CHAPTER 4 – CULVERT ASSESSMENT AND DECISION-MAKING EXAMPLES

The following scenarios are three examples of using the assessment and decision-making tools to evaluate in the field and make appropriate recommendations for a concrete box, corrugated metal pipe, and corrugated plastic pipe culvert. The concrete box and CMP culverts were assessed by FLH hydraulics engineers and the consultant team that prepared this manual, as part of a roadway project-specific inspection of culverts on Wawona Road in California's Yosemite National Park. The corrugated plastic culvert example was developed by the consultant team using an existing culvert within a park in the Washington D.C. region.

Each section is organized as follows: First, a summary of the inspection is presented along with an explanation of the completed Culvert Assessment Form. Next the Decision Making Tools are used to reach a recommended fix or action. The specific sequence steps through the FLH Culvert, Entry Diagram, Assessment Guide, Action Flowchart - Page 1 All Types, Continued Decision Process Flowchart – Pages 2 through 6 (material specific), Continued Decision Process Flowcharts – Pages 7 and 8 (as appropriate), and the repair or replace matrices.

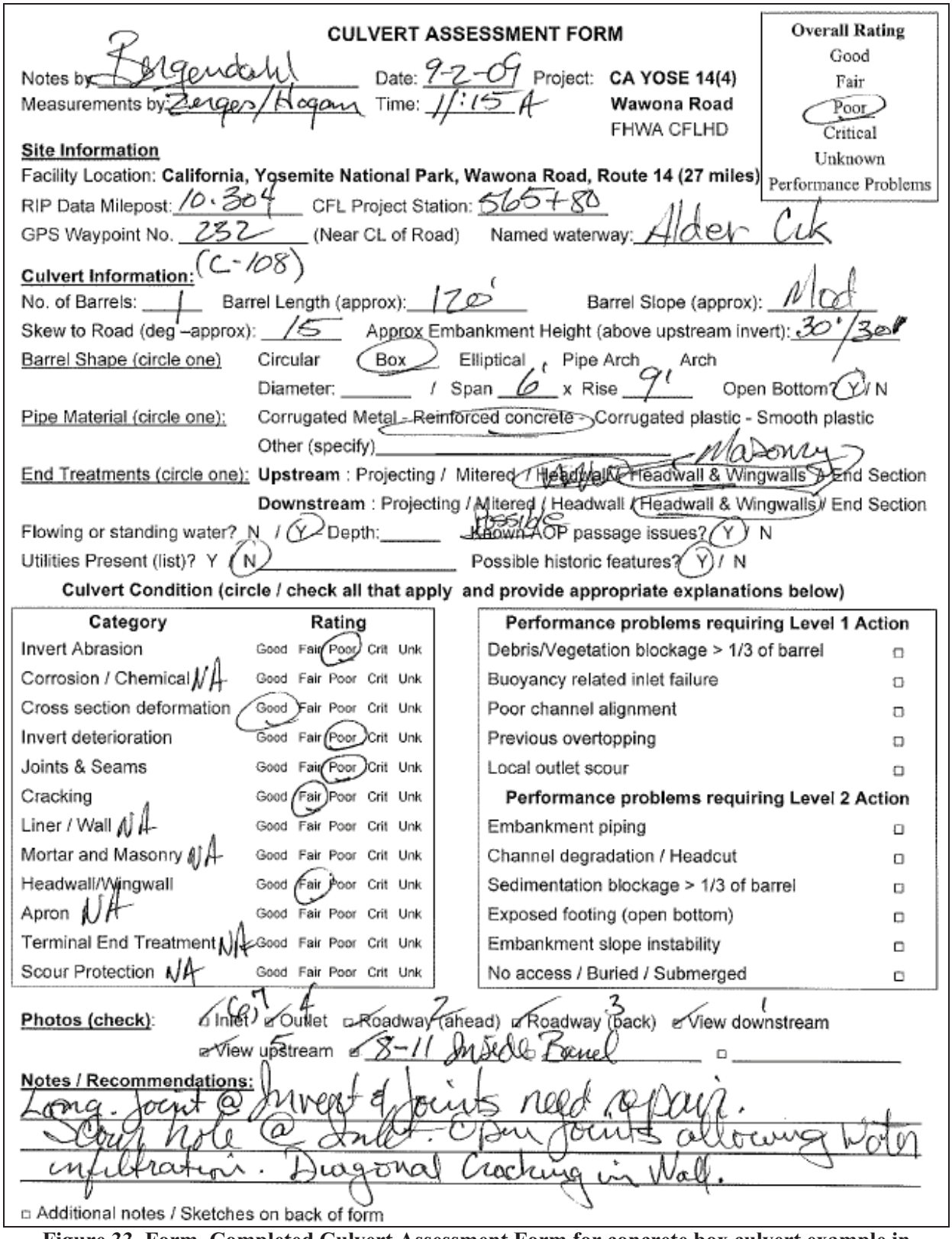
The following culverts are detailed below:

- A 6 foot wide x 9 foot rise Concrete Box, Yosemite National Park, CA
- A 30 inch Corrugated Metal Pipe (CMP) , Yosemite National Park, CA
- An18 inch High Density Polyethylene Pipe (HDPE), Fountainhead Park, VA

CONCRETE BOX CULVERT ASSESSMENT AND DECISION-MAKING EXAMPLE

The following example is a 6 foot wide x 9 foot rise reinforced concrete box conveying Adler Creek under Wawona Road (Route 14) in Yosemite National Park. The inspection was performed on September 2nd, 2009 by two knowledgeable hydraulic engineers from Central Division of FLH and an experienced consultant inspector, and took approximately 15 minutes. The completed Culvert Inspection Form is shown in the following Figure 33. The culvert received an overall rating of Poor.

Due to the larger culvert size and condition, there were no special entry restrictions, as shown in the following Culvert Entry Diagram in annotated Figure 34. The downstream view of the culvert is shown in the following Figure 35.



CULVERT ASSESSMENT FORM

Overall Rating: Good / Fair / (Poor) / Critical / Unknown Performance Problems

Notes by: Bergendahl Date: 9-2-09 Project: CA YOSE 14(4)
Measurements by: Zerges/Hogan Time: 11:15 A Wawona Road
FHWA CFLHD

Site Information

Facility Location: **California, Yosemite National Park, Wawona Road, Route 14 (27 miles)**
RIP Data Milepost: 10.304 CFL Project Station: 565+80
GPS Waypoint No. 232 (Near CL of Road) Named waterway: Alder Crk

Culvert Information: (C-108)

No. of Barrels: 1 Barrel Length (approx): 120' Barrel Slope (approx): Mod
Skew to Road (deg –approx): 15 Approx Embankment Height (above upstream invert): 30'/30'
Barrel Shape (circle one) Circular (Box) Elliptical Pipe Arch Arch
Diameter: ____ / Span 6' x Rise 9' Open Bottom? (Y) / N
Pipe Material (circle one): Corrugated Metal - Reinforced concrete - Corrugated plastic - Smooth plastic
Other (specify) Masonry
End Treatments (circle one): **Upstream** : Projecting / Mitered / Headwall / Headwall & Wingwalls / End Section
Downstream : Projecting / Mitered / Headwall / (Headwall & Wingwalls) / End Section
Flowing or standing water? N / (Y) Depth: ____ possible known AOP passage issues? (Y) / N
Utilities Present (list)? Y / (N) ____ Possible historic features? (Y) / N

Culvert Condition (circle / check all that apply and provide appropriate explanations below)

Category	Rating
Invert Abrasion	Good Fair (Poor) Crit Unk
Corrosion / Chemical NA	Good Fair Poor Crit Unk
Cross section deformation	(Good) Fair Poor Crit Unk
Invert deterioration	Good Fair (Poor) Crit Unk
Joints & Seams	Good Fair (Poor) Crit Unk
Cracking	Good (Fair) Poor Crit Unk
Liner / Wall NA	Good Fair Poor Crit Unk
Mortar and Masonry NA	Good Fair Poor Crit Unk
Headwall/Wingwall	Good (Fair) Poor Crit Unk
Apron NA	Good Fair Poor Crit Unk
Terminal End Treatment NA	Good Fair Poor Crit Unk
Scour Protection NA	Good Fair Poor Crit Unk

Performance problems requiring Level 1 Action	
Debris/Vegetation blockage > 1/3 of barrel	☐
Buoyancy related inlet failure	☐
Poor channel alignment	☐
Previous overtopping	☐
Local outlet scour	☐
Performance problems requiring Level 2 Action	
Embankment piping	☐
Channel degradation / Headcut	☐
Sedimentation blockage > 1/3 of barrel	☐
Exposed footing (open bottom)	☐
Embankment slope instability	☐
No access / Buried / Submerged	☐

Photos (check): ☑ Inlet (6) 7 ☑ Outlet 4 ☐ Roadway (ahead) 2 ☑ Roadway (back) 3 ☑ View downstream 1
☑ View upstream 5 ☑ 8-11 Inside Barrel ☐ ____

Notes / Recommendations:
Long. joint @ invert & joints need repair.
Scour hole @ Inlet. Open joints allowing water infiltration. Diagonal Cracking in Wall.

☐ Additional notes / Sketches on back of form

Figure 33. Form. Completed Culvert Assessment Form for concrete box culvert example in Yosemite National Park.

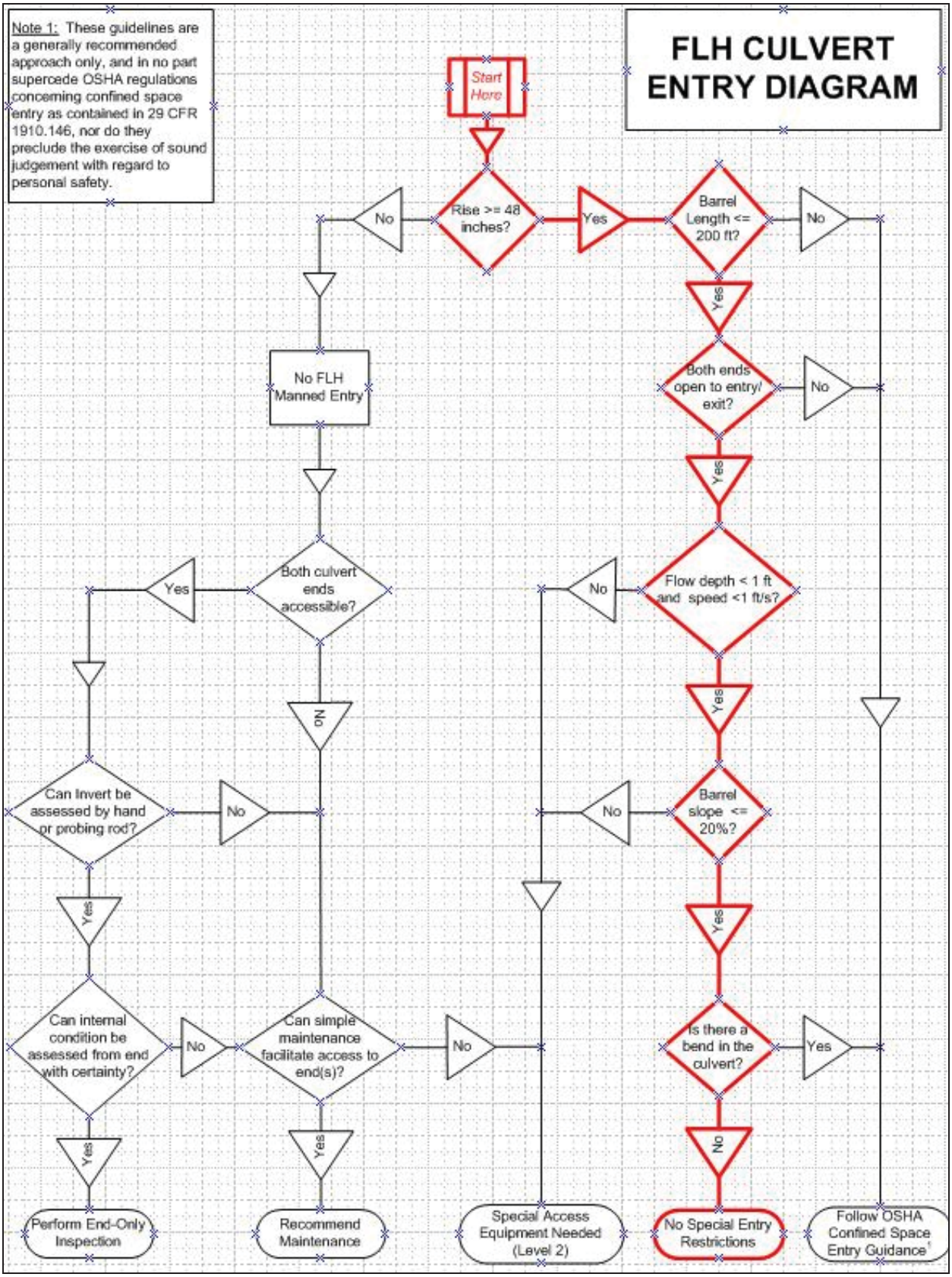


Figure 34. Flowchart. Annotated Culvert Entry Diagram for concrete box culvert example in Yosemite National Park.

Figure 35. Photo. View downstream of concrete box culvert with masonry appurtenances.

The culvert condition ratings by category of deterioration were noted as follows in Figure 36 below, using the Culvert Assessment Guide.

Category	Rating
Invert Abrasion	Good Fair **Poor** Crit Unk
Corrosion / Chemical NA	Good Fair Poor Crit Unk
Cross section deformation	**Good** Fair Poor Crit Unk
Invert deterioration	Good Fair **Poor** Crit Unk
Joints & Seams	Good Fair **Poor** Crit Unk
Cracking	Good **Fair** Poor Crit Unk
Liner / Wall NA	Good Fair Poor Crit Unk
Mortar and Masonry NA	Good Fair Poor Crit Unk
Headwall/Wingwall	Good **Fair** Poor Crit Unk
Apron NA	Good Fair Poor Crit Unk
Terminal End Treatment NA	Good Fair Poor Crit Unk
Scour Protection NA	Good Fair Poor Crit Unk

Figure 36. Form. Annotated Culvert Assessment Form for concrete box culvert deterioration categories.

The Invert Abrasion and Invert Deterioration were rated as Poor due to heavy invert abrasion, section loss, and exposed and corroding rebar, as shown in following Figure 37.

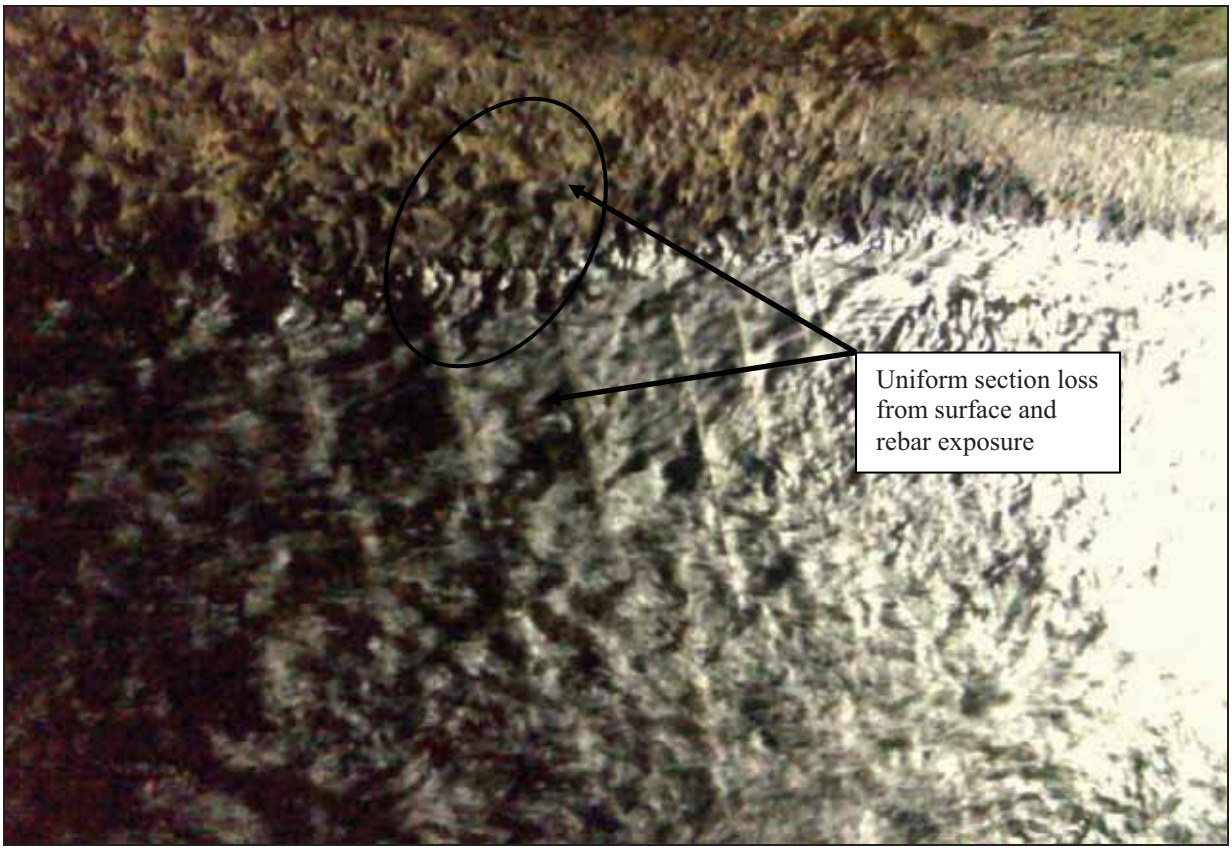


Figure 37. Photo. Invert abrasion damage with concrete section loss and exposed/corroding rebar.

Cracking was rated as Fair due to multiple cracks in the walls up to ¼ inch wide with exudence and minor spalling and infiltration of water, as shown in the following Figure 38 and 39. Joints & Seams were rated as Poor because the joints were spalled and open near the invert in some areas as shown in Figure 39, allowing water to infiltrate. Cracking in close proximity to joints was considered as deterioration to the joint, rather than categorically as cracking.

Headwall/Wingwall was rated Fair due to minor mortar joint deterioration. Due to the Poor ratings and subsequent repairs needed, the culvert was given an overall rating of Poor. There were no performance problems observed at the culvert or indicated on the assessment form.

Figure 38. Photo. Vertical crack in culvert wall with exudence.

Figure 39. Photo. Diagonal crack near joint and invert with water infiltration .

The decision-making part of the process was aided by the FLH Culvert Barrel Action Flowchart - Page 1 All Types, and Continued Decision Process Flowchart - Page 2 – Concrete & RCP, as shown in the following Figures 40 and 41 and described below.

FLH Culvert Barrel Action Flowchart - Page 1 All Types

Initial Field Assessment of Culvert Complete → Condition Rating Unknown? <No> → Observed performance problems requiring Level 2 actions? <No> → Observed performance problems requiring Level 1 fixes? <No> → Culvert barrel rated Good or Fair? <No> → Culvert barrel rated Poor or Critical → Is culvert in imminent danger of collapse? <No> → Open-bottom or possible fish passage/AOP/historical/cultural*? (possibly, but continue assessment in this case)* <No> → Special environmental permitting issues anticipated? <No> → Pipe Rise <= 36 in? <No> → Barrel rated Critical? <No> → Frequent overtopping known (as indicated by client)? <No> → Repair → Continue Decision Process per Type – pages 2-7.

FLH Culvert Continued Decision Process Flowchart - Page 2 – Concrete & RCP

Continued Decision Process Needed (From Page 1) → Cross Section Deformation Poor or Critical? <No> → Cracking Poor or Critical? <No> → Chemical Corrosion Poor or Critical? <No> → Invert Deterioration & Abrasion Poor or Critical? <Yes> → Aggressive Abrasion Environment? <No> → Rise <= 48" ? <No> → Most of Culvert Barrel Surface Affected by Poor/Critical Conditions? *(all of invert affected, but not barrel surface)* <No> → Localized Man-Entry Repair → *(trace back to)* Joints Poor or Critical <Yes> → Rise <= 48" ? <No> → Most of Culvert Barrel Surface Affected by Poor/Critical Conditions? <No> → Localized Man-Entry Repair

Based on the ratings and conditions determined in the Culvert Assessment Guide and material specific flow chart, a localized man-entry type of repair is recommended at this structure. Using the Localized Man-Entry Repair Selection Matrix, the following rehabilitation types would be recommended: Crack Epoxy Injection/Mortar, Crack/Spall Patching and Rebar Coating with Epoxy Grout, and Invert Lining. Note that although cracking was rated Fair, since repairs will be recommended for the Poor joints and invert, it is assumed other observed deterioration such as the Fair cracks will be repaired as well.

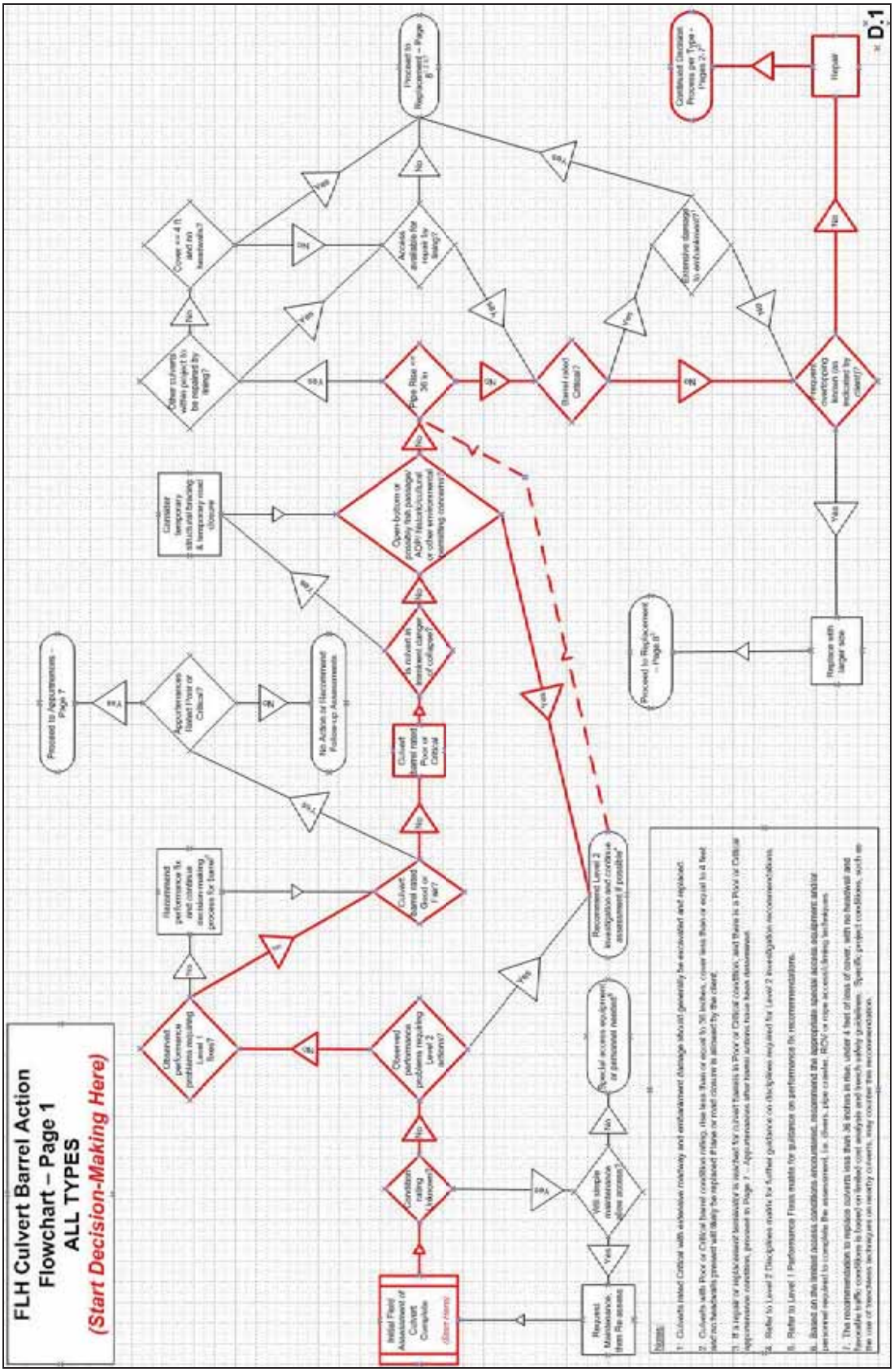


Figure 40. Flowchart. Annotated Culvert Barrel Flowchart – Page 1 ALL TYPES for concrete box example.

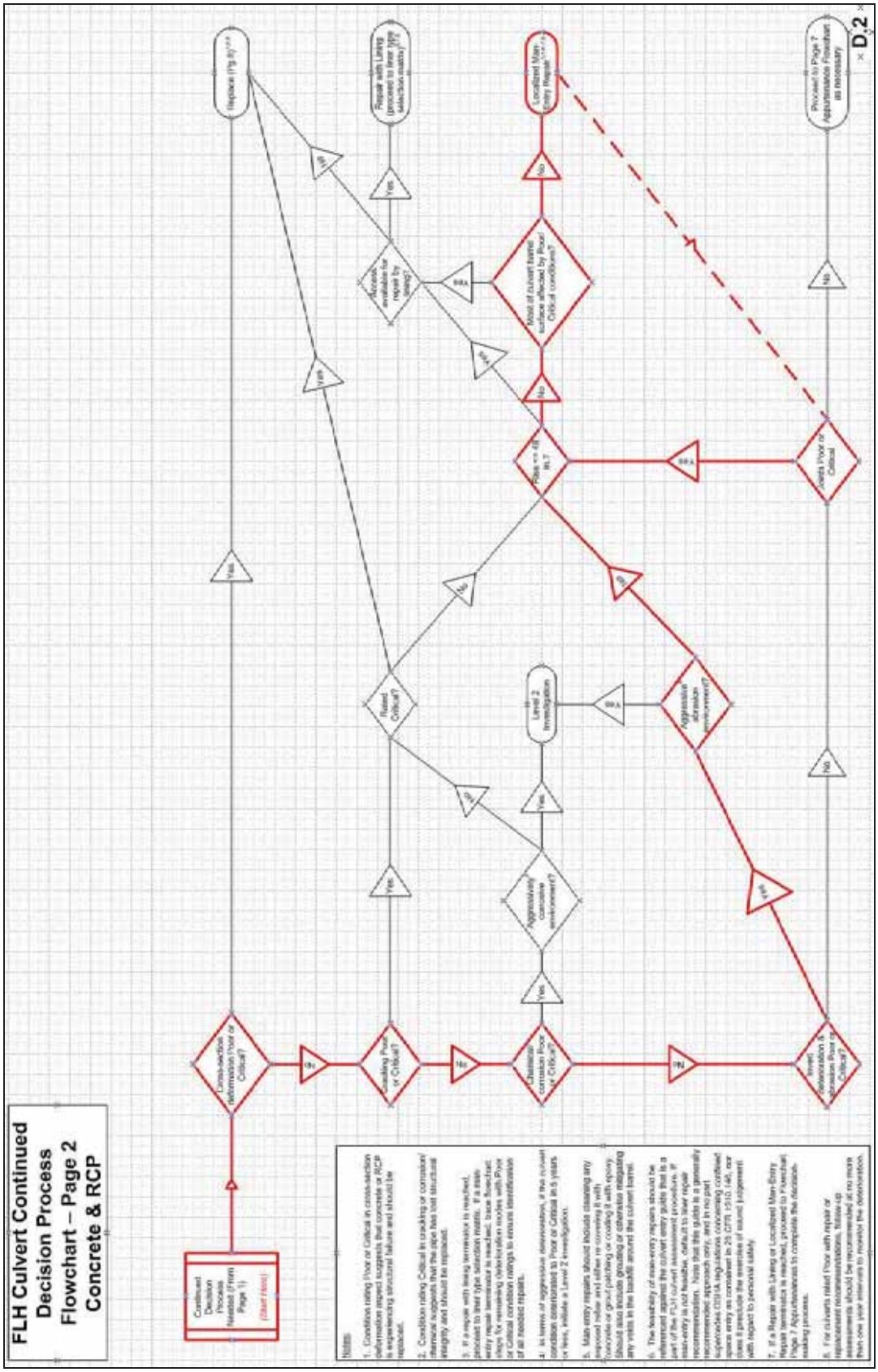
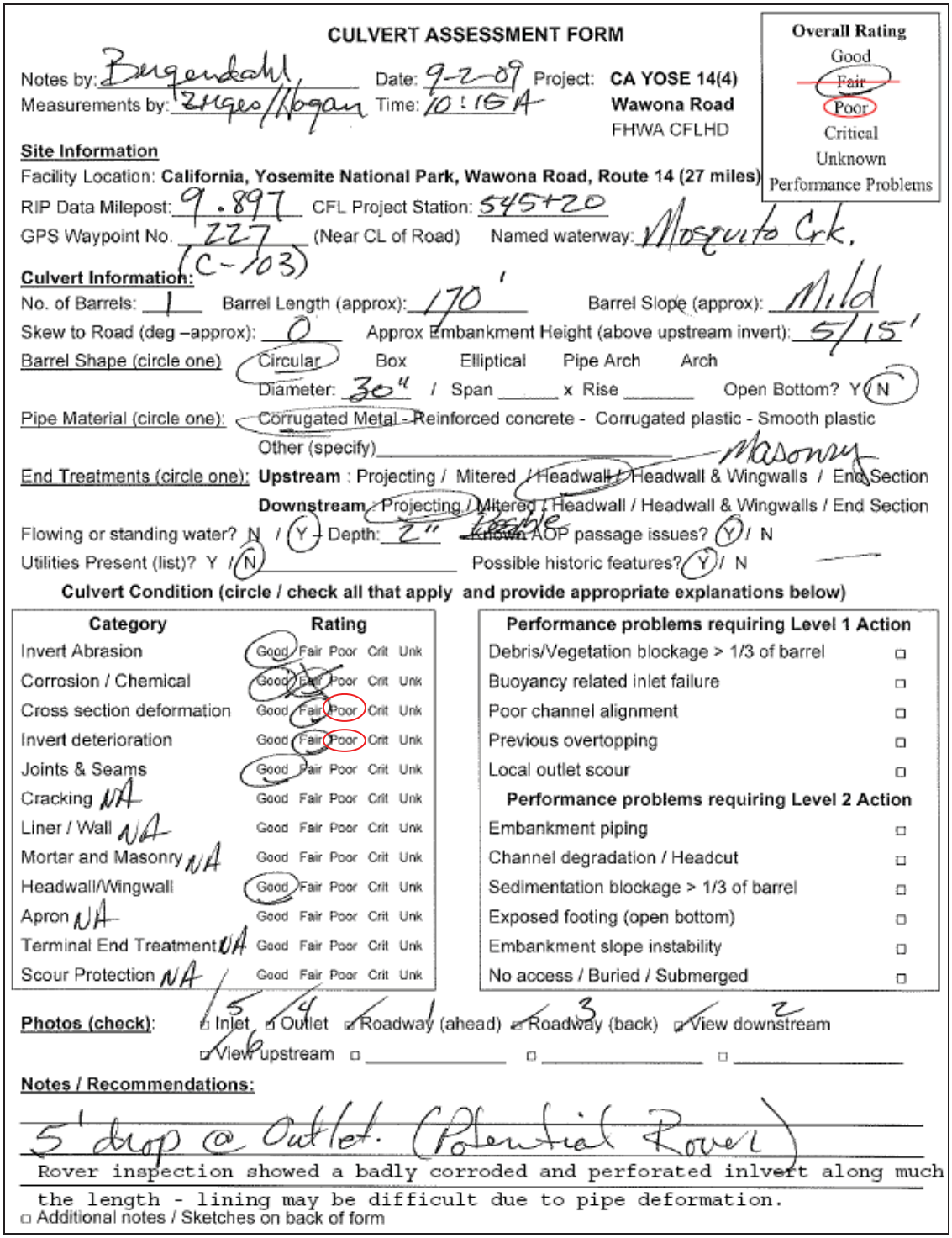


Figure 41. Flowchart. Annotated FLH Culvert Continued Flowchart – Page 2 for concrete box example.

CORRUGATED METAL PIPE (CMP) ASSESSMENT AND DECISION-MAKING EXAMPLE

The following example addresses a 170 foot long, 30 inch diameter CMP located under Wawona Road (Route 14) on Mosquito Creek in Yosemite National Park, California. The initial Level 1 assessment was performed on September 2nd, 2009 by two knowledgeable hydraulic engineers from Central Division of FLH and an experienced consultant inspector, and took approximately 15 minutes. It was noted on the form that the culvert was a potential site for using the ROV. A follow-up Level 2 investigation was conducted two days later using an FLH-owned and operated ROV. The completed and later modified Culvert Inspection Form is shown in the following Figure 42. The culvert initially received an Overall Rating of Fair, which was later changed to Poor following the Level 2 investigation.



CULVERT ASSESSMENT FORM

Overall Rating: Good / ~~Fair~~ / Poor / Critical / Unknown / Performance Problems

Notes by: Bergendahl Date: 9-2-09 Project: CA YOSE 14(4) Wawona Road FHWA CFLHD
Measurements by: Zuges/Hogan Time: 10:15A

Site Information

Facility Location: **California, Yosemite National Park, Wawona Road, Route 14 (27 miles)**
RIP Data Milepost: 9.897 CFL Project Station: 545+20
GPS Waypoint No. 227 (C-103) (Near CL of Road) Named waterway: Mosquito Crk.

Culvert Information:

No. of Barrels: 1 Barrel Length (approx): 170' Barrel Slope (approx): Mild
Skew to Road (deg –approx): 0 Approx Embankment Height (above upstream invert): 5/15'
Barrel Shape (circle one) (Circular) Box Elliptical Pipe Arch Arch
Diameter: 30" / Span ____ x Rise ____ Open Bottom? Y (N)
Pipe Material (circle one): (Corrugated Metal) Reinforced concrete - Corrugated plastic - Smooth plastic
Other (specify) Masonry
End Treatments (circle one): **Upstream** : Projecting / Mitered / ~~Headwall~~ / Headwall & Wingwalls / End Section
Downstream : Projecting / Mitered / Headwall / Headwall & Wingwalls / End Section
Flowing or standing water? N / (Y) Depth: 2" Possible Known AOP passage issues? (Y) / N
Utilities Present (list)? Y / (N) Possible historic features? (Y) / N

Culvert Condition (circle / check all that apply and provide appropriate explanations below)

Category	Rating
Invert Abrasion	(Good) Fair Poor Crit Unk
Corrosion / Chemical	(Good) Fair Poor Crit Unk
Cross section deformation	Good Fair (Poor) Crit Unk
Invert deterioration	Good Fair (Poor) Crit Unk
Joints & Seams	(Good) Fair Poor Crit Unk
Cracking NA	Good Fair Poor Crit Unk
Liner / Wall NA	Good Fair Poor Crit Unk
Mortar and Masonry NA	Good Fair Poor Crit Unk
Headwall/Wingwall	(Good) Fair Poor Crit Unk
Apron NA	Good Fair Poor Crit Unk
Terminal End Treatment NA	Good Fair Poor Crit Unk
Scour Protection NA	Good Fair Poor Crit Unk

Performance problems requiring Level 1 Action	
Debris/Vegetation blockage > 1/3 of barrel	☐
Buoyancy related inlet failure	☐
Poor channel alignment	☐
Previous overtopping	☐
Local outlet scour	☐
Performance problems requiring Level 2 Action	
Embankment piping	☐
Channel degradation / Headcut	☐
Sedimentation blockage > 1/3 of barrel	☐
Exposed footing (open bottom)	☐
Embankment slope instability	☐
No access / Buried / Submerged	☐

Photos (check): ☑ Inlet (5) ☑ Outlet (4) ☑ Roadway (ahead) (1) ☑ Roadway (back) (3) ☑ View downstream (2) ☑ View upstream (6) ☐ ____ ☐ ____ ☐ ____

Notes / Recommendations:

5' drop @ Outlet. (Potential Rover)
Rover inspection showed a badly corroded and perforated inlvert along much the length - lining may be difficult due to pipe deformation.
☐ Additional notes / Sketches on back of form

Figure 42. Form. Annotated FLH Culvert Entry Diagram for CMP example in Yosemite National Park.

Due to the smaller barrel size and longer length, an initial "end-only" assessment was made. There was at least one bend in the culvert evident upon initial inspection; therefore, it was concluded that the internal condition could not be assessed with certainty from the end. Per the annotated Culvert Entry Diagram in Figure 43, special access equipment was called for, in this case a pipe-crawler ROV that the FLH team had readily available for the project.

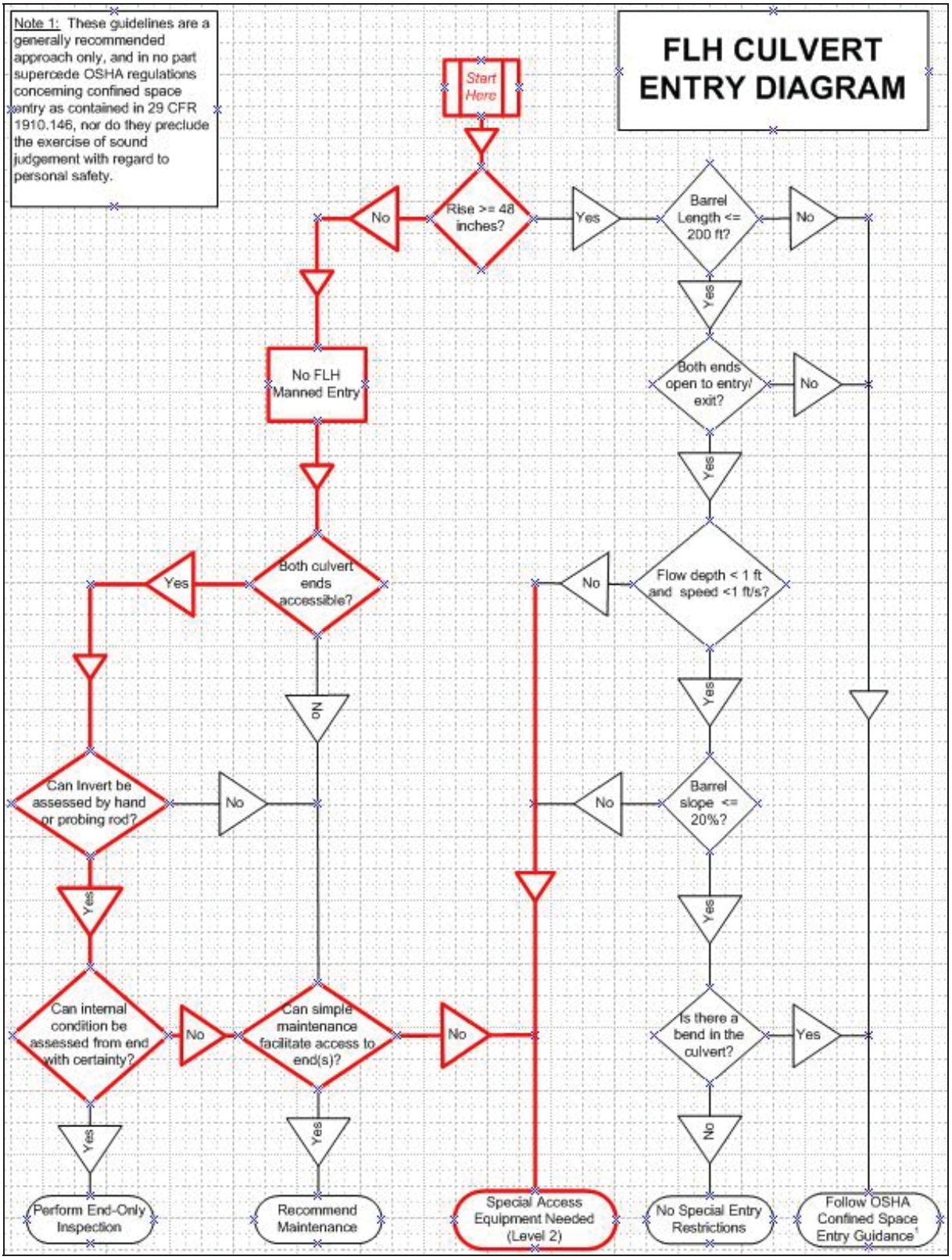


Figure 43. Flowchart. Annotated FLH Culvert Entry Diagram for CMP example in Yosemite National Park.

The culvert condition ratings by category of deterioration were initially noted in the Level 1 end-only assessment as follows in Figure 44, using the Culvert Assessment Guide.

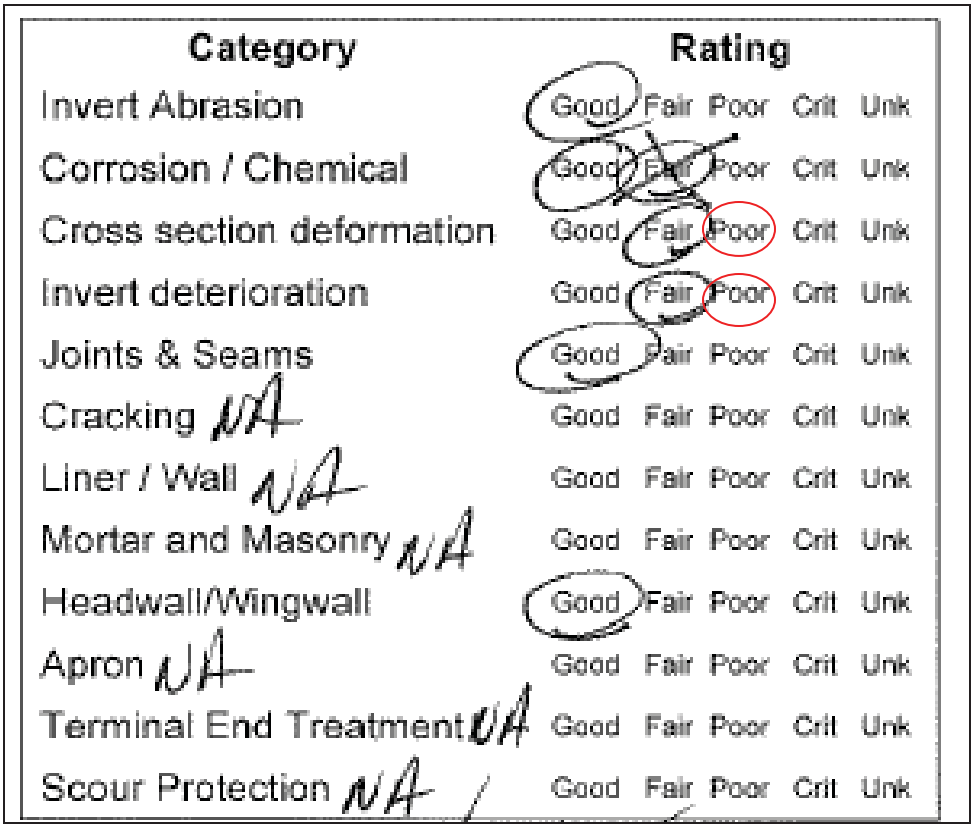


Figure 44. Form. Annotated Culvert Assessment Form for concrete box culvert deterioration categories.

The cross section deformation was rated as Fair due to minor deformation of the crown at the outlet, as well as possibly inside the barrel near the outlet. Invert deterioration was rated Fair based on the conditions visible at and near the pipe ends, which included general corrosion, staining, coating loss and minor pitting. Very minor surface rust extended above the normal invert and flow line delineation, likely to the high-flow event level; therefore, the corrosion/chemical category was rate as Good based on the end-only observations. The initial overall culvert rating was Fair, based on the limited Level 1 end-only assessment.

A Level 2 investigation was recommended as a follow-up action, based on specialty access equipment needed, with the intent to revise the rating as necessary based on those subsequent findings. Although there was minor scour and end projection noted at the pipe outlet end, there were no significant performance problems observed. The following Figures 45 and 46 show the pipe conditions as observed at the ends during the Level 1 initial assessment.

Figure 45. Photo. Light invert deterioration and minor local scour erosion at outlet of CMP example.

Figure 46. Photo. Light invert deterioration at inlet of CMP example on Mosquito Creek in Yosemite National Park.

Figure 47. Photo. Stable downstream channel conditions at the outlet of CMP example in Yosemite National Park.

The Level 2 investigation using the pipe-crawler ROV revealed significant crown bulging and cross-section deformation under the roadway, section loss and holes at multiple joints above the flow line, suspected water exfiltration below the flow line, structural cracking in the crown of the pipe, and 50 to 100 percent section loss in the invert due to corrosion and abrasion. Heavy corrosion, pitting and section loss was observed at and above the invert throughout the pipe; however, no significant soil or water infiltration was observed. Based on these findings, the overall condition of the culvert was changed to Poor, which initiated the decision-making process for determining repair and replacement recommendations. The following Figures 48 through 52 show the ROV unit and video screenshots of internal pipe deterioration that it observed.

Figure 48. Photo. Pipe crawler ROV system ready for Level 2 inspection of CMP example in Yosemite National Park.

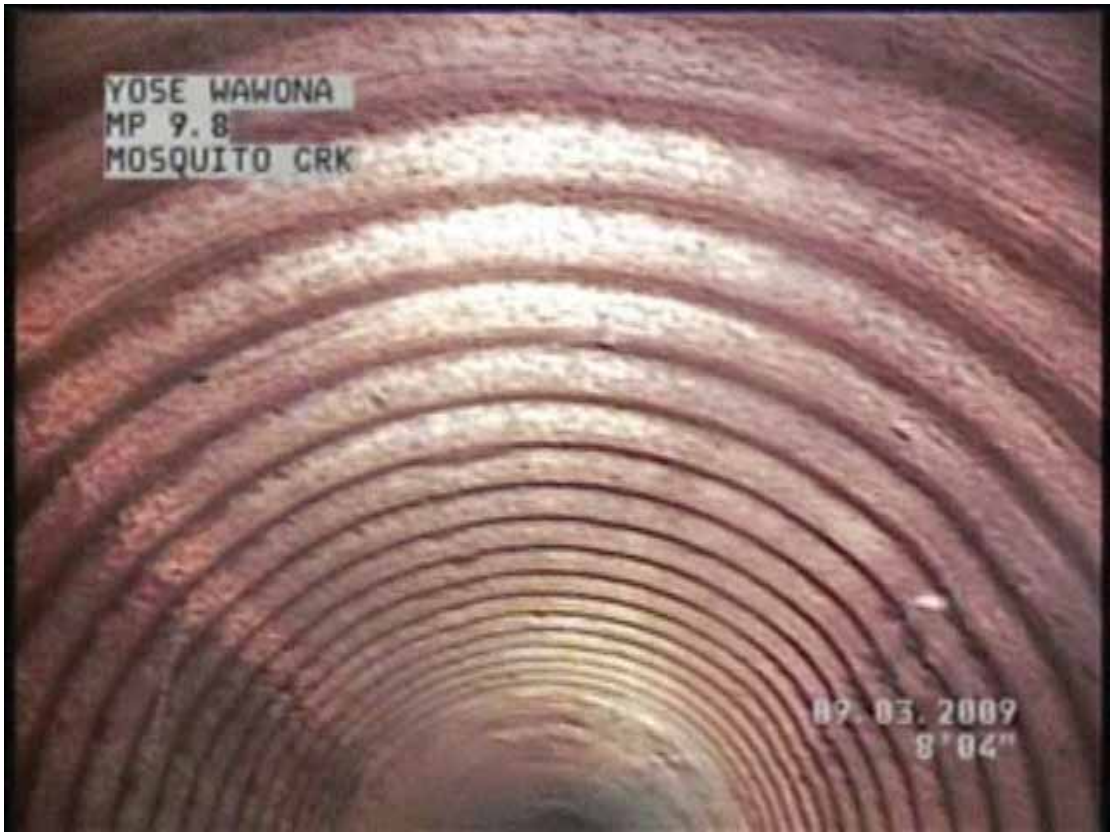


Figure 49. Photo. ROV video of CMP example showing typical corrosion above flow line.

Figure 50. Photo. ROV video of CMP example showing crown deformation and cracking.

Figure 51. Photo. ROV video of CMP example showing deformation and invert section loss.

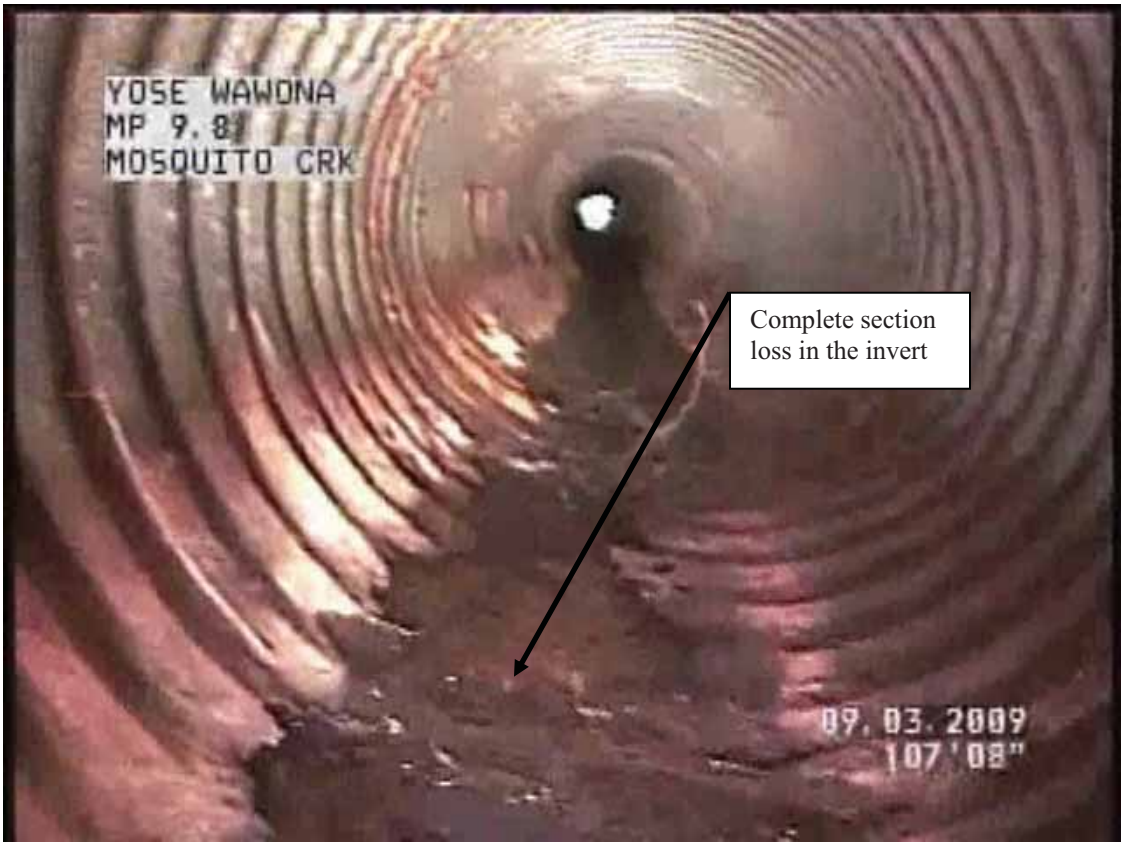


Figure 52. Photo. ROV video of CMP example showing complete invert section loss.

The decision-making part of the process, aided by the FLH Culvert Barrel Action Flowchart - Page 1 All Types, and Continued Decision Process Flowchart - Page 3 – CMP, as shown in the following Figures 53 and 54, was as follows.

FLH Culvert Barrel Action Flowchart - Page 1 All Types

Initial Field Assessment of Culvert Complete → Condition Rating Unknown? <No> → Observed performance problems requiring Level 2 actions? <No> → Observed performance problems requiring Level 1 fixes? <No> → Culvert barrel rated Good or Fair? <No> → Culvert barrel rated Poor or Critical → Is culvert in imminent danger of collapse? <No> → Open-bottom or possible fish passage/AOP/historical/cultural*? (possibly, but continue assessment in this case)* <No> → Special environmental permitting issues anticipated? → <No> → Pipe Rise <= 36 in? <Yes> → Other culverts within project to be repaired by lining? <Yes> *(assume possibly for now, to keep options open)* → Cover <= 4 ft and no headwalls? <No> → Access available for repair by lining? <Yes> → Barrel Rated Critical <No> → Frequent overtopping known (as indicated by client)? <No> → Repair → Continued Decision Process per Type – Pages 2-7.

The following Figure 53 shows the annotated decision path for the Page 1 flowchart.

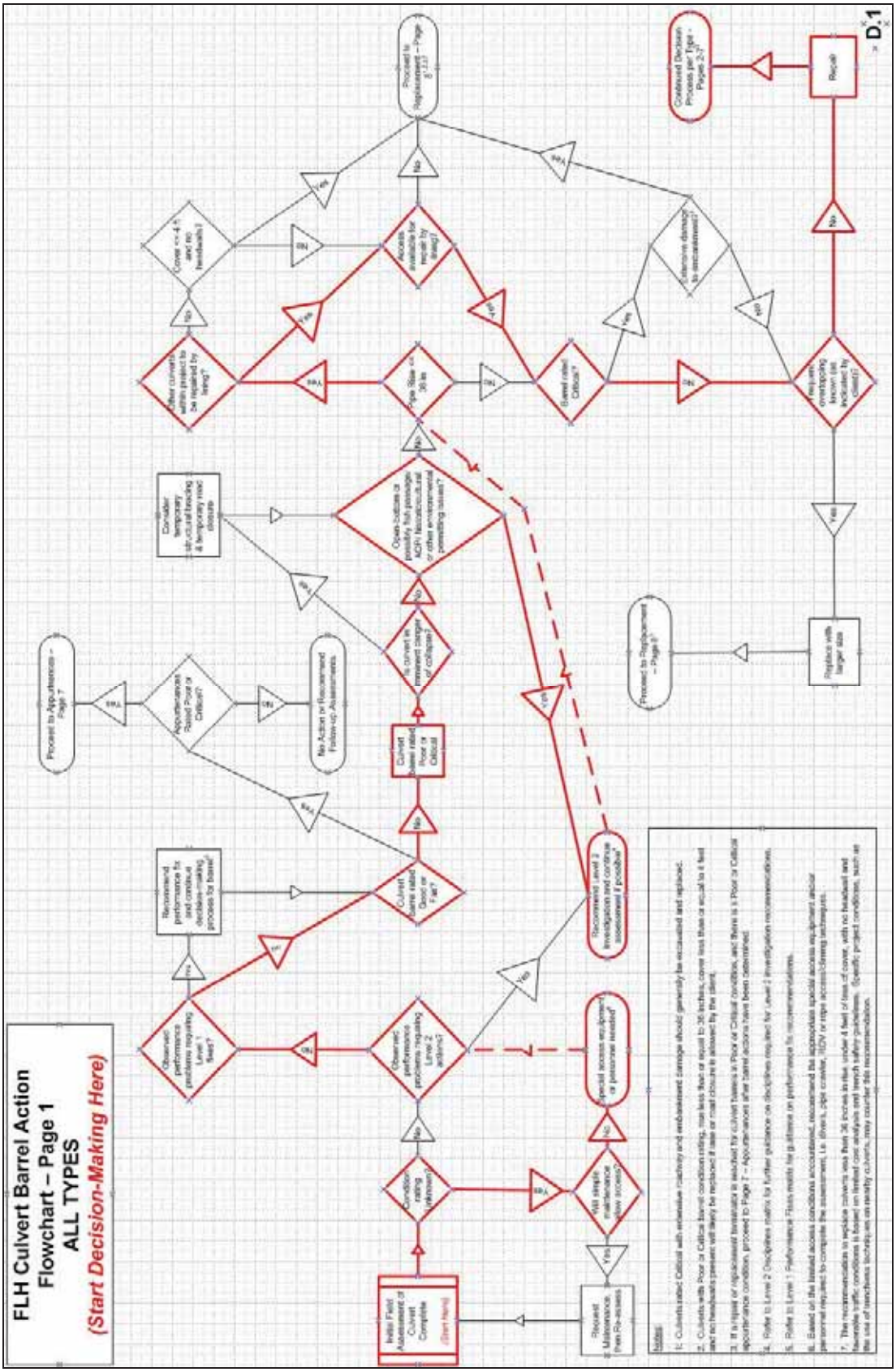


Figure 53. Flowchart. Annotated Barrel Action Flowchart – Page 1 for CMP example in Yosemite National Park.

FLH Culvert Continued Decision Process Flowchart - Page 3 – CMP

Continued Decision Process Needed (From Page 1) → Cross Section Deformation Poor or Critical? <Yes> → Cross Section Deformation Poor? <Yes> → Access available for repair by lining? <Yes> → Repair with Lining (proceed to liner type selection matrix).

Based on the ratings and conditions determined in the Culvert Assessment Guide and material specific flow chart, a liner repair is recommended at this structure, as shown in the following Figure 54. Using the Liner Selection Matrix, with prime consideration given to the localized bulges and cross-section deformations, the Spray-On Cement Mortar or Epoxy Lining types might be recommended; however, additional issues and pipe conditions eventually rule out these methods.

The pipe is rather long, with a bend and low-point in the middle where groundwater infiltration through the lost invert will likely pool water and prevent setup of the mortar. The longer length, bend in the middle, and bulges and deformations present possible issues with pulling the sled through the pipe at the steady rate required to control thickness of application. Lastly, the extent of invert loss may exceed the coating capabilities of this application method, requiring the use of local patches and/or reinforcement that require manned-entry. These added considerations suggest the spray-on liners may not be appropriate for this application. A note at the bottom of the Liner Selection Matrix directs the user to proceed to the Localized Man-Entry Repair or Replacement Matrix as appropriate if no liner can be selected. The combination of small size, long length and location of the worst deterioration at the middle of the run create conditions that may not be conducive to man-entry work. Although the 10 foot depth of cover exceeds the 4 foot delineator described in this procedure, there is room for road excavation equipment and traffic diversion is possible. Referencing the culvert Replacement Flowchart D.8 and the Culvert Replacement Techniques Matrix and comparing cost information, the recommended action is Open-Trench Excavation.

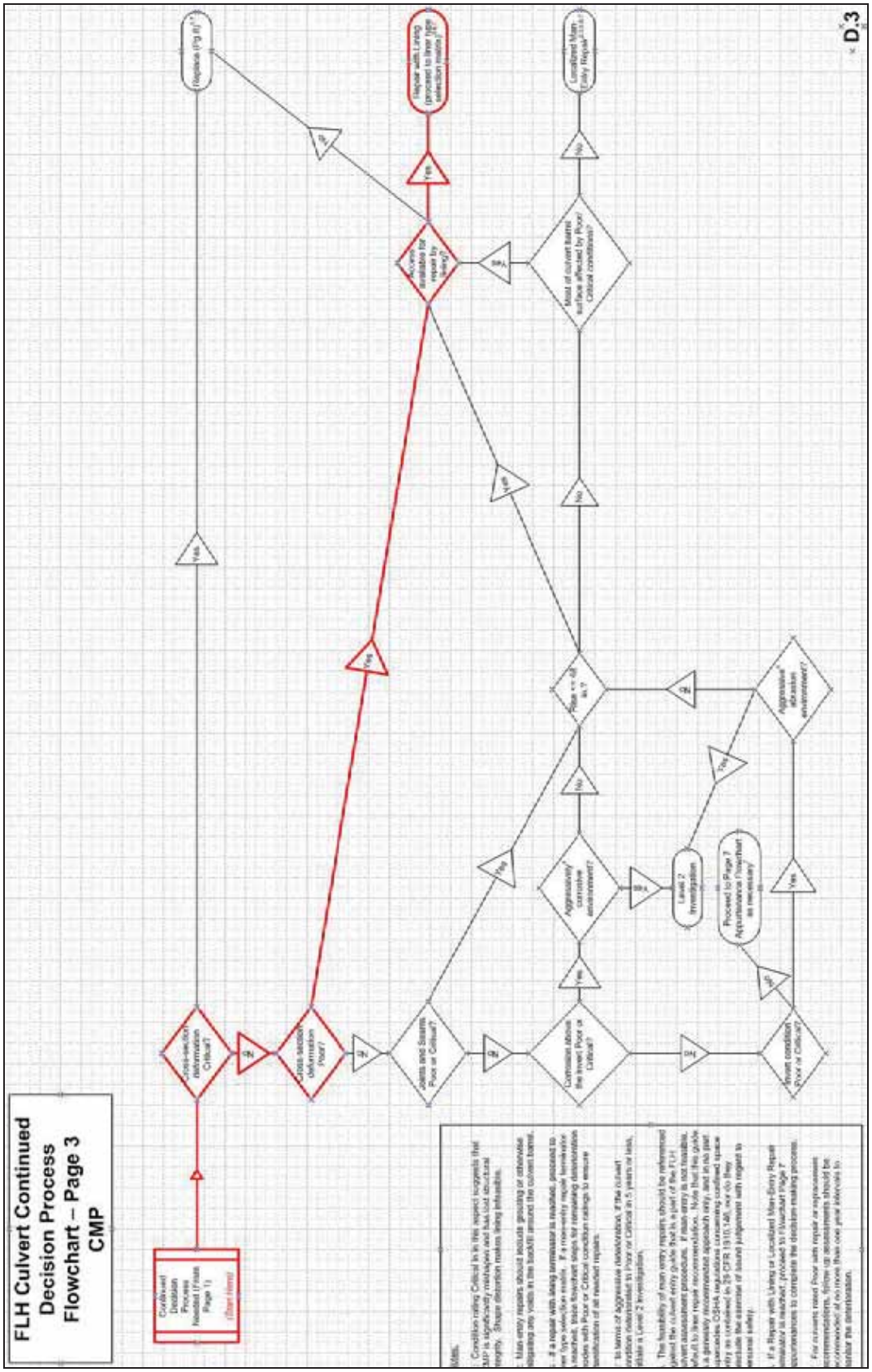


Figure 54. Flowchart. Continued Decision Process Flowchart – Page 3 for CMP example in Yosemite National Park.

PLASTIC PIPE CULVERT ASSESSMENT AND DECISION-MAKING EXAMPLE

The following example is a 15 inch diameter High Density Polyethylene Pipe (HDPE) pipe is one of two pipes inspected at Fountainhead Regional Park in Fairfax, Virginia, on January 7th , 2010. The assessment was performed by a two-person consultant team in approximately twenty minutes. The culvert and roadway are shown in the following Figures 55 through 57. The completed Culvert Inspection Form is shown in Figure 58. The culvert received an overall rating of Unknown, with additional notes made regarding the clogging throughout the pipe and completely buried outlet, which will lead to constant roadway overtopping and possible damage to the roadway and embankment.

Figure 55. Photo. View of inlet of plastic HDPE example in Fountainhead Regional Park, Fairfax, Virginia.

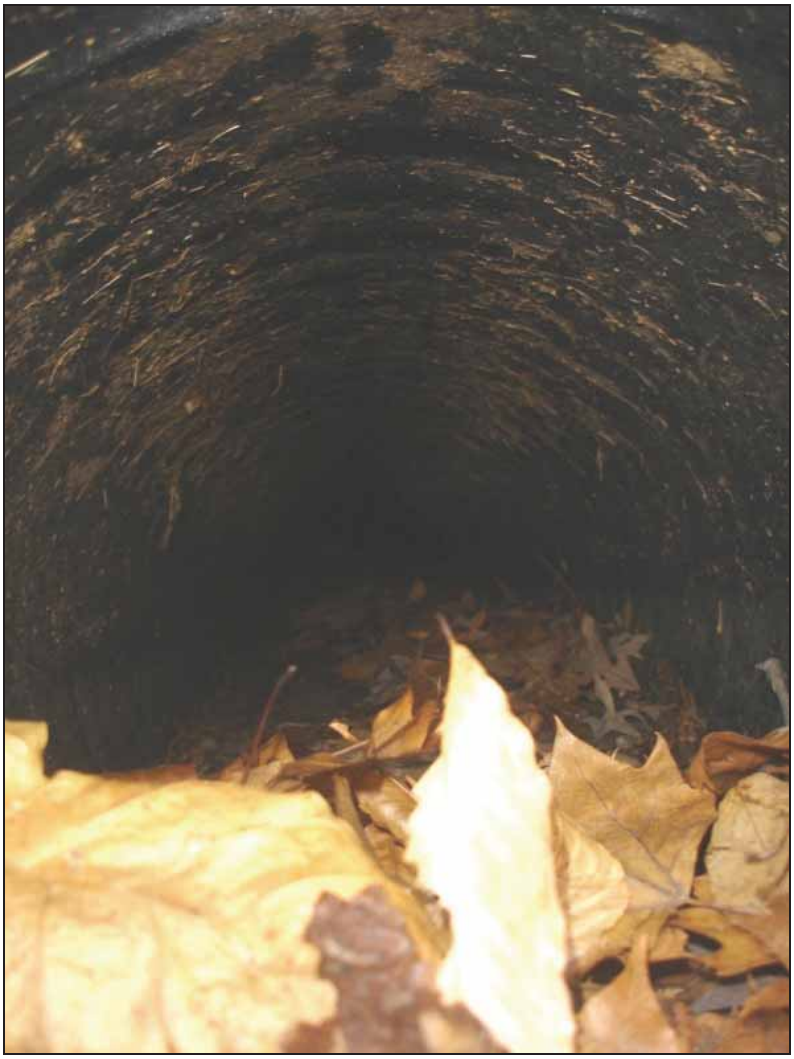
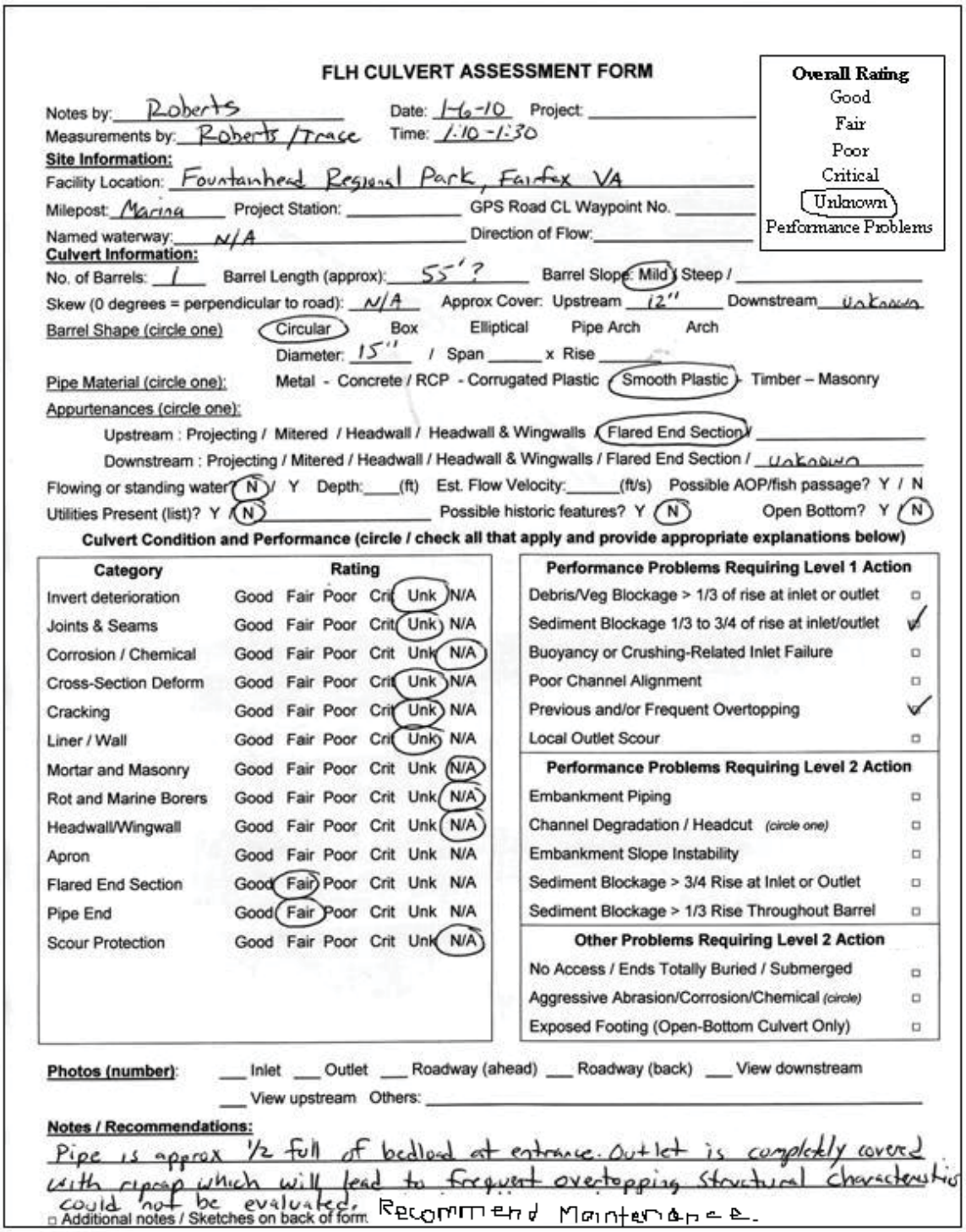


Figure 56. Photo. View of interior of plastic example in Fountainhead Park showing clogging.

Figure 57. Photo. View of roadway crossing at plastic pipe example in Fountainhead Park.



FLH CULVERT ASSESSMENT FORM

Overall Rating: Good / Fair / Poor / Critical / (Unknown) Performance Problems

Notes by: Roberts Date: 1-6-10 Project:
Measurements by: Roberts / Trace Time: 1:10 - 1:30

Site Information:
Facility Location: Fountainhead Regional Park, Fairfax VA
Milepost: Marina Project Station: GPS Road CL Waypoint No.
Named waterway: N/A Direction of Flow:

Culvert Information:
No. of Barrels: 1 Barrel Length (approx): 55'? Barrel Slope: (Mild) / Steep /
Skew (0 degrees = perpendicular to road): N/A Approx Cover: Upstream 12" Downstream unknown
Barrel Shape (circle one): (Circular) Box Elliptical Pipe Arch Arch
Diameter: 15" / Span x Rise
Pipe Material (circle one): Metal - Concrete / RCP - Corrugated Plastic (Smooth Plastic) - Timber – Masonry
Appurtenances (circle one):
Upstream : Projecting / Mitered / Headwall / Headwall & Wingwalls / (Flared End Section) /
Downstream : Projecting / Mitered / Headwall / Headwall & Wingwalls / Flared End Section / unknown
Flowing or standing water (N) / Y Depth: (ft) Est. Flow Velocity: (ft/s) Possible AOP/fish passage? Y / N
Utilities Present (list)? Y / (N) Possible historic features? Y (N) Open Bottom? Y (N)

Culvert Condition and Performance (circle / check all that apply and provide appropriate explanations below)

Category	Rating
Invert deterioration	Good Fair Poor Crit (Unk) N/A
Joints & Seams	Good Fair Poor Crit (Unk) N/A
Corrosion / Chemical	Good Fair Poor Crit Unk (N/A)
Cross-Section Deform	Good Fair Poor Crit (Unk) N/A
Cracking	Good Fair Poor Crit (Unk) N/A
Liner / Wall	Good Fair Poor Crit (Unk) N/A
Mortar and Masonry	Good Fair Poor Crit Unk (N/A)
Rot and Marine Borers	Good Fair Poor Crit Unk (N/A)
Headwall/Wingwall	Good Fair Poor Crit Unk (N/A)
Apron	Good Fair Poor Crit Unk N/A
Flared End Section	Good (Fair) Poor Crit Unk N/A
Pipe End	Good (Fair) Poor Crit Unk N/A
Scour Protection	Good Fair Poor Crit Unk (N/A)

Performance Problems Requiring Level 1 Action
- Debris/Veg Blockage > 1/3 of rise at inlet or outlet ☐
- Sediment Blockage 1/3 to 3/4 of rise at inlet/outlet ✓
- Buoyancy or Crushing-Related Inlet Failure ☐
- Poor Channel Alignment ☐
- Previous and/or Frequent Overtopping ✓
- Local Outlet Scour ☐

Performance Problems Requiring Level 2 Action
- Embankment Piping ☐
- Channel Degradation / Headcut (circle one) ☐
- Embankment Slope Instability ☐
- Sediment Blockage > 3/4 Rise at Inlet or Outlet ☐
- Sediment Blockage > 1/3 Rise Throughout Barrel ☐

Other Problems Requiring Level 2 Action
- No Access / Ends Totally Buried / Submerged ☐
- Aggressive Abrasion/Corrosion/Chemical (circle) ☐
- Exposed Footing (Open-Bottom Culvert Only) ☐

Photos (number): ___ Inlet ___ Outlet ___ Roadway (ahead) ___ Roadway (back) ___ View downstream ___ View upstream Others:

Notes / Recommendations:
Pipe is approx 1/2 full of bedload at entrance. Outlet is completely covered with riprap which will lead to frequent overtopping. Structural characteristics could not be evaluated. Recommend Maintenance.

☐ Additional notes / Sketches on back of form

Figure 58. Form. Annotated Culvert Assessment Form for plastic example in Fountainhead Park.

Due to the small barrel size and limited access, a maintenance recommendation was selected, as shown in the annotated entry diagram in Figure 59 below. The entrance was the only portion of the structure visible, with the invert substantially buried. The outlet could not be located and was presumed to be completely buried as well. Visibility inside the pipe was restricted due to sediment and debris. The team opted to conduct a partial Level 1 end-only assessment of the culvert to the extent possible from the inlet.

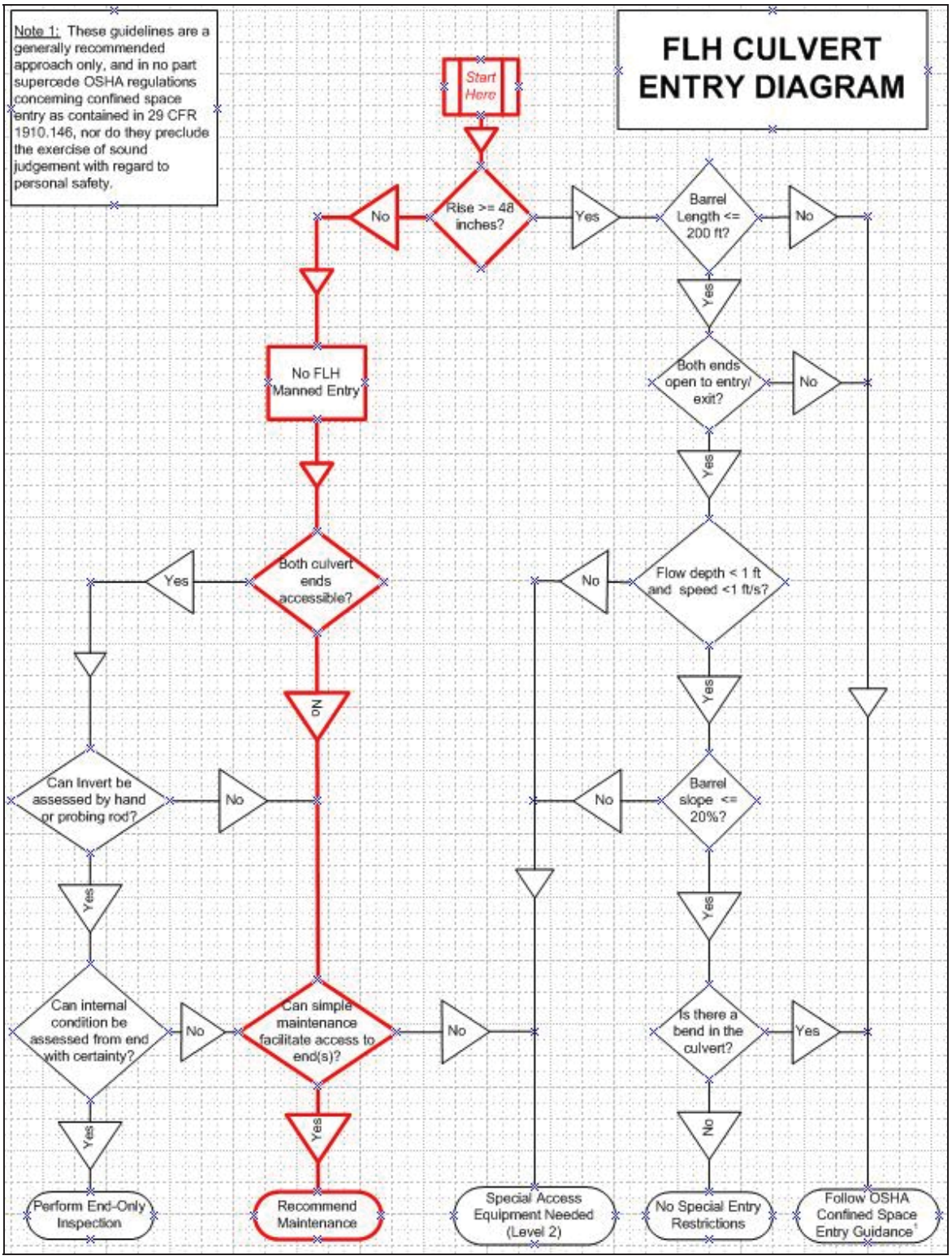
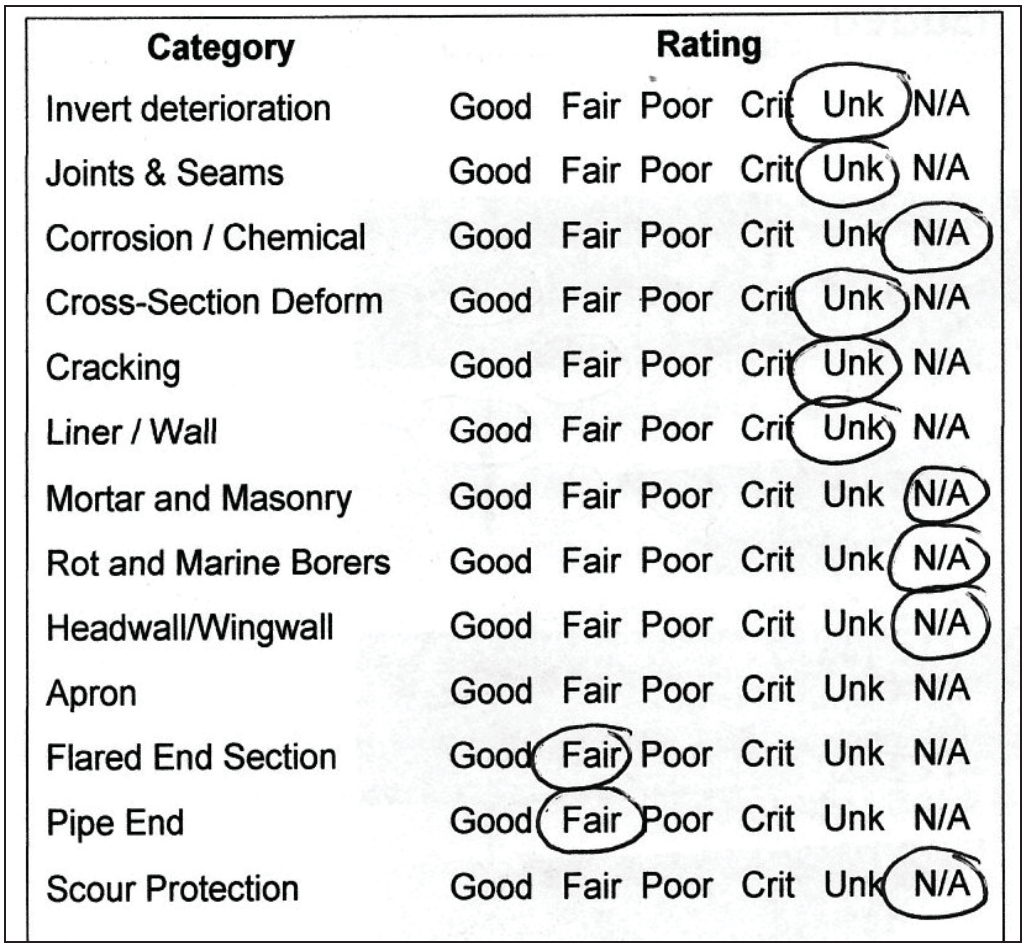


Figure 59. Flowchart. Annotated Culvert Entry Diagram for plastic HDPE example in Fountainhead Park.

The culvert condition categories were rated as shown in Figure 60 below, using the Culvert Assessment Guide. Many of the categories were rated Unknown due to the limited visibility caused by sediment and debris.



Category	Rating					
Invert deterioration	Good	Fair	Poor	Crit	Unk	N/A
Joints & Seams	Good	Fair	Poor	Crit	Unk	N/A
Corrosion / Chemical	Good	Fair	Poor	Crit	Unk	N/A
Cross-Section Deform	Good	Fair	Poor	Crit	Unk	N/A
Cracking	Good	Fair	Poor	Crit	Unk	N/A
Liner / Wall	Good	Fair	Poor	Crit	Unk	N/A
Mortar and Masonry	Good	Fair	Poor	Crit	Unk	N/A
Rot and Marine Borers	Good	Fair	Poor	Crit	Unk	N/A
Headwall/Wingwall	Good	Fair	Poor	Crit	Unk	N/A
Apron	Good	Fair	Poor	Crit	Unk	N/A
Flared End Section	Good	Fair	Poor	Crit	Unk	N/A
Pipe End	Good	Fair	Poor	Crit	Unk	N/A
Scour Protection	Good	Fair	Poor	Crit	Unk	N/A

Figure 60. Form. Annotated deterioration section of the Culvert Assessment Form for plastic example.

The decision-making part of the process, aided by the FLH Culvert Barrel Action Flowchart - Page 1 All Types as shown in the following Figure 61, was as follows.

FLH Culvert Barrel Action Flowchart - Page 1 All Types

Initial Field Assessment of Culvert Complete → Condition Rating Unknown? <Yes> → Will simple maintenance allow access? <Yes> → Request Maintenance, then Re-assess.

Based on the results for the partial Level 1 assessment and decision-making process, the recommended action is to immediately uncover the outlet and clean out the pipe to enable a complete Level 1 assessment. It is recommended that the Level 1 maintenance be done immediately to prevent roadway overtopping and possible embankment and roadway damage. Due to the small culvert size and presumably low, cross-drainage nature of the flows conveyed, total failure of the culvert is not anticipated to cause public safety issues; therefore, the culvert was not rated Critical, despite the urgency of the maintenance recommended.

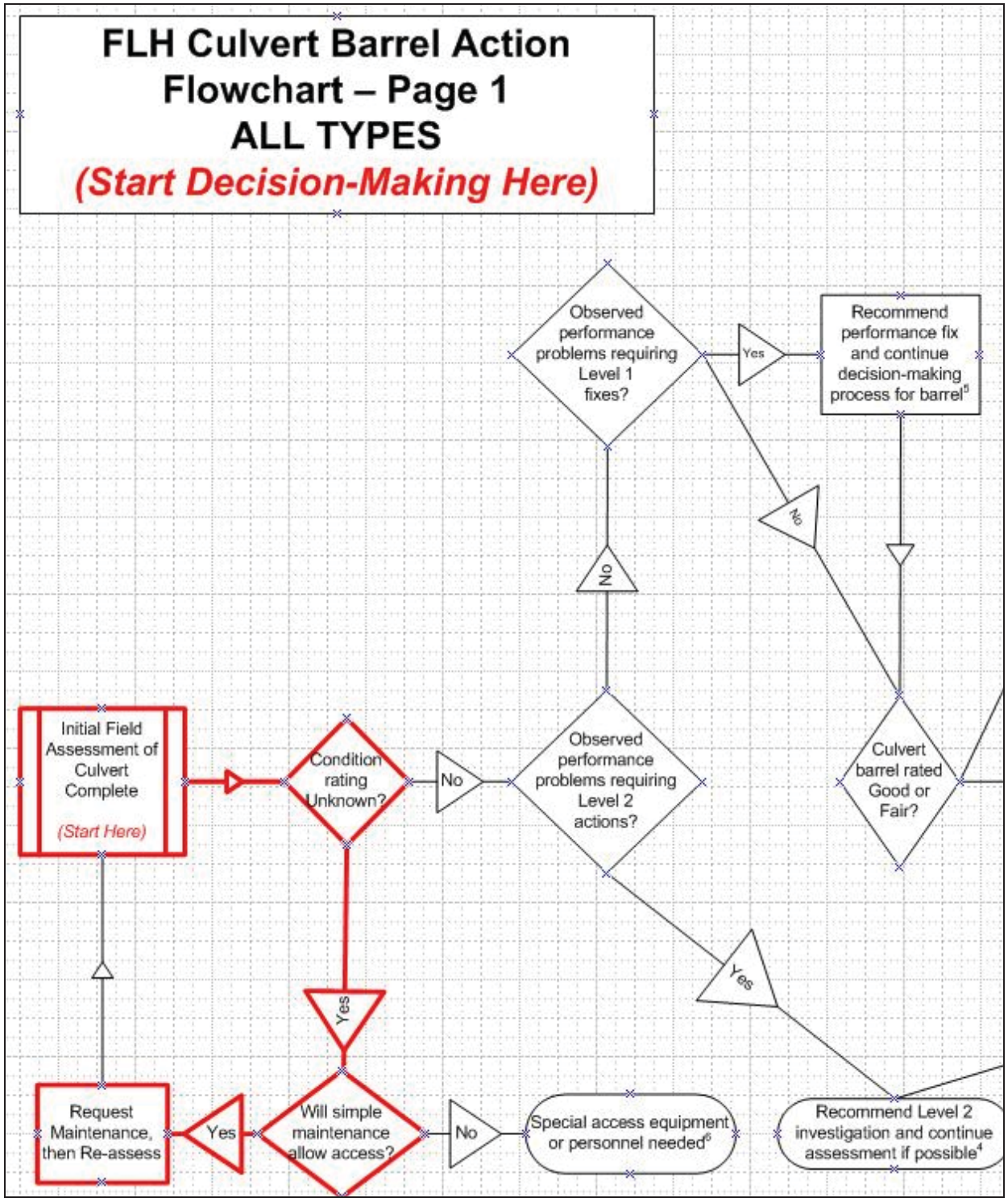


Figure 61. Flowchart. Annotated Culvert Barrel Action Flowchart – Page 1 for plastic HDPE example.