# Fundamentals of Restoration Project Development

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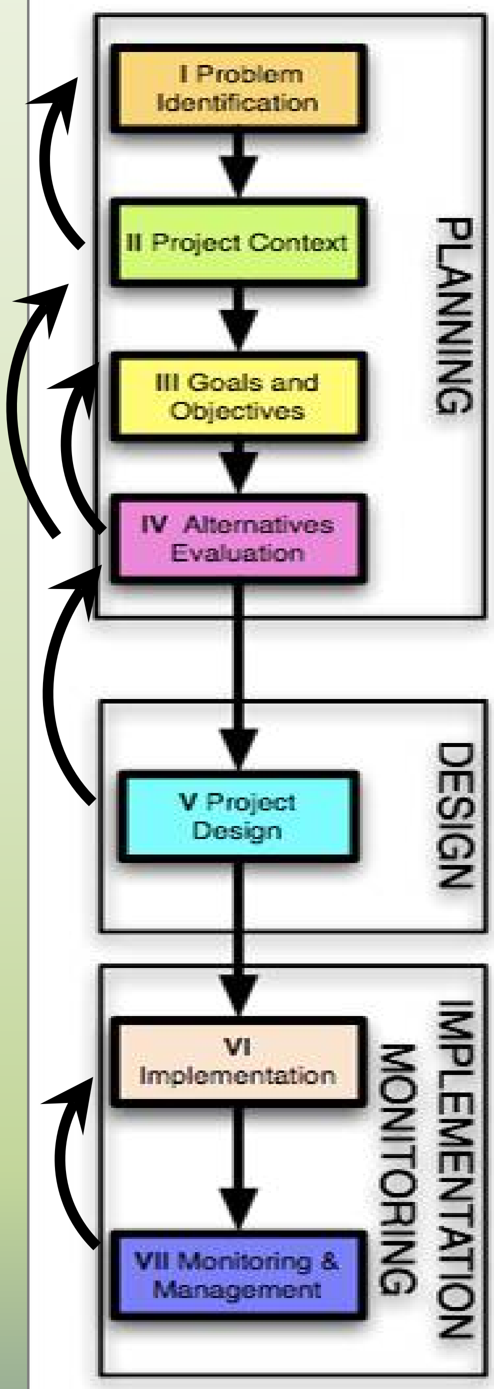
# Learning Objectives

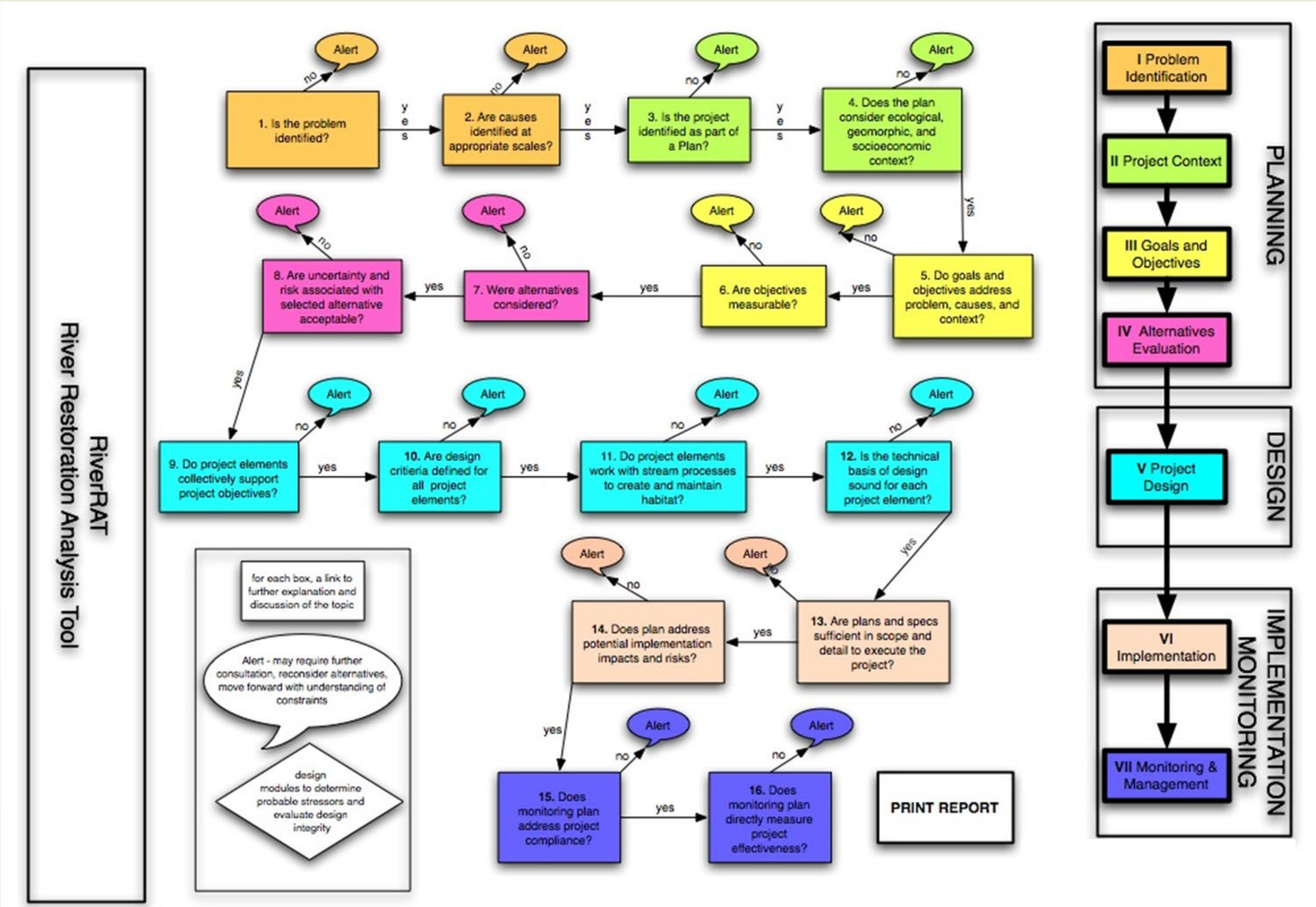
- Describe Steps in Effective Project Development Process
- Describe Problem Identification
- Explain Why Setting Goals and Objectives is Critical to Successful Projects
- Explain How to Develop Process-based Project Approaches

# Project Development Process




- Effective Planning Phase Important to Success
- Avoid Selecting Alternatives and Project Design Elements without Identifying Problem
- Project Development is a Sequential Process, but with Feedback Loops

# RiverRAT: Project Development Process



# Problem Identification

Distinguish between Symptoms (Structure and Form) and Causes (Processes and Functions)

Example: Channel Incision

Symptoms:

Eroding Banks

- Loss of Floodplain Connection

- Causes:
  - U/S Urbanization
  - D/S Removal of Wood
  - D/S Channel Straightening
  - U/S Flow Concentration

# Childs Meadow: A Typical Problem

# Problem Identification

## Identify Problem Scale

Spatial:

- Local
- Reach
- Watershed

Temporal:

- Incidental
- Chronic
- Trend

# Deer Creek, Tehama Co., CA

# Project Context

## Factors that Influence Restoration Opportunities and Outcome

Setting and Constraints:

- Physical/Geomorphic
- Social/Regulatory/Legacy

Recommendations:

- Work within Watershed Context
- Question Constraints

# Establish Goals and Objectives

**Goal** – **desired outcome**

- Defines intent and outcome
- Provides a guiding image
- Relevant to watershed context

**Objective** – **means to the outcome**

- Specific action that supports goal
- Measurable
- Relevant to the goal

# Setting Effective Goals

- Goals Should Address Identified Problems and Project Context
- Involve All Stakeholders (and Regulatory Agencies)
- Goal Setting is a Discovery Process – Identify What's Important
- Goal Statements Should <u>Not</u> Be Prescriptive

# Objectives

Statements of **Measurable** Outcomes that Support Achieving a Goal within a Specified **Time** Frame

- Objectives are Testable
- Fuzzy Objectives Indicate Uncertainties and Areas that May Require Further Investigation

# Process-based Principles for Restoring River Ecosystems

Principle 1: Target the root causes of habitat and ecosystem change.

Principle 2: Tailor restoration actions to local potential.

Principle 3: Match the scale of restoration to the scale of physical and biological processes

Principle 4: Be explicit about expected outcomes, including recovery time.

From: *Process-based Principles for Restoring River Ecosystems,* Beechie et al. 2010

# Identify Alternatives

- Conduct Additional Investigations as Required to Address Goals and Objective
- Evaluate Constraints:
  - Question Assumptions
  - Don’t Consider Cost as a Constraint
- Brainstorm Alternatives
  - Don’t Dismiss Because Impractical or Infeasible
- Consider No-action

# Evaluate Alternatives and Select Alternative

- Quantify Outcomes
  - Address Uncertainty and Risk
  - Enumerate Costs and Benefits for Short and Long Term
- Involve Stakeholders in Judgment Calls
- Don't Get Locked in to First Design
- Revise or Combine Alternatives if Appropriate
- Use Decision Making Tools to Screen, Rank, and Select Alternatives

**Table 29. Project Ranking and Final Scoring**

| Project | Project Cost | Habitat Output Units | Flood Storage | Sedimentation Capacity | Long Term Sustainability | Total Score |
|---|---|---|---|---|---|---|
| w/o Project | $ - | 0.10 | 0.17 | 0.12 | 0.20 | 0.49 |
| Alternative 1 | $ 4,380,100 | 0.51 | 0.92 | 0.94 | 0.30 | 2.16 |
| Alternative 2 | $ 5,267,300 | 0.94 | 1.00 | 1.00 | 0.40 | 2.40 |
| **Alternative 3** | **$ 5,794,800** | **1.00** | **0.87** | **0.81** | **0.80** | **2.48** |

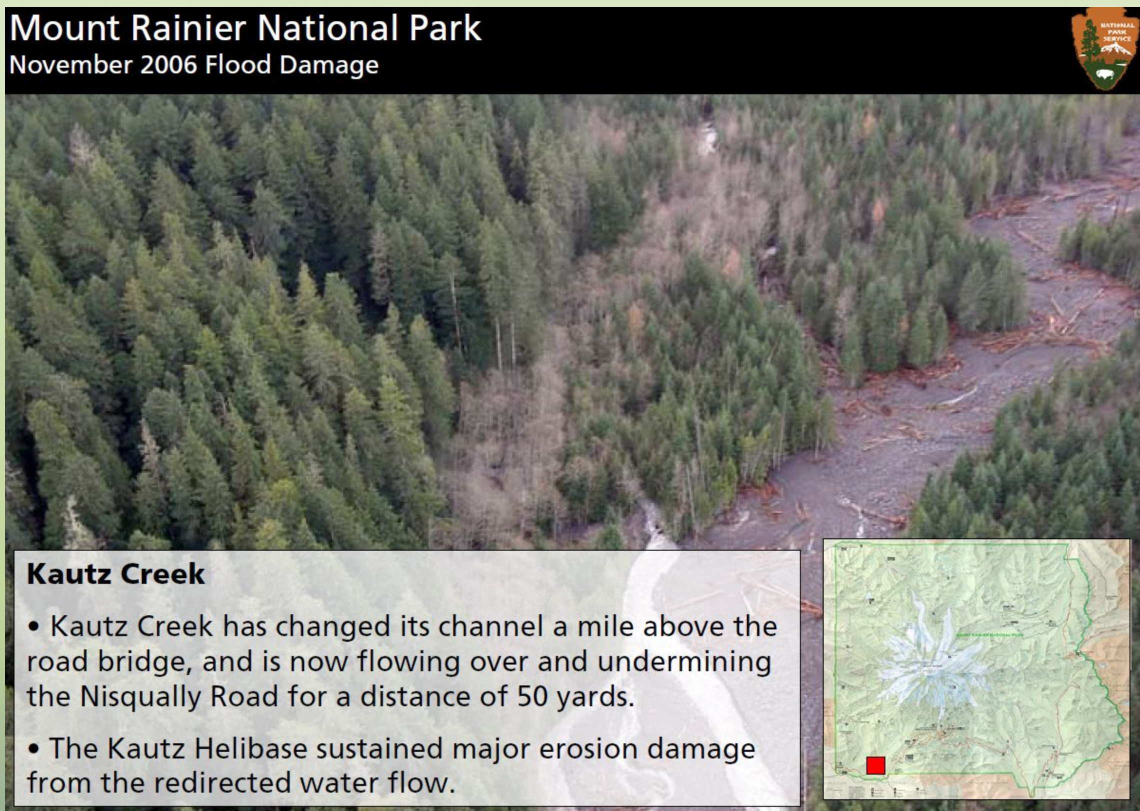
# Hazard and Risk

Hazard: is a Condition or Event that could Lead to Unplanned or Undesirable Event

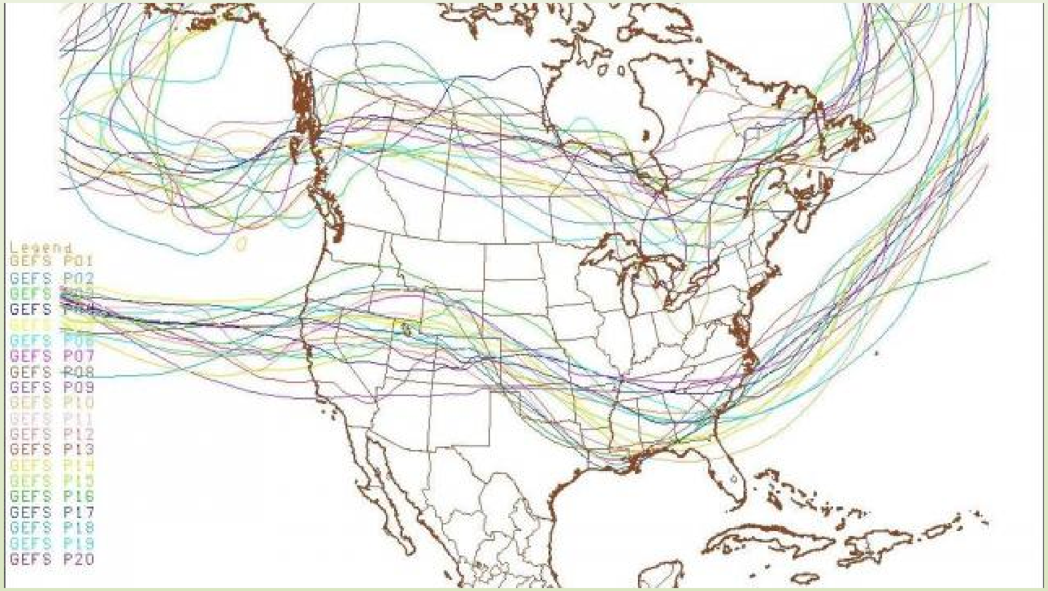
Risk: is the Combination of the Likelihood of the Occurrence of a Hazard and the Severity of that Hazard.

# Type of Risks in Restoration

- Risk to Project Owners (cost, liability)
- Risk to Ecosystem (design failures)
- Social Risk (public perception of project failing or not being cost effective)



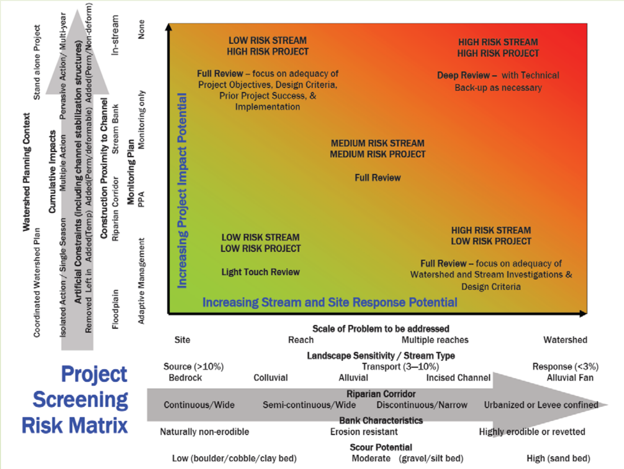
# Uncertainty




Two Sources:

- Natural Variability
  - Source: Complex Behavior Population of Natural Systems
  - Can Be Characterized, but not Reduced
- Knowledge Uncertainty
  - Source: Limits on Our Ability to Measure and Model Natural Systems
  - Limits – Costs, Time, Lack of Data, Lack of Understanding
  - Can be Reduced (perhaps) with Additional Investigations

# RiverRAT
# Risk Matrix




The screening tool is in the form of a 2-axis matrix:

X-axis:

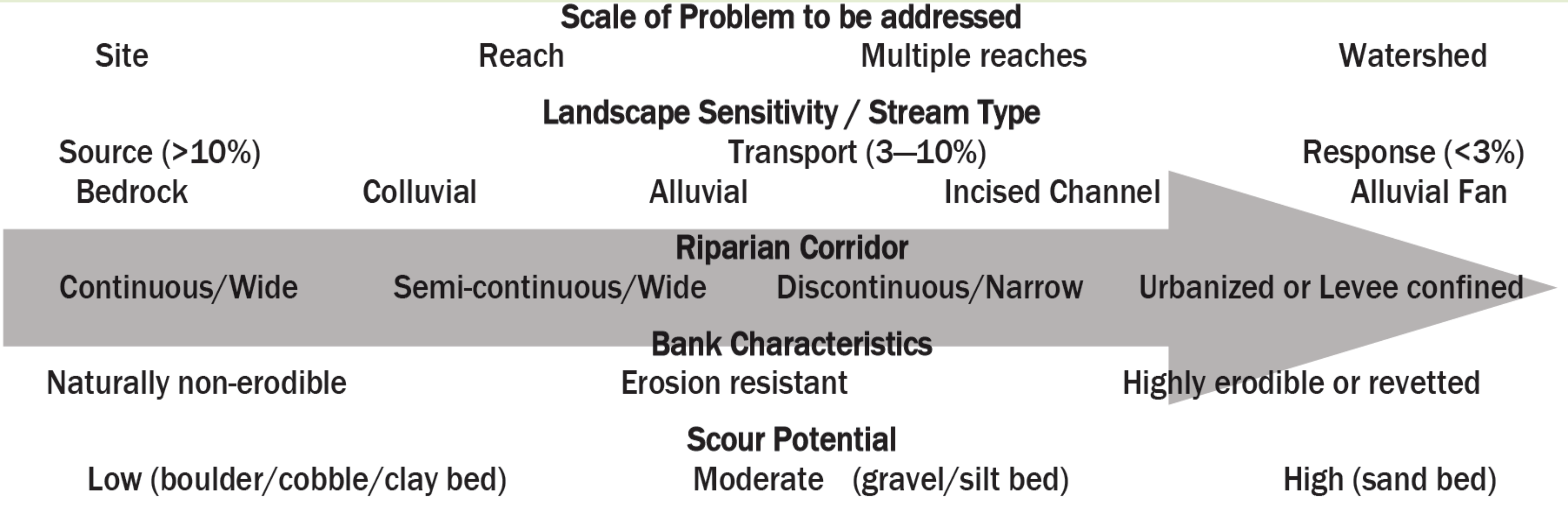
- Risk to Resource due to ***Inherent Site Response***

Y-axis

- Risk to Resource created by ***Project Actions***

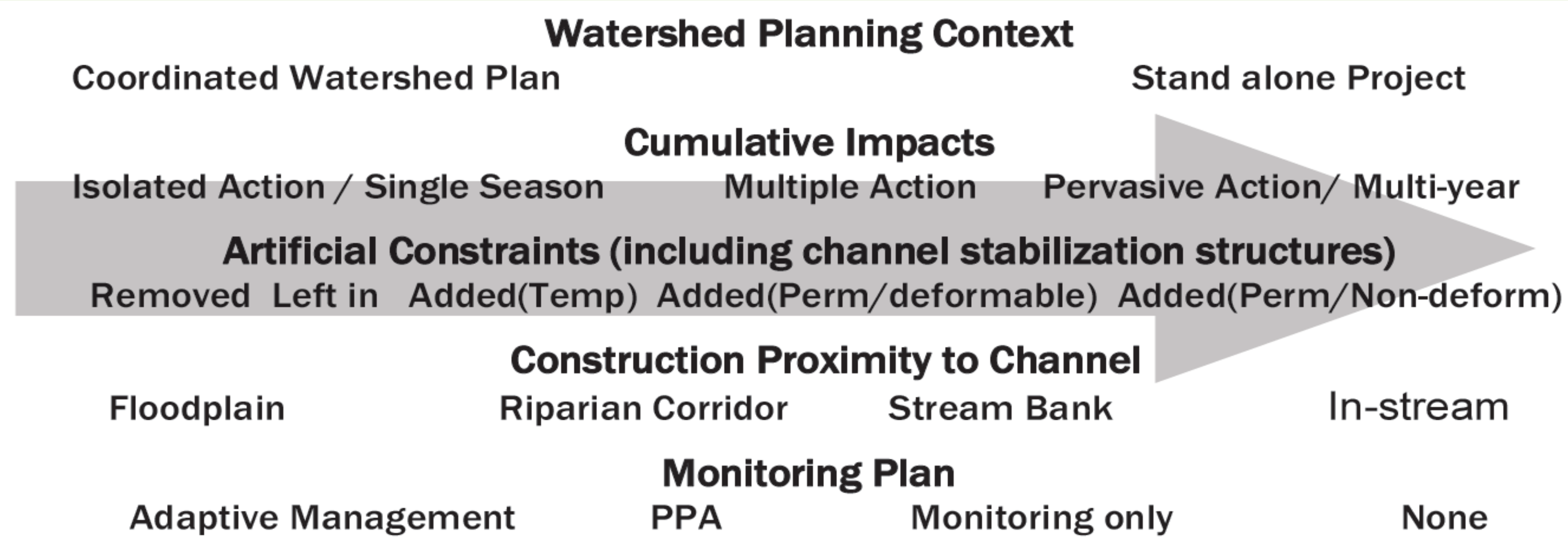
See: Thorne, C. et al. 2014. Project Risk Screening for River Management and Restoration.

# X-Axis: Site Response



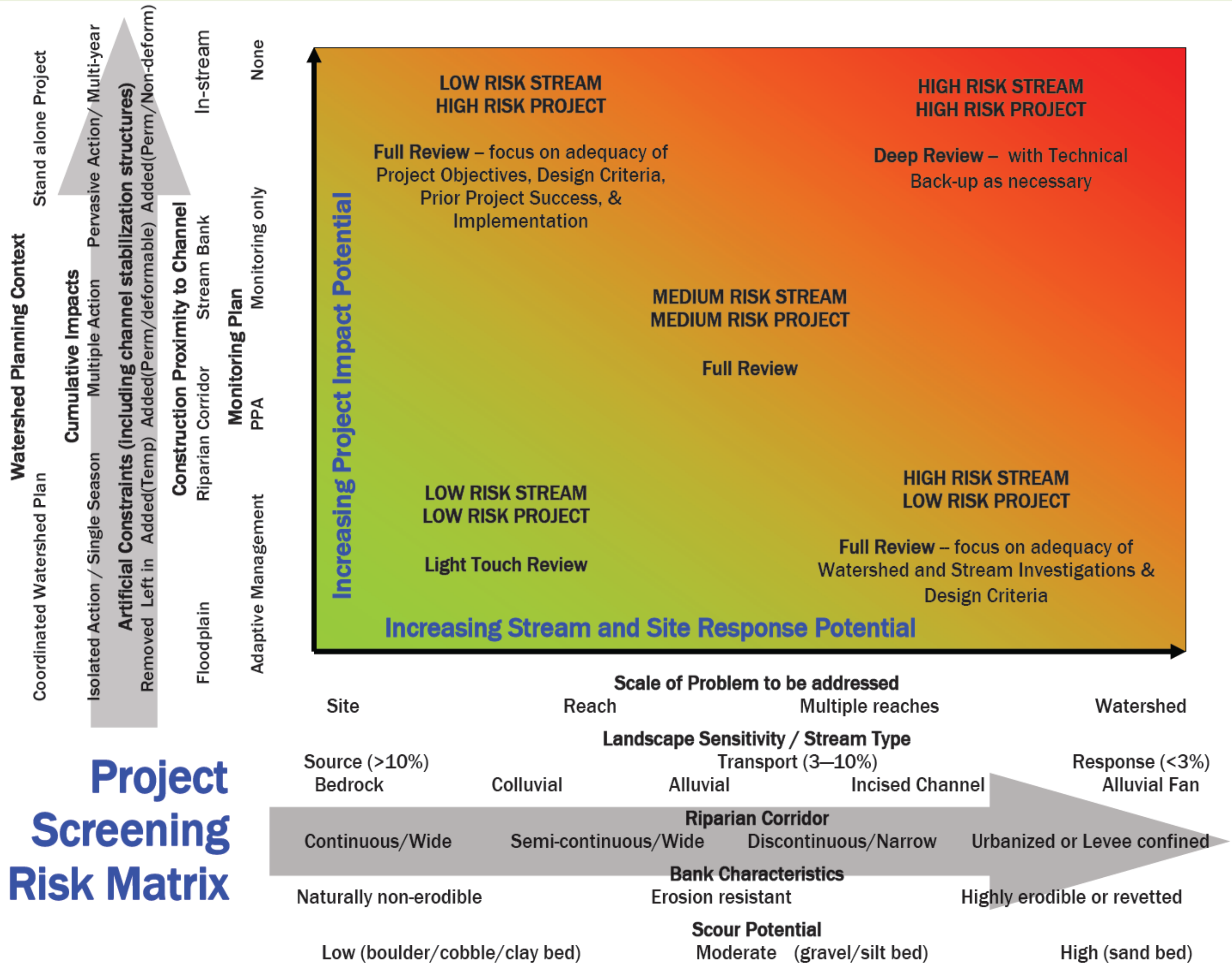

Increasing Risk (Probability x Hazard Consequences)

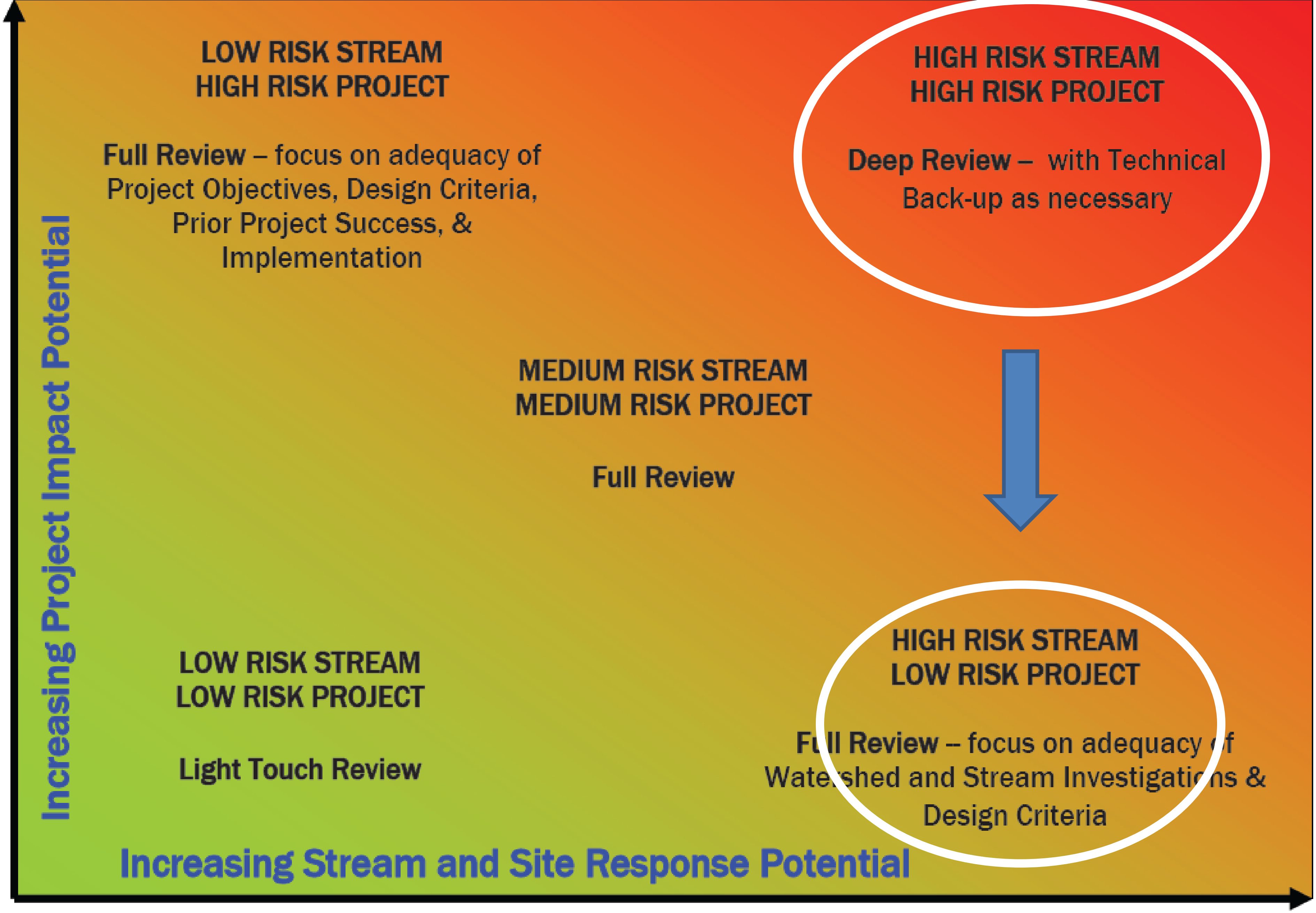
# Y-Axis: Project Actions




Increasing Risk (Probability x Hazard Consequences)

# Project Screening Risk Matrix




LOW RISK STREAM
HIGH RISK PROJECT
Full Review – focus on adequacy of Project Objectives, Design Criteria, Prior Project Success, & Implementation
HIGH RISK STREAM
HIGH RISK PROJECT
Deep Review – with Technical Back-up as necessary
MEDIUM RISK STREAM
MEDIUM RISK PROJECT
Full Review
LOW RISK STREAM
LOW RISK PROJECT
Light Touch Review
HIGH RISK STREAM
LOW RISK PROJECT
Full Review -- focus on adequacy of Watershed and Stream Investigations & Design Criteria
Increasing Project Impact Potential
Increasing Stream and Site Response Potential

# Large Wood Risk Screening Matrix

**Planning Context & Scale**
Coordinated Watershed Plan — Stand-alone Project
Site Scale — Reach Scale — Multi-Reach Scale

**Wood Length (multiple of channel width) & Wood Properties**
>2.5x with rootwad — 2x — 1.5x — <1.0x no rootwad
High Density, Slow Decay — Low Density, Fast Decay

**Anchoring**
None — Individual pieces — Entire Structure
Anchor Points — Vertical Posts — Ballast — Pinning — Cabling

**Infrastructure**
None — Parallel Roadways — Road Crossings — Structures — Piers

**Monitoring & Maintenance Plan**
Adaptive Management — Monitoring only — None


**Scale of Problem to be addressed**
Site — Reach — Multiple reaches — Watershed

**Landscape Sensitivity / Stream Type**
Source (>10%) — Transport (3—10%) — Response (<3%)
Bedrock — Colluvial — Alluvial — Incised Channel — Alluvial Fan

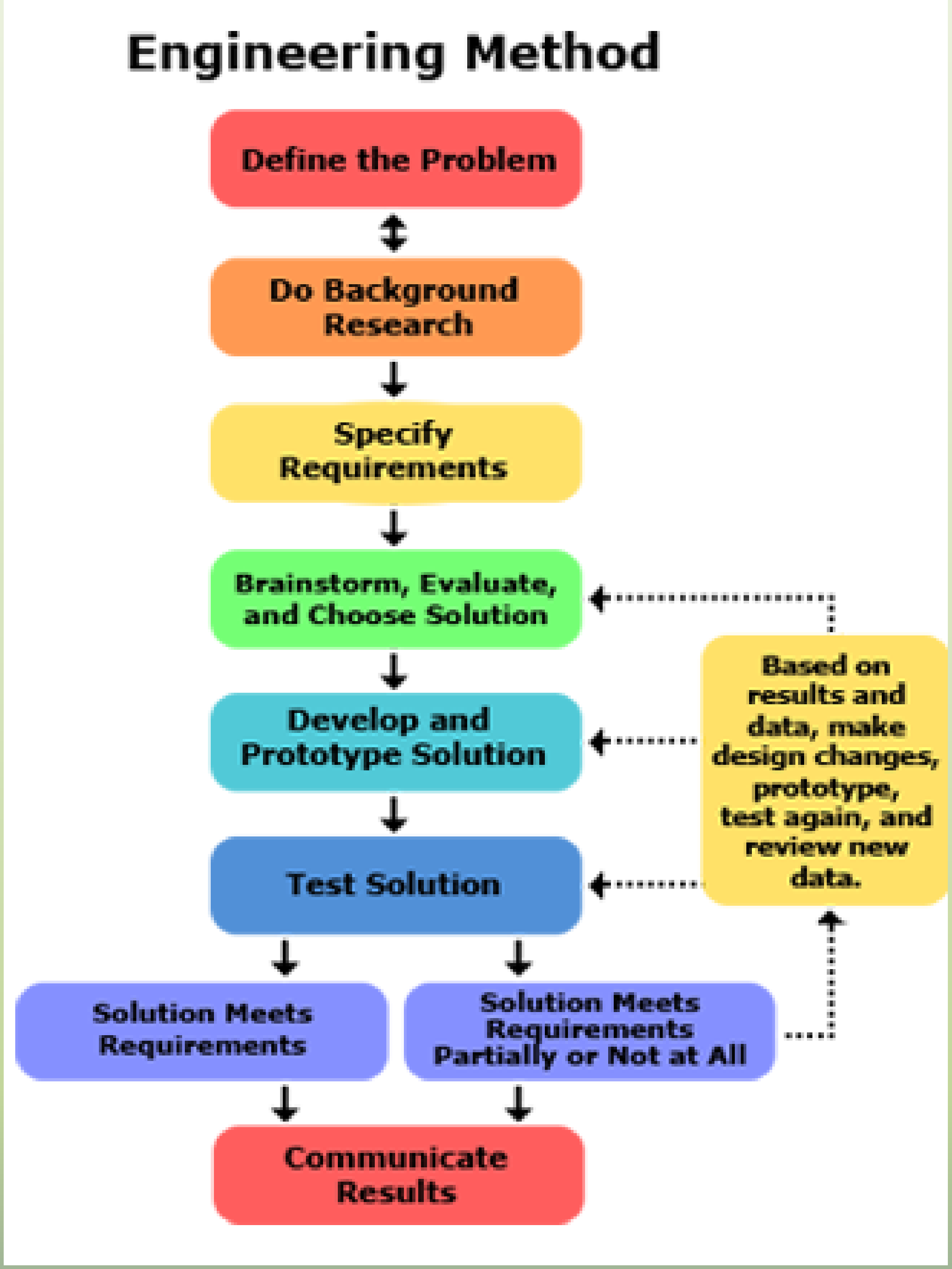
**Riparian Corridor**
Continuous/Wide — Semi-continuous/Wide — Discontinuous/Narrow — Urbanized or Levee Confined

**Bank Characteristics**
Naturally Non-erodible — Erosion Resistant — Highly Erodible or Revetted

**Bed Characteristics**
Low (boulder/cobble/clay bed) — Moderate (gravel/silt bed) — High (sand bed)

**Dominant Hydrologic Regime**
Spring-fed — Snowmelt — Rain — Rain-on-snow — Convective Thunderstorm

# Design Process



# Cautions About Engineering Designs

- Physical Reality Reduced to Resolvable Conceptual Problem
- Design Evaluated on Limited Set of Parameters E.g.: Salmonid Passage - Max Height and Velocity
- Design Optimized to Minimum Requirements

- Low Habitat Complexity
- Failure to Address Full Variability of Natural Environment
- Low Resilience

# How to Avoid Design Pitfalls

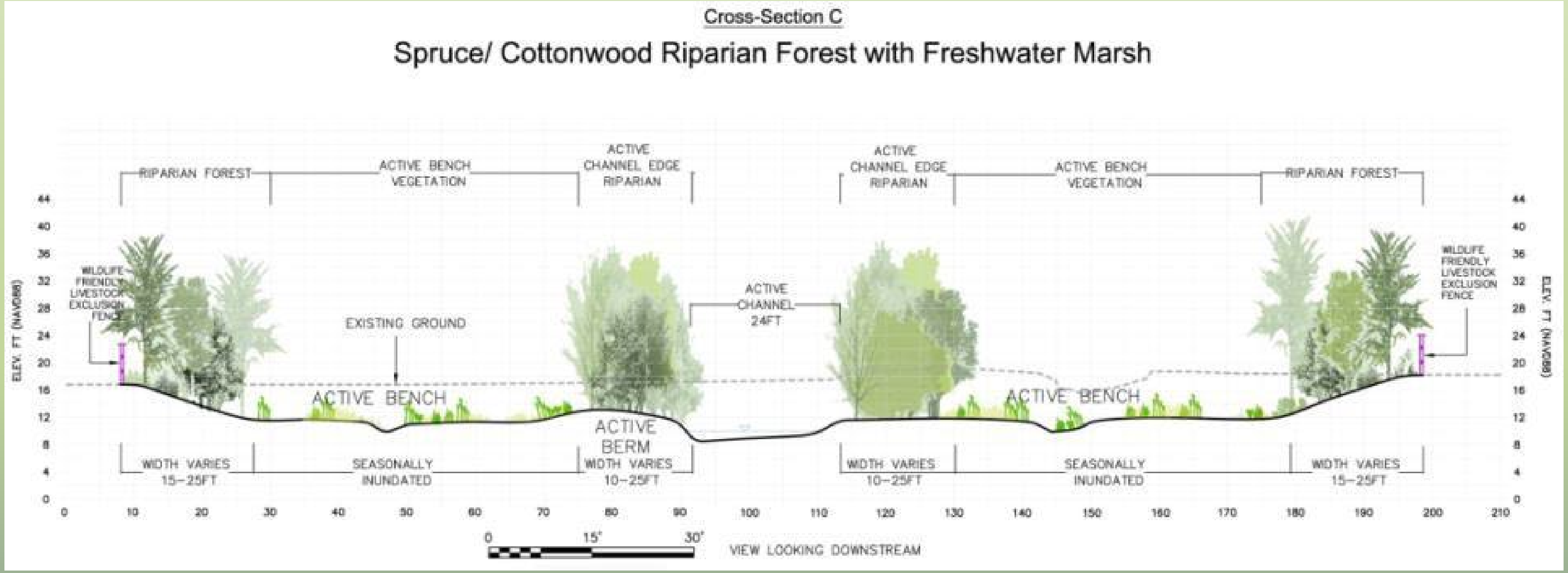
- **Collaborate:** Employ Mixed Discipline Teams

  Engineers, Biologists, Physical Scientists
- **Establish Common Language:**

  Avoid Jargon
- **Biologists, Ecologists:** Explain Behaviors
- **Engineers:** Explain How to Use, Not How it Works
- **Work with Regulators** to Improve Understanding

# Keys to Achieving Sustainable Designs

- Embrace Soft Approaches
- Work to Remove Anthropogenic Constraints
- Restore Physical Processes
- Provide Multiple Pathways



# Implementation

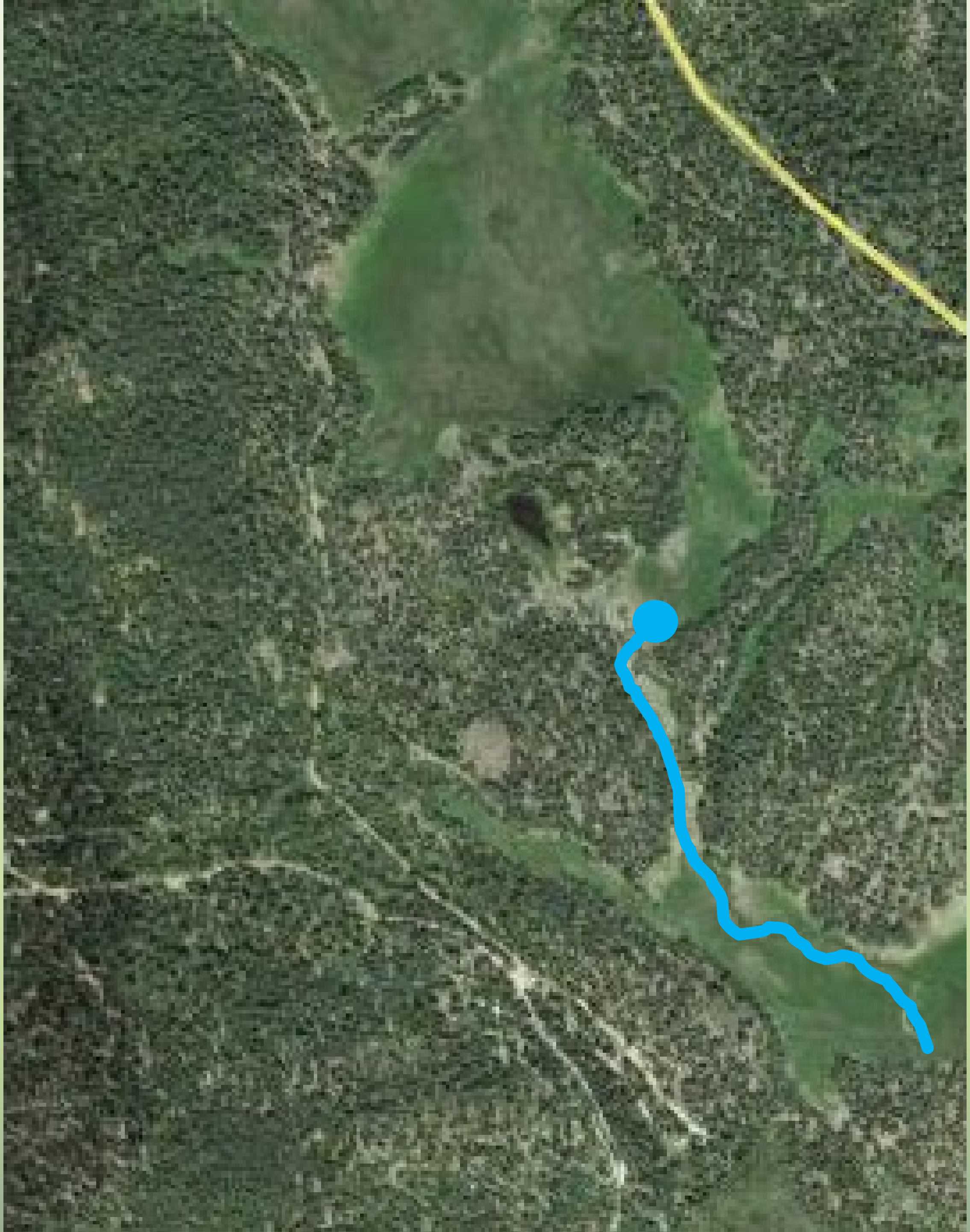
# Monitoring: Planning

- Plan Starts with Addressing Goals and Objectives
- Define Key Questions, and Spatial and Temporal Scale
- Select Appropriate Design
- Define Sample Methods, Locations, Frequency & Analysis
- Analyze and Report

# Type of Monitoring

| PHASE | TYPE |
| --- | --- |
| **Planning** | • Baseline<br>• Status & Trend |
| **Post Construction** | • Implementation: Was it Built Correctly?<br>• Effectiveness: Does it Work as Intended?<br>• Validation: Did it Achieve Goals? |

# Childs Meadow: Planning Exercise



# Exercise

**Break into Three Groups and Discuss Following:**

**(1) What are the Problems Symptoms, Potential Causes, and Scale?**

**(2) Is this a Problem?**

**(3) What Should you Investigate at this Site?**

**(4) What Actions Should You Undertake First?**