



HydInfra Inspection Manual

Culvert and Storm Drainage Systems

Condition Rating Codes:

Like new

1

Excellent – like new condition

Still okay

2

Fair – some wear, but structurally sound

Fix in project

3

Poor – deteriorated, consider for repair or replacement

Fix it sooner

4

Severe – serious deterioration

Unknown

0

Not able to rate, not visible

Notes:

- This guide is used to rate the condition of storm drainage system assets, including culverts where the pipe (or installations of more than one pipe) is less than 10 feet wide as measured along the centerline of roadway.
- The worst defect found in an asset determines its condition rating. (Refer to inspection criteria on pages 27 to 36).
- Drainage assets are rated on structural integrity and ability to perform their functions. Need for cleaning is NOT part of the Overall Condition rating.
- Phone in unsafe road problems to Maintenance Area Supervisor immediately.

MnDOT HydInfra Phone: 651/366-4474

Send questions to kellie.thom@state.mn.us

Internal Webpage: <http://ihub/bridge/hydraulics/hydinfra/index.html>

External: <http://www.dot.state.mn.us/bridge/hydraulics/inspector.html>

TAMS <https://tamsp.dot.state.mn.us>



Information about HydInfra Inspection

1) Get the most up-to-date version of the HydInfra inspection manual from the MnDOT HydInfra webpage <http://www.dot.state.mn.us/bridge/hydraulics/hydinfra.html>

2) To request this document in an alternative format call 651-366-4470.

3) HydInfra in Transportation Asset Management System (TAMS) software

This version of the HydInfra manual reflects changes for TAMS in 2018. HydInfra has been converted from an in-house program to Agile Assets software with ArcGIS Collector app for field inventory and inspection.

HydInfra in TAMS is still HydInfra. Previous HydInfra asset types have evolved into TAMS-HydInfra asset classes:

- Pipes and channels are captured as line features and include the end-sections (aprons) and components like bends and increaser/reducers.
- Hydraulic Structures are captured as point features, including manholes, catchbasins, drop inlets and buried structures; structural pollution control devices (SPCD); and Special Features.
- Ponds and Filtration or Infiltration Basins are captured as polygons.

4) HydInfra inspection criteria reflects updated criteria in the NCHRP 14-26 Culvert and Storm Drain Inspection Manual First Edition 2016

HydInfra includes improved 14-26 inspection criteria where applicable. The NCHRP 14-26 manual drew from HydInfra ideas – compare NCHRP 14-26 Section 4 Condition Rating System to page 1 of this manual and Other Materials criteria. HydInfra differs from the NCHRP14-26 draft manual because we use descriptive inspection flags and measures to describe defects, rather than a numerical rating for each culvert component. The 14-26 manual is not publically available yet.

A comparison of HydInfra condition ratings to the 1986 Culvert Inspection Manual 9 to 0 rating scale is available here: [HydInfra ratings compared to NBIS.pdf](#)

5) MnDOT uses a different program to inspect culverts larger than 10-foot span:

FHWA Bridge Inspector's Reference Manual Chapter 14,
<http://www.dot.state.mn.us/bridge/pdf/insp/birm/birmchapt14-inspofculverts.pdf>

6) Metro WRE As-Built requirements: <http://www.dot.state.mn.us/gisspec/methods/drainage.html> and [TABLE K](#) (requires Internet explorer)

7) MnDOT uses TAMS-HydInfra in these initiatives:

- Transportation Asset Management Plan (TAMP) <http://www.dot.state.mn.us/assetmanagement/tamp.html>
- Project Selection <http://www.dot.state.mn.us/projectselection/>
- CIMS (Corridor Investment Management Strategy) <http://www.dot.state.mn.us/cims/>
- Performance Measures <https://www.dot.state.mn.us/measures/index.html>
- MS4 permit reporting <http://www.dot.state.mn.us/environment/ms4/index.html>
- GSOC (Gopher State One Call) www.gopherstateonecall.org
- MnDOT Permit Reviews <http://www.dot.state.mn.us/utility/>
- Scoping for construction project design
- Maintenance repair planning

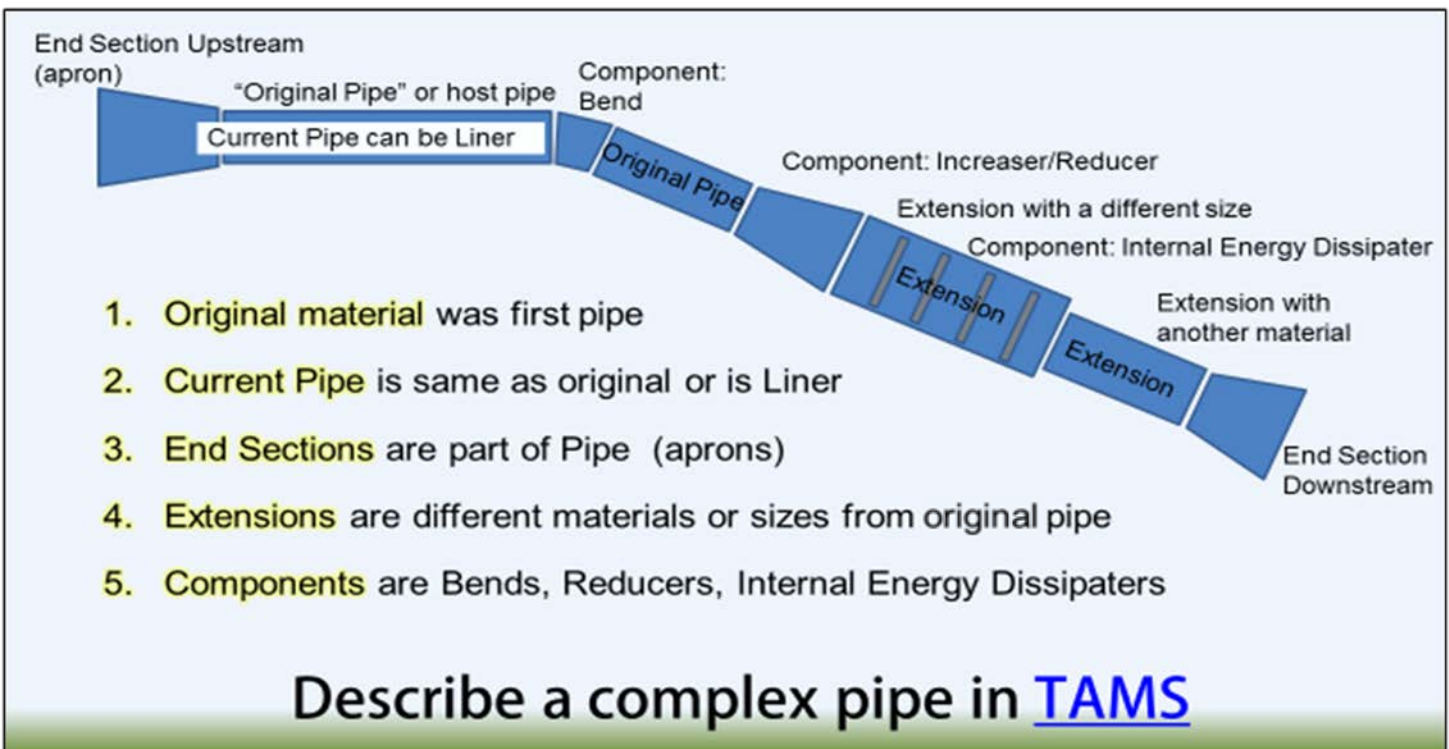
8) Learn about culvert hydraulics from these FHWA videos: [Hydraulic Engineering: Open Channel Flow and Culvert Hydraulics Demonstration Series](#) (turn on "CC" closed captions)

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HydInfra Asset – Pipes and Channels (line features)

| | Class Codes | Descriptive Fields | Description |
|-------------------|---------------|--------------------|---|
| Pipes HYD_CHANNEL | Culverts | End Sections | End Sections are aprons or safety aprons or box end sections or none |
| | | Extensions | Extensions describe additional materials, sizes or shapes of pipe |
| | | Components | Components describe added parts like fish passage or dissipater rings |
| | | Current pipe | Current pipe describes the inner pipe |
| | | Original pipe | Original pipe describes the outer or host pipe if lined, or same as current |
| | Storm Drain | End Sections | End Sections are aprons or safety aprons or box end sections or none |
| | | Extensions | Extensions describe additional materials, sizes or shapes of pipe |
| | | Components | Components describe added parts like fish passage or dissipater rings |
| | | Current pipe | Current pipe describes the inner pipe |
| | | Original pipe | Original pipe describes the outer or host pipe if lined, or same as current |
| | | Pipe Type | Pipe Type includes Slotted Drain, Gasketed, Non-gasketed, Open Flume |
| | Open Channels | Pipe Type | Pipe Type includes Open Flume |
| | Drain Tile | Material | Material list includes Perforated Plastic |



Hydraulic Structure

HYD_STRUCTURE (point features)

| | Asset Class | HYD_STRUCTURE_TYPE_NAME | Description |
|---------------|-----------------|------------------------------|--|
| HYD_STRUCTURE | Structure | Buried Manhole | Buried MH is hidden beneath surface |
| | | Catch Basin | CB structure has grate with inflow from pavement |
| | | Control Structure | Structure regulates water elevation or flow rate |
| | | Deck Drain | Deck Drain captures flow on a bridge |
| | | Diverter | Diverter structure splits or changes flow |
| | | Drop Inlet | DI captures drainage in ditch or swale |
| | | Inspection Tee | Inspection Tee is opening to view or maintain structure |
| | | Manhole | MH structure is a solid-top junction with no inflow |
| | | Other | Other may be an odd type of storm drain structure |
| | SPCD | SPCD - Filter | Filter uses sand, gravel or screens to separate sediment |
| | | SPCD - Grit Chamber | Grit Chamber has multiple cells to drop out sediment |
| | | SPCD - Infiltration Device | Infiltration device distributes water to gravel area below |
| | | SPCD - Separator | Separator swirls inflow to spin out cleaner outflow |
| | | SPCD - Skimmer | Skimmer holds back floatable debris and oils |
| | | SPCD - Sump MH | Sump manhole has pit in bottom to store some sediment |
| | | SPCD - Sump MH with Baffle | Baffle in Sump MH is a plate with holes to prevent re-suspension of sediment |
| | | Other | Other may be an odd type of water quality device |
| | Special Feature | SpecFeat - Ditch Block | Ditch Block is a tiny dam to divert water to a pipe |
| | | SpecFeat - Energy Dissipater | Energy Dissipater, usually of concrete, tumbles flow |
| | | SpecFeat - Floodgate | Floodgate caps downstream pipe end when it floods |
| | | SpecFeat - Overflow | Overflow structure handles highwater outflows |
| | | SpecFeat - Riprap | Riprap is broken rocks to dissipate flow velocity |
| | | SpecFeat - Weir | Weir is a partition designed to overflow at specific level |
| | | Other | Other is a strange structural asset not specifically listed |

Pond or Basin

HYD_POND (polygon features)

| | Class Code | Pond/Basin Type | Description |
|----------|------------|--------------------|--|
| HYD_POND | Pond | Dry Pond | Dry pond has outlet elevation at pond bottom and drains dry |
| | | Mitigation Wetland | Mitigation Wetland was built to offset wetland loss on a construction project. Look for NWC (New Wetland Credit) or PVC (Public Value Credit) or other note on plans |
| | | Natural Wetland | Natural Wetland identifies a pre-existing wetland protected by Minnesota or Federal law |
| | | Unknown | Unknown type is used when the type is unidentified |
| | | Wet Pond | Wet pond normally has water up to the level of the outlet structure and maintains a permanent pool of water |
| | Basin | Filtration Basin | Filtration Basins might have draitile that allows drawdown between rainfalls |
| | | Infiltration Basin | Infiltration Basins are built to leak into the ground until dry. They normally have living plants on basin bottom |



Ponds are designed to detain or retain stormwater and slow the rate of outflow

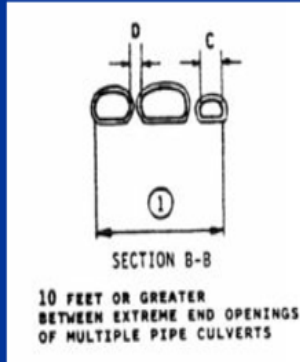


Basins are designed to filter or infiltrate stormwater

Is it a **Bridge** or a Culvert?

HydInfra Culvert pipes are those less than 10-foot span that do not fit the definition of a Minnesota Bridge:

It is a bridge (and not a HydInfra culvert) if Total Span is 10 feet or greater and the gap between pipes is less than half the smaller pipe's interior diameter.

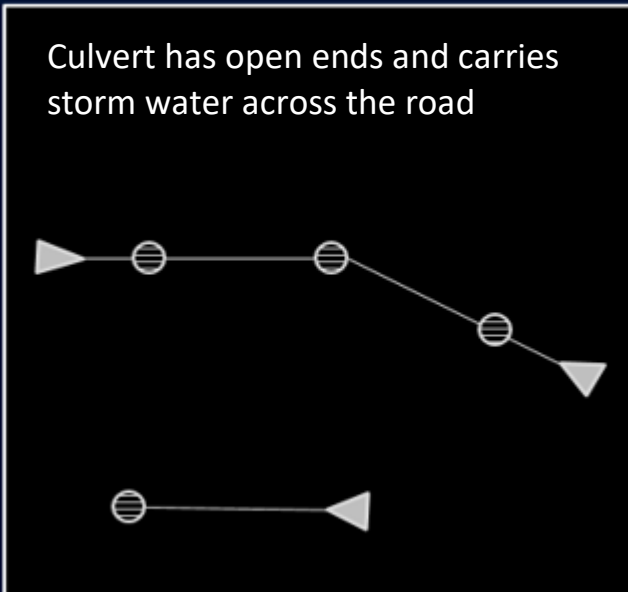


Two 8 ft. wide culverts with a five ft. space between them would not be a “bridge”.

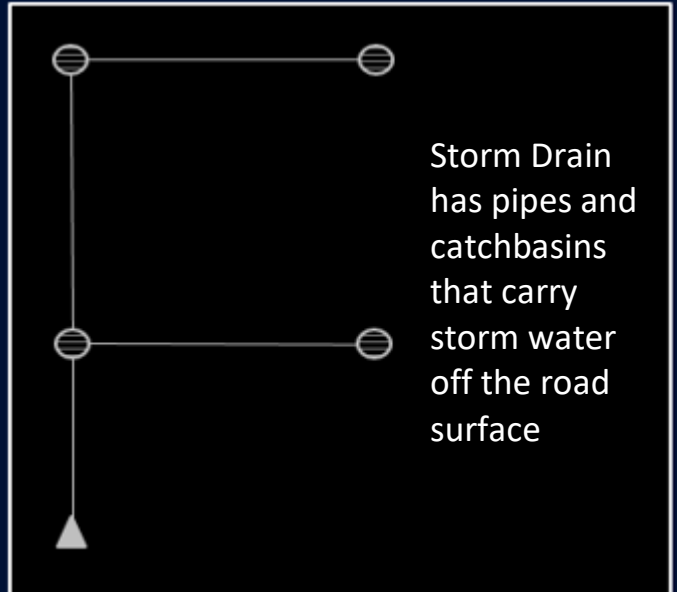
Two 6 ft. wide culverts with a 2 ft. space between them would be a “bridge”.

Is it a **Culvert** or **Storm Drain Pipe**?

Culvert has open ends and carries storm water across the road



Storm Drain has pipes and catchbasins that carry storm water off the road surface



Choose the **Class Code** in TAMS from this list:
Culvert, Storm Drain, Drain Tile or Open Channel

Drainage Performance Measure for Highway Culvert Inspection

Recommended Inspection Frequency for Highway Culverts*

| Overall Condition | Inspection Frequency Years | Comments |
|--|----------------------------|--|
| 4 - Very Poor | 2 | Pipes where problem is not under the road |
| | 1 | Pipes where problem requires a repair under the road |
| 3 - Poor | 4 | Most condition 3 pipes |
| | 2 | Condition 3 Pipes with Piping or Road Void ** |
| 1 - Like New or 2 - Fair | 6 | Pipes that do not need repair |
| 0 - Can't be Rated | 2 | Pipe condition is not visible |
| Pipes with no inspections | | Pipes created in TAMS-HydInfra without an inspection. Goal to inspect Highway Culverts within 6 years of Date Discovered |
| Overall Target: 80% of Highway Pipes meet Recommended Inspection Frequency | | |

The Drainage Performance Measure recommended inspection frequency applies to “Highway Culverts” (culverts under MnDOT highway traffic lanes).

*Highway Culverts, included in the Drainage Performance Measure, are HydInfra pipes where:


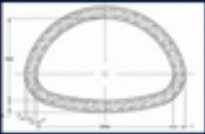
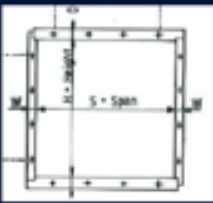
- Class Code is Culvert
- Roadway Type is Centerline, Collector/Distribut, Mainline, Median or Ramp/Loop or Roundabout
- Owner is not City, County or Private
- Status is Inplace or Proposed

Pipes that are not under State highway traffic lanes are not included in the performance measure. Pipes not included are “Side Pipes” with Roadway Types of Crossover, County, City, Township, Frontage, Entrance Pipes (Entrance, Field Entrance, Farm Entrance, Commercial Entrance) or others (Trail, Railroad, Bridge, Ditch Block or Other). Pipes that are not culverts are also not included in the Performance Measure. Pipes Class Codes of Storm Drain or Drain Tile are not counted as culverts.

**Condition 3 pipes with piping or road void have a 2-year inspection cycle because these serious conditions could lead to road problems.

Most Common Pipe Shapes

Pipe Shape

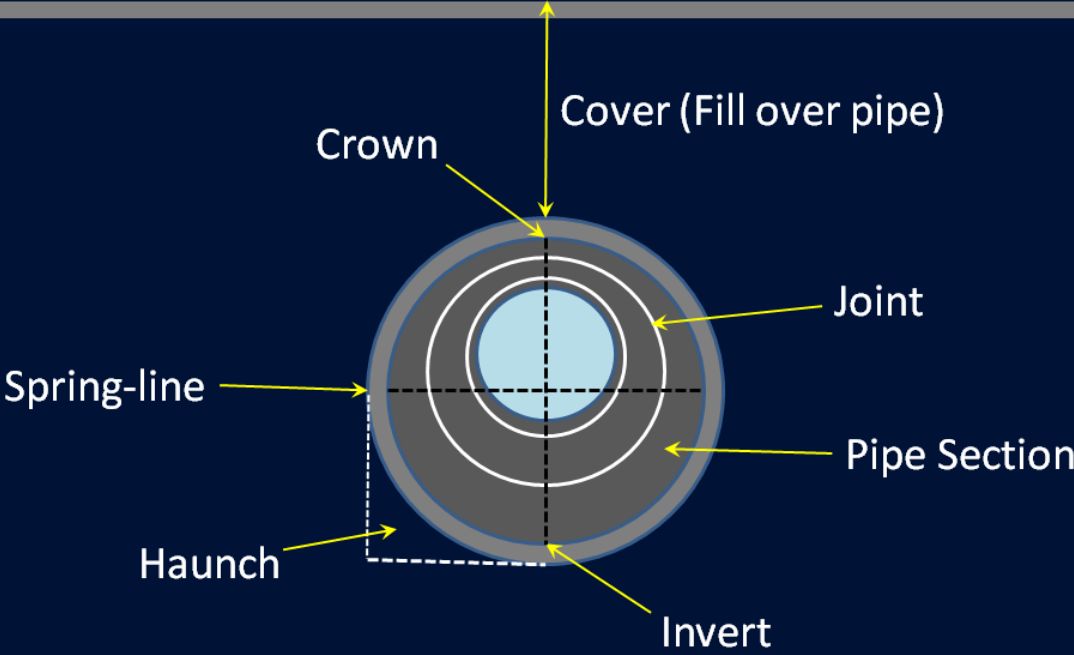
- Round 
- Arch 
- Box 

- Elliptical 

- CattlePass 

- Waterway
- Other
- (Do not use Tunnel or Cathedral)

Names for parts of a pipe



HydInfra Inspection Criteria

List of Inspection Flags and Measures for Pipes

| | | Images |
|--|--|---|
| <u>Condition Indicators</u> | <ul style="list-style-type: none"> Needs Repair? Repair under Road Piping Cracks Holes Deformation Misalignment Spalling/Flaking Pitting/Rusting Maximum Joint Separation Number of Separated Joints Apron Separated Infiltration | Needs Repair Repair Under Road Piping Cracks Holes Deformation Misalignment Spalling/Flaking Pitting Rusting Max Joint Sep # Joints to Fix Apron Separated Infiltration |
| <u>Roadway Clues to Condition</u> | <ul style="list-style-type: none"> Void in Road Road Distress Inslope Cavity Erosion/Scour | Road Void Road Distress Inslope Cavity Erosion |
| <u>Not in Condition Rating</u> | <ul style="list-style-type: none"> Needs Clean? Sediment % Full Plugged Water Observed Water % Full Illicit Discharge | Needs Clean Sediment % Full Plugged Water Observed Water Percent Full Illicit Discharge |
| <u>Inspector-Suggested Maintenance</u> | <ul style="list-style-type: none"> Needs Marker Replace Apron Repair Invert Suggested Repair Method | Needs Marker Replace Apron Repair Invert Suggested Repair |

Notes:

- Flags are yes/no fields that indicate specific problems.
- Measures are inspection fields with menus or lists of attributes to describe the defect.
- See [Definitions of data fields in TAMS-HydInfra](#) of flags and measures for Pond, Structure and Pipe assets.

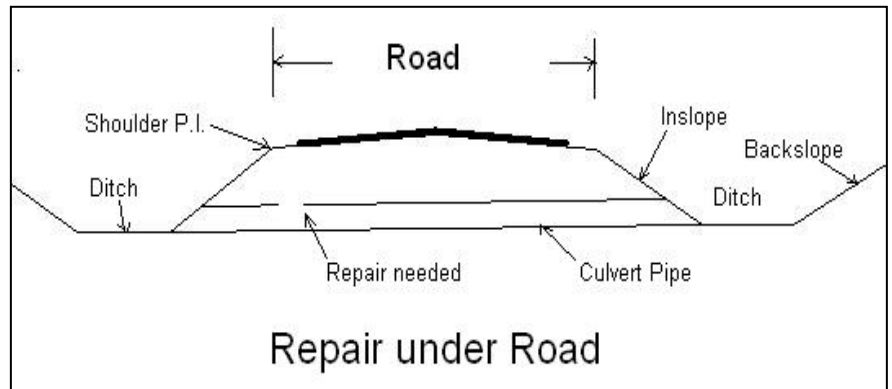
Definitions – HYDINFRA Flags and Measures

Condition Indicators

■ **Needs Repair?** – Does this asset need to be repaired?

■ **Repair under Road** –

If a repair is needed, the needed repair will encroach on the area between the two shoulder P.I.'s (point of intersection where the road surface intersects with the inslope). The Repair flag must be marked yes for Repair under Road to be valid.



■ **Pitting/Rusting** – Small pits are visible in the surface of the pipe. If metal, rusted but still solid. Concrete has exposed aggregate.

■ **Spalling/Flaking** – Loss of material as flat chips of concrete are lost from asset's surface, or if metal, flakes of rust are falling away.

■ **Cracks** – Describe crack severity: Not Visible (no crack), Crack (cracked), Fracture (broken), or Displaced (fractured with offset pieces)

■ **Holes** – Hole goes completely through the asset's material.

■ **Max Joint Separation** – Estimate or measure, in inches, the largest separation between pipe sections (interior of pipe).

■ **# Joints to Fix** – Count the number of joints that are separated by 1 inch or more, or have evidence of soil infiltrating the joints.

■ **Separated Apron** – Describe which end(s) of pipe has a separated apron, where the joints between the apron and first pipe section may be allowing soil to filter through to cause an Inslope Cavity.

■ **Misalignment** – Estimate, in inches, how far pipe sections are out of alignment. Good alignment is 0 to 1 inch offset (would not interfere with Slipliner).

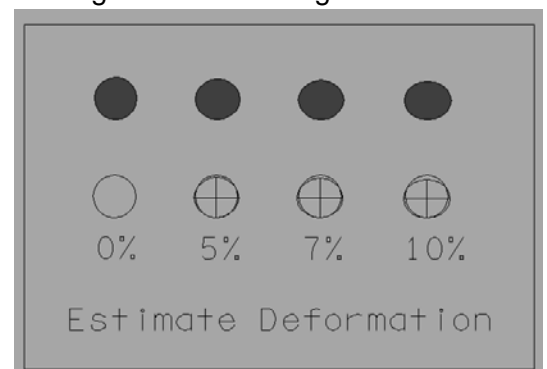
■ **Deformation** – Asset's shape is distorted or oveled. Use inspection comment to describe how deformed it is.

■ **Infiltration** – Evidence that soil or water is seeping into pipe.

■ **Piping** – Water is flowing along the outside of pipe, which causes loss of soil in roadbed (void in road).

■ **Deter. Ties (Deteriorated Ties)** – Pipe ties are corroded or broken. Pipe ties are bolts between concrete pipe sections that help maintain the alignment.

■ **Inspection Suggested Repair** – Inspector suggests a pipe repair method



Definitions – HYDINFRA Flags and Measures (continued)

Not in Condition Rating

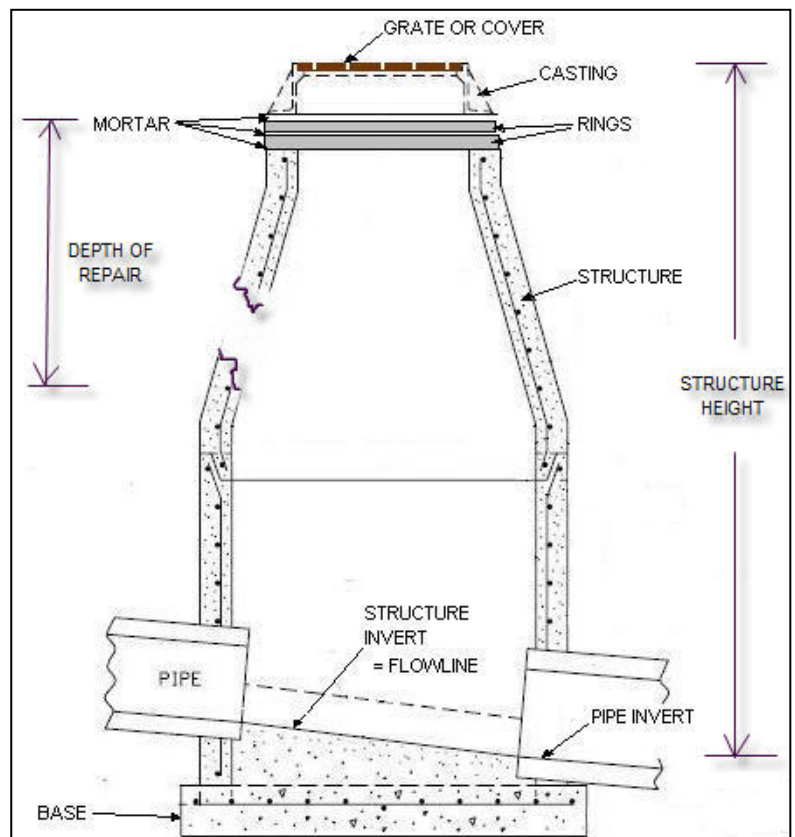
- **Needs Cleaning** – Does this asset need to be cleaned? ? Pipe is has sediment 30% of the pipe height or more, somewhere within the pipe. (See also Sediment % Full).
- **Plugged** – Something is in pipe causing water to backup or restrict the water flow.
- **Sediment % Full** – Estimate the depth of sediment, compared to the interior height of apron or pipe. For SPCDs and Ponds, estimate the percentage of the total volume that is filled by sediment.
- **Water Observed**– Describe the typical water situation in the pipe: Dry, Slow, Fast, Standing, or Full
- **Water % Full** – Describe the water level in the pipe at time of inspection as a percent of pipe height.

Roadway Indicator Flags (describe problems adjacent to an asset)

- **Inslope Cavity** – A cavity or hole in the inslope of the roadway above an apron or pipe joint. Usually found in areas where joint separation has occurred.
- **Road Distress** – Pavement problem – Road Bump, Dip, Pavement Patch or Cracks (indicators of possible loss of roadbed through poor condition pipe or structure).
- **Void in Road** – Evidence of a loss of soil from the road around or near the pipe or other asset. Pavement patches, holes in pavement or braided pavement cracks may be signs of Road Void.
- **Erosion**– Describe where the erosion is: Inlet, Outlet, Both (ends), Other, or None. Erosion, scour or channel degradation caused by water flows has occurred, as evidenced by a gully or loss of vegetation.

Structure Terms

- **Structure Type** – Manhole, Catchbasin, Drop Inlet, Buried Manhole, Control Structure, Deck Drain, Diverter, Inspection Tee
- **Structure Height** – Measure from top of grate to bottom of invert
- **Repair Depth** – Measure from bottom of casting to bottom of the needed repair (gaps, cracks, holes, missing blocks or brick, etc.)
- **Connected Pipes** – number of pipes attached to the structure
- **Sump** – a basin below the outgoing pipe that is deeper than 1 foot
- **Deteriorated Rings** – The adjusting rings (= layers below the iron casting assembly) are broken or cracked. Rings may also have missing mortar.



Materials in TAMS-HydInfra

- Concrete
- Brick/Masonry
- Aluminized Steel
- Corg. Steel (CSP)
- Structural Plate (Steel)
- Polymeric-Coated (Steel)
- Bituminous-Coated (Steel)
- Steel Casing
- Corg. Aluminum (CAP)
- Timber
- Vitrified Clay
- Other
- Corg. Plastic (HDPE)
- PVC
- PP - Polypropylene
- Perforated Plastic (pond drains)
- SRPE - Steel ribbed Polyethylene
- Liner HDPE
- Liner PVC
- Liner Cured in Place (CIPP)
- Liner Metal
- Liner Other

Concrete Pipe

**MATERIAL TYPE:
CONCRETE**



Corg. Steel (CSP)

**MATERIAL TYPE:
STEEL**



Zinc-galvanized steel pipe

Structural Plate

**MATERIAL TYPE:
STEEL**



US 61 Silver
Bay 1.p.
53.26

Galvanized steel plates are bolted together,
was used in larger diameter culverts

Polymeric-coated Steel

**MATERIAL TYPE:
STEEL**

Thin black plastic sheet applied to inside and outside of corrugated steel pipe. Look for peeling at edges.



Photo by Johnston-Fargo



39 year old Polymeric-coated pipes installed in 1977 held up where galvanized aprons rusted out. Most were Condition 2. District 3, MN 84 Pine River to Longville.

Photos from [Polymeric Coated Corrugated Steel Pipe Durability Update: October 27, 2016](#), Bob Moore



Bituminous-Coated Steel

**MATERIAL TYPE:
STEEL**



- Looks like tar on CMP, often flaking
- *May contain asbestos*
- Labeled in Plans as "AB-Bonded"
- Not installed since 1970's but still exists

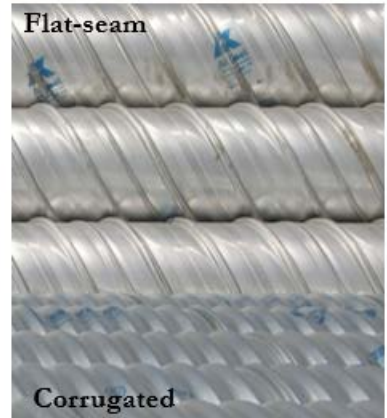


Aluminized Steel

**MATERIAL TYPE:
STEEL**



Flat-seam



Corrugated

Look for label on new pipes. Surface has a sheen like an aluminum pop can, but edges may be rusty. Aluminized Steel is magnetic.

Photo by Johnston-Fargo

Corg. Aluminum (CAP)

**MATERIAL TYPE:
ALUMINUM**

Often miss-identified where pipe material is actually Aluminized Steel, Inspector should look at pipe end edge to identify steel or aluminum material.



Photo from <http://www.lockernz.co.nz/>

All aluminum pipe, not steel so no rust, not magnetic, is more bendable

PVC

**MATERIAL TYPE:
PLASTIC**



Photo PVC pipe from <http://www.ipexinc.com/>

White or green, more brittle than HDPE, especially in cold

Corg. Plastic (HDPE)

**MATERIAL TYPE:
PLASTIC**



HDPE = High Density Polyethylene has smooth inside and corrugated outside. HDPE is always black

Corg. Plastic (HDPE)

**MATERIAL TYPE:
PLASTIC**



Single wall corrugated HDPE should not be used as highway culverts or storm drain.

SRPE -
Steel-Reinforced PolyEthylene

**MATERIAL TYPE:
PLASTIC**



Exterior flanges are steel, coated with HDPE



Blue spiraling line shows it's SRPE

[Photos of Durmaxx pipe by Contech](#)

Polypropylene

**MATERIAL TYPE:
PLASTIC**



PP = Polypropylene Pipe is grey and stiffer than HDPE

**MATERIAL TYPE:
PLASTIC**

Perforated Plastic

used in pond underdrains
to filter stormwater

MATERIAL TYPE: OTHER

- Vitrified Clay
- Timber
- Any other material



Wooden cattle pass in
D6 on MN 60 r.p.
185.91

Timber MATERIAL TYPE: OTHER

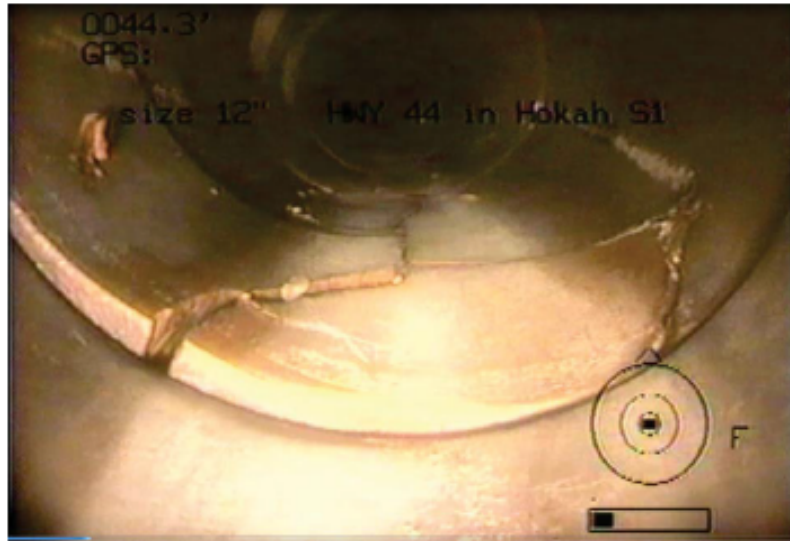
also used in wet box culverts

Wooden Pipe on Grand Ave,
MN 23 in Duluth



Vitrified Clay (VCP)

**MATERIAL TYPE:
OTHER**



Red fired clay tile exists in some old small town storm drains and old farm drain tile.

HIVE Inspection Rob Coughlin, D6



Other Material

**MATERIAL TYPE:
OTHER**



Photo from
HIVE Inspection
Video



Excavated 20 inch box "pipe" carved from limestone provides outlet for old VCP storm drain -- D6 Hwy 56 Kenyon

Brick/Masonry – describe in comment



Before Renovation



After Renovation
Photo 26OCT2016

Stone Culvert in Duluth on London Road
National List of Historic Places

Liner Materials:

**MATERIAL TYPE:
LINER**

- Liner HDPE
- Liner PVC
- Liner Cured in Place
- Liner Metal
- Liner Other
- Liner SRPE
- Liner PP

Liner HDPE

**MATERIAL TYPE:
LINER**



Like Snap-Tite or butt-fused HDPE liner has grout between original pipe and liner.

Liner PVC

**MATERIAL TYPE:
LINER**



Photo of PVC liner from Caltrans <http://www.dot.ca.gov/hq/oppd/dib/dib83.pdf>

Liner Cured in Place

**MATERIAL TYPE:
LINER**



CIPP Liner is resin-filled fabric, inflated and cured with hot water or steam or UV light till it's rigid

Liner Metal

**MATERIAL TYPE:
LINER**



Photo: Johnston-Fargo

Steel flat-seamed pipe is sometimes used as liner

Liner Other

**MATERIAL TYPE:
LINER**



Centrifugally Cast Concrete Pipe



Hand sprayed application

Sprayed-on cementitious pipe liner

Photos: CentriPipe, Bill Shook

HydInfra Inspection Criteria

Roadway Indicators

| Factors: Integrity of road fill material related to drainage assets | Flags |
|--|---|
| <p>Good or Fair Condition</p> <ul style="list-style-type: none"> ▪ No road settlement ▪ No pavement patching ▪ Road surface not affected | |
| <p>Poor Condition</p> <ul style="list-style-type: none"> ▪ Pavement cracking above pipe (Road Distress) ▪ Holes in inslope (inslope cavity) | Road Distress Inslope Cavity |
| <p>Severe Condition</p> <ul style="list-style-type: none"> ▪ Indications of voids around pipe or loss of road fill including Piping ▪ Settlement of road surface (Road Void) ▪ Holes in road surface caused by pipe or structure condition (Road Void) ▪ Evidence of repeated pavement patching ▪ Inslope failure, slumping, soil cracks parallel to road, ditch headcut | Piping Road Void Road Void Road Distress |

Notes:

The general conditions of the roadway and adjacent area are used as clues to help determine the condition rating for each hydraulic asset that is inspected. These general conditions may be indicators of concealed structural problems. Pipe failures with loss of road fill are often visible on road surface.



Road surface may indicate condition of pipe

MN 95 near MP 89, near Marine on the St. Croix



HydInfra Inspection Criteria

Concrete Pipe

Factors: Structural integrity, Integrity of surrounding material

1 Excellent Condition

- Like new
- May have minor chipping at joints or minor blemishes
- *Crack - Not Visible or hairline crack less than 1/100 inch

Concrete
Cracks-Not
Visible

2 Fair Condition

- Maximum Joint Separation less than 1 inch – broken or pulled apart anywhere along a joint
- *Exposed aggregate (pitting) or surface abrasion less than ¼ inch deep
- *Spalling or scaling to ½ inch depth in a patch less than 6 inch diameter
- *Lengthwise Crack less than 1/20 inch wide (thickness of one dime) or around the pipe with no infiltration (not wet, stained or deposition)
- Pipe is lined and in good condition

Joint Separation
Pitting/Rusting
Spalling/Flaking
Cracks-Crack

3 Poor Condition

- Maximum Joint Separation 1-3 inches – broken or pulled apart anywhere along a joint
- *Lengthwise crack with width 1/20 to 1/10 inch (thickness of 1 to 2 dimes)
- *Water infiltration through cracks (or rust staining or efflorescence)
- *Spalling or scaling ½ to ¾ inch depth in patch larger than 6 inch diameter
- *Abrasion or Spalling ¼ to ½ inch with deeply exposed aggregate or reinforcement beginning to show
- Erosion has undermined apron or pipe section at inslope
- Apron is separated from pipe but other joints not separated
- Inslope cavity
- Infiltration of soil into pipe causing soil loss from road inslope
- Pipe may be causing soil loss beneath road surface

Joint Separation
Cracks-Crack
Spalling/Flaking
Misaligned
Infiltration
Inslope Cavity
Erosion
Separated Apron
Road Distress

4 Severe Condition

- Maximum Joint Separation more than 3" – joint is pulled apart or broken at any point along joint (unless only at apron – see condition 3)
- *Lengthwise Fracture – crack greater than 1/10 inch wide (width of 2 dimes)
- *Fractured crack with displaced pipe pieces
- *Exposed and/or corroded steel reinforcement. Reinforcement fully exposed in places
- *Widespread spalling more than ¾ inch depth or invert deterioration and loss of pipe wall thickness
- *Holes through concrete or bottom gone
- *Slabbing – Pipe deformation with cracks and spalling
- Piles of soil at joints inside pipe, or any indication that soil infiltrates into pipe under roadway (piping or soil infiltration)
- Piping – Water flowing outside of pipe or other evidence of Road Void under road surface or shoulder

Joint Separation

Cracks–Fracture
or Displaced

Holes
Deformation
Road Void
Spalling/Flaking
Infiltration &
Piping

Notes:

*Criteria updated to match the NCHRP 14-26 draft 2016 Culvert and Storm Drain Inspection Manual, 06NOV17

Need for cleaning is NOT part of the Overall Condition rating but is noted by 'Clean? = Y' and "Sediment % Full" = >30%

HydInfra Inspection Criteria

Metal Pipe

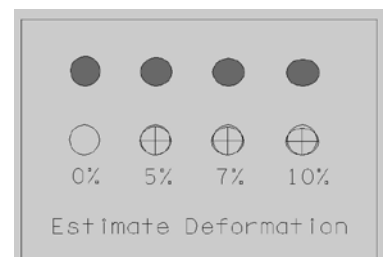
| Factors: Structural integrity, Integrity of surrounding material | Flags |
|--|---|
| 1 Excellent Condition <ul style="list-style-type: none"> Discoloration of surface Galvanizing intact No rust or pitting | |
| 2 Fair Condition <ul style="list-style-type: none"> Galvanizing gone from invert Pitting, superficial rust or tight rust flakes *Deformation less than 10% of original diameter Pipe is lined and in good condition | Pitting/Rusting |
| 3 Poor Condition <ul style="list-style-type: none"> Flaking rust evident, with some loss of wall thickness A hole, less than 1 inch in size *Deformation, deflection or distortion visible, up to 10% 10 to 15% of diameter *Can poke a hole in pipe with a sharp point or a hammer pick strike Inslope Cavity – Infiltration of soil into the pipe from road inslope (embankment) Infiltration of soil into pipe <u>may</u> be causing loss of fill beneath road surface Erosion has undermined apron or pipe Apron is separated from pipe or needs replacement | Spalling/Flaking Holes Deformation Spalling/Flaking Inslope Cavity Road Distress Erosion Separated Apron |
| 4 Severe Condition <ul style="list-style-type: none"> Hole 1 inch or greater, or many small holes, or bottom gone Cracks or tears *Severe deformation greater than 40% 15% of diameter Joints separated Misalignment Can poke a hole in pipe with a blunt rod Piping or Road Void – Pipe condition is causing soil loss beneath road surface | Holes Cracks Deformation Joint Separation Misaligned Spalling/Flaking Piping or Road Void |

Notes:

*Criteria updated to match the NCHRP 14-26 draft 2016 Culvert and Storm Drain Inspection Manual, 06NOV17

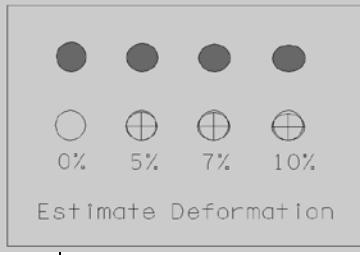
Need for cleaning is NOT part of the Overall Condition rating but is noted with a separate “Clean” flag (Clean? = Y) and a “Sediment % Full” value.

Attributes, such as hole-size or deformation %, won't be measured in most cases – inspectors estimate defects based on what they see from the pipe end.



HydInfra Inspection Criteria

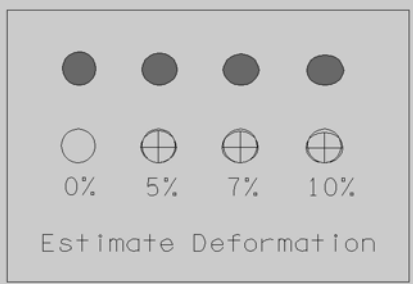
Dual Wall Plastic Pipe or Liners – HDPE or Polypropylene

| Factors: Structural integrity, Integrity of surrounding material | Flags |
|--|---|
| <p>1 Excellent Condition</p> <ul style="list-style-type: none"> • Pipe is straight • Joint separation less than 1" • *Deformation less than 5% of original inside diameter |  |
| <p>2 Fair Condition</p> <ul style="list-style-type: none"> • *Deformation of pipe 5% to 7% of original inside diameter • *Local buckling or rippling in wall. For dual wall HDPE pipe, liner buckling in 2 or fewer areas • *Blistering less than 25% of pipe interior surface • Joint separation less than 3" with no soil infiltration through joints • For dual wall HDPE pipe, circumferential cracking in PE liner only, above flow line and less than 1/4 of circumference, (if crack is below flow line, freeze/thaw may increase damage, use Condition 3) • Minor misalignment and settlement throughout pipe • Pipe is lined and in good condition | <p>Deformation</p> <p>Joint Separation</p> <p>Cracks</p> <p>Misalignment</p> |
| <p>3 Poor Condition</p> <ul style="list-style-type: none"> • Significant ponding of water due to sagging or vertical misalignment • *Deformation of pipe 7% to 10% of original inside diameter • *Abrasion more than 10% of wall thickness • *Blistering over more than 25% of pipe interior surface • For dual wall HDPE pipe, liner buckling in more than 2 areas • Joint separation more than 3 inches, but not detached • Evidence of soil infiltration in pipe under inslope • *For dual wall HDPE pipe, circumferential cracking in HDPE liner only, in upper or lower portion of pipe, less than 1/2 of pipe circumference, with no soil infiltration through joints • Erosion has undermined apron or pipe end • Apron is separated from pipe but not other pipe joints • Repair is needed but is not under road | <p>Misalignment</p> <p>Deformation</p> <p>Joint Separation</p> <p>Infiltration</p> <p>Inslope Cavity</p> <p>Crack-Fracture</p> <p>Cracks HDPE</p> <p>CIPP delamination</p> <p>Separated Apron</p> |
| <p>4 Severe Condition</p> <ul style="list-style-type: none"> • Floated – top of pipe is at or above ground surface • Joint separation allowing soil infiltration under road surface or shoulder • *Deformation greater than 10% of original inside diameter or kinked pipe wall • *For dual wall PE pipe, buckling of liner and exterior shell • Hole through pipe material • *Abrasion more than 25% of wall thickness • *For dual wall PE pipe, circumferential cracking greater than 1/2 of pipe circumference, in the liner only or longitudinal cracks less than 12 inches • *Soil infiltration under road surface or shoulder (including Piping or Road Void) • Burnt – describe in comments | <p>Misalignment –Float</p> <p>Joint Separation</p> <p>Deformation</p> <p>Holes</p> <p>Road Void, Piping</p> <p>Cracks</p> <p>Cracks</p> <p>Deformation</p> |

*Criteria updated to match the NCHRP 14-26 draft 2016 Culvert and Storm Drain Inspection Manual, 06NOV17

HydInfra Inspection Criteria

Single Wall Plastic Pipe or Liners – PVC or CIPP

| Factors: Structural integrity, Integrity of surrounding material | Flags |
|--|---|
| <p>1 Excellent Condition</p> <ul style="list-style-type: none"> • Pipe is straight • Joint separation less than 1" • *Deformation less than 5% of original inside diameter |  |
| <p>2 Fair Condition</p> <ul style="list-style-type: none"> • *Deformation of pipe 5% to 7% of original inside diameter • Joint separation less than 3" with no soil infiltration through joints • Minor misalignment and settlement throughout pipe • Pipe is lined and in good condition | <p>Deformation Joint Separation Misalignment</p> |
| <p>3 Poor Condition</p> <ul style="list-style-type: none"> • Significant ponding of water due to sagging or vertical misalignment • *Deformation of pipe 7% to 10% of original inside diameter • *Abrasion more than 10% of wall thickness • Joint separation more than 3 inches, but not detached • CIPP folds or flaps > 1" but not obstructing flow • CIPP localized delamination • Pipe condition is causing soil loss of inslope • Any crack in PVC pipe outside of road surface area • Erosion has undermined apron or pipe • Apron is separated from pipe • Repair is needed but is not under road | <p>Misalignment Deformation</p> <p>Max Joint-Separation Inslope Cavity or Infiltration Cracks Erosion Separated Apron</p> |
| <p>4 Severe Condition</p> <ul style="list-style-type: none"> • Floated – top of pipe is at or above ground surface • Joint separation allowing soil infiltration under road • *Deformation greater than 10% of original inside diameter • *Abrasion more than 25% of wall thickness • Hole through pipe material • CIPP delamination or gap that allows piping • Incomplete grouting of liner that allows piping • Uncured areas in CIPP walls • *Soil infiltration under road surface or shoulder (including Piping or Road Void) • Any crack in PVC pipe under road surface or shoulder • *Degradation from sunlight -- UV caused cracks or broken wall at exposed ends • Burnt -- describe in comments. | <p>Misalignment – Float Max Joint-Separation Deformation Holes Road Void, Piping</p> <p>Cracks</p> |

*Criteria updated to match the NCHRP 14-26 draft 2016 Culvert and Storm Drain Inspection Manual, 06NOV17

HydInfra Inspection Criteria

Open Channel or Ditch

| Factors: Vegetation, Erosion (Physical integrity), Flow Capacity or Sediment Deposition | Flags |
|--|-------|
| <p>1 Excellent Condition</p> <ul style="list-style-type: none"> ▪ Vegetation is well established, without noxious weeds (see county list of Noxious Weeds). ▪ No eroded rills ▪ If it is an Infiltration ditch, ditch is infiltrating water. | |
| <p>2 Fair Condition</p> <ul style="list-style-type: none"> ▪ Sediment deposition is visible. ▪ Limited patches of missing vegetation. ▪ Sheet erosion occurring (look for exposed grass roots). ▪ “Healed” (vegetated) rills. | |
| <p>3 Poor Condition</p> <ul style="list-style-type: none"> ▪ Noxious Weeds are present (see county list of Noxious Weeds). ▪ Ditch liner material (geotextile, clay liner, etc.) is damaged. ▪ Ditch grade headcut (ditch bottom is de-grading from downhill to uphill) is occurring – pipe aprons suspended above eroded ditch bottom may be an indicator. ▪ “Infiltration Ditch” (ditch constructed specifically to infiltrate stormwater) has dead vegetation where water ponds. ▪ “Infiltration Ditch” (ditch constructed specifically to infiltrate stormwater) has standing water for more than 3 days in a row. | |
| <p>4 Severe Condition</p> <ul style="list-style-type: none"> ▪ Eroded gully or slope failure presents a hazard to vehicles leaving the roadway or threatens road or embankment integrity. ▪ Sediment <u>in ditch</u> causing water to back up onto upstream or adjacent properties, or onto roadway. (Pipes are most likely the problem – check affected pipes first). ▪ Soil crack in the inslope or shoulder that is parallel to the roadway -- indicates a developing slope failure | |

Note:

Need for cleaning is NOT part of the Overall Condition rating but is noted with a separate “Clean” flag (Clean? = Y).

HydInfra Inspection Criteria

Hydraulic Structure (MH, CB & DI)

| Factors: Structural integrity, Integrity of surrounding material | Flags |
|--|-------|
| <p>1 Excellent Condition</p> <ul style="list-style-type: none"> ▪ Very minor defects in concrete rings ▪ None to hairline cracks evident ▪ None to slight spalling or scaling | |
| <p>2 Fair Condition</p> <ul style="list-style-type: none"> ▪ Some mortar missing at concrete rings ▪ Pitting on surface ▪ Aggregate is visible ▪ *Cracks between 0.01” and 0.05” ▪ *Evidence of seepage -- infiltration of water | |
| <p>3 Poor Condition</p> <ul style="list-style-type: none"> ▪ Concrete rings broken, or mortar missing – gaps 1/2” to 1” ▪ Settlement of pavement or soil adjacent to structure ▪ *Blocks/bricks flaking/crumbling ▪ *Spalling or scaling with some exposed reinforcing steel ▪ *Slight gaps in mortar between blocks or bricks of structure ▪ *Lengthwise crack with width 1/20 to 1/10 inch (thickness of 1 to 2 dimes) ▪ *Map-cracking ▪ *Water infiltration through cracks (or rust staining or efflorescence) ▪ *Spalling or scaling ½ to ¾ inch depth in patch larger than 6 inch diameter ▪ *Abrasion or Spalling ¼ to ½ inch with deeply exposed aggregate or reinforcement beginning to show | |
| <p>4 Severe Condition</p> <ul style="list-style-type: none"> ▪ Voids or depressed pavement adjacent to structure (caused by soil infiltration) ▪ *Gap at pipe joint ▪ *Structure settlement that affects structure stability or function (look for out-of-level structures and gaps at pipe connections) ▪ Concrete rings broken or mortar missing with gaps >1” ▪ *Blocks/bricks missing ▪ *Lengthwise Fracture – crack greater than 1/10 inch wide (width of 2 dimes) ▪ *Fractured crack or Crack with misaligned or displaced sides ▪ *Exposed and/or corroded steel reinforcement (look for rust staining along cracks or holes) ▪ *Widespread spalling more than ¾ inch depth or crumbling invert ▪ *Holes through structure ▪ *Slabbing – Deformation with cracks and spalling ▪ *Infiltration of soil | |

Notes:

*Criteria updated to match the NCHRP 14-26 draft 2016 Culvert and Storm Drain Inspection Manual, 06NOV17

Attributes such as crack width and spalling depth will not be measured in most cases – inspectors must estimate defects based on what they see from the pipe end.

Iron steps are not included in Structure rating. Add inspection comment to describe problems.

Need for cleaning is NOT part of the Overall Condition rating but is noted with a separate “Clean” flag (Clean? = Y) and a “Sediment % Full” value.

HydInfra Inspection Criteria

Other Materials or SPCD (Structural Pollution Control Device)

| Factors: Structural integrity, Water Quality Functions, Clogging, Integrity of surrounding material | Flags |
|---|-------|
| 1 Excellent Condition <ul style="list-style-type: none"> ▪ Materials are intact. | |
| 2 Fair Condition <ul style="list-style-type: none"> ▪ Materials have minor defects but the asset is structurally sound. ▪ The asset is functioning properly. | |
| 3 Poor Condition <ul style="list-style-type: none"> ▪ Materials have defects that may affect function or structural integrity of the asset but can wait for a repair ▪ Repair is needed but is not under road | |
| 4 Severe Condition <ul style="list-style-type: none"> ▪ Components are broken or not working ▪ Outflow is non-functional ▪ Piles of soil inside asset at the joints, or any indication that soil infiltrates into asset from under roadway (Piping, Road Void) ▪ Materials have severe defects and need repair soon. | |

Notes:

SPCD (Structural Pollution Control Device) is a asset built to improve water quality. Examples of SPCDs include “Grit Chambers” (like a partitioned box), swirling “Separators” (like Vortech, CDS, Stormceptor, Baysaver, Downstream Defender and other makes) “Skimmers” and “Filters”.

When inspecting manufactured SPCDs use inspection criteria from the manufacturer.

“Other Materials” may be any that are not described in Plastic, Metal or Concrete rating criteria.

For detailed concrete rating criteria go to [Hydraulic Structure – MH, CB & DI](#) criteria.

Need for cleaning is NOT part of the Overall Condition rating but is noted with a separate “Clean” flag (Clean? = Y) and a “Sediment % Full” value.

HydInfra Inspection Criteria

Pond

| Factors: Water Quality Functions, Water containment functions – basin integrity/clogging/overtopping, Vegetation | Flags |
|--|-------|
| <p>1 Excellent Condition</p> <ul style="list-style-type: none"> ▪ Embankment is sound. ▪ Outflow structures are clear of debris and functional ▪ Vegetation is well established, without any noxious weeds (see county list of Noxious Weeds). | |
| <p>2 Fair Condition</p> <ul style="list-style-type: none"> ▪ Limited patches of missing vegetation. ▪ Sheet erosion occurring (look for exposed grass roots). ▪ “Healed” (vegetated) rills. | |
| <p>3 Poor Condition</p> <ul style="list-style-type: none"> ▪ Evidence of overtopping (flow marks over embankment for example). ▪ Noxious Weeds are present (see county list of Noxious Weeds). ▪ Vegetation missing over 500 sq. ft. or more total area. ▪ Pond or embankment liner material (geotextile, clay liner, etc.) is damaged. | |
| <p>4 Severe Condition</p> <ul style="list-style-type: none"> ▪ Burrows, piping or alternate flow paths through embankment. ▪ Eroded gully or slope failure presents a hazard to vehicles leaving the roadway or threatens road or embankment integrity. ▪ Evidence of pond water backup onto upstream or adjacent properties or onto roadway. ▪ Normal outfall or emergency overflow or is non-functional or is bypassed. | |

Note:

Need for cleaning is NOT part of the Overall Condition rating but is noted with a separate “Clean” flag (Clean? = Y) and a “Sediment % Full” value.

Ponds are designed to detain or retain stormwater and slow the rate of outflow



HydInfra Inspection Criteria

Basin – Filtration or Infiltration

| Factors: Infiltration and Filtration Functions, Water Quality Functions, Water containment functions – basin integrity/clogging/overtopping, Vegetation | Flags |
|--|-------|
| <p>1 Excellent Condition</p> <ul style="list-style-type: none"> ▪ Embankment is sound. ▪ Outflow structures are clear of debris and functional ▪ Vegetation is well established, without any noxious weeds (see county list of Noxious Weeds). | |
| <p>2 Fair Condition</p> <ul style="list-style-type: none"> ▪ Limited patches of missing vegetation. ▪ Sheet erosion occurring (look for exposed grass roots). ▪ “Healed” (vegetated) rills. | |
| <p>3 Poor Condition</p> <ul style="list-style-type: none"> ▪ Evidence of overtopping (flow marks over embankment for example). ▪ Noxious Weeds are present (see county list of Noxious Weeds). ▪ Vegetation missing over 500 sq. ft. or more total area. ▪ Pond or embankment liner material (geotextile, clay liner, etc.) is damaged. ▪ Infiltration pond has dead vegetation where water stands. ▪ Infiltration pond has standing water for more than 3 days in a row. | |
| <p>4 Severe Condition</p> <ul style="list-style-type: none"> ▪ Burrows, piping or alternate flow paths through embankment. ▪ Eroded gully or slope failure presents a hazard to vehicles leaving the roadway or threatens road or embankment integrity. ▪ Evidence of pond water backup onto upstream or adjacent properties or onto roadway. ▪ Normal outfall or emergency overflow or is non-functional or is bypassed. | |

Note:

Need for cleaning is NOT part of the Overall Condition rating but is noted with a separate “Clean” flag (Clean? = Y) and a “Sediment % Full” value.

Basins are designed to filter or infiltrate stormwater



District Contacts

| District | Contact | Phone |
|----------------|---|----------------|
| Metro District | Metro Dispatch | 651-234-7500 |
| District 1 | Matt Meyer, Duluth | 218-725-2758 |
| District 2 | District 2 Hydraulics Engineer, Bemidji | 218-755-6500 |
| District 3 | Robert Miller, Hydraulics Engr, Baxter | 218-828-5700 |
| District 4 | District 4 Hydraulics Engr, Detroit Lakes | 1-800-657-3984 |
| District 6 | District 6 Hydraulics Engineer, Rochester | 507-286-7692 |
| District 7 | Scott Morgan, Hydraulics Engr, Mankato | 507-304-6210 |
| District 8 | District 8 Hydraulics Engineer, Willmar | 1-800-657-3792 |

Outfall Identification

An MS4 Outfall is a drainage conveyance where MnDOT stormwater permanently leaves MnDOT right of way or merges with a natural water (lake, stream, wetland, county ditch, etc.) and is located within an MS4 boundary.

Outfalls should be inspected for Illicit Discharges so that pollutants can be traced back to the source and eliminated. In TAMS, an MS4 Outfall is designated by checking both “Report MS4” and “Outfall” fields.

Underground Outfalls are any structures or inaccessible pipes where stormwater permanently leaves MnDOT right of way and goes into another municipal storm drain system. Underground Outfalls do not require MS4 inspections. Structures or pipes are designated in TAMS-HydInfra as Underground Outfalls with these data fields:

- Local Name: add “Underground Outfall” to the name
- Outfall flag = Yes
- Inspect for MS4 = No (is unchecked)

MS4 Outfalls are to be inspected once every 5 years if not underground.

MS4 Outfall does not include diffuse runoff (sheet flow) or natural waters passing through MnDOT Right of Way or municipal storm drains passing through MnDOT Right of Way without MnDOT inputs.

Illicit Discharge Identification

Illicit Discharge is a polluted inflow, or deposit of polluting materials liquid or solid, that can be transported to natural waterways.

Look for:

- Unexpected pipes coming into the highway storm drain system.
- Pipes flowing when storm drains should not be.
- Suspicious odors, floatables, colors or opaque water. (Do not sniff out an odor – your first impression is sufficient. Some substances are damaging to inhale.)
- Deposits of dumped or otherwise deposited polluting materials.

Report suspected Illicit Discharge to your District Contact within 24 hours for follow up.

Report accidental spills from trucks to District Dispatch, who forwards incident to MPCA Duty Officer.

Spill is cleaned up by trucking company’s contractor and not reported as Illicit Discharge.