



Linking Values and Goals to Model Outputs and Decision Points in Collaborative Geodesign

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Transdisciplinary Team

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- Nick Jordan Agroecology
- Len Kne GISci
- Peter Wringa GISci
- David Pitt L. Arch
- David Mulla Soil Science
- Madeline Goldkamp L. Arch
- Alexander Heid L. Arch
- Mike Reichenbach Extension

Overview

- Context
- Collaborative Geodesign
 - Part I
 - Part II
- Preliminary Results

Seven Mile Creek

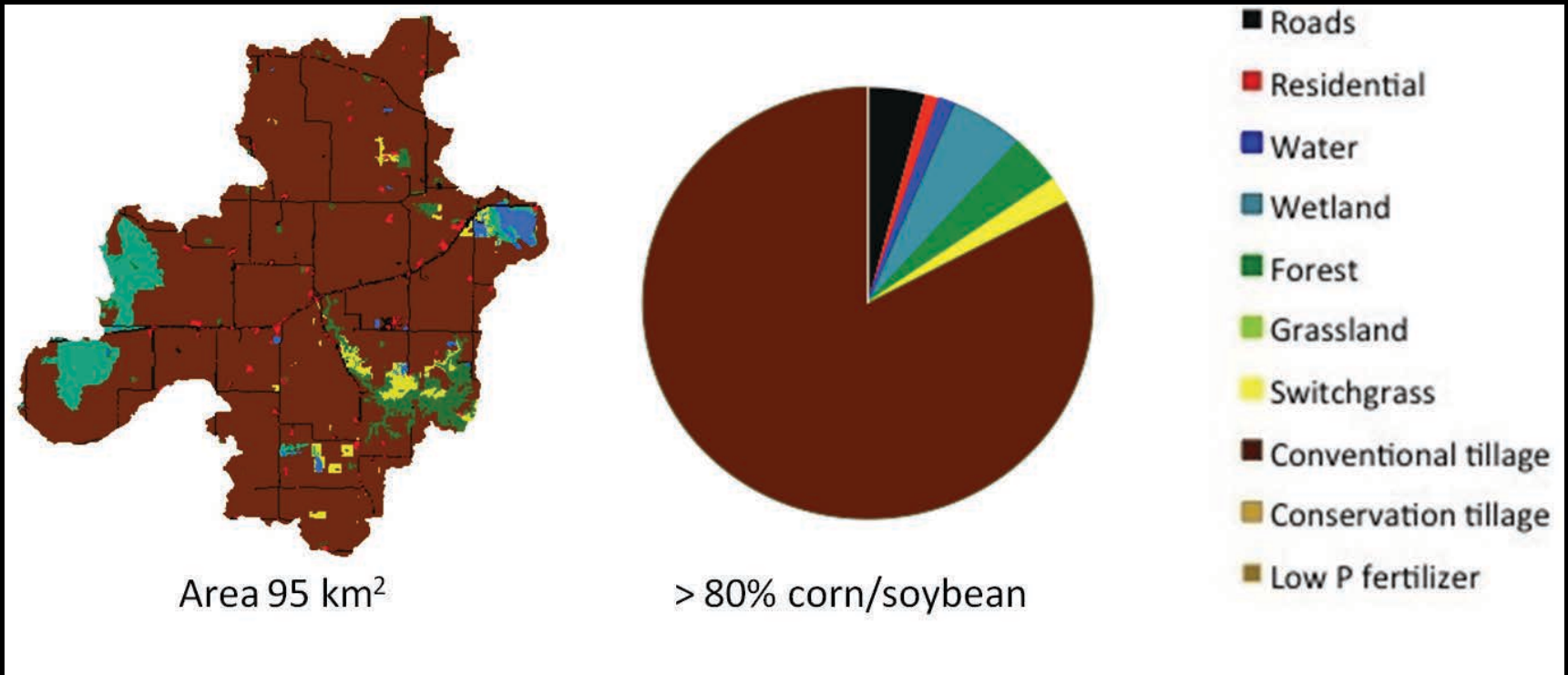
Nicollet County

Seven Mile Creek
watershed

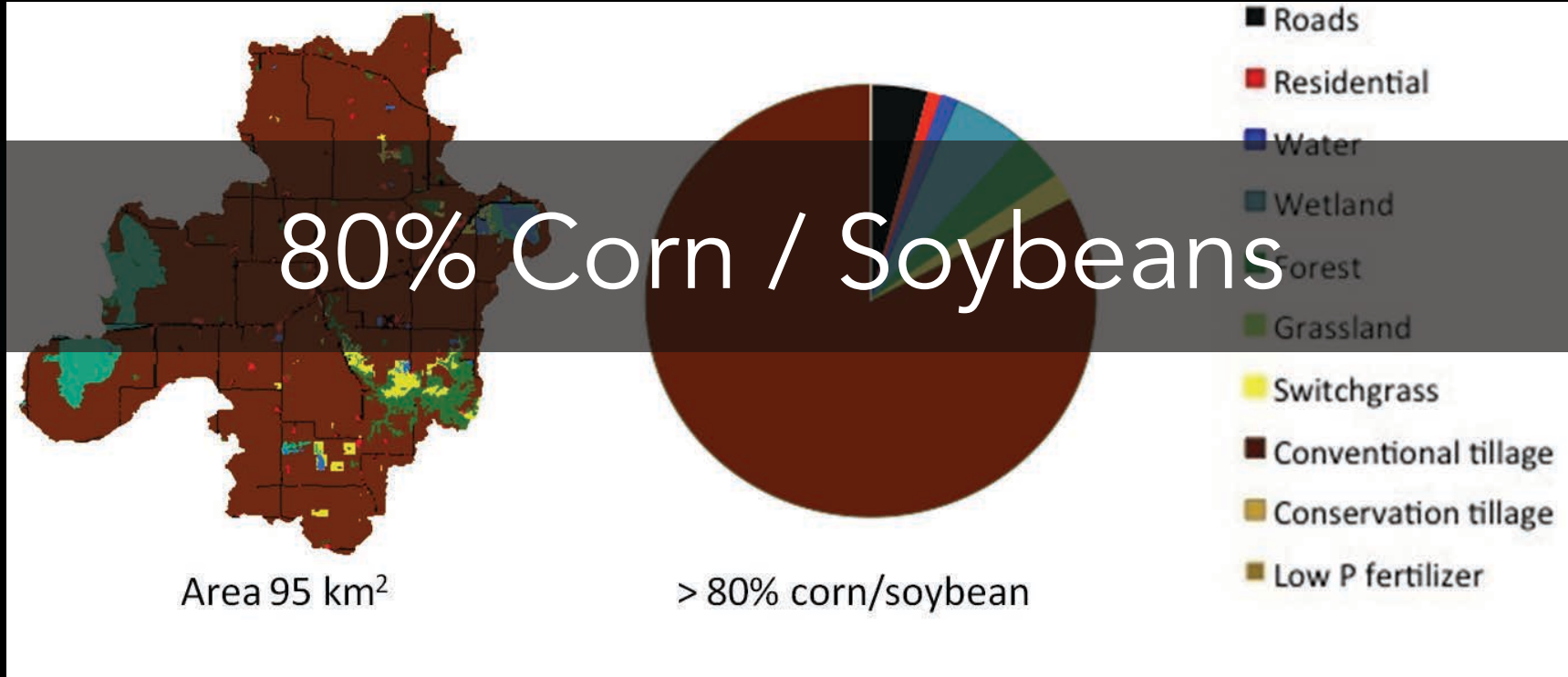
Minnesota



Current Land Use



Current Land Use



Current Land Use Problems



Socially Acceptable Solutions?

Socially Acceptable Solutions?

Information Exchange Between Stakeholders:

- Saliency
 - relevance to decision making
- Legitimacy
 - fair and unbiased information production that also respects stakeholders' values
- Credibility
 - scientific adequacy

Socially Acceptable Solutions? Biomass Production?

Jordan et al. 2007, 2011, 2013; Jordan & Warner 2010



Socially Acceptable Solutions? Biomass Production? Multifunctional Agriculture?



Socially Acceptable Solutions?
Biomass Production?
Multifunctional Agriculture?

Single field solutions
won't work



Socially Acceptable Solutions?
Biomass Production?
Multifunctional Agriculture?

landscape scale
solutions?

A dark, low-key photograph of a rural landscape. In the foreground, a white fence runs across the frame. Behind the fence, several cows are visible, their forms silhouetted against the background. The background shows rolling hills and trees under a dark sky. The overall mood is somber and contemplative.

Socially Acceptable Solutions?
Biomass Production?
Multifunctional Agriculture?

Emerging Approach

Collaborative Geodesign



Socially Acceptable Solutions?
Biomass Production?
Multifunctional Agriculture?

Collaborative Geodesign Case



Collaborative Geodesign [Part I]

Exploratory Workshops:

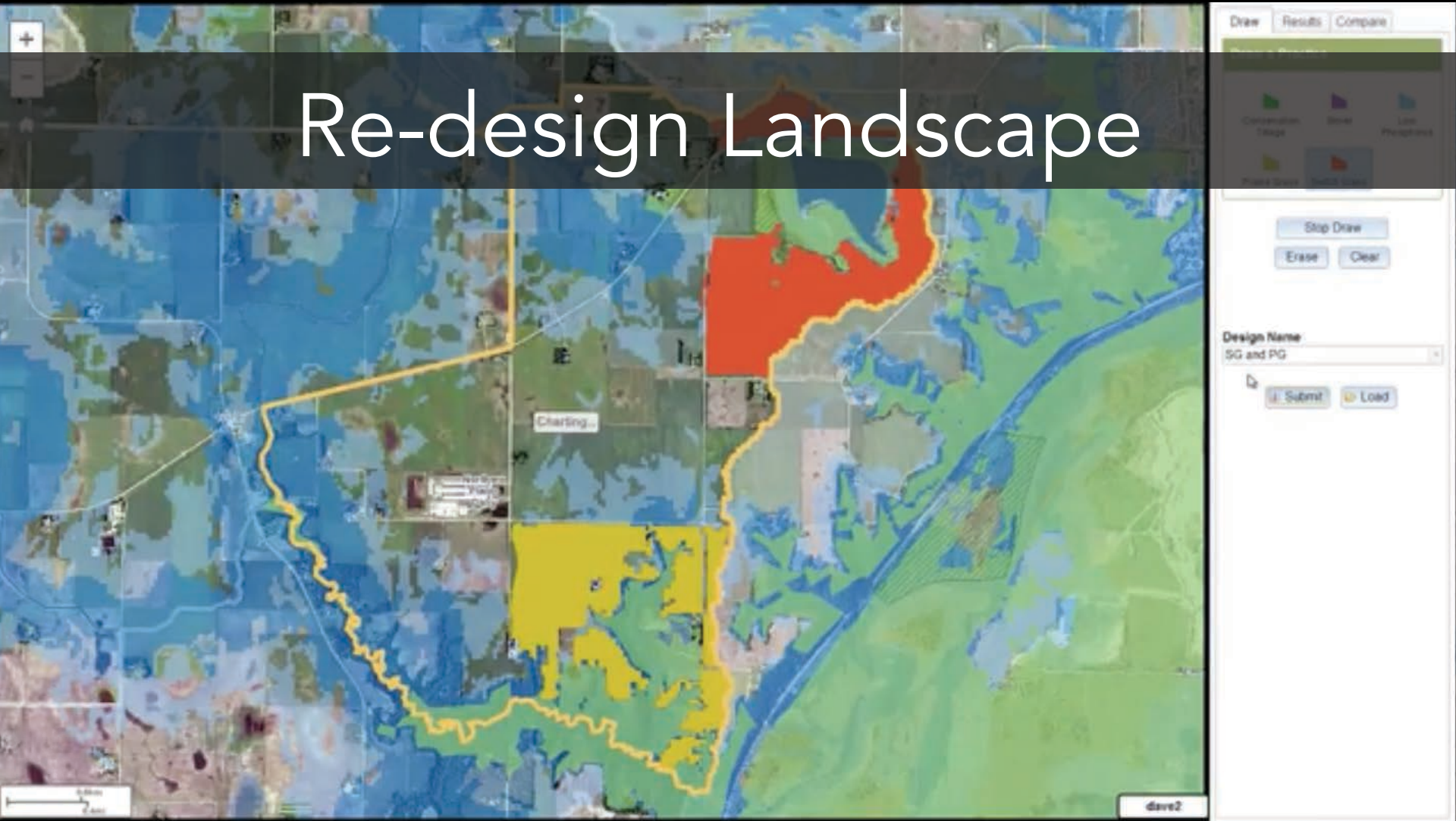
Are win-win solutions possible?

[Video](#)



Models + GIS + Design Interface

Re-design Landscape



Models + GIS + Design Interface

Quantitative Feedback

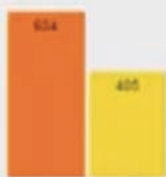
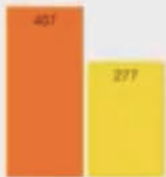


Carbon Sequestration
230 (t/yr)

Market Return
(Compared to Corn)
↓ \$-75,173 (\$/yr)

-21.87%

-28.08%

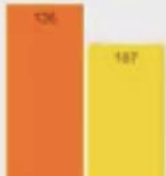


Sediment (t/yr)

Phosphorus (lb/yr)

-21.47%

+8.81%



Water Yield (ft³/yr)

Habitat

Before

After



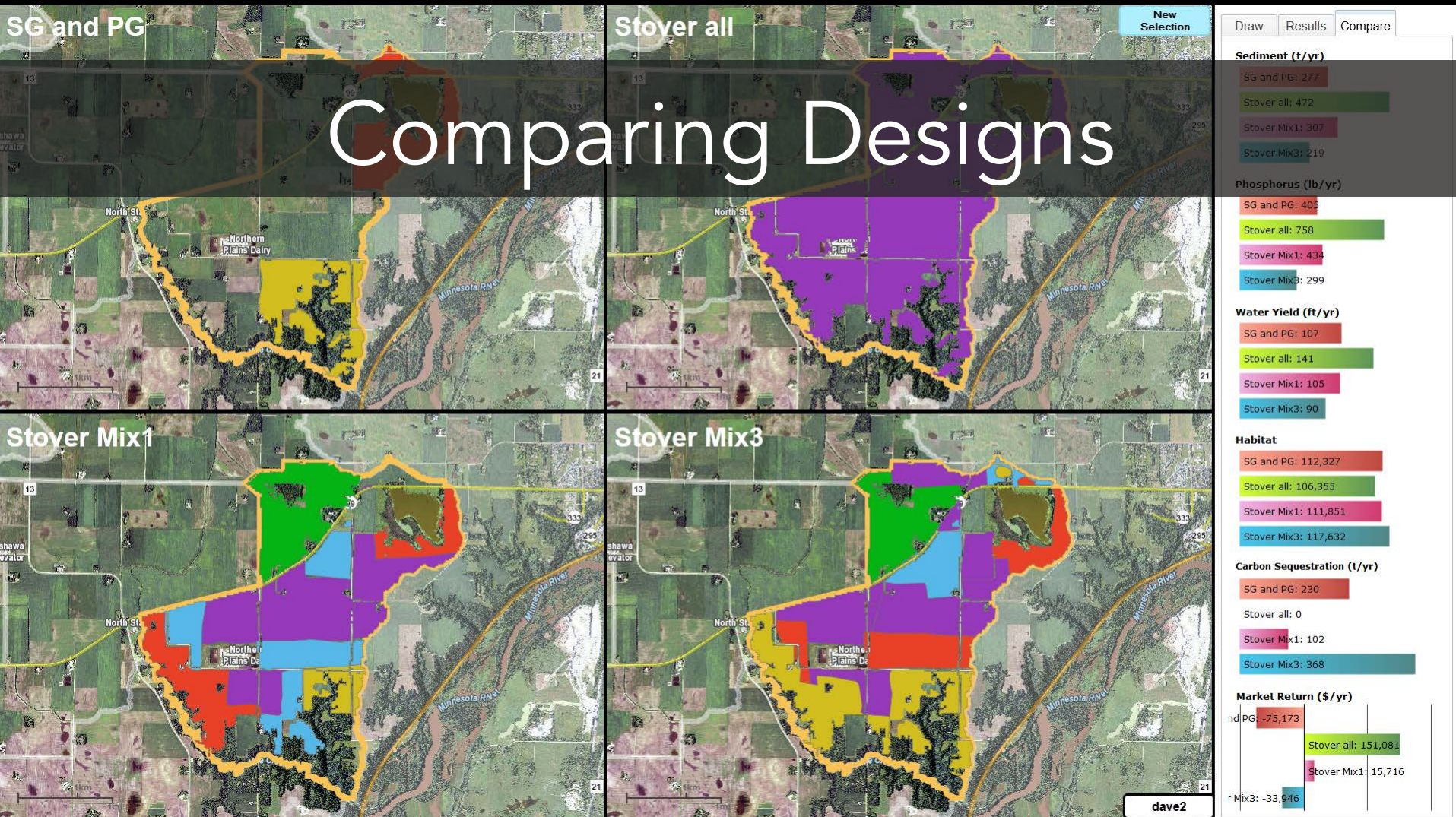
Draw Results Compare

Design Name

Prairie Grass

Switch Grass

Models + GIS + Design Interface



Collaborative Geodesign [Part I]

Exploratory Workshops:

Are win-win solutions possible?

[Video](#)

- 8 meetings
 - 4 background
 - 4 with tool



The People

Civic groups

Policy

Energy

Local Farmers

University Extension

Conservation

Agricultural
Industry

The People

Civic groups

Policy

Energy

Skills

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The People

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University Extension

Goals

Conservation

Agricultural
Industry

Socially Acceptable Solution?

Skills

Goals

Socially Acceptable Solution

Boundary Concepts

Socially Acceptable Solution

Boundary Concepts

Ideas that bridge
diverse people

Socially Acceptable Solution

New Agricultural Bioeconomy

Boundary Concepts

Socially Acceptable Solution

New Agricultural Bioeconomy

Technology

Policy

Markets

Explore win-win solutions

Boundary Concepts

Socially Acceptable Solution

New Agricultural Bioeconomy

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Policy

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Civic groups

University
Extension

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Boundary Concepts

Energy

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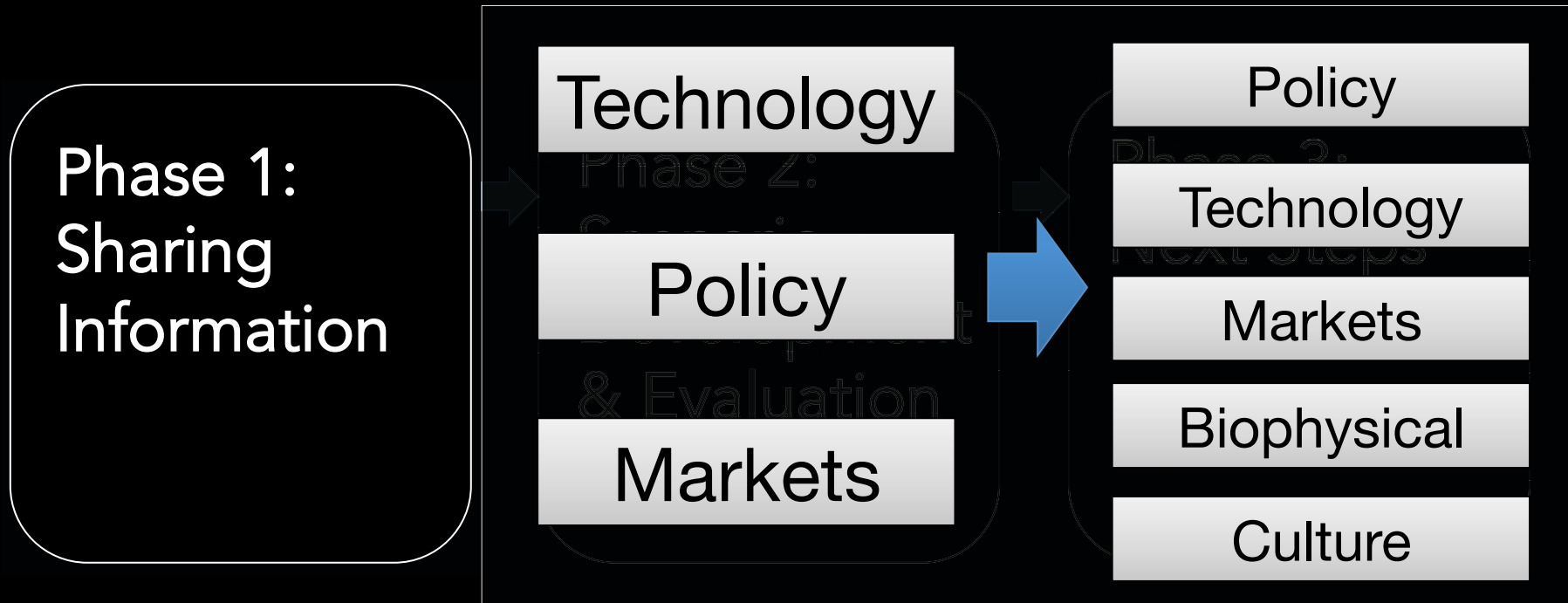
Collaborative Geodesign [Part II]

The Process

Phase 1:
Sharing
Information

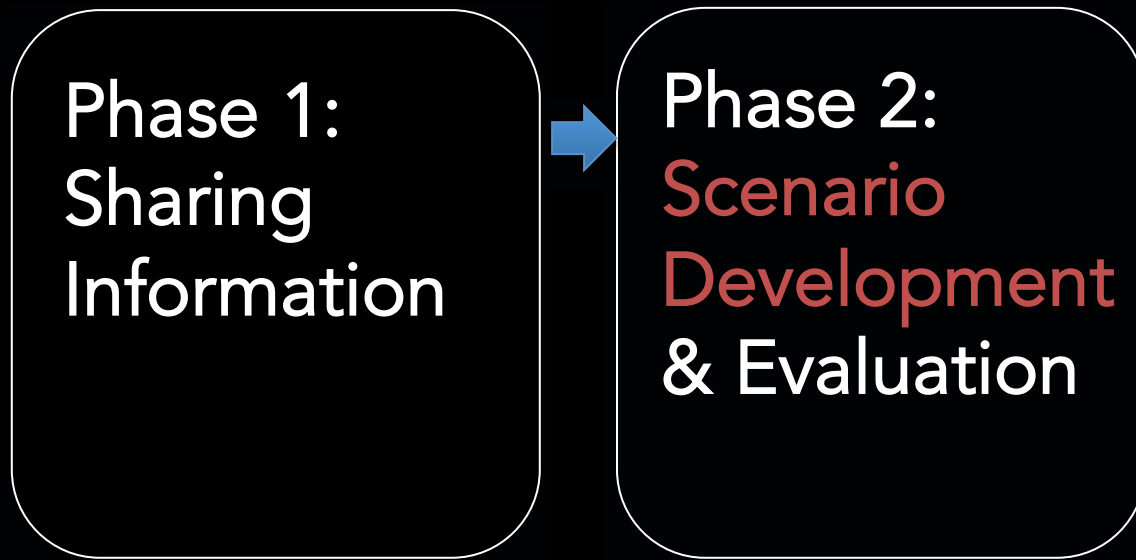
1. Opportunity exploration
2. Interviews >> Review Boundary Concepts

The Process



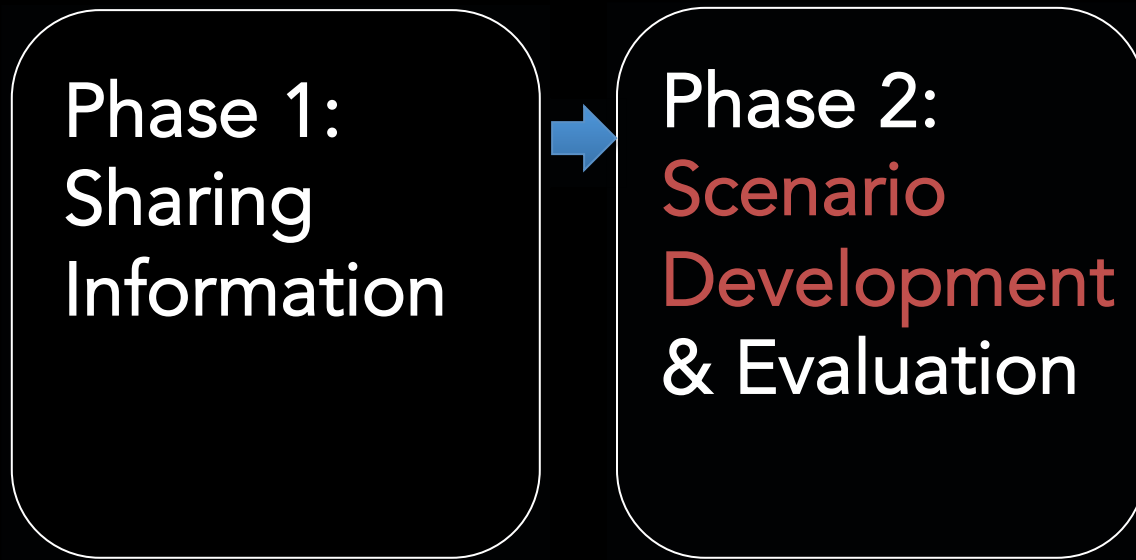
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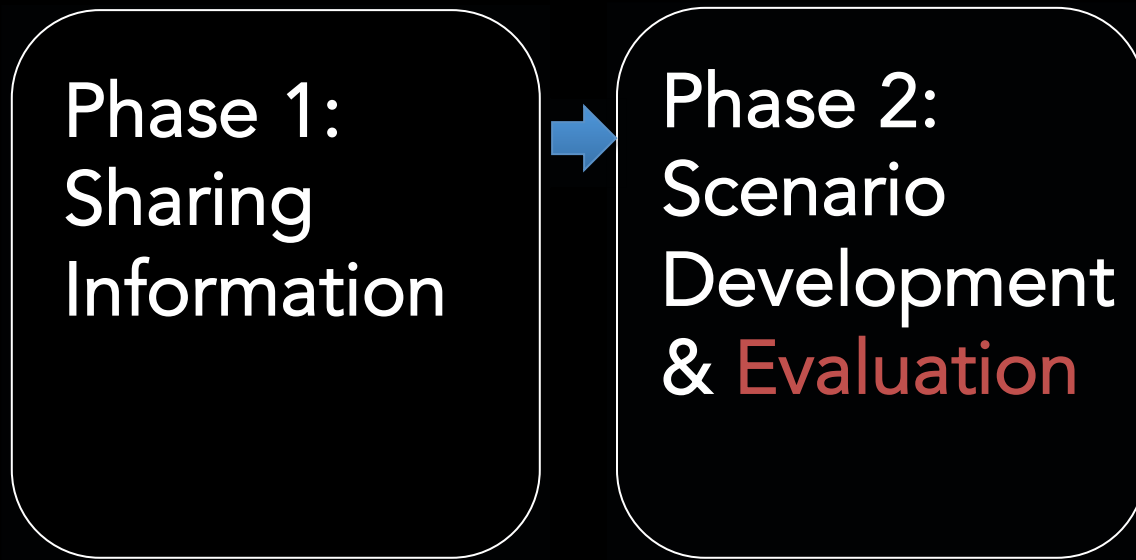
2. Interviews >>

The Process



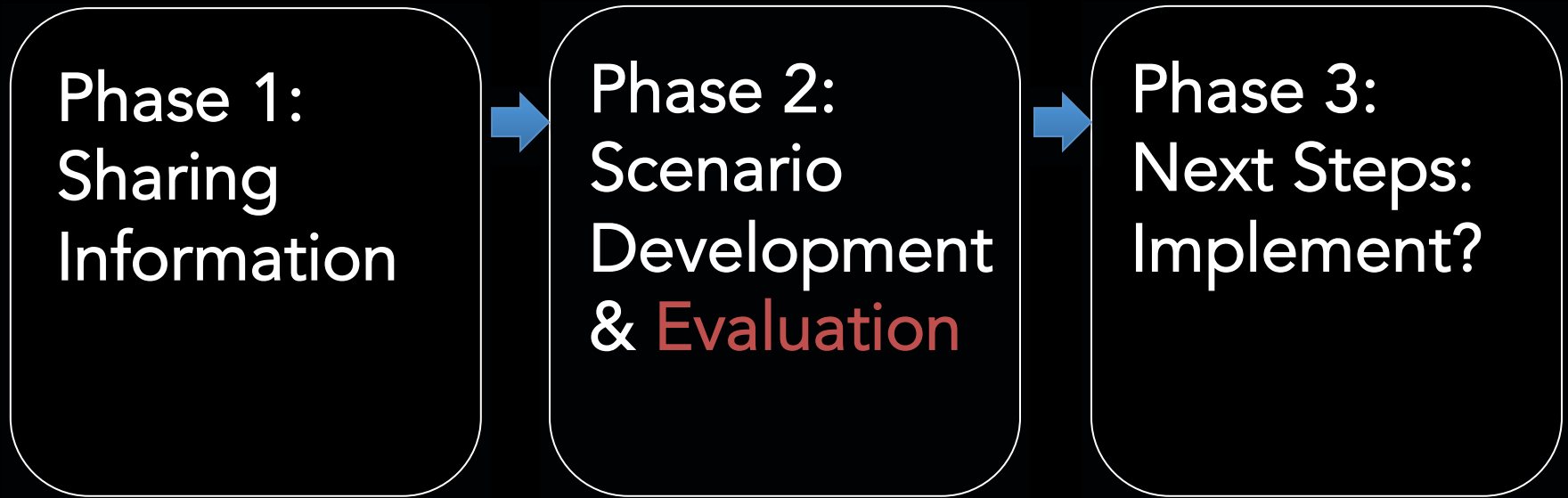
1. On-farm processing
2. Interviews >> 2. Medium-scale processing
3. Bolt-on facility (POET)
4. Increased animal agriculture
5. Cash crop winter annuals

The Process



Geodesign ^^

The Process



Geodesign ^^

Not here yet



Geodesign ^^

Models + GIS + Design Interface

SWAT Soil & Water
Assessment Tool

- Wtr Yld
- Sed
- P

InVEST

integrated valuation of
ecosystem services
and tradeoffs

- Carbon
- Habitat

Market Return

Models + GIS + Design Interface

With all this technology how
do we Link

Values and Goals to
Model Outputs
and Decision Points?

integrated valuation of
ecosystem services
and tradeoffs

User-Centered Design

Market Return

Arnold & Fohrer 2005

Models + GIS + Design Interface

With all this technology how
do we Link

Values and Goals to
Model Outputs
and Decision Points?

User-Centered Design

Models + GIS + Design Interface

Skills & Goals >> Process >>
Geodesign System

InVEST

integrated valuation of
ecosystem services
and tradeoffs

User-Centered Design

Arnold & Fohrer 2005

Models + GIS + Design Interface

Changes Made

- Modeling: additional practices
 - alfalfa
 - stover removal + cover crops

User-Centered Design



Models + GIS + Design Interface

Changes Made

- Modeling: additional practices
 - alfalfa
 - stover removal + cover crops
- User Interface
 - Split out field sources and in-stream sources
 - Provided real-time biomass production estimates



Collaborative Geodesign

Preliminary Results



Collaborative Geodesign

Research Questions

1. Do participants produce designs that are nearer to what is optimal? [Part I]
2. Does CG increase the legitimacy, credibility, and saliency of multiple forms of knowledge? [Part I]
3. Does CG enable stakeholders to identify action pathways? [Part II]

Collaborative Geodesign

Research Data [Part I]

- 8 Surveys
- 2 sets of interviews
- 1 focus group
- Designs
- Participant observation

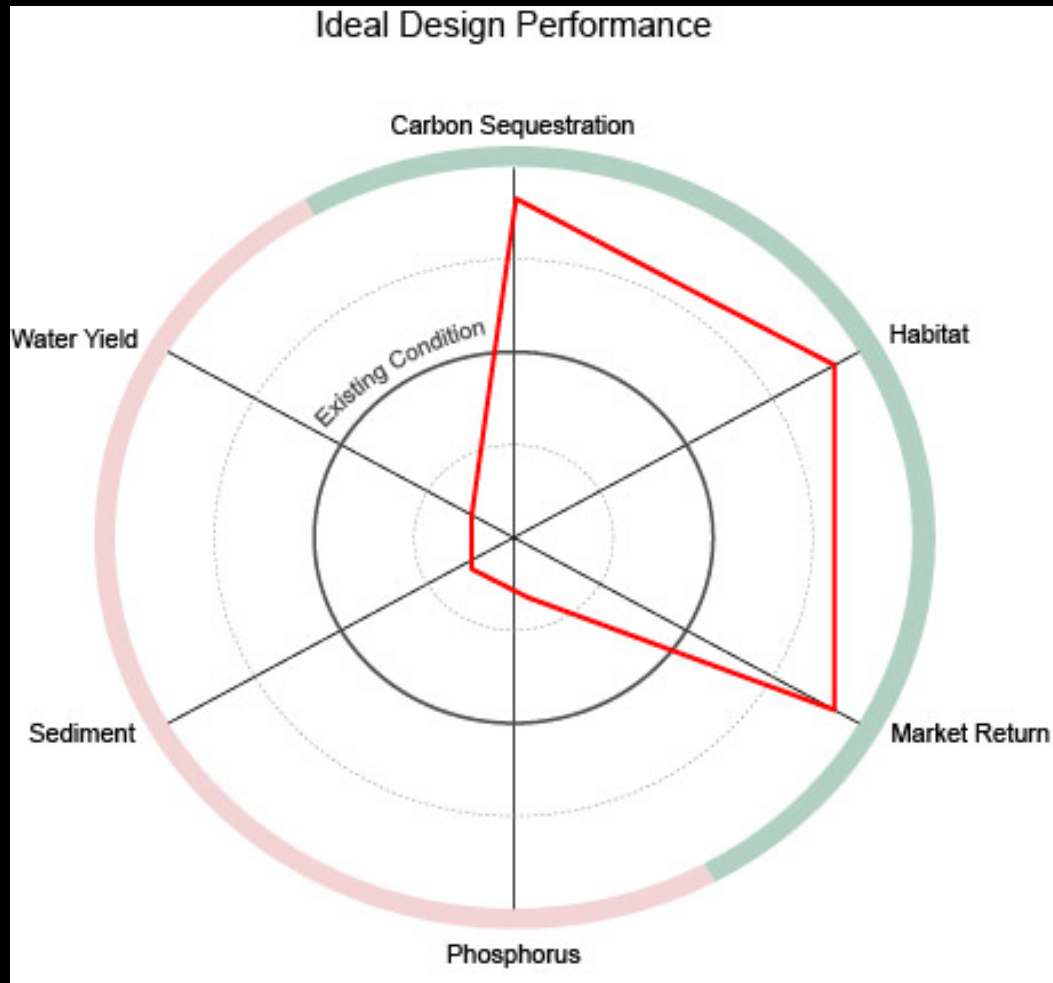
Collaborative Geodesign

Research Questions

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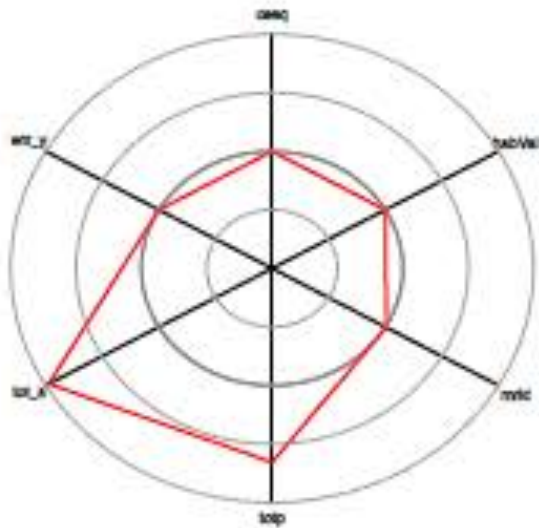
Collaborative Geodesign

Goal: identifying win-win scenarios



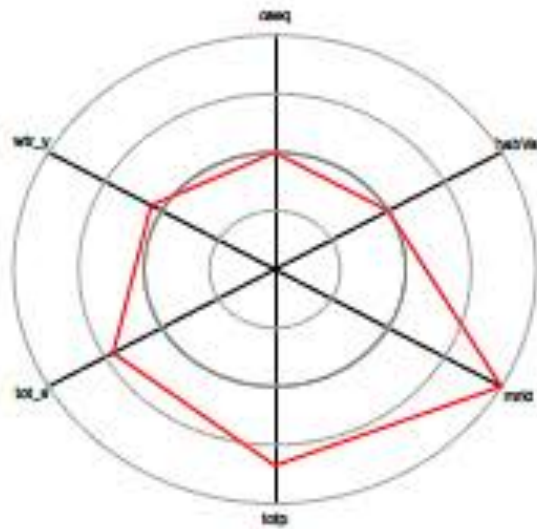
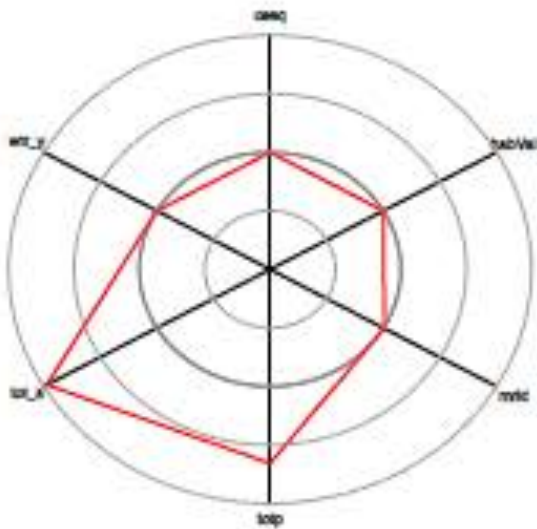
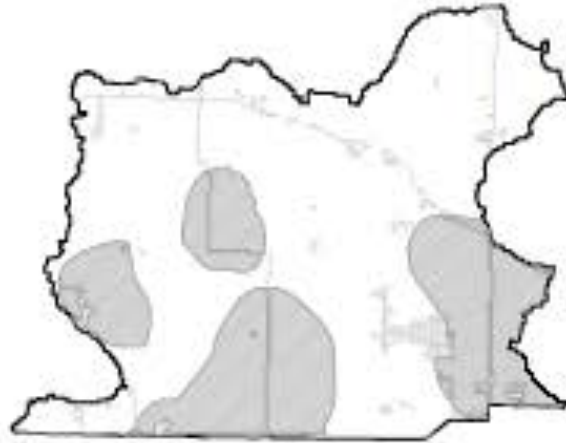
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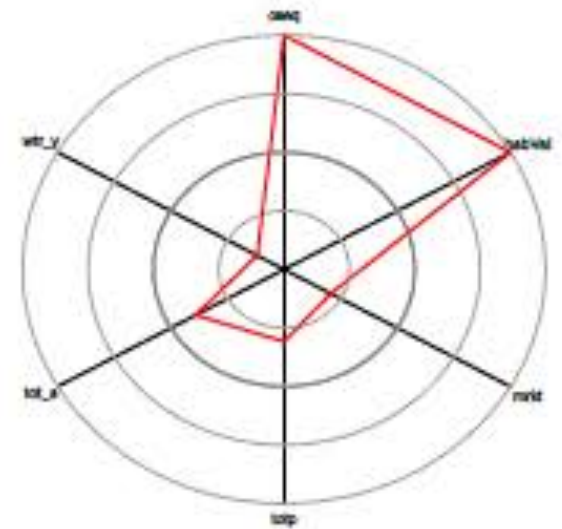
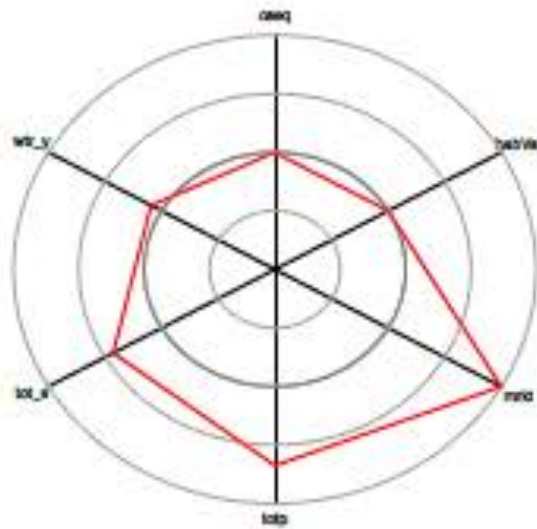
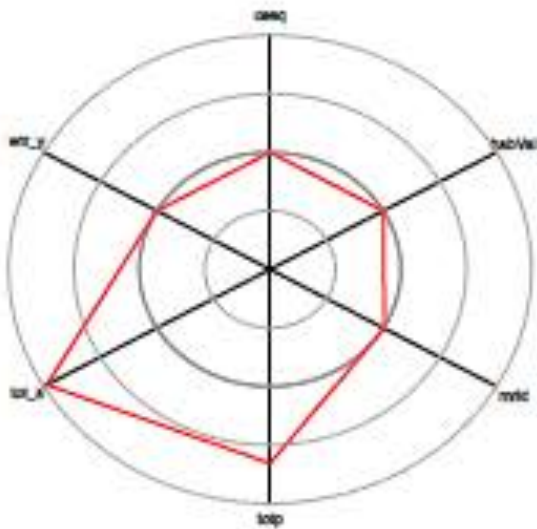
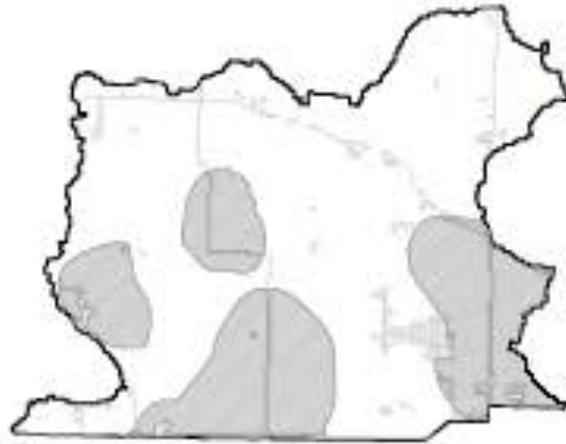
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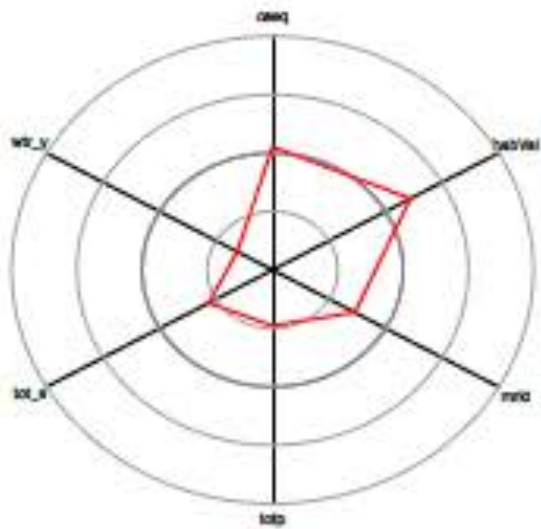
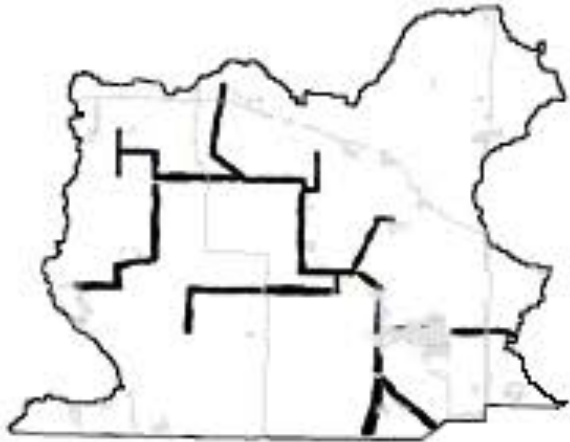
Collaborative Geodesign

Goal: identifying win-win scenarios



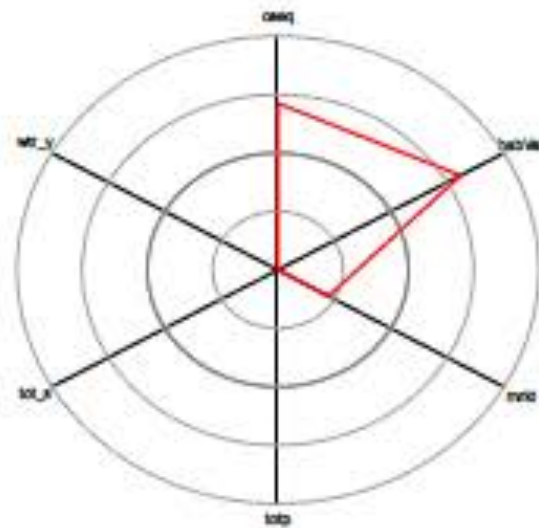
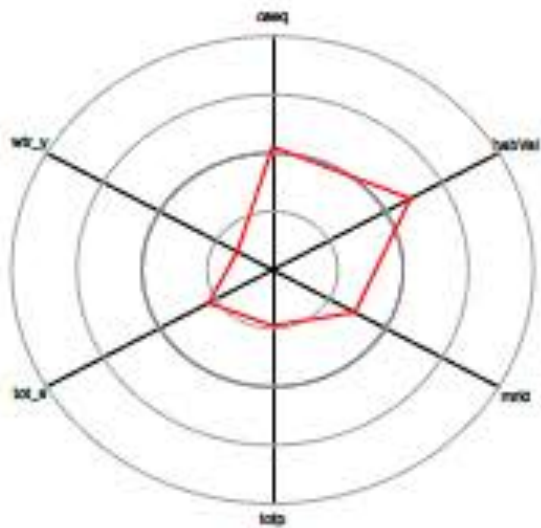
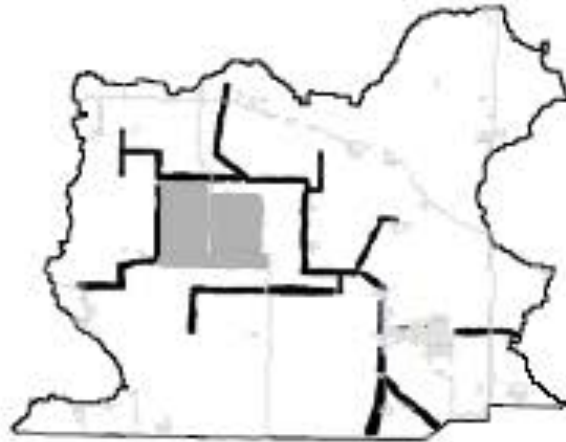
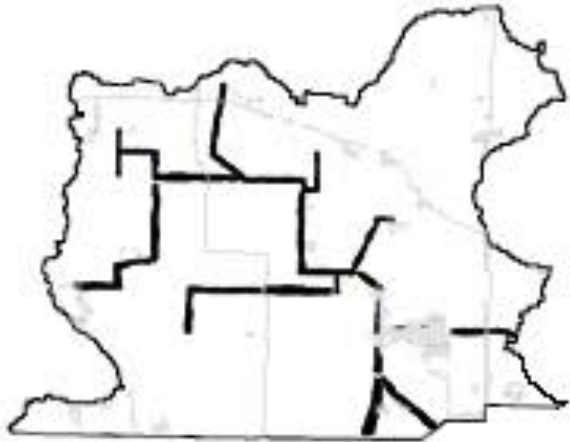
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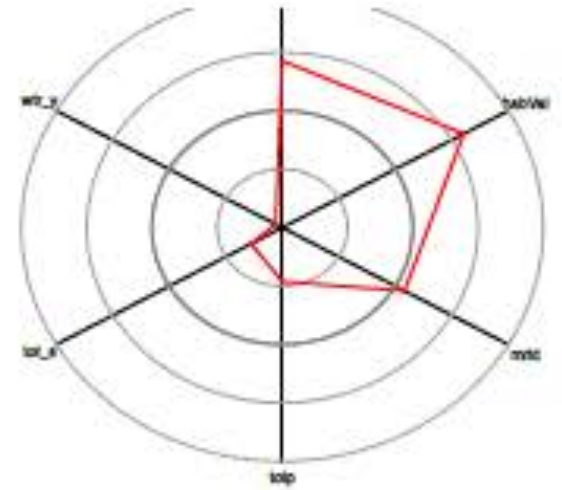
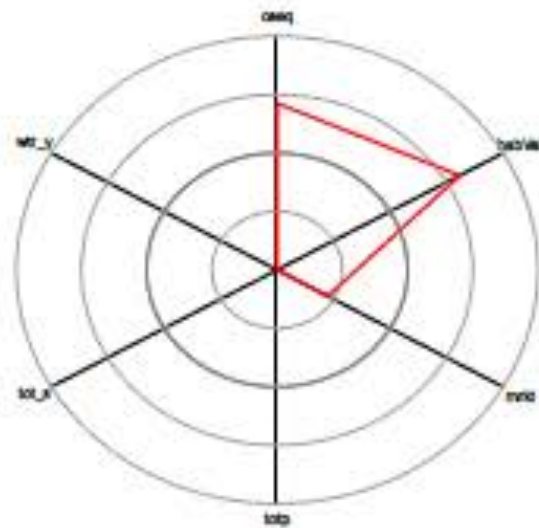
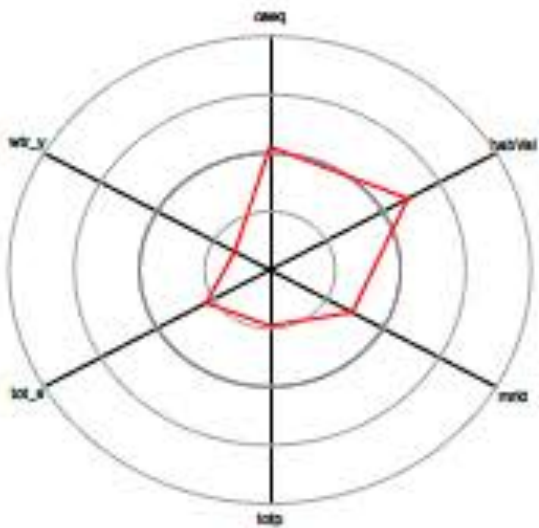
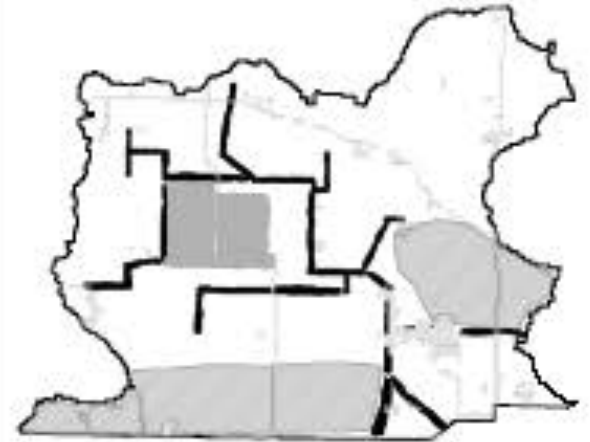
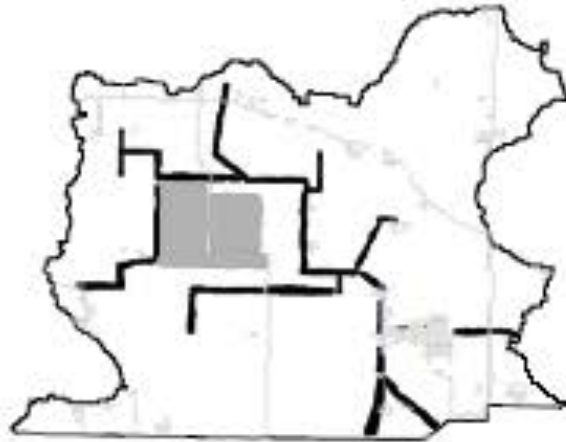
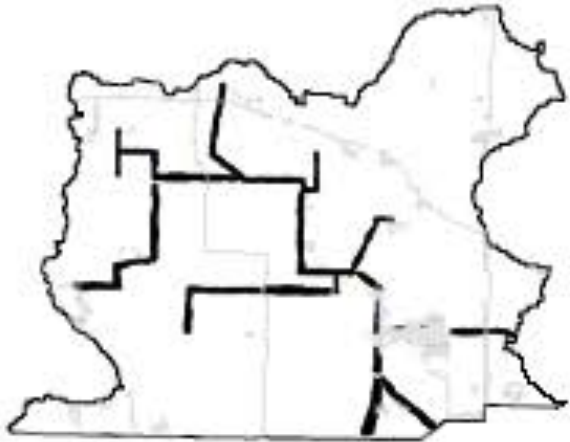
Collaborative Geodesign

Goal: identifying win-win scenarios



Collaborative Geodesign

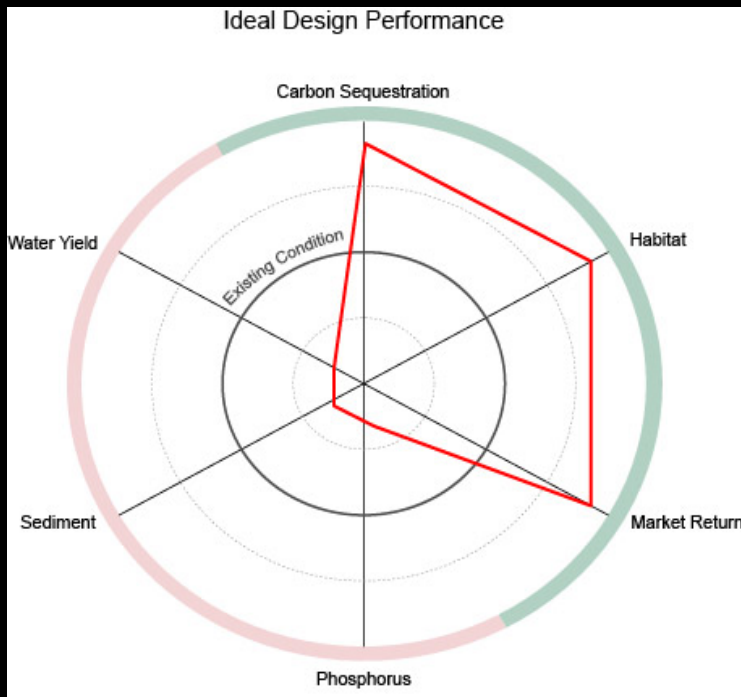
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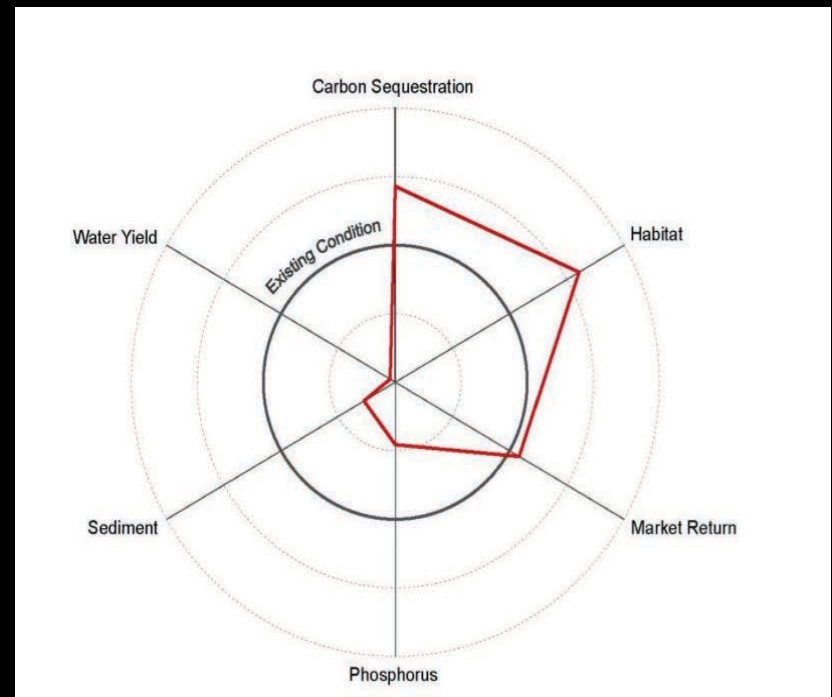
Final Design

Models + GIS + Design Interface

Research



“Win-Win”



Final Design

Collaborative Geodesign

Research Questions

1. Do participants produce designs that are nearer to what is optimal?

Collaborative Geodesign

Research Questions

1. Do participants produce designs that are nearer to what is optimal? **Maybe**

Collaborative Geodesign

Research Questions

1. Do participants produce designs that are nearer to what is optimal? Maybe
2. Does CG increase the legitimacy, credibility, and saliency of multiple forms of knowledge?

There's a real key benefit of this process. You know, getting different kinds of people together. Having them discuss a problem, communicate, and working out some things and they may not all agree from the get go of a course, . . .

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What was unique was the use of [geodesign] in the context of the conversation we were having about the [landscape]...

it allowed people to perhaps unintentionally lower those proposed barriers that they might normally have.

Collaborative Geodesign

Research Questions

1. Do participants produce designs that are nearer to what is optimal? Maybe
2. Does CG increase the legitimacy, credibility, and saliency of multiple forms of knowledge?
 - Deliberative learning + Geodesign

Collaborative Geodesign

Research Questions

1. Do participants produce designs that are nearer to what is optimal? Maybe
2. Does CG increase the legitimacy, credibility, and saliency of multiple forms of knowledge?
3. Does CG enable stakeholders to identify action pathways?

Next Steps

- Implementation
 - Alfalfa
 - Mid-size processing facility
 - Winter oilseed cover crops

Next Steps

- Implementation
 - Alfalfa
 - Mid-size processing facility
 - Winter oilseed cover crops
- Compare
 - Pareto efficiency optimization design
 - MCDA
 - Stakeholder designs

Funding

- MnDRIVE, University of Minnesota
- USDA-NRCS Conservation Innovation Grant Program
- U-Spatial, University of Minnesota
- Office of the VP for Research, University of Minnesota
- Institute for Renewable Energy and Environment, UMN

Thank you



Minnesota

Nicollet County

Seven Mile Creek
watershed

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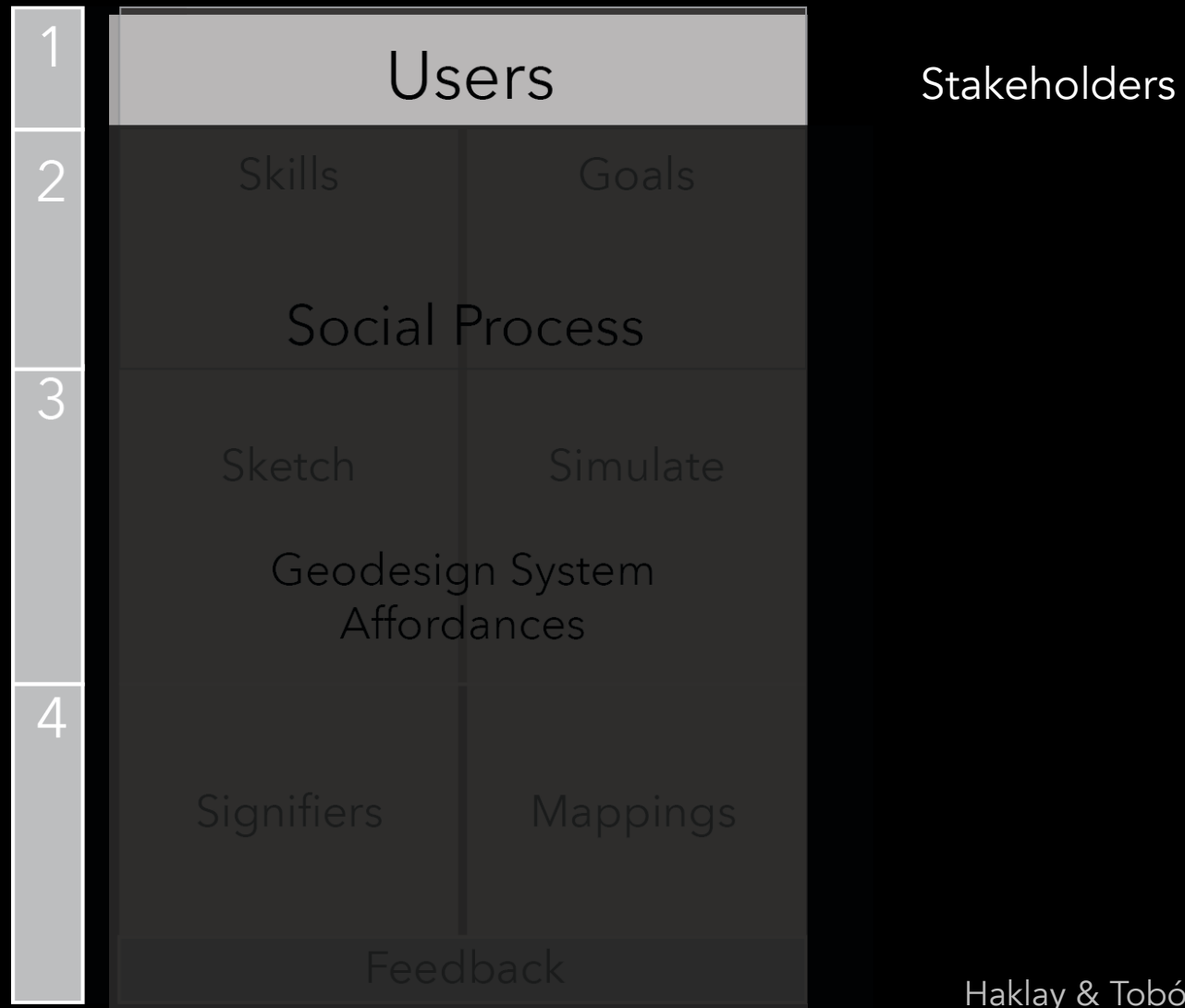
The Process

// Geodesign is a design and planning method which tightly couples the creation of design proposals with impact simulations informed by geographic contexts.

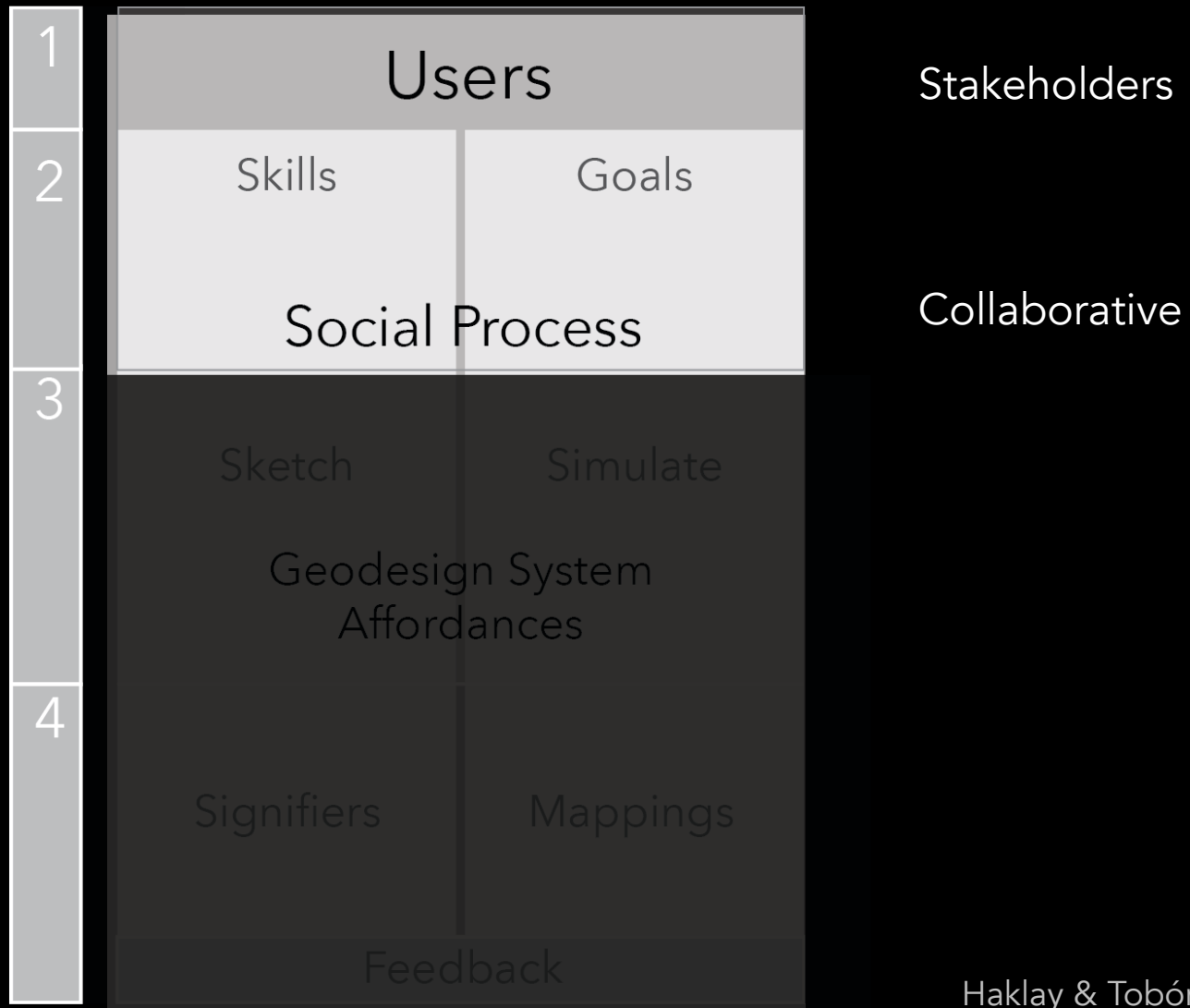
- Flaxman

Geodesign ^^

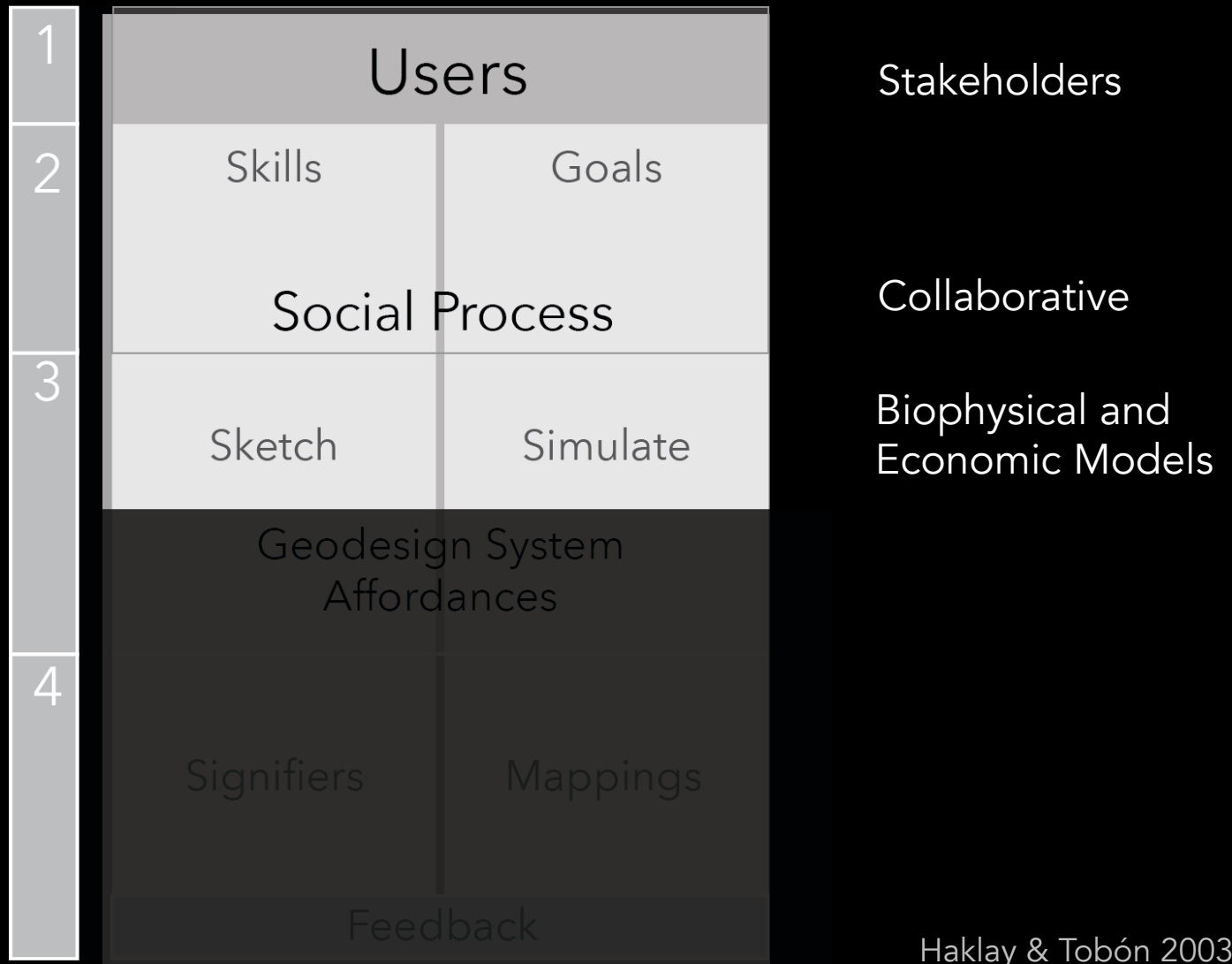
User-Centered Design



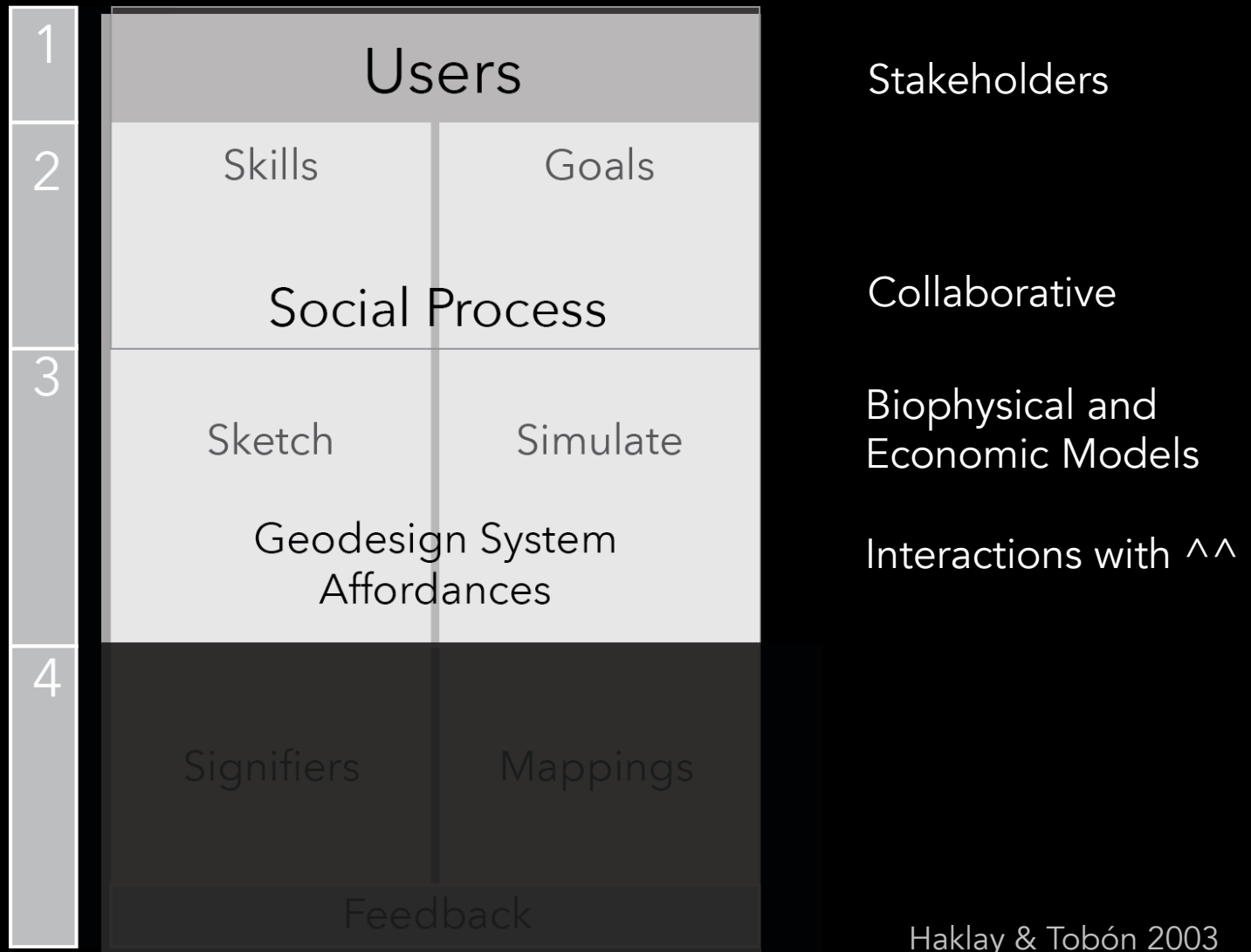
User-Centered Design



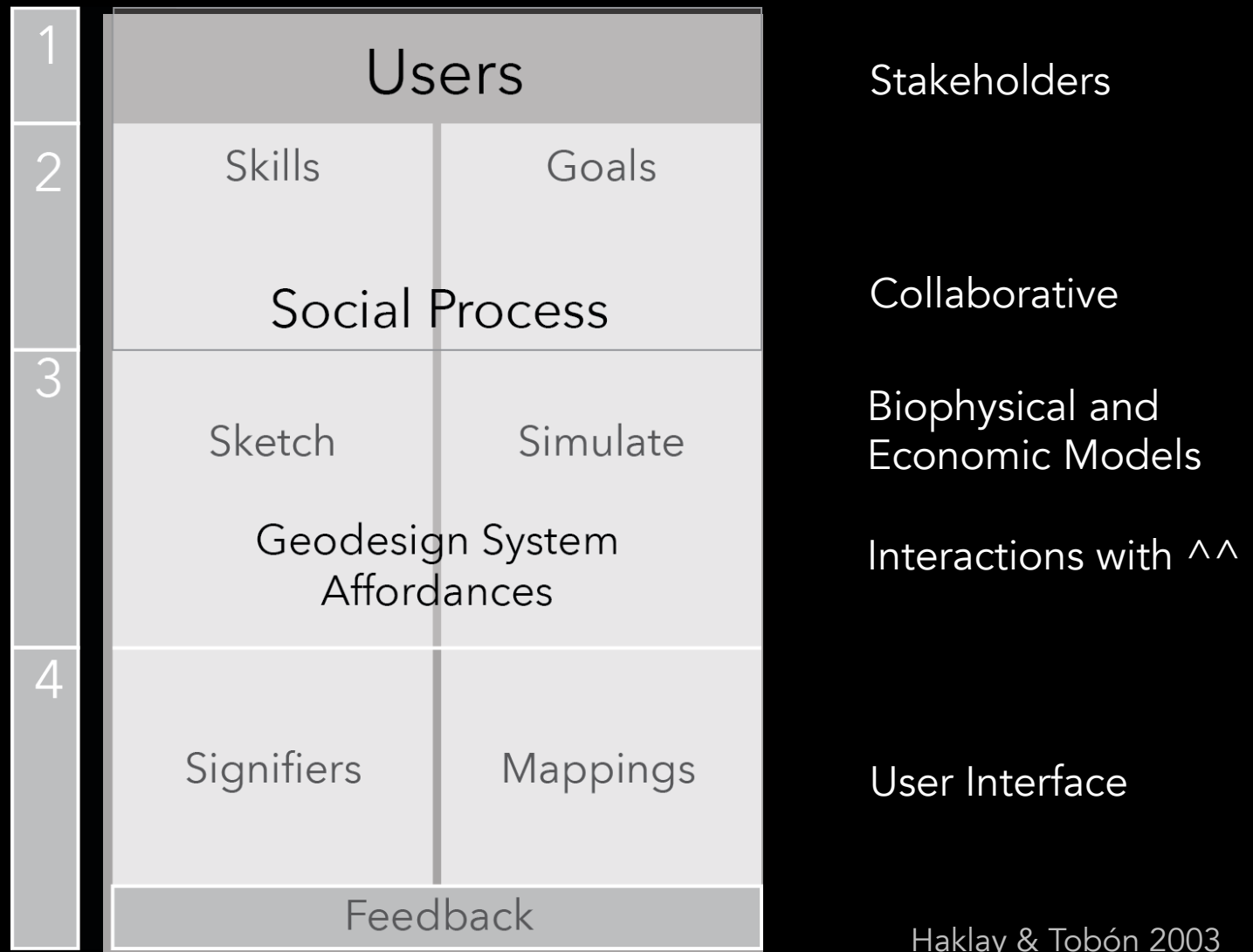
User-Centered Design



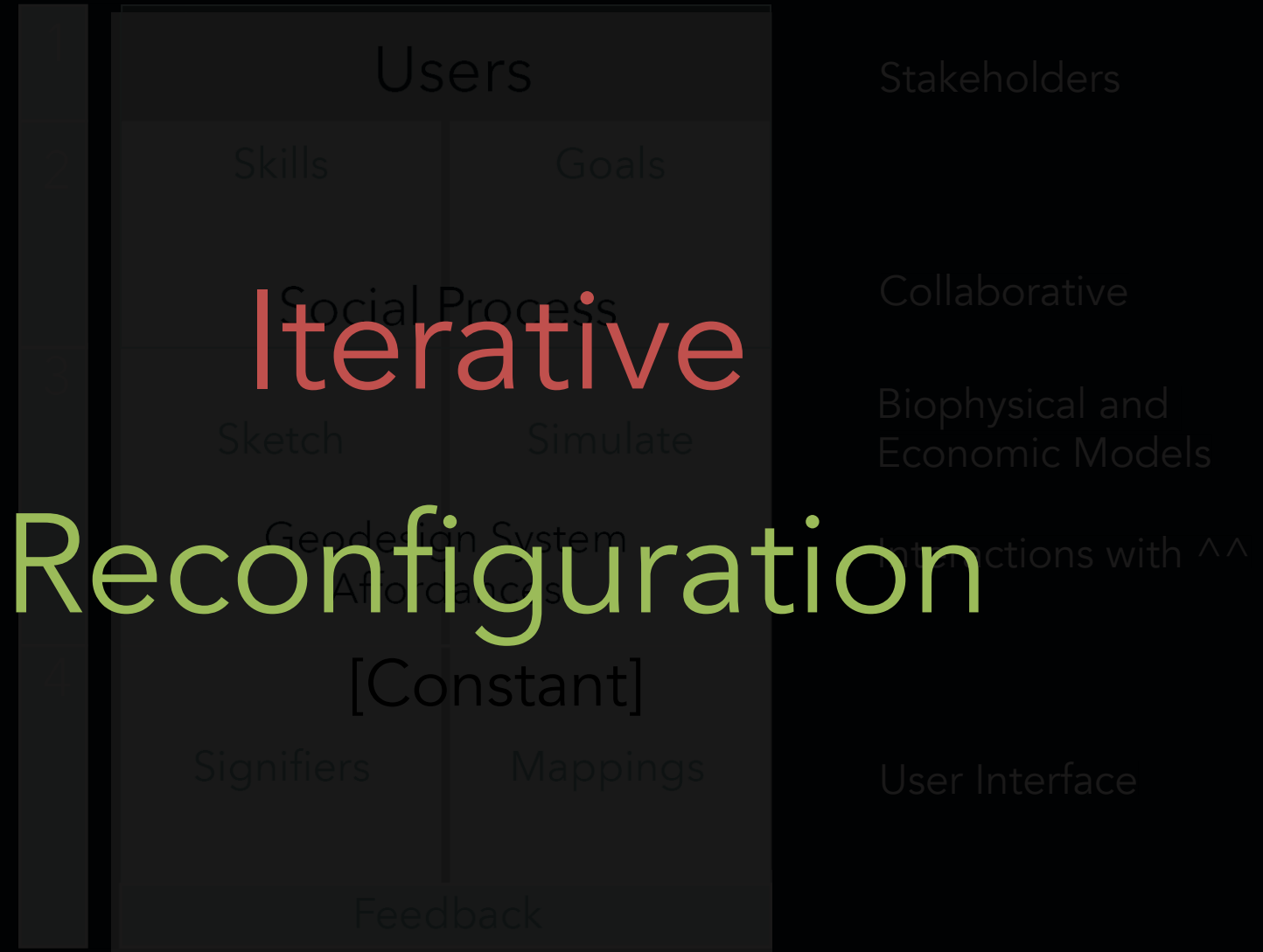
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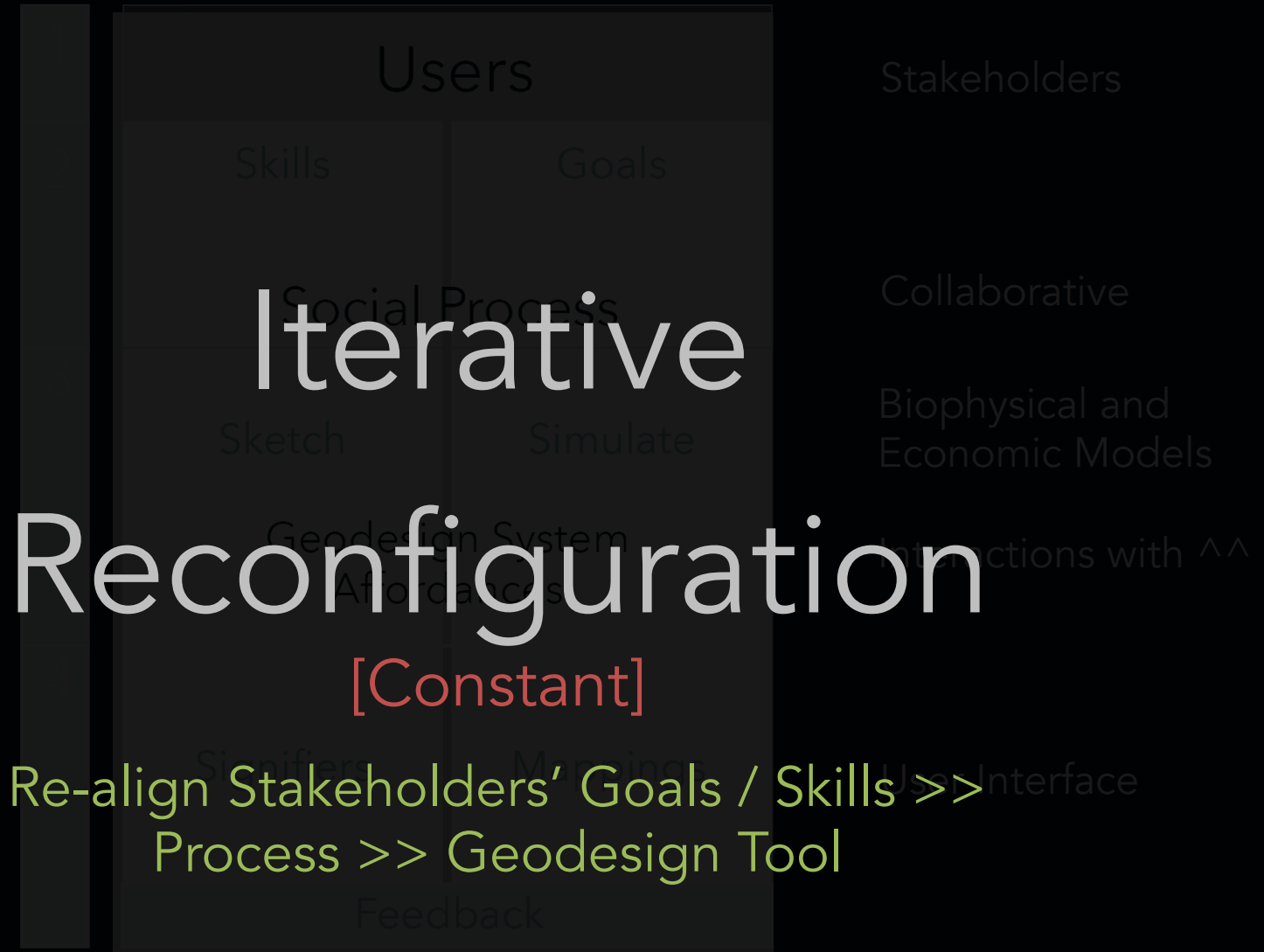
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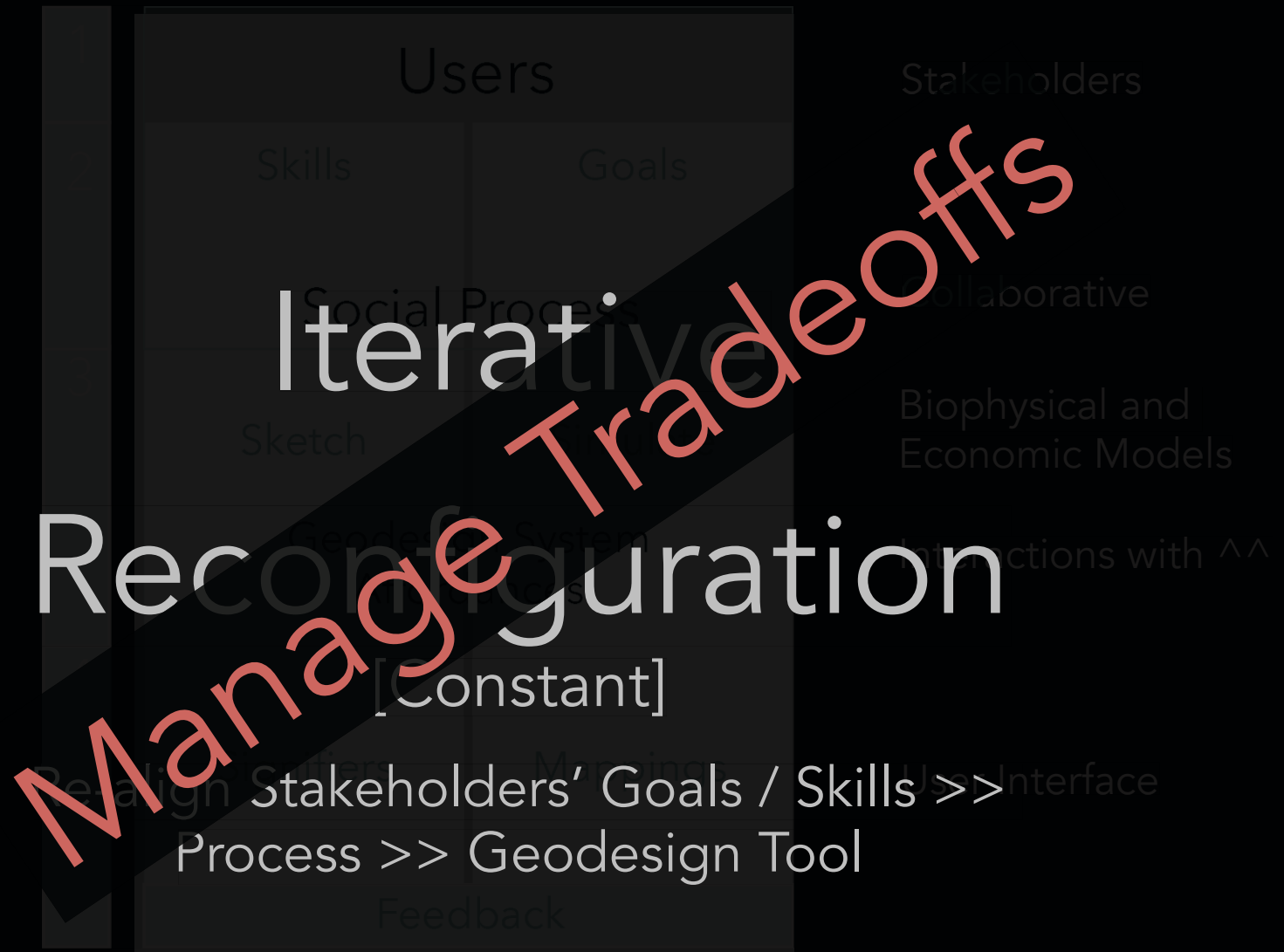
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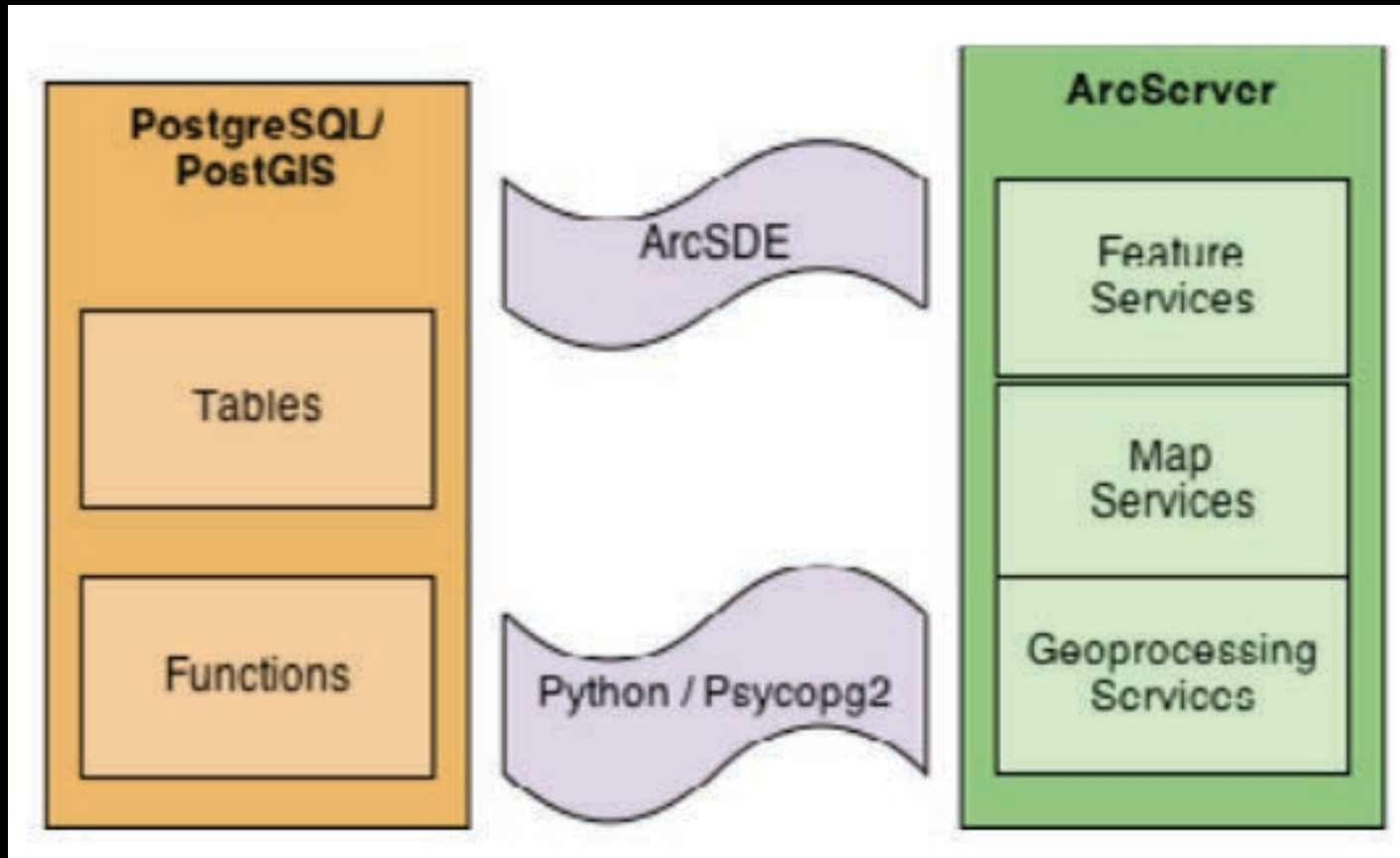


User-Centered Design



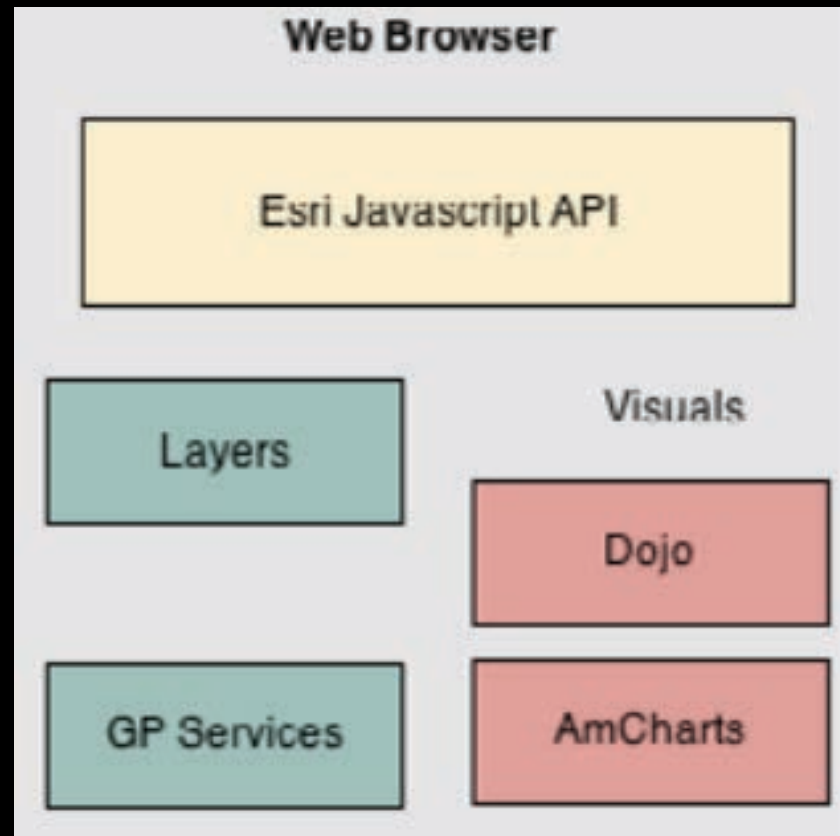
Models + GIS + Design Interface

Server



Models + GIS + Design Interface

Client

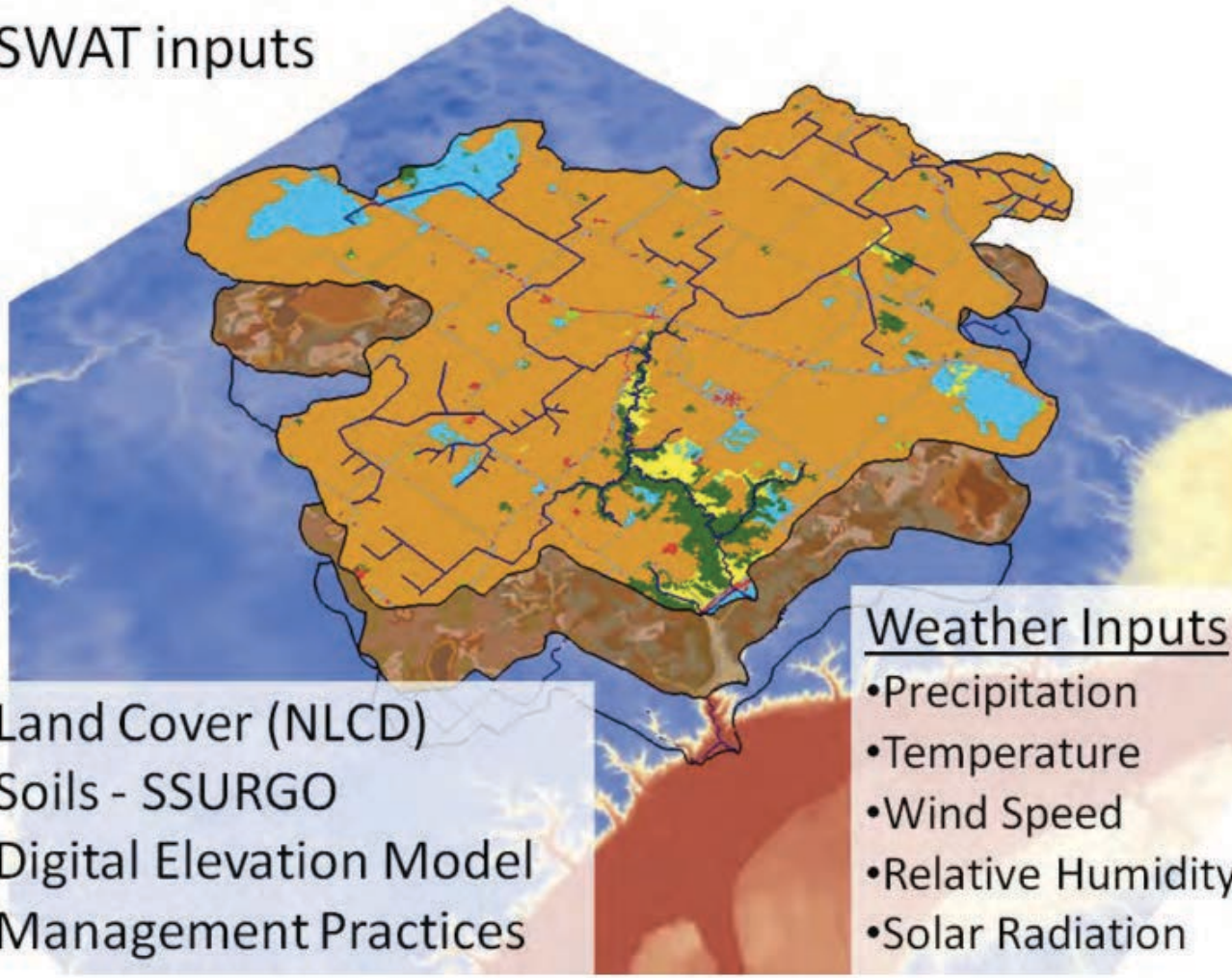


-D3



Models + GIS + Design Interface

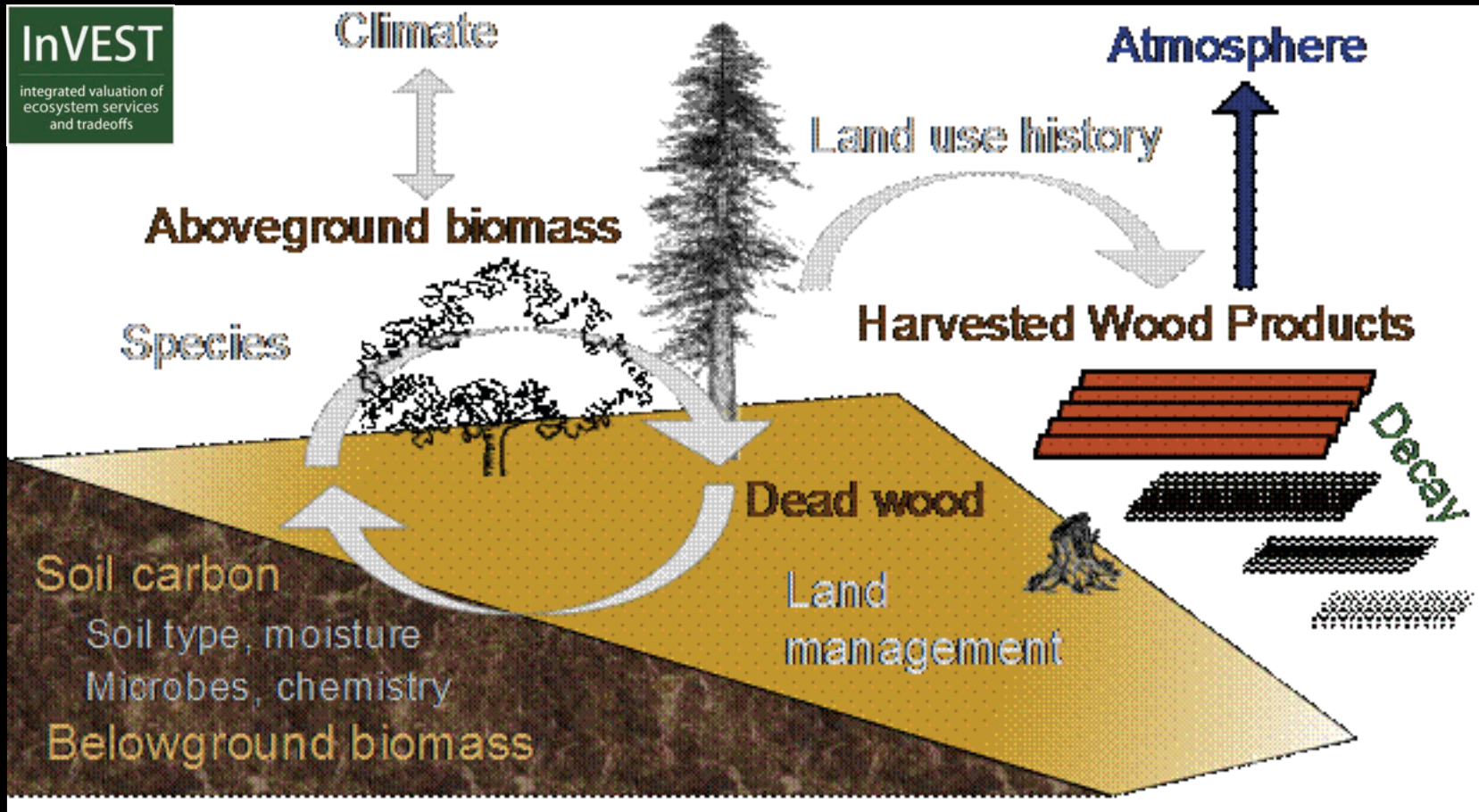
SWAT inputs



- Sediment
- P
- H2O Flow

Models + GIS + Design Interface

Carbon

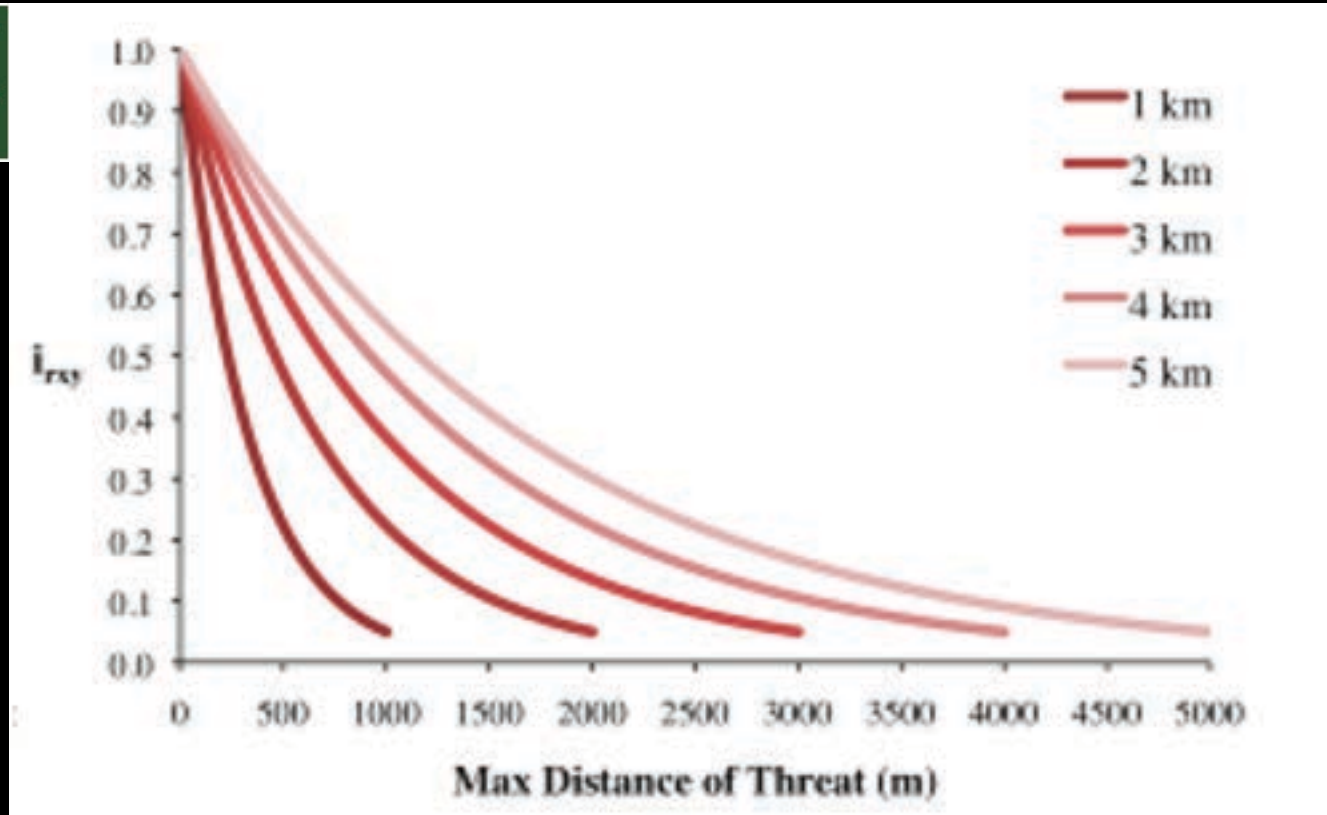


Models + GIS + Design Interface

Habitat

InVEST

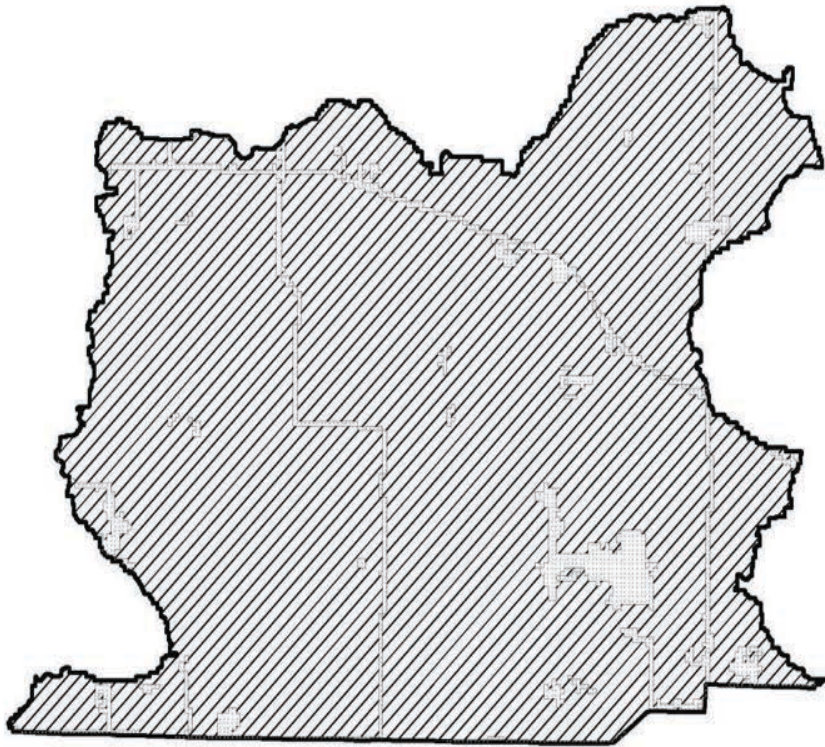
integrated valuation of
ecosystem services
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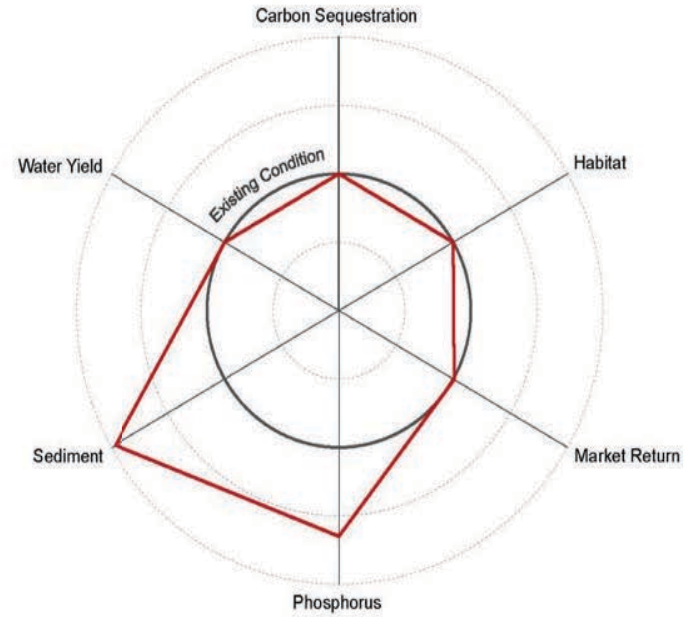
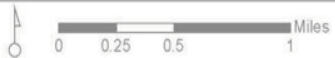
Group: 1

Design name: North cons tillage all

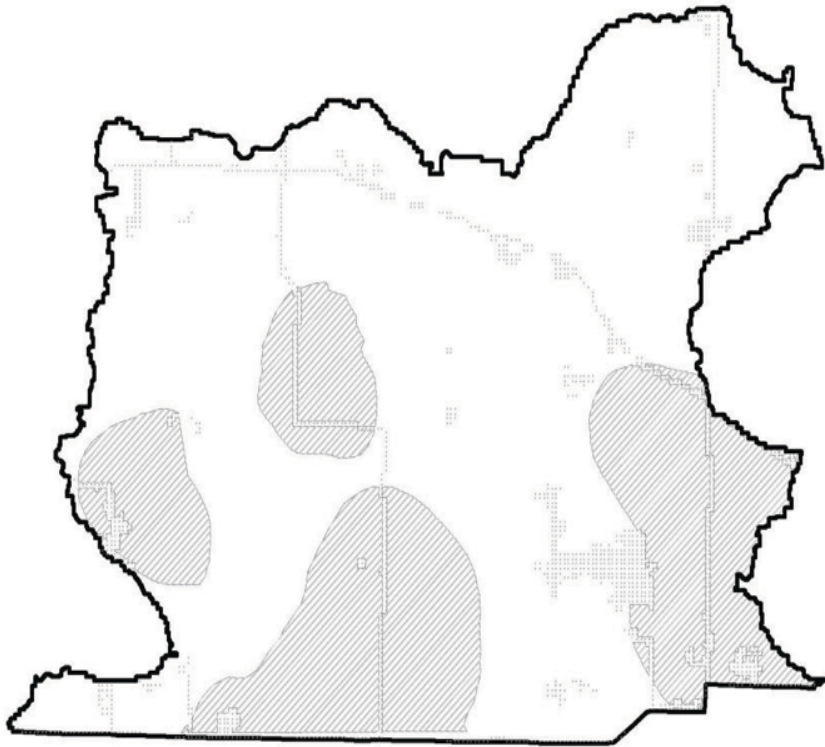
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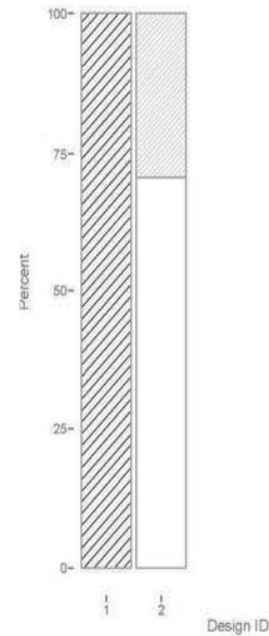
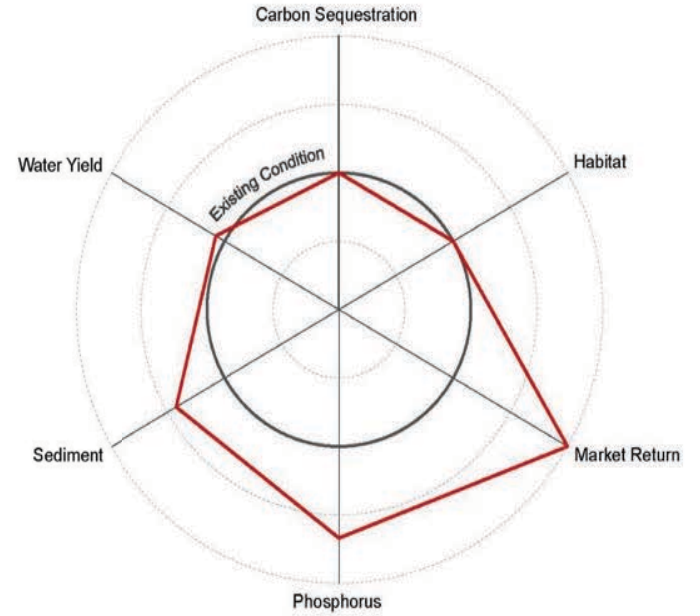
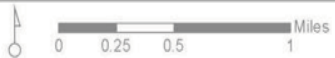
Land use practice



Design ID



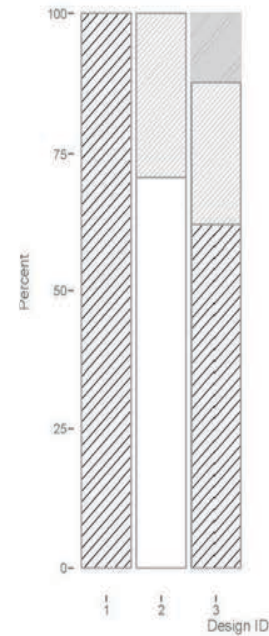
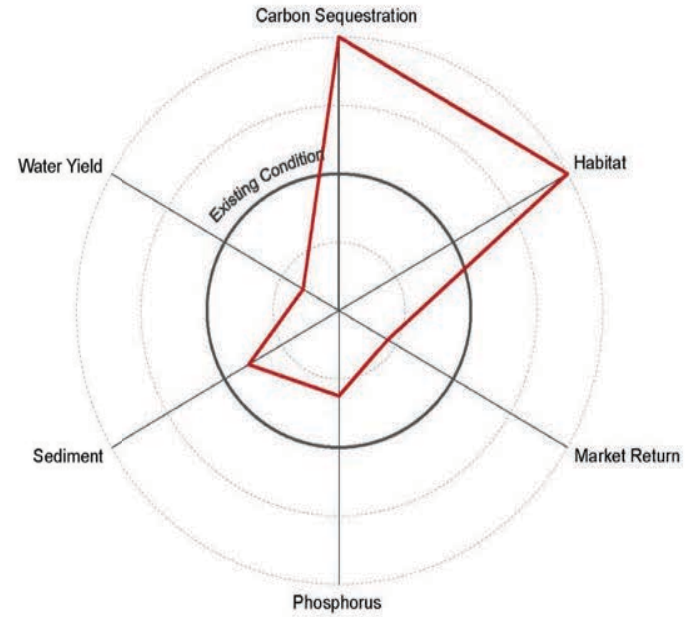
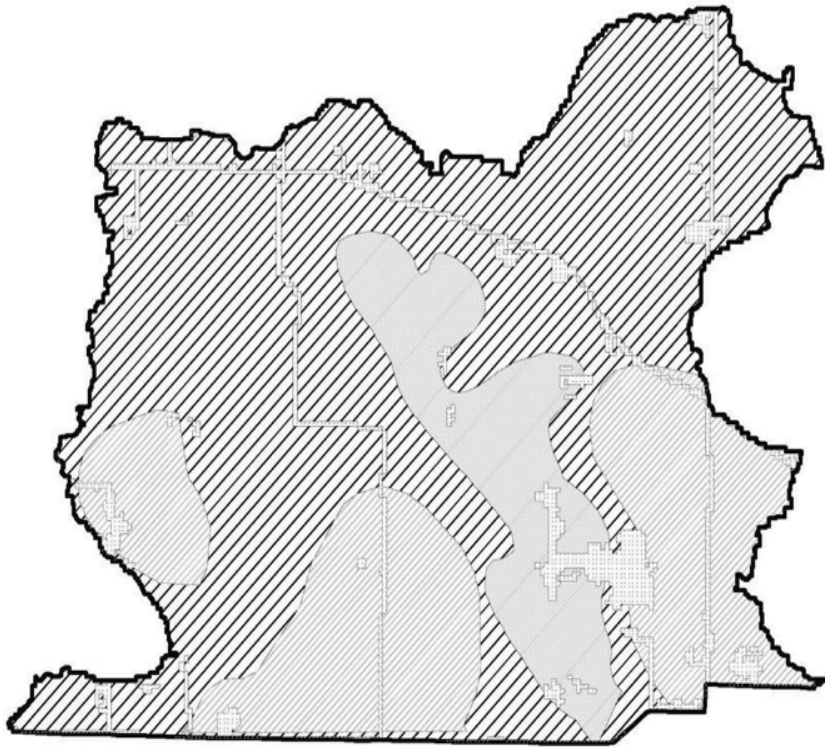
Land use practice



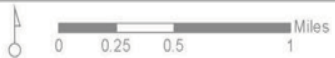
Group: 1

Design name: North cons tillage minus stover and prairie

ID: 3



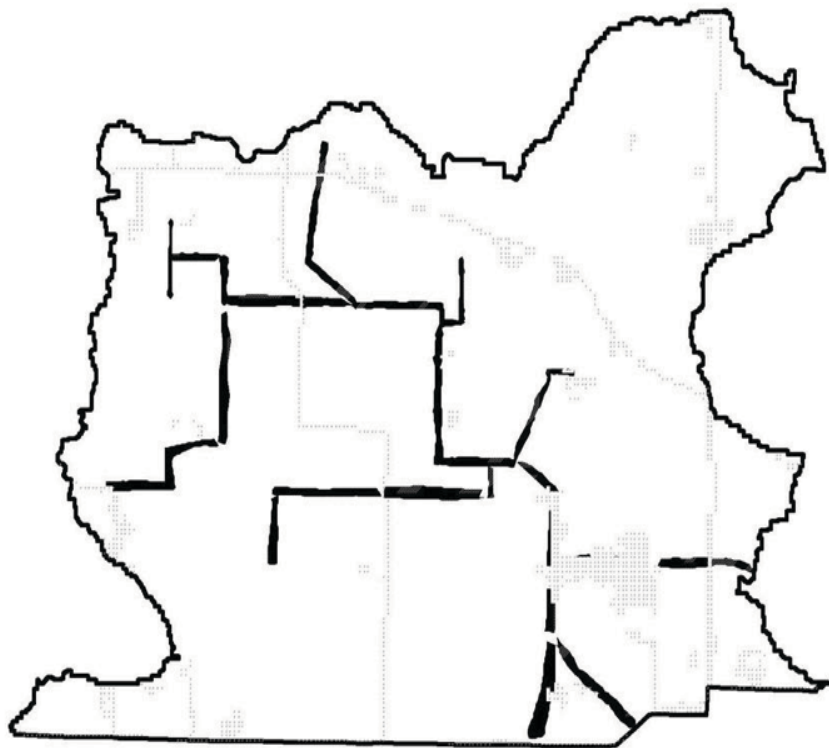
Land use practice



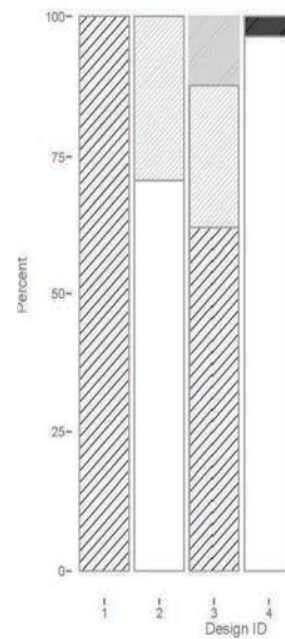
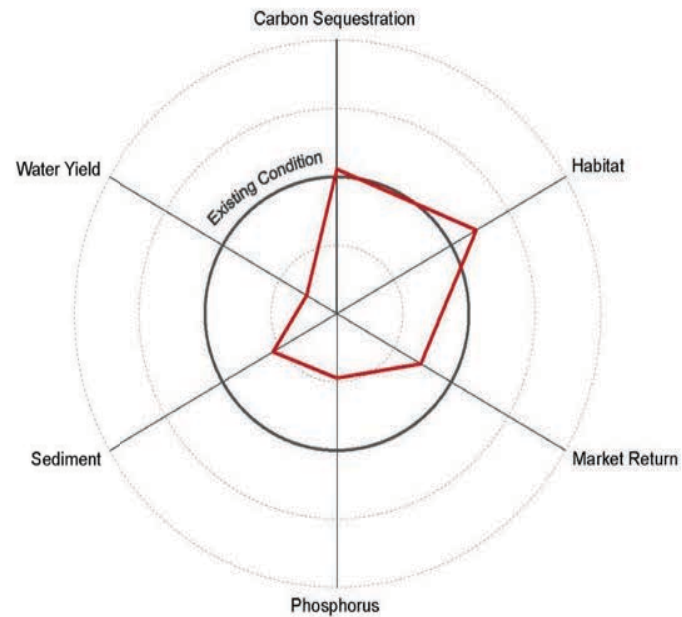
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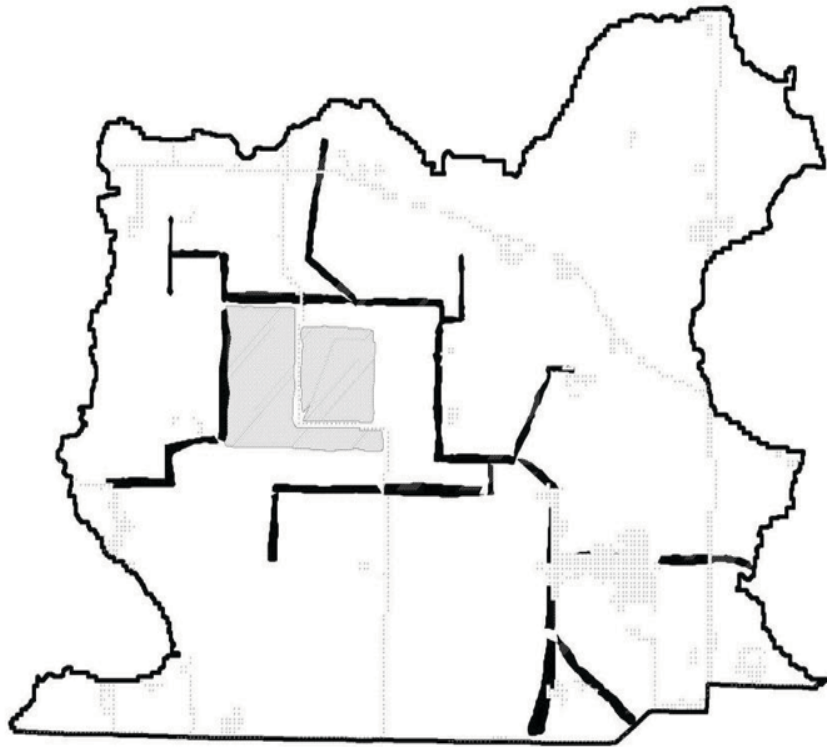
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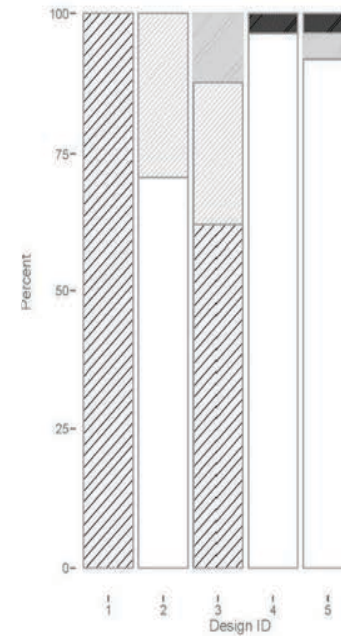
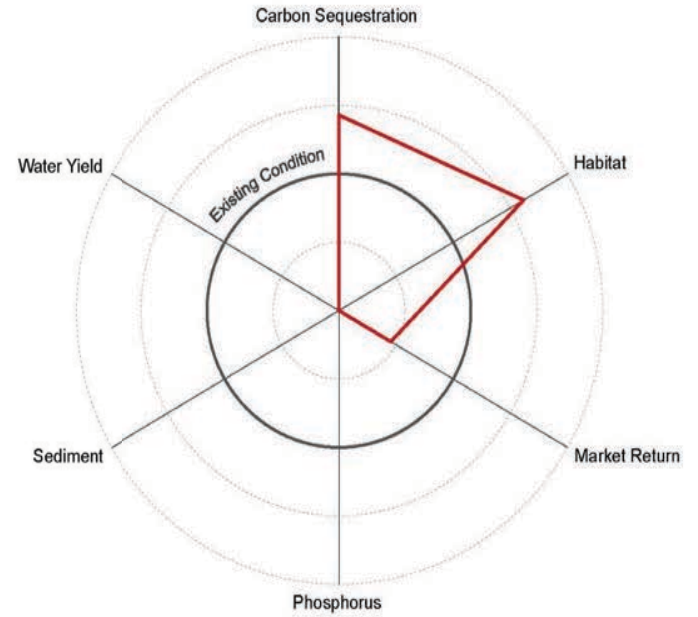


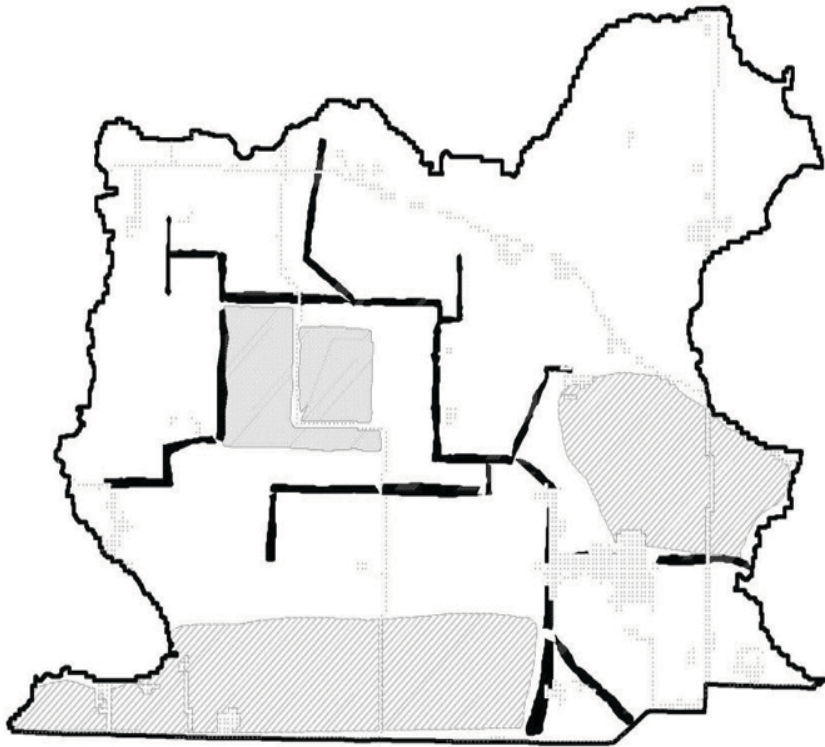
Land use practice



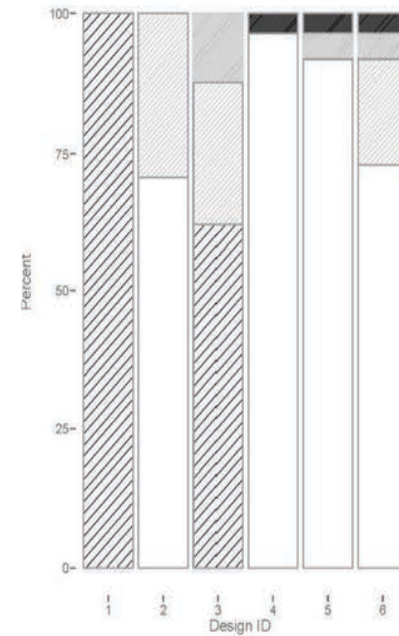
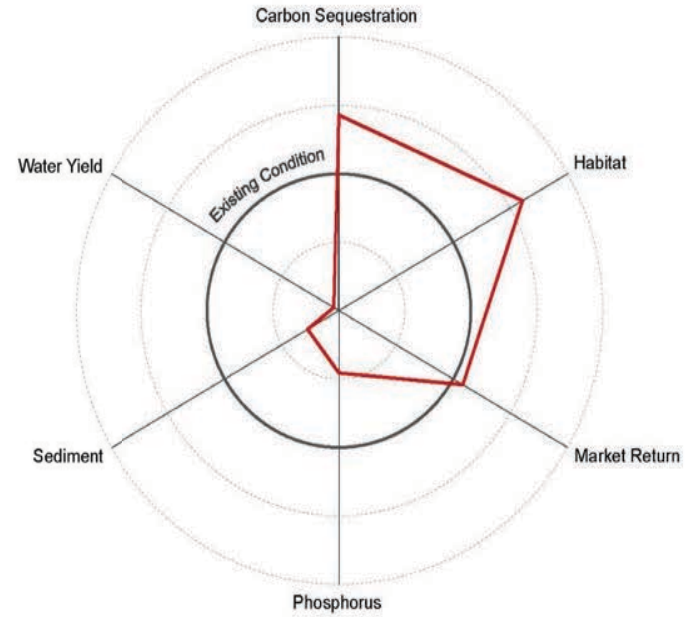


Land use practice





Land use practice



Group Design Process

Transformative Learning Through Adaptive Geodesign Process

