Regional Land Use Data Management

Using ArcGIS and GIS Programming

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Southern California Association of Governments (SCAG)

Nation's largest Metropolitan Planning Organization (MPO)

6 counties and 191 cities

19.1 million people (2018) in 38,000+ square miles

GRP in 2018: $1,259 Billion
(15th largest economy in the world)

BACKGROUND

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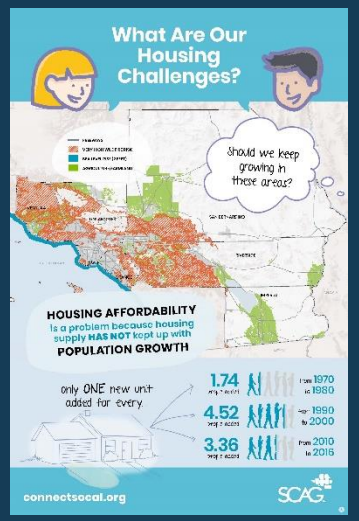
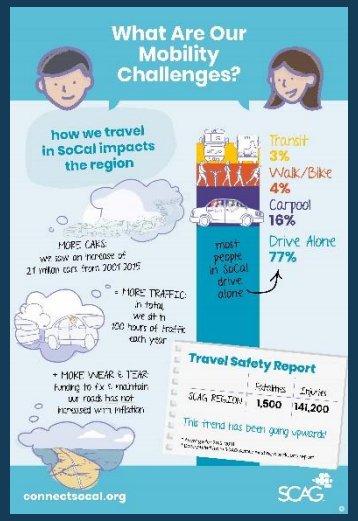
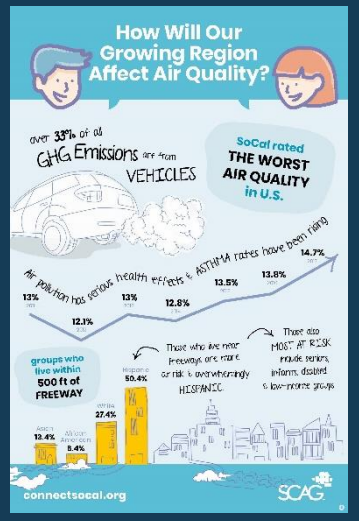
2020-2045 RTP/SCS ("Connect SoCal")

- **Develop the Regional Transportation Plan/Sustainable Communities Strategy (RTP/SCS) every 4 years**
  - A long-range visioning plan that balances future mobility and housing needs with economic, environmental and public health goals
  - Regional transportation strategies and investments to reduce traffic congestion, improve the efficiency of the network and expand mobility choices
  - Linkage among transportation, land use, housing and climate policy at the regional level to reduce GHG emissions
- **"Connect SoCal" – 2020-2045 RTP/SCS**
  - To be adopted in 2020

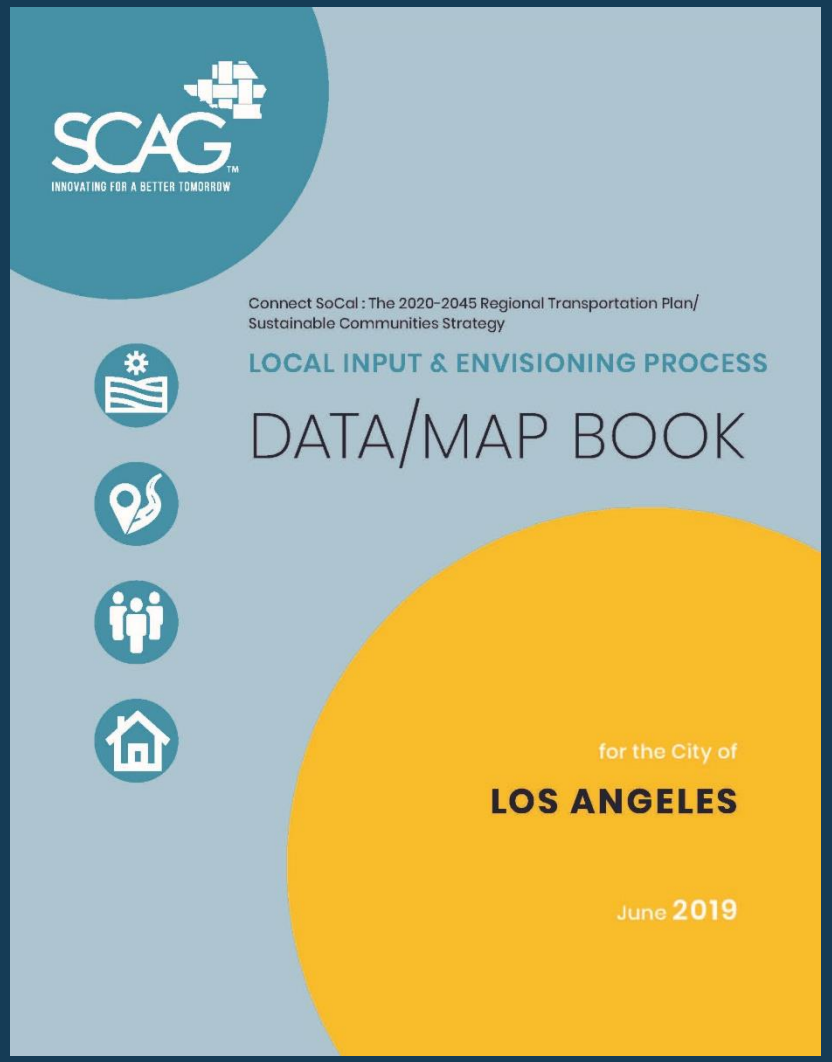






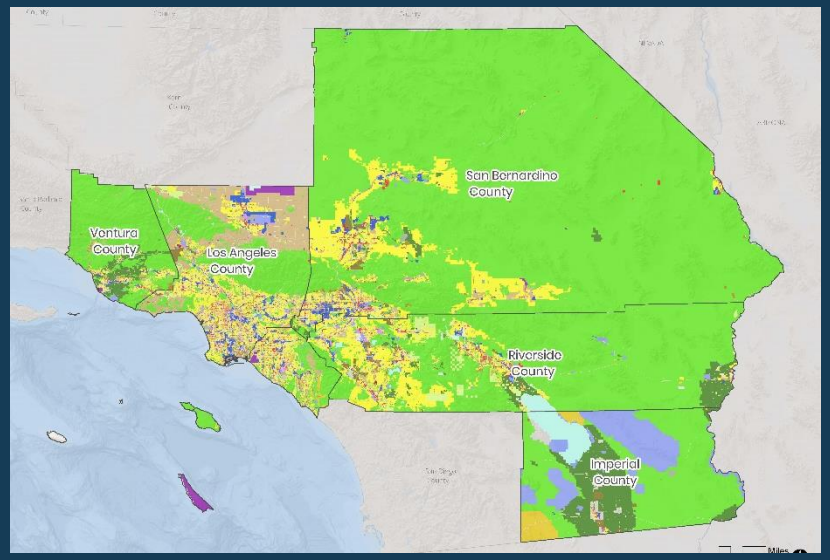
Regional Land Use Database for Connect SoCal

- **SCAG Data/Map Books for Connect SoCal**
  - Producing 197 Data/Map Books for individual local jurisdictions including land use, resource areas & farmland, transportation, administrative boundaries, growth forecast in preparation for the Connect SoCal development process
- **Regional Land Use Database**
  - Base data for regional transportation planning, scenario planning, growth forecasting, planning and policy analysis, etc.
  - Collaborated with local jurisdictions to collect local land use information and to ensure data accuracy
  - Developed every 4 years for the RTP/SCS development process



Regional Land Use Database – Overview

- **Land use types (2016)**
  - General plan land use
  - Specific plan land use
  - Zoning code
  - Existing land use
- **Parcel-based data at city and county level**
  - App. 5 million parcels in the SCAG Region
- **Land use classification standardization (2016)**
  - 22 general land use codes (level 1)
  - 136 detailed land use codes (level 2)



2016 SCAG Land Use Codes - Legend

Legend	Land Use Description
Single Family Residential	1110 Single Family Residential 1111 High Density Single Family Residential (9 or more DUs/ac) 1112 Medium Density Single Family Residential (3-8 DUs/ac) 1113 Low Density Single Family Residential (2 or less DUs/ac)
Multi-Family Residential	1120 Multi-Family Residential 1121 Mixed Multi-Family Residential 1122 Duplexes, Triplexes and 2- or 3-Unit Condominiums and Townhouses 1123 Low-Rise Apartments, Condominiums, and Townhouses 1124 Medium-Rise Apartments and Condominiums 1125 High-Rise Apartments and Condominiums
Mobile Homes and Trailer Parks	1130 Mobile Homes and Trailer Parks 1131 Trailer Parks and Mobile Home Courts, High-Density 1132 Mobile Home Courts and Subdivisions, Low-Density
Mixed Residential	1140 Mixed Residential 1100 Residential
Rural Residential	1150 Rural Residential
General Office	1210 General Office Use 1211 Low- and Medium-Rise Major Office Use 1212 High-Rise Major Office Use 1213 Skyscrapers
	1200 Commercial and Services 1220 Retail Stores and Commercial Services

Regional Land Use Database – Development Phases

- **Phase 1 – Preliminary land use data development**
  - Developing land use information based on the most recent resources (e.g., local's land use documents, assessor's property information, and new construction records)
- **Phase 2 – Draft land use data development**
  - Updating land use data by incorporating review comments and inputs submitted by local jurisdictions and stakeholders during the Connect SoCal local input process
- **Phase 3 – Final land use data development**
  - Incorporating additional inputs submitted by local jurisdictions and stakeholders

OBJECTIVES

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Objectives

- **Automating big data management workflow**
  - Developing an automated workflow to streamline the land use data management process by leveraging ArcGIS, GIS programming and Statistical Analysis Software (SAS)
- **Developing standardized and effective workflow for land use update and review process**
  - To streamline the repetitive geoprocessing tasks
  - To ensure consistent chain of data management and review process
  - To ensure standardized data format

METHODOLOGY

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Data Sources & Contents

- **Parcel boundary**
  - 2016 parcel boundary data from assessor's offices and a third-party vendor
- **Land use correspondence table**
  - General plan land use, specific plan land use and zoning
- **General plan land use**
  - Base data: SCAG's 2012 general plan land use data
  - Updated based on recently adopted local general plan land use elements
  - General plan land use designations (both local codes and SCAG codes)
  - Residential density information (average or min/max dwelling units per acre)
  - Correspondence table between local general plan land use designations and SCAG's standardized land use codes

Data Sources & Contents (cont.)

- **Specific plan land use**
  - Developed based on adopted local specific plan land use document
  - Specific plan land use designations (both local codes and SCAG codes)
  - Residential density information (average or min/max dwelling units per acre)
  - Developed specific plan area boundaries
  - Correspondence table between local specific plan land use designations and SCAG's standardized land use codes
- **Zoning code**
  - Developed based on the latest local zoning ordinance
  - Zoning codes (both local codes and SCAG codes)
  - Correspondence table between local zoning codes and SCAG's standardized land use codes which also includes **detailed zoning standards**, such as usage, residential density, FAR, minimum lot area, setbacks, parking, etc.

Data Sources & Contents (cont.)

- **Existing land use**
  - Base data: SCAG's 2012 existing land use data
  - Updated based on new construction data (2012-2016) and 2016 parcel property characteristics obtained from 6 county assessor's offices and a third-party vendor
  - Also, incorporated publicly available data, including:
    - California Protected Areas Database (CPAD) – open space
    - California School Campus Database (CSCD) – school, college and university
    - Farmland Mapping & Monitoring Program (FMMP) - farmland
  - Unit information not available yet

Data Processing using SAS and GIS Programming

- **Statistical Analysis Software (SAS) for parcel property data processing**
  - Manipulate and standardize parcel property data (app. 5.6 MM records)
  - Convert land use codes to SCAG's standardized land use codes
- **GIS programming with Python for parcel data management**
  - ArcPy site package
  - Automate repetitive and complicated geoprocessing
  - Ensure data consistency and accuracy (e.g. cleaning up duplicate records, feature comparison, spatial match, null value, etc.)

```
/* Merge parcel attribute with ParcelPoint by PROPDMPID */
%macro merge_pnt(cnty);

data work.POINT_&cnty;
    set work.POINT_&cnty;
    PROPERTY_DMP_ID = PROPDMPID;    * Create PROPERTY_DMP_ID for merge purpose;
run;

proc sort data=work.POINT_&cnty;
    by PROPERTY_DMP_ID;
run;

proc sort data=work.ATTR_&cnty;
    by PROPERTY_DMP_ID;
run;

data work.DMP_&cnty;
    merge work.POINT_&cnty(in=pnt) ATTR_&cnty(in=newconst);
    by PROPERTY_DMP_ID;
run;
%mend merge_pnt;
%merge_pnt(IM) %merge_pnt(LA) %merge_pnt(OR) %merge_pnt(RV) %merge_pnt(SB) %merge_pnt(VN)


/* Create 'APN' field for Join purpose */
%macro apn(cnty);
data work.DMP_APN_&cnty;
```

```
# Define shapefiles and file geodatabase
cntyFC = "P:/=existing_landuse_2016/shapes/LandUse_poly_scag.gdb/LandUse_poly_" + cnty
cityFC = "P:/=existing_landuse_2016/shapes/LandUse_poly_" + cnty + ".gdb/" + cityName

# Count the totel number of features in file geodatabase
cntRow = arcpy.GetCount_management(cityFC)

# Make a layer from the feature class
arcpy.MakeFeatureLayer_management(cntyFC, "gdb_cnty")
arcpy.MakeFeatureLayer_management(cityFC, "gdb_city")

# Join the file geodatabase with dbf file by SCAGUID16
print "===== Start join process ====="
print "Input file: " + cityFC
print "Target file: " + cntyFC

joinField = "SCAGUID16"
arcpy.AddJoin_management("gdb_cnty", joinField, "gdb_city", joinField)

print "===== Start update process ====="

# Select joined features and update values
expression = '"' + cityName + ".SCAGUID16" + '"' + " IS NOT NULL"
arcpy.SelectLayerByAttribute_management("gdb_cnty", "NEW_SELECTION", expression)

# Count the selected features
cntSelect = arcpy.GetCount_management("gdb_cnty")

arcpy.CalculateField_management("gdb_cnty", "LandUse_poly_" + cnty + ".LU16", "!" + cityName + ".LU16!", "PYTHON_9.3")
print "Updated: LU16"
arcpy.CalculateField_management("gdb_cnty", "LandUse_poly_" + cnty + ".NOTES", "!" + cityName + ".NOTES!", "PYTHON_9.3")
print "Updated: NOTES"
arcpy.CalculateField_management("gdb_cnty", "LandUse_poly_" + cnty + ".LU16_2ND", "!" + cityName + ".LU16_2ND!", "PYTHON_9.3")
print "Updated: LU16_2ND"
arcpy.CalculateField_management("gdb_cnty", "LandUse_poly_" + cnty + ".RATIO_2ND", "!" + cityName + ".RATIO_2ND!", "PYTHON_9.3")
print "Updated: RATIO_2ND"

print "===== Update process is completed ====="
```

Data Entry and Update Process

- **Updates to city-level land use data by SCAG staff**
  - Received review comments and inputs on the preliminary 2016 land use datasets from 156 local jurisdictions (app. 80% of total 197 jurisdictions) during the local input process
  - Updated land use data based on local's review comments and inputs either by manual update or GIS programming
- **Migration from city-level data to county-level data**
  - Using Python script to automatically transfer updated city-level data into county-level data
- **Review on potential human mistakes using GIS programming**
  - Incorrect or inconsistent attribute value of land use, city name, density, etc.
  - Incorrect or inconsistent parcel shape & location

CONCLUSIONS

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Conclusion

- **Benefits of GIS Programming for Big Data Management**
  - Time and labor efficiency in managing, updating and reviewing big geospatial land use dataset by automating repetitive workflows
  - Better data accuracy and consistency
  - Consistent workflow of data management and review process
  - Conformity with standardized data format
- **Next Steps**
  - Annual regional land use update process
    - Developing land use data more frequently—monthly or even real-time
  - Integrating additional information valuable for regional planning and policy analysis, such as building footprints and housing unit information
  - Land capacity and suitability models development
  - More detailed (level 3) land use classification

Thank you

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