

Appendix C

High Priority Concept Summaries

Adams' Farm East Gut (SG-G-2)
Divi Casino (TH-R-2A)
Divi Hotel/Resort (TH-R-3A)
Chenay Bay (SG-R-20A)
East End Bay Trail (TH-R-1)
Fire Station (SB-R-1B/A)
Goat Hill Rd. (TB-RC-4)
Milgie's Grocery Store (GP-RC-2)
Reef Golf Course (TB-R-3B/A; TB-G-1)
Ridge Rd. at Rt. 82(TB-RC-3)
Seven Flags Rd. (SB-R-3/SB-RC-9)
St. Croix Yacht Club (TB-R-2B)
Unnamed Rd. (GP-RC-33)

Adams' Farm (East Gut) Southgate

Project ID: SG-G-2

Type: Gut stabilization

Description: This concept is focused on the prevention of further migration of a 10'-12' deep, three-lobed headcut that is actively eroding southward across Adam's Farm cattle and horse pastureland towards an existing impoundment. The estimated drainage area to the gut is 130 acres. The estimated rate of headcut migration is approximately 10 ft/year based on a mapping analysis between comparing the location of the headcut perimeter between 2007 and 2011. This is consistent with anecdotal reports from the property owner estimating 10-15 ft/yr and is equivalent to erosion of almost 500 cubic yards of material. This concept involves the formalization and re-vegetation of the overland flow path between the pond and the gut, as well as the excavation, re-grading, and stabilization of the top of the gut.

Constraints: None. Access is good. It should be noted that stabilization with concrete and riprap is not necessarily the preferred approach to gut restoration; however, in this instance, a combination of "hard" and "soft" solutions is proposed.

Key Design Elements:

1. Installation of a culvert under dirt driveway that is designed to pass the 1-yr rainfall event;
2. Proposed 330 ft channel stabilized with turf reinforcement mat to convey overland flows to the existing gut;
3. Installation of a cattle crossing pad across for restricted, stabilized access across grass channel;
4. Use of a boulder drop structure to convey flows down into gut without additional erosion;

5. Grouted boulder low flow channel with 4:1 side slopes stabilized with coir fabric and local plantings; and
6. Two additional boulder drop structures (length ~100 ft) two convey flow from side lobes into grouted boulder low flow channel.

See more detailed design plan set at: www.horsleywitten.com/stx-east-end-watersheds/designs.html



Existing impoundment above headcut.

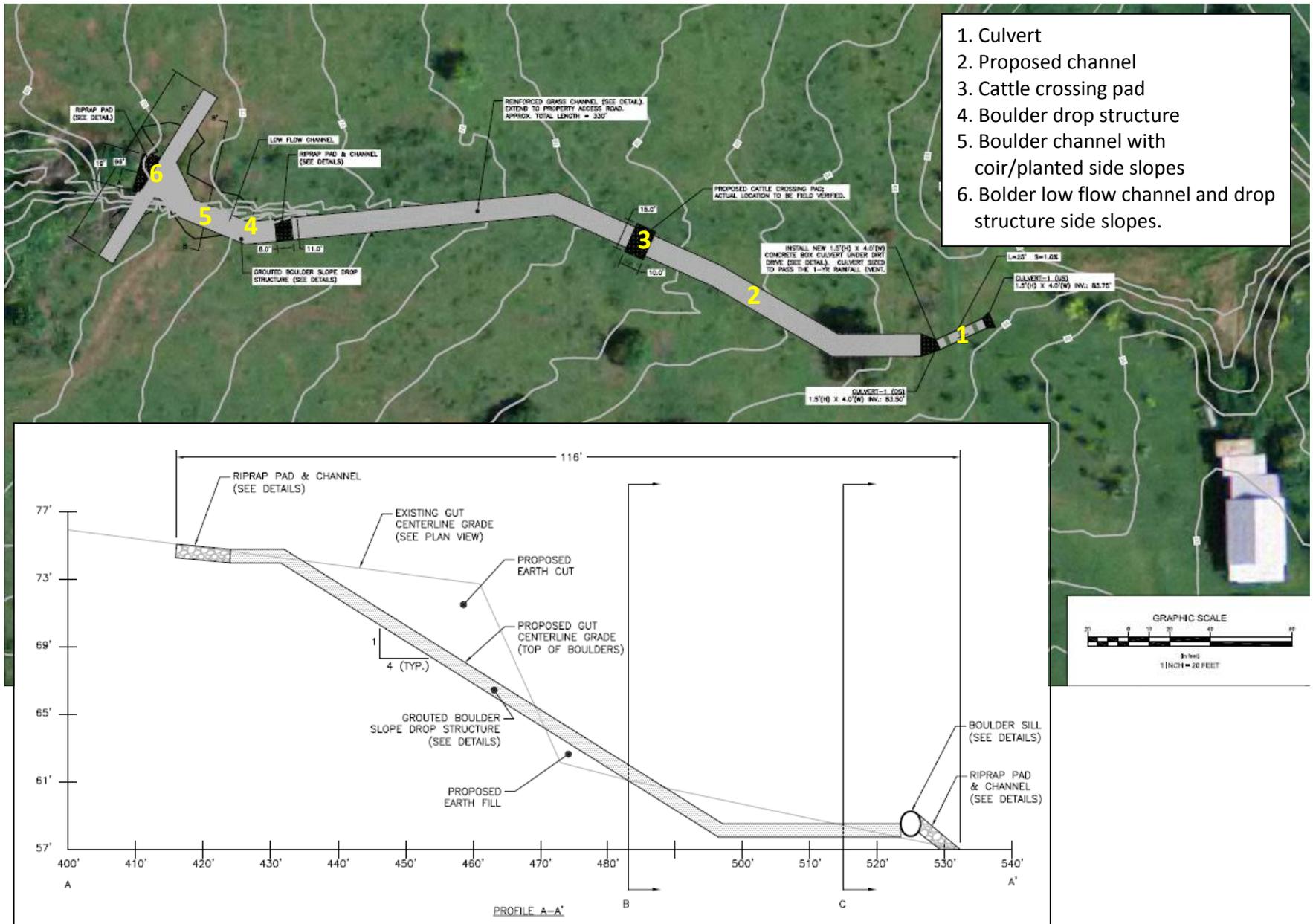


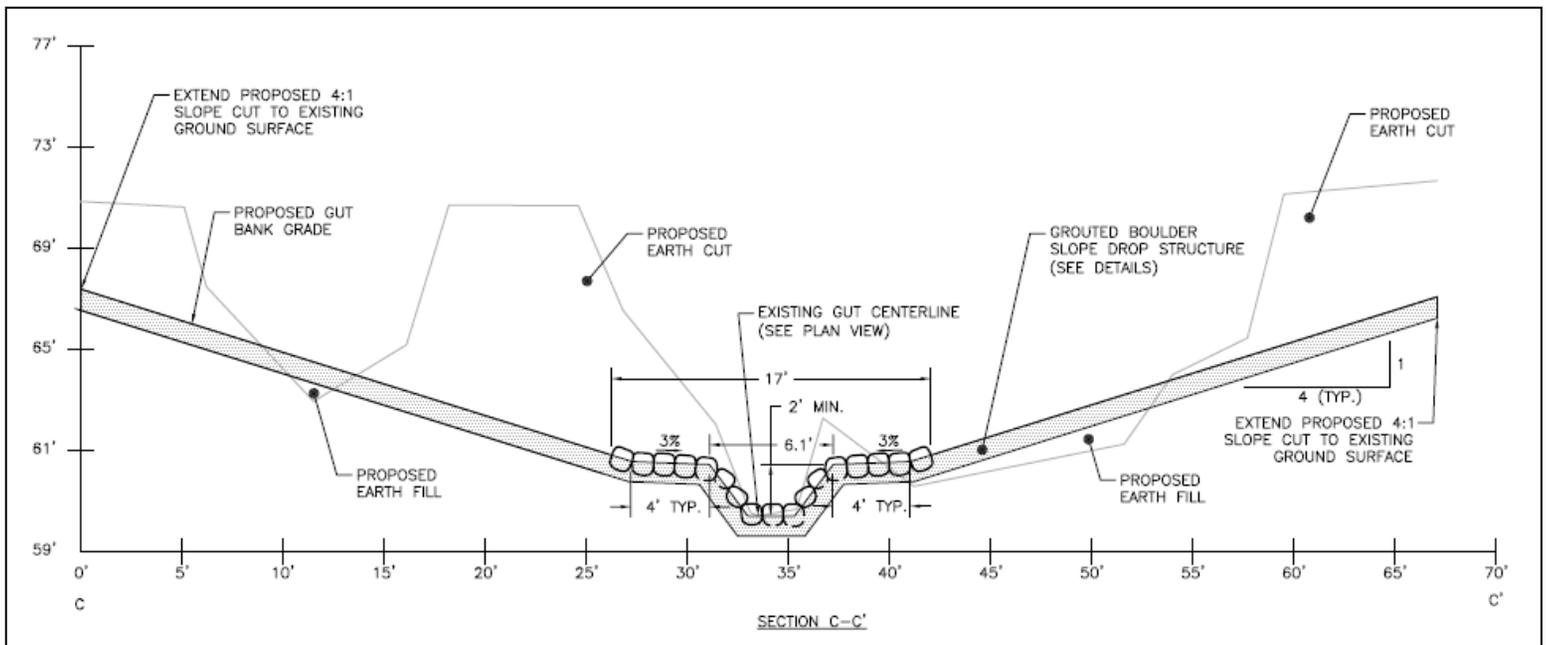
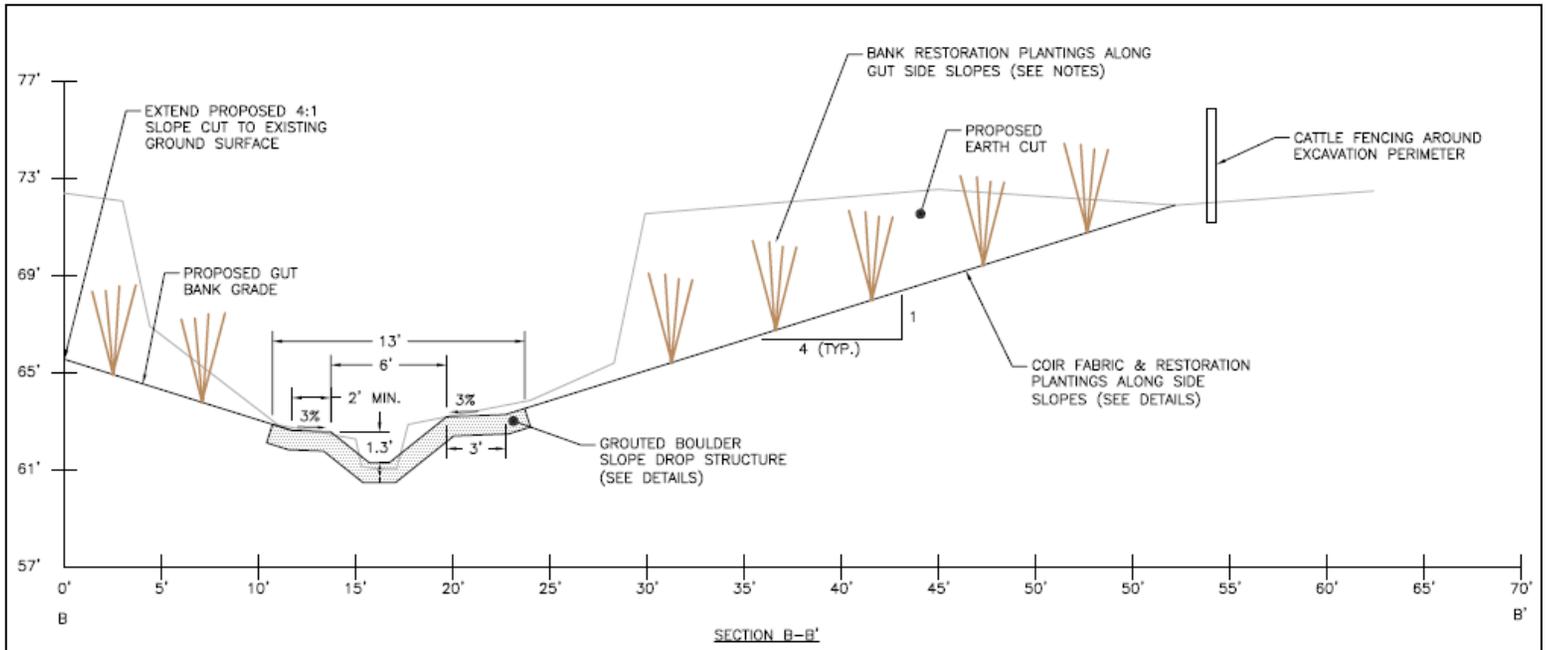
Existing overland flow path, and site of proposed reinforced channel.



The uppermost of three-lobed headcut.

Site Map:





Planning Level Cost Estimate:

**ADAMS' GUT RESTORATION
ESTIMATE OF CONSTRUCTION QUANTITIES & COSTS
ST. CROIX, USVI**

SEPT. 2011

Quantities listed are estimates only and not guaranteed to approximate the actual amounts to be used.

ITEM NUMBER	DESCRIPTION	ESTIMATED QUANTITY	UNIT	UNIT PRICE	STX UNIT PRICE	TOTAL AMOUNT
1.01	MOBILIZATION/DEMobilIZATION	1	LUMP SUM	-	\$10,000.00	\$10,000
1.02	SITE CLEARING & GRUBBING	580	SQUARE YARD	\$2.50	\$3.25	\$1,900
1.03	EXCAVATION	500	CUBIC YARD	-	\$27.00	\$13,500
1.04	FINE GRADING AND COMPACTION	1,200	SQUARE YARD	\$2.00	\$2.60	\$3,200
1.05	CLEAN SAND	80	CUBIC YARD	\$80.00	\$104.00	\$8,400
1.06	LOAM & SEED	440	SQUARE YARD	\$5.00	\$6.50	\$2,900
1.07	CRUSHED STONE	4	CUBIC YARD	\$42.00	\$54.60	\$300
1.08	RIPRAP	16	CUBIC YARD	\$50.00	\$65.00	\$1,100
1.09	BOULDERS FOR DROP STRUCTURE	200	CUBIC YARD	\$200.00	\$260.00	\$52,000
1.10	CONTROLLED DENSITY FILL	60	CUBIC YARD	-	\$200.00	\$12,000
1.11	1.5' X 4' CONCRETE BOX CULVERT	25	LINEAR FOOT	-	\$400.00	\$10,000
1.12	CONCRETE HEADWALLS & WINGWALLS	2	EACH	\$3,000.00	\$3,900.00	\$7,300
1.13	TURF REINFORCEMENT MAT	550	SQUARE YARD	\$8.00	\$10.40	\$5,800
1.14	FILTER FABRIC	60	SQUARE YARD	\$3.00	\$3.90	\$300
1.15	COIR FABRIC	250	SQUARE YARD	\$8.00	\$10.40	\$2,600
1.16	SILT FENCE FOR EROSION CONTROL	50	LINEAR FOOT	-	\$9.00	\$500
1.17	RESTORATION PLANTINGS	1	LUMP SUM	-	\$20,000.00	\$20,000

SUB TOTAL \$151,800

ESTIMATED BID PRICE **\$ 152,000**

Contingency 30% \$ 46,000

ESTIMATED CONSTRUCTION CONTRACT **\$ 198,000**

Project ID: TH-R-2A, TH-R-2A, TH-R-2C

Type: Retrofit, road stabilization

Description: Retrofit of existing detention basin to provide better water quality treatment and demonstrate preferred design feature of this type of BMP. Total drainage area to the existing practice is approximately 66 acres, with more than 13 acres of impervious cover consisting of parking lot, roads, and roof top.

Key Design Elements:

1. Installation of paved flumes to direct runoff from upper parking lot into existing grass swale;
2. Excavate existing grass swale along Ridge Rd. to remove sediment that has been deposited overtime; insert check dam below culvert to create sediment forebay to help trap sediment and slow velocities;
3. Install water bars on Ridge Rd. to stabilize road surface and direct runoff into existing swale;
4. Create sediment forebay where flows enter detention basin using check dam and concrete box structure that can be maintained;
5. Extend flow path within detention basin by the use of a gabion basket berm;
6. Raise existing berm and modify outlet structure to detain flows and provide opportunity for permant pool;
7. Plant wetland species;
8. Install simple rain gardens in existing landscape islands to provide additional pretreatment;

See more detailed design plan set at:
www.horsleywitten.com/stx-east-end-watersheds/designs.html



Existing swale along Ridge Rd. for proposed excavation and check dam installation. Install waterbars along road.



Existing detention basin with double outlet pipes along South Shore Rd.



Parking lot landscape island for proposed conversion to rain garden, which would provide additional pretreatment for detention basin.

Planning Level Cost Estimate:

**DIVI CASINO
ESTIMATE OF CONSTRUCTION QUANTITIES & COSTS
ST. CROIX, USVI**

SEPT. 2011

Quantities listed are estimates only and not guaranteed to approximate the actual amounts to be used.

ITEM NUMBER	DESCRIPTION	ESTIMATED QUANTITY	UNIT	MA UNIT PRICE	UNIT PRICE	TOTAL AMOUNT
1.0	MOBILIZATION/DEMobilIZATION	1	LUMP SUM		\$6,000.00	\$6,000
2.0	SITE CLEARING & GRUBBING	1,503	SQUARE YARD	\$2.50	\$3.25	\$4,883
3.0	EXCAVATION	272	CUBIC YARD	\$30.00	\$39.00	\$10,597
4.0	FINE GRADING AND COMPACTION	700	SQUARE YARD	\$2.00	\$2.60	\$1,820
5.0	LOAM & SEED	830	SQUARE YARD	\$5.00	\$6.50	\$5,397
6.0	RIPRAP	10	CUBIC YARD	\$100.00	\$130.00	\$1,300
7.0	GABION BASKET	16	CUBIC YARD		\$400.00	\$6,222
8.0	TIMBERS FOR SEDIMENT FOREBAY & CHECK DAMS	75	LINEAR FOOT	\$10.00	\$13.00	\$975
9.0	WATER BAR	2	EACH		\$2,000.00	\$4,000
10.0	BITUMINOUS BERM	40	LINEAR FOOT	\$10.00	\$13.00	\$520
11.0	CURB STOPS	25	EACH	\$60.00	\$78.00	\$1,950
12.0	SEDIMENT FOREBAY	1	EACH	\$4,000.00	\$5,200.00	\$5,200
13.0	6'X6' CONCRETE CONTROL STRUCTURE	1	EACH	\$4,000.00	\$5,200.00	\$5,200
14.0	RAIN GARDEN-PLANTS/SOIL/MULCH	1,200	SQUARE FOOT	\$10.00	\$13.00	\$15,600
15.0	PLANTS FOR DETENTION BASIN	2,472	SQUARE FOOT	\$6.00	\$7.80	\$19,282

SUB TOTAL \$89,000

\$ -

ESTIMATED BID PRICE

\$ 89,000

Contingency

30%

\$ 27,000

ESTIMATED CONSTRUCTION CONTRACT

\$ 116,000

This page intentionally left blank.

Project ID: TH-R-3A/B/C/D

Type: Retrofit

Description: Retrofit concept includes the expansion and modification of the existing detention basin to improve water quality treatment. The existing facility appears undersized for the amount of area draining to it. Other options for this site include installation of rain gardens in the parking lots and potential permeable pavement installation in small northern parking area.

Key Design Elements:

1. Modify existing detention basin:
 - Over-excavate to expand and to amend basin with organic soils;
 - Install culvert under existing walkway;
 - Create sediment forebay at existing inlet pipes with timber or concrete weir;
 - Plant with umbrella sedge or other hydrophilic species; and
 - Install new outlet pipe.
2. Permeable pavement in the small north parking lot;
3. Rain garden in existing landscaped area on edge of north lot (see existing curb cut); and
4. Rain garden/swale across South Shore Rd. along edge of gravel parking lot.



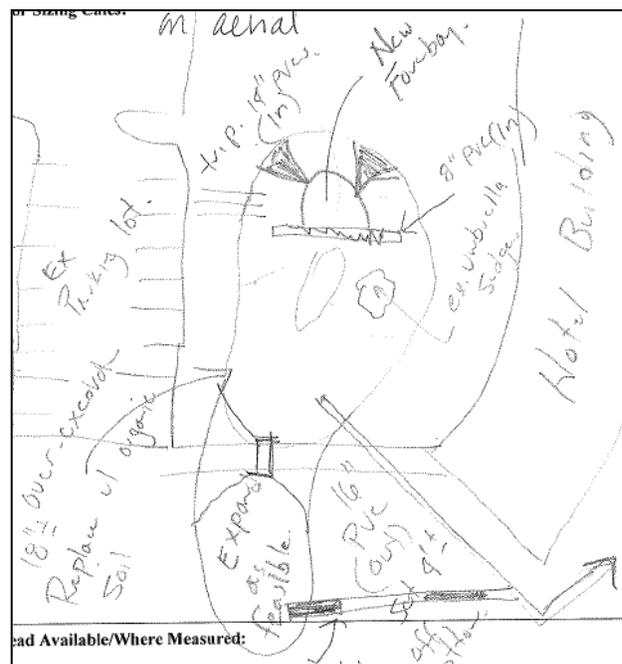
Existing detention basin proposed for modification.



Location for proposed rain garden or bioswale.

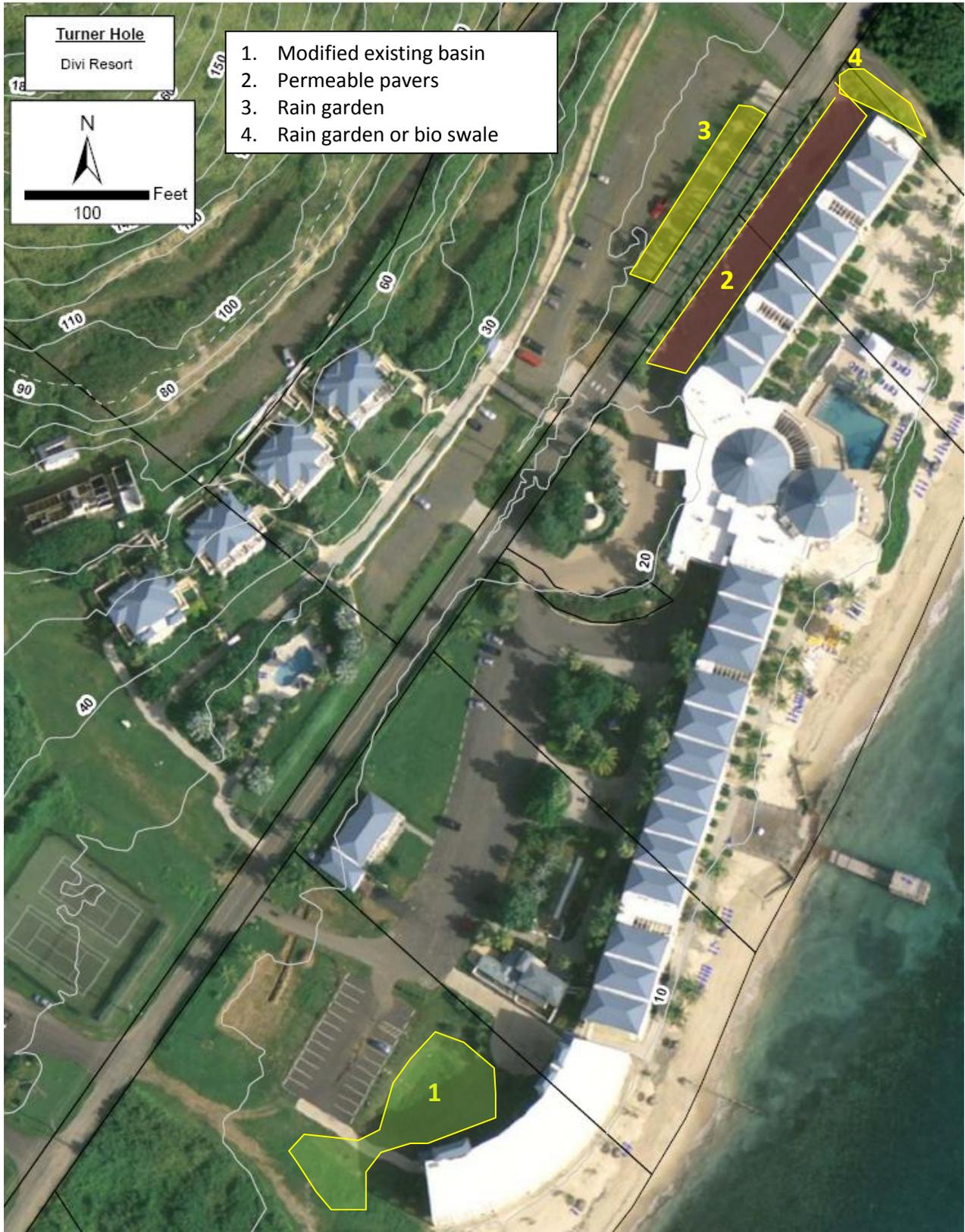


Small parking lot and landscaped area proposed for permeable pavement and rain garden.



Sketch of expanded detention basin and forebay.

Site Map:



Chenay Bay

Southgate

Project ID: SG-R-20A/B

Type: Retrofit, pollution prevention

Description: Retrofit concept includes the installation of a rain garden adjacent to the restaurant at Chenay Bay Resort, as well as the installation of a shallow bioretention in the parking lot to provide some water quality treatment prior to discharge into the adjacent wetland. Both features could serve not only to improve stormwater management, but can also improve site aesthetics. Pollution prevention activities at this site include the cleanup of trash in the wetland area, covering of outdoor material storage area, and restoration of riparian buffer adjacent to East Gut outlet.

Key Design Elements:

1. Extend paved flume around corner of restaurant and install gutter/downspout on new desk addition to convey flows into a small sediment forebay;
2. Excavate a ~900 sq ft (max to treat 1.25 inches) rain garden in turf area adjacent to restaurant. This highly visible location with good access can be used as a demonstration site, involve volunteers for construction, and the donation of plant materials;
3. Overflow from the rain garden can go towards the beach;
4. Remove pavement along wetland edge and install bioswale; repave and/or restripe parking lot;
5. Discharge overflow pipe into wetland area;
6. Install a cover on the existing concrete structure where outdoor materials are stored;
7. Coordinate with SEA to establish trash cleanup days for wetland and beach area.



Proposed area for rain garden installation. Extend existing paved flume and install gutter and downspouts to convey flows to sediment forebay.

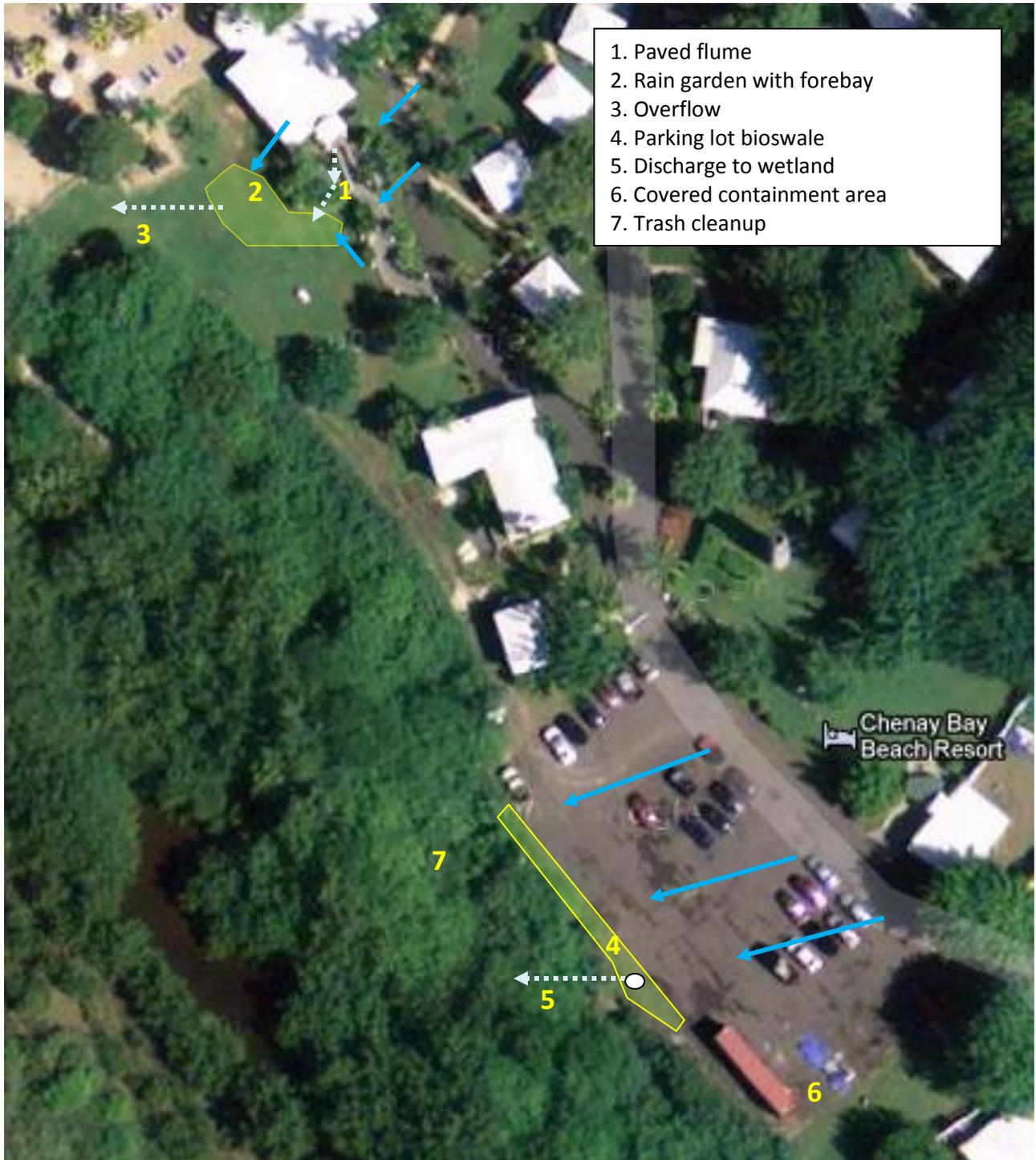


Location along edge of parking lot to install water quality facility to treat parking lot runoff.



Existing outdoor material storage area that could use a cover.

Site Map:



East End Bay Trail Turner Hole

Project ID: TH-R-1

Type: Retrofit

Description: Concept includes installing a bioretention facility adjacent to the recently stabilized trailhead at the East End/Point Udall to capture and treat runoff from the newly installed parking lot and East End Rd. Landscape plantings were specifically selected to reflect the dry conditions and native species located at the East End.

Constraints: Potential depth to bedrock/rotten rock. This plan was reviewed by site contractor and a bid estimate was generated based on the quantity take-off provided below. The bid estimate came back extremely high, with little justification provided per unit cost assumptions. There is little evidence that this concept, as proposed, will move forward; however, the plan details provide a model example of a dry climate bioretention application.

Key Design Elements:

1. Removal of debris pile and shallow excavation of area for proposed bioretention;
2. Use of existing rock on site to build revetment on hillside of proposed bioretention;
3. Install asphalt v-ditch to convey flows from edge of parking lot into rip rap channel;
4. 12-foot long rip-rap channel to convey flows into bioretention facility;
5. 560 sq ft bioretention facility planted with cactus and other drought/salt tolerant species; and
6. Overflow spillway back towards trail, uphill from first existing water bar/trail drainage stabilization feature.

See more detailed design plan set at: www.horsleywitten.com/stx-east-end-watersheds/designs.html. Note that plan set includes detailed Erosion and Sediment Control practices and detailed planting plan.



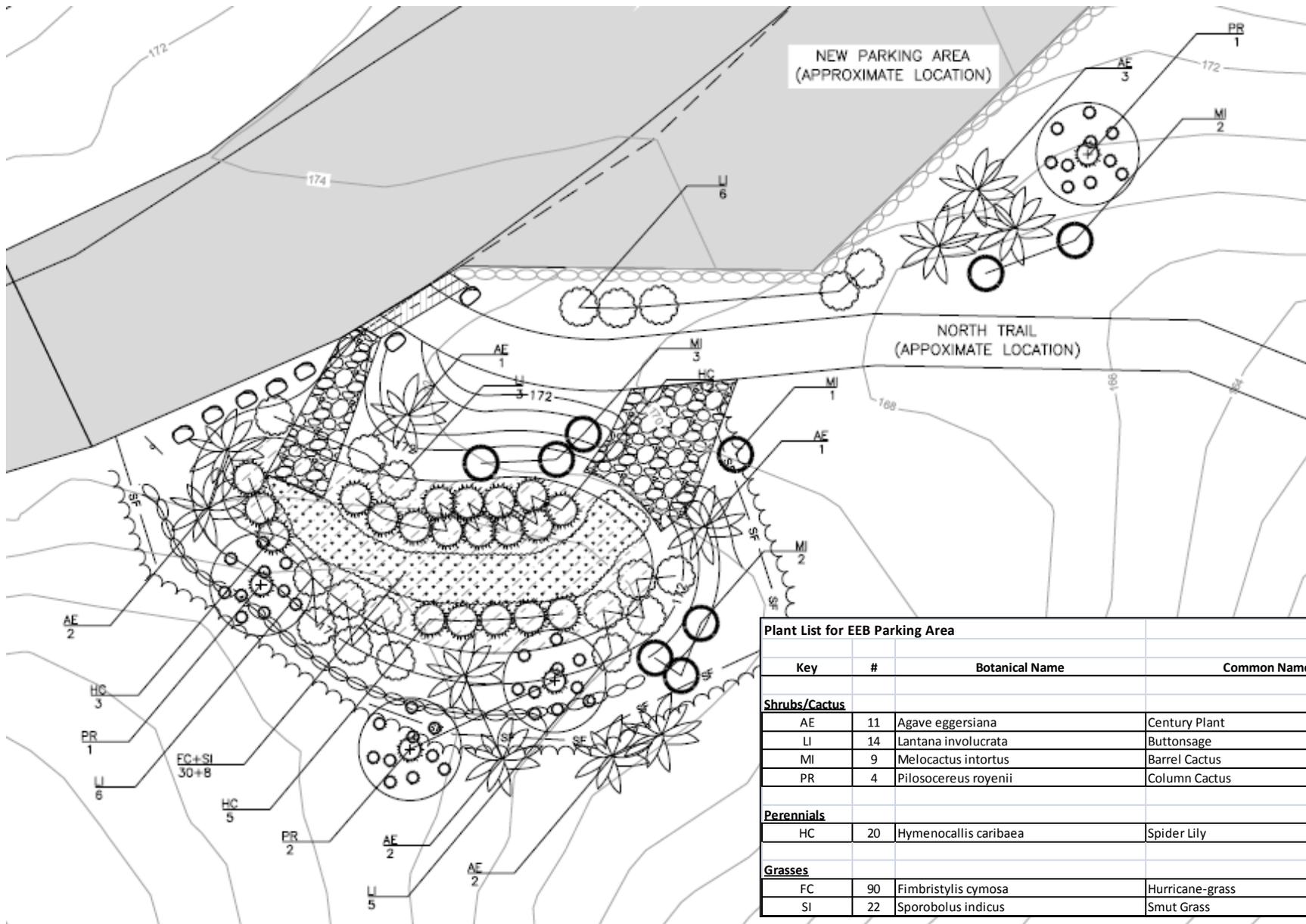
Trailhead location map.



Newly installed parking lot and trailhead.



Signage posted at site indicating funding and project oversight for the trail stabilization project.



Plant List for EEB Parking Area			
Key	#	Botanical Name	Common Name
Shrubs/Cactus			
AE	11	<i>Agave eggersiana</i>	Century Plant
LI	14	<i>Lantana involucrata</i>	Buttonsage
MI	9	<i>Melocactus intortus</i>	Barrel Cactus
PR	4	<i>Pilosocereus royenii</i>	Column Cactus
Perennials			
HC	20	<i>Hymenocallis caribaea</i>	Spider Lily
Grasses			
FC	90	<i>Fimbristylis cymosa</i>	Hurricane-grass
SI	22	<i>Sporobolus indicus</i>	Smut Grass

Planning Level Quantity Estimates:

**EAST END BAY TRAIL BIORETENTION AREA
ST. CROIX, USVI**

3/3/2011

Quantities listed are estimates only and not guaranteed to approximate the actual amounts to be used.

ITEM NUMBER	DESCRIPTION	ESTIMATED QUANTITY	UNIT
1.0	MOBILIZATION/DEMobilIZATION	1	LUMP SUM
2.0	SITE CLEARING & GRUBBING	170	SQUARE YARD
3.0	BIORETENTION	560	SQUARE FOOT
4.0	FILTER FABRIC	409	SQUARE FOOT
5.0	STONE RETAINING WALL/BOULDERS	25	CUBIC YARD
6.0	CLEAN SAND	2	CUBIC YARD
7.0	RIP RAP	6	CUBIC YARD
8.0	CRUSHED STONE	1	CUBIC YARD
9.0	ASPHALT	1	SQUARE YARD
10.0	EROSION CONTROL BLANKET	128	SQUARE YARD
11.0	SILT FENCE FOR EROSION CONTROL	77	LINEAR FOOT

Bioretention Broken Down			
ITEM	DESCRIPTION	UNIT	QUANTITY
	Bio Excavation	CY	135
	18" Planting Soil	CY	32
	3" Pea Gravel	CY	6
	9" Stone	CY	16
	Bioretention plantings	LS	1

Fire Station

Solitude Bay

Project ID: SB-R-1A/B

Type: Retrofit, pollution prevention

Description: Retrofit concept includes the installation of a rain garden and dry swale to capture and treat road and driveway drainage. It is assumed that the parking area for the proposed Police Substation will drain to the dry swale. A second part of the project entails the relocation of the Cotton Valley Dumpster Site to the Solitude Fire Station property, which would include upgrades to improve pollution prevention measures.

Site Constraints: There is an existing well at the site, which may limit the potential to install a rain garden.

Key Design Elements:

1. Install ~2,900 square foot rain garden at the corner of property; install paved flume and sediment forebay to better direct flows from road and trap sediment behind timber weir structure;
2. Rain garden overflow and additional road drainage conveyed via paved swale across bus stop and fire station entrance and proposed driveway to relocated dumpster area;
3. Drainage from the paved swales and from the proposed dumpster driveway are directed to the pretreatment forebay of a dry swale;
4. The dry swale outlet structure includes a trash rack, and discharges to the existing gut;
5. Construct covered enclosure for dumpster area, with concrete sidewalls and fencing in rear to reduce wind-blown trash accumulation in gut;

6. Install cistern to collect and reuse rooftop runoff from dumpster area; and
7. Remove invasive species and enhance native plantings along gut buffer.

See more detailed design plan set at: www.horsleywitten.com/stx-east-end-watersheds/designs.html



Proposed area for rain garden.

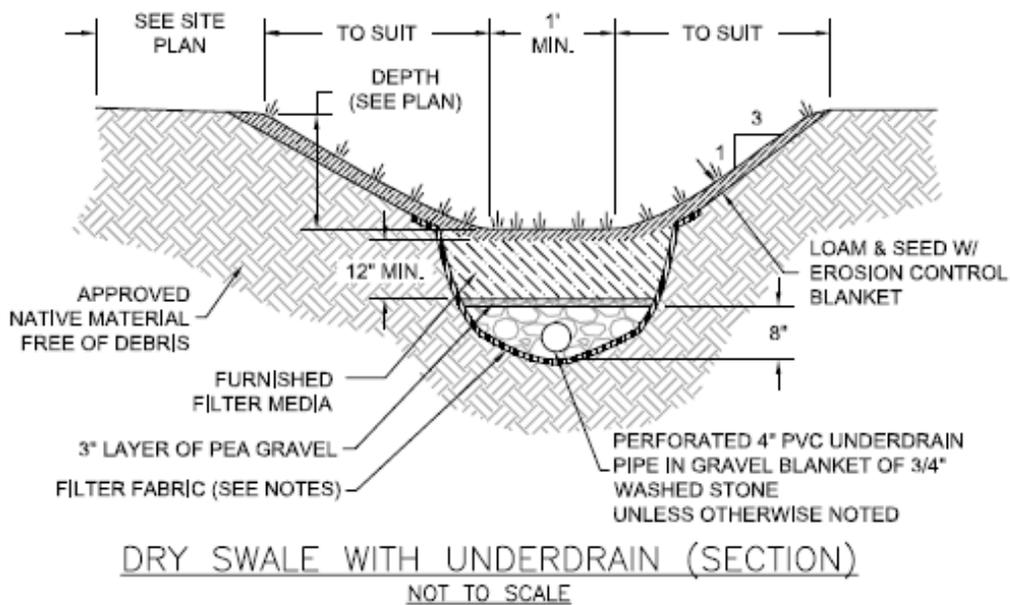
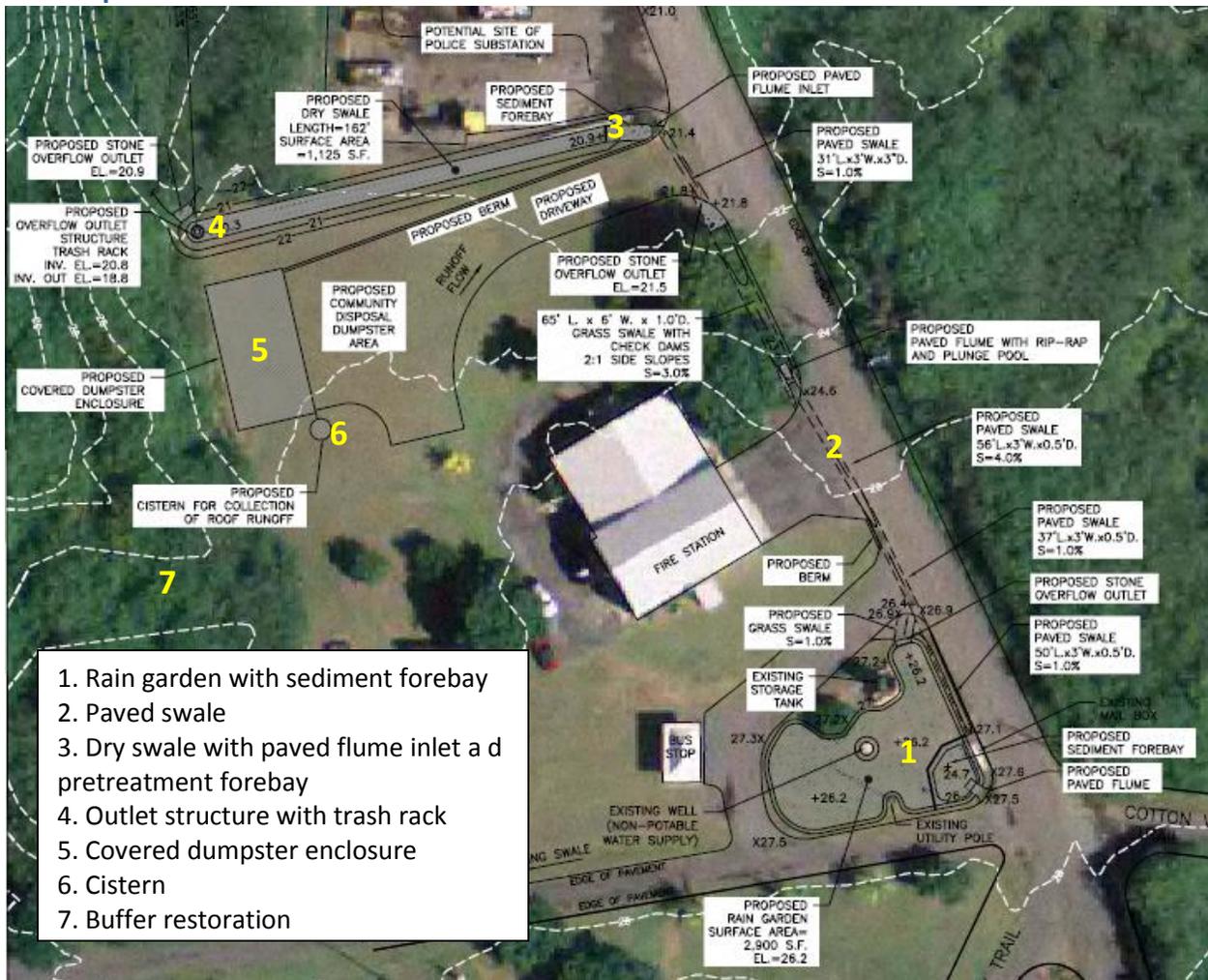


Existing swale to be converted to water quality dry swale.



Existing covered enclosure from St. Thomas similar to proposed dumpster enclosure design for Fire Station.

Site Map:



Planning Level Cost Estimate:

**SOLITUDE FIRE STATION-DRAINAGE
ESTIMATE OF CONSTRUCTION QUANTITIES & COSTS
ST. CROIX, USVI**

SEPT. 2011

Quantities listed are estimates only and not guaranteed to approximate the actual amounts to be used.

ITEM NUMBER	DESCRIPTION	ESTIMATED QUANTITY	UNIT	MA-UNIT PRICE	UNIT PRICE	TOTAL AMOUNT
1.0	MOBILIZATION/DEMObILIZATION	1	LUMP SUM	\$11,000.00	\$14,300.00	\$14,300
2.0	SITE CLEARING & GRUBBING	1,001	SQUARE YARD	\$2.50	\$3.25	\$3,300
3.0	EXCAVATION	400	CUBIC YARD	\$30.00	\$39.00	\$15,600
4.0	FINE GRADING AND COMPACTION	600	SQUARE YARD	\$2.00	\$2.60	\$1,600
5.0	CLEAN SAND	20	CUBIC YARD	\$80.00	\$104.00	\$2,100
6.0	LOAM & SEED	444	SQUARE YARD	\$5.00	\$5.00	\$2,300
7.0	CRUSHED STONE	9	CUBIC YARD	\$72.00	\$93.60	\$900
8.0	RIPRAP	20	CUBIC YARD	\$100.00	\$130.00	\$2,600
9.0	TIMBERS FOR SEDIMENT FOREBAY & CHECK DAMS	115	LINEAR FOOT	\$10.00	\$13.00	\$1,500
10.0	ASPHALT	10	TONS		\$200.00	\$2,100
11.0	BITUMINOUS BERM	10	LINEAR FOOT	\$10.00	\$13.00	\$200
12.0	PAVED FLUME	3	EACH	\$1,500.00	\$1,950.00	\$5,900
13.0	OVERFLOW OUTLET STRUCTURE	1	EACH	\$4,000.00	\$5,200.00	\$5,200
14.0	12" HDPE PIPE	165	LINEAR FOOT		\$150.00	\$24,800
15.0	12" FLARED END SECTION	1	EACH	\$1,000.00	\$1,300.00	\$1,300
16.0	FILTER FABRIC	230	SQUARE YARD	\$3.00	\$3.90	\$900
17.0	COIR FABRIC	205	SQUARE YARD	\$8.00	\$10.40	\$2,200
18.0	SILT FENCE FOR EROSION CONTROL	200	LINEAR FOOT		\$9.00	\$1,800
19.0	DRY SWALE-TURF/SOIL/STONE	162	LINEAR FOOT	\$24.00	\$31.20	\$5,100
20.0	RAIN GARDEN-PLANTS/SOIL/MULCH	1	LUMP SUM	\$27,000.00	\$35,100.00	\$35,100

SUB TOTAL \$128,800

ESTIMATED BID PRICE		\$ -
Contingency	30%	\$ 129,000
ESTIMATED CONSTRUCTION CONTRACT		\$ 168,000

**SOLITUDE FIRE STATION-COMMUNITY DUMPSTER AREA RELOCATION
ESTIMATE OF CONSTRUCTION QUANTITIES & COSTS
ST. CROIX, USVI**

SEPT. 2011

Quantities listed are estimates only and not guaranteed to approximate the actual amounts to be used.

ITEM NUMBER	DESCRIPTION	ESTIMATED QUANTITY	UNIT	MA-UNIT PRICE	UNIT PRICE	TOTAL AMOUNT
1.0	MOBILIZATION/DEMObILIZATION	1	LUMP SUM	\$12,950.00	\$16,835.00	\$16,900
2.0	SITE CLEARING & GRUBBING	1,035	SQUARE YARD	\$2.50	\$3.25	\$3,400
3.0	EXCAVATION	160	CUBIC YARD	\$30.00	\$39.00	\$6,300
4.0	FINE GRADING AND COMPACTION	718	SQUARE YARD	\$2.00	\$2.60	\$1,900
5.0	LOAM & SEED	60	SQUARE YARD	\$5.00	\$6.50	\$400
6.0	CRUSHED STONE	160	CUBIC YARD	\$72.00	\$93.60	\$15,000
7.0	COVERED DUMPSTER ENCLOSURE	1	LUMP SUM	\$60,000.00	\$78,000.00	\$78,000
8.0	ASPHALT	120	TONS		\$200.00	\$24,000
9.0	BITUMINOUS BERM	150	LINEAR FOOT	\$10.00	\$13.00	\$2,000
10.0	CISTERN	1	EACH	\$5,000.00	\$5,000.00	\$5,000
11.0	SILT FENCE FOR EROSION CONTROL	80	LINEAR FOOT		\$9.00	\$800

SUB TOTAL \$153,700

\$ -

ESTIMATED BID PRICE

\$ 154,000

Contingency 30%

\$ 47,000

ESTIMATED CONSTRUCTION CONTRACT

\$ 201,000

Goat Hill Rd. Teague Bay

Project ID: TB-RC-4

Type: Road stabilization

Description: Project concept is to stabilize approximately 1200 ft of unpaved road that is managed by The Nature Conservancy and the Department of Recreation.

Key Design Elements:

1. Install series of waterbars and stabilized outlets/bleed-offs in mid-upper portion of road as needed based on slope;
2. Restrict vehicle access;
3. Install bleed-offs and waterbars to maintain integrity of lower portion of road;
4. Install swale with check dams along inside right-of-way on East End Rd. to safely convey flows to existing paved cross-dip.



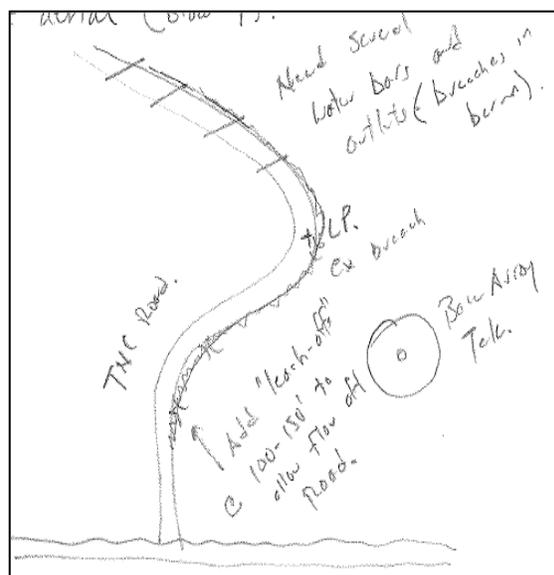
Lower portion of road that is relatively stable at this time.



Space alongside road to install stepped/check dam system.

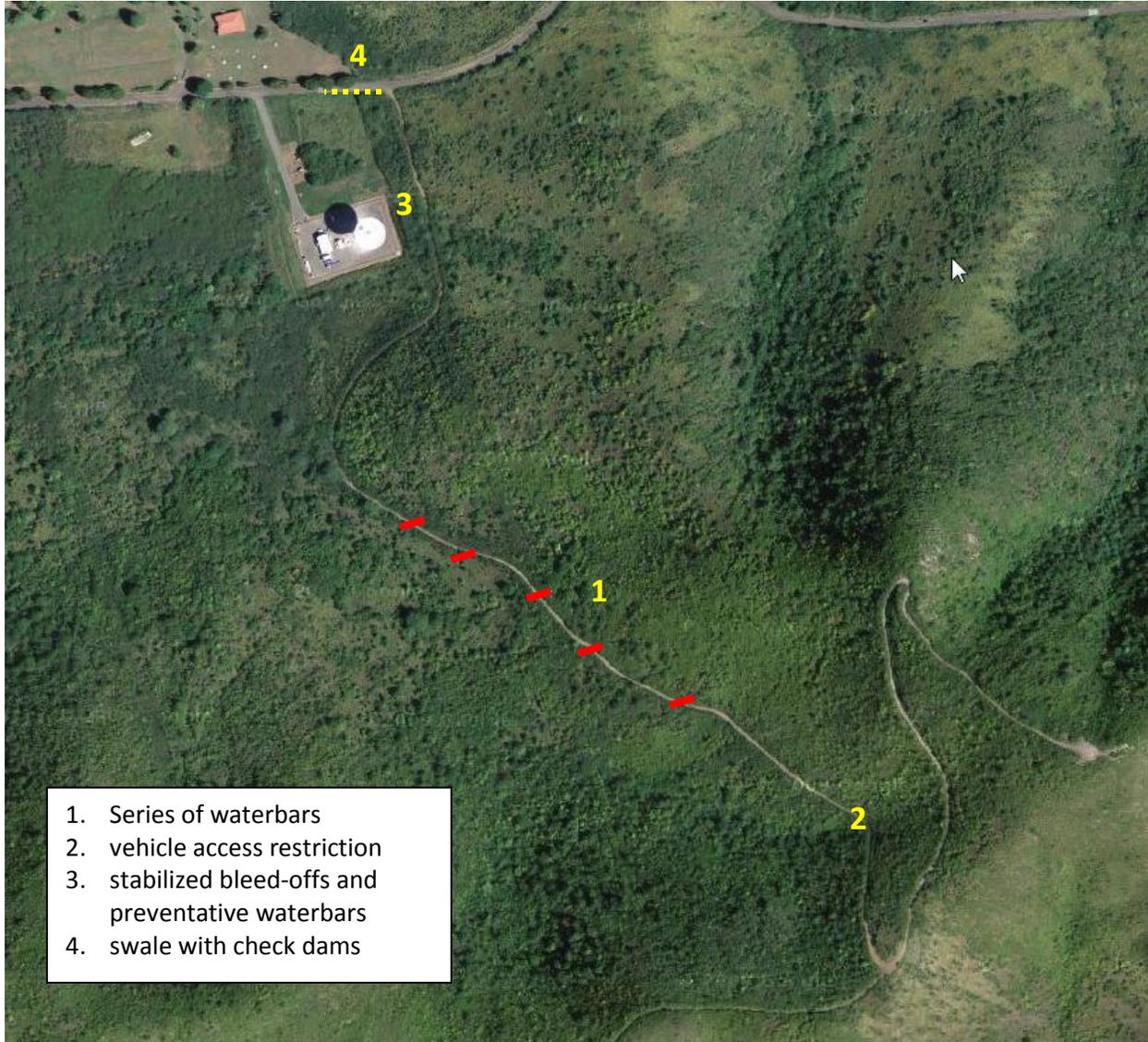


Erosion along ditch at upper portion of road.

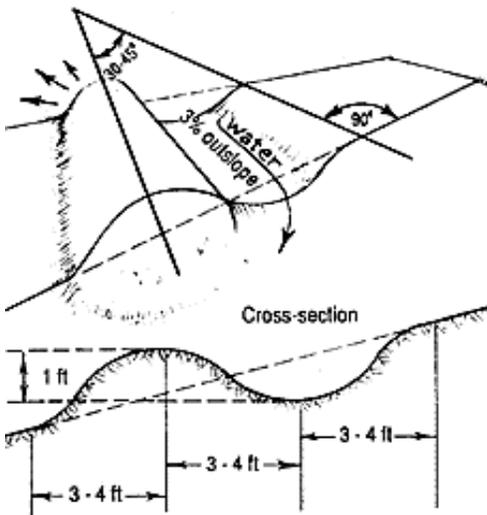


Sketch from field sheet.

Site Map



1. Series of waterbars
2. vehicle access restriction
3. stabilized bleed-offs and preventative waterbars
4. swale with check dams



Waterbar Cross Section
(Source: MN Extension Service)

Road Grade	Spacing (ft)		
	Waterbars	Dips	Cross Drains
2%	250	300	135
5%	135	180	100
10%	80	140	80
15%	60	Do not use	60
20%	45		45
25%	40		30

Source: HI DFW (2003) and VICES (2003); Coeur d'Alene RMP/EIS (2006)

Milgie's Grocery Culvert

Great Pond

Project ID: GP-RC-2

Type: Drainage improvement

Description: This project involves the realignment of the east gut flowing through Sally's Fancy and the installation of a culvert below Rt. 624.

While not a priority watershed restoration project, this location is a chronic flooding problem and requires consistent maintenance by DPW. The gut has been impacted by residential development and the direction of flow has been altered at the Rt. 624 crossing.

Culvert sizing calculations have not been done for this concept plan.

Key Design Elements:

1. Install box culvert and raise the road grade as necessary at the point where the gut meets Rt. 624 (prior to diversion along road);
2. Reconnect gut to downstream reach and restore floodplain wetland;
3. Install small wetland/sediment forebay and, potentially, a roadside swale to collect runoff from Milgie's grocery via the existing paved dip; and
4. Conduct residential survey to determine extent of encroachment into gut buffer and look for opportunities for restoration and pollution prevention;

Constraints: None. Existing utility pole threatened by gut erosion and ponding.



Location at Milgie's where East Gut flow is diverted along the parking area and then across Rt. 624 via an existing paved dip.

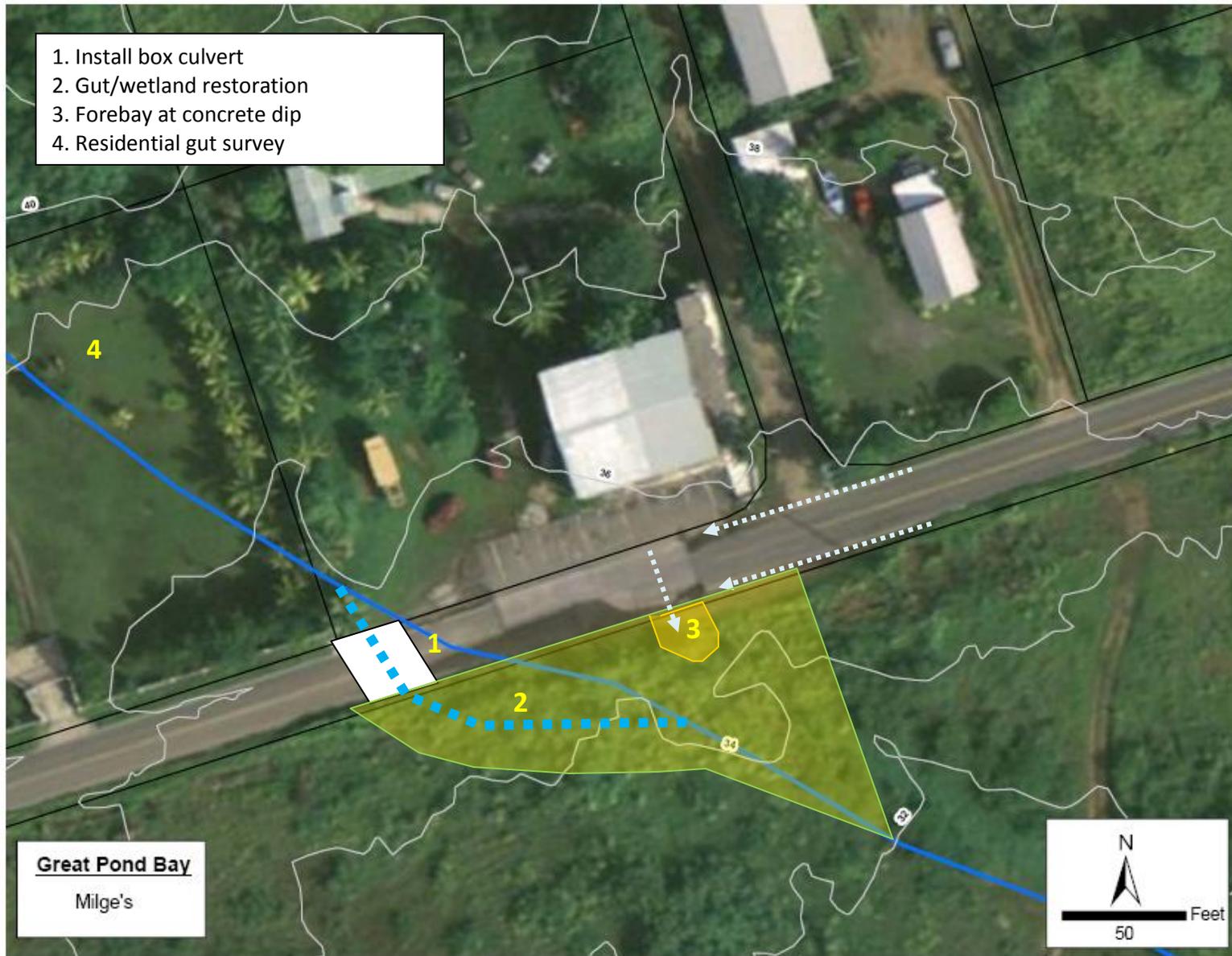


This area is a flooding nuisance and requires constant maintenance by DPW to clean out area where sediment settles and prevents drainage.



Restore gut and natural wetland/floodplain area.

Site Map:



Reef Golf Course Teague Bay

Project ID: TB-R-3A, TB-R-3B, TB-G1

Type: Retrofit; gut stabilization

Description: Concept includes two separate retrofits in combination with gut stabilization and culvert replacement on the Reef Golf Course and Duggan's property. Over 200 acres ultimately drain down to the gut and existing water features on the property. The gut that appears to have historically been relocated to the western edge of the property is actively eroding/widening, particularly where bedrock has been exposed. Sediment deposition at the bottom of the reach has completely blocked the culvert under East End Rd. The concepts include diverting flows from the gut to a new water feature on the golf course, stabilizing the gut, replacing the culvert, and creating a stormwater wetland across East End Rd.

Constraints: There may be permitting issues associated with construction in the gut and in a potential wetland area.

Key Design Elements:

1. Diversion structure:
 - Sends 2-inches of rainfall from gut to the proposed pond
 - Sends all additional rainfall through the gut
2. Pond
 - Designed with a permanent pool elevation of 17.5' (depth of 6.5')
 - Will overtop spillway crest at elevation 18.0' and conveyed back to gut
 - Rim Elevation = 19.0'
 - 4:1 side slopes: 4' berm top width
3. Culvert
 - 3'(H) x 5'(W) concrete box culvert
 - Designed to pass the 5-yr storm event without overtopping roadway
4. Constructed wetland
 - Permanent pool Elevation of 8.0'

- Must remove 12"-18" of existing muck
 - 3:1 side slopes
5. Gut restoration
 - About 600' of restoration required
 - Check dams spaced every 20'-25' when designed at 18" water depths
 - Reinforced with coir fabric

See more detailed design plan set at:
www.horsleywitten.com/stx-east-end-watersheds/designs.html



Gut along western property boundary for golf course.



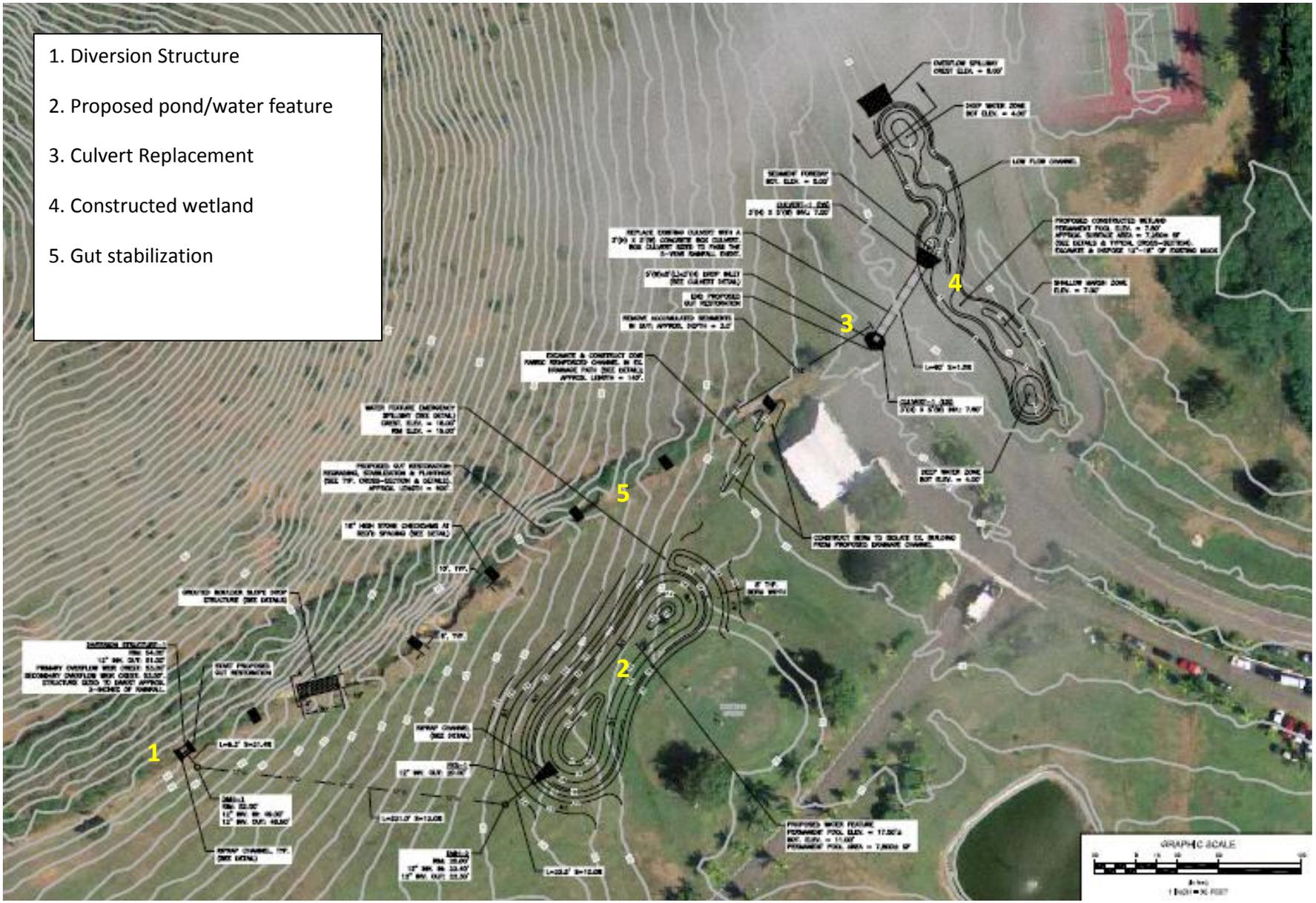
Proposed location of new water feature.



Area for proposed constructed wetland.

Site Map:

1. Diversion Structure
2. Proposed pond/water feature
3. Culvert Replacement
4. Constructed wetland
5. Gut stabilization



Planning Level Cost Estimate:

**REEF GOLF RESTORATION - GUT DIVERSION & WATER FEATURE
ESTIMATE OF CONSTRUCTION QUANTITIES
ST. CROIX, USVI**

SEPT. 2011

Quantities listed are estimates only and not guaranteed to approximate the actual amounts to be used.

ITEM NUMBER	DESCRIPTION	ESTIMATED QUANTITY	UNIT	MA UNIT PRICE	STX UNIT PRICE	TOTAL AMOUNT
1.01	MOBILIZATION/DEMOBILIZATION	1	LUMP SUM	-	\$9,200.00	\$9,200
1.02	EXCAVATION	1,500	CUBIC YARD	-	\$27.00	\$40,500
1.03	FINE GRADING AND COMPACTION	2,800	SQUARE YARD	\$2.00	\$2.60	\$7,300
1.04	CLEAN SAND	40	CUBIC YARD	\$80.00	\$104.00	\$4,200
1.05	LOAM & SEED	2,300	SQUARE YARD	\$5.00	\$6.50	\$15,000
1.06	CRUSHED STONE	5	CUBIC YARD	\$42.00	\$54.60	\$300
1.07	RIPRAP	6	CUBIC YARD	\$50.00	\$65.00	\$400
1.08	MANHOLE	2	EACH	\$3,000.00	\$3,900.00	\$7,800
1.09	DIVERSION STRUCTURE	1	EACH	\$10,000.00	\$13,000.00	\$13,000
1.10	12" HDPE PIPE	260	LINEAR FOOT	-	\$150.00	\$39,000
1.11	12" FLARED END SECTION	1	EACH	\$1,000.00	\$1,300.00	\$1,300
1.12	FILTER FABRIC	100	SQUARE YARD	\$3.00	\$3.90	\$400
1.13	COIR FABRIC	120	SQUARE YARD	\$8.00	\$10.40	\$1,300

SUB TOTAL \$139,700

ESTIMATED BID PRICE \$ 140,000

Contingency 30% \$ 42,000

ESTIMATED CONSTRUCTION CONTRACT \$182,000

**REEF GOLF RESTORATION - GUT RESTORATION & CULVERT REPLACEMENT
ESTIMATE OF CONSTRUCTION QUANTITIES
ST. CROIX, USVI**

SEPT. 2011

Quantities listed are estimates only and not guaranteed to approximate the actual amounts to be used.

ITEM NUMBER	DESCRIPTION	ESTIMATED QUANTITY	UNIT	MA UNIT PRICE	STX UNIT PRICE	TOTAL AMOUNT
2.01	MOBILIZATION/DEMOBILIZATION	1	LUMP SUM	-	\$8,900.00	\$8,900
2.02	SITE CLEARING & GRUBBING	560	SQUARE YARD	\$2.50	\$3.25	\$1,900
2.03	EXCAVATION	300	CUBIC YARD	-	\$27.00	\$8,100
2.04	FINE GRADING AND COMPACTION	700	SQUARE YARD	\$2.00	\$2.60	\$1,900
2.05	CLEAN SAND	140	CUBIC YARD	\$80.00	\$104.00	\$14,600
2.06	LOAM & SEED	670	SQUARE YARD	\$5.00	\$6.50	\$4,400
2.07	CRUSHED STONE	50	CUBIC YARD	\$42.00	\$54.60	\$2,800
2.08	RIPRAP	100	CUBIC YARD	\$50.00	\$65.00	\$6,500
2.09	BOULDERS FOR DROP STRUCTURE	40	CUBIC YARD	\$200.00	\$260.00	\$10,400
2.10	ASPHALT	12	TONS	-	\$200.00	\$2,400
2.11	CONTROLLED DENSITY FILL	26	CUBIC YARD	-	\$200.00	\$5,200
2.12	3' X 5' CONCRETE BOX CULVERT	60	LINEAR FOOT	-	\$500.00	\$30,000
2.13	REINFORCED CONCRETE HEADWALL/WINGWALLS	2	EACH	\$3,000.00	\$3,900.00	\$7,800
2.14	CONCRETE DROP INLET	1	EACH	\$5,000.00	\$6,500.00	\$6,500
2.15	FILTER FABRIC	200	SQUARE YARD	\$3.00	\$3.90	\$800
2.16	COIR FABRIC	670	SQUARE YARD	\$8.00	\$10.40	\$7,000
2.17	RESTORATION PLANTINGS	1	LUMP SUM	-	\$15,000.00	\$15,000

SUB TOTAL \$134,200

ESTIMATED BID PRICE **\$ 135,000**

Contingency 30% \$ 41,000

ESTIMATED CONSTRUCTION CONTRACT **\$ 176,000**

**REEF GOLF RESTORATION - CONSTRUCTED WETLAND
ESTIMATE OF CONSTRUCTION QUANTITIES
ST. CROIX, USVI**

SEPT. 2011

Quantities listed are estimates only and not guaranteed to approximate the actual amounts to be used.

ITEM NUMBER	DESCRIPTION	ESTIMATED QUANTITY	UNIT	MA UNIT PRICE	STX UNIT PRICE	TOTAL AMOUNT
3.01	MOBILIZATION/DEMOBILIZATION	1	LUMP SUM	-	\$4,300.00	\$4,300
3.02	EXCAVATION	600	CUBIC YARD	-	\$27.00	\$16,200
3.03	FINE GRADING AND COMPACTION	2,000	SQUARE YARD	\$2.00	\$2.60	\$5,200
3.04	LOAM & SEED	1,080	SQUARE YARD	\$5.00	\$6.50	\$7,100
3.05	CRUSHED STONE	3	CUBIC YARD	\$42.00	\$54.60	\$200
3.06	RIPRAP	11	CUBIC YARD	\$50.00	\$65.00	\$800
3.07	FILTER FABRIC	100	SQUARE YARD	\$3.00	\$3.90	\$400
3.08	COIR FABRIC	1,890	SQUARE YARD	\$8.00	\$10.40	\$19,700
3.09	SILT FENCE FOR EROSION CONTROL	50	LINEAR FOOT	-	\$9.00	\$500
3.10	RESTORATION PLANTINGS	1	LUMP SUM	-	\$10,000.00	\$10,000

SUB TOTAL \$64,400

ESTIMATED BID PRICE **\$ 65,000**

Contingency 30% \$ 20,000

ESTIMATED CONSTRUCTION CONTRACT **\$ 85,000**

This page intentionally left blank.

Ridge Rd. at Rt. 82

Teague Bay

Project ID: TB-RC-3

Type: Road stabilization

Description: Project concept is to stabilize approximately 600 ft of unpaved road that discharges sediment onto East End Rd. The deterioration of the drainage ditch at the lowest curve is evident, and there is extensive erosion of the road surface just uphill of this bend. This road is a candidate for paving; however, the installation of strategically placed waterbars is also an option.

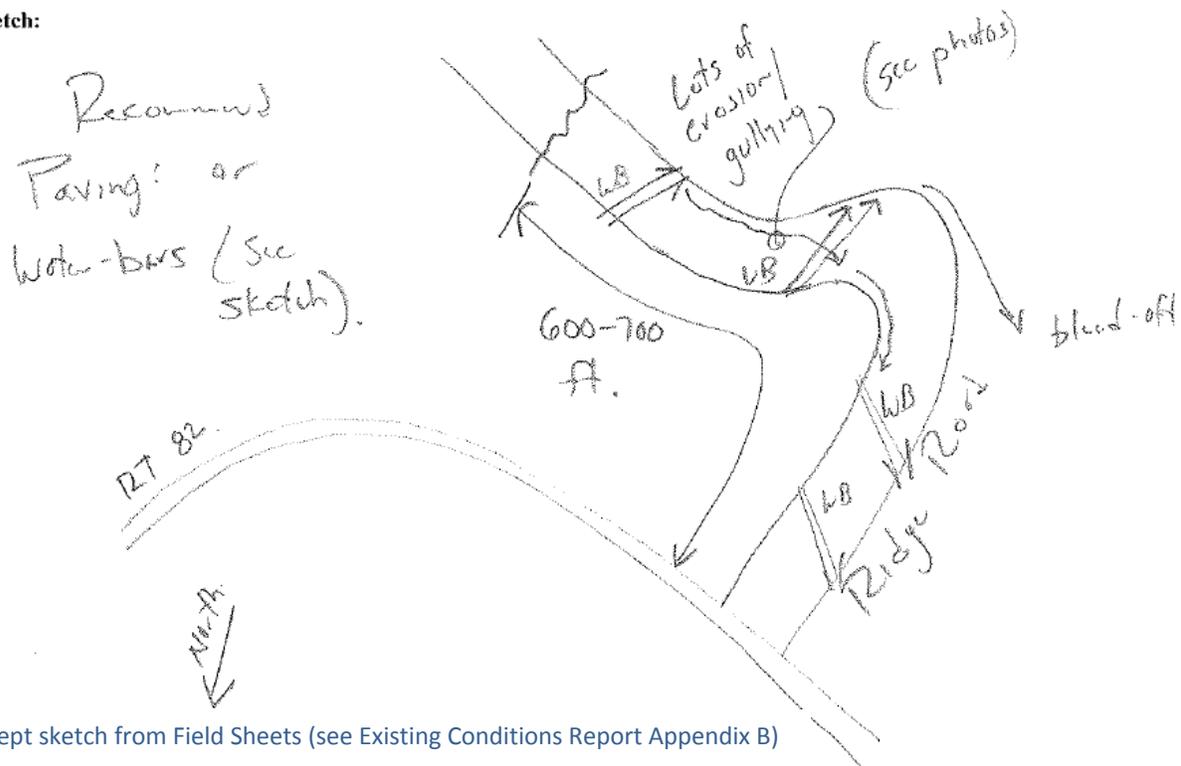


Erosion along ditch at bend in road.

Key Design Elements:

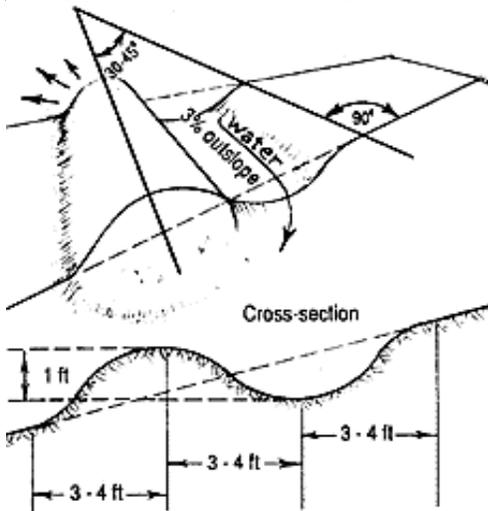
1. Pave lower section of road; or
2. Install a minimum of 4 waterbars;
3. Stabilized bleed-off at top of bend;
4. Install check dams as necessary in roadside ditch to prevent erosive flows;

Sketch:



Concept sketch from Field Sheets (see Existing Conditions Report Appendix B)

Site Map



Waterbar Cross Section
(Source: MN Extension Service)

Road Grade	Spacing (ft)		
	Waterbars	Dips	Cross Drains
2%	250	300	135
5%	135	180	100
10%	80	140	80
15%	60	Do not use	60
20%	45		45
25%	40		30

Source: HI DFW (2003) and VICES (2003); Coeur d'Alene RMP/EIS (2006)

Seven Flags Rd.

Solitude Bay

Project ID: SB-R-3; SB-RC-9

Type: Road stabilization, retrofit

Description: Pave 1000 ft of privately-owned road where existing ditch erosion is threatening buildings and utilities and clogging culverts, which causes flooding on East End Rd. The concept for this site also involves redirecting flows into a drainage easement further up the road, installing stepped, detention structures along the conveyance path, and piping overflows to a new culvert under East End Rd. The existing culverts under East End Road take flow from 88.1 acres, 13.8 acres impervious. Preventing road and roadside ditch erosion is the key water quality improvement of this project.

Key Design Elements:

- Divert flows at top of road with paved flume and grass channel into existing gut/drainage easement.
- Pave lower section of road and re-grade to better drain to new catch basins to be installed on the west side of the road.
- Install terraced detention cells (roughly 50 feet wide, 3 feet deep) in channel with amended soils to promote infiltration. Vegetation will be grass, so that vegetative maintenance will be limited.
- At the down-gradient end of the terraced system, install an outlet structure that discharges into a pipe, connecting with proposed road drainage.
- The pipe should be at least 48 inches in diameter to handle the estimated runoff – this will need to be confirmed as the design advances.
- Replace the two existing, damaged 24-inch culverts with two or more 36-inch culverts (depending on design storm).

- On the downstream end, install a stilling basin to reduce erosive velocities. Some clearing and grading will be required for this work since the area is currently wooded. Maintenance access should be provided.



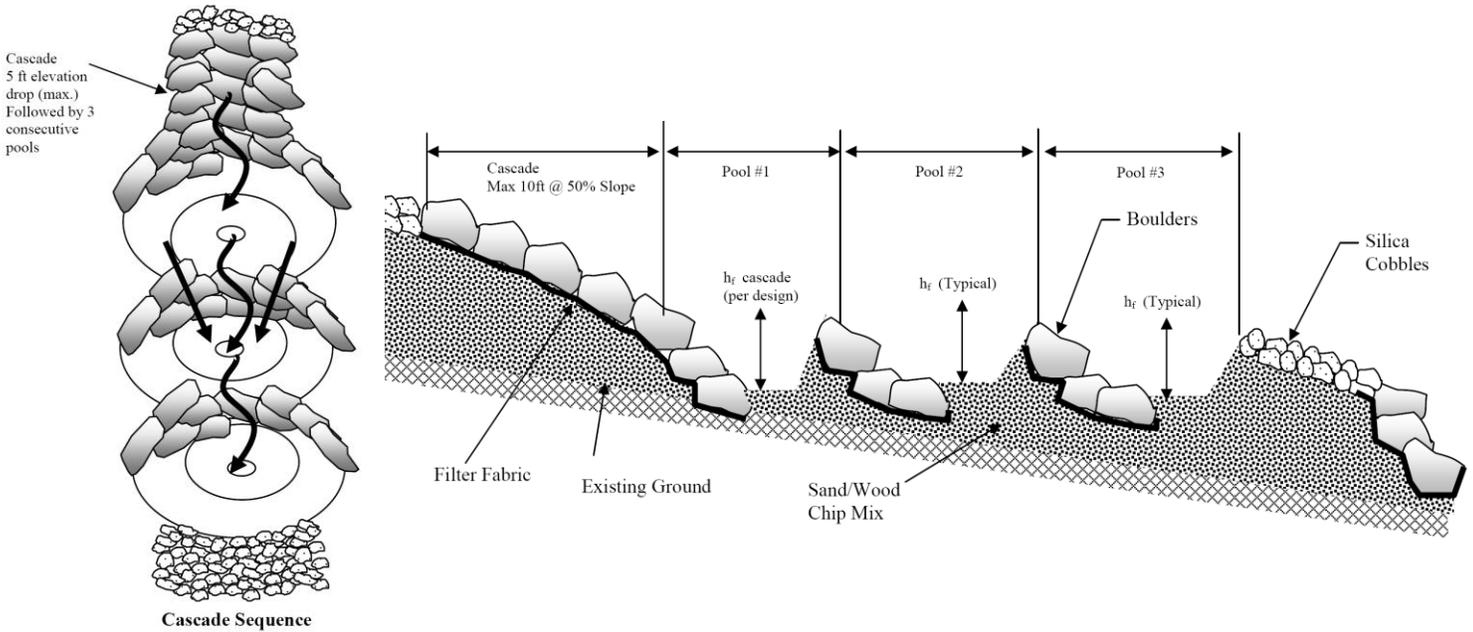
Eroding ditch along lower portion of Seven Flags Rd.



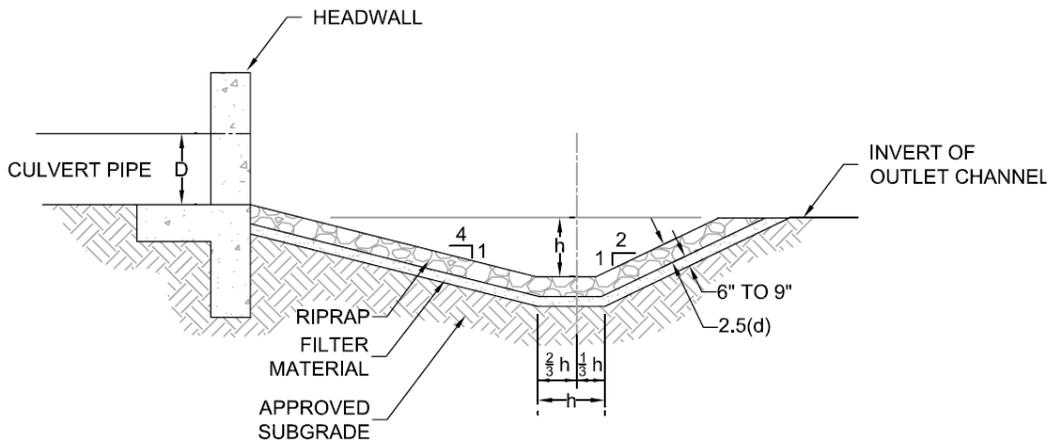
Proposed location for stepped stormwater conveyance.



Existing culverts under East End Rd.



Example plan and profile views of terraced conveyance systems.



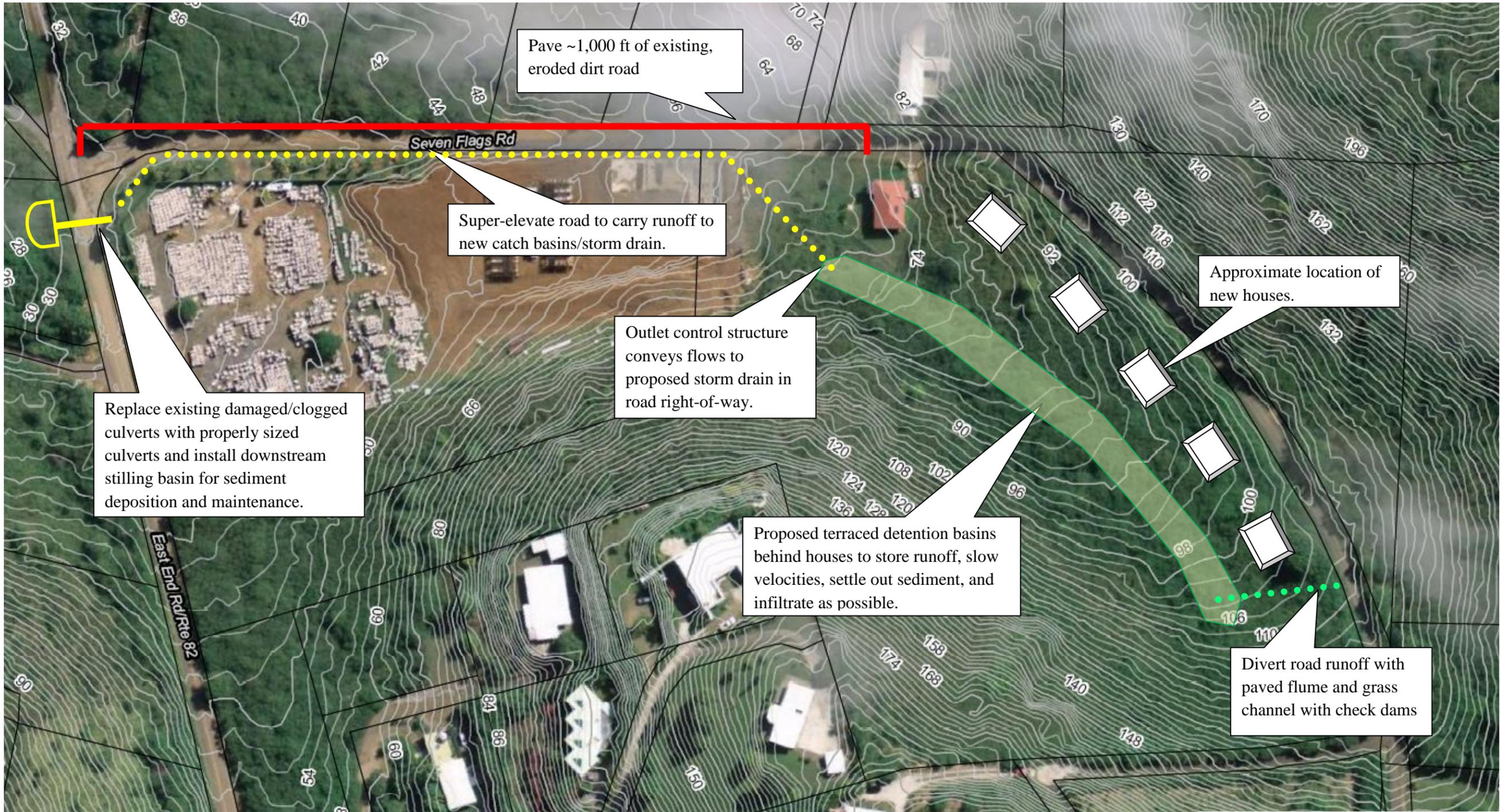
SECTION ALONG CENTERLINE

$$h = \left[0.148 \frac{Q}{D^{1/2} d^{3/2}} - 1.82dD^{1/2} \right]^{2/3}$$

Q = DESIGN DISCHARGE
D = CULVERT DIAMETER
d = RIPRAP d50 SIZE

OUTLET STILLING BASIN / PLUNGE POOL DETAIL

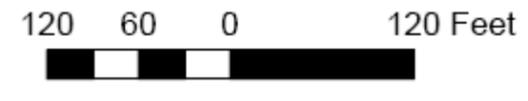
NOT TO SCALE




Horsley Witten Group, Inc.
 Sustainable Environmental Solutions
 www.horsleywitten.com
 90 Route 6A
 Sandwich, MA 02563
 508-833-6600 voice
 508-833-3150 fax

SB-R-1 Seven Flags Road
CONCEPTUAL DESIGN
 St. Croix, USVI

Prepared For:
NOAA Office of Ocean & Coastal Resources Mgt
 1305 East-West Hwy, SSMC-4 RM
 10414
 Silver Spring, MD 20910
 Phone: (301) 713-0820
 Fax: ---



St. Croix Yacht Club Teague Bay

Project ID: TB-R-2B/A

Type: Retrofit

Description: Retrofit concept includes the expansion and modification of the existing detention basin to improve water quality treatment. The existing facility appears undersized for the amount of area draining to it. Other options for this site include installation of rain gardens in the parking lots and potential permeable pavement installation in small northern parking area.

Key Design Elements:

1. Formalize swale area near entrance and along roadway (investigate additional storage potential);
2. Investigate potential for shallow rain garden in boat storage area;
3. Install waterbar and small shallow rain garden east of clubhouse;
4. Stabilize muddy/unpaved road with gravel and regrade so drains to swale;
5. Install culvert and new wetland forebay prior to discharge to gut.



Formalize existing swale along entrance to expand capacity and perhaps, provide for some storage



Continuation of existing swale.

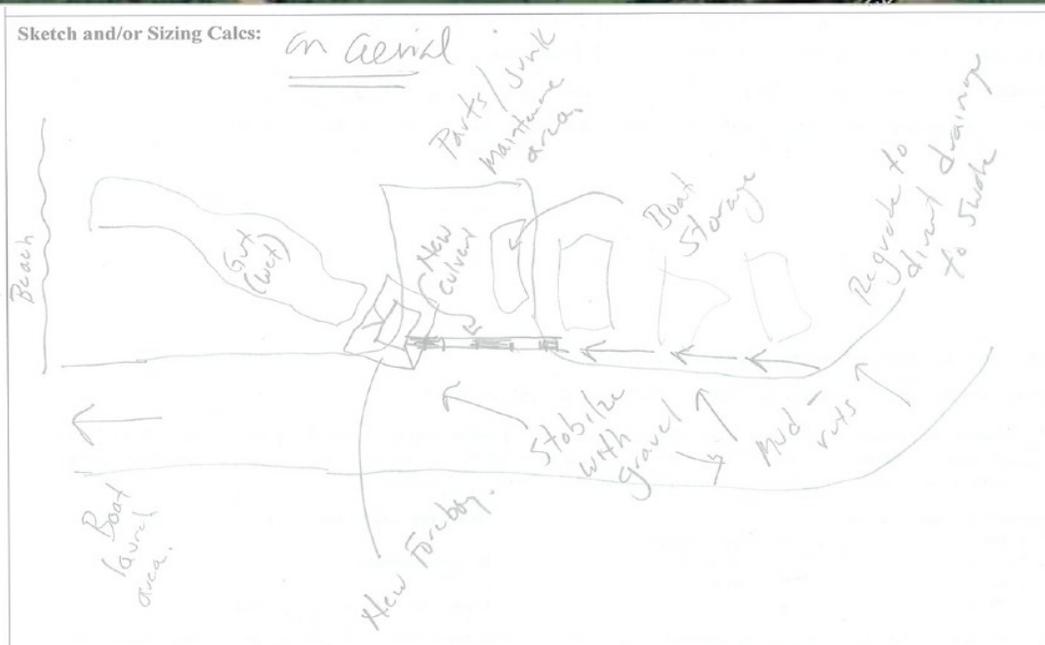


Area for proposed culvert and wetland forebay prior to discharge into gut.



Install water bar and direct some runoff to a shallow rain garden/landscaped area.

Site Map:



Unnamed Rd.

Great Pond Bay

Project ID: GP-RC-33

Type: Road stabilization

Description: Project concept is to stabilize over 300 ft of unpaved/gravel road that discharges sediment at outlet point across South Shore Rd. The deterioration of the paved surface of South Shore Rd. is evident where runoff from the unnamed road flows across the road surface into the wooded area. Sediment deposition in the wooded area was observed. Public Works has commented on this location as being a chronic problem.

This project, while not ranked as a high watershed restoration priority, provides design examples for options on how to stabilize unpaved road systems.

Key Design Elements:

- Install at least three waterbars along the length of the road to divert flows to swale on north side of road;
- Formalize existing road side swale to accept flows and safely convey to bottom of hill;
- Install check dams as necessary in channel to prevent erosive flows;
- Install culverts at existing driveways;
- Install a drop inlet structure with sump in the road-right-of way on the corner of South Shore Rd to collect sediment; and
- Install a culvert under South Shore Rd. to convey flows from inlet to a stabilized outlet structure with level spreader or stilling basin.
- Repave cut section of South Shore Rd.



Unnamed gravel road off of South Shore Rd. next to Washington Ln.



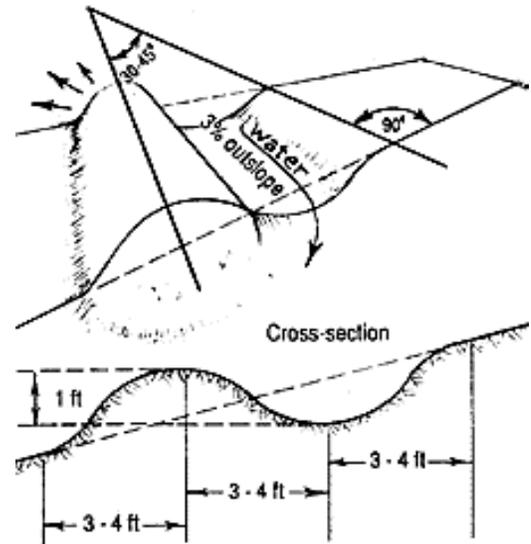
Sediment deposition at outlet location.



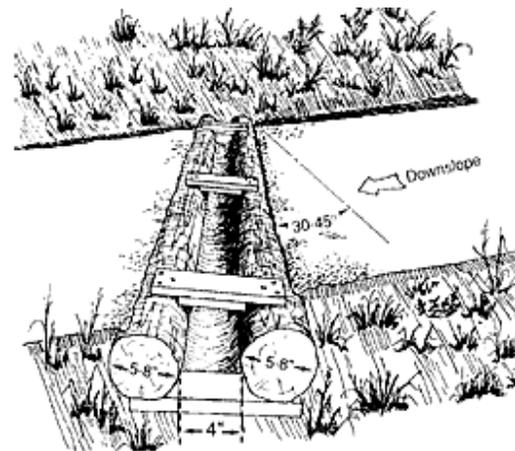
Surface deterioration of South Shore Rd.

Waterbar Design Criteria:

- Excavate trench at 30-45 degree angle across the road surface. Steeper grades with more surface flow should be closer to 45 degrees.
- Top of berm should be 12 inches higher than bottom of trench. To make a water bar easier to drive over, widen it by increasing the distance between the bottom of the dip and the top of the berm, maintaining the correct height.
- Pitch of waterbar is such that outlet end is at least 3 inches lower than the upper end (~3% slope).
- Extend waterbars beyond both travel edges of road to prevent water from flowing around ends.
- Direct diverted water into a stable, vegetated area or ditch. Do not discharge cross drains, culverts, water bars, dips, and other drainage structures onto erodible soils or fill slopes without outfall protection (rock piles, logs, etc.).



Waterbar Cross Section
(Source: MN Extension Service)

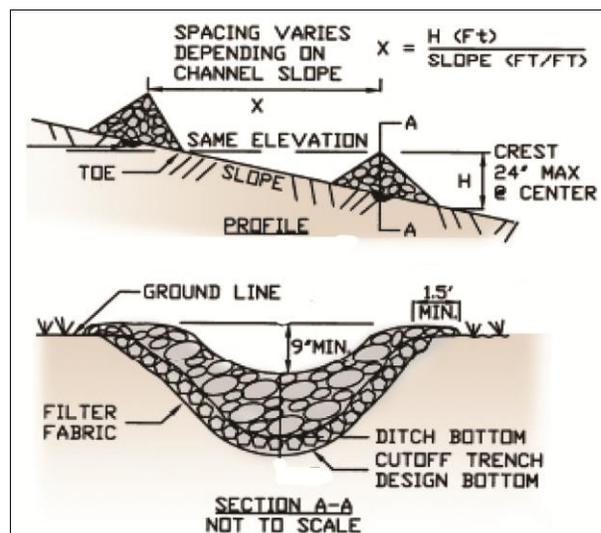


Water Trench
(Source: MN Extension Service)

Recommended Spacing of Waterbars and Cross Drains

Road Grade	Spacing (ft)		
	Waterbars	Dips	Cross Drains
2%	250	300	135
5%	135	180	100
10%	80	140	80
15%	60	Do not use	60
20%	45		45
25%	40		30

Source: HI DFW (2003) and VICIS (2003); Coeur d'Alene RMP/EIS (2006)

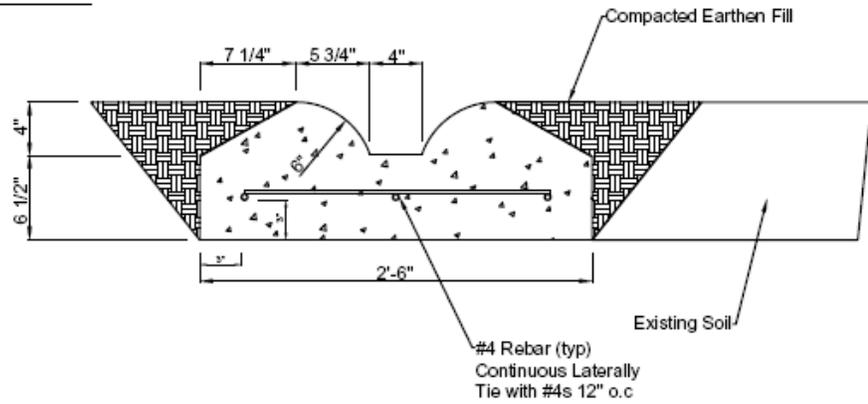


Check Dam Spacing and Cross Section

Water Bar Details

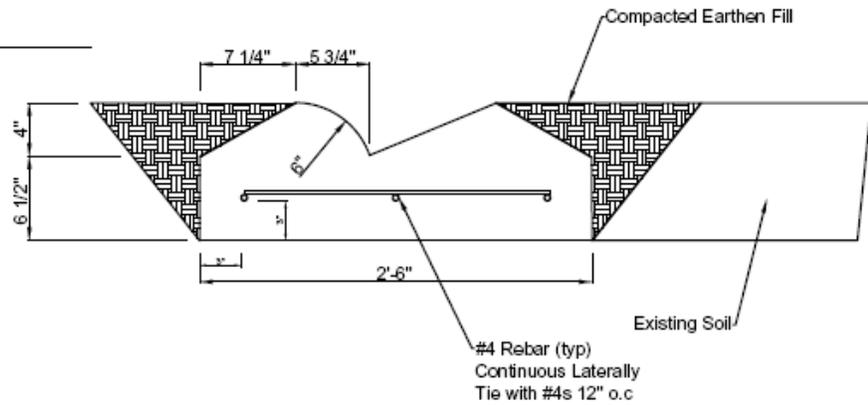
Detail A

N.T.S.



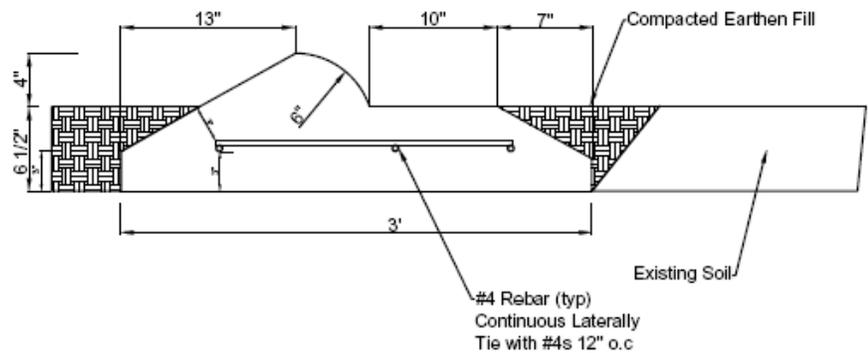
Detail B

N.T.S.

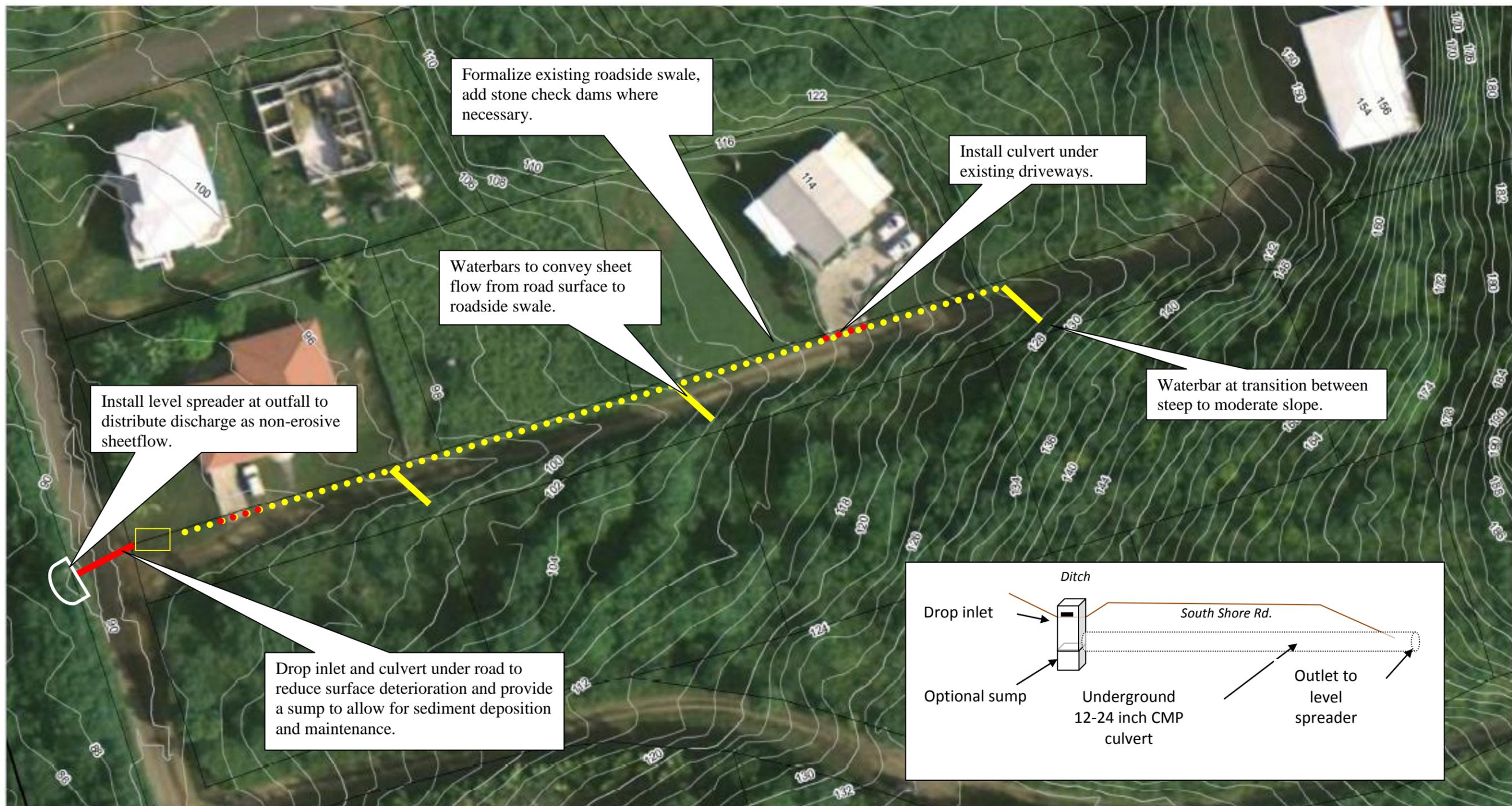


Detail C

N.T.S.



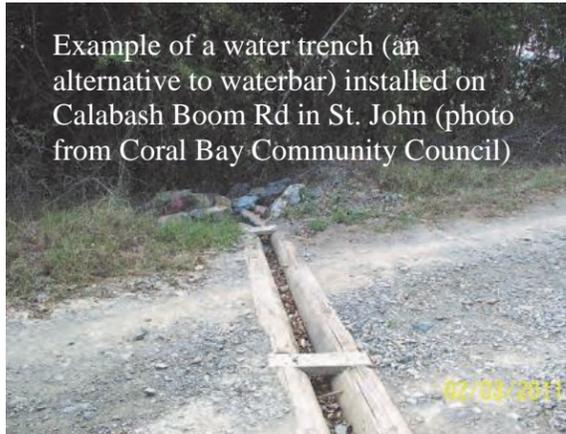
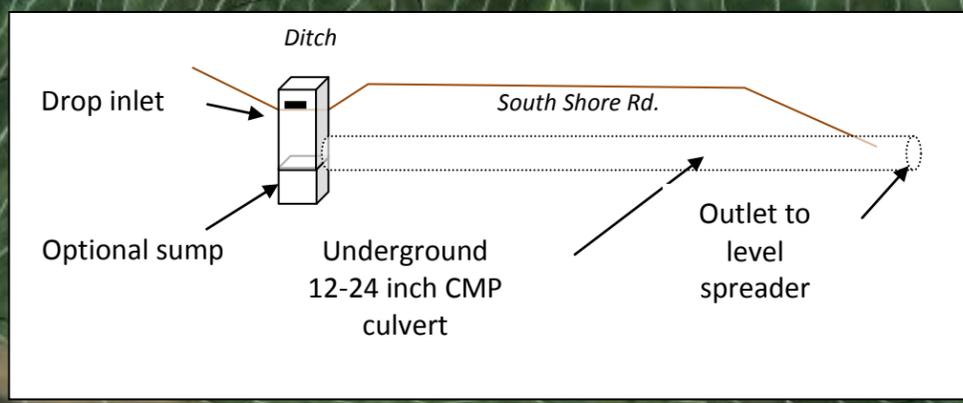
This page left intentionally blank.



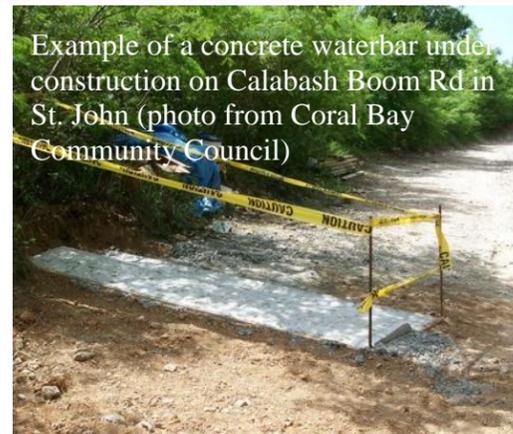

Horsley Witten Group, Inc.
 Sustainable Environmental Solutions
 www.horsleywitten.com
 90 Route 6A
 Sandwich, MA 02563
 508-833-6600 voice
 508-833-3150 fax

GP-RC-33 Un-named Road
 (Off Southshore Rd./Washington Ln.)
CONCEPTUAL DESIGN
 St. Croix, USVI

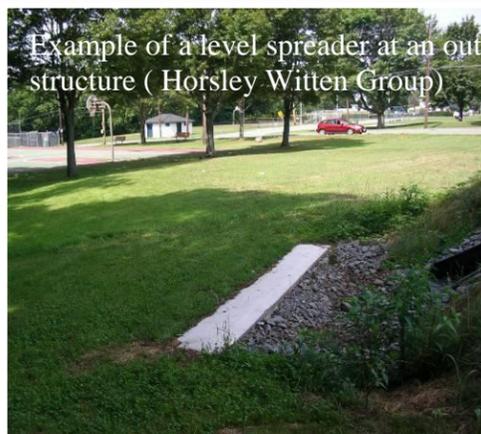
Prepared For:
NOAA Office of Ocean & Coastal Resources Mgt
 1305 East-West Hwy, SSMC-4 RM
 10414
 Silver Spring, MD 20910
 Phone: (301) 713-0820
 Fax: ---



Example of a water trench (an alternative to waterbar) installed on Calabash Boom Rd in St. John (photo from Coral Bay Community Council)



Example of a concrete waterbar under construction on Calabash Boom Rd in St. John (photo from Coral Bay Community Council)



Example of a level spreader at an outfall structure (Horsley Witten Group)

