TENNESSEE DEPARTMENT OF ENVIRONMENT AND CONSERVATION
Division of Water Resources
William R. Snodgrass Tennessee Tower, 312 Rosa L. Parks Avenue, 11th Floor, Nashville, Tennessee 37243
1-888-891-8332 (TDEC)

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

OFFICIAL STATE USE ONLY	Site #:		Permit #:	NRS 17.147

Section 1. Applicant Information *(individual responsible for site, signs certification below)*

Applicant Name: Town of Collierville			
Company: Town of Collierville, TN		Signatory's Title or Position:	
Mailing Address: 500 Poplar View Parkway		City: Collierville	State: TN Zip: 38017
Phone: 901.457.2340	Fax:	E-mail: dperryman@ci.collierville.tn.us	

Section 2. Alternate Contact/Consultant Information (*a consultant is not required*)

Alternate Contact Name: William Edwards			
Company: A2H, Inc.		Title or Position: Senior Civil Engineer	
Mailing Address: 3009 Davies Plantation Road		City: Lakeland	State: TN Zip: 38002
Phone: 901.372.0404	Fax: 901.373.4002	E-mail: bille@a2h.com	

Section 3. Fee *(check appropriate box and submit requisite fee with application)*

☐ No Fee Submitted ☒ Fee Submitted with Application Amount Submitted: $ 2,500.00

Current fee schedules for Aquatic Resource Alteration Permit processing may be found at the Division of Water Resources webpage at http://www.tn.gov/environment/permits/arap.shtml or by calling (615) 532-0625. Make checks payable to "Treasurer, State of Tennessee".

Section 4. Project Details *(fill in information and check appropriate boxes)*

Site or Project Name: Wolf River Lateral J; from confluence to Shelton Road Crossing		Nearest City, Town or Major Landmark: Collierville, TN
Street Address or Location: East and parallel to the Shelton Road wastewater treatment plant		
County(ies): Shelby	MS4 Jurisdiction:	Latitude (dd.dddd): 35.0841 to 35.0745 Longitude (dd.dddd): 89.6618 to 89.6661

Resource Proposed for Alteration: ☒ Stream ☐ Wetland ☐ Reservoir

Name of Water Resource: Wolf River Lateral J

Brief Project Description (a more detailed description is required under Section 8):

Stabilize the stream gradient using four (4) grade control structures to prevent future head cutting; and, re-grade and stabilize bank slopes in areas where infrastructure, including but not limited to WWTP outfall lines, residential properties, and bridge crossing, is threatened.

Does the proposed activity require approval from the U.S. Army Corps of Engineers, the Tennessee Valley Authority, or any other federal, state, or local government agency? ☒ Yes ☐ No

If Yes, provide the permit reference numbers: Application made concurrently

Is the proposed activity associated with a larger common plan of development? ☐ Yes ☒ No

If Yes, submit site plans and identify the location and overall scope of the common plan of development. Plans attached? ☒ Yes ☐ No

If applicable, indicate any other federal, state, or local permit authorizations that the overall project site (common plan of development) has obtained in the past (i.e. construction general permit coverage and/or other ARAPs):

Section 5. Project Schedule *(fill in information and check appropriate boxes)*

Start date: May 2018	Estimated end date: May 2022

Is any portion of the activity complete now? ☐ Yes ☒ No If yes, describe the extent of the completed portion:

The Town has found it necessary to make three (3) isolated emergency repairs to the west bank to protect the outfall lines from the wwtp and the access road to maintain the sewer outfall lines.

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The required information in Sections 6-11 must be submitted on a separate sheet(s) and submitted in the same numbered format as presented below. If any question in not applicable, state the reason why it is not applicable.

Section 6. Project Description		**Attached** Yes	No
6.1	A narrative description of the scope of the project	☒	☐
6.2	USGS topographic map indicating the exact location of the project (*can be a photographic copy*)	☒	☐
6.3	Photographs of the resource(s) proposed for alteration with location description (*photo locations should be noted on map*)	☒	☐
6.4	A narrative description of the **existing** stream and/or wetland characteristics including, but not limited to, dimensions (e.g., depth, length, average width), substrate and riparian vegetation	☒	☐
6.5	A narrative description of the **proposed** stream and/or wetland characteristics including, but not limited to, dimensions (e.g., depth, length, average width), substrate and riparian vegetation	☒	☐
6.6	In the case of wetlands, include a wetland delineation with delineation forms and site map denoting location of data points	☐	☒
6.7	A copy of all hydrologic or jurisdictional determination documents issued for water resources on the project site	☐	☒

Section 7. Project Rationale	**Attached** Yes	No
Describe the need for the proposed activity, including, but not limited to, the purpose, alternatives considered, and what will be done to avoid or minimize impacts to streams or wetlands.	☒	☐

Section 8. Technical Information		**Attached** Yes	No
8.1	Detailed plans, specifications, blueprints, or legible sketches of present site conditions and the proposed activity. Plans must be 8.5.x 11 inches. Additional larger plans may also be submitted to aid in application review. The detailed plans should be superimposed on existing and new conditions *(e.g., stream cross sections where road crossings are proposed)*	☒	☐
8.2	For both the proposed activity and compensatory mitigation, provide a discussion regarding the sequencing of events and construction methods	☒	☐
8.3	Depiction and narrative on the location and type of erosion prevention and sediment control (EPSC) measures for the proposed alterations	☒	☐

Section 9. Water Resources Degradation (degree of proposed impact) *Note that in most cases, activities that exceed the scope of the General Permit limitations are considered greater than de minimis degradation to water quality.*

My activity, as proposed:

a. ☐ Will not cause measurable degradation to water quality

b. ☐ Will only cause de minimis degradation to water quality

c. ☒ Will cause more than de minimis degradation to water quality (*Complete additional sections 9-11*)

d. ☐ Unsure/need more information

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For information and guidance on the definition of de minimis and degradation, refer to the Antidegradation Statement in Chapter 0400-40-03-.05 of the Tennessee Water Quality Criteria Rule: https://www.tn.gov/sos/rules/0400/0400-40/0400-40-03.20131216.pdf. For more information on specifics on what General Permits can cover, refer to the Natural Resources Unit webpage at http://www.tn.gov/environment/permits/arap.shtml

If you checked "c." above in Section 9, complete the following 2 sections, 10-11.

Section 10. Detailed Alternative Analysis		**Attached** Yes	No
10.1	Analyze all reasonable alternatives and describe the level of degradation caused by each of the feasible alternatives	☒	☐
10.2	Discuss the social and economic consequences of each alternative	☒	☐
10.3	Demonstrate that the degradation associated with the preferred alternative will not violate water quality criteria for uses designated in the receiving waters, and is necessary to accommodate important economic and social development in the area	☒	☐

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Section 11. Compensatory Mitigation		Attached Yes	Attached No
11.1	A detailed discussion of the proposed compensatory mitigation	☒	☐
11.2	Describe how the compensatory mitigation would result in no net loss of resource value	☒	☐
11.3	Provide a detailed monitoring plan for the compensatory mitigation site	☒	☐
11.4	Describe the long-term protection measures for the compensatory mitigation site *(e.g., deed restrictions, conservation easement)*	☒	☐

Certification and Signature

An application submitted by a corporation must be signed by a principal executive officer; from a partnership or proprietorship, by the partner or proprietor respectively; from a municipal, state, federal or other public agency or facility, the application must be signed by either a principal executive officer, ranking elected official, or other duly authorized employee.

"I certify under penalty of law that this document and all attachments were prepared by me, or under my direction or supervision. The submitted information is to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment. As specified in Tennessee Code Annotated Section 39-16-702(a)(4), this declaration is made under penalty of perjury".

Stan Joyner, Jr.	Mayor		6/1/2017
Printed Name	Official Title	Signature	Date

Submitting the form and obtaining more information Note that this form must be signed by the principal executive officer, partner or proprietor, or a ranking elected official in the case of a municipality; for details see **Certification and Signature** statement above. For more information, contact your local EFO at the toll-free number 1-888-891-8332 (TDEC). Submit the completed ARAP Application form (keep a copy for your records) to the appropriate EFO for the county(ies) where the ARAP activity is located, addressed to **Attention: ARAP Processing**. You may also electronically submit the complete application and all associated attachments (e.g., maps, wetland delineations and narrative portions) to water.permits@tn.gov.

EFO	Street Address	Zip Code	EFO	Street Address	Zip Code
Memphis	8383 Wolf Lake Drive, Bartlett	38133-4119	Cookeville	1221 South Willow Ave.	38506
Jackson	1625 Hollywood Drive	38305-4316	Chattanooga	1301 Riverfront Pkwy., Ste. 206	37402
Nashville	711 R S Gass Boulevard	37243	Knoxville	3711 Middlebrook Pike	37921
Columbia	1421 Hampshire Pike	38401	Johnson City	2305 Silverdale Road	37601

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Received Date:	Permit Number:	Reviewer:	Field Office:
Fee amount paid:	T & E Aquatic Flora and Fauna:	Impaired Receiving Stream:	Application Review:
Date:			☐ Deficient Date:
Check #:	Exceptional TN Water:		☐ Complete Date:

6.1 SCOPE OF PROJECT

The confluence of Wolf River Lateral J with the Wolf River occurs approximately 3,070 feet west, as the crow flies, from the Collierville- Arlington Road crossing of the River. The stream reach of interest is from this confluence to the Shelton Road crossing of Lateral J. The length of this reach measured along the flow line of the channel is 4,017 lineal feet. The outfall from the Shelton Road wastewater treatment plant (wwtp) which consists of two (2) 24-inch diameter pipe lines runs parallel to the west bank of the stream. Records show that since 1994 the elevation of the flow line of the lateral has lowered approximately 6 feet. These same records show that the channel bottom at the Shelton Road bridge crossing has lowered approximately 1.9 feet.

The lowering of the bottom is attributed to head cutting which has occurred over the years in response to head cutting that has occurred in the Wolf River channel. In 2006 a project stabilize the stream banks and bottom gradient of the Wolf River between the bridge at Houston Levee Road and Collierville – Arlington Road was completed by the US Army Corps of Engineers. The stabilization of the Wolf River bottom gradient has eliminated the primary cause of the head cutting.

A hydraulic analysis of Lateral J was conducted. As a result of this analysis it was determined that a stable stream gradient for the lateral is 0.00112 ft./ft. (0.112%). By analyzing the profile of the existing stream it was determined that from the mouth of the lateral continuing for approximately 2,500± lineal feet upstream the bottom gradient approximates the stable stream gradient. However, the bottom gradient of the remainder of the stream up to the bridge at Shelton Road is significantly steeper. The bottom would be approximately 5 feet lower at Shelton Road if the stable gradient is projected upstream from the current stream bottom of the lateral at its mouth to the bridge crossing.

As a result of the head cutting, even though the downstream reach is at a stable bottom gradient, the bottom is incised. The banks have steep, unstable side slopes. The stream banks are eroding in such a manner that eventually a stable slope will be established. If this erosion is not controlled it is probable that the outfall lines from the wwtp will be undermined.

Although the lower 2,500 lineal feet of the lateral's stream bottom appears stable, the flowline of the Wolf River channel opposite the mouth of the lateral is approximately 8 feet lower than that of Lateral J at its mouth. There is the possibility that long term the gradient of the lateral could continue to degrade until the flowline of the River bottom is reached.

The confluence of Lateral J with the Wolf River is near the middle of the outside of a hairpin bend in the River channel. The river bank on the outside of the bend is actively eroding so that the top of the near vertical banks is moving south.

The purpose of the project is twofold. Stabilize the bottom gradient to prevent any future head cutting; and, establish stable stream bank slopes in areas where uncontrolled bank erosion will result in the undermining and failure of adjacent infrastructure. Presently there is concern about the stability of the sanitary sewer outfall lines from the Shelton Road waste water treatment

plant which discharges into the Wolf River. There is approximately 1,020 lineal feet of two (2) side by side 24-inch diameter sewer lines running parallel to the stream bank that is in danger of being undermined by stream bank erosion.

The bottom gradient will be stabilized using four (4) grade control structures. The structures will consist of sheet pile; trapezoidal shaped weirs with rip-rap slope protection up and downstream of the weir. The length of the slope protection varies at each structure based upon the stream hydraulics.

The downstream most grade control will be set so that the flowline of the weir is at the existing stream bottom. The pile tip of the sheet pile wall will be set deep enough to protect against the possibility of Wolf River undercutting the structure. The sheet pile structure shall be extended into the banks to preclude the stream flows in the lateral from flanking the structure. The east side of the structure will be battered and extended into the banks to protect against the possibility that the river bank on the outside of the bend does not erode past the end of the structure.

The upstream most structure will be located approximately 200 feet downstream of the bridge at Shelton Road. This is at the point where the most recent round of head cutting had progressed as evidenced by the undermining of a waterline crossing. The flow line of the weir will be set at approximately the same elevation as the existing stream flowline at the downstream face of the bridge. This will set the lip of the weir approximately 2 feet above the current stream bottom at that point. This will create an instream pool behind the weir. It is anticipated that over time the area upstream of the weir would fill with silt. The two foot drop across the weir will create a scour potential. Rip rap will be used to armor against scour.

There will be two additional intermediate grade control structures. Their positions were determined by the projection upstream of the established stable gradient. Each weir will be stepped approximately 2 feet such that the 6 feet of vertical change that has occurred in the past 23 years is counterbalanced. The conditions upstream and downstream of the intermediate structures are similar to those of the upstream most structure.

There are several areas where the stream banks will be regraded to establish a stable slope. In those area where stream hydraulics allow permanent turf reinforcement matting (TRM) will be used to stabilize the slopes. Prior to installing the TRM the slopes will be seeded with a seed mixture of natural grasses and forbs. Rip rap will be used only in those areas with hydraulic conditions preclude the use of TRM. The hydraulic model created to aid in the analysis and design of the stream stabilization indicates that the stream flows often running bank full or out of banks. The plan is to install the rip rap and TRM from toe to the top of bank to protect against erosion when the stream is flowing bank full. This will also protect the banks from the effects of erosion caused when the flood waters recede and the waters flow across the top bank when re-entering the stream channel flow.

In order to control scour rip rap will be placed across the stream bottom downstream of the three (3) upstream weirs. The length of the bottom rip rap blanket will be 50 feet. There is existing rip rap across the full stream channel section between the most upstream grade control

structure and the Shelton Road bridge crossing. This rip rap will be reshaped and supplemented to provide the needed protection against erosion immediately downstream of the bridge.

The table below lists the locations the grade control structures and the locations and lengths of the planned stream bank and bottom stabilization measures.

STREAM STABILIZATION MEASURES

LOCATION		LENGTH OF STABILIZTION MEASURES				
		LEFT BANK		BOTTOM	RIGHT BANK	
FROM	TO	RIP RAP	TRM	RIP RAP	RIP RAP	TRM
0+40	1+75				130	
1+75	2+05	30			30	
2+05		GRADE CONTROL STRUCTURE No. 1				
2+05	3+30	125			125	
3+30	3+50	20				20
3+50	5+25					175
9+00	14+00					500
21+00	21+50				50	
21+50	23+00					150
23+00	24+70		170			170
24+70	24+95	25			25	
24+95	25+45	50		50	50	
25+45		GRADE CONTROL STRUCTURE No. 2				
25+45	26+50	105			105	
26+50	28+00				150	
30+00	31+57		157			157
31+57	32+07	50		50	50	
32+07		GRADE CONTROL STRUCTURE No. 3				
32+07	32+65	58			58	
32+65	36+90		425			
36+90	38+00		110			110
38+00	38+18	18			18	
38+18	38+68	50		50	50	
38+68		GRADE CONTROL STRUCTURE No. 4				
38+68(1)	40+57(2)	189		189	189	

LEFT BANK RIP RAP(3) 720

LEFT BANK TRM 862

BOTTOM RIP RAP(3) 339

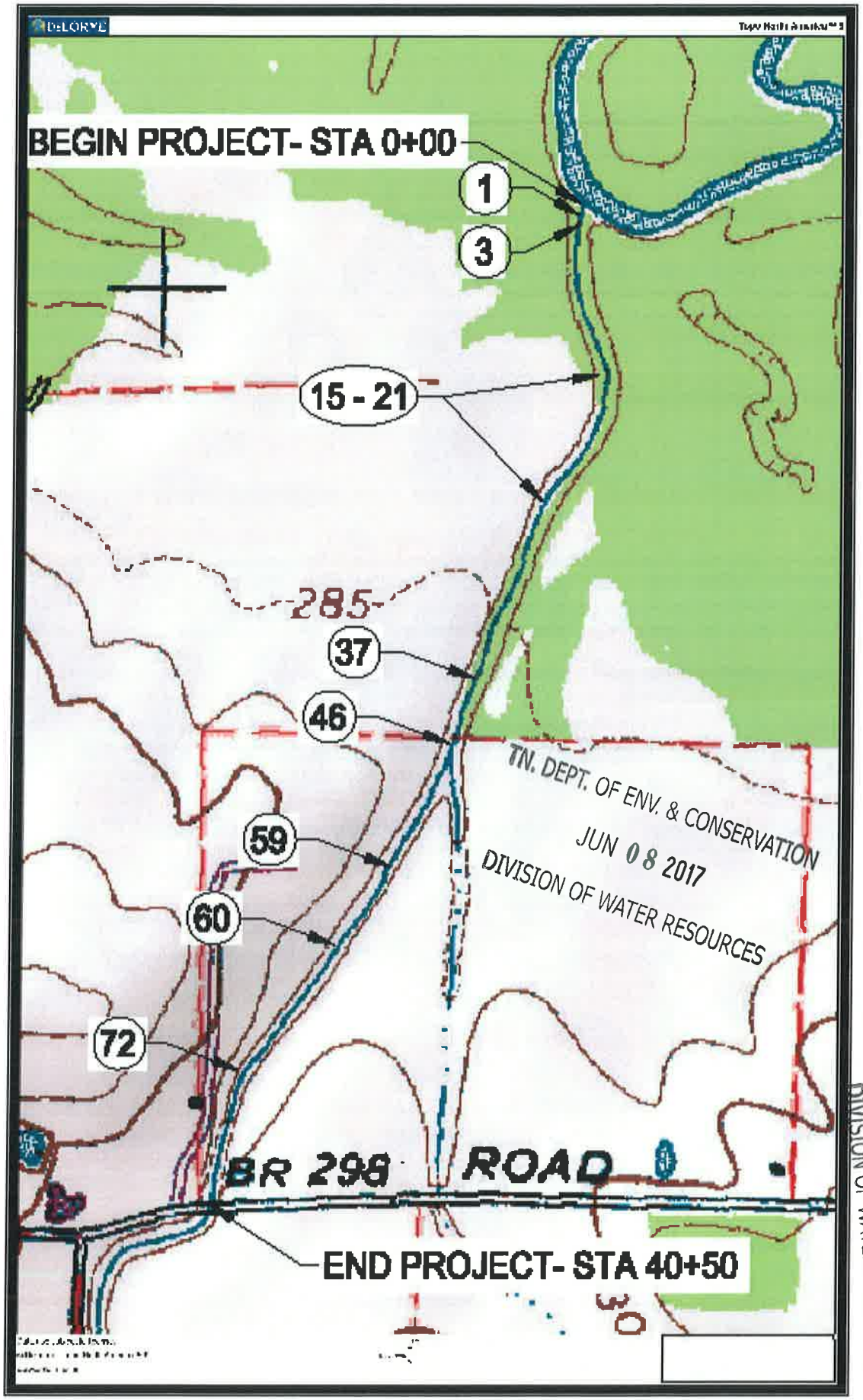
RIGHT BANK RIP RAP(3) 1,030

RIGHT BANK TRM 1,282

TOTAL STREAM LENGTH MEASURED ALONG FLOWLINE OF CHANNEL IS 4,017 L.F.

(1) Existing rip rap from here to bridge to be reshaped and supplimented.
(2) Downstream face of Shelton Road bridge crossing.
(3) Included 189 lineal feet of existing rip rap to be reshaped and supplimented

6.2 USGS MAP



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6.3 PHOTOGRAPHS

An inventory of existing conditions along the reach of Wolf River Lateral J was performed on April 22, 2016. A copy of the report and photo log of the inventory results entitled "Wolf River Lateral "J" Collierville, TN Field Inventory April 22, 2016 Photo Log" is attached.

The locations of key points of interest are noted on the vicinity map. The numbers on the map reference a particular figure or group of figures in the report. Those key points are as follows:

Figure No.	Description
1	Unstable vertical bank on the outside of the bend in the Wolf River channel
3	Location of Grade Control Structure No. 1 – approximately 150± feet upstream of the mouth of Wolf River Lateral J
15 -21	Unstable West bank of Lateral J where active failures and erosion are occurring; threatening to undermine the outfall lines from the Shelton Road WWTP
37	Uncontrolled bank erosion downstream of storm drain culvert
46	Approximate location of Grade Control Structure No. 2
59 – 60	Grade Control Structure No. 3 is between these two locations
72	Grade Control Structure No. 4 located just downstream of waterline crossing shown in the photo. This waterline was undermined by head cutting in 2014 and was removed and re-routed.

WOLF RIVER LATERAL "J"
COLLIERVILLE, TN
FIELD INVENTORY
APRIL 22, 2016 PHOTO LOG

Aerial Photograph Taken 03/31/1998

Aerial Photograph Taken 04/22/2014

The site inventory was conducted beginning at the confluence of Wolf River and Lateral "J" and progressed upstream to the bridge crossing at Shelton Road. Due to recent rainfall events the depth of flow in the Wolf River was above ordinary high water. As a result backwater from the Wolf extended up Lateral "J" for some distance. During a site visit in 2013 an obvious step in the stream bottom was observed. No such obvious indication of active head cutting was observed during this inventory of current conditions as of April 22, 2016.

Figure 1: Standing over SS Outfall at the confluence of the Lateral with the Wolf

Figure 2: Sanitary Sewer Outfall into the Wolf River

Figure 3: Evidence of recent bank erosion of the Lateral at the confluence

Figure 4: Looking up stream from same vantage point as Figure 3

The outfall line for the Shelton Road Waste Water Treatment Plant (WWTP) is located adjacent and parallel to the west bank of Lateral "J". The lateral intercepts the Wolf River at approximately the mid-point of a "hairpin" bend in the Wolf River. There is active erosion of the river bank on the outside of the bend as evidenced by the shear vertical bank (see Figure 1). The top bank of the bend has migrated south and is threatening the sewer outfall. The banks of the lateral immediately upstream are sloughing. A short distance upstream there is evidence of resent degradation of the bottom as evidenced by the vertical lower bank and the sloping upper bank. The change in slope is denoted by the red arrow in figure 4.

Figure 5: Stabilization of past bank failure; note the undermined and leaning trees just upstream of the bank repair

Figure 6: East bank just upstream of bank repair; note that root system of several trees are undermined

Figure 7: Upstream end of first bend looking downstream at the bank repair; note that the slope of the sloughed bank downstream of the repair is approximately the same as the slope of the repaired bank.

Figure 8: Lower end of next bend; note the deposition on the inside (west side) and the undermining of the east bank

Figure 9: Mid-point of bend looking at the east bank

Figure 10: Just upstream of the bend looking downstream; the channel has undermined the upper bank on both sides; the blue arrow denotes the point where a wet weather conveyance discharges into the Lateral from the east

Figure 11: Looking upstream along a straight section of highly eroded bank; note the slope failure at the downstream end of the bend

Figure 12: Looking downstream just beyond the end of the bend

Figure 13: Looking downstream from approximately the mid-point of the bend; the change where the soil profile changes for the upper silty loam to the underlying clay is clearly evident (denoted by black arrow)

Figure 14: Looking upstream from the same vantage point as in figure 13

Both banks of the section of the stream represented in photos 11, 12, and 14 are eroded and standing at a near vertical slope. There has been a resent slope failure occur near the downstream of the bend shown in these photos. At the failure the soils from the slope have "slid" out into the channel (see the area in figure 11 boxed in red).

Figure 15: Looking downstream at the disturbed slope

Figure 16: Looking upstream at the recently disturbed slope from same vantage point as figure 15

Figure 17: Blue arrow indicates the point Where a side ditch from the east enters the Lateral

Figure 18: Red arrows indicate the ends of of a vertical shear crack formed along the top bank

Figure 19: Face of recent bank failure just upstream of the shear crack

Figure 20: Looking upstream from the end of the failing section of the west bank

Figure 21: Looking downstream along the unstable bank shown in figures 15, 16, 18, and 19

The 500± lineal feet of the west bank shown in figures 15, 16, 18, 19 and 21 is unstable and has recently failed and/or there are indications of imminent failure.

Figure 22: Looking upstream at the Beginning of a bend in the stream

Figure 23: East bank at the beginning of of the bend

Figure 24: Mid-point of bend with deposits on the inside of the bend; note the bank has laid back on an approximation of a 2:1 slope

Figure 25: Isolated deposit of sedimentary rock (possible a conglomerate)

Figure 26: Looking upstream near the end of the bend

Figure 27: Just beyond the end of the bend looking downstream.

The bend shown in figures 22 through 27 exhibits the typical pattern of erosion of the bend in a stream with active erosion of the bank on the outside of the bend and the deposition of material on the inside of the bend. There are areas near the mid-point of the bend where the west (inside) slope of the bend has laid back on a slope that is approximately a 2:1 slope.

Figure 28: The beginning of a relatively Long stream section where only minor meanders occurring

Figure 29: Looking upstream from the same vantage point as figure 28; note that east bank slope is beginning to lay back while the west bank is near vertical; the red arrows indicate where the root ball of trees have been undermined and failure is imminent

Figure 30: Undermined tree roots on the west bank

Figure 31: Close up of erosion around a root ball on the east bank

Figure 32: West bank erosion; note the Vertical slope of the upper layer of silty Loam and sloping gradient of the lower clay soils

Figure 33: Looking upstream; note the sudden widening of the west bank where a bank failure has occurred and the more narrow section just upstream

Figure 34: View from edge of the washout noted in figure 33; note the root ball beginning to slide down the slope

Figure 35: Standing at the edge of bank just upstream of the washout looking downstream

The bank conditions along the slightly meandering stream section depicted in figures 28 through 35 demonstrate the effects that trees can have upon the slope stability. The majority of the bank slopes on the west side of the stream are vertical and near vertical. The root systems of the trees along the top of the west bank are serving to temporarily stabilize the vertical slopes. Much of the slopes along the east bank have a curved alignment that becomes steeper near the top of bank. There are areas along the east bank where trees are growing near the toe of slope. There is evidence of a past slope failure downstream of some of the trees near the toe of slope as evidenced by the sandy deposits in the area where you would expect an eddy to occur (see figure 35).

Figure 36: Culvert discharge over vertical slope

Figure 37: Second view of culvert crossing of access road; note how close to the top of the vertical bank is to the road

There is the potential for a washout to occur downstream of several culvert discharge points along the stream bank. The culvert shown in figures 36 and 37 is the first encountered during the inventory.

Figure 38: Looking upstream; the yellow arrow indicates the toe of a slope failure of the west bank; note the large leaning tree indicated by the red arrow.

Figure 39: Standing at the toe of the slope failure of west bank looking downstream

Figure 40: Leaning tree noted in figure 38

Figure 41: Bank erosion upstream of Leaning tree; the blue arrow is pointing to the flowline of the ditch beyond that serves as the outlet for the discharge from the pond in the adjacent subdivision

Figure 42: Looking downstream at bank Erosion shown in figures 40 and 42

Figure 43: Looking upstream from same vantage point as figure 42

There appear to be several factors contributing to the ongoing erosion along the stream reach represented in figures 38 through 43. The reach contains a series of tight bends (see figure 38). There is the indication of silt deposits and active bank erosion on alternate banks of the stream. There is a side ditch that enters the stream from the east that serves as the discharge for the large pond located in the adjacent subdivision. Apparently the flows from the side ditch have undermined the root ball of a large tree has slid and is leaning into the channel of the Lateral and has altered the stream flow causing erosion of both banks.

Figure 44: Looking downstream at east bank undercut by erosion

Figure 45: Looking upstream from same vantage point as figure 44; note the short meander pattern and the slope failure of the west bank on the outside bend

Figure 46: Closer view of slope failure Shown in figure 45

Figure 47: Upper end of the meandering pattern shown in figure 45 looking Downstream; note the outside bend erosion in the background

Figure 48: End of culvert from under gravel Drive; washout is overgrown.

Figure 49: Close up of end of culvert

Figure 50: Looking downstream at outside bend erosion of east bank; standing on toe Of the silt deposits on the inside of the bend

Figure 51: Looking up ditch serving as an outfall for part of the storm sewer system serving the adjacent subdivision

Figure 52: Looking upstream from same vantage point as figure 50; note the failure of the rip-rap at the end of the storm sewer outlet ditch, and the three trees that have slide into the stream channel

Figure 53: Slope repair using grouted Rip-rap; note the cantilevered pipe in the background

Figure 54: Close up of grouted rip-rap

Figure 55: Outlet end of culvert from under gravel drive that discharges into the cantilevered pipe

Figure 56: Pipe cantilevered from bank

Figure 57: Outside bend erosion along a high bank on the east bank; note the tree that has re-rooted at the toe of the near vertical slope

Figure 58: Just upstream of figure 57 looking upstream at bend erosion along a a low bank on the east side

Figure 59: Standing on nearly vertical west Bank looking at outside bend on east side; Note the stepped bank on the east

Figure 60: Looking downstream along a straight channel reach toward a downstream bend

Figure 61: Looking upstream; note the Naturally formed mild bank slope on the east side

Figure 62: Looking downstream from the same vantage point as figure 61; note the near vertical slope on the west side

Figure 63: Crevice isolating an area on the west bank

Figure 64: Close up of the leading edge of the crevice

Figure 65: Looking upstream from the Middle of the outside (west) bank of a meander

Figure 66: Close up of sand and gravel deposits on the inside bend

Figure 67: Slope failure of the west bank on the inside of a bend

Figure 68: Broken concrete used as rip-rap at the upstream end of the failure shown in figure 67

Figure 69: Gully erosion down the west Bank just upstream of the slope failure shown In figure 65

Figure 70: Upstream of the meander shown in figure 65; note the concrete rubble rip-rap (same as in figure 68)

Figure 70: Approximately 300 feet downstream of Shelton Road looking upstream

Figure 71: Looking downstream from the same vantage point as figure 70

The conditions at the bridge crossing of Shelton Road are a dramatic example of the recent and potential future negative impacts due to head cutting.

Figure 72: Water line crossing in 2013

Figure 73: 2016 water line undermined and removed.

Figure 74: Bridge pilings in 2013

Figure 75: Approximately 1+ of additional pile length exposed in 2016

6.4 EXISTING STREAM CHARACTERISTICS

The stream reach of Lateral J between its confluence with the Wolf River and the Shelton Road bridge crossing is irregular. There are some irregular meanders located between straight and/or mildly curving alignments. It is entrenched due to naturally occurring stream processes; however, the entrenchment has been greatly exacerbated by ongoing head cutting. It is documented that the stream bottom at its mouth has lowered approximately 6 feet in the past 23 years. The predominate soils types in the bank profile are silty clays with some traces of sand. It was determined from soils borings that there is an underlying layer of lean firm moist clay. Below the lean clay layer there is a continuous thick layer of fine to course sand. Occasionally the lean clay can be observed in the bottom of the stream channel. There are some isolated seams of sand, gravel or sandstone.

The channel depth varies from 14 feet to 9 feet. The bottom width varies from as wide as 42 feet in some of the channel bends to as narrow as 16 feet near the bridge crossing. Likewise, the top width of the channel varies widely – from 75 to 35 feet.

The stream gradient for the lower half of the stream reach is extremely mild, averaging 0.00112 feet/feet. Irregularities in the bottom create a mild pool and riffle affect. There is still active head cutting occurring in the upper half of the reach and the pools and riffles are more pronounced. There are sand and silt deposits forming point bars on the inside of the bends in the stream.

Throughout the majority of the reach the stream bank slopes are steep to very steep. Trees and shrubs along the top banks are the primary vegetation. At various locations along the stream banks the root systems of the trees have been undercut creating a concave bank slope. There are ongoing efforts to remove fallen trees from the channel; however, there are areas where unusual bank erosion has been caused and is occurring due to undercut trees falling into the channel.

There is an approximately 600 lineal foot section of the west stream bank where active slope erosion is ongoing. This erosion process occurs when weak vertical planes are created by downward seepage near the face of the near vertical bank. A crack then appears parallel to the top of bank along the weakened planes. The thin column of soil then sloughs off into the channel. The process then repeats itself. The following photo is of an area where the crack has formed but the column of soil has not yet collapsed into the stream channel. The red arrows point to either end of the crack. The black arrow and ellipse indicate the location of a sewer manhole on the waste water treatment plant outfall line.

SECTION 6.5 PROPOSED STREAM CHARACTERISTICS

The plans for the alterations to the Wolf River Lateral J were developed based upon the following goals and objectives:

1. Prevent head cutting from continuing in the future.
2. Establish a stable bottom gradient though out the reach.
3. Stabilize the stream banks to protect the sanitary sewer outfall line and other infrastructure from damage due to erosion of the banks.
4. Keep the existing horizontal alignment of the stream.
5. Avoid and minimize, when it is necessary, disturbing the stream bottom.

As a part of the design process a hydraulic model of the stream reach using HEC RAS was developed. The model was used to define the stable stream gradient to be used for design. Since the stream flows increase as you progress downstream, the model was used to define the best fit bottom width for a theoretical symmetrical trapezoidal channel section for sub-reaches. Three bottom widths were used 19.5, 18, and 15.5 feet. The widths decrease as you progress upstream.

A new stream bottom profile was defined using historic data, the stable stream gradient and the current stream bottom profile to best locate where "steps" in the flowline alignment should be placed to make up the 6 feet of vertical drop created by past head cutting. Sheet pile weirs were set at these locations to create a hard point control of the bottom gradient and channel flow geometry. The sheet piles are 3/8" thick and will create a "waffle" footprint 12-inches wide. The tumbling stream flow over the lip of the weir will require protection against bottom scour; therefore, 50 lineal feet rip rap will be placed on the bottom. Upstream of the weir a pool will be created in the bottom

Theoretical cross-sections for the entire reach were plotted using the stepped vertical alignment, the stable stream slope, and the best trapezoidal channel sections. These cross-sections were examined to determine where the projected bank slope of the ideal channel shape would impact existing infrastructure. This information was used to define the areas where the stream banks must be regraded and stabilized. Unless stream hydraulics would not allow it to be used the stream banks will be stabilized using permanent turf reinforcing mattings planted with a mixture of native grasses and forbs. In areas where necessary to insure long term stability, such as in the transitional flow areas just upstream and downstream of the weirs, the banks will be stabilized with rip rap.

Where there is no threat of ongoing bank erosion undermining existing public and private infrastructure the banks will not be altered.

SECTION 6.7 HYDROLOGIC DETERMINATIONS

The stream is known to be and acknowledged as a waters of the state; therefore, no additional hydrologic or jurisdictional reviews or determinations were sought.

SECTION 8.2 SEQUENCING OF EVENTS AND CONSTRUCTION METHODS; AND SECTION 8.3 EROSION PREVENTION AND SEDIMENT CONTROL.

For this project the two subjects are closely related. No construction equipment will be allowed to operate in the bottom of the channel. The work will proceed from downstream to upstream. No work related to the re-grading of the channel banks shall be undertaken until the sheet pile weir has been installed. The equipment required to drive the sheet piles shall be operated from the banks of the stream; it shall not be staged from the bottom. Any materials temporarily stored at the site shall be positioned a minimum of 20 feet from the existing top bank of the stream.

The weather forecast shall be closely monitored during the planning and implementation of the stream bank grading and stabilization activities. Only the amount of work that can be undertaken and completed during a forecast period of favorable weather shall be undertaken.

Each phase of the bank stabilization shall be treated as a separate job in that it must be inspected and found complete before work is begun on the next section of bank to be stabilized.

SECTION 10.3 WATER RESOURCE DEGRADATION

This project will result in a de minimis degradation of water quality for the following reasons:

1. There will be no loss of stream length
2. There will be no loss of in stream habitat. Rather the creation of pools upstream of the grade control structures will introduce new habitat.
3. The longstanding and ongoing stream stability issues will be resolved.
4. The species composition will not be compromised. The elimination of silt from the stream that was in the past created both directly and indirectly by the head cutting will enhance the water quality and coincidently the habitat for any in stream species present.
5. The re-grading and stabilization of the banks using natural grasses and forbs in combination with a turf reinforcement matting will filter overbanks flows that previously ran over bare, un-vegetated slopes.

SECTION 11.1, SECTION 11.2 and SECTION 11.3 MITIGATION, RESOURCE VALUE and MONITORING

The project will curtail the continue loss of stream resource due to the erosion that has been accelerated and exacerbated by the head cutting. This will result in no net loss of stream resources, thus there is no adverse impact to mitigate.

SECTION 11.4 PROTECTION MEASURES

The majority of the stream reach traverses land owned by either the Town of Collierville or the Chickasaw Basin Authority. The remaining property traversed by the stream is Common Open Space owned by the Raintree Homeowners Association, Inc. A drainage easement of sufficient width to encompass the stream as it traverses the property will be acquired by the Town of Collierville. The easement will obligate the Town to safeguard the stream.

STREAM GRADIENT STABILIZATION
OF
WOLF RIVER LATERAL "J"
DOWNSTREAM OF SHELTON ROAD
FOR
TOWN OF COLLIERVILLE, TN

MAY 10, 2017

A2H
ENGINEERS • ARCHITECTS • PLANNERS

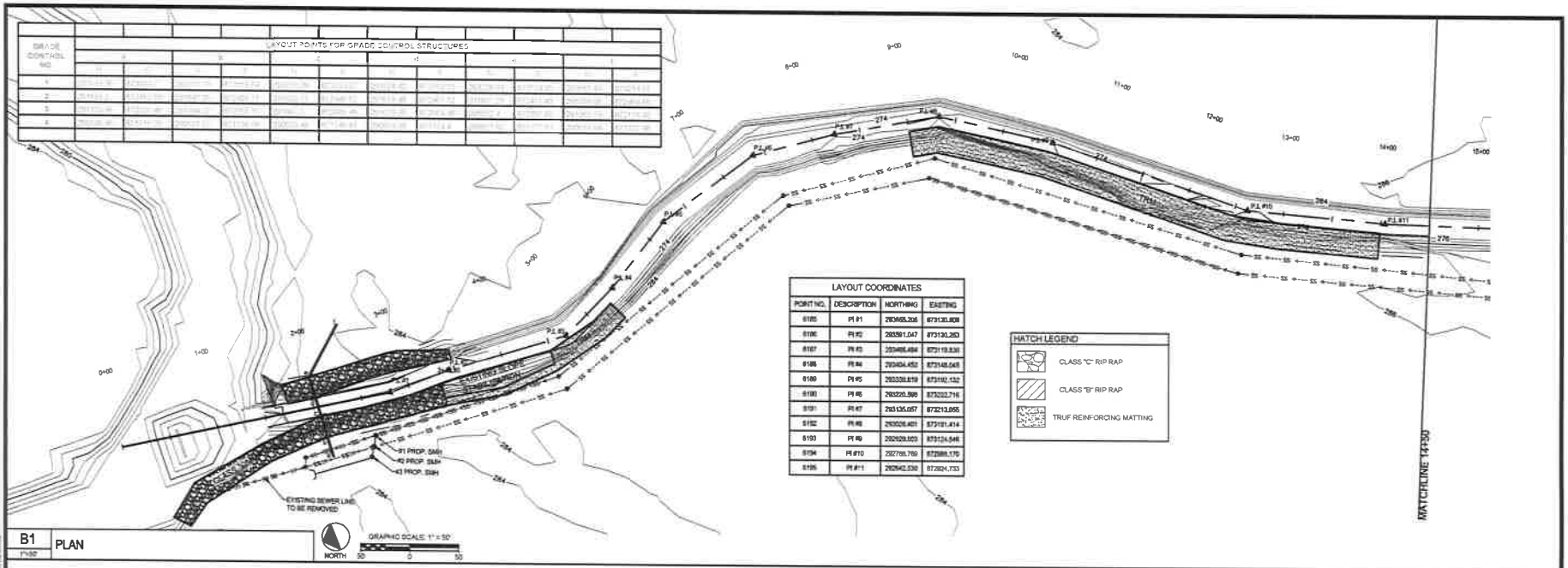
GENERAL	
Sheet Number	Sheet Name
G0.0	COVER SHEET/GENERAL NOTES

CIVIL	
Sheet Number	Sheet Name
C2.0	PROFILES STATION: 0+00 TO 14+50
C3.0	PROFILES STATION: 14+50 TO 25+60
C4.0	PROFILES STATION: 25+60 TO END
C5.0	DETAILS
C5.1	DETAILS
C5.2	DETAILS
C5.3	DETAILS
C10.0	CROSS SECTIONS STA 1+00 TO STA 7+00
C11.0	CROSS SECTIONS STA 7+00 TO STA 13+00
C12.0	CROSS SECTIONS STA 13+00 TO STA 19+00
C13.0	CROSS SECTIONS STA 19+00 TO STA 25+00
C14.0	CROSS SECTIONS STA 25+00 TO STA 31+00
C15.0	CROSS SECTIONS STA 31+00 TO STA 37+00
C16.0	CROSS SECTIONS STA 37+00 TO STA 39+00

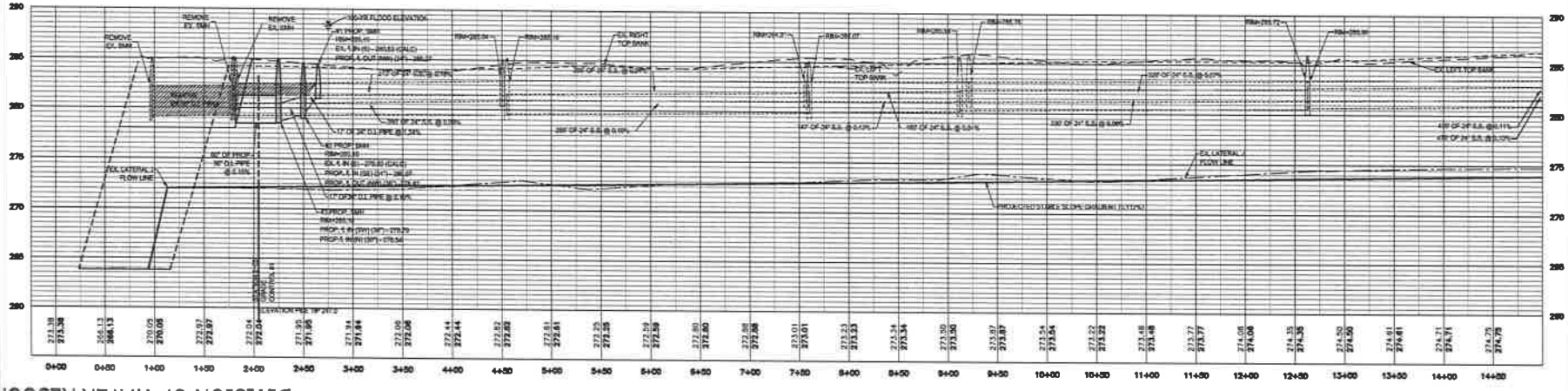
VICINITY MAP
N.T.S.

CIVIL ENGINEER

A2H PROJECT #14264.01



B1 PLAN 1"=50'



D1 PROFILE

DIVISION OF WATER RESOURCES
JUN 08 2017
TN. DEPT. OF ENV. & CONSERVATION

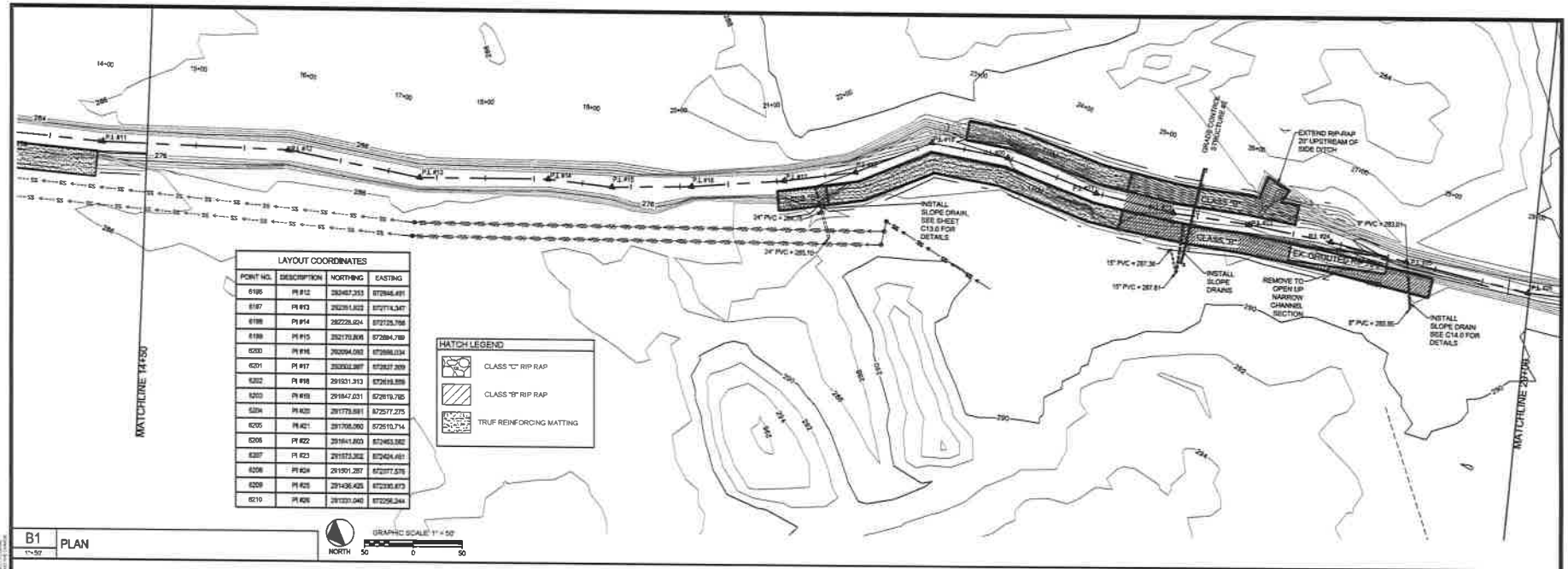
A2H
ENGINEERS | ARCHITECTS | PLANNERS

SEAL

LATERAL J, STREAM BANK STABILIZATION
THE TOWN OF COLLIERVILLE
500 KEOUGH ROAD, COLLIERVILLE, TN 38017

REVISIONS

PROJECT NO: 1-054401
DATE: MAY 10, 2017
DRAWN: MMD
CHECKED: SE
SHEET TITLE: PROFILE STATION: 0+00 TO 14+50
SHEET NO: C2.0



LAYOUT COORDINATES			
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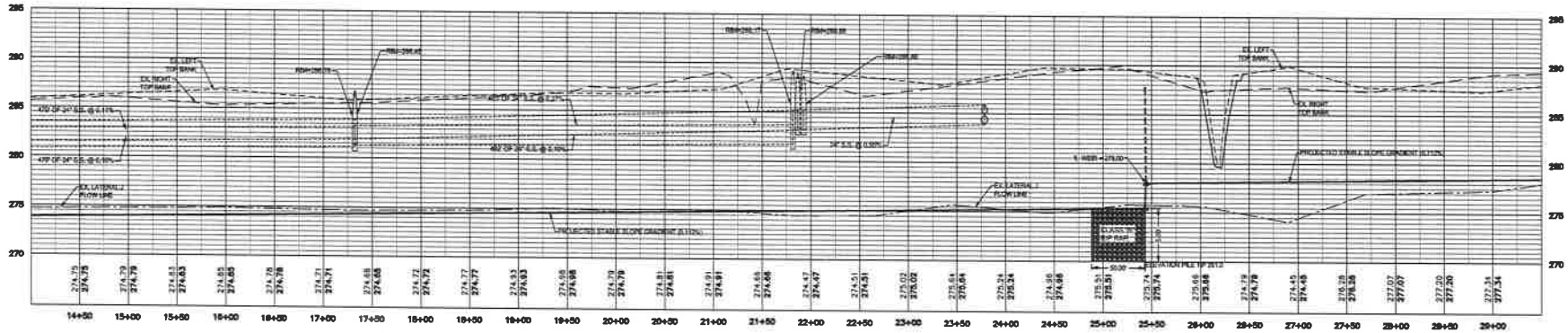
6197	PI #13	292351.822	872714.347
6198	PI #14	292228.924	872725.766
6199	PI #15	292170.806	872894.789
6200	PI #16	292094.092	872986.034
6201	PI #17	292002.997	872827.909
6202	PI #18	291931.313	872618.899
6203	PI #19	291847.031	872619.785
6204	PI #20	291773.591	872577.275
6205	PI #21	291706.060	872510.714
6206	PI #22	291641.803	872463.582
6207	PI #23	291573.352	872424.491
6208	PI #24	291501.287	872377.575
6209	PI #25	291436.425	872330.673
6210	PI #26	291331.040	872256.244

B1 PLAN



D1 PROFILE

DIVISION OF WATER RESOURCES
JUN 08 2017
TN. DEPT OF ENV. & CONSERVATION

A2H
ENGINEERS • ARCHITECTS • PLANNERS

SEAL

LATERAL J, STREAM BANK STABILIZATION
THE TOWN OF COLLIERVILLE
500 KEOUGH ROAD, COLLIERVILLE, TN 38017

REVISIONS

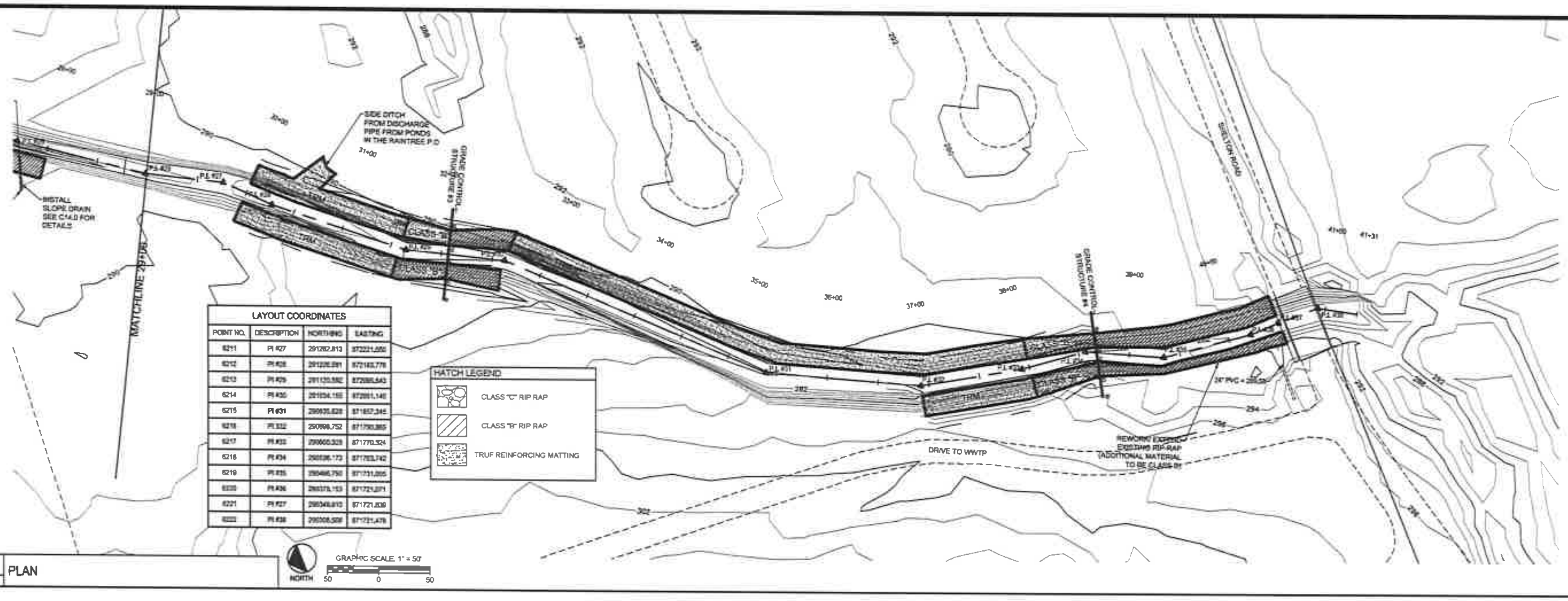
PROJECT NO.
14264.01

DATE:
MAY 10, 2017

DRAWN: MMD | CHECKED: BE

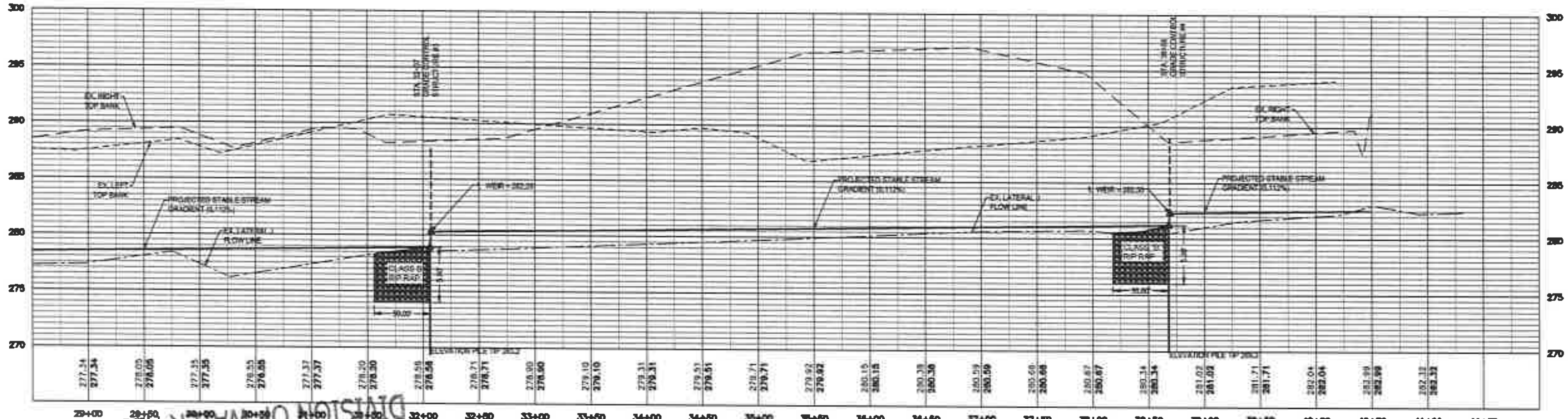
SHEET TITLE:
PROFILE STATION 14+50 TO 29+00

SHEET NO:
C3.0


SIDE DITCH
FROM DISCHARGE
PIPE FROM PONDS
IN THE RAINTREE P.D
GRADE CONTROL
STRUCTURE #3
INSTALL
SLOPE DRAIN
SEE C4.0 FOR
DETAILS
MATCHLINE 29+08
GRADE CONTROL
STRUCTURE #4
SHELTON ROAD
DRIVE TO WWTP
REWORK EXISTING
EXISTING RIP-RAP
(ADDITIONAL MATERIAL
TO BE CLASS B)
HATCH LEGEND
CLASS "C" RIP RAP
CLASS "B" RIP RAP
TRUF REINFORCING MATTING
GRAPHIC SCALE 1" = 50'
NORTH

LAYOUT COORDINATES			
POINT NO.	DESCRIPTION	NORTHING	EASTING
6211	PI #27	291282.813	872221.050
6212	PI #28	291226.081	872183.776
6213	PI #29	291120.592	872085.643
6214	PI #30	291034.150	872001.146
6215	PI #31	290935.828	871857.345
6216	PI #32	290898.752	871790.865
6217	PI #33	290605.323	871770.524
6218	PI #34	290536.173	871763.742
6219	PI #35	290466.750	871731.005
6220	PI #36	290378.153	871721.071
6221	PI #37	290349.813	871721.039
6222	PI #38	290308.508	871721.476

B1 PLAN
1"=50'


EX. RIGHT TOP BANK
EX. LEFT TOP BANK
PROJECTED STABLE STREAM GRADIENT (0.112%)
EX. LATERAL J FLOW LINE
WEIR = 282.29
WEIR = 282.00
CLASS B RIP RAP
ELEVATION PILE TIP 263.2
STA. 32+07 GRADE CONTROL STRUCTURE #3
STA. 38+66 GRADE CONTROL STRUCTURE #4
300
295
290
285
280
275
270
29+00
29+50
30+00
30+50
31+00
31+50
32+00
32+50
33+00
33+50
34+00
34+50
35+00
35+50
36+00
36+50
37+00
37+50
38+00
38+50
39+00
39+50
40+00
40+50
41+00
41+50
277.34
278.05
277.35
276.55
277.37
278.20
278.56
278.71
278.90
279.10
279.31
279.51
279.71
279.92
280.15
280.38
280.59
280.68
280.67
280.34
281.02
281.71
282.04
282.99
282.32

D1 PROFILE

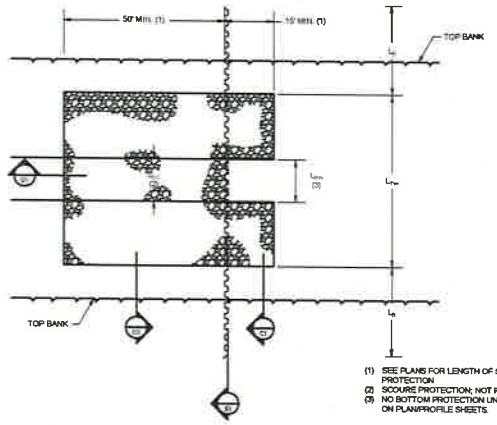
LATERAL J, STREAM BANK STABILIZATION
THE TOWN OF COLLIERVILLE
500 KEOUGH ROAD, COLLIERVILLE, TN 38017

A2H
ENGINEERS - ARCHITECTS - PLANNERS

SEAL

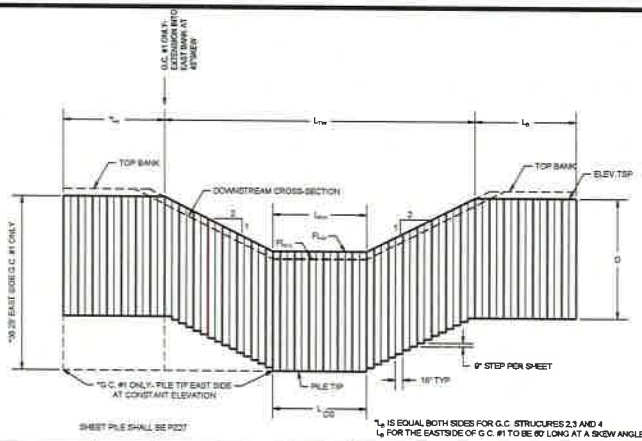
REVISIONS

PROJECT NO. 14264.01
DATE: MAY 10, 2017
DRAWN: MMD CHECKED: BE
SHEET TITLE: PROFILE STATION 29+00 TO END
SHEET NO: C4.0



(1) SEE PLANS FOR LENGTH OF SLOPE PROTECTION
(2) SCOURS PROTECTION; NOT REQ'D STR #1
(3) NO BOTTOM PROTECTION UNLESS SHOWN ON PLAN/PROFILE SHEETS.

B1 N.T.S. GRADE CONTROL STRUCTURE PLAN VIEW

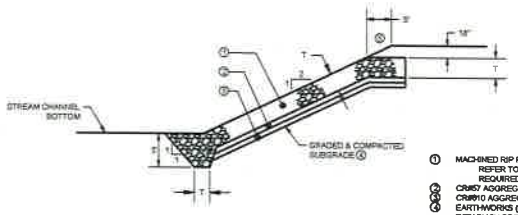


*L_e IS EQUAL BOTH SIDES FOR G.C. STRUCURES 2,3 AND 4
L_e FOR THE EASTSIDE OF G.C. #1 TO BE 60' LONG AT A SKEW ANGLE OF 45°

GRADE CONTROL STRUCTURE		FLW ELEV FLOWLINE WEIR	PILE TIP ELEV	TSP ELEV TOP SHEET PILE	LENGTH OF SHEET PILE (FT.)	WW WIDTH BOTTOM OF WEIR (FT.)	TW WIDTH TOP OF WEIR (FT.)	LB LENGTH EXTENDED INTO BANK (FT.)	FLDS ELEV BOTTOM DOWN STREAM	LDS WIDTH CHANNEL BOTTOM DOWN STREAM (FT.)
NO.	STATION									
1	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
2	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
3	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
4	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

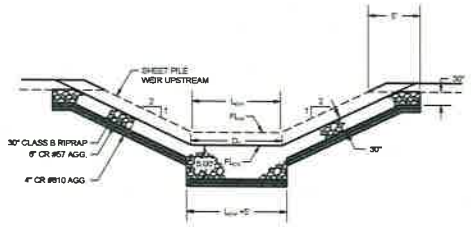
(1) EAST SIDE OF GRADE CONTROL STRUCTURE #1 ONLY- THE LENGTH SHALL VARY FROM 35.2' TO 36.25'
(2) EAST SIDE OF GRADE CONTROL STRUCTURE #1 ONLY- LS TO BE 60.0' EXTENDED AT 45° SKEW

B3 N.T.S. SHEET PILE GRADE CONTROL DIMENSIONS

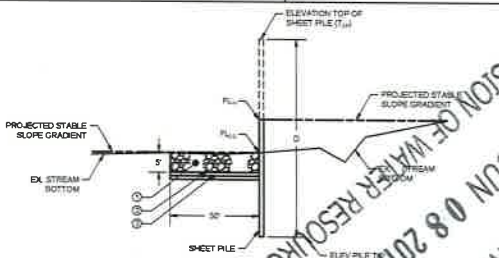


① MACHINED RIP RAP, CLASS B OR C REFER TO PLAN FOR TYPE RIP RAP REQUIRED AT A SPECIFIC LOCATION.
② CR#57 AGGREGATE FILTER MATERIAL, 6" THK
③ CR#810 AGGREGATE FILTER MATERIAL, 4" THK
④ EARTHWORKS (CUT/FILL) ACTIVITIES TO ESTABLISH PROPER SUBGRADE; SOIL SHALL BE COMPACTED TO A MINIMUM 95% STANDARD PROCTOR.
⑤ SEED AND MULCH UPPER BANK & MINIMUM OF 5' BEYOND TOP BANK.

C1 N.T.S. TYPICAL RIP RAP SLOPE PROTECTION



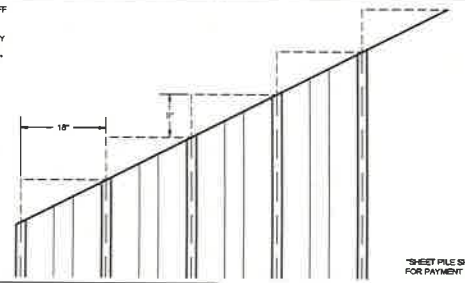
C3 N.T.S. SCOUR PROTECTION DOWNSTREAM



D1 N.T.S. GRADE CONTROL PROFILE

TOP OF SHEET PILES TO BE CUT OFF TO FORM A 2:1 SLOPE

LABOR AND MATERIALS NECESSARY TO CUT OFF TOPS OF PILES TO BE INCLUDED IN THE COST PER SQ.FT * OF SHEET PILES



*SHEET PILE SHALL BE MEASURED FOR PAYMENT PRIOR TO CUTOFF

D3 N.T.S. PILE CUTOFF DETAIL

STEEL SHEET PILES

1. THE STEEL SHEET PILES SHALL CONFORM TO REQUIREMENTS OF ASTM A 572 GRADE 50 AND HAVE THE MINIMUM SECTION MODULUS, WEIGHT, SHAPE AND SIZE FOR A PZ 27 SECTION.
2. THE SHEET PILE WALLS SHALL BE INSTALLED WITH A VIBRATORY HAMMER AND NOT AN IMPACT HAMMER IF POSSIBLE IN ORDER TO MINIMIZE VIBRATIONAL FORCES.
3. THE POSSIBLE NEED FOR DRIVING SHOES SHOULD BE CONSIDERED BY THE INSTALLATION CONTRACTOR TO PROTECT THE END OF THE PILING.
4. WATER JETTING INSTALLATION OF THE SHEET PILING SHALL NOT BE PERMITTED.
5. THE SHEET PILES SHALL BE DRIVEN TO ELEVATION SHOWN ON THE PLANS OR AS DIRECTED BY THE GEOTECHNICAL ENGINEER, WHERE IMPRACTICAL TO DRIVE TO PLAN ELEVATION DUE TO SUBSURFACE CONDITION, THE DRIVING OF PILES MAY BE STOPPED AT HIGHER ELEVATION WITH THE WRITTEN PERMISSION OF THE GEOTECHNICAL ENGINEER.
6. THE TOP OF THE PILING SHALL BE DRIVEN OR CUT-OFF TO A STRAIGHT LINE AT THE ELEVATION INDICATED ON THE PLANS. THE LENGTH OF PILE CUT OFF SHALL BE SUFFICIENT TO PERMIT THE REMOVAL OF ALL DAMAGED MATERIAL. STEEL SHEET PILES SHALL BE CUT OFF IN CLEAN, STRAIGHT LINES. ANY IRREGULARITIES SHALL BE LEVELED OFF WITH DEPOSITS OF WELD METAL OR BY GRINDING.
7. PILING GUIDES AND FRAME TEMPLATES SHALL BE EMPLOYED TO OBTAIN PROPER PLUMBNESS OF THE SHEET PILE WALL. THE PILING SHALL BE DRIVEN IN SUCH A MANNER AS TO INSURE PERFECT INTERLOCKING THROUGHOUT THE ENTIRE LENGTH OF EACH PILE TO THE DEPTH SPECIFIED. TEMPORARY GUIDE STRUCTURES SHALL BE REMOVED WHEN THEY HAVE SERVED THEIR PURPOSE.
8. SHEET PILING SHALL BE INSTALLED PLUMB AND TRUE WITH THE FOLLOWING TOLERANCES:
   A. DEVIATION FROM VERTICAL: NOT MORE THAN 1/8-INCH PER FOOT.
   B. ALIGNMENT: IN ANY GIVEN 30-FEET LENGTH OF WALL, NO POINT AT THE TOP OF THE WALL SHALL DEVIATE MORE THAN 2-INCHES FROM A STRAIGHT LINE.
9. THE CONTRACTOR SHALL ASCERTAIN THE LOCATION OF ALL UTILITIES OR DRAIN LINES THAT PASS THROUGH THE AREA IN WHICH THE SHEET PILING IS TO BE DRIVEN, AND SHALL PROTECT SAME DURING INSTALLATION OF SHEET PILING.

D5 N.T.S. SHEET PILE NOTES

A2H
ENGINEERS • ARCHITECTS • PLANNERS
[illegible]

SEAL

LATERAL J, STREAM BANK STABILIZATION
THE TOWN OF COLLIERVILLE
500 KEOUGH ROAD, COLLIERVILLE, TN 38017

REVISIONS

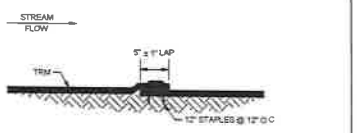
PROJECT NO.
14264.01

DATE:
MAY 10, 2017

DRAWN: MMD | CHECKED: BE

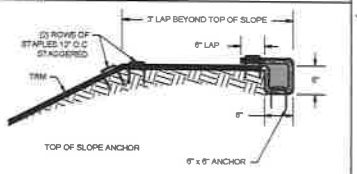
SHEET TITLE:
DETAILS

SHEET NO:
C5.0



LONGITUDINAL LAP- SHINGLED IN DIRECTION OF FLOW

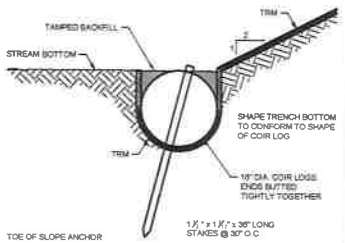
A1 DETAIL A N.T.S.



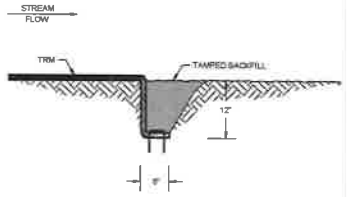
TRENCH: FIT TRM INTO BOTTOM AND WALLS AS SHOWN STAPLE TO BOTTOM OF TRENCH (12" O.C)

TAMP BACKFILL INTO TRENCH
FOLD TRM BACK OVER TRENCH WITH A 6" OVER LAP STAPLE LAP EVERY 12" O C.

B1 DETAIL B N.T.S.



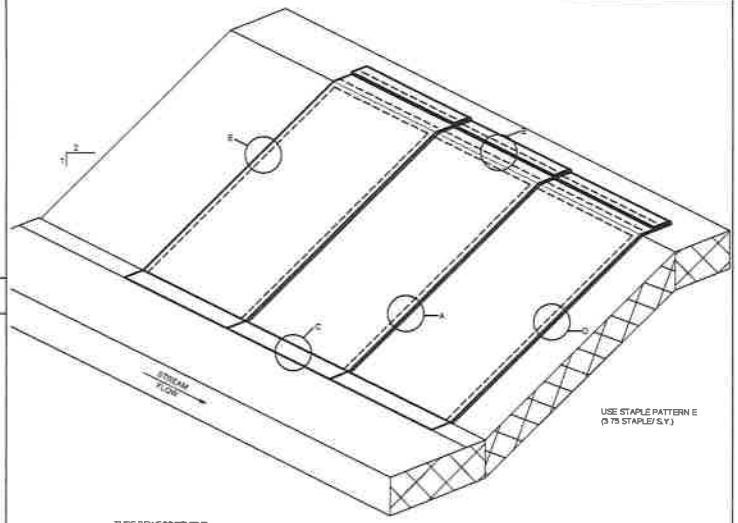
C1 DETAIL C N.T.S.



TERMINATION OF DOWNSTREAM END OF TRM AT INTERFACE WITH NATURAL CHANNEL BANK

NOTE: DOWNSTREAM TERMINATION AGAINST RIP RAP MIRROR IMAGE OF DETAIL E

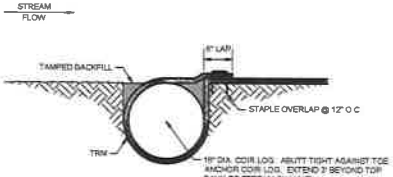
D1 DETAIL D N.T.S.



USE STAPLE PATTERN E (3.75 STAPLE/ S.Y.)

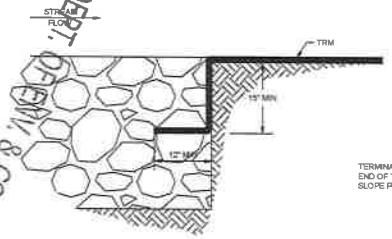
TURF REINFORCEMENT MATTING STREAM BANK STABILIZATION

B2 BANK STABILIZATION N.T.S.



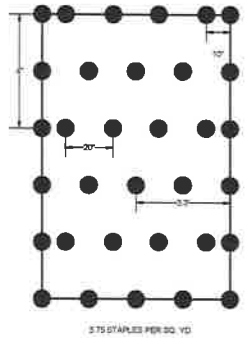
SHAPE TRENCH BOTTOM TO CONFORM TO SHAPE OF CHOIR LOG

TERMINATION OF UPSTREAM END OF TRM AT INTERFACE WITH NATURAL CHANNEL BANK



TERMINATION OF UPSTREAM END OF TRM AGAINST RIP RAP SLOPE PROTECTION

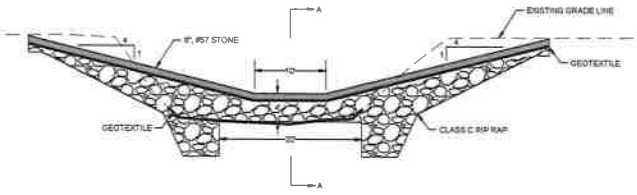
D2 DETAIL E N.T.S.

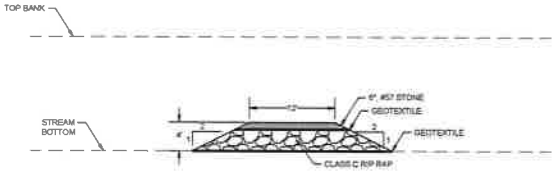


3.75 STAPLES PER SQ. YD

STAPLE PETTERN

B4 DETAIL F N.T.S.





D4 LOW WATER CROSS SECTION N.T.S.

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LATERAL J, STREAM BANK STABILIZATION
THE TOWN OF COLLIERVILLE
500 KEOUGH ROAD, COLLIERVILLE, TN 38017

REVISIONS

PROJECT NO.
142641

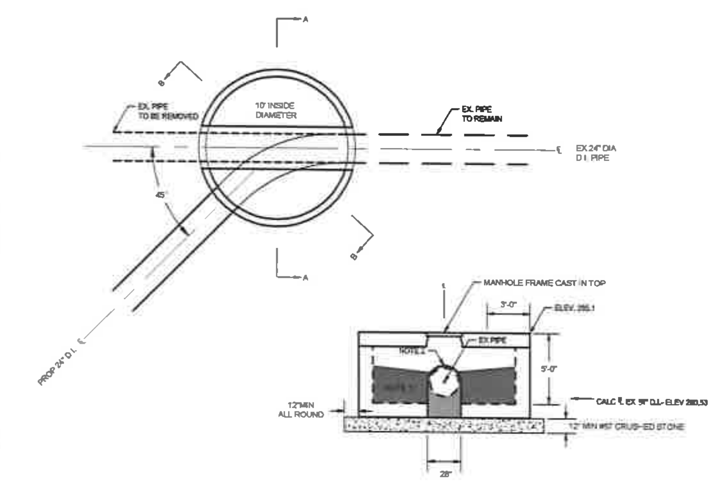
DATE:
MAY 10, 2017

DRAWN: MMD | CHECKED: BE

SHEET TITLE:
DETAILS

SHEET NO:
C5.1

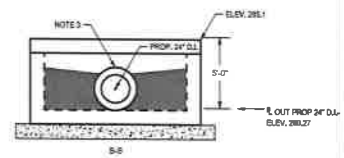
SEWER MANHOLES #1 AND #2 SHALL BE DOGHOUSE MANHOLES



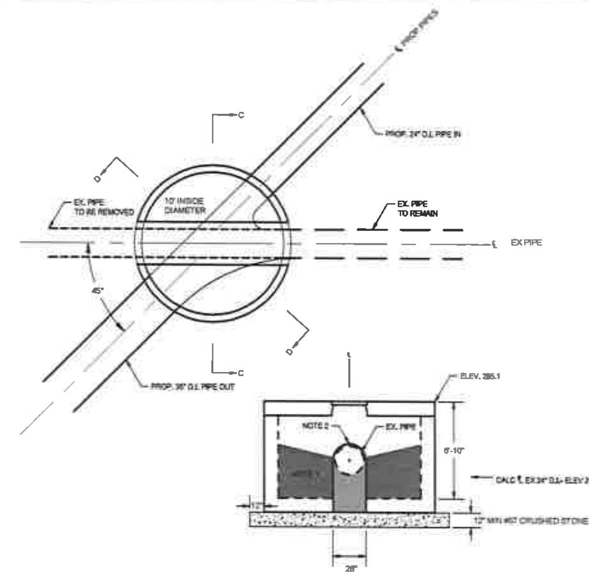
B1 DETAILS SMH #1
N.T.S.

NOTES

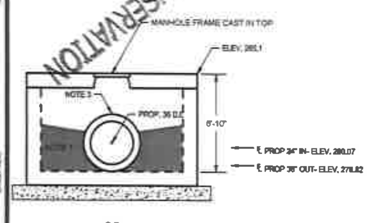
1. PRIOR TO ORDERING THE PRECAST MANHOLES, THE CONTRACTOR SHALL DETERMINE THE ELEVATIONS OF THE FLOWLINES OF THE EXISTING PIPES. SHOULD THE FLOWLINE ELEVATIONS VARY FROM THE CALCULATED ELEVATIONS. THE CONTRACTOR SHALL CONTACT THE ENGINEER SO THAT ADJUSTMENTS CAN BE MADE TO THE PLANNED FLOWLINE ELEVATIONS.
2. SHAPE BENCH AND INVERT USING HIGH EARLY STRENGTH CONCRETE. MINIMUM SLOPE OF BENCHES SHALL BE 48:1. DEPTH OF INVERT CHANNEL WILL BE 24"
3. ANNULAR SPACE BETWEEN MANHOLE WALL AND EXISTING PIPE TO REMAIN SHALL BE SEALED WITH NON-SRINK GROUT.
4. THE OPENING BETWEEN THE MANHOLE OPENING AND THE PROPOSED PIPE SHALL BE SEALED WITH AN APPROVED RESILIENT CONNECTOR.
5. THE MANHOLE FRAME SHALL BE CAST INTO THE FLAT TOP. THE FRAME AND COVER SHALL BE EAST JORDAN IRONWORKS #1205 WITH SOLID GASKET SEALED COVER



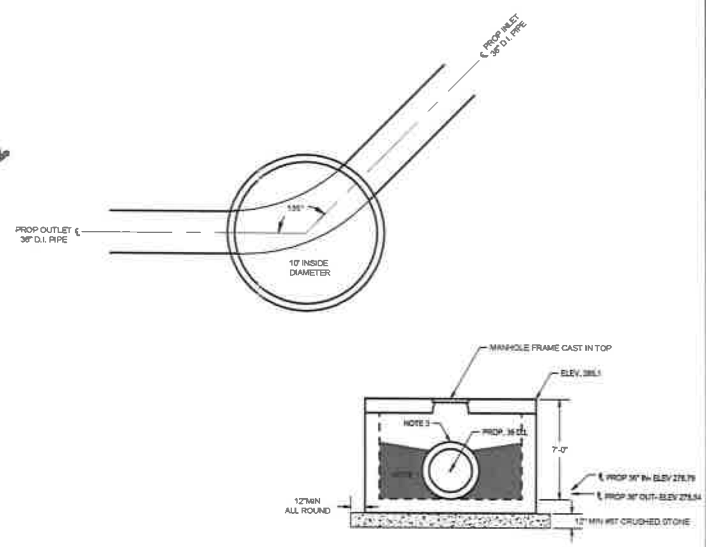
B3 DETAILS SMH #1
N.T.S.



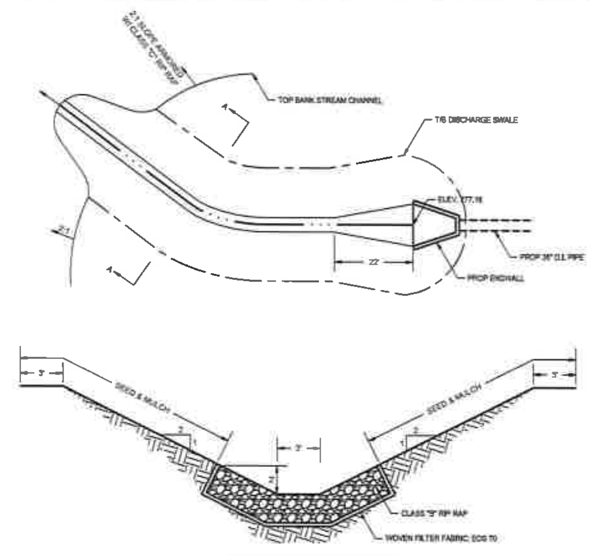
B4 DETAILS SMH #2
N.T.S.



D1 DETAILS SMH #2
N.T.S.



D2 DETAILS SMH #3
N.T.S.



D4 SEWER OUTFALL DISCHARGE SWALE
N.T.S.

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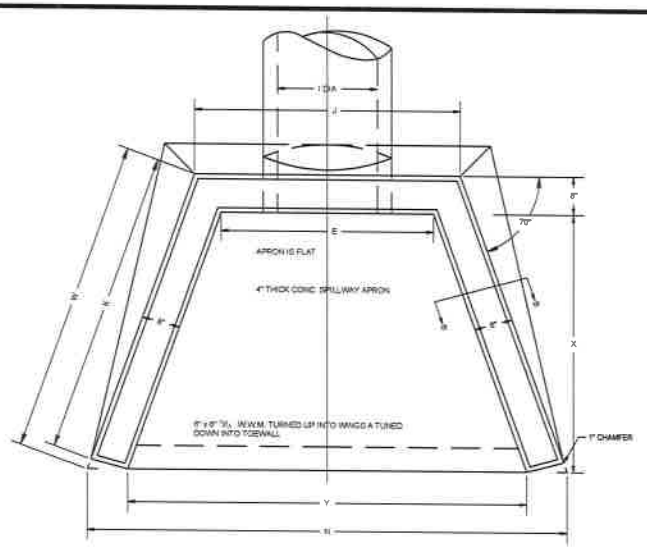
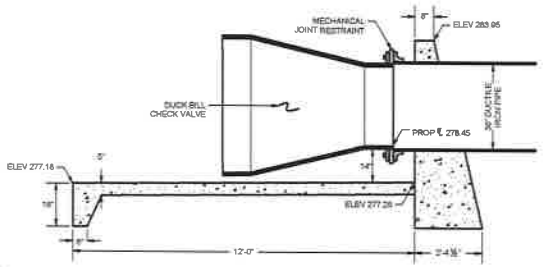
SHEET NO:	C5.2



B1 PLAN- OUTLET
N.T.S.

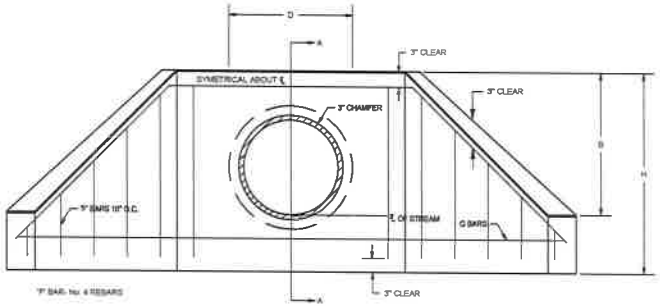
MODIFIED TYPE "D" ENDWALL
PIPE SIZE36" DUCTILE IRON PRESSURE CLASS 200
MIN WALL THICKNESS- 0.42"



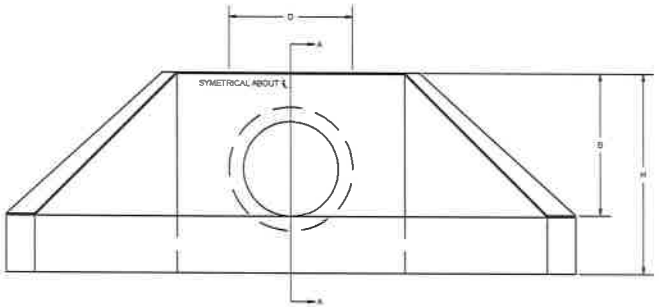
NOTES:

1) THE MECHANICAL JOINT CONSTANT SHALL BE MEGALUG SERIES 1100 WITH MEGABOND COATING SYSTEM
2) THE DUCKBILL CHECK VALVE SHALL BE AN ELASTOMER DUCKBILL WITH A FLANGED CONNECTION. THE BACKUP FLANGE SHALL BE 316 STAINLESS STEEL

B3 MODIFIED TYPE "D" ENDWALL
N.T.S.



D1 ELEVATION- INLET
N.T.S.



D3 ELEVATION- OUTLET
N.T.S.

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PROJECT NO.
14284.01

DATE:
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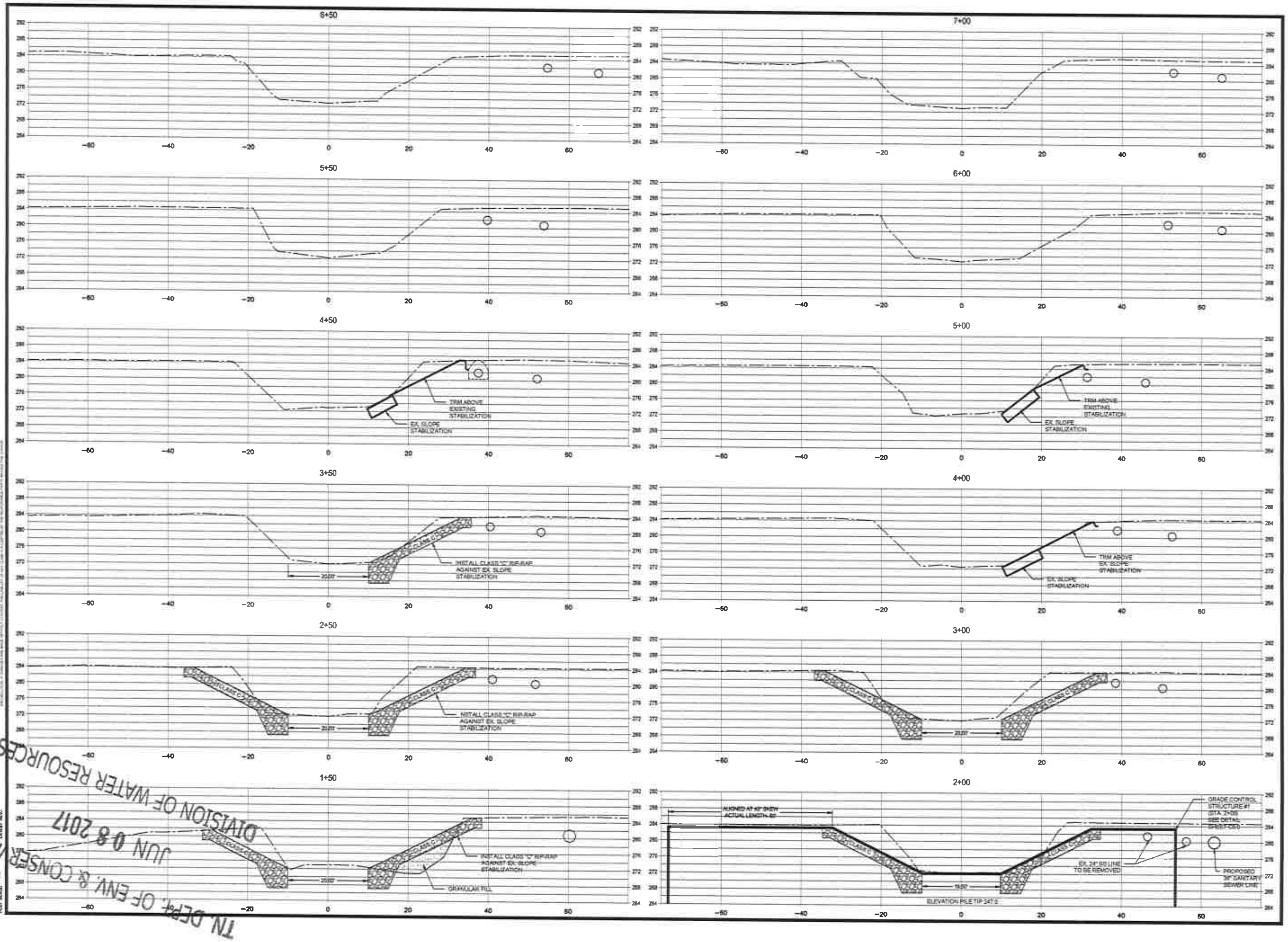
DRAWN: MMD | CHECKED: BE

SHEET TITLE:
DETAILS

SHEET NO:
C5.3


8+50
7+00
5+50
6+00
4+50
TRIM ABOVE EXISTING STABILIZATION
EX. SLOPE STABILIZATION
5+00
TRIM ABOVE EXISTING STABILIZATION
EX. SLOPE STABILIZATION
3+50
INSTALL CLASS "C" RIP-RAP AGAINST EX. SLOPE STABILIZATION
20.00'
4+00
TRIM ABOVE EX. SLOPE STABILIZATION
EX. SLOPE STABILIZATION
2+50
INSTALL CLASS "C" RIP-RAP AGAINST EX. SLOPE STABILIZATION
20.00'
3+00
20.00'
1+50
INSTALL CLASS "C" RIP-RAP AGAINST EX. SLOPE STABILIZATION
GRANULAR FILL
20.00'
2+00
ALIGNED AT 45° SKEW ACTUAL LENGTH= 85'
GRADE CONTROL STRUCTURE #1 STA. 2+00 SEE DETAIL SHEET C8.0
EX. 24" SS LINE TO BE REMOVED
PROPOSED 36" SANITARY SEWER LINE
19.50'
ELEVATION PILE TIP 247.0
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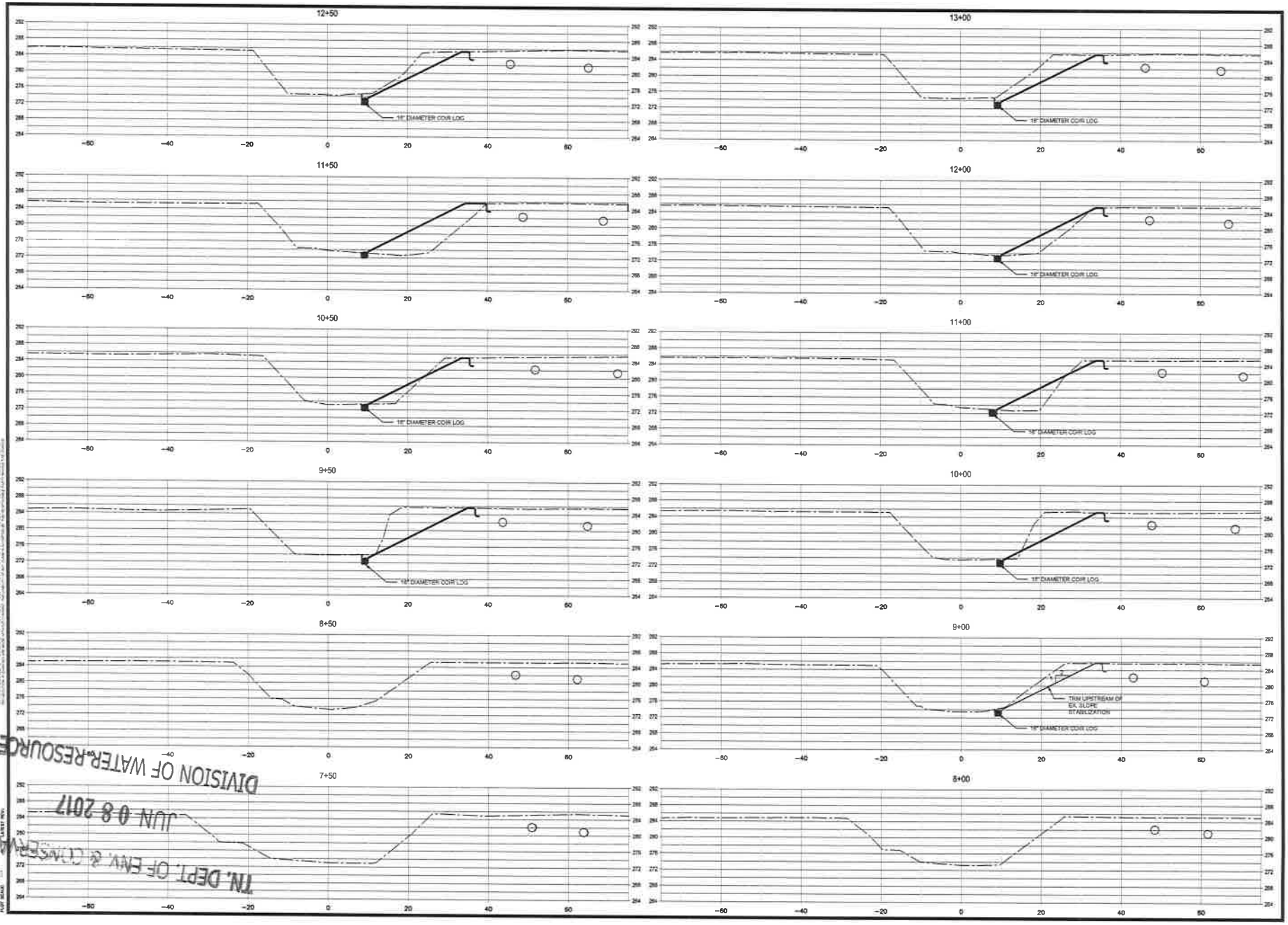
PROJECT NO.: 14284.01
DATE: MAY 10, 2017
DRAWN: MMD | CHECKED: BE
SHEET TITLE: CROSS SECTIONS STA 1+50 TO STA 7+00
SHEET NO.: C10.0



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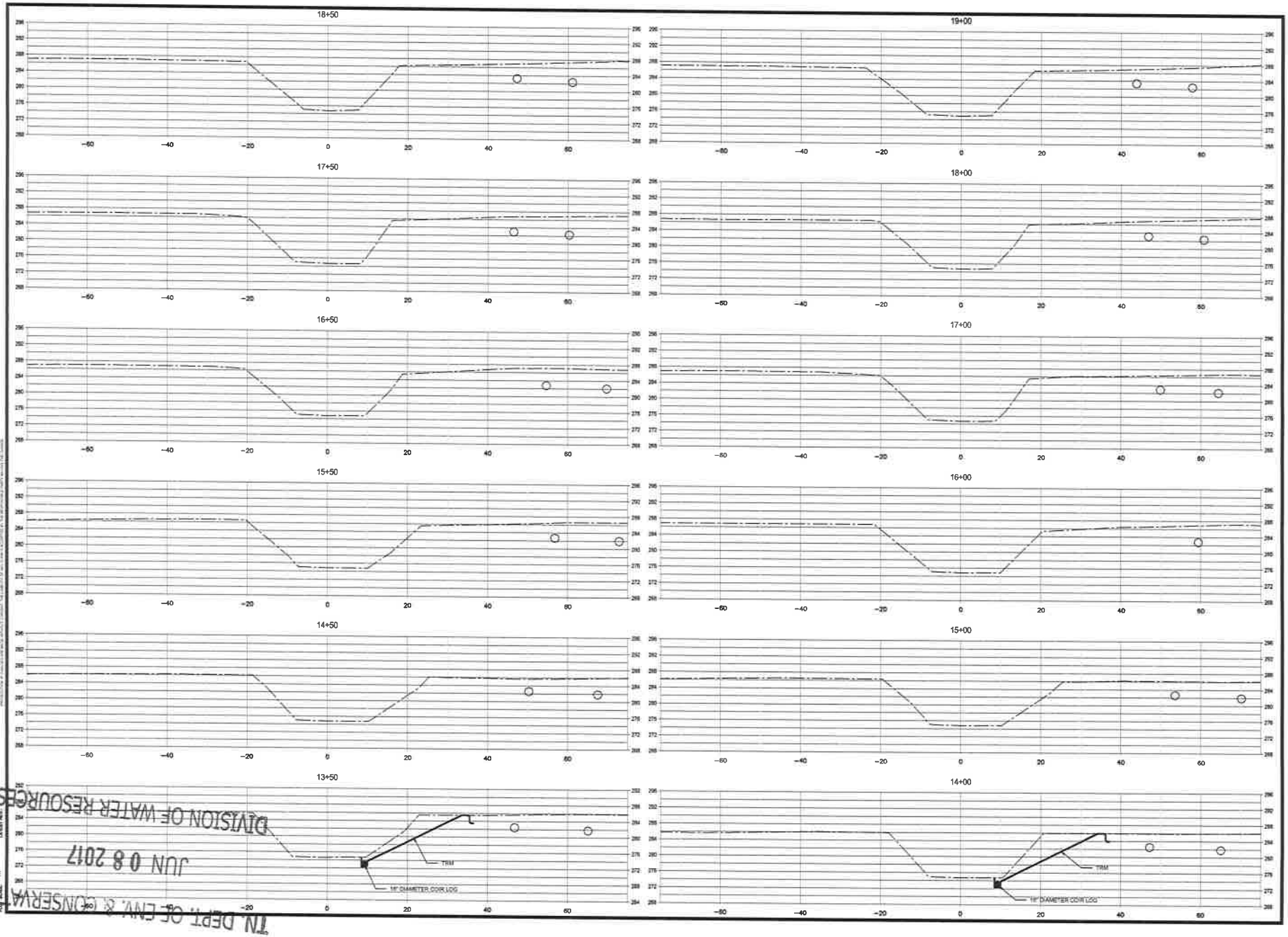
PROJECT NO.
14C64.01

DATE:
MAY 10, 2017

DRAWN: MMD | CHECKED: BF

SHEET TITLE:
CROSS SECTIONS
STA 7+50 TO STA 13+00

SHEET NO:
C11.0



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PROJECT NO.
142641.01

DATE:
MAY 10, 2017

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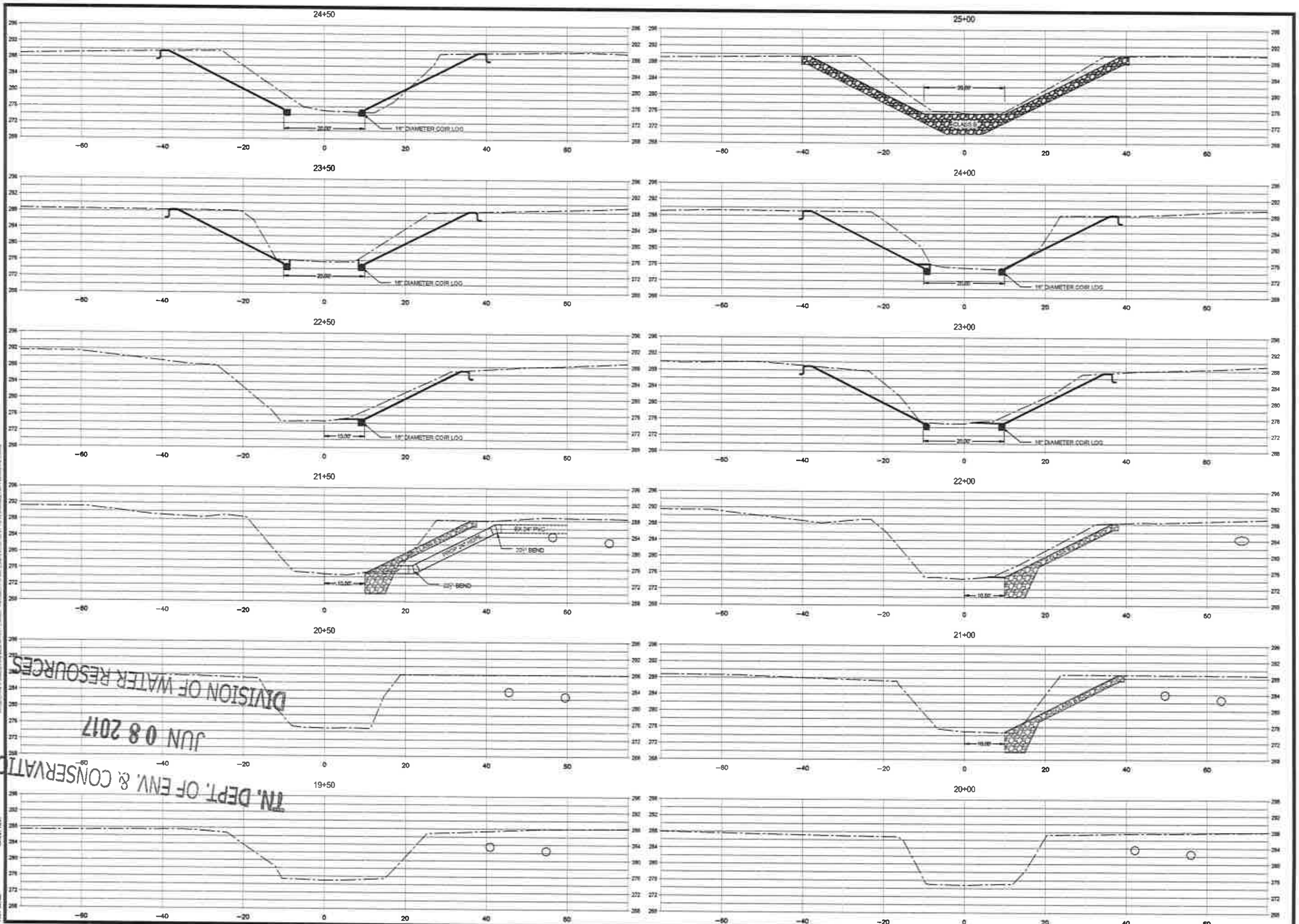
SHEET TITLE:
CROSS SECTIONS
STA 13+50 TO STA 19+00

SHEET NO:
C12.0



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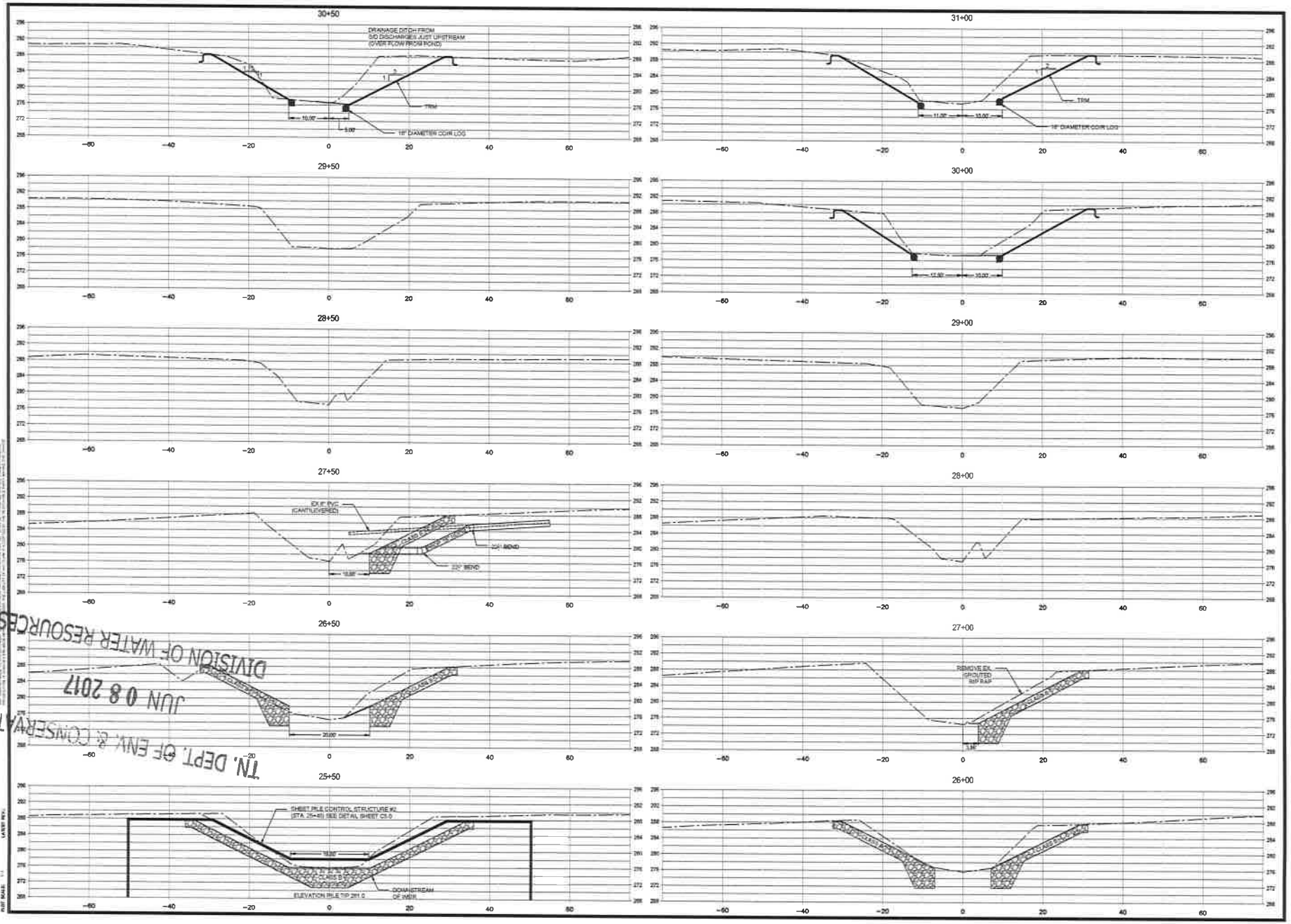
PROJECT NO. 14094.01
DATE: MAY 10, 2017
DRAWN: MMD CHECKED: BE
SHEET TITLE: CROSS SECTIONS STA 19+50 TO STA 25+00
SHEET NO: C13.0



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REVISIONS

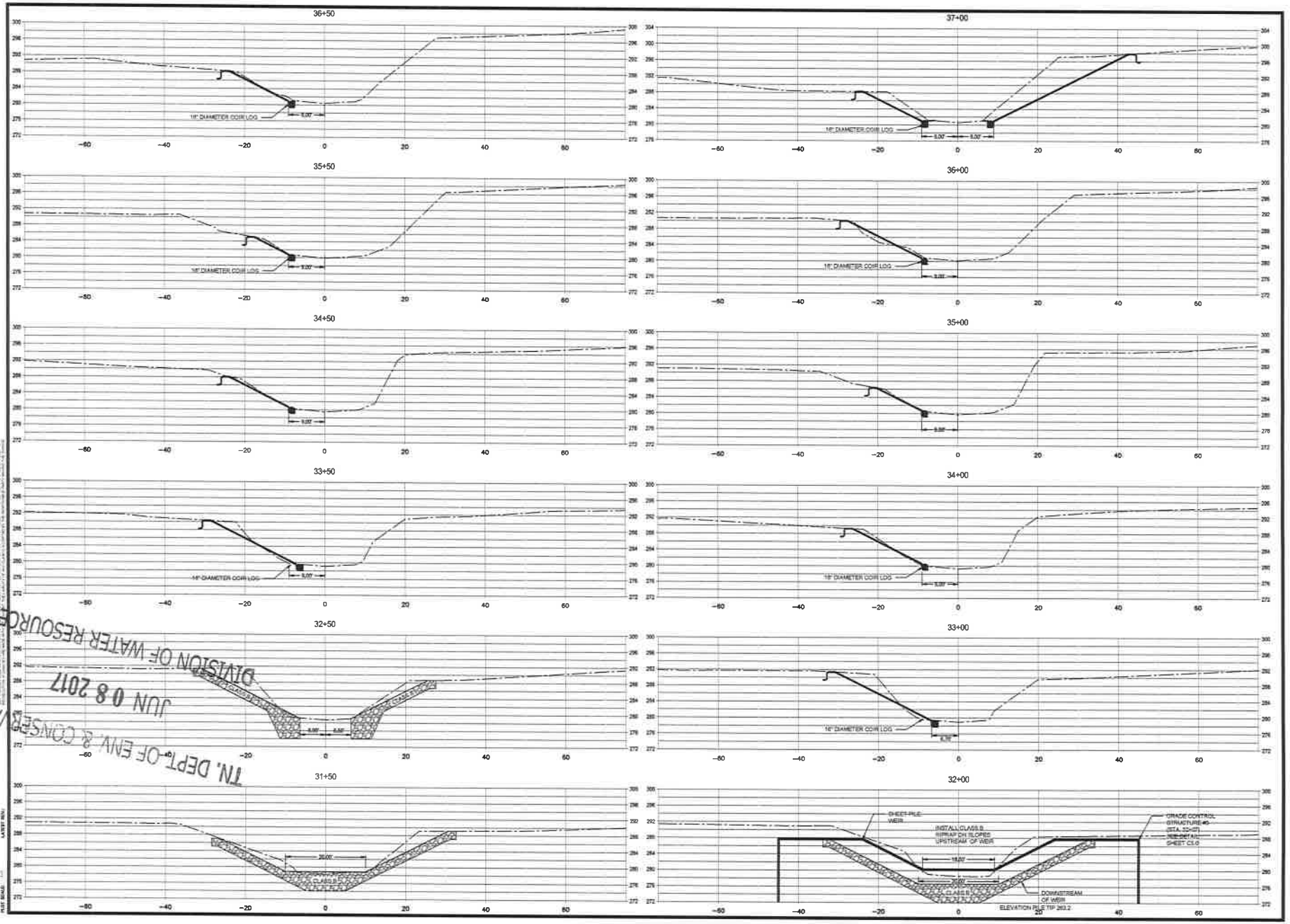
PROJECT NO.
142481

DATE:
MAY 10, 2017

DRAWN: MMO | CHECKED: BE

SHEET TITLE:
CROSS SECTIONS
STA 25+50 TO STA 31+00

SHEET NO:
C14.0



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DATE:
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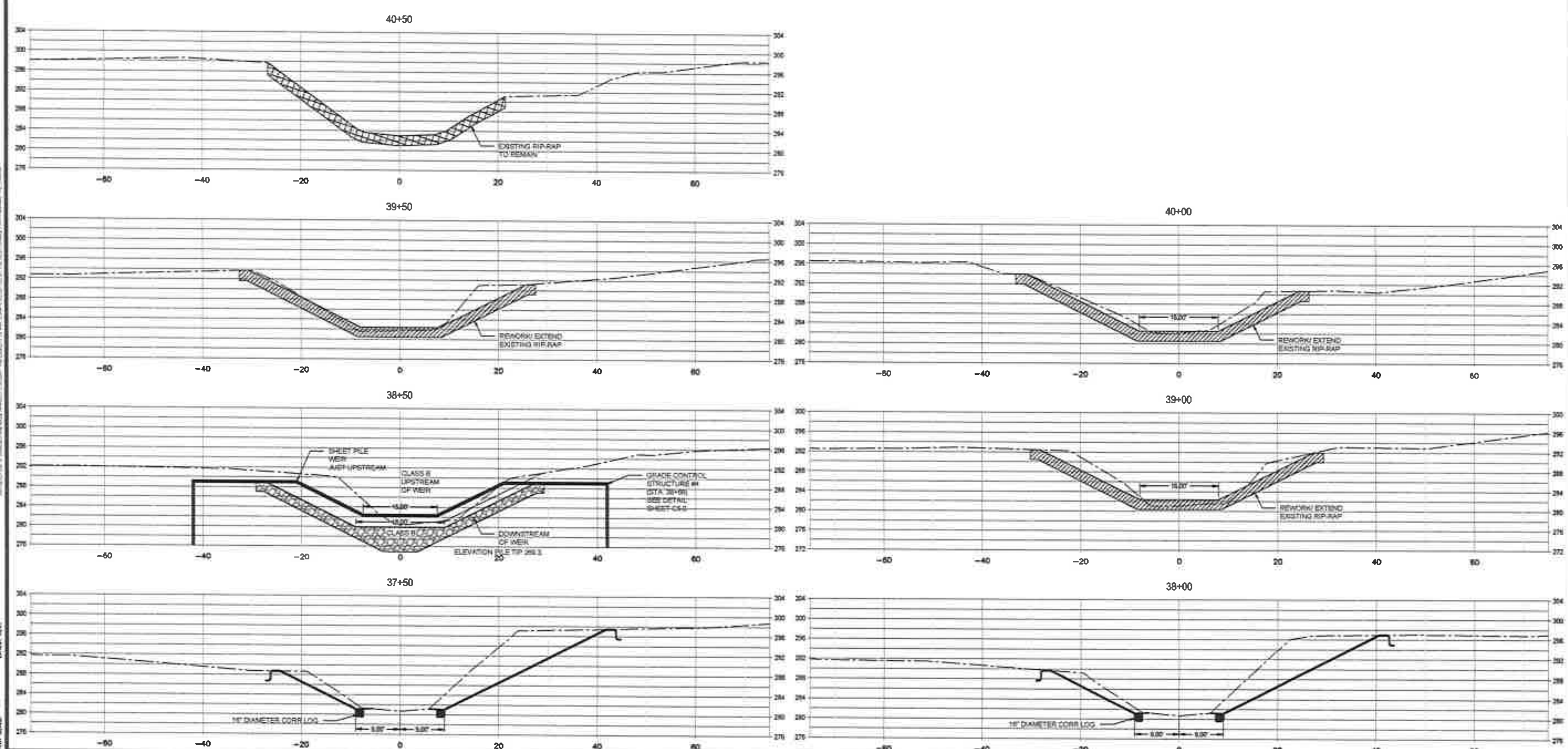
DRAWN: MMD | CHECKED: BE

SHEET TITLE:
CROSS SECTIONS
STA 31+50 TO STA 37+00

SHEET NO:
C15.0



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REVISIONS

PROJECT NO. 142640
DATE: MAY 10, 2017
DRAWN: MMD
CHECKED: SE
SHEET TITLE: CROSS SECTIONS STA 37+50 TO STA 40+50
SHEET NO: C16.0