



Vanasse Hangen Brustlin, Inc.

7056 US Route 7
Post Office Box 120
North Ferrisburgh, Vermont 05473
802.425-7788
Fax 802.425.7799

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Project 57346.03
No.:
From: Krista Reinhart, CPESC, CPSWQ Re: Operational Phase Stormwater
Jeffrey A. Nelson, CPESC, CPSWQ Management Alternative Design and
Performance Monitoring Plan

1.0 Introduction

VHB/Vanasse Hangen Brustlin, Inc. has prepared this memorandum to summarize the Alternative Stormwater Treatment Practice (STP) Design¹ associated with operational phase stormwater management of runoff from impervious surfaces proposed for the Kingdom Community Wind Project (KCW project). The KCW project is a 21-turbine wind power project located in Lowell, Vermont. The project developer is Green Mountain Power (GMP) and the project engineer, working in collaboration with VHB on the operational phase and construction phase stormwater management plans, is Krebs and Lansing Consulting Engineers, Inc. (K&L).

The overall objective of the use of the Alternative STP Design approach, in accordance with Section 2.5 of the Vermont Stormwater Management Manual (VSMM), has been to reduce overall environmental impacts associated with stormwater management for the project. Conventional stormwater treatment would typically involve the construction of stormwater basins, with associated infrastructure (e.g., swales, culverts) to convey runoff to these facilities. Given the linear nature of the KCW project, as well as its ridgeline location, the use of such a conventional approach would require a large number (30+) of stormwater basins, and extensive additional earthwork to enable conveyance of runoff from impervious surfaces to these basins. The alternative approach utilizes the natural features of the site, along with design that is sensitive to the site, to treat, manage, and disperse stormwater runoff in a manner that achieves the VSMM treatment criteria, while reducing the clearing and earth disturbance associated with stormwater management facilities. This approach also dovetails with efforts by the Vermont Department of Environmental Conservation (VT DEC) to amend the existing

¹ "Alternative STP Design" as referenced herein is specific to the Vermont Stormwater Management Manual (VSMM), Section 2.5 Alternative STP Design and associated criteria.

stormwater treatment requirements to enable the effective authorization and implementation of such practices in Vermont.

2.0 Background

On July 2, 2010, VT DEC issued *Draft Proposed Amendments to the Vermont Stormwater Management Manual* (VSMM), which provides draft regulatory standards and criteria associated with high-elevation renewable energy projects.² These draft regulatory standards and criteria allow for use of a Watershed Hydrology Protection Credit (the credit) to meet the following VSMM requirements: Water Quality Volume (WQ_v), Groundwater Recharge (Re), and Channel Protection Volume (CP_v). In turn, compliance with the credit allows the project to reduce or eliminate the use of structural treatment practices (e.g., stormwater basins), which otherwise could result in excessive earth disturbance impacts. In general, the credit promotes runoff dispersal, preservation of natural surface and sub-surface drainage features, and maintenance of natural groundwater conditions.

As outlined in VT DEC's *Draft Proposed Amendments to the VSMM*, in order for a proposed project to be eligible for the credit, certain specific criteria must be met regarding: (1) limitations on total amount of impervious cover within a given watershed, (2) maintenance of a percentage of forest cover within a given watershed, and (3) maintenance of stream buffers pursuant to *Acceptable Management Practices for Maintaining Water Quality on Logging Jobs in Vermont* (State of Vermont, 1987). The technical design criteria of the credit establishes specific stormwater treatment practices which, if followed, would result in a determination by VT DEC that the project is appropriately managing stormwater runoff via: (1) collection and bypass of runoff and groundwater, (2) groundwater interception, and/or (3) redistribution and disconnection of stormwater. As the draft proposal currently stands, a project is eligible for coverage under VT DEC General Permit 3-9015 provided that the eligibility criteria are met, the technical criteria are followed, and the project is not located within a stormwater impaired watershed.

3.0 Stormwater Discharge Permitting

As an initial step in the stormwater management design process, the project team assessed multiple options for managing stormwater runoff both from a regulatory and a technical

² An Act of the 2009 VT Legislature required the Secretary of the Vermont Agency of Natural Resources (ANR) to develop guidance for high elevation renewable energy projects by January 15, 2010. The draft guidance represents a proposal by ANR based on this legislative requirement.

standpoint. As part of this process, the team focused on the ability of the project to comply with both the eligibility and technical criteria of VT DEC's *Draft Proposed Amendments to the VSMM*. Through this process, it was determined that the project could meet the technical criteria, but not the eligibility criteria of the credit. More specifically, it would not be possible for the project to maintain a maximum impervious cover of 5 percent or less within all watersheds nor would the project be able to assure ongoing maintenance of at least 90 percent of the forested land within all contributing watersheds, as required of the credit.

Although the eligibility criteria of the credit could not be met, the project team remained committed to meeting the technical criteria of the credit in the context of an individual permit application via implementation of level spreaders and vegetated buffers, which, as indicated above, reduces overall earth disturbance as compared to a fully conventional design. Unfortunately, given that the eligibility criteria could not be met, the project still requires conventional treatment practices for CP_v compliance. To meet this criterion, the overall stormwater management plan needed to include a certain amount of storage volume, as is provided by stormwater basins. Therefore, the resulting stormwater management design includes a combination of level spreaders and vegetated buffers for disconnection that are then offset by conventional VSMM-compliant stormwater basins. Together, these STPs meet WQ_v, Re, CP_v, Q₁₀, and Q₁₀₀, as required per the VSMM.

Although the proposed approach to managing stormwater runoff from the KCW project site follows the proposed VT DEC technical criteria for high elevation renewable energy projects, it is not currently accepted as a standard practice in the VSMM. Therefore, the proposed level spreaders and vegetated buffers currently fall under the category of an Alternative STP Design (as briefly referenced in the footnote in Section 1.0 of this memorandum). Pursuant to Section 2.5 of the VSMM, proposals for use of an Alternative STP Design "shall meet the applicable treatment standards specified in section 1.1 [of VSMM] and shall have the capability to achieve long-term performance in the field". These practices also require consideration of the design through the use of the individual permit application process, as opposed to authorization pursuant to General Permit 3-9015. Therefore, it is proposed that operational phase discharges from the project be permitted by VT DEC through an individual permit.

4.0 Stormwater Management Design

As outlined in Section 2.5 of the VSMM, there are two methods by which a designer may propose an Alternative STP Design; these include:

1. Proposal of an existing alternative design that has been installed and has demonstrated compliance with applicable criteria of the VSMM, or
2. Proposal of a new alternative design that may not have been installed but contains a designer's certification of compliance, as well as a post-construction performance monitoring plan.

With regard to the KCW project, the proposed approach to manage stormwater is to meet technical design criteria set forth in the VT DEC's *Draft Proposed Amendments to the VSMM*, where applicable, for: stone-lined ditches, level spreader disconnection, by-pass of cross drainage, and elevated roadways. The technical basis for the use of these practices to ensure that the water quality volume (WQ_v) and groundwater recharge (Re) criteria of VSMM are met include the following:

1. The level spreader and vegetated buffer design criteria are similar to the Section 3.3 Disconnection of Non-Rooftop Runoff Credit of the VSMM although modified to be applicable to site characteristics that exist at high elevations, such as is present at the KCW project site. More specifically, the design meets the 30 percent slope threshold and provides for a minimum of 150 feet of disconnection length. By providing this generous length in a forest or meadow environment, runoff will either infiltrate into the soil or be filtered by travelling for an extended distance as overland flow.
2. The State of Maine Department of Environmental Protection BMP Technical Design Manual provides a basis for the use of vegetated buffers for the treatment of stormwater runoff. From Chapter 5 Vegetated Buffers, "Buffer strips are natural, undisturbed strips of natural vegetation or planted strips of close-growing vegetation adjacent to and downslope of developed areas. As stormwater runoff travels over the buffer area, vegetation slows the runoff and traps particulate pollutants", and "the irregular microtopography of undisturbed buffers provides small areas within which runoff can pool, encouraging infiltration and reducing the amount of runoff." This type of treatment, promoting infiltration and promotion of pollutant removal, is the focus of water quality and groundwater recharge treatment standards.

However, as determined through extensive communication with counterparts in Maine, as well as a site visit to a similar high elevation renewable energy project in Maine, no data associated with performance of these types of systems are currently available. Therefore, the proposed approach for stormwater management associated with the KCW project falls under the latter category of Alternative STP Designs, requiring a designer's certification of compliance and a post-construction performance monitoring plan.

5.0 Post-construction Performance Monitoring Plan

The following is an overview of the proposed KCW Post-Construction Performance Monitoring Plan, which has been prepared in compliance with Section 2.5.2 of the VSMM for New-Design Alternative Systems. This monitoring plan is specific to performance of level spreaders and vegetated buffers at managing stormwater runoff from impervious surfaces associated with the KCW project. It is intended that these monitoring activities would be conducted in addition to any annual or bi-annual inspections and reporting that are required pursuant to the individual discharge permit for the site. Specific VSMM-required components of the monitoring plan would involve:

1. Sampling of at least five storm events over the course of three years, following completion of construction but not within the first year of completion of construction.³
2. Sampling of those five storm events (minimum) to occur such that, collectively, the storm events provide a representative range of precipitation intensities and antecedent conditions.
3. Concentrations, if any, to be flow-weighted.
4. The monitoring plan to be independently verified by VT DEC.
5. The monitoring plan to be conducted in the field, as opposed to in the laboratory.⁴

The following is an overview of the monitoring design, which is being presented in two parts. The first part (Part 1) represents an approach to analyzing level spreader and vegetated buffer performance via photographic and video documentation. The second part (Part 2) involves water quality monitoring to assess potential sediment loading (or lack thereof) associated with the level spreader and vegetated buffer systems.

Part 1: Photographic and Video Documentation:

- Establish photographic and video stations at representative level spreader and vegetated buffer systems⁵ and their receiving waters
- Position stations at upslope, central, and downslope locations of those representative level spreaders and vegetated buffers, and at upstream, central, and downstream locations of their associated receiving waters

³ It is assumed that “completion of construction” is defined by the date that the Notice of Termination (NOT) associated with the construction phase stormwater discharge permit is filed with VT DEC.

⁴ It is assumed that this requirement is with exception to water chemistry analyses that may need to be conducted by a testing laboratory.

⁵ Specific level spreader and vegetated buffer systems to be monitored will be determined in the field following construction, and in consultation with VT DEC.

- Capture photographs and video during a minimum of five snowmelt and/or rainfall events (pursuant to Section 2.5.2 of the VSMM)
- Document presence or absence of concentrated runoff, erosive flows, areas of ponding, sedimentation, and/or other observations that support either effectiveness or ineffectiveness of level spreader and vegetated buffer systems at managing stormwater runoff

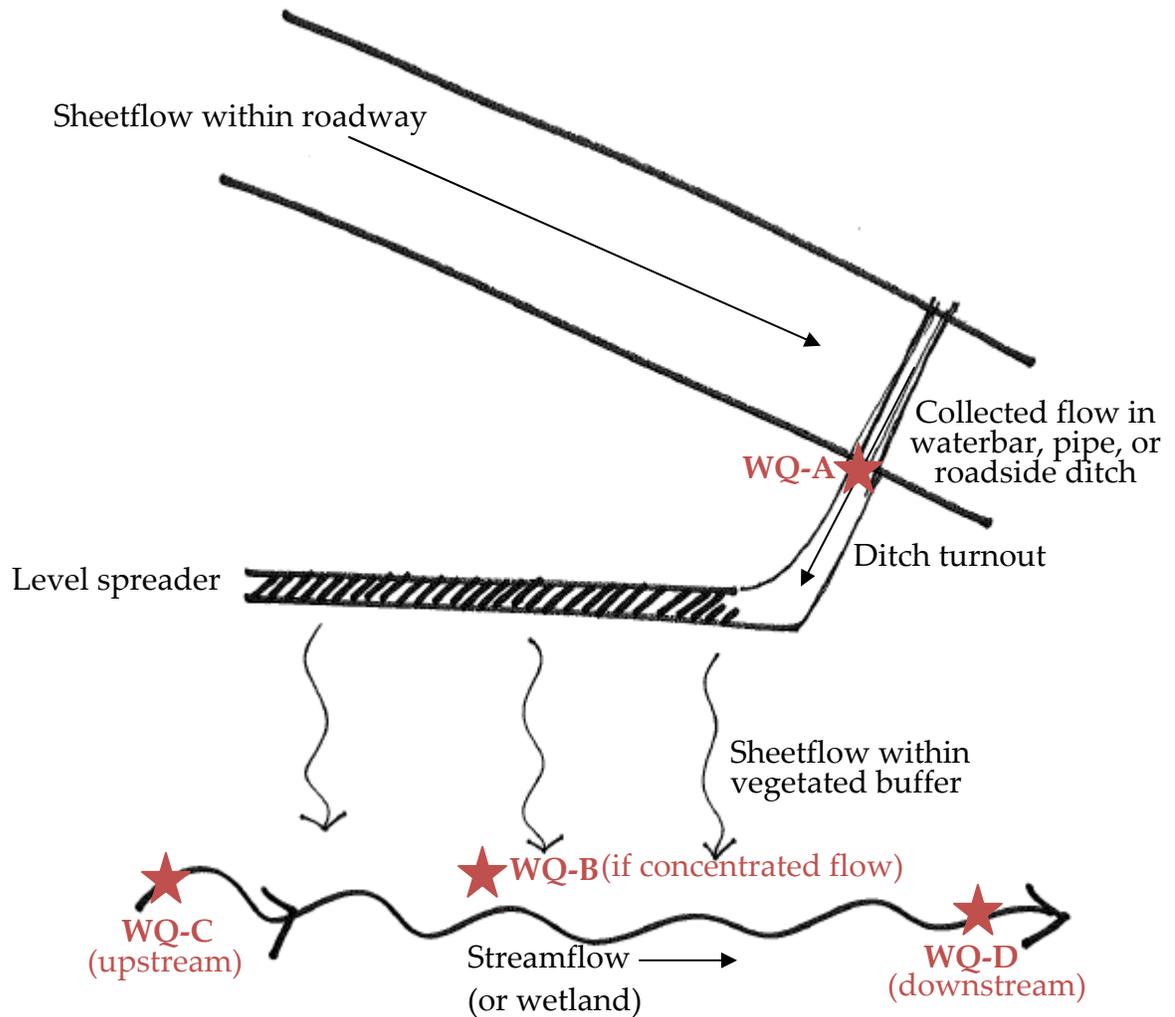
Part 2: Water Quality Monitoring:

- Conduct water quality monitoring of same representative level spreader and vegetated buffer systems that are being documented in *Part 1*
- For level spreaders that are capturing concentrated runoff from impervious surfaces via roadside ditches, culverts, or waterbars (see Sketch #1):
 - Collect samples of concentrated stormwater runoff, where feasible, including:
 - WQ-A: At the outfall of the ditch, culvert, or waterbar
 - WQ-B: Downslope of the level spreader and within the vegetated buffer
 - WQ-C: Within the receiving stream or wetland in a location that is upstream/upslope of the point at which the resource area receives project-related runoff
 - WQ-D: Within the receiving stream or wetland in a location that is downstream/downslope of the point at which the resource area receives project-related runoff
- For level spreaders that are capturing sheetflow runoff from impervious surfaces (see Sketches #2 and #3):
 - Collect samples of concentrated stormwater runoff, where feasible, including:
 - WQ-A: Downslope of the level spreader and within the vegetated buffer
 - WQ-B: Within the receiving stream or wetland in a location that is adjacent to where project-related runoff is entering the system
 - WQ-C: Within the receiving stream or wetland in a location that is upstream/upslope of the point at which the resource area receives project-related runoff
 - WQ-D: Within the receiving stream or wetland in a location that is downstream/downslope of the point at which the resource area receives project-related runoff
- Analyze collected water quality samples for Total Suspended Solids (TSS) and Total Phosphorus (TP) to assess TSS and TP removal

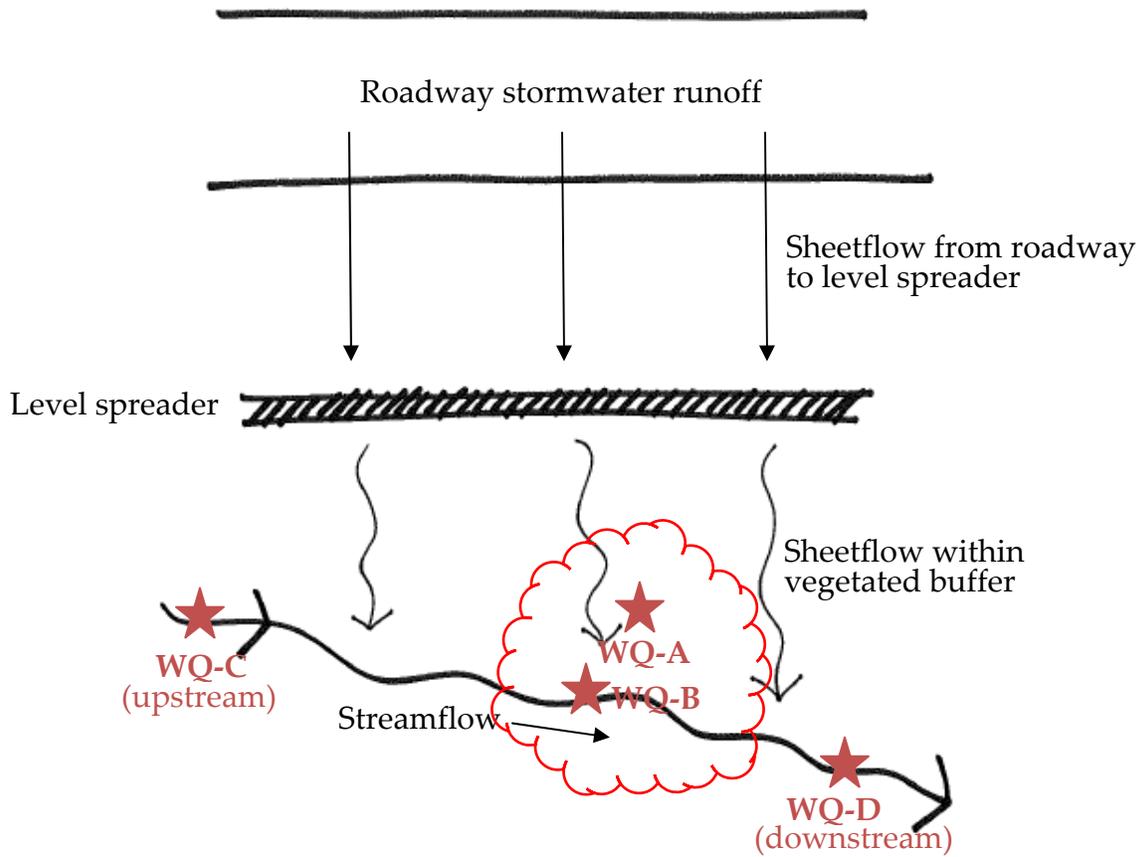
Implementation of Part 1 and Part 2:

- Qualified environmental consultant to conduct a site visit to identify level spreader and vegetated buffer systems that are representative of conditions present throughout the project site
- Qualified environmental consultant to conduct a training with a member of the Operations & Maintenance team, who will be responsible for implementing the monitoring plan on a long-term basis
- Qualified environmental consultant to continue to provide oversight and review of monitoring activities and reporting
- Qualified environmental consultant to assimilate monitoring data and prepare a brief memorandum that summarizes results of the performance monitoring plan; reporting to occur on an annual basis, with a final report at the close of the three-year monitoring period

SKETCH #1: Water Quality Monitoring / Concentrated Flow to a Stream or Wetland



SKETCH #2: Water Quality Monitoring / Sheetflow to a Stream



SKETCH #3: Turbidity Monitoring / Wetland Receiving Water

