



**San Diego State University**  
*Field Stations Program*  
*Environmental Sciences Program*

**A Regional Resource for Environmental  
Information, Research, and Education**

**Est. 1962**

**Matt Rahn, Ph.D., J.D.**

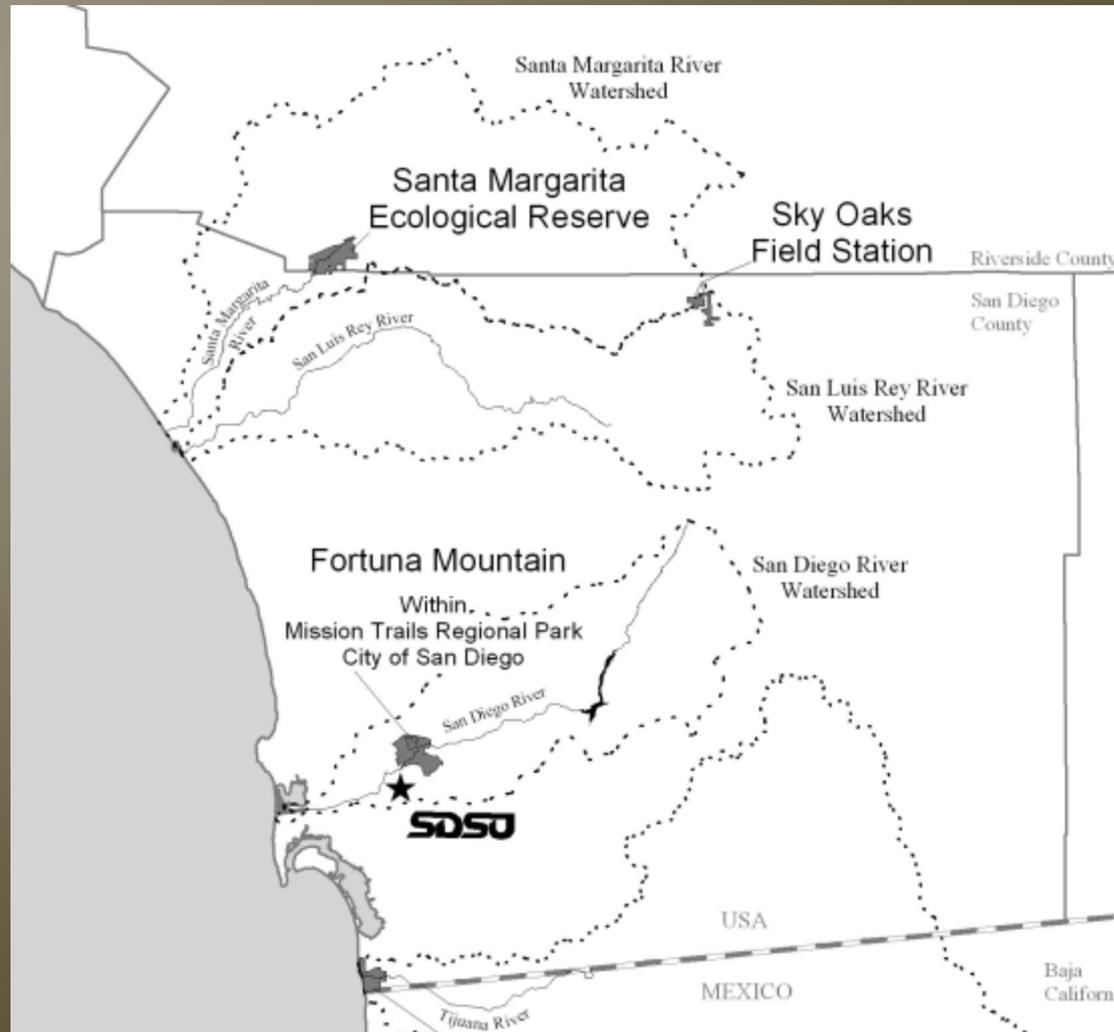


# Mission

- To support research and education on the ecosystems of Southern California by collecting, sharing, and understanding environmental data.

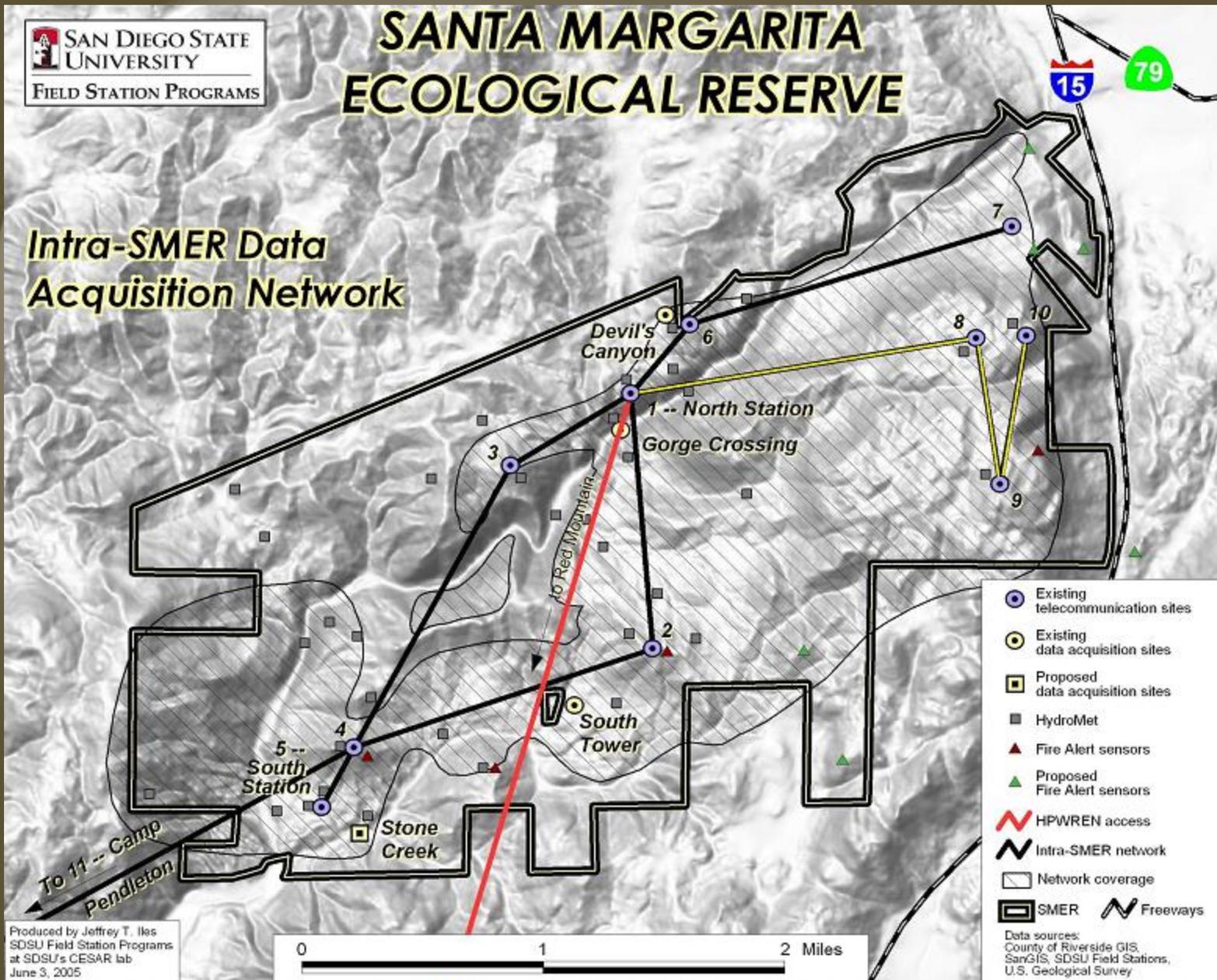


# 4 Research Stations + 1 Network Office



# SANTA MARGARITA ECOLOGICAL RESERVE

## Intra-SMER Data Acquisition Network



Produced by Jeffrey T. Iles  
SDSU Field Station Programs  
at SDSU's CESAR lab  
June 3, 2005

0 1 2 Miles

# Early-Warning Environmental Network

Importance of Environmental Data



Wildfire



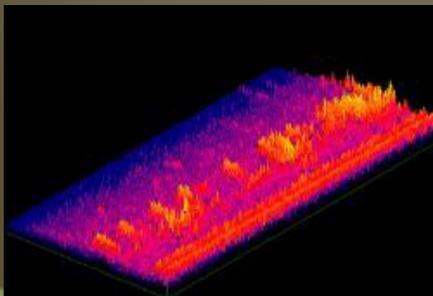
Visual Sensing & Analysis



Earth Quakes



Flooding & Water Quality

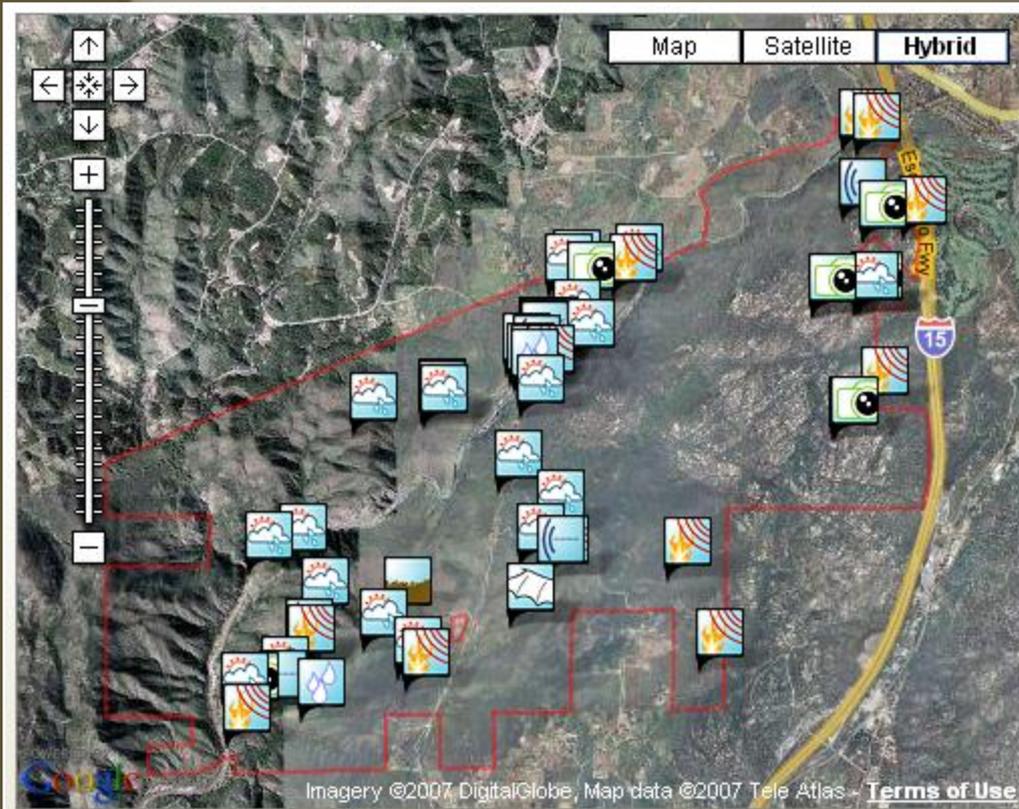


Sound Pollution

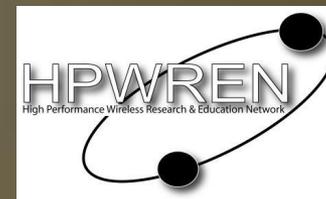
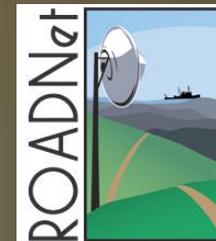


Air Pollution, Santa Ana Winds

# High-tech Environmental Sensor Network at San Diego State University Santa Margarita Ecological Reserve



- Show/Hide Observatories:**
- Acoustic
  - Air Quality
  - Anabat
  - Fire Sensor
  - Network
  - Seismic
  - Soil
  - Water Quality
  - Weather
  - Web Camera
  - All Observatories



wireless bubble over 90% of 4500 acre reserve  
238 environmental sensors at 66 observatories



# Our sensor network serves researchers ...

**Real-time Environmental Monitoring and Observation Technology**  
**SMER Bug Trail Weather Observatory**

About REMOT:

- [Intro to REMOT](#)
- [Network Infrastructure](#)
- [Technology Transfer](#)
- [Future Directions](#)

About This Observatory:

- [Data](#)
- [Description](#)
- [Lessons Learned](#)
- [Equipment Used](#)
- [Operated by Scripps](#)

Observatories at [SMER](#):

- [Avocado Grove](#)
- [Bug Trail](#)
- [Dead Coyote](#)
- [Devils Canyon](#)
- [East Gorge](#)
- [Gorge Crossing](#)
- [Gorge Overlook](#)
- [Lost Creek](#)

**Latest Data**  
Data time\*: 2007-04-10 15:55:00

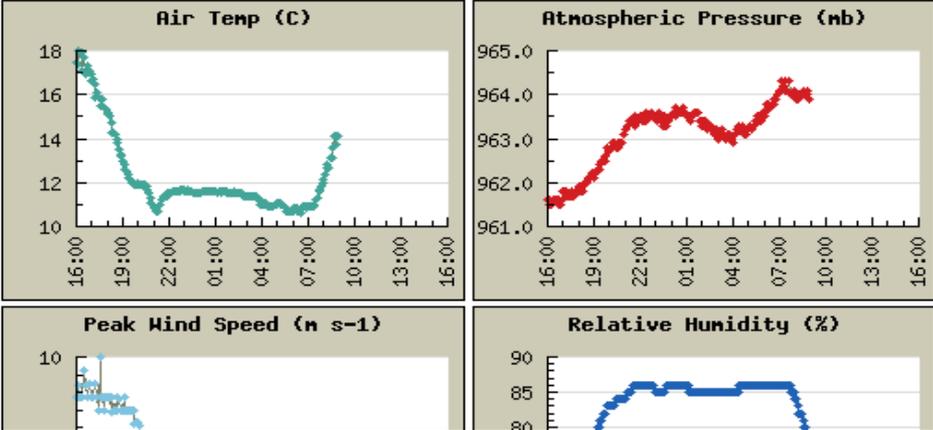
Air Temp	14.1 C
Atmospheric Pressure	963.9 mb
Peak Wind Speed	1.7 m s <sup>-1</sup>
Relative Humidity	78.0 %
Solar Radiation	536.3 W m <sup>-2</sup>
Total Precipitation	6.0 inches
Wind Direction	286 degrees
Wind Speed	0.7 m s <sup>-1</sup>

**Nearest Web Camera Observatory**  
[Gorge Camera Observatory](#) has 3 cameras:



[Gorge Axis1](#)      [Gorge Axis2](#)      [Go](#)

**Latest 24 Hours Data**  
2007-04-09 16:00:00 to 2007-04-10 16:00:00



**Air Temp (C)**

Time	Air Temp (C)
16:00	17.5
19:00	12.0
22:00	11.5
01:00	11.5
04:00	11.0
07:00	11.0
10:00	14.0

**Atmospheric Pressure (mb)**

Time	Atmospheric Pressure (mb)
16:00	961.5
19:00	962.5
22:00	963.5
01:00	963.5
04:00	963.0
07:00	964.5
10:00	964.0

**Peak Wind Speed (m s<sup>-1</sup>)**

Time	Peak Wind Speed (m s <sup>-1</sup> )
16:00	10.0
19:00	5.0
22:00	2.0
01:00	2.0
04:00	2.0
07:00	2.0
10:00	2.0

**Relative Humidity (%)**

Time	Relative Humidity (%)
16:00	80.0
19:00	85.0
22:00	85.0
01:00	85.0
04:00	85.0
07:00	85.0
10:00	85.0

from over 80 colleges/universities

(SDSU, UCSD, UC Riverside, UC Davis, CalState LA, CSU San Marcos, etc.)

# public agencies ...

## Real-time Environmental Monitoring and Observation Technology SDSU Field Stations Program Web Camera

About REMOT:

- [Introduction](#)
- [Network Infrastructure](#)
- [Technology Transfer](#)
- [Future Directions](#)

About This Observatory:

- [Data](#)
- [Description](#)
- [Lessons Learned](#)
- [Equipment Used](#)
- [Operated by FSP](#)

Observatories at [SMER](#):

-  [Avocado Grove](#)
-  [Bug Trail](#)
-  [Dead Coyote](#)
-  [Devils Canyon](#)
-  [East Gorge](#)
-  [Gorge Crossing](#)
-  [Gorge Overlook](#)

earlier

18:48:28



18:33:22



18:18:18



18:03:12



Requested time: Mon, 09 Apr 2007 07:09:00 PM (PDT)

Image time: Mon, 09 Apr 2007 07:03:31 PM (PDT)



[-1 wk](#) < [-1 day](#) < [-6 hrs](#) < [-1 hr](#) < > [+1 hr](#) > [+6 hrs](#) > [+1 day](#) > [+1 wk](#) >

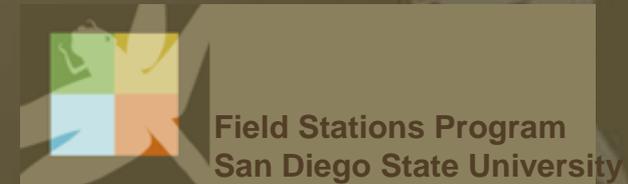
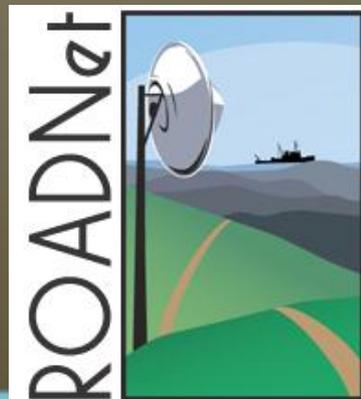
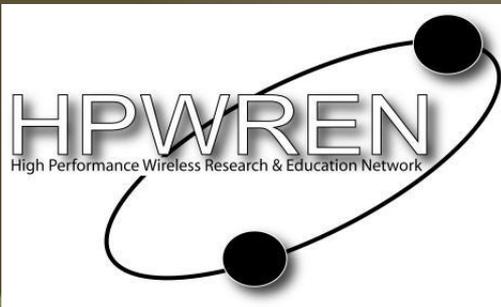
[Get the Latest Image](#)

April 9 2007 19:09 Go

date time

National Weather Service, CalFire, North County Fire Protection District, etc.

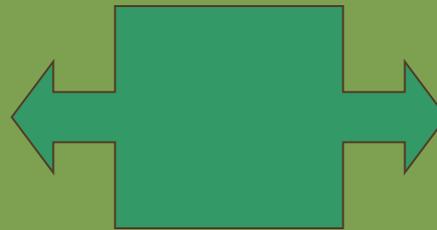
# and K-12, community fairs, and Tribal Learning Centers



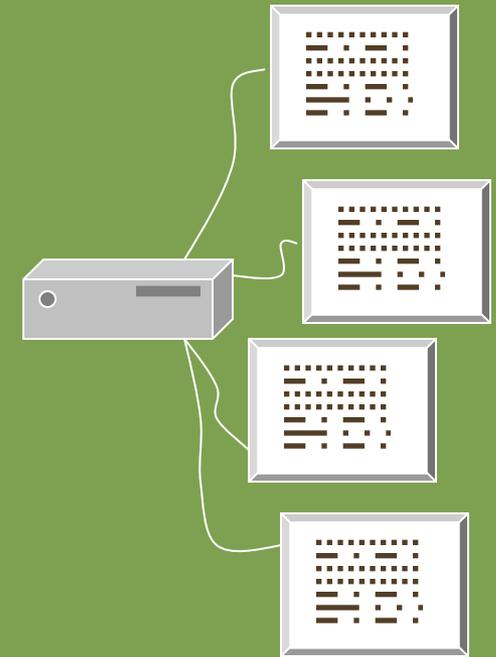
# High-tech Environmental Sensor Network



Automated Sensors



Fault-tolerant  
middleware



Data Delivery



# The San Diego River Research Center

*“Serving our Local Watershed through Applied  
Science and Education”*



# Environmental Law and Policy: Analysis and Support

- Legal, Regulatory, and Policy Issues:
  - Water Quality and Management
  - Legislation Review and Analysis
  - Economic Impacts/Benefits Analysis
  - Environmental Impact Analysis
  - Endangered Species and Conservation Planning



# Science Support

- Cultural Resources
- Habitat Restoration
- Watershed Monitoring
- Watershed Modeling (inc. groundwater)
- BMPs and Engineering Solutions
- Workforce Training



# Benefits to High-tech Environmental Sensor Network

Unpredictable storm extent  
Unpredictable storm intensity  
Managed river channels  
Dynamic tide  
Dynamic ocean currents  
Rapidly urbanizing landscape  
Sewage treatment plant(s)  
Unpredictable trash debris

---

Complex System

Early detection of events

- public policy
- conservation
- improve research design

Rapidly repair problems

Engaging for education

Flexible platform



# San Diego RiverNet



SAN DIEGO STATE  
UNIVERSITY



SAN DIEGO RIVER CONSERVANCY



Field Stations Program  
San Diego State University



The Great Seal



# San Diego River Water Quality Monitoring Stations



# Current Objectives

- Installation of 4 water quality monitoring stations
- Identification/prioritization of “wireless watershed”
- 52 miles of river monitoring
  - From headwaters (near Julian) into the Ocean
- Data/Information Sharing (Bay Delta)

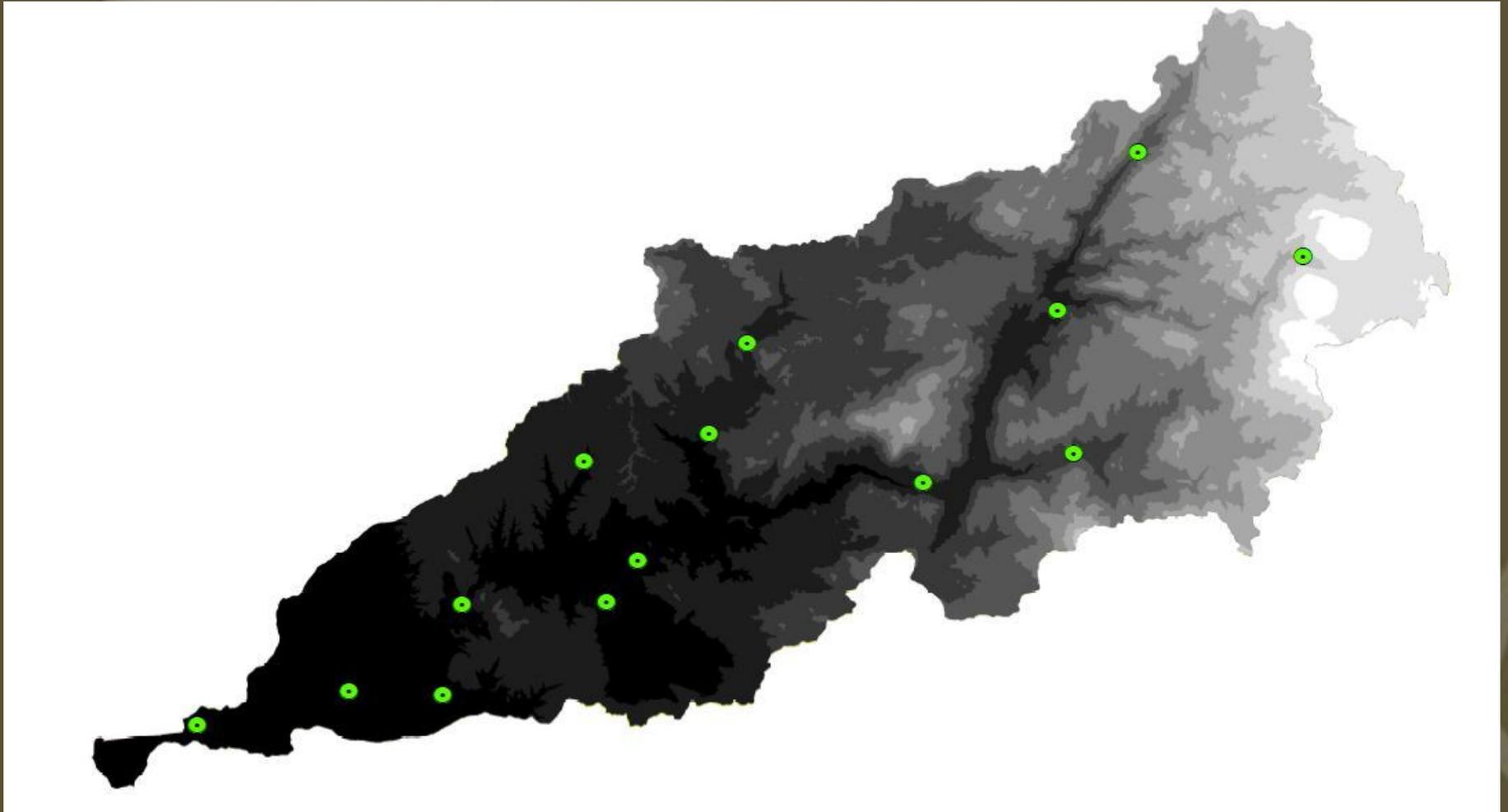


# Monitoring the Watershed

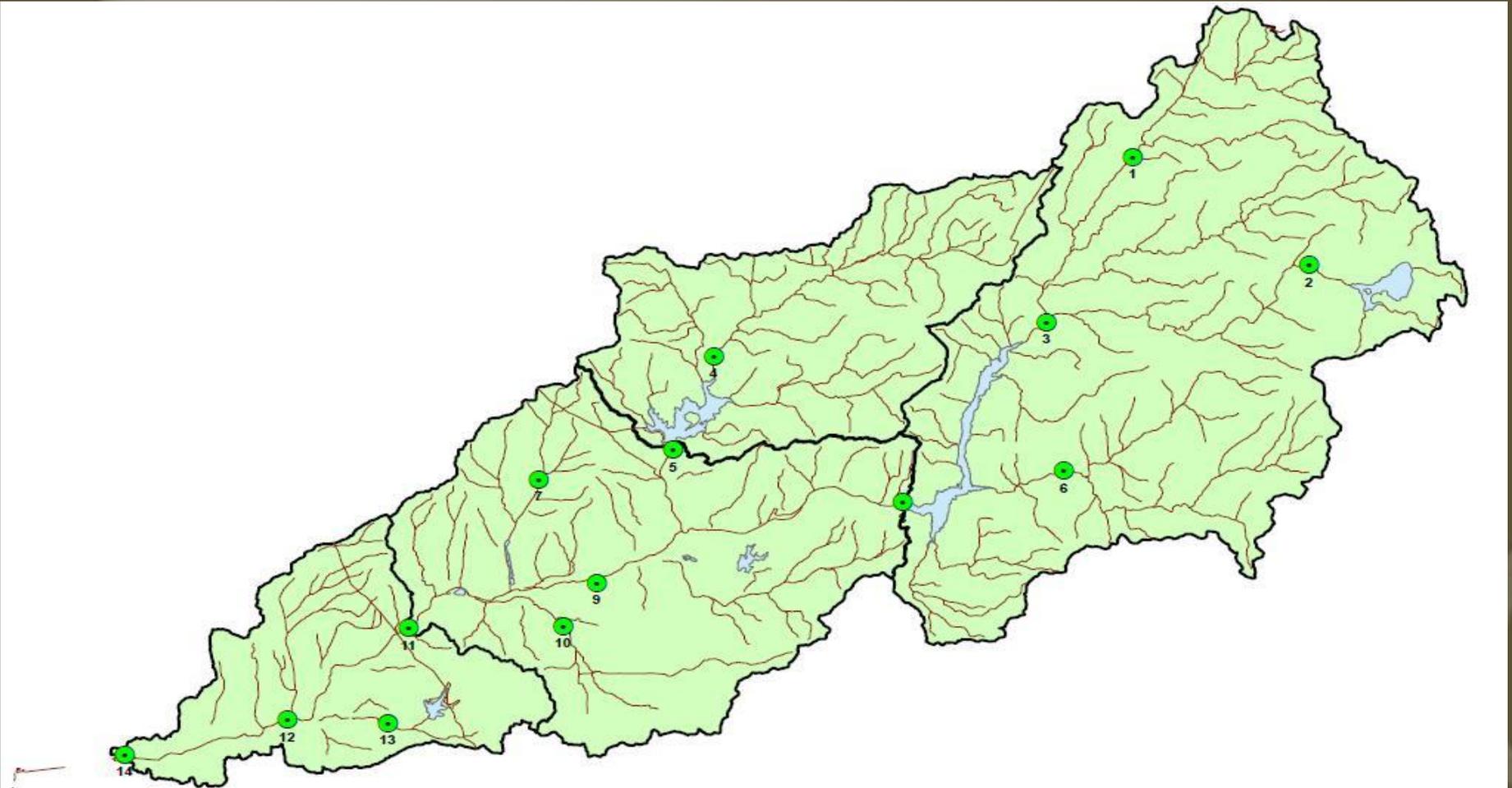
- San Diego "RiverNet"



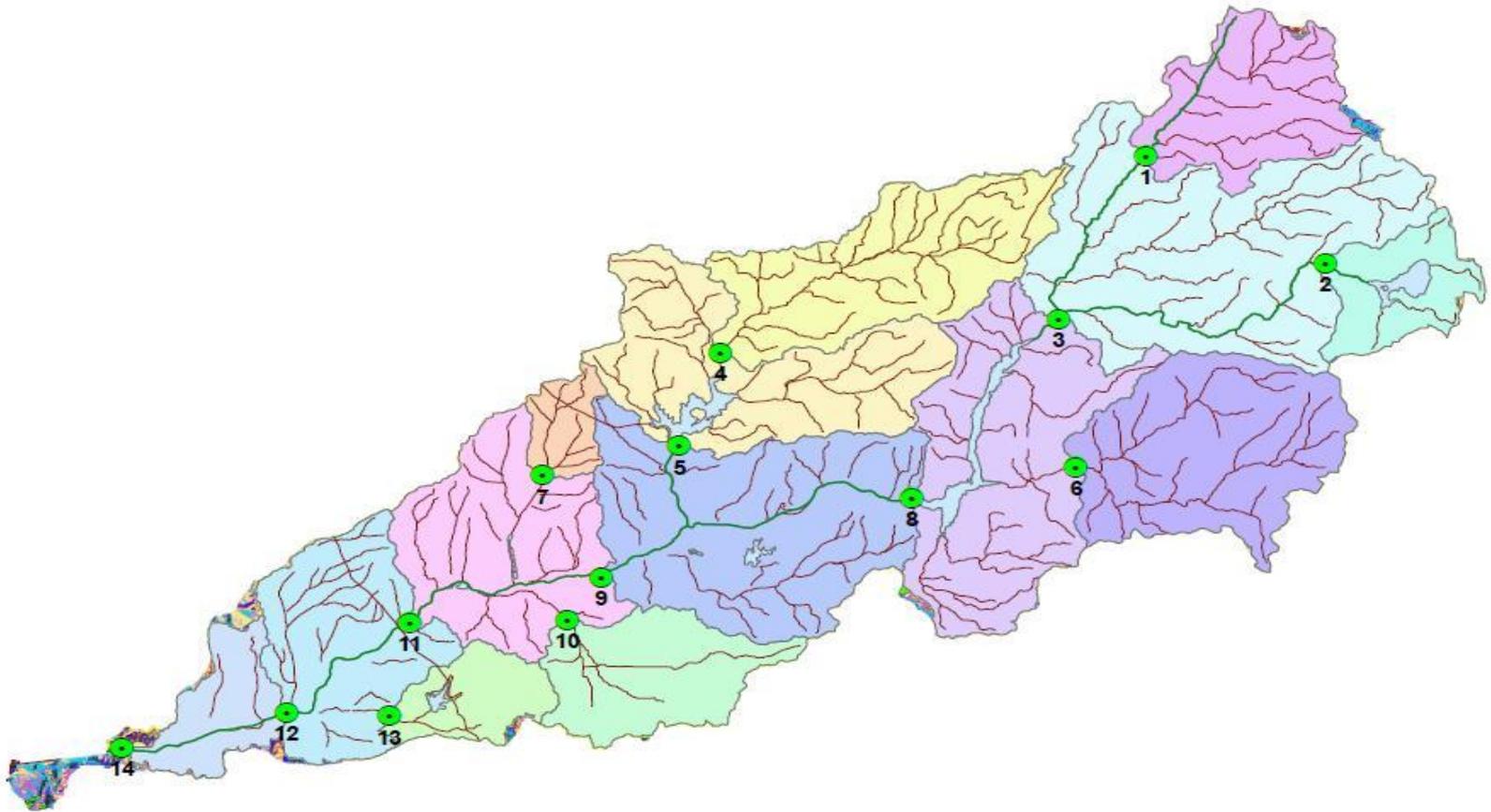
# Flow Accumulation Map



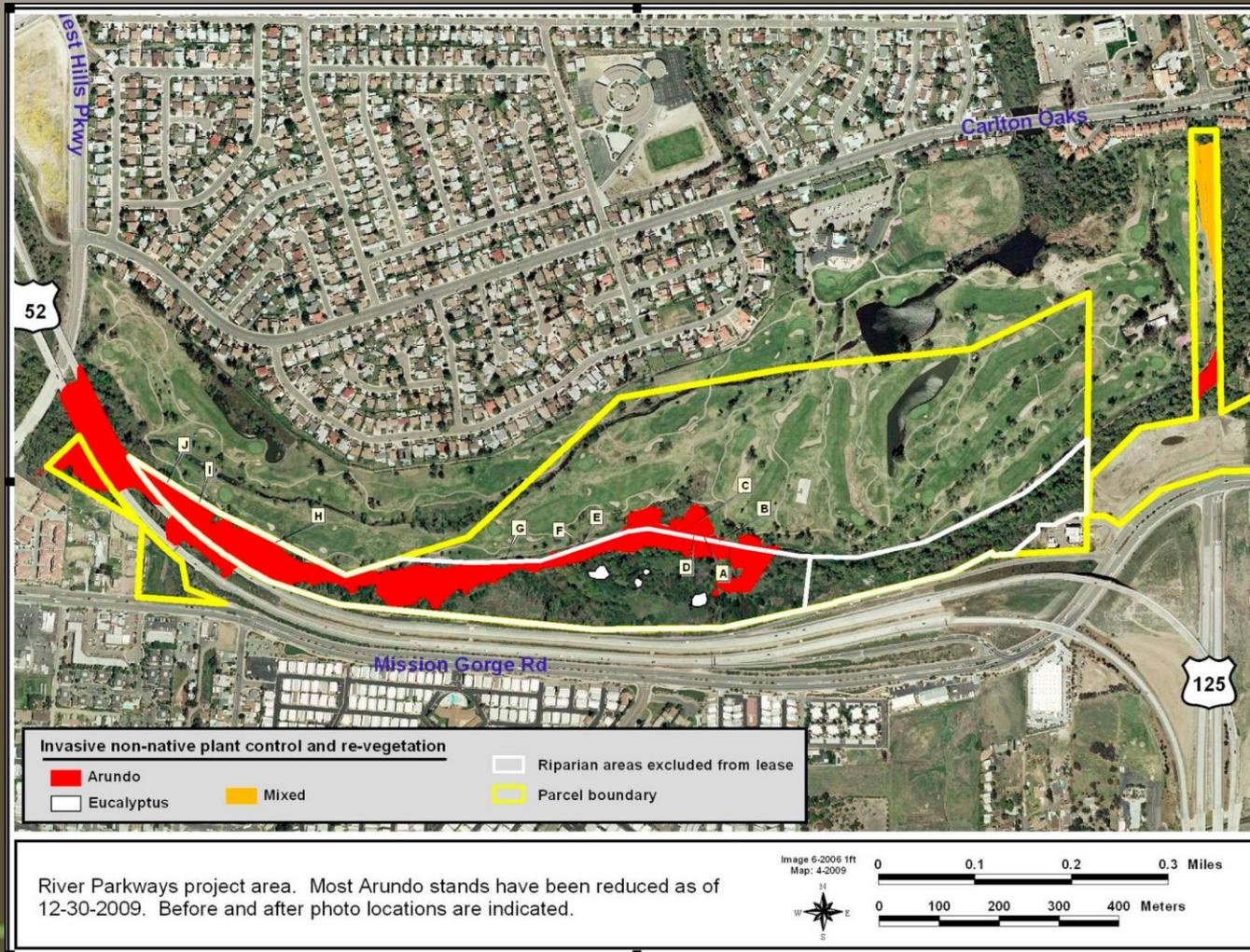
# Sub Watersheds



# Sub-watersheds Created by the Points



# Watershed Restoration and Research



# Before and After

