Exhibit 4-1

Fish Passage Through Road Crossings Assessment Form

This document is intended to provide general instructions and explanations for use of the accompanying fish passage through road crossings field data sheet. The data sheet was developed for collecting information required for assessment of fish passage through culverts on fish bearing streams, with the option of using the FishXing software as an analysis tool on culverts with an evaluation rating of Grey, or undeterminable.

The pre-assessment strategy is to consider all fish passage culverts on perennial and intermittent streams up to a gradient of 20% for assessment. Map the stream/road intersect using a District Topography Map or create a GIS stream/road intersect map. Use fish distribution information to determine which species and life history stages would require fish passage. Pre-assessment site information should be filled out as part of the pre-assessment office phase on a data form for each culvert site to be visited. Pre-assessment information is the basic data that can be inputted prior to field work and includes items such as: Road Number, Quad, T, R, Sec., Aliquot Part, Stream name, Species, Habitat Length, etc.

A two-person field crew will visit each identified site. Surveys are to be completed using an auto level on tripod, total station, laser on tripod, or other approved method. Once the general stream crossing field data has been collected, the sites need to be categorized by whether or not the culverts are an obvious barrier, passable or fish passage is undeterminable. This determination should be made in the field at the time of the assessment. Fish passage evaluation criteria are found in Table 1. If it is not readily apparent whether a culvert is a fish barrier, further hydraulic analysis could be performed using FishXing. The optional tailwater cross-section information, channel roughness, and channel slope at tailwater control can be helpful for culverts that are initially considered undeterminable. The FishXing software is available on the web at: http://www.stream.fs.fed.us/fishxing. (See last page of this document for more discussion about this program)

Field work should be completed by each Forest by August 31, 2001. A final report from each Forest summarizing the fish passage through road crossings assessment should be completed by September 28, 2001. This includes a review of the inputted database information. Information included in the final report should include total number of sites, percent red-green-grey, total miles of habitat blocked summarized by species, and top Forest priorities for fish passage restoration. A Regional roll-up of the Forest data should be completed by late November, 2000.

"Site"

Most of this information may be collected in the office and is entered on a data sheet for each site before beginning the field portion of the assessment. Many of the fields on the form are self-explanatory.

Road / INFRA Mile post/Comments/Culvert ID Tag/Multiple Pipes: Record the road number and the mile post at the stream crossing. If the INFRA milepost is known place that in the INFRA milepost cell.

When traveling from the beginning of the road that the culvert crosses: An Distance Measuring Instrument (DMI) should be used to determine exact milepost where access to the culvert is from the beginning of the road. If multiple pipes are located at one crossing identify each pipe at the inlet by the odometer reading, i.e. 1.015 mile for pipe #1, 1.017 mile pipe #2, etc. For this reason, a DMI attached to the vehicle is the most accurate method and is fairly inexpensive. http://www.nu-metrics.com/ Click on NITESTAR on left column. Approximate cost is around $150-$250 for unit, installation kit, and installation. **Place in INFRA Milepost.**

When not traveling from the beginning of the road that the culvert crosses: The team realizes that travel time to culverts can sometimes be minimized by accessing them from a different road then what the culvert crosses. Culvert Inventory Tag ID number should be used. This number should correspond to the future INFRA number, such as road number plus approximate milepost (1900011.25). The reason for this is to have a unique culvert identifier so the Forest can find the exact culvert again. Ultimately, INFRA is the best tool for identifying culverts, so updating the database to remove the Culvert Inventory Tag ID with the INFRA milepost should be done as soon as possible. Write in the milepost comments section description of point of references to find the culvert again (e.g. 1.5 miles from intersection of road 123 with road 145)

Optional Information: GPS LAT/LONG(decimal degrees), Stream LLID (unique control number for routed stream), Stream Measure(unique identifier along routed stream), FEAT_CN (INFRA generated feature control number), and State Identifier.

6th Field Watershed: Enter the Hydrologic Unit Code (HUC) number of the watershed or sub-watershed.

Legal/Quad/Ownership: input the legal (T,R,SECTION, ALIQUOT PART(1/4 NE, 1/4SW), the quad, and ownership.

Surveyors: Record both surveyors' names here.

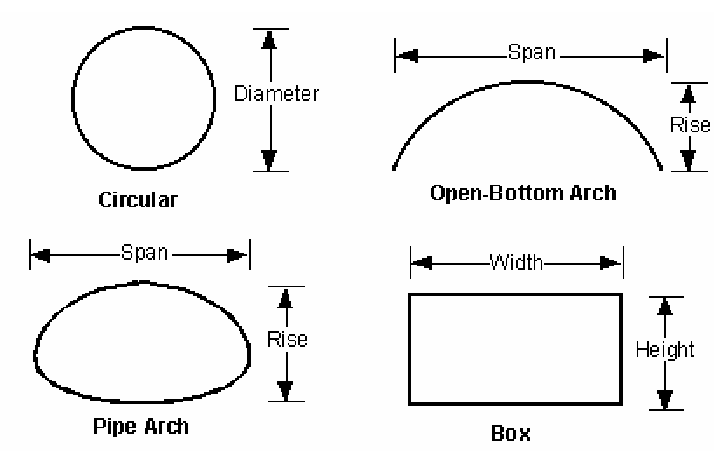
Field date: The date the field data is collected should be entered here.

Stream Name: From USGS 7.5' quad or other local sources.

"Culvert/Channel" (Note: all equations for slopes are based on assuming an elevation at the level NOT just by reading the rod height and taking the differences. Slopes should be negative (except maybe the inlet gradient) and perch and depths should be positive.)

Pipe Shape: Choose appropriate type of culvert. Depicted below are the end-sections of common culvert types. (Not all are noted below but the most popular ones are.

Vertical Size = diameter, rise, and height Horizontal Size = span and width



FORD: Note if there is a low flow water crossing and make comments on condition and problems.

Vertical Size- The height, rise, or diameter (measured vertically) of the culvert, measured from the inside of the corrugations. If the culvert bottom is completely covered with bedload (embedded) estimate the culvert height based on the shape (e.g. assume the height = width for circular culverts). For Open-Bottom Arches, measure the height from the streambed to the top of the culvert.

Horizontal Size- The maximum width, span or diameter (measured horizontally) of the culvert as measured from the inside of the corrugations. It is important to measure both the height and width on circular culverts since they often become squashed after installation.

Material: If the culvert material does not fall into one of the following categories, give a brief description characterizing the roughness of the material and input closes material type into the database.

> CMP = Corrugated Metal Pipes are constructed of a single sheet of corrugated galvanized steel. May be annular or spiral. Spiral pipes have helical corrugations reduces the culvert roughness.
>
> Aluminum = Corrugated aluminum, no rust line.
>
> PVC = Plastic that often has corrugations.
>
> Concrete = Most box and some circular and arch culverts are constructed of concrete.
>
> Log = Includes log stingers and some log box culverts.
>
> Wood = Includes some older box and circular culverts that are constructed of wood.
>
> SSP = Structural Steel Plate pipes are constructed of multiple plates of corrugated galvanized steel.

Pipe construction: corrugations: Measure the width and depth of the corrugations in inches. Most CMP have 2 2/3 in. x ½ in. corrugations. SSP pipes often have 6 in. x 2 in. corrugations. The size of the corrugations determines the culvert roughness.

Culvert Length: The culvert length should be measured between the surveyed inlet and outlet points. Culverts that are +100 ft and/or steep slopes calculate horizontal length; otherwise use field determined slope length (on shorter distances and flatter sites where the difference will be minimal).

Inlet and Outlet invert elevations: Invert is the bottom inside surface of the culvert. It is convenient to set up your level at a location that allows a clear line-of-sight to all the required survey points. This will avoid the need to move the instrument and keep the survey calculations simple. Often the easiest location to set up your level is in the channel directly downstream of the culvert. At crossings with small fills, the level can also be located on the road above the culvert. The site characteristics will generally dictate where you can set up the level.

Culvert Slope: **(FRAME OF REFERENCE: all slopes shall be taken from the reference point of looking downstream. Therefore, all slopes shall be inputted as a negative.)** Culvert slope is determined by the outlet invert elevation minus the inlet invert elevation divided by culvert length, multiplied by 100. The difference between upstream and downstream elevation is measured with a rod and hand level or more sensitive instrument. The minimum equipment required for surveying is a level (Philadelphia) rod, measuring tape, and either an auto level mounted on a tripod, total station or laser on a tripod. When surveying breaks-in-slope within the culvert a flashlight and pocket stadia (Philadelphia) rod may also be required. Note: this number is automatically calculated for you in the database.

It is important to tie all surveyed points to a common datum. The center of the culvert inlet bottom is often used, but any point that can be reoccupied in the future will suffice. An elevation must be assigned to the datum (100ft is commonly used). Then rod heights surveyed with the level are converted to elevations relative to the datum and entered on the data sheet. This may require a piece of scratch paper or calculator.

Fill Volume: (**DO A VISUAL ESTIMATION OF FILL DEPTHS ON INLET AND OUTLET SIDE ONLY. DO NOT SPEND A LOT OF TIME ON THIS ITEM. JUST GET AN ESTIMATE OF FILL FOR INITIAL COSTING PURPOSES)** Estimating the fill volume is useful when attempting to prioritize stream crossing replacements. Excavation of existing fill can add substantial cost to a project. Conversely, when stream crossings with large fill volumes fail they can deliver greater amounts of sediment directly into adjacent streams. Dramatically undersized stream crossings with large fill volumes, even if they are not fish barriers, may need to be replaced.

Lu: Upstream fill slope length, measured from toe of the fill at the culvert inlet to inboard edge of road surface.

Su: Upstream fill slope, measured with hand level.

Ld: Downstream fill slope length, measured from toe of the fill near the culvert outlet to outer edge of road surface.

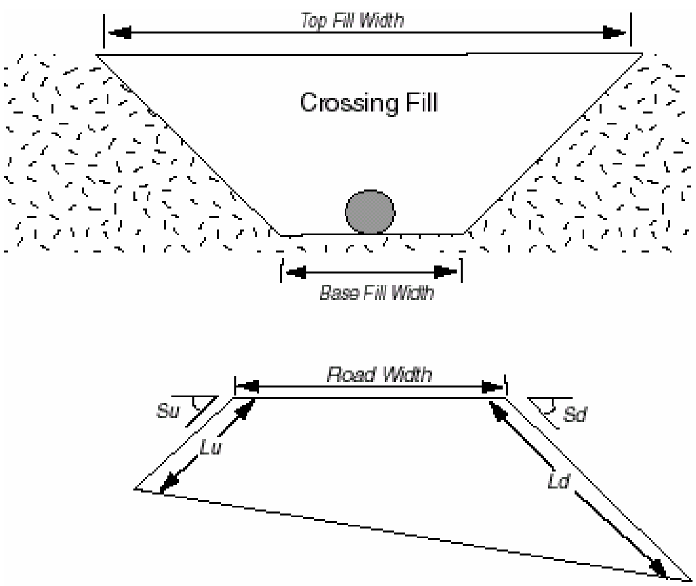
Sd: Downstream fill slope, measured with hand level.

Road Width: Width of the road above the stream crossing, measured perpendicular to the road centerline. For this project, the idea is to determine fill volumes needed so the total subgrade roadbed width is necessary, not just the travel way. This is to get an idea of the approximate fill.

Top Fill Width: Width of the fill measured along the road centerline and perpendicular to culvert axis.

Base Fill Width: Width at the base of the fill (original channel width) measured perpendicular to culvert axis.

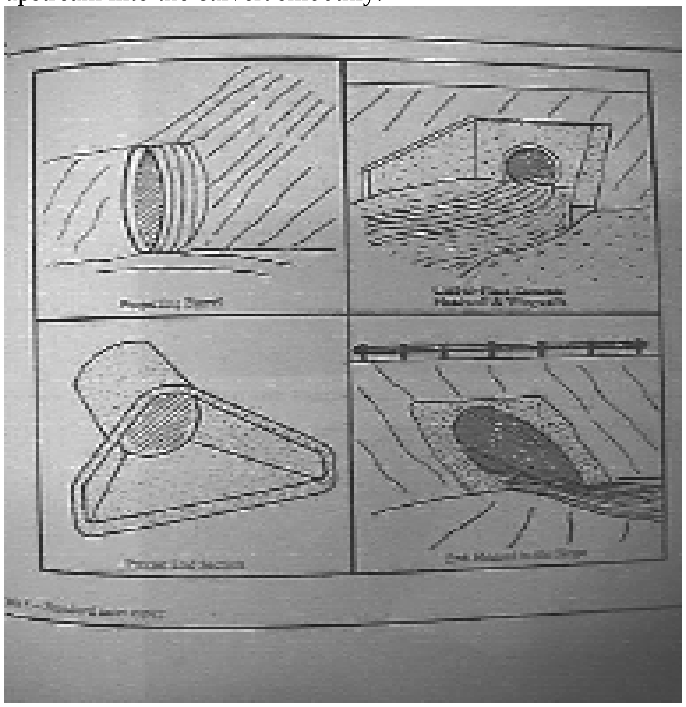
For a description of how to calculate the fill volume refer to Flanagan et al. (1998), which can be downloaded at:



Crossing fill measurements. Note that Ld, the downstream fill slope length often extends below the culvert outlet. These measurements are for obtaining a rough estimate of the fill volume and not intended for use in contract specifications.

http://watershed.org/wmc/pdf/xing_handbook.pdf

Culvert Inlet Type: Circle the inlet description that most closely matches the situation. The culvert inlet type will change the headloss coefficient at the inlet of the pipe. This coefficient is a measure of the efficiency of the inlet to transition flow from upstream into the culvert smoothly.



Above are the four main types: (from top left going clockwise) projecting, headwall and wingwall, mitered, and wingwall.

Baffles: If the culvert contains baffles or weirs, circle yes/no and note the type and give a brief description. Since baffle designs are often not standardized, a sketch of the retrofit/design along with dimensions is extremely useful.

Breaks in Slope Inside of Culvert: Does the culvert have any, yes or no? Make sure they are actual breaks and not just debris build up. If removing the debris would eliminate the break, it is not a slope break. Estimate horizontal distance to the break from the outlet and estimate the vertical difference.

Installation Grade:Sunken or Embedded: If the culvert has stream substrate retained within at least a third, and in some cases 20%, of the culvert consider it sunken. Estimate the depth of the substrate at the inlet and outlet. Estimating the culvert height and substrate depth can be difficult with pipe arch and box culverts that contain sediment throughout. Best estimates of the sunken depth will suffice. Only mark "Yes" if the pipe is sunken throughout. If it is not, check "No" but place the sunken depth in this cell if there is some substrate.

Inlet Blocked: if the inlet is blocked it will affect the rating of the pipe. Select the blockage that applies.

"Channel"

Outlet Pool Condition(OPC)

If the culvert outlet is perched directly over the outlet plunge pool, the following measurements are appropriate. **(SEE THE DRAWING FOR A DETAILED PROCEDURE WHEN LOW FLOW DOES NOT OCCUR AND THE RESIDUAL POOL DEPTH IS NOT OBVIOUS):**

Residual Pool Depth: This is the depth of the pool measured at its deepest point if the water flow was turned off and the pool drained to the point where the top of the pool is equal to the pool tail crest height or hydraulic control.

"D" (Vertical Leap Distance): This is the perch measurement. The distance from the bottom of the culvert outlet to the residual pool elevation in the plunge pool is recorded in this space. It is roughly the height the fish would need to jump. This is determined from the equation shown on page 3 and is automatically calculated in the database.

"L" (Horizontal Leap Distance): This measurement is the distance a fish would need to jump from the center of the plunge pool to the inlet of the culvert. It is the distance measured from the estimated center of the plunge pool to the outlet invert of the culvert.

Channel Gradient(one representative gradient): **(Reference: looking downstream so slope shall be negative.)** Channel gradient is the difference in the elevation of the water level measured at two points along a stream divided by the length of channel between those two points. The measured length should follow the stream's course and not the shortest distance between two points. Take one representative measurement of either the upstream and downstream channel gradients by moving above and below the culvert influence area. Get the maximum distance between the points that visual contact will allow. The distance is dependant upon brush in the area. Minimum distance should be 8-10 feet. **Measure gradient from water surface to water surface.**

Gradient from pipe inlet one pipe diameter upstream**(Reference: looking downstream so slope will probably be negative.)** Undersized culverts can influence channel morphology and the bank full water level for several hundred feet upstream as a result of high flow pond formation and sediment deposition. Fish passage will be impaired if channel gradient directly above the pipe is steeper then the average channel gradient. Measure the channel gradient from the upstream culvert invert, one pipe diameter distance upstream. Measure gradient from substrate.

Bankfull channel widths(BFW)(one representative): Measure the width of the channel at the bankfull level that should be measured beyond the influence of the culvert. Bankfull flow is a winter high or peak flow that usually occurs on average every 1 to 2 years. It is below the stream's flood flow level. Look for indicators on each bank of the highest annual water scour marks. Use a pin or flagging to mark the elevation of the points on each bank, then measure the stream's width between them. The most consistent indicators of bankfull flow are, the top of unvegetated gravel bars or deposits, a change in vegetation, bank /topography, or the size of streambed material. Other indicators are, a line defining the lower limit of lichen colonization, exposed roots, a stain line visible on bare substrate, or an undisturbed line of organic debris on the ground.

BFW ratio: The ratio of the horizontal size of the pipe over the bankfull channel width. This measurement is calculated automatically in the database.

Span to Bankfull Ratio
If a culvert is undersized, it can constrict the stream flow during fish migration periods. Water will pond at the culvert inlet creating a hydraulic pressure head, the water at the inlet is higher than the water inside the culvert. A hydraulic head produces pressure causing the water to accelerate as it enters the culvert resulting in excessive velocities that can be a barrier to fish passage. The span to bankfull ratio can be used as a coarse screen to detect excessive stream constrictions caused by undersized culverts. However, if the stream is unconfined, wide and shallow, the bankfull width can give a false indication of quantity of water in the stream when compared to the culvert span (as an indicator of the capacity of the culvert). **Caution should be used if this is the only evaluation criterion that results in a "red" finding**. Placing the culvert into the "gray" category may be appropriate until further evaluation is done to determine if the culvert is causing a flow constriction.

Fish Passage Result: Evaluation Criteria:Green/Red/Grey: Using the evaluation criteria, circle green if the stream crossing is not a fish passage barrier. Circle red if a definite fish passage barrier is present. If fish passage is undeterminable, circle grey and gather the optional tailwater cross-section data if you would like to use the FishXing software to help answer the fish passage question. The database will do an automatic rating system. The Forest may place their ranking in the database in the cell below the database generated result. Make sure that a reason is given in the comment field for the difference.

Barrier is there for a reason: If the culvert is a barrier due to fish management benefits note it here by answering yes or no.

For grey pipes only…Culvert and Channel Substrate: Manning's Channel Roughness Coefficient: This describes how much resistance the streambed material will have on the stream's flow. Smooth bed material, such as bedrock, imposes less resistance and results in faster flows or a lower Manning's coefficient. The rougher the material, the more the resistance, resulting in slower flows or a higher Manning's coefficient. Estimate what the composition of the bed material of the pipe streambed and immediately downstream of the cross-section. Classify the dominant substrate of both the channel and inside the culvert. See inventory sheet for selection options.

"Problems"

Potential Problems: note items that are listed in survey sheet that is occurring. Select the item that closely describes the situation as possible.

"Species"

Fish Species and Passage Requirements.: List up to five species and associated age classes of fish that the stream crossing should pass in both directions. Primary fish should be the weakest species, otherwise the species that the forest would design the culvert to pass. The species should be inputted as: #1 Priority species, #2 second weakest species and etc. **DO NOT INPUT BOTH LIFESTAGES OF A SINGLE SPECIES. INPUT ONLY THE WEAKEST. UNLESS THIS ASSUMPTION IS NOT VALID: IF A JUVENILE RAINBOW EXISTS THEN ADULT RAINBOWS DO ALSO. INPUT JUVENILE.**

Length of upstream habitat: If the surveyed culvert is a barrier, this will assist in quantifying the amount of potential habitat that can be made accessible if the barriers are removed. What is the length in miles of stream channel that is, or would be accessible to fish assuming no barrier exists downstream. **INPUT IN MILES.**

"Graphic"

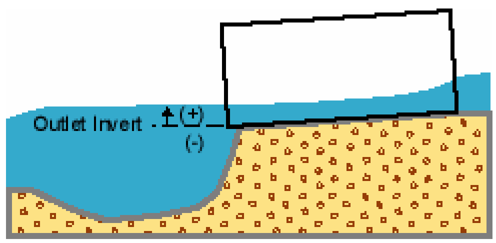
Photo numbers: Photos should be taken of both the culvert inlet and outlet. Record the photo numbers here. Information on the culvert should be included on a marker board that is in the photo. A photo of the top of road and surrounding areas is useful in determining if a culvert or a bridge would fit to the site. Many times a sketch is more valuable then a photo. If this is a difficult site to photograph, include a plan view or cross section sketch at the end of the form.

"Cross Section": (PRE-PROJECT: GREY PIPE IN HIGH PRIORITY AREAS ONLY WHERE A CONSTANT TAILWATER IS NOT POSSIBLE)

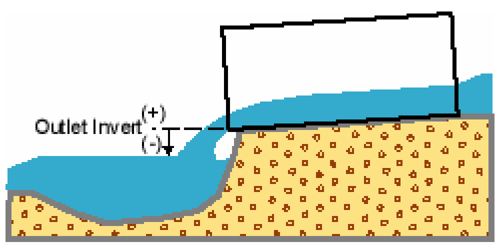
Tailwater Depth: Tailwater depth is the water depth immediately downstream of the culvert outlet measured from the culvert outlet bottom (invert). The tailwater cross-section is used to estimate the tailwater elevation at different flows by constructing a flow verses tailwater elevation rating curve. This method is most appropriate for stream crossings with unimpeded flow downstream of the outlet and possessing little or no outlet pool. It can also be used successfully when the tailwater control is the pool tailout. Although cross-sections of downstream weirs cannot be used explicitly in FishXing, they can be informative when attempting to estimate water elevations at various flows.

The cross-section should be located at the tailwater control perpendicular to the stream channel. Cross-sections typically start on the left bank looking downstream. String a measuring tape across the channel from left to right. Make sure the first survey point is well out of the channel. Proceed to survey along the tape, taking points at each break in slope. Record the station (distance across the channel as indicated on the tape) and survey the rod height. The rod heights must then be converted to elevations relative to the datum. Also record points of interest, such as the locations of the bank full.

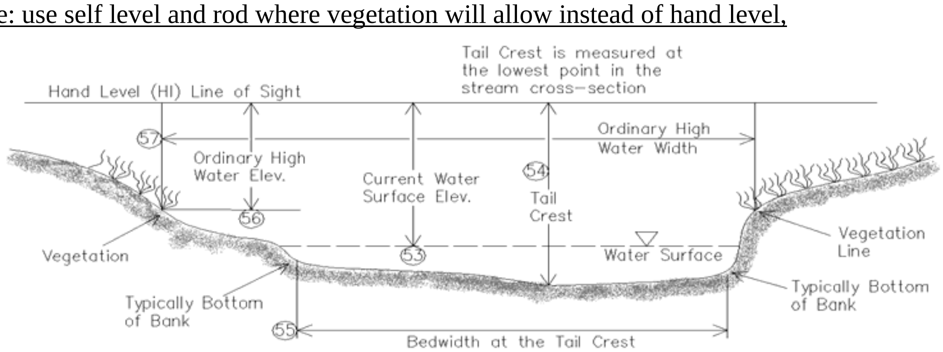
- Positive depths occur when the tailwater elevation is greater than the outlet bottom elevation. No leap is required for the fish to enter the culvert when the Tailwater Depth is positive.



- A negative tailwater depth occurs when the tailwater elevation is less than the outlet bottom elevation. This occurs when the culvert outlet is perched above the downstream channel. This situation may require the fish to leap in order to reach the culvert outlet.



NOTE: If the tailwater depth is greater than both the critical and normal depths, a backwater effect may be caused in the culvert. In general, backwater effects are beneficial to fish passage because they reduce water velocities and increase water depth. Check the water surface profiles (WSP) to determine the extent of the backwater effect.
Note: use self level and rod where vegetation will allow instead of hand level,



Typical Tail Crest Cross-Section

Channel Slope at Tailwater Control: The slope of the channel reach leading downstream from the tailwater cross-section. The change in elevation of the channel thalwag over a measured length will be used to calculate the slope.

Select the length of channel to measure. The channel reach should begin at the cross-section and continue until the channel slope or width noticeably changes, typically 20 to 30 feet. Survey the thalwag near the tailwater control and record the rod height. Then proceed to survey the thalwag at the downstream end of the selected reach. Record the rod height and measure the distance between the two points. The change in the rod height divided by the length will give you the channel slope downstream of the tailwater control.

Information to consider for the Comments Section

Site Sketches: Include plan or cross section sketches to help tell the fish passage story. At many sites a sketch is more valuable then a photo.

Upstream Culverts: If any culverts exist upstream within the range of historical habitat, make note. Do not count culverts that are on historically non-fish bearing portion of the stream.

No. of Culverts: Number of upstream culverts.

Barriers: Are any of these culverts barriers to upstream fish movement? To answer this question, a complete analysis of the upstream culverts may be required.

Distance: If there are upstream culvert barriers, measure the stream distance from the culvert inlet to the first upstream culvert barrier. This is best done using a hip-chain, but can be estimated using air photos or USGS topographic maps.

Downstream Culverts: Are any culverts downstream of the stream crossing?

No. of Culverts: Number of downstream culverts.

Barriers: Check yes if any of these culverts are barriers to upstream fish movement. To answer this question, a complete analysis of the downstream culverts may be required.

Distance: If there are culvert barriers downstream, measure the stream distance from the culvert outlet to the first downstream culvert barrier.

Inlet/Channel Alignment: The approach angle of the upstream channel. Standing at the inlet looking upstream estimate the approach angle of the channel with respect to culvert centerline.

Cascade over riprap = Culvert outlet is perched above the downstream channel and exiting water sheets over riprap or bedrock making it difficult for fish to swim or leap into the culvert.

Outlet Apron: Aprons are commonly constructed of concrete or grout and extend downstream from the culvert outlet. They are typically designed to prevent erosion at the toe of the stream crossing fill. Place this in comment section by shape if the culvert has an outlet apron and give a brief description. Note if the end of the apron has a weir or influences the flow within the culvert. Include a sketch on the back of the data sheet if needed.

Channel approach angles greater than 30 degrees can increase the likeliness of culvert plugging, which results in blockage of both upstream and downstream fish movement and can result in catastrophic failure of the stream crossing. Additionally, in some situations poor channel alignment can create adverse hydraulic conditions for fish passage.

Other (FishXing information for Grey culverts only)

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The FishXing software is available on the web at: http://www.stream.fs.fed.us/fishxing. See instructions and help files prior to running the program.

Not all the information necessary to run the program successfully is included in the assessment. Other items that need to be placed into the program for grey culverts that are not field items are:

-Hydraulic Criteria	Low Passage Flow and High Passage Flow
-Compute Water Surface Profiles at these Flows	(Range of three flows (cfs))
-Velocity Reduction for Fish	Velocity reductions at inlet, barrel, and outlet due to location of culvert on migration path. (see FishXing help files page 9 for more information)
-User or Default Swim Speeds	Determine which is applicable
-Fish size	(mm)
-Minimum water depth	For fish to swim in (ft)
-Migration Season	Months of the year that fish migrate