5A. Site Assessment: Field Measurements and Interpretations

Initial Assessment, Reference Reach, Roadway Considerations, Site Maps, Planform Characteristics, Longitudinal Profile

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Acknowledgements
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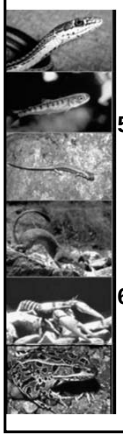
Stream Simulation Site Assessment Process



- **Initial Site Assessment (Phase 1)**
- Site Assessment (Phase 2)

5A
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6A
- Channel Cross Sections
- Characterizing Channel-Bed Sediments and Channel-Bank Material
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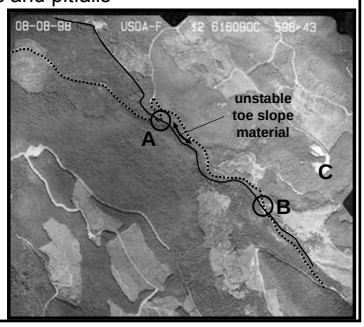
What is the purpose of the initial site assessment?

- Provides a large-scale view by putting the road-stream crossing (site specific) in the context of the larger watershed and past/present/future management activities
- Necessary to develop realistic project objectives
- Minimizes potential errors and pitfalls



Initial Site Assessment

- Are there large-scale events that can affect our site?
  - Geologic and watershed processes (e.g., glaciation, landslides, fire, earthquakes, floods, river base level adjustments, etc.)
  - Management activities (e.g., grazing, timber harvests, water diversions, dams, ski resorts, etc.)
- How valuable is the aquatic resource at the site within the context of the watershed?
  - Aquatic organisms present
  - Threatened and endangered species
  - Extent and quality of habitat
- What are the road issues?
  - Maintenance history
  - Right of way concerns
  - Type of vehicle use
- Are there other factors and concerns known about the site?
  - Recent floods, floodplain constriction, channel stability, etc.

Large Scale Data for Initial Site Assessment

Watershed Information
- Past/Present/Future Management Activities
- Road History
- Geology, Soils, Vegetation of Area
- Flood Hydrology
- Slope Stability/Hazard Assessment
- Air Photo Interpretation

Channel Information
- Channel Types
- Channel Stability
- Large Woody Debris

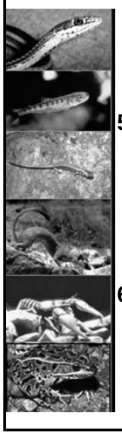
Biological Information
- Organisms Present
- Extent of Habitat
- Quality of Habitat

Possible Information Sources
- USGS Publications
- NRCS Publications
- Research Publications
- MS Theses, PhD Dissertations
- Watershed Analyses
- Access Travel Management Plans
- Stream Surveys
- Habitat, Spawning Surveys

Initial Site Assessment

Develop preliminary objectives
- Provide unimpeded passage for fish and other aquatic organisms
- Reduce chronic debris accumulation at structure inlet
- Reduce long-term road maintenance costs
- Restore and maintain floodplain continuity and function
- Accommodate lateral channel migration
- Provide terrestrial wildlife passage
- Restore degraded channel
- Prevent upstream progression of headcut

Stream Simulation Site Assessment Process



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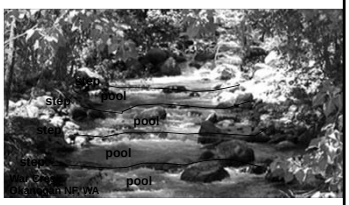
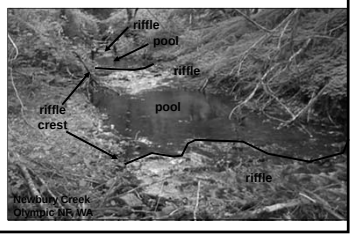
What is the purpose of the reference reach?

- **Provides a template of channel/floodplain dimensions, features, and sediment characteristics along a stable, representative reach of the channel that can be used to develop a design channel through the road-stream crossing.**
- **Developing a design channel gradient, cross section shape, bedform spacing, and bed/bank sediment characteristics through the road-stream crossing that is similar to those of the stable, nearby reference reach allows for natural fluvial processes to operate through the structure and provide unimpeded aquatic organism passage.**



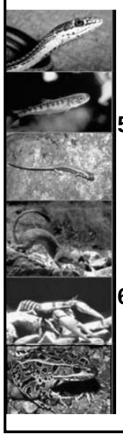


Selecting a Preliminary Reference Reach

- **The reference is typically selected upstream from the road-stream crossings, but a downstream reference reach can be selected depending on site conditions.**
- **Should be outside the influence of the existing culvert, but within 20 to 30 channel widths of the crossing inlet and outlet.**
- **The gradient and length of the design channel through the structure should be similar to those in the reference reach.**

During the collection of data for the site assessment, we are making the first attempt at determining the reference reach. The preliminary reference reach selected needs to be verified (or a new reference reach selected) after the longitudinal profile, channel cross sections, and channel-bed sediments, and channel pattern are analyzed and interpreted.

Stream Simulation Site Assessment Process



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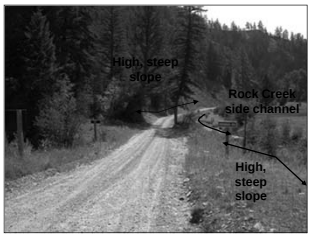
What is the purpose of considering the roadway?

- **Need to know the type of vehicle use, utilities near the site, property boundaries near the site, material staging areas, etc. to understand constraints during construction and for reconfiguring the roadway.**
- **Information is critical in order to assess whether the road alignment, road grade, road width, and fill height can be changed to improve the culvert/stream alignment and/or reduce the length of the structure**



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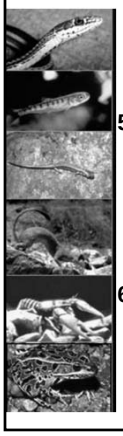

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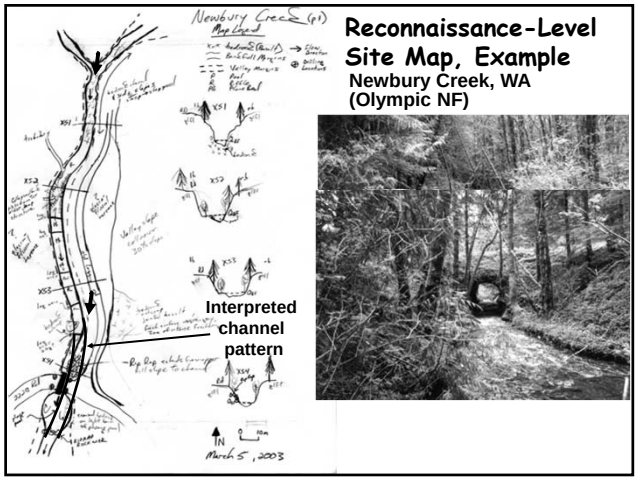
What is the Purpose of the Reach-Scale Site Maps? (Geomorphic sketch and Topo)

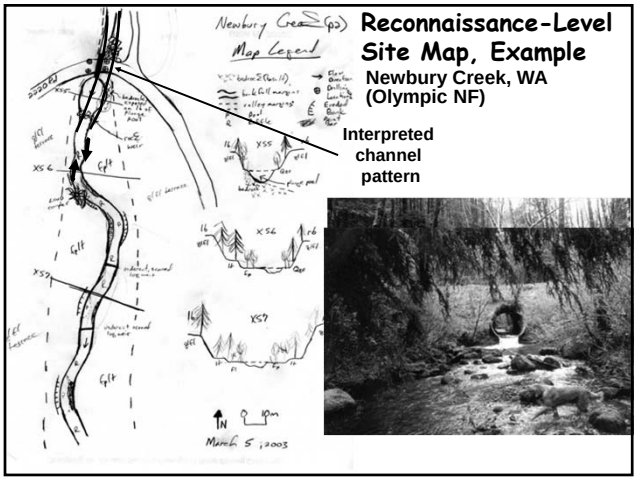
- Characterizes and documents the spatial distribution of channel/floodplain features and their relation to the road crossing.
- The alignment of the channel and road can be evaluated. Provides a template for considering channel and road realignment options.
- The lateral migration characteristics of the channel can be evaluated (channel migration zone).
- Required for structure designs at road-stream crossings and assists in subsurface investigations at the site.

Reconnaissance-Level Site Maps

- Sketch map that illustrates the spatial relationship of geomorphic features, road characteristics, and their relation to each other.
- Great way to identify features to be surveyed and for labeling of features described in field notes and in photographs.
- Geomorphic Features: Channel pattern, channel units, key grade control features, large woody debris, floodplain, terraces, valley wall, channel bars, vegetation changes, gravel bars, eroding banks, bankline pattern, etc.
- Engineering Features: Road alignment, road curvature, ditchline, inlet and outlet characteristics of existing structure, potential temporary roads and storage areas, hazard trees, utilities, property boundaries, etc.
- Great way to share pertinent site information with various specialists involved in the project.



Reconnaissance-Level Site Map, Example
Newbury Creek, WA (Olympic NF)

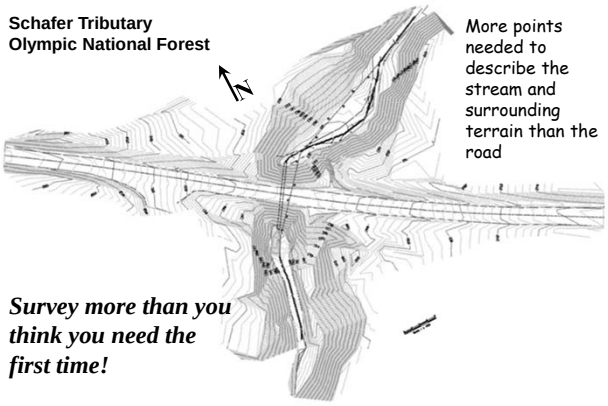


Reconnaissance-Level Site Map, Example
Newbury Creek, WA (Olympic NF)

Engineering Map: Topographic Surveys

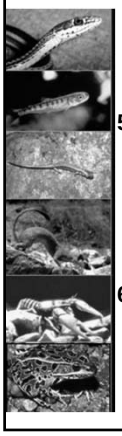
- **Detailed survey of features identified on the reconnaissance-level map (3-10 mm accuracy)**
- **Needed for determining best horizontal and vertical alignments for the road and stream/structure**
- **Needed for developing contract quantities**
- **Dimensions of existing culvert are surveyed**
- **Road surface centerline, shoulders, and ditchline are surveyed**
- **Benchmarks and reference points are established and surveyed**
- **Utilities, property lines, hazard trees, etc. are surveyed**
- **Channel features (thalweg, waters edge, lower channel banks, upper channel banks, foot of valley slope or terraces, key grade control features, cross section locations, etc.) should be surveyed farther than the anticipated regrade upstream and downstream from crossing**

Example of an Engineering Topographic Map



Survey more than you think you need the first time!

Stream Simulation Site Assessment Process



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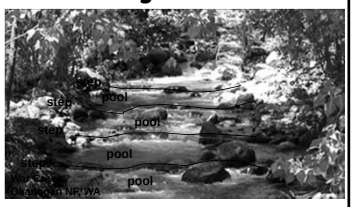
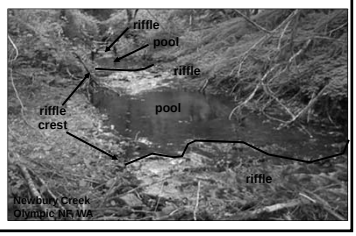
What is the Purpose of a Longitudinal Profile?

- **Establishes natural channel gradient characteristics (average and variability)**
- **Delineates channel grade controls upstream/downstream from the road crossing (both natural and human)**
- **Establishes the spacing and length of channel units**
- **Determines the elevation difference of the channel immediately upstream and downstream from the "undersized" pipe.**
- **Identifies the vertical adjustment potential of the channel (scour depth and potential aggradation surfaces).**
- **Determines the design channel gradient through the crossing (structure profile and invert elevations).**

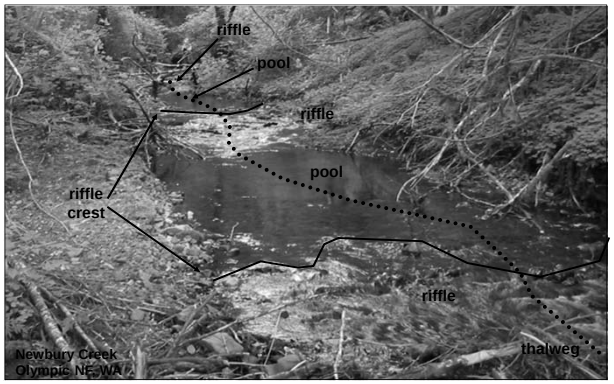
Typical Measuring Points for a Longitudinal Profile

- Beginning, end, and maximum depth of pools.
- Crest and base of cobble, boulder, and LWD steps.
- Beginning and end of riffles, runs, lag deposits.
- Top and base of steps (LWD or rock), transverse ribs.
- Bedrock exposures: Falls, ledges, etc.
- Beginning and end of reach/channel types and other points of interest (changes in bed material size, gradations, forcing features, etc.).

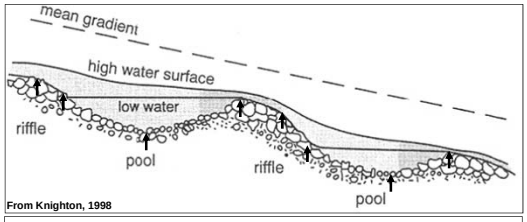




Longitudinal Profile: Pool-Riffle Channel



Typical Measuring Points of a Longitudinal Profile for a Pool-Riffle Channel



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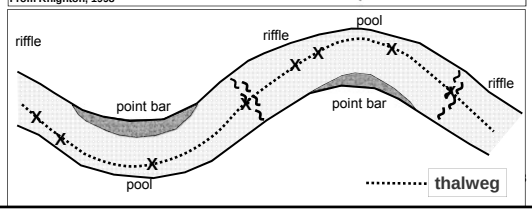
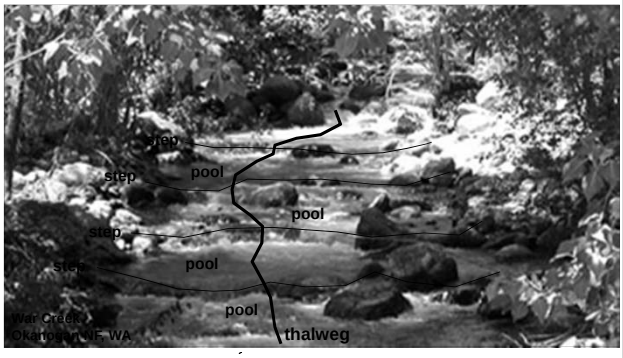
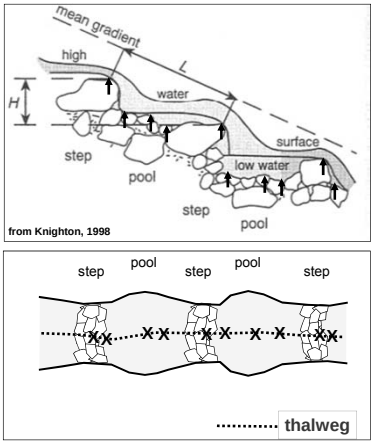


Longitudinal Profile: Step-Pool Channel (Rosgen A, B, G)





Typical Measuring Points of a Longitudinal Profile for a Step-Pool Channel

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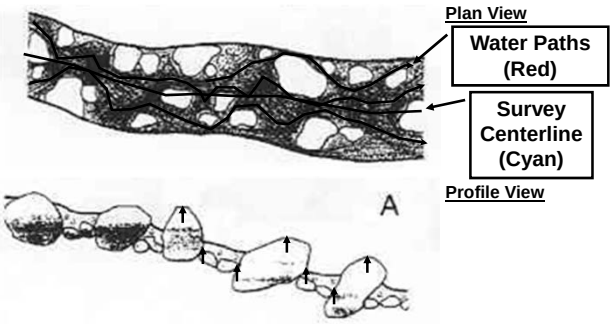
Longitudinal Profile: Cascade Channel (Rosgen Aa)

Water Paths (Red)

Survey Centerline Profile (Cyan)

Typical Measuring Points of a Longitudinal Profile for a Cascade Channel

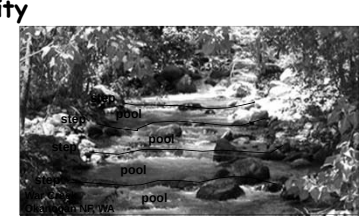


What should be the length of the longitudinal profile survey?

- **Extend well upstream and downstream from the influence of the undersized culvert.**
- **Of sufficient length to identify repeating sequences of channel units. *Typically a length of 20-30 times the bankfull width is* adequate.**
- **In high gradient streams (>5%) When two or more stable, bedrock or boulder grade-control features are identified and surveyed. *Make sure you have enough channel segments to determine spacing and dimensions of the grade controls!***

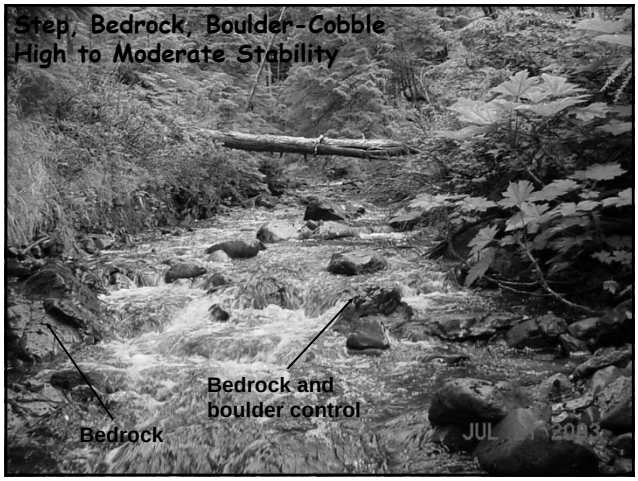
Physical Factors Influencing Bedform and Large Woody Debris Stability

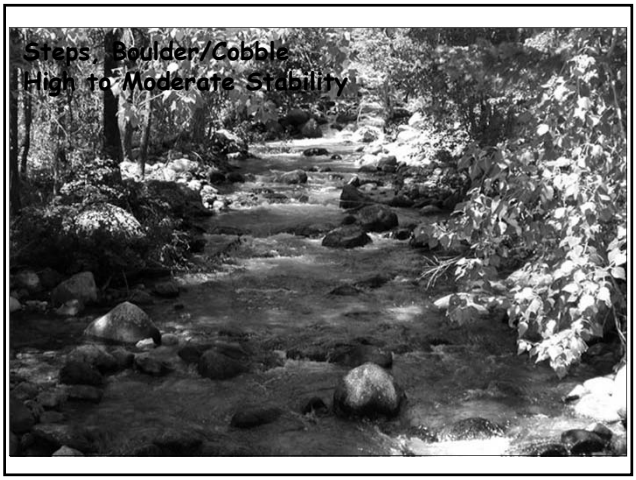
- Size, strength, and durability of rocks.
- Embedment and packing of particles.
- Type, length, diameter, and condition of wood.
- Orientation and extent of particles and wood pieces with respect to channel.
- Relationship to other bedform structures.



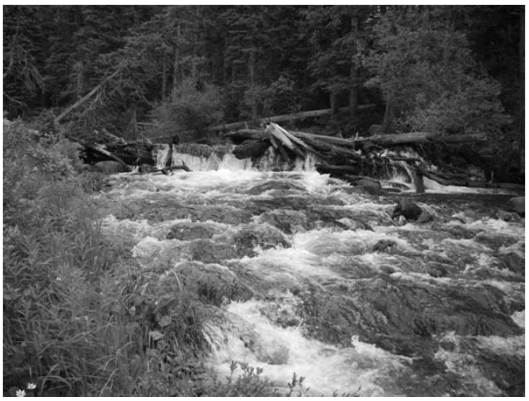
Qualitative stability assessment rating of channel-bed structures (bedforms)

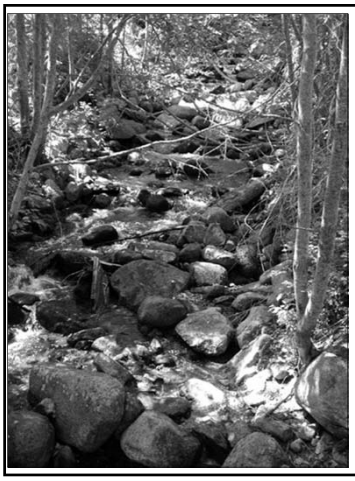
Bedform	Material Type and Size	Stability Rating	Bedform Characteristics
Steps	*Boulder-Cobble*	High	Boulder-cobble steps that span the width of the active channel and are keyed into the banks. Particles are tightly packed. Keyed-in particles extend below the maximum depth of the pool below the step.
Steps	*Boulder-Cobble, Cobble-Gravel*	Mod-erate	Boulder-cobble or cobble-gravel steps that do not span the width of the active channel or are loosely keyed into the banks. Particles are moderately packed or key pieces are not in contact with each other. Keyed-in particles extend below the maximum depth of the pool below the step.
Steps	*Cobble-Gravel*	Low	Boulder-cobble or cobble-gravel steps that do not span the width of the active channel. Evidence of lateral scour along flanks of structure. Particles are poorly packed and key pieces are not in contact with each other. Keyed-in particles do not extend below the maximum depth of the pool below the step.
Riffles with Ribs	*Cobble-Boulder, Cobble-Gravel*	High	Typically steep riffles composed of cobble-boulder or cobble-gravel material that are tightly packed and embedded in the channel bed. Pool tailcrests and/or coarse transverse ribs (microsteps) within the riffle span the width of the active channel. Pool tailcrests and transverse ribs particles are tightly packed and embedded in the channel bed, and coarser than the surrounding riffle material.
Riffles	*Cobble-Boulder, Cobble-Gravel*	Mod-erate	Riffles composed of cobble-boulder or cobble-gravel material that are moderately packed and embedded in the channel bed.
Riffles	*Cobble-Gravel*	Low	Riffles composed of cobble-gravel material that are loosely packed and embedded in the channel bed.
Steps and Riffles	*Bedrock*	High	Steps and riffles composed of bedrock (exposed at surface or just below a thin veneer of alluvial material) that span the width of the active channel.
Steps and Riffles	*Wood and Rock*	High	Wood and rock (boulder-cobble) that form a composite structure. Combination of wood and rock span the width of the active channel and is keyed into the banks. Wood is sound and competent, and partially anchored by the channel bed and banks. Boulder-cobble particles are tightly packed and embedded in the channel bed. For steps, keyed-in particles extend below the maximum depth of the pool below the step.
Steps and Riffles	*Wood and Rock*	Mod-erate	Wood and rock (boulder-cobble) that form a composite structure. Combination of wood and rock that span the span the width of the active channel, but is not well keyed into the banks. Evidence of lateral scour along flanks of structure. Wood is beginning to soften and decay, and is partially anchored by the channel bed and banks. Boulder-cobble particles are moderately packed and embedded in the channel bed. For steps, keyed-in particles extend below the maximum depth of the pool below the step.
Steps and Riffles	*Wood and Rock*	Low	Wood and rock (boulder-cobble) that form a composite structure. Combination of wood and rock that do not span the width of the active channel. Evidence of lateral scour along flanks of structure. Wood is rotten and punky, and not anchored by the channel bed and banks. Boulder-cobble particles are loosely packed and embedded in the channel bed. For steps, keyed-in particles do not extend below the maximum depth of the pool below the step.
Steps and Riffles	*Wood*	High	Wood is sound and competent. The wood piece or pieces span the width of the active channel and are well anchored by the channel bed and banks.
Steps and Riffles	*Wood*	Mod-erate	Wood is beginning to soften and decay. The wood piece or pieces do not completely span the width of the active channel and are poor to moderately anchored by the channel bed and banks.
Steps and Riffles	*Wood*	Low	Wood is rotten and punky. The wood piece or pieces do not completely span the width of the active channel and are not or poorly anchored by the channel bed and banks.
Beaver Dams	Wood, Sticks, Mud	Mod-erate	Beaver dam is well constructed with a good distribution of large wood, small sticks, and mud. Beavers are actively utilizing and maintaining the dam. Abundant beaver food resources in vicinity of dam for long-term sustainability. Consider consequences of failure from large flood over the service-life of the crossing structure.
Beaver Dams	Wood, Sticks, Mud	Low	Beaver dam is poorly constructed and inactive (i.e., not maintained). Large wood pieces are not present. Evidence of lateral scour along flanks of structure. Also, construction of beaver dams on large streams during drought conditions. High likelihood that these structures will fail during large floods or when flow conditions return to normal.





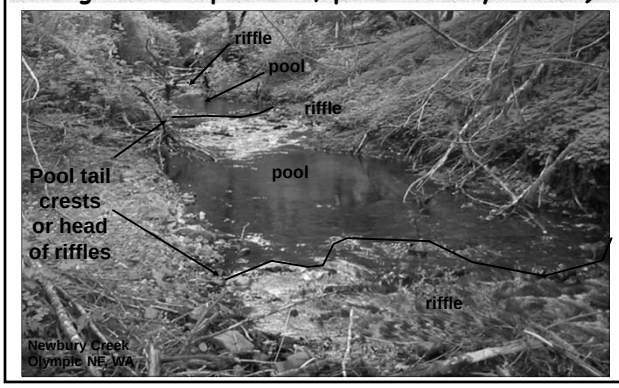
Steps, Boulder/Cobble and Wood
High to Moderate Stability





Cascade Channel, Boulder-Cobble High to Moderate Stability

Riffles, Cobble-Boulder to Cobble-Gravel High to Low Stability (depends on size and arrangement of particles, pool/riffle hydraulics)

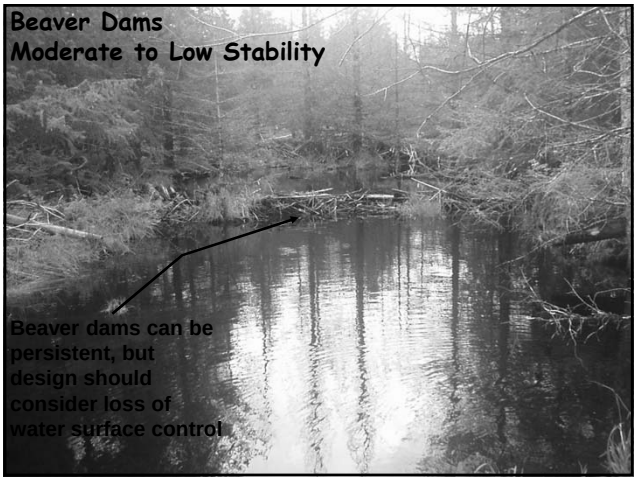


Steep Riffles, Boulder-Cobble to Cobble-Gravel
Transverse Ribs within riffle
High Stability (depends on size and arrangement of particles, pool/riffle hydraulics)

Step, Wood
High to Low Stability (depends on type, size, and arrangement of wood)

How long will this grade control last?

Beaver Dams
Moderate to Low Stability



Geomorphic Controls or Causal Features Forming and Maintaining Pools

- channel bend
- obstruction plunge
- obstruction backwater
- obstruction/constriction

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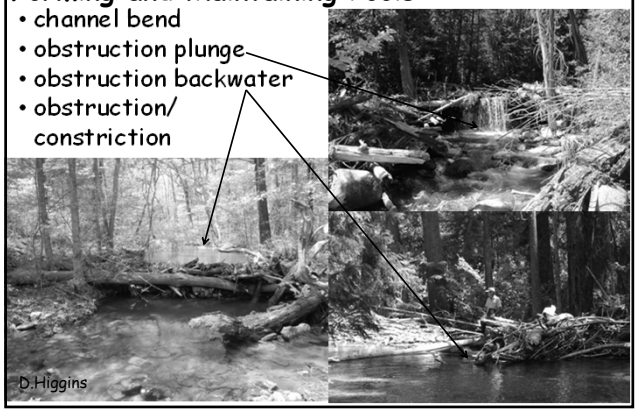

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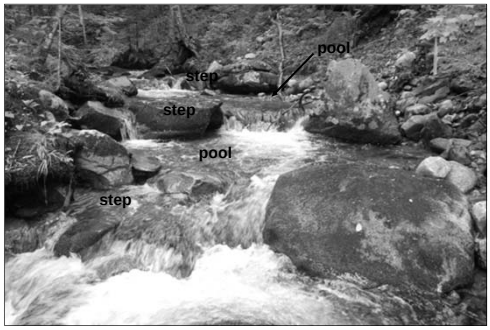

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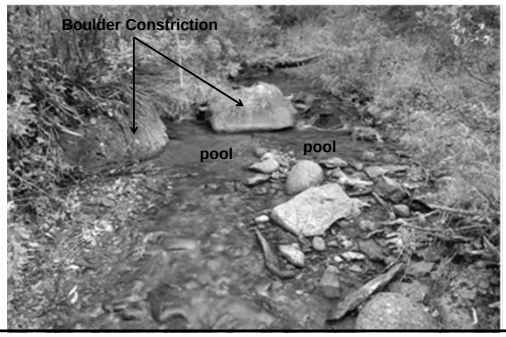
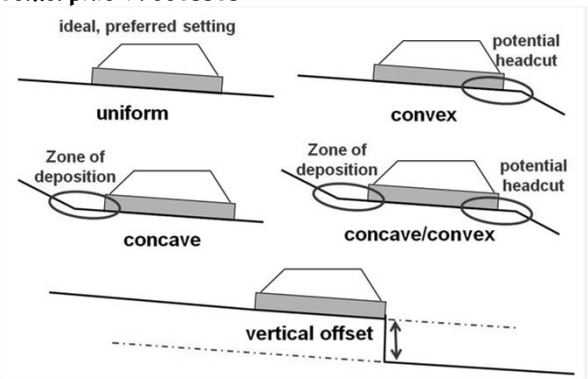
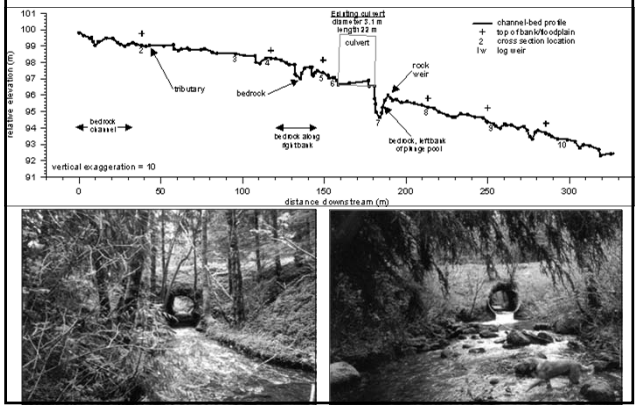


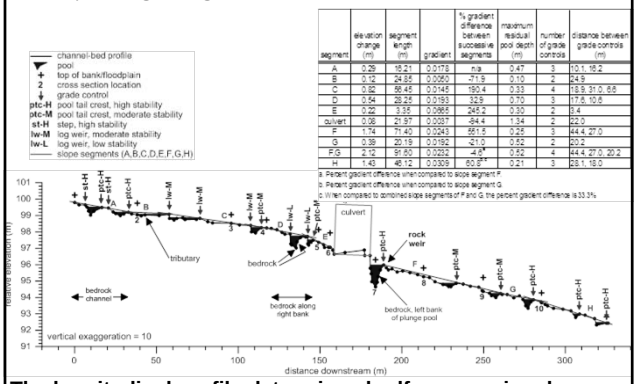
Interpreting Longitudinal Profile Shapes at Road-Stream Crossings: Slope Transitions and Geomorphic Processes



Interpreting Longitudinal Profiles at the Reach Scale



Interpreting Longitudinal Profiles at the Reach Scale

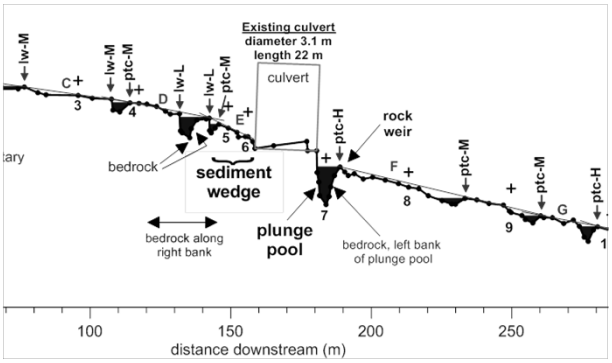


segment	elevation change (m)	segment length (m)	gradient	% gradient difference between successive segments	maximum residual pool depth (m)	number of grade controls	distance between grade controls (m)
A	0.29	16.21	0.0178	n/a	0.47	3	10.1, 16.2
B	0.12	24.85	0.0050	-71.9	0.10	2	24.9
C	0.82	56.45	0.0145	190.4	0.33	4	18.9, 31.0, 6.6
D	0.54	28.24	0.0193	32.9	0.70	3	17.6, 10.6
E	0.22	3.35	0.0665	245.2	0.30	2	3.4
culvert	0.08	21.97	0.0037	-84.4	1.34	2	22.0
F	1.74	71.40	0.0243	551.5	0.25	3	44.4, 27.0
G	0.38	20.19	0.0192	-21.0	0.52	2	20.2
F,G	2.12	91.59	0.0232	-4.6[a]	0.52	4	44.4, 27.0, 20.2
H	1.43	46.12	0.0309	60.9[b]	0.21	3	28.1, 18.0

a. Percent gradient difference when compared to slope segment F
b. Percent gradient difference when compared to slope segment G
c. When compared to combined slope segments of F and G, the percent gradient difference is 33.3%

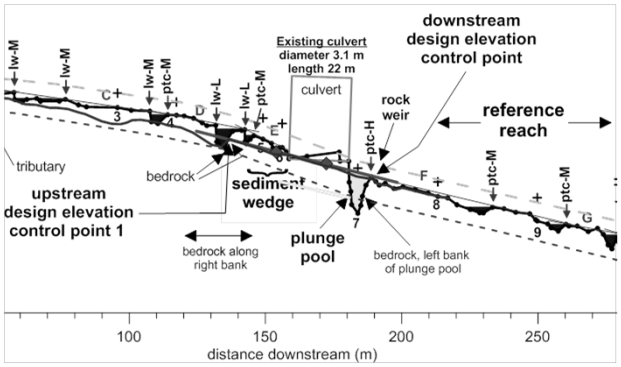
The longitudinal profile determines bedform spacing, key grade controls, gradient variability, and scour depth ranges

Interpreting Longitudinal Profiles at the Reach Scale



The longitudinal profile determines local degradation and aggradation associated with the undersized culvert.

Interpreting Longitudinal Profiles at the Reach Scale



The longitudinal profile is used to develop the design channel profile through the replacement structure.

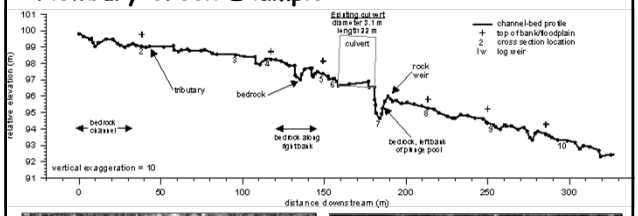
Longitudinal Profile Assessment Process

1. **Identify pools and grade controls.**
2. **Determine the types of grade controls along the longitudinal profile.**
3. **Assess the relative stability of each grade control.**
4. **Determine the geomorphic controls of the pools (Note: compare the longitudinal profile with the planform map)?**
5. **Delineate slope segments.**
6. **Calculate the elevation change, length, and gradient of each slope segment. Determine the percent difference between adjacent segments.**
7. **Determine the maximum scour depth (residual pool depth) for each slope segment and culvert plunge pool. How does culvert pool scour depth compare to other pool depths along profile?**

Longitudinal Profile Assessment Process

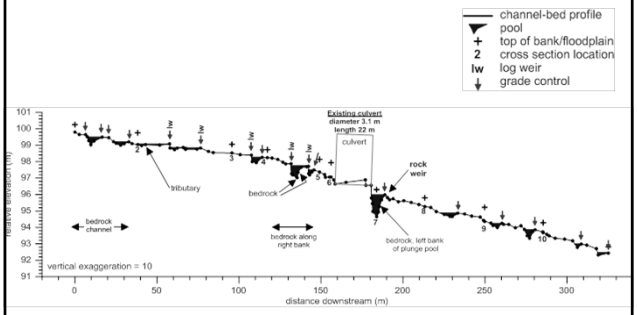
8. **Determine the number of and distance between grade controls for each slope segment.**
9. **Identify and delineate the extent of sediment aggradation (thickness and length) upstream from culvert inlet.**
10. **Identify the shape of the longitudinal profile.**
11. **Delineate the upper vertical adjustment potential line along the longitudinal profile. Indicate the geomorphic evidence used to delineate the upper vertical adjustment potential line.**
12. **Delineate the lower vertical adjustment potential line along the longitudinal profile. Indicate the geomorphic evidence used to delineate the lower vertical adjustment potential line.**

Longitudinal Profile Assessment Process Newbury Creek Example



Newbury Creek, longitudinal profile assessment

1) Identify pools and grade controls



Newbury Creek, longitudinal profile assessment

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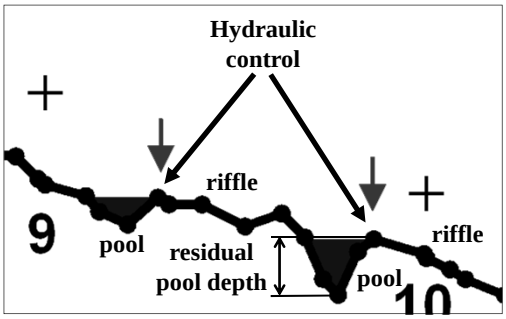
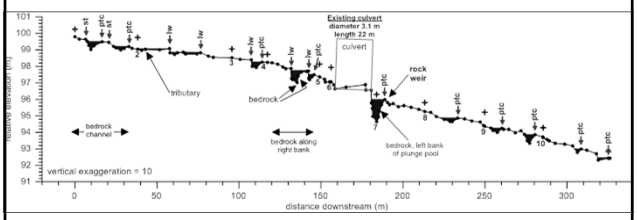


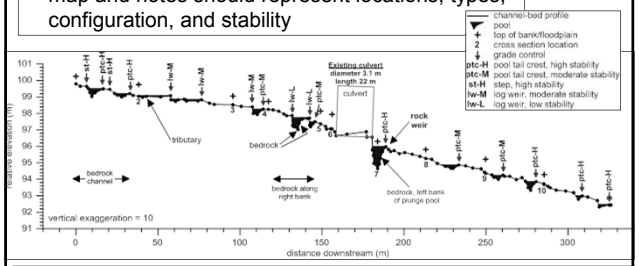
Newbury Creek, longitudinal profile assessment

2. Determine the types of grade controls along the longitudinal profile.
Note: Identified and surveyed in the field. Sketch map and notes should represent locations, types, configuration, and stability



Newbury Creek, longitudinal profile assessment

3) Assess the relative stability of each grade control. Note: Identified and surveyed in the field. Sketch map and notes should represent locations, types, configuration, and stability



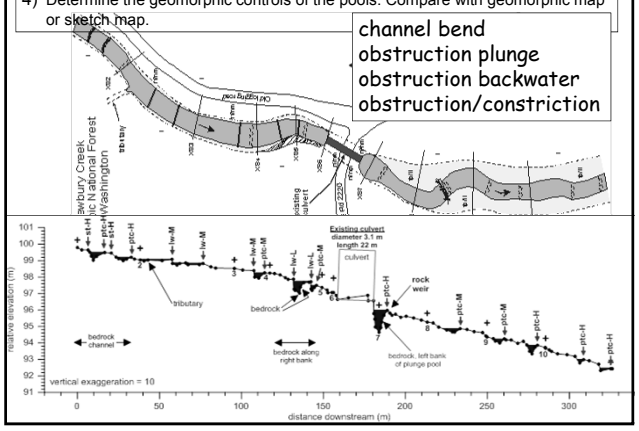
st-H: step, high stability, channel spanning, tightly packed and embedded boulders-cobbles or bedrock.
ptc-H: pool tail crest of downstream steep riffle with transverse ribs, high stability, tightly embedded and packed boulders-cobbles.
ptc-M: pool tail crest, moderate stability, moderately embedded and packed cobbles-gravels.
lw-M: log weir, moderate stability, channel spanning, embedded in banks, wood beginning to soften and decay.
lw-L: log weir, low stability, channel spanning, minimal bank embedment, wood beginning to soften and decay.

Qualitative stability assessment rating of channel-bed structures (bedforms)

Bedform	Material Type and Size	Stability Rating	Bedform Characteristics
Steps	*Boulder-Cobble*	High	Boulder-cobble steps that span the width of the active channel and are keyed into the banks. Particles are tightly packed. Keyed-in particles extend below the maximum depth of the pool below the step.
Steps	*Boulder-Cobble, Cobble-Gravel*	Mod-erate	Boulder-cobble or cobble-gravel steps that do not span the width of the active channel or are loosely keyed into the banks. Particles are moderately packed or key pieces are not in contact with each other. Keyed-in particles extend below the maximum depth of the pool below the step.
Steps	*Cobble-Gravel*	Low	Boulder-cobble or cobble-gravel steps that do not span the width of the active channel. Evidence of lateral scour along flanks of structure. Particles are poorly packed and key pieces are not in contact with each other. Keyed-in particles do not extend below the maximum depth of the pool below the step.
Riffles with Ribs	*Cobble-Boulder, Cobble-Gravel*	High	Typically steep riffles composed of cobble-boulder or cobble-gravel material that are tightly packed and embedded in the channel bed. Pool tail crests and/or coarse transverse ribs (microsteps) within the riffle span the width of the active channel. Pool tail crests and transverse ribs particles are tightly packed and embedded in the channel bed, and coarser than the surrounding riffle material.
Riffles	*Cobble-Boulder, Cobble-Gravel*	Mod-erate	Riffles composed of cobble-boulder or cobble-gravel material that are moderately packed and embedded in the channel bed.
Riffles	*Cobble-Gravel*	Low	Riffles composed of cobble-gravel material that are loosely packed and embedded in the channel bed.
Steps and Riffles	*Bedrock*	High	Steps and riffles composed of bedrock (exposed at surface or just below a thin veneer of alluvial material) that span the width of the active channel.
Steps and Riffles	*Wood and Rock*	High	Wood and rock (boulder-cobble) that form a composite structure. Combination of wood and rock span the width of the active channel and is keyed into the banks. Wood is sound and competent, and partially anchored by the channel bed and banks. Boulder-cobble particles are tightly packed and embedded in the channel bed. For steps, keyed-in particles extend below the maximum depth of the pool below the step.
Steps and Riffles	*Wood and Rock*	Mod-erate	Wood and rock (boulder-cobble) that form a composite structure. Combination of wood and rock that span the span the width of the active channel, but is not well keyed into the banks. Evidence of lateral scour along flanks of structure. Wood is beginning to soften and decay, and is partially anchored by the channel bed and banks. Boulder-cobble particles are moderately packed and embedded in the channel bed. For steps, keyed-in particles extend below the maximum depth of the pool below the step.
Steps and Riffles	*Wood and Rock*	Low	Wood and rock (boulder-cobble) that form a composite structure. Combination of wood and rock that do not span the width of the active channel. Evidence of lateral scour along flanks of structure. Wood is rotten and punky, and not anchored by the channel bed and banks. Boulder-cobble particles are loosely packed and embedded in the channel bed. For steps, keyed-in particles do not extend below the maximum depth of the pool below the step.
Steps and Riffles	*Wood*	High	Wood is sound and competent. The wood piece or pieces span the width of the active channel and are well anchored by the channel bed and banks.
Steps and Riffles	*Wood*	Mod-erate	Wood is beginning to soften and decay. The wood piece or pieces do not completely span the width of the active channel and are poor to moderately anchored by the channel bed and banks.
Steps and Riffles	*Wood*	Low	Wood is rotten and punky. The wood piece or pieces do not completely span the width of the active channel and are not or poorly anchored by the channel bed and banks.
Beaver Dams	Wood, Sticks, Mud	Mod-erate	Beaver dam is well constructed with a good distribution of large wood, small sticks, and mud. Beavers are actively utilizing and maintaining the dam. Abundant beaver food resources in vicinity of dam for long-term sustainability. Consider consequences of failure from large flood over the service-life of the crossing structure.
Beaver Dams	Wood, Sticks, Mud	Low	Beaver dam is poorly constructed and inactive (i.e., not maintained). Large wood pieces are not present. Evidence of lateral scour along flanks of structure. Also, construction of beaver dams on large streams during drought conditions. High likelihood that these structures will fail during large floods or when flow conditions return to normal.

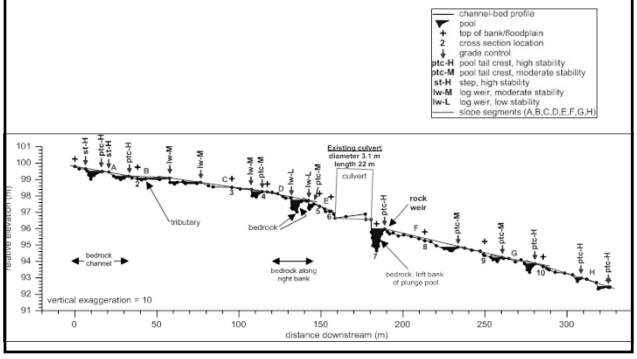
Newbury Creek, longitudinal profile assessment

4) Determine the geomorphic controls of the pools. Compare with geomorphic map or sketch map.



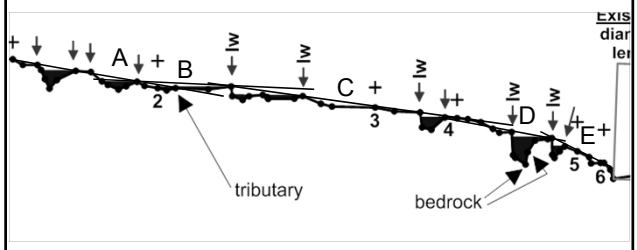
Newbury Creek, longitudinal profile assessment

5) Delineate slope segments.



Newbury Creek, longitudinal profile assessment

5) Delineate slope segments.



Newbury Creek, longitudinal profile assessment

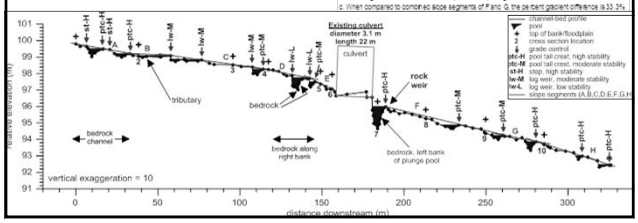
6) Calculate the elevation change, length, and gradient of each slope segment. Determine the percent different between adjacent segments.

$$\text{Gradient} = \frac{\text{Rise}}{\text{Run}} = \frac{\text{Elevation Change}}{\text{Segment Length}}$$

$$\text{\% Gradient Difference Between Successive Slope Segments} = -\left[\frac{(S_{downstream} - S_{upstream})}{S_{upstream}}\right](100)$$

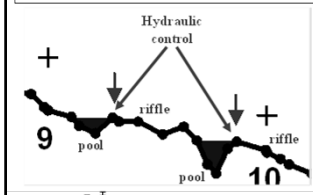
segment	elevation change (m)	segment length (m)	gradient	% gradient difference between successive segments
A	0.29	16.21	0.0178	n/a
B	0.12	24.85	0.0050	-71.9
C	0.82	56.45	0.0145	190.4
D	0.54	28.25	0.0193	32.9
E	0.22	3.35	0.0665	245.2
culvert	0.08	21.97	0.0037	-94.4
F	1.74	71.40	0.0243	551.5
G	0.39	20.19	0.0192	-21.0
F,G	2.12	91.60	0.0232	-4.6[a]
H	1.43	46.12	0.0309	60.8[b,c]

a. Percent gradient difference when compared to slope segment F.
b. Percent gradient difference when compared to slope segment G.
c. When compared to combined slope segments of F and G, the percent gradient difference is 33.3%.



Newbury Creek, longitudinal profile assessment

7) Determine the maximum scour depth (residual pool depth) for each slope segment and culvert plunge pool.



segment	elevation change (m)	segment length (m)	gradient	% gradient difference between successive segments	maximum residual pool depth (m)
A	0.29	16.21	0.0178	n/a	0.47
B	0.12	24.85	0.0050	-71.9	0.10
C	0.82	56.45	0.0145	190.4	0.33
D	0.54	28.25	0.0193	32.9	0.70
E	0.22	3.35	0.0665	245.2	0.30
culvert	0.08	21.97	0.0037	-94.4	1.34
F	1.74	71.40	0.0243	551.5	0.25
G	0.39	20.19	0.0192	-21.0	0.52
F,G	2.12	91.60	0.0232	-4.6[a]	0.52
H	1.43	46.12	0.0309	60.8[b,c]	0.21

a. Percent gradient difference when compared to slope segment F.
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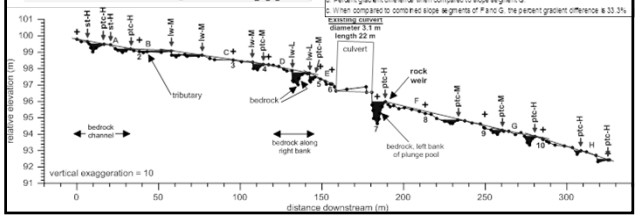

Newbury Creek, longitudinal profile assessment

8) Determine the number of and distance between grade controls for each slope segment.

channel-bed profile
pool
top of bank/floodplain
cross section location
grade control
ptc-H pool tail crest, high stability
ptc-M pool tail crest, moderate stability
st-H step, high stability
lw-M log weir, moderate stability
lw-L log weir, low stability
slope segments (A,B,C,D,E,F,G,H)

segment	elevation change (m)	segment length (m)	gradient	% gradient difference between successive segments	maximum residual pool depth (m)	number of grade controls	distance between grade controls (m)
A	0.29	16.21	0.0178	n/a	0.47	3	10.1, 16.2
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H	1.43	46.12	0.0309	60.8[b,c]	0.21	3	28.1, 18.0

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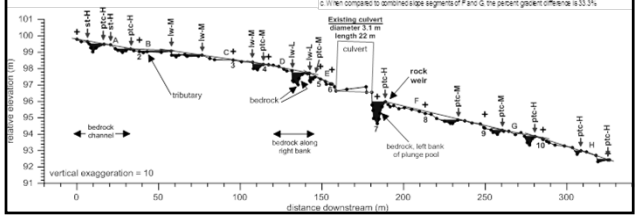
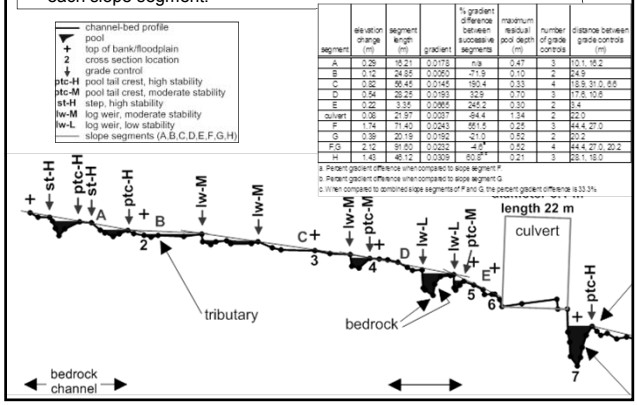


Newbury Creek, longitudinal profile assessment

8) Determine the number of and distance between grade controls for each slope segment.



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a. Percent gradient difference when compared to slope segment F
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Newbury Creek, longitudinal profile assessment

9) Identify and delineate extent of sediment aggradation (thickness and length) upstream from culvert inlet.

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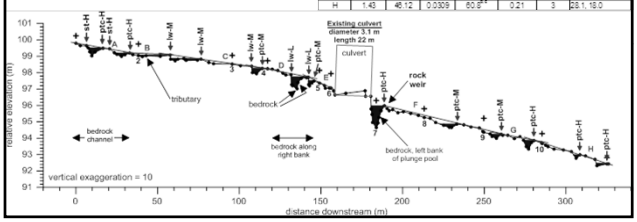

Newbury Creek, longitudinal profile assessment

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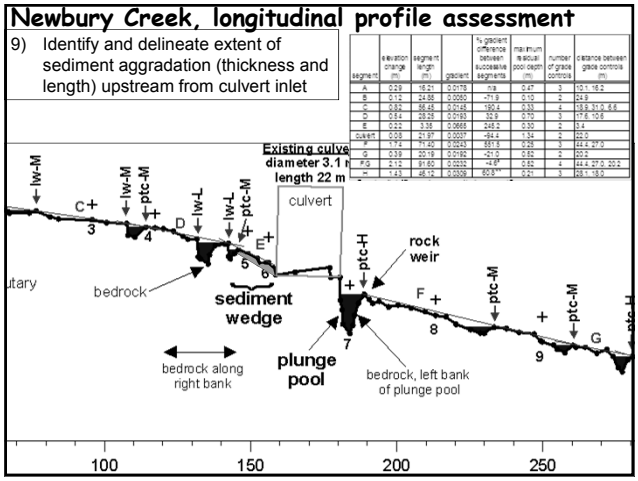
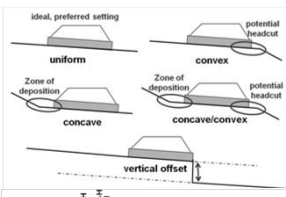


Newbury Creek, longitudinal profile assessment

10) Identify the shape of the longitudinal profile.



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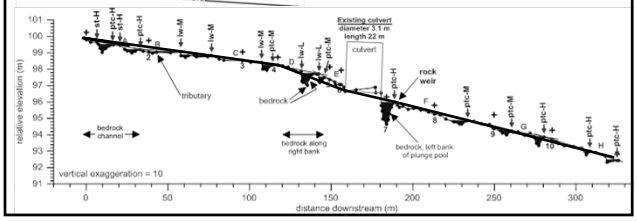
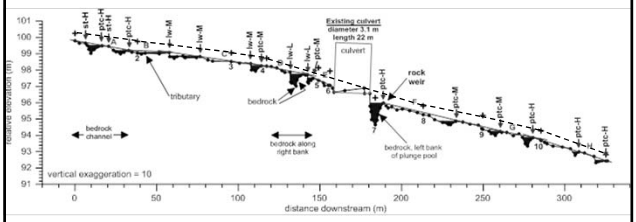


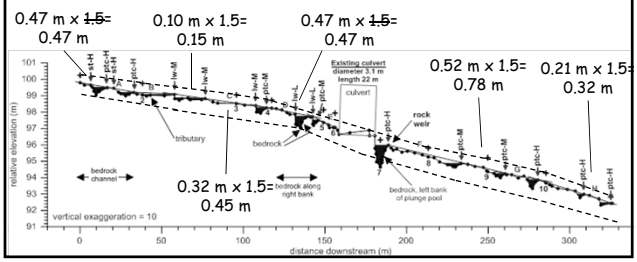
Newbury Creek, longitudinal profile assessment

11) Delineate the upper vertical adjustment potential line.
Highest channel-bed surface (aggradation) determined using geomorphic evidence (e.g., upper bank/floodplain surface, crest of large wood debris complex, past flood/debris flow deposits)



Newbury Creek, longitudinal profile assessment

12) Delineate the lower vertical adjustment potential (scour) line.
- Choose deepest pool along channel not influenced by the undersized culvert.
- Adjust line to reflect scour/fill processes that occur during floods. Recommended criteria:
  - o 1.00 x Pool Max Depth (PMD): Step-pool channels, S > 5%, boulder-cobble boundaries.
  - o 1.25 x PMD: Step-pool channels with S < 5%, cobble-gravel boundaries.
  - o 1.50 x PMD: Steep riffles with ribs, cobble-gravel boundaries.
  - o 1.75 x PMD: Riffles, gravel-cobble boundaries.
  - o 2.00 x PMD: Rffles, sand-fine gravel boundaries.
  - o No adjustment for bedrock.



Longitudinal Profile Interpretations: Summary

- **Types of Grade Controls and Stability**
- **Pool Scour Depths and Controls**
- **Delineating Distinct Slope Segments and Determining their Gradients**
- **Spacing of Channel Units**
- **Aggradation at Culvert Inlet, Tributaries**
- **Degradation (local vs. regional channel incision)**
- **Profile Shape and Geomorphic Processes**
- **Vertical Adjustment Potential (upper and lower)**