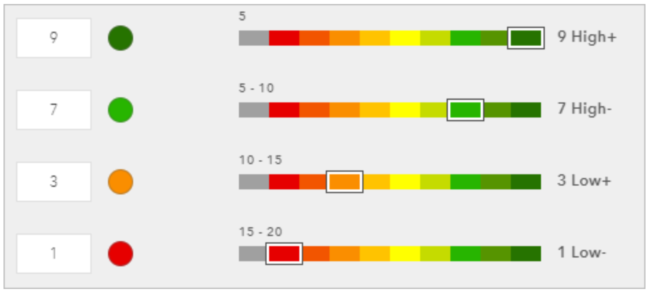


Figure 10: Suitability scores for the walking-time intervals

5. Configure the following scales:
   - **5**: **9 High+**
   - **5 - 10**: **7 High-**
   - **10 - 15**: **3 Low+**
   - **15 - 20**: **1 Low-**
6. Click **Save As**.

Classifying the layer will create a new layer, so you need to add a title: “Classified Walk Area”

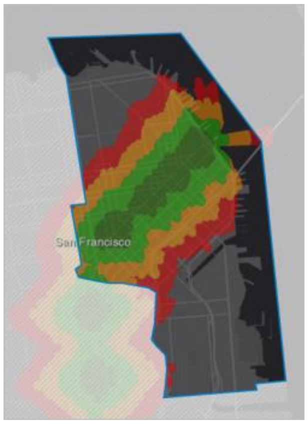


Figure 11: the Walking-time intervals classified on a red-green scale

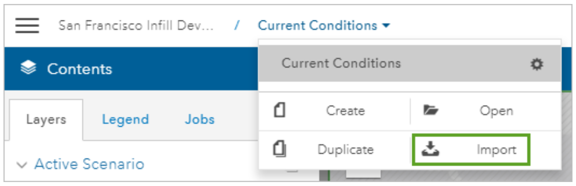
7. Click **Save**.
8. The new layer is added to the map and the **Contents** pane. It shows the same walk-time areas as the original layer, but now classified on a red-green scale that more strongly conveys the suitability of each area.

You now have a layer that can help you make decisions about which vacant parcels to turn into affordable housing.

Import vacant parcels into the scenario

Next, you'll add vacant parcels to the scenario. Among your data layers is a layer named Vacant Land Use, which shows all the vacant parcels in the study area. While you could turn on this layer and compare it visually to the walk-times layer, it'd be more useful for planning purposes if you could change individual vacant parcels to new types of land use. In the previous lesson, you added design types to the Potential Sites layer for land-use types. You'll import the vacant parcels into that layer so you can make use of the design types you added earlier.

1. On the ribbon, click **Current Conditions** and choose **Import**.



The **Import Features to Scenario** window opens. For **Source**, choose **Vacant Land Use**. For **Target**, choose **Potential Sites**. Click **Next**.

The next set of parameters involves feature type mapping. You can choose which of the six design types in the Potential Sites layer you apply to the imported features. You can either choose a single type for all features or determine types by attribute information. Because all the imported parcels are vacant, you'll import them with the **Vacant** type.

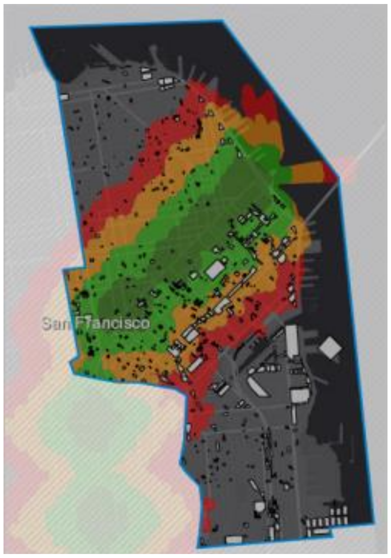


Figure 12: Adding Vacant parcel to the study area

2. Click **Select a feature type for all features**. For **Target**, choose **Vacant**. Click **Next**.

The next set of parameters involves field mapping, or matching the fields in the Vacant Land Use layer to those in the Potential Sites layer. The parameters automatically match fields with the same name, so you don't need to worry about these parameters.

3. Click **Next**. And Click **Import**.

The features are imported. Because the **Potential Sites** layer is already turned on, the vacant parcels appear on the map.

Explore parcel metrics with the dashboard

How many parcels are in each area? Visually exploring each parcel on the map would take a lot of time. To quickly review statistics about the parcels, you'll use the dashboard. The information you uncover will help you propose alternatives for housing development.

1. On the map toolbar, click the **Dashboard** button. 

It displays two pie charts, one for the potential sites and one for the walk-time areas. The charts display the percentage of potential sites within each area. One of the pie charts is a solid circle, as it shows the percentage of vacant sites within the **Potential Sites** layer (which is 100 percent).

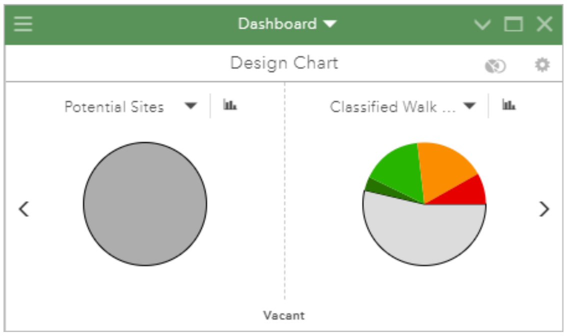
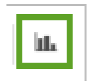
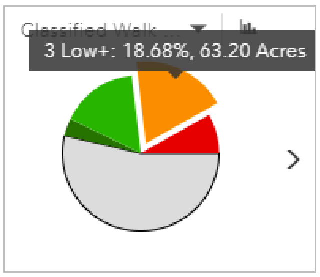


Figure 13: A pie chart of vacant parcels and the percentage of each walking-time intervals for the vacant parcels

2. For the **Potential Sites** pie chart, click the **Column** button.  The pie chart turns into a bar chart.
3. Point to the bar chart. The hover text indicates that there are about 340 acres of vacant parcels in the study area, which is a significant number for a densely populated, highly developed city like San Francisco.
4. Point to the orange wedge in the **Classified Walk Areas** pie chart.



According to the hover text, 18.68 percent of vacant parcels (about 63 acres) are in the orange walk-time area. This walk-time area reflects areas within 10 to 15 minutes of a BART station.

5. Point to the other walk-time zones on the pie chart.

About 4 percent of vacant parcels are within the highest suitability zone. You'll focus on these parcels when planning where to develop new housing.

6. Save the project.

You've created a scenario for the current conditions of vacant parcels in the study area. You also performed analysis to help decide which areas are most appropriate for the development of affordable housing. Next, you'll create more scenarios that depict possible plans for development.

Part 3: Propose alternatives

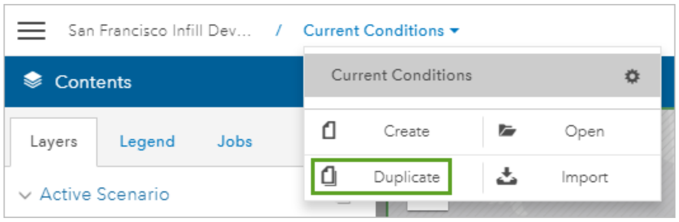
Previously, you created a scenario that showed the current conditions of vacant parcels in San Francisco. Now that you have a better understanding of those conditions, you can propose an alternative.

Next, you'll create two scenarios for proposed new housing. The first will show proposed housing throughout the study area, while the second will show only parcels within five minutes of a station. You'll change the status of these parcels from vacant to residential or mixed residential to reflect planning alternatives. Then, you'll assess the effectiveness of one of your scenarios using a key performance indicator.

Duplicate the scenario

Your first alternative will use existing scenario as a base, because it has all of the data you need. You'll duplicate the scenario and change the symbology of certain parcels to indicate a proposal to develop them for specific types of land use.

1. Click **Current Conditions** and choose **Duplicate**.



2. Give your scenario a title (“Proposed housing”)
3. Click **Save**.

The scenario is duplicated. On the ribbon, **Proposed Housing** is indicated as the active scenario. (You can switch between scenarios by clicking the scenario name on the ribbon.) Next, you'll change the design of some of the vacant parcels to propose them for either residential or mixed residential development. The changes you make will only apply to the new scenario. You'll also be able to track your changes in the dashboard.

4. If necessary, open the dashboard.
5. Zoom closer to the walk-time areas.

As mentioned previously, this scenario is for proposing new housing throughout the study area, and not only within the highest-suitability walk-time area. For this scenario, you'll propose new housing based on the size of the parcel, prioritizing larger parcels that are relatively close to stations.

On the ribbon, click **Design** and click the **Paint** button. This pane displays the six design types you specified for the **Potential Sites** layer in the first lesson. You'll start by proposing new mixed residential developments.

6. Click the **Mixed Res** symbol.
7. Click a few of the larger vacant parcels on the map, prioritizing those that are close to green walk-time areas. The parcels you click update to use the symbol for mixed residential land use. The dashboard updates to show the percentage of sites within each walk-time area.
8. In the **Symbol Palette** pane, click the **Residential** symbol. Click a few other large vacant parcels.

Figure 14: zoom into the walk-time areas and explore the parcel metrics with the dashboard

The bar chart on the left shows the total percentage of each parcel type, while the pie chart on the right shows the percentage of residential parcels per walk-time area. This information can help you decide how to plan development.

9. Close the dashboard. On the ribbon, click **Explore** to stop painting.
10. Zoom back out to the full extent of the data.

Filter sites within the walk-time area

Although you've designed a possible plan for housing development, your decisions were mostly made based on your judgment of parcel size and proximity. For your next alternative proposal, you'll plan new housing only in parcels within five minutes of a station. To make sure only parcels that fit the criteria are displayed, you'll filter the layer using the **Find Existing Locations** analysis tool. This tool creates a layer of features based on an expression of your specification.

1. On the ribbon, click **Analysis**. Click **Find Locations** and choose **Find Existing Locations**.
2. For **Select Feature Layer**, choose **Potential Sites**.

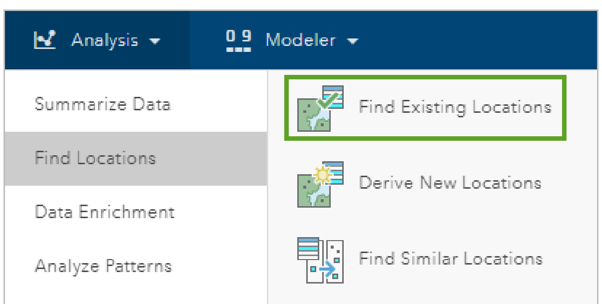
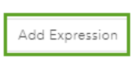
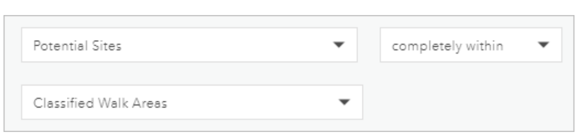


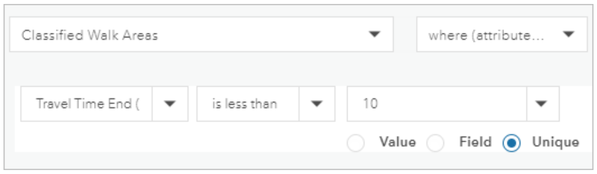
Figure 15: Finding Existing Locations

You'll build two expressions to achieve the desired result of finding features within a five-minute walk of a station. First, you'll create an expression that specifies that potential sites are completely within the walk-time area. Then, you'll create an expression that limits the walk-time areas only to those within 10 minutes of a station.

3. For **Build a query to find features**, click **Add Expression**. 
.
4. Update **where (attribute query)** to **completely within** and change **Study Area** to **Classified Walk Areas**. The final expression should read **Potential Sites completely within Classified Walk Areas**. Click **Add**.



Next, you'll add the second expression, which will limit the walk areas to only those less than 10 minutes (which is only the 5-minute walk areas): Create the expression **Classified Walk Areas where (attribute query) Travel Time End (Minutes) is less than 10**. Click Add.



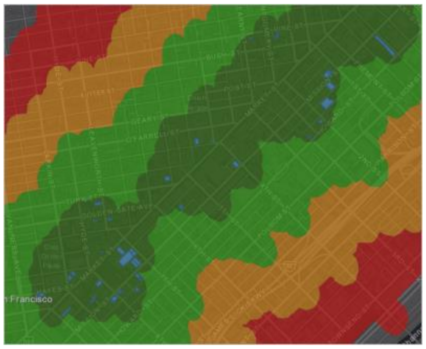


Figure 16: Potential sites within 5 Minutes

5. Change **Result layer name** to Potential Sites within 5 Minutes. Add your name or initials to the end of the name. Click **Run Analysis**.
6. Turn off the **Potential Sites** layer. Click the **Options** button for **Potential Sites within 5 Minutes**. The layer displays only parcels within the highest-suitability walk-time area (you may need to turn off the potential sites layer) and zoom to the newly created layer.

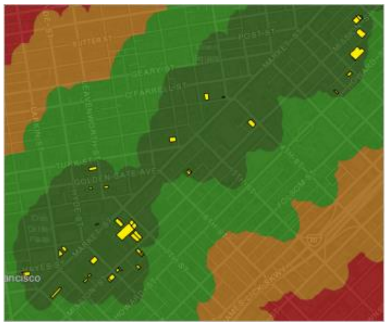
Propose housing close to the stations

Next, you'll create another scenario to propose housing within five minutes of a BART station. You'll import your result layer into the new scenario and automatically change all of its features from the vacant type to the housing type.

1. On the ribbon, click **Proposed Housing** and choose **Create**.
2. Give your scenario a title ("Proposed Housing 5 Minutes from Stations")
3. Click **Create**.

The final scenario is created. Next, you'll import the potential sites within five minutes to the Potential Sites layer so you can mark them as potential residential developments.

4. Click **Proposed Housing 5 Minutes from Stations** and choose **Import**.
5. For **Source**, choose **Potential Sites within 5 Minutes**. For **Target**, choose **Potential Sites**. Click **Next**.



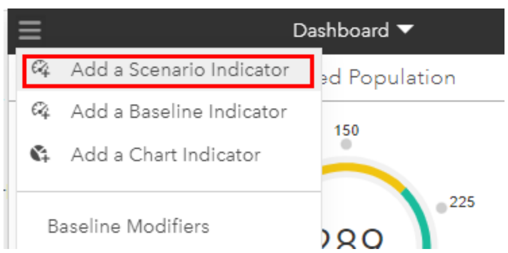
You'll make all the imported features use the **Residential** type. Click **Select a feature type for all features** and choose **Residential**.

6. Click **Next** two more times. Click **Import**.
7. Turn on the **Potential Sites** layer and turn off the **Potential Sites within 5 Minutes** layer. Zoom in if necessary.

The scenario now displays only potential sites within the five-minute walk-time area. All of the potential sites are depicted as residential developments.

Create a scenario indicator

You've planned some scenarios for housing development in San Francisco. But how well do those scenarios reflect your planning objectives? To find out, you'll create a scenario indicator, which shows scenario performance in relation to a specific planning goal. Yours will calculate the total number of new housing units you can create with the planned residential lots in your scenario. You'll create the performance indicator for the Proposed Housing 5 Minutes from Stations scenario, although you could also create it for your other scenario.



1. Open the dashboard. Click the **Dashboard Options** button and choose **Add a Scenario Indicator**.
2. For **Caption**, type Potential Housing Units.

You'll choose options so that your indicator provides a numeric estimation of how many housing units can be built in the planned residential areas. You'll calculate the indicator with an equation that multiplies the acreage of residential areas by the density of housing units.

3. For **Type**, choose **Numeric**. If necessary, for **Scenario Layer**, choose **Potential Sites**.
4. Click **Equation Builder**.

The **Potential Sites** window opens. You'll create your equation based on fields of information contained in the data.

5. For **Fields**, click **[DU_Density]**. The field is added to the equation. DU_Density stands for Dwelling Unit Density. It indicates the typical density of housing units per acre. The final equation reads **[DU_Density]*[acres]**. Click **OK**.

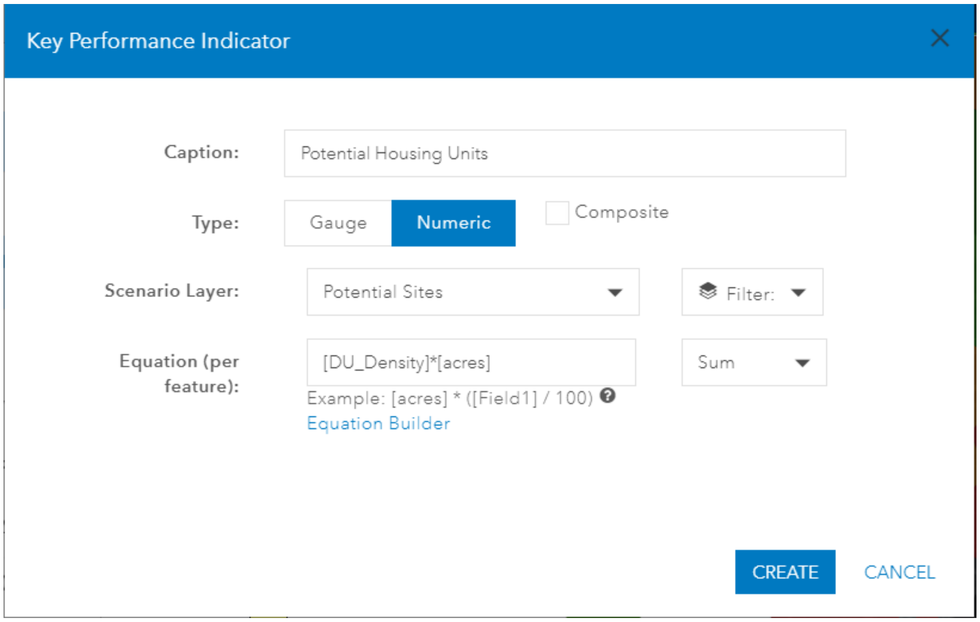


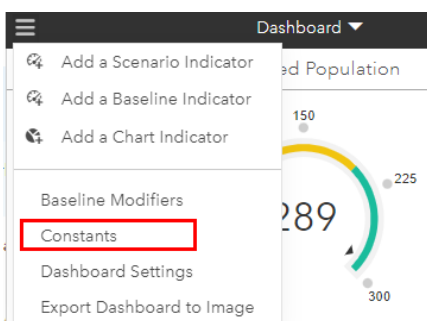
Figure 17: Create a new key performance indicator (KPI)

The equation is added to the **Scenario Indicator** window. Click **Create**.

The dashboard displays the **Potential Housing Units scenario indicators**. According to your indicator, if you followed through with your Proposed Housing 5 Minutes from Stations scenario, the city could create 160 new housing units.

Create a constant

One hundred and sixty new housing units might be enough, but how many people can that house? The average number of people per household is 1.8. By multiplying the number of new housing units by that average, you come up with a total of 289 people housed. However, it's likely that after review, changes are made to the proposed plan. Rather than multiply your KPI by 1.8 anytime you make a change, you'll create a constant (a value that is always the same) that defines persons per household as 1.8. Then, you'll create another performance indicator to automatically calculate the number of people that can be housed by your scenario.



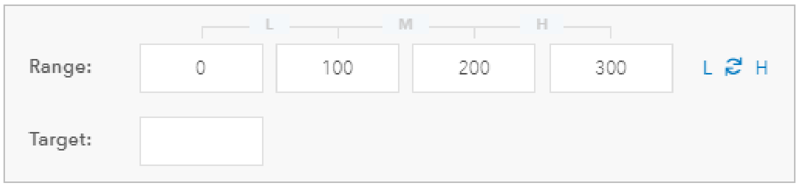
1. In the dashboard, click **Dashboard Options** and choose **Constants**.
2. Click **Add**.
3. For **Name**, type Persons Per Household. For **Value**, type 1.8.
4. Click **Save**.

The constant is created. However, the dashboard still displays only the number of potential housing units. You'll create a new KPI that multiplies that number by the constant you created.

5. Click **Dashboard Options** and choose **Add a Scenario Indicator**.
6. In the **Scenario Indicator** window, for **Caption**, type Estimated Population.

   Rather than depict the KPI as only a number, like you did with the previous KPI, you'll show the value within a range of other values to better visualize how the scenario performs against established goals. For instance, for the purposes of the exercise, assume that the city specifically hopes to create housing for up to 300 people. You'll choose ranges that reflect this value.

7. Select **Gauge** for type. For **Range**, type 0, 100, 200, and 300 in the four boxes.



8. For **Scenario Layer**, choose **Potential Sites**. Click **Equation Builder**.
9. Using the operators, build the equation **[DU_Density]*[acres]* [Persons Per Household]**.
10. Click **OK** and **Create**.

   The dashboard now displays the **Estimated Population**

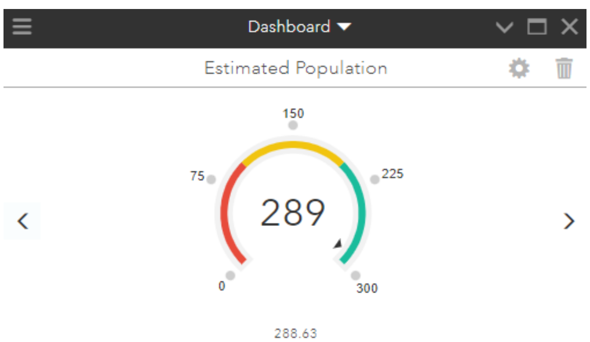
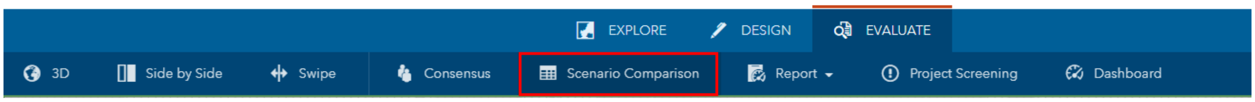


Figure 18: the Estimated Population for vacant parcels with 5 minutes walking distance.

With this housing development scenario, an estimated 289 people could be housed, which is close to the city's goal of 300. If the city insisted on a number closer to 300, you would probably need to create a new scenario that includes parcels in the 10-minute walk-time area. For the purposes of this lesson, your value of 289 is good enough, but in real planning scenarios, there is often a lot of revising and reworking involved.

Homework:

1. Calculate additional scenario indicators using the assumptions provided below and based on the number of new housing units or the total population (please note that this will entail creating composite indicators). Under the Evaluate tab, select 'Scenario comparison'. Select the 'proposed housing' and the 'proposed housing 5 miles from stations' scenario and include the table (10 points).



Scenario performance indicators	**Assumption**
Additional total annual household energy consumption (in kWh)	Annual Household Energy Use: In 2019, the average annual electricity consumption for a U.S. residential utility customer (assume a household) was 10,649 kilowatthours (kWh) (U.S. **Energy** Information Administration, 2019)
Additional total parking spots required	Number of vehicles: On **average**, there are 1.88 **vehicles per** U.S. **household**. This figure is somewhat lower for San Francisco (1 car per household)
Additional total population (residents)	Persons per Household: According to the US Census, the average household had 2.53 people in 2020. This is slightly lower in San Francisco (2.36)
Additional total daily water consumption	Daily Household Water Use: According to the Environmental Protection Agency (EPA), "the ***average*** American ***family uses*** more than 300 gallons of ***water per day*** at ***home***."
Additional total household vehicle trip per day	Household Vehicle Trips per Day: 5 household trips per day (US Department of Energy Efficiency and Renewable Energy).
Additional total CO2 emissions	San Francisco per capita emissions: 6.4 mt CO2

2. Create an additional scenario that prioritizes proximity to parks. Identify vacant properties that are within half mile of parks and open spaces. This time use buffer analysis instead of travel-time areas. Calculate the scenario performance indicators listed in question 1. Include the scenario comparison table (40 points). Compare and contrast the 2 scenarios in terms of their performance indicators? (5 points)