APPENDIX H- DRAINAGE/ STORMWATER

TABLE OF CONTENTS

- **Definitions**
- **Purpose**
- **Recommendations**
- **Hydrology**
- **Hydraulics**
- **Exhibit 1 - Recommended Residential Stormwater Sizing Chart**
- **Exhibit 2 - Recommended Maximum Allowable Design Velocities Chart**

DEFINITIONS

Applicant. An owner or developer of a site who executes or develops a stormwater plan pursuant to Champion Hills POA Recommended Stormwater Guidelines.

Built-Upon Area. That portion of a development project that is covered by impervious or partially impervious surface including, but not limited to, buildings; pavement and gravel areas such as roads, parking lots, and paths; and recreation facilities such as tennis courts. "Built-upon area" does not include a wooden slatted deck, the water area of a swimming pool, or pervious or partially pervious paving material to the extent that the paving material absorbs water or allows water to infiltrate through the paving material.

Design Professional. A professional civil engineer or registered landscape architect who prepares the Stormwater Plan for the person or agent engaged in land-disturbing activity.

Detain. To store and slowly release stormwater runoff following precipitation by means of a surface depression or tank and an outlet structure.

Development. Any land disturbing activity which adds to or changes the amount of impervious or partially pervious cover on a land area or which otherwise decreases the infiltration of precipitation into the soil, other than a rebuilding activity that does not qualify as redevelopment.

Ditch. "Ditch or canal" means a man-made channel, other than a modified natural stream, constructed for drainage purposes.

Drainage structures. Should include paved or grassed swales, channels, storm sewers, curb inlets, yard inlets, culverts, and other structures designed or used to convey stormwater.

Driveway/Entryway. An area used for ingress or egress of vehicles allowing access from a traveled way onto a property.

Energy Dissipater. A structure or a shaped channel section with mechanical armoring placed at the outlet of pipes or conduits to receive and break down the energy from high velocity flow.

Ground Cover. Any natural vegetative growth or other material which renders the soil surface stable against accelerated erosion.

Impervious surface. Any surface that, in whole or in part, restricts or prevents the natural absorption of water into the ground. Such surfaces may include, but are not limited to, gravel, concrete, asphalt or other paving material, and all areas covered by the footprint of buildings or structures.

Non-Erosive Velocity. Means the flow rate of water, usually measured in feet per second, that does not exceed the maximum permissible velocity for the condition and type of soil and groundcover over which the water is flowing. Erosion occurs when the maximum permissible velocity is exceeded. See Exhibit 2 for recommended maximum allowable design velocities.

Two-year, 24-hour storm. The surface runoff resulting from a 24-hour rainfall of an intensity expected to be equaled or exceeded, on average, once in 2 years and with a duration of 24-hours.

Ten-year, 24-hour storm. The surface runoff resulting from a 24-hour rainfall of an intensity expected to be equaled or exceeded, on average, once in 10 years and with a duration of 24-hours.

Redevelopment. For the purposes of this stormwater guideline, redevelopment is defined as adding increased square footage and/or impervious surface to an existing dwelling that is contained under a roof.

Stormwater. Water resulting from rainfall events that is deposited on the earth's surface

Stormwater Runoff. The surface flow of water resulting from precipitation in any form and occurring immediately after rainfall or snowmelt.

Velocity. The average speed of flow through the wetted cross section of a channel at the peak flow of the storm of interest.

PURPOSE

The purpose of the Champion Hills POA Recommended Stormwater Guidelines is to provide the recommended minimum standards for the design of stormwater systems for residential development within the Champion Hills community. This document and the recommendations presented herein apply to all new residential development and re-development. This document is not applicable to community wide "master" drainage infrastructure.

It is required for all new residential development and re-development to have storm drainage facilities designed, constructed and maintained so that adjacent properties are not unreasonably burdened with surface waters as a result of such improvements. More specifically for new residential development the following practices should be considered:

1. Whenever practical, the drainage system of a residential development site should connect to the community drainage system or drainage ways on surrounding properties or streets.
2. Stormwater should not be diverted from one natural drainage basin into another.
3. Stormwater directed into sanitary sewers is strictly prohibited.

If new Built-Upon-Area is anticipated to cause excessive or problematic runoff to an adjacent property owner, or to community wide infrastructure, appropriate stormwater detention is required as outlined herein

OBJECTIVE & METHODOLIGIES

General: No two sites in Champion Hills are identical. The section below entitled "Recommendations" outlines a General Approach to stormwater management design. This approach utilizes stormwater detention. The goal is to prevent additional flows created by new development from adding to existing peak flows downstream. This approach is best defined as the "default approach". The methodology is described in detail, and the required analysis determines a specific volume of stormwater to be detained. This approach was formulated to be user-friendly and yield a quantified result.

1. Certain sites may not require the full "default approach". Examples include those discharging to lakes, to streams, or to an offsite area outside Champion Hills. In these cases it will be the responsibility of the applicant to demonstrate that their stormwater runoff will have no adverse impacts downstream.
2. Certain sites may require additional measures beyond the "default approach". Examples include sites requiring measures to prevent erosion and/or increased turbidity downstream of the applicant's site. There may be cases where detention volumes must exceed the "default" quantity. Again, it will be the responsibility of the applicant to demonstrate that their improvements will not result in adverse impacts downstream.
3. Certain sites may benefit from "Light Impact Development" (LID) practices. LID examples include bio-swales, rain gardens, and the use of porous pavement.

RECOMMENDATIONS

Recommended Design Parameters

Excess runoff volume resulting from new Built-Upon-Area [BUA] should be detained. The designer should consider either:

a) Using the provided stormwater sizing chart located in Exhibit 1 for detention volume sizing. [detention volumes may be stored in pipes, tanks, rain barrels, earthen basins, etc.]

OR

b) Providing peak runoff attenuation for the 2-yr, and 10-yr, 24 hr storm.

Approval

Requires submittal of stormwater management plans, specifications, and/or calculations sealed by a design professional and transmitted to Champion Hills ARC.

Post-Construction

It is recommended that as-built drawings are provided to the owner/application at the project conclusion to provide insight for maintenance in the future.

HYDROLOGY

This section describes recommended procedures to determine runoff flows and volumes for residential project sites within Champion Hills. It is assumed that practicing Design Professionals preparing stormwater plans have a general understanding of the following procedures. These recommendations are not intended to be a step-by-step guide to stormwater design but rather an acceptable guide for an applicable methodology. Any issues concerning these stormwater guidelines should be brought to the attention of the Champion Hills ARC.

Design Storm

The selection of the design storm is the fundamental component for any stormwater design. Each aspect of the stormwater system has a different design storm associated to provide a safe and functional system. The table below outlines the recommended storm event applicable to certain stormwater element analysis.

DESIGN STORM	
Stormwater Element	**Design Storm**
Stormwater Pipes	10 yr
Stormwater Swales	10 yr
Detention Devices	2 & 10 yr [detention)

Calculations

The recommended calculation method is the *Rational Method* whereby the runoff calculation for sites is computed as follows:

Calculation: O=C*l*A, where:

0= Runoff, cfs

C= Runoff Coefficient

I= Rainfall Intensity, in/hr *{See latest NOAA rainfall intensities]*

A=Drainage Area, acres

HYDRAULICS

This section provides recommended procedures for the design of stormwater systems and devices.

Design Flows

Design flows should be calculated by the appropriate method outlined in the referenced Hydrology Section. Each stormwater element should be designed using the correct design storm.

Mannings "n"

- The recommended pipe materials are HDPE and Concrete.
- Typical Mannings "n" values for ditches and pipes are shown below.

MANNING'S "n"	
Materia l	"n" - value
HDPE-Pipe	0.011
Concrete Pipe	0.013
Earthen/Sod Ditch	0.03
Rip-Rap Ditch	0.035

Stormwater Pipe

- Minimum driveway pipe size should be 15"
- Minimum slope for all stormwater pipes should be 0.5%.
- The hydraulic flow should be calculated using the appropriate design storm as outlined herein.
- All stormwater pipes should have a rip-rap pad or other suitable velocity dissipater at the outlet adequately designed for the velocities exiting the pipe. Recommended maximum discharge velocity is per Appendix B.

Channels/Swales

- The hydraulic flow should be calculated using the appropriate design storm as outlined herein.
- Manning's equation should be used to determine the size of the channel for the design flow.
- Minimum slope of a grassed ditch should be 2%. Minimum slope of a concrete lined ditch should be 1%.
- All swales should be appropriately lined to minimize erosive conditions.

Detention Devices

- Detention devices should use the appropriate runoff method and design storm outlined in this manual.
- One foot of freeboard is recommended on all devices.
- If the project site has multiple drainage areas due to a topographic divide and/ or multiple outlets/ swales, the designer should attempt to not increase stormwater runoff on the adjacent property owner for either drainage area.

Exhibit 1 - Recommended Residential Stormwater Sizing Chart

Root Area (SF)**	Detention Volume (CF)	Detention Volume (Gal)	Orifice Size
0-500	N/A	N/A	N/A
501-1000	73	546	2"
1001-2000	119	890	2"
2001-3000	342	2558	2"
3001-4500	559	4182	2"
4501-6000	787	5887	2"
6001-8000	1108	8288	2"
8001 +	Engineering Design Required		

Notes:

1. Entire roof area or equivalent impervious area should be piped to detention system.
2. Each detention system should be inspected routinely for functionality.
3. Detention volumes listed are recommended total volumes for each single-family lot. Multiple detention devices may be used as long as the total cumulative volume is greater than or equal the volumes listed above.
4. Where multiple detention devices are utilized, the total of all orifices shall have a combined area of no larger than 3.14 sq. inches [2" equivalent]. Each orifice shall be proportionately sized to accommodate the detention device in which it serves.

**See Figure 1

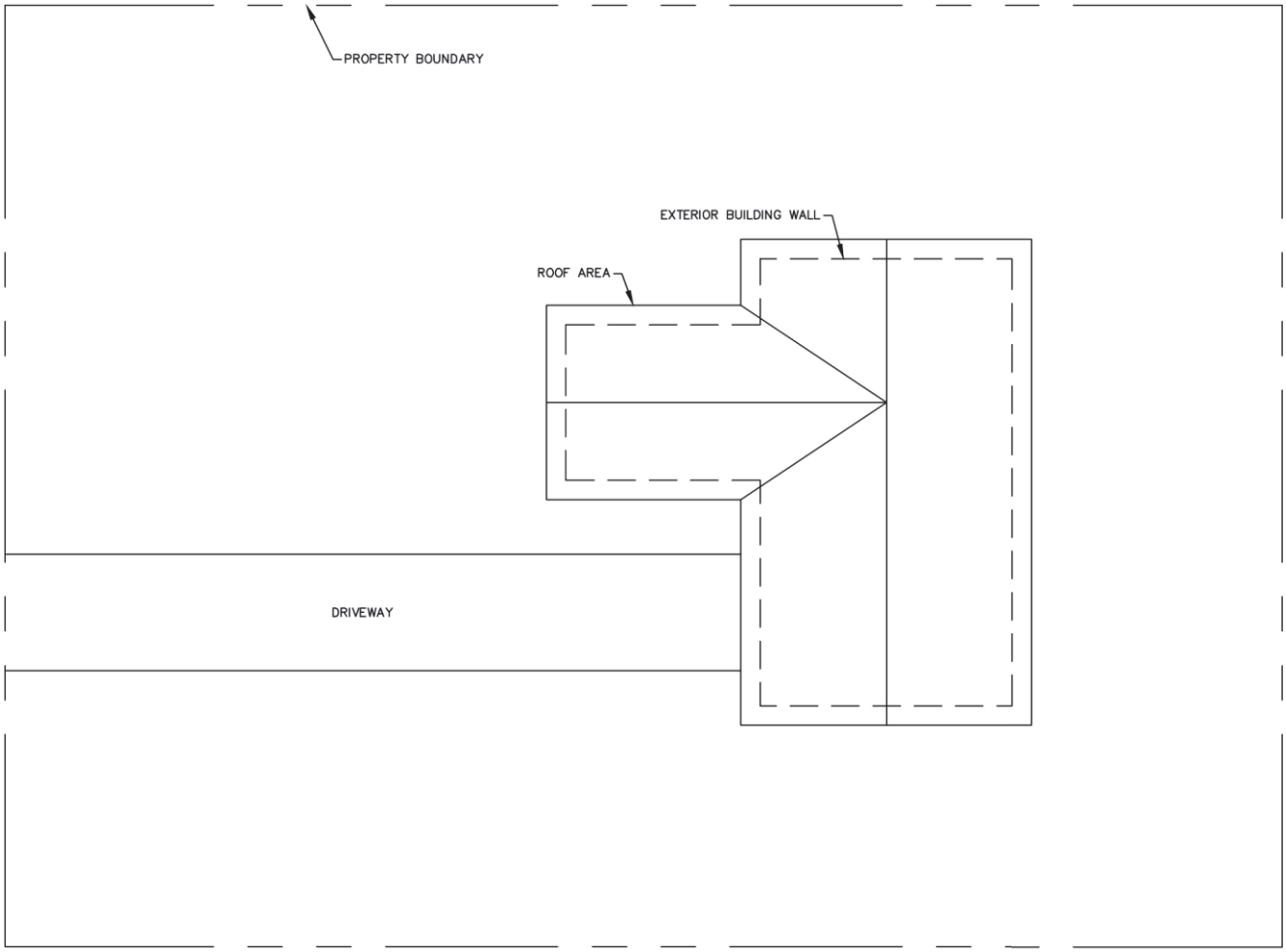


FIGURE 1 – ROOF AREA
NOT TO SCALE

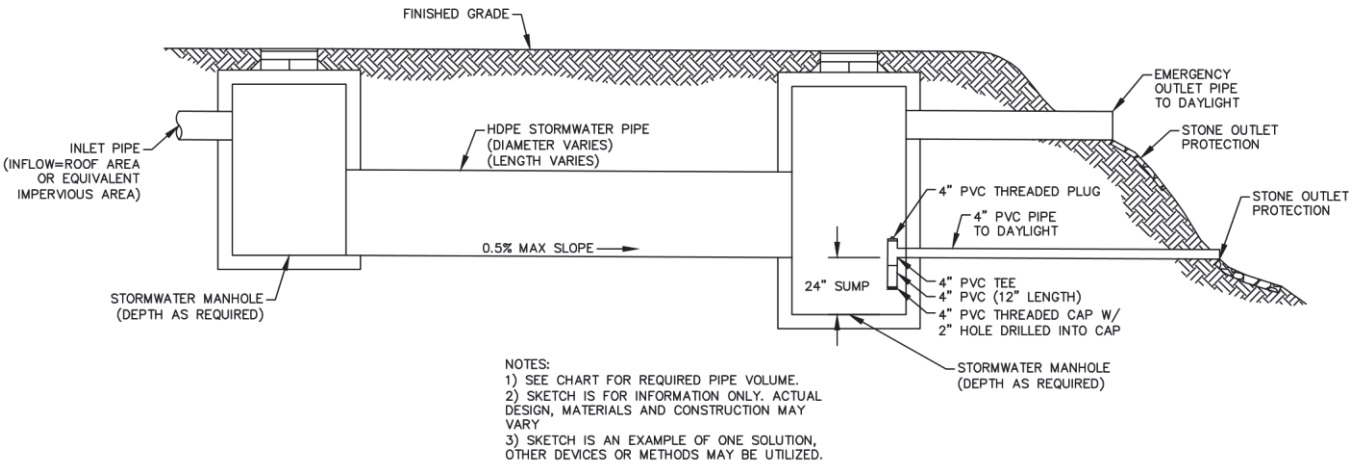


FIGURE 2 – EXAMPLE STORMWATER SOLUTION
NOT TO SCALE

Exhibit 2 - Recommended Maximum Allowable Design Velocities Chart

Typical Channel Slope Application	Soil Characteristics	Grass Lining	Permissible Velocity[3] for Established Grass Lining (ft/sec)
0-5%	Easily Erodible	Bermudagrass	5.0
	Non-plastic	Tallfescue	4.5
	[sands & silts]	Bahiagrass	4.5
		Kentucky bluegrass	4.5
		Grass-legume mixture	4.5
	Erosion Resistant	Bermudagrass	6.0
	Plastic	Tallfescue	5.5
	[clay mixes]	Bahiagrass	5.5
		Kentucky bluegrass	5.5
		Grass-legume mixture	4.5
5-10%	Easily Erodible	Bermudagrass	4.5
	Non-plastic	Tallfescue	**4.0**
	[sands & silts]	Bahiagrass	**4.0**
		Kentucky bluegrass	**4.0**
		Grass-legume mixture	3.0
	Erosion Resistant	Bermudagrass	5.5
	Plastic	Tallfescue	5.0
	[clay mixes]	Bahiagrass	5.0
		Kentucky bluegrass	5.0
		Grass-legume mixture	3.5
>10%	Easily Erodible	Bermudagrass	3.5
	Non-plastic	Tallfescue	2.5
	[sands & silts]	Bahiagrass	2.5
		Kentucky bluegrass	2.5
	Erosion Resistant	Bermudagrass	4.5
	Plastic	Tallfescue	3.5
	[clay mixes]	Bahiagrass	3.5
		Kentucky bluegrass	3.5

Source: USDA-SCS Modified

NOTES:

[1]Permissible Velocity based on 10-year storm peak runoff.

[2]Soil erodibility based on resistance to soil movement from concentrated flowing water.

[3]Before grass is established, permissible velocity is determined by the type of temporary liner used.

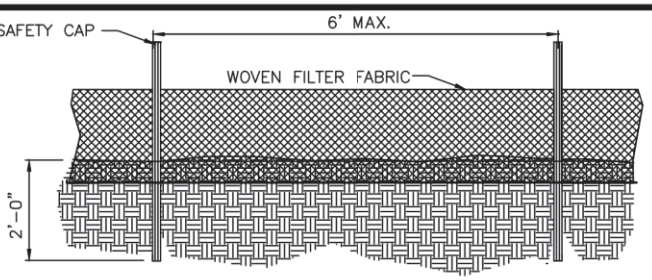
>10%	Easily Erodible	Bermudagrass	3.5
	Non-plastic	Tall fescue	2.5
	[Sands & Silts)	Bahiagrass	2.5
		Kentucky bluegrass	2.5
	Erosion Resistant	Bermudagrass	4.5
	Plastic	Tall fescue	3.5
	[Clay mixes)	Bahiagrass	3.5
		Kentucky bluegrass	3.5

Source: USDA-SCS Modified

NOTE: [1]Permissible Velocity based on 10-year storm peak runoff
[2]Soil erodibility based on resistance to soil movement from concentrated flowing water.
[3]Before grass is established, permissible velocity is determined by the type of temporary liner used.

GENERAL NOTES:

1. WOVEN FILTER FABRIC BE USED WHERE SILT FENCE IS TO REMAIN FOR A PERIOD OF MORE THAN 30 DAYS.
2. STEEL POSTS SHALL BE 5'–0" IN HEIGHT AND BE OF THE SELF–FASTENER ANGLE STEEL TYPE.
3. TURN SILT FENCE UP SLOPE AT ENDS.
4. ORANGE SAFETY FENCE IS REQUIRED AT BACK OF SILT FENCE WHEN GRADING IS ADJACENT TO SWIM BUFFERS, STREAMS OR WETLANDS (REFER TO SWIM BUFFER GUIDELINES). THE COLOR ORANGE IS RESERVED FOR VISUAL IDENTIFICATION OF ENVIRONMENTALLY SENSITIVE AREAS.
5. DRAINAGE AREA CAN NOT BE GREATER THAN 1/4 ACRE PER 100 FT OF FENCE.
6. SLOPE LENGTHS CAN NOT EXCEED CRITERIA SHOWN IN TABLE 6.62A NORTH CAROLINA EROSION AND SEDIMENT CONTROL PLANNING AND DESIGN MANUAL.
7. DO NOT INSTALL SEDIMENT FENCE ACROSS STREAMS, DITCHES, WATERWAYS OR OTHER AREAS OF CONCENTRATED FLOW.

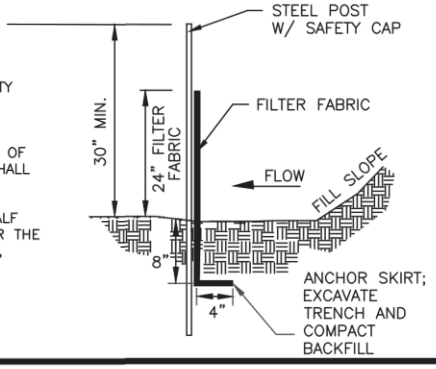


MAINTENANCE NOTES:

1. FILTER BARRIERS SHALL BE INSPECTED BY THE FINANCIALLY RESPONSIBLE PARTY OR HIS AGENT IMMEDIATELY AFTER EACH RAINFALL AND AT LEAST DAILY DURING PROLONGED RAINFALL. ANY REPAIRS NEEDED SHALL BE MADE IMMEDIATELY.

2. SHOULD THE FABRIC DECOMPOSE OR BECOME INEFFECTIVE PRIOR TO THE END OF THE EXPECTED USABLE LIFE AND THE BARRIER STILL IS NECESSARY, THE FABRIC SHALL BE REPLACED PROMPTLY.

3. SEDIMENT DEPOSITS SHOULD BE REMOVED WHEN DEPOSITS REACH APPROX. HALF THE HEIGHT OF THE BARRIER. ANY SEDIMENT DEPOSITS REMAINING IN PLACE AFTER THE SILT FENCE IS REMOVED SHALL BE DRESSED TO CONFORM TO THE EXISTING GRADE, PREPARED AND SEEDED.



SILT FENCE

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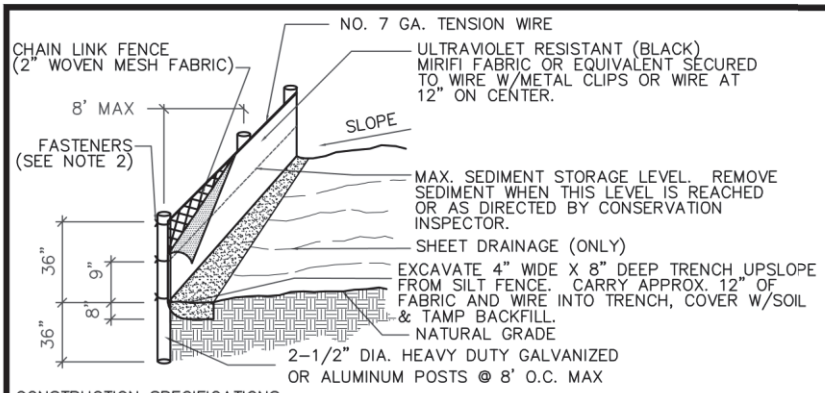

NOTES:
1) SILT FENCES SHOULD NOT BE USED IN AREAS OF CONCENTRATED FLOW (CREEKS, SWALES, ETC.)
2) FASTENERS USED TO FASTEN CHAIN LINK FENCE TO POSTS SHALL BE SPACED AT 14" MAX, USE NO. 9 GA. ALUMINUM WIRE OR NO. 9 GALVANIZED STEEL PRE–FORMED CLIPS. FASTENERS USED TO FASTEN CHAIN LINK TO TENSION WIRE TO BE SPACED AT 60" MAX, USE NO. 13.5 GA. GALVANIZED STEEL WIRE. FASNTENERS USED TO FASTEN FABRIC TO CHAIN LINK TO BE SPACED AT 24" O.C. USE 13.5 GA. GALVANIZED STEEL WIRE.

CONSTRUCTION SPECIFICATIONS

1. CONSTRUCT THE SEDIMENT BARRIER OF STANDARD OR EXTRA STRENGTH SYNTHETIC FILTER FABRIC.
2. ENSURE THAT THE HEIGHT OF THE SEDIMENT FENCE DOES NOT EXCEED 24 INCHES ABOVE THE GROUND SURFACE.
3. CONSTRUCT THE FILTER FABRIC FROM A CONTINUOUS ROLL CUT TO THE LENGTH OF THE BARRIER TO AVOID JOINTS. WHEN JOINTS ARE NECESSARY, SECURELY FASTEN THE FILTER CLOTH ONLY AT A SUPPORT POST WITH 4 FEET MINIMUM OVERLAP TO THE NEXT POST.
4. SUPPORT STANDARD STRENGTH FILTER FABRIC BY WIRE MESH FASTENED SECURELY TO THE UPSLOPE SIDE OF THE POSTS. EXTEND THE WIRE MESH SUPPORT TO THE BOTTOM OF THE TRENCH. FASTEN THE WIRE REINFORCEMENT, THEN FABRIC ON THE UPSLOPE SIDE OF THE FENCE POST. WIRE OR PLASTIC ZIP TIES SHOULD HAVE MINIMUM 50 POUNDS TENSILE STRENGTH.
5. WHEN A WIRE MESH SUPPORT FENCE IS USED, SPACE POSTS A MAXIMUM OF 8 FEET APART. SUPPORT POSTS SHOULD BE DRIVEN SECURELY INTO THE GROUND A MINIMUM OF 24 INCHES.
6. EXTRA STRENGTH FILTER FABRIC WITH 6 FEET POST SPACING DOES NOT REQUIRE WIRE MESH SUPPORT FENCE. SECURELY FASTEN THE FILTER FABRIC DIRECTLY TO POSTS. WIRE OR PLASTIC ZIP TIES SHOULD HAVE MINIMUM 50 POUND TENSILE STRENGTH.
7. EXCAVATE A TRENCH APPROXIMATELY 4 INCHES WIDE AND 8 INCHES DEEP ALONG THE PROPOSED LINE OF POSTS AND UPSLOPE FROM THE BARRIER.
8. PLACE 12 INCHES OF THE FABRIC ALONG THE BOTTOM AND SIDE OF THE TRENCH.
9. BACKFILL THE TRENCH WITH SOIL PLACED OVER THE FILTER FABRIC AND COMPACT. THOROUGH COMPACTION OF THE BACKFILL IS CRITICAL TO SILT FENCE PERFORMANCE.
10. DO NOT ATTACH FILTER FABRIC TO EXISTING TREES.

SUPER SILT FENCE

FOR USE ADJACENT TO GOLF COURSE, STREAMS AND OTHER SENSITIVE AREAS

9–26–2023 NOT TO SCALE 3.12