WILLIAMSBURG ENVIRONMENTAL GROUP, INC.
Environmental Consultants

September 5, 2008

James City County Stormwater Division
Attn: Mr. Wayland Bass
287 McLaws Circle, Suite 1
Wiliamsburg, VA 23185

Re: **Site Assessment and Conceptual Plan**
Kristiansand Tributary Project, James City County, Virginia
WEG Project #3935

Mr. Bass:

This correspondence presents the results of a site assessment and drainage evaluation study performed by Williamsburg Environmental Group, Inc. (WEG) for the County of James City, Virginia within the Kristiansand Tributary project limits (Figure 1). The approximate 46-acre project area is comprised of the draw surrounding an unnamed Yarmouth Creek tributary extending from Richmond Road to the confluence near the Drammer Court cul-de-sac. The study limits are situated west of Richmond Road, south of Nina Lane in the Kristiansand subdivision, and north of Arthur Hills Drive in the Colonial Heritage development (Figure 2). The site can be accessed by several roads in the Kristiansand subdivision. The purpose of the investigation was to assess existing site conditions in order to identify potential preventative and/or restorative stream measures, including BMPs, which may provide further stabilization and increased water quality functions to the water resources onsite. WEG performed a general site reconnaissance in May and June 2008 to document site conditions relative to water resources.

BACKGROUND

The onsite stream resources are a part of the Yarmouth Creek Watershed, which flows into the Chickahominy River within the James River drainage basin. According to James City County's Yarmouth Creek Watershed Plan (2003), the Yarmouth Creek drainage area has a high risk of becoming impacted due to increased land development within the headwaters of its tributaries. The aforementioned project area is included within Subwatershed 104 of the Watershed Plan, and it was estimated that impervious cover made up 9.0% (77.4 acres) of the 860 acres of Subwatershed 104 at the time of the Watershed Plan, and future land use impervious cover is estimated at 19.7% (169.42 acres). A quick reference to the Yarmouth Creek Watershed Plan has been provided within Appendix F at the end of this report.

OFFSITE ANALYSIS

Prior to conducting fieldwork, WEG consulted the USGS Topographical Quadrangle (Quad) map for Norge, Virginia, (1984), the National Wetlands Inventory (NWI) Online Interactive Mapper, administered by the U.S. Fish and Wildlife Service, and the Natural Resources Conservation Service (NRCS) Web Soil Survey. The USGS map shows a completely forested project area with an intermittent stream of approximately 4,000 linear feet (LF) surrounded by steep slopes. The

NWI map depicts freshwater forested wetlands surrounding the stream. Finally, the soil survey indicates the site is underlain primarily by Johnston complex and Emporia complex. Johnston complex is classified by the USDA as a hydric soil.

WETLAND WALKOVER

The onsite investigation was conducted on May 13, 2008, using the Routine Determination Method, as outlined in the 1987 *Corps of Engineers Wetland Delineation Manual*, as a basis for identifying areas subject to potential jurisdiction by the Corps and/or the DEQ. This method involves the positive identification of three parameters in the determination of wetland boundaries: hydrophytic vegetation, hydric soils, and wetland hydrology.

The results of the wetland walkover are provided on the Stream Condition Summary Map (Map Pocket). Based upon the fieldwork completed, wetlands exist in conjunction with the floodplain of the unnamed Yarmouth Creek tributary. Typically the limits of the wetlands extend from the toe-of-slope on both sides of the stream. Other Waters of the United States include nine (9) first order streams flowing into the drainage. The majority of the vegetative communities present can best be classified as forested. However, there is a sewer easement trends along the southern side of the draw. The sewer easement can best be described as an emergent wetland since the trees were all cleared. Common vegetation in the forested areas included black gum (*Nyssa sylvatica*), sycamore (*Platanus occidentalis*), ironwood (*Carpinus caroliniana*), spicebush (*Lindera benzoin*), lizard's tail (*Saururus cernuus*), common rush (*Juncus effusus*), golden ragwort (*Senecio aureus*), and skunk cabbage (*Symplocarpus foetidus*). The emergent wetlands in conjunction with the sewer easement typically contain common rush (*Juncus effusus*), hop sedge (*Carex lupulina*), Nepalese brown top (*Microstegium vimineum*) and restricted to the western portion were black willow saplings (*Salix nigra*). Soils onsite are typically very dark gray to black (2.5Y 3/1 to 2.5Y 2.5/1 in Munsell color notation) in color, with faint redox features, and can be characterized as hydric. Wetland hydrology onsite is typically met by saturation within the first 12 inches of the soil and occasional inundation.

STREAM ASSESSMENT

WEG conducted a baseline assessment of all onsite stream resources in May 2008, which included identification of existing stream and riparian buffer conditions. The Environmental Protection Agency Rapid Bioassessment Protocol (EPA RBP) and the Virginia Department of Environmental Quality (DEQ) and the Army Corps of Engineers (Corps) Unified Stream Methodology (USM) were applied to all onsite stream resources. In addition, stream geomorphic measurements were collected at representative locations to help quantify channel stability conditions. Representative Photographs were also taken and are provided in Appendix A.

RBP Assessment

The EPA RBP for Streams and Wadeable Rivers is an evaluation of 10 physical habitat characteristics that influence the quality of the water resource and the condition of the resident aquatic community (Barbour et al. 1999). Parameters relating to instream habitat, channel morphology, bank structural features, and riparian vegetation are observed as a function of overall water quality. In order to account for natural differences in coastal plain verses mountain region habitats, low- and high-gradient assessment methods were developed. The low-gradient assessment for coastal plain systems was utilized for the project area.

The onsite stream resources received RBP scores between 43 and 174, which are shown on the Stream Condition Summary Map (Map Pocket), and reflect a range of stream quality onsite. Generally, reaches located in mature forest and wetland areas scored in the Optimal category (166-200), while streams located in the eastern end of the property, in closer proximity to current land development, received scores within the Poor category (0-47) to Suboptimal category (113-153). The category for scores that fall between the thresholds is determined by more detailed assessment of existing conditions and best professional judgment. Poor to Suboptimal reaches generally experienced deficiencies within the categories of pool variability, vegetative bank protection, and riparian buffer conditions, with fewer deficiencies in other categories.

USM Assessment

The Unified Stream Methodology is used to score streams and assign a relative functional "value," called a Reach Condition Index (RCI), based on four stream quality metrics: channel condition, riparian buffer, instream habitat, and channel alteration. The overall RCI score, along with best professional judgment, is used to determine the potential for improvement within a given stream channel.

The USM Reach Condition Index (RCI) scores are listed on the Stream Condition Summary Map, and reflect similar stream quality scores to the RBP Assessment. Please refer to Appendix B for complete USM assessment forms.

Rosgen Stream Classification

Rosgen stream classification is based on parameters that affect the stability of channel morphology, including channel width, depth, slope, and particle roughness and distribution. The methodology utilizes the measured parameters to classify stable channels into A, B, C, D, and E stream types, while unstable channels generally fall into G and F stream types. Selected cross sections are analyzed in order to provide much of the data necessary for channel classification in a timely, cost effective manner.

Representative cross-sections were taken and analyzed to determine preliminary geomorphic conditions for the onsite stream resources. A Rosgen classification summary is provided on the Stream Condition Summary Map (Map Pocket). Reach 1 exhibits unstable bed and bank conditions, a low entrenchment ratio, low sinuosity, and a steep slope, all of which place this reach in the "G" channel category. Reach 2 receives runoff flow from a parking lot, and exhibits incision, however, was not classified due to its non-jurisdictional nature and obstruction of the channel by root mat. Reach 4 exhibits a moderate entrenchment ratio, high width/depth ratio, and moderate slope, and receives an estimated classification of a stable "C" channel. Reach 4 shows signs of previous enhancement activity in the form of rock cross vanes and coir log bank stabilization, as shown in Photograph 3, Appendix A. Reach 3, 5, 7, and 8 flow into the main tributary of Yarmouth Creek, and demonstrate characteristics of a stable "E" channel, with the exception of average stream slope. Some areas at the headwaters of these systems show signs exhibit headcuts, which are discussed in the Stream Improvement section. Reach 6 was classified as a stable "E" channel in the field due to a high entrenchment ratio and sinuosity, and gentle slope, though the width/depth ratio is out of range for the "E" channel classification.

Channel Evolution Model

The CEM was applied to all onsite reaches during the field reconnaissance in May 2008. The Channel Evolution Model (CEM) was developed in 1984 by Schumm, Harvey and Watson, to provide a tool for classifying a subject stream on a "stability" scale. The CEM has 5 categories (I-V) with I and V indicating a stable stream channel. Stage II indicates a channel is degrading and is actively lowering its base elevation, as exhibited in Reach 1 and 2 onsite. Stage III is associated with a channel as it widens to create capacity. Stage IV indicates that a channel is sloughing and beginning to stabilize at a new floodplain elevation (Reach 3, 4, 5, 7, and 8). Stage V indicates that a channel has stabilized at a new floodplain elevation, as observed in Reach 6.

Stream Improvement Recommendations

In general, the field assessment reflects various states of stream stability. Reaches 4 and 6 are stable, and require no stream improvement measures at this time. The remaining reaches exhibit various forms of instability, including bank erosion, incision, and headcutting, which ultimately degrade water quality and aquatic habitat within the Yarmouth Creek Watershed. Unstable reaches are stream enhancement or restoration candidates. Please refer to the Stream Condition Summary Map (Map Pocket) for the general location of proposed stream improvement activities.

Stream Enhancement – Degraded streams that may contain one or two forms of instability (i.e. incision, over widening, bank failure, etc.), but do not require restoration of dimension, pattern, and profile, are designated as stream enhancement. WEG staff identified Reach 1 and portions of Reaches 3, 7, and 8 as stream enhancement opportunities, for a total of 1,186 linear feet (LF). Stream enhancement may include the following activities:

- Instream structures (i.e. – cross vanes, j-hooks, log deflectors);
- Bank grading measures (i.e. – bankfull bench enhancement or grading);
- Streambank plantings (i.e. – livestakes, stabilizing seed planting mix);
- Preservation and/or planting of the riparian buffer directly adjacent to the stream channel.

Stream Restoration – These activities can be applied to severely degraded stream systems that require restoration of the dimension, pattern, and profile in order to address current physical, chemical, and/or biological deficiencies. These stream systems are restored to a dynamic, yet stable, functioning stream system. WEG staff identified three potential stream restoration opportunities exist within Reach 2, 5, and 7, for a total of 194 LF. Stream restoration activities may include the following activities:

- Local stabilization of incision within Reach 2;
- Outfall protection or other measures for the runoff area of Reach 2, as discussed in the Watershed Evaluation – Site 23 (Appendix C);
- Local stabilization and outfall protection at upstream limit of Reach 5, as discussed in the Watershed Evaluation – Site 32 (Appendix C);
- Headcut stabilization within Reach 7, as discussed in the Watershed Evaluation – Site 28 (Appendix C);
- All measures discussed within the Stream Enhancement Section above.

DRAINAGE EVALUATION

WEG staff has evaluated the existing watershed conditions throughout the contributing area to the Kristiansand Tributary and identified numerous stormwater management retrofit opportunities, which are shown on the Watershed Evaluation Summary Map (Map Pocket). These retrofits address various stormwater concerns and collectively should improve downstream water quality and stream function. The retrofits have been grouped into 6 categories based on their respective general characteristics and intended function, as discussed below.

1. Retrofit of existing Best Management Practice (BMP) – Modification of existing BMPs to repair deficiencies and/or provide enhanced water quality treatment benefits.

2. Construction of new BMP – Installation of new stormwater management practices to treat areas currently uncontrolled. May consist of a variety of different practices to be selected in accordance with site specific constraints and treatment objectives.

3. Energy dissipation – Construction of energy dissipation measures at existing stormwater outfalls in order to resolve existing scour problems or prevent future potential concerns.

4. Repair of existing drainage system – Repairs or upgrades to existing stormwater conveyance systems to address existing damages or apparent capacity issues.

5. Erosion and sediment control – Improvements or repairs to existing temporary erosion and sediment control practices within active construction areas, or implementation of sediment control or stabilization measures for areas currently untreated or exhibiting problems.

6. Point source pollution control – Installation of treatment practices such as spill prevention or containment measures within areas identified as potential point source problems or known "hot spots." Appropriate practices should address site-specific concerns.

Although some of the retrofits are clearly defined by a specific category, many incorporate features from multiple categories. The identified retrofits are shown on the Watershed Evaluation Summary Map (Map Pocket), and a discussion of the existing conditions and potential improvements associated with each are provided in Appendix C. Although efforts were taken to identify as many potential retrofit opportunities as possible, similar retrofit activities may still be feasible elsewhere in the watershed. Before implementation of the retrofits included herein, it is recommended that further review and/or detailed design calculations be completed since the scope of this study was general in nature and the retrofits were described qualitatively.

EASEMENT/OWNERSHIP INFORMATION

WEG reviewed County plat and plan information related to landowner and drainage easements adjacent to the project limits. A summary of adjacent landowner information is provided in Appendix D, and can be referenced to the Stream Condition Summary Map (Map Pocket) via the Parcel ID Number (PIN) for each property. Sewer and utility easement information is pending, and will be included upon receipt from James City County.

AGENCY DATABASE REVIEW

Natural Heritage Resources

Natural heritage resources are defined as the habitat of rare, threatened, or endangered plant and animal species, unique or exemplary natural communities, and significant geologic formations. According to formal database results from the Virginia Department of Conservation and Recreation (DCR) dated June 2, 2008, natural heritage resources have been documented within the vicinity of the project area. Specifically, DCR notes the potential for the occurrence of federal species of concern Virginia least trillium (*Trillium pusillum* var. *virginianum*) within the project limits and recommends an inventory of the project site in order to more accurately assess potential impacts to this species. In addition, the U.S. Fish and Wildlife (FWS) list of endangered and threatened species for James City County was reviewed for known occurrences of listed species within the locality. According to the FWS lists, the federally and state threatened small whorled pogonia (*Isotria medeoloides*) and federal species of concern Virginia least trillium have been documented within James City County. FWS currently requires surveys for the small whorled pogonia within localities with known occurrences of these species. In addition, the Virginia Department of Environmental Quality (DEQ) often requests surveys for the state rare Virginia least trillium during the permitting process.

WEG conducted a preliminary evaluation to determine if potential habitat is present for Virginia least trillium and small whorled pogonia. Additional discussion of these surveys is provided in the Threatened and Endangered Species Evaluation Section; however, overall existing conditions reflect poor and/or minimal habitat available for either species.

A search of the Virginia Department of Game and Inland Fisheries (DGIF) Fish and Wildlife Information Service (VAFWIS) database was conducted to identify occurrences of natural heritage resources within a 2-mile radius of the project site. The presence of three threatened or endangered species have been identified within the vicinity of the project site, including the state threatened peregrine falcon (*Falco perigrinus*), state threatened loggerhead shrike (*Lanius ludovicianus*) and state threatened bald eagle (*Haliaeetus leucocephalus*). Due to the distance to the documented resources and the scope of the proposed activity, we do not anticipate that the project will have any adverse effect on these natural heritage resources; however, additional species surveys may be required during the permitting process.

Cultural Resources

WEG requested a Virginia Department of Historic Resources (VDHR) letter report and database search of the Data Sharing System (DSS) for evidence of known cultural resources within the proposed project area. According to the Detailed Archives Search, dated June 30, 2008, no architectural or archeological features were documented within the proposed project area (Appendix D).

THREATENED & ENDANGERED SPECIES EVALUATION

WEG conducted a preliminary review of the project area to determine if potential habitat is present for two rare species known to occur in James City County; Virginia least trillium (*Trillium pusillum. var. virginianum*) and small whorled pogonia (*Isotria medeoloides*).

Small whorled pogonia (SWP) – This species is a self-pollinating perennial orchid (Family: Orchidaceae), four to twelve inches in height, with a characteristic whorl of five to seven leaves at the summit of a singular, hollow, pale green stem with one or two pale yellowish-green irregular flowers (Mehrhoff 1983, Gleason and Cronquist 1991, Vitt and Campbell 1997). SWP occupies a very specific habitat type within its range. In particular, the species seems to require the following conditions: mature, mixed hardwood, upland forests; generally open understory conditions with minimal aggressive ground level species; generally level to moderately sloping land within shallow upland draws often of northerly or easterly exposure; scattered ground-level sunlight; and, acidic, sandy loam soils (Ware 1991, Gleason and Cronquist 1991, Weakley 2006). In addition, many professionals have noted a prevalence of decaying logs and a well-developed detritus layer on the forest floor.

Based on the review of the study area, uplands within the Kristiansand project site can be characterized as poor habitat for SWP. Mature mixed-hardwood communities with open understory were limited to very small isolated areas and lack the community structure and herbaceous associates typically found in suitable SWP habitat. In addition, steep slopes and dense understory vegetation throughout the study area combined with the close proximity to existing utility easements and adjacent homes further preclude the likelihood of SWP colonization.

Virginia least trillium (VLT) – This species is a small herbaceous perennial of the lily family (Liliaceae) with three lance-elliptic to lance-ovate leaves and white to pinkish petals that turn rose-purple with aging (Gleason and Cronquist 1991, Radford et al. 1968). Seedlings of the Virginia least trillium consist of a single leaf with a roundish to elliptical blade (Ware 1996). Flowering typically occurs from March to May (Grimm 1993), but the plant is otherwise unassuming and somewhat cryptic in the herbaceous layer. VLT is found in the Coastal Plain of Virginia and Maryland (Gleason and Cronquist 1991), and occurs in swamps and bottomland forests or locally on small mesic beech islands (Weakley 2002) and acidic groundwater discharge seeps. Although it is generally restricted to wetland habitats or their borders, the micro-sites on which the least trillium occurs may not be permanently saturated (Ware 1996).

Potential habitat for VLT was identified in limited areas, specifically along the margins of the wetlands limits and in occasional side slope seeps within the study area. This species does not carry a legal state or federal status and thus, would not be subject to the requirements of Section 7 of the Endangered Species Act. However, the agencies may request an additional species survey during the permitting process.

PRELIMINARY COST OPINION

A preliminary cost opinion for the potential stream improvement work is provided in Appendix E. The cost opinion includes measures depicted on the Stream Condition Summary Map (Map Pocket). If the County chooses to implement a subset of activities based on the proposed BMP measures discussed in the Watershed Evaluation section of this report, WEG will revise the cost opinion include the chosen BMP measures.

RECOMMENDATIONS

Based upon the information provided in this report, WEG would like to coordinate a meeting with James City County to discuss the recommendations and finalize the cost opinion for the Kristiansand Tributary Project. Please call to set up a meeting date or to discuss any questions regarding our investigation.

Sincerely,

Travis Crayosky
Program Manager, Streams

Daniel Proctor, P.E.
Water Resources Engineer II

Enclosures
smw



SCALE: 1 INCH = 2.4 MILES

SOURCE: VIRGINIA ATLAS AND GAZETTEER, DeLORME MAPPING CO., 1995.

WILLIAMSBURG ENVIRONMENTAL GROUP, INC.

FIGURE 1
PROJECT VICINITY MAP
JCC - KRISTIANSAND

JAMES CITY COUNTY, VIRGINIA | AUGUST 2008

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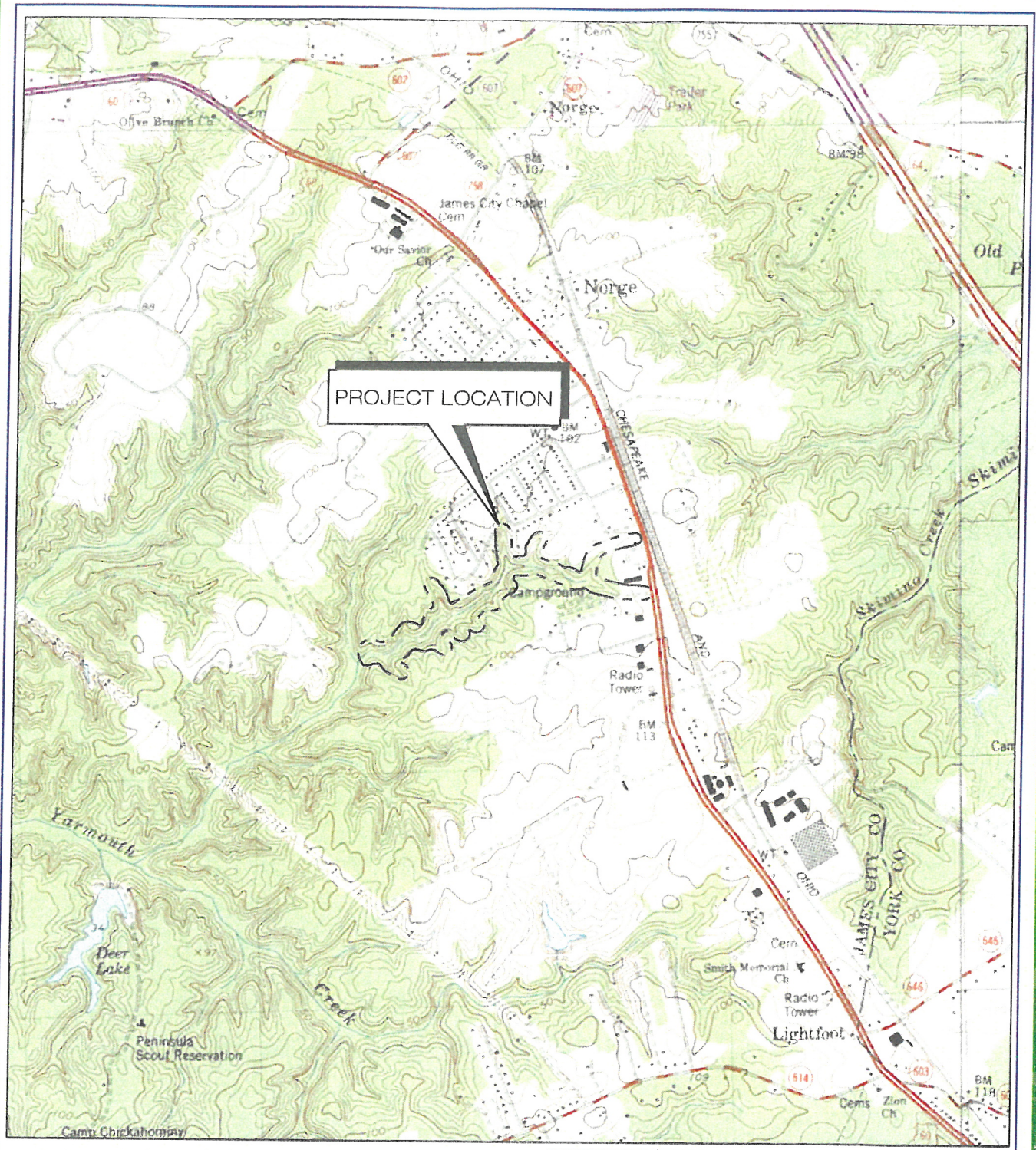

2000' 1000' 0' 2000'

SCALE: 1 INCH = 2000 FEET

LATITUDE: 37° 21'25.86"N
LONGITUDE: 76°46'19.53"W

SOURCE: USGS 7.5 MINUTE SERIES TOPOGRAPHIC MAP, NORGE, VA QUADRANGLE, 1984.

WILLIAMSBURG ENVIRONMENTAL GROUP, INC.

FIGURE 2
PROJECT LOCATION MAP
JCC - KRISTIANSAND

JAMES CITY COUNTY, VIRGINIA | AUGUST 2008

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APPENDIX A



Photograph 1: Reach 1 – Looking upstream (potential stream enhancement).



Photograph 2: Reach 2 – Incision below effective rooting depth (potential stream restoration).



Photograph 3: Reach 3 – Looking downstream (potential stream enhancement).



Photograph 4: Reach 4 – Within currently enhanced area.



Photograph 5: Reach 5 – Looking upstream.



Photograph 6: Reach 6 – Looking downstream.



Photograph 7: Reach 7 – Looking upstream.



Photograph 8: Reach 7 – Headcut area (potential stream restoration).



Photograph 9: Reach 8 – Looking downstream.



Photograph 10: Reach 8 – Representative existing BMP.

APPENDIX B

HABITAT ASSESSMENT FIELD DATA SHEET—LOW GRADIENT STREAMS (FRONT)

STREAM NAME R1	LOCATION Kristiansand - JCC	
STATION # _____ RIVERMILE _____	STREAM CLASS	
LAT _____ LONG _____	RIVER BASIN Yarmouth Creek	
STORET #	AGENCY	
INVESTIGATORS Sarah Woodford - Brook Reggi		
FORM COMPLETED BY BLJR	DATE 5-2-08 TIME _____ AM PM	REASON FOR SURVEY

Parameters to be evaluated in sampling reach

Habitat Parameter	Condition Category			
	Optimal	Suboptimal	Marginal	Poor
1. Epifaunal Substrate/ Available Cover	Greater than 50% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are not new fall and not transient).	30-50% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall, but not yet prepared for colonization (may rate at high end of scale).	10-30% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 10% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
SCORE 10	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
2. Pool Substrate Characterization	Mixture of substrate materials, with gravel and firm sand prevalent; root mats and submerged vegetation common.	Mixture of soft sand, mud, or clay; mud may be dominant; some root mats and submerged vegetation present.	All mud or clay or sand bottom; little or no root mat; no submerged vegetation.	Hard-pan clay or bedrock; no root mat or vegetation.
SCORE 8	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
3. Pool Variability	Even mix of large-shallow, large-deep, small-shallow, small-deep pools present.	Majority of pools large-deep; very few shallow.	Shallow pools much more prevalent than deep pools.	Majority of pools small-shallow or pools absent.
SCORE 8	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
4. Sediment Deposition	Little or no enlargement of islands or point bars and less than <20% of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 20-50% of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 50-80% of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development; more than 80% of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
SCORE 11	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
5. Channel Flow Status	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills >75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
SCORE 7	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0

- Enhancement potential

HABITAT ASSESSMENT FIELD DATA SHEET—LOW GRADIENT STREAMS (BACK)

Parameters to be evaluated broader than sampling reach

Habitat Parameter	Condition Category			
	Optimal	Suboptimal	Marginal	Poor
6. Channel Alteration	Channelization or dredging absent or minimal; stream with normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yr) may be present, but recent channelization is not present.	Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely.
SCORE 15	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
7. Channel Sinuosity	The bends in the stream increase the stream length 3 to 4 times longer than if it was in a straight line. (Note - channel braiding is considered normal in coastal plains and other low-lying areas. This parameter is not easily rated in these areas.)	The bends in the stream increase the stream length 1 to 2 times longer than if it was in a straight line.	The bends in the stream increase the stream length 1 to 2 times longer than if it was in a straight line.	Channel straight; waterway has been channelized for a long distance.
SCORE 9	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
8. Bank Stability (score each bank)	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.	Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.
SCORE 4 (LB)	Left Bank 10 9	8 7 6	5 4	3 2 1 0
SCORE 4 (RB)	Right Bank 10 9	8 7 6	5 4	3 2 1 0
9. Vegetative Protection (score each bank) Note: determine left or right side by facing downstream.	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.
SCORE 3 (LB)	Left Bank 10 9	8 7 6	5 4	3 2 1 0
SCORE 3 (RB)	Right Bank 10 9	8 7 6	5 4	3 2 1 0
10. Riparian Vegetative Zone Width (score each bank riparian zone)	Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone.	Width of riparian zone 12-18 meters; human activities have impacted zone only minimally.	Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.	Width of riparian zone <6 meters: little or no riparian vegetation due to human activities.
SCORE 5 (LB)	Left Bank 10 9	8 7 6	5 4	3 2 1 0
SCORE 9 (RB)	Right Bank 10 9	8 7 6	5 4	3 2 1 0

Total Score 96

HABITAT ASSESSMENT FIELD DATA SHEET—LOW GRADIENT STREAMS (FRONT)

STREAM NAME R3		LOCATION Kristiansand. – J C C	
STATION # _____ RIVERMILE _____		STREAM CLASS	
LAT _____ LONG _____		RIVER BASIN Yarmouth Creek	
STORET #		AGENCY	
INVESTIGATORS Sarah Woodford – Brock Reggi			
FORM COMPLETED BY BWR	DATE 5-2-06 TIME _____ AM PM	REASON FOR SURVEY	

Parameters to be evaluated in sampling reach

Habitat Parameter	Condition Category			
	Optimal	Suboptimal	Marginal	Poor
1. Epifaunal Substrate/ Available Cover	Greater than 50% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are not new fall and not transient).	30-50% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall, but not yet prepared for colonization (may rate at high end of scale).	10-30% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 10% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
SCORE 15	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
2. Pool Substrate Characterization	Mixture of substrate materials, with gravel and firm sand prevalent; root mats and submerged vegetation common.	Mixture of soft sand, mud, or clay; mud may be dominant; some root mats and submerged vegetation present.	All mud or clay or sand bottom; little or no root mat; no submerged vegetation.	Hard-pan clay or bedrock; no root mat or vegetation.
SCORE 14	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
3. Pool Variability	Even mix of large-shallow, large-deep, small-shallow, small-deep pools present.	Majority of pools large-deep; very few shallow.	Shallow pools much more prevalent than deep pools.	Majority of pools small-shallow or pools absent.
SCORE 7	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
4. Sediment Deposition	Little or no enlargement of islands or point bars and less than <20% of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 20-50% of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 50-80% of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development; more than 80% of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
SCORE 13	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
5. Channel Flow Status	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills >75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
SCORE 13	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0

Preservation

HABITAT ASSESSMENT FIELD DATA SHEET—LOW GRADIENT STREAMS (BACK)

Parameters to be evaluated broader than sampling reach

Habitat Parameter	Condition Category			
	Optimal	Suboptimal	Marginal	Poor
6. Channel Alteration	Channelization or dredging absent or minimal; stream with normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yr) may be present, but recent channelization is not present.	Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely.
SCORE 18	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
7. Channel Sinuosity	The bends in the stream increase the stream length 3 to 4 times longer than if it was in a straight line. (Note - channel braiding is considered normal in coastal plains and other low-lying areas. This parameter is not easily rated in these areas.)	The bends in the stream increase the stream length 1 to 2 times longer than if it was in a straight line.	The bends in the stream increase the stream length 1 to 2 times longer than if it was in a straight line.	Channel straight; waterway has been channelized for a long distance.
SCORE 16	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
8. Bank Stability (score each bank)	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.	Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.
SCORE 7 (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE 7 (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0
9. Vegetative Protection (score each bank) Note: determine left or right side by facing downstream.	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.
SCORE 8 (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE 8 (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0
10. Riparian Vegetative Zone Width (score each bank riparian zone)	Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone.	Width of riparian zone 12-18 meters; human activities have impacted zone only minimally.	Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.	Width of riparian zone <6 meters: little or no riparian vegetation due to human activities.
SCORE 7 (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE 9 (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0

Total Score 142

HABITAT ASSESSMENT FIELD DATA SHEET—LOW GRADIENT STREAMS (FRONT)

STREAM NAME 124		LOCATION Kristiansand - JCC	
STATION # _____ RIVERMILE _____		STREAM CLASS	
LAT _____ LONG _____		RIVER BASIN Yarmouth Creek	
STORET #		AGENCY	
INVESTIGATORS Sarah Woodford - Brock Reppi			
FORM COMPLETED BY BWR	DATE 5-2-08 TIME _____ AM PM	REASON FOR SURVEY	

Parameters to be evaluated in sampling reach	Habitat Parameter	Condition Category			
		Optimal	Suboptimal	Marginal	Poor
	1. Epifaunal Substrate/ Available Cover	Greater than 50% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are not new fall and not transient).	30-50% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall, but not yet prepared for colonization (may rate at high end of scale).	10-30% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 10% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
	SCORE 15	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
	2. Pool Substrate Characterization	Mixture of substrate materials, with gravel and firm sand prevalent; root mats and submerged vegetation common.	Mixture of soft sand, mud, or clay; mud may be dominant; some root mats and submerged vegetation present.	All mud or clay or sand bottom; little or no root mat; no submerged vegetation.	Hard-pan clay or bedrock; no root mat or vegetation.
	SCORE 16	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
	3. Pool Variability	Even mix of large-shallow, large-deep, small-shallow, small-deep pools present.	Majority of pools large-deep; very few shallow.	Shallow pools much more prevalent than deep pools.	Majority of pools small-shallow or pools absent.
	SCORE 6	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
	4. Sediment Deposition	Little or no enlargement of islands or point bars and less than <20% of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 20-50% of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 50-80% of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development; more than 80% of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
	SCORE 13	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
	5. Channel Flow Status	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills >75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
	SCORE 15	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0

Preservation

HABITAT ASSESSMENT FIELD DATA SHEET—LOW GRADIENT STREAMS (BACK)

Parameters to be evaluated broader than sampling reach

Habitat Parameter	Condition Category			
	Optimal	Suboptimal	Marginal	Poor
6. Channel Alteration	Channelization or dredging absent or minimal; stream with normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yr) may be present, but recent channelization is not present.	Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely.
SCORE 12	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
7. Channel Sinuosity	The bends in the stream increase the stream length 3 to 4 times longer than if it was in a straight line. (Note - channel braiding is considered normal in coastal plains and other low-lying areas. This parameter is not easily rated in these areas.)	The bends in the stream increase the stream length 1 to 2 times longer than if it was in a straight line.	The bends in the stream increase the stream length 1 to 2 times longer than if it was in a straight line.	Channel straight; waterway has been channelized for a long distance.
SCORE 7	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
8. Bank Stability (score each bank)	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.	Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.
SCORE 7 (LB)	Left Bank 10 9	8 7 6 5	4 3	2 1 0
SCORE 7 (RB)	Right Bank 10 9	8 7 6 5	4 3	2 1 0
9. Vegetative Protection (score each bank) Note: determine left or right side by facing downstream.	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.
SCORE 6 (LB)	Left Bank 10 9	8 7 6 5	4 3	2 1 0
SCORE 6 (RB)	Right Bank 10 9	8 7 6 5	4 3	2 1 0
10. Riparian Vegetative Zone Width (score each bank riparian zone)	Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone.	Width of riparian zone 12-18 meters; human activities have impacted zone only minimally.	Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.	Width of riparian zone <6 meters: little or no riparian vegetation due to human activities.
SCORE 8 (LB)	Left Bank 10 9	8 7 6 5	4 3	2 1 0
SCORE 8 (RB)	Right Bank 10 9	8 7 6 5	4 3	2 1 0

Total Score 126

HABITAT ASSESSMENT FIELD DATA SHEET—LOW GRADIENT STREAMS (FRONT)

STREAM NAME RS	LOCATION Kristiansand - UCC		
STATION # _____ RIVERMILE _____	STREAM CLASS		
LAT _____ LONG _____	RIVER BASIN Yarmouth Creek		
STORET #	AGENCY		
INVESTIGATORS Sarah Broadhurst - Brock Regai			
FORM COMPLETED BY B.W.R	DATE 5-2-08 TIME _____ AM PM	REASON FOR SURVEY	

Parameters to be evaluated in sampling reach	Habitat Parameter	Condition Category			
		Optimal	Suboptimal	Marginal	Poor
	1. Epifaunal Substrate/ Available Cover	Greater than 50% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are not new fall and not transient).	30-50% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall, but not yet prepared for colonization (may rate at high end of scale).	10-30% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 10% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
	SCORE 13	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
	2. Pool Substrate Characterization	Mixture of substrate materials, with gravel and firm sand prevalent; root mats and submerged vegetation common.	Mixture of soft sand, mud, or clay; mud may be dominant; some root mats and submerged vegetation present.	All mud or clay or sand bottom; little or no root mat; no submerged vegetation.	Hard-pan clay or bedrock; no root mat or vegetation.
	SCORE 9	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
	3. Pool Variability	Even mix of large-shallow, large-deep, small-shallow, small-deep pools present.	Majority of pools large-deep; very few shallow.	Shallow pools much more prevalent than deep pools.	Majority of pools small-shallow or pools absent.
	SCORE 6	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
	4. Sediment Deposition	Little or no enlargement of islands or point bars and less than <20% of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 20-50% of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 50-80% of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development; more than 80% of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
	SCORE 15	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
	5. Channel Flow Status	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills >75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
	SCORE 16	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0

Preservation

HABITAT ASSESSMENT FIELD DATA SHEET—LOW GRADIENT STREAMS (BACK)

Parameters to be evaluated broader than sampling reach

Habitat Parameter	Condition Category			
	Optimal	Suboptimal	Marginal	Poor
6. Channel Alteration	Channelization or dredging absent or minimal; stream with normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yr) may be present, but recent channelization is not present.	Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely.
SCORE 11	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
7. Channel Sinuosity	The bends in the stream increase the stream length 3 to 4 times longer than if it was in a straight line. (Note - channel braiding is considered normal in coastal plains and other low-lying areas. This parameter is not easily rated in these areas.)	The bends in the stream increase the stream length 1 to 2 times longer than if it was in a straight line.	The bends in the stream increase the stream length 1 to 2 times longer than if it was in a straight line.	Channel straight; waterway has been channelized for a long distance.
SCORE 14	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
8. Bank Stability (score each bank)	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.	Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.
SCORE 5 (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE 6 (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0
9. Vegetative Protection (score each bank) Note: determine left or right side by facing downstream.	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.
SCORE 5 (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE 6 (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0
10. Riparian Vegetative Zone Width (score each bank riparian zone)	Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone.	Width of riparian zone 12-18 meters; human activities have impacted zone only minimally.	Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.	Width of riparian zone <6 meters: little or no riparian vegetation due to human activities.
SCORE 4 (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE 3 (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0

Total Score 117

HABITAT ASSESSMENT FIELD DATA SHEET—LOW GRADIENT STREAMS (FRONT)

STREAM NAME RG	LOCATION Kristiansand - JCC		
STATION # _____ RIVERMILE _____	STREAM CLASS		
LAT _____ LONG _____	RIVER BASIN Yarmouth Creek		
STORET #	AGENCY		
INVESTIGATORS Sarah Woodfield - Brock Reggi			
FORM COMPLETED BY BWR	DATE 5-2-08 TIME _____ AM PM	REASON FOR SURVEY	

Parameters to be evaluated in sampling reach	Habitat Parameter	Condition Category			
		Optimal	Suboptimal	Marginal	Poor
	1. Epifaunal Substrate/ Available Cover	Greater than 50% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are not new fall and not transient).	30-50% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall, but not yet prepared for colonization (may rate at high end of scale).	10-30% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 10% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
	SCORE 17	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
	2. Pool Substrate Characterization	Mixture of substrate materials, with gravel and firm sand prevalent; root mats and submerged vegetation common.	Mixture of soft sand, mud, or clay; mud may be dominant; some root mats and submerged vegetation present.	All mud or clay or sand bottom; little or no root mat; no submerged vegetation.	Hard-pan clay or bedrock; no root mat or vegetation.
	SCORE 16	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
	3. Pool Variability	Even mix of large-shallow, large-deep, small-shallow, small-deep pools present.	Majority of pools large-deep; very few shallow.	Shallow pools much more prevalent than deep pools.	Majority of pools small-shallow or pools absent.
	SCORE 18	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
	4. Sediment Deposition	Little or no enlargement of islands or point bars and less than <20% of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 20-50% of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 50-80% of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development; more than 80% of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
	SCORE 17	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
	5. Channel Flow Status	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills >75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
	SCORE 18	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0

Preservation

HABITAT ASSESSMENT FIELD DATA SHEET—LOW GRADIENT STREAMS (BACK)

Parameters to be evaluated broader than sampling reach

Habitat Parameter	Condition Category			
	Optimal	Suboptimal	Marginal	Poor
6. Channel Alteration	Channelization or dredging absent or minimal; stream with normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yr) may be present, but recent channelization is not present.	Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely.
SCORE 18	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
7. Channel Sinuosity	The bends in the stream increase the stream length 3 to 4 times longer than if it was in a straight line. (Note - channel braiding is considered normal in coastal plains and other low-lying areas. This parameter is not easily rated in these areas.)	The bends in the stream increase the stream length 1 to 2 times longer than if it was in a straight line.	The bends in the stream increase the stream length 1 to 2 times longer than if it was in a straight line.	Channel straight; waterway has been channelized for a long distance.
SCORE 16	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
8. Bank Stability (score each bank)	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.	Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.
SCORE 8 (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE 8 (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0
9. Vegetative Protection (score each bank) Note: determine left or right side by facing downstream.	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.
SCORE 9 (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE 9 (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0
10. Riparian Vegetative Zone Width (score each bank riparian zone)	Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone.	Width of riparian zone 12-18 meters; human activities have impacted zone only minimally.	Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.	Width of riparian zone <6 meters: little or no riparian vegetation due to human activities.
SCORE 9 (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE 9 (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0

Total Score 174

HABITAT ASSESSMENT FIELD DATA SHEET—LOW GRADIENT STREAMS (FRONT)

STREAM NAME R7 - Pres.	LOCATION Kristiansand - JCC
STATION # _____ RIVERMILE _____	STREAM CLASS
LAT _____ LONG _____	RIVER BASIN Yarmouth Creek
STORET #	AGENCY
INVESTIGATORS Sarah Woolfrid - Brook Reggi	
FORM COMPLETED BY BWR	DATE 5-2-08 TIME _____ AM PM / REASON FOR SURVEY

Parameters to be evaluated in sampling reach

Habitat Parameter	Condition Category			
	Optimal	Suboptimal	Marginal	Poor
1. Epifaunal Substrate/ Available Cover	Greater than 50% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are not new fall and not transient).	30-50% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall, but not yet prepared for colonization (may rate at high end of scale).	10-30% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 10% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
SCORE 16	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
2. Pool Substrate Characterization	Mixture of substrate materials, with gravel and firm sand prevalent; root mats and submerged vegetation common.	Mixture of soft sand, mud, or clay; mud may be dominant; some root mats and submerged vegetation present.	All mud or clay or sand bottom; little or no root mat; no submerged vegetation.	Hard-pan clay or bedrock; no root mat or vegetation.
SCORE 13	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
3. Pool Variability	Even mix of large-shallow, large-deep, small-shallow, small-deep pools present.	Majority of pools large-deep; very few shallow.	Shallow pools much more prevalent than deep pools.	Majority of pools small-shallow or pools absent.
SCORE 10	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
4. Sediment Deposition	Little or no enlargement of islands or point bars and less than <20% of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 20-50% of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 50-80% of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development; more than 80% of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
SCORE 14	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
5. Channel Flow Status	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills >75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
SCORE 16	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0

- Preservation potential for reaches w/ confl. at lower portion of Reach 6
- headcut stabilization in reach on RB Reach 6

HABITAT ASSESSMENT FIELD DATA SHEET—LOW GRADIENT STREAMS (BACK)

Parameters to be evaluated broader than sampling reach

Habitat Parameter	Condition Category			
	Optimal	Suboptimal	Marginal	Poor
6. Channel Alteration	Channelization or dredging absent or minimal; stream with normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yr) may be present, but recent channelization is not present.	Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely.
SCORE 14	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
7. Channel Sinuosity	The bends in the stream increase the stream length 3 to 4 times longer than if it was in a straight line. (Note - channel braiding is considered normal in coastal plains and other low-lying areas. This parameter is not easily rated in these areas.)	The bends in the stream increase the stream length 1 to 2 times longer than if it was in a straight line.	The bends in the stream increase the stream length 1 to 2 times longer than if it was in a straight line.	Channel straight; waterway has been channelized for a long distance.
SCORE 13	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
8. Bank Stability (score each bank)	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.	Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.
SCORE 9 (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE 9 (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0
9. Vegetative Protection (score each bank) Note: determine left or right side by facing downstream.	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.
SCORE 9 (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE 9 (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0
10. Riparian Vegetative Zone Width (score each bank riparian zone)	Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone.	Width of riparian zone 12-18 meters; human activities have impacted zone only minimally.	Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.	Width of riparian zone <6 meters: little or no riparian vegetation due to human activities.
SCORE 4 (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE 4 (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0

Total Score 144

HABITAT ASSESSMENT FIELD DATA SHEET—LOW GRADIENT STREAMS (FRONT)

STREAM NAME RB-Pres.	LOCATION Kristiansand - JCC	
STATION # _____ RIVERMILE _____	STREAM CLASS	
LAT _____ LONG _____	RIVER BASIN Yarmouth Creek	
STORET #	AGENCY	
INVESTIGATORS Sarah Woodford - Brock Regal		
FORM COMPLETED BY BLR	DATE 5-2-08 TIME _____ AM PM	REASON FOR SURVEY

Parameters to be evaluated in sampling reach

Habitat Parameter	Condition Category			
	Optimal	Suboptimal	Marginal	Poor
1. Epifaunal Substrate/ Available Cover	Greater than 50% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are not new fall and not transient).	30-50% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall, but not yet prepared for colonization (may rate at high end of scale).	10-30% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 10% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
SCORE 16	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
2. Pool Substrate Characterization	Mixture of substrate materials, with gravel and firm sand prevalent; root mats and submerged vegetation common.	Mixture of soft sand, mud, or clay; mud may be dominant; some root mats and submerged vegetation present.	All mud or clay or sand bottom; little or no root mat; no submerged vegetation.	Hard-pan clay or bedrock; no root mat or vegetation.
SCORE 13	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
3. Pool Variability	Even mix of large-shallow, large-deep, small-shallow, small-deep pools present.	Majority of pools large-deep; very few shallow.	Shallow pools much more prevalent than deep pools.	Majority of pools small-shallow or pools absent.
SCORE 10	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
4. Sediment Deposition	Little or no enlargement of islands or point bars and less than <20% of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 20-50% of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 50-80% of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development; more than 80% of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
SCORE 14	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
5. Channel Flow Status	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills >75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
SCORE 15	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0

- preservation potential downstream of retention ponds / existing development

HABITAT ASSESSMENT FIELD DATA SHEET—LOW GRADIENT STREAMS (BACK)

Parameters to be evaluated broader than sampling reach

Habitat Parameter	Condition Category			
	Optimal	Suboptimal	Marginal	Poor
6. Channel Alteration riprap SCORE 14	Channelization or dredging absent or minimal; stream with normal pattern. 20 19 18 17 16	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yr) may be present, but recent channelization is not present. 15 14 13 12 11	Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted. 10 9 8 7 6	Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely. 5 4 3 2 1 0
7. Channel Sinuosity SCORE 11	The bends in the stream increase the stream length 3 to 4 times longer than if it was in a straight line. (Note - channel braiding is considered normal in coastal plains and other low-lying areas. This parameter is not easily rated in these areas.) 20 19 18 17 16	The bends in the stream increase the stream length 1 to 2 times longer than if it was in a straight line. 15 14 13 12 11	The bends in the stream increase the stream length 1 to 2 times longer than if it was in a straight line. 10 9 8 7 6	Channel straight; waterway has been channelized for a long distance. 5 4 3 2 1 0
8. Bank Stability (score each bank) SCORE 9 (LB) SCORE 9 (RB)	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected. Left Bank 10 9 Right Bank 10 9	Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion. 8 7 6 8 7 6	Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods. 5 4 5 4	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars. 3 2 1 0 3 2 1 0
9. Vegetative Protection (score each bank) Note: determine left or right side by facing downstream. SCORE 9 (LB) SCORE 9 (RB)	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally. Left Bank 10 9 Right Bank 10 9	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining. 8 7 6 8 7 6	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining. 5 4 5 4	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height. 3 2 1 0 3 2 1 0
10. Riparian Vegetative Zone Width (score each bank riparian zone) SCORE 4 (LB) SCORE 4 (RB)	Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone. Left Bank 10 9 Right Bank 10	Width of riparian zone 12-18 meters; human activities have impacted zone only minimally. 8 7 6 8	Width of riparian zone 6-12 meters; human activities have impacted zone a great deal. 5 4 5 4	Width of riparian zone <6 meters: little or no riparian vegetation due to human activities. 3 2 1 0 3 2 1 0

Total Score 137

Stream Assessment Form (Form 1)

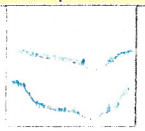
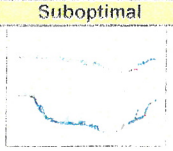
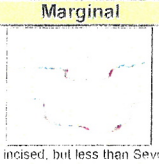
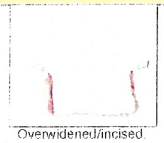
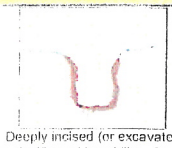
Unified Stream Methodology for use in Virginia

For use in wadeable channels classified as intermittent or perennial

Project #	Project Name	Locality	Cowardin Class.	HUC	Date	SAR #	Impact/SAR length	Impact Factor
3935	Kristiansand	JCC		02060208	5-2-08	1	685	0

Name(s) of Evaluator(s)	Stream Name and Information
sw, br	Tributary to Yarmouth Creek

1. Channel Condition: Assess the cross-section of the stream and prevailing condition (erosion, aggradation)

	Conditional Category					
	Optimal	Suboptimal	Marginal	Poor	Severe	
Channel Condition	 Very little incision or active erosion: 80-100% stable banks. Vegetative surface protection or natural rock prominent (80-100%), AND/OR Stable point bars/bankfull benches are present. Access to their original floodplain or fully developed wide bankfull benches. Mid-channel bars, and transverse bars few. Transient sediment deposition covers less than 10% of bottom.	 Slightly incised, few areas of active erosion or unprotected banks. Majority of banks are stable (60-80%). Vegetative protection or natural rock prominent (60-80%) AND/OR Depositional features contribute to stability. The bankfull and low flow channels are well defined. Stream likely has access to bankfull benches, or newly developed floodplains along portions of the reach. Transient sediment covers 10-40% of the stream bottom.	 Often incised, but less than Severe or Poor. Banks more stable than Severe or Poor due to lower bank slopes. Erosion may be present on 40-60% of both banks. Vegetative protection on 40-60% of banks. Streambanks may bevertical or undercut. AND/OR 40-60% of stream is covered by sediment. Sediment may be temporary/transient, contribute instability. Deposition that contribute to stability, may be forming/present, AND/OR V-shaped channels have vegetative protection on > 40% of the banks and depositional features which contribute to stability.	 Overwidened/incised. Vertically/laterally unstable. Likely to widen further. Majority of both banks are near vertical. Erosion present on 60-80% of banks. Vegetative protection present on 20-40% of banks, and is insufficient to prevent erosion. AND/OR 60-80% of the stream is covered by sediment. Sediment is temporary/transient in nature, and contributing to instability. AND/OR V-shaped channels have vegetative protection is present on > 40% of the banks and stable sediment deposition is absent.	 Deeply incised (or excavated), vertical/lateral instability. Severe incision, flow contained within the banks. Streambed below average rooting depth, majority of banks vertical/undercut. Vegetative protection present on less than 20% of banks, is not preventing erosion. Obvious bank sloughing present. Erosion/raw banks on 80-100%. AND/OR Aggrading channel. Greater than 80% of stream bed is covered by deposition, contributing to instability. Multiple thread channels and/or subterranean flow.	CI
Score	3	2.4	2	1.6	1	1.6
NOTES>>						

2. RIPARIAN BUFFERS: Assess both bank's 100 foot riparian areas along the entire SAR. (rough measurements of length & width may be acceptable)

	Conditional Category						RB - outer parking lot; LB - woods
	Optimal	Suboptimal		Marginal		Poor	
Riparian Buffers	Tree stratum (dbh > 3 inches) present with > 60% tree canopy cover **and a non-maintained understory**. Wetlands located within the riparian areas.	**High Suboptimal:** Riparian areas with tree stratum (dbh > 3 inches) present, with 30% to 60% tree canopy cover and containing both herbaceous and shrub layers or a non-maintained understory.	**Low Suboptimal:** Riparian areas with tree stratum (dbh > 3 inches) present, with > 30% tree canopy cover and a maintained understory. Recent cutover (dense vegetation).	**High Marginal:** Non-maintained, dense herbaceous vegetation with either a shrub layer or a tree layer (dbh > 3 inches) present, with <30% tree canopy cover.	**Low Marginal:** Non-maintained, dense herbaceous vegetation, riparian areas lacking shrub and tree stratum, hay production, ponds, open water. If present, tree stratum (dbh >3 inches) present with <30% tree canopy cover with maintained understory.	**High Poor:** Lawns, mowed, and maintained areas, nurseries; no-till cropland; actively grazed pasture, sparsely vegetated non-maintained area, recently seeded and stabilized, or other comparable condition.	**Low Poor:** Impervious surfaces, mine spoil lands, denuded surfaces, row crops, active feed lots, trails, or other comparable conditions.	
		High	Low	High	Low	High	Low	
Condition Scores	1.5	1.2	1.1	0.85	0.75	0.6	0.5	

1. Delineate riparian areas along each stream bank into Condition Categories and Condition Scores using the descriptors.
2. Determine square footage for each by measuring or estimating length and width. Calculators are provided for you below.
3. Enter the % Riparian Area and Score for each riparian category in the blocks below.

Ensure the sums of % Riparian Blocks equal 100

Right Bank	% Riparian Area>	70%	30%					100%	
	Score >	1.2	0.5						
								CI= (Sum % RA * Scores*0.01)/2	
Left Bank	% Riparian Area>	100%						100%	Rt Bank CI > 0.99 / Lt Bank CI > 1.20 / CI 1.10
	Score >	1.2							

3. INSTREAM HABITAT: Varied substrate sizes, water velocity and depths; woody and leafy debris; stable substrate; low embededness; shade; undercut banks, root mats, SAV, riffle pools complexes, stable features.

NOTES>>

	Conditional Category				
	Optimal	Suboptimal	Marginal	Poor	
Instream Habitat/ Available Cover	Habitat elements are typically present in greater than 50% of the reach.	Stable habitat elements are typically present in 30-50% of the reach and are adequate for maintenance of populations.	Stable habitat elements are typically present in 10-30% of the reach and are adequate for maintenance of populations.	Habitat elements listed above are lacking or are unstable. Habitat elements are typically present in less than 10% of the reach.	CI
Score	1.5	1.2	0.9	0.5	0.90

Stream Impact Assessment Form Page 2

Project #	Applicant	Locality	Cowardin Class.	HUC	Date	Data Point	SAR length	Impact Factor

4. CHANNEL ALTERATION: Stream crossings, riprap, concrete, gabions, or concrete blocks, straightening of channel, channelization, embankments, spoil piles, constructions, livestock

NOTES>>

	Conditional Category						
	Negligible	Minor		Moderate		Severe	
Channel Alteration	Channelization, dredging, alteration, or hardening absent. Stream has an unaltered pattern or has naturalized.	Less than 20% of the stream reach is disrupted by any of the channel alterations listed in the parameter guidelines.	20-40% of the stream reach is disrupted by any of the channel alterations listed in the parameter guidelines.	40 - 60% of reach is disrupted by any of the channel alterations listed in the parameter guidelines. If stream has been channelized, normal stable stream meander pattern has not recovered.	60 - 80% of reach is disrupted by any of the channel alterations listed in the parameter guidelines. If stream has been channelized, normal stable stream meander pattern has not recovered.	Greater than 80% of reach is disrupted by any of the channel alterations listed in the parameter guidelines AND/OR 80% of banks shored with gabion, riprap, or cement.	
SCORE	1.5	1.3	1.1	0.9	0.7	0.5	1.30

REACH CONDITION INDEX and STREAM CONDITION UNITS FOR THIS REACH

NOTE: The CIs and RCI should be rounded to 2 decimal places. The CR should be rounded to a whole number

THE REACH CONDITION INDEX (RCI) >>	0.98
RCI= (Sum of all CI's)/5	
COMPENSATION REQUIREMENT (CR) >>	0
CR = RCI X LF X IF	

INSERT PHOTOS:

DESCRIBE PROPOSED IMPACT:

Stream Assessment Form (Form 1)

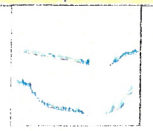
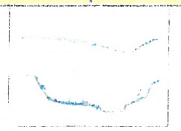
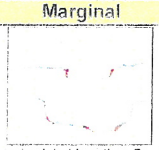
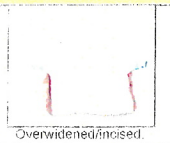
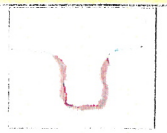
Unified Stream Methodology for use in Virginia

For use in wadeable channels classified as intermittent or perennial

Project #	Project Name	Locality	Cowardin Class.	HUC	Date	SAR #	Impact/SAR length	Impact Factor
3935	Kristiansand	JCC		02060208	5-2-08	3	1511	0

Name(s) of Evaluator(s)	Stream Name and Information
sw, br	Tributary to Yarmouth Creek

1. Channel Condition: Assess the cross-section of the stream and prevailing condition (erosion, aggradation)

	Conditional Category					
	Optimal	Suboptimal	Marginal	Poor	Severe	
Channel Condition	 Very little incision or active erosion: 80-100% stable banks. Vegetative surface protection or natural rock, prominent (80-100%). AND/OR Stable point bars/bankfull benches are present. Access to their original floodplain or fully developed wide bankfu	 Slightly incised, few areas of active erosion or unprotected banks. Majority of banks are stable (60-80%). Vegetative protection or natural rock prominent (60-80%) AND/OR Depositional features contribute to stability. The bankfull and low flow channels	 Often incised, but less than Severe or Poor. Banks more stable than Severe or Poor due to lower bank slopes. Erosion may be present on 40-60% of both banks. Vegetative protection on 40-60% of banks. Streambanks may bevertical or undercut. AND/OR 40-60%	 Overwidened/incised. Vertically/laterally unstable. Likely to widen further. Majority of both banks are near vertical. Erosion present on 60-80% of banks. Vegetative protection present on 20-40% of banks and is insufficient to prevent erosion. AND/OR	 Deeply incised (or excavated), vertical/lateral instability. Severe incision, flow contained within the banks. Streambed below average rooting depth, majority of banks vertical/undercut. Vegetative protection present on less than 20% of banks, is not p	CI
Score	3	2.4	2	1.6	1	2.0
NOTES>>						

2. RIPARIAN BUFFERS: Assess both bank's 100 foot riparian areas along the entire SAR. (rough measurements of length & width may be acceptable)

	Conditional Category							
	Optimal	Suboptimal		Marginal		Poor		
Riparian Buffers	Tree stratum (dbh > 3 inches) present with > 60% tree canopy cover **and a non-maintained understory**. Wetlands located within the riparian areas.	**High Suboptimal:** Riparian areas with tree stratum (dbh > 3 inches) present, with 30% to 60% tree canopy cover and containing both herbaceous and shrub layers or a non-maintained understory.	**Low Suboptimal:** Riparian areas with tree stratum (dbh > 3 inches) present with > 30% tree canopy cover and a maintained understory. Recent cutover (dense vegetation).	**High Marginal:** Non-maintained, dense herbaceous vegetation with either a shrub layer or a tree layer (dbh > 3 inches) present, with <30% tree canopy cover.	**Low Marginal:** Non-maintained, dense herbaceous vegetation, riparian areas lacking shrub and tree stratum, hay production, ponds, open water if present, tree stratum (dbh >3 inches) present, with <30% tree canopy cover with maintained understory.	**High Poor:** Lawns, mowed, and maintained areas, nurseries, no-till cropland, actively grazed pasture, sparsely vegetated non-maintained area, recently seeded and stabilized, or other comparable condition.	**Low Poor:** Impervious surfaces, mine spoil lands, denuded surfaces, row crops, active feed lots, trails, or other comparable conditions.	
		High	Low	High	Low	High	Low	
Condition Scores	1.5	1.2	1.1	0.85	0.75	0.6	0.5	

1. Delineate riparian areas along each stream bank into Condition Categories and Condition Scores using the descriptors.
2. Determine square footage for each by measuring or estimating length and width. Calculators are provided for you below.
3. Enter the % Riparian Area and Score for each riparian category in the blocks below.

Ensure the sums of % Riparian Blocks equal 100

Right Bank	% Riparian Area>	100%						100%	
	Score >	1.2							
Left Bank	% Riparian Area>	70%	30%					100%	CI= (Sum % RA * Scores*0.01)/2
	Score >	1.2	0.6						Rt Bank CI > 1.20
									Lt Bank CI > 1.02

CI: 1.11

3. INSTREAM HABITAT: Varied substrate sizes, water velocity and depths; woody and leafy debris; stable substrate; low embededness; shade; undercut banks; root mats; SAV; riffle pools complexes; stable features

NOTES>>

	Conditional Category			
	Optimal	Suboptimal	Marginal	Poor
Instream Habitat/ Available Cover	Habitat elements are typically present in greater than 50% of the reach.	Stable habitat elements are typically present in 30-50% of the reach and are adequate for maintenance of populations.	Stable habitat elements are typically present in 10-30% of the reach and are adequate for maintenance of populations.	Habitat elements listed above are lacking or are unstable. Habitat elements are typically present in less than 10% of the reach.
Score	1.5	1.2	0.9	0.5

CI: 1.20

Stream Impact Assessment Form Page 2

Project #	Applicant	Locality	Cowardin Class.	HUC	Date	Data Point	SAR length	Impact Factor

4. CHANNEL ALTERATION: Stream crossings, riprap, concrete, gabions, or concrete blocks, straightening of channel, channelization, embankments, spoil piles, constrictions, livestock

NOTES>>

	Conditional Category						
	Negligible	Minor		Moderate		Severe	
Channel Alteration	Channelization, dredging, alteration, or hardening absent. Stream has an unaltered pattern or has naturalized.	Less than 20% of the stream reach is disrupted by any of the channel alterations listed in the parameter guidelines	20-40% of the stream reach is disrupted by any of the channel alterations listed in the parameter guidelines	40 - 60% of reach is disrupted by any of the channel alterations listed in the parameter guidelines. If stream has been channelized, normal stable stream meander pattern has not recovered.	60 - 80% of reach is disrupted by any of the channel alterations listed in the parameter guidelines. If stream has been channelized, normal stable stream meander pattern has not recovered.	Greater than 80% of reach is disrupted by any of the channel alterations listed in the parameter guidelines AND/OR 80 + of banks shored with gabion, riprap, or cement.	
SCORE	1.5	1.3	1.1	0.9	0.7	0.5	1.30

REACH CONDITION INDEX and STREAM CONDITION UNITS FOR THIS REACH

NOTE: The CIs and RCI should be rounded to 2 decimal places. The CR should be rounded to a whole number.

THE REACH CONDITION INDEX (RCI) >>	1.12
RCI= (Sum of all CIs)/5	
COMPENSATION REQUIREMENT (CR) >>	0
CR = RCI X LF X II	

INSERT PHOTOS:

DESCRIBE PROPOSED IMPACT:

Stream Assessment Form (Form 1)

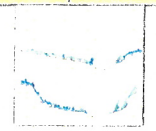
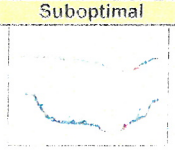
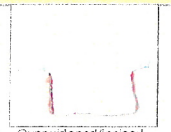
Unified Stream Methodology for use in Virginia

For use in wadeable channels classified as intermittent or perennial

Project #	Project Name	Locality	Cowardin Class.	HUC	Date	SAR #	Impact/SAR length	Impact Factor
3935	Kristiansand	JCC		02060208	5-2-08	4	342	0

Name(s) of Evaluator(s)	Stream Name and Information
sw, br	Tributary to Yarmouth Creek

1. Channel Condition: Assess the cross section of the stream and prevailing condition (erosion, aggradation)

	Conditional Category					
	Optimal	Suboptimal	Marginal	Poor	Severe	
Channel Condition	 Very little incision or active erosion; 80-100% stable banks. Vegetative surface protection or natural rock, prominent (80-100%). AND/OR Stable point bars/bankfull benches are present. Access to their original floodplain or fully developed wide bankfu	 Slightly incised, few areas of active erosion or unprotected banks. Majority of banks are stable (60-80%). Vegetative protection or natural rock prominent (60-80%) AND/OR Depositional features contribute to stability. The bankfull and low flow channels	 Often incised, but less than Severe or Poor. Banks more stable than Severe or Poor due to lower bank slopes. Erosion may be present on 40-60% of both banks. Vegetative protection on 40-60% of banks. Streambanks may bevertical or undercut. AND/OR 40-60%	 Overwidened/incised. Vertically/laterally unstable. Likely to widen further. Majority of both banks are near vertical. Erosion present on 60-80% of banks. Vegetative protection present on 20-40% of banks, and is insufficient to prevent erosion. AND/OR	 Deeply incised (or excavated) vertical/lateral instability. Severe incision, flow contained within the banks. Streambed below average rooting depth, majority of banks vertical/undercut. Vegetative protection present on less than 20% of banks, is not p	CI
Score	3	2.4	2	1.6	1	2.0
NOTES>>						

2. RIPARIAN BUFFERS: Assess both bank's 100 foot riparian areas along the entire SAR. (rough measurements of length & width may be acceptable)

	Conditional Category						
	Optimal	Suboptimal		Marginal		Poor	
Riparian Buffers	Tree stratum (dbh > 3 inches) present, with > 60% tree canopy cover **and a non-maintained understory**. Wetlands located within the riparian areas.	**High Suboptimal:** Riparian areas with tree stratum (dbh > 3 inches) present, with 30% to 60% tree canopy cover and containing both herbaceous and shrub layers or a non-maintained understory.	**Low Suboptimal:** Riparian areas with tree stratum (dbh > 3 inches) present, with > 30% tree canopy cover and a maintained understory. Recent cutover (dense vegetation).	**High Marginal:** Non-maintained, dense herbaceous vegetation with either a shrub layer or a tree layer (dbh > 3 inches) present, with <30% tree canopy cover	**Low Marginal:** Non-maintained, dense herbaceous vegetation, riparian areas lacking shrub and tree stratum hay production, ponds, open water. If present, tree stratum (dbh >3 inches) present, with <30% tree canopy cover with maintained understory	**High Poor:** Lawns, mowed, and maintained areas, nurseries, no-till cropland, actively grazed pasture, sparsely vegetated non-maintained area, recently seeded and stabilized, or other comparable condition.	**Low Poor:** Impervious surfaces, mine spoil lands, denuded surfaces, row crops, active feed lots, trails, or other comparable conditions.
		High	Low	High	Low	High	Low
Condition Scores	1.5	1.2	1.1	0.85	0.75	0.6	0.5

1. Delineate riparian areas along each stream bank into Condition Categories and Condition Scores using the descriptors
2. Determine square footage for each by measuring or estimating length and width. Calculators are provided for you below
3. Enter the % Riparian Area and Score for each riparian category in the blocks below.

Ensure the sums of % Riparian Blocks equal 100

Right Bank	% Riparian Area>	80%	20%					100%			
	Score >	1.2	0.75								
									CI= (Sum % RA * Scores*0.01)/2		
Left Bank	% Riparian Area>	80%	20%					100%	Rt Bank CI >	1.11	CI
	Score >	1.2	0.75						Lt Bank CI >	1.11	1.11

3. INSTREAM HABITAT: Varied substrate sizes, water velocity and depths, woody and leafy debris, stable substrate, low embededness, shade, undercut banks, root mats, SAV, riffle pools complexes, stable features

NOTES>>

	Conditional Category				
	Optimal	Suboptimal	Marginal	Poor	
Instream Habitat/ Available Cover	Habitat elements are typically present in greater than 50% of the reach.	Stable habitat elements are typically present in 30-50% of the reach and are adequate for maintenance of populations	Stable habitat elements are typically present in 10-30% of the reach and are adequate for maintenance of populations.	Habitat elements listed above are lacking or are unstable. Habitat elements are typically present in less than 10% of the reach.	CI
Score	1.5	1.2	0.9	0.5	1.20

Stream Impact Assessment Form Page 2

Project #	Applicant	Locality	Cowardin Class.	HUC	Date	Data Point	SAR length	Impact Factor

4. CHANNEL ALTERATION: Stream crossings, riprap, concrete, gabions, or concrete blocks, straightening of channel, channelization, embankments, scour pites, constrictions, livestock

NOTES>>

	Conditional Category						
	Negligible	Minor		Moderate		Severe	
Channel Alteration	Channelization, dredging, alteration, or hardening absent. Stream has an unaltered pattern or has naturalized	Less than 20% of the stream reach is disrupted by any of the channel alterations listed in the parameter guidelines	20-40% of the stream reach is disrupted by any of the channel alterations listed in the parameter guidelines	40 - 60% of reach is disrupted by any of the channel alterations listed in the parameter guidelines. If stream has been channelized, normal stable stream meander pattern has not recovered	60 - 80% of reach is disrupted by any of the channel alterations listed in the parameter guidelines. If stream has been channelized, normal stable stream meander pattern has not recovered	Greater than 80% of reach is disrupted by any of the channel alterations listed in the parameter guidelines. AND/OR 80% of banks shored with gabion, riprap, or cement	
SCORE	1.5	1.3	1.1	0.9	0.7	0.5	1.30

REACH CONDITION INDEX and STREAM CONDITION UNITS FOR THIS REACH

NOTE: The CIs and RCI should be rounded to 2 decimal places. The CR should be rounded to a whole number.

THE REACH CONDITION INDEX (RCI) >>	1.12
RCI= (Sum of all CI's)/5	
COMPENSATION REQUIREMENT (CR) >>	0
CR = RCI X LF X IF	

INSERT PHOTOS:

DESCRIBE PROPOSED IMPACT:

Stream Assessment Form (Form 1)

Unified Stream Methodology for use in Virginia

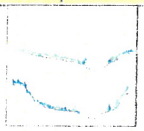
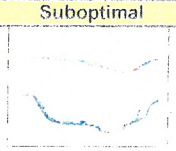
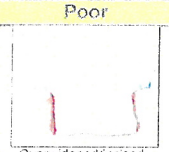
For use in wadeable channels classified as intermittent or perennial

Project #	Project Name	Locality	Cowardin Class.	HUC	Date	SAR #	Impact/SAR length	Impact Factor
3935	Kristiansand	JCC		02060208	5-2-08	5	628	0

Name(s) of Evaluator(s)	Stream Name and Information
sw, br	Tributary to Yarmouth Creek

1. Channel Condition: Assess the cross-section of the stream and prevailing condition (erosion, aggradation)

Conditional Category

	Optimal	Suboptimal	Marginal	Poor	Severe	
Channel Condition	 Very little incision or active erosion; 80-100% stable banks. Vegetative surface protection or natural rock. prominent (80-100%). AND/OR Stable point bars/bankfull benches are present. Access to their original floodplain or fully developed wide bankfu	 Slightly incised, few areas of active erosion or unprotected banks. Majority of banks are stable (60-80%). Vegetative protection or natural rock prominent (60-80%) AND/OR Depositional features contribute to stability. The bankfull and low flow channels	 Often incised, but less than Severe or Poor. Banks more stable than Severe or Poor due to lower bank slopes. Erosion may be present on 40-60% of both banks. Vegetative protection on 40-60% of banks. Streambanks may be vertical or undercut. AND/OR 40-60%	 Overwidened/incised. Vertically/laterally unstable. Likely to widen further. Majority of both banks are near vertical. Erosion present on 60-80% of banks. Vegetative protection present on 20-40% of banks, and is insufficient to prevent erosion. AND/OR	 Deeply incised (or excavated), vertical/lateral instability. Severe incision, flow contained within the banks. Streambed below average rooting depth, majority of banks vertical/undercut. Vegetative protection present on less than 20% of banks, is not p	CI
Score	3	2.4	2	1.6	1	2.0
NOTES>>						

2. RIPARIAN BUFFERS: Assess both bank's 100 foot riparian areas along the entire SAR. (rough measurements of length & width may be acceptable)

Conditional Category

	Optimal	Suboptimal		Marginal		Poor	
Riparian Buffers	Tree stratum (dbh > 3 inches) present, with > 60% tree canopy cover **and a non-maintained understory**. Wetlands located within the riparian areas.	**High Suboptimal:** Riparian areas with tree stratum (dbh > 3 inches) present, with 30% to 60% tree canopy cover and containing both herbaceous and shrub layers or a non-maintained understory.	**Low Suboptimal:** Riparian areas with tree stratum (dbh > 3 inches) present, with > 30% tree canopy cover and a maintained understory. Recent cutover (dense vegetation).	**High Marginal:** Non-maintained, dense herbaceous vegetation with either a shrub layer or a tree layer (dbh > 3 inches) present, with <30% tree canopy cover.	**Low Marginal:** Non-maintained, dense herbaceous vegetation, riparian areas lacking shrub and tree stratum, hay production, ponds, open water. If present, tree stratum (dbh >3 inches) present, with <30% tree canopy cover with maintained understory.	**High Poor:** Lawns, mowed, and maintained areas nurseries; no-till cropland; actively grazed pasture, sparsely vegetated non-maintained area, recently seeded and stabilized, or other comparable condition.	**Low Poor:** Impervious surfaces, mine spoil lands, denuded surfaces, row crops, active feed lots, trails, or other comparable conditions.
		High	Low	High	Low	High	Low
Condition Scores	1.5	1.2	1.1	0.85	0.75	0.6	0.5

1. Delineate riparian areas along each stream bank into Condition Categories and Condition Scores using the descriptors.
2. Determine square footage for each by measuring or estimating length and width. Calculators are provided for you below.
3. Enter the % Riparian Area and Score for each riparian category in the blocks below.

Ensure the sums of % Riparian Blocks equal 100

Right Bank	% Riparian Area>	70%	30%					100%			
	Score >	1.2	0.75								
									CI= (Sum % RA * Scores*0.01)/2		
Left Bank	% Riparian Area>	80%	20%					100%	Rt Bank CI >	1.07	CI
	Score >	1.5	0.75						Lt Bank CI >	1.35	1.21

3. INSTREAM HABITAT: Varied substrate sizes, water velocity and depths; woody and leafy debris; stable substrate; low embededness; shade; undercut banks; root mats; SAV; riffle pools complexes, stable features

NOTES>>

Conditional Category

	Optimal	Suboptimal	Marginal	Poor	
Instream Habitat/ Available Cover	Habitat elements are typically present in greater than 50% of the reach.	Stable habitat elements are typically present in 30-50% of the reach and are adequate for maintenance of populations.	Stable habitat elements are typically present in 10-30% of the reach and are adequate for maintenance of populations.	Habitat elements listed above are lacking or are unstable. Habitat elements are typically present in less than 10% of the reach.	CI
Score	1.5	1.2	0.9	0.5	1.20

Stream Impact Assessment Form Page 2

Project #	Applicant	Locality	Cowardin Class.	HUC	Date	Data Point	SAR Length	Impact Factor

4. CHANNEL ALTERATION: Stream crossings, riprap, concrete, gabions, or concrete blocks, straightening of channel, channelization, embankments, spoil piles, constructions, livestock

NOTES>>

	Conditional Category						
	Negligible	Minor		Moderate		Severe	
Channel Alteration	Channelization, dredging, alteration, or hardening absent. Stream has an unaltered pattern or has naturalized.	Less than 20% of the stream reach is disrupted by any of the channel alterations listed in the parameter guidelines.	20-40% of the stream reach is disrupted by any of the channel alterations listed in the parameter guidelines.	40 - 60% of reach is disrupted by any of the channel alterations listed in the parameter guidelines. If stream has been channelized, normal stable stream meander pattern has not recovered.	60 - 80% of reach is disrupted by any of the channel alterations listed in the parameter guidelines. If stream has been channelized, normal stable stream meander pattern has not recovered.	Greater than 80% of reach is disrupted by any of the channel alterations listed in the parameter guidelines, and/or 80% of banks shored with gabion, riprap, or cement.	
SCORE	1.5	1.3	1.1	0.9	0.7	0.5	1.30

REACH CONDITION INDEX and STREAM CONDITION UNITS FOR THIS REACH

NOTE: The CIs and RCI should be rounded to 2 decimal places. The CR should be rounded to a whole number.

THE REACH CONDITION INDEX (RCI) >>	1.14
RCI= (Sum of all CI's)/5	
COMPENSATION REQUIREMENT (CR) >>	0
CR = RCI X LF X IF	

INSERT PHOTOS:

DESCRIBE PROPOSED IMPACT:

Stream Assessment Form (Form 1)

Unified Stream Methodology for use in Virginia

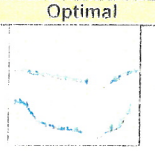
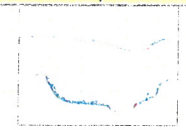
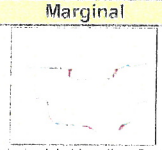
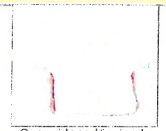
For use in wadeable channels classified as intermittent or perennial

Project #	Project Name	Locality	Cowardin Class.	HUC	Date	SAR #	Impact/SAR length	Impact Factor
3935	Kristiansand	JCC		02060208	5-2-08	6	3534	0

Name(s) of Evaluator(s)	Stream Name and Information
sw, br	Tributary to Yarmouth Creek

1. Channel Condition: Assess the cross-section of the stream and prevailing condition (erosion, aggradation)

Conditional Category

	Optimal	Suboptimal	Marginal	Poor	Severe	
Channel Condition	 Very little incision or active erosion; 80-100% stable banks. Vegetative surface protection or natural rock prominent (80-100%). AND/OR Stable point bars/bankfull benches are present. Access to their original floodplain or fully developed wide bankfu	 Slightly incised, few areas of active erosion or unprotected banks. Majority of banks are stable (60-80%). Vegetative protection or natural rock prominent (60-80%) AND/OR Depositional features contribute to stability. The bankfull and low flow channels	 Often incised, but less than Severe or Poor. Banks more stable than Severe or Poor due to lower bank slopes. Erosion may be present on 40-60% of both banks. Vegetative protection on 40-60% of banks. Streambanks may bevertical or undercut. AND/OR 40-60%	 Overwidened/incised. Vertically/laterally unstable. Likely to widen further. Majority of both banks are near vertical. Erosion present on 60-80% of banks. Vegetative protection present on 20-40% of banks, and is insufficient to prevent erosion. AND/OR	 Deeply incised (or excavated), vertical/lateral instability. Severe incision, flow contained within the banks. Streambed below average rooting depth, majority of banks vertical/undercut. Vegetative protection present on less than 20% of banks, is not p	CI
Score	3	2.4	2	1.6	1	2.4
NOTES>>						

2. RIPARIAN BUFFERS: Assess both bank's 100 foot riparian areas along the entire SAR. (rough measurements of length & width may be acceptable)

Conditional Category

	Optimal	Suboptimal		Marginal		Poor	
Riparian Buffers	Tree stratum (dbh > 3 inches) present, with > 60% tree canopy cover **and a non-maintained understory**. Wetlands located within the riparian areas.	**High Suboptimal:** Riparian areas with tree stratum (dbh > 3 inches) present, with 30% to 60% tree canopy cover and containing both herbaceous and shrub layers or a non-maintained understory.	**Low Suboptimal:** Riparian areas with tree stratum (dbh > 3 inches) present, with > 30% tree canopy cover and a maintained understory. Recent cutover (dense vegetation).	**High Marginal:** Non-maintained, dense herbaceous vegetation with either a shrub layer or a tree layer (dbh > 3 inches) present, with <30% tree canopy cover.	**Low Marginal:** Non-maintained, dense herbaceous vegetation, riparian areas lacking shrub and tree stratum, hay production, ponds, open water. If present, tree stratum (dbh >3 inches) present, with <30% tree canopy cover with maintained understory	**High Poor:** Lawns, mowed, and maintained areas, nurseries; no-till cropland; actively grazed pasture, sparsely vegetated non-maintained area, recently seeded and stabilized, or other comparable condition.	**Low Poor:** Impervious surfaces, mine spoil lands, denuded surfaces, row crops, active feed lots, trails, or other comparable conditions.
		High	Low	High	Low	High	Low
Condition Scores	1.5	1.2	1.1	0.85	0.75	0.6	0.5

1. Delineate riparian areas along each stream bank into Condition Categories and Condition Scores using the descriptors.
2. Determine square footage for each by measuring or estimating length and width. Calculators are provided for you below.
3. Enter the % Riparian Area and Score for each riparian category in the blocks below.

Ensure the sums of % Riparian Blocks equal 100

Right Bank	% Riparian Area>	100%						100%	
	Score >	1.5							
Left Bank	% Riparian Area>	100%						100%	
	Score >	1.5							

CI= (Sum % RA * Scores*0.01)/2

Rt Bank CI >	1.50	CI
Lt Bank CI >	1.50	1.50

3. INSTREAM HABITAT: Varied substrate sizes, water velocity and depths, woody and leafy debris, stable substrate, low embededness, shade, undercut banks, root mats, SAV, riffle pools complexes, stable features

NOTES>>

Conditional Category

	Optimal	Suboptimal	Marginal	Poor	
Instream Habitat/ Available Cover	Habitat elements are typically present in greater than 50% of the reach	Stable habitat elements are typically present in 30-50% of the reach and are adequate for maintenance of populations.	Stable habitat elements are typically present in 10-30% of the reach and are adequate for maintenance of populations.	Habitat elements listed above are lacking or are unstable. Habitat elements are typically present in less than 10% of the reach.	CI
Score	1.5	1.2	0.9	0.5	1.50

Stream Impact Assessment Form Page 2

Project #	Applicant	Locality	Cowardin Class.	HUC	Date	Data Point	SAR length	Impact Factor

4. CHANNEL ALTERATION: Stream crossings, riprap, concrete, gabions, or concrete blocks, straightening of channel, channelization, embankments, spoil piles, constrictions, livestock

	Conditional Category						NOTES>>
	Negligible	Minor		Moderate		Severe	
Channel Alteration	Channelization, dredging, alteration, or hardening absent. Stream has an unaltered pattern or has naturalized.	Less than 20% of the stream reach is disrupted by any of the channel alterations listed in the parameter guidelines.	20-40% of the stream reach is disrupted by any of the channel alterations listed in the parameter guidelines.	40 - 60% of reach is disrupted by any of the channel alterations listed in the parameter guidelines. If stream has been channelized, normal stable stream meander pattern has not recovered.	60 - 80% of reach is disrupted by any of the channel alterations listed in the parameter guidelines. If stream has been channelized, normal stable stream meander pattern has not recovered.	Greater than 80% of reach is disrupted by any of the channel alterations listed in the parameter guidelines. AND/OR 80% of banks shored with gabion, riprap, or cement.	
SCORE	1.5	1.3	1.1	0.9	0.7	0.5	

REACH CONDITION INDEX and STREAM CONDITION UNITS FOR THIS REACH	
THE REACH CONDITION INDEX (RCI) >>	1.38
RCI= (Sum of all CI's)/5	
COMPENSATION REQUIREMENT (CR) >>	0
CR = RCI X LF X IF	

NOTE: The CIs and RCI should be rounded to 2 decimal places. The CR should be rounded to a whole number.

INSERT PHOTOS:

DESCRIBE PROPOSED IMPACT:

Identifier:	Kristiansand - 9
Location:	Behind BayLands Federal Credit Union west of Rt. 60

Existing Conditions:

Grassed swales convey runoff from bank into detention basin. An existing pipeline is exposed across the facility.

Potential Improvements:

Improve grassed swales to better promote infiltration. Improvements may include soil amendments and/or installation of check dams. Convert detention basin into a shallow marsh facility. Further review of existing pipeline needed to determine any design implications it may introduce, such as limited wet pool areas.







Identifier:	Kristiansand - 10
Location:	Between Econo Lodge and BayLands Federal Credit Union

Existing Conditions:

Uncontrolled runoff from Rt. 60 causing major erosion downstream of outfall, exposed utilities, and incised channel.

Potential Improvements:

Pending intended use of barren lot adjacent to Econo Lodge, a stormwater management basin could be constructed upstream of existing stream channel. Proposed BMP may be a retention pond or enhanced extended-detention facility, pending detailed design considerations. New BMP construction would require significant grading and adjustment of storm sewer outfall. Stabilize downstream headcut and restore incised portions of stream channel. At a minimum, proper energy dissipation and headcut stabilization required at outfall.





Identifier:	Kristiansand - 11
Location:	Econo Lodge (southeast of parking lot near entrance)
Existing Conditions: Open space adjacent to parking lot. Curb and gutter along parking lot edge.	
Potential Improvements: Install curb cuts and offline bioretention filter within adjacent open area.	





Identifier:	Kristiansand - 12
Location:	Econo Lodge (along southern edge of parking lot)
Existing Conditions: Open space/brush adjacent to parking lot, curb and gutter along parking lot edge.	
Potential Improvements: Install curb cuts and offline bioretention filter within adjacent open area.	





Identifier:	Kristiansand - 13
Location:	Econo Lodge (southwest corner of parking lot near dumpster)
Existing Conditions: Open space/brush adjacent to parking lot, curb and gutter along parking lot edge.	
Potential Improvements: Install curb cuts and offline bioretention filter within adjacent open area.	





Identifier:	Kristiansand - 14
Location:	Econo Lodge (western edge of parking lot near swimming pool)
Existing Conditions: Open space adjacent to parking lot. Curb and gutter along parking lot edge.	
Potential Improvements: Install curb cuts and offline bioretention filter within adjacent open area.	



Identifier:	Kristiansand – 15
Location:	Behind lot northeast of Winterberry Drive cul-de-sac
Existing Conditions: Stream channel close to existing deck, with bank erosion occurring.	
Potential Improvements: Stabilize stream bank along property line, in particular the outside bend at the northeast corner of the parcel.	





Identifier:	Kristiansand - 16
Location:	At end of Pinebrook Rd, north of Winterberry Ct

Existing Conditions:

Existing retention pond with majority of side slopes lined with riprap.

Potential Improvements:

Replace riprap slopes with natural buffer enhancement and aquatic bench. May also consider extending natural buffer zone beyond perimeter fence rather than maintained turf pending authorization from Colonial Heritage. At a minimum, consider the use of additional joint planting throughout riprap if replacement is not feasible. Further review of outlet structure design may also identify potential optimization for enhanced water quality treatment and/or channel protection.





Identifier:	Kristiansand - 17
Location:	Behind houses north of Pinebrook Rd and east of Levingston Ln

Existing Conditions:

Concrete level spreader and filter strip which appears to be functioning well. Some barren areas near treeline.

Potential Improvements:

Install bioretention filter upslope of level spreader. Repair bare spots. Consider the use of natural buffer enhancement downslope rather than just maintained turf.



Identifier:	Kristiansand - 18
Location:	North of Pinebrook Rd, between Newport Forest and Livingston Lon

Existing Conditions:

Concrete level spreader and filter strip which appear to be functioning moderately well, but downslope area is relatively steep with some rills forming. May be too steep/channelized for proper function of filter strip.

Potential Improvements:

Construct bioretention filter upslope of level spreader. Recommend removing level spreader and provide stable conveyance down slope, especially if erosion problems begin to occur. At a minimum, ensure ends of level spreader are fully tied into slopes, repair rills, and consider the use of natural buffer enhancement downslope.







Identifier:	Kristiansand - 19
Location:	West of Pinebrook Rd, between Sandford Arms and Newport Forest
Existing Conditions: Existing dry detention basin.	
Potential Improvements: Convert basin to an enhanced shallow marsh facility. Provide additional upland buffer plantings around buffer perimeter.	



Stream Assessment Form (Form 1)

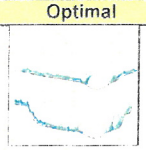
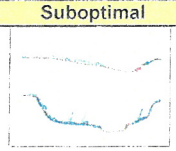
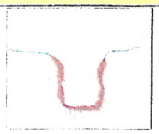
Unified Stream Methodology for use in Virginia

For use in wadeable channels classified as intermittent or perennial

Project #	Project Name	Locality	Cowardin Class.	HUC	Date	SAR #	Impact/SAR length	Impact Factor
3935	Kristiansand	JCC		02060208	5-2-08	7	663	0

Name(s) of Evaluator(s)	Stream Name and Information
sw, br	Tributary to Yarmouth Creek

1. Channel Condition: Assess the cross-section of the stream and prevailing condition (erosion, aggradation)

	Conditional Category					
	Optimal	Suboptimal	Marginal	Poor	Severe	
Channel Condition	 Very little incision or active erosion; 80-100% stable banks. Vegetative surface protection or natural rock, prominent (80-100%). AND/OR Stable point bars/bankfull benches are present. Access to their original floodplain or fully developed wide bankfu	 Slightly incised, few areas of active erosion or unprotected banks. Majority of banks are stable (60-80%). Vegetative protection or natural rock prominent (60-80%) AND/OR Depositional features contribute to stability. The bankfull and low flow channels	 Often incised, but less than Severe or Poor. Banks more stable than Severe or Poor due to lower bank slopes. Erosion may be present on 40-60% of both banks. Vegetative protection on 40-60% of banks. Streambanks may bevertical or undercut. AND/OR 40-60%	 Overwidened/incised. Vertically/laterally unstable. Likely to widen further. Majority of both banks are near vertical. Erosion present on 60-80% of banks. Vegetative protection present on 20-40% of banks, and is insufficient to prevent erosion. AND/OR	 Deeply incised (or excavated), vertical/lateral instability. Severe incision, flow contained within the banks. Streambed below average rooting depth, majority of banks vertical/undercut. Vegetative protection present on less than 20% of banks, is not p	CI
Score	3	2.4	2	1.6	1	2.4
NOTES>>						

2. RIPARIAN BUFFERS: Assess both bank's 100 foot riparian areas along the entire SAR. (rough measurements of length & width may be acceptable)

	Conditional Category						
	Optimal	Suboptimal		Marginal		Poor	
Riparian Buffers	Tree stratum (dbh > 3 inches) present, with > 60% tree canopy cover and a non-maintained understory. Wetlands located within the riparian areas.	**High Suboptimal:** Riparian areas with tree stratum (dbh > 3 inches) present, with 30% to 60% tree canopy cover and containing both herbaceous and shrub layers or a non-maintained understory.	**Low Suboptimal:** Riparian areas with tree stratum (dbh > 3 inches) present, with > 30% tree canopy cover and a maintained understory. Recent cutover (dense vegetation).	**High Marginal:** Non-maintained, dense herbaceous vegetation with either a shrub layer or a tree layer (dbh > 3 inches) present, with <30% tree canopy cover.	**Low Marginal:** Non-maintained, dense herbaceous vegetation, riparian areas lacking shrub and tree stratum, hay production, ponds, open water. If present, tree stratum (dbh >3 inches) present, with <30% tree canopy cover with maintained understory	**High Poor:** Lawns, mowed, and maintained areas, nurseries, no-till cropland, actively grazed pasture, sparsely vegetated non-maintained area, recently seeded and stabilized, or other comparable condition.	**Low Poor:** Impervious surfaces, mine spoil lands, denuded surfaces, row crops, active feed lots, trails, or other comparable conditions.
		High	Low	High	Low	High	Low
Condition Scores	1.5	1.2	1.1	0.85	0.75	0.6	0.5

1. Delineate riparian areas along each stream bank into Condition Categories and Condition Scores using the descriptors.
2. Determine square footage for each by measuring or estimating length and width. Calculators are provided for you below.
3. Enter the % Riparian Area and Score for each riparian category in the blocks below.

Ensure the sums of % Riparian Blocks equal 100

Right Bank	% Riparian Area>	100%						100%	
	Score >	1.5							
								CI= (Sum % RA * Scores*0.01)/2	
Left Bank	% Riparian Area>	80%	20%					100%	Rt Bank CI > 1.50
	Score >	1.5	0.85						Lt Bank CI > 1.37

CI: 1.44

3. INSTREAM HABITAT: Varied substrate sizes, water velocity and depths; woody and leafy debris; stable substrate; low embededness; shade; undercut banks; root mats; SAV; riffle poole complexes, stable features.

NOTES>>

	Conditional Category				
	Optimal	Suboptimal	Marginal	Poor	
Instream Habitat/ Available Cover	Habitat elements are typically present in greater than 50% of the reach.	Stable habitat elements are typically present in 30-50% of the reach and are adequate for maintenance of populations.	Stable habitat elements are typically present in 10-30% of the reach and are adequate for maintenance of populations.	Habitat elements listed above are lacking or are unstable. Habitat elements are typically present in less than 10% of the reach.	CI
Score	1.5	1.2	0.9	0.5	0.90

Stream Impact Assessment Form Page 2

Project #	Applicant	Locality	Cowardin Class.	HUC	Date	Data Point	SAR length	Impact Factor

4. CHANNEL ALTERATION: Stream crossings, riprap, concrete, gabions, or concrete blocks, straightening of channel, channelization, embankments, spoil piles, constrictions, livestock

NOTES>>

	Conditional Category						
	Negligible	Minor		Moderate		Severe	
Channel Alteration	Channelization, dredging, alteration, or hardening absent. Stream has an unaltered pattern or has naturalized.	Less than 20% of the stream reach is disrupted by any of the channel alterations listed in the parameter guidelines	20-40% of the stream reach is disrupted by any of the channel alterations listed in the parameter guidelines	40 - 60% of reach is disrupted by any of the channel alterations listed in the parameter guidelines. If stream has been channelized, normal stable stream meander pattern has not recovered.	60 - 80% of reach is disrupted by any of the channel alterations listed in the parameter guidelines. If stream has been channelized, normal stable stream meander pattern has not recovered.	Greater than 80% of reach is disrupted by any of the channel alterations listed in the parameter guidelines AND/OR 80% of banks shored with gabion, riprap, or cement.	
SCORE	1.5	1.3	1.1	0.9	0.7	0.5	1.50

REACH CONDITION INDEX and STREAM CONDITION UNITS FOR THIS REACH

NOTE: The CIs and RCI should be rounded to 2 decimal places. The CR should be rounded to a whole number.

THE REACH CONDITION INDEX (RCI) >>	1.25
RCI= (Sum of all CI's)/5	
COMPENSATION REQUIREMENT (CR) >>	0
CR = RCI X LF X IF	

INSERT PHOTOS:

DESCRIBE PROPOSED IMPACT:

Stream Assessment Form (Form 1)

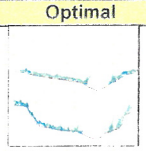
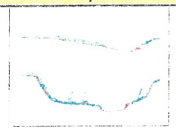
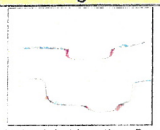
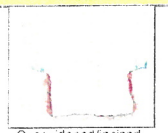
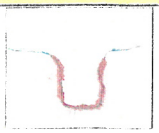
Unified Stream Methodology for use in Virginia

For use in wadeable channels classified as intermittent or perennial

Project #	Project Name	Locality	Cowardin Class.	HUC	Date	SAR #	Impact/SAR length	Impact Factor
3935	Kristiansand	JCC		02060208	5-2-08	8	1276	0

Name(s) of Evaluator(s)	Stream Name and Information
sw, br	Tributary to Yarmouth Creek

1. Channel Condition: Assess the cross-section of the stream and prevailing condition (erosion, aggradation)

	Conditional Category					
	Optimal	Suboptimal	Marginal	Poor	Severe	
Channel Condition	 Very little incision or active erosion; 80-100% stable banks. Vegetative surface protection or natural rock, prominent (80-100%). AND/OR Stable point bars/bankfull benches are present. Access to their original floodplain or fully developed wide bankfu	 Slightly incised, few areas of active erosion or unprotected banks. Majority of banks are stable (60-80%). Vegetative protection or natural rock prominent (60-80%) AND/OR Depositional features contribute to stability. The bankfull and low flow channels	 Often incised, but less than Severe or Poor. Banks more stable than Severe or Poor due to lower bank slopes. Erosion may be present on 40-60% of both banks. Vegetative protection on 40-60% of banks. Streambanks may bevertical or undercut. AND/OR 40-60%	 Overwidened/incised. Vertically/laterally unstable. Likely to widen further. Majority of both banks are near vertical. Erosion present on 60-80% of banks. Vegetative protection present on 20-40% of banks and is insufficient to prevent erosion. AND/OR	 Deeply incised (or excavated), vertical/lateral instability. Severe incision, flow contained within the banks. Streambed below average rooting depth, majority of banks vertical/undercut. Vegetative protection present on less than 20% of banks, is not p	CI
Score	3	2.4	2	1.6	1	2.4
NOTES>>						

2. RIPARIAN BUFFERS: Assess both bank's 100 foot riparian areas along the entire SAR. (rough measurements of length & width may be acceptable)

	Conditional Category						
	Optimal	Suboptimal		Marginal		Poor	
Riparian Buffers	Tree stratum (dbh > 3 inches) present, with > 60% tree canopy cover and a non-maintained understory. Wetlands located within the riparian areas.	**High Suboptimal:** Riparian areas with tree stratum (dbh > 3 inches) present, with 30% to 60% tree canopy cover and containing both herbaceous and shrub layers or a non-maintained understory.	**Low Suboptimal:** Riparian areas with tree stratum (dbh > 3 inches) present, with > 30% tree canopy cover and a maintained understory. Recent cutover (dense vegetation).	**High Marginal:** Non-maintained, dense herbaceous vegetation with either a shrub layer or a tree layer (dbh > 3 inches) present, with <30% tree canopy cover.	**Low Marginal:** Non-maintained, dense herbaceous vegetation, riparian areas lacking shrub and tree stratum, hay production, ponds, open water. If present, tree stratum (dbh >3 inches) present, with <30% tree canopy cover with maintained understory.	**High Poor:** Lawns, mowed, and maintained areas nurseries; no-till cropland; actively grazed pasture, sparsely vegetated, non-maintained area, recently seeded and stabilized, or other comparable condition.	**Low Poor:** Impervious surfaces, mine spoil lands, denuded surfaces, row crops, active feed lots, trails, or other comparable conditions.
		High	Low	High	Low	High	Low
Condition Scores	1.5	1.2	1.1	0.85	0.75	0.6	0.5

1. Delineate riparian areas along each stream bank into Condition Categories and Condition Scores using the descriptors.
2. Determine square footage for each by measuring or estimating length and width. Calculators are provided for you below.
3. Enter the % Riparian Area and Score for each riparian category in the blocks below.

Ensure the sums of % Riparian Blocks equal 100

Right Bank	% Riparian Area>	70%	30%					100%	
	Score >	1.5	0.6						
								CI= (Sum % RA * Scores*0.01)/2	
Left Bank	% Riparian Area>	70%	30%					100%	Rt Bank CI > 1.23 CI
	Score >	1.5	0.6						Lt Bank CI > 1.23 1.23

3. INSTREAM HABITAT: Varied substrate sizes, water velocity and depths; woody and leafy debris; stable substrate; low embededness; shade; undercut banks; root mats; SAV; riffle poole complexes, stable features

NOTES>>

	Conditional Category				
	Optimal	Suboptimal	Marginal	Poor	
Instream Habitat/ Available Cover	Habitat elements are typically present in greater than 50% of the reach.	Stable habitat elements are typically present in 30-50% of the reach and are adequate for populations.	Stable habitat elements are typically present in 10-30% of the reach and are adequate for maintenance of populations.	Habitat elements listed above are lacking or are unstable. Habitat elements are typically present in less than 10% of the reach.	CI
Score	1.5	1.2	0.9	0.5	1.20

Stream Impact Assessment Form Page 2

Project #	Applicant	Locality	Cowardin Class.	HUC	Date	Data Point	SAR length	Impact Factor

4. CHANNEL ALTERATION: Stream crossings, riprap, concrete, gabions, or concrete blocks, straightening of channel, channelization, embankments, spoil piles, constrictions, livestock

culvert and rip rap protection at outfall

	Conditional Category						
	Negligible	Minor		Moderate		Severe	
Channel Alteration	Channelization, dredging, alteration, or hardening absent. Stream has an unaltered pattern or has naturalized.	Less than 20% of the stream reach is disrupted by any of the channel alterations listed in the parameter guidelines.	20-40% of the stream reach is disrupted by any of the channel alterations listed in the parameter guidelines.	40 - 60% of reach is disrupted by any of the channel alterations listed in the parameter guidelines. If stream has been channelized, normal stable stream meander pattern has not recovered.	60 - 80% of reach is disrupted by any of the channel alterations listed in the parameter guidelines. If stream has been channelized, normal stable stream meander pattern has not recovered.	Greater than 80% of reach is disrupted by any of the channel alterations listed in the parameter guidelines AND/OR 80% of banks shored with gabion, riprap, or cement.	
SCORE	1.5	1.3	1.1	0.9	0.7	0.5	1.30

REACH CONDITION INDEX and STREAM CONDITION UNITS FOR THIS REACH

NOTE: The CIs and RCI should be rounded to 2 decimal places. The CR should be rounded to a whole number.

THE REACH CONDITION INDEX (RCI) >>	1.23
RCI= (Sum of all CI's)/5	
COMPENSATION REQUIREMENT (CR) >>	0
CR = RCI X LF X IF	

INSERT PHOTOS:

DESCRIBE PROPOSED IMPACT:

APPENDIX C

Identifier:	Kristiansand - 1
Location:	Go-Karts Plus (southern end of parking lot)
Existing Conditions: Existing curb cut from parking lot into grassed swale.	
Potential Improvements: Install bioretention filter or engineered swale. May be difficult to daylight underdrains.	







Identifier:	Kristiansand - 2
Location:	Go-Karts Plus (overflow parking to the north)
Existing Conditions: Runoff from parking lot discharges via gravel channel to low spot near railroad tracks and adjacent field.	
Potential Improvements: Construct infiltration/bioretention basin or shallow marsh facility, pending further soil evaluation at outfall.	







Identifier:	Kristiansand - 3
Location:	Go-Karts Plus

Existing Conditions:

Overflow from water feature discharges to parking lot. Depending on treatment techniques employed, could be a point source pollution problem. Additional review of facility needed to identify other potential point sources such as fuel and vehicle storage areas.

Potential Improvements:

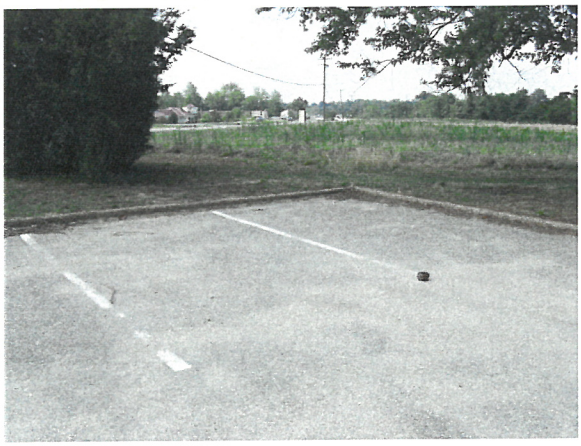
Modify water feature overflow or treatment techniques to avoid discharge of harmful chemicals downstream to surface waters. Employ spill prevention and/or containment measures at any other hot spots onsite.



Identifier:	Kristiansand - 4
Location:	Go-Karts Plus (northern edge of parking lot)
Existing Conditions: Open areas adjacent to curb and gutter along parking lot.	
Potential Improvements: Install curb cuts and offline bioretention filters treating parking lot. May be difficult to daylight underdrains.	









Identifier:	Kristiansand - 5
Location:	Colonial Towne Plaza (southeast of shopping center near Tequila Rose)

Existing Conditions:

Uncontrolled runoff from parking lot draining towards Rt. 60. Some trash present near roadway.

Potential Improvements:

Construct bioretention filter to treat parking lot runoff immediately north of the entrance near Tequila Rose. Biofilter could be installed within the open space adjacent to the Rt. 60 right-of-way. Removal of excess pavement could be considered to increase biofilter size. Likely, a trench drain will need to be installed across the entrance to capture the parking lot runoff. Underdrains could daylight into Rt. 60 ditch. Remove existing trash.





Identifier:	Kristiansand - 6
Location:	Colonial Towne Plaza (southeast of Shopping Center behind Tequila Rose)
Existing Conditions: Uncontrolled runoff from Tequila Rose draining to adjacent open field. Some bare soil in field.	
Potential Improvements: Treat runoff with bioretention filter or level spreader/filter strip. Stabilize any barren areas with permanent seeding and soil amendments (as needed).	



Identifier:	Kristiansand - 7
Location:	Colonial Towne Plaza (northwest of Shopping Center, behind buildings)
Existing Conditions: Bare soils resulting in noticeable sediment discharge during storm events (as observed on 7/8/08) as surface runoff flows across this area.	
Potential Improvements: Provide sufficient erosion stabilization in barren areas (such as minor grading, soil amendments, and matting). Evaluate the need for a conveyance channel adjacent to the existing gravel access road.	



Identifier:	Kristiansand - 8
Location:	Colonial Towne Plaza (northeast of Shopping Center near Antique Mall)

Existing Conditions:

Uncontrolled runoff from much of the parking lot draining into an open area near Rt. 60. There are multiple drop inlets located near Rt. 60 receiving the runoff, one covered with debris and damaged.

Potential Improvements:

Construct a stormwater management basin within the open area between the Shopping Center and the Antique Mall. Repair the existing storm sewer system and modify to accommodate the basin outlet structure. The use of an enhanced extended-detention basin (shallow marsh) or an infiltration/bioretention facility should be explored pending further soil evaluation.









Identifier:	Kristiansand - 20
Location:	Northwest of intersection of Arthur Hills Dr and Pinebrook Rd

Existing Conditions:

Existing detention basin with forebay near intersection and preserved wooded buffer within basin interior.

Potential Improvements:

Enhance the cleared portions of basin (including forebay) with shallow marsh plantings and/or micro-pools. Avoid disturbance of mature trees during retrofit activities.







Identifier:	Kristiansand - 21
Location:	West of Sprucemont
Existing Conditions: Overland flow down grassed slope to riprap check dam at transition to stream. Erosion occurring along slope and at interfaces of riprap berm.	
Potential Improvements: Repair erosion and provide a stabilized flow path down slope. May also be potential to construct biofiltration filter or shallow marsh basin pending further soil review.	







Identifier:	Kristiansand - 22
Location:	North of Arthur Hills Dr, between St Albans and Garden View

Existing Conditions:

Existing dry detention basin, with forebay separated by riprap berm. Some erosion present on bottom of basin.

Potential Improvements:

Maximize the basin area and convert to a wet pond or an enhanced shallow marsh facility. Provide additional upland buffer plantings around basin perimeter. At a minimum, repair erosion areas and construct a more stable pilot channel.







Identifier:	Kristiansand - 23
Location:	North of Valley Green
Existing Conditions: Riprap apron at storm sewer outfall. Appears to be stable.	
Potential Improvements: Construct small stormwater basin (such as a shallow marsh) within apron area for improved water quality treatment.	







Identifier:	Kristiansand – 24
Location:	North of Arthur Hills Dr, between Cliffside Drive and St. Albans
Existing Conditions: Existing drop inlet receiving residential drainage in between multiple lots.	
Potential Improvements: Construct bioretention filter around existing drop inlet.	



Identifier:	Kristiansand - 25
Location:	South of Nina Lane, between Drammon Ct and Sandstad Ct

Existing Conditions:

Existing concrete channel conveying stormwater from roadway to stream. Segments of the channel are damaged and clogged with debris. The ultimate outfall has a significant amount of sediment accumulation upstream of an apparent riprap check dam. Some erosion occurring between riprap and stream channel.

Potential Improvements:

Repair damaged segments of channel and remove debris. Remove and dispose of sediment at channel outfall. Modify outfall and/or extend riprap protection as needed to ensure stable transition to stream channel.







Identifier:	Kristiansand - 26
Location:	South of Nina Lane, between Drammon Ct and Sandstad Ct

Existing Conditions:

Drop inlet conveying roadside drainage to concrete channel between the existing residences.

Potential Improvements:

Install a bioretention filter in the location of the drop inlet which may require a moderate amount of earthwork to construct, but there is ample space. Coordination with the homeowner will be critical.





Identifier:	Kristiansand - 27
Location:	Herstad Ct Cul-de-sac

Existing Conditions:

Stormwater runoff from existing roadways is collected in concrete ditches and transported to this outfall culvert which connects to a manhole in the adjacent property owner's backyard and ultimately to the stream channel.

Potential Improvements:

Remove and dispose of sediment and debris from downstream invert. Modify outfall and/or provide outlet protection as needed to ensure stable transition to stream channel.





Identifier:	Kristiansand - 28
Location:	West of Torea Court, downstream of Retrofit # 29

Existing Conditions:

Shallow swale conveying stormwater runoff through existing woods. Not well defined flowpath and some erosion present within the swale. Headcut formed at confluence with stream channel.

Potential Improvements:

Improve existing swale to better promote infiltration. Improvements may include minor grading, soil amendments, and/or installation of check dams. Repair and stabilize all eroded areas. Provide headcut stabilization.







Identifier:	Kristiansand - 29
Location:	South of Nina Lane, between Kroken Court and Haradd Lane

Existing Conditions:

A culvert outfall from the roadside ditch to an open space parcel behind the existing residences. The precise outfall location could not be determined and may be buried beneath yard waste. Ultimately, the runoff is conveyed into a shallow swale through the existing woods.

Potential Improvements:

Remove any debris blocking culvert outfall and provide adequate outlet protection and/or transition channel. Potential for installation of BMP within the open space parcel, such as a shallow marsh or infiltration/bioretention basin pending further review.





Identifier:	Kristiansand - 30
Location:	Stravenger Ct Cul-de-sac

Existing Conditions:

Existing concrete channel conveying stormwater from roadway to stream. Segments at the channel are damaged and undermined by scour along sides.

Potential Improvements:

Repair damaged segments of channel. Fill back in scour holes and stabilize. Modify outfall and/or provide outlet protection as needed to ensure stable transition to stream channel.





Identifier:	Kristiansand - 31
Location:	West of Haradd Lane before cul-de-sac
Existing Conditions: Erosion noted at outfall of roof downspouts.	
Potential Improvements: Repair/stabilize erosion areas and ensure surface drainage is conveyed down the slope in a stabilized manner (such as slope drains, conveyance channels, or rock chutes).	





Identifier:	Kristiansand - 32
Location:	Corner of Telemark Drive and Rodane Place

Existing Conditions:

Open space parcel leading to stream channel. A substantial amount of yard waste is piled along the treeline near the roadway. Roadway storm sewer discharges to stream at toe of slope. Extensive gully erosion present upslope of outfall and channel erosion downstream. Some debris and sediment clogging part of pipe.

Potential Improvements:

Excavate back from storm sewer outfall and shorten pipe. Install energy dissipation at outfall and repair/stabilize all eroded areas. May be potential to construct small shallow marsh facility between outfall and stream channel, pending earthworks.









Identifier:	Kristiansand - 33
Location:	Western edge of Williamsburg Village

Existing Conditions:

Appears to be a large, shallow dry detention/infiltration facility, but currently under construction. Some sediment accumulation and rill erosion present. Pretreatment swales direct runoff from condos to basin. Drop inlet structure uncovered and clogged with debris. Standing water within riser, and outfall pipe could not be located.

Potential Improvements:

Remove and dispose of accumulated sediment. Install nested bioretention filter within basin area. Potential for compost amended soils and enhanced vegetative cover for improved water quality treatment. Remove debris from drop inlet, locate and remove blockage, replace top of inlet structure, and ensure outfall pipe is properly daylighted. Additional review may yield potential to optimize outlet structure for improved water quality treatment and channel protection.









Identifier:	Kristiansand - 34
Location:	Southern edge of Williamsburg Village
Existing Conditions: Dry detention basin with timber weir wall and perforated pipe outlet.	
Potential Improvements: Convert to an infiltration/bioretention basin or shallow marsh facility pending further soil evaluation. Ensure ends of weir wall are fully tied into slopes.	







Identifier:	Kristiansand - 35
Location:	Between Williamsburg Village and Williamsburg Dodge

Existing Conditions:

Existing wet pond and wetland fringe. Low flow orifice does not have a debris rack, but currently not clogged. Large areas of riprap at inflow points. Some barren areas in uplands.

Potential Improvements:

Install debris rack over low flow orifice. Provide soil amendments and permanent seeding in any barren areas. Provide joint plantings within riprap areas, where appropriate, or replace with vegetated buffer. Evaluate the potential to expand the pond size (may be some room adjacent to parking lot of Williamsburg Dodge) and/or adjust outlet structure to treat other contributing areas than initially designed for. Should also consider installing submerged gabion wall across inflow points to create sediment forebays.





Identifier:	Kristiansand - 36
Location:	Parking lot in rear of Williamsburg Dodge
Existing Conditions: Open area adjacent to parking lot near existing curb inlet.	
Potential Improvements: Construct curb cuts and offline bioretention filter or infiltration trench between parking lot and existing pond.	



Identifier:	Kristiansand - 37
Location:	Between Williamsburg Village and Williamsburg Dodge

Existing Conditions:

Concrete channel receiving flow from Rt. 60 and adjacent development. Channel ultimately outfalls to existing pond discussed in Retrofit #35. A large amount of sediment accumulation is present at bottom of channel, burying what is assumed to be a drop inlet connecting to the pond.

Potential Improvements:

Remove and dispose of accumulated sediment. Construct an offline bioretention filter at end of channel (downslope of drop inlet). Alternately, a pre-treatment sediment forebay could be constructed at the end of the channel and outfall adjusted accordingly. Further evaluation could also be provided to determine the feasibility of replacing the concrete-lined channel with another which better promotes infiltration. This may consist of a grassed swale with soil amendments and check dams (however the longitudinal slope and number of check dams could be problematic).



Identifier:	Kristiansand - 38
Location:	Corner of Norge Office Park

Existing Conditions:

Existing gravel infiltration trench adjacent to parking lot. Some sediment accumulation/bare soil present at inlet to basin. The overflow structure is near level with the basin surface. Another riser is present which appears to contain electrical features, but is not covered.

Potential Improvements:

Remove and dispose of accumulated sediment and ensure inflow to basin is stabilized. Recommend extending overflow structure so that a larger amount of surface ponding is possible before bypassing. Evaluate the additional riser and electrical features to ensure the basin function does not create a concern. A locked cover should be provided over electrical area to prevent tampering (especially considering that children may have played within the basin in the past, as visible in the stone alignment on the overflow structure). Additionally, to improve the aesthetic value of the facility, perimeter landscaping and/or a surface layer of topsoil and vegetative ground cover could be employed. If the basin is to be topdressed, further evaluation of its function should be performed to ensure water quality benefits are not compromised and to determine the new design configuration.





Identifier:	Kristiansand - 39
Location:	Norge Office Park (southeast corner)

Existing Conditions:

Existing gravel infiltration trench adjacent to parking lot. Appears to be functioning well.

Potential Improvements:

To improve the aesthetic value of the facility, perimeter landscaping and/or a surface layer of topsoil and vegetative ground cover could be employed. If the basin is to be topdressed, further evaluation of its function should be performed to ensure water quality benefits are not compromised and to determine the new design configuration (may require an overflow structure).





Identifier:	Kristiansand - 40
Location:	Norge Office Park (northeast corner)

Existing Conditions:

Existing gravel infiltration trench adjacent to parking lot. Appears to be functioning well.

Potential Improvements:

To improve the aesthetic value of the facility, perimeter landscaping and/or a surface layer of topsoil and vegetative ground cover could be employed. If the basin is to be topdressed, further evaluation of its function should be performed to ensure water quality benefits are not compromised and to determine the new design configuration (may require an overflow structure).





Identifier:	Kristiansand - 41
Location:	Shops at Kristiansand, North of Nina Lane

Existing Conditions:

Existing concrete-lined channels and grassed swales receiving runoff from Nina Lane and the Shops at Kristiansand. Some sediment accumulation within concrete channels.

Potential Improvements:

Improve existing channels to better promote infiltration. Improvements may include minor grading, soil amendments, and/or check dams. Remove and dispose of accumulated sediment. Further evaluate the concrete channels to determine if they can be replaced by grassed swales with check dams. Alternately, bioretention filters could be installed within select areas of the swale.





Identifier:	Kristiansand - 42
Location:	Front of Williamsburg Honda
Existing Conditions: Existing infiltration basin between Rt. 60 and parking lot of Williamsburg Honda which appears to be functioning well.	
Potential Improvements: Identified in Yarmouth Creek Watershed Plan (104-R1). Enhance existing basin by adding landscaping and mulch layer to function more like a bioretention facility.	





Identifier:	Kristiansand - 43
Location:	Norge Elementary School (southeast corner of parking lot near Rt. 60

Existing Conditions:

Open area adjacent to parking lot receiving surface runoff from pavement. Some sediment accumulation at edge of parking lot.

Potential Improvements:

Construct a bioretention filter or infiltration trench to treat the parking lot runoff. Remove and dispose of accumulated sediment and configure entrance to biofilter to help prevent future sediment buildup. Stabilized overflow or level spreader needed as biofilter outlet. Cooperation with the school as an educational tool is also recommended. Other retrofits not identified herein may also be feasible at the school pending further evaluation.



Identifier:	Kristiansand - 44
Location:	Norge Elementary School (southern edge of parking lot)

Existing Conditions:

Open area adjacent to parking lot receiving surface runoff from pavement.

Potential Improvements:

Construct bioretention filters, an infiltration trench, or an engineered swale to treat the parking lot runoff. Discharge into proposed Retrofit #43. Cooperation with the school as an educational tool is also recommended. Other retrofits not identified herein may also be feasible at the school pending further evaluation.



Identifier:	Kristiansand - 45
Location:	Norge Elementary School (south behind school, near bend in access road)

Existing Conditions:

Concrete flume conveying roadway runoff into drop inlet.

Potential Improvements:

Construct a bioretention filter around existing drop inlet. Ensure adequate protection at inflow from flume. Tie underdrains of biofilter into existing inlet. Cooperation with the school as an educational tool is also recommended. Other retrofits not identified herein may also be feasible at the school pending further evaluation.



Identifier:	Kristiansand - 46
Location:	Norge Elementary School (within the school grounds)

Existing Conditions:

Multiple drop inlets (some not shown) receiving surface runoff. Building downspouts do not discharge to surface but are piped underground.

Potential Improvements:

Construct bioretention filters around existing drop inlets. Modify building downspouts in these areas to discharge above ground, across a level spreading device and grassed filter strip, and ultimately into the biofilters (similar rooftop disconnection measures may be employed elsewhere onsite). Tie underdrains of biofilters into existing inlets. Cooperation with the school as an educational tool is also recommended. Other retrofits not identified herein may also be feasible at the school pending further evaluation.







Identifier:	Kristiansand - 47
Location:	Norge Elementary School (behind school to the west)

Existing Conditions:

Existing wetland area or shallow BMP surrounded by chain link fence. Appears to be outfall from the school storm sewer system.

Potential Improvements:

Even though this area drains away from the tributary of concern for this study (as may other portions of Norge Elementary School), it could be evaluated for potential retrofits. This area was not reviewed in great detail in this study, but there may be potential for a shallow marsh BMP retrofit, outlet protection, pre-treatment forebay, and/or existing wetland enhancement pending further evaluation.





Identifier:	Kristiansand - 48
Location:	Open field west of development on Rt. 60, immediately north of school

Existing Conditions:

Runoff from commercial areas west of Rt. 60 discharge into existing open field with no defined outfall.

Potential Improvements:

Construct treatment practices downslope of developed areas. May include practices such as level spreaders, filter strips, engineered swales, bioretention filters, or infiltration basins pending further evaluation.



Identifier:	Kristiansand - 49
Location:	Open field west of Motor Lodge on Rt. 60

Existing Conditions:

Runoff from commercial areas west of Rt. 60 discharge into existing open field with no defined outfall.

Potential Improvements:

Construct treatment practices downslope of developed areas. May include practices such as level spreaders, filter strips, engineered swales, bioretention filters, or infiltration basins pending further evaluation.





APPENDIX D

KRISTIANSAND TRIBUTARY PROPERTY

Adjacent Parcel Information

Parcel ID # (PIN)	Federal ID (FID)	Parcel Area (Acres)	Parcel Owner	Mailing Address	
2320100051	77	2.48	FORD, SHARYN	126 RONDANE	PL
2320100051A	64	0.18	JCC	201 HARADD	LN
2320600001A	84	3.41	KRISTIANSAND HOA	208 HARADD	LN
2320600077	83	0.35	HILL, ERIC	101 TELEMARK	DR
2320600104	79	0.44	SCOTT, KRASTON AND SUZANNE	211 HARADD	LN
2320600105	81	--	--	--	
2320600107	75	0.38	DOYLE, AMY	207 HARADD	LN
2320600108	73	0.69	SCHMID, FREDDIE	205 HARADD	LN
2320600109	72	0.66	DUMONT, PAUL & BONNIE	203 HARADD	LN
2320600111	66	0.57	BEAN, DAVID	104 ASTRID	CT
2320600112	60	1.28	VIBRANT LIFE MINISTRIES	103 ASTRID	CT
2320600113	63	0.50	RETAN, RANDALL	101 ASTRID	CT
2320600130	58	1.45	SNYDER, SCOTT & LYNNE	119 HARADD	LN
2320600132	47	0.96	SOLTIS, MARK CHRISTIAN	104 STAVENGER	CT
2320600133	41	1.64	TAINTER, LELAND & BARBARA	105 STAVENGER	CT
2320600134	45	0.79	LEACH, VERNON & DONNA	103 STAVENGER	CT
2320600137	54	1.72	LASSITER, NANCY	104 TOREA	CT
2320600138	55	0.71	CONWAY, TODD & NATALIE	105 TOREA	CT
2320600160	52	0.38	RENAULT, GEORGE & LUCINDA	262 NINA	LN
2320600161	42	0.69	KRIETEMEYER, DONALD & MOLLIE	260 NINA	LN
2320600162	37	1.59	ROCKWELL, STANLEY, JR	258 NINA	LN
2320600163	36	1.19	ROCKWELL, MARION	1 HERSTAD	CT
2320900001C	65	12.44	COLONIAL HERITAGE LLC.	--	
2320900023	40	0.23	HOGANMILLER, ROBERT & BARBARA	4772 WINTERBERRY	CT
2320900024	46	0.29	JACOBI, LESLIE (TRUSTEE)	4776 WINTERBERRY	CT
2320900025	50	0.24	GARDNER, DENNIS (TRUSTEE)	4780 WINTERBERRY	CT
2320900026	49	0.26	HILLARD, ANNE	4775 WINTERBERRY	CT
2320900027	44	0.24	MAROHL, DON & SANDRA	4771 WINTERBERRY	CT
2320900053	51	0.13	BOZSIK, CHARLES & LINDA LEE	7151 PINEBROOK	RD
2320900061	56	0.17	REISACK, JOSEPH & LOUISE	4716 LEVINGSTON	LN
2320900062	59	0.21	ROSZKOWSKI, JOSEPH & KATHERINE	4720 LEVINGSTON	LN
2320900063	62	0.26	ADAMSON, JOHN & JANET	4724 LEVINGSTON	LN
2320900064	57	0.37	MCKENNY, MARILYNN	4723 LEVINGSTON	LN
2320900065	53	0.32	DOBRATZ, DUANE & NOREEN	4719 LEVINGSTON	LN
2320900073	43	0.13	VEASEY, WALTER & GRACE	4716 NEWPORT	FRST
2320900074	39	0.11	KUBA, CAROL	4723 NEWPORT	FRST
2320900075	38	0.11	FRANCIS, MARVIN & JINNETT	4719 NEWPORT	FRST
2320900087	34	0.13	LA BELLE, PATRICE	4719 SANFORD	ARMS
2320900088	35	0.13	DILLON, PAUL & LILLIAN	4721 SANFORD	ARMS
2321000400	80	2.61	WILLIAMSBURG VILLAGE HOA	400 KINDE	CIR
2321000500	82	4.09	WILLIAMSBURG VILLAGE HOA	500 RUSTADS	CIR
2321001200	78	0.79	WILLIAMSBURG VILLAGE, LLC.	1200 RUSTADS	CIR
2321001300	74	0.82	WILLIAMSBURG VILLAGE, LLC.	1300 RUSTADS	CIR
2321001400	71	2.06	WILLIAMSBURG VILLAGE, LLC.	1400 RUSTADS	CIR
2321001500	69	0.77	WILLIAMSBURG VILLAGE, LLC.	1500 RUSTADS	CIR
2321001800	68	1.43	WILLIAMSBURG VILLAGE, LLC.	1800 RUSTADS	CIR
2321001900	67	1.18	WILLIAMSBURG VILLAGE, LLC.	1900 RUSTADS	CIR
2321002000	70	0.28	WILLIAMSBURG VILLAGE, LLC.	2000 RUSTADS	CIR
2340300164	29	1.11	MORSE, COLUMBUS	3 HERSTAD	CT
2340300165	30	0.61	KENDALL, DEBORAH	2 HERSTAD	CT
2340300189	24	1.43	LUNT, DAVID & VALERIE	3 DRAMMEN	CT
2340300190	1	0.52	WALK, LAWRENCE, SR	1 DRAMMEN	CT
2340300193	26	1.65	PINCKNEY, WILLIAM	2 SANDSTAD	CT
2340300194	20	0.91	MOORE, MICHAEL & SIMMONS, IDA	3 SANDSTAD	CT
2340300195	21	0.67	FAHRINGER, DAVID & VICTORIA	1 SANDSTAD	CT
2340300196	28	0.72	FAHRINGER, DAVID & VICTORIA	248 NINA	LN
2340700085	31	0.13	THIR, ALBERT & MARTHA	4715 SANFORD	ARMS
2340700086	32	0.13	FRAIZE, RINALDO & CAROL	4717 SANFORD	ARMS
2340800001A	33	4.38	COLONIAL HERITAGE HOA	--	
2340800009	0	0.11	COLLINS, PHYLLIS (TRUSTEE)	4332 SPRUCEMONT	
2340800010	27	0.12	OSMON, ROBERT	4347 SPRUCEMONT	
2340800011	25	0.14	MAZZEO, ANDREW & MARILYN	4343 SPRUCEMONT	
2340800022	18	0.14	MISTLER, DOUGLAS & CAROL	4320 GARDEN	VW
2340800023	19	0.14	SKINNER, ROBERT, JR & KAREN	4324 GARDEN	VW
2340800024	2	0.13	KALISON, PETER & MARSHA	4340 GARDEN	VW
2340800025	23	0.08	CRIST, RAYMOND & SANDRA	4344 GARDEN	VW
2340800026	22	0.14	CIOPPA, ALFRED, JR & JANET	4341 GARDEN	VW
2341200001A	10	1.07	COLONIAL HERITAGE LLC.	--	
2341200001B	3	8.54	COLONIAL HERITAGE HOA	--	
2341200004	17	0.13	BROWN, WILLIAM, III &RENE	6937 VALLEY	GRN
2341200005	16	0.13	BARTOLICH, JEANNE & EUGENE	6933 VALLEY	GRN
2341200006	15	0.13	MACDONALD, MARY (TRUSTEE)	6929 VALLEY	GRN
2341200007	14	0.13	YUHONG, JUNG & YU, SUNHA	6925 VALLEY	GRN
2341200008	13	0.11	CAVANAUGH, DONALD & JOYCE	6915 VALLEY	GRN
2341200010	12	0.11	JENKINS, ELBERT (TRUSTEE)	6905 VALLEY	GRN
2341200011	11	0.11	MYERS, HARRY, JR. & SHARON	6901 VALLEY	GRN
2341200015	9	0.13	JENNINGS, THOMAS & LINDA	4209 CLIFFSIDE	DR
2341200016	7	0.13	BOYDEN, RICHARD & BENDER, KATHRYN	4205 CLIFFSIDE	DR
2341200018	4	0.16	RIFFER, WILLIAM & CECILIA	6884 ARTHUR HILLS	DR
2341200019	5	0.16	MAROHL, DON & SANDRA	6888 ARTHUR HILLS	DR
2341200020	6	0.19	GORDON, QUINTON & IDELLE	6896 ARTHUR HILLS	DR
2341200021	8	0.31	KIM, PILKYU & BOCKSOON	6900 ARTHUR HILLS	DR
2410100008	76	6.40	DODSON, JOHN	7101 RICHMOND	RD
2410100011	61	2.02	WARE, DAVID	7049 RICHMOND	RD
2410100012	48	3.35	BAYLANDS FEDERAL CREDIT UNION	7031 RICHMOND	RD

*Parcel locations are referenced on the Stream Condition Summary Map via the Parcel Identification Number (PIN)

3935

FILE COPY

L. Preston Bryant, Jr.
Secretary of Natural Resources

Joseph H. Maroon
Director

COMMONWEALTH of VIRGINIA

DEPARTMENT OF CONSERVATION AND RECREATION

217 Governor Street
Richmond, Virginia 23219-2010
(804) 786-7951 FAX (804) 371-2674

June 2, 2008

Stephanie Friend
Williamsburg Environmental Group
5209 Center Street
Williamsburg, VA 23188

Re: JCC - Kristiansand

Dear Ms. Friend:

The Department of Conservation and Recreation's Division of Natural Heritage (DCR) has searched its Biotics Data System for occurrences of natural heritage resources from the area outlined on the submitted map. Natural heritage resources are defined as the habitat of rare, threatened, or endangered plant and animal species, unique or exemplary natural communities, and significant geologic formations.

According to the information currently in our files there is potential for the Virginia least trillium (*Trillium pusillum* var. *virginianum*, G3T2/S2/SOC/NL) to be within the project limits. Virginia least trillium is a state rare perennial herb that primarily inhabits somewhat acidic, moist to saturated soils, although it does not grow in standing water. The plant is most often found on the margins of swamps, on high spots within swamps or in ground-water seepage areas. Direct destruction of individuals, loss of habitat, and alterations of water quality are the primary threats to this species (Clark and Potter, 1995). This herb species blooms from late March to May (Radford et. al., 1968). Please note that this species is currently tracked as a species of concern by the United States Fish and Wildlife Service (USFWS), however this designation has no official legal status.

Due to the potential for this site to support populations of this natural heritage resource, DCR recommends an inventory for the resource in the study area. With the survey results we can more accurately evaluate potential impacts to natural heritage resources and offer specific protection recommendations for minimizing impacts to the documented resources.

Under a Memorandum of Agreement established between the Virginia Department of Agriculture and Consumer Services (VDACS) and the Virginia Department of Conservation and Recreation (DCR), DCR represents VDACS in comments regarding potential impacts on state-listed threatened and endangered plant and insect species. The current activity will not affect any documented state-listed plants or insects.

In addition, our files do not indicate the presence of any State Natural Area Preserves under DCR's jurisdiction in the project vicinity.

New and updated information is continually added to Biotics. Please contact DCR for an update on this natural heritage information if a significant amount of time passes before it is utilized.

A fee of $125.00 has been assessed for the service of providing this information. Please find enclosed an invoice for that amount. Please return one copy of the invoice along with your remittance made payable to the Treasurer of Virginia, Department of Conservation and Recreation, 203 Governor Street, Suite 423D, Richmond, VA 23219, ATTN: Cashier. Payment is due within thirty days of the invoice date. Please note late payment may result in the suspension of project review service for future projects.

The Virginia Department of Game and Inland Fisheries maintains a database of wildlife locations, including threatened and endangered species, trout streams, and anadromous fish waters, which may contain information not documented in this letter. Their database may be accessed from http://www.dgif.virginia.gov/wildlife/info_map/index.html , or contact Shirl Dressler at (804) 367-6913.

Should you have any questions or concerns, feel free to contact me at (804) 692-0984. Thank you for the opportunity to comment on this project.

Sincerely,

Kristal McKelvey

Kristal McKelvey
Coastal Zone Locality Liaison

Cc: Tylan Dean, USFWS

Literature Cited

Clark, K.H. and J.L. Potter. 1995. North Landing River Natural Area Preserve Resource Management Plan, First Edition. Natural Heritage Technical Document 95-9. Virginia Department of Conservation and Recreation, Richmond, Virginia. February 1995.

Radford, A.E., H.A. Ahles, C.R. Bell. 1968. Manual of the Vascular Flora of the Carolinas. University of North Carolina Press, Chapel Hill. p. 292

Virginia Department of Game and Inland Fisheries

5/8/2008 2:41:12 PM

Fish and Wildlife Information Service

VaFWIS Search Report Compiled on 5/8/2008, 2:41:12 PM

Help

Known or likely to occur within a **2 mile radius of 37,21,26. 76,46,20.**

in **095 James City County, 199 York County, VA**

496 Known or Likely Species ordered by Status Concern for Conservation
(displaying first 46) (46 species with Status* or Tier I**)

BOVA Code	Status*	Tier**	Common Name	Scientific Name	Confirmed	Database(s)
030074	FESE		Turtle, Kemp's (= Atlantic) Ridley sea	Lepidochelys kempii		BOVA
030071	FTST	I	Turtle, loggerhead sea	Caretta caretta		BOVA
040120	FTST	I	Plover, piping	Charadrius melodus		BOVA
020052	SE	II	Salamander, eastern tiger	Ambystoma tigrinum tigrinum		BOVA
030013	SE	II	Rattlesnake, canebrake	Crotalus horridus		BOVA
040096	ST	I	Falcon, peregrine	Falco peregrinus	Yes	CBC,BOVA
040129	ST	I	Sandpiper, upland	Bartramia longicauda		BOVA
040293	ST	I	Shrike, loggerhead	Lanius ludovicianus	Yes	CBC,BOVA
020044	ST	II	Salamander, Mabee's	Ambystoma mabeei		BOVA
020002	ST	II	Treefrog, barking	Hyla gratiosa		BOVA
040093	ST	II	Eagle, bald	Haliaeetus leucocephalus	Yes	BBA,CBC,BOVA
040292	FSST		Shrike, migrant loggerhead	Lanius ludovicianus migrans		BOVA
040110	FS	I	Rail, black	Laterallus jamaicensis		BOVA
010032	FSSS	II	Sturgeon, Atlantic	Acipenser oxyrinchus		BOVA
030067	FSCC	II	Terrapin, northern diamond-backed	Malaclemys terrapin terrapin		BOVA
040320	FS	II	Warbler, cerulean	Dendroica cerulea		BOVA
100001	FS	IV	fritillary, Diana	Speyeria diana		BOVA
010077	SS	I	Shiner, bridle	Notropis bifrenatus		BOVA

040029	SS	II	Heron, little blue	Egretta caerulea caerulea		BOVA
040381	SS	II	Sparrow, saltmarsh sharp-tailed	Ammodramus caudacutus		BOVA
040186	SS	II	Tern, least	Sterna antillarum		BOVA
040266	SS	II	Wren, winter	Troglodytes troglodytes	Yes	CBC,BOVA
030063	CC	III	Turtle, spotted	Clemmys guttata		BOVA
040094	SS	III	Harrier, northern	Circus cyaneus	Yes	CBC,BOVA
040034	SS	III	Heron, tricolored	Egretta tricolor		BOVA
040040	SS	III	Ibis, glossy	Plegadis falcinellus		BOVA
040036	SS	III	Night-heron, yellow-crowned	Nyctanassa violacea violacea		BOVA
040204	SS	III	Owl, barn	Tyto alba pratincola		BOVA
040270	SS	III	Wren, sedge	Cistothorus platensis		BOVA
040264	SS	IV	Creeper, brown	Certhia americana	Yes	CBC,BOVA
040180	SS	IV	Tern, Forster's	Sterna forsteri	Yes	CBC,BOVA
040364	SS		Dickcissel	Spiza americana		BOVA
040032	SS		Egret, great	Ardea alba egretta	Yes	CBC,BOVA
040366	SS		Finch, purple	Carpodacus purpureus	Yes	CBC,BOVA
040285	SS		Kinglet, golden-crowned	Regulus satrapa	Yes	CBC,BOVA
040112	SS		Moorhen, common	Gallinula chloropus cachinnans		BOVA
040262	SS		Nuthatch, red-breasted	Sitta canadensis	Yes	CBC,BOVA
040020	SS		Pelican, brown	Pelecanus occidentalis carolinensis		BOVA
040189	SS		Tern, Caspian	Sterna caspia	Yes	CBC,BOVA
040188	SS		Tern, sandwich	Sterna sandvicensis acuflavidus		BOVA
040278	SS		Thrush, hermit	Catharus guttatus	Yes	CBC,BOVA
040314	SS		Warbler, magnolia	Dendroica magnolia		BOVA
050110	SS		Mole, star-nosed	Condylura cristata parva		BOVA
050045	SS		Otter, northern river	Lontra canadensis lataxina		BOVA
040225		I	Sapsucker, yellow-	Sphyrapicus varius	Yes	CBC,BOVA

			bellied			
040319		I	Warbler, black-throated green	Dendroica virens		BOVA

To view **All 496 species** View 496

* FE=Federal Endangered; FT=Federal Threatened; SE=State Endangered; ST=State Threatened; FP=Federal Proposed; FC=Federal Candidate; FS=Federal Species of Concern; SC=State Candidate; CC=Collection Concern; SS=State Special Concern

** I=VA Wildlife Action Plan - Tier I - Critical Conservation Need; II=VA Wildlife Action Plan - Tier II - Very High Conservation Need; III=VA Wildlife Action Plan - Tier III - High Conservation Need; IV=VA Wildlife Action Plan - Tier IV - Moderate Conservation Need

View Map of All Query Results from All Observation Tables

Anadromous Fish Use Streams

N/A

Fish Impediments (3 records) View Map of All Fish Impediments

ID	Name	River	View Map
603	BEECHWOOD DAM	FRANCE SWAMP	Yes
805	DEER LAKE DAM	TR-YARMOUTH CK	Yes
602	OLD MILL POND DAM	SKIMINO CREEK	Yes

Colonial Water Bird Survey

N/A

Threatened and Endangered Waters

N/A

Cold Water Stream Survey (Trout Streams)
Summary of Recent Observations

N/A

Scientific Collections

Scientific Collections

Collection	Date Collected	Collector	Collection Species			View Map
			Different Species	Highest TE*	Highest Tier**	
40623	Oct 16 2001	Greenlee, DMC, Paul, Karen	16		IV	Yes
40667	Oct 16 2001	Greenlee, DMC, Paul, Karen	6		IV	Yes
64600	Jul 10 2000	RUSS BENEDICT (PRINCIPLE PERMITTEE)	3			Yes
64599	Jul 8 2000	RUSS BENEDICT (PRINCIPLE PERMITTEE)	1			Yes
40613	Sep 16 1996	ADAMS, GONZALES	6			Yes
17766	Jan 1 1900		1			Yes
18138	Jan 1 1900		1			Yes
19250	Jan 1 1900		1			Yes
19341	Jan 1 1900		1			Yes
25513	Jan 1 1900		1			Yes
25543	Jan 1 1900		1			Yes
25579	Jan 1 1900		1			Yes
28238	Jan 1 1900	Mitchell, J. C.	1			Yes

Biologist Observations

N/A

Virginia Breeding Bird Atlas Blocks (4 records)

View Map of All Query Results
Virginia Breeding Bird Atlas Blocks

BBA ID	Atlas Quadrangle Block Name	Breeding Bird Atlas Species			View Map
		Different Species	Highest TE*	Highest Tier**	
56074	Norge, CE	3			Yes
56072	Norge, NE	2			Yes
56086	Toano, SE	38		III	Yes
57071	Williamsburg, NW	1	ST	II	Yes

USFWS Breeding Bird Survey Routes

N/A

Christmas Bird Count Survey (1 records)

View Map of All Query Results
Christmas Bird Count Survey

CBC ID	Survey Name	Christmas Bird Count Species			View Map
		Different Species	Highest TE*	Highest Tier**	
880020	Williamsburg	144	ST	I	Yes

Public Holdings:

N/A

USGS 7.5' Quadrangles:
Norge
Toano
Williamsburg
Gressitt

Va. NRCS Watersheds:
UPPER YORK RIVER/POROPOTANK RIVER/QUEEN CREEK/WARE CREEK
LOWER CHICKAHOMINY RIVER/MORRIS CREEK/LOWER DIASCUND CREEK
JAMES RIVER/POWHATAN CREEK/GRAYS CREEK

audit no. 178059 5/8/2008 2:41:13 PM Virginia Fish and Wildlife Information Service

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Define Point of Interest

37,21,26.0 -76,46,20.0
is the Search Point

Submit | Cancel

Search Point

- **Change** to "clicked" map point
- **Fixed** at 37,21,26.0 - 76,46,20.0

Show Position Rings

- Yes
- No

1 mile and 1/4 mile at the **Search Point**

Show Search Area

- Yes
- No

2 miles

Search Point is at map center

Base Map Choices
Topography

Map Overlay Choices
Current List: Position, Search

Map Overlay Legend

Position Rings 1 mile and 1 4 mile at the Search Point

2 mile radius Search Area

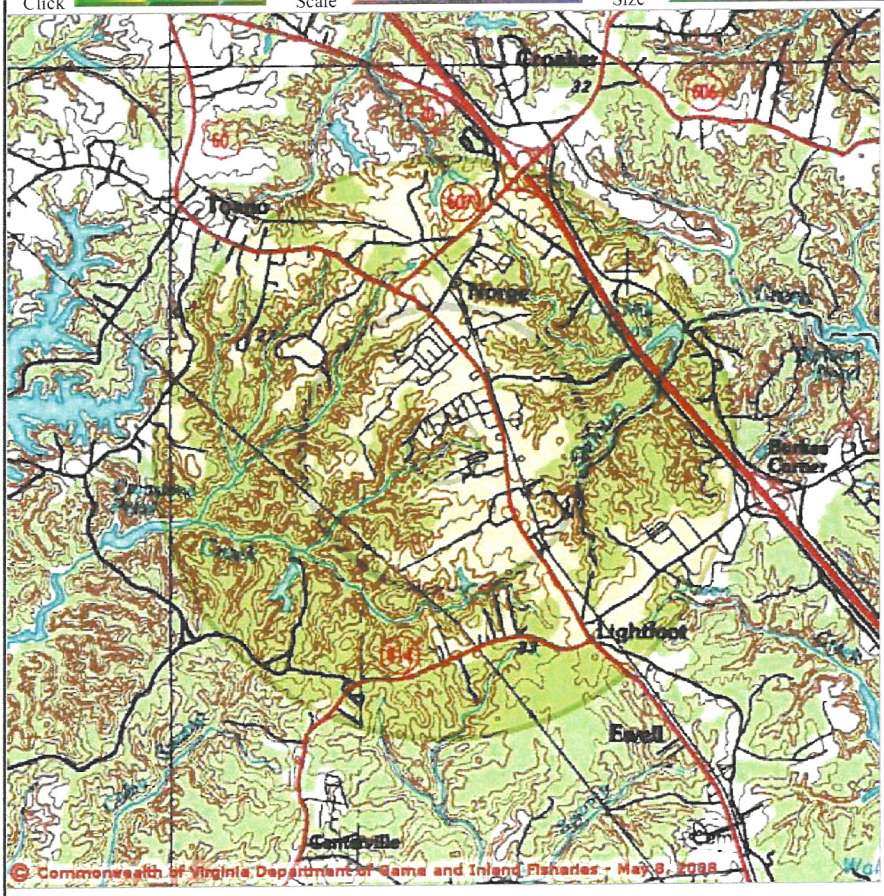
Refresh Browser Page

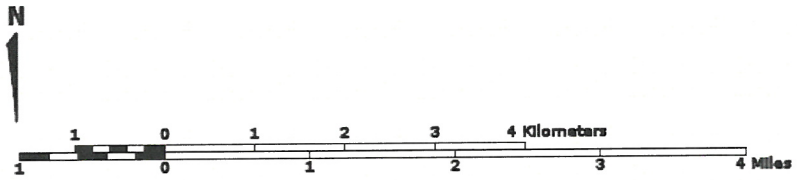
Map Click: Pan

Map Scale: In Zoom Out

Screen Size: Small Size Big

Help





Point of Search 37,21,26.0 -76,46,20.0
Map Location 37,21,26.0 -76,46,20.0

Select **Coordinate System:**

- Degrees,Minutes,Seconds Latitude - Longitude
- Decimal Degrees Latitude - Longitude
- Meters UTM NAD83 East North Zone
- Meters UTM NAD27 East North Zone

Base Map source: USGS 1:100,000 topographic maps (see terraserver-usa.com for details)

Map projection is UTM Zone 18 NAD 1983 with left 338263 and top 4140789. Pixel size is 16 meters . Coordinates displayed are Degrees, Minutes, Seconds North and West.Map is currently displayed as 600 columns by 600 rows for a total of 360000 pixles. The map display represents 9600 meters east to west by 9600 meters north to south for a total of 92.16 square kilometers. The map display represents 31501 feet east to west by 31501 feet north to south for a total of 35.59 square miles.

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map assembled 2008-05-08 14:38:47 (qa/qc May 8, 2008 13 10 - tn=178059 dist=3218 I)

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CBC Williamsburg

37,21,26.0 -76,46,20.0
is **the Search Point**

Display **Item Location** is not in center at map center

Show Position Rings

○ Yes ○ No

1 mile and 1/4 mile at the **Search Point**

Show Search Area

○ Yes ○ No

2 miles

Search Point is at map center

Base Map Choices

Topography

Map Overlay Choices

Current List: Search, Observation

Map Overlay Legend

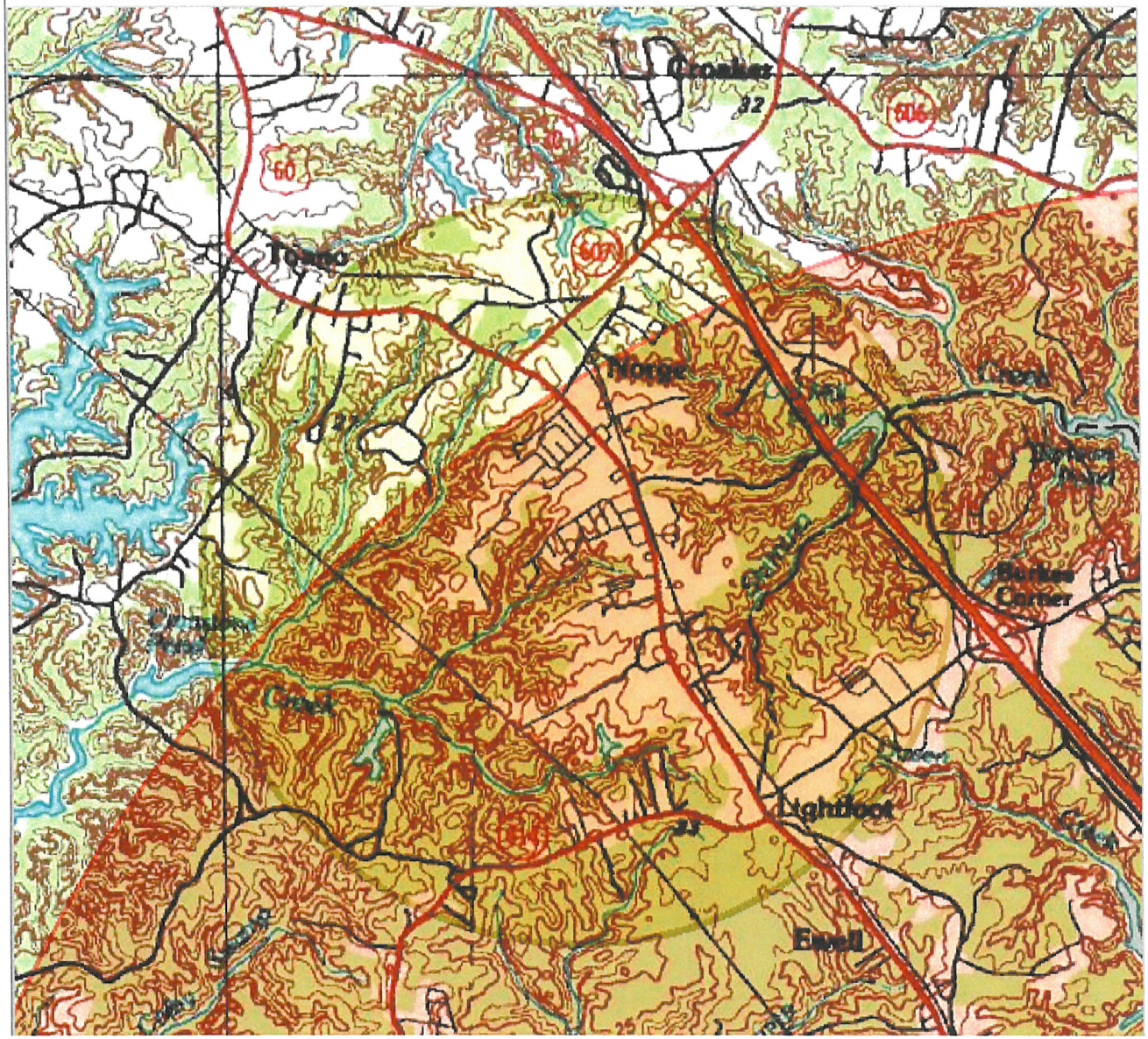
2 mile radius Search Area

Data Collection Site

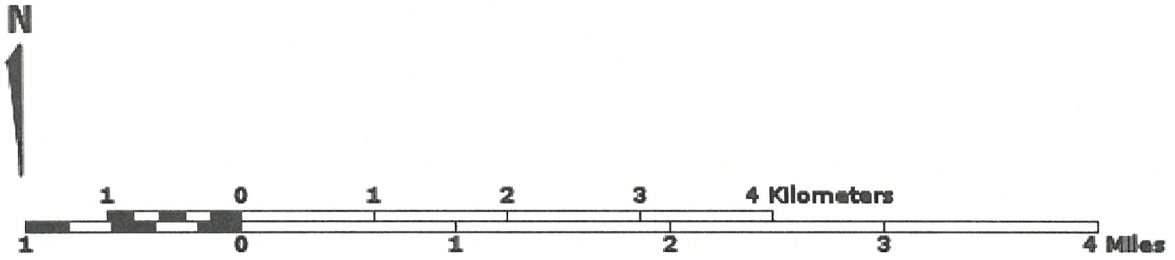
Virginia Fish and Wildlife Information Serv

Refresh Browser Page

Map Click Pan Id M Map Scale In Zoom Out Screen Size Small Size Big Help







Point of Search 37,21,26.0 -76,46,20.0

Map Location 37,21,26.0 -76,46,20.0

Select **Coordinate System:**

- ○ Degrees,Minutes,Seconds Latitude - Longitude
- ○ Decimal Degrees Latitude - Longitude
- ○ Meters UTM NAD83 East North Zone
- ○ Meters UTM NAD27 East North Zone

Base Map source: USGS 1:100,000 topographic maps (see terraserver-usa.com for details)

Map projection is UTM Zone 18 NAD 1983 with left 338262 and top 4140790. Pixel size is 16 meters . Coordinates displayed are Degrees, Minutes, Seconds North and West.Map is currently displayed as 600 columns by 600 rows for a total of 360000 pixles. The map display represents 9600 meters east to west by 9600 meters north to south for a total of 92.1 square kilometers. The map display represents 31501 feet east to west by 31501 feet north to south for a total of 35.5 square miles.

Black and white aerial photography aquired near 1990 and topographic maps are from the United States Department of the Interior, United States Geological Survey.
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map assembled 2008-07-25 16:28:44 (qa/qc May 21, 2008 10 49 - tn=192861.2 dist=3218 I)

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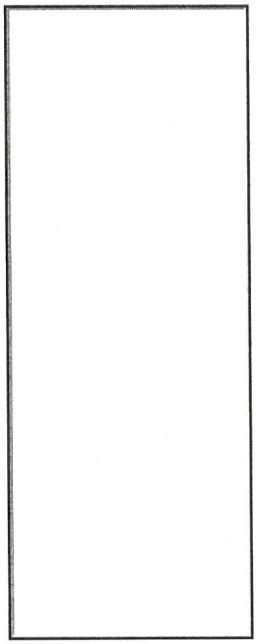

3935

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JUL 01 2008

WEG

COMMONWEALTH of VIRGINIA

Department of Historic Resources

L. Preston Bryant, Jr.
Secretary of Natural Resources

2801 Kensington Avenue, Richmond, Virginia 23221

Kathleen S. Kilpatrick
Director

Tel: (804) 367-2323
Fax: (804) 367-2391
TDD: (804) 367-2386
www.dhr.virginia.gov

June 30, 2008

Matt McWhorter
Williamsburg Environmental Group
5209 Center Street
Williamsburg, VA 23188

RE: Detailed Archives Search
Kristiansand

Dear Mr. McWhorter:

Thank you for your recent request for information from our Archives on previously recorded archaeological and architectural resources within the area of potential effect, as delineated on your map, for the above-referenced project. Please note that your request for information from the Department of Historic Resources (DHR) Archives concerning the location of historic resources does not relieve you or your client from possible obligations under state or federal historic preservation regulations. I strongly recommend that you contact Marc Holma, Manager, DHR's Resource Services and Review Division at (804) 367-2323, extension 114, if you have any questions concerning state and federal regulatory requirements.

Enclosed are the maps showing the locations of any archaeological or architectural resources previously recorded at DHR. Since no sites or structures were found to have been previously identified in your project area, no records were copied for inclusion in this packet.

DHR serves as the official state repository on historic resources. This information has been compiled primarily by independent cultural resource consultants. DHR makes no warranty as to the fitness of the data for any purpose. The absence of historic resources in DHR records does not necessarily mean that no historic properties are present. It is advisable to check with local government planning offices for information on any properties that may meet the age and significance tests of the National Register criteria and have not yet been recorded in the DHR Archives. Also, the area in question may not have been systematically surveyed for resources, possibly necessitating a survey and submittal of that data with your Project Review application.

Please contact me at (804) 367-2323, extension 125, if I can be of further assistance.

Sincerely,

Dewey Wellford

Ann Drury Wellford
Archives - DHR

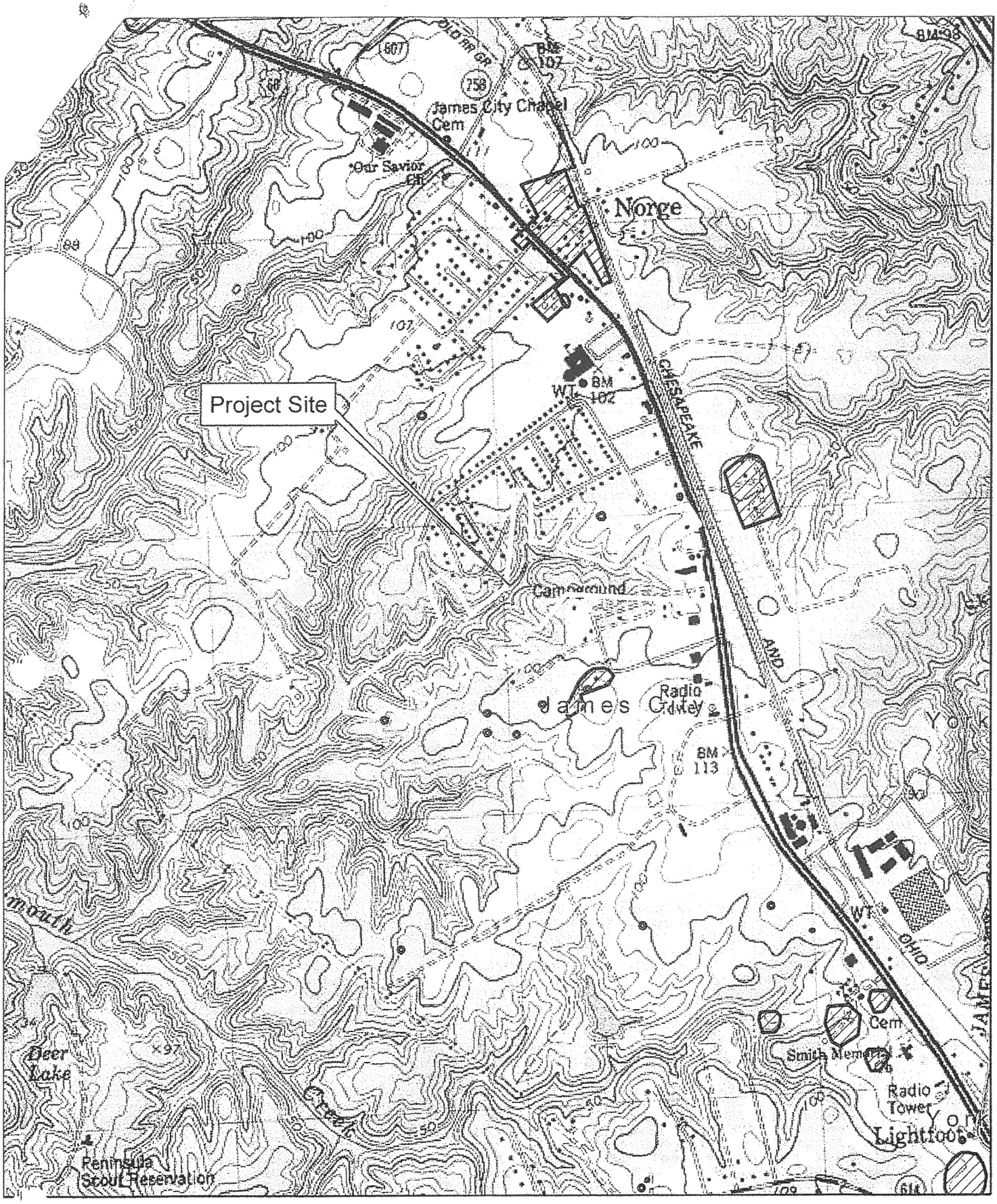
Administrative Services
10 Courthouse Ave.
Petersburg, VA 23803
Tel: (804) 863-1624
Fax: (804) 862-6196

Capital Region Office
2801 Kensington Office
Richmond, VA 23221
Tel: (804) 367-2323
Fax: (804) 367-2391

Tidewater Region Office
14415 Old Courthouse Way
2nd Floor
Newport News, VA 23608
Tel: (757) 886-2807
Fax: (757) 886-2808

Roanoke Region Office
1030 Pennar Avenue, SE
Roanoke, VA 24013
Tel: (540) 857-7585
Fax: (540) 857-7588

Winchester Region Office
107 N. Kent Street, Suite 203
Winchester, VA 22601
Tel: (540) 722-3427
Fax: (540) 722-7535



Kristiansand
Williamsburg Environmental Group
Norge Quad/James City County
06/30/2008
Drury Wellford/VDHR

0 0.125 0.25 0.5 Miles

Archaeological Sites
Architectural Resources

Data Sources: VDHR 2006, National Geographic 2003, VGIN 2002

APPENDIX E

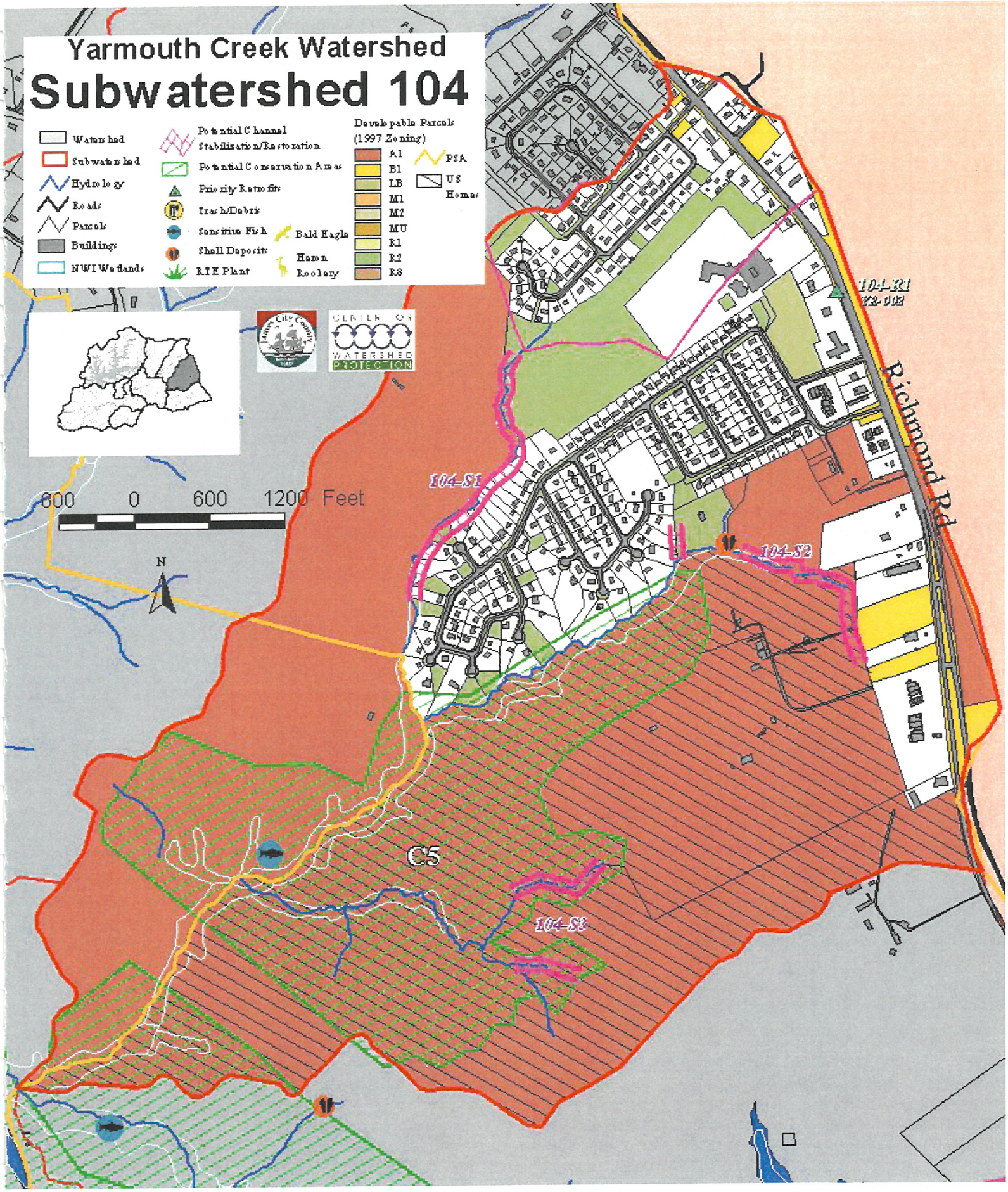
KRISTIANSAND TRIBUTARY
Preliminary Stream Cost Opinion

Activity	Amount	Cost per	Total
Design Phase			
Detailed Delineation and Confirmation	1	$2,350	$2,350
Permitting	1	$6,500	$6,500
Landowner Coordination	1	$10,000	$10,000
Survey Fieldwork/Design	1	$15,000	$15,000
Construction Plans	1	$20,000	$20,000
Bid Support/Specs	1	$5,000	$5,000
Construction Phase			
Contractor Oversight	1	$15,000	$15,000
Stream Enhancement (LF)	1,186	$125	$148,250
Stream Restoration (LF)	194	$175	$33,950
Replanting (Approximate Acres)	1.6	$7,000	$11,088
Monitoring and Reporting Phase			
As-built	1	$6,000	$6,000
Monitoring (Years)	3	$5,200	$15,600
Sub Total			**$288,738**
20% contingency			$57,748
Project Total			**$346,486**
Per Linear Foot (1,380 LF)			$245

NOTE: All values are approximate, subject to change, and based on preliminary site analyses in absence of detailed inventories and design.

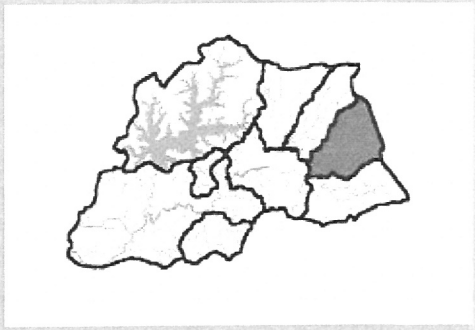
NOTE: Proposed BMP retrofits are not included in the Stream Cost Opinion.

APPENDIX F


Yarmouth Creek Watershed
Subwatershed 104
Watershed
Subwatershed
Hydrology
Roads
Parcels
Buildings
NWI Wetlands
Potential Channel Stabilization/Restoration
Potential Conservation Areas
Priority Retrofits
Trash/Debris
Sensitive Fish
Shell Deposits
RTE Plant
Bald Eagle
Heron Rookery
Developable Parcels (1997 Zoning)
A1
B1
LB
M1
M2
MU
R1
R2
RS
PSA
US Homes
104-R1
104-R2
104-S1
104-S2
104-S3
C5
Richmond Rd
600 0 600 1200 Feet
N

Subwatershed 104

Overall Characterization



Subwatershed 104 is currently in the SENSITIVE category at 9.0% impervious cover and under the current zoning was projected to have a buildout imperviousness of 11.6%, which would shift its classification to IMPACTED. Recently, a significant portion of the subwatershed was rezoned from agricultural to residential, which shifted the future impervious cover projection to 19.3%. Currently, the subwatershed is moderately developed with residential and commercial areas in the upper portion. The upper western tributary has been impacted by uncontrolled stormwater from an older residential development, and the stream appears to be straightening as well as carrying a an excess sediment load. The eastern and lower portions of the subwatershed have excellent stream conditions. A fish survey below the confluence of the two upper tributaries showed eight fish species including the sensitive brook lamprey. Good quality floodplain forest exists here as well as the shell-marl ravine forest, though the shell areas have been affected by the spread of invasive Nepal microstegium associated with the sewer line. Upland areas may provide habitat for the rare small whorled pogonia, which was recently located in this subwatershed by Williamsburg Environmental Group. This area contains relatively mature contiguous forest.

General Characteristics

Drainage Area	860 acres
Length of Mapped Streams	3.78 miles

Current Land Use and Stream Classification in Subwatershed 104

1996 Impervious Cover	9.0%
Initial Stream Classification	Sensitive
Current Stream Condition	Good

Future Land Use and Stream Classification in Subwatershed 104

Buildout Impervious Cover	19.3%
Projected Stream Classification	Impacted
Developable Area	573.6 acres
Developable Area %	67%

Conservation Areas in Subwatershed 104

Existing RPA wetland area	24 acres
Existing RPA wetland %	3%

Contiguous Forest Yes, 200 acre forested plot

Presence of RTE species: A small whorled pogonia population is located in the uplands and there are shell deposits indicative of the shell-marl ravine forest located in the upper watershed. Conditions in the eastern tributary are affected by the invasive Nepal microstegium.

Wetlands (from NWI): 42.7 acres of wetlands (5% of subwatershed), mostly riparian. High quality wetlands associated with the floodplain occur along with beaver dams in the lower portions of the subwatershed.

Other Conservation Areas: None found

Table 104-1. Priority Conservation Areas in Subwatershed 104

Rank	ID	Approx. Area* (acres)		Description	Score	Management Recommendations
		Total	Developable			
5 out of 8	C5	190	140	Subwatershed 104; sensitive stream, contiguous forest, shell-marl	54	Targeted for development; RPA protection for all first order streams, BSD

*These are approximate areas calculated using GIS and rounded to the nearest tenth. Total area represents the total acreage within the conservation area boundary. The developable area within those conservation areas was calculated by subtracting unbuildable land and built-out land from the total area. Unbuildable land included the NWI wetlands, open water, the existing RPAs (not including RPA buffer), stream valleys (a 100-foot buffer on either side of all streams), and slopes greater than 25% (derived from 5-foot contour lines). Because this estimate was based on limited data and certain assumptions were made about how to estimate this area, it should only be used as a planning tool only and not as an actual guide for development.

General Stream Conditions in Subwatershed 104

Habitat Assessment: The upper western tributary has been impacted by uncontrolled stormwater from residential development, and the stream appears to be straightening as well as carrying a large sediment load. The eastern and lower portions of the subwatershed have good stream conditions. A fish survey below the confluence of the two upper tributaries showed eight fish species including the sensitive brook lamprey.

Stormwater Management in Subwatershed 104

There is an opportunity to retrofit the development on the western tributary to provide channel protection and limit downstream impacts of stormwater runoff. Another opportunity for stormwater retrofitting may be to expand the capacity of an infiltration basin to provide more storage.

Table 104-2. Retrofit Opportunities in Subwatershed 104

ID	Facility Type	Description	Comments	Priority
104-R1	Infiltration Basin	Consider adding bioretention elements to enhance the facility. Mulch the base of the facility, and incorporate a variety of plants.	This facility is currently recorded as a dry pond.	Low

Stream Restoration/ Channel Stabilization in Subwatershed 104

There is the potential for several stream stabilization and one potential stream restoration project in Subwatershed 104. The stream restoration project is associated with the degraded western tributary. However the source of the stormwater that is degrading the channel is undetermined. Treatment of the stormwater prior to restoration should be a prerequisite for this project. The bioengineering concept for the restoration project is located in Section 3 Watershed Recommendations. Descriptions of the potential channel stabilization projects are located in Table 104-3.

Table 104-3. Stream Restoration/ Channel Stabilization Opportunities in Subwatershed 104

Site	Description	Type of Effort	Priority
104-S1	Reach of stream adjacent to the west side of the Kristansand neighborhood in Subwatershed 104	Stream restoration -Should be combined with a retrofit, habitat and stability should be restoration goals.	Medium
104-S2	Two reaches on the south side of Kristansand neighborhood experiencing streambank erosion and headcutting	Channel stabilization	Medium
104-S3	Two small headwater channels with active headcuts in subwatershed 104 downstream of the proposed US Homes development	Channel stabilization	Medium