

Grant Application

Low-Carbon Transportation Materials Program Inflation Reduction Act Section 60506

Volume 1: Technical Application

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Agency Technical Contact: Peter Schmalzer, P.E.
Assistant Chief Materials Engineer
Nevada Department of Transportation
1263 South Stewart Street
Carson City, Nevada 89712
pschmalzer@dot.nv.gov
(775) 888-7737

Agency Budgetary Contact: Tiffany Smorra
Chief Accountant
Nevada Department of Transportation
1263 South Stewart Street
Carson City, Nevada 89712
tsmorra@dot.nv.gov <mailto:kverre@dot.nv.gov>
(775) 888-7452



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1.0 Introduction

The Nevada Department of Transportation (NDOT) is pleased to submit this application in response to the Federal Highway Administration (FHWA) Request for Applications (RFA) for the use of substantially low-carbon materials and products on construction projects funded under 23 U.S.C. FHWA's Low Carbon Transportation Materials (LCTM) Program provides funding for using construction materials that have substantially lower levels of greenhouse gas (GHG) emissions. NDOT support the goals of the FHWA LCTM Program, which are to:

- 1) Increase the use of low carbon transportation materials and products in projects funded under 23 U.S.C.;
- 2) Demonstrate these materials meet necessary engineering and durability design requirements;
- 3) Demonstrate engineering performance through trial field placements;
- 4) Support State highway agencies (SHAs) to develop low-carbon material identification frameworks that include environmental quantification techniques;
- 5) Provide technology transfer and workforce development for the agency personnel and the transportation construction workforce in general;
- 6) Support SHAs in updating or developing specifications to allow for use of low-carbon transportation materials in future construction projects.

NDOT is eager to participate in this program and leverage grant funding to update its relevant specifications, policies and procedures to reduce embodied carbon on its construction contracts while maintaining or improving long-term durability and performance. NDOT is also excited by the opportunity to jump-start local contractor, supplier, consultant and academic experience and capacity for using low carbon materials.

2.0 Administration Priorities

NDOT considered the following U.S. Department of Transportation (DOT) priorities when developing the NDOT LCTM Program presented in this application.

2.1 Climate Change and Sustainability

The NDOT LCTM Program will identify low carbon transportation materials that comply with the U.S. Environmental Protection Agency (EPA) Interim Determination (ID) on selecting materials and products that meet the standards of the Inflation Reduction Act (IRA, Pub. L. 117-169, August 16, 2022, Sections 60503 and 60506) for the reduction of GHG emissions. The approach to compliance is presented in Section 3.0.

2.2 Safety

The NDOT LCTM Program will align with the National Roadway Safety Strategy (NRSS) and the Fiscal Years 2022-2026 DOT Strategic Plan with respect to advancing safe and efficient transportation.

2.3 Equity and Environmental Justice

To the extent permitted by other constraints, the NDOT LCTM Program will support activities and projects, consistent with Executive Order 13985, Advancing Racial Equity and Support for

Underserved Communities Through the Federal Government (86 FR 7009), that will create proportional impacts to all populations and remove transportation-related disparities to all populations in project areas throughout the state, and increase equitable access to project benefits.

2.4 Workforce Development, Job Quality, and Wealth Creation

The NDOT LCTM Program will, where possible, include the participation of Disadvantaged Business Enterprises, Minority-owned Businesses, Women-owned Businesses, or 8(a) firms. The program will support Made in America goals consistent with Executive Order 14005, Ensuring the Future Is Made in All of America by All of America's Workers (86 FR 7475).

3.0 Project Description

3.1 Overview

NDOT will undertake a comprehensive LCTM Program to use construction materials and products that have “substantially lower” levels of embodied carbon. Determination of substantially lower will be in accordance with the rules outlined in the RFA – simply put, NDOT will seek to use materials in the top 20%, based on the industry data to be listed on the FHWA website. Due to local conditions, we are aware that thresholds based on nationwide averages can be challenging for some material types, in which case NDOT may elect to develop regional thresholds.

NDOT will develop specification language and conduct identification activities needed to demonstrate these low carbon transportation materials are appropriate for use on Federal-aid construction projects. Additionally, NDOT will contract to construct projects using low carbon transportation materials and will establish procedures to monitor and report the performance of those projects after construction.

The NDOT LCTM Program will incorporate reclaimed asphalt pavement (RAP) mixtures, Warm Mix asphalt, Type IT Cements, Reduced Cement Mixtures, and Roller Compacted Concrete (RCC). Exhibit A in the Additional Supporting Documents provides a list of these low carbon transportation materials being considered for use in the NDOT LCTM Program.

The NDOT LCTM Program will be implemented through a number of tasks specific to each potential type of low carbon transportation material presented in Section 3.2. The processes associated with each task will be documented using Implementation Progress Reports (IPRs). These IPRs will be submitted to FHWA for approval before beginning construction work.

3.2 Technical Description

For each potential type of low carbon transportation material, the NDOT LCTM Program will involve a sequence of tasks to accomplish the goals presented in Section 1.0. NDOT has developed an overall approach and work plan, with variances noted for each type of low carbon transportation material.

After notification of award for this grant and receiving a notice to proceed, NDOT will engage consultants and university partners, as needed, to assist in performing the implementation activities necessary for responsible use of each low carbon transportation material. The work will be funded through the incremental funding process as described in the RFA.

An IPR will be developed for each material and submitted to FHWA for approval prior to use of grant funds for construction. The IPR will discuss implementation activities and demonstrate readiness for responsible use of federal funds for construction. Additional IPRs will be developed, if needed, as the program evolves.

It is understood that approval of the IPRs is required before the FHWA releases funds for construction. Approval must occur before the obligation deadline of September 30, 2026. Agency personnel will lead specification writing and the assessment of laboratory capabilities, with support from consultants and university partners. Throughout the program, NDOT personnel, as well as contractor and material producer personnel, will be trained.

The NDOT LCTM Program will address Reclaimed Asphalt Pavement (RAP) mixtures, Warm Mix Asphalt, IT Cements, Reduced Cement Mixtures, and Roller Compacted Concrete (RCC), as described below. NDOT's work plan for each type of low carbon transportation material is outlined in Section 3.2.6, with nuances noted for each material. These work plans will become part of the submittal and approval process for IPRs.

3.2.1 High RAP Mixtures

NDOT will seek to reduce carbon embodied in asphalt mixtures by increasing RAP content while maintaining or improving long term performance and durability. NDOT currently allows use of 15% RAP in asphalt mixtures. Prior research has indicated that higher amounts of RAP can be used while maintaining performance and durability with certain mitigation strategies. NDOT will investigate such mitigation strategies, including their impacts on performance, embodied carbon reduction, specifications, and required changes to acceptance testing. As higher RAP contents are expected to reduce contractor costs in most cases, in general, changing specification requirements alone is expected to be enough to incentivize use.

3.2.2 Warm Mix

NDOT currently allows the option to use Warm Mix additives or technology but does not allow such use to enable lower production and compaction temperatures. Warm Mix additives and technologies allow for production temperature reductions, thereby reducing fuel use at the plant and thus embodied carbon. Further implementation work is necessary to allow for production temperature reductions on NDOT contracts; this includes the means to evaluate additives and technologies for approval and the means to incorporate them into NDOT's mix design process. It also includes allowing for acceptance procedures so that such additives/technologies are being used as required. Some types of Warm Mix technologies, such as foaming process, are likely to pay for themselves in reduced fuel use, and no additional encouragement beyond allowing reduction in mixing temperatures will be necessary. Other types, such as additives, may or may reduce fuel usage sufficiently to offset their cost, and consideration of whether and how to encourage their use will be considered as part of the implementation process.

3.2.3 Type IT Cement

Type IT Cement, usually containing limestone as well as a pozzolan, should significantly reduce embodied carbon compared to conventional Type II/V cements, which are currently used in Nevada. As a state with significant alkali-silica reaction (ASR) and sulfate attack issues, NDOT

relies on physical testing of cementitious systems for approval and more frequent chemical testing of cement and pozzolans for acceptance. Type IT Cements will need to be evaluated to determine that the long-term durability in our environment is equivalent to the existing systems, and will likely require updates to the acceptance testing scheme so that the approved product is the same product supplied from the batch plant's silos. NDOT expects after implementation that Type IT Cements will be allowed in all concrete mixtures, but possibly mandated in certain applications, such as full depth reclamation.

3.2.4 Reduced Cement Mixtures

Northern Nevada portland cement concrete mixes, in particular, have high cement content. Reducing cement content can be achieved, but current specifications do not adequately reward the contractor/supplier to do so, relative to the perceived risk of failing 28-day strength requirements. Using funds from this grant, NDOT proposes to commission reduced embodied carbon concrete mix designs from multiple local sources, to evaluate and demonstrate them, to reach out to local industry partners to understand and alleviate potential concerns, and then to develop specifications that will lead to their use. The focus will be on non-pavement uses, such as barrier rail, curb/gutter, and sidewalk. While reducing cement content will slightly decrease the cost of the mixture itself, this may not (at least initially) be enough to offset workability and strength concerns. Specifications directly or indirectly controlling cement content, such as maximum cement content, paste volume or shrinkage, will be considered.

3.2.5 Roller Compacted Concrete

Roller Compacted Concrete (RCC) can have significantly reduced cement content compared to conventional Portland Cement Concrete Pavement (PCCP) mixtures, as it is not as reliant on paste to provide workability. However, RCC is novel to the Nevada market, and it will take a high level of effort for NDOT to develop design details, mix design methodology, specifications (including plant requirements), and construction acceptance procedures. It is understood that in order to be eligible for this program, RCC must fit within the existing PCR for concrete, and this will be investigated and confirmed prior to expending significant effort on this material. The RCC specification will be developed to ensure reductions in embodied carbon relative to conventional PCCP.

3.2.6 NDOT LCTM Program Work Plan

The overall approach for implementing the NDOT LCTM Program is similar for each material type. Unique activities for each material type are identified for each task, as appropriate.

3.2.6.1 Task 1 – Literature Review and Best Practices

NDOT will review and summarize the most recent developments, guidance, and best practices from lead states and industry sources for the following eligible construction materials. The results will inform subsequent tasks and recommendations for mix designs.

- **RAP:** While RAP is an established concept, its use continues to evolve. The literature review will identify initial options for mix design, which will include increasing RAP usage, changes to virgin binder grade, addition of rejuvenators, air voids reduction, and

gradation changes. This will result in lower virgin binder contents and lower GHG emissions.

- **Warm Mix:** The use of Warm Mix is increasing every year. Task 1 will help identify which technologies are better than others, issues related to construction and testing, sample specifications, and expected performance.
- **Type IT Cement:** Task 1 will help identify which IT Cements are available in the local and national markets, obtain material certifications and Environmental Product Declarations (EPD), and obtain and sample specifications and best practices for use.
- **Reduced Cement Mixtures:** Published research papers and guidance documents will provide a baseline for initial specifications, gradation changes, and other mix characteristics. Specific applications, such as concrete barrier rail, concrete pavements, sidewalks, and other concrete roadway items, will also be investigated.
- **RCC:** The literature review will identify examples of RCC specifications, mix design procedures, and mix designs, as well as RCC performance and durability history.

3.2.6.2 Task 2 – EPDs, Threshold and Energy Star Performance Score Establishment

NDOT will establish a process to collect EPDs for each type of low carbon transportation material. In compliance with FHWA LCTM Program rules, NDOT will develop special provision language to define EPD requirements. The collection of EPDs will require cooperation with material providers and contractors, as well as investigation into how the available low carbon transportation materials fit into existing Product Category Rules (PCR). Stakeholder outreach will involve industry partners to socialize the new protocols and specification requirements. It will be necessary to ensure that a facility-specific material/product-specific EPD, developed using International Organization for Standardization (ISO) procedures, can be delivered at the time of construction for each type of low carbon transportation material. A process for storing EPDs will be defined.

NDOT will determine how to pay contractors for providing EPDs. Many NDOT projects in remote areas are reliant on mobile plants (often operating in State-owned pits) for producing mixtures, which may make producing a compliant EPD under current PCRs problematic. This will be investigated and considered, and it may mean that EPDs will need to be non-mandatory on certain projects during the grant period of performance.

NDOT will also determine if the EPDs will be a pay once per material type, or a pay for each mix design submitted. NDOT's contractors often submit multiple mix designs from different suppliers to remain flexible and to decrease their dependency on any one supplier. However, NDOT wants to be sure contractors are not paid for EPDs without a reasonable intent of supplying that material on the contract.

An important component of Task 2 is to establish substantially lower embodied carbon thresholds that meet the EPA Interim Determination. As part of the IPR for Task 2, NDOT will detail the process to be used for determining the GWP threshold for each type of material.

The RFA provides two options to establish thresholds for each eligible material:

- Option 1: An agency may reference the established thresholds as published on the FHWA website.

- Option 2: An agency may determine local or regional thresholds for concrete (and cement), asphalt mix, steel, and/or glass, following accepted ISO standards to develop thresholds.

NDOT will also provide workshops and training for NDOT staff, as well as contractors, suppliers, consultants, and other partners. Topics will include how to develop EPDs, how EPDs can be used as a tool for optimizing mixes with regards to embodied carbon, and how to evaluate EPDs for compliance with contract requirements.

NDOT will also review the EPA's Energy Star program as it relates to the low carbon transportation materials selected for this program, and determine if and how its Energy Performance Indicator can be implemented on NDOT construction projects.

3.2.6.3 Task 3 – LCTM Laboratory Testing and Development

It will be important to develop experience with testing low carbon transportation materials in the laboratory, including how materials perform under existing test methods, and what new methods may be necessary to ensure adequate performance. This will include review of test methods, quality assurance testing of samples, evaluation of results, purchase of test equipment, and training for technicians. Some potential equipment purchases include auto extractor/recovery devices, IDEAL-CT, laboratory foam generators and a higher power XRF.

3.2.6.4 Task 4 – Trial Mix Designs

NDOT will determine if any changes in its mix design processes will be required. This will be informed by the literature review conducted in Task 1. Activities for each type of material will include:

- **RAP:** Obtain typical materials (RAP, aggregates, binder, rejuvenator) from local sources. Run trial mix designs based on recommendations from Task 1, and iteratively adjust as necessary. If there is a softer grade than is typical, the binder may need to be custom produced and purchased. Evaluate the use of rejuvenators in the mix designs.
- **Warm Mix:** Obtain typical materials (RAP, aggregates, binder, rejuvenator) from local sources. Run trial mix designs based on recommendations from Task 1, and iteratively adjust as necessary. If there is a softer grade than is typical, the binder may need to be custom produced and purchased. Additives may also need to be bought. Mix designs will need to be evaluated by lab testing evaluation and performance testing.
- **Type IT Cement:** Obtain typical aggregates from local sources and Type IT from manufacturers who supply the local market. Substitute Type IT into conventional mixes in place of approved cementitious system. Perform regular approval/acceptance tests for cement, and mixtures and determine if and how current specifications may need to be changed.
- **Reduced Cement Mixtures:** Obtain materials from local sources (potentially all batch plants in the Reno area and representative plants in Las Vegas). Produce optimized mix designs using maximum cementitious established in Task 5. Note Task 5 will be performed after Initial Carbon Analysis for Reduced Cement Mixture.
- **RCC:** Obtain typical aggregates from local sources and run trial mix designs based on recommendations from Task 1.

3.2.6.5 Task 5 – Initial Carbon Analysis

Based on extrapolation from example EPDs from the local market (resulting from Task 2), NDOT will assess the carbon footprint relative to the FHWA LCTM Program requirements. NDOT will evaluate the potential for sufficient reduction of the carbon footprint for each type of low carbon transportation material, as follows:

- **RAP:** Investigate how changes to RAP content, rejuvenator, air voids/binder content in mixes affect embodied carbon.
- **Warm Mix:** See how changes to plant production temperatures, possibly offset by Warm Mix carbon footprint, affect overall embodied carbon.
- **Type IT Cement:** See how Type IT would compare to conventional cements.
- **Reduced Cement Mixtures:** (Note: this will be performed before Trial Mix.) Determine the maximum cement content that is allowable to comfortably meet the requirements of this program. Cement content will be the target for the Initial Carbon Analysis for Type IT Cements.
- **RCC:** Evaluate how RCC mixes compare to conventional PCCP mixes relative to embodied carbon. Task 5 will run concurrently, and potentially iteratively, with Tasks 3 and 4, so that the materials and mixtures selected meet durability and performance requirements and meet the grant requirements for substantially reduced embodied carbon.

3.2.6.6 Task 6 – Test Strips

NDOT will build two test strips for each material on parking lots, frontage roads, or other suitable areas off of mainline. One should be built in the Reno area and one in the Las Vegas area, as these localities have very different mixes, aggregates, and climates. For each test strip, NDOT will observe patterns, assess constructability, perform acceptance testing as if on a real contract, and perform additional testing indicating long term durability, such as IDEAL-CT.

3.2.6.7 Task 7 – Specification Development

Updating the existing Standard Specifications or developing special provisions for new materials will follow from the preliminary mixture designs in the laboratory and limited field testing of the test strips to ensure constructability. This will include requirements for approvals, QPL category requirements (as appropriate for the material) and acceptance testing (to be performed by NDOT), as well as training for NDOT construction personnel and consultant augmentation personnel in the enforcement of the specifications. NDOT's acceptance testing program includes quality assurance during construction. NDOT will conduct workshops to inform industry partners of the development process and give opportunity for feedback.

The Standard Specifications will cover requirements for providing EPDs and Energy Star Performance Scores, as appropriate.

- **RAP:** This will entail updates to Specification sections 401 and 402. Develop and include additional requirements and acceptance testing to ensure process control for RAP (especially including recycled binder properties).
- **Warm Mix:** This will entail updates to Specification sections 401 and 402. Create QPL category and requirements. Develop and include additional requirements and acceptance

testing to ensure proper compaction. Investigate tools to ensure that approved additive is added in correct dosage, possibly including FTIR fingerprinting.

- **Type IT Cement:** This will entail updates to Specification section 701. Develop and include additional requirements and acceptance testing to verify material supplied is as approved, i.e., quick screening to tie back to physical testing, which may include XRF fingerprinting.
- **Reduced Cement Mixtures:** This will entail updates to Specification section 501. Develop and include additional requirements that allow and encourage and possibly mandate contractors to select low carbon mixtures.
- **RCC:** Refine specifications based on lessons learned in test strips.

3.2.6.8 Task 8 – EPD Verification Process and Incremental Cost Methodology

NDOT will develop a process for verifying EPDs for low carbon transportation materials and for verifying that materials delivered to the construction site are the low carbon transportation materials covered by those EPDs. EPDs will be checked to confirm that they comply with the relevant PCR, are signed or validated by a competent authority, and that they comply with the contract documents. Payment for the low carbon material can be made contingent on approval of the EPD within NDOT's AASHTOWare Project system, similar to how Buy America and Build America certificates are implemented.

NDOT will develop a methodology to determine the incremental costs associated with a NDOT LCTM Program project and to evaluate other costs of using the low carbon transportation materials. Applicable Federal cost principles will be followed. This may include costs for a contractor to mobilize for the project (e.g., temporary materials silo) or additional workforce training or certification. If allowed, adding work to existing contracts using the Change Order process will allow a more direct means of establishing the incremental cost.

3.2.6.9 Task 9 – IPR Development and Construction Project Identification

NDOT will prepare an IPR for each low carbon transportation material, documenting the activities performed in Tasks 1 to 8, and submit to them FHWA. The IPRs will conform to the requirements in Appendix A of the RFA. It is anticipated that for most, but possibly not all, materials, the IPR will demonstrate readiness for progress to the construction phase (Task 10), and the IPR will request FHWA authorization for funding the incremental cost of using low carbon transportation materials on construction projects. Each IPR will be submitted at least three months prior to the cutoff for obligation of funds, but preferably earlier, NDOT has the longest possible window for using grant funds for construction. IPRs for each individual material will be submitted individually when they are ready.

While the IPR is under FHWA review, NDOT will compile a list of construction projects that are eligible to use the incremental funding allowed under this grant. Ideally, this will include any eligible contract "docking" between the expected date of approval of the relevant IPR and the cutoff date for obligation of funds. However, with FHWA approval, NDOT will also seek to add contract language regarding low carbon transportation materials to previously awarded eligible contracts, using the established Change Order process.

NDOT understands that eligible contracts include those funded under 23 U.S.C., except that funds cannot be used for additional through travel lanes for single-occupant passenger vehicles. In practice for NDOT, this means that funds can be used for routine “Pavement Improvement”/3R projects on the National Highway System (NHS). These projects do not have a long enough lead time to be identified in this application; however, example projects are those on our 3R list that are on the NHS. NDOT will work further with FHWA to determine the intent of “additional through travel lanes.” Some potential projects on US-93 and US-95, for example, include portions of widening to serve as passing lanes, which may or may not be eligible, depending on the interpretation.

3.2.6.10 Task 10 – Construction

Task 10 includes collecting EPDs during construction and verifying compliance with the EPA ID. NDOT will, as necessary, add a pay item to construction contracts for EPD collection. Additionally, as available, NDOT will request Energy Star Performance Scores from upstream material producers. Appropriate and necessary quality incentives as part of the special provisions or by other means within the construction contracting process will be established. Any other additional agency costs incurred in the use of the low carbon transportation materials in a specific project will be identified, and reimbursement will be requested using the appropriate IPR process. All reimbursements will be in accordance with federal regulations and cost control provisions.

During construction, the acceptance testing developed in Task 7 and written into the Contract Specifications will be implemented and performed. The plan will verify that as-placed materials meet both the developed embodied carbon thresholds and the necessary engineering requirements. The validation may require inspections at material production facilities to observe low carbon transportation materials production, followed by testing to validate EPD compliance and to verify that key engineering properties are met. The sampling process will be thorough without being onerous. Access to materials for sampling and delays in construction due to testing will be minimized through cooperation and communication with all stakeholders. It may be necessary to provide quality incentives to achieve all desired properties for the low carbon transportation materials construction.

The process will follow Stewardship and Oversight requirements outlined by the FHWA division office.

3.2.6.11 Task 11 – Extended Monitoring Post Construction

A performance monitoring plan for each project will assess post-construction and long-term performance of the low carbon transportation materials in constructed projects. Extended monitoring will continue at least to the deadline for expenditures (2031) for test strips and construction contracts. Annual crack mapping, photo documentation, mix design information, acceptance test results, etc., will be monitored. It is expected that NDOT will award a contract with a consultant prior to the obligation cutoff, and extending to the expenditure cutoff to perform this monitoring. Reporting mechanisms will be established for providing data to NDOT, and the data will be organized and stored in databases. This task may also include participation in workshops and conferences to communicate lessons learned, as well as publication of

preliminary results. Full analysis and reporting will probably need to wait for additional data collection past 2031, which will be funded outside of this grant.

3.2.7 *Technical Summary*

The table below summarizes specific activities for each task.

1. Literature Review and Best Practices
Research and summarize recent development, guidance, and best practices
2. EPDs, Threshold and Energy Star Performance Score Establishment
Develop of a process to collect and store EPDs
Assess how local practices (especially mobile operations) can fit in existing PCRs
Conduct industry and stakeholder outreach, workshops and coordination
Investigate contractual mechanisms for obtaining EPDs
Establish substantially lower embodied carbon thresholds meeting EPA interim determination
As necessary, develop regional “substantially lower” embodied carbon thresholds
Investigate Energy Star Program as relates to materials under consideration
3. LCTM Laboratory Testing and Development
Evaluate adequacy of existing test procedures
Investigate, develop, and implement new test procedures, including acquiring new equipment and training
Perform testing of LCTMs, including testing indicating long-term durability and performance
4. Trial Mix Designs
Conduct preliminary mixture design and testing to evaluate materials
5. Initial Carbon Analysis
Assess embodied carbon in trial mix designs, compare to thresholds
6. Test Strips
Identify and construct test strips – one in Reno and one in Las Vegas
Perform acceptance testing
7. Specification Development
Update existing material specifications or develop new special provision to facilitate use on projects
Establish approval and QPL category requirements
Conduct training for inspectors and testers
8. EPD Verification Process and Incremental Cost Methodology
Develop a process for collecting and evaluating EPDs for contract compliance
Develop methodology to determine incremental costs eligible for reimbursement
9. IPR Development and Construction Project Identification
Prepare an IPR documenting Tasks 1 to 8 for each material
Identify eligible Federal-aid projects
10. Construction
Construct projects
Collect EPDs during construction
Collect Energy Star Performance Score, as appropriate
Determine compliance with thresholds and identify and reimburse agency costs incurred from use of LCTM
Perform acceptance testing
11. Extended Monitoring Post Construction
Develop performance monitoring plan
Collect and store relevant construction data
Conduct annual performance monitoring, including distress data, roughness data and other relevant data
Conduct workshops and conferences, publish preliminary results

3.3 Team Information

3.3.1 NDOT Personnel

The NDOT LCTM Program has the full support at all levels of the NDOT organization. The Construction, Materials, Structures, Environmental, and Communications Divisions, as well as the front office, provided input to the development of the work plan presented in the application. Financial and accounting management will be provided by the NDOT Financial Management Division, and the grant agreement will be managed by Administrative Services. Tiffany Smorra will be responsible for project accounting, and Natalie Lieb will be responsible for obligation and programming.

The technical aspects of the NDOT LCTM Program will be managed by Charlie Pan, NDOT Chief Materials Engineer of the Materials Division. He will be supported by a Project Coordinator whose time will be dedicated 75% to the program. This position will be a Materials Research Engineer who will be hired by July 2024. Two technical leads will conduct the day-to-day work. George Helgerson, Principal Materials Engineer, will lead the work related to bituminous materials. Peter Schmalzer, Assistant Chief Materials Engineer, will lead the work related to concrete materials.

An Advisory Committee of NDOT personnel will provide management and technical assistance as needed in their respective areas of expertise. The committee members are Sam Lompa, Chief Construction Engineer; Jessen Mortensen, Chief Structures Engineer; My-Linh Nguyn, Chief of Environmental Division; Kevin Verre, Chief Planner; Sajid Sulahria, Deputy Director for Project Delivery; and Jae Pullen, Assistant Director Operations.

NDOT plans to engage consultants and university staff to support and augment NDOT personnel as needed. Areas that NDOT has identified include the identification of eligible materials, training, data collection, development of the IPRs, specification and special provision development, assessment of laboratory capabilities, monitoring of documentation and test results, and other program tasks as identified. NDOT will engage these partners through its standard RFP process after the grant is in place.

3.3.2 Anticipated Partners

Recognizing that the success of the NDOT LCTM Program is dependent upon the acceptance of the contracting community of the program's requirements, NDOT anticipates regular communications and engagement with industry organizations during development and implementation of the NDOT LCTM Program. The planned approach to the NDOT LCTM Program will be provided to member firms long in advance of rolling it out in construction projects. The intention is to garner input, feedback, and cooperation from industry partners throughout the development and implementation of the program.

For example, NDOT will reach out to the Nevada chapter of the Associated General Contractors Association of America. Also, the NDOT LCTM Program will be one of the discussion topics at the annual regional meetings of the Nevada Asphalt Conference, the Nevada Infrastructure Concrete Conference, and the Nevada Transportation Conference.

NDOT will set up a contact database for interested stakeholders and will send out periodic emails with updates on the program and its implementation. Additional partners for RAP and Warm Mix will include other state DOTs, FHWA, Pacific Coast and Rocky Mountain User Producer Groups, Asphalt Institute, and the National Asphalt Pavement Association. For Type IT Cement, Reduced Cement Mixtures, and RCC, additional partners will include other state DOTs, FHWA, Southwest Concrete Pavement Association, and the American Concrete Institute.

3.4 Overall Readiness

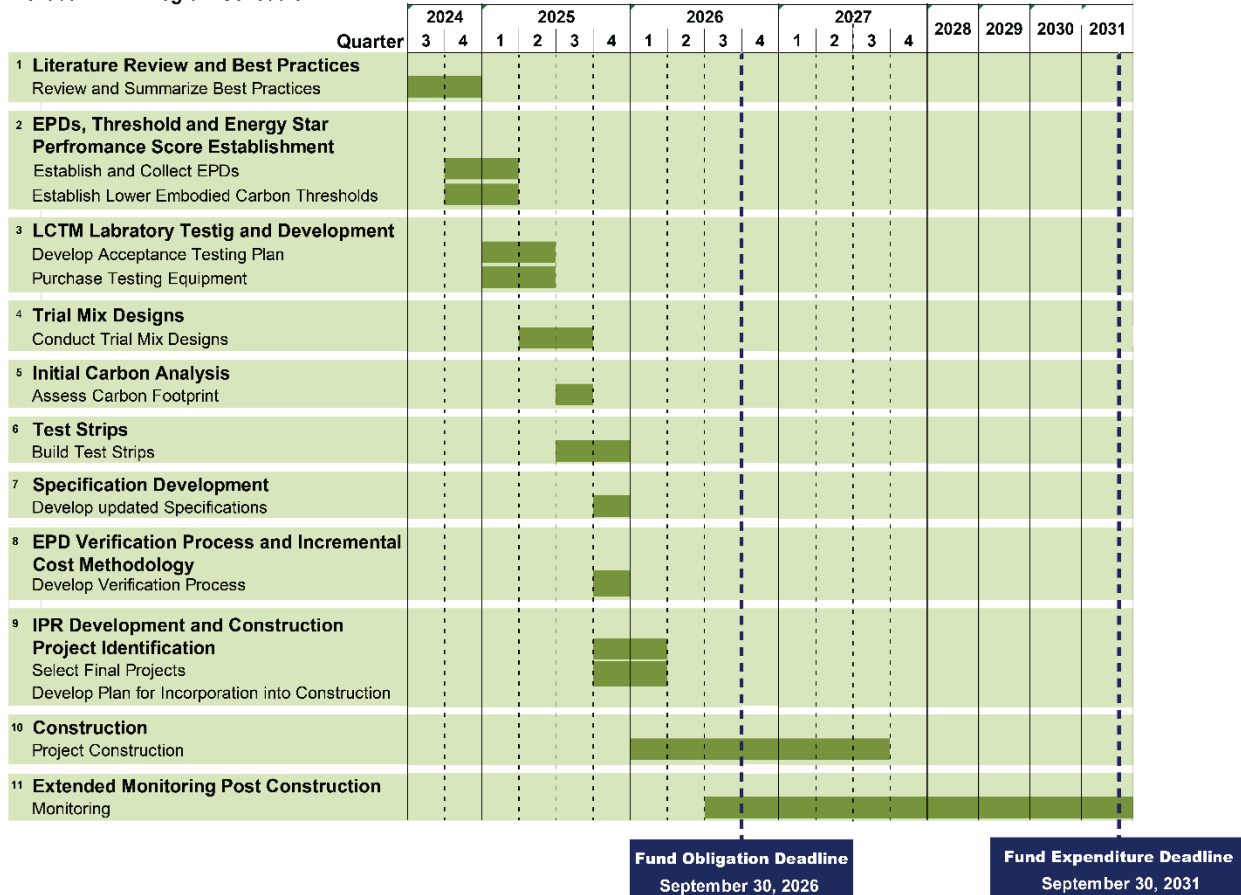
NDOT has planned for adequate staffing to launch the program upon grant award and notice to proceed, as discussed in Section 3.3. In addition, NDOT proactively developed the work plan presented in Section 3.2.6, thinking through the possibilities and identifying the materials that have the potential to have low carbon footprints in Nevada.

Potential project risks and mitigation strategies are presented in Section 3.4.2. The basis for the cost estimate presented in Volume 2 of the application identifies contingency levels appropriate for the scope, schedule, and budget.

3.4.1 Schedule

NDOT has the staff and processes in place to begin work soon after the award is announced the third quarter of 2024. The schedule below shows the timelines for each of tasks presented in Section 3.2.6.

Nevada LCTM Program Schedule



NDOT intends to largely complete implementation activities and incorporate the selected low carbon transportation materials into projects beginning in 2025. The IPR approval process will be completed and awarded funds will be fully obligated by September 30, 2026; and the materials placement will be completed by the September 30, 2031 deadline.

3.4.2 Project Risks and Mitigation Strategies

NDOT has identified the following potential risks and mitigation strategies:

- The September 30, 2026 cutoff for obligation of funds (including approval of the IPRs) will be very demanding, especially considering the diverse range of activities that need to be completed before projects can proceed to construction. To mitigate this, NDOT created the Materials Research Engineer position (a registered professional engineer) whose time will be 75% committed to coordinating these activities so they can be completed as efficiently as possible.
- Under the rules of the FHWA LCTM Program, materials must demonstrate lower embodied carbon under a “cradle-to-gate” measurement scheme, neglecting haul costs from the plant and long-term durability. If implemented naively, this “cradle-to-gate” concept could incentivize contractors to haul materials hundreds of miles from Reno or

Las Vegas into the desert because those plants run on piped-in natural gas, whereas a mobile plant at the job site would run on propane or diesel fuel. It could also encourage trading off life expectancy versus initial construction-embodied carbon in a way that actually increases emissions over the long term. NDOT will mitigate this by considering how to implement EPDs on remote projects under existing PCRs, and by evaluating low carbon transportation materials so they provide equal or better long-term performance to conventional materials.

- Industry cooperation is essential for success of this project. The degree of cooperation expected varies according to the material type. For concrete, low carbon and high durability are generally related, and the primary stumbling block is the contractor's concerns about workability and risk of not achieving 28-day strength. In contrast, for asphalt, low carbon and low durability are generally related, and the primary stumbling block is the agency's risk of poor long-term performance. Nevada also has major variations in supplier capability between urban and remote areas. Some suppliers in urban areas already having produced EPDs, whereas in remote areas there are concerns that some suppliers cannot produce an EPD under current PCRs. Also, other suppliers already find NDOT specifications to be onerous, and additional requirements may result in them being unwilling to do further business with the Department. Fortunately, NDOT has regular meetings and open communication with the local chapters of the Association of General Contractors and the Southwest Concrete Paving Association. NDOT will use these regular meetings, in addition to workshops funded under this grant, to seek feedback and cooperation from industry partners.
- Cooperation with consultants and university academia is essential for the success of this project. While NDOT expects contractors to be eager to assist, the level of effort required to achieve these program goals within the required timeframe is well above the routine baseline for this type of work within the region. This will be exacerbated by an already tight labor market for civil engineering in general, as well as similar demands for labor from other DOTs participating in this grant. NDOT is, however, a comparatively nimble organization with high commitment to this program. NDOT intends to execute consultant and interlocal agreements (i.e., with the state university system) rapidly once notified of grant award.

3.5 Eligible Application Factors

The RFA identifies the following key factors to be reviewed in the application process.

- **Factor 1: Substantially Lower Embodied Carbon Identification**
 - *Identification of eligible construction materials:* Materials covered under this application are concrete, cement and asphalt mixtures. Further details are provided in Sections 3.2.1 through 3.2.5.
 - *Energy Star Performance Scores:* These will be investigated in Task 2, with related specification development in Task 7 and collection in Task 10, as appropriate.
 - *EPD Process:* These will be investigated in Task 2, with related specification development in Task 7 and collection in Task 10.

- *Substantially Lowered Embodied Carbon Threshold:* Thresholds will be investigated in Task 2, with preliminary evaluation in Task 5, specification development in Task 7, and evaluation during construction in Task 10.
- **Factor 2: Quality Assurance and Materials Acceptance**
 - *Materials Specification:* Specifications for materials will be developed on Task 7. This includes acceptance testing, which will be performed by NDOT under Task 10. NDOT does not formally use the term “Quality Assurance” in the construction context; however, the concept is covered in its acceptance testing program.
 - *Verification Process:* Acceptance testing requirements for engineering properties will be developed in Task 7 and implemented in Task 10. Embodied carbon thresholds will be established in Task 2, with verification procedures developed in Task 8 and implementation in Task 10.
 - *Monitoring:* Performance monitoring of materials placed under this grant will be performed in Task 11, which is intended to extend until the cutoff for expenditure of funds.
- **Factor 3: Use of Materials and Products on Construction Projects**
 - *General Approach:* NDOT will develop specifications and procedures that, depending on the material allow, encourage, or mandate contractors to provide low carbon materials on its construction projects. Further general information is provided in Sections 3.1 and 3.2, especially the material-specific discussion in Sections 3.2.1 through 3.2.5.
 - *Industry Outreach:* Industry outreach will be provided in Task 2 and Task 7. Further information is provided in Section 3.3.2.
 - *Calculating Incentive or Reimbursement:* This application only includes reimbursement of incremental costs. A methodology for determining incremental costs on construction contracts will be developed in Task 8.
 - *Specific Construction Projects:* Once the IPR for a material is approved, NDOT intends to include that material on all eligible construction projects utilizing that type of material. For NDOT, this generally means any 3R project on NHS. Further information is provided in Task 9.
- **Factor 4: Schedule and Budget**
 - A schedule is provided in Section 3.4.1. This includes the cutoff dates for obligation and expenditure of funds.
 - A budget is provided in Volume 2.