

Support for the Development of Management Actions in the Cuyahoga Area of Concern



Development of Management Actions in the Cuyahoga Area of Concern

Final Contract Report
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PRESENTED TO

Ohio Environmental Protection Agency
P.O. Box 1049
Columbus, OH 43216-1049

PRESENTED BY

Tetra Tech, Inc. (216) 861-2950
1468 W. 9th Street, #620 tetrattech.com
Cleveland, OH 44113

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ACRONYMS/ABBREVIATIONS

Acronyms/Abbreviations	Definition
AOC	area of concern
AU	assessment unit
BUI	beneficial use impairment
GLNPO	Great Lakes National Program Office (U.S. EPA)
GLWQA	Great Lakes Water Quality Agreement
MS4	municipal separate storm sewer system
Ohio EPA	Ohio Environmental Protection Agency
U.S. EPA	U.S. Environmental Protection Agency

1.0 INTRODUCTION

1.1 PURPOSE

The purpose of this report is to document the analyses that were performed to develop a list of prioritized management actions for the Cuyahoga area of concern (AOC). These analyses were performed primarily by Tetra Tech, Inc. under contract to the Ohio Environmental Protection Agency (Ohio EPA). Tetra Tech worked closely with Ohio EPA, the Cuyahoga AOC Advisory Committee, and the the Advisory Committee's Strategic Implementation Subcommittee. The list of management actions is intended to be used by Ohio EPA and the Advisory Committee to help secure funding, primarily from the U.S. Environmental Protection Agency (U.S. EPA) through the Great Lakes Restoration Initiative and also through other potential funding sources.

1.2 BACKGROUND

The Great Lakes Water Quality Agreement (GLWQA) is an agreement between the United States and Canada to restore and protect the waters of the Great Lakes and provide a framework for identifying priorities and implementing actions that improve environmental quality in AOCs. In 1987, the GLWQA designated 43 AOCs across the Great Lakes basin, including the Cuyahoga AOC that drains to Lake Erie in Ohio. Nine beneficial use impairments (BUIs) were identified for the Cuyahoga AOC. The focus of this study is upon three biological and habitat BUIs (Table 1).

Table 1. Biological and habitat beneficial use impairments

BUI	Beneficial use impairment
3	Degradation of fish populations (3a)*
6	Degradation of benthos
14	Degradation of fish habitat (14a)*

Note *: The wildlife components of these BUIs are not covered by this document as they are not listed as impaired in the Cuyahoga AOC.

The GLWQA requires the United States and Canada to restore and delist AOCs. In the United States, U.S. EPA implements the GLWQA through its Great Lakes National Program Office (GLNPO). Restoration and delisting is achieved through the identification and implementation of management actions to address each BUI. Each year GLNPO funds the implementation of management actions in selected AOCs. To this end, states must provide lists of management actions for each of their AOCs.

In Ohio, Ohio EPA defined methods to evaluate BUI status and to establish restoration targets that are used to support the identification of management actions for each Ohio AOC. The AOC restoration targets and status of the biological and habitat BUIs are discussed in Section 2.0.

The objective of this study was to develop a list of prioritized proposed management actions for the Ohio EPA and the Cuyahoga AOC Advisory Committee. The lists of proposed management actions presented herein are “living documents” and will be revised as data gaps are filled, as new data becomes available, as BUI status changes, and as additional management actions are identified.



Figure 1. Location of the Cuyahoga AOC.

2.0 STATUS OF BENEFICIAL USE IMPAIRMENTS

Fish and benthic macroinvertebrate populations and fish habitat scores, based upon data collected from 2006 through 2016, were evaluated against Ohio's AOC restoration targets to determine the existing condition of each of the three biological and habitat BUIs in this study. The evaluations are discussed in the following subsections, and maps showing the location of sample sites and the status of each BUI are in Appendices A and B.

2.1 RESTORATION TARGETS

Ohio EPA (2016) developed restoration targets for each BUI. The AOC restoration targets for the fish population component (BUI #3a) and benthos (BUI #6) use the same biological community health indices¹, aquatic life use designations², and ecoregions³ that are used in Ohio's water quality standards. Similarly, the AOC restoration targets for fish habitat (BUI #14a) use the same habitat index and aquatic life uses that Ohio EPA uses to assess causes of impairment when Ohio's water quality standards are not met. The major differences between Ohio's AOC restoration targets and Ohio's water quality standards are (1) that the biological and habitat indices scores are evaluated on a site-by-site basis to determine if a watershed attains water quality standards but are averaged across a reach or assessment unit (AU) for evaluation with AOC restoration targets, (2) AOC restoration targets for these indices include a standardized non-significant departure from Ohio water quality standards, and (3) AOC restoration targets were developed for streams designated limited resources waters, which do not have codified water quality standards.



Figure 2. Eroding banks along Big Creek.

2.2 BUIS IN THE CUYAHOGA AOC

Across the 19 AUs within the Cuyahoga, AOC restoration targets are met in 4 AUs for degradation to fish populations (BUI #3a), are met in 8 AUs for degradation to benthos (BUI #6), and are met in 12 AUs for loss of fish habitat (BUI #14a)(Table 2). All three BUIs are met in two AUs (Furnace Run and Willow Lake). These data are presented by AU in Appendix A with maps. Due to data gaps, one AU, Headwaters Chippewa Creek, has insufficient data to evaluate the degradation to benthos BUI. Additionally, one AU, Brandywine Creek, has data older than 10 years that does not meet the AOC restoration targets; the AU is therefore assumed to not meet restoration targets.

The evaluation of BUIs shown in Table 2 used available data collected within the past 10 years and did not account for the minimum sample data needs defined by a geometric sample plan (CRR 2015).

¹ Index of Biotic Integrity (fish), Modified Index of well-being (fish), and Invertebrate Community Index (benthos).

² Exceptional warmwater habitat, warmwater habitat, modified warmwater habitat, and limited resources water.

³ Erie/Ontario Lake Plain and Huron-Erie Lake Plain.

Table 2. Status of BUIs #3a, #6, and #14a in the Cuyahoga AOC

Assessment unit		Degradation of fish populations	Degradation to benthos	Loss of fish habitat
ID	Name	BUI #3a	BUI #6	BUI #14a
<i>Cuyahoga (hydrologic unit code 04110002)</i>				
Little Cuyahoga River				
03 03	Wingfoot Lake-Little Cuyahoga River	Does not meet	Meets	Does not meet
03 04	City of Akron-Little Cuyahoga River	Does not meet	Meets	Does not meet
Yellow Creek-Cuyahoga River				
04 01	Mud Brook	Does not meet	Does not meet	Does not meet
04 02	Yellow Creek	Does not meet	Does not meet	Does not meet
04 03	Furnace Run	Meets	Meets	Meets
04 04	Brandywine Creek	Does not meet	Data gap ^a	Meets
04 05	Boston Run-Cuyahoga River	Does not meet	Meets	Meets
Tinker's Creek-Cuyahoga River				
05 01	Pond Brook	Meets	Does not meet	Meets
05 02	Headwaters Tinker's Creek	Does not meet	Does not meet	Does not meet
05 03	Headwaters Chippewa Creek	Meets	Data gap	Meets
05 04	Town of Twinsburg-Tinker's Creek	Does not meet	Does not meet	Meets
05 05	Willow Lake-Cuyahoga River	Meets	Meets	Meets
Big Creek-Cuyahoga River				
06 01	Mill Creek	Does not meet	Meets	Meets
06 02	City of Independence-Cuyahoga River	Does not meet	Meets	Meets
06 03	Big Creek	Does not meet	Does not meet	Meets
06 04	Cuyahoga Heights-Cuyahoga River	Does not meet	Meets	Does not meet
06 05	City of Cleveland-Cuyahoga River	Does not meet	Does not meet	Meets
<i>Ashtabula-Chagrin (hydrologic unit code 04110003)</i>				
Euclid Creek-Frontal Lake Erie				
05 03	Euclid Creek	Does not meet	Does not meet	Does not meet
05 04	Doan Brook-Frontal Lake Erie	Does not meet	Does not meet	Meets

Note a: Brandywine Creek (*04 04) is assumed to not meet the AOC restoration targets because historic ICI data collected during several years do not meet the targets.

3.0 EVALUATION OF POTENTIAL MANAGEMENT ACTIONS

The objective of this study was to develop lists of proposed management actions for the Cuyahoga AOC. To achieve this end, projects that may improve fish or benthic macroinvertebrate communities' health or habitat within impaired AUs were identified, evaluated, and prioritized. This section describes the development of the list of management actions.

3.1 EXPECTED BENEFITS

Management actions include projects that may improve fish and benthic macroinvertebrate populations and habitat. A common assumption is that stream and habitat restoration projects will improve aquatic community health. However, many factors influence the effect of restoration projects on aquatic community health, and not all restoration projects improve the aquatic community. Key studies were evaluated to support the ranking of potential projects in the Cuyahoga AOC; the results from these evaluations were used to inform the project prioritization process, as further discussed in Section 3.3.

Roni et al. (2008) reviewed 345 papers that reported the effectiveness of habitat rehabilitation techniques, which included road improvements, riparian rehabilitation, floodplain connectivity and rehabilitation, instream habitat improvement, and nutrient enrichment. Their analysis of biotic responses focused on fish, with some analysis of macroinvertebrates as well. The majority of studies involved instream habitat enhancement projects or instream structures. The authors found variable results for species and structure type, a limited number of statistically rigorous studies, and differing response based on species or life stage. They recommend that projects take into consideration scale, watershed conditions, and watershed processes, and that rigorous monitoring programs be developed.



Figure 3. Lack of riparian habitat along a segment of Doan Brook just downstream of the Superior Avenue bridge.

To improve the chances that a project will result in ecological restoration, the scale of restoration relative to the scale of degradation needs to be considered. Other watershed stressors related to water quality, hydrology, sediment transport, stream gradient, riparian conditions, and upslope conditions can influence the success of instream habitat enhancement projects at specific sites (Roni et al. 2008). For example, in Larson et al. (2001), high sediment loads from upstream sources in a restored reach buried log installations. This issue of scale likely explains the higher success rate of restorations in forested areas than in other, more disturbed watersheds (Miller et al. 2010). Other watershed stressors related to water quality, hydrology, sediment transport, stream gradient, riparian conditions, and upslope conditions can influence the success of instream habitat enhancement projects (Roni et al. 2008). Ohio's AOC guidance (Ohio EPA 2016) allows for exceptions for watershed-scale stressors that are beyond the scope of Ohio's AOC program (e.g., combined sewer overflows under a long term control plan and stormwater impacts from areas address as regulated municipal separate storm sewer systems). Ohio EPA encourages organizations to consider watershed-scale factors and stressors when designing and implementing reach-scale habitat restoration projects.



Figure 4. Floodplain reconnection and stream restoration project on Euclid Creek in Cleveland Metroparks Acacia Reservation.

rehabilitation (creation of floodplain ponds, channels, lakes, flooding, beaver reintroduction), and placement of instream habitat structures. Miller et al. (2010) found that the addition of large woody debris significantly increased macroinvertebrate richness and density, whereas increases from boulder additions were not statistically significant. Large woody debris was likely more successful at increasing habitat heterogeneity through the resulting increase in the amount of pool–riffle morphologies.

3.2 PROJECT IDENTIFICATION

Candidate projects for inclusion in the management actions list were recommended by organizations and government entities that operate within the Cuyahoga AOC. Candidate projects were compiled by CRR (2015, 2016) and were solicited from such organizations as the Cleveland Metroparks, Northeast Ohio Regional Sewer District, and many watershed groups operating in the Cuyahoga AOC..

As previously stated, the management action effort and this report should be understood to be a *living document* and subject to changes. While considerable effort was made to include all available proposals for remedial projects, limited projects were identified for a few tributary AUs in the Cuyahoga AOC. Efforts will continue in 2017 to identify projects for these AUs, including work to be performed by the Central Lake Erie Basin Collaborative. Projects identified by the Central Lake Erie Basin Collaborative or other entities will be added to the candidate list of Cuyahoga AOC’s management actions, and will be evaluated using the assessment framework described in Section 3.3.

Sundermann et al. (2011) found that restoration outcome is also dependent on the proximity of a nearby benthic invertebrate species pool for recolonization. In their analysis of 24 river restoration projects in Germany, restoration increased the quality of the benthic invertebrate community for sites that were located close to river reaches with a high abundance of the desired stream taxa. Over the short term (i.e., several years), the authors found that benthic invertebrates disperse over distances of five kilometers or less. If data are not available to assess the nearby species pool, land use can be used as a proxy for the quality of the regional species pool.

Certain restoration techniques are more effective than others. Ohio EPA has observed significant benefits from dam removals that have been performed throughout the state, including within the Cuyahoga River watershed. Roni et al. (2008) found that the most promising techniques are those that reconnect isolated habitats (e.g., side channels, ponds, lakes, wetlands), floodplain

3.3 PROJECT ASSESSMENT

After candidate projects were identified, they were assessed to determine if they would help address a BUI (i.e., if the project would qualify for inclusion on the management actions lists). To qualify, such a project would need a high likelihood of improving biological or habitat conditions in an impaired AU. Based upon the cursory literature review (Section 3.1) and discussion with Ohio EPA biologists, the following factors were considered when determining the likelihood of improving biological or habitat conditions:

- Location within an impaired AU relative to (1) impaired segments, (2) available monitoring data, and (3) barriers⁴ and impoundments⁵ (e.g., dams, culverts)
- Project relevance or impact to causes and sources of impairment within the AU
- Potential benefit to biological and habitat indices scores of the impaired segment⁶ and impaired AU, with a focus upon improving the scores of AUs that are just barely below AOC restoration targets

While all the candidate projects would benefit the natural environment, many projects were excluded from the management actions lists because they were within AUs meeting AOC restoration targets, were distant from impaired segments or available monitoring data, were upstream of barriers to migration or colonization, or did not address the primary stressors impairing the AU.

Once a project was determined to be likely to improve biological or habitat conditions, the project was evaluated to determine if the project would be fundable and implementable under existing AOC-specific funding requirements. The following factors were considered.

- Relevance to Great Lakes Restoration Initiative Funding
- Sequence of implementation (relative to other potential management actions in the impaired AU)
- Land ownership
- Operations and maintenance (i.e., is there an entity who will maintain the site into the future)

Based on discussions with Ohio EPA, projects that focused directly on habitat restoration (stream restoration, wetland restoration, removal of



Figure 5. A culvert (top) and waterfall (bottom) along Euclid Creek are fish passage barriers.

⁴ Barriers impede migration or colonization of aquatic life. Barriers may be natural (e.g., waterfall) or anthropogenic (e.g. dam); they may be structural (e.g., dam) or impassable water (e.g., high temperature).

⁵ Impoundments are often associated with structural barriers (e.g., a pool behind a dam). Water collected in the impoundment often impairs aquatic life; for example, pooled, stagnant water behind a dam can heat up and algae can proliferate, both of which decreases dissolved oxygen to levels that may be lethal to fish.

⁶ "If a single assessment unit has multiple criteria that apply to that unit (e.g. wading, boating, lacustrary), then the unit should be evaluated in segments based on each criteria" (Ohio EPA 2016, p. 25).

barriers or impoundments, culverted stream daylighting) were considered more likely to receive AOC funding than other types of projects (e.g., stormwater management, removal of invasive species). Projects on public lands or that otherwise were more likely to have sustained maintenance also received more favorable consideration.

Candidate projects in the Cuyahoga AOC were also ranked. Ranking was necessary because 90 projects in the Cuyahoga AOC were identified and evaluated and such projects could be implemented in different combinations to meet AOC restoration targets in certain impaired AUs. Management actions were ranked separately across three categories:

- barriers to migration or colonization (e.g., a dam that prevents fish passage)
- physical habitat rehabilitation and floodplain/watershed connectivity restoration
- studies to determine causes and sources of impairment



Figure 6. Removal of the West Creek flume (left) and the Canal Diversion Dam (right) are examples of the candidate projects that were evaluated as part of this effort.

4.0 SUMMARY OF PROPOSED MANAGEMENT ACTIONS

The Gorge Dam sediment and dam removal project is the highest priority management action for the Cuyahoga AOC, followed by the project to remove the Canal Diversion Dam. Both projects will remove major barriers and impoundments on the Cuyahoga River. The estimated costs of removing and permanently disposing of the contaminated sediment in the Gorge Dam pool is \$58 million, while the estimated cost for dam demolition and disposal is \$12 million. The entire Gorge Dam project is anticipated to be funded through multiple sources that are not typical funding sources for management actions (e.g., a GLNPO-funded stream restoration). The removal of the Canal Diversion Dam and installation of a pump to maintain water levels in the Ohio and Erie Canal is \$1,300,000; \$900,000 will be paid by the city of Akron and \$400,000 was requested from U.S. EPA GLNPO. While the Gorge Dam and Canal Diversion Dam projects are the highest priority management actions for the Cuyahoga AOC, they are excluded from the summary of management actions presented below (Table 3).

Excluding the Gorge Dam and Canal Diversion Dam projects and the two Cuyahoga Valley National Park (CVNP) projects discussed in the next paragraph, 31 projects are proposed as management actions to address biological and habitat BUIs and these 31 projects cost approximately \$34 million (Table 3 and Figure 7). Proposed management actions are delineated into three categories in Table 3: barrier and impoundment bypass or removal projects; habitat restoration and floodplain reconnection projects on tributaries to the Cuyahoga River; and habitat creation and restoration projects in the Cuyahoga River. The categories are further delineated into highest priority projects and other projects that are necessary to restore the Cuyahoga AOC; the highest priority projects are recommended to be implemented first.

Two habitat restoration projects along the Cuyahoga River in the CVNP, with a total cost of \$10,190,000, are included in this report but these projects are likely to be funded by other funding mechanisms, such as with inter-agency agreements between U.S. EPA and the U.S. Department of Interior. These projects are not included in the summary of management actions presented below (Table 3) but these projects should be considered to be actions required to restore the Cuyahoga AOC. Appendix B presents tables of proposed management actions by categories and includes information for each project (e.g., description, implementer, total cost).

Table 3. Summary of proposed management actions for the Cuyahoga AOC

Type of management action	Priority	No. of projects	Funding to be requested
Barrier and impoundment bypass or removal	Highest	6	\$9,895,036
	Other Necessary	2	\$719,220
Habitat restoration and floodplain reconnection in the tributaries to the Cuyahoga River	Highest	10	\$6,386,862
	Other Necessary	10	\$11,779,558
Habitat creation and restoration in the Cuyahoga River	Highest	3 ^a	\$6,100,000
Sub-totals	Highest	19^a	\$22,381,898
	Other Necessary	12	\$12,498,778
	Total	31^a	\$34,880,676

Notes

This table excludes four projects on the Cuyahoga River mainstem: the Gorge Dam sediment and dam removal, the Canal Diversion dam removal, and the two CVNP habitat restoration projects.

a. In each instance, \$3,000,000 of projects to create habitat along the federal ship channel is counted as one project; however, the allocated \$3,000,000 may be spent across several projects.

The full list of proposed management actions is available in Appendix B:

- a summary of all the proposed management actions organized by BUI and subwatershed across the entire AOC (Table B-1);
- projects to remove and dispose of the Gorge Dam and contaminated sediment in the dam pool and the removal of the Canal Diversion Dam (Table B-2);
- dam and impoundment bypass or removal projects (Table B-3);
- habitat restoration and floodplain reconnection in the tributaries to the Cuyahoga River (Table B-4);
- mainstem Cuyahoga River projects (Table B-5). Individual candidate projects to create habitat in the federal ship channel were not selected at this time, but an estimated total cost of \$3 million is allocated for one or more projects; all 14 candidate projects are presented in Table B-6.

Eight projects that will contribute to restoring the Cuyahoga AOC have already been fully funded (Table B-7). The remaining candidate projects that were not selected as management actions are presented in Table B-8; such projects may be eligible for other sources of funding (e.g., Section 319, Water Resource Restoration Sponsor Program). Other types of management actions (i.e., assessments, inventories, and studies) that could support BUI removal are listed in Appendix C.

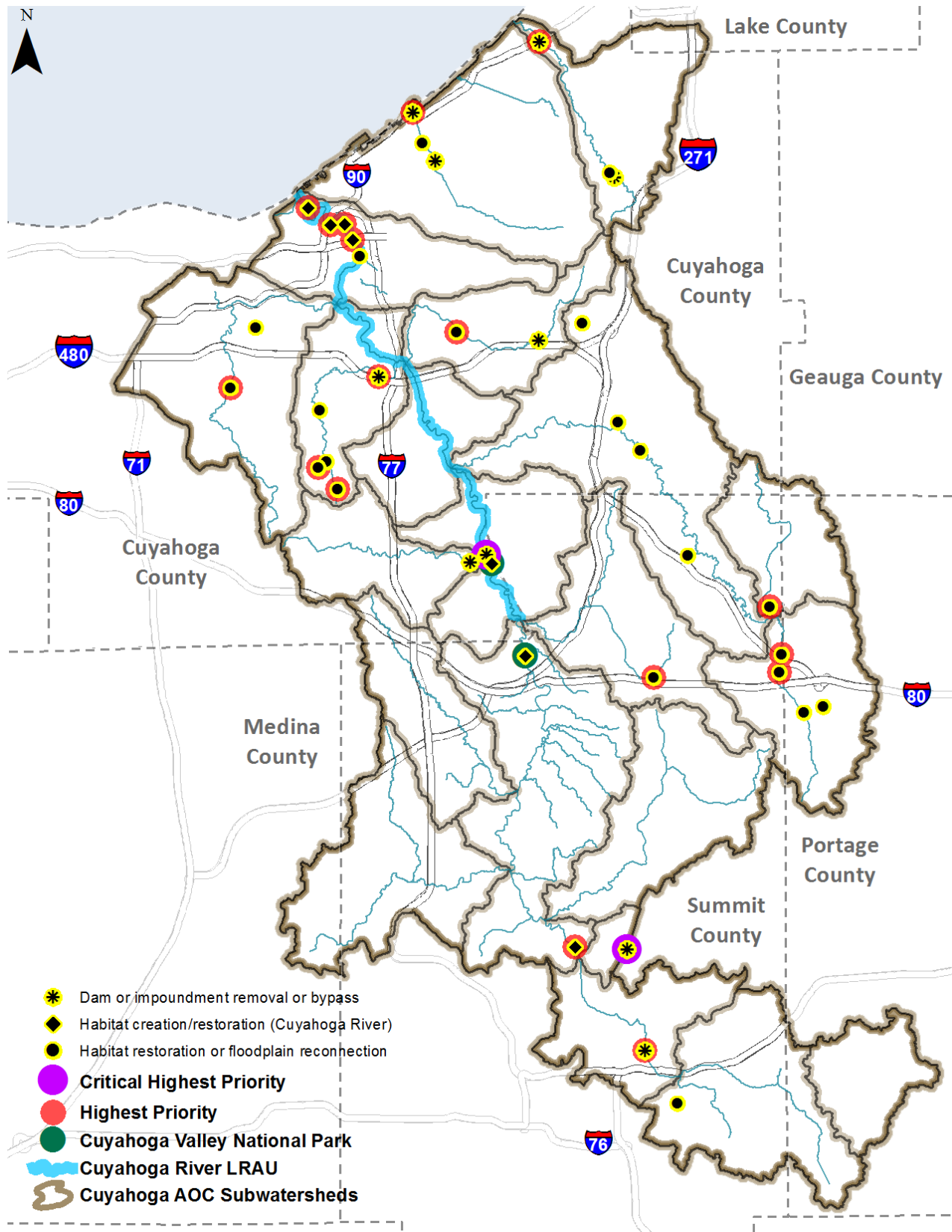


Figure 7. Proposed management actions in the Cuyahoga AOC.

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Appendix A.

Cuyahoga AOC Assessments Units

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ACRONYMS/ABBREVIATIONS

Acronyms/Abbreviations	Definition
AOC	area of concern
BUI	beneficial use impairment
CRR	Cuyahoga River Restoration
LRAU	large river assessment unit
USFWS	U.S. Fish and Wildlife Service (U.S. Department of the Interior)

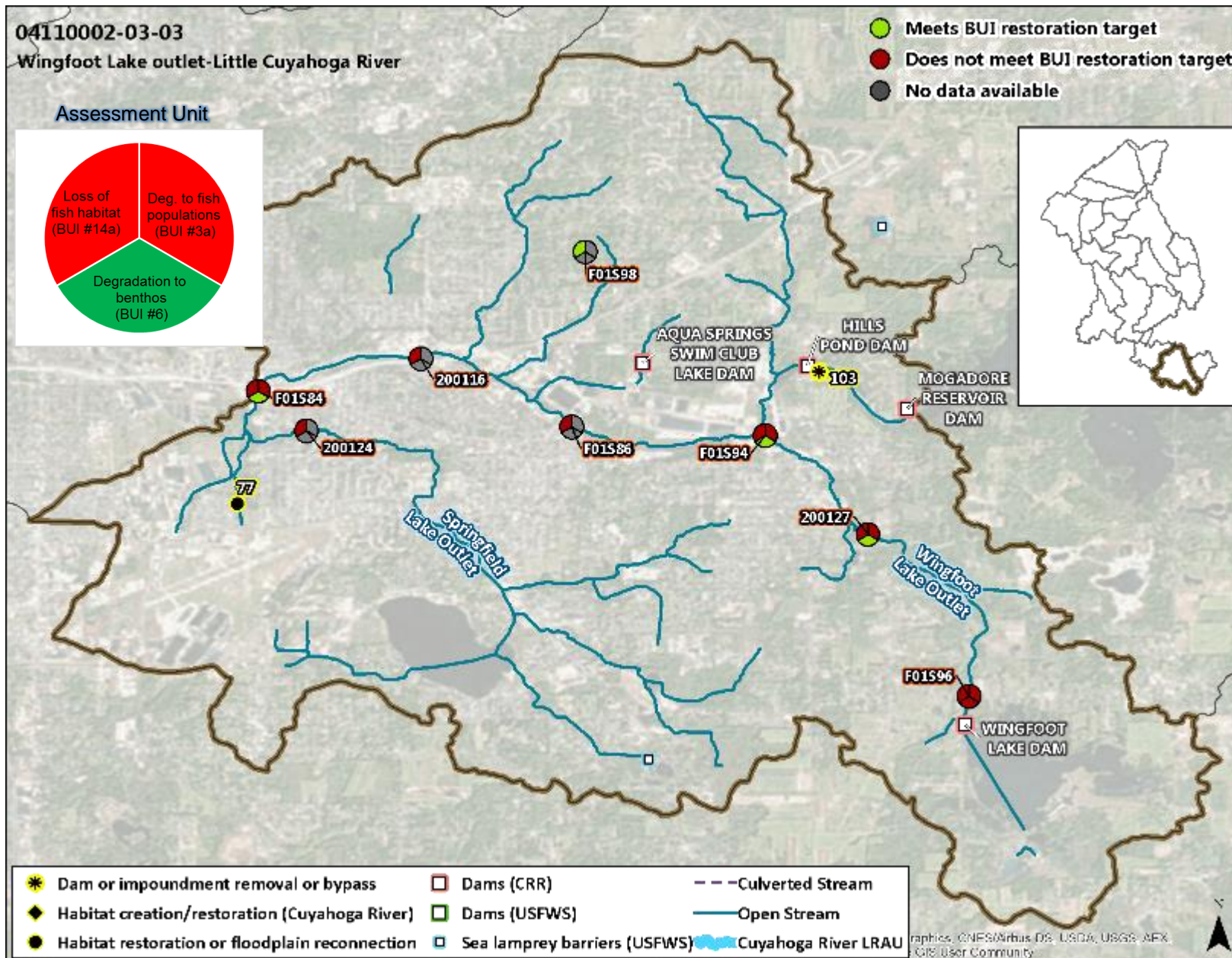


Figure A-1. Wingfoot Lake outlet-Little Cuyahoga River.

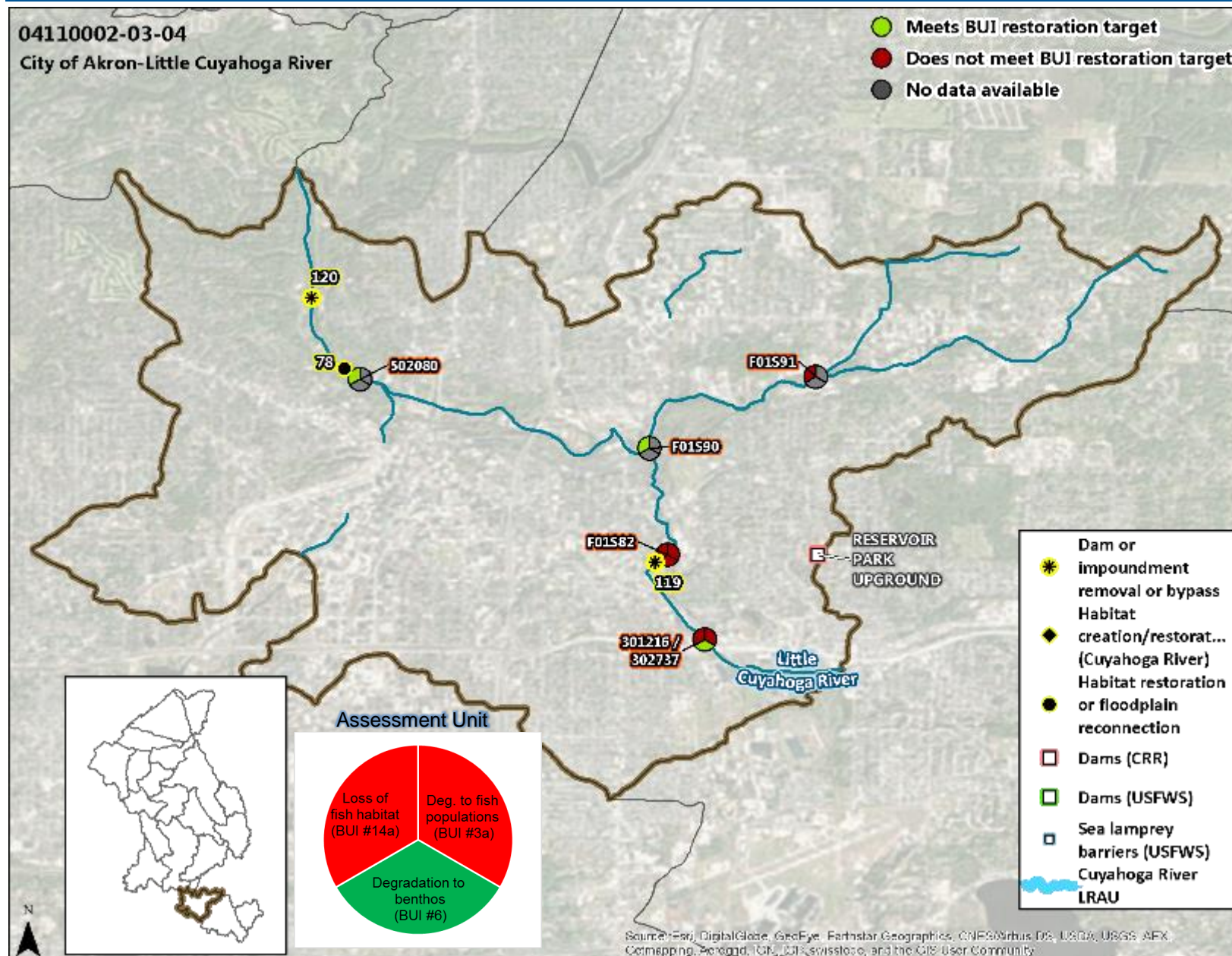


Figure A-2. City of Akron-Little Cuyahoga River.

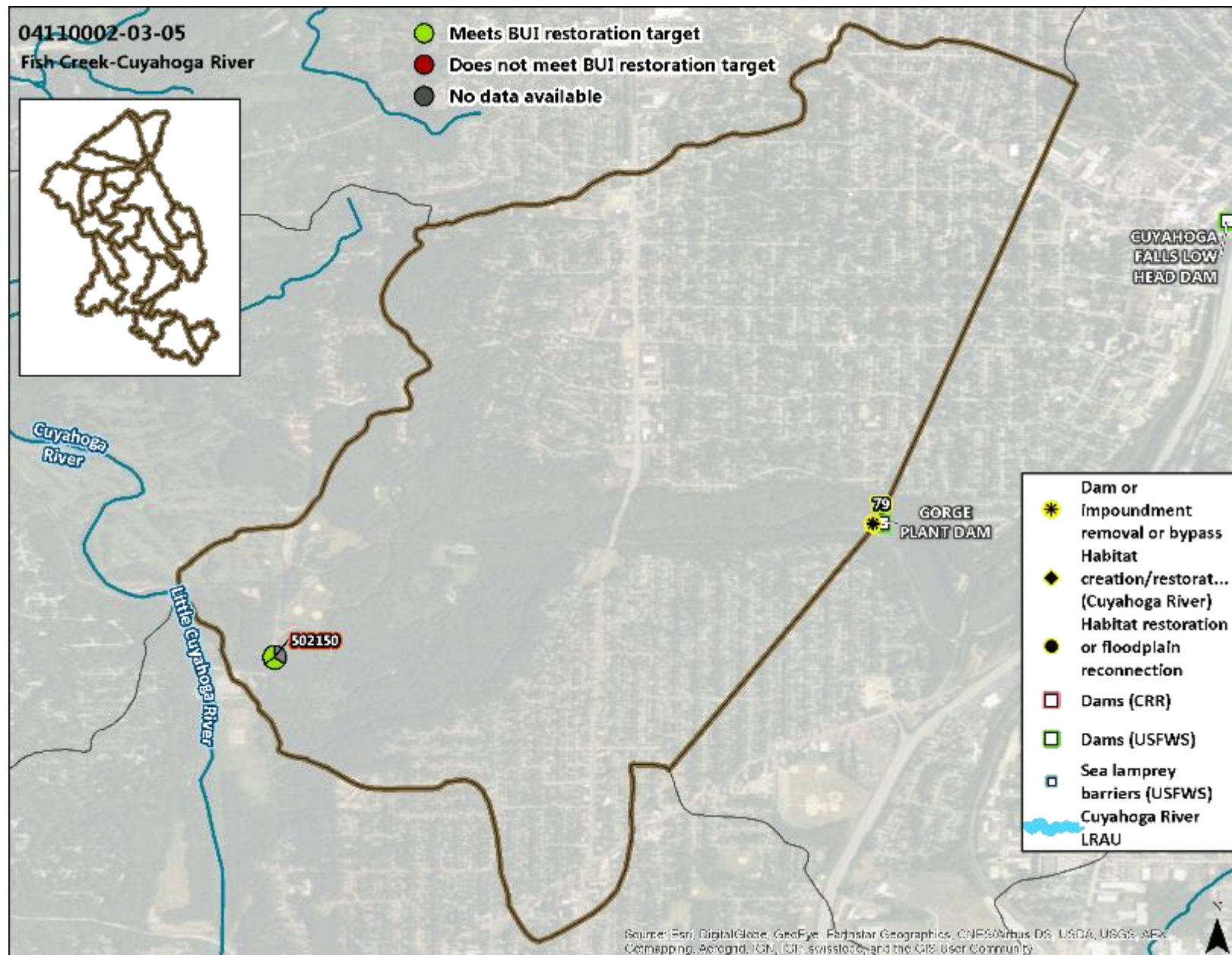


Figure A-3. Fish Creek-Cuyahoga River (partial assessment unit)

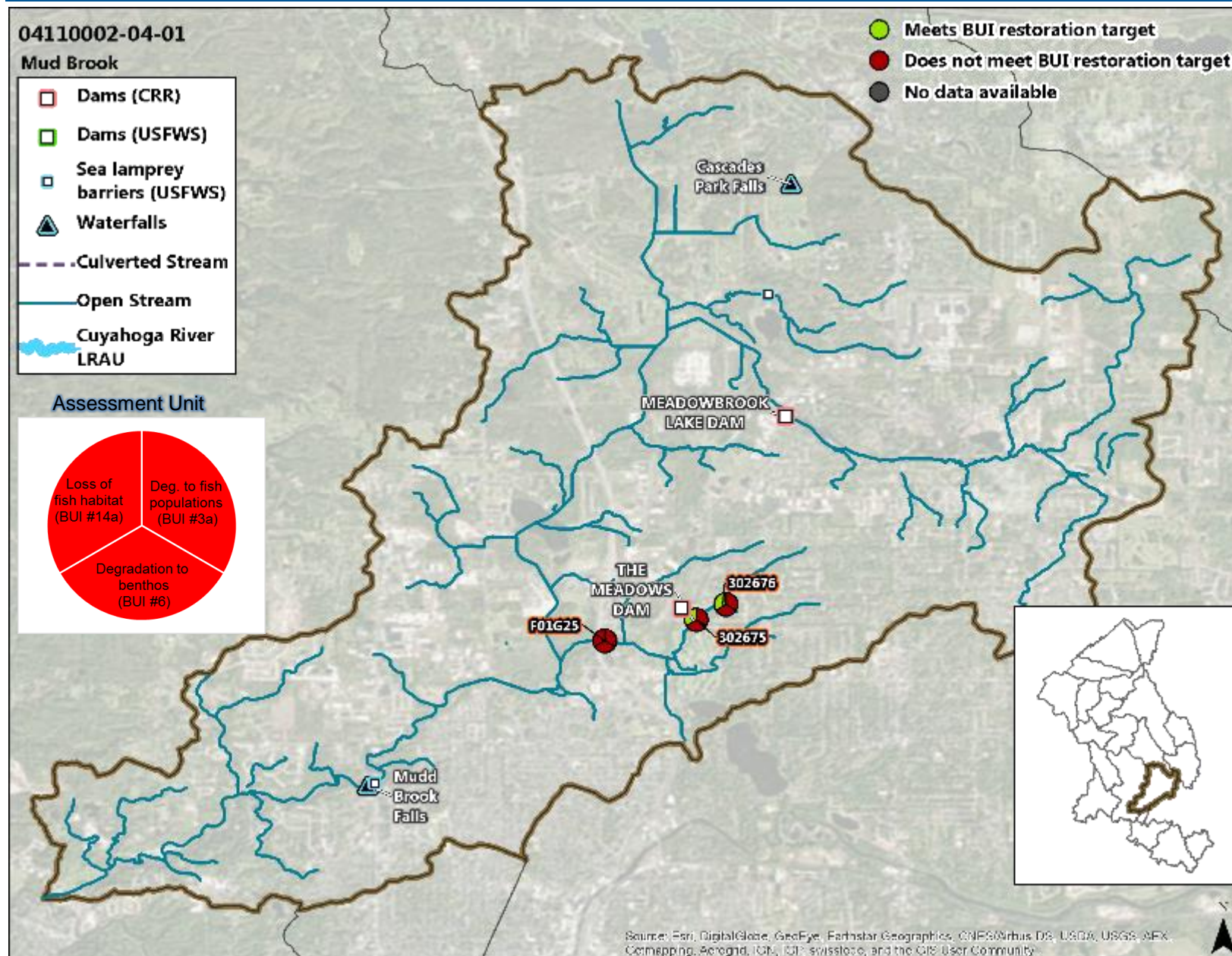


Figure A-4. Mud Brook.

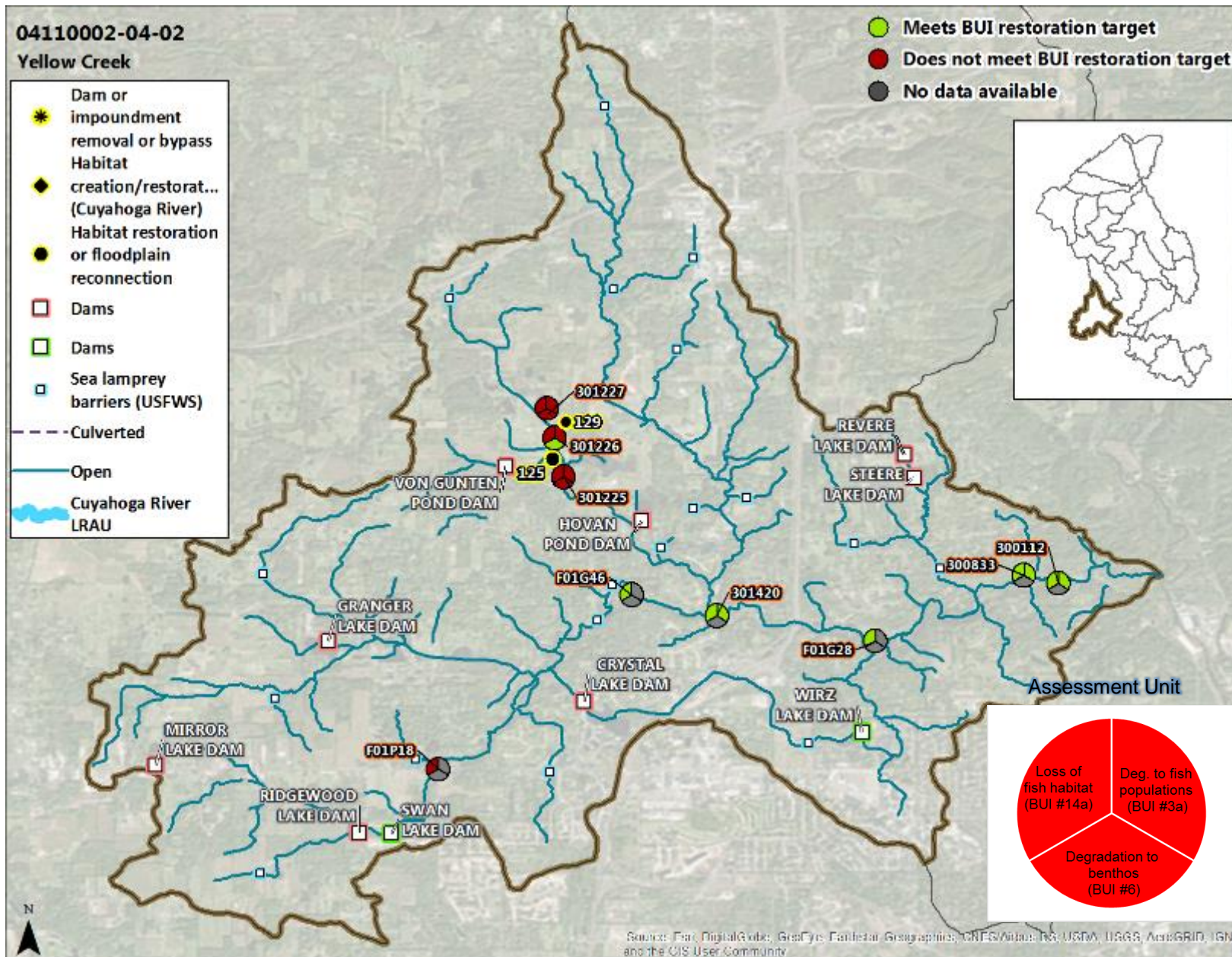


Figure A-5. Yellow Creek.

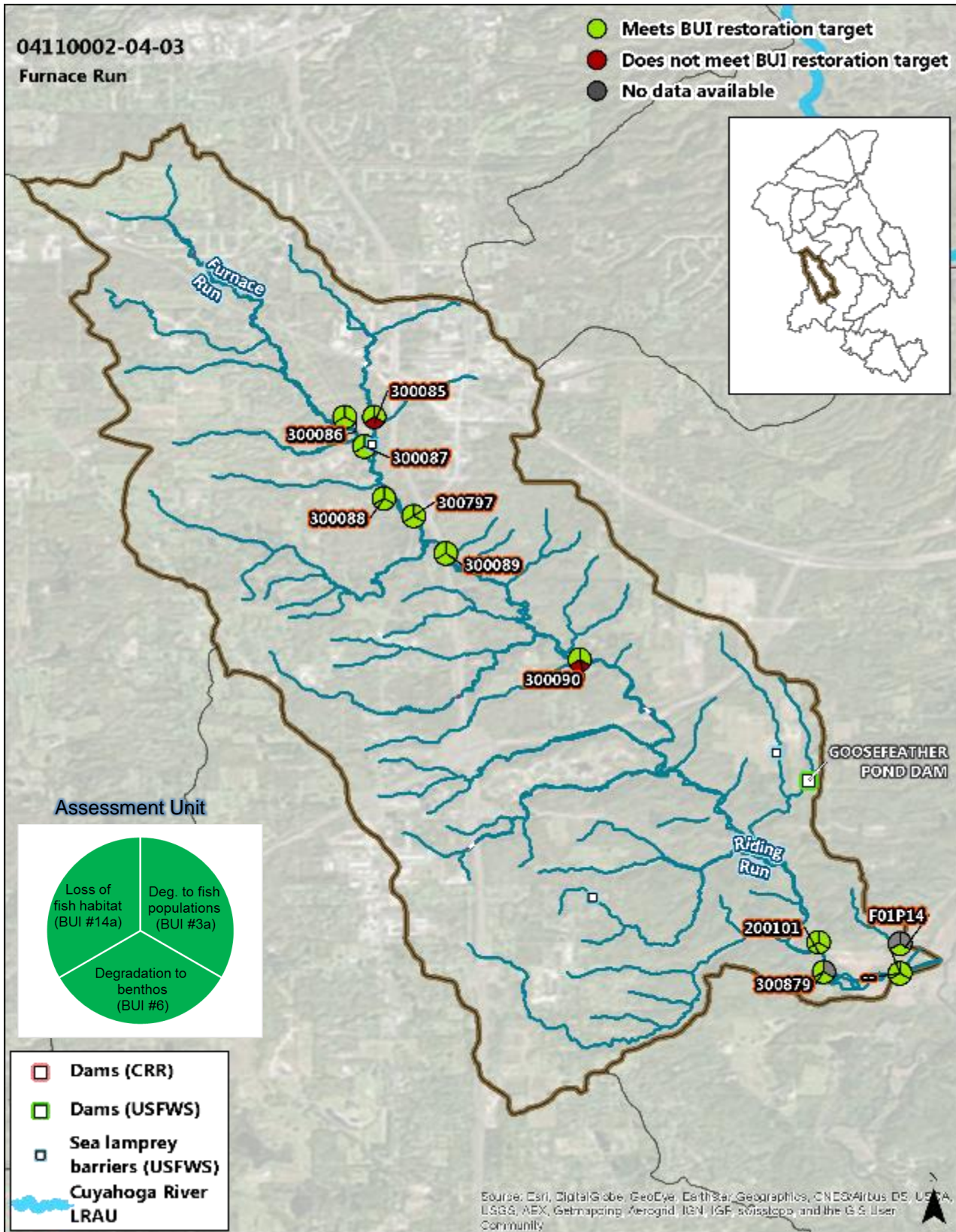


Figure A-6. Furnace Run.

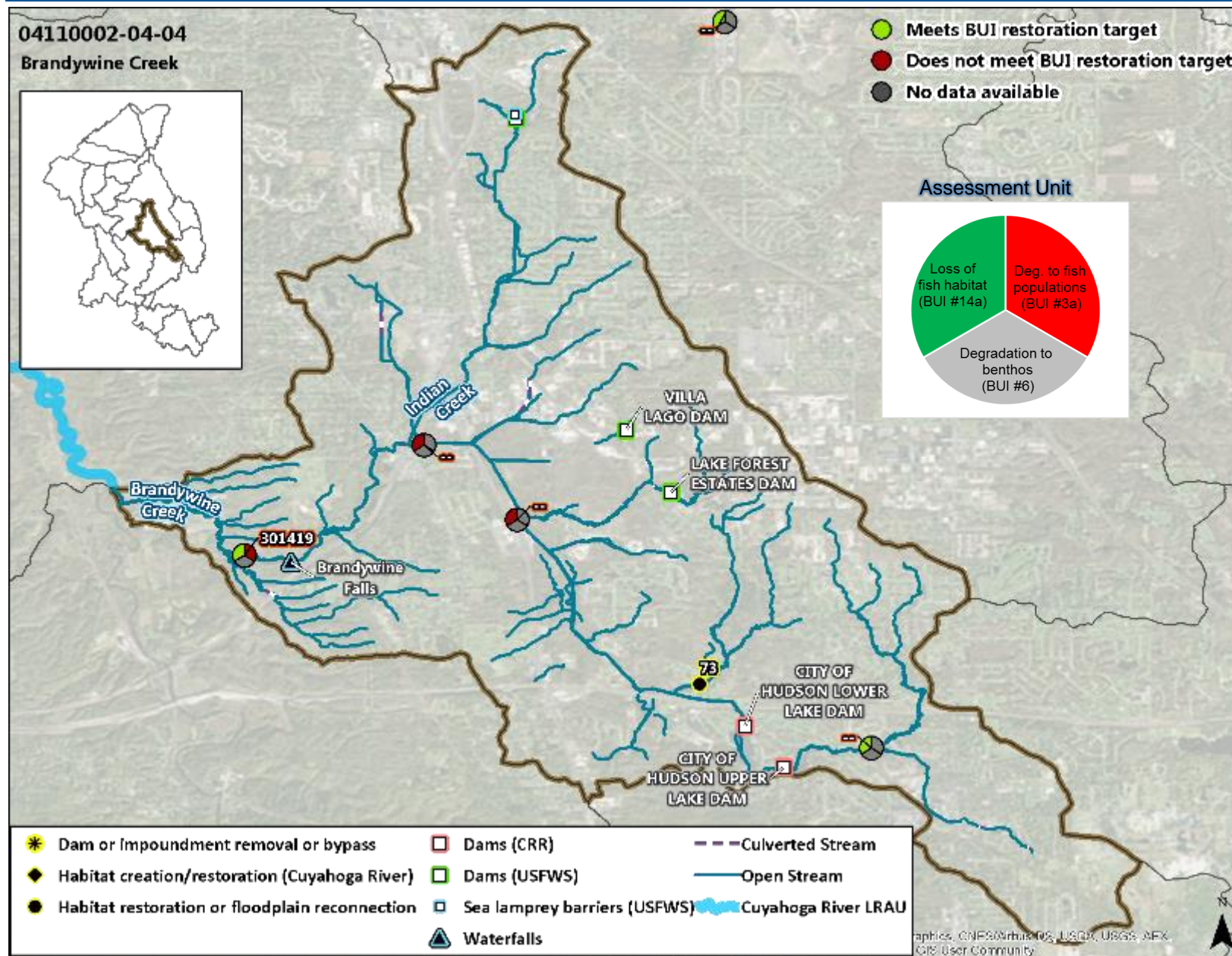


Figure A-7. Brandywine Creek.

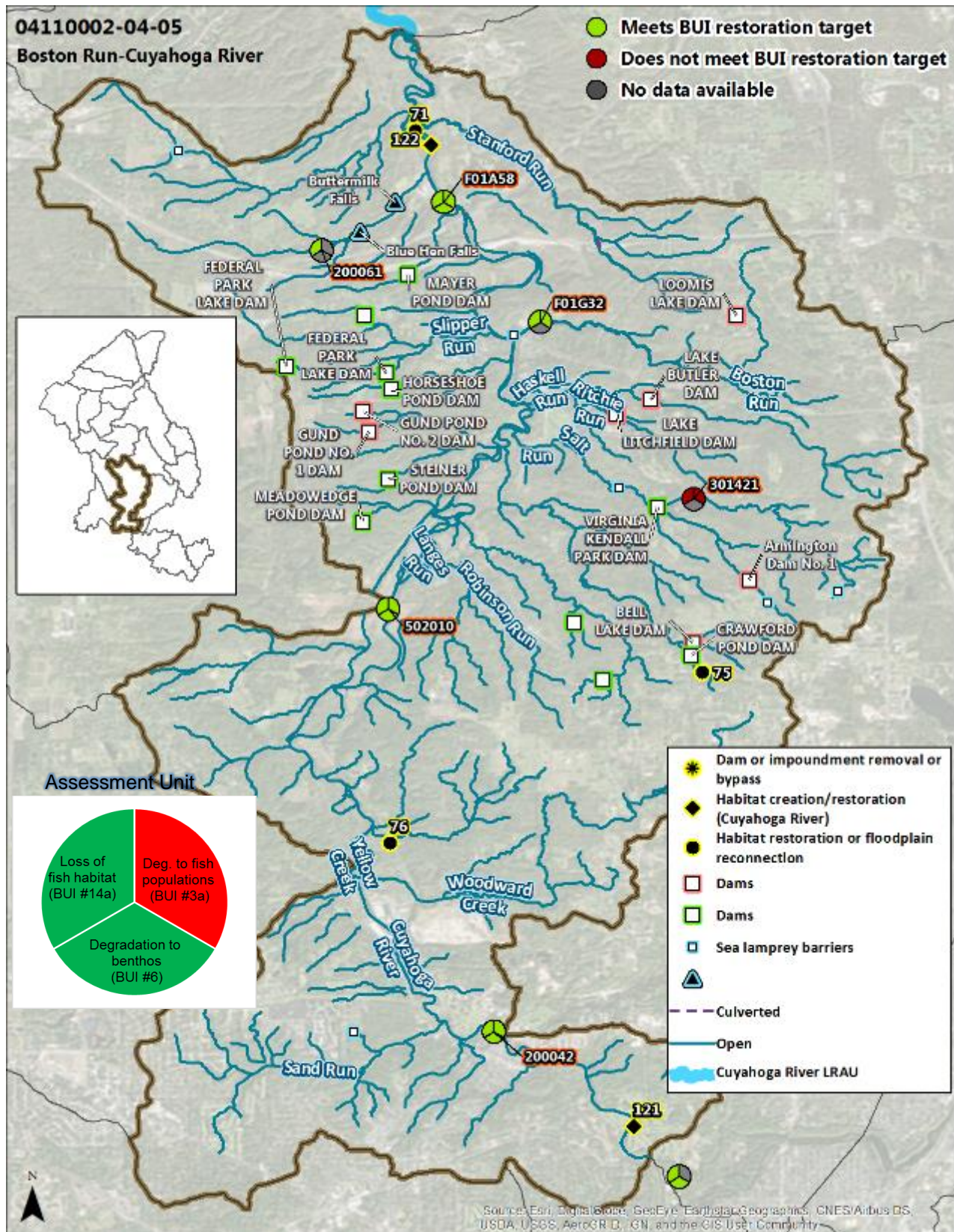


Figure A-8. Boston Run-Cuyahoga River.

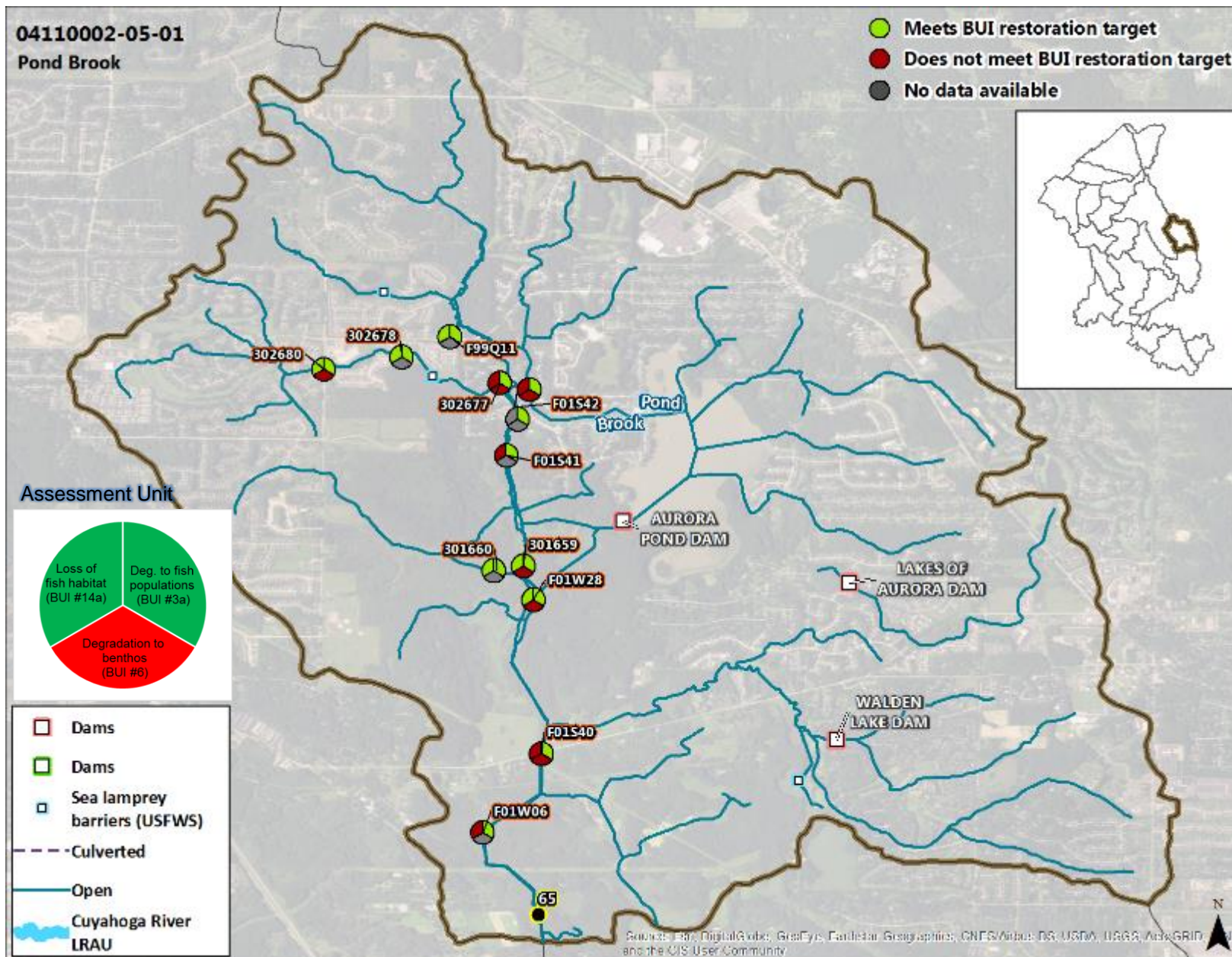


Figure A-9. Pond Brook.

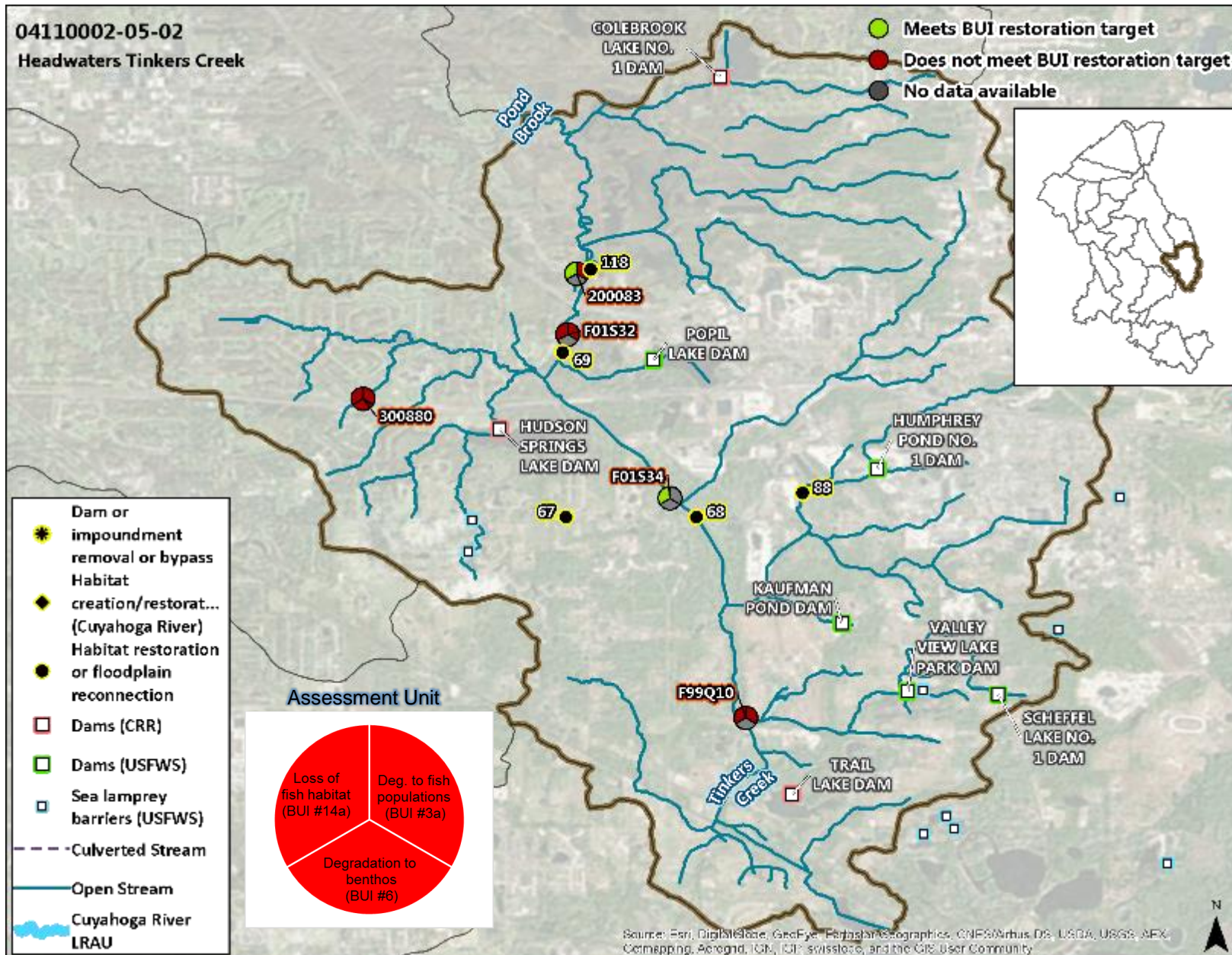


Figure A-10. Headwaters Tinker's Creek.

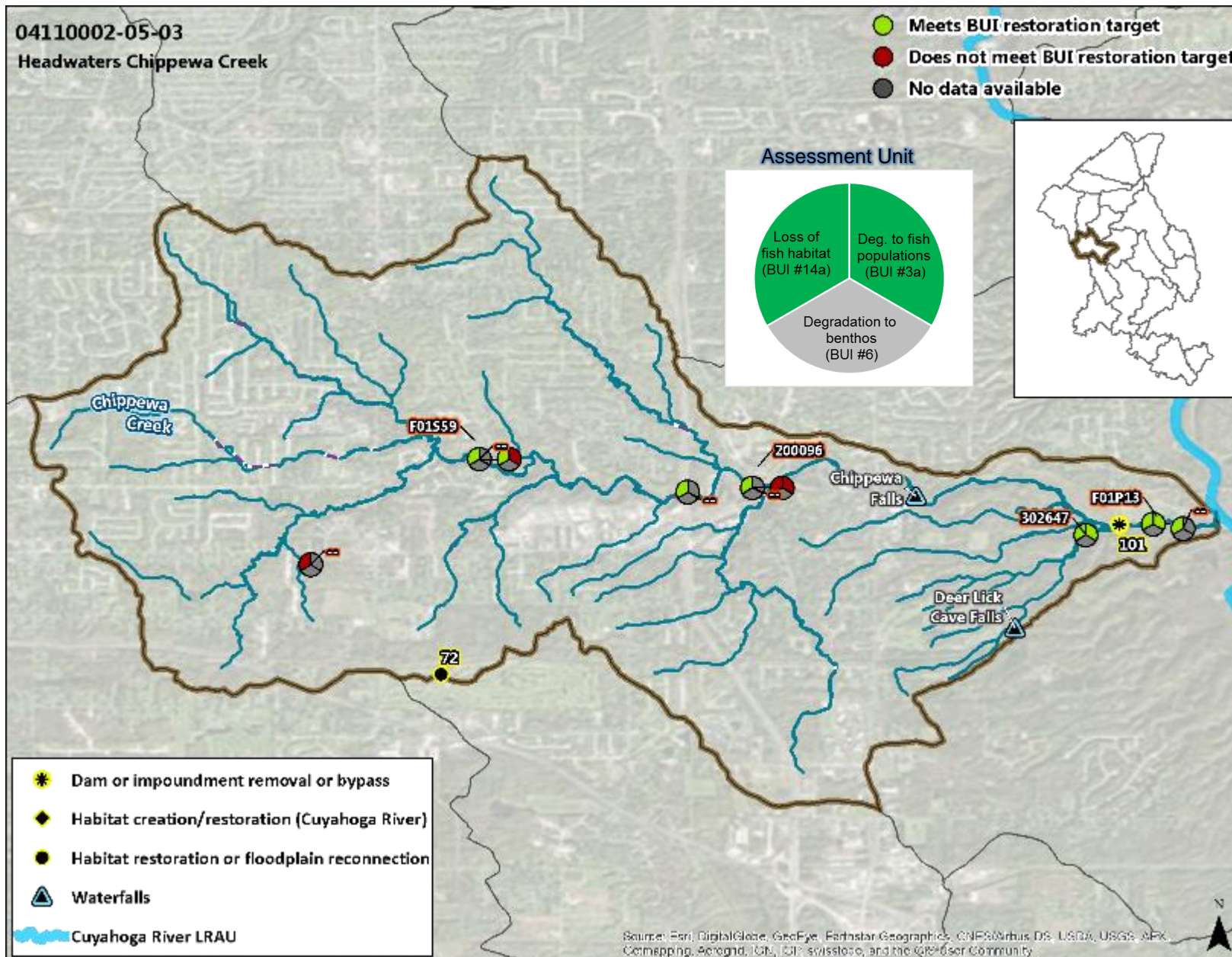


Figure A-11. Headwaters Chippewa Creek.

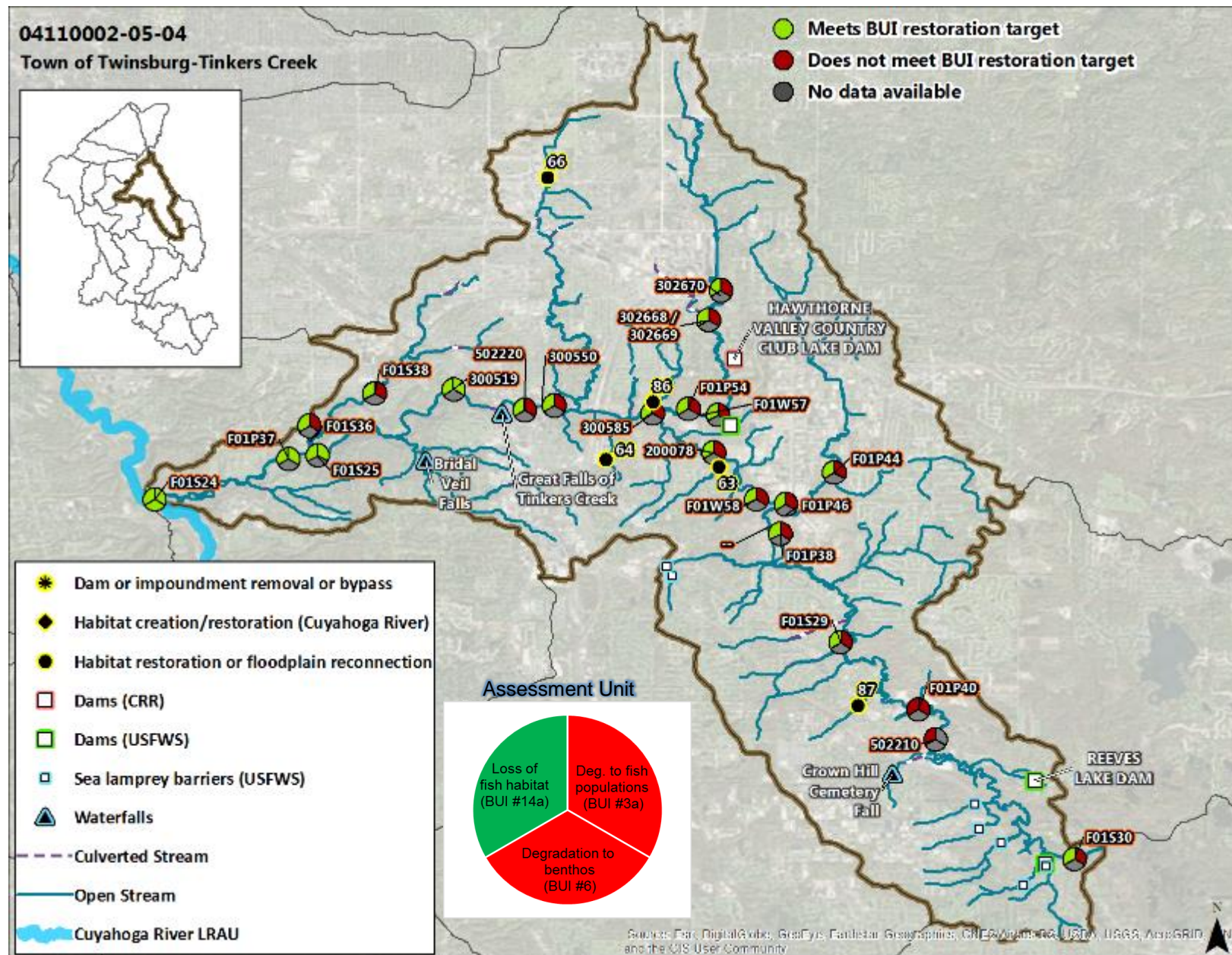


Figure A-12. Town of Twinsburg-Tinker's Creek.

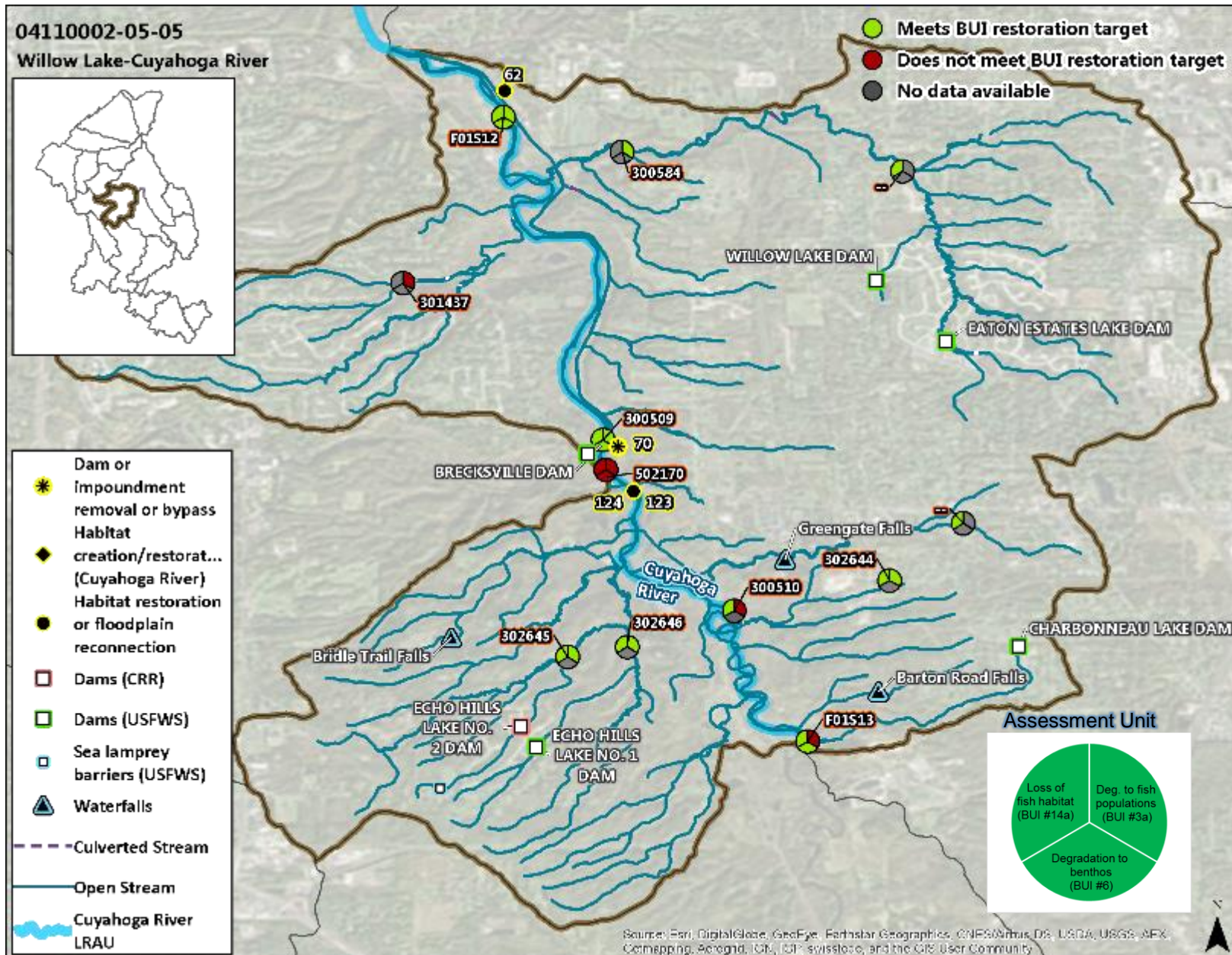


Figure A-13. Willow Lake-Cuyahoga River.

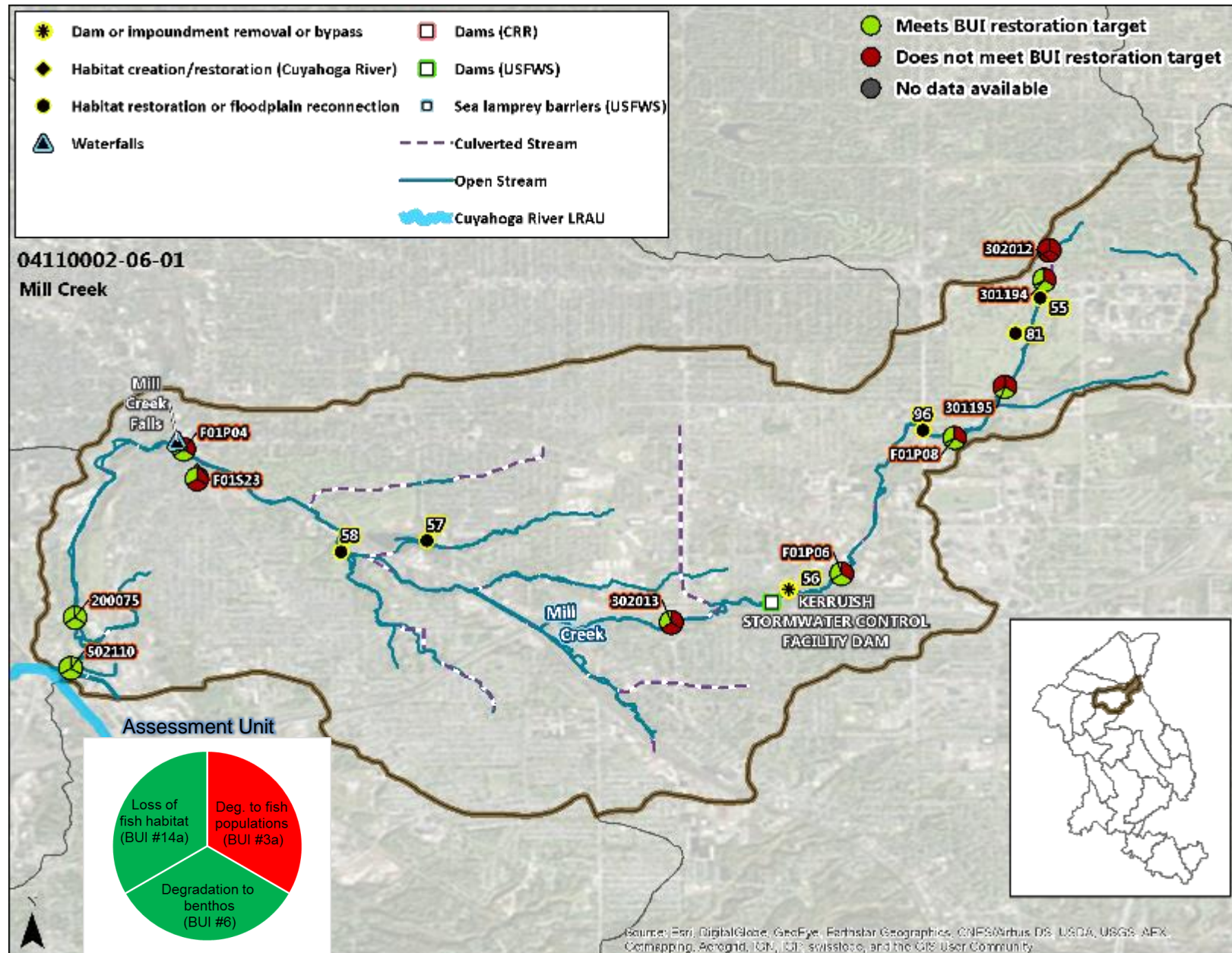


Figure A-14. Mill Creek.

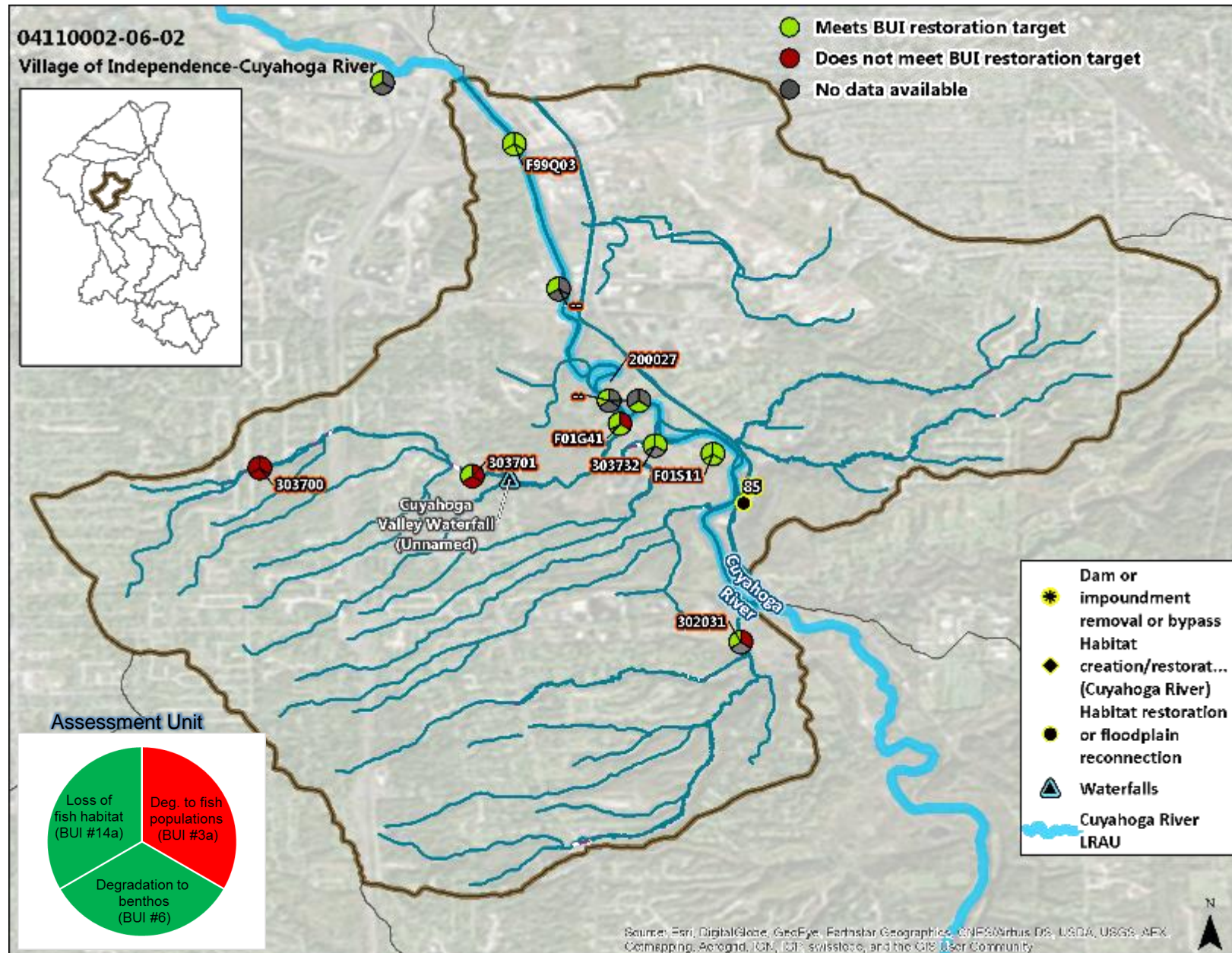


Figure A-15. Village of Independence-Cuyahoga River.

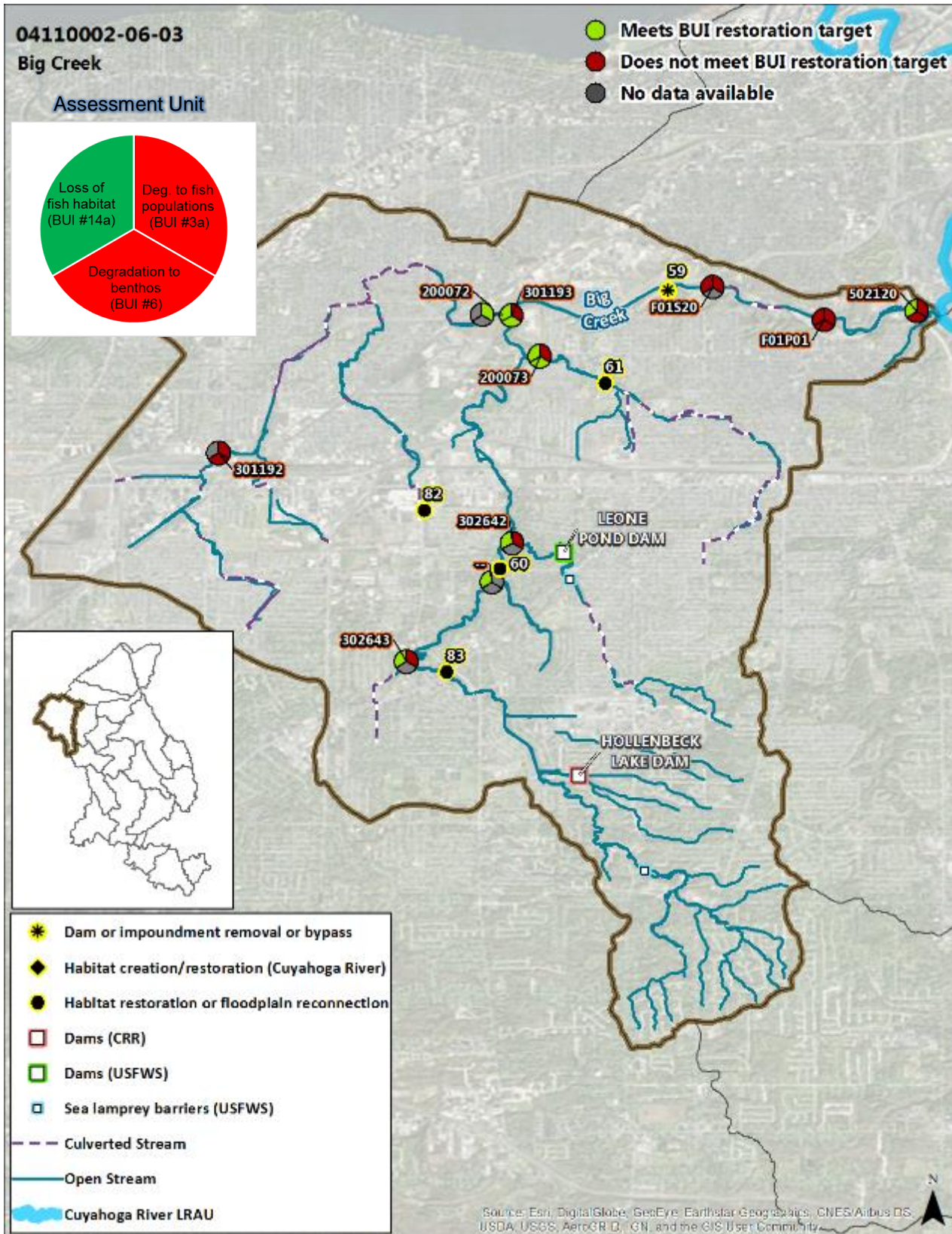


Figure A-16. Big Creek.

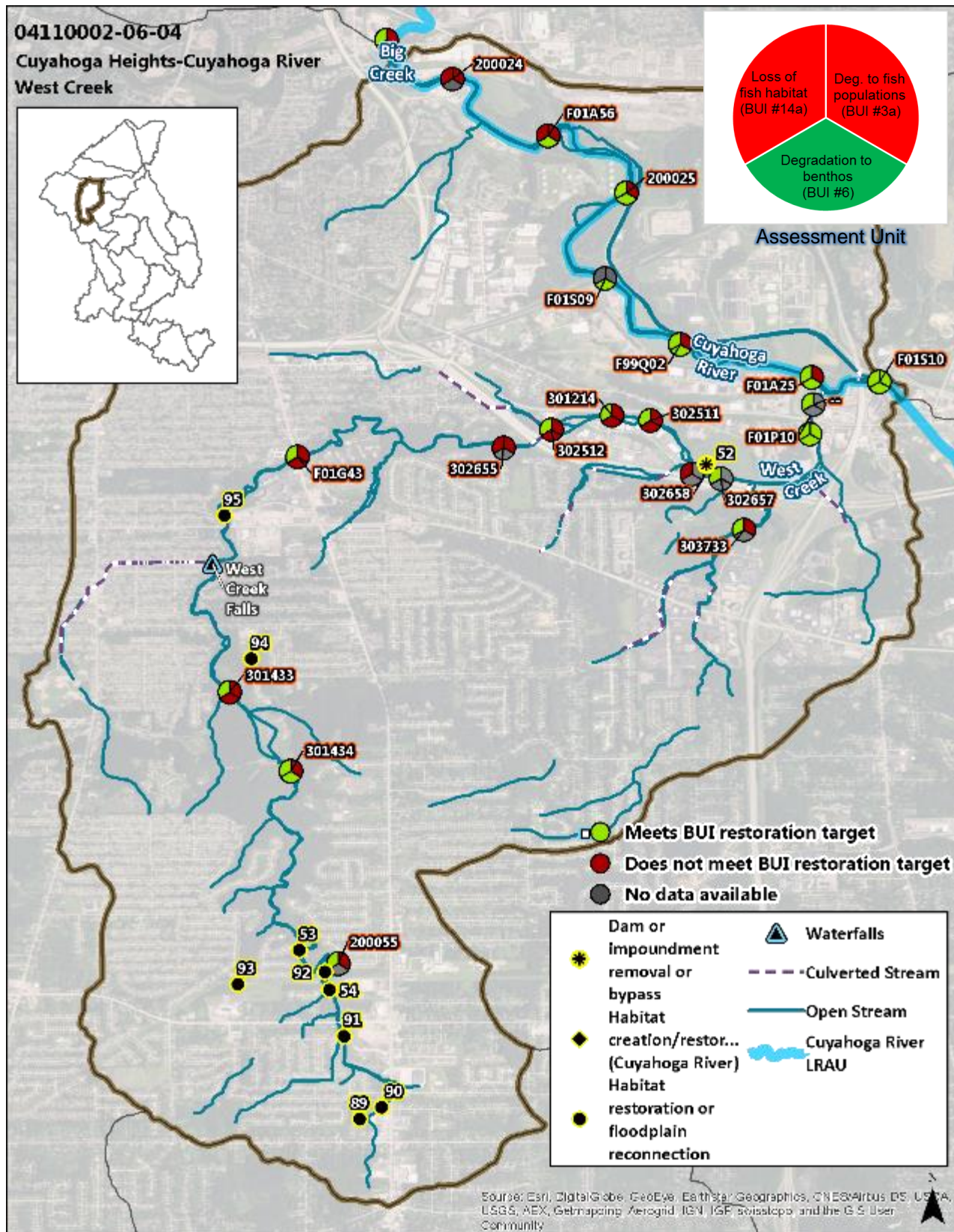


Figure A-17. Cuyahoga Heights-Cuyahoga River.

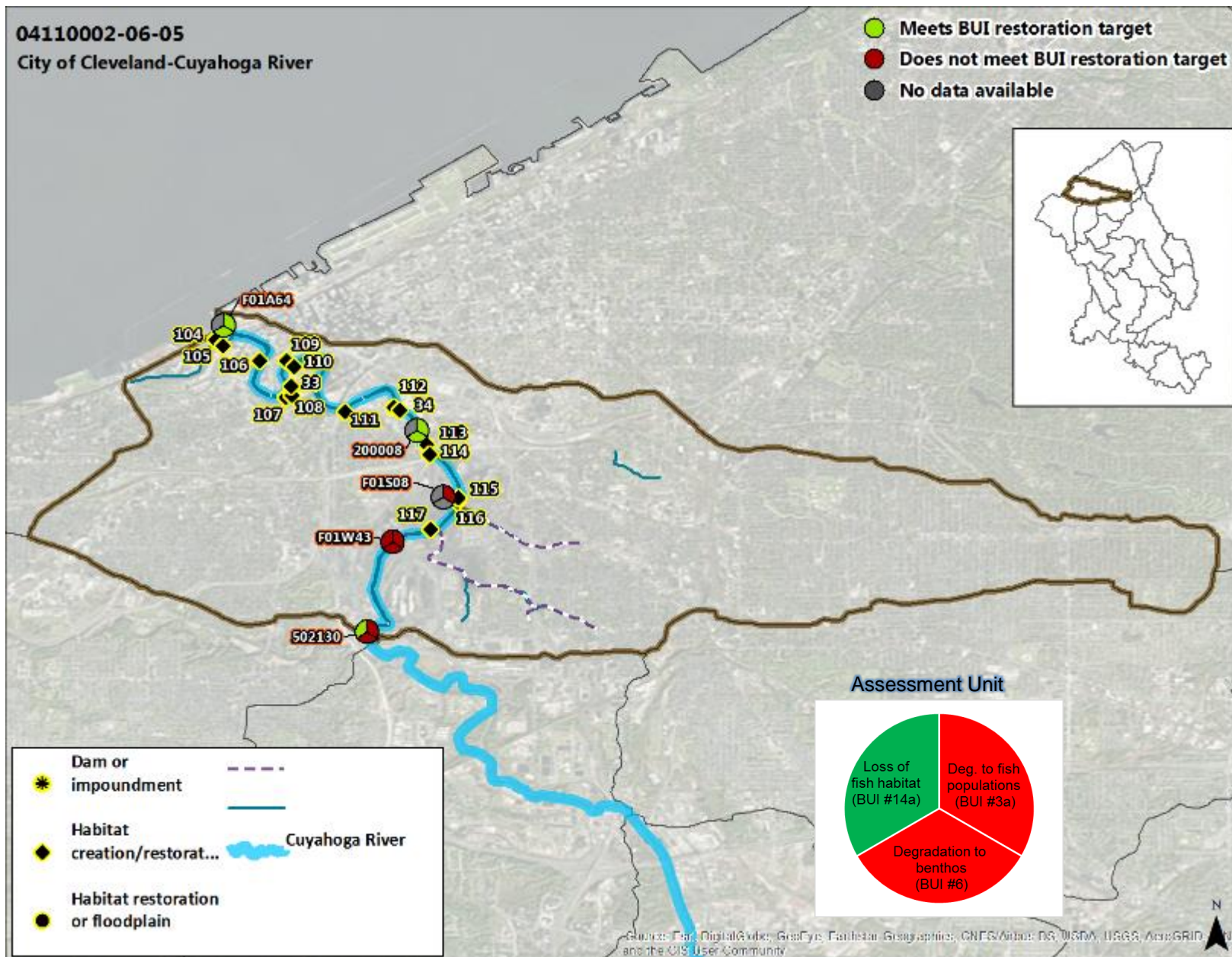


Figure A-18. City of Cleveland-Cuyahoga River.

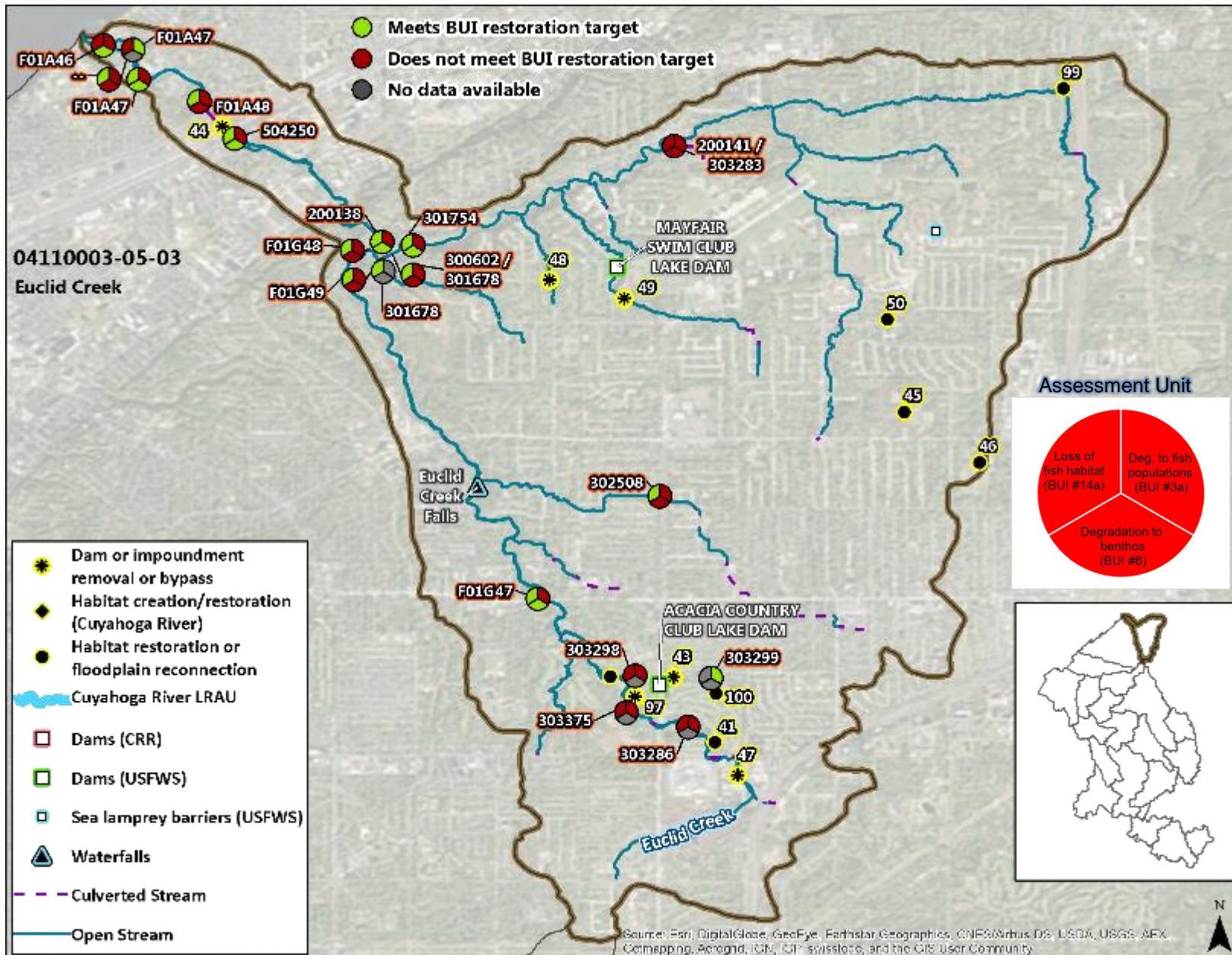


Figure A-19. Euclid Creek.

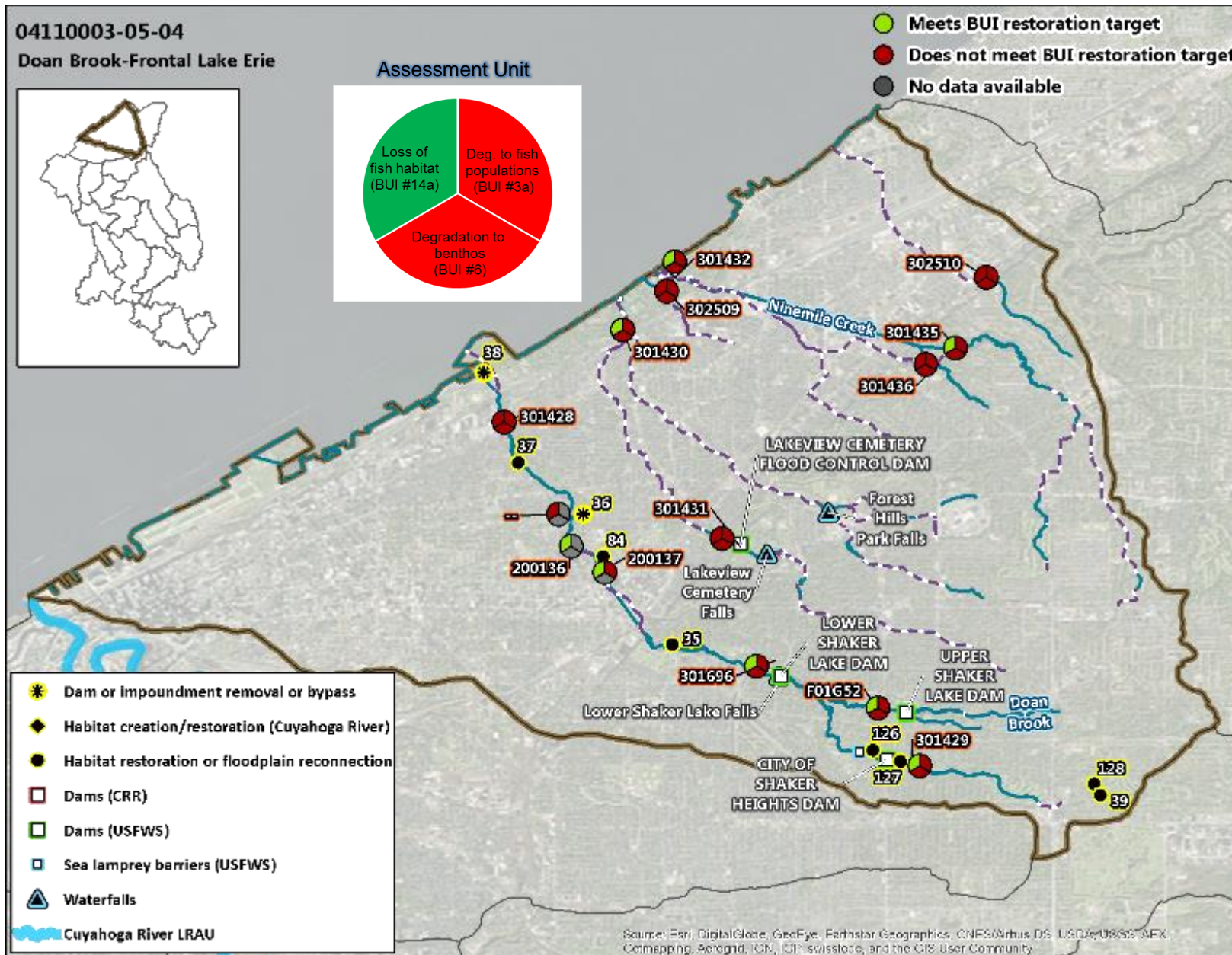


Figure A-20. Doan Brook-Frontal Lake Erie.

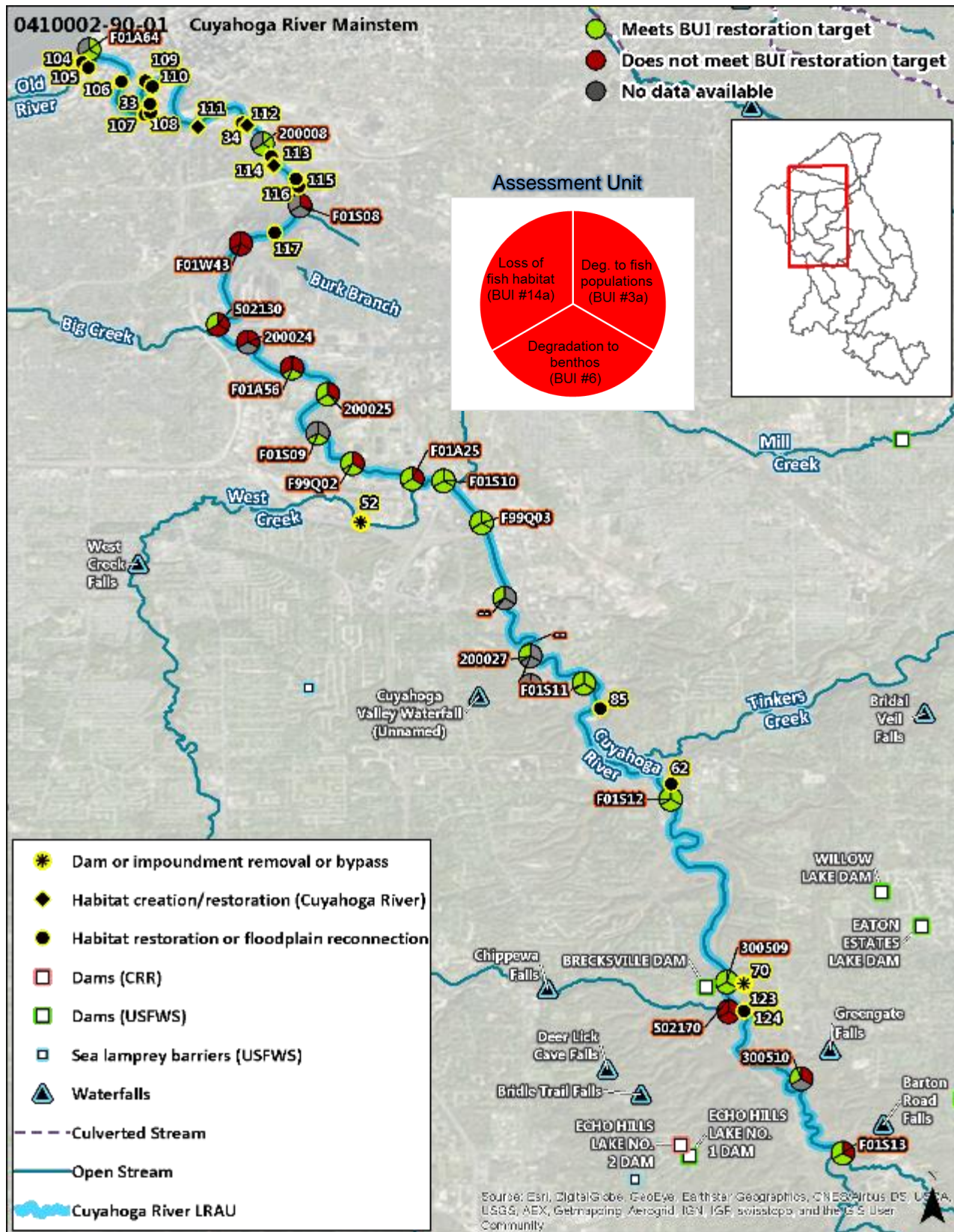


Figure A-21. Cuyahoga River large river assessment unit.

Appendix B.

Cuyahoga AOC Proposed Management Actions and Other Projects

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ACRONYMS/ABBREVIATIONS

Acronyms/Abbreviations	Definition
AOC	area of concern
BCC	Big Creek Connects
BUI	beneficial use impairment
CCCPA	Cleveland-Cuyahoga County Port Authority
CleMet	Cleveland Metroparks
CRR	Cuyahoga River Restoration
CVNP	Cuyahoga Valley National Park
DBWP	Doan Brook Watershed Partners
MCP	Mill Creek Partners
n/a	not available
NEFCO	Northeast Ohio Four County Regional Planning and Development Organization
NEORS	Northeast Ohio Regional Sewer District
ODNR	Ohio Department of Natural Resources
ODOT	Ohio Department of Transportation
Ohio EPA	Ohio Environmental Protection Agency
OTC	Ohio Turnpike Commission
TBD	to be determined
TCWP	Tinker's Creek Watershed Partners
TNC	The Nature Conservancy
USACE	U.S. Army Corp of Engineers (U.S. Department of Defense)
U.S. EPA	U.S. Environmental Protection Agency
USGS	U.S. Geological Survey (U.S. Department of the Interior)
WCC	West Creek Conservancy
WRLC	Western Reserve Land Conservancy

B-1 PROPOSED MANAGEMENT ACTIONS FOR BUIS #3A, #6, AND #14A

Management actions are generally divided into two categories: (1) removal or bypass of a barrier or impoundment and (2) habitat restoration and floodplain reconnection. A summary of management actions by category and watershed is presented in Table B-1; other candidate projects, which are not designated as management actions, are also presented in Table B-1.

Two projects, both dam removals, are the two most critical projects to the restoration of the Cuyahoga River upstream of the federal shipping channel. The removal of both dam structures will open significant segments of the Cuyahoga River for re-colonization of numerous fish species. The Gorge Dam project (#79) will incorporate two phases, removal of sediments in the dam pool and removal of the dam structure. The removal of the sediments in the dam pool will preclude any contamination within the sediments from migrating downstream when the dam structure is removed. The Gorge Dam (#79; Table B-1) is the single, largest barrier to fish migration in the Cuyahoga AOC, and thus, is the highest priority project in the AOC. Second to the Gorge Dam is the Canal Diversion Dam (#70; Table B-1). Because of the importance of these two projects, they are included in this report but the Gorge Dam sediment and dam removal project will likely be funded by the Great Lakes Legacy Act and other, non-GLRI funding mechanisms and only a portion of the Canal Diversion Dam sediment and dam removal project is expected to be funded by GLRI.

After these barriers and resultant impoundments are removed, the focus should be placed on major tributaries (Table B-3). Highest priority projects should be completed first. For example, removing or bypass the East 185th spillway (#44) will open up the Euclid Creek watershed; the bypass of the low-head dam on the Cleveland Clinic Lyndhurst Campus (#97) will be more beneficial once the East 185th spillway is addressed.

Habitat restoration and floodplain reconnection management actions are presented for the tributaries of the Cuyahoga River (Table B-4) and to the mainstem of the Cuyahoga River (Table B-5). Highest priority projects are also identified for habitat restoration and floodplain reconnection for the tributaries; similar to the dams and impoundments, highest priority projects should be completed first. For the Cuyahoga River federal ship channel, candidate projects are presented in Table B-6; as presented in Table B-5, a subset of these candidate projects should be proposed as management actions.

Two projects, located within the Cuyahoga Valley National Park, are included in this report (Table B-5) but these projects are likely be funded by other, non-GLRI funding mechanisms, such as with inter-agency agreements between U.S. EPA and the U.S. Department of Interior.

Funded projects that will address biological or habitat beneficial use impairments but are not management actions that need funding are presented in Table B-7. During the evaluation and prioritization of management actions, these projects were assumed to be completed within the next few years.

Other candidate projects that are not currently proposed as management actions are presented in Table B-8. In the future, if some proposed management actions become unviable, then the other candidate projects should be reevaluated.

Proposed management actions are plotted in the assessment unit maps presented in Appendix A.

Table B-1. Summary of proposed management actions across the Cuyahoga AOC

Assessment unit		BUIs ^a			Management actions			Other candidate projects			Funded by another source
ID	Name	3a	6	14a	Dam ^b	Habitat ^c	Cuyahoga ^d	Dam ^b	Habitat ^c	Cuyahoga ^d	
Cuyahoga (hydrologic unit code 04110002)											
Little Cuyahoga River											
03 03	Wingfoot Lake-Little Cuyahoga River	D	M	D	--	77	n/a	103	--	n/a	--
03 04	City of Akron-Little Cuyahoga River	D	M	D	119, 120	--	n/a	--	--	n/a	78
Yellow Creek-Cuyahoga River											
04 01	Mud Brook	D	D	D	--	--	n/a	--	124	n/a	--
04 02	Yellow Creek	D	D	D	--	--	n/a	--	125, 129	n/a	--
04 03	Furnace Run	M	M	M	--	--	n/a	--	--	n/a	--
04 04	Brandywine Creek	D	D ^e	M	--	73	n/a	--	--	n/a	--
04 05	Boston Run-Cuyahoga River	D	M	M	79^f	--	121, 122^g	--	75	--	71, 76
Tinker's Creek-Cuyahoga River											
05 01	Pond Brook	M	D	M	--	65	n/a	--	--	n/a	--
05 02	Headwaters Tinker's Creek	D	D	D	--	68, 69, 88, 118	n/a	--	67	n/a	--
05 03	Headwaters Chippewa Creek	M	?	M	101	--	n/a	--	72	n/a	--
05 04	Town of Twinsburg-Tinker's Creek	D	D	M	--	63, 66, 86, 87	n/a	--	64	n/a	--
05 05	Willow Lake-Cuyahoga River	M	M	M	70	124	123 ^g	--	--	62	--
Big Creek-Cuyahoga River											
06 01	Mill Creek	D	M	M	56	58	n/a	--	55, 57, 96	n/a	57, 81
06 02	City of Independence-Cuyahoga River	D	M	M	--	--	--	--	--	85	--
06 03	Big Creek	D	D	M	--	60, 61	n/a	--	59, 82	n/a	83
06 04	Cuyahoga Heights-Cuyahoga River	D	M	D	52	53, 90, 93, 94	--	--	89, 91, 92, 95	--	--
06 05	City of Cleveland-Cuyahoga River	D	D	M	--	--	34, 104-117^h	--	--	33, 104-117 ^h	--
Ashtabula-Chagrin (hydrologic unit code 04110003)											
Euclid Creek-Frontal Lake Erie											
05 03	Euclid Creek	D	D	D	44, 97	98	n/a	43, 47, 48, 49	45, 46, 50, 99, 100	n/a	41
05 04	Doan Brook-Frontal Lake Erie	D	D	M	38	37	n/a	36	35, 39, 126-128	n/a	84

Notes
 Highest priority management actions are **bolded in blue** and *italicized* projects are in the Cuyahoga Valley National Park.
 n/a = not applicable because the Cuyahoga River does not flow through these assessment units.
 a. Beneficial use impairments (BUIs) for the degradation of fish populations (3a), degradation of benthos (6), and loss of fish habitat (14a). **M** = meets BUI restoration target. **D** = Does not meet BUI restoration target. **?** = No current or historic data available.
 b. Dam or impoundment bypass or removal.
 c. Habitat restoration or floodplain reconnection on tributaries (excluding the Cuyahoga River).
 d. Habitat creation or restoration along the Cuyahoga River mainstem.
 e. Brandywine Creek (*04 04) is assumed to not meet the AOC restoration targets because historic Invertebrate Community Index data collected during several years do not meet the targets.
 f. The Gorge Dam sediment and dam removal and disposal (#79) is in the Fish Creek-Cuyahoga River (*05 06) assessment unit, which is only partially in the Cuyahoga AOC.
 g. East of Boston Mills Ski Area (#122) and Station Road Area (#123) are in the Cuyahoga Valley National Park and would likely be funded by other, non-GLRI funding mechanisms, such as with inter-agency agreements between U.S. EPA and the U.S. Department of Interior.
 h. Some but not all of the 14 Cuyahoga River federal ship channel habitat creation projects (#104-117) will need to be completed as management actions.

Table B-2. Proposed management actions - Critical management actions on the main stem of the Cuyahoga River that will benefit the entire AOC

Project name	Map ID	Waterbody	Brief description	Land owner	Implementer	O&M	Status	Total project cost	Requested funds
Gorge Dam sediment removal	79	Cuyahoga River	Contaminated sediment removal and disposal	Summit MetroParks	U.S. EPA	Summit MetroParks	In planning	\$58,000,000	none at this time ^a
Gorge Dam removal	79	Cuyahoga River	Gorge Dam removal and disposal following contaminated sediment removal and disposal	Summit MetroParks	Ohio EPA	Summit MetroParks	In planning	\$12,000,000	TBD ^b
Canal Diversion Dam removal	70	Cuyahoga River	Remove Canal diversion dam and install pump to maintain water levels in Ohio & Erie Canal	CVNP	CVNP & Ohio EPA	NEORS	In planning	\$1,300,000	\$400,000

Notes
 a. Ohio EPA anticipates requesting Great Lakes Legacy Act funding for the Gorge Dam sediment removal (#79). Should U.S. EPA Great Lakes National Program Office fund this project, U.S. EPA will select the sediment removal contractor.
 b. Ohio EPA has not determined if funding will be requested for the Gorge Dam removal (#79) since the removal of the dam is dependent upon the removal of the sediment.

Table B-3. Proposed management actions - Barrier and impoundment bypass or removal on major tributaries to the Cuyahoga River in the Cuyahoga AOC

Project name	Map ID	Waterbody	Brief description	Land owner	Implementer	O&M	Status	Total project cost	Requested funds
Highest Priority Projects									
West Creek flume removal	52	West Creek	Remove large, failing concrete flume	ODOT	WCC & NEORS	WCC & NEORS	In planning	\$2,000,000	\$2,000,000
East 185 th Spillway	44	Euclid Creek	Remove or bypass large drop-structure at highway and railroad crossing	NEORS	Cuyahoga SWCD	NEORS	In planning	\$2,000,000	\$2,000,000
Little Cuyahoga River Restoration and Kent Street dam removal	119	Little Cuyahoga River	Dam removal; part of larger ecological restoration project	Private	Akron	Akron	In planning	\$4,000,000	\$2,600,000
Doan Brook estuary restoration (DB-2)	38	Doan Brook	Daylight culverted stream, reroute stream to marina, and create estuary	Cleveland	DBWP & NEORS	CCCPA, CleMet, Cleveland, & NEORS	In planning	\$1,710,036	\$1,710,036
Cleveland Clinic Lyndhurst Campus (EC-2)	97	Euclid Creek	700-foot stream restoration and floodplain reconnection; low-head dam modification; 1.8-acres of lawn and low quality forest replaced with native riparian forest; 0.1-acres of wetland created	Private	Cuyahoga SWCD	Private	In planning	\$585,000	\$585,000
Memorial parkway project	120	Little Cuyahoga River	Low-head dam removal and sewer crossing removal. (Akron to build CSO storage basin)	Akron	Akron	Akron	Concept identified	\$16,322,060	\$1,000,000
Other Priority Projects Necessary to Restore the Cuyahoga AOC									
Kerruish Park restoration (MC-1)	56	Mill Creek	Dam modification and floodplain reconnection	Cleveland	MCP	NEORS	In planning	\$818,862	\$409,431
Ford removal at Chippewa Creek Metropark	101	Chippewa Creek	Ford removal	CleMet	CleMet	CleMet	Concept identified	\$309,789	\$309,789

Note: Proposed management actions are sorted by rank from top to bottom within each table delineation. See Section 3.3 of the main report for a description of the ranking protocol.

Table B-4. Proposed management actions - Habitat restoration and floodplain reconnection along the tributaries to the Cuyahoga River

Project name	Map ID	Waterbody	Brief description	Land owner	Implementer	O&M	Status	Total project cost	Requested funds
Highest Priority Projects									
Pond Brook	65	Pond Brook	6,500-foot stream restoration and wetland restoration	Summit MetroParks	Summit MetroParks	Summit MetroParks	Concept identified	\$868,000	\$868,000
Hudson Tenbroeck (TC-2)	69	Tinker's Creek	3,100-foot stream restoration	Summit MetroParks & Hudson Township	TCWP	Summit MetroParks & Hudson Township	In planning	\$191,500	\$191,500
Hudson Mainstem Restoration Extension	118	Tinker's Creek	1.23-mile stream restoration	Portage County Park District	Portage county Park District & TCWP	Portage County Park District	In planning	\$400,000	\$400,000
West Creek at Bigelow (WC-2)	90	West Creek	Stream restoration and floodplain reconnection	Private	WCC	Private	In planning	\$383,918	\$383,918
Coventry Drive stream stabilization (WC-5)	93	West Creek tributary	Stream restoration	Parma	WCC	Parma	In planning	\$149,254	\$149,254
Sowinski Park restoration (DB-3)	37	Doan Brook	Stream restoration, wetland creation, & floodplain reconnection	Cleveland	Cleveland & NEORS	Cleveland & NEORS	In planning	\$397,260	\$397,260
Twinsburg High School stream restoration (TC-6)	87	Tinker's Creek	200-foot stream restoration	Twinsburg City School District	TCWP	Twinsburg City School District	In planning	\$169,573	\$169,573
Brandywine Creek former Summit County Boys Home	73	Brandywine Creek & tributary	8,775-foot stream restoration and 8.8-acre floodplain restoration	Summit County, Hudson, & OTC	Summit County	Summit County	Concept identified	\$2,648,720	\$2,648,720
Snow Road stream restoration	60	Big Creek	850-foot floodplain restoration	CleMet	BCC & CleMet	CleMet	Concept identified	\$778,637	\$778,637
Wolf Creek stream restoration	58	Wolf Creek & Mill Creek	Stream restoration	CleMet	CleMet	CleMet	Concept identified	\$400,000	\$400,000
Other Priority Projects Necessary to Restore the Cuyahoga AOC									
SR14 drainage ditch (TC-3)	88	Tinker's Creek tributary	2,200-foot stream restoration	TBD	TCWP, WCC, & WRLC	TBD	In planning	\$769,664	\$769,664
West Creek flood control	53	West Creek tributary	1,100-foot stream restoration and culvert replacement	TBD	CleMet	TBD	Unknown	\$150,000	\$150,000
Adams Run restoration (LC-1)	77	Adams Run	1,800-foot stream restoration	Akron & Private	NEFCO & WRLC	Akron	In planning	\$455,000	\$455,000
Bear Creek continuation (TC-1)	66	Tinker's Creek	800-foot stream restoration and wetland creation	Private	TCWP	Warrensville	In planning	\$627,800	\$627,800
West Creek at Sprague Road - St. Sava Recreation Area (WC-6)	94	West Creek tributary	Culverted stream daylighting and storm water infrastructure installation	Private	WCC	TBD	In planning	\$753,952	\$753,952
Glenwillow stream restoration (TC-7)	63	Tinker's Creek	3,677-foot stream restoration	Glenwillow, Private, & Twinsburg	TCWP	Glenwillow & Twinsburg	In planning	\$2,157,308	\$2,157,308
Bedford Heights Stream and Floodplain Wetland Restoration at the Bus Garage (TC-5)	86	Tinker's Creek	700-foot stream restoration and 0.5-acre wetland creation	Bedford City School District & Private	Bedford Heights & TCWP	TBD	In planning	\$213,865	\$213,865
Stickney Creek stream restoration	61	Stickney Creek	400-foot stream restoration	TBD	BCC & NEORS	NEORS	Concept identified	\$850,000	\$150,000

Project name	Map ID	Waterbody	Brief description	Land owner	Implementer	O&M	Status	Total project cost	Requested funds
Mayfield Sand Ridge Restoration (EC-1a/b)	98	Euclid Creek	Stream restoration	Private	Cuyahoga SWCD	Private	In planning	\$4,833,000	\$4,833,000
303 culvert project (TC-4)	68	Tinker's Creek	3,575-foot stream restoration and floodplain reconnection	TBD	TCWP	TBD	In planning	\$1,668,969	\$1,668,969

Note: Proposed management actions are sorted by rank from top to bottom within each table delineation. See Section 3.3 of the main report for a description of the ranking protocol.

Table B-5. Proposed management actions - Habitat restoration and floodplain reconnection along the main stem of the Cuyahoga River

Project name	Map ID	Waterbody	Brief description	Land owner	Implementer	O&M	Status	Total project cost	Requested funds
Highest Priority									
Habitat for Hard Places	34	Cuyahoga River	Replace damaged habitat structures and maintain or enhance existing structures	Multiple (public & private)	CRR	CRR	Ready for construction	\$100,000	\$100,000
Cascade Metro Park Valley View Area	121	Cuyahoga River & tributaries	3,500-foot stream restoration (Cuyahoga River), 2,300-foot stream restoration (tributaries), 28-acre wetland restoration, 20,000-foot tile daylighting/disabling, 92-acre forest restoration, 26-acre meadow restoration	Summit Metro Parks	Summit Metro Parks	Summit Metro Parks	In planning	\$7,303,852	\$3,000,000
Federal ship channel habitat creation	104-117 ^a	Cuyahoga River	Habitat creation along the federal ship channel. To be selected from Table B-6	Varies	CRR	Varies	Concept identified	\$3,000,000 ^b	\$3,000,000
Cuyahoga Valley National Park projects expected to be funded through federal interagency funding mechanisms									
East of Boston Mills Ski Area	122	Cuyahoga River	5,750-foot stream restoration and 30-acre reforestation	CVNP	CVNP	CVNP	Concept identified	\$2,650,000	\$2,650,000
Station Road Area	123	Cuyahoga River	18,000-foot stream restoration and 3-acre forest restoration. Follow-up to dam removal (#70)	CVNP	CVNP	CVNP	Concept identified	\$7,540,000	\$7,540,000

Notes
 Proposed management actions are sorted by rank from top to bottom. See Section 3.3 of the main report for a description of the ranking protocol.
 a. The federal ship channel habitat creation projects were not scored and ranked against one another. A subset of these candidate projects are recommended and should be selected at a later time. All 14 candidate projects are presented in Table B-6.
 b. As discussed in the preceding footnote, a subset of projects to be selected, which will total \$3,000,000, from the full list of 14 candidate projects that total \$10,520,000.

Table B-6. Candidate projects for habitat creation along the Cuyahoga River federal ship channel

Project name	Map ID	Waterbody	Brief description	Land owner	Implementer	O&M	Status	Total project cost	Requested funds
Center St. Bridge West Bank (CR-3)	106	Cuyahoga River	Create habitat by excavating shallow pools with cutting the bulkhead below water level to allow fish access	Cleveland	CRR and TBD	Cleveland	Concept identified	\$500,000	\$500,000
West Bank, Carter Road Bridge Approach (CR-7)	110	Cuyahoga River	Habitat refugia creation behind bulkhead with cutting entrance/exit into bulkhead	Cleveland	CRR and TBD	Cleveland	Concept identified	\$1,500,000	\$1,500,000
Willow Ave Bridge North Habitat Enhancement (CR-1)	104	Cuyahoga River (Old River Channel)	Create habitat by excavating shallow pools	Private	CRR and TBD	TBD	Concept identified	\$220,000	\$220,000
Willow Avenue South Habitat Pool (CR-2)	105	Cuyahoga River (Old River Channel)	Create habitat by excavating shallow pools with cutting the bulkhead below water level to allow fish access	Private	CRR and TBD	TBD	Concept identified	\$500,000	\$500,000
West Bank, south of Columbus Road bridge (CR-4)	107	Cuyahoga River	Habitat refugia creation behind bulkhead with cutting entrance/exit into bulkhead	Private	CRR and TBD	TBD	Concept identified	\$700,000	\$700,000
West Bank, across from The Foundry (CR-5)	108	Cuyahoga River	Habitat refugia creation behind bulkhead with cutting entrance/exit into bulkhead	Private	CRR and TBD	TBD	Concept identified	\$1,500,000	\$1,500,000
East Bank, Carter Road Bridge Approach/Sherwin Williams (CR-6)	109	Cuyahoga River	Habitat refugia creation behind bulkhead with cutting entrance/exit into bulkhead	Private	CRR and TBD	TBD	Concept identified	\$1,000,000	\$1,000,000
East Bank, Marathon Bend (CR-8)	111	Cuyahoga River	Create an in-and-out channel parallel to the main channel	Private	CRR and TBD	TBD	Concept identified	\$700,000	\$700,000
West Bank, Drydock/Mahoning Habitat Area (CR-9)	112	Cuyahoga River	Habitat refugia creation behind bulkhead with cutting entrance/exit into bulkhead	Private	CRR and TBD	TBD	Concept identified	\$1,000,000	\$1,000,000
East Bank, North of I-490 Habitat Area Enhancement (CR-10)	113	Cuyahoga River	Habitat refugia creation behind bulkhead with cutting entrance/exit into bulkhead	Private	CRR and TBD	TBD	Concept identified	\$200,000	\$200,000
West Bank, Under I-490 Fish Habitat (CR-11)	114	Cuyahoga River	Create an in-and-out channel parallel to the main channel	Private	CRR and TBD	TBD	Concept identified	\$800,000	\$800,000
West Bank, ArcelorMittal RR Bridge Enhancement North (CR-12)	115	Cuyahoga River	Habitat refugia creation behind bulkhead with cutting entrance/exit into bulkhead	Private	CRR and TBD	TBD	Concept identified	\$500,000	\$500,000
West Bank, ArcelorMittal Clark/W. 3rd Bridge (CR-13)	116	Cuyahoga River	Habitat refugia creation behind bulkhead with cutting entrance/exit into bulkhead	Private	CRR and TBD	TBD	Concept identified	\$400,000	\$400,000
West Bank, ArcelorMittal Clark/W. 3rd Bridge (CR-14)	117	Cuyahoga River	Habitat refugia creation behind bulkhead with cutting entrance/exit into bulkhead	Private	CRR and TBD	TBD	Concept identified	\$1,000,000	\$1,000,000

Note: The first two candidate projects are on land owned by the city of Cleveland; the remainder of candidate projects are sorted numerically from top to bottom.

Table B-7. Already funded projects

Project name	Map ID	Waterbody	Brief description	Land owner	Implementer	O&M
Construction completed (post-construction monitoring to occur in the near future)						
Seneca parking lot retrofit	72	n/a	Storm water infrastructure installation	CleMet	CleMet	CleMet
Highland Hills golf course stream restoration	81	Mill Creek	Dam removal, 4,000-foot stream restoration, and floodplain reconnection	Cleveland	NEORS	Cleveland
Chevrolet detention basin	82	Big Creek-Chevy Branch	Storm water detention basin construction	TBD	NEORS	NEORS
Construction ongoing						
Euclid Creek Floodplain Reconnection at Acacia	41	Euclid Creek	1,200-foot stream restoration, floodplain reconnection, and stormwater water quality treatment	CleMet	CleMet	CleMet & NEORS
Hampton Hills floodplain plantings	76	Cuyahoga River tributary	15-acre reforestation	CVNP	CVNP	CVNP
Mill Creek quarries restoration	57	Mill Creek tributary	1,500-foot stream restoration and 30-acre surface restoration	Cleveland	Cleveland & NEORS	Cleveland
Ready for construction						
Columbo Park stream restoration	83	Big Creek	300-foot stream restoration	Parma Heights	NEORS	Parma Heights
Little Cuyahoga River sewer crossing	78	Little Cuyahoga River	Low-head dam removal, sewer crossing removal, and stream channel restoration (Akron to redirect sewer)	Akron	Akron	Akron
Stanford Run stream restoration	71	Stanford Run	2,000-foot stream restoration and bridge installation	CVNP	CVNP	CVNP
In planning						
Doan Brook bank stabilization	84	Doan Brook	This project will stabilize approximately 880 linear feet of Doan Brook in the City of Cleveland.	City of Cleveland	NEORS	NEORS

Note: Proposed management actions are sorted alphabetically by waterbody name from top to bottom.

B-2 OTHER PROJECTS TO ADDRESS BUIS #3A, #6, AND #14A

Candidate projects that were evaluated but are not proposed as management actions are presented in Table B-8. These candidate projects are plotted in the assessment unit maps presented in Appendix A.

Table B-8. Other candidate projects

Project name	Map ID	Waterbody	Brief description	Land owner	Implementer	O&M	Status	Total project cost
Dam and impoundment bypass or removal								
Big Creek channel & drop structure enhancement project	59	Big Creek	Re-route Big Creek under railroad and interstate highway right-of-ways; significant costs for interstate and railroad construction	TBD	BCP & NEORS	TBD	Concept identified	\$100,000,000
Check dams altered (DB-1)	36	Doan Brook	Remove check dams and reconnect floodplain	Cleveland	Cleveland & NEORS	Cleveland & NEORS	In planning	\$429,526
David Myers Parkway Dam	47	Euclid Creek	Dam removal or bypass	Private	Cuyahoga SWCD	Private	Concept identified	\$449,829
Richmond Road Dam decommissioning	43	Euclid Creek tributary	Dam removal or bypass	CleMet	Cuyahoga SWCD	CleMet	Unknown	TBD
Dumbarton Dam removal	48	Euclid Creek-East Branch's tributary	Dam removal	Private	Cuyahoga SWCD	Private	Concept identified	TBD
Mayfair East Branch Reforestation and dam removal	49	Euclid Creek-East Branch's tributary	Dam removal and 1,100-foot stream restoration	Cuyahoga County & Private	Cuyahoga SWCD	Cuyahoga County & Private	Concept identified	\$1,115,848
Hills Pond dam removal	103	Little Cuyahoga River	Dam removal	TBD	Portage County Regional Planning Commission	TBD	Concept identified	\$498,000
Habitat restoration and floodplain reconnection - Tributaries								
Bath Nature Preserve Area	125	Bath Creek	6,175-foot stream restoration	Bath Township & Private	Bath Township & CVNP	Bath Township	Concept identified	\$1,599,000
Fern Gully wetland restoration	129	Bath Creek	Upland, forested wetland restoration	Private	Bath Township & University of Akron	University of Akron	In planning	\$30,000
Dickerson Run Reforestation	75	Dickerson Run	36-acre forest restoration	CVNP	CVNP	CVNP	Construction ongoing	TBD
South Branch restoration (DB-4)	39	Doan Brook-South Branch	Stream restoration and floodplain reconnection	Private	DBWP & NEORS	Private	In planning	\$291,719
Belvoir Road stream restoration	128	Doan Brook-South Branch	350-foot stream restoration and 0.5-acre wetland restoration	Private	Private	Private	Concept identified	\$327,193
Acacia Reservation NE Pond Enhancements and Outlet Daylighting (EC-4)	100	Euclid Creek tributary	Culverted stream daylighting and wetland creation	CleMet & Private	CleMet	CleMet & NEORS	In planning	\$199,169
Willoughby Eastlake School of Innovation (EC-3)	99	Euclid Creek-East Branch	700-foot stream restoration; 0.1-acre wetland creation; 0.8-acres degraded forest converted to native floodplain vegetation; 3.3-acres of riparian forest enhancement	Willoughby Eastlake City School District	Cuyahoga SWCD	Willoughby Eastlake City School District	In planning	\$243,000
Highland Heights Community Park storm water retrofit	45	Euclid Creek-East Branch tributary	N/A	Highland Heights	Cuyahoga SWCD	Highland Heights	Concept identified	TBD

Project name	Map ID	Waterbody	Brief description	Land owner	Implementer	O&M	Status	Total project cost
Mayfield High School Upper East Branch storm water retrofit	46	Euclid Creek-East Branch tributary	0.25-acre wetland creation	Mayfield City School District	Cuyahoga SWCD	Mayfield City School District	Concept identified	TBD
Highland Heights wetland restoration	50	Euclid Creek-East Branch tributary	12-acre wetland restoration	Highland Heights	Cuyahoga SWCD	Highland Heights	In planning	TBD
Green Lake restoration	127	Green Lake	Wetland branch creation	Shaker Heights & Private	DBWP	Shaker Heights & Private	Concept identified	\$1,125,018
Marshall Lake Floating Wetlands	126	Marshall Lake	Installation of floating wetland treatment systems	Shaker Heights & Private	DBWP	Shaker Heights & Private	Concept identified	\$758,601
Mill Creek at Warrensville Center Road bank stabilization	96	Mill Creek	400-foot stream restoration and floodplain reconnection	Warrensville Heights	MCP	Warrensville Heights	Concept identified	\$250,000
Silver Lake Country Club area	124	Mud Brook tributary	4,700-foot stream restoration	Stow & Private	Stow & CVNP	Stow & Private	Concept identified	\$1,645,000
Headwaters West Creek at Sprague Road (WC-1)	89	West Creek	Storm water infrastructure installation	TBD	WCC	TBD	In planning	\$216,932
West Creek at Pleasant Valley Shopping Center (WC-3)	91	West Creek	Storm water infrastructure installation	Private	WCC	Private	In planning	\$792,507
West Creek at Giant Eagle (WC-4)	92	West Creek	Storm water infrastructure installation	Private	WCC	Private	In planning	\$354,455
Snow Road Shopping Plaza (WC-7)	95	West Creek	Storm water infrastructure installation	Private	WCC	Private	In planning	\$836,487
Habitat restoration and floodplain reconnection - Cuyahoga River								
Cuyahoga River bank stabilization	85	Cuyahoga River	TBD	TBD	TBD	TBD	Concept identified	\$1,125,000
Pleasant Valley wetland restoration	62	Cuyahoga River	10-acre wetland restoration	CVNP	CVNP	CVNP	Concept identified	TBD
Irishtown bend hillside stabilization	33	Cuyahoga River	The Port Authority completed a \$300,000 engineering study in 2015 that detailed how Irishtown Bend could be stabilized for \$49 million.	TBD	CCCPA	TBD	In planning	\$49,000,000

Note: Proposed management actions are sorted alphabetically by waterbody name from top to bottom within each table delineation.

Appendix C.

Cuyahoga AOC Assessments and Studies

LIST OF TABLES

Table C-1. Critical assessments and studies to support BUI removal	C-3
Table C-2. Proposed inventories and studies that may assist with BUI evaluation	C-4

ACRONYMS/ABBREVIATIONS

Acronyms/Abbreviations	Definition
AOC	area of concern
BUI	beneficial use impairment

Table C-1. Critical assessments and studies to support BUI removal

Study name	ID	Brief description
Man-made barrier study	5	Evaluation of assessment units that may not be able to achieve BUI restoration targets due man-made barriers and impoundments
Imperviousness study	7	Evaluation of assessment units that may not be able to achieve BUI restoration targets due to high levels of imperviousness
Fish tumor study	10	Evaluation of past tumor studies and reassessment of brown bullhead liver tumors and DELTs
Algal study of Mogadore Reservoir	25	Evaluation of algal communities in the Mogadore Reservoir and potentially other impoundments
Collection of biological and habitat data	200	Data collection and monitoring of the Index of Biotic Integrity, Modified Index of well-being, Invertebrate Community Index, and Qualitative Habitat Evaluation Index for assessment units with data gaps or with data that are or will soon be 10 years old or more
Bacterial study	213	Compilation of available bacteria data and evaluation of data with BUI restoration targets for beaches and paddleable streams

Notes

Critical assessments and studies are sorted numerically from top to bottom.
Funding is not requested at this time for these assessments and studies.

Table C-2. Proposed inventories and studies that may assist with BUI evaluation

Study name	ID	Brief description
Bedload interceptor migratory fish study	1	Evaluation of the impact of the bedload interceptor upon migratory larval fish
Tributary sedimentation study	8	Evaluation of the impact of sedimentation from tributary assessment units upon the Cuyahoga River (similar to John Peck's study of Furnace Run)
Dredge material re-use study	11	Evaluation of upland beneficial re-use of sediment material dredged from the Cuyahoga River federal ship channel
Updated wetland inventory	12	Update the wetland inventory across the entire AOC
Riparian canopy inventory	13	Evaluation of the health of riparian corridors throughout the AOC
Large parking lot inventory	14	Evaluation of parking lots greater than 5 acres to determine if such lots can be beneficially re-used or removed
Shipping channel thermal pollution study	15	Identification of the source of thermal pollution in the turning basin of the federal ship channel
Comprehensive invasive species study	17	Identification of areas throughout the AOC that need to be treated for invasive species
Eutrophication and cyanophyte study	18	Evaluation of NEORSD data and Kevin Kayle's study to determine if BUI restoration targets are met
Beach closings source study	19	Evaluation of bacteria data collected from beaches and Lake Erie nearshore areas with data from CSOs and tributary inputs to identify sources and determination of the need for DNA-testing to determine sources of bacteria
Monitoring program to assess recreation use	20	Development of a plan for continuous monitoring of bacteria in the Cuyahoga River and Tinker's Creek
Recreation use removal	21	Determination if BUI restoration targets for recreation use are met
Euclid Creek HHEI	27	Evaluation of the headwaters of Euclid Creek and update assessment data for sample sites nearing expiration
Increased community education program for sustainable living	28	Education of public in impaired assessment units of the benefits of sustainable living
Climate resilience study	29	Evaluation and application of Cleveland Climate Action Plan to smaller municipalities

Study name	ID	Brief description
Nearshore habitat beneficial re-use	30	Identification of priority areas and evaluation of feasibility to expand nearshore habitat zones within the AOC
Streambank restoration in the Navigation Channel	31	Identification of conversion potential of sites within the navigation channel to enhance streambank habitat
Old River Channel legacy sediments	32	Development of feasibility study of potential remedial actions for legacy contaminated sediments in the Old River Channel
Forest Hills Dugway restoration	40	Identification of restoration opportunities in Forest Hills Park and Eastside Greenway corridor for habitat enhancement and improvement

Notes

Identified inventories and studies are sorted numerically from top to bottom.
Funding is not requested at this time for these inventories and studies.