VIRGINIA DEPARTMENT OF TRANSPORTATION

LOCATION AND DESIGN DIVISION

INSTRUCTIONAL AND INFORMATIONAL MEMORANDUM

GENERAL SUBJECT: DRAINAGE INSTRUCTIONS	NUMBER: IIM-LD-223
SPECIFIC SUBJECT: CULVERTS, STORM SEWERS AND MISC. DRAINAGE ITEMS (Supplement to VDOT's Drainage Manual)	DATE: APRIL 5, 2001
	SUPERSEDES: LD-97 (D) 121.13
DIVISION ADMINISTRATOR APPROVAL: *C. F. Boles, III* Acting Location and Design Engineer	

EFFECTIVE DATE

- This memo is effective upon receipt for all projects entering the drainage design phase of plan development. For projects that are past the Field Inspection stage, revisions in the drainage design should not be made if only for the purpose of complying with this memo, but revisions should be made if significant plan revisions are needed for other reasons. The intent is to not delay plan development or project construction for the sole purpose of complying with this memo.

INSTRUCTIONS

- Additional general drainage design instructions may be found in the VDOT Road Design Manual, Section 2D-5.

Type of Structure Selection – Culverts

- Because of the numerous types of drainage structures that are available, a general rule would dictate that various types such as box culverts, pipe culverts, standard bridges, etc., be taken into consideration when determining the proposed structure.

- This design evaluation should consider cost comparisons, construction time, earth movement, maintenance and service life expectancy.

- All metal culverts:

  - are comparatively flexible

  - rely on uniform soil pressure around the entire circumference of the structure to maintain proper and equal load distributions

  - are more sensitive to improper bedding and backfill than rigid structures

- Structural plate pipe arch culverts:

  - concentrate considerable pressure in the haunch area.

  - require near perfect backfill and compaction in haunch area during construction.

  - should be avoided wherever alternate structural shapes are feasible, such as:

  - aluminum or steel box culverts

  - bottomless arch culverts on footings

  - circular culverts buried below streambed

End Treatment

- End Treatments will be provided, regardless of the highway classification, on:

  - all culverts conveying a live stream

  - all culverts with a diameter of 48” (1200 mm) or greater

  - all culverts with arch or elliptical configuration and 48” (1200 mm) or greater equivalent diameter or accumulated end areas, in the case of multiple lines.

- Types of End Treatments:

  - Standard endwall

- Modified endwall or special design end wall

- Special Design Concrete Slab End Treatment, Special Design Drawing No. isd-2045 and msd-2045

- Other types of end treatment that provide sufficient width and depth to protect the culvert bedding material from seepage.

Pipe in High Fills

- Concrete pipe with a height of cover exceeding 30' (9.1 m) requires Special Design Pipe, certified in accordance with Section 105 of VDOT's Road and Bridge Specifications and Method A Bedding is to be used. Applicable pipes are to be noted on the plans as follows:

  "Pipe design to be in accordance with Section 105 of VDOT's Road and Bridge Specifications".

- The drainage description for these pipes should specify "Special Design Concrete Pipe, Method A Bedding".

Culverts In Dam Of Stormwater Management Basins

- For details and instructions regarding culverts through the dams of Stormwater Management basins please see the latest version of IIM LD- (D) 195.

Skewed Box Culvert Details

- Where box culverts are to be constructed on a skew, the Drainage Designer is to request, from the Structure and Bridge Division, the required details for modification of the standard drawings. This information is to be requested on Form LD-423. Box Culvert skews should be shown to the nearest 5° increment.

Existing Box Culvert Extensions

- When the extension of an existing box culvert is required, the Drainage Designer shall specify Standard BCE-01 as a part of the box culvert description on the plans.

Box Culverts in Shallow Fills

- Box culverts with heights < 4' (1.2 m) should not be proposed or approved for construction due to concerns with inspection and maintenance. If a box culvert with a height < 4' (1.2 m) is needed, the District Drainage Engineer should be consulted to determine if the structure can be approved for use.

Pile Foundation Design for Box Culverts

- Special Design Pile Foundations for Box Culverts are to be requested by the Road Designer (when recommended by the Materials Division,) from the Structure and Bridge Division on Form LD-422.

Jacking Pipe

- There are certain cases where it is not feasible to install pipe through the existing embankment by the usual open trench method. The alternative is to jack the pipe through the embankment. The designer is to specify the pipe as jacked pipe. The contractor then has the option of tunneling or boring the pipe in accordance with Section 302.03 of VDOT's Road and Bridge Specifications. Foundation information should be requested for any size pipe that is to be jacked or bored in order to determine the feasibility of installation.

- Concrete pipe is normally employed in a jacking operation. In some cases, it is preferred to jack a Smooth Wall Steel Pipe (See Sec. 232 of VDOT'S Road and Bridge Specifications) through the embankment as the encasement structure.

- A concrete (or occasionally metal) pipe is then threaded inside of the steel pipe to act as the carrier of the drainage. The void between the two pipes is to be pressure grouted using non-shrink grout. The details and pay items for this procedure should be specified as part of a special design item.

- On some specific occasions, it has been deemed appropriate to install only the Smooth Wall Steel Pipe and to let it serve as the carrier pipe. THIS IS NOT TO BE CONSIDERED AS A UNIVERSALLY ACCEPTABLE PRACTICE.

- The installation of Smooth Wall Steel Pipe as the carrier pipe must conform to Notes 1,2 and 4 for Table A of "Allowable Types of Pipe" (Sheet 2 of IIM LD- (D) 121). Smooth wall pipe can be asphalt coated. Any deviation from this policy must be approved by the State Location and Design Engineer.

Fish Passage

- There is a need to design highway culverts that convey live streams to accommodate the passage of fish. The design criteria are described on pages 61 through 66 of "An Analysis of the Impediments to Spawning Migrations of Anadromous Fish in Virginia Culverts". A copy of these documents has been furnished to the District and Central Office Drainage Designers.

- Summary of Design Criteria:

  - Criteria apply to normal water (ordinary high water) conditions.

  - Set invert elevations of the low flow culvert 6" (150 mm) minimum below the streambed.

  - Maintain a depth, width and velocity of flow in the culvert that matches the depth, width and velocity of flow in the natural channel adjacent to the culvert.

Concrete Pipe on Radius

- Concrete Pipe may be laid on a radius when necessary to conform to design features, alignment, or topography and to eliminate or minimize the need for manholes or other structures.

- Installation of concrete pipe on a radius may be done by one of the following methods:

  - Open-Joint Method - relatively long radius - using standard pipe and opening the joints a maximum of 25% of the spigot length.

  - Bevel Method - mid range radius - using modified pipe with one side shorter than the other.

  - Bevel and open joint method - for shortest radius - a combination of the two methods above.

  - Bevel pipe is expensive to manufacture and somewhat difficult to install. It is generally more economical to use bend joints in cases where three or more joints of bevel pipe would be required.

- The minimum radius obtainable is dependent upon two factors that differ between manufacturers:

  - Spigot or tongue length

  - Pipe joint length

  The following table is a guideline for the minimum radius that should be obtainable using pipe from any manufacturer. A longer radius may be used as needed with the plan description denoting the method of obtaining the required radius. Standard pipe from certain manufacturers can utilize a radius shorter than that in the table, the drainage designer is directed to contact the Central Office Hydraulics Section for further information.

GUIDELINES FOR MINIMUM RADII – CONCRETE PIPE							
Pipe Diameter		MINIMUM RADIUS BASED ON 2.438 M (8') PIPE JOINT LENGTH					
		Open Joint 25% Spigot Length		Full Bevel		Full Bevel Plus Open Joint 25%	
mm	inches	meters	feet	meters	feet	meters	feet
300	12	73	240	29	95	21	70
375	15	85	280	38	125	28	90
450	18	90	295	38	125	28	90
525	21	104	340	38	125	28	90
600	24	107	350	37	120	28	90
675	27	119	390	37	120	28	90
750	30	120	395	37	120	28	90
825	33	122	400	37	120	28	90
900	36	123	405	37	120	28	90
1050	42	125	410	37	120	28	90
1200	48	162	530	37	120	29	95
1350	54	154	505	37	120	31	100
1500	60	152	500	37	120	31	100
1650	66	157	515	37	120	31	100
1800	72	171	560	37	120	31	100
1950	78	174	570	37	120	31	100
2100	84	198	650	37	120	31	100
2250	90	200	655	37	120	31	100
2400	96	223	730	37	120	31	100
2700	108	187	615	37	120	31	100

DRAINAGE ON STEEP SLOPES

- In situations where it is necessary to convey stormwater down a fill slope, pipe is to be used in all possible situations.

- If concrete pipe is to be used, the grade of the pipe should not be steeper than 16%. If the concerns with the steep grade cannot be adequately addressed by deeper structures and/or stepping of the pipe system, concrete pipe can be used on grades steeper than 16% by use of anchor blocks. When anchor blocks are required, they should be installed at every other pipe joint as a minimum.

- See Special Design Drawing No. A-73 and MA-73 for Anchor Details for Concrete Pipe.

- Corrugated pipe on steep slopes may be used in situations similar to those where shoulder slot inlets are used. Corrugated pipe should not be used in areas where the flow is expected to carry an abrasive bed load or that have PH and resistivity factors beyond the ranges specified in the "Allowable Types of Pipe" IIM LD- (D) 121.

- See VDOT's 2001 Road and Bridge Standard PI-1, Sheet 104.37 for Anchor Details for Corrugated Pipe.

- Step Down Manholes – In situations where the pipe grade needs to be more than 16%, structures at the upper end of the pipe system should be made deeper to help reduce the gradient. Additional "step down" manholes may also be added to the system to reduce the gradient. Where "step down" manholes are used, the designer should provide any needed protection to prevent erosion in the bottom of the manhole. The protection can be provided by a 1/2" (12 mm) steel plate in the bottom of the manhole or by providing a 3' (.9 m) deep pit in the base of the manhole and filling the pit with Class I Dry Rip Rap. This protection may be needed if:

    1. The flow drops more than about 4' (1.2 m)

    OR

    2. The flow is expected to carry any abrasive material.

    OR

    3. Continuous live flow or live flow lasting several days may be expected.

    OR

    4. The size of the pipes carrying the flow requires a manhole base unit greater than 48" (1200 mm).

- Velocity dissipation is usually needed at the outlet of pipes on steep grades and the Drainage Designer should provide the type of dissipation appropriate for velocity, pipe size, discharge and site constraints.

DEEP MANHOLES AND DROP INLETS – SAFETY SLABS

- Deep drainage structures will probably need Safety Slabs (Standard SL-1) in order to reduce the hazard potential for persons falling into a deep structure. The Safety Slabs should not be located below the inflow pipe if the flow dropping within the structure could become blocked by the Safety Slab. If Safety slabs cannot be used, a special locking cover may be needed to reduce the hazard of the deep structure. See VDOT's Road and Bridge Standard SL-1.

PIPE PLUGGING

- The Drainage Designer will determine if existing culverts, storm sewers and box culverts will be utilized, removed, or abandoned (due to high fills, utility conflicts, under traffic, etc.) Any drainage facility that is abandoned and left in place shall be backfilled and plugged in accordance with VDOT's Road and Bridge Standard PP-1. These structures are to be labeled on the plans "To be abandoned". The following pay item includes furnishing and placing backfill material and plugging both ends of the drainage facility.

  PAY ITEM:

ITEM	UNIT	ITEM CODE
Flowable Backfill	C.Y. (m^3)	00529

  SUMMARIZATION:

  The quantity for Flowable Backfill (includes flowable backfill or fine aggregate) is to be estimated in accordance with Standard PP-1. This estimated quantity is to be summarized in the Drainage Summary. The pipe location/structure number should be shown in the Drainage Summary and the pipe size should be noted in the remarks column.

  EXAMPLE:

D R A I N A G E S U M M A R Y	
FLOWABLE BACKFILL	REMARKS
C.Y.	
25	48" concrete pipe to be abandoned

GENERAL NOTE:

Drainage Note D-13 (See IIM LD-110) is to be included on the General Note Sheet in all applicable project assemblies:

D-13 All existing drainage facilities labeled “to be abandoned” shall be left in place, backfilled and plugged in accordance with Road and Bridge Standard PP-1. Payment will be in C.Y. (m^3) of Flowable Backfill.

PIPES UNDER RAILROADS

- When a VDOT project needs to construct a culvert or storm sewer under a railroad, the drainage designer should contact the Department of Rail and Public Transportation to determine the specific pipe criteria required by the railroad. It is noted that the Norfolk Southern Railroad does not normally allow concrete pipe. Some of the basic criteria for culverts under railroads are shown below.

Concrete Pipe

- Concrete pipes under railroads shall be Class V pipe and shall have a minimum cover of 5.5’ (1.68 m) as measured from the top of the pipe to the bottom of the rail. For fill heights above 14’ (4.27 m) and for elliptical pipe not available in Class V pipe, the structural design calculations for the pipe must be approved by the railroad. If the minimum cover of 5.5’ (1.68 m) cannot be obtained, an exception may be granted by the railroad as negotiated by the Department of Rail and Public Transportation.

Corrugated Metal Pipe

- Corrugated metal pipe culverts under railroads shall be permitted in the geographic areas of the State where normally permitted under major highways in accordance with IIM LD-121. Minimum cover shall be 5.5’ (1.68 m). For maximum cover and gage of metal, see Standard PC-1.

Appurtenant Features

- For the placement of pipe endwalls, manholes and other structures adjacent to railroads see IIM LD-176.

PROTECTIVE COATING FOR CULVERTS, STORM SEWERS AND CONCRETE STRUCTURES EXPOSED TO TIDAL WATER OR CORROSIVE ENVIRONMENT

- Treatment of concrete exposed to tidal water is defined in Section 404 of the VDOT Road and Bridge Specifications.

- Corrosive environment may be indicated in certain geographic areas by the degradation of concrete culverts, concrete lined ditches or other concrete structures. Proposed concrete items in these areas should have protective coating or alternative materials should be considered.

- The drainage designer is responsible for preliminary determination for need and location of protective coating and is to specify on the Field Inspection Plans with the drainage structure description where protective coating is needed.

- The final determination for need and location of protective coating should be made by the Materials Division. The request for the final determination should be made either by the use of Form LD-252 or direct contact between the drainage designer and the Materials Division.

- The drainage designer is responsible for including the following notation in the final drainage structure description on the plans and in the summary:

  Pipe or structure is to have protective coating applied in accordance with Section 404 of the VDOT Road and Bridge Specifications.

REQUESTING FOUNDATION DATA/MATERIALS DIVISION RECOMMENDATIONS

- The Drainage Designer will determine locations where foundation investigation is required.

- Data for foundation, pH and the Resistively and recommendations for bedding, pipe camber and protective coating will be requested by the roadway designer, from the Materials Division, on Form LD-252. This request will be made immediately after locations have been determined by the drainage designer or as soon after Field Inspection as possible.

FOUNDATION INVESTIGATION

- Foundation data will be requested for all culvert installations with spans of 36" (900 mm) or greater. Foundation data may be requested for culverts with less than 36" (900 mm) span if deemed necessary. Foundation data should be requested on all pipes of any size that are to be bored or jacked.

- Foundation data (a soil boring) for the base of the dam should be requested for all SWM basins in order to determine if the native material will support the dam and not allow ponded water to seep under the dam. An additional boring near the center of the basin should also be requested if:

  1) Excavation from the basin may be used to construct the dam,
     OR
  2) Rock may be encountered in the area of excavation,
     OR
  3) A High water table is suspected which may alter the performance of the SWM basin.

- For large basins, more than 1 boring for the dam and 1 boring for the area of the basin may be needed. The number and locations of the borings are to be requested by the Drainage Designer.

- The existing foundation soils data is not to be shown on the plans, however, the recommended foundation material is to be shown.

- Locations that require a pH and Resistively Analysis as well as an evaluation of the abrasive bedload potential should be noted on the plans that are used to request culvert foundation information from the Materials Division. The pH and Resistively Analysis of the soil are to be requested for each culvert location allowing a metal culvert where any of the following conditions exist:

  1) 36" (or equivalent) or larger culvert
     OR
  2) Live stream
     OR
  3) Areas of known premature pipe failure

- In areas of known premature pipe failure, the pH and Resistively Analysis is to be requested for any type of proposed pipe material.

PIPE BEDDING AND BACKFILL

- For instructions on Pipe Bedding and Backfill, see IIM LD- (D) 225.

PIPE CAMBER

- Construction of longitudinal camber in a pipeline shall be considered when all of the following conditions are present:

  - Grade of the pipe is less than 0.5%
  - Fills greater than 20’ (6 m)
  - Diameter 36” (900 mm) or greater
  - Foundation is subject to settlement

- The drainage designer will request that the Materials Division determine the amount of anticipated settlement along the pipeline. The request will accompany the request for culvert foundation data. The plan description will then show a camber equal to the amount of anticipated settlement.

GENERAL NOTES

- C.M. Pipe

  The Drainage Designer should refer to IIM LD- (D) 110 for the general notes pertaining to drainage and shall select the appropriate drainage notes to be used on each project.

SUMMARIES

Standard and Streamlined

- The following methods of listing pipe in Drainage Summary and Streamlined Summary are to be used to eliminate a possible contractor’s error when obtaining the pipe.

- When a specific type of pipe is required, such as concrete for the extension of an existing pipe or corrugated for a bridge or shoulder slot inlet; etc., the type of pipe required is to be specified in the streamlined or detailed summary even though the type may be shown in the plan drainage description.

- Following are the methods of listing the pipe in the Drainage Summary and Streamlined Summary:

Standard Summary:

IMPERIAL

DRAINAGE SUMMARY					
	PIPE	CORRUGATED PIPE	CONCRETE PIPE	CONCRETE PIPE	REMARKS
	15”	15”	15”	24”	
	L.F.	L.F.	L.F.	L.F.	
	20				
				20	EXTEND EXIST. PIPE
			20		EXTEND EXIST. PIPE
		20			EXTEND EXIST. PIPE
		20			FOR BRIDGE SHOULDER SLOT INLET
TOTALS	20	40	20	20	

METRIC

DRAINAGE SUMMARY					
	PIPE	CORRUGATED PIPE	CONCRETE PIPE	CONCRETE PIPE	REMARKS
	375mm	375mm	375mm	600mm	
	METERS	METERS	METERS	METERS	
	6.5				
				6.5	EXTEND EXIST. PIPE
			6.0		EXTEND EXIST. PIPE
		6.0			EXTEND EXIST. PIPE
		6.5			FOR BRIDGE SHOULDER SLOT INLET
TOTALS	6.5	12.5	6.0	6.5	

- Streamlined Summaries are generally limited to Minimum Plan, No Plan, Safety, and Plant Mix Projects.

- Example:

(Imperial)

*800 L.F. 15” Pipe
*200 L.F. 15” Pipe (Corrugated)
*200 L.F. 15” Pipe (Conc.)
100 L.F. 24” Pipe (Conc.)
200 L.F. 72” Pipe (Special Design Conc.)

(Metric)

*244 m 375 mm Pipe
* 61 m 375 mm Pipe (Corrugated)
* 61 m 375 mm Pipe (Conc.)
30.5 m 600 mm Pipe (Conc.)
61 m 1800 mm Pipe (Special Design Conc.)

*Combine totals on Estimates

The type of pipe is to be specified on the estimate only when:

1 - It is the only type of pipe required for that particular size.

2 - It is the only type of pipe required for the project (e.g., concrete pipe on an Urban project).

PLAN DESCRIPTIONS

- Please note that METRIC descriptions for hydraulic items shall be shown on the plans in accordance with the following:

- Pipe Culverts

1 - Length of culverts shall be shown to the nearest 0.5 m.

2 - Invert elevations shall be shown to the nearest 0.1 m. In some cases elevations may need to be shown to the nearest 0.01 m.

- Storm Sewer

1 - Length of culverts shall be shown to the nearest 0.5 m.

2 - Invert elevations shall be shown to the nearest 0.01 m.

3 - Heights of manholes and inlets shall be shown to the nearest 0.05 m.

- Channels & Ditches

  1 - Show width and depth to the nearest 0.1m.

- Pipe Cover

  1 - Pipe Cover shall be shown to the nearest 0.1m.

Culvert Installations

- Each description should list the categories of information, as may be appropriate in the following order:

  1 - All data pertaining to the pipe or culvert barrel

  2 - The end treatment

  3 - The recommended foundation data and minor structure excavation quantities

- See IIM LD-71 for more information on Minor Structures.

Structure Number ____
Length and Size (Concrete Pipe Req'd. or just Pipe Req'd. if allowable pipe types are set up or Box Culvert Req'd.)
Cover ____, ____, Skew
Inv. El. ____ (in.), ____ (out)
*Type of End Treatment
*Erosion Control Treatment
____Tons Bedding Material Aggregate No. 25 or 26
*___Tons Bedding Material Aggregate No. 57
____C.Y. Class I Backfill
____C.Y. Class II Backfill
*Excavate ____ and backfill with (recommended ** material)
____ C.Y. (m^3) Minor Structure Excavation

* Denotes item that may not be needed on each culvert

**See subsurface investigation report.

- The “Design Height of Cover” must be shown at each pipe installation description on the plans (including entrance pipes) and on the Drainage Summary. This allows the contractor to determine the proper strength, sheet thickness, or class of pipe, from Road and Bridge Standard PC-1, applicable to a particular location.

- In cases of structures with spans of 36” (900 mm) and greater it will be necessary to show any recommended foundation material on the construction plans and summary sheets. There may be exceptions to this procedure in special cases. The designer will show the recommended foundation material for any structure when that information is available.

- The strength, thickness, gage, class of pipe or method of bedding will not be noted on the plans except in those cases where, for specific reasons, Road and Bridge Standards PC-1 and PB-1 Tables will not govern.

Structure Numbers

- A numbering system is to be used to number all proposed drainage items on the plans.

  (Exception – Projects with minimal drainage items that will use a streamline summary.) The number will be assigned by the Drainage Designer. These numbers are not to be changed without the knowledge of the Drainage Designer. The first number will designate the sheet number of the plan sheet that contains the item and the second number will designate the assigned item number. (e.g., 4-20 is Sheet 4, item number 20; 11B-2 is sheet 11B, item number 2.)

- The junction points (inlets, manholes, etc.) on a storm drain project shall be individually numbered and the pipe connecting two such points shall be individually numbered in order to facilitate the plan summaries.

Example:

(Imperial)

3-3 1 St’d. DI-3B Req’d.
L=8’ H=5.1’ Inv. 197.6’

3-5 14.6 L.F. St’d. MH-1 Req’d.
1 St’d. MH-1 Frame and Cover Req’d.
Inv. 197.0’

3-4 196’-24” Conc. Pipe Req’d. (11’ Cover)
Inv. In 197.6’ Inv. Out 197.0’

(Metric)

3-3 1 St'd. DI-3B Req'd.
L=2.4 m H=1.55 m Inv. 60.23

3-5 4.45 m St'd. MH-1 Req'd
1 St'd. MH-1 Frame and Cover Req'd.
Inv. 60.05 m

3-4 5.9m – 600 mm Conc. Req'd. (3.4 m Cover)
Inv. (In) 60.23m Inv. (Out) 60.05 m

- When Drainage Summary sheets are compiled, the drainage items are to be referenced only by the assigned numbers with no further reference to sheet number, station, or location needed.

Storm Drains

- On projects which involve some storm drains and some cross drains (especially in areas which allow optional pipe material) it will be necessary for the pipe description to specify concrete pipe if the pipe is or could become a component part of a storm drain system under a roadway classification that requires concrete pipe only.

(Imperial)

(Storm Drain Concrete Only) 80'-36" Conc. Pipe Req'd.

(Metric)

(Storm Drain Concrete Only) 24.5 m – 900 mm Conc. Pipe Req'd.

Concrete Pipe on Radius

- Concrete pipe for installation on a radius <u>using the open joint method</u> is standard pipe and is <u>not</u> to be summarized as "concrete radius pipe."

- Where open joint pipe is used, the plan description would be:

(Imperial)

200’ – 48” Concrete Pipe Required (530’ Radius with open joint – using 8’ pipe joint lengths). Joints are to be opened a maximum of 25% of the spigot or tongue length

(Metric)

61.0 m – 1200 mm Concrete Pipe Required (162 m Radius with open joint – using 2.438 m pipe joint lengths). Joints are to be opened a maximum of 25% of the spigot or tongue length

- Where it is proposed to use bevel pipe, the amount of radius pipe must be specified in the plans, summaries, and estimates.

- The plan description for bevel pipe would be:

(Imperial)

100’ – 48” Concrete Radius Pipe Required (120’ Radius – using 8’ pipe joint lengths with full bevel)

(Metric)

30.5m – 1200 mm Concrete Radius Pipe Required (37 m Radius – using 2.438 m pipe joint lengths with full bevel)

- The plan description for bevel pipe with open joints would be as follows:

(Imperial)

100’ – 48” Concrete Radius Pipe Required (95’ radius with open joints – using 8’ pipe joint lengths with full bevel). Joints are to be opened a maximum of 25% of the spigot or tongue length.

(Metric)

30.5 m – 1200 mm Concrete Radius Pipe Required (29 m radius with open joints – using 2.438 m pipe joint lengths with full bevel). Joints are to be opened a maximum of 25% of the spigot or tongue length.

STRUCTURES

Multigrate Drop Inlets

- As a general rule the Standard DI-12 Multigrate Drop Inlet is to be used in lieu of the Standard DI-5 drop inlet and is only to be located in areas not normally subject to traffic. The drop inlet has been developed to provide one (1) standard grate configuration to handle the various traversable and non-traversable ditch slopes. The reduced width makes it more adaptable to narrow medians where difficulty retaining a traversable slope has been experienced with the DI-7's width. The DI-7 is still to be used in situations where a traversable slope can be maintained.

- To provide the most economical design, all locations should first be checked to see if the smaller chamber DI-12B or DI-12C drop inlet could be used.

- The restrictions that will not allow the use of Standard DI-12B or DI-12C drop inlets are:

  - Size of pipe(s).
  - Size of chamber that pipe(s) will be located.

Height of Drop Inlet

- The Standard DI-12 and DI-12A drop inlets are to be specified at locations that, for reasons stated above, the DI-12B and DI-12C drop inlets cannot be used.

- Toe of fill and top of cut ditches with 2:1 slopes may use the St'd. DI-12 series drop inlet as well as the St'd. DI-5 and St'd. DI-7.

- DI-5 drop inlets shall specify the type of cover (St'd. PG-2A Type) which most closely matches the ditch configuration at the inlet location. This data shall be shown both in the structure description on the plans and in the drainage summary.

Concrete Gutters

- Where DI-7 or 12 series inlets are utilized to intercept concentrated flow (e.g. roadside, median, berm or toe ditches) the type of inlet that requires the concrete gutter should be specified (e.g. DI-7A, DI-7B, DI-12A or DI-12C).

Grates

- When grate drop inlets, such as DI-5's, DI-7's and DI-12's are required, it is necessary to specify on the plans and in the drainage summary the type of grate that is required. A general guideline for selecting Grate Type is:

DI-5	DI-7 Grate A	DI-12	
	Type I	Type I	Type I Limited Access and Rural Unlimited Access- Pedestrian Access Unlikely
Type III	Type III	Type II	Urban Areas-Pedestrian Accessible Areas

- Grate is to be placed so that bars are parallel to flow line of ditch or swale.

- When it is necessary to locate a DI-7 in an area subject to traffic (e.g. shoulders, parking areas, etc.) the load carrying Grate B shall be specified.

- When traversable pipe endwalls with load carrying grates (St'd. EW-11 and EW-11A) are required, see DRAINAGE DESIGN, Section 2D-5, of VDOT's Road Design Manual for design consideration.

Structure Heights

- All drop inlets (both curb and median), catch basins, junction boxes and other structures that require a frame and cover or grate at finished ground elevation, shall show the height dimension (H) on the plans and on the Drainage Summary. This dimension is to be measured from the invert elevation to the top of structure and is to be shown in the drainage description. The height is to be shown in linear feet (meters) to the nearest 0.1' (.05 m). Manholes will continue to be shown as the number of feet (meters) required, as measured from the invert to the top of the concrete or masonry structure, not including the frame and cover.

Manholes

- Where cast in place or precast manholes are to be allowed at the contractor's option, the plans are to show height in feet (meters) to the nearest 0.1' (.05 m) of St'd. MH-1 or St'd. MH-2 Req'd. At locations where the option will not be allowed due to existing pipe lines, utilities, size of pipe etc., only the appropriate type will be designated. Designers are cautioned to determine that the limitations on placement and areas of holes for pipe in the precast units are not exceeded before allowing the optional construction.

Manhole Safety Slabs

- Safety Slabs will be used when recommended by the Drainage Designer.

- Standard SL-1, manhole safety slabs, should be required as part of the drainage design for manholes, junction boxes and drop inlets with heights greater than 10' (3 m). The spacing of the slabs should be 8' to 12' (2.4 m – 3.6 m). The slabs should be located so as to not interfere with the flow into or through the structure. On tall structures, where pipes inflow at various locations vertically, the slabs should not be placed below a 30" (750 mm) or larger pipe opening.

- The cost of the SL-1 is included in the structure. The drainage descriptions should specify how many safety slabs are needed for each structure and the quantity should be noted in the remarks column on the Drainage Summary.

Paved Flumes

- It is recommended that flumes not be used on fill slopes due to the substantial number of failures and continual maintenance problems associated with PG-4 flumes on fill slopes. The use of paved flumes at bridge drainage aprons was discontinued several years ago due to such problems. The drainage aprons were replaced by slot inlets and the PG-4 was replaced by corrugated pipe with anchors. (See IIM LD-150 Shoulder Slot Inlets)

- In lieu of paved fumes, the appropriate type of drop inlet and pipe are recommended. For design concerns of pipe on steep slopes see section under "Steep Slopes" in this memorandum.

- Similar problems and concerns have been noted with paved flumes in cut sections. The alternatives for paved flumes in cut sections are usually very limited unless the cut is of a shallow depth.

- When design situations involve the apparent need for paved flumes, the Drainage Designer should explore all feasible alternatives to develop a design that will address both "construct ability" and future maintenance concerns.

Payment

- Ditch Flume connector (St'd. PG-7) shall be measured and paid for in units of each, complete in place. A Special Provision Copied Note is available from the Construction Division. The following pay item has been established:

Pay Item	Pay Unit	Item Code
Ditch Flume Connector St'd. PG-7	EA.	09248

INSERTABLE SHEETS RELEVANT TO THIS MEMORANDUM

Current insertable sheets are available on Falcon DMS, under the PPMS# eng-ser, Division of minsert for insertion into applicable plan assemblies.

- Typical Method of Installation of Concrete Pipe On Fill Slopes, Drawing No. A-73 and MA-73.

- Special Design Concrete Slab End Treatment, Drawing No. isd-2045 and msd-2045.