

**Mitigation Plan
for
Stream and Wetland Impacts**

**Joes Run Mine Site
(KDNR #830-0092, Amend. #3)**

Daviess County, Kentucky

Prepared for:

**Western Kentucky Minerals
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Stream and Wetland Mitigation Plan

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C. Compensatory Mitigation: Joes Run Mine Site – Amendment #3

(1) Goals and Objectives

Streams will be replaced on site and will perform the same functions as the existing streams as described in the baseline report. The goal of stream mitigation will be to provide in-stream habitat and to construct stable stream systems that convey the bankfull discharge and sediment supplied by the watershed. Stream dimensions, patterns, and profiles will be constructed so as to create stream types that would naturally occur within the proposed valleys and hydrologic conditions. Existing wetland functions are described in the *Individual 401 Permit Application* and the baseline report. Wetland mitigation will occur on-site and will provide the same or enhanced functions as the existing wetlands (i.e., impacted emergent wetlands will be replaced with forested wetlands). The wetland mitigation site will adjoin a previously approved wetland restoration site, providing forested wetlands on both sides of Joes Run. The stream and wetland plans were developed and designed by consultants and applicant staff with training and experience in Rosgen natural stream design and in wetland design methodologies. They have additional training and experience in hydrology, and construction. The stream and wetland mitigation will occur in two phases, concurrent with phased mining.

(2) Site Selection

Site selection for stream mitigation was based on the principal of replacing the aquatic resource impacted on-site and in-kind. The most practical way to replace the existing stream functions and contribute to the aquatic resource needs of the watershed is to create stream systems and drainage networks that are similar to, or better than, the existing conditions. On-site selection for wetland mitigation involved several factors. Areas considered good candidates for wetland mitigation must meet certain criteria including adequate hydrology, the potential to develop wetland soils and vegetation, and have a high probability for success. The mitigation sites chosen, for both streams and wetlands, have a great potential for success and improvement over existing conditions. The perennial/intermittent stream has a large watershed to provide more than adequate hydrology for maintaining flow regime status and overbank flooding for the wetland site. The broad valley floodplain allows for establishment of proper stream meanders and floodprone widths, and the development of a bottomland forested wetland.

Challenges to the stream and wetland mitigation plan include the re-creation of watersheds similar in size and slope during reclamation. Like any construction site of this size, variability in topography, erosion and sediment control/maintenance will have to be addressed; especially during the time vegetation is first being established. To lessen impacts from erosion and

excessive sedimentation, efforts will be made for channel construction to be performed during the dry conditions. Seed mixes and trees will have to be checked for viability and prevention of unwanted species being introduced. In-stream structure placement and other critical construction points will require the presence of trained staff or consultant personnel. Although mitigation construction presents challenges, it can be successfully performed.

(3) Baseline Information

(a) All stream mitigation that will be performed on-site will at the approximate location of existing streams. Wetland mitigation will be conducted on-site where the largest existing wetlands will be impacted during mining; and subject to approval by the USACE. The site considered for wetland mitigation is located in the floodplain along a large perennial/intermittent stream to be mitigated (near its most downstream point within the permit boundary) and will be adjacent to previously approved wetland areas. See Section A of the IP Application for impacts discussion.

(b) It is proposed that a total of 1552 feet of ephemeral stream, 7253 feet of intermittent stream, 1151 feet of perennial stream, and 2.20 acres of palustrine forested (PFO) wetlands will be restored on-site. As proposed, the ephemeral streams will be restored at a 0.6:1 ratio. The combined lengths for intermittent and perennial streams will be at a 1:1 ratio. The wetlands will be restored at a 2.5:1 ratio.

(c) The aquatic resource type includes ephemeral, intermittent, and perennial streams, and forested and emergent wetlands.

(d) Please refer to the "Stream Habitat Assessment and Wetland Delineation Report" prepared for Western Kentucky Minerals, for existing conditions of streams and wetlands. The proposed wetland site will be located along the main perennial/intermittent stream that runs through the site. Most of the impacted and proposed resources are within the floodplain of Joes Run. The largest existing wetland site is forested, but some emergent wetlands are present. Elevations of the project site range from around 430 feet to 460 feet MSL, and the 100-year flood elevation is approximately 450 feet above mean sea level (according to FEMA flood mapping). The site is within one HUC-12 watersheds; the Joes Branch-North Fork Panther Creek watershed (twelve-digit HUC 051100050304). According to NRCS climate data, the region receives approximately 48 inches of rainfall per year.

(4) Mitigation Work Plan

(a) Boundaries of the proposed mitigation sites are provided in the exhibits.

(b) Stream construction will be conducted concurrently with the reclamation phases of the project. Stream construction will be integrated within valleys and floodplains having

characteristics corresponding to appropriate stream types. Valley stream morphology will consist of landform features that will correspond to proposed stream system morphology including meander planform (radius of curvature, wavelength, belt width and sinuosity), channel profile morphology (riffle/pool or step/pool bed features) and cross section dimensions (low flow, bankfull and flood prone).

Stream construction sequence will be as follows:

1. Locate and flag proposed thalweg.
2. Excavate corresponding bankfull width to bankfull elevation as indicated on plans.
3. Excavate bankfull channel to dimensions indicated on profile and cross sections.
4. Grade side slopes to obtain appropriate flood prone width.
5. Grade side slopes to tie into existing ground.
6. Install in-stream structures.
7. Add substrate in riffle and run sections if necessary to provide armoring and riffle habitat.
8. Prepare streambanks and riparian area for seeding.
9. Seed area with native seed mixture as indicated on planting detail sheet.
10. Install erosion control blanket as needed.
11. Plant native trees and shrubs.

(c) Wetland Construction will be conducted on-site in conjunction with stream mitigation construction. Please review the wetland mitigation report for mitigation and construction details.

Generally, wetland construction shall proceed as follows:

1. Implement erosion control measures.
2. Grade floodplain and overbank areas.
3. Prepare site for planting
4. Install vegetation

(d) Proposed streams will have similar drainage patterns and connectivity as existing conditions. Water sources for the proposed wetlands will include overbank flooding from Joes Run, watershed runoff, and direct rainfall.

(e) Native vegetation to be planted along stream banks and riparian zones include the following species or species available at the time of ordering and approved by USACE:

Grasses - Virginia wild rye (*Elymus virginicus*), Switchgrass (*Panicum virgatum*), Rough banyard grass (*Echinochloa muricata*), Big bluestem (*Andropogon gerardii*), Forking panic grass/smooth panic grass (*Dichanthelium dichotomum/dichotomiflorum*) and Annual rye (*Lolium perenne*).

Shrubs – Rough-leaf dogwood (*Cornus drummondii*), Strawberry bush (*Euonymus americanus*), and Indigo-bush (*Amorpha fruticosa*). Shrubs will be 3-gallon container grown, planted along the streambanks at high shear locations (ex., outside bends).

Trees – For perennial/intermittent streams: Pignut hickory (*Carya glabra*), Red oak (*Quercus rubra*), Chestnut oak (*Quercus orinus*), Black walnut (*Juglans nigra*), and White oak (*Quercus alba*). For ephemeral streams: Shagbark hickory (*Carya ovata*), Black cherry (*Prunus serotina*), Black oak (*Quercus velutina*), Flowering dogwood (*Cornus florida*), and Red bud (*Ceris canadensis*). Trees will be either 3-gallon container grown RPM planted at the rate of 60 trees per acre, or 3-gallon non-RPM planted at a rate of 120 trees per acre, or non-RPM bare root seedlings (minimum of 30 inches in height) planted at a rate of 450 stems per acre. Per Kentucky Division of Mine Permits (KDMP) requirements: planting of woody species will occur during first dormant season following stream restoration.

Native vegetation to be planted within the proposed wetland includes the following species:

Herbaceous – A herbaceous seed mix will be applied. The options are either the use of Cardino JFNew's "Wooded Wetland Establishment" seed mix, or plant the following list: Green bulrush (*Scirpus atrovirens*), Virginia wild rye (*Elymus virginicus*), Fox sedge (*Carex vulpinoidea*), Soft rush (*Juncus effuses*), Woolgrass (*Scirpus cyperinus*), and Common sneezeweed (*Helenium autumnale*).

Trees –Shellbark hickory (*Carya laciniosa*), Cherrybark oak (*Quercus pagoda*), Pin oak (*Quercus palustris*), Swamp white oak (*Quercus bicolor*), and Overcup oak (*Quercus lyrata*). Planting rates, sizes, spacing, and seeding are addressed on the stream and wetland mitigation plan sheets or in the wetland mitigation description. Changes to the planting plan shall be approved by USACE.

(f) Any vegetation that would hinder planting or provide excessive competition to natural regeneration of planted species will be removed with appropriate treatment, and documented in each annual monitoring report.

(g) Exotic vegetation control: The following efforts will be made to reduce introduction and dispersal of invasive species: removal of exotic species before mitigation begins, cleaning equipment before it reaches the site, inspecting labels on seed mixtures and mulch for composition and vegetative monitoring during the required monitoring period. Volunteers, invasives, and/or exotic vegetation along riparian zones and/or in wetland mitigation areas will be removed by mowing, digging, spraying, burning or a combination of these during annual maintenance; and documented in each annual monitoring report.

(h) The proposed mitigation plan sheets provide elevation and slope details for both stream and wetland designs.

(i) Erosion control methods will consist of the following: constructing stream channels during low or no flow periods, allowing vegetation to become established before flow is allowed into the channels, applying seed and installing erosion control blanket immediately after final

grading, planting trees and shrubs and installing silt fence as needed. Stream restoration will proceed in a downstream direction to avoid re-suspension of sediment.

(j) The proposed stream design is based on geomorphic and hydrologic principles incorporated with natural channel design techniques utilizing in-stream structures for habitat diversity and stream bank protection.

(k) The proposed stream plans indicate stream type, pattern, profile and dimensions for each stream. Stream morphology was determined by using regional curve data, collecting and studying data from the existing streams, sediment transport and hydrologic calculations, and experience designing and constructing streams.

(l) Natural channel design methods, in-stream structures and habitat enhancement features have been incorporated into the mitigation plan. The "C" Rosgen Stream Types are typically low relief channels found in well-developed floodplains, and have been designed to be more sinuous, with J-hooks, cross-vanes and/or pools placed at high shear locations along outside bends. The "E" Rosgen Stream Types have been designed to maintain a high resistance to bank erosion and downcutting. The relatively narrow and deep channel (low width/depth ratio) will help maintain transport capacity and the wide active floodplain will reduce shear stresses during high flow events. Habitat enhancement features will consist of root wads, log overhangs and submerged logs. These features will also provide bank stability while vegetation becomes established. Step-pool structures will be installed on "B" Stream Types. Through a series of rapids and scour pools, stream energy is dissipated and channel stability maintained. Pool to pool spacing will be based on bankfull width and stream gradient. In general, the steeper the slope the closer the pool to pool spacing will be. The ephemeral mitigation will include in-stream structures, such as log weirs and log overhangs for habitat and stability, and a wide riparian zone. If it is determined during stream construction that adequate riffle material is not present, then appropriately sized material will be supplied to riffle and run sections.

(m) Mitigation sites will be permanently protected and maintenance will be provided as needed throughout the monitoring period. Site protection will be provided through use of a restrictive/protective covenant. Maintenance will include elimination of volunteer species by use of general or spot applications of herbicides, hand picking and mowing where appropriate.

(o) A representative from the design team will be on site during critical phases of the construction process. The representative will make periodic site visits and will familiarize construction personnel with design plans and restoration methods.

(5) Performance Standards/Success Criteria

(a) Standards for assessing **stream** mitigation goals include:

1. Streams must be constructed to meet the dimension, pattern and profile of the indicated Rosgen Stream Type.
2. There should be no signs of excessive stream bank erosion or severe headcutting.
3. At the end of the monitoring period, the streams shall have average riffle cross section dimensions reflective of the indicated Rosgen Stream Type.
4. At the end of the monitoring period, the streams shall be progressing toward a minimum EPA Rapid Bioassessment Protocol Score in the sub-optimal range.
5. Root Production Method (RPM) trees will be planted at a rate of 60 trees per acre, or non-RPM 3-gallon container trees will be planted at a rate of 120 trees per acre, or bare root seedlings (minimum height - 30 inches) will be planted at a rate of 450 trees per acre.
6. Riparian vegetation shall have at least an 80 percent survival rate of the initial planting of 450 stems per acre, with no single planted tree species constituting more than 25 percent of the surviving species. The survival rate for RPM plantings is 90 percent. No one species shall comprise more than 25 percent of the surviving RPM plantings.
7. Riparian vegetation will consist of no volunteer species at the end of the monitoring period, although native volunteer hard mast species (oak and hickory spp.) may be allowed based on approval from the USACE.
8. Per Kentucky Division of Mine Permits (KDMP) requirements: one measure of project success will be final stream data sheet scores that equal or exceed pre-project scores.
9. In the riparian areas, herbaceous plantings must provide a minimum of 70 percent ground cover; with no one species accounting for more than 40 percent ground cover.
10. Linear footage and flow regimes will match the USACE approved mitigation plan.
11. Streams will have a definable bed and bank, with an Ordinary High Water Mark.
12. Stream channel and in-stream structures must be stable and functioning as designed.
13. Stream morphology must meet the proposed Rosgen classification (i.e., stream slope, sinuosity, belt width, meanders, bankfull cross-sectional area, width/depth ratios).
14. Annual monitoring should indicate that mitigation is progressing toward meeting success criteria.

(a) Standards for assessing **wetland** mitigation goals include:

1. Success will be based on the 2009 Draft Interim Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Eastern Mountains and Piedmont Region¹. The wetland area will be determined at the end of the monitoring period and will be based on

¹ U.S. Army Corps of Engineers. 2010. Interim Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Eastern Mountains and Piedmont Region, ed. J.S. Wakeley, R.W. Lichvar, and C.V. Noble. ERDC/EL TR-10-XX. Vicksburg, MS: U.S. Army Engineer Research and Development Center.

criteria outlined in the manual for wetland hydrology, hydric soils, and hydrophytic vegetation.

2. The following planting requirements apply to bare root seedlings; if alternative plantings are proposed (e.g., Root Production Method trees or transplanted trees) then planting rates and success criteria will be negotiated with USACE. A minimum of 450 seedlings will be planted per acre. A minimum of five species will be utilized, and no single species may constitute more than twenty percent of the initial planting. At the end of the monitoring period, no one tree species may constitute more than 25 percent of the final surviving stock, and 80 percent of the initial stock of bare root seedlings must survive, not including volunteers. Root shoots from dead stems will not be counted toward success.

For the herbaceous component, a minimum of five species will be planted. Herbaceous plantings will provide a minimum of 70 percent ground cover at the end of monitoring period, with no one species comprising more than 40 percent of the final cover.

3. Annual monitoring should indicate that mitigation is progressing toward meeting success criteria.

4. At the end of monitoring, a full delineation and land survey will be completed to determine the acreage of wetlands established.

(b) Adaptive Management

If success criteria are not met for any portion of the monitoring year and/or final success criteria are not satisfied, an analysis of the contributing conditions will be conducted and documented. Remedial action, if required by USACE, will be performed and documented by the applicant. Remedial actions may include replanting trees and shrubs, reseeding grasses, adjusting in-stream structures and repairing eroded banks. These actions will be performed at least twice, depending on the nature of the problem. Should these efforts not resolve the problem, another site will be found to replace failed sections of the mitigation site. The payment of an in-lieu fee is another option to compensate for sections of streams or wetlands that do not meet performance standards, based on the length of stream or acreage of wetland that does not support its intended function during the monitoring period.

(c) Project Performance Evaluations

All stream and wetland mitigation sites will be monitored in accordance with the Mitigation Final Rule, 2008. In general, the following guidelines will be used:

1. The monitoring period must be sufficient to demonstrate that the compensatory mitigation has met performance standards. The monitoring period length shall be a minimum of five years unless performance standards are met in less than five years. In this case, the

monitoring period length can be reduced if there are at least two consecutive monitoring reports that demonstrate that performance standards have been met. Longer monitoring timeframes are necessary for compensatory mitigation projects that take longer to develop. The monitoring period length shall be ten years for palustrine forested wetlands. The applicant can petition for early release after five years if success is assured.

2. Biannual inspections will be conducted each year during the first and last month of the growing season.

3. The first monitoring report will be due after the first full growing season following the initial planting.

4. Monitoring reports are due to USACE by January 31 for the previous year, and to the Kentucky Division of Mine Permits (KDMP) by December 31 for the same monitoring year.

5. Photo stations and monitoring stations will be at the same location.

6. For wetlands, one monitoring station will be required for every three acres of similar wetland type. At least one monitoring station will be required for each different wetland type. USACE data forms will be utilized to record conditions.

7. For streams, monitoring stations will be set at a minimum of 1 per 1500 feet of ephemeral stream, and 1 per 500 feet of intermittent stream.

8. The same monitoring stations shall be used every year.

9. Personnel familiar with natural stream and wetland design principles will perform monitoring tasks.

10. Stream monitoring will consist of assessing stream parameters and documenting vegetation survival.

11. Stream channel form and in-stream stability will be monitored to ensure stream functionality. Maintenance will be performed if the following conditions develop: excessive bank erosion occurs (RBP scores in the marginal range for bank stability), erosion around or under structures that would render them ineffective or cause collapse, excessive siltation of pools that reduces their effectiveness in reducing energy and/or adversely affects pool habitat, and upstream vertical bed erosion (headcut) that would jeopardize structure stability and lead to unstable channel conditions (RBP scores in the marginal range for epifaunal/substrate cover or sediment deposition). Channels will be inspected frequently by design and/or stream construction team. Stream channel maintenance will be performed as needed to ensure stream stability, function and value.

12. Monitoring reports will include a discussion of inspection findings. Conditions such as bank erosion, streambed characteristics and vegetation survival will be documented. Stream assessments will be conducted and RBP scores will be compared to pre-disturbance

scores and previous monitoring scores to determine if mitigation is progressing towards meeting goals. Any problems will be identified and remedial action taken.

13. Monitoring reports will include RPB assessments with conductivity, pH, and temperature readings. They will include photographic documentation of streams and riparian vegetation. In addition, riparian vegetation will be inspected and density, survivorship, composition, percent cover, and any non-native species will be documented.

14. Parties responsible for monitoring will be Armstrong personnel familiar with the project and natural channel design, or USACE-approved consultants.

15. For wetlands, monitoring wells will be installed per TN WRAP 05-02 (USACE 2005)² to establish flooding frequency and wetland boundaries. One piezometric well will be installed for the 2.20 acres proposed. Guidelines for well installation and interpretation as detailed in the USACE technical document will be followed.

16. When petitioning the Corps for release of mitigation requirements a full stream delineation for the mitigation site will be provided (e.g., linear footage, Rosgen, RBP, flow regimes, riffle/pool count, riparian vegetation survivability); for wetlands a delineation will also be provided (e.g., acreage, hydric soil development, hydrology, tree and herbaceous survivability)

(6) Project Success

The applicant will be responsible for all mitigation including construction oversight, monitoring and reports, corrective measures, site access control and protection. The surface mining operation will obtain and submit to KDMP a certification from a registered professional engineer that all mitigation work has been completed in accordance with the conditions of the Water Quality Certification.

(7) Site Protection

All mitigation property will be permanently protected through a restrictive/protective covenant. The covenant will be executed after completion of the mitigation construction. It will be recorded within 60 days after mitigation construction completion, with USACE notification of recording at the time of execution. Durable signs will be placed identifying all mitigation sites as areas not to be disturbed. They will be placed on approximately 500 foot intervals along streams and around the wetland perimeter. The mitigation sites will be integrated into the reclamation plan, with site access limited.

² U.S. Army Corps of Engineers. 2005. "Technical Standard for Water-Table Monitoring of Potential Wetland Sites," *WRAP Technical Notes Collection* (ERDC TN-WRAP-05-2), U.S. Army Engineer Research and Development Center, Vicksburg, MS.

(8) Contingency Plan

If success criteria are not met for any portion of the monitoring year and/or final success criteria are not satisfied, an analysis of the contributing conditions will be conducted and documented. Remedial action, if required by USACE, will be performed and documented by the applicant. Should these efforts not resolve the problem, the contingency plan for proposed streams or wetlands will be payment of in-lieu fees. Contingency payment will be based on the type and length of stream, or acreage of wetland, that does not support its intended function during the monitoring period.

(9) Monitoring and Long-Term Management

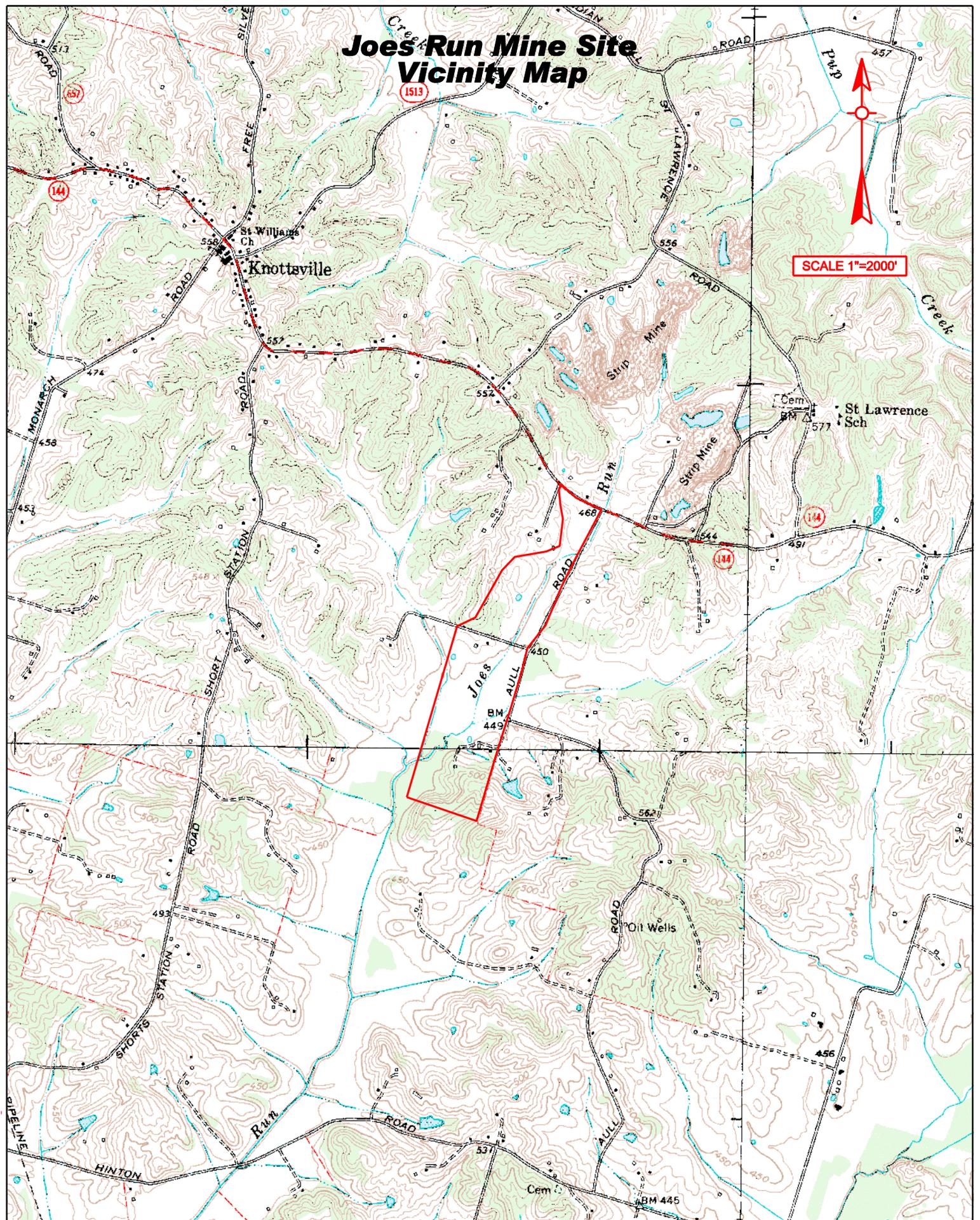
(a) The applicant will be responsible for accomplishing, maintaining, and monitoring all mitigation sites. Long-term management will include a restrictive/protective covenant to be recorded with property deeds. The covenant will be filed once mitigation has been completed.

(b) Monitoring plans will be provided as discussed under Performance Standards.

(10) Financial Assurances

The applicant will be responsible for managing any financial assurances and contingency funds set-aside for remedial measures. The USACE, Louisville District, currently does not have the means to handle financial assurances; therefore, no USACE-managed financial assurances are proposed for this project.

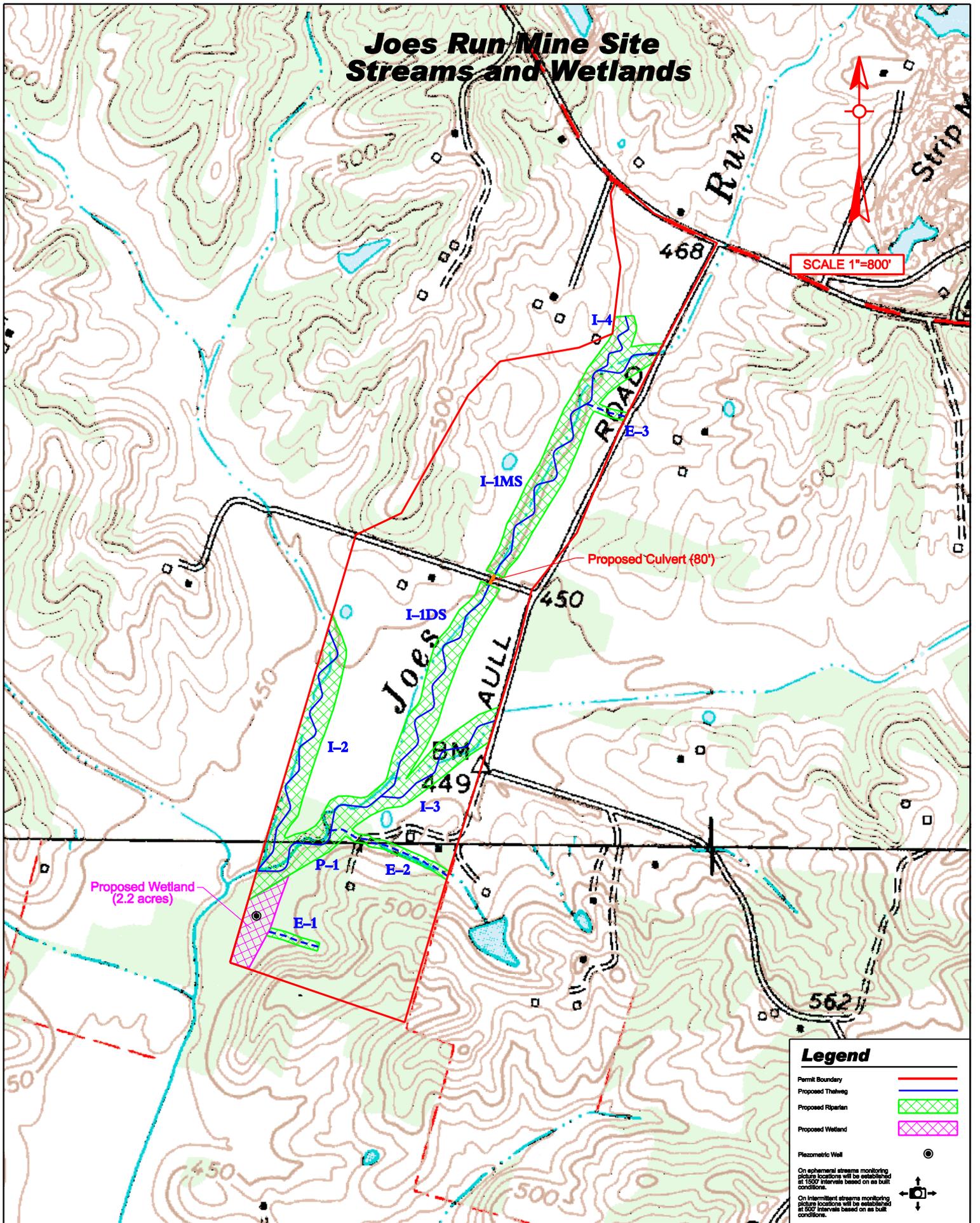
Joess Run Mine Site Vicinity Map



T.H.E. Engineers, Inc.	PROJECT: JOESS RUN MINE SITE - JURISDICTIONAL WATERS DELINEATION		STREAMS: UT'S OF NORTH FORK PANTHER CREEK	
	COUNTY: DAVIESS	STATE: KY	NEAR: KNOTTSVILLE	ITEM: VICINITY MAP
				EXHIBIT 1

DATE:

Joess Run Mine Site Streams and Wetlands



**T.H.E.
Engineers, Inc.**

PROJECT: JOESS RUN MINE SITE - PROPOSED MITIGATION SITES DELINEATION

STREAMS: UT'S OF NORTH FORK PANTHER CREEK

COUNTY: DAVIESS

STATE: KY

NEAR: KNOTTSVILLE

ITEM: QUAD MAP

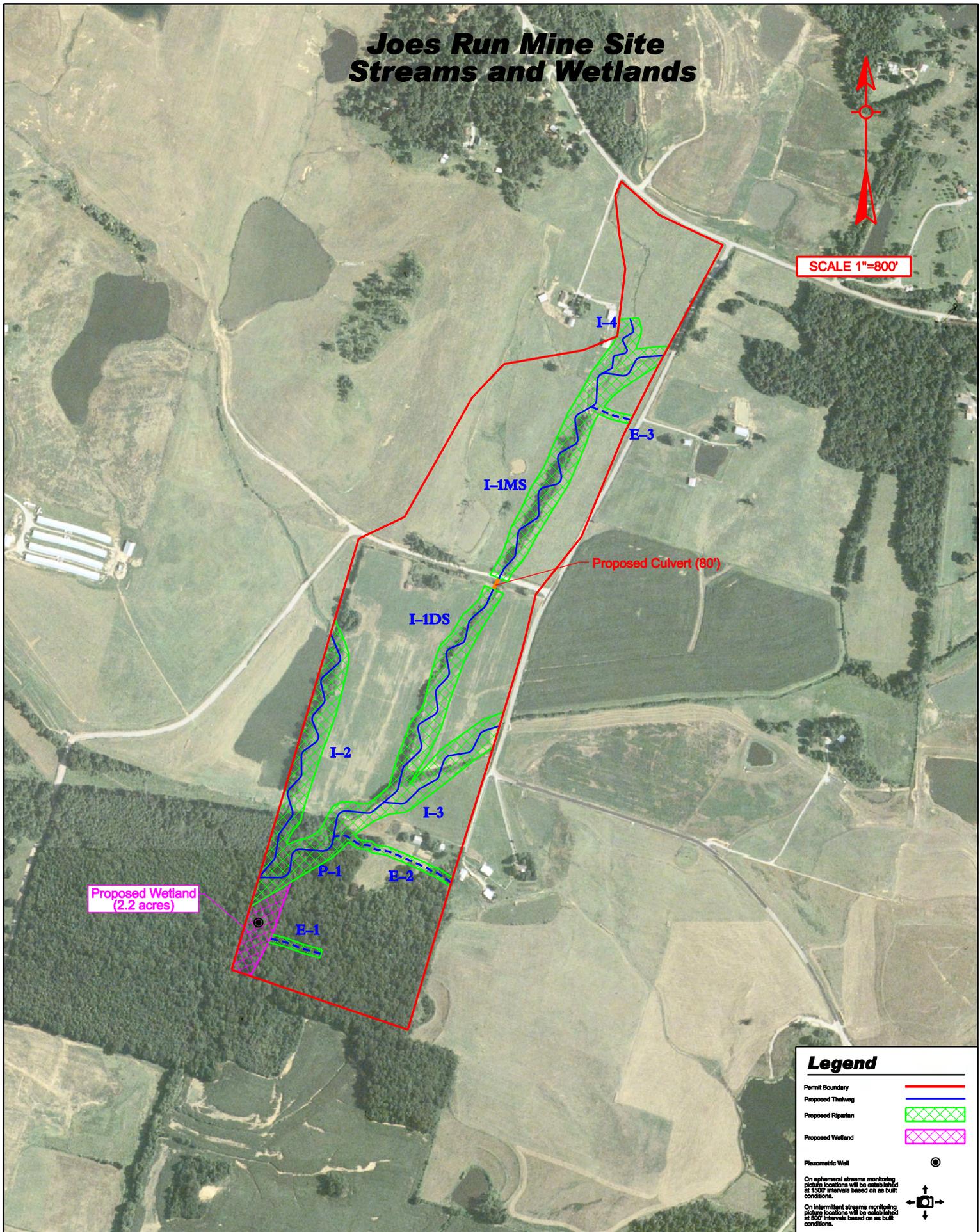
EXHIBIT 2

DATE:

Joes Run Mine Site Streams and Wetlands



SCALE 1"=800'



Legend

- Permit Boundary —
 - Proposed Thalweg —
 - Proposed Riparian ▨
 - Proposed Wetland ▨
 - Piezometric Well ●
- On ephemeral streams monitoring picture locations will be established at 1500' intervals based on as built conditions.
- On intermittent streams monitoring picture locations will be established at 500' intervals based on as built conditions.
-

**T.H.E.
Engineers, Inc.**

PROJECT: JOES RUN MINE SITE - PROPOSED MITIGATION SITES DELINEATION

STREAMS: UT'S OF NORTH FORK PANTHER CREEK

COUNTY: DAVIESS

STATE: KY

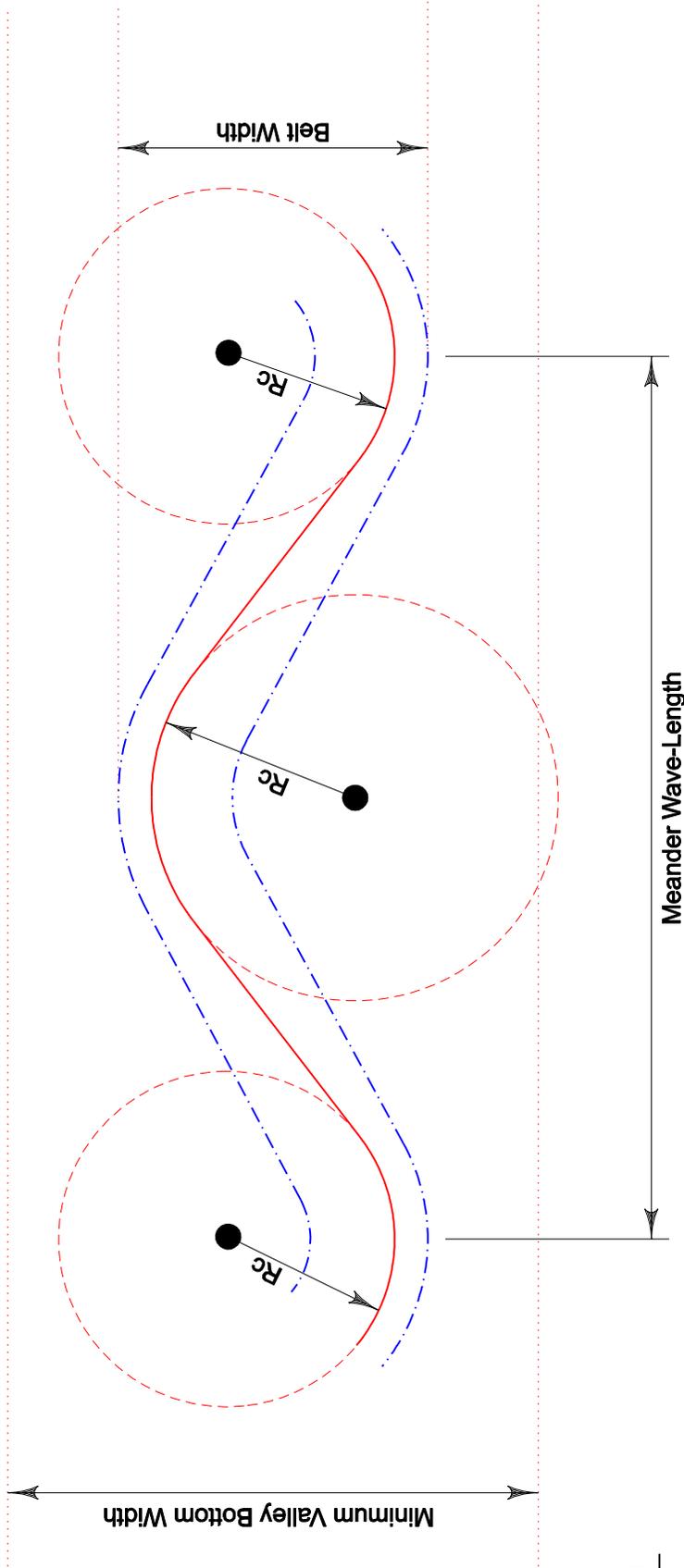
NEAR: KNOTTSVILLE

ITEM: AERIAL MAP

EXHIBIT 3

DATE:

Typical Meander Pattern for Rosgen Stream Type "C" Stream PER-1



Legend

- Bankfull — blue dash-dot line
- Thalweg — red solid line

- Bankfull Width=22.4'
- Radius of Curvature (Rc) Ranges from 56' to 67.5'
- Belt Width Ranges from 179' to 246'
- Meander Wave-Length Ranges from 201' to 314'
- Approximate Proposed Reach Length = 1151'
- Proposed Stream Gradient Ranges from 0.4% to 0.5%
- Proposed Valley Slope Ranges from 0.5% to 0.58%
- Minimum Valley Bottom Width = 260'

T.H.E. Engineers, Inc.	PROJECT: JOES RUN MINE SITE - JURISDICTIONAL WATERS DELINEATION			STREAM: PERENNIAL 1	
	COUNTY: DAVIESS	STATE: KY	NEAR: KNOTTSVILLE	ITEM: PROPOSED TYPICAL MEANDOR PATTERN	EXHIBIT 4

EROSION CONTROL BLANKET (may be used as needed)

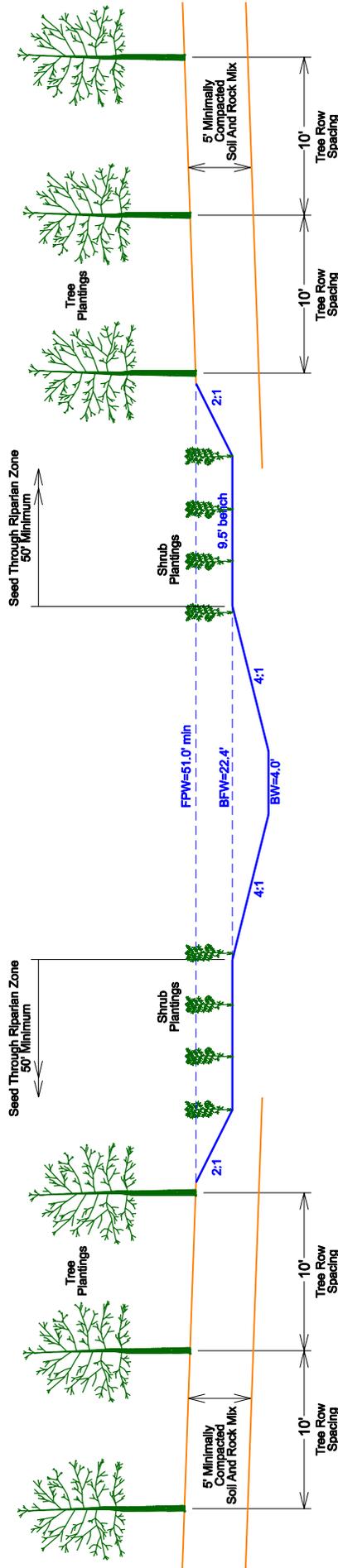
- E.C.B. 1 shall meet the following specifications:
- * Netting: Biodegradable, natural fiber.
 - * Matrix Material: 100% coconut fiber.
 - * Stitching: Biodegradable thread on 1.5 inch centers.
 - * Shear stress: 2.35 lbs / SQ. FT.
 - * Velocity: 10 feet per second.
 - * Longevity: up to 24 months.
 - * North American Green C125 BN or equivalent shall be used.
- E.C.B. 2 shall meet the following specifications:
- * Netting: 100% Biodegradable, natural fiber.
 - * Matrix Material: 100% straw.
 - * Stitching: Biodegradable thread on 1.5 inch centers.
 - * Shear stress: 1.855 lbs. / SQ. FT.
 - * Velocity: 6 feet per second.
 - * Longevity: up to 12 months.
 - * North American Green S150 BN or equivalent shall be used.

Note

- * E.C.B. 1, E.C.B. 2, straw mulch or a combination of each will be used to prevent erosion and assist vegetation establishment along stream banks and throughout the riparian zone. Straw mulch will be crimped, tacked, or held in place with a biodegradable net, as needed.

Proposed Channel Dimensions

- BFW=22.4'
- BFA=30.4 SF
- BF mean D=1.36'
- BF max D = 2.3'
- FPW= min 51.0'
- W/D=16.47
- Entrenchment Ratio 2.26 min
- Bench Width= 9.5'min



Note

- * Tree spacing shown (10' x 10') is based on bare root seedlings. See mitigation plan for other tree planting options.

**Typical Riffle Cross Section Stream PER-1
Rosgen Stream Type "C"
Scale: 1"=10'**

T.H.E. Engineers, Inc.	PROJECT: JOES RUN MINE SITE - JURISDICTIONAL WATERS DELINEATION			STREAM: PERENNIAL 1	
	COUNTY: DAVIESS	STATE: KY	NEAR: KNOTTSVILLE	ITEM: PROPOSED TYPICAL RIFFLE CROSS SECTION	EXHIBIT 5

EROSION CONTROL BLANKET (may be used as needed)

E.C.B. 1 shall meet the following specifications:

- * Netting: Biodegradable, natural fiber.
- * Matrix Material: 100% coconut fiber.
- * Stitching: Biodegradable thread on 1.5 inch centers.
- * Shear stress: 2.35 lbs / SQ. FT.
- * Velocity: 10 feet per second.
- * Longevity: up to 24 months.
- * North American Green C125 BN or equivalent shall be used.

E.C.B. 2 shall meet the following specifications:

- * Netting: 100% Biodegradable, natural fiber.
- * Matrix Material: 100% straw.
- * Stitching: Biodegradable thread on 1.5 inch centers.
- * Shear stress: 1.855 lbs. / SQ. FT.
- * Velocity: 6 feet per second.
- * Longevity: up to 12 months.
- * North American Green S150 BN or equivalent shall be used.

In bend sections, the outside bend may be stabilized with a combination of Erosion Control Blanket Type 1 (E.C.B. 1) and shrub plantings. E.C.B. 1 shall be anchored in at residual pool elevation and extend to Flood Prone Elevation. Beyond this elevation E.C.B. 2 may be placed throughout the riparian zone. In bend sections where structures (J-Hooks, Cross Vanes, etc.) are specified, E.C.B. 1 installation shall begin just above the structure location.

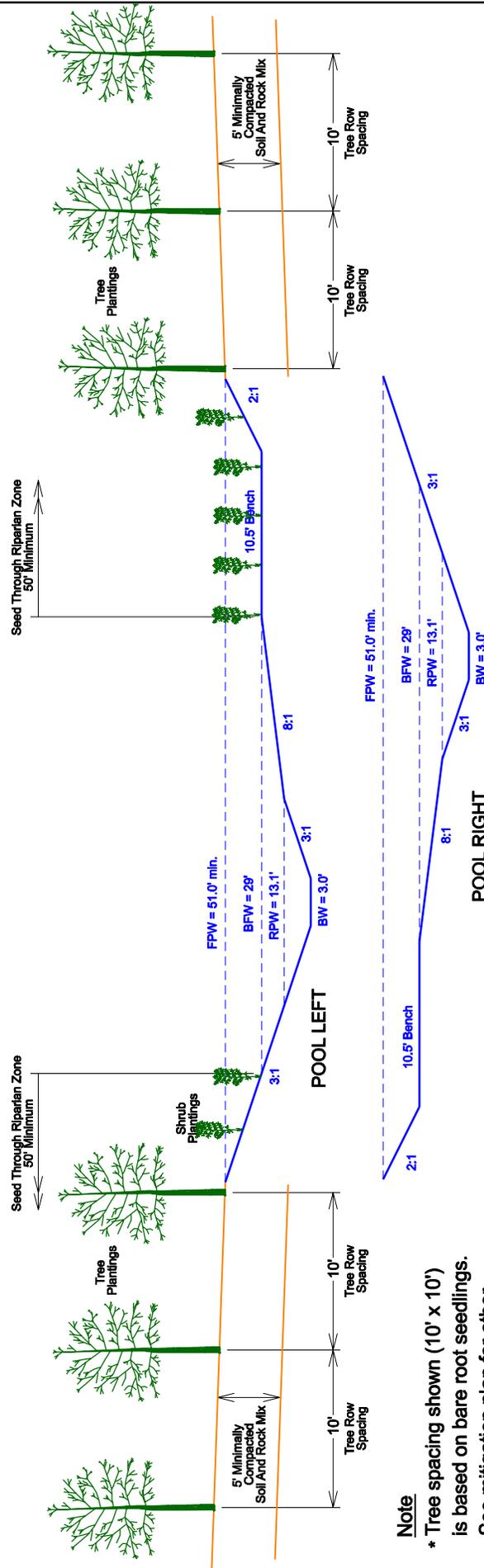
In bend sections, E.C.B. 1 may be placed along the inside bend (Point Bar). Blanket installation shall begin at the bottom of the point bar slope (just above Residual Pool Elevation) and extend to Flood Prone Elevation. E.C.B. 2 may be placed beyond this location as needed.

Proposed Channel Dimensions

- BFW=29.0'
- BFA=43.94 SF
- BF mean D=1.52'
- BF max D = 3.12'
- FPW= 51' min
- W/D=19.14
- BW=3.0'
- RPwidth=13.1'
- RPdepth=1.68'
- Bench Width= 10.5'min

Note

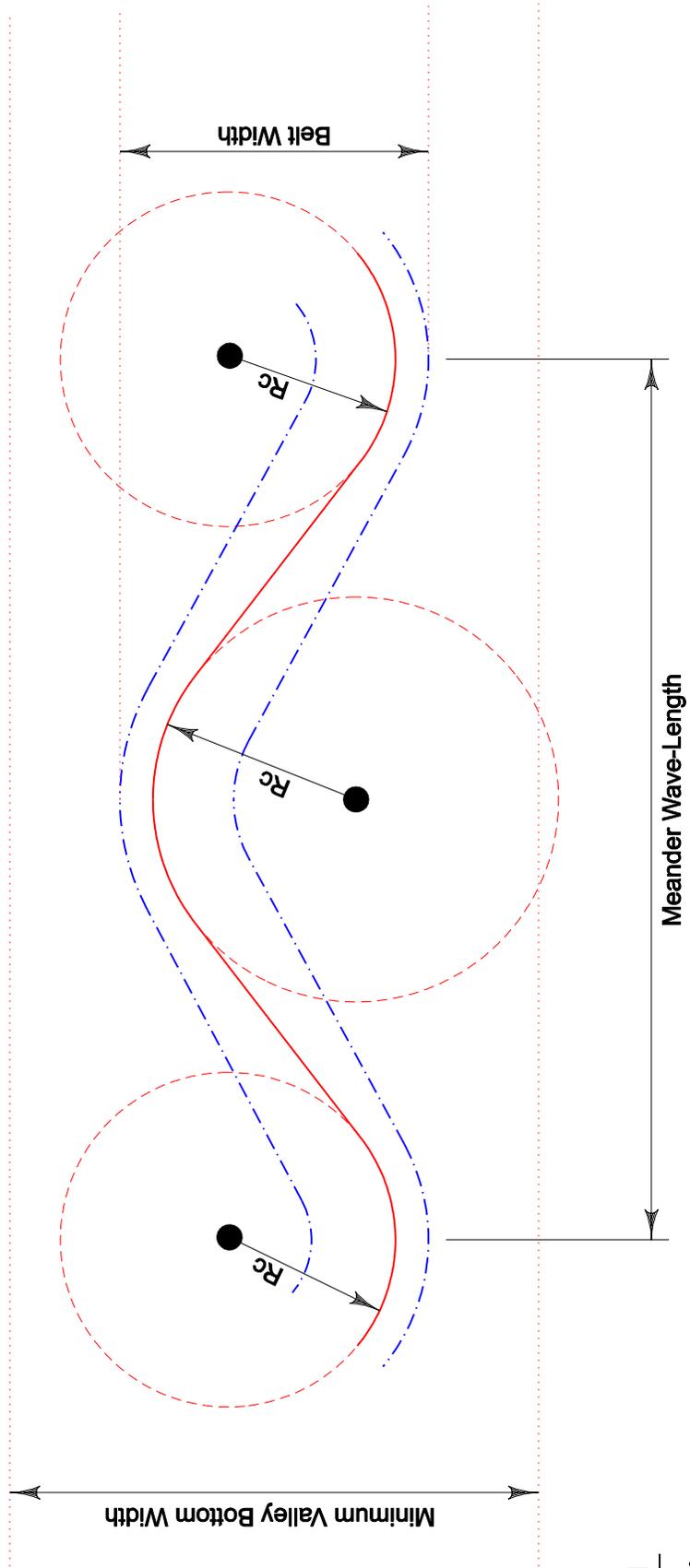
- * Durable rock may be used instead of ECB 1 along outside bends. The rock shall be placed at bottom of pool and extend to bankfull elevation.
- ECB 1 may be used above this elevation, rock size shall be a minimum of 1' diameter and shall be keyed into bank and bottom of channel.



**Typical Pool Cross Section Stream PER-1
Rosgen Stream Type "C"
Scale: 1"=10'**

T.H.E. Engineers, Inc.	PROJECT: JOES RUN MINE SITE - JURISDICTIONAL WATERS DELINEATION			STREAM: PERENNIAL I	
	COUNTY: DAVIESS	STATE: KY	NEAR: KNOTTSVILLE	ITEM: PROPOSED TYPICAL POOL CROSS SECTION	EXHIBIT 6

Typical Meander Pattern for Rosgen Stream Type "C" Stream INT-1MS



Legend

- Bankfull ————
- Thalweg ————

- Bankfull Width=17'
- Radius of Curvature (Rc) Ranges from 42.5' to 51.0'
- Belt Width Ranges from 136' to 187'
- Meander Wave-Length Ranges from 153' to 238'
- Approximate Proposed Reach Length = 2161'
- Proposed Stream Gradient Ranges from 0.35% to 0.45%
- Proposed Valley Slope Ranges from 0.4% to 0.5%
- Minimum Valley Bottom Width = 200'

T.H.E. Engineers, Inc.	PROJECT: JOES RUN MINE SITE - JURISDICTIONAL WATERS DELINEATION			STREAM: INTERMITTENT I MIDSTREAM	
	COUNTY: DAVIESS	STATE: KY	NEAR: KNOTTSVILLE	ITEM: PROPOSED TYPICAL MEANDOR PATTERN	EXHIBIT 7

EROSION CONTROL BLANKET (may be used as needed)

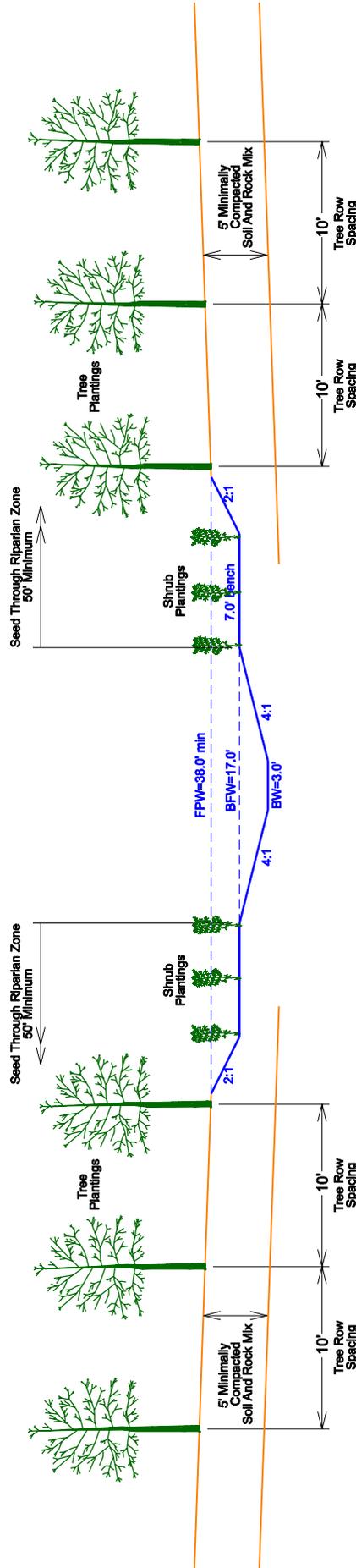
- E.C.B. 1 shall meet the following specifications:
- * Netting: Biodegradable, natural fiber.
 - * Matrix Material: 100% coconut fiber.
 - * Stitching: Biodegradable thread on 1.5 inch centers.
 - * Shear stress: 2.35 lbs / SQ. FT.
 - * Velocity: 10 feet per second.
 - * Longevity: up to 24 months.
 - * North American Green C125 BN or equivalent shall be used.
- E.C.B. 2 shall meet the following specifications:
- * Netting: 100% Biodegradable, natural fiber.
 - * Matrix Material: 100% straw.
 - * Stitching: Biodegradable thread on 1.5 inch centers.
 - * Shear stress: 1.855 lbs. / SQ. FT.
 - * Velocity: 6 feet per second.
 - * Longevity: up to 12 months.
 - * North American Green S150 BN or equivalent shall be used.

Note

- * E.C.B. 1, E.C.B. 2, straw mulch or a combination of each will be used to prevent erosion and assist vegetation establishment along stream banks and throughout the riparian zone. Straw mulch will be crimped, tacked, or held in place with a biodegradable net, as needed.

Proposed Channel Dimensions

- BFW=17.0'
- BFA=17.5 SF
- BF mean D=1.03'
- BF max D = 1.75'
- FPW= min 38.0'
- W/D=16.5
- Entrenchment Ratio 2.23 min
- Bench Width= 7.0' min



**Typical Riffle Cross Section Stream INT-1MS
Rosgen Stream Type "C"
Scale: 1"=10'**

Note

- * Tree spacing shown (10' x 10') is based on bare root seedlings. See mitigation plan for other tree planting options.

T.H.E. Engineers, Inc.	PROJECT: JOES RUN MINE SITE - JURISDICTIONAL WATERS DELINEATION			STREAM: INTERMITTENT MIDSTREAM	
	COUNTY: DAVIESS	STATE: KY	NEAR: KNOTTSVILLE	ITEM: PROPOSED TYPICAL RIFFLE CROSS SECTION	EXHIBIT 8

EROSION CONTROL BLANKET (may be used as needed)

E.C.B. 1 shall meet the following specifications:

- * Netting: Biodegradable, natural fiber.
- * Matrix Material: 100% coconut fiber.
- * Stitching: Biodegradable thread on 1.5 inch centers.
- * Shear stress: 2.35 lbs / SQ. FT.
- * Velocity: 10 feet per second.
- * Longevity: up to 24 months.
- * North American Green C125 BN or equivalent shall be used.

E.C.B. 2 shall meet the following specifications:

- * Netting: 100% Biodegradable, natural fiber.
- * Matrix Material: 100% straw.
- * Stitching: Biodegradable thread on 1.5 inch centers.
- * Shear stress: 1.855 lbs. / SQ. FT.
- * Velocity: 6 feet per second.
- * Longevity: up to 12 months.
- * North American Green S150 BN or equivalent shall be used.

In bend sections, the outside bend may be stabilized with a combination of Erosion Control Blanket Type 1 (E.C.B. 1) and shrub plantings. E.C.B. 1 shall be anchored in at residual pool elevation and extend to Flood Prone Elevation. Beyond this elevation E.C.B. 2 may be placed throughout the riparian zone. In bend sections where structures (J-Hooks, Cross Vanes, etc.) are specified, E.C.B. 1 installation shall begin just above the structure location.

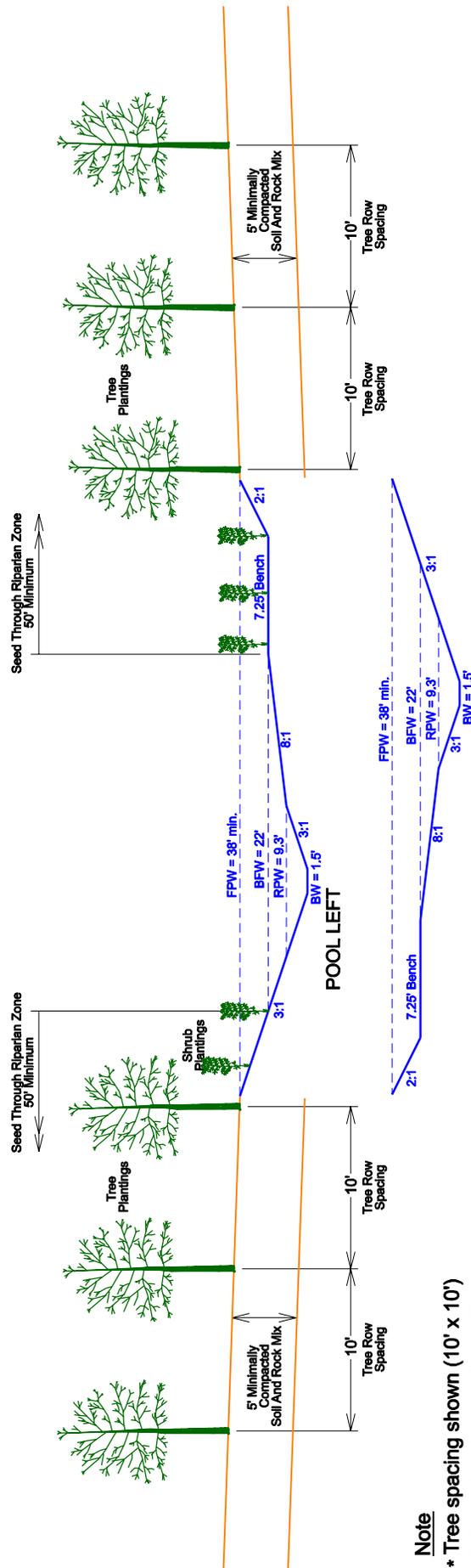
In bend sections, E.C.B. 1 may be placed along the inside bend (Point Bar). Blanket installation shall begin at the bottom of the point bar slope (just above Residual Pool Elevation) and extend to Flood Prone Elevation. E.C.B. 2 may be placed beyond this location as needed.

Proposed Channel Dimensions

- BFW=22.0'
- BFA=24.53 SF
- BF mean D=1.12'
- BF max D = 2.42'
- FPW= 38' min
- W/D=19.64
- BW=1.5'
- RPwidth=9.3'
- RPdepth=1.3'
- Bench Width= 7.25'min

Note

- * Durable rock may be used instead of ECB 1 along outside bends. The rock shall be placed at bottom of pool and extend to bankfull elevation. ECB 1 may be used above this elevation, rock size shall be a minimum of 1' diameter and shall be keyed into bank and bottom of channel.



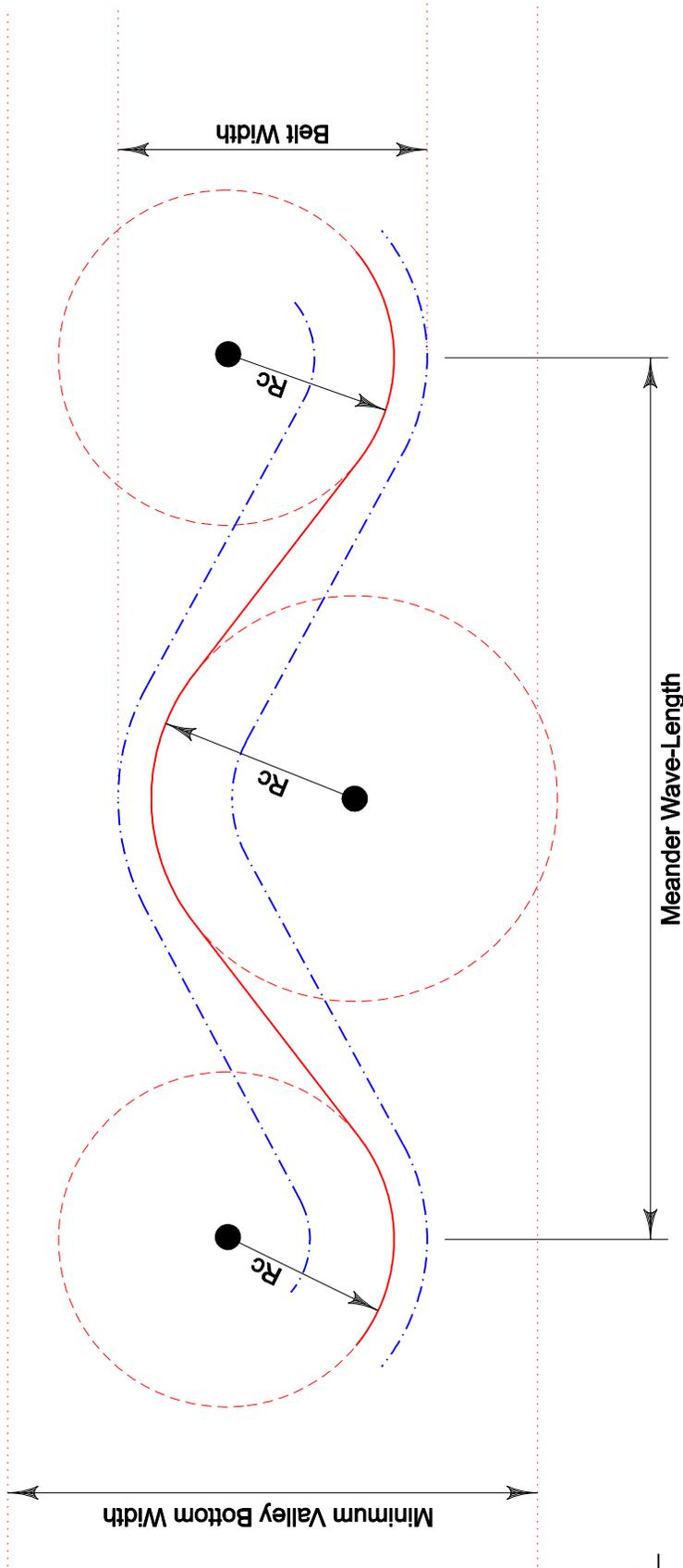
Note

- * Tree spacing shown (10' x 10') is based on bare root seedlings. See mitigation plan for other tree planting options.

POOL RIGHT

**Typical Pool Cross Section Stream INT-1MS
Rosgen Stream Type "C"
Scale: 1"=10'**

Typical Meander Pattern for Rosgen Stream Type "C" Stream INT-1DS



Legend

- Bankfull ———— (blue dash-dot line)
- Thalweg ———— (red solid line)

- Bankfull Width=17.4'
- Radius of Curvature (Rc) Ranges from 43.5' to 52.2'
- Belt Width Ranges from 139' to 192'
- Meander Wave-Length Ranges from 156' to 244'
- Approximate Proposed Reach Length = 1721'
- Proposed Stream Gradient Ranges from 0.35% to 0.45%
- Proposed Valley Slope Ranges from 0.4% to 0.5%
- Minimum Valley Bottom Width = 205'

T.H.E. Engineers, Inc.	PROJECT: JOES RUN MINE SITE - JURISDICTIONAL WATERS DELINEATION			STREAM: INTERMITTENT 1 DOWNSTREAM	
	COUNTY: DAVIESS	STATE: KY	NEAR: KNOTTSVILLE	ITEM: PROPOSED TYPICAL MEANDOR PATTERN	EXHIBIT 10

DATE:

EROSION CONTROL BLANKET (may be used as needed)

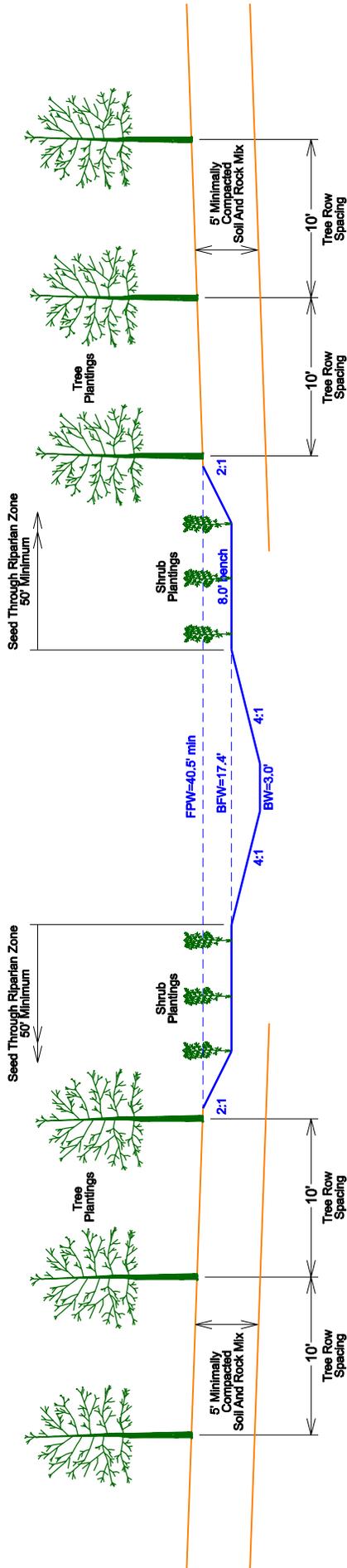
- E.C.B. 1 shall meet the following specifications:
- * Netting: Biodegradable, natural fiber.
 - * Matrix Material: 100% coconut fiber.
 - * Stitching: Biodegradable thread on 1.5 inch centers.
 - * Shear stress: 2.35 lbs / SQ. FT.
 - * Velocity: 10 feet per second.
 - * Longevity: up to 24 months.
 - * North American Green C125 BN or equivalent shall be used.
- E.C.B. 2 shall meet the following specifications:
- * Netting: 100% Biodegradable, natural fiber.
 - * Matrix Material: 100% straw.
 - * Stitching: Biodegradable thread on 1.5 inch centers.
 - * Shear stress: 1.855 lbs. / SQ. FT.
 - * Velocity: 6 feet per second.
 - * Longevity: up to 12 months.
 - * North American Green S150 BN or equivalent shall be used.

Note

- * E.C.B. 1, E.C.B. 2, straw mulch or a combination of each will be used to prevent erosion and assist vegetation establishment along stream banks and throughout the riparian zone. Straw mulch will be crimped, tacked, or held in place with a biodegradable net, as needed.

Proposed Channel Dimensions

- BFW=17.4'
- BFA=18.4 SF
- BF mean D=1.06'
- BF max D = 1.8'
- FPW= min 40.5'
- WD=16.5
- Entrenchment Ratio 2.32 min
- Bench Width= 8.0' min



Note

- * Tree spacing shown (10' x 10') is based on bare root seedlings. See mitigation plan for other tree planting options.

Typical Riffle Cross Section Stream INT-1DS
Rosgen Stream Type "C"
Scale: 1"=10'

T.H.E. Engineers, Inc.	PROJECT: JOES RUN MINE SITE - JURISDICTIONAL WATERS DELINEATION			STREAM: INTERMITTENT I DOWNSTREAM	
	COUNTY: DAVIESS	STATE: KY	NEAR: KNOTTSVILLE	ITEM: PROPOSED TYPICAL RIFFLE CROSS SECTION	EXHIBIT II

EROSION CONTROL BLANKET (may be used as needed)

E.C.B. 1 shall meet the following specifications:

- * Netting: Biodegradable, natural fiber.
- * Matrix Material: 100% coconut fiber.
- * Stitching: Biodegradable thread on 1.5 inch centers.
- * Shear stress: 2.35 lbs / SQ. FT.
- * Velocity: 10 feet per second.
- * Longevity: up to 24 months.
- * North American Green C125 BN or equivalent shall be used.

E.C.B. 2 shall meet the following specifications:

- * Netting: 100% Biodegradable, natural fiber.
- * Matrix Material: 100% straw.
- * Stitching: Biodegradable thread on 1.5 inch centers.
- * Shear stress: 1.855 lbs. / SQ. FT.
- * Velocity: 6 feet per second.
- * Longevity: up to 12 months.
- * North American Green S150 BN or equivalent shall be used.

In bend sections, the outside bend may be stabilized with a combination of Erosion Control Blanket Type 1 (E.C.B. 1) and shrub plantings. E.C.B. 1 shall be anchored in at residual pool elevation and extend to Flood Prone Elevation. Beyond this elevation E.C.B. 2 may be placed throughout the riparian zone. In bend sections where structures (J-Hooks, Cross Vanes, etc.) are specified, E.C.B. 1 installation shall begin just above the structure location.

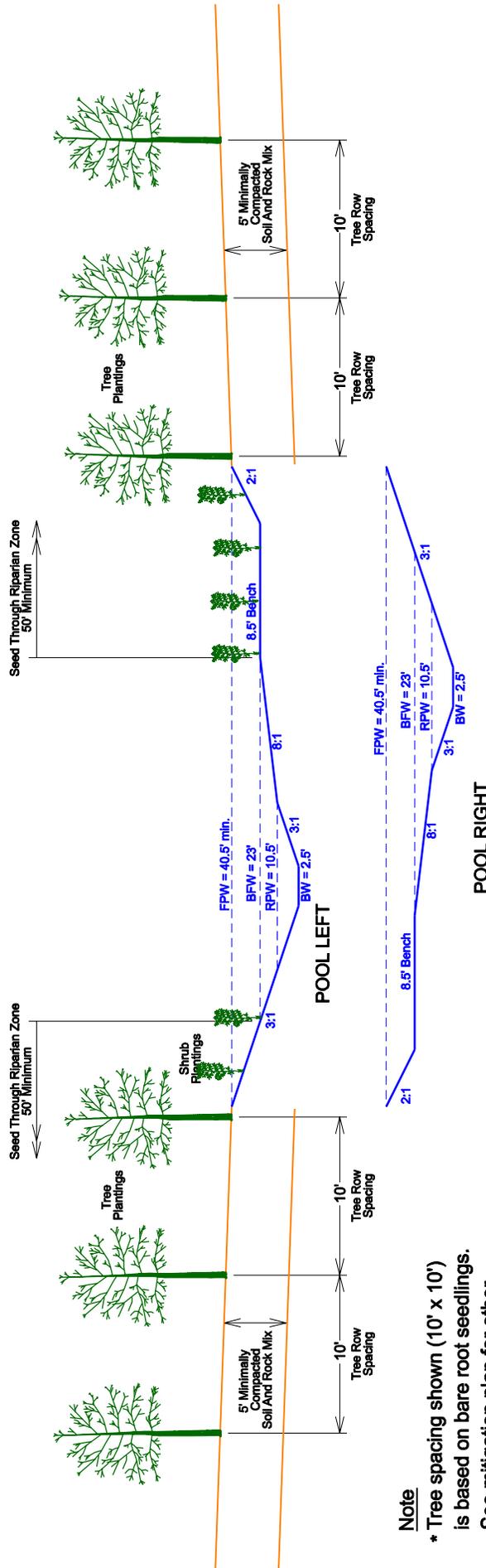
In bend sections, E.C.B. 1 may be placed along the inside bend (Point Bar). Blanket installation shall begin at the bottom of the point bar slope (just above Residual Pool Elevation) and extend to Flood Prone Elevation. E.C.B. 2 may be placed beyond this location as needed.

Proposed Channel Dimensions

- BFW=23.0'
- BFA=27.2 SF
- BF mean D=1.18'
- BF max D = 2.44'
- FPW= 40.5' min
- W/D=19.5
- BW=2.5'
- RPwidth=10.5'
- RPdepth=1.34'
- Bench Width= 8.5'min

Note

* Durable rock may be used instead of ECB 1 along outside bends. The rock shall be placed at bottom of pool and extend to bankfull elevation. ECB 1 may be used above this elevation, rock size shall be a minimum of 1' diameter and shall be keyed into bank and bottom of channel.

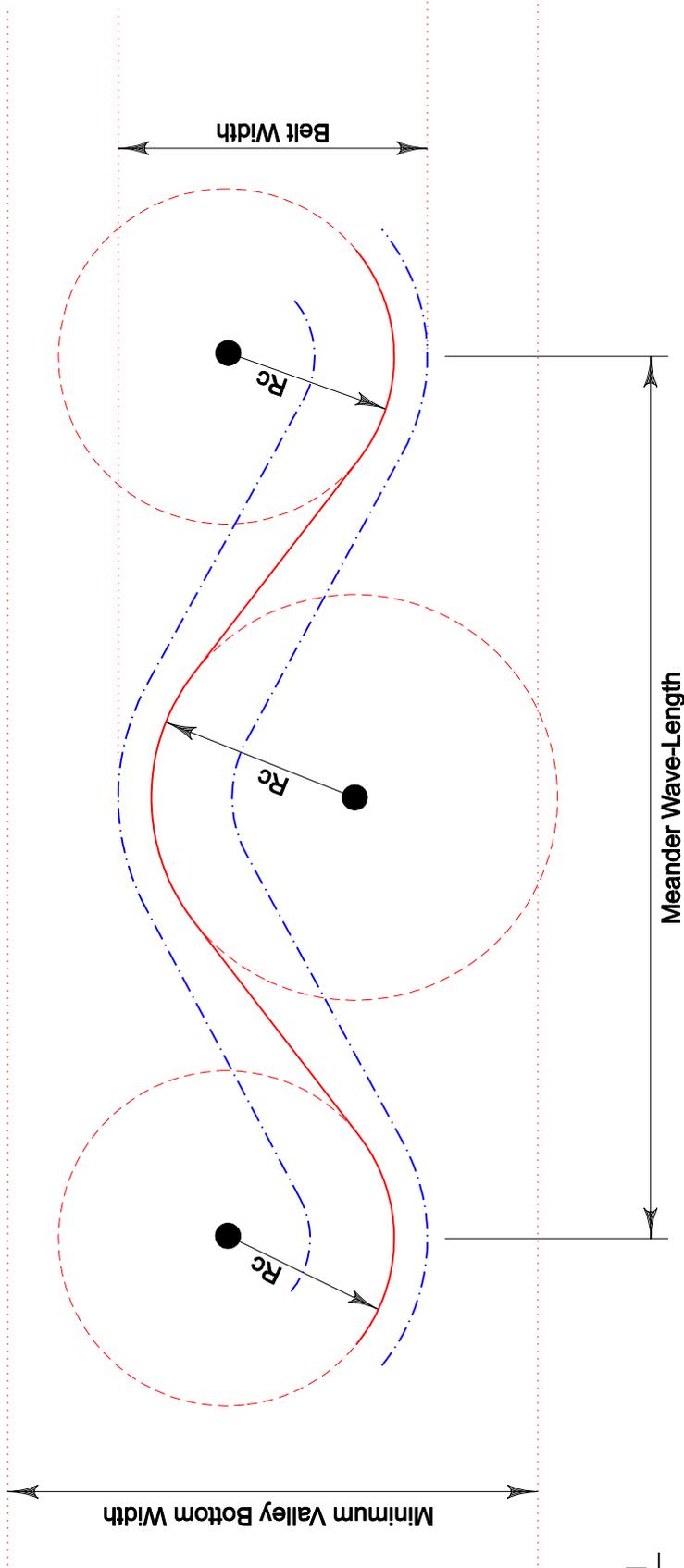


Note

* Tree spacing shown (10' x 10') is based on bare root seedlings. See mitigation plan for other tree planting options.

**Typical Pool Cross Section Stream INT-1DS
Rosgen Stream Type "C"
Scale: 1"=10'**

Typical Meander Pattern for Rosgen Stream Type "C" Stream INT-2



Legend

- Bankfull - - - -
- Thalweg —

- Bankfull Width=16.6'
- Radius of Curvature (Rc) Ranges from 41' to 50'
- Belt Width Ranges from 132' to 183'
- Meander Wave-Length Ranges from 149' to 232'
- Approximate Proposed Reach Length = 1858'
- Proposed Stream Gradient Ranges from 0.4% to 0.5%
- Proposed Valley Slope Ranges from 0.45% to 0.55%
- Minimum Valley Bottom Width = 200'

T.H.E. Engineers, Inc.	PROJECT: JOES RUN MINE SITE - JURISDICTIONAL WATERS DELINEATION			STREAM: UT'S OF NORTH FORK PANTHER CREEK	
	COUNTY: DAVIESS	STATE: KY	NEAR: KNOTTSVILLE	ITEM: PROPOSED TYPICAL MEANDOR PATTERN	EXHIBIT 13

DATE:

EROSION CONTROL BLANKET (may be used as needed)

- E.C.B. 1 shall meet the following specifications:
 - * Netting: Biodegradable, natural fiber.
 - * Matrix Material: 100% coconut fiber.
 - * Stitching: Biodegradable thread on 1.5 inch centers.
 - * Shear stress: 2.35 lbs / SQ. FT.
 - * Velocity: 10 feet per second.
 - * Longevity: up to 24 months.
- * North American Green C125 BN or equivalent shall be used.

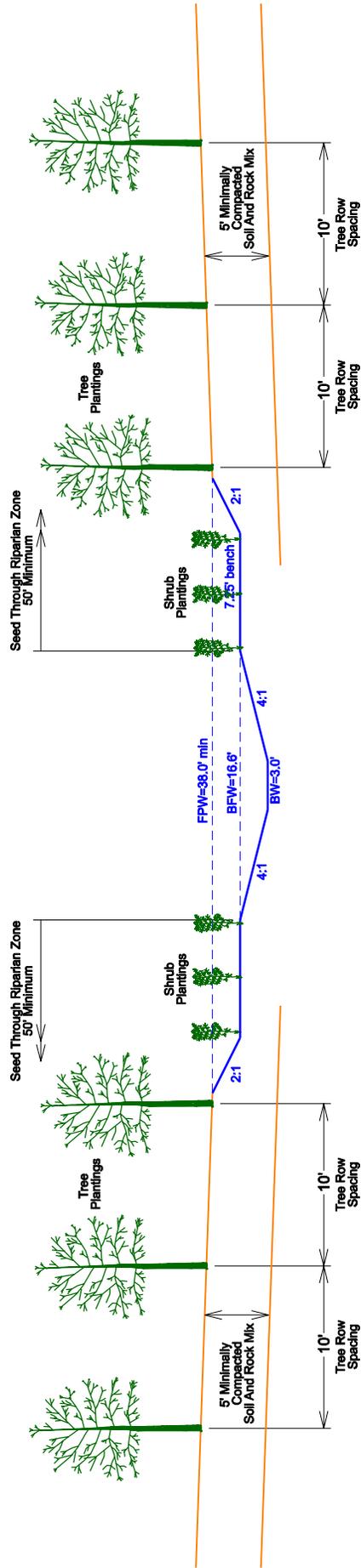
- E.C.B. 2 shall meet the following specifications:
 - * Netting: 100% Biodegradable, natural fiber.
 - * Matrix Material: 100% straw.
 - * Stitching: Biodegradable thread on 1.5 inch centers.
 - * Shear stress: 1.855 lbs. / SQ. FT.
 - * Velocity: 6 feet per second.
 - * Longevity: up to 12 months.
- * North American Green S150 BN or equivalent shall be used.

Note

- * E.C.B. 1, E.C.B. 2, straw mulch or a combination of each will be used to prevent erosion and assist vegetation establishment along stream banks and throughout the riparian zone. Straw mulch will be crimped, tacked, or held in place with a biodegradable net, as needed.

Proposed Channel Dimensions

- BFW=16.6'
- BFA=16.7 SF
- BF mean D=1.0'
- BF max D = 1.7'
- FPW= min 38.0'
- W/D=16.5
- Entrenchment Ratio 2.29 min
- Bench Width= 7.25'min



Note

- * Tree spacing shown (10' x 10') is based on bare root seedlings. See mitigation plan for other tree planting options.

**Typical Riffle Cross Section Stream INT-2
Rosgen Stream Type "C"
Scale: 1"=10'**

T.H.E. Engineers, Inc.	PROJECT: JOES RUN MINE SITE - JURISDICTIONAL WATERS DELINEATION			STREAM: INTERMITTENT 2	
	COUNTY: DAVIESS	STATE: KY	NEAR: KNOTTSVILLE	ITEM: PROPOSED TYPICAL RIFFLE CROSS SECTION	EXHIBIT 14

EROSION CONTROL BLANKET (may be used as needed)

E.C.B. 1 shall meet the following specifications:

- * Netting: Biodegradable, natural fiber.
- * Matrix Material: 100% coconut fiber.
- * Stitching: Biodegradable thread on 1.5 inch centers.
- * Shear stress: 2.35 lbs / SQ. FT.
- * Velocity: 10 feet per second.
- * Longevity: up to 24 months.
- * North American Green C125 BN or equivalent shall be used.

E.C.B. 2 shall meet the following specifications:

- * Netting: 100% Biodegradable, natural fiber.
- * Matrix Material: 100% straw.
- * Stitching: Biodegradable thread on 1.5 inch centers.
- * Shear stress: 1.855 lbs. / SQ. FT.
- * Velocity: 6 feet per second.
- * Longevity: up to 12 months.
- * North American Green S150 BN or equivalent shall be used.

In bend sections, the outside bend may be stabilized with a combination of Erosion Control Blanket Type 1 (E.C.B. 1) and shrub plantings. E.C.B. 1 shall be anchored in at residual pool elevation and extend to Flood Prone Elevation. Beyond this elevation E.C.B. 2 may be placed throughout the riparian zone. In bend sections where structures (J-Hooks, Cross Vanes, etc.) are specified, E.C.B. 1 installation shall begin just above the structure location.

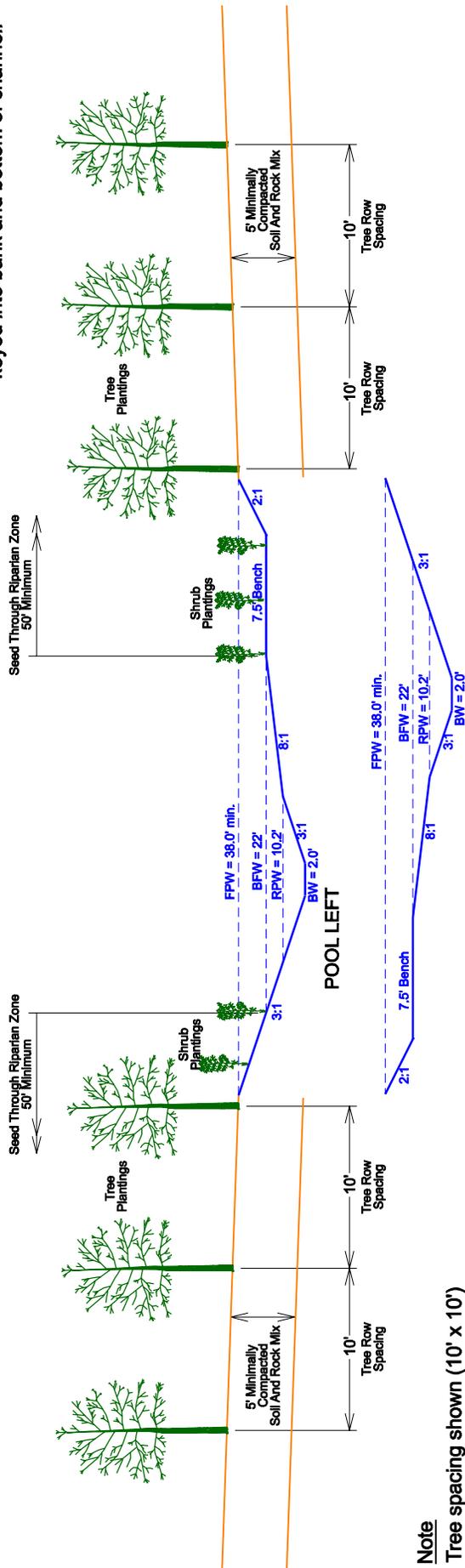
In bend sections, E.C.B. 1 may be placed along the inside bend (Point Bar). Blanket installation shall begin at the bottom of the point bar slope (just above Residual Pool Elevation) and extend to Flood Prone Elevation. E.C.B. 2 may be placed beyond this location as needed.

Proposed Channel Dimensions

- BFW=22.0'
- BFA=25.1 SF
- BF mean D=1.14'
- BF max D = 2.41'
- FPW= 38' min
- W/D=19.28
- BW=2.0'
- RPwidth=10.2'
- RPdepth=1.37'
- Bench Width= 7.5'min

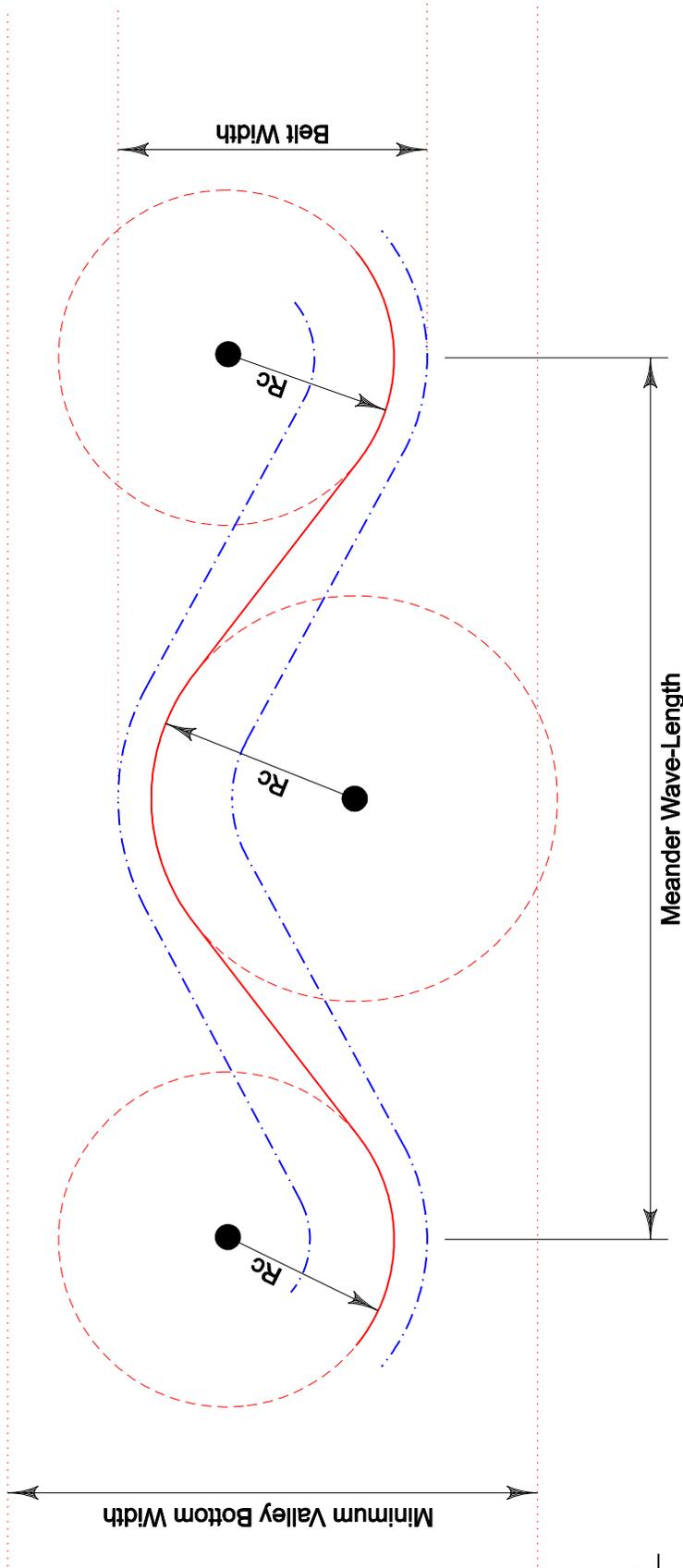
Note

- * Durable rock may be used instead of ECB 1 along outside bends. The rock shall be placed at bottom of pool and extend to bankfull elevation.
- ECB 1 may be used above this elevation, rock size shall be a minimum of 1' diameter and shall be keyed into bank and bottom of channel.



**Typical Pool Cross Section Stream INT-2
Rosgen Stream Type "C"
Scale: 1"=10'**

Typical Meander Pattern for Rosgen Stream Type "C" Stream INT-3



Legend

- Bankfull - · - · -
- Thalweg —

- Bankfull Width = 18.3'
- Radius of Curvature (Rc) Ranges from 45.5' to 55'
- Belt Width Ranges from 146' to 201'
- Meander Wave-Length Ranges from 165' to 256'
- Approximate Proposed Reach Length = 1000'
- Proposed Stream Gradient Ranges from 0.45% to 0.55%
- Proposed Valley Slope Ranges from 0.5% to 0.6%
- Minimum Valley Bottom Width = 215'

T.H.E. Engineers, Inc.	PROJECT: JOES RUN MINE SITE - JURISDICTIONAL WATERS DELINEATION			STREAM: INTERMITTENT 3	
	COUNTY: DAVIESS	STATE: KY	NEAR: KNOTTSVILLE	ITEM: PROPOSED TYPICAL MEANDOR PATTERN	EXHIBIT 16

DATE:

EROSION CONTROL BLANKET (may be used as needed)

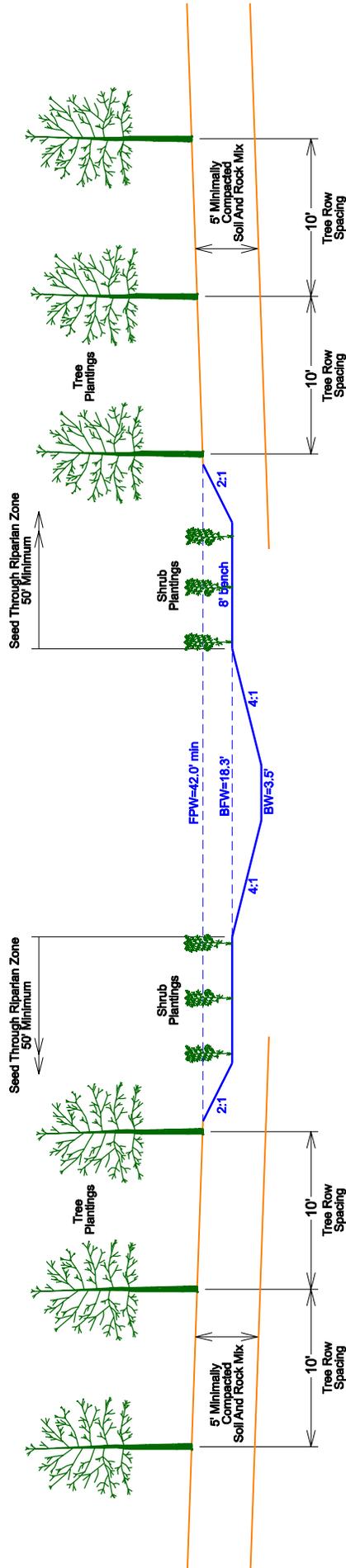
- E.C.B. 1 shall meet the following specifications:
- * Netting: Biodegradable, natural fiber.
 - * Matrix Material: 100% coconut fiber.
 - * Stitching: Biodegradable thread on 1.5 inch centers.
 - * Shear stress: 2.35 lbs / SQ. FT.
 - * Velocity: 10 feet per second.
 - * Longevity: up to 24 months.
 - * North American Green C125 BN or equivalent shall be used.
- E.C.B. 2 shall meet the following specifications:
- * Netting: 100% Biodegradable, natural fiber.
 - * Matrix Material: 100% straw.
 - * Stitching: Biodegradable thread on 1.5 inch centers.
 - * Shear stress: 1.855 lbs. / SQ. FT.
 - * Velocity: 6 feet per second.
 - * Longevity: up to 12 months.
 - * North American Green S150 BN or equivalent shall be used.

Note

- * E.C.B. 1, E.C.B. 2, straw mulch or a combination of each will be used to prevent erosion and assist vegetation establishment along stream banks and throughout the riparian zone. Straw mulch will be crimped, tacked, or held in place with a biodegradable net, as needed.

Proposed Channel Dimensions

- BFW=18.3'
- BFA=20.2 SF
- BF mean D=1.01'
- BF max D=1.85'
- FPW= min 42'
- W/D=16.6
- Entrenchment Ratio 2.3 min
- Bench Width= 8'min



**Typical Riffle Cross Section Stream INT-3
Rosgen Stream Type "C"
Scale: 1"=10'**

- Note**
- * Tree spacing shown (10' x 10') is based on bare root seedlings. See mitigation plan for other tree planting options.

T.H.E. Engineers, Inc.	PROJECT: JOES RUN MINE SITE - JURISDICTIONAL WATERS DELINEATION			STREAM: INTERMITTENT 3	
	COUNTY: DAVIESS	STATE: KY	NEAR: KNOTTSVILLE	ITEM: PROPOSED TYPICAL RIFFLE CROSS SECTION	EXHIBIT 17

EROSION CONTROL BLANKET (may be used as needed)

E.C.B. 1 shall meet the following specifications:

- * Netting: Biodegradable, natural fiber.
- * Matrix Material: 100% coconut fiber.
- * Stitching: Biodegradable thread on 1.5 inch centers.
- * Shear stress: 2.35 lbs / SQ. FT.
- * Velocity: 10 feet per second.
- * Longevity: up to 24 months.
- * North American Green C125 BN or equivalent shall be used.

E.C.B. 2 shall meet the following specifications:

- * Netting: 100% Biodegradable, natural fiber.
- * Matrix Material: 100% straw.
- * Stitching: Biodegradable thread on 1.5 inch centers.
- * Shear stress: 1.855 lbs. / SQ. FT.
- * Velocity: 6 feet per second.
- * Longevity: up to 12 months.
- * North American Green S150 BN or equivalent shall be used.

In bend sections, the outside bend may be stabilized with a combination of Erosion Control Blanket Type 1 (E.C.B. 1) and shrub plantings. E.C.B. 1 shall be anchored in at residual pool elevation and extend to Flood Prone Elevation. Beyond this elevation E.C.B. 2 may be placed throughout the riparian zone. In bend sections where structures (J-Hooks, Cross Vanes, etc.) are specified, E.C.B. 1 installation shall begin just above the structure location.

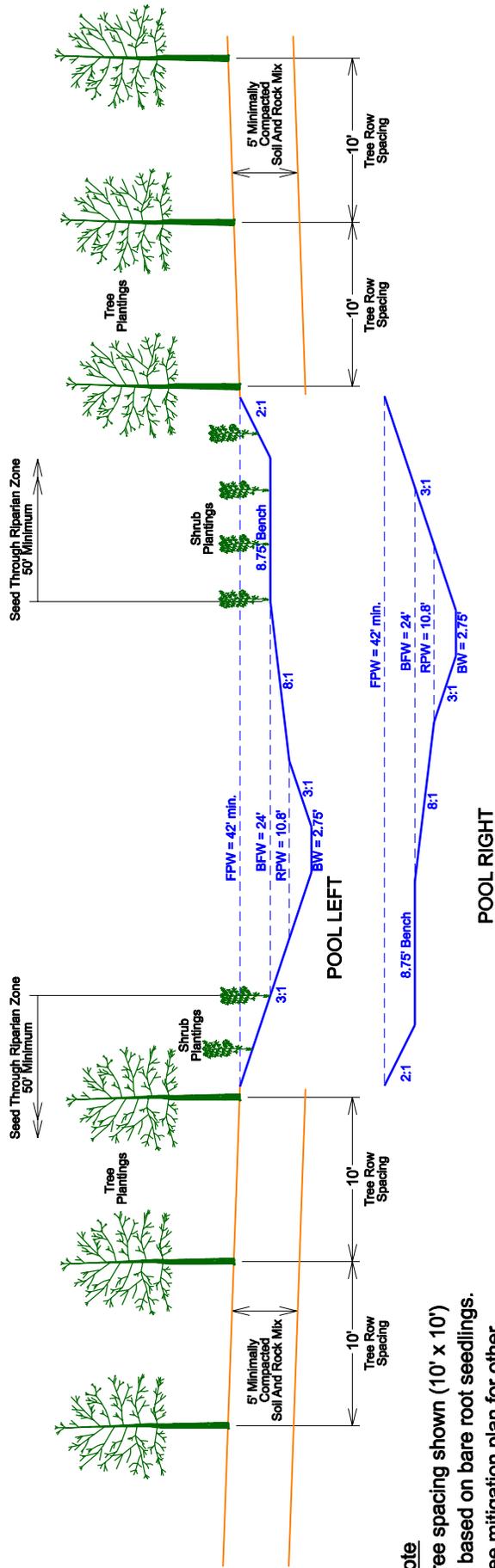
In bend sections, E.C.B. 1 may be placed along the inside bend (Point Bar). Blanket installation shall begin at the bottom of the point bar slope (just above Residual Pool Elevation) and extend to Flood Prone Elevation. E.C.B. 2 may be placed beyond this location as needed.

Proposed Channel Dimensions

- BFW=24.0'
- BFA=29.3 SF
- BF mean D=1.22'
- BF max D = 2.51'
- FPW= 42' min
- W/D=19.66
- BW=2.75'
- RPwidth=10.8'
- RPdepth=1.34'
- Bench Width= 8.75'min

Note

- * Durable rock may be used instead of ECB 1 along outside bends. The rock shall be placed at bottom of pool and extend to bankfull elevation.
- ECB 1 may be used above this elevation, rock size shall be a minimum of 1' diameter and shall be keyed into bank and bottom of channel.



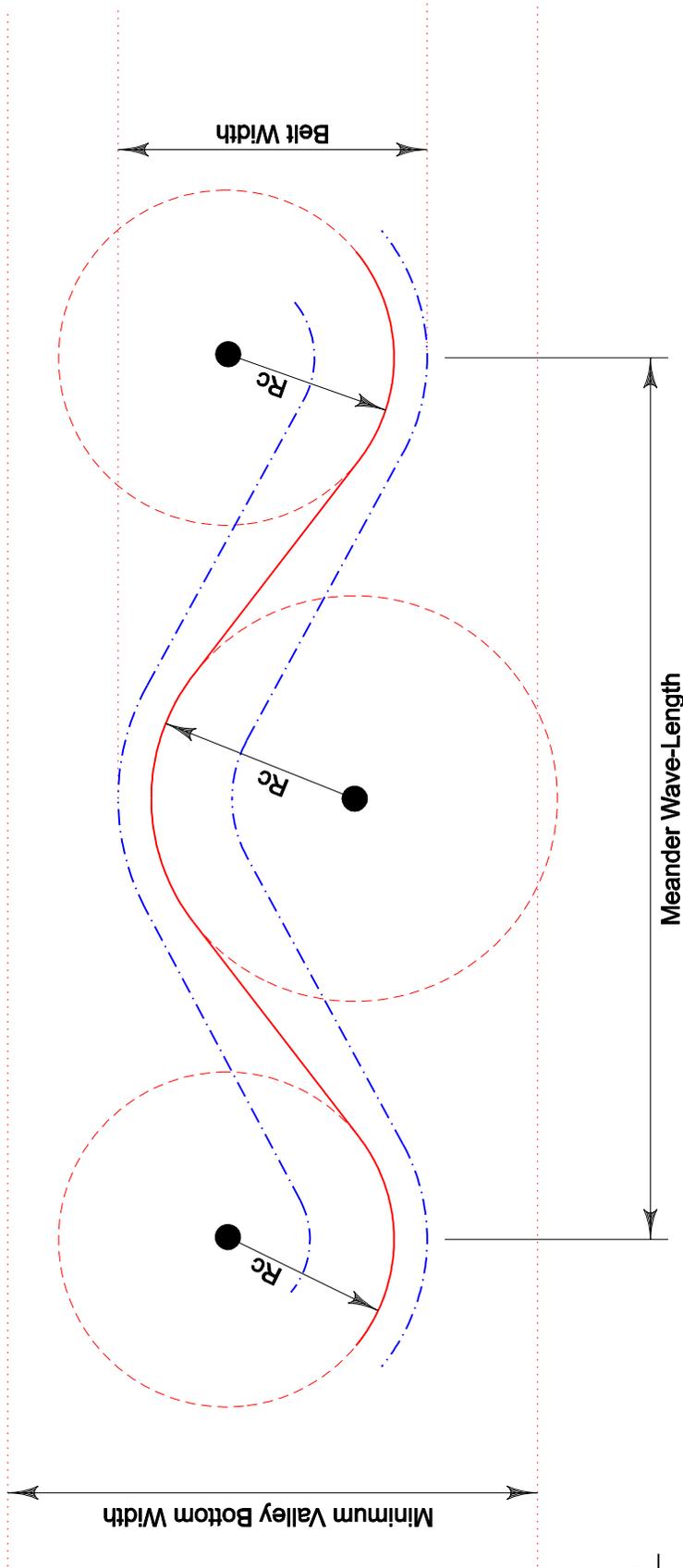
Note

- * Tree spacing shown (10' x 10') is based on bare root seedlings. See mitigation plan for other tree planting options.

**Typical Pool Cross Section Stream INT-3
Rosgen Stream Type "C"
Scale: 1"=10'**

T.H.E. Engineers, Inc.	PROJECT: JOES RUN MINE SITE - JURISDICTIONAL WATERS DELINEATION			STREAM: INTERMITTENT 3	
	COUNTY: DAVIESS	STATE: KY	NEAR: KNOTTSVILLE	ITEM: PROPOSED TYPICAL POOL CROSS SECTION	EXHIBIT 18

Typical Meander Pattern for Rosgen Stream Type "E" Stream INT-4



Legend

- Bankfull - - - - -
- Thalweg —————

- Bankfull Width=7.0'
- Radius of Curvature (Rc) Ranges from 17.5' to 21.0'
- Belt Width Ranges from 70' to 126'
- Meander Wave-Length Ranges from 70' to 98'
- Approximate Proposed Reach Length = 513'
- Proposed Stream Gradient Ranges from 0.5% to 1.5%
- Proposed Valley Slope Ranges from 1.0% to 2.0%
- Minimum Valley Bottom Width = 135'

T.H.E. Engineers, Inc.	PROJECT: JOES RUN MINE SITE - JURISDICTIONAL WATERS DELINEATION			STREAM: INTERMITTENT 4	
	COUNTY: DAVIESS	STATE: KY	NEAR: KNOTTSVILLE	ITEM: PROPOSED TYPICAL MEANDOR PATTERN	EXHIBIT 19

DATE:

EROSION CONTROL BLANKET (may be used as needed)

- E.C.B. 1 shall meet the following specifications:
 - * Netting: Biodegradable, natural fiber.
 - * Matrix Material: 100% coconut fiber.
 - * Stitching: Biodegradable thread on 1.5 inch centers.
 - * Shear stress: 2.35 lbs / SQ. FT.
 - * Velocity: 10 feet per second.
 - * Longevity: up to 24 months.
- * North American Green C125 BN or equivalent shall be used.

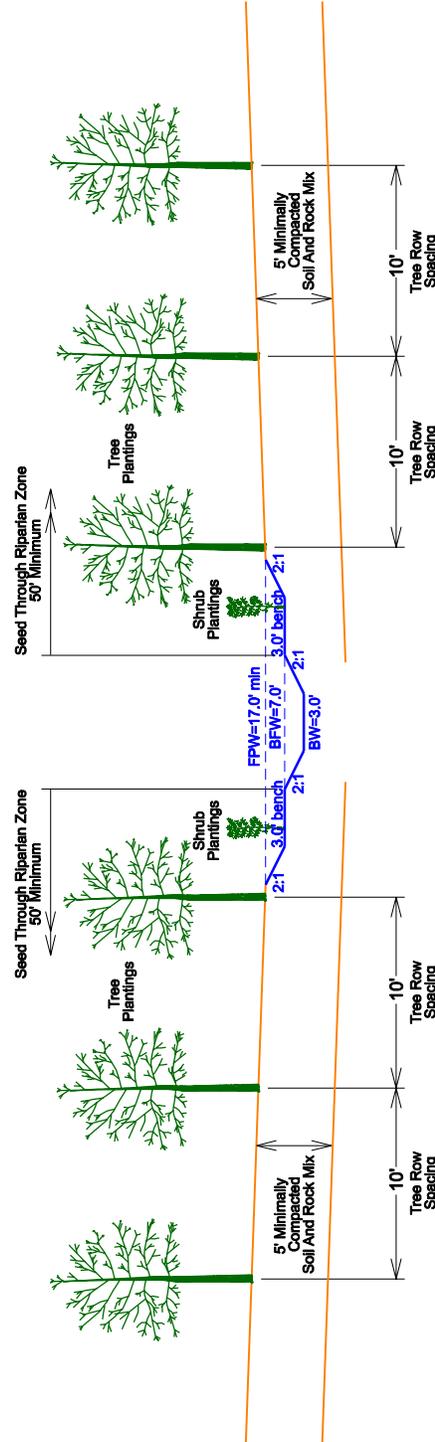
- E.C.B. 2 shall meet the following specifications:
 - * Netting: 100% Biodegradable, natural fiber.
 - * Matrix Material: 100% straw.
 - * Stitching: Biodegradable thread on 1.5 inch centers.
 - * Shear stress: 1.855 lbs. / SQ. FT.
 - * Velocity: 6 feet per second.
 - * Longevity: up to 12 months.
- * North American Green S150 BN or equivalent shall be used.

Note

* E.C.B. 1, E.C.B. 2, straw mulch or a combination of each will be used to prevent erosion and assist vegetation establishment along stream banks and throughout the riparian zone. Straw mulch will be crimped, tacked, or held in place with a biodegradable net, as needed.

Proposed Channel Dimensions

- FPW=7.0'
- BFA=5.06 SF
- BF mean D=0.72'
- BF max D = 1.0'
- FPW= min 17.0'
- W/D=9.68
- Entrenchment Ratio 2.42 min
- Bench Width= 3.0'min



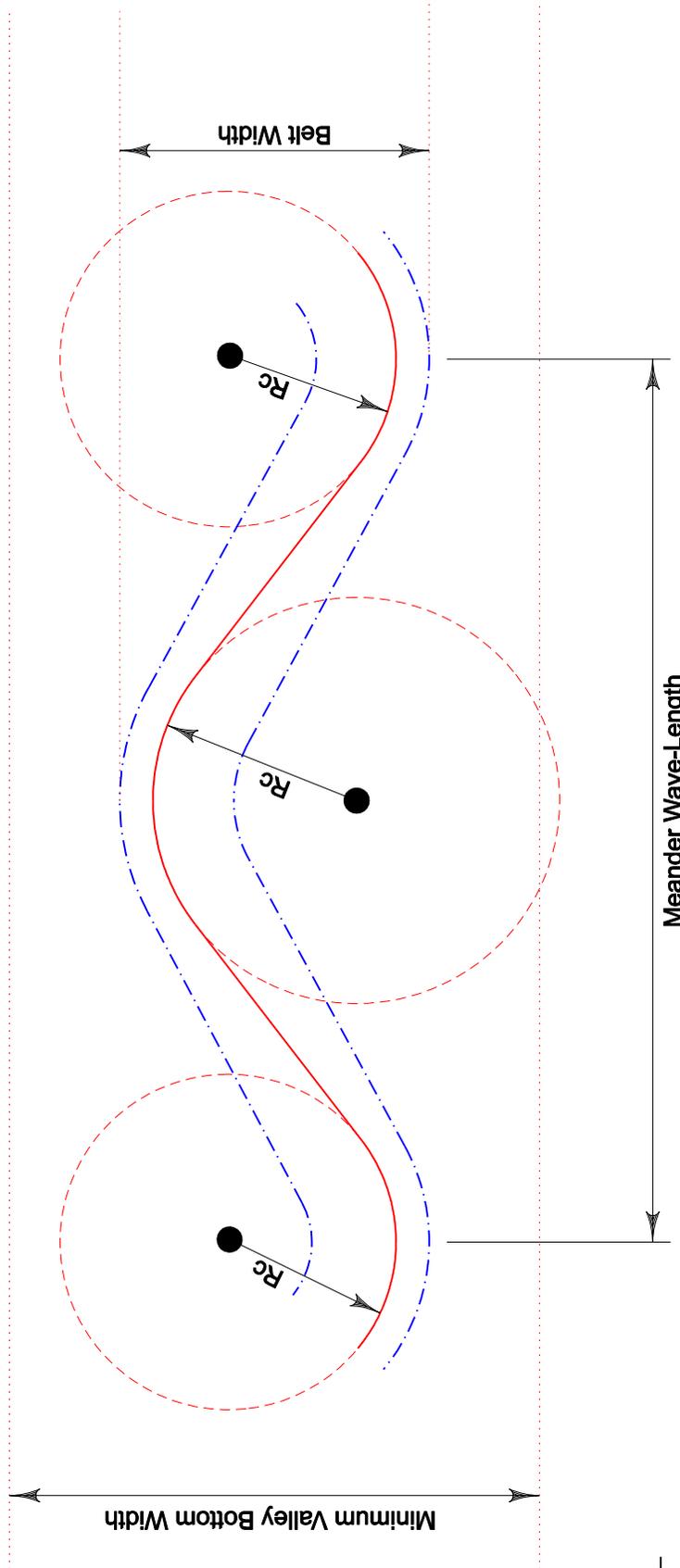
Note

- * Tree spacing shown (10' x 10') is based on bare root seedlings. See mitigation plan for other tree planting options.

**Typical Riffle Cross Section Stream INT-4
Rosgen Stream Type "E"
Scale: 1"=10'**

T.H.E. Engineers, Inc.	PROJECT: JOES RUN MINE SITE - JURISDICTIONAL WATERS DELINEATION			STREAM: INTERMITTENT 4	
	COUNTY: DAVIESS	STATE: KY	NEAR: KNOTTSVILLE	ITEM: PROPOSED TYPICAL RIFFLE CROSS SECTION	EXHIBIT 20

Typical Meander Pattern for Rosgen Stream Type "B" Stream EPH 1



Legend

- Bankfull - - - - -
- Thalweg —————

- Bankfull Width=3.4'
- Radius of Curvature (Rc) Ranges from 8.5' to 10'
- Belt Width Ranges from 13.5' to 17'
- Meander Wave-Length Ranges from 27' to 34'
- Approximate Proposed Reach Length = 322'
- Proposed Stream Gradient Ranges from 3.0% to 4.0%
- Minimum Valley Bottom Width = 25'

EROSION CONTROL BLANKET (may be used as needed)

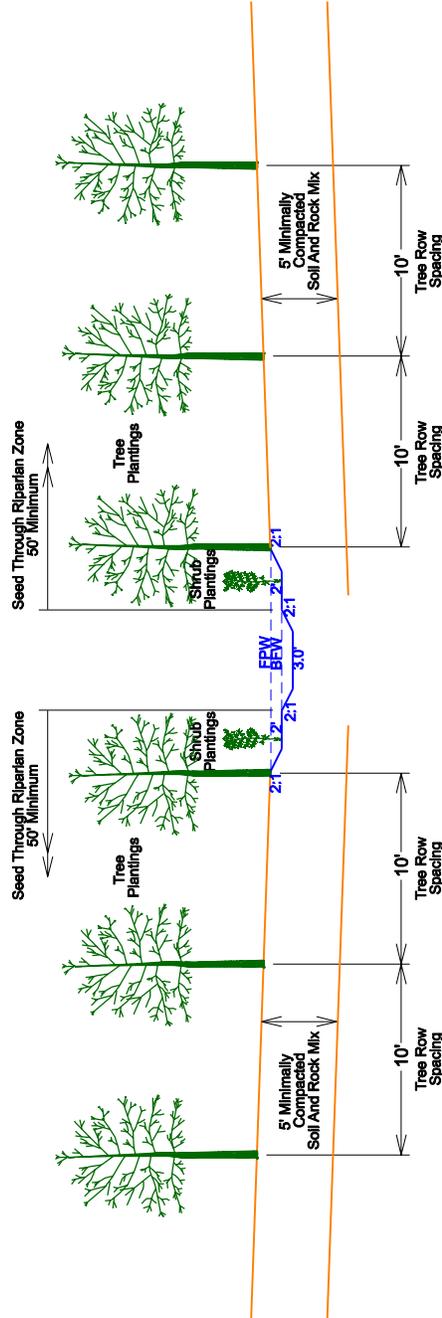
- E.C.B. 1 shall meet the following specifications:
- * Netting: Biodegradable, natural fiber.
 - * Matrix Material: 100% coconut fiber.
 - * Stitching: Biodegradable thread on 1.5 inch centers.
 - * Shear stress: 2.35 lbs / SQ. FT.
 - * Velocity: 10 feet per second.
 - * Longevity: up to 24 months.
 - * North American Green C125 BN or equivalent shall be used.
- E.C.B. 2 shall meet the following specifications:
- * Netting: 100% Biodegradable, natural fiber.
 - * Matrix Material: 100% straw.
 - * Stitching: Biodegradable thread on 1.5 inch centers.
 - * Shear stress: 1.855 lbs. / SQ. FT.
 - * Velocity: 6 feet per second.
 - * Longevity: up to 12 months.
 - * North American Green S150 BN or equivalent shall be used.

Note

- * E.C.B. 1, E.C.B. 2, straw mulch or a combination of each will be used to prevent erosion and assist vegetation establishment along stream banks and throughout the riparian zone. Straw mulch will be crimped, tacked, or held in place with a biodegradable net, as needed.

Proposed Channel Dimensions

- BFW=3.4'
- BFA=0.93SF
- BF mean D=0.28'
- BF max D = 0.35'
- FPW= max 6.76'
- W/D=12.1
- Entrenchment Ratio 2.0
- Bench Width= 1'



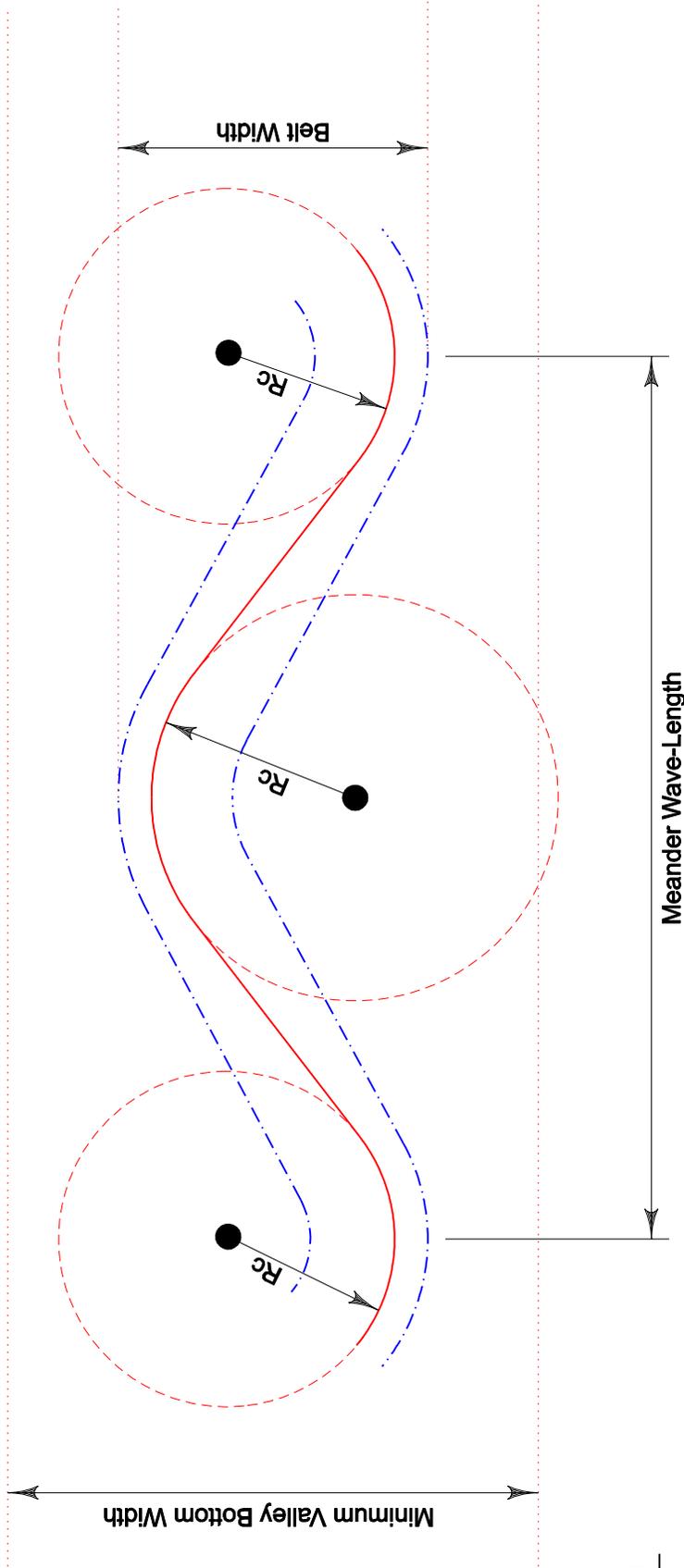
Note

- * Tree spacing shown (10' x 10') is based on bare root seedlings. See mitigation plan for other tree planting options.

**Typical Riffle Cross Section Stream EPH-1
Rosgen Stream Type "B"
Scale: 1"=10'**

T.H.E. Engineers, Inc.	PROJECT: JOES RUN MINE SITE - JURISDICTIONAL WATERS DELINEATION			STREAM: EPHEMERAL I	
	COUNTY: DAVIESS	STATE: KY	NEAR: KNOTTSVILLE	ITEM: PROPOSED TYPICAL RIFFLE CROSS SECTION	EXHIBIT 22

Typical Meander Pattern for Rosgen Stream Type "B" Stream EPH2



Legend

- Bankfull - - -
- Thalweg —

- Bankfull Width=5.3'
- Radius of Curvature (Rc) Ranges from 13' to 16'
- Belt Width Ranges from 21' to 27'
- Meander Wave-Length Ranges from 42' to 53'
- Approximate Proposed Reach Length = 820'
- Proposed Stream Gradient Ranges from 2.0% to 3.0%
- Minimum Valley Bottom Width = 38'

T.H.E. Engineers, Inc.	PROJECT: JOES RUN MINE SITE - JURISDICTIONAL WATERS DELINEATION			STREAM: EPHEMERAL 2	
	COUNTY: DAVIESS	STATE: KY	NEAR: KNOTTSVILLE	ITEM: PROPOSED TYPICAL MEANDOR PATTERN	EXHIBIT 23

DATE:

EROSION CONTROL BLANKET (may be used as needed)

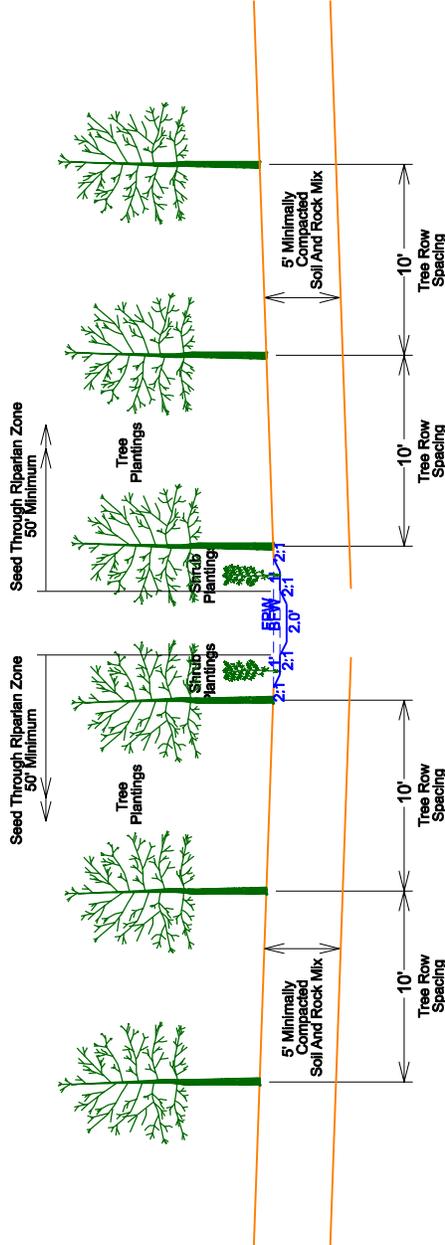
- E.C.B. 1 shall meet the following specifications:
- * Netting: Biodegradable, natural fiber.
 - * Matrix Material: 100% coconut fiber.
 - * Stitching: Biodegradable thread on 1.5 inch centers.
 - * Shear stress: 2.35 lbs / SQ. FT.
 - * Velocity: 10 feet per second.
 - * Longevity: up to 24 months.
 - * North American Green C125 BN or equivalent shall be used.
- E.C.B. 2 shall meet the following specifications:
- * Netting: 100% Biodegradable, natural fiber.
 - * Matrix Material: 100% straw.
 - * Stitching: Biodegradable thread on 1.5 inch centers.
 - * Shear stress: 1.855 lbs. / SQ. FT.
 - * Velocity: 6 feet per second.
 - * Longevity: up to 12 months.
 - * North American Green S150 BN or equivalent shall be used.

Note

- * E.C.B. 1, E.C.B. 2, straw mulch or a combination of each will be used to prevent erosion and assist vegetation establishment along stream banks and throughout the riparian zone. Straw mulch will be crimped, tacked, or held in place with a biodegradable net, as needed.

Proposed Channel Dimensions

- BFW=5.3'
- BFA=2.39SF
- BF mean D=0.45'
- BF max D = 0.58'
- FPW= max 11.5'
- W/D=12
- Entrenchment Ratio 2.19 max
- Bench Width= 2.0' max



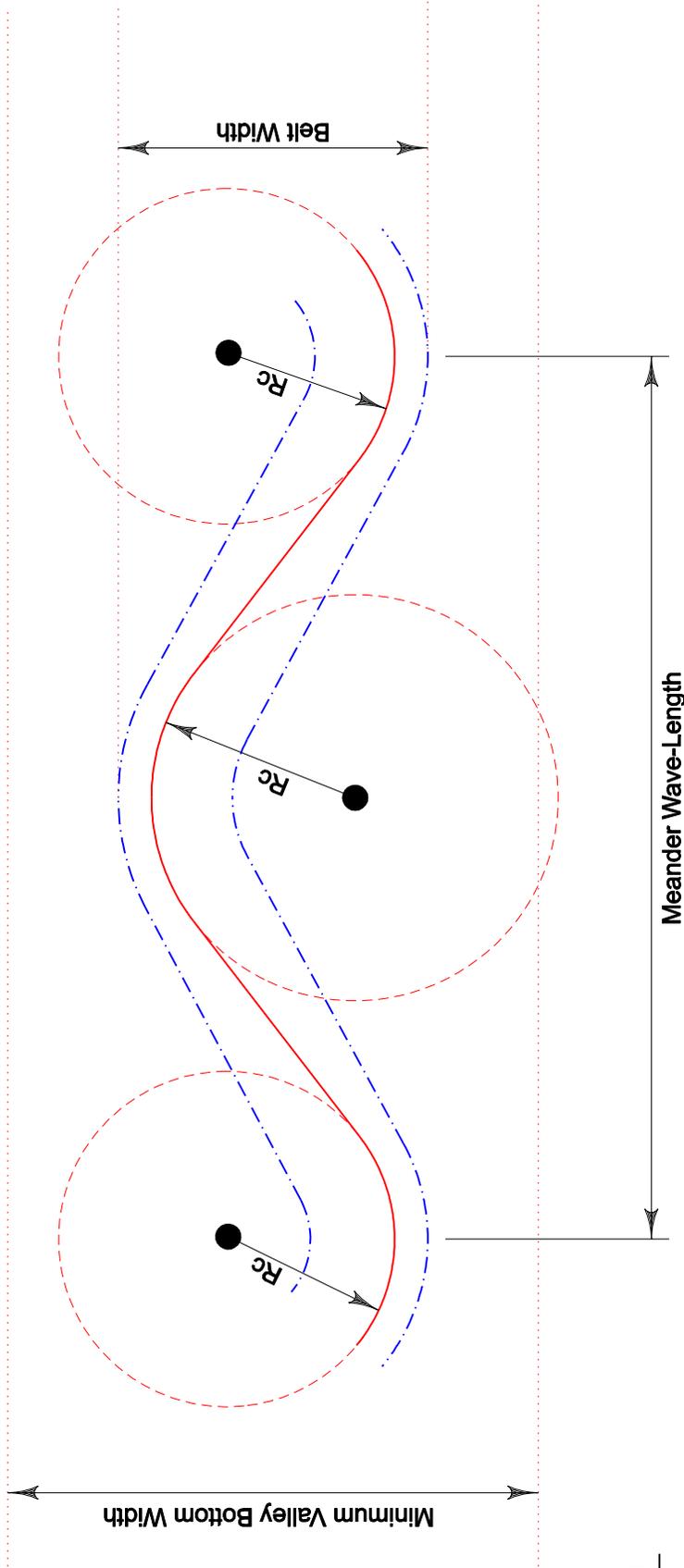
Note

- * Tree spacing shown (10' x 10') is based on bare root seedlings. See mitigation plan for other tree planting options.

**Typical Riffle Cross Section Stream EPH-2
Rosgen Stream Type "B"
Scale: 1"=10'**

T.H.E. Engineers, Inc.	PROJECT: JOES RUN MINE SITE - JURISDICTIONAL WATERS DELINEATION			STREAM: EPHEMERAL 2	
	COUNTY: DAVIESS	STATE: KY	NEAR: KNOTTSVILLE	ITEM: PROPOSED TYPICAL RIFFLE CROSS SECTION	EXHIBIT 24

Typical Meander Pattern for Rosgen Stream Type "B" Stream EPH-3



Legend

- Bankfull - - - - -
- Thalweg —————

- Bankfull Width=4.3'
- Radius of Curvature (Rc) Ranges from 10.5' to 13'
- Belt Width Ranges from 17' to 21.5'
- Meander Wave-Length Ranges from 34' to 43'
- Approximate Proposed Reach Length = 410'
- Proposed Stream Gradient Ranges from 2.0% to 3.0%
- Minimum Valley Bottom Width = 31'

T.H.E. Engineers, Inc.	PROJECT: JOES RUN MINE SITE - JURISDICTIONAL WATERS DELINEATION			STREAM: EPHEMERAL 3	
	COUNTY: DAVIESS	STATE: KY	NEAR: KNOTTSVILLE	ITEM: PROPOSED TYPICAL MEANDOR PATTERN	EXHIBIT 25

DATE:

EROSION CONTROL BLANKET (may be used as needed)

- E.C.B. 1 shall meet the following specifications:
- * Netting: Biodegradable, natural fiber.
 - * Matrix Material: 100% coconut fiber.
 - * Stitching: Biodegradable thread on 1.5 inch centers.
 - * Shear stress: 2.35 lbs / SQ. FT.
 - * Velocity: 10 feet per second.
 - * Longevity: up to 24 months.
 - * North American Green C125 BN or equivalent shall be used.

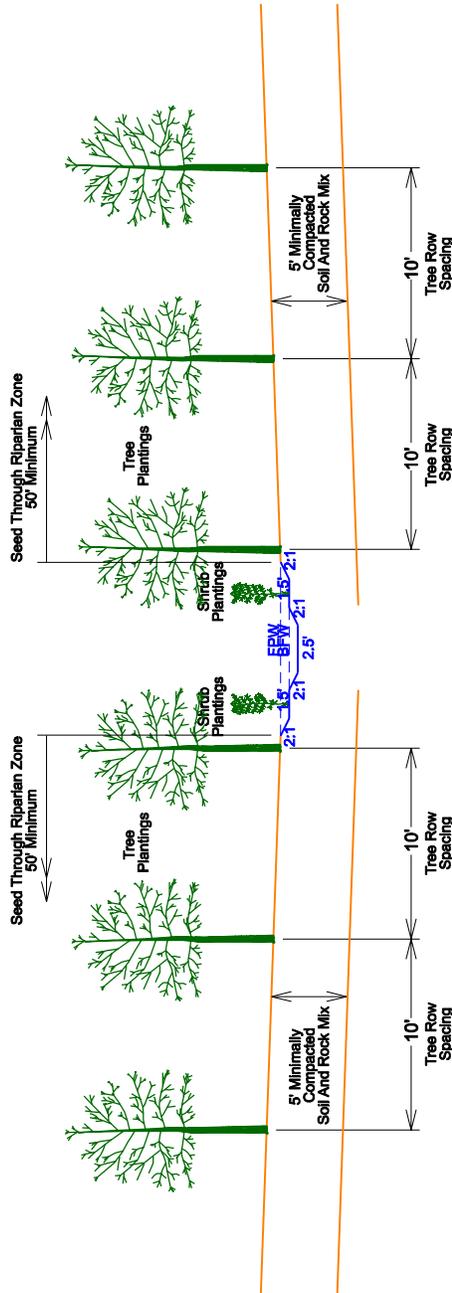
- E.C.B. 2 shall meet the following specifications:
- * Netting: 100% Biodegradable, natural fiber.
 - * Matrix Material: 100% straw.
 - * Stitching: Biodegradable thread on 1.5 inch centers.
 - * Shear stress: 1.855 lbs. / SQ. FT.
 - * Velocity: 6 feet per second.
 - * Longevity: up to 12 months.
 - * North American Green S150 BN or equivalent shall be used.

Note

- * E.C.B. 1, E.C.B. 2, straw mulch or a combination of each will be used to prevent erosion and assist vegetation establishment along stream banks and throughout the riparian zone. Straw mulch will be crimped, tacked, or held in place with a biodegradable net, as needed.

Proposed Channel Dimensions

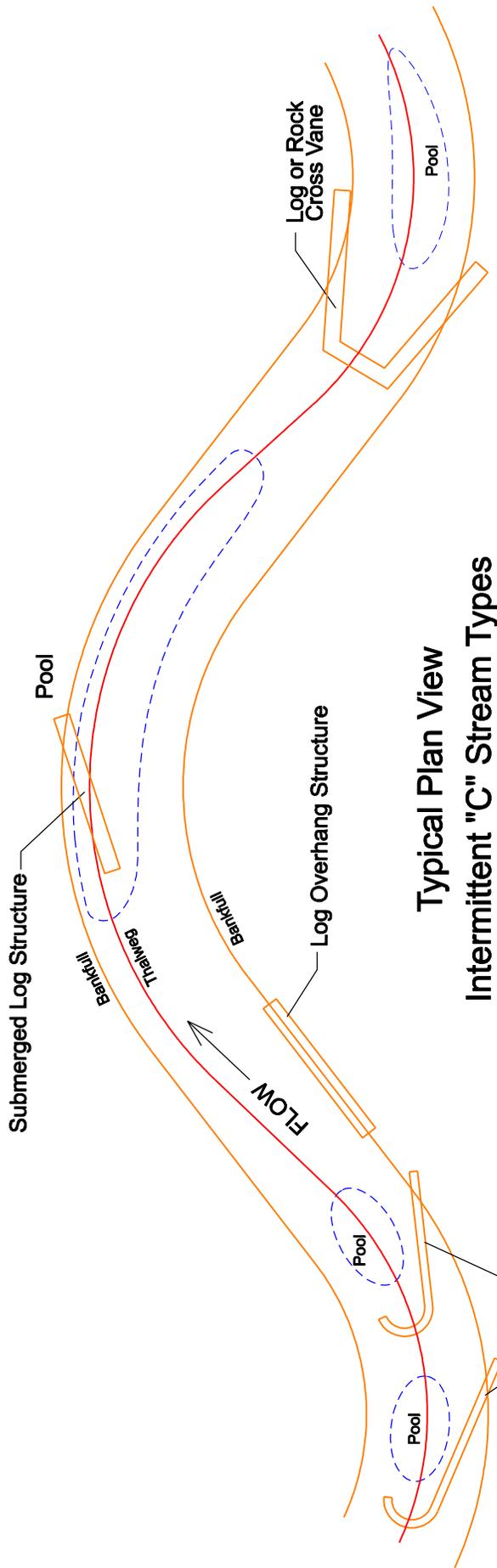
- BFW=4.3'
- BFA=1.53SF
- BF mean D=0.36'
- BF max D = 0.45'
- FPW= max 9.1'
- W/D=12.1
- Entrenchment Ratio 2.1 max
- Bench Width= 1.5' max



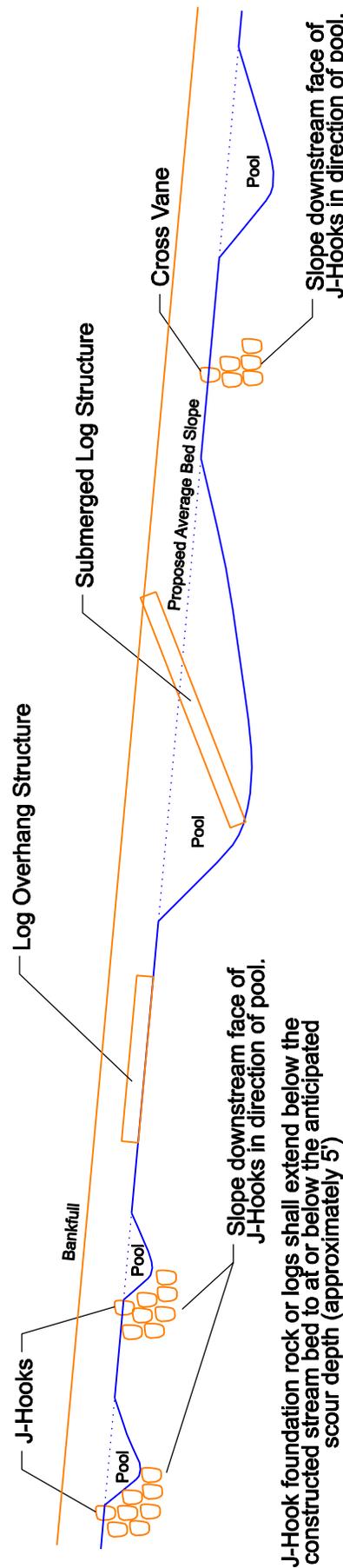
Note

- * Tree spacing shown (10' x 10') is based on bare root seedlings. See mitigation plan for other tree planting options.

**Typical Riffle Cross Section Stream EPH-3
Rosgen Stream Type "B"
Scale: 1"=10'**



**Typical Plan View
Intermittent "C" Stream Types**



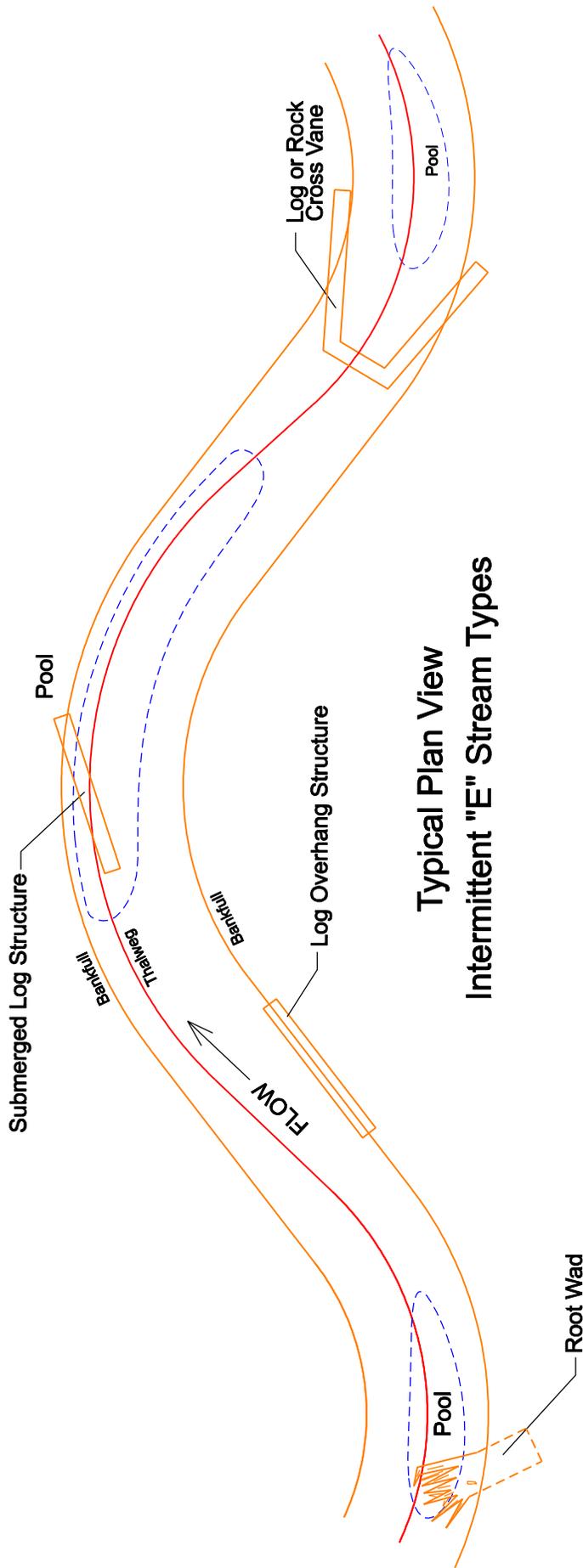
**Typical Profile View
Intermittent "C" Stream Types**

Pools, J-Hooks, Cross Vanes or submerged logs will be placed in outside meander bends on Intermittent "C" Stream Types. Structure dimensions, including rock and log diameter will be based on channel size and slope. Log Overhang Structures will be placed in straight or tangent sections of the stream. The frequency and randomness of structure placement will be determined as the stream is constructed.

Cross Vane foundation rock or logs shall extend below the constructed stream bed to at or below the anticipated scour depth (approximately 5')

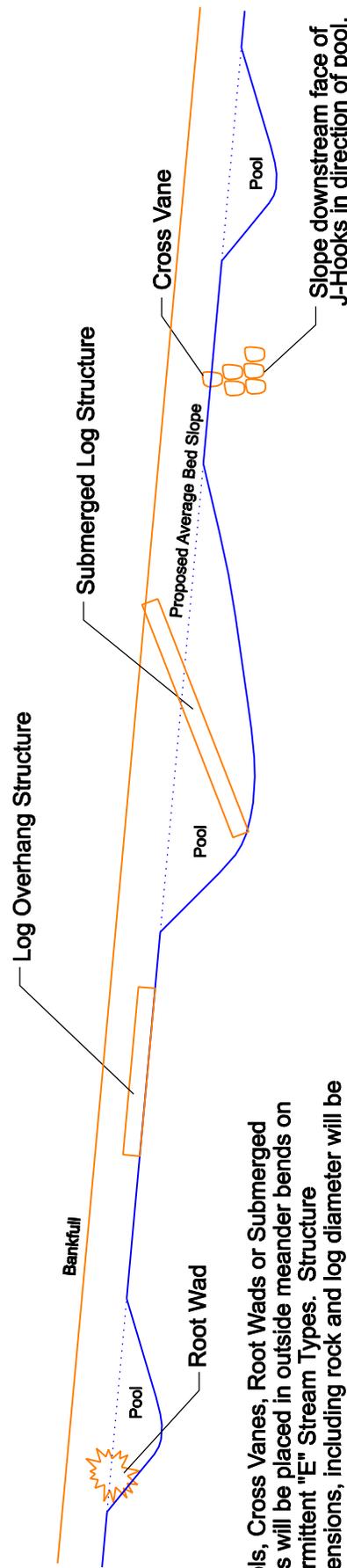
T.H.E. Engineers, Inc.	PROJECT: JOES RUN MINE SITE		STREAM: UT'S OF NORHT FORK PANTHER CREEK		
	COUNTY: DAVIESS	STATE: KY	NEAR: KNOTTSVILLE	ITEM: TYPICAL PLAN AND PROFILE VIEW	EXHIBIT 27

DATE:



**Typical Plan View
Intermittent "E" Stream Types**

Maximum pool depth
to be 1' to 2'.



**Typical Profile View
Intermittent "E" Stream Types**

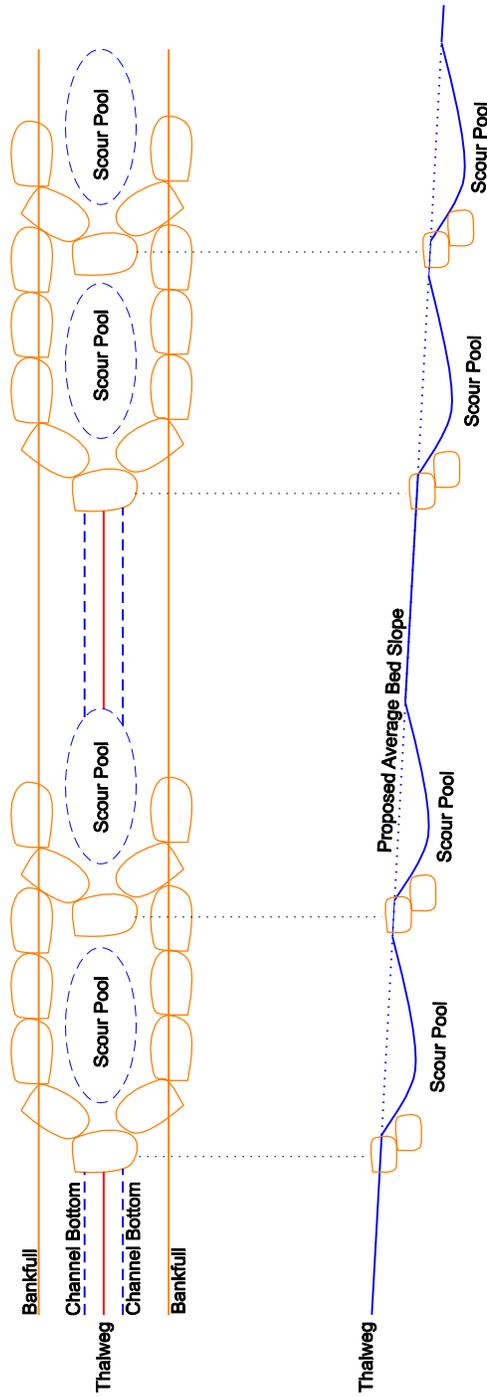
Cross Vane foundation rock or logs shall extend below the
constructed stream bed to at or below the anticipated
scour depth (approximately 5')

Pools, Cross Vanes, Root Wads or Submerged
Logs will be placed in outside meander bends on
Intermittent "E" Stream Types. Structure
dimensions, including rock and log diameter will be
based on channel size and slope. Log Overhang
Structures will be placed in straight or tangent sections
of the stream. The frequency and randomness of
structure placement will be determined as the stream
is constructed.

T.H.E. Engineers, Inc.	PROJECT: JOES RUN MINE SITE		STREAM: UT'S OF NORHT FORK PANTHER CREEK		
	COUNTY: DAVIESS	STATE: KY	NEAR: KNOTTSVILLE	ITEM: TYPICAL PLAN AND PROFILE VIEW	EXHIBIT 28

DATE:

Typical Plan View Rock Step Structure Alternate Ephemeral "B" Stream Types

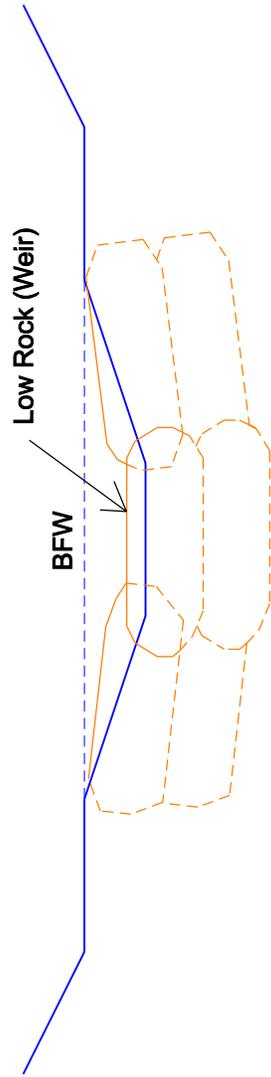


Typical Profile of Intermittent "B" Stream Types Step-Pool Channel

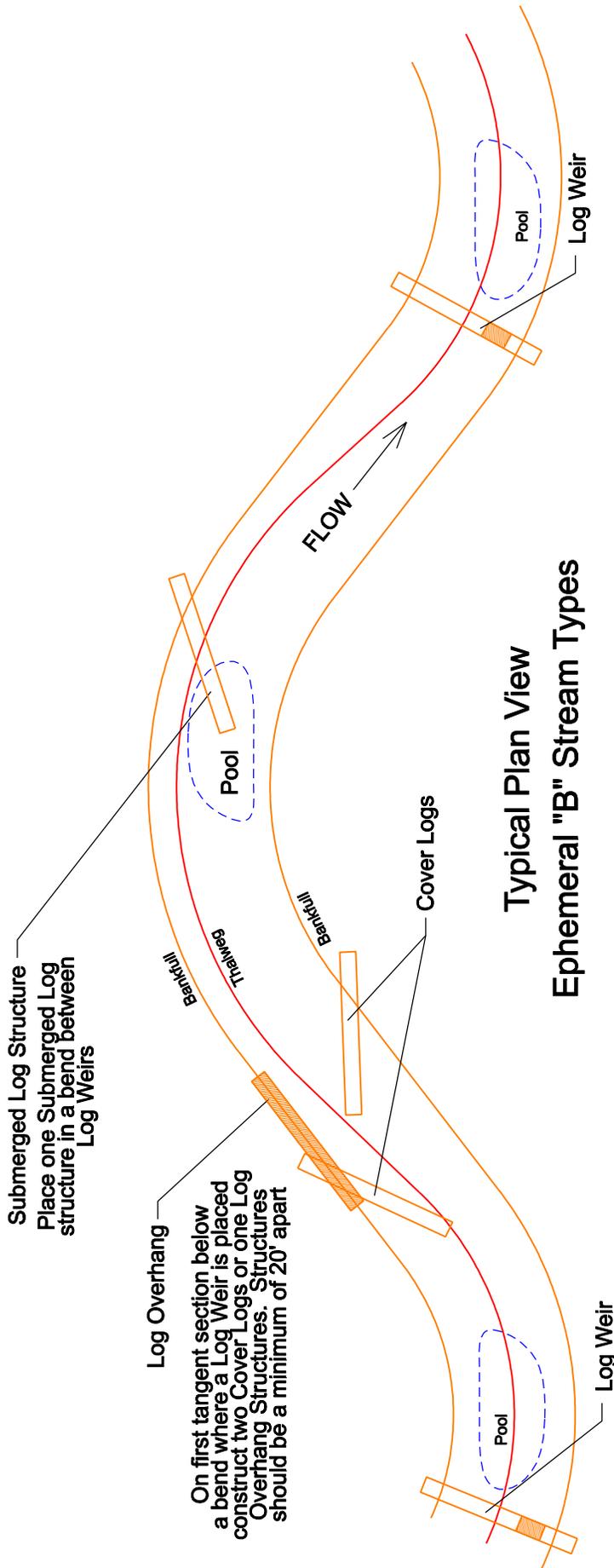
Spacing of Rock Step Structures and size of rock used will be based on channel size and channel slope. These structures will be used on Ephemeral "B" Stream Types as alternatives.

Pools are to be excavated just downstream of low rock (weir). Pool depths will vary from 0.5 foot to 1.0 foot.

When rock is not available, logs spanning the stream bottom and buried into the banks at least $\frac{1}{2}$ the bankfull stream width can be substituted. Top of the logs need to be placed so that they are level with the bankfull elevation and a notch cut out to form a weir at least $\frac{1}{2}$ the bank full depth and running $\frac{1}{3}$ of the length of the bankfull width. Logs should be buried below the stream bottom to prevent scour.

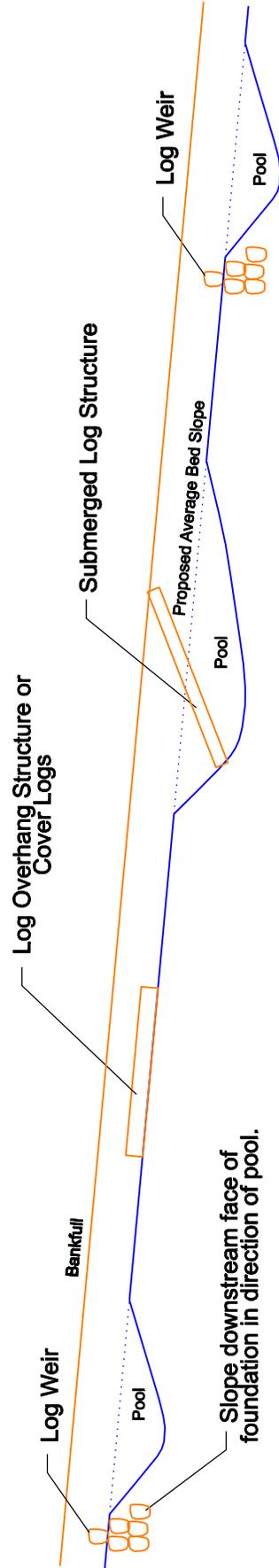


Typical Section of Rock Step Structure



**Typical Plan View
Ephemeral "B" Stream Types**

Max pool depths to be 1' to 2'.



**Typical Profile View
Ephemeral "B" Stream Types**

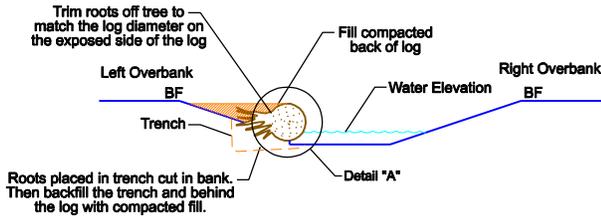
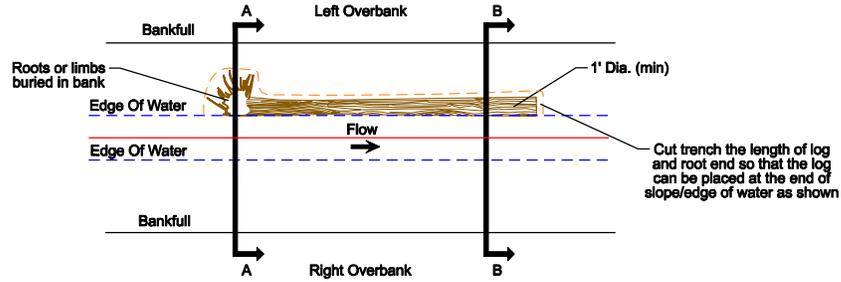
Foundation logs below the exposed weir log shall extend below the constructed stream bed to at or below the anticipated scour depth (approximately 5').

Note: Meander Length may vary. Generally place a Log Weir every 150'-250' along the stream reach at the beginning of a bend in the stream.

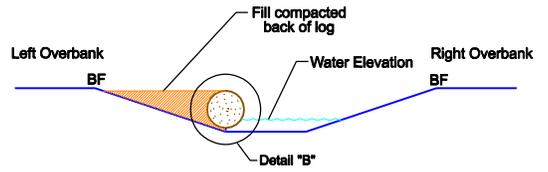
Habitat Structure Details

Intermittent "E" & "C" Type Streams

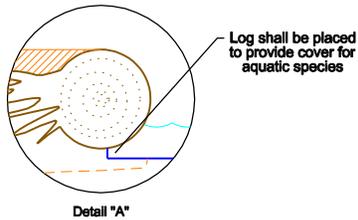
Log Overhang Structure



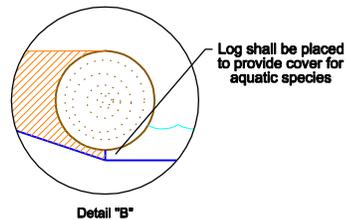
Section A-A



Section B-B

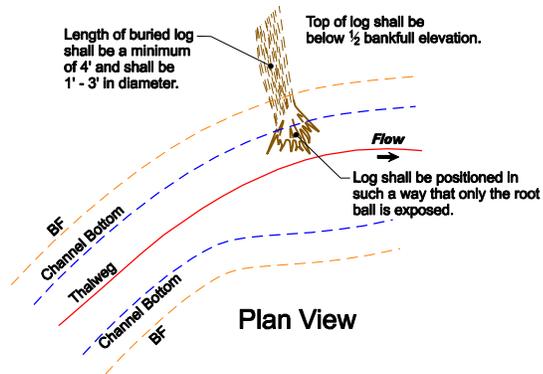


Detail "A"



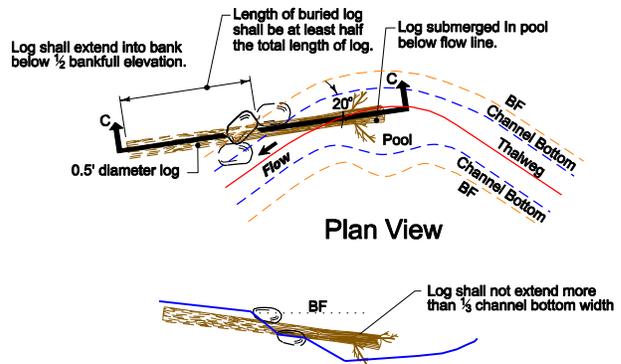
Detail "B"

Root Wad



Plan View

Submerged Log Structure



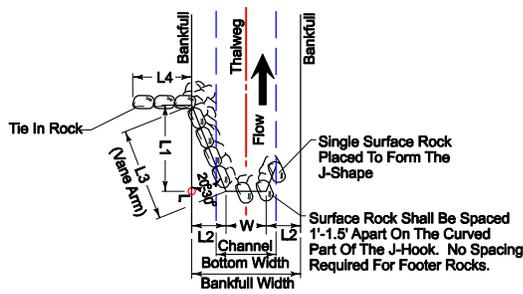
Plan View

Section C-C

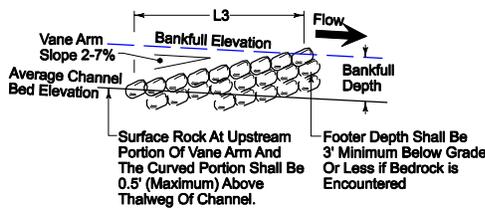
Stability And Habitat Structure Details

Intermittent "E" & "C" Type Streams

Rock J-Hook

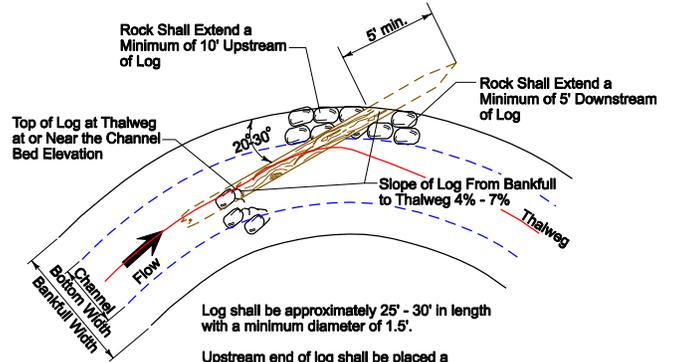


(Plan View)



(Profile Along Vane Arm)

Log Vane With J-Hook



Log shall be approximately 25' - 30' in length with a minimum diameter of 1.5'.

Upstream end of log shall be placed a minimum of 5' into bank at bankfull elevation. The log can be sawed at a sharp angle and driven into bank or placed in trench and backfilled.

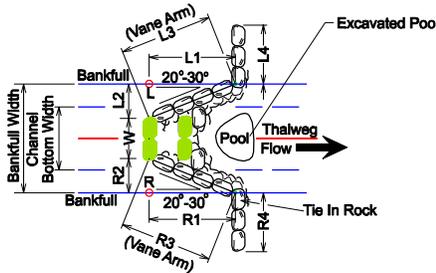
Downstream end of log shall be placed in the channel bottom at center of thalweg.

Rock protection shall be placed along the bank upstream and downstream of the log. Rock placement shall begin at channel bottom toe of slope and extend to bankfull elevation. Rock shall be a minimum of 1.5' diameter and keyed into channel bank.

Rock that is to be placed in the channel to form the J shape shall meet same specifications as those required on Rock J-Hook Structures.

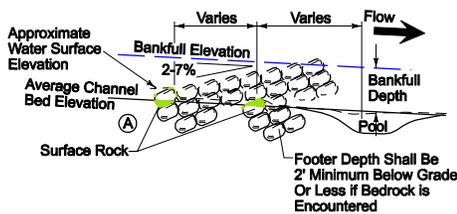
The log at bankfull shall be buried into the channel bank a minimum of 5'.

Double Invert Cross Vane



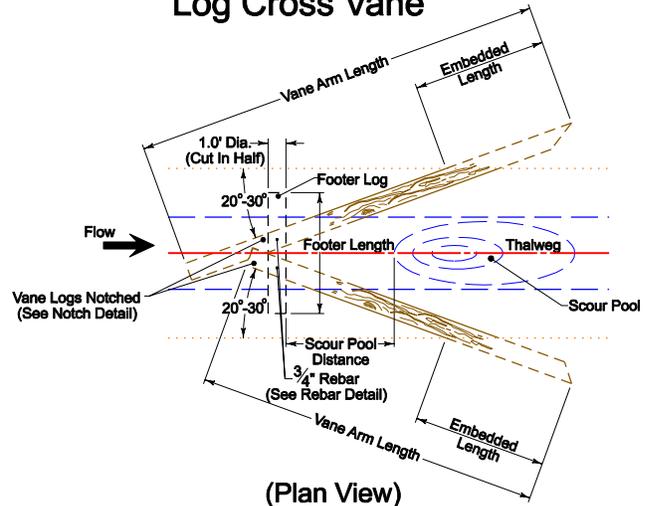
Top Of Cross-Vane Across Width (W) Is Level. Surface Rock In This Level (Upstream) Portion Is 0.5' (Maximum) Above Thalweg Of Channel.

(Plan View)

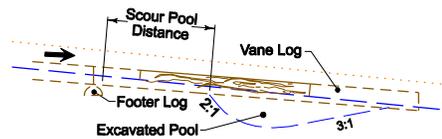


(Profile)

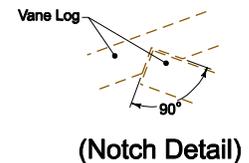
Log Cross Vane



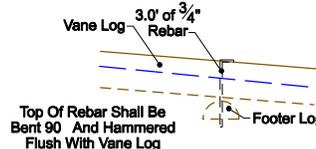
(Plan View)



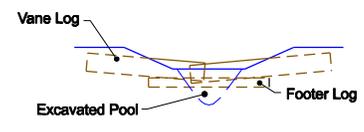
(Profile)



(Notch Detail)



(Rebar Detail)

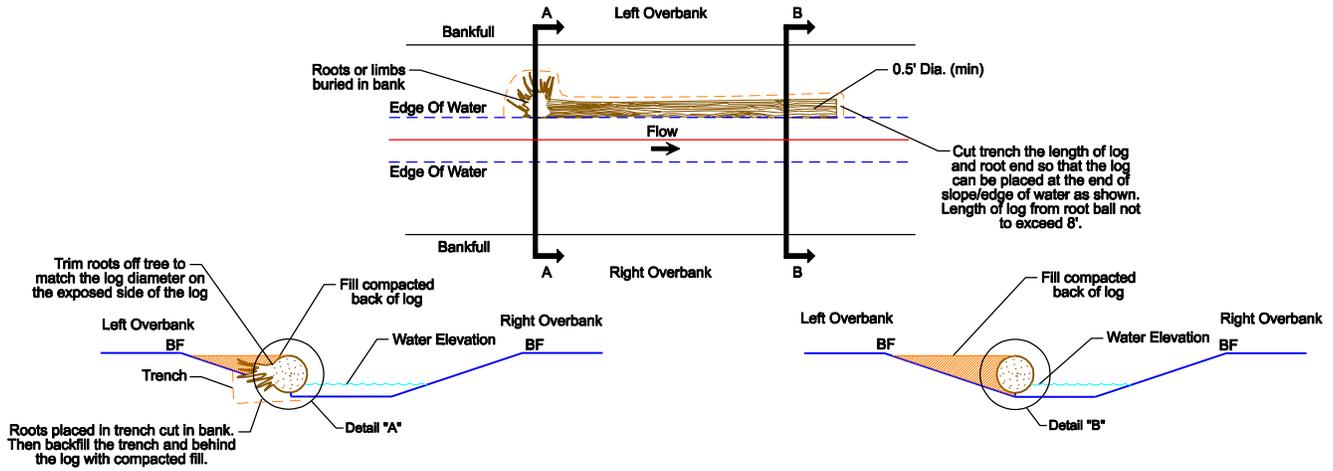


(Cross Section View)

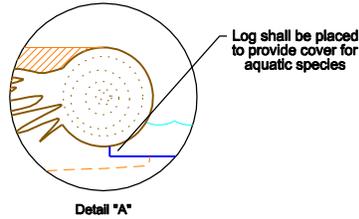
Habitat Structure Details

Ephemeral "B" Type Streams

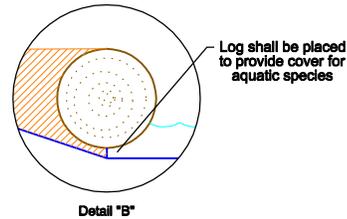
Log Overhang Structure



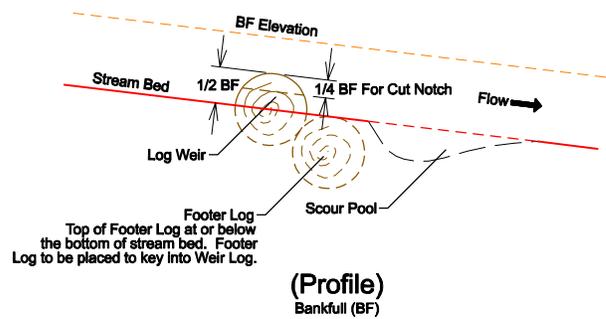
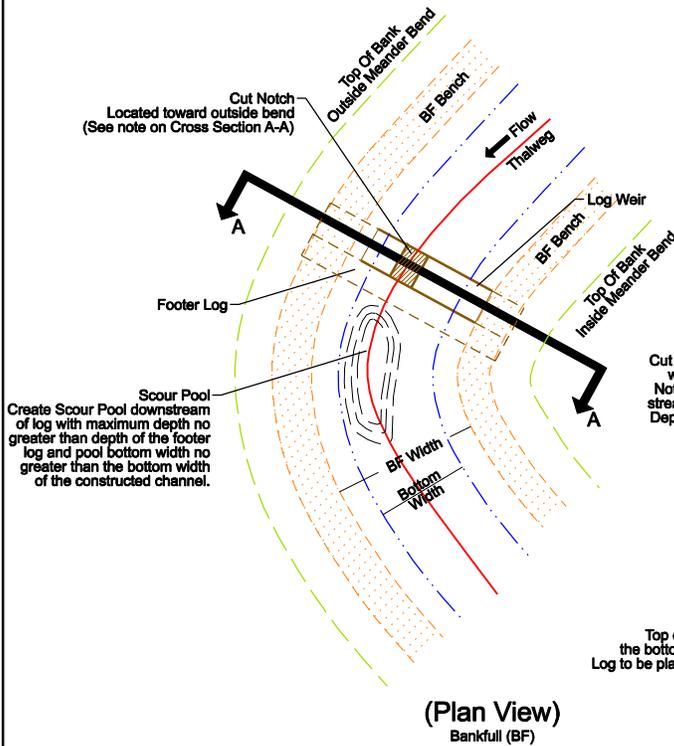
Section A-A



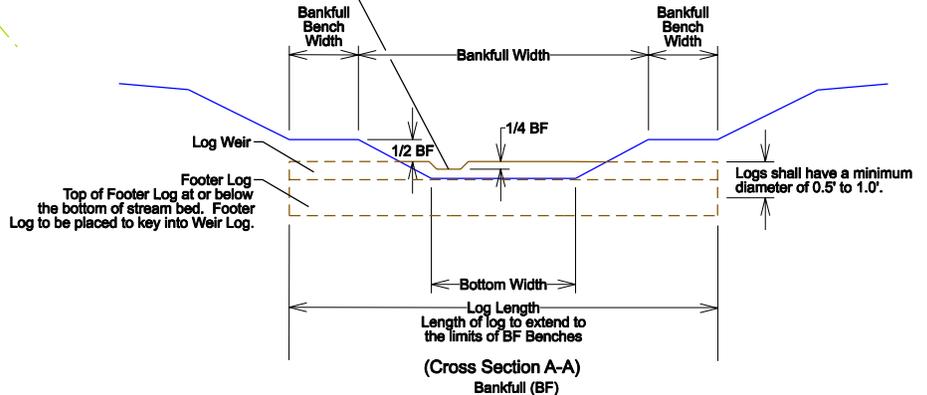
Section B-B



Log Weir



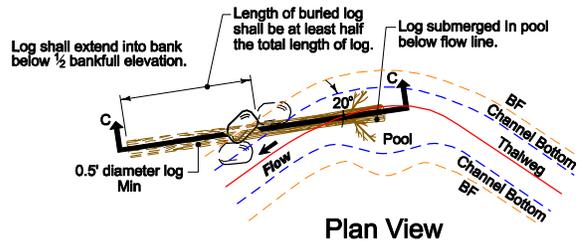
Cut Notch in log to create a weir with width 1/3 to 1/2 the Bottom Width. Notch to be offset from the center of stream channel toward outside bend. Depth of Notch to be no greater than 1/4 BF Max. Depth.



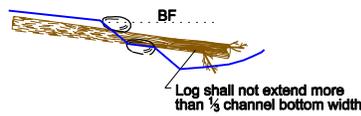
Habitat Structure Details

Ephemeral "B" Type Streams

Submerged Log Structure

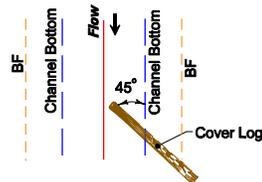


Plan View

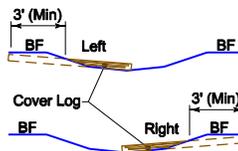


Section C-C

Cover Log



Plan View



Cross Section View

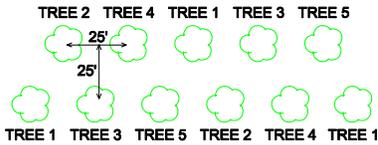
Cover log shall consist of a 0.5' to 1.0' diameter log placed flush on channel bottom. One end of log will extend a minimum of 3.0' into channel bank and other end will extend to $\frac{1}{4}$ to $\frac{1}{3}$ channel bottom width. The log shall be angled in upstream direction.

Log will alternate sides. (See Plan Sheets)

RIPARIAN ZONE PLANTING NOTES

(USE OPTION ONE OR OPTION TWO FOR TREE PLANTINGS)

PLAN VIEW: PLANTING DETAIL RPM Riparian Trees (Option One)



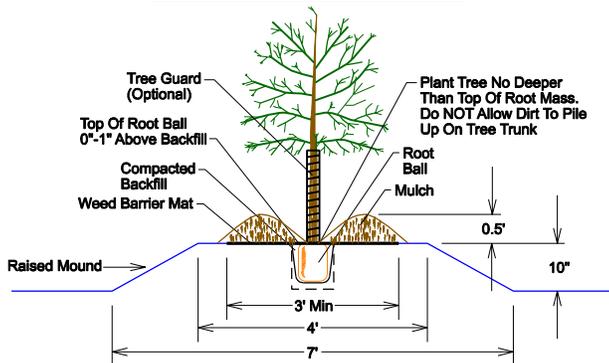
RPM RIPARIAN TREE PLANTINGS (OPTION ONE)

1. Only trees that have been produced by the Root Production Method (RPM) shall be planted in the Riparian zone.
2. The trees shall be three gallon container grown.
3. The trees shall be planted between the dates of October 1 and December 15.
4. Trees in the same row shall be planted on 25 foot spacing.
- ★5. The first row of trees nearest the channel shall be planted approximately 8 feet beyond the shrub plantings.
6. The second row shall be planted 25 feet behind the first row. The subsequent rows will also be on 25 foot spacing.
7. The trees shall be planted in a staggered pattern, not one directly behind the other.
- ★8. The trees shall be planted with alternating species.

RECOMMENDED PROCEDURES FOR PLANTING RPM TREES

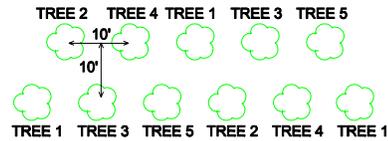
1. Site preparation - trees are to be planted on a raised mound of existing soil. The mound shall be 8-10 inches high after mild compaction. The base of the mound shall have a minimum width of seven feet with a flat crown (top) at approximately four feet.
2. The hole shall be approximately the same size as the container (10 inch diameter-8 inch depth).
- ★3. After unloading trees, they shall be watered thoroughly and protected from excessive heat or cold. Do not allow rootball to freeze or dry out.
- ★4. If the trees are not to be planted for several days or weeks, they should be watered every 3-4 days and again immediately before planting.
- ★5. Remove the plastic container in which the trees have been growing prior to planting. Do not disturb rootball after container has been removed.
- ★6. Do not plant trees any deeper than the level at which they were growing in the container. It is acceptable to plant the trees 1 inch above the level they were growing in the container.
7. Trees planted between October 1 and December 15, will require the application of a slow release fertilizer after planting. 1-1 1/2 tablespoons around drip zone is recommended. An analysis of 27-3-7 with I.B.D.U. or similar is recommended.

RPM TREE PLANTING DETAIL



Mound hardwood mulch chips around base of each tree. Diameter of mulch placed around tree trunk can vary from 3' to 4'. Maximum depth of mulch to be 0.5' one foot from center of tree trunk. Lessen depth of mulch closer to the trunk to provide a minimal layer of mulch over the top of the root ball. Mounding should form a cone area near the trees trunk that will trap water around the tree. During the first growing season, trees should be watered thoroughly at least once a week.

PLAN VIEW: PLANTING DETAIL NON - RPM Riparian Trees (Option Two)



TREE PLANTING (OPTION TWO)

1. Trees shall be container grown or bare root.
2. Bare root stock must be a minimum 30" (inches) in height and planted on 10' x 10' spacing in a staggered pattern.
3. Three-gallon trees shall be planted on 19' x 19' spacing in a staggered pattern.
4. NOTE: Option One notes with ★ also apply to Option Two

THE FOLLOWING TREES WILL BE USED FOR BOTH OPTIONS

An equal amount of the following trees are to be planted throughout the riparian zone.

INTERMITTENT/PERENNIAL TREE LIST

Tree 1: Black walnut (*Juglans nigra*)
 Tree 2: Pignut hickory (*Carya glabra*)
 Tree 3: Chestnut oak (*Quercus prinus*)
 Tree 4: Red oak (*Quercus rubra*)
 Tree 5: White oak (*Quercus alba*)

EPEMERAL STREAM TREE LIST

Tree 1: Shagbark hickory (*Carya glabra*)
 Tree 2: Black cherry (*Prunus serotina*)
 Tree 3: Black oak (*Quercus velutina*)
 Tree 4: Flowering dogwood (*Cornus florida*)
 Tree 5: Red bud (*Ceris canadensis*)

SHRUB PLANTINGS (These will not be RPM Plantings)

PLAN VIEW: SHRUB PLANTING DETAIL



The following shrubs are to be planted near bankfull elevation. See typical cross sections for number of rows and placement.

Shrub 1: Rough-leaf Dogwood (*Cornus drummondii*)
 Shrub 2: Strawberry Bush (*Euonymus americanus*)
 Shrub 3: Indigo Bush (*Amorpha fruticosa*)

Three gallon container shrubs shall be planted on approximate 4' spacing with an equal amount of each species planted in random sequence.

SEEDING:

The following native grasses will be sown along both stream banks and throughout the riparian zone:

Switchgrass (<i>Panicum virgatum</i>)	20%
Virginia Wild Rye (<i>Elymus virginicus</i>)	20%
Rough Barmyard Grass (<i>Echinochloa muricata</i>)	10%
Annual Rye (<i>Lolium perenne</i>)	10%
Big bluestem (<i>Andropogon gerardii</i>)	20%
Forking panic grass/smooth panic grass (<i>Dichanthelium dichotomum/ dichotomiflorum</i>)	20%

Apply seed at a rate of 20 pounds/acre or as recommended by seed supplier.

Straw mulch or erosion control blanket shall be placed immediately following seeding.

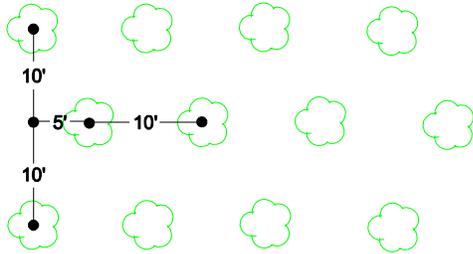
Additional native species may be substituted based on approval of Army Corps of Engineers

Riparian Zone Width will be a minimum of 100' for intermittent streams

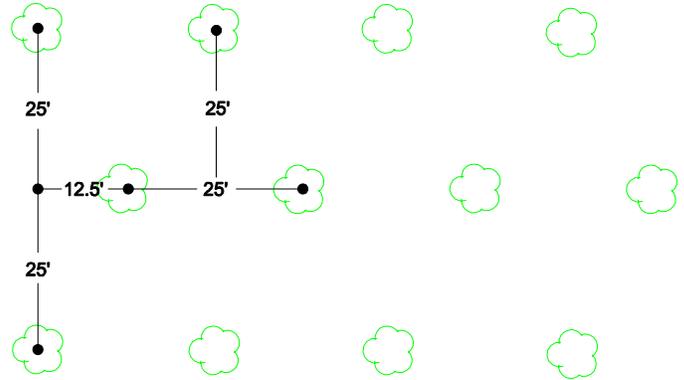
**Shrub plantings and seeding
will be the same for each option.**

WETLAND PLANTING DETAILS

If using tree seedlings, use 10 foot spacing.



If using RPM trees, use 25 foot spacing.
(non-RPM 3-gal. trees, use 19 foot spacing)



Planting Quantities Shall Meet Densities Stated in The Wetland Mitigation Planting Plan. Plant Locations Shall Be Irregularly Spaced And Distributed Such That No Area Is Dominated By Any Single Species

WETLAND PLANTING SPECIES LIST

TREES

- Shellbark hickory (*Carya laciniosa*)
- Cherrybark oak (*Quercus pagoda*)
- Pin oak (*Quercus palustris*)
- Swamp white oak (*Quercus bicolor*)
- Overcup oak (*Quercus lyrata*)

HERBACEOUS SEED MIX

- Cardno JFNew's "Wooded Wetland Establishment" seed mix OR
- Green bulrush (*Scirpus atrovirens*)
- Virginia wild rye (*Elymus virginicus*)
- Fox sedge (*Carex vulpinoidea*)
- Soft rush (*Juncus effusus*)
- Woolgrass (*Scirpus cyperinus*)
- Common sneezeweed (*Helenium autumnale*)

RECOMMENDED PROCEDURES FOR PLANTING RPM TREES

1. Site preparation - trees are to be planted on a raised mound of existing soil. The mound shall be 8-10 inches high after mild compaction. The base of the mound shall have a minimum width of seven feet with a flat crown (top) approximately three to four feet in width.
2. The hole shall be approximately the same size as the container (10 inch diameter-8 inch depth) or slightly larger.
3. After unloading trees, they shall be watered thoroughly and protected from excessive heat or cold. Do not allow rootball to freeze or dry out.
4. If the trees are not to be planted for several days or weeks, they should be watered every 3-4 days and again immediately before planting.
5. Remove the plastic container in which the trees have been growing prior to planting. Rough up the sides and bottom of planting hole so roots can penetrate the soil. Position tree in hole with top of root mass level with top of mound. Backfill hole with loose soil.
6. Trees planted between October 1 and December 10, will require the application of a slow release fertilizer after trees are dormant in late fall or winter. 1 tablespoon of Scottfield fertilizer 27-3-6 with IBDU or equal applied to the soil around the base of the trees is recommended.
7. Install 4'x4' weed mat, if desired.
8. Install 24" tree guard around tree, if desired.
9. Planted trees should be watered daily for 7 to 10 days, then watered every other day for the next 2 weeks (or the equivalent in rainfall).

RPM TREE PLANTING DETAIL

