

Appendix B Drainage Facility Condition Surveys Guideline

Existing drainage facilities including pipes, catch basins, manholes, junction chambers, sedimentation/gross particle separators, cross culverts and ditches/swales which are scheduled to remain in use as part of the project should be inspected to verify their general condition early in the design process. A condition survey must be conducted for drainage systems that already have a service life of 10 years or more. Available previous condition reports should be reviewed prior to inspection to identify critical areas that need special attention.

Visual inspection should be performed to verify the existing drainage facilities' condition by referencing the AASHTO Highway Drainage Guidelines Volume XIV, CULVERT INSPECTION MANUAL (FHWA-IP-86-2), CULVERT REPAIR PRACTICES MANUAL Volume I (FHWA-RD-94-096), CULVERT REPAIR PRACTICES MANUAL, Volume II (FHWA-RD-95-089), and the Department's Bridge Inspection Manual. The inspection should be conducted in conformance with the Department's confined space program. Where siltation build-up hampers inspection, the drainage systems should be cleaned and visually inspected prior to recommending a video inspection. Normally video inspection of pipes should only be done if there is an indication that there may be evidence of distress such as roadway settlement, pavement patches, roadway build-up or embankment failure.

The condition survey should be documented in a report that includes the time and date of inspection; plans with sketches and measurements; itemized listing of the drainage facilities' location and condition; and photographic evidence of drainage facility/roadway section/embankment side slope erosion or failure. The report should also include expected service life and recommendations considering life cycle analysis; and specific recommendations on how the identified deficient drainage facilities can be remedied to avoid potential problems during construction. A copy of the report should also be provided in electronic format.

The designer should consult with the Drainage Engineer of the appropriate Departmental District for past problems, site conditions and proposed future improvements.

The following key elements where appropriate should be identified as part of the condition survey:

Structures

- Siltation, debris
- Crack, spall, settlement, etc.

Pipe / Culvert

- Corrosion, abrasion of pipes and bolt
- Water leakage
- Joint, seam defect and misalignment
- Cracking
- Visible waterline
- Deformation of pipe cross section

- Pipe material (concrete, steel, masonry stone, plastic, etc.)
- Siltation, debris

Inlet / Outlet

- Erosion
- Siltation, debris
- Condition of inverts (buried)
- Piping
- Condition of culvert ends / headwalls / wingwalls
- Undermining
- Scouring
- Outlet protection (type, limits and condition)
- Waterway condition

Roadway / Embankment Slope

- Settlement
- Cracking
- Patching
- Frequent overlays
- Erosion

Form 1: STORM SEWER SYSTEM – PIPES BETWEEN DRAINAGE STRUCTURES

Station, Offset: _____
 Type: _____
 Size: _____
 Length : _____

Project No. _____
 Route No. _____
 Date _____

	Condition Rating *	Condition			
	(0-9)	Good	Fair	Poor	N/A
Siltation, Debris		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Visible Waterline		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Water Leakage		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Alignment	<input type="checkbox"/>				<input type="checkbox"/>
Joints	<input type="checkbox"/>				<input type="checkbox"/>
Concrete	<input type="checkbox"/>				<input type="checkbox"/>
Shape	<input type="checkbox"/>				<input type="checkbox"/>
Horizontal Diameter	<input type="checkbox"/>				<input type="checkbox"/>
Seams	<input type="checkbox"/>				<input type="checkbox"/>
Corrosion and Rust	<input type="checkbox"/>				<input type="checkbox"/>

* - See Tables B-1 and B-2 for ratings. These tables may be used for various pipe materials (where appropriate).

Remarks/Findings:

Recommendations:

FORM 2: STORM SEWER SYSTEM – DRAINAGE STRUCTURES

Station, Offset: _____

Project No. _____

Type: _____

Route No. _____

Date _____

Condition

	Good	Fair	Poor	N/A
Cover	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Grate	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Top	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Crack, Spall, Settlement	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Siltation, Debris	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Remarks/Findings:

Recommendations:

FORM 3: STORM SEWER SYSTEM – INLET/OUTLET FACILITIES TO/FROM CHANNEL, DITCHES, ETC...

Station, Offset: _____

Project No. _____

Type: _____

Route No. _____

Outlet Protection (type and limits): _____

Date _____

	Condition			
	Good	Fair	Poor	N/A
Erosion	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Inverts	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Piping	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Siltation, Debris	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Culvert Ends	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Wingwalls	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Headwalls	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Undermining	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Scour	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Waterway Adequacy	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Outlet Protection	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Remarks/Findings:

Recommendations:

RATING GUIDELINES FOR ROUND CORRUGATED METAL PIPE BARRELS

Table B-1

RATING	CONDITION	RATING	CONDITION
9	New condition	4	<p><u>Shape</u>: marginal significant distortion throughout length of pipe, lower third may be kinked</p> <ul style="list-style-type: none"> - <u>Horizontal diameter</u>: 10 percent to 15 percent greater than design <p><u>Seams or joints</u>: moderate cracking at bolt holes on one seam near top of pipe, deflection caused by loss of backfill through open joints</p> <p><u>Metal</u>:</p> <ul style="list-style-type: none"> - <u>Aluminum</u>: extensive corrosion, significant attack of core alloy - <u>Steel</u>: extensive heavy rust, deep pitting
8	<p><u>Shape</u>: good, smooth curvature in barrel</p> <ul style="list-style-type: none"> - <u>Horizontal</u>: within 10 percent of design <p><u>Seams and joints</u>: tight, no openings</p> <p><u>Metal</u>:</p> <ul style="list-style-type: none"> - <u>Aluminum</u>: superficial corrosion, slight pitting - <u>Steel</u>: superficial rust, no pitting 	3	<p><u>Shape</u>: poor with extreme deflection at isolated locations, flattening of crown, crown radius 20 to 30 feet</p> <ul style="list-style-type: none"> - <u>Horizontal diameter</u>: in excess of 15 percent greater than design <p><u>Seams</u>: 3 in. long cracks at bolt holes on one seam</p> <p><u>Metal</u>:</p> <ul style="list-style-type: none"> - <u>Aluminum</u>: extensive corrosion, attack of core alloy, scattered perforations - <u>Steel</u>: extensive heavy rust, deep pitting, scattered perforations
7	<p><u>Shape</u>: generally good, top half of pipe smooth but minor flattening of bottom</p> <ul style="list-style-type: none"> - <u>Horizontal diameter</u>: within 10 percent of design <p><u>Seams or joints</u>: minor cracking at a few bolt holes, minor joint or seam openings, potential for backfill infiltration</p> <p><u>Metal</u>:</p> <ul style="list-style-type: none"> - <u>Aluminum</u>: moderate corrosion, no attack of core alloy - <u>Steel</u>: moderate rust, slight pitting 	2	<p><u>Shape</u>: critical, extreme distortion and deflection throughout pipe, flattening of crown, crown radius over 30 feet</p> <ul style="list-style-type: none"> - <u>Horizontal diameter</u>: More than 20 percent greater than design <p><u>Seams</u>: Plate cracked from bolt to bolt on one seam</p> <p><u>Metal</u>:</p> <ul style="list-style-type: none"> - <u>Aluminum</u>: extensive perforations due to corrosion - <u>Steel</u>: extensive perforations due to rust
6	<p><u>Shape</u>: fair, top half has smooth curvature but bottom half has flattened significantly</p> <ul style="list-style-type: none"> - <u>Horizontal diameter</u>: within 10 percent of design <p><u>Seams or joints</u>: minor cracking at bolt is prevalent in one seam in lower half of pipe. Evidence of backfill infiltration through seams or joints</p> <p><u>Metal</u>:</p> <ul style="list-style-type: none"> - <u>Aluminum</u>: significant corrosion, minor attack of core alloy - <u>Steel</u>: fairly heavy rust, moderate pitting 	1	<p><u>Shape</u>: partially collapsed with crown in reverse curve</p> <p><u>Seams</u>: failed</p> <p><u>Road</u>: closed to traffic</p>
5	<p><u>Shape</u>: generally fair, significant distortion at isolated locations in top half and extreme flattening of invert</p> <ul style="list-style-type: none"> - <u>Horizontal diameter</u>: 10 percent to 15 percent greater than design <p><u>Seams or joints</u>: moderate cracking at bolt holes along one seam near bottom of pipe, deflection of pipe caused by backfill infiltration through seams or joints</p> <p><u>Metal</u>:</p> <ul style="list-style-type: none"> - <u>Aluminum</u>: significant corrosion, moderate attack of core alloy - <u>Steel</u>: scattered heavy rust, deep pitting 	0	<p><u>Pipe</u>: totally failed</p> <p><u>Road</u>: closed to traffic</p>

RATING GUIDELINES FOR REINFORCED CONCRETE PIPE BARRELS

Table B-2

RATING	CONDITION	RATING	CONDITION
9	New condition	4	<u>Alignment</u> : marginal; significant settlement and misalignment of pipe; evidence of piping; end sections dislocated about to drop off <u>Joints</u> : differential movement and separation of joints, significant infiltration or exfiltration at joints <u>Concrete</u> : cracks open more than 0.12 in. with efflorescence and spalling at numerous locations; spalls have exposed rebars which are heavily corroded; extensive surface scaling on invert greater than 0.5 in.
8	<u>Alignment</u> : good, no settlement or misalignment <u>Joints</u> : tight, with no defects apparent <u>Concrete</u> : no cracking, spalling, or scaling present; surface in good condition	3	<u>Alignment</u> : poor with significant ponding of water due to sagging or misalignment of pipe; end section drop off has occurred <u>Joints</u> : significant openings; dislocated joints in several locations exposing fill material; infiltration or exfiltration causing misalignment of pipe and settlement or depressions in roadway <u>Concrete</u> : extensive cracking; spalling, and minor slabbing; invert scaling has exposed reinforcing steel
7	<u>Alignment</u> : generally good; minor misalignment at joints; no settlement <u>Joints</u> : minor openings, possible infiltration/exfiltration <u>Concrete</u> : minor hairline cracking at isolated locations; slight spalling or scaling present on invert	2	<u>Alignment</u> : critical; culvert not functioning due to alignment problems throughout <u>Concrete</u> : severe slabbing has occurred in culvert wall, invert concrete completely deteriorated in isolated locations
6	<u>Alignment</u> : fair, minor misalignment and settlement at isolated locations <u>Joints</u> : minor backfill infiltration due to slight opening at joints; minor cracking or spalling at joints allowing exfiltration <u>Concrete</u> : extensive hairline cracks, some with minor delaminations or spalling; invert scaling less than 0.25 in. deep or small spalls present	1	<u>Culvert</u> : partially collapsed <u>Road</u> : closed to traffic
5	<u>Alignment</u> : generally fair, minor misalignment or settlement throughout pipe; possible piping <u>Joints</u> : open and allowing backfill to infiltrate; significant cracking or joint spalling <u>Concrete</u> : cracking open greater than 0.12 in. with moderate delamination and moderate spalling exposing reinforcing steel at isolated locations; large areas of invert with surface scaling or spalls greater than 0.25 in. deep	0	<u>Culvert</u> : total failure of culvert and fill <u>Road</u> : closed to traffic