



# **TRANSPORTATION MODELING FORUM**

December 9, 2020

***SANDAG***



# Forum Agenda

- Welcome, Introductions and Announcements
- Social Equity Analysis and Regional Planning
- RTP Modeling Retrospective
- Growth Forecast Lifecycle Policy
- ABM2+ Subarea Enhancements

# Welcome, Introductions and Announcements

- Welcome to SANDAG Jielin Sun!!
- Welcome back to SANDAG Susan Xu!!
- New Model Website – coming soon
  - Update of SANDAG Regional Models website expected December/January
  - New wiki pages for ABM2+
    - <https://github.com/SANDAG/ABM/wiki>
- Other Announcements?

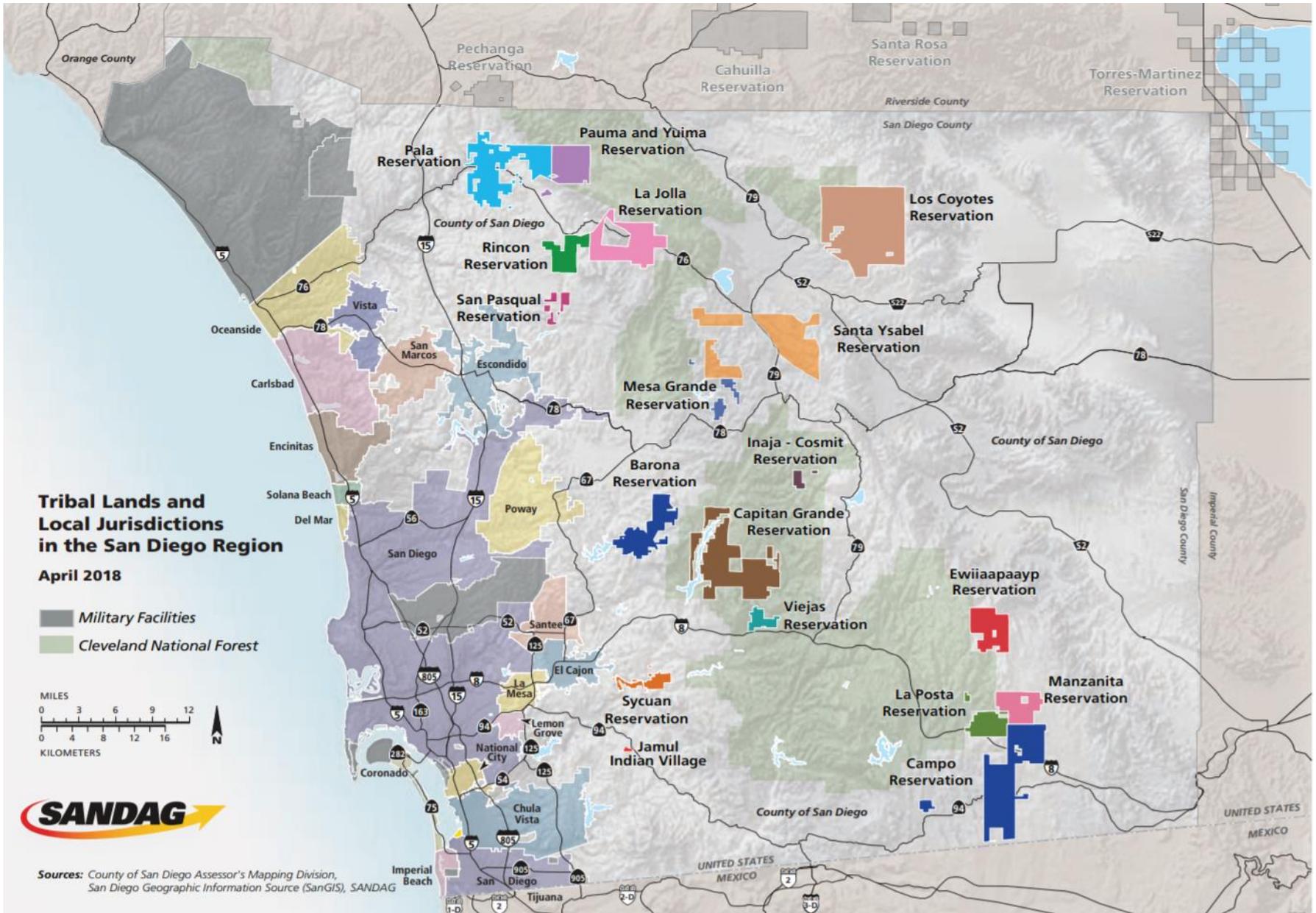
# RIP Bill McFarlane

- William “Bill” McFarlane, 1951 – 2020
- Passed away on November 17, 2020
  - <https://www.legacy.com/us/obituaries/madison/name/william-mcfarlane-obituary?pid=197148380>
- Career
  - Longtime SANDAG transportation modeling manager
  - Architect and developer of one of the most advanced 4-step models in the nation
  - Integration of GIS and transportation modeling
  - Use of microzones and transit access points for detailed representation of transit accessibility and non-motorized travel



We stand on his shoulders and carry on his legacy



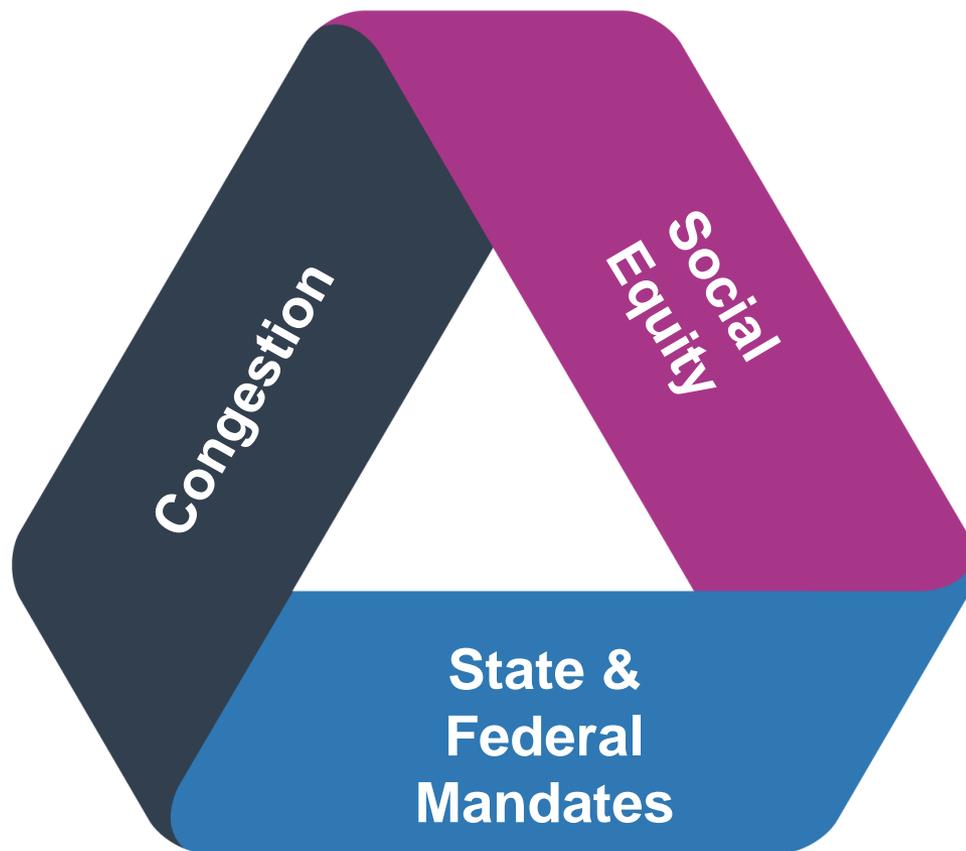




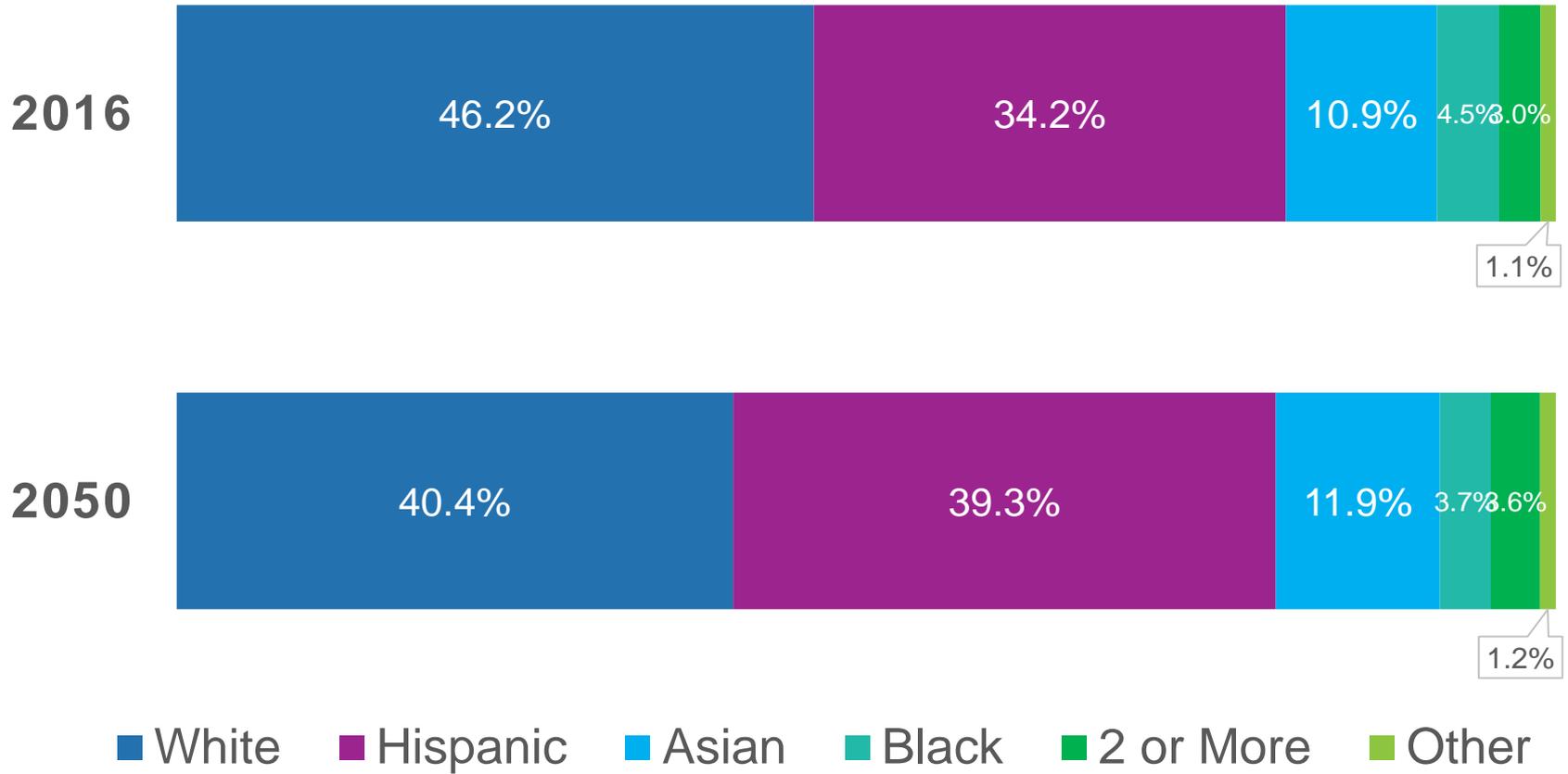
# A Vision for the 2021 Regional Plan

# Three challenges

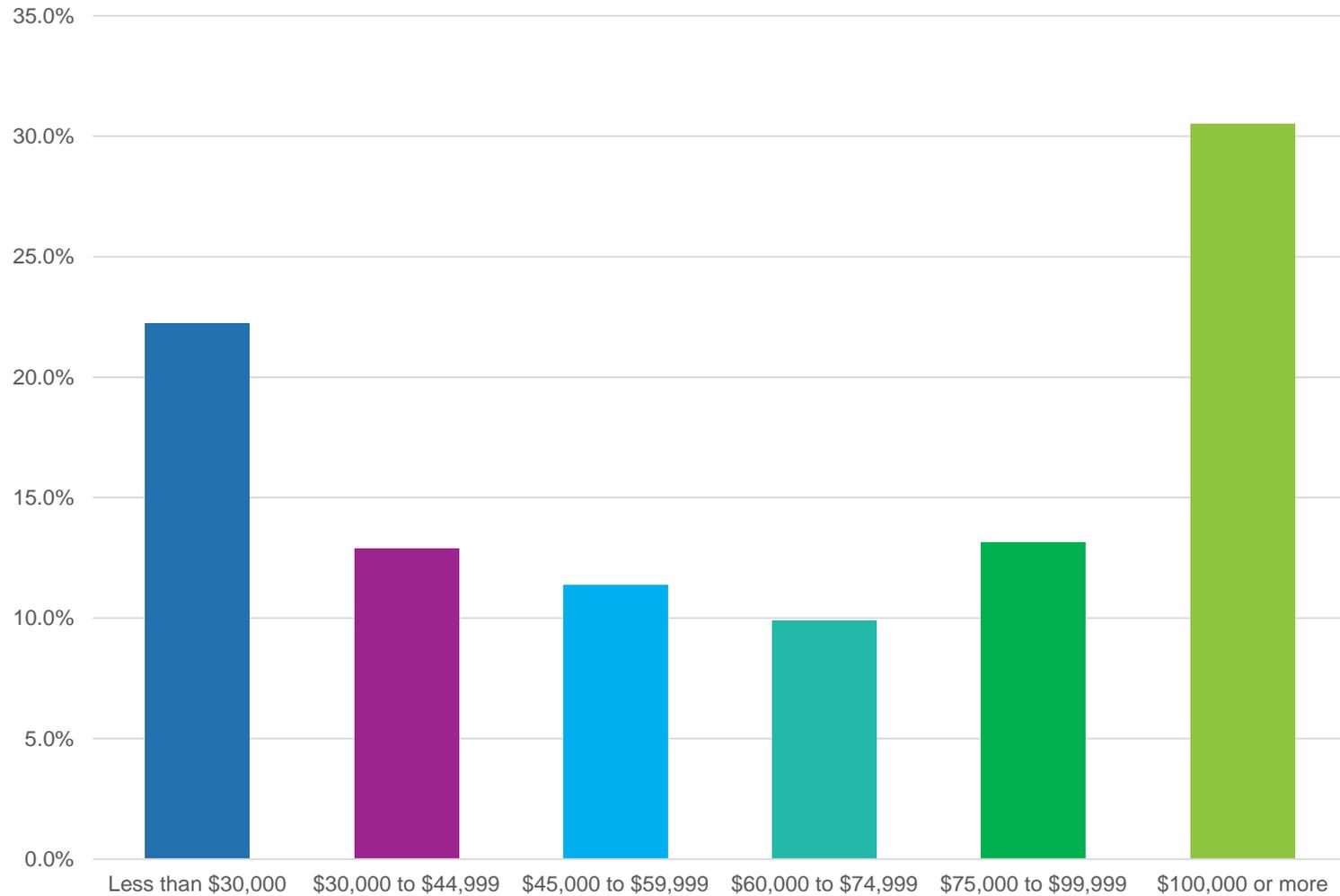
Reduce *congestion*  
Improve *social equity*  
Meet *state and federal mandates* –  
to be **faster, fairer,**  
and **cleaner**



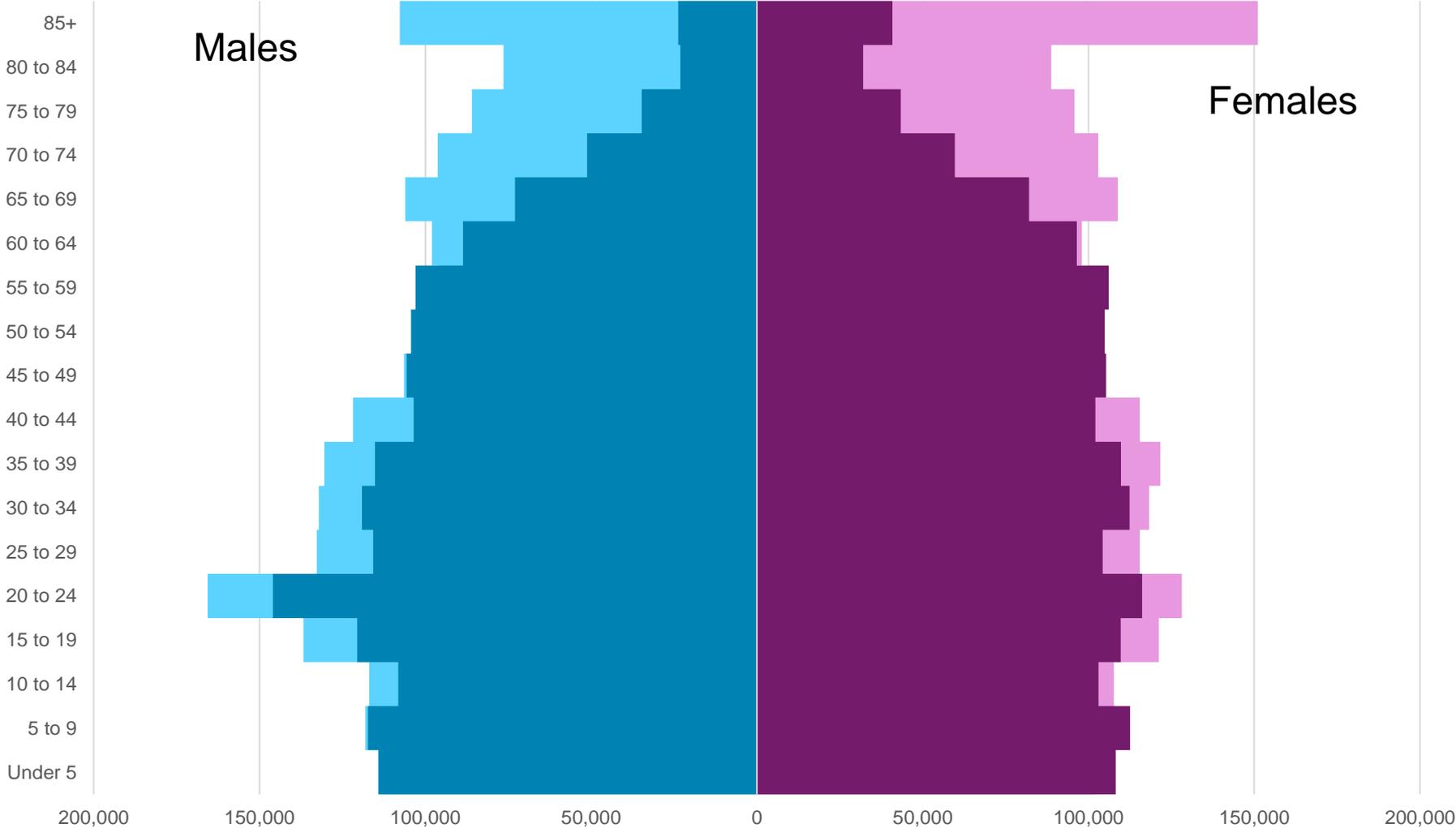
# San Diego Region Population by Race and Ethnicity



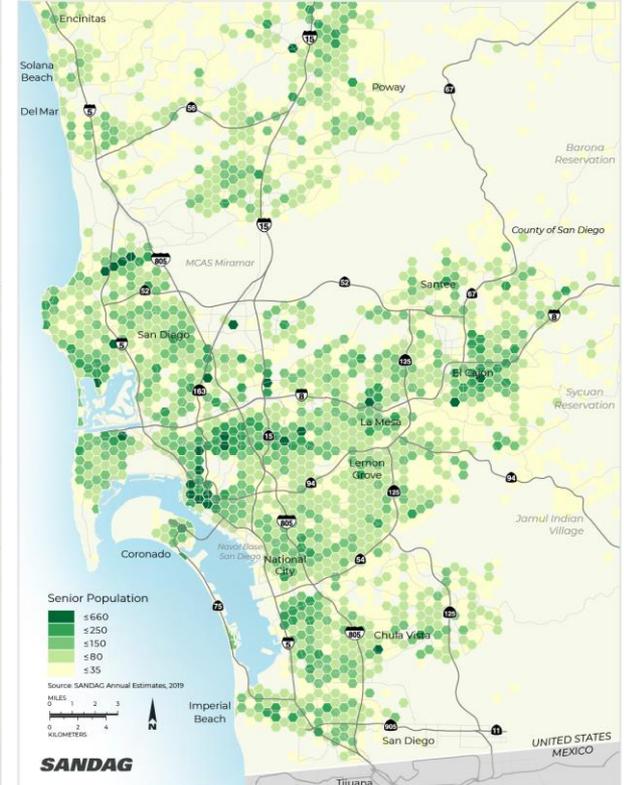
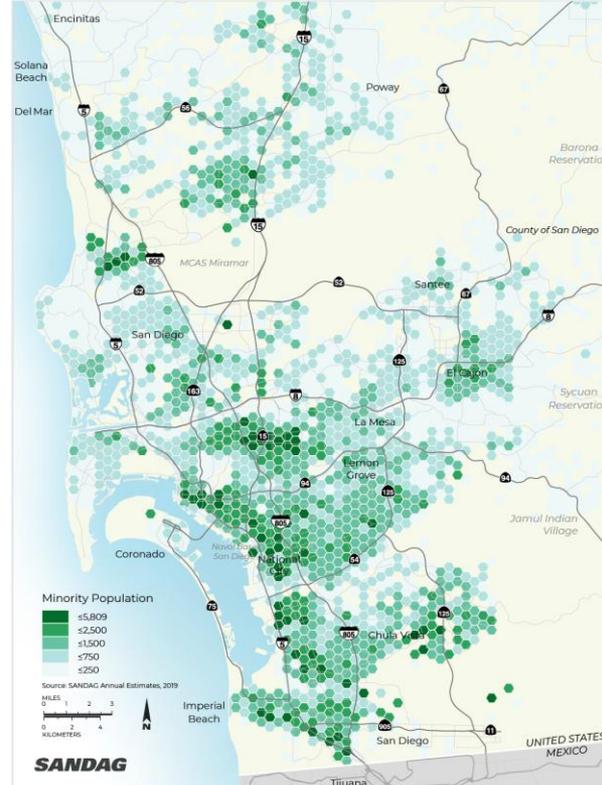
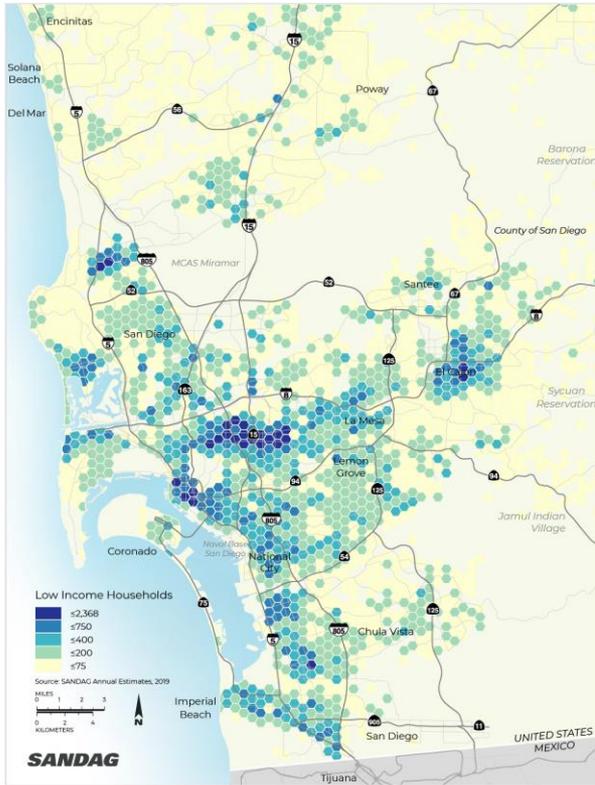
# San Diego Region Household Income Distribution, 2016



# San Diego Region Age and Sex Composition, 2016 and 2050

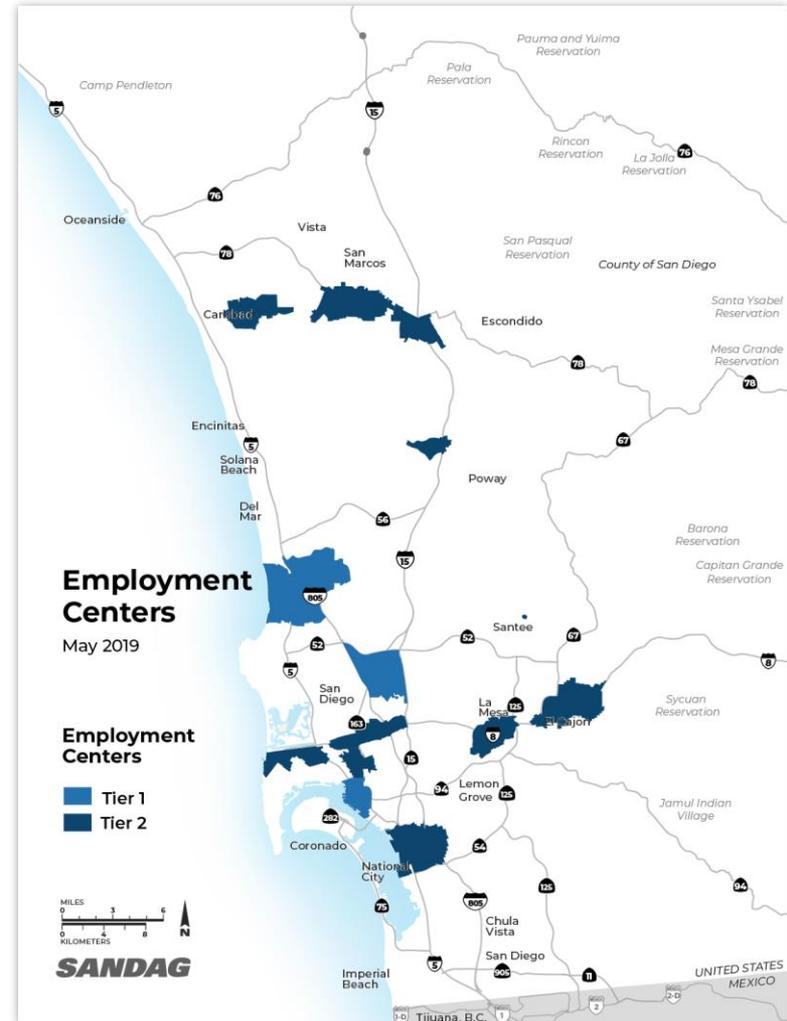
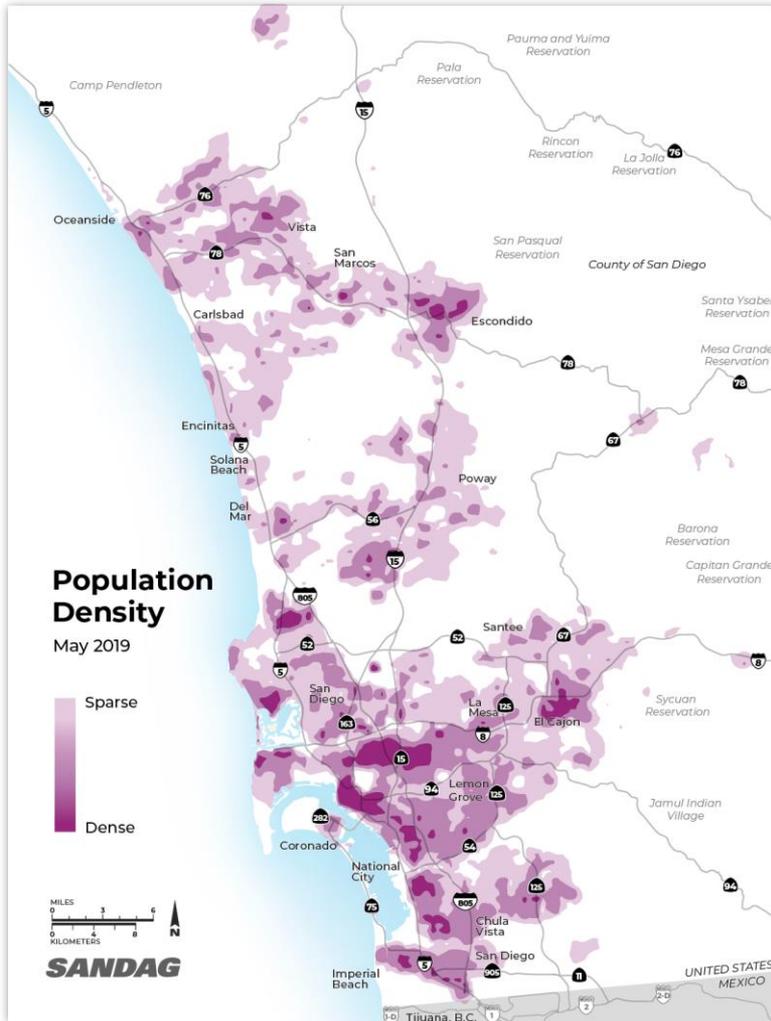


# Social Equity Focus Populations

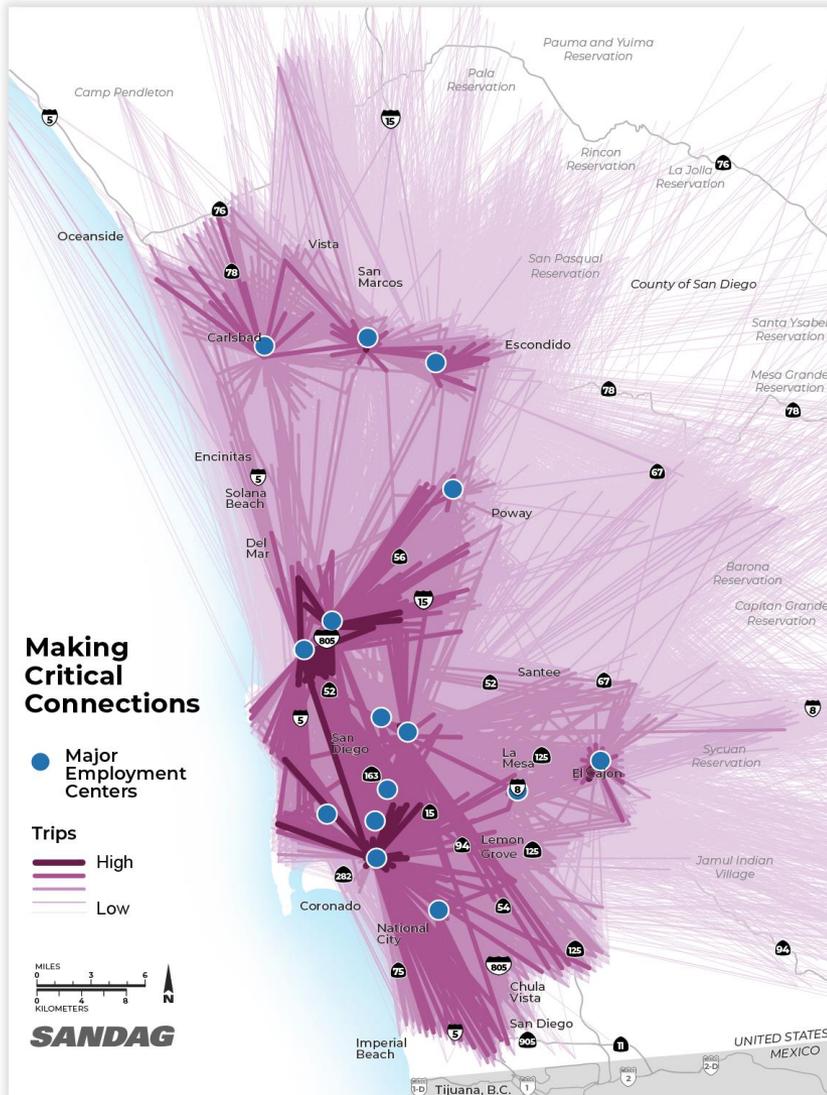


# Data-Driven Planning

Where people live and work



# Trips to and from employment centers are the most predictable





**7%** low-income residents have access to fast and frequent transit service



The median transit travel time is **51 minutes** –  
double the travel time for people who drive to work



**10%** of the region's population has a disability



**13%** of our population will be age 75 or older in 2050

# Social Equity Analysis in the Regional Plan

	2050 RTP (2011)	San Diego Forward (2015)	San Diego Forward (2021)
Process	<ul style="list-style-type: none"> <li>• Formal Stakeholders Working Group</li> <li>• CBOs part of SWG</li> <li>• EJ Subcommittee</li> <li>• CBO grants (8)</li> <li>• 6 months into process thru Plan adoption</li> </ul>	<ul style="list-style-type: none"> <li>• 14 CBOs as Community Based Consultants</li> <li>• Social Equity Peer Group</li> <li>• Education/Outreach/ Advocacy</li> <li>• From PIP thru 3 months after plan (3 yrs)</li> </ul>	<ul style="list-style-type: none"> <li>• 12 CBOs from EJ Communities per Calenviroscreen</li> <li>• CBO Working Group</li> <li>• CBO Network for education/outreach/advocacy</li> <li>• Resourced throughout approval of RP</li> </ul>
Analysis	<ul style="list-style-type: none"> <li>• Travel Demand Model (4-Step)</li> <li>• Unit of Analysis: TAZ analysis</li> <li>• Indexes for Communities of Concern</li> <li>• Basic comparison of Performance Measures</li> </ul>	<ul style="list-style-type: none"> <li>• ABM/PECAS</li> <li>• Unit of Analysis: Traveler/HH</li> <li>• Demographic that can be forecast only</li> <li>• Social Equity Calculation based on the 80/20 rule</li> </ul>	<ul style="list-style-type: none"> <li>• ABM2+</li> <li>• Unit of Analysis: Traveler/HH</li> <li>• Demographic that can be forecast only</li> <li>• Social Equity Calculation based on the 80/20 rule</li> <li>• AB805 Pollution Reduction Strategies for EJ Communities</li> </ul>

# Evolving Definitions: Communities of Concern

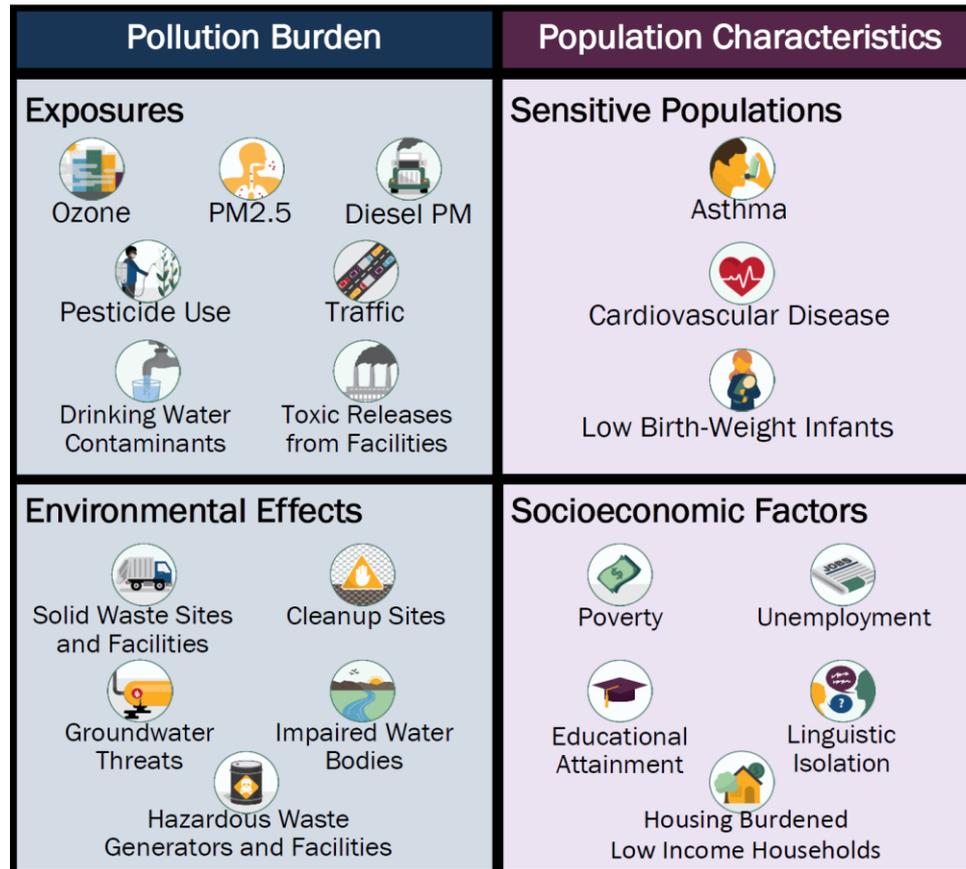
2050 RTP (2011)	San Diego Forward (2015)	San Diego Forward (2021)
Minorities – TAZ w/ 65%	All Minorities	All Minorities
Low –Income <ul style="list-style-type: none"> <li>• Income</li> <li>• Severe overcrowding</li> <li>• Poverty</li> </ul>	Low-Income – 200% of Federal Poverty Level	Low-Income – 200% of Federal Poverty Level
Low Mobility No car households Disabled 75 +	Seniors – 75+	Seniors – 75+
Low Civic Engagement <ul style="list-style-type: none"> <li>• Educational attainment</li> <li>• Linguistic Isolation</li> </ul>		



# CalEnviroScreen 3.0 Indicators

**Exposure:**  
contact with pollutants

**Environmental Effects:**  
Adverse environmental conditions caused by pollution

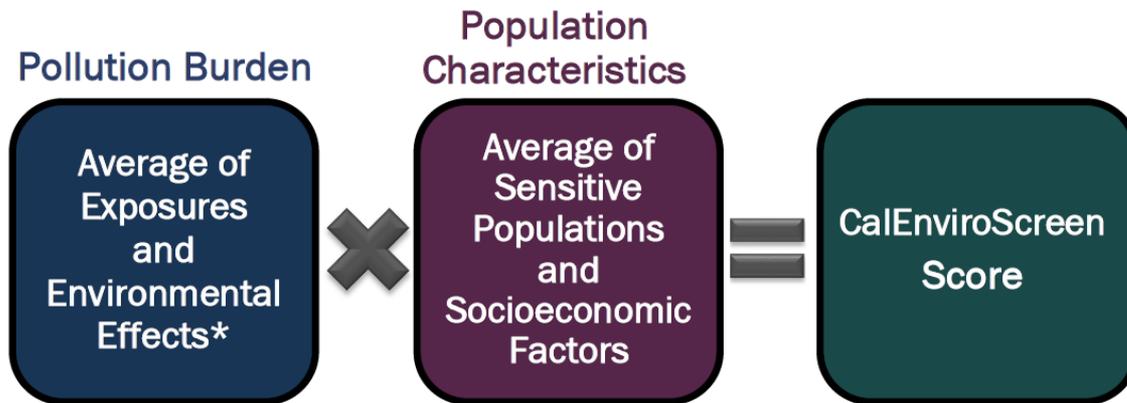


**Sensitive Populations:**  
Biological traits that may magnify the effects of pollution exposures

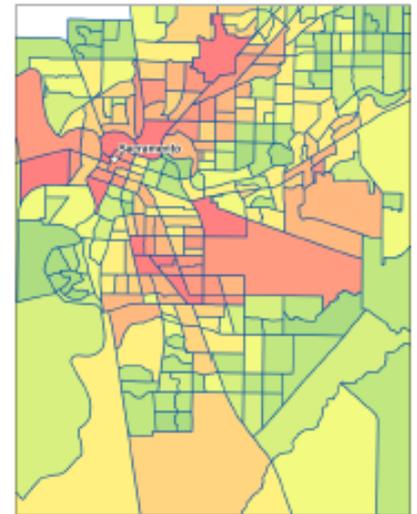
**Socioeconomic Factors:** Community characteristics that result in increased vulnerability to pollution

# CalEnviroScreen 3.0 Formula

## CalEnviroScreen Formula

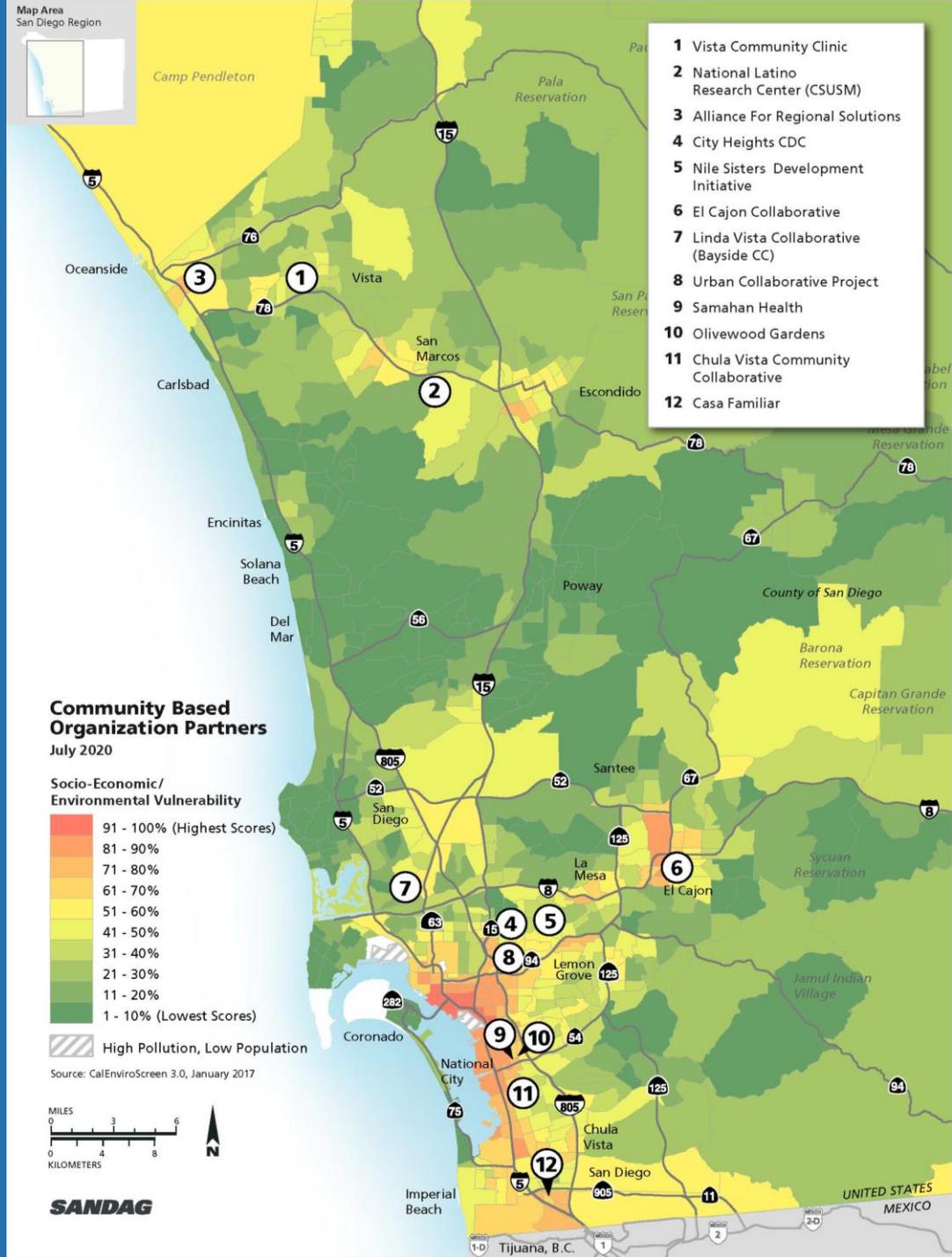


\*The Environmental Effects component is weighted one-half when combined with the Exposures component.





# CBO Partner Network



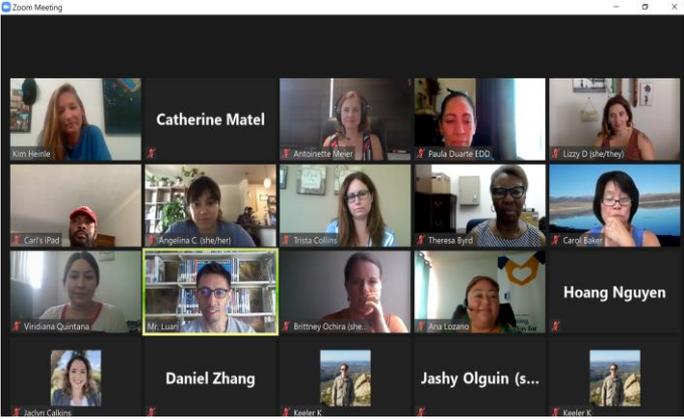
# Human-Centered Design

By listening to residents throughout the region, we can plan for improvements that address their unique needs



# CBO Partners

Voices from  
Environmental  
Justice  
Communities

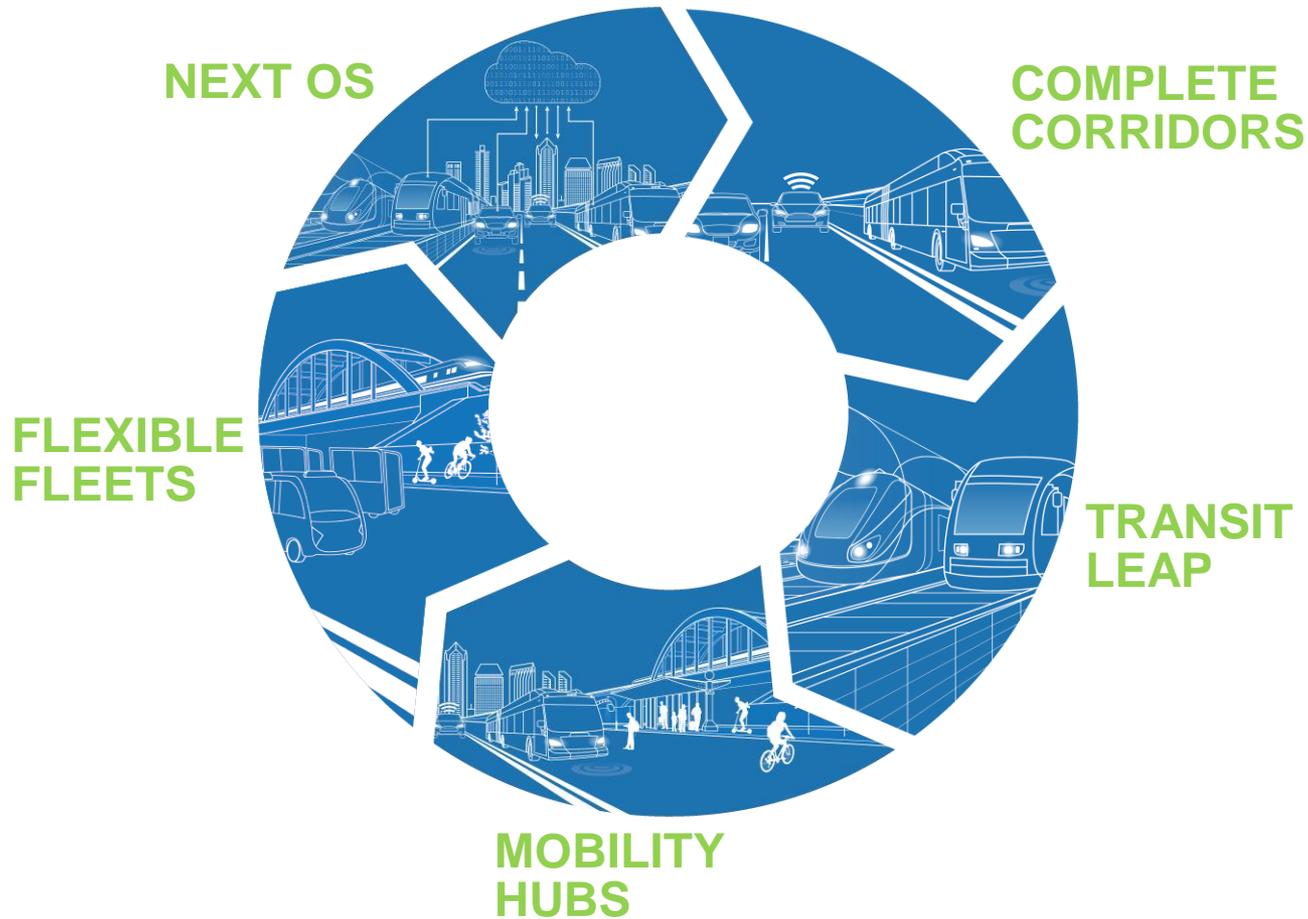


# Tribal input in the 2021 Regional Plan



# 5 Big Moves

Inter-reliant strategies that work as one and enhance each other



# Social Equity Performance Measures

Equity Area	Measure
Economy	Access to opportunities via transit (employment centers and higher education)
	Benefit Cost Ratio
	Transportation system use costs
Enviro. and Quality of Life	Access to basic needs (retail, parks, and medical)
	Average Particulate Matter (PM 2.5)
	People within ¼ mile of bicycle facilities
Mobility and Safety	People within ½ mile of transit (by transit tier)

# Technical Aspects of Performance Measures

- Streamlined process
- Disaggregated simulation model to simulate an individual travel pattern
- Regional or sub regional measures
- ABM2+ outputs stored in SQL database
- SQL stored procedures/python scripts to summarize performance measures
- Python script to write out measures to an Excel template with multiple tabs for a series of years and scenarios

Social Equity Performance Measures			2016	No-Build Horizon Years			Plan Network Horizon Years		
Scenario ID				2025	2035	2050	2025	2035	2050
SE-M-1-a	Access to Basic Needs								
	% of population w/in 15 minutes of retail								
		Walk							
		Bike							
	low income -	Walk, Micromobility, Microtransit							
	Regional	Walk, Bike, Micromobility, Microtransit							
		nst - Accessed by Walk and Flexible Fleet - Speed One							
		Driving (drive alone)							
		Walk							
		Bike							
	low income -	Walk, Micromobility, Microtransit							
	Mohubs	Walk, Bike, Micromobility, Microtransit							
		nst - Accessed by Walk and Flexible Fleet - Speed One							
		Driving (drive alone)							
	% of population w/in 15 minutes of retail								
		Walk							
		Bike							
	non low income -	Walk, Micromobility, Microtransit							
	Regional	Walk, Bike, Micromobility, Microtransit							
		nst - Accessed by Walk and Flexible Fleet - Speed One							
		Driving (drive alone)							
		Walk							
		Bike							
	non low income -	Walk, Micromobility, Microtransit							
	Mohubs	Walk, Bike, Micromobility, Microtransit							
		nst - Accessed by Walk and Flexible Fleet - Speed One							
		Driving (drive alone)							
	% of population w/in 15 minutes of retail								
		Walk							
		Bike							
	minority - Regional	Walk, Micromobility, Microtransit							
		Walk, Bike, Micromobility, Microtransit							
		nst - Accessed by Walk and Flexible Fleet - Speed One							
		Driving (drive alone)							
		Walk							
		Bike							



# RTP Modeling Retrospective

Joaquin Ortega

Neeco Beltran

# Introduction/Project Intent

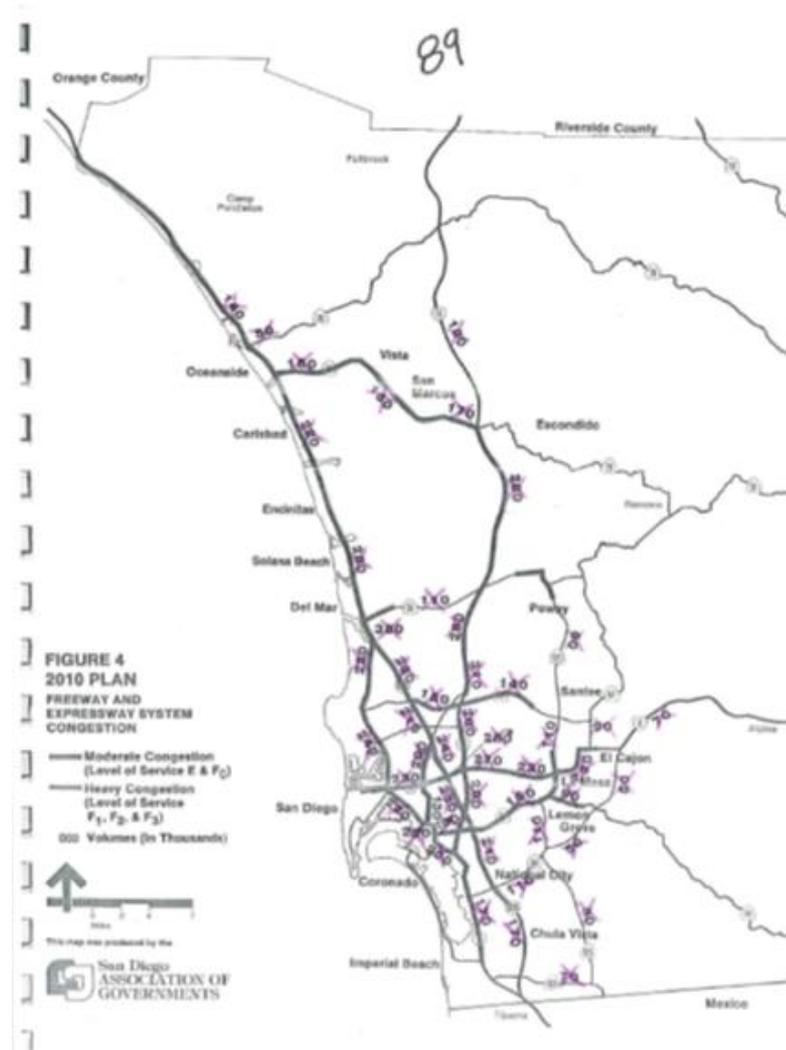
- Regional Transportation Plans Have Been a Requirement for Decades
  - Plans are completed at the moment in time with the best available information, analysis, and tools
  - Plans are approved by decision makers in that time period
- Project Intents/Goals
  - To compare the differences between forecasted traffic volumes and measured traffic volumes
  - To assess the causes of differences between forecasted traffic volumes and measured traffic volumes

# Forecast Data Collection

- There are 7 historic RTP hard copy documents in the SANDAG transportation library. These historic RTP documents contain maps with forecasted screen line volumes.
- Forecasted screen line volumes are for years that have already passed
- Manual interpretation of the exact location based on the placement of the label point.
- If the label point was in an area where it could be ascribed to multiple locations, it was excluded.
- Sampling Results

RTP YEAR	FORECAST YEAR	SAMPLES
1976	1995	23
1980	2000	37
1984	1995	34
1984	2005	37
1986	1995	36
1986	2005	41
1989	2000	42
1989	2010	46
1997	2010	48
2000	2010	43

Note: All location sampling was done prior to any processing of empirical count data.



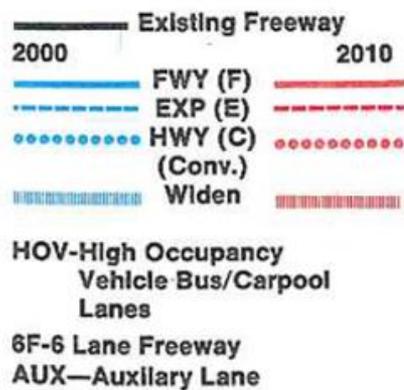
# Historic Count Data Acquisition

- Data Source: SANDAG ADT Link count spreadsheet
  - Caltrans Adjusted 5 day counts
  - Date range for fwy ADT Link 5 day counts 1980-2012 (Starting in 2013 all counts now gathered from PeMS)
- Two methods for processing empirical counts
  - Absolute Count: The single count that matches the forecast year
  - Average Count: 2 years prior to the forecast year + the forecast year + 2 years after the forecast year (5 year average)
- Highway network ground truth status
  - Planned highway projects sometimes were not on the ground in the year specified by some past plans.
  - Classify each sample with a Network Status Flag

# Historic Count Data Acquisition

- -1 = The highway facility did not exist on the ground in the forecast year.
- 0 = The highway facility existed in the forecast year but the planned improvement did not.

**FIGURE 14  
FREEWAY &  
EXPRESSWAY  
SYSTEM PLAN**



1989 RTP

Network Status = -1

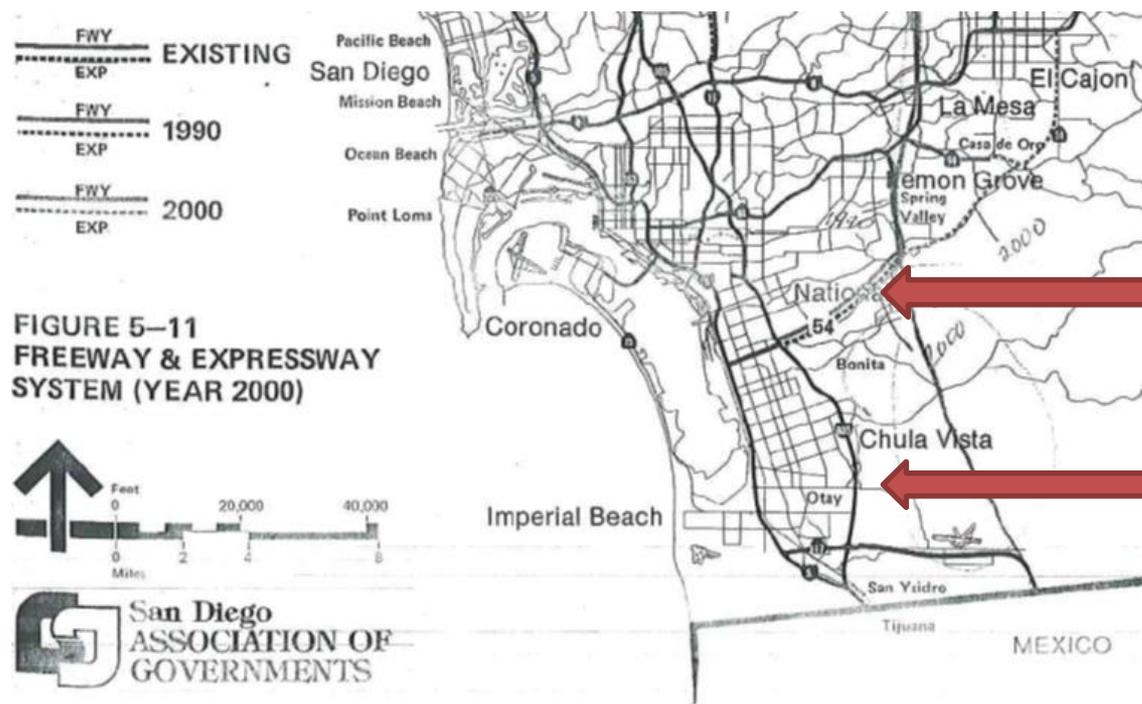
SR-125 was never completed past its current terminus at SR-52

Network Status = 0

I-5 was complete as a freeway but no HOV facility was constructed in this section of the corridor.

# Historic Count Data Acquisition

- 1 = The highway facility exists as planned or improved in the forecast year
- 2 = The highway facility existed but it is unclear if improvements were planned for the forecast year



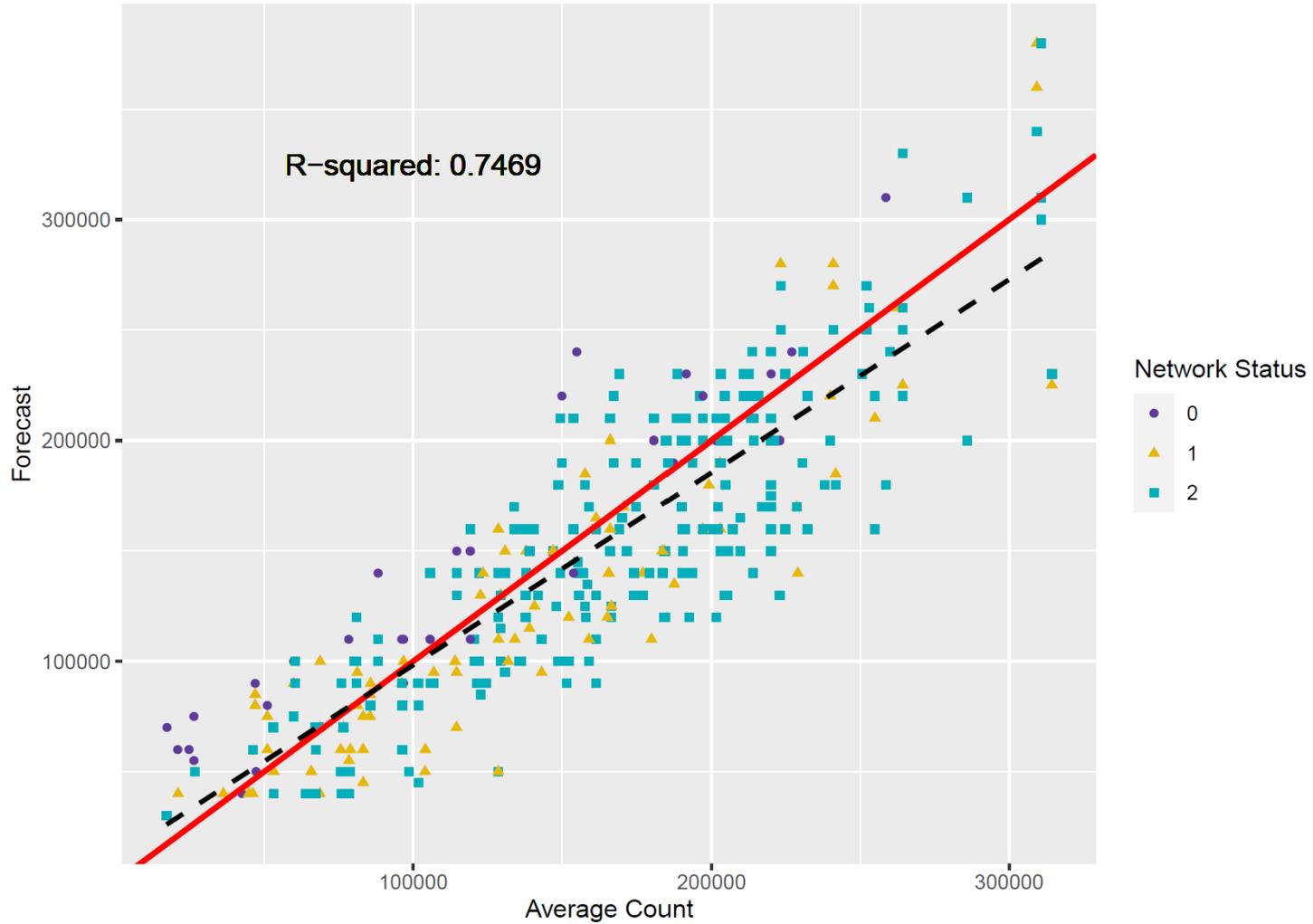
## 1980 RTP

Network Status = 1  
SR-54 was completed as a freeway in this section in the late 1990's

Network Status = 2  
I-805 was complete as a freeway by 1980 but it is unclear if any improvements were noted by 2000

# Preliminary Results

Validation Plot (Analysis Set)



# Preliminary Results

## Results by Network Status (Analysis Set)

Range	0	1	2
-10% to 10%	36.11%	25.00%	35.24%
-20% to 20%	52.78%	57.14%	58.15%
-30% to 30%	61.11%	80.95%	81.06%
Outside of +/- 30%	100.00%	100.00%	100.00%

## Results by Plan Year (Analysis Set)

Range	1976	1980	1984	1986	1989	1997	2000
-10% to 10%	0.00%	16.13%	14.29%	19.72%	42.50%	60.00%	64.10%
-20% to 20%	16.67%	19.35%	41.27%	59.15%	70.00%	80.00%	76.92%
-30% to 30%	33.33%	38.71%	76.19%	90.14%	83.75%	93.33%	89.74%
Outside of +/- 30%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%

# Preliminary Results

- Mean Absolute Percentage Error (MAPE):

$$\frac{1}{n} \sum_{i=1}^n \left| \frac{Actual_i - Forecast_i}{Actual_i} \right|$$

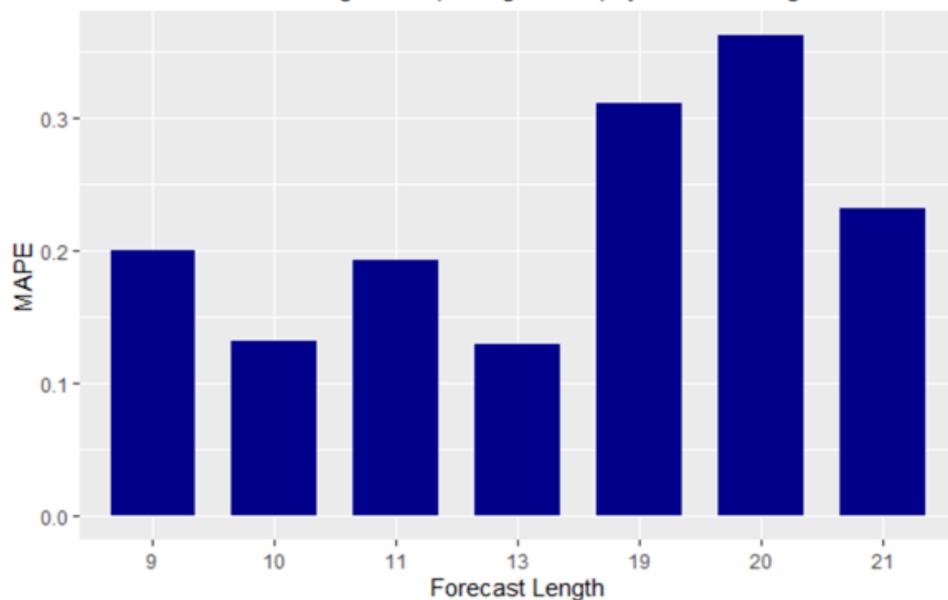
- Mean Absolute Percentage Error Advantages

- Easy to interpret
- Unit-free
- Accounts for large spread between units, specifically between positive and negative values
- Drawback: Doesn't tell if overcounting or undercounting

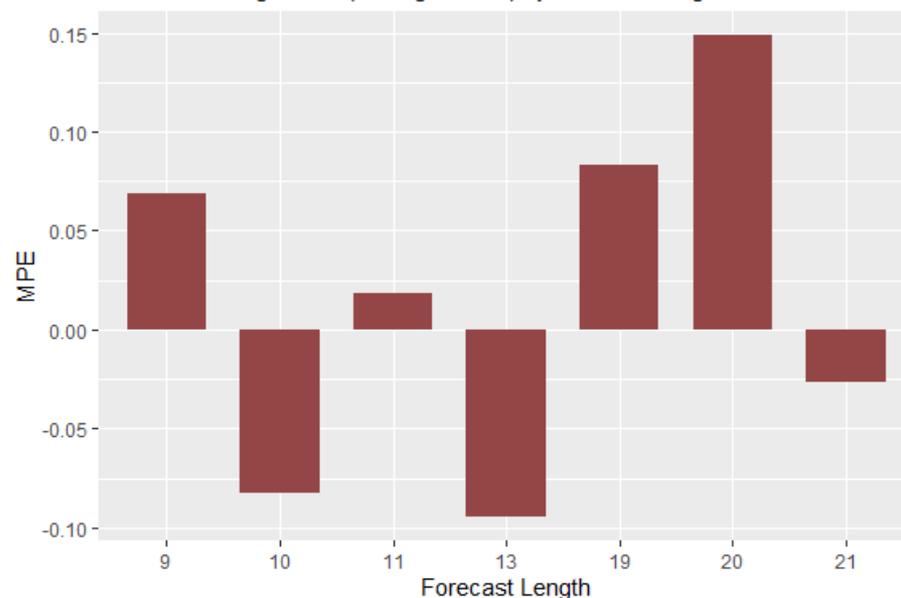
- Mean Percentage Error (MPE):

$$\frac{1}{n} \sum_{i=1}^n \frac{Actual_i - Forecast_i}{Actual_i}$$

Mean Absolute Percentage Error (Average Count) by Forecast Length

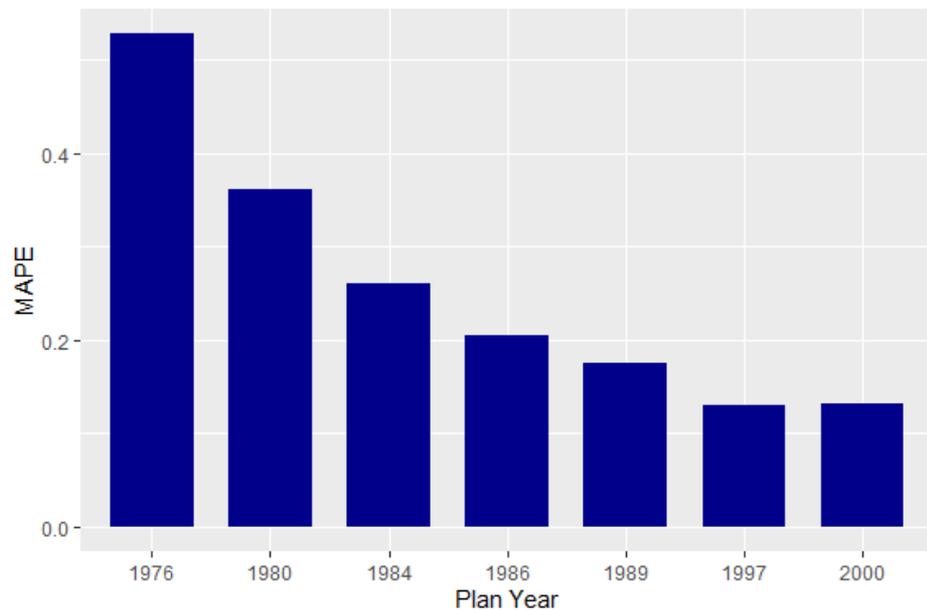


Mean Percentage Error (Average Count) by Forecast Length

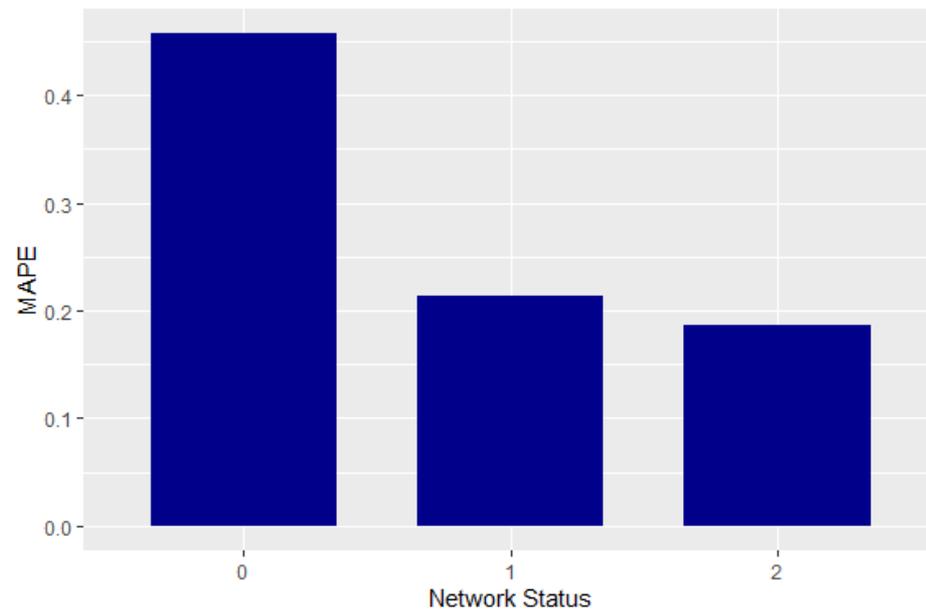


# Preliminary Results

Mean Absolute Percentage Error (Average Count) by Plan Year



Mean Absolute Percentage Error (Average Count) by Network Status



# Next Steps

- Evaluating other modes of transportation
  - Recall: this analysis only measures freeway screenline volumes
  - Public transit forecasts and other metrics can help contextualize inaccuracies in freeway/highway traffic forecasts
- Assessing the causes of model forecast inaccuracy
  - Model Inputs
    - a) Population forecasts
    - b) Economic forecasts
    - c) Land use forecasts
  - Exogenous variables not captured by the model
    - a) Sudden economic changes: recessions, fuel cost changes
    - b) Societal changes: labor force participation rate for women

# Questions



# Growth Forecast Lifecycle Policy

Rick Curry

# Growth Forecast Lifecycle Policy

- SANDAG Service Bureau governance, including use of growth forecasts and models, is defined in Board Policy #12
- Where can you find SANDAG's board policies?
  - <https://www.sandag.org/index.asp?fuseaction=about.bylaws>
- And specifically Board Policy #12?
  - [https://www.sandag.org/organization/about/pubs/policy\\_012.pdf](https://www.sandag.org/organization/about/pubs/policy_012.pdf)



## BOARD POLICY NO. **012**

### **SANDAG SERVICE BUREAU**

The SANDAG Service Bureau provides informational and technical services to member agencies, nonmember government agencies, and private organizations and individuals. It is the purpose of the Service Bureau to offer products and services that meet the needs of decision makers in the public and private sectors while enhancing the quality and extent of demographic, economic, transportation, land use, criminal justice, and other information maintained in our Regional Information System (RIS). The Service Bureau may provide services through SANDAG and the SourcePoint Corporation.

The SANDAG Executive Committee serves as the Service Bureau's governing body and the Board of Directors of SourcePoint.

# Growth Forecast Lifecycle Policy

## Key Recent Dates and Changes

- May 2017
  - Board Policy #12 amended (formally modified February 2018)
  - Lifecycle policy formally adopted for Service Bureau and informally adopted for SANDAG projects
- December 2017
  - Executive Committee establishes project priorities when SANDAG has more projects than available staff
    - First priority: The Regional Plan and other agency priorities
    - Second priority: Member and other government agency project requests
    - Third priority: Private-sector development project requests

# Growth Forecast Lifecycle Policy

## Key Recent Dates and Changes

- February 2019
  - SANDAG Board approves a bigger and bolder transportation vision with planned adoption as the 2021 Regional Plan
  - SANDAG starts work on ABM2+
- October 2019
  - Emergency adoption of 2019 Federal RTP
  - ABM2 with Growth Forecast series 14 (version 17)
- Jan 2020
  - Board Policy #12 temporarily amended
  - SANDAG Executive Committee approved a temporary waiver of the enforcement of the requirement that all new projects use the current version of the model

# Growth Forecast Lifecycle Policy

**What was the result when the 2019 Federal RTP was adopted (Nov 2019) and Board Policy #12 was amended (Feb 2020)?**

Status	Regional Growth Forecast	Travel Demand Model Platform	Use in Service Bureau Modeling Jobs
Retired	Series 12	4-Step Model	No longer used for modeling projects
Prior Model	Series 13	ABM1	For continuation of work that started in ABM1 <i>New work that requires land use modifications</i>
Current Model	Series 14 (version 17)	ABM2	New work for regional data extraction and network scenarios

# Growth Forecast Lifecycle Policy

**What will be the result when the 2021 RP is adopted in November 2021?**

Status	Regional Growth Forecast	Travel Demand Model Platform	Use in Service Bureau Modeling Jobs
Retired	Series 13	ABM1	No longer used for modeling projects
* Prior Model	Series 14 (version 17)	ABM2	For continuation of work that had started in ABM2
Current Model	Series 14 (version 38,39)	ABM2+	All new modeling projects

# ABM2+ Subarea Enhancements

Ziying Ouyang

Mike Calandra

# ABM2+ Subarea Enhancements: Project Goals

- Implement land use overrides by MGRA in ABM2+
  - Update synthetic population for the study area
  - Update the employment density table
  - Implement new land use unit types
- Allow for use of flexible Traffic Analysis Zone (TAZ) layers
- QA/QC and subarea report automation
- Define reporting thresholds

# ABM2+ Subarea Enhancements: Scope of Work

- Task Descriptions
  - Task 1: Project Management
  - Task 2: Employment Density Update
  - Task 3: Review Existing Process and Produce a Model Enhancements Plan
  - Task 4: Model Enhancements
  - Task 5: Trip Data Report and Threshold Definition
  - Task 6: Application Tests
  - Task 7: Final Report and Workshop
  - Task 8: As-Needed Support
- Scope put to bid in summer 2020
- RSG selected as the consultant in fall of 2020
- October 22, 2020 kickoff meeting

# ABM2+ Subarea Enhancements: Project Management

- Project Management Plan
  - Communications
  - Key staff
  - Budget and invoicing
  - Project schedule and deliverables
- Bi-weekly project meetings and minutes
  - Set time and day
  - Setup confluence project page
- Monthly progress reports

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# ABM2+ Subarea Enhancements: Employment Density Update

## • Update non-residential employment density table

1. Agriculture and mining
2. Construction
3. Manufacturing
4. Wholesale trade
5. Retail trade
6. Transportation and warehousing, and utilities
7. Information, finance and real estate
8. Professional and business services
9. Education and health services
10. Leisure and hospitality
11. Other services
12. Government
13. Self-employed and domestic workers (employees per square foot)

## • Update non-residential unit type support

1. Outdoor and recreational land uses (Employees per Acre)
2. Group Quarters (Employees per Bed)
3. Other potential unit types:

LAND USE CATEGORY	UNIT TYPE
Gas Stations	Pumps
Car Washes	Stalls
Casinos	Slots & Gaming Tables
Campgrounds	Campsites
Marinas	Berths
Movie Theaters	Seats & Screens
Sports Activities	Courts
Bowling Alleys	Lanes
Golf Courses	Holes
Parking Lots & Garages	Spaces

# ABM2+ Subarea Enhancements: Model Enhancement Plan

- Review and document existing process
  - Requirements
  - Use cases
  - Issues and opportunities for improvement
- Develop model enhancement plan
  - Data pipeline and management system
  - Review duplication in inputs
  - Incorporate employment density updates
  - Update the population synthesizer for the study area
  - Apply population over/under-sampling for subareas
  - Develop automated QA/QC reports

# ABM2+ Subarea Enhancements: Model Enhancement Feature

- Traffic Analysis Zone splitting
  - Lost in translation from the 4-Step model to ABM1
  - Internal TAZ and network building process remains unchanged
    - Modify local TAZ layer using MGRA boundaries
    - Change / add zone connectors to accommodate new TAZ(s)
    - Run script to refresh lookup tables that include TAZ
    - Build updated Hwycov, Trcov and bike network layers
  - Improves subarea model calibration accuracy
  - Important when analyzing infill development
  - Boosts confidence of analysis in supporting documents
  - Increases client satisfaction

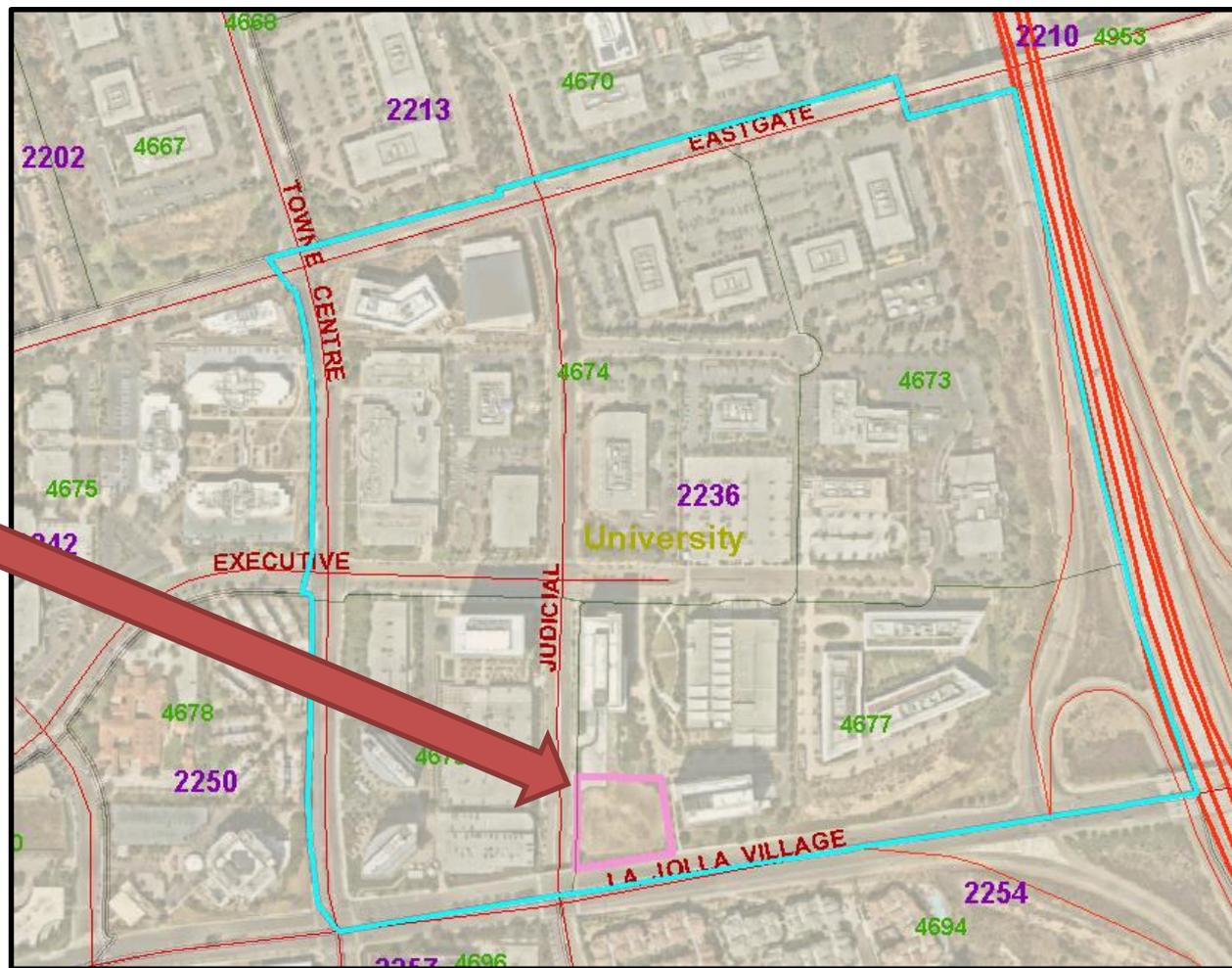
# ABM2+ Subarea Enhancements: Model Enhancement Feature

- Traffic Analysis Zone splitting challenge

One TAZ & Four MGRAs include 100+ MF dwelling units & 5700+ industrial and office employees

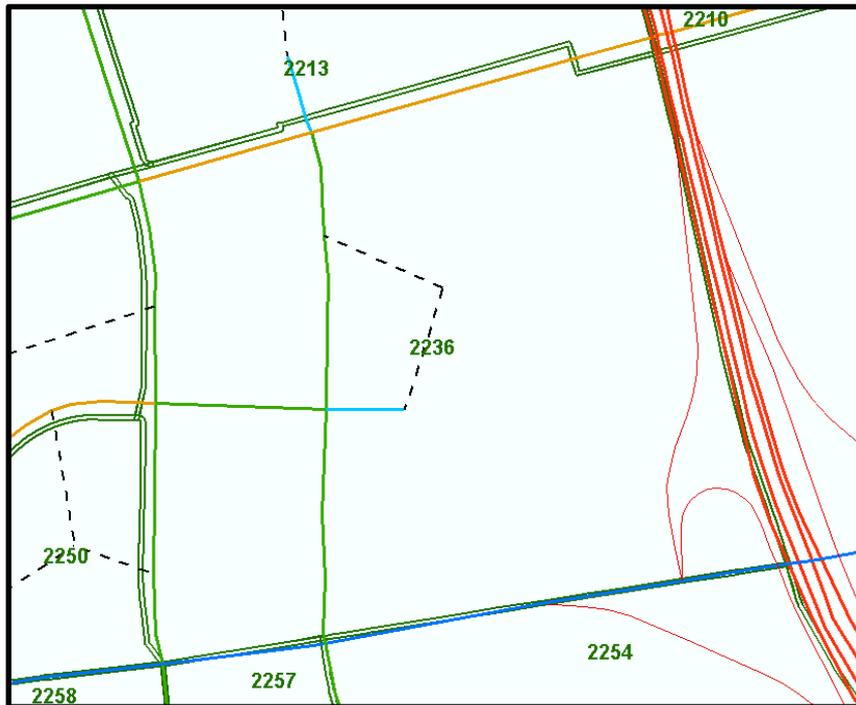
The property owner wants to develop a vacant parcel

How do we provide accurate distribution and VMT analysis for only the proposed hotel?

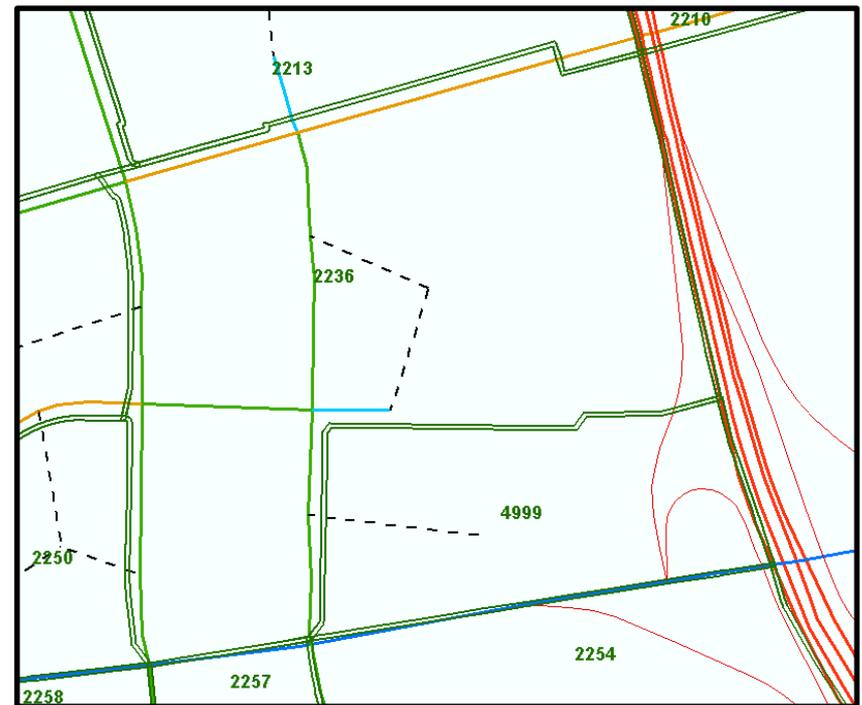


# ABM2+ Subarea Enhancements: TAZ Split

- Regional Network

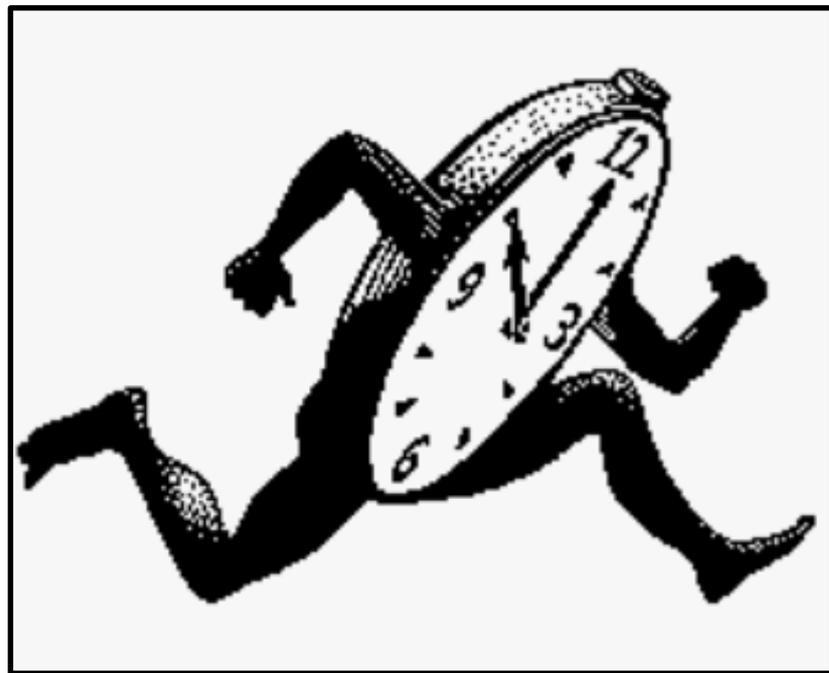


- Subarea Network



# ABM2+ Subarea Enhancements: Model Enhancement Feature

- Intelligent Sampling
  - Over-sampling the population in the subarea at a rate over one
  - Reducing the sample rate with respect to increased distance from the subarea
  
- Reduce Monte Carlo variation
- Reduce model run times



# ABM2+ Subarea Enhancements: Model Enhancements

- Implement each improvement as a data pipeline step
- Deliver a clear user interface for application workflow
- Identify existing procedures that can be streamlined or optimized
- Manage work items with JIRA Issue Tracker
- Deliver code in GitHub repository
- Document subregional applications in ABM Wiki

## SAN DIEGO ASSOCIATION OF GOVERNMENTS (SANDAG) ACTIVITY-BASED TRAVEL DEMAND MODEL



This wiki is intended to serve as a user guide to describe the overall structure of the modeling system, how to set up and run the model system, and the model system inputs and outputs. Additionally, this wiki discusses the reporting system developed for the model.

### Overview

The SANDAG resident travel model is based on the CT-RAMP (Coordinated Travel Regional Activity-Based Modeling Platform) family of activity-based models. The model has been developed to ensure that the regional transportation planning process can rely on forecasting tools that will be adequate for new socioeconomic environments and emerging planning challenges. It is also equally suitable for conventional highway projects, transit projects, and various policy studies such as highway pricing and HOV analysis.

In addition to the CT-RAMP resident travel model, a number of other model components have been developed and integrated into an overall modeling system. These other model components include:

- A heavy truck model covering heavy (8,500 pounds or more) trucks into, out of, and through San Diego
- An interim commercial vehicle model covering other goods and services movements within San Diego
- An internal-external travel model covering travel into and out of San Diego made by San Diego residents
- An external-internal travel model covering non-resident travel into and out of San Diego made by non-Mexican residents

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### User Guide

- ▼ ABM2+
  - Model Overview
  - System Design
  - Model Setup
    - Computing Environment
    - Setup and Configuration
    - Scenario Directory
  - Run the Model
  - Data Dictionary
    - Main Properties File
    - Input Files
    - Output Files
    - Report Files

### Appendices

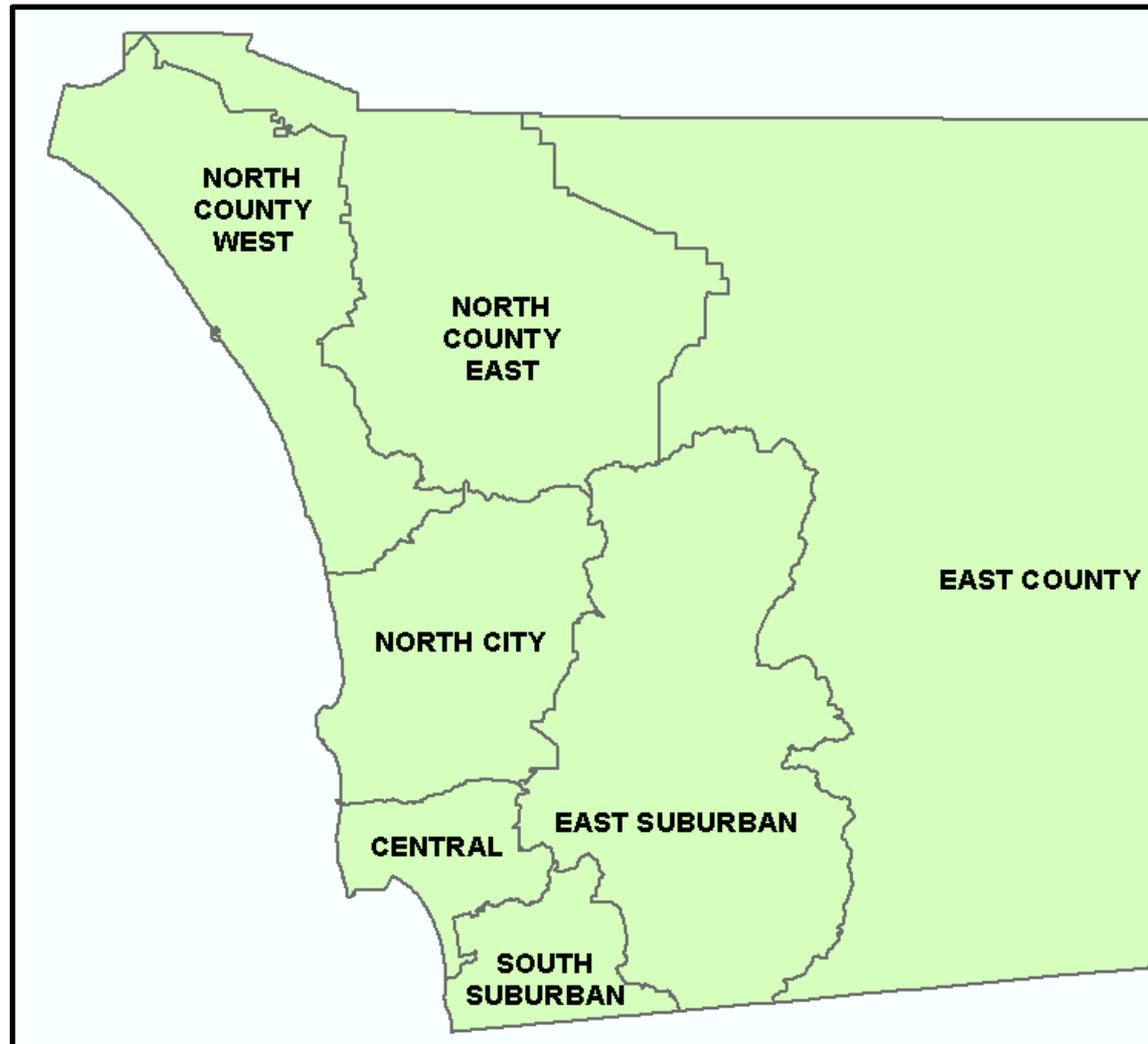
- Build SANDAG Jar File
- SANDAG Server Specifications
- Reports and Documents
- Output Files Data Dictionary

Clone this wiki locally

<https://github.com/SANDAG/A>

# ABM2+ Subarea Enhancements: Trip Data Reports and Threshold Definitions

- Trip data reports
  - Person and Vehicle trips from the 2016 base year
    - Parsed by Land Use Code
    - Parsed by Unit Type
    - Regionwide and parsed by Major Statistical Area (MSA)
- Threshold definitions
  - Population and employment activity thresholds and confidence levels for subarea reporting



# ABM2+ Subarea Enhancements: Application Tests

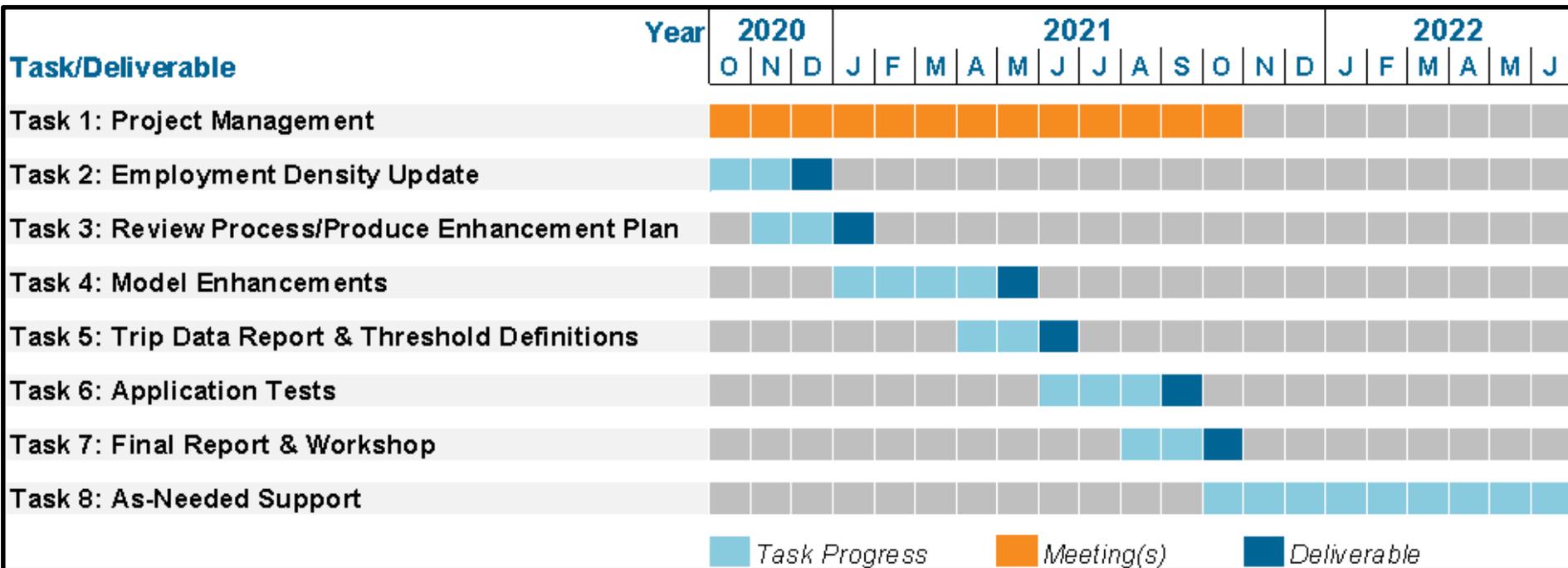
- Develop a testing plan to define application tests
  - Define 12 land use scenarios
- Run 12 Application Tests
  - SANDAG to provide inputs
  - RSG to evaluate model outputs and document
- Update modeling procedures if needed

# ABM2+ Subarea Enhancements: Final Report and Workshop

- Executive summary
- Objectives and limitations of the project
- Methodology of enhanced features and technical approach
- Application test results, including analysis and insights as well as runtime performance
- Conclusions on the strengths and limitations of the enhancements
- User guide appendix, including data dictionaries for input and output files, guidance on applying the enhanced model, and standard reports and thresholds
  
- As needed support

# ABM2+ Subarea Enhancements: Project Schedule

- Aligned with the expected Board of Director's adoption of the 2021 Regional Plan



# Forum Agenda Recap

- Welcome, Introductions and Announcements
- Social Equity Analysis and Regional Planning
- RTP Modeling Retrospective
- Growth Forecast Lifecycle Policy
- ABM2+ Subarea Enhancements

**Next**  
**Transportation**  
**Model Forum:**

**June 9, 2021**



# **TRANSPORTATION MODELING FORUM**

December 9, 2020

***SANDAG***

