



# A BioGeomorphic Approach to Creating Off-Channel Habitats in Tributaries of the Lower Klamath River, Northern California



*Photo by Thomas B. Dunklin*

# Contributors

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# Thanks Also To Funders, Landowners and Cooperators



- U.S. Fish and Wildlife Service
- U.S. Bureau of Reclamation
- National Oceanic and Atmospheric Administration – ARRA
- CA Dept of Fish and Game
- Green Diamond Resources Company
- Yurok Tribe Watershed Restoration Dept.
- Yurok Tribe Environmental Program



# Outline

Overview of Recent Projects

Hunter Creek

Terwer Creek

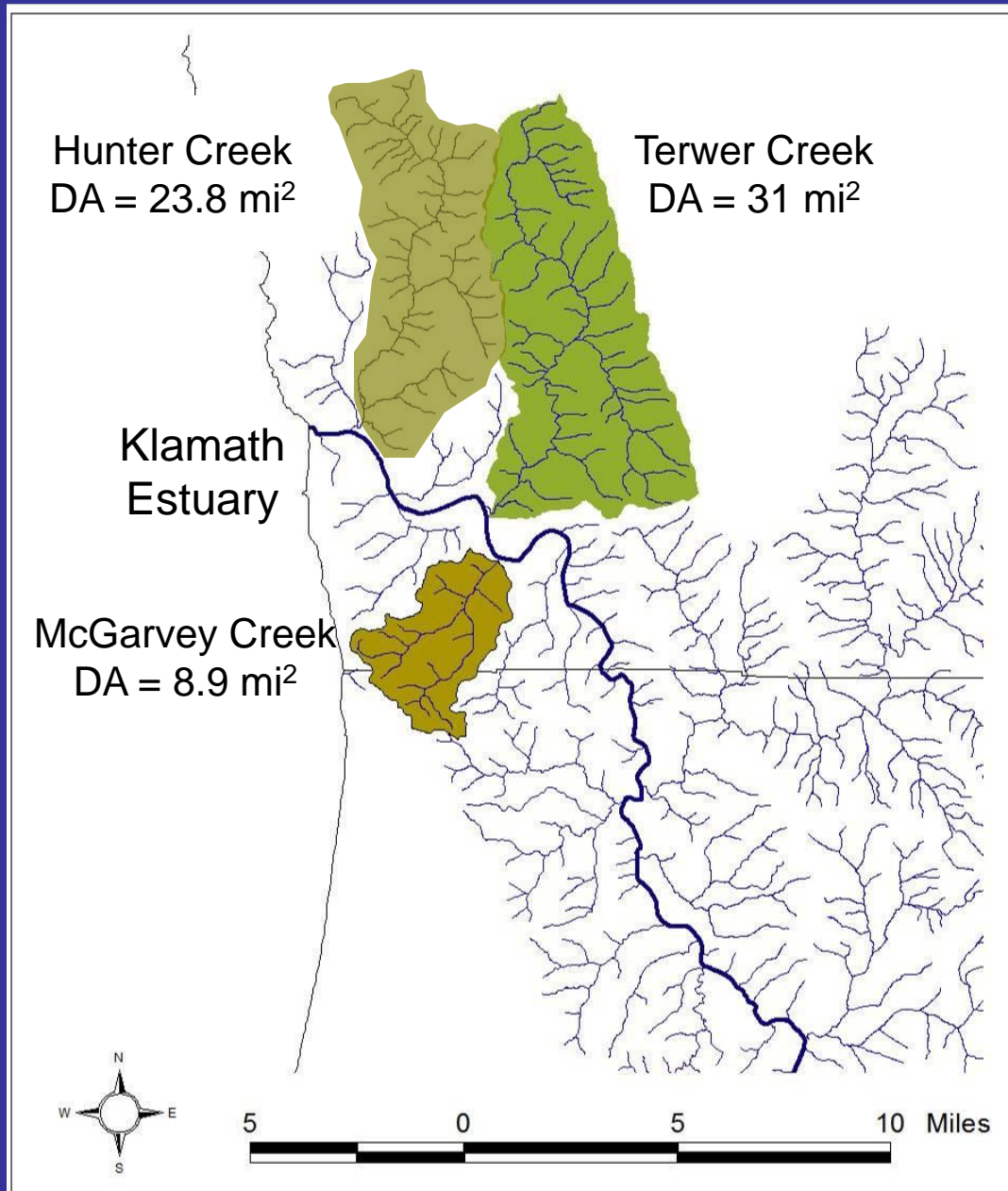
McGarvey Creek

Hydrostratigraphic Lessons Learned

Design Solutions

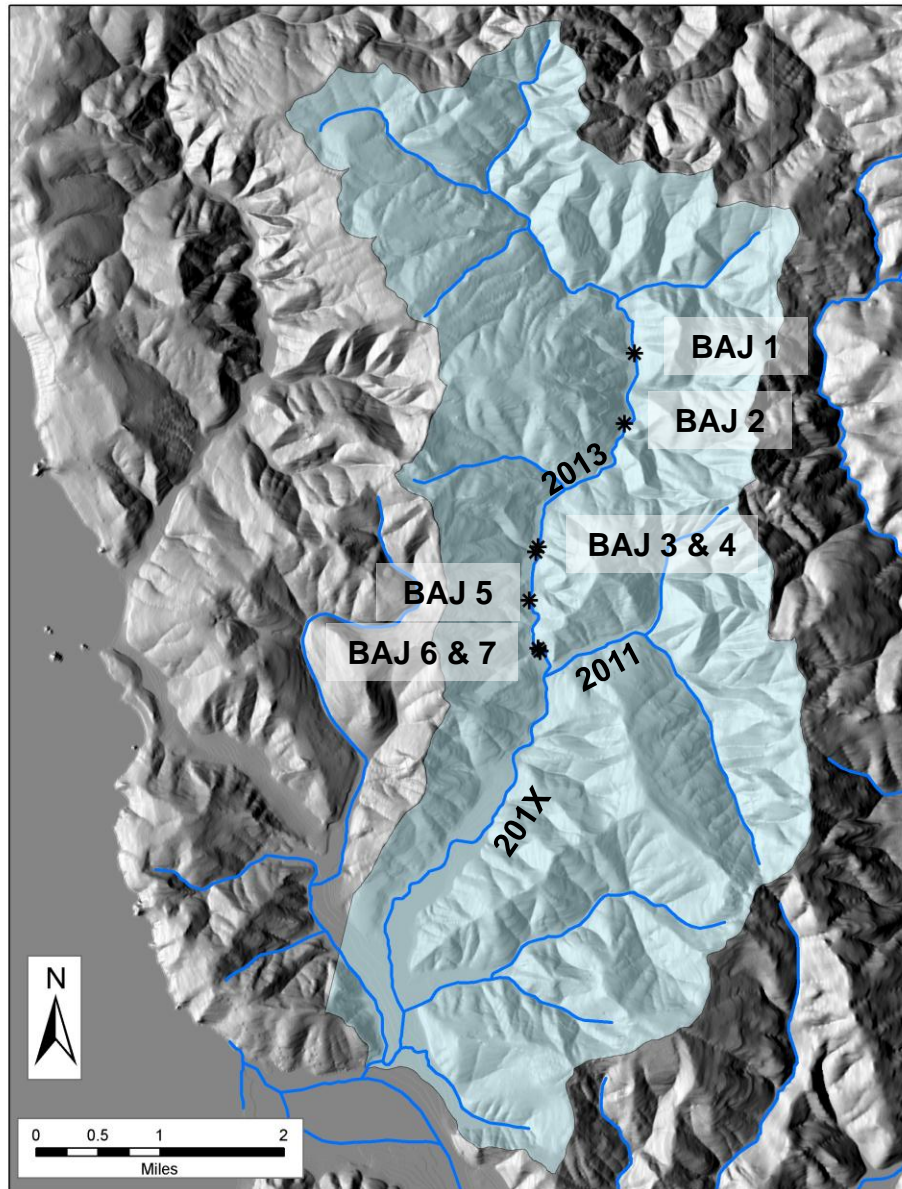
Infiltration Galleries & Hyporheic Windows

# Project Locations

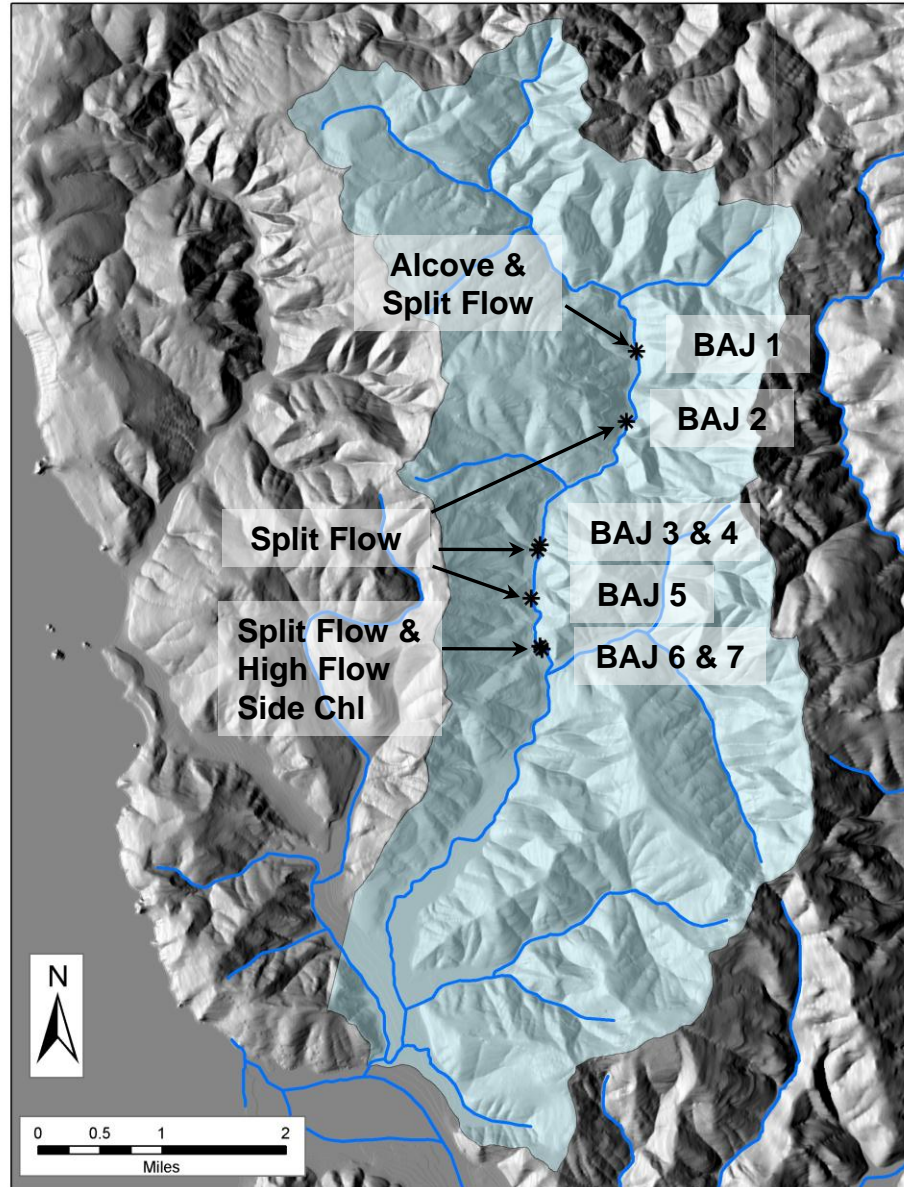




# Hunter Creek



# Hunter Creek





# Hunter Creek - Alcove I Downstream View



Redwood Stump





# Hunter Creek - Alcove I at Bar Apex Jam 1

Pre-Construction



Post-Construction



Post-Construction





# Hunter Creek – Alcove I Upstream View



BAJ 1





# Hunter Creek – Bar Apex Jam 2



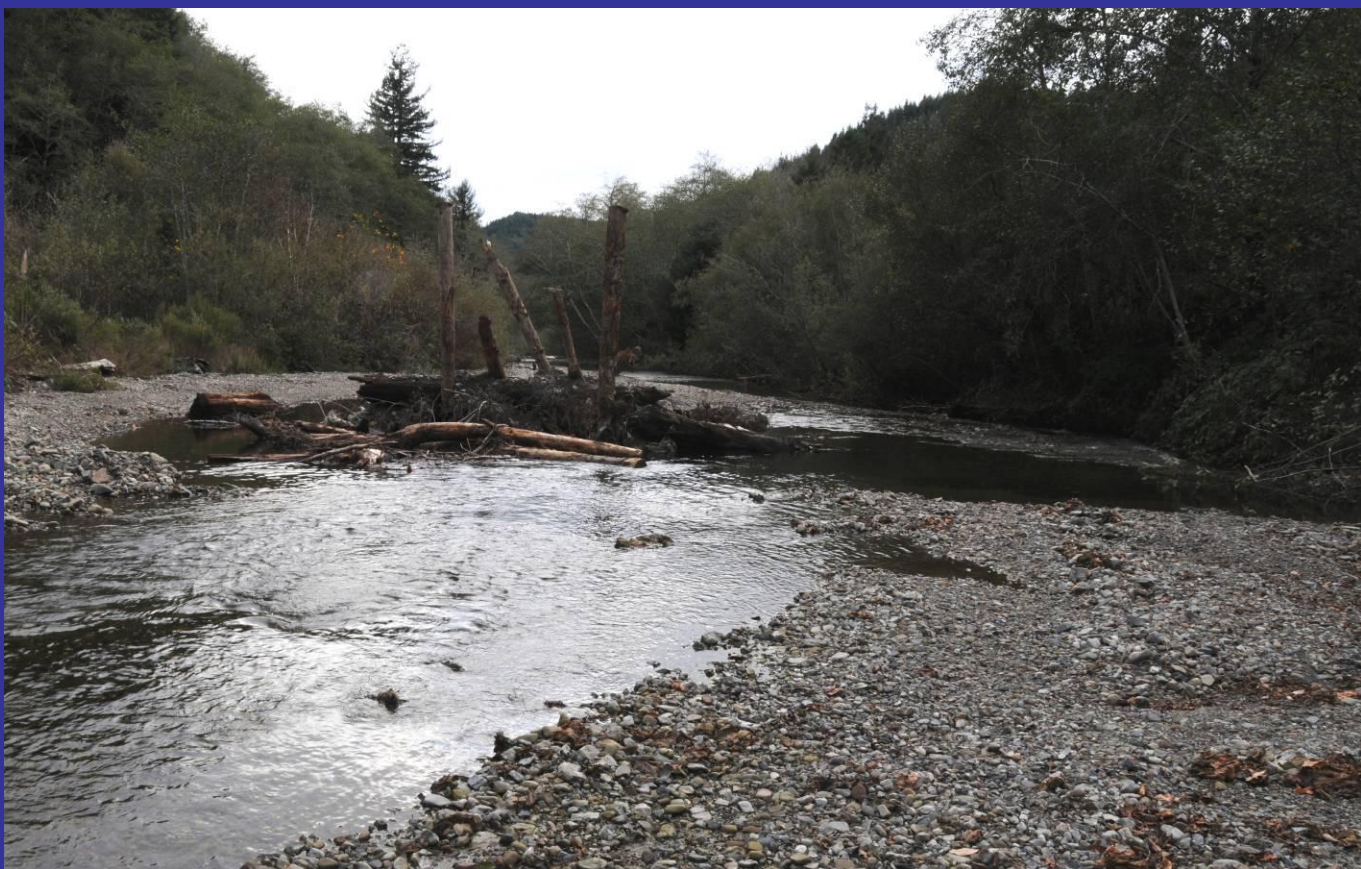


# Hunter Creek – Bar Apex Jam 3 Downstream View





# Hunter Creek – BAJ 4 Downstream View



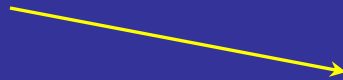
Tributary  
Confluence



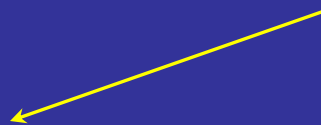


# Hunter Creek – BAJ 4 Profile View

Crescent Shaped  
Scour Pool with  
Cover



Riparian Planting  
Area in Wake  
Zone



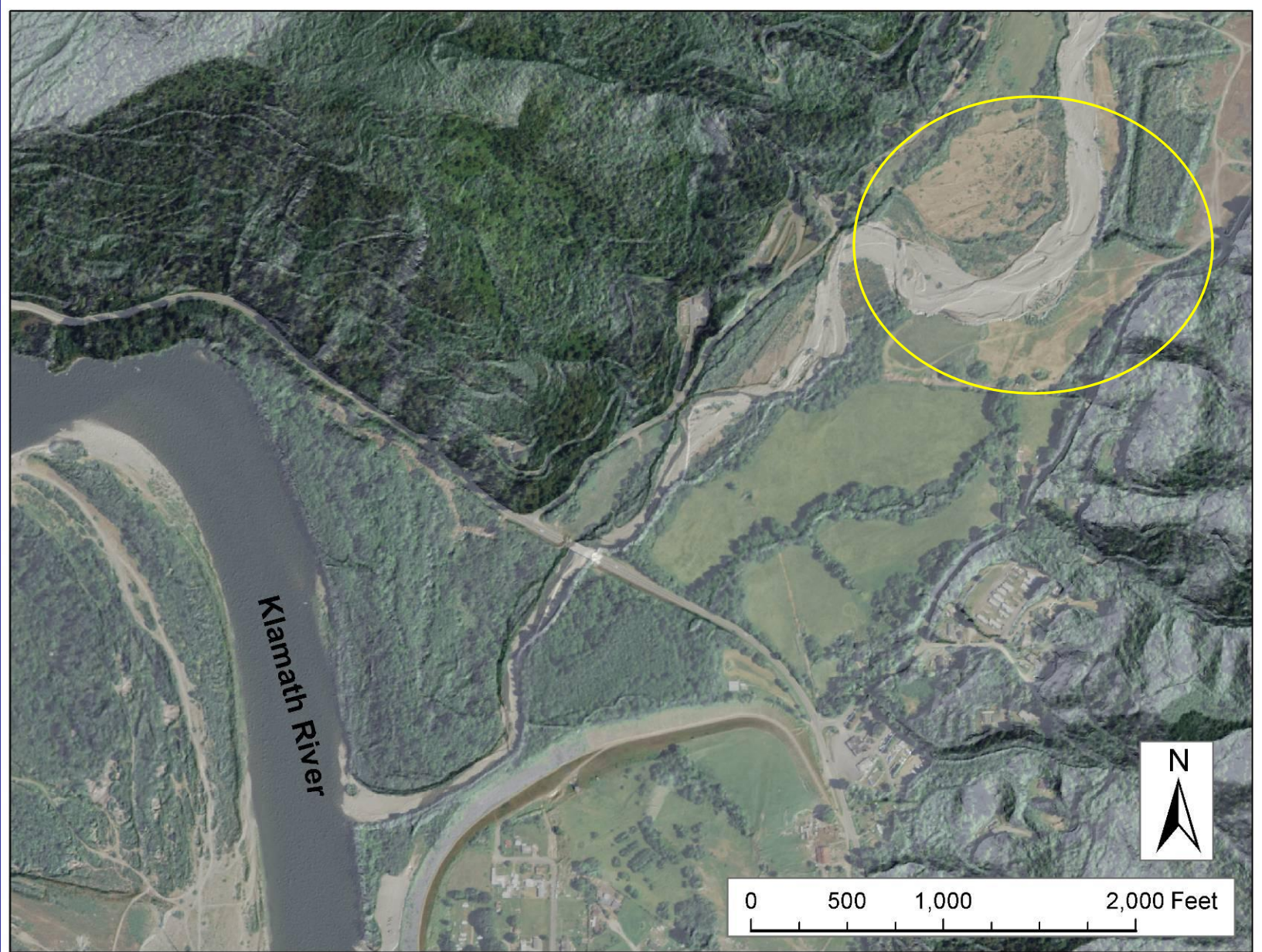


# Terwer Creek





# Terwer Creek



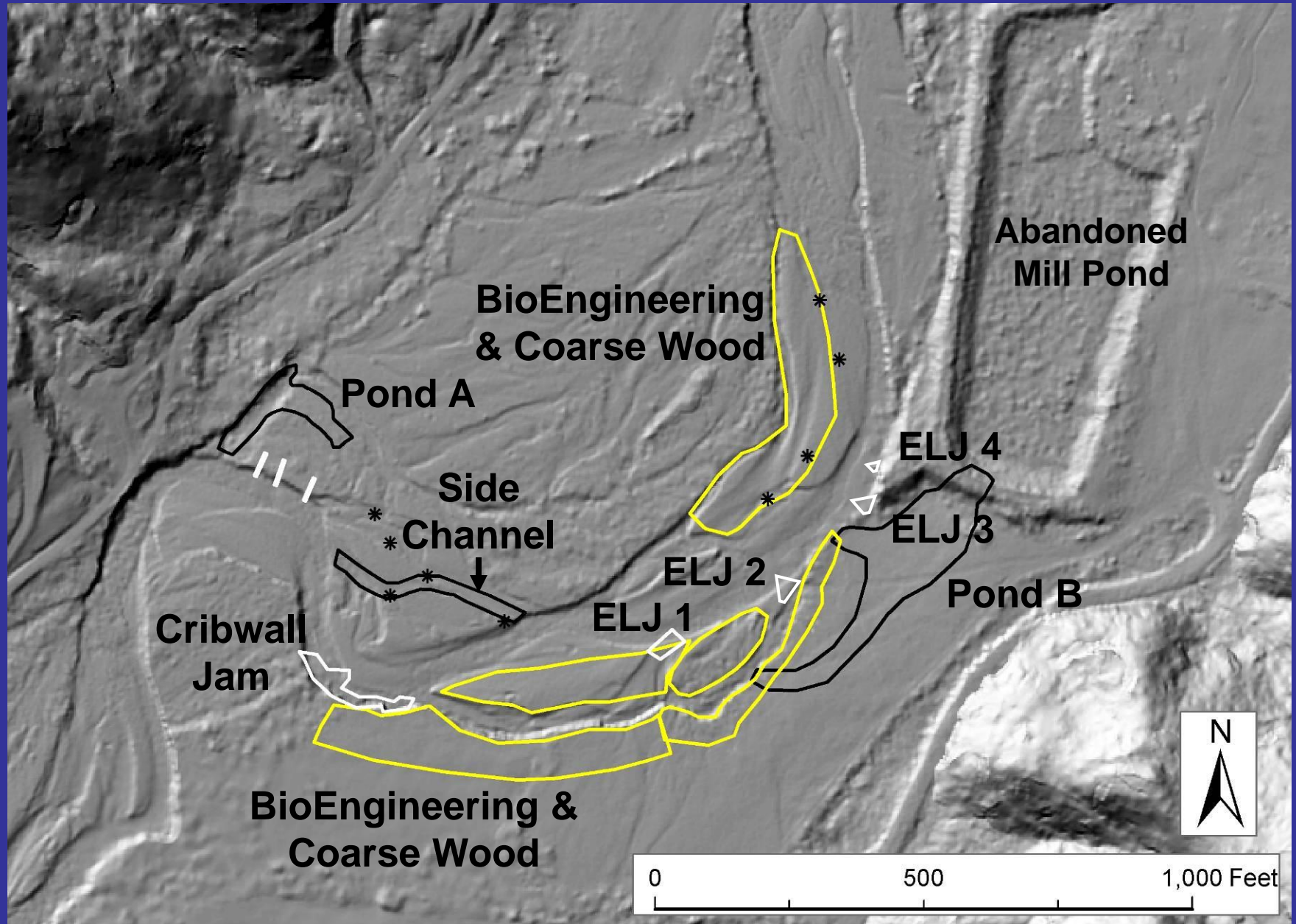


# Terwer Creek





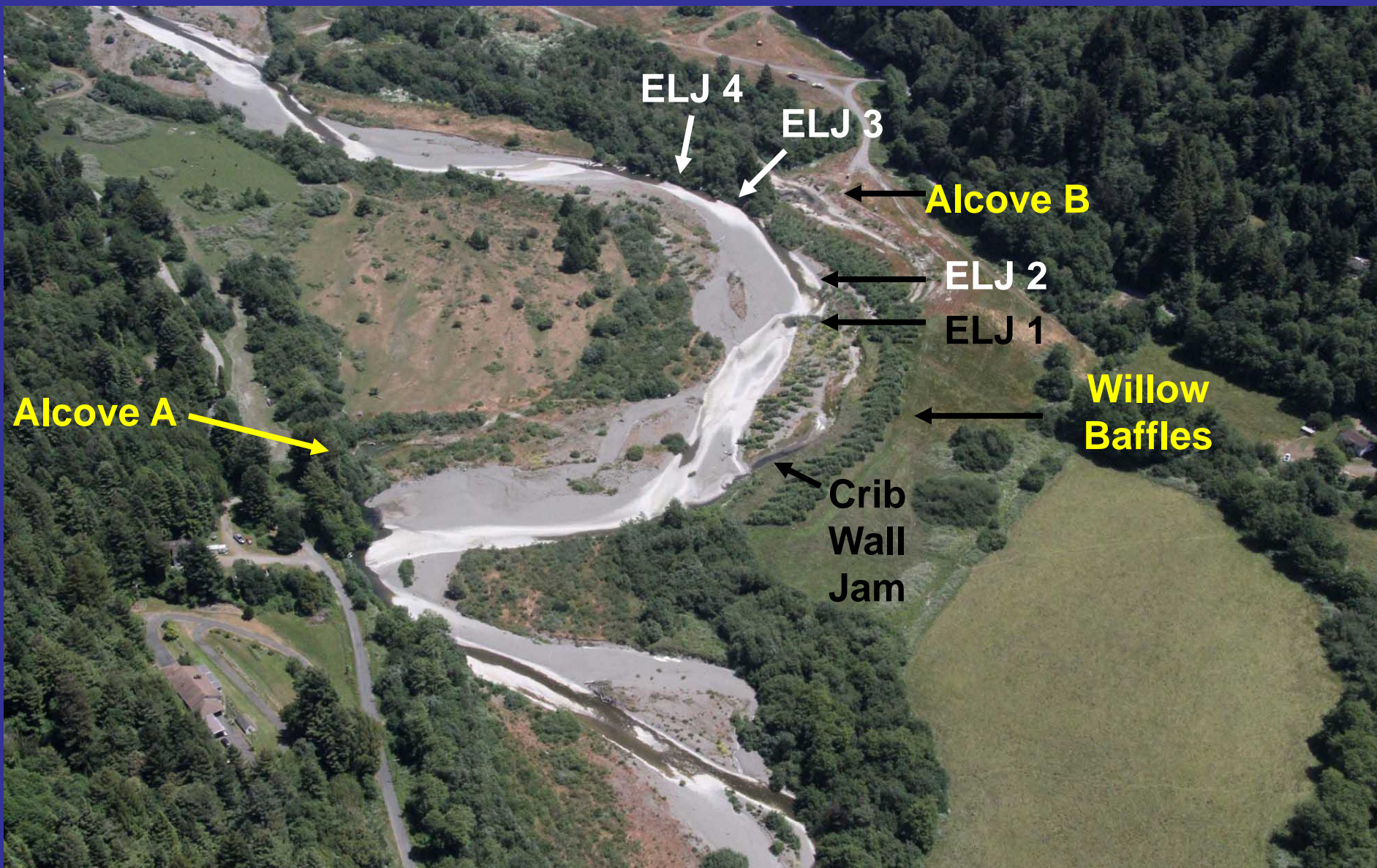
# Terwer Creek





# Terwer Creek

## Integrated Use of ELJs, Alcoves & BioEngineering





**ELJ 1 - Post-  
Construction**



**2 Years Post-  
Construction**



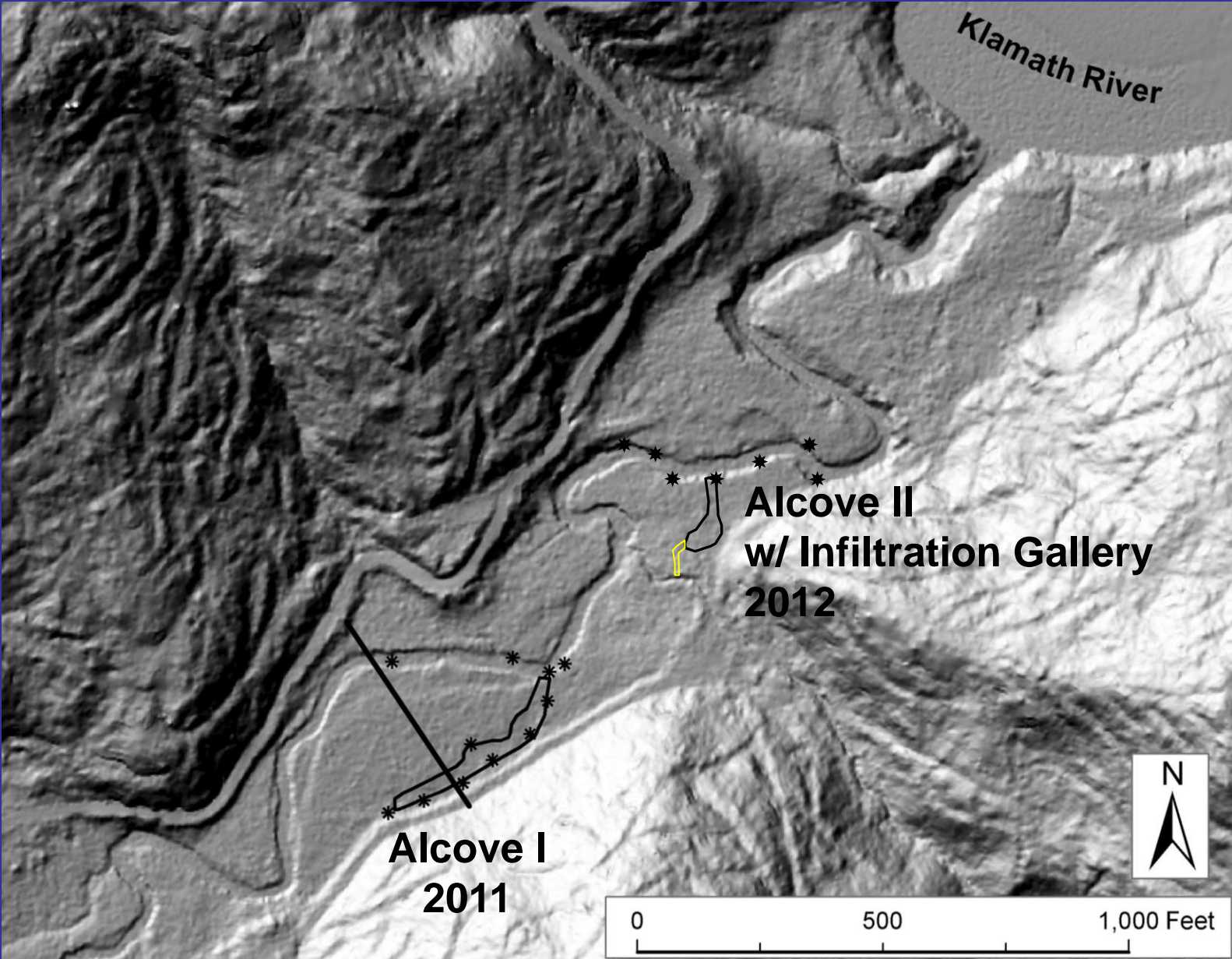


**Terwer Creek  
First Winter  
Post-Project**





# McGarvey Creek





# McGarvey Creek – Alcove I

**Pre-  
Construction**



**Post-  
Construction**





# McGarvey Creek – Alcove II

Infiltration Gallery

PIT Tag Antenna

Log Jam at Confluence





# Influence of Hydrostratigraphy On Off-Channel Habitat Function

Type	Simplified Alluvial Architecture	Permeability	Design Opportunities & Constraints
1	Coarse grain (gravels)	>>> K	Hydroperiod depends on depth to bedrock and summer ground water elevation. Severe riparian recovery conditions.
2	Medium grain (sands & silts)	>> K	Hydroperiod depends on depth to bedrock and summer ground water elevation. Difficult riparian recovery conditions.
	Coarse grain (gravels)	>>> K	
3	Fine grain (silts & clays)	>K	Hydroperiod may be extended by constructing within fine grain unit. Favorable riparian recovery conditions.
	Coarse grain (gravels)	>>>K	
4	Medium grain (sands & silts)	>> K	DO may limit fish use. Anoxic soil may impair riparian recovery.
	Fine grain (silts & clays)	>K	
5	Highly Stratified	Complex	Requires detailed field investigation to characterize and design.
BRX-s BRX-d	Depth to Bedrock Modifier	Variable	Shallow depth to bedrock favors perennial surface flow
	Shallow verses Deep		

# Hydrostratigraphy – Terwer Creek



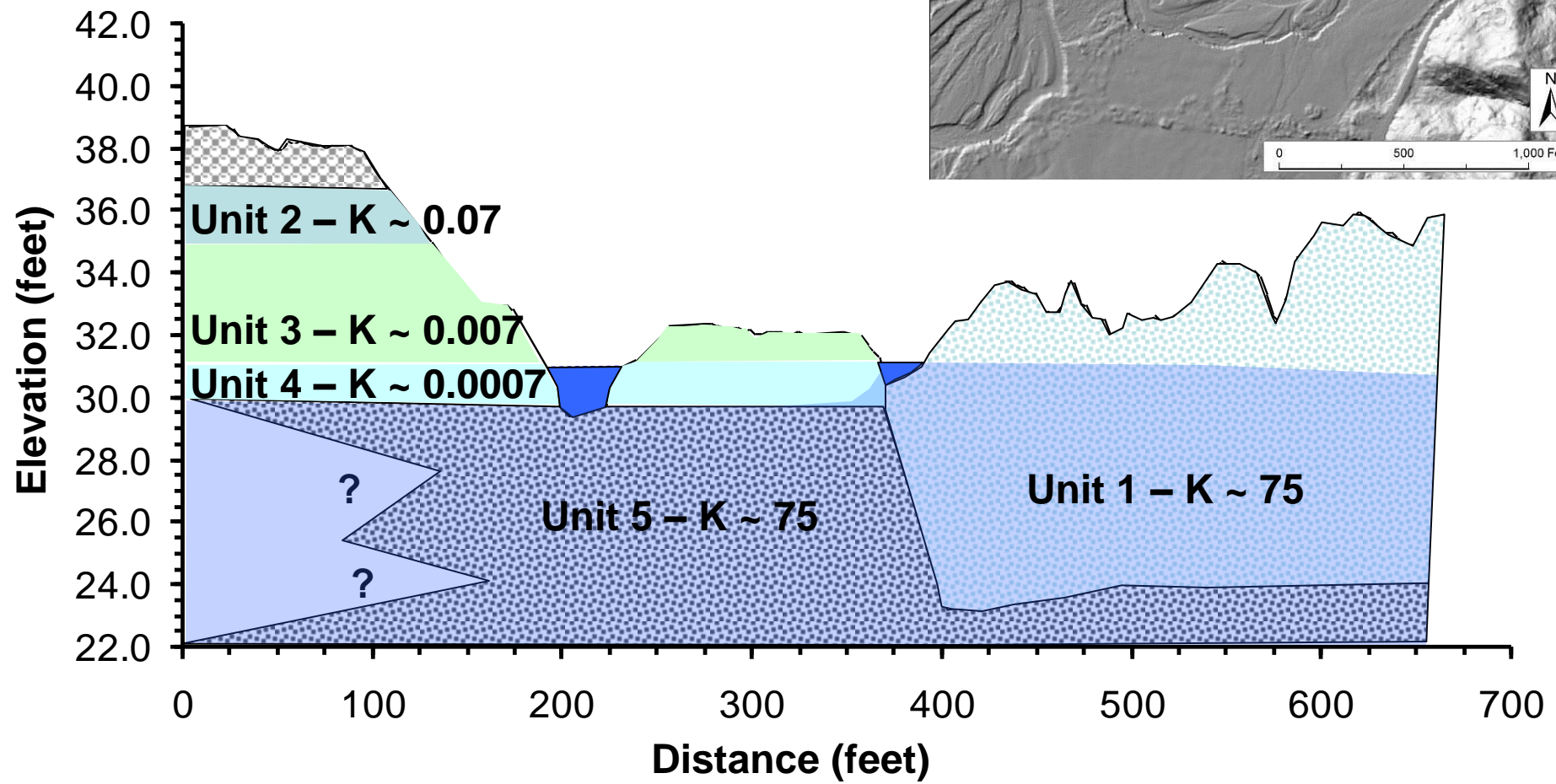
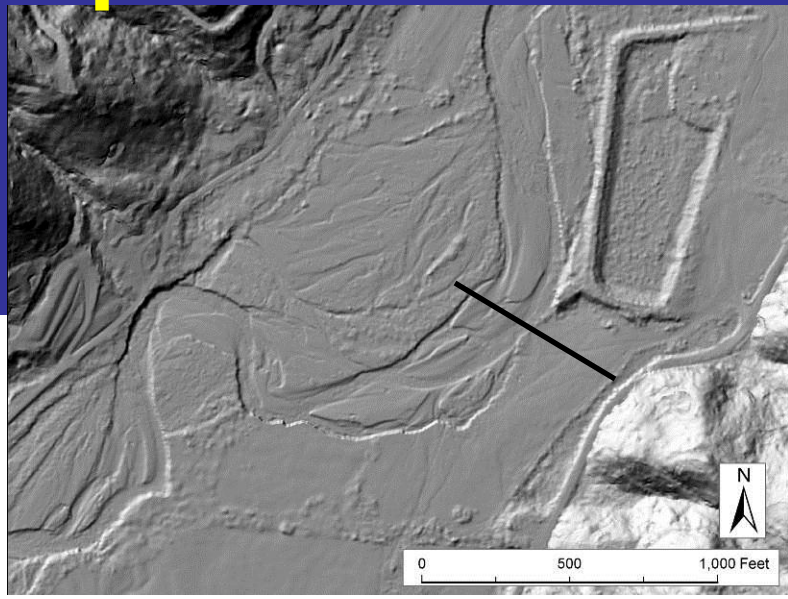
Unit #	Geologic Description	Estimated K L/day/m <sup>2</sup> (gal/day/ft <sup>2</sup> )
2	Plow Layer - Overbank Deposits Sandy silt 1 to 2 feet thick	0.07 (0.8)
3	Horizontally stratified overbank & backwater deposits  Weakly consolidated clayey silts with sand and occasional gravel lenses.  Unit thickness is highly varriable – 2 to 10 feet	0.007 (0.08)
4	Horizontally stratified overbank and backwater deposits Moderately consolidated clay with silts and sand 2 to 5 feet thick	0.0007 (0.008)
1	Recent high energy fluvial deposits Gravels and sands 6 to 12 feet thick	75 (803)
5	Older fluvial deposits Predominantly gravels and sands at depth > 100 feet thick	75 (803)



# Hydrostratigraphic Conceptual Model

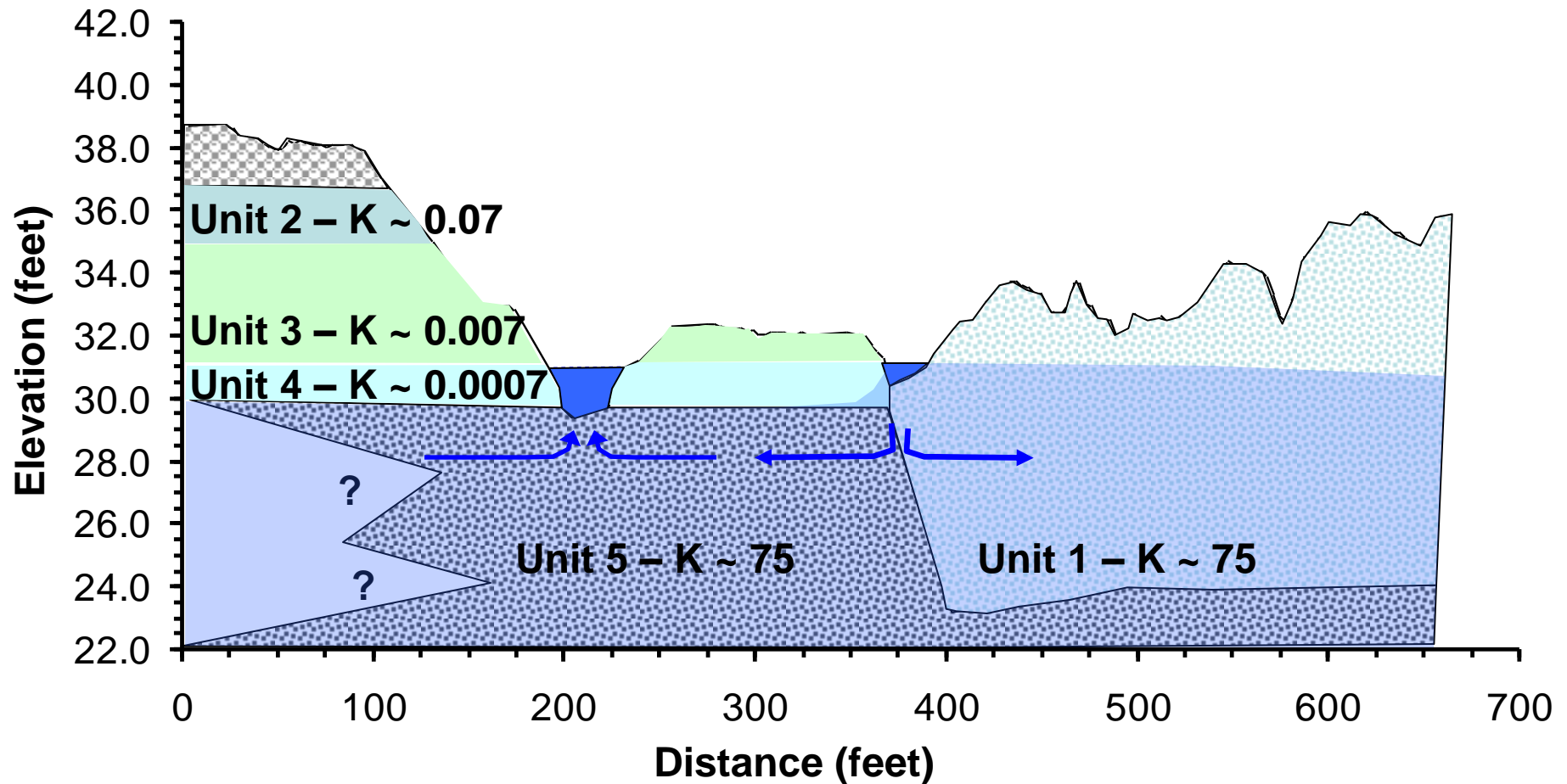
## Terwer Creek

(Type 3 Conditions)



# Terwer Creek

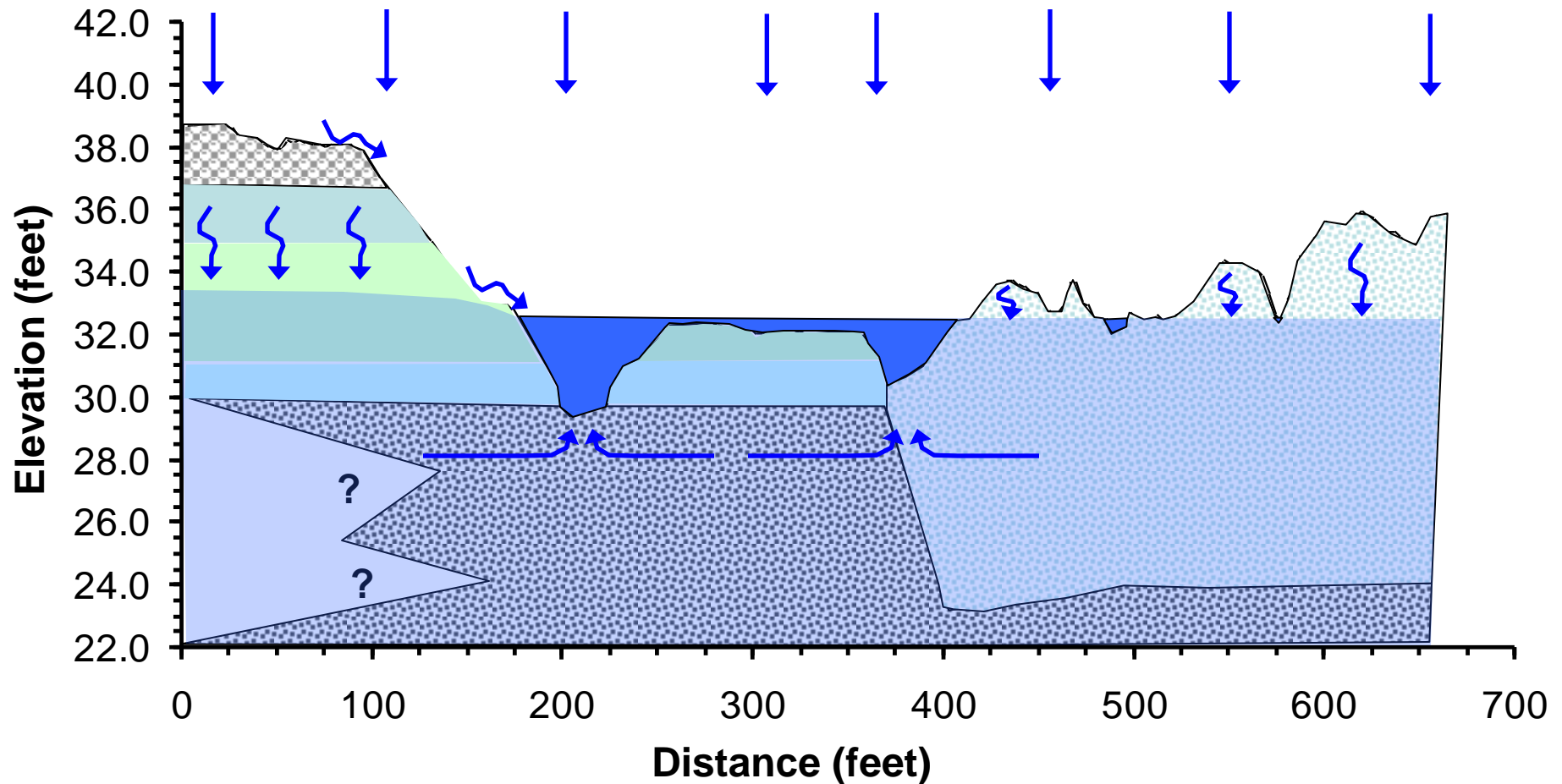
## Baseflow Conditions





# Terwer Creek

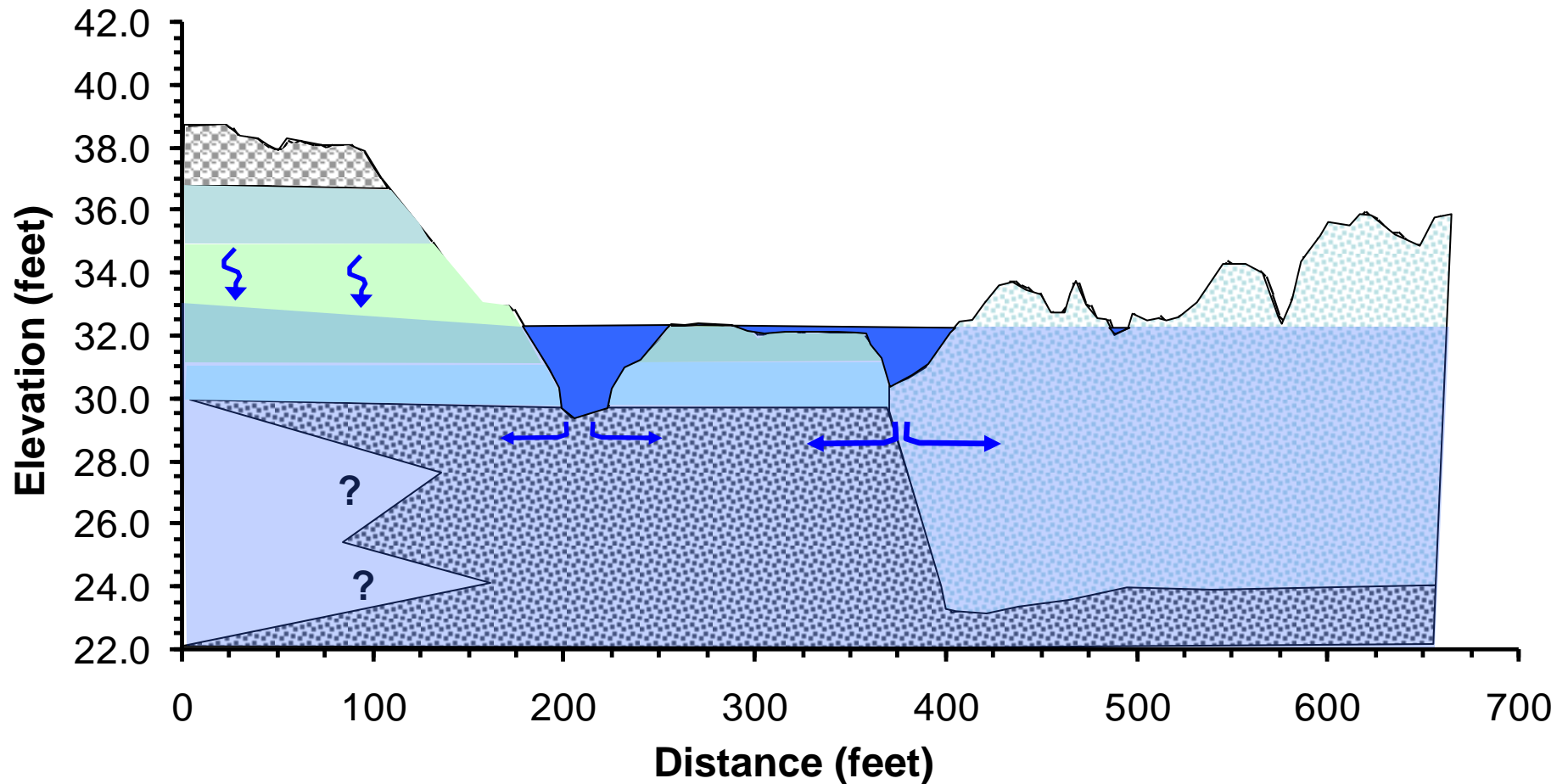
## Storm Flow Conditions





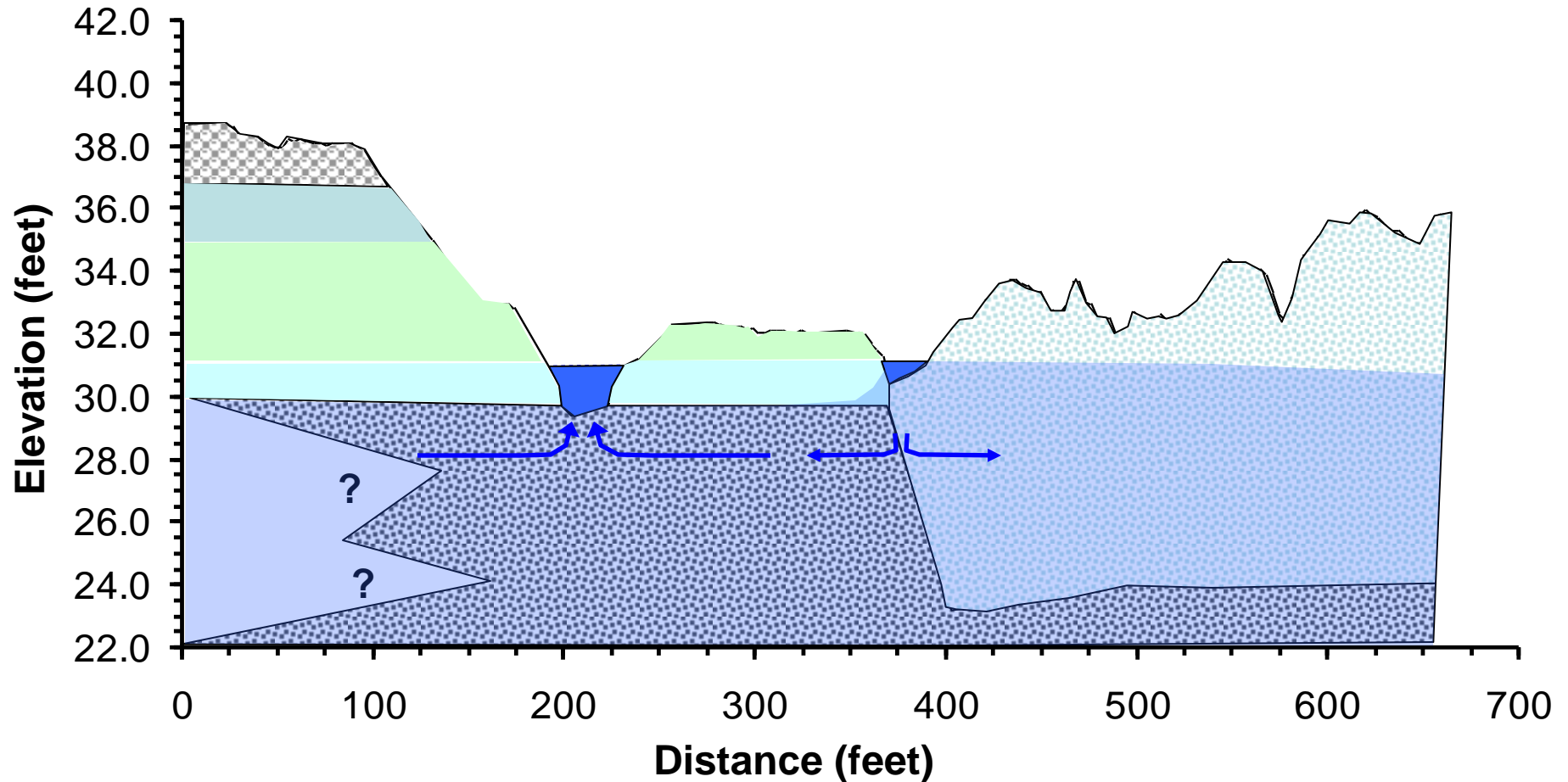
# Terwer Creek

## Recession Limb Conditions – Stage 1



# Terwer Creek

## Baseflow Conditions





# Hydrostratigraphy – McGarvey Creek

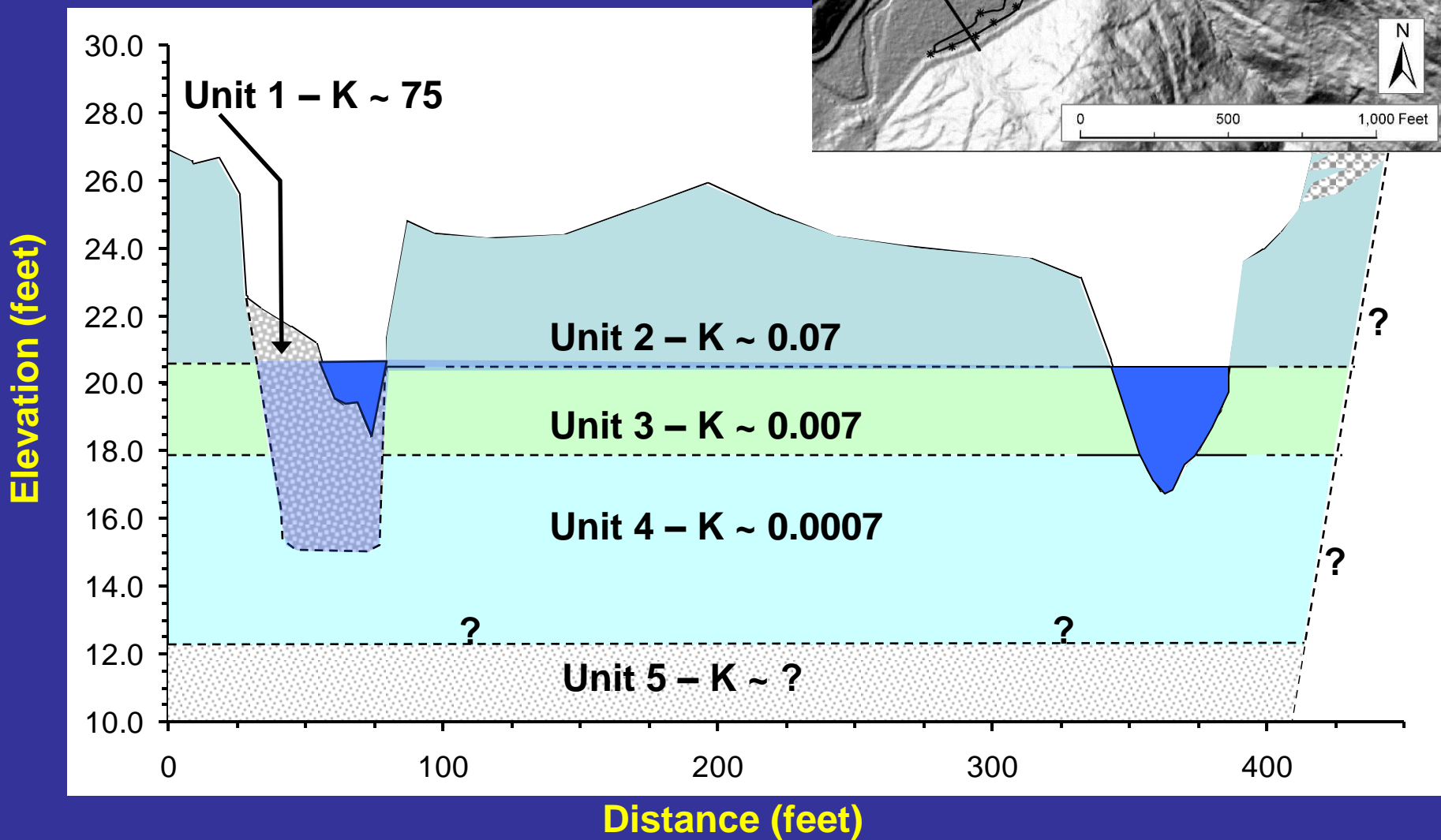
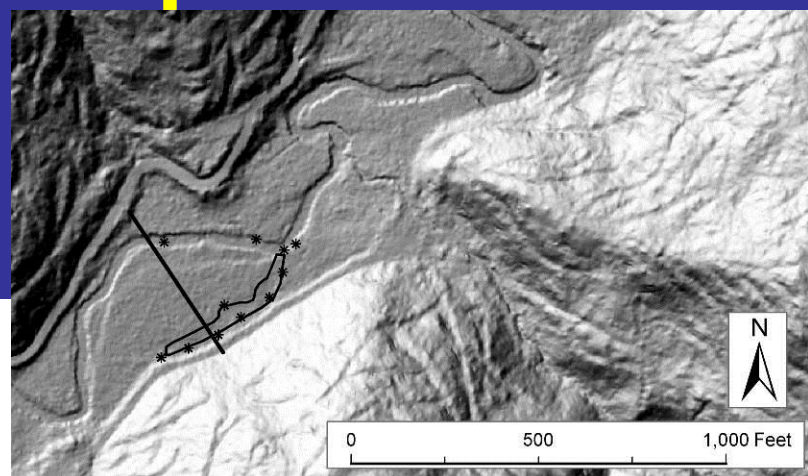


Unit #	Geologic Description	Estimated K L/day/m <sup>2</sup> (gal/day/ft <sup>2</sup> )
2	Horizontally stratified overbank deposits  Weakly consolidated clayey silts with sand and occasional gravel lenses. 3 to 5 feet thick	0.07 (0.8)
3	Horizontally stratified overbank and backwater deposits Moderately consolidated clayey silts with sand. >7 feet thick	0.007 (0.08)
1	Recent high energy fluvial deposits Gravels and Sands 3 to 7 feet thick	75 (803)
4	Backwater deposits Moderately consolidated silty clay >7 feet thick	0.0007 (0.008)
5	Older fluvial deposits at depth Grain sizes & thickness undetermined	NA

# Hydrostratigraphic Conceptual Model

## McGarvey Creek

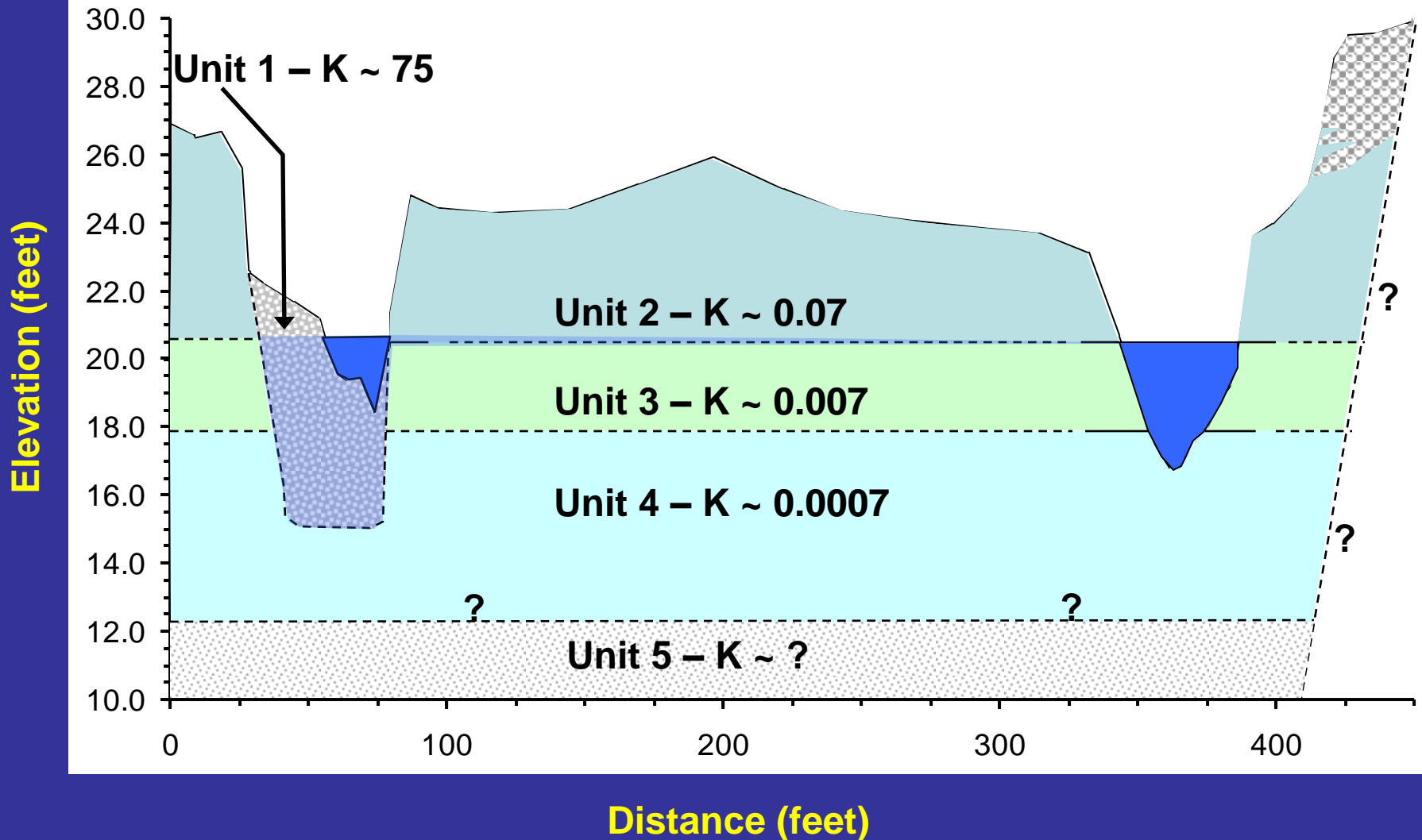
(Type 4 Conditions)





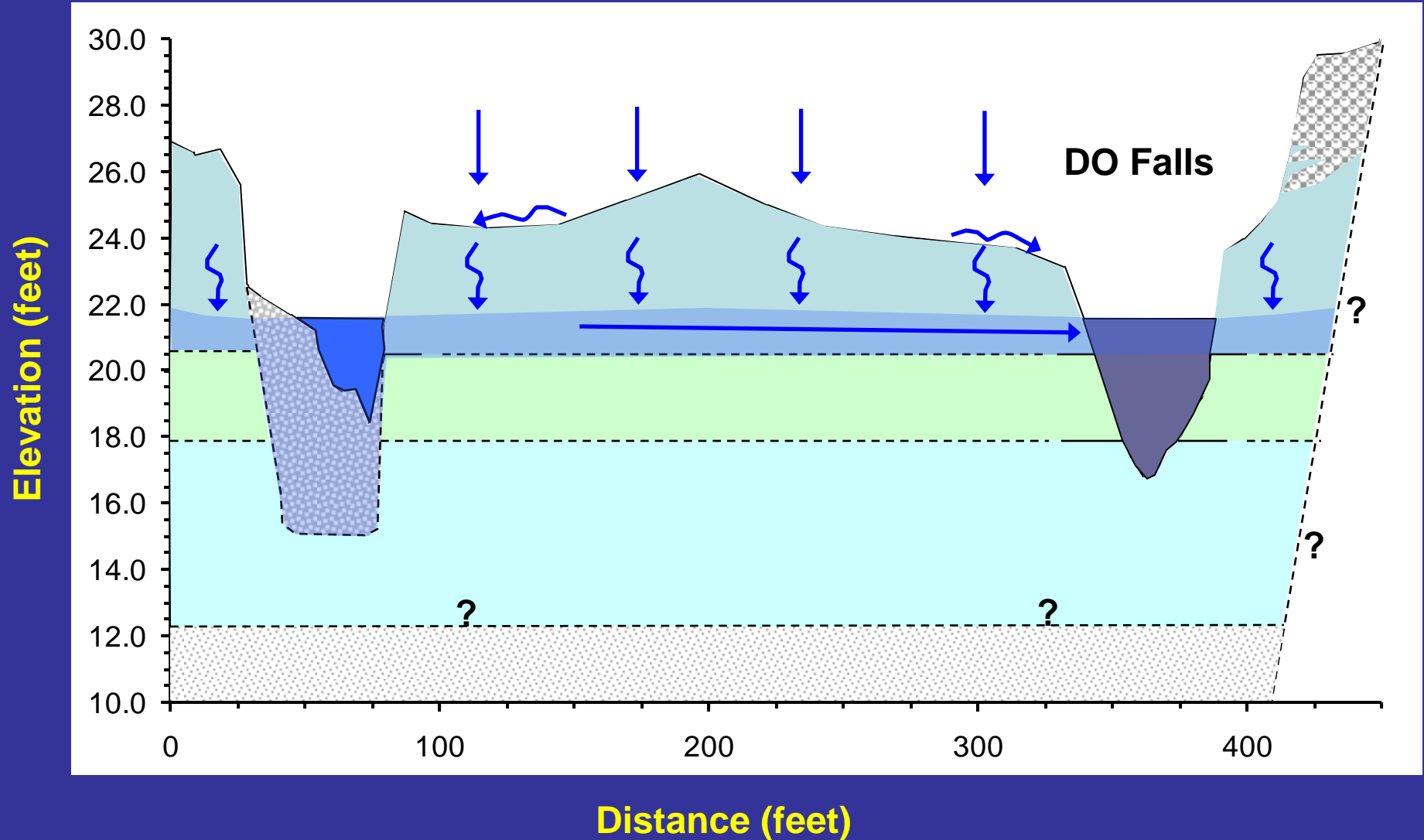
# McGarvey Creek

## Baseflow Conditions



# McGarvey Creek

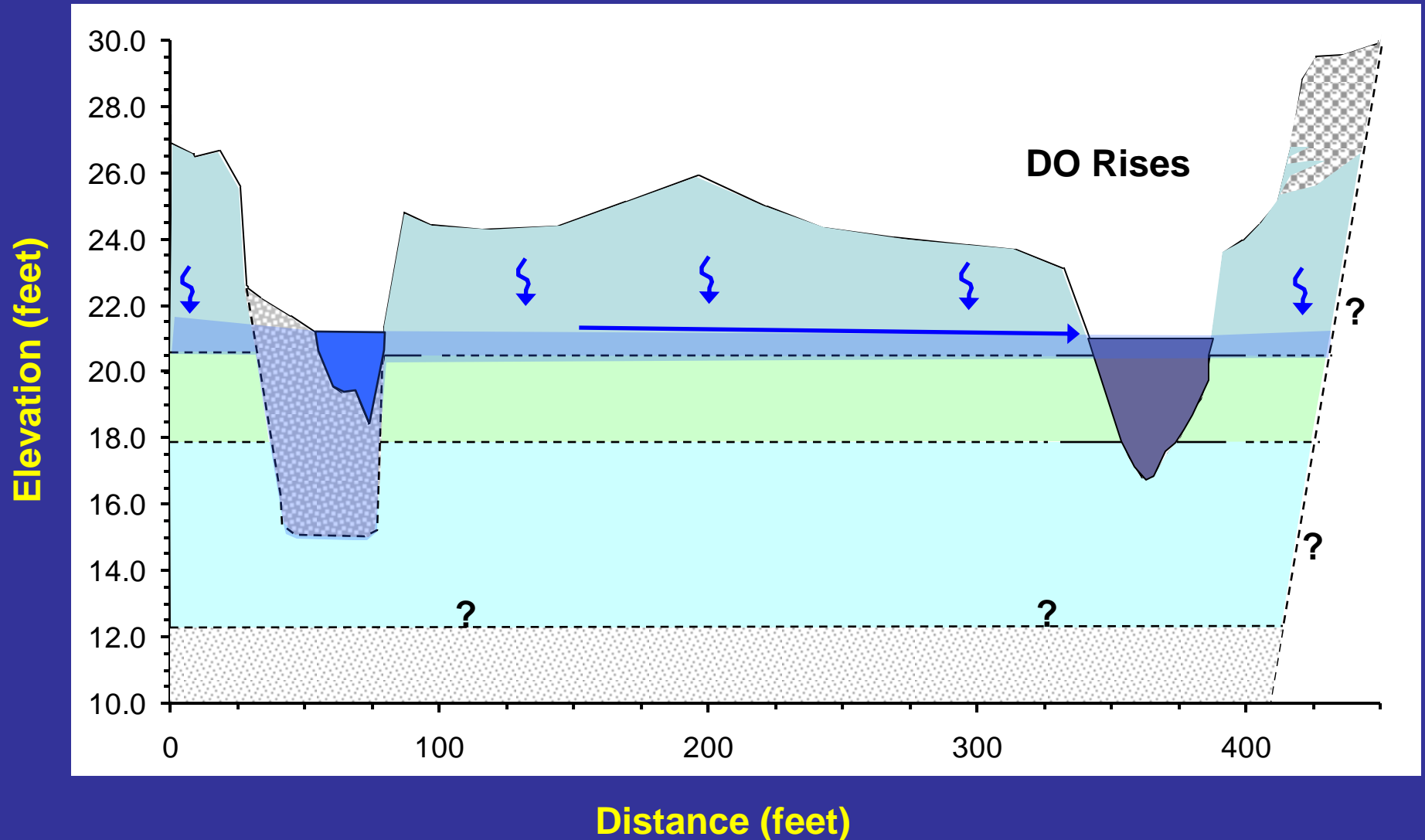
## Storm Flow Conditions





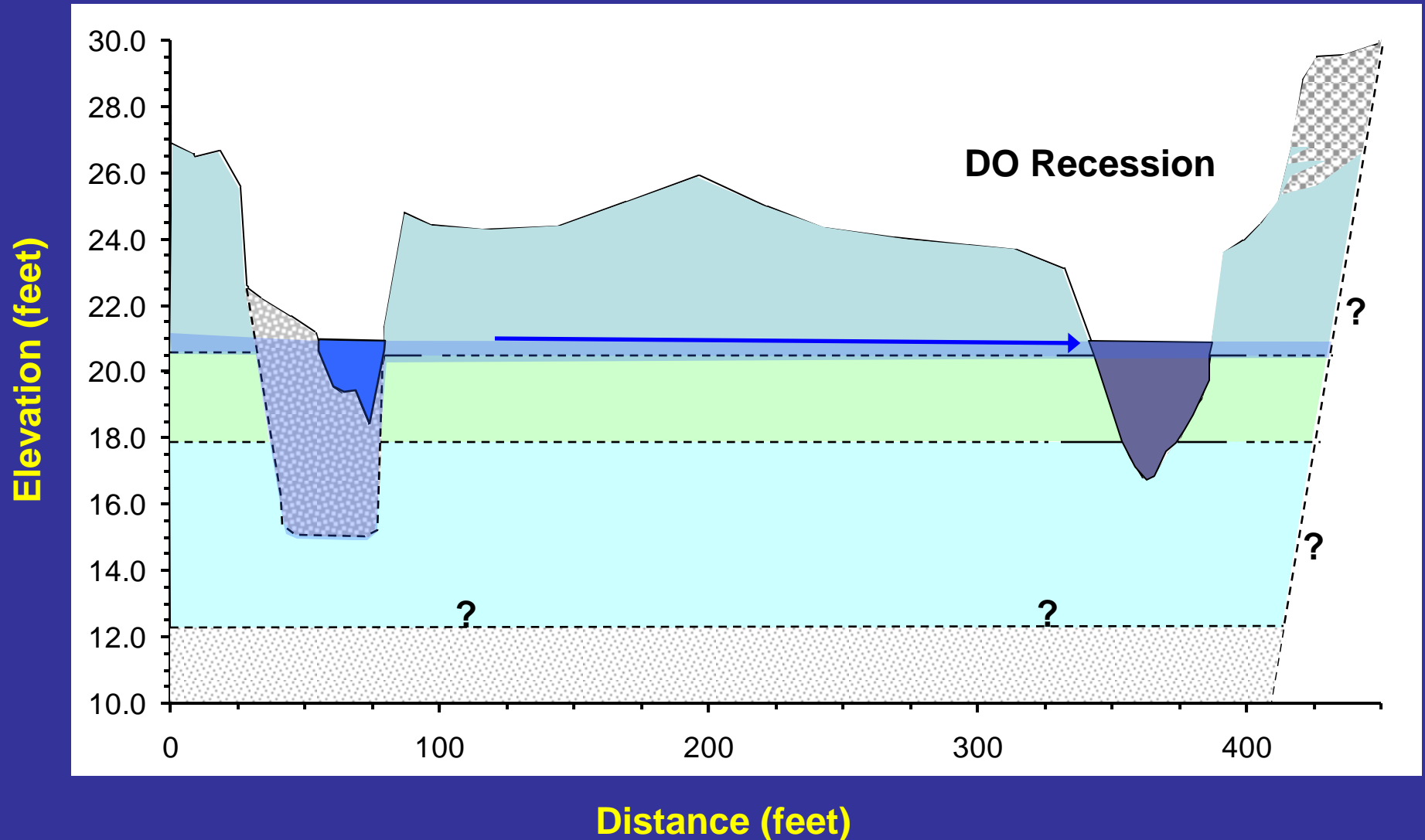
# McGarvey Creek

## Recession Limb Conditions – Stage 1



# McGarvey Creek

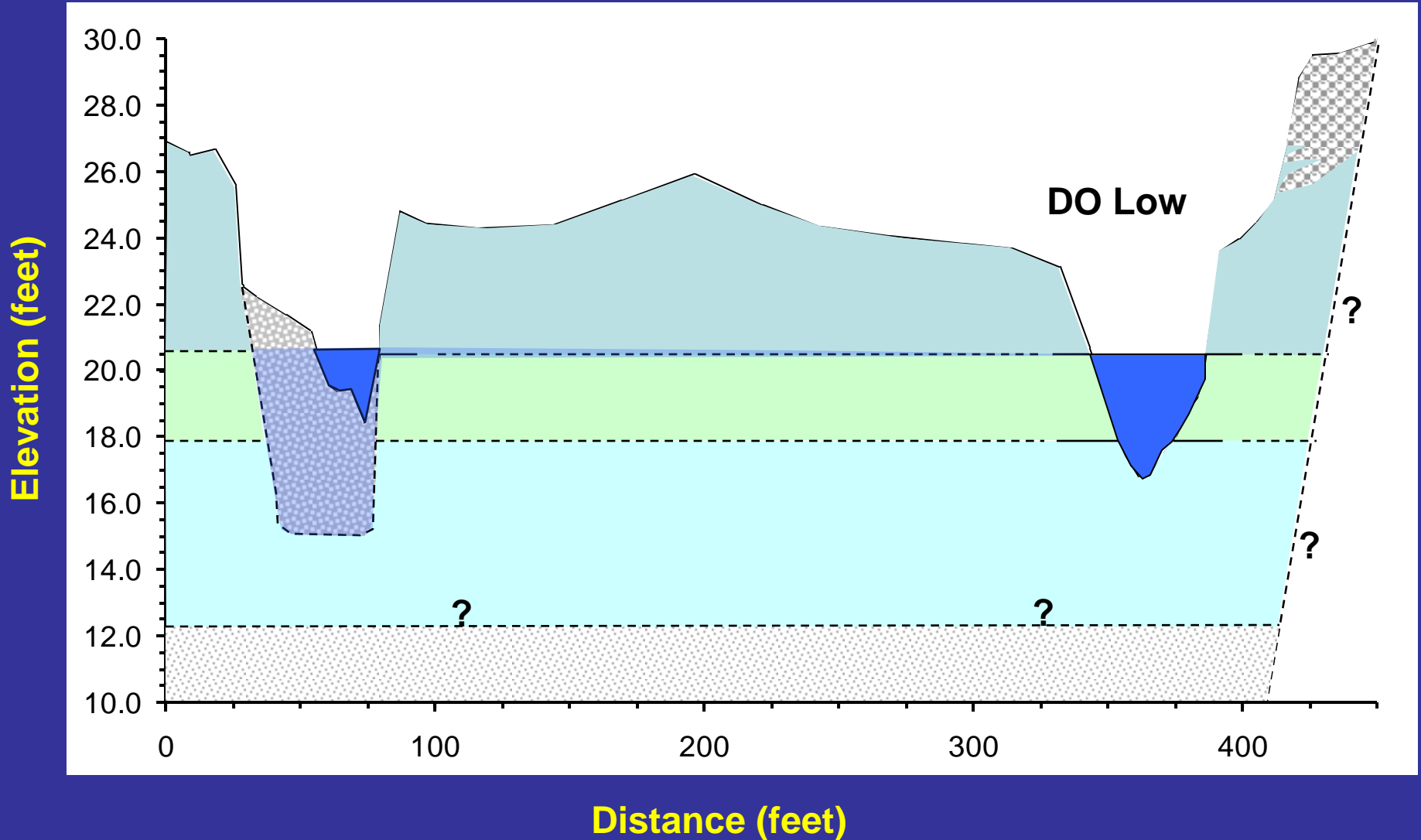
## Recession Limb Conditions – Stage 2



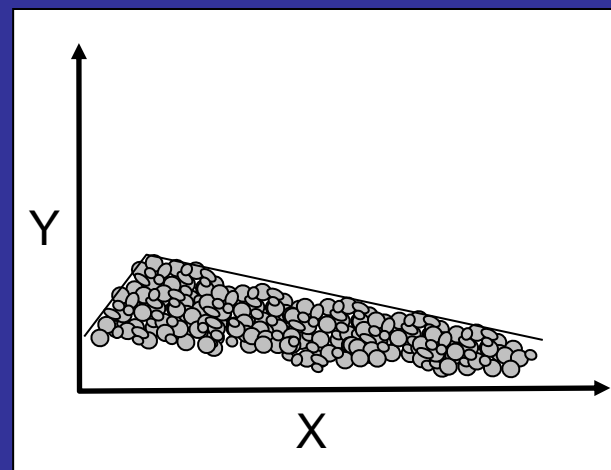
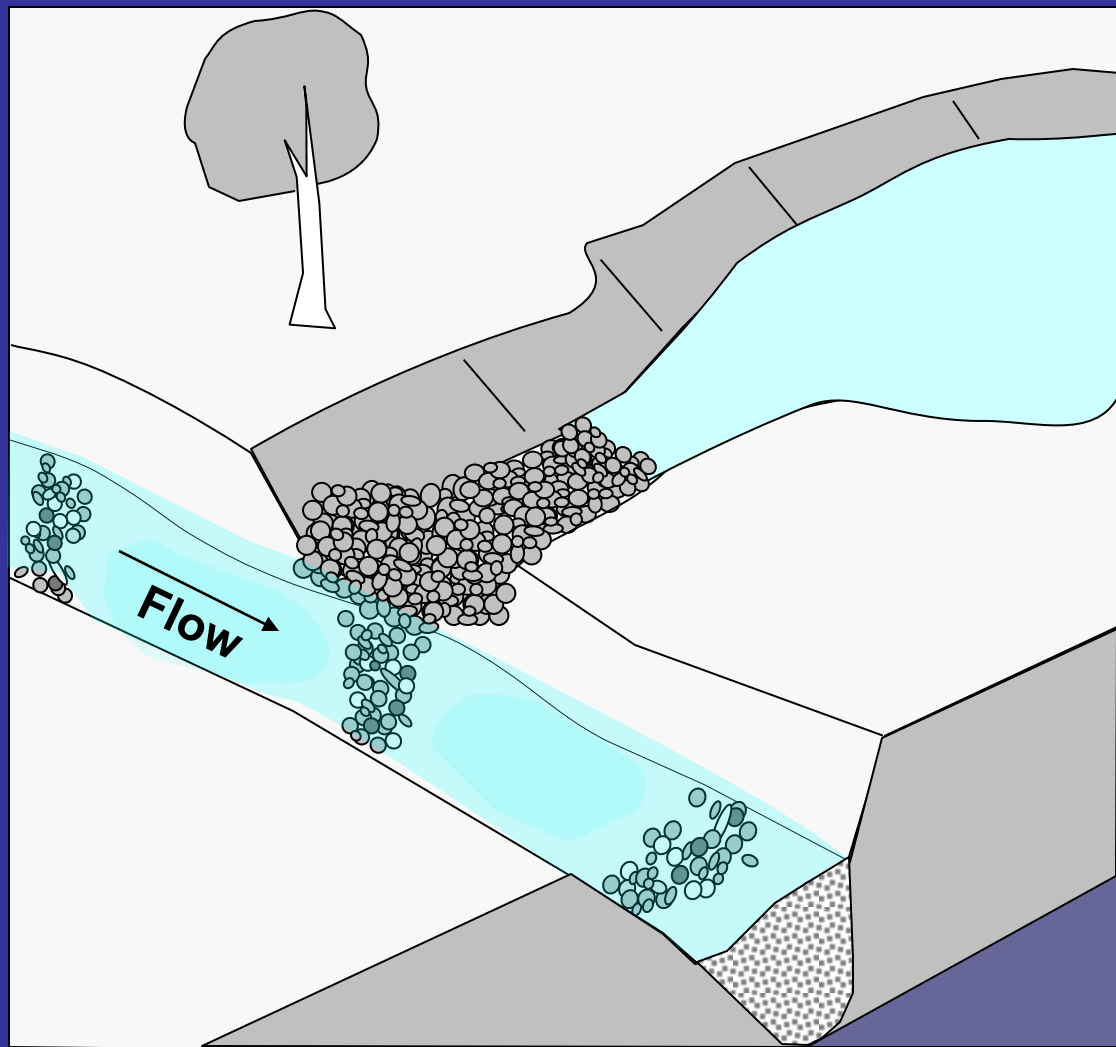


# McGarvey Creek

## Baseflow Conditions

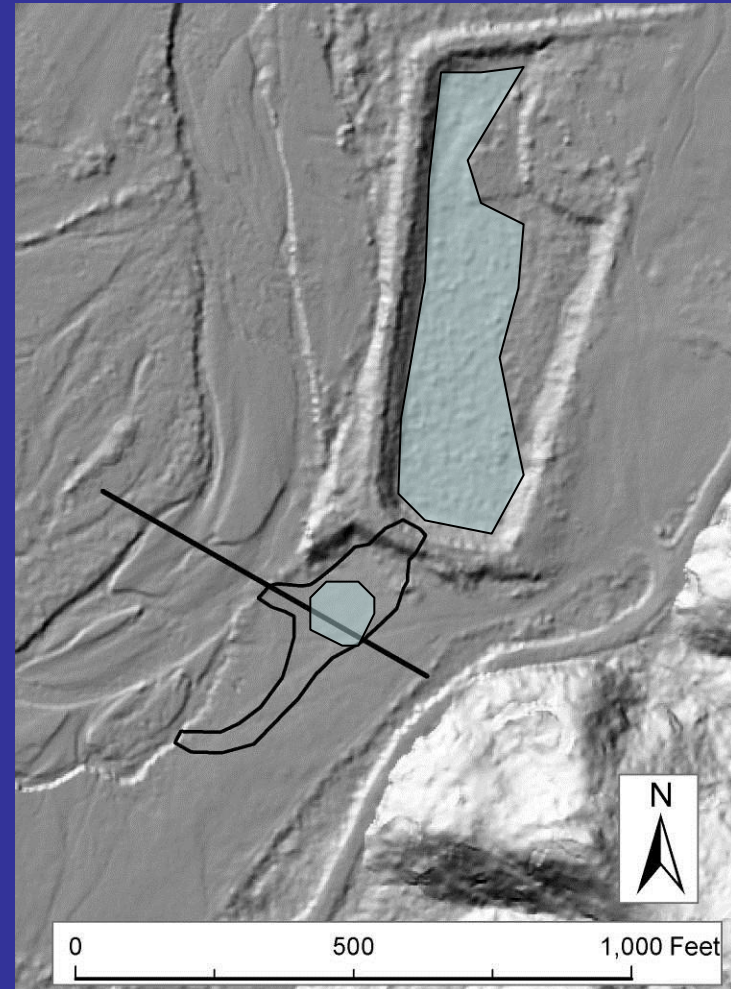
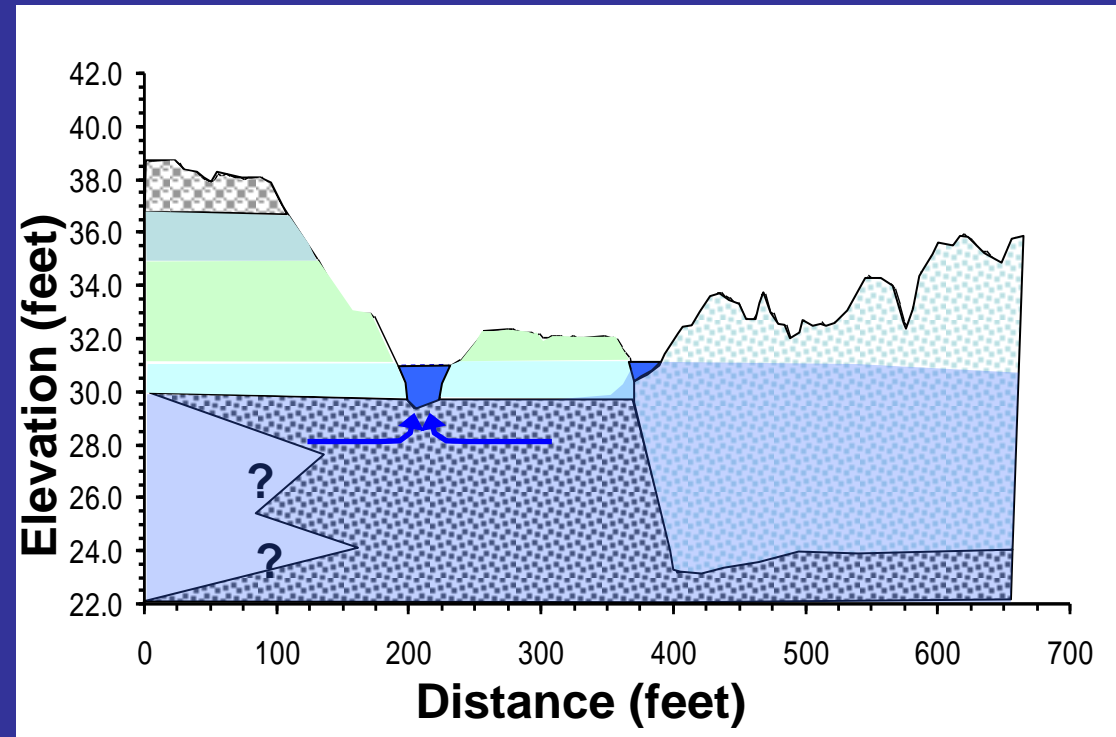


# Infiltration Gallery





# Hyporheic Windows





# Questions - Comments





# Thank You

