



SAN ANTONIO  
RIVER AUTHORITY

# Use of Comprehensive Models for Targeting Green Stormwater Infrastructure Lecture #2



# Agenda

- Background
- WQ Model Development
- Results
- BMP Prioritization Map
- Potential Water Quality Projects



# San Antonio River Authority

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



 [STRATEGIC PLAN 2021-2023](#)

 [GENERAL FACTS SHEET 2023-2024](#)



## ABOUT THE AUTHORITY

### San Antonio River Authority

In 1917, the voters of Texas, recognizing the necessity of developing and conserving the State's water resources and inspired by devastating floods of 1913 and 1914, passed a Constitutional amendment allowing the Legislature to create special purpose political subdivisions of the State to serve regional areas, generally coincidental with river basins and to be generally known as river authorities.

San Antonio River Authority, created in 1937, is one of many such active river authorities in the State of Texas. Its jurisdiction covers 3,658 square miles—all of Bexar, Wilson, Karnes and Goliad Counties.

[CONTACT US](#)



#### VISION

Inspiring Actions for Healthy Creeks and Rivers.



#### MISSION

Committed to Safe, Clean, Enjoyable Creeks and Rivers.



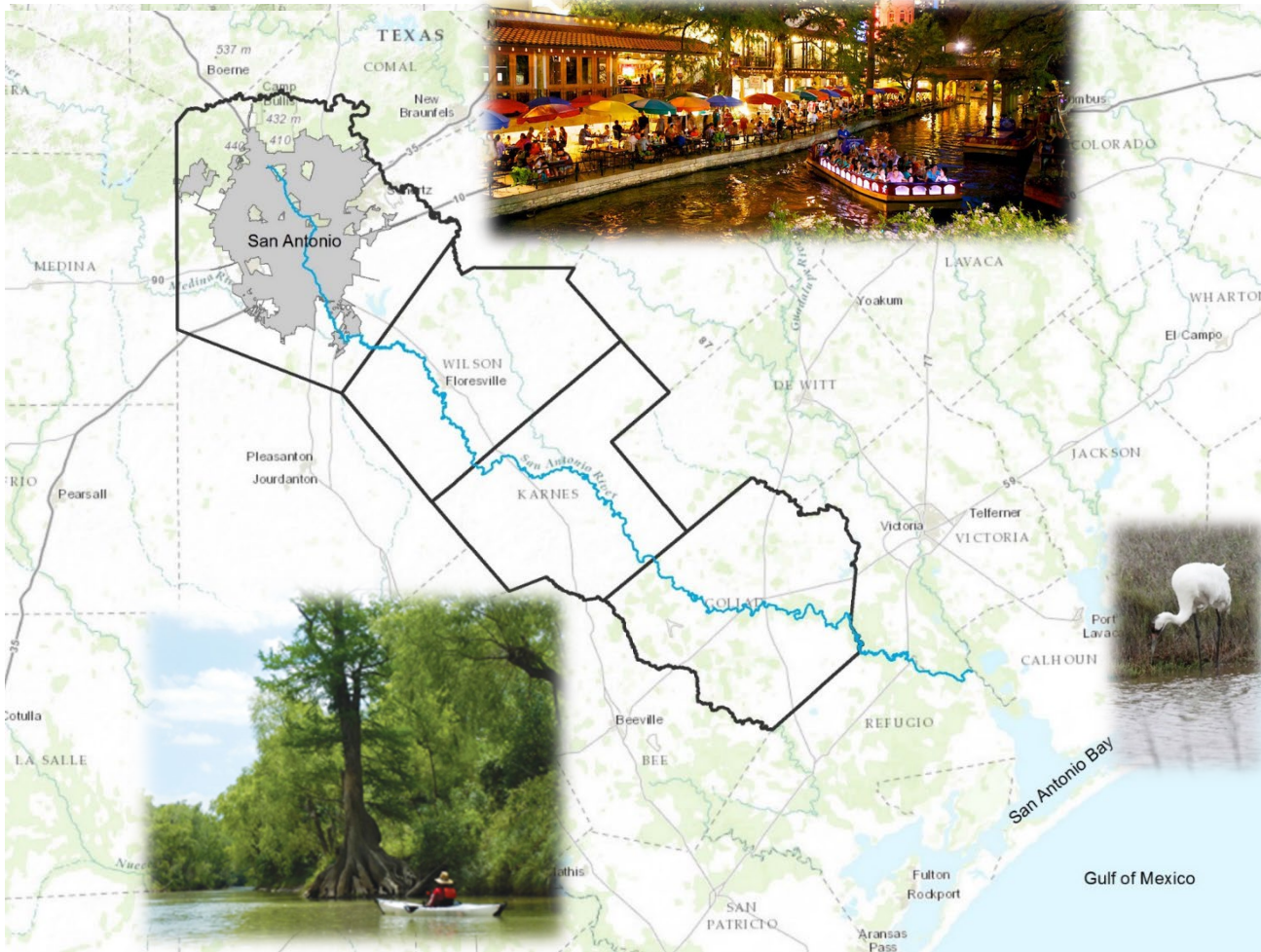
#### JUST CAUSE

To harmonize the needs of people and nature through our stewardship of rivers and land.



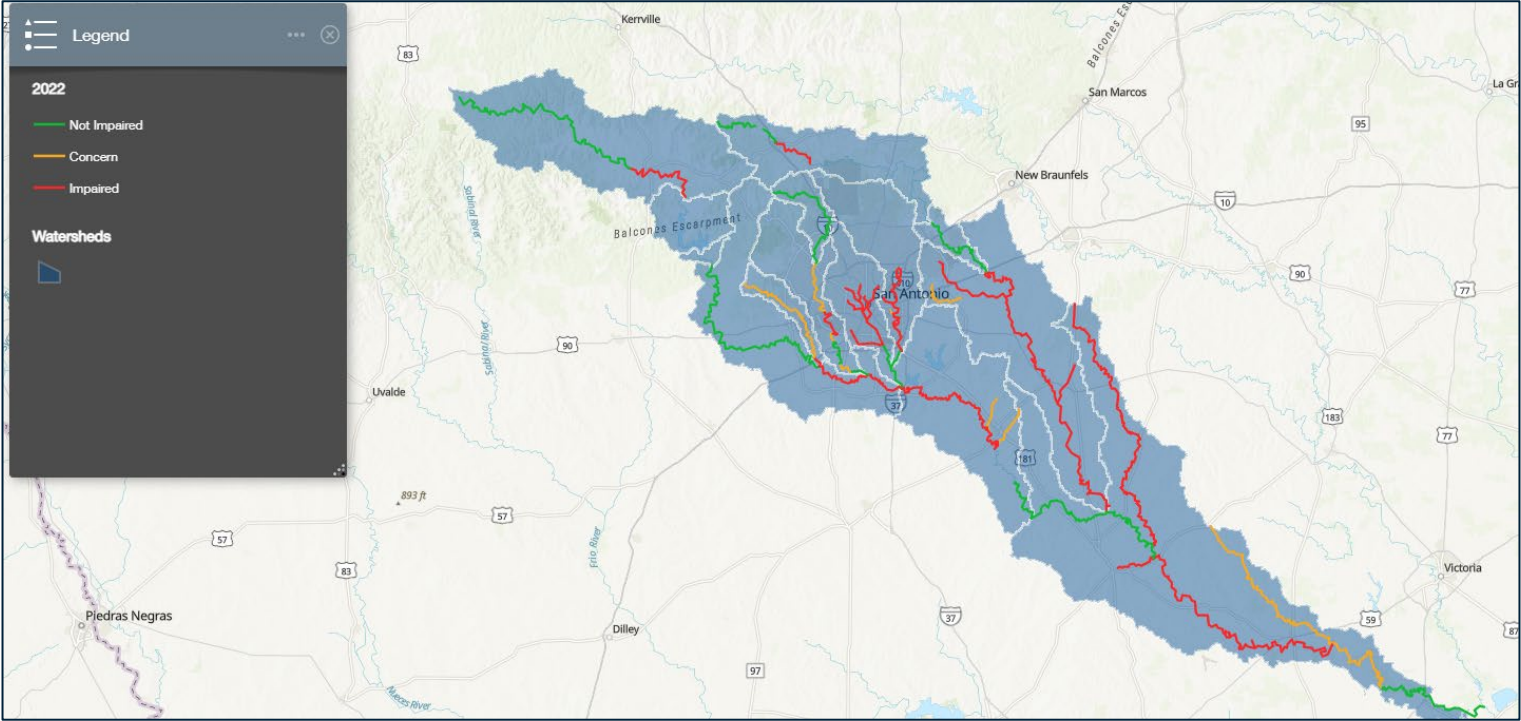






**Committed to Safe, Clean, Enjoyable Creeks and Rivers.**

# Impaired Waterbodies for Primary Contact Recreation



Source: San Antonio River Watershed Water Quality Viewer



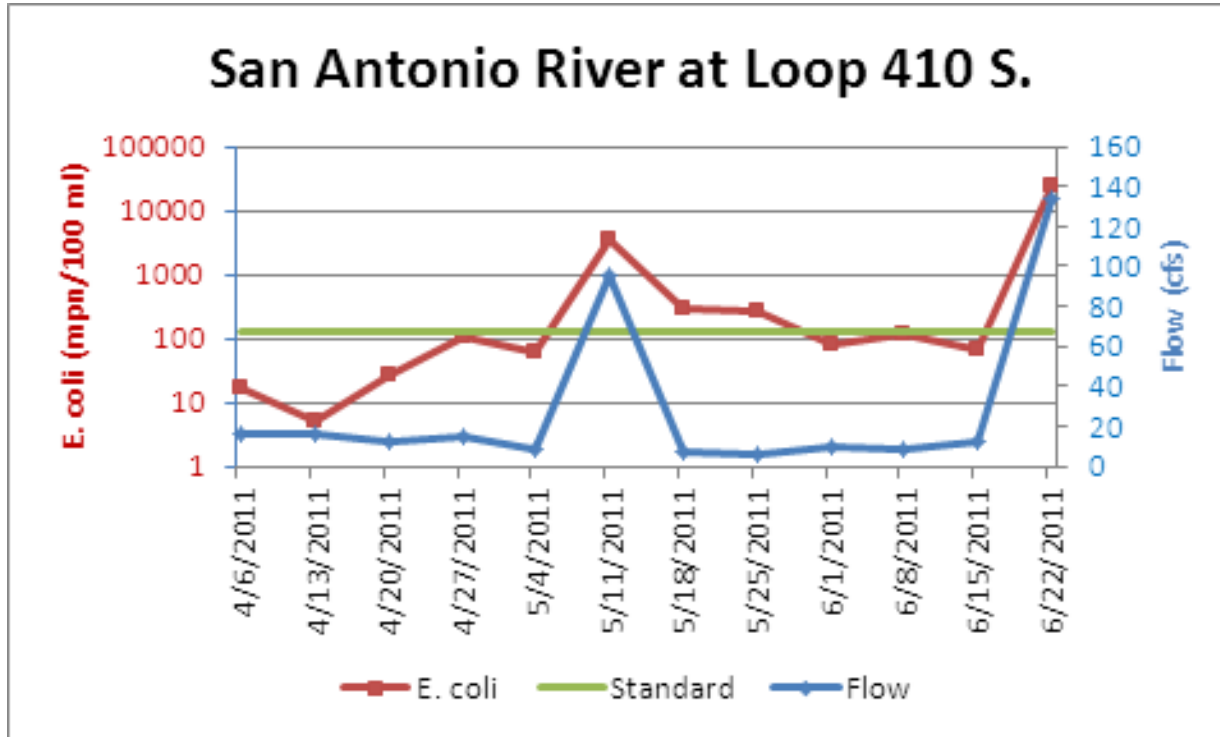
# Contact Recreation E-coli Standards

E-Coli Standards	Concentration
Primary Contact Recreation 1	126 #/dL
Primary Contact Recreation 2	206 #/dL
Secondary Contact Recreation 1	630 #/dL
Secondary Contact Recreation 2	1030 #/dL
Noncontact Recreation	2060 #/dL

\*Source: 2022 Texas Surface Water Quality Standards

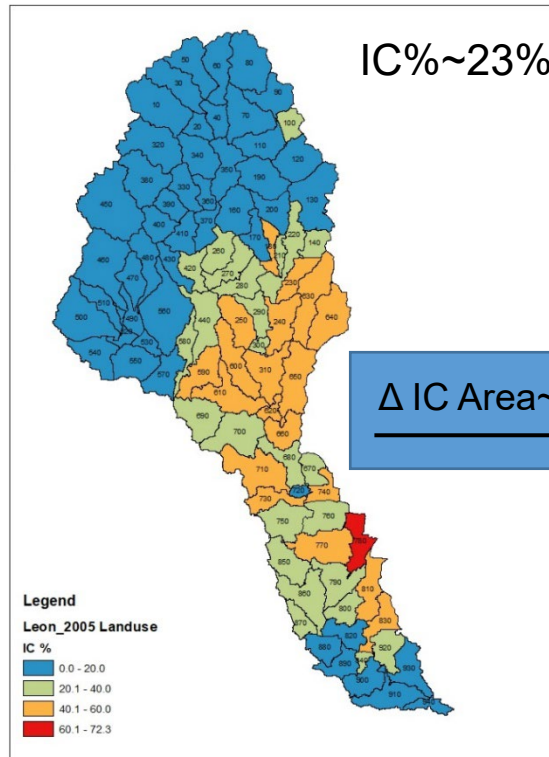


# Impacts of Stormwater Runoff

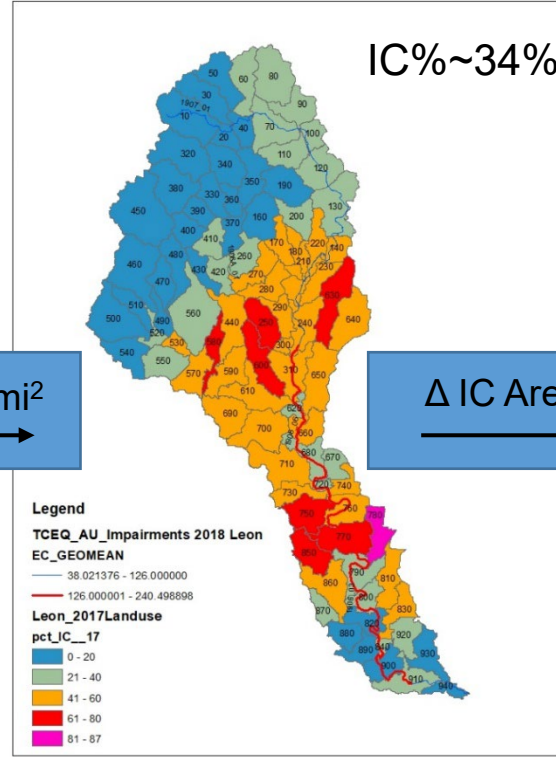




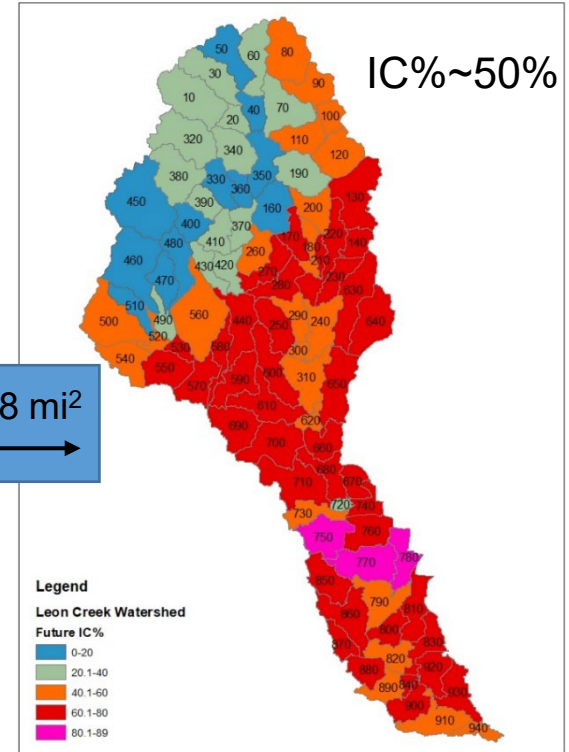
# Leon Creek Watershed



2005 Impervious Cover



2017 Impervious Cover



2040 Impervious Cover

Δ IC Area~26 mi<sup>2</sup>

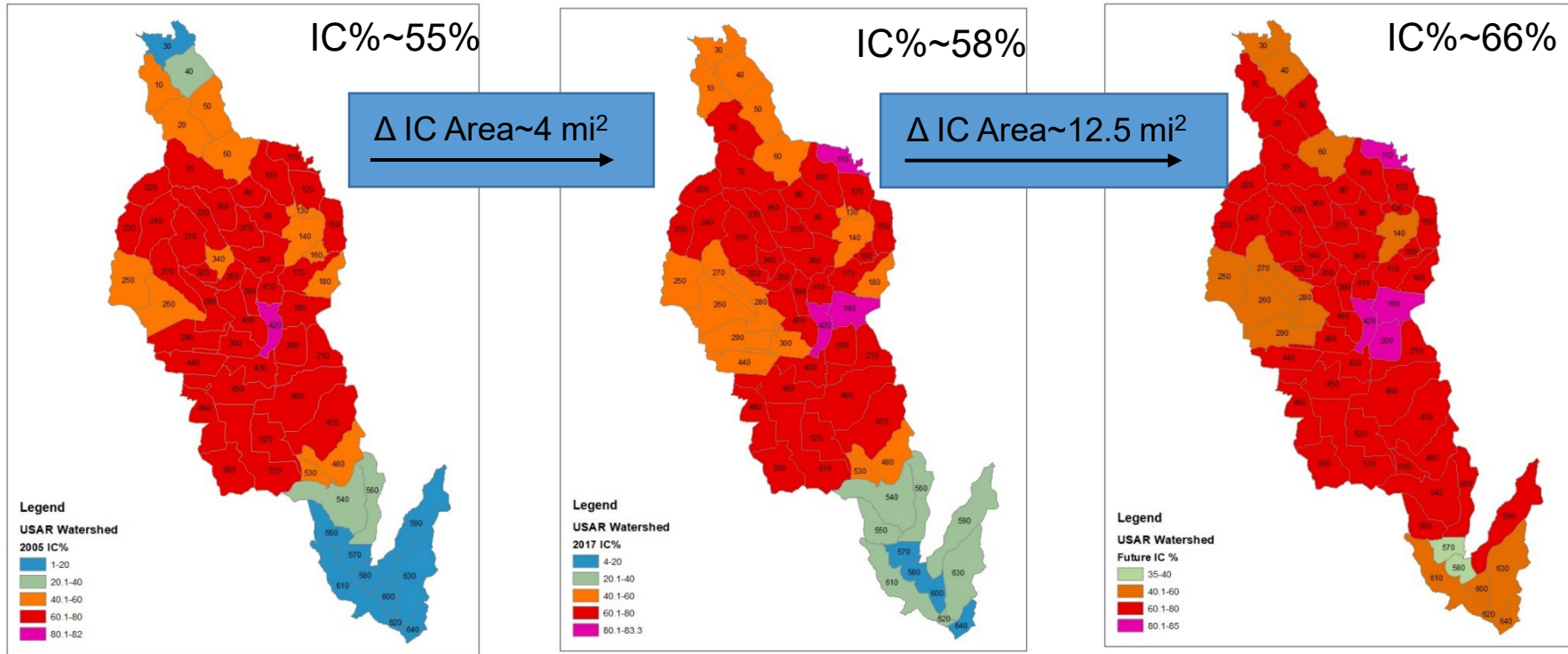
→

Δ IC Area~38 mi<sup>2</sup>

→



# USAR Watershed



2005 Impervious Cover

2017 Impervious Cover

Future Conditions Impervious Cover



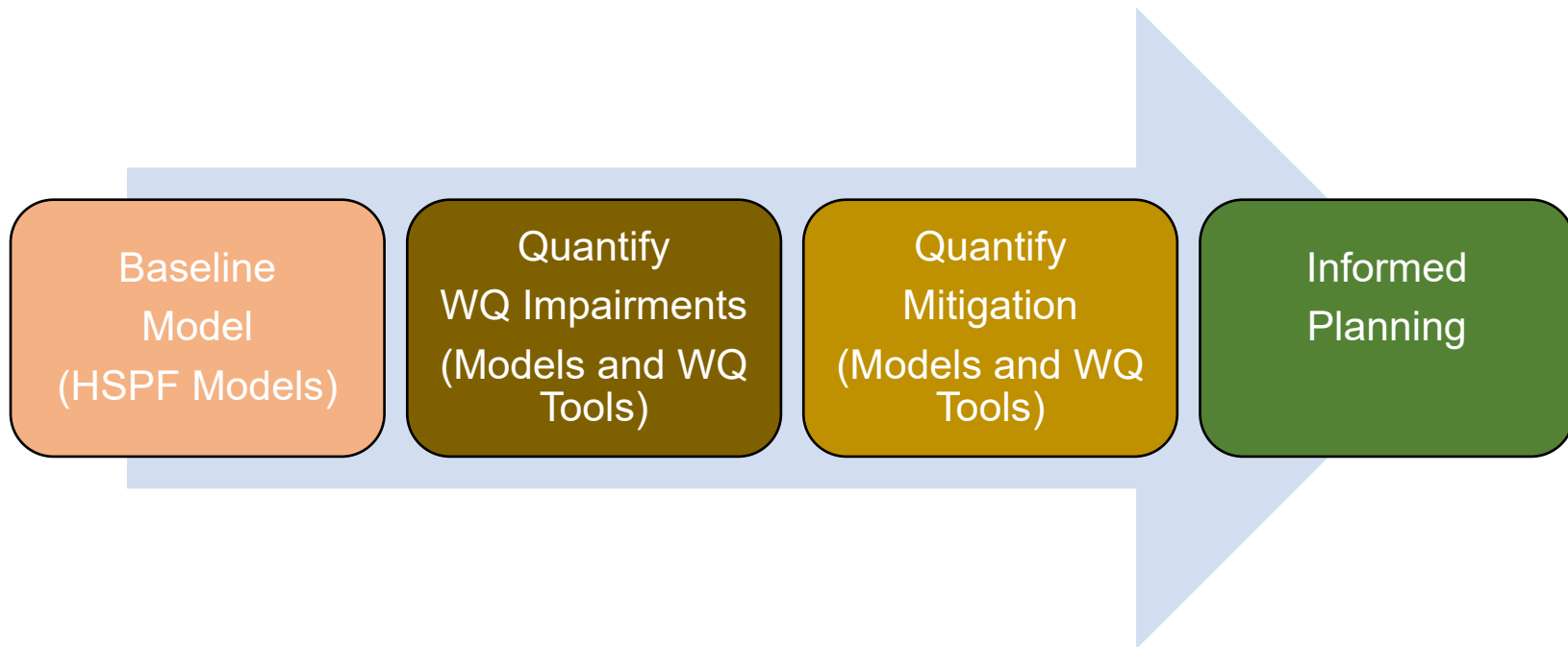
# Water Quality Watershed Master Planning



- **To date: somewhat Qualitative**
  - Best Management
  - To the extent possible/practicable
- **303(d)/ Impairments listing based on monitoring data (CRP)**
  - Quarterly monitoring – temporal gap
  - SWQM station locations – spatial gap
- **BMPs/LIDs planning:**
  - Little modeling; the “right kind” of models don’t exist.
  - Build first, then monitor to see effectiveness



# Our Approach



# SARA Project Team



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Dr. Russell Persyn, P.E.



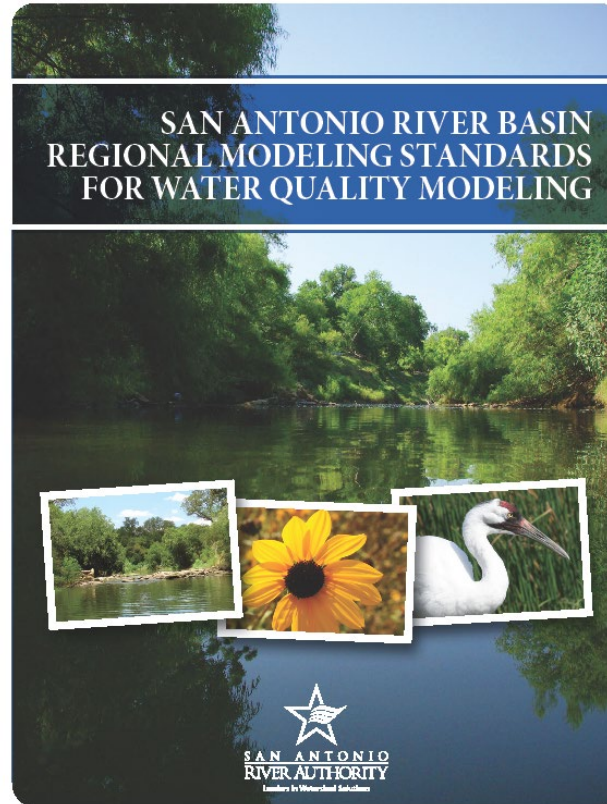


# SARA Suite of WQ Modeling Tools

- **Approach and Tools to allow quantitative WQ planning:**
  - SARA WQ modeling standards
  - WQ model development and calibration
    - HSPF
  - Timeseries Utility Tool
  - SARA Landuse Adjustment Tool
  - Identify WQ Damage Centers
  - Load Reduction Tool
  - SARA Enhanced BMP Tool
    - BMP Database
    - CEV Tool
  - BMP Compiler
  - BMP Processor
  - BMP Reporter
  - EPDRiv1 Enhancements
  - Model Simulation Manager
  - BMP Equivalent Tool



# SARA WQ Modeling Standards



# Data Needed for WQ Modeling

- DFIRM
  - Subbasin delineation
  - Stream shapefile
  - HEC-HMS
  - HEC-RAS
- Topography
  - DEM
  - Contours
- Channel XS
- Dams/reservoirs
- TUNNELS!!!
- Aerial images
- SSURGO soil data
- Landuse & IC%

- Met data (NOAA)
- Rainfall
  - NOAA
  - EAA (gage, NEXRAD)
  - SARA
  - USGS
- Diversion
- USGS flow data
- Groundwater recharge & spring flow
- Latest 303(d)
- CRP Screening levels

- Water Quality
  - SWQM
  - USGS
- Wastewater data
- SSO
- OSSF (estimates)
- QUAL-TX models
- Atmospheric deposition
- Rural watershed data
  - Agricultural data
  - SELECT or EC loading estimates



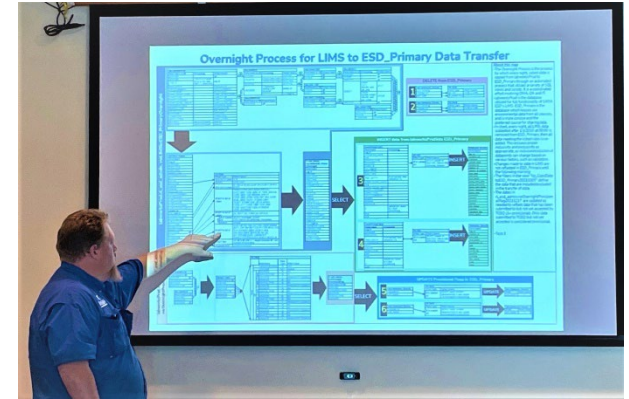
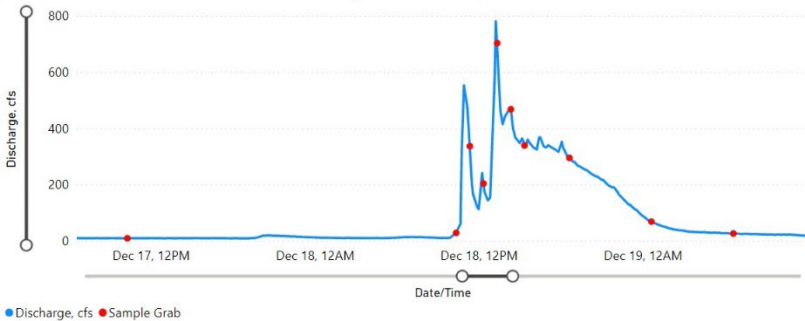
# Water Quality Data

## Environmental Services Department Superstars!



San Antonio River at Mitchell


Discharge, cfs, with Sample Grabs







**Legend**


**Edwards Aquifer**


 <all other values>

**TYPE**


 Edwards Aquifer Contributing Zone

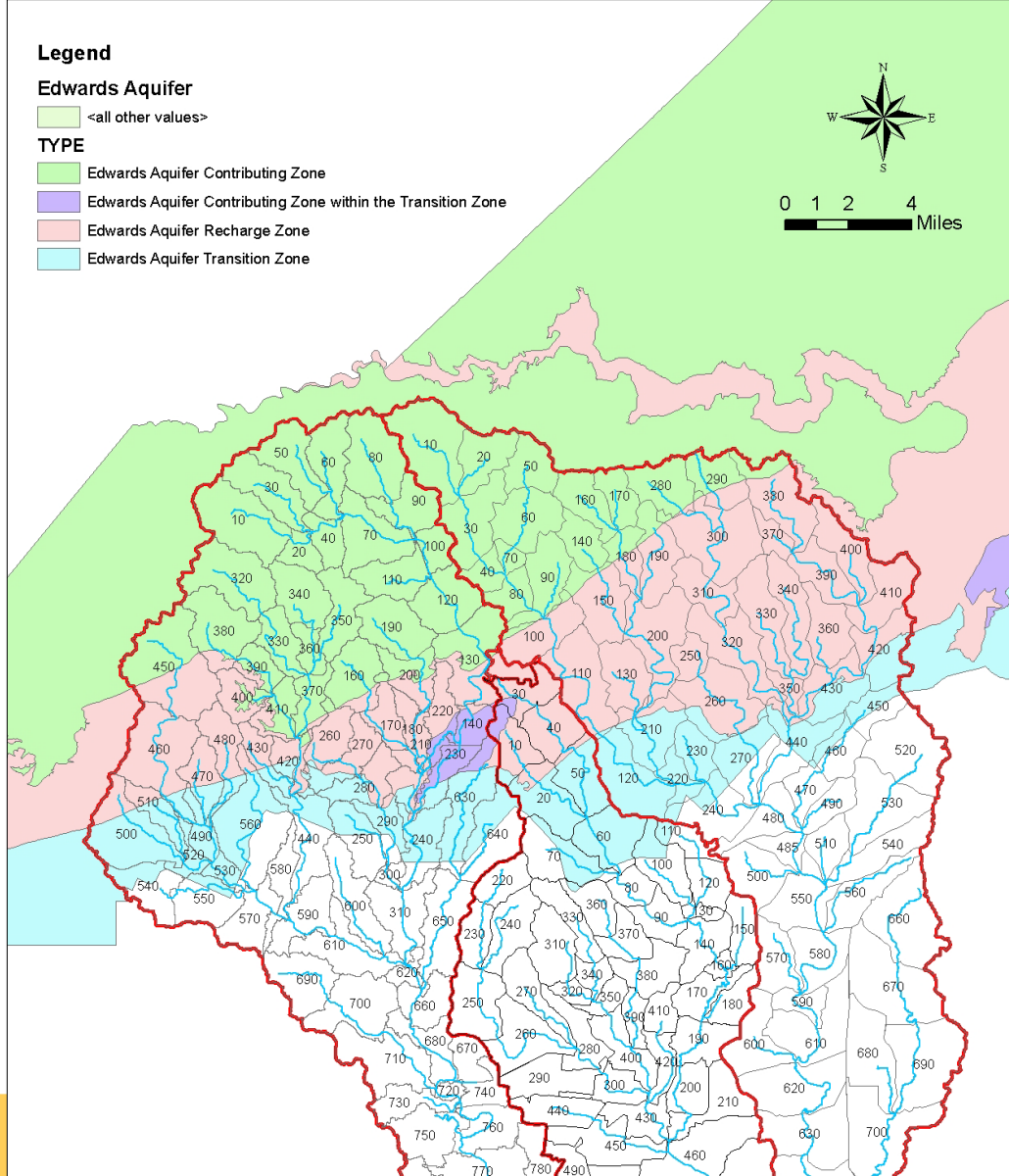
 Edwards Aquifer Contributing Zone within the Transition Zone

 Edwards Aquifer Recharge Zone

 Edwards Aquifer Transition Zone



0 1 2 4  
 Miles



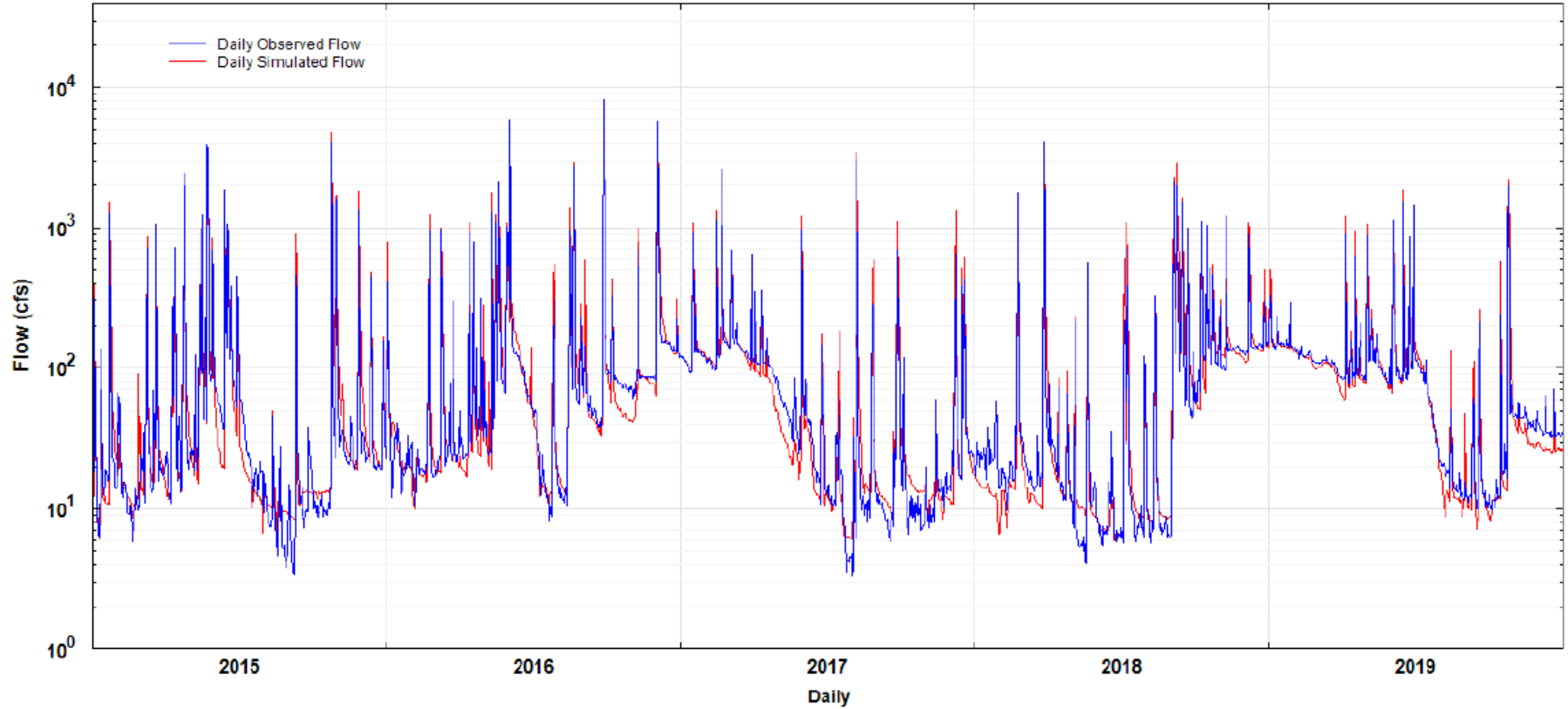
# SARB Modeling Challenge

## Edwards Aquifer Recharge Zone

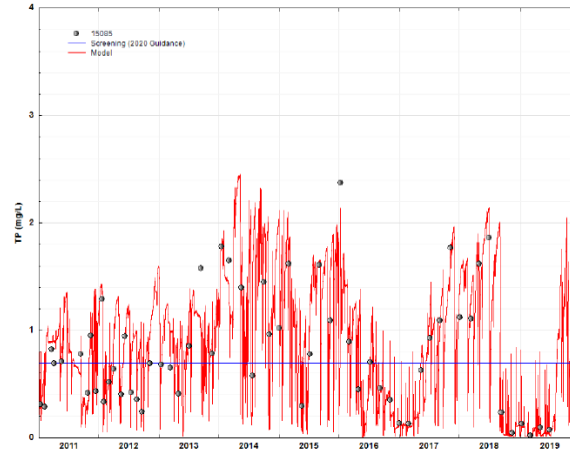
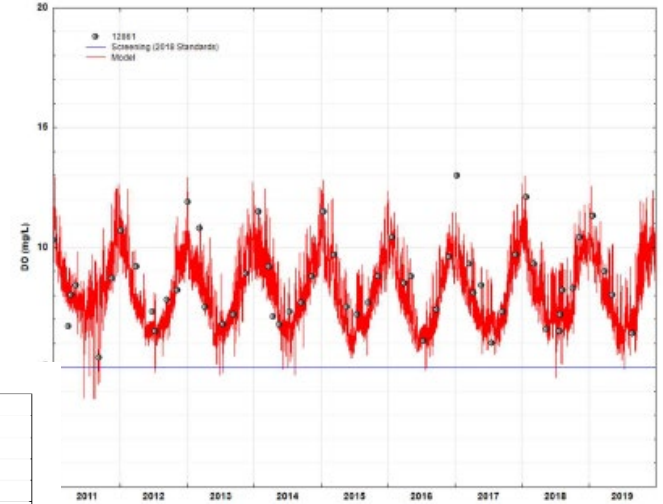
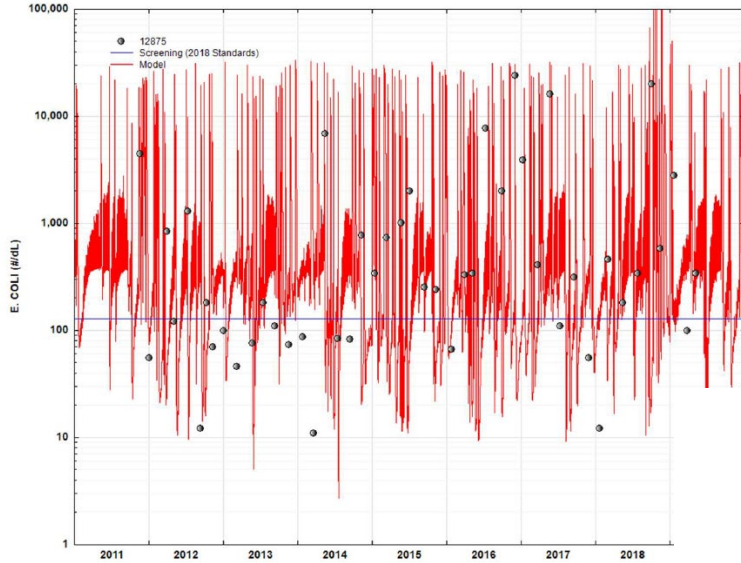




# Comparison of Simulated and Observed Flows for San Antonio River @ Loop 410

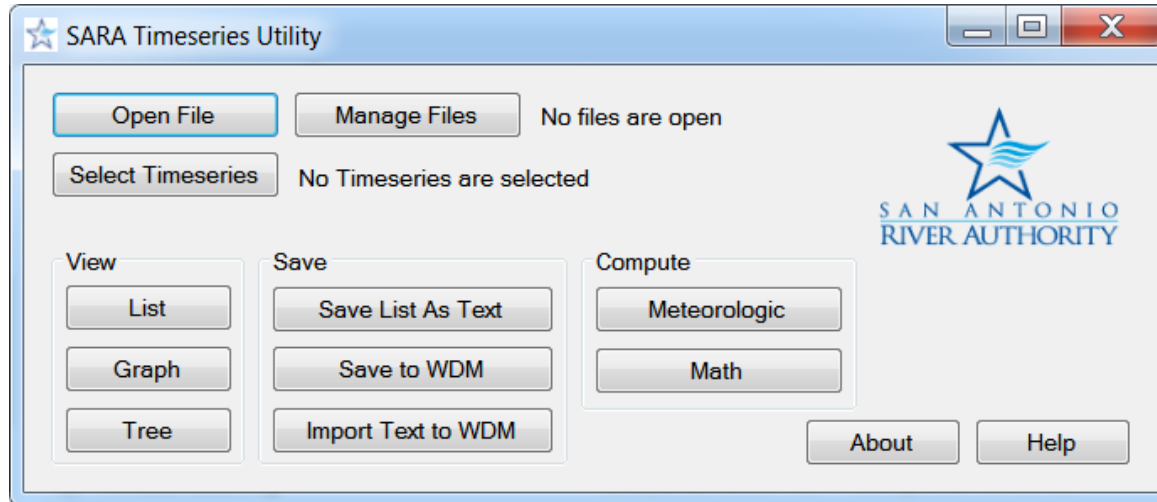


# Water Quality Comparisons



# SARA Timeseries Utility Tool

- Enhanced efficiency in reading large timeseries records (e.g. HSPF binary output).
- Developed, tested, and released to public through EPA BASINS user community on 10/24/2013.
- Replaced WDMUtil
- Added GSSHA Converter in 2014



# SARA Load Reduction Tool

**Calibrated HSPF model UCI**



## **User Specification**

- Target Subbasins/Landuses for BMP
- Target constituents
  - Concentration threshold
  - Reduction Tolerance
  - Maximum removal
- Target point source



## **Automatic Load Reduction**

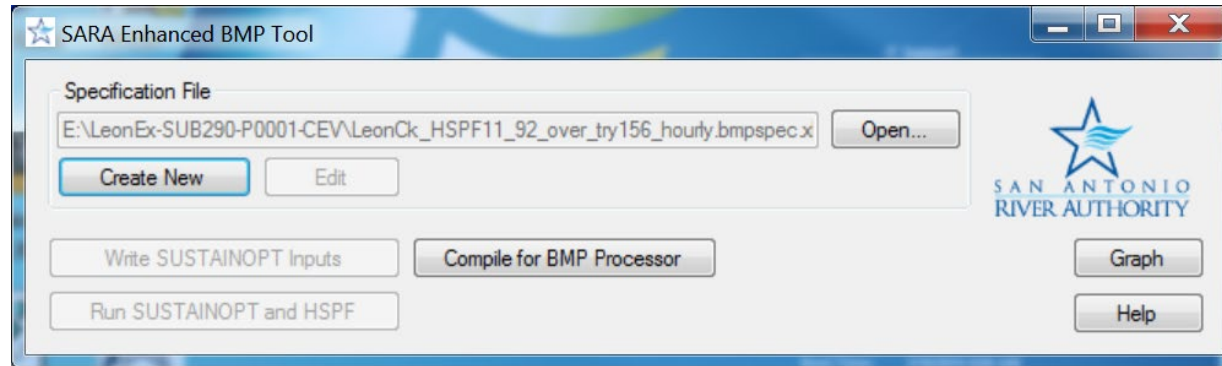
- From upstream to downstream subbasins
- Generate detailed report

- Uses load reduction factors in HSPF BMP Module.
- Automates tedious process for large watershed models.
- Compared to manual processes.
- Developed, tested, and released to public through EPA BASINS user community on 5/09/2014.



# SARA Enhanced BMP Tool

- Identify LID/BMPs to achieve needed load reductions.
- Use LRT results or any calibrated HSPF models.
- Combines robust land surface representation from HSPF with EPA SUSTAIN's BMP capabilities.
- Avoids ArcGIS version issue inherent in SUSTAIN by using non-GIS component (SUSTAINOPT)





# SARA BMP Tool Database

SustainBMPParameters\_021015TextOnly - Excel

FILE HOME INSERT PAGE LAYOUT FORMULAS DATA REVIEW VIEW Juhn-Yuan Su

Clipboard Font Alignment Number Styles Cells Editing

F26 : X ✓ fx 5

	A	B	C	D	E	F	G	H
	cBMP SITE	BMP NAME	BMP TYPE	DArea	NUMUNIT	DDAREA	PreLUType	AquiferID
2								
3	1	DryPond_Ave	DRYPOND	-99	-99	10	1	0
4	2	ExtendedDetention_Small	DRYPOND	-99	-99	10	1	0
5	3	ExtendedDetention_Ave	DRYPOND	-99	-99	42.5	1	0
6	4	ExtendedDetention_Large	DRYPOND	-99	-99	75	1	0
7	5	StreetSweep_Arterial_4X	DRYPOND	-99	-99	1	1	0
8	6	StreetSweep_Arterial_4X_New	DRYPOND	-99	-99	1	1	0
9	7	StreetSweep_Arterial_8X	DRYPOND	-99	-99	1	1	0
10	8	StreetSweep_Arterial_8X_New	DRYPOND	-99	-99	1	1	0
11	9	StreetSweep_Resid_2X	DRYPOND	-99	-99	1	1	0
12	10	StreetSweep_Resid_2X_New	DRYPOND	-99	-99	1	1	0
13	11	StreetSweep_Resid_4X	DRYPOND	-99	-99	1	1	0
14	12	StreetSweep_Resid_4X_New	DRYPOND	-99	-99	1	1	0
15	13	StreetSweep_CBD_363	DRYPOND	-99	-99	1	1	0
16	14	StreetSweep_CBD_363_New	DRYPOND	-99	-99	1	1	0
17	15	StreetSweep_CBD_182	DRYPOND	-99	-99	1	1	0
18	16	StreetSweep_CBD_182_New	DRYPOND	-99	-99	1	1	0
19	20	RainBarrel_Ave	RAINBARREL	-99	-99	0.01377	1	0
20	30	BioRetentionBasin_Ave	BIORETENTION	-99	-99	2.5	1	0
21	31	BioRetentionBasin_Small	BIORETENTION	-99	-99	0.03061	1	0
22	32	BioRetentionBasin_Large	BIORETENTION	-99	-99	5	1	0
23	33	PlanterBox_Ave	BIORETENTION	-99	-99	0.35	1	0
24	40	WetPond	WETPOND	-99	-99	25	1	0
25	41	StormWaterWetland	WETPOND	-99	-99	10	1	0
26	45	WetPond	WETPOND	-99	-99	10	1	0

BMP\_LanduseMatrix | BMP\_Trains | 715\_BMPDef | 725\_ClsABMPParm | 730\_CisternControl | 735\_ClsBBMPParm ...

READY 120%

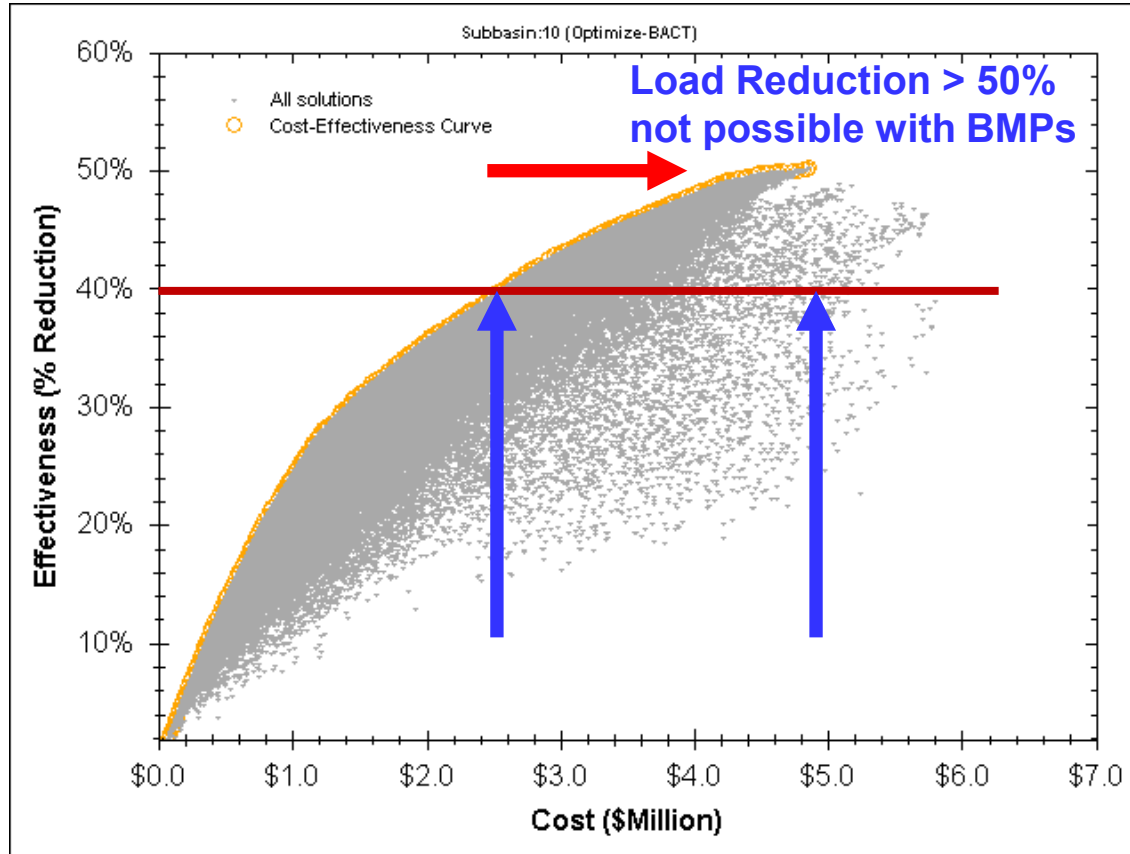


# SARA BMP Tool Database

LID/BMPs	Fecal Coliform		E. coli		Pathogens		Total P	
	% Effectiveness		% Effectiveness		% Effectiveness		% Effectiveness	
	From	To	From	To	From	To	From	To
<b>STRUCTURAL</b>								
Bioretention Basin	70	70	70	70			50	50
Bioswale	-187	84			-100	-25	-100	89
Catch Basin Insert (see Note 2)	50	50					5	10
Dry Pond					30	30	0	0
Extended Detention Basin	0	0			70	70	20	94
Green Roof	99.3	99.3					-839	-839
Infiltration Basin	75	98			65	100	50	80
Infiltration Trench	96	96			65	100	15	45
Media Filter	47	47			30	30	30	30
Porous Pavement/Permeable Pavement	71	71					20	78
Rain Barrel/Cistern	100	100	100	100	100	100	100	100
Sand Filter	-70	54			30	30	27	80
Stormwater Wetland	85	85			55	87	48	48
Vegetative Filter Strip/Buffer Strip	0	0			30	30	-36	-36
Vegetative Swale	0	0			30	30	15	45
Vortex Separator	50	50					15	20
Wet Pond	64	99			30	30	43	43
Wet Vault					30	30	30	30
<b>NON-STRUCTURAL</b>								
Pet Waste Management (see Note 3)	2	6					5	5
Storm Sewer Maintenance								
Street Sweeping Art 4X	29.2	29.2	29.2	29.2	29.2	29.2	29.2	29.2
Street Sweeping Art 8X	58.4	58.4	58.4	58.4	58.4	58.4	58.4	58.4
Street Sweeping Res 2X	36.8	36.8	36.8	36.8	36.8	36.8	36.8	36.8
Street Sweeping Res 4X	73.6	73.6	73.6	73.6	73.6	73.6	73.6	73.6
Street Sweeping CBD 363	98	98	98	98	98	98	98	98
Street Sweeping CBD 182	49.1	49.1	49.1	49.1	49.1	49.1	49.1	49.1



# Cost Saving with Optimization



**Target: 40% Load Reduction**

**Optimal BMPs: \$2.5 MM**

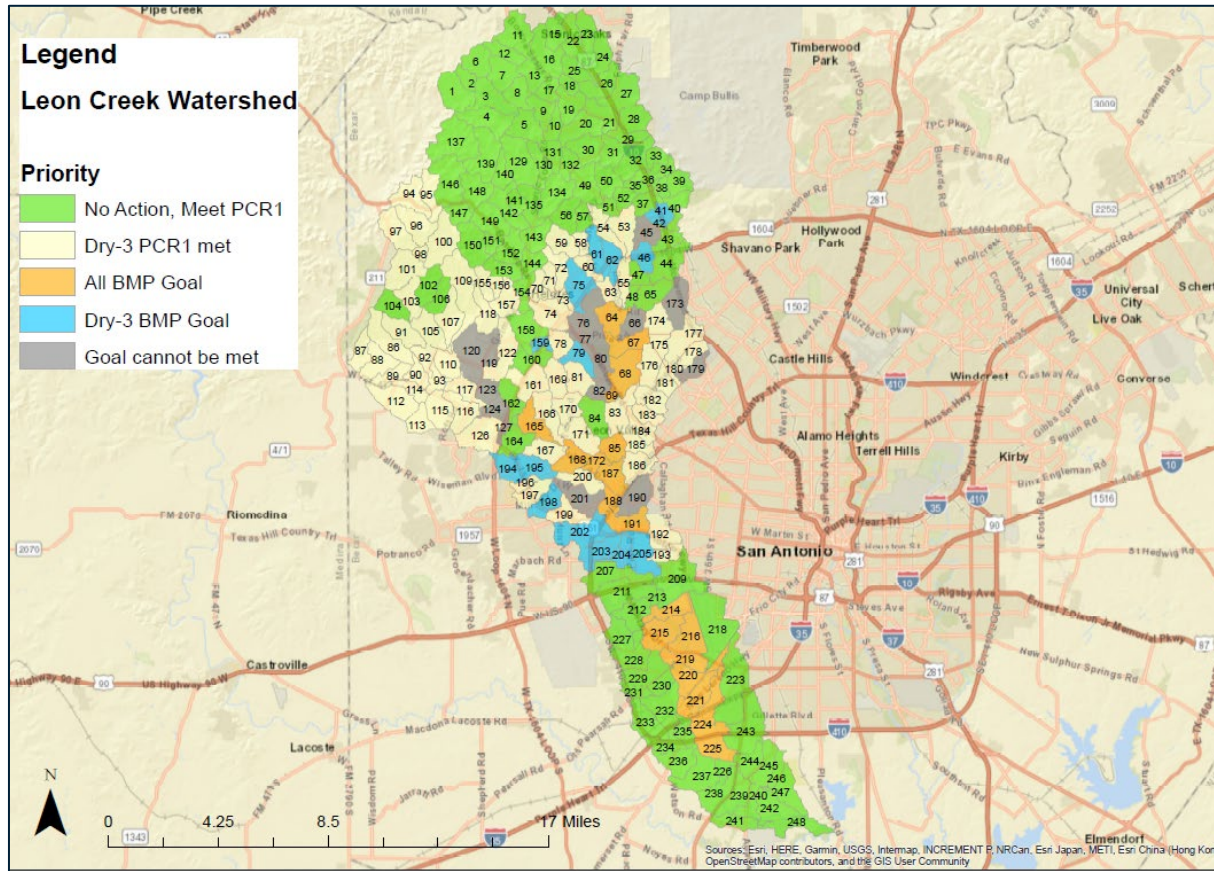
**Non-Optimal BMP Combinations: can be > \$5MM**

**Cost Saving: can be \$2.5 MM or 100%**

**Avoid building first then discover it won't work or too costly**



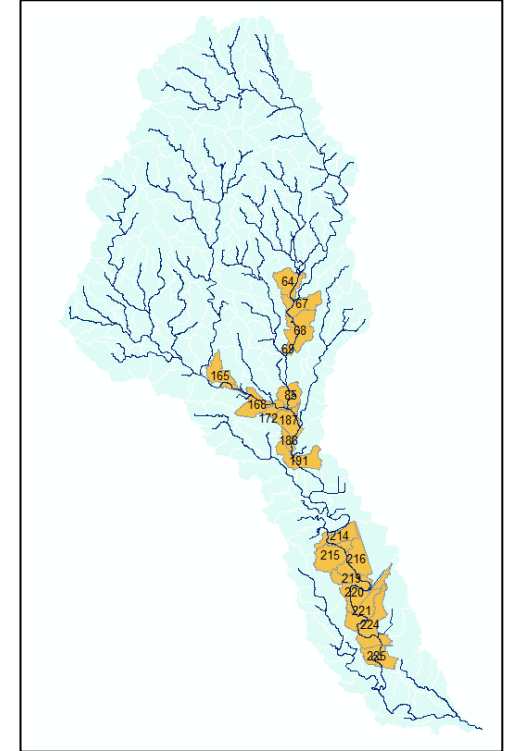
# BMP Implementation – Leon Creek



# BMP Implementation Category

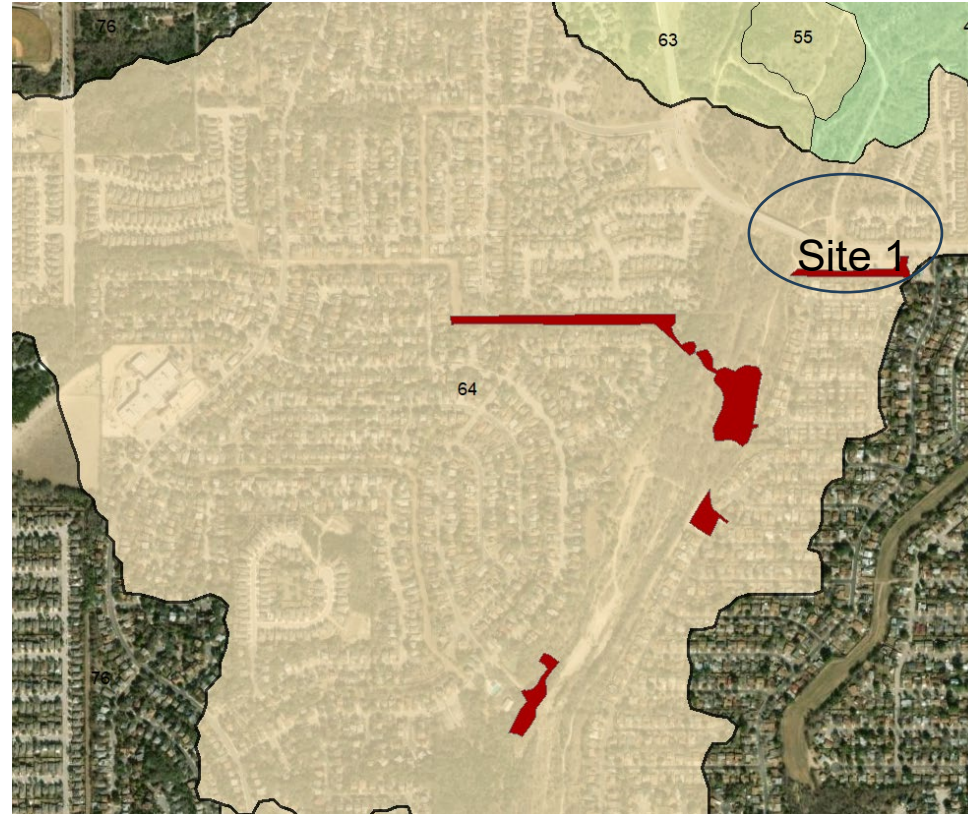
- Subbasins account for 8.8% of the Watershed

Subbasin ID	Edwards Aquifer Regulatory Zone	Area (acres)	%IC Existing	% IC Difference	Required BMP Footprint (acres)	Required Footprint as % Subbasin area	Regional Center
64	Yes	733.7	51.96	4.82	11.0	1.5%	Northwest
67	Yes	700.5	48.08	2.51	17.4	2.5%	Northwest
68	Yes	1049.6	46.15	1.4	34.7	3.3%	Northwest
69		134.5	45.79	11.79	3.6	2.7%	West Northwest
85		566.0	55.58	4.78	17.0	3.0%	West Northwest
165		712.9	60.2	4.4	24.6	3.4%	West Northwest
168		685.9	55.8	9.7	24.9	3.6%	Far West
172		282.4	54.5	3.6	7.6	2.6%	West Northwest
187		698.8	43.72	12.69	19.2	2.7%	West Northwest
188		235.2	48.04	20.7	7.9	3.4%	Far West
191		855.1	45.19	32.67	22.5	2.6%	Far West
214		637.2	40.82	35.26	4.6	0.7%	Port SA
215		1003.1	57.54	23.66	22.8	2.3%	Port SA
216		1015.5	72.71	16.88	30.5	3.0%	Port SA
219		590.9	25.96	19.23	11.7	2.0%	Port SA/Southwest
220		805.9	21.57	11.1	7.7	1.0%	Southwest
221		820.3	38.24	36.91	20.7	2.5%	Southwest
224		1152.8	19.1	44.2	8.2	0.7%	Southwest
225		701.5	15	48.7	0.8	0.1%	Far Southwest





# Subbasin 64





# Subbasin 64 - Site 1



# Example of Application of WQ Modeling and Analysis



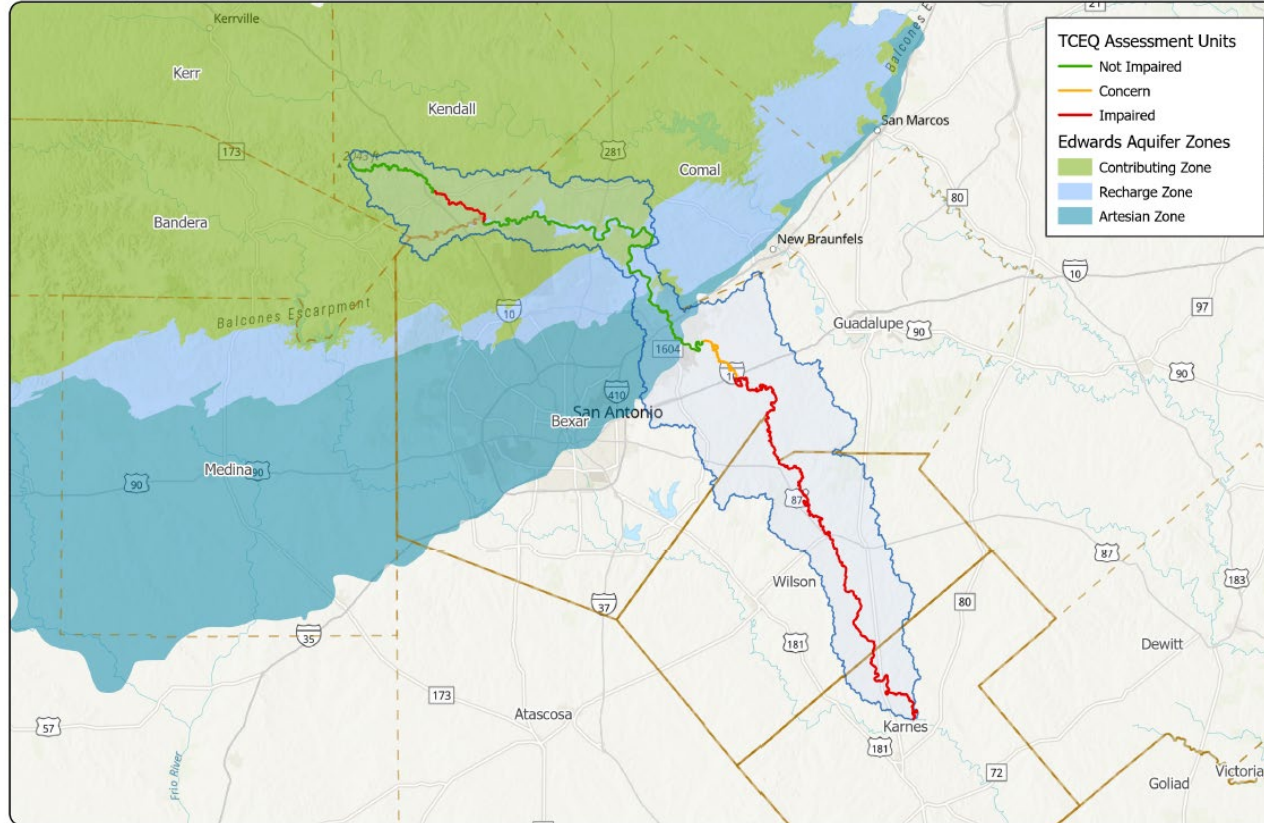
LID Features:  
Multiple biorientation cells (4410 ft<sup>2</sup>)  
Permeable pavement (1410 ft<sup>2</sup>)

Broadway Street Corridor (2017-2022 Bond Project)





# On-going Model Updates (Cibolo Creek Watershed)



# Project Exposure

- Conferences
- Newsletters
- Awards
  - 2016 Gold Medal Award TX ACEC
  - 2016 National Recognition Award ACEC
  - 2021 WEF Project Excellence Award



# SARA WQ Modeling Tools Download Website

<https://www.sariverauthority.org/services/sustainability/low-impact-development/>



LID TECHNICAL DESIGN  
MANUAL



NATURAL CHANNEL  
DESIGN PROTOCOL  
MANUAL



LID TRAINING PROGRAM



WATER QUALITY  
MODELING TOOLS



THREATS TO A  
WATERSHED

## Water Quality Modeling Tools

A key component to holistic watershed master planning and stormwater management is the identification and implementation of best management practices (BMPs) and low-impact development (LID) strategies to address urban runoff pollution.

Until now, the selection of BMP and LID strategies has been limited to qualitative planning, hindering the planners' ability to discern effective BMP/ LID practices without long-term monitoring. Consequently, the San Antonio River Authority (River Authority) lead the development of several innovative water quality modeling tools to allow quantitative water quality master planning and BMP/LID prioritization for three major watersheds in the San Antonio River Basin.

The River Authority project earned a Gold Medal in the 2016 American Council of Engineering Companies (ACEC) Texas Engineering Excellence Awards, and an ACEC National Recognition Award.

### RIVER AUTHORITY WATER QUALITY MODELING STANDARDS



In 2013, the River Authority authored the Water Quality Modeling Standards document, which details



*Questions?*

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