US Army Corps of Engineers®

CHICAGO DISTRICT

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RIVER RIPARIAN CONNECTIVITY & HABITAT SECTION 506

CHICAGO, IL

Civil Engineering Appendix

Preliminary Submittal

ATR Review

11 January 2016

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1.0 Site selection and project development

The National Ecosystem Restoration (NER) Plan selected that maximizes ecosystem restoration benefits compared to costs is Alternative 4. The plan includes hydrology restoration, removal of concrete dam and about 400 ft of concrete channel, bank stabilization, invasive species removal, and native plant restoration.

The purpose of this section is to 1) describe the design criteria, engineering methods, procedures, and assumptions that were used for layout and perform preliminary design analysis of the recommended plan; 2) present the methods used and calculations developed for earthwork quantities, 3) present the requirements for the real estate needed; 4) present criteria and requirements for utility interferences; and 5) discuss the engineering design analysis requirements for the next phase of the project.

2.0 Study Location and Real Estate

The River Riparian Connectivity and Habitat Restoration study area is located within the City of Chicago, Cook County, IL and bounded by Peterson Ave on the north and Lawrence Ave on the south and along the North Branch Chicago River (NBCR) and North Shore Channel (NSC). The study area consists of three connected parks along the Chicago River. The three parks are Legion Park at the northern boundary, River Park, and Ronan Park at the southern boundary. River Park is located at the confluence of the NBCR and NSC. A dam is also located at the confluence.

All three parks are leased, maintained and managed by the Chicago Park District (CPD), but currently owned by the Metropolitan Water Reclamation District of Greater Chicago (MWRDGC). The proposed project areas shown on the Real Estate Map were coordinated with CPD.

2.1 Staging and Storage

There are two staging and storage areas proposed for the project. Staging Area 1 is located within Legion Park on the west bank, and Staging Area 2 is located on the east bank of River Park. Access to staging area 1 will be from Bryn Mawr Ave and utilizing existing pathway. Foster Ave. or Francisco Ave can be used to access staging area 2. A third staging area is proposed at the south end of the project area. The staging area is located at the east bank between Argyle St and Lawrence Ave. The staging areas are open areas with a few tree covers. The few trees in the areas can be protected to avoid any impact to trees. The staging areas will be secured with perimeter fences and gates. The proposed staging and storage areas will be restored upon construction completion.

2.2 Access Roads\Haul Routes

2.2.1 Land Access

The project areas can be accessed from the major and local roads. Entry points to the sites are shown on the drawings and are connected to existing pathway. A few of the access points have obstructions such as bollards which will be removed and replaced after construction. The existing pathways will be used as haul routes where necessary within the project areas. The existing pathways or multi-use trails are heavily used by pedestrians and bikers. It is recommended that the trails/pathways are closed to the public during heavy construction period, which has to be coordinated with the CPD. Construction damages to the paths will repaired or replaced upon construction completion.

Pic 1: East Access to Legion Park from Ardmore Ave.

2.2.2 River Access

River access is needed for dam removal, concrete demolition, and step stones/riffle placement. Accesses, upstream and downstream of the dam, will be provided on the west-south bank of the dam. There is an existing boat launch downstream of the dam, which can be used to access the dam for removal. The boat launch is fairly new and coordination with the CPD is necessary to determine if the boat launch ramp and be temporary removed and a temporary ramp placed over the existing stairs for river access. The depth of the river at this location is unknown and survey data should be reviewed to ensure that equipment can traverse the river to access the dam. The depth of the river from the upstream side of the dam is 2 feet or less, and equipment can traverse the river the reach the dam from the upstream side. Another option for dam

removal is to place equipment at the south-east platform next to the dam (see picture below). Clearing and grubbing maybe necessary for access.

Pic 2: Downstream Access for Dam Removal

There is an existing river access upstream of the dam that can be used to access for the river for dam removal, concrete removal, and step stone/riffle placement. Clearing and grubbing maybe necessary for the haul route to the river access.

Pic 3: Upstream Access for River Work

3.0 Interior Drainage

4.0 Utilities

An Information Retrieval Process (IPR) is being initiated with the City of Chicago Office of Underground Coordination (OUC). A map of the project site was submitted to the OUC on 10 December 2015. The OUC will send the map to the utility companies for their review and response. Results from inquires will be available 30 days after an OUC # has been issued. The result will provide information of utilities in the areas with contact information for further coordination. Utility conflicts identified will be further investigated during the design phase.

5.0 Surveying and Mapping

The horizontal coordinates used for this project referenced the Illinois State Plane Coordinate System, East Zone (Zone Number 1201), North American Datum of 1983 (NAD83) U.S. feet. The elevations used is referenced to the North American Vertical Datum of 1988 (NAVD 88) U.S. feet. The elevation data used is from a GIS Lidar data from a 2003 data provided by the Cook County of Illinois. This data set was created by Cook County to serve as part of a standard database for virtually all geospatial applications in Cook County, and is intended to support general location, planning, and cartography projects, as well as general inventory and asset management, Census analysis and mapping, and geocoding by address. This data set is

adequate for this feasibility study and actual survey of the site will be performed for the design phase.

A draft Scope of Work (SOW) for survey has been completed for a survey contract to begin in the winter of 2016. The SOW includes: topographic surveys of the river banks and upland areas within the project limits; hydrographic/bathymetric survey at the confluence of NBCR and NSC to locate the existing scour hole directly below the dam; and channel cross-sections at the NBCR, upstream of the dam to the existing pedestrian bridge. The survey will include all utilities encountered within the project areas. Existing trees to remain will also be surveyed.

6.0 Recommended Plan Project Features

6.1 Dam Removal

It is assumed that the dam will be removed under wet conditions. However, the use of a cofferdam or a bypass system may be an option if this system will be used for other work in the vicinity such as excavation of the channel for the step stones and riffle placement. The entire dam will be removed from bank to bank. The existing retaining walls connected to the dam will not be removed. The weir segment of the dam will first be removed to allow for the initial draw down of the river and removal of the rest of the dam can be completed.

It is assumed that the concrete debris from dam removal activities will be reused on site. The concrete will be crushed to 3 inches or less and can be used as bedding stones for the toe stone protection.

6.2 Concrete Removal

The channel upstream of the dam is lined with concrete. There is also a concrete platform that collapsed across the river. These concrete features will be removed from the channel. The concrete channel will be removed from the dam to the existing pedestrian bridge. A boring test will be performed under the soil boring contract to determine the thickness of the concrete and presence of reinforcement in the concrete. It is assumed that the concrete debris from concrete removal activities will be reused on site. The concrete will be crushed to 3 inches or less and can be used as bedding stones for the toe stone protection.

6.3 Step Stones and Riffle Placement

Step stones and riffles will be placed after dam removal. There is approximately 13 feet elevation difference from the dam to the confluence. Step stones and riffles will be placed to transition the change in elevation along the river. Seven step stones and riffles will be placed starting from the existing pedestrian bridge to the confluence. Refer to the H&H appendix for design details of these features.

The river bed will be excavated to place the step stones and riffles. It is assumed that excavation will be completed under dry conditions. A river bypass system is proposed to divert water away from the excavation area. There are different options for the bypass system. A stone dam or water bladder can be placed in the river, along the river, to section off the area of excavation while allowing for flow around the system in the channel. This will keep the channel partially opened. During high events, water will be allowed to flow over the excavated area. After these events, the excavated areas will be pumped and excavation work can proceed. Another option for a bypass system is to channel flow through a bypass pipe and around the area of excavation. The bypass pipe will outfall downstream of the dam. It is recommended to have the contractor provide a proposal for the bypass system under certain criteria to be specified in the contract documents. For cost estimating purposes, two (2) 48" bypass concrete pipes will be used to channel the river flow around the excavation areas. During high flow events, water will be allowed back into the channel which will have to be pumped to continue excavation work.

6.4 Tree and Shrub Removal

6.4.1 Clearing and Grubbing

Clearing and grubbing will be completed where grading will be performed.

6.4.2 Selective Tree Removal

Selective tree removal will be completed at the upland areas within the project limits.

6.5 Bank Grading and Stabilization

Most of the banks along the channel are eroded and will be graded to achieve a stable slope suitable for planting. Some banks are highly eroded compared to other areas and grading can be prioritize if necessary. Clearing and grubbing will be completed where grading will occur, which is acceptable to the CPD. The banks will be graded to a proposed slope of 3(H):1(V). More gradual slopes can be used, but will claim more park land and tree removal. Grading will impact some of the park features such as the pathways and multi-use trails. The trails and pathways impacted from grading will be replaced. The CPD have been notified of these impacts and have confirmed that replacement of the impacted paths are acceptable. The graded banks will be planted and bio-de-gradeable coconut erosion control blankets will be placed for bank stabilization.

There are two baseball fields in close proximity to the river at the east bank just south of W. Bryn Mawr Ave. A 3(H):1(V) slope will impact these fields. Therefore, terrace retaining walls are proposed at this location for bank stabilization. For cost estimating, a flagstone wall is assumed for the retaining walls. Other wall options can be evaluated during design. Toe protection will be placed along the retaining for erosion protection and also serve as flagstone habitat.

The CPD requested a mulch trail along the river where grading will be performed. A 3 FT trail will be incorporated into the grading plan. The trees removed will be chipped for the mulch trail.

6.6 Toe Stone Protection

Toe stone protection will be placed at a few areas along the river banks. Refer to the H&H appendix for more information on toe protection. The toe protection areas are identified on the drawings. Toe protection will be at the following areas:

6.6.1 NBCR and NSC Confluence

The east bank opposite from the confluence between the NBCR and NSC is highly eroded due to forces from the Chicago River. The bank will be graded and 250 LF of toe protection will be placed. There is an existing concrete outlet structure at this area and toe protection will be placed on either side of this structure. Tree revetment will also be placed under the banks and along the toe protection for ecological habitat.

Pic 4: Toe Protection Area

6.6.2 West Bank between Peterson Ave. and Bryn Mawr Ave.

There is an existing outlet structure on the east bank approximately mid-point between Peterson Ave. and Bryn Mawr Ave. The flow from the structure is causing erosion at the opposite bank. 200 LF of toe protection will be placed on the west bank across from the outlet structure. Tree revetment will also be placed under the banks and along the toe protection for ecological habitat.

6.6.3 West Bank of Existing Bridges

At areas where grading will be completed, there are three locations identified for toe protection at the west bank and adjacent to existing bridges. 200 LF of toe protection will be placed at these locations.

6.6.4 Potential Seepage Problem Areas

Three areas along the river banks have been identified to have potential seepage problems. These are areas where historic maps shows the old river channel remeandered and intercepts with the current channel alignment. There is assumed that the material used to fill the river will not be suitable for grading and therefore may cause seepage. Geotechnical borings will be performed during the design phase for further investigations. Refer to the Geotechnical Appendix for more information. Toe stone protection will be placed where grading will be performed at these areas. The first area is located on the west bank between Peterson Ave. and Bryn Mawr Ave, approximately 100 LF of bank may be impacted. The second area is located on the east bank between Peterson Ave. and Bryn Mawr Ave., approximately 100 LF of river bank may be impacted. The third location is located between Bryn Mawr Ave., and Foster Ave at the east bank and approximately 100LF of river bank may be impacted.

6.6.5 Toe of Retaining Wall

Toe protection and flagstone habitat will be placed along the terrace retaining walls. The flagstone walls are proposed adjacent to the existing baseball parks due to close proximity of the parks to the river.

7.0 Maintenance and Traffic

Maintenance of traffic during construction is required. Pavement for the road surfaces damaged during construction will be removed and replaced in accordance with IDOT specifications for pavement patching.

8.0 References

U.S. Army Corps of Engineers, 1993, *Engineering and Design Cost Engineering Policy and General Requirements, Engineering Regulation 1110-1-1300,* Department of the Army, Washington D.C., 26 March 1993.

U.S. Army Corps of Engineers, 1999, *Engineering and Design for Civil Works Projects, Engineering Regulation 1110-2-1150,* Department of the Army, Washington D.C., 31 August 1999.

9.0 Attachments

9.1 Bid Schedule

Title: Bid Schedule - Section 00010
Project Name: River Riparian Connectivity and Habitat Section 506
Phase: Feasibility
Date: 1/8/2016
Lead Engineer: Faye Leffler
Estimator: Witold Kluza

ITEM	DESCRIPTION	Quantity	U/M	Unit Price	Amount
00 01	MOBILIZATION/DEMOBILIZATION	1	JOB		
00 02	TEMPORARY CONSTRUCTION FACILITIES	1	JOB		
00 03	MAINTENANCE OF TRAFFIC	1	JOB		
00 04	DEMOLITION AND REMOVAL	1	JOB		
00 05	CLEARING AND GRUBBING	10	AC		
00 06	EARTHWORK FOR GRADING, EXCESS CUT	41,000	CY		
00 07	EARTHWORK FOR STEP STONES AND RIFFLES CONSTRUCTION, EXCESS CUT	3,100	CY		
00 08	STEP STONES AND RIFFLES	1,700	TON		
00 09	RIVER BYPASS	1	JOB		
00 10	TOE STONE PROTECTION	2,300	TON		
00 11	FLAGSTONE RETAINING WALL	1,800	TON		
00 12	3 FT MULCH TRAIL	7,900	LF		
00 13	MULTI-USE TRAIL REPLACEMENT	3,400	SY		
00 14	EROSION CONTROL BLANKET - BIODEGRADABLE COCONUT BLANKET	43,000	SY		
00 15	TURBIDITY CURTAIN	250	LF		
00 16	SELECTIVE TREE AND SHRUB REMOVAL	14.2	AC		
00 17	PRESCRIBED BURN	14.2	AC		
00 18	SEEDING				
00 18 A A	AQUATIC BED SEED MIX	3.0	AC		
00 18 A B	BANK SEED MIX	26.2	AC		
00 18 A C	SAVANNA SEED MIX	29.2	AC		
00 18 A D	STREAM SEED MIX	1.0	AC		
00 19	PLUGS				
00 19 A A	AQUATIC BED PLUGS	4,000	EA		
00 19 A B	BANK PLUGS	56,800	EA		
00 19 A C	SAVANNA PLUGS	116,800	EA		
00 19 A D	STREAM PLUGS	4,000	EA		
00 20	1 GALLON TREES	947	EA		
00 21	5 GALLON TREES	539	EA		
00 22	SITE PREPARATION, YEAR 1	1	JOB		
00 23	INVASIVE SPECIES CONTROL AND ESTABLISHMENT ACTIVITIES, YEAR 2	54	AC		
00 24	INVASIVE SPECIES CONTROL AND ESTABLISHMENT ACTIVITIES, YEAR 3	54	AC		
00 25	INVASIVE SPECIES CONTROL AND ESTABLISHMENT ACTIVITIES, YEAR 4	54	AC		
00 26	INVASIVE SPECIES CONTROL AND ESTABLISHMENT ACTIVITIES, YEAR 5	54	AC		
00 27	PERFORMANCE AND PAYMENT BOND	1	COST		
	Total Estimate				

9.2 Quantity Takeoff

US Army Corps of Engineers, Chicago District	PROJECT TITLE: River Riparian Connectivity and Habitat Section 506	COMPUTED BY: FAYE LEFFLER	DATE: 12/29/2015
	COMPUTATION TITLE: QUANTITY COMPUTATIONS	CHECKED BY: WITOLD KLUZA	DATE: 1/8/2016

TEMPORARY CONSTRUCTION FACILITY

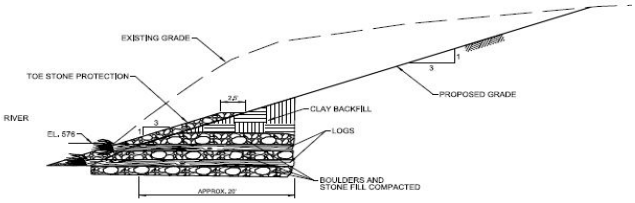
6FT Chainlink Fencing will be placed along areas of grading and staging areas.
There are 12 site access identified where chainlink fence will be placed.

Fencing Location	Length (FT)
West Bank A & B	4241
West Bank C	1104
East Bank A	3250.4
East Bank B	3170.4
East Bank C	3429
	15194.8

Total Chainlink Fence length = 15194.8 LF
Total number of gates for access = 12 Gates

EARTHWORK FOR GRADING

The banks for the project were graded using a 3H:1V slope, except for where flagstone walls are placed. Due to space limitations, the riverside of the flagstone walls were graded with a 2(H):1(V) slope. Terrain model to terrain model volume method was use to compute the earthwork volumes for the bank grading with the exception of East Bank B. End Area Volumes method was used to compute earthwork volumes for East Bank B grading and flagstone placement.
The surface area for grading were provided in the grading terrain model report.
Additional 30% will be added to the excess cut material to account for the logs and stone/bounder placement for the 450LF tree revetment to be placed.



BANK GRADING WITH TOE STONE PROTECTION AND TREE REVETMENT- TYPICAL SECTION
N.T.S.

Grading Locations	Cut Volume (CF)	Fill Volume (CF)	Cut Balance (CF)	Cut Balance (CY)	Surface Area (SF)	Grading Length (FT)
West Bank A	110152.323	0.003	110152.32	4079.715556	21681.269	352.4956
West Bank B	287480.176	0.433	287479.743	10647.39789	68820.997	1298.599
West Bank C	46428.196	7.15	46421.046	1719.298	12186.061	243.0729
East Bank A	413282.979	18.189	413264.79	15306.10333	107831.625	921.6949
East Bank B	0	0	0	0	124173.507	2449.5049
East Bank C	228244.439	1.649	228242.79	8453.436667	52054.73	2400
TOTAL =				40205.95144	386748.189	7665.3673
					42972.021 SY	

Total Grading Volume (Excess) = 40205.95144 CY
Percentage of grading versus tree revetment length = 6%
Additional 30% of excess cut of tree revetment placement = 708.0943721 CY
Total Excess Grading Cut = 40914.04582 CY

CLEARING AND GRUBBING

clearing and grubbing will be completed at all graded areas.

Total Area = 386748.189 SF
8.878516736 AC

3FT MULCH TRAIL

3FT mulch trail will be placed close to the river along the graded areas at the banks.

Trail Locations	Length (FT)
West Bank A	352.4956
West Bank B	1298.599
West Bank C	243.0729
East Bank A	2400
East Bank B	2450.4764
East Bank C	1075.1439
	7819.7878 LF

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MULTI-USE TRAIL REPLACEMENT

Grading of the banks will impact sections of the multi-use trail located at the top of the bank. The existing trail is asphalt and the sections impacted will be replaced with asphalt.

Trail Locations	Length (FT)	Trail Width (FT)	Pathway Area (SF)
West Bank A	210	6	1260
West Bank B	1257	6	7542
West Bank C	207	10	2070
East Bank A	611	10	6110
East Bank B	1303	10	13030
East Bank C	0	10	0
			30012

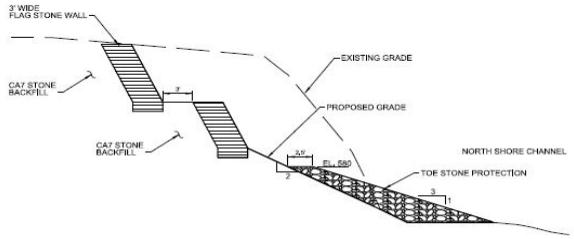
Total Area of Trail to be replaced = 3334.666667 SY

EROSION CONTROL BLANKET - BIODEGRADABLE COCONUT BLANKET

Biodegradable coconut erosion blanket will be placed over the graded area for bank stabilization.
Total Area = 42972.021 SY

FLAGSTONE RETAINING WALL

There are existing baseball field in close proximity to the river. A 3H:1V grade will impact these field. Therefore, terace retaining walls are proposed at this location with a 2H:1V grading slope at the river. Toe protection will be provided along the retaining walls for erosion protection.



TERRACE FLAGSTONE WALL -TYPICAL SECTION
N.T.S.

Length of Walls =	1037	LF
Flagstone wall surface area =	7741	SF
Flagstone wall Vol. =	779.4	CY
Assuming 2.2 CY/TN	1714.68	TN

Quantity Check of Flagstone Volume

Average Area landward wall =	22	SF
Wall length =	520	LF
Average Area riverward wall =	18	SF
Wall Length =	517	LF
Total Wall Volume =	768.3703704	CY

DEMOLITION AND REMOVAL

Concrete Removal (Upstream of Dam)

Assumptions: depth of concrete is 1 foot

Length	360	LF
Area	23346.0248	SF
Concrete Volume	864.7	CY

Concrete will be crushed and used to fill in the scour hole upstream of dam and bedding stones for the riffle and toe protection

Dam Removal

Assumptions: Dam thickness = 18"; Dam average height from river bed = 8';
Add 50% to the dam wall volume to account for the four wing walls connected to the dam.

Dam Length	105	FT
Volume of Concrete	46.66666667	CY
50% Addition	70	CY

Concrete will be crushed and used as bedding stones for the riffle and toe protection

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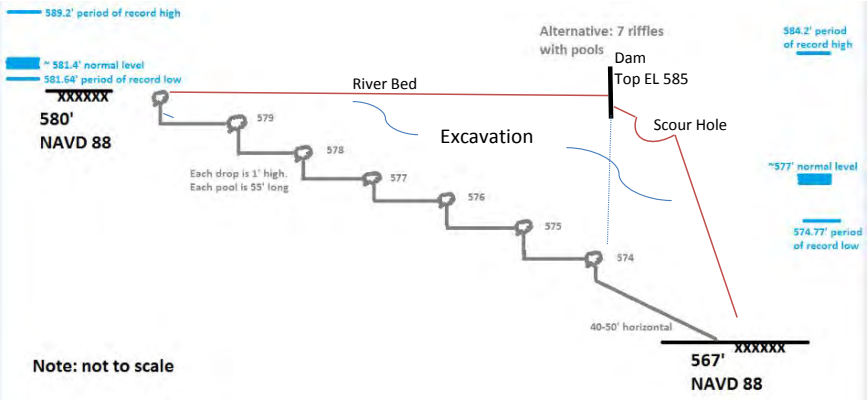
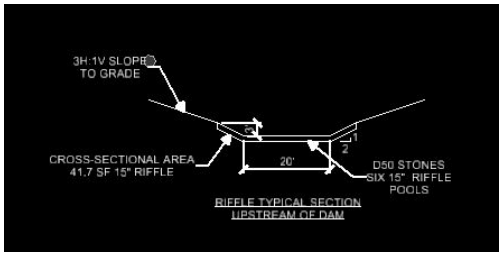
STEP STONES AND RIFFLES

Assumptions: the river bottom width is 20 feet upstream of dam and channel width is 65 FT. Immediately downstream of the dam, there are walls on both sides and no banks. Therefore the river bottom and channel have the same average width of 90 FT

Design Parameters: A total of 7 step stones and riffles; 6 riffles are 55 FT long and 1 riffle is 50 feet long (horizontal). Each step stone has a 1 FT drop.
Riffles will transition river bedding elevation from EL. 580 at the existing pedestrian bridge to EL. 567 at the confluence. A total drop of 13 feet.



Length for Riffle Segment	380	FT
Average channel Width, dam upst	65	FT
Average channel Width, dam dow	90	FT
River Bottom Width, dam upstrea	20	FT
River Bottom Width, dam downstr	90	FT
Riffle length	55	FT



6 Riffles at 55 FT		
15" riffles cross-section area =	41.7	SF
6 riffles at 55 FT length =	330	FT
D50 Stone Volumes =	13761	CF
Weight: 1.6 TN/CY	815.47	TON

1 Riffle at 50 FT		
Surface area =	5146.1	SF
30" Depth D50 Stone Volume =	12865.25	CF
Weight: 1.6 TN/CY	762.39	TON

7 Step Stones at Each Riffle		
Assume thickness of step stones of 30"		
River Bottom Width =	20	FT
Depth of Stone =	2.5	FT
Stone thickness =	2.5	FT
D50 Stone Vol for 7 Step Stones =	32.40740741	CY
Weight: 1.6 TN/CY	51.85185185	TON
Total Stone Volume =	1629.70	TON

RIVER BYPASS AND EARTHWORK FOR STEP STONES AND RIFFLES

Excavation for Step Stones/Riffle Construction

A bypass system will be necessary to excavate the channel in the dry.

Excavation Upstream of Dam

Excavation Area =	1320	SF
River Bottom Width =	20	FT
Average channel width =	90	FT
River Slope Width (one bank) =	35	FT
River Bottom Excavation Vol =	977.7777778	CY
River Slopes Excavation Vol =	1711.111111	CY
Excavation Vol =	2688.888889	CY

US Army Corps of Engineers, Chicago District	PROJECT TITLE:	COMPUTED BY:	DATE:
	River Riparian Connectivity and Habitat Section 506	FAYE LEFFLER	12/29/2015
	COMPUTATION TITLE:	CHECKED BY:	DATE:
	QUANTITY COMPUTATIONS	WITOLD KLUZA	1/8/2016

Excavation Downstream of Dam

Excavation Area =	100	SF
Ave. River/Channel Width	90	FT
Excavation Vol =	333.3333333	CY
*Total Excavation Volume =	3022.222222	CY

River Bypass for Step Stones/Riffle Construction

A 48" bypass pipe will be placed on the North bank from the pedestrian bridge to the river confluence.

Length of 48" Bypass Pipe:	566	FT
Barrier Wall (Water Bladder)	70	FT

TOE STONE PROTECTION

Toe Stone Protection. See typical detail above.

Toe Stone Protection Location	Stone Vol (CY)	Length (FT)	Tree Revetment Length (FT)
West Bank A	126	200	
West Bank B	125.9	200	200
West Bank B, Seepage/Bridge	143.6	228.6	
East Bank A, Seepage	63	100	
East Bank B, Terrace Wall	623.1	511.6	
East Bank B, Seepage	62.9	100	
East Bank C	157.2	250	250
West Bank C	124.7	200	
	1426.4	1790.2	450

Total Stone Volume =	1426.4	CY
Assuming 1.6CY/TN	2282.24	TN
Length of toe stone protection =	1790.2	FT
Length of Tree Revetment =	450	FT

TURBIDITY CURTAIN

Turbidity curtain will be place along the river where stones will be placed in the river. The longest segment of toe stone protection along the river is 250 LF. Therefore 250 LF is estimated for the curtain and will be reused at each area where toe stone protection will be placed.

Length of Turbidity Curtain =	250	LF

TOTAL PROJECT AREA

Locatoin	Area (SF)	
West Bank Peterson-Bryn Mawr	610165.7369	
East Bank Peterson-Bryn Mawr	434467.4533	
East Bank Bryn Mawr-Foster	406527.8222	
East Bank Foster-Argyle	336134.8644	
West Bank Foster-Argyle	195652.2808	
West Bank Argyle-Lawrence	177342.2406	
East Bank Argyle-Lawrence	205528.9806	
	2365819.379	SF
	54.31173964	AC

US Army Corps of Engineers Chicago District	PROJECT TITLE: River Riparian Connectivity and Habitat Section	COMPUTED BY: FAYE LEFFLER	DATE: 12/15/2015
	COMPUTATION TITLE: PowerInroads Volume Report	CHECKED BY: WITOLD KLUZA	DATE: 1/8/2016

End Area Volume Report for East Bank B Grading and Flagstone Wall Placement

Cross Section Set Name: East Bank B1
Alignment Name: East Bank B

Input Grid Factor: 1 Note: All units in this report are in feet, square feet and cubic feet unless specified otherwise.

Baseline Station	Station Quantities								Mass
	Cut				Fill				
	Factor	Area	Volume	Adjusted	Factor	Area	Volume	Adjusted	Ordinate
0+79.0000	1	163	0	0	1	0	0	0	0
1+00.0000	1	180	3601.8	3601.8	1	0	3.4	3.4	3598.4
1+50.0000	1	238	10447.6	10447.6	1	0	0	0	14046
2+00.0000	1	157	9875	9875	1	0	0	0	23920.9
2+50.0000	1	179	8416.5	8416.5	1	0	0	0	32337.4
3+00.0000	1	202	9522	9522	1	0	0	0	41859.5
3+50.0000	1	220	10543.9	10543.9	1	0	0	0	52403.4
4+00.0000	1	182	10057.7	10057.7	1	0	0	0	62461.1
4+50.0000	1	235	10427.2	10427.2	1	0	0	0	72888.3
5+00.0000	1	202	10915.1	10915.1	1	0	0	0	83803.4
5+50.0000	1	161	9056.1	9056.1	1	0	0	0	92859.5
6+00.0000	1	339	12486.7	12486.7	1	0	0	0	105346.2
6+50.0000	1	323	16549.9	16549.9	1	0	0	0	121896.1
7+00.0000	1	305	15710.3	15710.3	1	0	0	0	137606.4
7+50.0000	1	305	15256.3	15256.3	1	0	0	0	152862.7
8+00.0000	1	327	15790	15790	1	0	0	0	168652.7
8+50.0000	1	304	15764.8	15764.8	1	0	0	0	184417.5
9+00.0000	1	287	14779.6	14779.6	1	0	0	0	199197.1
9+50.0000	1	274	14033	14033	1	0	0	0	213230.1
10+00.0000	1	256	13263.5	13263.5	1	0	0	0	226493.6
10+50.0000	1	286	13552.8	13552.8	1	0	0	0	240046.4
11+00.0000	1	307	14820.8	14820.8	1	0	0	0	254867.2
11+50.0000	1	354	16537.3	16537.3	1	0	0	0	271404.5
12+00.0000	1	344	17465.6	17465.6	1	0	0	0	288870.1
12+50.0000	1	310	16364.4	16364.4	1	0	0	0	305234.5
13+00.0000	1	344	16357.6	16357.6	1	0	0	0	321592.1
13+50.0000	1	231	14382.8	14382.8	1	0	0	0	335974.9
14+00.0000	1	223	11351	11351	1	0	0	0	347325.8
14+50.0000	1	273	12400.7	12400.7	1	0	0	0	359726.6
15+00.0000	1	259	13318	13318	1	0	0	0	373044.6
15+50.0000	1	213	11803.5	11803.5	1	0	0	0	384848.1
16+00.0000	1	254	11673.9	11673.9	1	0	0	0	396522
16+50.0000	1	293	13676.5	13676.5	1	0	0	0	410198.5
17+00.0000	1	355	16198.5	16198.5	1	0	0	0	426397
17+50.0000	1	331	17153.7	17153.7	1	0	0	0	443550.6
18+00.0000	1	303	15839.7	15839.7	1	0	0	0	459390.3
18+50.0000	1	341	16093.5	16093.5	1	0	0	0	475483.8
19+00.0000	1	307	16194.4	16194.4	1	0	0	0	491678.2
19+50.0000	1	334	16015.1	16015.1	1	0	0	0	507693.3
20+00.0000	1	307	16019.3	16019.3	1	0	0	0	523712.6
20+50.0000	1	329	15887.4	15887.4	1	0	0	0	539600
21+00.0000	1	373	17550.6	17550.6	1	0	0	0	557150.6
21+50.0000	1	438	20292.6	20292.6	1	0	0	0	577443.2
22+00.0000	1	431	21739.9	21739.9	1	0	0	0	599183.1
22+50.0000	1	418	21242	21242	1	0	0	0	620425.1
23+00.0000	1	415	20829.1	20829.1	1	0	0	0	641254.2
23+50.0000	1	438	21321.8	21321.8	1	0	0	0	662575.9
24+00.0000	1	479	22931.1	22931.1	1	0	0	0	685507
24+50.0000	1	503	24561.2	24561.2	1	0	0	0	710068.3
25+00.0000	1	522	25623.8	25623.8	1	0	0	0	735692
25+27.0000	1	510	13930.8	13930.8	1	0	0	0	749622.9
Grand Total:			749626.3	749626.3			3.4	3.4	

US Army Corps of Engineers Chicago District	PROJECT TITLE: River Riparian Connectivity and Habitat Section	COMPUTED BY: FAYE LEFFLER	DATE: 12/15/2015
	COMPUTATION TITLE: PowerInroads Volume Report	CHECKED BY: WITOLD KLUZA	DATE: 1/8/2016

West Bank A Volume Report

Terrain to Terrain Volume

Terrain Exst To Terrain West Bank A
Cut Factor = 1.000
Fill Factor = 1.000

Cut = sf3	110152.323	CF
Fill = sf3	0.003	CF
Balance = sf3	-110152.319	CF

West Bank B Volume Report

Terrain to Terrain Volume

Terrain Exst To Terrain West Bank B
Cut Factor = 1.000
Fill Factor = 1.000

Cut = sf3	287480.176	CF
Fill = sf3	0.433	CF
Balance = sf3	-287479.743	CF

East Bank A Volume Report

Terrain to Terrain Volume

Terrain Exst To Terrain East Bank A
Cut Factor = 1.000
Fill Factor = 1.000

Cut = sf3	413282.979	CF
Fill = sf3	18.189	CF
Balance = sf3	-413264.789	CF

East Bank C Volume Report

Terrain to Terrain Volume

Terrain Exst To Terrain East Bank C
Cut Factor = 1.000
Fill Factor = 1.000

Cut = sf3	228244.439	CF
Fill = sf3	1.649	CF
Balance = sf3	-228242.789	CF

West Bank C Volume Report

Terrain to Terrain Volume

Terrain Exst To Terrain West Bank C
Cut Factor = 1.000
Fill Factor = 1.000

Cut = sf3	46428.196	CF
Fill = sf3	7.15	CF
Balance = sf3	-46421.045	CF

Elements Component Quantities Report

Input Grid Factor:

Note: All units in this report are in feet, square feet and cubic yard unless specified otherwise.

Surface	Material	Area	Volume	Unit Cost	Material Cost
Corridor:			East Bank B		
Flagstone Wall Volume	C-I-Wall:		779.4		
Flagstone Wall Surface Area	C-I-Wall Toe Outline:	7741			
	C-Sidewalk:	3090			
	C-Channel Top of Bank:	117797			
	Bottom Mesh:	6871			

US Army Corps of Engineers, Chicago District	PROJECT TITLE: River Riparian Connectivity and Habitat Section 506	COMPUTED BY: FAYE LEFFLER	DATE: 12/15/2015
	COMPUTATION TITLE: Toe Stone Protection Quantity PowerInroads Report	CHECKED BY: WITOLD KLUZA	DATE: 1/8/2016

Elements Component Quantities Report

Input Grid Factor:

Note: All units in this report are in feet, square feet and cubic yard unless specified otherwise.

Surface	Material	Area	Volume	Unit Cost	Material Cost
Corridor:			West Bank A_Toe Protection		
	C-Riprap Revetment:		126	[redacted]	[redacted]
Corridor:			West Bank B_Toe Protection		
	C-Riprap Revetment:		125.9	[redacted]	[redacted]
Corridor:			West Bank B_Bridge and Seepage Toe Protection		
	C-Riprap Revetment:		143.6	[redacted]	[redacted]
Corridor:			East Bank A_Seepage Toe Protection		
	C-Riprap Revetment:		63	[redacted]	[redacted]
Corridor:			East Bank B_Toe Protection at Terrace Wall		
	C-Riprap Revetment:		623.1	[redacted]	[redacted]
Corridor:			East Bank B_Seepage toe protection		
	C-Riprap Revetment:		62.9	[redacted]	[redacted]
Corridor:			East Bank C_Toe Protection		
	C-Riprap Revetment:		157.2	[redacted]	[redacted]
Corridor:			West Bank C_Toe Protection		
	C-Riprap Revetment:		124.7	[redacted]	[redacted]
Totals:					
	C-Riprap Revetment:		1426.4	[redacted]	[redacted]
Total Estimated Cost:					[redacted]

9.3 Project Feature Map

U.S. Army Corps Of Engineers ®
Chicago District

Legend

- TOE PROTECTION
- TOE PROTECTION AND TREE REVETMENT HABITAT
- TOP PROTECTION AND FLAG STONE HABITAT
- FLAG STONE
- GRADING AREA
- FENCING (Work Limits)
- WORK LIMITS
- STEP STONES AND RIFFLES

1 in = 200 ft

0.05 0.025 0 0.05 0.1 Miles

N E S W

RIVER RIPARIAN
ECO RESTORATION
SECTION 506
SHEET 1 of 3
Chicago District, U.S. Army Corps of Engineers

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U.S. Army Corps Of Engineers ®
Chicago District

Legend

- TOE PROTECTION
- TOE PROTECTION AND TREE REVETMENT HABITAT
- TOE PROTECTION AND FLAG STONE HABITAT
- FLAG STONE
- GRADING AREA
- FENCING (Work Limits)
- WORK LIMITS
- STEP STONES AND RIFFLES

1 in = 200 ft

0.05 0.025 0 0.05 0.1 Miles

N E S W

RIVER RIPARIAN
ECO RESTORATION
SECTION 506
SHEET 2 of 3

Chicago District, U.S. Army Corps of Engineers

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Chicago District

Legend

- TOE PROTECTION
- TOE PROTECTION AND TREE REVETMENT HABITAT
- TOP PROTECTION AND FLAG STONE HABITAT
- FLAG STONE
- GRADING AREA
- FENCING (Work Limits)
- WORK LIMITS
- STEP STONES AND RIFFLES

1 in = 200 ft

0.05 0.025 0 0.05 0.1 Miles

N E S W

RIVER RIPARIAN
ECO RESTORATION
SECTION 506
SHEET 3 of 3

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