WRRSP Preliminary Restoration Project Plan
Baldwin Creek Dam Removal & Restoration Project
Cuyahoga County
November 2010

I. Plan Summary

The main goals of this project include restored fish passage, improved fish in-stream habitat, reduced channel and bank erosion, and improved water quality. Causes and sources of impairments have been documented in the Rocky River TMDL Report, the Rocky River Watershed Action Plan and Ohio EPA's 2010 Integrated Report.

Baldwin Creek is located within an urbanized region of Cuyahoga County, Ohio. As a result of this urbanized state, sections of Baldwin Creek have been modified or altered the past 100 years that have prohibited natural fish passage to thrive and limits its biological attainment.

The project proposes to remove the one intact dam and two partially intact dams that serve as barriers to fish passage in Baldwin Creek, and that sever populations of the state-threatened Bigmouth Shiner (*Notropis dorsalis*) in Baldwin Creek and the East Branch of the Rocky River. Channel stabilization up- and downstream of the dam sites and aquatic habitat enhancement will also be conducted as part of the project. As identified in the Rocky River TMDL Report and the Rocky River Watershed Action Plan, the removal of these structures and associated in-stream habitat restoration will restore the fish community to WWH standards in the lower 0.9 miles of Baldwin Creek.

II. Description of Water Resources to be Restored

A. Identification and Location of Water Resources

The Baldwin Creek Dam Removal and Habitat Enhancement project site is located in the City of Berea, Cuyahoga County, Ohio. The site is located on the property of the City of Berea, adjacent to the Cleveland Metroparks Mill Stream Run Reservation. The HUC-11 for the East Branch of the Rocky River, including Baldwin Creek, is 04110001070. The HUC-12 for Baldwin Creek and neighboring tributaries to the East Branch is 041100010702, and the HUC-14 for Baldwin Creek is 04110001070030.

A location map indicating the project are in the State of Ohio is attached here as Appendix A.

Topographic maps of the project site are attached here as Appendix B.

B. Overview of Water Resources

Baldwin Creek rises in North Royalton and flows in a westerly direction through Parma, Middleburg Heights, Strongsville, and Berea before entering the East Branch of the Rocky River near the Berea Water Treatment Plant. It drains approximately 10 square miles. At one time, the creek was impounded to form Coe Lake. The flow of the Creek

has since been redirected to bypass Coe Lake. However, the earthen dam that separates Coe Lake from Baldwin Creek faces erosion issues originating from flow alterations caused by the dam at South Rocky River Drive (Dam #3) and associated debris jams. The watershed is dominated by restrictive (Class C and D) soils.

One intact dam and two smaller, partially breached dams impede fish migration and degrade habitat throughout the project reach. Dam #1 is located at the confluence with the East Branch of the Rocky River (River Mile 0.0), Dam #2 is at the Berea Water Treatment Plant Access Road (River Mile 0.06) and Dam #3 is immediately upstream of South Rocky River Drive (River Mile 0.4). Dam #1 and #2 are partially breached, while Dam#3 is intact. There is an additional dam upstream (River Mile 0.95) on private property that is not included in this project.

Baldwin Creek is designated as Warm Water Habitat (WWH), and Antidegradation Tier 1/General High Quality Waters, as identified by Ohio EPA. Based upon these standards, Baldwin Creek is in partial attainment of these standards within the East Branch due to the IBI (index of biotic integrity) indicating departure from applicable biocriteria for the water body as outlined in the Rocky River TMDL report (2001).

C. Biological Features of Water Resources

The dam effectively isolates populations of the state threatened Bigmouth Shiner (*Notropis dorsalis*) upstream of the dam sequence and downstream in the East Branch of the Rocky River. This project will expand the habitat area available to these populations in an effort to reconnect them. The Bigmouth Shiner is a prairie relic species from the Cyprinidae (minnows and carp) family. While common throughout portions of the Upper Midwest and Great Plains, its range in Ohio is limited to Baldwin Creek, the East Branch of the Rocky River, and the West Branch of the Black River. Bigmouth shiners are found in pools where they swim in schools just above the substrate.

The Rocky River TMDL indicates an IBI (fish community) score of 24 in the project reach, which is a significant departure from the WWH criteria (minimum score = 38). Additional sampling completed by Cleveland Metroparks in 2009 indicates the fish community is “marginally good” (IBI = 36) below Dam #3 but “poor” (IBI = 20) above Dam #3. Additionally, species encountered below the dam but absent above include: Northern Hog Sucker, Blacknose Dace, Striped Shiner, Yellow Bullhead, Largemouth Bass, Pumpkinseed Sunfish and Greenside Darter.

Invasive Zebra mussels and Round Goby have been observed in Baldwin Creek, but only in limited numbers.

Ohio EPA has assessed the lower 8.0 miles of Baldwin Creek. None of these miles are attaining designated aquatic uses. The mean QHEI score is 52.75 but individual scores are highly variable ranging from 32.0 to 67.0. This score indicates that the stream is marginally suited to supporting normal Warm Water stream communities. The QHEI in the project reach ranges from 47 to 57.5, with a mean of 51.5.

Overall, scouring flows and sedimentation degrades habitat. Conditions tend to worsen as one proceeds downstream reflecting the cumulative impact of urban drainage.

Embedded substrates and riffles were observed at all sites, while channel modifications and limited in-stream cover characterized downstream sites. One intact dam and two smaller, partially breached dams impede fish migration and degrade habitat throughout the project reach (see map). Dam #1 is located at the confluence with the East Branch of the Rocky River (River Mile 0.0), Dam #2 is at the Berea Water Treatment Plant Access Road (River Mile 0.06) and Dam #3 is immediately upstream of South Rocky River Drive (River Mile 0.4). Dam #1 and #2 are partially breached, while Dam#3 is intact. There is an additional dam upstream (River Mile 0.95) on private property that is not included in this project. Despite these challenges, the 2001 Rocky River TMDL states, "Unlike many urban streams in Ohio, analysis of the Baldwin Creek QHEI data does lead to a conclusion that habitat restoration in the stream could have a high degree of success… If implemented in conjunction with stream channel barrier removal or enhancements, stream bank erosion protection, and storm water controls, the capability for Baldwin Creek to attain Warm Water Habitat Biocriteria would be significantly improved." The proposed project is one of the recommended actions for Baldwin Creek in the 2006 Rocky River Watershed Action Plan (updated 2010).

III. Description of Surrounding Land Use

Land use in the Baldwin Creek watershed is 71% residential, 24% undeveloped, and 5% commercial/industrial/institutional, resulting in approximately 26% impervious cover. That undeveloped land is largely present in public parks, including portions of the Cleveland Metroparks Mill Stream Run and Big Creek Reservations, in the lower portion of the watershed. There is no cropland in the watershed, and agricultural activity is limited to a few small recreational horse facilities.

The vast majority of the development in Baldwin Creek occurred before any state or local regulations requiring storm water management were in place, leading to widespread degraded water quality and stream habitat conditions, especially in headwater stream systems. This degradation is caused by the effects of storm water runoff generated by the increased impervious area (such as parking lots, rooftops, and roads) that accompanies urban and suburban development. Specifically, the increased quantity of water delivered to the stream system and the increased speed at which this water is delivered lead to large spikes in stream flow, even during common rain events. This increased flow scours the stream bed and erodes stream banks, both of which result in increased sediment loads and poor habitat conditions for fish and benthic macroinvertebrates, as well as increased flood frequency. Increased loading of nonpoint source pollutants such as nitrogen and phosphorus that are carried in the storm water runoff or in the sediment from the eroded bank material further contributes to the ecological degradation of this urban/suburban stream system.

Despite these impairments, relatively little new development is expected in the watershed. Any new development that does occur will have substantially less impact on the watershed, since the watershed communities have adopted ordinances controlling Riparian and Wetland Setbacks, Construction Site Sediment and Erosion Control and Post-Construction Water Quality as part of their NPDES Phase II storm water programs, effectively limiting the negative impacts any new development that is occurring.

The project site is located entirely on public property owned by the City of Berea, and bordered by the Cleveland Metroparks Mill Stream Run Reservation. Upstream of Dam #3, the city property is adjacent to residential properties to the south of Baldwin Creek.

A parcel map of the project area is attached as Appendix C.

IV. Identification of Key Issues Related to Support of Aquatic Life Uses

Baldwin Creek currently does not meet the Ohio EPA's standards for aquatic life. Fish populations appear to be more impacted than the macroinvertebrates.

A. QHEI

Ohio EPA has assessed the lower 8.0 miles of Baldwin Creek. None of these miles are attaining designated aquatic uses. The mean QHEI score is 52.75 but individual scores are highly variable ranging from 32.0 to 67.0. This score indicates that the stream is marginally suited to supporting normal Warm Water stream communities. The QHEI in the project reach ranges from 47 to 57.5, with a mean of 51.5.

The course of Baldwin Creek in the project reach has been moved, and the channel modified, various times over the past 175 years. It was first moved to accommodate sandstone quarry and railroad development in the mid-1800's. Once the quarry was closed, flow was re-directed into the quarry, creating Coe Lake. Finally, in the second half of the 20th century, flow was once more directed around Coe Lake, in order to prevent contamination of Berea's secondary drinking water source (Coe Lake). Various small dams were constructed throughout Berea during this time, on the East Branch Rocky River as well as Baldwin Creek, largely to serve gristmills. The three dams on Baldwin Creek being addressed through this project, however, appear to have been used primarily for grade control.

B. Origins of Impairments

The primary causes of impairment in the Baldwin Creek watershed are organic enrichment, nutrient enrichment, flow alteration and habitat degradation. The origins of the impairments include older infrastructure from historical development. Hydrological alteration associated with land development and the development and subsequent decommissioning of sandstone quarries, urban runoff, failing septic systems and underperforming wastewater treatment plants, and the loss of wetlands and floodplain function have been the primary contributors to the impairment of biological communities in the Baldwin Creek Watershed.

C. History of Water Quality Improvements

Baldwin Creek water quality continues to evolve over time as land use changes and practices occur. Wastewater treatment plants have been upgraded pr eliminated, eliminating many of the point source pollution issues. Sewer lines have been extended to various areas with failing septic systems. Finally, the watershed communities have adopted ordinances controlling Riparian and Wetland Setbacks, Construction Site Sediment and Erosion Control and Post-Construction Water Quality as part of their NPDES Phase II storm water programs.

D. Current Watershed Efforts

Since the full endorsement of the Rocky River Watershed Action Plan in 2006 by OEPA and ODNR, the Rocky River Watershed Program has been working to implement various aspects of the plan.

A recently completed storm water retrofit opportunities inventory study identified and prioritized properties with the potential for successful storm water retrofit projects. This will facilitate enhanced storm water treatment in the developed areas of the watershed, as indicated on page G-17 of the Rocky River Watershed Action Plan.

Funding is currently being sought for the Baldwin Creek Sediment Reduction Project through the Ohio EPA 319 grant program. If funded, the project will provide cost-share funding to riparian property owners for streambank stabilization activities, reducing sediment loading in Baldwin Creek by 115 tons/year, also as indicated on page G-17 of the Rocky River Watershed Action Plan.

As previously mentioned, most areas of the watershed that can be developed, already have been, and any new development, including redevelopment, will be required to meet minimum standards for storm water treatment, and riparian and wetland protection.

Furthermore, Cuyahoga Soil & Water Conservation District and the watershed communities of Berea, Middleburg Heights, Parma and North Royalton are targeting education and outreach messages to residents regarding residential practices such as rain gardens and rain barrels.

E. Problem/Issue Statement

With a median Index of Biotic Integrity (IBI) score of 24, Ohio EPA considers Baldwin Creek to be in impairment of its Warm Water Habitat Designated Aquatic Life Use. Urban development, historic stream alterations, including channel straightening, and a series of dams and dam remnants along the creek's lower course, effectively limit fish passage while negatively impacting channel morphology and impairing aquatic habitat. Sampling completed by Cleveland Metroparks in 2009 indicates the fish community is "marginally good" (IBI = 36) below Dam #3 but "poor" (IBI = 20) above the dam. The dam effectively isolates populations of the state threatened Bigmouth Shiner (*Notropis dorsalis*) upstream of the dam sequence and downstream in the East Branch of the Rocky River. Additional species encountered below the dam but absent above include: Northern Hog Sucker, Blacknose Dace, Striped Shiner, Yellow Bullhead, Largemouth Bass, Pumpkinseed Sunfish and Greenside Darter.

V. Restoration Objective

The goal of the Baldwin Creek Dam Removal and Restoration project is to restore the lower 0.9 miles of Baldwin Creek to meet Warm Water Habitat Biocriteria by removing three barriers to fish passage, enhancing in-stream habitat to a minimum QHEI of 65 through the installation of in-stream structures, and reducing sediment loading by stabilizing the channel at and upstream of dam removal sites.

VI. Alternatives to Achieve Restoration Objective

a. No Action: Maintains status quo, resulting in continued impaired condition of Baldwin Creek relative to Warm Water habitat Biocriteria. This alternative is not included in the WAP.
   Estimated Cost: $0
b. Remove Dams Only: Dam removal without the installation of in-stream habitat/channel stability structures could be done, but would conceivably threaten the stability of the project reach, especially upstream of S. Rocky River Dr./Dam #3. Also, removing the dams without improving the habitat would restore fish passage, but would not necessarily improve utilization of the project reach by the fish community. Uncertain if fish community (IBI) scores will meet minimum Warm Water Habitat Biocriteria. This alternative is included in the WAP (which further recommends habitat enhancements and channel stabilization).
   Estimated Cost: $180,000
c. Remove Dams and Install Habitat/Stabilization Structures: Results in highest degree of restoration of Baldwin Creek. Provides for fish passage, channel stabilization and enhanced aquatic habitat. Anticipated to restore 0.9 miles of Baldwin Creek to Full Attainment of Warm Water Habitat Biocriteria. This alternative is included in the WAP (page G-17). Estimated Cost: $484,200

VII. Selected Alternative and Basis for Selection

The Remove Dams and Install Habitat/Stabilization Structures alternative appears to be the most logical approach to achieving the objectives set for this restoration project, as it has the highest likelihood of achieving the objectives of the project, while providing necessary channel stabilization, especially upstream of Dam #3/S. Rocky River Dr.

Despite its lower cost, the Remove Dams Only alternative does not provide for adequate aquatic habitat enhancement or channel stabilization, especially upstream of Dam #3/S. Rocky River Dr.

The No Action alternative will preclude the restoration of Baldwin Creek to Warm Water Habitat biocriteria.

The selected alternative is included on page G-17 of the Rocky River Watershed Action Plan.

A concept plan for the selected alternative is included as Appendix D.

VIII. Implementation Plan for Selected Alternative

Responsible Parties

The design and engineering of the project will be funded through an Ohio EPA Surface Water Improvement Fund (SWIF) grant awarded to Cuyahoga Soil & Water Conservation District (SWCD) in October 2010. The SWIF grant will also cover some of

the implementation aspects of the project. The design and engineering, including selection of the design and engineering consultant, will be coordinated by Cuyahoga SWCD, in collaboration with the City of Berea (property owner), Northeast Ohio Regional Sewer District (NEORSD, the sponsor) and Cleveland Metroparks (property owner). NEORSD, the sponsor, will manage and oversee project construction, including contractor selection, with input from Cuyahoga SWCD, the City of Berea and Cleveland Metroparks. NEORSD has overseen similar channel restoration projects, also funded through WRRSP, on West Creek and Euclid Creek. The construction work will be advertised under a competitive bid process. Construction services will be procured with the goal of securing a contractor with natural channel construction experience. Design and engineering plans for the restoration work will be submitted to Ohio EPA for review.

The City of Berea and Cleveland Metroparks (the property owners) will be responsible for perpetual post-project management of the restoration site. Cleveland Metroparks owns and manages more than 20,000 acres of parkland, including environmental restoration projects and capital improvement projects. The City of Berea also manages and maintains capital improvement projects through its service and engineering departments.

Agreements

Multiple agreements will be enacted between the project partners in order to ensure the successful completion of the project. These include the Sponsorship Agreement between Cuyahoga SWCD and NEORSD, and Environmental Covenants between Ohio EPA and the City of Berea, and between Ohio EPA and Cleveland Metroparks. An access agreement, if needed, may be negotiated between Cleveland Metroparks and Cuyahoga SWCD and/or NEORSD in order to access the project sites through Cleveland Metroparks property in its Mill Stream Run Reservation.

Project Tasks

1. Pre-project Monitoring: The site will be evaluated to determine the pre-project ecological condition of the site. Metrics to be evaluated include QHEI, IBI and ICI.
2. Community Outreach/Education:
    a. A fact sheet describing the project will be posted on the Cuyahoga SWCD, City of Berea and Rocky River Watershed Council web sites.
    b. Regular project updates will be included in the Cuyahoga SWCD and Rocky River Watershed Council newsletters.
    c. Three community meetings will be held to inform the public of project activities and to address any questions or concerns. These meetings will target the residents in the neighborhood adjacent to the project site. One will be held before design begins, another will be held as the design is being finalized, and one will be held upon project completion.

    d. Two tours of the site will be held. The first will be conducted after the design is complete, but prior to any construction activities. The second tour will occur after construction has been completed.
    e. Press releases will be issued to the local media as project milestones are reached.
3. Finalize Agreements
    a. Sponsorship Agreement
    b. Environmental Covenant(s)
    c. Access Agreement
4. Contract Design & Engineering Consultant:
    a. Publish RFP
    b. Review proposals and select consultant
    c. Finalize contract
5. Project Design and Engineering
    a. Hydraulic/hydrologic analysis
    b. Sediment analysis
    c. Storm Water Pollution Prevention Plan (SWPPP) development
    d. Dam demolition plan/sequence
    e. Design of channel stabilization measures
    f. Design of habitat enhancement measures
    g. Construction access/staging plan
6. Permitting – to include Nationwide/401/404 permits, as necessary. Also, a recommendation of approval from the City of Berea and Cuyahoga SWCD will be required for the SWPPP.
7. Site preparation/staging,
    a. preparation of access routes and staging areas
    b. establish pump-around
    c. install erosion and sediment control practices
8. In-stream restoration
    a. Dam deconstruction and removal
    b. Installation of habitat structures
    c. Installation of channel stabilization practices
9. Site Clean-up
    a. Permanent stabilization of disturbed soils (at access/staging areas, etc.)
    b. Tree planting/vegetation re-establishment
    c. Material Disposal
10. Post-project Monitoring: The site will be evaluated to determine the post-project ecological condition of the site. Metrics to be evaluated include QHEI, IBI and ICI.

Detailed Budget

A. Implementer/Personnel

1. Salaries/Wages **$4136.00**
   Cuyahoga SWCD staff time for project management and education/outreach. 200 hours @ $20.68/hr.

2. Benefits **$1902.56**
   Associated with Cuyahoga SWCD staff time for project management and education/outreach. 46% of staff time ($4136.00 x .46).

B. Implementer/Non-Personnel

1. Materials $0.00

2. Equipment $0.00

3. Administrative/Legal Fees **$2000.00**
   Title search for City of Berea property.

4. Property Acquisition $0.00

C. Implementer Contracted Services

1. Consultants **$33,192.00**
   For design and engineering, permitting, hydraulic/hydrologic analysis, sediment analysis (upstream of dams, especially Dam #3) and Storm Water Pollution Prevention Plan development. $58,808 of the estimated $92,000 cost is being provided through the Ohio EPA Surface Water Improvement Fund (SWIF).

2. Restoration Work (Construction) **$301,235.00**
   Total construction cost is $397,635. The Ohio EPA SWIF grant is covering $87,400 of the total, leaving the proposed WRRSP amount for this budget category at $301,235. These costs are based upon the project concept plan (see Appendix D). These are estimates and are dependent upon the results of the final design.

Pre/Post Site Preparation	
Temporary Access Roads	$15,000
Landscaping/Cleanup	$10,000
Sediment and Erosion Control	$15,000
Critical Area Plantings	$3,400
Mobilization/Deliveries	$20,000
Dam #1 (Confluence with East Branch Rocky River)	
Dam Removal	$8,000
Rock Cross Vane (Construction)	$5,000
Rock Cross Vane (Materials)	$1,000
Riffle (Construction)	$1,000

Riffle (Materials)	$1,000
Rootwad (Construction)	$500
Dam #2 (Berea WTP Access Road)	
Dam Removal	$8,000
Rock Cross Vane (Construction)	$5,000
Rock Cross Vane (Materials)	$1,000
Riffle (Construction)	$1,000
Riffle (Materials)	$1,000
Rootwad (Construction)	$500
Dam #3 (South Rocky River Dr.)	
Dam Removal	$20,000
Rock Cross Vane (4)	$20,000
Rock Cross Vanes (Materials)	$4,000
Riffle Structure (5)	$15,000
Riffle Materials	$10,000
Rock Vanes (5 for bankfull bench)	$15,000
Rock Vane Materials (for bankful bench vanes)	$5,000
Bankfull Bench (1000' long x 4' wide)	$75,000
Bankfull Bench (materials)	$87,500
Live Stakes (Bankfull Bench)	$2,000
Contingency (15%)	$48,735

3.	Other	$.0.00
4.	Project Total	$488,573.56
5.	**WRRSP Total:**	**$342,465.56**

<u>Implementation Schedule</u>

Pre-project monitoring: May 2009, May 2011

Community Outreach/Education:

Fact sheet posted on Web Sites – November 2010
Project updates in newsletters – quarterly, beginning November 2010
Community meetings – January 2011, September 2011, June 2012
Tours – September 2011, June 2012
Press Releases – TBD (at project milestones)

Finalize Agreements:

Sponsorship Agreement – November 2010
Environmental Covenant – January 2011
Access Agreement – January 2011

Contract Design and Engineering Consultant (funded through OEPA SWIF):

Publish RFP – February 2011
Review Proposals & Select Consultant – March 2011

Finalize Contract – March 2011

Project design & Engineering, including the following: Complete by August 2011

Hydraulic/hydrologic analysis
Sediment analysis
Storm Water Pollution Prevention Plan (SWPPP) development
Dam demolition plan/sequence
Design of channel stabilization measures
Design of habitat enhancement measures
Construction access/staging plan

Permitting – Complete by October 2011

Site Prep/Staging – November 2011

In-stream Restoration – November-December 2011

Site Cleanup:

Material Disposal – December 2011
Permanent stabilization of disturbed soils – December 2011
Tree planting/vegetation re-establishment – December 2011-March 2012

Post-project Monitoring: May 2012, May 2013

Perpetual Property Management

The City of Berea will be responsible for maintaining the dam removal sites and any structures or practices that are installed on city property for habitat improvement or channel stability as part of the project. Cleveland Metroparks will maintain any structures or practices installed on its property. Any additional maintenance recommendations that may be developed as part of the final design work will also be incorporated.

Cuyahoga SWCD and the city will inspect the project site annually against the as-built specifications and the photo-documentation of the completed project to insure that structures and practices are intact and in place. Cuyahoga SWCD and Cleveland Metroparks will do likewise with any portion of the project site on Metroparks property.

QHEI results from the monitoring program will also be used to evaluate the status of habitat quality at the project site.

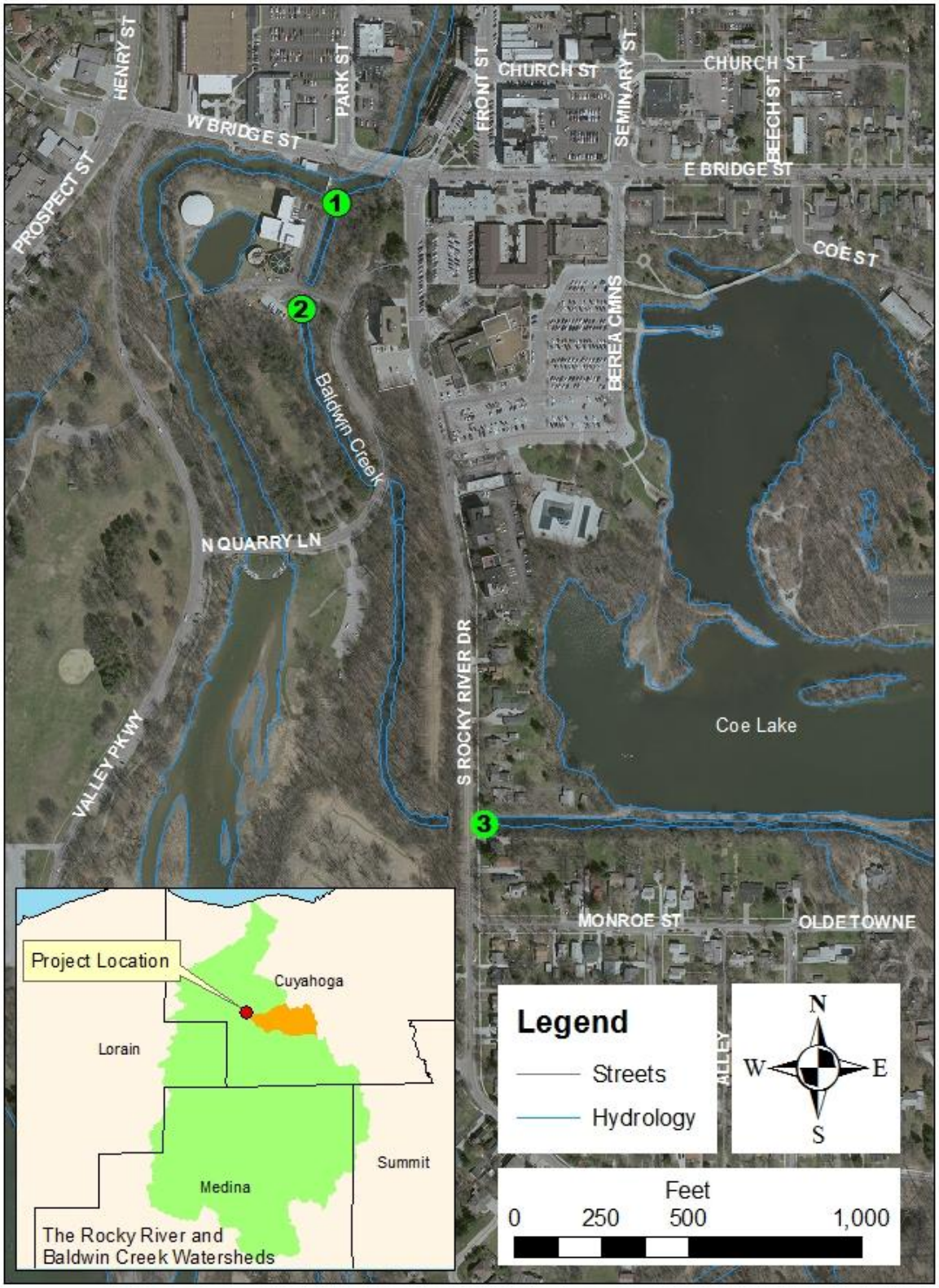
Cleveland Metroparks owns and manages more than 20,000 acres of parkland, including environmental restoration projects and capital improvement projects. The City of Berea also manages and maintains capital improvement projects through its service and engineering departments.

Monitoring Plan

The project reach will be monitored annually, for no less than five years following completion of the project, by Cleveland Metroparks Natural Resources staff, in collaboration with Cuyahoga SWCD. At a minimum, QHEI and IBI (Fish) will be monitored. A project study plan detailing the monitoring program will be developed prior to construction of the project and developed as a result of the approved restoration design and engineering drawings, and submitted to the state for approval through the Ohio EPA Credible Data Program. The data generated through the monitoring will be used to determine if QHEI targets are met, and to determine warm Water Habitat attainment status in the project reach.

Appendix A – Project Location Maps

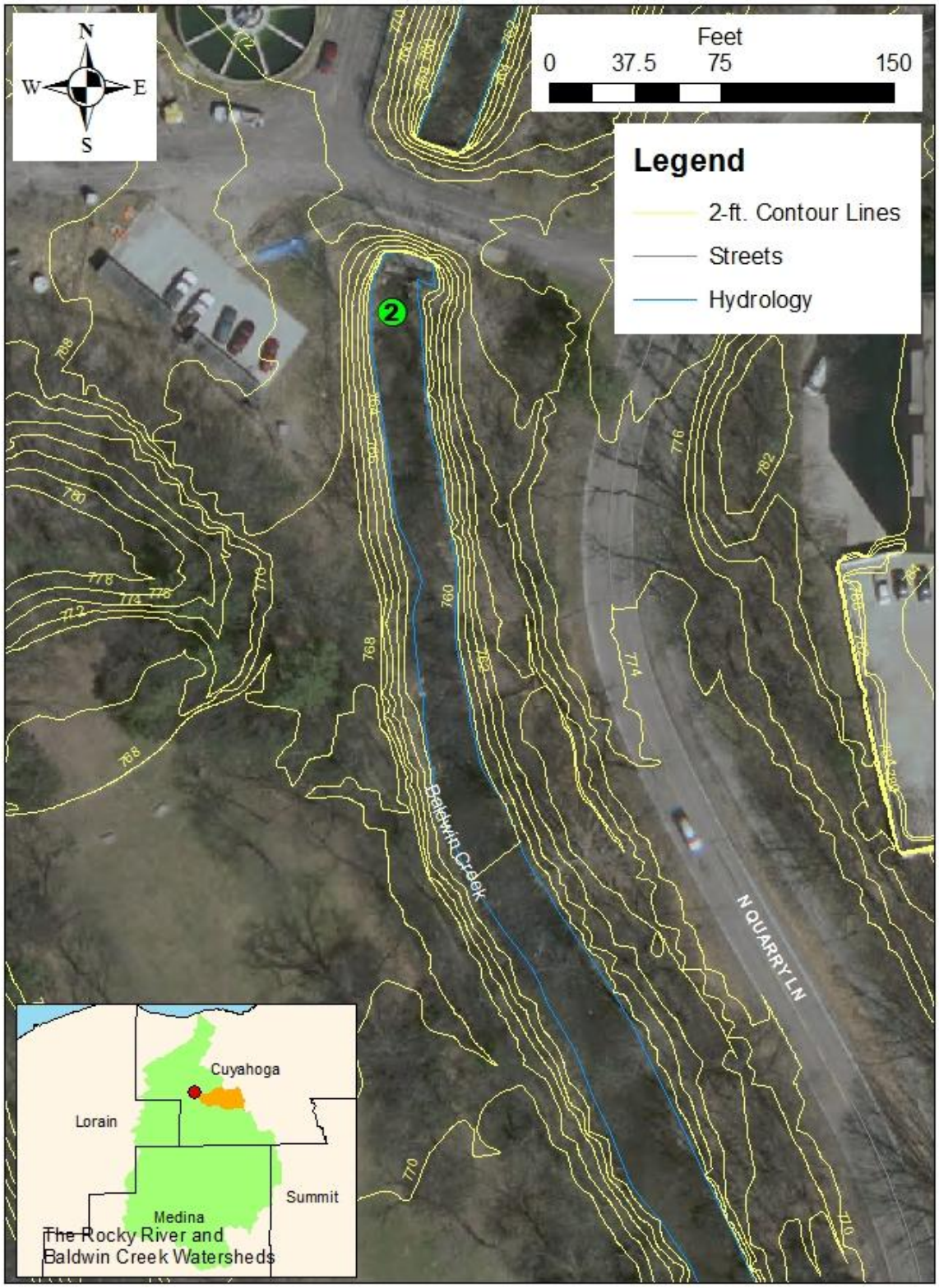
Baldwin Creek Dam Removal Project Locations



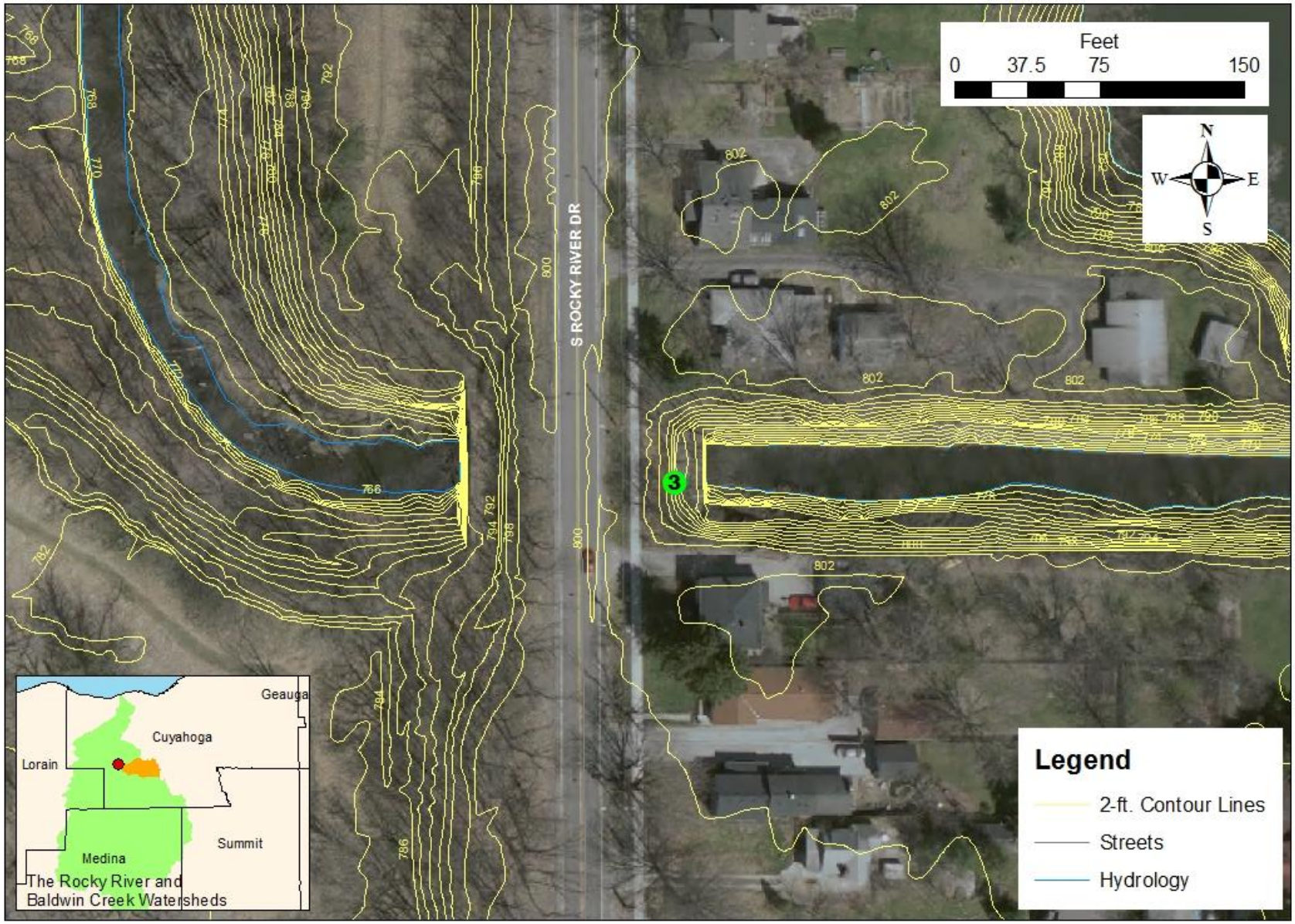
Appendix B – Topographical Maps

Baldwin Creek Dam #1 Topography

Baldwin Creek Dam #2 Topography

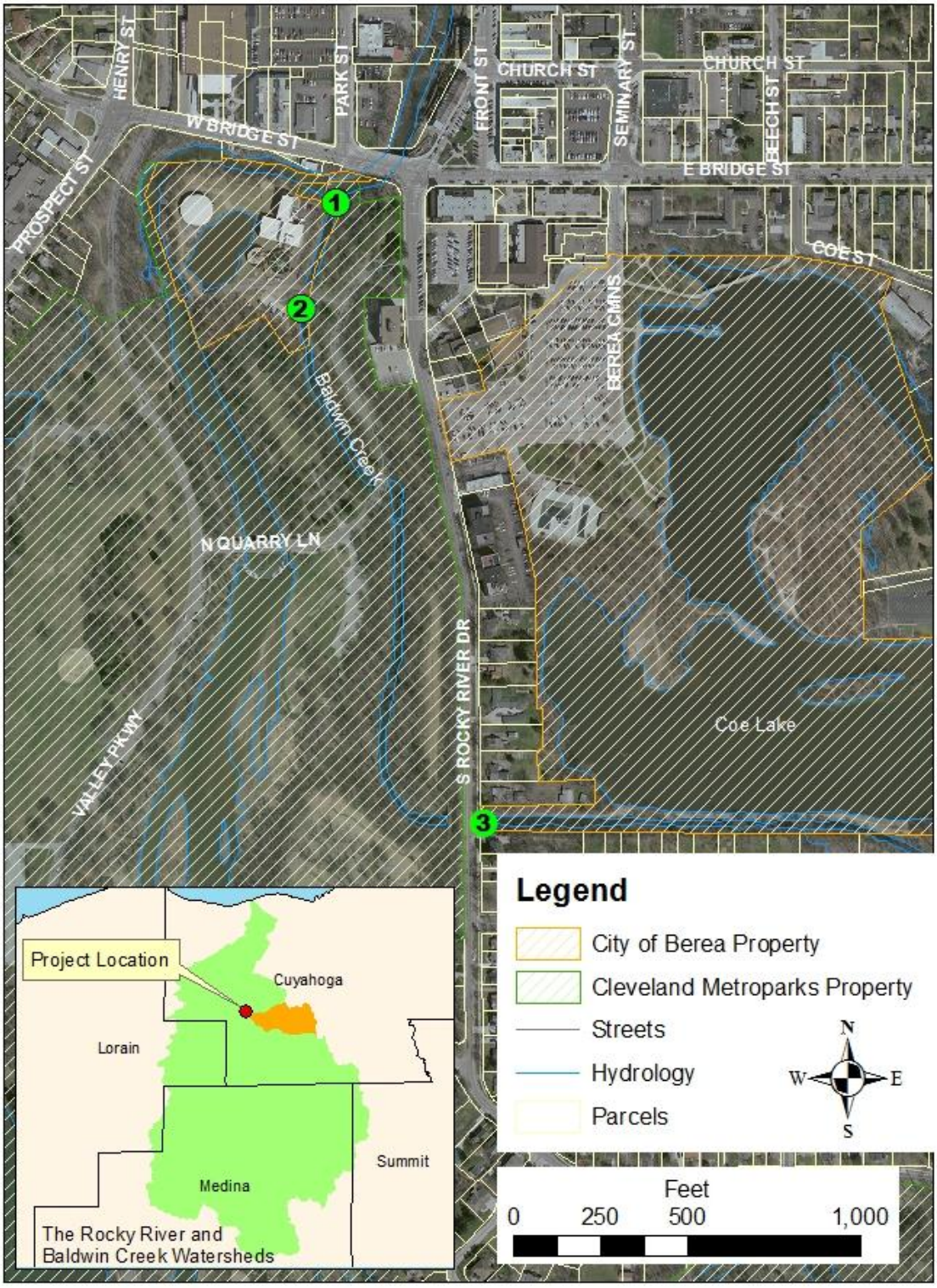


Baldwin Creek Dam #3 Topography



Appendix C – Parcel Map

Baldwin Creek Dam Removal Project Parcels

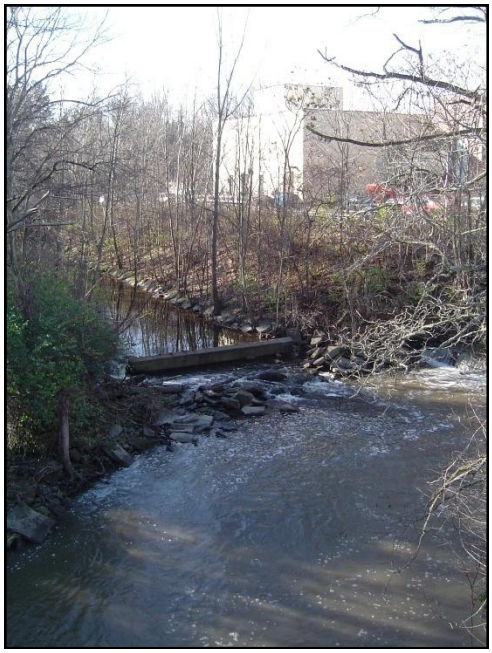


Appendix D – Preliminary Concept Plan for the Selected Alternative

Conceptual recommendations are the product of a site visit made by Fluvial Geomorphologist Vince Sortman of Biohabitats, Inc. on September 18, 2008, and were developed to enhance aquatic habitat and improve QHEI scores rather than restore the creek to a different geomorphic condition. Recommendations are preliminary and should be used for planning purposes only.

DAM #1 – Confluence with East Branch Rocky River

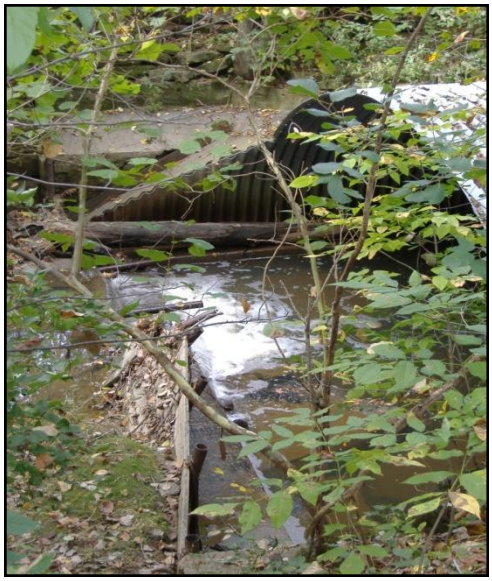
Concrete dam about four feet high is currently breached on right bank. This reach of Baldwin Creek is straight and lined with concrete slabs along toe (both sides). Banks are well vegetated with trees and shrubs; however, there is no floodplain. The channel is stable but lacks bed diversity (well defined riffle/pool sequences). Removing the dam will improve fish migration but most likely will not improve bed diversity due to the straight, trapezoidal channel. After removal of the dam, we recommend installation of a rock cross vane approximately at the mid-point of the reach or slightly downstream. The cross vane should be installed at least one foot higher than the existing bed elevation. The throat of the cross vane should be constructed to form small drops to allow fish passage. A riffle can then be constructed upstream with the rock cross vane as the base. The rock cross vane will naturally form a pool downstream of the structure. Installing the cross vane high will form a pool upstream of the structure (in this case, upstream of the riffle). Woody material such as rootwads could be installed in the pools to increase aquatic habitat. There will probably be some tree removal for equipment access so there should be rootwad material readily available.



Baldwin Creek Dam #1 at the confluence with the East Branch of the Rocky River

DAM #2 – Berea WTP Access Road

Concrete dam is only about one foot high with remnants of the wooden flash boards. This reach of channel is also very straight and trapezoidal with no floodplain, although it looks more natural farther upstream of the dam. The channel banks are well vegetated with trees and shrubs. The channel is stable but lacks bed diversity in the vicinity of the dam. There is a deep pool on the downstream side of the dam at the inlet of the arch culvert. Similar to dam #1 we recommend removing the dam and installing



Dam #2 immediately upstream of Berea WTP access road.

a rock cross vane at the inlet of the arch culvert. Installing a rock cross vane at this location will protect the arch culvert from bank erosion, maintain the existing pool, and move sediments through the culvert. Again, installing the cross vane high will allow a riffle to be constructed upstream of the cross vane and also form a pool upstream of the riffle. The cross vane should be costructed to allow fish passage. As at Dam #1 trees will need to be removed for construction access which could be used for rootwads.

Clockwise from upper left: Looking upstream of Dam #3, Full View of South Rocky River Drive Bridge, Close-up of Dam #3.

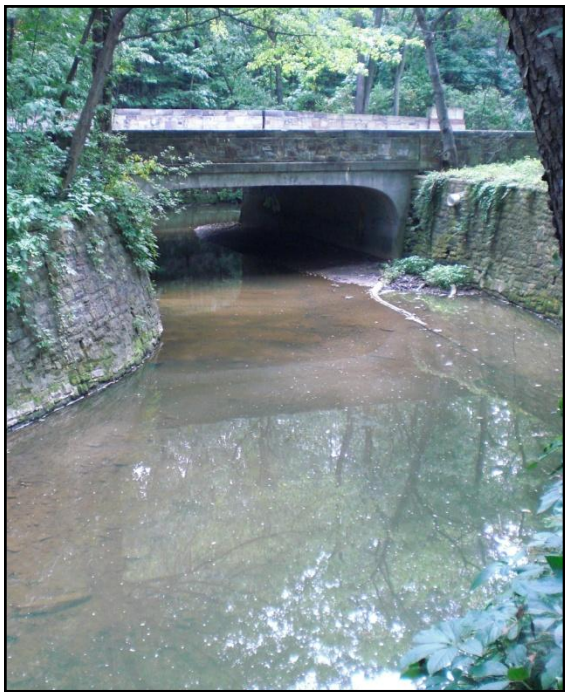
DAM #3 – South Rocky River Drive

Concrete dam is about four feet high and located at the inlet to the culvert under South Rocky River Drive. The dam forms a long pool in a straight, deep, low-gradient channel. The banks of the channel are composed of fine-layered shale and are about 15 feet high. Some shrubs and ground cover are growing on the left bank but there is nothing growing on the right bank. Trees are growing at the top of both banks. This dam is definitely a fish barrier and it also creates maintenance problems for the City. The dam should be removed and replaced with a series of rock step/pools or rock cross vanes to maintain the current water surface elevation but allow fish passage. Maintaining the current water surface elevation will maintain the low gradient and low velocities in this highly entrenched reach. Riffle structures similar to Newbury weirs should be installed throughout the pool to create riffles. A narrow bankfull bench should be installed along the right bank. This bench can be formed by installing rock vanes along the right bank

and building up the bench between the vanes using riprap at the base and sandy loam on top. Live stakes would be installed in the bench to establish woody vegetation.

Habitat Improvement through Stone Retaining Wall Section

This reach is very wide and shallow. We recommend installing a grade control structure, such as a step/pool or cross vane at the downstream end of the reach to raise the water surface and thus deepen the pool. This structure should only be about one foot higher than the existing channel bed and allow for fish passage. Low rock vanes could also be installed along the inside of the turn to narrow the cross section and form a point bar.



The section of Baldwin Creek that flows through the retaining walls downstream of North Quarry Lane.