FIGURES

TABLES

APPENDICES

SECTION 12. STORMWATER MANAGEMENT

As determined during the pre-application meeting, Bangor Hydro-Electric Company (BHE) is providing a separate stormwater management analysis for the utility line corridor and any associated temporary access roads, and the modifications to the Orrington Substation. Stormwater management for the utility line corridor and associated temporary access roads is discussed in section 12.A. and stormwater management for the modifications to the Orrington Substation is discussed in Sections 12.C through 12.G below.

12.A Utility Line Corridor

This section addresses stormwater management for the utility line corridor and associated access roads. The proposed Northeast Reliability Interconnect (NRI) project does not cross any lake, coastal wetlands, or stream watersheds that are listed in Chapter 502 of Maine Department of Environmental Protection (DEP) Regulations as “Most at Risk from Development”. The project crosses portions of the Penobscot, Union, Narraguagus, Machias, East Machias, and St. Croix River watersheds. A location map of the proposed alignment is presented as Figure 1-1 in Section 1, Development Description. A summary table of the waterbodies crossed by the project (including perennial and intermittent waterbodies) is provided in Appendix 7-4 of Section 7, Wildlife and Fisheries.

The NRI has been designed to minimize potential impacts to the environment and, with the exception of the transmission line structures (poles), there will be no permanent conversion of vegetated areas to impervious surfaces along the corridor. Specifically, as described more fully in Section 1, clearing of the right-of-way (ROW) will require the removal of overstory species (trees and woody vegetation), as necessary to allow placement of pole structures and ensure adequate clearance between any vegetation and the conductors. The removal of understory vegetation and ground cover will be required only as needed to install a structure. In addition, restoration activities following construction are designed to restore site contours to pre-construction conditions and areas disturbed during construction will be revegetated as discussed in Section 14, Erosion and Sedimentation Control. Thus, of the four factors affecting runoff and infiltration (climate, topography, soil characteristics, and vegetative cover types), the only factor affected by the construction of the transmission line ROW is the vegetative cover type. Generally, the conversion of a forest cover to a scrub-shrub or early successional cover type (for example, graminoid species) within a transmission line ROW will improve the ability of the land to absorb runoff due to the increased density of the root mass associated with the resultant vegetative cover. Non-wooded cover types will generally remain the same as pre-development cover types. A detailed summary of the cover types crossed by the project ROW is presented in Section 7.

Detailed drawings of the proposed project are provided on the project Plan and Profile drawings (scale: 1 inch = 200 feet) provided as part of this application. These drawings show the plan view with an aerial photograph background and profile view (topography) of the transmission line route with proposed structure locations, affected ground area, locations where site work will be conducted, wetlands, waterbodies, landowner and political boundaries.

Because the transmission line ROW will remain vegetated, there will be no significant change in stormwater runoff characteristics (peak discharge rates), and therefore no special measures are required to control peak flow from the ROW. Similarly, no special measures are required to control stormwater quality. As noted above, the project does not cross any lakes, coastal wetlands or rivers, streams or brooks listed as Most at Risk from Development. In addition, no controls are necessary to prevent an unreasonable impact on other lakes located along the project route. Similarly, although the project crosses rivers, streams and brooks considered sensitive or threatened (all rivers, streams or brooks not identified as most at risk are considered sensitive or threatened under the Site Law, see, e.g., Chapter 502, Section 3.B.2(b)), the project does not drain to such a waterbody within two miles above a public water supply intake. Nevertheless, to the extent applicable, BHE will meet the basic stabilization standard of Chapter 500, Section 4.A.(2)(d), thereby further ensuring adequate control of stormwater quality.

BHE will utilize existing public roads, abandoned town roads, the Stud Mill Road and other logging roads to access the ROW for clearing, construction and maintenance activities. Use of existing roads and traveling down the ROW itself eliminates the need for BHE to construct any new permanent access roads for project operation. In addition, the existing network of roads will allow construction of the project to be completed without building any new temporary access roads.

Use of logging roads will be required where other road crossings (paved or gravel state and local roads) do not exist. All access roads were selected to avoid impacts to vegetative cover and protected resources to the greatest extent practicable. Improvements to some of the logging roads (e.g., trimming overhanging vegetation, minor grading or additional gravel, replacing damaged or nonfunctional culverts, and installing temporary timber mat bridges) may be required due to the size and nature of the equipment that will utilize the road. Any new gravel or grading will be limited to that necessary to maintain a safe, reliable surface, will not result in any new impervious surface, and will not be placed in protected resources such as wetlands. Any improvements to existing access roads will be completed using DEP *Basic Stabilization Standards*. The temporary construction access points along the ROW are indicated on the temporary access roads and construction staging areas figure provided in Appendix 1-1 of Section 1.

Because the ROW will remain vegetated and there are no new permanent access roads being constructed, no further analyses are required to demonstrate compliance with the stormwater standards. BHE has developed the NRI Project Erosion and Sedimentation Control Plan (the NRI E&S Plan or Plan) for use by the contractors during construction of the project. The NRI E&S Plan is based on the Department's *Maine Erosion and Sediment Control BMPs*, dated March 2003. As detailed in the NRI E&S Plan, the placement and type of temporary erosion and sedimentation control measures will be determined in the field during a site walk-through prior to construction. The erosion and sedimentation control measures will be installed and maintained prior, during, and following construction to prevent soil erosion and sediment laden runoff. The NRI E&S Plan is located in Appendix 14-1

12.B Orrington Substation - Narrative

Sections 12.B through 12.G provide narrative descriptions of pre-development and post-development site conditions and the estimated effects of post-development site runoff on peak discharge rates, flooding, and water quality for the proposed modifications to the Orrington Substation. The proposed modifications will be designed, constructed, and maintained in accordance with applicable DEP stormwater management requirements. As a result, there will be no unreasonable effects on runoff and infiltration relationships and no unreasonable effects on surface water quality in accordance with the “No Adverse Effect Standard” of the Site Location Law. The Orrington Substation is not located in a “Watershed Most at Risk from Development” or a “Sensitive or Threatened Region or Watershed” listed in Chapter 502 of Department Regulations. However, it is located in a lake watershed (Fields Pond) and, as mentioned above, for purposes of the Site Law all projects not located in a Watershed Most at Risk from Development are considered to be in a Sensitive or Threatened Watershed.

12.B.1 Development Location

The Orrington Substation is located on Fields Pond Road in Orrington, Penobscot County, Maine as shown on Figure 12-1. The site consists of approximately 14 acres and is accessed by two gravel drives off Fields Pond Road. Two existing transmission line ROWs enter the substation from the south, combine into single ROW approximately 1,000 feet beyond the substation and continue on to the north. The new area to be developed is located on the southern end of the site, between Fields Pond Road and the existing substation, and is contiguous with the existing substation. The NRI transmission line will follow the existing ROW that leaves the substation to the north.

The proposed development will add approximately 34,800 square feet (0.8 acre) of impervious surface to the Orrington Substation, consisting of additional facilities with a crushed stone surface, new gravel access roads and the redesign of an existing retention pond for oil spill containment to a combined oil spill retention pond/stormwater detention pond.

FIGURE 12-1 SITE LOCATION MAP

The total area that will be disturbed during construction of the substation is approximately 104,000 square feet (2.4 acres). Access to the expansion area is from an existing gravel access road and two short new gravel access roads off Fields Pond Road. One of the new access roads will replace an existing access road. The proposed substation modification area drains onto gently sloping vegetated land towards an emergent wetland that is dominated by cattails. This wetland ultimately drains toward Fields Pond.

12.B.2 Surface Water on or Abutting the Site

There is an emergent, cattail marsh abutting the east side of the site. The wetland is a tributary to Fields Pond.

12.B.3 Downstream Ponds and Lakes

Fields Pond is located approximately 3,000 feet down gradient of the proposed development. Fields Pond is not a Waterbody Most at Risk from Development but was considered a Threatened or Sensitive Watershed for purposes of stormwater management.

12.B.4 General Topography

The substation modification area generally slopes in a southeasterly direction toward the emergent wetland. Most of the site is moderately sloping (about 5 percent) with a few small areas of strong slopes on either sides of existing drainage swales. Topographic mapping depicts a high elevation on the site of 156 feet located northeast of the substation and a low elevation on the site of 129 feet at the existing spill pond outlet.

12.B.5 Flooding

There are no known buildings or facilities on or adjacent to the site that historically flood or that would be affected by flooding following development of the site as proposed. As indicated on Figure 19-1 (see Section 19, Flooding) the site boundary and proposed development is not located within a 100-year flood zone based on Q3 Flood Data derived from the Department of Housing and Urban Development Federal Insurance Administration (FIA) Flood Hazard Boundary Map No. H 13, Community Number 230180, dated February 7, 1975. The proposed development will be designed, constructed, and maintained such that the flood extent and frequency of downstream waterbodies (Fields Pond) will not be increased.

12.B.6 Alterations to Natural Drainage Ways

There are no natural drainage ways on-site. Concentrated flow through the site is conveyed to the wetland via man-made swales and roadside ditches.

12.B.7 Alterations to Land Cover

As stated above, the proposed development consists of modifications to an existing substation. The new substation area (inside the fence) will be covered with crushed stone (modeled as gravel). Two new gravel access roads from Fields Pond Road will be constructed. In addition, an existing oil spill retention pond will be expanded and turned into a lined stormwater detention/spill retention pond. Graded and disturbed areas around the new construction will be permanently stabilized in accordance with the NRI E&S Plan. The NRI E&S Plan is provided in Section 14, Erosion and Sedimentation Control, Appendix 14-1. These areas will then be allowed to revert to the current brush/weed land cover. A summary of the pre- and post-development cover types and net change for the affected watershed is presented in Table 12-1.

TABLE 12-1. PRE- AND POST-DEVELOPMENT COVER TYPES

Cover Type	Pre-development Area (acres)	Post-development Areas (acres)	Net Change (acres)
Impervious (paved, roof, foundations, pond)	0.10	0.23	+0.13
Gravel (road, HSG C)[1]	0.23	0.10	-0.13
Gravel (substation, HSG C)[1]	1.56	2.37	+0.81
Brush (good, HSG C)[1]	2.86	2.07	-0.79
Totals	**4.75**	**4.77**	**+0.02**

[1] HSG=Hydrologic Soil Group

12.B.8 Modeling Assumptions

The stormwater runoff was estimated using HydroCAD, Version 7.0. HydroCAD is based on methodologies developed by the U. S. Department of Agriculture Soil Conservation Service (now called the Natural Resources Conservation Service (NRCS)), namely TR-55 and TR-20, in combination with other hydraulic and hydrology calculations. Based on site specific information and rainfall data, the program estimates inflow and outflow hydrographs for a watershed.

The pre- and post-development watershed boundaries and hydrologic flow lines used to determine the time of concentration are indicated on the Pre- and Post-Development Drainage Plans located in Appendix 12-1. The watershed boundaries were determined from the one-foot contours developed for the project and a site visit; the times of concentration were determined from the contour of the site. The pre-development stormwater analysis used one watershed of about 4.75 acres in size. One watershed was used because it is not a complex site and the resulting analysis will be conservative. The control point used for the pre-development analysis was the existing spill pond (see below). The control point for the post-development analysis was the proposed new pond. Both ponds are located within approximately the same footprint.

Storm events modeled for the pre- and post-development analyses assumed precipitation events with a 24-hour duration having a type III distribution and rainfall amounts of 2.7, 4.1, 4.8, and 5.8 inches, with return frequencies of 2-, 10-, 25-, and 100-years, respectively. The storm type and rainfall amounts are based on Table 3-4, “24 Hour Storm Duration Rainfalls for Various Return Periods” from the DEP *Stormwater Management for Maine: Best Management Practices*.

12.B.9 Water Quantity Control

An assessment of the potential impacts from the post-development peak flow events at the control point was assessed by determining the expected volume of stormwater runoff. The post-development peak flow will exceed the pre-development peak flow without treatment. A summary of the pre- and post-development peak runoff at the control point is summarized in Table 12-2. In accordance with DEP rules and regulations, increased runoff from development must be controlled at the project site. A detention pond will be used to mitigate the runoff increases. Installation and maintenance of the detention pond and other drainage features, as described herein, will ensure that the project will not have an adverse impact on surrounding properties.

TABLE 12-2. PRE- AND POST-DEVELOPMENT PEAK OUTFLOW COMPARISON

Storm Frequency	Development Case	Control Point Peak Outflow (cfs[1])
2-year	Pre-development	2.40
	Post-development	2.86
	Change	+0.46
	Percent Change	19%
10-year	Pre-development	5.81
	Post-development	4.89
	Change	-0.92
	Percent Change	-16%
25-year	Pre-development	7.72
	Post-development	6.18
	Change	-1.54
	Percent Change	-20%

[1] Control Point Peak Outflow is measured in cubic feet per second (cfs).

12.B.10 Water Quality Treatment

Stormwater quality treatment practices that will be used to reduce the impacts of site runoff on downstream water quality include the Basic Stabilization Standards (consisting of ditches, swales, culverts with inlet and outlet protection, slope stabilization, and revegetation of disturbed areas). To achieve long-term erosion and sedimentation control, the stabilization methods will be designed, constructed, and maintained using the best management practices (BMPs) in the NRI E&S Plan. The NRI E&S Plan is based on DEP's *Maine Erosion and Sediment Control BMPs*, dated March 2003.

Although the Orrington Substation is not located in a "Watershed Most at Risk" and therefore subject only to the Basic Stabilization Standards, the detention pond will also function as a "wet" pond for purposes of spill containment and therefore should provide some additional water quality treatment. The location of the detention pond is shown on the Post-Development Drainage Plan provided in Appendix 12-1). Given this level of treatment, the proposed development will have no unreasonable effects on surface water quality in accordance with the "No Adverse Effect Standard" of the Site Location Law.

12.B.11 Off-site Credits

This section is not applicable to this project.

12.B.12 Compensation Fees

This section is not applicable to this project.

12.B.13 Development Impacts

The impacts from development on water quantity are described in Section 12.B.9, above. Water quality impacts are discussed in Section 12.B.10. Based on the analysis conducted, the proposed development will have no unreasonable effects on runoff and infiltration relationships and no unreasonable affects on surface water quality.

12.C Maps

12.C.1 United States Geological Survey (USGS) Quadrangle Map with Site Boundaries

The USGS Map with the site boundaries is provided as Figure 12-1.

12.C.2 NRCS Soils Map with Site Boundaries

The NRCS Soils Map with the site boundaries is provided as Figure 12-2. The Class C Soil Survey mapping, prepared by a Maine-certified soils scientist, is provided in Section 11, Soils, Appendix 11-1.

12.D Drainage Plans

The Pre-development Drainage Plan and the Post-development Drainage Plan for the proposed modifications are provided in Appendix 12-1. Both plans include contours, cover types, soils groups, watershed boundaries, hydrologic flow lines, time of concentration flow lines, existing features, drainage ways, detention/retention ponds, and the watershed analyses control points.

FIGURE 12-2 NRCS SOILS MAP

12.E Runoff Analysis

The pre- and post-development stormwater analysis calculations are provided in Appendix 12-2. The analyses include computations for determining the curve numbers for the pre-development and post-development watersheds and the HydroCAD output, which includes time of concentration calculations, travel time calculations, peak discharge calculations for the 24-hour storms of the 2-, 10-, 25-, and 100-year frequencies, and reservoir routing calculations.

12.E.1 Curve Number Computations

A summary of the cover types, hydrologic soil group, and curve numbers for the pre-and post-development watershed is provided in Table 12-3 and is also included in the stormwater calculation package in Appendix 12-2. Cover types for the affected area were determined from the topographic field survey and a site visit and are indicated on the Pre- and Post-development Drainage Plans.

The soils and hydrologic soil groups (HSGs) within the area to be developed are based on the Class C Medium-High-Intensity Soil Survey provided in Appendix 11-1. Soils and hydrologic soil groups information for areas outside of the project area are based on medium-intensity soil survey mapping obtained from “Soil Survey of Penobscot County, Maine” (Figure 12-2). The soils and hydrologic soil group within the watershed analysis areas are shown on the Pre- and Post-development Drainage Plans.

The runoff curve numbers were developed from Appendix D-13: “Runoff Curve Numbers for use in TR-55 and TR-20” of the DEP *Stormwater Management for Maine: Best Management Practices* and HydroCAD, based on the observed cover types and hydrologic soil groups. The weighted curve number calculations for the subwatersheds are included within the HydroCAD output provided in the stormwater calculation package.

TABLE 12-3. PRE- AND POST-DEVELOPMENT COVER TYPES, HYDROLOGIC SOIL GROUPS (HSG), AND CONTROL POINT WEIGHTED CURVE NUMBERS (CN)

Cover Type and HSG	Pre-development Weighted CN	Pre-development Area, acres	Post-development Weighted CN	Post-development Area, acres
Impervious (paved, roof, foundations, pond)		0.10		0.23
Gravel (road) HSG C		0.23		0.10
Gravel (substation) HSG C		1.56		2.37
Brush (good) HSG C		2.86		2.07
Totals	75	**4.75**	79	**4.77**

12.E.2 Time of Concentration Calculations

Time of concentration was calculated using NRCS TR-55 methodologies for each watershed considering the hydrologic flow lengths, slope, vegetative cover, surface roughness, and each structure's stage-storage relationship. The type and length of each hydrologic flow line for determining time of concentration and travel times in the area to be developed are indicated on the Pre- and Post-development Drainage Plans. The maximum sheet flow length used for this analysis (labeled "SF" on the drawings) was generally 150 feet. Flow lengths beyond 150 feet were assumed to be shallow concentrated flows (labeled as "SCF" on the drawings). Shallow concentrated flow lengths varied for each watershed and were extended until they reached the end of the watershed or until it reached a concentrated flow channel (labeled as "CF"). A summary of the input data used to estimate the time of concentration for each subwatershed is provided in the calculation package.

12.E.3 Travel Time Calculations

The travel time for each watershed was calculated using a spreadsheet based on equations prepared by the NRCS. These times were then inputted directly into HydroCAD. The spreadsheets are included in the calculations.

12.E.4 Peak Discharge Calculations

Peak discharge calculations are included in the HydroCAD output. A summary of the peak discharges is presented in Section 12.B.9.

12.E.5 Reservoir Routing Calculations

Reservoir routing calculations are included in the HydroCAD output. The "storage-indication+translation" method was used in the analyses. This method first performs a storage-indication routing, and then translates the resulting hydrograph by the travel time.

12.F Stormwater Quantity Control Plan

12.F.1 Variance Submissions

A variance from the peak flow standard is not necessary for the proposed modifications to the Orrington Substation. This section does not apply to this project.

12.F.2 Sizing of Storm Drains and Culverts

The calculations for the sizing of proposed culverts and other conveyance structures are presented in the stormwater calculation package (Appendix 12-2). Construction detail drawings (CS-1, CS-2, and CS-3) for the proposed on-site conveyance structures, including vegetated drainage swales, culverts with inlet and outlet protection, catch basins, and underground pipes are provided in Appendix 12-1. The stabilization methods will be designed, constructed and maintained using the BMPs in the NRI E&S Plan.

12.F.3 Stormwater Ponds and Basins

The proposed stormwater pond (detention basin/wet pond) will be located in the same location as an existing SPCC spill pond. BHE will replace the existing pond and construct a new pond in this location that will function as both a spill containment (retention) pond and as a stormwater detention pond. The "wet" pond will utilize a water bottom of between 2 to 3 feet in conjunction with an underflow weir structure to contain an oil spill in the event one of the transformers ruptures. The pond will be sized to accommodate a 33,400 gallon oil (mineral oil) spill. Water will be contained within the pond through the use of a synthetic geomembrane liner specifically formulated for oil containment. The liner, an XR-5 as manufactured by Seaman Corporation, is very durable, UV resistant and should provide a service life of over 30 years. Per the Class C soils report, groundwater is expected to be from 1 to 4 feet below the surface minimizing the potential to "float" the liner. To facilitate cleaning of the pond, a layer of riprap will be installed on the bottom to protect the liner and to provide an audible cue when bottom has been reached.

The pond will be used to control peak flows from the 2-year, 10-year and 25-year storm events. The underflow weir outlet structure will have the capacity to convey a 25-year storm. The emergency spillway is designed to convey a 25-year storm in the event the outlet structure is clogged or excess flow for more severe storm events.

The diaphragm-type wet pond was designed in accordance with the recommendations as provided in the U.S. Department of the Interior, Bureau of Reclamation, *Design of Small Dams* and the NRCS Handbook, *Ponds-Planning, Design, Construction*. A "diaphragm" pond utilizes a liner or other impervious layer to prevent the hydraulic pressure from water contained within the pond from seeping through the embankment and potentially causing the embankment to fail. In this case, the XR-5 liner installed for oil spill containment purposes will also act as the diaphragm. To ensure pond stability, the embankment will be constructed of granular material (MDOT 703.06(E)) with 3 horizontal to 1 vertical sideslopes.

The construction detail drawings in Appendix 12-1 show design and construction details for the pond, pond outlet structure, outlet structure plunge pool and emergency spillway.

12.F.4 Infiltration Systems

There are no proposed infiltration systems. This section does not apply to this project.

12.F.5 Drainage Easement Declarations

There are no on-site or off-site drainage easements to be designated as components to the stormwater management system.

12.G Stormwater Quality Treatment Plan Peak Discharge Calculations

12.G.1 Basic Stabilization Plan

In accordance with the Basic Stabilization Standards, stormwater conveyance structures will be designed, constructed, and stabilized using erosion and sedimentation (E&S) BMPs and receive adequate routine maintenance to ensure their continued function. The site will be maintained to prevent or correct erosion problems. The basic strategy of the NRI E&S Plan (Appendix 14-1) is to prevent erosion from occurring, rather than correcting problems. The NRI E&S Plan contains the details and specifications for general stabilization measures to be used during construction and stabilization of the substation. These measures will be used to protect exposed soils during construction and during the service life of the project.

The stabilization measures for the site will include temporary and permanent E&S controls; appropriate design of swales, culverts, the detention pond and related evaluation of slope stability and erosion protection for earthen cut and fill slopes; and provisions for future maintenance of the site. The vegetated swales, culverts, pond and plunge pool design calculations are contained in Appendix 12-2.

12.G.2 80 Percent Total Suspended Solids (TSS) Removal Plan

This section is not applicable to this project.

12.G.3 Phosphorus Control Plan

This section is not applicable to this project.

12.G.4 Offset Credits

This section is not applicable to this project.

12.G.5 Runoff Treatment Measures

The design, siting and selection of the proposed BMPs used to treat the runoff were chosen from the DEP's *Stormwater Management for Maine: Best Management Practices*. The runoff treatment measures include structural and non-structural measures (vegetated swales, check dams, culverts with inlet and outlet protection, plunge pools, and a detention/retention pond). The design calculations and drawings details are provided in Appendices 12-1 and 12-2.

12.G.6 Control Plan for Thermal Impacts to Coldwater Fisheries

Stormwater runoff from the Orrington Substation does not discharge to a coldwater fishery, and, in general, waterbodies downstream of Fields Pond do not support coldwater fisheries. Further, the proposed modifications to the Orrington Substation are not expected to significantly change the temperature of runoff from the site. Therefore, a control plan for thermal impacts to coldwater fisheries is not required.

12.G.7 Control Plan for Other Pollutants

As stated above, the detention pond and underflow weir outlet structure will be designed to also act as a retention pond to capture any potential oil spills that may occur in the substation yard. The Spill Prevention Control and Countermeasures (SPCC) plan for the project will address this potential impact (see Section 15, Groundwater, Appendix 15-2).

12.G.8 Engineering Inspection of Stormwater Management Facilities

The engineering and inspection of stormwater management facilities are presented in Section 13, Maintenance of Common Facilities or Property. Generally, the proposed facilities will be operated and maintained in a manner consistent with good utility practices, including monthly substation inspections and transmission line helicopter inspections three times per year. BMPs for erosion control and stormwater pollution prevention during construction will include weekly or more frequent inspection and maintenance of items such as temporary and permanent erosion control measures; stabilization of the substation site, road ditches, and the ROW; culvert and check dam condition/performance; detention pond embankment, liner, outlet structure and emergency spillway condition; sediment build-up; and signs of erosion or sedimentation. Sample forms for the inspection of stormwater management facilities and erosion controls are provided in Appendix 13-1.

APPENDIX 12-1

PRE- AND POST-DEVELOPMENT DRAINAGE PLANS AND CONSTRUCTION DETAIL DRAWINGS

APPENDIX 12-2

STORMWATER CALCULATION PACKAGE