Developing Tools for Hydromodification Management and Assessment

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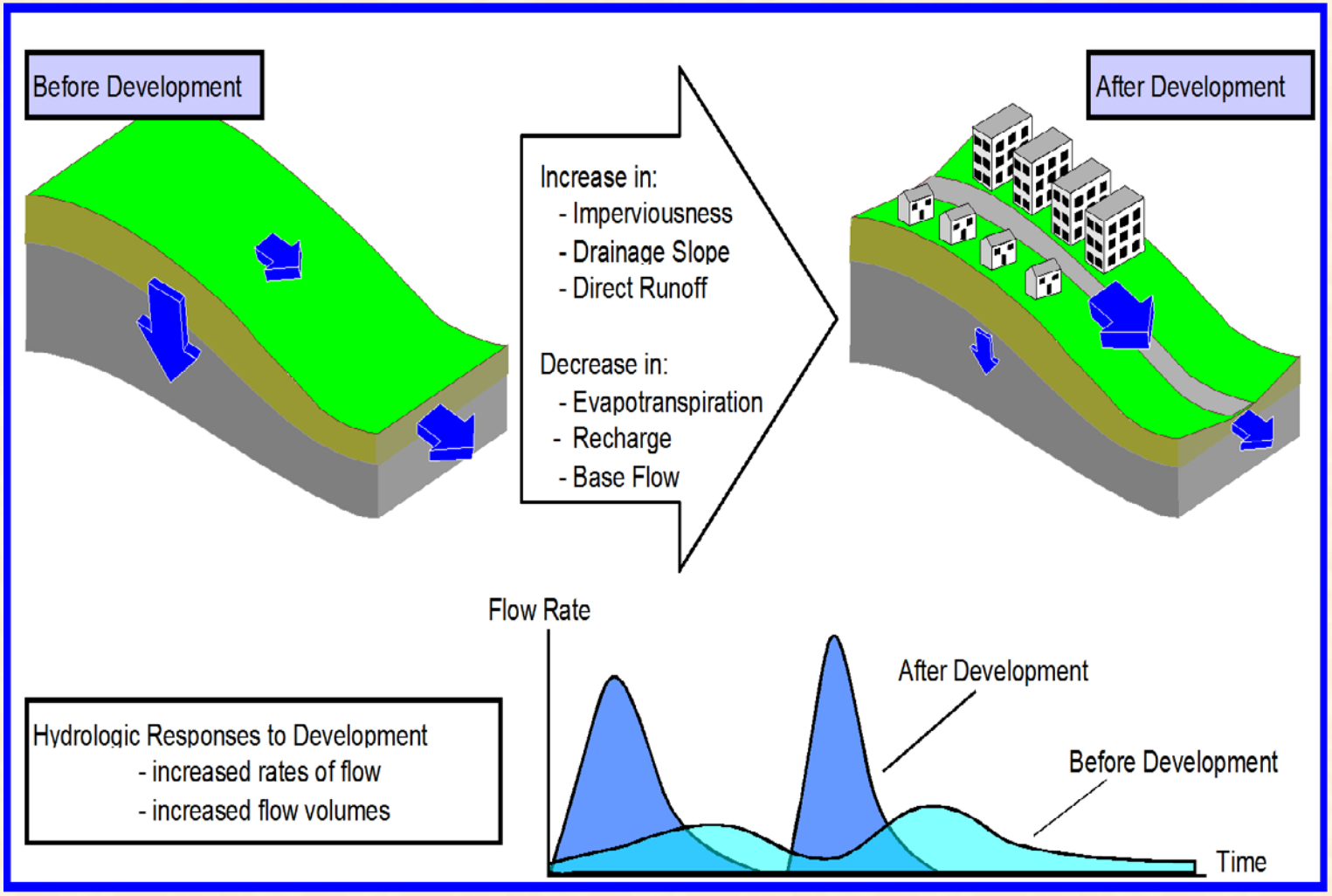
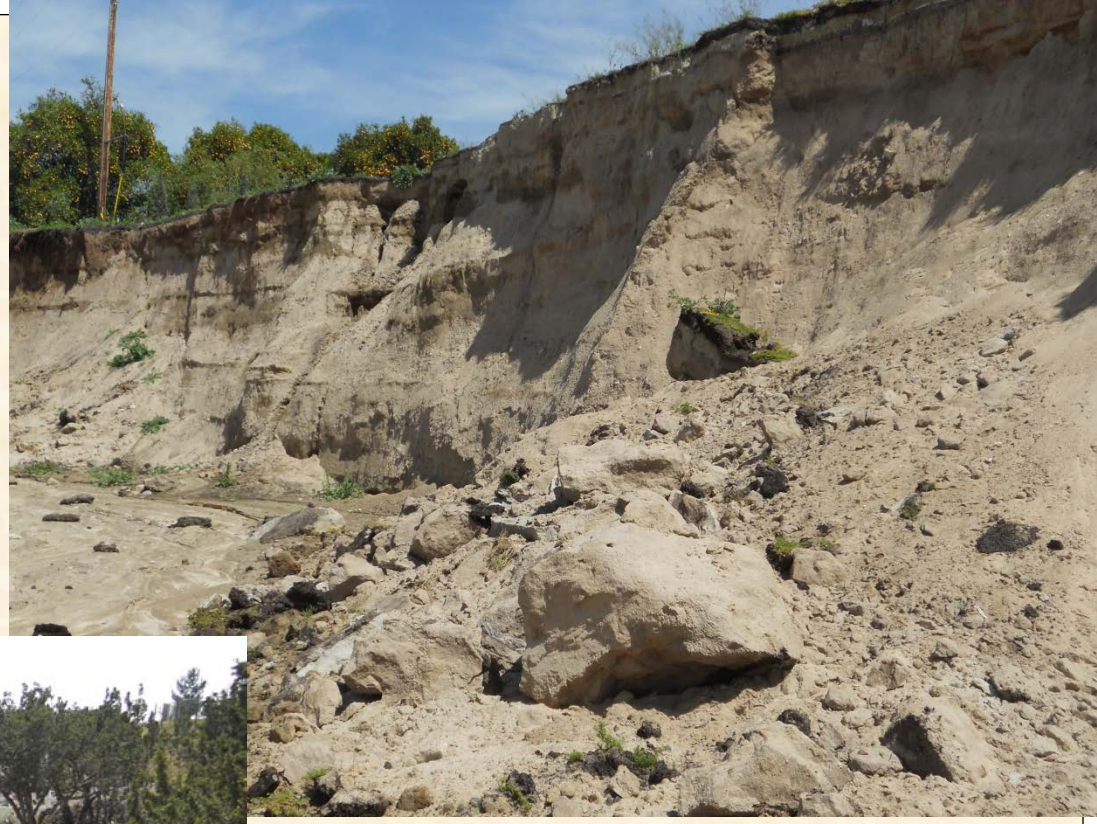
Hydromodification = Channel Erosion

Change in Runoff Processes



Need to Solve This First



- Water quality
- Recharge
- Benthic ecology
- Species habitat
- Sedimentation

Managing Hydromodification is Challenging

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

"The HMP shall require controls to manage the increases in the magnitude (e.g., flow control), frequency, volume and duration of runoff from development projects in order to protect receiving waters from increased potential for erosion and other adverse impacts with consideration towards maintaining (or reproducing) the pre-development hydrology. The HMP shall address, but not be limited to, the following:

"Traditional" Management Approaches

- Management triggers based on impervious cover
- Focus on runoff and flow-duration control (e.g. 10% Q2)
- Exemptions where hydromodification requirements don't apply






Impervious Cover & Runoff Control Alone Are Not Enough

- ~~*Hydromodification = Alteration of stream channel/channel erosion*~~

- *Hydromodification = Alteration of watershed structure and processes*
  - Sediment supply
  - Hillslope coupling
  - Sediment transport capacity
  - Floodplain connections

All streams are not the same

Responses differ:

Need a tool to prioritize level of attention & inform management response

What is a Manager To Do?

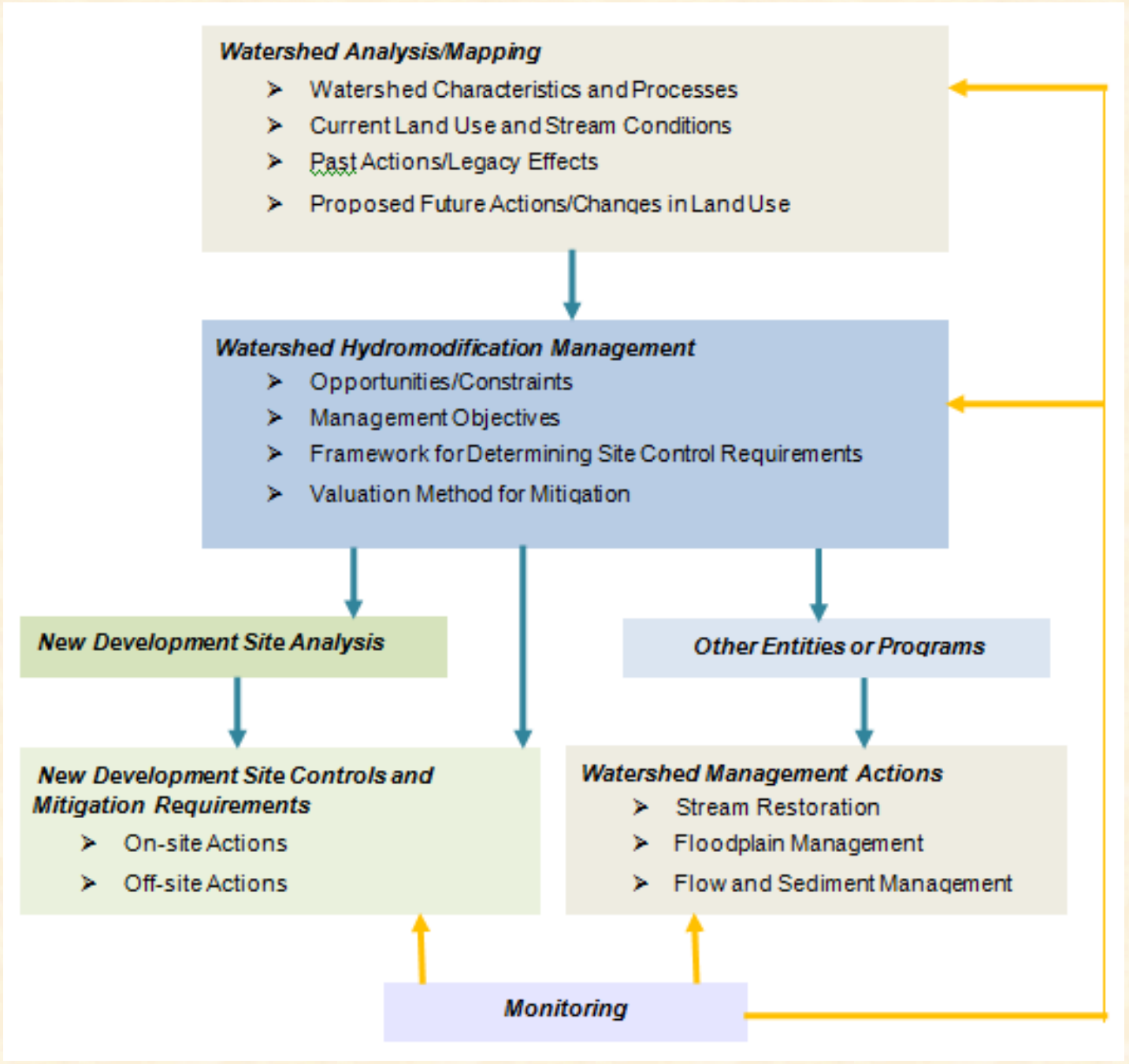
Tools to Support Management Response

- Increasing understanding of controlling processes
- Develop tools to support decisions
- Watershed based management framework
- Template for integrated monitoring

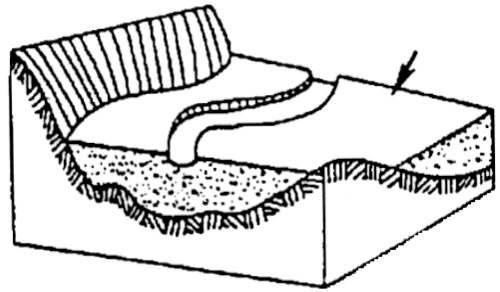
Framework for Hydromodification Management

Technical guidance on ***assessment*** of hydromodification impacts, development of strategies and approaches to ***management*** of hydromodification effects, and ***monitoring*** the effect of management actions.

SCCWRP Technical Report #667
http://www.sccwrp.org/Documents/TechnicalReports.aspx

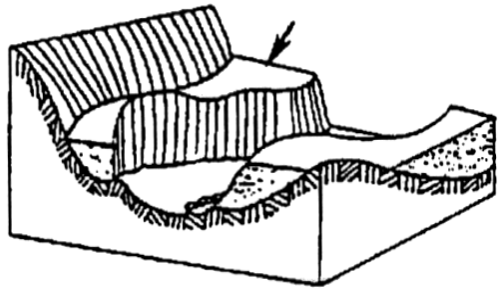

Watershed Analysis/Mapping
Watershed Characteristics and Processes
Current Land Use and Stream Conditions
Past Actions/Legacy Effects
Proposed Future Actions/Changes in Land Use
Watershed Hydromodification Management
Opportunities/Constraints
Management Objectives
Framework for Determining Site Control Requirements
Valuation Method for Mitigation
New Development Site Analysis
Other Entities or Programs
New Development Site Controls and Mitigation Requirements
On-site Actions
Off-site Actions
Watershed Management Actions
Stream Restoration
Floodplain Management
Flow and Sediment Management
Monitoring

Setting Management Endpoints



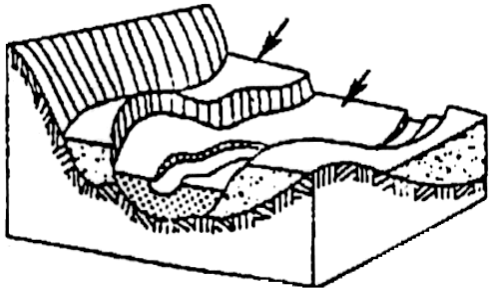
Protect

- manage runoff
- buffer stream



Restore

- stabilize
- recontour



Manage for New Condition

- new stream type

Risk

- infrastructure
- ecology

+

Susceptibility

+

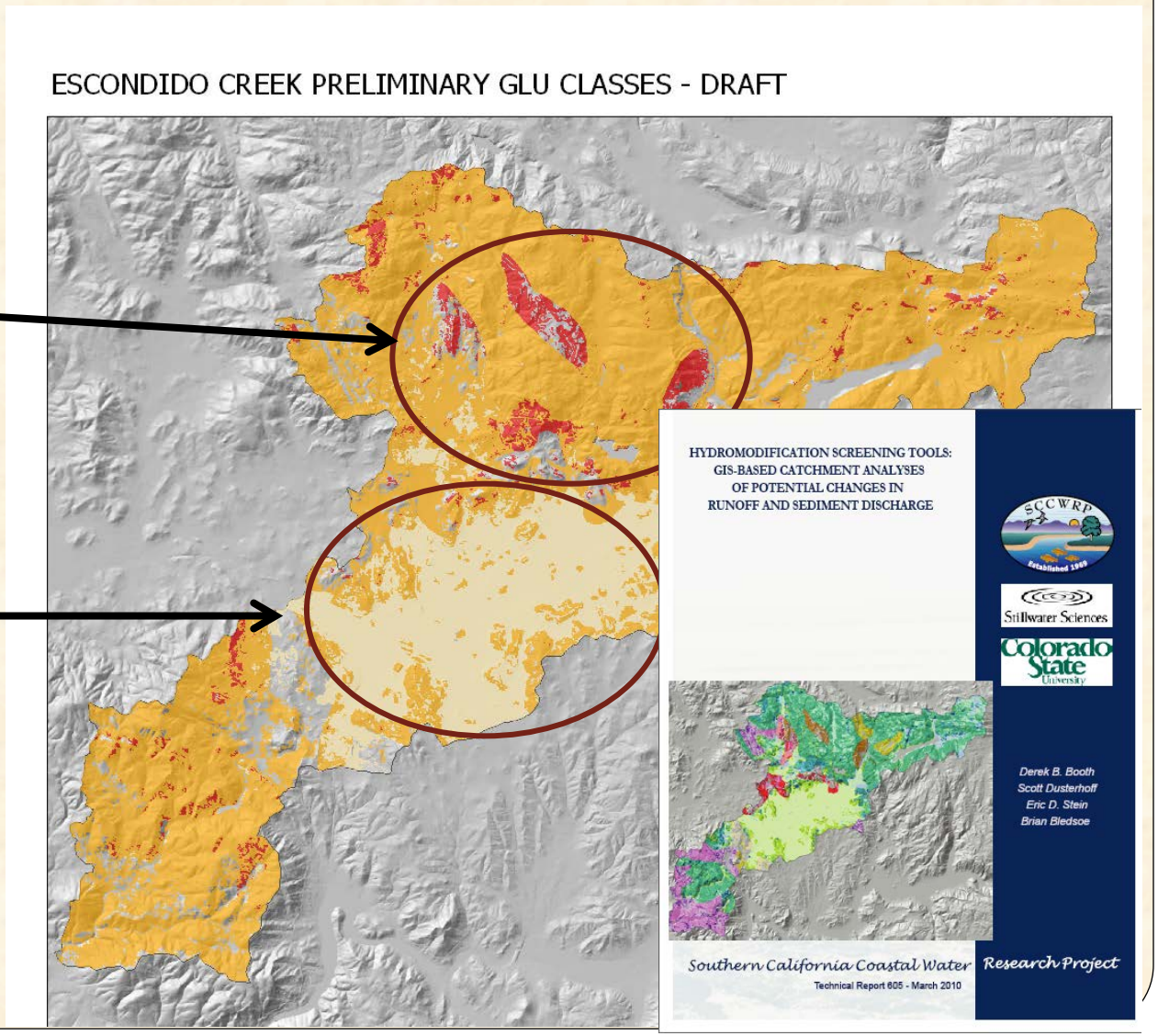
Management Goals

Hydromodification Risk Mapping

High Risk

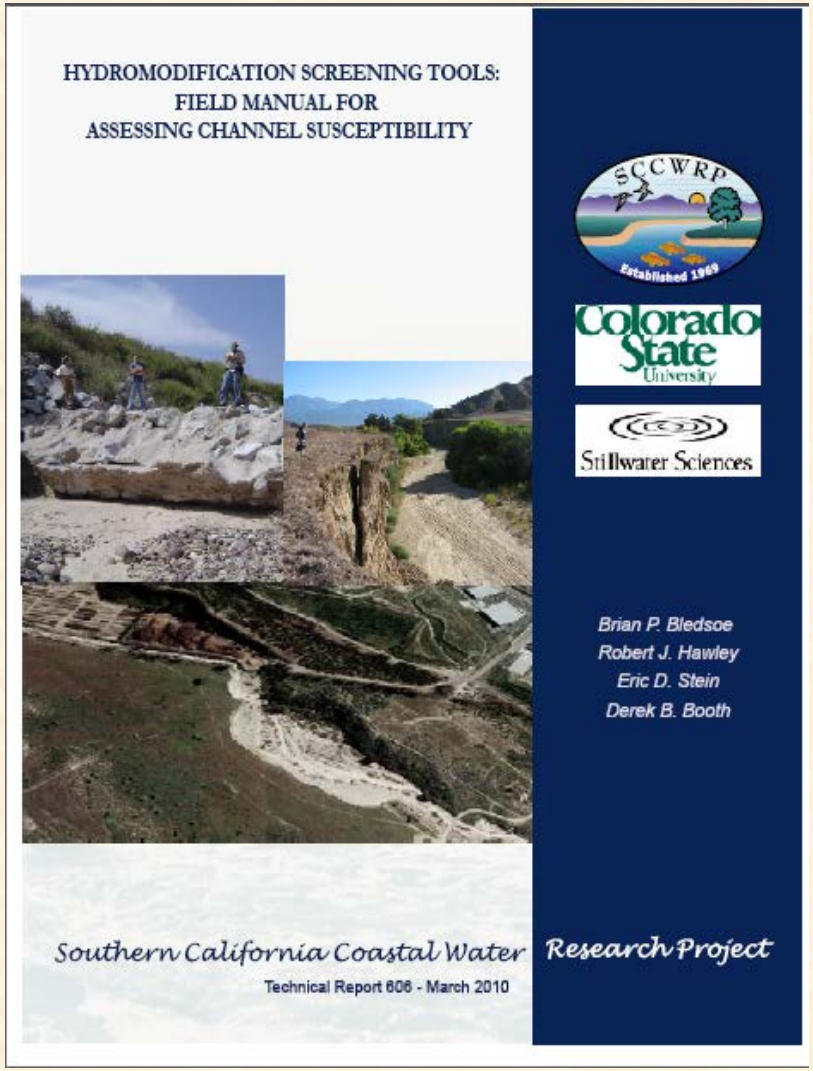
- Coarse sediment yield
- Avoid

Low Risk

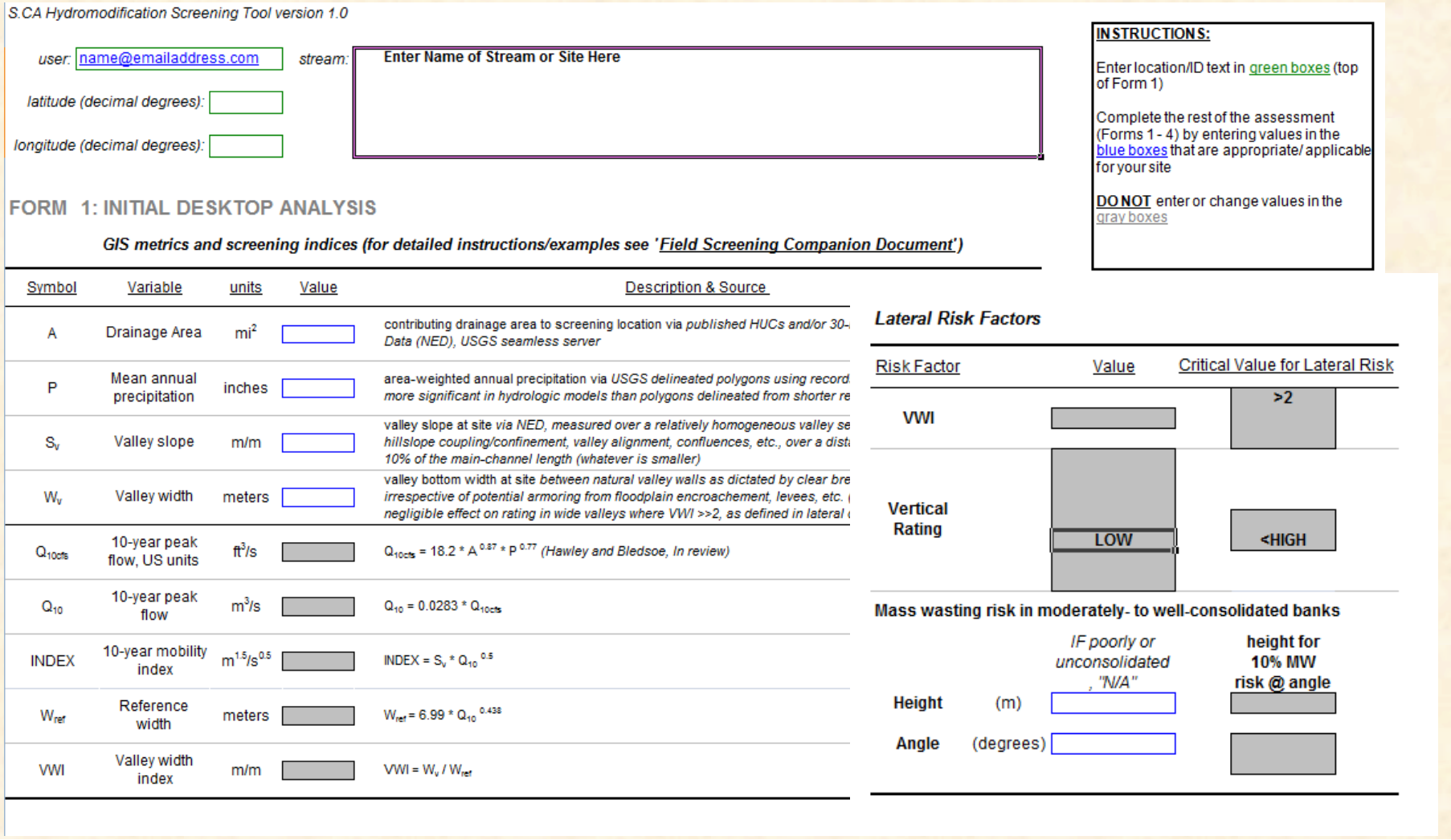


Field Screening Tool

- Decision trees
  - Clear endpoints – *very high, high, medium, low*
- Classify streams by:
  - Likely severity of response
  - Likely direction of response
- Simple to apply field metrics
  - Does not rely on complex field measures
- Locally calibrated
- Rapid - < 1 day in office + 1 day in field



Online Data Form



S.CA Hydromodification Screening Tool version 1.0

user: name@emailaddress.com stream: Enter Name of Stream or Site Here

latitude (decimal degrees):

longitude (decimal degrees):

INSTRUCTIONS:

Enter location/ID text in green boxes (top of Form 1)

Complete the rest of the assessment (Forms 1 - 4) by entering values in the blue boxes that are appropriate/ applicable for your site

DO NOT enter or change values in the gray boxes

FORM 1: INITIAL DESKTOP ANALYSIS

GIS metrics and screening indices (for detailed instructions/examples see 'Field Screening Companion Document')

Symbol	Variable	units	Value	Description & Source
A	Drainage Area	mi^2		contributing drainage area to screening location via *published HUCs and/or 30-* *Data (NED), USGS seamless server*
P	Mean annual precipitation	inches		area-weighted annual precipitation via *USGS delineated polygons using record* *more significant in hydrologic models than polygons delineated from shorter re*
S_v	Valley slope	m/m		valley slope at site *via NED, measured over a relatively homogeneous valley se* *hillslope coupling/confinement, valley alignment, confluences, etc., over a dist* *10% of the main-channel length (whatever is smaller)*
W_v	Valley width	meters		valley bottom width at site *between natural valley walls as dictated by clear bre* *irrespective of potential armoring from floodplain encroachement, levees, etc.* *negligible effect on rating in wide valleys where VWI >>2, as defined in lateral*
Q_{10cfs}	10-year peak flow, US units	ft^3/s		$Q_{10cfs} = 18.2 * A^{0.87} * P^{0.77}$ *(Hawley and Bledsoe, In review)*
Q_{10}	10-year peak flow	m^3/s		$Q_{10} = 0.0283 * Q_{10cfs}$
INDEX	10-year mobility index	$m^{1.5}/s^{0.5}$		$INDEX = S_v * Q_{10}^{0.5}$
W_{ref}	Reference width	meters		$W_{ref} = 6.99 * Q_{10}^{0.438}$
VWI	Valley width index	m/m		$VWI = W_v / W_{ref}$

Lateral Risk Factors

Risk Factor	Value	Critical Value for Lateral Risk
VWI		>2
Vertical Rating	LOW	<HIGH

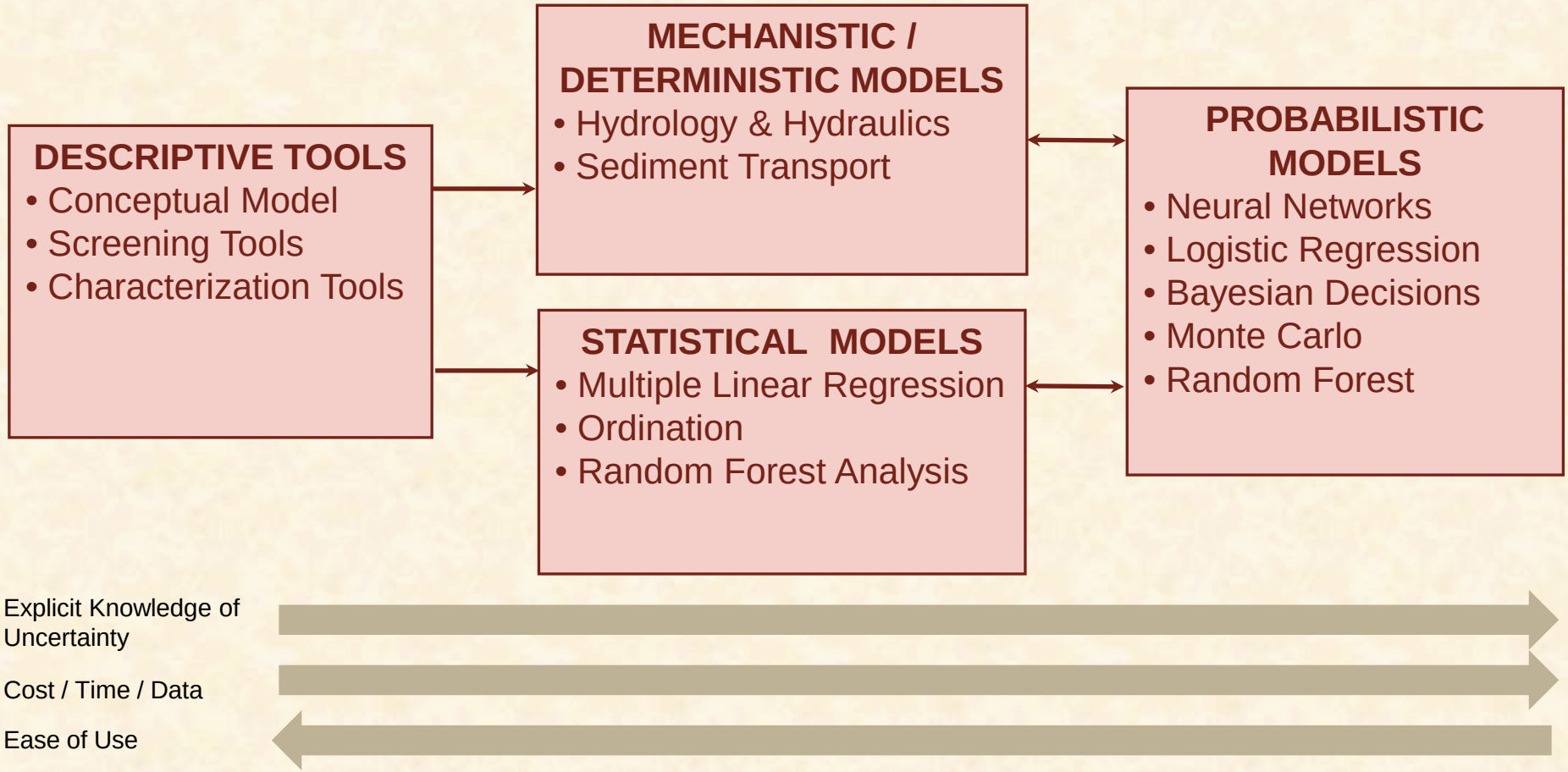
Mass wasting risk in moderately- to well-consolidated banks

		IF poorly or unconsolidated , "N/A"	**height for 10% MW risk @ angle**
Height	(m)		
Angle	(degrees)		

ftp://ftp.sccwrp.org/pub/download/TOOLS/HydromodFieldScreeningTool-DataEntryForm.xls

http://www.projectcleanwater.org/images/stories/Docs/LDS/HMP/0311_SD_HMP_wAppendices.pdf

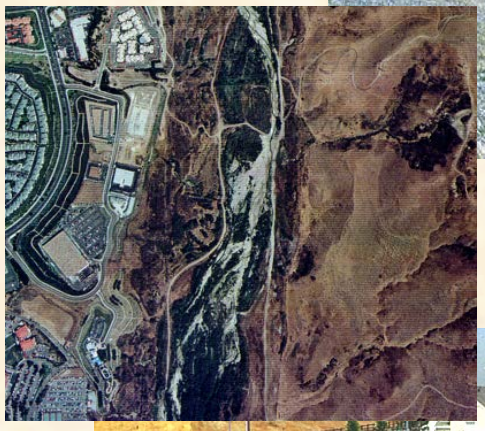
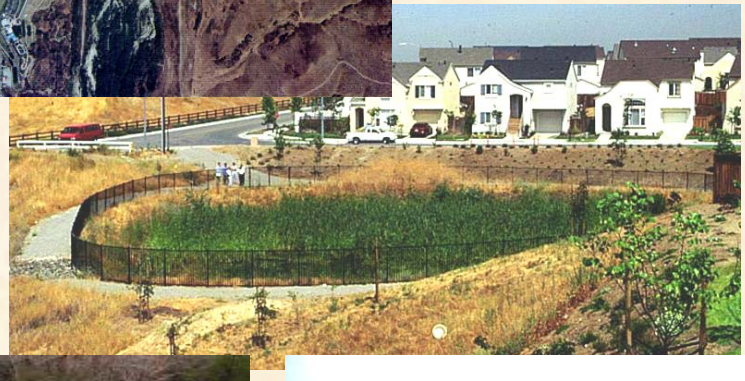
Guidance on Modeling Tool Selection



Appropriate tool or combinations of tools based on information needs, desired level of certainty, data availability etc.

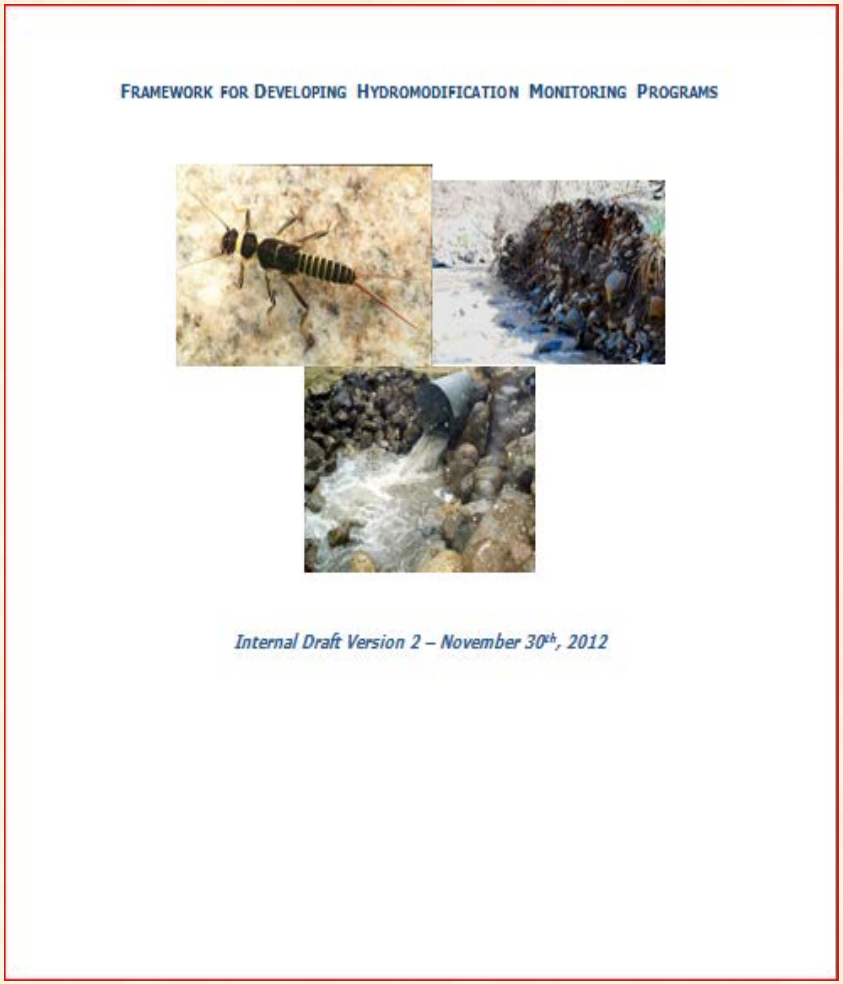
Decision Support for Management Actions

- Where in the watershed is the project?
- What type of stream/water body is the project discharging into?
  - What are the anticipated effects?
- What are the management goals for the receiving waterbody?
- What are the upstream and downstream opportunities?
  - Available land/resources
  - Greatest potential effect

Framework for Hydromodification Monitoring (draft)

- Question driven with clear assessment endpoints
- Multiple indicators (hydrologic, physical, and biological)
- Modular
- Consistent with other regional programs
- Adaptive
- Long-term



Monitoring Elements

Severe lack of data on hydromodification responses

- **Performance**
- **Effectiveness**

- Initial priority
- Basis for assessing compliance
- Local agencies are primarily responsible
- Shorter –term (multi-year)

- **Trends**
- **Characterization**

- Builds from compliance monitoring
- Informs adaptive management
- Cooperative regional monitoring
- Long term, ongoing (decadal)

Monitoring with Multiple Assessment Endpoints

- Pressure (hydrology)

Geomorphic Indicators	Biologic Indicators
Bed material composition	Benthic macroinvertebrates
Armoring potential	Stream algae
Grade control	California Rapid Assessment Method
Incision/downcutting risk	
Probability of mass wasting	
Evidence of fluvial erosion	**Hydrologic Indicators**
Consolidation of bank material	continuous stream flow measures
Channel width:valley width	BMP outflow
Channel Evolution Model class	
Channel geometry	
Physical Habitat Assessment (PHAB)	

SCCWRP Tools to Help Address the Issues

- **Increasing understanding of controlling processes**
  - Regionally calibrated flow relationships
  - Land use relationships to predict sediment yield
  - Regional rating curves
- **Develop tools to support decisions**
  - Screening tools to assess risk and susceptibility
  - Modeling and assessment tools to help predict effects
- **Watershed based management framework**
  - Framework document for development hydromodification management strategies
  - Decision support tools for selecting specific management actions/BMPs (pending)
- **Template for integrated monitoring**
  - Template for hydromodification monitoring programs
  - Development of flow-ecology relationships (future project)

Future Directions

- Explore relationship of various flow metrics to hydromodification effects relative to biological and geomorphic endpoints
  - Aid in establishment management and monitoring targets
  - Relationship to bio-objectives and other compliance measures
- Central database for hydromodification BMP/LID performance and effectiveness monitoring data
- Tools to determine appropriate "off-site mitigation" requirements
- Pilot project to demonstrate watershed-based approaches

  Looking for partners and suitable locations

QUESTIONS ?

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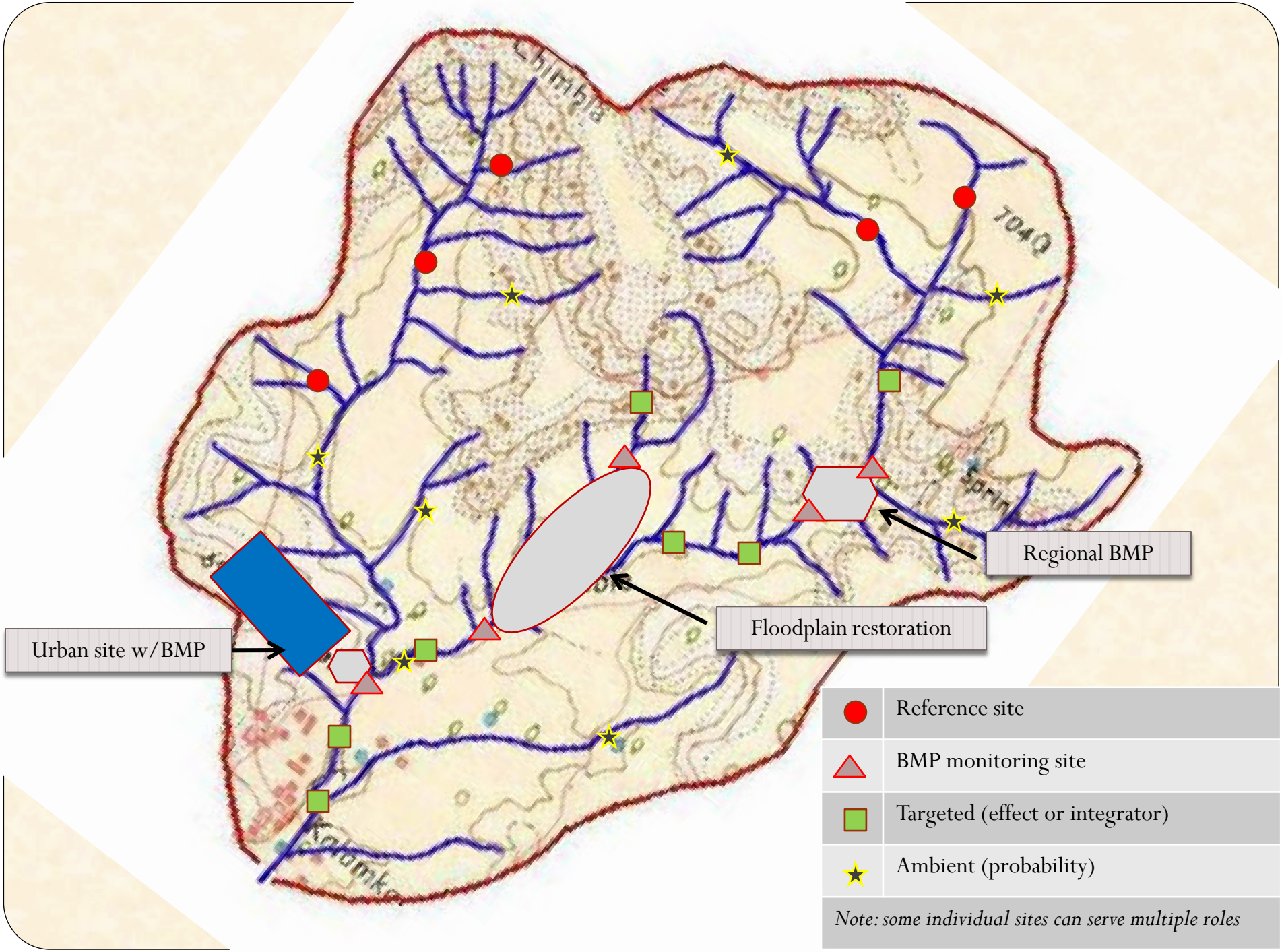
Regional BMP
Floodplain restoration
Urban site w/BMP
Reference site
BMP monitoring site
Targeted (effect or integrator)
Ambient (probability)
Note: some individual sites can serve multiple roles