



**GMP Kingdom Community Wind Stormwater System  
Permit Condition Compliance and Water Quality Protection**

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**Summary:**

- The Kingdom Community Wind (KCW) Project in Lowell VT was designed, permitted and constructed with an alternative design stormwater system which reduced forest clearing by about 12 acres.
- The stormwater system included a large number of treatment systems, including “level spreaders” which are ideally suited to the site setting.
- Permit conditions included a requirement for a performance study of the level spreader systems.
- Results from the 3-year level spreader study demonstrate that the level spreaders are performing as designed and the project is not negatively impacting water quality. The level spreader study was completed in late 2018 and the final report was filed in February 2019.
- All KCW stormwater systems are monitored annually for compliance with permit conditions with reports submitted to DEC and any deficiencies corrected promptly.

**Technical Discussion:**

The Kingdom Community Wind (KCW) Project was constructed between 2011 and 2013, in compliance with the terms and conditions of numerous permits issued for the Project as well as a Certificate of Public Good issued by the PSB in Docket 7628. Several permits and the CPG were appealed by project opponents, and all appeals resulted in issued permits and approvals being upheld.

The management of stormwater runoff from jurisdictional impervious surfaces during the operational phase of a project is regulated in Vermont under state statute (10 VSA § 1264) which is administered by the Vermont Department of Environmental Conservation (DEC), which has adopted a Stormwater Management Rule and Stormwater Management Manual (VSMM) to implement the regulatory program. DEC requirements include provisions for the management of peak flow rates, treatment of stormwater to protect water quality, and the maintenance of base flows (dry weather flows) in receiving streams.

The KCW Project involves approximately 27.5 acres of impervious area, which is comprised of the unpaved access road, crane path, crate pads, turbine foundations, and the O&M building rooftop and parking area. Stormwater runoff from all impervious areas associated with the project is directed to one or more



stormwater treatment practices (STPs). The unique characteristics of the site and project, including the steep mountain setting, the linear nature of the project, and the presence of significant natural communities presented both a challenge and an opportunity to implement a stormwater treatment system that recognized and took advantage of these features.

The stormwater management system design for KCW, which included both traditional stormwater ponds, as well as level spreaders and vegetated buffer strips, was designed and constructed to achieve compliance with the DEC stormwater management requirements as presented in the 2002 VSMM. The system includes 31 level spreaders, 4 dry ponds, 16 wet ponds and an infiltration basin. The VSMM contains a list of accepted STPs that DEC has previously approved for use. These STPs are considered to be established and proven effective in the field when properly sized and installed according to the specifications in the VSMM. However, the Manual also allows for “alternative STPs”—STPs not specifically set out in the Manual—to be used in a project. In order for such alternative STPs to be used, DEC technical staff must determine that a proposal will meet the treatment standards of VSMM and will have the ability to achieve long term performance in the field. The KCW design was found to meet these criteria. While level spreaders are considered “alternative” in the context of the VSMM, that does not equate to “experimental”. Level spreaders have long been used successfully in a variety of stormwater management applications throughout the United States, and the record in Vermont is similar, as discussed below.

A level spreader is a constructed feature comprised of a trough and an overflow lip, aligned across a slope. The spreader is used to convert concentrated runoff (e.g. runoff entering from a roadside ditch) to sheet flow and release it in a non-erosive manner across a slope, which in this case is a wooded/vegetated buffer. Vegetated buffers describe the land areas immediately downslope of the level spreader which provide for the “disconnection” of runoff within undisturbed natural vegetated terrain. At KCW, the vegetated buffers extend a minimum of 150 feet downslope of the level spreaders before the treated stormwater runoff reaches a stream or wetland.

The use of level spreaders and vegetated buffers is an appropriate technology and is well suited to the KCW project site for several reasons. First, this system is well suited to the linear nature of the project since level spreaders are small and fit well with existing mountainous topography. In essence, these are small-scale features well suited to handling small amounts of runoff from short segments of roadway on this mountainous site. Second, use of level spreaders and vegetated buffers enable a reduction in the amount of clearing and earth disturbance necessary for the treatment practices, compared to that which would be required for conventional pond-based STPs. Use of level spreaders in the design reduced the need for clearing of forested land by about 12 acres. Third, use of level spreaders and vegetated buffers reduce the required disturbance along roadways that would be needed to convey stormwater runoff to a smaller number of large ponds. Finally, the use of level spreaders and vegetated buffers dispersed through the project site maintains natural mountain hydrology since there is less collection and consolidation of stormwater flows at specific (pond) locations.



It should also be noted that the VSMM was revised in 2017 to include a section titled Watershed Hydrology Protection (Section 4.2.4) that explicitly allows the use of level spreaders as an accepted practice for stormwater treatment at projects such as KCW.

Throughout permitting, construction, and post-construction compliance, the KCW Project has been subject to an unprecedented level of ongoing monitoring and reporting associated with the management of stormwater and protection of water quality. Broadly, these monitoring activities fall in three areas:

1. **Ongoing annual operation and maintenance reporting:** When an Individual Stormwater Discharge permit is issued by DEC, such as the permit for the KCW Project, the term of the permit is 5 years, and conditions for maintenance, monitoring and reporting are included. As a result, all components of the stormwater system, including ponds and level spreaders are subject to regular inspections, along with maintenance and reporting requirements. GMP, with assistance from VHB, has conducted more inspections than required by the permit and has conducted ongoing maintenance on the stormwater system as necessary. Thus, these requirements are being fully met by the project and document that the stormwater basins and level spreaders are functioning as designed and being properly maintained.
2. **Watershed wide stream testing:** Specific to the KCW project, as a requirement of the Section 401 Water Quality Certification issued by ANR, a comprehensive program of watershed based stream monitoring has been occurring in the vicinity of the site. The 401 requires testing of all of the mountain streams surrounding the project site for water chemistry, temperature, substrate (streambed materials) and aquatic biota (insects/fish). All monitoring stations were selected at locations downstream of KCW-related activities to ensure that any potential impacts to water quality were detected. This monitoring began prior to the construction of the project and was completed annually through 2018. GMP has contracted with VHB scientists to complete the monitoring under strict quality assurance/quality control requirements, and prepare annual reports for review by ANR. The data collected pursuant to the 401 monitoring have shown continued compliance of these streams with the Vermont Water Quality Standards, with no appreciable change in the water quality of streams due to the KCW project.
3. **Alternative design testing:** This program involved a special study to specifically evaluate the individual performance of a representative set of three level spreaders. The study plan was originally approved when the stormwater permit was issued for implementation beginning a year following the completion of KCW project construction. However, DEC subsequently asked for some modifications and refinements to this monitoring plan. VHB worked with DEC staff, which included site visits to look at various parts of the system, and confirm the selected set of level spreaders to be monitored. The study plan was revised in 2015 and 2016, and was implemented over three field seasons between 2016 and 2018. A final report presenting the results of this study has been prepared and submitted to DEC in February 2019. As noted above, if KCW were permitted under the 2017 VSMM, such field testing would not be required, as these systems are now explicitly included in the manual.



In summary, the stormwater systems for the KCW project have been constructed in accordance with the permits and approvals issued for the Project. Several scales and types of ongoing monitoring were included in these permits and approvals and are being undertaken as required. Data collected at the site has documented that the stormwater treatment practices are performing as intended and are successful in managing stormwater runoff from the site and protecting water quality of mountain streams in the vicinity of the KCW project.