Field Assessment for Determining Fish Passage Status Of Closed Bottom Structures

BC Ministry of Environment

4th Edition

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Contents

1 Introduction

Lack of fish passage at road crossings continues to be a significant concern in British Columbia (Northcote and Hartman 2004). Surveys in the province and other jurisdictions consistently show that many culverted road crossings do not allow fish to pass (United States Government Accounting Office 2001; Northcote and Hartman 2004, Chesnut 2002, Forest Practices Board 2009) because of issues related to velocity, turbulence, and perching. Culverts may be impassable under all flow conditions or only during some flow velocities / fish life stages (e.g., juvenile vs. adult); many require retrofitting or replacing with more effective designs (Stream Enhancement Research Committee et al. 1980; Slaney and Zaldokas 1997).

The protocol presented here summarizes the field component (Data Collection Phase) of a systematic, watershed-based process used to determine and restore fish passage at culverted fish-stream crossings. This process is outlined in a document entitled **The Strategic Approach: Protocol for Planning and Prioritizing Culverted Sites for Fish Passage Assessment and Remediation** and illustrated in Figure 1 and available at http://www.for.gov.bc.ca/hcp/fia/landbase/standards/fishpassage.htm. The results of these assessments are used in the process to develop an implementation plan for fish passage restoration.

This version (4th edition, 2011) represents a significant update to the protocol. While the basic indicators and measurements remain unchanged, the process for collecting and submitting the data to the Provincial Government has evolved with the creation of a dedicated database. This database is called the Provincial Stream Crossing Inventory System (PSCIS) and will house all Fish Passage Culvert Inspection data in one central repository. This database will also house design and remediation information for those sites which have been repaired. Having all of this data in one system will allow government and clients to view the data spatially allowing spatial analysis and improved decisions regarding priorities for restoration.

This field assessment provides a procedure to quickly answer the question: *"Does this stream crossing likely provide safe fish passage?"* The objective is to effectively answer this question in as little on-site time as possible. The protocol uses a cumulative scoring approach because determinations of fish passage often involve evaluating a suite of indicators, that assessed in combination, may result in fish failing to pass, rather than assigning a simple yes/no response to a single threshold value.

Some background to this protocol follows this introduction. Section 3 outlines the required field information to collect and Section 4 provides the means to determine the likelihood that a crossing is a barrier to fish passage. The last two sections of the protocol describe the data submission (Section 5) and the use of the assessment results. Appendix 1 contains an example of the field form used to collect assessment data.

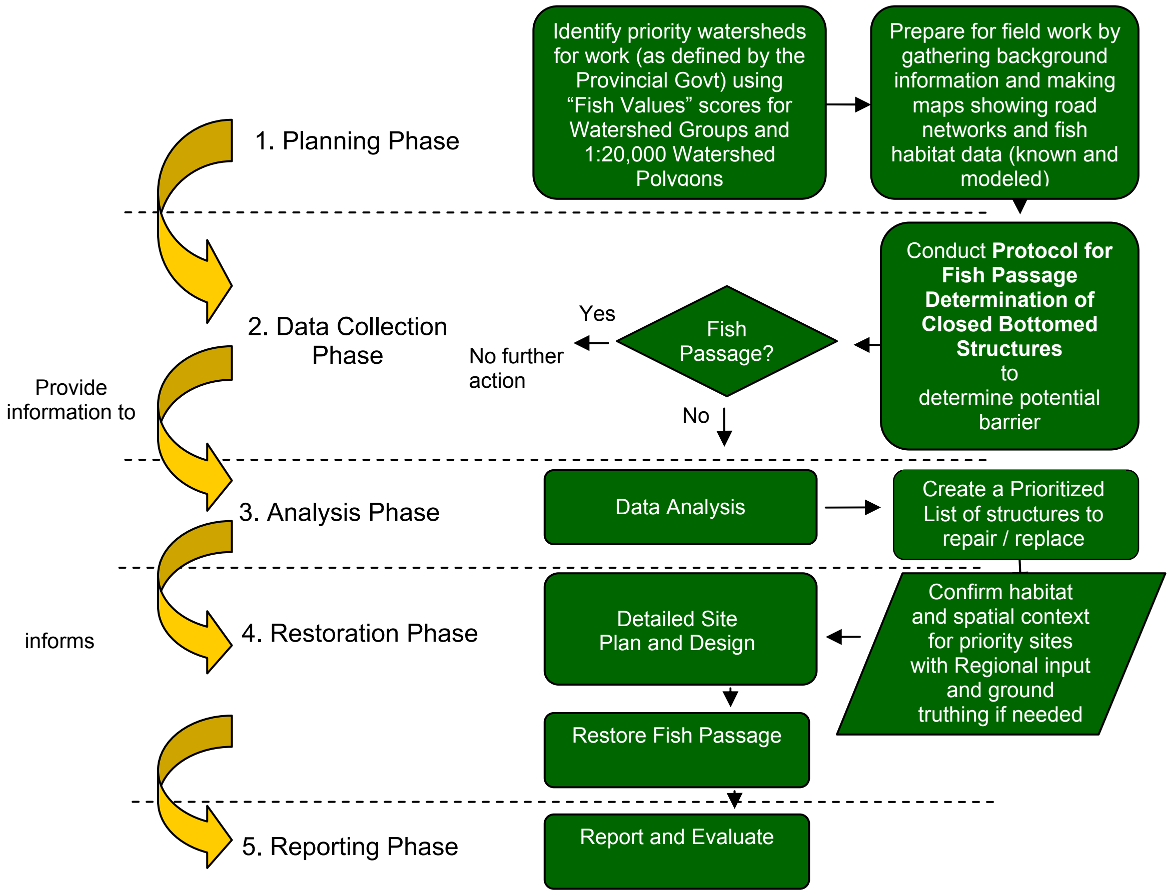

Figure 1: Strategic Approach for Restoring Habitat Upstream of Culverted Crossings

2 Background to the Protocol

Stream crossings are generally grouped into two main types—open bottom structures (OBS) and closed bottom structures (CBS). Open bottom structures include bridges and open bottom culverts (log and arch culverts). The most common closed bottom structures used on fish streams are corrugated pipes (primarily metal), which are ideally embedded to retain stream substrate and to provide fish habitat and passage.

If CBS are not embedded and are placed on excessive slopes or where they constrict the natural stream channel, then one or more of the following conditions may jeopardize fish passage:

- A drop at the outlet (downstream end of the culvert)
- Excessive velocities and (or) turbulence inside the culvert
- An area of high water velocity acceleration at the inlet
- Excessive length or slope within the culvert

This protocol focuses on CBS because of problems associated with fish passage if these structures are not properly designed, installed and maintained (Slaney and Zaldokas 1997). It is based on principles related to those hydraulic conditions within, above, and below a stream crossing that are necessary to provide safe fish passage. The measurement of hydraulic surrogates allows the assessment to be done over a wide range of stream conditions and have a consistent comparable result. It should be noted, however, that "proving" fish passage is beyond the scope of this protocol. Conclusive proof of fish passage requires more detailed data on water velocity at different flow stages combined with fish sampling (minnow traps and electro-fishing) both up and downstream of culverts. Nevertheless, the assessments outlined here enable reasonable inferences to be made about the effectiveness of fish passage and the impact on fish habitat at these locations.

Finally, the purpose of this protocol is to determine the likelihood that a culverted stream crossing provides safe fish passage; it should not be construed as providing design guidelines (for information on design, see the Fish Stream Crossing Guidebook, B.C. Ministry of Forests et al. [2002]) . For instance, if a closed bottom culvert has adequate embedding material that is only 30 cm deep in some parts, it will likely pass fish. However, this depth of embedding would be inadequate for a new design that requires deeper embedding to ensure adequate roughness and cover and reduce the likelihood that the material will scour out.

3 Field Protocol

For most stream crossings, the required field measurements should take no longer than 10-15 minutes. For safety and efficiency, a crew of two should complete the assessments.

Equipment List

- rod and level (rod 5 m or longer for use where large fills are encountered)
- GPS unit
- clinometer
- 30 m fibre tape
- meter stick or carpenters measuring tape
- digital camera (set to the appropriate image resolution)
- waders / boots
- spare batteries for all electronic devices
- data sheets and pencils
- felt pen and flagging tape
- white board dry erase pen(optional)
- laser range finder (optional)
- safety vest and other appropriate safety equipment (sunglasses, first aid kit, radio for active haul roads, etc.)

3.1 Crew Training

The field assessment was designed to be undertaken by a two-person crew: one with a strong background in fish habitat and the other with relevant expertise in designing, costing, and installing different types of stream crossings. It is important that all members of the field assessment crew receive training regarding the application of this protocol. **http://www.for.gov.bc.ca/hfp/fish/Fish_Passage_Training/player.html** **.** This ensures not only that the mechanics of the assessment are understood but, more importantly, that the concepts underlying the mechanics are understood.

3.2 Data Collection

The information collected through the Assessment Methodology (see Field Form Appendix 1) falls into five broad categories as follows:

1. Location and Overview Information (i.e. date, UTM Co-ordinates in ZEN format, stream name, road name, etc.)
2. Field Observations and Assessment Measurements (i.e. crossing types, culvert size, outlet drop, slope, channel width, etc.)
3. Stream Information – (i.e. stream width, stream slope, habitat value, etc.)
4. Scoring Data – these values are automatically calculated by the spreadsheet to determine the pass / fail status of the crossings
5. Recommendations – (i.e. crossing fix, comments, etc.)

NOTE: Data collection requirements vary depending on the type of structure present at the site.

- ***Closed Bottom Structures on fish streams collect all of the data in section 3 plus 5 photos.***
- ***Open Bottom Structures on fish streams collect a limited set of data…. all of the location information Section 3.2.1 and the crossing type, span and width from section 3.2.2 plus 5 photos.***

Figure 2 illustrates some of the terminology used in these assessments.

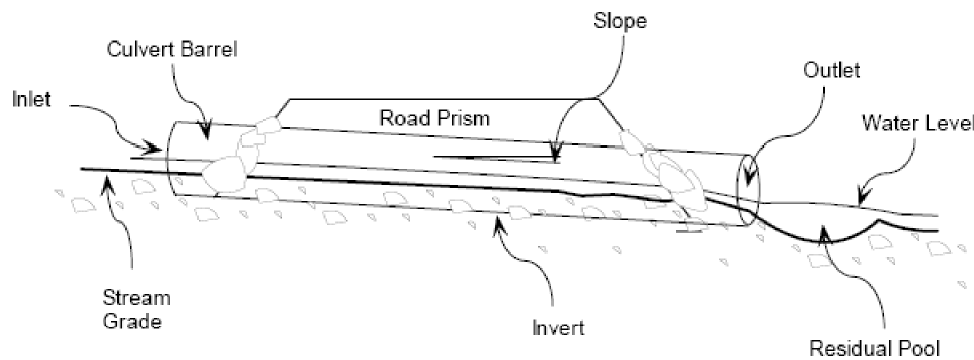

Figure 2: **Culvert Terminology**

All of the data fields outlined in this section should be completed at the time of field assessment for all CBS on fish streams. While not all the information collected is required to determine whether this crossing is a barrier, the baseline data recorded for the crossing provides a reference for further monitoring and helps facilitate the planning of a suitable retrofit or replacement.

The unit of measure has been standardized to meters for all linear measures. Record all measurements to two decimal places (i.e., outlet drop 1.31 m, 0.36 m, etc.). Slopes are measured in percent

The components of the field assessment are described below. Appendix 1 contains an example of a hard copy field form. Alternatively, crews may enter the data directly into the PSCIS Assessment Data Submission Template if they choose to have a laptop in the field with them. Regardless of the method used to record the data in the field, all assessment data must be submitted using the PSCIS Assessment Data Submission Template.

3.2.1 Location and Overview Data

Date of Assessment: (YYYY-MM-DD) The date when the assessment was completed.

PSCIS Crossing ID: The Provincial Stream Crossing Inventory System (PSCIS) generated crossing ID. It is only necessary to fill this field in if this is a re-assessment and a **PSCIS Crossing ID** has already been assigned to the site. If this is a first assessment, leave this field blank

My Crossing Reference: Assign a unique number for each crossing surveyed. This is for assessor data management purposes and can be cross-referenced with your field notes, report and maps so that information collected at the site can be retrieved at a later date.

Crew Members: The initials of the crew members taking measurements.

Note: It is good practice to flag each site assessed. Mark the flagging with Date, Crossing Reference and Crew Members initials. It will help with relocation of sites for design or further quality assurance monitoring.

UTM Zone : UTM Zone of the crossing at the longitudinal centre obtained by GPS (NAD 83)

UTM Easting : UTM Easting co-ordinate of the crossing at the longitudinal centre obtained by GPS (NAD 83)

UTM Northing: UTM Northing co-ordinate of the crossing at the longitudinal centre obtained by GPS (NAD 83)

These are strictly numeric fields – no letters or other information is required. Keep GPS unit turned on during the entire time on-site to derive as accurate a co-ordinate as possible.

Stream Name: Enter name from maps; if no name is given for the watercourse, then record the stream that it is a tributary to (e.g., "Trib. to Bear Cr.").

Road Name : Enter the road name (and branch) by which it is best known (e.g. Branch 2, Owen Lake Forest Service Road).

Road Kilometer Mark: The road kilometer position of the crossing to the nearest 0.1 km, matching the kilometer markers, if present.

Road Tenure : The best available ID for the Road at the time of assessment. For example, the Forest File ID of a Road Permit or Forest Service Road.

3.2.2 Field Observations and Assessment Measurements

Crossing Type (pick list): Select the appropriate crossing type: *Open Bottom Structure (OBS), Closed Bottom Structure (CBS), Other*

Crossing Subtype (pick list): Select the appropriate crossing subtype: Valid Subtypes depend on Crossing Type. *Open Bottom Structure* subtypes are *Bridge*, *Pipe Arch* and *Wood Box Culvert*. *Closed Bottom Structure* subtypes are *Round Culvert, Oval Culvert* and *Concrete Box*. *Other* subtypes are *Ford*

Diameter or Span (meters, to the nearest 0.01m): For round culverts, measure diameter with tape or meter stick at the outlet. For other shapes (e.g., a pipe arch or bridge), measure the width/span. For culvert crossings with multiple pipes, record the primary dimensions for the pipe that is lowest in elevation at the outlet.

Note: For the barrier determination use the metrics from the pipe lowest in elevation at the outlet. For pipes installed at the same elevation at the outlet, add diameters for SWR criteria and use the highest slope, and length measurement.

Length or Width (meters, to the nearest 0.01m): If it is a culvert, the length of the structure is measured from the outlet to the inlet. Measurement can be made quickly using a laser range finder by either sighting through the pipe with your field partner at the other end, or measure road surface and then estimate distance from road surface to each end of the pipe and sum the three numbers.

If the structure is an open bottomed structure, provide the width of the road running surface.

Continuous Embeddedment? Yes/No: An indicator value identifying if the culvert is continuously buried in the stream substrate throughout its entire length.

Note: for a culvert to be considered continuously embedded you should not be able to see any bare culvert along the length of the invert. For example a culvert that has material both at its inlet and outlet but has bare sections in the middle is not a continuously embedded culvert. Similarly a culvert that has large boulders scattered throughout its length but the intervening areas are bare pipe is not a continuously embedded culvert.

Figure 3: Example of a continuously embedded culvert

Average Depth Embededdment (meters, to the nearest 0.01m): If answer to previous field = N, then this value is not needed.
If answer to previous field = Y, then provide the average depth of the substrate within the culvert.

The average depth of embededdment for a round culvert can be obtained by measuring the distance from the top of the culvert to the top of the stream substrate and subtracting this number from the culvert diameter. Take this measurement at both the inlet and outlet and average the two numbers. (For elliptical culverts or pipe arches where the height is known the measurement is similar. If the height is not known then some attempt should be made to estimate the depth of substrate through direct measurement such as moving some substrate).

Resemble Channel: (YES/NO) Refers to whether or not the bed of the culvert resembles the native streambed e.g. if the culvert has been filled with coarse angular shot rock and the streambed above and below the culvert consists of a mix of cobbles, gravel and sands you would mark NO… the material does not resemble the native streambed.

Backwatered?: (YES/NO) Backwatering refers to the damming (or back-up) of water as a result of a downstream control (e.g., weir or debris jam). This slows water flow and raises water height above the invert of the CBS. Backwatered conditions are easy to recognize: simply throw a rock in the water. If the waves from the thrown rock move upstream before being washed downstream, then backwatering or damming is occurring downstream. Also, backwatered areas have minimal water surface slopes and often have a glassy or relatively smooth appearance.

Percent Backwatered: If answer to previous question = NO, this value is not needed. If answer to previous question = YES, provide the percentage of total culvert length that the outlet pool fills back into the culvert.

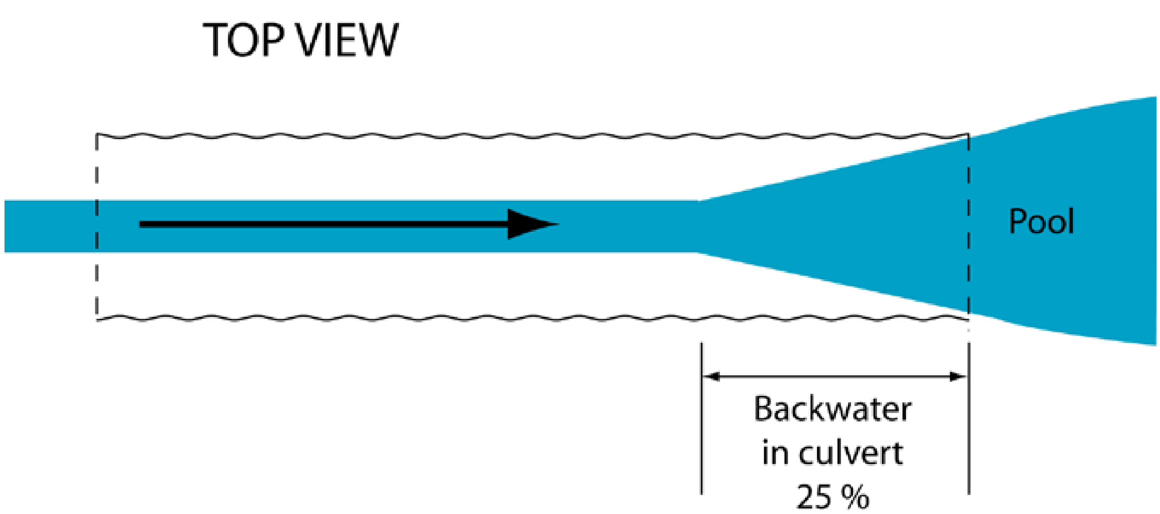

Figure 4 – Culvert Backwatering

Fill Depth (meters, to the nearest 0.01m): Record the average depth of road fill over the culvert. This measurement is used to estimate the cost of removal during the analysis phase of the overall protocol document

Outlet Drop (meters, to the nearest 0.01m): Outlet drop is the distance from the invert (bottom) of the culvert to the top of the residual pool. The residual pool is the pool that would remain at the point that water just stops flowing out of the pool. To measure this distance you need to take two measurements and sum A + B as shown in figure 5. **A** is the distance between the culvert invert and the top of the current water level (ToP). **B** is the height of the outlet control or the height from the top of the current water level (ToP) to the bottom of the outlet control (BoC). To determine the bottom of the outlet control you can probe a cross section of the stream at the outlet of the pool and find the deepest point. Measure from the bottom of the stream to the top of the current water level.

Note: The measurement is made to the residual pool as this ensures that the measurement is consistent regardless of the current flow in the stream. The height of the residual pool can be estimated even when the stream is dry or no longer flowing by using your 30 meter tape to create a level line from the deepest point along the outlet control to an area below the culvert invert and then measuring from the invert of the culvert to your level tape (the level tape simulates the top of the water for the residual pool).

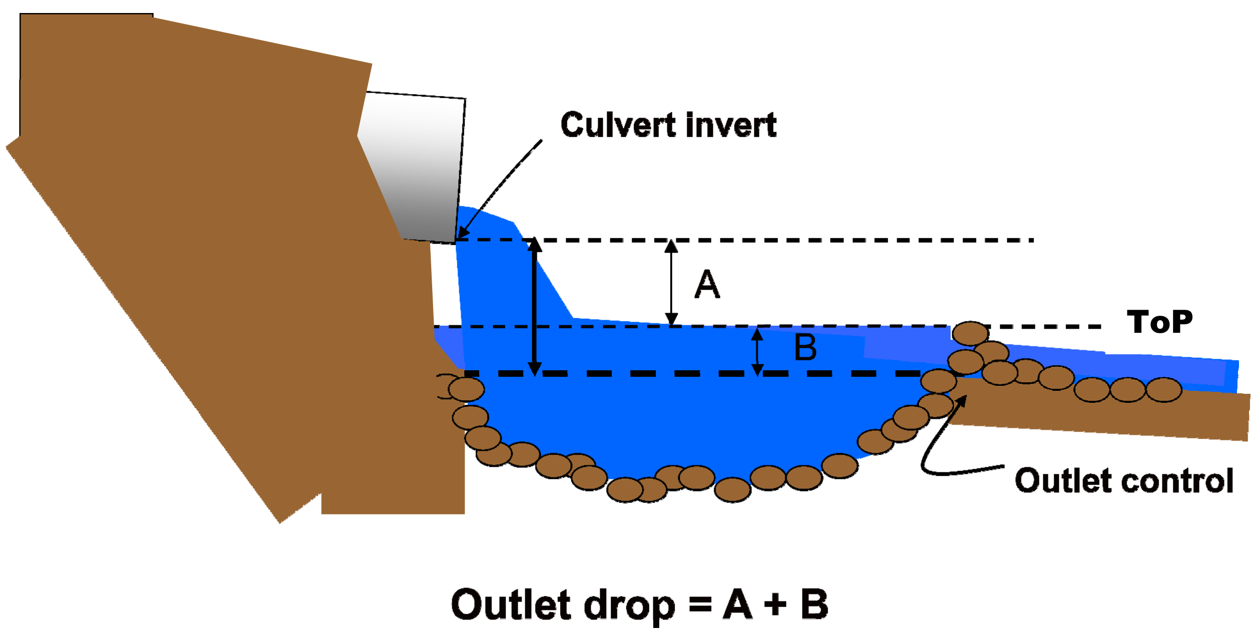

Figure 5 – Determination of Outlet Drop

Outlet Pool Depth (meters, to the nearest 0.01m): Record the residual Outlet Pool Depth (OPD) by measuring the current water depth in the pool downstream of the crossing and then measure and subtract the current water depth at the outlet control (figure 6). Note the measurement B for calculation of the residual pool depth is the same measurement as B in the outlet drop measurement.

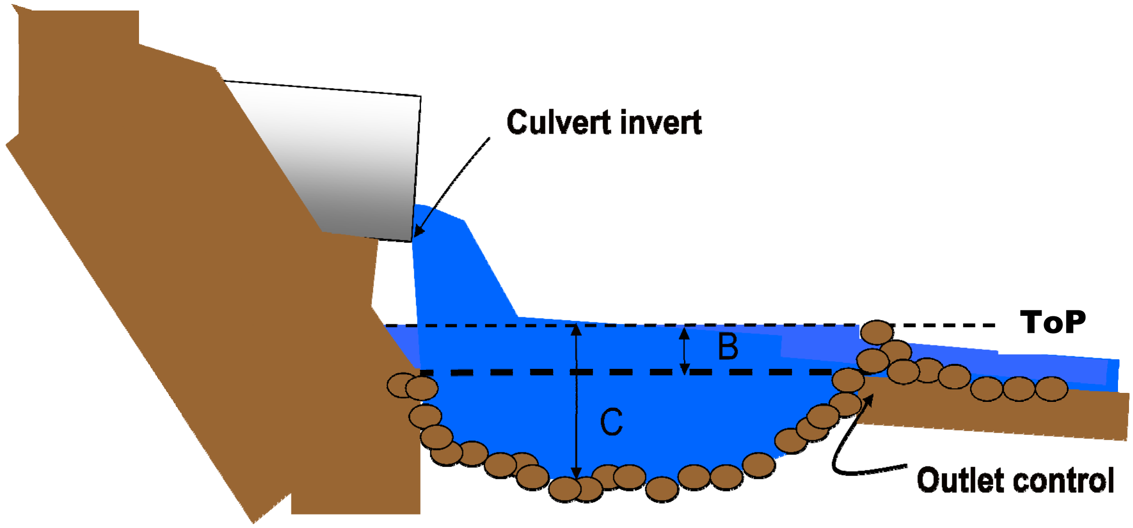

Figure 6 – Determination of residual Outlet Pool Depth

Inlet Drop: (YES/NO) Choose Yes or No in response to the following question: Is there a drop between the streambed elevation and the invert of the culvert at the inlet?

An inlet drop exists when the water level drops suddenly at a culvert inlet, causing increases in water speed and turbulence. Inlet drops usually occur as the result of material accumulation (rock, streambed material, woody debris) at the culvert inlet. These velocity jumps can be physical barriers to fish and other aquatic organisms when they are swimming upstream and are unable to swim out of the culvert.

Culvert Slope (%): Looking upstream in the culvert, estimate its slope using a clinometer (i.e., sight on a common spot in the culvert such as bolt line or the top of the culvert upstream). If the initial culvert slope is 4% or greater, then record the estimated slope (%). If the initial reading is less than 4%, then measure the slope using a more precise instrument such as a level (nearest 0.1 %).

3.2.3 Stream Information

Channel Width (meters, to the nearest 0.01m): Stream channel width is the horizontal distance between the opposite stream banks, measured at right angles to the general orientation of the banks (see Figures 7 and 8). The methodology followed here is identical to that in the Fish-stream Identification Guidebook (B.C. Ministry of Forests 1998) except that only three widths are required. To avoid measuring channel width in an area influenced by road clearing or culvert flows, take measurements below the influence of the outlet, usually downstream of the road right-of-way (clearing width).

The width measured is the active width during normal high water, not the width that appears wetted when taking the measurements. The point on each bank from which width is measured is usually indicated by a definite change in vegetation and sediment texture. This border is sometimes shown by the edges of rooted terrestrial vegetation. Above this border, the soils and terrestrial plants appear undisturbed by recent stream erosion. Below this border, the banks typically show signs of both scour and sediment deposition. Indicators of high water may also include evidence of staining from turbid water, pieces of drift caught on vegetation (these look like small bird nests), and the crest of banks on low-gradient, unconfined alluvial streams.

Multiple Channels

To determine the stream channel width where multiple channels are present, include all un-vegetated gravel bars in the measurement (these usually show signs of recent scour or deposition). If multiple channels are separated by one or more vegetated islands, then calculate the width as the sum of all the separate channel widths; exclude the islands from the measurement.

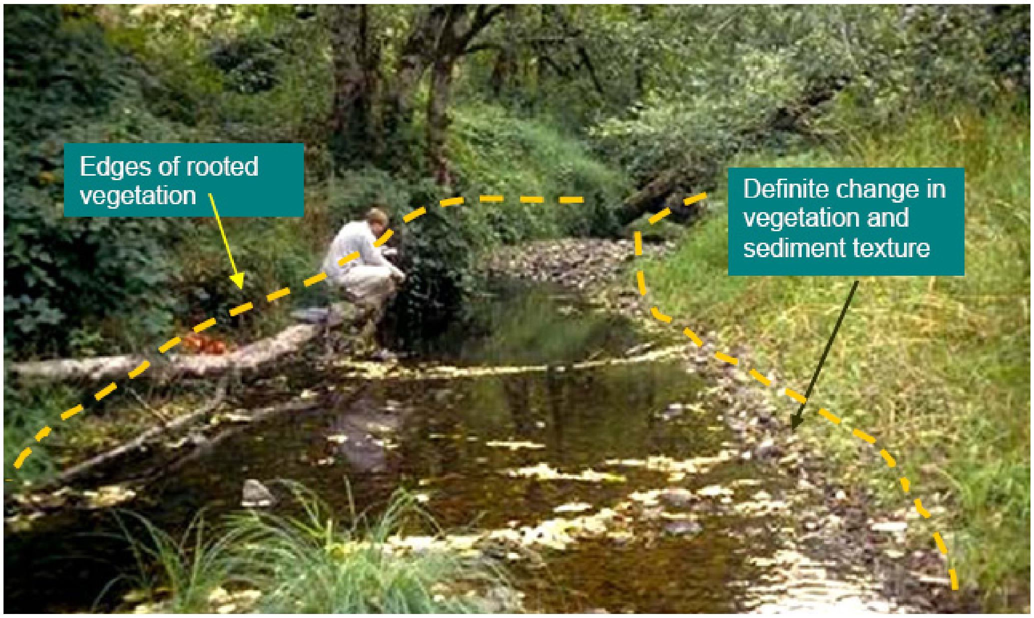

Figure 7 : Photographic example of Stream channel width

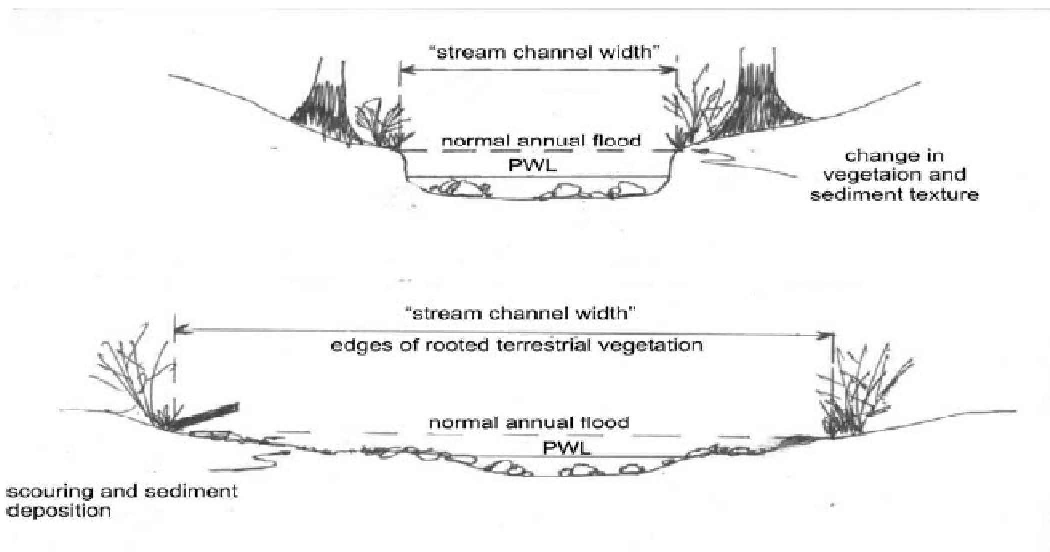

Figure 8: Illustrations of stream channel width.

Wetland or Lake Immediately Downstream

If a lake or wetland occurs immediately downstream from the road crossing, take the channel width measurements upstream of the crossing, instead of downstream. Take several channel widths to obtain an accurate width measurement that is free of crossing effects. If the crossing has lakes or wetlands immediately upstream and downstream, then record the structure width as the stream channel width, which will result in a Stream Width Ratio of one. In this case, record some comments about the size of the culvert and any evidence of overtopping. Overtopping evidence includes drift material on the crossing fill at a higher elevation than the crossing, or indications of water erosion on the road surface.

This information is used in identifying potential remedies (i.e. depth of fill, valley fill, habitat value etc.) and assists in establishing priorities for restoration.

Stream Slope (%): Measure the slope of a section of stream either upstream or downstream of the culvert using a clinometer. If the stream is at the confluence of a lake, wetland, or larger river, then measure the slope of an upstream section beyond the influence of the road right-of-way.

Beaver Activity: (YES/NO) . Evidence of beaver activity is usually most pronounced on the upstream (inlet) side of the culvert. This is a maintenance issue and may influence restoration options. Devices or fencing will often be installed to inhibit beaver activity at the inlet. If beaver devices (such as cages) or fencing occur near the inlet, then record this as beaver activity and describe the device in comments. Take extra photographs of the situation.

Fish Sighted: (YES/NO) If fish are observed at the crossing, at the time of assessment, then circle Yes on the form. Note where the fish were seen i.e. upstream, downstream, etc. This field is not intended to present other fish inventory findings from other studies. This type of information should be presented in the report.

Valley Fill (Deep Fill/Shallow Fill/Bedrock): Circle the appropriate code in response to the question: Is there evidence of a deep valley, or is the stream running on bedrock, or is it on shallow fill over bedrock? For wide valleys the answer is usually deep fill (DF). If bedrock occasionally shows along the bed or banks of the stream, then shallow fill (SF) will be the answer. If a large area of bedrock is evident, then the answer is bedrock (BR). This attribute is important in determining whether a closed bottom structure streambed simulation is appropriate as a possible replacement design. Bedrock or shallow fill will make it difficult or impossible to properly embed a culvert for a streambed simulation.

Habitat Value (High/Medium/Low): Evaluate the habitat value at the crossing site and record as High, Medium, or Low. When evaluating, try to achieve consensus among assessment team members as this is a somewhat subjective value. Place particular emphasis on habitat upstream of the CBS as this is the habitat that will be gained if and when fish passage is restored. Table 1 presents some habitat value criteria to guide the evaluation.

Table 1: Habitat Value Criteria

Habitat u/s of Crossing Site	
	Fish Habitat Criteria
High	• The presence of high-value spawning or rearing habitat (e.g. locations with abundance of suitably sized gravels deep pools, undercut banks, or stable debris, which are critical to the fish population downstream of the subject crossing
Medium	• Important migration corridor • Presence of suitable spawning habitat • Habitat with moderate rearing potential for the fish species present
Low	• The absence of suitable spawning habitat, and habitat with low rearing potential (e.g. locations with distinct absence of deep pools, undercut banks, or stable debris, and with little or no suitably sized spawning gravels for the fish species present

Comments: Include any relevant comments that may assist in determining barrier or recommending solution.

3.2.4 Scoring Data

The next section reflects the scoring values used to determine whether the closed bottoms structure is passable, possible barrier or a barrier. If the field data is entered into the excel spreadsheet the data template is automatically populated using the values that were entered. The scores are calculated as follows:

Culvert Length Score: Fish Barrier Scoring. Culvert Length scores are <15m = 0, 15-30m = 3, >30m = 6

Embeded Score : If there is not continuous embeddedment, then score = 10.
If continuous embeddedment is present but less than 20% of pipe diameter or less than 30cm deep, then score = 5.
If continuous embeddedment is present and greater than 20% of pipe diameter or greater than 30cm deep, then score = 0.

Outlet Drop Score: Fish Barrier Scoring. Outlet Drop scores are <15cm = 0, 15-30cm = 5, >30cm = 10

Culvert Slope Score: Fish Barrier Scoring. Culvert Slope scores are <1% = 0, 1-3% = 5, >3% = 10

Stream Width Ratio: The Stream Width Ratio is simply the ratio determined by stream channel width over the culvert width shown as:

$$\frac{\text{Channel Width}}{\text{Culvert Width}}$$

SWR Score : Fish Barrier Scoring. Stream Width Ratio scores are <1.0 = 0, 1.0-1.3 = 3, >1.3 = 6

Final Score : Fish Barrier Scoring. Sum of Fish Barrier Scoring values. Scores of 0-14 indicate passable, 15-19 are potential barriers, and >20 is a barrier

Barrier Result: Evaluation of the crossing as a barrier to fish passage, based on FINAL_SCORE. (Passable/Potential barrier/Barrier)

3.2.5 Recommendations

Crossing Fix: If the stream fails to meet fish passage criteria and the assessment team concludes that it does not pass fish (see Section 4), recommend an appropriate fix from the following (choose one):

1. **Removal** – (RM) Complete removal of the structure and deactivation of the road if access is not required. May not be able to conclusively decide this at time of assessment
2. **Open Bottom Structure** –(OBS) Replacing the culvert with a bridge or other open bottom structure. Note proposed span and any other aspects of OBS deemed relevant.
3. **Streambed Simulation** - (SS) Replacing the structure with a streambed simulation design culvert. Note proposed length of culvert.
4. **Additional Substrate Material** – Add additional substrate to the culvert and/or downstream weir(s) to reduce overall velocity and turbulence and provide low velocity areas. *Note: This option should be considered only on sites where there is no Outlet Drop (OD), culvert slope < 1.0 %, Stream Width Ratio (SWR) less than 1.0. Design and installation should not impact flood event design.*
5. **Backwater** - Backwatering the structure to reduce velocity and turbulence. *Note: This option should be considered only on sites where OD < 30 cm., slope < 2.0 %, Stream Width Ratio (SWR) less than 1.2 and stream profiling indicates it would be effective. Design of downstream weirs should be given careful consideration and based on a detailed stream profile.* Backwatering design requires additional information for proper design. See http://www.for.gov.bc.ca/hcp/fia/landbase/fishpassage.htm

Recommended Diameter or Span (meters, to the nearest 0.01m): The approximate length (streambed simulation) or span (bridge) of proposed replacement structure.

4 Determination of a Barrier

Numerous studies have established thresholds for the main hydraulic surrogates (see, for example, Clarkin et al. 2003; Robison and Walsh 2003; Appendix A). However, for any one surrogate (e.g., slope), values at or near the threshold create reasonable doubt that a structure is a barrier to fish passage. Obviously, as the surrogate measurement further exceeds the threshold value, the level of confidence increases in "labeling" a crossing as a barrier to fish passage.

Determining whether a culvert is a barrier to fish passage is therefore based on the cumulative score of the five fish passage criteria (see Table 2). These criteria are:

- depth and degree of embedment
- outlet drop
- stream width ratio (SWR; calculated by dividing channel width by culvert diameter)
- culvert slope
- culvert length

Values assigned to each criterion are based on both the sensitivity of the surrogate and the likelihood that the measured value is sufficient to label the crossing as a barrier to fish passage. For example, degree of embedment, outlet drop, and slope will determine the ability of fish to pass more than SWR or length.

Table 2: Fish Barrier Scoring[1]

Embedded (9)	value	OD (10)	value	SWR (11)	value	Slope (12)	value	Length (13)	value	SCORE
>30 cm. or > 20% of Diameter and continuous (Full)	0	< 15	0	< 1.0	0	< 1	0	< 15	0	
< 30 cm. or 20% of Diameter but continuous (Partial, contin.)	5	15 - 30	5	1.0 - 1.3	3	1 - 3	5	15 – 30	3	
No embeddment or discontinuous (None, discont)	10	> 30	10	> 1.3	6	> 3	10	> 30	6	

[1]For the barrier determination of multiple culverts, use the metrics from the pipe lowest in elevation at the outlet. For pipes installed at the same elevation at the outlet, add diameters for SWR criteria and use the highest slope, and length measurement.

As shown in Table 3 a cumulative score of 20 or greater has been established as the threshold value for a barrier base on the score for the 5 criteria. A cumulative score of between 15 and 19 is labeled a potential barrier, while a score of less than 15 is considered passable to fish. This information is used in Phases 3 and 4 in the overall process to develop an implementation plan for fish passage restoration.

Table 3: Fish barrier result

Cumulative Score	Result
0 - 14	passable
15 - 19	potential barrier
> 20	barrier

5 Data Submission

As part of the new Provincial Stream Crossing Inventory System (PSCIS) system, there is a new data entry template that will be used by all assessors.

All supporting files and documentation are available at the Fish Passage Activity web site (http://www.for.gov.bc.ca/hcp/fia/landbase/standards/fishpassage.htm). Find

- Data Deliverables Requirements
- PSCIS Assessments Data Submission Template (MS Excel file)
- PSCIS Assessments Data Submission Template User Guide

These are the instructions found on the front page of the template:

Enter all required information on the Cover Page. This includes your Project Number (FIA / LBI), your Consultant phone number and Email Address, and any project specific details such as budget and budget source. Please ensure the 'Responsible Client Number' and the 'Consultant Client Number' is correct

Enter as many assessments as needed (split into more than one sheet if there are more than 200 assessments) on the PSCIS Assessment Worksheet. Enter a single assessment on each row, leaving no spaces between assessment rows. If there is a space between any assessments, they will not be validated or processed. ***NOTE****: When copying data from a different spreadsheet, paste any copied fields as plain text using "Paste Special > Values". This will ensure the correct data is copied and validated by the PSCIS Assessment Worksheet*

Once all data are ready (Cover Page worksheet has been completed, all assessments have been entered on the PSCIS Assessment Worksheet, and the image directories are created and filled with the appropriate images) the document must be validated. Validate the document by clicking the "Validate Assessment" button located on the PSCIS Assessment Worksheet. You will be unable to generate a submission until all errors are eliminated. Descriptive validation error messages are summarized on the "Errors" Sheet, as well as interactively on screen. As corrections are made, re-validate by clicking the "Validate Assessment" button as needed

Once all assessment rows are validated, you can generate the ESF Submission document. Click the "Generate Submission" button located on the PSCIS Assessment Worksheet. This will re-validate the data, create a ZIP file, and create a submission xml document. A wizard will be displayed with instructions on completing each step of the submission generation process. ***NOTE****: Any project with a large number of assessments will take some time to zip. As zipping submission files over a network can add to processing time, it is advised to hold all files on a local drive when generating a submission*

It should be noted that the excel spreadsheet contains various **macros and code** that rely on the spreadsheet being setup in a certain way. Macros must be turned on in order for the built-in data validation to work. It is recognized that despite best efforts, spreadsheets can be manipulated in a number of ways such as renaming and reordering and even inserting fields amongst other things. We would request that you not tamper with the spreadsheet at a structural level and not seek to 'customize' it in any way and simply use it for data entry / submission purposes in the manner described below. Users can enter multiple 'sheets' of data – all of the data for a project does not have to be entered at once. In fact, if your project contains more than 200 records, you should break it up into more manageable chunks so as not to overload the system. The database will be able to summarize all of the data for a given Project ID.

5.1 Photo Documentation:

A series of photos should be taken at each culvert site as part of the assessment protocol. Record the date, crossing number and short photo description on a sheet of paper and include it in the photograph. The five required photos are:

- culvert inlet.
- culvert outlet.
- culvert barrel.
- downstream of the culvert - away from the area of road influence to capture the essence of the natural stream condition.
- upstream of the culvert - away from the area of road influence to capture the essence of the natural stream condition.

Additional photographs (to a maximum of 10 total photos per crossing) that show beaver activity, multiple culverts at the crossing, backwatered conditions near the culvert or anything else that is worth noting in the comments are also requested.

Here are a number of '**best practices'** for taking field photos of culverts:

- Photos should ideally be taken in snow-free conditions
- Photos should not exceed 1 MB in size (600 x800 resolution is adequate). It is easiest to set your camera up to shoot low-res images before you go in the field but if you forgot and have a number of large file size images to submit, you need to 'downsample' them using any one of a the image manipulation software applications that are freely available on the internet. (Google 'free batch image resizer')
- Photos should be taken in good light conditions
- Photos should clearly show the stream and culvert. To accomplish that, some underbrush may need to be cleared away before photos are taken

Refer to separate document – PSCIS User Guide – how to load your data available at:

http://www.for.gov.bc.ca/hcp/fia/landbase/standards/fishpassage.htm

6 Use of Results

For more detail on using a systematic approach, see the The Strategic Approach: Protocol for Planning and Prioritizing Culverted Sites for Fish Passage Assessment and Remediation http://www.for.gov.bc.ca/ftp/hcp/external/!publish/web/fia/Process_Protocol.pdf

This assessment method may also be used to monitor fish passage restoration projects to help determine whether the restoration has been effective at restoring fish passage.

7 References

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Closed Bottom Structure (CBS) Field Measurement Form

Location and Overview Data			
Date of Assessment			
PSCIS Crossing ID *(only needed if this is a re-assessment)*			
My Crossing Reference			
Crew Members			
UTM/GPS (NAD 83)	*Zone*	*Easting*	*Northing*
Stream Name			
Road Name			
Road Km Mark			
Road Tenure			
Stream Information			
Channel Width *Stream Width Ratio*	*Avg. Channel Width*	*Culvert Dia.*	*SWR*
Stream Slope (%)			
Beaver Activity	*Yes No*		
Fish Sighted?	*Yes No*		
Valley Fill	*DF*	*SF*	*BR*
Habitat Value	*Low*	*Medium*	*High*

Field Observations and Assessment Measurements			
Crossing Type	*OBS CBS Other*		
Crossing Subtype	*Bridge, Pipe Arch, Wood Box Culvert, Round Culvert, Oval Culvert, Concrete Box, Ford*		
Culvert Diameter or Span for OBS (m)			
Culvert Length or Width for OBS (m)			
Continuous Embeddedment?	*Yes No*		
If Embedded, Average Depth of Embeddedment	*Inlet* ____*m*	*Outlet* ____*m*	*Average* ____*m*
Resemble Channel?	*Yes No*		
Backwatered?	*Yes No*		
If Backwatered, to what Percentage			
Fill Depth (m)			
Outlet Drop (A+B)	*Invert-ToP (A)*	*ToP – BoC (B)*	*OD*
Outlet Pool Depth (m) (C-B)	*ToP –BoP (C)*	*ToP – BoC (B)*	*OPD*
Inlet drop	*Yes No*		
Culvert Slope (%)			
Recommendations			
Culvert Fix	*RM OBS SS ASM BW*		
Recommended Diameter or Span (m)			

Comments:

Fish Barrier Scoring[1]

Risk	Embedded[2]	value	Outlet drop	value	Slope	value	SWR	value	Length	value
low	> 30 cm. or > 20% of Diameter and continuous	0	< 15	0	< 1	0	< 1.0	0	< 15	0
mod	< 30 cm. or 20% of Diameter but continuous	5	15 - 30	5	1 - 3	5	1.0 - 1.3	3	15 – 30	3
high	No embeddment or discontinuous	10	> 30	10	> 3	10	> 1.3	6	> 30	6

Notes
1. For the barrier determination of multiple culverts, use the metrics from the pipe lowest in elevation at the outlet. For pipes installed at the same elevation at the outlet, add diameters for SWR criteria and use the highest slope, and length measurement.
2 Properly embedded culverts are considered passable as per natural stream channel. No further consideration of other surrogates is required.

Cumulative Score	Result
0 - 14	passable
15 - 19	potential barrier
> 20	barrier