TDOT DESIGN DIVISION

DRAINAGE MANUAL

CHAPTER III
DRAINAGE PLAN REQUIREMENTS

CHAPTER 3 – DRAINAGE PLAN REQUIREMENTS

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SECTION 3.01 – INTRODUCTION

This chapter discusses the various components of drainage design required to be included on the plans and in the design records. The requirements for each phase of the plan submittal process (preliminary, right-of-way, and construction) are discussed separately herein. The Preliminary plans contain information for use up to and including the public hearing, including preliminary design data for cross culverts, ditches, and channels which will impact the general location of the proposed right-of-way and easements. The Right-of-Way plans include all completed drainage design information in order to accurately delineate and describe proposed right-of-way and easements necessary for acquisition of the required property. The Construction plans contain all tabulated drainage quantities for the project in addition to the information included in the right-of-way plans.

SECTION 3.02 – GENERAL INFORMATION

All current Tennessee Department of Transportation (TDOT) drafting standards (including standard symbols for drainage related items) are to be utilized in developing the plans. The format of notes and general sheet layout for drainage design is presented in later sections of this chapter on the sample drawings.

Sheets in the plans where drainage related information is normally shown include:

- Index Sheet
- Estimated Roadway Quantities Sheet
- Typical Sections Sheet
- General Notes and Special Notes Sheet
- Tabulated Quantities Sheet
- Right-of-Way Acquisition Table Sheet
- Present Layout Sheet
- Proposed Layout Sheet
- Side Road and Ramp Profile Sheet
- Private Drive and Field Ramp Profile Sheet
- Drainage Map Sheet
- Culvert Sections Sheet

Other sheets may contain drainage related information in certain cases.

The following sections contain information which is to be shown on appropriate drawings within the design plans. The Appendix at the end of this chapter contains samples of portions of the drawings.

SECTION 3.03 - PRELIMINARY PLANS

During the Preliminary Plans phase, all cross culverts are designed and preliminary design is performed on other drainage components in order that the profile grade of the proposed roadway improvement and preliminary right-of-way and easement requirements can be established. This information is necessary to develop the plans to a level adequate to be used in the public hearing. The following presents the drainage information required to be shown on the respective sheets in the preliminary plans.

3.03.1 TYPICAL SECTIONS SHEET

The Typical Sections Sheet shows typical road sections and includes details of the standard template ditches in cut sections. Information concerning side slopes, ditch stabilization, and rounding is shown on this sheet. Figure 3A-1 is a sample of a portion of a Typical Sections Sheet showing proposed template ditches. These sheets also show curbs and gutters in curbed streets. Figure 3A-2 is a sample of a portion of a Typical Sections Sheet showing a curb and gutter section.

3.03.2 PRESENT LAYOUT SHEET

The Present Layout Sheet indicates existing conditions in the area of the proposed road. Also, some of the features of the proposed road are shown, including the proposed cross culverts. The size and type of the cross culverts are shown, but the invert elevations are not. Any drainage features which are to be removed are noted on these sheets. Figure 3A-3 is a sample of a portion of a Present Layout Sheet showing a proposed pipe culvert. Figure 3A-4 is a sample showing a proposed box culvert. Figure 3A-5 is a sample showing a proposed box bridge.

3.03.3 PROPOSED LAYOUT SHEET

The Proposed Layout Sheet contains the geometric design and drainage design data for the proposed project. The proposed cross culverts are shown with size, type, and invert elevations in the plan view. Invert elevations for pipe culverts are shown at the end of the end treatment. The roadway profile shows the graphical location and size of cross culverts, the proposed road centerline station at each culvert, the culvert size, skew angle (from the centerline of the proposed road, 90 degrees or less), type of end treatment, standard drawing numbers for the specified end treatment, and pertinent hydrologic and hydraulic design data. The graphical location and size of existing cross culverts are also shown in the profile. Figure 3A-6 is a sample of a portion of a Proposed Layout Sheet showing a proposed pipe culvert. Also shown on Figure 3A-6 is information required for a driveway culvert. Figure 3A-7 shows a proposed box culvert. Figure 3A-8 shows a proposed box bridge. The box bridge requires additional hydraulic design data and quantities for pay items shown in the profile.

3.03.4 SIDE ROAD AND RAMP PROFILE SHEET

The Side Road and Ramp Profile Sheet contain the same data as required in the roadway profile of the Proposed Layout Sheet.

3.03.5 PRIVATE DRIVE AND FIELD RAMP PROFILE SHEET

The Private Drive and Field Ramp Profile Sheet show data necessary to construct private drives and field ramps. Drainage information shown is a graphical representation of the culvert under the drive along with the size of the culvert. Invert elevations are not shown. Figure 3A-9 shows a sample private drive profile.

3.03.6 DRAINAGE MAP SHEET

The Drainage Map Sheet shows the approximate limits and general flow patterns of drainage areas along with basic hydrologic design data. The location and sizes of the cross culverts are shown. Other pertinent drainage features such as existing major streams and wetlands and proposed drainage easements are included. The Drainage Map Sheet is a relatively small scale map showing very general drainage features. It is not intended to be used for detailed drainage design. Figure 3A-10 is a sample of a portion of a Drainage Map Sheet.

SECTION 3.04 – RIGHT-OF-WAY PLANS

During the Right-of-Way Plans phase, all remaining detailed drainage design is completed on the project. This allows for the final determination of the limits of proposed right-of-way and required easements. The following presents the drainage information required to be shown on the respective sheets in the right-of-way plans.

3.04.1 TYPICAL SECTIONS AND DETAILS SHEET

(Same as Preliminary Plans)

3.04.2 RIGHT-OF-WAY ACQUISITION TABLE SHEET

The Right-of-Way Acquisition Table Sheet contains information related to property owners and proposed right-of-way and easements to be acquired. Most drainage features will be located inside the areas designated as right-of-way. Permanent drainage easements are required when drainage features are located outside the right-of-way. The necessity for drainage easements will be addressed by the designer and approved by TDOT during the design process. If drainage easements are necessary, they are tabulated on the Right-of-Way Acquisition Table.

3.04.3 PRESENT LAYOUT SHEET

Additional information shown on the Present Layout Sheet includes limits of detention systems. Figure 3A-11 is a sample of a portion of a Present Layout Sheet with an area designated for a detention system.

3.04.4 PROPOSED LAYOUT SHEET

The cross culvert information shown on the Proposed Layout Sheet is the same as shown on the preliminary plans.

Culverts under median openings are shown in the plan view with the structure number of the end treatment, type of end treatment, and invert elevation at the end of the end treatments. The profile shows the graphical location of the culvert along with the structure number and type of end treatment. The top number in the circle labeling the drainage structure denotes the structure number specific to the project. The bottom designation denotes the type of structure used. Figure 3A-12 is a sample of a portion of a Proposed Layout Sheet with a median culvert.

Special ditches required which are not standard template ditches are shown in the plan view along with the type of ditch and specified lining. The profile shows the special ditch slope and elevations at break points along with the station of the break point. Figure 3A-13 is a sample of a portion of a Proposed Layout Sheet with a special ditch. Template ditches are not shown on the Proposed Layout Sheets.

Storm sewer systems are shown in the plan view along with the pipe sizes, structure numbers, the type of structure, grate elevation and invert elevations of each structure. Figure 3A-14 shows a portion of a Proposed Layout Sheet with a storm sewer system in the plan view. The profile for the storm sewers shows the graphical location of the storm sewer system along with the structure number and type of structure and size of pipe. Figure 3A-15 shows a portion

of a Proposed Layout Sheet with a storm sewer in the profile view. Figure 3A-16 shows a portion of a Proposed Layout Sheet with a detention system in the plan view. A separate large-scale plan showing details of the detention system should be provided in the plans.

3.04.5 SIDE ROAD AND RAMP PROFILE SHEET

(Same as Preliminary Plans)

3.04.6 PRIVATE DRIVE AND FIELD RAMP PROFILE SHEET

(Same as Preliminary Plans)

3.04.7 DRAINAGE MAP SHEET

(Same as Preliminary Plans)

3.04.8 CULVERT SECTIONS SHEET

The Culvert Sections Sheet shows a profile of the cross culverts on the project. The existing and proposed grades along the centerline of the culvert are shown. The road centerline station where the culvert is located is shown along with the size and material of the culvert, invert elevations, skew angle (from the centerline of the proposed road, 90 degrees or less), type of end treatment, standard drawing numbers for the specified end treatment, and pertinent hydrologic and hydraulic design data. Invert elevations for pipe culverts are shown at the end of the end treatment. Figure 3A-17 is a sample of a portion of a Culvert Sections Sheet showing a pipe culvert. Box culvert and box bridge sections show the same information as pipe culverts along with additional hydraulic design data and pay item quantities for the culvert and end treatment. A box bridge is defined as a box culvert with a total width greater than 20 feet. Figure 3A-18 is a sample of a portion of a Culvert Sections Sheet showing a box culvert. Figure 3A-19 is a sample of a portion of a Culvert Sections Sheet showing a box bridge.

3.04.9 CROSS SECTIONS SHEET

The Cross Sections Sheet includes information for both standard template ditches and special ditches. Figure 3A-20 is a sample of a portion of a Cross Sections Sheet showing both types of ditches. Figure 3A-21 is a sample of a portion of a Cross Sections Sheet showing a detention basin.

SECTION 3.05 - CONSTRUCTION PLANS

The preparation of the Construction Plans involves the tabulation of bid quantities for the project. All drainage design should have previously been completed during the preparation of the Right-of-Way plans. The following presents the drainage information required to be shown on the respective sheets in the construction plans.

3.05.1 INDEX SHEET

In addition to the index of drawing numbers for the plans, the Index Sheet contains a list of Standard Drawings which relate to the project. Some of these are printed with the plans and some are referenced. Drainage related standards are included here.

3.05.2 ESTIMATED ROADWAY QUANTITIES SHEET

The Estimated Roadway Quantities Sheet shows a summary of all the bid items for the project. The item number, description, unit, and total quantity are shown for each bid item.

3.05.3 TYPICAL SECTIONS AND DETAILS SHEET

The drainage related features for the roadway typical sections will be the same as shown on the preliminary plans. In addition, special ditch details and tabulations are included. The special ditches are ditches (other than standard template ditches) required in the drainage design. The location of each ditch, side slopes, bottom width, type of ditch, and specified lining is shown. Also, a typical section of each type of ditch used is shown. Figure 3A-22 is a sample of Tabulated Ditches and Ditch Sections on a Typical Sections Sheet.

3.05.4 GENERAL NOTES AND SPECIAL NOTES SHEET

The General Notes and Special Notes Sheet contains standard and project specific notes related to the project.

3.05.5 TABULATED QUANTITIES SHEET

The Tabulated Quantities Sheets contain the detailed tabulation of various components of the roadway design. Several of these components are drainage related items. Data regarding location, size and/or type, length, pay item quantities, and standard drawing numbers for each component of the drainage system is shown.

3.05.6 RIGHT-OF-WAY ACQUISITION TABLE SHEET

(Same as Right-of-Way Plans)

3.05.7 PRESENT LAYOUT SHEET

(Same as Right-of-Way Plans)

3.05.8 PROPOSED LAYOUT SHEET

(Same as Right-of-Way Plans)

3.05.9 SIDE ROAD AND RAMP PROFILE SHEET

(Same as Right-of-Way Plans)

3.05.10 PRIVATE DRIVE AND FIELD RAMP PROFILE SHEET

(Same as Right-of-Way Plans)

3.05.11 DRAINAGE MAP SHEET

(Same as Right-of-Way Plans)

3.05.12 CULVERT SECTIONS SHEET

(Same as Right-of-Way Plans)

3.05.13 CROSS SECTIONS SHEET

(Same as Right-of-Way Plans)

SECTION 3.06 - DRAINAGE DESIGN RECORDS

3.06.1 OVERVIEW

3.06.1.1 INTRODUCTION

An important part of the design or analysis of any hydraulic facility is the documentation. Appropriate documentation of the design of any hydraulic facility is essential because of:

- The importance of public safety
- Justification of expenditure of public funds
- Future reference by engineers (when improvements, changes, or rehabilitations are made to the highway facilities)
- Information leading to the development of defense in matters of litigation
- Public information

Frequently, it is necessary to refer to plans, specifications and analysis long after the actual construction has been completed. Documentation permits evaluation of the performance of structures after flood events to determine if the structures performed as anticipated or to establish the cause of unexpected behavior, if such is the case. In the event of a failure, it is essential that contributing factors be identified in order that recurring damage can be avoided.

3.06.1.2 DEFINITION

The definition of hydrologic and hydraulic documentation as used in this chapter is the compilation and preservation of the design and related details as well as all pertinent information on which the design and decisions were based.

3.06.1.3 PURPOSE

This purpose of the drainage documentation is to support the development of plans and to serve as a diary of the drainage design process for TDOT projects. This portion of the Drainage Manual focuses on the documentation of the findings obtained in using the other chapters of this Manual, and thus designers should be familiar with all the hydrologic and hydraulic design procedures associated with these chapters. In this portion of the Manual, TDOT's system for organizing the documentation of hydraulic designs is presented. The documentation will provide as complete a history of the drainage design process as is practical.

The major purpose of providing good documentation is to define the design procedure that was used and to show how the final design and decisions were arrived at. Often there is expressed the myth that avoiding documentation will prevent or limit litigation losses as it supposedly precludes providing the plaintiff with incriminating evidence. This is seldom if ever the case and documentation should be viewed as the record of reasonable and prudent design analysis based on the best available technology. Thus, good documentation can provide the following:

- Protection for TDOT by proving that reasonable and prudent actions were, in fact, taken
- Identifying the situation at the time of design

- Documenting that rationally accepted procedures and analysis were used at the time of the design which were commensurate with the perceived site importance and flood hazard
- A continuous site history to facilitate future reconstruction
- File data necessary to quickly evaluate any future site problems that might occur during the facilities service life
- Expediting plan development by clearly providing the reasons and rationale for specific design decisions

3.06.1.4 TYPES

There are three basic types of documentation which will be considered: preconstruction, design, and construction / operation.

1. Preconstruction documentation includes the following if available:

   a. Aerial photographs
   b. Contour mapping
   c. Watershed map or plan including:
      - Flow directions
      - Watershed boundaries
      - Watershed areas
      - Natural storage areas
   d. Surveyed data reduced to include:
      - Existing hydraulic facilities
      - Existing controls
      - Profiles - roadway, channel, driveways
      - Cross sections - roadway, channels, faces of structures
   e. Flood insurance studies and maps by FEMA
   f. National Resource Conservation Service soil maps (if used during design)
   g. Field reconnaissance report(s) which may include:
      - Video cassette recordings
      - Audio tape recordings
      - Still camera photographs
      - Movie camera films
      - Written analysis of findings with sketches
   h. Reports from other agencies (local, State or Federal), TDOT personnel, newspapers, and abutting property owners.

2. Design documentation includes all the information used to justify the design, including:

   a. Reports from other agencies
   b. Hydrological report
   c. Hydraulic report
   d. Approvals

3. Construction or operation documentation includes:

   a. Plans

b. Revisions
c. Record drawings
d. Photographs
e. Record of operation during flooding events, complaints and resolutions

It is important to prepare and maintain, in a permanent file, the record drawings and plans for every drainage structure to document subsurface foundation elements such as footing types and elevations, pile types and (driven) tip elevations, etc. There may be other information which should be included or may become evident as the design or investigation develops. This additional information may also be incorporated at the discretion of the designer.

3.06.1.5 SCHEDULING

Documentation shall not be considered as occurring at specific times during the design or as the final step in the process which could be long after the final design is completed. Documentation should rather be an ongoing process and part of each step in the hydrologic and hydraulic analysis and design process. This will increase the accuracy of the documentation, provide data for future steps in the plan development process, and provide consistency in the design even when different designers are involved at different times of the plan development process. The drainage design records and documentation will be assembled appropriately for permanent storage. The notebook will be retained by the designer.

3.06.1.6 RESPONSIBILITY

The designer will be responsible for determining what hydrologic analyses, hydraulic design, and related information will be documented during the plan development process. These hydrologic analyses, hydraulic designs, related information, and procedures are covered in depth in the remainder of this manual. The designer will make a determination that complete documentation has been achieved during the plan development process which will include the final drainage design.

3.06.2 PROCEDURES

3.06.2.1 INTRODUCTION

A complete hydrologic and hydraulic design and analysis documentation file for each waterway encroachment or crossings will be developed. Where applicable this file will include such items as:

1. Identification and location of the facility
2. Photographs (ground and aerial)
3. Hydrology investigations
4. Drainage area maps, vicinity maps and topographic maps
5. Contour maps
6. Interviews (local residents, adjacent property owners and maintenance forces)
7. Newspaper clippings
8. Design notes and correspondence relating to design decisions
9. History of performance of existing structure(s)
10. Assumptions

The documentation file will contain design/analysis data and information which influenced the facility design.

3.06.2.2 PRACTICES

Following are the Department's practices related to documentation of hydrologic and hydraulic designs and analyses.

1. Hydrologic and hydraulic data, preliminary calculations and analyses and all related information used in developing conclusions and recommendations related to drainage requirements, including estimates of structure size and location, will be compiled in a documentation file.

2. The designer will document all design assumptions and selected criteria including the decisions related thereto.

3. The amount of detail of documentation for each design or analysis will be commensurate with the risk and the importance of the facility.

4. Documentation will be organized to be as concise and complete as practicable so that knowledgeable designers can understand years hence what was done by predecessors.

5. In cases where there are potential unknown design factors, this should be stated in the design assumptions.

6. Provide all related references in the documentation file to include such things as publishes data and reports, memos and letters and interviews. Include dates and signatures where appropriate.

7. Documentation will be organized to logically lead the reader from past history through the problem background, into the findings and through the performance.

8. A summary at the beginning of the documentation will provide an outline of the documentation file to assist users in finding detailed information.

3.06.3 DOCUMENTATION COMPONENTS

3.06.3.1 ASSEMBLY

The following sections discuss the items that will be included in the drainage design records. The intent is not to limit the data to only those items listed, but rather to establish a minimum requirement consistent with the hydraulic design procedures as outlined in TDOT manuals. If circumstances are such that the drainage facility is sized by other than normal procedures or if the size of the facility is governed by factors other than hydrologic or hydraulic factors, a narrative summary detailing the design basis will be included in the records. Additionally, the designer will include in the documentation items not listed below but which are useful in understanding the analysis, design, findings and final recommendations.

The design records should be assembled in a manner that will allow the various components to be found as readily as possible.

1. Each section of the drainage records that contains computations will start with all assumptions used by the designer(s).

2. Copies of reports, meetings, or correspondence regarding the drainage design will be included in the design records.

3. All pages larger than 8 1/2 x 11 inches will be neatly folded and labeled to allow the contents of the page and its station(s) to be identified without unfolding the page. The quantity of folded pages should be kept to a minimum.

4. Computer calculations require both the input files and the computer output.

5. Sheets that contain manual calculations, non-departmental forms, and any other material which support the hydraulic results should be included.

6. Drainage items designed or analyzed should be identified such that they may be readily found in the construction plans.

All hand calculations should be initialed and dated by the designer. Computer inputs and outputs should be initialed by the person entering the data and running the computer program. Such initialing may be construed as a check of the computer output to be a reasonable result. Appropriate quality control procedures should be documented by the designer.

3.06.3.2 HYDROLOGY

Detailed requirements are presented in Chapter 4 of this Manual. To aid in assembling the design records these categories should be reviewed for inclusion:

1. List all assumptions used in the design or analysis
2. Maps or data used to delineate drainage areas
3. How methods for design or analysis were selected
4. Criteria selected for design or analysis
5. Findings of analysis or design

3.06.3.3 ROADSIDE DITCHES AND STREAMS

All channels on the project shall be analyzed hydraulically. This includes roadway cut ditches, surface ditches, special ditches, interceptor ditches, inlet and outlet ditches, streams, and channels. Detailed requirements are presented in Chapter 5 and Chapter 11 of this Manual. To aid in assembling the design records these categories should be reviewed for inclusion:

1. Cross section(s) used in the design water surface determinations and their locations
2. Roughness coefficient assignments ("n" values)
3. Information on the method used for design water surface determinations
4. Observed high water, dates and discharges
5. Channel velocity measurements or estimates and locations
6. Design or analysis of materials proposed for the channel bed and banks
7. Energy dissipation calculations and designs
8. Copies of all computer analyses

3.06.3.4 CULVERTS

Detailed requirements for culverts (cross drains, side drains, etc.) are presented in Chapter 6 of this Manual. Documentation should be provided indicating the amount of runoff estimated for each structure. When the estimation indicates a flow greater than 500 cfs, TDOT's Structures Division, Hydraulics Section performs the design. Copies of correspondence informing the Hydraulics Section of these structures will be included. For structures receiving less than or equal to 500 cfs, detailed design and documentation requirements are presented in Chapter 6 of this Manual. To aid in assembling the design records these categories should be reviewed for inclusion:

1. Allowable headwater elevation and basis for its selection
2. Roughness coefficient assignments ("n" values)
3. Observed high water, dates and discharges
4. Calculated headwater elevations, outlet velocities, and scour (if applicable) and any historical floods
5. Type of culvert entrance condition and whether outlet or inlet control
6. Culvert outlet appurtenances and energy dissipation calculations and designs (if applicable)
7. Copies of all computer analyses
8. Potential flood hazard to adjacent properties

3.06.3.5 STORM DRAINAGE SYSTEM

Detailed requirements for storm drainage systems are presented in Chapter 7 of this Manual. To aid in assembling the design records these categories should be reviewed for inclusion:

1. Computations for inlets and pipes, including hydraulic grade lines
2. Copies of storm sewer computation sheets or computer analyses
3. Complete drainage area map (addresses inlet spacing)
4. Design frequency
5. Information concerning outfalls, existing storm drains, and other design considerations including connecting structures
6. Calculations for any special drainage details
7. A schematic indicating the storm drainage system layout with design information

3.06.3.6 STORM WATER STORAGE FACILITIES

Detailed requirements for storm water detention and/or retention design are presented in Chapter 8 of this Manual. To aid in assembling the design records these categories should be reviewed for inclusion:

1. Computations indicating the hydraulic design of the system, including routing the specified storms through the detention/retention system
2. Design frequencies
3. Sketches and/or reduced scale plans showing the layout and dimensions of the pond(s)
4. Information concerning the discharge pipe(s) or weir(s), including energy dissipation calculations and design
5. Copies of all computer analyses

3.06.3.7 DESIGN RECORDS EXCLUSIONS

To clarify the information included in the design records and to reduce the overall size, several specific items should **not** be included:

1. Full set of plans
2. Full size present and proposed layout sheets
3. Intermediate computer runs (input and output files)

3.06.3.8 SEQUENCE OF DESIGN RECORDS COMPONENTS

The following order should be followed by the designer when assembling the drainage design records:

1. Reports and Correspondence
2. Hydrology
3. Roadside Ditches and Streams
4. Culverts
5. Storm Sewers/Inlet Spacing
6. Special Drainage Structures
7. Stormwater Storage Facilities (Detention/Retention)
8. Erosion Prevention and Sediment Control
9. Stream Relocations

Photographs can be included in an appendix or in the section in which they are referenced.

TDOT DESIGN DIVISION

DRAINAGE MANUAL

CHAPTER III
APPENDIX 3A

SECTION 3.07 – APPENDIX

3.07 APPENDIX

3.07.1 FIGURES AND TABLES

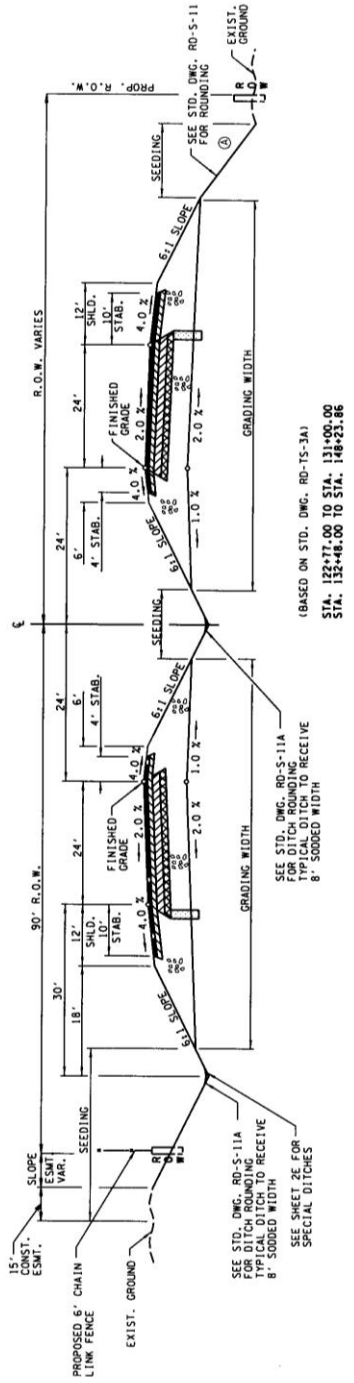
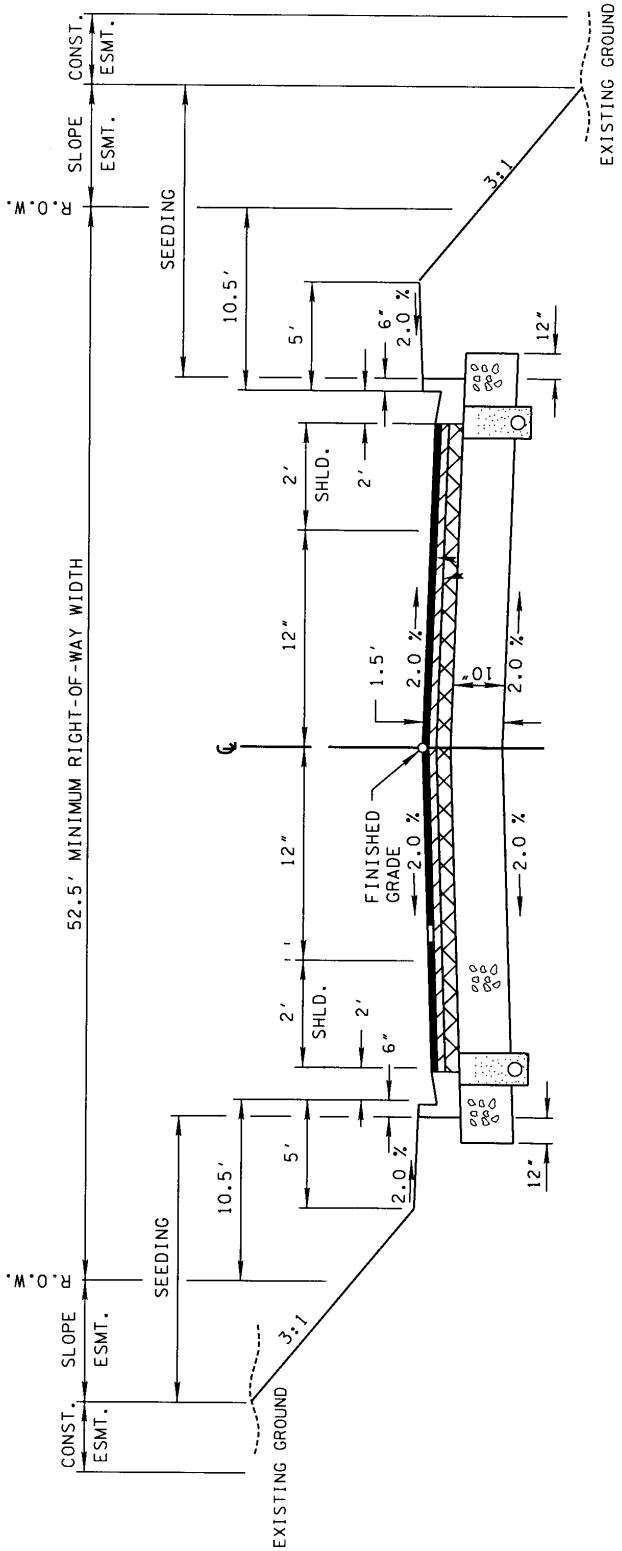


Figure 3A-1
Portion of Typical Sections Sheet (Road Section)



TANGENT SECTION
(BASED ON STD. DWG. RD01-TS-7A)

STA. 10+20 TO STA. 10+51

Figure 3A-2
Portion of Typical Sections Sheet (Curb and Gutter)

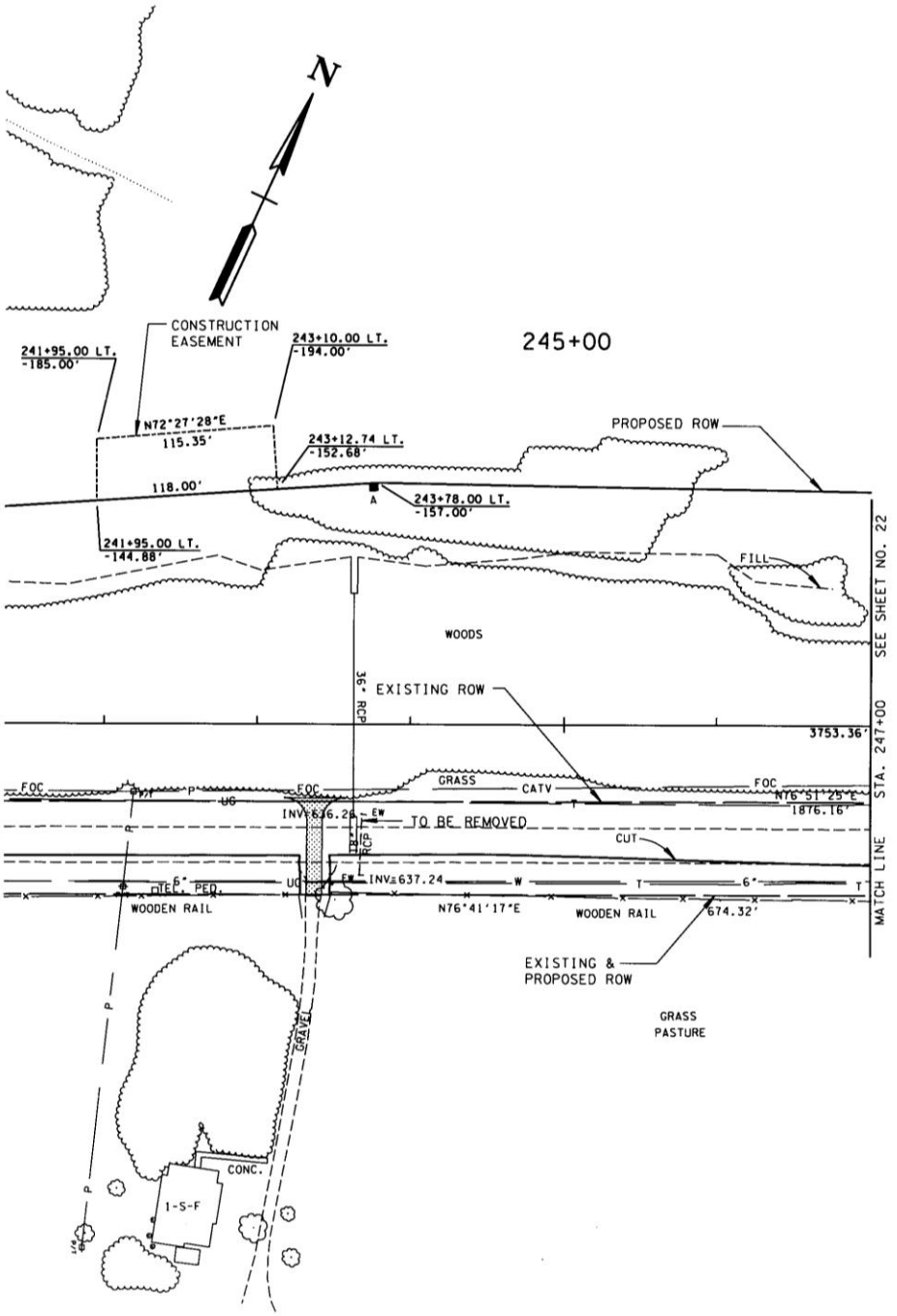


Figure 3A-3
Portion of Present Layout Sheet (Pipe Culvert)

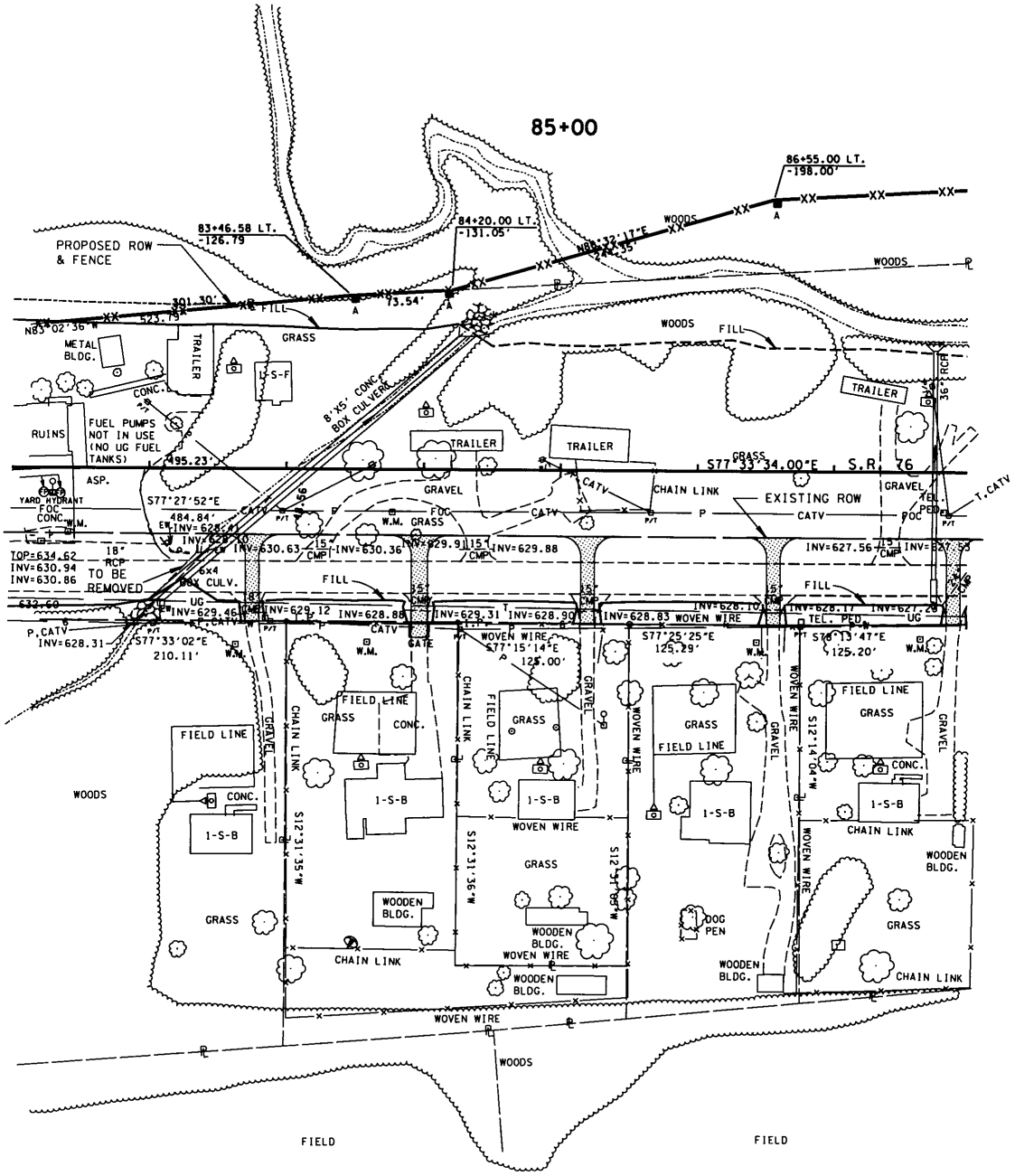


Figure 3A-4
Portion of Present Layout Sheet (Box Culvert)

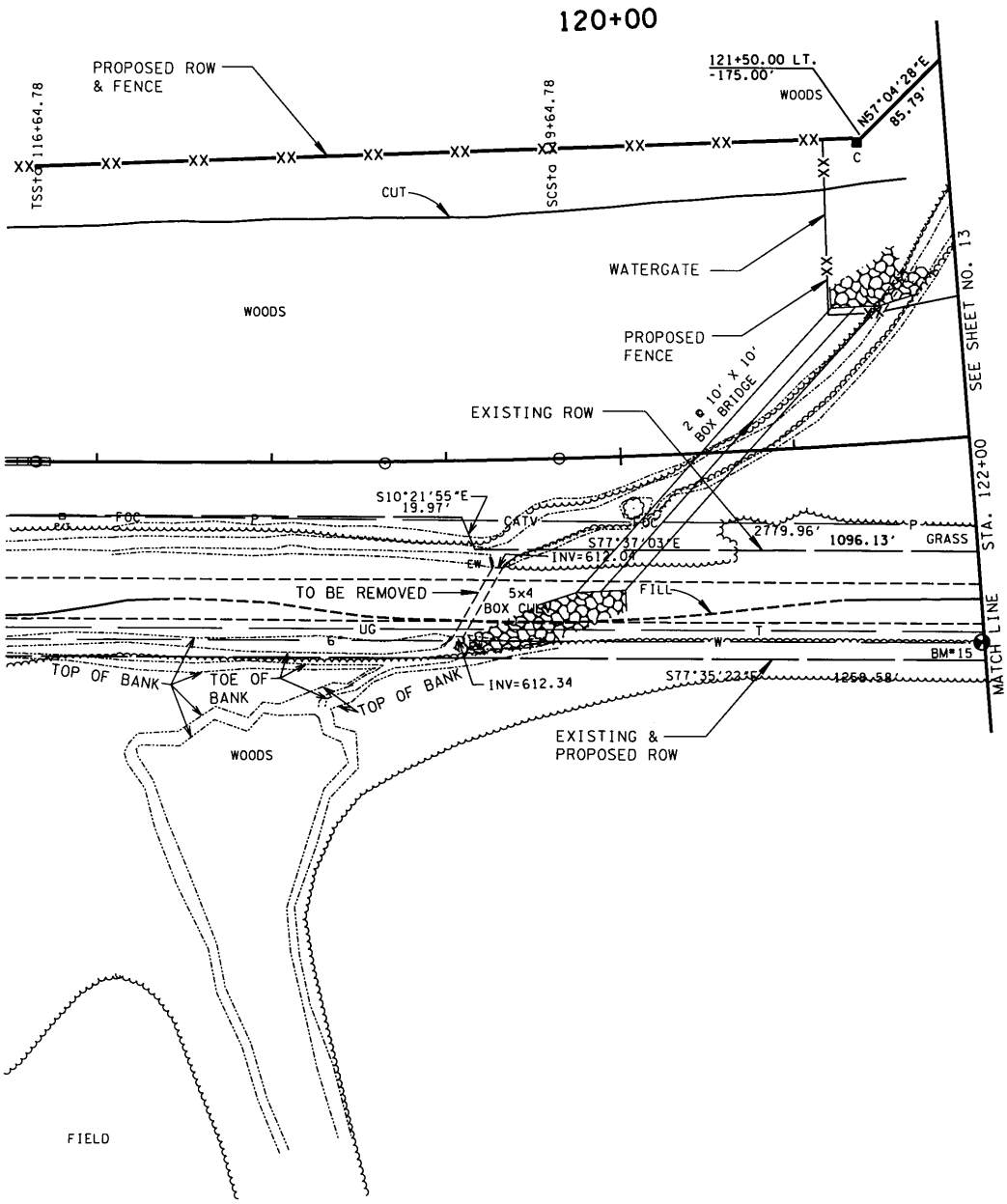


Figure 3A-5
Portion of Present Layout Sheet (Box Bridge)

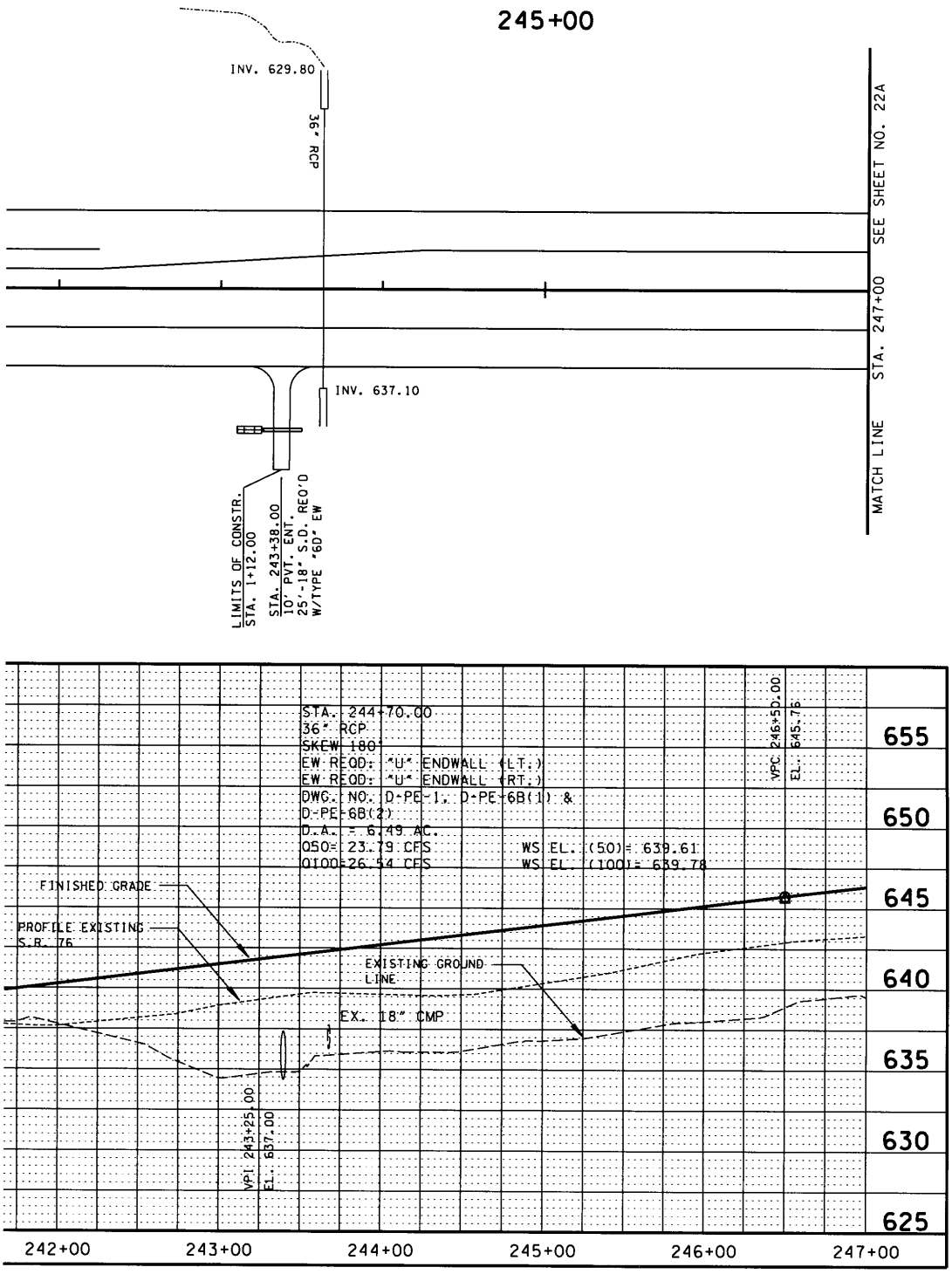


Figure 3A-6
Portion of Proposed Layout Sheet (Pipe Culvert)

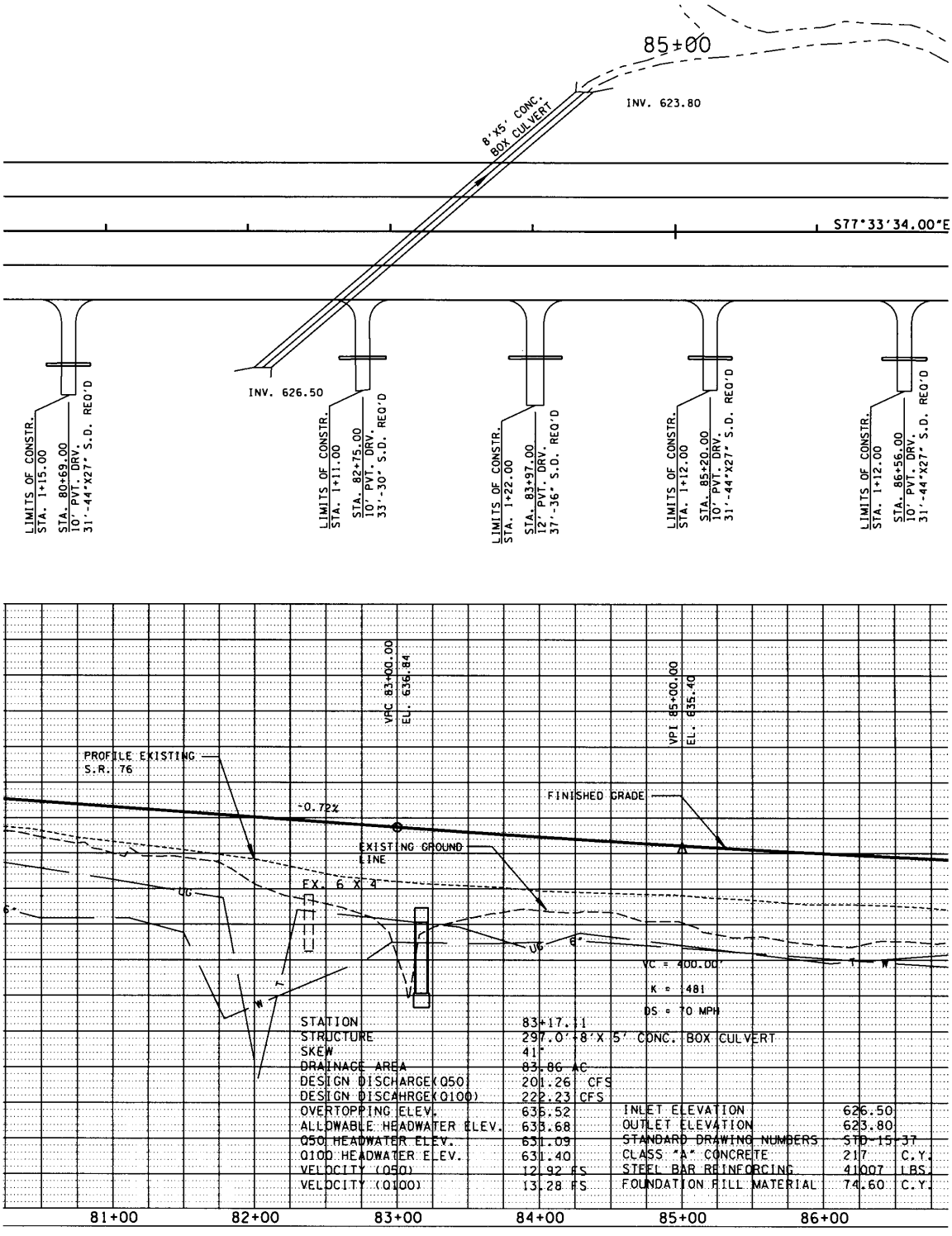
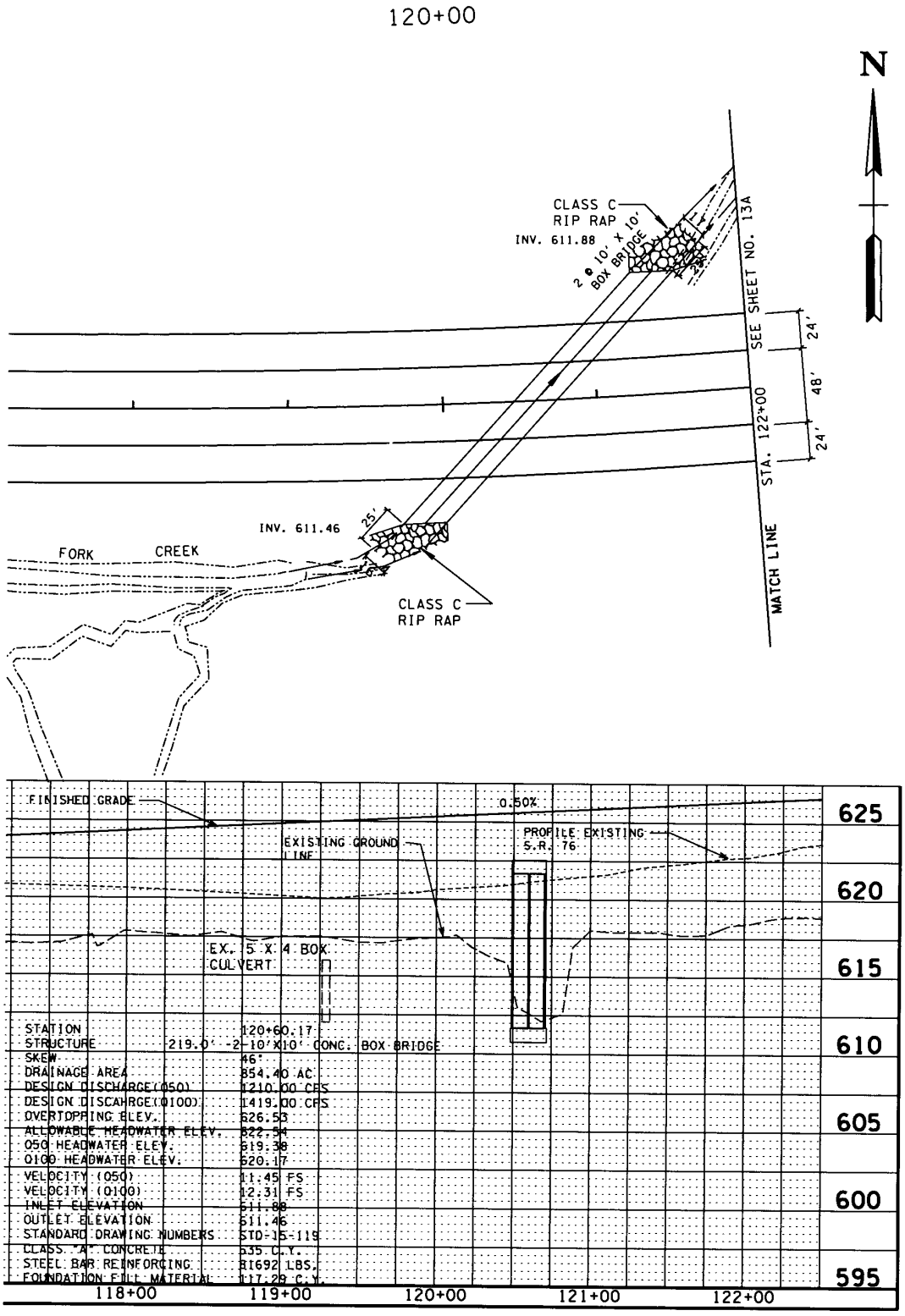


Figure 3A-1
Portion of Proposed Layout Sheet (Box Culvert)


120+00
N
CLASS C
RIP RAP
INV. 611.88
2 @ 10' X 10'
BOX BRIDGE
SEE SHEET NO. 13A
24'
48'
24'
STA. 122+00
MATCH LINE
INV. 611.46
25'
FORK
CREEK
CLASS C
RIP RAP
FINISHED GRADE
0.50%
EXISTING GROUND LINE
PROFILE EXISTING S.R. 76
EX. 5 X 4 BOX CULVERT
625
620
615
610
605
600
595
STATION 120+60.17
STRUCTURE 219.0' - 2-10'X10' CONC. BOX BRIDGE
SKEW 46°
DRAINAGE AREA 854.40 AC.
DESIGN DISCHARGE(Q50) 1210.00 CFS
DESIGN DISCAHRGE(Q100) 1419.00 CFS
OVERTOPPING ELEV. 626.53
ALLOWABLE HEADWATER ELEV. 622.54
Q50 HEADWATER ELEV. 619.38
Q100 HEADWATER ELEV. 620.17
VELOCITY (Q50) 11.45 FS
VELOCITY (Q100) 12.31 FS
INLET ELEVATION 611.88
OUTLET ELEVATION 611.46
STANDARD DRAWING NUMBERS STD-15-119
CLASS "A" CONCRETE 635 C.Y.
STEEL BAR REINFORCING 81692 LBS.
FOUNDATION FILL MATERIAL 417.29 C.Y.
118+00
119+00
120+00
121+00
122+00

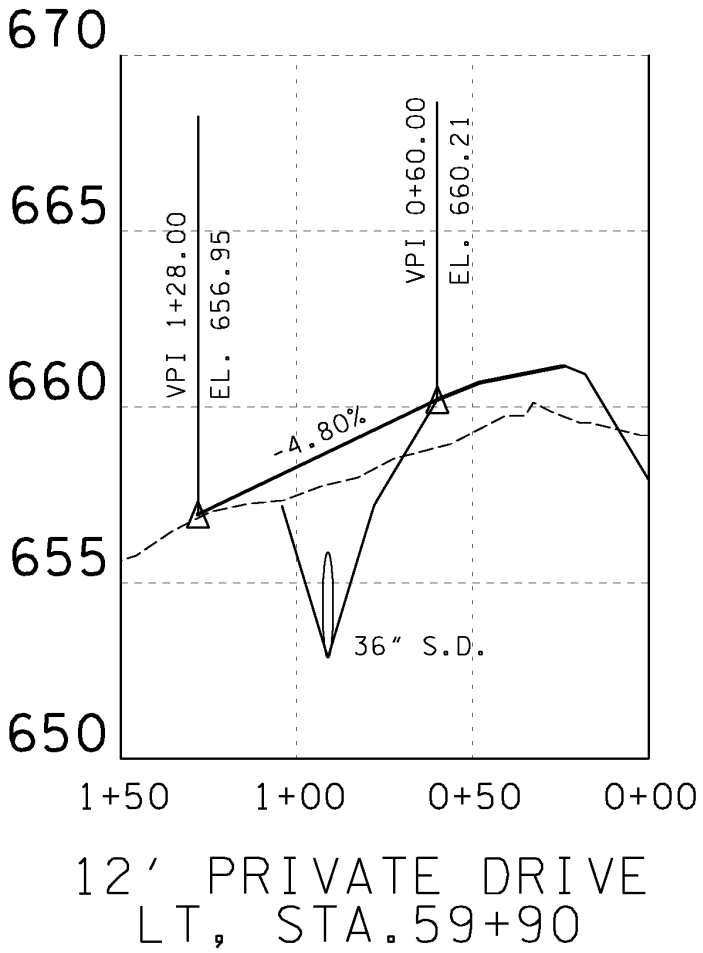
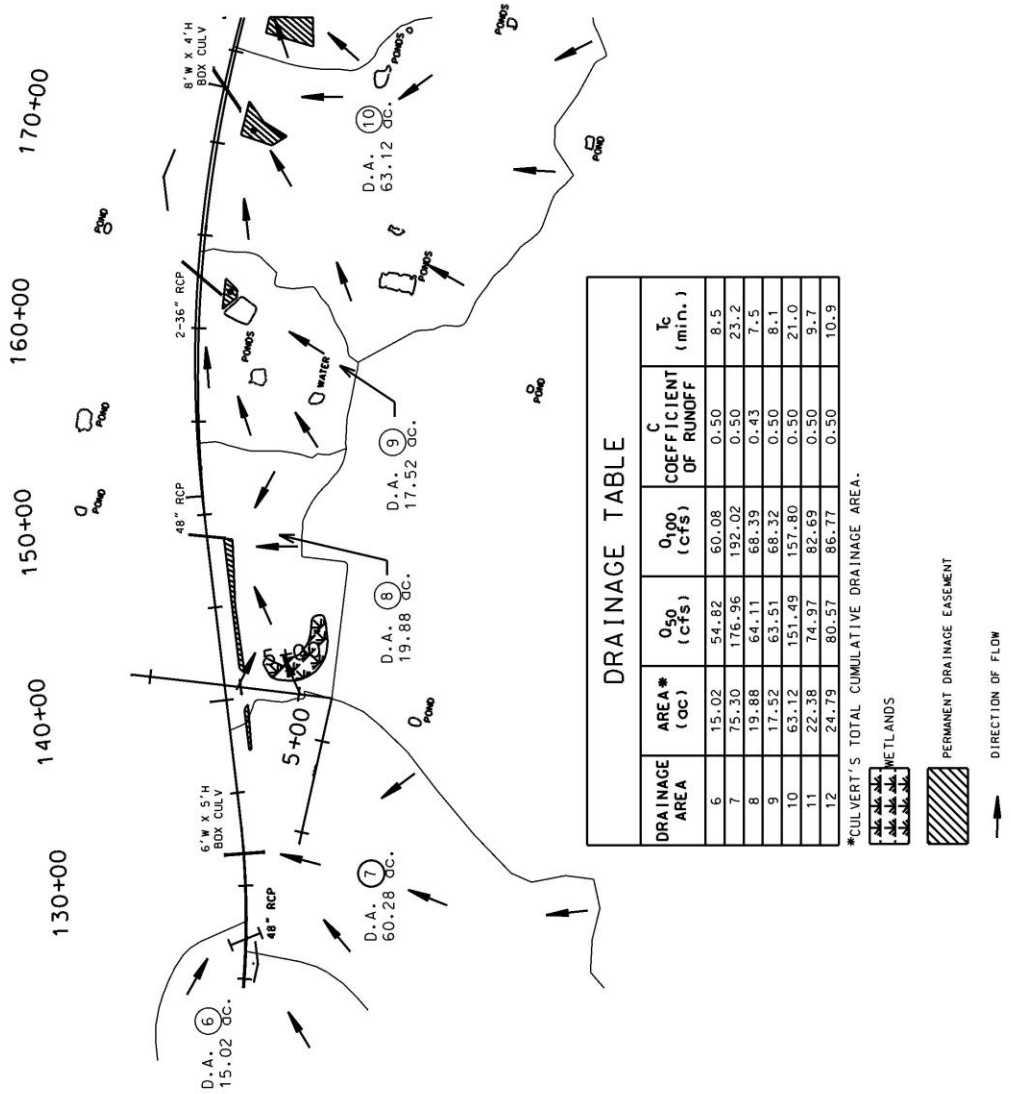


Figure 3A-9
Portion of Private Drive and Field Ramp Profile Sheet


130+00
140+00
150+00
160+00
170+00
5+00
6'W X 5'H BOX CULV
6'W X 4'H BOX CULV
48" RCP
2-36" RCP
48" RCP
D.A. 6 15.02 ac.
D.A. 7 60.28 ac.
D.A. 8 19.88 ac.
D.A. 9 17.52 ac.
D.A. 10 63.12 ac.
POND
WATER
PONDS
DRAINAGE TABLE
DRAINAGE AREA
AREA* (ac)
Q_{50} (cfs)
Q_{100} (cfs)
C COEFFICIENT OF RUNOFF
T_c (min.)
6 15.02 54.82 60.08 0.50 8.5
7 75.30 176.96 192.02 0.50 23.2
8 19.88 64.11 68.39 0.43 7.5
9 17.52 63.51 68.32 0.50 8.1
10 63.12 151.49 157.80 0.50 21.0
11 22.38 74.97 82.69 0.50 9.7
12 24.79 80.57 86.77 0.50 10.9
*CULVERT'S TOTAL CUMULATIVE DRAINAGE AREA.
WETLANDS
PERMANENT DRAINAGE EASEMENT
DIRECTION OF FLOW

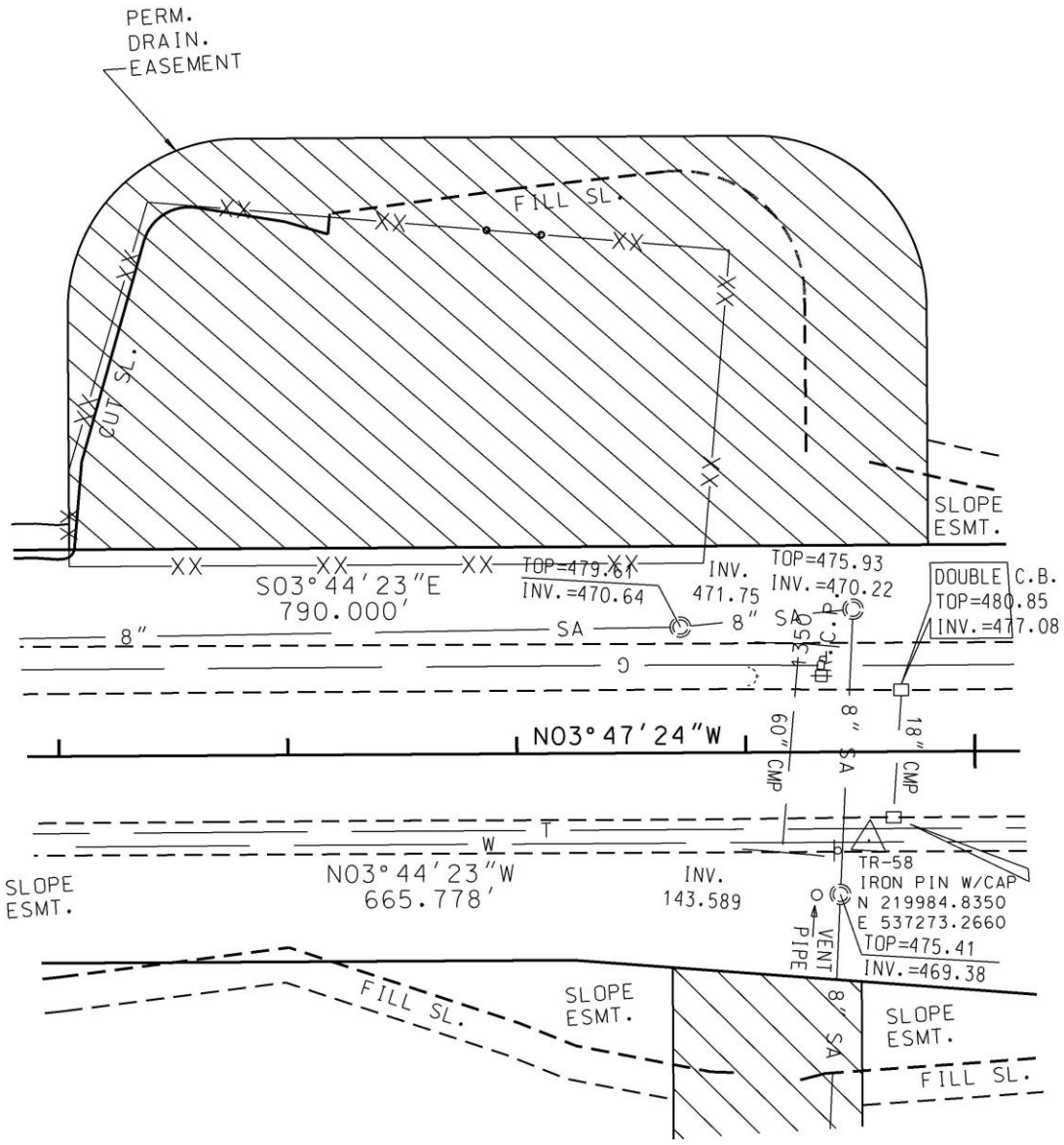


Figure 3A-11
Portion of Present Layout Sheet (Detention System)

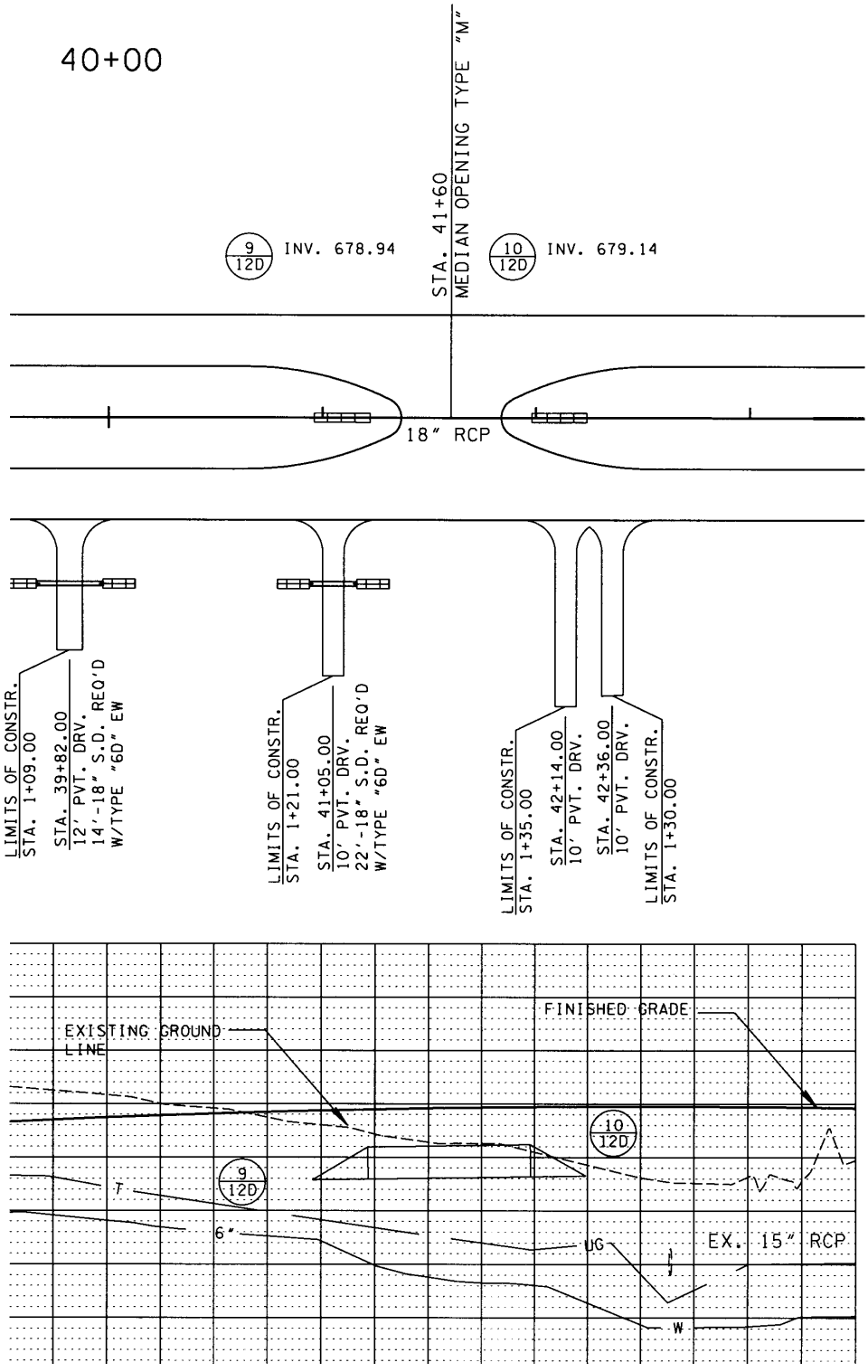


Figure 3A-12
Portion of Proposed Layout Sheet (Median Culvert)

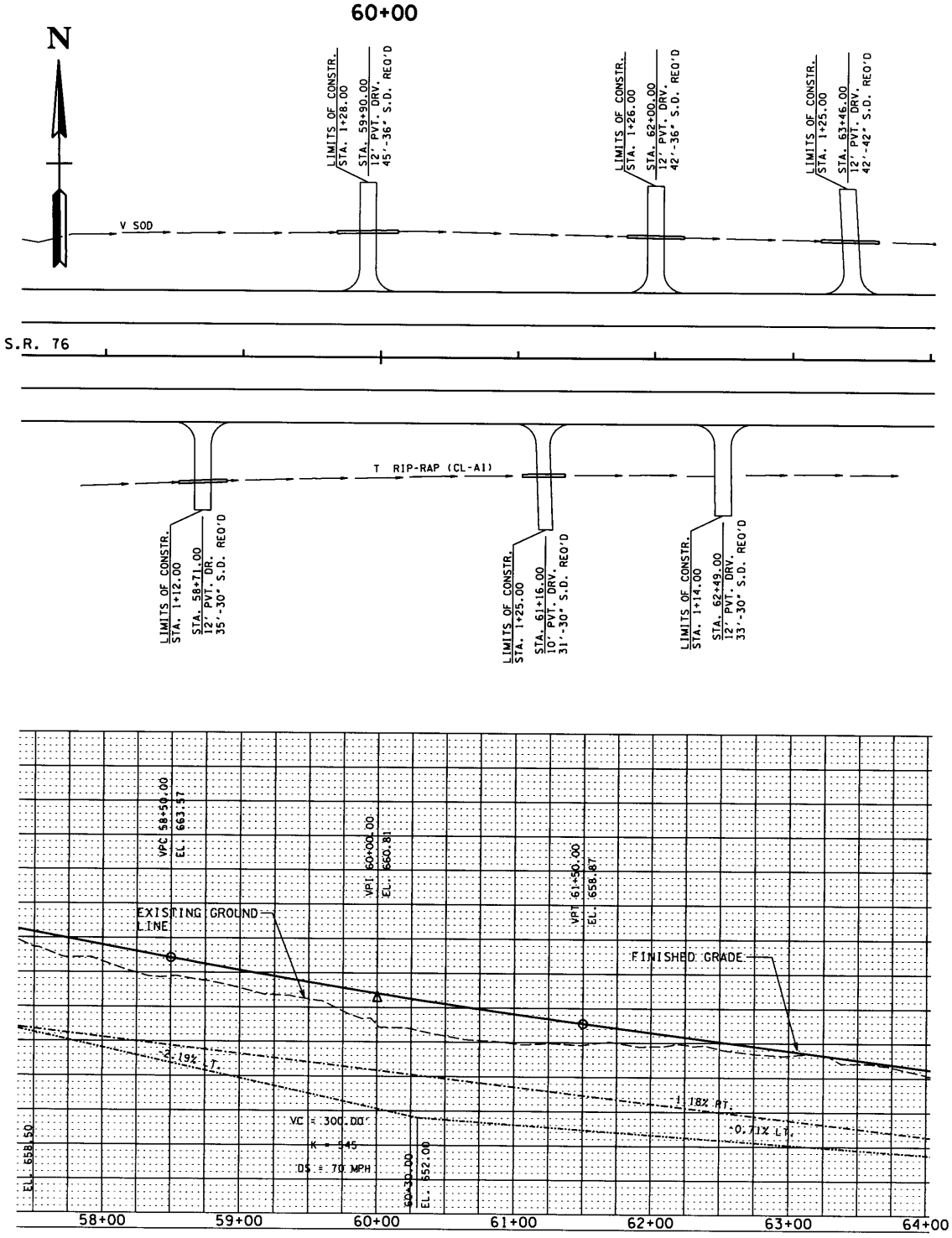


Figure 3A-13
Portion of Proposed Layout Sheet (Special Ditch)

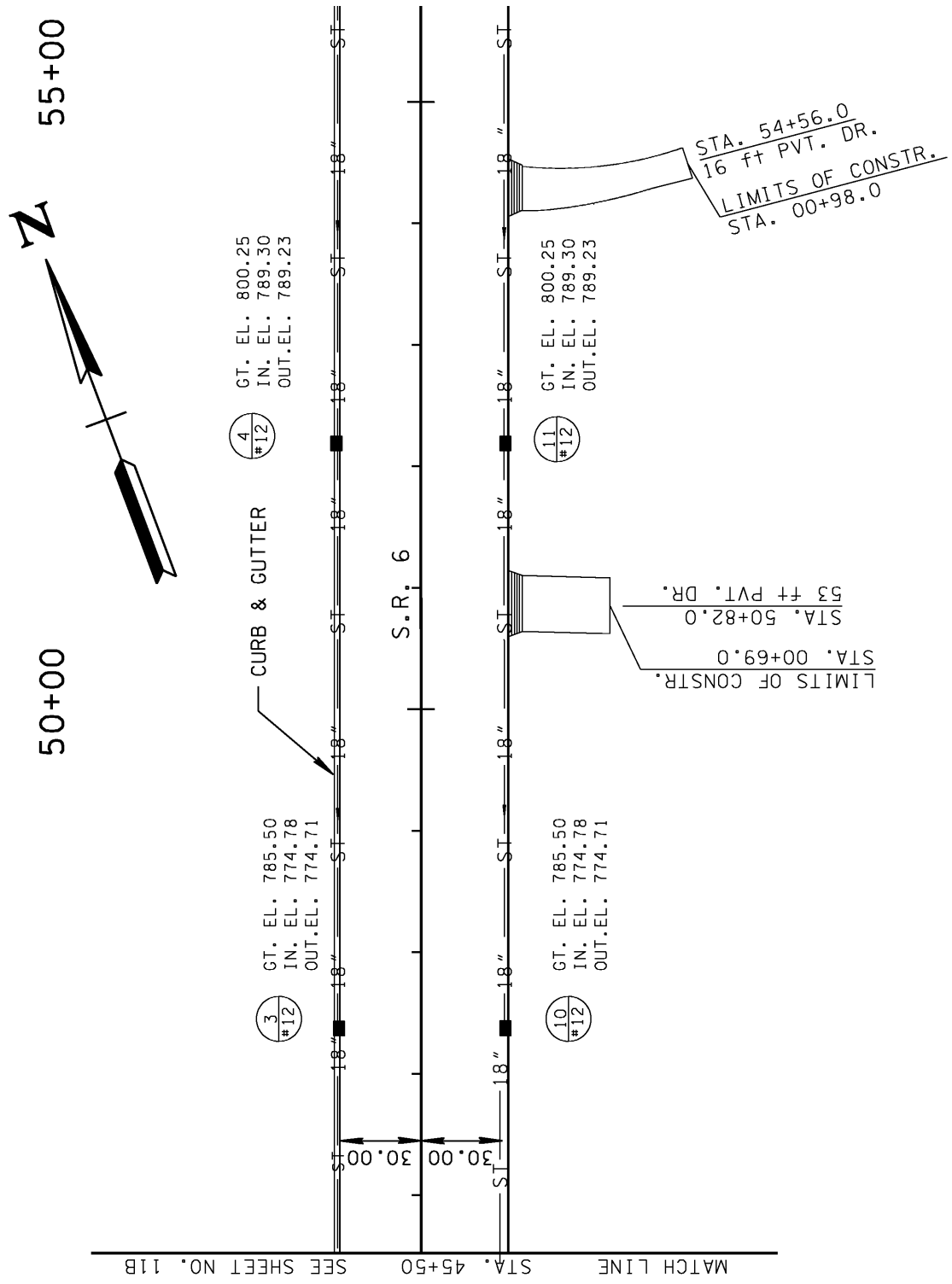


Figure 3A-14
Portion of Proposed Layout Sheet (Storm Sewer Plan)

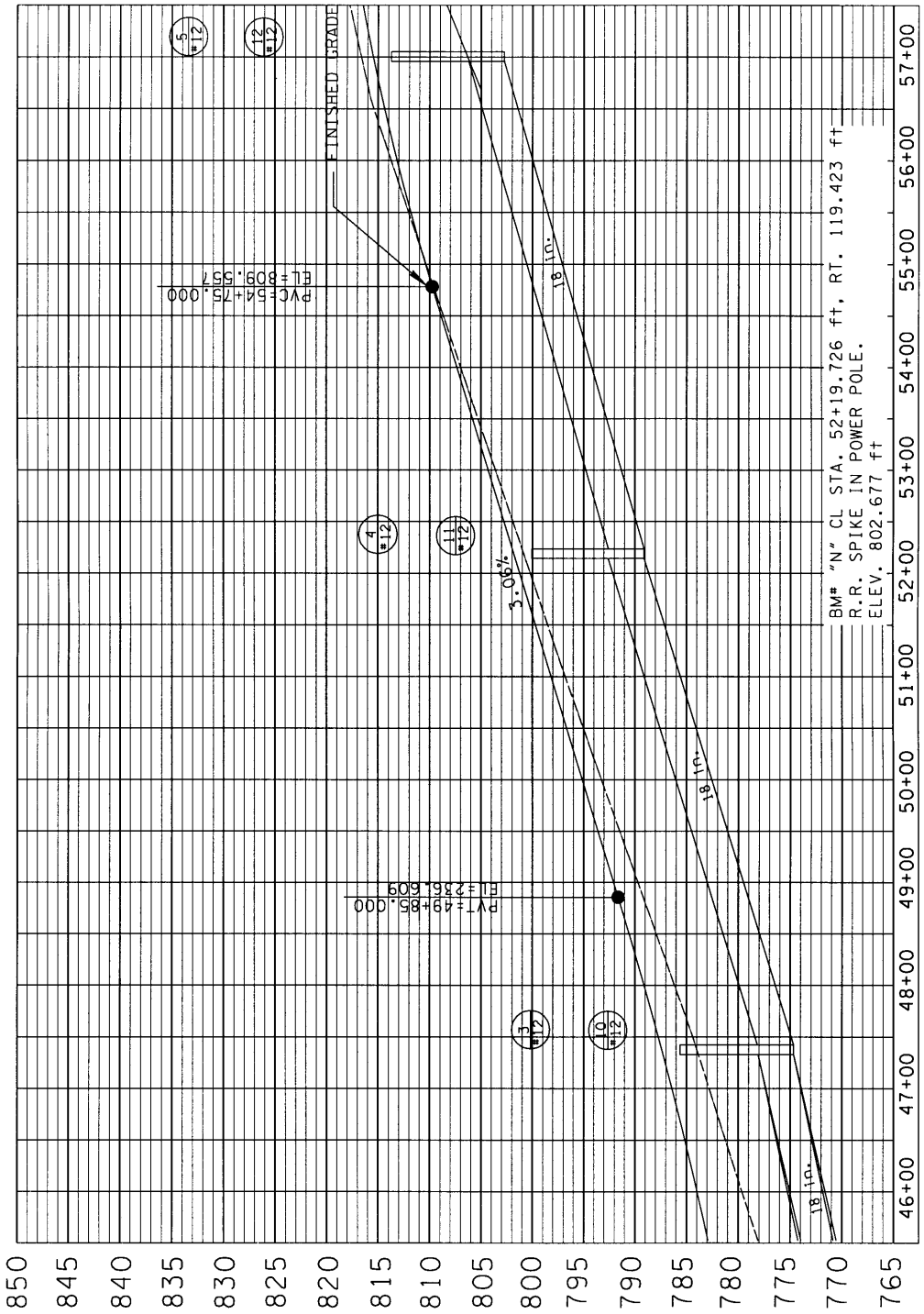


Figure 3A-15
Portion of Proposed Layout Sheet (Storm Sewer Profile)

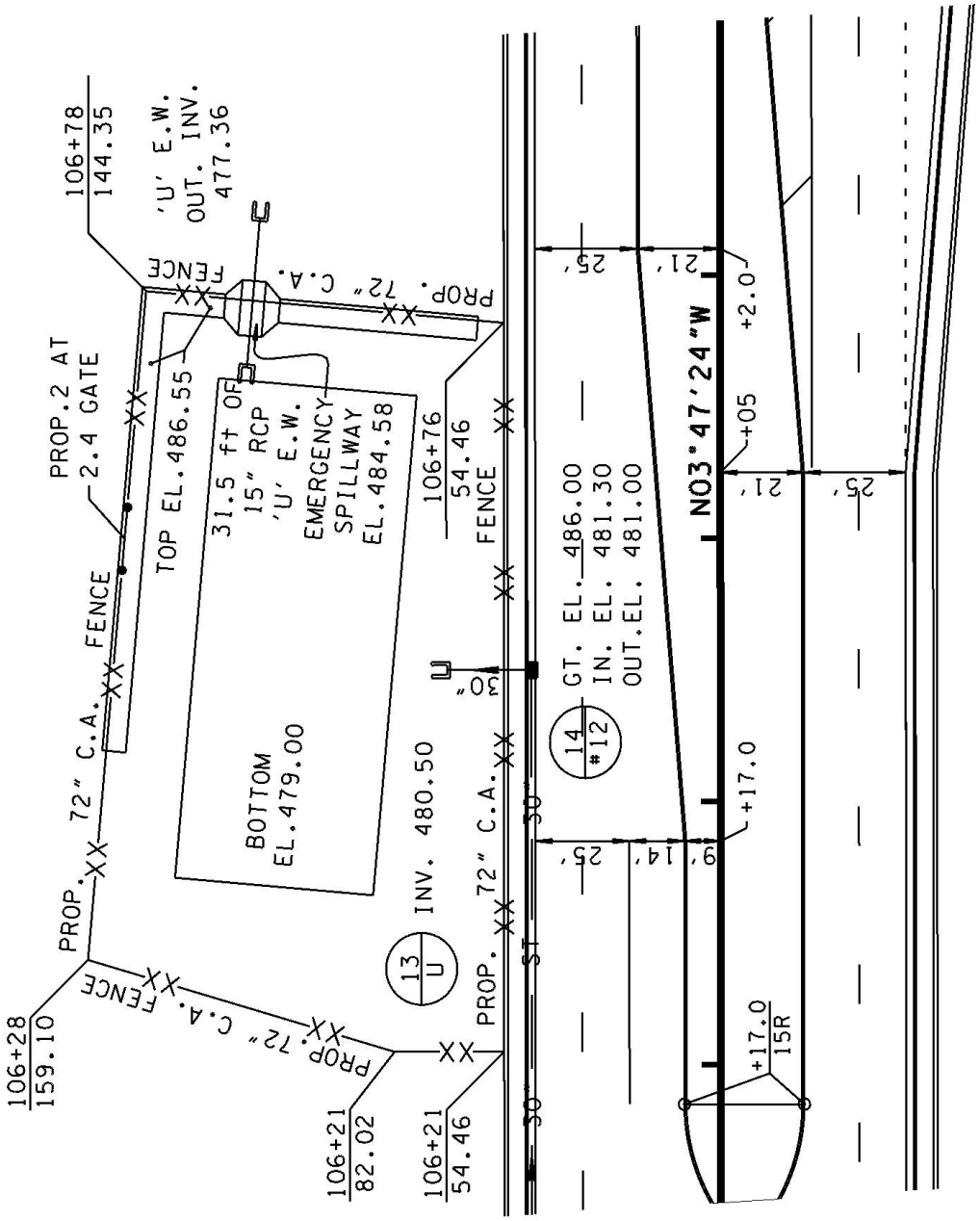


Figure 3A-16
Portion of Proposed Layout Sheet (Detention System)

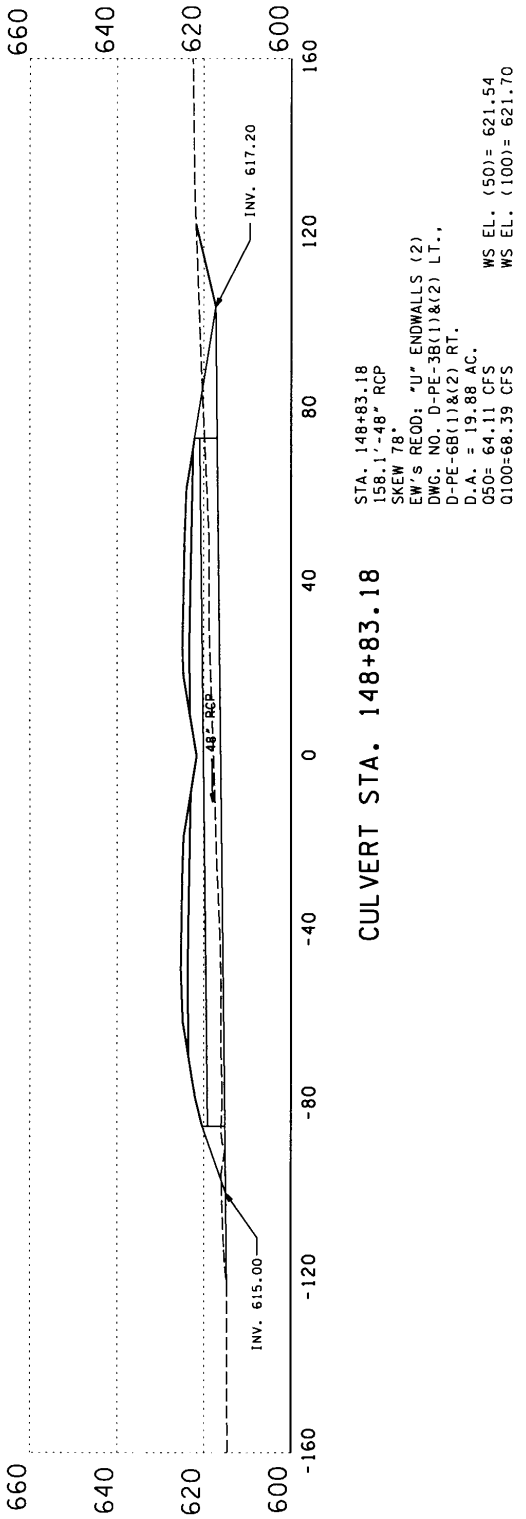


Figure 3A-17
Portion of Culvert Sections Sheet (Pipe Culvert)

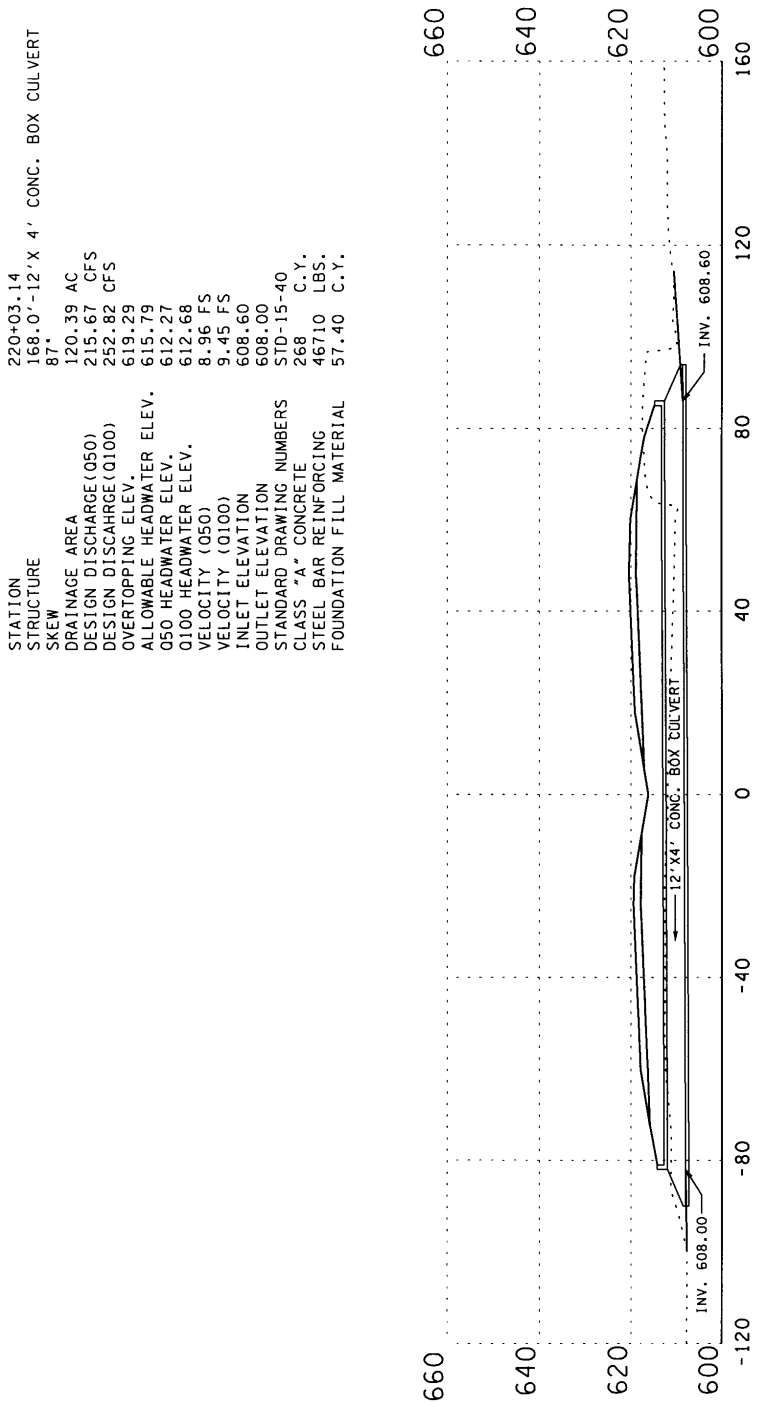


Figure 3A-18
Portion of Culvert Sections Sheet (Box Culvert)

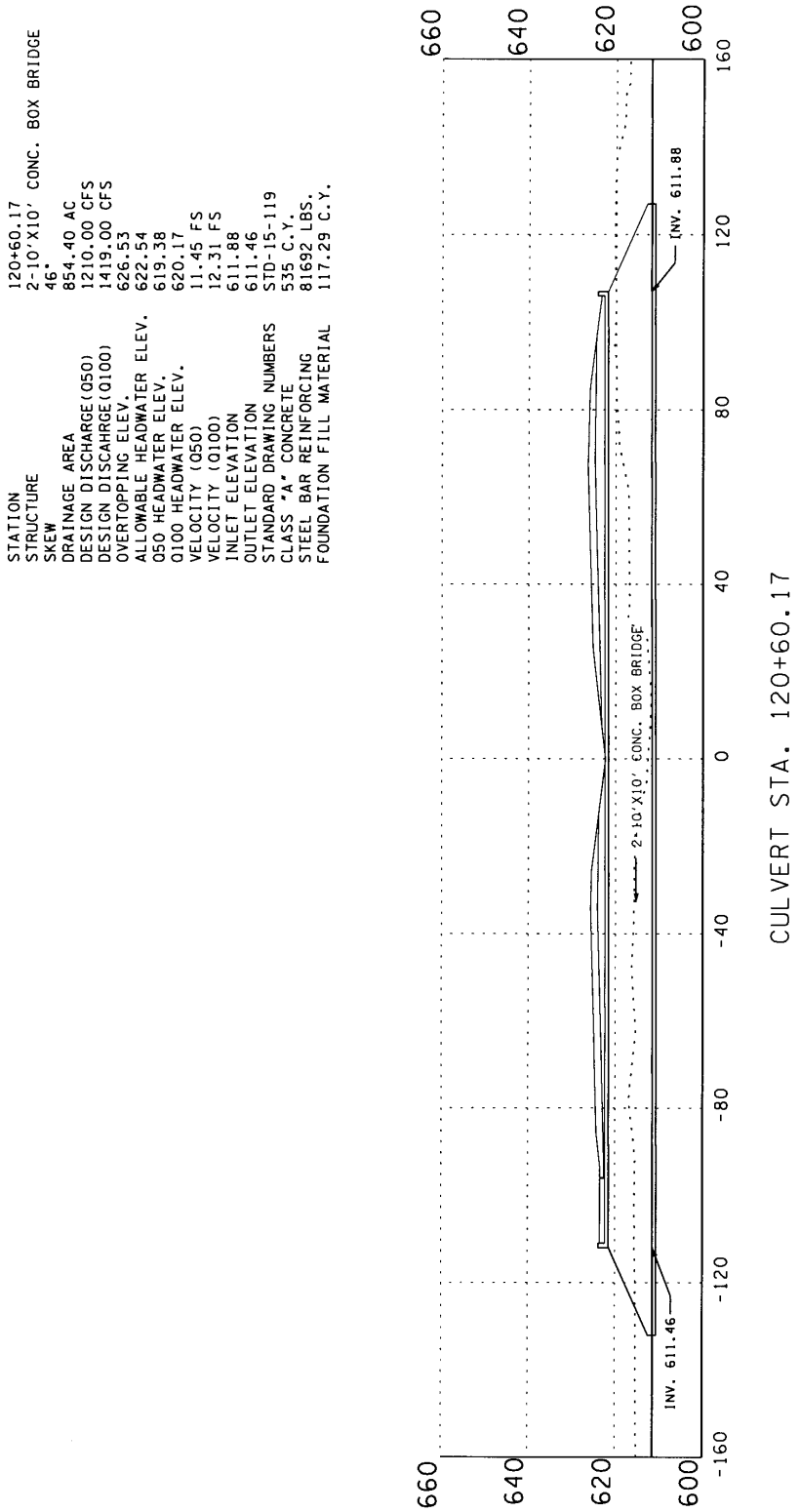


Figure 3A-19
Portion of Culvert Sections Sheet (Box Bridge)

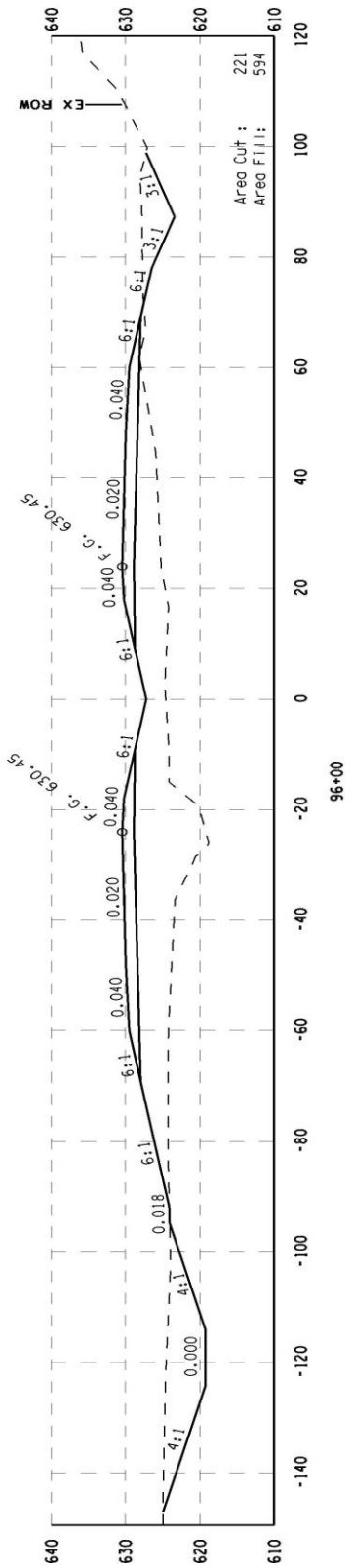


Figure 3A-20
Portion of Cross Section Sheet (With Template Ditch and Special Ditch)

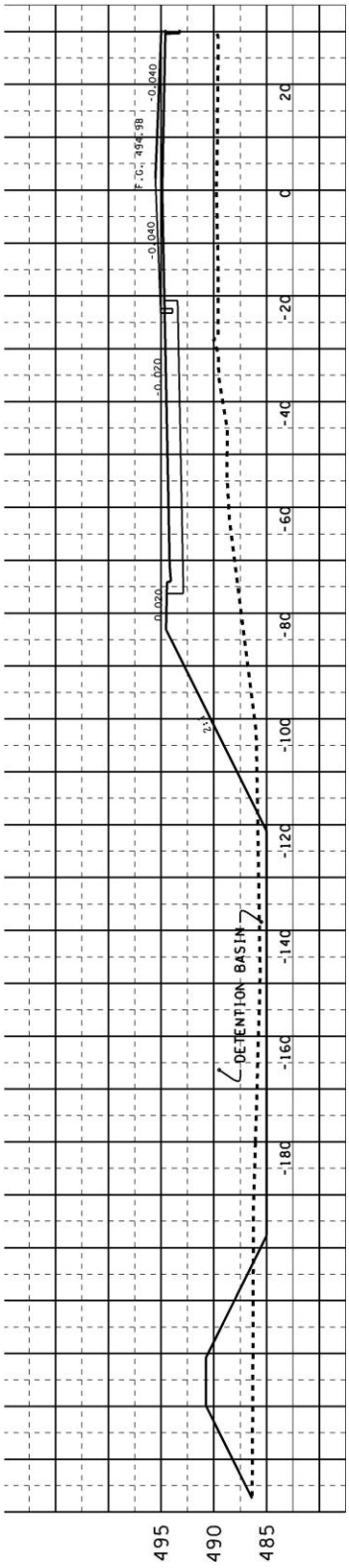


Figure 3A-21
Portion of Cross Section Sheet (Detention Basin)

SPECIAL DITCHES

ROAD	STATION FROM	STATION TO	SLOPE FORE (h/v)	SLOPE BOT WIDTH (ft)	SLOPE BACK (h/v)	DETAIL NUMBER	TYPE
SR 76	220+00	226+00	3:1	0	3:1	1	SOD
SR 76	226+00	229+75	3:1	0	3:1	1	RIP-RAP (A-1)
SR 76	229+75	230+25	3:1	0	3:1	1	RIP-RAP (A-1)
SR 76	230+25	235+75	3:1	2	3:1	3	RIP-RAP (A-1)
SR 76	235+75	236+75	3:1	0	3:1	1	RIP-RAP (A-1)
SR 76	242+30	243+25	6:1	0	4:1	2	SOD
SR 76	243+25	244+75	6:1	0	4:1	2	SOD
SR 76	244+50	250+00	4:1	0	4:1	1	RIP-RAP (A-1)
SR 76	244+75	245+75	6:1	0	4:1	2	SOD
SR 76	250+00	251+50	4:1	0	4:1	1	RIP-RAP (A-1)
SR 76	257+00	262+25	3:1	2	3:1	3	SOD
SR 76	262+25	265+00	3:1	0	3:1	1	SOD
SR 76 EX. E. CONN.	1+80	7+67	3:1	0	3:1	1	SOD
SR 76 EX. E. CONN.	1+90	3+65	3:1	0	3:1	2	SOD
GIBBS ROAD	1+40	2+20	3:1	0	4:1	1	SOD
GIBBS ROAD	1+40	2+70	3:1	0	4:1	2	SOD
LIVERPOOL ROAD	1+90	2+20	3:1	0	3:1	1	RIP-RAP (A-1)
LIVERPOOL ROAD	2+70	3+80	3:1	0	3:1	1	SOD
LIVERPOOL ROAD	3+80	5+15	3:1	0	3:1	2	SOD
LIVERPOOL ROAD	3+80	5+15	3:1	0	3:1	1	SOD

Figure 3A-22
Portion of Tabulated Ditches and Ditch Section Sheet

3.07.2 REFERENCES

American Association of State Highway and Transportation Officials. *Model Drainage Manual [Metric Edition]*. Washington, D.C. 1999.

Indiana Department of Transportation. *Indiana Design Manual Part IV Volume 1*. Indianapolis, IN, 1999.

Kentucky Transportation Cabinet, *Drainage Guidance Manual* - Proposed Revisions. Frankfort, KY. September 29, 2000.

Tennessee Department of Transportation. *Design Guidelines - English*, Nashville, TN, May, 2012.

3.07.3 ABBREVIATIONS

Following are the abbreviations used in the descriptions of Federal policies:

AC. – Acres
C.Y. – Cubic Yards
CFS – Cubic Feet Per Second
CMP – Corrugated Metal Pipe
D.A. – Drainage Area
DS – Design Speed
EL – Elevation
ESMT – Easement
EW – Endwall
FEMA – Federal Emergency Management Agency
FPS – Feet Per Second
GT. – Gutter
h/v – Horizontal to Vertical
INV – Invert
PVT. DRV. – Private Drive
R.O.W – Right-of-Way
RCP – Reinforced Concrete Pipe
S.D. – Storm Drain
SHLD. – Shoulder
SL. – Slope
STAB – Stabilized
TDOT – Tennessee Department of Transportation
VC – Vertical Curve
VPC- Vertical Point of Curvature
VPI – Vertical Point of Intersection
WS – Water Surface