Effectiveness Evaluation

Forest and Range Evaluation Program
Victoria, BC
February 16, 2023

BY:

DAVE MALONEY

FOREST WATER MANAGEMENT OFFICER

FOREST SCIENCE, PLANNING AND PRACTICES BRANCH

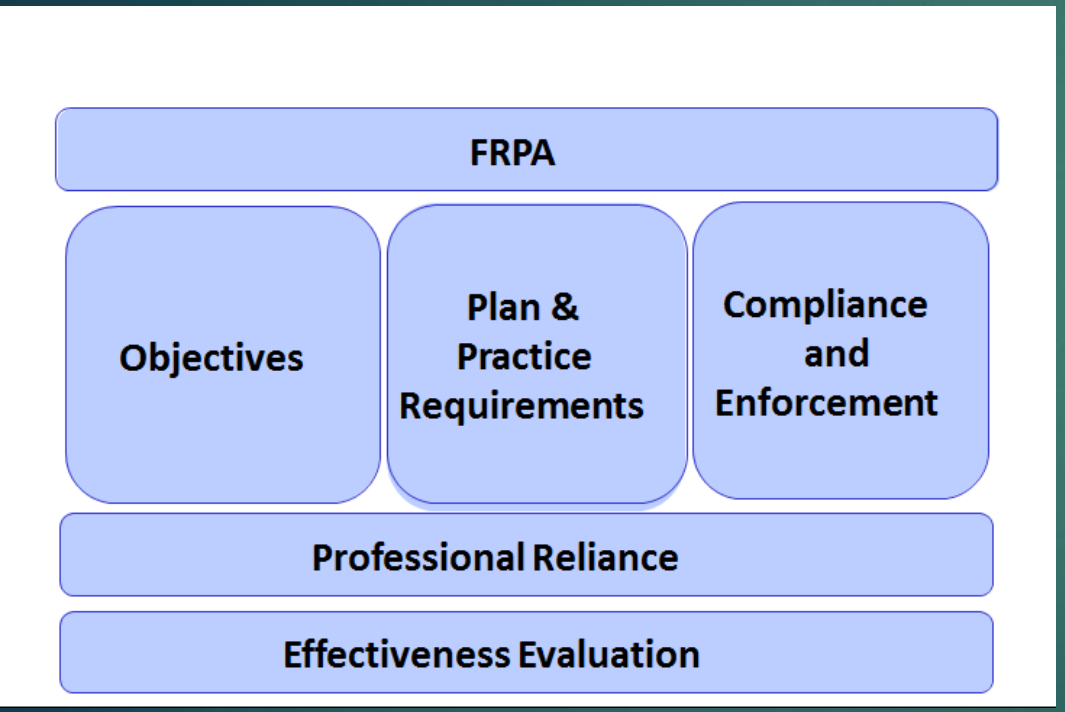
MINISTRY OF FORESTS

Outline – Water Quality

- Why are we monitoring?
- What is being monitored
  - Monitoring question
  - Protocol summary
  - Scoring
  - WQ app
  - Scoring
- Results / recommendation
- Application of results
  - FREP dashboard
  - District reporting
- Reports & publications

Why: Forest and Range Practices Act (FRPA)

FRPA: Results-based, Professional Reliance Model



- Assessments to determine if the FRPA Professional Reliance Model is managing and protecting the 11 FRPA values:
  - *Water quality: Are forest practices effective in protecting water quality for fish habitat and domestic purposes*
- Evaluate operational outcomes
- Conduct timely, credible and appropriate evaluations
- Make recommendations on legislation & policy
- Manage information & data
- Communicate results & recommendations

Why: Provincial / Federal legislation

Provincial

Forest & Range Practices Act

Legislation / Reg's: FRPA, FPPR, WLPPR & RPPR

Example: FPPR:

- Objective 8.0, 8.1, & 8.2
  - FPPR: s. 39, 50, 52, 54, 55, 57, 58, 59,
  - 60, 61, 62, 63, 82 & 84

- Drinking Water Protection Act
- Water Sustainability Act
- Waste Disposal Act

Federal

Federal Fisheries Act

34 (1) deleterious substance means

(a) any substance that, if added to any water, would degrade or alter…

34.3 (1) …. ensure the free passage of fish

34.4 (1) No… work, undertaking or activity, other than fishing, that results in the death of fish.

35 (1) No person shall carry on any work, undertaking or activity that results in the harmful alteration, disruption or destruction of fish habitat (HADD).

FREP Water Quality question

Water quality:

- Are forest practices effective in protecting water quality for fish habitat and drinking water?

Completed by:

- Routine level assessment, conducted by district staff
  - **Routine evaluations** are low intensity, overview evaluations that use relatively simple qualitative indicators that can be obtained at most sites, such as visual estimates (length/width/% cover etc.) and/or yes/no answers.
- Randomly selected cutblocks (unbiased sampling)
- Focus on fine (<1mm) sediment generation
- Repeatable
- Fast (<1/2 hour per site)
- Evaluates current condition
- Provides a means to communicate
- Identifies order of magnitude estimate for sediment generation & severity of ill effects on fish habitat

Summary of WQEE protocol

- Monitors randomly selected cutblocks and roads
- Follows the road back to the mill / landing
- Estimate connectivity
- Assess exposed mineral soil, soil texture, amount of traffic, slope, road construction materials, stream characteristics, fecal coliforms connectivity (range)
- Estimate volume of fines erodible
- Estimate bankful discharge
- Estimate severity of ill effects on fish habitat
- Identifies remediation opportunities (if necessary)
- Reports Moderate/High scores to managers / licensees

WQEE scoring

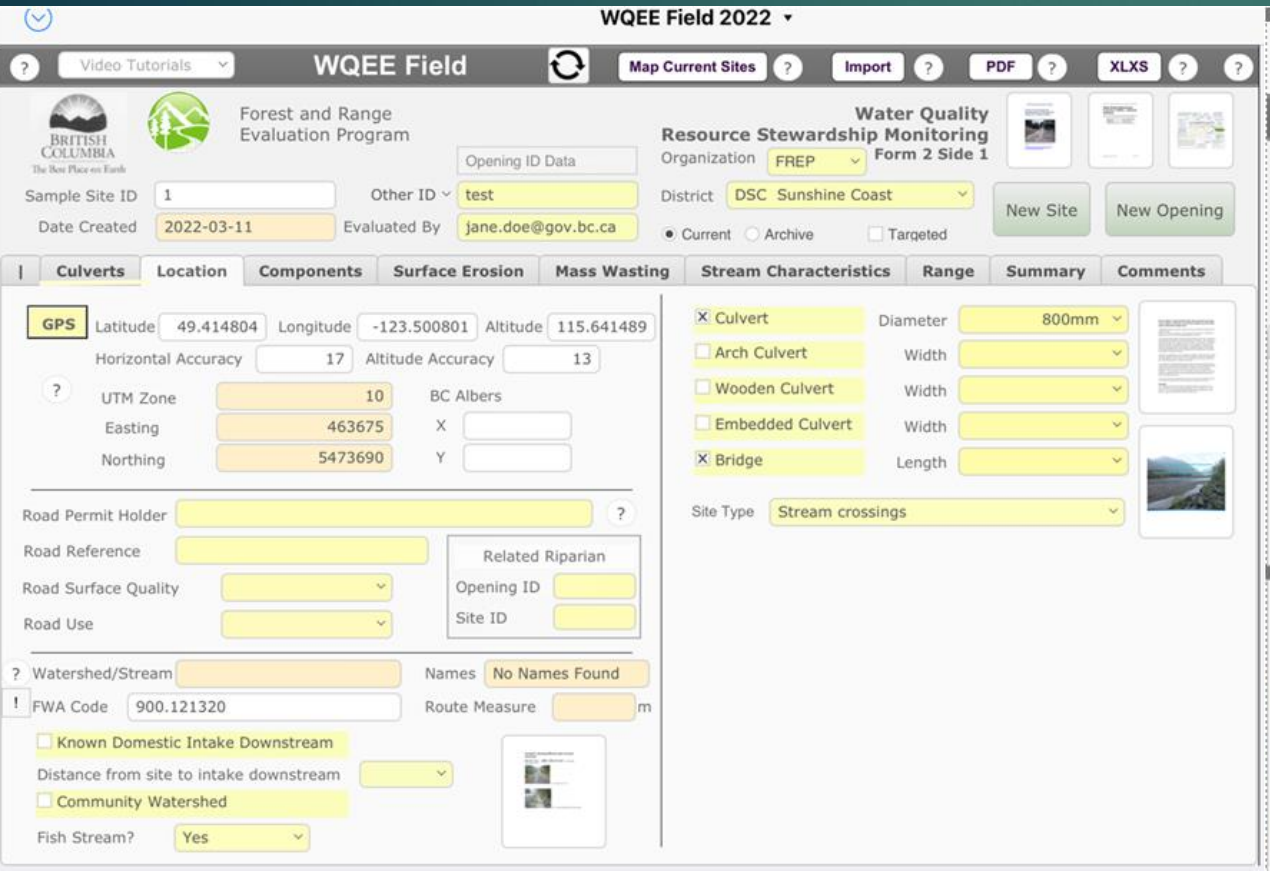
Volume based scoring

Total Volume of Fine Sediment generated at site (WQ Index)	Site Sediment Generation Potential Classes (based on consensus of field practitioners)	Associated General Level of Management of Site
<0.2 m^3	Very Low	Good
0.2-1 m^3	Low	
1-5 m^3	Moderate	
5-20 m^3	High	
>20 m^3	Very High	Poor

Severity of ill effects – based on estimated levels of turbidity over 10 days on sensitive fish (salmon and trout - Newcombe).

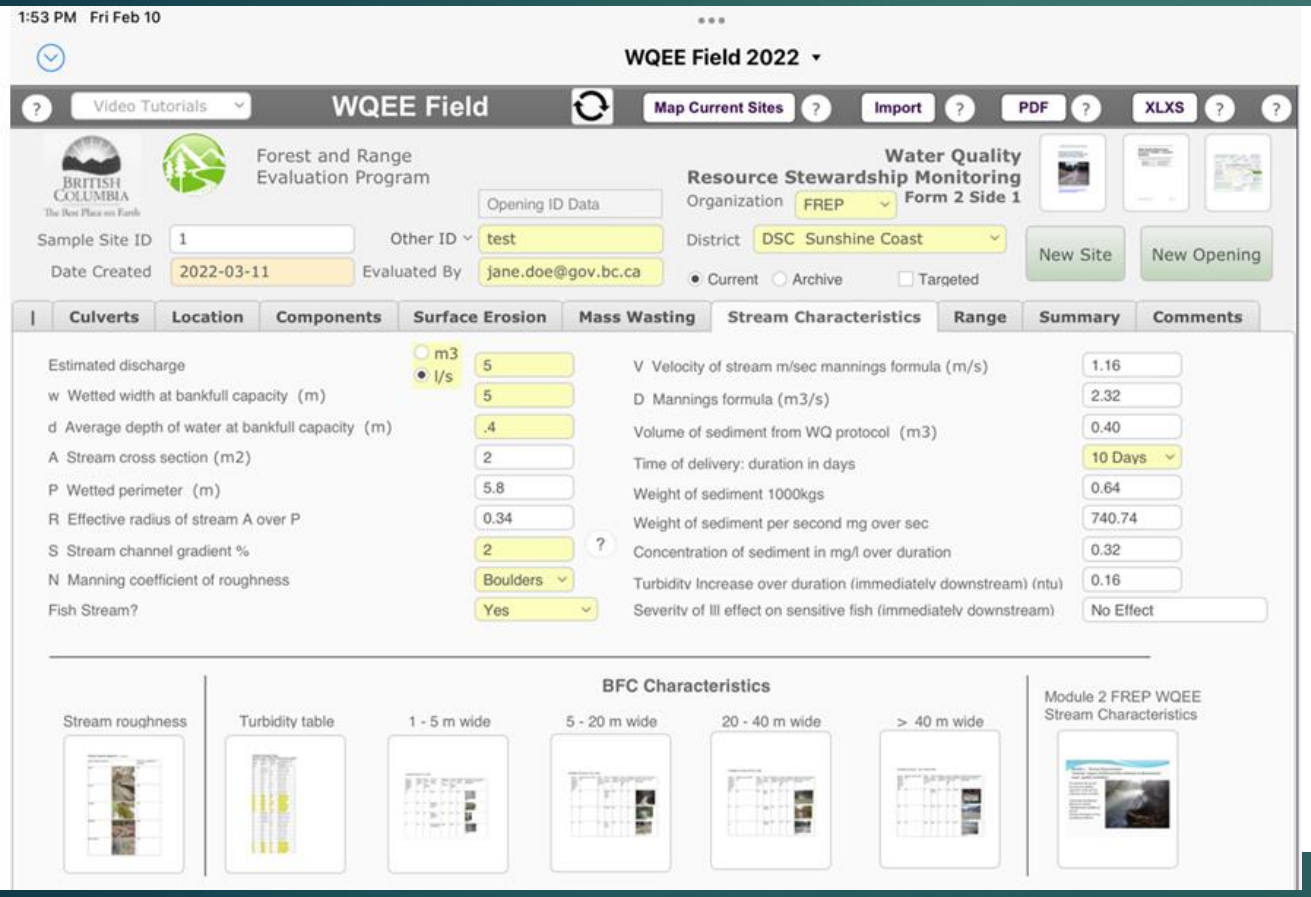
Effect on Sensitive Fish	Sediment duration of 10 days
Not impaired *(Impact Class 0)*	< 10 mg/l (<5 ntu)
Slightly Impaired Minor Physiological stress *(Impact Class 1,2,3)*	10-40 mg/l (5-20 ntu)
Moderately impaired *(Impact class 4,5,6,7, 8)*	20- 400 mg/l (20- 200 ntu)
Severely Impaired *(Impact class 9,10,11,12)*	>400 mg/l (> 200 ntu)

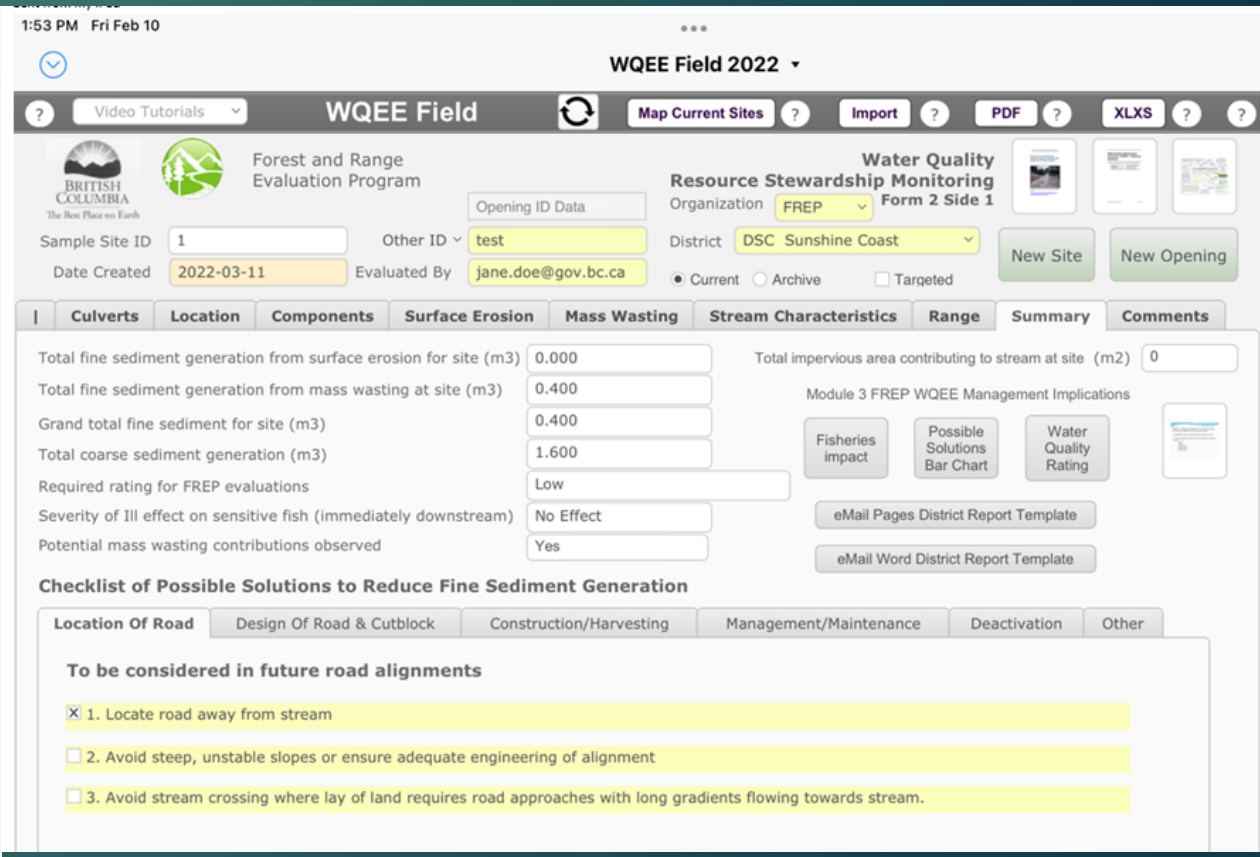
FREP WQ app


WQEE Field 2022
Video Tutorials
WQEE Field
Map Current Sites
Import
PDF
XLXS
Forest and Range
Evaluation Program
Water Quality
Resource Stewardship Monitoring
Form 2 Side 1
Opening ID Data
Organization FREP
Sample Site ID 1
Other ID test
District DSC Sunshine Coast
Date Created 2022-03-11
Evaluated By jane.doe@gov.bc.ca
Current Archive Targeted
New Site
New Opening
Culverts Location Components Surface Erosion Mass Wasting Stream Characteristics Range Summary Comments
GPS
Latitude 49.414804
Longitude -123.500801
Altitude 115.641489
Horizontal Accuracy 17
Altitude Accuracy 13
UTM Zone 10
BC Albers
Easting 463675
X
Northing 5473690
Y
Culvert
Diameter 800mm
Arch Culvert
Width
Wooden Culvert
Width
Embedded Culvert
Width
Bridge
Length
Site Type Stream crossings
Road Permit Holder
Road Reference
Road Surface Quality
Road Use
Related Riparian
Opening ID
Site ID
Watershed/Stream
Names No Names Found
FWA Code 900.121320
Route Measure
m
Known Domestic Intake Downstream
Distance from site to intake downstream
Community Watershed
Fish Stream? Yes

:52 PM Fri Feb 10
WQEE Field 2022
Video Tutorials
WQEE Field
Map Current Sites
Import
PDF
XLXS
Forest and Range
Evaluation Program
Water Quality
Resource Stewardship Monitoring
Form 2 Side 1
Opening ID Data
Organization FREP
Sample Site ID 1
Other ID test
District DSC Sunshine Coast
Date Created 2022-03-11
Evaluated By jane.doe@gov.bc.ca
Current Archive Targeted
New Site
New Opening
Culverts Location Components Surface Erosion Mass Wasting Stream Characteristics Range Summary Comments
Components and Characteristics
Column 1
Identify individual components of the site within the shared drainage
(Table 2)
Column 2
Estimate connectivity between artificial and natural drainage
Optionally refine your estimate using table 4
Distance over forest floor between ditch outlet and wetted width of stream (m)
Approximate area of disturbed drainage area upslope of storm drainage outfall (m2)
Column 3
Estimate Portion of fine sediment in matrix of eroded/ erodible material
(Table 5)
Active road surfaces always 1
Road surfaces
L Left
DS
0 None
1 all
Road ditches
Other disturbed area

FREP WQ app


1:53 PM Fri Feb 10
WQEE Field 2022
Video Tutorials
WQEE Field
Map Current Sites
Import
PDF
XLXS
Forest and Range Evaluation Program
Water Quality Resource Stewardship Monitoring
Form 2 Side 1
Opening ID Data
Organization FREP
Sample Site ID 1
Other ID test
District DSC Sunshine Coast
Date Created 2022-03-11
Evaluated By jane.doe@gov.bc.ca
Current Archive Targeted
New Site
New Opening
Culverts Location Components Surface Erosion Mass Wasting Stream Characteristics Range Summary Comments
Estimated discharge m3 l/s 5
w Wetted width at bankfull capacity (m) 5
d Average depth of water at bankfull capacity (m) .4
A Stream cross section (m2) 2
P Wetted perimeter (m) 5.8
R Effective radius of stream A over P 0.34
S Stream channel gradient % 2
N Manning coefficient of roughness Boulders
Fish Stream? Yes
V Velocity of stream m/sec mannings formula (m/s) 1.16
D Mannings formula (m3/s) 2.32
Volume of sediment from WQ protocol (m3) 0.40
Time of delivery: duration in days 10 Days
Weight of sediment 1000kgs 0.64
Weight of sediment per second mg over sec 740.74
Concentration of sediment in mg/l over duration 0.32
Turbidity Increase over duration (immediately downstream) (ntu) 0.16
Severity of Ill effect on sensitive fish (immediately downstream) No Effect
BFC Characteristics
Stream roughness
Turbidity table
1 - 5 m wide
5 - 20 m wide
20 - 40 m wide
> 40 m wide
Module 2 FREP WQEE Stream Characteristics


1:53 PM Fri Feb 10
WQEE Field 2022
Video Tutorials
WQEE Field
Map Current Sites
Import
PDF
XLXS
Forest and Range Evaluation Program
Water Quality Resource Stewardship Monitoring
Form 2 Side 1
Opening ID Data
Organization FREP
Sample Site ID 1
Other ID test
District DSC Sunshine Coast
Date Created 2022-03-11
Evaluated By jane.doe@gov.bc.ca
Current Archive Targeted
New Site
New Opening
Culverts Location Components Surface Erosion Mass Wasting Stream Characteristics Range Summary Comments
Total fine sediment generation from surface erosion for site (m3) 0.000
Total fine sediment generation from mass wasting at site (m3) 0.400
Grand total fine sediment for site (m3) 0.400
Total coarse sediment generation (m3) 1.600
Required rating for FREP evaluations Low
Severity of Ill effect on sensitive fish (immediately downstream) No Effect
Potential mass wasting contributions observed Yes
Total impervious area contributing to stream at site (m2) 0
Module 3 FREP WQEE Management Implications
Fisheries impact
Possible Solutions Bar Chart
Water Quality Rating
eMail Pages District Report Template
eMail Word District Report Template
Checklist of Possible Solutions to Reduce Fine Sediment Generation
Location Of Road
Design Of Road & Cutblock
Construction/Harvesting
Management/Maintenance
Deactivation
Other
To be considered in future road alignments
1. Locate road away from stream
2. Avoid steep, unstable slopes or ensure adequate engineering of alignment
3. Avoid stream crossing where lay of land requires road approaches with long gradients flowing towards stream.

Results: By Area (2008-2021)

Score	North (%)	South (%)	Coast (%)	Province (%)
Very Low (<0.2 m3)	29	26	29	28
Low (0.2 – 1m3)	35	45	48	43
Moderate (1-5m3)	25	24	21	23
High (>5m3)	10	5	2	5
Sample size	2464	3290	3759	9513

https://www2.gov.bc.ca/gov/content/industry/forestry/managing-our-forest-resources/integrated-resource-monitoring/forest-range-evaluation-program

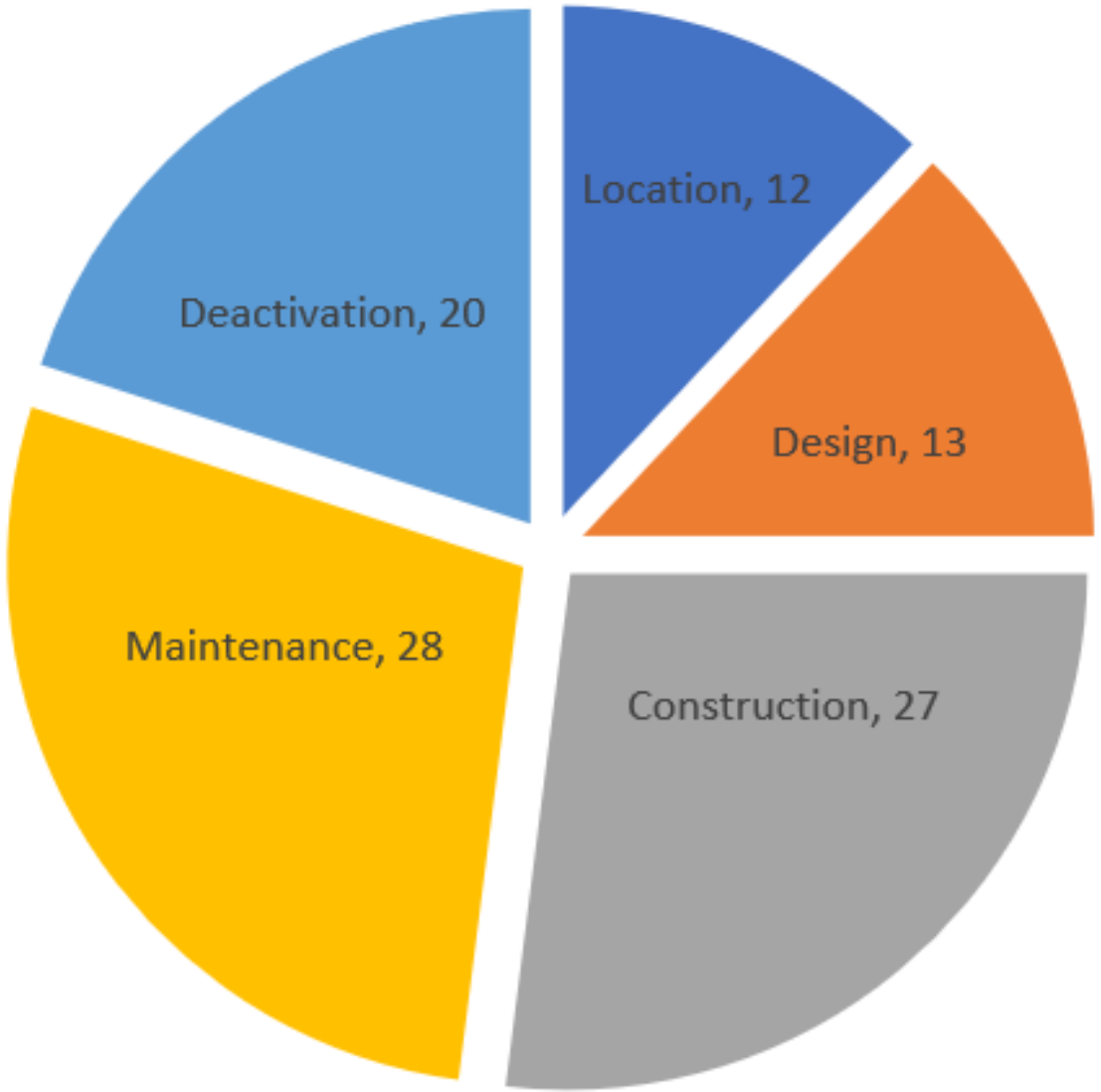
Results: By Year (2021), by Feature

Count of District	Column Labels						
Row Labels	Very Low	Low	Moderate	High	Very High	Grand Total	Mod.+ %
DCC	31	40	25	2		98	28
DCK	13	16	8	1		38	24
DCR	1	2	1			4	25
DCS	27	29	18	4		78	15
DKA	7	15	9	2	1	34	35
DKM	6	5	5			16	31
DMH	7	14	10	1		32	34
DMK	3	3	8	5		19	68
DND	4	4	4			12	33
DNI	13	24	14			51	28
DOS	5	15	12			32	38
DPC		1	4			5	80
DPG	4	5	1			10	10
DRM	38	15	8	1		62	15
DSE	6	6	1			13	8
DSI	7	26	10		1	44	23
DSN	4	8	4			16	25
DSQ	7	22	12			41	29
DSS	12	14	2	5	1	34	24
(blank)							
Grand Total	195	264	156	21	3	639	28
DFN						0	
DQU						0	
DSC						0	
DQC						0	

Count of Road Use	Column Labels						
Row Labels	**Very Low**	**Low**	**Moderate**	**High**	**Very High**	**(blank)**	**Grand Total**
Deactivated	36	42	11	1			90
Light	66	119	58	5	3		251
Moderate	25	68	43	3	3		142
Heavy	7	13	13	7	1		41
(blank)							
Grand Total	**134**	**242**	**125**	**16**	**7**		**524**

Count of Stream class	Column Labels						
Row Labels	**No Effect**	**Slightly impaired**	**Moderately impaired**	**Severely Impacted**	**Undefined**	**(blank)**	**Grand Total**
<1.5	66	8	4	4	246		328
1.5-5	78	4	4	2	88		176
5-20	37				9		46
>20	8				2		10
(blank)							
Grand Total	**189**	**12**	**8**	**6**	**345**		**560**

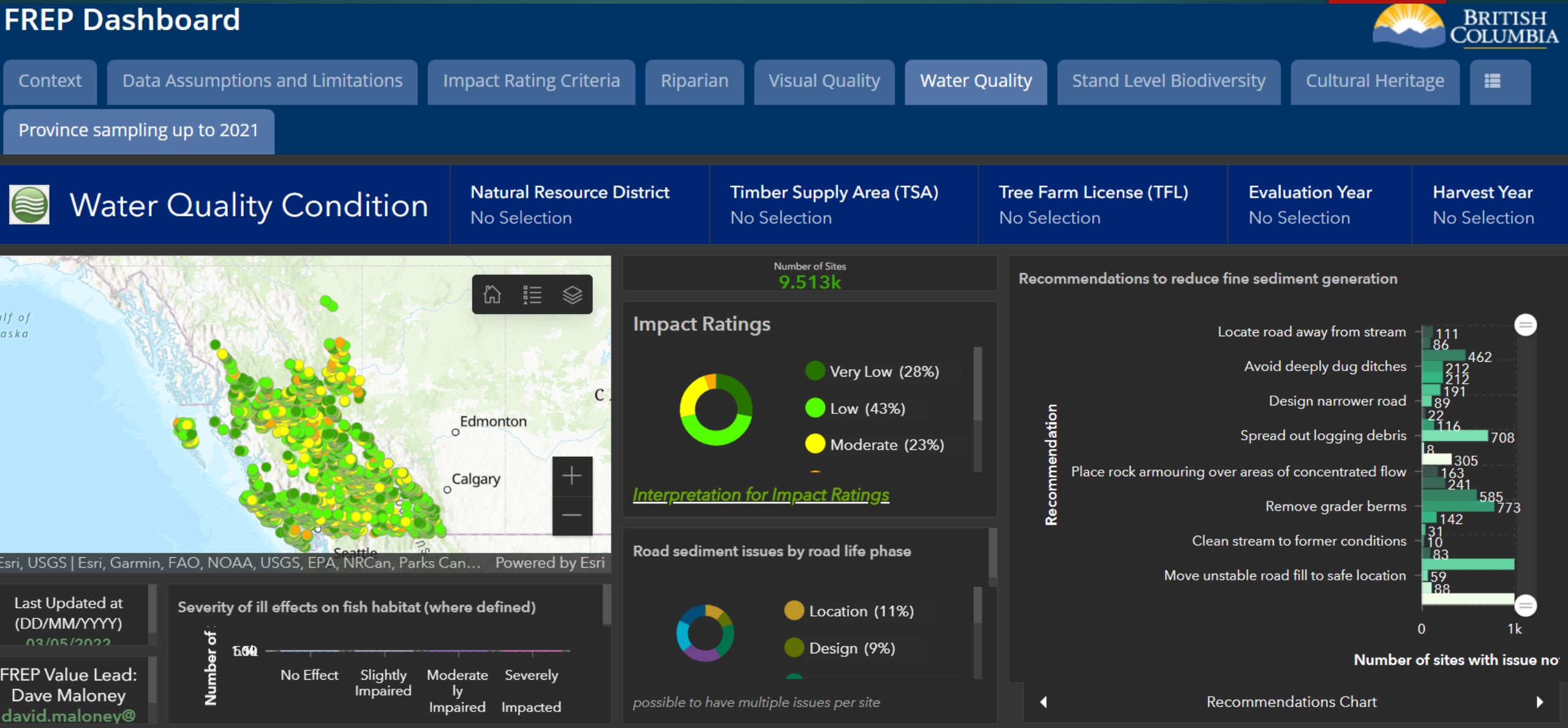
Results: 2008 – 2021 Recommendations for Improvement



Recommendations for improvement (2008-2021)

Road phase	Recommendation	Prov. %
Location	Locate road away from stream	2
	Avoid steep unstable slopes	2
	Avoid stream crossing	8
	Sub-total	**12**
Design	Avoid deeply dug ditches	4
	Plan for sufficient number of culverts	4
	Design bridge deck higher than road grade	3
	Design narrower road	2
	Ensure that remaining trees are wind firm	0
	Sub-total	**13**
Construction	Avoid soil disturbance wherever possible	2
	Spread out logging debris	12
	Avoid compaction of skid trails	0
	Use good quality road materials	5
	Place rock armouring over areas of conc. flow	3
	Construct sediment basin	4
	Sub-total	**26**
Maintenance	Ensure good quality road fill	10
	Manage grader berms	14
	Reduce vehicular traffic during wet weather	3
	Reduce vehicular traffic on road	1
	Clean stream to former condition	0
	Improve range management	1
	Sub-total	**29**
Deactivation	Install strategically placed cross ditches	17
	Move unstable road fill to safe location	1
	Pull culverts armour crossing	2
	Sub-total	**20**
	Total	**5677**

Results: FREP Dashboard



FREP WEBSITE (OR GOOGLE FREP DASHBOARD)

HTTPS://WWW2.GOV.BC.CA/GOV/CONTENT/INDUSTRY/FORESTRY/MANAGING-OUR-FOREST-RESOURCES/INTEGRATED-RESOURCE-MONITORING/FOREST-RANGE-EVALUATION-PROGRAM

Application of Results: District reporting

A FREP water quality assessment was conducted in WFP's Jeune Landing Operation on the Cygl road system and Marine Drive (RO6897) starting in Cutblock 33507.

The FREP Water Quality Effectiveness Evaluation (WQEE) protocol evaluates the potential of forestry disturbed sites (ie roads, landslides) to generate and transport fine sediment to natural water bodies, including fish streams and (or) drinking water sources.

Nine sample locations were assessed. Sample locations and ratings are provided in the attached KML file. Of the 9 sample locations, 8 sample sites were rated as **Low** or **Very Low** and 1 sample site was rated as **Moderate**. One sample site (Sample Site 3) was rated as **Low** but cold easily have become a **High**. A rating of **Low** or **Very Low** indicates good water quality management at the time of sampling and that no action is required. A rating of **Moderate** or **High** indicates some concerns and will have recommendations for improvement. Definitions of the ratings are provided in Table 11 below.

Findings

Sample Site 2-**Moderate**

Photo 2-1

The **Moderate** rating at Sample Site 2 is due to the 100m long section of road and the adjacent unstable cutbank that transport sediment towards the stream. The rating would change to **Low** by:

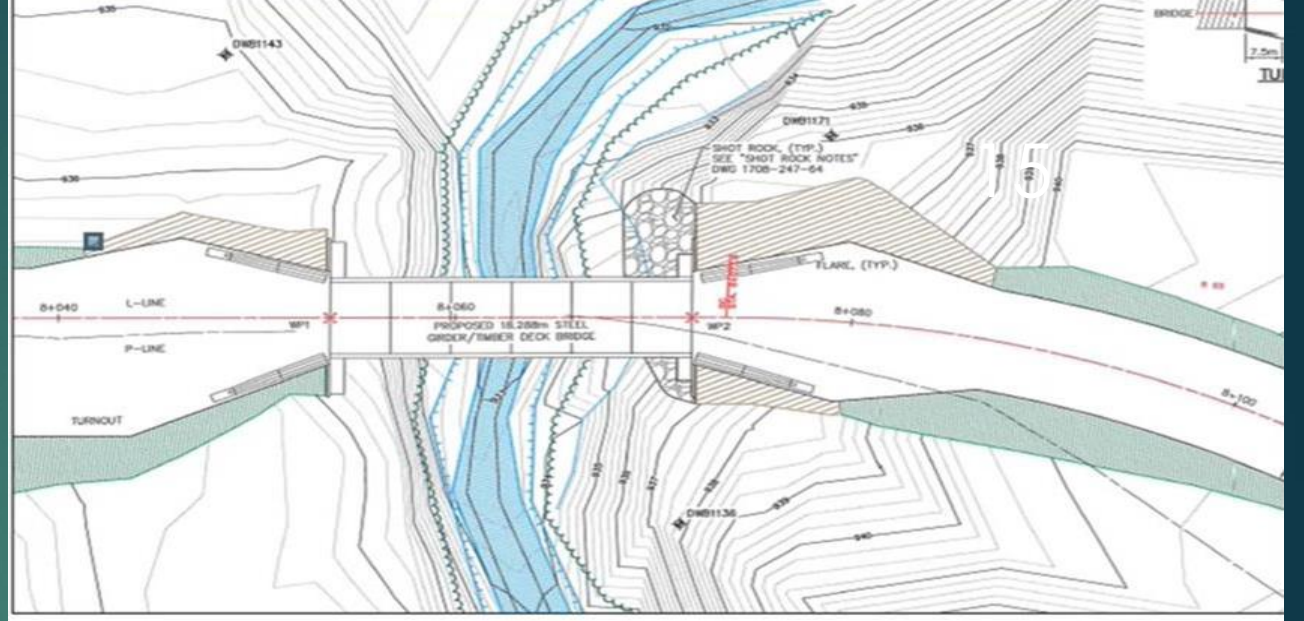
- Installing effective waterbars and/or cross-ditches and ditch blocks at strategic locations
- Stabilizing the erodible portions of the cutbank (armoring, grass-seeding, bio-engineering, spreading logging slash over exposed soil).

Reports can be:

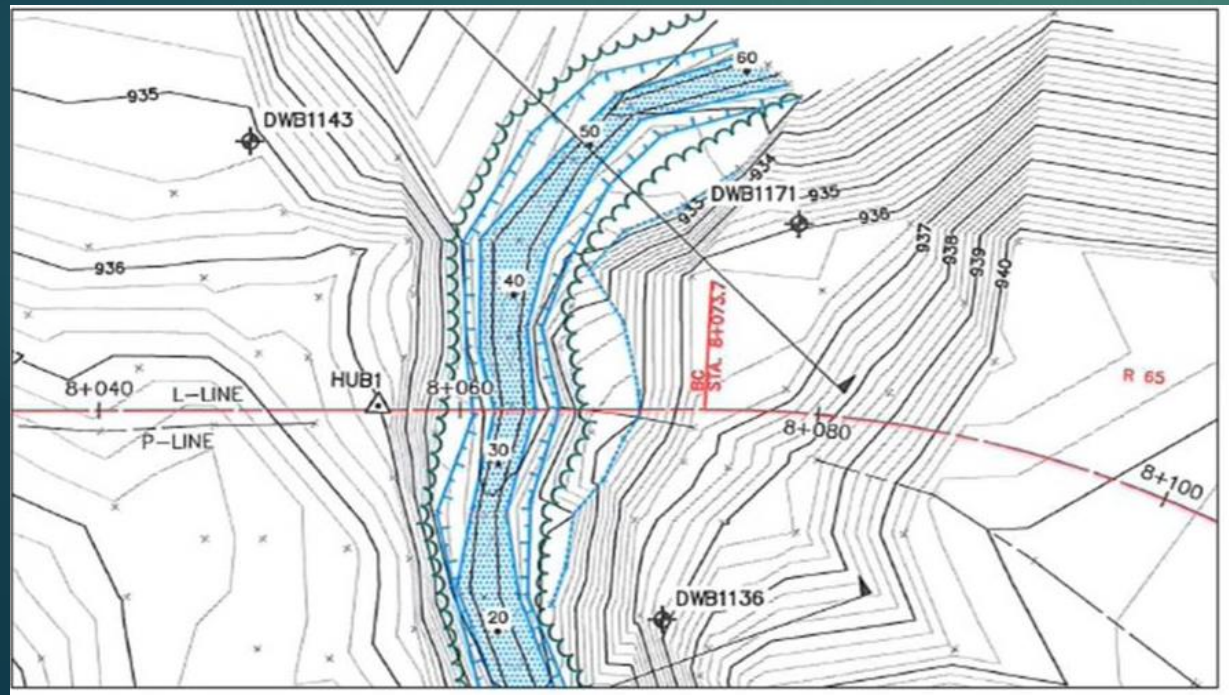
- End of to day to report an emergency situation
- Mini report / end of season – as above
- Data to server requiring reviewed/certified data

Application of Results: Industry partners

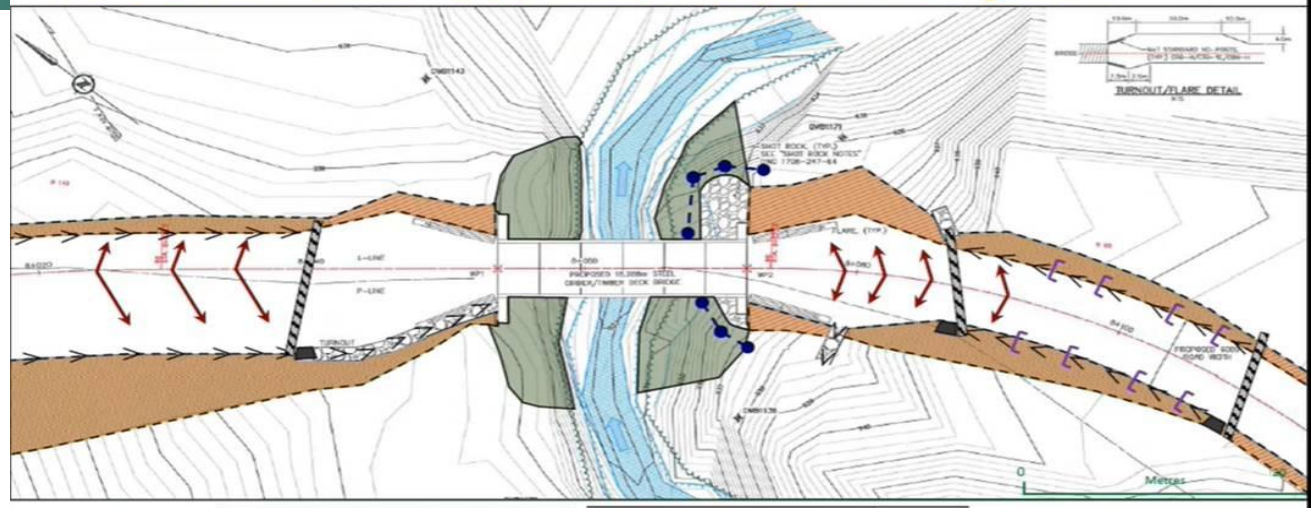
- Awareness of fine sediment as an issue
- Be prepared to manage sediment for all road life stages
- Grader course mandatory
- Communication between resource managers
- FREP WQEE assessment information
- Engineering Manual
- Monitor
- Know what is happening on the ground in your district
- FREP WQEE
- Knowledge / remediation
- Use FREP WQEE data (Moderates/Highs), site remediation
- On-site training - FPInnovations, FREP WQEE, BCTS, licensees



Erosion and sediment control plan



Courtesy of DWB Consulting Services Ltd.



SEDIMENT FENCE	DUFF / VEGETATION RETENTION
WATER BAR	STRAW / WOOD MULCH
WING DITCH	SURFACE ROUGHENING / SEED
DITCH BLOCK	COIR MATTING
COIR LOG	SOIL RETAINING BERM
WATTLE	CULVERT
CHECK DAM	CROWN ROAD SURFACE
SEDIMENT TRAP	BENCH MARK
WOODY DEBRIS BERM	
SCATTER WOODY DEBRIS ON SLOPE	

Courtesy of DWB Consulting Services Ltd.

Application of Results

Chapter 9: Forest Resource Road and Crossing Erosion and Sediment Management

Forest resource roads and crossings are sources of sediment. This chapter provides general guidance for considerations for forest resource road erosion and sediment management for those involved with Forest Service Roads.

Roads and associated crossings should be designed, constructed, inspected, maintained, and deactivated recognizing that they are sources of sediment that can detrimentally impact upon other forest resources such as water quality, fish streams and fish habitat.

Consideration for management of sediment should be made through the life-cycle phases of forest resource roads and crossings. Each phase impacts sediment development and mobilization. It is more effective and efficient to integrate sediment management in road activities than to deal with it in a reactive manner. Plan all activities to minimize the potential for sediment development and movement.

FLNRORD Engineering Manual - engineering roads policy, procedures, guidance manual for engineering activities associated with forest and resource roads

Chapter 9: Forest Resource Road and Crossing Erosion and Sediment Management

9.1 Road and Crossing Life Cycle Phases and Sediment
- 9.1.1 Planning and design
- 9.1.2 Construction
- 9.1.3 Inspection
- 9.1.4 Maintenance
- 9.1.5 Deactivation

9.2 Resources

https://www2.gov.bc.ca/gov/content/industry/natural-resource-use/resource-roads/engineering-publications-permits/engineering-manual/resource-road-and-crossing-erosion-and-sediment-management#life_cycle_phases

FREP WQ Reports & Publications

- Sustainable Forest Management Practices
- Timber Supply Review & Allowable Annual Cut
- Forest Inventory
- Forest Health
- Soil Conservation
- Forest Stewardship Plans
- Silviculture
- Wildfire Management
- Tree Seed
- Visual Resource Management
- Integrated Resource Monitoring
  - Integrated Monitoring Reports
  - Forest & Range Evaluation Program
    - FREP Monitoring Protocols
    - FREP Multiple Resource Value Assessments
    - **FREP Reports & Publications**
- Managed Resource Features

FREP Reports & Publications

The Forest & Range Evaluation Program (FREP) produces a variety of publications such as scientific reports, annual reports and newsletters. Click on the drop-down arrows below for more information and to view the individual publications.

Expand All | Collapse All

- **FREP Assistant Deputy Minister's Reports**
- **FREP Multiple Resource Value Assessment (MRVA) Reports**
- **FREP Reports**
- **FREP Extension Notes**
- **FREP Technical Guidance**
- **Watershed Status Evaluation Reports**
- **FREP Newsletters**
- **Strategic Plans**
- **Annual Reports**

Subscribe

Enter your email address to subscribe to updates of this page.

Email

Email addresses are collected under section 26(c) of the Freedom of Information and Protection of Privacy Act, for the purpose of providing content updates. Questions about the collection of email addresses can be directed to the Manager of Corporate Web, Government Digital Experience Division. PO Box 9409, Stn Prov Govt, Victoria, BC V8W 9V1

Submit

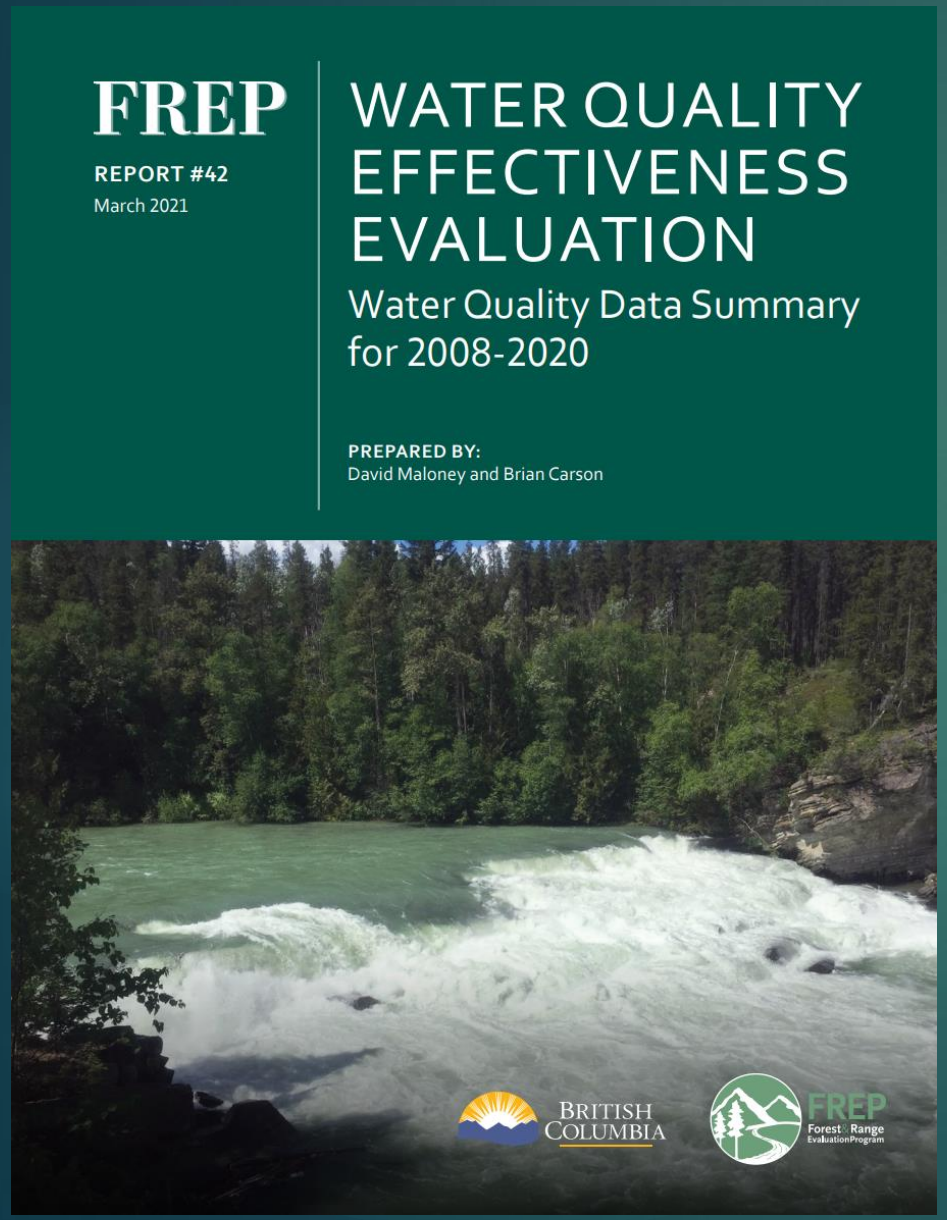
Contact Information

For more information about the program:

- FREP@gov.bc.ca

https://www2.gov.bc.ca/gov/content/industry/forestry/managing-our-forest-resources/integrated-resource-monitoring/forest-range-evaluation-program/frep-reports-extension-notes

FREP WQ Reports and Publications



Links to FREP extension notes and reports:

- FREP Extension Note #7 (PDF, 1.4MB): Why the Forest and Range Evaluation Program is Important to You as a Forest Manager and Decision Maker
- FREP Extension Note #12 (PDF, 2.3MB): What is a Water Quality Effectiveness Evaluation?
- FREP Extension Note #22 (PDF, 1.2MB): Summary of Provincial Water Quality Effectiveness Evaluation Results (2008-2010)
- FREP Extension Note #29 (PDF): Water Quality Effectiveness Evaluation Results (2008-2012): Results and Opportunities For Continued Improvement
- FREP Extension Note #31 (PDF): Potential Uses of the FREP Water Quality Effectiveness Evaluation Procedure
- FREP Report #42 (PDF, 7 MB): Water Quality Effectiveness Evaluation: Water Quality Data Summary for 2008-2020
- The FREP WQ app is available to everyone (free)
- FREP WQ app protocol at: https://www2.gov.bc.ca/assets/gov/farming-natural-resources-and-industry/forestry/frep/protocol-documents/2018_wqee_protocol.pdf

Thank you