Appendix I-3
Culvert Assessment Report

APPENDIX I-3
NEW YORK STATE DEPARTMENT OF TRANSPORTATION
INTERSTATE 81 (I-81) VIADUCT PROJECT
CULVERT ASSESSMENT REPORT

INTRODUCTION

In total, AKRF surveyed and assessed 79 culverts, two bridges, and 14 stormwater outfalls located within the four Project study areas (Central Study Area, I-481 South Study Area, I-481 East Study Area, and I-481 North Study Area) in October 2017, June and August 2018, September and October 2019, June 2020, and May 2021. The results of the surveys informed the assessment of potential effects to surface waters for the Draft Design Report/Draft Environmental Impact Statement (DDR/DEIS) for the Interstate 81 (I-81) Viaduct Project (the "Project"). The culvert assessment was performed to provide a systematic assessment of aquatic organism passage (AOP) for existing culverts, to evaluate the potential for the Project to affect AOP, and to identify potential opportunities for enhancing aquatic organism passage through culvert replacement or rehabilitation.

BACKGROUND

The culvert assessment study area for each of the following four Project study areas comprises the Project area of disturbance, as well as a 100-foot buffer around the area of disturbance (see **Figure I-3-1**). The four Project study areas are as follows:

(1) Central Study Area—Located in downtown Syracuse, the Central Study Area is within the Onondaga Lake watershed and comprises two sub watersheds, those of Onondaga Creek and Ley Creek.

(2) I-481 South Study Area—Located at the I-81 and I-481 interchange south of downtown Syracuse, the I-481 South Study Area is also within the Onondaga Lake watershed and comprises two watersheds, middle Onondaga Creek and Butternut Creek. Directly to the west of the I-481 South Study Area, City Line Brook, a tributary of Onondaga Creek, surfaces from spring seeps in carbonate rock and flows in a western and northern. In the eastern portion of the I-481 South Study Area, an unnamed tributary to Butternut Creek flows from west to east, south of I-481 and north of Rock Cut Road.

(3) I-481 East Study Area—The I-481 East Study Area is a largely linear, north-south section of I-481, to east of downtown Syracuse, between the I-481 and I-90 interchange in the north and the I-481 and NYS Route-5 interchange in the south. This study area drains to two different watersheds, Butternut Creek and North Branch Ley Creek. The Butternut Creek watershed drains east and northeast and comprises Butternut Creek and seven unnamed tributaries of Butternut Creek, while the northern portion of the I-481 East Study Area drains generally east to two unnamed tributaries of North Branch Ley Creek.

(4) I-481 North Study Area—Located at the I-81 and I-481 interchange north of downtown Syracuse. This study area includes Beartrap Creek (a tributary of Ley Creek), an unnamed tributary to the Oneida River adjacent to Wetlands 10h and 10i, and Mud Creek and a number of its tributaries, which flow westwards through natural and channelized drainage ways and wetlands, eventually into the Oneida River, which discharges to Oneida Lake.

Within these study areas, culverts conveying surface waters and culverts connecting wetlands to surface waters were assessed; stormwater drainage pipe locations and conditions were noted when discovered in the field, but were not assessed for aquatic organism passage, as this is not the function of this type of structure.

The majority of the surface waters within the Project Area are characterized by disturbance. They are located in close proximity to highway and railroad infrastructure and, in many cases, have been channelized or diverted underneath roads, ramps, and railroads via culvert inlets/outlets. Those culvert structures that would potentially be impacted by the Project were assessed using the North Atlantic Aquatic Connectivity Collaborative (NAACC) 2015 rapid assessment protocol for evaluating aquatic passability at road-stream crossings[1], as described below in "Methodology." The assessments were used to identify potential opportunities for culvert replacement or enhancement and to evaluate the potential for the Project to affect surface water resources.

FIELD INSPECTION RESULTS

The results of the culvert assessment are presented below for each of the four Project study areas. In terms of the organization of the mapping and the narrative as presented in this report, delineated wetlands and surface waters are presented in an alpha-numeric format. The Project study area identifiers are the following: Central Study Area ("C"); I-481 South Study Area ("S"); I-481 East Study Area ("E"); and I-481 North Study Area ("N").

METHODOLOGY

Surface waters surveys were conducted to determine the general characteristics of all bodies of surface water within and adjacent to the project, including named and unnamed tributaries, streams, creeks, rivers, ponds, lakes, wetlands, and special aquatic sites (as defined in Section 404 of the Clean Water Act). AKRF employed methodology adapted from the United States Department of Agriculture (USDA) Forest Service 1994 Stream Channel Reference Sites: An Illustrated Guide to Field Technique and where possible, Wolman Pebble Counts were conducted. Two cross sections were taken upstream and downstream of every culvert crossing within the study areas. The initial surface waters surveys were conducted from October 2 through 6, 2017. The full results of the surface waters surveys can be found in the Wetland Delineation and Surface Waters Survey Report that is currently being prepared for inclusion in the Final EIS. More information on the methodology, and a summary of the results, can be found in **Appendix I-2: Wetland Delineation and Surface Water Assessment Memorandum**.

Following the surface water survey, the culverts were assessed using field data in conjunction with the NAACC 2015 rapid assessment protocol for evaluating aquatic passability at road-stream crossings.[2] In June and August 2018, additional culvert assessment field surveys were completed using the NAACC rapid assessment field forms in order to characterize all of the culverts within the study areas. Additional culvert surveys were completed in September and October 2019, June 2020, and May 2021. The NAACC protocol includes two scoring systems – a numeric fine rating system for computing an aquatic organism passage score ranging from 0 (severe barrier to aquatic organism passage) to 1 (no

[1] North Atlantic Aquatic Connectivity Collaborative (NAACC) 2015. Scoring Road Stream Crossings as Part of the North Atlantic Aquatic Connectivity Collaborative (NAACC).

[2] Ibid, 2016.

barrier to aquatic organism passage), and a coarse screening system with three categories: 1)"Full AOP", 2)"Reduced AOP," and 3)"No AOP." Both the coarse and fine rating methods consider the culvert inlet grade, if there is a vertical drop from the culvert outlet to the stream water surface, the substrates within the culvert, and the presence of physical barriers within and around the culvert. The coarse screening classification table is shown in **Table I-3-1**, and the fine rating parameters and equation are shown in **Table I-3-2**. For the coarse screening system, the AOP classification is assigned by comparing the culvert conditions to the descriptions in the table. A structure can only be described as having "Full AOP" if all conditions in that column are met, but if any of the conditions in the "No AOP" or "Reduced AOP" columns are met then the culvert is assigned the lower rating. In the fine rating system, each parameter is assigned a score based on the culvert condition, and then the scores are weighted and summed, and assigned a descriptor based on the final score.

Table I-3-1
NAACC Coarse Rating

Metric	Flow Condition	Crossing Classification		
		Full AOP	**Reduced AOP**	**No AOP**
		If all are true	*If any are true*	*If any are true*
Inlet Grade		At Stream Grade	Inlet Drop or Perched	
Outlet Grade		At Stream Grade		Cascade, Free Fall onto Cascade
Outlet Drop to Water Surface		= 0		≥ 1 ft
Outlet Drop to Water Surface/ Outlet Drop to Stream Bottom				> 0.5
Inlet or Outlet Water Depth	Typical-Low	> 0.3 ft		< 0.3 ft w/Outlet Drop to Water Surface > 0
	Moderate	> 0.4 ft		< 0.4 ft w/Outlet Drop to Water Surface > 0
Structure Substrate Matches Stream		Comparable or Contrasting		
Structure Substrate Coverage		100%	< 100%	
Physical Barrier Severity		None	Minor or Moderate	Severe

Table I-3-2
NAACC Fine Rating Parameters with Component Scores

Parameter	Level or Equation	Score	Weight				
Constriction	Severe	0	0.090				
	Moderate	0.5					
	Spans only bankfull/active channel	0.9					
	Spans full channel and bank s	1					
Inlet Grade	At stream grade	1	0.088				
	Inlet drop	0					
	Perched	0					
	Clogged/collapsed/submer ged	1					
	Unknown	1					
Internal Structures	None	1	0.032				
	Baffles/weirs	0					
	Supports	0.8					
	Other	1					
Outlet Armoring	Extensive	0.00	0.037				
	Not extensive	0.50					
	None	1.00					
Physical Barriers	None	1.00	0.135				
	Minor	0.80					
	Moderate	0.50					
	Severe	0.00					
Scour Pool	Large	0	0.071				
	Small	0.8					
	None	1					
Substrate Coverage	None	0	0.057				
	25%	0.3					
	50%	0.5					
	75%	0.7					
	100%	1					
Substrate Matches Stream	None	0	0.070				
	Not appropriate	0.25					
	Contrasting	0.75					
	Comparable	1					
Water Depth Matches Stream	No (significantly deeper)	0.5	0.082				
	No (significantly shallower)	0					
	Yes (comparable)	1					
	Dry (stream also dry)	1					
Water Velocity Matches Stream	No (significantly faster)	0	0.080				
	No (significantly slower)	0.5					
	Yes (comparable)	1					
	Dry (stream also dry)	1		a	b	d	k

Table I-3-2, cont'd
NAACC Fine Rating Parameters with Component Scores

Parameter	Level or Equation	Score	Weight				
Openness (x=cross sectional area/structure length)	$S_o = a*(1-e^{(-k*x*(1-d))})^{(1/(1-d))}$	-	0.052	1	-	0.62	15
Height (x)	$S_h = \min(((a*x^2) / (b^2+x^2)),1)$	-	0.045	1.1	2.2		
Outlet Drop to Water Surface (x)	$S_{od} = 1 - ((a*x^2) / (b^2+x^2))$	-	0.161	1.029412	0.51449575		
Aquatic Passability Score = Min[Composite Score, Outlet Drop score]							
Descriptor	**Aquatic Passability Score(s)**						
No barrier	1.0						
Insignificant barrier	0.80 – 0.99						
Minor barrier	0.60 – 0.79						
Moderate barrier	0.40 – 0.59						
Significant barrier	0.20 – 0.39						
Severe barrier	0.00 – 0.19						

EXISTING CONDITIONS

The existing culverts and outfalls that were assessed for the Project are described below, and summarized in **Table I-3-3** and **Table I-3-4**.

CENTRAL STUDY AREA

The Central Study Area is located in downtown Syracuse and is divided into two sub watersheds, Onondaga Creek and Ley Creek (see **Figures I-3-1** through **I-3-4**). Both are tributaries to Onondaga Lake, which is located to the west of the 100-foot study area. The majority of the Central Study Area drains to the Onondaga Creek watershed, and within the study area, Onondaga Creek flows north and northwest under I-81 and local roads. The Ley Creek watershed is in the northern part of the study area, and within the Central Study Area, Ley Creek flows southwest under I-81. In general, these water resources are characterized by disturbance associated with roadway, commercial, industrial, and residential development.

Onondaga Creek

Onondaga Creek is one of the largest tributaries to Onondaga Lake; its drainage area is approximately 110 square miles. The creek meanders in a northerly direction through the western part of the Central Study Area for 2,243 linear feet (lf), has a surface area of 2.67 acres and is classified as a NYSDEC Class C[3] stream. The southern portion of the study area, from East Brighton Avenue north to Garfield

[3] Class C waters are those that support fisheries and are suitable for non - contact activities (http://www.dec.ny.gov/permits/6042.html).

Place, is within the watershed, but does not contain the stream segment for the middle section of Onondaga Creek, which is designated as Class B. The creek is mapped by NWI as a lower perennial riverine system with an unconsolidated bottom that is permanently flooded. It is channelized within the Central Study Area, with a trapezoidal cross section and heavily armored banks. The Final NYSDEC 2018 Section 303(d) List of Impaired Waters Requiring a TMDL or other restoration strategy[4] indicates this portion of Onondaga Creek is impaired due to turbidity, deriving from streambank erosion, and contamination, which includes fecal coliform, nutrients (phosphorus), and ammonia due to Combined Sewer Overflows (CSOs), municipal sources, and urban runoff. Within the Central Study Area, 10 bridges cross Onondaga Creek (from downstream to upstream): the Bear Street bridge, the Evans Street bridge, a ramp from Franklin Street to North Water Street, a ramp from westbound I-690 to West Street, the westbound and eastbound I-690 bridges, a ramp from West Street to eastbound I-690, a ramp from West Street to Herald Place, the West Genesee Street bridge, and the Erie Boulevard bridge. The bridges span the full width of the channel during all flow conditions and do not impact aquatic organism passage.

Within the Central Study Area, along the portion of Onondaga Creek between Erie Boulevard and Evans Street, there are three stormwater outfalls ranging in size from 8 to 24 inches (C-1 through C-4), and two CSO outfalls, CSO-020, a 68-inch diameter double-barrel RCP, and CSO-021, a 30" HDPE pipe (see **Figure I-3-3** and **Table I-3-4**). The CSO outfalls discharge under high flow conditions onto a concrete spillway positioned at the level of the floodplain, above bankfull elevation. Further downstream within the Central Study Area, where Bear Street crosses over Onondaga Creek, there are four additional stormwater outfalls (C-5 through C-8), ranging in size from 12 to 30 inches in diameter (see **Figure I-3-4** and **Table I-3-4**).

Ley Creek

Located north of Onondaga Creek, Ley Creek is another large tributary to Onondaga Lake, draining an area of about 30 square miles. Ley Creek is a NYSDEC Class C stream that flows from east to west through the Central Study Area for 282 lf, with a surface area of 0.31 acres. Ley Creek is mapped by NWI as a lower perennial riverine system with an unconsolidated bottom that has been excavated and is permanently flooded. Within the Central Study Area, the creek has been channelized and has rip-rap along the upper edges of the banks and gravels along the lower edges, with common reed dominant lower on the banks of the creek and along mudflats. The 303(d) List indicates Ley Creek is impaired due to contamination, which includes fecal coliform, nutrients (phosphorus), and ammonia due to CSOs, municipal sources, and urban runoff. Additionally, Ley Creek has a fish advisory due to contaminated sediment, which contains toxins including dioxin, mercury, and PCBs.

Within the Central Study Area, a 42-inch metal stormwater outfall, designated C-4, protrudes from the stream bank at bankfull elevation (see **Figure I-3-2**). The outfall has a 2.6-foot drop from the apron to the channel bed and does not transport water under dry-weather conditions (see **Table I-3-4**). Within the study area, a ramp from Old Liverpool Road and Onondaga Lake Parkway to southbound I-81 crosses over the creek. The bridge spans the full width of the creek during all flow conditions and does not impact aquatic organism passage.

All the pipes assessed within the Central Study Area (C-1 through C-8 and CSO-021 and CSO-021) were determined to be stormwater drainage pipes or combined sanitary sewer pipes, not surface water

[4] https://www.dec.ny.gov/docs/water_pdf/section303d2018.pdf.

crossing structures, so they were not scored using NAACC methodology, as they are not intended to provide AOP.

Within the Central Study Area, two culverts convey Wetlands 1a and 1b under highway ROW (refer to **Figure I-3-2**). **Table I-3-3a** lists the rating and scores for each culvert within the study area. Culvert C-1, a 24" concrete culvert, conveys Wetland 1a underneath of the highway ROW. The culvert was observed to have no dry-weather flow within the structure, the culvert moderately constricted the wetland area, there was only about 25% substrate coverage within the culvert, there was riprap from the embankment in the channel upstream of the inlet, the outlet was slightly submerged and partially buried by sediment, and the structure had a low openness score. Due to these observed conditions, culvert C-1 was determined to have "Reduced AOP" and is an "insignificant barrier", with a fine rating score of 0.82.

Culvert C-2, a 52" concrete culvert, connects Wetland 1a to Wetland 1b underneath of the highway ROW. The culvert was observed to moderately constrict the wetland area, the culvert had extensive riprap outlet armoring, there was about 75% substrate coverage within the culvert, the outlet was slightly submerged and partially buried with sediment, and the structure had a low openness score. Due to these observed conditions, culvert C-2 was determined to have "Reduced AOP" and is a "minor barrier", with a fine rating score of 0.73.

I-481 SOUTH STUDY AREA

The majority of the I-481 South Study Area is also within the Onondaga Lake watershed, although the eastern-most portions of the I-481 South Study Area is within the Butternut Creek watershed. The majority of the study area is characterized by highway infrastructure and ancillary roads.

City Line Brook

City Line Brook, a tributary of Onondaga Creek, is the only surface water identified within or directly adjacent to the Onondaga Lake watershed portion of this study area (see **Figure I-3-1**). City Line Brook and its tributaries flow north and west, until they reach Onondaga Creek; the surface waters originate in part from surface flows from the local high points within the Study Area, which move west outside of the Study Area through fissures in the limestone Karst topography. Additionally, the historic sinkhole under southbound I-81 (filled during the construction of I-81 and now identified by NYSDOT as a gravel pit) creates a preferential flow path for from surface water from within the Study Area to enter the karst topography. The springs seep out of carbonate bedrock fractures at four identified locations along the slopes west of the Cunningham Building and the Loretto Health Care Facility, to the east of N Monticello Drive. South and to the west, in an unfilled portion of a glacial outwash ravine, emergent springs form a small creek which has historically been mapped as part of the southern tributary of City Line Brook. Downstream of the emergent springs and the resulting channels, tufa dam formations (unique formations created by mineral deposits within the stream) are present within both City Line Brook and its southern tributary (citation/reference). Downstream of the tufa formations, City Line Brook and its tributary are conveyed through the residential neighborhood via a series of lined channels, channelized un-lined channels, and pipes; City Line Brook is undergrounded at Slayton Ave and outfalls into Onondaga Creek (the middle portion) at Ballantyne Road. City Line Brook and its tributaries are also on the 303(d) List due to turbidity, fecal coliform, nutrient (phosphorus), and ammonia contamination from streambank erosion, CSOs, municipal sources, and urban runoff. These creeks do not appear on NWI maps, although they are mapped by

NYSDEC as Class B creeks. No culverts, outfalls, or bridges convey the brook through the study area, so no assessment for AOP was conducted.

Unnamed Tributary to Butternut Creek

The eastern part of the I-481 South Study Area is within the Butternut Creek Watershed, which drains to Oneida River. Within the study area, an unnamed tributary to Butternut Creek, Ont. 66-11-P 26-37-6-13,[5] flows eastward parallel to I-481 for 2,068 lf within the study are and has a surface area of 1.02 acres (see **Figure I-3-5**). Outside of the I-481 South Study Area, the creek is conveyed under Ram's Gulch Road and railroad tracks, into Ram's Gulch. The portion of the tributary that is within the study area, to the west of Rams Gulch Road, is not mapped by NYSDEC or NWI, but downstream, Ram's Gulch is mapped by NWI as a perennial riverine system with an unconsolidated bottom that is permanently flooded. Ram's Gulch is also classified as a NYSDEC Class AA stream, with AA(T) water quality standards. The tributary is not on the 2018 303(d) List. There are no culverts conveying the creek within this portion of the study area.

I-481 EAST STUDY AREA

The I-481 East Study Area includes Butternut Creek, seven unnamed tributaries of Butternut Creek, and two unnamed tributaries of North Branch Ley Creek (see **Figure I-3-1**). The I-481 East Study Area consists of linear portions of I-481 from the I-90 interchange in the north to the NYS Route-5 interchange in the south. The I-481 East Study Area is generally characterized by development associated with the railroad, businesses, industry, and roadway infrastructure, although edges of the 100-foot study area in some locations contain forested and emergent wetlands, some of which are mapped by NYSDEC and NWI.

Butternut Creek

Butternut Creek flows northeastward along the eastern edge of I-481 and discharges to Chittenango Creek, eventually discharging to Oneida Lake in Bridgeport, New York, where it has a drainage area of about 63 square miles. NWI maps the creek as a lower perennial riverine system with an unconsolidated bottom that is permanently flooded. Butternut Creek is a NYSDEC Class C stream, with Class C(T) water quality standards for the upstream portion of the creek, south of the East Genesee Street Bridge. It is listed as impaired on the 2018 303(d) List due to municipal sources contributing to fecal coliform contamination and the exceedance of the NYS Water Quality Standard for dissolved oxygen. Within the study area, the Class C(T) portion of the stream is 899 lf with a surface area of 0.79 acres, while the downstream, Class C portion of the stream is 3,861 lf with a surface area of 4.31 acres.

There are no culverts conveying Butternut Creek within the study area, but the creek passes under two bridges, the NYS Route-5 bridge and the I-481 northbound on-ramp bridge (see **Figure I-3-6**). There are six culverts that outfall along the western bank of Butternut Creek within the study area, which convey the unnamed Butternut Creek tributaries and are described below. Additionally, five

---

[5] Thompson Reuters. 2016. New York Codes, Rules and Regulations. Title 6, Chapter X, Subchapter B, Article 14. Oswego River Drainage Basin Series. Accessed October 20th, 2016 at https://govt.westlaw.com/nycrr/Browse/Home/NewYork/NewYorkCodesRulesandRegulations?guid=I3563adb0b5a111dda0a4e17826ebc834&originationContext=documenttoc&transitionType=Default&contextData=(sc.Default)&bhcp=1.]

highway stormwater runoff outfalls drain water from I-481 to the embankment that forms the western floodplain of Butternut Creek (see **Figures I-3-6** and **I-3-7**, and **Table I-3-4**).

Unnamed Tributaries to Butternut Creek

The seven unnamed tributaries to Butternut Creek that pass through the I-481 East Study Area are described below, from north to south within the study area. Within the I-481 East Study Area, a total of 12 stormwater outfalls and 40 culverts convey highway drainage, wetlands, and the unnamed tributaries to Butternut Creek through multiple flow paths, as described below. Refer to **Figures I-3-6** through **I-3-12**, and **Table I-3-3b** for culvert locations, descriptions, and causes of reduced AOP, and to **Table I-3-4** for stormwater outfall locations and descriptions.

Wetland 7—Near the northwest edge of the Butternut Creek watershed portion of the I-481 East Study Area, culvert E-40 conveys highway drainage from west to east underneath I-481 into Wetland 7 (refer to **Figure I-3-11**). The culvert is a 54" CMP with wing walls and rebar trash racks/fencing at both ends of the culvert. At the time of the culvert survey, conducted during dry-weather conditions, a thick layer of silt was present along the length of the structure, but a narrow, low-flow channel was also observed in the culvert. Additionally, the flow depth was similar to that seen upstream and downstream of the culvert, indicating that AOP for larger organisms might be less restricted at higher flows. The bars on the fencing are spaced 10” apart, allowing for small mammal movement through the channel at low flows; tracks were observed in the mud inside of the culvert, at the inlet. The culvert has a NAACC coarse rating of “Reduced AOP” and a fine score of 0.88, or an insignificant barrier to AOP.

Tributary 1—The northernmost tributary to Butternut Creek within the I-481 East Study Area is unnamed and unmapped by NWI or NYSDEC. The tributary flows southwards along the outside edges of the eastern I-481-Kirkville interchange ramps and under Kirkville Road via culvert E-38. To the east of the northbound I-481 Kirkville East ramp, the tributary is joined by a smaller tributary (identified herein as Tributary 1.1), then meanders southeast away from I-481, outside of the limits of the I-481-East Study Area, towards the confluence with Butternut Creek (see **Figure I-3-10**). Within the study area, the tributary is 2,747 lf with a surface area of 1.63 acres. Culvert E-38 is a quadruple-barrel culvert located to the west of the I-481/I-81 interchange that was observed to moderately constrict the channel and have low openness due to the length of the structures, but otherwise did not inhibit AOP. The NAACC coarse rating assigned was “Reduced AOP” and the fine rating score was 0.90, indicating that the culvert is an “insignificant barrier” to AOP.

Tributary 1.1—Along the western I-481-Kirkville interchange ramps, the tributary to Tributary 1 flows southwards, parallel to the ROW, and is conveyed under Kirkville Road via culvert E-39. Tributary 1.1 turns southeast as it is conveyed under I-481 via culvert E-37, and the confluence with Tributary 1 is downstream of the study area (see **Figure I-3-10**). Within the study area, the tributary is 2,009 lf with a surface area of 1.31 acres. The upstream culvert, E-39, is a triple-barrel culvert located to the east of the I-481/I-81 interchange that was observed to moderately constrict the channel and have low openness due to the length of the structures, but otherwise did not inhibit AOP. The culvert’s coarse rating assigned was “Reduced AOP” and the fine rating score was 0.90, indicating that the culvert is an “insignificant barrier” to AOP.

Culvert E-37, further downstream, is a relatively new double-barrel culvert, with large rip-rap cobbles armoring both the inlet and outlet, only 75% substrate coverage within the structure, and low openness due to the length of the structure under the highway. These conditions lead to a NAACC coarse rating of "Reduced AOP" and the fine rating score was 0.84, indicating that culvert E-37 is an "insignificant barrier" to AOP.

Wetland 6—Further south within the study area, I-481 is elevated over Wetland 6, a highway maintenance road, and CSX railroad tracks. Culverts E-34, E-35, and E-36 connect the east and west sides of Wetland 6 underneath of this highway maintenance road (refer to **Figure I-3-10**). Culvert E-36, the furthest north in the cluster of culverts conveying Wetland 6 under the maintenance road, is a 24" HDPE culvert with 60" metal apron, was determined to have "Reduced AOP", and was rated as an insignificant barrier to AOP, with a score of 0.86. The culvert moderately constricts the stream-wetland channel under typical flow conditions, was observed to have only 50% substrate coverage, and a small scour pool formed downstream of the culvert. Although it did not affect AOP, it should be noted that culvert E-36 had some erosion at the banks where the culvert passed under the maintenance road, and the apron was not fully connected to the culvert pipe; these structural deficiencies may result in decreased culvert performance.

Culvert E-35, a 32" HDPE culvert, connects Wetland 6 underneath of the highway maintenance road. The culvert was observed to have lower water depth and lower water velocity within the structure than in the upstream and downstream wetland area, the culvert moderately constricted the wetland area, there was only about 25% substrate coverage within the culvert, and the substrate in the culvert was gravel rather than the silt observed in the stream-wetland channel. Due to these observed conditions, culvert E-35 was determined to have "Reduced AOP" and is a "minor barrier", with a fine rating score of 0.70.

Furthest south within Wetland 6, culvert E-34, a 30" HDPE pipe with a 60" metal apron at the outlet, is the primary connection for Wetland 6 under the highway infrastructure. Culvert E-34 severely constricts the large wetland area, and was observed to have 75% substrate cover within the structure, and low openness. The culvert was determined to have a coarse rating of "Reduced AOP" and a fine rating score of 0.83, classifying it as an "insignificant barrier".

Tributary 2—Further south, and upstream within the watershed, an unnamed tributary to Butternut Creek, Ont. 66-11-P 26-37-6-2-c[6], flows east and northeast through the northern half of the I-481/I-690 interchange, via a series of stream-wetland complexes connected under the ROW by four culverts (E-26 through E-29). Within the study area, the tributary is 2,763 lf with a surface area of 0.81 acres. Downstream of culvert E-28 and upstream of culvert E-29, in the wooded portion of the interchange between southbound I-481 and northbound I-481, two small tributaries (Tributaries 2.2 and 2.3, described below) converge with Tributary 2. The junction of Tributary 2 and Tributary 2.1 (also described below) is downstream of culvert E-29, on the eastern side of northbound I-481. Tributary 2 then flows north via surface ditches and culverts (E-30, E-32, and E-33), parallel along the east side of I-481 and under Manlius Center Road and the CSX railroad tracks via culverts, before flowing east to its confluence with Butternut Creek outside of the I-481 East Study Area (see **Figure I-3-9**). Wetland 4a is hydraulically connected to Wetland 4b and Tributary 2 via culvert E-31, which conveys the surface water under I-481. NWI maps this tributary as a perennial riverine system with an unconsolidated bottom that is permanently flooded. The tributary is a NYSDEC Class C stream listed

[6] Ibid, 2016.

as impaired on the 2018 303(d) List due to municipal sources contributing to fecal coliform contamination and the exceedance of the standard for dissolved oxygen.[7]

Culvert E-26, 24" CMP culvert with wing walls mitered to the slope, is the furthest west of the culverts that convey Tributary 2 through I-481/I-690 Interchange, under the western side of the ramp from northbound I-481 to southbound I-481 (see **Figure I-3-8**). The culvert was determined to have a NAACC coarse rating of “No AOP”, and was determined to be a minor barrier, with a fine rating score of 0.73. The culvert was severely clogged by sediment, plants, and water, which reduced the capacity at the inlet and outlet, creating a sever barrier to AOP. In addition, no dry-weather flow was observed in the upstream channel and inlet during typical flow conditions, and the structure had low openness and moderately constricted the stream-wetland complex.

Downstream of culvert E-26, Tributary 2 flows northeast through the interchange before it is conveyed under the northbound I-481 to southbound I-481 ramp via culvert E-27, a 24" CMP culvert with broken wing walls mitered to the slope. The culvert had a NAACC coarse rating of “No AOP”, and was determined to be a minor barrier, with a fine rating score of 0.70. The culvert was severely clogged by debris, sediment, plants, and water, which reduced the culvert capacity at the inlet and outlet, creating a sever barrier to AOP. In addition, no dry-weather flow was observed in the upstream channel and inlet during typical flow conditions, while the water in the outlet was deeper than in the downstream stream-wetland channel, which was observed to be at a higher elevation than the culvert due to plant roots in the channel trapping sediment. The culvert also had low openness and moderately constricted the stream-wetland complex.

Tributary 2 continues to flow northeast through the interchange, before culvert E-28, 24" CMP culvert with wing walls mitered to the slope, conveys Tributary 2 under southbound I-481 (see **Figure I-3-8**). The culvert was determined to have a NAACC coarse rating of “No AOP”, and was a minor barrier to AOP, with a fine rating score of 0.65. The culvert was severely clogged by debris, sediment, plants, and water, which reduced the culvert capacity at the inlet and outlet, creating a sever barrier to AOP. Additionally, the water in the culvert was observed to be deeper than in the upstream and downstream stream-wetland complex, and the structure had low openness and severely constricted the stream-wetland channel both upstream and downstream of the culvert.

Downstream of Culvert E-28, Tributary 2 flows east through the wooded interchange, then under northbound I-481 via culvert E-29. The culvert is a 42" RCP with wing walls mitered to the slope, and during the culverts survey, the water in the culvert was observed to be deeper than that in the upstream and downstream wetlands. The NAACC coarse rating of the culvert was “Full AOP”, and the fine rating score was 0.81, making the culvert an insignificant barrier to AOP. The severe constriction of the surface water, low openness score, and slightly submerged nature of the structure contributed to the reduction in culvert AOP.

Downstream of culvert E-29, Tributary 2 flows northwards for about 30 feet, parallel to northbound I-481, before being culverted underground for about 1300 feet by culvert E-30. Culvert E-30 is a rusted and deformed 48" CMP culvert with wing walls and an apron that have been separated from the main barrel of the structure at the inlet. The top of the pipe barrel is at a lower elevation than the top of the inlet wing wall and apron structure, and the water in the culvert is deeper in the culvert than

[7] https://www.dec.ny.gov/docs/water_pdf/303dListdraft2018.pdf

in the tributary upstream and downstream. In addition to the inlet deformation, the structure severely constricts the surface water and has a low openness score. Culvert E-30 was determined to have Full AOP using the coarse rating system, and a NAACC fine rating score of 0.81, an insignificant barrier to AOP.

The culvert E-30 outlet is just upstream of where Wetland 4 converges with Tributary 2, downstream of culvert E-31 (see **Figure I-3-9**). Culvert E-31 is a 24" CMP structure, with wing walls mitered to the slope, and was determined to have a NAACC coarse rating of "Reduced AOP", with an AOP fine score of 0.84, making it an insignificant barrier to AOP. The substrate type, and water depth, and water velocity within the culvert were observed to be comparable between the structure and the surface waters upstream and downstream of the crossing. However, the culvert severely constricted the wetland and has a low openness score. Also, although it has no influence on the AOP score, it is notable that the culvert outlet was observed to be submerged during typical flow conditions.

Several hundred feet downstream, culvert E-32 conveys the Tributary 2 channel underneath of Manlius Center Road (refer to **Figure I-3-9**). The culvert is a 48" RCP structure with wing walls, with a submerged outlet and a nearly full inlet, under typical flow conditions. The culvert moderately constricts the stream channel, but otherwise does not inhibit AOP; the culvert was determined to have "Full AOP" on the NAACC coarse rating scale and a fine rating score of 0.90, which is an insignificant barrier to AOP.

Further downstream, culvert E-33 conveys Tributary 2 and Wetland 5 underneath of the CSX railroad right-of-way (refer to **Figure I-3-9**). The culvert inlet is a 36" circular CMP, while the outlet is elliptical in shape and made of HDPE; it is likely that the culvert was extended after the initial construction. The culvert moderately constricts the stream channel and has a low openness score, but otherwise is an insignificant barrier to AOP, with a NAACC fine rating score of 0.94 and a coarse rating of "Full AOP".

Tributary 2.1—The furthest downstream tributary to Tributary 2 is unmapped by NWI or NYSDEC and flows east and northeast through the I-481/I-690 interchange, beginning on the western side of the highway maintenance facility access road from the eastbound I-690 to southbound I-481 ramp (see **Figure I-3-8**). Within the study area, the tributary is 984 lf with a surface area of 0.18 acres. The tributary is conveyed east under southbound I-481 via culvert E-21, a 24" CMP culvert with wing walls mitered to the slope. During the culvert survey, no dry-weather flow was observed in culvert or channel, and plants and sediment were observed to create a moderate barrier at the culvert outlet. Additionally, the culvert created a moderate constriction of the channel, and the structure had a low openness score. Because of the observed conditions, culvert E-21 was assessed as having "Reduced AOP", and a NAACC fine score of 0.84, making the structure an insignificant barrier to AOP.

Tributary 2.1 continues for about 30 feet though the interchange before it is conveyed northeast under a highway maintenance road via culvert E-22, a 24" deformed CMP culvert with broken wing walls. The deformation of the pipe and the broken wing walls at the inlet trap sediment and plants have grown, creating a moderate barrier at the inlet. Additionally, during the culvert survey, the water in the structure was observed to be deeper than in the upstream and downstream channels, the structure moderately constricts the channel, and has a low openness score. The NAACC coarse rating for the structure was "Reduced AOP", and the NAACC fine score was 0.73, indicating that the structure is a minor barrier to AOP.

Downstream of culvert E-22, Tributary 2.1 flows northeast through a wooded area in the interchange, before being culverted under the northbound I-481 to eastbound I-690 ramp via culvert E-23. Culvert E-23 is a 36" CMP culvert with wing walls mitered to the slope. During the culvert survey, no flow was observed in the inlet or in the channel upstream of the culvert. Sediment and plants were observed to clog and elevate the channel at inlet and outlet of the culvert, creating a minor barrier. Culvert E-23 was determined to have "Reduced AOP" using the NAACC coarse rating system, and a fine rating score of 0.82, making it an insignificant barrier to AOP. The reduced AOP was also caused by the severe constriction of the channel by the culvert and low openness of the structure.

The channel downstream of culvert E-23 is not well-defined but continues to drain northeast through a wooded interchange before it flows under northbound I-481 via culvert E-24. Culvert E-24 is a rusted 36" CMP culvert with wing walls mitered to the slope, and a broken wing wall at the outlet. During the culvert survey, sediment and plants in the structure were observed to reduce the structure capacity, creating a minor barrier. Additionally, the structure was slightly submerged, and the water was deeper in the culvert than in upstream and downstream channels. Additionally, the culvert severely constricted the channel and the structure had a low openness score. Culvert E-23 was assessed as having a "Reduced AOP" using the NAACC coarse rating system, and a fine rating score of 0.78, making it a minor barrier to AOP. Downstream of culvert E-24, Tributary 2.1 continues flowing north, parallel to the highway ROW, to the confluence with Tributary 2, downstream of culvert E-29 (see **Figure I-3-8**).

Tributaries 2.2 and 2.3— The furthest upstream tributaries to Tributary 2 are within a wooded wetland area confined by highway ROW: southbound I-481, northbound I-481, the eastbound I-690 to northbound I-481 ramp, and the northbound I-481 to westbound I-690 ramp. Tributary 2.2, on the southern bank of Tributary 2, is an L-shaped channel, 1,089 lf with a surface area of 0.25 acres, and flows east and then north before the confluence with Tributary 2. Tributary 2.3 is on the right bank of the stream, approximately perpendicular to Tributary 2. Tributary 2.3 is 254 lf with a surface area of 0.08 acres. Neither of these tributaries pass through culverts.

In the center of the I-481/I-690 interchange, culvert E-25 (see **Figure I-3-8**) creates a hydrologic connection under southbound I-481. The culvert is a rusted 18" CMP with a buried or removed inlet; during the culvert survey, a little water was observed in the topographic low-point near where the inlet was expected, but the remnants of a gravel maintenance road were observed in the area, and may be covering the inlet. Dense *Phragmites* was present both upstream and downstream of the culvert. Sediment and standing water were observed to reduce culvert capacity at the outlet, creating a sever barrier. The water was deeper at the topographic low point near the buried inlet and at the culvert outlet than in the upstream and downstream wetlands. Additionally, the culvert severely constricted the channel and the structure had a low openness score. Culvert E-25 was determined to have a NAACC coarse rating of "No AOP", and a fine rating score of 0.64, which categorizes the structure as a minor barrier to AOP.

Tributary 3—A third tributary to Butternut Creek, unmapped by NWI or NYSDEC, flows north and northeast through the I-481/I-690 interchange (via culvert E-17 and E-18), beginning near the southwestern edge of Wetland 3, to the east of Towpath Road (see **Figure I-3-7**). The northern portion of Wetland 3 is also conveyed under the highway ROW via two culverts that pass under the southbound ramp from eastbound I-690 (culvert E-19) and under southbound I-481 (culvert E-20). Culvert E-19 is a 24" RCP culvert with wing walls mitered to the slope and concrete aprons at the inlet and outlet. The inlet is perched about 2 inches above the bottom of the upstream channel, and no dry-weather flow was present in the culvert or channel at the time of the culvert survey. A thick layer of sediment was visible along the entire length of the culvert, and a pile of debris and sediment was observed to create a moderate barrier at the outlet, reducing the capacity of the structure. Additionally, the culvert moderately constricted the channel and the structure had a low openness score. Culvert E-19 was determined to have a NAACC coarse rating of "Reduced AOP", and a NAACC fine score of 0.73, classifying the structure as a minor barrier to AOP. Downstream of culvert E-19, culvert E-20 continues the conveyance of Wetland 3 eastward under the highway ROW. Culvert E-20 is a 24" RCP with wing walls mitered to the slope. No dry-weather flow was observed within the culvert or the upstream and downstream channels at the time of the culvert survey. Dense *Phragmites* and a thick layer of sediment create moderate barriers at both the inlet and outlet, and reduce the culvert capacity. Additionally, the culvert moderately constricted the channel and the structure had a low openness score. Culvert E-20 was rated as having "Reduced AOP", using the NAACC coarse rating system, and had a NAACC fine rating score of 0.81, rating it as an insignificant barrier to AOP.

Tributary 3 flows through Wetland 3, north along the western side of the eastbound I-690 to southbound I-481 ramp, and is culverted under the ROW via culvert E-17. Culvert E-17 is an elliptical CMP, 24" wide and 18" tall, with metal wing walls mitered to the slope. During the culvert survey, *Phragmites* was observed to grow upstream of the inlet, downstream of the outlet, as well as within the structure itself, creating a severe barrier. Additionally, the water within the culvert was shallower than in the upstream or downstream channels. The culvert created a moderate constriction of the tributary and had a low openness score. The culvert has assessed to have "Reduced AOP" using the NAACC coarse rating scale, and was a minor barrier to AOP on the fine rating scale, with a score of 0.66.

Downstream of culvert E-17, Tributary 3 flows northeast through the southern portion of Wetland 3 in the wooded area between northbound and southbound I-481. The northern portion of Wetland 3 connects with the Tributary 3 channel just upstream of culvert E-18, which conveys the tributary under the I-481 northbound lanes and Butternut Drive, outside of the study area. Culvert E-18 is a 36" CMP culvert with wing walls mitered to the slope and rusted, broken metal apron. During the culvert survey, there was no substrate coverage within the culvert, although debris and sediment form minor barrier at broken inlet apron. The water within the culvert was shallower and faster than in the upstream or downstream channels. Additionally, the culvert created a moderate constriction of the tributary and had a low openness score. The culvert has determined to have "Reduced AOP" using the NAACC coarse rating scale, and with a fine rating score of 0.57, was a moderate barrier to AOP. Downstream of culvert E-18 and outside of the I-481 East Study Area, Tributary 3 flows northeast to the confluence with Butternut Creek. Within the Study Area, the tributary is 2,606 lf with a surface area of 0.39 acres.

Tributary 4—A fourth Butternut Creek tributary within the study area, is unmapped by NWI or NYSDEC and flows south along Towpath Road, on the west side of the I-481/I-690 interchange. Culvert E-16 conveys Tributary 4 east underneath of I-481 at the southern edge of the I-481/I-690 interchange (refer to **Figure I-3-7**). The culvert is a double-barreled structure with elliptical pipes 36" tall by 60" wide. One of the two pipes was observed to be 50-75% blocked with sediment and other debris at the time of the survey, contributing to the NAACC coarse score of "Reduced AOP". The fine rating score of 0.82 resulted in a classification of this culvert as an "insignificant barrier" to AOP. Downstream of culvert E-16, Tributary 4 flows south and east into Butternut Creek, north of Cedar Bay. Within the study area, the tributary is 247 lf with a surface area of 0.04 acres.

Tributary 5 —Ont. 66-11-P 26-37-6-8[8], locally known as Meadow Brook, flows northward along the west side of the I-481 East Study Area, approximately parallel to the ROW. NWI maps Meadow Brook as a lower perennial riverine system with an unconsolidated bottom that has been excavated and is permanently flooded. The tributary is a NYSDEC Class C stream, listed as impaired on the 2018 303(d) List due to municipal sources contributing to fecal coliform contamination and the exceedance of the standard for dissolved oxygen.[9] Within the study area, Meadow Brook, including the Cedar Bay portion, is 1,431 lf with a surface area of 0.33 acres. The tributary enters the study area just south of Route-5, to the west of the I-481/Route-5 interchange, and flows under Route-5 via culvert E-1 (see **Figure I-3-6**). The culvert is an 82" wide by 96" tall RCP box culvert with wing walls at both the inlet and outlet. The culvert has a relatively high openness score, but creates a severe constriction within the stream channel, and a minor barrier was created by a tree root and rip rap from an upstream stormwater channel, which form a weir at the downstream end of the outlet wing walls. Culvert E-1 had "Reduced AOP", and was rated as an insignificant barrier to AOP, with a NACC fine rating score of 0.88.

Downstream of culvert E-1, Meadow Brook continues to flow north, parallel to I-481, until just south of Kinne Road, when it turns to the northeast and is conveyed underneath I-481 via culvert E-15 (refer to **Figure I-3-7**). The culvert is an elliptical RCP, 66" tall by 84" wide, however, it severely constricts the stream channel, which is about 30 feet wide upstream of the crossing and about 85 feet wide downstream of the crossing. At the time of the culvert survey, algal blooms and floating debris were observed to partially clog the inlet, and the structure has a low openness score, both of which led to a minor reduction in the AOP score. The NAACC fine score for culvert E-15 was 0.84, which is equivalent to an insignificant barrier to AOP; the coarse score was "Reduced AOP." Culvert E-15, outlets upstream and to the west of the confluence of Cedar Bay and Butternut Creek, part of the old Erie Canal (see **Figure I-3-7**).

Wetland 2— Further south and upstream within the I-481 East Study Area, Wetland 2 is hydrologically connected from west to east by two culverts, draining the surface water towards Butternut Creek (**Figure 1-3-7**). The southernmost of these two structures is culvert E-14, an elliptical RCP 52" wide and 36" tall, with wing walls and headwall at the inlet and a concrete headwall with a solid metal cover over the outlet. The outlet cover blocks flow and AOP, the culvert creates a minor constriction of the stream channel, there is small scour pool at the outlet, and the culvert has low openness. Therefore, culvert E-14 was rated as having no AOP, and scored 0.00 on the fine rating scale, making it a severe barrier to AOP.

Further upstream along Butternut Creek, culvert E-13, a 30" RCP with wing walls and outlet armoring, also conveys Wetland 2 underneath of I-481 (see **Figure I-3-7**). The NAACC coarse rating of the structure was "No AOP", due to the extensive outlet armoring and 3-foot cascade down the embankment from the outlet to Butternut Creek. The culvert creates a moderate constriction in the channel, there was no substrate in structure at the time of the survey, and the structure had low openness. The NAACC fine score for culvert E-13 was 0.50, ranking it as a moderate barrier to AOP.

Tributary 6—Further upstream within the I-481 East Study Area, a sixth unnamed tributary unmapped by NWI or NYSDEC, flows through the I-481 and NYS Route-5 interchange infrastructure (see

[8] Ibid, 2016.

[9] Ibid.

Figure I-3-6). To the north of Route-5, the tributary connects Wetland 2, on the west side of the southbound I-481 exit ramp to Butternut Creek, via a series of wooded wetland-stream channels and culverts (E-10 through E-13), that flow northeast and east through the northwestern interchange and the northeastern triangle. Within the study area, the tributary is 1,369 lf with a surface area of 0.21 acres.

Culvert E-10 is a 32" RCP with wing walls and a projecting inlet that conveys Wetland 2 east under the southbound I-481 to Route-5 interchange. The culvert was determined to have no AOP on the coarse rating scale, but a fine rating score of 0.63, designating it a minor barrier. Culvert E-10 was observed to create a severe constriction of the stream channel, and a tree was growing on side of inlet wing walls, breaking the structure. Within the culvert, there was contrasting substrate (as compared to in the stream), and the culvert was dry, even though there was water in the stream at the time of the survey. Additionally, the structure has a low openness score.

Downstream along unnamed tributary 6, culvert E-11, a 24" RCP with wing walls, a projecting inlet, and a bend along the pipe alignment, conveys surface water northeast and east, from the northwestern portion of the interchange to the northeastern triangular open area within the interchange. Culvert E-11 was rated as having “No AOP” when assessed using the NAACC coarse scale, due to the severe physical barrier created by a tree growing on side of the inlet wing walls, breaking the structure and causing erosion of the bank and sedimentation, with a large and contrasting sediment type, within the structure. Additionally, the culvert creates a moderate constriction along the stream channel and has a low openness score. Using the NAACC fine rating scale, the culvert structure scored 0.61, and is classified as a minor barrier to AOP.

Further downstream along Tributary 6, culvert E-12 conveys the channel underneath of the ramp from westbound Route-5 to northbound I-481. Culvert E-12 is a 32" RCP with a projecting inlet, and concrete wing walls and aprons at both the inlet and outlet. The inlet wing walls and apron are no longer connected to the culvert barrel. At the time of the survey, the culvert was dry, even though there was water in the upstream and downstream channels. Additionally, there was about 50% substrate coverage in structure, which has a low openness score, and is a point of moderate stream constriction. Culvert E-12 was assessed as having “Reduced AOP”, with a fine rating as a minor barrier and a score of 0.71.

Upstream of Tributary 6, culvert E-9, a 24" RCP with an old cobble rip-rap cascade at the outlet, conveys surface drainage to the Butternut Creek embankment from the northbound I-481 to westbound Route-5 interchange (see **Figure I-3-6**). The structure creates minor constriction of the channel, and has a low openness score. At the time of the survey, no substrate coverage was observed in the structure and there was no flow surface flow in the culvert or the upstream or downstream channels. The structure was assessed to have “No AOP” under the coarse rating system and is a severe barrier under the fine rating system, with a score of 0.00.

Further upstream along the Butternut Creek embankment, but outside of the study area, culvert E-7, a 24" RCP with a crumbling inlet with wing walls mitered to the slope, conveys surface drainage to Butternut Creek under the eastbound Route-5 to northbound I-481 interchange (see **Figure I-3-6**). Culvert E-7 has low openness, and creates a minor constriction in the channel. Plants and sediment clog the inlet and there was no dry-weather flow in the culvert or channel at the time of the survey. The structure was determined to have “Reduced AOP”, and with a fine ratings score of 0.89, is an insignificant barrier to AOP. Further downstream, surface water is conveyed under the northbound

I-481 to eastbound Route-5 ramp via culvert E-8, a 24" RCP with wing walls and an old cobble rip-rap channel extending down the embankment to Butternut Creek. Plants and sediment clog the inlet, and at the outlet, there is extensive armoring and 4-foot cascade down the embankment. Additionally, the structure is a point of minor constriction of the stream, has low openness, and during the survey, no dry-weather flow was observed in the culvert or channel. The culvert is a severe barrier with "No AOP" under the coarse rating system and a fine rating score of 0.00.

Tributary 7—On the south side of Route 5, highway drainage and a wetland-stream complex are conveyed through the upstream-most extent of the I-481 East Study Area via five culverts (E-2 through E-6). Culvert E-2 conveys surface drainage eastward underneath the southwestern cloverleaf interchange from southbound I-481 to eastbound Route-5, beginning in the triangular interchange (see **Figure I-3-6**). Culvert E-2, is a 24" RCP with wing walls mitered to the slope at the inlet. The structure is a point of minor constriction in the channel, and plants and sediment clogged the inlet at the time of the survey, creating a minor barrier. Additionally, there was no sediment in the culvert, nor was there flow in the culvert or the channel at the time of the survey, and the structure has a low openness score. The culvert was determined to have "Reduced AOP", and is considered a minor barrier with a fine rating score of 0.76. The outlet of culvert E-2 is an unnamed stream-wetland complex, Tributary 7. Within the study area, Tributary 7 is 933 lf with a surface area of 0.27 acres.

Southeast and downstream within the interchange, culvert E-3 conveys the channel under the southbound I-481 to eastbound Route-5 ramp (see **Figure I-3-6**). The structure is a 24" RCP culvert with wing walls mitered to the slope, and is at a lower elevation than the surrounding land, making it submerged at both the inlet and the outlet, though no water was flowing in the culvert or channel at the time of the survey. The culvert is a point of minor constriction within the tributary's flow path, has a low openness score. Within the culvert, there was 75% sediment coverage at the time of the survey, and the sediment was contrasting in size from that of stream channel. Culvert E-3 was rated as having "Reduced AOP", and is an insignificant barrier with a fine rating score of 0.88. Culvert E-3 outlets to the stream-wetland complex in the interchange triangle between the eastbound Route 5 to southbound I-481 ramp and southbound I-481.

Further south, culvert E-4 conveys surface water northeast from Wetland 2 under the Route-5 to southbound I-481 ramp and into Tributary 7, downstream of the culvert E-3 outlet. Culvert E-4 is a 32" RCP culvert with wing walls mitered to the slope, with a small drop at the outlet, to a cobble-lined scour pool and energy dissipator. In addition to the low structure openness and moderate constriction of the stream channel, the culvert has extensive outlet armoring, a 0.25-foot drop to the water surface, and a small tailwater scour pool. There was no substrate coverage in structure and no dry-weather flow in the culvert or channel at the time of the survey. Culvert E-4 was determined to have a coarse rating of "Reduced AOP" and a fine rating score of 0.68, making it a minor barrier to AOP.

Further downstream, culvert E-5 conveys Tributary 7 from the west side of I-481 to the triangle on the eastern side of I-481 (see **Figure I-3-6**). Culvert E-5, a 42" RCP mitered to the slope, with wing walls and a cobble-lined scour pool and energy dissipator at the outlet. Culvert E-5 has low openness, is a point of moderate stream constriction, and has extensive outlet armoring. At the time of the survey, there was about 25% substrate coverage in the structure and no dry-weather flow in the culvert or the channel. With a coarse rating of "Reduced AOP" and a fine rating score of 0.82, the structure was rated as an insignificant barrier to AOP.

Downstream and further north, within the most southern extent of the study area, culvert E-6 convey Tributary 7 underneath the northbound I-481 to eastbound Route 5 ramp (see **Figure I-3-6**). Culvert E-6 is a 42" RCP with wing walls is mitered to the slope, which outlets into a cobble-lined energy dissipator and scour pool upstream of a short, silty, ephemeral channel in the highway embankment, several hundred feet upstream from Butternut Creek. The culvert is a point of moderate constriction and has low openness. The structure has extensive outlet armoring, a 1-foot drop to water surface, and a small tailwater scour pool. There is no substrate coverage in structure and there was no dry-weather flow in the culvert or channel at the time of the survey. This culvert was assessed to have a coarse rating of "No AOP", with a fine rating score of 0.19, and is a severe barrier to AOP.

Unnamed Tributaries to North Branch Ley Creek

The northern part of the I-481 East Study Area drains to the North Branch Ley Creek Watershed, and one unnamed tributary to North Branch Ley Creek, P 154-3-10-1, flows through the I-481 and I-90 interchange (see **Figure I-3-12**). The tributary is mapped by NYSDEC as Class C streams and is mapped by NWI as a perennial riverine system with an unconsolidated bottom that is permanently flooded. The tributary is listed as impaired on the 303(d) List due to contamination, which includes fecal coliform, nutrients (phosphorus), and ammonia from CSOs, municipal sources, and urban runoff. A fish advisory is also in place for these tributaries due to contaminated sediment containing toxins, including dioxin, mercury, and PCBs. Within the study area, the tributary is 280 lf with a surface area of 0.06 acres. This tributary has a small tributary of its own, which flows southeast from the I-90 and I-481 interchange through culvert E-42 and culvert E-43, then south along the edge of the highway ROW, as described below. Within the study area, this tributary is 793 lf with a surface area of 0.10 acres.

In the northernmost extents of the study area, culvert E-43 connects the highway interchange and Wetland 9 under southbound I-481 to eastbound I-90. The culvert is a 32" CMP culvert with wing walls mitered to the slope. The structure was observed to moderately constrict the channel and had a low openness score. Culvert E-43 was assessed as provided "Full AOP" when using the NAACC coarse rating scale, and scored a 0.89 on the NAACC fine rating scale, which is classified as an insignificant barrier to AOP.

Further downstream, culvert E-42 continues conveyance of Wetland 9 under the ramp from westbound I-90 to southbound I-481. Culvert E-42 is a 32" CMP with wing walls mitered to the slope. The structure moderately constricts the channel and had a low openness score. Culvert E-42 was determined to have "Full AOP" using the NAACC coarse rating scale, and 0.89, or an insignificant barrier to AOP, using the NAACC fine rating scale.

Downstream of culvert E-42, the tributary and Wetland 9 are conveyed under I-481 via culvert E-41, and continue east outside of the study area. During the surface waters survey, up to approximately one foot of water was observed in the creek channel to the east of culvert E-41, while to the west of the culvert the channel was poorly defined, heavily armored with gravel at the culvert inlet, and surrounded by common reed. The triple-barrel culvert structure contains one 65-inch corrugated metal pipe (CMP) that is deteriorating at the outlet and two 54-inch high-density polyethylene (HDPE) pipes that are in good condition; the pipes are encased in a concrete headwall that holds back the highway embankment. While there was no water in the channel upstream of the culverts, the downstream ends had water intruding into them at a depth of about 2 inches, and thus did not have a drop from the culvert end to the stream water surface, although there was a drop from the bottoms of the pipes to the streambed. The structure was observed to carry no flow or sediment during typical flow conditions. The NAACC coarse rating was “No AOP”, and the fine rating was moderate barrier to AOP, with a score of 0.52.

I-481 NORTH STUDY AREA

The I-481 North Study Area contains a complex system of wetlands and surface waters (see **Figure I-3-1**). This study area is generally characterized by development associated with roadway infrastructure and residential development, although edges of the 100-foot study area in some locations contain forested and emergent wetlands, some of which are mapped by NYSDEC and NWI. The I-481 North Study Area includes Beartrap Creek (a tributary of Ley Creek), an unnamed tributary to the Oneida River adjacent to Wetlands 10h and 10i, and Mud Creek and a number of its tributaries, which flow westwards through natural, channelized, and piped drainage ways and wetlands into the Oneida River, which discharges to Oneida Lake. All of the surface waters associated with Mud Creek are designated as NYSDEC Class C and are not listed on the 303(d) List of impaired waters. Beartrap Creek is designated as NYSDEC Class C(T) and is on the 303(d) List of impaired waters due to contamination, which includes fecal coliform, nutrients (phosphorus), and ammonia, from CSOs, municipal sources, and urban runoff.[10]

Unnamed tributary to Oneida River – In the very north of the study area, is an unnamed tributary to Oneida River, Ont. 66-11-11-13, flows through Wetlands 10i and 10h, and is conveyed from east to west under I-481 via culvert N-1, a 24" RCP culvert with wing walls. The pipe is slightly submerged below the elevation of the upstream and downstream channels. Additionally, the culvert created a moderate constriction of the tributary and had a low openness score. The NAACC coarse rating was “Full AOP”, and the fine score was 0.84, rating Culvert N-1 as an insignificant barrier.

Slightly further south, culvert N-2 conveys Wetland 13 westward under I-481 (see **Figure I-3-13**). The structure is a 24” RCP with wing walls and was about 25% full of sediment at the time of the surface waters survey. The structure also moderately constricted the wetland and had a low openness score. Culvert N-2 was determined to have “Reduced AOP”, and was rated an insignificant barrier to AOP, with a fine rating score of 0.81.

Unnamed Tributaries to Mud Creek

Six tributaries to Mud Creek are in the vicinity of the I-481 North Study Area and converge into the main stem of Mud Creek within the study area (see **Figure I-3-1**). Many of the tributaries are unnamed and are differentiated using their NYSDEC index stream segment numbers, where available. These tributaries all have drainage areas of less than one square mile upstream of their respective confluences with the main stem of Mud Creek (Ont. 66-11-11-10). Using the coarse screening system, the culverts conveying the Mud Creek tributaries were nearly all assessed as having reduced AOP under typical flow conditions; only culverts N-3 and N-7 were rated as having no AOP. **Table I-3-3c** describes the culverts and causes of reduced AOP; refer to **Figures I-3-13** through **I-3-16** for culvert locations.

Tributary 1 – Segment Ont. 66-11-11-10-1, Pine Grove Brook (see **Figure I-3-13**), is a Class C stream mapped by NYSDEC and a riverine intermittent streambed that is seasonally flooded (R4SBC) as per NWI. Within the study area, Pine Grove Brook is 102 lf with a surface area of 0.02 acres. Pine Grove

[10] https://www.dec.ny.gov/docs/water_pdf/section303d2018.pdf

Brook runs northwest underneath South Bay Road through culvert N-5. The culvert was designated as having reduced AOP under the coarse rating system and is considered a moderate barrier to AOP using the fine rating system, with a score of 0.60. Culvert N-5 had moderate constriction, low openness, and a small tailwater scour pool. Downstream of culvert N-5, tributary 1 turns towards the west, and flows under the north and southbound lanes of I-81 via culvert N-6, then daylights in the vicinity of a ditch. Under the coarse rating system, the culvert was determined to have reduced AOP, and using the fine rating system, culvert N-6 was designated as moderate barrier to AOP, with a score of 0.60. The culvert had moderate constriction, low openness, and there was no dry-weather flow in culvert at the time of the first survey, but at the time of the second survey, following wet weather, the water in the culvert was observed to be shallower and have a faster velocity than the water in the stream. From the outlet of culvert N-6, tributary 1 continues west into culvert N-7, running underneath a car dealership and shopping center. Culvert N-7 had no AOP using the coarse rating system, primarily due to the low openness of the culvert and bend(s) in the piping under the shopping center. However, culvert N-7 is classified as a minor barrier to AOP with a fine rating score of 0.72, due to moderate constriction, lack of substrate within the structure, and shallower and faster water in the structure than in the stream channel. Outside of the study area, Pine Grove Brook (tributary 1) daylights at NYSDEC-mapped Wetland BRE-18, a Class II wetland, west of the car dealership.

Tributary 2 – Just upstream of the culvert N-6 inlet, an unnamed, unmapped tributary converges with Pine Grove Brook (see **Figure I-3-13**). This tributary is, in part, a channel that originates on private property located east of a ROW fence, continues west into the ROW, travels through Wetland 10, and connects to a drainage ditch that runs parallel to the northbound lanes of I-81, south to Pine Grove Brook (tributary 1). The drainage ditch is not mapped by NYSDEC, NWI, or USGS. Within the study area, the tributary is 218 lf with a surface area of 0.05 acres.

Tributary 3 – As shown on **Figure I-3-13**, another tributary runs east to west through the I-481 North Study Area and is located to the north of tributary 2. It is not mapped by NYSDEC, NWI, or USGS. Within the study area, Tributary 3 is 923 lf with a surface area of 0.15 acres. This northern tributary enters the study area via culvert N-3, located to the east of the ROW fence, in the vicinity of East Pine Grove Road. Culvert N-3 was rated as having no AOP (under the coarse rating system) and being a moderate barrier, with a score of 0.56 (under the fine rating system). The low openness of the metal pipe, the drop form the pipe to the stream bed, and the small tailwater scour pool were the primary reasons for the moderate and "no AOP" ratings. The tributary continues west from the culver N-3 outlet, through the ROW, and is conveyed under I-81 via culvert N-4. Culvert N-4 is a 24" RCP with wing walls, which is mitered to the slope. The culvert was rated as having reduced AOP on the coarse rating scale and has a score of 0.65 when using the fine rating scale, making it a minor barrier to AOP. The culvert is a point of moderate constriction in the stream channel, has low openness, and sediment and plant matter form barriers at the inlet and the outlet. Tributary 3 daylights at the culvert N-4 outlet, on the west side of I-81, and connects to a north-south oriented ditch. There is an abandoned culvert located in the west bank of this drainage ditch, as shown in **Figure I-3-13**. It does not appear that flow from tributary 3 enters the abandoned culvert, which is clogged by sediment and vegetation, but instead it travels south via the drainage ditch to a confluence with Pine Grove Brook (tributary 1) on the west side of I-81, at culvert N-6. This ditch is very pronounced and maintained (i.e., by mowing) and is not mapped by NYSDEC, NWI, or USGS.

Tributary 4 – Stream segment Ont. 66-11-11-10-1-1, the South Branch of Pine Grove Brook, is north of the I-81 on-ramp from I-481 and flows from east to west underneath I-81 via culvert N-8 inlet/outlets (see **Figure I-3-13**). Culvert N-8 has reduced AOP and was designated as a minor barrier to AOP using the fine rating system, and had a score of 0.72. Culvert N-8 had a minor amount of stream constriction, little to no substrate cover within the structures, and less water in the structures than in the channels. South Branch Pine Grove Brook is a Class C stream mapped by NYSDEC and a riverine intermittent streambed that is seasonally flooded (R4SBC) as per NWI. The South Branch of Pine Grove Brook forms in the forested area east of I-81 and travels west through the I-481 North Study Area south of South Bay Road, towards the car dealership parking lot. Within the study area, the tributary is 562 lf with a surface area of 0.06 acres. Outside of the study area, South Branch Pine Grove Brook crosses under South Bay Road before being piped under the car dealership and daylighting at an NWI-mapped freshwater pond, which is the confluence of South Branch Pine Grove Brook and Pine Grove Brook.

Tributary 5 – Stream segment Ont. 66-11-11-10-2, shown on **Figure I-3-14**, is located along the east side of I-81 and flows north and west underneath I-81 and the ramps connecting to I-481 via culverts N-17, N-19, and N-14 inlet/outlets before exiting the study area, flowing under I-481, and connecting with the main branch of Mud Creek downstream of culvert N-13 (discussed below). This tributary is a Class C stream mapped by NYSDEC and a riverine intermittent streambed that is seasonally flooded (R4SBC) as per NWI. Within the study area, Tributary 5 is 1,484 lf with a surface area of 0.82 acres. As mentioned above, culverts N-17, N-19, and N-14 convey tributary Ont. 66-11-10-2[11] through the highway interchange. These culverts all have reduced AOP and are rated as insignificant and minor barriers to AOP, with the furthest upstream culvert, N-17, having the lowest rating of 0.78 (a minor barrier) due to the metal debris rack at the outlet. Culvert N-17 only had about 50% substrate coverage within the structure, some of which was comprised of cobbles, in contrast to the silt observed in the stream channel. Additionally, the growth of common reed (*Phragmites australis*) in the channel appeared to create an elevated mat of roots that raised the stream bed and created a small drop from the stream bed to the bottom of the culvert N-17 inlet, which caused a slight localized increase in water velocity. Culvert N-19, downstream of N-17, is an elliptical culvert that is 60" wide by 40" high and spans the stream channel at about bankfull elevation, and was observed to carry flow during dry-weather conditions, although a small scour pool was observed at the culvert outlet, which lowered the AOP score slightly (to 0.93), in addition to having low openness and stream channel moderate constriction. Further downstream, culvert N-14 conveys flow during dry weather conditions, but the inlet was partially clogged (about 25% of the open area was blocked) by debris and plant matter. Additionally, the substrate within culvert N-14 was not comparable with that in the channel, and covered about 75% of the structure; overall, culvert N-14 had a fine rating score of 0.90.

Culvert N-18 connects Wetland 10 under portions of the I-81 interchange with I-481, upstream of the Mud Creek tributary Ont. 66-11-10-2. The culvert was rated as having reduced AOP on the coarse rating scale and has a score of 0.88 when using the fine rating scale, making it an insignificant barrier to AOP. Culvert N-18 is also upstream of culvert N-19, and although it did not have any flow under dry-weather conditions, neither did the channel upstream or immediately downstream of the crossing. The culvert had a small outlet scour pool and only had about 25% substrate cover, and the substrate within the structure was observed to be larger than that in the channel outside of the structure.

[11] Ibid, 2016.

Tributary 6 – Stream segment Ont. 66-11-11-10-4 is also a Class C stream mapped by NYSDEC and a riverine intermittent streambed that is seasonally flooded as per NWI. This tributary flows southeast, then west, and connects with the main stem of Mud Creek, which then crosses underneath of I-481 via culvert N-25 (see **Figure I-3-15**; culvert described below). Within the study area, the tributary is 1,429 lf with a surface area of 1.95 acres.

Mud Creek

The main stem of Mud Creek, Waters Index Number Ont. 66-11-11-10,[12] originates to the east of the I-481 North Study Area and flows west underneath I-481 through a series of culverts (see **Figure I-3-14** and **Figure I-3-15**). It connects emergent and forested wetlands via culverts located underneath the highway and eventually drains to the Oneida River. The eastern part of Mud Creek is mapped by NWI as an intermittent riverine system with a seasonally flooded streambed. As the stream moves west, it becomes a lower perennial riverine system with an unconsolidated bottom that has been excavated and is permanently flooded. Within the study area, Mud Creek is 1,780 lf with a surface area of 0.59 acres. During the stream and culvert assessment survey, Mud Creek was observed to be a low gradient, low energy stream system with sections of stream/wetland complex and sections with a more defined stream channel lined with woody and herbaceous vegetation. Common reed was observed to be less prevalent in sections with more woody vegetation and more pervasive in areas adjacent to culverts. In addition to the culverts described above, there are culverts that connect wetlands (described in DEIS **Chapter Section 6-4-7.1.1**) to the main stem and tributaries of Mud Creek: culverts N-9, N-10, N-11, N-15, N-16, and N-18 (see **Figure I-3-14**). Culverts N-9, N-11, N-16, and N-18 were rated to be insignificant barrier to AOP, with scores ranging from 0.82 to 0.88, while culverts N-10 and N-15 were described as minor barriers to AOP with a scores of 0.66 and 0.78, respectively. All six culverts convey flow through the I-481 and I-81 interchange system and connect highway drainage to wetland areas, but N-10 scored lowest because of the vertical inlet, and the "minor barrier" rating for N-15 score was due to an inlet heavily clogged by debris that act as a physical barrier to aquatic organism passage.

Culverts N-9 through N-11 connect swale-like wetlands on the north side of Mud Creek to larger and more heavily vegetated wetlands on the Mud Creek floodplain. All three were dry when surveyed, with no flow in the channels up or downstream of the culverts. In addition, N-9 only had 75% substrate cover within the structure and N-10 has a vertical inlet for overflow from the wetland into the culvert structure, rather than an inlet at stream-grade due to the steep change in elevation from the upstream area to the downstream wetland on the other side of the highway ramp. N-11 did not have any additional barriers to AOP. Both N-11 and N-9 would likely have higher AOP scores under wet-weather flow conditions.

The culverts connecting the main stem of Mud Creek (N-12, N-13, and N-20 through N-25 – see **Figure I-3-14** and **Figure I-3-15**) were observed to be in moderate or good condition with little erosion or deposition and were assessed under the NAACC coarse screening system as having "Reduced AOP," with the exception of the culvert located furthest upstream (culvert N-25 – see **Figure I-3-15**), which was determined to have "No AOP," under no-flow conditions, as it does not convey water or sediment during dry-weather. The NAACC fine rating system resulted in an assessment of the culverts N-20 through N-23 as minor barriers to aquatic organism passage, with

[12] Ibid.

scores ranging from 0.68 to 0.76, while culverts N-12, N-13, N-24, and N-25 were assessed as insignificant barriers to AOP with scores of 0.86-0.92 (see **Table I-3-3c**). The culverts that convey the main stem of Mud Creek all moderately to severely constrict the stream channel, and those that were rated as "minor" barriers had shallower and faster water flowing in them than in the stream channel, making them less suitable for aquatic organism passage.

The fine rating system does not penalize culverts for having no flow when the stream channel is also not flowing, which is partially why N-25 was found to have a higher score than reflected by the coarse rating. Culvert N-24 is a double-barrel culvert that connects the channel that forms upstream of this culvert and downstream of culvert N-25 to the stream-wetland complex that is the main stem of Mud Creek (refer to Appendix I-2 for additional stream survey observations). Continuing downstream, culverts N-23, N-22 and N-21 are all large (84-inch diameter) metal structures with shallower and faster water in the structure than in the channel. As the creek increases in width and flow depth from upstream to downstream, the constriction of the channel increases from moderate at culverts N-23 and N-22 to severe at culvert N-21. Culvert N-20 is a double-barrel culvert that also severely constricts the stream channel. This double-barrel culvert utilizes a smaller (48-inch) single culvert set at a higher elevation for large storm-events and a larger (60-inch) single culvert for typical flow conditions. The constriction of the channel during typical flow conditions likely lead to the small scour pool observed downstream of the structure. Culvert N-12 is more similar to those upstream of culvert N-20; it is an 84-inch metal culvert that severely constricts the stream channel. Culvert N-13 is a 60-inch plastic double-barrel culvert. Both culverts N-12 and N-13 are mostly submerged, with very little space to carry higher flows, although neither is fully submerged, so the AOP does not reflect this condition.

Beartrap Creek

Beartrap Creek, Waters Index Number Ont. 66-12-12-P 154-3-1, is located in the vicinity of the I-481 North Study Area and flows from north to south until its confluence with Ley Creek, outside of the study area (see **Figure I-3-17** and **Figure I-3-18**). Beartrap Creek is a NYSDEC Class C(T) creek, mapped by NWI as riverine intermittent streambed that is seasonally flooded (R4SBC). Within the study area, the creek is 2,113 lf with a surface area of 0.74 acres, and is a low gradient, low sinuosity, meandering stream with a silty sand streambed with woody and herbaceous vegetation on the floodplain. Beartrap Creek and its floodplain are moderately confined by the highway ROW, a culvert (N-26), and a shared use path near the northern extent of the study area, as well as where it passes through two culvert structures (N-34 and N-35) underneath the northbound I-81/I-90 interchange within the southern extent of the I-481 North Study Area. Eight additional culverts (N-27 through N-33 and N-36) convey wetlands and stormwater underneath the I-81 ROW and were evaluated for AOP during the surface water and culvert surveys (see **Table I-3-3c**).

The culverts connecting the main stem of Beartrap Creek (N-26, N-34, and N-35 – see **Figure I-3-17** and **Figure I-3-18**) were observed to be in moderate or good condition with little erosion or deposition and moderately constrict the stream channel. The culverts were assessed under the NAACC coarse screening system as having "Reduced AOP," with the exception of Culvert N-26, which was determined to have "Full AOP." Culvert N-26 and N-35, which are large double-barrel CMP culverts conveying Beartrap Creek as described above, were determined to be "insignificant" barriers to AOP using the NAACC fine rating, with scores of 0.85 and 0.88, respectively. Culvert N-34, also a large double-barrel CMP culvert, was rated as a "minor barrier" to AOP and had a score of

0.66, due to the slightly perched inlet, low sediment coverage in the culvert, and the water in the culvert being shallower and faster than in the channel upstream or downstream of the culvert.

AOP ratings for culverts N-27 through N-33 and culvert N-36, which convey wetlands and highway drainage under the I-81 ROW, were assessed under the NAACC coarse screening system as having "Reduced AOP" (see **Figure I-3-17**, **Figure I-3-18**, and **Table I-3-3c**). These culverts all severely constrict the surface water flow and have low openness, contributing to their NAACC fine ratings that ranged from insignificant barriers to severe barriers. Culvert N-29, a 12" RCP, was determined to be an "insignificant barrier" to AOP, with a score of 0.82. Culverts N-28, N-30, and N-36 were "minor" barriers, with AOP scores of 0.74, 0.65, and 0.68, respectively. Culverts N-28 and N-30 are 12" RCPs with concrete aprons and wingwalls mitered to the slope, and culvert N-36 is a 30" RCP with a concrete apron and wingwalls that are mitered to the slope. The outlet of culvert N-30 was observed to be entirely submerged under water and about 75% full of sediment. Culverts N-27 and N-33 scored 0.50 and 0.45, respectively, which categorized them as "moderate" barriers to AOP. Culvert N-27 is a 24" RCP with internal weirs and a small scour pool downstream of the outlet, shallower and faster water than in the downstream channel, and very little sediment within the structure. Culvert N-33 is a 30" RCP with internal deformation or pipe misalignments, a small scour pool, extensive outlet armoring, minimal sediment and shallow water within the structure. Culverts N-31 and N-32 are both 24" RCP with concrete apron and wingwalls mitered to the slope and were determined to be "severe" barriers to AOP, with scores of 0.19 and 0.01, respectively. Both culverts outlet into scour pools that lead into incised tributaries to Beartrap Creek. The erosion at the outlets created one foot or larger vertical drops to the stream surface and stream bottom, inhibiting AOP, and both structures were observed to have internal deformation or pipe misalignments, shallow water, and 25% or less sediment within the structures.

Two highway drainage pipes were observed in the I-481 North Study Area, Outfall N-1 and Outfall N-2, and will be impacted by the project. Neither pipe was assessed for aquatic organism passability, as there is no dry-weather flow through the pipes. Outfall N-1 neither inlets nor outlets into wetlands or stream habitat and Outfall N-2 carries highway drainage to an outfall that empties into a gully connected to the main stem of Mud Creek. As these pipes were determined not to be crossing structures, they were not scored using NAACC methodology.

CONCLUSIONS

Based on the NAACC scoring (both fine and coarse rating) there are opportunities for improving AOP at each culvert assessed. Opportunities for addressing the parameters impeding passage range from complete replacement to address all parameters and restore full AOP, to rehabilitation of the structure or inlet or outlet grade to increase AOP within the existing structure.

Table I-3-3a
AOP of Existing Culverts Within the I-481 East Study Area

Study Area	Culvert ID	Description	NAACC Coarse AOP Rating	NAACC Fine AOP Score/ Rating	Parameter(s) Impeding Passage
Central	C-1	24" concrete culvert with wing walls, apron, and headwall mitered to the slope. Conveys Wetland 1A west under highway ROW.	Reduced AOP	0.82 Insignificant Barrier	• Moderate Constriction • Outlet armoring • 25% substrate coverage in structure • No dry-weather flow in at culvert inlet • Riprap from embankment in channel upstream of inlet • Outlet slightly submerged and partially buried with sediment • Low openness
Central	C-2	52" concrete culvert with wing walls, apron, and headwall mitered to the slope. Connects Wetland 1A to Wetland 1B under highway ROW.	Reduced AOP	0.73 Minor Barrier	• Moderate Constriction • Extensive outlet armoring • 75% substrate coverage in structure • Outlet slightly submerged and partially buried with sediment • Low openness

Table I-3-3b
AOP of Existing Culverts Within the I-481 East Study Area

Study Area	Culvert ID	Description	NAACC Coarse AOP Rating	NAACC Fine AOP Score/ Rating	Parameter(s) Impeding Passage
East	E-1	82" wide by 96" tall RCP box culvert with wing walls. Conveys Meadow Brook under Rt-5, west of the interchange with I-481.	Reduced AOP	0.88 Insignificant Barrier	• Severe Constriction • Tree root and rip rap from stormwater channel form weir at downstream of outlet wing wall
East	E-2	24" RCP culvert with wing walls, mitered to the slope. Conveys surface drainage and Wetland 2d to Butternut Creek through I-481 and Rt-5 interchange.	Reduced AOP	0.76 Minor Barrier	• Minor constriction • Plants and sediment clog inlet • No sediment in culvert • No dry-weather flow in culvert or channel • Low openness (cross sectional area / structure length)
East	E-3	24" RCP culvert with wing walls, mitered to the slope, and submerged. Conveys surface drainage to Butternut Creek through I-481 and Rt-5 interchange.	Reduced AOP	0.88 Insignificant Barrier	• Minor constriction • Inlet and outlet slope downwards so structure is submerged • 75% sediment coverage in structure, sediment contrast from stream • Low openness
East	E-4	32" RCP with wing walls mitered to the slope, a concrete apron, and a small drop to a cobble-lined scour pool/energy dissipator. Conveys surface drainage and Wetland 2a to Butternut Creek through I-481 and Route-5 interchange.	Reduced AOP	0.68 Minor Barrier	• Moderate Constriction • Extensive outlet armoring • 0.25-foot drop to water surface • Small scour pool • No substrate coverage in structure • No dry-weather flow in culvert or channel • Low openness
East	E-5	42" RCP with wing walls, mitered to the slope, with a cobble-lined scour pool/energy dissipator. Conveys surface drainage and Wetland 2b to Butternut Creek through I-481 and Rt-5 interchange.	Reduced AOP	0.82 Insignificant Barrier	• Moderate Constriction • Extensive outlet armoring • 25% substrate coverage in structure • No dry-weather flow in culvert or channel • Low openness
East	E-6	42" RCP culvert with wing walls, mitered to the slope, with a cobble-lined scour pool/energy dissipator. Conveys surface drainage and Wetland 2c to Butternut Creek through I-481 and Rt-5 interchange.	No AOP	0.19 Severe Barrier	• Moderate Constriction • Extensive outlet armoring • 1-foot drop to water surface at outlet • Small scour pool • No substrate coverage in structure • No dry-weather flow in culvert or channel • Low openness
East	E-7	24" RCP culvert with crumbling inlet, mitered to the slope. Conveys surface drainage to Butternut Creek through I-481 and Rt-5 interchange.	Reduced AOP	0.89 Insignificant Barrier	• Minor constriction • Plants and sediment clog inlet • No dry-weather flow in culvert or channel • Low openness

Table I-3-3b, cont.
AOP of Existing Culverts Within the I-481 East Study Area

Study Area	Culvert ID	Description	NAACC Coarse AOP Rating	NAACC Fine AOP Score / Rating	Parameter(s) Impeding Passage
East	E-8	24" RCP culvert with wing walls, an apron, and an extensive cobble rip-rap energy dissipator. Outlets to slightly eroded preferential flow path on Butternut Creek embankment. Conveys surface drainage to Butternut Creek through I-481 and Route 5 interchange.	No AOP	0.00 Severe Barrier	• Minor constriction • Plants and sediment clog inlet • Extensive outlet armoring and 4-foot cascade • No dry-weather flow in culvert or channel • Low openness
East	E-9	24" RCP culvert with wing walls, an apron, and a light cobble rip-rap energy dissipator. Outlets to slightly eroded preferential flow path on Butternut Creek embankment. Conveys surface drainage to Butternut Creek through I-481 and Rt-5 interchange.	No AOP	0.00 Severe Barrier	• Minor constriction • Extensive outlet armoring and 4-foot cascade • No substrate coverage in structure • No dry-weather flow in culvert or channel • Low openness
East	E-10	32" RCP culvert with wing walls and a projecting inlet. Conveys Wetland 2i to Butternut Creek through I-481 and Rt-5 interchange.	No AOP	0.63 Minor Barrier	• Severe Constriction • Tree growing on side of inlet wing wall, breaking the structure • Contrasting substrate in structure • Dry culvert, with water in the stream • Low openness
East	E-11	24" RCP culvert with wing walls, a projecting inlet, and a bend along the pipe alignment. Conveys Wetland 2h to Butternut Creek through I-481 and Rt-5 interchange.	No AOP	0.61 Minor Barrier	• Moderate Constriction • Tree growing on side of inlet wing wall, breaking the structure • Contrasting substrate in structure • Shallow water depth and low velocity • Low openness
East	E-12	32" RCP culvert with wing walls and a projecting inlet. Conveys Wetland 2i to Butternut Creek through I-481 and Rt-5 interchange.	Reduced AOP	0.71 Minor Barrier	• Moderate Constriction • Inlet wing wall and apron broken off pipe • Dry culvert, with water in the stream • 50% substrate coverage in structure • Low openness
East	E-13	30" RCP culvert with wing walls and outlet armoring. Conveys Wetlands 2i and 2q underneath I-481.	No AOP	0.50 Moderate Barrier	• 3-foot cascade from culvert to stream • Moderate constriction • Extensive outlet armoring • No substrate in structure • Low openness
East	E-14	Elliptical RCP culvert - 52" wide and 36" tall. Metal cover and concrete headwall at outlet, wingwalls and headwall at inlet. Conveys Wetlands 2i and 2q underneath I-481.	No AOP	0.00 Severe Barrier	• Metal cover over outlet blocks flow • Minor constriction • Small scour pool • Low openness

Table I-3-3b, cont.
AOP of Existing Culverts Within the I-481 East Study Area

Study Area	Culvert ID	Description	NAACC Coarse AOP Rating	NAACC Fine AOP Score / Rating	Parameter(s) Impeding Passage
East	E-15	Elliptical RCP culvert, 84" wide by 66" tall with headwalls and wing walls. Conveys Meadow Brook to Cedar Bay.	Reduced AOP	0.84 Insignificant Barrier	• Moderate Constriction • Debris and algae form a moderate physical barrier at the stream surface • Low openness
East	E-16	Double-barrel culvert under I-481. Elliptical CMPs, 60" wide by 36" tall, with headwall and wing walls. Conveys an Unnamed Butternut Creek Tributary under I-481.	Reduced AOP	0.85 Insignificant Barrier	• Severe constriction • One culvert pipe is 50-75% full of debris and sediment • Low openness
East	E-17	Elliptical CMP culvert - 24" wide and 18" tall - with wing walls. Conveys Wetland 3a to an Unnamed Butternut Creek Tributary.	Reduced AOP	0.66 Minor Barrier	• Moderate constriction • Plants are moderate barrier at inlet, outlet, and within the structure • Shallow water depth • Low openness
East	E-18	36" CMP culvert with wing walls mitered to the slope and rusted apron. Conveys Wetland 3a to an Unnamed Butternut Creek Tributary.	Reduced AOP	0.57 Moderate Barrier	• Moderate constriction • Debris and sediment form minor barrier at broken inlet apron • No substrate coverage • Shallow water depth and high velocity • Low openness
East	E-19	24" RCP culvert with wing walls mitered to the slope. Conveys Wetlands 3b and 3e through I-481/I-690 Interchange.	Reduced AOP	0.73 Minor Barrier	• Moderate constriction • Perched inlet • Debris and sediment are moderate barrier at the outlet • No dry-weather flow in culvert or channel • Low openness
East	E-20	24" RCP culvert with wing walls mitered to the slope. Conveys Wetlands 3e and 3a through I-481/I-690 Interchange.	Reduced AOP	0.81 Insignificant Barrier	• Moderate constriction • Plants and sediment are moderate barrier at both the inlet and outlet • No dry-weather flow in culvert or channel • Low openness
East	E-21	24" CMP culvert with wing walls mitered to the slope. Conveys Wetland 3q through I-481/I-690 Interchange.	Reduced AOP	0.84 Insignificant Barrier	• Moderate constriction • Plants and sediment are moderate barrier at the outlet • No dry-weather flow in culvert or channel • Low openness
East	E-22	24" deformed CMP culvert with broken wing walls. Conveys Wetlands 3f and 3h through I-481/I-690 Interchange.	Reduced AOP	0.73 Minor Barrier	• Severe constriction • Deformed and broken pipe and wing walls, plants, and sediment are moderate barrier at the inlet • Water deeper in culvert than in wetland and downstream channel • Low openness

Table I-3-3b, cont.
AOP of Existing Culverts Within the I-481 East Study Area

Study Area	Culvert ID	Description	NAACC Coarse AOP Rating	NAACC Fine AOP Score / Rating	Parameter(s) Impeding Passage
East	E-23	36" CMP culvert with wing walls mitered to the slope. Conveys Wetlands 3h and 3k through I-481/I-690 Interchange.	Reduced AOP	0.82 Insignificant Barrier	• Severe constriction • Sediment and plants elevate the channel at inlet and outlet - a minor barrier • No dry-weather flow in upstream channel and inlet • Low openness
East	E-24	36" CMP culvert with wing walls mitered to the slope. Conveys Wetlands 3k and 3l through I-481/I-690 Interchange.	Reduced AOP	0.78 Minor Barrier	• Severe constriction • Sediment and plants reduce capacity - a minor barrier • Water deeper in culvert than in upstream and downstream wetlands • Low openness
East	E-25	18" CMP culvert with buried or removed inlet. Hydrologic connection between I-481/I-690 Interchange ramps.	No AOP	0.64 Minor Barrier	• Severe constriction • Clogged/collapsed/buried inlet • Sediment, plants, and water clog and reduce capacity at the outlet - sever barrier • Water deeper at inlet and outlet than in upstream and downstream wetlands • Low openness
East	E-26	24" CMP culvert with wing walls mitered to the slope. Conveys Wetlands 3m and 3n through I-481/I-690 Interchange.	No AOP	0.75 Minor Barrier	• Moderate constriction • Clogged/collapsed inlet • Sediment, plants, and water clog and reduce capacity at the inlet and outlet - sever barrier • No dry-weather flow in upstream channel and inlet • Low openness
East	E-27	24" CMP culvert with broken wing walls and mitered to the slope. Conveys Wetlands 3n and 3o through I-481/I-690 Interchange.	No AOP	0.70 Minor Barrier	• Moderate constriction • Clogged/collapsed inlet • Sediment, plants, and water clog and reduce capacity at the inlet and outlet - sever barrier • Debris and sediment form moderate barrier at both inlet and outlet • No dry-weather flow in upstream channel and inlet. Water in outlet is deeper than in downstream channel, which is at a higher elevation due to plant roots and sediment. • Low openness

Table I-3-3b, cont.
AOP of Existing Culverts Within the I-481 East Study Area

Study Area	Culvert ID	Description	NAACC Coarse AOP Rating	NAACC Fine AOP Score / Rating	Parameter(s) Impeding Passage
East	E-28	24" CMP culvert with wing walls mitered to the slope. Conveys Wetlands 3o and 3p through I-481/I-690 Interchange.	No AOP	0.66 Minor Barrier	• Severe constriction • Clogged/collapsed inlet • Sediment, plants, and water clog and reduce capacity at the inlet and outlet - sever barrier • Water deeper in culvert than upstream or downstream wetlands • Low openness
East	E-29	42" RCP culvert with wing walls mitered to the slope. Conveys Wetlands 3p and 3l through I-481/I-690 Interchange.	Full AOP	0.81 Insignificant Barrier	• Severe constriction • Water deeper in culvert than in upstream and downstream wetlands • Low openness
East	E-30	48" CMP culvert with wing walls. Conveys unnamed stream-wetland complex north towards Wetland 5 and an Unnamed Butternut Creek Tributary.	Full AOP	0.81 Insignificant Barrier	• Severe constriction • Clogged/collapsed inlet • Water deeper in culvert than in upstream and downstream wetlands • Low openness
East	E-31	24" CMP culvert with wing walls mitered to the slope. Connects Wetland 4 under I-481 to an Unnamed Butternut Creek Tributary.	Full AOP	0.84 Insignificant Barrier	• Severe constriction • Low openness
East	E-32	48" RCP culvert with wing walls. Conveys Unnamed Butternut Creek Tributary under Manlius Center Road.	Full AOP	0.90 Insignificant Barrier	• Moderate constriction
East	E-33	Circular 36" CMP inlet extended with elliptical 42" wide by 24" high HDPE pipe at outlet. Conveys Unnamed Butternut Creek Tributary under CSX railroad tracks.	Full AOP	0.89 Insignificant Barrier	• Moderate constriction • Low openness
East	E-34	30" HDPE culvert with 60" metal apron on downstream side. Connects Wetlands 6a and 6b under highway maintenance road under highway bridge.	Reduced AOP	0.83 Insignificant Barrier	• Severe Constriction • 75% sediment coverage in structure • Low openness
East	E-35	32" HDPE culvert. Connects Wetlands 6a and 6b under highway maintenance road under highway bridge.	Reduced AOP	0.70 Minor Barrier	• Moderate constriction • 25% substrate coverage in structure • Substrate in structure contrasting to substrate in channel • Shallower water and slower velocity • Low openness
East	E-36	24" HDPE culvert with 60" metal apron. Connects to Wetlands 6c and 6d under highway maintenance road under highway bridge. Standing, stagnant water in pipe during dry weather.	Reduced AOP	0.86 Insignificant Barrier	• Moderate constriction • Small scour pool • 50% substrate coverage in structure

Table I-3-3b, cont.
AOP of Existing Culverts Within the I-481 East Study Area

Study Area	Culvert ID	Description	NAACC Coarse AOP Rating	NAACC Fine AOP Score / Rating	Parameter(s) Impeding Passage
East	E-37	Two 42" HDPE culverts with wing walls. Convey Wetland 6c and Unnamed Butternut Creek Tributary under I-481 to confluence with Butternut Creek.	Reduced AOP	0.84 Insignificant Barrier	• Moderate constriction • Extensive outlet armoring • Low openness
East	E-38	Three elliptical CMPs - 60" wide by 36" tall, with wing walls. Conveys highway drainage ditch and Wetland 6f under Kirkville Road, east of I-481, to Butternut Creek.	Reduced AOP	0.90 Insignificant Barrier	• Moderate constriction • Low openness
East	E-39	Four elliptical CMPs - 60" wide by 36" tall, with wing walls. Conveys highways drainage ditch under Kirkville Road, west of I-481, into Wetland 6c and Unnamed Butternut Creek Tributary.	Reduced AOP	0.90 Insignificant Barrier	• Moderate constriction • Low openness
East	E-40	54" CMP culvert with wing walls. Connects highway drainage ditch to Wetland 7 under I-481 – tributary of Butternut Creek.	Reduced AOP	0.91 Insignificant Barrier	• Minor constriction • Inlet and outlet trash racks with 10" openings • Low openness
East	E-41	One 65" CMP culvert and two 54" HDPE culverts set in a concrete headwall. Outlets into Wetland 9b – tributary of North Branch Ley Creek.	No AOP	0.52 Moderate Barrier	• Severe Constriction • Perched Inlet • Small scour pool • Lack of substrate in structure • Shallow water depth and low velocity
East	E-42	32" CMP culvert with wing walls mitered to the slope. Conveys Wetland 9a through the I-90 and I-481 Interchange.	Full AOP	0.89 Insignificant Barrier	• Moderate constriction • Low openness
East	E-43	32" CMP culvert with wing walls mitered to the slope. Conveys Wetland 9a through the I-90 and I-481 Interchange.	Full AOP	0.89 Insignificant Barrier	• Moderate constriction • Low openness

Table I-3-3c
AOP of Existing Culverts Within the I-481 North Study Area

Study Area	Culvert ID	Description	NAACC Coarse AOP Rating	NAACC Fine AOP Score/ Rating	Parameter(s) Impeding Passage
North	N-1	24" RCP with wing walls. Conveys Wetlands 10h and 10i from east to west under I-481	Full AOP	0.84 Insignificant Barrier	• Moderate constriction • Culvert is slightly submerged • Low openness (cross sectional area / structure length)
North	N-2	24" RCP with wing walls. Conveys Wetlands 13a and 13b from east to west under I-481.	Reduced AOP	0.81 Insignificant Barrier	• Moderate constriction • About 25% filled with sediment • Low openness (cross sectional area / structure length)
North	N-3	18" CMP, outlet protruding from bank. Conveys unnamed tributary to Pine Grove Brook from where it was piped under residential units towards I-481.	No AOP	0.56 Moderate Barrier	• Moderate constriction • Small tail water scour pool • No substrate coverage in structure • No dry-weather flow in culvert • Low openness
North	N-4	24" RCP with wing walls, mitered to the slope. Conveys unnamed tributary to Pine Grove Brook from east to west under I-481.	Reduced AOP	0.65 Minor Barrier	• Moderate constriction • Sediment and plant matter form barriers at inlet and outlet • Low openness
North	N-5	24" RCP with outlet protruding from embankment. Conveys Pine Grove Brook under South Bay Road	Reduced AOP	0.60 Moderate Barrier	• Moderate constriction • Small tail water scour pool • Low openness
North	N-6	32" RCP with wing walls mitered to slope. Conveys Pine Grove Brook under I-481	Reduced AOP	0.60 Moderate Barrier	• Moderate constriction • No substrate coverage in structure • No dry-weather flow in culvert, during wet weather flows, water is shallower and has a faster velocity • Low openness
North	N-7	32" RCP with wing walls detached from main pipe. Conveys Pine Grove Brook west under shopping center	No AOP	0.72 Minor Barrier	• Moderate constriction • No substrate coverage in structure • Shallower water and faster velocity • Bend in pipe and long pipe network under developed area • Low openness
North	N-8	36" RCP. Outlets into dense common reed low area on edge of highway that becomes South Branch of Pine Grove Brook.	Reduced AOP	0.72 Minor Barrier	• Minor constriction • 25% substrate coverage in structure • Shallower water and faster velocity • Low openness
North	N-9	24" RCP. Inlet and outlet are Mud Creek tributary wetland areas.	Reduced AOP	0.86 Insignificant Barrier	• Moderate constriction • No dry-weather flow in culvert or channel • Low openness

Table I-3-3c, cont.
AOP of Existing Culverts Within the I-481 North Study Area

Study Area	Culvert ID	Description	NAACC Coarse AOP Rating	NAACC Fine AOP Score/ Rating	Parameter(s) Impeding Passage
North	N-10	24" RCP. Inlet and outlet are highway drainage swale tributary to Wetland 10m and Mud Creek. No dry weather flow.	Reduced AOP	0.66 Minor Barrier	• Moderate constriction • Vertical inlet • No dry-weather flow in culvert or channel • Low openness
North	N-11	24" CMP. Inlet and outlet are highway drainage swale tributary to Wetland 10l and Mud Creek. No dry weather flow.	Reduced AOP	0.88 Insignificant Barrier	• Moderate constriction • No dry-weather flow in culvert or channel • Low openness
North	N-12	84" CMP. Inlet and outlet are Mud Creek.	Reduced AOP	0.90 Insignificant Barrier	• Severe constriction
North	N-13	60" HDPE double-barrel culvert. Inlet and outlet are Mud Creek.	Reduced AOP	0.86 Insignificant Barrier	• Severe constriction • Most of the culvert is submerged • Low openness
North	N-14	60" CMP. Inlet and outlet are Mud Creek tributary Ont. 66-11-10-2.	Reduced AOP	0.90 Insignificant Barrier	• Moderate constriction • Low openness
North	N-15	24" CMP. Inlet is a drainage ditch area, outlet is Wetland 10.	Reduced AOP	0.78 Minor Barrier	• Moderate constriction • Inlet partially clogged by debris and plant matter • Low openness
North	N-16	24" RCP. Outlets to drainage ditch connected to Wetland 10 by culvert N-9.	Reduced AOP	0.82 Insignificant Barrier	• Moderate constriction • No dry-weather flow in culvert or channel • Low openness
North	N-17	60" CMP. Inlet and outlet are Mud Creek tributary Ont. 66-11-10-2	Reduced AOP	0.78 Minor Barrier	• Moderate constriction • Outlet has metal trash rack • Some cobbles in the culvert • *Phragmites* created mat that elevated stream bed at inlet and caused drop into inlet
North	N-18	36" CMP. Connects drainage ditches in Wetlands 10r and 10s under clover leaf ramp.	Reduced AOP	0.88 Insignificant Barrier	• Moderate constriction • Small outlet scour pool
North	N-19	Elliptical CMP - 60" wide by 40" high. Inlet and outlet are Mud Creek tributary Ont. 66-11-10-2	Reduced AOP	0.93 Insignificant Barrier	• Low openness

Table I-3-3c, cont.
AOP of Existing Culverts Within the I-481 North Study Area

Study Area	Culvert ID	Description	NAACC Coarse AOP Rating	NAACC Fine AOP Score/ Rating	Parameter(s) Impeding Passage
North	N-20	Double-barrel culvert. 60” CMP and 48” RCP set at a higher elevation. Inlet and outlet are Mud Creek.	Reduced AOP	0.68 Minor Barrier	• Severe constriction • Small scour pool • Shallower water and faster velocity • Low openness
North	N-21	84" CMP. Inlet and outlet are Mud Creek.	Reduced AOP	0.70 Minor Barrier	• Severe constriction • Shallower water and faster velocity
North	N-22	84" CMP. Inlet and outlet are Mud Creek.	Reduced AOP	0.76 Minor Barrier	• Moderate constriction • Shallower water and faster velocity
North	N-23	84" CMP. Inlet and outlet are Mud Creek.	Reduced AOP	0.68 Minor Barrier	• Moderate constriction • Substrate in structure differs from substrate in channel • Shallower water and faster velocity
North	N-24	Double-barrel 24" RCP. Inlets and outlets are Mud Creek under Thompson Road.	Reduced AOP	0.86 Insignificant Barrier	• Moderate constriction • Substrate in structure contrasting from substrate in channel
North	N-25	56” CMP, 20’ long concrete headwall. Inlet is Wetland 10w, outlet is Mud Creek. No dry-weather flow through the culvert.	Reduced AOP	0.92 Insignificant Barrier	• No dry-weather flow in culvert or channel
North	N-26	Double-barrel culvert with two elliptical CMP - 144" wide by 78" high, with wingwalls mitered to the slope. Inlet and outlets are Beartrap Creek and adjacent Wetland 15f and 15e.	Full AOP	0.85 Insignificant Barrier	• Moderate constriction • Cobbles from embankment present in culvert and channel • Shallower water • High openness • Eastern culvert provides extra conveyance for high flows, though it is somewhat blocked by *Phragmites* and silt.
North	N-27	24" RCP with concrete apron and wingwalls mitered to the slope. Conveys surface water and highway drainage west to east under I-81 ROW. Outlet is Beartrap Creek.	Reduced AOP	0.50 Moderate Barrier	• Severe constriction • Internal weirs • Small scour pool • No substrate coverage in structure • Shallower water and faster velocity • Low openness
North	N-28	12" RCP with concrete apron and wingwalls mitered to the slope. Conveys surface water and highway drainage west to east under I-81 ROW. Outlets on the floodplain/embankment of Beartrap Creek.	Reduced AOP	0.74 Minor Barrier	• Severe constriction • Shallower water than in stream • Low openness
North	N-29	12" RCP. Conveys surface water and highway drainage west to east under I-81 ROW. Outlets in Wetland 15e, upstream of Beartrap Creek.	Reduced AOP	0.82 Insignificant Barrier	• Severe constriction • Low openness

Table I-3-3c, cont.
AOP of Existing Culverts Within the I-481 North Study Area

Study Area	Culvert ID	Description	NAACC Coarse AOP Rating	NAACC Fine AOP Score/ Rating	Parameter(s) Impeding Passage
North	N-30	12" RCP with concrete apron and wingwalls mitered to the slope. Conveys surface water and highway drainage west to east under I-81 ROW. Outlets in Wetland 15e, upstream of Beartrap Creek. Completely submerged at time of survey.	Reduced AOP	0.65 Minor Barrier	• Severe constriction • Outlet is entirely submerged and about 75% full of sediment • Deeper water than in stream • Low openness
North	N-31	24" RCP with concrete apron and wingwalls mitered to the slope. Conveys surface water and highway drainage under I-81 ROW. Outlet is a small, incised channel tributary to Beartrap Creek.	Reduced AOP	0.19 Severe Barrier	• Severe constriction • Deformation/pipe misalignment within the structure • Small scour pool and outlet drop • 25% substrate coverage in structure • Shallower water than in stream • Low openness
North	N-32	24" RCP with concrete apron and wingwalls mitered to the slope. Conveys surface water and highway drainage west to east under I-81 ROW. Outlet is an incised tributary to Beartrap Creek and is heavily eroded around structure.	Reduced AOP	0.01 Severe Barrier	• Severe constriction • Deformation/pipe misalignment within the structure • Large scour pool and outlet drop • No substrate coverage in structure • Shallower water and faster velocity • Low openness
North	N-33	30" RCP with concrete apron, wingwalls mitered to the slope, and headwall. Conveys Wetland 15d under I-81 interchange ROW. Outlets in an armored channel in Wetland 15e, upstream of Beartrap Creek.	Reduced AOP	0.45 Moderate Barrier	• Severe constriction • Extensive outlet armoring • Deformation/pipe misalignment within the structure • Small scour pool • No substrate coverage in structure • Shallower water than in stream • Low openness
North	N-34	Double-barrel culvert with two elliptical CMP - 114" wide by 78" high, with wingwalls mitered to the slope. Inlet and outlets are Beartrap Creek.	Reduced AOP	0.66 Minor Barrier	• Moderate constriction • Perched inlet • 25% substrate coverage in structure • Shallower water and faster velocity • High openness
North	N-35	Double-barrel culvert with two 87" CMP and concrete headwall. Inlet and outlets are Beartrap Creek.	Reduced AOP	0.88 Insignificant Barrier	• Moderate constriction • Inlet partially blocked by woody debris • Deeper water than in stream • High openness
North	N-36	30" RCP with concrete apron and wingwalls mitered to the slope. Conveys surface water and highway drainage under I-81 ROW. Outlets in an armored scour pool upstream of Wetland 15b.	Reduced AOP	0.68 Minor Barrier	• Severe constriction • Extensive outlet armoring • No substrate coverage in structure • Low openness

Table I-3-4
Existing Outfalls Observed During Field Work Within the Study Areas[1]

Study Area	Outfall ID	Description
Central	CSO-020	68" concrete double-barrel culvert, one closed with 90" cast iron cap, 20.3' concrete apron. Combined Sewer Overflow (CSO) outfall, CSO-20. Outlets to Onondaga Creek, 1.5 feet above the creek bed.
Central	C-1	8" metal outfall. Stormwater runoff conveyance. Outlets to Onondaga Creek, 2.5 feet above the creek bed.
Central	CSO-021	30" high density polyethylene (HDPE) outfall. Set flush with bridge pier, in the constructed "floodplain". CSO outfall CSO-021. Outlets to Onondaga Creek, 5.5 feet above the creek bed.
Central	C-2	24" HDPE pipe, 59" metal apron. Set in the constructed "floodplain". Stormwater runoff conveyance. Outlets to Onondaga Creek, 4.5 feet above the creek bed.
Central	C-3	Three 14" clay pipes with stone surround, half buried in water and sediment in the stream bank/bed. Stormwater runoff conveyance. Outlets to Onondaga Creek.
Central	C-4	42" corrugated metal pipe (CMP) outfall, 90" metal apron. Stormwater runoff drainage. Outlets into Ley Creek, 2.6 feet above the creek bed.
Central	C-5	Elliptical RCP outfall pipe, 24" wide and 12" tall, with a concrete headwall protruding from the eroded embankment under the bridge. Stormwater outfall, outlets to Onondaga Creek.
Central	C-6	Elliptical RCP outfall pipe, 60" wide and 36" tall, with a concrete headwall protruding from the eroded embankment under the bridge. Stormwater outfall, outlets to Onondaga Creek.
Central	C-7	24" HDPE outfall pipe with wing walls, upstream of rip-rap cascade, and forebay enclosed by geotextile-covered concrete. Forebay overflows into Onondaga Creek.
Central	C-8	34" CMP outfall with concrete headwall. Stormwater runoff drainage. Creates a small scour pool where it outlets into Onondaga Creek.
East	E-1	24" RCP outfall pipe with wing walls. Conveys highway stormwater drainage from northwestern portion of I-481 and Kirkville interchange to unnamed tributary of Butternut Creek.
East	E-2	24" RCP outfall pipe with wing walls. Conveys highway stormwater drainage from southwestern portion of I-481 and Kirkville interchange to unnamed tributary of Butternut Creek.
East	E-3	24" RCP outfall pipe with wing walls. Conveys highway stormwater drainage under I-481 southbound on-ramp to unnamed tributary of Butternut Creek.
East	E-4	24" RCP outfall pipe with wing walls. Conveys highway stormwater drainage to unnamed tributary of Butternut Creek under I-481 northbound off ramp to Krikville Road.
East	E-5	24" RCP outfall pipe with wing walls. Conveys highway stormwater drainage from southeastern portion of I-481 and Kirkville interchange to unnamed tributary of Butternut Creek.
East	E-6	24" RCP outfall pipe with wing walls. Conveys highway stormwater drainage from northeastern portion of I-481 and Kirkville interchange to unnamed tributary of Butternut Creek.
East	E-7	24" CMP outfall pipe with 4" drop from pipe to embankment. Conveys highway stormwater drainage to highway embankment upstream of Butternut Creek.
East	E-8	24" CMP outfall pipe with 2" drop from pipe to embankment. Conveys highway stormwater drainage to highway embankment upstream of Butternut Creek.
East	E-9	24" RCP outfall pipe with wing walls, a trash rack within the pipe, and 6" drop from the apron to the embankment. Conveys highway stormwater drainage to highway embankment upstream of Butternut Creek.
East	E-10	Elliptical CMP outfall pipe, 30" wide and 20" tall, with rusted metal wing walls and apron, and 6" drop from the apron to the embankment. Conveys highway stormwater drainage to highway embankment upstream of Butternut Creek.
East	E-11	24" CMP outfall pipe with rusted metal wing walls and apron, and 4" drop from pipe to embankment. Conveys highway stormwater drainage to highway embankment upstream of Butternut Creek.
East	E-12	12" RCP outfall, half buried in sediment and vegetation. Conveys highway stormwater drainage to I-481 & Rt.-5 quad.
North	N-1	24" reinforced concrete pipe (RCP). Highway drainage. Outlets into dry swale densely populated with common reed.
North	N-2	36" CMP. Highway drainage. Outlets into a steep wet-weather flow drainage ditch to Mud Creek that appears to be eroding the culvert outlet.

Notes: [1]Additional outfalls are likely present within all study areas, but were not observed or evaluated during field work.

ATTACHMENTS

Culvert Component Score Descriptive Table

Culvert Component Scores Table

AKRF

Project: I-81 Viaduct Project

Component Score Descriptive Table - North Study Area

Culvert ID	**N-1**	**N-2**	**N-3**	**N-4**	**N-5**	**N-6**	**N-7**	**N-8**
Constriction: Wetted width at low flow compared to channel wetted width	Moderate: The crossing is greater than 50% of the bankfull or active width of the natural stream, but less than the full bankfull or active channel width	Moderate: The crossing is greater than 50% of the bankfull or active width of the natural stream, but less than the full bankfull or active channel width	Moderate: The crossing is greater than 50% of the bankfull or active width of the natural stream, but less than the full bankfull or active channel width	Moderate: The crossing is greater than 50% of the bankfull or active width of the natural stream, but less than the full bankfull or active channel width	Moderate: The crossing is greater than 50% of the bankfull or active width of the natural stream, but less than the full bankfull or active channel width	Moderate: The crossing is greater than 50% of the bankfull or active width of the natural stream, but less than the full bankfull or active channel width	Moderate: The crossing is greater than 50% of the bankfull or active width of the natural stream, but less than the full bankfull or active channel width	Spans only bankfull/active channel: The crossing encompasses the approximate width of the bankfull or active channel
Inlet grade: An observation of the relative elevation of the stream bottom as it enters the structure. This is not an assessment of stream slope (gradient).	Clogged/ Collapsed/ Submerged: The structure inlet is either full of debris, collapsed, or completely underwater	At Stream Grade: The inlet of the structure is at approximately the same elevation as the stream bottom upstream of the structure.	Unknown: Inlet is outside of the Study Area.	At Stream Grade: The inlet of the structure is at approximately the same elevation as the stream bottom upstream of the structure.	Unknown: Inlet is outside of the Study Area.	At Stream Grade: The inlet of the structure is at approximately the same elevation as the stream bottom upstream of the structure.	At Stream Grade: The inlet of the structure is at approximately the same elevation as the stream bottom upstream of the structure.	At Stream Grade: The inlet of the structure is at approximately the same elevation as the stream bottom upstream of the structure.
Internal structures: These may include baffles or weirs used to slow flow velocities and help to pass fish, as well as trusses, rods, piers or other structures intended to support a crossing structure, but which may interfere with flow and aquatic organism passage.	None: There are no apparent structures inside the crossing structure	None: There are no apparent structures inside the crossing structure	None: There are no apparent structures inside the crossing structure	None: There are no apparent structures inside the crossing structure	None: There are no apparent structures inside the crossing structure	None: There are no apparent structures inside the crossing structure	None: There are no apparent structures inside the crossing structure	None: There are no apparent structures inside the crossing structure
Outlet armoring: Indicate the presence and extent of material placed below the outlet for the purpose of diffusing flow and minimizing scour. The most common form of outlet armoring is a layer of riprap placed below the outlet. A few pieces of rock that may have fallen into the stream near the structure's outlet do not constitute outlet armoring. Armoring of the road embankment and stream banks should not be confused with armoring of the stream bottom.	None: You may observe rocks that have fallen from the embankment or that are natural to the stream.	None: You may observe rocks that have fallen from the embankment or that are natural to the stream.	None: You may observe rocks that have fallen from the embankment or that are natural to the stream.	None: You may observe rocks that have fallen from the embankment or that are natural to the stream.	None: You may observe rocks that have fallen from the embankment or that are natural to the stream.	None: You may observe rocks that have fallen from the embankment or that are natural to the stream.	None: You may observe rocks that have fallen from the embankment or that are natural to the stream.	None: You may observe rocks that have fallen from the embankment or that are natural to the stream.
Physical barriers: Examples include debris/sediment/rock, deformation, fencing, a dry structure (when the stream is flowing)	None: There are no physical barriers associated with this structure.	Debris/Sediment/Rock: Woody debris or synthetic material, rock, or sediment blocks the flow of water into or through the structure. This can consist of wood or other vegetation, trash, sand, gravel, or rock. Moderate: 10% - 50% of open area blocked. About 4" of sediment is present at the inlet and 6" of sediment at the outlet.	Dry: There is no water in this structure, though water is flowing in the stream. Minor: May be passable at somewhat higher flows.	Debris/Sediment/Rock: Woody debris or synthetic material, rock, or sediment blocks the flow of water into or through the structure. This can consist of wood or other vegetation, trash, sand, gravel, or rock. Severe: > 50% of open area blocked. About 15" of sediment is present at the outlet. A root and soil mat creates and elevation barrier at the inlet.	None: There are no physical barriers associated with this structure.	None: There are no physical barriers associated with this structure.	None: There are no physical barriers associated with this structure.	None: There are no physical barriers associated with this structure.
Scour pool: This is a pool created downstream of a crossing as a result of high flows exiting the crossing. Use as a reference natural pools in a portion of the stream that is outside the influence of the crossing structure. A scour pool is considered to exist when its size (a combination of length, width, and depth) is larger than pools found in the natural stream.	None: There is no difference between the length, width, or depth of the tailwater pool compared with reference pools, or no tailwater pool exists at the site.	None: There is no difference between the length, width, or depth of the tailwater pool compared with reference pools, or no tailwater pool exists at the site.	Small: The tailwater pool is between one and two times the length, width, or depth of reference pools.	None: There is no difference between the length, width, or depth of the tailwater pool compared with reference pools, or no tailwater pool exists at the site.	Small: The tailwater pool is between one and two times the length, width, or depth of reference pools.	None: There is no difference between the length, width, or depth of the tailwater pool compared with reference pools, or no tailwater pool exists at the site.	None: There is no difference between the length, width, or depth of the tailwater pool compared with reference pools, or no tailwater pool exists at the site.	None: There is no difference between the length, width, or depth of the tailwater pool compared with reference pools, or no tailwater pool exists at the site.
Substrate coverage: The extent of the substrate inside the crossing structure as a continuous layer across the entire bottom of the structure from bank to bank.	100%: Substrate forms a continuous layer throughout the entire structure.	100%: Substrate forms a continuous layer throughout the entire structure.	None: Substrate covers less than 25% of the length of the structure, or there is no substrate inside the structure at all.	100%: Substrate forms a continuous layer throughout the entire structure.	100%: Substrate forms a continuous layer throughout the entire structure.	None: Substrate covers less than 25% of the length of the structure, or there is no substrate inside the structure at all.	None: Substrate covers less than 25% of the length of the structure, or there is no substrate inside the structure at all.	25%: Substrate covers at least 25% of the length of the structure.
Substrate matches stream: Comparison of the substrate (e.g., rock, gravel, sand) inside the structure and the substrate in the natural, undisturbed stream channel.	Comparable: The substrate inside the structure is similar in size to the substrate in the natural stream channel.	Comparable: The substrate inside the structure is similar in size to the substrate in the natural stream channel.	None: Select this option when there is very little (e.g., a thin layer of silt or a few pieces of rock) or no substrate inside the structure.	Comparable: The substrate inside the structure is similar in size to the substrate in the natural stream channel.	Comparable: The substrate inside the structure is similar in size to the substrate in the natural stream channel.	None: Select this option when there is very little (e.g., a thin layer of silt or a few pieces of rock) or no substrate inside the structure.	None: Select this option when there is very little (e.g., a thin layer of silt or a few pieces of rock) or no substrate inside the structure.	Comparable: The substrate inside the structure is similar in size to the substrate in the natural stream channel.
Water Depth Matches Stream: Compare the water depth inside the structure with the water depth in the natural stream channel away from the influence of the crossing.	No-Deeper: The water depth in the crossing is greater than depths that occur naturally in a similar length of the undisturbed stream.	Comprable: The depth in the crossing falls within the range of depths naturally occurring in that reach of the stream and for comparable distances along the length of the stream.	No-Shallower: The water depth in the crossing is less than depths that occur naturally in a similar length of the undisturbed stream, or the shallower depth through the structure covers a greater length than occurs in the natural stream.	Comprable: The depth in the crossing falls within the range of depths naturally occurring in that reach of the stream and for comparable distances along the length of the stream.	Comprable: The depth in the crossing falls within the range of depths naturally occurring in that reach of the stream and for comparable distances along the length of the stream.	No-Shallower: The water depth in the crossing is less than depths that occur naturally in a similar length of the undisturbed stream, or the shallower depth through the structure covers a greater length than occurs in the natural stream.	No-Shallower: The water depth in the crossing is less than depths that occur naturally in a similar length of the undisturbed stream, or the shallower depth through the structure covers a greater length than occurs in the natural stream.	No-Shallower: The water depth in the crossing is less than depths that occur naturally in a similar length of the undisturbed stream, or the shallower depth through the structure covers a greater length than occurs in the natural stream.
Water Velocity Matches Stream: Compare the water velocity inside the structure with the velocity in the natural stream channel away from the influence of the crossing.	Comprable: The water velocity in the crossing falls within the range of velocities naturally occurring in that reach of the stream for comparable distances.	Comprable: The water velocity in the crossing falls within the range of velocities naturally occurring in that reach of the stream for comparable distances.	No-Slower: The velocity in the crossing is less than velocities that occur naturally in a similar length of the undisturbed stream.	Comprable: The water velocity in the crossing falls within the range of velocities naturally occurring in that reach of the stream for comparable distances.	Comprable: The water velocity in the crossing falls within the range of velocities naturally occurring in that reach of the stream for comparable distances.	No-Faster: The water velocity in the structure is greater than velocities that occur naturally in a similar length of the undisturbed stream, or the velocity through the structure persists over a longer distance than occurs in the natural stream.	No-Faster: The water velocity in the structure is greater than velocities that occur naturally in a similar length of the undisturbed stream, or the velocity through the structure persists over a longer distance than occurs in the natural stream.	No-Faster: The water velocity in the structure is greater than velocities that occur naturally in a similar length of the undisturbed stream, or the velocity through the structure persists over a longer distance than occurs in the natural stream.
Openess (x=cross sectional area/structure length)	0.02	0.02	0.00	0.02	0.01	0.02	0.00	0.03
Height of structure (ft)	2.00	2.00	1.50	2.00	1.50	2.50	2.50	3.00
Outlet drop to water surface (ft)	0.00	0.00	0.21	0.00	0.00	0.00	0.00	0.00

Project: I-81 Viaduct Project

Component Score Descriptive Table - North Study Area

Culvert ID	N-9	N-10	N-11	N-12	N-13	N-14	N-15	N-16
Constriction: Wetted width at low flow compared to channel wetted width	Moderate: The crossing is greater than 50% of the bankfull or active width of the natural stream, but less than the full bankfull or active channel width	Moderate: The crossing is greater than 50% of the bankfull or active width of the natural stream, but less than the full bankfull or active channel width	Moderate: The crossing is greater than 50% of the bankfull or active width of the natural stream, but less than the full bankfull or active channel width	Severe: The total width of the crossing is less than 50% of the bankfull or active width of the natural stream, or the total wetted width of the crossing is less than 50% of the wetted width of the stream.	Severe: The total width of the crossing is less than 50% of the bankfull or active width of the natural stream, or the total wetted width of the crossing is less than 50% of the wetted width of the stream.	Moderate: The crossing is greater than 50% of the bankfull or active width of the natural stream, but less than the full bankfull or active channel width	Moderate: The crossing is greater than 50% of the bankfull or active width of the natural stream, but less than the full bankfull or active channel width	Moderate: The crossing is greater than 50% of the bankfull or active width of the natural stream, but less than the full bankfull or active channel width
Inlet grade: An observation of the relative elevation of the stream bottom as it enters the structure. This is not an assessment of stream slope (gradient).	At Stream Grade: The inlet of the structure is at approximately the same elevation as the stream bottom upstream of the structure.	Perched: The inlet of the structure is set too high for the stream, and little water passes through the structure during normal low summer flows, though the stream has water upstream and downstream of the crossing. The structure inlet is above the surface of water in the stream. Water can enter the structure only at higher flows.	At Stream Grade: The inlet of the structure is at approximately the same elevation as the stream bottom upstream of the structure.	At Stream Grade: The inlet of the structure is at approximately the same elevation as the stream bottom upstream of the structure.	At Stream Grade: The inlet of the structure is at approximately the same elevation as the stream bottom upstream of the structure.	At Stream Grade: The inlet of the structure is at approximately the same elevation as the stream bottom upstream of the structure.	Clogged/ Collapsed/ Submerged: The structure inlet is either full of debris, collapsed, or completely underwater	At Stream Grade: The inlet of the structure is at approximately the same elevation as the stream bottom upstream of the structure.
Internal structures: These may include baffles or weirs used to slow flow velocities and help to pass fish, as well as trusses, rods, piers or other structures intended to support a crossing structure, but which may interfere with flow and aquatic organism passage.	None: There are no apparent structures inside the crossing structure	None: There are no apparent structures inside the crossing structure	None: There are no apparent structures inside the crossing structure	None: There are no apparent structures inside the crossing structure	None: There are no apparent structures inside the crossing structure	None: There are no apparent structures inside the crossing structure	None: There are no apparent structures inside the crossing structure	None: There are no apparent structures inside the crossing structure
Outlet armoring: Indicate the presence and extent of material placed below the outlet for the purpose of diffusing flow and minimizing scour. The most common form of outlet armoring is a layer of riprap placed below the outlet. A few pieces of rock that may have fallen into the stream near the structure's outlet do not constitute outlet armoring. Armoring of the road embankment and stream banks should not be confused with armoring of the stream bottom.	None: You may observe rocks that have fallen from the embankment or that are natural to the stream.	None: You may observe rocks that have fallen from the embankment or that are natural to the stream.	None: You may observe rocks that have fallen from the embankment or that are natural to the stream.	None: You may observe rocks that have fallen from the embankment or that are natural to the stream.	None: You may observe rocks that have fallen from the embankment or that are natural to the stream.	None: You may observe rocks that have fallen from the embankment or that are natural to the stream.	None: You may observe rocks that have fallen from the embankment or that are natural to the stream.	None: You may observe rocks that have fallen from the embankment or that are natural to the stream.
Physical barriers: Examples include debris/sediment/rock, deformation, fencing, a dry structure (when the stream is flowing)	None: There are no physical barriers associated with this structure.	Other: Vertical inlet. Severe: > 0.5 foot vertical drop	None: There are no physical barriers associated with this structure.	None: There are no physical barriers associated with this structure.	None: There are no physical barriers associated with this structure.	None: There are no physical barriers associated with this structure.	Debris/Sediment/Rock: Woody debris or synthetic material, rock, or sediment blocks the flow of water into or through the structure. This can consist of wood or other vegetation, trash, sand, gravel, or rock. Moderate: 10% - 50% of open area blocked	None: There are no physical barriers associated with this structure.
Scour pool: This is a pool created downstream of a crossing as a result of high flows exiting the crossing. Use as a reference natural pools in a portion of the stream that is outside the influence of the crossing structure. A scour pool is considered to exist when its size (a combination of length, width, and depth) is larger than pools found in the natural stream.	None: There is no difference between the length, width, or depth of the tailwater pool compared with reference pools, or no tailwater pool exists at the site.	None: There is no difference between the length, width, or depth of the tailwater pool compared with reference pools, or no tailwater pool exists at the site.	None: There is no difference between the length, width, or depth of the tailwater pool compared with reference pools, or no tailwater pool exists at the site.	None: There is no difference between the length, width, or depth of the tailwater pool compared with reference pools, or no tailwater pool exists at the site.	None: There is no difference between the length, width, or depth of the tailwater pool compared with reference pools, or no tailwater pool exists at the site.	None: There is no difference between the length, width, or depth of the tailwater pool compared with reference pools, or no tailwater pool exists at the site.	None: There is no difference between the length, width, or depth of the tailwater pool compared with reference pools, or no tailwater pool exists at the site.	None: There is no difference between the length, width, or depth of the tailwater pool compared with reference pools, or no tailwater pool exists at the site.
Substrate coverage: The extent of the substrate inside the crossing structure as a continuous layer across the entire bottom of the structure from bank to bank.	75%: Substrate covers at least 75% of the length of the structure.	100%: Substrate forms a continuous layer throughout the entire structure.	100%: Substrate forms a continuous layer throughout the entire structure.	100%: Substrate forms a continuous layer throughout the entire structure.	100%: Substrate forms a continuous layer throughout the entire structure.	100%: Substrate forms a continuous layer throughout the entire structure.	75%: Substrate covers at least 75% of the length of the structure.	25%: Substrate covers at least 25% of the length of the structure.
Substrate matches stream: Comparison of the substrate (e.g., rock, gravel, sand) inside the structure and the substrate in the natural, undisturbed stream channel.	Comparable: The substrate inside the structure is similar in size to the substrate in the natural stream channel.	Comparable: The substrate inside the structure is similar in size to the substrate in the natural stream channel.	Comparable: The substrate inside the structure is similar in size to the substrate in the natural stream channel.	Comparable: The substrate inside the structure is similar in size to the substrate in the natural stream channel.	Comparable: The substrate inside the structure is similar in size to the substrate in the natural stream channel.	Comparable: The substrate inside the structure is similar in size to the substrate in the natural stream channel.	Contrasting: The substrate inside the structure is different in size from the substrate in the natural channel.	Contrasting: The substrate inside the structure is different in size from the substrate in the natural channel.
Water Depth Matches Stream: Compare the water depth inside the structure with the water depth in the natural stream channel away from the influence of the crossing.	Yes: dry	Yes: dry	Yes: dry	Comprable: The depth in the crossing falls within the range of depths naturally occurring in that reach of the stream and for comparable distances along the length of the stream.	Comprable: The depth in the crossing falls within the range of depths naturally occurring in that reach of the stream and for comparable distances along the length of the stream.	Comprable: The depth in the crossing falls within the range of depths naturally occurring in that reach of the stream and for comparable distances along the length of the stream.	Comprable: The depth in the crossing falls within the range of depths naturally occurring in that reach of the stream and for comparable distances along the length of the stream.	Yes: dry
Water Velocity Matches Stream: Compare the water velocity inside the structure with the velocity in the natural stream channel away from the influence of the crossing.	Dry (stream also dry)	Dry (stream also dry)	Dry (stream also dry)	Comprable: The water velocity in the crossing falls within the range of velocities naturally occurring in that reach of the stream for comparable distances.	Comprable: The water velocity in the crossing falls within the range of velocities naturally occurring in that reach of the stream for comparable distances.	Comprable: The water velocity in the crossing falls within the range of velocities naturally occurring in that reach of the stream for comparable distances.	Comprable: The water velocity in the crossing falls within the range of velocities naturally occurring in that reach of the stream for comparable distances.	Dry (stream also dry)
Openess (x=cross sectional area/structure length)	0.04	0.02	0.02	0.43	0.06	0.06	0.04	0.03
Height of structure (ft)	2.00	2.00	2.00	7.00	5.00	5.00	2.00	2.00
Outlet drop to water surface (ft)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

AKRF

Project: I-81 Viaduct Project

Component Score Descriptive Table - North Study Area								
Culvert ID	**N-17**	**N-18**	**N-19**	**N-20**	**N-21**	**N-22**	**N-23**	**N-24**
Constriction: Wetted width at low flow compared to channel wetted width	Moderate: The crossing is greater than 50% of the bankfull or active width of the natural stream, but less than the full bankfull or active channel width	Moderate: The crossing is greater than 50% of the bankfull or active width of the natural stream, but less than the full bankfull or active channel width	Spans only bankfull/active channel: The crossing encompasses the approximate width of the bankfull or active channel	Severe: The total width of the crossing is less than 50% of the bankfull or active width of the natural stream, or the total wetted width of the crossing is less than 50% of the wetted width of the stream.	Severe - The total width of the crossing is less than 50% of the bankfull or active width of the natural stream, or the total wetted width of the crossing is less than 50% of the wetted width of the stream.	Moderate: The crossing is greater than 50% of the bankfull or active width of the natural stream, but less than the full bankfull or active channel width	Moderate: The crossing is greater than 50% of the bankfull or active width of the natural stream, but less than the full bankfull or active channel width	Moderate: The crossing is greater than 50% of the bankfull or active width of the natural stream, but less than the full bankfull or active channel width
Inlet grade: An observation of the relative elevation of the stream bottom as it enters the structure. This is not an assessment of stream slope (gradient).	Inlet Drop: Water in the stream has a near-vertical drop from the stream channel down into the inlet of the structure.	At Stream Grade: The inlet of the structure is at approximately the same elevation as the stream bottom upstream of the structure.	At Stream Grade: The inlet of the structure is at approximately the same elevation as the stream bottom upstream of the structure.	At Stream Grade: The inlet of the structure is at approximately the same elevation as the stream bottom upstream of the structure.	At Stream Grade: The inlet of the structure is at approximately the same elevation as the stream bottom upstream of the structure.	At Stream Grade: The inlet of the structure is at approximately the same elevation as the stream bottom upstream of the structure.	At Stream Grade: The inlet of the structure is at approximately the same elevation as the stream bottom upstream of the structure.	At Stream Grade: The inlet of the structure is at approximately the same elevation as the stream bottom upstream of the structure.
Internal structures: These may include baffles or weirs used to slow flow velocities and help to pass fish, as well as trusses, rods, piers or other structures intended to support a crossing structure, but which may interfere with flow and aquatic organism passage.	None: There are no apparent structures inside the crossing structure	None: There are no apparent structures inside the crossing structure	None: There are no apparent structures inside the crossing structure	None: There are no apparent structures inside the crossing structure	None: There are no apparent structures inside the crossing structure	None: There are no apparent structures inside the crossing structure	None: There are no apparent structures inside the crossing structure	None: There are no apparent structures inside the crossing structure
Outlet armoring: Indicate the presence and extent of material placed below the outlet for the purpose of diffusing flow and minimizing scour. The most common form of outlet armoring is a layer of riprap placed below the outlet. A few pieces of rock that may have fallen into the stream near the structure's outlet do not constitute outlet armoring. Armoring of the road embankment and stream banks should not be confused with armoring of the stream bottom.	None: You may observe rocks that have fallen from the embankment or that are natural to the stream.	None: You may observe rocks that have fallen from the embankment or that are natural to the stream.	None: You may observe rocks that have fallen from the embankment or that are natural to the stream.	None: You may observe rocks that have fallen from the embankment or that are natural to the stream.	None: You may observe rocks that have fallen from the embankment or that are natural to the stream.	None: You may observe rocks that have fallen from the embankment or that are natural to the stream.	None: You may observe rocks that have fallen from the embankment or that are natural to the stream.	None: You may observe rocks that have fallen from the embankment or that are natural to the stream.
Physical barriers: Examples include debris/sediment/rock, deformation, fencing, a dry structure (when the stream is flowing)	Fencing: The structure has some sort of fencing. It may directly block the movement of aquatic and terrestrial organisms, and it may become clogged with debris. Minor: Widely spaced wires or grating with > 0.5 foot (6") gaps. Debris/Sediment/Rock: Woody debris or synthetic material, rock, or sediment blocks the flow of water into or through the structure. Minor: < 10% of the open area of the structure is blocked.	None: There are no physical barriers associated with this structure.	None: There are no physical barriers associated with this structure	None: There are no physical barriers associated with this structure.	None: There are no physical barriers associated with this structure.	None: There are no physical barriers associated with this structure.	None: There are no physical barriers associated with this structure.	None: There are no physical barriers associated with this structure.
Scour pool: This is a pool created downstream of a crossing as a result of high flows exiting the crossing. Use as a reference natural pools in a portion of the stream that is outside the influence of the crossing structure. A scour pool is considered to exist when its size (a combination of length, width, and depth) is larger than pools found in the natural stream.	None: There is no difference between the length, width, or depth of the tailwater pool compared with reference pools, or no tailwater pool exists at the site.	Small: The tailwater pool is between one and two times the length, width, or depth of reference pools.	None: There is no difference between the length, width, or depth of the tailwater pool compared with reference pools, or no tailwater pool exists at the site.	Small: The tailwater pool is between one and two times the length, width, or depth of reference pools.	None: There is no difference between the length, width, or depth of the tailwater pool compared with reference pools, or no tailwater pool exists at the site.	None: There is no difference between the length, width, or depth of the tailwater pool compared with reference pools, or no tailwater pool exists at the site.	None: There is no difference between the length, width, or depth of the tailwater pool compared with reference pools, or no tailwater pool exists at the site.	None: There is no difference between the length, width, or depth of the tailwater pool compared with reference pools, or no tailwater pool exists at the site.
Substrate coverage: The extent of the substrate inside the crossing structure as a continuous layer across the entire bottom of the structure from bank to bank.	50%: Substrate covers at least 50% of the length of the structure.	100%: Substrate forms a continuous layer throughout the entire structure.	100%: Substrate forms a continuous layer throughout the entire structure.	100%: Substrate forms a continuous layer throughout the entire structure.	50%: Substrate covers at least 50% of the length of the structure.	75%: Substrate covers at least 75% of the length of the structure.	75%: Substrate covers at least 75% of the length of the structure.	100%: Substrate forms a continuous layer throughout the entire structure.
Substrate matches stream: Comparison of the substrate (e.g., rock, gravel, sand) inside the structure and the substrate in the natural, undisturbed stream channel.	Comparable: The substrate inside the structure is similar in size to the substrate in the natural stream channel.	Comparable: The substrate inside the structure is similar in size to the substrate in the natural stream channel.	Comparable: The substrate inside the structure is similar in size to the substrate in the natural stream channel.	Comparable: The substrate inside the structure is similar in size to the substrate in the natural stream channel.	Comparable: The substrate inside the structure is similar in size to the substrate in the natural stream channel.	Comparable: The substrate inside the structure is similar in size to the substrate in the natural stream channel.	Not Appropriate: The substrate inside the structure is very different in size (usually much larger) than the substrate in the natural stream channel.	Contrasting: The substrate inside the structure is different in size from the substrate in the natural channel.
Water Depth Matches Stream: Compare the water depth inside the structure with the water depth in the natural stream channel away from the influence of the crossing.	Comprable: The depth in the crossing falls within the range of depths naturally occurring in that reach of the stream and for comparable distances along the length of the stream.	Comprable: The depth in the crossing falls within the range of depths naturally occurring in that reach of the stream and for comparable distances along the length of the stream.	Comprable: The depth in the crossing falls within the range of depths naturally occurring in that reach of the stream and for comparable distances along the length of the stream.	No-Shallower: The water depth in the crossing is less than depths that occur naturally in a similar length of the undisturbed stream, or the shallower depth through the structure covers a greater length than occurs in the natural stream.	No-Shallower: The water depth in the crossing is less than depths that occur naturally in a similar length of the undisturbed stream, or the shallower depth through the structure covers a greater length than occurs in the natural stream.	No-Shallower: The water depth in the crossing is less than depths that occur naturally in a similar length of the undisturbed stream, or the shallower depth through the structure covers a greater length than occurs in the natural stream.	No-Shallower: The water depth in the crossing is less than depths that occur naturally in a similar length of the undisturbed stream, or the shallower depth through the structure covers a greater length than occurs in the natural stream.	Comprable: The depth in the crossing falls within the range of depths naturally occurring in that reach of the stream and for comparable distances along the length of the stream.
Water Velocity Matches Stream: Compare the water velocity inside the structure with the velocity in the natural stream channel away from the influence of the crossing.	Comprable: The water velocity in the crossing falls within the range of velocities naturally occurring in that reach of the stream for comparable distances.	Comprable: The water velocity in the crossing falls within the range of velocities naturally occurring in that reach of the stream for comparable distances.	Comprable: The water velocity in the crossing falls within the range of velocities naturally occurring in that reach of the stream for comparable distances.	No-Faster: The water velocity in the structure is greater than velocities that occur naturally in a similar length of the undisturbed stream, or the velocity through the structure persists over a longer distance than occurs in the natural stream.	No-Faster: The water velocity in the structure is greater than velocities that occur naturally in a similar length of the undisturbed stream, or the velocity through the structure persists over a longer distance than occurs in the natural stream.	No-Faster: The water velocity in the structure is greater than velocities that occur naturally in a similar length of the undisturbed stream, or the velocity through the structure persists over a longer distance than occurs in the natural stream.	No-Faster: The water velocity in the structure is greater than velocities that occur naturally in a similar length of the undisturbed stream, or the velocity through the structure persists over a longer distance than occurs in the natural stream.	Comprable: The water velocity in the crossing falls within the range of velocities naturally occurring in that reach of the stream for comparable distances.
Openess (x=cross sectional area/structure length)	0.22	0.12	0.07	0.17	0.32	0.39	0.12	0.10
Height of structure (ft)	5.00	3.00	3.00	5.00	7.00	7.00	7.00	2.00
Outlet drop to water surface (ft)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Project: I-81 Viaduct Project

Component Score Descriptive Table - North Study Area									
Culvert ID	N-25	N-26	N-27	N-28	N-29	N-30	N-31	N-32	N-33
Constriction: Wetted width at low flow compared to channel wetted width	Spans only bankfull/active channel: The crossing encompasses the approximate width of the bankfull or active channel	Moderate: The crossing is greater than 50% of the bankfull or active width of the natural stream, but less than the full bankfull or active channel width	Severe - The total width of the crossing is less than 50% of the bankfull or active width of the natural stream, or the total wetted width of the crossing is less than 50% of the wetted width of the stream.	Severe - The total width of the crossing is less than 50% of the bankfull or active width of the natural stream, or the total wetted width of the crossing is less than 50% of the wetted width of the stream.	Severe - The total width of the crossing is less than 50% of the bankfull or active width of the natural stream, or the total wetted width of the crossing is less than 50% of the wetted width of the stream.	Severe - The total width of the crossing is less than 50% of the bankfull or active width of the natural stream, or the total wetted width of the crossing is less than 50% of the wetted width of the stream.	Severe - The total width of the crossing is less than 50% of the bankfull or active width of the natural stream, or the total wetted width of the crossing is less than 50% of the wetted width of the stream.	Severe - The total width of the crossing is less than 50% of the bankfull or active width of the natural stream, or the total wetted width of the crossing is less than 50% of the wetted width of the stream.	Severe - The total width of the crossing is less than 50% of the bankfull or active width of the natural stream, or the total wetted width of the crossing is less than 50% of the wetted width of the stream.
Inlet grade: An observation of the relative elevation of the stream bottom as it enters the structure. This is not an assessment of stream slope (gradient).	At Stream Grade: The inlet of the structure is at approximately the same elevation as the stream bottom upstream of the structure.	At Stream Grade: The inlet of the structure is at approximately the same elevation as the stream bottom upstream of the structure.	Unknown: Inlet is outside of the Study Area.	Unknown: Inlet is outside of the Study Area.	Unknown: Inlet is outside of the Study Area.	Unknown: Inlet is outside of the Study Area.	Unknown: Inlet is outside of the Study Area.	Unknown: Inlet is outside of the Study Area.	At Stream Grade: The inlet of the structure is at approximately the same elevation as the stream bottom upstream of the structure.
Internal structures: These may include baffles or weirs used to slow flow velocities and help to pass fish, as well as trusses, rods, piers or other structures intended to support a crossing structure, but which may interfere with flow and aquatic organism passage.	None: There are no apparent structures inside the crossing structure	None: There are no apparent structures inside the crossing structure	Weirs: full width, not notched, are incorporated inside the structure	None: There are no apparent structures inside the crossing structure	None: There are no apparent structures inside the crossing structure	None: There are no apparent structures inside the crossing structure	None: There are no apparent structures inside the crossing structure	None: There are no apparent structures inside the crossing structure	None: There are no apparent structures inside the crossing structure
Outlet armoring: Indicate the presence and extent of material placed below the outlet for the purpose of diffusing flow and minimizing scour. The most common form of outlet armoring is a layer of riprap placed below the outlet. A few pieces of rock that may have fallen into the stream near the structure's outlet do not constitute outlet armoring. Armoring of the road embankment and stream banks should not be confused with armoring of the stream bottom.	None: You may observe rocks that have fallen from the embankment or that are natural to the stream.	None: You may observe rocks that have fallen from the embankment or that are natural to the stream.	None: You may observe rocks that have fallen from the embankment or that are natural to the stream.	None: You may observe rocks that have fallen from the embankment or that are natural to the stream.	None: You may observe rocks that have fallen from the embankment or that are natural to the stream.	None: You may observe rocks that have fallen from the embankment or that are natural to the stream.	None: You may observe rocks that have fallen from the embankment or that are natural to the stream.	None: You may observe rocks that have fallen from the embankment or that are natural to the stream.	Extensive: Select this option only if you observe an extensive layer of material covering an area more than 50% of the stream width, which was put in place specifically to minimize scour at the outlet.
Physical barriers: Examples include debris/sediment/rock, deformation, fencing, a dry structure (when the stream is flowing)	None: There are no physical barriers associated with this structure.	None: There are no physical barriers associated with this structure.	None: There are no physical barriers associated with this structure.	None: There are no physical barriers associated with this structure.	None: There are no physical barriers associated with this structure.	Debris/Sediment/Rock: Woody debris or synthetic material, rock, or sediment blocks the flow of water into or through the structure. This can consist of wood or other vegetation, trash, sand, gravel, or rock. Severe: More than 50% of open area of the structure is blocked. The outlet is entirely submerged underwater.	Deformation: Significant dents, crushed metal, collapsing or miasligned structures. Severe: Flow is limited >50%.	Deformation: Significant dents, crushed metal, collapsing or miasligned structures. Severe: Flow is limited >50%.	Deformation: Significant dents, crushed metal, collapsing or miasligned structures. Severe: Flow is limited between 10% - 50%.
Scour pool: This is a pool created downstream of a crossing as a result of high flows exiting the crossing. Use as a reference natural pools in a portion of the stream that is outside the influence of the crossing structure. A scour pool is considered to exist when its size (a combination of length, width, and depth) is larger than pools found in the natural stream.	None: There is no difference between the length, width, or depth of the tailwater pool compared with reference pools, or no tailwater pool exists at the site.	None: There is no difference between the length, width, or depth of the tailwater pool compared with reference pools, or no tailwater pool exists at the site.	Small: The tailwater pool is between one and two times the length, width, or depth of reference pools.	None: There is no difference between the length, width, or depth of the tailwater pool compared with reference pools, or no tailwater pool exists at the site.	None: There is no difference between the length, width, or depth of the tailwater pool compared with reference pools, or no tailwater pool exists at the site.	None: There is no difference between the length, width, or depth of the tailwater pool compared with reference pools, or no tailwater pool exists at the site.	Small: The tailwater pool is between one and two times the length, width, or depth of reference pools.	Large: The tailwater pool is more than twice the length, width or depth of reference pools	Small: The tailwater pool is between one and two times the length, width, or depth of reference pools.
Substrate coverage: The extent of the substrate inside the crossing structure as a continuous layer across the entire bottom of the structure from bank to bank.	75%: Substrate covers at least 75% of the length of the structure.	100%: Substrate forms a continuous layer throughout the entire structure.	None: Substrate covers less than 25% of the length of the structure, or there is no substrate inside the structure at all.	100%: Substrate forms a continuous layer throughout the entire structure.	100%: Substrate forms a continuous layer throughout the entire structure.	100%: Substrate forms a continuous layer throughout the entire structure.	25%: Substrate covers at least 25% of the length of the structure.	None: Substrate covers less than 25% of the length of the structure, or there is no substrate inside the structure at all.	None: Substrate covers less than 25% of the length of the structure, or there is no substrate inside the structure at all.
Substrate matches stream: Comparison of the substrate (e.g., rock, gravel, sand) inside the structure and the substrate in the natural, undisturbed stream channel.	Comparable: The substrate inside the structure is similar in size to the substrate in the natural stream channel.	Contrasting: The substrate inside the structure is different in size from the substrate in the natural channel.	None: Select this option when there is very little (e.g., a thin layer of silt or a few pieces of rock) or no substrate inside the structure.	Comparable: The substrate inside the structure is similar in size to the substrate in the natural stream channel.	Comparable: The substrate inside the structure is similar in size to the substrate in the natural stream channel.	Comparable: The substrate inside the structure is similar in size to the substrate in the natural stream channel.	Comparable: The substrate inside the structure is similar in size to the substrate in the natural stream channel.	None: Select this option when there is very little (e.g., a thin layer of silt or a few pieces of rock) or no substrate inside the structure.	None: Select this option when there is very little (e.g., a thin layer of silt or a few pieces of rock) or no substrate inside the structure.
Water Depth Matches Stream: Compare the water depth inside the structure with the water depth in the natural stream channel away from the influence of the crossing.	Yes: dry	No-Shallower: The water depth in the crossing is less than depths that occur naturally in a similar length of the undisturbed stream, or the shallower depth through the structure covers a greater length than occurs in the natural stream.	No-Shallower: The water depth in the crossing is less than depths that occur naturally in a similar length of the undisturbed stream, or the shallower depth through the structure covers a greater length than occurs in the natural stream.	No-Shallower: The water depth in the crossing is less than depths that occur naturally in a similar length of the undisturbed stream, or the shallower depth through the structure covers a greater length than occurs in the natural stream.	Comprable: The depth in the crossing falls within the range of depths naturally occurring in that reach of the stream and for comparable distances along the length of the stream.	No-Deeper: The water depth in the crossing is greater than depths that occur naturally in a similar length of the undisturbed stream.	No-Shallower: The water depth in the crossing is less than depths that occur naturally in a similar length of the undisturbed stream, or the shallower depth through the structure covers a greater length than occurs in the natural stream.	No-Shallower: The water depth in the crossing is less than depths that occur naturally in a similar length of the undisturbed stream, or the shallower depth through the structure covers a greater length than occurs in the natural stream.	No-Shallower: The water depth in the crossing is less than depths that occur naturally in a similar length of the undisturbed stream, or the shallower depth through the structure covers a greater length than occurs in the natural stream.
Water Velocity Matches Stream: Compare the water velocity inside the structure with the velocity in the natural stream channel away from the influence of the crossing.	Dry (stream also dry)	Comprable: The water velocity in the crossing falls within the range of velocities naturally occurring in that reach of the stream for comparable distances.	No-Faster: The water velocity in the structure is greater than velocities that occur naturally in a similar length of the undisturbed stream, or the velocity through the structure persists over a longer distance than occurs in the natural stream.	Comprable: The water velocity in the crossing falls within the range of velocities naturally occurring in that reach of the stream for comparable distances.	Comprable: The water velocity in the crossing falls within the range of velocities naturally occurring in that reach of the stream for comparable distances.	Comprable: The water velocity in the crossing falls within the range of velocities naturally occurring in that reach of the stream for comparable distances.	Comprable: The water velocity in the crossing falls within the range of velocities naturally occurring in that reach of the stream for comparable distances.	No-Faster: The water velocity in the structure is greater than velocities that occur naturally in a similar length of the undisturbed stream, or the velocity through the structure persists over a longer distance than occurs in the natural stream.	Comprable: The water velocity in the crossing falls within the range of velocities naturally occurring in that reach of the stream for comparable distances.
Openess (x=cross sectional area/structure length)	0.04	2.23	0.01	0.00	0.00	0.00	0.02	0.01	0.05
Height of structure (ft)	4.67	6.5	2.00	1.00	1.00	1.00	2.00	2.00	2.50
Outlet drop to water surface (ft)	0.00	0.00	0.00	0.00	0.00	0.00	1.00	2.50	0.00

AKRF

Project: I-81 Viaduct Project

Component Score Descriptive Table - North Study Area			
Culvert ID	**N-34**	**N-35**	**N-36**
Constriction: Wetted width at low flow compared to channel wetted width	Moderate: The crossing is greater than 50% of the bankfull or active width of the natural stream, but less than the full bankfull or active channel width	Moderate: The crossing is greater than 50% of the bankfull or active width of the natural stream, but less than the full bankfull or active channel width	Severe - The total width of the crossing is less than 50% of the bankfull or active width of the natural stream, or the total wetted width of the crossing is less than 50% of the wetted width of the stream.
Inlet grade: An observation of the relative elevation of the stream bottom as it enters the structure. This is not an assessment of stream slope (gradient).	Perched: The inlet of the structure is set too high for the stream, and little water passes through the structure during normal low summer flows, though the stream has water upstream and downstream of the crossing. The structure inlet is above the surface of water in the stream. Water can enter the structure only at higher flows.	Clogged/ Collapsed/ Submerged: The structure inlet is either full of debris, collapsed, or completely underwater	At Stream Grade: The inlet of the structure is at approximately the same elevation as the stream bottom upstream of the structure.
Internal structures: These may include baffles or weirs used to slow flow velocities and help to pass fish, as well as trusses, rods, piers or other structures intended to support a crossing structure, but which may interfere with flow and aquatic organism passage.	None: There are no apparent structures inside the crossing structure	None: There are no apparent structures inside the crossing structure	None: There are no apparent structures inside the crossing structure
Outlet armoring: Indicate the presence and extent of material placed below the outlet for the purpose of diffusing flow and minimizing scour. The most common form of outlet armoring is a layer of riprap placed below the outlet. A few pieces of rock that may have fallen into the stream near the structure's outlet do not constitute outlet armoring. Armoring of the road embankment and stream banks should not be confused with armoring of the stream bottom.	None: You may observe rocks that have fallen from the embankment or that are natural to the stream.	None: You may observe rocks that have fallen from the embankment or that are natural to the stream.	Extensive: Select this option only if you observe an extensive layer of material covering an area more than 50% of the stream width, which was put in place specifically to minimize scour at the outlet.
Physical barriers: Examples include debris/sediment/rock, deformation, fencing, a dry structure (when the stream is flowing)	None: There are no physical barriers associated with this structure.	None: There are no physical barriers associated with this structure.	None: There are no physical barriers associated with this structure.
Scour pool: This is a pool created downstream of a crossing as a result of high flows exiting the crossing. Use as a reference natural pools in a portion of the stream that is outside the influence of the crossing structure. A scour pool is considered to exist when its size (a combination of length, width, and depth) is larger than pools found in the natural stream.	None: There is no difference between the length, width, or depth of the tailwater pool compared with reference pools, or no tailwater pool exists at the site.	None: There is no difference between the length, width, or depth of the tailwater pool compared with reference pools, or no tailwater pool exists at the site.	None: There is no difference between the length, width, or depth of the tailwater pool compared with reference pools, or no tailwater pool exists at the site.
Substrate coverage: The extent of the substrate inside the crossing structure as a continuous layer across the entire bottom of the structure from bank to bank.	25%: Substrate covers at least 25% of the length of the structure.	100%: Substrate forms a continuous layer throughout the entire structure.	None: Substrate covers less than 25% of the length of the structure, or there is no substrate inside the structure at all.
Substrate matches stream: Comparison of the substrate (e.g., rock, gravel, sand) inside the structure and the substrate in the natural, undisturbed stream channel.	Comparable: The substrate inside the structure is similar in size to the substrate in the natural stream channel.	Comparable: The substrate inside the structure is similar in size to the substrate in the natural stream channel.	None: Select this option when there is very little (e.g., a thin layer of silt or a few pieces of rock) or no substrate inside the structure.
Water Depth Matches Stream: Compare the water depth inside the structure with the water depth in the natural stream channel away from the influence of the crossing.	No-Shallower: The water depth in the crossing is less than depths that occur naturally in a similar length of the undisturbed stream, or the shallower depth through the structure covers a greater length than occurs in the natural stream.	No-Deeper: The water depth in the crossing is greater than depths that occur naturally in a similar length of the undisturbed stream.	Comprable: The depth in the crossing falls within the range of depths naturally occurring in that reach of the stream and for comparable distances along the length of the stream.
Water Velocity Matches Stream: Compare the water velocity inside the structure with the velocity in the natural stream channel away from the influence of the crossing.	No-Faster: The water velocity in the structure is greater than velocities that occur naturally in a similar length of the undisturbed stream, or the velocity through the structure persists over a longer distance than occurs in the natural stream.	Comprable: The water velocity in the crossing falls within the range of velocities naturally occurring in that reach of the stream for comparable distances.	Comprable: The water velocity in the crossing falls within the range of velocities naturally occurring in that reach of the stream for comparable distances.
Openess (x=cross sectional area/structure length)	0.57	0.19	0.02
Height of structure (ft)	6.50	7.25	2.50
Outlet drop to water surface (ft)	0.00	0.00	0.00

AKRF

Project: I-81 Viaduct Project

Component Score Descriptive Table - East Study Area

Culvert ID	E-1	E-2	E-3	E-4	E-5	E-6	E-7	E-8
Constriction: Wetted width at low flow compared to channel wetted width	Severe: The total width of the crossing (sum of widths of all crossing structures) is less than 50% of the bankfull or active width of the natural stream, or the total wetted width of the crossing is less than 50% of the wetted width of the stream.	Spans only bankfull/active channel: The crossing encompasses the approximate width of the bankfull or active channel	Spans only bankfull/active channel: The crossing encompasses the approximate width of the bankfull or active channel	Moderate: The crossing is greater than 50% of the bankfull or active width of the natural stream, but less than the full bankfull or active channel width	Moderate: The crossing is greater than 50% of the bankfull or active width of the natural stream, but less than the full bankfull or active channel width	Moderate: The crossing is greater than 50% of the bankfull or active width of the natural stream, but less than the full bankfull or active channel width	Spans only bankfull/active channel: The crossing encompasses the approximate width of the bankfull or active channel	Spans only bankfull/active channel: The crossing encompasses the approximate width of the bankfull or active channel
Inlet grade: An observation of the relative elevation of the stream bottom as it enters the structure. This is not an assessment of stream slope (gradient).	At Stream Grade: The inlet of the structure is at approximately the same elevation as the stream bottom upstream of the structure.	Clogged/ Collapsed/ Submerged: The structure inlet is either full of debris, collapsed, or completely underwater	Clogged/ Collapsed/ Submerged: The structure inlet is either full of debris, collapsed, or completely underwater	At Stream Grade: The inlet of the structure is at approximately the same elevation as the stream bottom upstream of the structure.	At Stream Grade: The inlet of the structure is at approximately the same elevation as the stream bottom upstream of the structure.	At Stream Grade: The inlet of the structure is at approximately the same elevation as the stream bottom upstream of the structure.	At Stream Grade: The inlet of the structure is at approximately the same elevation as the stream bottom upstream of the structure.	At Stream Grade: The inlet of the structure is at approximately the same elevation as the stream bottom upstream of the structure.
Internal structures: These may include baffles or weirs used to slow flow velocities and help to pass fish, as well as trusses, rods, piers or other structures intended to support a crossing structure, but which may interfere with flow and aquatic organism passage.	None: There are no apparent structures inside the crossing structure	None: There are no apparent structures inside the crossing structure	None: There are no apparent structures inside the crossing structure	None: There are no apparent structures inside the crossing structure	None: There are no apparent structures inside the crossing structure	None: There are no apparent structures inside the crossing structure	None: There are no apparent structures inside the crossing structure	None: There are no apparent structures inside the crossing structure
Outlet armoring: Indicate the presence and extent of material placed below the outlet for the purpose of diffusing flow and minimizing scour. The most common form of outlet armoring is a layer of riprap placed below the outlet. A few pieces of rock that may have fallen into the stream near the structure's outlet do not constitute outlet armoring. Armoring of the road embankment and stream banks should not be confused with armoring of the stream bottom.	None: You may observe rocks that have fallen from the embankment or that are natural to the stream.	None: You may observe rocks that have fallen from the embankment or that are natural to the stream.	None: You may observe rocks that have fallen from the embankment or that are natural to the stream.	Extensive: Select this option only if you observe an extensive layer of material covering an area more than 50% of the stream width, which was put in place specifically to minimize scour at the outlet.	Extensive: Select this option only if you observe an extensive layer of material covering an area more than 50% of the stream width, which was put in place specifically to minimize scour at the outlet.	Extensive: Select this option only if you observe an extensive layer of material covering an area more than 50% of the stream width, which was put in place specifically to minimize scour at the outlet.	None: You may observe rocks that have fallen from the embankment or that are natural to the stream.	Extensive: Select this option only if you observe an extensive layer of material covering an area more than 50% of the stream width, which was put in place specifically to minimize scour at the outlet.
Physical barriers: Examples include debris/sediment/rock, deformation, fencing, a dry structure (when the stream is flowing)	None: There are no physical barriers associated with this structure	Other: Plants (moss), sediment. Minor: < 10% of the open area of the structure is blocked	None: There are no physical barriers associated with this structure	None: There are no physical barriers associated with this structure	None: There are no physical barriers associated with this structure	None: There are no physical barriers associated with this structure	Other: Plants (moss), sediment. Minor: < 10% of the open area of the structure is blocked	Other: Plants (moss), sediment. Minor: < 10% of the open area of the structure is blocked
Scour pool: This is a pool created downstream of a crossing as a result of high flows exiting the crossing. Use as a reference natural pools in a portion of the stream that is outside the influence of the crossing structure. A scour pool is considered to exist when its size (a combination of length, width, and depth) is larger than pools found in the natural stream.	None: There is no difference between the length, width, or depth of the tailwater pool compared with reference pools, or no tailwater pool exists at the site.	None: There is no difference between the length, width, or depth of the tailwater pool compared with reference pools, or no tailwater pool exists at the site.	None: There is no difference between the length, width, or depth of the tailwater pool compared with reference pools, or no tailwater pool exists at the site.	Small: The tailwater pool is between one and two times the length, width, or depth of reference pools.	None: There is no difference between the length, width, or depth of the tailwater pool compared with reference pools, or no tailwater pool exists at the site.	Small: The tailwater pool is between one and two times the length, width, or depth of reference pools.	None: There is no difference between the length, width, or depth of the tailwater pool compared with reference pools, or no tailwater pool exists at the site.	None: There is no difference between the length, width, or depth of the tailwater pool compared with reference pools, or no tailwater pool exists at the site.
Substrate coverage: The extent of the substrate inside the crossing structure as a continuous layer across the entire bottom of the structure from bank to bank.	100%: Substrate forms a continuous layer throughout the entire structure.	None: Substrate covers less than 25% of the length of the structure, or there is no substrate inside the structure at all.	75%: Substrate covers at least 75% of the length of the structure.	None: Substrate covers less than 25% of the length of the structure, or there is no substrate inside the structure at all.	25%: Substrate covers at least 25% of the length of the structure.	None: Substrate covers less than 25% of the length of the structure, or there is no substrate inside the structure at all.	100%: Substrate forms a continuous layer throughout the entire structure.	100%: Substrate forms a continuous layer throughout the entire structure.
Substrate matches stream: Comparison of the substrate (e.g., rock, gravel, sand) inside the structure and the substrate in the natural, undisturbed stream channel.	Comparable: The substrate inside the structure is similar in size to the substrate in the natural stream channel.	None: Select this option when there is very little (e.g., a thin layer of silt or a few pieces of rock) or no substrate inside the structure.	Contrasting: The substrate inside the structure is different in size from the substrate in the natural channel.	None: Select this option when there is very little (e.g., a thin layer of silt or a few pieces of rock) or no substrate inside the structure.	Comparable: The substrate inside the structure is similar in size to the substrate in the natural stream channel.	None: Select this option when there is very little (e.g., a thin layer of silt or a few pieces of rock) or no substrate inside the structure.	Comparable: The substrate inside the structure is similar in size to the substrate in the natural stream channel.	Comparable: The substrate inside the structure is similar in size to the substrate in the natural stream channel.
Water Depth Matches Stream: Compare the water depth inside the structure with the water depth in the natural stream channel away from the influence of the crossing.	Comprable: The depth in the crossing falls within the range of depths naturally occurring in that reach of the stream and for comparable distances along the length of the stream.	Yes: dry	Yes: dry	Yes: dry	Yes: dry	Yes: dry	Yes: dry	Yes: dry
Water Velocity Matches Stream: Compare the water velocity inside the structure with the velocity in the natural stream channel away from the influence of the crossing.	Comprable: The water velocity in the crossing falls within the range of velocities naturally occurring in that reach of the stream for comparable distances.	Dry (stream also dry)	Dry (stream also dry)	Dry (stream also dry)	Dry (stream also dry)	Dry (stream also dry)	Dry (stream also dry)	Dry (stream also dry)
Openess (x=cross sectional area/structure length)	0.22	0.04	0.02	0.05	0.05	0.09	0.04	0.03
Height of structure (ft)	8.00	2.00	2.00	2.67	3.50	3.50	2.00	2.00
Outlet drop to water surface (ft)	0.00	0.00	0.00	0.25	0.00	1.00	0.00	4.00

AKRF

Project: I-81 Viaduct Project

Component Score Descriptive Table - East Study Area

Culvert ID	**E-9**	**E-10**	**E-11**	**E-12**	**E-13**	**E-14**	**E-15**	**E-16**	**E-17**
Constriction: Wetted width at low flow compared to channel wetted width	Spans only bankfull/active channel: The crossing encompasses the approximate width of the bankfull or active channel	Severe: The total width of the crossing (sum of widths of all crossing structures) is less than 50% of the bankfull or active width of the natural stream, or the total wetted width of the crossing is less than 50% of the wetted width of the stream.	Moderate: The crossing is greater than 50% of the bankfull or active width of the natural stream, but less than the full bankfull or active channel width	Moderate: The crossing is greater than 50% of the bankfull or active width of the natural stream, but less than the full bankfull or active channel width	Moderate: The crossing is greater than 50% of the bankfull or active width of the natural stream, but less than the full bankfull or active channel width	Spans only bankfull/active channel: The crossing encompasses the approximate width of the bankfull or active channel	Moderate: The crossing is greater than 50% of the bankfull or active width of the natural stream, but less than the full bankfull or active channel width	Severe: The total width of the crossing (sum of widths of all crossing structures) is less than 50% of the bankfull or active width of the natural stream, or the total wetted width of the crossing is less than 50% of the wetted width of the stream.	Moderate: The crossing is greater than 50% of the bankfull or active width of the natural stream, but less than the full bankfull or active channel width
Inlet grade: An observation of the relative elevation of the stream bottom as it enters the structure. This is not an assessment of stream slope (gradient).	At Stream Grade: The inlet of the structure is at approximately the same elevation as the stream bottom upstream of the structure.	At Stream Grade: The inlet of the structure is at approximately the same elevation as the stream bottom upstream of the structure.	At Stream Grade: The inlet of the structure is at approximately the same elevation as the stream bottom upstream of the structure.	At Stream Grade: The inlet of the structure is at approximately the same elevation as the stream bottom upstream of the structure.	At Stream Grade: The inlet of the structure is at approximately the same elevation as the stream bottom upstream of the structure.	At Stream Grade: The inlet of the structure is at approximately the same elevation as the stream bottom upstream of the structure.	At Stream Grade: The inlet of the structure is at approximately the same elevation as the stream bottom upstream of the structure.	At Stream Grade: The inlet of the structure is at approximately the same elevation as the stream bottom upstream of the structure.	At Stream Grade: The inlet of the structure is at approximately the same elevation as the stream bottom upstream of the structure.
Internal structures: These may include baffles or weirs used to slow flow velocities and help to pass fish, as well as trusses, rods, piers or other structures intended to support a crossing structure, but which may interfere with flow and aquatic organism passage.	None: There are no apparent structures inside the crossing structure	None: There are no apparent structures inside the crossing structure	None: There are no apparent structures inside the crossing structure	None: There are no apparent structures inside the crossing structure	None: There are no apparent structures inside the crossing structure	None: There are no apparent structures inside the crossing structure	None: There are no apparent structures inside the crossing structure	None: There are no apparent structures inside the crossing structure	None: There are no apparent structures inside the crossing structure
Outlet armoring: Indicate the presence and extent of material placed below the outlet for the purpose of diffusing flow and minimizing scour. The most common form of outlet armoring is a layer of riprap placed below the outlet. A few pieces of rock that may have fallen into the stream near the structure's outlet do not constitute outlet armoring. Armoring of the road embankment and stream banks should not be confused with armoring of the stream bottom.	Not Extensive: There is of a layer of material covering an area less than 50% of the stream width placed purposefully below the outlet specifically to minimize the effects of scour.	None: You may observe rocks that have fallen from the embankment or that are natural to the stream.	None: You may observe rocks that have fallen from the embankment or that are natural to the stream.	None: You may observe rocks that have fallen from the embankment or that are natural to the stream.	Extensive: Select this option only if you observe an extensive layer of material covering an area more than 50% of the stream width, which was put in place specifically to minimize scour at the outlet.	Extensive: Select this option only if you observe an extensive layer of material covering an area more than 50% of the stream width, which was put in place specifically to minimize scour at the outlet.	None: You may observe rocks that have fallen from the embankment or that are natural to the stream.	None: You may observe rocks that have fallen from the embankment or that are natural to the stream.	None: You may observe rocks that have fallen from the embankment or that are natural to the stream.
Physical barriers: Examples include debris/sediment/rock, deformation, fencing, a dry structure (when the stream is flowing)	None: There are no physical barriers associated with this structure	Debris/Sediment/Rock: Woody debris or synthetic material, rock, or sediment blocks the flow of water into or through the structure. This can consist of wood or other vegetation, trash, sand, gravel, or rock. Severe: > 50% of open area of structure is blocked	Debris/Sediment/Rock: Woody debris or synthetic material, rock, or sediment blocks the flow of water into or through the structure. This can consist of wood or other vegetation, trash, sand, gravel, or rock. Severe: > 50% of open area of structure is blocked	Dry: There is no water in this structure, though water is flowing in the stream. Minor: May be passable at somewhat higher flows.	Fencing/Other: large metal cover over outlet. Severe: > 50% of open area of structure is blocked	None: There are no physical barriers associated with this structure	Debris/Sediment/Rock: Woody debris or synthetic material, rock, or sediment blocks the flow of water into or through the structure. This can consist of wood or other vegetation, trash, sand, gravel, or rock. Moderate: 10% - 50% of open area blocked	Debris/Sediment/Rock: Woody debris or synthetic material, rock, or sediment blocks the flow of water into or through the structure. This can consist of wood or other vegetation, trash, sand, gravel, or rock. Severe: > 50% of open area blocked	Debris/Sediment/Rock: Woody debris or synthetic material, rock, or sediment blocks the flow of water into or through the structure. This can consist of wood or other vegetation, trash, sand, gravel, or rock. Severe: > 50% of open area blocked
Scour pool: This is a pool created downstream of a crossing as a result of high flows exiting the crossing. Use as a reference natural pools in a portion of the stream that is outside the influence of the crossing structure. A scour pool is considered to exist when its size (a combination of length, width, and depth) is larger than pools found in the natural stream.	None: There is no difference between the length, width, or depth of the tailwater pool compared with reference pools, or no tailwater pool exists at the site.	None: There is no difference between the length, width, or depth of the tailwater pool compared with reference pools, or no tailwater pool exists at the site.	None: There is no difference between the length, width, or depth of the tailwater pool compared with reference pools, or no tailwater pool exists at the site.	None: There is no difference between the length, width, or depth of the tailwater pool compared with reference pools, or no tailwater pool exists at the site.	Small: The tailwater pool is between one and two times the length, width, or depth of reference pools.	None: There is no difference between the length, width, or depth of the tailwater pool compared with reference pools, or no tailwater pool exists at the site.	None: There is no difference between the length, width, or depth of the tailwater pool compared with reference pools, or no tailwater pool exists at the site.	None: There is no difference between the length, width, or depth of the tailwater pool compared with reference pools, or no tailwater pool exists at the site.	None: There is no difference between the length, width, or depth of the tailwater pool compared with reference pools, or no tailwater pool exists at the site.
Substrate coverage: The extent of the substrate inside the crossing structure as a continuous layer across the entire bottom of the structure from bank to bank.	None: Substrate covers less than 25% of the length of the structure, or there is no substrate inside the structure at all.	100%: Substrate forms a continuous layer throughout the entire structure.	100%: Substrate forms a continuous layer throughout the entire structure.	50%: Substrate covers at least 50% of the length of the structure.	100%: Substrate forms a continuous layer throughout the entire structure.	None: Substrate covers less than 25% of the length of the structure, or there is no substrate inside the structure at all.	100%: Substrate forms a continuous layer throughout the entire structure.	100%: Substrate forms a continuous layer throughout the entire structure.	100%: Substrate forms a continuous layer throughout the entire structure.
Substrate matches stream: Comparison of the substrate (e.g., rock, gravel, sand) inside the structure and the substrate in the natural, undisturbed stream channel.	None: Select this option when there is very little (e.g., a thin layer of silt or a few pieces of rock) or no substrate inside the structure.	Comparable: The substrate inside the structure is similar in size to the substrate in the natural stream channel.	Contrasting: The substrate inside the structure is different in size from the substrate in the natural channel.	Comparable: The substrate inside the structure is similar in size to the substrate in the natural stream channel.	Comparable: The substrate inside the structure is similar in size to the substrate in the natural stream channel.	None: Select this option when there is very little (e.g., a thin layer of silt or a few pieces of rock) or no substrate inside the structure.	Comparable: The substrate inside the structure is similar in size to the substrate in the natural stream channel.	Comparable: The substrate inside the structure is similar in size to the substrate in the natural stream channel.	Comparable: The substrate inside the structure is similar in size to the substrate in the natural stream channel.
Water Depth Matches Stream: Compare the water depth inside the structure with the water depth in the natural stream channel away from the influence of the crossing.	Yes: dry	No-Deeper: The water depth in the crossing is greater than depths that occur naturally in a similar length of the undisturbed stream.	No-Shallower: The water depth in the crossing is less than depths that occur naturally in a similar length of the undisturbed stream, or the shallower depth through the structure covers a greater length than occurs in the natural stream.	No-Shallower: Dry. The water depth in the crossing is less than depths that occur naturally in a similar length of the undisturbed stream, or the shallower depth through the structure covers a greater length than occurs in the natural stream.	Comprable: The depth in the crossing falls within the range of depths naturally occurring in that reach of the stream and for comparable distances along the length of the stream.	Comprable: The depth in the crossing falls within the range of depths naturally occurring in that reach of the stream and for comparable distances along the length of the stream.	Comprable: The depth in the crossing falls within the range of depths naturally occurring in that reach of the stream and for comparable distances along the length of the stream.	Comprable: The depth in the crossing falls within the range of depths naturally occurring in that reach of the stream and for comparable distances along the length of the stream.	No-Shallower: The water depth in the crossing is less than depths that occur naturally in a similar length of the undisturbed stream, or the shallower depth through the structure covers a greater length than occurs in the natural stream.
Water Velocity Matches Stream: Compare the water velocity inside the structure with the velocity in the natural stream channel away from the influence of the crossing.	Dry (stream also dry)	No-Slower: The velocity in the crossing is less than velocities that occur naturally in a similar length of the undisturbed stream.	No-Slower: The velocity in the crossing is less than velocities that occur naturally in a similar length of the undisturbed stream.	No-Slower: Dry. The velocity in the crossing is less than velocities that occur naturally in a similar length of the undisturbed stream.	Comprable: The water velocity in the crossing falls within the range of velocities naturally occurring in that reach of the stream for comparable distances.	Comprable: The water velocity in the crossing falls within the range of velocities naturally occurring in that reach of the stream for comparable distances.	Comprable: The water velocity in the crossing falls within the range of velocities naturally occurring in that reach of the stream for comparable distances.	Comprable: The water velocity in the crossing falls within the range of velocities naturally occurring in that reach of the stream for comparable distances.	Comprable: The water velocity in the crossing falls within the range of velocities naturally occurring in that reach of the stream for comparable distances.
Openess (x=cross sectional area/structure length)	0.03	0.04	0.01	0.06	0.02	0.05	0.07	0.06	0.02
Height of structure (ft)	2.00	2.67	2.00	2.67	2.50	3.00	5.50	3.00	1.50
Outlet drop to water surface (ft)	4.00	0.00	0.00	0.00	0.50	3.00	0.00	0.00	0.00

Component Score Descriptive Table - East Study Area

Culvert ID	E-18	E-19	E-20	E-21	E-22	E-23	E-24	E-25	E-26
Constriction: Wetted width at low flow compared to channel wetted width	Moderate: The crossing is greater than 50% of the bankfull or active width of the natural stream, but less than the full bankfull or active channel width	Moderate: The crossing is greater than 50% of the bankfull or active width of the natural stream, but less than the full bankfull or active channel width	Moderate: The crossing is greater than 50% of the bankfull or active width of the natural stream, but less than the full bankfull or active channel width	Moderate: The crossing is greater than 50% of the bankfull or active width of the natural stream, but less than the full bankfull or active channel width	Severe: The total width of the crossing (sum of widths of all crossing structures) is less than 50% of the bankfull or active width of the natural stream, or the total wetted width of the crossing is less than 50% of the wetted width of the stream.	Severe: The total width of the crossing (sum of widths of all crossing structures) is less than 50% of the bankfull or active width of the natural stream, or the total wetted width of the crossing is less than 50% of the wetted width of the stream.	Severe: The total width of the crossing (sum of widths of all crossing structures) is less than 50% of the bankfull or active width of the natural stream, or the total wetted width of the crossing is less than 50% of the wetted width of the stream.	Severe: The total width of the crossing (sum of widths of all crossing structures) is less than 50% of the bankfull or active width of the natural stream, or the total wetted width of the crossing is less than 50% of the wetted width of the stream.	Moderate: The crossing is greater than 50% of the bankfull or active width of the natural stream, but less than the full bankfull or active channel width
Inlet grade: An observation of the relative elevation of the stream bottom as it enters the structure. This is not an assessment of stream slope (gradient).	At Stream Grade: The inlet of the structure is at approximately the same elevation as the stream bottom upstream of the structure.	Perched: The inlet of the structure is set too high for the stream, and little water passes through the structure during normal low summer flows, though the stream has water upstream and downstream of the crossing. The structure inlet is above the surface of water in the stream. Water can enter the structure only at higher flows.	At Stream Grade: The inlet of the structure is at approximately the same elevation as the stream bottom upstream of the structure.	At Stream Grade: The inlet of the structure is at approximately the same elevation as the stream bottom upstream of the structure.	At Stream Grade: The inlet of the structure is at approximately the same elevation as the stream bottom upstream of the structure.	At Stream Grade: The inlet of the structure is at approximately the same elevation as the stream bottom upstream of the structure.	At Stream Grade: The inlet of the structure is at approximately the same elevation as the stream bottom upstream of the structure.	Clogged/ Collapsed/ Submerged: The structure inlet is either full of debris, collapsed, or completely underwater	Clogged/ Collapsed/ Submerged: The structure inlet is either full of debris, collapsed, or completely underwater
Internal structures: These may include baffles or weirs used to slow flow velocities and help to pass fish, as well as trusses, rods, piers or other structures intended to support a crossing structure, but which may interfere with flow and aquatic organism passage.	None: There are no apparent structures inside the crossing structure	None: There are no apparent structures inside the crossing structure	None: There are no apparent structures inside the crossing structure	None: There are no apparent structures inside the crossing structure	None: There are no apparent structures inside the crossing structure	None: There are no apparent structures inside the crossing structure	None: There are no apparent structures inside the crossing structure	None: There are no apparent structures inside the crossing structure	None: There are no apparent structures inside the crossing structure
Outlet armoring: Indicate the presence and extent of material placed below the outlet for the purpose of diffusing flow and minimizing scour. The most common form of outlet armoring is a layer of riprap placed below the outlet. A few pieces of rock that may have fallen into the stream near the structure's outlet do not constitute outlet armoring. Armoring of the road embankment and stream banks should not be confused with armoring of the stream bottom.	None: You may observe rocks that have fallen from the embankment or that are natural to the stream.	None: You may observe rocks that have fallen from the embankment or that are natural to the stream.	None: You may observe rocks that have fallen from the embankment or that are natural to the stream.	None: You may observe rocks that have fallen from the embankment or that are natural to the stream.	None: You may observe rocks that have fallen from the embankment or that are natural to the stream.	None: You may observe rocks that have fallen from the embankment or that are natural to the stream.	None: You may observe rocks that have fallen from the embankment or that are natural to the stream.	None: You may observe rocks that have fallen from the embankment or that are natural to the stream.	None: You may observe rocks that have fallen from the embankment or that are natural to the stream.
Physical barriers: Examples include debris/sediment/rock, deformation, fencing, a dry structure (when the stream is flowing)	Debris/Sediment/Rock: Woody debris or synthetic material, rock, or sediment blocks the flow of water into or through the structure. Minor: < 10% of the open area of the structure is blocked	Debris/Sediment/Rock: Woody debris or synthetic material, rock, or sediment blocks the flow of water into or through the structure. This can consist of wood or other vegetation, trash, sand, gravel, or rock. Moderate: 10% - 50% of open area blocked.	Debris/Sediment/Rock: Woody debris or synthetic material, rock, or sediment blocks the flow of water into or through the structure. This can consist of wood or other vegetation, trash, sand, gravel, or rock. Moderate: 10% - 50% of open area blocked.	Debris/Sediment/Rock: Woody debris or synthetic material, rock, or sediment blocks the flow of water into or through the structure. This can consist of wood or other vegetation, trash, sand, gravel, or rock. Moderate: 10% - 50% of open area blocked.	Debris/Sediment/Rock: Woody debris or synthetic material, rock, or sediment blocks the flow of water into or through the structure. This can consist of wood or other vegetation, trash, sand, gravel, or rock. Moderate: 10% - 50% of open area blocked. Deformation: Significant dents, crushed metal, collapsing structures. Moderate: Flow is limited between 10% - 50%.	Debris/Sediment/Rock: Woody debris or synthetic material, rock, or sediment blocks the flow of water into or through the structure. This can consist of wood or other vegetation, trash, sand, gravel, or rock. Minor: Less than 10% of open area of the structure is blocked. Dry: There is no water in this structure, though water is flowing in the stream. Minor: May be passable at somewhat higher flows.	Debris/Sediment/Rock: Woody debris or synthetic material, rock, or sediment blocks the flow of water into or through the structure. This can consist of wood or other vegetation, trash, sand, gravel, or rock. Minor: Less than 10% of open area of the structure is blocked.	Debris/Sediment/Rock: Woody debris or synthetic material, rock, or sediment blocks the flow of water into or through the structure. This can consist of wood or other vegetation, trash, sand, gravel, or rock. Severe: More than 50% of open area of the structure is blocked.	Debris/Sediment/Rock: Woody debris or synthetic material, rock, or sediment blocks the flow of water into or through the structure. This can consist of wood or other vegetation, trash, sand, gravel, or rock. Severe: More than 50% of open area of the structure is blocked.
Scour pool: This is a pool created downstream of a crossing as a result of high flows exiting the crossing. Use as a reference natural pools in a portion of the stream that is outside the influence of the crossing structure. A scour pool is considered to exist when its size (a combination of length, width, and depth) is larger than pools found in the natural stream.	None: There is no difference between the length, width, or depth of the tailwater pool compared with reference pools, or no tailwater pool exists at the site.	None: There is no difference between the length, width, or depth of the tailwater pool compared with reference pools, or no tailwater pool exists at the site.	None: There is no difference between the length, width, or depth of the tailwater pool compared with reference pools, or no tailwater pool exists at the site.	None: There is no difference between the length, width, or depth of the tailwater pool compared with reference pools, or no tailwater pool exists at the site.	None: There is no difference between the length, width, or depth of the tailwater pool compared with reference pools, or no tailwater pool exists at the site.	None: There is no difference between the length, width, or depth of the tailwater pool compared with reference pools, or no tailwater pool exists at the site.	None: There is no difference between the length, width, or depth of the tailwater pool compared with reference pools, or no tailwater pool exists at the site.	None: There is no difference between the length, width, or depth of the tailwater pool compared with reference pools, or no tailwater pool exists at the site.	None: There is no difference between the length, width, or depth of the tailwater pool compared with reference pools, or no tailwater pool exists at the site.
Substrate coverage: The extent of the substrate inside the crossing structure as a continuous layer across the entire bottom of the structure from bank to bank.	None: Substrate covers less than 25% of the length of the structure, or there is no substrate inside the structure at all.	100%: Substrate forms a continuous layer throughout the entire structure.	100%: Substrate forms a continuous layer throughout the entire structure.	100%: Substrate forms a continuous layer throughout the entire structure.	100%: Substrate forms a continuous layer throughout the entire structure.	100%: Substrate forms a continuous layer throughout the entire structure.	100%: Substrate forms a continuous layer throughout the entire structure.	100%: Substrate forms a continuous layer throughout the entire structure.	100%: Substrate forms a continuous layer throughout the entire structure.
Substrate matches stream: Comparison of the substrate (e.g., rock, gravel, sand) inside the structure and the substrate in the natural, undisturbed stream channel.	None: Select this option when there is very little (e.g., a thin layer of silt or a few pieces of rock) or no substrate inside the structure.	Comparable: The substrate inside the structure is similar in size to the substrate in the natural stream channel.	Comparable: The substrate inside the structure is similar in size to the substrate in the natural stream channel.	Comparable: The substrate inside the structure is similar in size to the substrate in the natural stream channel.	Comparable: The substrate inside the structure is similar in size to the substrate in the natural stream channel.	Comparable: The substrate inside the structure is similar in size to the substrate in the natural stream channel.	Comparable: The substrate inside the structure is similar in size to the substrate in the natural stream channel.	Comparable: The substrate inside the structure is similar in size to the substrate in the natural stream channel.	Comparable: The substrate inside the structure is similar in size to the substrate in the natural stream channel.
Water Depth Matches Stream: Compare the water depth inside the structure with the water depth in the natural stream channel away from the influence of the crossing.	No-Shallower: The water depth in the crossing is less than depths that occur naturally in a similar length of the undisturbed stream, or the shallower depth through the structure covers a greater length than occurs in the natural stream.	Yes: dry	Yes: dry	Yes: dry	No-Deeper: The water depth in the crossing is greater than depths that occur naturally in a similar length of the undisturbed stream.	Comprable: The depth in the crossing falls within the range of depths naturally occurring in that reach of the stream and for comparable distances along the length of the stream.	No-Deeper: The water depth in the crossing is greater than depths that occur naturally in a similar length of the undisturbed stream.	No-Deeper: The water depth in the crossing is greater than depths that occur naturally in a similar length of the undisturbed stream.	Comprable: The depth in the crossing falls within the range of depths naturally occurring in that reach of the stream and for comparable distances along the length of the stream.
Water Velocity Matches Stream: Compare the water velocity inside the structure with the velocity in the natural stream channel away from the influence of the crossing.	No-Faster: The water velocity in the structure is greater than velocities that occur naturally in a similar length of the undisturbed stream, or the velocity through the structure persists over a longer distance than occurs in the natural stream.	Dry (stream also dry)	Dry (stream also dry)	Dry (stream also dry)	Comprable: The water velocity in the crossing falls within the range of velocities naturally occurring in that reach of the stream for comparable distances.	Comprable: The water velocity in the crossing falls within the range of velocities naturally occurring in that reach of the stream for comparable distances.	Comprable: The water velocity in the crossing falls within the range of velocities naturally occurring in that reach of the stream for comparable distances.	Comprable: The water velocity in the crossing falls within the range of velocities naturally occurring in that reach of the stream for comparable distances.	Comprable: The water velocity in the crossing falls within the range of velocities naturally occurring in that reach of the stream for comparable distances.
Openess (x=cross sectional area/structure length)	0.04	0.03	0.03	0.03	0.04	0.05	0.05	0.00	0.03
Height of structure (ft)	3.00	2.00	2.00	2.00	2.00	3.00	3.00	0.00	2.00
Outlet drop to water surface (ft)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

AKRF

Project: I-81 Viaduct Project

Component Score Descriptive Table - East Study Area

Culvert ID	**E-27**	**E-28**	**E-29**	**E-30**	**E-31**
Constriction: Wetted width at low flow compared to channel wetted width	Moderate: The crossing is greater than 50% of the bankfull or active width of the natural stream, but less than the full bankfull or active channel width	Severe: The total width of the crossing (sum of widths of all crossing structures) is less than 50% of the bankfull or active width of the natural stream, or the total wetted width of the crossing is less than 50% of the wetted width of the stream.	Severe: The total width of the crossing (sum of widths of all crossing structures) is less than 50% of the bankfull or active width of the natural stream, or the total wetted width of the crossing is less than 50% of the wetted width of the stream.	Severe: The total width of the crossing (sum of widths of all crossing structures) is less than 50% of the bankfull or active width of the natural stream, or the total wetted width of the crossing is less than 50% of the wetted width of the stream.	Severe: The total width of the crossing (sum of widths of all crossing structures) is less than 50% of the bankfull or active width of the natural stream, or the total wetted width of the crossing is less than 50% of the wetted width of the stream.
Inlet grade: An observation of the relative elevation of the stream bottom as it enters the structure. This is not an assessment of stream slope (gradient).	Clogged/ Collapsed/ Submerged: The structure inlet is either full of debris, collapsed, or completely underwater	Clogged/ Collapsed/ Submerged: The structure inlet is either full of debris, collapsed, or completely underwater	At Stream Grade: The inlet of the structure is at approximately the same elevation as the stream bottom upstream of the structure.	Clogged/ Collapsed/ Submerged: The structure inlet is either full of debris, collapsed, or completely underwater	At Stream Grade: The inlet of the structure is at approximately the same elevation as the stream bottom upstream of the structure.
Internal structures: These may include baffles or weirs used to slow flow velocities and help to pass fish, as well as trusses, rods, piers or other structures intended to support a crossing structure, but which may interfere with flow and aquatic organism passage.	None: There are no apparent structures inside the crossing structure	None: There are no apparent structures inside the crossing structure	None: There are no apparent structures inside the crossing structure	None: There are no apparent structures inside the crossing structure	None: There are no apparent structures inside the crossing structure
Outlet armoring: Indicate the presence and extent of material placed below the outlet for the purpose of diffusing flow and minimizing scour. The most common form of outlet armoring is a layer of riprap placed below the outlet. A few pieces of rock that may have fallen into the stream near the structure's outlet do not constitute outlet armoring. Armoring of the road embankment and stream banks should not be confused with armoring of the stream bottom.	None: You may observe rocks that have fallen from the embankment or that are natural to the stream.	None: You may observe rocks that have fallen from the embankment or that are natural to the stream.	None: You may observe rocks that have fallen from the embankment or that are natural to the stream.	None: You may observe rocks that have fallen from the embankment or that are natural to the stream.	None: You may observe rocks that have fallen from the embankment or that are natural to the stream.
Physical barriers: Examples include debris/sediment/rock, deformation, fencing, a dry structure (when the stream is flowing)	Debris/Sediment/Rock: Woody debris or synthetic material, rock, or sediment blocks the flow of water into or through the structure. This can consist of wood or other vegetation, trash, sand, gravel, or rock. Severe: More than 50% of open area of the structure is blocked. Deformation: Significant dents, crushed metal, collapsing structures. Moderate: Flow is limited between 10% - 50%.	Debris/Sediment/Rock: Woody debris or synthetic material, rock, or sediment blocks the flow of water into or through the structure. This can consist of wood or other vegetation, trash, sand, gravel, or rock. Severe: More than 50% of open area of the structure is blocked.	None: There are no physical barriers associated with this structure	None: There are no physical barriers associated with this structure	None: There are no physical barriers associated with this structure
Scour pool: This is a pool created downstream of a crossing as a result of high flows exiting the crossing. Use as a reference natural pools in a portion of the stream that is outside the influence of the crossing structure. A scour pool is considered to exist when its size (a combination of length, width, and depth) is larger than pools found in the natural stream.	None: There is no difference between the length, width, or depth of the tailwater pool compared with reference pools, or no tailwater pool exists at the site.	None: There is no difference between the length, width, or depth of the tailwater pool compared with reference pools, or no tailwater pool exists at the site.	None: There is no difference between the length, width, or depth of the tailwater pool compared with reference pools, or no tailwater pool exists at the site.	None: There is no difference between the length, width, or depth of the tailwater pool compared with reference pools, or no tailwater pool exists at the site.	None: There is no difference between the length, width, or depth of the tailwater pool compared with reference pools, or no tailwater pool exists at the site.
Substrate coverage: The extent of the substrate inside the crossing structure as a continuous layer across the entire bottom of the structure from bank to bank.	100%: Substrate forms a continuous layer throughout the entire structure.	100%: Substrate forms a continuous layer throughout the entire structure.	100%: Substrate forms a continuous layer throughout the entire structure.	100%: Substrate forms a continuous layer throughout the entire structure.	100%: Substrate forms a continuous layer throughout the entire structure.
Substrate matches stream: Comparison of the substrate (e.g., rock, gravel, sand) inside the structure and the substrate in the natural, undisturbed stream channel.	Comparable: The substrate inside the structure is similar in size to the substrate in the natural stream channel.	Comparable: The substrate inside the structure is similar in size to the substrate in the natural stream channel.	Comparable: The substrate inside the structure is similar in size to the substrate in the natural stream channel.	Comparable: The substrate inside the structure is similar in size to the substrate in the natural stream channel.	Comparable: The substrate inside the structure is similar in size to the substrate in the natural stream channel.
Water Depth Matches Stream: Compare the water depth inside the structure with the water depth in the natural stream channel away from the influence of the crossing.	No-Deeper: The water depth in the crossing is greater than depths that occur naturally in a similar length of the undisturbed stream.	No-Deeper: The water depth in the crossing is greater than depths that occur naturally in a similar length of the undisturbed stream.	No-Deeper: The water depth in the crossing is greater than depths that occur naturally in a similar length of the undisturbed stream.	No-Deeper: The water depth in the crossing is greater than depths that occur naturally in a similar length of the undisturbed stream.	Comprable: The depth in the crossing falls within the range of depths naturally occurring in that reach of the stream and for comparable distances along the length of the stream.
Water Velocity Matches Stream: Compare the water velocity inside the structure with the velocity in the natural stream channel away from the influence of the crossing.	Comprable: The water velocity in the crossing falls within the range of velocities naturally occurring in that reach of the stream for comparable distances.	Comprable: The water velocity in the crossing falls within the range of velocities naturally occurring in that reach of the stream for comparable distances.	Comprable: The water velocity in the crossing falls within the range of velocities naturally occurring in that reach of the stream for comparable distances.	Comprable: The water velocity in the crossing falls within the range of velocities naturally occurring in that reach of the stream for comparable distances.	Comprable: The water velocity in the crossing falls within the range of velocities naturally occurring in that reach of the stream for comparable distances.
Openess (x=cross sectional area/structure length)	0.02	0.02	0.08	0.01	0.01
Height of structure (ft)	2.00	2.00	3.50	4.00	2.00
Outlet drop to water surface (ft)	0.00	0.00	0.00	0.00	0.00

Culvert ID	**E-32**	**E-33**	**E-34**	**E-35**
Constriction: Wetted width at low flow compared to channel wetted width	Moderate: The crossing is greater than 50% of the bankfull or active width of the natural stream, but less than the full bankfull or active channel width	Moderate: The crossing is greater than 50% of the bankfull or active width of the natural stream, but less than the full bankfull or active channel width	Severe: The total width of the crossing (sum of widths of all crossing structures) is less than 50% of the bankfull or active width of the natural stream, or the total wetted width of the crossing is less than 50% of the wetted width of the stream.	Moderate: The crossing is greater than 50% of the bankfull or active width of the natural stream, but less than the full bankfull or active channel width
Inlet grade: An observation of the relative elevation of the stream bottom as it enters the structure. This is not an assessment of stream slope (gradient).	At Stream Grade: The inlet of the structure is at approximately the same elevation as the stream bottom upstream of the structure.	At Stream Grade: The inlet of the structure is at approximately the same elevation as the stream bottom upstream of the structure.	At Stream Grade: The inlet of the structure is at approximately the same elevation as the stream bottom upstream of the structure.	At Stream Grade: The inlet of the structure is at approximately the same elevation as the stream bottom upstream of the structure.
Internal structures: These may include baffles or weirs used to slow flow velocities and help to pass fish, as well as trusses, rods, piers or other structures intended to support a crossing structure, but which may interfere with flow and aquatic organism passage.	None: There are no apparent structures inside the crossing structure	None: There are no apparent structures inside the crossing structure	None: There are no apparent structures inside the crossing structure	None: There are no apparent structures inside the crossing structure
Outlet armoring: Indicate the presence and extent of material placed below the outlet for the purpose of diffusing flow and minimizing scour. The most common form of outlet armoring is a layer of riprap placed below the outlet. A few pieces of rock that may have fallen into the stream near the structure's outlet do not constitute outlet armoring. Armoring of the road embankment and stream banks should not be confused with armoring of the stream bottom.	None: You may observe rocks that have fallen from the embankment or that are natural to the stream.	None: You may observe rocks that have fallen from the embankment or that are natural to the stream.	None: You may observe rocks that have fallen from the embankment or that are natural to the stream.	None: You may observe rocks that have fallen from the embankment or that are natural to the stream.
Physical barriers: Examples include debris/sediment/rock, deformation, fencing, a dry structure (when the stream is flowing)	None: There are no physical barriers associated with this structure	None: There are no physical barriers associated with this structure	None: There are no physical barriers associated with this structure	None: There are no physical barriers associated with this structure
Scour pool: This is a pool created downstream of a crossing as a result of high flows exiting the crossing. Use as a reference natural pools in a portion of the stream that is outside the influence of the crossing structure. A scour pool is considered to exist when its size (a combination of length, width, and depth) is larger than pools found in the natural stream.	None: There is no difference between the length, width, or depth of the tailwater pool compared with reference pools, or no tailwater pool exists at the site.	None: There is no difference between the length, width, or depth of the tailwater pool compared with reference pools, or no tailwater pool exists at the site.	None: There is no difference between the length, width, or depth of the tailwater pool compared with reference pools, or no tailwater pool exists at the site.	None: There is no difference between the length, width, or depth of the tailwater pool compared with reference pools, or no tailwater pool exists at the site.
Substrate coverage: The extent of the substrate inside the crossing structure as a continuous layer across the entire bottom of the structure from bank to bank.	100%: Substrate forms a continuous layer throughout the entire structure.	100%: Substrate forms a continuous layer throughout the entire structure.	75%: Substrate covers at least 75% of the length of the structure.	25%: Substrate covers at least 25% of the length of the structure.
Substrate matches stream: Comparison of the substrate (e.g., rock, gravel, sand) inside the structure and the substrate in the natural, undisturbed stream channel.	Comparable: The substrate inside the structure is similar in size to the substrate in the natural stream channel.	Comparable: The substrate inside the structure is similar in size to the substrate in the natural stream channel.	Comparable: The substrate inside the structure is similar in size to the substrate in the natural stream channel.	Contrasting: The substrate inside the structure is different in size from the substrate in the natural channel.
Water Depth Matches Stream: Compare the water depth inside the structure with the water depth in the natural stream channel away from the influence of the crossing.	Comprable: The depth in the crossing falls within the range of depths naturally occurring in that reach of the stream and for comparable distances along the length of the stream.	Comprable: The depth in the crossing falls within the range of depths naturally occurring in that reach of the stream and for comparable distances along the length of the stream.	Comprable: The depth in the crossing falls within the range of depths naturally occurring in that reach of the stream and for comparable distances along the length of the stream.	No-Shallower: The water depth in the crossing is less than depths that occur naturally in a similar length of the undisturbed stream, or the shallower depth through the structure covers a greater length than occurs in the natural stream.
Water Velocity Matches Stream: Compare the water velocity inside the structure with the velocity in the natural stream channel away from the influence of the crossing.	Comprable: The water velocity in the crossing falls within the range of velocities naturally occurring in that reach of the stream for comparable distances.	Comprable: The water velocity in the crossing falls within the range of velocities naturally occurring in that reach of the stream for comparable distances.	Comprable: The water velocity in the crossing falls within the range of velocities naturally occurring in that reach of the stream for comparable distances.	No-Slower: The velocity in the crossing is less than velocities that occur naturally in a similar length of the undisturbed stream.
Openess (x=cross sectional area/structure length)	0.11	0.01	0.13	0.03
Height of structure (ft)	4.00	2.50	2.50	2.67
Outlet drop to water surface (ft)	0.00	0.00	0.00	0.10

Project: I-81 Viaduct Project

Component Score Descriptive Table - East Study Area

Culvert ID	E-36	E-37	E-38	E-39	E-40	E-41	E-42	E-43
Constriction: Wetted width at low flow compared to channel wetted width	Moderate: The crossing is greater than 50% of the bankfull or active width of the natural stream, but less than the full bankfull or active channel width	Moderate: The crossing is greater than 50% of the bankfull or active width of the natural stream, but less than the full bankfull or active channel width	Moderate: The crossing is greater than 50% of the bankfull or active width of the natural stream, but less than the full bankfull or active channel width	Moderate: The crossing is greater than 50% of the bankfull or active width of the natural stream, but less than the full bankfull or active channel width	Spans only bankfull/active channel: The crossing encompasses the approximate width of the bankfull or active channel	Severe: The total width of the crossing (sum of widths of all crossing structures) is less than 50% of the bankfull or active width of the natural stream, or the total wetted width of the crossing is less than 50% of the wetted width of the stream.	Moderate: The crossing is greater than 50% of the bankfull or active width of the natural stream, but less than the full bankfull or active channel width	Moderate: The crossing is greater than 50% of the bankfull or active width of the natural stream, but less than the full bankfull or active channel width
Inlet grade: An observation of the relative elevation of the stream bottom as it enters the structure. This is not an assessment of stream slope (gradient).	At Stream Grade: The inlet of the structure is at approximately the same elevation as the stream bottom upstream of the structure.	At Stream Grade: The inlet of the structure is at approximately the same elevation as the stream bottom upstream of the structure.	At Stream Grade: The inlet of the structure is at approximately the same elevation as the stream bottom upstream of the structure.	At Stream Grade: The inlet of the structure is at approximately the same elevation as the stream bottom upstream of the structure.	At Stream Grade: The inlet of the structure is at approximately the same elevation as the stream bottom upstream of the structure.	Perched: The inlet of the structure is set too high for the stream, and little water passes through the structure during normal low summer flows, though the stream has water upstream and downstream of the crossing. The structure inlet is above the surface of water in the stream. Water can enter the structure only at higher flows.	At Stream Grade: The inlet of the structure is at approximately the same elevation as the stream bottom upstream of the structure.	At Stream Grade: The inlet of the structure is at approximately the same elevation as the stream bottom upstream of the structure.
Internal structures: These may include baffles or weirs used to slow flow velocities and help to pass fish, as well as trusses, rods, piers or other structures intended to support a crossing structure, but which may interfere with flow and aquatic organism passage.	None: There are no apparent structures inside the crossing structure	None: There are no apparent structures inside the crossing structure	None: There are no apparent structures inside the crossing structure	None: There are no apparent structures inside the crossing structure	None: There are no apparent structures inside the crossing structure	None: There are no apparent structures inside the crossing structure	None: There are no apparent structures inside the crossing structure	None: There are no apparent structures inside the crossing structure
Outlet armoring: Indicate the presence and extent of material placed below the outlet for the purpose of diffusing flow and minimizing scour. The most common form of outlet armoring is a layer of riprap placed below the outlet. A few pieces of rock that may have fallen into the stream near the structure's outlet do not constitute outlet armoring. Armoring of the road embankment and stream banks should not be confused with armoring of the stream bottom.	None: You may observe rocks that have fallen from the embankment or that are natural to the stream.	Extensive: Select this option only if you observe an extensive layer of material covering an area more than 50% of the stream width, which was put in place specifically to minimize scour at the outlet.	None: You may observe rocks that have fallen from the embankment or that are natural to the stream.	None: You may observe rocks that have fallen from the embankment or that are natural to the stream.	None: You may observe rocks that have fallen from the embankment or that are natural to the stream.	None: You may observe rocks that have fallen from the embankment or that are natural to the stream.	None: You may observe rocks that have fallen from the embankment or that are natural to the stream.	None: You may observe rocks that have fallen from the embankment or that are natural to the stream.
Physical barriers: Examples include debris/sediment/rock, deformation, fencing, a dry structure (when the stream is flowing)	None: There are no physical barriers associated with this structure	None: There are no physical barriers associated with this structure	None: There are no physical barriers associated with this structure	None: There are no physical barriers associated with this structure	Fencing: The structure has some sort of fencing. It may directly block the movement of aquatic and terrestrial organisms, and it may become clogged with debris. Minor: Widely spaced wires or grating with > 0.5 foot (6") gaps.	None: There are no physical barriers associated with this structure	None: There are no physical barriers associated with this structure	None: There are no physical barriers associated with this structure
Scour pool: This is a pool created downstream of a crossing as a result of high flows exiting the crossing. Use as a reference natural pools in a portion of the stream that is outside the influence of the crossing structure. A scour pool is considered to exist when its size (a combination of length, width, and depth) is larger than pools found in the natural stream.	Small: The tailwater pool is between one and two times the length, width, or depth of reference pools.	None: There is no difference between the length, width, or depth of the tailwater pool compared with reference pools, or no tailwater pool exists at the site.	None: There is no difference between the length, width, or depth of the tailwater pool compared with reference pools, or no tailwater pool exists at the site.	None: There is no difference between the length, width, or depth of the tailwater pool compared with reference pools, or no tailwater pool exists at the site.	None: There is no difference between the length, width, or depth of the tailwater pool compared with reference pools, or no tailwater pool exists at the site.	Small: The tailwater pool is between one and two times the length, width, or depth of reference pools.	None: There is no difference between the length, width, or depth of the tailwater pool compared with reference pools, or no tailwater pool exists at the site.	None: There is no difference between the length, width, or depth of the tailwater pool compared with reference pools, or no tailwater pool exists at the site.
Substrate coverage: The extent of the substrate inside the crossing structure as a continuous layer across the entire bottom of the structure from bank to bank.	50%: Substrate covers at least 50% of the length of the structure.	75%: Substrate covers at least 75% of the length of the structure.	100%: Substrate forms a continuous layer throughout the entire structure.	100%: Substrate forms a continuous layer throughout the entire structure.	100%: Substrate forms a continuous layer throughout the entire structure.	None: Substrate covers less than 25% of the length of the structure, or there is no substrate inside the structure at all.	100%: Substrate forms a continuous layer throughout the entire structure.	100%: Substrate forms a continuous layer throughout the entire structure.
Substrate matches stream: Comparison of the substrate (e.g., rock, gravel, sand) inside the structure and the substrate in the natural, undisturbed stream channel.	Comparable: The substrate inside the structure is similar in size to the substrate in the natural stream channel.	Comparable: The substrate inside the structure is similar in size to the substrate in the natural stream channel.	Comparable: The substrate inside the structure is similar in size to the substrate in the natural stream channel.	Comparable: The substrate inside the structure is similar in size to the substrate in the natural stream channel.	Comparable: The substrate inside the structure is similar in size to the substrate in the natural stream channel.	None: Select this option when there is very little (e.g., a thin layer of silt or a few pieces of rock) or no substrate inside the structure.	Comparable: The substrate inside the structure is similar in size to the substrate in the natural stream channel.	Comparable: The substrate inside the structure is similar in size to the substrate in the natural stream channel.
Water Depth Matches Stream: Compare the water depth inside the structure with the water depth in the natural stream channel away from the influence of the crossing.	Comprable: The depth in the crossing falls within the range of depths naturally occurring in that reach of the stream and for comparable distances along the length of the stream.	Comprable: The depth in the crossing falls within the range of depths naturally occurring in that reach of the stream and for comparable distances along the length of the stream.	Comprable: The depth in the crossing falls within the range of depths naturally occurring in that reach of the stream and for comparable distances along the length of the stream.	Comprable: The depth in the crossing falls within the range of depths naturally occurring in that reach of the stream and for comparable distances along the length of the stream.	Comprable: The depth in the crossing falls within the range of depths naturally occurring in that reach of the stream and for comparable distances along the length of the stream.	No-Shallower: The water depth in the crossing is less than depths that occur naturally in a similar length of the undisturbed stream, or the shallower depth through the structure covers a greater length than occurs in the natural stream.	Comprable: The depth in the crossing falls within the range of depths naturally occurring in that reach of the stream and for comparable distances along the length of the stream.	Comprable: The depth in the crossing falls within the range of depths naturally occurring in that reach of the stream and for comparable distances along the length of the stream.
Water Velocity Matches Stream: Compare the water velocity inside the structure with the velocity in the natural stream channel away from the influence of the crossing.	Comprable: The water velocity in the crossing falls within the range of velocities naturally occurring in that reach of the stream for comparable distances.	Comprable: The water velocity in the crossing falls within the range of velocities naturally occurring in that reach of the stream for comparable distances.	Comprable: The water velocity in the crossing falls within the range of velocities naturally occurring in that reach of the stream for comparable distances.	Comprable: The water velocity in the crossing falls within the range of velocities naturally occurring in that reach of the stream for comparable distances.	Comprable: The water velocity in the crossing falls within the range of velocities naturally occurring in that reach of the stream for comparable distances.	No-Slower: The velocity in the crossing is less than velocities that occur naturally in a similar length of the undisturbed stream.	Comprable: The water velocity in the crossing falls within the range of velocities naturally occurring in that reach of the stream for comparable distances.	Comprable: The water velocity in the crossing falls within the range of velocities naturally occurring in that reach of the stream for comparable distances.
Openess (x=cross sectional area/structure length)	0.20	0.07	0.12	0.17	0.09	0.19	0.06	0.04
Height of structure (ft)	2.00	3.50	3.00	3.00	4.50	5.42	2.67	2.67
Outlet drop to water surface (ft)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

AKRF

Project: I-81 Viaduct Project

Component Score Descriptive Table - Central Study Area		
Culvert ID	**C-1**	**C-2**
Constriction: Wetted width at low flow compared to channel wetted width	Moderate: The crossing is greater than 50% of the bankfull or active width of the natural stream, but less than the full bankfull or active channel width	Moderate: The crossing is greater than 50% of the bankfull or active width of the natural stream, but less than the full bankfull or active channel width
Inlet grade: An observation of the relative elevation of the stream bottom as it enters the structure. This is not an assessment of stream slope (gradient).	At Stream Grade: The inlet of the structure is at approximately the same elevation as the stream bottom upstream of the structure.	At Stream Grade: The inlet of the structure is at approximately the same elevation as the stream bottom upstream of the structure.
Internal structures: These may include baffles or weirs used to slow flow velocities and help to pass fish, as well as trusses, rods, piers or other structures intended to support a crossing structure, but which may interfere with flow and aquatic organism passage.	None: There are no apparent structures inside the crossing structure	None: There are no apparent structures inside the crossing structure
Outlet armoring: Indicate the presence and extent of material placed below the outlet for the purpose of diffusing flow and minimizing scour. The most common form of outlet armoring is a layer of riprap placed below the outlet. A few pieces of rock that may have fallen into the stream near the structure's outlet do not constitute outlet armoring. Armoring of the road embankment and stream banks should not be confused with armoring of the stream bottom.	Not Extensive: There is of a layer of material covering an area less than 50% of the stream width placed purposefully below the outlet specifically to minimize the effects of scour.	Extensive: Select this option only if you observe an extensive layer of material covering an area more than 50% of the stream width, which was put in place specifically to minimize scour at the outlet.
Physical barriers: Examples include debris/sediment/rock, deformation, fencing, a dry structure (when the stream is flowing)	Debris/Sediment/Rock: Woody debris or synthetic material, rock, or sediment blocks the flow of water into or through the structure. This can consist of wood or other vegetation, trash, sand, gravel, or rock. Moderate: 10% - 50% of open area blocked. About 3" of sediment is present at the outlet and heavy riprap has fallen into the channel at the inlet.	None: There are no physical barriers associated with this structure
Scour pool: This is a pool created downstream of a crossing as a result of high flows exiting the crossing. Use as a reference natural pools in a portion of the stream that is outside the influence of the crossing structure. A scour pool is considered to exist when its size (a combination of length, width, and depth) is larger than pools found in the natural stream.	None: There is no difference between the length, width, or depth of the tailwater pool compared with reference pools, or no tailwater pool exists at the site.	None: There is no difference between the length, width, or depth of the tailwater pool compared with reference pools, or no tailwater pool exists at the site.
Substrate coverage: The extent of the substrate inside the crossing structure as a continuous layer across the entire bottom of the structure from bank to bank.	25%: Substrate covers at least 25% of the length of the structure.	75%: Substrate covers at least 75% of the length of the structure.
Substrate matches stream: **C**omparison of the substrate (e.g., rock, gravel, sand) inside the structure and the substrate in the natural, undisturbed stream channel.	Comparable: The substrate inside the structure is similar in size to the substrate in the natural stream channel.	Comparable: The substrate inside the structure is similar in size to the substrate in the natural stream channel.
Water Depth Matches Stream: Compare the water depth inside the structure with the water depth in the natural stream channel away from the influence of the crossing.	Comprable: The depth in the crossing falls within the range of depths naturally occurring in that reach of the stream and for comparable distances along the length of the stream.	No-Deeper: The water depth in the crossing is greater than depths that occur naturally in a similar length of the undisturbed stream.
Water Velocity Matches Stream: Compare the water velocity inside the structure with the velocity in the natural stream channel away from the influence of the crossing.	Comprable: The water velocity in the crossing falls within the range of velocities naturally occurring in that reach of the stream for comparable distances.	No-Faster: The water velocity in the structure is greater than velocities that occur naturally in a similar length of the undisturbed stream, or the velocity through the structure persists over a longer distance than occurs in the natural stream.
Openess (x=cross sectional area/structure length)	0.06	0.12
Height of structure (ft)	2.00	4.33
Outlet drop to water surface (ft)	0.00	0.00

AKRF

Project: I-81 Viaduct Project

Culvert Component Scores - North Study Area																									
Culvert ID	**N-1**	**N-2**	**N-3**	**N-4**	**N-5**	**N-6**	**N-7**	**N-8**	**N-9**	**N-10**	**N-11**	**N-12**	**N-13**	**N-14**	**N-15**	**N-16**	**N-17**	**N-18**	**N-19**	**N-20**	**N-21**	**N-22**	**N-23**	**N-24**	**N-25**
Constriction	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.90	0.50	0.50	0.50	0.00	0.00	0.50	0.50	0.50	0.50	0.50	0.90	0.00	0.00	0.50	0.50	0.50	0.90
Weighted	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.08	0.05	0.05	0.05	0.00	0.00	0.05	0.05	0.05	0.05	0.05	0.08	0.00	0.00	0.05	0.05	0.05	0.08
Inlet grade	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Weighted	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.00	0.09	0.09	0.09	0.09	0.09	0.09	0.00	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09
Internal structures	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Weighted	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03
Outlet armoring	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Weighted	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04
Physical barriers	1.00	0.50	0.80	0.00	1.00	1.00	1.00	1.00	1.00	0.00	1.00	1.00	1.00	1.00	0.50	1.00	0.80	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Weighted	0.14	0.07	0.11	0.00	0.14	0.14	0.14	0.14	0.14	0.00	0.14	0.14	0.14	0.14	0.07	0.14	0.11	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14
Scour pool	1.00	1.00	0.80	1.00	0.80	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.80	1.00	0.80	1.00	1.00	1.00	1.00	1.00
Weighted	0.07	0.07	0.06	0.07	0.06	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.06	0.07	0.06	0.07	0.07	0.07	0.07	0.07
Substrate coverage	1.00	1.00	0.00	1.00	1.00	0.00	0.00	0.30	0.70	1.00	1.00	1.00	1.00	1.00	0.70	0.30	0.50	1.00	1.00	1.00	0.50	0.70	0.70	1.00	0.70
Weighted	0.06	0.06	0.00	0.06	0.06	0.00	0.00	0.02	0.04	0.06	0.06	0.06	0.06	0.06	0.04	0.02	0.03	0.06	0.06	0.06	0.03	0.04	0.04	0.06	0.04
Substrate matches stream	1.00	1.00	0.00	1.00	1.00	0.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.75	0.75	1.00	1.00	1.00	1.00	1.00	1.00	0.25	0.75	1.00
Weighted	0.07	0.07	0.00	0.07	0.07	0.00	0.00	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.05	0.05	0.07	0.07	0.07	0.07	0.07	0.07	0.02	0.05	0.07
Water depth matches stream	0.50	1.00	0.00	1.00	1.00	0.00	0.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00	0.00	0.00	0.00	1.00	1.00
Weighted	0.04	0.08	0.00	0.08	0.08	0.00	0.00	0.00	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.00	0.00	0.00	0.00	0.08	0.08
Water velocity matches stream	1.00	1.00	0.50	1.00	1.00	0.00	0.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00	0.00	0.00	0.00	1.00	1.00
Weighted	0.08	0.08	0.04	0.08	0.08	0.00	0.00	0.00	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.00	0.00	0.00	0.00	0.08	0.08
Openess	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.00	0.00	0.79	0.04	0.04	0.02	0.01	0.42	0.16	0.05	0.27	0.63	0.74	0.15	0.10	0.02
Weighted	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.00	0.00	0.00	0.00	0.02	0.01	0.00	0.01	0.03	0.04	0.01	0.01	0.00
Height of structure (max)	0.50	0.50	0.35	0.50	0.35	0.62	0.62	0.72	0.50	0.50	0.50	1.00	0.92	0.92	0.50	0.50	0.92	0.72	0.72	0.92	1.00	1.00	1.00	0.50	0.90
Weighted	0.02	0.02	0.02	0.02	0.02	0.03	0.03	0.03	0.02	0.02	0.02	0.05	0.04	0.04	0.02	0.02	0.04	0.03	0.03	0.04	0.05	0.05	0.05	0.02	0.04
Outlet drop to water surface	1.00	1.00	0.85	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Weighted	0.16	0.16	0.14	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16
Composite Score	0.84	0.81	0.56	0.75	0.86	0.60	0.60	0.72	0.86	0.66	0.88	0.90	0.86	0.90	0.78	0.82	0.78	0.88	0.93	0.69	0.70	0.76	0.68	0.87	0.92
Aquatic Passibility Score	0.84	0.81	0.56	0.75	0.86	0.60	0.60	0.72	0.86	0.66	0.88	0.90	0.86	0.90	0.78	0.82	0.78	0.88	0.93	0.69	0.70	0.76	0.68	0.87	0.92
Descriptor	Insignificant Barrier	Insignificant Barrier	Moderate Barrier	Minor Barrier	Insignificant Barrier	Moderate Barrier	Moderate Barrier	Minor Barrier	Insignificant Barrier	Minor Barrier	Insignificant Barrier	Insignificant Barrier	Insignificant Barrier	Insignificant Barrier	Minor Barrier	Insignificant Barrier	Minor Barrier	Insignificant Barrier	Insignificant Barrier	Minor Barrier	Minor Barrier	Minor Barrier	Minor Barrier	Insignificant Barrier	Insignificant Barrier

Culvert Component Scores - North Study Area											
Culvert ID	**N-26**	**N-27**	**N-28**	**N-29**	**N-30**	**N-31**	**N-32**	**N-33**	**N-34**	**N-35**	**N-36**
Constriction	0.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.50	0.50	0.00
Weighted	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.05	0.05	0.00
Inlet grade	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00	1.00	1.00
Weighted	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.00	0.09	0.09
Internal structures	1.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Weighted	0.03	0.00	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03
Outlet armoring	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00	1.00	1.00	0.00
Weighted	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.00	0.04	0.04	0.00
Physical barriers	1.00	1.00	1.00	1.00	0.00	0.00	0.00	0.00	1.00	1.00	1.00
Weighted	0.14	0.14	0.14	0.14	0.00	0.00	0.00	0.00	0.14	0.14	0.14
Scour pool	1.00	0.80	1.00	1.00	1.00	0.80	0.00	0.80	1.00	1.00	1.00
Weighted	0.07	0.06	0.07	0.07	0.07	0.06	0.00	0.06	0.07	0.07	0.07
Substrate coverage	1.00	0.00	1.00	1.00	1.00	0.30	0.00	0.00	0.30	1.00	0.00
Weighted	0.06	0.00	0.06	0.06	0.06	0.02	0.00	0.00	0.02	0.06	0.00
Substrate matches stream	0.75	0.00	1.00	1.00	1.00	1.00	0.00	0.00	1.00	1.00	0.00
Weighted	0.05	0.00	0.07	0.07	0.07	0.07	0.00	0.00	0.07	0.07	0.00
Water depth matches stream	0.00	0.00	0.00	1.00	0.50	0.00	0.00	0.00	0.00	0.50	1.00
Weighted	0.00	0.00	0.00	0.08	0.04	0.00	0.00	0.00	0.00	0.04	0.08
Water velocity matches stream	1.00	0.00	1.00	1.00	1.00	1.00	0.00	1.00	0.00	1.00	1.00
Weighted	0.08	0.00	0.08	0.08	0.08	0.08	0.00	0.08	0.00	0.08	0.08
Openess	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.90	0.33	0.00
Weighted	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.05	0.02	0.00
Height of structure (max)	0.99	0.50	0.19	0.19	0.19	0.50	0.50	0.62	0.99	1.00	0.62
Weighted	0.04	0.02	0.01	0.01	0.01	0.02	0.02	0.03	0.04	0.05	0.03
Outlet drop to water surface	1.00	1.00	1.00	1.00	1.00	0.19	0.01	1.00	1.00	1.00	1.00
Weighted	0.16	0.16	0.16	0.16	0.16	0.03	0.00	0.16	0.16	0.16	0.16
Composite Score	0.85	0.50	0.74	0.82	0.65	0.43	0.18	0.45	0.66	0.88	0.68
Aquatic Passibility Score	0.85	0.50	0.74	0.82	0.65	0.19	0.01	0.45	0.66	0.88	0.68
Descriptor	Insignificant Barrier	Moderate Barrier	Minor Barrier	Insignificant Barrier	Minor Barrier	Severe Barrier	Severe Barrier	Moderate Barrier	Minor Barrier	Insignificant Barrier	Minor Barrier

AKRF

Project: I-81 Viaduct Project

Culvert Component Scores - East Study Area																									
Culvert ID	**E-1**	**E-2**	**E-3**	**E-4**	**E-5**	**E-6**	**E-7**	**E-8**	**E-9**	**E-10**	**E-11**	**E-12**	**E-13**	**E-14**	**E-15**	**E-16**	**E-17**	**E-18**	**E-19**	**E-20**	**E-21**	**E-22**	**E-23**	**E-24**	**E-25**
Constriction	0.00	0.90	0.90	0.50	0.50	0.50	0.90	0.90	0.90	0.00	0.50	0.50	0.50	0.90	0.50	0.00	0.50	0.50	0.50	0.50	0.50	0.00	0.00	0.00	0.00
Weighted	0.00	0.08	0.08	0.05	0.05	0.05	0.08	0.08	0.08	0.00	0.05	0.05	0.05	0.08	0.05	0.00	0.05	0.05	0.05	0.05	0.05	0.00	0.00	0.00	0.00
Inlet grade	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00
Weighted	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.00	0.09	0.09	0.09	0.09	0.09	0.09
Internal structures	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Weighted	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03
Outlet armoring	1.00	1.00	1.00	0.00	0.00	0.00	1.00	0.00	0.50	1.00	1.00	1.00	0.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Weighted	0.04	0.04	0.04	0.00	0.00	0.00	0.04	0.00	0.02	0.04	0.04	0.04	0.00	0.00	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04
Physical barriers	1.00	0.80	1.00	1.00	1.00	1.00	0.80	0.80	1.00	0.00	0.00	0.80	0.00	1.00	0.50	1.00	0.00	0.80	0.50	0.50	1.00	0.50	0.80	0.80	0.00
Weighted	0.14	0.11	0.14	0.14	0.14	0.14	0.11	0.11	0.14	0.00	0.00	0.11	0.00	0.14	0.07	0.14	0.00	0.11	0.07	0.07	0.14	0.07	0.11	0.11	0.00
Scour pool	1.00	1.00	1.00	0.80	1.00	0.80	1.00	1.00	1.00	1.00	1.00	1.00	0.80	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Weighted	0.07	0.07	0.07	0.06	0.07	0.06	0.07	0.07	0.07	0.07	0.07	0.07	0.06	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07
Substrate coverage	1.00	0.00	0.70	0.00	0.30	0.00	1.00	1.00	0.00	1.00	1.00	0.50	1.00	0.00	1.00	1.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Weighted	0.06	0.00	0.04	0.00	0.02	0.00	0.06	0.06	0.00	0.06	0.06	0.03	0.06	0.00	0.06	0.06	0.06	0.00	0.06	0.06	0.06	0.06	0.06	0.06	0.06
Substrate matches stream	1.00	0.00	0.75	0.00	1.00	0.00	1.00	1.00	0.00	1.00	0.75	1.00	1.00	0.00	1.00	1.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Weighted	0.07	0.00	0.05	0.00	0.07	0.00	0.07	0.07	0.00	0.07	0.05	0.07	0.07	0.00	0.07	0.07	0.07	0.00	0.07	0.07	0.07	0.07	0.07	0.07	0.07
Water depth matches stream	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.50	0.00	0.00	1.00	1.00	1.00	1.00	0.00	0.00	1.00	1.00	0.50	0.50	1.00	0.50	0.50
Weighted	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.04	0.00	0.00	0.08	0.08	0.08	0.08	0.00	0.00	0.08	0.08	0.04	0.04	0.08	0.04	0.04
Water velocity matches stream	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.50	0.50	0.50	1.00	1.00	1.00	1.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Weighted	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.04	0.04	0.04	0.08	0.08	0.08	0.08	0.08	0.00	0.08	0.08	0.08	0.08	0.08	0.08	0.08
Openess	0.41	0.01	0.00	0.03	0.03	0.09	0.02	0.01	0.01	0.02	0.00	0.03	0.00	0.03	0.05	0.04	0.00	0.01	0.01	0.01	0.01	0.01	0.03	0.03	0.00
Weighted	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Height of structure (max)	1.00	0.50	0.50	0.65	0.79	0.79	0.50	0.50	0.50	0.65	0.50	0.65	0.62	0.72	0.95	0.72	0.35	0.72	0.50	0.50	0.50	0.50	0.72	0.72	0.00
Weighted	0.05	0.02	0.02	0.03	0.04	0.04	0.02	0.02	0.02	0.03	0.02	0.03	0.03	0.03	0.04	0.03	0.02	0.03	0.02	0.02	0.02	0.02	0.03	0.03	0.00
Outlet drop to water surface	1.00	1.00	1.00	0.80	1.00	0.19	1.00	0.00	0.00	1.00	1.00	1.00	0.50	0.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Weighted	0.16	0.16	0.16	0.13	0.16	0.03	0.16	0.00	0.00	0.16	0.16	0.16	0.08	0.00	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16
Composite Score	0.88	0.76	0.88	0.68	0.82	0.59	0.89	0.69	0.61	0.63	0.61	0.71	0.62	0.60	0.84	0.85	0.66	0.57	0.73	0.81	0.84	0.73	0.82	0.78	0.64
Aquatic Passibility Score	0.88	0.76	0.88	0.68	0.82	0.19	0.89	0.00	0.00	0.63	0.61	0.71	0.50	0.00	0.84	0.85	0.66	0.57	0.73	0.81	0.84	0.73	0.82	0.78	0.64
Descriptor	Insignificant Barrier	Minor Barrier	Insignificant Barrier	Minor Barrier	Insignificant Barrier	Severe Barrier	Insignificant Barrier	Severe Barrier	Severe Barrier	Minor Barrier	Minor Barrier	Minor Barrier	Moderate Barrier	Severe Barrier	Insignificant Barrier	Insignificant Barrier	Minor Barrier	Moderate Barrier	Minor Barrier	Insignificant Barrier	Insignificant Barrier	Minor Barrier	Insignificant Barrier	Minor Barrier	Minor Barrier

Culvert Component Scores - East Study Area																		
2020 Culvert ID	**E-26**	**E-27**	**E-28**	**E-29**	**E-30**	**E-31**	**E-32**	**E-33**	**E-34**	**E-35**	**E-36**	**E-37**	**E-38**	**E-39**	**E-40**	**E-41**	**E-42**	**E-43**
Constriction	0.50	0.50	0.00	0.00	0.00	0.00	0.50	0.50	0.00	0.50	0.50	0.50	0.50	0.50	0.90	0.00	0.50	0.50
Weighted	0.05	0.05	0.00	0.00	0.00	0.00	0.05	0.05	0.00	0.05	0.05	0.05	0.05	0.05	0.08	0.00	0.05	0.05
Inlet grade	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00	1.00	1.00
Weighted	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.00	0.09	0.09
Internal structures	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Weighted	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03
Outlet armoring	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00
Weighted	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.00	0.04	0.04	0.04	0.04	0.04	0.04
Physical barriers	0.00	0.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.80	1.00	1.00	1.00
Weighted	0.00	0.00	0.00	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.11	0.14	0.14	0.14
Scour pool	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.80	1.00	1.00	1.00	1.00	0.80	1.00	1.00
Weighted	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.06	0.07	0.07	0.07	0.07	0.06	0.07	0.07
Substrate coverage	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.70	0.30	0.50	0.70	1.00	1.00	1.00	0.00	1.00	1.00
Weighted	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.04	0.02	0.03	0.04	0.06	0.06	0.06	0.00	0.06	0.06
Substrate matches stream	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.75	1.00	1.00	1.00	1.00	1.00	0.00	1.00	1.00
Weighted	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.05	0.07	0.07	0.07	0.07	0.07	0.00	0.07	0.07
Water depth matches stream	1.00	0.50	0.50	0.50	0.50	1.00	1.00	1.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	0.00	1.00	1.00
Weighted	0.08	0.04	0.04	0.04	0.04	0.08	0.08	0.08	0.08	0.00	0.08	0.08	0.08	0.08	0.08	0.00	0.08	0.08
Water velocity matches stream	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.50	1.00	1.00	1.00	1.00	1.00	0.50	1.00	1.00
Weighted	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.04	0.08	0.08	0.08	0.08	0.08	0.04	0.08	0.08
Openess	0.01	0.00	0.00	0.07	0.00	0.00	0.14	0.00	0.17	0.01	0.35	0.05	0.17	0.27	0.09	0.34	0.03	0.02
Weighted	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.01	0.00	0.02	0.00	0.01	0.01	0.00	0.02	0.00	0.00
Height of structure (max)	0.50	0.50	0.50	0.79	0.84	0.50	0.84	0.62	0.62	0.65	0.50	0.79	0.72	0.72	0.89	0.94	0.65	0.65
Weighted	0.02	0.02	0.02	0.04	0.04	0.02	0.04	0.03	0.03	0.03	0.02	0.04	0.03	0.03	0.04	0.04	0.03	0.03
Outlet drop to water surface	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.96	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Weighted	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.15	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16
Composite Score	0.75	0.70	0.66	0.81	0.81	0.84	0.90	0.89	0.83	0.70	0.86	0.84	0.90	0.90	0.91	0.52	0.89	0.89
Aquatic Passibility Score	0.75	0.70	0.66	0.81	0.81	0.84	0.90	0.89	0.83	0.70	0.86	0.84	0.90	0.90	0.91	0.52	0.89	0.89
Descriptor	Minor Barrier	Minor Barrier	Minor Barrier	Insignificant Barrier	Insignificant Barrier	Insignificant Barrier	Insignificant Barrier	Insignificant Barrier	Insignificant Barrier	Minor Barrier	Insignificant Barrier	Insignificant Barrier	Insignificant Barrier	Insignificant Barrier	Insignificant Barrier	Moderate Barrier	Insignificant Barrier	Insignificant Barrier

Project: I-81 Viaduct Project

Culvert Component Scores - Central Study Area		
Culvert ID	**C-1**	**C-2**
Constriction	0.50	0.50
Weighted	0.05	0.05
Inlet grade	1.00	1.00
Weighted	0.09	0.09
Internal structures	1.00	1.00
Weighted	0.03	0.03
Outlet armoring	0.50	0.00
Weighted	0.02	0.00
Physical barriers	1.00	1.00
Weighted	0.14	0.14
Scour pool	1.00	1.00
Weighted	0.07	0.07
Substrate coverage	0.30	0.70
Weighted	0.02	0.04
Substrate matches stream	1.00	1.00
Weighted	0.07	0.07
Water depth matches stream	1.00	0.50
Weighted	0.08	0.04
Water velocity matches stream	1.00	0.00
Weighted	0.08	0.00
Openess	0.04	0.15
Weighted	0.00	0.01
Height of structure (max)	0.50	0.87
Weighted	0.02	0.04
Outlet drop to water surface	1.00	1.00
Weighted	0.16	0.16
Composite Score	0.82	0.73
Aquatic Passibility Score	0.82	0.73
Descriptor	Insignificant Barrier	Minor Barrier