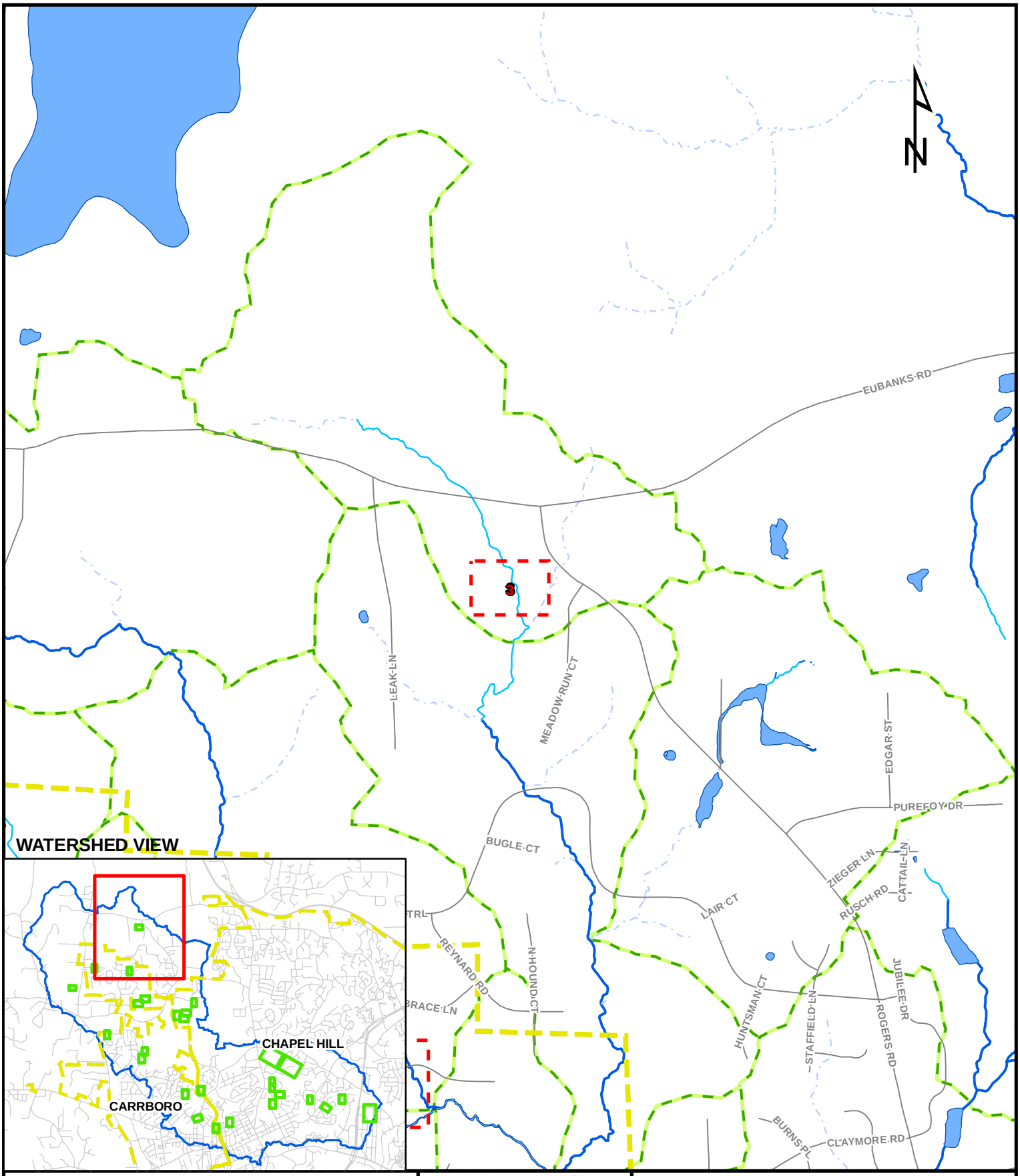
SITE 3

Stabilization of Headcut on Intermittent Channel

Index Sheet No.: 7
Raw Data Name: BD 27

Estimated Construction Cost: $19,200-$54,000



Legend

- Ambient Monitoring
- Benthic Monitoring
- Fish Sampling
- Municipal Boundary
- Orange County Roads
- Subwatersheds
- Perennial Stream
- Intermittent Stream
- Ephemeral Stream
- Stream, unknown flow

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SITE 3
VICINITY MAP

Geomorphic Analysis and Identification of Potential Sites for Stormwater BMPs
Orange County, North Carolina

0 500 1,000 2,000 Feet

1 inch equals 1,000 feet

Project Description

	Drainage Area (acres)	Impervious Area (acres)	% Impervious
Site 3	127.2	2.4	1.9%

Location

Site 3 is located to the southwest of the intersection of Rogers Rd and Eubanks Rd. Access to the site can be obtained by following a powerline easement west from Rogers Rd until it reaches a stream.

Problem Description

The primary problem at Site 3 is a headcut in a channel which was observed to be an intermittent stream channel. The stream has a headcut which is progressing upstream towards the powerline. The difference between the bed elevation upstream and downstream of the headcut is approximately 4 feet. Upstream of the headcut, the channel is relatively stable, shows very little incision, and still accesses its floodplain. Downstream of the headcut, the stream channel is incised for its entire length until it reaches a residential area and converges with a larger channel. Actively eroding banks along this reach are contributing sediment to the watershed, and as the headcut continues to work upstream, which will continue to add a significant amount of sediment to the system during this downcutting process. Once the channel can no longer access its floodplain, the shear stress will continue to increase, and continue to add massive sediment loads to receiving waters. The process of channel incision is much, much easier to stop than it is to repair. The typical stream restoration is a project of massive proportion and effort that is focused on restoring channel stability by providing a proper channel geometry and a shear stress reducing floodplain. The channel downstream is in trouble and would take an expensive project to repair. The channel upstream of the headcut is still in great shape and could be maintained by stopping the headcut.
Sediment export rates from bank erosion have been estimated and are shown in **Table 3.1**.

Table 3.1

Pre-Treatment	
Estimated Total Sediment Export	160.9 tons/year
Erosion per length of Channel	2.7 tons/yr/ft
Pounds of Nitrogen	321.9 lbs/year
Pounds of Phosphorus	160.9 lbs/year
Post-Treatment	
Estimated Total Sediment Export	0.3 tons/year
Erosion per length of Channel	0 tons/yr/ft
Pounds of Nitrogen	0.5 lbs/year
Pounds of Phosphorus	0.3 lbs/year

Proposed Solution

To stop the advancing headcut, grade control structures should be used in the stream channel. Grade control structures are commonly employed in stream restoration practices, where a hard, immovable mass is needed to limit degradation of the bed of a channel. These structures are available in several different forms, the most common of which are the cross vane, log vane and grade control vane. These vanes are most often constructed from rock or logs to provide the needed mass, while also providing habitat and a natural appearance.

Several grade control vanes should be constructed at the upstream end of the advancing headcut. This will serve two functions by defining pools for energy dissipation and acting as a back-up for the downstream grade control. Three more should be constructed in sequence on the headcut itself and then backfilled, in order to create a "step-pool" feature. This will provide a more gradual transition between the two different streambed elevations, dissipate the confined energy and also aid in the prevention of any future degradation in the upstream channel. Along with this treatment, a bankfull bench should be built in the incised channel downstream for approximately 50 feet in order to lower near bank stresses on the banks that could potentially degrade and cut around the grade control structures.

There is a nearby powerline easement to this site which should provide easy construction access from nearby Rogers Rd.

Constraints

Implementation of the work at this site will require some removal of over-story hardwood trees. Period maintenance will be required if a stormwater wetland is built in the floodplain. Because the project is adjacent to a utility easement, memorandums of agreement (MOA) or memorandums of understanding (MOU) may be required to implement work.

Alternatives

Several alternatives are possible at this site:

Alternative 1: As mentioned above, build three grade control vanes structures in the area of the headcut to create a "step-pool", and place several more grade control structures upstream. Construct a bankfull bench downstream by sloping the streambank back.

Alternative 2: Implement the work mentioned in Alternative A, and also restore the downstream channel until its confluence with the next downstream tributary. Upstream, redefine the channel as it flows through the power line easement.

Construct a stormwater wetland in the adjacent floodplain of the stream. This wetland will serve to attenuate peak flows and thus help to alleviate stress on the downstream channel. Another benefit of side channel storage is it's potential to augment baseflow. A flow splitting device should be placed in the stream channel, which will allow a portion

of the increased storm flows to be diverted into the wetland. The bottom elevation of the permanent pools of the wetland should not be lower than the bed of the stream channel, so that water stored in the wetland can properly infiltrate and recharge the stream channel. Though clay soils have low permeability, saturated soils can and do provide baseflow, as they do in a natural system. Micro-topographic features of the natural terrain retain small amounts of runoff, slowly infiltrate into piedmont soils and thus recharge aquifers and provide for baseflow in intermittent and perennial streams.

Alternative 3: Construct only the grade control upstream of the headcut. This would be the lowest cost option, but should provide the necessary grade control to stop the advance of the headcut.

Cost-Estimate Breakdown

Table 3.2, 3.3 and 3.4 show conceptual itemized cost estimates for the three alternatives. These costs represent construction and maintenance costs only. The cost for stormwater wetlands is derived from an equation developed by Brown and Schueler (1997). The contingency fee for this site has been increased due to the difficulty of access and proximity to a utility easement.

Table 3.2

SITE 3 ALTERNATIVE 1

Pay Item Description	Estimated Quantity	Unit	Unit Bid Price	Bid Amount
Excavation	60.0	CY	15.00	$900
Site Preparation and Planting	0.0	AC	7500.00	$150
Rip Rap Class B	5.0	Tons	45.00	$225
Filter Fabric	15.0	SY	5.00	$75
Grade Control Vanes	6.0	EA	3000.00	$18,000
Silt Fence	500.0	FT	3.75	$1,875
Construction Safety Fence	665.0	LF	2.50	$1,663
Construction Entrance	1.0	Ea	2500.00	$2,500
			Total	$25,388
Mobilization (5%)	1.0	LS		$1,269
Contingencies (20%)	1.0	LS		$5,078
	Total +	Mobilization and Contingencies		**$31,734**

Table 3.3

SITE 3 ALTERNATIVE 2

Pay Item Description	Estimated Quantity	Unit	Unit Bid Price	Bid Amount
Excavation	60.0	CY	15.00	$900
Stormwater Wetland	8375.0	CF	Equation Derived	$16,550
Site Preparation and Planting	0.1	AC	7500.00	$750
Rip Rap Class B	5.0	Tons	45.00	$225
Filter Fabric	15.0	SY	5.00	$75
Grade Control Vanes	6.0	EA	3000.00	$18,000
Silt Fence	500.0	FT	3.75	$1,875
Construction Safety Fence	665.0	LF	2.50	$1,663
Construction Entrance	1.0	Ea	2500.00	$2,500
			Total	$42,538
Mobilization (5%)	1.0	LS		$2,127
Contingencies (20%)	1.0	LS		$8,508
	Total +	Mobilization and Contingencies		**$53,172**

Maintenance Costs

Maintenance (5% of base construction cost)	1.0	Year	**$2,659**

Table 3.4

SITE 3 ALTERNATIVE 3

Pay Item Description	Estimated Quantity	Unit	Unit Bid Price	Bid Amount
Excavation	0.0	CY	15.00	$0
Site Preparation and Planting	0.0	AC	7500.00	$0
Rip Rap Class B	5.0	Tons	45.00	$225
Filter Fabric	15.0	SY	5.00	$75
Grade Control Vanes	4.0	EA	3000.00	$12,000
Silt Fence	100.0	FT	3.75	$375
Construction Safety Fence	100.0	LF	2.50	$250
Construction Entrance	1.0	Ea	2500.00	$2,500
			Total	$15,425
Mobilization (5%)	1.0	LS		$771
Contingencies (20%)	1.0	LS		$3,085
	Total +	Mobilization and Contingencies		**$19,281**

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SITE 3

ROGERS RD

ALTERNATIVE 2:
REDEFINE CHANNEL IN POWERLINE EASMENT

ALTERNATIVE 2:
CONSTRUCT OFFLINE STORMWATER WETLAND
FOR PEAK FLOW ATTENUTATION

FOREBAY

POOL

POOL

SHALLOW LAND

POOL

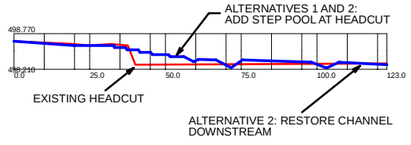
OUTLET WEIR

ALTERNATIVES 1, 2 AND 3- ADD GRADE CONTROL STRUCTURES UPSTREAM OF HEADCUT

ALTERNATIVE 1 AND 2- BUILD STEP POOL AT HEADCUT

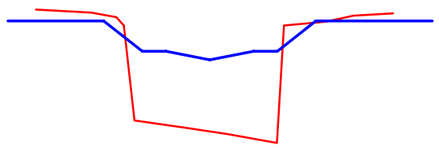
ALTERNATIVE 2-
RESTORE CHANNEL
DOWNSTREAM

CONCEPTUAL PROFILE



NOT TO SCALE

CONCEPTUAL CROSS SECTION



NOT TO SCALE

Legend

- Stormwater Lines
- Impervious Surfaces
- Perennial Stream
- Intermittent Stream
- Ephemeral Stream
- Stream, unknown flow
- Contours

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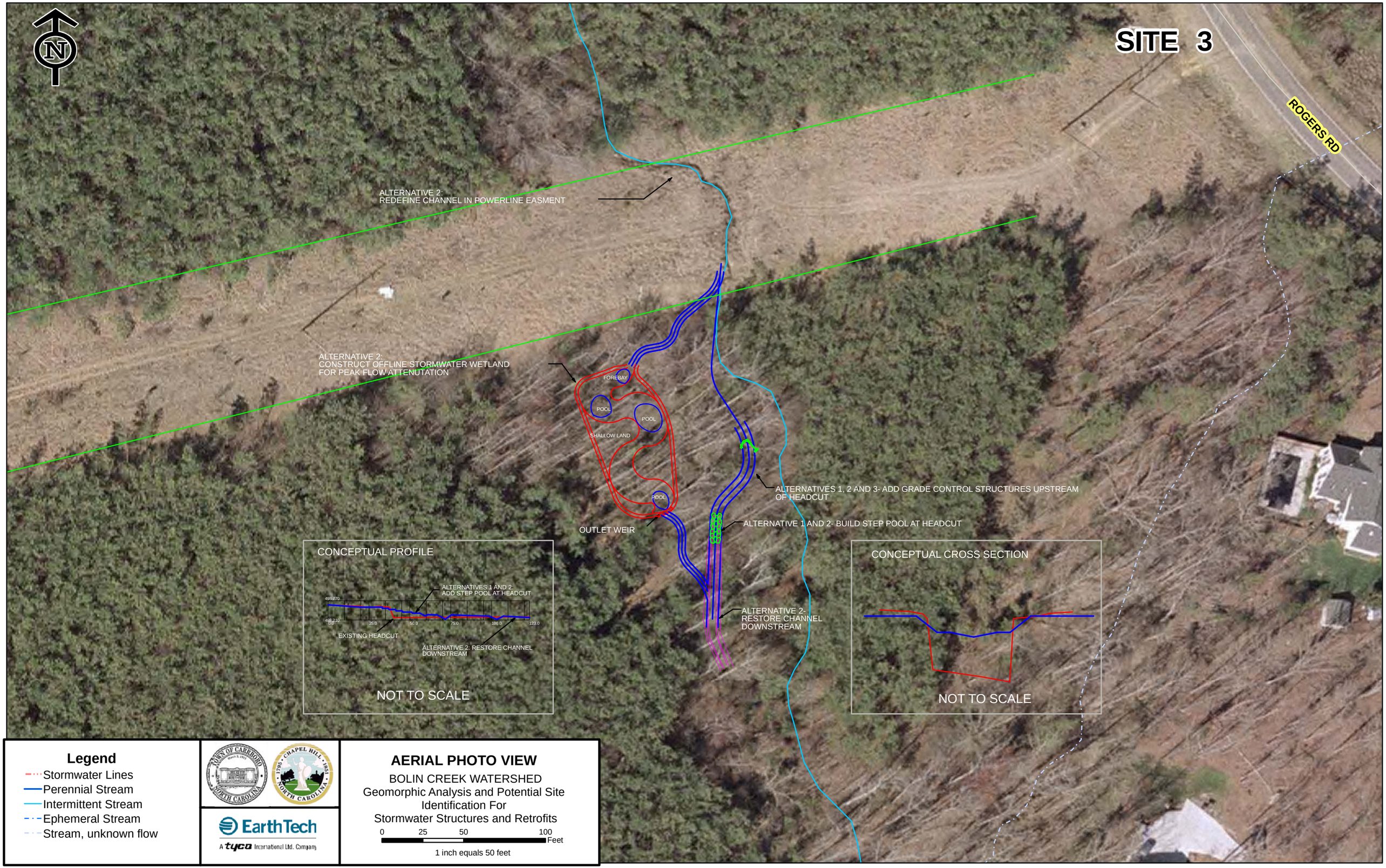
CONCEPTUAL PLAN VIEW
BOLIN CREEK WATERSHED
Geomorphic Analysis and Potential Site Identification For
Stormwater Structures and Retrofits

0 25 50 100 Feet

1 inch equals 50 feet


SITE 3
ROGERS RD
ALTERNATIVE 2:
REDEFINE CHANNEL IN POWERLINE EASMENT
ALTERNATIVE 2:
CONSTRUCT OFFLINE STORMWATER WETLAND
FOR PEAK FLOW ATTENUTATION
FOREBAY
POOL
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OUTLET WEIR
ALTERNATIVES 1, 2 AND 3- ADD GRADE CONTROL STRUCTURES UPSTREAM
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ALTERNATIVE 1 AND 2- BUILD STEP POOL AT HEADCUT
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CONCEPTUAL PROFILE
ALTERNATIVES 1 AND 2:
ADD STEP POOL AT HEADCUT
EXISTING HEADCUT
ALTERNATIVE 2: RESTORE CHANNEL
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AERIAL PHOTO VIEW
BOLIN CREEK WATERSHED
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Stormwater Structures and Retrofits
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