

DESIGN GUIDE MD #1

Roof Gutter Design Method

**CONSTRUCTION DETAILS
AND SPECIFICATIONS**



Maryland

Revised – October 2004

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SECTION I

GENERAL

This design guide is a technical resource prepared by the Maryland NRCS Engineering staff and is intended for use by the NRCS in Maryland and its partners. Construction drawings for some of the gutter options are included, as well as other appropriate construction details and specifications.

To aid in the design process, some drawings and specifications are available online at the Maryland NRCS website at www.md.nrcs.usda.gov. No changes are allowed on these details without prior approval from the NRCS engineering staff.

There are many different manufactures of roof gutter and related materials. The flows and capacities of the roof gutter and downspouts shown in this design guide are based on actual measurements taken from some of the materials available. For practical purposes the roof gutter depths and areas used are assumed to hold true for all available gutter of a given style, top width and material even though differences do occur. It is the judgement of the engineering staff that these differences are minor and are neglected in the development of this design guide. The capacities of downspout outlets are based on using the manufacturers preformed (insert) outlets.

Not all sizes of downspouts will fit on a given size of roof gutter. Typically, a 5-inch top width K-style gutter can receive a 2" x 3" downspout. A 3" x 4" downspout can also fit. Some trimming of the flange on the preformed outlet may be required. A 6-inch top width K-style gutter can receive a 3' x 4" downspout. A 4" x 5" downspout can also fit, but again some trimming of the flange of the preformed downspout outlet may be required. The above sizing is reflected in the development of Figure 4 (Downspout Outlet Sizing, Leader Pipe Sizing). The use of 4" x 5" downspout outlets starts at a depth of gutter of 4.5 inches. This corresponds to a minimum top width of 6 inches. The availability of 7-inch top width K-style gutter has been poor in the past. However, in recent years some seamless forms of 7-inch gutter as well as other sizes have become available. Sizes larger than 7 inches have also been developed. Check for local availability before specifying sizes 7 inches or larger.

In section II, Construction Check Data are contractor certification statements. Contractor certification is highly encouraged. Many roof runoff systems are constructed on buildings requiring a ladder or hydraulic lift in order to properly inspect the work being completed. In addition, the type of hangers used and materials available is constantly changing. In lieu of climbing ladders and using the hydraulic lifts to inspect the installed work, the contractor certifications are recommended.

The use of snow guards is not mentioned and their use is neither encouraged nor discouraged. Some of the buildings in which roof gutters are being installed are over a century old. Even though the condition of these buildings may be good, we feel it inappropriate to add any loading to the roofs. The decision for the use of snow guards is that of the landowners.

Rafters and fascia boards must be in good conditions in order to properly hang and support the roof gutter. It is common for rafter ends to be damaged and fascia boards to be missing or damaged. Rafter ends must be repaired and fascia boards replaced as needed. When roofs are in poor conditions repairs should be made by the landowner before any recommendations to install roof gutter are made. There may be situations when a roof is in a poor or unsafe condition and alternatives other than roof runoff structure will be required. See Figure 7 for a flow chart in determining fascia board replacement.

In section IV of the design guide is a sample design, which includes design calculations and plan sketch.

SECTION II

DESIGN DATA

Record on appropriate engineering paper. The following is a list of the minimum required design data:

1. Determine roofs, which need roof runoff structure and where the systems may safely outlet.
2. Determine peak runoff from each roof for the design storm selected.
3. Select type of gutter to be used.
4. Size gutter based on type, peak flow and slope. (See Figures 1,2 and 3).
5. Determine the downspout outlets required for each roof to be guttered, and choose a downspout system. (See Figure 4).
6. Drawings shall include the following as a minimum: Plan view; gutter location, gage, type, size, direction, slope, fascia board and rafter end replacement or repair, and mounting instructions, underground outlet type, size, direction and installation instructions, and construction specifications.

CONSTRUCTION CHECK DATA

Record on appropriate engineering paper. The following is a list of the minimum required construction check data:

1. Documentation of site visits on CPA-6. The documentation shall include the date, who performed the inspection, specifics as to what was inspected, all alternatives discussed, and decisions made and by whom.
2. Contractor certification – certifying the roof gutter and downspout type, sizes, gage, roof gutter slope and mounting method.

If rafter ends or fascia boards are repaired or replaced, the certification shall also include the rafter end and fascia board material size, type and mounting method.

I certify that the roof gutter and downspout type, size, gage, roof gutter slope and mounting method are as shown on the plans and specifications.

(contractor) (date)

I certify that the roof gutter and downspout type, size, gage, roof gutter slope and mounting method are as shown on the plans and specifications. Rafter ends and/or fascia boards have been repaired or replaced as follows:

(Contractor) (Date)

3. Verify the roof gutter, size and gage, downspout opening size, downspout size, length and location.
4. When applicable, verify the underground outlet size, type, location, outlet type, rodent guard type, vertical distance between invert of outlet pipe and normal water in outlet stream or ditch and vertical distance between invert of outlet pipe and top of bank.
5. Sign and date final notes and plans and include statement that practice meets or exceeds plans and NRCS practice standard.

ROOF GUTTER DESIGN INSTRUCTIONS

1. Choose the 10-year frequency 5 minute rainfall (see Chart 1). Record this on line 1 of worksheet 1. For animal waste management use the 25-year frequency 5-minute rainfall.
2. Label roof or roof segments and calculate roof area. Record this on line 2.
3. Multiply roof area (sq.ft.) by rainfall intensity (ft./sec.) to obtain peak flow (cfs). Place on line 2 of worksheet.
4. Choose a roof gutter type, size and slope from Figures 1, 2 or 3 to carry the desired peak flow for each roof segment. If a reasonable size and slope do not exist, break the roof into smaller segments and repeat. Record this on line 3 of worksheet.

Make sure the type selected is readily available locally.

During the design procedure, when possible, attempt to keep the roof gutter size and slope uniform. This will help to minimize confusion during installation.

Keep in mind that the slope and length of the gutter, width of fascia board and roofing slope and overhang are critical to make sure that snow will not hang up on gutter and that roof runoff will not overshoot the gutter. Steep roof gutter slopes should be reserved for short runs only.

5. Sizing the gutter outlet is a two-stage operation. The first step consists of choosing the downspout outlets required for the given peak flow. The second step consists of choosing a leader pipe for the peak flow or combination of peak flows.

Keep in mind the following when sizing downspout outlets for different sizes of roof gutter. Typically, a 5-inch top width K-style gutter can receive a 2" x 3" downspout. A 3" x 4" downspout can also fit. Some trimming of the flange on the preformed outlet may be required. A 6-inch top width K-style gutter can receive a 3' x 4" downspout. A 4" x 5" downspout can also fit, but again some trimming of the flange of the preformed downspout outlet may be required.

- a. From Figure 4, using the depth of gutter for the roof gutter size chosen read vertically up to the desired peak flow. Choose any downspout/combination above this level.
 - b. Because of increased head, a combination of downspouts and roof segments may be added together into one pipe. If the combined peak flow is less than 1.0 cfs, use 4" schedule 40 pipe. If the combined peak flow is between 1.0 and 2.5 cfs use 6" schedule 40 pipe. If the combined peak flow is between 2.5 and 4.8 cfs use 8" schedule 40 pipe. Note: Sizing is based on a leader pipe height of 10 feet and a minimum slope of 25 percent.
6. If the roof runoff system outlets into an underground system, use the underground outlet, design sheet and Figures 5 and 6 to design a gravity flow outlet system. Record this on worksheet 2. Figures 5 and 6 may also be used to size horizontally suspended leader pipes. These are often used on larger roof runoff systems.

Work Sheet 1 – Roof Gutter Design

COOPERATOR _____ DATE _____

ADDRESS _____ BY _____

- 1) Ten-year or twenty-five-year frequency five minute rainfall, from Chart 1.
 (Rainfall intensity _____ ft./sec.)

Note: For systems protecting a waste storage structures, use the 25-year frequency.

2)	Roof Area	X	Rainfall Intensity	=	Peak Flow
Roof # _____	_____ sq.ft.	X	_____ ft./sec.	=	_____ cfs
Roof # _____	_____ sq.ft.	X	_____ ft./sec.	=	_____ cfs
Roof # _____	_____ sq.ft.	X	_____ ft./sec.	=	_____ cfs
Roof # _____	_____ sq.ft.	X	_____ ft./sec.	=	_____ cfs
Roof # _____	_____ sq.ft.	X	_____ ft./sec.	=	_____ cfs
Roof # _____	_____ sq.ft.	X	_____ ft./sec.	=	_____ cfs
Roof # _____	_____ sq.ft.	X	_____ ft./sec.	=	_____ cfs
Roof # _____	_____ sq.ft.	X	_____ ft./sec.	=	_____ cfs

3) Roof Gutter Size (From Figures 1, 2 or 3)

(Circle One)

Roof # _____	Use _____"	Top (Aluminum/galvanized)	@ _____"	Pitch in 100 ft.
Roof # _____	Use _____"	Top (Aluminum/galvanized)	@ _____"	Pitch in 100 ft.
Roof # _____	Use _____"	Top (Aluminum/galvanized)	@ _____"	Pitch in 100 ft.
Roof # _____	Use _____"	Top (Aluminum/galvanized)	@ _____"	Pitch in 100 ft.
Roof # _____	Use _____"	Top (Aluminum/galvanized)	@ _____"	Pitch in 100 ft.
Roof # _____	Use _____"	Top (Aluminum/galvanized)	@ _____"	Pitch in 100 ft.
Roof # _____	Use _____"	Top (Aluminum/galvanized)	@ _____"	Pitch in 100 ft.
Roof # _____	Use _____"	Top (Aluminum/galvanized)	@ _____"	Pitch in 100 ft.

4) Downspout Opening (orifice) Sizing. (See Figure 4).

(combination)

Roof # _____	Use _____ - _____"	X _____"	Downspout w/ _____"	Leader _____
Roof # _____	Use _____ - _____"	X _____"	Downspout w/ _____"	Leader _____
Roof # _____	Use _____ - _____"	X _____"	Downspout w/ _____"	Leader _____
Roof # _____	Use _____ - _____"	X _____"	Downspout w/ _____"	Leader _____
Roof # _____	Use _____ - _____"	X _____"	Downspout w/ _____"	Leader _____
Roof # _____	Use _____ - _____"	X _____"	Downspout w/ _____"	Leader _____
Roof # _____	Use _____ - _____"	X _____"	Downspout w/ _____"	Leader _____

5 Minute Rainfall Intensities for Ten and Twenty Year Frequency Storms

Chart 1

<u>County</u>	<u>10 Year Ft./Sec.</u>	<u>25 Year Ft./Sec.</u>
Allegany	0.00015	0.00017
Anne Arundel	0.00015	0.00019
Baltimore	0.00015	0.00018
Calvert	0.00015	0.00019
Caroline	0.00016	0.00019
Carroll	0.00015	0.00018
Cecil	0.00015	0.00018
Charles	0.00015	0.00019
Dorchester	0.00016	0.00019
Frederick	0.00015	0.00018
Garrett	0.00015	0.00017
Harford	0.00015	0.00018
Howard	0.00015	0.00018
Kent	0.00015	0.00019
Montgomery	0.00015	0.00018
Prince George's	0.00015	0.00019
Queen Anne's	0.00015	0.00019
Somerset	0.00016	0.00020
St. Mary's	0.00015	0.00019
Talbot	0.00016	0.00019
Washington	0.00015	0.00018
Wicomico	0.00016	0.00020
Worcester	0.00016	0.00020

Figure 1 - PEAK FLOW ESTIMATES FOR GALVANIZED K-STYLE ROOF GUTTER

5" TOP WIDTH K STYLE GUTTER

AREA = 0.1192 sq.ft. WP = 1.042 ft N = 0.012

PITCH IN 100 FT.	1/2"	1"	1 1/2"	2"	2 1/2"	3"	3 1/2"	4"
SLOPE FT/FT	0.00042	0.00083	0.00125	0.00167	0.00208	0.00250	0.00292	0.00333
Q CFS	0.071	0.100	0.123	0.142	0.159	0.174	0.188	0.201

PITCH IN 100 FT.	5"	6"	7"	8"	9"	10"	11"	12"
SLOPE FT/FT	0.00417	0.00500	0.00583	0.00667	0.00750	0.00833	0.00917	0.01000
Q CFS	0.225	0.246	0.266	0.285	0.302	0.318	0.334	0.349

6" TOP WIDTH K STYLE GUTTER

AREA = 0.1671 sq.ft. WP = 1.204 ft N = 0.012

PITCH IN 100 FT.	1/2"	1"	1 1/2"	2"	2 1/2"	3"	3 1/2"	4"
SLOPE FT/FT	0.00042	0.00083	0.00125	0.00167	0.00208	0.00250	0.00292	0.00333
Q CFS	0.114	0.160	0.197	0.227	0.253	0.278	0.300	0.321

PITCH IN 100 FT.	5"	6"	7"	8"	9"	10"	11"	12"
SLOPE FT/FT	0.00417	0.00500	0.00583	0.00667	0.00750	0.00833	0.00917	0.01000
Q CFS	0.359	0.393	0.424	0.454	0.481	0.507	0.532	0.556

7" TOP WIDTH K STYLE GUTTER

AREA = 0.2482 sq.ft. WP = 1.5 ft N = 0.012

PITCH IN 100 FT.	1/2"	1"	1 1/2"	2"	2 1/2"	3"	3 1/2"	4"
SLOPE FT/FT	0.00042	0.00083	0.00125	0.00167	0.00208	0.00250	0.00292	0.00333
Q CFS	0.190	0.267	0.328	0.379	0.423	0.464	0.502	0.536

PITCH IN 100 FT.	5"	6"	7"	8"	9"	10"	11"	12"
SLOPE FT/FT	0.00417	0.00500	0.00583	0.00667	0.00750	0.00833	0.00917	0.01000
Q CFS	0.599	0.656	0.709	0.758	0.804	0.847	0.889	0.928

NOTE: AREA AND WP ARE BASED ON ARMCO GALVANIZED K STYLE GUTTER

Figure 2 - PEAK FLOW ESTIMATES FOR ALUMINUM K-STYLE ROOF GUTTER

5" TOP WIDTH K STYLE GUTTER

AREA = 0.1042 sq.ft. WP = 0.9333 ft N = 0.012

PITCH IN 100 FT.	1/2"	1"	1 1/2"	2"	2 1/2"	3"	3 1/2"	4"
SLOPE FT/FT	0.00042	0.00083	0.00125	0.00167	0.00208	0.00250	0.00292	0.00333
Q CFS	0.061	0.086	0.106	0.123	0.137	0.150	0.162	0.173

PITCH IN 100 FT.	5"	6"	7"	8"	9"	10"	11"	12"
SLOPE FT/FT	0.00417	0.00500	0.00583	0.00667	0.00750	0.00833	0.00917	0.01000
Q CFS	0.194	0.212	0.229	0.245	0.260	0.274	0.287	0.300

6" TOP WIDTH K STYLE GUTTER

AREA = 0.154 sq.ft. WP = 1.1167 ft N = 0.012

PITCH IN 100 FT.	1/2"	1"	1 1/2"	2"	2 1/2"	3"	3 1/2"	4"
SLOPE FT/FT	0.00042	0.00083	0.00125	0.00167	0.00208	0.00250	0.00292	0.00333
Q CFS	0.105	0.147	0.180	0.208	0.233	0.255	0.276	0.294

PITCH IN 100 FT.	5"	6"	7"	8"	9"	10"	11"	12"
SLOPE FT/FT	0.00417	0.00500	0.00583	0.00667	0.00750	0.00833	0.00917	0.01000
Q CFS	0.329	0.361	0.389	0.417	0.442	0.466	0.488	0.510

7" TOP WIDTH K STYLE GUTTER

AREA = 0.2278 sq.ft. WP = 1.3333 ft N = 0.012

PITCH IN 100 FT.	1/2"	1"	1 1/2"	2"	2 1/2"	3"	3 1/2"	4"
SLOPE FT/FT	0.00042	0.00083	0.00125	0.00167	0.00208	0.00250	0.00292	0.00333
Q CFS	0.178	0.251	0.308	0.356	0.397	0.435	0.470	0.502

PITCH IN 100 FT.	5"	6"	7"	8"	9"	10"	11"	12"
SLOPE FT/FT	0.00417	0.00500	0.00583	0.00667	0.00750	0.00833	0.00917	0.01000
Q CFS	0.562	0.615	0.665	0.711	0.754	0.794	0.833	0.870

NOTE: AREA AND WP ARE BASED ON ALCOA AND ARMCO ALUMINUM K STYLE GUTTER

Figure 3 - PEAK FLOW ESTIMATES FOR SCHEDULE 40 1/2 ROUND ROOF GUTTER

4" TOP WIDTH 1/2 ROUND GUTTER

AREA = 0.044 sq.ft. WP = 0.524 ft N = 0.011

PITCH IN 100 FT.	1/2"	1"	1 1/2"	2"	2 1/2"	3"	3 1/2"	4"
SLOPE FT/FT	0.00042	0.00083	0.00125	0.00167	0.00208	0.00250	0.00292	0.00333
Q CFS	0.023	0.033	0.040	0.047	0.052	0.057	0.062	0.066

PITCH IN 100 FT.	5"	6"	7"	8"	9"	10"	11"	12"
SLOPE FT/FT	0.00417	0.00500	0.00583	0.00667	0.00750	0.00833	0.00917	0.01000
Q CFS	0.074	0.081	0.087	0.093	0.099	0.104	0.109	0.114

6" TOP WIDTH 1/2 ROUND GUTTER

AREA = 0.098 sq.ft. WP = 0.785 ft N = 0.011

PITCH IN 100 FT.	1/2"	1"	1 1/2"	2"	2 1/2"	3"	3 1/2"	4"
SLOPE FT/FT	0.00042	0.00083	0.00125	0.00167	0.00208	0.00250	0.00292	0.00333
Q CFS	0.068	0.095	0.117	0.135	0.151	0.166	0.179	0.191

PITCH IN 100 FT.	5"	6"	7"	8"	9"	10"	11"	12"
SLOPE FT/FT	0.00417	0.00500	0.00583	0.00667	0.00750	0.00833	0.00917	0.01000
Q CFS	0.214	0.234	0.253	0.271	0.287	0.302	0.317	0.331

8" TOP WIDTH 1/2 ROUND GUTTER

AREA = 0.175 sq.ft. WP = 1.05 ft N = 0.011

PITCH IN 100 FT.	1/2"	1"	1 1/2"	2"	2 1/2"	3"	3 1/2"	4"
SLOPE FT/FT	0.00042	0.00083	0.00125	0.00167	0.00208	0.00250	0.00292	0.00333
Q CFS	0.147	0.207	0.254	0.293	0.327	0.359	0.388	0.414

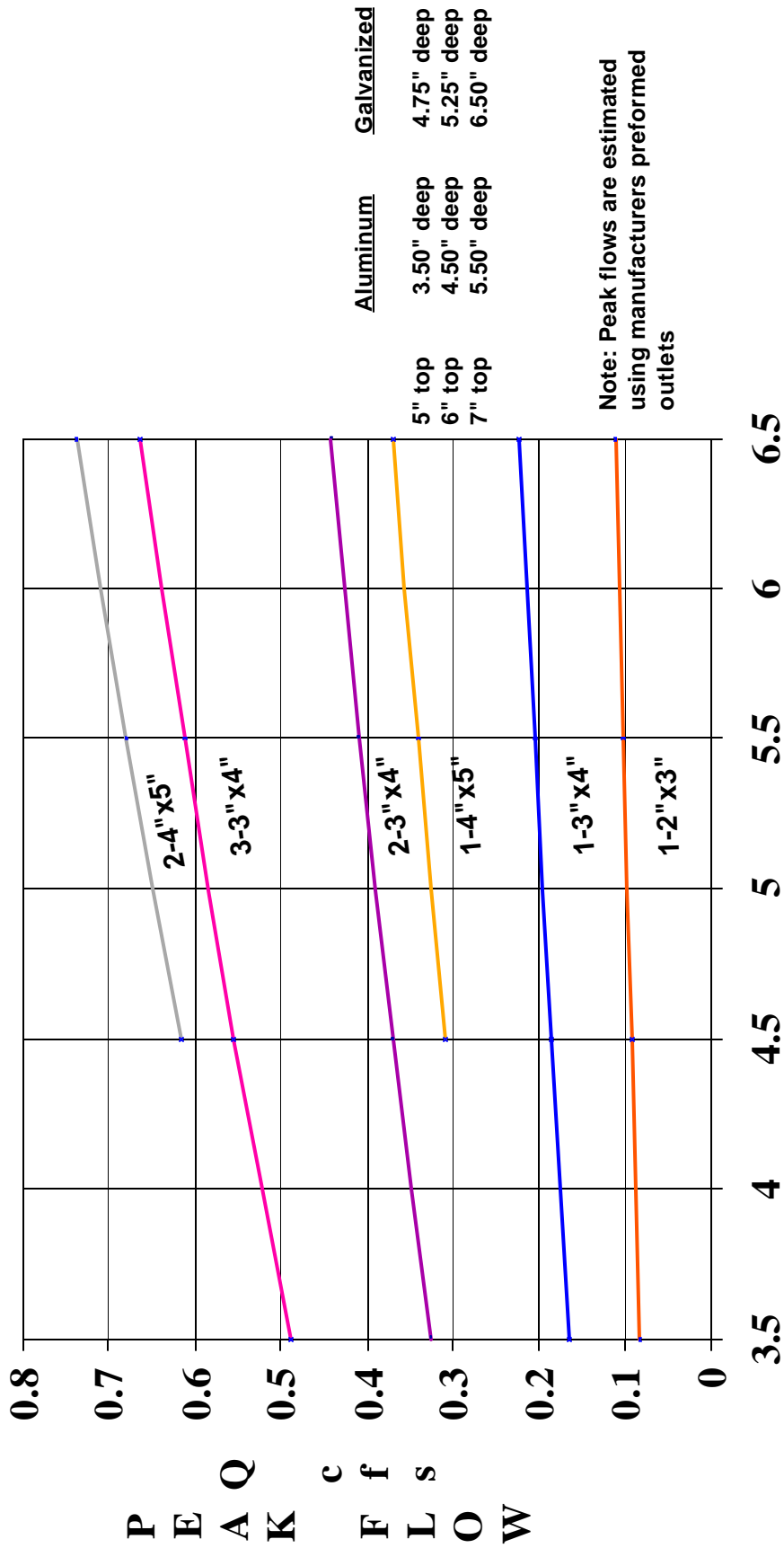
PITCH IN 100 FT.	5"	6"	7"	8"	9"	10"	11"	12"
SLOPE FT/FT	0.00417	0.00500	0.00583	0.00667	0.00750	0.00833	0.00917	0.01000
Q CFS	0.463	0.507	0.548	0.586	0.621	0.655	0.687	0.717

NOTE: AREA AND WP ARE BASED ON 1/2 OF CIRCULAR SCHEDULE 40 PIPE

DOWNSPOUT OUTLET SIZING

LEADER PIPE SIZING

Figure 4



DEPTH OF ROOF GUTTER (INCHES)

DOWNSPOUT LEADER SIZING

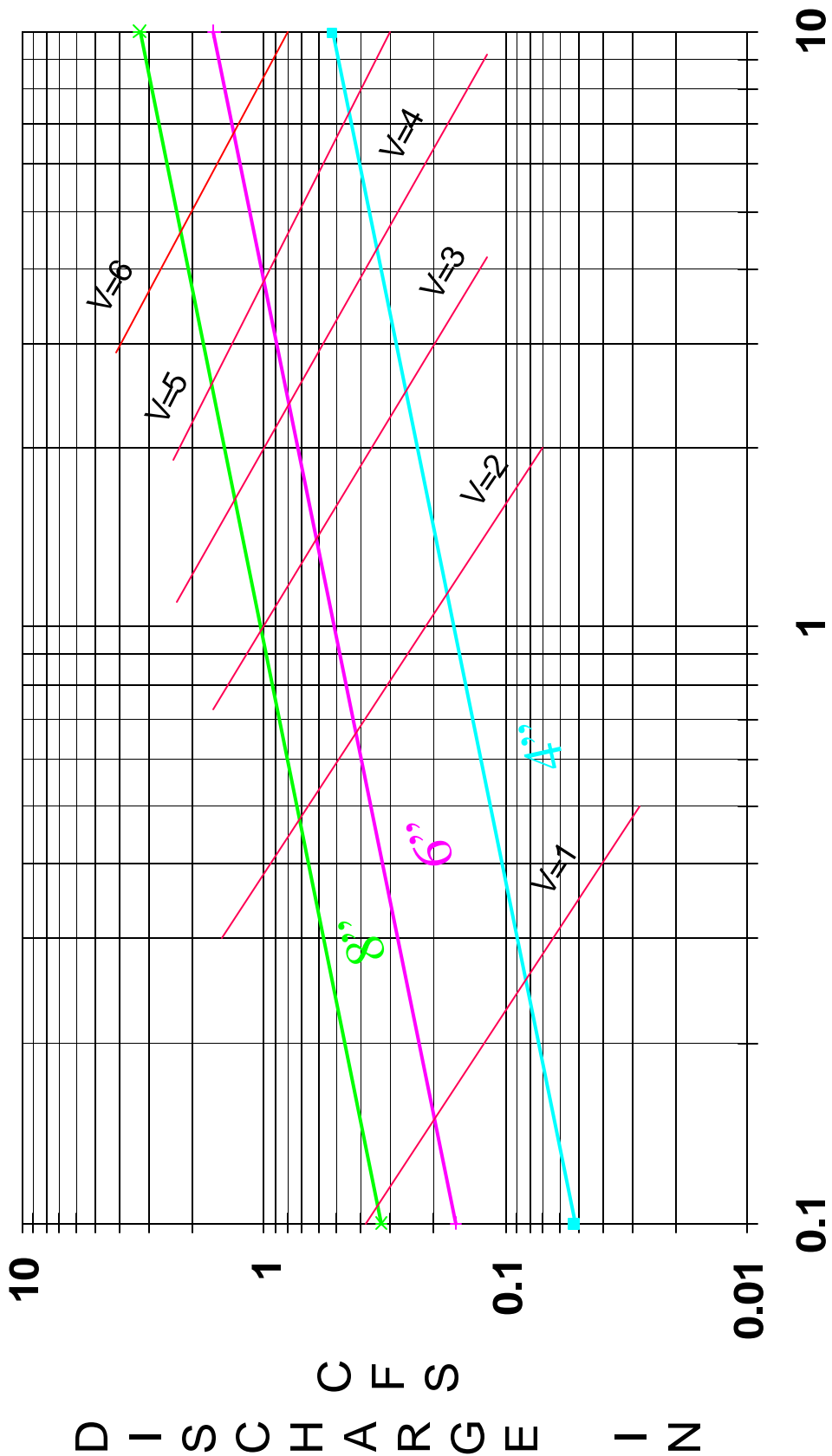
- From 0 - 1.0 cfs use a 4" diameter downspout leader pipe
- From 1.0 - 2.5 cfs use a 6" diameter downspout leader pipe
- From 2.5 - 4.8 cfs use a 8" diameter downspout leader pipe

UNDERGROUND OUTLET DRAIN CHART

CORRUGATED PLASTIC DRAIN TUBING

FIGURE 5

MANNING N=0.015

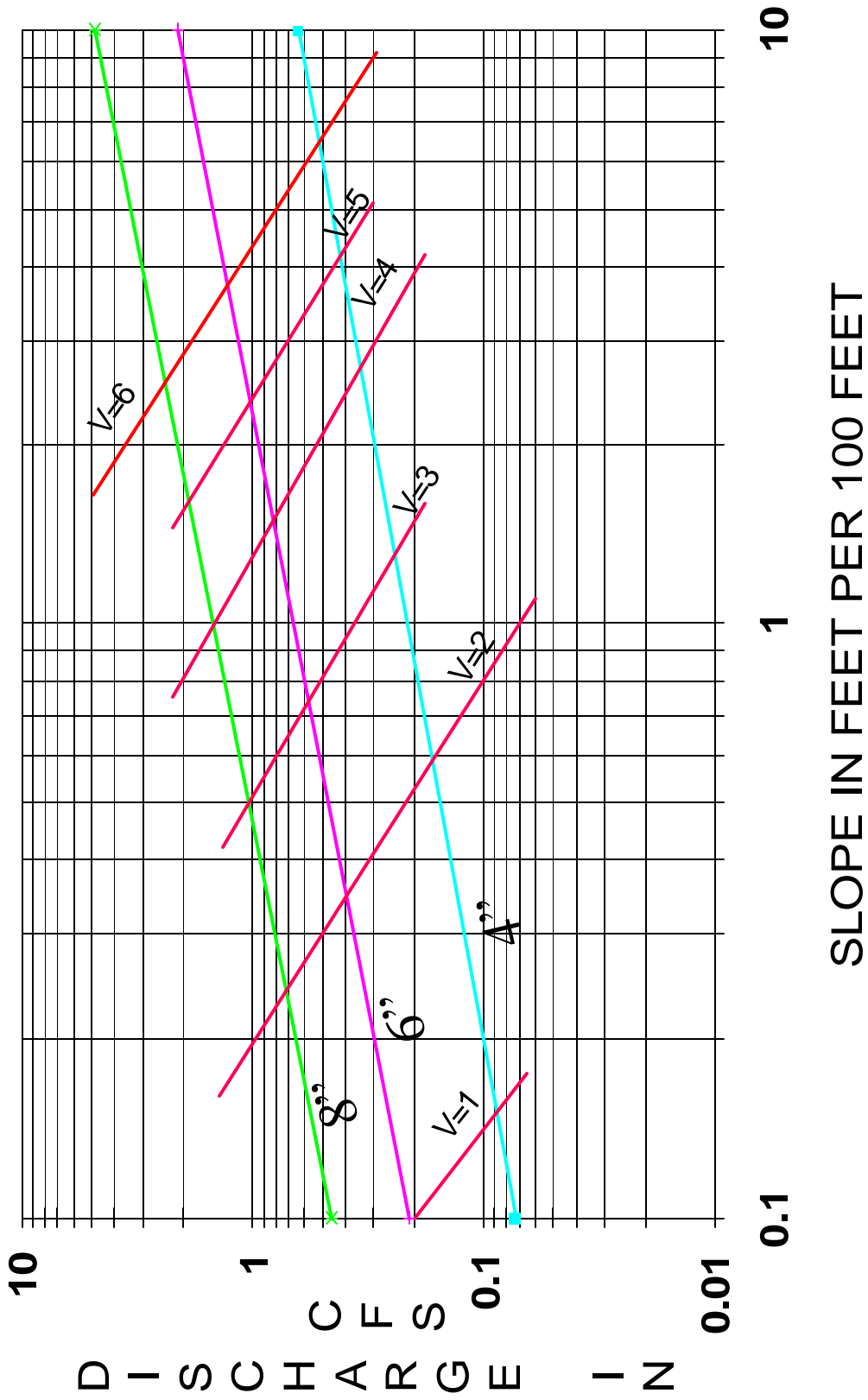


UNDERGROUND OUTLET DRAIN CHART

SMOOTH SURFACE TUBING

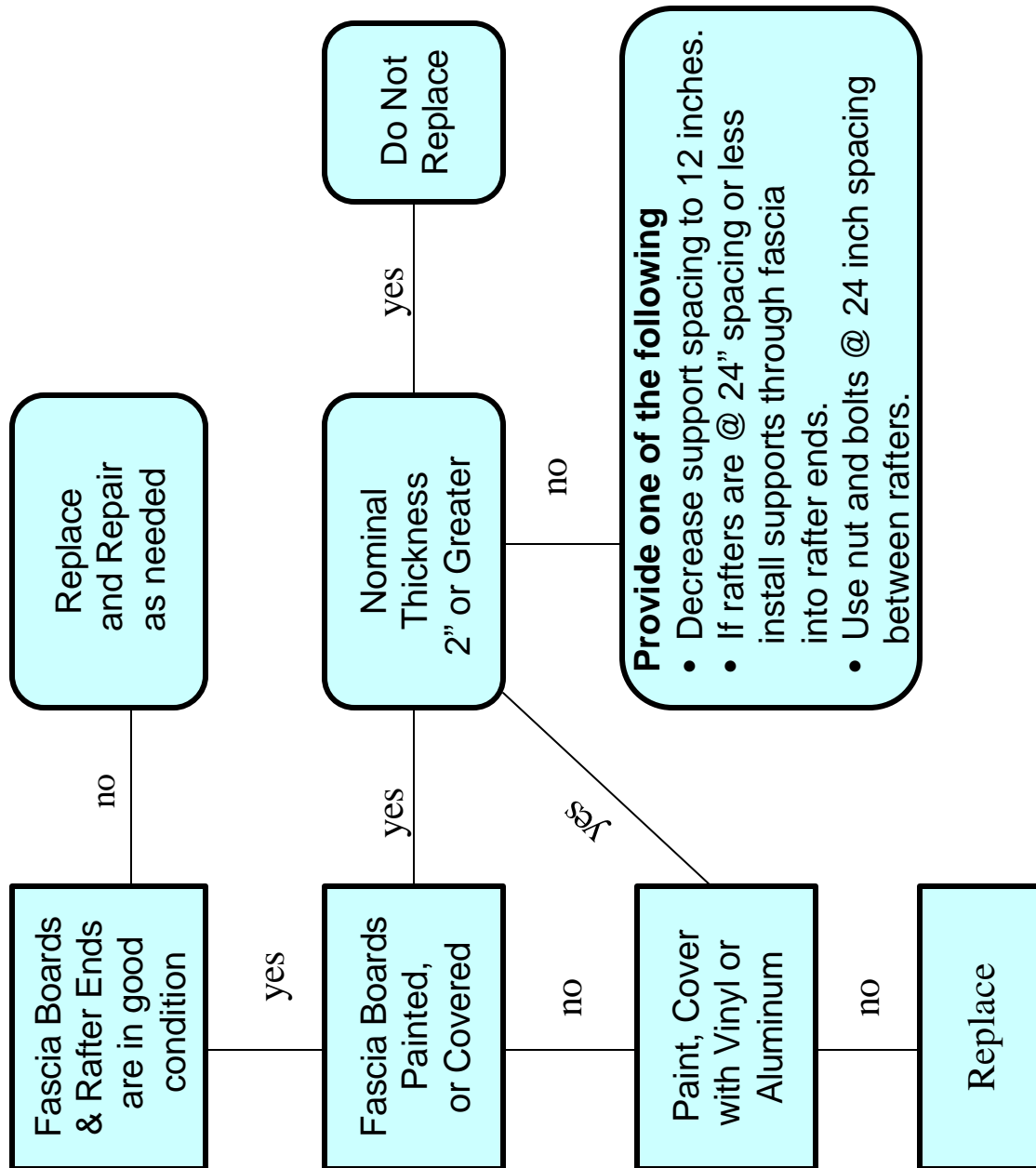
FIGURE 6

MANNING N=0.011



FASCIA BOARD REPLACEMENT

Figure 7



SECTION III

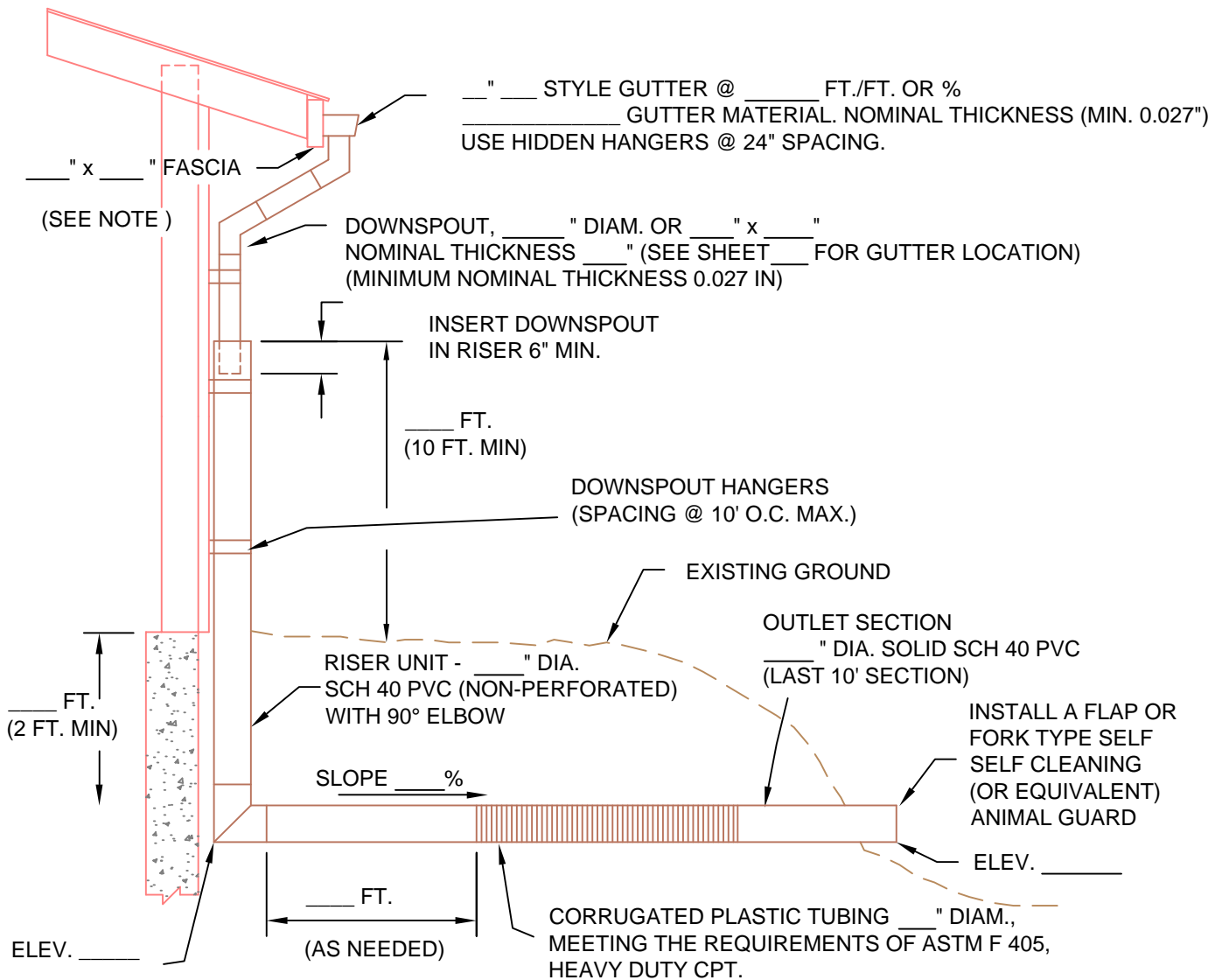
CONSTRUCTION SPECIFICATIONS

1. All materials and construction shall be in accordance with applicable NRCS standards and construction specifications.
2. All components of the completed system shall conform to the lines, grades, elevations, dimensions and materials shown on the plans.
3. Any changes in the plans or specifications must be approved by the original plan approver prior to being made. Changes are to be reviewed by the landowner for concurrence.
4. All disturbed areas shall be fertilized, seeded, and mulched or otherwise stabilized as required on the construction plans.
5. Existing fascia boards that are damaged, rotten, otherwise unstable or with a nominal thickness less than 2 inches, shall be replaced.
6. Rafter ends that are damaged or rotted shall be repaired.
7. All lumber used for fascia boards or for rafter end repair shall have a nominal thickness of 2 inches. Cover all fascia boards with aluminum or vinyl flashing or paint before the roof gutter is installed.
8. Down spout outlet connections shall be the manufacturer's preformed (insert) outlets for the given size shown on the design, unless otherwise approved.
9. Aluminum gutters and downspouts shall have a minimum thickness of 0.027 inch.
10. Galvanized steel gutters and downspouts shall have a minimum thickness of 28 gage.
11. Where animals or equipment may come in contact with downspouts, steel pipe, schedule 40 PVC or similar material will be used for the downspout.
12. Roof gutter supports shall have a maximum spacing of 24 inches unless otherwise approved. Roof gutters shall be mounted to the fascia board using hidden hangers, bolts and ferrules, gutter screws and ferrules, or cradles. Other methods must be approved by the engineer. **Spike and ferrules are not approved.**
13. Itemized invoices from suppliers shall be provided to verify gutter and downspout size, length, material, material gage, and hanger type.
14. The Soil Conservation District makes no representation as to the existence or nonexistence of any utilities at the construction site. Shown on these construction drawings are those utilities, which have been identified. It is the responsibility of the landowners or operators and contractors to assure themselves that no hazard exists or damage will occur to utilities. Miss Utility should be contacted at 1 800-257-7777.

SECTION IV

Construction Drawings

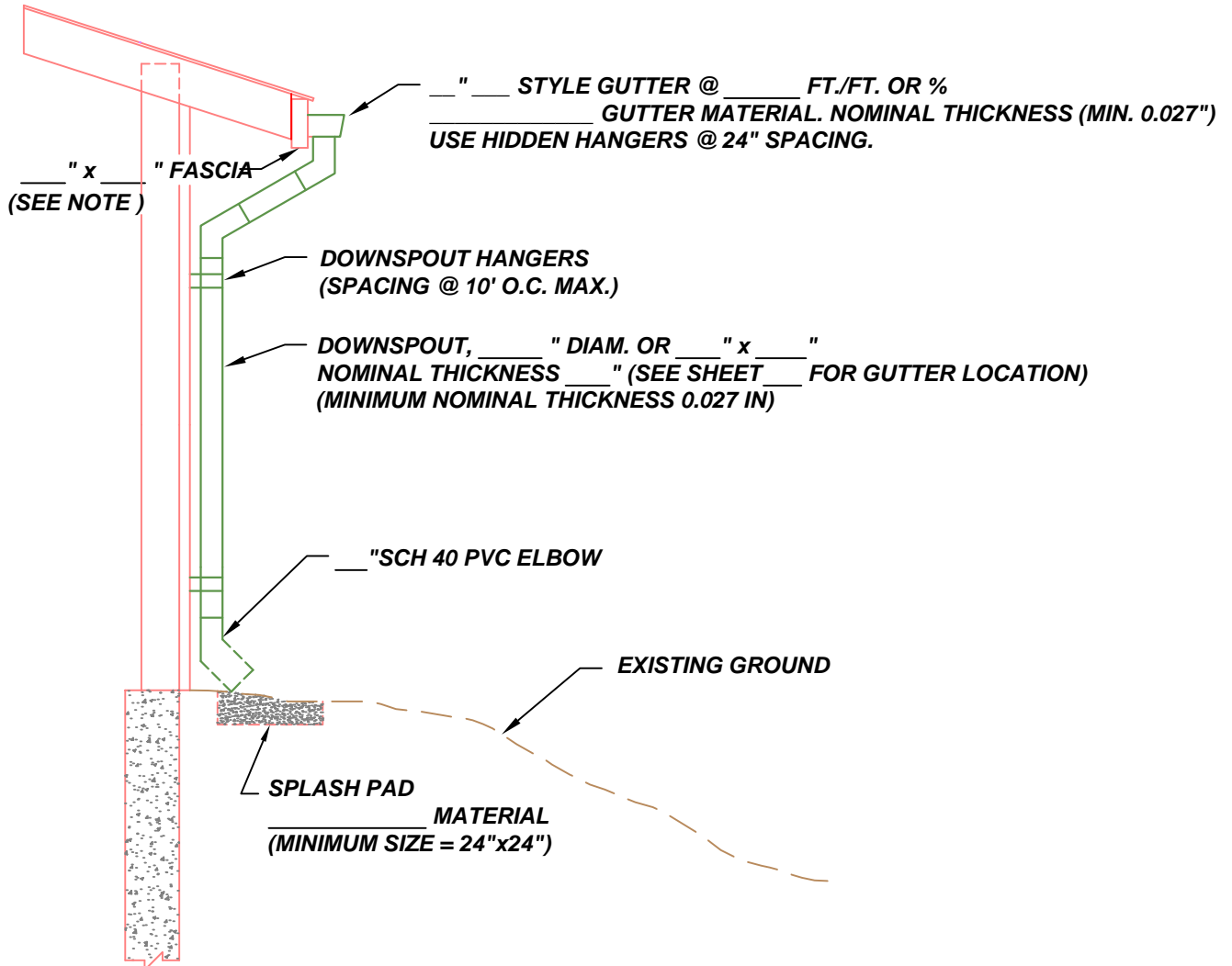
MARYLAND STANDARDS FOR AGRICULTURAL BMPS DETAIL 558-A - ROOF RUNOFF



NOTE:

- 1) FASCIA BOARD MATERIAL TO BE SPRUCE PINE FIR OR BETTER, COVER WITH ALUMINUM FLASHING OR PAINT PRIOR TO INSTALLATION OF ROOF GUTTER.

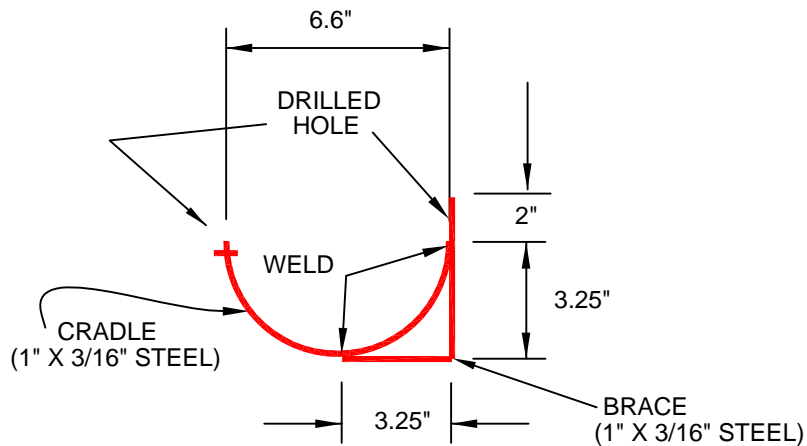
MARYLAND STANDARDS FOR AGRICULTURAL BMPS DETAIL 558-B - ROOF RUNOFF



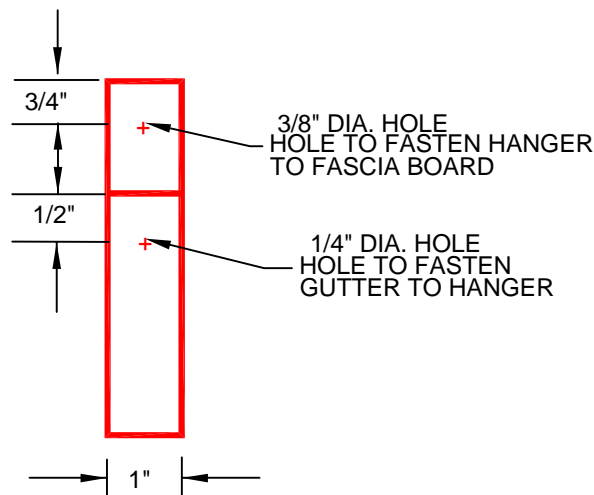
NOTE:

- 1) FASCIA BOARD MATERIAL TO BE SPRUCE PINE FIR OR BETTER, COVER WITH ALUMINUM FLASHING OR PAINT PRIOR TO INSTALLATION OF ROOF GUTTER.
- 2) ABOVE GROUND OUTLET TO BE USED ONLY IF WATER IS DRAINED AWAY FROM THE FOUNDATION.

MARYLAND STANDARDS FOR AGRICULTURAL BMPS DETAIL 558-C - ROOF RUNOFF



SIDE VIEW



FRONT VIEW

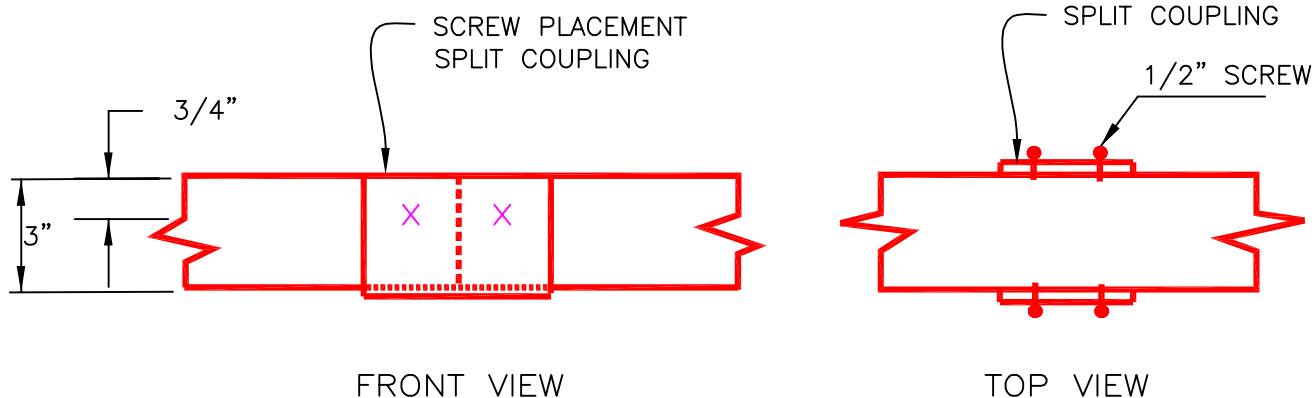
1. GUTTER HANGERS SHALL BE MADE OF 1" X 3/16" STEEL.
2. HANGER SPACING SHALL NO GREATER THAN 32".
3. HANGERS SHALL BE BACKED WITH FASCIA BOARDS WITH A MINIMUM NOMINAL THICKNESS OF 2 INCHES.
4. HANGERS SHALL BE FASTENED TO THE FASCIA BOARD BY:
 - A. MINIMUM 1/4" DIA. BOLTS (GALVANIZED)
5. FASCIA BOARDS MUST BE SECURELY FASTENED TO RAFTERS AND SHALL BE REPLACED OR REPAIRED AS NECESSARY.
6. HANGERS SHALL HAVE A MINIMUM ONE COAT OF PAINT.

N.T.S.

U.S.DEPARTMENT OF AGRICULTURE NATURAL RESOURCES CONSERVATION SERVICE	558-C-ROOF RUNOFF .DWG	MARYLAND DEPARTMENT OF AGRICULTURE MARYLAND SOIL CONSERVATION DISTRICTS
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MARYLAND STANDARDS FOR AGRICULTURAL BMPS DETAIL 558-D - ROOF RUNOFF

1. GLUE ALL JOINTS
2. USE SAME SCREW SPACE PLACEMENT ON BACK SIDE OF GUTTER



PVC ROOF GUTTER DETAILS

1. GUTTER SHALL BE SPLIT 6" SCHEDULE 40 PVC PIPE
2. GUTTER LENGTHS SHALL BE CONNECTED BY USING SPLIT SCHEDULE 40 COUPLING. EACH COUPLING SHALL BE GLUED AND SCREWED. SCREWS SHALL BE SELF TAPPING WITH AN APPROXIMATE LENGTH OF 1/2 INCH. USE 4 SCREWS PER COUPLING
3. GUTTER ENDS SHALL BE SPLIT SCHEDULE 40 CAPS OR SIMILAR . ENDS SHALL BE FASTENED BY GLUING AND SCREWED WITH 2 SELF TAPPING SCREWS AS DESCRIBED ABOVE.
4. SCHEDULE 40 TEES SHALL BE USED FOR DOWN SPOUT OUTLETS EACH OUTLET SHALL BE GLUED AND HAVE A MINIMUM OF 4 SCREWS TO FASTEN OUTLET TO THE ROOF GUTTER.
5. THE GUTTER SHALL BE ATTACHED TO THE HANGERS USING 1/4" DIA. BOLTS. ONE BOLT SHALL BE USED AT EACH HANGER.

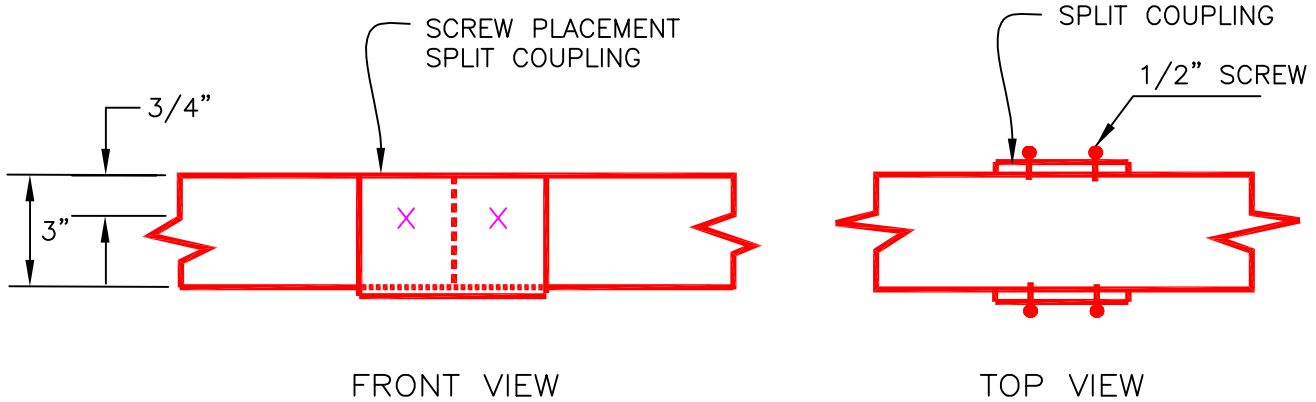
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MARYLAND STANDARDS FOR AGRICULTURAL BMPS

DETAIL 558-E - ROOF RUNOFF

1. GLUE ALL JOINTS
2. USE SAME SCREW SPACE PLACEMENT ON BACK SIDE OF GUTTER



PVC ROOF GUTTER DETAILS

1. GUTTER SHALL BE SPLIT 8" SCHEDULE 40 PVC PIPE
2. GUTTER LENGTHS SHALL BE CONNECTED BY USING SPLIT SCHEDULE 40 COUPLING. EACH COUPLING SHALL BE GLUED AND SCREWED. SCREWS SHALL BE SELF TAPPING WITH AN APPROXIMATE LENGTH OF 1/2 INCH. USE 4 SCREWS PER COUPLING
3. GUTTER ENDS SHALL BE SPLIT SCHEDULE 40 CAPS OR SIMILAR . ENDS SHALL BE FASTENED BY GLUING AND SCREWED WITH 2 SELF TAPPING SCREWS AS DESCRIBED ABOVE.
4. SCHEDULE 40 TEES SHALL BE USED FOR DOWN SPOUT OUTLETS EACH OUTLET SHALL BE GLUED AND HAVE A MINIMUM OF 4 SCREWS TO FASTEN OUTLET TO THE ROOF GUTTER.
5. THE GUTTER SHALL BE ATTACHED TO THE HANGERS USING 1/4" DIA. BOLTS. ONE BOLT SHALL BE USED AT EACH HANGER.

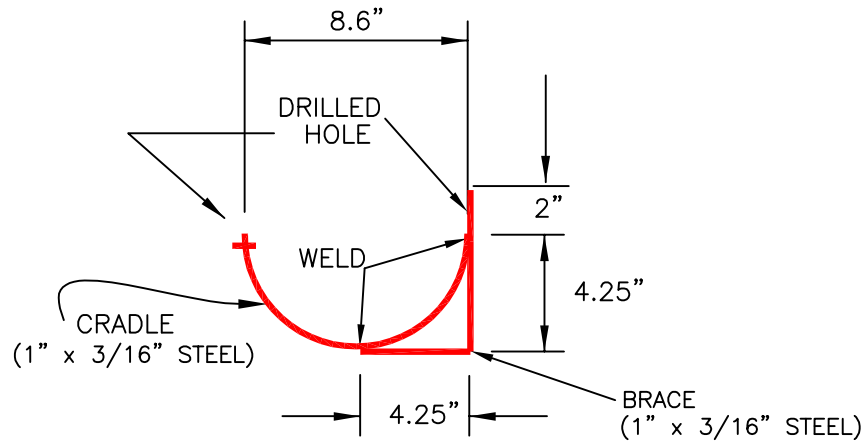
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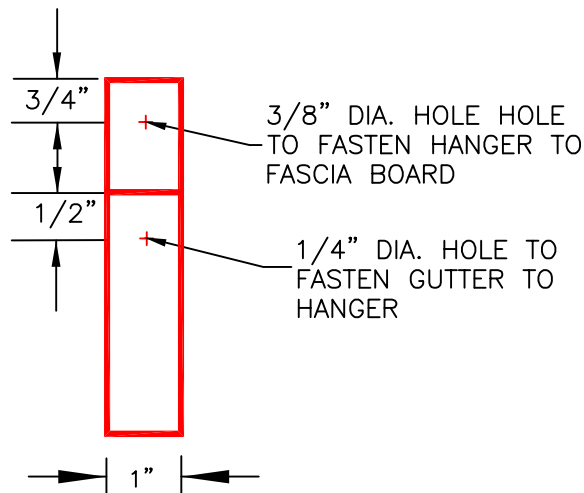
558-E-ROOF RUNOFF
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MARYLAND STANDARDS FOR AGRICULTURAL BMPS DETAIL 558-F - ROOF RUNOFF



SIDE VIEW



FRONT VIEW

1. GUTTER HANGERS SHALL BE MADE OF 1" X 3/16" STEEL.
2. HANGER SPACING SHALL NO GREATER THAN 32".
3. HANGERS SHALL BE BACKED WITH FASCIA BOARDS WITH A MINIMUM NOMINAL THICKNESS OF 2 INCHES.
4. HANGERS SHALL BE FASTENED TO THE FASCIA BOARD BY:
 - A. MINIMUM 1/4" DIA. BOLTS (GALVANIZED)
5. FASCIA BOARDS MUST BE SECURELY FASTENED TO RAFTERS AND SHALL BE REPLACED OR REPAIRED AS NECESSARY.
6. HANGERS SHALL HAVE A MINIMUM ONE COAT OF PAINT.

N.T.S.

U.S.DEPARTMENT OF AGRICULTURE
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MARYLAND SOIL CONSERVATION DISTRICTS

SECTION V

Sizing Example

Location: Carroll County

Divert roof runoff from buildings 1, 2 and 3 to avoid contamination of clean water with animal wastes.

1. **Choose the Design Storm** - Choose the 25-year frequency 5 minute rainfall (see Chart 1). Record this on line 1 of worksheet 1. For animal waste management use the 25-year frequency 5-minute rainfall. **Carroll County = 0.00018 ft/sec**
2. **Calculate the Roof Area** - Label roof or roof segments and calculate roof area for buildings 1, 2 and 3. Record this on line 2 of worksheet 1.
3. **Calculate the Peak Flow** - Determine peak flow for each roof area - Multiply roof area (sq.ft.) for buildings 1, 2 and 3 by the rainfall intensity 0.00018 (ft./sec.) to obtain peak flow (cfs). Record on line 2 of worksheet 1.
4. **Size the Roof Gutter** - Choose a roof gutter type. From Figures 1, 2 or 3 choose a roof gutter size and slope to carry the desired peak flow for each roof segment. For this example, Aluminum K-style gutter was used. From figure 2, a 6-inch top width gutter was chosen with slopes of 4", 2 ½" and 2" for roofs 1a&b, 2, and 3a&b respectively. Record this information on line 3 of worksheet.
5. **Size the Downspout Outlet and Leader Pipe** - Sizing the gutter outlet is a two-stage operation. The first step consists of choosing the downspout outlets required for the given peak flow. The second step consists of choosing a leader pipe for the peak flow or combination of peak flows.
 - a. **Size the Downspout Outlet** - From Figure 4, using a roof gutter depth of 4.5 inches (i.e. 6 inch top width aluminum roof gutter) read vertically up at 4.5 inch depth to the desired peak flow 0.284 then read up to the next downspout size. One 4"x5" downspout outlet would carry the design flow but would be difficult to fit in a 6-inch roof gutter. Two 3"x4" downspout was chosen instead. Record this information on line 4 of the worksheet. Repeat this step for roofs 2, and 3a&b.
 - b. **Size the Leader Pipe** - Because of increased head, a combination of downspouts and roof segments may be added together into one pipe. If the combined peak flow is less than 1.0 cfs, use 4" schedule 40 pipe. If the combined peak flow is between 1.0 and 2.5 cfs use 6" schedule 40 pipe. If the combined peak flow is between 2.5 and 4.8 cfs use 8" schedule 40 pipe. For roofs 1a and 1b, which have a peak flow of 0.284 cfs from each roof, a 4-inch downspout pipe was chosen. These pipe were then combined in one 6-inch leader pipe. The 6-inch was chosen to match the size of the underground outlet in the next step.
6. **Design the underground Outlet System** – Complete worksheet 2 for the underground system, using Figures 5 and 6 to design a gravity flow outlet system. Record this on worksheet 2.

1) Ten-year or twenty-five-year frequency five minute rainfall, from Chart 1.
 (Rainfall intensity = **0.00018** ft./sec.)

Note: For systems protecting a waste storage structures, use the 25-year frequency.

2)	Roof Area	X	Rainfall Intensity	=	Peak Flow
Roof # <u>1a&b</u>	<u>1575</u> sq.ft.	X	<u>0.00018</u> ft./sec.	=	<u>0.284</u> cfs
Roof # <u>2</u>	<u>1260</u> sq.ft.	X	<u>0.00018</u> ft./sec.	=	<u>0.227</u> cfs
Roof # <u>3a&b</u>	<u>475</u> sq.ft.	X	<u>0.00018</u> ft./sec.	=	<u>0.086</u> cfs
Roof # _____	_____ sq.ft.	X	_____ ft./sec.	=	_____ cfs
Roof # _____	_____ sq.ft.	X	_____ ft./sec.	=	_____ cfs
Roof # _____	_____ sq.ft.	X	_____ ft./sec.	=	_____ cfs
Roof # _____	_____ sq.ft.	X	_____ ft./sec.	=	_____ cfs
Roof # _____	_____ sq.ft.	X	_____ ft./sec.	=	_____ cfs

3) Roof Gutter Size (From Figures 1, 2 or 3)

(Circle One)

Roof # <u>1a&b</u>	Use <u>6"</u>	Top (<u>Aluminum</u> /galvanized)	@ <u>4"</u>	Pitch in 100 ft.
Roof # <u>2</u>	Use <u>6"</u>	Top (<u>Aluminum</u> /galvanized)	@ <u>2 1/2"</u>	Pitch in 100 ft.
Roof # <u>3a&b</u>	Use <u>6"</u>	Top (<u>Aluminum</u> /galvanized)	@ <u>2"</u>	Pitch in 100 ft.
Roof # _____	Use _____"	Top (Aluminum/galvanized)	@ _____"	Pitch in 100 ft.
Roof # _____	Use _____"	Top (Aluminum/galvanized)	@ _____"	Pitch in 100 ft.
Roof # _____	Use _____"	Top (Aluminum/galvanized)	@ _____"	Pitch in 100 ft.
Roof # _____	Use _____"	Top (Aluminum/galvanized)	@ _____"	Pitch in 100 ft.
Roof # _____	Use _____"	Top (Aluminum/galvanized)	@ _____"	Pitch in 100 ft.

4) Downspout Opening (orifice) Sizing. (See Figure 4).

					(combination)
Roof # <u>1a</u>	Use <u>2</u> - <u>3"</u>	X <u>4"</u>	Downspout w/ <u>4"</u>	Leader <u>6" Leader</u>	
Roof # <u>1b</u>	Use <u>2</u> - <u>3"</u>	X <u>4"</u>	Downspout w/ <u>4"</u>	Leader <u>6" Leader</u>	
Roof # <u>2</u>	Use <u>2</u> - <u>3"</u>	X <u>4"</u>	Downspout w/ <u>4"</u>	Leader <u>N/A</u>	
Roof # <u>3a</u>	Use <u>1</u> - <u>3"</u>	X <u>4"</u>	Downspout w/ <u>4"</u>	Leader <u>N/A</u>	
Roof # <u>3b</u>	Use <u>1</u> - <u>3"</u>	X <u>4"</u>	Downspout w/ <u>4"</u>	Leader <u>N/A</u>	
Roof # _____	Use _____ - _____"	X _____"	Downspout w/ _____"	Leader _____	
Roof # _____	Use _____ - _____"	X _____"	Downspout w/ _____"	Leader _____	

