About this release

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Control
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Feedback
Any errors, omissions, comments or suggestions should be submitted to the Roads and Traffic Authority of NSW for possible inclusion in a future issue. Send submissions to:

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1 Introduction

1.1 Culvert Management Framework

The RTA has introduced an improved framework for the long-term management of culverts across the RTA road network. The culvert management framework consists of:

- A guideline for consistent collection of culvert inventory and initial risk assessment.
- A training accreditation program for culvert inventory inspectors, including confined spaces training, prior to collection of inventory data.
- A guideline for detailed risk assessment of culverts if an assessment is required.
- A training program for detailed risk assessment of culverts.
- A central database of all culvert location and condition data, developed as a component of the Road Asset Management System (RAMS).

This work is being undertaken as a component of ongoing asset management works to ensure road network availability. The information collected will provide the RTA with improved knowledge of potential culvert risks and allow for priority programming of repair works.

The first stage of the process is the progressive systematic collection of culvert inventory. The RTA requires an understanding of the following:

- The number, location and type of culverts across the RTA road network.
- The condition of each culvert and its surrounding embankment.

The second stage comprises a formal risk assessment for those culverts identified as requiring further appraisal, and does not form part of the inventory collection phase.

Definition: For the purposes of the RTA’s culvert management framework, a culvert is defined as any pipe, box or arch that allows the flow of water or something else under a roadway. This includes culverts designed to allow pedestrian, cycle, and vehicular thoroughfare.

1.2 Purpose of this Guideline

The Culvert Inventory Collection Guideline will:

- Assist in training inspectors in the specific requirements of culvert inventory collection.
- Guide inspectors in the completion of the Culvert Data Collection Form.
- Guide inspectors in completing the Risk Screening Checklist which is part of the form. The checklist is a tool for allowing a determination on whether further assessment is required – whether immediately or at a later date.
- Ensure that a systematic and consistent approach is followed for the collection of the culvert inventory.
- Ensure that reporting and documentation of the culvert inventory is done in a consistent and accurate manner.

The collection and management of data in a uniform and consistent manner is essential to the success of the overall program.

1.3 Inventory Collection Roles

The following roles are referred to in this guideline:

**Inspector** A trained person who undertakes a culvert inspection. This may be an RTA employee or a person contracted by the RTA for inspection work.
Project Manager
An employee of the RTA who is responsible for organising and managing a body of inspection work. This role will provide information to inspectors and manage the inspection task.

Corridor Asset Manager
The Corridor Asset Manager, Infrastructure Maintenance.

1.4 Inspector Training

Training of inspectors is undertaken in a two day workshop. Training consists of a half day classroom workshop, then one and a half days of guided field inspection of local culverts.

General goals of the training include:

• Explaining the importance and necessity of the process.
• Explaining the Culvert Data Collection Form and its correct usage.
• Explaining the Risk Screening Checklist and its correct usage.
• Certifying inspectors as competent, and issuing an Inspector Number to each inspector.

Specific goals of the training include:

• Familiarising inspectors with issues and concepts such as culvert types, defect types, early embankment failure signs, and maintenance issues that, if identified early, can prevent the eventual failure of a culvert or embankment.
• Familiarising inspectors with the use of required equipment such as laser measuring devices, GPS units and correct recording of location coordinates, and explaining correct techniques in the taking of photographs to record culvert information.
• Ensuring that each inspector is fully capable of understanding the inspection and documentation process and can be certified as such.
• Ensuring that the limitations of this inspection process are known. For instance, restrictions may apply when entering the culvert – is the culvert a “confined space?”

Inspectors must be certified and issued with an inspector number prior to undertaking field inspections of culverts. As well as Culvert Inspection training, an inspector may require other specific training or competencies appropriate to the task before they can be permitted to carry out inspections. Examples are traffic safety training, industrial ropes training, confined spaces assessment training, and training in GPS unit use.
2 Inspection Planning

2.1 Inspector Responsibilities

The responsibility of the culvert inspector is to:

- Locate culverts along a given section of the RTA road network.
- Locate and gather data from any available design plan information.
- Locate culverts during the inspection process along a given section of roadway that have NOT been identified on RTA design plans (through careful field observation).
- Provide a reliable record of a culvert's condition.
- Undertake risk screening, so that the RTA can assess the requirement for a further risk assessment of that culvert.
- Identify culverts that pose an immediate threat to public safety. If an immediate threat to public safety exists, the inspector **MUST** notify their Project Manager immediately, who will then notify their Asset Manager.
- Recommend routine maintenance actions.

2.2 Understanding the Inspection Process

This guide provides:

- Notes on preliminary requirements prior to field work.
- Descriptions, definitions, photos and diagrams to allow inspectors to systematically inspect culverts.
- A step by step process for completing the **Culvert Data Collection Form**.
- A procedure to record construction or condition defects in culverts or the surrounding embankment, in a manner which is consistent and accurate.
- A procedure to be followed to alert necessary personnel as to the requirements for immediate assessment or else other maintenance on each culvert.

The usefulness of information collected in the field depends greatly upon how well the inspection is implemented and documented.

2.3 Existing Information

The following information should be gathered from the relevant RTA office prior to any field work being conducted. Usually the Project Manager will gather and prepare this information, but it may vary depending on regional practice and resources or contractual obligations.

- Local culvert list. This will assist in scheduling the culverts or sections of road to be inspected in a session (nominally a 1 week period for each session).
- Design plans for the sections of road to be inspected.
- Previous culvert inspection information, including access and safety notes.
- Segment and RoadLoc lists. This will be a list of segment numbers and RoadLoc data for the section of road to be inspected.
- Slope Numbers for slopes on the section of road – available from the Project Manager from the Road Slope Management System (RSMS).
- Bridge Numbers for any bridge sized culverts on the section of road – available from the Project Manager from the Bridge Information System (BIS).
- Safety procedures to be followed when working on roads, culverts and embankments – see section 2.4 on page 4.
• Traffic Control Plans specific to this session of field work. Usually prepared by the Project Manager, but Inspectors may be required to prepare and submit these for the sections of road they will inspect.

Use the above information to prepare a schedule of culverts to visit, and prepare a Culvert Data Collection Form for each culvert, so it has some data already filled in prior to the field inspection.

2.4 Safety on Site

Safety in completing the culvert inspections is the inspector’s number one priority. Prior to conducting any field work each inspection team must have:

• Two inspectors – inspections must always be undertaken by two qualified inspectors (except in rare circumstances, if approval is granted, where the second person may be unqualified).

• A Safe Work Method Statement (SWMS) for culvert inspections. The SWMS is developed by the contractor or the Project Manager. Refer to Developing Safe Work Method Statements, on the Internet at http://www.rta.nsw.gov.au/doingbusinesswithus/downloads/contractor-ohs/08_cont_ohs.pdf

• An induction into the specific requirements of the next road section to be inspected. For instance, are there specific traffic control requirements for that section of roadway?

• An approval from their Project Manager that they are capable of safely carrying out the required inspections.

The SWMS must address issues from working near traffic, and it must also address specific issues arising from work in confined spaces and work with difficulty of access.

2.4.1 Confined Spaces

Under NSW legislation, every culvert is a “confined space” unless assessed otherwise, so an assessment of each as a confined space must be made, by a suitably qualified person. An inspector must not enter a culvert without first having assessed all of the risks of doing so.

Determination of “confined space”


The following procedure is a synopsis of the methodology.

1. Is the space enclosed or partly enclosed?
2. Is the space at atmospheric pressure during the occupancy?
3. Is the space designed primarily as a place of work?

If questions 1 and 2 are answered YES, and question 3 NO, (which is the usual case for culverts) then ask:

Is the space liable at any time to:

4. Have an oxygen deficiency or excess?
5. Have an atmosphere which contains potentially harmful levels of contaminants?
6. Cause engulfment?

If any one of the questions from 4 to 6 is answered YES, then it is a confined space.

If it is a “confined space”:

• Inspectors who do not hold the appropriate confined spaces training must not enter any culvert that is defined as a confined space.

• Inspectors must comply with the Confined Spaces Policy whilst undertaking the inspection.
2.4.2 Difficult Access

If culverts are encountered where access is difficult, the following procedure must be followed:

1. An assessment must be made as to whether a safe inspection is possible. For instance, the culvert may be on a steep embankment and rope access may be required.
2. If deemed safe, then proceed with caution.
3. If any external equipment is required to access a culvert (e.g., rope and harness), the inspector must be suitably trained with that equipment prior to use.
4. If deemed unsafe to proceed, then a note should be made on the Culvert Data Collection Form in the Location Comment box with wording such as “Culvert unable to be inspected – rope and harness required” or similar.

2.5 Planning Checklist

Prior planning is critical to the success of the inspection process. The following should be checked prior to any field inspection taking place.

- Inspectors have been qualified and inspector number obtained.
- The schedule of inspections has been prepared.
- Safety requirements are met (assessments have been undertaken, plans have been prepared, training has been undertaken).
- A Culvert Data Collection Form for each culvert has been prepared.
- Sufficient blank copies of the Culvert Data Collection Form are to hand.
- Field equipment has been gathered (see section 2.6 below), and where required inspectors have been trained in its use, e.g., in taking accurate GPS readings, or industrial ropes training.

2.6 Field Equipment Checklist

The following equipment may be required when undertaking field inspections. Culvert inspectors should discuss this list with their Project Manager prior to field work being undertaken.

2.6.1 Inspection equipment

- Backpack appropriate for carrying equipment in the field.
- Clipboard for writing. One capable of storing items inside it is recommended.
- Notepad and sketchpad.
- Chalk – for non-permanent culvert marking where spray painting is inappropriate.
- Digital camera with flash capability (preferably with remote control and a long stem handle).
- Geological hammer – to sound culverts and for scraping corrosion.
- GPS unit – to be used by an experienced operator to obtain global positioning system coordinates of the culvert.
- Groundsheet – for protecting equipment.
- Magnet – useful in distinguishing steel from aluminium pipe.
- Measuring wheel – to measure along road surface for culvert length or other information.
- Red laser measuring device (e.g., Disto) – to measure through to the other side of the culvert – used in conjunction with a flat board at the other end of the culvert.
- Ruler – for measuring purposes.
- Spray paint – for the following purposes:
  - Highlighting culvert defects.
2.6.2 Safety equipment
- First aid kit which includes snake bite treatment (refer to SWMS).
- Gumboots or waders.
- Mobile phone and two-way radios (walkie-talkie).
- Mosquito repellent and sunscreen.
- Personal Protective Equipment (PPE) as outlined in the SWMS – includes dayglow jackets.
- Traffic cones and signs.
- Enough drinking water for the day.

2.6.3 Bush clearing equipment
- Brush hook – for clearing through bush and lantana.
- Petrol trimmer with metal chain-saw blade – for quick access through overgrown vegetation.
- Secateurs – for cutting twigs and leaves off trees and bushes.
- Shovel – for clearing debris.

2.6.4 Equipment check
All field equipment must be checked to ensure it is in proper working order:
The following supplies should be reviewed as a minimum:
- Batteries for GPS unit, camera, laser measuring device, mobile phone/2 way radio.
- Petrol for the brush cutter.
- Sufficient petrol in vehicle.
Ensure the vehicle is in proper working order, including attached equipment such as flashing lights.
3 Inspection Process

This is a simple outline of the inspection process.

Once you have determined the sites to be inspected for the day and have gathered the equipment you need, the process is as follows, though you may need to adjust it to suit your local situation.

Travel along your inspection route. When you reach a culvert site:

1. Consult your notes about that culvert and its Culvert Data Collection Form.
2. Put traffic and other safety controls into operation.
3. Load your equipment bag with what you might need for this culvert.
4. At the road sides, can you see the inlet or outlet? If you can’t see the culvert, you will have to climb down and look around, but first determine if access will require safety equipment. If you don’t have the equipment then make a note to come back, and move on to the next site on your list.
5. If you can’t find it after a reasonable time (say 1 hour) then give up, make a note on the data collection form, and go on to the next site. If you can only find the inlet, or the outlet, then still inspect.
6. Once you find the inlet, then GPS it and mark the inlet with its culvert number according to local rules, and take photos. Carry out your inspections on that side, filling out the data collection form as you go. Do not go into the culvert without following confined spaces procedures.
7. Look for junction pits along the length of the culvert. As you get to them, take a GPS reading, inspect, photograph, and fill out the data collection form.
8. Do the same on the outlet side: mark the outlet, take its readings, photograph, inspect and fill out the form, and look for junction pits.
9. Once you are back on the road, at the inlet side, take a GPS reading at the roadside for the inlet, and mark the road side according to local marking rules. Do the same for the outlet: GPS it and mark the roadside.
10. Complete the form. Be sure to complete the list of photographs and make a site sketch if needed to show access routes and identify concerns.
11. If you find a lost culvert, then take a blank Culvert Data Collection Form, fill in the location details for the lost culvert so it won’t get lost again, and then carry out an inspection and fill out the form as for any other culvert.
12. Then move on to the next culvert on your list.

Repeat the steps above for each culvert.

Section 4 following explains data collection in detail. Section 5 tells you what to do once you have finished your inspections.
4 Data Collection

The Culvert Data Collection Form is to be completed for each culvert that is inspected. A copy is shown in the Appendices – see section 8.1. It is available on the RTA intranet.

The basic idea

Once on site, take GPS readings, inspect the culvert, take photographs of inlet, outlet, pits and any issues or problems, and put your results in the Culvert Data Collection Form.

The form should already have some data filled in before you take it into the field, depending on what was available in current records in the office.

What’s on the form

Items on the form are grouped as follows:

1. Identification – use office information sources to complete data entry for numerical identification of the culvert. Provides information on access and location markings, so that future inspections are easier.
2. Culvert Location – identifies how the culvert is identified according to one of three different criteria.
3. Design Data – office based compilation of available design information regarding the culvert – information obtained from available Road Design Plans.
4. Culvert Details – field based observations of specific culvert information such as joint type, material type, construction type, and dimensions.
5. Culvert Attributes – dimensions and other attributes of the culvert.
6. Culvert Condition – field based observations of any defects associated with the culvert, such as flow restrictions, inlet and outlet conditions, and embankment condition.
7. Drainage Pits – field based observations regarding any pits associated with the culvert.
8. Photo and Image Files – a list of the photographs and sketches that were taken during the inspection process.
9. Risk Screening Checklist – field based observations of possible defects in a culvert or surrounding embankment.

The checklist is a critical part of data collection, as it is the primary tool for identifying which culverts may pose a future or immediate risk. It may prompt a risk assessment, to be conducted on that culvert later on by a trained engineer.

4.1 Identification Data

The section identifies the culvert, the date of inspection, who inspected it, and a comment so you can find it again. It looks like this:

![Identification data](image)

Figure 1 Identification data
Culverts and bridges

If the culvert span is greater than 6 metres in total, it is considered a bridge sized structure, and a Bridge Number will be assigned from the Bridge Information System by the Project Manager. Note that a 6 metre span might be comprised, for example, of three 2.4 metre cells.

If it is bridge sized, a unique Culvert Number (see below) must still be assigned to the culvert and all information is required, just as for a standard culvert. Not many culverts are bridge sized. If it is bridge sized but has no Bridge Number, notify your Project Manager.

How many culverts?

If a culvert is joined along its length by a pit consider whether to record it as one or two (or more) culverts. The documented regional policy should be followed, and in general it is only one culvert.

A culvert is a single culvert if it is joined by a drop structure which does not break the continuity of the pipe – see Figure 2. (Record the drop structures on the Culvert Data Collection Form as Drainage Pits – see section 4.7.)

One or two (or more) culverts can be recorded if it is clear that individual culverts enter and exit the pit – see Figure 3. (In this case the inlet or outlet drop structure is also a Drainage Pit, so record it as a Drainage Pit on the Culvert Data Collection Form under the “Drainage Pit” section.)

Figure 2  Culvert with junction pits – one culvert

Figure 3  Culvert with junction pits – one or two culverts
### 4.1.1 Culvert Number

**About the data:**
- Culvert Number is a unique number for identifying any culvert in the RTA network.
- Culvert Number is a mandatory field of exactly 6 digits.
- Each RTA region uses a different range of numbers – the range is:
  - 100000-199999 in Southwest Region.
  - 200000-299999 in Western Region.
  - 300000-399999 in Hunter Region.
  - 400000-499999 in Sydney Region.
  - 500000-599999 in Northern Region.
  - 600000-699999 in Southern Region.

**What to write:**
- You will have been given a batch of numbers by your Project Manager. Write the next one on the form. Don’t use that number again for any other culvert.
- Also write the culvert number at the top of every page, in case pages get separated.

### 4.1.2 Date

**About the data:**
- This is a mandatory date field.
- Inspection date has the format dd/mm/yyyy (eg 25/03/2008).

**What to write:**
- Enter the date on which the inspection occurs.

### 4.1.3 Inspector Number

**About the data:**
- This is a mandatory numeric field of 3 digits.
- There are two fields so that two numbers can be entered.
- Each inspector is provided with a unique Inspector Number upon successful completion of their training.

**What to write:**
- Enter your 3 digit Inspector number in one field. Enter leading zeros, eg 007.
- Enter the number of your fellow inspector in the other field.

### 4.1.4 Local Number

**About the data:**
- Depending on your region and its previous inventory, culverts might already have a local identifying number other than the Culvert Number.
- This is an optional text field, of up to 10 characters.

**What to write:**
- If it has one, enter the local number.
- If it has a Bridge Number you must enter it in this field.
4.1.5 Region Code

About the data:
- This is a mandatory field of exactly 3 digits.
- Region Codes are as follows:

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>753</td>
<td>Hunter</td>
</tr>
<tr>
<td>750</td>
<td>Northern</td>
</tr>
<tr>
<td>757</td>
<td>Southern</td>
</tr>
<tr>
<td>758</td>
<td>Southwest</td>
</tr>
<tr>
<td>471</td>
<td>Sydney</td>
</tr>
<tr>
<td>766</td>
<td>Western</td>
</tr>
</tbody>
</table>

What to write:
- This might already be entered on the form.
- Enter the Region Code (not its name).

4.1.6 Slope Number

About the data:
- A Slope number is available from the Road Slope Management System (RSMS) if the culvert lies on an RTA identified slope.
- This is an optional numeric field, of up to 6 digits.

What to write:
- This might already be entered on the form.
- If it is on a managed slope, enter the Slope Number.

4.1.7 Culvert Comment

About the data:
- A comment should be added regarding access, location and non-critical issues.
- This is a mandatory text field of up to 200 characters.

What to write:
- Example comments might be:
  - Distance from a certain landmark, e.g. “near State Creek”, “100 metres south of Anzac Bridge”.
  - “Access on opposite carriageway, access requires permission from house 100 metres north of road”.
  - “Careful of the bull in the paddock, key to gate available from house”.
  - A reference to paint marks placed on the guardrail.
  - If access is difficult or equipment is required, make a note about it.

4.1.8 Requires Rope Access?

About the data:
- This is a mandatory item.

What to write:
- If rope access is required tick Yes, otherwise tick No.
4.2 Culvert Location Data

This section records the location of a culvert by Latitude/Longitude (GPS), RoadLoc Linear Referencing, and Segment/Offset. It looks like this:

<table>
<thead>
<tr>
<th>Culvert Location</th>
<th>Collect at least one of Lat/Long, RoadLoc, or Segment/Offset.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Culvert Location</strong></td>
<td><strong>Collect at least one of Lat/Long, RoadLoc, or Segment/Offset.</strong></td>
</tr>
<tr>
<td><strong>Latitude</strong></td>
<td><strong>Longitude</strong></td>
</tr>
<tr>
<td>Inlet</td>
<td></td>
</tr>
<tr>
<td>Outlet</td>
<td></td>
</tr>
<tr>
<td><strong>Off-road Latitude</strong></td>
<td><strong>Off-road Longitude</strong></td>
</tr>
<tr>
<td>Inlet</td>
<td></td>
</tr>
<tr>
<td>Outlet</td>
<td></td>
</tr>
</tbody>
</table>

Figure 4  Culvert Location data

Methodology for location data gathering:

Three kinds of location systems are used in the RTA. Only one of the three location formats is required to start with, in order to find the culvert in the field, but you must end up with all three filled in on the form before its submission for loading into RAMS.

1. **Before you go out**, look up the culvert on design plans or other records. If Latitude/Longitude, RoadLoc information or Segment information is available, put it on the form.
2. **In the field**, obtain and confirm Latitude/Longitude information. Segment information can sometimes be obtained in the field.
3. **When you return** to the office, convert what you have eg convert Latitude/Longitude to obtain RoadLoc before submitting the form.

Can’t find it?

If a culvert cannot be located in the field after a reasonable amount of time is spent looking (nominally 1 hour), then note this in the Culvert Comment box (see 4.1.7 above), with wording such as “Culvert could not be located”.

Found something else?

Be alert for culverts that you don’t know of and are not shown on design plans. It is critical to locate these in the field and collect them on a data collection form. If you do find one, then commence a new Culvert Data Collection Form. Assign a Culvert Number to it and complete all the other data.

4.2.1 Inlet and Outlet Latitude and Longitude

**About the data:**

- These are mandatory items.
- They are locations at the roadside.
- Data items must be recorded with 5 decimal places.
- GPS information is to be accurate to within 10m.

**What to do:**

- Be sure your GPS unit is set to the right datum.
- Take a GPS reading at the roadside near the inlet, and do the same near the outlet of the culvert.
- If the inlet or outlet structures are more than 10 m away from the edge of the carriageway, refer to section 4.2.5 on page 14.
What to write:
• This might have already been entered on the form, but check it is correct.
• Enter the GPS roadside latitude and longitude readings for both the inlet and outlet.
• Negative signs don’t need to be entered.

4.2.2 Road Number, Carriageway Code, Link, Offset along Link (RoadLoc)

About the data:
The RTA’s Linear Referencing (RoadLoc) system is a tool for identifying any location along the RTA road network. A reference has four items:
• Road Number: Each road has a 7 character number.
• Link: A road is divided into links, and each link has a four digit number.
• Carriageway Code: Individual carriageways in each link have an alphabetic code.
  • If the link is undivided road there is a single Carriageway and its code is A.
  • If the road is divided with a centre median there is a separate code for each carriageway. The carriageway along the prescribed direction is B. If the carriageway is opposite to the prescribed direction, the code is C.
  • The “prescribed direction” is the direction of increasing chainage.
• Offset along link: The distance (chainage) along the carriageway from the control point (start) of the link in kilometres to the nearest metre (ie it is kilometres to three decimal places).

What to do:
• RoadLoc linear references can be calculated from the latitudes and longitudes collected in 4.2.1 above, by using the Gridloc program.

What to write:
• If not provided already on the form, then RoadLoc information must be added to the form.
• Enter the four items (Road number, Link number, Carriageway Code and Offset along Link) into separate fields.
• There are fields for inlet RoadLoc, and fields for outlet RoadLoc.

Figure 5  Example RoadLoc Diagrams

4.2.3 Segment Number and Segment Offset

About the data:
• Segment Number and Segment Offset is an older, but still commonly used means of identifying points along a road. A segment is a similar concept to a link. Its use varies across RTA regions, and segment numbers are not sufficient by themselves to uniquely identify a point on the whole road network.
• The segment number is a maximum of 5 digits, for example: 01125.

1 There are other less common Carriageway Codes you might need to use. The Carriageway also has a version number, but that is not needed here, as you are always inspecting the latest version.
• Segment offset is the distance from the segment start in metres, taken from the start of the segment going in the direction of increasing segment number.

Figure 6  Segment marking example

What to do:
• Segment number and offset can be completed using the design plan information, or from segment markings in the field. Segment number is written on the road or a guidepost. Its placement depends on which region you are working in. Consult your Project Manager for typical markings.
• Segment offset distance can be measured by vehicle odometer if used carefully, or preferably by using a measuring wheel.

What to write:
• Enter Segment Number and Segment Offset. There is a row for inlet location and a row for outlet location.

4.2.4  Speed Limit
About the data:
• Speed limit is useful when assessing risk.
• RAMS does not yet have all speed limits for links in its database, so it needs to be collected.
• This is a mandatory numeric field, of up to three digits.
• It is the maximum signposted limit in either direction.

What to do:
• Look for the posted speed limit for the road at the inlet and outlet points in both directions.

What to write:
• Enter the maximum as-posted speed limit at the inlet as digits eg 70 for 70 kilometres per hour.
• Enter the maximum as-posted speed limit at the outlet. You don’t need to enter leading zeros.

4.2.5  Inlet/Outlet Off-Road Latitude and Longitude Co-ordinates
About the data:
• This is a mandatory item if the inlet or outlet is more than 10m from the road edge, so that the inlet and outlet can be easily found again.
• Items must be recorded with 5 decimal places.
• GPS information is to be accurate to within 10m.
• Edge-line co-ordinates are always entered, using the fields in section 4.2.1 on page 12. The inlet and outlet off-road locations are possible additional coordinates, as shown in Figure 7.
  • XX and YY (on road) must always be recorded.
  • WW and ZZ (off road) must be recorded whenever the inlets or outlets are too far away from the road.
4.2.6 Left or Right of Carriageway

About the data:
• This is a mandatory item.
• This field is used to indicate on which side of the carriageway the Culvert inlet and outlet are located, if travelling in the prescribed direction (increasing link or segment number).

What to write:
• Tick the Left or Right boxes as appropriate.

4.2.7 Marked at Roadside

About the data:
• This is a mandatory item.

What to do:
• Are there any markers indicating the existence of the culvert inlet and the culvert outlet at the side of the roadway? Delineator posts and traffic guard rails are the two common markers for culvert locations.
• If not marked, and if it is possible to mark, then the inspector is to mark the roadside or guardrail according to regional marking standards (commonly a vertical or perpendicular-to-road white paint mark, at least 100mm wide).

What to write:
• Tick the Yes or No boxes as appropriate.
4.3 Design Data

The Design Data section looks like this:

<table>
<thead>
<tr>
<th>Plan Number</th>
<th>Sheet Number</th>
<th>Pipe/Box Number</th>
<th>Discharge</th>
<th>Flow potential</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Figure 9  Design Data

Obtaining plans

Culvert design data may be available from the RTA Design Plans for that specific section of roadway. Road construction plans are stored as paper files or electronic files. These will be supplied by the Project Manager. The Inspector or Project Manager should review the available culvert design information prior to field inspection. Figure 10 is an example of a design plan.

If plans are not available for a culvert, the Inspector might be able to source the information in the field – occasionally design data is marked on the culvert. If data is on the culvert, copy it into the relevant section on the form.

Figure 10  Example design plan
4.3.1 **Plan Number, Sheet Number, Pipe/Box Number**

*About the data:*
- These are mandatory if plans are available.
- The three items are optional text fields (of up to 50 characters in total).

*What to do:*
- The plan number is located at the bottom of each RTA plan.
- The sheet number is also located at the bottom of each RTA plan.
- The pipe/box number (depending on type of culvert) is located in tabular format on a drainage plan sheet. See Figure 10.

*What to write:*
- Enter the numbers as found.

4.3.2 **Capacity Description**

*About the data:*
- This describes the designed capacity of the culvert.
- This item is an optional text field of up to 200 characters.

*What to do:*
- The capacity description will be located in a tabular format on a drainage plan sheet.

*What to write:*
- Enter the description as found.

4.3.3 **Discharge**

*About the data:*
- This is the discharge volume in cubic metres per second.
- This item is mandatory if drainage plans are available.
- It is a numeric field.

*What to do:*
- It is presented in a tabulated form within the set of Design plans.
- Discharge should be stated in cubic metres per second (cu m/s). Ensure litres per second is converted to cubic metres per second by dividing by 1000 (1000 L/s is 1 cu m/s).

*What to write:*
- Enter the number.

4.3.4 **Flood Potential**

*About the data:*
- This allows for a comment to be made based on site observations or known history.
- The item is an optional text field of up to 200 characters.

*What to do:*
- The inspector should assess the issues associated with the culvert. For instance – is the immediate catchment for the culvert large, and only a small diameter culvert? How does the situation compare to its designed capacity?
- Comment can be made on evidence of previous flooding, such as:
  - An observed high water mark on embankment.
- Debris found under guardrail indicating possible water flow over road.
- Amount of debris on the top side of the culvert inlet and outlet.
- Evidence of overtopping.
- No signs of previous flooding.

What to write:
- Enter comments as appropriate.

### 4.4 Culvert Details

This section allows the inspector to record details about the construction of the culvert. It looks like this:

<table>
<thead>
<tr>
<th>Culvert Details</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Purpose</strong> (tick 1 only)</td>
</tr>
<tr>
<td>Pave drainage</td>
</tr>
<tr>
<td>Catchment drainage</td>
</tr>
<tr>
<td>Pedestrian / bicycle access</td>
</tr>
<tr>
<td>Stock / fauna access</td>
</tr>
<tr>
<td>Utilities</td>
</tr>
<tr>
<td>Vehicle</td>
</tr>
<tr>
<td><strong>Culvert Type</strong> (tick 1 only)</td>
</tr>
<tr>
<td>Pipe</td>
</tr>
<tr>
<td>Box</td>
</tr>
<tr>
<td>Arch</td>
</tr>
<tr>
<td>Composite (tick if more than 1 type)</td>
</tr>
<tr>
<td><strong>Barrel or cell construction</strong></td>
</tr>
<tr>
<td>Spiral wound steel pipe</td>
</tr>
<tr>
<td>Multi-plate corrugated steel</td>
</tr>
<tr>
<td>Spiral wound aluminium pipe</td>
</tr>
<tr>
<td>Multi-plate corrugated aluminium</td>
</tr>
<tr>
<td>Plastic corrugated</td>
</tr>
<tr>
<td>Plastic uncorrugged</td>
</tr>
<tr>
<td>Other (eg. terracotta)</td>
</tr>
<tr>
<td><strong>Culvert Joints</strong></td>
</tr>
<tr>
<td>Butt – unsealed</td>
</tr>
<tr>
<td>Butt – sealed</td>
</tr>
<tr>
<td>Spigot &amp; socket – rubber ring</td>
</tr>
<tr>
<td>Spigot &amp; socket – grouted</td>
</tr>
<tr>
<td>Other (describe)</td>
</tr>
<tr>
<td><strong>Box Culvert Types</strong></td>
</tr>
<tr>
<td>Cast in situ</td>
</tr>
<tr>
<td>Pre-cast crown, cast insitu base slab</td>
</tr>
<tr>
<td>Pre-cast with pre-cast floor</td>
</tr>
<tr>
<td>Multi-cell with link slabs</td>
</tr>
<tr>
<td>Other (describe)</td>
</tr>
<tr>
<td><strong>Lining</strong></td>
</tr>
<tr>
<td>Fully lined</td>
</tr>
<tr>
<td>Invert only lined</td>
</tr>
<tr>
<td>Unlined</td>
</tr>
<tr>
<td>Other (if selected, write Lining Comment below)</td>
</tr>
<tr>
<td><strong>Lining Materials</strong></td>
</tr>
<tr>
<td>Plastic</td>
</tr>
<tr>
<td>Reinforced concrete</td>
</tr>
<tr>
<td>Fibre reinforced concrete</td>
</tr>
<tr>
<td>Bituminous</td>
</tr>
<tr>
<td>Hazardous (eg. coal tar or asbestos)</td>
</tr>
<tr>
<td><strong>Lining Comment</strong></td>
</tr>
</tbody>
</table>

**Figure 11 Culvert Details**

What to do:
- All the items can be noted during a single inspection.
- You will need to inspect both ends of the culvert, but first assess if it is safe to do so.
- Only enter the culvert if it has been assessed for safety.
- Mark the culvert number on the inlet and outlet of the culvert (eg on the headwalls) with spray paint or chalk. Use 100mm high figures above or beside the culvert.

### 4.4.1 Purpose of Culvert

About the data
- Culverts are classified according to a specific purpose.

What to write
- It is mandatory to tick one only of the following types.
- Tick the main purpose if it seems that more than one applies.
<table>
<thead>
<tr>
<th><strong>Pavement Drainage Culvert</strong></th>
<th>Pavement drainage culverts are used specifically to drain surface water from the road pavement.</th>
</tr>
</thead>
</table>
| **Catchment Drainage Culvert** | Catchment drainage culverts convey water under the road from surrounding catchment areas.  
Catchment drainage culverts are identified by the existence of both inlet and outlet water courses. |
| **Pedestrian/Bicycle Access Culvert** | Pedestrian/bicycle access culverts are built for pedestrian and bicycle passage under busy roads.  
Pedestrian/bicycle access culverts are identified by their join to footpaths or cycleways at both sides of the road. |
<p>| <strong>Stock/Fauna Access Culvert</strong> | Stock/fauna access culverts are built for stock/fauna passage under busy roads. |</p>
<table>
<thead>
<tr>
<th><strong>Utilities Culvert</strong></th>
<th>Utilities culverts are built for utilities (e.g. Telstra lines) to cross the road.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Vehicle Underpass</strong></td>
<td>Allows the passage of vehicles under a roadway.</td>
</tr>
<tr>
<td>-----------------------</td>
<td>-----------------------------------------------------------------------------</td>
</tr>
</tbody>
</table>

### 4.4.2 Culvert Type

**About the data**
- Culverts are classified according to construction type.

**What to write**
- It is mandatory to tick one only of the following culvert types.

<table>
<thead>
<tr>
<th><strong>Pipe Culvert</strong></th>
<th>Pipe culverts are identified by their circular or elliptical shape.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Culvert Type</td>
<td>Description</td>
</tr>
<tr>
<td>----------------------</td>
<td>-----------------------------------------------------------------------------</td>
</tr>
<tr>
<td><strong>Box Culvert</strong></td>
<td>Box culverts are identified by their rectangular shape.</td>
</tr>
<tr>
<td><img src="image1.jpg" alt="Box Culvert Image" /></td>
<td></td>
</tr>
<tr>
<td><strong>Arch Culvert</strong></td>
<td>Arch culverts are identified by their semi-circular shape.</td>
</tr>
<tr>
<td><img src="image2.jpg" alt="Arch Culvert Image" /></td>
<td></td>
</tr>
<tr>
<td><strong>Composite Culvert</strong></td>
<td>Composite culverts are identified by the combination of two culvert types, i.e. arch and box, box and pipe, pipe and box, or other combination. If selected, a description must be provided.</td>
</tr>
<tr>
<td><img src="image3.jpg" alt="Composite Culvert Image" /></td>
<td></td>
</tr>
</tbody>
</table>
4.4.3 Barrel or Cell Construction

About the data
- Culverts can be classified by construction material used.

What to write
- Tick one or more of the following types.

<table>
<thead>
<tr>
<th>Spiral Wound Steel/Aluminium Pipe</th>
<th>Spiral wound steel pipes are corrugated metal pipes with interlocking or welded seam along the pipe. This seam is visible from the inside of the pipe. Joins are bands wrapped around the outside of the join between each pipe section. To determine whether aluminium, use judgement, or else a magnet – aluminium is not magnetic.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Multi-Plate Corrugated Steel/Aluminium</td>
<td>Bolts/nuts will be visible where the adjacent plates join. To determine whether aluminium, use judgement, or else a magnet – aluminium is not magnetic.</td>
</tr>
<tr>
<td>Corrugated Plastic Pipe</td>
<td>These pipes are known as High Density Polyethylene (HDPE). Wall thickness will vary but is generally thin.</td>
</tr>
<tr>
<td>Un-corrugated Plastic Pipe</td>
<td>Un-corrugated plastic pipes are known commercially as PVC pipes.</td>
</tr>
<tr>
<td>---------------------------</td>
<td>---------------------------------------------------------------</td>
</tr>
<tr>
<td>Steel Reinforced Concrete (RCP)</td>
<td>Steel Reinforced Concrete (RCP) pipe will be the most prevalent form of concrete culvert. Steel reinforced concrete pipe generally is supplied in 2.4m lengths, look for pipe segments that length. This pipe will have a lifting lug on the upper inside of the pipe. When hit with a hammer it will have a “clink” sound.</td>
</tr>
<tr>
<td>Fibre Reinforced Concrete</td>
<td>The inspector may notice the fibre in the concrete if the surface has been damaged. Fibre reinforced pipe does not have a lifting lug inside the pipe. Fibre reinforced pipe is generally in 4 metre long segments, and is thinner walled than RCP’s. When hit with a hammer it will have a “thud” sound.</td>
</tr>
<tr>
<td><strong>Pre-cast Concrete Arch</strong></td>
<td>Pre-cast concrete arch is usually mounted on cast in situ footing. Note – if the span is greater than 6m, this will also be classified as a bridge.</td>
</tr>
<tr>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td><strong>Stone or Masonry Barrel</strong></td>
<td>Stone barrels are built from irregular non uniformed stone blocks joined together with mud and mortar.</td>
</tr>
<tr>
<td><strong>Brick Barrel</strong></td>
<td>Brick barrels are lined with uniform shaped bricks joined together with mud and mortar. Look for stepped cracks in the mortar.</td>
</tr>
<tr>
<td><strong>Timber Barrel</strong></td>
<td>Barrels constructed of timber are uncommon and usually box shaped consisting of heavy treated or hard wood members.</td>
</tr>
</tbody>
</table>
4.4.4 Culvert Joints

About the data
- Joints are generally only recorded for concrete pipes.
- Multiplate steel pipes do not have joints.
- Pipes can have different kinds of jointing.
- All tick boxes are optional.

What to do
- If the culvert is concrete, tick one or more of the following joint types, illustrated below.
- During the inspection if it is noticed that joints have separated to a degree whereby water or embankment fill is penetrating into the joint, this should be noted and immediately reported to the Project Manager.

What to write
- It is mandatory to tick one or more of the following for concrete pipes.
- If uncertain whether butt joints are Butt – sealed or Butt – unsealed, tick Butt – unsealed.

Butt – Unsealed Pipe Joint

The difference between an unsealed pipe joint and sealed pipe joint can be hard to see. Pipes are laid next to each other with no interlocking at the joints. This can result in misaligned pipes, allowing the ingress of embankment material.
<table>
<thead>
<tr>
<th>Joint Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Butt – Sealed Pipe Joint</td>
<td>Pipes are laid next to each other with no interlocking at the joints.</td>
</tr>
<tr>
<td></td>
<td>However, an external band is wrapped around the joint to prevent loss of</td>
</tr>
<tr>
<td></td>
<td>bedding material into the pipe.</td>
</tr>
<tr>
<td><img src="image.png" alt="Butt Joint Diagram" /></td>
<td></td>
</tr>
<tr>
<td>Spigot &amp; Socket – Rubber Ring Joint</td>
<td>Pipes are joined together via spigot-socket interlocking mechanism.</td>
</tr>
<tr>
<td></td>
<td>The rubber ring joint is wrapped around the spigot surface and it prevents</td>
</tr>
<tr>
<td></td>
<td>water seepage when the pipe is operating under pressurized conditions.</td>
</tr>
<tr>
<td></td>
<td>The inlet will have the Socket end visible.</td>
</tr>
<tr>
<td><img src="image.png" alt="Rubber Ring Joint Diagram" /></td>
<td></td>
</tr>
<tr>
<td>Spigot &amp; Socket – Grouted Joint</td>
<td>As for above, however the joints are grouted with a cement based material.</td>
</tr>
<tr>
<td><img src="image.png" alt="Grouted Joint Diagram" /></td>
<td></td>
</tr>
<tr>
<td>Other – tick box</td>
<td>These fields are to be used when the culvert jointing is not any of the</td>
</tr>
<tr>
<td>Other – description</td>
<td>above four types. If selected, a description is required.</td>
</tr>
<tr>
<td></td>
<td>Examples are flange joints in concrete pipes, and overlapping finger joints</td>
</tr>
<tr>
<td></td>
<td>in steel pipes.</td>
</tr>
<tr>
<td><img src="image.png" alt="Other Joint Diagram" /></td>
<td></td>
</tr>
</tbody>
</table>
### 4.4.5 Box Culvert Type (if Culvert is Rectangular)

#### About the data
- Box culverts can be classified by construction method.

#### What to write
- Tick one or more of the following types.

<table>
<thead>
<tr>
<th>Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Cast in Situ Box</strong></td>
<td>The centre wall of the culvert will be homogenous to both sides. There is no jointing of individual sections within the culvert (do not confuse with expansion joints). The floor, sides and roof are continuous with no seams (except for expansion joints).</td>
</tr>
<tr>
<td><strong>Pre-cast Crown with Cast in Situ Base Slab</strong></td>
<td>Individual sections of the culvert sides and top will be noticeable. The base slab will be continuous with no obvious jointing between sections of culvert. Note: the base slab may show expansion joints.</td>
</tr>
<tr>
<td><strong>Pre-cast Box with Pre-cast Floor</strong></td>
<td>Individual sections of the culvert sides and top may be noticeable. Manufacturers stamp will be visible at eye height. Sections will generally be 1.2m wide.</td>
</tr>
</tbody>
</table>
Multi-cell Box with Link Slabs (Lintels)

Multi-cell box culverts with lintels are identified by the presence of lintel slab joining between two or more pre-cast box culverts.

Other – tick box
Other – description

These fields are to be used when the box type is not any of the above types.
If selected, a description is required.

4.4.6 Lining

About the data
- Culverts can be coated (lined) with a protection layer to prevent corrosion or abrasion and hence to improve durability.

What to do
- Look inside the culvert and check whether it is fully lined, invert lined only or unlined.

What to write
- Tick one or more of the following lining types.

Fully Lined

Fully lined culverts are lined around the full inside circumference of the barrel.
<table>
<thead>
<tr>
<th><strong>Invert Only Lined</strong></th>
<th>Invert lined with concrete to protect the pipe against water carrying stones and abrasive materials or corrosion at low flows. Lining might be concrete without reinforcing.</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image1" alt="Invert Only Lined" /></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Unlined</strong></th>
<th>No lining to the interior of the pipe. This can lead to extensive corrosion in Corrugated Steel Pipes.</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image2" alt="Unlined" /></td>
<td></td>
</tr>
</tbody>
</table>
### 4.4.7 Lining Materials

#### About the data
- Different lining materials are in use.
- Some lining materials may be hazardous; for example fibre reinforced pipes installed before 1990 are likely to contain asbestos. Some examples are noted below:
  - Coal Tar – identified by creosote odour and black colour.
  - Bituminous – black and smooth.
  - Asbestos – was used for corrosion resistance – do not scrape/loosen the lining if it appears to be asbestos.

#### What to do
- Look inside of the culvert.

#### What to write
- Tick none, one or more of the following material types.

<table>
<thead>
<tr>
<th>Lining Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plastic Lining</td>
<td>Smooth plastic lining to prevent corrosion and abrasion.</td>
</tr>
<tr>
<td>Reinforced Concrete/Fibre</td>
<td>Smooth concrete lining to prevent corrosion and abrasion.</td>
</tr>
<tr>
<td>Reinforced Concrete/Lining</td>
<td>Fibre reinforced concrete may be difficult to determine – however if lining is damaged, fibres may be visible.</td>
</tr>
<tr>
<td>Bituminous Lining</td>
<td>Bituminous/tar lining is sprayed or painted on to act as a waterproofing membrane. It is important to note defects, as the culvert may no longer be waterproofed if the lining is damaged.</td>
</tr>
</tbody>
</table>
4.4.8 Lining Comment

About the data

- The condition of the culvert lining is important in risk assessment.
- This item is a text field of up to 200 characters.

What to write

- Describe the current condition of the lining. Examples of this comment include:
  - Lining is still intact;
  - Lining is washed away;
  - Lining is degraded; or
  - Lining is uniform in appearance and in good condition.

4.5 Culvert Attributes

This section captures dimensions and some other attributes. It looks like this:

<table>
<thead>
<tr>
<th>Culvert length (overall) metres</th>
<th>No of cells/barrels/pipes</th>
<th>Pipe inside diameter mm</th>
<th>Cell/barrel/arch width mm</th>
<th>Cell/barrel/arch height mm</th>
<th>Length of cell (between joints) mm</th>
<th>Depth of cover (inlet side) metres</th>
<th>Depth of cover (outlet side) metres</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nature of Fill</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Shale</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sand</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rocky material</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Clay</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Decomposed Granite</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other (describe)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Is the culvert long enough?</td>
<td>O Yes</td>
<td>O No</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Grates</td>
<td>O Yes</td>
<td>O No</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Floodgates</td>
<td>O Yes</td>
<td>O No</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tidal Flows</td>
<td>O Yes</td>
<td>O No</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Figure 12 Culvert Attributes

Figure 13 Culvert dimensions
About the data
• The dimensions of the culvert are important in risk assessment.
• The following culvert attributes should be measured using appropriate equipment. Some dimensions are illustrated in the sketch below.
• All items in this section are mandatory, except length of cell between joints.

What to do
• Collect and enter the following measurements.

4.5.1 Culvert length overall
• Use the “Disto” laser measuring device.
• Measure in metres, enter up to three digits and a decimal digit on the form.

4.5.2 Number of cells (boxes), barrels, or pipe (across)
• Count them.
• Enter up to three digits into the form.
• Examples:

4 across the span

2 across the span

Cells/barrels are to be lettered A, B, C... In order, in the prescribed direction. Mark barrels with their letters, and take a photo down the barrel of each cell.

4.5.3 Pipe inside diameter
• Measure in millimetres and enter onto the form, up to 4 digits.

4.5.4 Cell, barrel, or arch width
• Measure in millimetres and enter onto the form, up to 4 digits.

4.5.5 Cell, barrel, or arch height
• Measure in millimetres and enter onto the form, up to 4 digits.

4.5.6 Length of cell (between joints)
• Measure in millimetres and enter onto the form, up to 4 digits.

4.5.7 Depth of cover at road (inlet side)
• Measure or estimate in metres on the inlet side and enter on the form, up to 99.9.

4.5.8 Depth of cover at road (outlet side)
• Measure or estimate in metres on the outlet side, up to 99.9.
4.5.9 Nature of Fill

- Tick one or more of the types of fill.
- If 'Other' is ticked, comment about fill material, ie texture, material type, and surface - this is a text field of up to 200 characters.

![Diagram of road widening and culvert](image)

**Figure 14  Culvert too short**

4.5.10 Is the Culvert Long Enough

- This is a mandatory yes/no item.
- A culvert is considered 'not long enough' if the length of the culvert is a limiting factor in the shoulder width of the road. If the culvert forms a pinch point it is not long enough.
- In some cases, the batters for these culverts can be locally steepened and unstable.

4.5.11 Grates, Floodgates, Tidal Flows

- These three items are mandatory yes/no items.
- Tick yes or no as appropriate.
- The following photos show examples.

<table>
<thead>
<tr>
<th>Grates</th>
<th>Grate at inlet to stop debris and solids from entering the pipe.</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image" alt="Grate Image" /></td>
<td><img src="image" alt="Grate Image" /></td>
</tr>
</tbody>
</table>
Flood Gates

Flaps or gates at outlet to stop water flowing the wrong way back into the pipe.

Tidal Flows

Tidal inflow prevention gate at outlet.
A culvert with tidal flows might not have gates.
The concern indicated by this item is the potential effects of saline flow.

4.6 Culvert Condition

This section is for recording the current condition of the culvert. It looks like this:

<table>
<thead>
<tr>
<th>During this inspection is there water in the culvert?</th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>Barrel Flow (tick 1)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Inlet Flow (tick 1)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Outlet Flow (tick 1)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Inlet Conditions</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Outlet Conditions</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Structure Conditions</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Road Surface Condition</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Batter Condition</td>
<td></td>
<td></td>
</tr>
<tr>
<td>What routine maintenance is required?</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Figure 15  Culvert Condition fields
What to do

- When approaching the culvert, take note of the surroundings and general condition of the culvert from an overall perspective. Notice whether there is ponding in the culvert or any damage to the embankment, noting where any damage is relative to the culvert.

- The culvert condition should be noted with photographs taken to the best of the inspector’s ability using flash or torch to illuminate inside of the culvert – Refer to 4.8.4 regarding techniques for taking photographs.

### 4.6.1 Is there water in the culvert?

- Was there water in the culvert at the time of inspection?
- This field is mandatory. Tick Yes or No.

<table>
<thead>
<tr>
<th>Clear</th>
<th>No blockage, up to 10% blocked.</th>
</tr>
</thead>
<tbody>
<tr>
<td>25% blocked</td>
<td>Blockage from 10% blockage up to 25%.</td>
</tr>
</tbody>
</table>

### 4.6.2 Barrel Water Flow

- This field is mandatory.
- Estimate the amount of blockage within the barrel of the culvert, choosing a value that represents the worst condition. Approximations should be rounded up to the next quartile. For example, a culvert blocked at 35% would be recorded on the form as 50%.
- If it is estimated that blockage is 10% or less, this should be rounded down as “Clear”.

Whether or not there is any water trapped in the culvert during the inspection. This could result from vertical movement of a culvert section or blockages inside or outside the culvert.

Is water running through the culvert? Is water ponded?
The concern is whether it is there.
<table>
<thead>
<tr>
<th>50% blocked</th>
<th>Blockage from 26% up to 50%.</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image" alt="50% blocked" /></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>75% blocked</th>
<th>Blockage from 51% up to 75%.</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image" alt="75% blocked" /></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>100% blocked</th>
<th>Blockage from 76% to fully blocked.</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image" alt="100% blocked" /></td>
<td></td>
</tr>
</tbody>
</table>

4.6.3 Inlet/Outlet Water Flow

- An estimate should be made and approximations should be rounded up to the next quartile. For example, if you believe that the inlet is 35% blocked, then round this up to 50%.
- Between 0% and 10% blocked is regarded as “clear”.
- This field is mandatory.

<table>
<thead>
<tr>
<th>Clear</th>
<th>Clear, with no blockage, up to 10% blocked.</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image" alt="Clear" /></td>
<td></td>
</tr>
<tr>
<td>Percentage Blocked</td>
<td>Description</td>
</tr>
<tr>
<td>--------------------</td>
<td>-------------</td>
</tr>
<tr>
<td>25% blocked</td>
<td>Inlet/outlet is between 10% and 25% blocked. Blockage can be vegetation, embankment material, rocks, or other obstruction.</td>
</tr>
<tr>
<td>50% blocked</td>
<td>Blockage from 26% up to 50%.</td>
</tr>
<tr>
<td>75% blocked</td>
<td>Blockage from 51% up to 75%.</td>
</tr>
<tr>
<td>100% blocked</td>
<td>Blockage from 76% up to 100%.</td>
</tr>
</tbody>
</table>
### 4.6.4 Inlet Condition, Outlet Condition

- Make site observations of adverse conditions inside and around the culvert inlet and outlet.
- These fields are optional, tick as they apply to the inlet or the outlet. More than one can be ticked.

<table>
<thead>
<tr>
<th>Inlet/Outlet Scour</th>
<th>Inlet scour is where the velocity of water picks up soil and erodes the channel leaving large voids at the inlet of the culvert. Outlet scour is when the soil at the outlet is washed away due to heavy flows and velocities.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vegetation</td>
<td>Overgrown vegetation causes the culvert to become blocked.</td>
</tr>
<tr>
<td>Damaged Drainage Blanket</td>
<td>Drainage blankets (bidum, growth mat) protect the channel against outlet scour. Note: This drainage blanket is in good condition – not damaged.</td>
</tr>
</tbody>
</table>
### Boulder Trap Full/Compromised
Grates are used to stop boulders from entering the culvert. However these need to be cleaned out at regular maintenance intervals.

### Other Structures in Drainage Line
Large pieces of timber or other materials may cause drainage channels and culverts to become blocked.
Example structures are utilities ducts, farmer’s stock gates, propping. Report other structures to your Project Manager, and make a note in the ‘Routine maintenance required’ comments field.

### 4.6.5 Structure Conditions
- The inspector should look for the following within the outlet, inlet and barrel of culvert.
- If there are significant issues, the Project Manager should be immediately notified.
- These fields are optional, tick as they apply. More than one can be ticked.

<table>
<thead>
<tr>
<th>Headwall missing/damaged</th>
<th>Wingwall missing/damaged</th>
</tr>
</thead>
<tbody>
<tr>
<td>Headwall has either not been installed during construction or has been washed away over time.</td>
<td></td>
</tr>
<tr>
<td>Wingwall has either not been installed during construction or has been washed away over time.</td>
<td></td>
</tr>
<tr>
<td>If the culvert was built without headwalls or wingwalls make a note in the ‘Routine maintenance required’ comments field.</td>
<td></td>
</tr>
</tbody>
</table>
### Pipe/box damage

This photo shows deformation likely resulting from voids formed above and around the culvert and/or the embankment collapsing around the culvert.

### Joint Damage

The joint in the photo leaves a void above the culvert and can potentially contribute to road subsidence. Look for embankment material or water seeping through joints – both at the top and bottom of the culvert. Drainage blankets can also be washed through the joints of some culverts.

---

**4.6.6 Road Surface Conditions**

**About the data**

- Road surface conditions can indicate potential culvert failure.
- This is an optional text field, of up to 200 characters.

**What to do**

- The inspector should make site observations of adverse structural indications on the surface of the roadway, including:
  - Pavement cracks parallel or perpendicular to the culvert centreline;
  - Frequent potholing or pothole patches;
  - Guardrail sag, and;
  - Depressions in the road surface.
- Provide photographs of all adverse features and a sketch (if necessary) showing dimensions and depths. See examples below.

**What to write**

- Enter a comment about adverse features. Describe extent of faults and damage as this may be up to 20m away from the culvert.
- If condition is good, write “Good”.

---
Pavement cracking

Longitudinal or transverse cracking can indicate impending embankment failure.

**NOTE:** If cracking extends through travelled lanes, notify the Project Manager immediately.

Frequent potholing

Multiple layers of pothole patching indicate frequent cracking and/or subsidence in roadway.

Any significant potholes should be reported to the Project Manager immediately.
Guardrail sag

NOTE: In these cases, the Project Manager should be notified immediately.

Depression in road surface

Look for significant depressions in the road surface that may indicate embankment instability.

NOTE: In these cases, the Project Manager should be notified immediately.
4.6.7 Batter Condition

About the data

• Batter slump is an example of deteriorating batter. In this case, the toe of the embankment may have been eroded, and the batter slumps downward, sometimes forming a bulge at the base – which may cover the inlet.

• Embankment erosion can occur due to lack of vegetation, or a slope too steep.

• This is an optional text field, of up to 200 characters.

What to do

• Walk around the site. Note the general condition of the batter on both inlet and outlet sides.

• Provide an approximate distance from the culvert to the batter slump.

• Provide photographs allowing overall assessment of the slump or batter failure. See example photographs below.

What to write

• Enter observations about adverse any batter features.

### Batter slump

Site observations of batter failure.

Identify whether the batter slump is blocking the culvert or eroding onto the road.

Batter slump is evident where soil has been washed away.
A void in the road batter is formed by soil eroding near an outlet or behind a wing wall.

### Embankment erosion

Embarkment erosion is caused by water running down the slope.
Locating where the water is coming from is the issue. Sometimes this is simply caused by heavy rain falling on the batter, but often debris build-up under guard rails or on verges or road shoulders will direct water to the lowest point in the road, usually above a culvert. Blocked, damaged or under capacity edge drains can also direct water down a slope. More importantly, erosion can be signs of the road overtopping, or piping through the embankment or above the pipe itself.

In all cases embankment erosion should be noted, as if unchecked it will lead to reduced embankment life.
Slope failure can occur due to saturation of the slope materials, erosion, creep, or simply the embankment being too steep. The most critical factor of failure is generally water. Poor drainage and damaged culverts are a critical factor in slope failure. It is critical to note any form of embankment failure.

### 4.6.8 What routine maintenance is required?

**About the data**

A routine maintenance action enables the culvert to operate at its optimal performance and extends the life of the culvert. Maintenance can include but is not limited to any of the following activities:

- Clear sediment/debris.
- Repair headwall/wingwall.
- Road patching required.
- Clear vegetation/overgrowth.
- Reshape/vegetate embankment.
- Place/replace inlet/outlet rock bedding.

**What to write**

- This is a mandatory text field of up to 200 characters.
- Note any routine maintenance that should be undertaken.
- If the culvert is in ‘As-Built’ condition and/or doesn’t require any maintenance, the inspector should mark this field with the word “None”.
- Defects that are not minor and are covered in the Risk Screening Checklist should be ticked and commented on in the Risk Screening Comment box – see section 4.9.
4.7 Drainage Pits

This section is for recording drainage pit structures located along the culvert. It looks like this:

<table>
<thead>
<tr>
<th>Drainage Pits</th>
<th>(Up to 4 pits here. If the inlet or outlet above is also a pit, list it here, using the same lat and long)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pit Latitude</td>
<td>Pit Longitude</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Pit Comments

Figure 16  Drainage Pit fields

The list allows data for 4 pits to be entered. If there are more than four pits, then add a separate page with the same details.

Sometimes a pit may be the inlet or outlet of the culvert – refer to the notes and diagrams in section 4.1. If the inlet or outlet is itself a pit, you should include it in this list.

4.7.1  Pit Attributes

All drainage pits that exist along the culvert centreline should be listed, with the following attributes:

<table>
<thead>
<tr>
<th>Pit Attribute</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pit Latitude &amp; Pit Longitude</td>
<td>Obtained from a GPS reading at the centre of the pit.</td>
</tr>
<tr>
<td>Pit Type</td>
<td>Choose one type. Various pit types are shown in the example photos below.</td>
</tr>
<tr>
<td>Depth</td>
<td>Distance from the inlet to the pit floor, in metres to two decimal places.</td>
</tr>
<tr>
<td>Pedestrian safe</td>
<td>Determine if inlet pit poses any risks to the public when traversed by pedestrians, for example:</td>
</tr>
<tr>
<td></td>
<td>• large openings in the grate;</td>
</tr>
<tr>
<td></td>
<td>• raised pit edges can cause pedestrians to trip over or to fall inside;</td>
</tr>
<tr>
<td></td>
<td>• displaced inlet lid.</td>
</tr>
<tr>
<td>Bike Safe</td>
<td>Determine if the pit poses any risks to the public when traversed by cyclists, for example:</td>
</tr>
<tr>
<td></td>
<td>• are the slots in the pit grate wide enough to catch a bicycle tyre and cause injury to the rider:</td>
</tr>
<tr>
<td></td>
<td>• can a small road bike’s tyres drop into or jam in the grate.</td>
</tr>
<tr>
<td>Pit Comments</td>
<td>General description of pit condition including comments such as why pit is pedestrian/cyclists unsafe, inlet blocked, high water marks, and other pit condition comments.</td>
</tr>
</tbody>
</table>
### 4.7.2 Pit Types

<table>
<thead>
<tr>
<th>Pit Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gully Pit</td>
<td>Exists along a kerb line.</td>
</tr>
<tr>
<td>Junction Pit</td>
<td>Two pipes coming together.</td>
</tr>
<tr>
<td>Junction Box</td>
<td>Looks similar to the junction pit with a separate pipe going in and out of the box.</td>
</tr>
<tr>
<td>Inlet sump</td>
<td>Found at the base of a catchment.</td>
</tr>
<tr>
<td>Blind Pit</td>
<td>Usually cannot be seen as it is buried.</td>
</tr>
<tr>
<td>Raised Inlet</td>
<td>The lid of the pit is raised so water enters through the side, not the top.</td>
</tr>
</tbody>
</table>

### 4.8 Photo and Image Files

This section is used to record the file name and a descriptive caption for each photo that you have taken. If you have also scanned any images or documents that are relevant to this culvert then also list them with a caption.

Each photo must have its filename and caption listed in the table.

The section looks like this. It has space for 15 photos. If there are more, then attach a list.

<table>
<thead>
<tr>
<th>File Name</th>
<th>Caption</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inlet</td>
<td></td>
</tr>
<tr>
<td>Outlet</td>
<td></td>
</tr>
<tr>
<td>Barrel</td>
<td></td>
</tr>
</tbody>
</table>

**Figure 17 Photo and Image data**
The following is an example of files names and captions for Culvert 600007. File naming is described in section 4.8.3.

<table>
<thead>
<tr>
<th>File Name</th>
<th>Caption</th>
</tr>
</thead>
<tbody>
<tr>
<td>600007_20080502_P01.JPG</td>
<td>Inlet</td>
</tr>
<tr>
<td>600007_20080502_P02.JPG</td>
<td>Outlet</td>
</tr>
<tr>
<td>600007_20080502_P03.JPG</td>
<td>Barrel - unable to photograph due to water sitting in the barrel</td>
</tr>
<tr>
<td>600007_20080502_P04.JPG</td>
<td>Batter Scour, Washout at outlet</td>
</tr>
<tr>
<td>600007_20080502_P05.JPG</td>
<td>General Site</td>
</tr>
<tr>
<td>600007_20080502_S06.JPG</td>
<td>Guard rail marking</td>
</tr>
<tr>
<td>600007_20080502_S06.JPG</td>
<td>Sketch of the general site</td>
</tr>
</tbody>
</table>

4.8.1 Mandatory Photographs

Inspectors **must** take photographs of the following:

- The inlet;
- The outlet;
- The barrel.

Photographs of the culvert inlet and outlet should include the culvert number; written by the inspector in marking paint or chalk in clearly visible form.

Photographs must also be taken to show:

- Any damage to the culvert inlet or outlet. Take a photo showing this in detail and also an overall photo showing a general view of the layout of the damaged area.
- Any damage to the embankment. Take a photo of the damage, plus an overall photo showing a general view of the layout of the damaged area.
- Each drainage pit.

4.8.2 Sketches

It is sometimes useful to make a sketch of the site to fully describe issues and indicate some significant features. An example sketch is shown. Sketches should be scanned as JPEG files and added to the list.

![Example site sketch](image)
4.8.3 Naming and Format of Photographs

- Photos and Images are to be provided in accordance with the Data Collection contract specification for file storage and transfer. For example, they might need to be provided on a CD or DVD.
- Each image file should be listed in the Culvert Data Collection Form.
- Photo file naming pattern should be NNNNNNYYYYMMDD_PNN.filetype, where:
  - NNNNNN is the culvert number.
  - YYYYMMDD is the date the photo was taken (note reversed order).
  - P is a code for photos; S is a code for sketches or diagrams.
  - NN is the photo number.
- For example, 600007_20080502_P01.JPG is a photograph of culvert 60007 taken on 2 May 2008, and is the first photograph.
- Filetype is usually JPEG (or JPG). JPEG files must be supplied with a 300kB limit, with a preferred range from 200kB to 300kB. However, any higher resolution originals should also be provided on CD. High-res file names use the convention described above, but with an “F” (for “full resolution”) added after the photo number: eg NNNNNN YYYYMMDD_PNNF.JPG

4.8.4 Hints on Taking Photographs

- When taking photographs inside the culvert barrel, the camera should be angled towards the wall of the barrel. This will allow the illuminated wall to occupy the larger area on the photograph.
- In detail photos, include an object to help show scale – eg a tape measure, or mobile phone.
- When taking photographs external to the culvert, include enough surroundings in the photograph to allow an overall assessment of the culvert to be made.

Examples of photographing techniques:

<table>
<thead>
<tr>
<th>Photograph</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image1" alt="Photo" /></td>
<td>A photo that has been taken with the camera pointing along the centreline of the barrel. Notice the lack of detail in the photo.</td>
</tr>
<tr>
<td><img src="image2" alt="Photo" /></td>
<td>A photo that has been taken with the camera pointing on an angle to the centreline of the barrel. Notice the better detail showing on the photo.</td>
</tr>
</tbody>
</table>
4.9 Risk Screening Checklist

This checklist is the precursor to the risk assessment process, and is used to determine whether further investigation and a detailed risk analysis are required.

If a Risk Screening Checklist box is ticked, the inspector should provide comment describing what was seen and any other factors contributing to why the condition was checked in the comment space at the bottom of the Risk Screening Checklist.

Some characteristics can indicate multiple culvert issues. Tick the condition that is most relevant.

The box entitled “Detailed Risk Assessment Required” should be ticked if any of the boxes above it are ticked.

4.9.1 External Condition checklist

<table>
<thead>
<tr>
<th>Checklist item</th>
<th>What to look for</th>
<th>Example photo</th>
</tr>
</thead>
</table>
| Subsidence in the road | • Visible dips in the roadway.  
                          | • Suspension of passing vehicles shows noticeable movement passing over culvert.  
                          | • Look along roadway over a long enough length to allow depressions to be seen.  
<pre><code>                      | • Longitudinal or transverse cracking that extends into the travelled lane.  |
</code></pre>
<table>
<thead>
<tr>
<th>Checklist item</th>
<th>What to look for</th>
<th>Example photo</th>
</tr>
</thead>
</table>
| **Extensive patching and/or crack sealing of the road above the culvert**    | • The presence of multiple layers of patching on the roadway above the culvert.  
• Patching is to repair shape of roadway – i.e - sub-pavement distress.  
• If patching has repaired roadway – guardrail may be sagged.                                                             |              |
| **Significant cracking or deformation of the road above the culvert**         | • Longitudinal or transverse cracking on the roadway above the culvert that is greater than 5mm wide.  
• If uncertain of cracking type or extent – tick the box.                                                                          |              |
<table>
<thead>
<tr>
<th>Checklist item</th>
<th>What to look for</th>
<th>Example photo</th>
</tr>
</thead>
</table>
| **Holes or cavities in the road fill around the inlet or outlet or above the culvert** | • Localised depressions in the area surrounding the roadway above the culvert.  
• Holes already established in the surrounding embankment. | ![Image](image1.png) |
| **Embankment failure at the culvert outlet** (slumping, cracking) | • Detached/missing end structures (Headwalls, wingwalls) at culvert outlet.  
• Significant batter slump.  
• Debris at inlet/outlet.  
• Cracking in pavement  
Headwall/wingwall detached.  
• Voids or scour holes behind the headwall. | ![Image](image2.png) |
| **Seepage emerging around the outside of the pipe**    | • Water visually exiting out from under and around the culvert barrel.  
• Evidence of backfill entering into the barrel. | n/a |
| **Severe scour erosion of the road fill batters**      | • Voids directly above culvert greater than 150 mm deep.  
• Overtopping of the roadway – some debris remaining under guardrail.  
• Batter slump/significant scouring. | ![Image](image3.png) |
| **Severe scour erosion below the outlet or at the inlet** | • Overtopping of the roadway – some debris remaining under guardrail.  
• Slumping on inlet higher up embankment.  
• Scour on outlet side of embankment. | ![Image](image4.png) |
<table>
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<th>What to look for</th>
<th>Example photo</th>
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| Headwalls missing or displaced                      | • Missing headwall/wingwall.  
• Headwall/wingwall separation that allows embankment material to erode between the culvert and headwall.                                                                                         | ![Image](image1) |
| Inconsistent flow of water between inlet and outlet | • Visual flow or water flowing into pipe but not out.  
• Visual flow or water flowing out of the pipe but not in.                                                                                                               | n/a           |
| History of water flow over road                     | • Flood marks on the headwall embankment above the barrel.  
• Culvert under water.  
• Evidence of debris flowing over road.  
• Local historical information from Project Manager.                                                                                                                   | n/a           |
| Squeeze point and/or locally steep batter           | • Noticeable pinch points in embankment due to road widening but not culvert lengthening.  
• Batter slope steeper than 1:1.                                                                                                                                         | ![Image](image2) |
| Occupied buildings downstream that could be at risk (within 100 metres) | • Any occupied buildings within 100 metres downstream of the culvert.                                                                                                      | n/a           |
| Culvert conveys tidal flows or has floodgates present | • Flood gates.  
• Evidence of tide effects, tide marks, proximity to estuary or ocean.                                                                                             | ![Image](image3) |
### 4.9.2 Culvert barrel type

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<td>Metal, plastic, brick, stone, terracotta, masonry, timber, composite, or barrel type classified as “other”</td>
<td>• Tick this box if you have any other type of culvert than concrete.</td>
<td>n/a</td>
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</table>

### 4.9.3 Internal condition

<table>
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| Extensive cracking and deformation of the internal walls | • Cracks in concrete barrel units that run for the length of the unit – hairline cracks included.  
• Cracking in headwall may indicate further cracking inside pipe.  
• Any water or fill ingress into the culvert.  
• Note: if the culvert is propped notify your Project Manager. | ![Example photo](image1)  
![Example photo](image2) |
| Evidence of corrosion of steel reinforcement | • Rust and pitting marks on the exposed steel reinforcement at any location on the concrete barrel. | ![Example photo](image3)  
![Example photo](image4) |
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<td>Spalling or delamination of concrete</td>
<td>• Slices of concrete have fallen away from the main culvert.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Exposure of steel reinforcement.</td>
<td></td>
</tr>
<tr>
<td>Noticeable displacement or separation across joints</td>
<td>• Visible vertical displacement in butt joints.</td>
<td></td>
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<tr>
<td></td>
<td>• Evidence of water or embankment entering the pipe through cracks or through joints.</td>
<td></td>
</tr>
<tr>
<td>Evidence of groundwater entering into the pipe</td>
<td>• Deposits of soil backfill in the culvert invert that has entered through cracks (i.e. not debris that has flowed through the pipe).</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Water flowing out of pipe not flowing into inlet.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Water coming through the culvert joints.</td>
<td></td>
</tr>
<tr>
<td>Evidence of water being lost out of joints or other defects in the pipe</td>
<td>• Water flowing through pipe inlet but not exiting through outlet.</td>
<td>n/a</td>
</tr>
<tr>
<td>Evidence of erosion through joints</td>
<td>• Deposits of soil in the culvert invert.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Scour holes and voids around the culvert barrel.</td>
<td></td>
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<td></td>
<td>• Depressions and sags on the roadway above the culvert.</td>
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<tr>
<td></td>
<td>• Seepage inflows carrying fines, soil accumulation at joints.</td>
<td></td>
</tr>
<tr>
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| **Bowing of culvert**              | • Ponding of water in the centre of the culvert.  
• Visually the centre of the culvert appears lower than the outlet.  
• NOTE here the sideways diversion of the waterflow indicating a bending of the culvert base.                                                            |               |
| **Geometry change**                | • Crushing or squashed top of culvert.                                                                                                                                                                          |               |
| **Debris and vegetation inside culvert** | • Debris inside the centre position of the culvert greater than 100 mm high.  
• Vegetation growth inside and/or into the culvert, including roots.                                                                                             |               |
Acid sulfate soils – acid bearing rock

- This box is to be filled in using maps or the local knowledge of the Project Manager.

4.9.4 Detailed Risk Assessment Required
Tick this box if any of the checklist boxes above have been ticked.

4.9.5 Risk Screening Comment
A comment must be made if any items have been ticked in the Risk Screening Checklist.

In cases where the inspector believes that potential risk is being posed to the public, the word “URGENT” should be entered into the comment box. The following cases indicate urgency:

- 50% or greater blockage of the inlet, outlet or culvert barrel.
- Cracking extending past the travelled lane.
- Guardrail hanging.
- Props in culvert.
- Utilities in culvert not designed as utilities culvert.
- Significant dip in the pavement.
- Anything which poses a potential risk to vehicles or the general public.

NOTE: In these cases, notify the Project Manager immediately, who will then notify the Corridor Asset Manager.
5 Inspection Completion

5.1 Tasks for Inspectors

Once the form has been completed in the field, the following tasks must be done when back in the office:

- Make sure there are RoadLoc linear references in the Location section of the form.
- Complete the Photo and Image Details section and transfer all digital photographs onto CD or other agreed storage.
- Where urgent work or hazardous conditions have been noted for any culverts, notify your Project Manager immediately. Notify by email or in writing, and record who you notified, and the date.
- Notify your Project Manager if culverts could not be located or accessed or if new culverts were discovered.
- Make local copies of all completed forms and digital files (photos and other images).
- Provide the batch of completed forms and files to your Project Manager.

5.2 Tasks for Project Managers

Once you have the results from the inspectors:

- Follow up all urgent or hazardous notifications, and confirm follow-ups with inspectors who reported them, by email or in writing.
- Reschedule inspections for any culverts that were missed.
- Reschedule for culverts that were not able to be fully inspected at the time, eg because the barrel was blocked by silt, or was full of water at the time. As necessary, arrange for the barrel to be cleaned and reinspected, and/or for the culvert to be inspected by CCTV.
- Make local copies of all completed forms and digital files (photos and other images).
- Forward batches of forms and photograph files to the Corridor Asset Manager within 14 days, in batches of about 100.
- Audit the results to assess completion of contract, and look for changes that will improve the process. Send your audit notes to the Corridor Asset Manager.
6 Terminology

Terms are as follows:

- **Abrasion**: Wearing or grinding away of material by water laden with sand, gravel, stones or other abrasive material.
- **Aggradation**: Deposition of materials in culverts or stream beds (compare with Degradation).
- **Assets**: Physical infrastructure that either belongs to or is the responsibility of the RTA.
- **Backfill**: The material used to refill a trench.
- **Bedding**: The embankment placed over the top of the bedding and culvert.
- **Buckling**: Failure by an inelastic change in alignment (usually as a result of compression).
- **Catchment**: The area which is drained by a watercourse.
- **Compaction**: Reduction in volume of a material.
- **Corrosion**: Deterioration or dissolution of a material by chemical or electrochemical reaction with its environment.
- **Cover**: The depth of backfill over the top of a culvert.
- **Crack**: A fissure in an installed culvert or pavement.
- **Crown**: The top or highest point of the transverse cross section of a culvert.
- **Culvert**: Any pipe, box or arch that allows the flow of water or something else under a roadway.
- **Debris**: Any material, including floating timber materials and other trash, suspended sediment, or bed load.
- **Degradation**: General progressive lowering of the stream channel by erosion.
- **Delamination**: The removal of surface material exposing the underlying structural member.
- **Drainage**: Interception and removal of groundwater or surface water by artificial or natural means.
- **Drainage Basin**: See Catchment.
- **Embankment**: A bank of earth, rock or material constructed above the natural ground level.
- **End Section**: A concrete or steel attachment to the end of a culvert for the purpose of hydraulic efficiency and anchorage.
- **Erosion**: Wearing or grinding away of bedding or embankment material by water.
- **Flood Frequency**: The average time interval in years in which a flow of a given magnitude, taken from an infinite series, will recur.
- **Flood Potential**: Based on design storm frequencies and observations of previous flooding.
- **Foundation**: The in situ material beneath the pipe and pipe bedding material.
- **Grade/Gradient**: The longitudinal slope of the channel as a ratio of the drop in elevation to the distance.
- **Hairline Cracks**: Very small cracks that form in the surface of a pipe due to tension caused by loading.
- **Headwall**: A structure placed at the inlet and outlet of a culvert to protect the embankment slopes, anchor the culvert and prevent undercutting.
- **Homogeneous**: A common wall between culverts.
- **Inlet Control**: A culvert operates with inlet control when the flow capacity is controlled at the entrance by the depth of headwater and the entrance geometry.
- **Invert**: The bottom or lowest point of the internal surface of the transverse cross section of a culvert. Opposite to Crown.
Joint
A connection between two culvert sections made either with or without the use of additional parts.

Metal Corrosion
A process involving an electrolyte (moisture), an anode (the metallic surface where oxidation occurs), a cathode (the metallic surface that accepts electrons and does not corrode) and a conductor (the metal pipe itself).

Outfall/Outlet
The discharge end of culvert drains, sewers and pipelines.

Outlet Control
A culvert operates with outlet control when the flow capacity is controlled at the outlet by the depth of water and the exit geometry.

Piping
A process of subsurface erosion in which surface runoff flows along the outside of a culvert and with sufficient hydraulic gradient erodes and carries away material from around or beneath the culvert.

Ponding
Water backed upstream of a culvert.
Standing water within the barrel of a culvert.

Prescribed direction
Generally, East from Sydney, South from Sydney, North from Sydney, West from Sydney.

RAMS
Road Asset Management System.

Reinforced Concrete Pipe
A concrete pipe designed with either steel or fibre reinforcement as a composite structure.

Rigid Pipe
A pipe with a high resistance to bending.

Risk
The chance of something happening that will have an impact on objectives.

• A risk is often specified in terms of an event or circumstance and the consequences that may flow from it.

• Risk is measured in terms of a combination of the consequences of an event and their likelihood.

• Risk may have a positive or negative impact.

Risk Analysis
Systematic process to understand the nature of and to deduce the level of risk.
Provides the basis for risk evaluation and decisions about risk treatment.

Risk Assessment
The process of risk analysis and risk evaluation.

Risk Evaluation
The stage at which value judgements enter the decision process, explicitly or implicitly, by consideration of the importance of the estimated risks and the associated social, environmental and economic consequences, in order to identify a range of alternatives for managing the risks.

Risk Management
The complete process of risk assessment and risk control.

Risk Rating
The level of risk posed by culvert damage to roads/assets. It is also a reflection of the level of damage that might be reasonably incurred by the asset as a result of the possible damage.

RoadLoc
RTA Road Location identifier. RoadLoc uses the Linear Referencing System.

Scour
Erosion of material causing rutting or washing away of the embankment or area downstream of the outlet.

Seepage
The flow of water through soil or other material.

Soil
The naturally occurring, unconsolidated or loose covering of broken rock particles and decaying organic matter (humus) on the surface of the earth.

Slumping
The collapse of a bank or other material.

Spall
Flakes of a material that are broken off a larger solid body, which can be produced by a variety of mechanisms, such as projectile impact, corrosion, weathering, cavitation.

Vegetation
A general term for the plant life of a region; it refers to the ground cover life forms, structure, spatial extent or any other specific botanical or geographic characteristics.
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<td>22</td>
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<tr>
<td>Squeeze point</td>
<td>52</td>
</tr>
<tr>
<td>Steel Reinforced Concrete</td>
<td>23</td>
</tr>
<tr>
<td>Stock/Fauna Access</td>
<td>19</td>
</tr>
<tr>
<td>Stone or Masonry Barrel</td>
<td>24</td>
</tr>
<tr>
<td>Structure Conditions</td>
<td>39</td>
</tr>
<tr>
<td>Structures in Drainage Line</td>
<td>39</td>
</tr>
<tr>
<td>Subsidence in the road</td>
<td>49</td>
</tr>
<tr>
<td>Tar/Hazardous Lining</td>
<td>31</td>
</tr>
<tr>
<td>Terracotta</td>
<td>25</td>
</tr>
<tr>
<td>Tidal Flows</td>
<td>34</td>
</tr>
<tr>
<td>Timber Barrel</td>
<td>24</td>
</tr>
<tr>
<td>Training</td>
<td>2</td>
</tr>
<tr>
<td>Un-corrugated Plastic Pipe</td>
<td>23</td>
</tr>
<tr>
<td>Unlined</td>
<td>29</td>
</tr>
<tr>
<td>Urgent</td>
<td>56</td>
</tr>
<tr>
<td>Utilities</td>
<td>20</td>
</tr>
<tr>
<td>Vegetation</td>
<td>38</td>
</tr>
<tr>
<td>Vehicle Underpass</td>
<td>20</td>
</tr>
<tr>
<td>Water in the culvert</td>
<td>34</td>
</tr>
<tr>
<td>Wingwall missing/damaged</td>
<td>39</td>
</tr>
</tbody>
</table>
8 Appendices

8.1 Culvert Data Collection Form

A blank version of the Culvert Data Collection Form is attached. See following 4 pages.
### Identification

<table>
<thead>
<tr>
<th>Culvert Number</th>
<th>Date</th>
<th>Inspector Numbers</th>
<th>Local Number</th>
<th>Region Code</th>
<th>Slope Number</th>
</tr>
</thead>
</table>

**Culvert Comment**
access, location, non-critical issues

**Requires Rope Access?**  ○ Yes  ○ No

### Culvert Location

<table>
<thead>
<tr>
<th>Latitude</th>
<th>Longitude</th>
<th>Road No</th>
<th>C’way Code</th>
<th>Link No</th>
<th>Offset on link (km)</th>
<th>Seg No</th>
<th>Seg Offset (km)</th>
<th>Speed limit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inlet</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Outlet</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Off-road Latitude</th>
<th>Off-road Longitude</th>
<th>Left or Right of C’way</th>
<th>Marked at roadside</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inlet</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Outlet</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Design Data

<table>
<thead>
<tr>
<th>Plan Number</th>
<th>Sheet Number</th>
<th>Pipe/Box Number</th>
<th>Discharge cu m/s</th>
</tr>
</thead>
</table>

**Description Of Capacity**

**Flood potential**

### Culvert Details

**Purpose**
(tick 1 only)

- ○ Pavement drainage
- ○ Catchment drainage
- ○ Pedestrian / bicycle access
- ○ Stock / fauna access
- ○ Utilities
- ○ Vehicle

**Culvert Type**
(tick 1 only)

- ○ Pipe
- ○ Box
- ○ Arch
- ○ Composite (tick this if more than 1 type)

**Barrel or cell construction**

- ○ Spiral wound steel pipe
- ○ Multi-plate corrugated steel
- ○ Spiral wound aluminium pipe
- ○ Multi-plate corrugated aluminium
- ○ Plastic corrugated
- ○ Plastic un-corrugated
- ○ Steel reinforced concrete RCP
- ○ Fibre reinforced concrete FRC
- ○ Pre-cast concrete arch
- ○ Stone or masonry
- ○ Brick
- ○ Timber
- ○ Other (eg. terracotta)

**Culvert Joints**

- ○ Butt – unsealed
- ○ Butt – sealed
- ○ Spigot & socket – rubber ring
- ○ Spigot & socket – grouted
- ○ Other (describe)

**Box Culvert Types**

- ○ Cast in situ
- ○ Pre-cast crown, cast insitu base slab
- ○ Pre-cast with pre-cast floor
- ○ Multi-cell with link slabs
- ○ Other (describe)

**Lining**

- ○ Fully lined
- ○ Invert only lined
- ○ Unlined
- ○ Other (if selected, write Lining Comment below)

**Lining Materials**

- ○ Plastic
- ○ Reinforced concrete
- ○ Fibre reinforced concrete
- ○ Bituminous
- ○ Hazardous (eg. coal tar or asbestos)

**Lining Comment**

### Culvert length

<table>
<thead>
<tr>
<th>Culvert length (overall) metres</th>
<th>No of cells/barrels/pipes</th>
<th>Pipe inside diameter mm</th>
<th>Cell/barrel/arch width mm</th>
<th>Cell/barrel/arch height mm</th>
<th>Length of cell (between joints) mm</th>
<th>Depth of cover (inlet side) metres</th>
<th>Depth of cover (outlet side) metres</th>
</tr>
</thead>
</table>

**Nature of Fill**

- ○ Shale
- ○ Sand
- ○ Rocky material
- ○ Clay
- ○ Decomposed Granite
- ○ Other (describe)

**Is the culvert long enough?**  ○ Yes  ○ No

**Grates**  ○ Yes  ○ No

**Floodgates**  ○ Yes  ○ No

**Tidal Flows**  ○ Yes  ○ No
### Culvert Condition

**During this inspection is there water in the culvert?**

<table>
<thead>
<tr>
<th></th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Barrel Flow</strong> (tick 1)</td>
<td>O Clear</td>
<td>O 25% Blocked</td>
</tr>
<tr>
<td><strong>Inlet Flow</strong> (tick 1)</td>
<td>O Clear</td>
<td>O 25% Blocked</td>
</tr>
<tr>
<td><strong>Outlet Flow</strong> (tick 1)</td>
<td>O Clear</td>
<td>O 25% Blocked</td>
</tr>
</tbody>
</table>

#### Inlet Conditions

- Inlet Scour
- Vegetation
- Damaged drainage blanket
- Boulder Trap Full / Compromised
- Other structures in drainage line

#### Outlet Conditions

- Outlet Scour
- Vegetation
- Damaged drainage blanket
- Boulder Trap Full / Compromised
- Other structures in drainage line

#### Structure Conditions

- Headwall missing / damaged
- Wing wall missing / damaged
- Pipe / Box Damage
- Joint Damage

### What routine maintenance is required?

### Drainage Pits

(Up to 4 pits here. If the inlet or outlet above is also a pit, list it here, using the same lat and long)

<table>
<thead>
<tr>
<th>Pit</th>
<th>Lat</th>
<th>Long</th>
<th>Pit Type (tick one)</th>
<th>Depth metres</th>
<th>Ped. Safe?</th>
<th>Bike Safe?</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td></td>
<td>○ Gully pit ○ Inlet Sump ○ Junction pit ○ Blind ○ Junction box ○ Raised Inlet</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
<td></td>
<td>○ Gully pit ○ Inlet Sump ○ Junction pit ○ Blind ○ Junction box ○ Raised Inlet</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td></td>
<td></td>
<td>○ Gully pit ○ Inlet Sump ○ Junction pit ○ Blind ○ Junction box ○ Raised Inlet</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td></td>
<td></td>
<td>○ Gully pit ○ Inlet Sump ○ Junction pit ○ Blind ○ Junction box ○ Raised Inlet</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Photo and image files

<table>
<thead>
<tr>
<th>File Name</th>
<th>Caption</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inlet</td>
<td></td>
</tr>
<tr>
<td>Outlet</td>
<td></td>
</tr>
<tr>
<td>Barrel</td>
<td></td>
</tr>
</tbody>
</table>

...
# Risk Assessment Checklist

## External Condition

Are any of the following conditions evident at the culvert location? Tick if yes

<table>
<thead>
<tr>
<th>Condition</th>
<th>Tick</th>
</tr>
</thead>
<tbody>
<tr>
<td>Subsidence in the road</td>
<td></td>
</tr>
<tr>
<td>Significant patching of the road above the culvert</td>
<td></td>
</tr>
<tr>
<td>Significant cracking or deformation of the road above the culvert</td>
<td></td>
</tr>
<tr>
<td>Holes or cavities in the road fill around the inlet or outlet or above the culvert</td>
<td></td>
</tr>
<tr>
<td>Embankment failure at the culvert outlet eg slumping, cracking</td>
<td></td>
</tr>
<tr>
<td>Seepage emerging around the outside of the pipe</td>
<td></td>
</tr>
<tr>
<td>Significant scour erosion of the road fill batters</td>
<td></td>
</tr>
<tr>
<td>Significant scour erosion below the outlet or at the inlet</td>
<td></td>
</tr>
<tr>
<td>Headwalls missing or displaced</td>
<td></td>
</tr>
<tr>
<td>Inconsistent flow of water between inlet and outlet</td>
<td></td>
</tr>
<tr>
<td>History of water flow over road</td>
<td></td>
</tr>
<tr>
<td>Squeeze point and/or locally steep batter</td>
<td></td>
</tr>
<tr>
<td>Occupied buildings downstream that could be at risk (within 100 metres)</td>
<td></td>
</tr>
<tr>
<td>Culvert conveys tidal flows or has floodgates present</td>
<td></td>
</tr>
</tbody>
</table>

## Culvert Barrel Type

Are any of the following culvert barrel types present? Tick if yes

<table>
<thead>
<tr>
<th>Barrel Type</th>
<th>Tick</th>
</tr>
</thead>
<tbody>
<tr>
<td>Metal, plastic, brick, stone, terracotta, masonry, timber, composite, or barrel type classified as “Other”</td>
<td></td>
</tr>
</tbody>
</table>

## Internal Condition of the Culvert

Are any of the following conditions evident within the culvert barrel? Tick if yes

<table>
<thead>
<tr>
<th>Condition</th>
<th>Tick</th>
</tr>
</thead>
<tbody>
<tr>
<td>Significant cracking and deformation of the internal walls</td>
<td></td>
</tr>
<tr>
<td>Evidence of corrosion of steel reinforcement (eg. exposed reinforcement, iron staining, leaching)</td>
<td></td>
</tr>
<tr>
<td>Spalling or delamination of concrete</td>
<td></td>
</tr>
<tr>
<td>Noticeable displacement or separation across joints (butt joints ≥ 20mm, spigot and socket joints ≥ 50mm)</td>
<td></td>
</tr>
<tr>
<td>Evidence of groundwater entering into the pipe</td>
<td></td>
</tr>
<tr>
<td>Evidence of water being lost out of joints or other defects in the pipe</td>
<td></td>
</tr>
<tr>
<td>Evidence of erosion through joints (eg. seepage inflows carrying fines, soil accumulation at joints)</td>
<td></td>
</tr>
<tr>
<td>Bowing of culvert</td>
<td></td>
</tr>
<tr>
<td>Geometry change</td>
<td></td>
</tr>
<tr>
<td>Debris or vegetation inside culvert</td>
<td></td>
</tr>
<tr>
<td>Acid sulfate soils and/or acid bearing rock</td>
<td></td>
</tr>
</tbody>
</table>

Detailed Risk Assessment required. If any of the above are present, then tick here and add a comment below.
### Notes for data entry

Some fields can be filled in at the office before taking the form into the field.

### Culvert Details
- **Culvert Number**: This number is to be assigned to each culvert, from a pool of numbers assigned to each region.
  - Please write the culvert number at the top of all pages, in case they get separated.
- **Local Number**: Enter any currently used local culvert number. If it's a bridge size culvert, enter its bridge number.
- **Region Code**: Use code. 753=Hunter, 750=Northern, 757=Southern, 758=South-West, 471=Sydney, 766=Western
- **Slope Number**: If the culvert is on a slope in the Slope Management System, enter the slope number if known.
- **Culvert Comment**: Eg how to find it, access issues, culvert features, location notes
- **Inlet & outlet locations**: GPS lat/long is sufficient in field, but must convert to Roadloc in office.
  - Left or right is when travelling in prescribed direction.
  - Take a photo of inlet and outlet.
- **Design Data**: Enter these details if known, usually from the plans. Enter capacity and flooding notes if applicable.
- **Culvert Details**: Some of these might be gathered from the plans beforehand.
  - For ‘purpose’ and ‘type’ tick one only. For the other fields you can tick more than one.
  - Pipe/box/cell/arch measurements should be in millimetres, eg 450 for a 450mm pipe, 1200 for a width of 1.2 metres.
  - ‘Culvert Length’ is in metres, estimated overall from inlet to outlet, eg 45
  - ‘Number of pipes/boxes’ is number of waterways under the road.
  - For width, height and so on, where there are different pipe/box sizes, enter the maximum or ruling size.
  - ‘Depth of cover’ is estimated vertical depth of material at carriageway edge, from surface to culvert top, in metres, eg 4.5. Estimate for both inlet and outlet.
- **Culvert Condition**: Tick one item for inlet flow, outlet flow and barrel flow.
  - Tick more than one for other conditions if applicable.
  - Take photos of problems.
- **Road Surface Condition**: Comment on subsidence, cracking, extensive patching and sink holes. Comment should include degree and consequence.
  - REPORT ANY SUBSIDENCE OR SINKHOLMES TO THE REGIONAL ASSET MANAGER IMMEDIATELY.
- **Batter Condition**: Is it blocking the culvert? Is it eroding onto the road? What is the potential impact?
- **Drainage Pits**: GPS lat/long is sufficient. For pit type, select one. For depth enter metres, eg 5.2 if estimated to be 5.2 metres deep.
  - Tick yes/no box if pit is safe for pedestrians, and also if safe for bicycles.
  - Take a photo of each pit and grate.
  - If there are more than 4 pits, attach an additional list.
  - Pits can be waypoints on a culvert, or the inlet or outlet of a culvert (depending on what the region defines as a ‘culvert’). If the inlet and/or outlet of this culvert is a pit, use this data group to also capture its pit status.
- **Photos and Images**: Photograph the inlet, outlet, barrel, pits, grates, and any features, problems.
  - If you have made sketches, scan them as jpegs and add them to this list.
  - List the filename of each photo or image. Enter a caption for each photo or image.
  - File naming pattern is NNNNNN_YYYYMMDD_Pnn.filetype
    - NNNNN is culvert number and YYYYMMDD is date in year month day format.
    - Note - use P for photos, which will usually have filetype jpg. Use P01, P02, etc for photos 1, 2,...of that culvert.
    - Use S for sketches/maps/plans, they will usually have filetype jpg or pdf depending on how you scanned it.
    - If useful, scan old plans and add them.
  - For example a file with the name 600017_20080623_P02.JPG would be the second photo, taken on the 23rd of June 2008, for culvert number 6000017.
  - If more than 15 image files, then attach an additional list.
- **Risk Checklist**: Tick any box that applies.
  - If any box has been ticked, then the final box should be ticked, as a detailed risk assessment will be required. The final box is the one we are interested in.
8.2 Worked Culvert Data Collection Form

A copy with sample data filled in is attached. See following 4 pages.
### RTA Culvert Data Collection Form

#### Identification

<table>
<thead>
<tr>
<th>Culvert Number</th>
<th>Date</th>
<th>Inspector Numbers</th>
</tr>
</thead>
<tbody>
<tr>
<td>600007</td>
<td>23 / 05 / 2008</td>
<td>007 113</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Local Number</th>
<th>Region Code</th>
<th>Slope Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>501-1157</td>
<td>757</td>
<td></td>
</tr>
</tbody>
</table>

**Culvert Comment**

MOSS VALE ROAD, MR261, Laurie Barker’s farm, 50m east of Kangaroo Valley Road

**Requires Rope Access?**  ○ Yes  ● No

### Culvert Location

Collect at least one of Lat/Long, RoadLoc, or Segment/Offset.

<table>
<thead>
<tr>
<th>Inlet</th>
<th>Outlet</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inlet Latitude</td>
<td>34.74663</td>
</tr>
<tr>
<td>Inlet Longitude</td>
<td>150.56134</td>
</tr>
<tr>
<td>Inlet Road No</td>
<td>0000261</td>
</tr>
<tr>
<td>Inlet Link</td>
<td>A</td>
</tr>
<tr>
<td>Inlet Offset on link</td>
<td>5.655</td>
</tr>
<tr>
<td>Inlet Seg No</td>
<td>2030</td>
</tr>
<tr>
<td>Inlet Seg Offset</td>
<td>0.157</td>
</tr>
<tr>
<td>Inlet Speed limit</td>
<td>80</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Inlet Off-road Latitude</th>
<th>Inlet Off-road Longitude</th>
<th>Inlet Left or Right of C’way</th>
<th>Inlet Marked at roadside</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Outlet</th>
<th>Inlet</th>
</tr>
</thead>
<tbody>
<tr>
<td>Outlet Latitude</td>
<td>34.74650</td>
</tr>
<tr>
<td>Outlet Longitude</td>
<td>150.56317</td>
</tr>
<tr>
<td>Outlet Road No</td>
<td>0000261</td>
</tr>
<tr>
<td>Outlet Link</td>
<td>A</td>
</tr>
<tr>
<td>Outlet Offset on link</td>
<td>5.660</td>
</tr>
<tr>
<td>Outlet Seg No</td>
<td>2030</td>
</tr>
<tr>
<td>Outlet Seg Offset</td>
<td>0.157</td>
</tr>
<tr>
<td>Outlet Speed limit</td>
<td>80</td>
</tr>
</tbody>
</table>

### Design Data

**Flood potential**

Outlet Scour due to obvious flash-flood water overtopping road pavement levels

### Culvert Details

**Purpose**

- ○ Pavement drainage
- ● Catchment drainage
- ○ Pedestrian / bicycle access
- ○ Stock / fauna access
- ○ Utilities
- ○ Vehicle

**Type**

- ● Pipe
- ○ Box
- ● Arch
- ○ Composite (tick this if more than 1 type)

**Barrel or cell construction**

- ○ Spiral wound steel pipe
- ○ Multi-plate corrugated steel
- ○ Spiral wound aluminium pipe
- ○ Multi-plate corrugated aluminium
- ○ Plastic corrugated
- ○ Plastic uncorrugated
- ○ Steel reinforced concrete RCP
- ○ Fibre reinforced concrete FRC
- ○ Pre-cast concrete arch
- ○ Stone or masonry
- ○ Brick
- ○ Timber
- ○ Other (eg. terracotta)

**Joints**

- ○ Butt – unsealed
- ○ Butt – sealed
- ○ Spigot & socket - rubber ring
- ○ Spigot & socket – grouted
- ○ Other (describe)

**Box Culvert Types**

- ○ Cast in situ
- ○ Pre-cast crown, cast insitu base slab
- ○ Pre-cast with pre-cast floor
- ○ Multi-cell with link slabs
- ○ Other (describe)

**Lining**

- ○ Fully lined
- ○ Invert only lined
- ○ Unlined
- ○ Other (if selected, write lining comment below)

**Lining Materials**

- ○ Plastic
- ○ Reinforced concrete
- ○ Fibre reinforced concrete
- ○ Bituminous
- ○ Hazardous (eg. coal tar or asbestos)

**Lining Comment**

### Culvert Details

<table>
<thead>
<tr>
<th>Culvert length (overall) metres</th>
<th>No of cells/barrels/pipes</th>
<th>Pipe inside diameter mm</th>
<th>Cell/barrel/arch width mm</th>
<th>Cell/barrel/arch height mm</th>
<th>Length of cell (between joints) mm</th>
<th>Depth of cover (inlet side) metres</th>
<th>Depth of cover (outlet side) metres</th>
</tr>
</thead>
<tbody>
<tr>
<td>20</td>
<td>2</td>
<td>375</td>
<td>2400</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>4</td>
</tr>
</tbody>
</table>

**Nature of Fill**

- ○ Shale
- ○ Sand
- ○ Rocky material
- ○ Clay
- ○ Decomposed Granite
- ○ Other (describe)

**Nature of Fill**

- Silty Soil

**Is the culvert long enough?**  ○ Yes  ● No

- Grates  ○ Yes  ● No

- Floodgates  ○ Yes  ● No

- Tidal Flows  ○ Yes  ● No
**Culvert Condition**

During this inspection is there water in the culvert?  
- Yes ☐  
- No ☐

**Barrel Water Flow (tick 1)**
- Clear ☐  
- 25% Blocked ☐  
- 50% Blocked ☐  
- 75% Blocked ☐  
- 100% Blocked ☐

**Inlet Water Flow (tick 1)**
- Clear ☐  
- 25% Blocked ☐  
- 50% Blocked ☐  
- 75% Blocked ☐  
- 100% Blocked ☐

**Outlet Water Flow (tick 1)**
- Clear ☐  
- 25% Blocked ☐  
- 50% Blocked ☐  
- 75% Blocked ☐  
- 100% Blocked ☐

**Inlet Conditions**
- Inlet Scour ☐  
- Vegetation ☐  
- Damaged drainage ☐  
- Boulder Trap Full / Compromised ☐  
- Other structures in drainage line ☐

**Outlet Conditions**
- Outlet Scour ☐  
- Vegetation ☐  
- Damaged drainage ☐  
- Boulder Trap Full / Compromised ☐  
- Other structures in drainage line ☐

**Structure Conditions**
- Headwall missing/ damaged ☐  
- Wing wall missing / damaged ☐  
- Pipe / Box Damage ☐  
- Joint Damage ☐

**Road Surface Condition**
- Good, non existent batter, guard rail at risk.

**Batter Condition**
- Embankment compromised, Batter Washed away

**What minor routine maintenance is required?**
- Clean out channel, clear surrounding vegetation, Channel silted up, pipe is full of water, outlet under water, may need increased capacity with larger pipe size

**Drainage Pits**  
(Up to 4 pits here. If the inlet or outlet above is also a pit, list it here, using the same lat and long)

<table>
<thead>
<tr>
<th>Pit</th>
<th>Pit Latitude</th>
<th>Pit Longitude</th>
<th>Pit Type (tick one)</th>
<th>Depth (metres)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>O Gully pit</td>
<td>O Inlet Sump</td>
<td>O Junction Blind</td>
<td>Ped. Safe? Yes No Bike Safe? Yes No</td>
</tr>
<tr>
<td>2</td>
<td>O Gully pit</td>
<td>O Inlet Sump</td>
<td>O Junction Blind</td>
<td>Ped. Safe? Yes No Bike Safe? Yes No</td>
</tr>
<tr>
<td>3</td>
<td>O Gully pit</td>
<td>O Inlet Sump</td>
<td>O Junction Blind</td>
<td>Ped. Safe? Yes No Bike Safe? Yes No</td>
</tr>
<tr>
<td>4</td>
<td>O Gully pit</td>
<td>O Inlet Sump</td>
<td>O Junction Blind</td>
<td>Ped. Safe? Yes No Bike Safe? Yes No</td>
</tr>
</tbody>
</table>

**Photo and image files**

<table>
<thead>
<tr>
<th>File Name</th>
<th>Caption</th>
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<tbody>
<tr>
<td>600007_20080502_P01.JPG</td>
<td>Inlet</td>
</tr>
<tr>
<td>600007_20080502_P02.JPG</td>
<td>Outlet</td>
</tr>
<tr>
<td>600007_20080502_P03.JPG</td>
<td>Barrel unable to photograph due to water sitting in the barrel</td>
</tr>
<tr>
<td>600007_20080502_P04.JPG</td>
<td>Batter Scour, Wash out</td>
</tr>
<tr>
<td>600007_20080530_S01.JPG</td>
<td>General Site</td>
</tr>
<tr>
<td>600007_20080530_S02.JPG</td>
<td>Sketch of area</td>
</tr>
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</table>
**Risk Screening Checklist**

**External Condition**
Are any of the following conditions evident at the culvert location? Tick if yes

- Subsidence in the road
- Extensive patching of the road above the culvert
- Significant cracking or deformation of the road above the culvert
- Holes or cavities in the road fill around the inlet or outlet or above the culvert
- Embankment failure at the culvert outlet eg slumping, cracking
- Seepage emerging around the outside of the pipe
- Severe scour erosion of the road fill batters
- Severe scour erosion below the outlet or at the inlet
- Headwalls missing or displaced
- Inconsistent flow of water between inlet and outlet
- History of water flow over road
- Squeeze point and/ or locally steep batter
- Occupied buildings downstream that could be at risk (within 100 metres)
- Culvert conveys tidal flows or has floodgates present

**Culvert Barrel Type**
Are any of the following culvert barrel types present? Tick if yes

- Metal, plastic, brick, stone, terracotta, masonry, timber, composite, or barrel type classified as “Other”

**Internal Condition of the Culvert**
Are any of the following conditions evident within the culvert barrel? Tick if yes

- Extensive cracking and deformation of the internal walls
- Evidence of corrosion of steel reinforcement (eg. exposed reinforcement, iron staining, leaching)
- Spalling or delamination of concrete
- Noticeable displacement or separation across joints (butt joints ≥ 20mm, spigot and socket joints ≥ 50mm)
- Evidence of groundwater entering into the pipe
- Evidence of water being lost out of joints or other defects in the pipe
- Evidence of erosion through joints (eg. seepage inflows carrying fines, soil accumulation at joints)
- Bowing of culvert
- Geometry change
- Debris or vegetation inside culvert
- Acid sulfate soils and/or acid bearing rock

**Detailed Risk Assessment required. If any of the above are present then tick here and add a comment.**

**URGENT called Jason Lloyd 2nd May 2008**
Severe batter Scour on outlet side about 100m, Unable to determine internal culvert conditions due to water, Culverts significantly undersized
Photos and images that were taken for this site, as examples.

Note: They will be included on the CD returned to the Project Manager; and don’t need to be printed.

600007_20080502_P01.JPG

600007_20080502_P02.JPG

600007_20080530_S01.JPG
During this inspection is there water in the culvert? □ Yes □ No

Barrel Water Flow (tick 1)
- □ Clear
- □ 25% Blocked
- □ 50% Blocked
- □ 75% Blocked
- □ 100% Blocked

Inlet Water Flow (tick 1)
- □ Clear
- □ 25% Blocked
- □ 50% Blocked
- □ 75% Blocked
- □ 100% Blocked

Outlet Water Flow (tick 1)
- □ Clear
- □ 25% Blocked
- □ 50% Blocked
- □ 75% Blocked
- □ 100% Blocked

Inlet Conditions
- □ Inlet Scour
- □ Vegetation
- □ Damaged drainage blanket
- □ Boulder Trap Full / Compromised
- □ Other structures in drainage line

Outlet Conditions
- □ Outlet Scour
- □ Vegetation
- □ Damaged drainage blanket
- □ Boulder Trap Full / Compromised
- □ Other structures in drainage line

Structure Conditions
- □ Headwall missing/ damaged
- □ Wing wall missing / damaged
- □ Pipe / Box Damage
- □ Joint Damage

Road Surface Condition
- Good, non existent batter, guard rail at risk.

Batter Condition
- Embankment compromised, Batter Washed away

What minor routine maintenance is required?
- Clean out channel, clear surrounding vegetation, Channel silted up, pipe is full of water, outlet under water, may need increased capacity with larger pipe size

Drainage Pits
(Up to 4 pits here. If the inlet or outlet above is also a pit, list it here, using the same lat and long)

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<th>Ped. Safe?</th>
<th>Outlet Sump</th>
<th>Bike Safe?</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Gully pit</td>
<td>□ Yes</td>
<td>□ Blind</td>
<td>□ Yes</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Junction pit</td>
<td>□</td>
<td>□ Raised Inlet</td>
<td>□ Yes</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Junction box</td>
<td>□</td>
<td>□ Blind</td>
<td>□ Yes</td>
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Pit Latitude
Pit Longitude
Pit Type (tick one)
- Depth metres

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- Gully pit
- Junction pit
- Junction box
- Ped. Safe? Yes
- Bike Safe? No
- Inlet Sump
- Blind
- Raised Inlet

2
- Gully pit
- Junction pit
- Junction box
- Ped. Safe? Yes
- Bike Safe? No
- Inlet Sump
- Blind
- Raised Inlet

3
- Gully pit
- Junction pit
- Junction box
- Ped. Safe? Yes
- Bike Safe? No
- Inlet Sump
- Blind
- Raised Inlet

4
- Gully pit
- Junction pit
- Junction box
- Ped. Safe? Yes
- Bike Safe? No
- Inlet Sump
- Blind
- Raised Inlet

Pit Comments

Photo and image files
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- Caption

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