# HydInfra Inspection Manual
## Culvert and Storm Drainage Systems

### Condition Rating Codes:

<table>
<thead>
<tr>
<th>Code</th>
<th>Condition Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Not able to rate, not visible</td>
</tr>
<tr>
<td>1</td>
<td>Excellent – like new condition</td>
</tr>
<tr>
<td>2</td>
<td>Fair – some wear, but structurally sound</td>
</tr>
<tr>
<td>3</td>
<td>Poor – deteriorated, consider for repair or replacement</td>
</tr>
<tr>
<td>4</td>
<td>Severe – serious deterioration</td>
</tr>
</tbody>
</table>

#### Notes:
- This guide is used to rate the condition of culverts, where the pipe (or installations of more than one pipe) is less than 10 feet wide as measured along the centerline of roadway, or any storm drainage system features.
- The worst defect found in a feature determines its condition rating. (Refer to condition rating criteria on pages 13 to 20).
- Drainage features 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.
# Index to HydInfra Inspection Manual

<table>
<thead>
<tr>
<th>Page</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>HydInfra Condition Rating Codes (on cover)</td>
</tr>
<tr>
<td>2</td>
<td>Index (this page)</td>
</tr>
<tr>
<td>3</td>
<td>HydInfra Features</td>
</tr>
<tr>
<td>4-6</td>
<td>Definitions – HydInfra Flags and Measures</td>
</tr>
<tr>
<td>7</td>
<td>Pipe Shape</td>
</tr>
<tr>
<td>8</td>
<td>Pipe Function</td>
</tr>
<tr>
<td>9</td>
<td>Activity and Status</td>
</tr>
<tr>
<td>9</td>
<td>GPS Import Files</td>
</tr>
<tr>
<td>10</td>
<td>Pipe Materials and Material Types</td>
</tr>
<tr>
<td>11</td>
<td>Roadway Types Describe the Feature's Location</td>
</tr>
<tr>
<td>12</td>
<td>Inspection Cycle for Drainage Performance Measure</td>
</tr>
</tbody>
</table>

## Inspection Criteria

<table>
<thead>
<tr>
<th>Page</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>13</td>
<td>Roadway Indicators</td>
</tr>
<tr>
<td>14</td>
<td>Structure (MH, CB, DI) Rating Criteria</td>
</tr>
<tr>
<td>15</td>
<td>Plastic Pipe – HDPE or PVC Rating Criteria</td>
</tr>
<tr>
<td>16</td>
<td>Metal Pipe and Special Structure Rating Criteria</td>
</tr>
<tr>
<td>17</td>
<td>Concrete Pipe and Special Structure Rating Criteria</td>
</tr>
<tr>
<td>18</td>
<td>Other Materials or SPCD (Structural Pollution Control Device) Rating Criteria</td>
</tr>
<tr>
<td>19</td>
<td>Pond Rating Criteria</td>
</tr>
<tr>
<td>20</td>
<td>Ditch Rating Criteria</td>
</tr>
</tbody>
</table>

## MS4 –Related

<table>
<thead>
<tr>
<th>Page</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>21</td>
<td>Illicit Discharge</td>
</tr>
<tr>
<td>21</td>
<td>Outfall Identification</td>
</tr>
<tr>
<td>21</td>
<td>District Phone Numbers for Immediate Reporting</td>
</tr>
</tbody>
</table>
Find data formatting information at:

HydInfra Inspector webpage [http://www.dot.state.mn.us/bridge/hydraulics/inspector.html](http://www.dot.state.mn.us/bridge/hydraulics/inspector.html) – .hif format from Trimble Terrasync GPS inspection

HydInfra Data Formatting webpage [http://www.dot.state.mn.us/bridge/hydraulics/data.html](http://www.dot.state.mn.us/bridge/hydraulics/data.html) – HydInfra Published Format
# HydInfra Features

<table>
<thead>
<tr>
<th>HydInfra Feature</th>
<th>GPS hif Record Name</th>
<th>Description</th>
<th>Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pipe</td>
<td>T_PipeandInsp</td>
<td>Culverts and storm drains of various shapes with sizes less than 10 foot span. Deep Tunnels may be any size.</td>
<td>Physical asset</td>
</tr>
<tr>
<td></td>
<td>ExPipeandInsp</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Structure</td>
<td>ExStrucandInsp</td>
<td>Catch Basin, Manholes, Drop Inlet</td>
<td>Physical asset</td>
</tr>
<tr>
<td></td>
<td>T_StrucandInsp</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Special Structure</td>
<td>ExSpStrucandInsp</td>
<td>Aprons, most commonly, but this catch-all feature also includes Slotted Drain, Headwalls, Wingwalls, open Flumes, Weirs, Expanders,Reducers, Floodgates, Energy Dissipaters, Bends</td>
<td>Physical asset</td>
</tr>
<tr>
<td></td>
<td>T_SpStrucandInsp</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pond</td>
<td>ExPondInsp</td>
<td>Basin holds water temporarily or long-term</td>
<td>Physical asset</td>
</tr>
<tr>
<td></td>
<td>T_PondandInsp</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SPCDs (Structural Pollution Control Devices)</td>
<td>ExSPCDInsp</td>
<td>Water quality device including swirling settler, skimmer, filter or other hardware</td>
<td>Physical asset</td>
</tr>
<tr>
<td></td>
<td>T_SPCDandInsp</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ditch</td>
<td>T_DitchandInsp</td>
<td>Open channel along a roadway or an off-take drainage way</td>
<td>Physical asset</td>
</tr>
<tr>
<td>Outfall (Discharge Point)</td>
<td>T_ExOutfall_Infall</td>
<td>Associated with a feature – Outfall or Infall or Other flow, and where it goes to or from</td>
<td>Add-on to asset</td>
</tr>
<tr>
<td>Illicit Discharge</td>
<td>T_Illicit_Discharge</td>
<td>Track water quality offenses</td>
<td>Inspection record</td>
</tr>
<tr>
<td>Environmental Inspection</td>
<td>T_Environmental</td>
<td>Record soil chemistry – pH, conductivity, resistivity data at a location and associate it with a feature</td>
<td>Inspection record</td>
</tr>
<tr>
<td>Culvert Group</td>
<td>(N.A.)</td>
<td>Group multiple pipe, structures, special structures using ArcGIS tool.</td>
<td>Grouping of assets</td>
</tr>
<tr>
<td>Pond Group</td>
<td>(N.A.)</td>
<td>Group multiple pipe, structures, special structures, ponds, spcds &amp; ditches using ArcGIS tool</td>
<td>Grouping of assets</td>
</tr>
</tbody>
</table>

Note:  
1) Field Record Names are record types in the HydInfra data dictionary.  
2) A record type that starts with “T_” creates a new feature with a new ID when uploaded in HydInfra.  
3) Use the “Ex_” record types to re-inspect an existing feature – with its HydInfra ID.
<table>
<thead>
<tr>
<th><strong>Condition Indicators</strong></th>
<th><strong>Images</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Needs Repair?</td>
<td>Needs Repair</td>
</tr>
<tr>
<td>Repair under Road</td>
<td>Repair Under Road</td>
</tr>
<tr>
<td>Piping</td>
<td>Piping</td>
</tr>
<tr>
<td>Cracks</td>
<td>Cracks</td>
</tr>
<tr>
<td>Holes</td>
<td>Holes</td>
</tr>
<tr>
<td>Deformation</td>
<td>Deformation</td>
</tr>
<tr>
<td>Misalignment</td>
<td>Misalignment</td>
</tr>
<tr>
<td>Spalling/Flaking</td>
<td>Spalling/Flaking</td>
</tr>
<tr>
<td>Pitting/Rusting</td>
<td>Pitting Rusting</td>
</tr>
<tr>
<td>Joints Separated*</td>
<td>Joints Separated</td>
</tr>
<tr>
<td>Maximum Joint Separation</td>
<td>Max Joint Sep</td>
</tr>
<tr>
<td>Number of Separated Joints</td>
<td># Joints to Fix</td>
</tr>
<tr>
<td>Separated Apron</td>
<td>Apron Separated</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Roadway Indicators</strong></th>
<th><strong>Images</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Void in Road</td>
<td>Road Void</td>
</tr>
<tr>
<td>Road Distress</td>
<td>Road Distress</td>
</tr>
<tr>
<td>Inslope Cavity</td>
<td>Inslope Cavity</td>
</tr>
<tr>
<td>Erosion/Scour</td>
<td>Erosion</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Not in Condition Rating</strong></th>
<th><strong>Images</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Needs Clean?</td>
<td>Needs Clean</td>
</tr>
<tr>
<td>Plugged</td>
<td>Plugged</td>
</tr>
<tr>
<td>Silt</td>
<td>Silt</td>
</tr>
<tr>
<td>Standing Water*</td>
<td>Water</td>
</tr>
<tr>
<td>Typical Water Flow</td>
<td>Typical Water Flow</td>
</tr>
</tbody>
</table>

* Not collected in field inspections as of 2013.

Notes:
1) Flags are yes/no fields that indicate specific problems.
2) Measures are inspection fields with menus or lists of attributes to describe the hydraulic feature.
Definitions – HYDINFRA Flags and Measures

Condition Indicators

- **Needs Repair?** – Does this feature need to be repaired?

- **Repair under Road** –
  
  If a repair is needed, the needed repair is located between the two shoulder PIs (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, or if metal, rusted but still solid.

- **Spalling/Flaking** – Flat chips of concrete are lost from feature’s surface or if metal, flakes of rust are falling away.

- **Cracks** – Visible crack.

- **Holes** – Hole goes completely through the feature’s material.

- **Joints Separated** – The joints between two pipe sections are separated (lengthwise) and may be allowing soil to filter through. (This flag is not collected in field inspections as of 2013).

- **Max Joint Separation** – Estimate or measure 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, causing an Inslope Cavity.

- **Misalignment** - The pipe sections are offset and alignment is bad.

- **Deformation** – Feature’s shape is distorted, flattened or ovalled.

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

- **Piping** – Water is flowing along the outside of pipe (causes loss of soil in roadbed).

- **Deter. Ties** (Deteriorated Ties) – Pipe ties are corroded or broken.
**Not in Condition Rating**  [back to summary of Inspection Flags]

- **Clean?** – Does this feature need to be cleaned? Pipe is 1/3 or more full of sediment. Sediment or Debris will impede drainage. (See also Sediment % Full).

- **Standing Water** – Feature is normally wet – may indicate downstream plug or problem. (No longer collected in 2013).

- **Typical Water Flow** – Describe the typical water situation in the pipe: Dry, Slow, Fast, Standing, or Full

- **Silt** – Sediment buildup or deposit in pipe. The silt may or may not slow water flow, but may restrict the view of feature’s condition.

- **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.

**Roadway Indicator Flags** (adjacent to feature)  [back to summary of Inspection Flags]

- **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 feature.

- **Erosion** (formerly Scour) – Erosion or channel degradation has occurred as evidenced by a gully or loss of vegetation, caused by water flows.

**Structure Terms**

- **Structure Height** – Measure from top of grate to bottom of invert

- **Repair Depth** – Measure from bottom of casting to bottom of the needed repair

- **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.

- **Structure Type:**
  - Manhole - MH
  - Catchbasin - CB
  - Drop Inlet – DI
Pipe Shape

- Round
- Arch
- Box
- Elliptical
- CattlePass
- Other HydInfra “Shapes”
  - Slot Drain
  - Other
  - Open Flume
  - Tunnel

Names for parts of a pipe

- Crown
- Cover (Fill over pipe)
- Spring-line
- Joint
- Haunch
- Pipe Section
- Invert
Pipe Function

Function defines the category or use of the pipe.
This is a new field in 2013.

Culverts vs Storm Drain definition:

1. If the primary purpose is to carry stormwater across the road, then it's a culvert.
   • A culvert can have up to 2 catchbasin structures (carrying pavement drainage) as long as the pipe mostly conveys water from ditch to ditch.
   • A culvert can have another pipe that connects into the culvert pipe that brings in ditch drainage (like tee structures shown in Standard Plates Design PC or PM).
   • A culvert can have bends.
   • A culvert can have a drop inlet. For example, a pipe that collects water from the ditch and conveys it under the roadway is a culvert, even if it has a structure on the upstream end.
   • A cattle pass is a culvert whether it carries water or not.

2. If the primary purpose is to carry stormwater off the road surface, it's a storm drain.
   • Storm drains have one or more pipes but at least one inlet must directly collect pavement runoff.
   • A system with a network of pipes is typically a storm drain.
   • Storm drains can outlet into a culvert. This can occur when a multi-pipe storm drain system discharges into a large centerline culvert that carries water through the roadway embankment (so part is named “Storm Drain” and part is named “Culvert”).

3. If you can’t define it, call it “Unknown”
   • Unknown Function pipes will be included as Culverts in the Performance Measures.
Activity and Status

The **Activity** field captures activities done to the feature, whereas the **Status** field indicates whether the feature is Inplace, Proposed (created from plan data) or is no longer used. If the Inspector chooses “Removed”, “Abandoned” or “Duplicate” for the Activity, then Bon will update the Status to take it out of the set of active features and put it in the archives. If Activity is “Install”, “Clean”, “Repair” or “Clean/Repair” then the pipe can be included on a Pipe Maintenance Report.

- Discover for first location of features in HydInfra
- Install for brand new features (not liners)
- Verify for re-inspection of existing
- Extension for pipes that have been extended
- Duplicate to get rid of excess features
- Removed if feature was taken out
- Abandoned if plugged and left in the ground

**GPS Import Files and Zombies**

Import files are Terrasync GPS files with HydInfra feature data that Inspectors can edit. Instructions to use import files are on the HydInfra Inspector webpage: [http://www.dot.state.mn.us/bridge/hydraulics/hydinfra/inspector.html](http://www.dot.state.mn.us/bridge/hydraulics/hydinfra/inspector.html)

**Hydinfra Inspection using GPS Import files (PDF)**

Zombies are not real. Zombies are included in the import file, or in a separate background file, as markers for former Pipes that had been Inplace sometime during the last couple years, but the Status has now been changed to “Removed”, “Abandoned” or is “Bridge”.

Inspectors will look for Zombies on the ground to find and inventory the new feature that replaced the former feature. A Bridge Zombie should be ignored.
Pipe Materials

Accurate pipe material identification is essential to tracking material performance

Notes:
1) If pipe is lined, choose material "Liner"+ material name.
2) Specific pipe material identification is essential to tracking material performance over time. View the HydInfra Materials PowerPoint to see examples of pipe materials.
3) Other materials are available in the data dictionary to describe structures, SPCDs and other features.
### Roadway Types Describe the Feature’s Location

<table>
<thead>
<tr>
<th>Highway Culverts</th>
<th>Side Culverts</th>
<th>Not Culvert</th>
</tr>
</thead>
</table>

**Highway Culverts** include:
- Centerline – drainage crosses the entire highway
- Median – feature drains the median ditch
- Ramp/Loop – feature is on a ramp or loop
- Use Ramp-Loop instead of Collector-Distribut (from 2016 on)
- (Mainline should describe storm drain pipes not culverts)
### Recommended Inspection Frequency for Highway Culverts*

<table>
<thead>
<tr>
<th>Overall Condition</th>
<th>Recommended Inspection Frequency Years</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>4 Very Poor</td>
<td>2</td>
<td>Pipes where problem is not under the road</td>
</tr>
<tr>
<td></td>
<td>1</td>
<td>Pipes where problem requires a repair under the road</td>
</tr>
<tr>
<td>3 Poor</td>
<td>4</td>
<td>Most condition 3 pipes</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>Condition 3 Pipes with Piping or Road Void **</td>
</tr>
<tr>
<td>1 &amp; 2 Like New and Fair</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>0 Can't be Rated</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Pipes with no inspections</td>
<td>Goal to inspect Highway Culverts within 6 years of Date Discovered***</td>
<td></td>
</tr>
</tbody>
</table>

**Overall Target: 80% of Highway Pipes meet Recommended Inspection Frequency**

The Drainage Performance Measure recommended inspection frequency applies to “Highway Culverts”.

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

- Roadway Type is Centerline, Collector/Distribut, Mainline, Median, Ramp/Loop
- Pipe shape is Round, Arch, Box, Elliptical, CattlePass or Other
- Function is Culvert, Unknown or blank
- Maintenance Responsibility 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) or others (Trail, Railroad, Bridge, Ditch Block or Other). Pipes that are not culverts are also not included in the Performance Measure. Pipes with Functions of Storm Drain, Drain Tile, Tunnel or Other 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.**

***For pipes with no inspections and the Date Discovered is prior to 2013, a target inspection date of 2019 was assigned.**
## Roadway Indicators

### Factors: Integrity of road fill material related to drainage features

<table>
<thead>
<tr>
<th>Good or Fair Condition</th>
<th>Flags and Images</th>
</tr>
</thead>
<tbody>
<tr>
<td>▪ No road settlement</td>
<td></td>
</tr>
<tr>
<td>▪ No pavement patching</td>
<td></td>
</tr>
<tr>
<td>▪ Road surface not affected</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Poor Condition</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>▪ Pavement cracking above pipe (road distress)</td>
<td>Road Distress</td>
</tr>
<tr>
<td>▪ Holes in inslope (inslope cavity)</td>
<td>Inslope Cavity</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Severe Condition</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>▪ Indications of voids around pipe or loss of road fill including piping</td>
<td>Piping</td>
</tr>
<tr>
<td>▪ Settlement of road surface (void in road)</td>
<td>Road Void</td>
</tr>
<tr>
<td>▪ Holes in road surface caused by pipe or structure condition (void in road)</td>
<td>Road Void</td>
</tr>
<tr>
<td>▪ Evidence of repeated pavement patching</td>
<td>Road Distress</td>
</tr>
</tbody>
</table>

### Notes:

The general conditions of the roadway and adjacent area are used as clues to help determine the condition rating for each hydraulic feature that is inspected. These general conditions may be indicators of concealed structural problems.
### Structure (MH, CB & DI)

**Factors:** Structural integrity, Integrity of surrounding material  
**Flags and Images**

<table>
<thead>
<tr>
<th>Condition</th>
<th>Description</th>
</tr>
</thead>
</table>
| 1 Excellent     | - Very minor defects in concrete rings  
- None to hairline cracks evident  
- None to slight spalling or scaling |
| 2 Fair          | - Some mortar missing at concrete rings  
- Pitting of pre-cast concrete  
- Aggregate is visible  
- Spalling or scaling to 1/4 inch depth  
- Cracks less than 1/8 inch  
- Evidence of infiltration of water or soil |
| 3 Poor          | - Concrete rings broken, or mortar missing – gaps 1/2” to 1”  
- Settlement of pavement or soil adjacent to structure  
- Reinforcement shows  
- Blocks/bricks flaking/crumbling  
- Cracking evident with widths 1/8 - 1/4 inch  
- Spalling or scaling > 1/4 inch depth |
| 4 Severe        | - Concrete rings broken or mortar missing – gaps >1”  
- Voids in soil or depressed pavement adjacent to structure, caused by infiltration  
- Structure settlement that affects structure stability or function  
- Extensive exposure of reinforcement  
- Cracks that show movement (misaligned pieces)  
- Blocks/bricks missing  
- Holes through the structure |

**Notes:**

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

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 Ratings Guide

#### Plastic Pipe or Liners – HDPE or PVC or CIPP

Factors: Structural integrity, Integrity of surrounding material

<table>
<thead>
<tr>
<th>Condition</th>
<th>Description</th>
</tr>
</thead>
</table>
| 1 **Excellent Condition** | • Pipe is straight  
• Joint separation less than 1”  
• Deformation less than 5% of original inside diameter |
| 2 **Fair Condition** | • Deformation of pipe 5% to 7% of original inside diameter  
• For dual wall HDPE pipe, liner buckling in 2 or fewer areas  
• 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 |
| 3 **Poor Condition** | • Significant ponding of water due to sagging or vertical misalignment  
• Deformation of pipe 7% to 10% of original inside diameter  
• 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  
• Pipe condition is causing soil loss in road shoulder  
• Any crack in PVC pipe outside of road surface area  
• 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  
• Apron is separated from pipe  
• Repair is needed but is not under road |
| 4 **Severe Condition** | • Floated – top of pipe is at or above ground surface  
• Joint separation allowing major soil infiltration  
• Deformation greater than 10% of original inside diameter  
• Hole through pipe material  
• Pipe condition is causing soil loss beneath road surface  
• Any crack in PVC pipe under road surface area  
• For dual wall PE pipe, circumferential cracking greater than 1/2 of pipe circumference, in the liner only  
• For dual wall PE pipe, buckling of liner and exterior shell  
• Burnt (there is no inspection flag for burnt pipe, use spalling/flaking or holes) |

### Flags and Images

- Deformation
- Joint Separation
- Cracks
- Misalignment
- Infiltration
- Inslope Cavity
- Cracks
- Cracks HDPE
- CIPP delamination
- Separated Apron
- Road Void
- Piping
- Holes
- Burnt HDPE
## Metal Pipe and Special Structure

### Factors: Structural integrity, Integrity of surrounding material

<table>
<thead>
<tr>
<th>Condition</th>
<th>Notes</th>
</tr>
</thead>
</table>
| 1 Excellent Condition | • Discoloration of surface  
• Galvanizing intact  
• No rust or pitting |
| 2 Fair Condition    | • Galvanizing gone  
• Pitting, superficial rust or tight rust flakes |
| 3 Poor Condition    | • 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% of diameter  
• Can poke a hole in pipe with a sharp point  
• Inslope Cavity – Infiltration of soil into the pipe from road inslope (embankment)  
• Infiltration of soil into pipe may be causing loss of fill beneath road surface  
• Erosion has undermined apron or pipe  
• Apron is separated from pipe  
• Repair is needed but is not under road |
| 4 Severe Condition  | • Hole 1 inch or greater, or many small holes, or bottom gone  
• Cracks or tears  
• Severe deformation greater than 10% 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 |

### Flags and Images

<table>
<thead>
<tr>
<th>Condition 1 Steel</th>
<th>Pitting/Rusting</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spalling/Flaking Holes</td>
<td>Deformation</td>
</tr>
<tr>
<td>Spalling/Flaking Inslope Cavity</td>
<td>Road Distress</td>
</tr>
<tr>
<td>Spalling/Flaking Erosion</td>
<td>Separated Apron</td>
</tr>
<tr>
<td>Holes</td>
<td>Cracks</td>
</tr>
<tr>
<td>Deformation</td>
<td>Joint Separation</td>
</tr>
<tr>
<td>Misaligned</td>
<td>Spalling/Flaking</td>
</tr>
<tr>
<td>Piping or Road Void</td>
<td></td>
</tr>
</tbody>
</table>

### Notes:

Special Structures is the catch-all feature that includes Aprons, Headwalls, Headwall Wingwalls, Weirs, Expander/Reducers, Bends, Floodgates, Energy Dissipaters and other items that are not Pipes, Structures, SPCDs (Structural Pollution Control Devices), Ponds or Ditches.

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 Ratings Guide

### Concrete Pipe & Special Structure

**Factors:** Structural integrity, Integrity of surrounding material

<table>
<thead>
<tr>
<th>Condition</th>
<th>Description</th>
<th>Notes</th>
</tr>
</thead>
</table>
| **1 Excellent Condition** | - Minor chipping at joints/openings  
- Hairline cracks  
- Insignificant spalling or scaling | Condition 1 Concrete Hairline cracks |
| **2 Fair Condition** | - Joints broken or pulled apart up to 1” (anywhere along joint)  
- Aggregate exposed (pitting)  
- Cracks evident with widths up to 1/8 inch  
- Spalling or scaling to 1/4 inch depth | Joint Separation Pitting/Rusting Cracks Spalling/Flaking |
| **3 Poor Condition** | - Joints broken or pulled apart 1”-3” (anywhere along the joint)  
- Cracking evident with widths 1/8 - 1/4 inch  
- Spalling or scaling > 1/4 inch depth  
- Reinforcement beginning to show  
- Ends misaligned or shifted  
- Infiltration of soil into pipe under inslope causing soil loss in road shoulder  
- Pipe may be causing soil loss beneath road surface  
- Erosion has undermined apron or pipe  
- Apron is separated from pipe  
- Repair is needed but is not under road | Joint Separation Cracks Spalling/Flaking Misaligned Infiltration Inslope Cavity Road Distress Erosion Separated Apron |
| **4 Severe Condition** | - Joints pulled apart or broken more than 3” at any point along joint (unless only at apron – see condition 3)  
- Cracking evident with widths > 1/4 inch or cracks showing movement – pipe pieces have shifted  
- Reinforcement fully exposed in places  
- Holes through concrete or bottom gone  
- Deformation – pipe is misshapen (look also for cracks and spalling or slabbing)  
- Piles of soil at joints, or any indication that soil infiltrates into pipe under roadway | Joint Separation Cracks Spalling/Flaking Holes Deformation Road Void Infiltration & Piping |

**Notes:**

Special Structures is the catch-all feature that includes Aprons, Headwalls, Headwall Wingwalls, Weirs, Expander/Reducers, Bends, Floodgates, Energy Dissipaters and other items that are not Pipes, Structures, SPCDs (Structural Pollution Control Devices), Ponds or Ditches.

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 crack width and spalling depth won’t be measured in most cases – inspectors must estimate sizes based on what they see.
### HydInfra Ratings Guide

#### Other Materials or SPCD (Structural Pollution Control Device)

<table>
<thead>
<tr>
<th>Factors: Structural integrity, Water Quality Functions, Clogging, Integrity of surrounding material</th>
<th>Flags and Images</th>
</tr>
</thead>
</table>
| **1 Excellent Condition**  
- Materials are intact. | |
| **2 Fair Condition**  
- Materials have minor defects but the feature is structurally sound.  
- The feature is functioning properly. | |
| **3 Poor Condition**  
- Materials have defects that may affect function or structural integrity of the feature  
- Repair is needed but is not under road | |
| **4 Severe Condition**  
- Components are broken or not working  
- Outflow is non-functional  
- Piles of soil inside feature at the joints, or any indication that soil infiltrates into feature from under roadway  
- Materials have severe defects and need repair soon. | |

#### Notes:
- 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.
- SPCD (Structural Pollution Control Device) is a feature built to improve water quality. Examples of SPCDs include “Grit Chambers” (like baffled box), swirling “Separators” (like Vortech, CDS, Stormceptor, Baysaver, Downstream Defender and other makes) “Skimmers” and “Filters”.
- “Other Materials” may be any that is not described in Plastic (pg. 15) Metal (pg.16) or Concrete (pg.17) rating criteria.
- For detailed concrete rating criteria, refer to page 14, “Structure – MH &CB – Condition”.

---

---
### HydInfra Ratings Guide

#### Pond

<table>
<thead>
<tr>
<th>Factors: Water Quality Functions, Water containment functions – basin integrity/clogging/overtopping, Vegetation</th>
<th>Flags and Images</th>
</tr>
</thead>
</table>

1 **Excellent Condition**
   - 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).

2 **Fair Condition**
   - Limited patches of missing vegetation.
   - Sheet erosion occurring (look for exposed grass roots).
   - “Healed” (vegetated) rills.

3 **Poor Condition**
   - 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.

4 **Severe Condition**
   - 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.
## Ditch

### 1 Excellent Condition
- 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.

### 2 Fair Condition
- Sediment deposition is visible.
- Limited patches of missing vegetation.
- Sheet erosion occurring (look for exposed grass roots).
- “Healed” (vegetated) rills.

### 3 Poor Condition
- 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.

### 4 Severe Condition
- Eroded gully or slope failure presents a hazard to vehicles leaving the roadway or threatens road or embankment integrity.
- Sediment in ditch causing water to back up onto upstream or adjacent properties, or onto roadway. (Pipes are most likely the problem – check affected pipes first).

### Flags and Images

<table>
<thead>
<tr>
<th>1 Excellent Condition</th>
<th>2 Fair Condition</th>
<th>3 Poor Condition</th>
<th>4 Severe Condition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vegetation</td>
<td>Sediment deposition</td>
<td>Noxious Weeds</td>
<td>Eroded gully or slope failure</td>
</tr>
<tr>
<td>without noxious weeds</td>
<td>is visible.</td>
<td>are present</td>
<td>presents a hazard to vehicles</td>
</tr>
<tr>
<td>(see county list of Noxious Weeds)</td>
<td></td>
<td>(see county list of Noxious Weeds)</td>
<td>leaving the roadway or threatens road</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(ditch constructed specifically to infiltrate stormwater) has</td>
<td>or embankment integrity.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>dead vegetation where water ponds.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>“Infiltration Ditch” (ditch constructed specifically to infiltrate stormwater) has</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>standing water for more than 3 days in a row.</td>
<td></td>
</tr>
</tbody>
</table>

### Erosion or Headcut

<table>
<thead>
<tr>
<th>3 Poor Condition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Noxious Weeds are present (see county list of Noxious Weeds).</td>
</tr>
<tr>
<td>Ditch liner material (geotextile, clay liner, etc.) is damaged.</td>
</tr>
<tr>
<td>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.</td>
</tr>
<tr>
<td>“Infiltration Ditch” (ditch constructed specifically to infiltrate stormwater) has dead vegetation where water ponds.</td>
</tr>
<tr>
<td>“Infiltration Ditch” (ditch constructed specifically to infiltrate stormwater) has standing water for more than 3 days in a row.</td>
</tr>
</tbody>
</table>

### 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.
HydInfra Ratings Guide

**Illicit Discharge Identification**

Illicit Discharge is a discharge 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 shouldn't be.
- Suspicious odors, floatables, colors or opaque water. (Don’t sniff out an odor – your first impression is sufficient. Some substances are damaging to inhale.)

HYDINFRA can also be used to record deposits of dumped or otherwise deposited polluting materials.

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

Accidental spills by trucks, that are reported to Dispatch, forwarded to MPCA Duty Officer and cleaned up by trucking company’s contractor are not reported as Illicit Discharge, but are logged by Dispatch.

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

**Outfall Identification**

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

MS4 Outfall does NOT Include:
- Diffuse runoff (sheet flow)
- Natural waters passing through MnDOT Right of Way
- Municipal storm drains passing through MnDOT Right of Way without MnDOT inputs
Pipe Materials & Liner Types

- Concrete
- Aluminized Steel
- Corrugated Steel (CSP)
- Structural Plate
- Polymeric-Coated
- Bituminous-Coated
- Corrugated Aluminum (CAP)
- Timber
- Other

“Liner” materials describe a lined pipe:
- Liner HDPE
- Liner PVC
- Liner Cured in Place
- Liner Metal
- Liner Other

Concrete Pipe
Material Type: Concrete

Corg. Steel (CSP)
(galvanized steel pipe)

Material Type: Steel

Structural Plate
Material Type: Steel

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

http://www.dot.state.mn.us/bridge/hydraulics/inspector.html
**Polymeric-coated Steel**  
Material Type: Steel  
Thin black plastic sheet inside and outside of cmp  
Photos by Johnston-Fargo

**Bituminous-Coated Steel**  
Material Type: Steel  
Looks like tar on cmp  
*May contain asbestos*  
Labeled in Construction Plans as “AB-Bonded”  
Not installed since 1970’s but exists in field

**Aluminized Steel**  
Material Type: Steel  
Magnetic and has a sheen like the inside of a pop can but edges may be rusty  
Photos at right by Johnston-Fargo

**Corg. Aluminum (CAP)**  
Material Type: Aluminum  
All aluminum pipe, not steel so no rust, not magnetic, is more bendable  
Photo from http://www.lockernz.co.nz/
PVC

Material Type: Plastic

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

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

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

Corg. Plastic (HDPE)

Material Type: Plastic

Add a comment because single wall corrugated HDPE should not be used as highway culverts or storm drain.

SRPE - Steel-Reinforced PolyEthylene

Material Type: Plastic

Blue line shows it’s SRPE

Exterior flanges are steel, coated with HDPE

Photos of Durmaxx pipe by Contech
Polypropylene  

Material Type: Plastic

PP = Polypropylene Pipe is grey and stiffer than HDPE

Perforated Plastic  

Material Type: Plastic

used in pond underdrains to filter stormwater

Material Type: Other

- Vitreous Clay
- Timber
- Any other material

Timber  

Material Type: Other

also used in wet box culverts

Wooden Pipe on Grand Ave, MN 23 in Duluth

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

http://www.dot.state.mn.us/bridge/hydraulics/inspector.html
Vitrified Clay (VCP)  
Material Type: Other

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

Other Material  
Material Type: Other

(add a comment to describe it)

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

Material Type: Liner

Liner Materials:
- 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/dlh/dlh83.pdf](http://www.dot.ca.gov/hq/oppd/dlh/dlh83.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  

Use Comments to describe this.  
For example, “Sprayed on concrete liner”

http://www.dot.state.mn.us/bridge/hydraulics/inspector.html
1. Transfer the .imp (import) data file onto the GPS unit. The Import file has data for existing HydInfra pipes, structures and special structures. After 7 days, Trimble data files won’t allow edits, so transfer data to PC and download a copy of the import file once a week.
2. Transfer the most current HydInfra data dictionary onto the GPS unit.
3. Click Start button.
4. Choose TerraSync (wait a few seconds while it opens).
5. In TerraSync, click Status button and choose Data.
6. Click on the New button and choose Existing from the menu.
7. Choose the .imp file that you transferred and click Open. (Confirm the antenna height if asked).
8. The list of existing pipes comes up.
9. Click on Distance, to sort by the nearest pipe to the farthest. (Change Units to feet in the Setup menu if needed, find Setup under Data button).
10. **Open Map** by clicking the Data button.
11. Click Options button and choose Auto Pan to GPS Position.
12. Choose **Zoom In** from top left menu to click and drag a box to zoom to the pipes you will inspect.
13. Zoom tools at bottom of screen are similar but different.
14. **Click the big dot button** and choose Basic Session to start your data file (Basic Session is only needed once, at the beginning of the file. It adds information to each of the following features).
15. Click Data button again and watch the distance as you go to the nearest pipe. When you are on it, click on the listed pipe and click Begin button.
16. **MAKE SURE YOU HAVE THE RIGHT PIPE.**
17. The ExPipeandInsp record opens, with the Pipe ID and previous inspection data loaded. Change the data to reflect current pipe conditions. Enter data in the blank fields. Use the Inspection Comment to describe oddities.
18. Scroll to the top and check that “Mark as Updated” has a check mark next to it. Only the checked pipes will get updated in HydInfra.
19. Click OK to save and close the updated feature.
20. Add a New Feature from Map view – click dot to open features types menu (new features begin with “T_”).
21. Instructions to Extract the edited and new features from the import file –
   b. Go to Data and File Manager and highlight the Import file
      o Click on Options button and choose “Extract data from file”.
      o Name the _split file by Hwy number and reference point. Keep the “_split” in the name.
      o Check “Include updated features”
      o Click OK (this will take a few minutes if original file includes all District pipes).
   c. The extracted pipes will be removed from the original import file and saved in the “_split” file.
   d. Always RENAME the _Split file if you extract a second time from the Import file, or you will overwrite your data!

22. Transfer the file to your PC and process it like a normal field file. Sometimes the extracted file won’t transfer or won’t open. If this happens, go back to File Manager on the GPS unit and extract from the previously extracted _split file to get a split_split file. Don’t use the original Import file. Be careful – see 21 d. above. (Thanks to Patti Wallin-Johnson D3 for coming up with this solution).

23. Pathfinder Office hif ASCII export setup must have this setting on the Data tab: “Export New and Updated Features” (otherwise every uninspected feature will be exported).