Image credit: Helen Florez

GIS in Design:

How landscape architecture students use GIS in design

2018 Education Summit at Esri UC
07/07/2018

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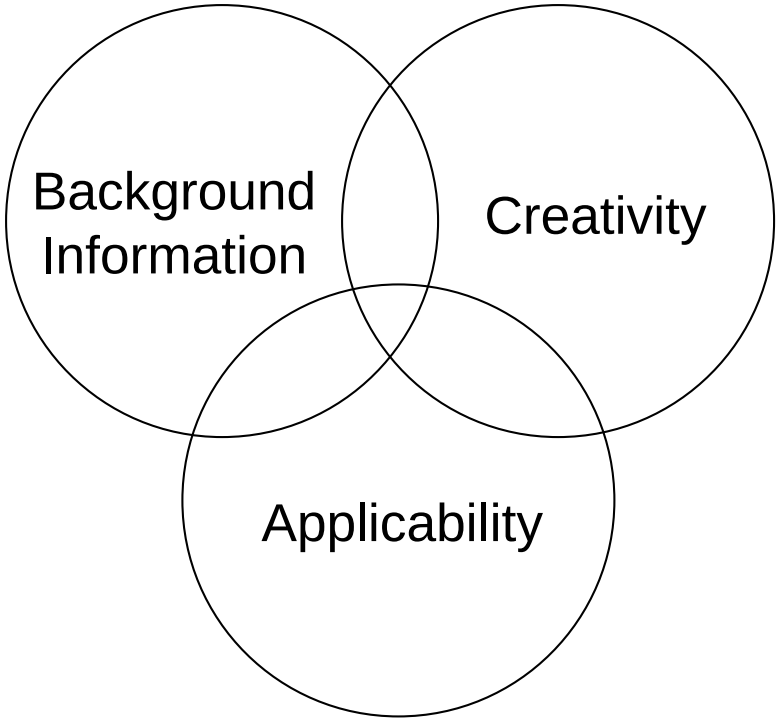
Landscape Architecture Department
College of Architecture Environmental Design
CAL POLY San Luis Obispo, CA

WHAT?

Projects from LA438: GIS Application to Design Projects to see how students in Landscape Architecture use GIS in the design process

Design (Process)



OBJECTIVES

To understand the role of GIS in the design process

To identify the potential and possible improvements for GIS courses in the design field

To recognize the potential and possible improvements for GIS technology

- LA 438 GIS Application to design projects
- Student projects
- Findings

LA438 GIS APPLICATION TO DESIGN PROJECTS

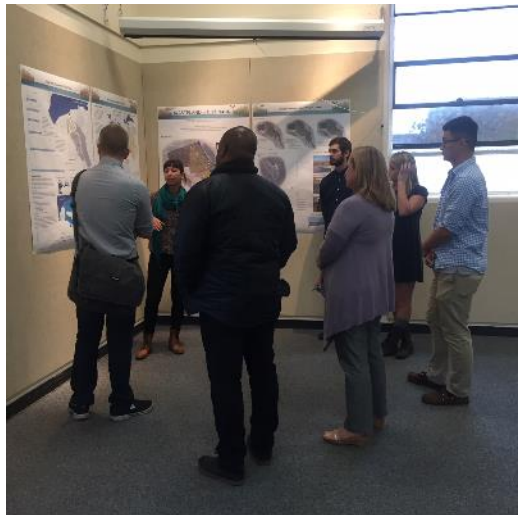
- An introductory GIS course in the landscape architecture department
- Assisting students with design background to integrate and apply basic GIS skills into their design projects
- Developing critical thinking and logical design decisions
- Average 15 students for 4 hours each class, two classes per week (8hours per week)
- Course structure
  - Lectures, demos, and in-class exercises (6wks)
  - Project (3 - 4wks)

LA438 TOPICS

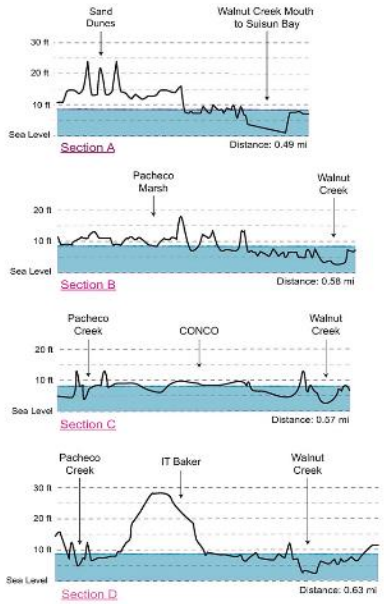
- Base Map
- Feasibility Study
- Demographic Study
- Use of Digital Elevation Model and Lidar Point Cloud
- Spatial Analyst and Hydrology Tools
- Soils
- Google Earth and ArcScene
- Visualization and communication

LA438 ACTIVITIES

- Integration with other design courses
- Collaboration with similar courses
- Desk critiques
- Client and expert presentations
- Exhibits and GIS related activities



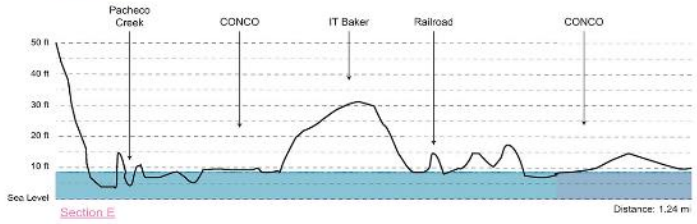
BASE MAP, SECTIONS, GIS AND GOOGLE EARTH

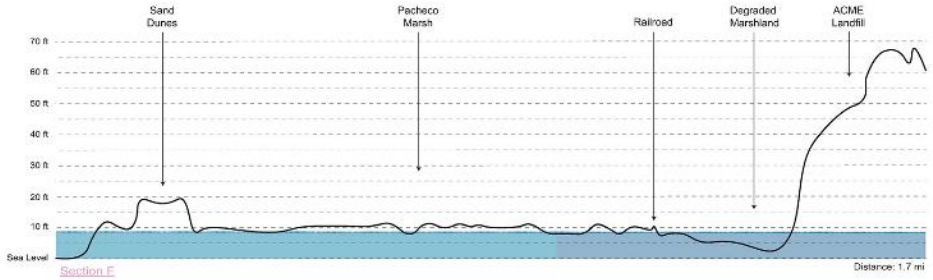


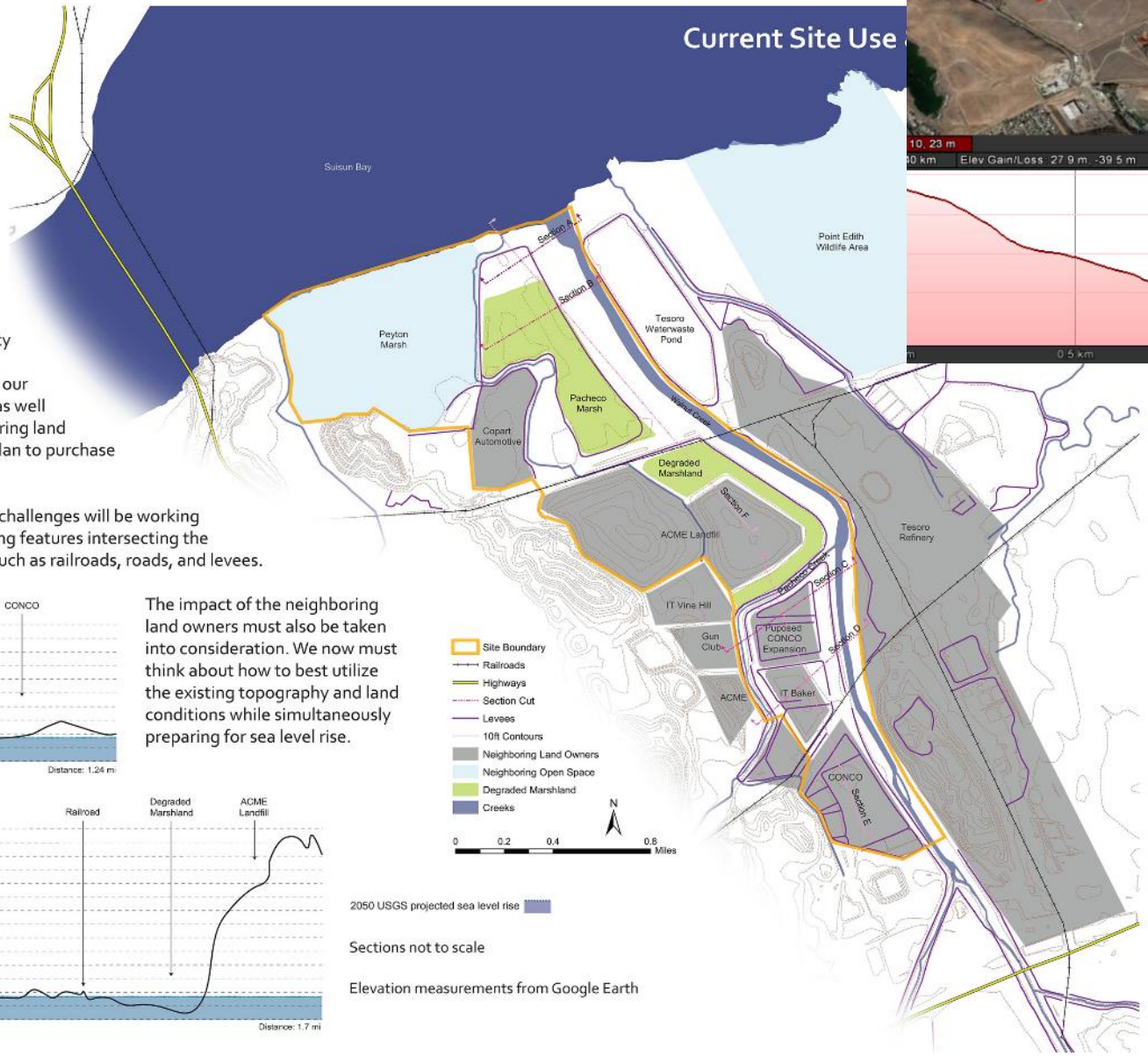
There are a variety of land types and elevations within our site boundaries, as well as many neighboring land parcels that we plan to purchase in the future.

Our main design challenges will be working around the existing features intersecting the land of our site, such as railroads, roads, and levees.

The impact of the neighboring land owners must also be taken into consideration. We now must think about how to best utilize the existing topography and land conditions while simultaneously preparing for sea level rise.







Sections not to scale

Elevation measurements from Google Earth

Image credit: Annelie Heinemann

SOILS

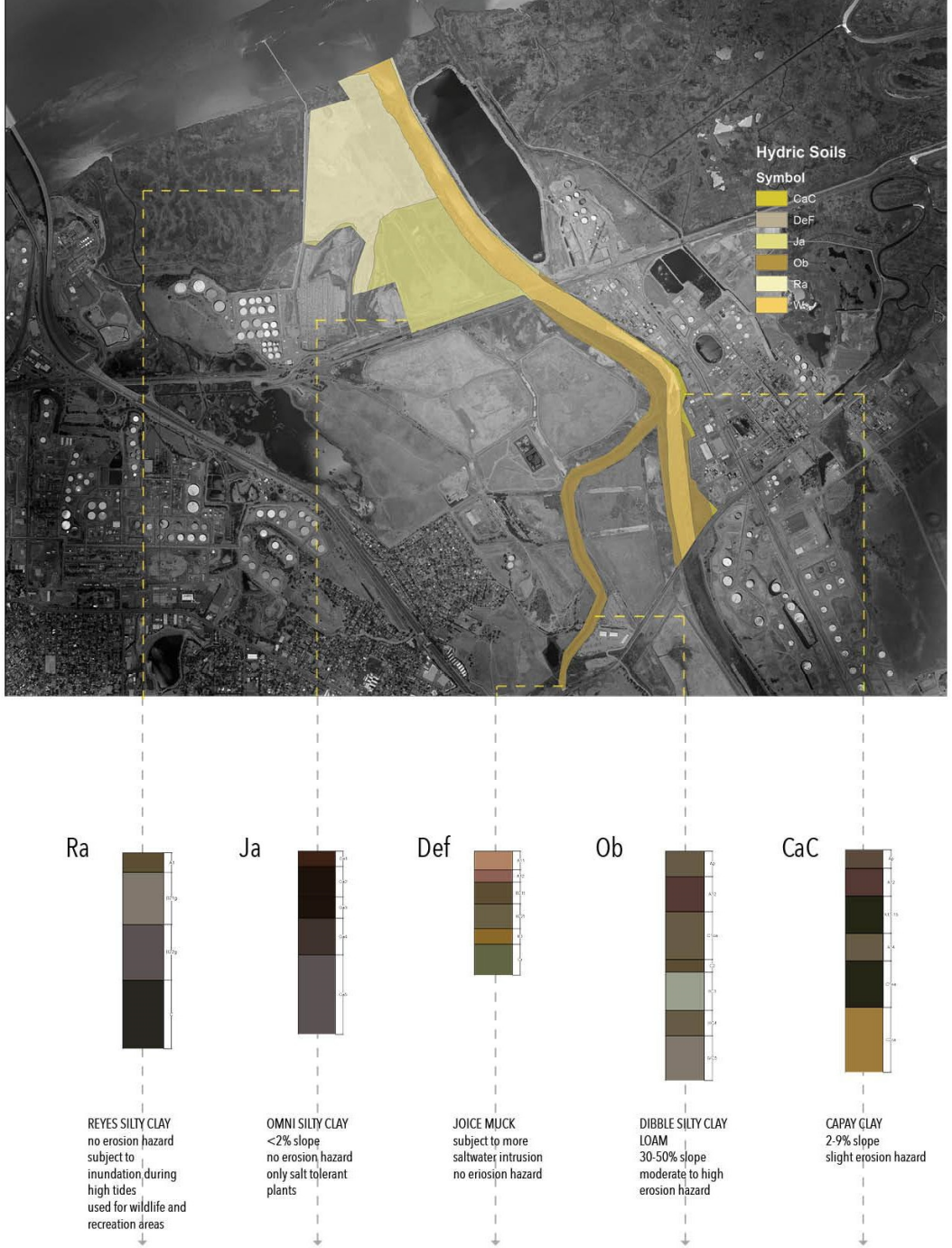
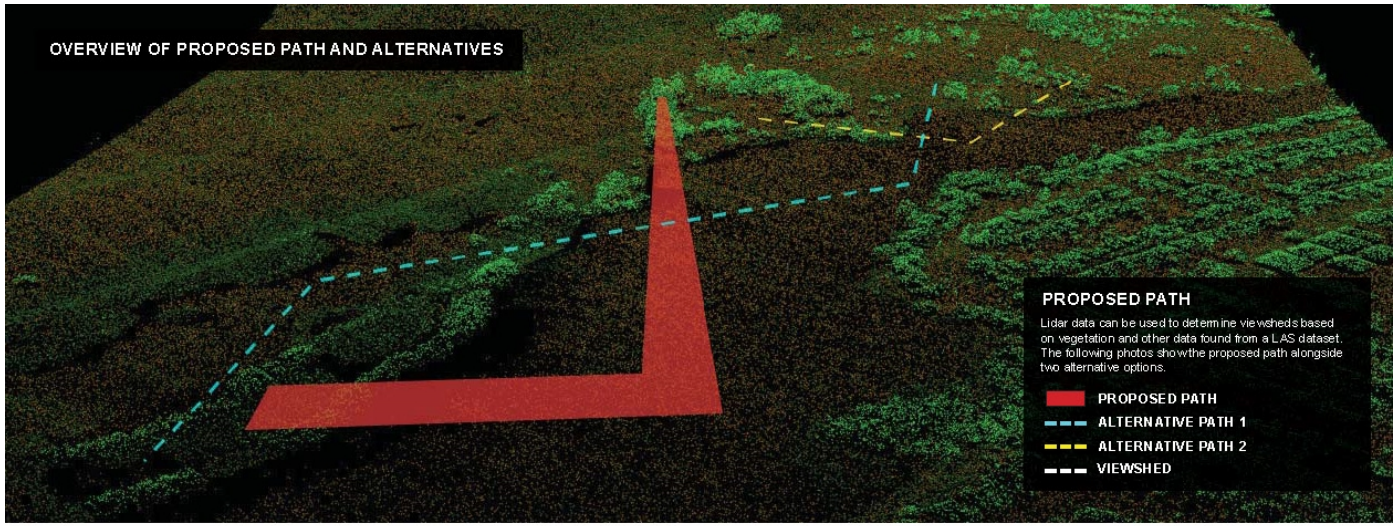
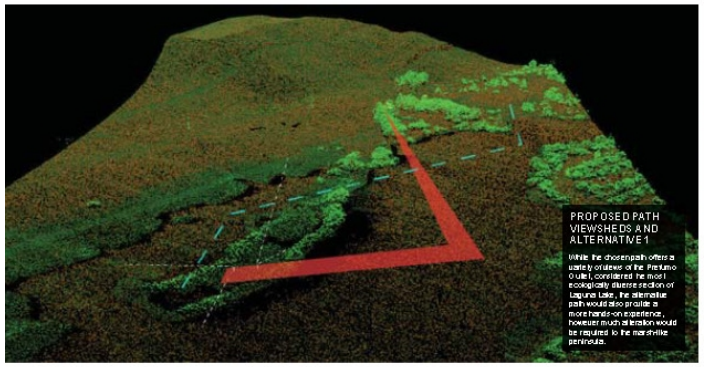
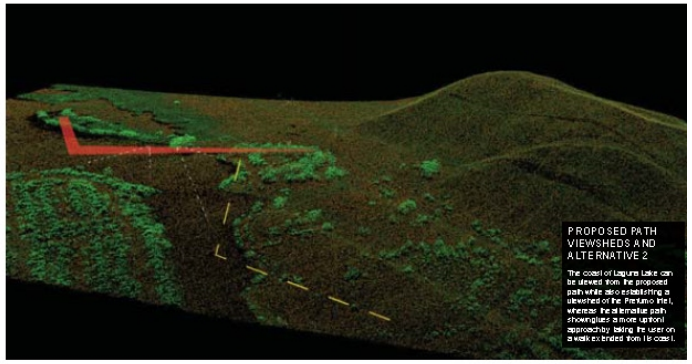


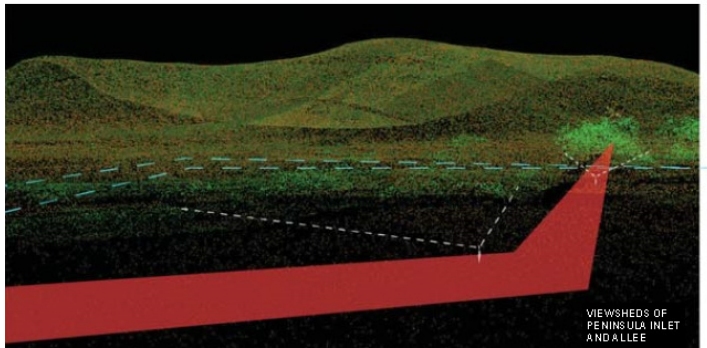
Image credit: Maren Hill

LIDAR POINT CLOUD AND LAS DATASET









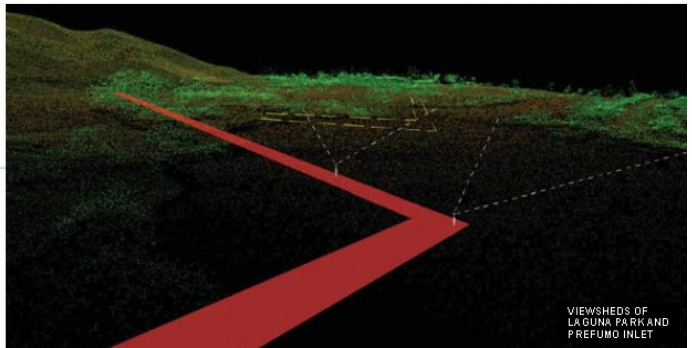


Image credit: Brandon Rommos

LA438 FOCUS

- A tool for design decisions

“Any place is ***the sum of historical, physical and biological processes****, that these are dynamic, that they constitute social values, that* ***each area has an intrinsic suitability for certain land uses*** *and finally, that certain areas lend themselves to multiple coexisting land uses…* ***A planning process that is rational, explicit, replicatable****…”*

Ian L. McHarg ‘Design with Nature’

LA438 FOCUS

- Creative activity

"I discuss mapping as an active agent of cultural intervention. Because my interests lie in the various processes and effects of mapping, I am less concerned with what mapping means than with what it actually does. Thus, I am less interested in maps as finished artifacts than I am in ***mapping as a creative activity****. It is in this participatory sense that I believe* ***new and speculative techniques of mapping may generate new practices of creativity****, practices that are expressed not in the invention of novel form but* ***in the productive reformulation of what is already given****. By showing the world in new ways,* ***unexpected solutions and effects may emerge****. …..Mapping and contemporary spatial design techniques more generally have yet to find adequate ways to engage creatively with the dynamic and promiscuous character of time and space today"*

James Corner 'The Agency of Mapping: Speculation, Critique and Invention'

SUITABILITY

Waiting for Water:

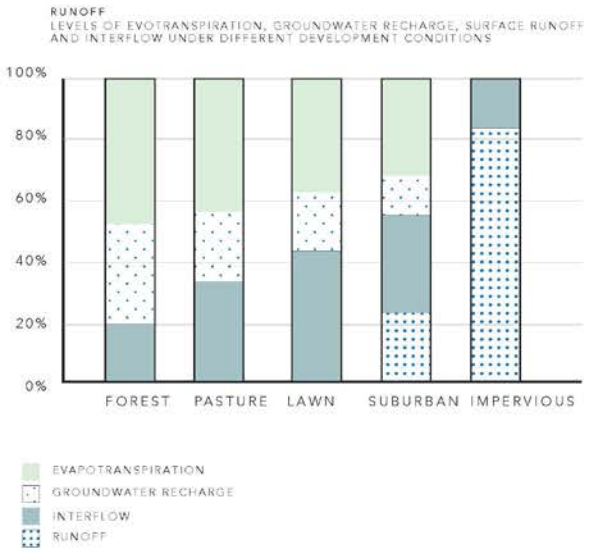
The Healing Power of Time

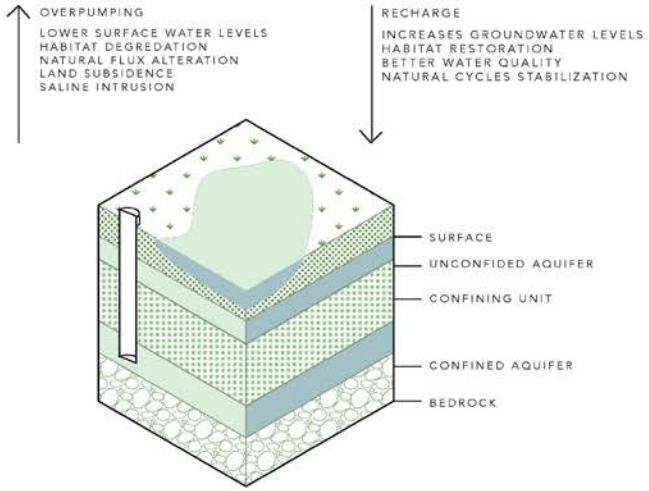
by Miguel Mendez, Sasha Shebalin, and Tyler Ellison
LA438 and LA403 (A design studio)

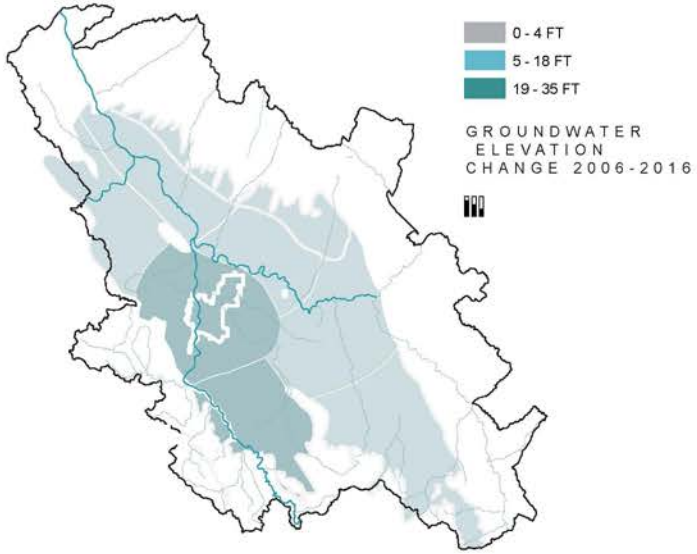
Paso Robles depends on groundwater pumping to sustain social and economic life. However, the effects of **over pumping** put water sustainability at serious risk.

The students have identified three primary causes of groundwater decrease: **unsustainable water consumption, insufficient recharge opportunities, and underdeveloped water infrastructure.**

The project seeks to clean and recharge rainwater runoff into the groundwater basin through a set of adaptive landscape strategies.

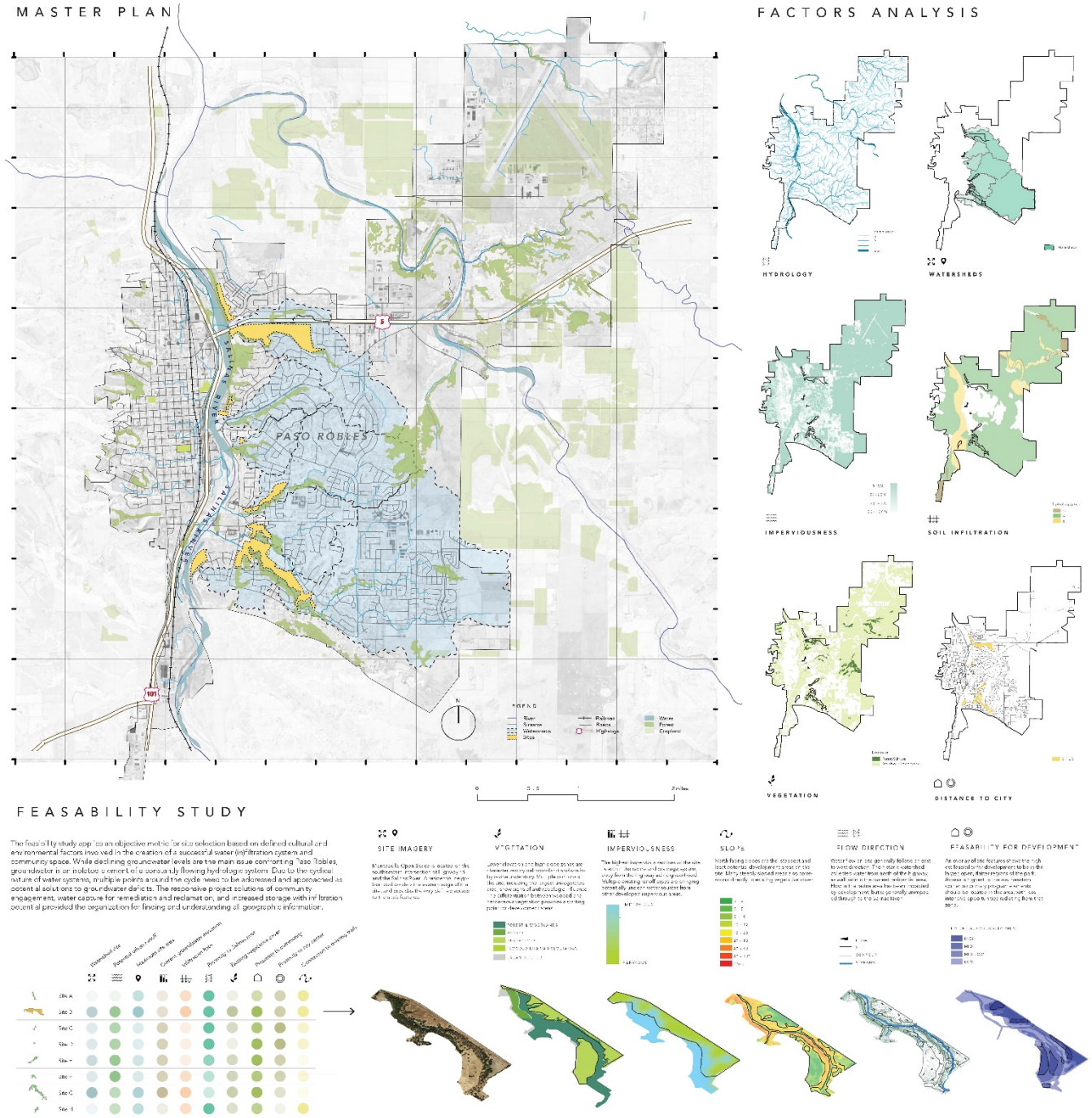






Natural and anthropological conditions were analyzed through **a feasibility metric to select a site best suited for the design** of a sustainable groundwater system.

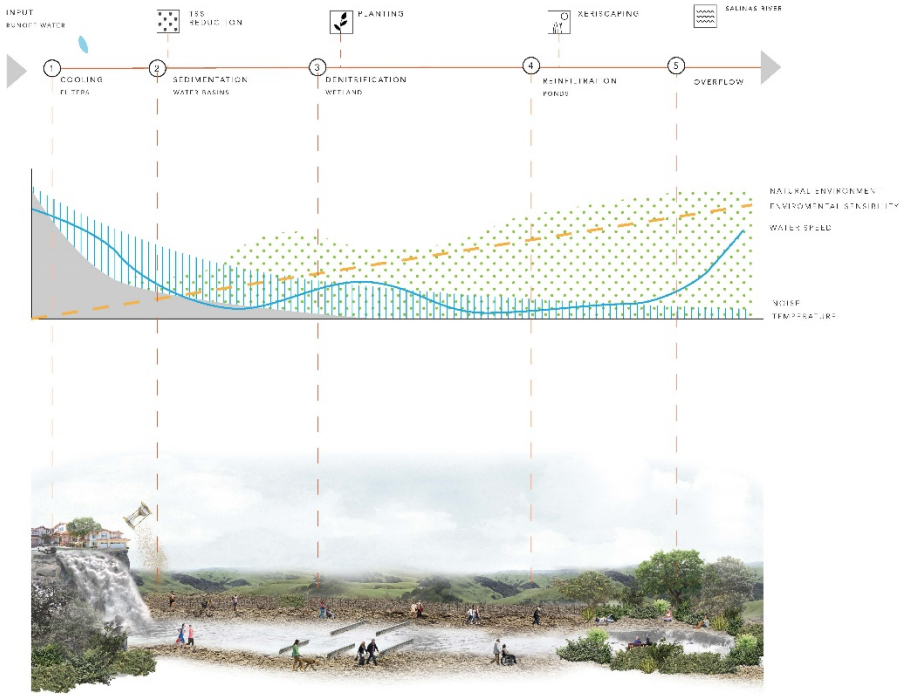
- Watershed size
- Potential urban runoff
- Maximum site area
- Current groundwater elevation
- Infiltration Rate
- Proximity to Salinas River
- Existing vegetation cover
- Proximity to community
- Proximity to city center
- Connection to existing trails



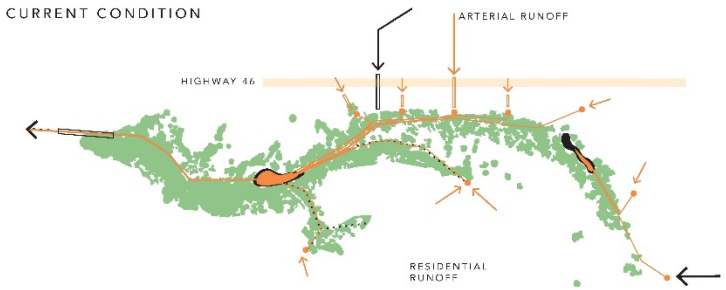
SYSTEM & PROGRAM CONCEPT

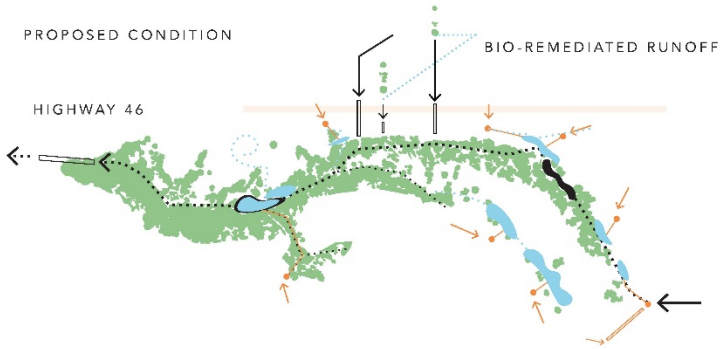
Runoff water processing follows conventional successions of sedimentation, aeration, biofiltration, and infiltration in adaptive methods that maximize site area and cleaning potential. The primary neighborhood runoff cleaning ponds can hold up to 175,000 cubic feet of stormwater runoff, and are located in a highly visible location of the park. This allows every park user to observe one method to sustainable groundwater development, while other site specific interventions are located along trails in the primary drainage pattern. Eight harmful runoff inputs were identified, and all but two are now treated on-site, with suggestions for the remaining to be processed using typical sustainable stormwater strategies closer to the source.

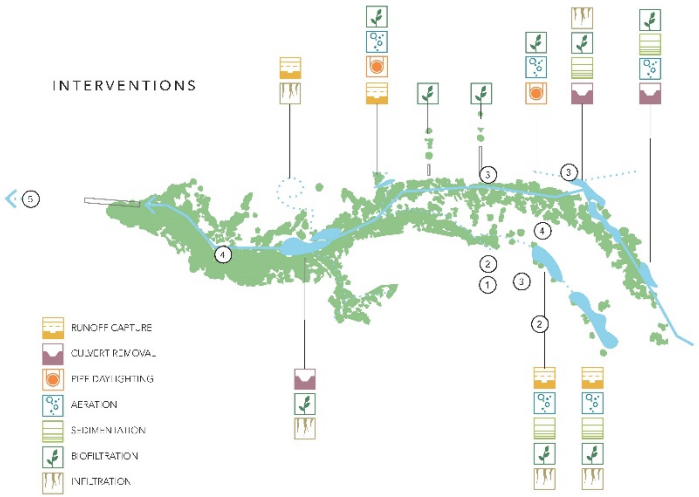
Program components follow the process of water and visit key site regions of capture, cleaning or groundwater infiltration. Paved and decomposed granite pathways span the site, giving various users the ability to bike, walk, or run throughout. Trails are marked with informative signage explaining water systems and frequently interact with water bodies via bridges and overhangs. Located near the entrance to maximize community accessibility, playgrounds for all ages, restrooms, basketball, and multiple gathering spaces cluster between topographic elements, an multi-use field, and the cleaned neighborhood runoff cells. Gathering spaces are accommodated with shade structures, trash cans, and seating in the form of picnic tables, classic benches, or "conversation" benches. A series of intimate spaces weave throughout the park, taking advantage of many of the unique zones and views. Some are located within the seasonal garden which is planted with shrubs and herbaceous perennials that sequentially bloom or offer distinct aesthetic interest throughout the year. As a conclusion for visitors who have traversed through the most developed and active site areas, a massive land art and water infiltration cell can be discovered at the northwest corner, serving as the contemplative end of the community water system experience.



SITE STRATEGIES







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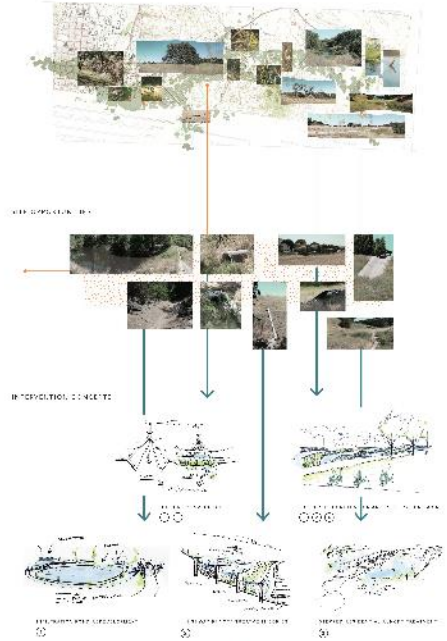
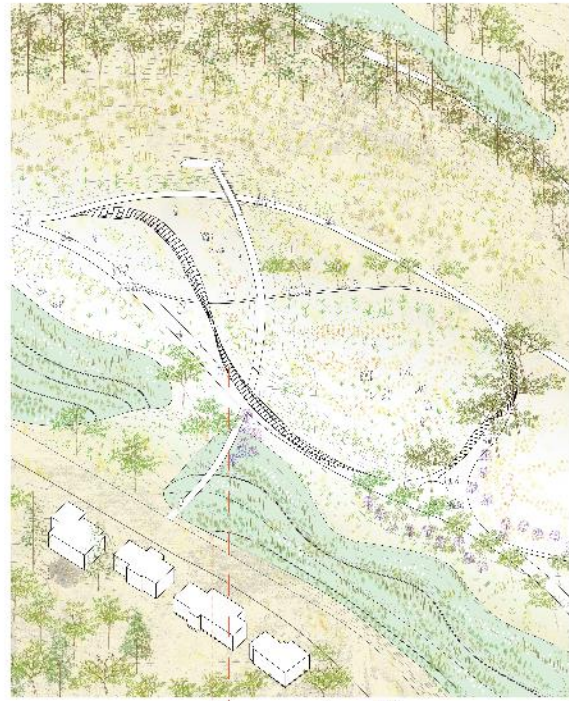
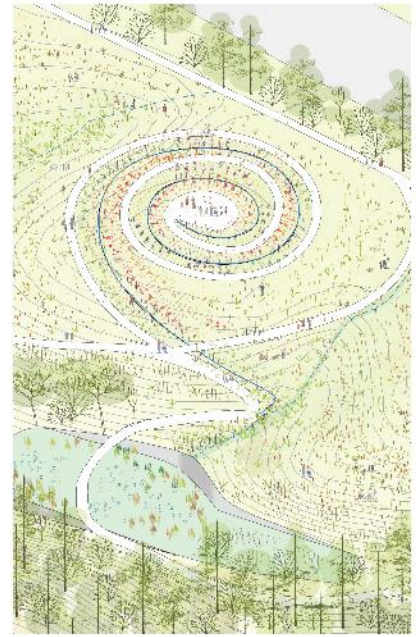
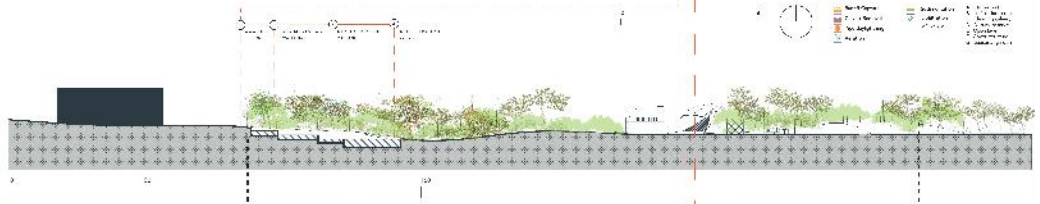
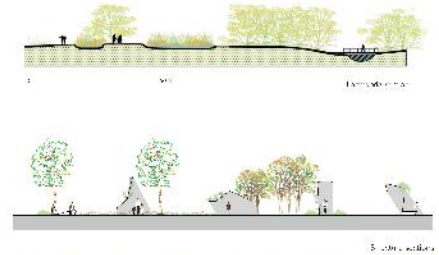
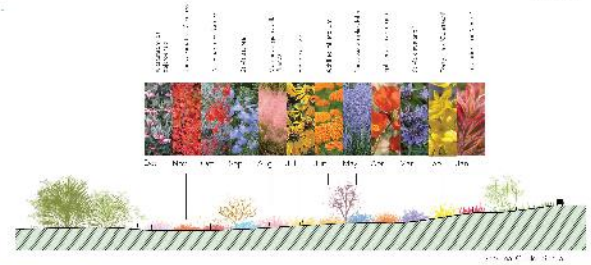












REFORMATION

ZONING:

IMPACT ON CITY OF LOS ANGELES

by July Aung and Jiyu Kang
LA438 and LA437 (3D Representation class)

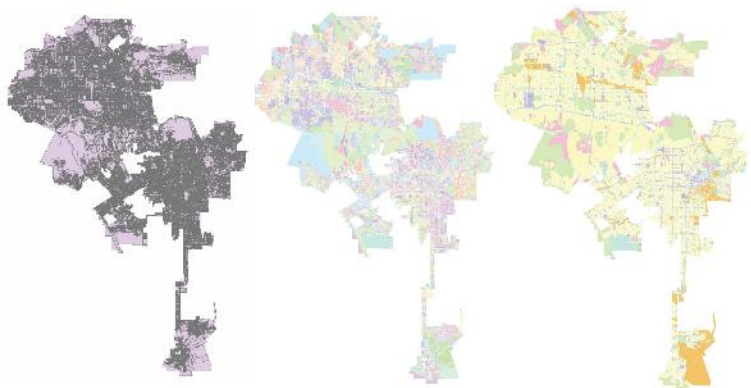
The style of virtual object was strategically chosen to show **the correlation between the zoning codes, crime rates, income level, and population density.** Thus, virtual object answers and reflects how zoning perpetuates such elements.

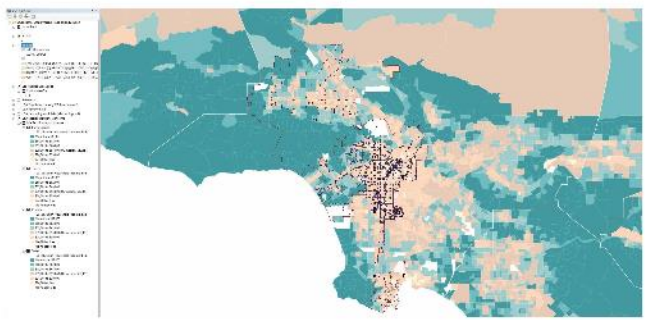
STEP 1: ZONING

Retrieve zoning codes of city of Los Angeles
(http://zeminuler2ly.org/

> Add all values to display all the different types of zoning codes throughout the city boundary
> total comes out to be 314,870 different zoning codes within the city of Los Angeles

> Group values into 6 general zoning codes
Agricultural
Commercial
Manufacturing
Open Space + Government Facilities
Residential
(https://planning.lacity.org/zone_code/Appendices/sum_of_zone.pdf)





STEP 3: INCOME LEVEL

Retreive average household income level
(https://www.arcgis.com/home/item.html?id=4911bc58c65a4de7a3839f7e3326e314)

> insert city of Los Angeles boundary shape file

> turn off all the other layers except the USA Median House hold Income

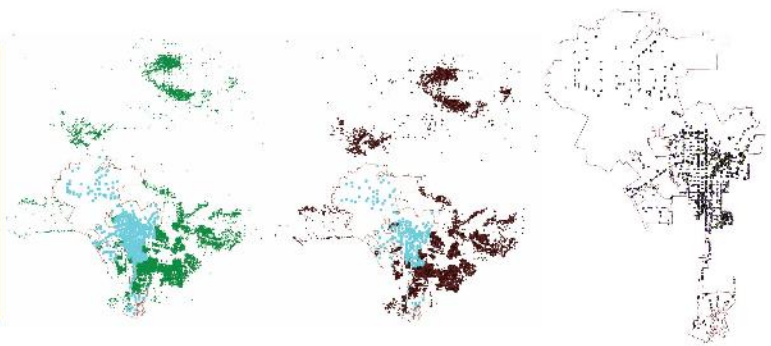
> Clip country data down to Los Angeles city boundary

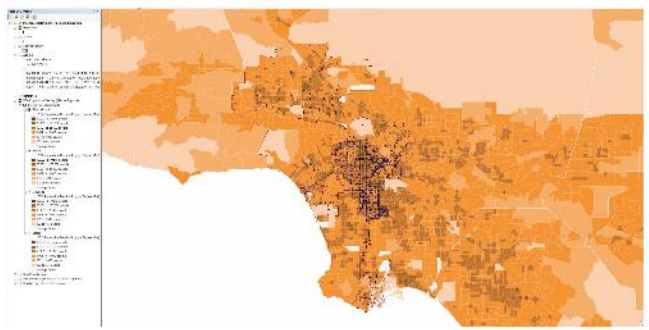
STEP 2: CRIME RATES

Retrieve crime rates throughout the city of Los Angeles
(https://www.arcgis.com/home/item.html?id=e3[illegible]a0b, https://www.arcgis.com/home/item.html?id=11a76458ee[illegible]7de903f27701e1b16c2#overview

> Insert city of Los Angeles boundary shape file
> Clip county data down to city boundary (select by location)

> Combine robbery layer with assaults layer





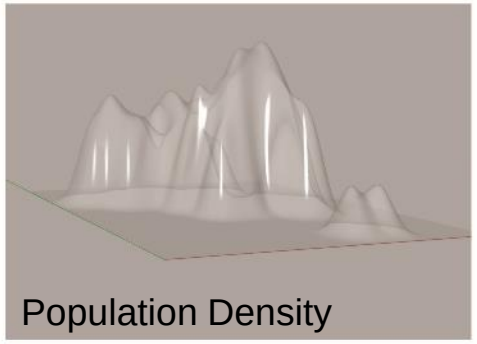
STEP 4: POPULATION DENSITY

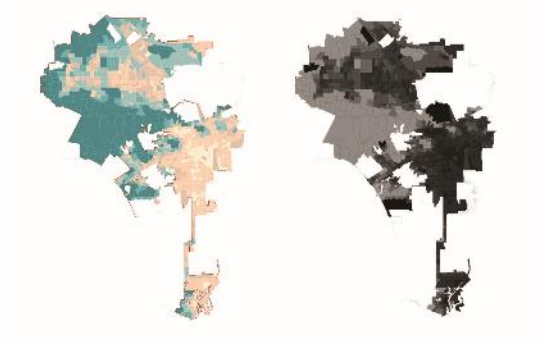
Retreive average household income level
(https://www.arcgis.com/home/item.html?id=5913b5317e6449909e4139117c96a878)

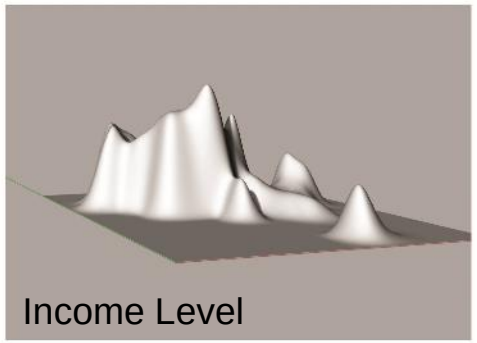
> insert city of Los Angeles boundary shape file

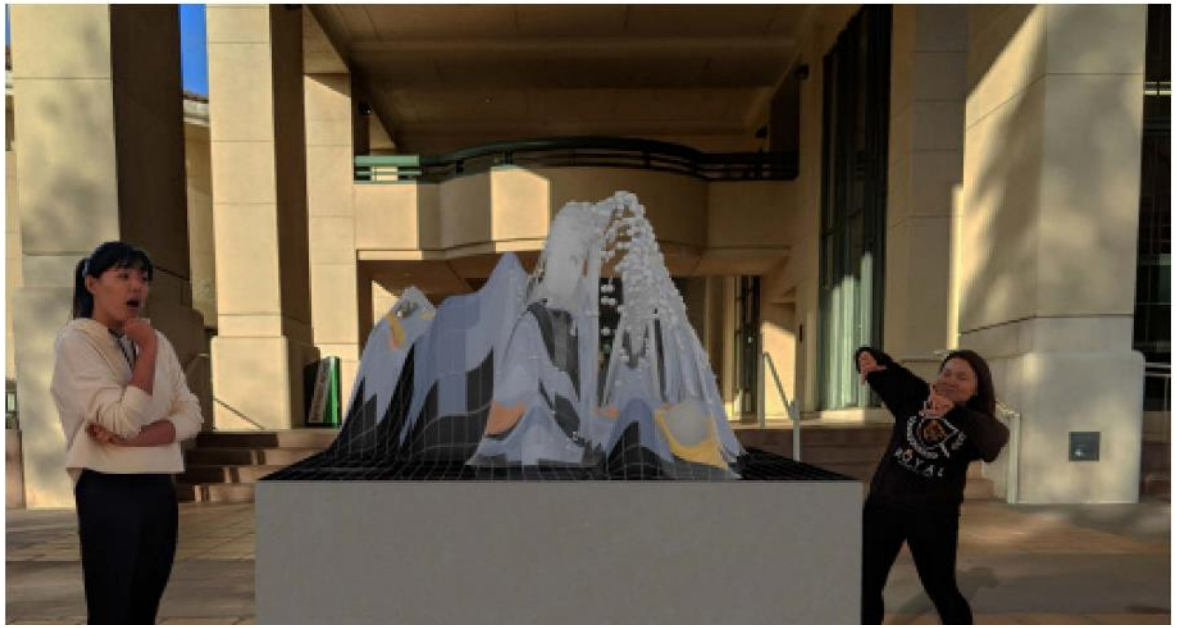
> turn off all the other layers except the USA Population Density

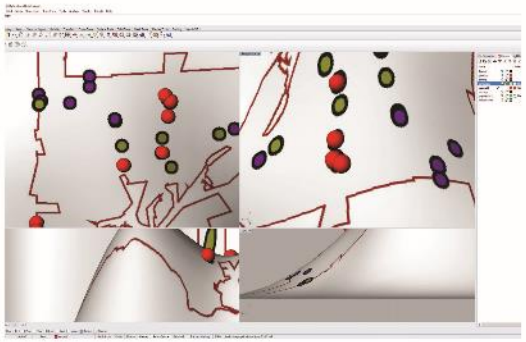
> Clip country data down to city boundary

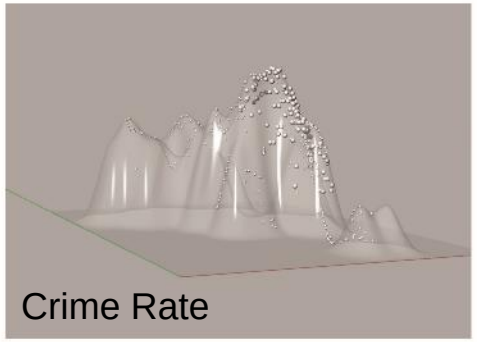

Population Density

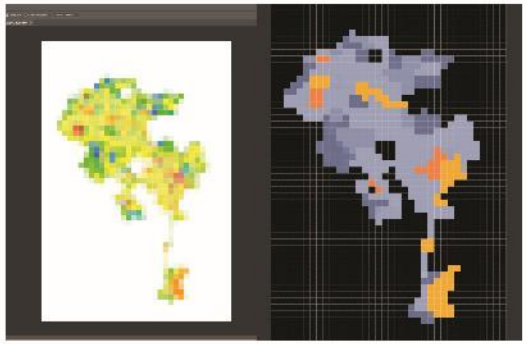


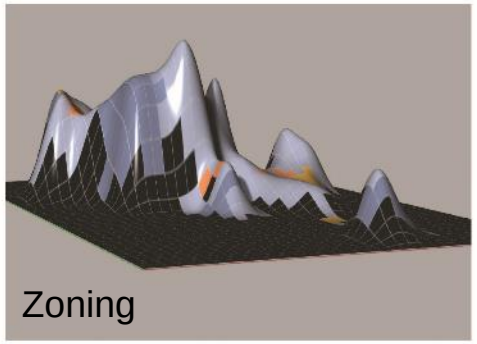

Income Level






Crime Rate

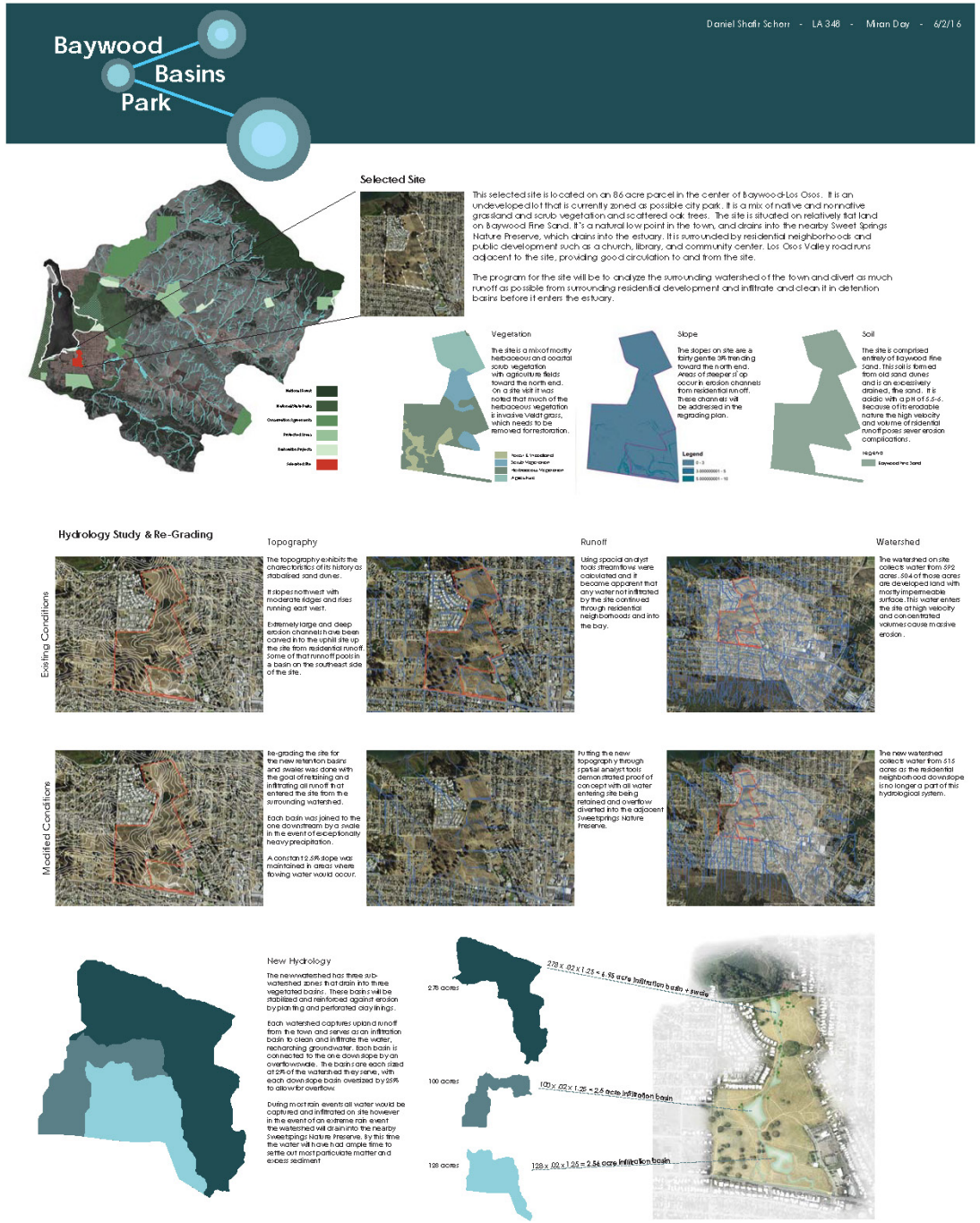



Zoning

WATERSHED AND TERRAIN MODIFICATION

Baywood Basins Park

by Daniel Shafir-Schorr
LA438 and LA403 (A design studio)

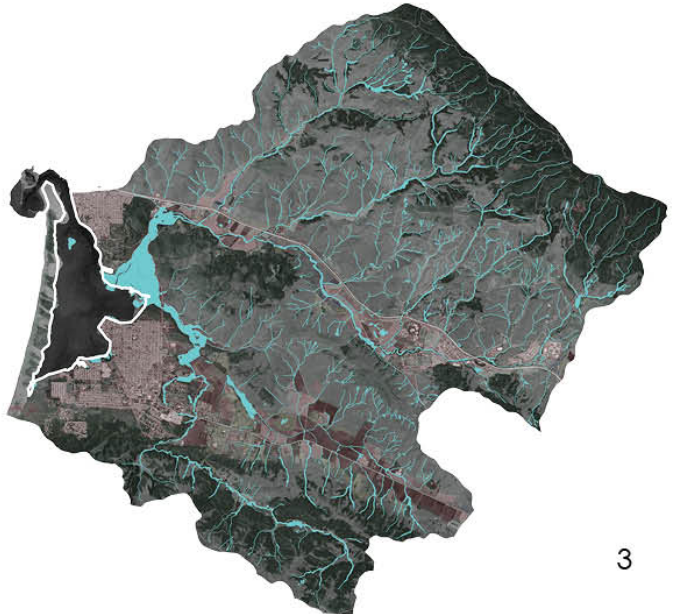


The Morro Bay Watershed

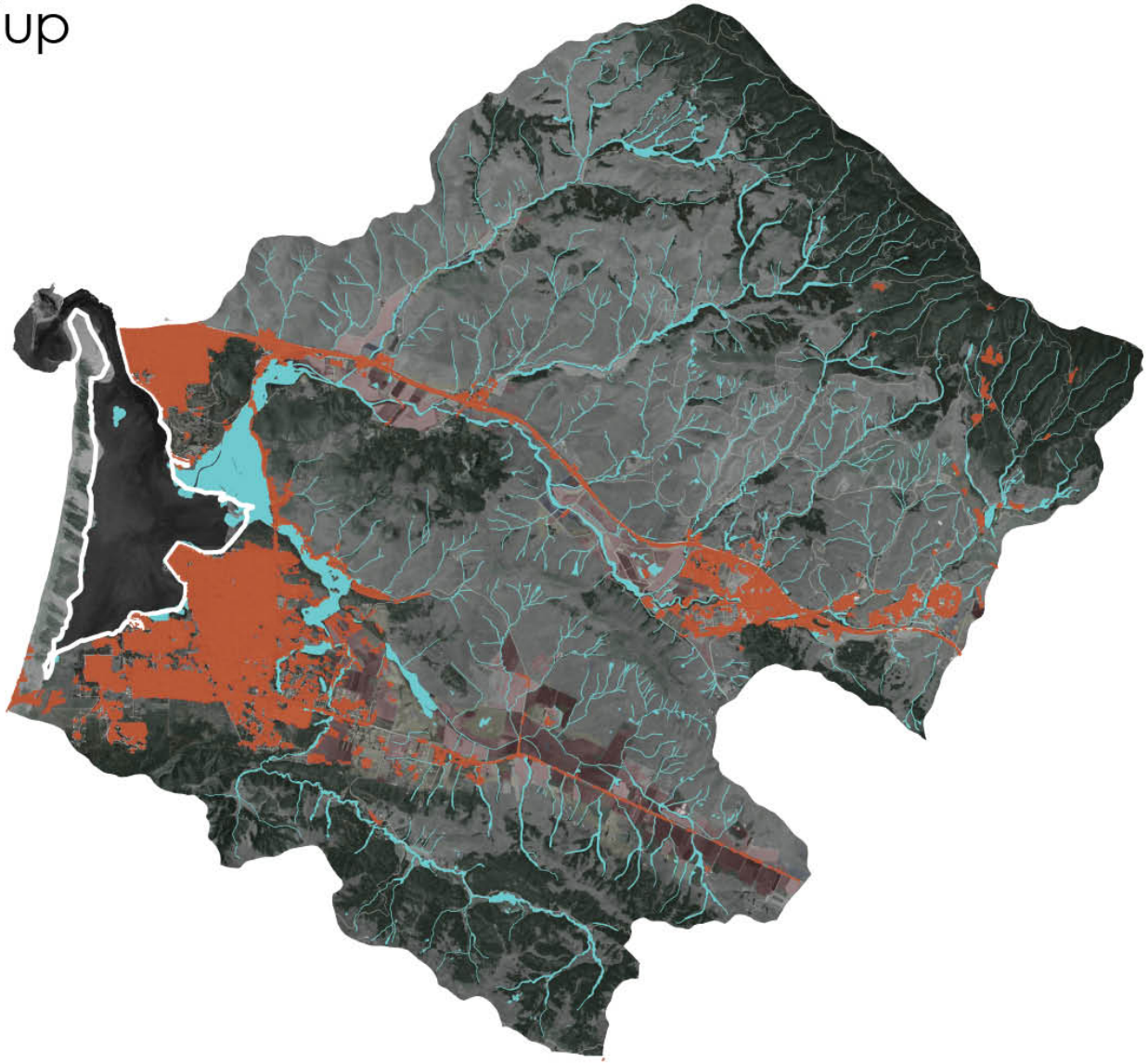
The Morro Bay watershed encompasses one of the largest and least disturbed estuaries remaining on the California coast. Where the watershed discharges into the bay a unique estuarine habitat is formed. It is serves as an important migratory stop for many birds and the estuary and surrounding watershed is home to several severely endangered endemic species.

However, the estuary has been suffering from negative environmental impacts associated with human development in the watershed. Agriculture and grazing lands release excess nitrogen and nutrients into the streams, which flow through the watershed and into the bay. Runoff from the surrounding towns of Baywood - Los Osos and Morro Bay release toxic heavy metals, hydrocarbons, and chemicals. Sedimentation from erosion has been a recurring problem, filling up parts of the bay and converting once healthy estuarine habitat into marshes and riparian woodland. These factors degrade the health of the estuary and threaten the sensitive ecosystems that it supports.

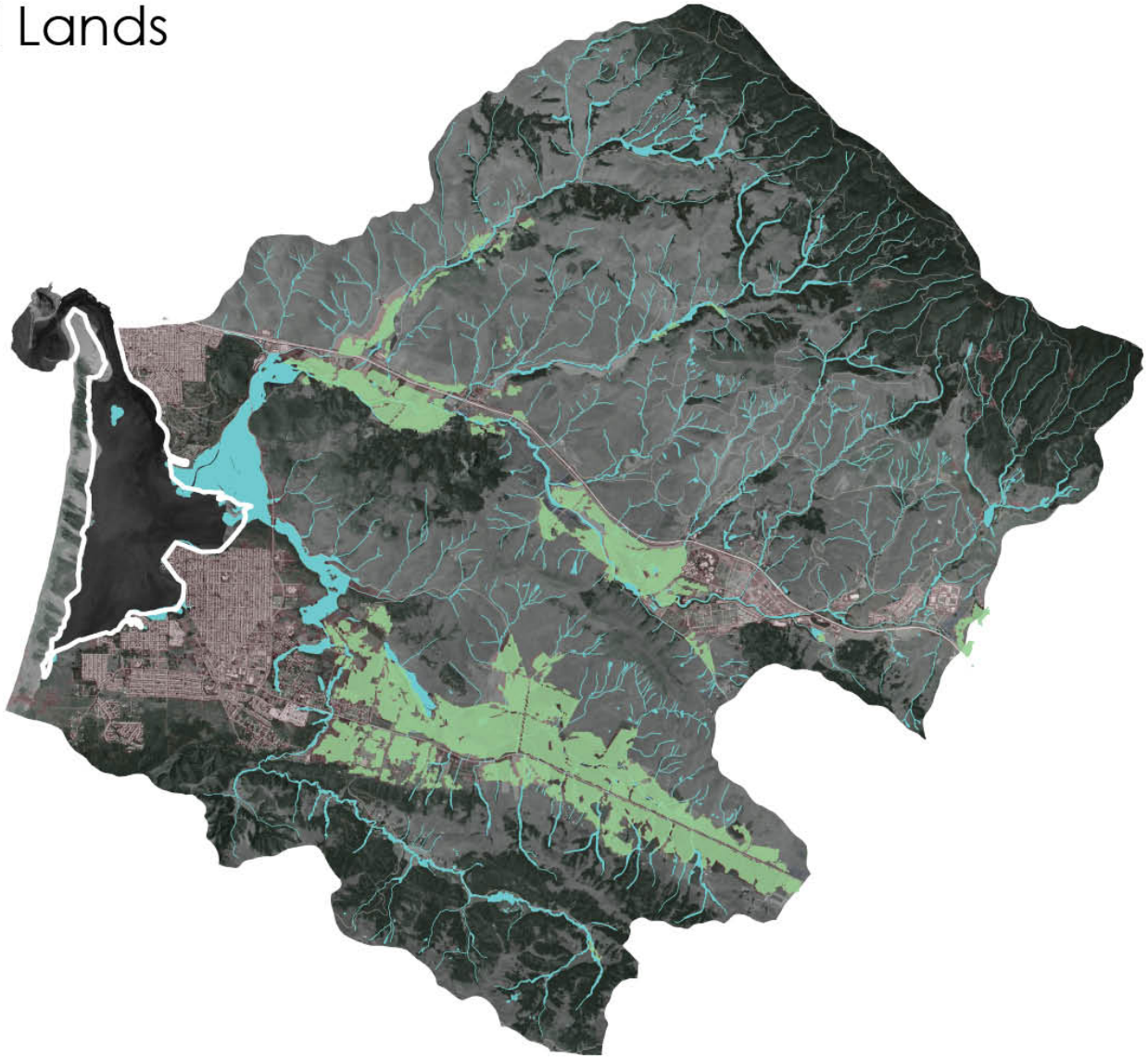
This projects' focus will be to analyze the watershed's conditions, select a focus site, and to explore develop strategies and programs on site to help mitigate the negative impacts that are affecting the bay.

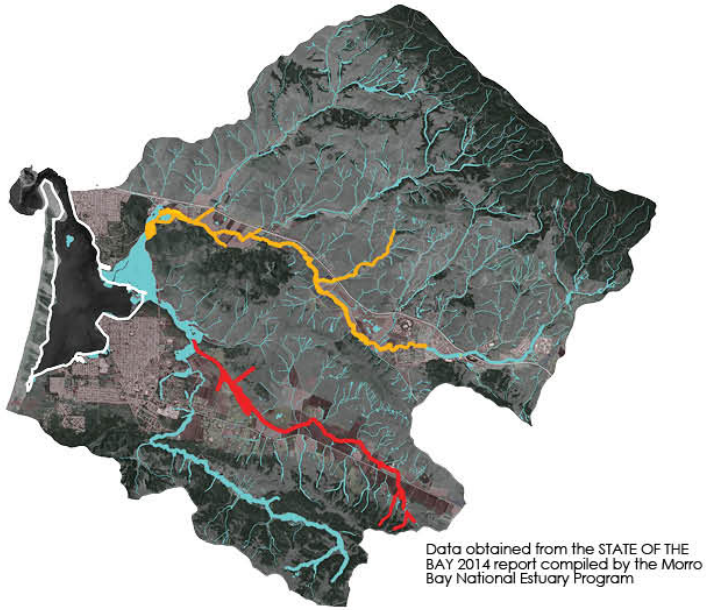


Urban Buildup



Agricultural Lands



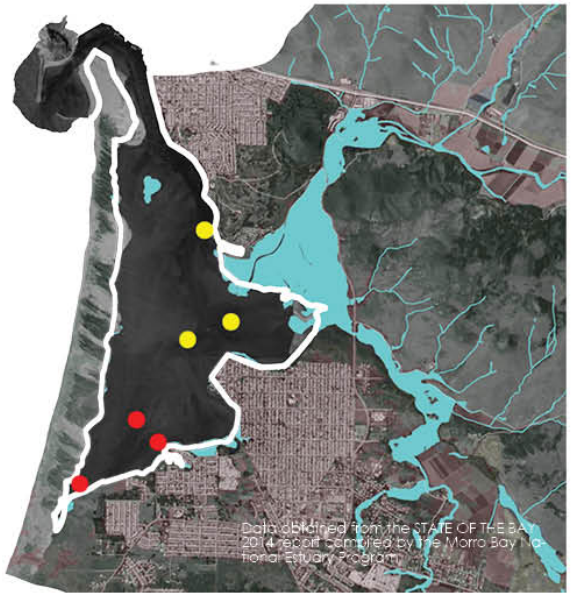


Creek Nitrate Levels

This map shows the streams that are heavily impacted by high nitrate levels.

The most heavily impacted areas are most of Chorro Creek and areas of Warden Creek. They correspond directly with zones of intense agricultural and pasture land.

Methods to reduce nitrate loads include reducing excess fertilization and putting up cattle fencing around streams in conjunction with providing alternate sources of water for grazing livestock.

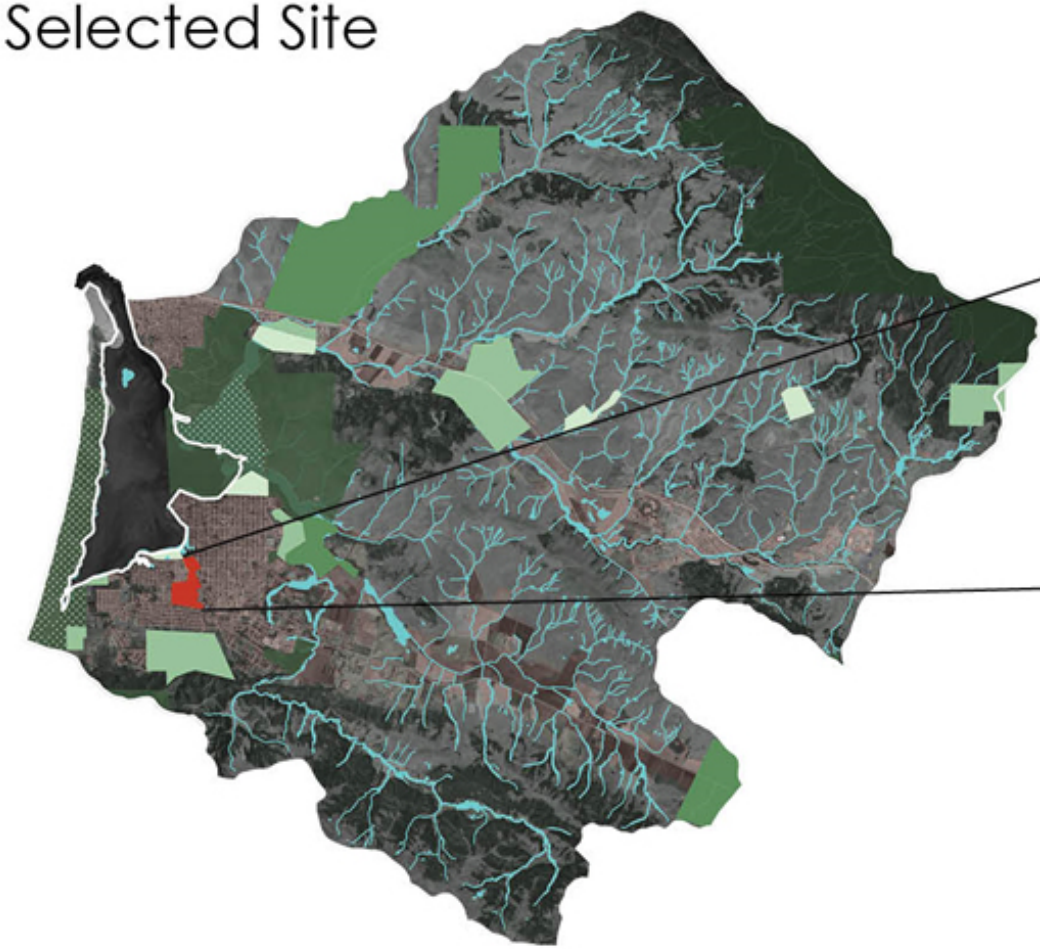


Dissolved Oxygen Levels

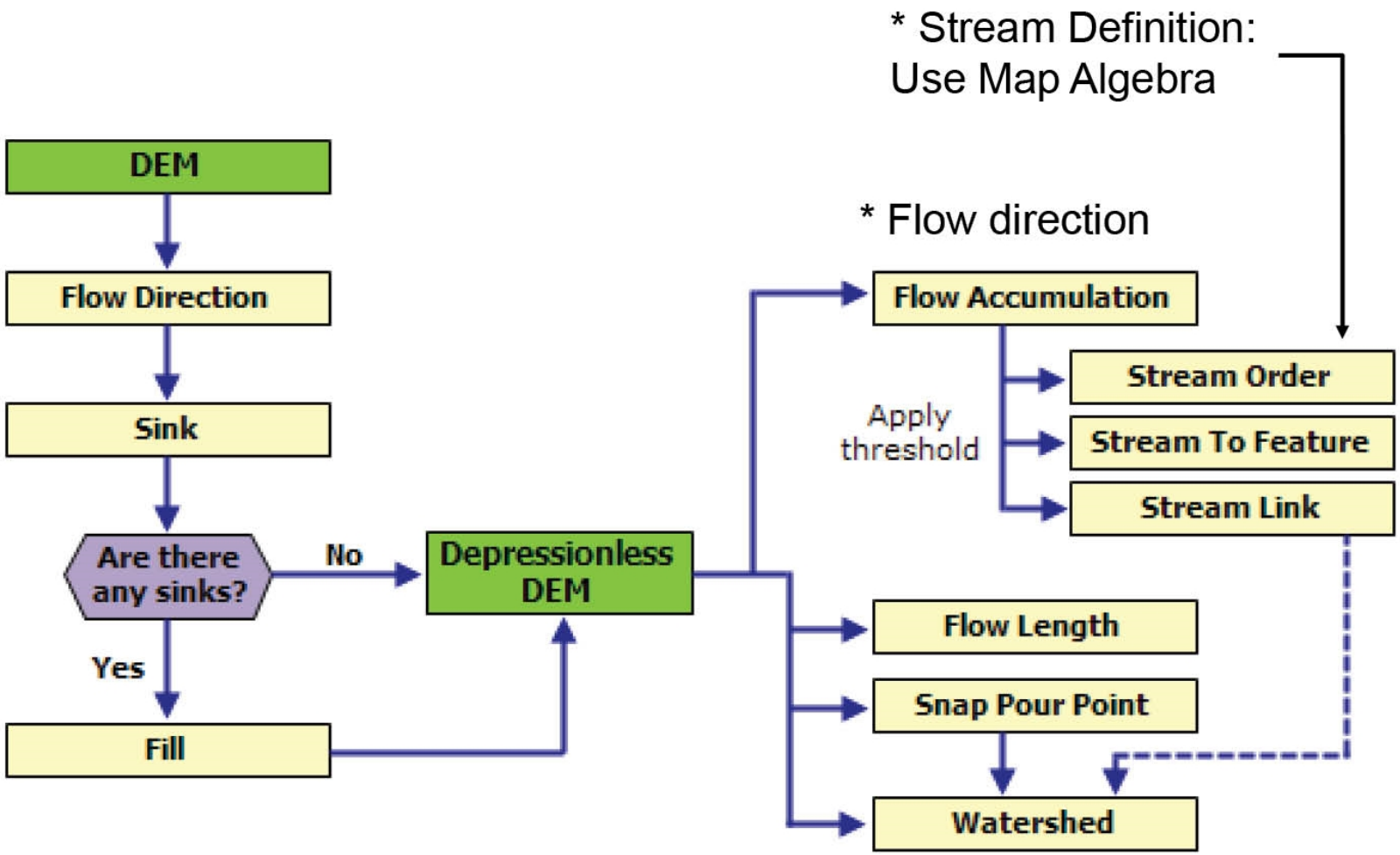
Dissolved oxygen levels spot checked in the bay show depleted levels throughout most of the bay and severe depletion levels at the south end. This is in part due to th natural formation of the bay at that end but human activity exacerbates the situation.

Warmer water holds less dissolved oxygen and the increased sedimentation decreases water depth and raises water temperatures. This combined with excess nutrients from agriculture promoting algae growth promotes dead zones of low oxygen content.

Selected Site

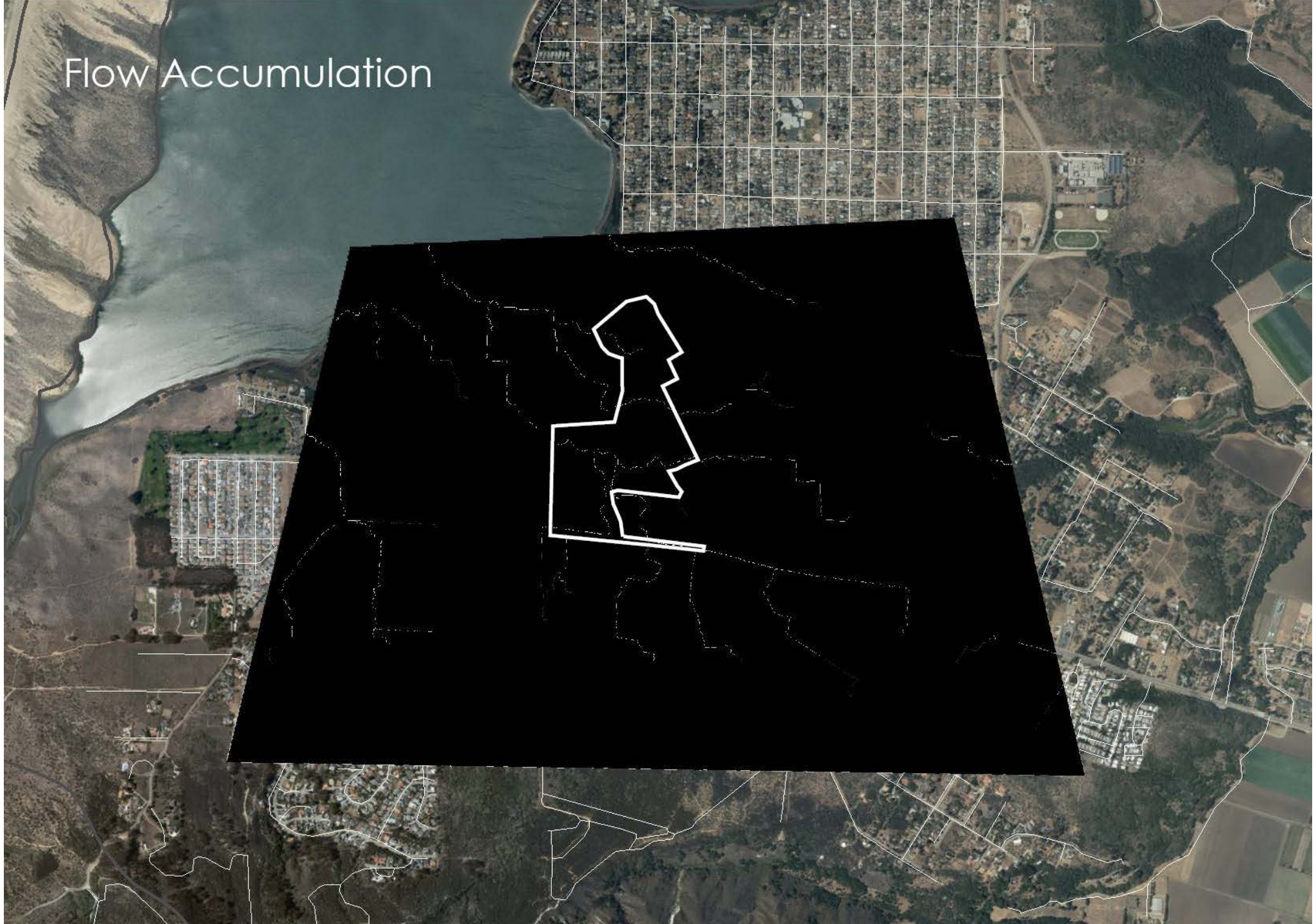


Hydrology Tools

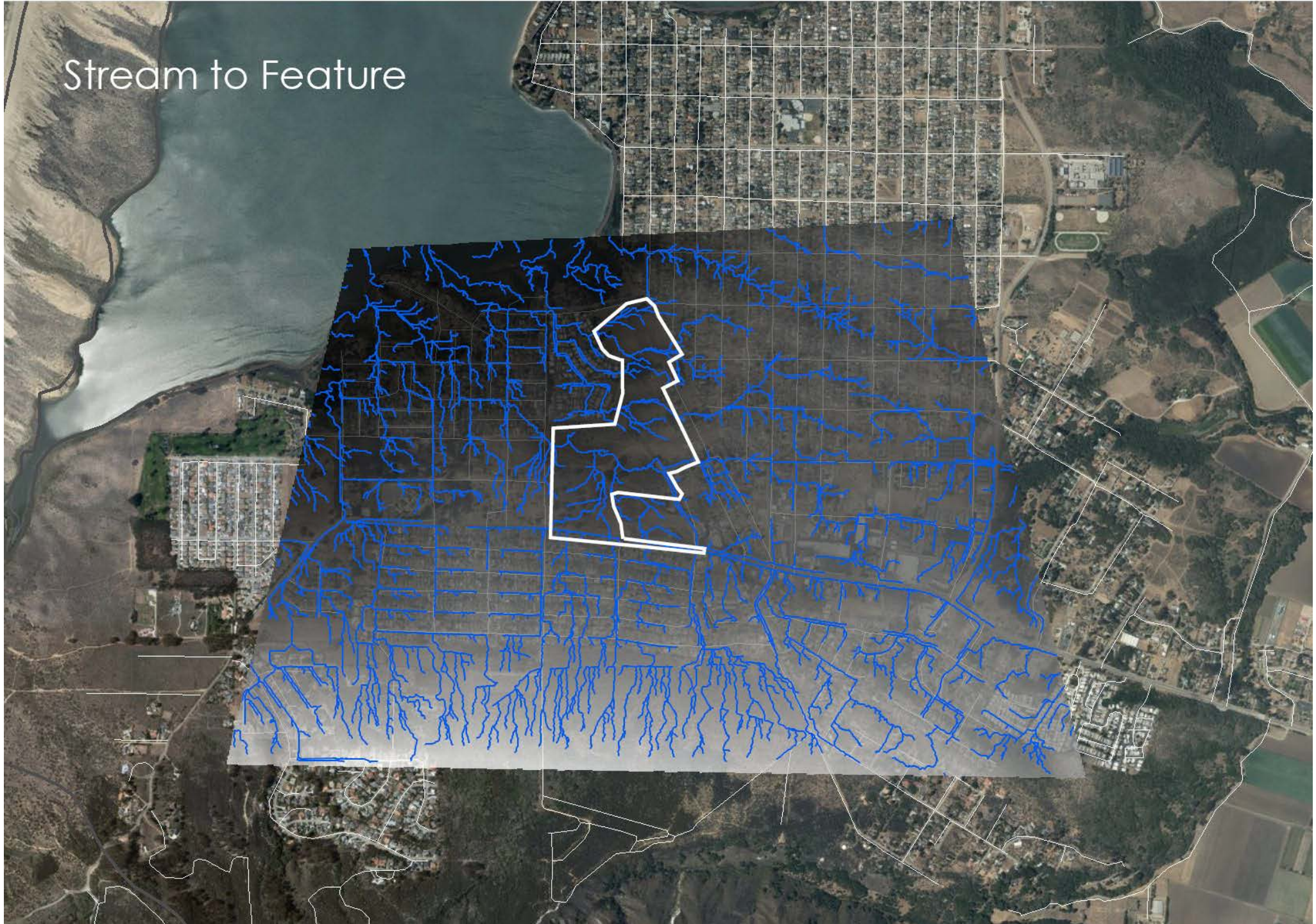



1m DEM

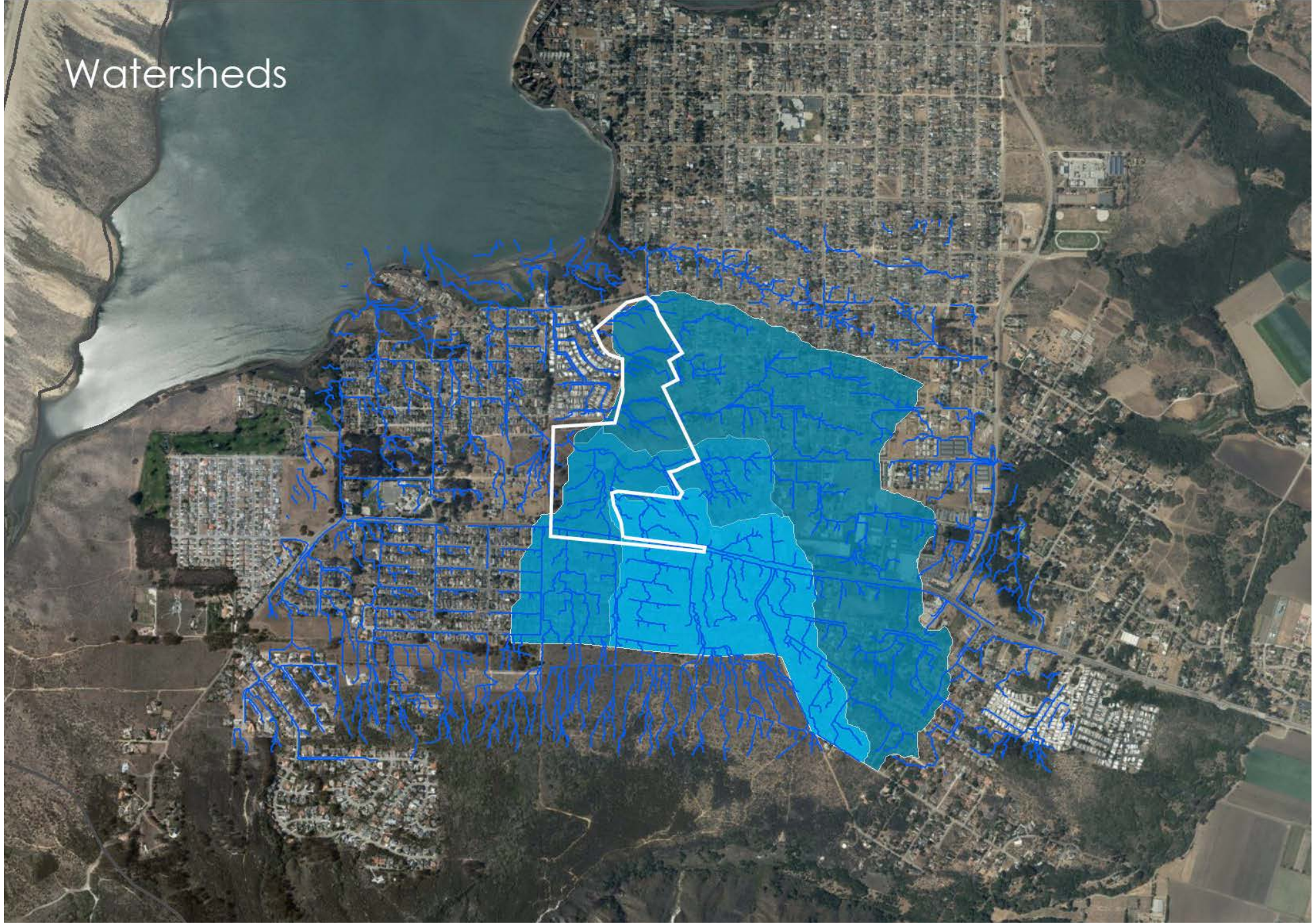
Flow Accumulation



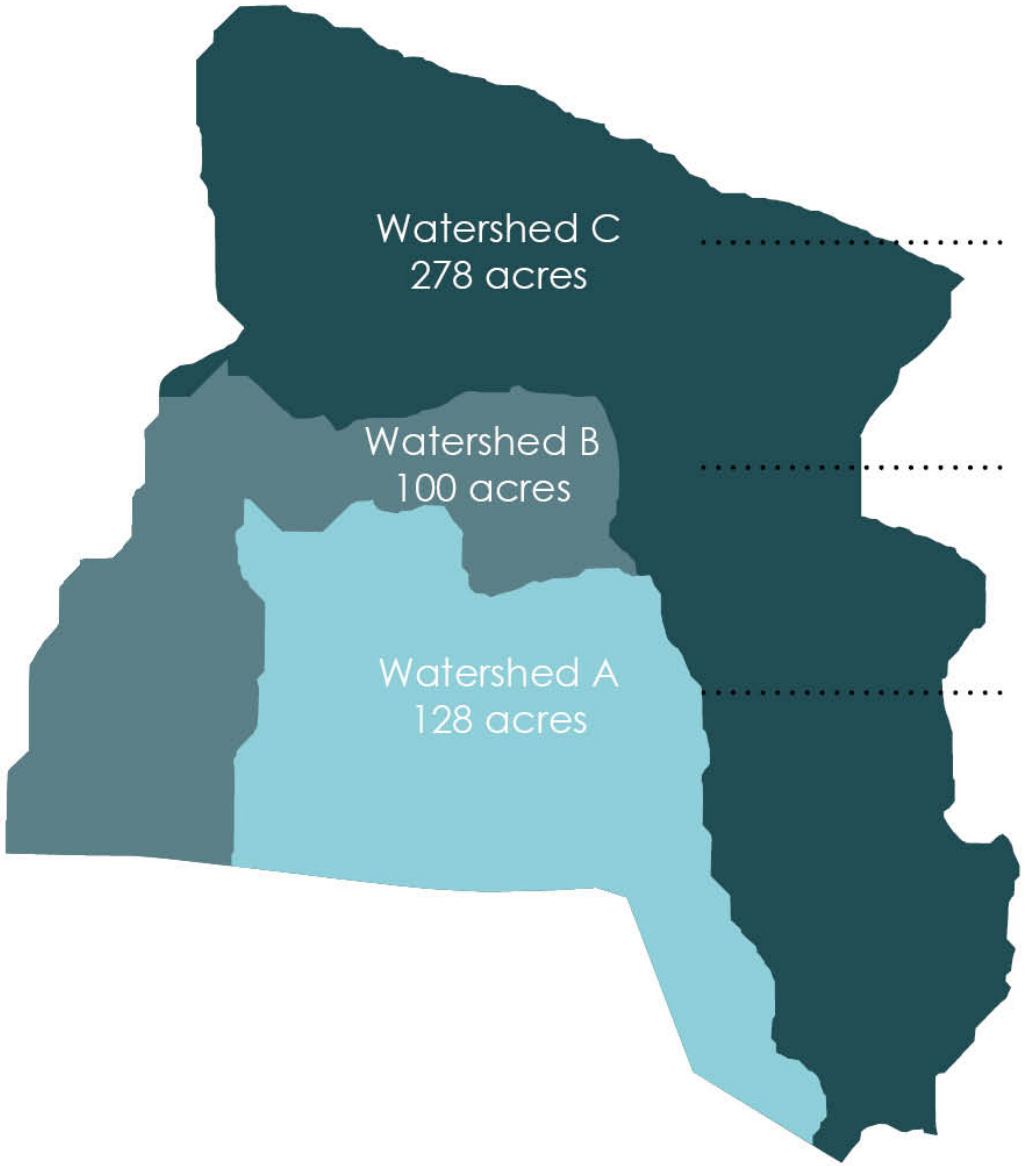
Stream to Feature



Watersheds



Basin Formation



= 6.95 acre Basin & Swale

= 2.5 acre Basin

= 2.56 acre Basin

Existing Topography

Re-Graded Topography

SURVEY

- What problem did you solve with GIS?
- What types of geospatial analysis did you use?
- What are your findings or results?
- **Advantages of GIS in Design**
- **Challenges of GIS in Design**

FINDINGS

Advantages of GIS in Design

- **Base map development to scale**
- **Understanding of site conditions – site analysis**
- Understanding of spatial relationships
- Methodical and rational process
- In depth research and site selection
- Data driven design
- Interactive and visualization of patterns and systems
- Broad area coverage – almost every city and town contribute to the data

FINDINGS

Challenges of GIS in Design

- **Finding and acquiring data applicable to design projects**
- **Quality of data**
- **Correlation between data and design**
- Handling of data
- Easy to forget importance of non-spatial information

GIS Program Challenges

- **Understanding of the broad range of tools and steps**
- Computer system slow down and network connection
- Program configuration: layout capabilities, functions, icons, etc.
- Unstable conversion process

WORKS CITED:

McHarg, I. L. (1992). *DESIGN WITH NATURE.* Hoboken, New Jersey: John Wiley & Sons, Inc.

Corner, J. (1999). The agency of mapping: speculation critique and invention. In D. Cosgrove, *Mappings* (pp. 213-300). London: Reaktion Books.

THANK YOU

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QUESTIONS and COMMENTS