APPROACHES TO DESIGNING AND CONSTRUCTING WOOD JAMS IN MANAGED TIMBERLAND SETTINGS IN NORTHERN CALIFORNIA

2018 Large Wood Technical Field School

Salmonid Restoration Federation

Trout Unlimited

- Ask yourself, why are you doing what your doing?
- What are your specific reach scale goals?
- How did you choose where to implement your project?
- Consider all the tools and techniques that are available to you…in other words, don't get stuck on one technique and employ it everywhere you happen to have access….
- Base your project on an analysis of the watersheds immediate and long term needs, informed by past, current, and future expected watershed disturbances…
- Keep in mind that the fundamental cause of many dysfunctional streams is that the system of wood recruitment and retention is broken, simply adding wood for habitat is not solving that problem, its treating a symptom.

THINK THINGS OUT, DON'T RUSH TO FAILURE OR WASTE LIMITED RESTORATION DOLLARS….

DEFINE YOUR RESTORATION APPROACH, AND HENCE YOUR PERFORMANCE OBJECTIVES, BY EXAMINING PAST LANDSCAPE DISTURBANCES AND THEIR IMPACTS

- What landscape disturbances has the stream been subjected to?
- How have those disturbances impacted the watershed?
- Are the disturbances ongoing, slowing down, or relicts from the past?
- How… or can, you mitigate the watershed impacts by installing wood jams?
- Define your objectives and recognize the associated risks….
- Defining your objectives will assure that you are implementing the best plan in the best location….
- What tools, loading, and anchoring techniques do you have at your disposal?

WOOD….ITS NOT JUST FOR HABITAT ANYMORE…

- What functions does wood perform in northern California stream channels?
  - Provides habitat
  - Provides roughness
  - Provides grade control
  - Provides bank protection
  - Provides durability for apex bar jams
  - Sorts bedload

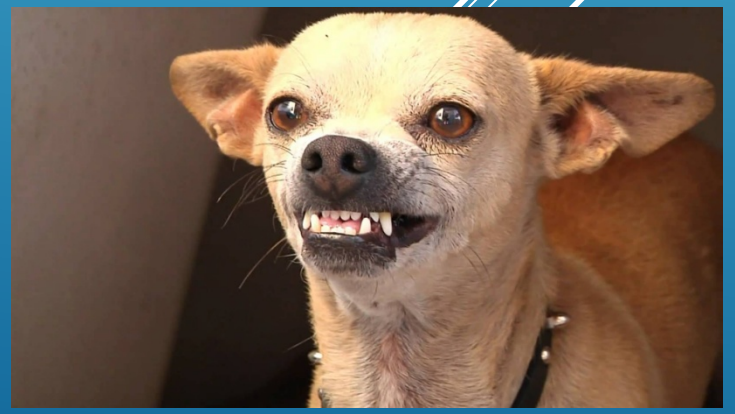
FUNDAMENTAL DISTURBANCES IMPACTING FORESTED WATERSHEDS

- Road Construction
  - Alters surface and ground water hydrology
  - Primary source of accelerated fine sediment delivery
  - Drains groundwater
- Stream Disturbance
  - Tractor logging
  - Stream clearing
  - Riparian disturbance/conversion
- Forest age and composition change

CUMULATIVE IMPACTS…AKA

(THE TRAGEDY OF THE COMMONS)
(DEATH BY A THOUSAND CUTS)
(MAULED BY A PACK OF CHIHUAHUA)

- Individuals acting independently and quasi-rationally according to each's self-interest behave contrary to the best interests of the whole group by depleting some common resource such as water volume, water quality, and fisheries resources



ROAD AND SKID TRAIL CONSTRUCTION

A QUICK CALCULATION

- The watershed is subjected to 7' (84") of rain per year
- Assume a watershed has 120 miles (633,600') of road
- The average road width is 12'
- The road system as a whole exhibits 50% hydrologic connectivity

- Calculate amount of rainfall that lands on the road
- (633,600' x 12') x 7' = 53,222,400 cu. ft. of water
- Calculate runoff
- 53,222,400 cu. ft. x 0.5 = 26,611,200 cu. ft. of water runoff from road
- Convert to gallons
- 26,611,200 cu. ft. x 7.48 gal./cu. ft. = 199,051,776 gallons per year

STREAM DISTURBANCE, ROAD CONSTRUCTION, AND FOREST AGE AND COMPOSITION CHANGE

REACH SCALE CHANNEL RESPONSES TO WATERSHED DISTURBANCES IN FORESTED LANDSCAPES

Initially you get one of two responses from watershed scale disturbances

- Channel Aggradation
- Channel Scour

Its what follows the initial channel response that often drives the most appropriate restoration actions

Let's look at a couple of scenarios

TWO CHANNEL EVOLUTION SCENARIOS

Two unique scenarios that result in an incised stream channel

Aggradation

Pre-disturbance conditions	Post-disturbance conditions	Post-disturbance adjustments
		
Stream hydrology, sediment supply, and natural wood recruitment system in balance	Channel aggridation from watershed disturbance	Post aggridation adjustment
Typical channel reach characteristics	**Typical channel reach characteristics**	**Typical channel reach characteristics**
-Floodplain frequently connected to stream -Wide variety of vertical channel structure (i.e. inset terraces, etc.) -Channel sinuous within the valley corridor -Riparian vegetation mature, flourishing, and conifer dominant -Riparian vegetation naturally recruiting mature conifers to stream	-Stream floods frequently and is unconfined -Lack of vertical channel structure -Channel unconfined and shallow -Riparian vegetation youthful and hardwood dominant -Riparian vegetation recruiting young hardwoods to stream	-Floodplain totally disconnected from channel -Lack of vertical channel structure -Channel totally confined -Lack of velocity refuge for fish -Riparian vegetation mature and hardwood dominant -Riparian vegetation recruiting older hardwoods to stream -Channel substrate coarse and angular

Incision

Pre-disturbance conditions	Post-disturbance conditions	Post-disturbance adjustments
		
Stream hydrology, sediment supply, and natural wood recruitment system in balance	Channel incision from a combination of increased peak runoff and stream clearing	Post incision adjustment slow to evolve
Typical channel reach characteristics	**Typical channel reach characteristics**	**Typical channel reach characteristics**
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AN INCISED STREAM CHANNEL THAT DEVELOPED AS A RESULT OF AGGRADATION AND SUBSEQUENT INCISION

SOME WOOD LOADING OBJECTIVES

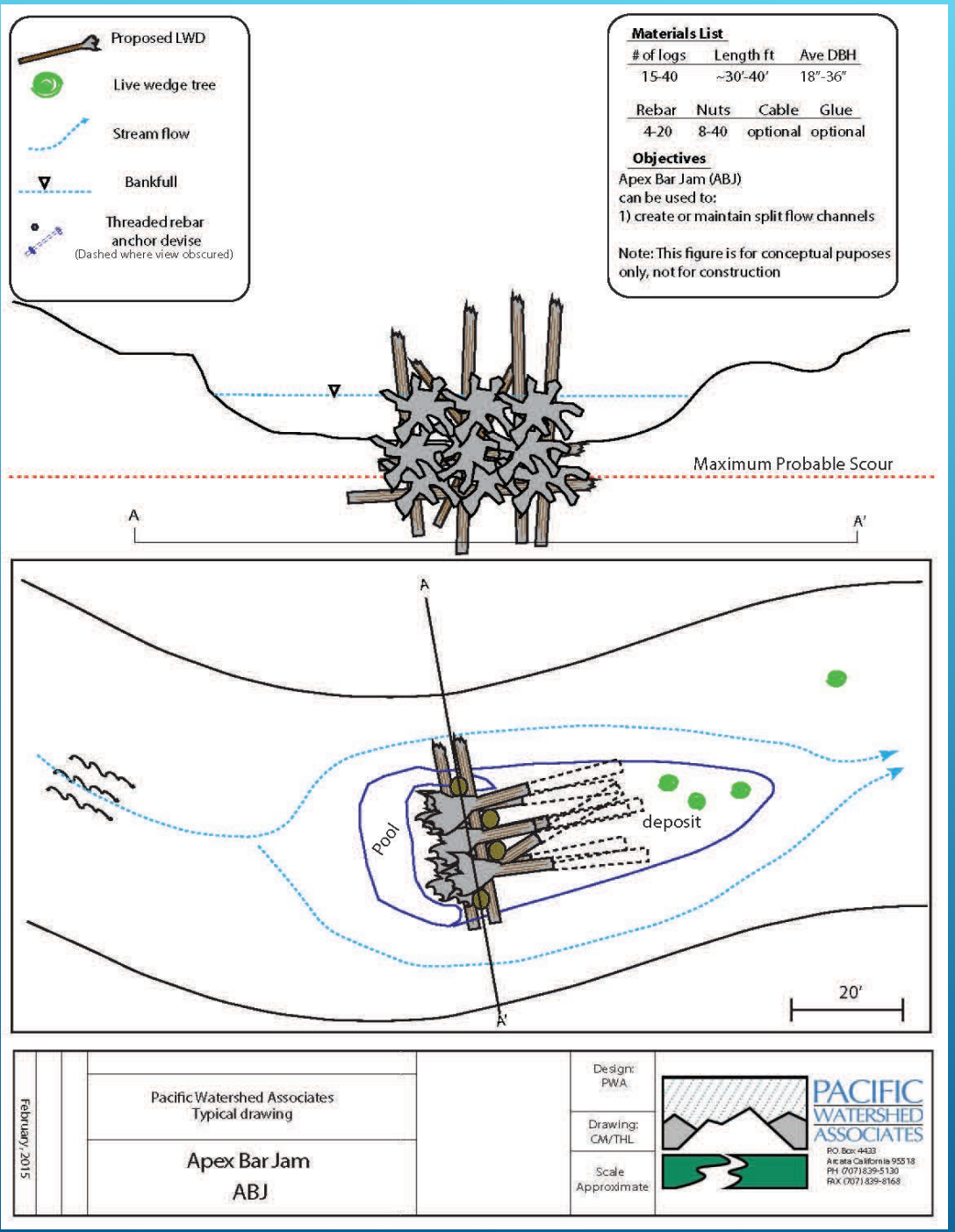
- Provide Habitat
  - Scour pools
  - Store gravel
  - Sort gravel
  - Velocity refuge
  - Provide cover
- Engineering
  - Provide grade control
  - Protect channel banks
  - Provide apex for mid-channel jams
- Reach scale fluvial geomorphology
  - Force lateral scour
  - Reach scale aggradation
  - Raise water surface elevations
  - Increase sinuosity
  - Slow channel reach velocities

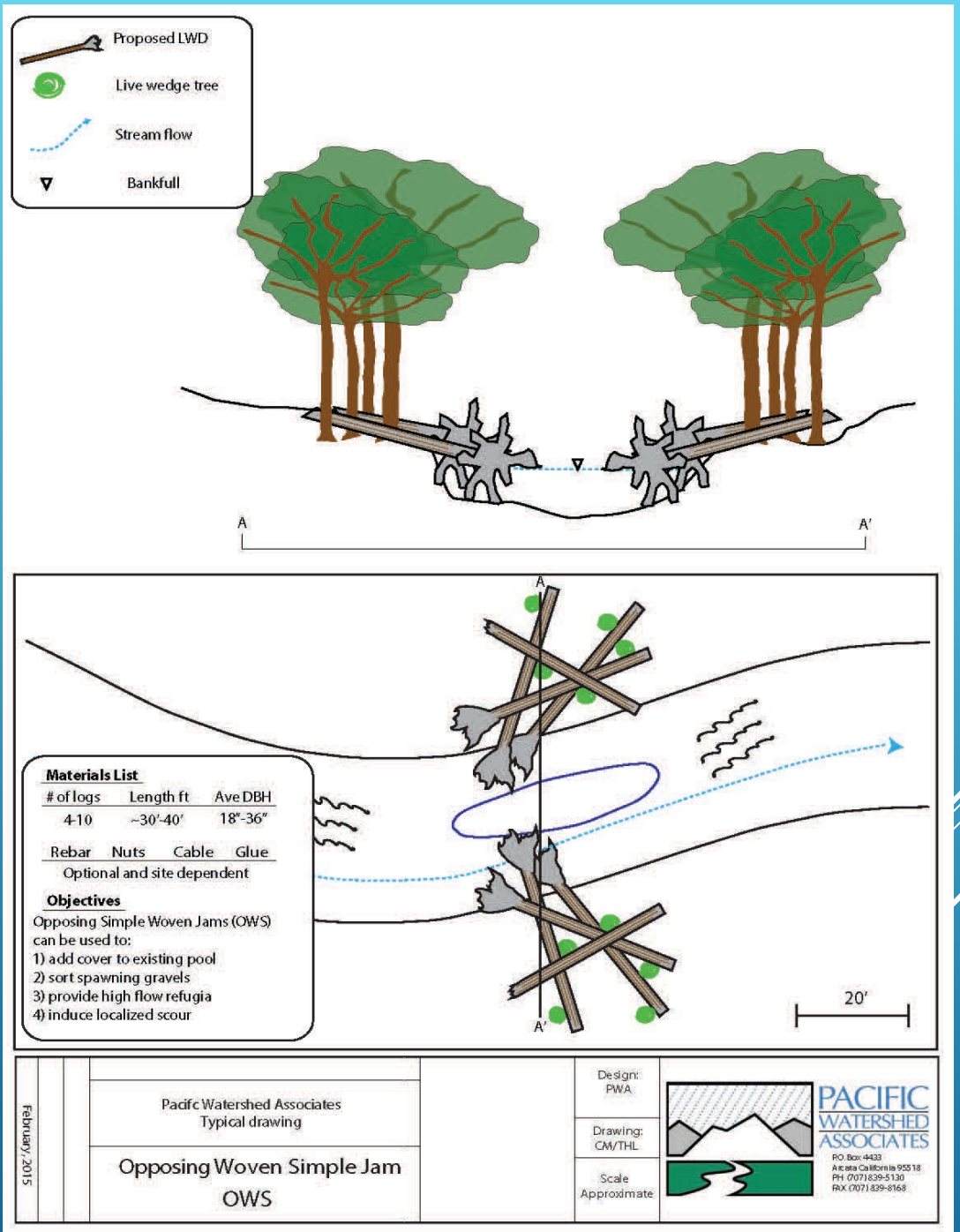
SOME INSTALLATION TECHNIQUES AND A FEW THOUGHTS

- Excavator with log tongs
  - Most versatile of all the techniques
- Grapple cat
  - Allows some directional log installs, good for moving trees
- Skidder
  - Allows some directional log installs, good for moving trees
- Chop and drop (accelerated recruitment)
  - Fast and cheap, outcomes less predictable, typically uses trees from riparian, can be employed where heavy equipment cannot get to
- Helicopter
  - Expensive, can move big trees, can be employed where heavy equipment cannot get to
- Hand crews (CCC style)
  - Can integrate with other installation techniques well, can be employed where heavy equipment cannot get to
- Yoder
  - Relatively slow and expensive, can minimize riparian disturbance

SOME JAM ANCHORING TECHNIQUES

- Wedging
- Trenching
- Bolting
- 1.5-2.0 x Bankfull width
- Bank injection
- Pile driving
- Ballasting


Proposed LWD
Live wedge tree
Stream flow
Bankfull
Threaded rebar anchor devise
(Dashed where view obscured)
Materials List
# of logs Length ft Ave DBH
15-40 ~30'-40' 18"-36"
Rebar Nuts Cable Glue
4-20 8-40 optional optional
Objectives
Apex Bar Jam (ABJ)
can be used to:
1) create or maintain split flow channels
Note: This figure is for conceptual puposes only, not for construction
Maximum Probable Scour
A
A'
Pool
deposit
20'
Pacific Watershed Associates
Typical drawing
Apex Bar Jam
ABJ
February, 2015
Design: PWA
Drawing: CM/THL
Scale Approximate
PACIFIC WATERSHED ASSOCIATES
P.O. Box 4433
Arcata California 95518
PH (707)839-5130
FAX (707)839-8168


Proposed LWD
Live wedge tree
Stream flow
Bankfull
A
A'
Materials List
# of logs Length ft Ave DBH
4-10 ~30'-40' 18"-36"
Rebar Nuts Cable Glue
Optional and site dependent
Objectives
Opposing Simple Woven Jams (OWS)
can be used to:
1) add cover to existing pool
2) sort spawning gravels
3) provide high flow refugia
4) induce localized scour
20'
Pacifc Watershed Associates
Typical drawing
Opposing Woven Simple Jam
OWS
February, 2015
Design: PWA
Drawing: CM/THL
Scale Approximate
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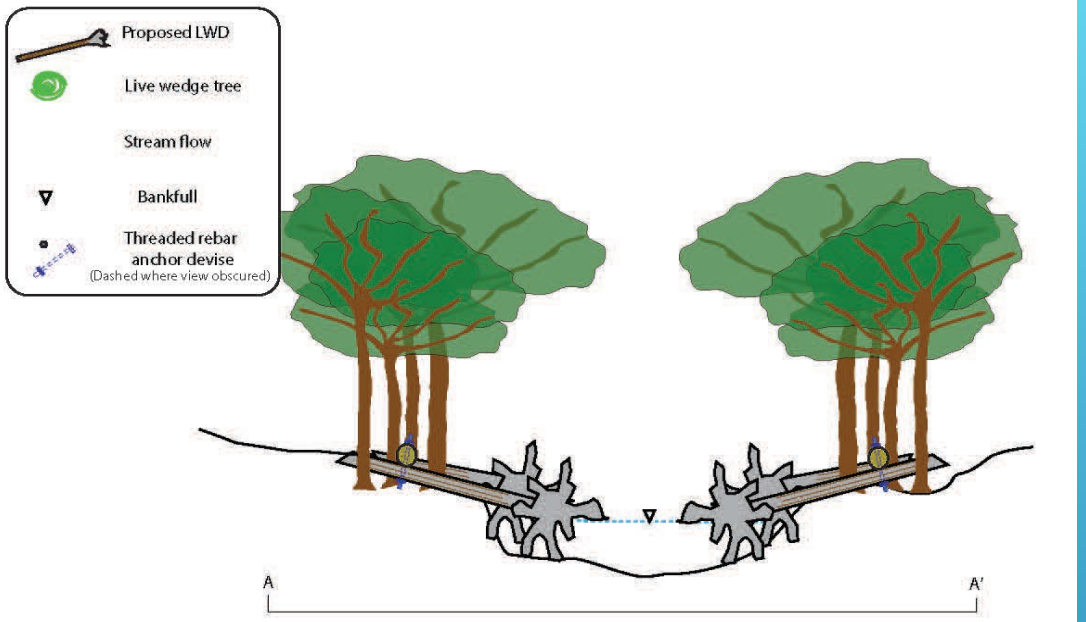

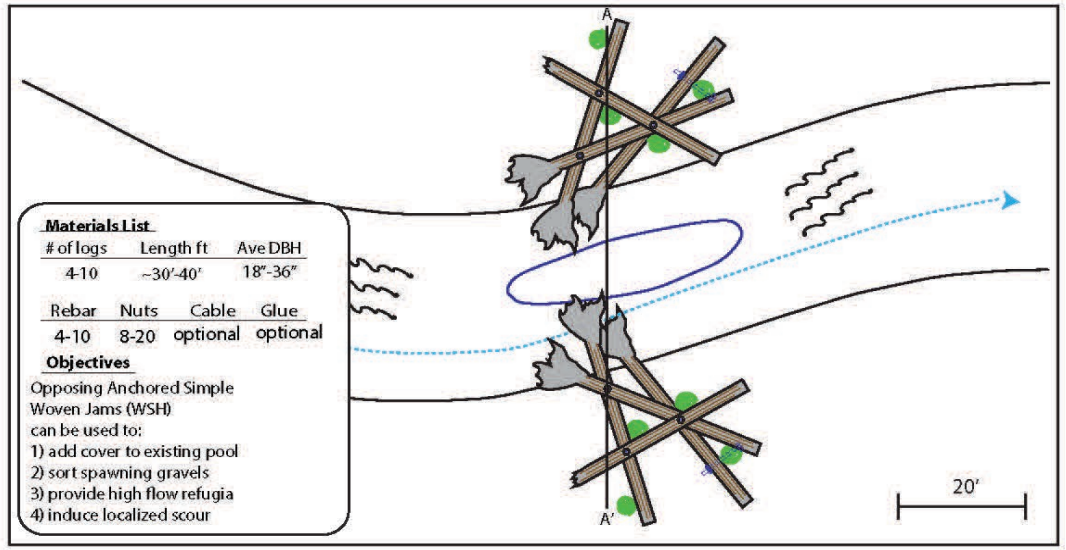

February, 2015

Pacifc Watershed Associates
Typical drawing

Opposing woven Simple Jam
(Anchored)
OWSH

Design: PWA
Drawing: CM/THL
Scale Approximate

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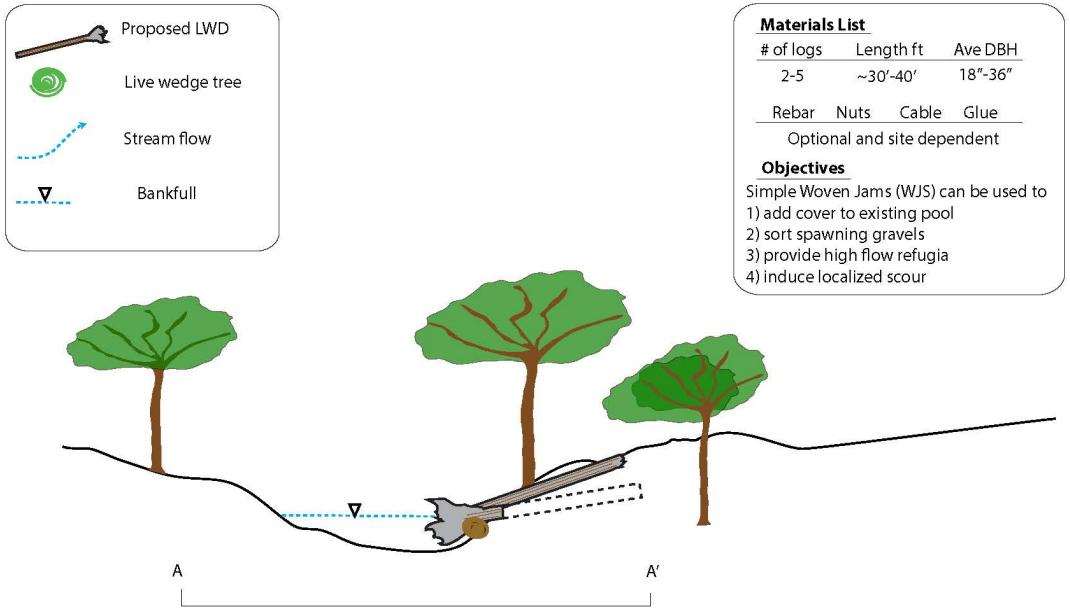

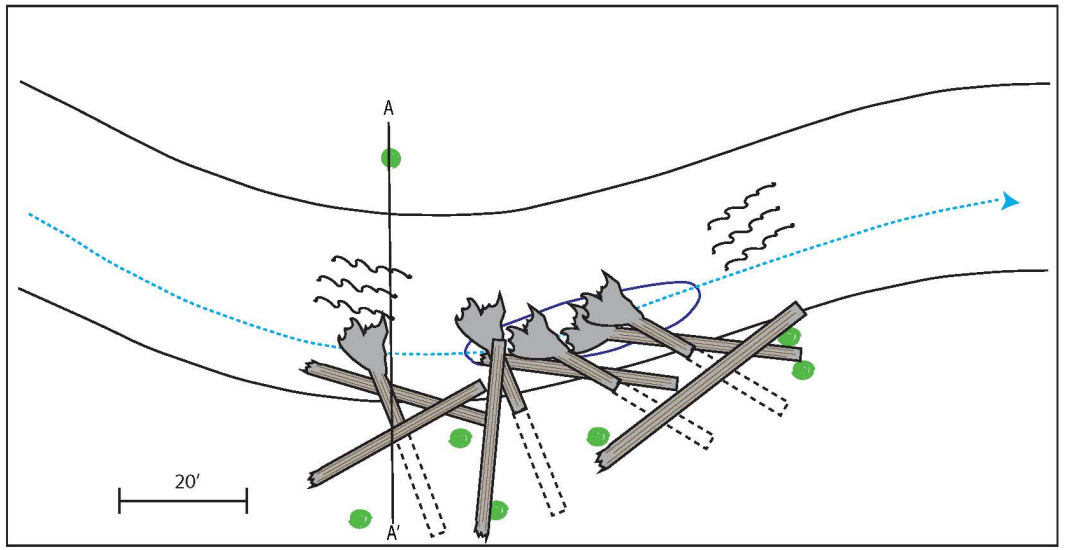

February, 2015

Pacifc Watershed Associates
Typical drawing

Complex trenched unanchored jam
TC

Design: PWA
Drawing: CM
Scale Approximate

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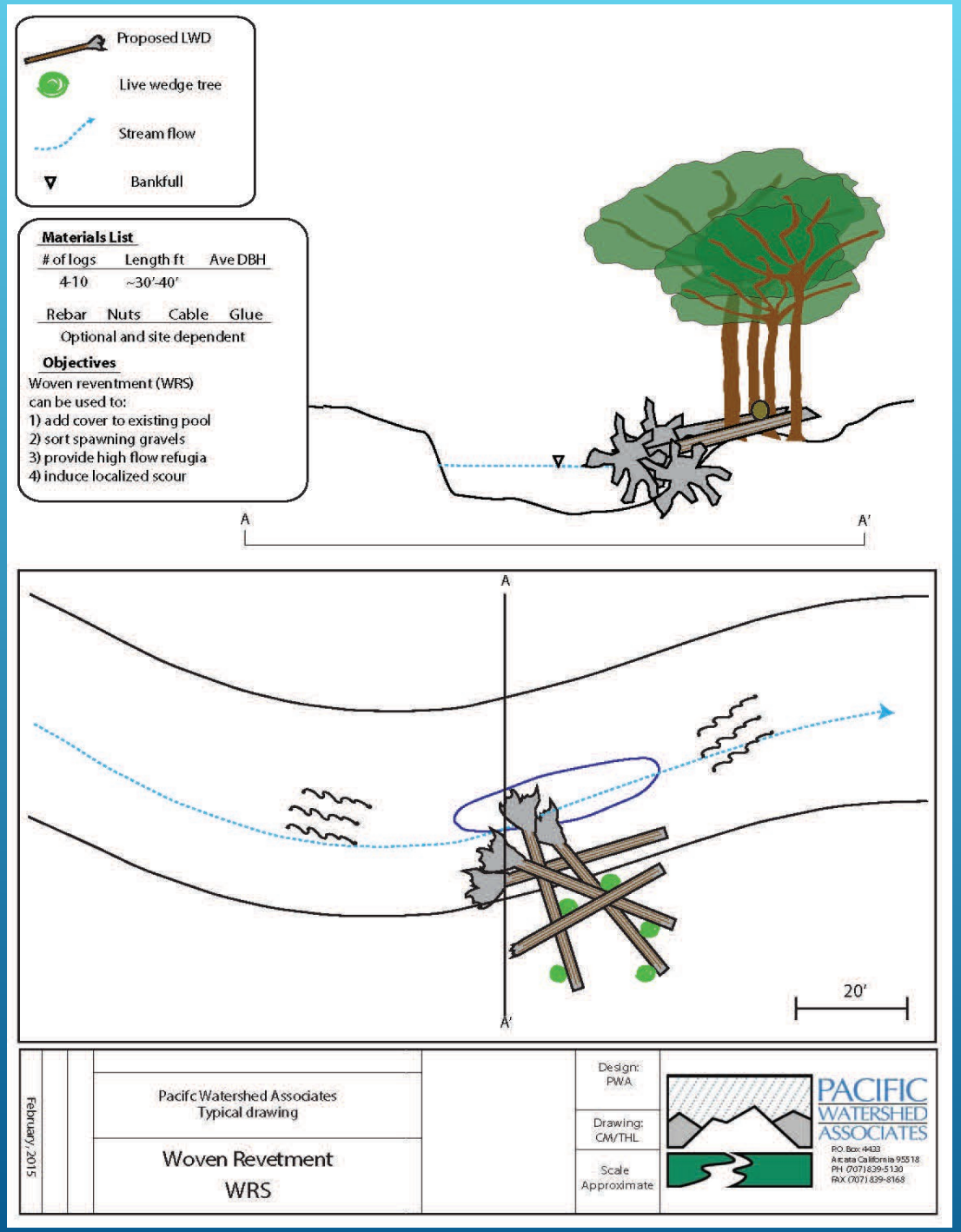


DON'T FORGET REVETMENTS!

LETS LOOK AT A FEW CASE STUDIES…

……

ANDERSON CREEK

ANDERSON CREEK PRE-IMPLEMENTATION CONDITIONS

- **Watershed Impacts**
  - Heavily logged repeatedly between 1900 and 1990
  - Significant road construction
  - Tractor logging in stream corridors
  - Stream clearing between 1970 and 1980s
  - Riparian converted from old growth redwood and fir to alder dominant
  - Several significant logs jams exist within the stream corridor
- **Unique Conditions**
  - Pleistocene/Holocene fluvial terrace transitions from 40' above the current channel to 0' above the channel over a distance of 3.5 miles

LOWER ANDERSON CREEK PRE IMPLEMENTATION CONDITIONS

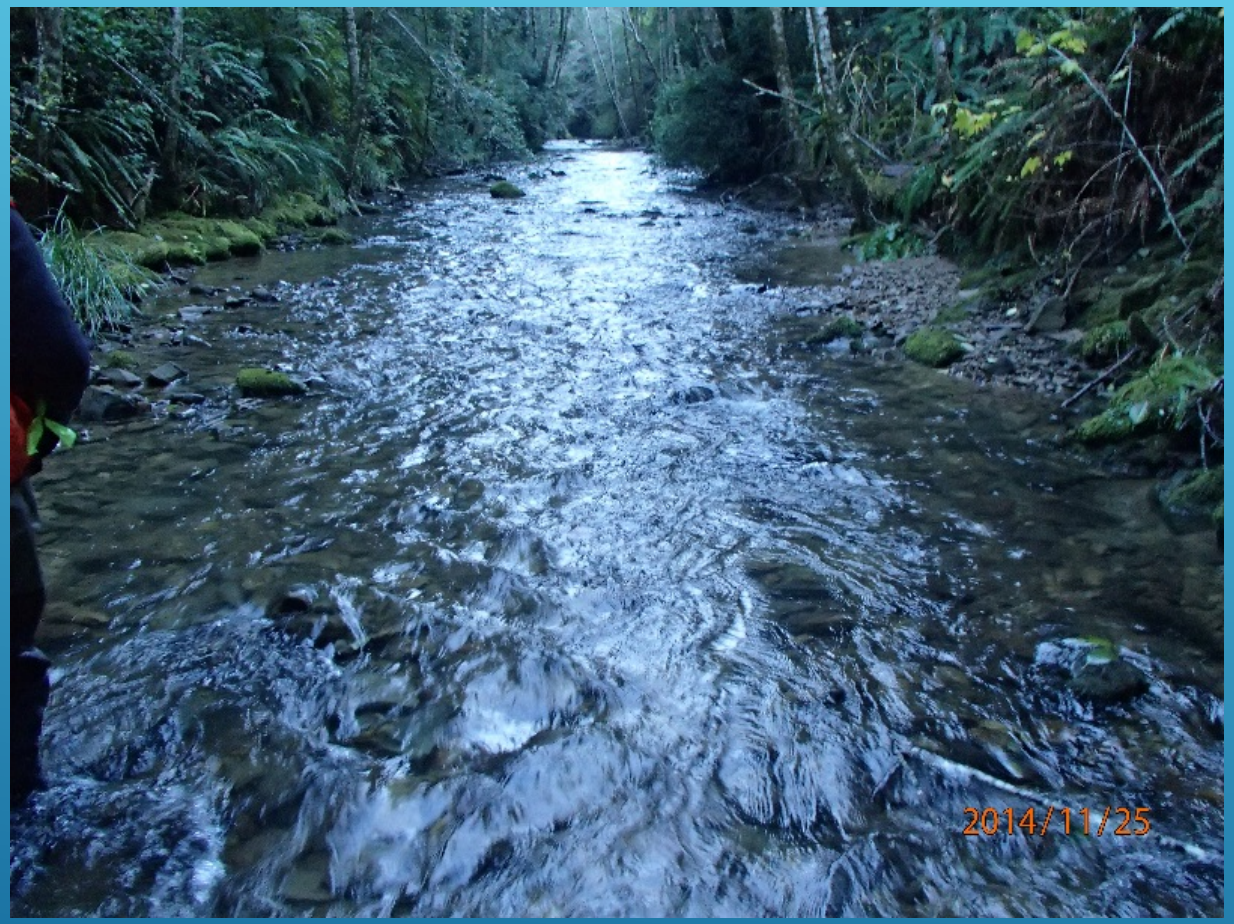
UPPER ANDERSON CREEK PRE IMPLEMENTATION CONDITIONS

ANDERSON CREEK SITE A1 (LOWER STREAM REACH)

Feature A1 before looking UPS facing South

Feature A1 After looking UPS at right bank

ANDERSON CREEK SITE A2 (LOWER STREAM REACH)



Feature A2 Before looking DNS facing south

Feature A2 After looking DNS

ANDERSON CREEK SITE A2-3 (MIDDLE STREAM REACH)

Feature 2-3 before looking upstream

Feature 2-3 after looking upstream

ANDERSON CREEK PRE-IMPLEMENTATION CONDITIONS (UPPER STREAM REACH)

ANDERSON CREEK PRE-IMPLEMENTATION CONDITIONS (UPPER STREAM REACH)

ANDERSON CREEK POST-IMPLEMENTATION CONDITIONS (UPPER STREAM REACH)

LITTLE NORTH FORK NOYO PRE-IMPLEMENTATION CONDITIONS

- **Watershed Impacts**
  - Heavily logged repeatedly between 1900 and 1990
  - Significant road construction
  - Tractor logging in stream corridors
  - Stream clearing between 1970 and 1980s
  - Riparian converted from old growth redwood and fir to alder dominant
  - Several significant logs jams exist within the stream corridor
  - Stream corridor almost completely filled with anthropogenic sedimentation
- **Unique Conditions**
  - Upper stream reach heavily aggraded, lower stream reach heavily incised, reaches separated by a migrating headcut

LITTLE NORTH FORK NOYO PRE-IMPLEMENTATION CONDITIONS

Upper reach

Lower reach

LITTLE NORTH FORK NOYO PRE-IMPLEMENTATION CONDITIONS

The headcut separating the upper and lower stream reaches

LITTLE NORTH FORK NOYO POST-IMPLEMENTATION CONDITIONS

CONCLUSIONS AND TIDBITS OF UNSOLICITED ADVISE

- Use all the tools and techniques available to you, don't just apply one technique your comfortable with where you can procure access (If a hammer is your only tool, every problem looks like a nail).....
- Define your project objectives based on the watershed conditions and construct your jams to meet those objectives, it might be a mistake to simply say "I'm creating fish habitat". Think about both feature specific and reach specific objectives....
- Only procure existing conifers from the riparian corridor (that would otherwise fall in the stream naturally at a later date) if you really need to. Remember your over arching goal should be to fix the broken system of wood recruitment and retention).....
- Fir logs are a better choice than redwood for key logs....
- Keep the root wads on your trees, it makes them heavier and creates more roughness and complexity in the stream....
- An excavator with a thumb and log tongs allows you to create effective wood jams on both sides of the stream channel and allows for trench anchoring....

CONCLUSIONS AND TIDBITS OF UNSOLICITED ADVISE

- Construct jams at the base of riffles to maximize stream power, adding wood to existing pools may cause sedimentation…
- Construct jams using existing stable wood where possible….
- Mimic wood size, orientation, and function for your watershed and stream reach…..
- Determine why you are observing channel incision, and construct jams accordingly….
- Understand all of your projects associated risks and mitigate for them appropriately…
- Wear a hardhat, don't be stupid…..Trees branches can fall hours after harvesting….
- Try to anchor without hardware if possible, its really just more garbage in the stream….
- Construct jams to adjust vertically