MAINE
ROAD-STREAM CROSSING SURVEY
MANUAL

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INSTRUCTIONS FOR COMPLETING FIELD FORMS

ROAD-STREAM CROSSING SURVEYS

OVERVIEW

Tens of thousands of miles of streams flow throughout the state of Maine. Most of these streams are crossed by a network of thousands of miles of roads. Structures such as bridges and culverts that occur at road-stream crossings have the potential to limit the movement of fish and terrestrial species, particularly on smaller streams. In addition, incorrectly sized or poorly placed culverts can have a significant impact on stream processes. In order to reconnect riverine habitats for many species across Maine, efforts are underway to improve the condition of road-stream crossings.

It is essential to know the location and condition of structures in our streams in order to improve habitat connectivity in Maine. The Maine *Road-Stream Crossing Survey* has been designed to collect information to help evaluate the impact of crossing structures on streams. Many state and federal agencies and nonprofit organizations are helping to survey crossings of our streams to help make better decisions about improvements to restore habitat across the state. Our goal is to use volunteers and professionals involved in the protection and restoration of fish habitat to collect data that feeds into a statewide inventory of road-stream crossings. Once we know which of these crossings act as barriers to fish and terrestrial species, we can then use our data to set priorities for habitat restoration.

This document is meant as a practical guide to the completion of the *Road-Stream Crossing Survey* form used to assess structures at road-stream intersections. Specialized knowledge and tools are not required, but anyone undertaking such surveys should be trained by one of the organizations sponsoring the surveys to ensure that they will provide data that is consistent with that collected by others across the state.

SAFETY

Streams can be hazardous places to work, so take good care to sensibly evaluate risks before you begin to survey road-stream crossings. While our efforts to record data about in-stream structures are important, they are not as important as your life and limb. These surveys will work best with two people to make measurements easier, but also to provide help if needed.

Take measurements seriously and carefully, but also know that estimates may be necessary. Avoid wading into even small streams at high flows, pools of unknown depths, or scaling steep and rocky embankments. There are usually ways to make effective estimates of structure dimensions without risking harm. Using an accurate laser rangefinder is one way to measure with less risk. Other approaches include measuring culvert lengths over the top of the roadway instead of through them, and measuring an approximate pool width from the roadway, aligning ends of the tape measure with the outside edges of the pool perpendicular to the road.

EQUIPMENT

To collect data on road-stream crossing structures, you will need a few essential pieces of equipment for measuring and recording:

Road-Stream Crossing Maps – For planning sites to survey, and to record sites assessed, a DeLorme *Maine Atlas and Gazetteer* is very helpful as a guide as well.
Road-Stream Crossing Survey forms – Best printed on waterproof paper; including companion form, **Unsurveyed Site Log**, for recording sites visited but not surveyed.
GPS Receiver – Set to collect data in WGS84 datum and UTM Meters coordinates
Digital Camera – with sufficient battery power for a full day of surveying, and capable of storing approximately 100 low to moderate resolution images (approximately 100 - 300 kilobyte stored size, generally less than 1 million pixels).
Measuring Tapes
  30 Meter or 100 Foot Reel Tape – For measuring structure lengths and channel widths
  Pocket Tape – Perhaps 7.6 meter/25 foot metal tape for shorter dimensions
Measuring Rod – Marked at 1 meter or 3 feet for measuring pool depths
Clipboard
Pencils & Erasers

Additional or optional equipment recommended based on equipment availability, funding, survey crew, stream size and weather:

Laser Rangefinder – to safely take measurements without crossing structures, busy roadways or streams **–** should be accurate to within one foot for adequate data accuracy.
Stadia Rod – telescoping 5-8 meter/ 16-25 feet long to easily measure some structure dimensions, including water depth and clearance
Anchor Pin – to hold one end of reel tape when measuring channel width (a 100d nail works well in most situations)
Sun Protection – Hat, sunglasses and sunscreen as needed
Insect Repellent – to protect from annoying or dangerous bites
Waders or Hipboots – to stay dry, insulate from cold water and minimize abrasions, and to allow access to tailwater pools and deeper streams

A Note on Measurement Units

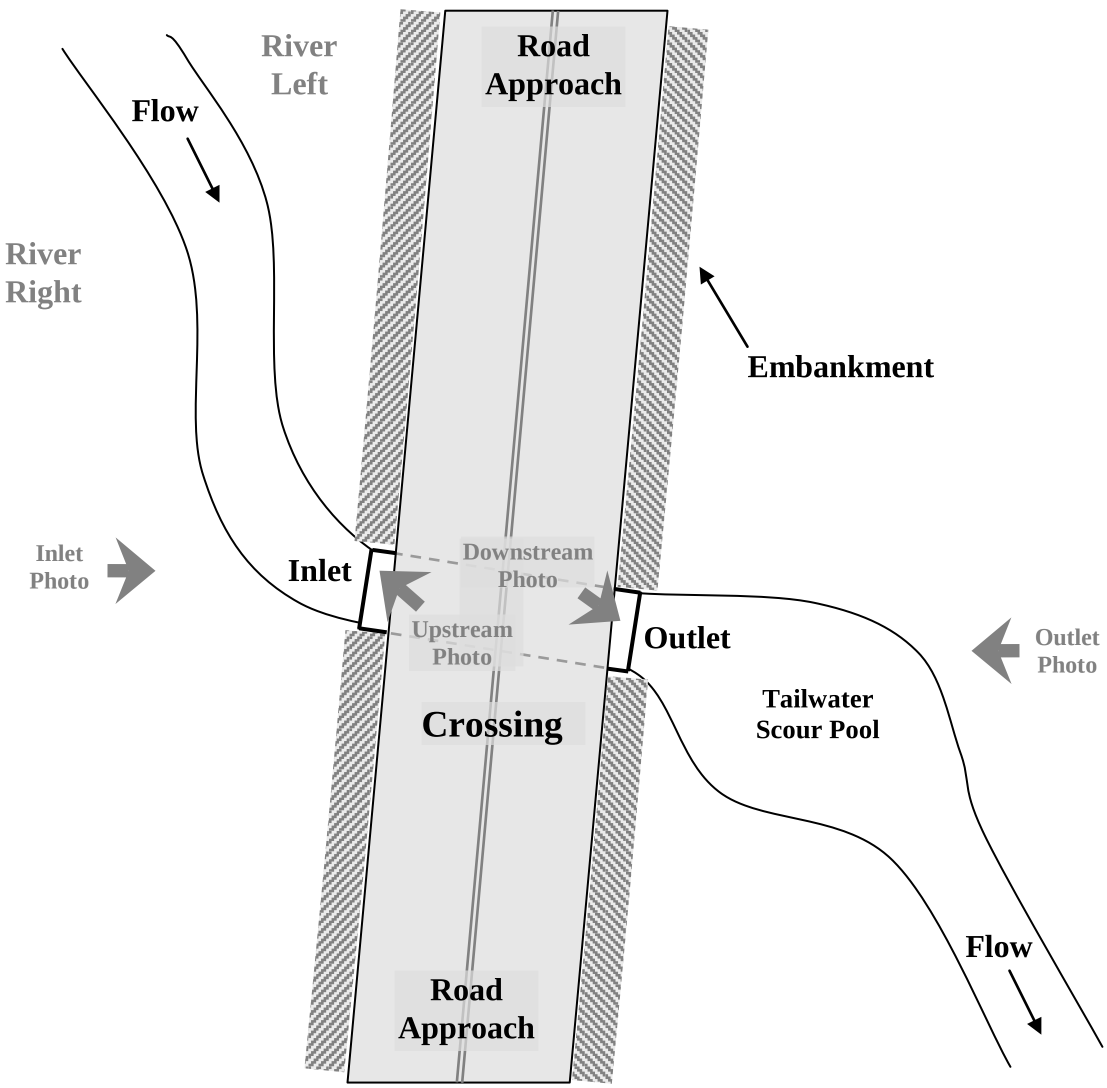
It is essential that whatever instruments you use for measuring use the same units throughout the survey. Beware of using mixing equipment marked in feet and inches in combination with others marked in feet and tenths of feet (or metric units). It is best to use either feet and tenths or metric units. ***Do not use equipment marked in feet and inches.***

Shaded Boxes

Shaded boxes and bold type on the survey form serve to visually divide data elements to make it easier to follow, and do not imply greater importance over data in normal type or unshaded areas.

Site Identification

While each crossing surveyed will be different from others, there are many common features that will be assessed, measured, or otherwise observed in the process of surveying a site. The diagram below is meant to provide the basic terms for these features in a simplified overhead view.



Following is an explanation of the data required for each item on the survey form:

Date – Date that the site was surveyed (in the form *mm*/*dd*/*yyyy*).

Time – Approximate local time in 12-hour format that the site was surveyed (*hh:mm)*.

Sequence # – Record as an integer the order in which this site was surveyed in relation to others surveyed on this date by this survey crew (i.e., 1, 2, 3, etc.).

Site ID – Unique numeric or alpha-numeric identification code used to uniquely identify the survey site for inclusion in the statewide barrier inventory database. Each major watershed has been designated with a series of numbers for assignment to crossing sites. The organization responsible for your survey area should know, and may have already mapped, the series of numbers for each of the sites you will survey. Please contact Alex Abbott at the Gulf of Maine Coastal Program of the U.S. Fish and Wildlife Service (alexoabbott@hotmail.com; telephone 207-781-8364 ext. 21) with questions about numbers assigned to your survey area.

Observer(s) – Name(s) of site evaluator(s), comprised of at least a first initial and last name.

Organization – Name or acronym of the organization sponsoring or conducting the survey.

Stream/River – Provide the name of the stream or river, generally relying on names from U.S. Geological Survey topographic maps. Use *Unnamed* if the waterway is not named, or *Unknown* if you are not sure. If a different local name exists, provide that in parentheses.

Tributary to – Name of the stream or river into which the surveyed stream flows. This is especially helpful when surveying streams that are unnamed or for which a name is not known. If this stream has no name, enter *Unnamed*, and if you cannot determine a name enter *Unknown*.

Town – Town in which the survey takes place. Verify on your survey maps if unsure.

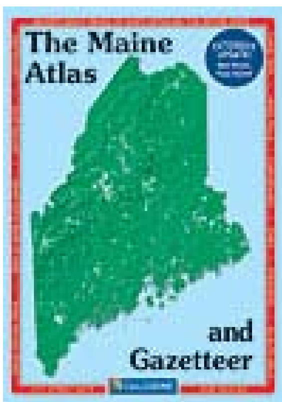
Road – Name of the road or *Unnamed* if the road does not have a name. Use *Unknown* if you are unsure whether or not the road is named or you don't know the road name.

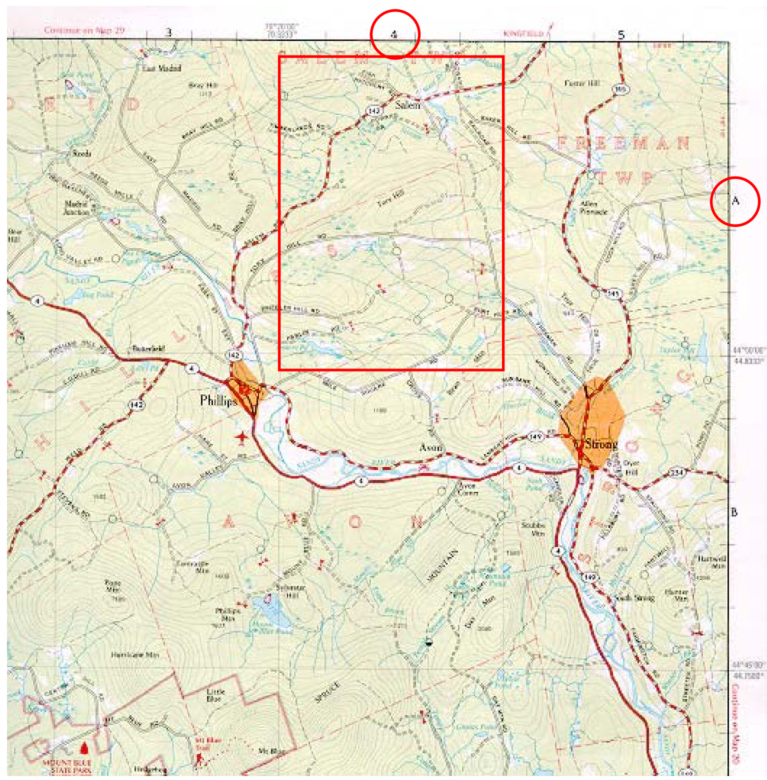
Road Type – Road type refers primarily to surface type, but also to driveways, railroads, or to small trails not normally considered roads used mostly by all-terrain vehicles, snowmobiles or logging equipment. Check the type that best characterizes the roadway. Trails are distinguished from unpaved roads primarily by their narrow width and low frequency of use.

GPS Coordinates – Use a GPS (Global Positioning System) receiver to provide the coordinates for the structure location. Try to collect a position close to the middle of the structure if possible. Be sure the unit is set to collect positions in the UTM (Universal Transverse Mercator) Zone 19 North Meters coordinate system in the Datum normally referred to as WGS84 (World Geodetic System of 1984). Your GPS receiver may only refer to the coordinate system as UTM and may set the zone automatically. Refer to your receiver's manual to properly set the coordinate system.

Enter coordinates in the blanks provided for Easting, then Northing, rounding to the nearest whole meter. Note that Easting coordinates are always composed of six digits in Maine, though in some GPS receivers there will be a leading zero as the first digit. In the field form this leading zero has already been entered. Northing coordinates are always composed of seven digits in Maine. These coordinates are simply the number of meters in each direction from the southwest corner (coordinates 0 E / 0 N) of a rectangle that defines the extent of UTM Zone 19 North.

<u>DeLorme Atlas Data</u> – Referring to *The Maine Atlas and Gazetteer* published by DeLorme, enter the Map number from the bottom of the page (the same as the number on the statewide map grid on the back of the atlas) in the first blank, and enter the map grid reference in the second, listing the letter followed by the number read from the border of the map (e.g., A4 as in the map image below). The letters run down the sides, numbers on the top.





<u>Photo IDs</u> – Digital photographs are an essential tool for assessing potential fish passage barriers. Use the date/time stamp to code each photo if possible, and record the photo ID number from the camera of each photo in the appropriate blank for each perspective listed on the form. It is important to set the camera to record at the correct resolution so that the photographs do not take up too much space when downloaded for storage (150 – 300 kilobytes each, often set at 1 “megapixel”). Test to be sure your camera is set at the correct resolution before starting surveys, and that you have sufficient battery power for a full day.

The four photos that are most useful to be able to visually review the site are the first four: *Inlet, Outlet, Upstream* (from the inlet), and *Downstream*.(from the outlet) Be sure to show the entire inlet and outlet in those views, and include at least a portion of the structure or roadway in the views upstream and downstream. Though not recommended, if only two photographs were to be taken at a site, *Inlet* and *Outlet* images would be essential, and most useful if they can take in some of the surrounding area to provide context.

RR Approach and *RL Approach* refer to views of the road approaches *toward* the *River Right* (RR) and *River Left* (RL) as judged facing downstream, and should include at least part of the structure in the foreground. For example, to take a *RR Approach* photo, stand somewhere near the *left* bank side of the structure and take the photo facing *toward the right bank* and its road approach so that the photo shows part of the structure for perspective. Enter multiple photo IDs for particular perspectives as space allows. Note that the outlet photos below do not show the entire structure openings due to vegetation, and should have been taken at a different angle if at all possible to show important aspects such as outlet drops.

Site 1 **Site2** **Site 3**

Inlet



Outlet



Upstream



Downstream



RR Approach



RL Approach



At multiple culvert sites, it is best if you can take one photo for each perspective to capture all of the culverts at the site, but especially to focus on the primary culvert. If there are additional overflow culverts apart from the others, though, additional photos of a second, third or fourth culvert are appropriate, but be sure to name them appropriately as described below after they are downloaded from the camera or memory card.

At the end of each day of surveying, photos should be downloaded and renamed to ensure they represent the correct sites and views; it is often easy to confuse inlets and outlets and upstream and downstream views later. This is also when you delete photos that are essentially the same as others, or so poor in quality that they are essentially useless. Photo names should explicitly code them as associated with the particular site surveyed and the perspective they represent. For instance, if the SiteID is 1000, the photos of the inlet and upstream should be named *1000-Inlet* and *1000-Upstream*, and those of the outlet and downstream should be named *1000-Outlet* and *1000-Downstream*. Likewise, road approach photos should be named *1000-RRApproach* and *1000-RLApproach*. If multiple photos are taken and saved from the same perspective, they should be coded with *A*, *B*, *C* after the name to indicate additional photos (e.g., *1000-InletA*, *1000-InletB*).

<u>Flow</u> – Record the level of flow in the stream as compared with its banks and limits of vegetation. In general, when you are working in a relatively small area for a day, all of your sites for that day will likely record the same *Flow*. To record *Low*, the stream flow should be obviously low relative to the stream banks, vegetation and the crossing structure. Note that most surveys are scheduled for the summer to make assessment easier, and so most sites will likely be recorded as *Low*. To record *High*, the flow should be obviously high relative to the stream banks and structure and likely exhibits significant turbulence. There should have been a recent or ongoing rain event causing the high flows. It is very likely you will have great difficulty taking measurements safely in these conditions—BE CAREFUL!

Record *NONE* when there is NO flow through the crossing, though there may be standing water in the crossing and stream. This would be likely during a drought, or possibly if surveying what may actually be an intermittent stream, flowing only after rain events. Record *Moderate*, then, when flow does not match any of the other choices. Flow will likely be up to a line of vegetation on the stream banks, and there would likely have been recent rains.

<u>Basic Structure Type</u> – Record the basic structure type by checking one of the boxes. For most survey projects, you will only survey bridges when they are obvious impediments to fish passage, or are in very poor condition. Most sites surveyed will likely be listed as either *Culvert*, or *Multiple Culverts*.

Be sure to note the number of culverts for *Multiple Culverts* sites. For multiple culverts, you will use just one field form to characterize the structures and site, using the front of the form to record information about the primary culvert, and the back of the form to record the dimensions of additional culverts. In low gradient areas, look beyond the immediate stream channel to see if there are additional overflow culverts in the adjacent floodplain.

For **multiple culverts**, it is important to focus first on the culvert with the majority of the flow passing through it, the *Primary* culvert. Normally, one culvert at a site receives most of the flow, usually because it is set lower than others (see red arrows in images below). It is the one most relevant to fish passage at low flows, and should be used to collect most of the data on this form. For instance, when assessing the *Outlet Condition* of a multiple culvert site, be sure to record the condition for the primary culvert. While secondary or additional culverts at multiple culvert sites need to be recorded, it is the primary culvert that matters most. Secondary culverts are often meant to carry water only at high flows.



Record the type of culvert and dimensions of each additional structure at the site on the back of the field form. Use separate sections for each structure (e.g., Culvert 2 of 3, Culvert 3 of 3). These dimensions allow a calculation of the total volume of water that can pass a crossing.

Use the *Multiple Culvert Comments* section at the bottom of the back of the field form to record important information if there are significant differences between the arrangement or materials of additional culverts. For instance, for multiple culverts set at dramatically different heights, perhaps stacked on top of one another, or spread out across the floodplain (not laid side-by-side), record the dimensional data for each on the back of the field form in as many sections as needed to record all structures at the site, and then make note of any important differences of arrangement or materials in the *Multiple Culvert Comments* section.

A *Ford* is a shallow water crossing through a streambed, normally with logs, stone, or concrete to stabilize the bottom. Fords are relatively rare in Maine, and are generally found on roads or trails that are not frequently used. Measure the length and width of the ford structure from top to bottom and side to side. If there is no obvious structure, measure the wetted channel width as the ford width or span (Dimension A on the back of the field form), and measure the road width as the ford length (Dimension D).




The *Removed Structure* option is to record when there is no longer a crossing structure in place. Perhaps you had expected to find a structure, but it had been removed because a road had been abandoned. It may still be useful to complete as much of the form as possible to describe the current state of the site, particularly if it looks like it blocks fish passage.

Material – Primary type of material used in the structure being surveyed. If the structure is composed of more than one material, such as with multiple culverts of different types, check the *Other* option, and record the materials in the blank.

For multiple culverts of different materials, include more information as needed in the *Multiple Culvert Comments* section.

SPECIFIC STRUCTURE TYPE & DIMENSIONS

Refer to the third page of the field form to complete this section.

Specific Structure Type – Record the specific structure type by checking one of the boxes representing a particular diagram on the form. For **multiple culverts**, first select the structure type of the primary culvert (e.g., Culvert 1 of 3), then use the back of the field form to check the box for each additional structure's type in the space provided.

1. *Round Culvert* will be a circular pipe. It may or may not have substrate in it (the diagram on the field form shows a layer of substrate), and it may be compressed in one dimension.



2. *Pipe Arch Culvert* is essentially a "squashed" round culvert where the lower portion is flatter, and the upper portion is a semicircular arch. It may or may not have substrate in it (the diagram on the field form shows a layer of substrate).



3. *Open Bottom Arch* will often look like a round culvert on the top half, but will not have a bottom. It will have some sort of footings to stabilize it, either buried metal or concrete footings, or concrete footings that rise some height above the channel bottom, and it will

have natural substrate throughout the structure. To distinguish between an embedded *Pipe Arch Culvert* and an *Open Bottom Arch*, note that the sides of the *Pipe Arch* curve inward in their lower section, while the sides of the *Open Bottom Arch* will run straight downward into the substrate or to a vertical footing. Beware of confusion between an *Open Bottom Arch* and an embedded round culvert; the former tends to be much larger than most round culverts.



4. *Box Culvert* will usually be made of concrete, though it could be made of stone or wood, and is normally composed of a top, bottom and two sides. A variation, called a *Bottomless Box Culvert* is to be considered as Type 6, or the same as a *Bridge with Abutments*, since both have natural bottoms and require the same dimensional measurements. The images below are of Type 4 *Box Culverts*.



5. *Bridge with Side Slopes* will have angled sides up to the bottom of the road deck.

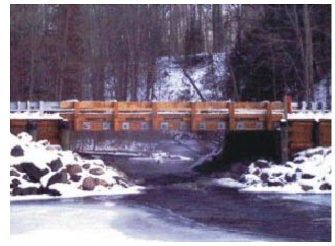


6. *Bridge with Abutments* with sides at right angles. Though often considered a type of culvert, a *Bottomless Box Culvert* should be listed as a Type 6 structure (bridge).



7. *Bridge with Side Slopes and Abutments* will have both sloping sides and sides at right angles to give the bridge additional height above the stream. Be sure to measure the A*butment Height* for such structures (Dimension E).





CULVERT & BRIDGE CHARACTERISTICS

CHANNEL WIDTH OPTIONAL – Check with survey organizers to see if you need to record this data. This assessment takes as much time as the rest of the survey, and must be evaluated well away from the influence of the crossing to achieve accurate results.

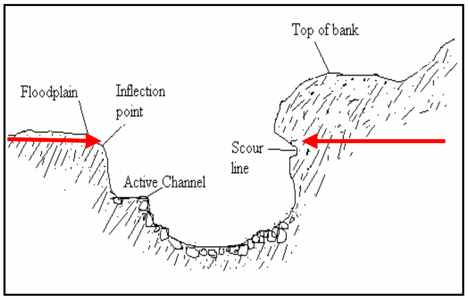
<u>Channel Width</u> – Measure the width of the channel *away from* the influence of the structure. Move downstream well beyond any tailwater pool, upstream of any impoundment formed above the inlet, and away from any wetland areas, and measure the *Bankfull* width, or, if necessary, the *Wetted* width of the stream there. The wetted width is simply the width of the water surface, and does not generally serve as a good guide of stream width given changes in stream flow conditions; it **should only be taken if a *Bankfull* measurement cannot be taken**. Be sure to note whether the width has been estimated instead of measured.

Bankfull width is that set by dominant channel forming flows, ranging in frequency from twice a year to once every two years for most streams, and if assessed correctly, provides a far better measure of channel width. Flows beyond these *Bankfull* flows would result in a rapid widening of the stream with overflow onto the floodplain. Look for multiple indicators, and measure more than one location to get the most useful measurement. To be considered valid, each indicator should be within approximately 0.5 feet (6 inches) or 0.15 meters (15 centimeters) of other indicators, as measured above the water surface, and is most accurately assessed at riffle features. Indicators of *Bankfull* width include[*]:

- *Abrupt transition from bank to floodplain.* The change from a vertical or steep bank to a horizontal surface is the best identifier of the floodplain and bankfull stage, especially in low-gradient meandering streams.

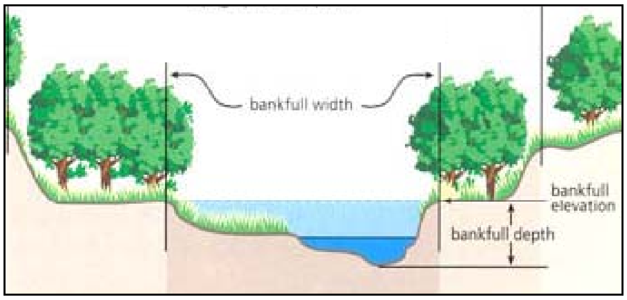

- *Top of point bars.* The point bar consists of channel material deposited on the inside of meander bends. Set the top elevation of point bars as the lowest possible bankfull stage. *Top of lateral bars*, deposited along the banks parallel to flow, may also indicate the lower limit of bankfull flows (see image at right).

- *Bank undercuts.* Maximum heights of bank undercuts are useful indicators in steep channels lacking floodplains.



- *Change in bank material.* Changes in soil particle size may indicate the operation of different processes. Changes in slope may also be associated with a change in particle size.

- *Change in vegetation.* Look for the low limit of perennial woody vegetation on the bank, or a sharp break in the density or type of vegetation.



Text adapted from Georgia Adopt-A-Stream "Visual Stream Survey" manual. Georgia Department of Natural Resources, 2002.

Be sure to mark whether the width is Measured or Estimated.

Inlet Condition – Identify issues present at the inlet of the structure.

Pick only one of these three Inlet Conditions below:

- *At Stream Grade* means the inlet of the structure is roughly at the same elevation as the stream bottom upstream of the structure.



- *Inlet Drop* means there is a drop from the stream channel down to the inlet. This might be because the culvert was set too low initially, or because sediment has accumulated above the inlet. The drop should be very obvious, and if not, choose *At Stream Grade*.



- *Perched* means the inlet is set above the stream, and is accessible only at higher flows. This is a relatively rare condition found mostly on very small streams. There will generally be an impoundment (though often very small) above the inlet at such sites. In some cases water could be "piping" underneath the structure.



Check any or all of the three Inlet Conditions below:

- *Deformed* means the structure itself is deformed at the inlet. Select this box if the structure is deformed to the point that it obviously affects flow.

- *Beaver Fencing* refers to devices meant to keep beavers from damming the inlet, but also prevent other wildlife from passing through a culvert.

- *Blocked* means there is sufficient debris, sediment, or other material to significantly restrict flow into the structure. Describe in the space provided or in *Comments* what is creating the blockage, and circle the degree of blockage: 25%, 50%, 75% or 100%. Natural substrate **within** an embedded structure should be considered in assessing how much of a structure opening is blocked. That is, if a 3 foot span pipe is already embedded with natural substrate such that 25% of its opening is taken up by that substrate, assess the percentage of the remaining opening that is blocked. Beware of identifying a crossing as blocked with only a few sticks across its inlet; the opening should be very obviously blocked by AT LEAST the amount selected.

► **A NOTE ON ESTIMATED MEASUREMENTS:** Be sure to note any values that are estimated rather than measured directly by writing EST after the number.

Inlet Water Depth – Record the depth of water at the inlet just inside the structure. If there is substrate in the inlet of a structure with a bottom, you do not need to dig down to the bottom. In these cases, take a few quick measurements to get an idea of what the average depth is, especially given the variation of depths inevitable among larger substrates.

Inlet Span – Record the interior width of the structure (inlet dimension A). For *Round Culvert* (Type 1) and *Pipe Arch Culvert* (Type 2), be sure to measure at the widest point.

Inlet Clearance – Record the height from the underside of the top of the structure down to the **water surface** (inlet dimension B). Measure to the stream bottom if there is no flow. Note that a total structure height (above the substrate or structure bottom) can be calculated from this measurement combined with the water depth already measured.

Inlet Wetted Width – Record the width of the actual stream channel (*Wetted Width*) just inside the inlet of the structure (inlet dimension C). For *Box Culverts* without substrate in them this dimension is normally the same as the *Inlet Span*.

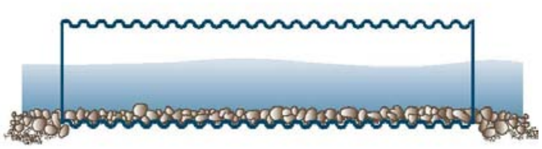
Upstream Substrate – Refer to the table below to record the dominant substrate upstream of the crossing site. You must pick only the one size class that covers more of the stream channel than any other. Be sure to get away from the immediate area of the inlet to make an reasonable assessment.

Size Class	Millimeters	Inches	Approximate Relative Size
Boulder	> 256	> 10.1	Bigger than a Basketball
Cobble	64 – 256	2.5 - 10.1	Tennis ball to basketball
Gravel	2 – 64	0.08 – 2.5	Peppercorn to tennis ball
Sand	0.06 – 2.00	0.002 – 0.08	Salt to peppercorn
Silt	< 0.06	< 0.002	Finer than salt

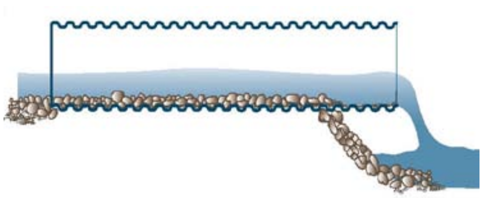
Outlet Condition **–** This is a critical element of the assessment, so be sure of your choice.

Identify only one of these four conditions at the outlet of the structure.

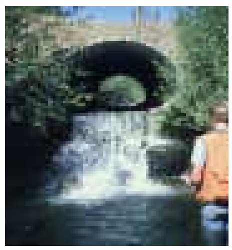
- *At Stream Grade* means the outlet of the structure is at roughly the same elevation as the stream bottom just downstream and in the general vicinity of the structure. If the gradient immediately downstream of the outlet is much steeper than the general channel gradient in the area it should be considered a Cascade.



- *Perched* means there is a vertical drop from the structure outlet down to the stream channel, normally into a tailwater pool, but possibly onto substrate. A *Perched* outlet can occur with a *Cascade* (see right-most image below); if that is the case, check both *Perched* and *Cascade*.



- *Cascade* means the stream flows much more steeply from the outlet than the general stream gradient for some distance before it reaches a slope more representative of that section of stream. If there is s vertical drop from the outlet to the *Cascade*, you should

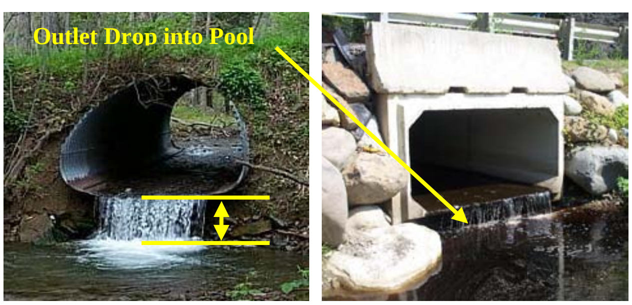



section of stream. If there is s vertical drop from the outlet to the *Cascade*, you should check *Perched Above Cascade*. A steep cobble or gravel riffle immediately downstream of the outlet would not normally be considered a C*ascade*.

- *Perched Above Cascade* means the stream drops some height onto a *Cascade*.

<u>Outlet Water Depth</u> – Record the depth of water at the outlet just inside the structure, and be sure to record the units. If there is substrate in the outlet of a structure with a bottom, you do not need to dig down to that material. In these cases, take a few quick measurements to get an idea of what the average depth is, especially given the variation of depths inevitable among larger substrates.

<u>Outlet Drop</u> – For *Perched* outlets, measure the drop from the top or inside surface of the outlet down to the water surface (see left photo below), or measure down to the substrate if the drop is onto a cascade (see right photo below) or there is no flow. Be sure to record the units you are using.



Tailwater Scour Pool – If the channel immediately downstream of the outlet is wider and deeper than the general run of the stream in this area, assess whether the pool is *Large* or *Small* according to the chart below, otherwise, mark *None* to indicate that the tailwater area is the same width and depth as the natural stream channel.

Compared to Natural Channel, Pool is	**Tailwater Scour Pool**
> 2 times Depth OR Wetted Width	Large
Between 1 and 2 times Depth OR Wetted Width	Small



Tailwater Pool Depth – Is the depth of the tailwater scour pool less than or greater than 3 feet or 1 meter? BE CAREFUL not to enter a pool that may be dangerously deep.

Tailwater Armoring – Is there material such as concrete, plastic o of an apron below the structure outlet meant to control flow and erosion? Assess whether that armoring is *Extensive* or *Not Extensive*. Mark *None* if there is no armoring present. Note that the vast majority of culverts do not have any armoring present, though there may be larger substrate below the outlet simply because that is the only size material that doesn't get moved by larger flows.




Outlet Span – Record the interior width of the structure (outlet dimension A). For *Round Culvert* (Type 1) and *Pipe Arch Culvert* (Type 2), be sure to measure at the widest point. This will normally be the same as the *Inlet Span*, but not always.

Outlet Clearance – Record the height from the underside of the top of the structure down to the **water surface** (outlet dimension B). Measure to the stream bottom if there is no flow. Note that a total structure height (above the substrate or structure bottom) can be calculated from this measurement combined with the water depth already measured.

Outlet Wetted Width – Record the width of the actual stream channel (*Wetted Width*) just inside the inlet of the structure (outlet dimension C). For *Box Culverts* without substrate in them this dimension is normally the same as the *Outlet Span*.

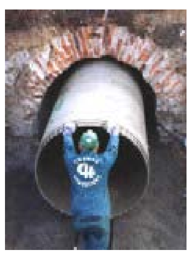
Downstream Substrate – Refer to the table above under *Upstream Substrate* to record the dominant substrate downstream of the crossing site. You must pick only the one size class that covers more of the stream channel than any other.

Crossing Structure Length – (dimension D) For all structures, measure the length of the structure from inlet to outlet. If it is not possible to walk through the structure, use an alternative: 1) hold the measuring tape at the inlet and let the current carry the free end (possibly tied to a floating object) to the outlet where someone else can hold it while you take a measurement, 2) use a tape to measure across the roadway, or 3) use a laser rangefinder accurate to within one foot. When in doubt about where to start and stop a length measurement, measure from the first part of the inlet structure you can see or feel to the last part of the outlet structure.

Abutment Height – (dimension E) *For Bridges with Side Slopes and Abutments* only, measure the height of the vertical abutments from the underside of the bridge down to where the sides start sloping.

Sliplined Culvert – Check *Yes* if the culvert has been retrofitted by lining with a smaller size pipe. Normally, sliplining is accomplished with smooth (rather than corrugated) plastic pipe sections, and there will be obvious grouting at the ends where the space between the two pipes has been filled for structural strength and to limit flow to the new pipe.

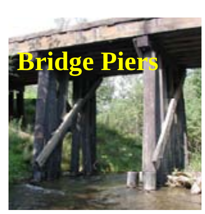
Do not select *Yes* simply because there is a plastic pipe; check to be sure the new pipe has been inserted to an existing pipe.



Crossing Substrate – If there is any substrate within the structure, assess whether it is *Comparable* or *Contrasting* in size to that upstream and downstream. Mark *None* if there is no substrate in the structure, and *Unknown* if you cannot tell.

Next, if there is substrate in the structure, assess whether or not it is *Continuous* throughout. Check *Yes* if there is some sort of substrate all the way through the crossing, and *No* if not. Select *Unknown* if you cannot tell; leave blank if there is no substrate within the structure.

Internal Structures – Indicate the presence of baffles or weirs used to slow flow velocities and pass fish, and identify trusses, rods, piers or others intended to support a crossing structure.

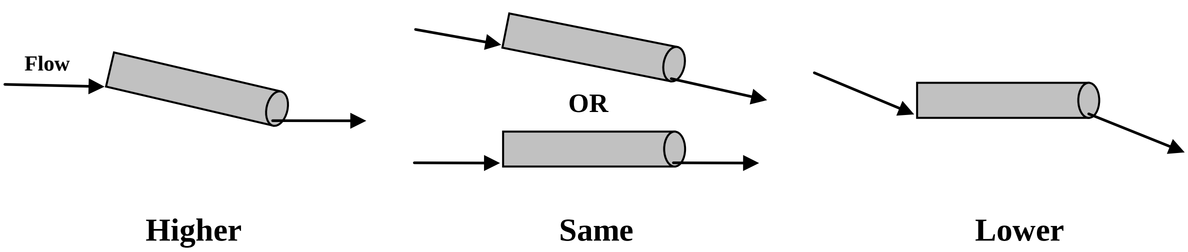


Corrugations – Check this item if culverts or arches have corrugations adding roughness to the crossing structure on its *inside* surface. Note that most plastic pipes are corrugated on the outside, but smooth inside.

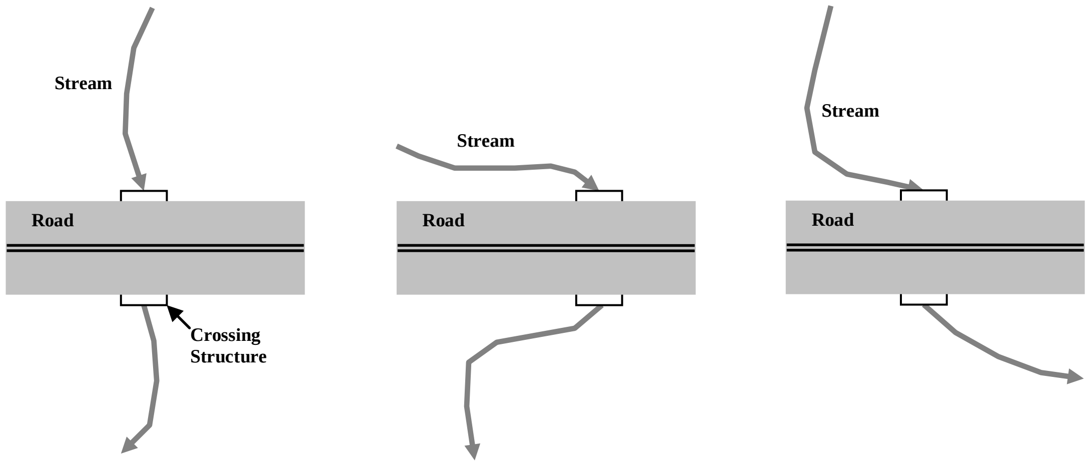
Water Depth Matches Stream – Check *Yes/Comparable* if the water depth within the structure is comparable to the depth of the stream in the area of the crossing, and *No* if there is a significant difference in depth between that in the structure and that upstream or downstream of the crossing. Do not compare with the depth of any tailwater pool.

Water Velocity Matches Stream – Check *Yes/Comparable* if the water velocity within the structure is comparable to that of the stream in the area of the crossing, and *No* if the velocity in the structure is noticeably different (often higher) than in the stream above or below the crossing.

Slope Compared to Channel Slope – Assess whether the slope inside the structure is higher, lower or the same as the general gradient of the stream channel in the area of the crossing. Look for significant differences; if you cannot tell for sure, mark *Same*. Note that flow velocity within a structure may be quite high simply because the stream is much wider than the structure so that the flow is accelerated when it enters the structure, not necessarily because of a difference in elevation between inlet and outlet.



Alignment – Taking account of the natural sinuosity of the stream outside of the influence of the crossing, is the structure aligned with the stream channel, or is it skewed? Does the stream approach the structure at an extreme angle, or relatively directly? In other words, if the structure and road were not there, would the stream flow in the same direction as it does now in the location of the crossing, or would it likely be quite different? If you are unsure, mark *Flow-Aligned*.



Flow-Aligned **Skewed** **Skewed**

<u>Significant Sediment Source</u> – Is a significant amount of sediment coming from the road surface or drainage ditches, from the embankments associated with the structure, or from the stream banks? Record the sources providing sediment U*pstream* AND D*ownstream* of the structure. Mark *None* if no significant source exists. To judge what is significant, consider whether the sediment entering the stream is altering the character of the stream at the site and within a short distance downstream. If the amount of sediment is small enough to be readily transported far away from the site, it should not be characterized as significant.

Note that you are looking here for obvious erosion problems, and are not being asked to assess the geomorphic effects of limited amounts of sediment.

<u>Wildlife Barriers</u> – Are there any physical barriers to wildlife outside of the stream channel *associated with the structure? Mark None if none of the barriers below are present;* otherwise, mark all that apply.

- *High Traffic Volume* refers to busy roadways, most often numbered highways or urban thoroughfares where vehicles cross the stream frequently enough (25 – 50 vehicles per minute) to inhibit wildlife passage across the roadway.
- *Steep Embankments* means any embankments associated with the structure that would likely impede movement of various amphibious and terrestrial animals.

- *Retaining Walls* refers to vertical walls usually made of concrete, but also *gabions* (rock walls contained by wire mesh in photo at right), that likely prevent passage of wildlife.

- *Jersey Barriers* are concrete structures, generally 12.5 feet (3.8 m) long by 32 inches (0.8 m) high, used to divide or limit traffic flow.

- *Fencing* refers to any continuous fencing that might impede the movement of wildlife from one side of the roadway to the other.

Comments – Use this section to explain any data element that requires further description or detail. (Use the *Multiple Culvert Comments* section on the back of the field form for information specifically about **multiple culvert** arrangements and materials.) Several data elements may often need additional comments to describe features not evident otherwise on the data sheet or in photographs. In particular, *Inlet Condition* and *Outlet Condition* may require additional description here.
You may choose to add here additional information for each structure that is not included above, but would be helpful to your organization's efforts. You may also use this space to sketch the site, or elements of the site, that the data above do not fully capture.

Fill Height – Record the height of fill material between the top of the culvert structure and the road surface to within 6 inches or 0.1 meters.

Condition – Select whether the crossing structure is in *Good* or *Poor* condition. A structure should be rated as poor if there is extensive rust, rot and/or cracks.

Tidal Site – Check *Yes* if you see obvious proof of tides regularly reaching the crossing site. Look for a clear *wrack line*, a line of debris, marking the height of recent tides. Look especially downstream for salt marsh plants (*spartina spp.*, not upland vegetation or freshwater wetland plants like cattails and common reed, or *phragmites*, though both of these wetland plants *can* exist on the fringes of salt marshes), and sometimes even rockweed on rocks downstream.

If the wrack line or other line of normal high water evident on rocks or vegetation is above the bottom of the crossing structure or stream bottom, you should check *Yes*. If downstream banks obviously contain no plants that could survive salt water inundation (alders, maples, ferns, etc. that you normally see on stream banks in upland areas), check *No.* If, however, you are unsure of whether the site is tidal, mark *Unsure*, and the designation can be verified later.

**** Note: Tidal Sites should be assessed within 1 hour before or after expected low tide for that area to best know what the outlet condition of the structure is near low tide.**

Units – Record the measurement units used throughout the survey, whether in feet or meters. Note that all measurements in feet should use tenths of feet.

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ROAD - STREAM CROSSING SURVEY

Date ______________ (mm/dd/yy) **Time** ____:____ **Sequence #**_______ **Site ID**

Observer (s) ________________________________ **Organization** ____

Stream ________________________ **Tributary to** ____________________________ **Town** _________________________

Road _______________________________________ **Type** ☐ Paved ☐ Unpaved ☐ Railroad ☐ Trail ☐ Driveway

GPS Coordinates [WGS84 UTM Zone 19N Meters] | 0 | | | | | | | **East** | | | | | | | | **North**

DeLorme Atlas Map # _____ **Grid Reference** _______ Location Description ____

Photo IDs Inlet __________ Outlet __________ Other ____________________ **Flow** ☐ Low ☐ High

Upstream _____________ Downstream _____________ ☐ Moderate ☐ NONE

Basic Structure Type ☐ Bridge ☐ Culvert ☐ Multiple Culverts # _____ ☐ Ford ☐ Removed Structure

Material ☐ Metal ☐ Concrete ☐ Plastic ☐ Wood ☐ Stone ☐ Other _____________________________

Specific Structure Type (see diagrams): ☐ **1** ☐ **2** ☐ **3** ☐ **4** ☐ **5** ☐ **6** ☐ **7**

Channel Width ________ ☐ **Bankfull Width** (*Preferred*) ☐ Wetted Width ☐ **Measured** ☐ **Estimated**

Inlet Condition ☐ At Stream Grade ☐ Inlet Drop ☐ Perched

☐ Deformed ☐ Beaver Fencing ☐ Blocked 25% 50% 75% 100% (Circle One)

Inlet Water Depth ________

Upstream Substrate

☐ Bedrock ☐ Boulder ☐ Cobble ☐ Gravel

☐ Sand ☐ Clay ☐ Organic ☐ Unknown

A) Inlet Span __________ **B) Inlet Clearance** __________ **C) Inlet Wetted Width** __________

Outlet Condition ☐ At Stream Grade ☐ Perched ☐ Cascade ☐ Perched Above Cascade

Outlet Water Depth _________ **Outlet Drop** __________

Tailwater Scour Pool ☐ Large ☐ Small ☐ None

Tailwater Pool Depth ☐ < 3 ft / 1 m ☐ > 3 ft / 1 m

Tailwater Armoring ☐ Extensive ☐ Not Extensive ☐ None

Downstream Substrate

☐ Bedrock ☐ Boulder ☐ Cobble ☐ Gravel

☐ Sand ☐ Clay ☐ Organic ☐ Unknown

A) Outlet Span _________ **B) Outlet Clearance** _________ **C) Outlet Wetted Width** _________

D) Crossing Structure Length _________ **E) Abutment Height** ________ **Sliplined Culvert** ☐ Yes ☐ No

Crossing Substrate ☐ None ☐ Comparable ☐ Contrasting ☐ Unknown ► **Continuous** ☐ Yes ☐ No ☐ Unknown

Internal Structures ☐ None ☐ Baffles / Weirs ☐ Bridge Piers ☐ Other _________ **Corrugations** ☐ Yes ☐ No

Water Depth Matches Stream ☐ Yes/Comparable ☐ No **Water Velocity Matches Stream** ☐ Yes/Comparable ☐ No

Slope Compared to Channel Slope ☐ Higher ☐ Lower ☐ Same **Alignment** ☐ Flow-Aligned ☐ Skewed

Significant Sediment Source **Upstream** ☐ Road / Ditches ☐ Embankment ☐ Stream Banks ☐ None

Downstream ☐ Road / Ditches ☐ Embankment ☐ Stream Banks ☐ None

Wildlife Barriers ☐ None ☐ High Traffic Volume ☐ Steep Embankments ☐ Retaining Walls ☐ Jersey Barriers ☐ Fencing

Comments:

Fill Height ______________

Condition ☐ **Good** ☐ **Poor**

Tidal Site ☐ **Yes** ☐ **No** ☐ **Unsure**

Units

☐ Feet

☐ Meters

Multiple Culvert Data

Culvert or Bridge Cell 2 of _______ **Specific Structure Type:** ☐ **1** ☐ **2** ☐ **3** ☐ **4** ☐ **5** ☐ **6** ☐ **7**

A) Inlet Span ________ ft/m **B) Inlet Clearance ________** ft/m **C) Inlet Wetted Width ________** ft/m

Inlet Water Depth ________ ft/m

A) Outlet Span ________ ft/m **B) Outlet Clearance ________** ft/m **C) Outlet Wetted Width ________** ft/m

Outlet Water Depth ________ ft/m **D) Crossing Structure Length ________** ft/m

Culvert or Bridge Cell 3 of _______ **Specific Structure Type:** ☐ **1** ☐ **2** ☐ **3** ☐ **4** ☐ **5** ☐ **6** ☐ **7**

A) Inlet Span ________ ft/m **B) Inlet Clearance ________** ft/m **C) Inlet Wetted Width ________** ft/m

Inlet Water Depth ________ ft/m

A) Outlet Span ________ ft/m **B) Outlet Clearance ________** ft/m **C) Outlet Wetted Width ________** ft/m

Outlet Water Depth ________ ft/m **D) Crossing Structure Length ________** ft/m

Culvert or Bridge Cell 4 of _______ **Specific Structure Type:** ☐ **1** ☐ **2** ☐ **3** ☐ **4** ☐ **5** ☐ **6** ☐ **7**

A) Inlet Span ________ ft/m **B) Inlet Clearance ________** ft/m **C) Inlet Wetted Width ________** ft/m

Inlet Water Depth ________ ft/m

A) Outlet Span ________ ft/m **B) Outlet Clearance ________** ft/m **C) Outlet Wetted Width ________** ft/m

Outlet Water Depth ________ ft/m **D) Crossing Structure Length ________** ft/m

Culvert or Bridge Cell 5 of _______ **Specific Structure Type:** ☐ **1** ☐ **2** ☐ **3** ☐ **4** ☐ **5** ☐ **6** ☐ **7**

A) Inlet Span ________ ft/m **B) Inlet Clearance ________** ft/m **C) Inlet Wetted Width ________** ft/m

Inlet Water Depth ________ ft/m

A) Outlet Span ________ ft/m **B) Outlet Clearance ________** ft/m **C) Outlet Wetted Width ________** ft/m

Outlet Water Depth ________ ft/m **D) Crossing Structure Length ________** ft/m

Culvert or Bridge Cell 6 of _______ **Specific Structure Type:** ☐ **1** ☐ **2** ☐ **3** ☐ **4** ☐ **5** ☐ **6** ☐ **7**

A) Inlet Span ________ ft/m **B) Inlet Clearance ________** ft/m **C) Inlet Wetted Width ________** ft/m

Inlet Water Depth ________ ft/m

A) Outlet Span ________ ft/m **B) Outlet Clearance ________** ft/m **C) Outlet Wetted Width ________** ft/m

Outlet Water Depth ________ ft/m **D) Crossing Structure Length ________** ft/m

Culvert or Bridge Cell 7 of _______ **Specific Structure Type:** ☐ **1** ☐ **2** ☐ **3** ☐ **4** ☐ **5** ☐ **6** ☐ **7**

A) Inlet Span ________ ft/m **B) Inlet Clearance ________** ft/m **C) Inlet Wetted Width ________** ft/m

Inlet Water Depth ________ ft/m

A) Outlet Span ________ ft/m **B) Outlet Clearance ________** ft/m **C) Outlet Wetted Width ________** ft/m

Outlet Water Depth ________ ft/m **D) Crossing Structure Length ________** ft/m

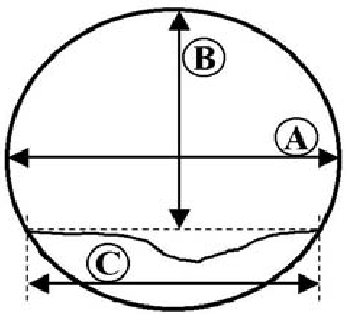
Multiple Culvert Comments:

Specific Structure Type & Dimensions

1) Select the Specific Structure Type from the diagrams below and check its number on the front of the field form.
In the case of multiple culverts, also note the structure code on the back of the form for each additional culvert.

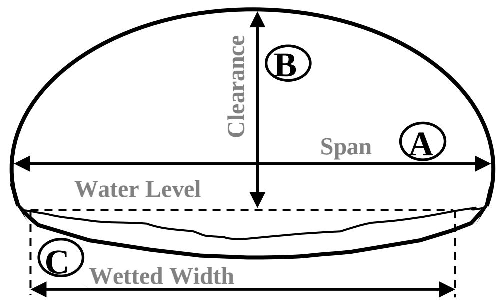
2) Record on the field form in the approriate blanks dimensions A, B, and C as shown in the diagrams, as well as the total Crossing Structure Length (D) for all. Record abutment height (E) only for Type 7 Structures.
In the case of multiple culverts, also record the dimensions on the back of the form for each additional culvert.

1



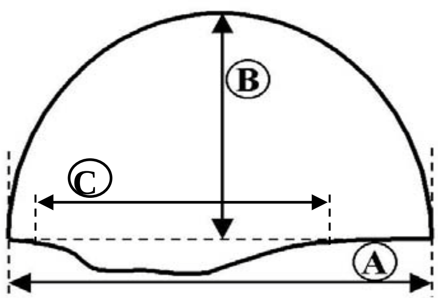
Round Culvert

2



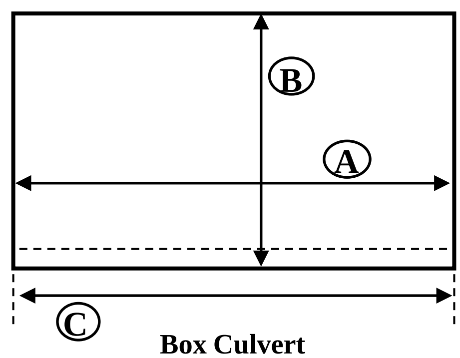
Pipe Arch Culvert

3



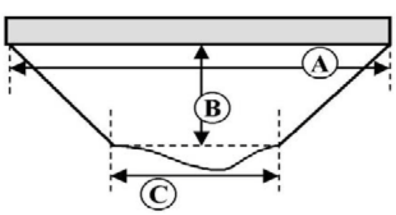
Open Bottom Arch

4



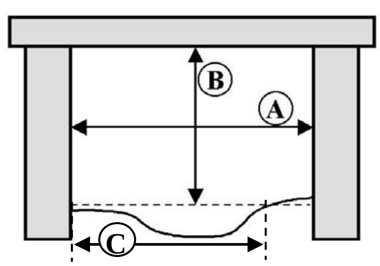
Box Culvert

5



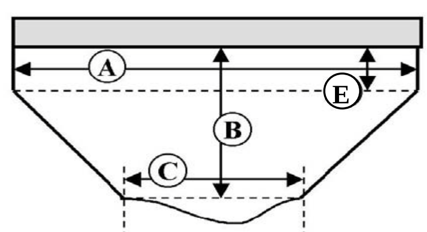
Bridge with Side Slopes

6



Bridge with Abutments
OR
Bottomless Box Culvert

7



Bridge with Abutments and Side Slopes

Unsurveyed Site Log

Date ___________________ (mm/dd/yy) **Observer (s)** _________________________ **Organization** __________________________

SiteID: ______________________________ **Sequence #** _____ ☐ **Road-Stream Crossing** ☐ **Dam**

Site Status ☐ **Bridge-Adequate** ☐ **Inaccessible** ☐ **Site Does Not Exist** ☐ **Structure Removed** ☐ **Total Span < 18 in**

Inaccessible Sites ☐ **Abandoned Road** ☐ **Posted** ☐ **Road Blocked** ☐ **Road Not Passable** ☐ **Danger** ☐ **Too Far**

Attempt Resurvey? ☐ **Yes** ☐ **No** **Comments:**

SiteID: ______________________________ **Sequence #** _____ ☐ **Road-Stream Crossing** ☐ **Dam**

Site Status ☐ **Bridge-Adequate** ☐ **Inaccessible** ☐ **Site Does Not Exist** ☐ **Structure Removed** ☐ **Total Span < 18 in**

Inaccessible Sites ☐ **Abandoned Road** ☐ **Posted** ☐ **Road Blocked** ☐ **Road Not Passable** ☐ **Danger** ☐ **Too Far**

Attempt Resurvey? ☐ **Yes** ☐ **No** **Comments:**

SiteID: ______________________________ **Sequence #** _____ ☐ **Road-Stream Crossing** ☐ **Dam**

Site Status ☐ **Bridge-Adequate** ☐ **Inaccessible** ☐ **Site Does Not Exist** ☐ **Structure Removed** ☐ **Total Span < 18 in**

Inaccessible Sites ☐ **Abandoned Road** ☐ **Posted** ☐ **Road Blocked** ☐ **Road Not Passable** ☐ **Danger** ☐ **Too Far**

Attempt Resurvey? ☐ **Yes** ☐ **No** **Comments:**

SiteID: ______________________________ **Sequence #** _____ ☐ **Road-Stream Crossing** ☐ **Dam**

Site Status ☐ **Bridge-Adequate** ☐ **Inaccessible** ☐ **Site Does Not Exist** ☐ **Structure Removed** ☐ **Total Span < 18 in**

Inaccessible Sites ☐ **Abandoned Road** ☐ **Posted** ☐ **Road Blocked** ☐ **Road Not Passable** ☐ **Danger** ☐ **Too Far**

Attempt Resurvey? ☐ **Yes** ☐ **No** **Comments:**

SiteID: ______________________________ **Sequence #** _____ ☐ **Road-Stream Crossing** ☐ **Dam**

Site Status ☐ **Bridge-Adequate** ☐ **Inaccessible** ☐ **Site Does Not Exist** ☐ **Structure Removed** ☐ **Total Span < 18 in**

Inaccessible Sites ☐ **Abandoned Road** ☐ **Posted** ☐ **Road Blocked** ☐ **Road Not Passable** ☐ **Danger** ☐ **Too Far**

Attempt Resurvey? ☐ **Yes** ☐ **No** **Comments:**

SiteID: ______________________________ **Sequence #** _____ ☐ **Road-Stream Crossing** ☐ **Dam**

Site Status ☐ **Bridge-Adequate** ☐ **Inaccessible** ☐ **Site Does Not Exist** ☐ **Structure Removed** ☐ **Total Span < 18 in**

Inaccessible Sites ☐ **Abandoned Road** ☐ **Posted** ☐ **Road Blocked** ☐ **Road Not Passable** ☐ **Danger** ☐ **Too Far**

Attempt Resurvey? ☐ **Yes** ☐ **No** **Comments:**

SiteID: ______________________________ Sequence # _____ ☐ Road-Stream Crossing ☐ Dam

Site Status ☐ Bridge-Adequate ☐ Inaccessible ☐ Site Does Not Exist ☐ Structure Removed ☐ Total Span < 18 in

Inaccessible Sites ☐ Abandoned Road ☐ Posted ☐ Road Blocked ☐ Road Not Passable ☐ Danger ☐ Too Far

Attempt Resurvey? ☐ Yes ☐ No Comments:

SiteID: ______________________________ Sequence # _____ ☐ Road-Stream Crossing ☐ Dam

Site Status ☐ Bridge-Adequate ☐ Inaccessible ☐ Site Does Not Exist ☐ Structure Removed ☐ Total Span < 18 in

Inaccessible Sites ☐ Abandoned Road ☐ Posted ☐ Road Blocked ☐ Road Not Passable ☐ Danger ☐ Too Far

Attempt Resurvey? ☐ Yes ☐ No Comments:

SiteID: ______________________________ Sequence # _____ ☐ Road-Stream Crossing ☐ Dam

Site Status ☐ Bridge-Adequate ☐ Inaccessible ☐ Site Does Not Exist ☐ Structure Removed ☐ Total Span < 18 in

Inaccessible Sites ☐ Abandoned Road ☐ Posted ☐ Road Blocked ☐ Road Not Passable ☐ Danger ☐ Too Far

Attempt Resurvey? ☐ Yes ☐ No Comments:

SiteID: ______________________________ Sequence # _____ ☐ Road-Stream Crossing ☐ Dam

Site Status ☐ Bridge-Adequate ☐ Inaccessible ☐ Site Does Not Exist ☐ Structure Removed ☐ Total Span < 18 in

Inaccessible Sites ☐ Abandoned Road ☐ Posted ☐ Road Blocked ☐ Road Not Passable ☐ Danger ☐ Too Far

Attempt Resurvey? ☐ Yes ☐ No Comments:

SiteID: ______________________________ Sequence # _____ ☐ Road-Stream Crossing ☐ Dam

Site Status ☐ Bridge-Adequate ☐ Inaccessible ☐ Site Does Not Exist ☐ Structure Removed ☐ Total Span < 18 in

Inaccessible Sites ☐ Abandoned Road ☐ Posted ☐ Road Blocked ☐ Road Not Passable ☐ Danger ☐ Too Far

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