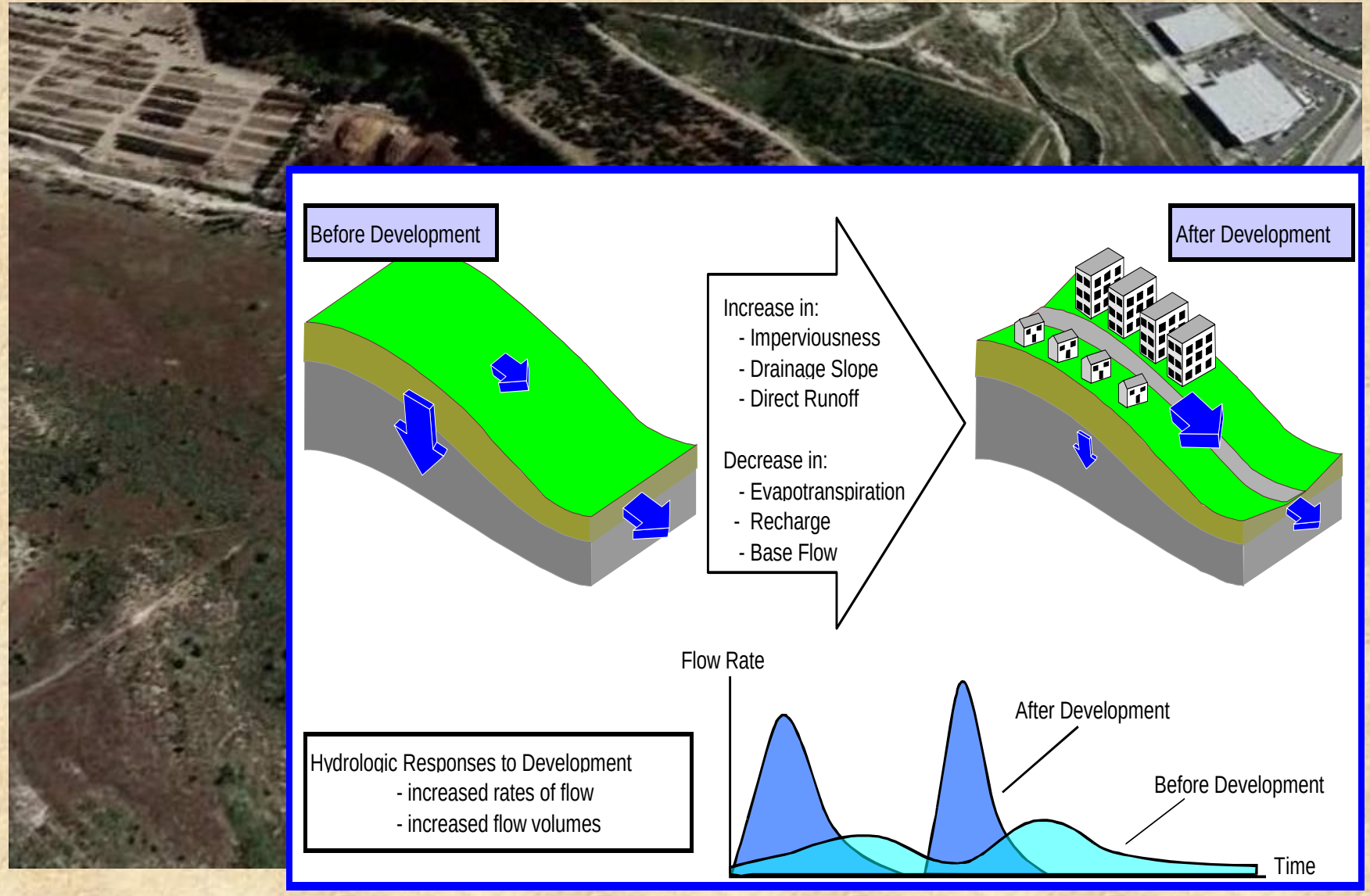
Developing Tools for Hydromodification Management and Assessment

Hydromodification: Channel Erosion



Hydromodification: Channel Erosion

Challenges in Managing Hydromodification

- Change can occur rapidly
- Streams respond differently
- May be dealing with legacy effects
- Responses are difficult to predict

Most stormwater permits require management of hydromodification effects

Effect of Single Storm

Dec. 2007, (0.3” rain)

Before

After

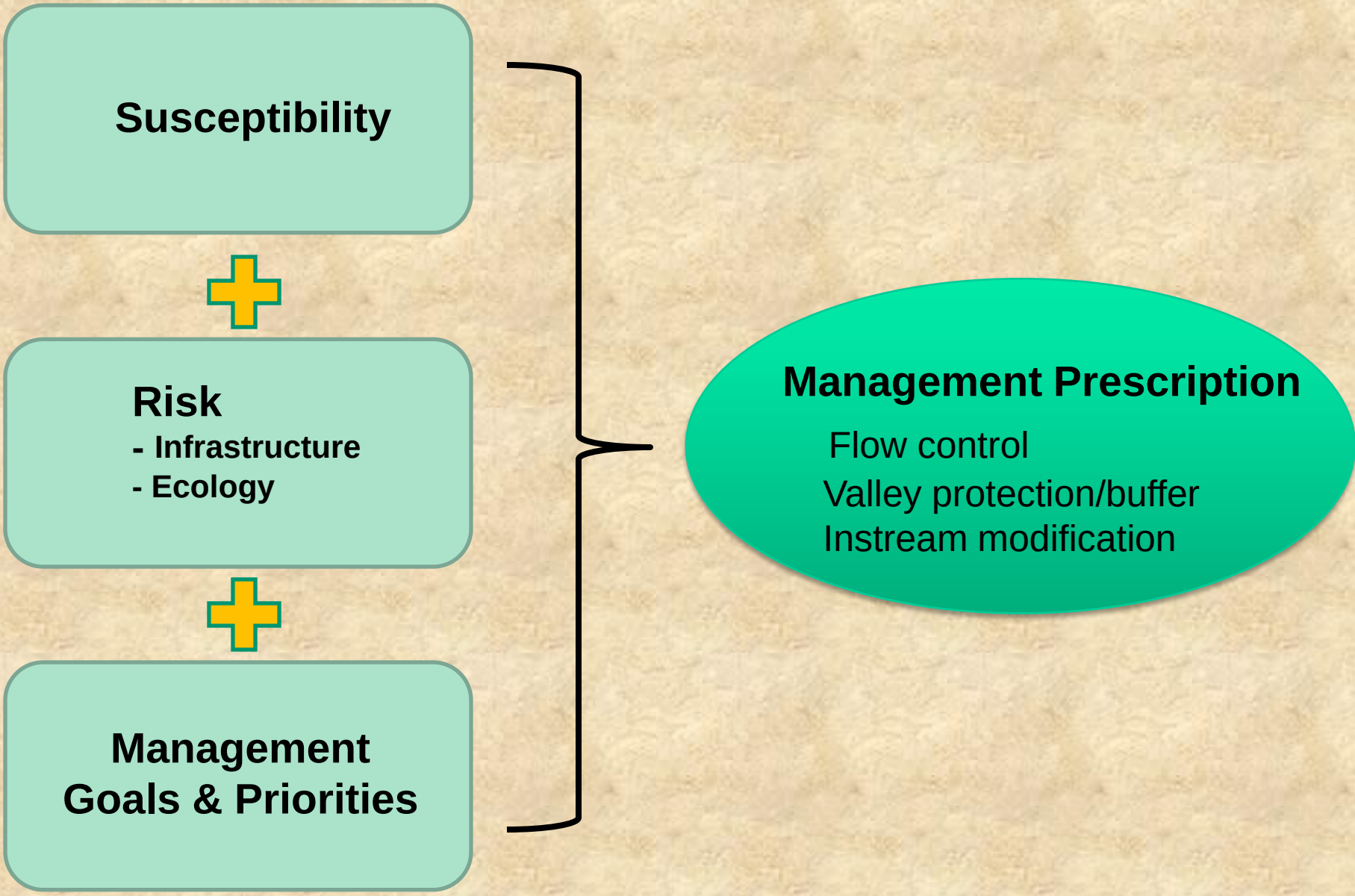
Current Study: Tool Development

1. Which streams are at the greatest risk of effects of hydromodification? → *Screening Tool*

2. What are the anticipated effects in terms of increased erosion, sedimentation, or habitat loss, associated with increases in impervious cover? → *Modeling Tools*

3. What are some potential management measures that could be implemented to offset hydromodification effects? → *Management Tools*

Informing Decisions

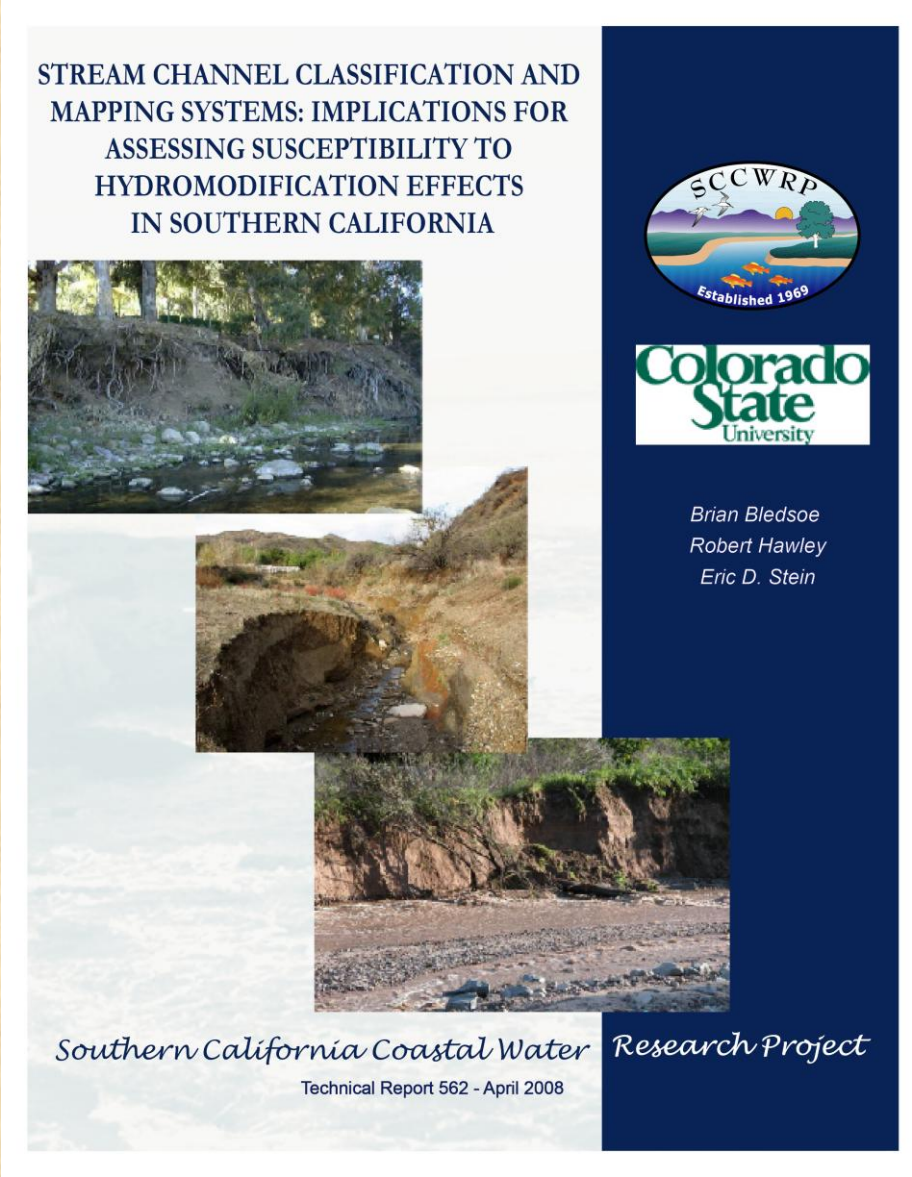


All streams are not the same

Need a tool to prioritize level of attention

Review of Existing Tools + Field Analysis

- Exhaustive review of existing methods and metrics
- Field data from 22 S. Ca. sites support metrics



Screening Tool General Approach

- Decision trees
  - ✓ Transparent logic , parsimonious
  - ✓ Clear endpoints – ***very high, high, medium, low***
  - ✓ repeatable
- Classify streams by:
  - ✓ Likely severity of response to hydromodification
  - ✓ Likely direction of response to hydromodification
- **Separate analysis for vertical vs. lateral response**
- Simple to apply field metrics
  - ✓ Does not rely on complex field measures of bankfull, bank vegetation, or sieve analysis
- Rapid - < 1 day in office + 1 day in field

Vertical (Bed) Susceptibility

Risk of incision relative to armoring potential

- Dominant bed material
- Amount of armoring
- Grade control
- Proximity to incision threshold

Vertical Susceptibility – Bed Resistance

Bed Material

- Labile (live) Bed
  - ✓ clearly sand dominated
  - ✓ Grade control has minimal effect
- Transitional/Intermediate Bed
  - ✓ gravel-/small-cobble dominated
- Coarse/Armored Bed
  - ✓ large cobbles or larger
  - ✓ Resistant bed material

Grade Control

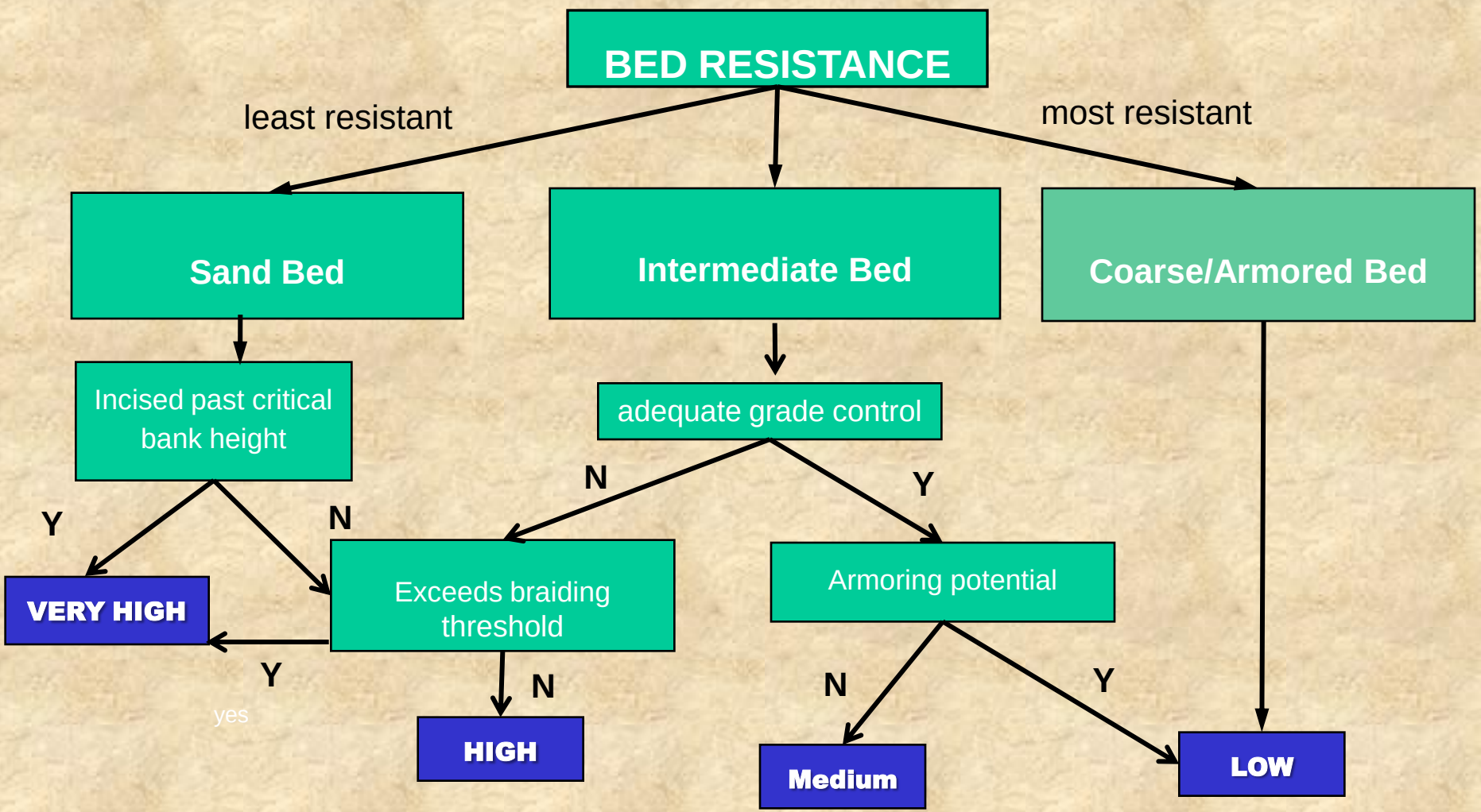
- Spacing
  - ✓ Close relative to valley slope
  - ✓ Proximity to reach of interest
- Height
- Integrity
  - ✓ Risk of failure
  - ✓ Evident undermining

Checklists and diagram for assessing potential bed erodibility – transitional/ intermediate bed material:

Checklist 1: Armoring Potential

- ☐ A. A mix of coarse gravels and cobbles that are tightly packed with < 5% surface material of diameter < 2 mm
- ☐ B. Intermediate to A. and C. or hardpan of unknown resistance, spatial extent (longitudinal and depth), or unknown armoring potential due to surface veneer covering gravel or coarser layer encountered with probe
- ☐ C. Gravels/cobbles that are loosely packed and/or > 25% surface material of diameter < 2 mm

VERTICAL SUSCEPTIBILITY



Lateral (Bank) Susceptiblity

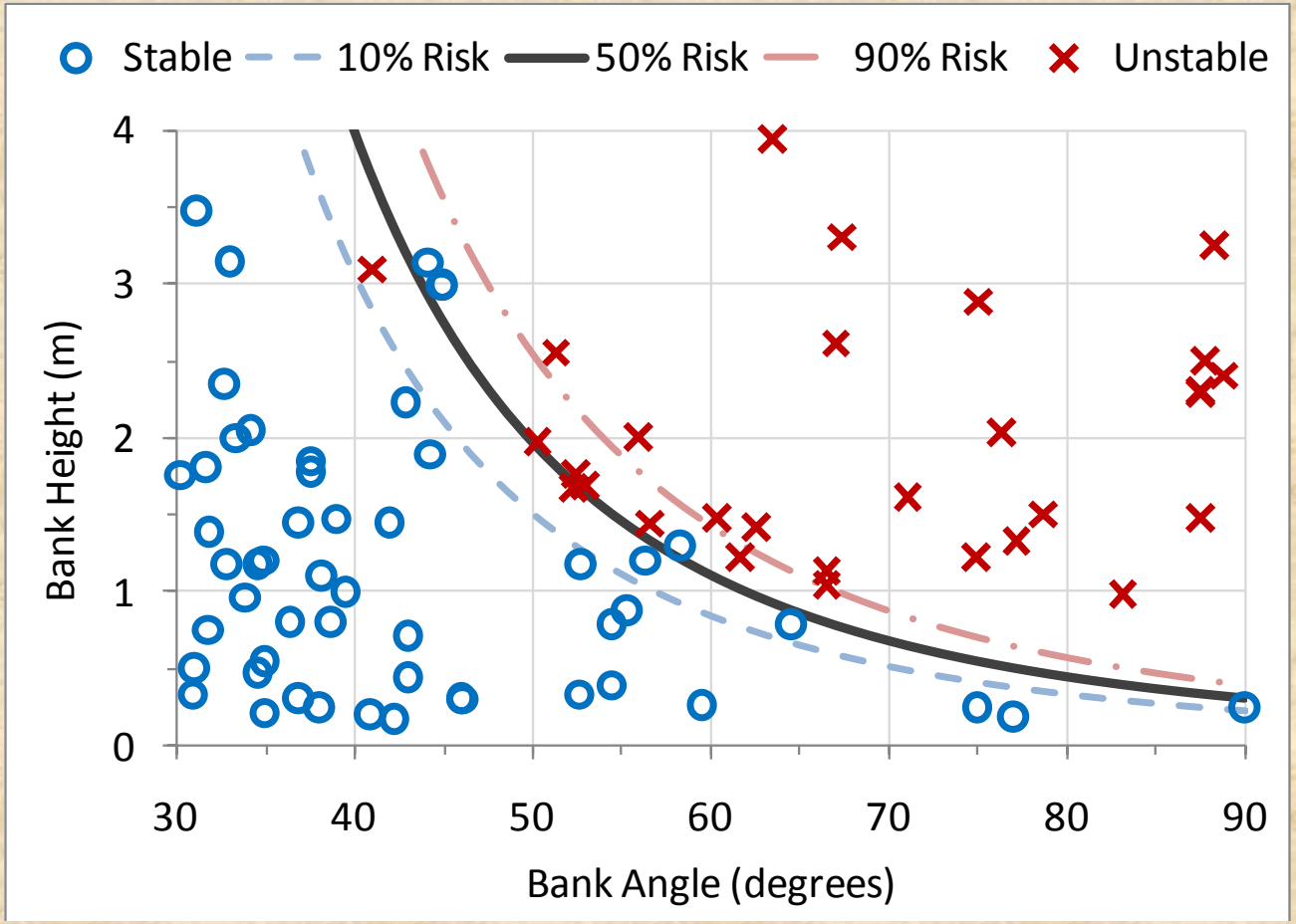
- Evidence of mass wasting or bank cutting
- Consolidation of bank material
- Toe material (coarse or fine)
- Proximity to braiding threshold
  - ✓ Dominant bank material and stream power
- Valley confinement
  - ✓ Valley Width Index (VWI)
  - ✓ valley bottom width versus channel width
- Bank height and angle

Toe failure

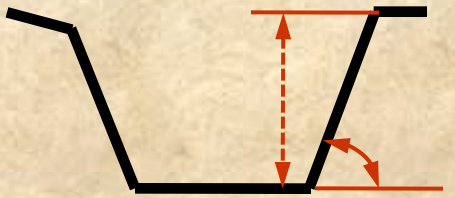
Poorly consolidated bank

Example – Bank Height vs. Angle

probability of mass wasting
in moderately/well consolidated banks



Bank angle	Bank height (m) (10% Risk of Mass Wasting)
30	7.6
35	4.7
40	3.7
45	2.1
50	1.5
55	1.1
60	0.85
65	0.66
70	0.52
80	0.34
90	0.24

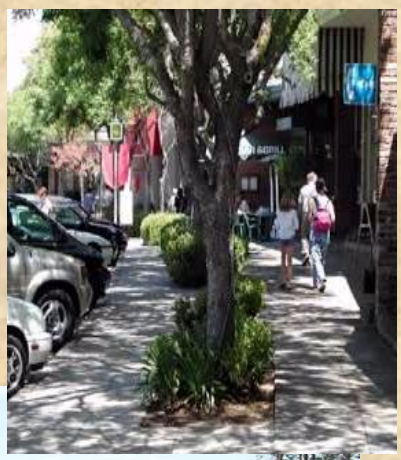


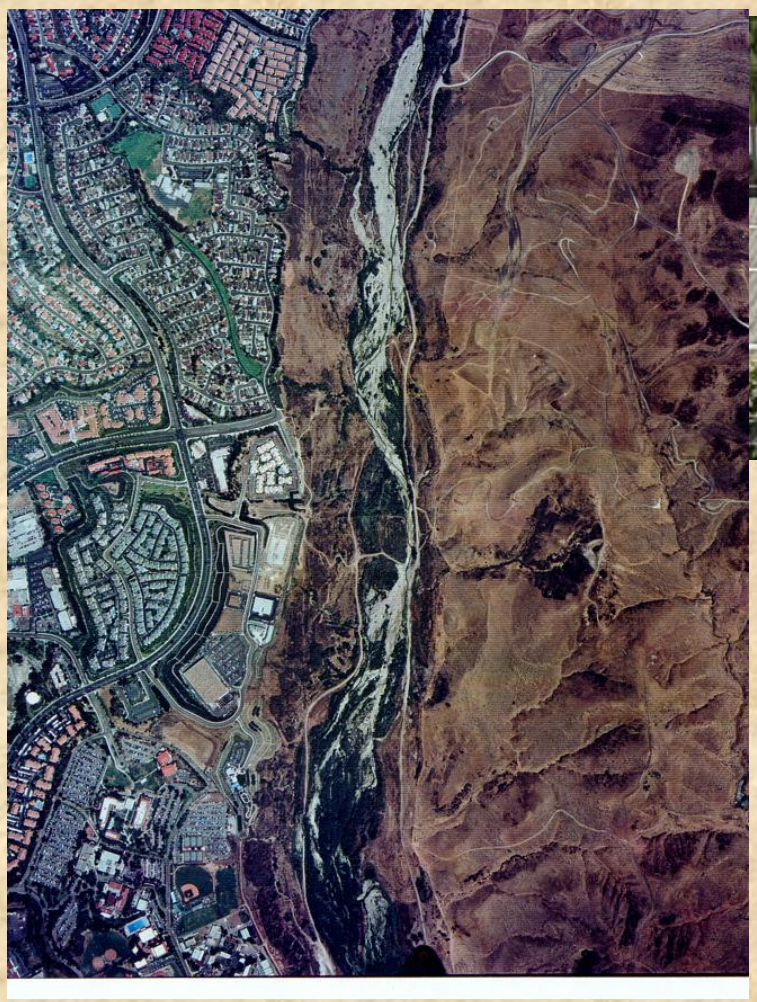
FORM 5: SEQUENCE OF LATERAL QUESTIONS OPTION

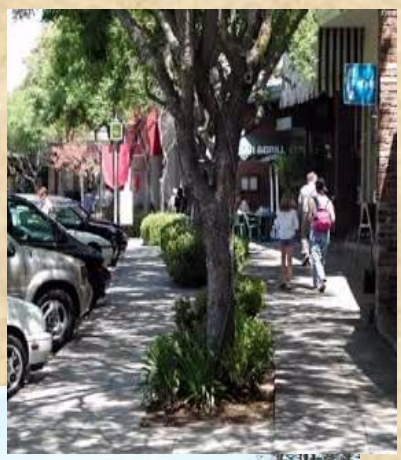
Channel fully confined with VWI ~1 – connected hillslopes OR fully-armored/engineered bed and banks in good condition?	if YES, then LOW	
if NO, is there active mass wasting or extensive fluvial erosion (> 50% of bank length)?	if YES, VWI ≤ 2 = HIGH, VWI > 2 = VERY HIGH	
if NO, are both banks consolidated?	if YES, how many risk factors present? All three = VERY HIGH two = HIGH one = MEDIUM none = LOW	Three risk factors: 1. Bank instability p > 10% 2. VWI > 2 3. Vertical rating ≥ High
if NO, are banks either consolidated or unconsolidated with coarse toe of d > 64 mm?	if YES, how many risk factors present? two = HIGH one = MEDIUM none = LOW	Two risk factors: 1. VWI > 2 2. Vertical rating ≥ High
if NO, at least one bank is unconsolidated with toe of d < 64 mm	how many risk factors present? two = VERY HIGH one = HIGH none = MEDIUM	Two risk factors: 1. VWI > 2 2. Vertical rating ≥ High

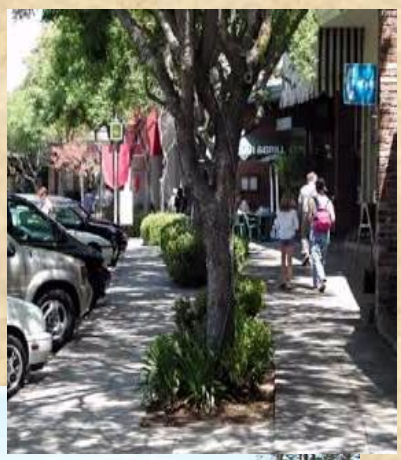
Screening Tool Summary

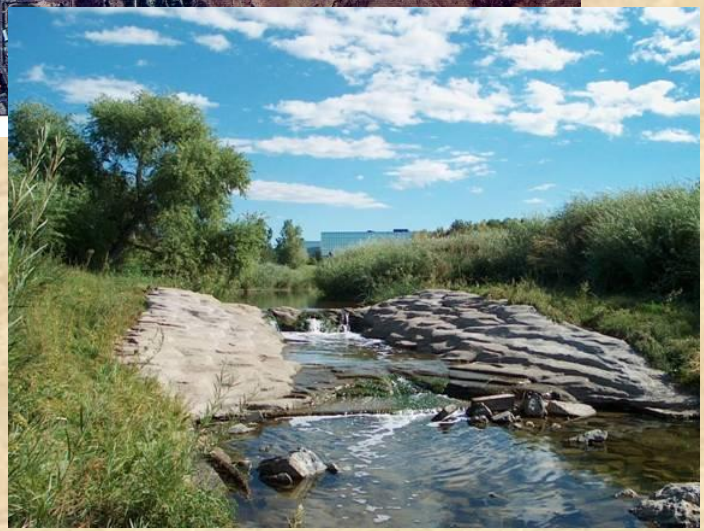
- Simple, observable field indicators
  - ✓ Ratio of disturbing to resistive forces
  - ✓ High, medium, low ratings for vertical AND lateral
- Empirically defined based on data from local streams
  - ✓ Proximity to geomorphic thresholds
  - ✓ Regionally-calibrated braiding/incision threshold based on surrogates for stream power and boundary resistance
- Ratings foreshadow the level of data collection, modeling, and ultimate mitigation efforts expected



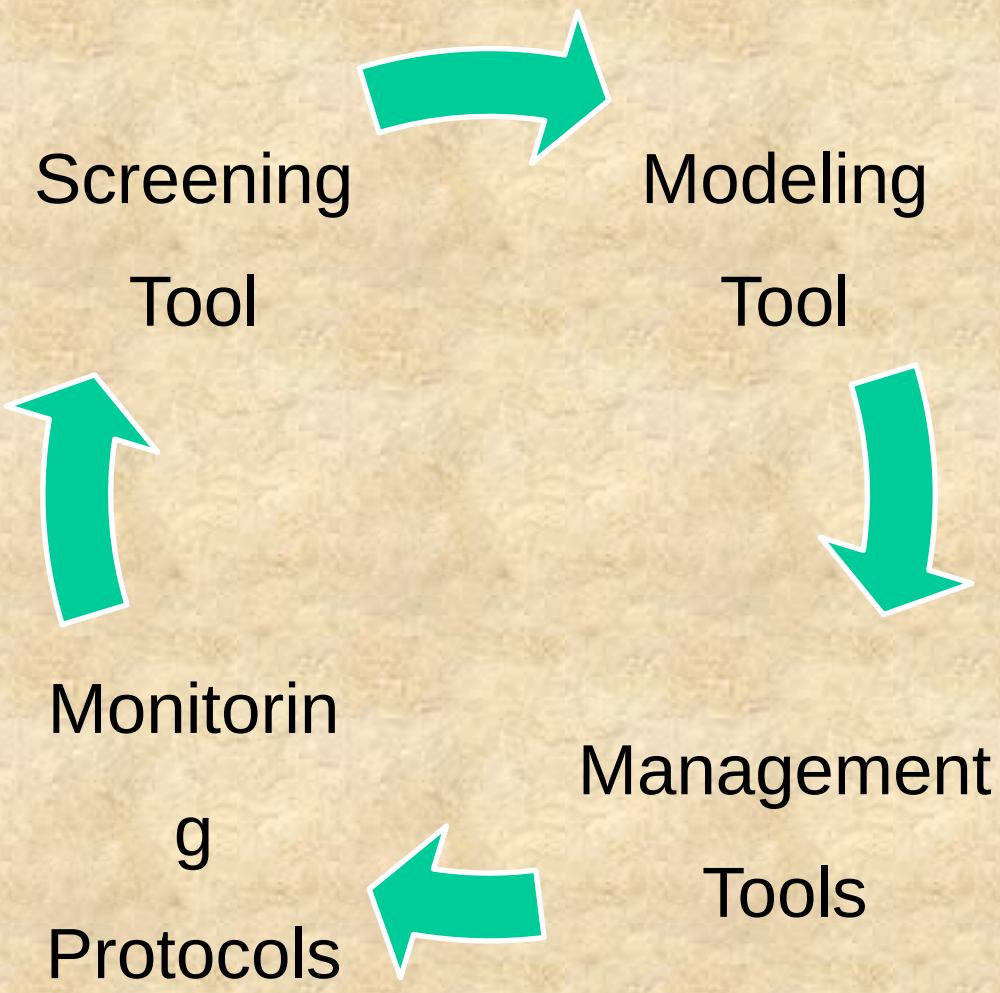








Project Synergy



Status

Hydromodification Screening Tool for Southern California

DRAFT

for

FIELD TESTING/TAC REVIEW

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SOUTHERN CALIFORNIA COASTAL WATER RESEARCH PROJECT

SCCWRP

November, 2009

- Finalize screening tools – Feb. 2010
- Monitoring framework - June 2010
- Produce set of assessment tools – Aug. 2010
- Management matrix – Jan. 2011

QUESTIONS ?

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What is susceptibility?

The *intrinsic* sensitivity of a channel system to hydromodification as determined by the *ratio of disturbing to resisting forces*, *proximity to thresholds of concern, probable rates of response and recovery, and potential for spatial propagation of impacts*.