Railway Brook Restoration

Wetland Mitigation for the Spaulding Turnpike Improvements
Newington, New Hampshire

PREPARED FOR

New Hampshire DOT
Department of Transportation

7 Hazen Drive, PO Box 483
Concord, NH 03302

PREPARED BY

vhb

2 Bedford Farms Drive, Suite 200
Bedford, NH 03110

November 2015

Table of Contents

2015 1st Year Monitoring Report
Railway Brook Restoration Project, Newington, NH

Report Narrative

Figures

Figure No.	Description
1	USGS Project Location Map
2	Railway Brook 1st Year Monitoring Map

Appendices

Appendix	Description
A	NHDES Wetlands Permit 2006-02007 & USACE Permit NAE-2004-3545
B	Railway Brook Success Standards and Criteria Evaluation Table
C	Shallow Groundwater Monitoring Well Field Documentation
D	Representative Site Photographs
E	Bank Erosion Hazard Index Field Documentation

Report Narrative

1.0 Project Overview

Restoration of Railway Brook, a perennial stream located in Newington, New Hampshire, commenced in July of 2014 and was completed in June of 2015 as one component of the compensatory wetland mitigation package for unavoidable wetland impacts resulting from the "Spaulding Turnpike Improvements" Project (NHDES Permit 2006-02007 and US Army Corps of Engineers Permit NAE-2004-3545 – see **Appendix A**). The mitigation package compensates for approximately 22.8 acres of both freshwater and tidal wetland impact associated with the Spaulding Turnpike Improvements Project, as well as at three previously permitted and completed highway projects located in the vicinity of the Newington-Dover project.

Restoration of Railway Brook involved the restoration and enhancement of approximately 2,900 linear feet (0.55 miles) of stream channel, including the restoration and creation of approximately 3.0 acres of wetlands and floodplain adjacent to the stream within an approximately 300-foot wide corridor, as well as preservation of approximately 23 acres of undeveloped upland and prime wetlands to buffer the restored brook. The restored riparian corridor is located on the Pease International Tradeport in Newington, New Hampshire at Lat/Long -70.81883, 43.10431. Refer to **Figure 1** – USGS Project Location Map.

The NHDES Wetlands Permit (2006-02007) issued for the Spaulding Turnpike Improvements Project contains conditions relative to the monitoring of the Railway Brook Restoration Site. Specifically, Condition #43 requires that a qualified professional shall conduct a follow-up inspection after the first growing season to review the success of the restoration work and to schedule remedial actions, if necessary. A report outlining these follow up measures and a schedule for completing remedial work shall be submitted to NHDES by December 1, 2015. Condition #43 also requires similar inspections, reports and remedial actions in at least the second, third and fifth years following completion of the mitigation site.

In accordance with the approved final mitigation report, VHB Senior Environmental Scientist, Kristopher Wilkes (CWS #288, CPESC #6137), designated as the Railway Brook Restoration Monitor, conducted two inspections on September 11, 2015 and October 28, 2015 as part of the 1st year monitoring requirements. Kristopher Wilkes was also present during implementation of the planting plan at the site which occurred in April and May of 2015.

This document shall serve as the 1st Annual Monitoring Report submitted to NHDES in accordance with Condition #43. The purpose of this document is to address how well the

Railway Brook Restoration Site is meeting eight success-standards outlined in the Final Mitigation Technical Report, prepared by VHB and dated June 2010. It is difficult to determine the extent of success of a restoration project after just one growing season. However based on observations made during inspections conducted by VHB in 2015, the Railway Brook Restoration Site is progressing as intended towards meeting all eight success standards. Additional data supporting this conclusion is discussed in **Section 3.0** of this report.

2.0 Site History and Project Rationale

During development of the mitigation package for the Spaulding Turnpike Improvements Project, Railway Brook was identified as an opportunity for restoration. A natural tributary to Pickering Brook, which flowed north and east discharging directly into the Piscataqua River, this stream was intercepted during the development of the former Pease Air Force Base and construction of railroad tracks. The stream corridor was severely altered, with the diversion of the stream through a deep, straight channel (subsequently named Railway Brook) constructed overland to Flagstone Brook to discharge into Trickys Cove on the Little Bay. Numerous concrete flood/spill control structures were added to detain flow and drop the elevation of the stream several feet at each weir as the watercourse descends in grade towards its outlet at Trickys Cove. The function and necessity of these structures came into question over time and they effectively destroyed the habitat value of the stream and adjacent wetlands. Additionally, much of the adjacent vegetation along the stream channel had been cut and cleared creating an opportunity for non-native invasive plant species to become established. A habitat assessment completed by VHB during the development of the mitigation package, indicated that the stream had poor water quality and lacked a diversity of habitat and aquatic life.

A design concept consisting of creation of a C5 Stream Type (Rosgen 1996) was developed by VHB for the restoration project between an existing wetland to the west and inactive railroad bed to the east. The restored stream begins just downstream of Arboretum Drive and extends downstream to within approximately 500 feet of the confluence of Railway Brook and Pickering Brook. The existing channel geometry has been modified to reduce the degree of incision, thereby creating a flood-prone area for natural dissipation of energy contained in high-flow/low frequency events. Another primary design parameter involved increasing sinuosity of the channel as much as possible within the site constraints. The restoration plan also involved creation of new wetlands along the restored stream corridor. In order to avoid disturbance to the existing railroad bed to the east, most of the increase in flood-prone area and sinuosity has been created to the west and designed to interface with and enhance existing wetlands. The restoration plan was designed to connect the stream to its floodplain, and thereby substantially improve the hydrologic and biologic function of Railway Brook as well as enhance/expand the adjacent wetland complex.

3.0 Restoration Site Performance Standards and Summary Data

The Railway Brook Restoration Site Success Standards, as listed in the US Army Corps of Engineers 2007 *Mitigation Guidance* Document and in the NHDES Wetlands Permit are outlined below. Additionally, a discussion of the associated criteria for each standard and evidence to support whether or not the Railway Brook Restoration is currently meeting, progressing towards or not yet meeting each standard is provided.

A summary of this information discussed below is provided in the Railway Brook Success Standards and Criteria Evaluation Table included as Appendix B.

3.1 Success Standard #1

The site has the hydrology, as demonstrated with well data collected at least weekly from March through June or other substantial evidence, to support the designed wetland type. Is the proposed hydrology met at the site? What percentage of the site is meeting projected hydrology levels? Areas that are too wet or too dry should be identified along with suggested corrective measures.

3.1.1 Criteria Evaluation

In order to assess the hydrology of the Railway Brook Restoration Site and ensure that the site is meeting the projected hydrology levels to support the designed wetland and stream type (i.e., soils are saturated to the surface for at least two weeks during the growing season; and groundwater is within one foot of the soil surface during this period), VHB installed four shallow monitoring wells by hand within Zone 2, established as forested floodplain wetland habitat, adjacent to Railway Brook. Wells were installed in accordance with the USACE guidance document "Installing Monitoring Wells/Piezometers in Wetlands," published by the Wetland Regulatory Assistance Program (ERDC TN-WRAP-00-002, July 2000). Wells were installed by VHB during the month of October 2015, which is outside the site's growing season. Therefore a determination cannot be made at this time as to whether or not Success Standard #1 is being met on-site. Well observations made during the second growing season (March through June 2016) and subsequent seasons throughout the duration of the monitoring period will provide the evidence required to make this determination.

Field evidence to support the successful establishment of hydrology within Zone 2 of the Railway Brook Restoration is also hindered at this time due to the presence of an upstream diversion still in place at the southern end of the restoration site as observed by VHB on October 28, 2015. The diversion is located on the opposite side of Arboretum Drive. The lowest flash board of the diversion has been removed allowing some flow to reach the restored channel, however NHDOT Construction Bureau Field Staff have indicated that the on-site

contractor has requested to leave the diversion in place until early November 2015 in order to allow as much time as possible for vegetation to become established within the restoration site. Without restoring full flow to Railway Brook, it is not possible to achieve an accurate depiction of the streams hydrological patterns (flooding and receding, etc.) as constructed.

Refer to **Figure 2** for the location of installed monitoring wells within Zone 2 of the restoration site as well **Appendix C** for field installation data sheets and photos.

3.2 Success Standard #2

Does the site have at least 500 trees and shrubs per acre, of which at least 350 per acre are trees for proposed forested cover types, that are healthy and vigorous and are at least 18″ tall in 75% of each planned woody zone AND at least the following number of non-exotic species including planted and volunteer species? Volunteer species should support functions consistent with the design goals. To count a species, it should be well represented on the site (e.g., at least 50 individuals of that species per acre).

# Species planted	***Minimum # species required (volunteer and planted)***
2	***2***
3	***3***
4	***3***
5	***4***
6	***4***
7	***5***
8	***5***
9 or more	***6***

3.2.1 Criteria Evaluation

Planting of the Railway Brook Restoration Site commenced in April 2015 and was completed in early June 2015. The planting plan gave preference to native plant species already found in wetlands within the project area. Bare root and container plantings, installation of live stakes, and application of seed in Restoration Zones 1 to 4, as identified on the Railway Brook Restoration Plans (dated 05/14/2012), were completed in accordance with plan notes, documented and approved (NHDOT & VHB) plant substitutions, and under the supervision of VHB and NHDOT Environmental and Construction Bureau Field Staff.

A total of four planting zones were installed as part of the restoration project including the following:

Zone 1- Streamside – Cowardin Classification: R3UBB
Zone 2 – Floodplain Wet – Cowardin Classification: PFO1E
Zone 3 – Floodplain Dry – Cowardin Classification: PFO1J
Zone 4 – Upland

Zone 1

A total of 7,360 plantings were installed within Zone 1 which has been designated as streamside. Zone 1 extends approximately 5-feet out from the top-of-bank of the brook. Approximately 95% of the plantings (7,020) installed consisted of live stakes approximately 3-feet in height above the ground surface. Live stake species include pussy willow (*Salix discolor*), red-osier dogwood (*Cornus sericea*), and silky willow (*Salix sericea*). The remaining five percent of plantings included two percent of bare root shrub species (152), two percent of herbaceous species in tuber form (150), and one-percent of shrub species (38) in container form.

Based on the total inventory of tree and shrub species planted (7,210) and the total acreage of Zone 1 (0.62 acres), tree and shrub species were planted at a rate of 11,629 species per acre significantly exceeding the minimum standards for density outlined in Success Standard #2. However, at this time it is difficult to determine the success of the live stake plantings in Zone 1. The stakes were installed in April 2015 and live stakes typically take at least a year to become established. The success of live stakes will continue to be monitored as part of the requirements of the restoration plan. Observations and recommendations will be documented in the annual monitoring reports.

The bare root and tuber species planted within Zone 1 were visually observed to be healthy and growing in excess of 18" tall at the time of the site inspections. In addition to the plantings, herbaceous species included in the seed mixes applied to Zones 1, 2 and 3 were found to be present and growing in dense colonies alongside the stream, particularly fox sedge (*Carex vulpinoides*), beggar-ticks (*Bidens frondosa*), and lance-leaved coreopsis (*Coreopsis lanceolata*), as well as several grasses. A number of weedy volunteer species, including nodding smartweed (*Polygonum lapathifolium*), cow vetch (*Vicia cracca*), species of clover (*Trifolium* spp.) and dandelion (*Taraxacum* spp.) have also densely colonized Zone 1.

Zone 2

A total of 2,658 plantings were installed within Zone 2. Zone 2 extends approximately 20 feet from the edge of Zone 1 or 25 feet from the top-of-bank and is intended to become established as forested floodplain wetland habitat that is seasonally flooded/saturated. Approximately 47% (1,255) of the total plantings within Zone 2 consisted of container tree species including silver maple (*Acer saccharinum*), red maple (*Acer rubrum*), American elm (*Ulmus americana*) and swamp white oak (*Quercus bicolor*). The remaining 53% of plantings consists of 41% of container and bare-root shrub species (1,103), and 12% of container herbaceous species (300).

Based on the total inventory of tree and shrub species planted (2,358) and the total acreage of Zone 2 within the restoration site (1.20 acres), tree and shrub species were planted at a rate of

1,965 species per acre which exceeds the minimum standards for density outlined in Success Standard #2. Shrubs and trees within Zone 2 were observed to be healthy during the site inspections and ranged from 2 and 6 feet tall based on observed species height, with some areas exhibiting saplings over six feet. Deer browse was found on approximately 10 planted tree species within Zone 2 in the northern half of the project site (north of Station 7010) while a small number of trees (estimated at 3%) were observed to be dead or dying. In addition to the plantings, herbaceous species included in the applied seed mixes as well as a number of weedy volunteer species (as previously described in Zone 1) were also observed to be densely growing throughout Zone 2.

Zone 3

A total of 4,103 plantings were installed within Zone 3. The width of Zone 3 varies throughout the restoration site and is intended to become established as forested floodplain that is intermittently flooded. Approximately 75% (3,058) of the total plantings in Zone 3 consisted of container or bare root tree species including red maple, sugar maple (*Acer saccharum*), blue beech (*Carpinus caroliniana*), shagbark hickory (*Carya Ovata*), white ash (*Fraxinus americana*), white pine (*Pinus strobus*), black cherry (*Prunus serotina*), and American basswood (*Tilia americana*). The remaining 25% (1,045) of plantings consisted of nannyberry (*Viburnum lentago*), Virginia creeper (*Parthenocissus quinquefolia*), and northern lady fern (*Aythrum filix-femina*).

Based on the total inventory of tree and shrub species planted (3,273) and the total acreage of Zone 3 within the restoration site (2.12 acres), tree and shrubs were planted at a rate of 1,544 species per acre within Zone 3 which exceeds the minimum standards for density outlined in Success Standard #2. Similar to Zone 2, trees and shrubs within Zone 3 were observed to be healthy during the site inspections and ranged from 2 and 6 feet tall based on observed species height, with some areas exhibiting saplings over six feet. Deer browse was found occasionally throughout Zone 3 (damage was insignificant relative the number of species planted), while a very small number plantings appeared to be dead or dying (< 3%). In addition to the plantings, herbaceous species included in the applied seed mixes, as well as a number of weedy volunteer species found to be growing in Zones 1 and 2, were also found in dense populations within Zone 3.

Zone 4

A total of 50 plantings were installed within Zone 4 in the spring of 2015. Zone 4 is confined to a single area approximately 0.05 acres in size located along the western side of Railway Brook. Zone 4 is intended to become established as forested upland habitat. Of the total plantings, 45 of them consisted of tree species including black birch (*Betula lenta*), shagbark hickory, beaked hazelnut (*Corylus cornuta*), white ash, white pine, black cherry, red oak (*Quercus rubra*), black oak (*Quercus velutina*), and American basswood. Tree plantings consisted of container, bare root, and balled and burlaped species. In addition to the tree plantings, five maple leaved viburnums (*Viburnum acerifolium*) in container form were planted. Based on the total inventory of tree and shrub species planted (50) and the total acreage of Zone 4 (0.05 acres), trees and shrubs were planted at a rate of 1,000 species per acre

within Zone 4 which exceeds the minimum standards for density outlined in Success Standard #2. All fifty of the tree and shrubs planted were observed to be in healthy condition with some growing over six feet tall. No deer browse or dead or dying species were observed. Lastly, herbaceous species included in the applied seed mixes as well as a number of weedy volunteer species found to be growing in Zones 1 through 3 have also densely colonized Zone 4.

A table summarizing the planting data outlined above with respect to Success Standard #2 is provided below. Also refer to **Appendix D** for photo-documentation of successful vegetative establishment within Zones 1 through 4. Corresponding photo locations are depicted on **Figure 2**.

Table 1: Success Standard #2 - Plantings Zones 1 through 4 of Railway Brook

Planting Zone	Acres	# of Tree and Shrub Species Planted	# of Tree and Shrub Species Per Acre	Estimated % Cover of Species Healthy and > 18" in Height	Volunteer Species Present?	Success Criteria Met?
1 – Streamside	0.62	7,210	11,629	TBD[1]	Yes	TBD[1]
2 – Wet Floodplain	1.20	2,358	1,965	> 75%	Yes	Yes
3 – Dry Floodplain	2.12	3,273	1,544	> 75%	Yes	Yes
4 - Upland	0.05	50	1,000	> 75%	Yes	Yes

1 - At this time it is difficult to determine the success of the live stake plantings in Zone 1. The success of live stakes will continue to be monitored as part of the requirements of the restoration plan. Observations and recommendations will be documented in the annual monitoring reports.

3.3 Success Standard #3

Does each mitigation site have at least 80% aerial cover, excluding planned open water or planned bare soil areas (such as turtle nesting), by non-invasive species? Do planned emergent areas on each mitigation site have at least 80% cover by non-invasive hydrophytes? Do planned scrub-shrub and forested cover types have at least 60% cover by non-invasive hydrophytes, of which at least 15% are woody species? For the purpose of this success standard, invasive species of hydrophytes are:

Cattails – Typha latifolia, Typha angustifolia, Typha glauca;
Common Reed – Phragmites australis;
Purple loosestrife – Lythrum salicaria;
Reed canary grass – Phalaris arundinacea; and
Buckthorn – Frangula alnus

3.3.1 Criteria Evaluation

As outlined in **Section 3.2.1**, a total of four planting zones were established as part of the restoration project. These zones were designed to support scrub-shrub and forested cover types. Percent aerial cover can be interpreted as the percentage of the ground surface covered by the vertical projection of the aerial portion of plants (i.e. the canopy). At this time, it is somewhat difficult to estimate the percent of aerial cover of the tree and shrub plantings due to their size and growth stage. The plantings have only been through one growing season with the majority of them at or just below eye-level in height. The plantings are also not yet large enough for percent cover to be interpreted through aerial imagery.

Based on observations made during inspections conducted by VHB in 2015, the woody plantings themselves do not account for 60% aerial cover at the site at this time. However when other species currently established at the site (those included in the applied seed mixes as well as a number of volunteer species) are factored in to total percent cover estimates, each planting zone far exceeds the 60% success criteria. In addition, based on site observations and the amount of woody species planted per zone (far exceeding the minimum per acre requirements of Success Standard 2), total percent cover of woody species within each zone was estimated above 15%. It is expected that the percent aerial cover of planted shrub and tree species will continue to grow over each of the next four growing seasons of the monitoring period and will eventually exceed 60% of the total aerial cover at the site. Bare ground was not included as a component of the restoration area and was not found to be present in any of the zones on-site.

Of the invasive species outlined in Success Standard #3 above, only purple loosestrife and narrow-leaf cattail were found to be growing in small numbers within the limits of the restoration site during the two site inspections conducted by VHB. Purple loosestrife and narrow-leaf cattail were observed to be growing directly within the streambed in the far southern (upstream) end of the restoration site from Station 7000 to 7009. The purple loosestrife was somewhat scattered throughout this reach, while the cattail has formed denser stands. However, the combined percent cover of these species within the stream bed from Station 7000 to 7009 was estimated at 15 percent in this location. An additional small (10’x5’) isolated stand of narrow-leaf cattail was also observed within the stream bed at Station 7012. Purple loosestrife and narrow-leaf cattail (apart from Station 7012) were absent within the stream bed from Stations 7009 to 7019, but again were found to be present within the stream bed directly adjacent to twin 36-inch culverts between Stations 7019 and 7022. At this location, purple loosestrife and narrow-leaf cattail were also observed to be growing within Zones 1 and 2 directly east of the brook within the limits of an existing overhead electric transmission line easement that intersects the restoration site from east to west. Invasive plants were denser in this location, with a combined percent cover estimated at 20 percent. Although both species are present within the restoration area, their total percent aerial cover relative the entire restoration site is well under 20 percent.

Based on the observed locations of purple loosestrife and cattail within the restored channel itself, establishment of this species appears to be the direct result of plant material being transported to the brook via drainage from other wetland systems present nearby. The establishment of purple loosestrife within Zones 1 and 2 between Stations 7019 and 7022 may also be influenced by the existing transmission line right-of-way which contains additional populations of purple loosestrife both outside of the eastern and western limits of the restoration site. It is also theorized that the establishment of these species within the stream bed is a direct result of the upstream diversion remaining in place. Without full flow restored to the channel, pockets of the stream are naturalizing as wetland habitat favoring the growth of vegetation of which would otherwise be absent if the brook contained flowing water.

No other areas of invasive species were identified within the restoration site. Refer to **Figure 2** for mapped locations of purple loosestrife and narrow-leaf cattail within the restoration site.

3.4 Success Standard #4

Are Common reed (Phragmites australis), Purple loosestrife (Lythrum salicaria), Russian and Autumn Olive (Elaeagnus spp.), Buckthorn (Rhamnus spp.), Japanese knotweed (Polygonum cuspidatum), and/or Multiflora rose (Rosa multiflora) plants at the mitigation site being controlled?

3.4.1 Criteria Evaluation

Purple loosestrife was the only invasive listed in Success Standard #4 above that was discovered to be growing within the restoration site during the two site inspections conducted by VHB in 2015. Restoration of Railway Brook was completed in June 2015, and purple loosestrife was not identified on-site until September 2015. Based on the timing of the discovery, treatment of purple loosestrife is not feasible this year. Treatment of purple loosestrife is most effective between mid-summer and early fall. Plants can be easily identified during this time, and treatment is best as soon as possible after the plants begins to flower. This minimizes seed production. Once flower petals start to drop from the bottom of the spike, the plant begins to produce seed. Control activities can occur outside of this optimum window, however extra care must be taken to prevent the dispersal of seeds from the plant.

Treatment including manual, chemical or biological control will be assessed as part of Years 2 through 5 of the monitoring period to ensure that purple loosestrife does not become further established within the restoration site.

3.5 Success Standard #5

Are all slopes, soils, substrates, and constructed features within and adjacent to the mitigation site stabilized?

3.5.1 Criteria Evaluation

Based on observations from the two inspections conducted by the Restoration Monitor in 2015, as well additional inspections conducted by VHB Stream Engineers, all areas of the restoration site have been permanently stabilized in accordance to the Project Restoration Plans (dated 05/14/2012). The banks and bed of Railway Brook were observed to be stable at the time of the inspection with no significant signs of erosion or scour present. The sand-bag diversion previously installed within the brook at the northern (upstream) end of the restoration site has been removed. The upstream diversion located at the southern end of the restoration site, on the opposite side of Arboretum Drive, remains in place at this time. The lowest flash board of the diversion has been removed allowing for some flow to reach the restored channel. NHDOT Construction Bureau Field Staff have indicated that the on-site contractor has requested to leave the diversion in place until early November 2015 in order to allow as much time as possible for vegetation to become established within the restoration site. As a result, only minimal flow was observed within the brook between Stations 7000 and 7020. Flow was moderate downstream of Station 7020 due to the presence of twin 36-inch culverts and tributaries from a wetland located to the west of the brook which contribute flow.

Generally, coir fiber matting and rolls installed along the banks of the brook remain securely in place as installed. Some sloughing was observed during a previous site visit conducted by VHB over the course of the planting and seeding work (May 2015), but has since been repaired and mitigated with the establishment of dense vegetation. Additionally, installed cross-vane structures, root wads, and boulder cluster grade controls remain in place with very little migration of bedding materials (cobble-gravel-sand) observed. Additional trimming of geotextile fabric below channel bed elevations at cross-vane locations is recommended by VHB and has been communicated to NHDOT and the on-site contractor. Deposition of some smaller cobble material was previously observed in the far northern (downstream) portion of the restored channel during the May 2015 site inspection. However, movement of the streambed material appeared to have been limited to the smaller particles which were on top of the channel bed, while the larger stones beneath did not move. Discharge from the twin 36-inch culverts located at Station 7020 and tributaries from the wetland located to the west contributed to stream flow which likely mobilized some of these smaller particles. Movement of smaller particles is expected as the streambed settles and streamflow moves stones until they embed or settle out. Some grade stakes were still observed within the channel at the time of the most previous inspection (October 28, 2015) and have been brought to the attention of NHDOT and the on-site contractor.

Lastly, stone has been removed from the construction access and staging area located at the southern (upstream) end of the restoration site and this area has been restored to pre-existing conditions and permanently stabilized with seed and mulch. Dense vegetation consisting of grasses and weedy species was observed within this area during the October 28th inspection by VHB.

Refer to **Appendix D** for photographs depicting a stable stream bed and banks as well as permanent stabilization of the surrounding restoration zones.

3.6 Success Standards #6 & 7

Success Standard #6
Wetland creation areas shall have at least 75% successful establishment of wetlands vegetation after two (2) growing seasons, or shall be replanted and re-established until a functional wetland is replicated in a manner satisfactory to NHDES (NHDES Permit Condition 44).

Success Standard #7
NHDOT shall delineate the wetlands and flood storage volume within the mitigation sites, document the delineation with US Army Corps of Engineers' data forms, and depict the delineation as an overlay of the final as-built plans after at least five full growing seasons (NHDES Permit Condition 45).

3.6.1 Criteria Evaluation

Both Success Standards #6 and 7 involve observations and/or activities that are intended to occur beyond the first growing season, and therefore the success of the restoration site in meeting these standards cannot be evaluated at this time. Success Standard #6 will be evaluated next year, after the second growing season. Success Standard #7 involves delineation of wetlands and flood storage volume within the restoration area after five full growing seasons, which will occur in 2019.

3.7 Success Standard #8

The stable stream condition for the restoration reach has been identified as a Rosgen C5 stream type. The range of conditions that define this stream type will comprise the performance standards for stream geomorphic parameters. In addition, rock cross-vanes and J-hooks must remain stable. The Bank Erosion Hazard Index (BEHI) for each bank within the stream restoration area will be assessed according to methods described in Rosgen (2001).

3.7.1 Criteria Evaluation

A VHB stream engineer inspected the Railway Brook Restoration Site to assess the Bank Erosion Hazard Index (BEHI) for each of the stream banks within the site in accordance with methods described in Rosgen. This methodology assigns point values to several bank

conditions and provides an overall score that can be used to assess stream bank erosion potential over large areas. VHB examined the banks in approximately 250-ft segments alternating between pool and riffle section of the stream profile. Bankfull width (BFW), Bankfull Height (BFH), and Bank Angle measurements were taken at each location. Root density and surface procreation were assessed for each reach. A root depth of 6" was estimated across the site based on the established vegetation which consisted of grasses and small shrubs and saplings.

The BEHI for Railway Brook restoration site ranged from 5.5 to 8.6 with an average ranking of 7.3 which has an erosion potential score of very low. To be conservative, the highest value for each bank condition range, as presented by Rosgen, was used to calculate the BEHI. The bankfull depth matched the bank height for the entire length of the restoration site. The vegetated root density covered approximately 90% to 100% of the bank areas. The areas without significant root density included portions of the coir mat and the coir log; however, the bank surface is protected by these erosion control measures. Side slopes ranged between 1(h):1(v) to 3(h):1(v) as designed. Overall, the Railway Brook stream banks are stable without any observed signs of erosion and a very low BEHI erosion potential.

Refer to **Appendix E** for BEHI field measurements and scores as well as corresponding photos.

4.0 Conclusion

After one full growing season, the Railway Brook Restoration Site was determined to be successfully meeting Standards 2, 3, 5, and 8 based on field assessments conducted by VHB in 2015. The remaining four standards (1, 4, 6 & 7) involve further assessment or activity which is planned for Years 2 through 5 of the monitoring period, and therefore a determination of success for these standards cannot be made at this time. Evidence of site hydrology to support the designed wetland zones will be gathered during the growing season in 2016. At that time a determination will be made as to whether or not any remedial actions, such as modifications to elevations, are required. Based on the presence of invasive species within the restoration site as observed during 2015, specifically purple loosestrife, an appropriate treatment plan will need to be developed in 2016 that fits the restoration goals. Successful establishment of wetland vegetation (75%) after two growing seasons will be also be assessed during field inspections in 2016. Lastly, the documentation of wetlands which become established within the restoration site will be completed by conducting an on-site delineation after five growing seasons in 2019. A summary table is provided in **Appendix B**, containing data and commentary on each of the eight success standards to support these conclusions.

Figures

Figure No.	Description
1	USGS Project Location Map
2	Railway Brook 1st Year Monitoring Map

\\nhbedata\projects\52012.00\GIS\project\Monitoring\Figure1USGS_SiteLocation.mxd

0 1000 2000 4000 Feet

Legend

Site Location

Railway Brook Restoration | Newington, NH

Site Location Map

Source: NHGRANIT, VHB

\\nhbedata\projects\52012.00\GIS\project\Monitoring\Figure2.mxd

0 40 80 160 Feet

Legend

- Project Stationing
- Photo Location
- Installed Shallow Groundwater Well (2015)
- Boulder Cluster
- Cross Vane
- Root Wad
- Previously Delineated Wetland Area (VHB)
- Invasives
- Planting Zone 1 (Streamside)
- Planting Zone 2 (Floodplain Wet)
- Planting Zone 3 (Floodplain Dry)
- Planting Zone 4 (Upland)

Railway Brook Restoration | Newington, NH

Railway Brook
1st Year Monitoring Map

Source: NHGRANIT, VHB

\\nhbedata\projects\52012.00\GIS\project\Monitoring\Figure2.mxd

0 40 80 160 Feet

Legend

- Project Stationing
- Photo Location
- Installed Shallow Groundwater Well (2015)
- Boulder Cluster
- Cross Vane
- Root Wad
- Previously Delineated Wetland Area (VHB)
- Invasives
- Planting Zone 1 (Streamside)
- Planting Zone 2 (Floodplain Wet)
- Planting Zone 3 (Floodplain Dry)
- Planting Zone 4 (Upland)

Railway Brook Restoration | Newington, NH

Railway Brook
1st Year Monitoring Map

Source: NHGRANIT, VHB

\\nhbedata\projects\52012.00\GIS\project\Monitoring\Figure2.mxd

0 40 80 160 Feet

Legend

- Project Stationing
- Photo Location
- Installed Shallow Groundwater Well (2015)
- Boulder Cluster
- Cross Vane
- Root Wad
- Previously Delineated Wetland Area (VHB)
- Invasives
- Planting Zone 1 (Streamside)
- Planting Zone 2 (Floodplain Wet)
- Planting Zone 3 (Floodplain Dry)
- Planting Zone 4 (Upland)

Railway Brook Restoration | Newington, NH

Railway Brook
1st Year Monitoring Map

Source: NHGRANIT, VHB

Appendices

Appendix	Description
A	NHDES Wetlands Permit 2006-02007 & USACE Permit NAE-2004-3545
B	Railway Brook Success Standards and Criteria Evaluation Table
C	Shallow Groundwater Monitoring Well Field Documentation
D	Representative Site Photographs
E	Bank Erosion Hazard Index Field Documentation

Appendix A

NHDES and USACE Permits

■

The State of New Hampshire

DEPARTMENT OF ENVIRONMENTAL SERVICES

Thomas S. Burack, Commissioner

June 17, 2009

Charles Hood
NH Dept of Transportation
7 Hazen Drive
Concord, NH 03301

RE: NH Dept of Transportation- File # 2006-02007 – Dover/ Newington

Dear Mr. Hood:

Attached please find Wetlands Permit # 2006-02007 to: Reconstruct and widen approximately 3.5 miles of highway, reconfigure interchanges, rehabilitate and widen the Little Bay Twin Bridges to eight lanes and rehabilitate the General Sullivan Bridge impacting approximately 20.4 acres of palustrine, riverine and estuarine wetlands.

Compensation for wetland impacts includes preservation of 150 to 250 acres of wetland and upland habitat along with the re-construction and preservation of more than 3,100 linear feet of Railway Brook, associated wetlands and adjacent uplands (approximately 23.4 acres). Mitigation is for this project and three previously permitted projects impacting a total of approximately 22.8 acres of jurisdictional areas. (NHDOT project # 11238).

The decision to approve this application was based on the following findings:

1. The purpose and need for the project has been documented in the Final Environmental Impact Statement (hereinafter "FEIS"), and materials presented in the NHDES file.
2. The proposed project is considered a major impact project per Rules Env-Wt 303.02(a) projects in tidal wetlands, Env-Wt 303.02(b) projects within 100 ft. of the highest observable tideline and Env-Wt 303.02(c) as impacts to jurisdictional areas exceed 20,000 sq. ft.
3. The need for the proposed access road has been recognized by varying levels of government since 1990 and once constructed, will become a part of the National Highway System. This project has consistently been acknowledged a vital component of the region's transportation network and included in the NHDOT Ten-Year Improvement Plans.
4. In 1990, the NH State Legislature recognized the need to study potential improvements in order to address safety concerns within the project area.
5. The proposed improvements and wetland impact locations generally follow along the existing roadway, which reduces the potential for impacts to new wetland and stream areas, with the exception of the construction of one new interchange.

DES Web site: **www.des.nh.gov**
P.O. Box 95, 29 Hazen Drive, Concord, New Hampshire 03302-0095
Telephone: (603) 271-2147 • Fax: (603) 271-6588 • TDD Access: Relay NH 1-800-735-2964

6. NHDOT is responsible for transportation functions in order to assure consistency and safety of the general public.
7. NHDOT has applied generally accepted methodologies to address the issues of traffic volume and projections.
8. Upon studying information provided by NHDOT, NHDES does not find any fundamental flaws in the existing traffic,study, and finds the traffic projections to be a reasonable demonstration of need as required by Rule Wt 302.04(a)(1).
9. Alternatives to the proposed reconstruction and widening of roadways, including transportation system management, transportation demand management, and other options were analyzed in the FEIS. It was determined that implementing those options alone do not fully address the safety and capacity needs in the project area.
10. The NHDOT performed an adequate screening process to identify alternatives that could potentially satisfy the project purpose and summarized environmental consequences of each alternative. As a result of the screening process, a reasonable range of alternatives was selected for analysis in the Draft EIS.
11. Field inspections were conducted over several years by NHDES in coordination with other local, state, and federal agency representatives and found that the wetlands delineation, functions and values, and impact analysis were consistent with the information submitted with the application.
12. The flagging and survey of wetland boundaries during final design phase shall be shown in detail on the contract plans.
13. A Public Hearing was held jointly with the Special Committee (appointed by the Governor and Executive Council), NHDES, NHDOT, the Federal Highway Administration (FHWA) and the US Army Corps of Engineers (USACOE) on September 21, 2006 in Dover.
14. The planning and review process provided opportunities for public involvement and participation through the utilization of an Advisory Task Force, Public Informational Meetings, the application review process and a joint Public Hearing with state and federal agencies.
15. The NHDES has received and reviewed a substantial number of letters both in support of, and in opposition to, the project. Those letters are in the file, and information in those letters has been considered as part of this decision.
16. Direct impact of approximately 20.4 acres of palustrine, riverine and estuarine wetlands will result from the Selected Alternative.
17. The project will impact 1.2 acres within the 100-year floodplain (3.9 acre-feet) and is not considered significant considering the size of the rivers watershed area.
18. The flood storage impacts shall be mitigated by providing flood storage in association with the brook construction mitigation area, along with Stormwater treatment in specially designed BMP's and extended detention basins.
19. Management of storm water and erosion control, to prevent any degradation to water quality, is found in Volume I of IV, Section 11-D.
20. The NHDOT Selected Alternative meets the project purpose and represents a balance between impacts to environmental resources, social, cultural, and economic effects with transportation needs.
21. It is the finding of NHDES that the applicant has addressed all application requirements of Parts Env-Wt 301, 302, 800, and RSA 482-A.

22. NHDES based its decision to approve this project on the record before it. The NHDES concluded after a review of the record that the proposed Selected Alternative addresses the project purpose and is the least adverse impact to areas and environments under the NHDES jurisdiction.
23. Best Management Practices for treating storm water runoff and erosion and sediment control shall be followed during construction limiting impacts to water resources in the project area. If the BMP conflicts with terms and conditions of this permit, the permit terms and conditions shall control.
24. After reviewing the Dredge and Fill application file, the DES finds that this project does not require a Comprehensive Shoreland Protection Act permit per rule Env-Wq 1406.03 (a), as the department has determined the property owner has incurred substantial liabilities in a reasonable, good faith reliance on the absence of a controlling law or regulation, sometimes called vested rights.

Mitigation Findings
25. The mitigation approved under this permit also includes compensation for permanent impacts from three other NHDOT projects in the vicinity including permit 2004-02195 Spaulding Turnpike (exits 4 and 4N), Shattuck Way and Nimble Hill Rd.; permit 2006-00263 for a park-and-ride facility in Dover and permit 2005-00763 on and adjacent to Rte. 155 in Madbury.
26. On April 22, 2008, the NHDES received a copy of the Conservation Easement Deed on 109.12 acres of the Tuttle Farm located in Dover as recorded at the Strafford County Register of Deeds.
27. On February 5, 2009, the NHDES received a copy of the Conservation Easement Deed on 40 acres of the Day property located in Dover as recorded at the Strafford County Register of Deeds.
28. The proposed protection within the mitigation plan will help maintain viable wildlife populations by adding to the connectivity of habitats previously fragmented by development.
29. The proposed mitigation measures will result in providing and protecting open space as a form of relief relative to future development in the surrounding towns.
30. Mitigation is not a factor considered by the NHDES in its determination of either need or impact, but is an accepted means to compensate for the impacts of the alternative with the least adverse impact. NHDES has compensatory mitigation rules, that prescribe when, and how much and what kind of, compensatory mitigation is appropriate for a given project's wetlands impact. The NHDES has concluded that the NHDOT has provided adequate compensatory mitigation relative to the project impacts.
31. A review of potential mitigation sites was conducted that resulted or will result in the preservation of wetlands and associated uplands to compensate for proposed impacts.
32. The mitigation proposal meets the NHDES regulatory mitigation ratios.
33. The entire mitigation proposal with all of the preservation components is appropriate for the scope and degree of impacts that will result from the proposed project.
34. The Department finds that the proposed impacts to wetlands and surface waters can be offset by the execution of an appropriate mitigation strategy.

Any party may apply for reconsideration with respect to any matter determined in this action within 30 days from the date of this letter. A motion for reconsideration must specify all grounds upon which future appeals may be based, and should include information not available to DES when the decision was made. DES may grant reconsideration if, in its opinion, good reason is provided in the motion.
Your permit must be signed, and a copy must be posted in a prominent location on site during construction.
If you have any questions, please contact our office at (603) 271-2147.

Sincerely,

Gino E. Infascelli
Public Works Supervisor
DES Wetlands Bureau

cc: Dover Conservation Commission
Dover Municipal Clerk
Newington Conservation Commission
Newington Municipal Clerk

The State of New Hampshire

DEPARTMENT OF ENVIRONMENTAL SERVICES

Thomas S. Burack, Commissioner

WETLANDS AND NON-SITE SPECIFIC PERMIT 2006-02007

Permittee: NH Dept of Transportation
7 Hazen Drive Concord, NH 03301
Project Location: Spaulding Turnpike, Dover - Newington
Waterbody: Bellamy River, Little Bay, Piscataqua River

NOTE-- CONDITIONS

APPROVAL DATE: 06/17/2009 **EXPIRATION DATE: 06/17/2014**

Based upon review of the above referenced application, in accordance with RSA 482-A and RSA 485-A:17, a Wetlands Permit and Non-Site Specific Permit was issued. This permit shall not be considered valid unless signed as specified below.

PERMIT DESCRIPTION: Reconstruct and widen approximately 3.5 miles of highway, reconfigure interchanges, rehabilitate and widen the Little Bay Twin Bridges to eight lanes and rehabilitate the General Sullivan Bridge impacting approximately 20.4 acres of palustrine, riverine and estuarine wetlands.

Compensation for wetland impacts includes preservation of 150 to 250 acres of wetland and upland habitat along with the re-construction and preservation of more than 3,100 linear feet of Railway Brook, associated wetlands and adjacent uplands (approximately 23.4 acres). Mitigation is for this project and three previously permitted projects impacting a total of approximately 22.8 acres of jurisdictional areas. (NHDOT project # 11238)

THIS APPROVAL IS SUBJECT TO THE FOLLOWING PROJECT SPECIFIC CONDITIONS:

1. The wetland impacts associated with this approval are based the New Hampshire Department of Environmental Services Wetlands Bureau (hereinafter "NHDES")/Army Corps of Engineers permit application received on August 11, 2006, the Final Environmental Impact Statement (hereinafter "FEIS") received on February 6, 2008 and the Record of Decision received on November 7, 2008.
2. During final design and construction work, wetland impacts that exceed 20.4 acres as represented in the plans provided in the NHDES/Army Corps of Engineers permit application and materials presented in the NHDES file, shall require submittal of a permit amendment request to be reviewed and approved by the NHDES.
3. During final design of roadway construction plans, a joint review shall be held by state and federal agencies regarding proposed water quality treatment features such as grass swales or detention basins that may cause additional jurisdictional impacts for construction to confirm need, location, and necessity for a permit amendment.
4. The water quality structures and basins shall be designed to avoid and minimize impacts to wetlands and surface waters.

5. Review and comments from NHDES shall be considered by the NH Department of Transportation (hereinafter "NHDOT") and incorporated into the design where it is reasonably appropriate.
6. Plan reviews shall be coordinated by the NHDOT at the Slope and Drain (SD) and the Preliminary Plans, Specifications and Estimates (PPSE) design phases along with an explanation of how jurisdictional impacts were avoided or, when not avoided, how the design minimizes impacts while allowing 30 days for review and comment at each of these design phases.
7. During design, efforts to avoid or minimize wetland and surface water impacts shall continue by evaluating the use of steep side slopes, and/or construction of retaining walls to the extent practicable.
8. Final design plans for roadway construction shall be submitted by the applicant, prior to construction, to NHDES and appropriate Conservation Commission for each contract with a summary of wetland impacts for the associated contract work.
9. The NHDOT shall comply with the provisions of the Section 401 Water Quality certification upon its issuance.
10. This permit is contingent upon compliance with the DES Alteration of Terrain requirements as indicated in the DES /NHDOT Memorandum of Understanding.
11. This permit is contingent upon the submission of a project specific stream diversion and erosion control plans to the NHDES Wetlands Bureau for review and approval. Those plans shall detail the timing and method of stream flow diversion during construction, shall show the temporary siltation, erosion and turbidity control measures to be implemented, shall follow the commitments noted in the FEIS section 11-N.
12. Dredged material shall be placed out of the NHDES jurisdiction unless otherwise specified.
13. Unconfined work within the river, exclusive of work associated with installation of a cofferdam, shall be done during periods of low flow.
14. Cofferdams shall not be installed during periods of high flow, whether due to seasonal runoff or precipitation. Once a cofferdam is fully effective, confined work can proceed without restriction.
15. Prior to commencing work on a substructure located within surface waters, a cofferdam shall be constructed to isolate the substructure work area from the surface waters, unless other methods are specifically authorized by the DES Wetlands Bureau after submittal of a SWPPP.
16. Temporary cofferdams shall be entirely removed immediately following construction.
17. Construction equipment shall not be located within surface waters.
18. Discharge from dewatering of work areas shall be to sediment basins that are: a) located in uplands; b) lined with hay bales or other acceptable sediment trapping liners; and c) set back as far as possible from wetlands and surface waters, in all cases with a minimum of 20 feet of undisturbed vegetated buffer.
19. Appropriate siltation/erosion/turbidity controls shall be in place prior to construction, shall be maintained during construction, and remain in place until the area is stabilized. Silt fence(s) must be removed once the area is stabilized.
20. Within three days of the last activity in an area, all exposed soil areas, where construction activities are complete, shall be stabilized by seeding and mulching during the growing season, or if not within the growing season, by mulching with tack on slopes steeper than 3:1 or netting /matting and pinning on slopes steeper than 2:1.

21. Where construction activities have been temporarily suspended within the growing season, all exposed soil areas shall be stabilized within 14 days by seeding and mulching or if temporarily suspended outside the growing season, all exposed areas shall be stabilized within 14 days by mulching, mulching with tack on slopes steeper than 3:1 and stabilized by matting and pinning on slopes steeper than 2:1.
22. The contractor responsible for completion of the work shall utilize techniques described in the New Hampshire Stormwater Manual, Volume 3, Erosion and Sediment Controls During Construction (December 2008).
23. Appropriate storm water management and erosion control Best Management Practices (BMP) shall be implemented to ensure turbidity impacts are minimized and water quality standards are not violated. If the BMP conflicts with terms or conditions of this permit, the terms and conditions of this permit shall control.
24. The project engineer shall oversee installation of erosion controls and periodically verify that the controls are properly maintained during construction.
25. The NHDOT shall limit unnecessary removal of vegetation within riparian areas during road construction and areas cleared of vegetation shall be re-vegetated as quickly as possible after construction to minimize erosion and restore wildlife habitat.
26. Land clearing in wetland areas during highway construction is to be kept to a minimum to reduce impacts on wildlife habitat.
27. Standard precautions shall be taken not to import or transport soil or seed stock from nuisance, invading species such as purple loosestrife or Phragmites.
28. There shall be no further alteration of wetlands or surface waters without amendment of this permit.
29. At least 48 hours prior to the start of each construction contract, a pre-construction meeting shall be held with NHDES Wetlands Bureau and / or other Land Resources Management Program staff at the project site, at the NHDES Office in Concord or Portsmouth, N.H. to review the conditions of this wetlands permit, the NHDES Water Quality Certificate and any environmental commitments stated in the approved documents.
30. It shall be the responsibility of the permittee to schedule and coordinate the pre-construction meeting providing at least 5-day notice to the NHDES Wetlands Bureau and / or other Land Resources Management Program staff, and the meeting shall be attended by the permittee, the contract administrator(s), wetlands scientist(s), erosion control monitor, and the contractor(s) responsible for performing the work.
31. All activity shall be in accordance with the Comprehensive Shoreland Protection Act, RSA 483-B.
32. Any temporary impacts within the undisturbed Tidal Buffer Zone shall be regraded to original contours and replanted with similar vegetation.
33. This permit is contingent on the execution of the mitigation components specified in the application and FEIS and shall be completed prior to the permit expiration.
34. Modifications to the mitigation proposal may be required if necessary changes to the project cause impacts that significantly exceed acres represented in the application.
35. NHDOT and NHDES shall form an Interdisciplinary Oversight Team to provide technical assistance on the construction and completion of the brook and wetland construction site.

36. Plans shall be submitted to a state and federal technical panel for review and approval during the various stages of design regarding the construction and preservation of more than 3,100 linear feet of brook, associated wetlands and adjacent uplands (approximately 23.4 acres) to replace the existing constructed channel (Railway Brook).
37. The schedule for the construction of the brook and wetland construction areas shall coincide with the highway-widening project unless otherwise authorized by NHDES.
38. The wetland creation areas shall be properly constructed, monitored, and managed in accordance with final mitigation plans approved by NHDES.
39. Wetland creation and flood storage replacement areas shall be properly constructed, landscaped, and monitored. Remedial actions may be necessary to create functioning wetland and floodplain areas similar to those destroyed by the project. Remedial measures may include replanting, relocating plantings, removal of invasive species, changing soil composition and depth, changing the elevation of the wetland surface, and changing the hydrologic regime.
40. NHDOT shall designate a qualified professional who will be responsible for monitoring and ensuring that the mitigation areas are constructed in accordance with the mitigation plans. Monitoring shall be accomplished in a timely fashion and remedial measures taken if necessary. NHDES shall be notified in writing of the designated professional prior to the start of work and if there is a change of status during the project.
41. The NHDOT shall notify, in writing, NHDES and the local conservation commission in the municipality where the construction is to take place of their intention to commence construction no less than 5 business days prior to construction.
42. A post-construction report, including a narrative and photographs, documenting the status of the completed mitigation projects shall be submitted to NHDES within 60 days of the completion of construction.
43. NHDOT or the designated qualified professional shall conduct a follow-up inspection after the first growing season, to review the success of the mitigation area and schedule remedial actions if necessary. A report outlining these follow-up measures and a schedule for completing the remedial work shall be submitted by December 1 of that year. Similar inspections, reports and remedial actions shall be undertaken in at least the second, third and fifth years following the completion of each mitigation site.
44. Wetland creation areas shall have at least 75% successful establishment of wetlands vegetation after two (2) growing seasons, or shall be replanted and re-established until a functional wetland is replicated in a manner satisfactory to NHDES.
45. NHDOT shall delineate the wetlands and flood storage volume within the mitigation sites, document the delineation with US Army Corps of Engineers' data forms, and depict the delineation as an overlay of the final as-built plans after at least five full growing seasons.
46. Preservation of 150 to 250 acres of wetland and upland habitat in Newington and Dover shall be in accordance with the FEIS and shall be completed prior to the permit expiration.
47. Baseline documentation reports for all lands to be protected shall be completed and submitted to NHDES within one year following NHDOT securing ownership of the parcels or completion of easement deeds.
48. The NHDOT shall provide information on the condition of the preserved lands, as part of the third and fifth year monitoring reports on the stream/wetland construction, to insure compliance with the preservation requirements.

49. The NHDES shall be notified in writing of any transfers of the preservation lands and mitigation sites to another organization that has been retained for management purposes and the name of the entity responsible to continue long-term management and/or stewardship of the lands.
50. Conservation easements that may be placed on the preservation areas shall be written to run with the land, and both existing and future property owners shall be subject to this easement.
51. Final conservation easement language shall be recorded at the Registry of Deeds Office and a copy submitted to the NHDES.
52. Activities in contravention of the conservation easement shall be construed as a violation of this permit, and those activities shall be subject to the enforcement powers of the NHDES and/or the New Hampshire office of the Attorney General.

GENERAL CONDITIONS THAT APPLY TO ALL DES WETLANDS PERMITS:

1. A copy of this permit shall be posted on site during construction in a prominent location visible to inspecting personnel;
2. This permit does not convey a property right, nor authorize any injury to property of others, nor invasion of rights of others;
3. The Wetlands Bureau shall be notified upon completion of work;
4. This permit does not relieve the applicant from the obligation to obtain other local, state or federal permits that may be required (see attached form for status of federal wetlands permit);
5. Transfer of this permit to a new owner shall require notification to and approval by the Department;
6. This permit shall not be extended beyond the current expiration date.
7. This project has been screened for potential impacts to **known** occurrences of rare species and exemplary natural communities in the immediate area. Since many areas have never been surveyed, or have received only cursory inventories, unidentified sensitive species or communities may be present. This permit does not absolve the permittee from due diligence in regard to state, local or federal laws regarding such communities or species.
8. The permittee shall coordinate with the NH Division of Historic Resources to assess and mitigate the project's effect on historic resources.

APPROVED: Gino Infascelli

Gino Infascelli
Public Works Supervisor
DES Wetlands Bureau

==========

BY SIGNING BELOW I HEREBY CERTIFY THAT I HAVE FULLY READ THIS PERMIT AND AGREE TO ABIDE BY ALL PERMIT CONDITIONS.

OWNER'S SIGNATURE (required) CONTRACTOR'S SIGNATURE (required)

accepted 7-09 i.k

DEPARTMENT OF THE ARMY
NEW ENGLAND DISTRICT, CORPS OF ENGINEERS
696 VIRGINIA ROAD
CONCORD, MASSACHUSETTS 01742-2751

REPLY TO:
ATTENTION OF:

March 15, 2010

Regulatory Division
CENAE-R-PEC01
Permit Number: NAE-2004-4545

Mr. Charles H. Hood.
NH Department of Transportation
Bureau of Environment
Concord, New Hampshire 03302-0483

Subject: Final Corps Permit Newington-Dover 11238

Dear Mr. Hood:

Enclosed is your Department of the Army permit authorizing the work described therein.

Please post the enclosed ENG Form 4336 (i.e., Notice of Authorization) in a conspicuous location at the job site whenever work is ongoing. If you need to change the plans or construction methods (i.e., for work in our jurisdiction), please contact us immediately to discuss modifying your permit prior to undertaking these changes.

This authorization requires you to 1. notify us before beginning work so we may inspect the project, and 2. submit a Compliance Certification Form. You must complete and return the enclosed Work Start Notification Form(s) to this office at least two weeks before the anticipated starting date. You must complete and return the enclosed Compliance Certification Form within one month following the completion of the authorized work and any required mitigation (but not mitigation monitoring, which requires separate submittals). Also, because your project involves mitigation, you must complete and return the attached Mitigation Work Start Notification Form.

This permit is a limited authorization containing a specific set of conditions. Please read the permit thoroughly to familiarize yourself with those conditions, **including any conditions contained on the attached state water quality certification.** If a contractor does the work for you, both you and the contractor are responsible for ensuring that the work is done in compliance with the permit's terms and conditions.

Please note that the Department of the Army permit process does not supersede any other agency's jurisdiction.

If you have any questions regarding this correspondence, please contact Richard Roach at (978) 318-8211.

Sincerely,

Jennifer L. McCarthy
Chief, Regulatory Division

Enclosures

RECEIVED
BUREAU OF ENVIRONMENT
MAR 18 2010
NH DEPARTMENT OF
TRANSPORTATION

DEPARTMENT OF THE ARMY PERMIT

Permittee New Hampshire Department of Transportation

Permit No. NAE-2004-3545

Issuing Office _____

NOTE: The term "you" and its derivatives, as used in this permit, means the permittee or any future transferee. The term "this office" refers to the appropriate district or division office of the Corps of Engineers having jurisdiction over the permitted activity or the appropriate official of that office acting under the authority of the commanding officer.

You are authorized to perform work in accordance with the terms and conditions specified below.

Project Description:

Fill approximately 21 acres of waters and wetlands in conjunction with the widening of the Spaulding Turnpike..

This work is shown on the attached application plans entitled, "SPAULDING TURNPIKE IMPROVEMENTS, NEWINGTON TO DOVER NHS-027-1(37), 11238, APPLICATION BY: NEW HAMPSHIRE, DEPARTMENT OF TRANSPORTATION.", in seven sheets plus a locus plan, dated "8/10/2006 ".

Project Location:

in Newington and Dover, New Hampshire.

Permit Conditions:

General Conditions:

1. The time limit for completing the work authorized ends on June 30, 2015. If you find that you need more time to complete the authorized activity, submit your request for a time extension to this office for consideration at least one month before the above date is reached.

2. You must maintain the activity authorized by this permit in good condition and in conformance with the terms and conditions of this permit. You are not relieved of this requirement if you abandon the permitted activity, although you may make a good faith transfer to a third party in compliance with General Condition 4 below. Should you wish to cease to maintain the authorized activity or should you desire to abandon it without a good faith transfer, you must obtain a modification of this permit from this office, which may require restoration of the area.

3. If you discover any previously unknown historic or archeological remains while accomplishing the activity authorized by this permit, you must immediately notify this office of what you have found. We will initiate the Federal and state coordination required to determine if the remains warrant a recovery effort or if the site is eligible for listing in the National Register of Historic Places.

4. If you sell the property associated with this permit, you must obtain the signature of the new owner in the space provided and forward a copy of the permit to this office to validate the transfer of this authorization.

5. If a conditioned water quality certification has been issued for your project, you must comply with the conditions specified in the certification as special conditions to this permit. For your convenience, a copy of the certification is attached if it contains such conditions.

6. You must allow representatives from this office to inspect the authorized activity at any time deemed necessary to ensure that it is being or has been accomplished in accordance with the terms and conditions of your permit.

Special Conditions:

1. The permittee shall ensure that a copy of this permit is at the work site whenever work is being performed and that all personnel performing work at the site of the work authorized by this permit are fully aware of the terms and conditions of the permit. This permit, including its drawings and any appendices and other attachments, shall be made a part of any and all contracts and sub-contracts for work which affects areas of Corps of Engineers jurisdiction at the site of the work authorized by this permit. This shall be done by including the entire permit in the specifications for work.

(Special Conditions continued on Page 4)

Further Information:

1. Congressional Authorities: You have been authorized to undertake the activity described above pursuant to:

( ) Section 10 of the Rivers and Harbors Act of 1899 (33 U.S.C. 403).

(✓) Section 404 of the Clean Water Act (33 U.S.C. 1344).

( ) Section 103 of the Marine Protection, Research and Sanctuaries Act of 1972 (33 U.S.C. 1413).

2. Limits of this authorization.

a. This permit does not obviate the need to obtain other Federal, state, or local authorizations required by law.

b. This permit does not grant any property rights or exclusive privileges.

c. This permit does not authorize any injury to the property or rights of others.

d. This permit does not authorize interference with any existing or proposed Federal project.

3. Limits of Federal Liability. In issuing this permit, the Federal Government does not assume any liability for the following:

a. Damages to the permitted project or uses thereof as a result of other permitted or unpermitted activities or from natural causes.

b. Damages to the permitted project or uses thereof as a result of current or future activities undertaken by or on behalf of the United States in the public interest.

c. Damages to persons, property, or to other permitted or unpermitted activities or structures caused by the activity authorized by this permit.

d. Design or construction deficiencies associated with the permitted work.

e. Damage claims associated with any future modification, suspension, or revocation of this permit.

4. Reliance on Applicant's Data: The determination of this office that issuance of this permit is not contrary to the public interest was made in reliance on the information you provided.

5. Reevaluation of Permit Decision. This office may reevaluate its decision on this permit at any time the circumstances warrant. Circumstances that could require a reevaluation include, but are not limited to, the following:

a. You fail to comply with the terms and conditions of this permit.

b. The information provided by you in support of your permit application proves to have been false, incomplete, or inaccurate (See 4 above).

c. Significant new information surfaces which this office did not consider in reaching the original public interest decision.

Such a reevaluation may result in a determination that it is appropriate to use the suspension, modification, and revocation procedures contained in 33 CFR 325.7 or enforcement procedures such as those contained in 33 CFR 326.4 and 326.5. The referenced enforcement procedures provide for the issuance of an administrative order requiring you to comply with the terms and conditions of your permit and for the initiation of legal action where appropriate. You will be required to pay for any corrective measures ordered by this office, and if you fail to comply with such directive, this office may in certain situations (such as those specified in 33 CFR 209.170) accomplish the corrective measures by contract or otherwise and bill you for the cost.

6. Extensions. General condition 1 establishes a time limit for the completion of the activity authorized by this permit. Unless there are circumstances requiring either a prompt completion of the authorized activity or a reevaluation of the public interest decision, the Corps will normally give favorable consideration to a request for an extension of this time limit.

Your signature below, as permittee, indicates that you accept and agree to comply with the terms and conditions of this permit.

Kevin A Costa — 2/22/10

(PERMITTEE) *(DATE)*

This permit becomes effective when the Federal official, designated to act for the Secretary of the Army, has signed below.

Jeff Dey — 3-15-2010

(DISTRICT ENGINEER) *(DATE)*

for Philip T. Feir
Colonel, Corps of Engineers

When the structures or work authorized by this permit are still in existence at the time the property is transferred, the terms and conditions of this permit will continue to be binding on the new owner(s) of the property. To validate the transfer of this permit and the associated liabilities associated with compliance with its terms and conditions, have the transferee sign and date below.

(TRANSFEREE) *(DATE)*

*U.S. GOVERNMENT PRINTING OFFICE: 1986 — 717-425

(Special Conditions continued from Page 2)

If the permit is issued after the construction specifications but before receipt of bids or quotes, the entire permit shall be included as an addendum to the specifications. If the permit is issued after receipt of bids or quotes, the entire permit shall be included in the contract or sub-contract as a change order. The term "entire permit" includes permit amendments. Although the permittee may assign various aspects of the work to different contractors or sub-contractors, all contractors and sub-contractors shall be obligated by contract to comply with all environmental protection provisions of the entire permit, and no contract or sub-contract shall require or allow unauthorized work in areas of Corps jurisdiction.

2. The permittee shall complete and return the enclosed Compliance Certification Form within one month following the completion of the authorized work.

3. The wetland impacts authorized by this permit are based on preliminary plans, and amount to a total of approximately 21 acres of direct fill. During final design of this project, the total wetland impact proposed may change. The NH DOT will, during final design, consult with the Army Corps of Engineers and the NH DES about the continuing accuracy of wetland delineation and projected impacts on wetlands. If the projected wetland impacts would increase by more than 10%, NH DOT will seek a permit amendment in writing and agree in writing on modified permit conditions before proceeding with the work. Failure to do so will subject the NH DOT to the enforcement provisions of the Corps Regulations.

4. The permittee will provide a complete mitigation plan to the Corps and receive written approval of the plan before construction contracts for any portion of the work are submitted to the Governor and Executive Council for approval. The Railway Brook restoration portion of the mitigation plan will be completed as part of the corresponding construction contract for the permitted work in Newington.

Appendix B

Success Standards and Criteria Evaluation Table

Railway Brook Restoration Success Standards and Criteria Evaluation - 1st Year Monitoring 2015			
Success Standard	**Criteria**	**Site Success**	**Explanation**
The Site has the hydrology to support the designed wetland type	Soils are saturated to the soils surface for at least two weeks during the growing season; groundwater is within one ft of the soil surface during this period as demonstrated with well data collected from March through June.	To Be Determined	Four shallow groundwater wells were installed within Zone 2, established as forested floodplain wetland habitat, adjacent to Railway Brook in October 2015. Well observations made during the second growing season (March through June 2016) and subsequent seasons throughout the duration of the monitoring period will provide the evidence required to make a success determination.
500 trees and shrubs per acre, and the minimum number of total species (planted and volunteer) as specified in the Guidance (2007)	At least 350 stems are species originally proposed for the forested zones, that are healthy and vigorous and ≥ 18 in. tall. Also, total number of species shall meet the requirements as listed in the Guidance.	Yes	Based on total inventory of tree and shrub species planted and total acreages of Zones 1, 2, 3, and 4, the Project is exceeding the mininum success standards for density. However, at this time it is difficult to determine the success of the live stake plantings in Zone 1. The stakes were installed in April 2015 and live stakes typically take at least a year to become established. The success of live stakes will continue to be monitored as part of the requirements of the restoration plan.
80% areal cover of the entire site by non-invasives (excluding open water or special bare soil areas, i.e., turtle nesting areas)	80% areal cover by non-invasives in emergent zones and 60% cover (of which 15% are woody species) in scrub-shrub and forested zones.	Yes	Woody plantings do not account for 60% aerial cover at the site at this time. However, when other species currently established at the site (those included in the applied seed mixes as well as a number of volunteer species) are factored in to total percent cover estimates, each planting zone far exceeds the 60% success criteria. In addition, based on site observations and the amount of woody species planted per zone (far exceeding the minimum per acre requirements of Success Standard 2), total percent cover of woody species within each zone was estimated above 15%. Only purple loosestrife and narrow-leaf cattail were found to be growing in small numbers within the limits of the restoration site during the two site inspections conducted by VHB. Both species are limited in their distribution, and are primarily growing directly within the stream bed with an estimated percent cover of 15 to 20 percent relative to the areas where they were mapped (not indicative of the entire site).
Common reed, purple loosestrife, Russian and autumn olive, and/or multiflora rose are controlled.	Absence of stems of these species on the site.	To Be Determined	Restoration of Railway Brook was completed in June 2015, and purple loosestrife was not identified on-site until September 2015. Based on the timing of the discovery, treatment of purple loosestrife is not feasible in 2015. Treatment will be assessed as part of Years 2 through 5 of the monitoring period.
All slopes, soils, substrates and constructed features are stabilized	No evidence of sedimentation in runoff from the site during storms and all erosion control measures are in good condition.	Yes	Based on observations from the two inspections conducted by the Restoration Monitor in 2015, as well additional inspectons conducted by VHB Stream Engineers, all areas of the restoration site have been permanently stabilized in accordance to the Project Restoration Plans (dated 05/14/2012).
At least 75% successful establishment of wetlands vegetation after two (2) growing seasons.	Seventy-five percent (75%) cover of wetland species in the floodplain and streamside planting zones within 2 growing seasons.	To Be Determined	Success standard to be evaluated after two full growing seasons in 2016.
NHDOT shall delineate the wetlands and flood storage volume within the mitigation sites, document the delineation with US Army Corps of Engineers' data forms, and depict the delineation as an overlay of the final as-built plans after at least five full growing seasons.	The areas proposed as floodplain and streamside wetlands meet the technical criteria contained within the 1987 Corps Manual for jurisdictional wetlands after five years.	To Be Determined	To be completed after five full growing seasons in 2019.
Restored stream channel exhibits increasing stability; in-stream grade control and habitat structures are stable and functioning.	BEHI index of less than 35 in Year 1, declining to less than 25 in Year 5	Yes	The BEHI for the Railway Brook restoration site ranged from 5.5 to 8.6 with an average ranking of 7.3 which has an erosion potential score of very low.

Appendix C

Shallow Groundwater Well Field Documentation

Installation Data Sheet

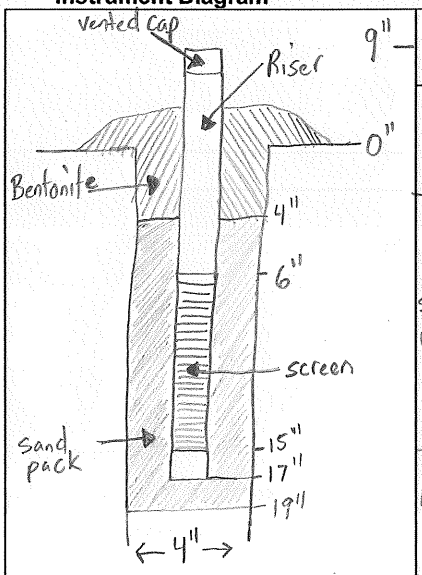
Project Name Railway Brook Restoration
Date of Installation 10-23-2015
Project Location Nechington, NH
Personnel Kristopher Wilkes
Well Identification Code #1

Attach map of project, showing well locations and significant topographic and hydrologic features.
Attach map of well site, showing locations and ground elevations of all instruments and microtopographic features of significance, with respect to reference datum.
Installed within Zone 2 along eastern side of brook adjacent to Station 7005-7006

Type of Instrument
Source of instrument / well stock Groundwater Supply Co.
Material of well stock Schedule 40 PVC
Diameter of pipe 1 inch
Slot size 0.010 inch
Slot spacing 0.5
Kind of well cap Commercial PVC Well Cap w/vent
Kind of well point / end plug 2" PVC Cap, vented

Nature of Installation Materials
Nature of packing sand 20-40 silica
Kind of bentonite Chips
Nature of backfill Bentonite
Depth of backfill 4 inches to ground surface
Was bentonite installed below groundwater depth at installation? NA
Was water added to bentonite for expansion? Yes
Method of measuring water levels in instrument Steel tape and soluble marker
How was instrument checked for clogging after installation? Water poured down well and drainage monitored. No water standing in well after ~15 mins.

Instrument Diagram



Soil Characteristics

Texture	Structure and Color	Roots	Consis-Tence	Redox Features
0-10": very fine sandy loam with some gravel and small stones	10YR 3/2 Granular	Few	very friable	10YR 3/6 ORCS
10-19": Clay	2.5Y 5/1 Blocky	None	very firm	2.5Y 5/6 conc. (many)

Show depths (heights) of soil horizons, riser, screen, sand pack, bentonite, backfill, etc.

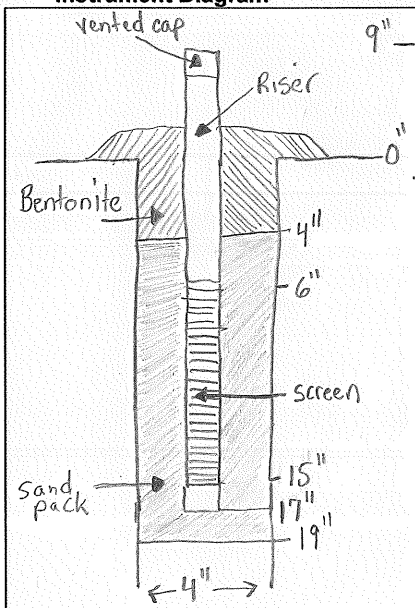
B. Blank master

Figure 6. (Concluded)

Installation Data Sheet

Project Name Railway Brook Restoration
Date of Installation 10-28-2015
Project Location Newington, NH
Personnel Kristopher Wilkes
Well Identification Code #2
Attach map of project, showing well locations and significant topographic and hydrologic features.
Attach map of well site, showing locations and ground elevations of all instruments and microtopographic features of significance, with respect to reference datum.
Installed within Zone 2 along western side of brook adjacent to Station 7012.
Type of Instrument
Source of instrument / well stock Groundwater Supply Co.
Material of well stock Schedule 40 PVC
Diameter of pipe 1 inch
Slot size 0.010 inch
Slot spacing 0.5
Kind of well cap Commercial Well Cap w/vent
Kind of well point / end plug 2" PVC Cap, vented
Nature of Installation Materials
Nature of packing sand 20-40 silica
Kind of bentonite Chips
Nature of backfill bentonite
Depth of backfill 4 inches to ground surface
Was bentonite installed below groundwater depth at installation? NA
Was water added to bentonite for expansion? Yes
Method of measuring water levels in instrument steel tape and soluble marker
How was instrument checked for clogging after installation? Water poured down well and drainage monitored. No water standing in well after ~15 mins.

Instrument Diagram



Soil Characteristics

Texture	Structure and Color	Roots	Consis-Tence	Redox Features
0-12": Very fine sandy loam w/some gravel + small stones	10YR 3/2 Granular	Few	very friable	None
12-19": Clay w/ some gravel	2.5Y 3/1 Blocky	None	Very firm	10YR 4/6 conc. 7.5YR 3/4 conc. 2.5Y 4/1 Dep.

Show depths (heights) of soil horizons, riser, screen, sand pack, bentonite, backfill, etc.

B. Blank master

Figure 6. (Concluded)

Installation Data Sheet

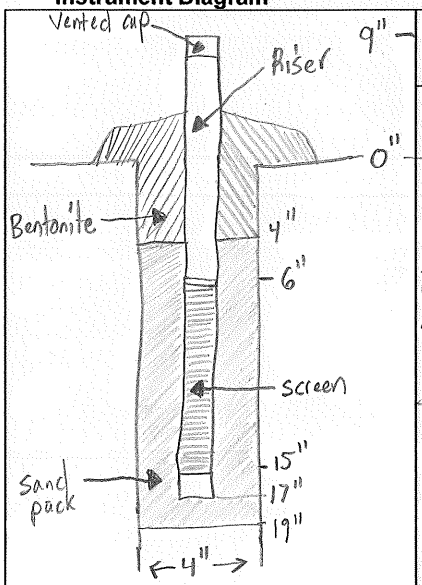
Project Name Railway Brook Restoration
Date of Installation 10-28-2015
Project Location Newington, NH
Personnel Kristopher Wilkes
Well Identification Code #3

Attach map of project, showing well locations and significant topographic and hydrologic features.
Attach map of well site, showing locations and ground elevations of all instruments and microtopographic features of significance, with respect to reference datum.
Installed within Zone #2 along western side of brook adjacent to Station 7018

Type of Instrument
Source of instrument / well stock Groundwater Supply Co.
Material of well stock Schedule 40 PVC
Diameter of pipe 1 inch
Slot size 0.010 inch
Slot spacing 0.5
Kind of well cap Commercial PVC Cap w/vent
Kind of well point / end plug 2" PVC Cap, vented

Nature of Installation Materials
Nature of packing sand 20-40 silica
Kind of bentonite Chips
Nature of backfill Bentonite
Depth of backfill 4 inches to ground surface
Was bentonite installed below groundwater depth at installation? NA
Was water added to bentonite for expansion? Yes
Method of measuring water levels in instrument steel tape and soluble marker
How was instrument checked for clogging after installation? water poured down well and drainage monitored. NO standing water in well after 15 mins

Instrument Diagram



Soil Characteristics

Texture	Structure and Color	Roots	Consis-Tence	Redox Features
0-12": very fine sandy loam w/some gravel + small stones.	10YR 3/2 Granular	Few	very friable	None
12-19": Clay w/ some gravel	2.5Y 3/1 Blocky	None	very firm	10YR 4/6 conc. 7.5YR 3/4 conc. 2.5Y 4/1 Dep.

Show depths (heights) of soil horizons, riser, screen, sand pack, bentonite, backfill, etc.

B. Blank master

Figure 6. (Concluded)

Installation Data Sheet

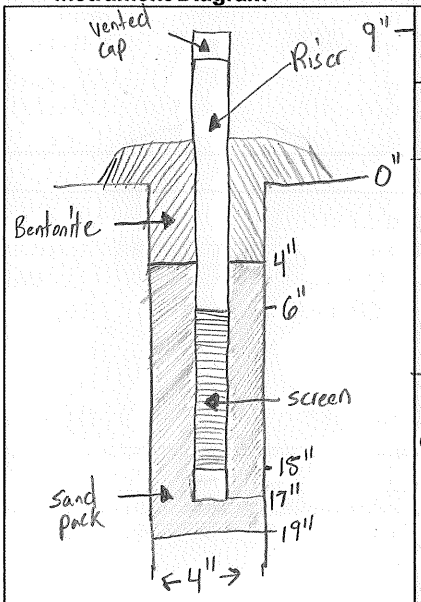
Project Name Railway Brook Restoration
Date of Installation 10-28-2015
Project Location Newington, NH
Personnel Kristopher Wilkes
Well Identification Code #4

Attach map of project, showing well locations and significant topographic and hydrologic features.
Attach map of well site, showing locations and ground elevations of all instruments and microtopographic features of significance, with respect to reference datum.
Installed within Zone 2 along eastern side of brook adjacent to Station 7025.

Type of Instrument
Source of instrument / well stock Groundwater Supply Co.
Material of well stock Schedule 40 PVC
Diameter of pipe 1 inch
Slot size 0.010 inch
Slot spacing 0.5
Kind of well cap Commercial PVC cap w/vent
Kind of well point / end plug 2" PVC cap, vented

Nature of Installation Materials
Nature of packing sand 20-40 silica
Kind of bentonite Chips
Nature of backfill Bentonite
Depth of backfill 4 inches to ground surface
Was bentonite installed below groundwater depth at installation? NA
Was water added to bentonite for expansion? Yes
Method of measuring water levels in instrument Steel tape and soluble marker
How was instrument checked for clogging after installation? Water poured down well and drainage monitored. No water standing in well after ~15 mins

Instrument Diagram



Soil Characteristics

Texture	Structure and Color	Roots	Consis-Tence	Redox Features
0-8": sandy loam w/ some gravel	10YR 3/2 saturated Granular	Few	very friable	None
8-19": Gravelly fine sandy loam 1-2" stones present	2.5Y 3/1 sub-angular blocky	Few	friable	7.5YR 3/4 conc. (many).

Show depths (heights) of soil horizons, riser, screen, sand pack, bentonite, backfill, etc.

B. Blank master

Figure 6. (Concluded)

Shallow Groundwater Monitoring Wells
Railway Brook Restoration Project, Newington, NH

Shallow Groundwater Well #1 installed within Zone 2 along the eastern side of Railway Brook adjacent to Stations 7005-7006. Date: 10-23-2015.

Shallow Groundwater Well #2 installed within Zone 2 along the western side of Railway Brook adjacent to Station 7012. Date: 10-28-2015.

Shallow Groundwater Monitoring Wells
Railway Brook Restoration Project, Newington, NH

Shallow Groundwater Well #3 installed within Zone 2 along the western side of Railway Brook adjacent to Station 7018. Date: 10-28-2015.

Shallow Groundwater Well #4 installed within Zone 2 along the eastern side of Railway Brook adjacent to Station 7025. Date: 10-28-2015.

Appendix D

Representative Site Photographs

■

Photo #1: View east toward Railway Brook from staging area.	Location: Railway Brook Restoration Site, Newington, NH
	Description: Stone has been removed from the construction access and staging area located at the southern end of the restoration site and this area has been restored with seed and mulch. Dense vegetation consisting of grasses and weeds have become established in this area.
Photo #2: View south at Railway Brook from Station 7001.	Location: Railway Brook Restoration Site, Newington, NH
	Description: Vegetation dominated by narrow-leaf cattail (*Typha angustifolia*), but also including nodding smartweed (*Polygonum lapathifolium*), beggar-ticks (*Bidens frondosa*), jewelweed (*Impatiens capensis*), species of vetch (*Vicia sp.*), fox sedge (*Carex vulpinoides*), three-way sedge (*Dulichium arundinaceum*), lance-leaved coreopsis (C*oreopsis lanceolata*), and barnyard grass (*Echinochloa crusgalli*) was observed to be growing within the stream bed from Station 7000 to Station 7008. Purple loosestrife was also present at this location. Narrow-leaf cattail and purple loosestrife were estimated to account for 15% of the total cover.
Photo #3: View south at Railway Brook from Station 7003.	Location: Railway Brook Restoration Site, Newington, NH
	Description: Another view of narrow-leaf cattail which was observed to be growing in small dense stands within the stream bed between Stations 7000 and 7009.

Photo #4: View south at Railway Brook from Station 7004.	Location: Railway Brook Restoration Site, Newington, NH
	Description: Coir fiber roll and rootwads installed along the eastern bank of Railway Brook between Stations 7002 and 7004 were observed to be stable and securely in place.
Photo #5: View north to Zone 3 plantings, east side of brook.	Location: Railway Brook Restoration Site, Newington, NH
	Description: Tree and shrub plantings were observed to be healthy and growing between 2 and 4 feet tall within Zone 3 along the eastern side of Railway Brook between Stations 7001 and 7004. In addition to the plantings, herbaceous plants and grasses included in applied seed mixes, have become densely established alongside the stream. A number of weedy volunteer species, such as nodding smartweed, were also observed to have densely colonized the streamside.
Photo #6: View north to Zones 1 and 2, west side of brook.	Location: Railway Brook Restoration Site, Newington, NH
	Description: Plantings were observed to be healthy and growing above 18" in height within Zones 1 and 2 along the western side of Railway Brook adjacent to Stations 7004 and 7005.

Photo #7: View north to Zones 1 and 2, east side of brook.	Location: Railway Brook Restoration Site, Newington, NH
	Description: Plantings were observed to be healthy and growing above 18" in height within Zones 1 and 2 along the eastern side of Railway Brook adjacent to Stations 7004 and 7005.
Photo #8: View north at Railway Brook from Station 7006+50	Location: Railway Brook Restoration Site, Newington, NH
	Description: Installed boulder cluster and rootwad at Station 7006+50 was observed to be stable at the time of the site inspections. Some vegetation is beginning to grow in along this section of the channel.
Photo #9: View south at Zones 2 and 3, east side of brook.	Location: Railway Brook Restoration Site, Newington, NH
	Description: Tree and shrub plantings were observed to be healthy and growing between 3 and 5 feet tall within Zones 2 and 3 along the eastern side of Railway Brook between Stations 7006 and 7009.

Photo #10: View south at Zones 1 and 2, west side of brook.	Location: Railway Brook Restoration Site, Newington, NH
	Description: Plantings were observed to be healthy and growing above 18" in height within Zones 1 and 2 along the western side of Railway Brook adjacent to Stations 7008 and 7009.
Photo #11: View N at Railway Brook from Station 7008+50.	Location: Railway Brook Restoration Site, Newington, NH
	Description: Additional trimming of geotextile fabric below channel bed elevations at cross vane locations has been recommended by VHB and communicated to NHDOT and the on-site contractor.
Photo #12: View north along west bank at Station 7010.	Location: Railway Brook Restoration Site, Newington, NH
	Description: View north at live stakes planted within Zone 1 along the western bank of Railway Brook near Station 7010. At this time it is difficult to determine the success of the live stake plantings. They were installed in April 2015 and live stakes typically take at least a year to become established. The success of the live stakes will continue to be monitored as part of the requirements of the restoration plan.

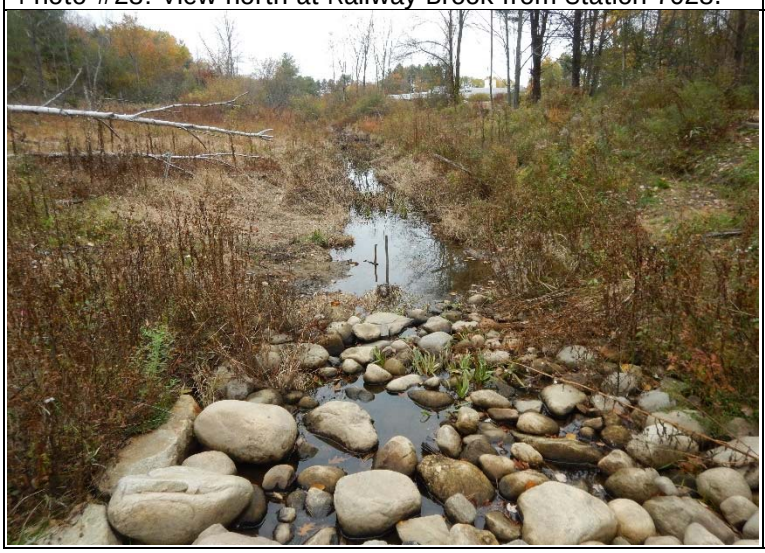
Photo #13: View north at Zones 2 and 3, west side of brook.	Location: Railway Brook Restoration Site, Newington, NH
	Description: Tree and shrub plantings were observed to be healthy and growing between 3 and 5 feet tall within Zones 2 and 3 along the western side of Railway Brook between Stations 7010 and 7012.
Photo #14: View north at Zone 4, west side of brook.	Location: Railway Brook Restoration Site, Newington, NH
	Description: Tree species, including white pine and black cherry, planted within Zone 4 along the western side of the brook (adjacent to Station 7011) were observed to be healthy and growing over 3 feet tall, with some exceeding 6 feet in height.
Photo #15: View south along Zone 1, east side of brook.	Location: Railway Brook Restoration Site, Newington, NH
	Description: View south at live stakes planted within Zone 1 along the eastern side of Railway Brook near Station 7013. Adjacent slopes are stable and well vegetated.

Photo #16: View north at Zones 2 and 3, east side of brook.	Location: Railway Brook Restoration Site, Newington, NH
	Description: Tree and shrub plantings were observed to be healthy and growing between 2 and 4 feet tall within Zones 2 and 3 along the eastern side of Railway Brook between Stations 7013 and 7016.
Photo #17: View north at Zones 2 and 3, west side of brook.	Location: Railway Brook Restoration Site, Newington, NH
	Description: Plantings appeared to be not as vigorous within Zones 2 and 3 along the western side of Railway Brook between Stations 7012 and 7014 with average species height ranging between 2 and 3 feet.
Photo #18: View south at Railway Brook from Station 7012.	Location: Railway Brook Restoration Site, Newington, NH
	Description: An isolated pocket of narrow-leaf cattail was observed within the stream bed at Station 7012. Coir fiber rolls installed along the eastern bank at this location are stable and remain securely in place.

Photo #19: View south at Zones 2 and 3, west side of brook.	Location: Railway Brook Restoration Site, Newington, NH
	Description: Tree and shrub plantings were observed to be healthy and growing between 2 and 4 feet tall within Zones 2 and 3 along the eastern side of Railway Brook between Stations 7015 and 7019.
Photo #20: Deer browse at Station 7016, west side of brook.	Location: Railway Brook Restoration Site, Newington, NH
	Description: Deer browse was found occasionally throughout Zones 2 and 3, primarily along the western side of Railway Brook. The extent of browse within the restoration site was observed to be very minor.
Photo #21: View north along the east bank at Station 7017.	Location: Railway Brook Restoration Site, Newington, NH
	Description: Steep slopes adjacent to the eastern bank of Railway Brook between Stations 7016 and 7018 are permanently stable with dense vegetation. No signs of erosion were noted.

Photo #22: View south at Railway Brook from Station 7019.	Location: Railway Brook Restoration Site, Newington, NH
	Description: Installed cross-vein at Station 7019 remains stable at this time. Additional trimming of geotextile fabric at this structure has been recommended by VHB and communicated to NHDOT and the on-site contractor.
Photo #23:View north at Railway Brook from Station 7019+50	Location: Railway Brook Restoration Site, Newington, NH
	Description: Dense vegetation, including purple loosestrife and narrow-leaf cattail, was observed within the stream bed near the outlet of twin 36-inch culverts during the site inspections.
Photo #24: View south at Railway Brook from Station 7021.	Location: Railway Brook Restoration Site, Newington, NH
	Description: Purple loosestrife and narrow-leaf cattail were also observed to be growing within Zones 1 and 2 directly east of the brook within the limits of an existing overhead electric transmission line easement that intersects the restoration site from east to west.

Photo #25: View N at Railway Brook from Station 7022+50.	Location: Railway Brook Restoration Site, Newington, NH
	Description: The northern end of Railway Brook contained moderate flow at the time of the inspections. Coir fiber rolls, and rootwads installed along the banks were observed to be stable.
Photo #26: View north at Zones 1 and 2, west side of brook.	Location: Railway Brook Restoration Site, Newington, NH
	Description: Zones 1 and 2 along the western side of Railway Brook at the northern end of the restoration site are stable and well vegetated.
Photo #27: View south at Zones 1-3, east side of brook.	Location: Railway Brook Restoration Site, Newington, NH
	Description: Zones 1, 2 and 3 along the eastern side of Railway Brook at the northern end of the restoration site were stable and well vegetated. Plantings within Zones 2 and 3 were observed to be healthy and growing between 18 inches and 3 feet in height.

Photo #28: View north at Railway Brook from Station 7028.	Location: Railway Brook Restoration Site, Newington, NH
	Description: View to the northern limits of the restoration site. The sand-bag restriction previously installed within the brook has been removed and the stream bed and adjacent areas remain stable.

Appendix E

Bank Erosion Hazard Index Field Documentation

Project: Railway Brook Restoration Site
Date: 10/30/2015
Inspector: Ryan Lizewski

Bank Erosion Hazard Index assessed in accordance with methods described in Rosgen (2001)

Table 1: BEHI field measurements and assessments

Location		BFW	BFH	H_b / H_{bfh}	D_{root} / H_b	Root Density	Slope	Bank Angle (deg)	Surf. Protection %
7002+75	Pool	19.0	3.33	1	15%	90%	3:1 -> 1.1	45	100%
7004+25	Riffle	15.5	2.00	1	25%	90%	2:1	26.6	100%
7006+00	Riffle	23.0	3.83	1	13%	95%	2:1 -> 1:1	45	100%
7009+00	Pool	20.0	2.25	1	22%	95%	3:1	18	100%
7011+00	Riffle	14.0	2.08	1	24%	95%	2:1	26.6	100%
7013+75	Riffle	16.5	3.25	1	15%	95%	2:1 -> 1:1	45	100%
7017+00	Pool	15.0	3.17	1	16%	100%	2:1	26.6	100%
7021+25	Pool	18.0	2.75	1	18%	100%	2:1	26.6	100%
7023+50	Riffle	13.5	2.08	1	24%	100%	2:1	26.6	100%
7025+75	Riffle	18.0	4.08	1	12%	95%	1:1	45	100%
7027+50	Pool	17.5	1.83	1	27%	95%	3:1	18	100%

Table 2: BEHI Scores

Location		BH Score	RDH Score	RD Score	BA Score	SP Score	Subtotal	Cobble Adjust.	Total
7002+75	Pool	1.9	7.9	1.9	3.9	1.9	17.5	-10	7.5
7004+25	Riffle	1.9	7.9	1.9	3.9	1.9	17.5	-10	7.5
7006+00	Riffle	1.9	9.0	1.9	3.9	1.9	18.6	-10	8.6
7009+00	Pool	1.9	7.9	1.9	1.9	1.9	15.5	-10	5.5
7011+00	Riffle	1.9	7.9	1.9	3.9	1.9	17.5	-10	7.5
7013+75	Riffle	1.9	7.9	1.9	3.9	1.9	17.5	-10	7.5
7017+00	Pool	1.9	7.9	1.9	3.9	1.9	17.5	-10	7.5
7021+25	Pool	1.9	7.9	1.9	3.9	1.9	17.5	-10	7.5
7023+50	Riffle	1.9	7.9	1.9	3.9	1.9	17.5	-10	7.5
7025+75	Riffle	1.9	9.0	1.9	3.9	1.9	18.6	-10	8.6
7027+50	Pool	1.9	7.9	1.9	1.9	1.9	15.5	-10	5.5
Material adjustment for cobble is -10								Average	7.3

BEHI Category

Very Low	<9.5
Low	10 - 19.5
Moderate	20 - 29.5
High	30-39.5
Very High	40 - 45
Extreme	> 45

All reaches assessed have a Very Low Bank Erosion Hazard Index score.

Table 3: BEHI Values

Adjective Hazard or risk rating categories		Bank Height/ Bankfull Ht	Root Depth/ Bank Height	Root Density %	Bank Angle (Degrees)	Surface Protection%	Totals
VERY LOW	Value	1.0-1.1	1.0-0.9	100-80	0-20	100-80	
	Index	1.0-1.9	1.0-1.9	1.0-1.9	1.0-1.9	1.0-1.9	5-9.5
LOW	Value	1.11-1.19	0.89-0.5	79-55	21-60	79-55	
	Index	2.0-3.9	2.0-3.9	2.0-3.9	2.0-3.9	2.0-3.9	10-19.5
MODERATE	Value	1.2-1.5	0.49-0.3	54-30	61-80	54-30	
	Index	4.0-5.9	4.0-5.9	4.0-5.9	4.0-5.9	4.0-5.9	20-29.5
HIGH	Value	1.6-2.0	0.29-0.15	29-15	81-90	29-15	
	Index	6.0-7.9	6.0-7.9	6.0-7.9	6.0-7.9	6.0-7.9	30-39.5
VERY HIGH	Value	2.1-2.8	0.14-0.05	14-5.0	91-119	14-10	
	Index	8.0-9.0	8.0-9.0	8.0-9.0	8.0-9.0	8.0-9.0	40-45
EXTREME	Value	>2.8	<0.05	<5	>119	<10	
	Index	10	10	10	10	10	46-50

The highest value from each range was used to calcaute the BEHI

Photo #1: Sta. 7002+75 – Looking upstream

Photo #2: Sta. 7004+25 – Looking Upstream

Photo #3: Sta. 7006+00 – Looking Downstream

Photo #4: Sta. 7009+00 – Looking Upstream

Photo #5: Sta. 7011+00 – Looking Upstream

Photo #6: Sta. 7013+75 – Looking Downstream

Photo #7: Sta. 7017+00 – Looking Downstream

Photo #8: Sta. 7021+25 – Looking Upstream

Photo #9: Sta. 7023+50 – Looking Upstream

Photo #10: Sta. 7025+75 – Looking Upstream

Photo #11: Sta. 7027+50 Looking Downstream