QUANTIFYING FUNCTIONAL LIFT USING THE CSQT BETA VERSION

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Calculating Stream Credits

Improvement in stream functions, or functional lift, at a compensatory mitigation site will be quantified using the CSQT workbook.

QUANTITY (linear feet of stream)

X CSQT CONDITION SCORE (% function)

FUNCTIONAL FEET

Functional lift or loss is (ΔFunctional Feet)

= Proposed FFS- Existing FFS

The delta can be either positive or negative. The delta is the unit of measure representing the loss or accrual of aquatic functions at an impact or project site.

Calculating Stream Credits – Step 1

During the initial mitigation site selection process for compensatory mitigation proposals, a catchment assessment is used to determine restoration potential and a basic assessment is used to estimate existing conditions.

This allows the sponsor to identify a preferred site with restoration potential within a targeted watershed.

Calculating Stream Credits – Step 1

Restoration Potential:

- Full Restoration Potential – The project has the potential to restore functions within all categories, including biology, to a reference standard.
- Partial Restoration Potential – The project has the potential to improve some functions compared with pre-project or baseline conditions. One or more functional categories may be restored to conditions typical of or approaching reference standard, but some catchment stressors or reach-scale constraints are preventing the site from reaching full potential.

Calculating Stream Credits – Step 1

Restoration Potential sets the stage to determine reasonable project goals and objectives regarding the potential lift that is possible.

The preferred site is not necessarily one with full restoration potential. Partial restoration potential sites **may** yield more lift.

Calculating Stream Credits – Step 1

Determining restoration potential:

- Consider catchment-scale stressors using Catchment Assessment
- Consider human-caused reach-scale constraints specific to project site
- Evaluate baseline condition of reach
- Consider current stage and future potential for stream evolution

Stream Evolution Model Stages (Cluer and Thorne 2013)	Corresponding Rosgen Stream Types
Stage 0 - Anastomosing	DA
Stage 1 – Sinuous Single Thread	C, E
Stage 2 - Channelized	C, E, → Gc
Stage 3 - Degradation	Gc
Stage 3a – Arrested Degradation	Gc → F → Bc
Stage 4 – Degradation and Widening	Gc → F
Stage 5 – Aggradation and Widening	F → C
Stage 6 – Quasi Equilibrium	C, E
Stage 7 – Laterally Active	C, E, F
Stage 8 - Anastomosing	DA

Calculating Stream Credits – Step 1

Additional note on site selection:

It is generally recommended to focus on whether a proposed site can achieve the following post-project condition scores:

- An index score of 0.70 or higher for floodplain connectivity, bed form diversity, and lateral migration; and
- An index score of 0.60 or higher for riparian vegetation (recognizing that riparian vegetation may take multiple years to reach full potential).

Credit Calculation Example: Permittee-responsible on-site, in-kind

The applicant begins by completing the Catchment Assessment and an existing condition assessment of the proposed mitigation site to determine the restoration potential and existing conditions.

Catchment Assessment Results:

Fair Watershed Condition

Restoration Potential:

Partial

CATCHMENT ASSESSMENT

Categories		Description of Catchment Condition			Rating (P/F/G)
		Poor	Fair	Good	
1	Impoundments	Project area located less than 1 mile upstream or downstream of an impoundment; or impoundments are less proximate, but have adverse effects within the project area.	Project area is located 1 mile or more upstream or downstream of an impoundment.	No impoundment upstream or downstream of project reach.	F
2	Flow Alteration	Substantial reduction or augmentation to one or more aspects of natural flow regime.	Moderate reduction or augmentation to one or more aspects of natural flow regime.	Little or no reduction or augmentation of natural flow regime.	G
3	Urbanization	Urban or rapidly urbanizing with ongoing or imminent large scale development.	Low density or rural communities or slow urban or suburban growth.	Predominantly natural land cover; or rural.	G
4	Fish Passage	Reach isolated by upstream and downstream anthropogenic barriers within 10 miles; or barriers otherwise severely affect fish populations within the project reach.	Reach isolated by upstream OR downstream anthropogenic barrier within 10 miles; or barriers otherwise have moderate effects on fish populations within the project reach.	No anthropogenic barriers within 10 miles upstream or downstream of the reach; or barriers otherwise have no effect on fish populations within a project reach.	G
5	Organism Recruitment	Channel immediately upstream or downstream of project reach (i.e., within 1 km or 0.62 mi) is concrete, piped, or hardened.	Channel immediately upstream or downstream of project reach (i.e., within 1 km or 0.62 mi) has native bed and bank material that is highly embedded by fine sediment.	Channel immediately upstream or downstream of project reach (i.e., within 1 km or 0.62 mi) has native bed and bank material.	G
6	Colorado Integrated Report (305(b) and 303(d)) status	In Category 5 due to nonsupport of aquatic life uses OR in Category 4 and aquatic life impairment not actively being mitigated.	In Category 4 due to nonsupport of aquatic life uses and aquatic life impairment actively being mitigated.	In category 1, 2, or 3 or aquatic life uses not evaluated.	F
7	Development: Oil, Gas, Wind, Pipeline, Mining, Timber Harvest, Roads	High development in contributing watershed or some within 1 mile of project reach, or >1 mile but available information indicates high potential for impacts to project reach.	Moderate development or moderate potential for impacts and none within 1 mile of project reach.	No development or no potential for impacts.	P
8	CDPS Permits	CDPS permitted facilities comprise a high percentage of the baseflow in the project reach OR 1 or more facilities present within 2 miles upstream of project reach have a high potential to threaten aquatic life.	CDPS permitted facilities comprise a low to moderate percentage of the baseflow in the project reach AND no facilities are located within 2 miles upstream of project reach.	No CDPS permitted facilities upstream of the project reach.	G
9	Riparian Vegetation	Natural plant community is limited within the floodplain (~100 yr) and riparian corridor is absent for substantial portions of the contributing stream length.	Natural plant community occurs in portions of the floodplain (~100 yr) and moderate gaps in the riparian corridor vegetation occur in the contributing stream length.	Natural plant community extends throughout majority of floodplain (~100 yr) and riparian corridor is mostly contiguous along contributing stream length.	F
10	Sediment Supply	High anthropogenic-caused sediment supply from upstream bank erosion and surface runoff.	Moderate anthropogenic-caused sediment supply from upstream bank erosion and surface runoff.	Low anthropogenic-caused sediment supply. Upstream bank erosion and surface runoff is minimal.	F

Calculating Stream Credits – Step 2

Once a mitigation site has been selected, the sponsor will collect additional baseline data according to the project goals and objectives.

These data will be entered into the CSQT Quantification Tool worksheet to calculate the existing condition score.

This existing condition score is then multiplied by the existing stream length.

Credit Calculation Example: Permittee-responsible on-site, in-kind

The applicant begins by completing an assessment of the proposed mitigation site to determine the existing conditions.

Functional Category	Function-Based Parameters	Existing Parameter
Reach Hydrology & Hydraulics	Reach Runoff	0.00
	Baseflow Dynamics	1.00
	Floodplain Connectivity	0.44
Geomorphology	Large Woody Debris	0.28
	Lateral Migration	0.30
	Bed Material Characterization	
	Bed Form Diversity	0.32
	Plan Form	0.00
	Riparian Vegetation	0.21
Physicochemical	Temperature	0.65
	Dissolved Oxygen	
	Nutrients	
Biology	Macroinvertebrates	0.05
	Fish	

Calculating Stream Credits – Step 3

The proposed condition score is generated using design specifications input into the CSQT Quantification Tool worksheet and then later **verified using monitoring data** entered into the Monitoring Data worksheet.

The proposed condition should reflect what is expected at the end of the monitoring period.

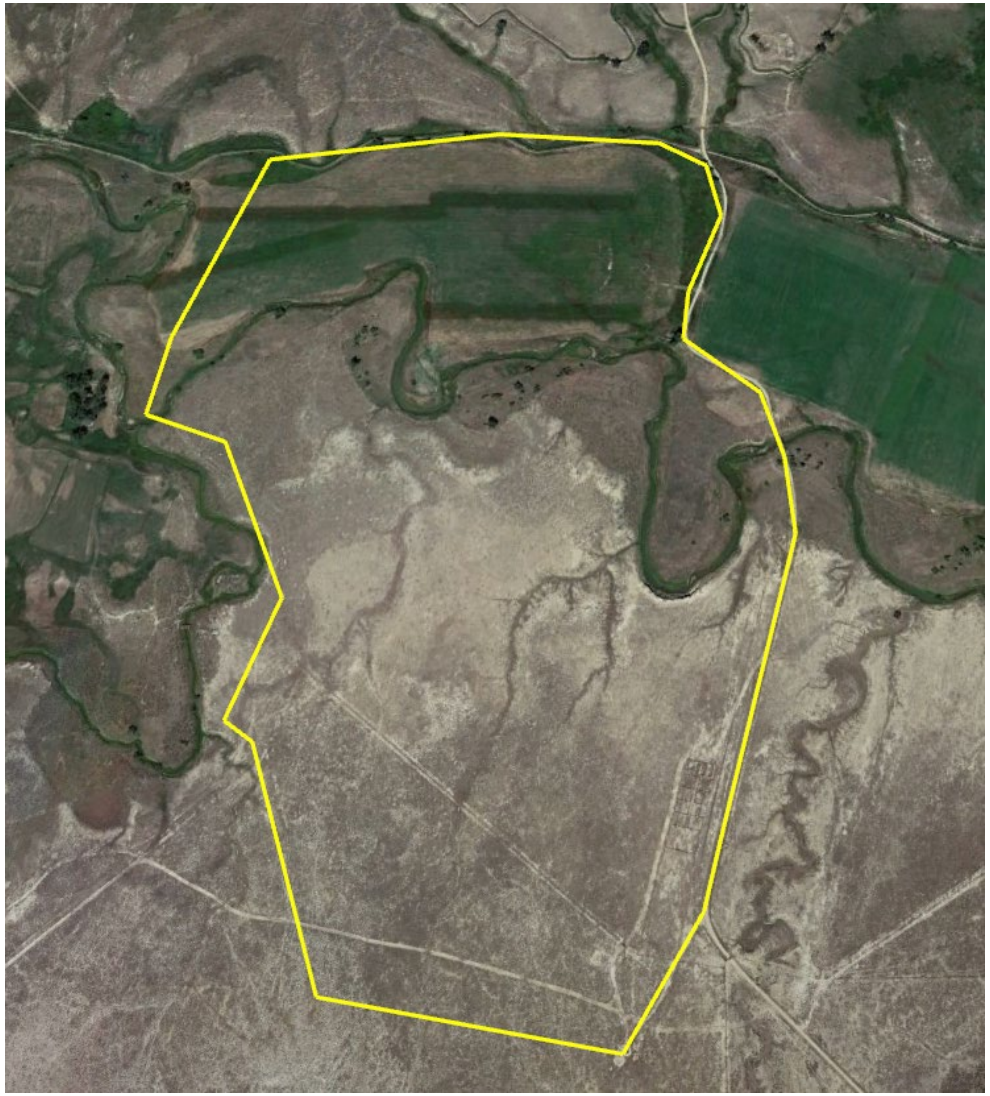
Functional Category	Function-Based Parameters	Existing Parameter	Proposed Parameter
Reach Hydrology & Hydraulics	Reach Runoff	0.00	0.67
	Baseflow Dynamics	1.00	1.00
	Floodplain Connectivity	0.44	0.80
Geomorphology	Large Woody Debris	0.28	0.33
	Lateral Migration	0.30	0.85
	Bed Material Characterization		
	Bed Form Diversity	0.32	0.98
	Plan Form	0.00	0.00
	Riparian Vegetation	0.21	0.62
Physicochemical	Temperature	0.65	0.68
	Dissolved Oxygen		
	Nutrients		
Biology	Macroinvertebrates	0.05	0.32
	Fish		

FUNCTIONAL CHANGE SUMMARY	
Existing Condition Score (ECS)	0.35
Proposed Condition Score (PCS)	0.62
Change in Functional Condition (PCS - ECS)	0.27
Existing Stream Length (ft)	1800
Proposed Stream Length (ft)	1800
Change in Stream Length (ft)	0
Existing Functional Feet (FF)	630
Proposed Functional Feet (FF)	1116
Proposed FF - Existing FF (ΔFF)	486
Percent Change in FF (%)	77%
ΔFF from Flow Alteration Module	
Total Proposed FF - Existing FF (ΔFF)	486.00

Calculating Stream Credits – Step 3

For reach runoff this means calculating the amount of land within the easement that will be changed from a runoff source area to a natural land use.

Function-Based Parameters	Existing Parameter	Proposed Parameter
Reach Runoff	0.00	0.67
Baseflow Dynamics	1.00	1.00
Floodplain Connectivity	0.44	0.80
Large Woody Debris	0.28	0.33
Lateral Migration	0.30	0.85
Bed Material Characterization		
Bed Form Diversity	0.32	0.98
Plan Form	0.00	0.00
Riparian Vegetation	0.21	0.62
Temperature	0.65	0.68
Dissolved Oxygen		
Nutrients		
Macroinvertebrates	0.05	0.32
Fish		



Calculating Stream Credits – Step 3

For floodplain connectivity this means measuring the design dimensions, grading extents, and whether any side channels are proposed in the plans.

		Existing	Proposed
Floodplain Connectivity	Return Interval (yr)		
	Bank Height Ratio	1.4	1
	Entrenchment Ratio	4	4.2
	Percent Side Channels (%)	0	30

Function-Based Parameters	Existing Parameter	Proposed Parameter
Reach Runoff	0.00	0.67
Baseflow Dynamics	1.00	1.00
Floodplain Connectivity	0.44	0.80
Large Woody Debris	0.28	0.33
Lateral Migration	0.30	0.85
Bed Material Characterization		
Bed Form Diversity	0.32	0.98
Plan Form	0.00	0.00
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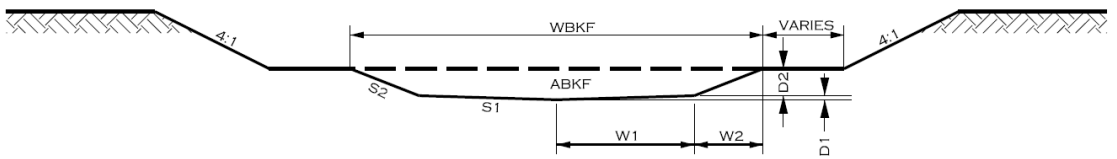
Temperature	0.65	0.68
Dissolved Oxygen		
Nutrients		
Macroinvertebrates	0.05	0.32
Fish		

PROJECT # 082 | SHEET NO. 2

DETAILS

"C" TYPE CHANNELS



TYPICAL RIFFLE CROSS SECTION

Calculating Stream Credits – Step 3

For large woody debris this involves a count of woody structures. It can include an estimate of LWD recruitment as well.

Function-Based Parameters	Existing Parameter	Proposed Parameter
Reach Runoff	0.00	0.67
Baseflow Dynamics	1.00	1.00
Floodplain Connectivity	0.44	0.80
Large Woody Debris	0.28	0.33
Lateral Migration	0.30	0.85
Bed Material Characterization		
Bed Form Diversity	0.32	0.98
Plan Form	0.00	0.00
Riparian Vegetation	0.21	0.62
Temperature	0.65	0.68
Dissolved Oxygen		
Nutrients		
Macroinvertebrates	0.05	0.32
Fish		

Calculating Stream Credits – Step 3

For riparian vegetation, it involved estimating what the vegetation plots will look like at project closeout.

Percent Width is measurable and unlikely to change from proposed condition.

Be wary of a 100% native cover value when invasive species are present in the existing condition.

Function-Based Parameters	Existing Parameter	Proposed Parameter
Reach Runoff	0.00	0.67
Baseflow Dynamics	1.00	1.00
Floodplain Connectivity	0.44	0.80
Large Woody Debris	0.28	0.33
Lateral Migration	0.30	0.85
Bed Material Characterization		
Bed Form Diversity	0.32	0.98
Plan Form	0.00	0.00
Riparian Vegetation	0.21	0.62
Temperature	0.65	0.68
Dissolved Oxygen		
Nutrients		
Macroinvertebrates	0.05	0.32
Fish		

Calculating Stream Credits – Step 3

- Field values are entered into the Proposed Condition section of the Quantification Tool worksheet.
- Proposed condition field values should consist of reasonable values for restored and impacted conditions. Users should rely on available data to estimate proposed condition field values, including project design studies and calculations, drawings, field investigations, and best available science.
- The same parameters used to calculate the existing condition score must also be used to estimate the proposed condition score.
- Proposed condition scores need to be verified using as-built and post-project monitoring data

Function-Based Parameter	Metric	Field Value
Reach Runoff	Land Use Coefficient Impervious Cover (%) Concentrated Flow Points (#/1000 LF) Water Quality Capture Volume	
Baseflow Dynamics	Average Velocity (fps) Average Depth (ft)	
Floodplain Connectivity	Return Interval (yr) Bank Height Ratio Entrenchment Ratio Percent Side Channels (%)	
Large Woody Debris	LWD Index No. of LWD Pieces/ 100 meters	
Lateral Migration	Greenline Stability Rating Dominant BEHI/NBS Percent Streambank Erosion (%) Percent Armoring (%)	
Bed Material Characterization	Size Class Pebble Count Analyzer (p-value)	
Bed Form Diversity	Pool Spacing Ratio Pool Depth Ratio Percent Riffle (%) Aggradation Ratio	
Plan Form	Sinuosity	
Riparian Vegetation	Riparian Width (%) Woody Vegetation Cover (%) Herbaceous Vegetation Cover (%) Percent Native Cover (%)	
Temperature	Daily Maximum Temperature (°C) MWAT (°C)	
Dissolved Oxygen	Dissolved Oxygen Concentration (mg/L)	
Nutrients	Chlorophyll a (mg/m2)	
Macroinvertebrates	CO MMI	
Fish	Native Fish Species Richness (% of Expected) SGCN Absent Score Wild Trout Biomass (% Change)	

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Percent Change in FF (%)	77%
ΔFF from Flow Alteration Module	
Total Proposed FF - Existing FF (ΔFF)	486.00

The applicant has determined catchment stressors that limit functional lift. Determined project goals and objectives, quantitatively assessed the existing condition, estimated the proposed condition and calculated lift.

Now monitoring events will track progress toward proposed condition.

If the project goals do not include Physicochemical and Biological lift, no data entry for these metrics is required.

Stream Credits – Secondary Effects

RGL 18-01 provides guidance to the Corps on factors that should be considered when determining the amount of mitigation credit generated from the removal of obsolete dams or other structures for stream restoration purposes.

In accordance with this guidance, on a case-by-case basis, the Corps may adjust the Δ functional feet score as a percentage increase.