EF Mission Creek

Refine Design Concepts

May 16, 2021

Natural Systems Design

Considerations

Goals of Project and Field Effort

- Project Goals
  - Alluvial water storage
  - Steelhead habitat
  - Address fish passage barrier
  - Address eroding road/trail – Erin working on re-route
- Field Effort/Task 1 goals
  - Refine locations and focus in on highest potential to define a fundable project (possibly in phases) with maximum benefit
  - Work with stakeholders to get to consensus on project addressing the framing of the project, the scale of the project, and stability/risk to downstream infrastructure
  - Define spatial extent for preliminary design
    - Also will inform extent needed for survey

Field Concepts

May 3 2021

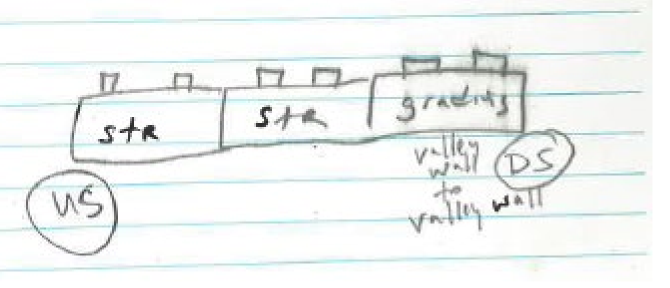
Conceptual Framework

- Treat for Habitat Issues
  - Critical:
    - Fish passage barrier
    - Flow along eroding road/trail and areas of high potential for this
    - Simplicity from entrenchment (treated via AWS treatment)
  - Less Critical:
    - Locations where culverts were pulled – prioritize for risk of road erosion
    - Local habitat – preserve/maintain incipient habitat development
- Alluvial Water Storage
  - Wide valley, entrenchment, pinch point downstream
- Road erosion areas
  - Ignore unless overlap with another high priority treatment –
    - often in narrow valleys, and threat to infrastructure doesn't matter, and not a habitat issue in and of themselves

Possible Phasing/Project Breakdown

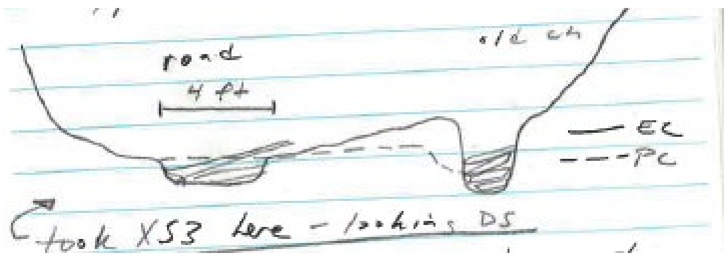
- Downstream reach – access from DS end
  - Farthest downstream reach with potential to avulse to road
  - Fish passage barrier + reach immediately downstream
  - AWS long stretch upstream of fish passage barrier
- Upstream reach – access from Beehive reservoir
  - Road erosion upstream of Kings Canyon
  - AWS long stretch downstream of Kings Canyon
  - Road crossings with high risk for avulsion
- Additive alternative or 3rd project
  - Intermittent AWS projects in the middle

Sequence of structures/treatments as lego blocks?



- Minimum length of each block?
- Order of blocks?
- Options for grading or not?

Designs for:

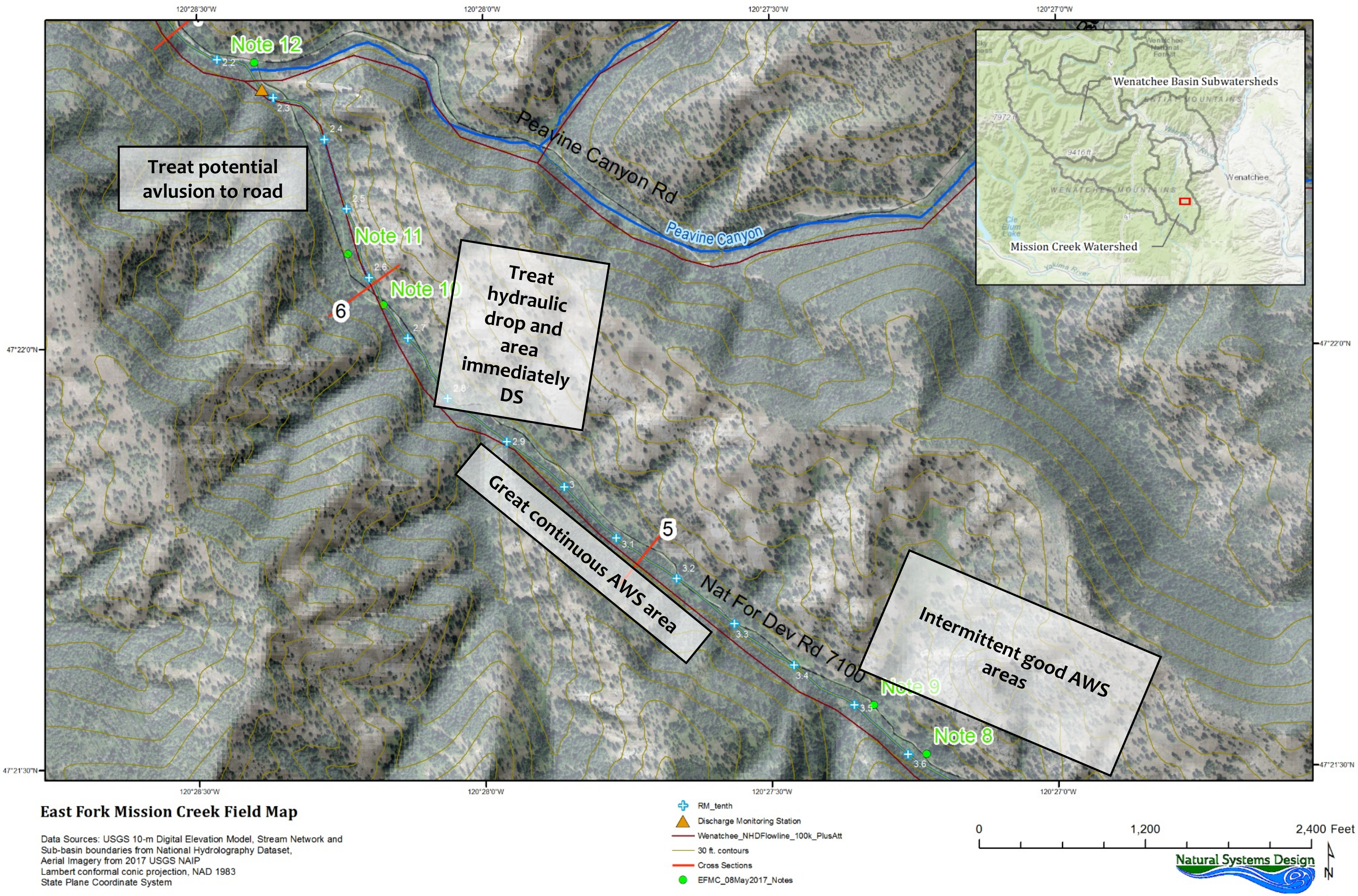


- Fish passage barrier
- Flow along eroding road/trail
- Preventing avulsion to road/ Locations where culverts were pulled
- Local habitat enhancement
- Road decommissioning and riparian reforestation – see upper Wenatchee sheet
- Alluvial Water Storage
  - Valley wall to valley wall treatment that involves re-grading
  - Wood structure entrenched into lower floodplain surface
  - Wood structure/rock? in channel only when entrenched and there's no lower surface?

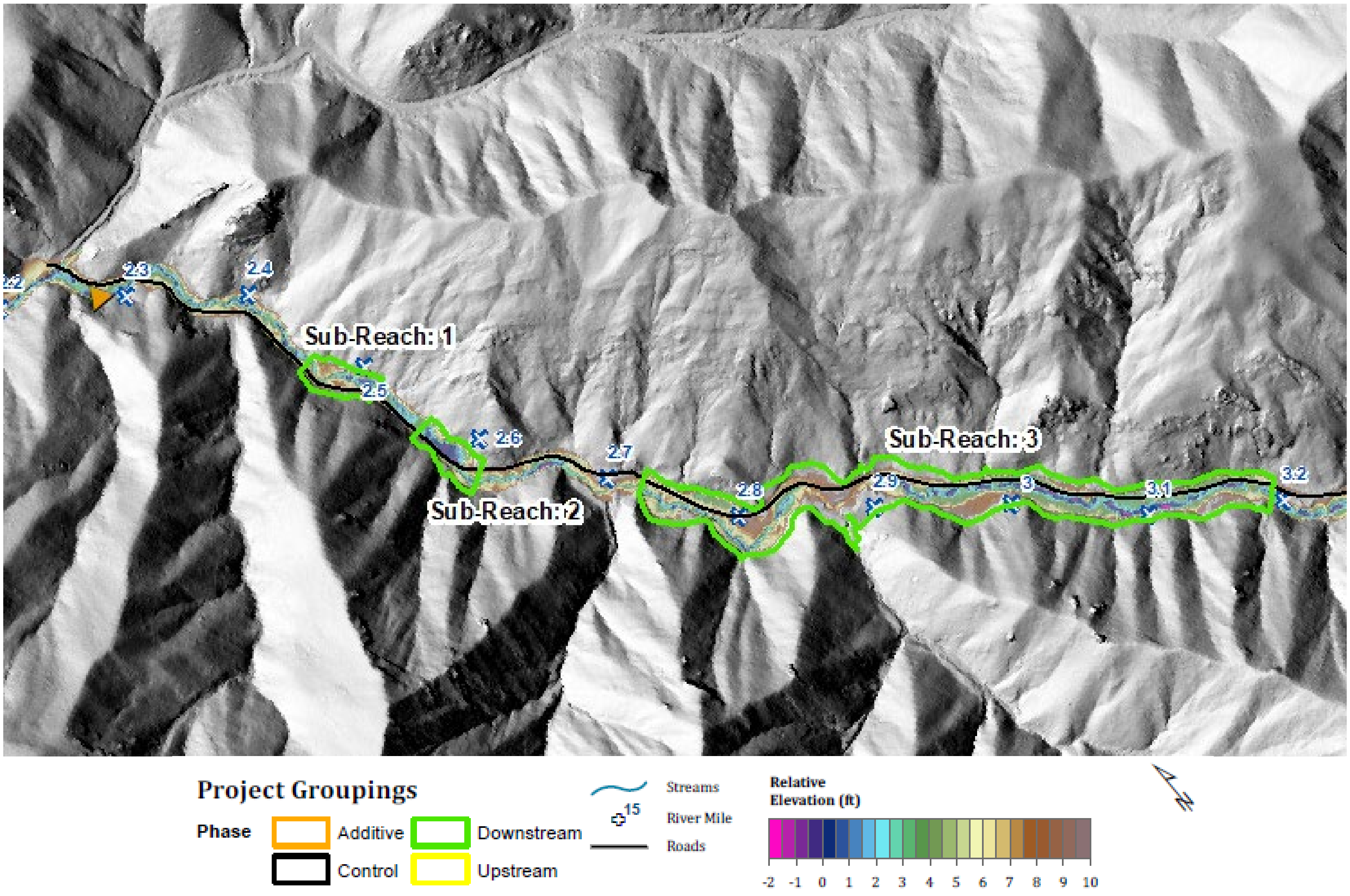
Concepts

May 2021

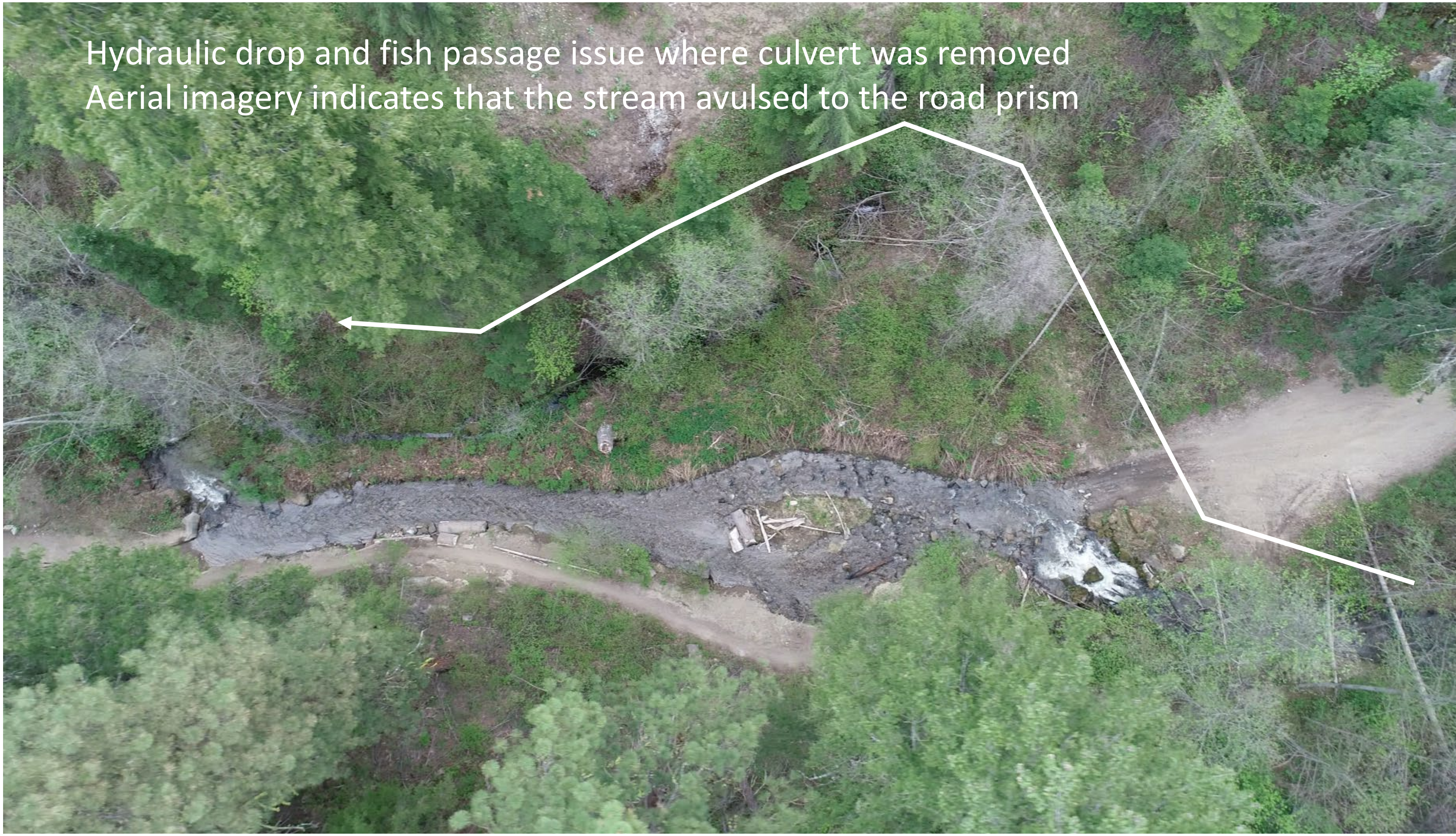
Overview – Downstream section



Downstream Reaches



Downstream Phase – Hydraulic Drop Reach



Downstream Phase – Hydraulic Drop Reach

- Habitat Restoration:
  - High, due to passage barrier, and simplification of habitat from entrenchment along road
- Alluvial Water Storage:
  - Medium due to constrained valley width
- Concept:
  - Rock riffle and re-grading to shallow slope, trigger aggradation DS of drop, direct flow toward pre-avulsion path, avoid additional avulsion into road at downstream end

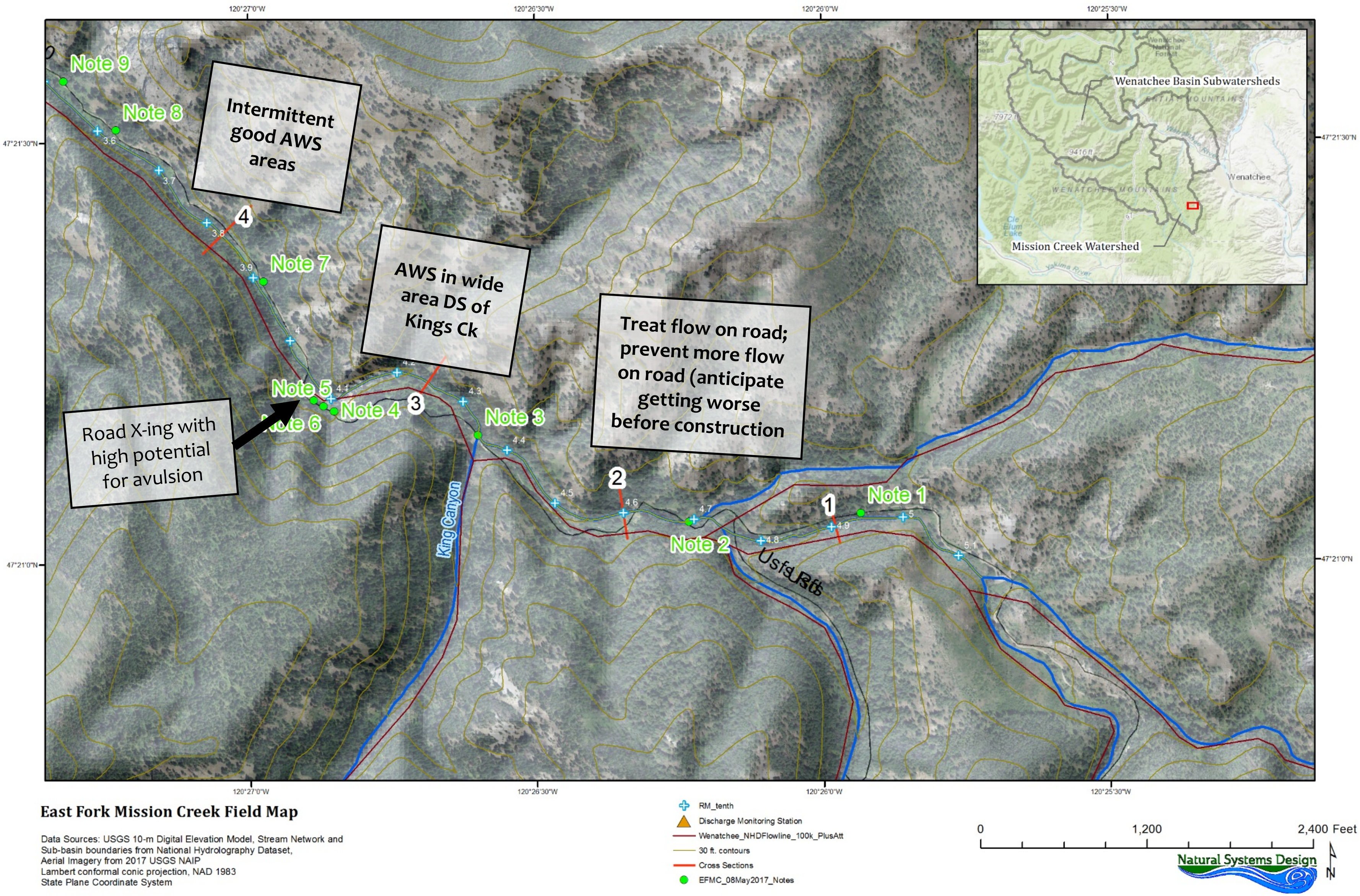
Downstream Phase – Alluvial Water Storage Reach Upstream of Drop

- Overview:
  - Wide valley for continuous AWS treatment, up to ~0.5 mile with bedrock constraint at DS end
  - Also: Note specific location for habitat structure to augment incipient flow split (~ RM3.18, note #12)
- Habitat Restoration:
  - Medium, due to habitat simplification from entrenchment
- Alluvial Water Storage:
  - High due to valley width and long treatment
- Concept:
  - Instream structures to prevent avulsion into road prism
  - Road decommissioning/roughening

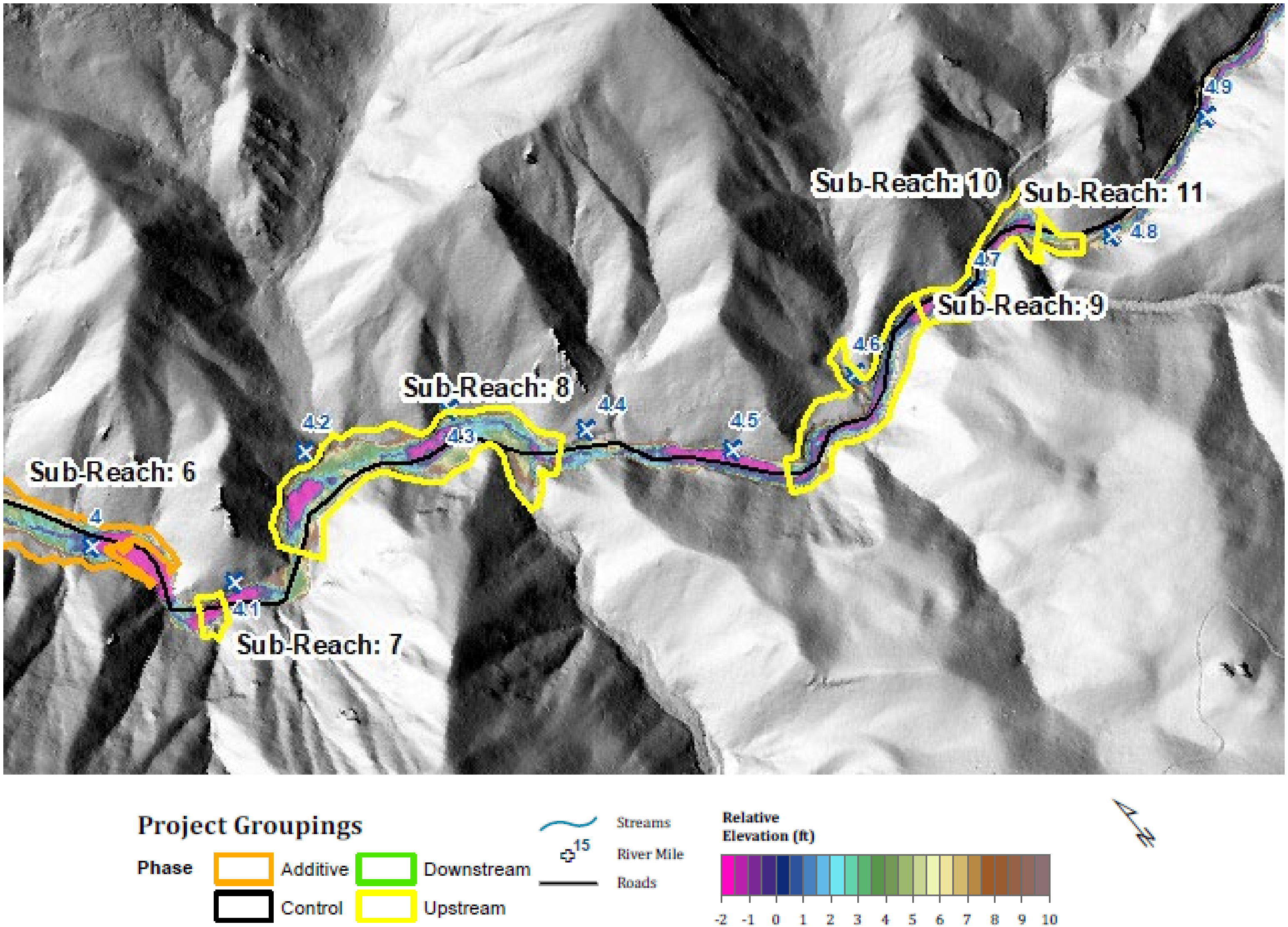
Downstream Phase – Alluvial Water Storage Reaches - Additive

- Overview:
  - Wide valleys for AWS treatment, with bedrock constraint at DS end, but discontinuous
- Habitat Restoration:
  - Medium, due to habitat simplification from entrenchment
- Alluvial Water Storage:
  - Medium due to valley width but shorter treatment
- Concept:
  - Valley wall to valley wall treatment at DS end
  - In-stream and in-FP structures depending on morphology

Overview – Upstream section



Upstream Reaches



Upstream Phase - High Risk for Avulsion into Road near RM 4.1

Upstream Phase - AWS Reach just DS of Kings Canyon

Upstream Phase - AWS Reach just DS of Kings Canyon

- Overview:
  - Wide valley for continuous AWS treatment, up to ~0.3 mile with bedrock constraint at DS end
  - Also: Note potential avulsion pathway just DS of Kings Cyn confluence
- Habitat Restoration:
  - Medium, due to habitat simplification from entrenchment
- Alluvial Water Storage:
  - High due to valley width and long treatment
- Concept:
  - Instream structures to prevent avulsion into road prism
  - Road decommissioning/roughening

Upstream Phase – Avulsion to Road US of Kings Canyon (upstream end of avulsion)

Upstream Phase – Avulsion to Road US of Kings Canyon (middle – parallel flow)

Upstream Phase – Avulsion to Road US of Kings Canyon

- Overview:
  - Stream has avulsed into and is entrenching the road (~0.1 mi)
  - High risk of continued DS propagation of avulsion (~0.2 mi)
- Habitat Restoration:
  - High, due to habitat degradation from entrenchment in road
- Alluvial Water Storage:
  - Low-Medium due to narrow valley and lower Q
- Concept:
  - Regrading and roughening to push stream back into original channel; wood structures to roughen and aggrade original channel; leverage 2 channels for dewatering
  - Road decommissioning/roughening to prevent additional avulsion

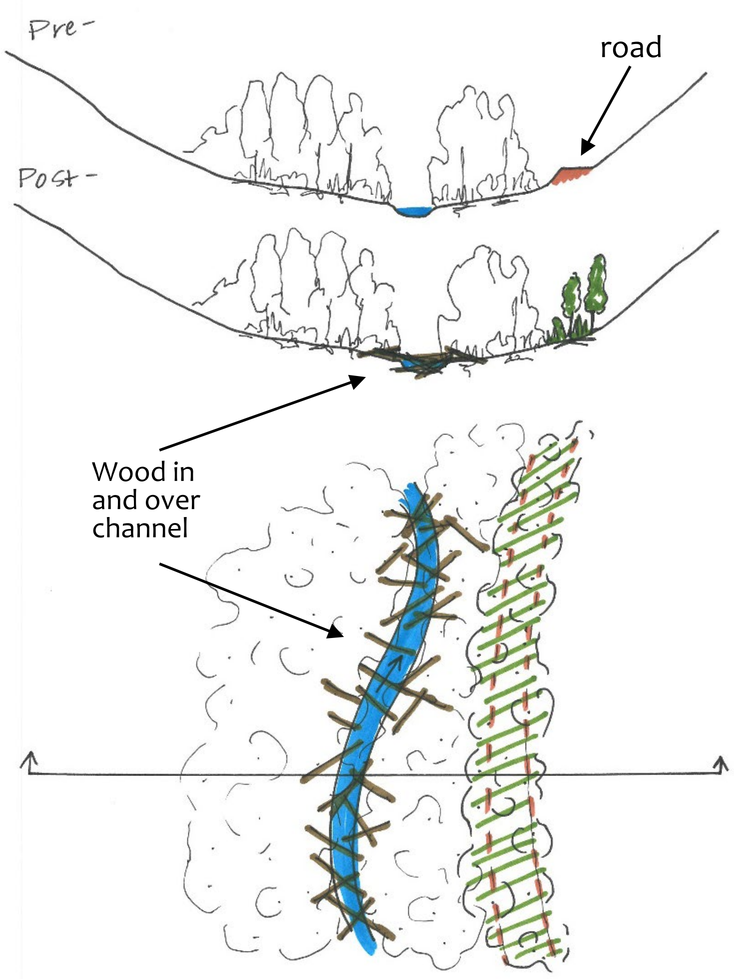
Questions To Address (Internally for Now)

- Characterization of passage barrier to define habitat ranking? All the time or at what flows? Juvenile salmonids spotted upstream
- Structure stability – flows, depths, velocity
- Depth to bedrock and options for stability
- Turn around points, material staging, dewatering
- Check notes – field ID of local habitat improvement areas

Previous (2018)

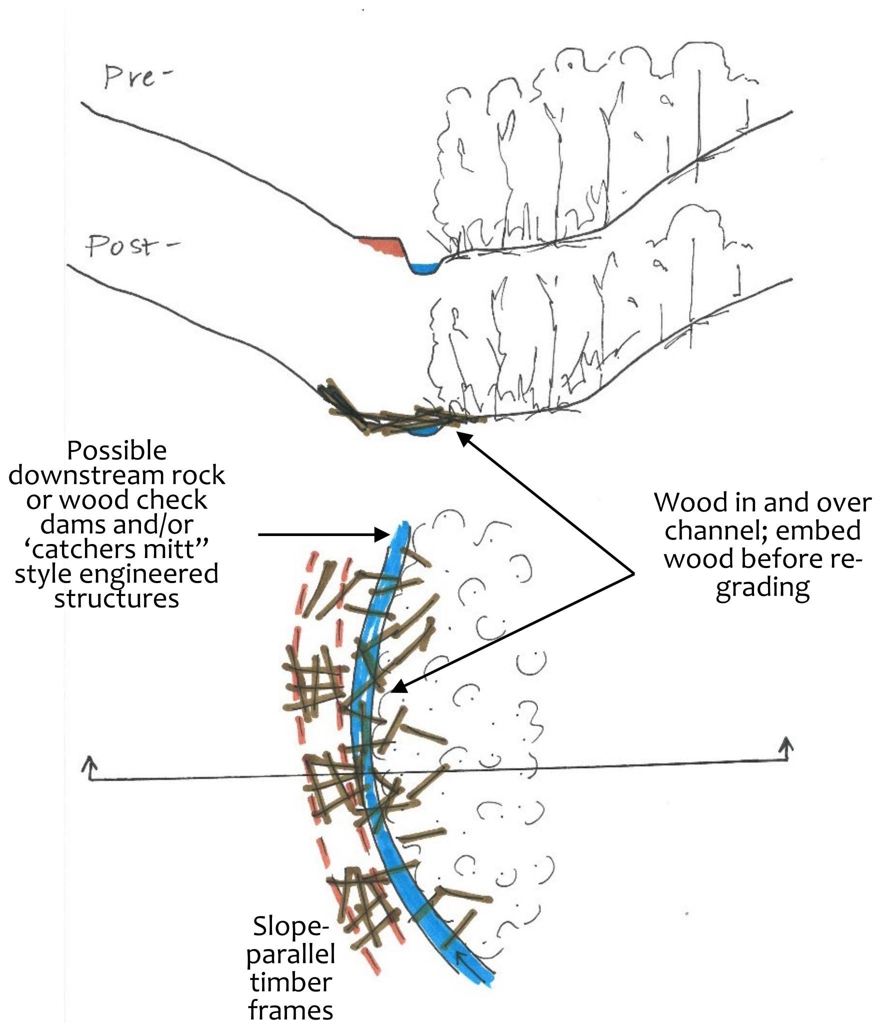
Treatment 1 – Large wood and slash to plug incised channel

- DS of Kings Creek, in wider sub-reaches where channel is away from road prism
- Goals: (1) raise incised channel
- Priority for water storage:
  - **medium** because high potential in wide areas of floodplain and low risk of loss of existing floodplain sediment with no action due to relatively dense floodplain vegetation
  - Prioritize within based on (1) wide sections, (2) low gradient sections, (3) more incision, (4) robust riparian vegetation
- Proposed actions:
  - Add large wood to channel and floodplain
  - Helicopter placement
  - Supplement w/ riparian felling where conditions allow
  - Rip road and replant (machine)



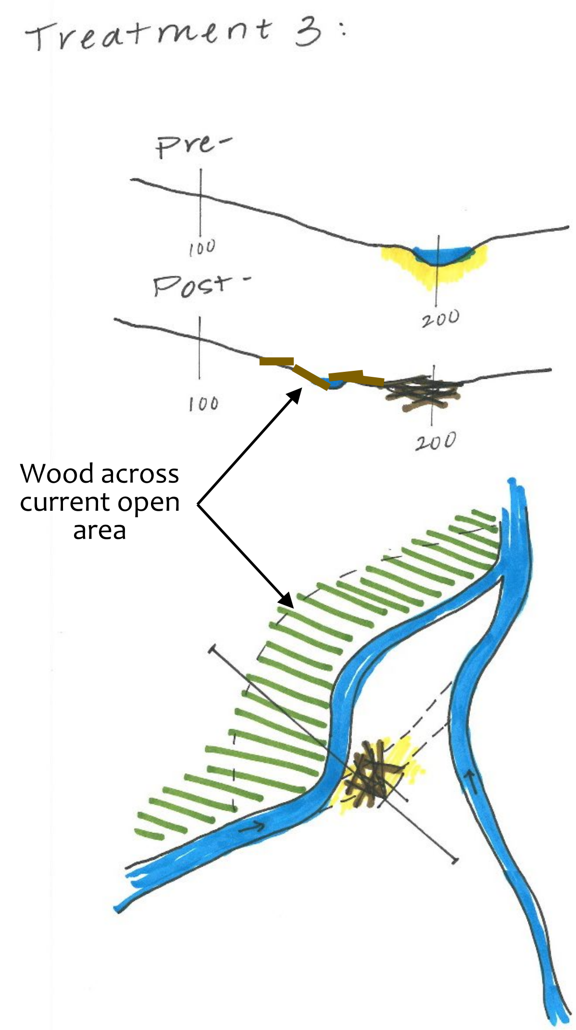
Treatment 2 – Stage 0 where Incised channel is laterally migrating into Road

- DS of Kings Creek, in wider sub-reaches where channel is adjacent to road prism
- Goals: (1) raise incised channel; (2) prevent erosion into/evacuation of road prism
- Priority for water storage:
  - **high** because high potential in wide areas of floodplain and high risk of evacuation of existing sediment (water storage) with no action
  - Prioritize within based on (1) wide sections, (2) low gradient sections, (3) more incision, (4) more lateral erosion/interaction w road
- Proposed actions:
  - Pull road prism into channel (machine access)
  - Add large wood to channel and road prism, bury some pieces in channel
  - Consider slope-parallel timber frame structure along previous road edge to establish vegetation and prevent undercutting of slope



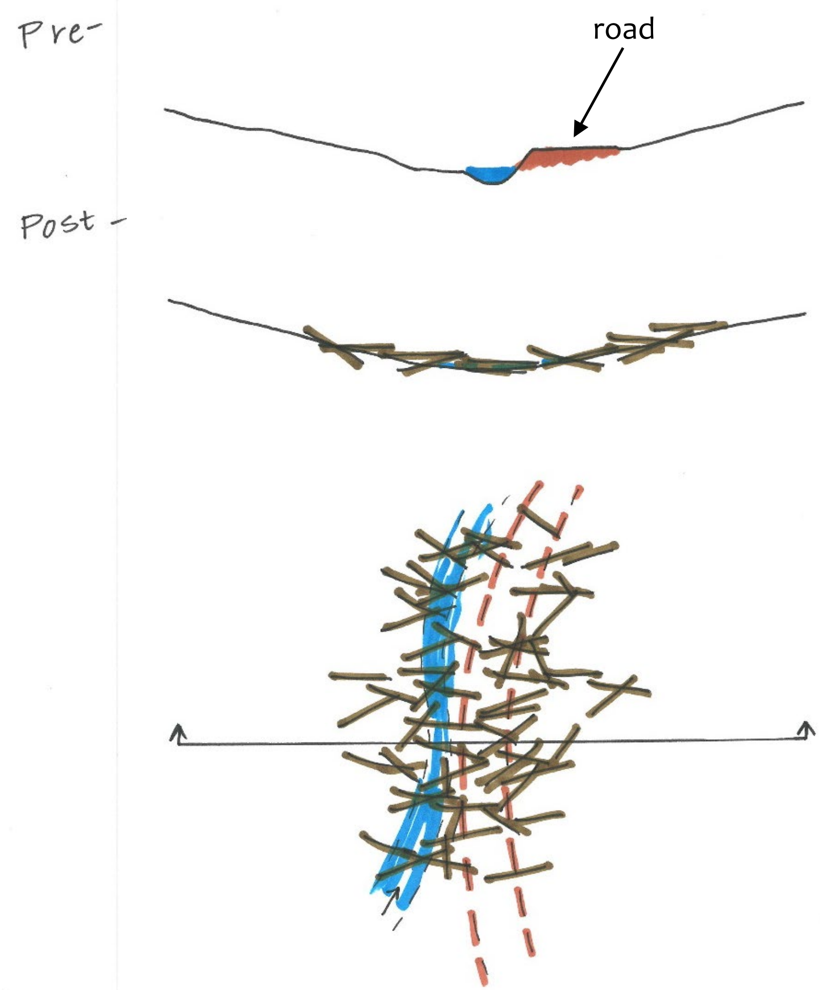
Treatment 3 – Stage 0 at confluence with Kings Creek

- Kings Creek, in section just upstream of confluence with EF Mission Ck
- Goals:
  - (1) Halt incision Kings Creek;
  - (2) raise incised channel
- Priority for water storage:
  - low-medium because less Q from Kings Creek, but high opportunity in wide area of floodplain
- Proposed actions:
  - Plug Kings Creek with large wood structure filled with slash
  - Roughen former staging area/road pull out with large wood
  - Roughen former Kings Creek channel and confluence to encourage development of new path in equilibrium with floodplain



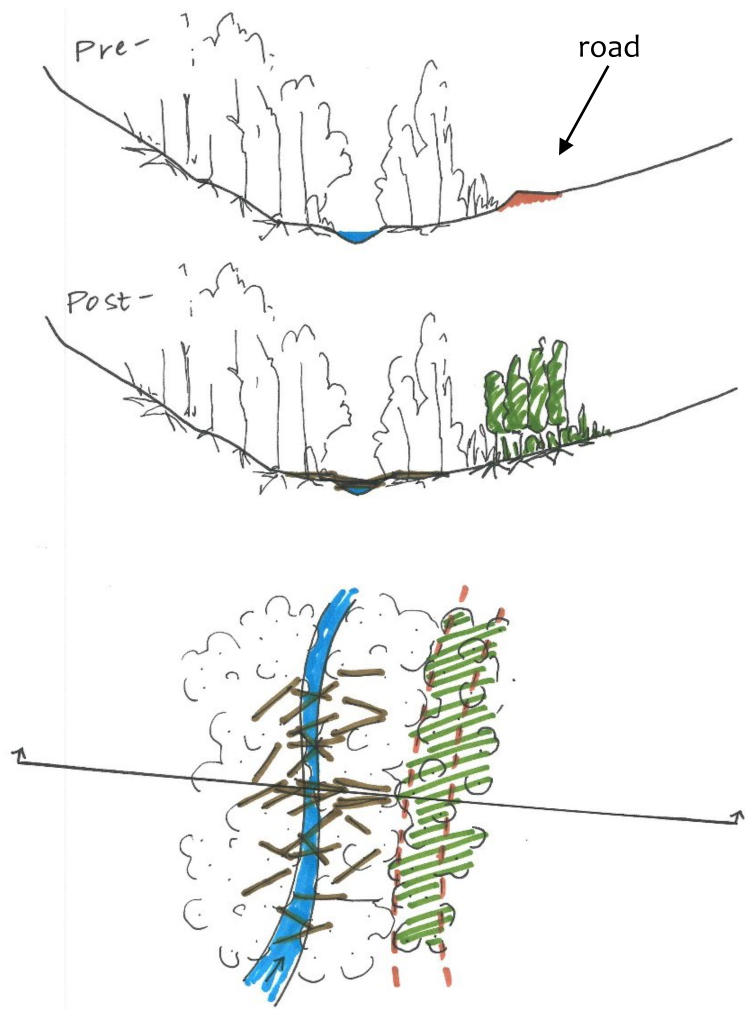
Treatment 4 – Stage 0 Approach to Road Decommissioning

- Sub-reaches immediately upstream and immediately downstream of Kings Creek, in sections where stream is flowing onto road prism
- Goals:
  - (1) Reduce risk of incision into road prism (loss of water storage);
  - (2) add hydraulic roughness to channel and valley
- Priority for water storage:
  - low-medium above Kings Creek and medium DS of Kings Creek because lower/higher Q and high risk of additional evacuation of sediment
- Proposed actions:
  - Pull road prism into channel; consider angle and avoid creating preferential flow paths
  - Place individual logs at moderate-high density in channel and valley



Treatment 5 – Road Decommissioning Plus

- Sub-reach upstream of Kings Creek, in sections where stream is below road prism
- Goals:
  - (1) Remove influence of road;
  - (2) add hydraulic roughness to channel and valley
- Priority for water storage:
  - lower because lower Q and lower risk of continued/accelerated incision
- Proposed actions:
  - Rip road prism and re-plant; consider angle and avoid creating preferential flow paths
  - Place individual logs at low-moderate density in valley
  - Consider beaver re-introduction

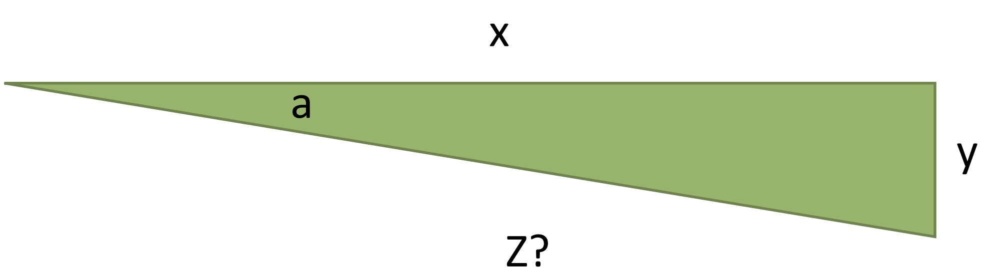


General – Wood loading density

- To re-aggrade bed, consider aggressive wood loading:
  - > 75th percentile of estimated reference condition
- Fox and Bolton (2007) for Ponderosa Forest:
  - > 29-35 key pieces per 100m (depending on bankfull width)
- Restoration logs are ~1/2 the length of reference condition key piece
- Consider ~70 log-truck size logs per 100m
- Assume 5 key pieces per structure based on channel size, need ~15 log truck logs per structure
- ~ 7 structures per 100m, or 1 structure per 14 m (47 feet)

General – Structure density

- Based on average gradient of 1.4%, what's the longitudinal influence of a 3' tall structure?
- Want continuous influence in the treatment reaches
- Z = 214 feet if structure height is 3 feet
- Z = 142 feet if structure height is 2 feet
- Therefore, structure placing of 47 feet may be redundant, depending on local slope; put some of wood loading to valley and floodplain



y/x = 0.014 = tan(a), solve for a

Y = 2 or 3 feet (structure height)

Z = Y/sin(a)

Reference Info

Hydrology

- Peak flows – Stream Stats

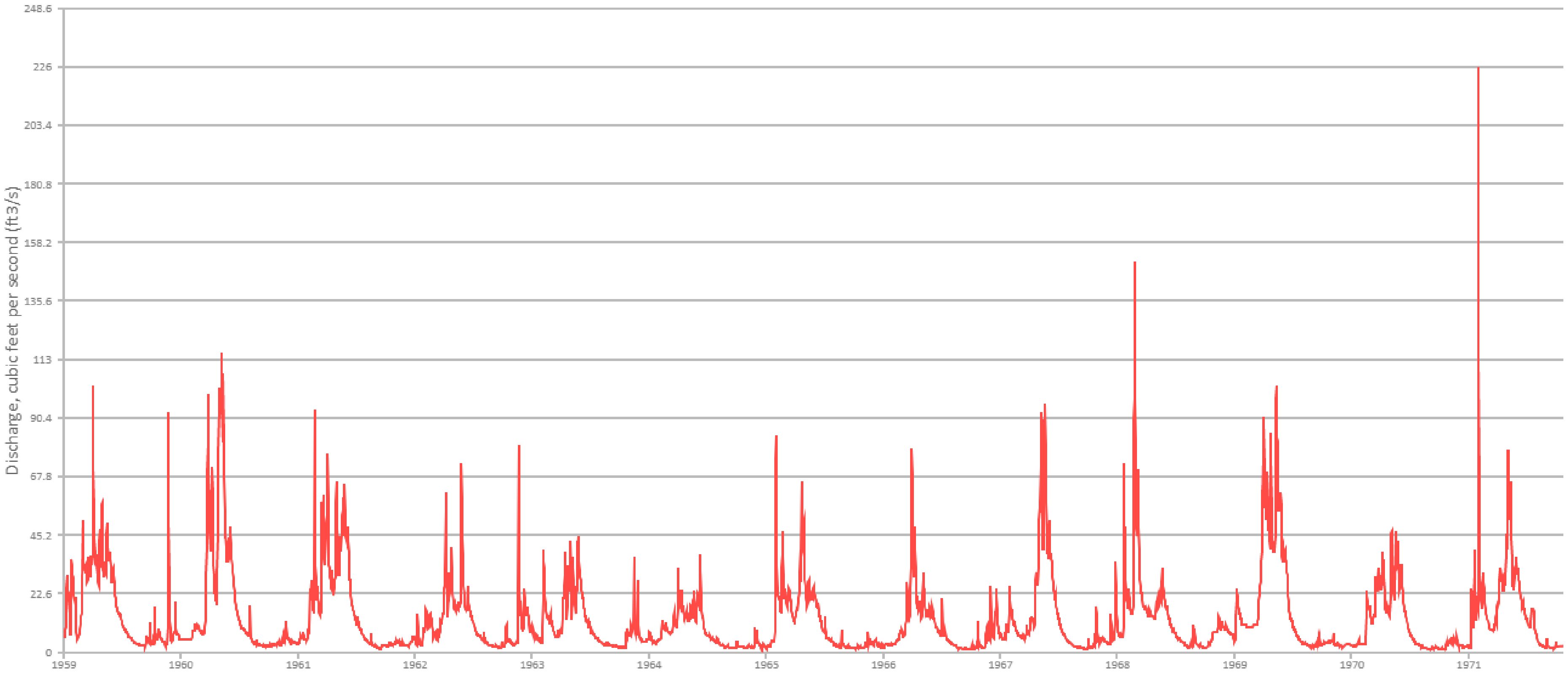
Peak-Flow Statistics Flow Report [Peak Region 2 2016 5118]

PII: Prediction Interval-Lower, Plu: Prediction Interval-Upper, SEp: Standard Error of Prediction, SE: Standard Error (other -- see report)

Statistic	Value	Unit	PII	Plu	SEp
2 Year Peak Flood	35.7	ft^3/s	11.6	110	77.2
5 Year Peak Flood	60.4	ft^3/s	21.7	168	69.1
10 Year Peak Flood	80.8	ft^3/s	27.9	234	72.2
25 Year Peak Flood	109	ft^3/s	34	351	81.2
50 Year Peak Flood	135	ft^3/s	38.3	473	89.2
100 Year Peak Flood	160	ft^3/s	41.9	612	96.9
200 Year Peak Flood	186	ft^3/s	44.3	776	106
500 Year Peak Flood	228	ft^3/s	48.3	1070	120

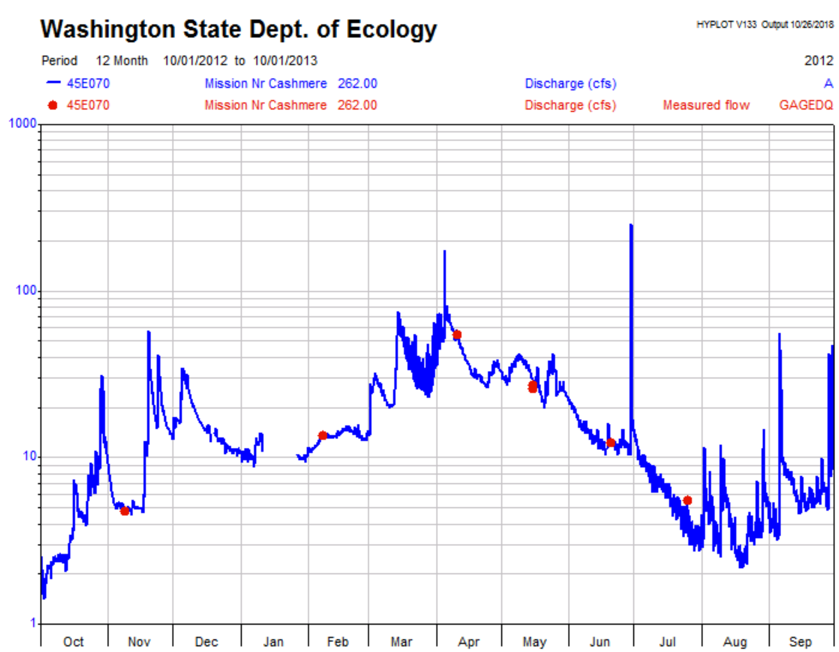
Hydrology

- Daily Flows – USGS Gage Abv Sand Creek, 1958-1977



Hydrology

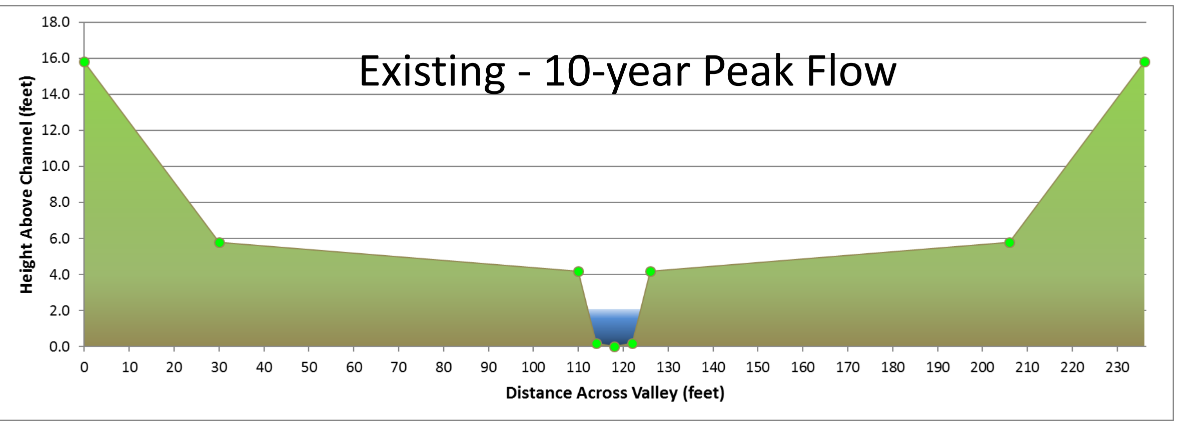
- Comparison to Devil's Gulch and potential for breach hydrology
- Peak flow on June 29, 2013



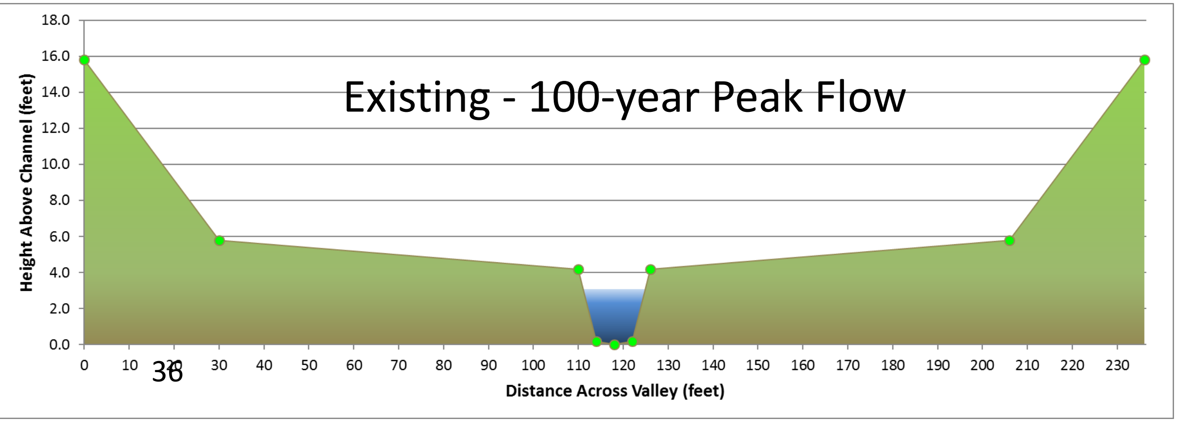
	EF Mission Ck	Mission Ck (Devil's Gulch)
Drainage Area (sq miles)	10.4	15.7
Mean Elev (ft)	3780	3940
Max Elev (ft)	6040	6840
Basin Avg 30-yr Mean Annual Ppt (inches)	24	29
% with slopes > 30%	74	86
% forested	63	58
100 year peak flow (regression-based)	160	302

Hydraulics

- At-a-section – existing conditions (n = 0.06 in channel, BFH = 4 ft)
- Flow generally in channel, velocities >= 4 ft/s

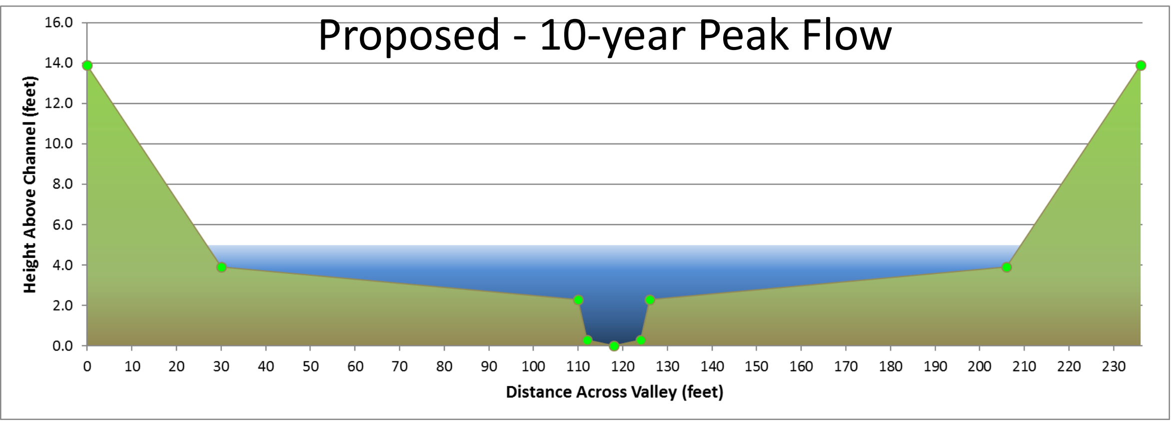


Q (cfs)	RI (yrs)	Vel (ft/s)	Shear (lbs/ ft2)
35	2	3.2	1.0
80	10	4.0	1.4
160	100	4.8	1.9



Hydraulics

- At-a-section – proposed conditions (n = 0.35 in channel, BFH = 2 ft)
- More flow overbank, reduced stream velocity
- Velocities drop below erodibility thresholds for vegetated surfaces (NRCS guidelines)



Q (cfs)	RI (yrs)	Vel (ft/s)	Shear (lbs/ft2)
35	2	**0.9**	2.1
80	10	**1.1**	3.0
160	100	**1.4**	3.9