Culvert Asset Management Program

Culvert Identification Handbook (revised 2023)

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Introduction

Welcome to the New Mexico Department of Transportation's Culvert Asset Management Program or CAMP. The purpose of this program is to inventory the culverts administered and maintained by the NMDOT. This includes Interstate, US, and State Roads. Funding for the program is awarded every two years up to six years by Asset Management with approval of the Federal Highway Administration (FHWA). FHWA funds 80% of the program with the remaining 20% from the state of New Mexico.

55,000 culverts were counted in an earlier inventory back in 2004. The project however was never completed due to slash of funding, retirement of key personnel and other external factors. A rough estimate of the total number of culverts in the state can be anywhere from 60,000 to 80,000.

As of May 2023, NMDOT administers and maintains 13,958 miles of roads of which 2,255 are interstate, 4,126 are US highways, and 7,576 miles are state roads. The state is divided into 6 Districts. District offices are located in Deming, Roswell, Albuquerque, Las Vegas, Santa Fe, and Milan. The Districts take care of the day-to-day affairs of maintaining, financing, and addressing concerns for their constituents for their roads. There are 82 Patrols administered by the Districts that maintain the physical condition of the roads. They are responsible for filling potholes, replacing guard rails whenever they are damaged by some traffic accident, and clearing the roads of snow during inclement weather, among other essential duties. They are the front-line troops of the NMDOT.

What is a culvert?

Culverts have to be distinguished from 'bridges'. Bridges, as defined by Bridge Inspector's Reference Manual, are any conveyance structure or culvert that is greater than 20 ft, as measured from the inside of opening at the center line of road (see page 8). This includes concrete box culverts, wood bridges, or a series of circular culverts, along with your typical multi-span bridges over rivers and highways. The state has 4,406 bridges. These are inspected bi-annually depending on its condition and importance to the travelling public. NMDOT is responsible for inspection of **all** the public bridges in the state including county and municipal bridges. In contrast, culverts are the forgotten assets; out of sight and out of mind. This project will focus on those conveyance structures not cataloged as bridges.

CAMP candidates may be at urban or rural locations statewide. CAMP candidates may be either major or minor culvert structures or storm sewers.

Major culvert structures are bridge class culvert crossings. Bridge class culverts typically have a Bridge number and can be found using the maps available in NMDOT's Internal Map Gallery.

Minor culvert structures are not major or bridge class culverts. Minor culvert structures have a span (W) less than 20 feet wide or have less than half (< 1/2) of the smallest diameter culvert pipe (D) between pipes.

Storm sewers are part of the storm drain system. Storm sewer inspection candidates are pipes or conduits which convey storm water to an approved body of water.

CAMP candidates are within NMDOT right-of-way (ROW), and maintained by NMDOT.

Highway 101

Mile Markers, Mile Posts

There are three roadway designations where culverts will be inventoried: Interstate, Federal, and State Routes. The sign designations are shown above. County and National Forests have their own. We will not concern ourselves with them. Highways, or routes, that run west-east are even numbered; south-north routes are odd-numbered. State route numbering follows the same convention but is a little more flexible.

Each highway is referenced by mileage from its place of origin. Generally, mile markers run from south to north or west to east. Mile markers numbering begins at zero at a state border and continues in the north or east direction until ending at a state border. There are many exceptions to that, of course. Interstate 25 (I-25) begins at the I-10/ I-25 interchange, Federal Highway 380 (US 380) begins at San Antonio, south of Socorro, State Route 1 (NM 1) begins at Exit 91 on I-25 above Alamosa Canyon and ends in Socorro, and so on.

Mile markers are narrow green signs seen at the right side of a highway. They are also referred to as mile posts. This is a useful tool for locating assets, culverts or problem areas.

Highway 101

Road Object Markers

Culverts will be referenced to a GIS mileage, or Milepoint, of the route it is on using NMDOT's Linear Referencing System (LRS). Note that the LRS Milepoint is the GIS as-driven mileage from the start of the route to the selected location on NMDOT's LRS. Mile markers, in contrast, are the green mile marker signs and are an approximation of the mileage at that location. Due to re-alignment of a highway over the course of its service life, the locations of the mile marker signs may not coincide with LRS Milepoint.

Although the LRS Milepoint will be entered into CAMP when data is post-processed, all teams should familiarize themselves with the mile markers when in the field.

Highway 101

Road Object Markers

A single t-post with three (3) amber reflectors facing on-coming traffic and a single amber reflector on the opposite side of t-post are placed adjacent to obstructions such as water valves, concrete structures and others that will alert highway workers or the travelling public of a hazard. In our case these will be culverts. Be aware that the same amber reflectors can be put on tight highway curves at the edge of the pavement. Instead of in threes, they are paired or a single reflector. For culverts, bridges and other structures that are at or very near driving lanes, an elongated rectangular sign with diagonal black and yellow stripes will be placed at the corner of structure (see top right photo below). If the culvert is under a deep embankment, the t-post may not be visible from the highway because it will be placed by the culvert. T-posts may not be present in some culverts for various reasons: an on-coming vehicle knocked it down or has not been put in by local patrol. Reading the landscape by identifying valleys and dips will help in locating culverts. Detail sheets for the 3-amber t-post and other road object markers are included with NMDOT Standard Drawings provided for this project.

Highway 101

Driving lanes and shoulders

Highways can have two, four or more driving lanes, depending on the anticipated traffic loads. Shoulders are paved sections along side of highway. They are added as safety features and for emergency parking. All interstate highways have shoulders (widths vary from 4 ft along medians to 10 ft on outside). Most US and State highways have shoulders of varying widths (4 ft to 8 ft). Older State highways in the more rural parts of state will have in some cases no shoulders. Shoulders will be your friends, your refuge. Park as far away as practicable from driving lanes on shoulder. On shoulder less roads (usually referred to as 'soft shoulders') 'where' and 'how' to park your vehicle should be given more consideration, especially where there are steep slopes, heavy traffic and muddy soils.

Images from Wiki Media Commons and Wikidata.

Culvert Identification Handbook

The order in which the contents of this handbook are presented is the same as those of the Trimble GPS Data Collector. However, this is subject to change as the data dictionary in the Trimble unit evolves over time. Each data entry has an explanation, sample photos and drawings. Hundreds of photos were reviewed to get the best possible representation of culverts in various states of health. There were some images picked out of the internet where needed. Unfortunately, at this time, the handbook does not cover the operations of the data collector. You will need to contact your advisors and professors concerning the operations of data collector and connectivity issues.

If any questions come up concerning culverts, please send email or call to the following contacts at the NMDOT Drainage Design Bureau (DDB):

David.X.Trujillo@dot.nm.gov, (505-470-8661)

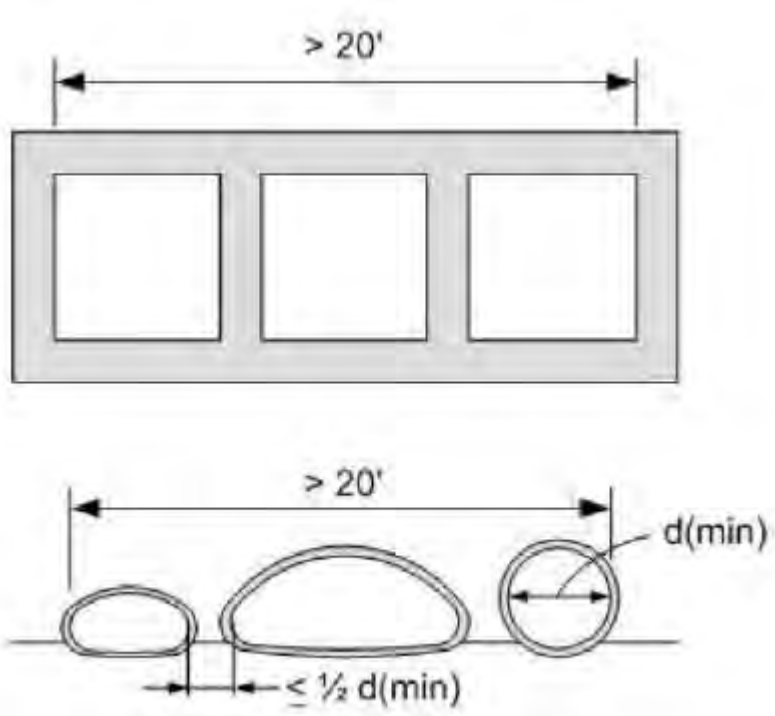
Susan.Lime@dot.nm.gov, (505-470-1899)

Steven.Morgenstern@dot.nm.gov, (505-231-7688)

Culvert vs. Bridge: Definition

As defined by Bridge Inspector's Reference Manual (FHWA)

A bridge is defined as a structure that measures greater than 20 ft. from the inside walls for a box culvert at the center line of road. The same applies to a battery of circular, arch or elliptical pipes. The measurement along center line of road, between inside faces of exterior walls. In addition, separation between pipes must be equal to or less than half the diameter of smallest pipe.



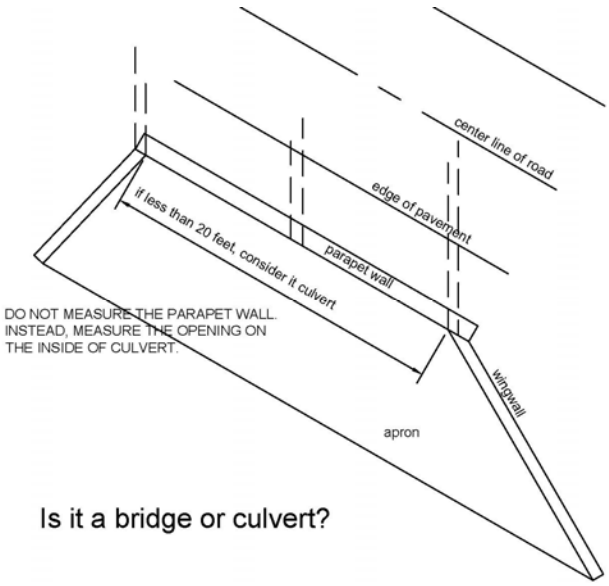
Culvert vs. Bridge: Definition

As defined by Bridge Inspector's Reference Manual (FHWA)

Bridges, other than the obvious (road deck over another road or waterway with support by abutments and piers) can be large box culverts or multi-barrel circular/arch pipe culverts spanning greater than 20 ft. A brass tag is usually placed on the parapet of a box culvert near the edge (See photo to the left). The bridge number is embossed in the tag. It is unique to that structure. If the structure is replaced, a new bridge number will be assigned to it.

An ArcMap point feature class and a *.kmz file of NMDOT bridges is available. These can be viewed in ArcMap, Google Earth, *.pdf or in your data collector, if internal memory of device permits.

When you approach a concrete box culvert and are not sure if it is designated as a bridge or not, either look for the tell-tale brass tag mentioned above or measure the span of the barrels. Geo-locate the crossing if the crossing is normal in skew and the width is less than 20 ft. Skewed crossings should be geo-located if the width is less than 30 ft. (See page 36 for definition of skew)



If you inadvertently geo-locate one of these structures, that is okay. Continue with your work. This will be identified later in the data processing.

Is Culvert Accessible?

There can be a number of reasons a culvert cannot be accessed. Choices given in the data dictionary are as follows: traffic is too heavy or dangerous; It cannot be found, even though there are indications that a culvert should exist; It is covered in debris, heavy tumbleweed accumulation, or vegetation; The culvert end is outside the right-of-way fence; The culvert is below very steep slopes. The culvert is completely silted up; The culvert is below water; And finally, 'other' where it is a catch-all for other reasons not given in the list. Refer to pages 20 and 21 of Handbook for determining inaccessibility in median, shoulder and curb drop inlets.

When we say 'inaccessible' it means it **cannot** be accessed. Examples of photos shown here were marked as 'inaccessible' by the 2021 survey. With a little effort, most culvert can be accessed by over coming minor obstacles like climbing a fence or removal of weeds.

Not all fences are right-of-way. Example to the right was labelled inaccessible because of 'right-of-way' fence. The fence was placed behind a series of metal culverts. Culverts could have been counted from the outside and measured indirectly or directly by climbing the fence.

GPS Coordinate Location

This is to identify the structure that is being located by the data collector. List includes inlet, outlet, MDI/SDI, CDI, slotted drain, turnouts (US, State, or County/Municipal roads) and private/ commercial driveways.

Skewed culvert to right is on NM 3, south of Ribera, San Miguel County. Triple CDI in the bottom is on US 70, Ruidoso, Lincoln County. Bottom right is on NM 2, south of Hagerman, Chaves County.

GPS Coordinate Location- Inlet or Outlet

Inlet is where flow enters into culvert, outlet is flow going out.

CBCs (concrete box culverts) shown above are outlets. Reading the landscape like mountains in the background ,which way the reeds bend, flow of water or the occurrence of scour can help in determining where a culvert outfalls. Image to left is on NM 3, near La Fragua, Miguel County. Image to right is on EB I-40, Rio San Jose, Valencia County.

The same applies to inlets. Both examples below are culvert inlets. However, in flat lands (like the bottom right image) it is hard to make the distinction. If in doubt, leave it blank. Locations are unknown.

GPS Coordinate Location - Median or Shoulder Drop Inlets

Drop inlets are concrete structures with grates where flow enters into a concrete chamber connecting to a culvert or culverts. Median drop inlets (MDI) are placed in road medians or locations outside of traffic. Shoulder drop inlets (SDI) are essentially the same size as median but are designed to withstand impacts from moving traffic.

When measuring an SDI/MDI, **do not measure** the dimensions of grate. Instead, get the span and rise of the culvert inside. Usually, a grate with a large mesh is easier to measure the pipes inside of box. Note the interior arrangements of pipes as shown in page 19 of this handbook. Measure the larger of the pipe and enter into data collector if multiple pipe are in the inlet. If you cannot get the span and/or rise dimensions, either because it is silted up or cannot see into drop inlet, then mark as 'silted', leave blank ('null') or mark as 'unknown'. If the mesh of grate is too small to see into box, then leave it blank ('null') or mark as 'unknown'.

EB I-40 MP 238.0, Torrance County

GPS Coordinate Location - Curb Drop Inlets

Curb drop inlets (CDI) are distinguished from other drop inlets in that they have an opening on the side of curb called a sweep. The majority have a grate built along with the side opening. There are some instances where there are only the side openings (bottom right).

As in SDI/MDIs, do not measure the exterior dimensions of CDI. Measure the dimensions of culvert inside if possible. The grates of CDIs invariably have a smaller mesh than SDI/MDIs, hence it is more difficult to see into them. If it is not possible to see inside CDI leave span and rise fields blank or 'null'.

NM 14 (Cerrillos Rd), Santa Fe, Santa Fe County

US 60 (California St.), Socorro, NM

NM 128, Jal, Lea County

Drop Inlets– Curb Drop Inlets cont.-

More examples of curb drop inlets (CDI)

NM 14 (Cerrillos Rd.) near General Office NMDOT, Santa Fe

Typical NMDOT curb drop inlet (CDI). They are 1.5 ft in width and come in 5 ft increments (5,10,15 ft.). CDIs are usually installed on highways with 6 to 8 inch curbing.

Image to left is transverse drop inlet. Width can vary from 4 ft up to the width of a driving lane. Location is on the junction of NM 2 and US 285, south of Roswell, Chaves County.

GPS Coordinate Location– Slotted Drains

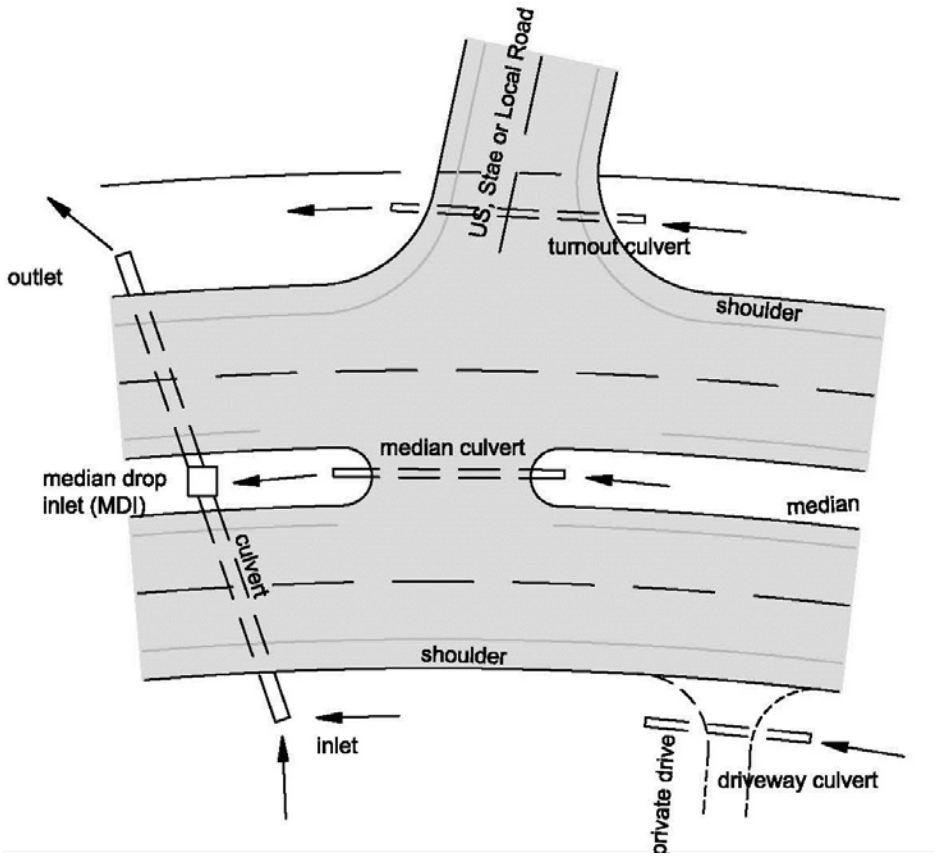
NM 68, Ranchos De Taos, Taos County

Slotted drains are metal culverts with a narrow grate placed above. They are usually along highway curbing or a shallow concrete ditch. They may be found as stand-alone or attached to a nearby drop inlet. The pipe associated with slotted drains come in 18 or 24 inch diameters. Place tape measure or a stiff narrow stick into slot and gently push into grate. Read the measurement and put value into 'rise'. There may be some silt in the slotted pipe, hence the need for a stick or prod to be worked to bottom of silt. Measure the length of the slotted drain in feet. Place measurement in 'width of multi-culverts' or as a note in 'comments'. If outlet is not known, leave field as blank ('null') or mark as 'unknown'.

NM 475 MP 13.0, Santa Fe County

GPS Coordinate Location –Turnouts, Driveways

Culverts crossing US or State roads, other culverts crossing public roads, median cross-over culverts, culverts crossing private drives into residential or commercial sites.



GPS Coordinate Location – Triple Amber Reflector T-post

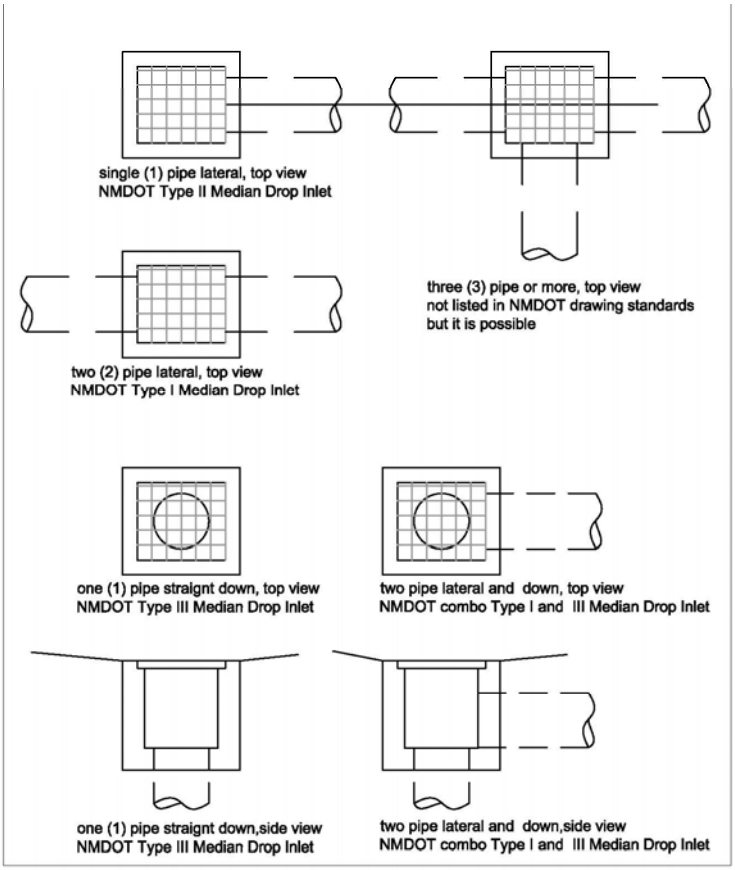
If there is no evidence of a culvert at a triple amber t-post, check the opposite side of road to see if culvert is visible. Also confirm that it is not marking another roadside 'obstruction' such as a telephone riser, protruding concrete structure, water-meter, etc. Geo-locate and mark GPS Coordinate Location as 'T-post Reflector'. Take a photograph of t-post and include some background information on the condition of surrounding areas. It is likely that the t-post marks the location of a culvert, albeit silted up or hidden in weeds or brush especially in rural areas. If in doubt, geo-locate it.

Photo on the right was geo-located on NM 4 MP 19.96. Collector commented that they were not sure if this was a culvert or not. It turns out that this is a typical structure for a water meter or water line shut-off valve. Once again, if in doubt, geo-locate any t-post with no apparent culverts and add a comment. This will be sorted out later.

Drop Inlets– MDI/SDI

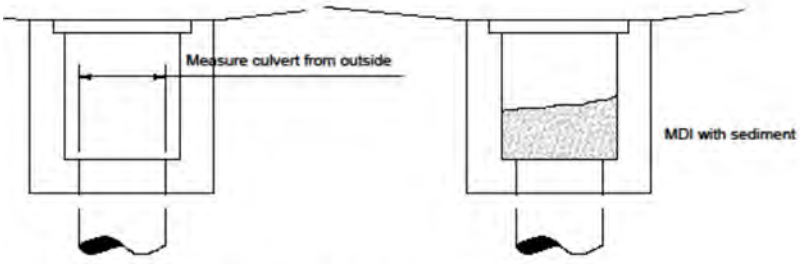
Identification of pipe layout in MDI/SDI.

As specified in previous pages, measure the interior diameters of pipe. Sizes will vary from 18 to 48 inches with the most common as 24 inches. If pipe sizes vary, measure the larger of the pipe for MDIs with two or more pipe. Grate size will not be needed. Photo taken of MDI will be sufficient. If outlet is not apparent, leave blank ('null') or mark as 'unknown'. This page is in reference to Page 13 (Geo-location of MDI/SDI).

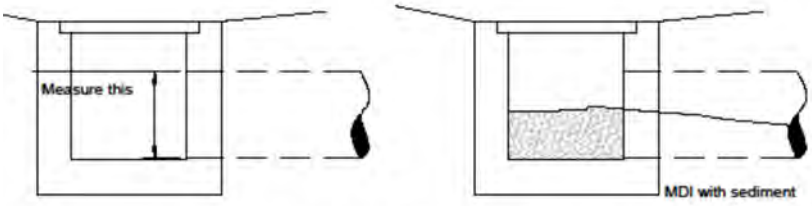


Measuring Pipe Inside Drop Inlets– MDI/SDI

As best as you can, measure pipe inside of drop inlet by projecting edges with tape measure (in the case of straight-down pipe) or measure directly if pipe is lateral. If sediment is in drop inlet, estimate the culvert diameter. Also estimate the amount of sediment in the inlet on the 'silting' field of collector. Once sediment buildup is above 60%, it will more difficult to get diameter (rise/span). If the pipe inside drop inlet is not evident, mark it as 'YES' for 'Is culvert inaccessible?' followed with 'silted up' as a reason for inaccessibility . Make sure the rise and span dimensions are 'null'.



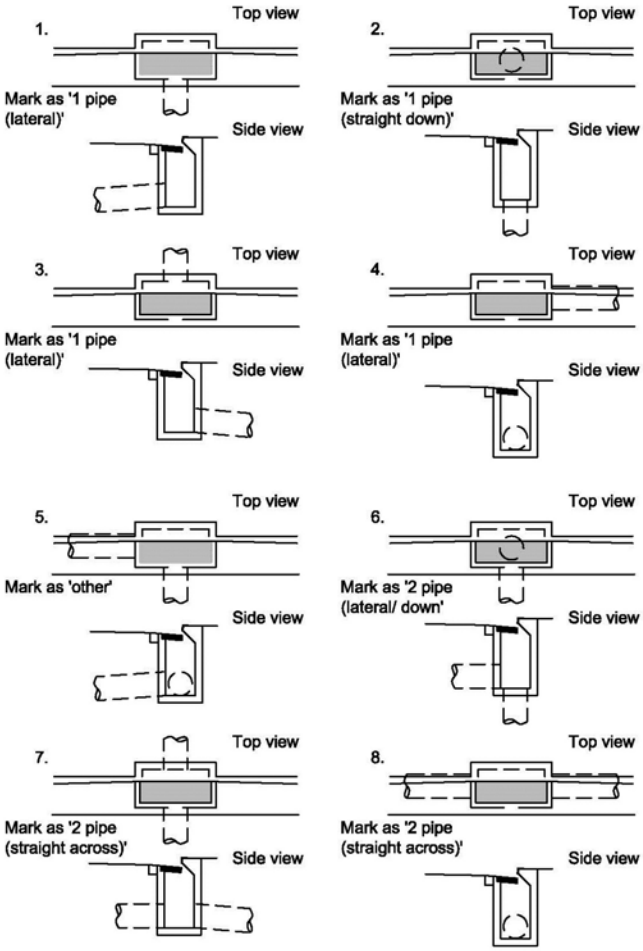
Median (or shoulder) drop inlet with straignt-down pipe.



Median (or shoulder) drop inlet with lateral pipe.

Drop Inlets– Curb Drop Inlet (CDI)

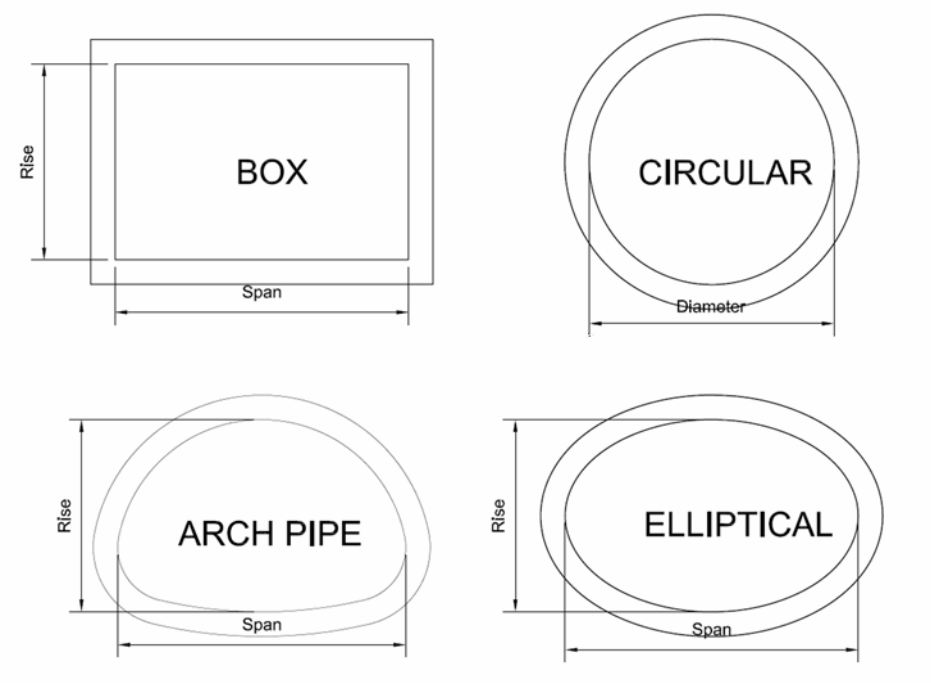
Most single and double pipe CDI configurations are shown below. Unlike MDI/SDIs, CDIs are difficult if not impossible to see inside box due to tight mesh of grate. Mark 'NO' for 'Is culvert inaccessible?' If pipe configuration shown below cannot be seen inside of CDI, leave blank ('null') or mark as 'unknown'. If outlet is unknown, then leave default value as blank ('null') or mark 'unknown'. If silting is evident mark as 'silted'.



Culvert Shapes

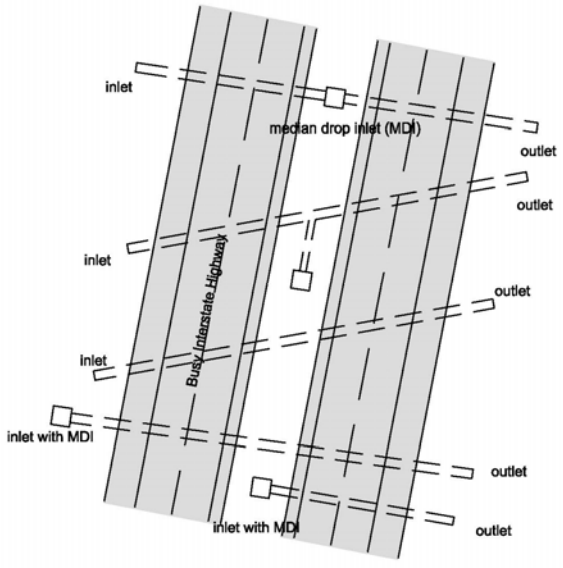
Most common shapes used by NMDOT.

Note that arch and elliptical are somewhat similar. The geometry of the arch pipe shape is made up circular curves with different radii (see pair of arch pipe on page 24), whereas elliptical is true to its geometry. Elliptical pipe can also be found where rise is greater than span. For any other shape of culvert found in the field, mark as 'other' and provide a note in the 'comment' field.



Is an MDI/SDI Entering into Culvert?

Default answer is 'NO' for most cases as shown on the third culvert on sketch below. Select 'YES' if culvert has an MDI draining into it. First two culverts on sketch below show MDI draining into their respective culverts. Note that the second culvert has a lateral culvert attached to main line. Length of lateral can vary from a few feet to several hundred feet. The greater the lateral length the harder it will be to distinguish if MDI is attached to main culvert or not without further exploration. If MDI is sufficiently far enough from main trunk, treat it as a separate GPS location point. The last two shown on sketch below are special cases of an inlet with an MDI or SDI. Select 'YES' for this culvert.



End Sections– None (or 'Projecting')

Applies to Inlet and Outlet

End sections are used to improve flow intake, protect culvert from damage and improve safety to the traveling public. In the examples below no end (or 'projecting' as it is referred to in Hydraulics) sections were used. This was common in older roads.

Corrugated metal culvert above. Image to left is located on NM 26 MP 36.5, Doña Ana County. Location of image to right is unknown.

End Sections-Metal and Concrete

Metal and concrete end sections are flared to improve flow of water and also to protect pipe end from damage. End sections are applied to both inlets and outlets of culverts.

Corrugated metal pipe above

Locations for all images are unknown.

Concrete culvert pipe below

End Sections– Headwall

Applies to inlet and outlet

Headwall is a vertical concrete structure placed at the end of a culvert or series of culverts. Use this for circular, elliptical or arch pipes for all material types. Box culverts will be treated separately in the following pages. Some headwalls may have wingwalls as shown on top right image. Image to left is located on NMRX (Railrunner), south of Santa Fe, Santa Fe County. Image to right is located on private drive into US 64, Shiprock, San Juan County.

Concrete culvert pipe below with concrete headwall

I-25, South of Belen, Valencia County

End Sections– Concrete Box Culverts

With wingwalls , parapet, with or without concrete aprons

Applies to inlet and outlet.

CBC with apron (see arrow on image to the left). Apron is a concrete floor between wingwalls. Generally it is an extension of CBC floor. A 3 ft. vertical wall (cutoff wall) is placed at the end of apron. This is to prevent erosion undercutting beneath apron.

CBC without apron. Common on structures built before 1970

Location of all CBCs shown here are unknown.

Apron not evident. Likely covered in silt.

End Sections– Concrete Slope Blanket

Mitered to slope. With or without safety grates.

Concrete slope blanket is a slab of concrete that is placed at the inlet/outlet of a culvert or series of culverts. Culverts are usually cut to match the slope of blanket. In some cases, safety grates are placed to prevent an errant vehicle from overturning into slope below.

Metal culverts, with safety grates. Location is on NM 2 south of NM 438, Eddy County.

Metal culvert, with safety grate. Location is unknown.

Concrete culvert pipe, no safety grate. Location is on US 84/ 285 south of Cuyamungue, Santa Fe County.

Metal culvert, no safety grate. Location is unknown.

End Sections– Other

Concrete , siphons, stonewalls, timber, etc.

For an end-section that does not fit any of the previous descriptions, select 'other'. For a culvert that is inaccessible, leave the default 'null' value. Note the concrete end section on the image below. This was a common feature placed on culverts during the early decades of the interstate system through New Mexico. Siphons (see image below) are used for irrigation ditches under a road where sight distance of oncoming traffic becomes a chief safety factor.

Concrete end sections common in construction of Interstates in the 1970s. Culvert to left is on I-25, south of Belen, Valencia County.

Concrete siphon used for irrigation ditches. Sample to the left has trash rack and built-in side gate. NM 3 near La Fragua, San Miguel County

Measuring Culverts

Span, Rise and Width for Circular, Arch and Elliptical Pipe

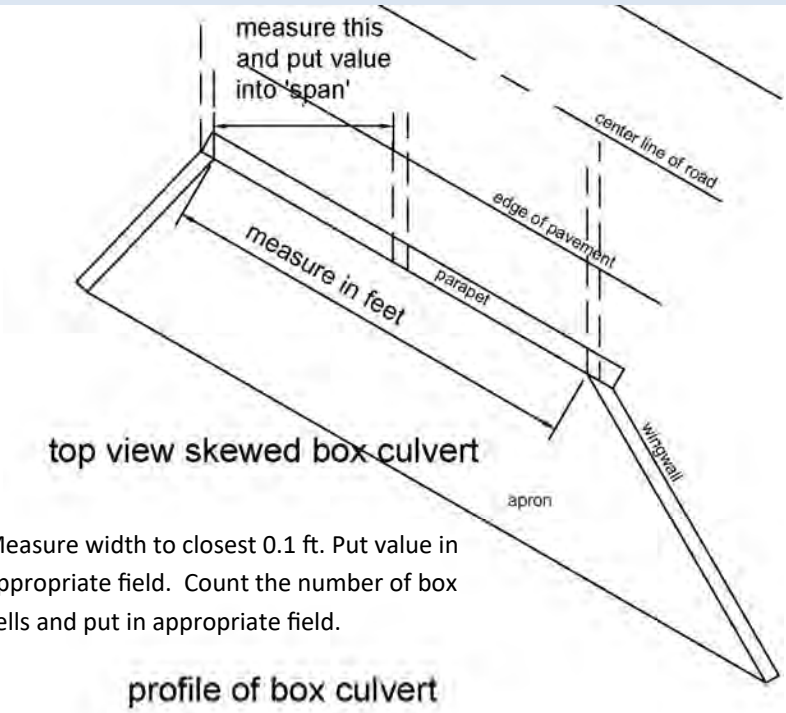
Diameters of circular culverts come in 6 inch increments (18, 24, 30, 36 etc). For arch pipe and elliptical, the measurements are dependent on the manufacturer. For all cases, measure to the closest inch for span and rise where ever possible. If culvert is partially silted, dig to the bottom of culvert to get value for rise.

For multi-barrel culverts (with or without concrete slope blankets), measure total width from end to end as shown in this image to the closest 0.1 ft. Count the number of pipe and put value in appropriate field.

Measuring Culverts

Span, Rise and Width for Single and Multi-barrel Box Culverts

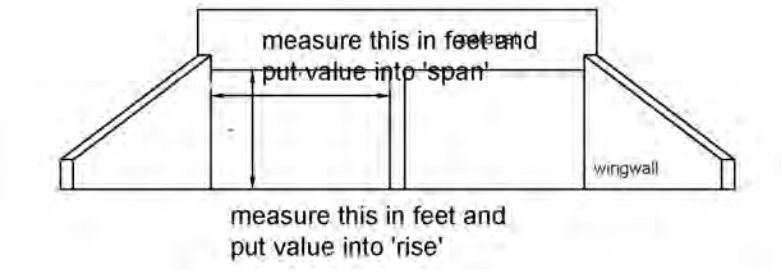
CBCs come in increments of 12 inches (both span and height). Measure to the closest 0.1 ft. If there is sediment, find the best possible location for measurements. In most instances, measuring one barrel will be enough. If sediment cannot be avoided, dig to find bottom of CBC. Use discretion in how much you dig.



top view skewed box culvert

Measure width to closest 0.1 ft. Put value in appropriate field. Count the number of box cells and put in appropriate field.

profile of box culvert



measure this in feet and
put value into 'rise'

Culvert Materials—Metal

Corrugated Metal Pipe (CMP). Also labelled as Corrugated Metal Culvert (CMC).

Top left is located on NM 165, near Placitas, Sandoval County. Top right is located on US 60 near NM 467, Curry County. Locations for remaining images are unknown.

Culvert Materials - Concrete

Concrete Box Culvert (CBC), Concrete Pipe Culvert (CPC). The latter can also be labeled Reinforced Concrete Pipe (RCP).

The CBC above is technically a bridge because it's width is greater than 20 ft. Shown here for illustrative purposes only. A single box can span from 2 ft to 14 ft.

Locations for all images are unknown.

Culvert Materials: Plastic

Rare, but is beginning to be used in new projects.

High Density Polyethylene (HDPE) is used in special cases for drainage where water and/or soils are highly corrosive . Other types are Poly vinyl chloride (PVC) used in sewer and water lines. It is sometimes used for driveway drainage. There are other types of plastic pipe in the market but are not shown here.

All images above are from Internet.

Culvert Types: Wood

Rare: Used for culverts and bridges prior to 1940.

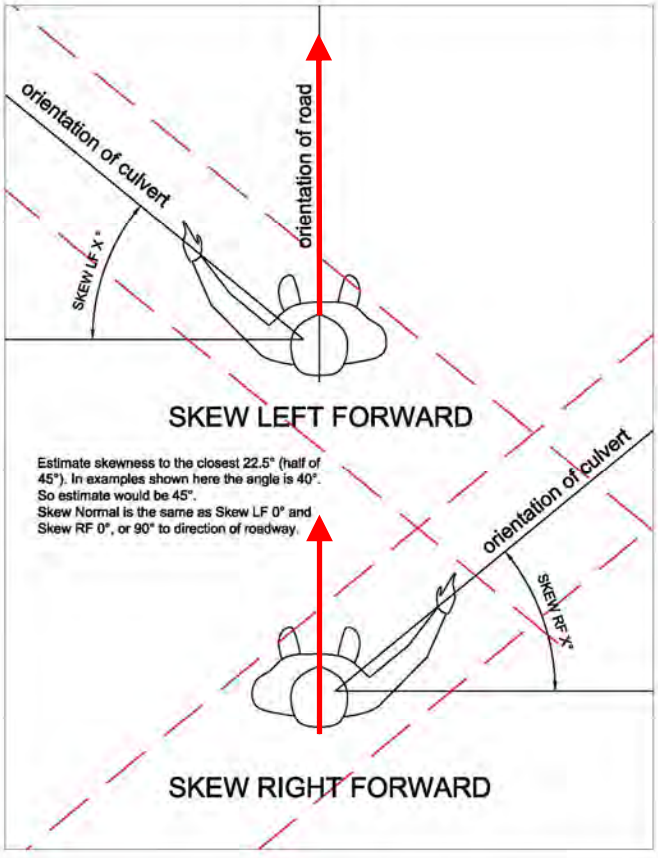
Photos shown below are timber boxes used for drainage and irrigation in railroads. As they age, they are being replaced by newer materials. Railroad culverts are not in the scope of this work.

Location of timber box culvert shown on left is adjacent to NM 116, Jarales, Valencia County

One of the few remaining wooden bridges along New Mexico highways. Image on the right is on NM 344, north of Cedar Grove, Santa Fe County.

Skew and Degree of Skew

Skew is the orientation of culvert (s) to the direction of road. This is illustrated below. For a culvert oriented perpendicular to road it is skew 'normal'. In most cases this holds true for most NMDOT culverts. It can be easily seen in the field if a culvert is skew right or left. However, if it cannot be determined, leave it blank (null). Eyeball the estimate the degrees of skew to the closest 22.5° (quarter of 90°). Once again, if uncertain, leave entry blank (null)



Erosion Control

Limits the erosive power of fast moving water from culvert outlets.

Wire-enclosed riprap

Loose rock riprap

Combination wire-enclosed riprap and gabions below CBC apron. Location unknown.

Grouted rip-rap (wire-enclosed or loose rock) - Above example is grouted loose rock. Average size of rock shown here is between 24 to 36 inches. Location is an arroyo paralleling NM 51, upstream of Elephant Butte Reservoir, Sierra County.

Note: For box culverts with no additional erosion protection other than the customary wingwalls and apron, leave the Erosion Control data entry blank (null). The same applies to culverts with no visible signs of erosion control measures.

Erosion Control

Further examples

Examples of energy dissipaters used for erosion control. Although structures shown above are considered bridges they illustrate types of 'concrete' structures that have been designed for erosion control. Both ED are located along US 54, south of Tularosa, Otero County.

Combination wire-enclosed riprap and gabions. Location is NB I-25 at MP 123.5.

Another example of 'concrete' structure used for erosion control. Location unknown.

Silting, Culverts

Siltation occurs when the carrying capacity of flowing water is less than the amount of silt being carried.

'Clean' or 'Less than 10% silting'

'Clean' or 'Less than 10% silting'

30% to 60% silting

Greater than 90% silting

Greater than 90% silting. The culvert shown by red arrow is almost covered. Only the t-post to the left gives away the culvert's location.

Locations for all culverts shown here are unknown.

Physical Condition of Culverts

Examples of culverts with little or no damage. Note that all examples shown here are culverts that have no end sections.

Culverts above show no signs of physical damage. Accept default value of 'null' value or enter 'none'.

Concrete and metal culverts show minor damage. Rim of concrete culvert is chipped but otherwise in good condition. Battery of metal culverts to right show minor dings at the tops. Damage here is considered minor.

Physical Condition of Culverts

Samples of moderate damage— This is a little more subjective call. The illustrations below and the following page will give some guidance but will depend on the judgement of the collector.

Spalling around edge of concrete end section is very evident. Spalling is when concrete chips or flakes away from structure. There are many causes, but most damage is done by the effects of years of de-icing roads with salt or other chemical interactions between concrete, soil and water.

Culverts to the right are collectively considered to have 'moderate' damage due to significant deformation of pipe openings . Corrosion, however is the big concern. That will be taken up on pages 47 and 48. Site is on NM 2 north of Dexter, Chaves County.

Physical Condition of Culverts

More samples of metal culvert moderate damage. Selected from the CAMP 2021 summer season.

Top row

US 60 MP 236.93 I-25 MP 33.34 NM 14 MP 17.58

Bottom row

NM 169 MP 3.35 NM 169 MP 17.04 US 60 MP 105.60

Physical Condition of Culverts

Samples of heavy damage on concrete box culverts and metal culverts

This is where rebar is exposed and considerable spalling has occurred in concrete box culverts. Heavy damage on a metal culvert would be the complete deformation of the pipe at the ends. This could also include signs of culvert bulging or collapsing in the interiors. Note this in the 'comments' field if it appears.

NM 120, MP 6.7, Colfax County

Box culvert interior to the left has severe spalling with exposed rebar. Location unknown. . Metal culvert to the right is heavily damaged from years of road work..

CBC to the left has spalling on the parapet but no exposed rebar evident in the picture. CBC to the right shows severe spalling and exposed rebar. Location is along US 285 north of Tres Piedras, Taos County.

Physical Condition of Culverts

More samples of heavy damage. Images at the bottom are from the 2021 CAMP summer season.

Two outer metal culverts to the left show 'heavy damage' . Center culvert would be considered having 'moderate damage'. Location is along US 60 between Cannon AFB and Clovis, Curry County. Photo was taken before road construction in 2019. This has been repaired since.

Bottom row

US 60 MP 92.95

NM 169 MP 7.04

US 380 MP 221.74

Physical Condition of Culverts

Concrete box culverts, slope blankets, other drainage related concrete features.

Wingwall is separating from the body of CBC due to differential settling of soils or scour beneath wingwall. Enter as 'severe cracks on concrete' for cracks wider than 1/4 inch. Location is along NM 68 east of Ohkay Owingeh, Tierra Amarilla County.

Physical Condition of Culverts– Circular Concrete Pipes

Damage on Circular/Elliptical or Arch concrete pipes. Images below are examples of exposed wire mesh and pipe separation for concrete pipe.

Image to right is located I-25 MP 86.27 (2021 CAMP inventory). Location of image below is un-known.

Note separation of concrete culvert sections on top left. Image on top right shows complete separation of end section to main culvert. Same image also shows major to severe scour. The concrete culvert below has chipped edges exposing the wire mesh reinforcement.

Corrosion of Metal Culverts

Some soils in the state are prone to rusting metal culverts more readily than others. This is either due to subsurface water, the chemistry of the soil or both. Examples of 'minor' or no corrosion ('none') below.

Minor corrosion on inside

None evident

Minor corrosion on inside

Minor corrosion on outside

Moderate corrosion on inside. Although not evident on outside, significant corrosion has occurred at the base of culvert. This is caused by abrasion from the movement of gravels and cobbles.

Corrosion of Metal Culverts

Major corrosion

Major, corrosion on inside and outside. Location is on NM 2, north of Dexter, Chaves County.

Major, metal has been corroded through culvert, exposing the fill dirt surrounding culvert. Location is WB I-25 MP 120.9.

Major corrosion - metal is corroded through culvert on the top of culvert exposing the fill dirt surrounding culvert. Location is on US 60, Mountainair, Torrance County.

Major corrosion - metal is almost completely disintegrated. Location unknown.

Channel Type

Examples of 'dry arroyo' (or ephemeral), 'running water' (intermittent or perennial)

Perennial Channel: Creek or stream that runs throughout the year. Location on left is EB I-40, Rio San Jose. Image on right is somewhere in Conejos County, Colorado.

Perennial or Intermittent? Possibly the later. The river runs only during monsoon season or snow-melt. Water is backed up due to an erosion control dam, hence the yellow color. Location is Rio Puerco as seen from US 550 bridge, Sandoval County.

Channel Type

Examples of ’dry arroyo’ (ephemeral) or ‘no channel visible’

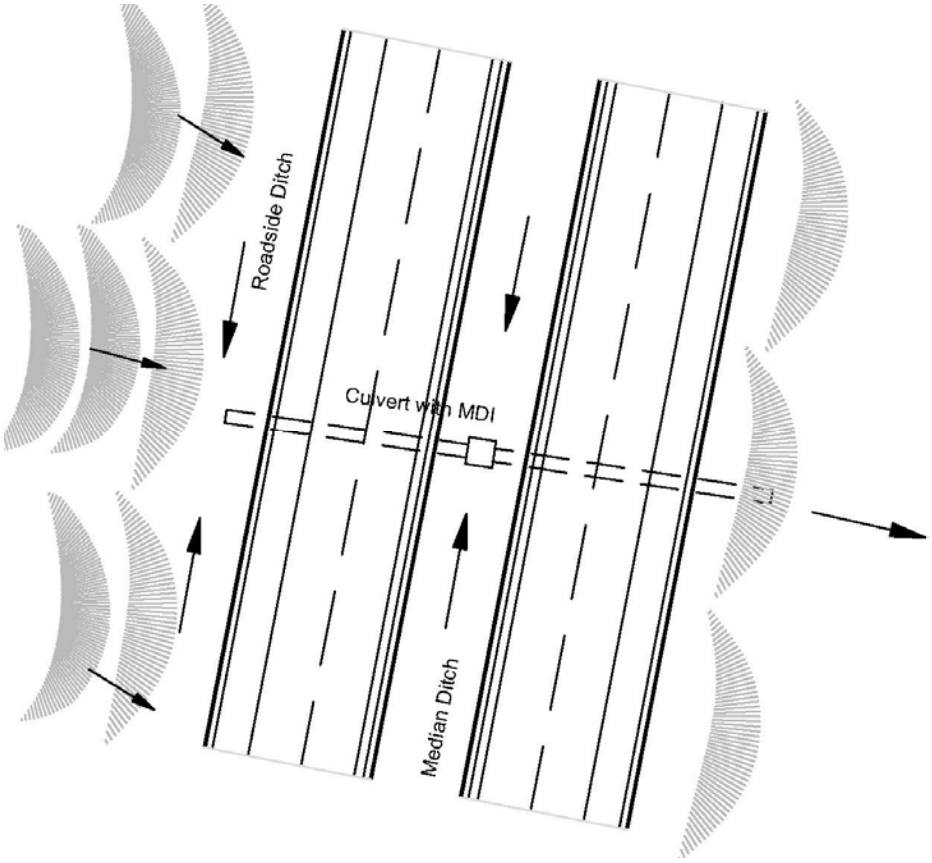
Ephemeral channel: arroyo or wash by any other name. It has a visible sand, gravel or cobble bed with vegetation in flood plain . Runs only during heavy rains. Locations unknown.

No channel evident– There is no visible characteristics associated with a dry arroyo. Vegetation is uniform throughout. Flow comes only during heavy or long duration rains as sheet flow. Location on left is unknown. Location on right is on NM 104, between Las Vegas and Trujillo, San Miguel County.

Channel Type

Illustration of median or roadside ditches.

Select ‘roadside/median ditch’ if the primary drainage is from within the right-of-way of road or a median ditch.



Channel Scour

Scour is the removal of river bed material at the outlet of culverts due to high velocities of water. Much more common at outlets than in inlets.

Culvert outlets above show minor scour (1 to 3 ft. depth). Location on left is on US 60 near Cannon AFB, Curry County. Location on right is on US 82, MP 136.0, Eddy County.

Culvert outlet shows little to no scour (less than 1 ft. depth). If outlet is covered partly in sediment, leave it as blank in data collector and move on. Location above is on NB I-25, south of Belen, Valencia County.

Channel Scour

Further examples of scour of the 'major' (3 ft. to 8 ft.) and 'severe' (greater than 8 ft.).

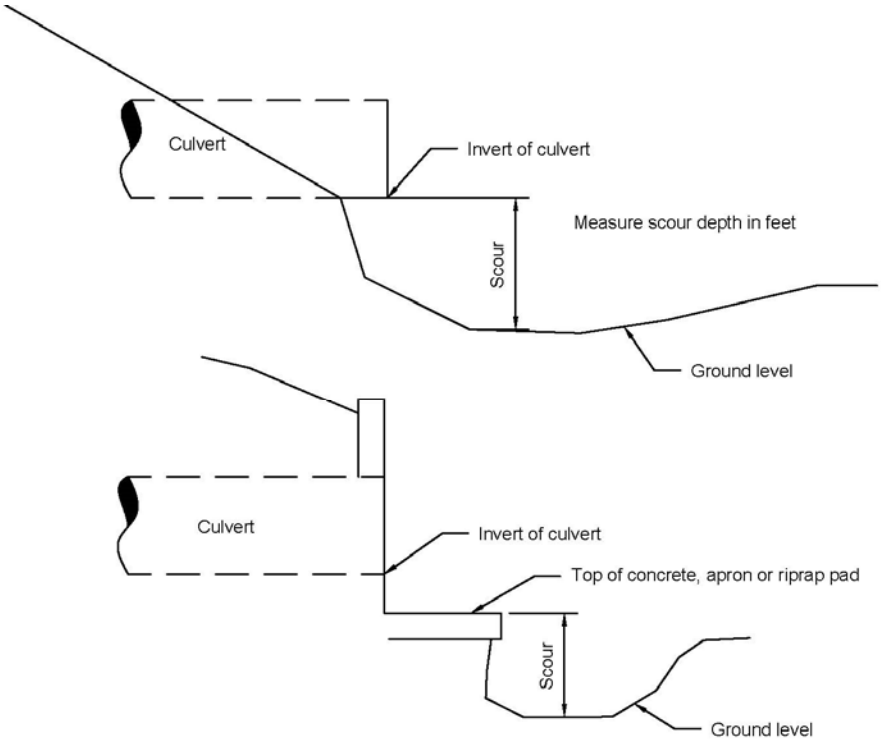
Major scour (from 3 ft. to 8 ft.) at the outlet of 2 barrel CBC. Note the absence of concrete apron, characteristic of older CBCs. Location Unknown.

Major scour at the outlet of concrete culvert. Although a scour hole formed at the base of culvert, the surrounding soils are cohesive enough to resist further erosion of flowing water after losing its energy in the scour hole. Location above is on SB I-25 near Hatch, Doña Ana County

Photo to the left is some serous scour of the dangerous kind. Mark as 'severe'(greater than 8 ft.) Note the observer in yellow vest on top of bank to the left. Location is on NM 68, north of Pilar, Taos County.

Channel Scour– Method of Measurement

Measure the depth of scour from the invert or flowline of the culvert to the bottom of scour hole if there is no rip-rap pad, apron or concrete pad. Measure scour depth of a culvert from the top of its apron, concrete pad or rip-rap blanket to the bottom of scour hole. These are illustrated below. Scour depths are entered by 'little or no scour (< 1 ft.)', 'minor scour (1 ft to 3 ft.)', 'major scour (3 ft. to 8 ft.), and 'severe scour (> 8 ft.). Once scour depths are near or at the severe end, measurement can become dangerous. Exercise caution!



Channel Condition

The general health of channel going into and coming out of culvert.

Grading the condition of a channel is a judgement call on the part of the collector. If in doubt, leave blank ('null')

Images to the left and below can be described as 'good' when entering the descriptor for Channel Condition. Both types are functioning as they should be without external disruptions. Many factors come into play when considering the health of the channel. It is better to leave this blank if not sure.

Upper image of river is somewhere in Conejos County, Colorado. Middle image location is on NM 502, east of Pojoaque. Image to the left is on NM 518 near La Cueva, Mora County.

Channel Condition— Continued

Channel above is swampy and heavily vegetated. Note the cattails growing in the foreground. Location is given on photo.

CBC below could be described as 'dry/ heavily vegetated' or 'weed/ debris'. Once again, if in doubt, leave data entry blank. Location is on US 82, west of NM 360 junction, Eddy County.

Channel above could be described as 'weeds/ debris'. Heavy weed growth on channel is due to a wet summer monsoon season. The same culvert is shown below looking at inlet. Location is on NM 53, east of Zuni, McKinley County.

Channel Condition— Continued

Images above and to the left would be marked as 'channel degrading' where there is scour at channel bottom. There can also be degradation of side banks of channel. Top image is on NM 344, MP 14.6, Santa Fe County.

Channels shown on images below can be considered as 'good'. They have well defined low flow channels with vegetation along their flood plains. Bottom left is the Aleman Draw in Sierra County near the Spaceport . Bottom right image is the Yappa Arroyo, NM 181 MP 3.8 in Sierra County.

Sample Data Entries

Sample below is a culvert on US 60 west of Mountainair.

District– 5 *[post-processing]*

County– Torrance *[post-processing]*

Patrol– Mountainair *[post-processing]*

Route Type– US *[post-processing]*

Route #- 60 *[post-processing]*

Mile Marker– 203.00 *[post-processing]*

Is Culvert Accessible?- Yes

If no, then- *[data entry left blank]*

GPS Coordinate Location– outlet

If MDI/ SDI or CDI, then- *[data entry left blank]*

Culvert Shape– circular

Is there an MDI/ SDI draining into culvert – no

Outlet End Section Type– none

Inlet End Section Type– none

Span– 36 *[inches]*

Rise– 36 *[inches]*

Number of Culverts– 1

Width (for two or more culverts)- *[data entry left blank]*

Culvert Material– corrugated metal

Skew– Left Forward

Degree of skew– Normal *[It's really about 10 degrees but since it is out of range of the 22.5 degrees, it can be marked as 'normal'.]*

Erosion Control– none

Silting– clean

Physical Damage– none

Corrosion– none evident *[or data entry can be left blank]*

Channel Type– ephemeral

Channel Scour– Major Scour (greater than 3 ft)

Channel Condition- *[This was left blank. None of the data collector choices fit the existing conditions. Channel became grass-covered outside of right-of-way fence.]*

Sample Data Entry–

78” Reinforced Concrete Pipe, NM 68 MP 6.57 near Ohkay Owingeh.

Outlet –78” RCP

The following 3 pages illustrate a more complex data entry sample. First two pages show photos of inlet, outlet and channel conditions . The last page show Trimble TDC600 data entry for this culvert. The outlet is selected for this sample. Note that the inlet is 54” corrugated metal culvert (CMP) rather than the 78” Reinforced Concrete Pipe (RCP) at outlet.

Inlet (side view)

Inlet –54” CMP (!)

Median drop inlet entering into culvert.

Sample Data Entry–

78” Reinforced Concrete Pipe, NM 68 MP 6.57 near Ohkay Owingeh.

Sample Data Entries-

78” Reinforced Concrete Pipe, NM 68 MP 6.57 near Ohkay Owingeh.

District– 5 *[post-processing]*

County– Rio Arriba *[post-processing]*

Patrol– Alcade *[post-processing]*

Route Type– NM *[post-processing]*

Route #- 68 *[post-processing]*

Mile Marker– 6.57 *[post-processing]*

Is Culvert Accessible?- No

If no, then- Weeds, debris, heavy vegetation *[Tumbleweeds are chest high and cover a large area]*

GPS Coordinate Location– outlet

If MDI/ SDI or CDI, then- *[data entry was left blank]*

Culvert Shape– circular

Is there an MDI/ SDI draining into culvert – yes

Outlet End Section Type– none

Inlet End Section Type– metal end section

Span– 78 *[inches] [assumed]*

Rise– 78 *[inches]*

Number of Culverts– 1

Width (for two or more culverts)-

Culvert Material– concrete

Skew– normal

Degree of skew– *[you can leave data entry blank or enter ‘0’ degrees]*

Erosion Control– not evident

Silting– minor silting (< 10%) *[although bottom of culvert was covered in weeds, measurement of rise was taken from top of culvert. Measurement coincided with culvert dimensions from an older survey, therefore this implied ’minor silting’.]*

Physical Damage– none

Corrosion– not known

Channel Type– ephemeral

Scour– *[This was left blank. Scour could not be determined because of heavy weed cover]*

Channel Condition– weeds and/or debris *[mostly tumbleweeds blown in from outside. Again, the Channel Condition choices are limited. Pick the best answer or leave blank]*

Comments– 54” CMP at inlet. MDI joins 54 and 78. Inlet also inaccessible. *[Comment was needed to address culvert type and size difference between inlet and outlet. Comment has 63 characters. You can put in comments up to 255 characters.]*

References-

The following were selected from the New Mexico Department of Transportation Standard Drawings for Highway and Bridge Construction– 2019 Edition

https://dot.state.nm.us/content/dam/nmdot/Plans_Specs_Estimates/Standard_Drawings/StandardDrawingsUpdate_(Mar2020).pdf

Cattle Pass, Culvert Headwalls, Mitered Concrete Slope Blankets –Sheets 511-01 to 511-77

Metal End Sections with Safety Grates for Metal Culverts—Sheets 511-78 to 511-79

Concrete Box Culverts— Sheets 511-80 to 511-111

Corrugated Pipe Slotted Drain—Sheet 570-01

Culvert Pipe End Sections (metal and concrete)—Sheets 570-02 to 570-03

Pipe Siphon—Sheet 570-03

Wire-enclosed riprap—Sheet 602-01

Erosion Control at Outlets—Sheet 602-02

Gabion Basket and Retain Wall Details—Sheets 602-03 to 602-04

Tire Bale Retain Walls—Sheets 602-05 to 602-06

Guard Rails—Sheets 606-01 to 606-21

Concrete Wall Barrier—Sheets 606-22 to 606-45

Barbed Wire Fence and Woven Wire Fence Replacement— Sheets 607-01 to 607-20

Headgate Detail—Sheet 612-01

Drop Inlets—Sheets 623-01 to 623-32

Road Obstruction Markers (including triple orange t-post)—Sheets 703-01 to 703-03

References-

Bridge Inspector's Reference Manual, Federal Highway Administration, Publication No. FHWA NCI 12-049, December 2012

Culvert & Storm Drain System Inspection Guide, American Association of State Highway and Transportation Officials (AASHTO), First Addition-2020, CSDIM-1

Drainage Design Manual, New Mexico Department of Transportation, July 2018