New Hampshire DOT
Department of Transportation

William Cass, P.E.
Commissioner

THE STATE OF NEW HAMPSHIRE
DEPARTMENT OF TRANSPORTATION

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David Rodrigue, P.E.
Assistant Commissioner

Her Excellency, Governor Kelly A. Ayotte
and the Honorable Council
State House
Concord, New Hampshire 03301

Bureau of Materials and Research
March 21, 2025

REQUESTED ACTION

Authorize the Department of Transportation to enter into a **Sole Source** Cooperative Project Agreement with the University of New Hampshire Sponsored Programs Administration (vendor 315187), Durham, New Hampshire, for a fee not to exceed $359,919, for a cooperative evaluation to implement cost and time saving *Measurement While Drilling and Permeafor* technologies effective upon Governor and Council approval through December 31, 2027. 100% Federal Funds.

Funds are available in the following account for Fiscal Year 2025, and are anticipated to be available in Fiscal Years 2026 and 2027, upon the availability and continued appropriation of funds in the future operating budgets, with the authority to adjust encumbrances between fiscal years within the price limitation through the Budget Office, if needed and justified:

04-96-96-962015-3036	FY 2025	FY 2026	FY 2027
SPR Research Funds			
046-500464 General Consultants Non-Benefit	$140,000	$140,000	$79,919

EXPLANATION

The following research study will address an immediate Department need; is unique to New Hampshire's environment and conditions, thereby requiring substantial local experience; and is directly aligned with a particular area of University expertise. In addition, the Principal Investigator is a nationally recognized expert in his field. As such, the proposed work does not lend itself to a selection process that includes private industry or out-of-state organizations, and it is in the Department's and the State's best interest to work directly with the University of New Hampshire, requiring this agreement to be **Sole Source**.

This work is part of the Department's Statewide Planning and Research (SPR) program. The Department of Transportation and the University of New Hampshire (UNH) have a long-standing cooperative relationship in transportation research. This relationship has been mutually beneficial, culminating in savings to the State while enhancing work force development and maintaining New Hampshire's position on the leading edge of new technology. Research studies conducted by UNH for the Department have led to numerous innovations in the highway and bridge industry, including improved pavement design, increased use of recycled materials, stormwater management evaluation, and rapid construction techniques.

Statewide-SPR 42372R, Development of Design Profiles & Parameters using MWD and Permeafor Data

The NHDOT has recently invested in two new technologies to improve geotechnical site characterization for stormwater best management practices (BMPs) and to improve the efficiency and accuracy of geotechnical subsurface models for bridge and roadway designs. The need for time consuming borehole infiltration testing and standard penetration testing may be reduced through further deployment of Permeafor and Measurement While Drilling (MWD). This project will advance integration of these technologies as follows:

- Ensure current hardware, software, and data analysis methods are updated with best available methods.
- Assist in installation and troubleshooting of new equipment on a recently acquired drill rig.
- Train field staff on the use and care of these technologies.
- Train technical staff on data reduction and interpretation of results.
- Propose specifications to be included in the NHDOT Geotechnical Manual.

This project builds upon work conducted under previous projects which led to significant improvements in the capabilities of the NHDOT Geotechnical section to meet their needs for the design of various structures across New Hampshire. These efforts will support more efficient use of design and construction resources, reduce the chance of delays due to unexpected subsurface conditions, and potentially help reduce the time associated with conventional subsurface investigation programs in the long term.

The Bureau of Materials & Research presented the problem statement that was selected by the NHDOT Research Advisory Council in January 2025.

The funding is 80% Federal Funds with 20% state match. Turnpike toll credits are being used for the match requirement, effectively using 100% Federal Funds. The Capital Budget Overview Committee approved the use of Turnpike Toll Credits on September 13, 2021.

This Agreement has been approved by the Attorney General as to form and execution. Copies of the fully-executed Agreement are on file at the Secretary of State's Office and the Department of Administrative Services, and subsequent to Governor and Council approval will be on file at the Department of Transportation.

It is respectfully requested that authority be given to enter into these sole-source Agreement for consulting services as outlined above.

Sincerely,

William Cass

William J. Cass, PE
Commissioner

Attachments

COOPERATIVE PROJECT AGREEMENT
between the
STATE OF NEW HAMPSHIRE, **DEPARTMENT OF TRANSPORTATION**
and the
University of New Hampshire of the UNIVERSITY SYSTEM OF NEW HAMPSHIRE

A. This Cooperative Project Agreement (hereinafter "Project Agreement") is entered into by the State of New Hampshire, **Department of Transportation**, (hereinafter "State"), and the University System of New Hampshire, acting through **University of New Hampshire**, (hereinafter "Campus"), for the purpose of undertaking a project of mutual interest. This Cooperative Project shall be carried out under the terms and conditions of the Master Agreement for Cooperative Projects between the State of New Hampshire and the University System of New Hampshire dated November 13, 2002, except as may be modified herein.

B. This Project Agreement and all obligations of the parties hereunder shall become effective on the date the Governor and Executive Council of the State of New Hampshire approve this Project Agreement ("Effective date") and shall end on **12/31/27**. If the provision of services by Campus precedes the Effective date, all services performed by Campus shall be performed at the sole risk of Campus and in the event that this Project Agreement does not become effective, State shall be under no obligation to pay Campus for costs incurred or services performed; however, if this Project Agreement becomes effective, all costs incurred prior to the Effective date that would otherwise be allowable shall be paid under the terms of this Project Agreement.

C. The work to be performed under the terms of this Project Agreement is described in the proposal identified below and attached to this document as Exhibit A, the content of which is incorporated herein as a part of this Project Agreement.
Project Title: **Development of Design Profiles & Parameters using Measurement While Drilling (MWD) and Permeafor Data**

D. The Following Individuals are designated as Project Administrators. These Project Administrators shall be responsible for the business aspects of this Project Agreement and all invoices, payments, project amendments and related correspondence shall be directed to the individuals so designated.

State Project Administrator

Name: David D. Gaylord

Address: NHDOT - Materials & Research
5 Hazen Drive PO Box 483
Concord, NH 03302-0483

Phone: 603-271-1659

Campus Project Administrator

Name: Gretchen Swain

Address: UNH Sponsored Program Administration-
51 College Road,
Durham, NH 03824-2620

Phone: N/A

E. The Following Individuals are designated as Project Directors. These Project Directors shall be responsible for the technical leadership and conduct of the project. All progress reports, completion reports and related correspondence shall be directed to the individuals so designated.

State Project Director

Name: Krystle J. Pelham

Address: NHDOT - Materials & Research
5 Hazen Drive PO Box 483
Concord, NH 03302-0483

Phone: 603-271-1657

Campus Project Director

Name: Jean Benoit

Address: UNH Civil and Environmental Engineering
Kingsbury Hall
Durham NH 03824

Phone: 603-978-5429

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F. Total State funds in the amount of **$359,919** have been allotted and are available for payment of allowable costs incurred under this Project Agreement. State will not reimburse Campus for costs exceeding the amount specified in this paragraph.

Check if applicable

☐ Campus will cost-share % of total costs during the term of this Project Agreement.

☒ Federal funds paid to Campus under this Project Agreement are from Grant/Contract/Cooperative Agreement No. **NA** from **USDOT FHWA** under CFDA# **20.205**. Federal regulations required to be passed through to Campus as part of this Project Agreement, and in accordance with the Master Agreement for Cooperative Projects between the State of New Hampshire and the University System of New Hampshire dated November 13, 2002, are attached to this document as Exhibit B, the content of which is incorporated herein as a part of this Project Agreement.

G. Check if applicable

☐ Article(s) of the Master Agreement for Cooperative Projects between the State of New Hampshire and the University System of New Hampshire dated November 13, 2002 is/are hereby amended to read:

H. ☐ State has chosen **not to take** possession of equipment purchased under this Project Agreement.
☒ State has chosen **to take** possession of equipment purchased under this Project Agreement and will issue instructions for the disposition of such equipment within 90 days of the Project Agreement's end-date. Any expenses incurred by Campus in carrying out State's requested disposition will be fully reimbursed by State.

This Project Agreement and the Master Agreement constitute the entire agreement between State and Campus regarding this Cooperative Project, and supersede and replace any previously existing arrangements, oral or written; all changes herein must be made by written amendment and executed for the parties by their authorized officials.

IN WITNESS WHEREOF, the University System of New Hampshire, acting through the **University of New Hampshire** and the State of New Hampshire, **Department of Transportation** have executed this Project Agreement.

By An Authorized Official of:
University of New Hampshire
Name: Karen Jensen
Title: Director, Pre-Award Compliance
Signature and Date: Karen Jensen Digitally signed by Karen Jensen Date: 2025.02.25 10:42:55 -05'00'

By An Authorized Official of:
NH Department of Transportation
Name: William J. Oldenburg
Title: Director of Project Development
Signature and Date: 4/30/25

By An Authorized Official of: the New Hampshire Office of the Attorney General
Name: Robert Pearce
Title: Attorney
Signature and Date: May 5, 2025

By An Authorized Official of: the New Hampshire Governor & Executive Council
Name:
Title:
Signature and Date:

Campus Authorized Official KJ
Date 2/24/25

EXHIBIT A

A. Project Title:

Integration of Measurement While Drilling (MWD) and Permeafor data in the development of design parameters and profiles for NHDOT highway and bridge projects.

B. Project Period:

Governor and Council approval through December 31, 2027

C. Objectives:

The New Hampshire Department of Transportation (NHDOT) has recently invested in two new technologies to improve geotechnical site characterization for stormwater best management practices (BMPs) and to improve the efficiency and accuracy of geotechnical subsurface models for bridge and roadway designs. In collaboration with the University of New Hampshire, SPR Project #26962U, **Improved Practices for Determining the Infiltration Characteristics of Soils for Design of Stormwater BMPs** and SPR Project #42372F, **Use of Drilling Parameters for Enhancing Geotechnical Site Investigations with Applications to Rock Assessment** have led to significant improvements in the capabilities of the NHDOT geotechnical department to meet their needs for the design of various structures across New Hampshire. These efforts will support more efficient use of design and construction resources, reduce the chance of delays due to unexpected subsurface conditions, and potentially help reduce the time associated with conventional subsurface investigation programs in the long term.

C1. Objectives - Soil Infiltration

The SPR Project #26962U, **Improved Practices for Determining the Infiltration Characteristics of Soils for Design of Stormwater BMPs**, was completed in March 2022 and led to the design, fabrication, and implementation of a new device to assess hydraulic conductivity in situ. Prior to this effort, soil infiltration properties used by the NHDOT to assess the suitability of a site for various BMPs and to properly size and design a treatment area were obtained on a site-to-site basis from borehole infiltration testing. This test is prescribed in the (Env-Wq 1500) NH Department of Environmental Services (NHDES) Alteration of Terrain (AoT) rules and uses conventional geotechnical drilling equipment. The test protocols are labor-intensive and time-consuming, often demanding more than 4 hours to

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complete a single test interval (depth). This is particularly inefficient if multiple depths require testing, e.g., the preferred "bottom of practice" has not been established. In addition, the existing test method may not replicate field conditions and is prone to missing important features in the soil profile, especially in more permeable ground conditions (i.e., sand).

As a result of the Environmental Protection Agency's (EPA) Municipal Separate Storm Sewer System (MS4) permit rules, the need for such testing is expected to increase, and due to its inefficiency, the borehole infiltration test will be unable to meet the testing demand for BMP design. In response to these drawbacks, a Permeafor device was investigated for suitability as an alternative to the currently used testing protocols. The investigation included the fabrication and improvement of the device, testing of the device and comparison to the borehole infiltration test and other commonly used methods of determining hydraulic conductivity, numerical modeling to confirm the theoretical basis of the device, and transfer of the device and supporting equipment to the NHDOT for its own use. To facilitate full implementation of this methodology NHDOT requires additional work be completed to establish the Permeafor as a formally accepted and typical test method for measuring hydraulic conductivity in situ for NHDOT projects. UNH will retain Mr. Steven Wuebbolt of Right-Trak Design (RTD) in Goffstown, NH to lead this portion of the project, given his experience and expertise with the Permeafor. Mr. Wuebbolt was previously the lead graduate student working on SPR Project #26962.

The objectives of the research on soil infiltration are as follows:

1. Complete additional Permeafor testing in various granular deposits to further compare results to other commonly used and more established methods of measuring hydraulic conductivity.
2. Assess the current equipment, software, and data analysis methods and, if applicable, update equipment, software, and methods to make the tool more efficient, user-friendly, robust, and more reliable.
3. Train NHDOT field staff on Permeafor use and care in the field and revise/amend existing documentation for Standard Operating Procedures and a video detailing step-by-step instructions.
4. Develop a training plan as an internal resource to NHDOT field staff to ensure continuity.
5. Train NHDOT technical staff on data reduction and interpretation.
6. Develop specifications for use in a format template provided by NHDOT for inclusion in the NHDOT geotechnical manual.

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D. Scope of Work

D1. Scope of Work - Soil Infiltration

The scope of work includes the following major tasks, with primary responsibility indicated in parentheses (RTD will lead all tasks noted as UNH):

Task 1: Evaluate existing equipment and data processing:

Assess the existing Permeafor probe and support equipment and recommend changes as necessary to existing device. Review and update data acquisition software, and/or data reduction and interpretation methods based on previous work or work completed as part of this research. Funds have been set aside in Materials & Supplies to replace the flowmeter and/or the pump, as needed during the project. (UNH)

Task 2: Permeafor data collection:

Identify project sites for testing in collaboration with NHDOT through a review of the NHDOT Ten-Year Plan. A minimum of three (3) sites will be evaluated. Permeafor borings will be advanced to depths of up to 40 feet, and tests will be completed at 2 to 5-foot intervals at each site. As the project develops, the number of tests and/or test sites may be adjusted to maximize the scientific impact of the research work. Permeafor results will be compared to the following methods: NHDOT standard borehole infiltration test, laboratory constant head test, field pneumatic slug test, and grain size correlations to hydraulic conductivity. The field pneumatic slug testing will be carried out using PVC casing set into completed SPT boreholes. The materials needed for these tests consist of a hand pump, connectors to a 2-inch PVC well and a pressure transducer. The tests, initially supervised by UNH, will be performed by the NHDOT Geotechnical field staff after training with the equipment and testing procedures. The PVC casing will be removed from the boreholes following test completion. The grain size distribution tests will be performed per ASTM D6913 by the NHDOT. For budgeting and planning purposes, we have assumed the following number of comparison tests.

Comparison Tests	Assumed Number of Tests/Total Days
Borehole Infiltration (ASTM D6381)	6/3
Laboratory Constant Head (ASTM D6913)	15 tests
Field Pneumatic Slug (ASTM D7242)	2/2

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One boring will be completed using standard penetration testing (SPT conducted in accordance with ASTM D1586) at each site to collect samples and evaluate soil stratigraphy and groundwater conditions. The SPT boreholes will be used for the borehole infiltration and pneumatic slug tests. A total of 19 days is expected to perform these various boreholes. When possible, one or more boreholes will be drilled using MWD technology by NHDOT staff to assess variations in soil conditions with depth. For budgeting purposes, Steven Wuebbolt of RTD will be on site for 12 days (120 hours) of field testing. In the event that unanticipated situations reduce the number of sites or test locations, data from the MWD portion of the project will be used to estimate hydraulic conductivity using measurements of flow and pressure as boreholes are advanced for MWD data collection. (NHDOT to provide drilling rig and staff and UNH will be present at least one day at each test site in addition to staff training)

Task 3: Field Training:

Train NHDOT exploration drilling staff and field engineers and geologists to prepare for and carry out Permeafor testing. Topics to be covered include but are not limited to; equipment required to perform the test, assembly of the probe and supporting equipment, preparation of the system for testing, general operation of the system, optimal system settings and drilling tools/methods depending on soil conditions, collection and viewing of test data, and requirements for test termination. Training is expected to be completed concurrently with Permeafor testing. However, we assume two (2) additional training days will be required to review tasks that would be completed off site, such as calculation of head loss calibrations. (UNH/NHDOT staff to be present together for training). This training will be performed at the Bureau of Materials and Research with the Geotechnical Staff. In addition to the in-person training, two (2) days will be dedicated to developing a training video that provides simple instructions for set-up and use of the Permeafor system.

Task 4: Data interpretation training:

Train NHDOT technical staff on how to process and interpret collected test data to develop a profile of hydraulic conductivity. A total of two (2) days is expected to complete training of technical staff. (UNH/NHDOT staff to be present for training). This training will be performed at the Bureau of Materials and Research with the Geotechnical Staff. In addition to the in-person training, two (2) days will be dedicated to preparing standard written instructions for processing and interpretation of the test data to develop hydraulic conductivity profiles.

Task 5: Develop Standard Operating Procedures:

Develop Standard Operating Procedures for field use (topics described under Task 3) and recommend data processing and interpretation methods (topics described in Task 4) based on work completed previously and as part of this contract. (UNH)

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Task 6: Final report/deliverable:

Provide a final report summarizing the research and recommendations for implementation by NHDOT. Include Standard Operating Procedures developed and other relevant details to be included in the NHDOT geotechnical manual. A poster summarizing the research methodology and findings will also be provided to the NHDOT upon submittal of the final report. (UNH) along with videos generated during the training as detailed above.

C2. Objectives - Measurement While Drilling (MWD)

The SPR Project #42372F, **Use of Drilling Parameters for Enhancing Geotechnical Site Investigations with Applications to Rock Assessment**, was recently completed in September 2024. The work performed by the University of New Hampshire, in collaboration with the NHDOT Geological Exploration team, consisted of the installation of an MWD system on one of the NHDOT drill rigs with torque measurement and field evaluation of MWD through testing at various sites across New Hampshire. MWD is a system that consists of several sensors directly mounted or connected to the NHDOT drill rig to continuously monitor in real-time all aspects of geotechnical borehole drilling and coring used in routine site investigations. These sensors record advance rate, rotation rate, downthrust (pressure and force), torque, water/mud flow, water/mud pressure, and vibration.

The latest MWD equipment and test procedures were gradually adapted and improved over an extensive field campaign, including approximately 40 boreholes conducted at 16 different NHDOT project sites with a wide range of geological conditions. MWD measurements were used to evaluate subsurface conditions and were compared to field logs and results from conventional geotechnical testing such as the Standard Penetration Test (SPT) and the piezocone (CPTu), as well as comparison to Rock Quality Designation (RQD) and visual inspection of retrieved cores when coring in bedrock.

The findings of that study confirm that MWD systems can greatly enhance site characterization continuously and in real-time, during boring advance in geological profiles typically encountered at sites in New Hampshire. It was demonstrated that MWD profiles are particularly helpful in delineating changes in stratigraphy, leading to more accurate geotechnical models essential in projects such as bridge foundation and highway designs. In addition MWD systems can aid in driller training and understanding of optimization of drilling operations through provision of real time data collection.

A newly acquired CME 55LC/300drill rig was delivered to the NHDOT in July 2024. Upon delivery, UNH has worked with the NHDOT drill crew on updating the software for the new MWD system. UNH will retain Dr. Bruma Morganna Mendonca de Souza of Weston & Sampson (W&S) in Reading, MA to assist with this portion of the project, given her

experience and expertise with MWD and to aid in provision of continuity with previous work. Dr. Souza was previously the lead graduate student working on SPR Project #42372F.

The objectives of the research on MWD are as follows:

1. Assist in the installation and troubleshooting of the new MWD equipment on the recently acquired CME 55LC/300 drill rig and installation of the additional set of sensors purchased by NHDOT not yet installed on a different drill rig.

2. Ensure that the current equipment, software, and data analysis methods are updated with currently available methods. This does not assume any purchasing of additional equipment or software.

3. Start developing an internal NHDOT MWD database summarizing ranges of drilling and compound parameters recorded at all test sites for different geological materials encountered in New Hampshire, aiming to facilitate comparisons of measurements across geological conditions and drilling techniques by NHDOT technical staff. The proposed project would provide it in Excel form for internal NHDOT use upon completion of the project.

4. Train NHDOT field staff on MWD use and care in the field and revise/amend existing documentation for Standard Operating Procedures and a video detailing step-by-step instruction.

5. Develop a training plan as an internal resource to NHDOT field staff.

6. Train NHDOT field staff on performing point test loads in the field and in the laboratory (in accordance with ASTM D5731).

7. Train NHDOT technical staff on data reduction and interpretation of drilling parameters to assess ground subsurface conditions.

8. Develop standard operating procedures for use of MWD for inclusion in the NHDOT geotechnical manual.

D2. Scope of Work - MWD:

The scope of work includes the following major tasks, with primary responsibility indicated in parentheses (W&S will lead all tasks noted as UNH):

Task 1: MWD data evaluation:

Assess existing data reduction and interpretation methods based on previous work or work to be completed as part of this research. This may include developing new or adjusting existing compound parameters suitable for geological conditions encountered in New

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Hampshire, including in rock with comparisons to point load testing and unconfined compression strength. (UNH)

Task 2: Field data collection:

Train NHDOT field exploration staff to collect MWD data independently while drilling and on using a point load test device to evaluate retrieved rock cores using ASTM D5731 procedures. Laboratory unconfined compression tests on rock cores will be performed per ASTM D2166 by the NHDOT. Perform a series of boreholes at sites to investigate the effect of drilling procedures on monitored drilling parameters. A total of 55 drilling days is expected to perform these various boreholes, including 2 days of field staff training in the first test site. For budgeting purposes, Bruma Souza of W&S will be on site for 7-8 days of field testing. Other sites and, therefore, additional field testing days may be selected based on planned investigations by the NHDOT for other planned projects through collaboration with NHDOT project development staff. Up to two field testing days will also be dedicated to developing a training video that provides simple instructions for set-up and use of the MWD system while field testing takes place. In the event that unanticipated situations reduce the number of sites or test locations, other MWD users (e.g. Terracon, University of Florida, MWD Users Group participants) will be solicited to foster collaboration. Data exchange using DIGGS will also facilitate the use of compatible data to advance our ability to develop empirical relationships and drilling protocols to be used in our research efforts in New Hampshire. (NHDOT to provide drilling rig and staff. UNH will be present at least one day at each test site after staff training)

For planning purposes, we have assumed the following number of comparison tests:

Comparison Test	Estimated Number of Tests
Point Load (ASTM D5731)	200
Laboratory Unconfined Compression (ASTM D2166)	40

Task 3: Drilling practice review:

Document and develop drilling guidelines based on MWD measurements to improve drilling efficiency resulting in quality drilling parameters for use in stratigraphic profiling and empirical relationships for estimating geotechnical properties of soils and rock. (UNH/NHDOT)

Task 4: Data interpretation training:

Concurrent with field work, train NHDOT technical staff on how to process and interpret collected test data to develop geotechnical profiles in terms of stratigraphy and properties.

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This will include training on downloading and management of tabulated data. A total of five (5) days is expected to complete training of technical staff. (UNH/NHDOT staff to be present for training at the Bureau of materials and Research)

Task 5: Develop specifications:

Develop standard operating procedures for field use and recommend data processing and interpretation methods based on work completed previously and as part of this research. (UNH)

Task 6: Data reporting:

Develop procedures to include organizing and uploading all recorded data into DIGGS (Data Interchange for Geotechnical and Geoenvironmental Specialists) for peer exchange/collaboration with other DOTs and geotechnical consultants. (UNH)

Task 7: Final report/deliverable:

Provide a final report summarizing the research and recommendations for implementation by NHDOT. Include specifications, developed videos and other relevant details to be included in the NHDOT geotechnical manual. A poster summarizing the research methodology and findings will also be provided to the NHDOT upon submittal of the final report. (UNH)

E. Deliverables Schedule:

Soil Infiltration Tentative Schedule	2025									2026												2027			
Tasks	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr
Assess and Update Equipment																									
Identify Test Sites																									
Complete UNH-Led Testing and Data Analysis																									
Train NHDOT Field Staff																									
Train NHDOT Technical Staff																									
Complete NHDOT-Led Testing and Data Analysis																									
Prepare Specifications for Geotechnical Manual																									
Provide Research Poster																									
Provide Final Report																									

Measurement While Drilling Tentative Schedule	2025									2026												2027			
Tasks	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr
Installation and Troubleshooting of MWD Equipment																									
Identify Test Sites																									
Train NHDOT Field Staff																									
Complete NHDOT-Led Testing and Data Analysis																									
Complete Drilling Practice Review																									
Train NHDOT Technical Staff																									
Prepare Specifications for Geotechnical Manual																									
Provide Research Poster																									
Provide Final Report																									

Quarterly summary reports will be submitted at the end of each three-month period each calendar year. The research group will meet with the Technical Advisory Group (TAG) quarterly or at major milestones. At these meetings, presentations of progress to-date and plans for continuing work will be presented to the TAG for comments and suggestions.

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Soil Infiltration Tentative Proposed Testing Schedule

Test Type	Site 1	Site 2	Site 3	Total Days per test
SPT	1/2	1/2	1/2	6
Slug	1/1	1/1		2
Infiltration	2/1	2/1	2/1	3
Permeafor	6/3	6/3	4/2	8
Total Days Onsite	7	7	5	**19**

Measurement While Drilling Proposed Testing Schedule

	Tests or Profiles/Days					
Test Type	**Site 1**	**Site 2**	**Site 3**	**Site 4**	**Site 5**	**Subtotals Days per Test**
MWD – Soil Drilling (estimated on a cased hole)	6/7	6/7	6/7	6/7	6/7	35
SPT Continuous Boring (cased)	1/2	1/2	1/2	1/2	1/2	10
MWD – Rock Coring (completed after SPT or MWD cased hole	2/2	2/2	2/2	2/2	2/2	10
Total days on site	11	11	11	11	11	**55**

*MWD Soil profiles will be completed adjacent to existing continuously sampled SPT holes to bedrock (for purposes of estimating on-site time, 40' soils per hole)
** MWD Rock coring 10' minimum at each profile
*** Point load test to be completed in lab, mark mechanical brakes, natural fractures and orientation. Select cores for unconfined compression testing
**** UNH onsite 2-3 days for first site, then 1 day per site (up to 4) – 10 days budgeted (includes field days and internal workshop days)

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F. Budget and Invoicing Instructions:

UNH will submit invoices to State on regular UNH invoice forms no more frequently than monthly and no less frequently than quarterly. Invoices will be based on actual project expenses settled and paid during the invoicing period and shall show current and cumulative expenses. State will pay UNH within 30 days of receipt of each invoice. UNH will submit its final invoice not later than 60 days after the Project Period end date. State may withhold 10% of funds until receipt of final report from UNH. State will provide final payment within 30 days of receipt of the accepted final report.

Budget Items:

1	Salaries and Wages Professor Benoît – approx. 6 weeks/year	$ 53,500
2.	Fringe Benefits:	$4,227
3.	Travel Domestic (Travel to test sites and NHDOT as well as attendance at conferences (e.g.TRB) $5,500 International (attendance at ISSMGE/MWD conference to present results) $3,500	$9,000
4	Materials & Supplies: Including purchase of drilling supplies such as 8 carbide roller bits and five core bits, maintenance of sensors and acquisition of additional sensors as needed to update or repair existing equipment. MWD display and analysis software ($10,000). Replace flowmeter and/or pump as necessary for the Permeafor system ($8,000). The remaining funds are for field supplies and repair costs.	$24,000
5	Service Providers Right-Trak Design (permeafor) $83,200 Weston & Sampson (MWD) $67,880 Other providers to support field testing (e.g. drilling) $24,800	$175,880
6.	Total Direct Cost	$266,607
7.	Facilities & Administrative:	$93,312
8.	Total Proposed Cost	$359,919

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EXHIBIT B

This Project Agreement is funded under a Grant/Contract/Cooperative Agreement to State from the Federal sponsor specified in Project Agreement article F. All applicable requirements, regulations, provisions, terms and conditions of this Federal Grant/Contract/Cooperative Agreement are hereby adopted in full force and effect to the relationship between State and Campus, except that wherever such requirements, regulations, provisions and terms and conditions differ for INSTITUTIONS OF HIGHER EDUCATION, the appropriate requirements should be substituted (e.g., OMB Circulars A-21 and A-110, rather than OMB Circulars A-87 and A-102). References to Contractor or Recipient in the Federal language will be taken to mean Campus; references to the Government or Federal Awarding Agency will be taken to mean Government/Federal Awarding Agency or State or both, as appropriate.

Special Federal provisions are listed here: ☐ None or **X Uniform Guidance issued by the Office of Management and Budget (OMB) in lieu of Circulars listed in paragraph above.**

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