


# Role of Ecosystem Services in Watershed Management

An aerial photograph of a coastal watershed. In the foreground, there is a dense forest of green trees. A river flows from the forest towards the ocean. A large dam or bridge structure spans across the river. To the right, there is a residential area with houses and a road. The ocean is visible in the background with waves breaking on the shore. The sky is clear and blue.

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Dennis King  
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# Los Peñasquitos Lagoon

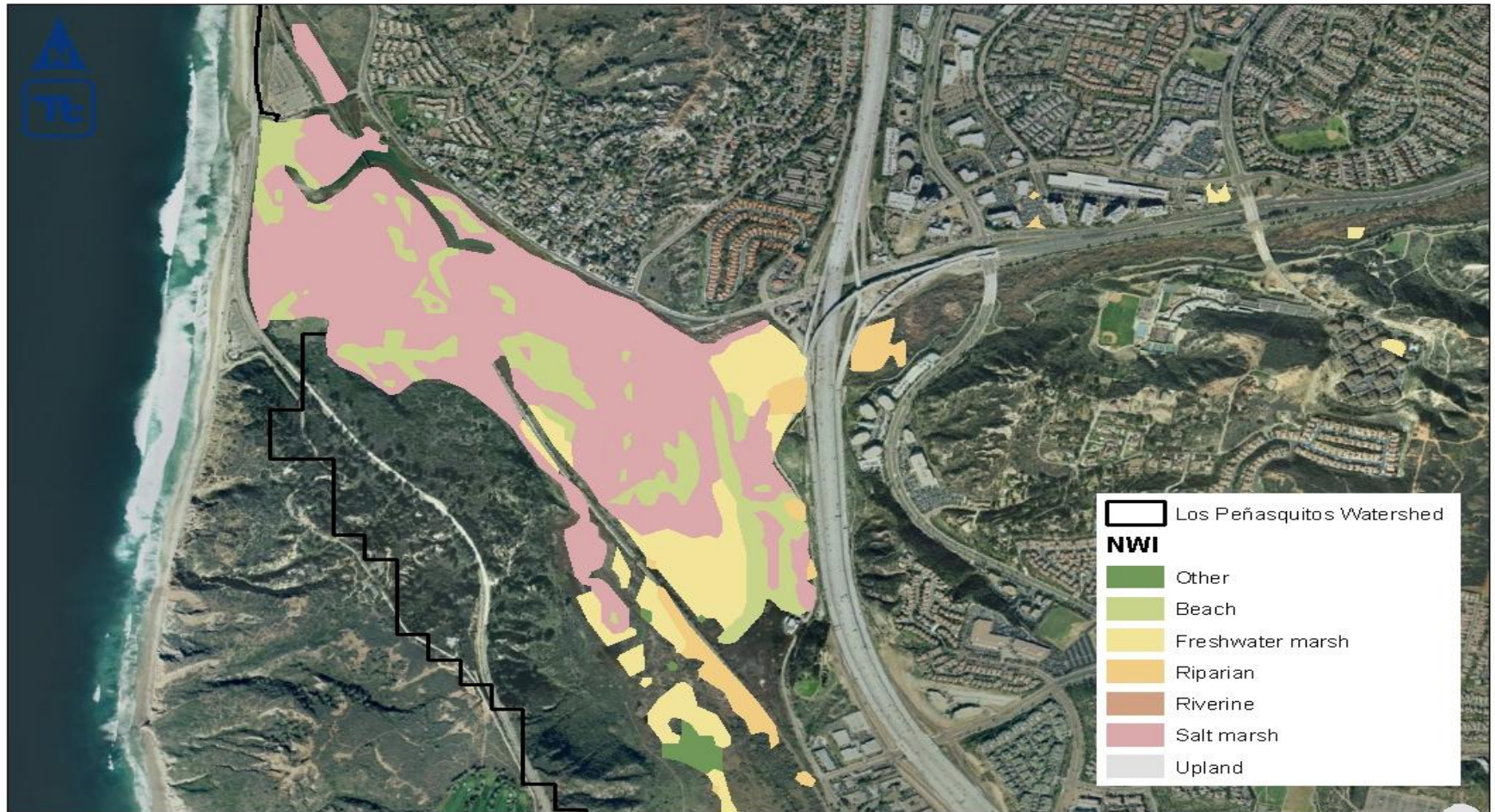


# Ecosystem Services within the Regulatory Framework

- Impairment Identified
  - Sedimentation of the lagoon
  - Ecosystem Services Lost – Loss of Saltwater Marsh
- Regulatory Driver – TMDL
  - Quantify Waste Load Allocations
  - Identify Numeric Targets
- Implementation Plan for Restoration Blueprint
  - Meet Waste Load Allocations
  - Restore Beneficial Uses of the Lagoon
  - Ecosystem Services to Prioritize Restoration Alternatives

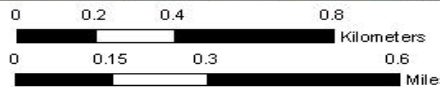


# National Wetland Inventory - 1985



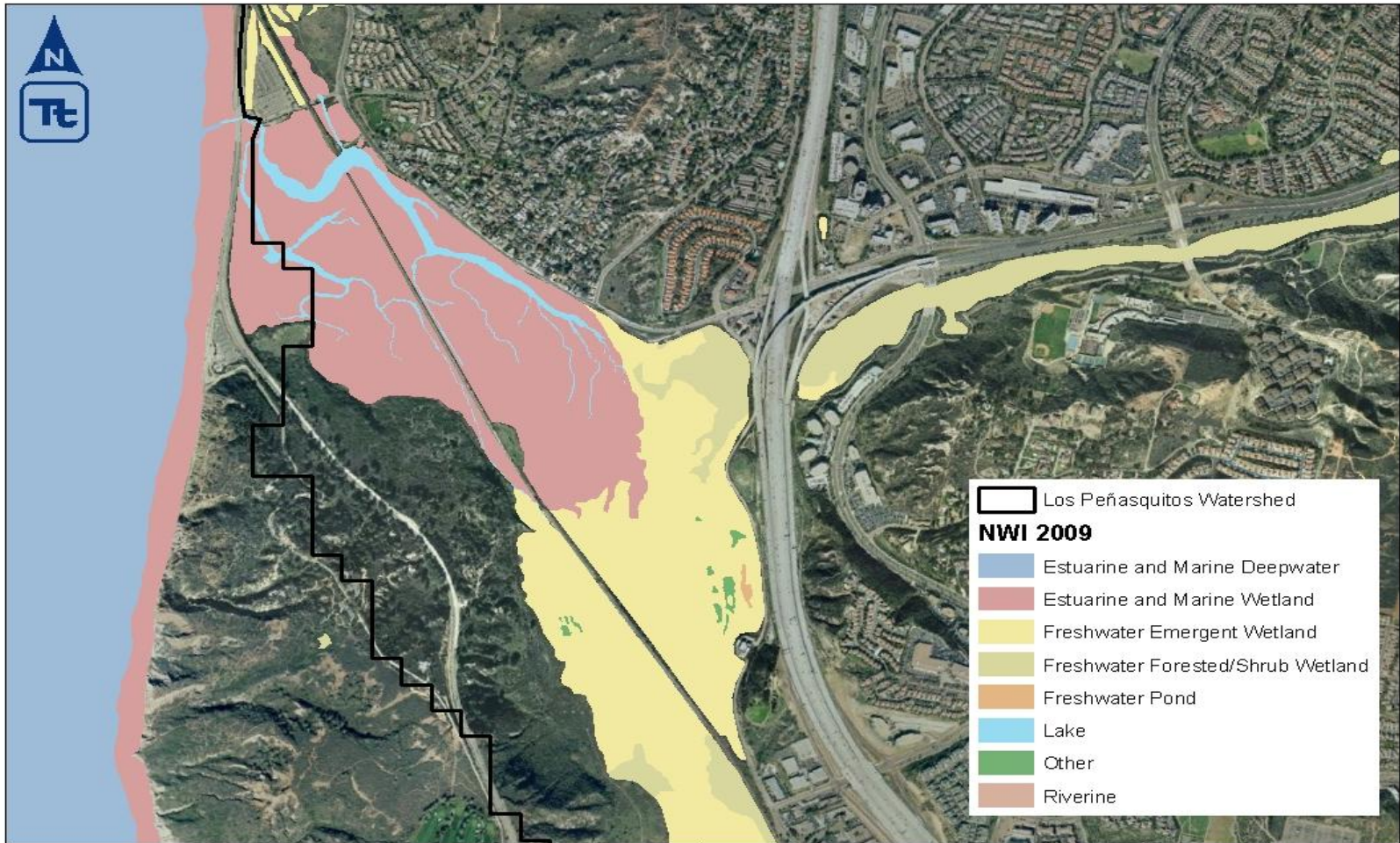
**Los Peñasquitos Watershed  
NWI Wetlands**

USA\_Contiguous\_Albers\_Equal\_Area\_Conic\_USGS\_version  
Map produced 05-05-2010



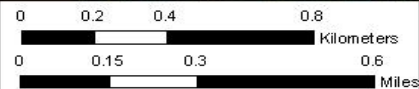


# National Wetland Inventory - 2009



**Los Peñasquitos Watershed  
NWI Wetlands (2009)**

USA\_Contiguous\_Albers\_Equal\_Area\_Conic\_USGS\_version  
Map produced 05-05-2010



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# Ecosystem Services Lost

- Wildlife habitat
- Endangered species protection
- Recreational uses (hiking, birding, boating)
- Fisheries (shellfish harvesting)
- Aesthetic value
- Education & research
- Flood protection



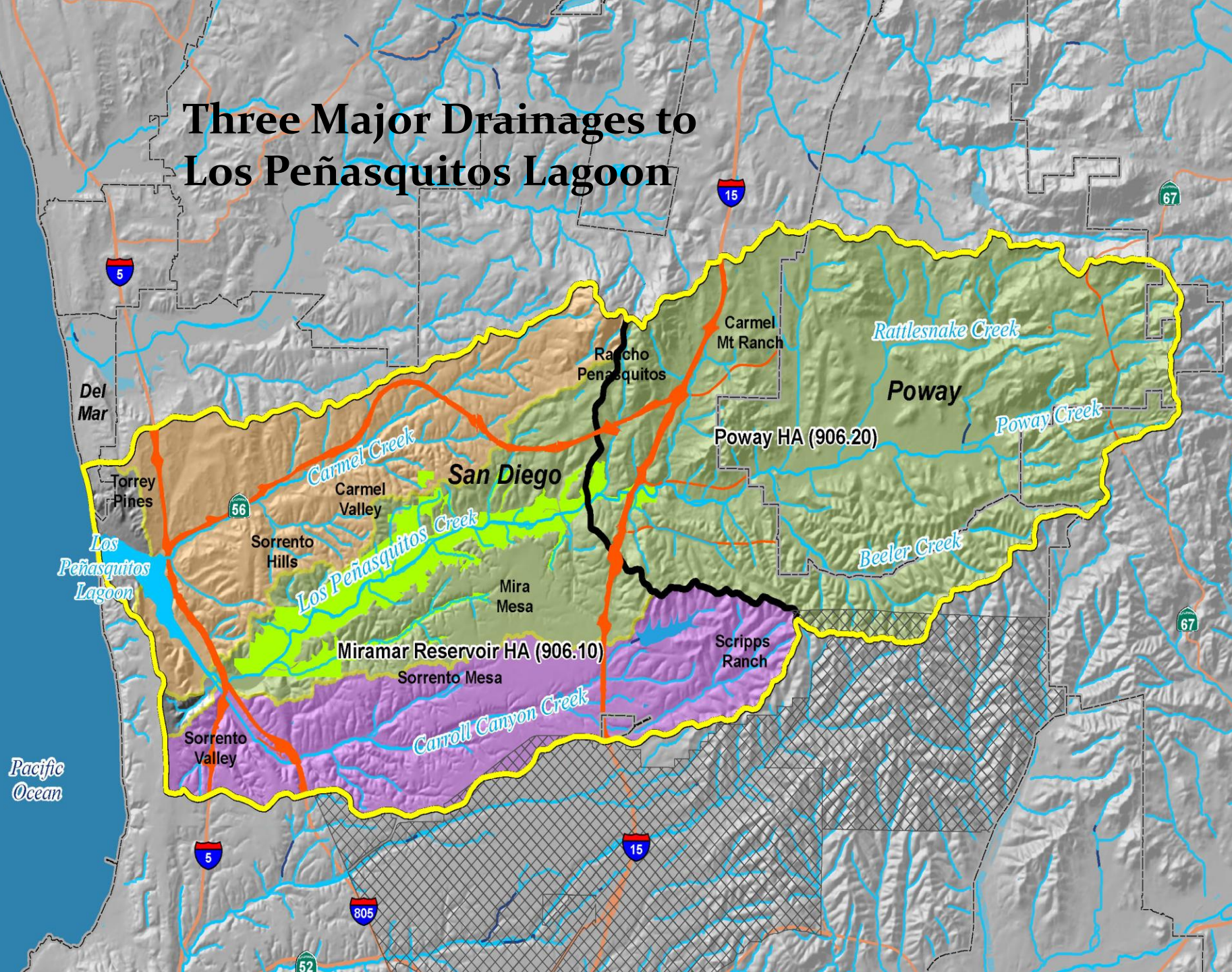
# Los Peñasquitos Lagoon Sediment/Siltation TMDL

$$\text{TMDL} = \sum \text{WLAs} + \sum \text{LAs} + \text{MOS}$$

Source	Current Load (tons)	Historical Load (tons)	Load Reduction (tons)	Percent Reduction Required
TMDL	13,663	12,360	1,303	10%
Watershed Contribution (WLA)	7,719	2,580	5,139	67%
Ocean boundary (LA)	5,944	9,780	+3,836 (increase)	+39% (increase)

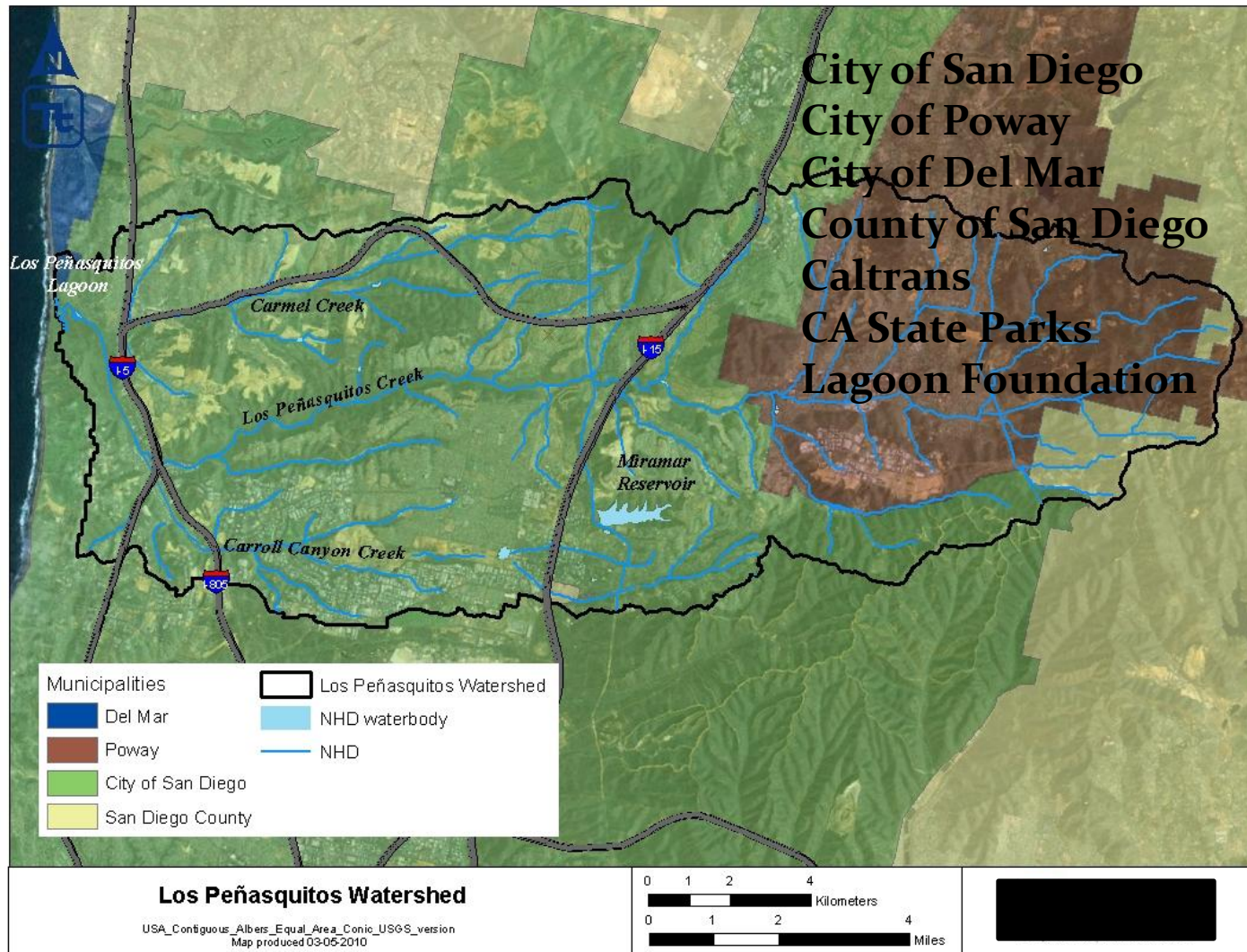


# Three Major Drainages to Los Peñasquitos Lagoon

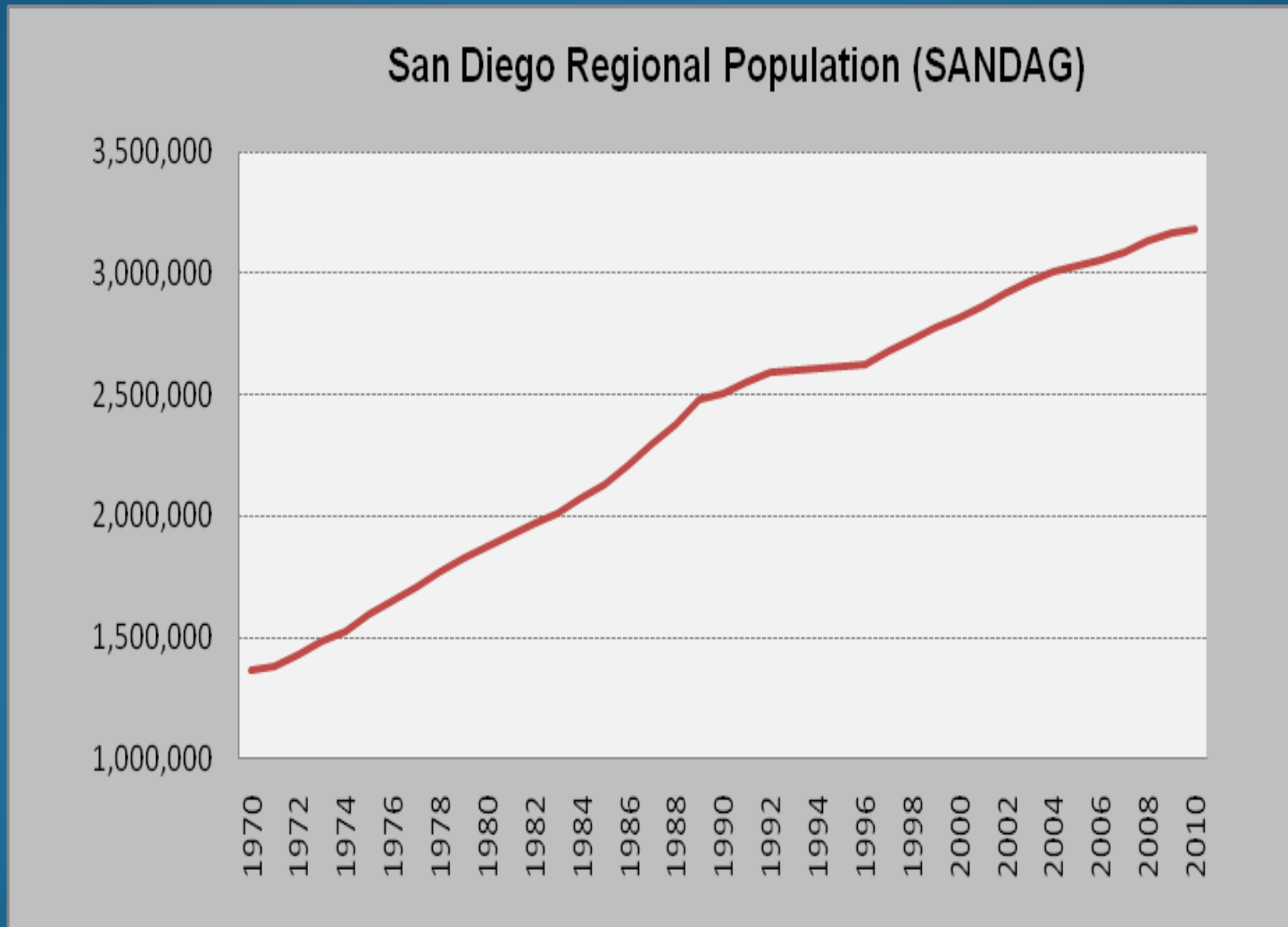




# Numerous Stakeholders



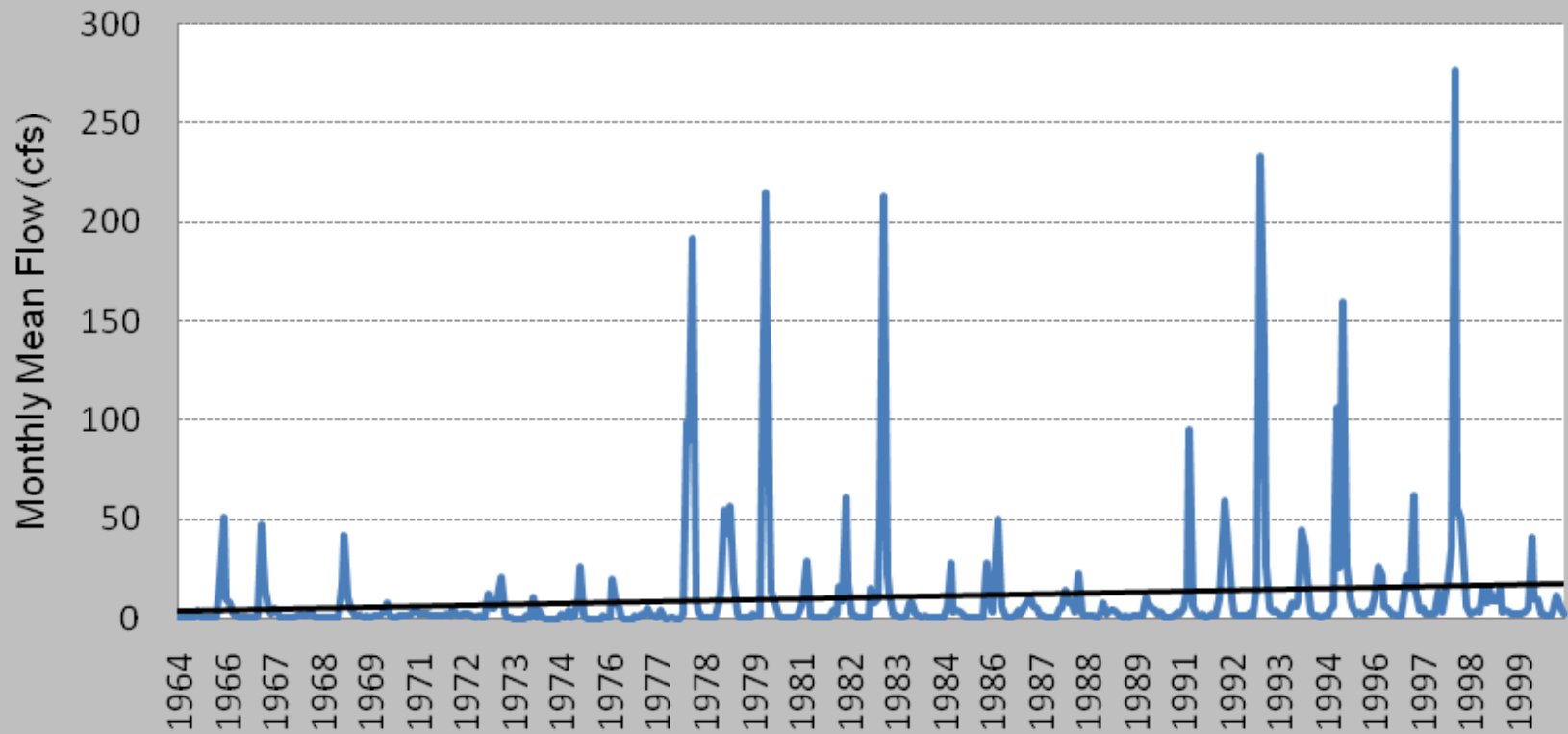
# Increasing Population in the Watershed





# Increasing Urbanization Leads to Larger Flows

Los Penasquitos Creek (USGS Gage 11023340)  
1964-2000 Monthly Flow





# Hydromodification





# Streambank Erosion





# Mining Operations















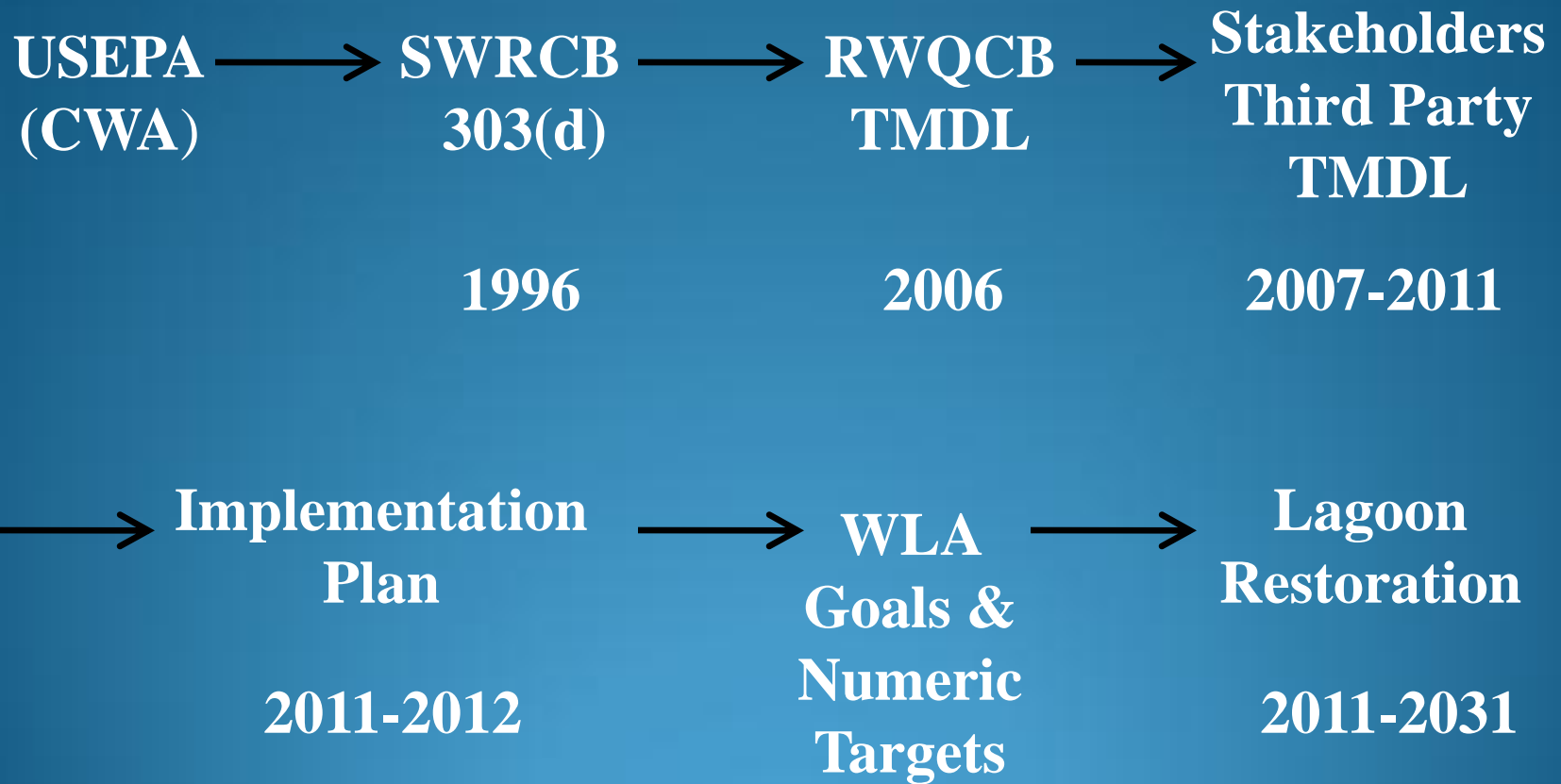








# Regulatory Process





# Ecosystem Services:

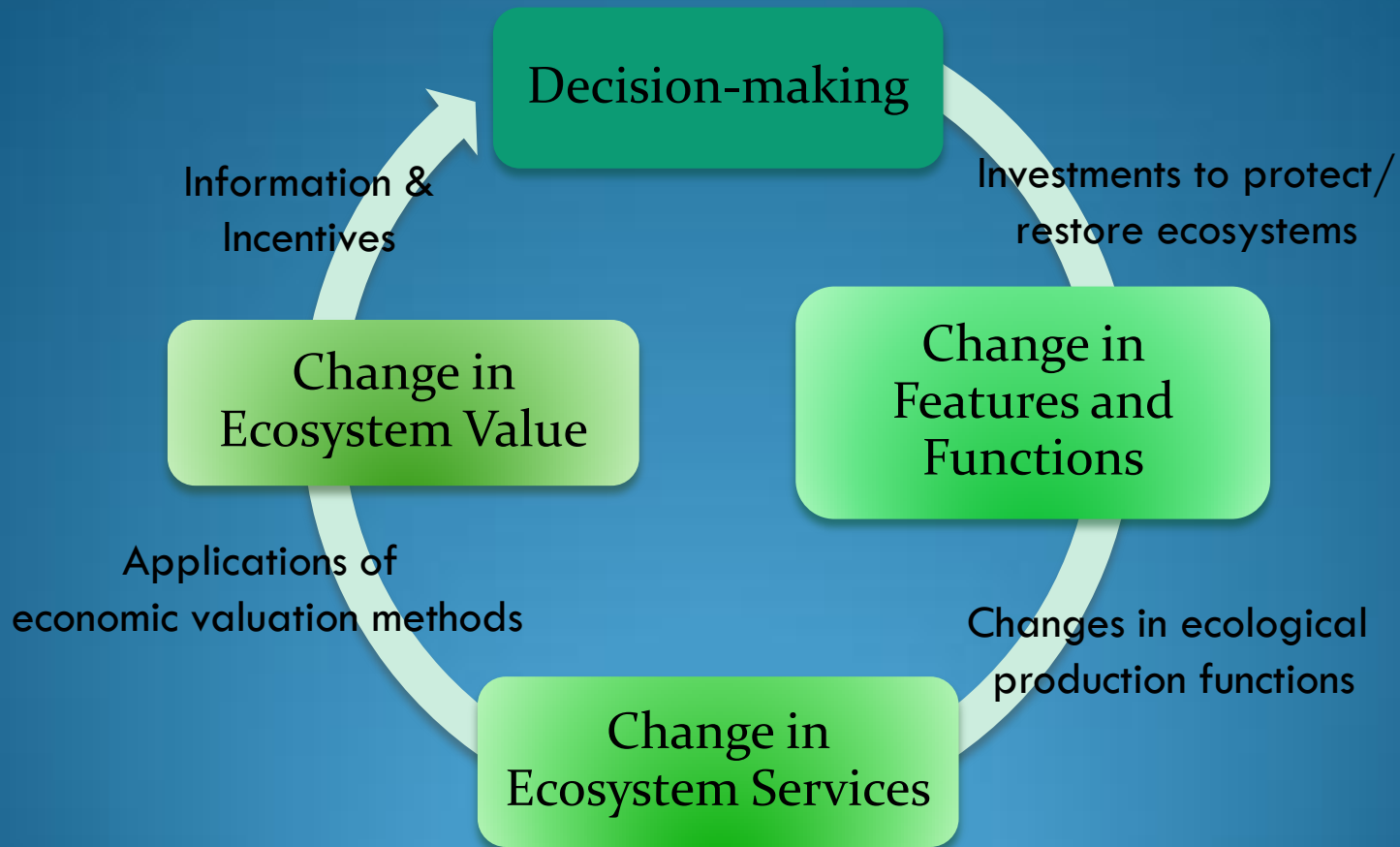
- Are the beneficial outcomes of ecosystem functions
- Include such things as clean air and water, flood control, various active and passive use values, and aesthetic and other “non-use values”
- Are often taken for granted as free
- Are often left out of important decisions

# Building Blocks of Ecosystem Services & Values





# Flow of Information About Ecosystem Services



# Key Questions

- What features of ecosystems support functions that generate valuable ecosystem services?
- What changes & trends in features & functions are affecting ecosystem services?
- What policies & investments will favorably affect these changes & trends?
- How much will those policies & investments cost?
- How should we decide among restoration alternatives?



# Cost-Effectiveness/ Incremental Cost Analysis

- Cost Effectiveness Analysis
  - Is used to ensure that the least cost alternative is identified for each possible level of output (e.g., production of ecosystem services)
- Incremental Cost Analysis
  - Reveals the additional cost of achieving increasing output
  - Presents tradeoffs for policy makers to determine whether the increase in output is worth the additional cost

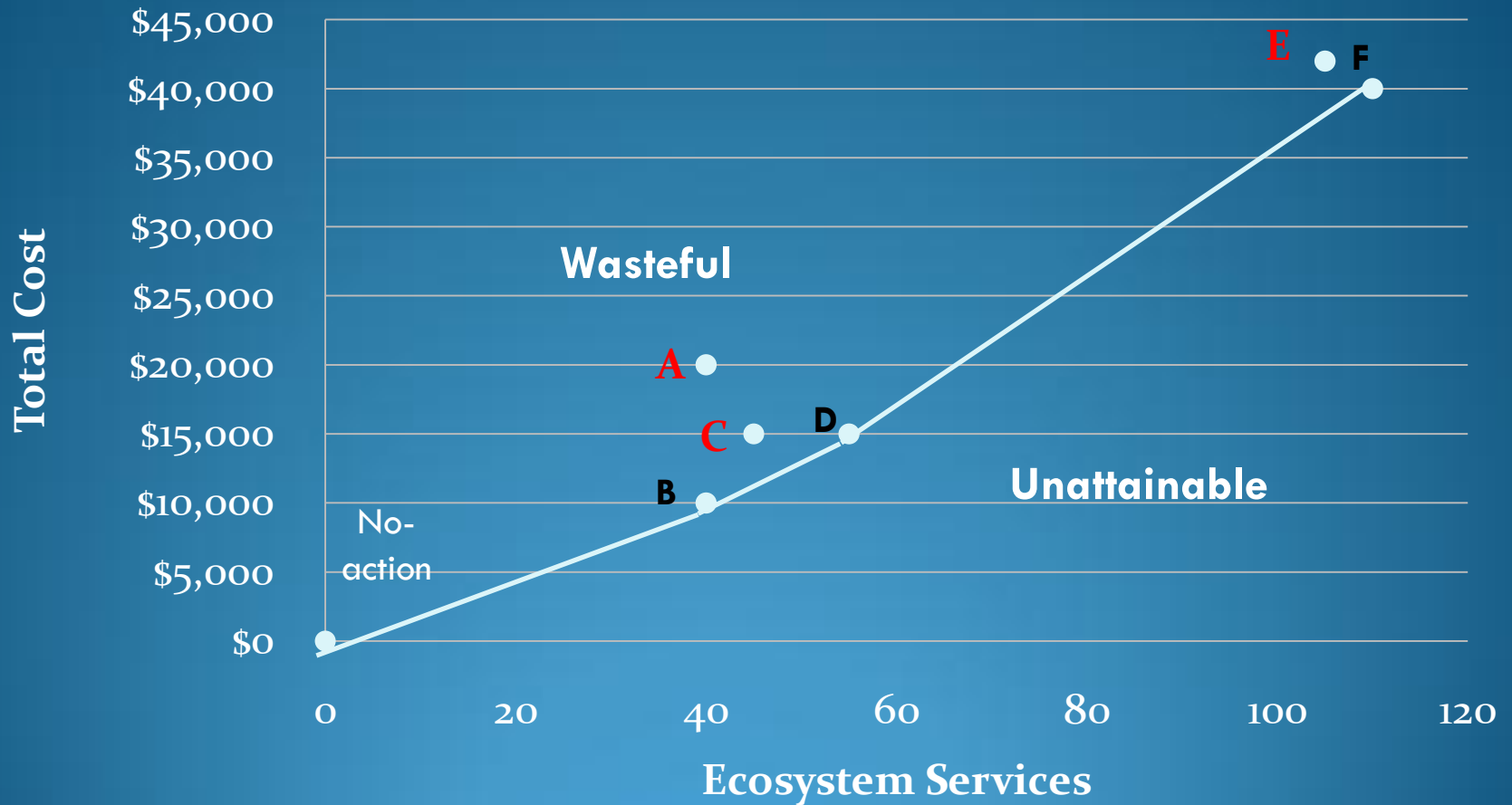
# Illustration: Cost-Effectiveness Analysis

Plan	Total Cost	Ecosystem Services
No-action	\$0	0
Plan A	\$20,000	40
Plan B	\$10,000	40
Plan C	\$15,000	45
Plan D	\$15,000	55
Plan E	\$42,000	105
Plan F	\$40,000	110

Plans are sorted in order of increasing output



# Cost-Effectiveness Frontier



# Incremental Cost Analysis

Plan	Cost	Output (Ecosystem Services)	Incremental Cost	Incremental Output	Incremental Cost per Unit Ecosystem Service (ES)
No-action	\$0	0	NA	NA	NA
Plan B	\$10,000	40	\$10,000	40	\$250/ES
Plan D	\$15,000	55	\$5,000	15	\$333/ES
Plan F	\$40,000	110	\$25,000	55	\$455/ES

Only cost-effective plans are carried forward for Incremental Cost Analysis.



# Decision-making Summary

- Identify, measure and, where necessary, rank and weight ecosystem services
- Identify outcome and cost thresholds
- Conduct cost effectiveness and incremental cost analysis
- Screen out clearly inferior alternatives
- Present tradeoffs for policy makers to consider when choosing among alternatives

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**Questions?**





