Galloway
Planning. Architecture. Engineering.

Drainage Letter

for:

MEADOWBROOK STORAGE

Lot 45A or Claremont Business,
Park Filing 2
El Paso County, Colorado Springs, Colorado

Prepared for:

Hammers Construction, LLC.
1411 Woolsey Heights
Colorado Springs, CO 809151
Phone (719) 571-1599
Attn: Yury Dyachenko

Prepared by:

Galloway & Company, Inc.
1755 Telstar Drive, Suite 107
Colorado Springs, CO 80918
Phone (719) 900-7220
Attn: Todd Cartwright PE, LEED AP

Dated:
April 24, 2016

Add Project Number, PPR-17-020

Galloway
Planning. Architecture. Engineering.

CERTIFICATION STATEMENTS

The attached drainage plan and report were prepared under my direction and supervision and are correct to the best of my knowledge and belief. Said drainage report has been prepared according to the established criteria for drainage reports and said report is in conformity with the master plan of the drainage basin. I accept responsibility for any liability caused by any negligent acts, errors or omissions on my part in preparing this report.

____

Todd Cartwright   Date
Registered Professional Engineer
State of Colorado No. 33365

Replace with the standard county signature block: The attached drainage plan and report were prepared under my direction and supervision and are correct to the best of my knowledge and belief. Said drainage report has been prepared according to the criteria established by the County for drainage reports and said report is in conformity with the applicable master plan of the drainage basin. I accept responsibility for any liability caused by any negligent acts, errors or omissions on my part in preparing this report.

Developer's Statement:
I, the developer have read and will comply with all of the requirements specified in this drainage report and plan.

____

Hammers Construction

By: __________________________________

Title: __________________________________

Address: 1411 Woolsey Heights
Colorado Springs, CO 80915

Revise to standard county signature block: Filed in accordance with the requirements of the Drainage Criteria Manual, Volumes 1 and 2, El Paso County Engineering Criteria Manual and Land Development Code as amended.

CITY OF COLORADO SPRINGS:
Filed in accordance with Section 7.7.906 of the Code of the City of Colorado Springs, 2001, as amended.

____________________________________   ____________________

For City Engineer   Date

Conditions:

Revise to Jennifer Irvine, P.E.
County Engineer/ECM Administrator

I. General Location and Drainage Design Description

A. Purpose

The purpose of this letter is to show that there shall be no negative drainage effects associated with the proposed development of Lot 45A within the Claremont Business Park Filing 2A, recorded 4/14/2010 under Reception No. 210713035 of the El Paso County Records. This final drainage letter is being submitted concurrently with the improvement construction plans proposing multiple storage building and the associated drivelines.

B. Property Description

The proposed project site is within the Northeast Quarter of Section 8, Township 14 South, Range 65 West of the 6th Principal Meridian. The site can be further described as bounded by Meadowbrook Parkway on the west, Highway 24 on the east, Woolsey Heights on the north, and an existing storage facility on the south. See Figure 1. Lot 45A consists of approximately 5.3 acres and is currently vacant. The proposed project consists of all infrastructure typically associated with multiple storage buildings. Most the site will consist of asphalt, curb, lighting, a subsurface Storm Water Quality Facility and landscaping.

C. Existing Drainage Characteristics

The site is currently vacant with a relatively new roadway infrastructure and associated utilities with slopes ranging from 0-4% from northeast to southwest. Flows from the site run in a sheet-flow manner and drain to the southwest portion of the site, and then eventually outfalls to an existing storm sewer collection system at the southwest corner of Lot 13 and ultimately discharges to the East Fork Sand Creek.

D. Floodplain Statement

According to FEMA FIRM map 08041C0752F, effective March 17, 1997, the site lies within Shaded Zone X. Shaded Zone X is identified as areas of 500-year flood; areas of 100-year flood with average depths of less than 1 foot.

E. Proposed Drainage Characteristics

Most the site will consist of concrete, buildings and, a subsurface Storm Water Quality Facility and landscaping. The subject site was previously analyzed within the Final Drainage Report (FDR) for Claremont Business Park Filing 2 prepared by Matrix Design Group approved 04/23/2007. Onsite Water Quality Control Volume (WQCV) is required but on-site storm water detention is not required per the FDR for Claremont Business Park Filling 2A.

The post-developed flows from Lot 45A shall be directed to a subsurface Storm Water Quality Facility (sand filter type), which is located along the western property line along Meadowbrook Parkway (See the Grading Plan and Figure 2 ï Proposed Drainage). Flows enter the Sand Filter near the southwestern portion of the site via a storm drain system (12 cfs for the 5-yr and 23 cfs for the 100-yr). See Appendix B for the hydraulic design details of the storm drain system. Flows also enter the Sand Filter near the northwestern portion of the site via curb opening (4 cfs for the 5-yr and 7 cfs for the 100-yr). The Rational calculations were made knowing an existing hydraulic soil group (HSC) of type A (See Appendix C).

Flows that penetrate the Sand Filter will discharge into an existing storm drain catch basin within Meadowbrook Parkway. Overflows from the Sand Filter will overtop a berm near the southwestern portion of the site and flow into Meadowbrook Parkway as it does currently.

F. **Water Quality Provisions – Sand Filter**

The proposed Sand Filter will be built per Urban Drainage and Flood Control recommendations (see Appendix A for additional information on the Sand Filter). There will be a geo-membrane liner within the Sand Filter since a storage structure is within proximity. The volume provided by the Sand Filter is approximately 8,000 cu-ft which exceeds the required Water Quality Control Volume of 7,600 cu-ft. The size of the Sand Filter is based on an impervious area of 89%, a drainage area of approximately 4.8 acres, and a runoff of 0.6-inches of precipitation per *City of Colorado Springs – Drainage Criteria Manual Volume 2*. See Appendix B for Design Procedure Form for Sand Filter.

G. **The Four-Step Process**

Revise the process to the counties four step process; section I.7.2A of the ECM.

Per the City of Colorado Springs Drainage Criteria Manual - Volume 1, the four-step process was implemented for stormwater management:

Step 1: Reduce runoff by disconnecting impervious area. Runoff is being reduced by implementing a Sand Filter type of Storm Water Quality Facility.

Step 2: Treat and slowly release the water quality control volume (WQCV). The WQCV will be routed through a Sand Filter located on the western portion of the site.

Step 3: Stabilize stream channels. There are no stream channels on this site to stabilize.

Step 4: Implement source controls. Due to the small-scale development of the site, no additional source controls are necessary.

H. **Private Water Quality Facility – Cost Estimate**

Private Subsurface Water Quality Facility (Sand Filter):$10,000

I. **Drainage Fees**

Since the property has already been platted, no drainage fees are required to be paid.

II. CONCLUSIONS

The proposed runoff patterns for the site have no negative drainage effects within Claremont Business Park Filing 2A or the surrounding area. The methodologies and drainage criteria used in the overall drainage design meet the current City DCM requirements.

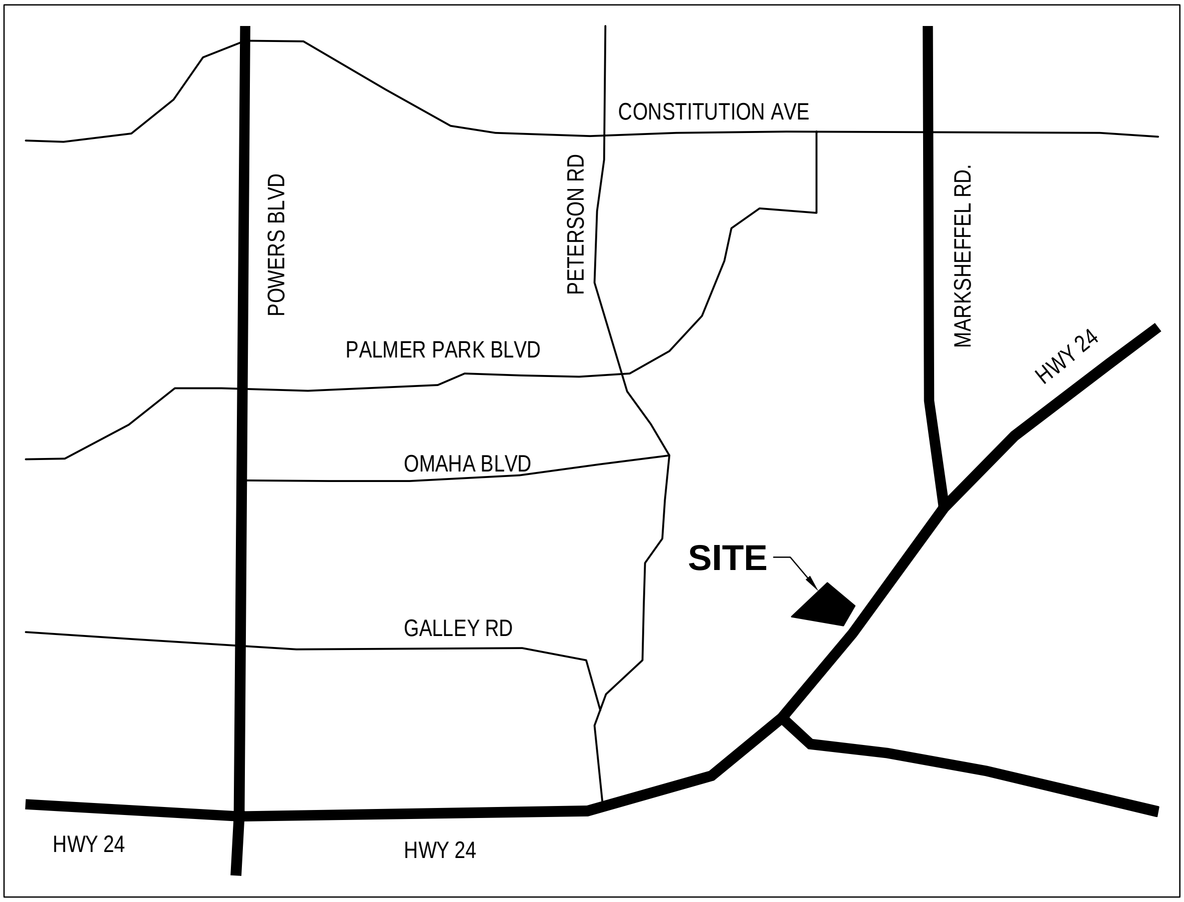
III. REFERENCES

1. *Drainage Criteria Manual Volumes 1 & 2*, City of Colorado Springs, most recent version.
2. *Urban Storm Drainage and Criteria Manual, Urban Drainage and Flood Control District,* most recent version.

Add previous drainage report

FIGURES

FIGURE 1: VICINITY MAP
FIGURE 2: PROPOSED DRAINAGE PLAN



VICINITY MAP

NTS

Add North arrow

LOT 45
HAMMERS CONSTRUCITON

751 MEADOWBROOK PARKWAY
COLORADO SPRINGS, CO

FIGURE 1 - VICINITY MAP

Project No:	HCI 1.01
Drawn By:	MBF
Checked By:	TAC
Date:	04/24/17

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515 South 700 East, Suite 3F
Salt Lake City, UT 84102
303.770.8884 O
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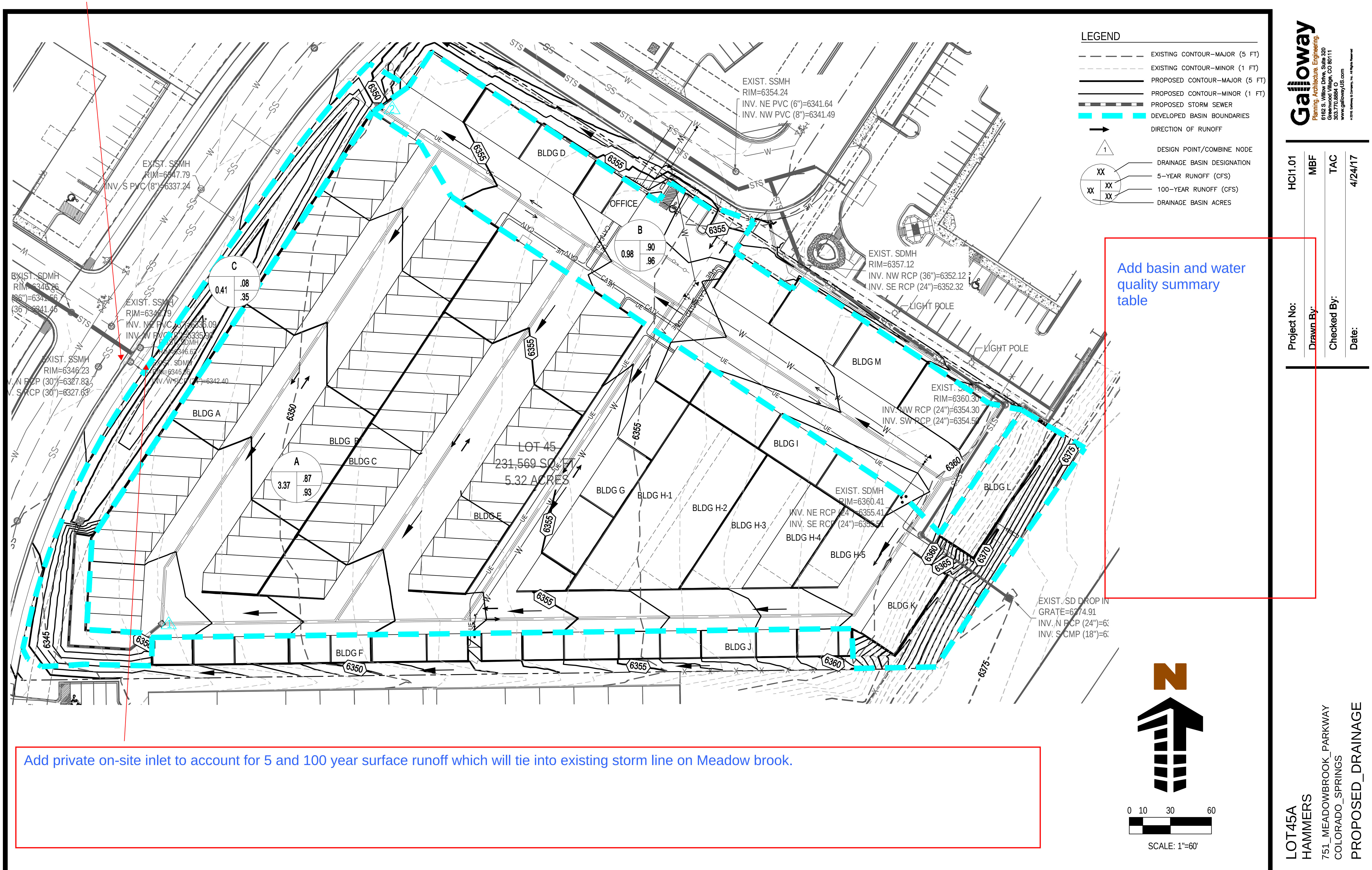
Emergency spillway?



Add basin and water quality summary table

Add private on-site inlet to account for 5 and 100 year surface runoff which will tie into existing storm line on Meadow brook.

APPENDIX A

SAND FILTER DESIGN INFORMATION

Description

Photograph SF-1. This sand filter, constructed on two sides of a parking garage, is accessible for maintenance, yet screened from public view by a landscape buffer.

A sand filter is a filtering or infiltrating BMP that consists of a surcharge zone underlain by a sand bed with an underdrain system. During a storm, accumulated runoff collects in the surcharge zone and gradually infiltrates into the underlying sand bed, filling the void spaces of the sand. The underdrain gradually dewaters the sand bed and discharges the runoff to a nearby channel, swale, or storm drain. It is similar to a BMP designed for bioretention in that it utilizes filtering, but differs in that it is not specifically designed for vegetative growth. The absence of vegetation in a sand filter allows for active maintenance at the surface of the filter, (i.e., raking for removing a layer of sediment). For this reason, sand filter criteria allows for a larger contributing area and greater depth of storage. A sand filter is also a dry basin, which can be designed to include the flood control volume above the WQCV or EURV. Sand filters can also be placed in a vault. Underground sand filters have additional requirements. See Fact Sheet T-11 for additional discussion on underground BMPs.

Sand/Media Filter	
Functions	
LID/Volume Red.	Yes
WQCV Capture	Yes
WQCV+Flood Control	Yes
Fact Sheet Includes EURV Guidance	No
Typical Effectiveness for Targeted Pollutants[3]	
Sediment/Solids	Very Good[1]
Nutrients	Good
Total Metals	Good
Bacteria	Moderate
Other Considerations	
Life-cycle Costs[4]	Moderate

[1] Not recommended for watersheds with high sediment yields (unless pretreatment is provided).

[3] Based primarily on data from the International Stormwater BMP Database (www.bmpdatabase.org).

[4] Based primarily on BMP-REALCOST available at www.udfcd.org. Analysis based on a single installation (not based on the maximum recommended watershed tributary to each BMP).

Site Selection

Sand filters require a stable watershed. When the watershed includes phased construction, sparsely vegetated areas, or steep slopes in sandy soils, consider another BMP or provide pretreatment before runoff from these areas reach the rain garden.

When sand filters (and other BMPs used for infiltration) are located adjacent to buildings or pavement areas, protective measures should be implemented to avoid adverse impacts to these structures. Oversaturated subgrade soil underlying a structure can cause the structure to settle or result in moisture-related problems. Wetting of expansive soils or bedrock can cause swelling, resulting in structural movements. A geotechnical engineer should evaluate the potential impact of the BMP on adjacent structures based on an evaluation of the subgrade soil, groundwater, and bedrock conditions at the site.

In locations where potentially expansive soils or bedrock exist, placement of a sand filter adjacent to a structure should only be considered if the BMP includes a drainage layer (with underdrain) structure, and is lined with an impermeable geomembrane liner designed to restrict seepage.

Benefits

- Filtering BMPs provide effective water quality enhancement including phosphorus removal.

Limitations

- This BMP may clog and require maintenance if a moderate to high level of silts and clays are allowed to flow into the facility.
- This BMP should not be located within 10 feet of a building foundation without an impermeable membrane. See *Bioretention* (BMP Fact Sheet T-3) of this manual for additional information.
- The sand filter should not be put into operation while construction or major landscaping activities are taking place in the watershed.

Designing for Maintenance

Recommended maintenance practices for all BMPs are provided in Chapter 6 of this manual. During design, the following should be considered to ensure ease of maintenance over the long-term:

- Do not put a filter sock on the underdrain. This is not necessary and can cause the BMP to clog.
- Install cleanouts. Cleanouts can be used for inspection (by camera) immediately following construction to ensure that the underdrain pipe was not crushed during construction. They can also be used to for ongoing maintenance practices. Consider locating cleanouts in the side slopes of the basin and above the depth of ponding.
- Provide vegetated side slopes to pre-treat runoff by filtering (straining). This will reduce the frequency of maintenance.

Design Procedure and Criteria

The following steps outline the design procedure and criteria for a sand filter.

1. **Basin Storage Volume**: Provide a storage volume above the sand bed of the basin equal to the WQCV based on a 12-hour drain time.

   - Determine the imperviousness of the tributary area (or effective imperviousness where LID techniques are implemented). Determine the required WQCV (watershed inches of runoff) using Figure 3-2 in Chapter 3 of this manual. The volume should be based on a drain time of 12 hours.
   - Calculate the design volume as follows:

   $$V = \left[\frac{\text{WQCV}}{12}\right] A \qquad \text{Equation SF-1}$$

   Where:

   V = design volume (ft^3)

   A = watershed area tributary to the sand filter (ft^2)

2. **Basin Geometry:** Use equation SF-2 to calculate the minimum filter area, which is the flat surface of the sand filter. Sediment will reside on the filter area of the sand filter. Therefore, if the filter area is too small, the filter may clog prematurely. If this is of particular concern, increasing the filter area will decrease the frequency of maintenance. The following equation provides the minimum filter area allowing for some of the volume to be stored beyond the area of the filter. **Note that the total**

volume must also equal or exceed the design volume.

The side slopes of the basin should be stable and maintainable. For vegetated side slopes, a 4:1 (horizontal: vertical) minimum slope is recommended. Use vertical walls where side slopes are steeper than 3:1

$$A_F = 0.0125AI \qquad \text{Equation SF-2}$$

Where:

A_F = minimum filter area (flat surface area) (ft^2)

A = area tributary to the sand filter (ft^2)

I = imperviousness of area tributary to the sand filter (percent expressed as a decimal)

Filter Material: Provide, at a minimum, an 18-inch layer of CDOT Class B or C filter material (see Table SF-1). Maintain a flat surface on the top of the sand bed.

Table SF-1. Gradation specifications for CDOT Class B or C filter material
(Source: CDOT Table 703-7)

	CDOT Class B filter material	CDOT Class C filter material
Sieve Size	Mass Percent Passing Square Mesh Sieves	
37.5 mm (1.5")	100	
19.0 mm (0.75")		100
4.75 mm (No.4)	20-60	60-100
1.18 um (No. 16)	10-30	
300 um (No. 50)	0-10	10-30
150 um (No. 100)		0-10
75 um (No. 200)	0-3	0-3

4. **Underdrain System**: Underdrains are typically required for sand filters and should be provided if infiltration tests show rates slower than 2 times that required to drain the WQCV over 12 hours, or where required to divert water away from structures as determined by a professional engineer. Infiltration tests should be performed or supervised by a licensed professional engineer and conducted at a minimum depth equal to the bottom of the sand filter. Additionally, underdrains are required where impermeable membranes are used. There are three basic types of sand filters:

   - **No-Infiltration Section**: This section includes an underdrain and an impermeable liner that prevents infiltration of stormwater into the subgrade soils. Consider using this section when any of the following conditions exist:
     - The site is a stormwater hotspot and infiltration could result in contamination of groundwater.
     - The site is located over contaminated soils and infiltration could mobilize these contaminants.
     - The facility is located over potentially expansive soils or bedrock that could swell due to infiltration and potentially damage adjacent structures (e.g., building foundation or pavement).
   - **Partial Infiltration Section**: This section does not include an impermeable liner, and allows some infiltration. Stormwater that does not infiltrate is collected and removed by an underdrain system.
   - **Full Infiltration Section**: This section is designed to infiltrate the water stored in the basin into the subgrade below. UDFCD recommends a minimum infiltration rate of 2 times the rate needed to drain the WQCV over 12 hours. A conservative design could utilize the partial infiltration section with the addition of a valve at the underdrain outlet. In the event that infiltration does not remain adequate following construction, the valve could be opened and allow this section to operate as a partial infiltration section. It is rare that sand filters are designed to fully infiltrate.

   When using an underdrain system, provide a control orifice sized to drain the design volume in approximately 12 hours or more (see Equation SF-3). Use a minimum orifice size of 3/8 inch to avoid clogging. This will provide detention and slow release of the WQCV to offset hydromodification. Provide cleanouts to allow inspection of the drainpipe system during and after construction to ensure that the pipe was not crushed or disconnected during construction and to allow for maintenance of the underdrain. Space underdrain pipes a maximum of 20 feet on-center.

$$D_{12\text{ hour drain time}} = \sqrt{\frac{V}{1414\, y^{0.41}}}$$ Equation SF-3

   Where:

   D = orifice diameter (in)

   y = distance from the lowest elevation of the storage volume (ft) (i.e., surface of the filter) to the center of the orifice

   V = volume to drain in 12 hours (WQCV) (ft^3)

   In previous versions of this manual, UDFCD recommended that the underdrain be placed in an aggregate layer and that a geotextile (separator fabric) be placed between this aggregate and the growing medium. This version of the manual replaces that section with materials that, when used together, eliminate the need for a separator fabric.

The underdrain system should be placed below the 18-inch (minimum) filter layer. The underdrain system should be placed within an 5-inch-thick section of CDOT Class C filter material meeting the gradation in Table SF-1. Areas of the underdrain layer may be deeper due to the slope of the underdrain. If no underdrain is required, the minimum section can be reduced to the 18-inch filter layer. Use slotted pipe that meets the slot dimensions provided in Table SF-2.

Table SF-2. Dimensions for Slotted Pipe[1]

Pipe Size	Slot Length	Maximum Slot Width	Slot Centers	Open Area (per foot)
4"	1-1/16"	0.032"	0.413"	1.90 in^2
6"	1-3/8"	0.032"	0.516"	1.98 in^2

[1] Pipe must conform to requirements of ASTM designation F949. There shall be no evidence of splitting, cracking, or breaking when the pipe is tested per ASTM test method D2412 in accordance with F949 section 7.5 and ASTM F794 section 8.5. Contech A-2000 slotted pipe (or equal).

Table SF-3. Physical Requirements for Separator Fabric[1]

Property	Class B		Test Method
	Elongation < 50%[2]	Elongation > 50%[2]	
Grab Strength, N (lbs)	800 (180)	510 (115)	ASTM D 4632
Puncture Resistance, N (lbs)	310 (70)	180 (40)	ASTM D 4833
Trapezoidal Tear Strength, N (lbs)	310 (70)	180 (40)	ASTM D 4533
Apparent Opening Size, mm (US Sieve Size)	AOS < 0.3mm (US Sieve Size No. 50)		ASTM D 4751
Permittivity, sec^{-1}	0.02 default value, must also be greater than that of soil		ASTM D 4491
Permeability, cm/sec	k fabric > k soil for all classes		ASTM D 4491
Ultraviolet Degradation at 500 hours	50% strength retained for all classes		ASTM D 4355

[1] Strength values are in the weaker principle direction
[2] As measured in accordance with ASTM D 4632

5. **Impermeable Geomembrane Liner and Geotextile Separator Fabric:** For no-infiltration sections, install a minimum 30-mil thick PVC geomembrane liner, per Table SF-4, on the bottom and sides of the basin, extending up at least to the top of the underdrain layer. Provide at least 9 inches (12 inches if possible) of cover over the membrane where it is attached to the wall to protect the membrane from UV deterioration. The geomembrane should be field-seamed using a dual track welder, which allows for non-destructive testing of almost all field seams. A small amount of single track and/or adhesive seaming should be allowed in limited areas to seam around pipe perforations, to patch seams removed for destructive seam testing, and for limited repairs. The liner should be installed with slack to prevent tearing due to backfill, compaction, and settling. Place CDOT Class B geotextile separator fabric above the geomembrane to protect it from being punctured during the placement of the filter material above the liner. If the subgrade contains angular rocks or other material that could puncture the geomembrane, smooth-roll the surface to create a suitable surface. If smooth-rolling the surface does not provide a suitable surface, also place the separator fabric between the geomembrane and the underlying subgrade. This should only be done when necessary because fabric placed under the geomembrane can increase seepage losses through pinholes or other geomembrane defects. Connect the geomembrane to perimeter concrete walls around the basin perimeter, creating a watertight seal between the geomembrane and the walls using a continuous batten bar and anchor connection (see Figure SF-3). Where the need for the impermeable membrane is not as critical, the membrane can be attached with a nitrile-based vinyl adhesive. Use watertight PVC boots for underdrain pipe penetrations through the liner (see Figure SF-2).

Table SF-4. Physical Requirements for Geomembrane

Property	Thickness 0.76 mm (30 mil)	Test Method
Thickness, % Tolerance	±5	ASTM D 1593
Tensile Strength, kN/m (lbs/in) width	12.25 (70)	ASTM D 882, Method B
Modulus at 100% Elongation, kN/m (lbs/in)	5.25 (30)	ASTM D 882, Method B
Ultimate Elongation, %	350	ASTM D 882, Method A
Tear Resistance, N (lbs)	38 (8.5)	ASTM D 1004
Low Temperature Impact, °C (°F)	-29 (-20)	ASTM D 1790
Volatile loss, % max.	0.7	ASTM D 1203, Method A
Pinholes, No. Per 8 m^2 (No. per 10 sq. yds.) max.	1	N/A
Bonded Seam Strength, % of tensile strength	80	N/A

6. **Inlet Works**: Provide energy dissipation and a forebay at all locations where concentrated flows enter the basin. Use an impact basin for pipes and a baffle chute or grouted sloping boulder drop if a channel or swale is used, or install a Type VL or L riprap basin underlain with geotextile fabric at the inlet (see Figure SF-1). Fill all rock voids with the filter material specified in Table SF-1.

7. **Outlet Works**: Slope the underdrain into a larger outlet structure. As discussed in Step 4, use an orifice plate to drain the WQCV over approximately 12 hours. Flows exceeding the WQCV should also drain into the outlet structure. Additional flow restrictions may be incorporated to provide full spectrum detention, as discussed in the *Storage* chapter of Volume 2, or peak reduction for other specific storm events.

   For full spectrum detention, perform reservoir routing calculations to design the outlet structure. The *UD-Detention* workbook, available at www.udfcd.org, can be used for this purpose. The design could include a second orifice located at the WQCV elevation or could include a downstream point of control designed to drain the full excess urban runoff volume (EURV).

Construction Considerations

Proper construction of sand filters involves careful attention to material specifications and construction details. For a successful project, do the following:

- Protect area from excessive sediment loading during construction. The portion of the site draining to the sand filter must be stabilized before allowing flow into the sand filter.

- When using an impermeable liner, ensure enough slack in the liner to allow for backfill, compaction, and settling without tearing the liner.

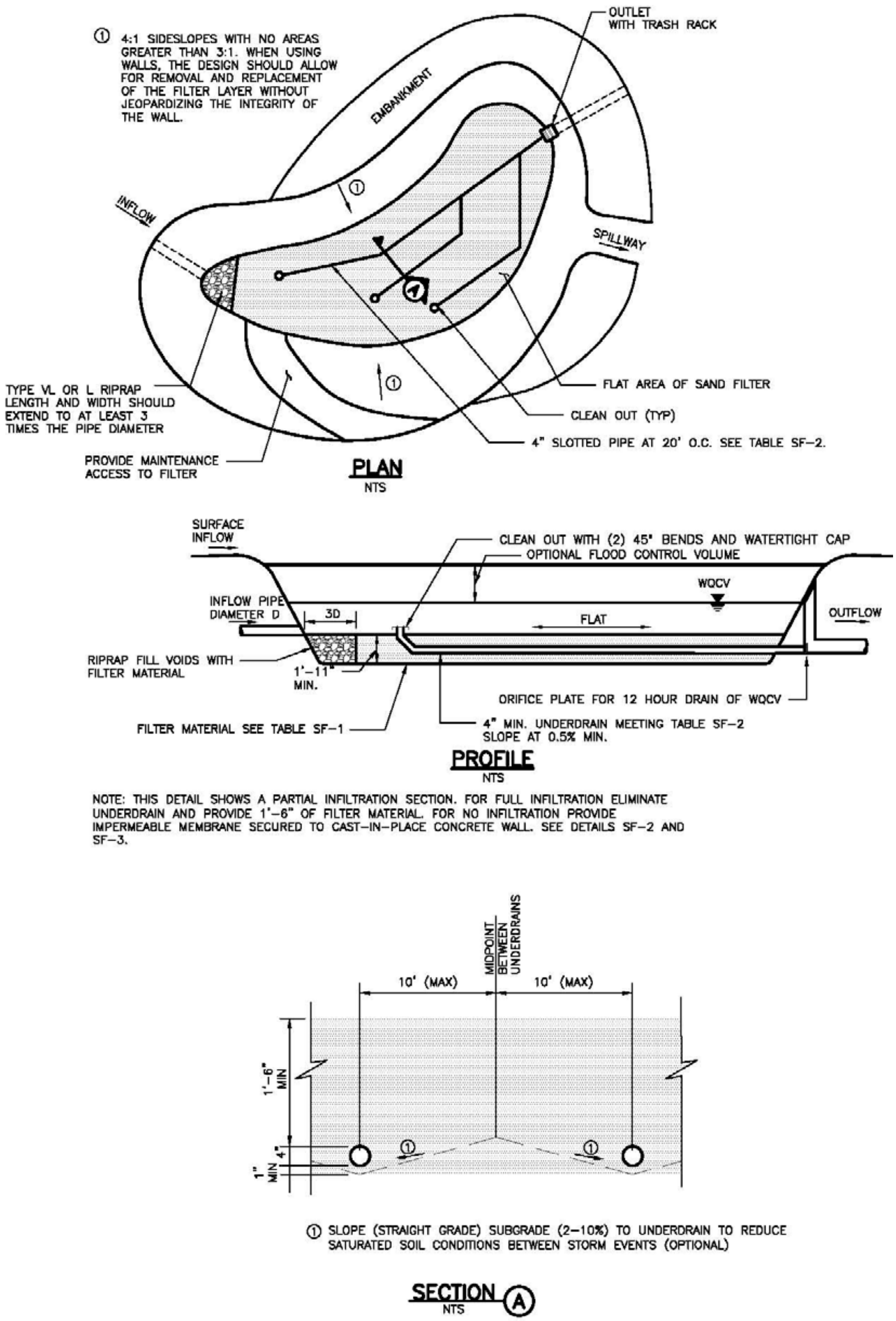


Figure SF-1. Sand Filter Plan and Sections

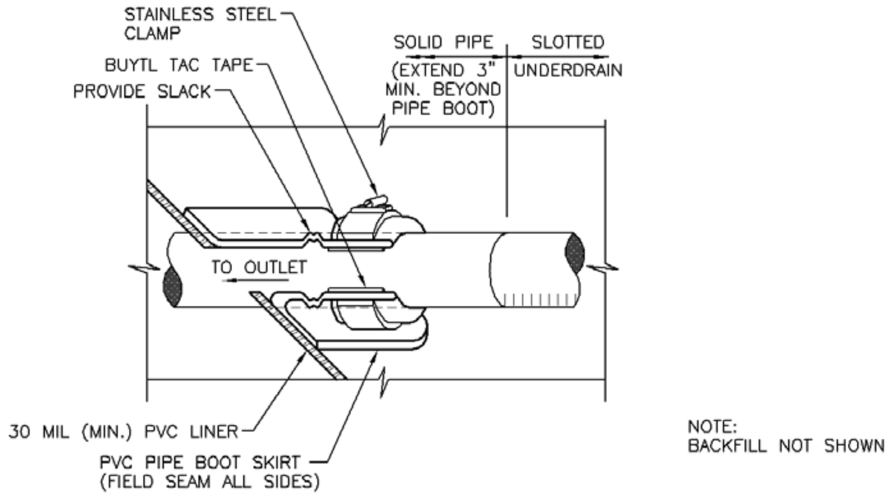


Figure SF-2. Geomembrane Liner/Underdrain Penetration Detail

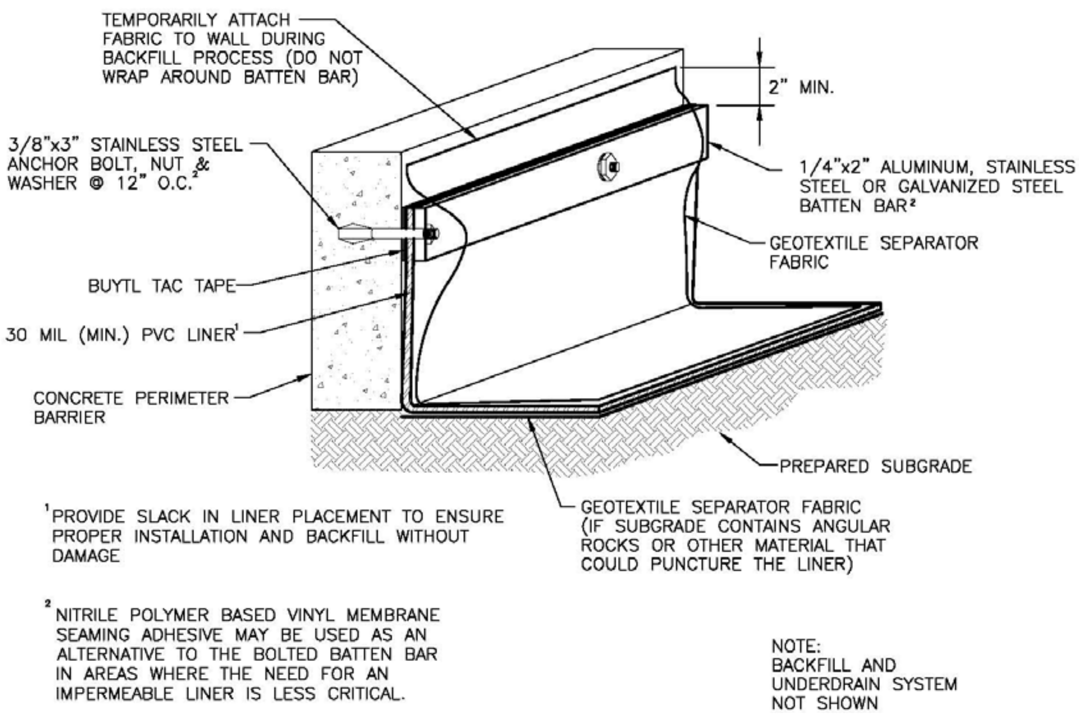


Figure SF-3. Geomembrane Liner/Concrete Connection Detail

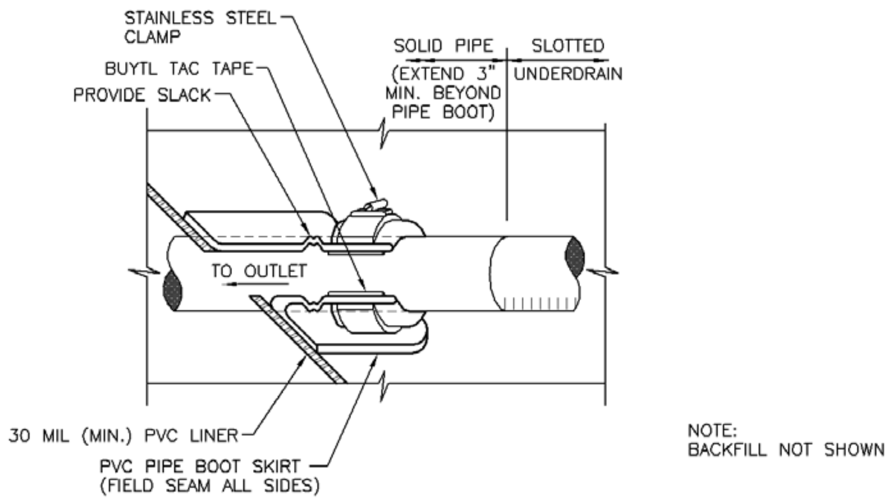


Figure B-2. Geomembrane Liner/Underdrain Penetration Detail

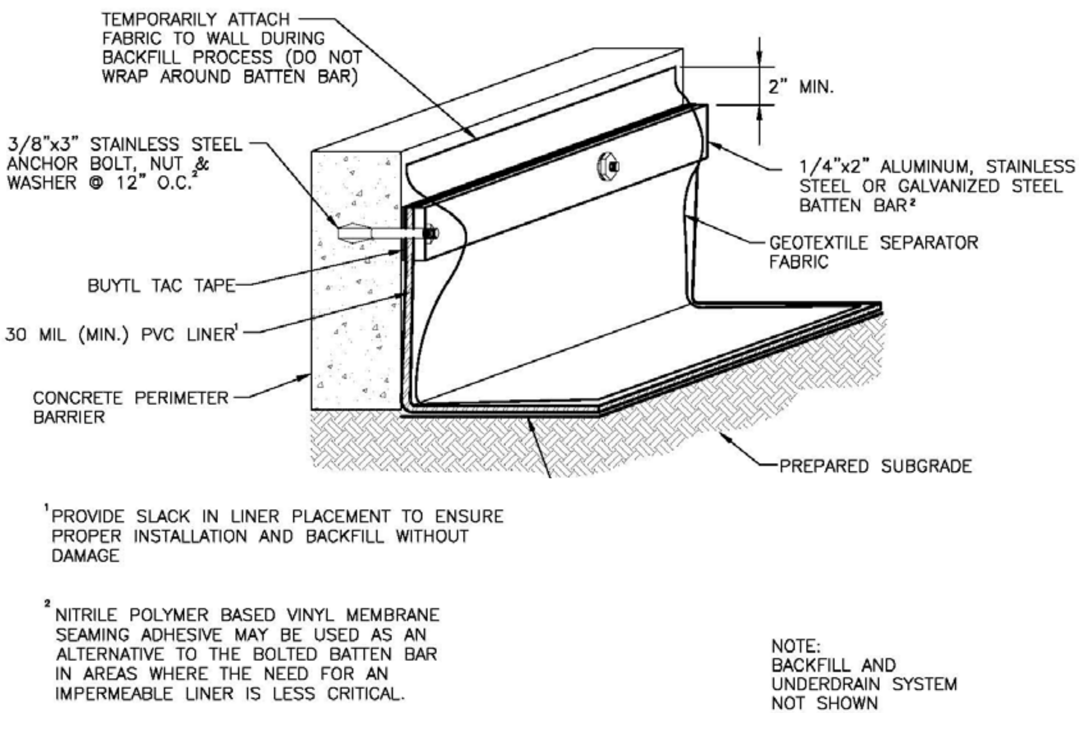


Figure B-3. Geomembrane Liner/Concrete Connection Detail

APPENDIX B

HYDRAULIC CALCULATIONS:

1) DESIGN PROCEDURE FOR SAND FILTERS
2) RATIONAL CALCULATIONS – PROPOSED CONDITOIN

Hammers Construction - RV Storage
Project# HCI001
Area Runoff Coefficient Summary - PROPOSED

			DEVELOPED			***UNDEVELOPED***			***WEIGHTED***	
BASIN	***TOTAL AREA***		***AREA***	***C_5***	***C_{100}***	***AREA***	***C_5***	***C_{100}***	***C_5***	***C_{100}***
	(SF)	***(Acres)***	***(Acres)***			***(Acres)***				
A	146,978	3.37	3.2	0.90	0.96	0.14	0.15	0.20	***0.87***	***0.93***
B	42,879	0.98	1.0	0.90	0.96	0.0	0.15	0.20	***0.90***	***0.96***

Total = 4.36

Calculated by: MBF
Date: 4/21/2017
Checked by: ____________

Hammers Construction - RV Storage

Project# HCI001

Area Drainage Summary - PROPOSED

		WEIGHTED		***OVERLAND***				***STREET / CHANNEL FLOW***					***T_t***	***CA***		***INTENSITY***		***TOTAL FLOW***	
BASIN	***AREA TOTAL (Acres)***	***C_5***	***C_{100}***	***C_5***	***Length (ft)***	***Height (ft)***	***T_C (min)***	***Grass/ Paved***	***Length (ft)***	***Slope (%)***	***Velocity (fps)***	***T_t (min)***	***TOTAL (min)***	***CA_5***	***CA_{100}***	***I_5 (in/hr)***	***I_{100} (in/hr)***	***Q_5 (c.f.s.)***	***Q_{100} (c.f.s.)***
		** For Calcs See Runoff Summary*																	
A	***3.37***	0.87	0.93	0.9	190	17	2.5 0.0 0.0	Paved	572	1.6%	1.4	6.7 0.0 0.0	9.2	2.93	3.13	4.2	7.3	***12***	***23***
B	***0.98***	0.90	0.96	0.9	16	1	0.8 0.0 0.0	Paved	559	1.0%	1.4	6.7 0.0 0.0	7.5	0.89	0.94	4.5	7.9	***4***	***7***

Calculated by: MBF
Date: 4/21/2017
Checked by: ____________

Revise to 100' per DCM 1 Ch.6 3.2.1 overland flow length

Design Procedure Form: Sand Filter (SF)

UD-BMP (Version 3.06, November 2016)

Designer: Mike Farley
Company: Galloway & Company
Date: April 21, 2017
Project: Hammers Construction - RV Storage
Location: Meadowbrook Pwky & Woolsey Hts

1. Basin Storage Volume	
A) Effective Imperviousness of Tributary Area, I_a (100% if all paved and roofed areas upstream of sand filter)	I_a = 89.0 %
B) Tributary Area's Imperviousness Ratio ($i = I_a/100$)	i = 0.890
C) Water Quality Capture Volume (WQCV) Based on 12-hour Drain Time $WQCV = 0.8 * (0.91 * i^3 - 1.19 * i^2 + 0.78 * i)$	WQCV = 0.31 watershed inches
D) Contributing Watershed Area (including sand filter area)	Area = 207,781 sq ft
E) Water Quality Capture Volume (WQCV) Design Volume V_{WQCV} = WQCV / 12 * Area	V_{WQCV} = 5,446 cu ft
F) For Watersheds Outside of the Denver Region, Depth of Average Runoff Producing Storm	d_6 = 0.60 in
G) For Watersheds Outside of the Denver Region, Water Quality Capture Volume (WQCV) Design Volume	$V_{WQCV\ OTHER}$ = 7,598 cu ft
H) User Input of Water Quality Capture Volume (WQCV) Design Volume (Only if a different WQCV Design Volume is desired)	$V_{WQCV\ USER}$ = ______ cu ft
2. Basin Geometry	Complete Sections 2,3, and 4.
A) WQCV Depth	D_{WQCV} = ______ ft
B) Sand Filter Side Slopes (Horizontal distance per unit vertical, 4:1 or flatter preferred). Use "0" if sand filter has vertical walls.	Z = ______ ft / ft
C) Minimum Filter Area (Flat Surface Area)	A_{Min} = ______ sq ft
D) Actual Filter Area	A_{Actual} = ______ sq ft
E) Volume Provided	V_T = ______ cu ft
3. Filter Material	Choose One ○ 18" CDOT Class B or C Filter Material ○ Other (Explain):
4. Underdrain System	
A) Are underdrains provided?	Choose One ◉ YES ○ NO
B) Underdrain system orifice diameter for 12 hour drain time	
i) Distance From Lowest Elevation of the Storage Volume to the Center of the Orifice	y = ______ ft
ii) Volume to Drain in 12 Hours	Vol_{12} = N/A cu ft
iii) Orifice Diameter, 3/8" Minimum	D_O = ______ in

Design Procedure Form: Sand Filter (SF)

Designer:	**Mike Farley**
Company:	**Galloway & Company**
Date:	**April 21, 2017**
Project:	**Hammers Construction - RV Storage**
Location:	**Meadowbrook Pwky & Woolsey Hts**

5. Impermeable Geomembrane Liner and Geotextile Separator Fabric

A) Is an impermeable liner provided due to proximity of structures or groundwater contamination?

Choose One

◉ YES ○ NO

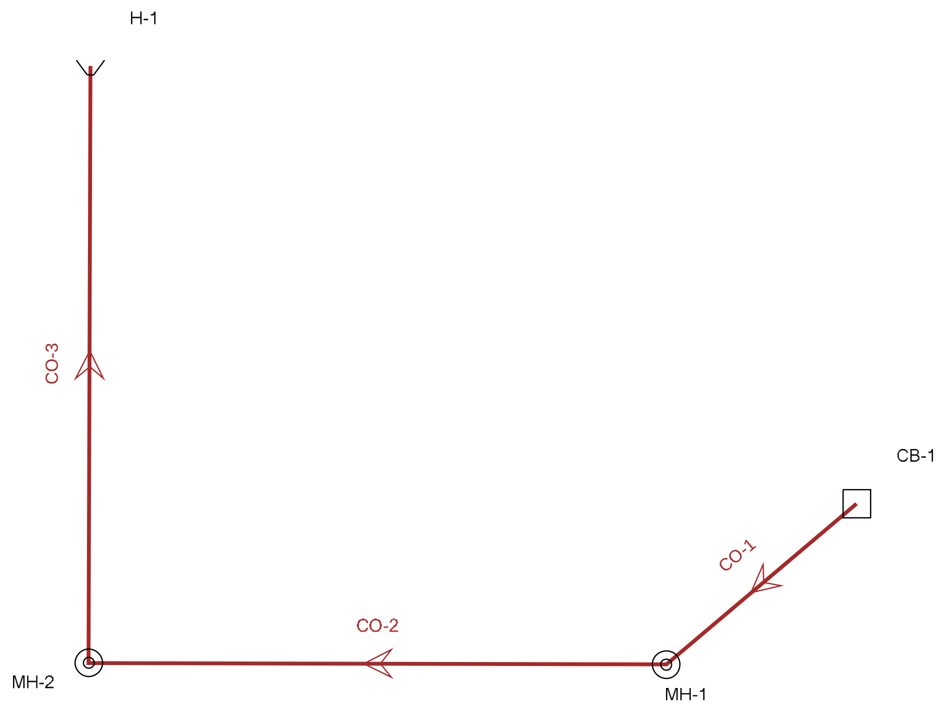
PROVIDE A 30 MIL (MIN) PVC GEOMEMBRANE PER TABLE SF-4 WITH SEPARATOR FABRIC (PER TABLE SF-3) ABOVE IT. PROVIDE SEPARATOR FABRIC BELOW THE GEOMEMBRANE AS WELL IF SUBGRADE IS ANGULAR OR COULD OTHERWISE PUNCTURE THE GEOMEMBRANE.

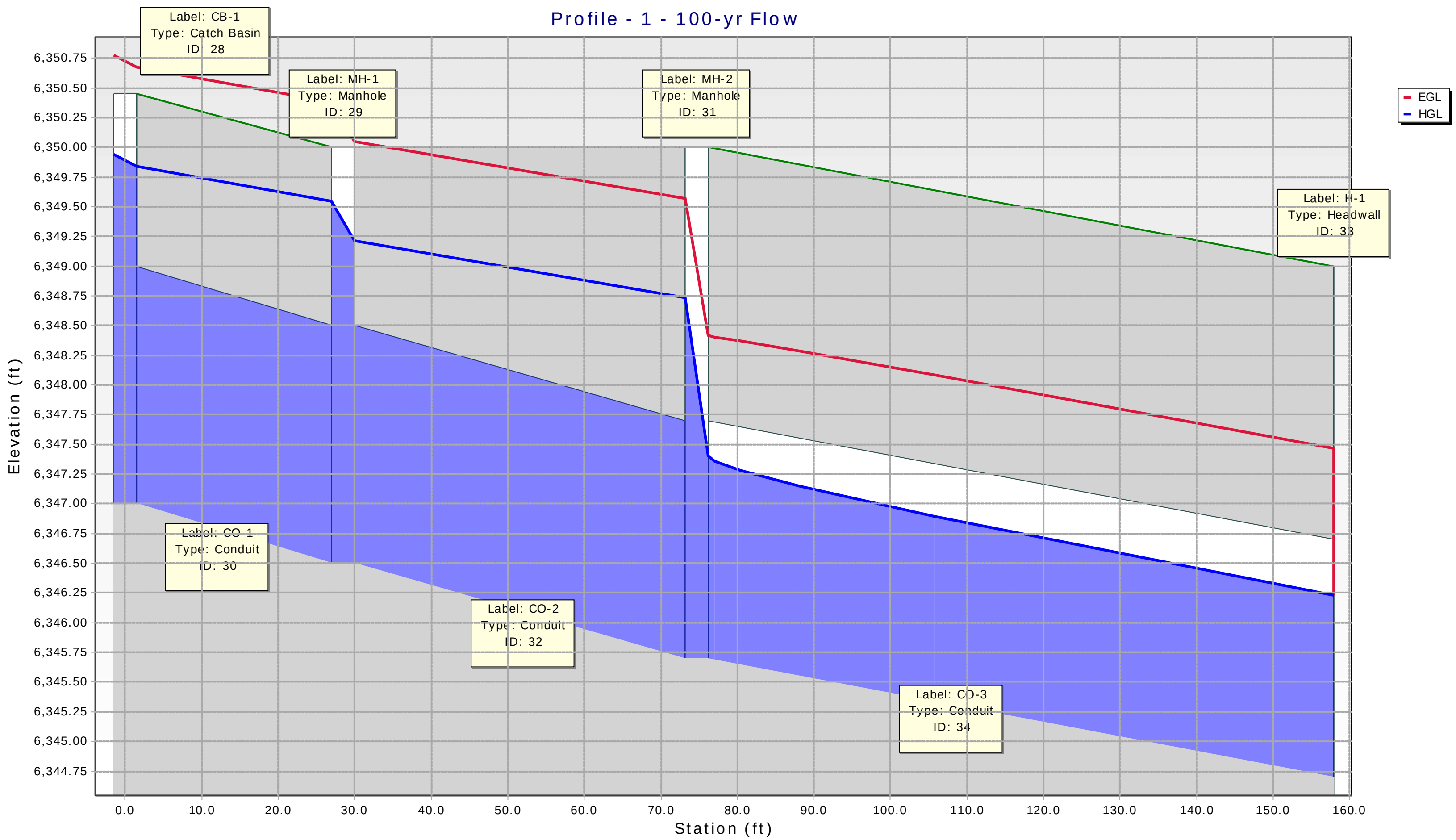
6-7. Inlet / Outlet Works

A) Describe the type of energy dissipation at inlet points and means of conveying flows in excess of the WQCV through the outlet

Notes:

Scenario: 100-yr Flow





Profile - 1 - 100-yr Flow
Label: CB-1
Type: Catch Basin
ID: 28
Label: MH-1
Type: Manhole
ID: 29
Label: MH-2
Type: Manhole
ID: 31
Label: H-1
Type: Headwall
ID: 33
Label: CO-1
Type: Conduit
ID: 30
Label: CO-2
Type: Conduit
ID: 32
Label: CO-3
Type: Conduit
ID: 34
EGL
HGL
Elevation (ft)
6,350.75
6,350.50
6,350.25
6,350.00
6,349.75
6,349.50
6,349.25
6,349.00
6,348.75
6,348.50
6,348.25
6,348.00
6,347.75
6,347.50
6,347.25
6,347.00
6,346.75
6,346.50
6,346.25
6,346.00
6,345.75
6,345.50
6,345.25
6,345.00
6,344.75
Station (ft)
0.0
10.0
20.0
30.0
40.0
50.0
60.0
70.0
80.0
90.0
100.0
110.0
120.0
130.0
140.0
150.0
160.0

FlexTable: Conduit Table

ID	Label	Start Node	Invert (Start) (ft)	Stop Node	Invert (Stop) (ft)	Length (User Defined) (ft)	Slope (Calculated) (ft/ft)
30	CO-1	CB-1	6,347.00	MH-1	6,346.50	28.4	0.018
32	CO-2	MH-1	6,346.50	MH-2	6,345.70	46.2	0.017
34	CO-3	MH-2	6,345.70	H-1	6,344.70	83.3	0.012

Diameter (in)	Manning's n	Flow (cfs)	Velocity (ft/s)	Capacity (Full Flow) (cfs)	Flow / Capacity (Design) (%)	Hydraulic Grade Line (In) (ft)	Hydraulic Grade Line (Out) (ft)
24.0	0.013	23.00	7.32	30.02	76.6	6,349.84	6,349.55
24.0	0.013	23.00	7.32	29.75	77.3	6,349.22	6,348.74
24.0	0.013	23.00	8.96	24.79	92.8	6,347.41	6,346.23

APPENDIX C

NRCS Soil Study

United States Department of Agriculture

Natural Resources Conservation Service

A product of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local participants

Custom Soil Resource Report for

El Paso County Area, Colorado

Hammers Construction - RV Storage

April 18, 2017

Preface

Soil surveys contain information that affects land use planning in survey areas. They highlight soil limitations that affect various land uses and provide information about the properties of the soils in the survey areas. Soil surveys are designed for many different users, including farmers, ranchers, foresters, agronomists, urban planners, community officials, engineers, developers, builders, and home buyers. Also, conservationists, teachers, students, and specialists in recreation, waste disposal, and pollution control can use the surveys to help them understand, protect, or enhance the environment.

Various land use regulations of Federal, State, and local governments may impose special restrictions on land use or land treatment. Soil surveys identify soil properties that are used in making various land use or land treatment decisions. The information is intended to help the land users identify and reduce the effects of soil limitations on various land uses. The landowner or user is responsible for identifying and complying with existing laws and regulations.

Although soil survey information can be used for general farm, local, and wider area planning, onsite investigation is needed to supplement this information in some cases. Examples include soil quality assessments (http://www.nrcs.usda.gov/wps/portal/nrcs/main/soils/health/) and certain conservation and engineering applications. For more detailed information, contact your local USDA Service Center (https://offices.sc.egov.usda.gov/locator/app?agency=nrcs) or your NRCS State Soil Scientist (http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/contactus/?cid=nrcs142p2_053951).

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

The National Cooperative Soil Survey is a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local agencies. The Natural Resources Conservation Service (NRCS) has leadership for the Federal part of the National Cooperative Soil Survey.

Information about soils is updated periodically. Updated information is available through the NRCS Web Soil Survey, the site for official soil survey information.

The U.S. Department of Agriculture (USDA) prohibits discrimination in all its programs and activities on the basis of race, color, national origin, age, disability, and where applicable, sex, marital status, familial status, parental status, religion, sexual orientation, genetic information, political beliefs, reprisal, or because all or a part of an individual's income is derived from any public assistance program. (Not all prohibited bases apply to all programs.) Persons with disabilities who require alternative means for communication of program information (Braille, large print, audiotape, etc.) should contact USDA's TARGET Center at (202) 720-2600 (voice and TDD). To file a complaint of discrimination, write to USDA, Director, Office of Civil Rights, 1400 Independence Avenue, S.W., Washington, D.C. 20250-9410 or call (800) 795-3272 (voice) or (202) 720-6382 (TDD). USDA is an equal opportunity provider and employer.

Contents

How Soil Surveys Are Made

Soil surveys are made to provide information about the soils and miscellaneous areas in a specific area. They include a description of the soils and miscellaneous areas and their location on the landscape and tables that show soil properties and limitations affecting various uses. Soil scientists observed the steepness, length, and shape of the slopes; the general pattern of drainage; the kinds of crops and native plants; and the kinds of bedrock. They observed and described many soil profiles. A soil profile is the sequence of natural layers, or horizons, in a soil. The profile extends from the surface down into the unconsolidated material in which the soil formed or from the surface down to bedrock. The unconsolidated material is devoid of roots and other living organisms and has not been changed by other biological activity.

Currently, soils are mapped according to the boundaries of major land resource areas (MLRAs). MLRAs are geographically associated land resource units that share common characteristics related to physiography, geology, climate, water resources, soils, biological resources, and land uses (USDA, 2006). Soil survey areas typically consist of parts of one or more MLRA.

The soils and miscellaneous areas in a survey area occur in an orderly pattern that is related to the geology, landforms, relief, climate, and natural vegetation of the area. Each kind of soil and miscellaneous area is associated with a particular kind of landform or with a segment of the landform. By observing the soils and miscellaneous areas in the survey area and relating their position to specific segments of the landform, a soil scientist develops a concept, or model, of how they were formed. Thus, during mapping, this model enables the soil scientist to predict with a considerable degree of accuracy the kind of soil or miscellaneous area at a specific location on the landscape.

Commonly, individual soils on the landscape merge into one another as their characteristics gradually change. To construct an accurate soil map, however, soil scientists must determine the boundaries between the soils. They can observe only a limited number of soil profiles. Nevertheless, these observations, supplemented by an understanding of the soil-vegetation-landscape relationship, are sufficient to verify predictions of the kinds of soil in an area and to determine the boundaries.

Soil scientists recorded the characteristics of the soil profiles that they studied. They noted soil color, texture, size and shape of soil aggregates, kind and amount of rock fragments, distribution of plant roots, reaction, and other features that enable them to identify soils. After describing the soils in the survey area and determining their properties, the soil scientists assigned the soils to taxonomic classes (units). Taxonomic classes are concepts. Each taxonomic class has a set of soil characteristics with precisely defined limits. The classes are used as a basis for comparison to classify soils systematically. Soil taxonomy, the system of taxonomic classification used in the United States, is based mainly on the kind and character of soil properties and the arrangement of horizons within the profile. After the soil scientists classified and named the soils in the survey area, they compared the individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

The objective of soil mapping is not to delineate pure map unit components; the objective is to separate the landscape into landforms or landform segments that have similar use and management requirements. Each map unit is defined by a unique combination of soil components and/or miscellaneous areas in predictable proportions. Some components may be highly contrasting to the other components of the map unit. The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The delineation of such landforms and landform segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, onsite investigation is needed to define and locate the soils and miscellaneous areas.

Soil scientists make many field observations in the process of producing a soil map. The frequency of observation is dependent upon several factors, including scale of mapping, intensity of mapping, design of map units, complexity of the landscape, and experience of the soil scientist. Observations are made to test and refine the soil-landscape model and predictions and to verify the classification of the soils at specific locations. Once the soil-landscape model is refined, a significantly smaller number of measurements of individual soil properties are made and recorded. These measurements may include field measurements, such as those for color, depth to bedrock, and texture, and laboratory measurements, such as those for content of sand, silt, clay, salt, and other components. Properties of each soil typically vary from one point to another across the landscape.

Observations for map unit components are aggregated to develop ranges of characteristics for the components. The aggregated values are presented. Direct measurements do not exist for every property presented for every map unit component. Values for some properties are estimated from combinations of other properties.

While a soil survey is in progress, samples of some of the soils in the area generally are collected for laboratory analyses and for engineering tests. Soil scientists interpret the data from these analyses and tests as well as the field-observed characteristics and the soil properties to determine the expected behavior of the soils under different uses. Interpretations for all of the soils are field tested through observation of the soils in different uses and under different levels of management. Some interpretations are modified to fit local conditions, and some new interpretations are developed to meet local needs. Data are assembled from other sources, such as research information, production records, and field experience of specialists. For example, data on crop yields under defined levels of management are assembled from farm records and from field or plot experiments on the same kinds of soil.

Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can predict with a fairly high degree of accuracy that a given soil will have a high water table within certain depths in most years, but they cannot predict that a high water table will always be at a specific level in the soil on a specific date.

After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

Soil Map

The soil map section includes the soil map for the defined area of interest, a list of soil map units on the map and extent of each map unit, and cartographic symbols displayed on the map. Also presented are various metadata about data used to produce the map, and a description of each soil map unit.

Custom Soil Resource Report
Soil Map

Map Scale: 1:1,290 if printed on A landscape (11" x 8.5") sheet.

Meters: 0, 15, 30, 60, 90

Feet: 0, 50, 100, 200, 300

N

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 13N WGS84

MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils
- Soil Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

Special Point Features
- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other
- Special Line Features

Water Features
- Streams and Canals

Transportation
- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background
- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:24,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: El Paso County Area, Colorado
Survey Area Data: Version 14, Sep 23, 2016

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Jun 3, 2014—Jun 17, 2014

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

El Paso County Area, Colorado (CO625)			
Map Unit Symbol	**Map Unit Name**	**Acres in AOI**	**Percent of AOI**
8	Blakeland loamy sand, 1 to 9 percent slopes	4.6	84.7%
28	Ellicott loamy coarse sand, 0 to 5 percent slopes	0.8	15.3%
Totals for Area of Interest		**5.5**	**100.0%**

Map Unit Descriptions

The map units delineated on the detailed soil maps in a soil survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions, along with the maps, can be used to determine the composition and properties of a unit.

A map unit delineation on a soil map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some minor components that belong to taxonomic classes other than those of the major soils.

Most minor soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, components. They may or may not be mentioned in a particular map unit description. Other minor components, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, components. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. If included in the database for a given area, the contrasting minor components are identified in the map unit descriptions along with some characteristics of each. A few areas of minor components may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into landforms or landform segments that have similar use and management requirements. The delineation of such segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, however, onsite investigation is needed to define and locate the soils and miscellaneous areas.

An identifying symbol precedes the map unit name in the map unit descriptions. Each description includes general facts about the unit and gives important soil properties and qualities.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer, slope, stoniness, salinity, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Alpha silt loam, 0 to 2 percent slopes, is a phase of the Alpha series.

Some map units are made up of two or more major soils or miscellaneous areas. These map units are complexes, associations, or undifferentiated groups.

A *complex* consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Alpha-Beta complex, 0 to 6 percent slopes, is an example.

An *association* is made up of two or more geographically associated soils or miscellaneous areas that are shown as one unit on the maps. Because of present or anticipated uses of the map units in the survey area, it was not considered practical or necessary to map the soils or miscellaneous areas separately. The pattern and relative proportion of the soils or miscellaneous areas are somewhat similar. Alpha-Beta association, 0 to 2 percent slopes, is an example.

An *undifferentiated group* is made up of two or more soils or miscellaneous areas that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils or miscellaneous areas in a mapped area are not uniform. An area can be made up of only one of the major soils or miscellaneous areas, or it can be made up of all of them. Alpha and Beta soils, 0 to 2 percent slopes, is an example.

Some surveys include *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Rock outcrop is an example.

El Paso County Area, Colorado

8—Blakeland loamy sand, 1 to 9 percent slopes

Map Unit Setting

National map unit symbol: 369v
Elevation: 4,600 to 5,800 feet
Mean annual precipitation: 14 to 16 inches
Mean annual air temperature: 46 to 48 degrees F
Frost-free period: 125 to 145 days
Farmland classification: Not prime farmland

Map Unit Composition

Blakeland and similar soils: 85 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Blakeland

Setting

Landform: Flats, hills
Landform position (three-dimensional): Side slope, talf
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium derived from sedimentary rock and/or eolian deposits derived from sedimentary rock

Typical profile

A - 0 to 11 inches: loamy sand
AC - 11 to 27 inches: loamy sand
C - 27 to 60 inches: sand

Properties and qualities

Slope: 1 to 9 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Somewhat excessively drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): High to very high (5.95 to 19.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 5 percent
Available water storage in profile: Low (about 4.5 inches)

Interpretive groups

Land capability classification (irrigated): 3e
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: A
Ecological site: Sandy Foothill (R049BY210CO)
Hydric soil rating: No

Minor Components

Other soils

Percent of map unit:
Hydric soil rating: No

Pleasant

Percent of map unit:
Landform: Depressions
Hydric soil rating: Yes

28—Ellicott loamy coarse sand, 0 to 5 percent slopes

Map Unit Setting

National map unit symbol: 3680
Elevation: 5,500 to 6,500 feet
Mean annual precipitation: 13 to 15 inches
Mean annual air temperature: 47 to 50 degrees F
Frost-free period: 125 to 145 days
Farmland classification: Not prime farmland

Map Unit Composition

Ellicott and similar soils: 85 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Ellicott

Setting

Landform: Flood plains, stream terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Sandy alluvium

Typical profile

A - 0 to 4 inches: loamy coarse sand
C - 4 to 60 inches: stratified coarse sand to sandy loam

Properties and qualities

Slope: 0 to 5 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Somewhat excessively drained
Runoff class: Very low
Capacity of the most limiting layer to transmit water (Ksat): High to very high (5.95 to 19.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: Frequent
Frequency of ponding: None
Available water storage in profile: Low (about 4.1 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7w
Hydrologic Soil Group: A
Ecological site: Sandy Bottomland LRU's A & B (R069XY031CO)
Other vegetative classification: SANDY BOTTOMLAND (069AY031CO)

Hydric soil rating: No

Minor Components

Fluvaquentic haplaquoll

Percent of map unit:
Landform: Swales
Hydric soil rating: Yes

Other soils

Percent of map unit:
Hydric soil rating: No

Pleasant

Percent of map unit:
Landform: Depressions
Hydric soil rating: Yes

Soil Information for All Uses

Soil Properties and Qualities

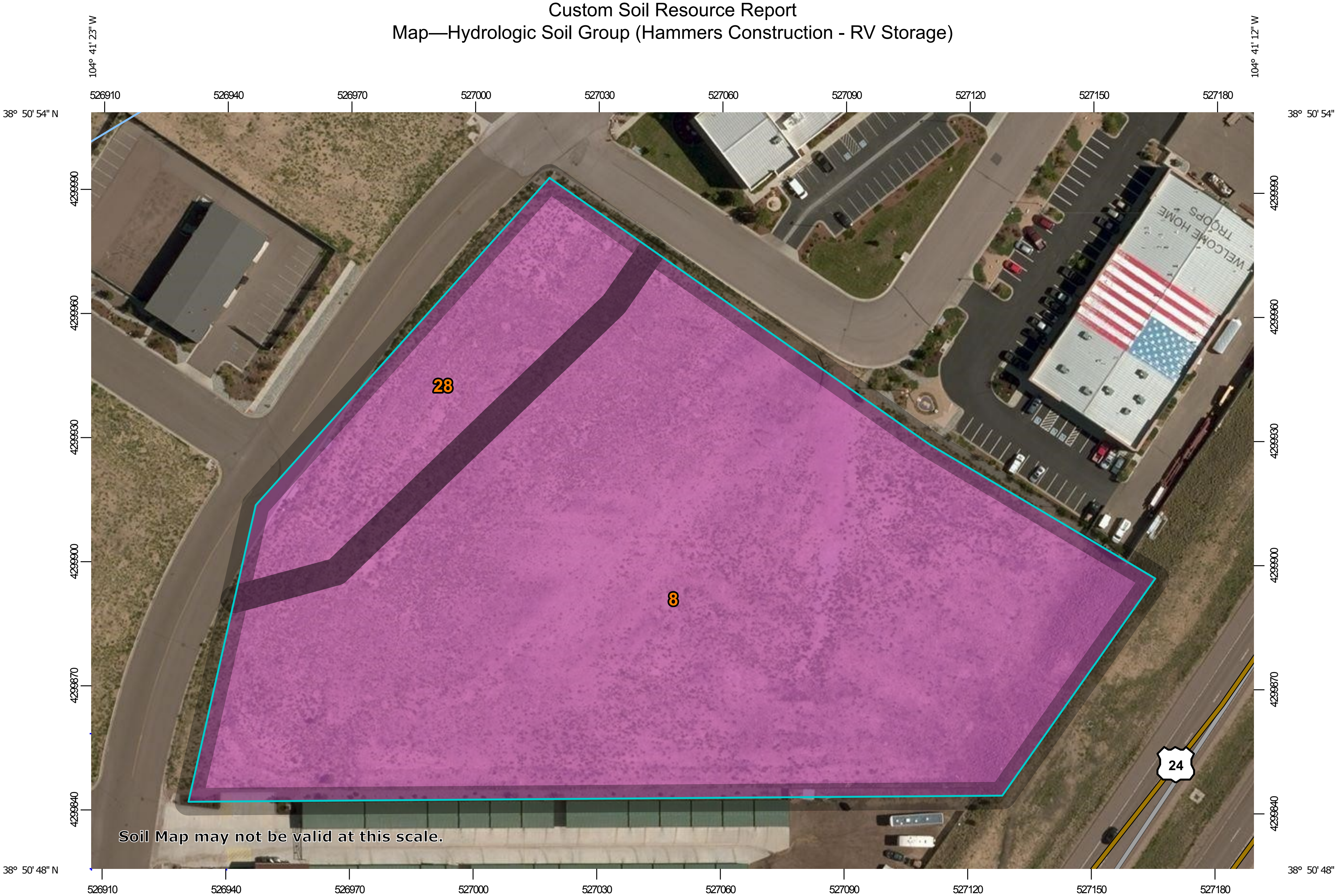
The Soil Properties and Qualities section includes various soil properties and qualities displayed as thematic maps with a summary table for the soil map units in the selected area of interest. A single value or rating for each map unit is generated by aggregating the interpretive ratings of individual map unit components. This aggregation process is defined for each property or quality.

Soil Qualities and Features

Soil qualities are behavior and performance attributes that are not directly measured, but are inferred from observations of dynamic conditions and from soil properties. Example soil qualities include natural drainage, and frost action. Soil features are attributes that are not directly part of the soil. Example soil features include slope and depth to restrictive layer. These features can greatly impact the use and management of the soil.

Hydrologic Soil Group (Hammers Construction - RV Storage)

Custom Soil Resource Report
Map—Hydrologic Soil Group (Hammers Construction - RV Storage)



Map Scale: 1:1,290 if printed on A landscape (11" x 8.5") sheet.

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 13N WGS84

MAP LEGEND

Area of Interest (AOI)

- Area of Interest (AOI)

Soils

Soil Rating Polygons

- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Soil Rating Lines

- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Soil Rating Points

- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Water Features

- Streams and Canals

Transportation

- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background

- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:24,000.

Warning: Soil Map may not be valid at this scale.

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Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: El Paso County Area, Colorado
Survey Area Data: Version 14, Sep 23, 2016

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Jun 3, 2014—Jun 17, 2014

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Table—Hydrologic Soil Group (Hammers Construction - RV Storage)

Hydrologic Soil Group— Summary by Map Unit — El Paso County Area, Colorado (CO625)				
Map unit symbol	**Map unit name**	**Rating**	**Acres in AOI**	**Percent of AOI**
8	Blakeland loamy sand, 1 to 9 percent slopes	A	4.6	84.7%
28	Ellicott loamy coarse sand, 0 to 5 percent slopes	A	0.8	15.3%
Totals for Area of Interest			**5.5**	**100.0%**

Rating Options—Hydrologic Soil Group (Hammers Construction - RV Storage)

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

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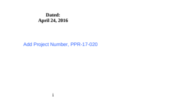
Markup Summary

1 (1)



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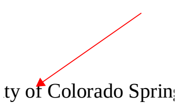
Add Project Number, PPR-17-020

2 (5)



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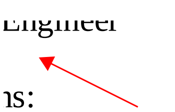

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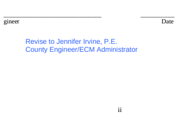

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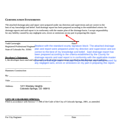
Revise to Jennifer Irvine, P.E.
County Engineer/ECM Administrator



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Replace with the standard county signature block: The attached drainage plan and report were prepared under my direction and supervision and are correct to the best of my knowledge and belief. Said drainage report has been prepared according to the criteria established by the County for drainage reports and said report is in conformity with the applicable master plan of the drainage basin. I accept responsibility for any liability caused by any negligent acts, errors or omissions on my part in preparing this report.

Subject: Text Box
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Revise to standard county signature block: Filed in accordance with the requirements of the Drainage Criteria Manual, Volumes 1 and 2, El Paso County Engineering Criteria Manual and Land Development Code as amended.

4 (1)

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Revise the process to the counties four step process; section I.7.2A of the ECM.

5 (1)

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Add previous drainage report

7 (1)

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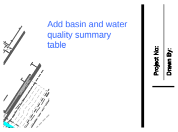
Add North arrow

8 (7)



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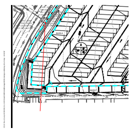
Add basin and water quality summary table



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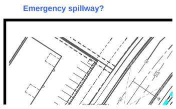

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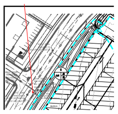
Emergency spillway?



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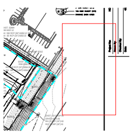

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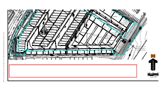

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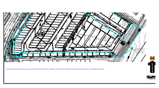

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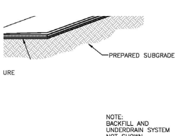
Add private on-site inlet to account for 5 and 100 year surface runoff which will tie into existing storm line on Meadow brook.

19 (1)



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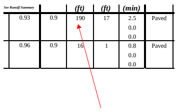

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Revise to 100' per DCM 1 Ch.6 3.2.1 overland flow length

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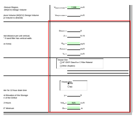
Revise to 100' per DCM 1 Ch.6 3.2.1 overland flow length

23 (2)



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Complete Sections 2,3, and 4.

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Complete Sections 2,3, and 4.