Application for Aquatic Resource Alteration Permit (ARAP) & State §401 Water Quality Permit Supporting Information

Nashville Zoo Dam/Weir Removals

Davidson County, Tennessee

Prepared by:

KCI TECHNOLOGIES

On behalf of:

CUMBERLAND RIVER COMPACT

October 2015

Table of Contents

Attachments

1.0 PROJECT GOALS AND OBJECTIVES

The primary goals of this project include:

- Improve/restore stream habitat by reconnecting up and downstream portions of the project stream;
- Remove an impediment to natural flow patterns;
- Create/improve habitat for the target species, Nashville Crayfish (*Orconectes shoupi*), listed as endangered since 1986.

These goals can be accomplished by:

- Removing the two existing concrete dam/weir structures;
- Replanting the buffer impacted from construction with native trees and a native seed mix.

2.0 EXISTING CONDITIONS

2.1 Site Description

The project site is located in Nashville, on the property of the Nashville Zoo at Grassmere. The project stream is referred to as Cathy Jo Branch and is a first-order, perennial stream. The stream is a bedrock dominated channel with some areas of cobble and gravel riffles, although the streambed in the project area is dominated by silt deposition. The project reach has a wide wooded buffer along the right bank. The left bank has a variable width buffer. The road exiting the zoo is close to the stream in certain locations and limits the left buffer width. The buffer is composed of a mix of hardwood canopy species, with the understory dominated by Chinese privet (*Ligustrum sinense*) and bush honeysuckle (*Lonicera sp*). The planform is variably sinuous between the two structures. Overall the banks within this reach are stable and low, with minimal incision, and vegetative cover throughout.

The structures to be removed were built in 1989 to create ponded conditions for site aesthetics. The first structure is a concrete dam that is 8" thick, 4'-5' tall, and approximately 40' wide. It has a low spillway and within this spillway a v-notch weir for low flows. This structure formerly tied into an earthen berm and was built to contain a pond. A breach between the dam and the berm occurred during historic flooding in May 2010 and the pond has since drained. Currently the stream still flows around this breach. The fine sediment that had accumulated in the pond has developed into a wetland with a stable, small stream flowing through it. At the breached point, the bottom portion of the berm is eroded and the stream pipes through rock before coming out on bedrock approximately 20' downstream of the breach.

The second dam/weir is located approximately 380 linear feet downstream of the first structure. This structure is also an 8" thick concrete dam/weir, approximately 3' tall, and 30' wide. This structure formerly contained a linear impoundment. In this location, the left bank of the stream is contiguous with the road fill that slopes up to the zoo exit road. The stream has not breached the structure, but it does flow around the dam and through the coarse rock that makes up the road fill, bypassing the structure. Upstream of the dam there is a small amount of water ponded, that varies depending on flow. Beneath the standing water is a variable amount of fine sediment on top of bedrock. This sediment is less than one foot deep at the dam and then decreases in depth farther upstream of the dam. The influence of this structure can be seen almost all the way upstream to the first dam. While there is not extensive backwater, most of the channel is composed of fine sediment that overlays bedrock, which is the former natural stream bed. These dams have significantly altered the habitat of this stream. The plan, as outlined

within this document, seeks to restore the channel to a more natural condition by removing the second weir and greatly improve stream functions by removing a portion of the first dam.

Photos of the structures are included in these permit materials.

On October 6, 2015 sediment samples were collected at four different locations on the project stream to test for pollutants at the site. The first site was upstream of the former pond and just downstream of a service road crossing. This area may still have been influenced by the former pond, since it was still silt dominated, but was in a section of freely flowing stream. The second location was within the streambed of the existing small stream that flows through the old pond bed. The third location was just upstream of the second structure in the backwater area. The fourth location was downstream of the second structure, just before the confluence with the tributary at Nolensville Pike. These four location IDs are "upstream", "pond", "weir", and "downstream," respectively. All of the samples were collected from approximately 6" below the surface of the sediment.

A particle size analysis was not conducted for these samples. Anecdotal observations about the sediment samples found that the upstream, pond and weir samples were similar. These consisted of fine silt and muck, while the downstream sample was significantly coarser, predominantly composed of sand and small gravel. Given the history of these structures trapping small sediment upstream of them, this is an expected observation.

When reviewing the testing data, it is important to note that the upstream and pond samples are just to evaluate what exists within the system, keeping in mind that this project will not disturb this sediment. The weir sample shows the condition of sediment that will remain in place during the project, but with Structure #2 removed, at some point this sediment may be moving downstream with storm events. The downstream sample is a comparison to show what is in the sediment now and is already freely moving through the system.

The laboratory analyses, which are included as an attachment to this document, tested for metals, gasoline range organics (GRO), and diesel range organics (DRO). These analyses were chosen because there is a history of a fuel spill upstream of the project within this watershed. The results indicate that for metals, all of the samples were below detectable limits or were within the background range expected for freshwater sediment according to the NOAA Screening Quick Reference Tables (SQuiRTs). The only value above the background level was recorded in the pond sample for arsenic. The value was still below the low-threshold values documented in the SQuiRTs. The results of the GRO and DRO analyses found that all of the samples were similar, either below detectable limits or at very low levels. These data indicate that these pollutants are not at levels that should cause alarm or prevent this project from proceeding as described here.

2.2 Wetlands

The proposed project was reviewed for the presence of wetlands and Waters of the United States. There is a wetland upstream of the first structure, but it has not been formally delineated. The project design will not impact this wetland. The only other Water of the United States is the stream channel itself.

2.3 Threatened and Endangered Species

A review of the TDEC Natural Heritage Program database (see attached letter) found that there have been observations of the federal and state listed endangered species, Nashville crayfish (*Orconectes*

shoupi) within one mile of the project site. For information about how this will affect the project, see the attached Biological Assessment.

Although not listed in the attached letter from Natural Heritage, the northern long eared bat (*Myotis septentrionalis*) is a federally threatened species whose habitat range covers Tennessee. Additionally, the Indiana bat (*Myotis sodalist*) is a federally endangered species whose habitat range also covers Tennessee. Both of these bats hibernate predominantly in caves during the winter months. Since construction at this site is planned for this time period and there are no caves in the work area, there is no risk of disturbing hibernating bats. The summer habitat for both of these bats is live trees and dead snags with crevices and shaggy bark. The construction at the site will not disturb any trees that could be used for summer roosting habitat for either bat species. Few of these trees exist within the work area and the construction will predominantly remove understory invasive trees and shrubs such as bush honeysuckle (*Lonicera spp.)* and Chinese privet (*Ligustrum sinense*). The only native species that will potentially be removed are box elder (*Acer negundo*) and sycamore (*Platanus occidentalis*). All efforts will be made to preserve these trees and if any have to be removed, they will be small trees with less than 8" diameter at breast height and not suitable for bat habitat.

2.4 Project Watershed

The project watershed at the second structure location is 0.42 mi^2 (268 ac) and can be seen in the attached watershed figure.

2.5 Surface Water Classification

Cathy Jo Branch has been listed on the State of Tennessee 303(d) list (2014) as impaired for nitrate and nitrite, total phosphorus, anthropogenic substrate alterations, and loss of biological integrity due to siltation.

2.6 Property Ownership

The project parcel (PIN 13300000400) is owned by the Metro Government of Nashville & Davidson County, TN (Metro).

2.7 Hydrologic Trespass/Floodplain Mapping

Since the stream is bypassing both of these structures, there is no flood storage upstream of the existing dams, so there is no risk for hydrologic trespass. The property is not in a mapped FEMA floodplain

3.0 Project Work Plan

3.1 Design Approach

The design sheets are attached as part of these permit materials. For Structure #1, the design approach involves first removing a portion of the dam (approximately 10') where an in-stream riffle feature will be installed to create a stable grade change from the existing wetland to the downstream stream bed. Currently this part of the channel already has a riprap bed, with the flows going mostly under the riprap. From the edge of the new channel, for approximately 14' towards the right bank, the dam will be cut down to the elevation of the upstream wetland. This elevation will connect the wetland to the rebuilt floodplain/bench of the stream downstream of the dam. A constructed riffle will be built in this part of the channel to connect the channel where the dam used to be. The berm will be graded back to a more stable slope. The toe of the berm will be stabilized with riprap and the graded portions of the berm will be stabilized with coir fiber matting and seed and straw.

Structure #2 will be completely removed from the channel. The riprap that has spilled into the channel downstream of the structure will also be removed from the channel. Once the structure is removed and water is allowed to flow back into the channel, we will be able to see if base flow is going to stay in the channel or pipe through the road fill on the left bank. If the flows are still piping through the left bank, this area of rock fill will be re-graded. This grading will involve removing the rock along the toe of the slope and placing filter fabric along the toe and then covering it with rock. This will minimize piping through the fill along the toe of the slope. A small amount of channel sediment may be removed when the concrete structure is removed from the channel, but the intent is to let the channel sediment distribute naturally through normal high flow events. It is expected that this will eventually lead to a natural bedrock bed in this section of channel.

While construction is being completed in both areas, the normal stream flow will be pumped around the work area. The portion of stream to be pumped around will be approximately 50' in each instance. There will be a small amount of clearing where equipment comes onto the site at Structure #1 and traverses down the right side of the channel to Structure #2. Tree removal will be kept to a minimum with most of the impacted vegetation being invasive shrubs.

3.2 Site Re-Vegetation

The areas disturbed by construction will be revegetated with native plants and a native seed mix. Any disturbed banks will be sloped and matted with live stakes installed on 3'-center spacing. Throughout the disturbed riparian buffer, native hardwood trees and shrubs will be installed at a minimum of 10'x10' spacing. These trees and shrubs will be container stock or equivalent and have an average height of 3.5'. All planting will take place during the dormant season.

3.3 Erosion and Sediment Control Measures

Temporary and permanent erosion and sediment controls will be implemented to control all disturbed sediment onsite. Any bank disturbed by construction will be stabilized with coir matting underlain by a permanent native seed mix and a temporary seed mix and straw. All temporary stockpiles of material will have silt fence installed along the low side of the pile until the stockpile is removed. The limits of disturbance for this project will 0.4 acre.

3.4 Expected Functional Lift Associated with the Project

The removal of these structures is expected to provide uplift to multiple stream functions for this reach. The functional lift anticipated for this project is listed below.

- Habitat Connectivity – Currently these structures are barriers to most aquatic species moving from downstream to upstream. Specifically, this will improve the potential habitat connectivity for the federally endangered Nashville crayfish (*Orconectes shoupi*). While few individuals have been found in the vicinity of the project, there are known populations downstream of the project and removing these structures would increase the ability of these populations to migrate throughout the stream corridor.
- Stream Habitat Diversity – The second structure has created an upstream silt dominated stream bed. The removal of this structure will return that channel to a more natural system, with diverse bed forms and a natural channel bottom.
- Sediment Transport – Much of the sediment that is coming from the upstream watershed is getting caught behind these structures. When they are removed, a natural sediment transport regime will redevelop in this reach, which will distribute fine sediments throughout the reach, creating more diversity in aquatic niche habitat.

4.0 Post-Project Monitoring

Following construction, the site will be monitored yearly and a monitoring report will be prepared and submitted to USACE and TDEC by December of each year. This monitoring is detailed in the Biological Assessment submitted with these permit materials.

5.0 Considerations for Nashville Crayfish

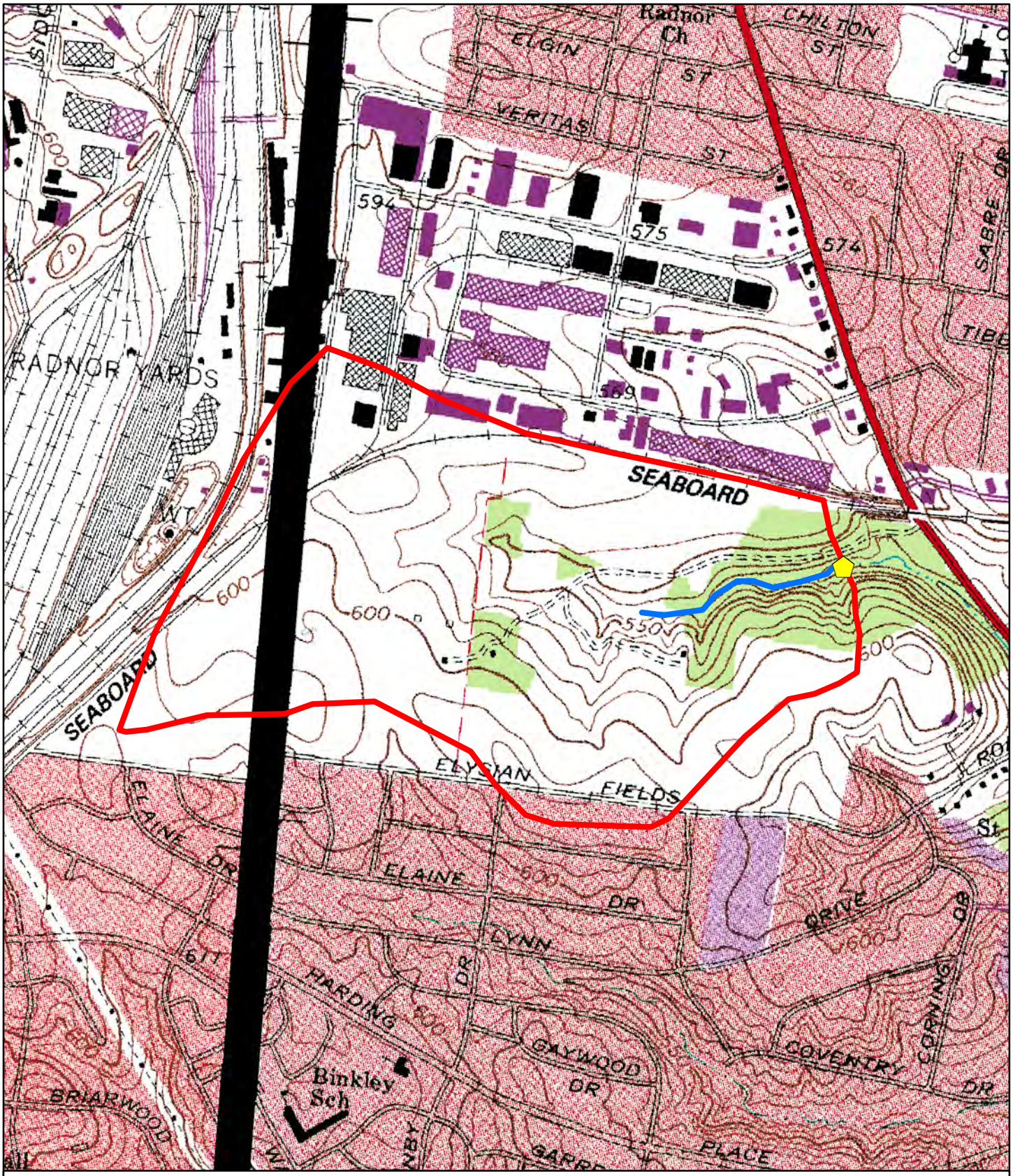
Multiple best practices will be observed during construction to protect the Nashville crayfish. These measures are detailed in the Biological Assessment submitted with these permit materials.

Photo 1. View looking at left side of pond dam where the stream has cut around the structure.

Photo 2. View looking upstream from pond dam to the former pond bed where there is an existing stable small stream and wetland.

Photo 3. View looking at second (downstream) weir/dam structure where it interfaces with the left bank.

Photo 4. Another view looking upstream at the second structure and the v-notch weir. Notice the standing water upstream of the structure and that the flow is not going through the weir opening. Instead it is flowing through the rock on the left bank, which is depicted in Photo 3.



Nashville Zoo Dam/Weir Removals - USGS Topographic Map

KCI

Project Dam

Project Stream

Project Watershed (0.42 sq. mi. / 268 acres)

N
W E
S

1,000 500 0 1,000

Feet

Source: USGS DRG, Antioch Quadrangle (1999).

STATE OF TENNESSEE

DEPARTMENT OF ENVIRONMENT AND CONSERVATION

Division of Natural Areas
Natural Heritage Program
William R. Snodgrass Tennessee Tower
312 Rosa L. Parks Avenue, 2nd Floor
Nashville, Tennessee 37243
Phone 615/532-0431 Fax 615/532-0046

October 2, 2015

Adam Spiller
KCI Technologies
7003 Chadwick Dr. Suite 343
Brentwood, TN 37027

Subject: Nashville Zoo Dam/Weir Removals
Location: 36° 5'23.62"N, 86°44'6.29"W
Davidson County, TN
Rare Species Database Review

Dear Mr. Spiller:

Thank you for your correspondence requesting a rare species database review for the removal of two small concrete dams/weirs. The stream is currently bypassing both structures. The upstream weir formerly impounded a small pond. The pond has since breached around the weir and the pond bottom has stabilized with vegetation, becoming a wetland, and a small stream has developed. The wetland will not be disturbed. A portion of the weir will be removed and a portion will be left in place. A stable, constructed riffle structure will be installed at the outlet of the wetland to reduce erosion at this location and connect stream habitat from the wetland to the stream below. The downstream weir will be removed and the left bank will be rebuilt to encourage flow to stay in the stream and reduce piping of flow through the road fill on the left side of the channel. The area impacted will be approximately 30' - 50' around each structure.

We have reviewed the state's natural heritage database with regard to the project boundaries, and we find that the following rare species have been observed previously within one mile of the project:

Type	Scientific Name	Common Name	Global Rank	St. Rank	Fed. Prot.	St. Prot.	Habitat
Invertebrate Animal	Orconectes shoupi	Nashville Crayfish	G1G2	S1S2	LE	E	1st-order & larger streams, generally with bedrock bottom, under slabrock; endemic to Mill Creek watershed; Davidson & William. cos.

Within four miles of the project the following additional rare species have been reported:

Type	Scientific Name	Common Name	Global Rank	St. Rank	Fed. Prot.	St. Prot.	Habitat
Vertebrate Animal	Ambystoma barbouri	Streamside Salamander	G4	S2	--	D	Seasonally ephemeral karst streams; middle Tennessee.
Vascular Plant	Astragalus tennesseensis	Tennessee Milk-vetch	G3	S3	--	S	Glades
Vertebrate Animal	Etheostoma luteovinctum	Redband Darter	G4	S4	--	D	Limestone streams; Nashville Basin & portions of Highland Rim.
Vascular Plant	Perideridia americana	Eastern Yampah	G4	S2	--	E	Cedar Barrens
Vascular Plant	Phemeranthus calcaricus	Limestone Fame-flower	G3	S3	--	S	Glades
Vascular Plant	Stellaria fontinalis	Water Stitchwort	G3	S3	--	S	Seeps And Limestone Creek Beds

Upon review of the project location, we do not anticipate any negative impact to rare, threatened, or endangered species within the project vicinity. Dam removal can be a highly effective river restoration tool to reverse negative impacts and restore rivers and streams. The removal of these two concrete dams/weirs on Cathy Jo Branch ultimately would benefit the aquatic species by improving flow, water quality, sediment release and transport, and connectivity of Sevenmile Creek.

Should suitable habitat exist on or immediately downstream of the site, we ask that project plans provide for the protection of these species. We ask that you coordinate this project with the TWRA (Rob Todd, rob.todd@tn.gov , 615-781-6577) to ensure that legal requirements for protection of state listed rare animals are addressed. Additionally, we ask that you contact the U.S. Fish and Wildlife Service Field Office, Cookeville, Tennessee (931-525-4970) for comments regarding federally listed species and removal of trees.

For stabilization of disturbed areas, the Tennessee Natural Heritage Program advocates the use of native trees, shrubs, and warm season grasses, where practicable. Care should be taken to prevent re-vegetation of disturbed areas with plants listed by the Tennessee Exotic Pest Plant Council as harmful exotic plants: http://www.tneppc.org/Please keep in mind that not all of Tennessee has been surveyed and that a lack of records for any particular area should not be construed to mean that rare species necessarily are absent. For information regarding species protection status and ranks, please visit http://www.tn.gov/environment/na/pdf/Status&Ranks.pdf.

Thank you for considering Tennessee's rare species throughout the planning of this project. Should you have any questions, please do not hesitate to contact Stephanie at (615) 532-4799 or stephanie.ann.williams@tn.gov .

Sincerely,

Stephanie Williams

Stephanie A. Williams
Natural Heritage Data Manager

STATE	KCI PROJECT NUMBER	SHEET NO.	TOTAL SHEETS
TN	16159514	1	6

REVISIONS		

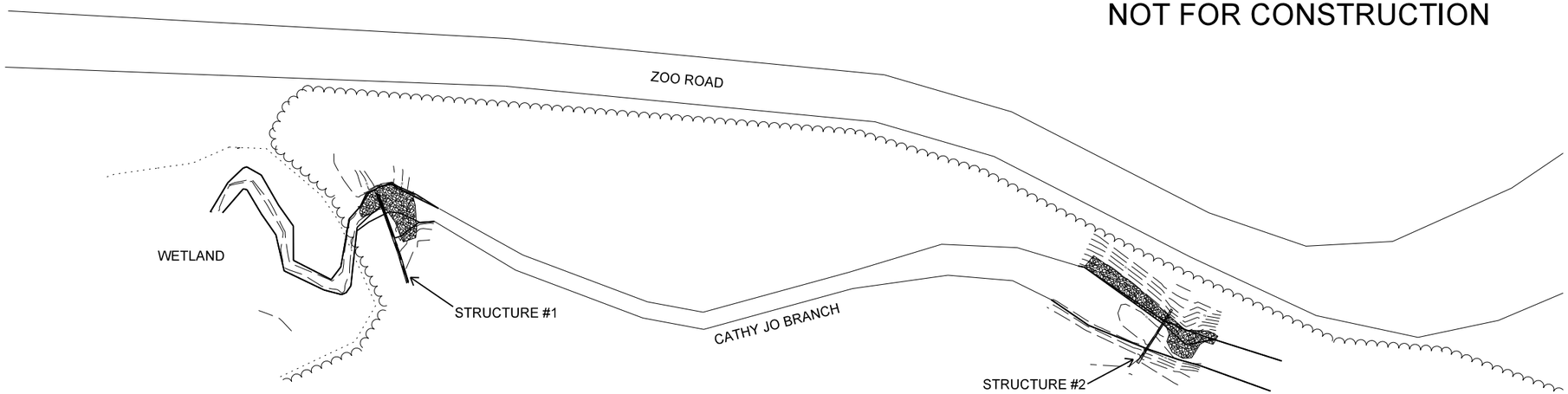
CUMBERLAND RIVER COMPACT

NASHVILLE ZOO DAM/WEIR REMOVALS PROJECT

NASHVILLE ZOO AT GRASSMERE
NASHVILLE, TENNESSEE

ISSUING AGENCY	*PERMIT #*
USACE NWP27:	
TDEC ARAP:	

PLANS FOR PERMIT APPLICATION
NOT FOR CONSTRUCTION



INDEX OF SHEETS

CALL TENESSEE 811 BEFORE EXCAVATION BEGINS TO LOCATE POTENTIAL UNDERGROUND UTILITIES

TN GRID MAG BS

NOT TO SCALE

DIRECTIONS TO SITE

From Downtown Nashville, take I-65 South. Take exit 80 for I-440 East. Merge onto I-440. Take exit 6 to merge onto US-41A South (Nolensville Pike). Proceed south on Nolensville Pike for 2.4 miles and then turn right onto Zoo Rd. at the entrance to the Nashville Zoo at Grassmere. The project site is located on the right side of the exit of the zoo, between the check-in station and Nolensville Pike.

PROJECT INFORMATION

Removal of two small concrete dams/weirs on Cathy Jo Branch on the Nashville Zoo at Grassmere property.

Prepared In the Office of:

KCI TECHNOLOGIES
7003 CHADWICK DRIVE, SUITE 343
BRENTWOOD, TN 37027

Prepared for:

MEKAYLE HOUGHTON
EXECUTIVE DIRECTOR
CUMBERLAND RIVER COMPACT

Prepared by:

GARY M. MRYNCZA, PE
PROJECT ENGINEER

ADAM SPILLER
PROJECT DESIGNER

PROJECT ENGINEER

GARY MICHAEL MRYNCZA
REGISTERED ENGINEER
AGRICULTURE
COMMERCE
No. 111554
STATE OF TENNESSEE

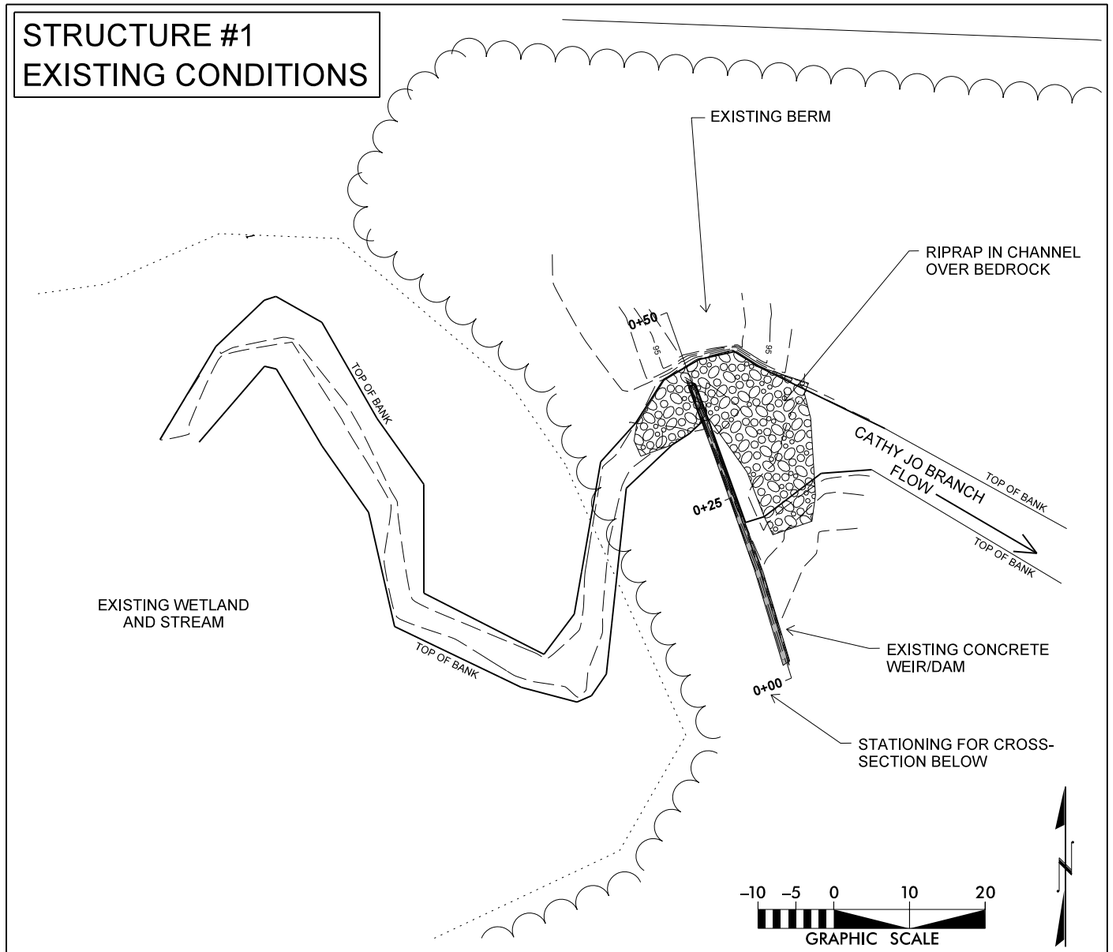
P.E.

SIGNATURE:

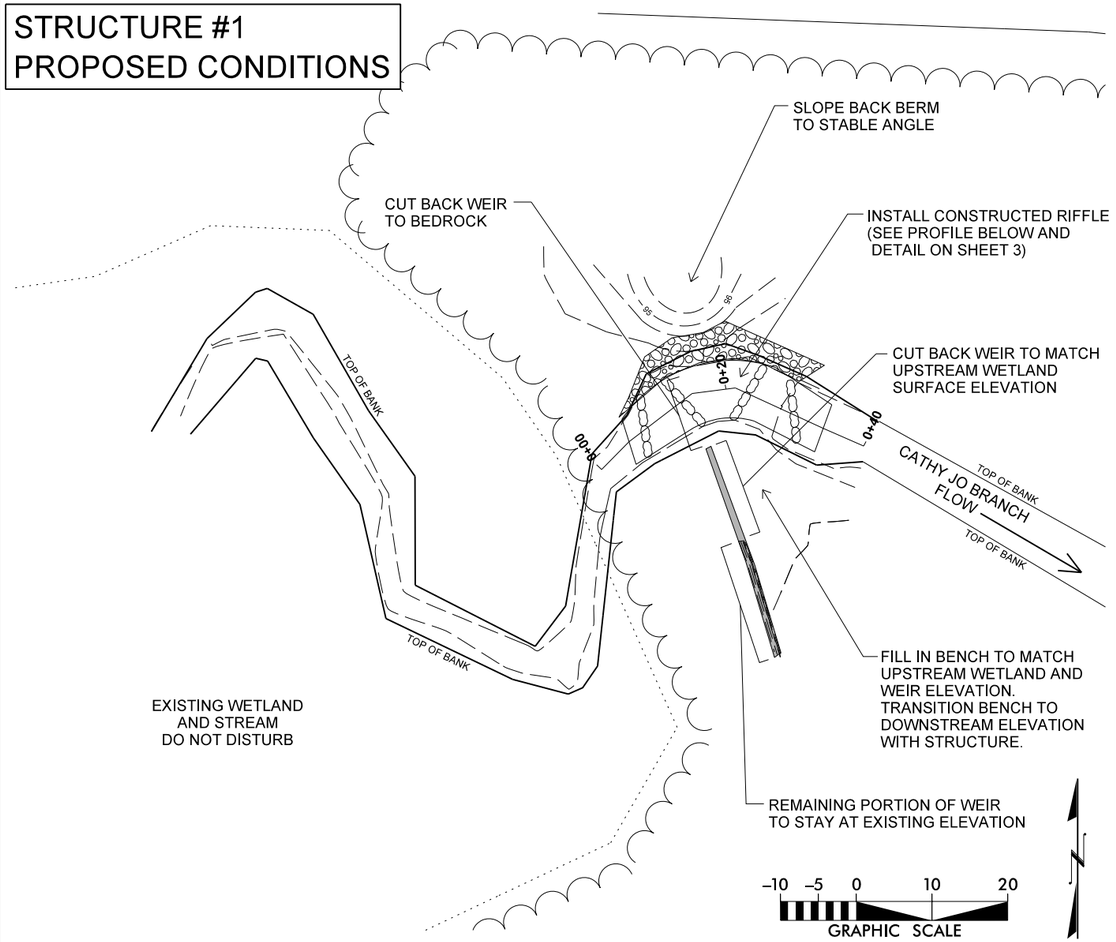
Prepared for:

CUMBERLAND RIVER COMPACT

STRUCTURE #1 EXISTING CONDITIONS

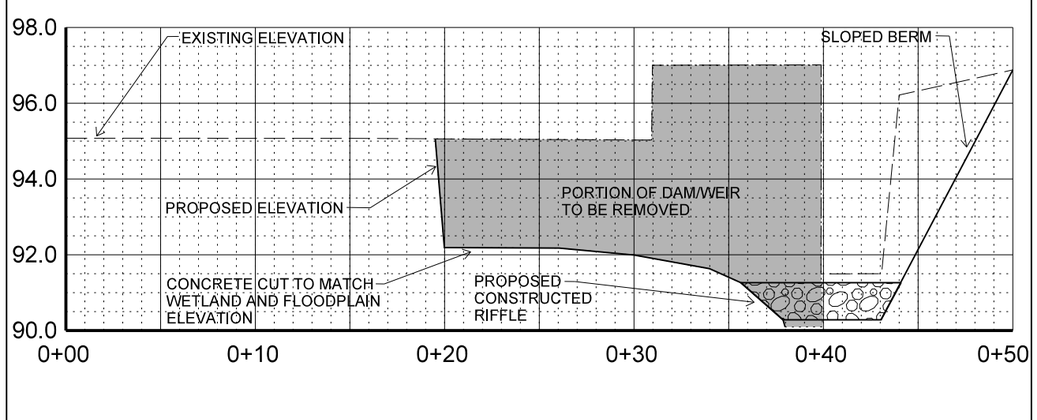


STRUCTURE #1 PROPOSED CONDITIONS



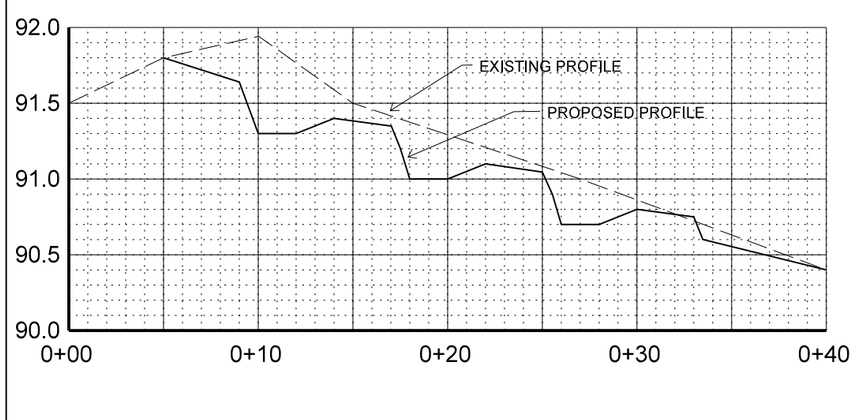
EXISTING/PROPOSED DAM/WEIR CROSS-SECTION

SEE EXISTING CONDITIONS ABOVE FOR CROSS-SECTION STATIONING



EXISTING/PROPOSED LONGITUDINAL PROFILE

SEE PROPOSED CONDITIONS ABOVE FOR PROFILE STATIONING



THE DATA SOURCE FOR THE TOPOGRAPIC MAPPING IS FROM A SURVEY CONDUCTED BY KCI TECHNOLOGIES IN SEPTEMBER 2015. ALL ELEVATIONS ARE ASSUMED.

GARY MICHAEL MRYNCZA
REGISTERED ENGINEER
AGRICULTURE
COMMERCE
No. 111554
STATE OF TENNESSEE

REVISIONS

SYM	DESCRIPTION	DATE	APPROVED

CUMBERLAND RIVER COMPACT

KCI TECHNOLOGIES
7003 CHADWICK DRIVE, SUITE 343
BRENTWOOD, TN 37027

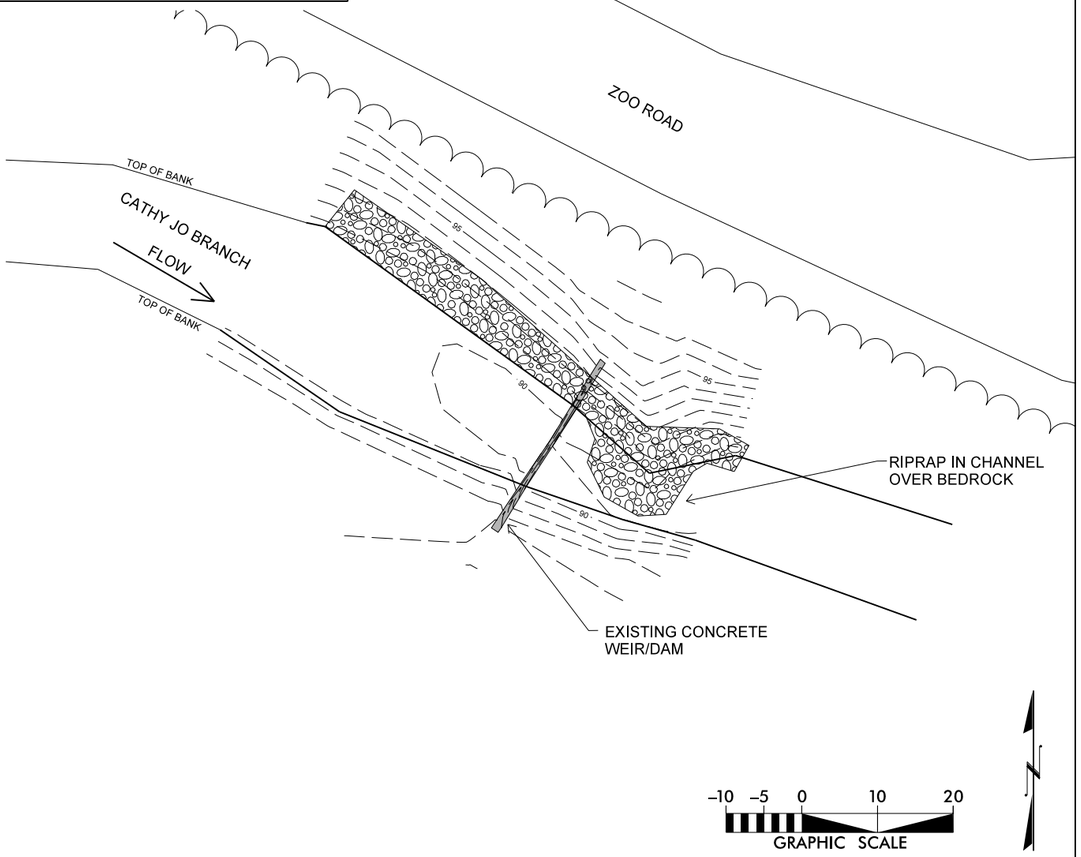
NASVILLE ZOO DAM/WEIR REMOVALS PROJECT

DAVIDSON COUNTY, TENNESSEE

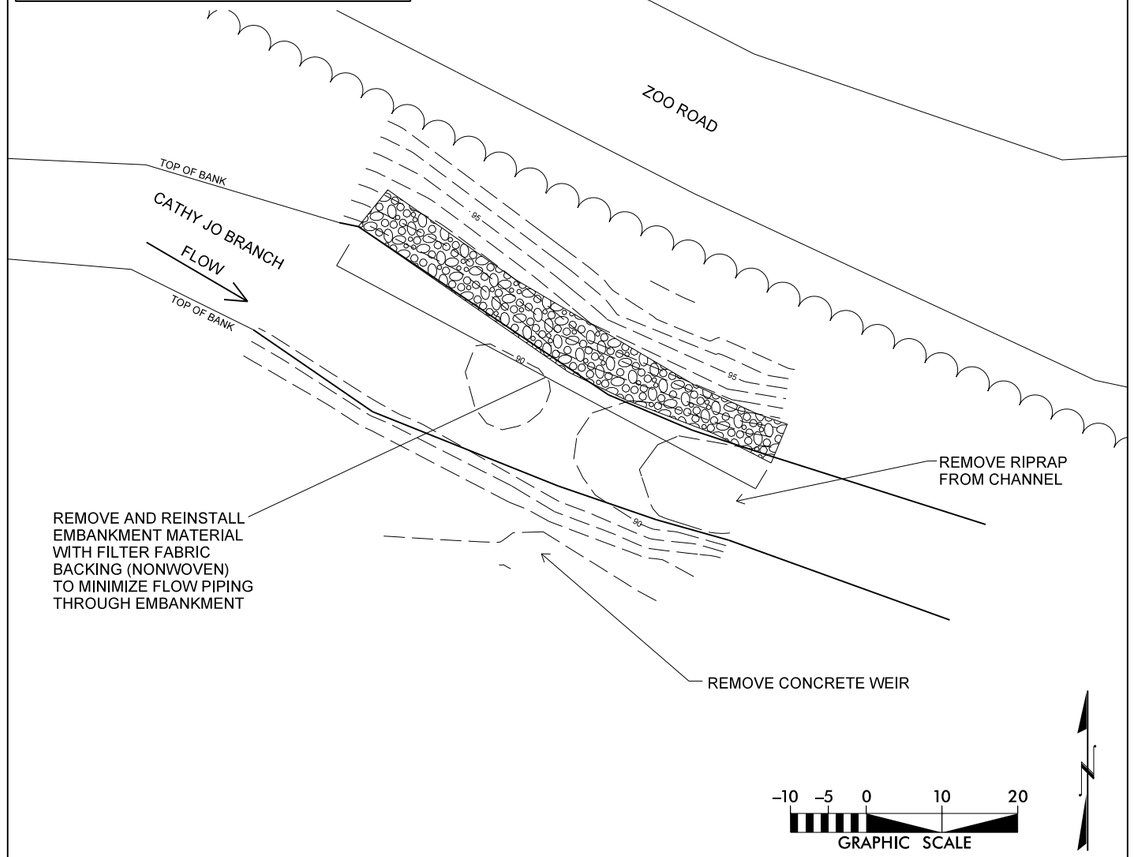
DATE: OCTOBER 2015
SCALE: GRAPHIC

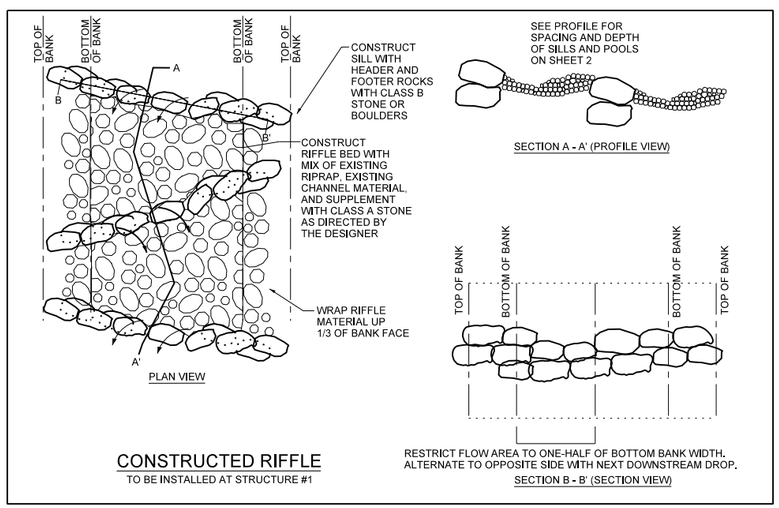
SITE PLAN

STRUCTURE #2
EXISTING CONDITIONS



STRUCTURE #2
PROPOSED CONDITIONS





CONSTRUCTED RIFFLE
TO BE INSTALLED AT STRUCTURE #1

THE DATA SOURCE FOR THE TOPOGRAPIC MAPPING IS FROM A SURVEY CONDUCTED BY KCI TECHNOLOGIES IN SEPTEMBER 2015. ALL ELEVATIONS ARE ASSUMED.

GARY MICHAEL MRYNCZA
REGISTERED ENGINEER
AGRICULTURE
COMMERCE
No. 111554
STATE OF TENNESSEE

REVISIONS

DESCRIPTION	DATE	APPROVED
SYM.		

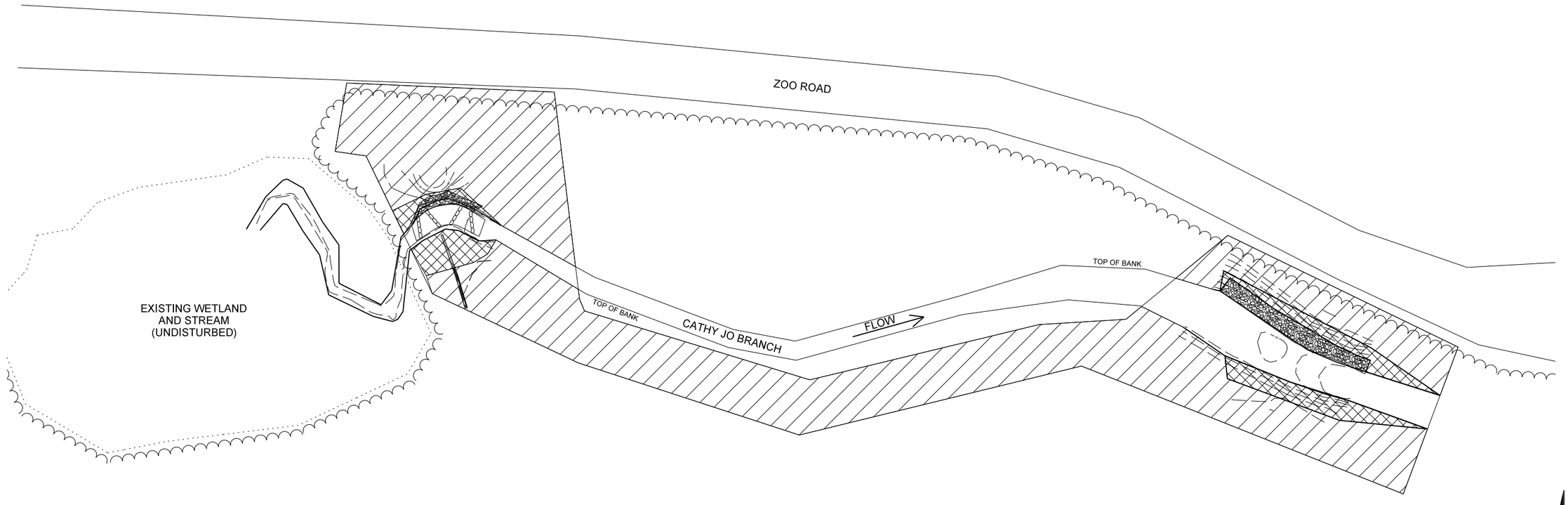
CUMBERLAND RIVER COMPACT

KCI TECHNOLOGIES
7003 CHADWICK DRIVE, SUITE 343
BRENTWOOD, TN 37027

NASVILLE ZOO DAM/WEIR
REMOVALS PROJECT
DAVIDSON COUNTY, TENNESSEE

DATE: OCTOBER 2015
SCALE: GRAPHIC

SITE PLAN



LIVE STAKING

COMMON NAME	SCIENTIFIC NAME
BLACK WILLOW	SALIX NIGRA
SILKY WILLOW	SALIX SERICEA
SILKY DOGWOOD	CORNUS AMOMUM
ELDERBERRY	SAMBUCUS CANADENSIS
BUTTONBUSH	CEPHALANTHUS OCCIDENTALIS

THE LIVE STAKES WILL BE INSTALLED ON APPROXIMATE 2' CENTERS AND BE COMPOSED OF A MIX OF THE ABOVE SPECIES ON ALL DISTURBED BANKS.

BUFFER PLANTING

COMMON NAME	SCIENTIFIC NAME
PERSIMMON	DIOSPYROS VIRGINIANA
WILLOW OAK	QUERCUS PHELLOS
WATER OAK	QUERCUS NIGRA
PIN OAK	QUERCUS PALUSTRIS
RIVER BIRCH	BETULA NIGRA
SYCAMORE	PLATANUS OCCIDENTALIS
WINTERBERRY	ILEX VERTICILLATA
SPICEBUSH	LINDERA BENZOIN

THE DISTURBED PORTIONS OF THE BUFFER WILL BE REPLANTED WITH FABRICATED ROOT BALL TREES WHERE TREES HAVE BEEN CLEARED. THESE TREES ARE EQUIVALENT TO 3 GALLON CONTAINERIZED TREES AND ARE APPROXIMATELY 4-6' IN HEIGHT. THE SPECIES TO BE PLANTED WILL INCLUDE A MIX OF THE ABOVE. IF SUBSTITUTIONS NEED TO BE MADE, THE SPECIES WILL BE NATIVE STREAMSIDE / BOTTOMLAND HARDWOOD SPECIES.

AREAS WITHIN THE LOD THAT ARE UNDISTURBED WILL NOT BE PLANTED.

PLANTING PLAN LEGEND

LIVE STAKING ZONE

BUFFER PLANTING ZONE

N

–20 –10 0 20 40

GRAPHIC SCALE

THE DATA SOURCE FOR THE TOPOGRAPIC MAPPING IS FROM A SURVEY CONDUCTED BY KCI TECHNOLOGIES IN SEPTEMBER 2015. ALL ELEVATIONS ARE ASSUMED.

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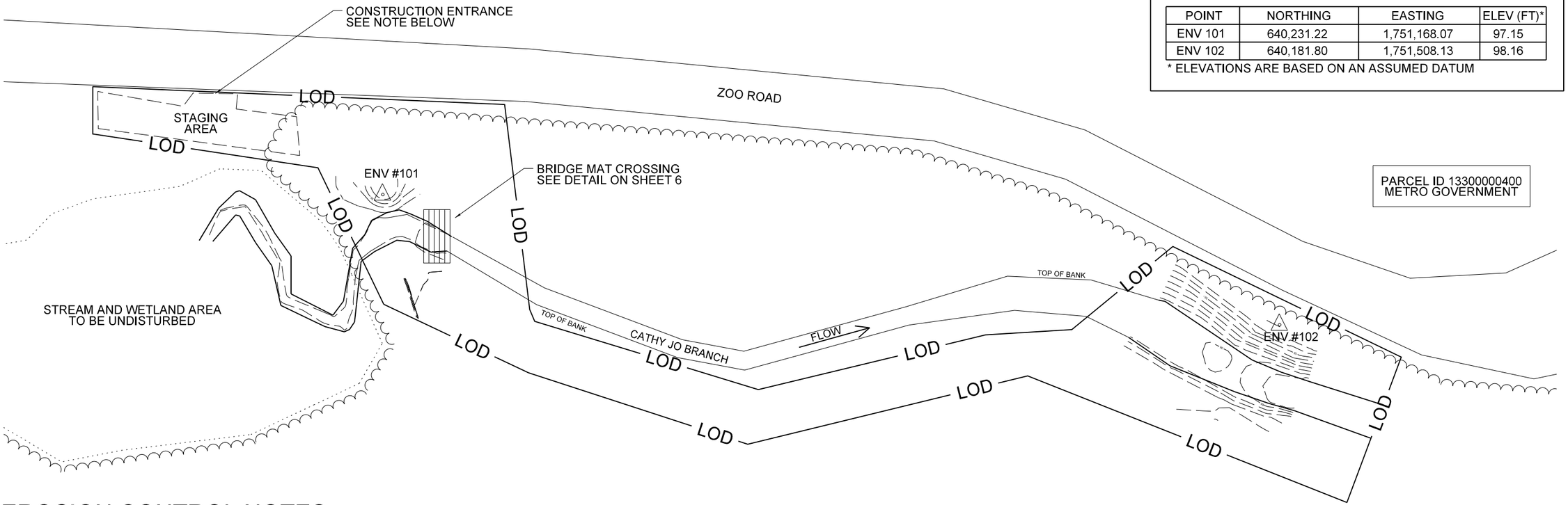
PLANTING PLAN



CONTROL POINTS

POINT	NORTHING	EASTING	ELEV (FT)*
ENV 101	640,231.22	1,751,168.07	97.15
ENV 102	640,181.80	1,751,508.13	98.16

* ELEVATIONS ARE BASED ON AN ASSUMED DATUM

PARCEL ID 13300000400
METRO GOVERNMENT

EROSION CONTROL NOTES

CONSTRUCTION ENTRANCE NOTE:

THE CONSTRUCTION ENTRANCE WILL BE MADE OF PLYWOOD ATTACHED TOGETHER SO THAT ALL TRUCKS ENTERING AND LEAVING THE SITE WILL NOT BE OFF OF A CLEAN SURFACE. THE TOTAL NUMBER OF TRUCK LOADS EXPECTED IS 10 OR LESS OVER THE COURSE OF THE PROJECT.

PROPERTY NOTE:

THE ENTIRE SITE IS LOCATED ON ONE PARCEL OWNED BY METRO GOVERNMENT. THE PARCEL NUMBER IS IN THE UPPER RIGHT CORNER OF THIS PLAN SHEET.

TOTAL LIMITS OF DISTURBANCE FOR THIS PROJECT IS 0.4 ACRES.

GENERAL NOTES:

THE CONTRACTOR SHALL INSTALL AND MAINTAIN THROUGHOUT THE PROJECT CONSTRUCTION ALL EROSION CONTROL MEASURES IN ACCORDANCE WITH THESE PLANS AND IN ACCORDANCE WITH APPLICABLE EROSION AND SEDIMENT CONTROL REGULATIONS. THE CONTRACTOR SHALL CONTINUOUSLY MAINTAIN ALL EROSION CONTROL DEVICES AND STRUCTURES TO MINIMIZE EROSION.

ALL EROSION CONTROL MEASURES SHALL BE CONSTRUCTED IN ACCORDANCE WITH THE TENNESSEE EROSION AND SEDIMENT CONTROL REGULATIONS, U.S. DEPARTMENT OF AGRICULTURE, AND U.S. SOIL CONSERVATION SERVICE REGULATIONS.

THE PROJECT SITE IS NOT IN A FEMA MAPPED FLOODWAY.

EROSION CONTROL PLAN

EROSION AND SEDIMENT CONTROL MEASURES SHALL BE MAINTAINED CONTINUOUSLY, RELOCATED WHEN AND AS NECESSARY, AND SHALL BE CHECKED AFTER EVERY RAINFALL. SEEDED AREAS SHALL BE CHECKED REGULARLY AND SHALL BE WATERED, FERTILIZED, RESEEDED AND MULCHED AS NECESSARY TO OBTAIN A DENSE STAND OF GRASS.

STABILIZATION IS THE BEST FORM OF EROSION CONTROL. ALL DISTURBED AREAS THAT ARE NOT OTHERWISE STABILIZED SHALL BE AMENDED AND SEEDED, TEMPORARILY OR PERMANENTLY IN ACCORDANCE WITH THE TENNESSEE SEDIMENT CONTROL REGULATIONS. PERMANENT SEEDING AND GRASS ESTABLISHMENT ARE REQUIRED PRIOR TO PROJECT COMPLETION AND ACCEPTANCE.

CONTRACTOR SHALL PROVIDE GROUND COVER ON EXPOSED SLOPES WITHIN 14 CALENDAR DAYS FOLLOWING COMPLETION OF ANY PHASE OF GRADING. PERMANENT GROUND COVER FOR ALL DISTURBED AREAS SHALL BE PROVIDED WITHIN 14 CALENDAR DAYS FOLLOWING COMPLETION OF CONSTRUCTION.

WHERE SEDIMENT IS TRANSPORTED ONTO A PAVED OR PUBLIC ROAD SURFACE, THE ROAD SURFACE SHALL BE CLEANED THOROUGHLY AT THE END OF EACH DAY.

DURING CONSTRUCTION OF THE PROJECT, SOIL STOCKPILES SHALL BE STABILIZED OR PROTECTED WITH SEDIMENT TRAPPING MEASURES. THE CONTRACTOR IS RESPONSIBLE FOR THE TEMPORARY PROTECTION AND PERMANENT STABILIZATION OF ALL SOIL STOCKPILES ON SITE AS WELL AS SOIL INTENTIONALLY TRANSPORTED FROM THE PROJECT SITE.

SEQUENCE OF CONSTRUCTION FOR DAM REMOVAL

THE CONTRACTOR SHALL ONLY CONDUCT WORK, INCLUDING CONCRETE REMOVAL, GRADING, STABILIZATION MEASURES AND SEEDING AND MULCHING WORK, ON A SECTION OF STREAM THAT CAN BE ENTIRELY COMPLETED WITHIN A SINGLE DAY OR THE SECTION OF CHANNEL MUST BE PUMPED AROUND CONTINUOUSLY, IN THE DRY, IF IT WILL NOT BE STABILIZED AT THE END OF THE DAY.

PHASE 1: INITIAL SITE PREPARATION
1. IDENTIFY PROJECT BOUNDARY, LIMITS OF DISTURBANCE, SENSITIVE AREAS, STAGING AREA, AND ACCESS POINTS WITH THE DESIGNER.
2. CONSTRUCT THE STAGING AREA IN A MANNER TO SUPPORT THE EXECUTION OF THE PROJECT IN PHASES AS INDICATED IN THE PLANS AND AS DIRECTED BY THE DESIGNER.
3. INSTALL EROSION CONTROL DEVICES IN ACCORDANCE WITH THE SITE STABILIZATION PLAN AND AS DIRECTED BY THE DESIGNER.

PHASE 2: STRUCTURE REMOVAL
4. CLEAR AND STOCKPILE WOODY DEBRIS TO BE REMOVED FROM THE SITE AS INDICATED ON THE PLAN SHEETS AND AS DIRECTED BY THE DESIGNER.
5. INITIATE REMOVAL OF STRUCTURE #2 AND REINSTALLATION OF ADJACENT EMBANKMENT IN A DRY SECTION OF CHANNEL THAT DOES NOT HAVE ACTIVE FLOW.
6. INITIATE PARTIAL REMOVAL OF STRUCTURE #1, INSTALLATION OF THE CONSTRUCTED RIFFLE, AND ADJACENT GRADING IN A DRY SECTION OF CHANNEL THAT DOES NOT HAVE ACTIVE FLOW.
7. INSTALL ALL SEED/STRAW AND PERMANENT STABIILZATION MEASURES THROUGHOUT THE SITE.

PHASE 3: PLANTING
8. LIVE STAKES AND BARE ROOT TREES SHALL BE INSTALLED DURING THE DORMANT SEASON (NOVEMBER 6 - MARCH 24). PREPARE AND INSTALL LIVE STAKES AND TREES IN ACCORDANCE WITH THESE PLANS AND AS DIRECTED BY THE DESIGNER.

PHASE 4: COMPLETION OF PROJECT SITE
9. REMOVE ALL REMAINING WASTE MATERIALS AND RESTORE THE REMAINING STAGING, STOCKPILING, AND ACCESS AREAS TO THEIR PRIOR CONDITION. SEED AND MULCH ALL DISTURBED AREAS UTILIZING THE SEED AND MULCH MIXES SPECIFIED IN THESE PLANS.

THE DATA SOURCE FOR THE TOPOGRAPIC MAPPING IS FROM A SURVEY CONDUCTED BY KCI TECHNOLOGIES IN SEPTEMBER 2015. ALL ELEVATIONS ARE ASSUMED.

GARY MICHAEL MRYNCZA
REGISTERED ENGINEER
AGRICULTURE
COMMERCE
No. 111554
STATE OF TENNESSEE

REVISIONS

SYM	DESCRIPTION	DATE	APPROVED

CUMBERLAND RIVER COMPACT

KCI TECHNOLOGIES
7003 CHADWICK DRIVE, SUITE 343
BRENTWOOD, TN 37027

NASVILLE ZOO DAM/WEIR REMOVALS PROJECT
DAVIDSON COUNTY, TENNESSEE

DATE: OCTOBER 2015
SCALE: GRAPHIC

SEDIMENT AND EROSION CONTROL PLAN

SHEET 5 OF 6

TEMPORARY SEED MIX:

COMMON NAME	SCIENTIFIC NAME	PLANTING RATE PER ACRE (LBS)	TIME PERIOD
RYE GRAIN	SECALE CERALE	120	8/15 - 5/1
WHEAT	TRITICUM AESTIVUM	30	8/15 - 4/15

PERMANENT SEED MIX:

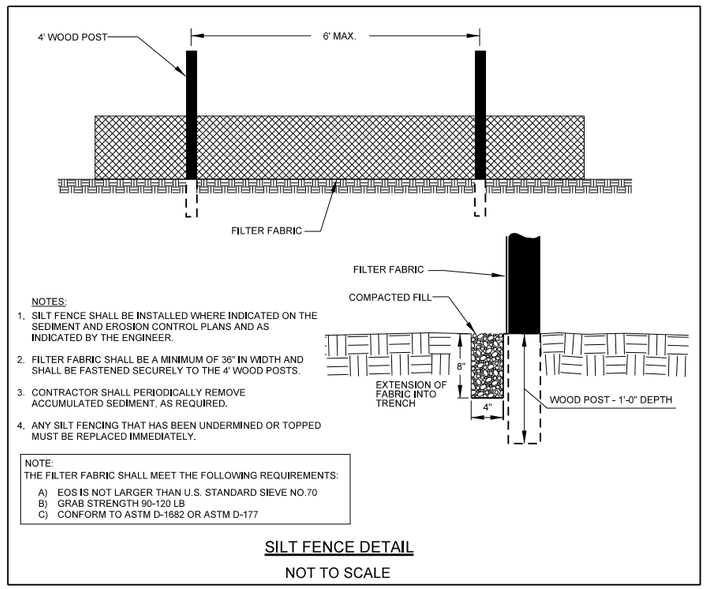
COMMON NAME	SCIENTIFIC NAME	PLANTING RATE PER ACRE (LBS)
SWITCHGRASS	PANICUM VIRGATUM	10
UPLAND BENTGRASS	AGROSTIS PERENNANS	2
SLIMSPIKE THEREON	ARISTIDA LONGESPICA	2
DEER TONGUE	PANICUM CLANDESTINUM	5
SHOWY TICKSEED	BIDENS ARISTOSA	5
NARROW-LEAF COREOPSIS	COREOPSIS LANCEOLATA	2
FOX SEDGE	CAREX VULPINOIDEA	5
RIVER OATS	CHASMANTHIUM LATIFOLIUM	1

IF ANY OF THE ABOVE SPECIES ARE NOT AVAILABLE A COMPARABLE WARM OR COOL SEASON NATIVE GRASS OR FORB WILL BE USED AS A REPLACEMENT.

MULCHING

SEEDED AREAS ARE TO BE PROTECTED BY SPREADING STRAW MULCH UNIFORMLY TO FORM A CONTINUOUS BLANKET (75% COVERAGE = 2 TONS/ACRE) OVER SEEDED AREAS. CONTRACTOR MAY PROPOSE ALTERNATE METHODS OF SEEDING AND MULCHING (HYDRO-SEEDING) UPON SUBMISSION TO THE ENGINEER OF CALCULATIONS SHOWING THE EQUIVALENCY OF THE PROPOSED METHOD.

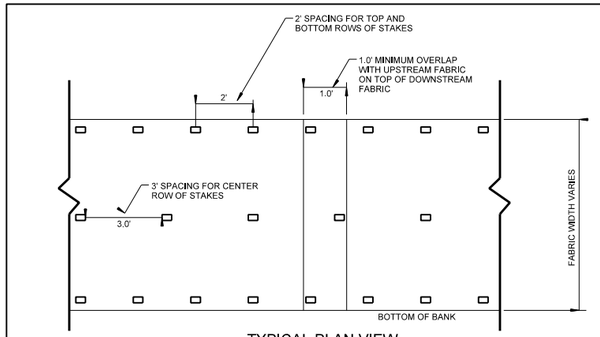
IN ACCORDANCE WITH METRO STORMWATER MANAGEMENT MANUAL, VOLUME 1, SECTION 3.9, AS-BUILT CERTIFICATIONS, MWS STORMWATER DIVISION MUST APPROVE THE FOLLOWING AS-BUILTS PRIOR TO ISSUANCE OF THE USE & OCCUPANCY PERMIT:
-UNDERGROUND DETENTION AND WATER QUALITY INFRASTRUCTURE
-ABOVE GROUND DETENTION AND WATER QUALITY INFRASTRUCTURE
-PUBLIC STORM SEWER AND WATER QUALITY INFRASTRUCTURE
-CUT & FILL IN THE FLOODPLAIN
-SINK HOLE ALTERATIONS
THE ENGINEER SHALL CONTACT THE STORMWATER DEVELOPMENT REVIEW STAFF FOR SUBMITTAL REQUIREMENTS.



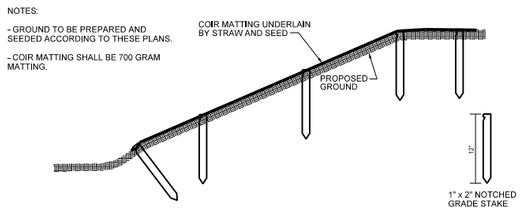
NOTES:
1. SILT FENCE SHALL BE INSTALLED WHERE INDICATED ON THE SEDIMENT AND EROSION CONTROL PLANS AND AS INDICATED BY THE ENGINEER.
2. FILTER FABRIC SHALL BE A MINIMUM OF 36" IN WIDTH AND SHALL BE FASTENED SECURELY TO THE 4' WOOD POSTS.
3. CONTRACTOR SHALL PERIODICALLY REMOVE ACCUMULATED SEDIMENT, AS REQUIRED.
4. ANY SILT FENCING THAT HAS BEEN UNDERMINED OR TOPPED MUST BE REPLACED IMMEDIATELY.

NOTE:
THE FILTER FABRIC SHALL MEET THE FOLLOWING REQUIREMENTS:
A) EOS IS NOT LARGER THAN U.S. STANDARD SIEVE NO.70
B) GRAB STRENGTH 90-120 LB
C) CONFORM TO ASTM D-1682 OR ASTM D-177

SILT FENCE DETAIL
NOT TO SCALE

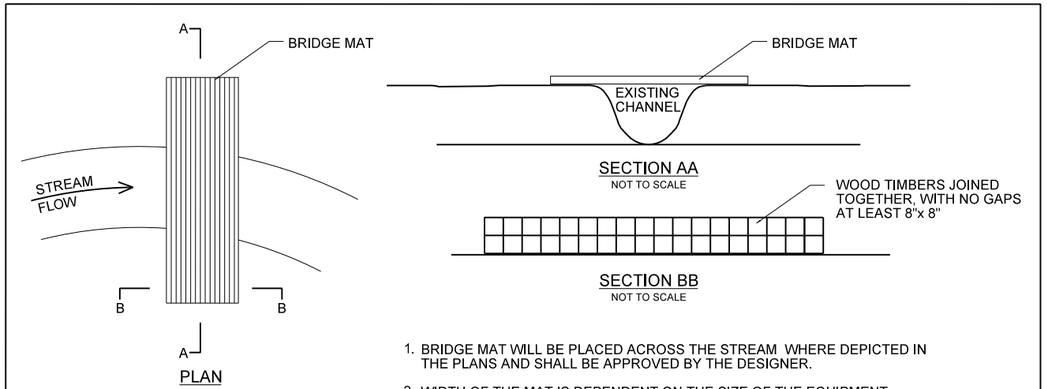


TYPICAL PLAN VIEW



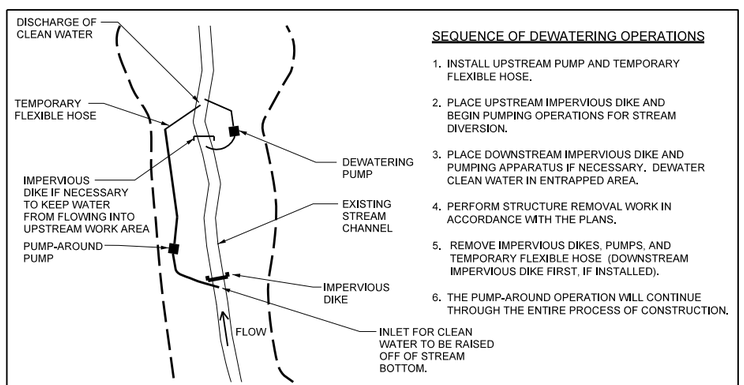
TYPICAL SECTION VIEW

COIR MATTING
SCALE: NTS



1. BRIDGE MAT WILL BE PLACED ACROSS THE STREAM WHERE DEPICTED IN THE PLANS AND SHALL BE APPROVED BY THE DESIGNER.
2. WIDTH OF THE MAT IS DEPENDENT ON THE SIZE OF THE EQUIPMENT MEANT TO CROSS IT.

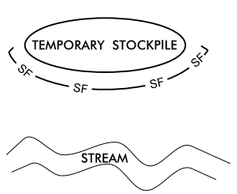
BRIDGE MAT CROSSING
PLACE AS SPECIFIED IN THE PLANS AND APPROVED BY THE DESIGNER



SEQUENCE OF DEWATERING OPERATIONS

1. INSTALL UPSTREAM PUMP AND TEMPORARY FLEXIBLE HOSE.
2. PLACE UPSTREAM IMPERVIOUS DIKE AND BEGIN PUMPING OPERATIONS FOR STREAM DIVERSION.
3. PLACE DOWNSTREAM IMPERVIOUS DIKE AND PUMPING APPARATUS IF NECESSARY. DEWATER CLEAN WATER IN ENTRAPPED AREA.
4. PERFORM STRUCTURE REMOVAL WORK IN ACCORDANCE WITH THE PLANS.
5. REMOVE IMPERVIOUS DIKES, PUMPS, AND TEMPORARY FLEXIBLE HOSE (DOWNSTREAM IMPERVIOUS DIKE FIRST, IF INSTALLED).
6. THE PUMP-AROUND OPERATION WILL CONTINUE THROUGH THE ENTIRE PROCESS OF CONSTRUCTION.

EXAMPLE OF PUMP-AROUND OPERATION



1.) SEDIMENT AND DAM MATERIALS WILL BE REMOVED FROM THE STREAM FROM A DRY SECTION OF CHANNEL IT IS ANTICIPATED THAT THESE MATERIALS WILL ONLY BE CONCRETE AND RUBBLE, WHICH WILL NOT HOLD SUBSTANTIAL MOISTURE. IF ANY MATERIALS THAT ARE REMOVED ARE SIGNIFICANTLY WET, THE STOCKPILING PROCEDURE DESCRIBED HERE WILL BE FOLLOWED. IF WET, THESE MATERIALS WILL NOT BE WATER LOGGED AND WILL ONLY NEED MINIMAL DRYING TIME.

2.) THESE MATERIALS WILL BE TEMPORARILY STOCKPILED WITHIN THE STAGING AREA INDICATED ON SHEET 5.

3.) ALL TEMPORARY STOCKPILES SHALL HAVE SILT FENCE INSTALLED ON THE DOWN GRADIENT SIDE OF THE STOCKPILE, AS SHOWN HERE IN THE TYPICAL DETAIL.

4.) ALL MATERIALS REMOVED FROM THE STREAM AREA WILL BE TAKEN OFF SITE TO AN APPROVED DISPOSAL FACILITY.

TEMPORARY STOCKPILE AND SILT FENCE NOTES

REVISIONS

SYM	DESCRIPTION	DATE	APPROVED

CUMBERLAND RIVER COMPACT

KCI TECHNOLOGIES
7003 CHADWICK DRIVE, SUITE 343
BRENTWOOD, TN 37027

NASVILLE ZOO DAM/WEIR REMOVALS PROJECT
DAVIDSON COUNTY, TENNESSEE

DATE: OCTOBER 2015
SCALE: GRAPHIC

SEDIMENT AND EROSION CONTROL PLAN

SHEET 6 OF 6

Sediment Sampling Procedure

Scope:
These SOPs are intended to describe procedures for a screening-level survey of contaminants in sediments behind dams where the pool is relatively small. These procedures are not intended for large impoundments. It is important to note that no sampling plan survives in its entirety after a day in the field. It is important to document the reasons for deviating from protocol in field notebooks for future reference if issues of data quality arise later.

Additional References:
A reference for sediment sampling protocols is:
Methods for Collection, Storage and Manipulation of Sediments for Chemical and Toxicological Analyses: Technical Manual (EPA-823-B-01-002). 2001. It is available online at http://www.epa.gov/waterscience/cs/collection.html

Additional references include:
US EPA ERT SOP #2006: Sampling Equipment Decontamination. 1994.
US EPA ERT SOP #2016: Sediment Sampling. 1994.

Where to Sample:
Because most of the projects are relatively small, we have been taking samples at three different locations
- one (1) directly downstream out of the influence of the dam
- one (1) in the impoundment
- one (1) upstream of the impoundment, out of the influence of the dam

At every sampling station, it is important to attempt to sample in depositional areas whenever possible. Depositional zones typically contain fine-grained sediment deposits, which are targeted because fine-grained sediments are a more likely repository for pollutants.

At each sampling station, you will need to take multiple grabs in order to collect enough sediment and to get a representative sample of the area (this is called a composite sample).

Because sampling stirs up bottom sediments, it's important to take samples starting from downstream and moving upstream so as not to potentially contaminate subsequent samples.

What to Sample With:
There are two general types of sediment collection devices; core samplers and grab samplers. If one of the objectives of the study is to look at historical verses recent contamination or there is a need to characterize contamination in deeper sediments, then a coring device should be employed. Depending on the sediment and the purposes of the sampling, different tools can accomplish different tasks.

It is important to come prepared with a variety of tools. Each sampler has its own strengths and weaknesses. If the sediments are soft and fined-grained, a 3" bucket auger works well.
The biggest drawback to an auger is that it only works well in fine grained sediments. In the case that there are too many course sediments, such as large gravel and cobble the auger may not be able to penetrate the sediment. In this case, a spade shovel may be the best method for digging a hole and then selecting sediment at varying depths to create the composite sample. In this case, generally the minimum sampling depth is half the estimated depth of the sediment behind the dam or as deep as site conditions will allow.

In addition to the sampling devices, you will need to have equipment to hold the sediment, homogenate it, and fill your sampling jars. All spoons, trowels, mixing bowls, and buckets should be made of stainless steel or non-reactive metal.

A simple procedure for sampling is to put the individual samples into a non-reactive bucket or large bowl and then stir the sediment with a stainless steel mixing spoon to make sure that the sample is well mixed. Using the spoon, select the finest sized portion of the sample and deposit it into the sample bottle. Decant as much of the water from the sample bottle as possible. Seal the bottle.

What to Sample For:
Generally, a screening level analysis includes testing for the standard EPA priority pollutants including metals, pesticides, and PCBs.

Decontamination:
All sampling gear (including spoons, trowels, mixing bowls, and buckets) need to be decontaminated between each sampling station. Our decontamination procedure consists of the following:

(1) distilled water rinse
(2) denatured alcohol rinse
(3) distilled water rinse

Also, remember to use gloves for each new sampling site if you are handling the sediment. Finally, once you've arrived at the next sampling site, give each of the sampling tools a final rinse by dipping it in the reservoir two or three times before you use it.

Prior to Field Collection:
It's advantageous to have all the sampling gear decontaminated prior to entering the field. It also makes it easier in the field if the appropriate number and type of sampling jars are pre-labeled and organized.

Don't forget to put waterproof tape over the labels! All field gear (GPS, camera, field notebooks, PPE, etc.) need to be assembled and organized (don't forget extra batteries).

Make sure to include coolers for samples in the field gear list.
Finally, we've found it useful to collect good site notes, with a sketch of the site during sampling.

Final Tidbits:
As much as possible, try and remove all the non-sediment debris from your sample (sticks, leaves, plant material, biota, etc.) before you begin filling your jars. It is important to homogenize the sample as thoroughly as is possible. Keep stirring until the sediment appears uniform throughout. If the sediment is fine-grained, let the sample sit for a few minutes after homogenization before decanting the water on top to allow the fine particles to settle. For ALL samples, decant the mixing bowl/bucket slowly so as not to lose the fines.

After you've filled each jar with sample, perform a final decant to remove as much remaining water as you can without losing the fine material. Use site water to clean off the jar threads so that the jar lids seal well. Rinse the outside of the jar with site water and place the sample in a ziplock bag wrapped in bubble wrap that has the sample number written on the outside (in case the label falls off the jar).

12065 Lebanon Rd.
Mt. Juliet, TN 37122
(615) 758-5858
1-800-767-5859
Fax (615) 758-5859

Tax I.D. 62-0814289

Est. 1970

Adam Spiller
KCI Technologies Inc.
7003 Chadwick Drive, Suite 343
Brentwood, TN 37027

Report Summary

Tuesday October 13, 2015

Report Number: L792717
Samples Received: 10/06/15
Client Project:

Description: Nashville Zoo

The analytical results in this report are based upon information supplied by you, the client, and are for your exclusive use. If you have any questions regarding this data package, please do not hesitate to call.

Entire Report Reviewed By: Darren O. Reeder

Darren Reeder , ESC Representative

Laboratory Certification Numbers

A2LA - 1461-01, AIHA - 100789, AL - 40660, CA - 01157CA, CT - PH-0197, FL - E87487, GA - 923, IN - C-TN-01, KY - 90010, KYUST - 0016, NC - ENV375/DW21704/BIO041, ND - R-140. NJ - TN002, NJ NELAP - TN002, SC - 84004, TN - 2006, VA - 460132, WV - 233, AZ - 0612, MN - 047-999-395, NY - 11742, WI - 998093910, NV - TN000032011-1, TX - T104704245-11-3, OK - 9915, PA - 68-02979, IA Lab #364, EPA - TN002

Accreditation is only applicable to the test methods specified on each scope of accreditation held by ESC Lab Sciences.

Where applicable, sampling conducted by ESC is performed per guidance provided in laboratory standard operating procedures: 060302, 060303, and 060304.

ESC LAB SCIENCES
YOUR LAB OF CHOICE

12065 Lebanon Rd.
Mt. Juliet, TN 37122
(615) 758-5858
1-800-767-5859
Fax (615) 758-5859

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Est. 1970

REPORT OF ANALYSIS

Adam Spiller
KCI Technologies Inc.
7003 Chadwick Drive, Suite 343
Brentwood, TN 37027

October 13, 2015

ESC Sample # : L792717-01

Date Received : October 06, 2015
Description : Nashville Zoo

Site ID :

Sample ID : UPSTREAM

Project # :

Collected By : Adam Spiller
Collection Date : 10/06/15 10:35

Parameter	Result	Det. Limit	Units	Method	Date	Dil.
Mercury	0.0290	0.0200	mg/kg	7471A	10/09/15	1
Antimony	BDL	2.00	mg/kg	6010B	10/12/15	1
Arsenic	BDL	2.00	mg/kg	6010B	10/12/15	1
Beryllium	0.415	0.200	mg/kg	6010B	10/12/15	1
Cadmium	BDL	0.500	mg/kg	6010B	10/12/15	1
Chromium	7.58	1.00	mg/kg	6010B	10/12/15	1
Copper	3.87	2.00	mg/kg	6010B	10/12/15	1
Lead	5.39	0.500	mg/kg	6010B	10/12/15	1
Nickel	5.41	2.00	mg/kg	6010B	10/12/15	1
Selenium	BDL	2.00	mg/kg	6010B	10/12/15	1
Silver	BDL	1.00	mg/kg	6010B	10/12/15	1
Thallium	BDL	2.00	mg/kg	6010B	10/12/15	1
Zinc	24.9	5.00	mg/kg	6010B	10/12/15	1
TPH (GC/FID) Low Fraction	BDL	0.500	mg/kg	8015D/GRO	10/12/15	5
Surrogate Recovery (70-130)						
a,a,a-Trifluorotoluene(FID)	97.2		% Rec.	8015D/GRO	10/12/15	1
TPH (GC/FID) High Fraction	5.38	4.00	mg/kg	3546/DRO	10/12/15	1
Surrogate recovery(%)						
o-Terphenyl	54.6		% Rec.	3546/DRO	10/12/15	1

BDL - Below Detection Limit
Det. Limit - Practical Quantitation Limit(PQL)
Note:
The reported analytical results relate only to the sample submitted.

.
Reported: 10/13/15 16:25 Printed: 10/13/15 16:25

ESC LAB SCIENCES
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Mt. Juliet, TN 37122
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REPORT OF ANALYSIS

Adam Spiller
KCI Technologies Inc.
7003 Chadwick Drive, Suite 343
Brentwood, TN 37027

October 13, 2015

ESC Sample # : L792717-02

Date Received : October 06, 2015
Description : Nashville Zoo

Site ID :

Sample ID : POND

Project # :

Collected By : Adam Spiller
Collection Date : 10/06/15 10:54

Parameter	Result	Det. Limit	Units	Method	Date	Dil.
Mercury	0.0253	0.0200	mg/kg	7471A	10/09/15	1
Antimony	BDL	2.00	mg/kg	6010B	10/12/15	1
Arsenic	2.23	2.00	mg/kg	6010B	10/12/15	1
Beryllium	0.455	0.200	mg/kg	6010B	10/12/15	1
Cadmium	BDL	0.500	mg/kg	6010B	10/12/15	1
Chromium	9.13	1.00	mg/kg	6010B	10/12/15	1
Copper	6.19	2.00	mg/kg	6010B	10/12/15	1
Lead	6.29	0.500	mg/kg	6010B	10/12/15	1
Nickel	7.05	2.00	mg/kg	6010B	10/12/15	1
Selenium	BDL	2.00	mg/kg	6010B	10/12/15	1
Silver	BDL	1.00	mg/kg	6010B	10/12/15	1
Thallium	BDL	2.00	mg/kg	6010B	10/12/15	1
Zinc	37.3	5.00	mg/kg	6010B	10/12/15	1
TPH (GC/FID) Low Fraction	BDL	0.500	mg/kg	8015D/GRO	10/12/15	5
Surrogate Recovery (70-130)						
a,a,a-Trifluorotoluene(FID)	100.		% Rec.	8015D/GRO	10/12/15	1
TPH (GC/FID) High Fraction	7.38	4.00	mg/kg	3546/DRO	10/13/15	1
Surrogate recovery(%)						
o-Terphenyl	72.7		% Rec.	3546/DRO	10/13/15	1

BDL - Below Detection Limit
Det. Limit - Practical Quantitation Limit(PQL)
Note:
The reported analytical results relate only to the sample submitted.

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Reported: 10/13/15 16:25 Printed: 10/13/15 16:25

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Est. 1970

REPORT OF ANALYSIS

Adam Spiller
KCI Technologies Inc.
7003 Chadwick Drive, Suite 343
Brentwood, TN 37027

October 13, 2015

ESC Sample # : L792717-03

Date Received : October 06, 2015
Description : Nashville Zoo

Site ID :

Sample ID : WEIR

Project # :

Collected By : Adam Spiller
Collection Date : 10/06/15 11:30

Parameter	Result	Det. Limit	Units	Method	Date	Dil.
Mercury	BDL	0.0200	mg/kg	7471A	10/09/15	1
Antimony	BDL	2.00	mg/kg	6010B	10/12/15	1
Arsenic	BDL	2.00	mg/kg	6010B	10/12/15	1
Beryllium	0.355	0.200	mg/kg	6010B	10/12/15	1
Cadmium	BDL	0.500	mg/kg	6010B	10/12/15	1
Chromium	7.32	1.00	mg/kg	6010B	10/12/15	1
Copper	4.68	2.00	mg/kg	6010B	10/12/15	1
Lead	5.32	0.500	mg/kg	6010B	10/12/15	1
Nickel	5.61	2.00	mg/kg	6010B	10/12/15	1
Selenium	BDL	2.00	mg/kg	6010B	10/12/15	1
Silver	BDL	1.00	mg/kg	6010B	10/12/15	1
Thallium	BDL	2.00	mg/kg	6010B	10/12/15	1
Zinc	30.2	5.00	mg/kg	6010B	10/12/15	1
TPH (GC/FID) Low Fraction	BDL	0.500	mg/kg	8015D/GRO	10/12/15	5
Surrogate Recovery (70-130)						
a,a,a-Trifluorotoluene(FID)	97.6		% Rec.	8015D/GRO	10/12/15	1
TPH (GC/FID) High Fraction	BDL	4.00	mg/kg	3546/DRO	10/12/15	1
Surrogate recovery(%)						
o-Terphenyl	64.0		% Rec.	3546/DRO	10/12/15	1

BDL - Below Detection Limit
Det. Limit - Practical Quantitation Limit(PQL)
Note:
The reported analytical results relate only to the sample submitted.

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REPORT OF ANALYSIS

Adam Spiller
KCI Technologies Inc.
7003 Chadwick Drive, Suite 343
Brentwood, TN 37027

October 13, 2015

ESC Sample # : L792717-04

Date Received : October 06, 2015
Description : Nashville Zoo

Site ID :

Sample ID : DOWNSTREAM

Project # :

Collected By : Adam Spiller
Collection Date : 10/06/15 11:57

Parameter	Result	Det. Limit	Units	Method	Date	Dil.
Mercury	0.0227	0.0200	mg/kg	7471A	10/09/15	1
Antimony	BDL	2.00	mg/kg	6010B	10/12/15	1
Arsenic	5.48	2.00	mg/kg	6010B	10/12/15	1
Beryllium	0.797	0.200	mg/kg	6010B	10/12/15	1
Cadmium	BDL	0.500	mg/kg	6010B	10/12/15	1
Chromium	11.9	1.00	mg/kg	6010B	10/12/15	1
Copper	8.32	2.00	mg/kg	6010B	10/12/15	1
Lead	16.7	0.500	mg/kg	6010B	10/12/15	1
Nickel	9.61	2.00	mg/kg	6010B	10/12/15	1
Selenium	BDL	2.00	mg/kg	6010B	10/12/15	1
Silver	BDL	1.00	mg/kg	6010B	10/12/15	1
Thallium	BDL	2.00	mg/kg	6010B	10/12/15	1
Zinc	54.4	5.00	mg/kg	6010B	10/12/15	1
TPH (GC/FID) Low Fraction	BDL	0.500	mg/kg	8015D/GRO	10/12/15	5
Surrogate Recovery (70-130)						
a,a,a-Trifluorotoluene(FID)	98.0		% Rec.	8015D/GRO	10/12/15	1
TPH (GC/FID) High Fraction	BDL	40.0	mg/kg	3546/DRO	10/12/15	10
Surrogate recovery(%)						
o-Terphenyl	77.8		% Rec.	3546/DRO	10/12/15	10

BDL - Below Detection Limit
Det. Limit - Practical Quantitation Limit(PQL)
Note:
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L792717-04 (DRO) - Cannot run at lower dilution due to viscosity of extract