NOAA ARRA USVI Watershed Stabilization Project

Coral Bay Watershed Management Project – John's Folly Drainage Improvements

National Oceanic and Atmospheric Administration
Virgin Islands Resource Conservation & Development Council
Coral Bay Community Council

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This report described the projects undertaken in one of six subwatersheds in Coral Bay, St. John, USVI with $1.5 million in National Oceanic and Atmospheric Administration (NOAA) Funding through the American Recovery and Reinvestment Act of 2009 (ARRA). These funds are part of the $2.7 million USVI Watershed Stabilization Project funds awarded to the Virgin Islands Resource Conservation & Development Council, Inc. (V.I. RC&D). The U.S. Environmental Protection Agency (EPA) provided $300,000 in funding to the Coral Bay Community Council (CBCC) under its Community Action for a Renewed Environment (CARE) program to provide the stormwater engineering expertise to provide the design portion of these projects and staff the CBCC Coral Bay Watershed Management Project. Local homeowners associations, the Virgin Islands government, and community volunteers have also provided more than $400,000 in resources and worked cooperatively to achieve the project objective of reducing the stormwater sediment plumes entering Coral Bay, thereby improving water quality, ecological health, and stormwater management while minimizing future negative impacts associated with roadways and new construction.

There are nine reports in this series, describing the complete NOAA ARRA USVI Watershed Stabilization Project:

- Coral Bay Watershed Management Project – Johnny Horn Trail Drainage Improvements
- Coral Bay Watershed Management Project – Hansen Bay Drainage Improvements
- Coral Bay Watershed Management Project – Lower Bordeaux Drainage Improvements
- Coral Bay Watershed Management Project – John’s Folly Drainage Improvements
- Coral Bay Watershed Management Project – Calabash Boom Drainage Improvements
- Coral Bay Watershed Management Project – Carolina Valley Drainage Improvements
- Fish Bay, St. John Drainage Improvements
- East End Bay, St. Croix Erosion Repairs, Trail Construction, and Drainage Improvements
- NOAA ARRA USVI Watershed Stabilization Project Summary Report

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Photos provided by the Coral Bay Community Council.

Overall project management was provided by the Virgin Islands Resource & Development Council and its Board of Directors listed below:

President - Diane Capehart
Vice President - Olasee Davis
Secretary - Marcia Taylor
Treasurer - Dee Osinski (first year)/Olasee Davis
At Large member - Paul Devine

Work would not have been possible without the contributed countless volunteer hours, including the project's Principal Investigator Marcia Taylor who put a substantial amount of volunteer time into this project.

Work in Coral Bay would not have been possible without the Coral Bay Community Council, Inc., a 501(c)(3) organization, its volunteer Board members and many community volunteers. President and Executive Director, Sharon Coldren, spent three years as a volunteer working almost fulltime to implement this project.

Project management and project completion were facilitated by the technical expertise and project management skills of NOAA's Restoration Center, specifically staff members Daphne MacFarlan and Julia Royster.

Executive Summary

The John's Folly Bay Watershed is like a steep-sided bowl around a small Caribbean-style embayment created by a coral reef berm growing across the bay mouth. Most of the hillside waterflows drain into three ghut paths that probably originally sheet-flowed through the vegetation on the flat land areas. There are no existing land-based wetlands, but there are considerable seagrass beds in the shallow bay, which long-term residents say have been negatively impacted by sedimentation. John's Folly Bay is known for lower rainfall levels than most of the island, as is evidenced by the cactus and scrub vegetation.

Poor development practices have caused increased concentrations of water flow and sedimentation (and altered flows) into Drainage Basins #1 and #2 (Figures 1 and 2) that drain into sensitive benthic habitats: a lagoon behind a reef (known as John's Folly Bay) and a thriving Elkhorn (*Acropora palmata*) reef area just outside John's Folly Bay. Drainage Basin #1 surrounds an unnamed ghut that forks into two branches before emptying into John's Folly Bay. Drainage Basin #2 surrounds a residential area that grew substantially in the early 2000's and increased stormwater flow so much that a delta of fist-sized rocks and dirt formed in the bay since 2004 (Google Earth time lapse photos show these occurrences). Land has been subdivided into lots as small as 10,000 square feet on steep hillsides with highly erodable soils.

Photo 1: Plume into John's Folly Bay prior to drainage improvements.

Drainage improvements to Route 107 and development of several subdivisions have disrupted the natural drainage, funneling stormwater and sediment flows down roads and directly into John's Folly Bay negatively affecting water turbidity (Photo 1). **The goal of this project is to restore natural drainage patterns, stabilize ghuts, and reduce dirt road erosion; thereby, reducing sediment reaching John's Folly Bay.**

In order to accomplish this goal, Coral Bay Community Council's (CBCC) first Stormwater Engineer, initially proposed ghut restoration and improvements such as rain gardens or bio-filtration areas, check dams, and rock filters, as described in the 2009 National Oceanic and Atmospheric Administration (NOAA) American Recovery and Reinvestment Act (ARRA) Coral Bay Workplan. Further investigation into watershed conditions and the causes of sedimentation led to refinements in the stormwater best management practices (BMPs) designed and the final selections. Ultimately, CBCC implemented two roadside drainage channels, a plunge pool and rock check dam, several swales, and some road paving. Figures 1 and 2 detail pre-existing and new stormwater structures and other watershed features in the two John's Folly drainage

basins. Once installed, these features helped to stabilize ghut channels and dirt roads, and redirect mismanaged water flows into the correct watershed. The net effects are:

1) Restoration of flows to the appropriate natural ghuts, and reduced flow in an overwhelmed ghut receiving new road drainage;

2) Stabilization of ghut channels;

3) Stabilization of drainage and reduced erosion by paving a road surface; and,

4) Reduced sediment-laden water reaching John's Folly Bay based on observations of area residents.

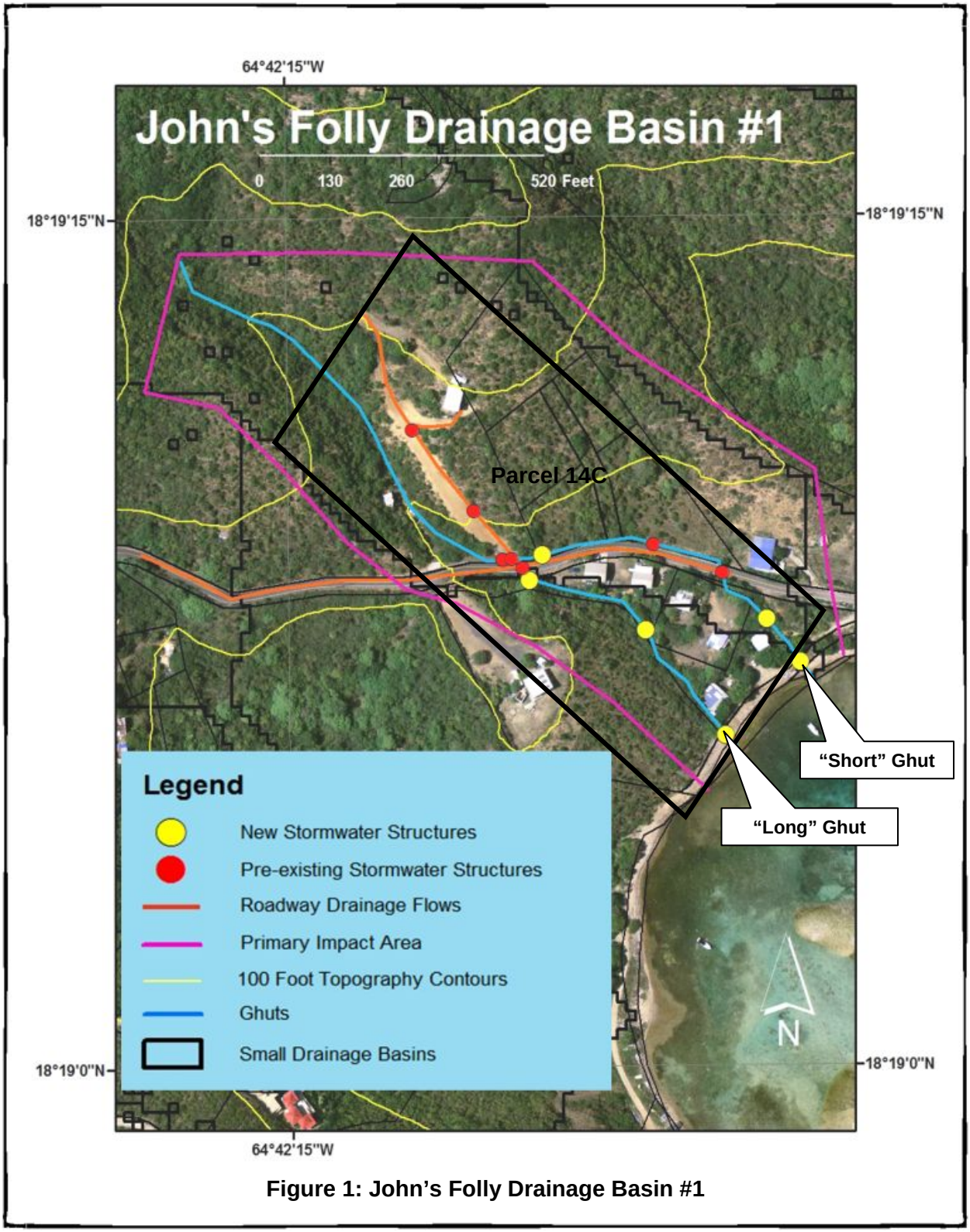


Figure 1: John's Folly Drainage Basin #1

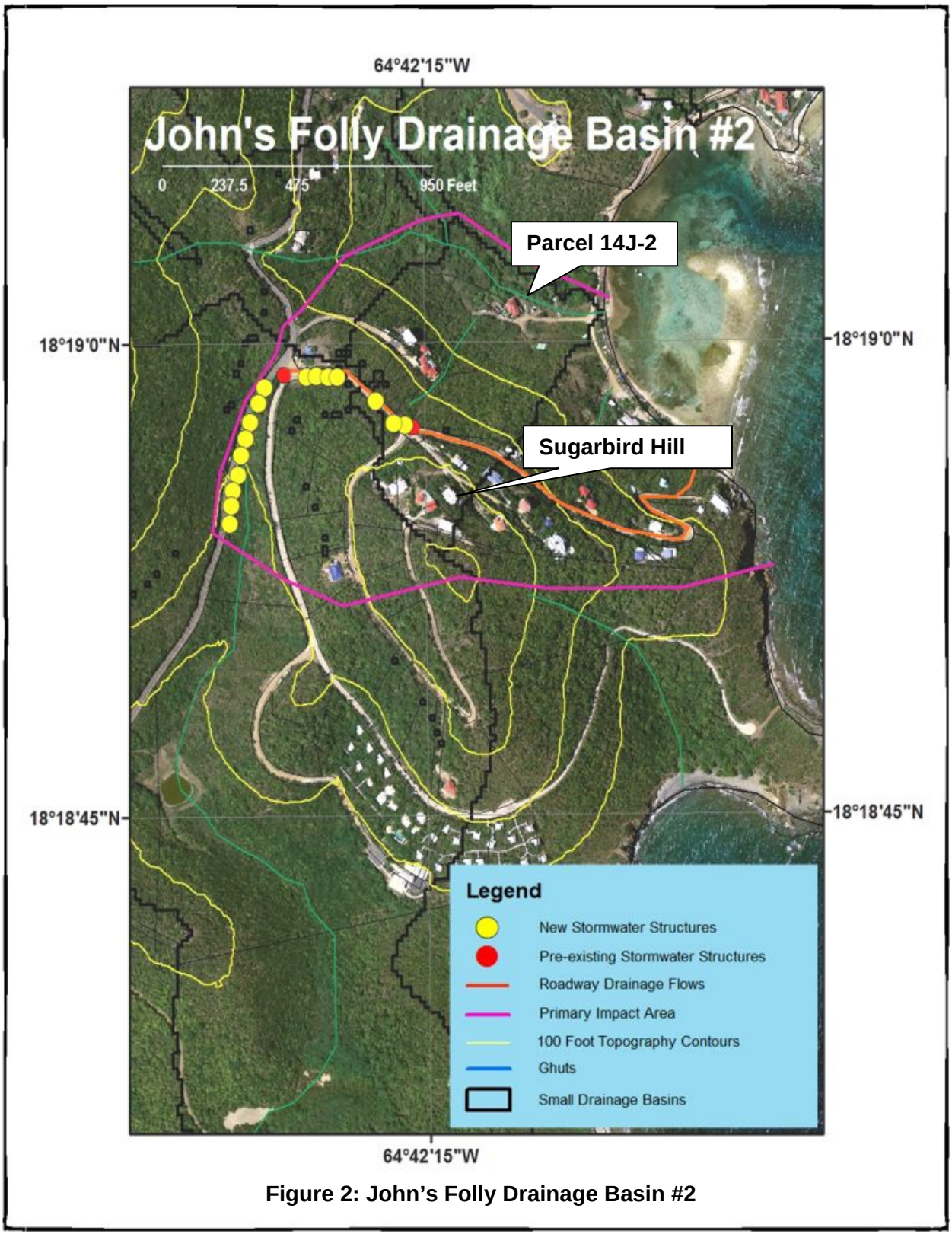


Figure 2: John's Folly Drainage Basin #2

1. Watershed Description

Photo 2: John's Folly Bay Watershed.

John's Folly Bay Watershed, shaped like a steep-sided bowl, encompasses approximately 50 acres of dry shrubland and residences (roughly 40 houses) surrounding a small Caribbean-style embayment created by a coral reef berm growing across the mouth (Photo 2). This bay contains seagrass beds in the lagoon and formations of thriving elkhorn coral (*A. palmata*) just outside the bay. Sugarbird Hill to the south stands at just over 400 feet and the ridgeline to the west and north is approximately 500 feet in elevation. The natural stormwater runoff travels downhill primarily as sheet flow and through three ghuts on the surrounding hills. In recent years, this flow has been interrupted and channeled by road construction and manmade drainage features.

2. Problem Statement

Poor development practices have caused increased concentrations of water flow and sedimentation (and altered flows) into two ghut areas that drain to sensitive benthic habitats: a lagoon behind a reef and a thriving Elkhorn (*A. palmata*) reef area just outside John's Folly Bay.

When Route 107 improvements were done in 2003 in the John's Folly Bay Watershed area, new stormwater drainage culverts were placed under the road, but little was done to stabilize the downstream ghut channels or ensure that all stormwater flowed into the intended culverts, thus contributing to new problems, described here as Drainage Basin #1 and #2.

Drainage Basin #1

On Parcel 14C John's Folly, an area subdivided into approximately twelve lots and split by Route 107, the road modifications described above led to an extremely erodable ghut channel running directly by several homes. Although Public Works (PW) made some efforts to armor the ghut channel near two houses in the area, no overall evaluation had been performed on how the the complete problem (not just the potential home damage) might be addressed. In addition, prior to the NOAA ARRA Project, a 30-year-old subdivision road had been re-cut up the hill alongside the ghut to allow for construction of a home without any stormwater management BMPs incorporated into the road design (Photo 3). In the NOAA ARRA Coral Bay Workplan, work in this area was expected to be limited to rock filters and checkdams in the ghuts to reduce velocities and help protect

Photo 3: Parcel 14C subdivision road runoff in Drainage Basin #1.

from additional bank erosion, as well as repair and installation of naturalized rock linings in eroded ghut areas within 300 yards of the ocean.

The ghuts emptying Parcel 14C flow over the acess road along the John's Folly Bay shoreline. This shoreline road is a narrow dirt road directly behind the cobble beach and vegetation berm that extends all the way along the bayfront. This road provides access to a number of shoreline properties, including several homes and a small seasonal beachside tourist stop. All stormwater flows entering John's Folly Bay cross the shoreline road, generally in wide natural swale areas or by running along this road (Photo 4). While traffic is limited on this road, after storms water sits in the low water crossing spots and the roadbed is further eroded by vehicle traffic, thus perpetuating puddle/pothole and related erosion problems (Photo 5). The shoreline road continues into Drainage Basin #2 and the above problem also exists there.

Photo 4: "Long" Ghut swale runoff over the shoreline road.

Photo 5: Runoff creating puddles/potholes along the shoreline road.

Drainage Basin #2

In spring 2009 when the NOAA ARRA Coral Bay Workplan was written, the flat outflow ghut area at Parcel 14J-2 John's Folly showed strong scouring due to stormflow erosion. The property also contained a newly-constructed home and centuries-old residential ruins, as well as two local dirt subdivision roads: one on the shoreline (noted above), and one leading to several vacant lots. The road leading to the vacant lots rises on a gentle slope, but in recent years has become a pathway for water coming down from newly cut/altered subdivision roads and residential rental villa construction on the hill above, and bypassing an old culvert placed during the original road construction to divert runoff water off the road and into the ghut. The dirt road has not been maintained since it was constructed more than a decade ago. The NOAA ARRA Coral Bay Workplan called for ghut restoration and improvements here, as well as stabilization and repairs where the water flow crossed or ran down roads. A new culvert was proposed for one water path, and armoring for the crossing on the shoreline road. It was also recommended that a naturalized raingarden and biofiltration area be added in the lowland ghut path.

This ghut area drains a residential area that grew substantially in the early 2000s. Flow increased so much that a delta of fist-sized rocks and dirt has been forming out in John's Folly Bay since 2004 (Google Earth time lapse photos show these occurrences). In the 1960s and 1970s, land in Estate Concordia was subdivided into lots as small as 10,000 square feet on steep hillsides with highly erodable soils, although almost no development took place here until the 2000s. During the course of project work, CBCC encouraged the owners of these new homes to form the Sugarbird Hill Homeowners Association (HOA), and this area subsequently became known as the Sugarbird Hill subdivision. The altered drainage flows in this location (Photo 6) and proposed solutions are discussed in detail in Section 4.2 BMP Selection Process.

Photo 6: Sugarbird Hill subdivision culvert sending flows downhill the wrong way to Parcel 14J-2.

3. Background and Project Planning

Research has shown that as development increased in Coral Bay so has sedimentation of the bay waters, thereby threatening the health of the bay and its marine habitats (Devine et al. 2003). In order to reduce this threat, the partner agencies, CBCC, NOAA, the Virgin Islands Department of Planning and Natural Resources (DPNR), the U.S. Environmental Protection Agency (EPA), and the Virgin Islands Resource Conservation and Development Council (V.I. RC&D), have aggressively spent the last five years planning and implementing actions to reduce sediment loads in Coral Bay.

Starting in 2007, NOAA funded the Coral Bay Watershed Management Plan (WMP) as a DPNR pilot watershed plan to provide a demonstration site for the whole U.S. Virgin Islands. Upon publication of the WMP in 2008, CBCC applied for a $300,000 EPA Community for a Renewed Environment (CARE) grant, and received it in early 2009 to begin implementation of the WMP as part of the overall Coral Bay Watershed Management Project. The primary goal of the EPA CARE grant was to implement *WMP Recommendation #1 – Provide direct, on-site technical assistance to watershed residents, businesses, developers, and others implementing watershed recommendations*. To help with this recommendation the WMP discussed five actions, two of which CBCC implemented as part of the EPA CARE grant:

- *Near-Term Action 1.1: Use EPA CARE grant as seed money to support a 1-2 year, full-time hydrologist/watershed manager for Coral Bay.*
- *Near-Term Action 1.4: DPNR and CBCC should consider providing resources needed to support new personnel (i.e. GIS, office basics, vehicle, etc.).*

In spring 2009, working through a local nonprofit partner, V.I. RC&D, CBCC secured $1.5 million of NOAA ARRA grant funds. CBCC and V.I. RC&D used these funds to implement actions

proposed in the NOAA ARRA Coral Bay Workplan prepared for the grant application, based on the expertise provided by the newly hired CBCC Stormwater Engineer (see Section 4.1). These NOAA ARRA funds allowed for the restoration of natural drainage functions and paving of roads in six subwatersheds in Coral Bay in order to eliminate or reduce the sediment-laden stormwater runoff plumes entering the bay. These projects also implemented portions of *WMP Recommendation #3 - Evaluate and repair erosion and drainage problems that are threatening property, damaging infrastructure, or delivering excessive sediment loads to Coral Bay*. CBCC's website contains a Project Overview of the USVI Watershed Stabilization Project in Coral Bay and a description of the Coral Bay Watershed Management Project.

In the NOAA ARRA Coral Bay Workplan, CBCC developed a list of watershed stabilization techniques appropriate for the Coral Bay environment (see Appendix A) and directly aimed at reducing sediment plumes to the bay. These were used to formulate the following goals for the John's Folly Project:

1. Restore natural drainage flow patterns to the greatest extent possible (Strategy 1);
2. Reduce stormwater velocities to reduce ghut bank erosion and increase infiltration (Strategy 2);
3. Stabilize ghut channels (Strategy 3); and,
4. Armor dirt road ghut crossings, and pave another road (Strategy 4).

4. Project Implementation

4.1 Project Design

CBCC hired Joseph Mina, P.E. as its Stormwater Engineer in 2009 using the EPA CARE grant funds to provide design expertise and recommendations. Initially, he wrote a series of engineering design memos based on field conditions to help identify the best BMPs for local implementation. He also contributed significantly to writing the NOAA ARRA Coral Bay Workplan and prioritizing the detailed projects in it. The EPA CARE grant funded the engineering design phase, with the NOAA ARRA funding taking over for the construction bidding and field construction phase. V.I. RC&D was directly responsible for the construction phases of the Coral Bay NOAA ARRA projects. For personal reasons, Mr. Mina had to leave CBCC's employment in June 2010 and CBCC hired Christopher Laude, P.E. to complete the design phase and implement the NOAA ARRA BMP projects over the following year.

John's Folly was slated as one of the later subwatersheds for design and project activities. As the overall project got underway, and CBCC was publically encouraging the formation of homeowners associations to care for subdivision roads, the residents starting to form a homeowners association in the Estate Concordia area of John's Folly (Drainage Basin #2) contacted CBCC. They were motivated to improve their roads and correct drainage patterns, in part because one of their owners provided maintenance for a rental villa downhill that received flooding stormwater flows from a culvert that drained their subdivision road. The runoff was visibly creating a new eroding ghut channel on the lower property. The initial contact in fall 2009 was inquiring about potential for funding from the NOAA ARRA Project. Initially CBCC indicated that only expert advice from the CBCC Stormwater Engineer through the EPA CARE grant funding would be available. One of the residents, an engineer, pointed out the errors in earlier

private road design and paving that ignored the natural topography and water flow. It became clear that a substantial portion of the water causing acute problems at Parcel 14J-2 John's Folly (see above Problem Statement), was originating from a culvert on the Sugarbird Hill subdivision road. This culvert was diverting flows that actually should have been going into a neighboring watershed and feeding a rare natural freshwater pond on the island. The HOA was encouraged to proceed with getting permissions, amplifying design, and raising funds to pave their entrance road and correct the drainage flows to restore flows to the pond. In 2010, CBCC committed to consider partial funding for the project, if funds were available in the later stages. Restoring natural flows high in the watershed would have the greatest positive impact on the downstream issues that had been identified earlier in the NOAA ARRA Coral Bay Workplan. Additional onsite evaluation of waterflows and current BMP conditions were necessary in 2010-2011 to complete final recommendations for BMPs to be implemented by the NOAA ARRA Project.

4.2 BMP Selection Process

Drainage Basin #1

During NOAA ARRA Coral Bay Workplan development, CBCC's focus was on a single ghut in Parcel 14C and alteration of water flow during PW Route 107 roadwork. A site evaluation by the CBCC Stormwater Engineer identified the detailed water flow conditions in this area, including the second deep ghut channel near the ocean, and the presence of sheet-flow areas and natural berming. The planned plunge pool and check dams, as well as some ghut cleaning could enhance the sediment filtration in both areas. The uphill dirt subdivision road section was identified as needing work, but the owner of the road portion was not able to be located. Thus, a diversion of the sediment-laden water into appropriate ghut channels was specified at the Route 107 intersection. A waterbar and a hydrodynamic separator were designed for installation within the previous PW work area to direct and then filter the water. However, these had to be dropped from the project's BMPs, because PW did not have the right equipment to commit to maintaining the hydrodynamic separator, and DPNR considered the waterbar to be on adjacent private land and not within the public road right of way and the owner could not be located to obtain permission to do the work. All of the proposed BMPs in this area are listed in Figure 3 below.

In the two areas where the water flows from these two ghuts cross the shoreline road, the crossings were specified to be stabilized with Armorflex® blocks. This permeable paving solution allows infiltration and is believed to be strong enough to withstand the occasional wave action it will receive in this location.

Drainage Basin #2

The NOAA ARRA Coral Bay Workplan recommended culvert replacement, swale (armoring) installation, and bio-filtration/rain garden construction at/near Parcel 14J-2. By early 2011, the owner of this parcel had already worked to re-naturalize the ghut, eliminating the need for any bio-filtration/rain garden construction with NOAA ARRA Project funding. As the John's Folly Project progressed, CBCC determined the uphill Sugarbird Hill subdivision proposed actions (see above and Figure 4) to divert waterflows from this area took priority over remedial actions on this property.

John's Folly 107
Project Layout

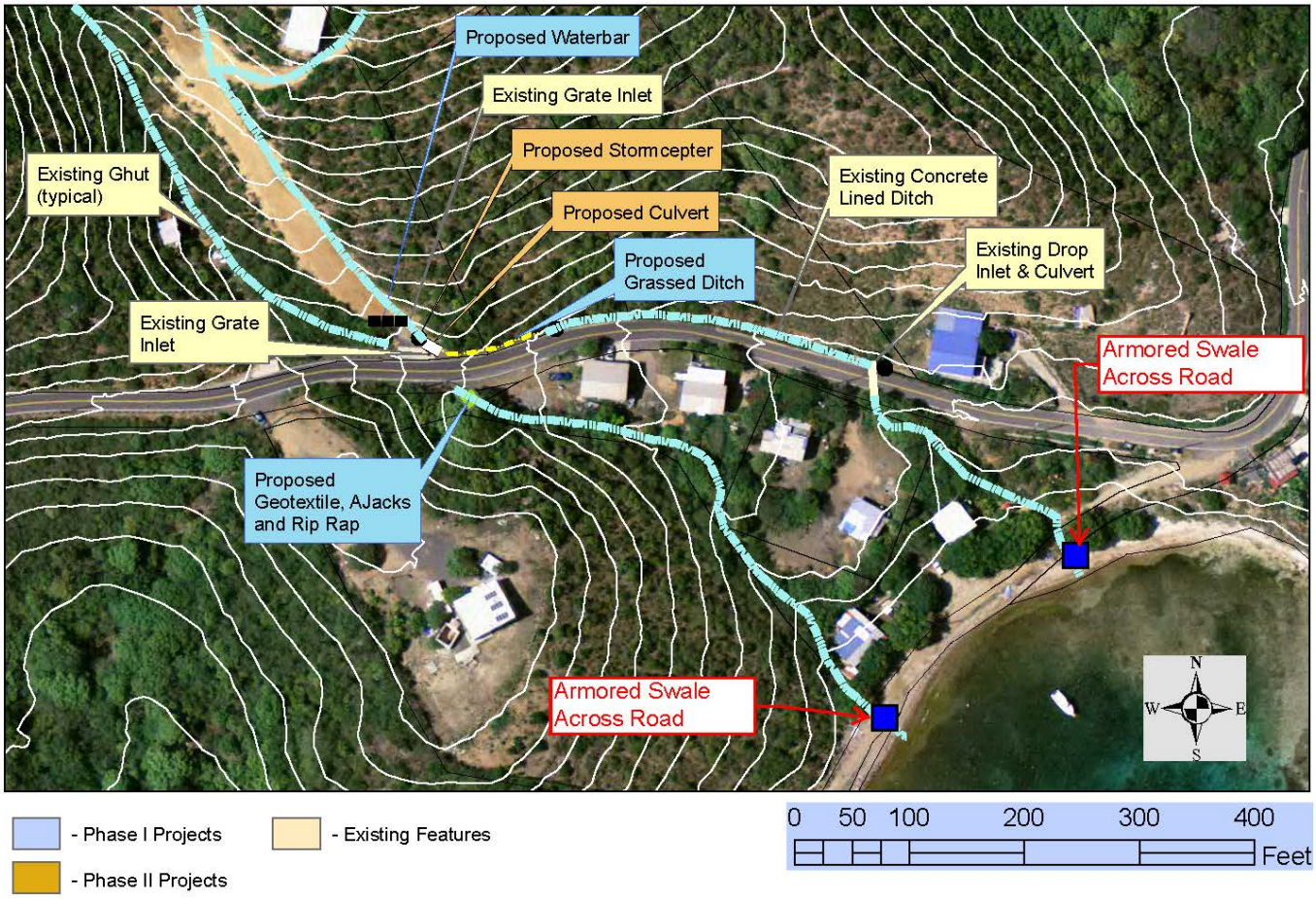


Figure 3: Drainage Basin #1 Existing Features, Phase I & II Project Layouts, and Phase I Armored Swale Locations.

Figure 4: Drainage Basin #2 - Sugarbird Hill Drainage Path (Red – constructed; Yellow – natural)

Finally, neighboring landowner permission for conducting the road swale work was not available because ownership was unknown and, as a result, DPNR would not issue a permit to conduct this roadwork. Thus, the selected BMPs in this area, with the Sugarbird Hill HOA and Concordia Eco-Resort financial contributions, focused on restoring natural flows high in the watershed, because this would have the greatest positive impact on the downstream issues that the NOAA ARRA Coral Bay Workplan had identified earlier.

Tables 1 & 2 summarize the transition from actions proposed in the NOAA ARRA Coral Bay Workplan to the implemented actions by including dates for proposal, dates for construction, and any additional comments necessary. All engineering design documents have been included in Appendix A.

Table 1: Workplan Proposed Actions (June 2009)

Location	Proposed Action	Status	Comments
Drainage Basin #1 (F-2)	Work in Parcel 14C John's Folly, will be limited to rock filters and check dams in ghuts to reduce velocities and help protect against additional bank erosion, as well as the repair and installation of naturalized rock linings in the eroded ghut within 300 yards of ocean.	Refined (April 2011) and constructed (July-August 2011).	Some of the focus was shifted to a previously unidentified ghut. Additionally, with the available Armorflex® armoring blocks from the Parcel 14J-2 Project, two swale areas could be added to this location.
Drainage Basin #2 (F-1)	Work in Parcel 14J-2 John's Folly, includes ghut restoration and other improvements (naturalized rain gardens and/or bio-filtration areas); and repairs to be made at road crossings (culvert at one place, cobbles at other).	Replaced with work uphill in the Sugarbird Hill subdivision of this drainage basin (April 2011).	A landowner conducted ghut re-naturalization and grassed the outflow area before Jan 2011; work on Sugarbird Hill was deemed to be a better solution; and, DPNR rejected to permit the shoreline road crossing work due to unknown ownership.

Table 2: Implemented Actions (April 2011)

Location	Implemented Action	Status	Comments
Drainage Basin #1	Install two road swales with Propex® turf reinforcement matting and Armorflex® blocks and remove ghut sand.	Constructed (July-August 2011)	This was a proposed action for Drainage Basin #2 and moved to Drainage Basin #1.
	Excavate and construct ditch.		This was an additional action not originally proposed.
	Excavate plunge pool, install plunge pool, and place riprap.		
	Install Propex® turf reinforcement matting and rock check dam in ghut below roadway inlet.		
Drainage Basin #2	Excavate and construct grass ditch, pave roadway, remove culvert and integrate swale in road paving in the Sugarbird Hill subdivision.	Constructed (July-August 2011)	This was a substitution for the proposed action because it was a better BMP solution.

4.3 Problems Encountered/Overcome

CBCC designed three BMP features for the John's Folly Bay Watershed that were dropped from final implementation because: (1) PW was could not commit to maintaining a hydrodynamic separator into the future; (2) a permit application was rejected by DPNR because the road owner could not be identified, since the last known owners had died in the 1980's after gifting the adjacent parcels prior to their deaths and not leaving any disposition of the road property in official records; and, (3) another permit application was denied because the owner of the underlying land could not be located. However, since the engineers had been working on multiple designs for this area, it was possible to shift focus to alternative BMP solutions/locations, always trying to get the greatest sediment plume reduction for the funds being spent.

This project was particularly impacted by the retirement of the long-time DPNR Coastal Zone Management staff member assigned to St. John at the same time as a new DPNR Commissioner was appointed. Long-standing policies regarding DPNR permitting/permissions required for road maintenance and stormwater BMP projects changed dramatically in early 2011 in their practical application in Coral Bay and on St. John. The legal documentation of subdivision and private road ownership and control is often not sufficient in Coral Bay to determine who owns or should maintain most roads. In the past, DPNR staff had relied on local knowledge when legal ownership documentation could not be found rather than requiring formal documentation to facilitate private investment in badly needed road and drainage improvements and maintenance, and thus reduce negative environmental impacts (on/for the overall community). Although this shift in DPNR policy reflected a tightening of standards, its impact in this case was to stop any permitting or work where the road ownership was unclear. The tightening of standards has also halted progress on a number of other local BMP and road improvement projects in Coral Bay in 2011. Resolving road ownership issues normally requires expensive legal court filings that take years to conclude. In spring 2012, DPNR staff would like to help develop a near-term practical resolution of this problem that facilitates implementation of environmental improvements such as stormwater BMPs and road maintenance.

4.4 Project Costs & Construction

After taking into consideration site conditions, BMP costs, and available project funds, the final BMPs implemented included creating drainage ditches, a plunge pool, a rock check dam, installing Armorflex® swales, and paving for a total cost of $96,890. Table 3 below details project costs and the following sections provide a more detailed description of construction. Appendix A has detailed design drawings.

Table 3: John's Folly Project Costs		
Segment	**Description**	**Total Cost**
Drainage Basin #1	Install two road swales with Propex® turf reinforcement matting and Armorflex® blocks.	$5,875
	Remove ghut sand and debris.	$1,845
	Excavate and construct 90 linear feet of roadside drainage channel.	$5,800
	Install plunge pool.	$3,600
	Install Propex® turf reinforcement matting.	$1,200
	Place riprap.	$15,200
	Seed.	$1,420
	Install Propex® turf reinforcement matting and rock check dam in ghut below roadway inlet.	$4,000
Drainage Basin #2**	Excavate and construct 484 linear feet of grass-lined roadside drainage channel.	$19,400
	Remove existing culvert.	$4,650
	Install 300 linear feet of concrete paving, incorporating swale.	$33,900
	Total Cost	$96,890**
The total project cost listed above includes $5,000 contributed by Concordia Eco-Resort and $10,000 contributed by the Sugarbird Hill HOA. After the project, the Sugarbird Hill HOA spent another $10,000 on BMPs for the Donkey Hill Road section of their subdivision, following expert advice from the CBCC Stormwater Engineer, funded by the EPA CARE grant. This redirected another flow back to its natural path and away from John's Folly Bay. Therefore, the Sugarbird Hill HOA spent an overall total of $20,000 to implement BMPs on Sugarbird Hill.		

Drainage Basin #1 Construction

Grass-Lined Roadside Drainage Channel Installation (Route 107)

Where possible, engineers design roadside drainage to funnel water to constructed drainage structures. Along Route 107, the contractor excavated approximately 90 linear feet of roadside drainage channel from an unpaved road, down Route 107 to a drop inlet culvert. The contractor then placed Propex® turf reinforcement matting (TRM) at excavation sub-grade, and seeded the area.

Ghut Debris Removal ("Long" Ghut)

If debris accumulates in a ghut, it can change the ghut path or cause overtopping. In some instances, debris removal is necessary to restore the ghut channel to more natural dimensions. For Drainage Basin #1, the contractor excavated accumulated ghut debris in one area of the "Long" Ghut.

Plunge Pool Repair ("Long" Ghut)

Plunge pools form as the result of scour where water comes off a waterfall or manmade object such as a spillway. At John's Folly, flows from a culvert outlet have eroded the ghut forming a plunge pool that requires repair and stabilization. The contractor excavated the plunge pool to produce a relatively smooth sided area. He then installed Propex® TRM on the excavation sub-grades. Finally he placed large rock riprap (<1' diameter) on the Propex® TRM and

Photo 7: Drainage Basin #1 plunge pool repair riprap.

then seeded and stabilized all disturbed areas (Photo 7).

Rock Riprap Check Dam Installation ("Short" Ghut)

Check dams are structures constructed across a channel to slow water velocities and reduce erosion. Check dams also capture sediment as water passes through the structure. For Drainage Basin #1, the contractor constructed a riprap check dam in the "Short" Ghut then seeded and stabilized the area.

Lined Swale Installation (Shoreline Road)

Stormwater managers typically use swales to convey runoff in a desired direction. For instance, "cross-road" swales are used to channel runoff from one side of the road to the other into appropriate drainages. For Drainage Basin #1, CBCC armored two existing swales across the shoreline road and into John's Folly Bay to stop deterioration of the road and reduce erosion, which was contributing sediment to the bay. The Stormwater Engineer chose to use Armorflex® articulated blocks in the swales partly as a demonstration project to see if they could be an alternative to concrete paving. Swale construction (Photo 8) included excavation and construction of Armorflex® lined swales with an erosion control mat underlay. Each swale was designed to be 12 feet wide, 1-foot deep, and 17 feet long.

Photo 8: Drainage Basin #1 shoreline swale under construction.

Drainage Basin #2 Construction

Concrete Paving

Roadway paving, although not typically considered a stormwater BMP, is frequently used in the Virgin Islands to control erosion off dirt roads and stabilize drainage flows. The contractor conducted the following tasks associated with paving 300 linear feet of pavement along Sugarbird Hill Road:

1. Placed sufficient fill to establish design road sub-grades and compacted;
2. Excavated tie-ins to existing concrete pavement (Photo 9);
3. Paved 10-foot wide road (Photos 10 & 11) with a grade of at least one inch in four feet to drain towards the grassed drainage channel and horizontal joints every 25 feet;
4. Installed eight-foot wide roadside swale according to detail drawing (Appendix A) (Photos 12-14).

Grass Lined Roadside Drainage Channel Installation

As noted above, engineers design roadside drainage to funnel water to appropriate drainage areas. At Sugarbird Hill, the contractor constructed a 484-foot long grass-lined drainage channel alongside Sugarbird Road to funnel water downhill towards Route 107 (Photos 12-14). Drainage channel construction included: (1) excavation so the finished channel drains at a grade of at least one inch in four feet without low spots that would hold water; (2) placing Propex® TRM

Photo 9: Sugarbird Hill roadwork showing paving installation.

Photo 10: Sugarbird Hill roadwork showing paving installation.

Photo 11: Sugarbird Hill roadwork showing paving installation.

Photo 12: Sugarbird Hill roadside drainage channel under construction.

Photo 13: Sugarbird Hill roadwork showing wide width of roadside swale and completed paving.

Photo 14: Sugarbird Hill new roadside swale leading to existing cross-road swale.

along the drainage channel excavation; and, (3) placing sufficient soil on the Propex® TRM to establish seed and stabilize the area.

Existing Culvert Abandonment

An existing culvert was funneling water underneath Sugarbird Hill Road and then allowing it to flow downhill into Drainage Basin #2 where it did not belong. In order for water to follow the

correct path, the contractor removed this culvert then backfilled the area. The area was then paved and incorporated a swale (Photo 15) redirecting the water into the roadside channel and ultimately to a freshwater pond.

Photo 15: Sugarbird Hill new swale paving to direct water to roadside channel.

4.5 Achieved Results

John's Folly residents have noticed a reduction of plumes after rainfall events. For a total project cost of $96,890 (including $15,000 in contributions from an HOA and local resort), the project was able to stabilize several ghuts, return flow to proper drainage areas, create two drainage ditches, and stabilize a road area to ensure less erosion and sediment runoff. The photos below depict completed BMPs including a riprap plunge pool outfall (Photo 16), Armorflex® swale (Photo 17), rock check dam (Photo 18), and roadside swale and paving (Photo 19). Attachment A includes the interpretive poster to highlight these achievements. Additionally, because CBCC's Stormwater Engineer provided additional expert advice on Sugarbird Hill's Donkey Trail Road, the HOA was able to fund construction to divert additional road runoff away from John's Folly Bay.

Photo 16: Drainage Basin #1 riprap plunge pool outfall.

Photo 17: Drainage Basin #1 Armorflex® swale.

Photo 18: Drainage Basin #1 rock check dam.

Photo 19: Drainage Basin #2 Sugarbird Hill roadwork.

5. Sediment Reduction Monitoring

Researchers did not undertake monitoring efforts in this remote area. However, John's Folly residents have reported seeing no sedimentation in the John's Folly Bay after heavy rains. One resident did report a small sediment plume during an October 6, 2011 rainfall event (0.5 inches of precipitation – not recorded at John's Folly), but said it did not recur in later storm events, so its origin remains a mystery.

6. Lessons Learned

Solving one of the issues in this watershed relied on the flexibility of the project to change BMP strategies/solutions midstream. The resolution showed the value of extending the search for solutions to John's Folly Bay plume problems into areas higher up in the watershed, at the same time being aware of solutions (BMPs) that could be implemented downstream near the shoreline. In an ideal world, one would be able to do both. However, with limited financial resources and limited time, having the flexibility to move the BMPs actually implemented to other places in the watershed allowed the project partners to provide a higher quality solution: i.e. the upland work in the Sugarbird Hill subdivision that diverted the road water to its predevelopment watershed to feed a rare freshwater pond. By having the grant funding commitment be focused on reducing sediment plumes into John's Folly Bay, rather than the other extreme of being focused on a particular implementation at a particular site, a much better long-term solution was found. This also had the benefit of managing greater stormwater volumes.

Problems encountered (and presented) by one landowner can perhaps most effectively be solved by BMP work done on another property owner's land. The second property owner may not be experiencing any "problem" from the waterflows and thus often has no incentive to make any monetary investment. Also, we need to recognize the historic management strategy of "get the water off my land as quickly as possible." This strategy often leads to water being unnaturally channeled. If more detailed engineering evaluations are funded upstream above the presenting "problem areas" – the nature of the problems and solutions may change. In this case, due to the fortuitous recognition by neighbors (after hearing about the Coral Bay Watershed Management project) that they might be part of the solution, an excellent success story resulted.

At the same time, two BMPs planned for this watershed - an armored swale on a portion of the shoreline road with unknown ownership and a waterbar at Parcel 14CC John's Folly - were not permitted by DPNR at the last minute, due to the lack of owner permission, since the owners could not be located. It was fortunate that there were additional local BMPs designed and unfunded that the project partners were able to incorporate into a reprioritized project suite and complete.

Effective stormwater BMPs will most often cross property lines. Flexibility in defining successful project implementation on a results/goals basis (even if not highly quantifiable) rather than construction of a particular BMP at a particular location is critical to project success. In hilly areas, such as St. John, projects and evaluating

government personnel should look for concentrated manmade flows upstream and determine if they can be altered in a way that provides more natural infiltration and drainage.

Don't allow subdivisions to be authorized without deference to contours of land and retaining natural drainage. Each of the subdivision areas in this watershed (for which we gained knowledge) was subdivided seemingly without deference to land contours and drainage patterns. They were simply drawn on surveys to maximize the number of saleable lots decades ago, in the 60s and 70s. The only government records available are plain subdivision surveys and deeds that contain only the simplest boilerplate and no reference to road or drainage maintenance or common subdivision lot owner responsibilities.

7. Next Steps

A great deal of additional work could be done in this watershed by the local owners, PW, and the HOA if ownership/permission issues could be resolved and funding secured. The benthic habitat in John's Folly Bay would greatly benefit from these activities and better development controls, especially for new house site planning and construction.

8. References

Devine, B., Brooks, G., and R. Nemeth. 2003. *Coral Bay Sediment Deposition and Reef Assessment Study*. State of the Bay, Final Project Report, Executive Summary. Submitted to VI DPNR Division of Environmental Protection MOA #NPS-01801.

Attachment A: Watershed Poster

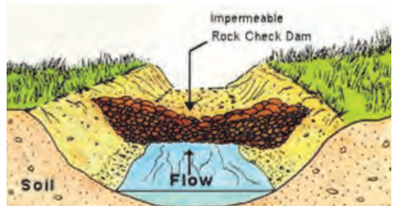
JOHN'S FOLLY; ROUTE 107 & SHORELINE RD

CORAL BAY COMMUNITY COUNCIL

WHAT IS HAPPENING HERE?

There are numerous issues that are contributing to the pollution and sedimentation of John's Folly Bay, reef, and lagoon. The natural drainage of John's Folly watershed has been altered by road cutting, residential development, and poor stormwater management practices. These alterations have resulted in increased runoff volumes and highly erosive flows, causing sedimentation of John's Folly Bay and negatively impacting reefs and endangered elkhorn coral formations. The goal in this watershed is to install rock check dams and roadside ditches and swales to help reduce runoff velocity, redirect flows to appropriate areas, and prevent erosion.

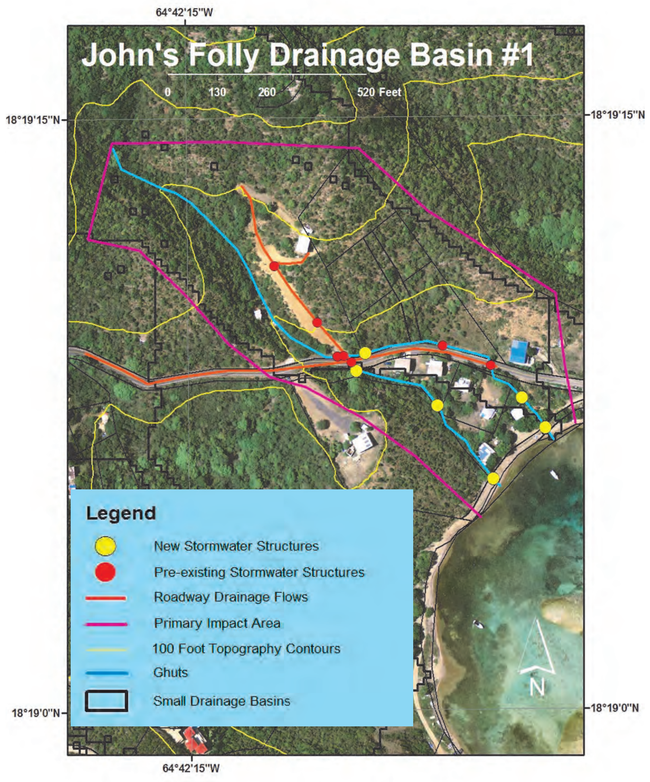
TYPICAL ROCK CHECK DAM



Source: Fisheries and Oceans, Canada DFO

BEFORE

DURING CONSTRUCTION



JOHN'S FOLLY WATERSHED

Drainage from the John's Folly watershed has a significant negative impact on the reefs and caused sedimentation of John's Folly Bay. The natural drainage of the watershed has been altered by road cutting, residential developments and poor stormwater management practices. This map shows the John's Folly area, sub-basins, natural drainage flow, and pre-existing and new drainage structures.

AFTER

STABILIZATION OBJECTIVES

- Reroute flow back into ghut and ditch along Route 107
- Reduce runoff from estate roads
- Reduce stormwater velocity
- Protect against additional ghut bank erosion
- Decrease sedimentation of bay and lagoon
- Improve water quality to maintain living marine resources

SITE LOCATIONS

WATERSHED SCALE GEOGRAPHIC INFORMATION SYSTEM (GIS) PLANNING TOOLS TARGETED WATER QUALITY MONITORING RESEARCH THAT HELPED IN SELECTING THE PRIORITY SITES FOR THESE SEDIMENT REDUCTION PROJECTS. FOLLOW-UP TERRESTRIAL AND MARINE SEDIMENT MONITORING WILL QUANTIFY AND DEMONSTRATE THE SUCCESS IN REDUCING SEDIMENT POLLUTION REACHING THE BAY.

WHAT YOU CAN DO!

⇒ Vegetate bare slopes with native plants
⇒ Minimize use of pesticides & fertilizers
⇒ Clean up driveways, roadsides and gutters
⇒ Use cut brush to create berms on steep slopes
⇒ Eliminate muddy run-off water
⇒ Never dump anything down storm culverts or ghuts
⇒ Properly dispose of oils, paints and chemicals
⇒ Do not disturb ghuts for 30 feet from center of ghut
⇒ Preserve all trees
⇒ Pump and inspect your septic tank regularly
⇒ Notify DPNR if you notice a problem
⇒ DPNR permits are needed for using backhoes & trackhoes
⇒ Educate each other
⇒ Participate in community projects!

THANKS TO OUR LEAD PARTNERS!

CORAL BAY COMMUNITY COUNCIL (CBCC)
VIRGIN ISLANDS RESOURCES CONSERVATION & DEVELOPMENT COUNCIL (VIRC&D)
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION (NOAA)
US ENVIRONMENTAL PROTECTION AGENCY (EPA)
VIRGIN ISLANDS DEPT. OF PLANNING AND NATURAL RESOURCES (DPNR)
VIRGIN ISLANDS DEPT. OF PUBLIC WORKS (DPW)
COMMUNITY VOLUNTEERS AND HOMEOWNERS' ASSOCIATIONS

PROTECTING COASTAL & CORAL REEF HABITATS BY REDUCING EROSION & SEDIMENTATION

THIS PROJECT IS ONE OF 18 IMPLEMENTED IN THE CORAL BAY WATERSHED WITH $1.5 MILLION IN NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION FUNDING UNDER THE AMERICAN RECOVERY AND REINVESTMENT ACT OF 2009, AS PART OF THE $2.7 MILLION USVI COASTAL HABITAT RESTORATION THROUGH WATERSHED STABILIZATION PROJECT TO REDUCE SEDIMENT LOADING RATES INTO THE COASTAL WATERS OF THREE USVI WATERSHEDS: CORAL BAY AND FISH BAY ON ST. JOHN AND EAST END BAY ON ST. CROIX. THE U.S. ENVIRONMENTAL PROTECTION AGENCY HAS PROVIDED FUNDING TO THE CORAL BAY COMMUNITY COUNCIL UNDER ITS COMMUNITY ACTION FOR A RENEWED ENVIRONMENT (CARE) PROGRAM TO SUPPORT THIS WORK. LOCAL HOMEOWNERS ASSOCIATIONS, THE VIRGIN ISLANDS GOVERNMENT AND COMMUNITY VOLUNTEERS HAVE ALSO PROVIDED RESOURCES AND WORKED COOPERATIVELY TO ACHIEVE THE PROJECT OBJECTIVE OF REDUCING THE STORMWATER SEDIMENT PLUMES ENTERING BEAUTIFUL BLUE CORAL BAY. THESE PROJECTS ARE ALSO PART OF IMPLEMENTING THE CORAL BAY WATERSHED MANAGEMENT PLAN THROUGH PUBLIC-PRIVATE PARTNERSHIPS TO IMPROVE WATER QUALITY, ECOLOGICAL HEALTH, AND STORMWATER MANAGEMENT WHILE MINIMIZING FUTURE IMPACTS ASSOCIATED WITH WATERSHED DEVELOPMENT.

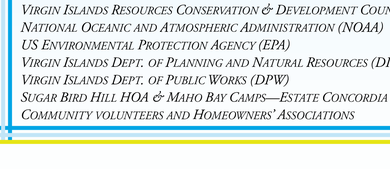
FOR MORE INFORMATION PLEASE CONTACT:
CORAL BAY COMMUNITY COUNCIL
(340) 776-2099
WWW.CORALBAYCOMMUNITYCOUNCIL.ORG

JOHN'S FOLLY: SUGAR BIRD HILL

WHAT IS HAPPENING HERE?

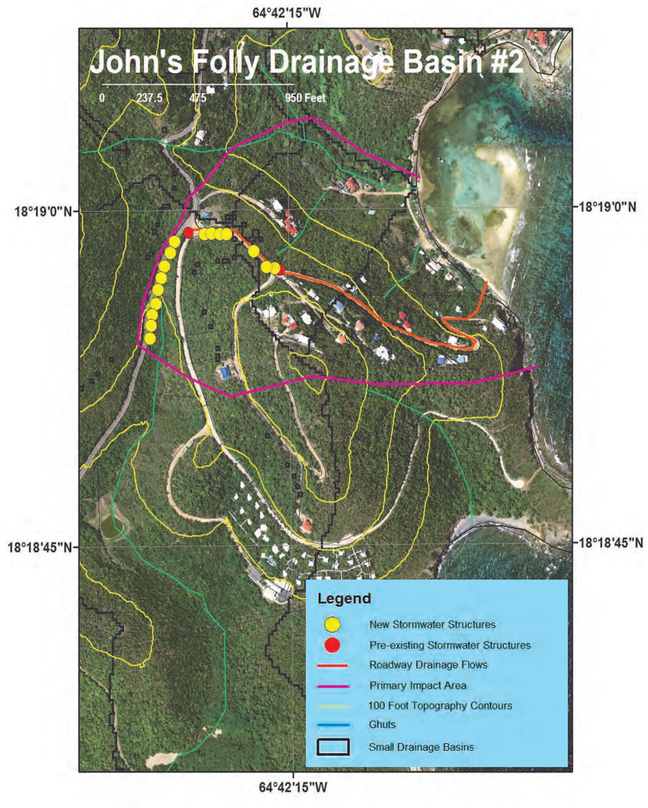
At Sugar Bird Hill drainage flows have been altered by road construction to deliver excessive new water flows down the hills in John's Folly causing erosion. This joint project with the Sugar Bird Hill Homeowners' Association returned the roadside water flow to its original area in the neighboring Concordia watershed; directing it into a natural freshwater pond. The project involved removing a culvert, adding a swale, and paving a section of road to stabilize future water flows. Maho Bay Camps – Estate Concordia Preserve also provided funding and assistance.

JOHN'S FOLLY BAY



BEFORE

DURING CONSTRUCTION



JOHN'S FOLLY WATERSHED

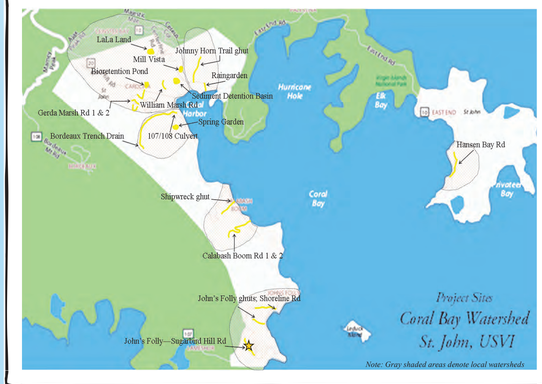
Drainage from the John's Folly watershed has significant sedimentation impacts on John's Folly Bay and its fringing reefs and sea grass beds. The natural drainage of the watershed has been altered by road cutting, residential developments and poor stormwater management practices. This map shows the John's Folly area, southern sub-basin, natural drainage flows, and pre-existing and new drainage structures.

AFTER

STABILIZATION OBJECTIVES

- Reroute flow back into ghut and ditch along Route 107
- Reduce runoff from estate roads
- Reduce stormwater velocity
- Protect against additional ghut bank erosion
- Decrease sedimentation of bay and lagoon
- Improve water quality to maintain living marine resources

SITE LOCATIONS



WATERSHED SCALE GEOGRAPHIC INFORMATION SYSTEM (GIS) PLANNING TOOLS TARGETED WATER QUALITY MONITORING RESEARCH THAT HELPED IN SELECTING THE PRIORITY SITES FOR THESE SEDIMENT REDUCTION PROJECTS. FOLLOW-UP TERRESTRIAL AND MARINE SEDIMENT MONITORING WILL QUANTIFY AND DEMONSTRATE THE SUCCESS IN REDUCING SEDIMENT POLLUTION REACHING THE BAY.

WHAT YOU CAN DO!

⇒ Vegetate bare slopes with native plants
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⇒ Properly dispose of oils, paints and chemicals
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⇒ Pump and inspect your septic tank regularly
⇒ Notify DPNR if you notice a problem
⇒ DPNR permits are needed for using backhoes & trackhoes
⇒ Educate each other
⇒ Participate in community projects!

THANKS TO OUR LEAD PARTNERS!

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NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION (NOAA)
US ENVIRONMENTAL PROTECTION AGENCY (EPA)
VIRGIN ISLANDS DEPT. OF PLANNING AND NATURAL RESOURCES (DPNR)
VIRGIN ISLANDS DEPT. OF PUBLIC WORKS (DPW)
SUGAR BIRD HILL HOA & MAHO BAY CAMPS—ESTATE CONCORDIA PRESERVE
COMMUNITY VOLUNTEERS AND HOMEOWNERS' ASSOCIATIONS

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(340) 776-2099
WWW.CORALBAYCOMMUNITYCOUNCIL.ORG

Appendix A: Engineering Designs & Drawings

CORAL BAY COMMUNITY COUNCIL, INC.

Mailing: 9901 Estate Emmaus, St. John, VI 00830
Office: 8-1 Estate Emmaus, Coral Bay, St. John, U.S. Virgin Islands
E-mail: coralbaycommunitycouncil@hotmail.com Phone/Fax: 340-776-2099

Coral Bay Projects Design Guidance

Strategies Appropriate for Coral Bay Environment

By: Joseph Mina, P.E.

1. Many natural drainage flows have been disturbed by construction and other man-made activities. A primary method of addressing water quality exiting the watershed into the bay will be to restore natural drainage flow patterns to the greatest extent possible both in intermittent drainage swales and ghuts and restoring sheet flow over steep slopes where possible. This will be accomplished primarily by:

a. Redirecting drainage from channels and redirecting the large areas of upslope water intercepted along many roads and construction sites and distribute that water using level spreaders, bioretention/infiltration devices and/or rock aprons or similar means to recreate the natural sheet flow, reduce velocity and improved percolation into soil.

i. Regrade roadbeds to direct flows to appropriate outflow devices where feasible, and add additional paving or permanent structures as appropriate to make preferred patterns of flow permanent.

ii. Add shallow vegetated swales, and detention areas with rocks and naturalized vegetation where possible to reduce velocity and promote infiltration.

iii. Install trench drains across driveways and roads into rain gardens, infiltration trenches, localized water collection systems for irrigation, or other appropriate devices.

b. Eliminate deep excavated unlined ditches which are common to many of the dirt roads in order to slow velocities and reduce amount of sediment produced by erosion. Check dams, bioretention swales, and underground stone trenches with perforated pipe will be installed where appropriate.

c. Reduce the length water travels in roadside swales by directing flow from roadways into devices often. Preferably at each switchback at a minimum by incorporating drywells, rain gardens and infiltration chambers using locally available materials and native species.

2. Retain and slow down water that reaches valley floor in larger scale regional detention/retention basins with Best Management Practices installed including forebays, infiltration cells and bioretention pond areas:

a. Devices will utilize native plantings and species where possible and available to mimic local Caribbean seasonal flow dry ghut conditions to promote both stormwater quality and to provide wildlife and riparian habitat restoration.

b. Sediment deposition retention area, cleaned regularly, with reuse of sediment material as gravel, topsoil, building sand, etc.

3. Provide “Last Chance” effort to reduce sediment entering sea at ends of ghuts and drainage ways immediately adjacent to where the flows enter the ocean.

a. Install devices just upstream of exit to the ocean from ghuts including:

i. Combination of weirs, pre-manufactured sediment retention chambers and/or small bioretention areas with local rock rip-rap aprons and multi-step natural rock retention step pools.

ii. Baffles and check dams where ghut is large enough.

iii. Construct and maintain natural “Caribbean Berm” (usually created by wave action and sand deposition) where water enters ocean in each area to provide natural sediment protection. Protection against mosquitoes and parasites in sitting water with guppies)

b. Slow, redirect and/or restore gut flow within 300 yards of ocean by installing the following where appropriate and feasible:

i. Re-vegetate gut outflow areas.

ii. Rock weirs, ghut slope and embankment protection including erosion control blankets, concrete cable mats or other manufactured devices to reduce erosion.

c. Install in-line biofiltration areas and flow spreading devices to slow velocities and provide opportunities for sediment to drop out and naturalized vegetation to reduce pollutant loading in the runoff.

4. Correction of failed devices, culverts, water routing by installing any appropriate Best Management Practices to attempt to solve some past poor choices of storm water management, or areas where no thought was given to management.

June 2009

John's Folly Route 107
Drainage Improvements
Scope of Work, Details & Specifications

PROJECT NO. F1

SITUATE IN
CORAL BAY, ST. JOHN
US VIRGIN ISLANDS

April 8, 2011

PREPARED FOR:
Coral Bay Community Council, Inc., and:
Virgin Islands Resource Conservation
& Development Council, Inc.
NOAA-ARRA Grant
9901 Emmaus
St. John, USVI 00830

PREPARED BY:
Christopher S. Laude, PE
9901 Emmaus
St John, VI 00830
910/612-5990

1.0 SCOPE OF WORK

Project is located in Coral Bay on St. John USVI. The project entails work in 2 separate areas along Route 107. Locations are as shown on the enclosed Site Location Map. Exact installation locations for work items shall be indicated in the field by the VIRC&D Inspector.

Area 1 – [redacted] Grass Lined Ditch.

Work proposed for Area 1 consists of constructing a [redacted] grass lined ditch in the approximate areas shown on Site Location map. The construction shall proceed as follows:

1. [redacted]
2. Excavate approximately 90-linear feet (LF) of roadside ditch (see attached Ditch Detail Sheet). Place Propex® Turf Reinforcement Matting (TRM) at excavation sub-grade in accordance with manufacturer's recommendations. Seed area where TRM was placed with Bermuda grass (98% purity) at a rate of to be determined by VI RC&D inspector. Spread a thin layer of soil on top of the seed to protect from foraging wildlife.

Area 2 – Plunge Pool Repair.

Work to be performed in Area 2 consists of repairing erosion caused by stormwater discharges from a culvert under Route 107 (See Plunge Pool Repair Detail). The construction shall proceed as follows:

1. Excavate eroded plunge pool to produce a relatively smooth sided excavation.
2. Install Propex® TRM on the excavation sub-grades in accordance with the manufacture's recommendations.
3. Place A-Jacks and large rock rip rap (<1' diameter) on the TRM.
4. Seed and stabilize all disturbed areas. Upon final grading of an area, all disturbed earth surfaces shall be seeded with Bermuda grass (98% purity) at a rate of to be determined by VI RC&D inspector.

NOTES AND CONDITIONS

Additional specifications and adjustments, at the discretion of the VIRC&D Inspector, shall be field implemented to adequately install devices and provide protection and stabilization. Contractor shall be responsible for implementing any such adjustments as deemed necessary by the Inspector that are reasonably similar to the written specifications.

a. A-Jacks and ArmorFlex concrete block shall be provided by VIRC&D. All other materials and supplies including but not limited to rock, concrete, and geotextile are to be provided by the contractor.
b. Contractor shall barricade freshly poured concrete for a minimum of 48 hours from the end of pour to prevent damage from traffic. All concrete shall have a minimum compressive strength at 28-days of 3,000 pounds per square inch (psi). Contractor shall

notify VI RC&D Inspector at least 24-hours in advance of each and every concrete pour so that the Inspector may verify construction. Contractor shall not pour any concrete unless the work has been observed and approved by the Inspector.

c. Contractor shall remove excess excavated material from the site. At the direction of the VI RC&D inspector, contractor may use such material to fill eroded roadway and roadside areas. All non-traffic areas filled and repaired, and all other disturbed areas shall be protected with Erosion Control Blanket (at the direction of the VI RC&D inspector) and seeded with Bermuda grass (98% purity) at 20lbs. per acre. No material other than that used for roadside repairs shall remain onsite. VIRCD shall provide Erosion Control Blanket, contractor shall install erosion control blanket and seed with Bermuda grass at specified rate.

d. Contractor shall maintain traffic flow in at least one lane at all times using appropriate traffic control methods in accordance with all Public Works requirements.

e. During grading & excavation work, sufficient water will be kept onsite to ensure that exposed soil and road surfaces can be sprayed down to control dust.

f. All workmanship shall comply with VI DPW specifications and FP-2006 specifications.

g. All grading and excavation included on this job shall include all rock and ledge removal necessary to install items as specified. No additional fees shall be charged for rock work.

h. Contractor shall be responsible for installing prior to start of construction up to four sign posts consisting of a 4" x 4" post set 2' into the ground and extending 6' above grade at locations to be determined upon the start of construction. Signs will be provided by VIRCD and mounted on the signpost by the contractor.

i. BUY AMERICAN CLAUSE: Contractors are hereby notified that they are encouraged, to the greatest extent practicable, to purchase American-made equipment and products with funding provided under this award.

j. Contractor shall have a VI business license to do the type of work that is being performed.

k. Contractor shall provide a valid DUNS number.

l. All workers on the projects must legally be able to work in the VI.

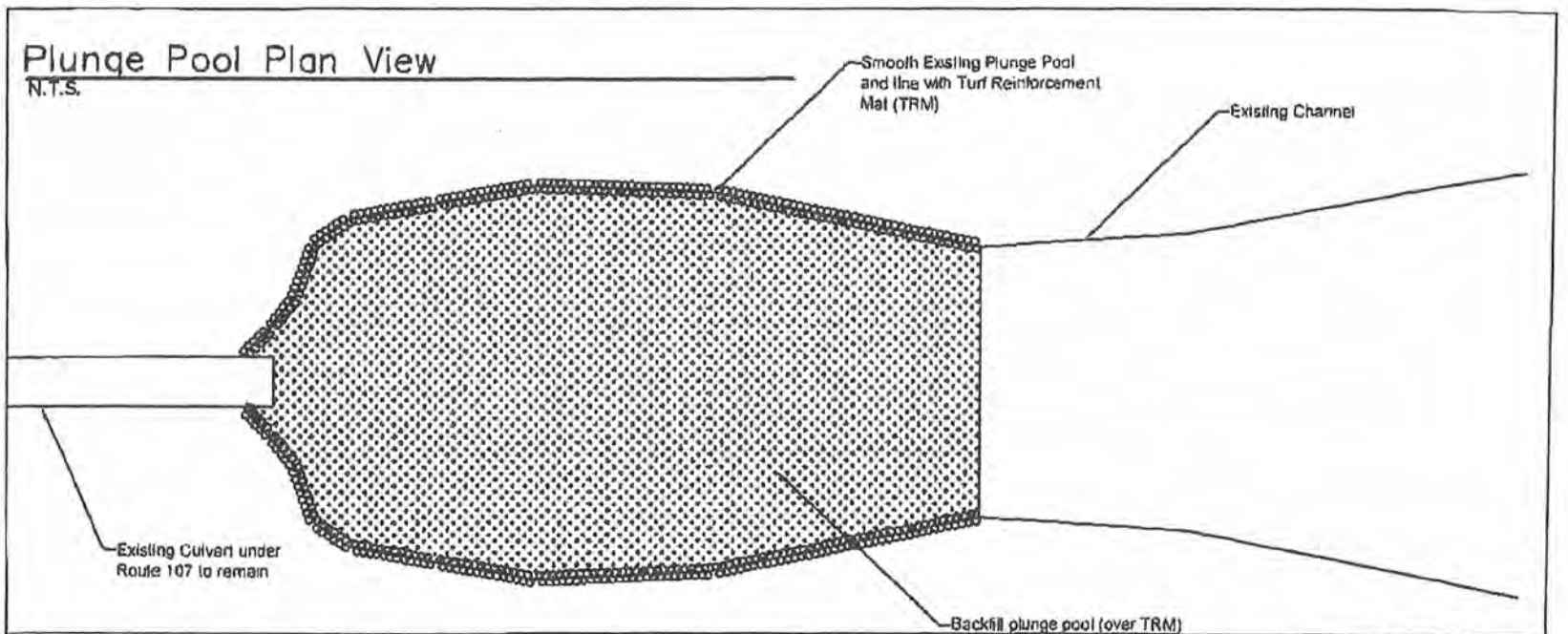
m. Contractor shall notify Project manager, CBCC and all abutters at least 4 days prior to beginning work. DPNR/CZM shall be notified 72 hours prior to beginning work.

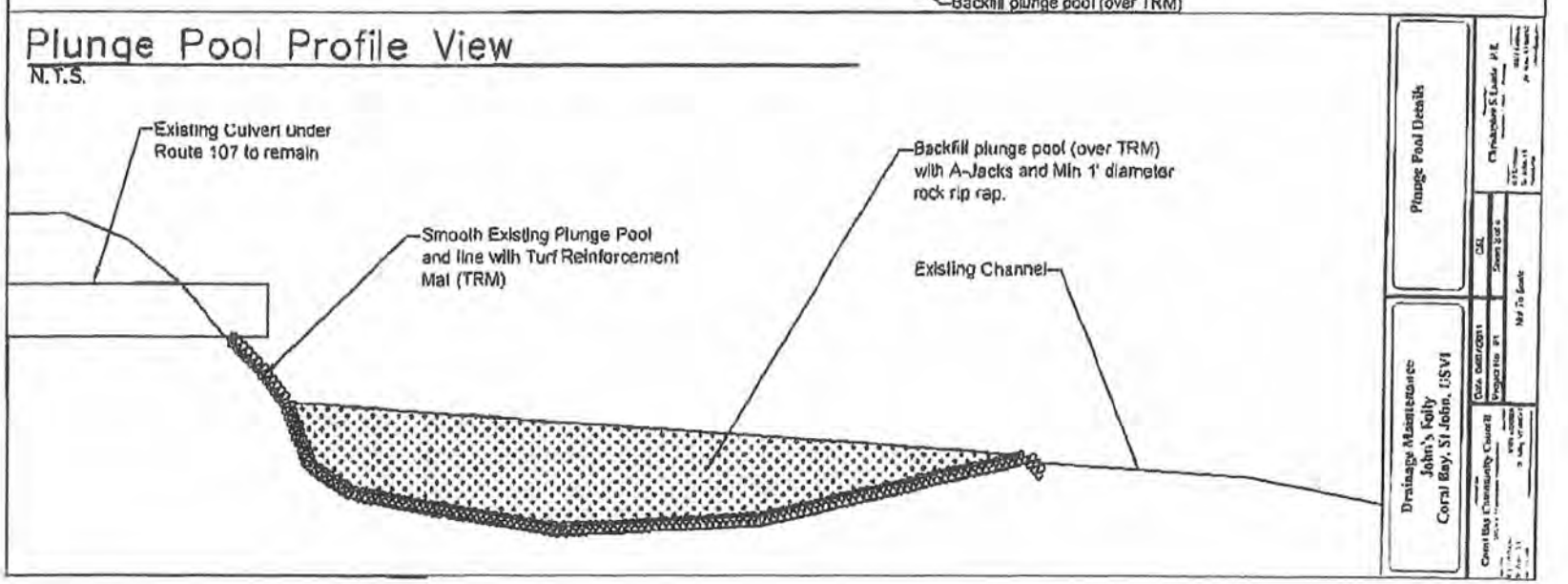
n. Contractor must conduct a weekly safety meeting for all on site personnel

o. Provide $ 1 million liability insurance with CBCC and VIRC&D as named insured

p. Comply with all Federal and VI, DPW and DPNR regulations and requirements.

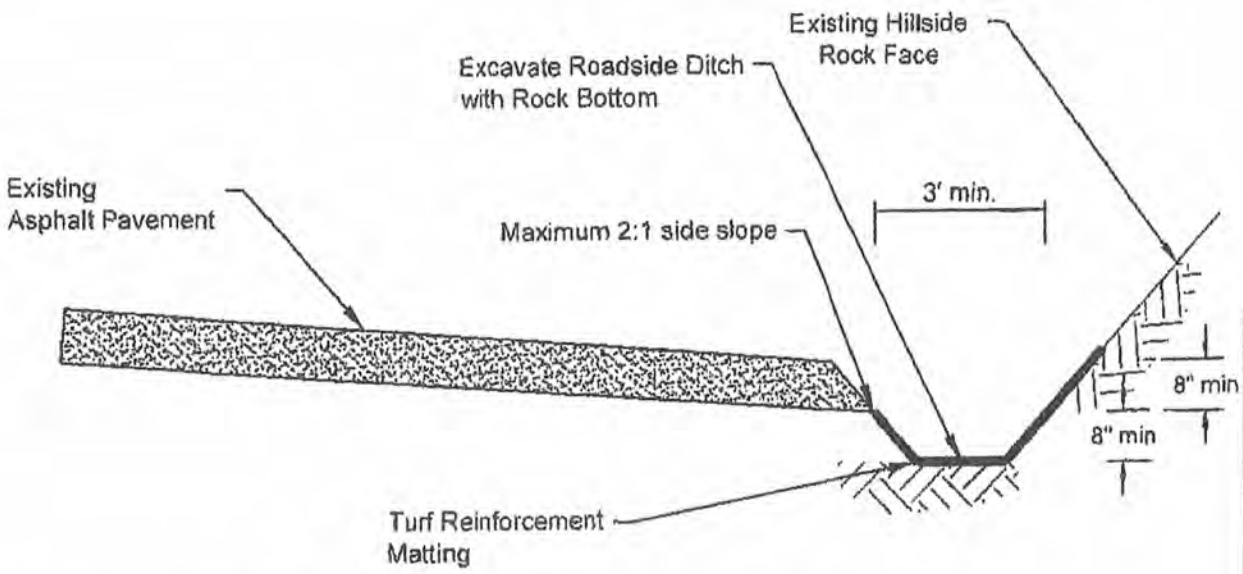
John's Folly 107
Project Layout


Plunge Pool Plan View
N.T.S.
Smooth Existing Plunge Pool and line with Turf Reinforcement Mat (TRM)
Existing Channel
Existing Culvert under Route 107 to remain
Backfill plunge pool (over TRM)


Plunge Pool Profile View
N.T.S.
Existing Culvert Under Route 107 to remain
Smooth Existing Plunge Pool and line with Turf Reinforcement Mat (TRM)
Backfill plunge pool (over TRM) with A-Jacks and Min 1' diameter rock rip rap.
Existing Channel
Plunge Pool Details
Drainage Maintenance
John's Folly
Coral Bay, St John, USVI

ROADSIDE DITCH DETAIL

N.T.S.



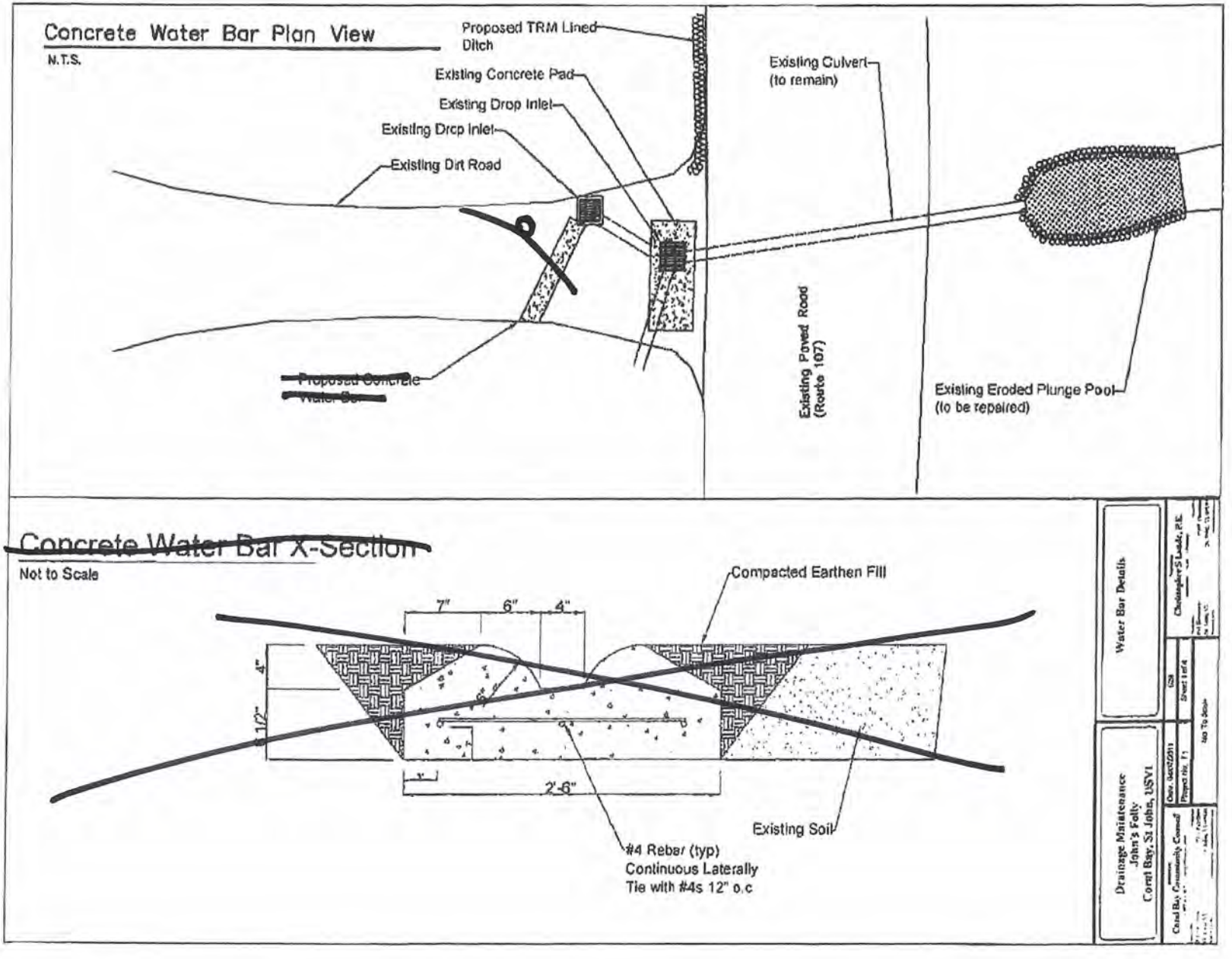
Notes:
Turf Reinforcement Matt (TRM) shall be approved by the VIRC&D Inspector prior to Installation.
Install Turf Reinforcing Matt in accordance with Manufacturer's recommendations.
Seed and cover TRM after installation.

Unpaved Section Ditch Details

Drainage Maintenance
John's Folly
Coral Bay, St John, USVI

Coral Bay Community Council

Christopher S Leeds, P.E.


Concrete Water Bar Plan View
N.T.S.
Proposed TRM Lined Ditch
Existing Concrete Pad
Existing Drop Inlet
Existing Drop Inlet
Existing Dirt Road
Proposed Concrete Water Bar
Existing Culvert (to remain)
Existing Paved Road (Route 107)
Existing Eroded Plunge Pool (to be repaired)
Concrete Water Bar X-Section
Not to Scale
Compacted Earthen Fill
7"
6"
4"
4"
12"
2'-6"
#4 Rebar (typ) Continuous Laterally Tie with #4s 12" o.c
Existing Soil
Water Bar Details
Drainage Maintenance
John's Folly
Coral Bay, St John, USVI
Christopher S Lusk, P.E.
Sheet 1 of 4
Coral Bay Community Council

John's Folly Route 107
Drainage Maintenance
Scope of Work, Details & Specifications

PROJECT NO. F1

SITUATE IN
CORAL BAY, ST. JOHN
US VIRGIN ISLANDS

May 5, 2011

PREPARED FOR:
Coral Bay Community Council, Inc., and:
Virgin Islands Resource Conservation
& Development Council, Inc.
NOAA-ARRA Grant
9901 Emmaus
St. John, USVI 00830

PREPARED BY:
Christopher S. Laude, PE
9901 Emmaus
St John, VI 00830
(910) 612-5990

1.0 SCOPE OF WORK

Project is located in John's Folly on St. John USVI. The project entails installing Armorflex-lined swales at three separate areas along a private drive off Route 107. Locations are as shown on the enclosed Site Location Map. Exact installation locations for work items shall be indicated in the field by the VIRC&D Inspector.

Armorflex Lined Swale Installation

Work shall consist of the installation of Armorflex lined swales the approximate areas shown on Site Location map. The construction shall proceed as follows:

1. Excavate and construct Armorflex lined swales at the locations indicated by the VI RC&D Inspector. Contractor shall install the Armorflex block in accordance with the manufacturer's recommendations. Each swale shall be about 12-foot long (across the road), 1-foot deep and 17-foot wide (along the road). See attached Armorflex Standard Details sheet.

2. Seed and stabilize all disturbed areas. Upon final grading of an area, all disturbed earth surfaces shall be seeded with Bermuda grass (98% purity) at a rate of to be determined by VI RC&D inspector.

Remove Accumulated Ghut Sand

Work shall consist of removing rock and sand that has accumulated in the Ghut channel in the approximate area shown on Site Location map. The construction shall proceed as follows:

3. Excavate accumulated ghut material in the area indicated by the VIRC&D inspector.

4. Remove the excavated material from the site and dispose of in accordance with VI DPNR regulations.

5. Seed and stabilize all disturbed areas. Upon final grading of an area, all disturbed earth surfaces shall be seeded with Bermuda grass (98% purity) at a rate of to be determined by VI RC&D inspector.

Construct Rock Rip Rap Check Dam

Work shall consist of the construction of a rock rip rap check dam at the approximate area shown on Site Location map. The construction shall proceed as follows:

6. Construct Rip Rap Check Dam at the location indicated by the VIRC&D inspector.

7. Seed and stabilize all disturbed areas. Upon final grading of an area, all disturbed earth surfaces shall be seeded with Bermuda grass (98% purity) at a rate of to be determined by VI RC&D inspector.

NOTES AND CONDITIONS

a. Additional specifications and adjustments, at the discretion of the VIRC&D Inspector, shall be field implemented to adequately install devices and provide protection and stabilization. Contractor shall be responsible for implementing any such adjustments as deemed necessary by the Inspector that are reasonably similar to the written specifications.

b. Armorflex matting shall be provided by VIRC&D. Contractor shall transport the matting to the jobsite and install. All other materials and supplies including but not limited to sand, rock, concrete and geotextile shall be provided by the contractor.

c. Contractor shall remove excess excavated material from the site. At the direction of the VI RC&D inspector, contractor may use such material to fill eroded roadway and roadside areas and to backfill the Armorflex block. All non-traffic areas filled and repaired, and all other disturbed areas shall be protected with Erosion Control Blanket (at the direction of the VI RC&D inspector) and seeded with Bermuda grass (98% purity) at 20lbs. per acre. No material other than that used for roadside repairs shall remain onsite. VIRCD shall provide Erosion Control Blanket, contractor shall install erosion control blanket and seed with Bermuda grass at specified rate.

d. Contractor shall maintain traffic flow in at least one lane at all times using appropriate traffic control methods in accordance with all Public Works requirements.

e. During grading & excavation work, sufficient water will be kept onsite to ensure that exposed soil and road surfaces can be sprayed down to control dust.

f. All workmanship shall comply with VI DPW specifications and FP-2006 specifications.

g. All grading and excavation included on this job shall include all rock and ledge removal necessary to install items as specified. No additional fees shall be charged for rock work.

h. Contractor shall be responsible prior to start of construction for installing up to four sign posts consisting of a 4" x 4" post set 2' into the ground and extending 6' above grade at locations to be determined upon the start of construction. Signs will be provided by VIRCD and mounted on the signpost by the contractor.

i. BUY AMERICAN CLAUSE: Contractors are hereby notified that they are encouraged, to the greatest extent practicable, to purchase American-made equipment and products with funding provided under this award.

j. Contractor shall have a VI business license to do the type of work that is being performed.

k. Contractor shall provide a valid DUNS number.

l. All workers on the projects must legally be able to work in the VI.

m. Contractor shall notify Project manager, CBCC and all adjoining parcel owners at least 24 hours prior to beginning work.

n. Contractor must conduct a weekly safety meeting for all on site personnel

o. Provide $1 million liability insurance with CBCC and VIRC&D as named insured

p. Comply with all Federal and VI, DPW and DPNR regulations and requirements.

John's Folly 107
Project Layout

O = AREAS Covered

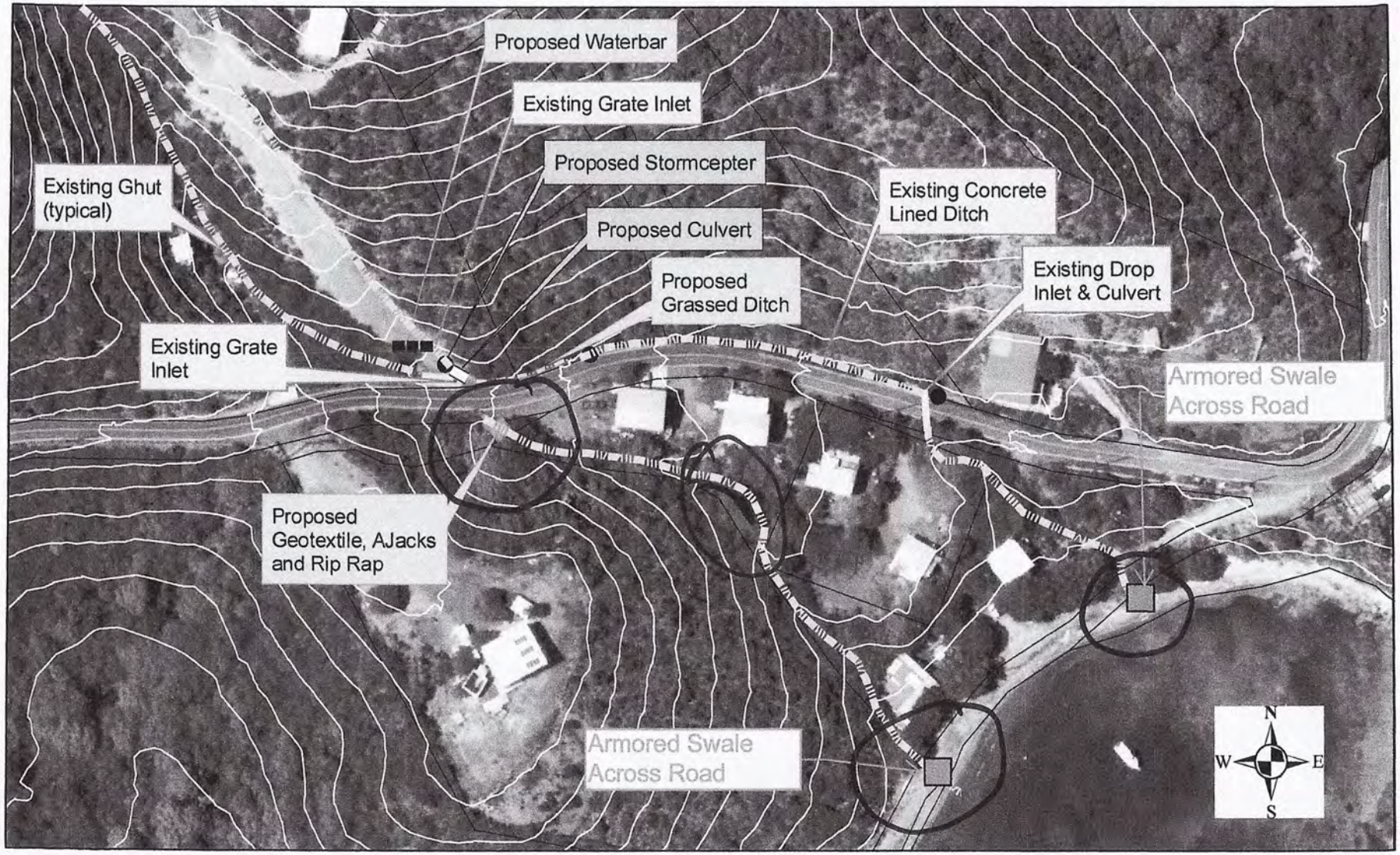


EXHIBIT "B"

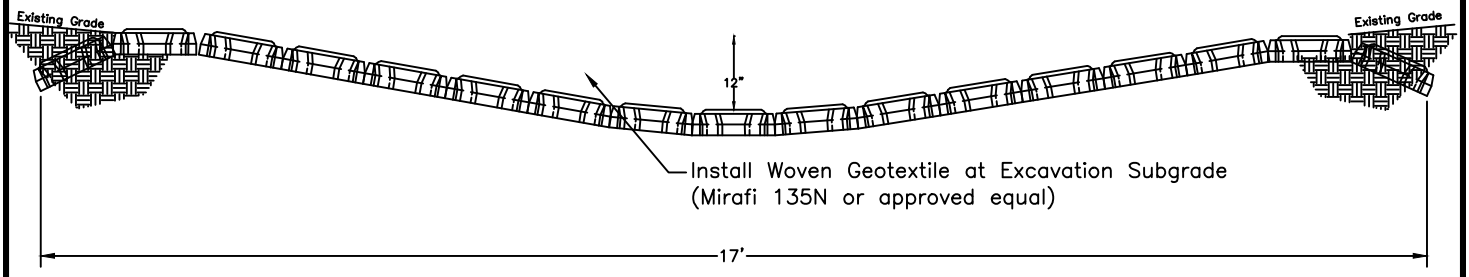
NOAA ARRA PROJECT DESCRIPTION

The NOAA ARRA project will

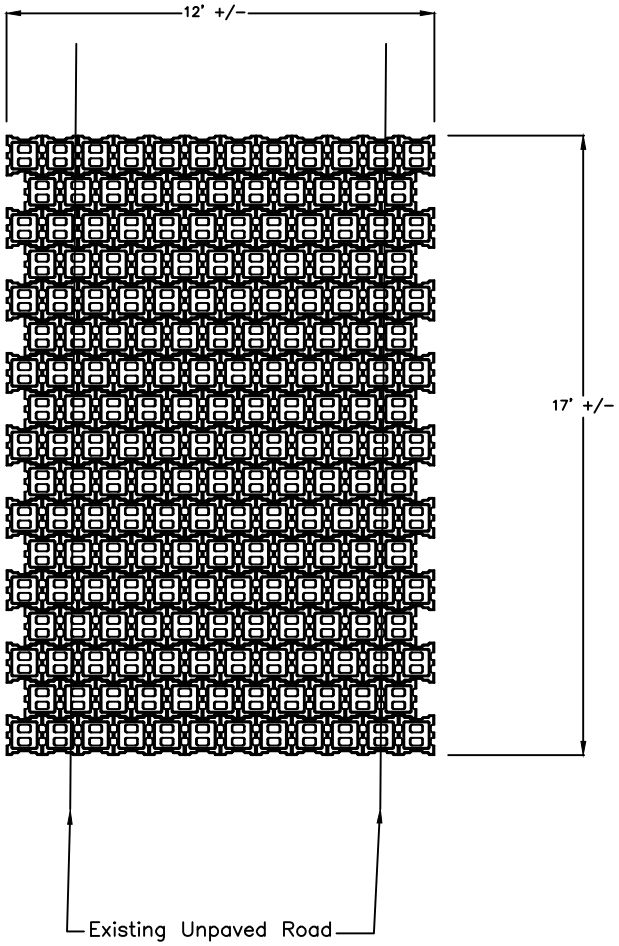
1. Install rip rap and other erosion control devices at the outlet of the culvert crossing Route 107 located at the boundaries of Parcel 14C and Parcel14C-REM and Parcel 14CA Estate John's Folly. In addition, the NOAA ARRA project will protect the road where stormwater crosses the estate road at the boundary between Parcel 14C-REM and Parcel 14C Estate Johns Folly by placement of concrete block, and other stormwater management devices as permitted by the Virgin Islands Department of Planning and Natural Resources.
2. Provide some limited removal of debris from the gut path on Parcel 14Ca John's Folly; and
3. Stabilize the two ghut crossings with Armorflex pavers on the shoreline road right of way located on parcels 14C- Remainder and 14Ce John's Folly.

The attached plan shows the locations of the work above.

X-SECTION



Plan View



DRAWN BY:	CHECKED BY:	DATE:	SCALE:
KWM	CBK	7/14/07	NTS

ARMORFLEX
STANDARD DETAIL
(S-Class Typical Mat)

ARMORTEC
Erosion Control Solutions
A CONTECH COMPANY
9025 CENTRE POINTE DR, SUITE 400
WEST CHESTER, OHIO 45069
PH: (513) 645-7000 FAX: (513) 645-7993

John's Folly –Sugarbird Hill
Drainage Improvements
Scope of Work, Details & Specifications

PROJECT NO. F2

SITUATE IN
CORAL BAY, ST. JOHN
US VIRGIN ISLANDS

April 27, 2011

PREPARED FOR:
Coral Bay Community Council, Inc., and:
Virgin Islands Resource Conservation
& Development Council, Inc.
NOAA-ARRA Grant
9901 Emmaus
St. John, USVI 00830

PREPARED BY:
Christopher S. Laude, PE
9901 Emmaus
St John, VI 00830
(910) 612-5990

1.0 SCOPE OF WORK

Project is located in Coral Bay on St. John USVI. The project entails work in the John's Folly Sugarbird Hill (Concordia) residential area and along Route 107. Locations are as shown on the enclosed Site Location Map.

VIRCD will have a survey done of the property lines in the project area. Based on the results of the survey, work item locations may change by a few feet. Exact installation locations for work items shall be indicated in the field by the VIRC&D Inspector.

Grassed Ditch

Work proposed is to construct about 789 linear feet of grass-lined ditches on the approximate alignments shown on the Site Location map. The construction shall proceed as follows:

1. Excavate ditch. The finished ditch shall drain towards Route 107 at a grade of at least 1" in 4'. Ditch excavation subgrade shall be uniform and without low spots that would hold water. Excavated materials may be used as fill to establish proposed road grades as approved by the VIRCD inspector. Place Propex turf reinforcement matting (TRM), which shall be provided by VIRCD, along the ditch excavation in accordance with the manufacturer's recommendations.
2. Seed and stabilize the propex matting with sufficient soil to establish the seed. Upon final grading of an area, all disturbed earth surfaces shall be seeded with Bermuda grass (98% purity) at a rate of to be determined by VI RC&D inspector.
3. Remove and dispose of the abandoned cat feeding station.
4. Relocate trash dumpster to nearby location indicated by the VIRCD Inspector
5. Remove trash and debris from work area and dispose of properly.

Abandon Existing Culvert

Work to be performed consists of removing an existing culvert at the approximate location shown on the Site Location Map. The construction shall proceed as follows:

1. Excavate to expose culvert.
2. Remove and dispose of culvert.
3. Backfill area to design sub-grade elevation by placing 8" loose lifts and compacting with a vibratory roller to at least 95% of the maximum dry density as determined by ASTM D-698 (standard Proctor Test).
4. Seed and stabilize all disturbed areas. Upon final grading of an area, all disturbed earth surfaces shall be seeded with Bermuda grass (98% purity) at a rate of to be determined by VI RC&D inspector.

Concrete Paving

Work proposed is to construct about 300 LF of concrete pavement along the alignment shown on the Site Location map. The construction shall proceed as follows:

1. Place sufficient fill to establish design road sub-grades. Fill material will be available at parcel 6-4 Carolina. Contractor shall install and maintain a minimum 20' wide by 25' long construction entrance at the 6-4 Carolina site that is acceptable to the VIRCD Inspector.
2. Compact fill to at least 95% of the maximum dry density as determined by the Standard Proctor Method (ASTM D-698).
3. Excavate tie-ins to existing concrete pavement (See attached Paving Details sheet).
4. Pave road (See attached Paving Details Sheet), install waterbars (see attached Water Bar Detail Sheet), and swale (see attached Swale Detail Sheet) at locations indicated by VIRCD Inspector.

Site Cleanup

The contractor shall remove all trash, debris and excavated material from the project work areas prior to demobilizing from the project. The contractor shall dispose of such material in accordance with Virgin Islands laws and regulations.

1. Remove and dispose of excavated soil and rock
2. Remove and dispose of trash and debris within work areas

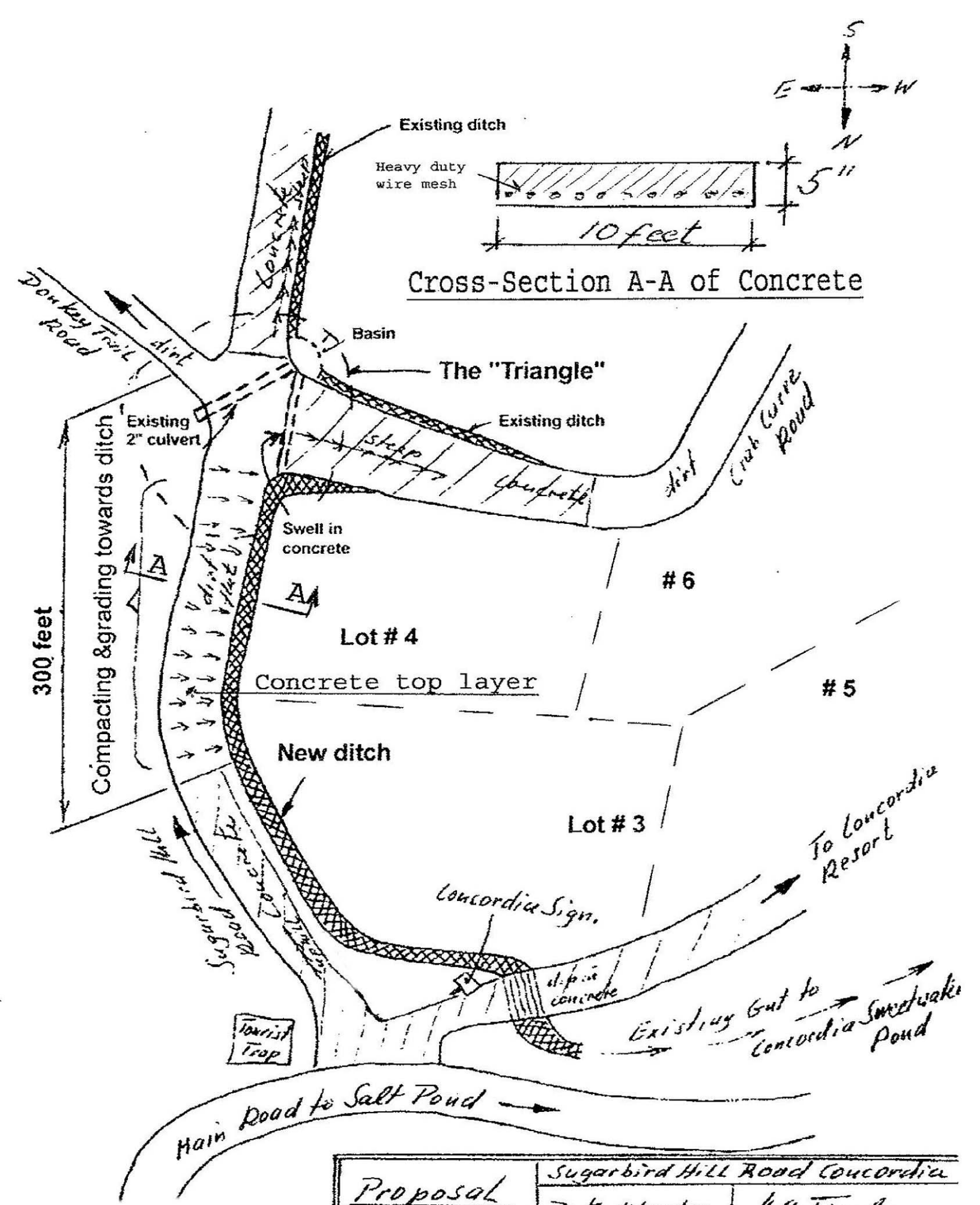
NOTES AND CONDITIONS

Additional specifications and adjustments, at the discretion of the VIRC&D Inspector, shall be field implemented to adequately install devices and provide protection and stabilization. Contractor shall be responsible for implementing any such adjustments as deemed necessary by the Inspector that are reasonably similar to the written specifications.

a. VIRCD shall provide Propex TRM and associated installation pins. All other materials and supplies including but not limited to rock, concrete, and geotextile are to be provided by the contractor.
b. Contractor shall barricade freshly poured concrete for a minimum of 48 hours from the end of pour to prevent damage from traffic. Contractor shall verify that all concrete achieves a minimum compressive strength at 28-days of 3,000 pounds per square inch (psi). Contractor shall notify VI RC&D Inspector at least 24-hours in advance of each and every concrete pour so that the Inspector may verify construction. Contractor shall not pour any concrete unless the work has been observed and approved by the Inspector.
c. Contractor shall remove excess excavated material from the site. At the direction of the VI RC&D inspector, contractor may use such material to fill eroded roadway and roadside areas. All non-traffic areas filled and repaired, and all other disturbed areas shall be protected with Erosion Control Blanket (at the direction of the VI RC&D inspector) and seeded with Bermuda grass (98% purity) at 20lbs. per acre. No material other than

that used for roadside repairs shall remain onsite. VIRCD shall provide Erosion Control Blanket, contractor shall install erosion control blanket and seed with Bermuda grass at specified rate.

d. Contractor shall maintain traffic flow in at least one lane at all times using appropriate traffic control methods in accordance with all Public Works requirements. If the contractor is unable to maintain one lane of traffic flow, they shall make arrangements that are satisfactory with the homeowners association representative.
e. During grading & excavation work, sufficient water will be kept onsite to ensure that exposed soil and road surfaces can be sprayed down to control dust.
f. All workmanship shall comply with VI DPW specifications and FP-2006 specifications.
g. All grading and excavation included on this job shall include all rock and ledge removal necessary to install items as specified. No additional fees shall be charged for rock work.
h. Contractor shall be responsible for installing prior to start of construction up to four sign posts consisting of a 4" x 4" post set 2' into the ground and extending 6' above grade at locations to be determined upon the start of construction. Signs will be provided by VIRCD and mounted on the signpost by the contractor.
i. BUY AMERICAN CLAUSE: Contractors are hereby notified that they are encouraged, to the greatest extent practicable, to purchase American-made equipment and products with funding provided under this award.
j. Contractor shall have a VI business license to do the type of work that is being performed.
k. Contractor shall provide a valid DUNS number.
l. All workers on the projects must legally be able to work in the VI.
m. Contractor shall notify Project manager, CBCC and all abutters at least 4 days prior to beginning work. DPNR/CZM shall be notified 72 hours prior to beginning work.
n. Contractor must conduct a weekly safety meeting for all on site personnel
o. Provide $ 1 million liability insurance with CBCC and VIRC&D as named insured
p. Comply with all Federal and VI, DPW and DPNR regulations and requirements.



Proposal	Sugarbird Hill Road Concordia	
	Date 4/28/10	A.J Fischer
Not to Scale	Rev.1 3/15/11	A.J. Fischer

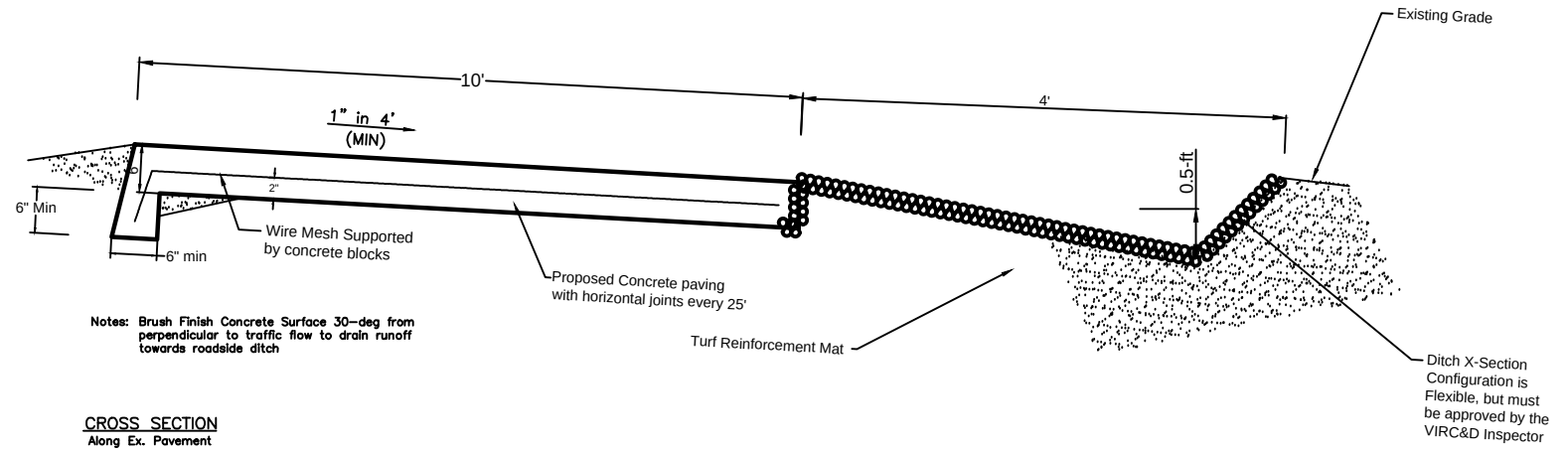
Revision 1:
Added Cross-Section A-A


Repair to Drainage Planned
Note dry pond area

CONCRETE PAVING DETAIL (ALT 1)

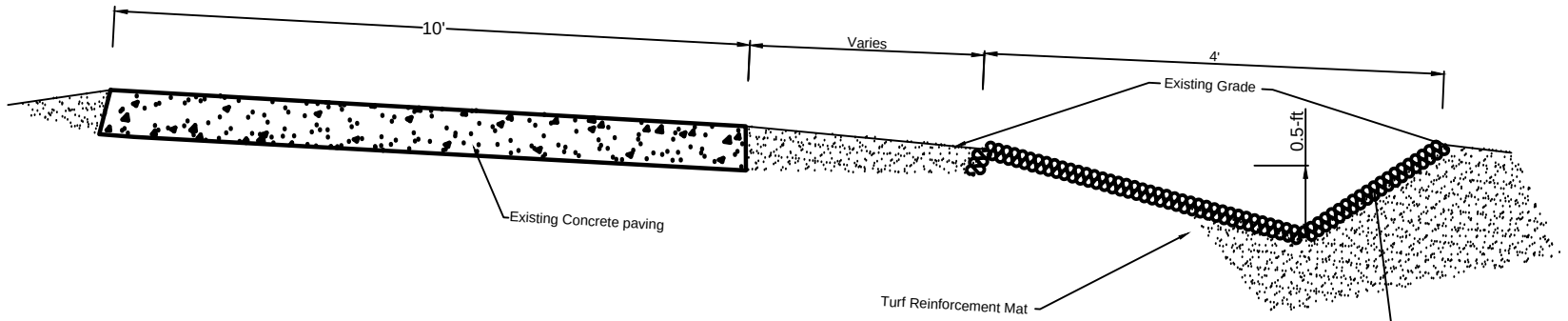
N.T.S.

CROSS SECTION
Along Prop. Pavement

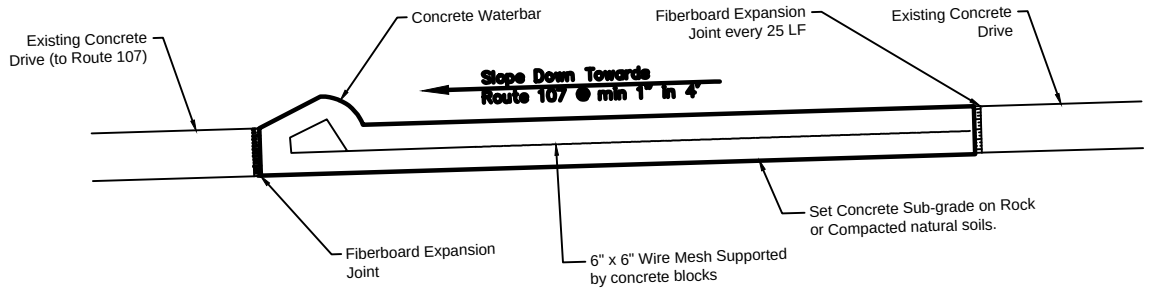


Notes: Brush Finish Concrete Surface 30–deg from perpendicular to traffic flow to drain runoff towards roadside ditch

CROSS SECTION
Along Ex. Pavement



PROFILE VIEW



Unpaved Section Ditch Details

Drainage Maintenance
John's Folly
Coral Bay, St John, USVI

Prepared by:
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Surveyor & Civil & Planning
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Prepared for:
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CSL
Date: 05/27/2011
Project No: F1
Sheet 2A of 7
Not To Scale