

C-10. Disconnected Impervious Surface



Design Objective

Disconnected Impervious Surface (DIS) is the practice of directing stormwater runoff from built-upon areas to properly sized, sloped and vegetated pervious surfaces. Both roofs and paved areas can be disconnected with slightly differing designs. DIS is low cost and has been proven to reduce the volume and flows associated with stormwater runoff. Much of the development across the state has been designed as **connected impervious surface**; that is, draining to pipes and ditches that rapidly convey stormwater without runoff reduction or treatment. Using DIS can help restore the hydrology of streams and reduce pollutant loadings.

Design Intensity

The design for disconnected impervious surface is based on a design intensity of 0.75 inch of rainfall per hour. The design standards provided below are based on this design intensity.

Important Links

Rule 15A NCAC 2H .1060. MDC for Disconnected Impervious Surface
SCM Credit Document, C-10. Credit for Disconnected Impervious Surface

Figure 1: Example Disconnected Rooftop: Plan View

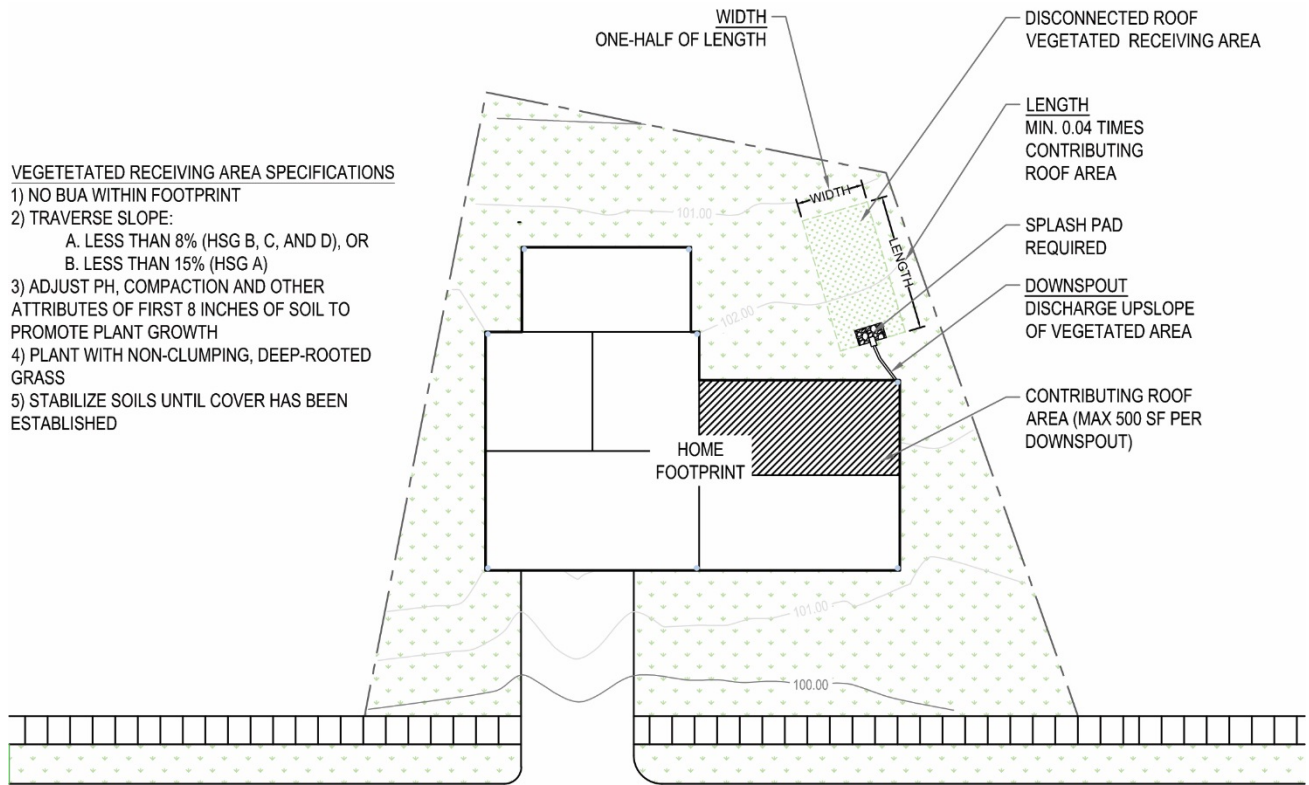
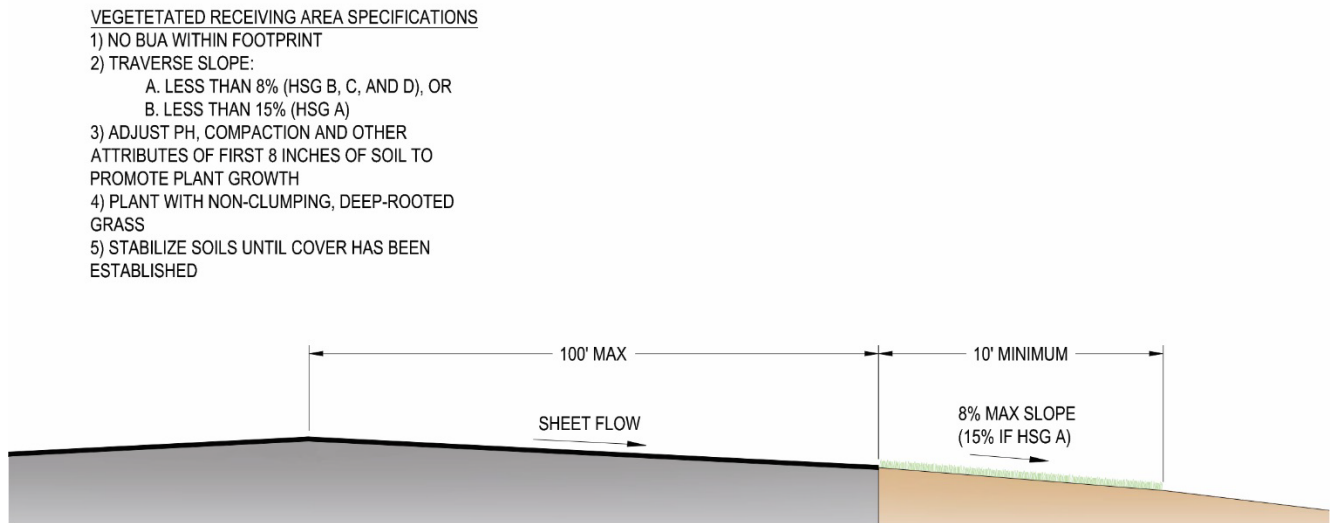


Figure 2: Example Disconnected Pavement: Plan View



Guidance on the MDC

DIS MDC 1. Vegetated Receiving Area for Disconnected Roofs

The following requirements shall apply to vegetated receiving areas for disconnected roofs:

- (a) A maximum of 500 square feet of roof shall drain to each disconnected downspout;
- (b) The receiving vegetated area shall be a rectangular shape. The length of the rectangle in the direction of flow shall be a minimum of 0.04 times the area of the roof that drains to it. The width of the rectangle shall be one-half the length of the rectangle.
- (c) The downspout shall discharge in the center of upslope end of the vegetated receiving area;
- (d) The downspout shall be equipped with a splash pad; and
- (e) The vegetated receiving area shall not include any built-upon area.

By following DIS MDC 1, an applicant can use lawn areas to reduce the size of SCMs needed to treat a high density development. Please note that DIS MDC 3: Vegetated Receiving Area Specifications shall also apply, as well as the Operation and Maintenance requirements that are associated with all types of SCMs.

For disconnected roofs, the gutter system shall be designed so that no more than 500 square feet of roof flows to each downspout if the downspout releases at a single point as shown in Figure 1. The size of the vegetated receiving area will vary based on the amount of roof draining to it.

There are many possible outlet configurations for a disconnected downspout. Figure 2 shows a variety of possibilities. All outlet configurations should be designed with maintenance in mind. As mentioned above, outlet configurations that are equipped with a durable means of spreading the flow evenly across the vegetated filter strip shall be able to serve a larger rooftop area.

Figure 3. Outlet configuration with a foundation planting (Carmen, NCSU)

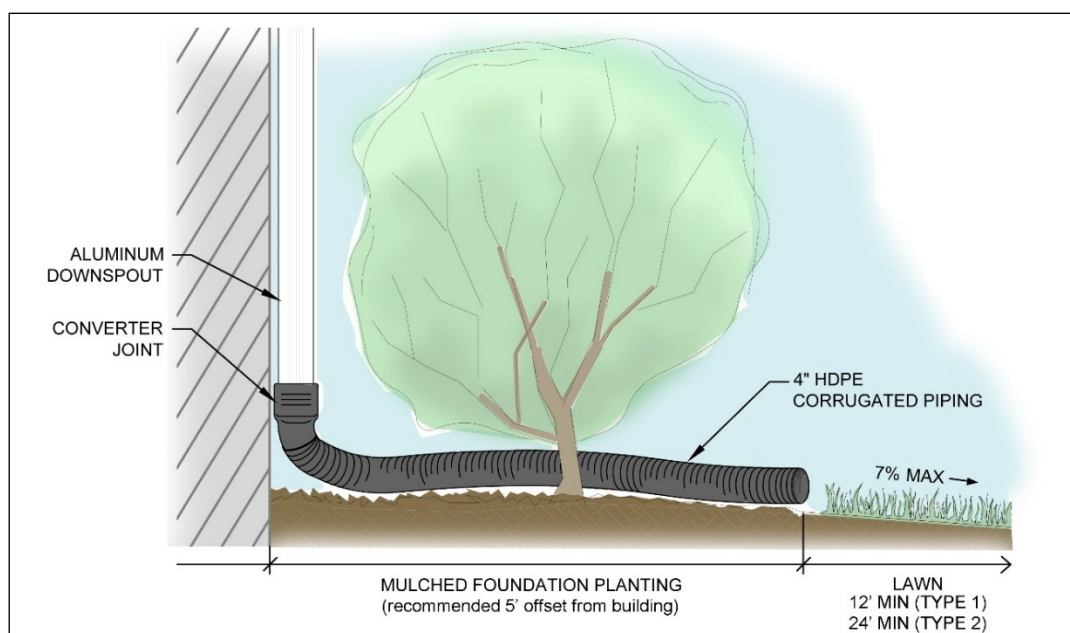


Figure 4. Hinged outlet configuration (Carmen, NCSU)

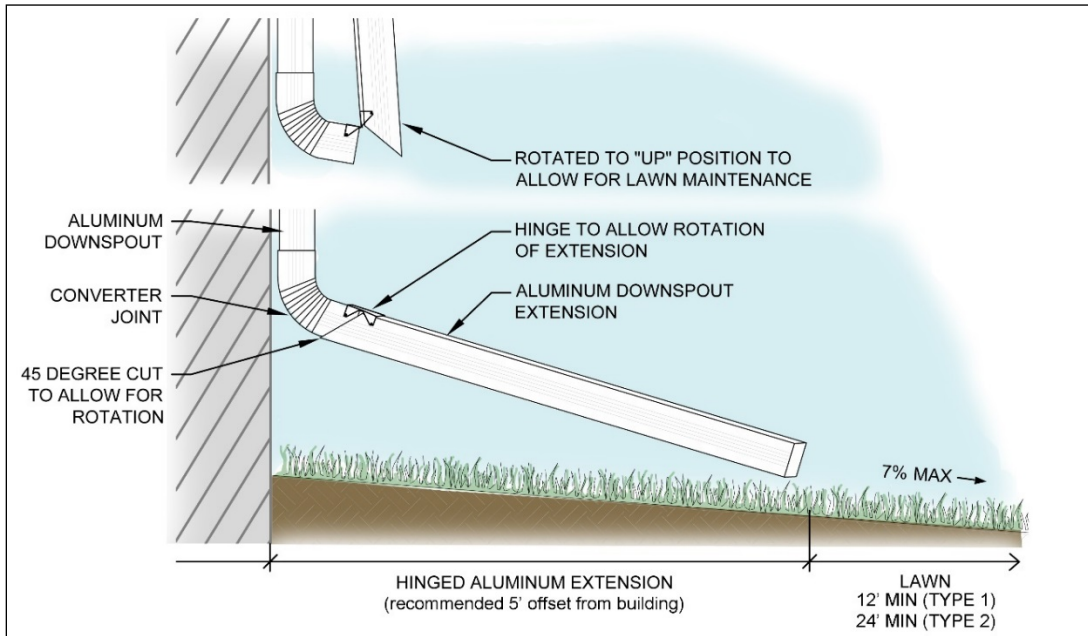
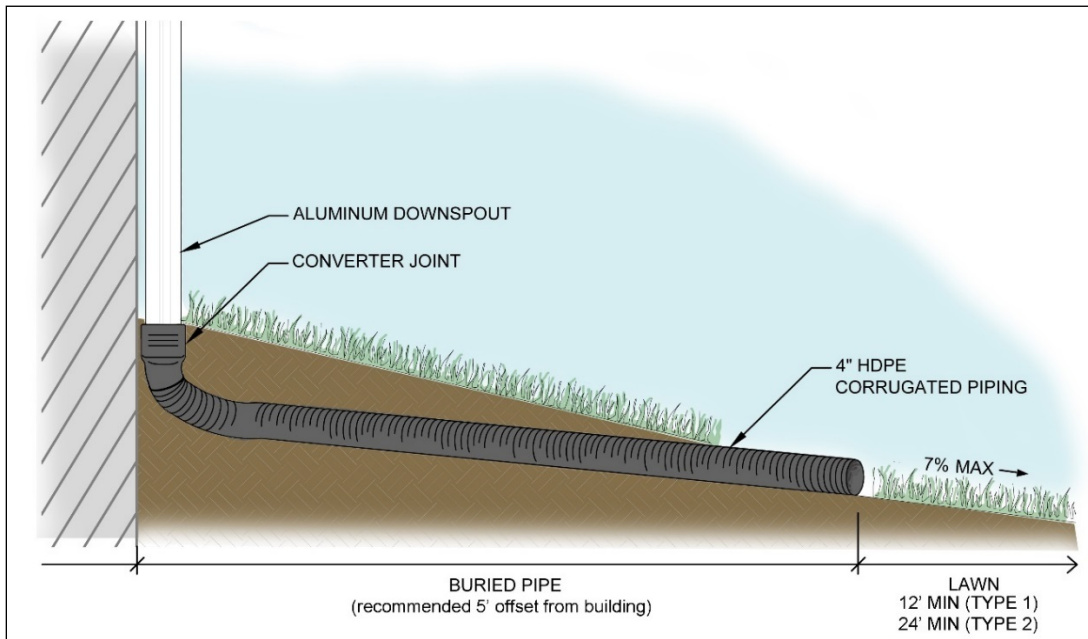


Figure 5. Buried pipe outlet configuration (Carmen, NCSU)



DIS MDC 2. Vegetated Receiving Area for Disconnected Pavement

The following requirements shall apply to the vegetated receiving area for disconnected pavement:

- (a) The pavement draining to the vegetated receiving area shall be a maximum of 100 feet in length in the direction of flow;
- (b) The vegetated receiving area shall be a minimum of 10 feet in length in the direction of flow; and
- (c) The vegetated receiving area shall not contain any built-upon area except for incidental areas such as utility boxes, signs and lamp posts.

For **disconnected paved areas**, the minimum length for the vegetated receiving area (in the direction of flow) is 10 feet. Additional length may be added for additional credit per the SCM Credit Document, Part C-9. A stone verge, concrete edge, or other transition shall be provided between the edge of the paved surface and the vegetated area. The maximum run of the flow on the pavement is 100 feet. This is not allowed to be increased. The vegetated receiving area specifications in DIS MDC 3 shall also be followed.

DIS MDC 3. Vegetated Receiving Area Specifications

The following specifications shall apply to the vegetated receiving areas for both disconnected roofs and disconnected pavement:

- (a) Vegetated receiving areas shall have a uniform transverse slope of 8 percent or less, except in Hydrologic Soil Group A soils where slope shall be 15 percent or less;
- (b) The pH, compaction, and other attributes of the first eight inches of the soil shall be adjusted if necessary to promote plant establishment and growth;
- (c) The vegetated receiving area shall be planted with a non-clumping, deep-rooted grass species; and
- (d) Soils shall be stabilized with temporary means such as straw or matting until the permanent vegetative cover has taken root or the runoff shall be directed elsewhere until vegetation has established

In addition to the minimum sizing for vegetated receiving area per DIS MDC 1 for disconnected roofs DIS or MDC 2 for disconnected pavement, vegetated receiving areas shall also comply with DIS MDC 3. In B, C and D soils, the vegetated receiving area shall have a uniform slope that does not exceed 7 percent. In A soils, the vegetated receiving area slope may be increased up to 15 percent. The vegetated area may be graded to achieve this slope, but shall have additional positive grade at the end of the receiving area for possible runoff to be directed offsite and not cause ponding.

If appropriate vegetation is not already established on site, then seed blend application is recommended. Seed blends should be selected based on shade/sun exposure of vegetated area and regional climate within North Carolina. A non-clumping species should be selected. Sod should not be grown in a clay base or otherwise should be washed.

Forested areas are not recommended as vegetated receiving areas because uneven micro-topography often causes channelization, which reduces surface area exposed to stormwater.

Design Variant

A larger vegetated receiving area for rooftop disconnection can be provided for an increased amount of runoff reduction credit per the SCM Credit Document, Part C-10.

Construction

For an existing home, downspouts can be disconnected easily with minimum effort and expense if there is already an appropriately sized, sloped and vegetated area on the lot. For a new construction project, a preconstruction meeting is highly recommended to ensure contractors understand the locations and function of the DIS. Contractors will need to understand the need to construct the site drainage system according to the plans. Also, contractors shall grade and till the vegetated receiving areas as one of the last steps in the site construction process.

Do not construct vegetated receiving areas until:

- Built-upon areas that will drain to the vegetated receiving areas are completed.
- Areas of the site adjacent to the vegetated receiving area are stabilized with vegetation, mulch, straw, seed, sod, fiber blankets or other appropriate cover.
- The forecast calls for a window of dry weather to prevent smearing and compaction if grading the vegetated receiving area is necessary.
- The forecast calls for extremely hot or cold temperatures, which can hinder establishment of vegetation.

The downspout system shall be installed per the plans. In the field, verify that the downspout system has been installed correctly and that the drainage areas do not exceed the allowable design standards.

It is important to ensure that the vegetated receiving areas are uniformly graded with no gullies, low spots or lateral slopes. Soils should be tilled to a depth of 8 inches unless this is an existing site that was built more than 50 years ago. When the sod is brought to the site, inspect it to be certain that it does not have a clay base or has been washed. A one-time fertilizer application and regular watering should be conducted to establish the vegetation in a DIS.

For a downspout disconnection system, the vegetated receiving area shall be kept off-line until vegetation has been established. For disconnected pavement, soils should be stabilized with temporary means such as straw or matting until the permanent vegetative cover has taken root.

After installation, an appropriately licensed NC design professional shall perform a final as-built inspection and certification that includes:

- Ensuring that the DIS is installed per the plans and specifications.
- Checking that the vegetated receiving areas are sized correctly and that the vegetated receiving areas are stabilized with vegetation.
- Checking that the impervious surfaces are free from sediment and debris.

Any deficiencies found during the as-built inspection shall be promptly addressed and corrected.

Maintenance

DIS requires maintenance to provide long-term stormwater benefits. Regular inspection will determine whether the impervious surface and the vegetated receiving area are draining and functioning as intended.

Communication with maintenance staff is important in maintaining DIS. Maintenance staff shall:

- Not regrade the vegetated receiving areas or cover them with impervious surfaces such as a shed or patio.
- Not stockpile soil, sand, mulch or other materials on the vegetated receiving area.
- Immediately repair any areas that are eroding or where vegetation has died.
- Immediately remove sediment and debris from contributing impervious surfaces.

Important operation and maintenance procedures:

1. The roof area will be maintained to reduce the debris and sediment load to the system. Excess debris can clog the system and lead to bypass of the design storm, reducing infiltration and pollutant removal.
2. To ensure proper operation as designed, a licensed Professional Engineer, Landscape Architect, or other qualified professional will inspect the system annually.
3. The system components will be repaired or replaced whenever they fail to function properly.

After the DIS is constructed, it shall be inspected **quarterly**. The inspector shall check each component and address any deficiencies in accordance with Table 1 below. The person responsible for maintaining the DIS shall keep a signed and notarized Operation and Maintenance Agreement and inspection records. These records shall be made available upon request.

Table 1: Sample Operation and Maintenance Provisions for DIS

SCM element:	Potential problems:	How to remediate the problem:
The contributing impervious area	Excess debris or sediment is present on the rooftop or	Remove the debris or sediment as soon as possible.

	impervious surface	
The gutter system (if applicable)	Gutters are clogged or water is backing up out of the gutter system.	Unclog and remove the debris. May need to install gutter screens to prevent future clogging.
	Rooftop runoff is not flowing into the gutter system.	Correct the positioning or installation of the gutters. Replace if necessary to capture the roof runoff.
Roadways & parking lots (if applicable)	Runoff flows to the pervious area as concentrated flow	Remove any sediment or obstructions at the pavement-vegetated area interface.
	The aggregate transition area or concrete edge restraint is cracked, settled, undercut, eroded or otherwise damaged.	Repair or replace the transition area or concrete edge restraint.
The vegetated receiving area	Areas of bare soil and/or erosive	Regrade the soil if necessary to remove the gully, re-seed

	gullies have formed	the vegetated receiving area and water until it is established. Provide lime and a one-time fertilizer application.
	Trees or shrubs have begun to grow.	Remove the trees or shrubs.
	Vegetation is too short or too long.	Maintain vegetation at a height of approximately three to four inches.

References

Carmen, N.B., Hunt, W.F., and Anderson, A.R. (2013). "Evaluating Residential Disconnected Downspouts as Stormwater Control Measures". 6th International Low Impact Development Conference. August 19-22, 2013. St. Paul, MN. (Extended Abstract)

Lowe's Home Improvement. (2013) "Shop at Lowes.com: Search Results." *Home: Search*. Lowe's Home Improvement, 2013.
 <<http://www.lowes.com/Search=hacksaw>>. (Aug. 1, 2013).