Wilson Center
LATIN AMERICAN PROGRAM

USAID
DEL PUEBLO DE LOS ESTADOS UNIDOS DE AMÉRICA

Presentado en el seminario:

Cambio Climático y Cuencas Hidrográficas Vulnerables en los Andes: discusión entre tomadores de decisión sobre gobernanza y capacidad institucional

21 de mayo de 2015

8:00 – 17:00

Lima, Perú

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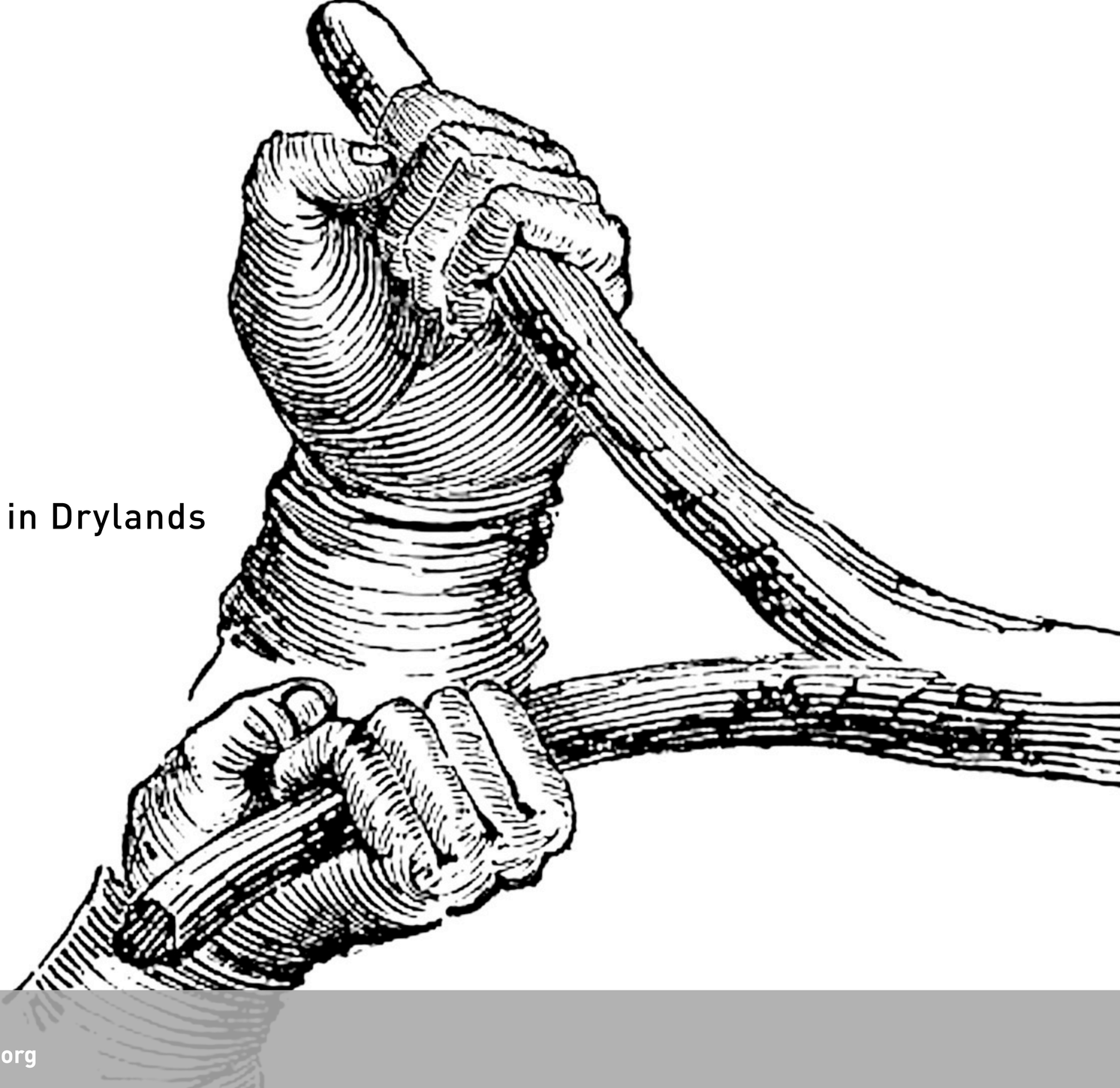
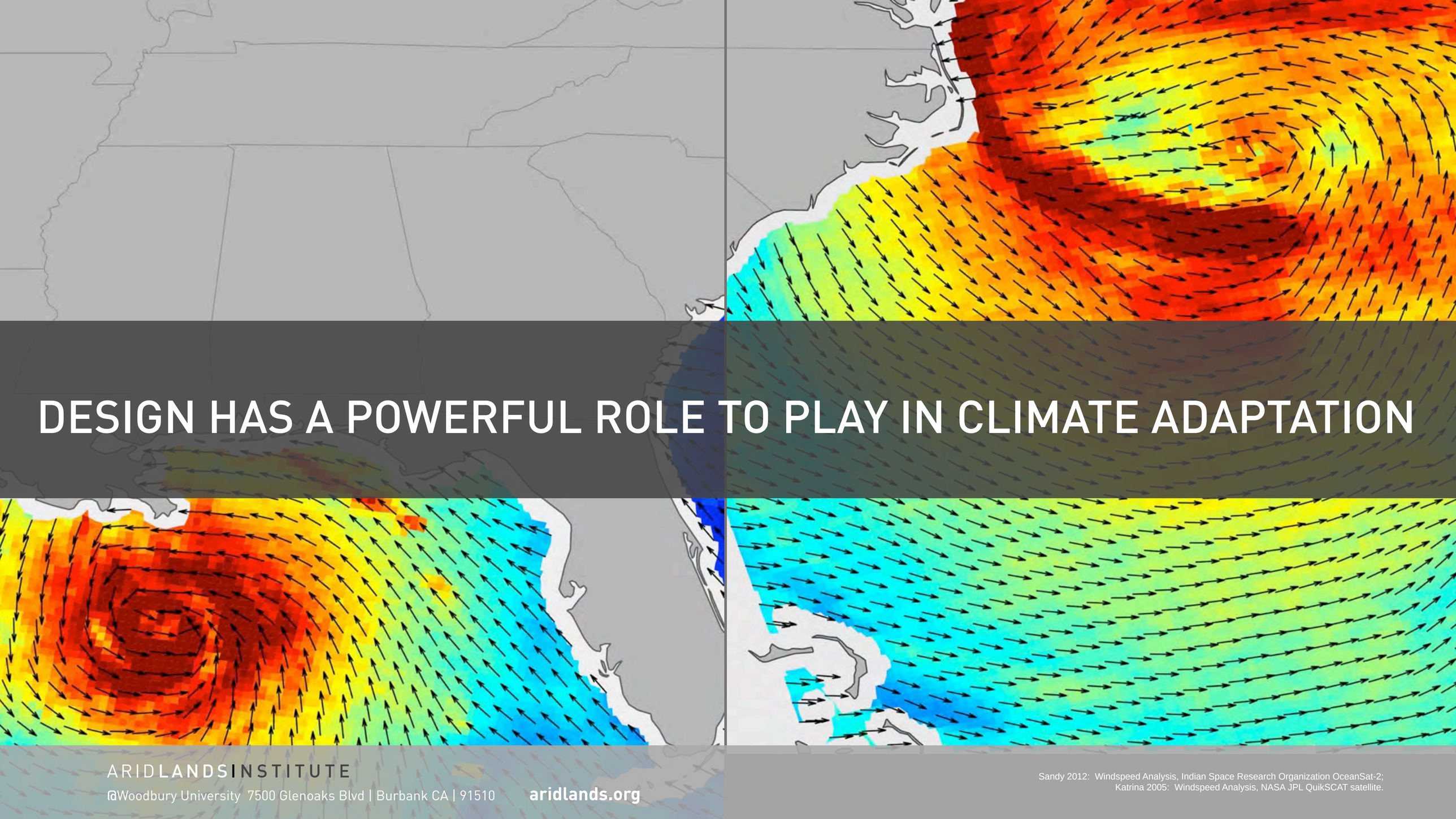
@ Woodbury University

aridlands.org

Designing Sponge Cities:
Climate Challenges and Opportunities in Drylands

Hadley Arnold, Executive Director
hadley.arnold@aridlands.org





DESIGN HAS A POWERFUL ROLE TO PLAY IN CLIMATE ADAPTATION

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Sandy 2012: Windspeed Analysis, Indian Space Research Organization OceanSat-2;
Katrina 2005: Windspeed Analysis, NASA JPL QuikSCAT satellite.

DRYLANDS RESILIENCE INITIATIVE [DRI]:
CAPACITY BUILDING IN THE FACE OF CLIMATE CHANGE

PROBLEM DEFINITION

1

WATER IS CHANGING:

HYDROLOGIC VARIABILITY;
WATER-ENERGY NEXUS;
SOCIAL VULNERABILITY;

PROPOSED SOLUTIONS

2

NEED FOR:

COLLABORATION ACROSS DISCIPLINES; NEW TOOLS;
BETTER INFORMATION;
LOCALIZATION OF SUPPLY

PROTOTYPING and MAKING

3

ITERATIVE PUBLIC PROCESSES:

DATA INTEGRATION;
TOOL DEVELOPMENT & TESTING;
ENGAGING COMMUNITIES;
VISUALIZING OUTCOMES;
REFINING TOOLS

WIDE-SCALE ADOPTION

4

DIVINING LOS ANGELES:

FUNDED PARTNERSHIPS:
DEMONSTRATION PROJECTS;
REPLICABILITY; SCALEABILITY;
SHAPING POLICY;
PATHS TO IMPLEMENTATION

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Photo: Los Angeles, CA 1850

Photographer Unknown, Source: waterandpower.org

Map: Los Angeles City Map No 1, 1850

Los Angeles City Map No 1, Ord Survey, 1849, Los Angeles Public Library

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Photo: Lima, Peru 1870

Photographer Unknown, Source: Library of Congress

Map: Lima, Peru. 1674

Planta de la muy yllustre ciudad de los reyes corte del reino del Peru, Principe, Bernardo Clemente, 1674

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Urban Fabric, Los Angeles, CA

Google Earth

Urban Fabric, Lima, Peru

Google Earth

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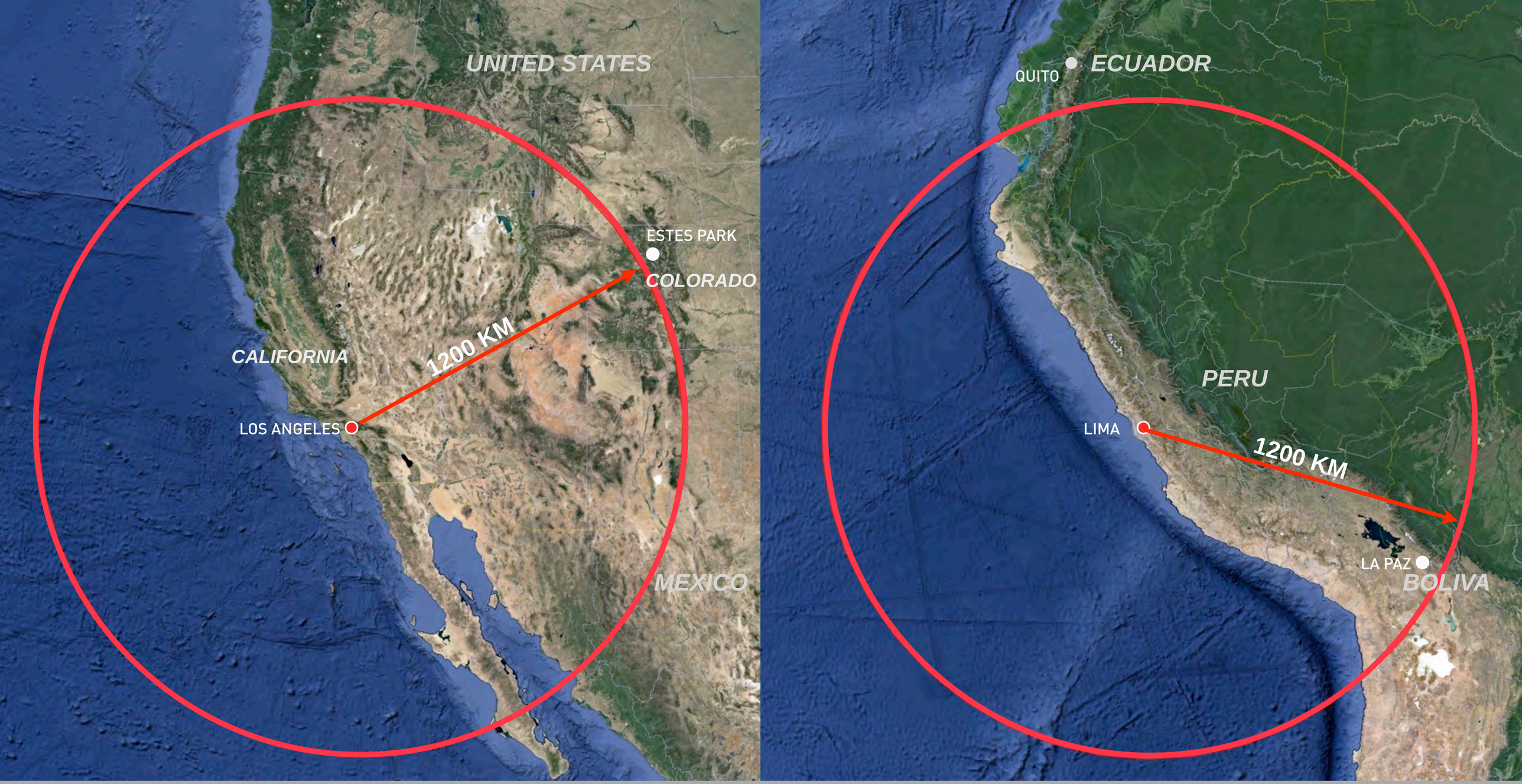
1

PROBLEM DEFINITION

GLOBAL WATER CYCLE IS CHANGING



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“CALIFORNIA’S **‘DISMALLY MEAGER’ SNOWPACK** SIGNALS MORE **DROUGHT**”

CA DWR, in National Geographic, Jan. 30, 2015

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PREPARE FOR HYDROLOGIC VARIABILITY.

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UNCOUPLE THE WATER + ENERGY NEXUS

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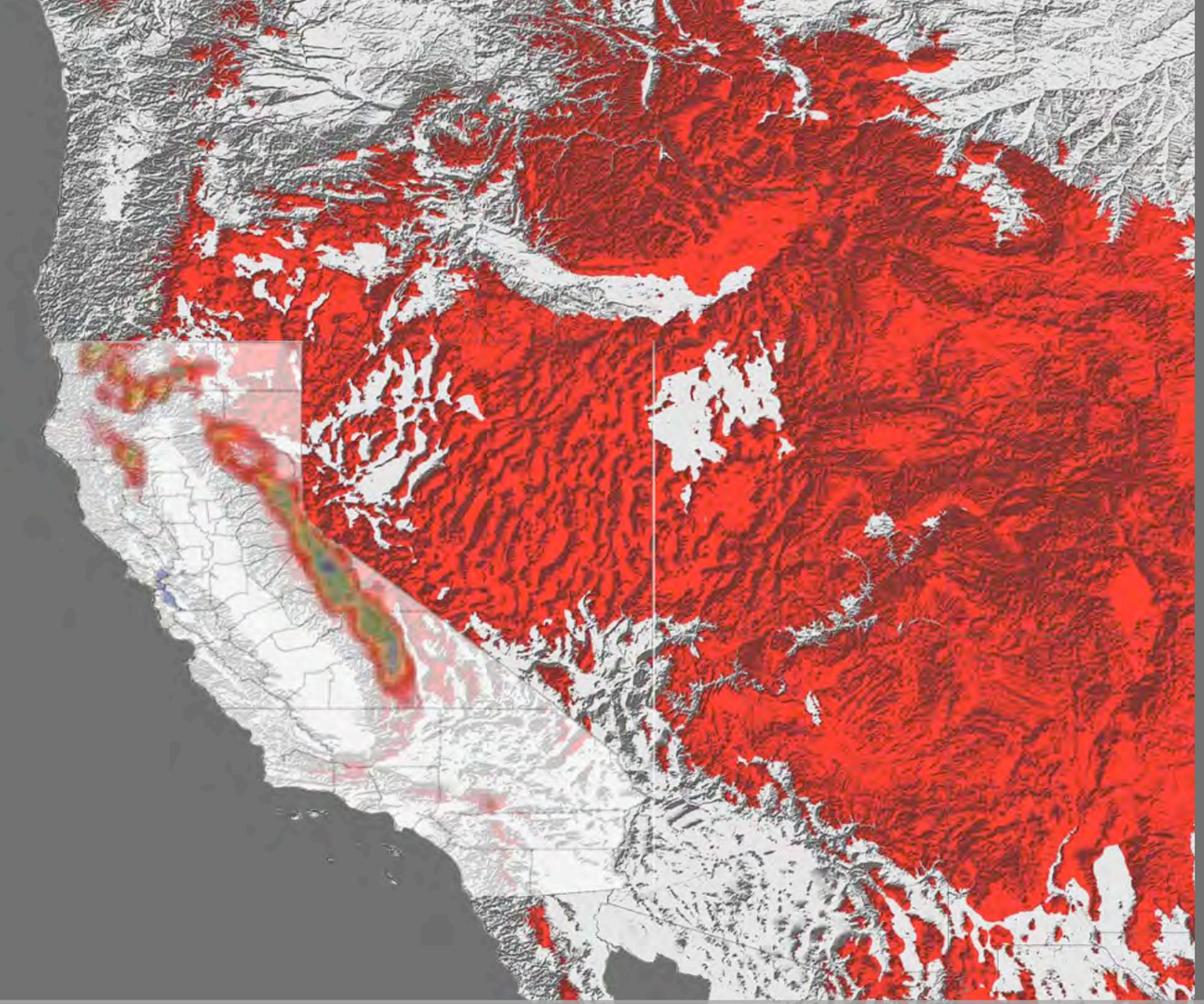
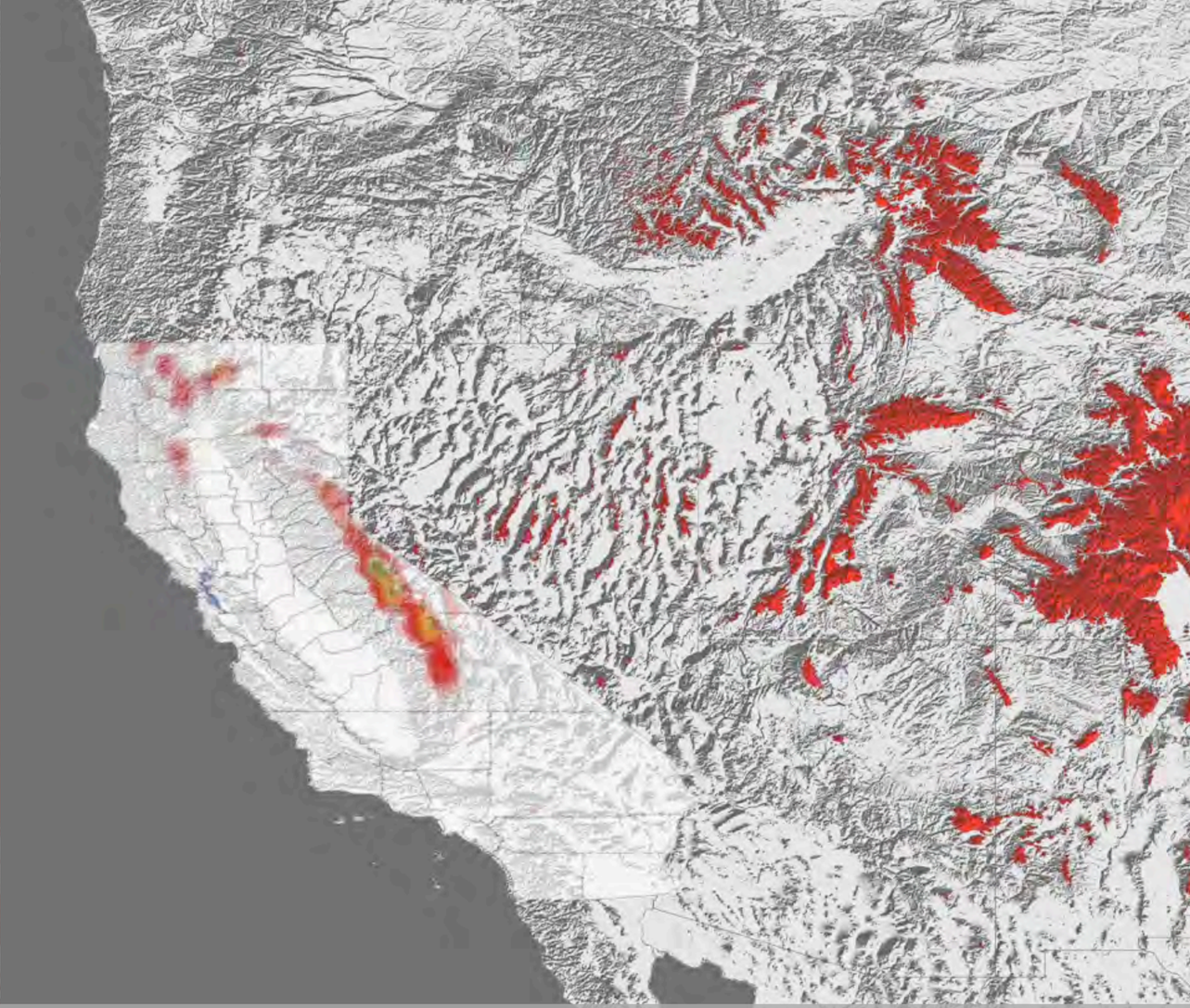


1850- 1990:
Snow Pack Levels

GIS Analytic Modeling: Arid Lands Institute
CA_Water Plan_2009: Potential Impacts on California's Water Supply



2010 - 2060:
Snow Pack Levels
[projected]

GIS Analytic Modeling: Arid Lands Institute
CA_Water Plan_2009: Potential Impacts on California's Water Supply

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Los Angeles Times

In a region that imports water, much goes to waste

By Bettina Boxall, Los Angeles Times

December 24, 2010

The L.A. River cascades under the Anaheim Street bridge on its way to Long Beach Harbor
(Brian van der Brug / Los Angeles Times / December 23, 2010)

Tens of billions of gallons of runoff went into the Pacific Ocean.

It is one of the Southland's enduring contradictions. The region that laid pipe across hundreds of miles and tunneled through mountains to import water also built an extensive storm drain system to get rid of rainfall as quickly as possible.

That's exactly what happened during the last week, when tens of billions of gallons of runoff that could lessen the region's need for those faraway sources were dumped into the Pacific. Enough water poured from Los Angeles streets to supply well over 130,000 homes for a year.

As Southern California's traditional water supplies diminish under a variety of pressures, all that runoff sheeting across sidewalks and roads into the maws of storm drains is finally getting some respect.

"This isn't wastewater until we waste it," said Noah Garrison, an attorney with the Natural Resources Defense Council who co-wrote a 2009 paper on capturing and reusing storm water.

The report concluded that the region could increase local supplies by an amount equal to more than half of Los Angeles' annual water demand by incorporating relatively simple water-harvesting techniques in new construction and redevelopments. These include installing cisterns and designing landscaping to retain runoff and let it seep into the ground.

Los Angeles is poised to adopt an ordinance that takes a step in that direction. Most new and redeveloped commercial, industrial and larger apartment projects would have to be designed to capture the runoff generated by the first three-quarters of an inch of rain. New single-family homes would have to install a rain-harvesting device, such as a rain barrel or a hose that diverts water from gutters to landscaping.

But the proposed rules would save only a fraction of the city's runoff. "If we're able to convince people to do it on their own, there's so much more" that can be captured, said Los Angeles Public Works Commissioner Paula Daniels. "The really important thing to do is unpave and change the texture of Los Angeles."

Water-quality regulations, which are clamping down on runoff pollution, are another big impetus for changing attitudes. In South Los Angeles, the city is converting a former bus depot into a nine-acre wetland park that will retain and filter runoff, keeping contaminants out of the L.A. River.

"I believe we will be able to start changing the footprint of the city to make it more water-friendly and hopefully look at storm water as a resource and a benefit," said Adel H. Hagekhalil, assistant director of the L.A. Bureau of Sanitation.

The storm system dumped copious amounts of snow — at least 10 to 12 feet and in some spots far more — in the Sierra Nevada, washing away vestiges of a three-year drought that ended last year. Statewide, 61% of the snowpack, or snow water content, normally measured on April 1 is already on the ground. Storage at most major reservoirs is well above average for this time of year. Dam operators have been releasing water to make sure they have enough space for inflow later in the season.

Managers are cautioning that snow and rain usually taper off in early winter under the La Niña weather conditions expected this year. "The characteristics, unfortunately, of La Niñas are generally a pretty good start and then a frequent lapse. Quite often January, February do not measure up," said Frank Gehrke, chief of the California Cooperative Snow Surveys Program.

But even if they don't, state hydrologist Maury Roos said California has been so thoroughly soaked this month that the year's water supplies will probably be above average.

In the Eastern Sierra, which supplies Los Angeles with a portion of its water, some Department of Water and Power stations have registered eye-popping measurements. At Independence, precipitation as of Tuesday was 549% of the norm for this time of year. Some areas were buried under snow depths usually not seen until the end of the winter.

James McDaniel, the DWP's senior assistant general manager, said the snowpack at Mammoth Pass had shot up to the levels of 1982-83, one of California's wettest winters. "We'll need more storms later in the season to build on that," he said, adding: "There's no denying this is a great beginning to the season."

The Metropolitan Water District of Southern California, which imports water from Northern California and the Colorado River, is refilling local reserves that had dwindled to levels that forced the agency to cut sales to member agencies.

"I think we're feeling a lot more comfortable about the availability of water supplies," said Debra Man, the MWD's assistant general manager. Still, she said the agency was not ready to scratch allocations that have reduced demand by more than 20%. "I think we're going to wait and see what January, February and March look like."

McDaniel also said L.A. would wait until winter's end before deciding if it would lift the water rationing imposed during the three-year drought. "Statewide storage has recovered well," he said. "But the piece of the puzzle that is not where we'd like to see it is the Colorado River," a source stuck in a long-term drought.

TREAT STORMWATER AS SUPPLY.

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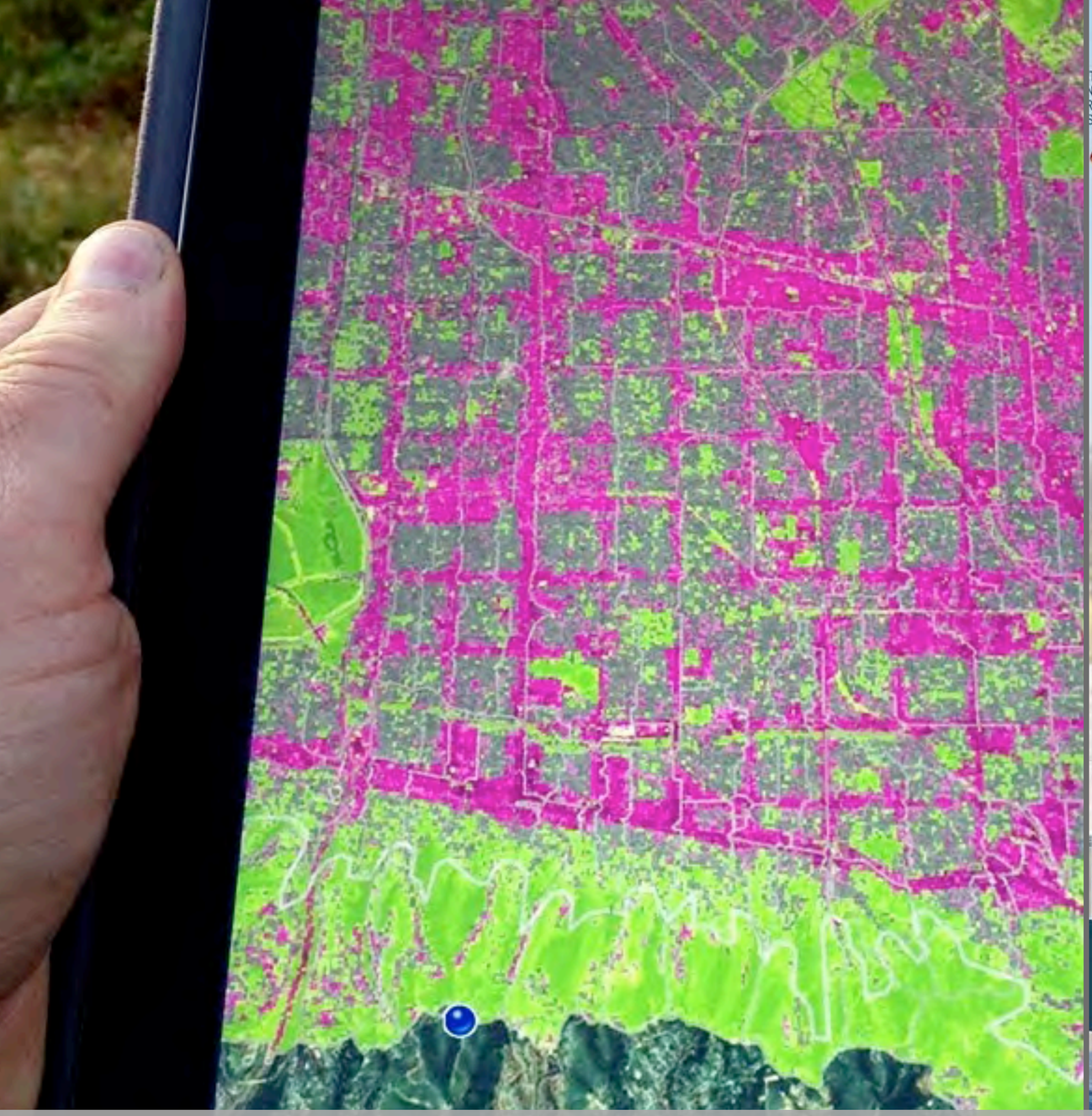
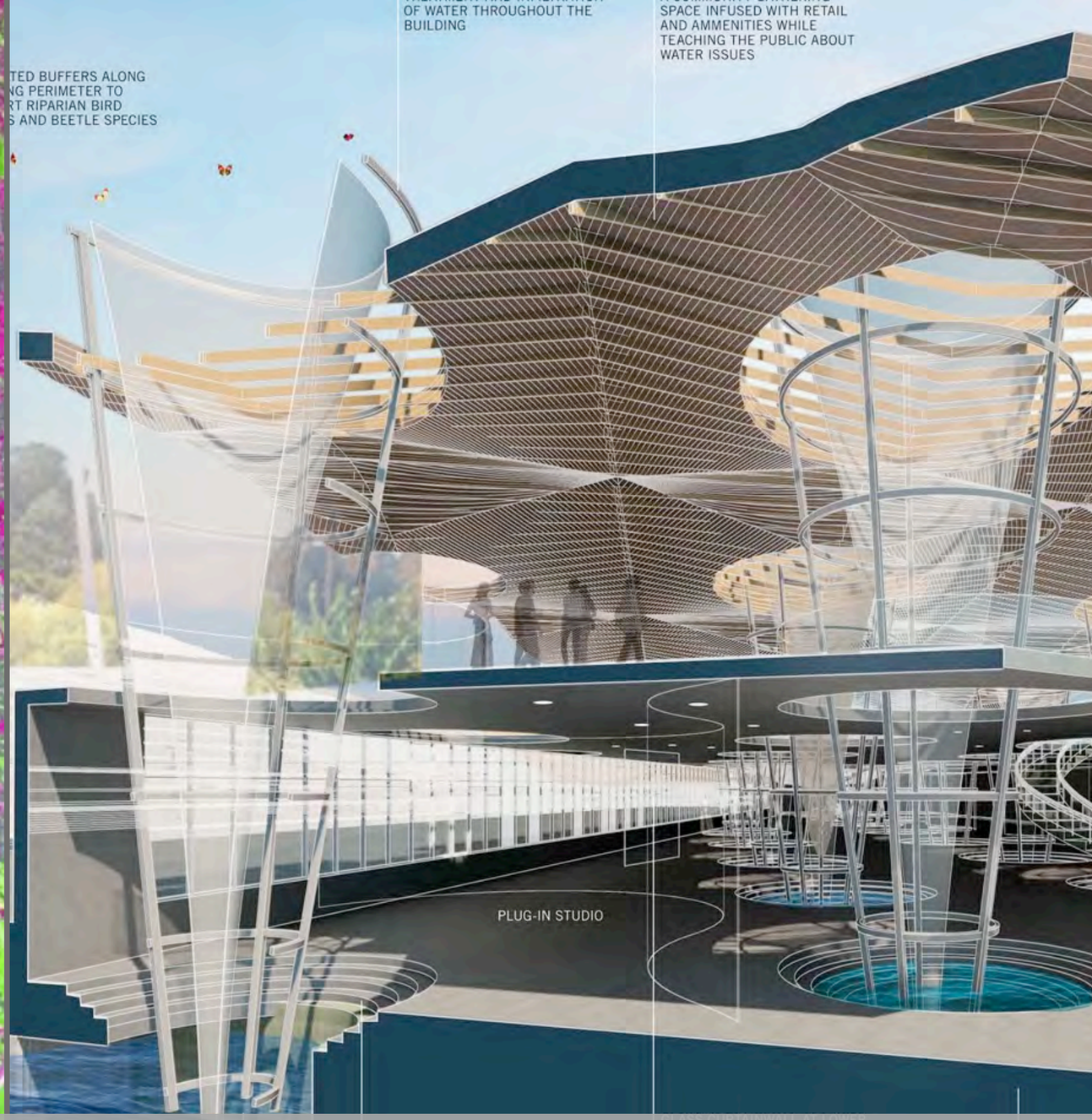
The opportunity:

LOS ANGELES as TEST-BED.

The case for localization.





ALI [left], Doug Bergert, Anne Smith, Alex Sands, Water Towers, Perkins+Will, DLC First Prize Winner, 2014 [right]

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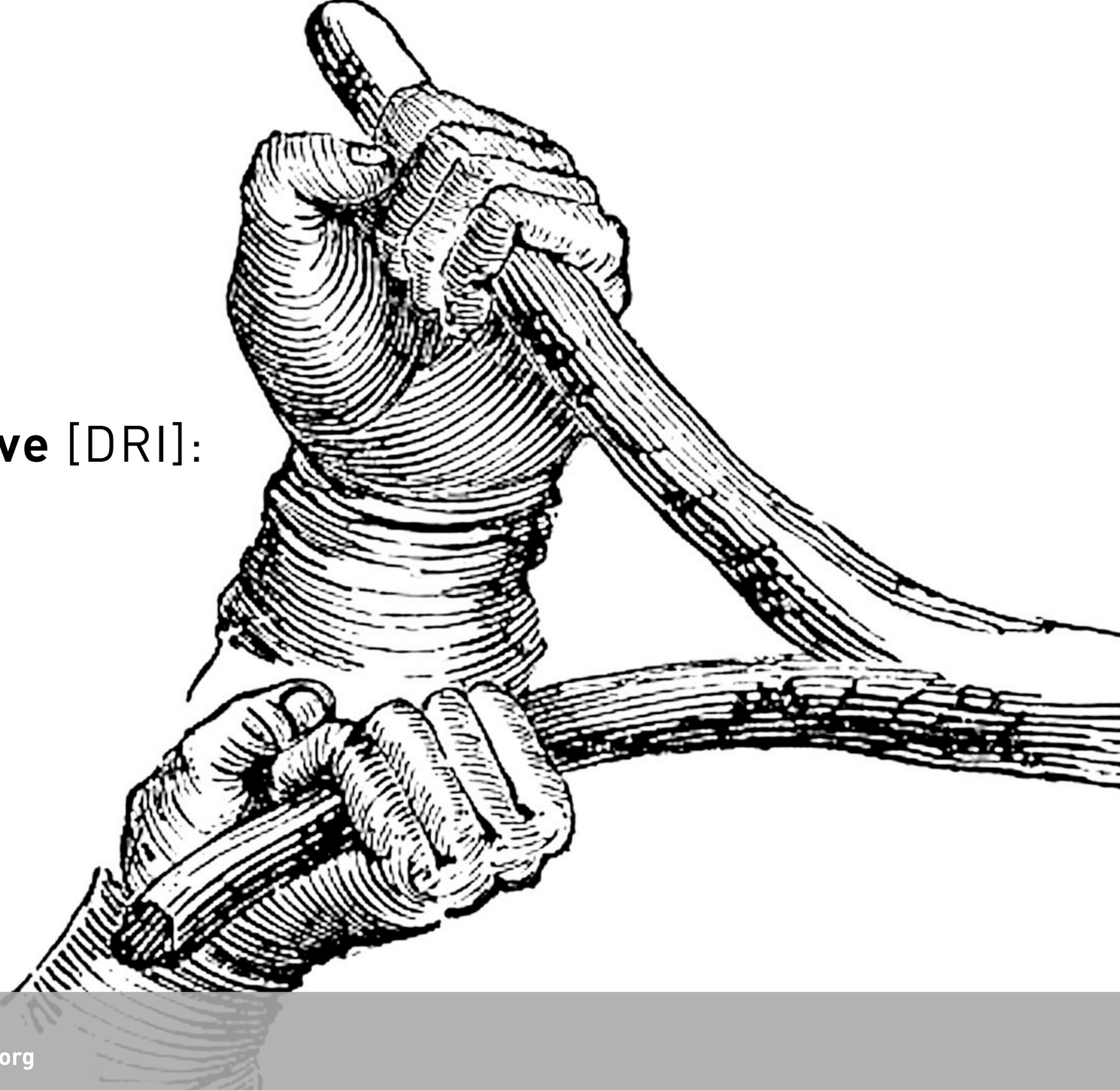
Drylands Resilience Initiative [DRI]:
New Tools for City Design in Drylands

Peter Arnold, Director of Research
peter.arnold@ridlands.org



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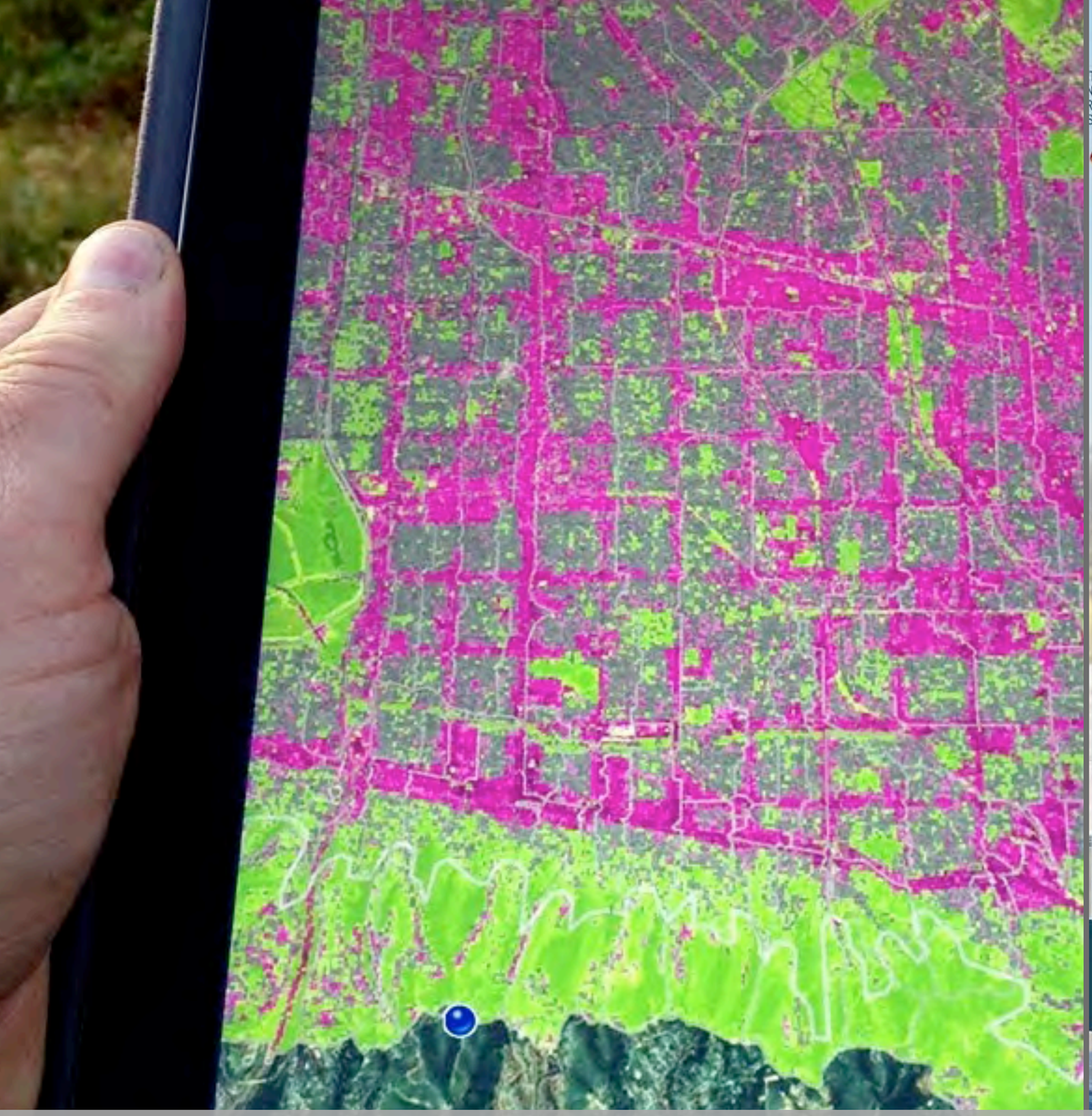
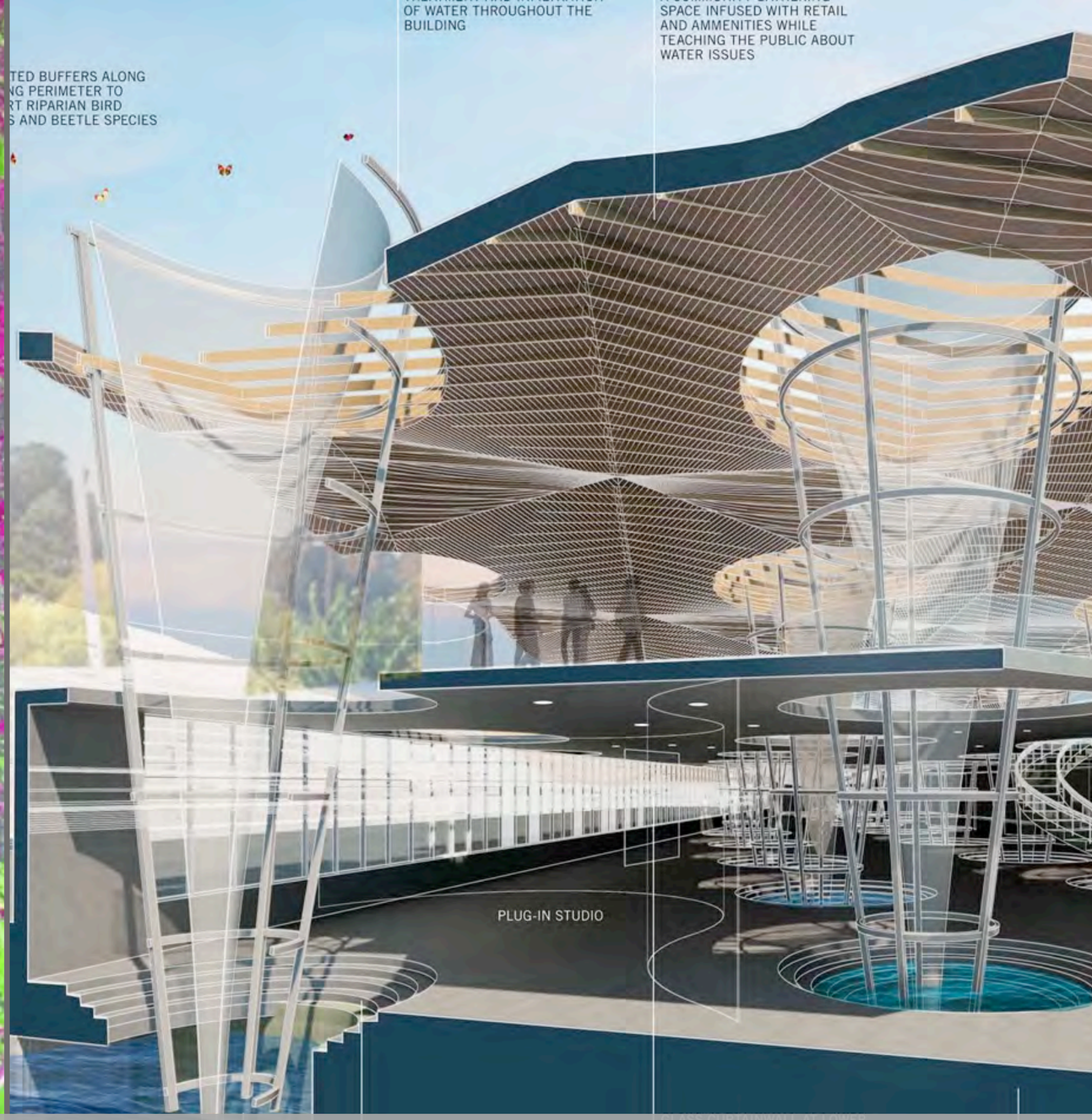
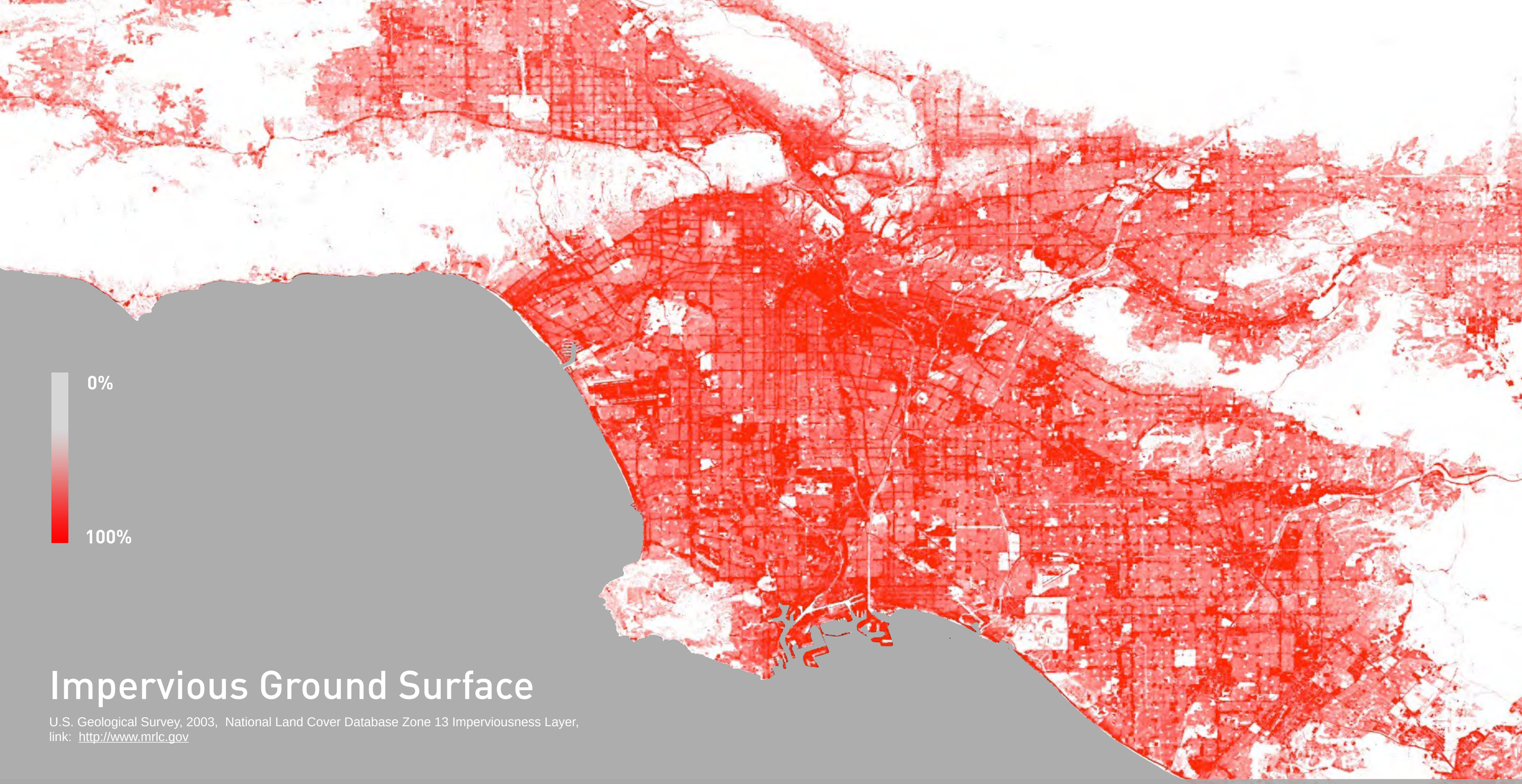
PROPOSED SOLUTIONS

NEED FOR NEW TOOLS





ALI [left], Doug Bergert, Anne Smith, Alex Sands, Water Towers, Perkins+Will, DLC First Prize Winner, 2014 [right]



Impervious Ground Surface

U.S. Geological Survey, 2003, National Land Cover Database Zone 13 Imperviousness Layer,
link: http://www.mrlc.gov

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Phase I: Probabilistic Overlay Approach

Geospatial Model

This model is both a computation device and visualization tool. We designed it to aid in the identification of the most opportunistic areas for capturing stormwater and safely infiltrating it to replenish groundwater supplies, a recognized priority for offsetting dependence on water imports. The model uses a multi-criteria decision-making approach to identify the most suitable areas for stormwater capture, detention, conveyance, and safe infiltration. Functionally, the model is composed of multiple components: a stormwater runoff model, an infiltration model, and a constraint model. Outputs from these components are combined to form a resultant infiltration suitability analysis and a subwatershed prioritization analysis.

Run Off Model

30-year Precipitation Normals

15m Remotely Sensed Impermeability Assessment

Infiltration Model

1915 + 1919 USDA Soil Survey for San Fernando Valley, LA Basin

2008 NRCS SSURGO Soil Survey [incomplete]

2012 CA Quaternary Surficial Geology

2003 CA Geologic Survey Soil Liquefaction

Constraint Fuzzy Logic Model

2007 EPA Superfund Plume Dataset

2012 EPA Toxic Release Database

2013 CA Water Resources Control Board Geotracker Sites

Resultant Model

Surface Run-Off Model:

Computes annual urban stormwater runoff derived from 30-year annual precipitation data coupled with impacts of ground surface impermeability within the San Fernando basin.

Annual Stormwater Run-Off Volume

low volume

high volume

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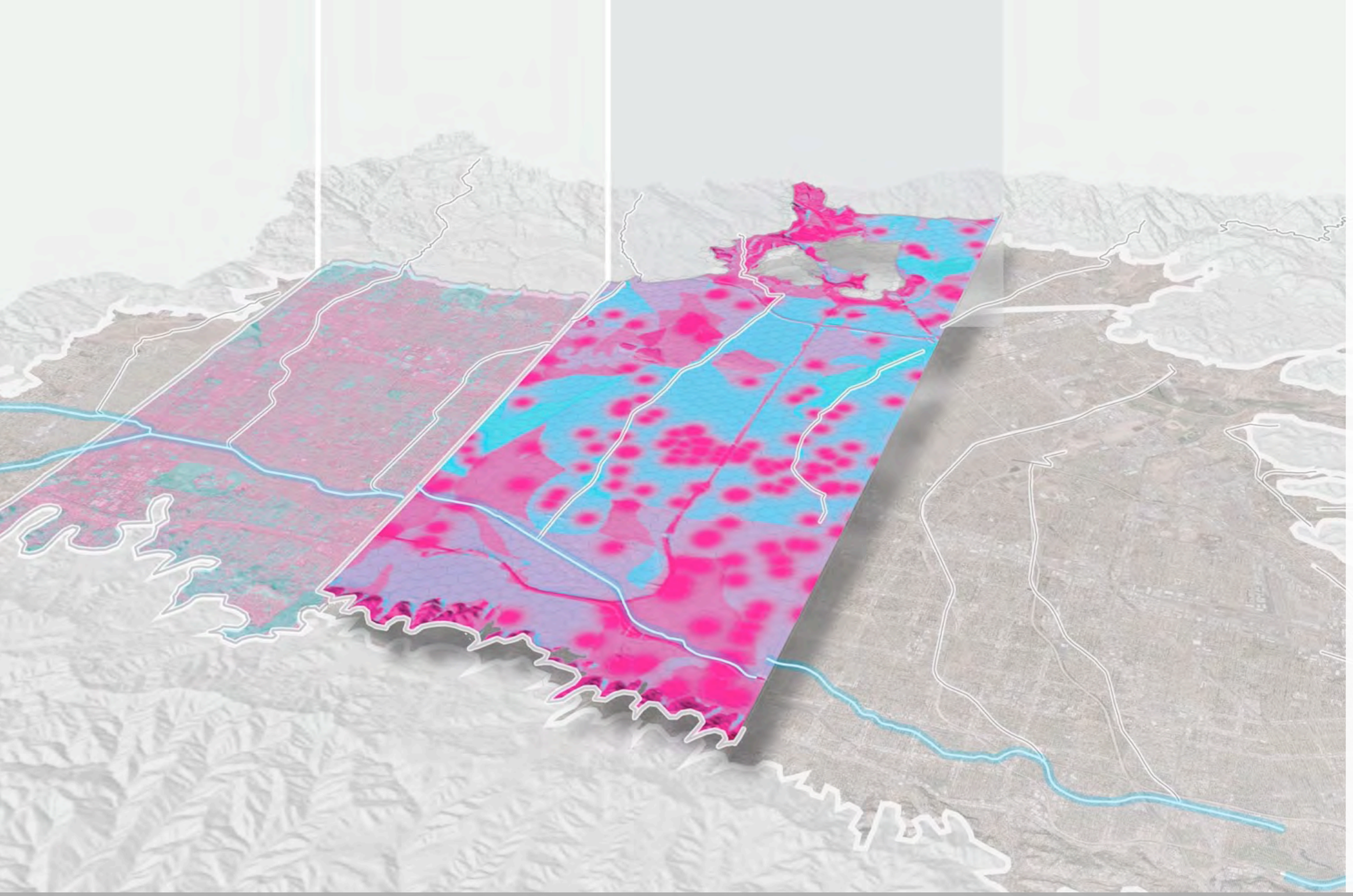

Resultant Analysis:

Combines infiltration model [assessing the soil types and conditions for infiltrating stormwater] with a constraint model [assessing risks associated with both surface and subsurface chemical contamination] to describe the suitability for safely infiltrating stormwater runoff within the San Fernando Valley basin, and pinpoints appropriate strategies for resource recovery within the basin. Three case studies are identified (at right).

Suitability Score for Safe Stormwater Infiltration

- highly suitable: 1.0
- moderate suitability: 0.8
- very low suitability: 0.5
- not suitable, avoid: 0.0

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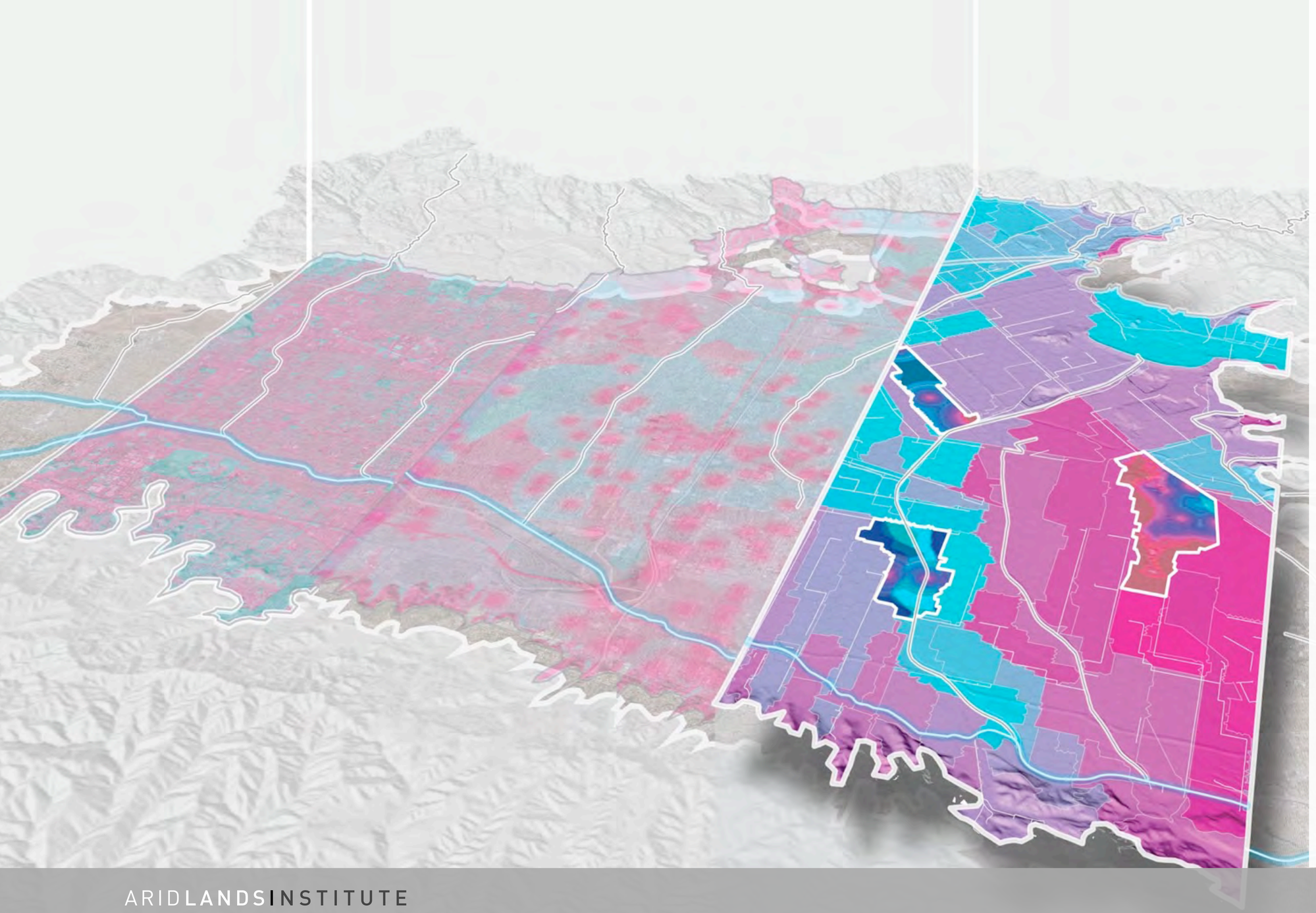

Subwatershed Prioritization:
How best to comprehensively manage stormwater runoff within the basin? The subwatershed prioritization ranks each of the subwatersheds according to their hydrologic function and suggests a subwatershed-scale approach to managing stormwater at the basin-scale.

Subwatershed Function

- Direct Infiltration
- Hybrid Strategies
- Conveyance + Filtration

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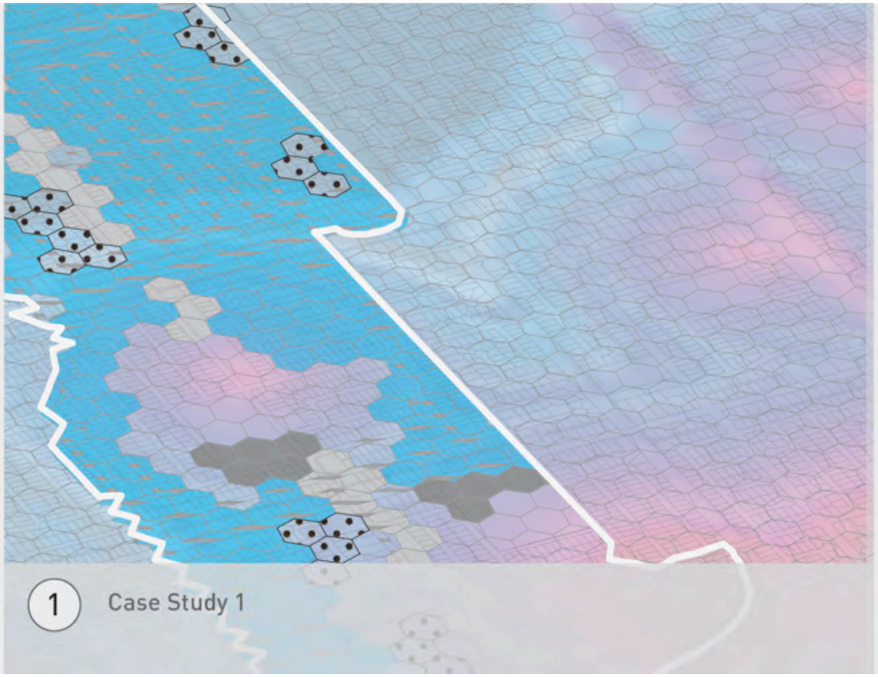
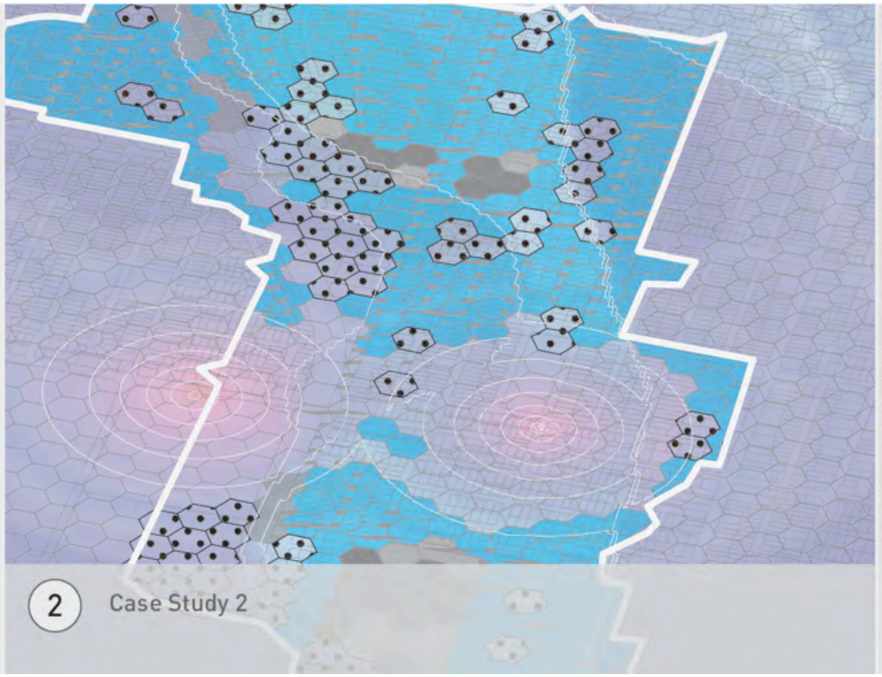
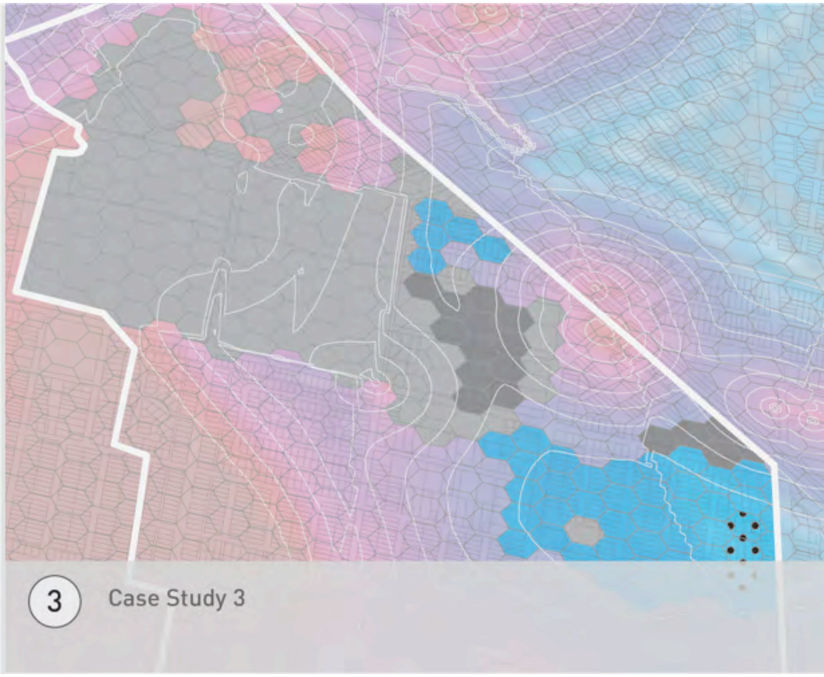
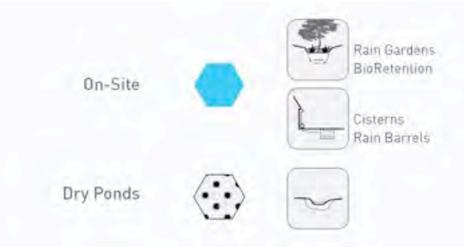






Case Study: Hybrid Strategies

Within this subwatershed, stormwater strategies are mixed: direct infiltration where possible, and—in areas where groundwater contamination is known—a combination of on-site detention and conveyance to areas more suitable for infiltration.



Case Study: Direct Infiltration

This subwatershed is well suited to maximum infiltration of stormwater and suggests a dense web of dry ponds and decentralized infiltration basins for public and municipal landuses. Water-smart streets with porous pavement, tree box filters, and curb extensions would be ideally suited here. On-site detention and direct use of stormwater through techniques such as rain gardens and cisterns would be appropriate for residential areas.

Case Study: Conveyance and Filtration

Due to highly contaminated groundwater and the risk that extensive stormwater infiltration may mobilize subsurface contaminants, opportunities for direct infiltration on this subwatershed are quite limited. Strategies to control, detain, and convey stormwater off the existing urban fabric to areas more suitable for direct infiltration are favored. A network of urban forests would aid in remediating brownfields, breaking up impervious surfaces, filtering particulate matter, and decreasing heat loads.

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ALI, Ethan Dingwell, Karim Snoussi

3

ITERATIVE PROCESSES, TESTING PROPOSED SOLUTIONS

TOOL DEVELOPMENT

HOW DO WE EVALUATE THE IMPACTS OF INTEGRATING NEW, MULTI- SCALAR, DISTRIBUTED WATER INFRASTRUCTURES INTO THE EXISTING BUILT ENVIRONMENT?

Until now, relevant water data has been insufficiently rich, integrated, and analyzable to inform effective site-specific decision making.

Water Infiltrated:

gallons (or acre/feet)

Energy Saved:

kwh

GHG Reduced:

tons of CO2E

Economic Cost/Benefit:

Dollars expended/saved

3

ITERATIVE PROCESSES, TESTING PROPOSED SOLUTIONS

TOOL DEVELOPMENT

HOW DO WE MAKE A DATA-RICH, ACCESSIBLE DECISION-MAKING TOOL AVAILABLE TO PLANNERS AND AND DESIGNERS ?

Design professions (and schools) don't have the tools they need to effectively engage the design of adaptation in drylands.

Phase II: ITERATIVE PROCESSES

Downscaled Climate Change Inputs
+ Parameterized Modifications to
Built Environment

Run Off Model

30-year Precipitation Normals

15m Remotely Sensed Impermeability Assessment

UCLA Downscaled GCM Predictions

Infiltration Model

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Resultant Model

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PERKINS + WILL

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Deborah Weintraub AIA
Chief Deputy City Engineer, Bureau of Engineering, Department of Public Works, City of Los Angeles, Los Angeles, CA

Leigh Christy AIA LEED AP BD+C
Associate Principal, Perkins + Will, Los Angeles, CA

John Haymaker PhD AIA
Director of Research, Perkins + Will, Atlanta, GA

HAZEL WILL:

- REPLENISH LOCAL WATER SUPPLIES;
- REDUCE RELIANCE ON CARBON-INTENSIVE WATER IMPORTS;
- IMPROVE NATIVE ENVIRONMENTAL FUNCTION;
- PROMOTE DESIGN INNOVATION AND CIVIC SPACE-MAKING;
- HONOR THE CHARACTER OF DIVERSE NEIGHBORHOODS;
- SERVE AS A PROTOTYPE FOR DRYLANDS GLOBALLY.

4

PATHS TO IMPLEMENTATION, WIDE-SCALE ADOPTION:

DIVINING LA:

FUNDED PARTNERSHIPS, PUBLIC ENGAGEMENT, DEMONSTRATION PROJECTS, and POLICY INNOVATIONS

[FEASIBILITY, REPLICABILITY, SCALEABILITY]

ARIDLANDSINSTITUTE
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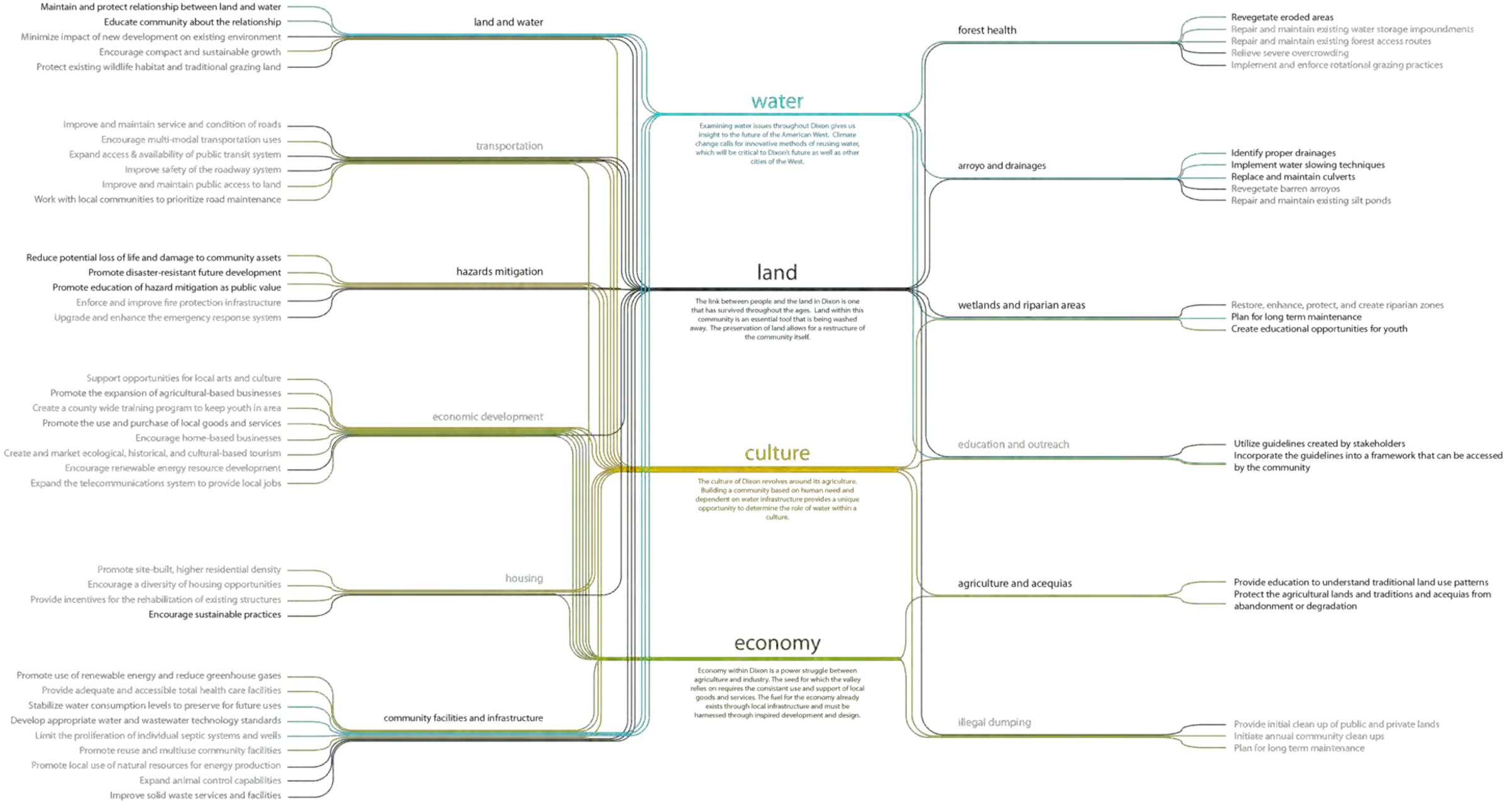
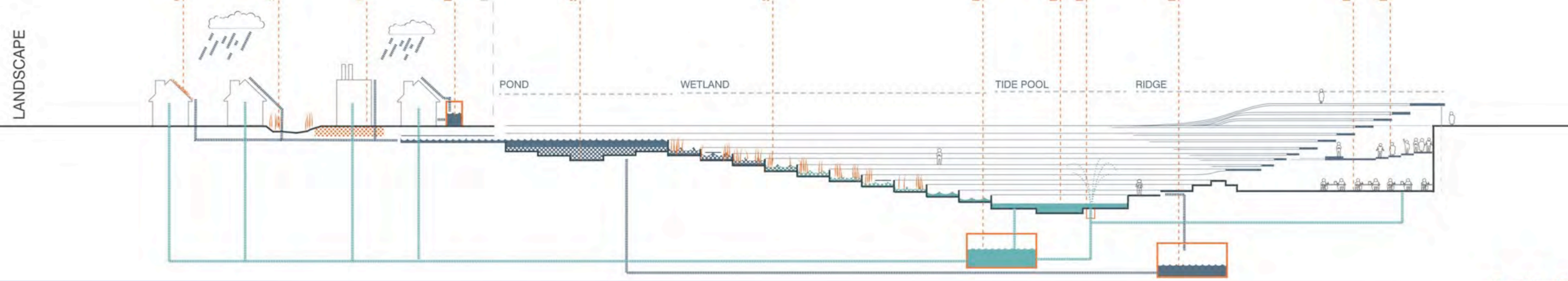
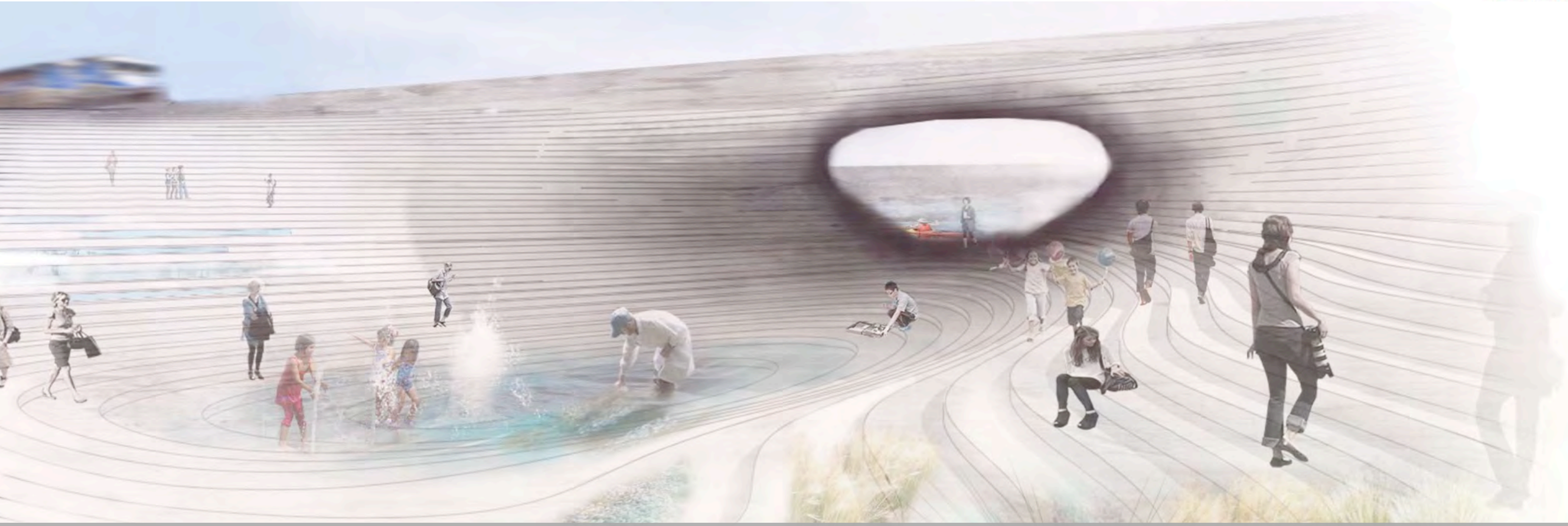

Maintain and protect relationship between land and water
Educate community about the relationship
Minimize impact of new development on existing environment
Encourage compact and sustainable growth
Protect existing wildlife habitat and traditional grazing land
land and water
Improve and maintain service and condition of roads
Encourage multi-modal transportation uses
Expand access & availability of public transit system
Improve safety of the roadway system
Improve and maintain public access to land
Work with local communities to prioritize road maintenance
transportation
Reduce potential loss of life and damage to community assets
Promote disaster-resistant future development
Promote education of hazard mitigation as public value
Enforce and improve fire protection infrastructure
Upgrade and enhance the emergency response system
hazards mitigation
Support opportunities for local arts and culture
Promote the expansion of agricultural-based businesses
Create a county wide training program to keep youth in area
Promote the use and purchase of local goods and services
Encourage home-based businesses
Create and market ecological, historical, and cultural-based tourism
Encourage renewable energy resource development
Expand the telecommunications system to provide local jobs
economic development
Promote site-built, higher residential density
Encourage a diversity of housing opportunities
Provide incentives for the rehabilitation of existing structures
Encourage sustainable practices
housing
Promote use of renewable energy and reduce greenhouse gases
Provide adequate and accessible total health care facilities
Stabilize water consumption levels to preserve for future uses
Develop appropriate water and wastewater technology standards
Limit the proliferation of individual septic systems and wells
Promote reuse and multiuse community facilities
Promote local use of natural resources for energy production
Expand animal control capabilities
Improve solid waste services and facilities
community facilities and infrastructure
water
Examining water issues throughout Dixon gives us insight to the future of the American West. Climate change calls for innovative methods of reusing water, which will be critical to Dixon's future as well as other cities of the West.
land
The link between people and the land in Dixon is one that has survived throughout the ages. Land within this community is an essential tool that is being washed away. The preservation of land allows for a restructure of the community itself.
culture
The culture of Dixon revolves around its agriculture. Building a community based on human need and dependent on water infrastructure provides a unique opportunity to determine the role of water within a culture.
economy
Economy within Dixon is a power struggle between agriculture and industry. The seed for which the valley relies on requires the consistant use and support of local goods and services. The fuel for the economy already exists through local infrastructure and must be harnessed through inspired development and design.
forest health
Revegetate eroded areas
Repair and maintain existing water storage impoundments
Repair and maintain existing forest access routes
Relieve severe overcrowding
Implement and enforce rotational grazing practices
arroyo and drainages
Identify proper drainages
Implement water slowing techniques
Replace and maintain culverts
Revegetate barren arroyos
Repair and maintain existing silt ponds
wetlands and riparian areas
Restore, enhance, protect, and create riparian zones
Plan for long term maintenance
Create educational opportunities for youth
education and outreach
Utilize guidelines created by stakeholders
Incorporate the guidelines into a framework that can be accessed by the community
agriculture and acequias
Provide education to understand traditional land use patterns
Protect the agricultural lands and traditions and acequias from abandonment or degradation
illegal dumping
Provide initial clean up of public and private lands
Initiate annual community clean ups
Plan for long term maintenance





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Thank you.