ENGINEERING STUDY
AND RECOMMENDATIONS

Replacement of NHDOT
Bridge No. 087/062 and 095/063
Linden and Court Street over Little River

PREPARED FOR:

Town of Exeter, New Hampshire

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Section 1

Engineering Study

PURPOSE

The purpose of this engineering study is to explore and analyze options for the replacement of the culverts that carry Linden and Court Street over the Little River, bridges 087/062 and 095/063, respectively, in the Town of Exeter, New Hampshire. This work is necessary to address deteriorating conditions of the existing steel pipe arches and hydraulic openings which are inadequate to pass current design flows. Court Street is part of New Hampshire Route 108 running north-south out of Exeter. Linden Street runs parallel to Court Street serving residential traffic from the side streets located along it.

This engineering study examines the following items specific to the new bridges: hydrologic data and hydraulic opening, substructure types and layout, superstructure types, subsurface investigations, permitting and environmental compliance documentation, roadway alignment and width, right-of-way impacts, utility coordination and relocation, and construction materials. Recommendations of this engineering study are provided based on feasibility of construction, cost efficiency, and over-the-shoulder reviews by the Town of Exeter Engineering and Public Works Departments throughout the development of the study.

EXISTING CONDITIONS

The Linden Street crossing over the Little River is a causeway like structure built in 1967 with a total length of 50 feet measured along the road. The river meanders upstream of the crossing and turns right as it flows through two Corrugated Metal Pipe (CMP) arch culverts, each with a 12.8-foot span and 8.3-foot rise. The CMP culverts are separated by 3.5 feet of fill with stone and cast-in-place concrete infill headwalls between the arches. W-beam guardrail with driven steel posts is located along both sides of the roadway providing a curb-to-curb width of approximately 24.6 feet. The structure carries 11.8-foot lanes, a 1-foot shoulder on the west side of the roadway, and a 7-foot sidewalk on the downstream (east) side for an overall width of 31.6 feet. The structure is listed in poor condition and is currently on the Municipal Red List after receiving a 4, on a scale of 0 to 9, on the most recent Department Bridge Inspection Report. Heavy rusting over time has resulted in section loss of the structural metal pipe arches to the extent that holes and severe pitting can be observed in the lower section of the side walls along the water line.

The Court Street Culvert crosses the Little River approximately a half mile downstream of the Linden Street Culvert. The structure was built in 1965 and is of similar construction to the Linden Street crossing with one 14.1 by 8.75-foot and two 12.8 by 8.3-foot CMP culverts and a total length of 85 feet measured along the road. The curb-to-curb width is approximately 34 feet. The structure carries a 12-foot lane with 2-foot shoulder in the north bound direction and a 13-foot lane with a 7-foot shoulder in the south bound direction. The sidewalk at the Court Street Culvert runs along the downstream (east) side of the roadway and is approximately 5 feet wide with granite curbing. Including the sidewalk, the roadway has an overall width of 39 feet. The Court Street Culvert is not presently on the Municipal Red List, with a rating of 5, however its condition is borderline and near Red List status. Despite the higher condition rating, the Court Street Culvert was observed by CMA Engineers to be in similar condition to the Red List Linden Street culvert. The Court Street Culvert is also currently classified as hydraulically deficient.

DESIGN CRITERIA

General: Plans, reports, and design standards use English units in accordance with current NHDOT practice. The NHDOT Bridge Design Manual, 2000, as amended and the NHDOT Highway Design Manual, 1999, as amended establish the design criteria for bridge and roadway design elements respectively. In addition to these manuals, the following references are used to develop the bridge and roadway design:

- NHDOT Standard Specifications for Road and Bridge Construction, 2010, as amended
- NHDOT Standard Plans for Road and Bridge Construction, 2010, with supplements
- AASHTO A Policy on Geometric Design of Highways and Streets, 2011 (Green Book)
- AASHTO LRFD Bridge Design Specifications, 7th edition, 2014
- AASHTO Standard Specifications for Highway Bridges, 17th edition, 2002 with interims
- AASHTO Manual for Bridge Evaluation, 2nd Edition, with 2011 with 2013 interim revisions
- AASHTO Manual for Condition Evaluation of Bridges, 2nd edition, 2000 with interims
- Federal Emergency Management Agency, DHS, 44 CFR
- NHDES Standards for design for Sewer and Wastewater Treatment

Hydraulic Criteria: Linden and Court Street are considered to be secondary or off-system highways. Highways and bridge structures with this designation are typically designed to have a low chord elevation of the 50-year design flood elevation plus 1-foot of freeboard and have a hydraulic opening capable of passing the 100-year flood event, as prescribed by the NHDOT Bridge Design Manual. It was determined that meeting this condition at the Court Street Bridge was not practical or feasible given the existing built environment surrounding the site and the general topography of the project area. A full discussion on the design of the vertical alignment is provided below in the *Vertical Alignment* section. Additional discussion and justification of the design approach is provided in the *Hydrologic and Hydraulic Studies* section below and the Hydrologic and Hydraulic Report (H&H) included in *Appendix D*.

Vehicular and Pedestrian Loading: The design approach for the proposed structures will be consistent with current NHDOT practice for HL-93 live loading in accordance with the AASHTO LRFD *Bridge Design Specifications*. The structures will possess sufficient capacity pursuant to RSA 234.4. Pedestrian loading of 75 lbs/ft^2 will be applied to the structures as applicable. Bridge railing selection will meet or exceed Test Level 3 (TL-3), the minimum required test level required by FHWA.

Roadway Design: Chapter 5 of AASHTO Green Book was utilized in developing the alignment and profile geometrics. The "Local Rural Roads" section outlines the importance of matching into existing conditions. This section allows for flexibility in design criteria such as lane width, design speed, vertical curve length, and superelevation. An important design consideration for both sites includes minimizing impacts to the adjacent properties and environmental resources. Preliminary engineering to date has determined that the proposed roadway design for each site is acceptable for the existing design speed of 30 MPH.

Utilities Design: Several utilities, public and privately operated, will be affected by construction of the replacement structures. Town standards for water and sewer installation, along with applicable

state and federal design guidelines will be used in utility design. There are multiple utilities running within the limits of proposed work at both sites which will require temporary or permanent relocation before work on the culvert can commence.

HYDROLOGIC AND HYDRAULIC STUDIES

The hydrologic and hydraulic report located in *Appendix D* presents the methodology for the development of the hydrology and hydraulic model, and the results for existing and proposed hydraulic analyses for the Court Street and Linden Street bridge replacements (Little River Study).

The Court Street and Linden Street bridges are similarly affected by the backwater from the Great Dam located downstream on the Exeter River. The hydraulic analysis for the proposed bridges assumes the partial removal of the Great Dam as studied in 2013 and voted upon affirmatively by the Town for removal in 2014.

The hydrology used for hydraulic analysis of the replacement bridges at Court Street and Linden Street was developed as part of the Great Dam Study and confirmed to be suitable for the current projects. A "rainfall-runoff" model was developed using the TR-20 methodology within the US Army Corps of Engineers Hydrologic Engineering Center's (USACE HEC) software HEC-HMS for the 50-year flow. The TR-20 50-year flow was used in the Great Dam Study and in the Little River Study. A "statistical" approach using the Bulletin 17B methodology (17B) which applies the Log Pearson Type III distribution was used in the Great Dam Study for the 2, 10, 50 (for comparison purposes only) and 100-year flows. The 17B 2, 10 and 100-year flows were used in the hydraulic analysis for the replacement bridges.

The Great Dam Study also developed a backwater model using the USACE HEC's software HEC-RAS for the Exeter River and Little River. The Little River reach within the model contains both the Court Street and Linden Street bridges. This section of the Great Dam HEC-RAS model was utilized for the hydraulic analysis of the two proposed bridges.

Several hydraulic analyses of existing configurations and proposed alternatives were made using the HEC-RAS model. The first analysis determined whether the peak flow at the Great Dam or the peak flow at the mouth of the Little River controlled the hydraulics at Court Street and Linden Street bridges. The hydraulic model was run for both the "Great Dam in Place" and the "Great Dam Removed" conditions. It was determined that the peak flow at the Great Dam controlled the hydraulics in the Little River for both the dam-in and dam-out conditions.

The second analysis compared the Great Dam hydraulic model results to the Little River Study results for existing conditions. The comparison showed the water surface elevations (WSE) were the same downstream of Court Street which means the two models matched at that point. Upstream of Court Street and Linden Street, the Little River Study WSEs are lower because the existing culverts were enlarged based on new survey that found that the culverts under both roads were larger than those modeled in the Great Dam Study.

The third analysis compared the existing Little River hydraulic results for the "Great Dam in Place" and the "Great Dam Removed" conditions. The comparison showed that with the dam removed, the

WSEs dropped 1.7 feet downstream of Court Street and 1.2 feet upstream of Linden Street.

The final analysis modeled the proposed bridges at Court Street and Linden Street. At Court Street, a single span bridge with a 55-foot wide opening (397 SF) was modeled, and at Linden Street, a single span bridge with a 45-foot wide opening (338 SF) was modeled. With the two proposed bridges, the WSE dropped 3 inches upstream of Court Street and just over 1-foot upstream of Linden Street. For the 50-year design flow, the WSE is about 5 inches below the low chord at the Court Street Bridge and is 1.5 feet below the low chord at the Linden Street Bridge.

ENVIRONMENTAL CONSIDERATIONS AND PERMITTING

General: The following is a synopsis of historical and environmental permitting needed to meet federal, state and local regulations for the proposed project.

Protection of Historic Resources: A Request for Project Review was submitted to the New Hampshire Department of Historical Resource (NHDHR) to determine the potential for the proposed project to affect historical resources. NHDHR responded that they do not expect historical resources to be affected by the project. NHDHR did recommend consulting with abutting property owners regarding construction or other impacts to their properties, some of which may be historic.

Required Permits: The following is a synopsis of state and local regulators who have been contacted in reference to the projects and status of the appropriate permits:

- NHDES Wetlands Bureau Dredge and Fill: The removal of the existing plate arch culverts and construction of the proposed abutment footings and stone fill installation will require excavation along the bank and within the Little River. Approval by NHDES as a "major impact" Dredge and Fill Permit will be required based on the proximity of both structures to Town designated prime wetlands and the size of the Little River watershed. A public hearing for the project facilitated by NHDES may be required to meet state regulations prior to issuing the permit.
- Conditional Use Permit: Conditional Use Permits from the Town of Exeter Planning Board are required for impacts within the Exeter Wetlands Conservation District as well as impacts within the Exeter Shoreland Protection District.

Conditionally Required Permits: Section 403 of the Clean Water Act stipulates that the project must be constructed in accordance with Title 1342 – the National Pollution Discharge Elimination System (NPDES).

Construction dewatering (associated with bridge abutment and wing wall construction) requires coverage under the Dewatering General Permit. Assuming no subsurface contaminated materials are encountered and given that receiving waters are not designated as NH Class A waters, Wild and Scenic, Outstanding Resource Waters, or Essential Fish Habitat (EFH), a Construction Dewatering Permit (NHG070000) applies in accordance with 40 CFR Section 122. The current Dewatering General Permit expired September 30, 2013. A draft permit has been issued for public comment. It is expected that the new permit will be finalized by the end of the year. The Town of Exeter and the Contractor will be required to submit a U.S. Environmental Protection Agency (EPA) Notice of Intent (NOI), in accordance with the new permit. The draft general permit requires, under Part 2, that

best management practices be implemented to ensure discharge from dewatering activities into surface water meet numeric and non-numeric effluent limits.

PROPOSED ROADWAY

General: The Linden Street corridor is primarily north-south. The existing Linden Street Bridge is located on a right hand curve (approaching from the south) with an approximate radius of 2300 feet. The roadway climbs gradually at an approximate grade of 1.65% (approaching from the south) to a high point centered over the proposed structure. From this point, the roadway falls at an approximate grade of 1.70% to the project limits.

The Court Street corridor runs parallel the Linden Street. The existing Court Street Bridge is partially located on a left hand curve (approaching from the south) with an approximate radius of 600 feet. The roadway climbs gradually (approaching from the south), ranging from 1.0% approximately 125 feet from the bridge to 2.4 percent just before the approach slab. The high point is approximately centered over the proposed structure. From this point, the roadway falls at 1.68% before reaching a low point approximately 125 feet away. From the low point, the roadway climbs at 0.5% for approximately 185 feet before meeting in with the existing roadway at 1.67% after another 100 feet.

Horizontal Alignment: The proposed horizontal alignments for both sites were developed in close coordination with the design of the proposed bridge structures. The primary design constraint for the Linden Street site is matching the overall width of the roadway section including the sidewalk. The alignment was developed to match the existing centerline and overall width along the entire length of the project. The width of the sidewalk over the bridge is proposed to be reduced from 7 feet to 5.5 feet to allow the curb-to-curb width of the roadway to be increased to 26 feet. This increase will allow for standard 11-foot design lanes with 2-foot shoulders along the length of the bridge. The sidewalk and lanes are tapered over the length of both approaches to match back into the existing approach roadway within the project limits.

The existing alignment for Court Street is sufficient such that the lanes, shoulders, and sidewalk do not require alterations. The existing alignment was checked to ensure that the proposed wingwalls will not interfere with the drainage outlet near the northeast corner of the bridge and will be tied into an extension of the existing stone masonry retaining wall at the northwest corner of the bridge.

Bell Avenue connects to Court Street just to the south of the existing culvert. Changes to the centerline or overall width of the alignment were avoided to minimize potential impacts to the intersection of Court Street and Bell Avenue.

Vertical Alignment: The profiles for the replacement bridges were developed utilizing the hydraulic analysis and preliminary structural sizing. The low chord elevation of each bridge was set from the hydraulic analysis. The preliminary sizing to pass the required hydraulic area resulted in a span with structure depth of approximately 2 feet, which was used to set minimum elevations of the bridge bearing seats at the abutments. The resultant proposed vertical alignment at Linden Street is composed of a single vertical curve approximately centered over the replacement bridge and two tangents connecting the profile back into the existing roadway. Based on the required low chord elevation and the required depth of the structure, it was determined that nearly matching the existing

profile grade at Linden Street provides sufficient vertical clearance for the proposed structure to pass either the 50-year flow with 1-foot of freeboard or the 100-year flow.

The vertical alignment for Court Street has several constraints based on existing conditions within and beyond the limits of the site. Similar to Linden Street, the low chord elevation was initially set using the 50-year flood elevation plus 1-foot of freeboard. Based on that low chord elevation, the proposed increase in the roadway elevation would have been approximately 2.25 feet. It was determined that this increase in roadway elevation would cause significant impacts to the nearby intersection of Bell Avenue, to properties along Court Street, and that extensive road work would be required to properly tie into the southerly roadway approach to the structure. Further, it was determined that due to tail water effects that even with 1-foot of freeboard at the bridge, the roadway would still be overtopped during the 50-year flow due to an existing low point approximately 1000 feet south of the Court Street culvert.

To limit the impacts to the intersection with Bell Avenue, the proposed low chord elevation was decreased by approximately 9 inches. The reduction in low chord elevation and corresponding freeboard was selected as it balances maintaining a shoulder elevation 1-foot above the WSE of the 50-year flow along the bridge and approach while minimizing project limits.

Typical Section: The approach roadway section for Linden Street was developed to transition between the existing roadway and the proposed roadway over the bridge. The proposed roadway transitions from the existing 32.7-foot rail-to-rail width to the proposed rail-to-rail width of 32 feet across the bridge. The proposed transition narrows the sidewalk down to a uniform 5.5-foot width to allow for standard 11-foot lanes with 2-foot shoulders running across the structure. The taper rate will be 50:1 in these areas.

The site at Court Street does not require any reconfiguration of the lanes, shoulders, or sidewalks. The approach roadway section for this site will match the existing conditions at both the northerly and southerly approaches.

The roadway cross section approaching the bridge will be normally crowned with a 2% cross slope in each direction. The proposed bridge structure type requires the placement of a structural concrete overlay. The overlay will serve to carry the crown across the bridge while also providing a finished surface to which the uniform layer of bituminous bridge asphalt can be applied.

RELATED ISSUES, STUDIES AND RECOMMENDATIONS

Utilities: Based upon the utility investigations completed to date, the proposed bridge replacement projects will require the relocation/replacement of several utilities within the limits of each project site. To notify and obtain additional information from the affected utilities, an on site meeting will be conducted in October 2014. This will allow for a review of the project design, outlining the utility impacts, and highlighting the project schedule.

Installation of the proposed pre-cast concrete box beams will likely require the temporary relocation of overhead electric wires at both sites. Installation of wing walls at the Court Street site may also require the relocation of utility pole #45 at the southeast corner of the proposed structure. Other

utilities including water, gas, and underground telephone will also require temporary or permanent relocations before the existing culverts can be removed. The site meeting will serve as an opportunity for utility owners to voice whether permanent relocation is feasible or if they wish to run their utilities along the structure once construction is completed.

Right of Way: The research conducted to date has resulted in a determination of right-of-way width of approximately 60 feet through the project limits at both sites. The existing structures at both sites have overall widths of approximately 75 feet. Temporary construction easements will be needed at all quadrants of the bridges to allow for installation of erosion control measures, removal of the existing structures, excavation for proposed structures, and construction dewatering. The objective of the temporary easements is to provide an adequate area allowing flexibility for the Contractor's means and methods of construction. An additional easement will also be required in the northwest quadrant of the Court Street site where an addition to the existing masonry retaining wall is proposed.

Maintenance of Traffic: Linden Street carried 4200 vehicles per day in 2006 and serves as a residential connector running parallel to Court Street. Court Street carried 6000 vehicles per day in 2008 and is part of NH Route 108 running north-south through the town of Exeter. Two options evaluated for providing access during construction included a closure with detour or phased construction of each proposed bridge.

Phased construction was initially considered as an option to avoid full closure of the bridges. The option for phased construction would involve the installation of sheet piling, shoring the metal plate arch structures, installing a temporary headwall along the centerline of the roadway to facilitate the closure and demolition of one lane of the bridge while allowing alternating traffic to continue to use a lane over the existing structure. This option would also require the installation of a temporary signal at both ends of the bridge to regulate traffic across the single open lane.

Full closure of each bridge would result in a detour along surrounding streets for the duration of each project. Depending on the current condition and original design volumes of the surrounding roads (i.e. Gary Lane), the additional traffic volume from a detour could cause accelerated deterioration to those roads. The additional cost of possible repairs is likely to be less expensive than the cost of implementing phased construction for the proposed bridges. The close proximity of the bridges creates a convenient detour option for both sites resulting in minimal impacts to travel time around the project sites. Since both projects will not be active at the same time, traffic can be detoured through the other site while each proposed bridge is being constructed. The approximate detour length for both sites is 1.8 miles.

Discussion about the preference of closure and detour for the duration of construction activities at both sites was held amongst CMA Engineers, Town officials and emergency response departments in October 2014. Updates will be throughout the final design process to ensure appropriate information is shared amongst the design team and service providers and concerns are addressed timely and efficiently prior to construction. While the closure would result in minor inconveniences to the traveling public, those costs are offset by the increased project duration and costs of phased construction.

BORING LAYOUT AND LOGS

CMA Engineers, Inc. engaged Great Works Test Boring to conduct a two day boring program for the project on July 7 and 8, 2014. Two boring locations were sampled at each Court and Linden Street. The locations of the four borings are detailed in the attached geotechnical report prepared by CMA Engineers, Inc. Refer to *Appendix E*.

Linden Street: Borings B-1 and B-2 were drilled near the north and south limits of the culvert to obtain subsurface information for foundation design. These borings were advanced to refusal then advanced an additional 1.7 feet using a roller drill bit. These borings were advanced using solid stem augers. Split spoon sampling with Standard Penetration Tests (SPT) were conducted at depth intervals of approximately 5 feet. B-1 and B-2 were drilled to a total depth of 30.1 and 31.8 feet below the ground surface, respectively.

Upper layer soil types observed at the site included asphalt pavement, embankment fill consisting of sand and gravel or silty clay, mixed with organics, wood and brick and finally a layer of soft silty clay. The embankment fill was generally of medium dense consistency based on SPT N-values ranging from 2 to 10 blows per foot. The silty clay deposits were 9 and 12 feet thick at borings B-1 and B-2, respectively, with vane shear tests indicating a shear strength of 530 to 730 pounds per square foot (psf).

Court Street: The same procedure was implemented for the borings done at Court Street. Borings B-1 and B-2 were advanced to refusal then advanced an additional 2.5 feet using a roller drill bit. B-1 and B-2 were drilled to a total depth of 45.0 and 41.5 feet below the ground surface, respectively.

Upper layer soil types observed at the site included asphalt pavement, embankment fill consisting of sand and gravel or silty clay, mixed with organics, wood and brick and finally layers of soft silty clay and glacial till. The embankment fill was generally of medium dense consistency based on SPT N-values ranging from 1 to 9 blows per foot. The silty clay deposits were 11 and 7.5 feet thick at borings B-1 and B-2, respectively, with vane shear tests indicating a shear strength of 440 to 450 pounds per square foot (psf). The glacial till was encountered at thicknesses of 19 and 21 feet at borings B-1 and B-2, respectively. SPT N-values for this layer ranged from 3 to 18 blows per foot. For additional descriptions of each layer, boring logs, and foundation recommendations, see the geotechnical report located in *Appendix E*.

STRUCTURE OPTIONS

General: As described in the NHDOT Bridge Inspection Report conducted in January 2012 at Linden Street, heavy rusting, moderate section loss, and undermining at the inlet and outlet were noted, threatening overall stability of the structure. While rehabilitation of the existing structure is feasible, it would require either full slip-lining or partial invert lining to achieve or maintain a capacity of 15 tons as required to qualify for state bridge-aid funding. While the rehabilitation is feasible, it should be considered an interim repair and the structure should be closely monitored until a proper replacement is undertaken. Based on the advanced deterioration, complete replacement of the culvert is recommended.

As described in the NHDOT Bridge Inspection Report conducted in January 2012 at Court Street, moderate rusting, sagging along the roof, and scour at the inlet and outlet were noted, highlighting the need for rehabilitation or replacement. With similar conditions to Linden Street observed at this culvert, a similar rehabilitation of the existing structure is feasible. However, the culvert at Court Street is also hydraulically deficient and would require expansion to achieve the required hydraulic opening needed to pass current design flows. Based on the borderline Red List status and the need to expand the hydraulic opening, complete replacement of the culvert is recommended.

As such, bridge superstructure options considered in detail by this study are precast prestressed box beams with a cast-in-place composite concrete overlay and a precast concrete 'buried' arch systems supporting a full depth roadway gravel and pavement section.

Two other options were initially considered, but eliminated based on key design requirements for these projects: Multi-span precast frame options were eliminated due to the potential for debris buildup which can result in clogging during both normal conditions and storm events. Steel girders were also eliminated due to costs and potential minimized life cycle due to rapid corrosion with minimum vertical clearances between the bottom chord and the normal water elevation. While Timber Glue-Lam and New England Bulb Tee girders are feasible, they were eliminated from consideration due to the need to minimize structure depth associated with vertical profile adjustment through the project site. Cast-in-place concrete rigid frame and precast concrete voided slabs were not considered due to the required length of the span being greater than the practical limits for these superstructure types. Twin leaf precast concrete arches were not considered due to hydraulic and profile restrictions of the crossing.

Bridge Span and Location: Consideration was given to the alignment of the Little River, right-of-way, and utilities within each of the project sites when determining the bridge span and location. Bridge span was determined through an iterative evaluation of hydraulic, environmental and constructability requirements ultimately resulting in proposed span lengths of 45'-0" and 55'-0" for Linden and Court Street, respectively. The proposed typical channel section to convey the Little River under each bridge was the primary influence on span at each site. The proposed channel is similar at both sites and consists of a trapezoidal shape with a flat channel bottom and 1.5H to 1V side slopes up to the abutments with a 3-foot wide bench at the top of bank to facilitate future bridge inspections and riparian animal passage. Locations of abutment bearing lines were established by centering the proposed span on the historic channel and top of bank locations, resulting in abutments approximately 8.5 and 4 feet beyond the existing culvert limits at Linden and Court Street, respectively. For additional discussion on substructure type considerations see *Substructure Layout and Options*, below.

Typical Section: Similar to the existing culvert at Linden Street, the replacement structure will have a width between the guardrails of 32 feet, representing two 11-foot lanes, a 2-foot north bound shoulder, a 2.5-foot south bound shoulder, and a 5.5-foot sidewalk. This differs slightly from the existing roadway section of 31.6 feet at the north and south bridge approaches, but is recommended to standardize the lane and shoulder widths without significantly expanding the rail-to-rail width of the roadway.

In this case, where it is preferential for the bridge superstructure to be constructed on a chord, the curved alignment will be accommodated with striping and slightly varying the shoulder widths over the deck length. The large curve radius and short span length of the proposed bridge limit the narrowing of the shoulders to a maximum of 1.5 inches at the middle of the Linden Street bridge.

NHDOT standard T101 Bridge and Approach Rail is shown mounted to the brush curbs. There will be a snow screen mounted to the outside face of the bridge rail on the east side of the bridge. The purpose of the snow screen is twofold in that it will help prevent salt laden snow from being pushed into the river at the bridge site and it will meet the 42-inch minimum rail height for sidewalks required by ADA Standards for Accessible Design.

The replacement structure for Court Street will have a width between the guardrails of 39.5 feet, representing a south bound lane with a 7.0-foot shoulder and 13-foot lane, a north bound lane with a 2-foot shoulder and 12-foot lane, and a 5.5-foot sidewalk. Matching into the existing horizontal alignment of Court Street requires a curve over approximately half of the proposed structure. The existing culvert configuration and minimal curvature allow the proposed bridge superstructure to be positioned such that the shoulders retain their minimum width over the entire length of the structure. A similar guardrail configuration; T101 Bridge Rail with Snow Screen , as proposed for Linden Street will be used at Court Street.

Superstructure Options: As mentioned above, the two primary superstructure types most efficient in carrying vehicular loads for the proposed spans are precast prestressed box beams and precast concrete arches. There are a variety of shapes and sizes available to choose from when specifying a precast concrete arch. These superstructure types were initially considered using 54 and 45-foot clear-span arches for Court and Linden Street, respectively.

As the span of a precast arch increases, the required leg height also increases since the section geometry is standardized by the bridge manufacturer to balance the loads in the rigid frame design. Based on the spans required for these sites, the corresponding arch heights would be 13.9 feet and 11.5 feet for Court and Linden Street, respectively. These heights do not include the additional 2.5-foot pile caps which would be required below the arch to transfer the loads from the arches to the pile foundation. The height of the arch and footing combined would result in significantly deeper excavations than what would be required for the precast prestressed box beams supported by stub abutments. The depth of excavation was a major deciding factor in structure type selection due to the close proximity to the river and the resultant amount of cofferdams that would be required to safely excavate below stream elevations to install foundations.

Steel girders were initially considered as an alternative to the precast prestressed box beams due to their similar span capabilities and abutment configuration. The primary issue with steel girders is that they would either need to be painted or fabricated from weathering steel with a sacrificial thickness to account for advanced deterioration. The option of painted girders was eliminated based on the increase in lifecycle cost from periodic maintenance to the paint. Weathering steel was also eliminated due to the minimal vertical clearance between the water and the low chord elevation of the girders. As a rule of thumb, weathering steel requires a minimum of approximately 8-10 feet over the water to maintain enough air flow to prevent rapid deterioration in a constantly wet environment.

While cast-in-place concrete and timber structures are feasible, they were not considered at this location due to the initial cost, lifecycle cost and longer construction durations.

Concrete superstructure elements are preferable to steel in this application as they do not require initial or maintenance paint, reducing initial and lifecycle costs of the structure when compared to a similar steel bridge. Precast prestressed concrete box beams are a common superstructure type for bridges in this span range and can be constructed in spread configuration with a cast-in-place concrete deck or butted together, transversely post-tensioned, and grouted to create a continuous deck surface on which a topping slab and asphalt can be placed. Preliminary sizing of the structural members to date has determined that a 24-inch depth butted box beam with concrete compressive strength of 6,000 psi and a 3.5 inch minimum concrete overlay with 2.5 inch asphalt wearing surface will be sufficient to carry design loads.

Substructure Layout and Foundations: Substructure type was an important consideration in the development of the proposed channel section. Shallow spread footings were initially considered to either directly support the precast concrete arch or to support a full height cast-in-place concrete abutment for the box beams.

The borings at both sites revealed soft clay with unacceptable allowable bearing capacity of less than 1,000 psf within the bearing stratum. Additionally, the long-term settlement due to the consolidation of the clay would lead to unacceptable levels of settlement after construction. Excavating the clay and replacing it with a suitable engineered fill would require over excavation below river elevation and the need for substantial cofferdams and specialized dewatering at both abutments to maintain a dry excavation. For these reasons, full-height abutments are not recommended at either site.

The proposed trapezoidal channel shape for each site described above lends itself well to a stub abutment configuration located at top of bank. To avoid geotechnical concerns related to bearing capacity of embankment fill, unsuitable soils, and liquefaction potential of underlying loose sand layers, stub abutments are proposed to be supported on steel end bearing H-piles.

The wingwall orientation will be U-back for Linden Street and flared for Court Street. The flared style was chosen for the Court Street Bridge due to a number of constraints at the site on the north and south ends of the bridge. The intersection of Court Street and Bell Avenue is located within 35 feet of the proposed south abutment of the Court Street Bridge. A U-back wing wall here would be in conflict with the sidewalk as it turns left (going south) off the bridge and onto Bell Avenue. A U-back wing wall would also not be suitable for the north-west corner of the bridge due to the additional amount of retaining wall which would be required to connect the existing retaining wall to the proposed wing wall. Due to these constraints, all four quadrants of the Court Street Bridge will have flared wing walls.

Retaining Wall Requirements: There is an existing rubble masonry wall located along the northwest bank of the Little River at the Court Street site. The existing wall is approximately 20 feet from the end of the proposed wing wall and ranges from 3 to 4 feet tall in exposed height. The slope along the bank between the roadway and existing retaining wall is currently stabilized with dry-laid cut granite blocks forming a banking sloped at approximately 1.3H to 1V.

Cost, aesthetics, and utilities in the vicinity of the wall were the primary factors used to evaluate the different retaining wall options. The three options evaluated were a cast-in-place concrete wall (gravity or cantilever), a pre-cast mechanically stabilized earth (MSE) wall, and a mortar rubble masonry wall. There is an 8" clay sewer pipe which runs under the area where the new retaining wall is being proposed. While it would not cause a conflict with the sewer pipe, the MSE wall requires the deepest excavation and is also the most expensive due to the price of the pre-cast panels. The cast-in-place concrete and mortar rubble masonry walls both had similar costs and excavation requirements. The recommendation to use mortar rubble masonry is based on its least-cost, least physical impacts, and high aesthetic value given the surrounding existing wall type.

OPINION OF COST

Cost Considerations: Opinions of project construction cost have been developed for two bridge structure options at both Court and Linden Street. Roadway and utility costs have been developed for the proposed profile line and grade discussed above and presented on the accompanying plans and combined with bridge structure items to develop a total cost for each structure option at both sites.

Item unit prices are based on average weighted unit prices published and updated quarterly by NHDOT. When specific items do not appear on that list engineering judgment and experience in conjunction with discussions between CMA Engineers, Inc. and local material suppliers, fabricators, and contractors are used to develop unit pricing for a specific item. Through these methods, the opinion of cost for a precast, prestressed concrete butted box superstructure is $711,000 and $870,000 for a precast concrete arch superstructure at the Linden Street site; a difference of approximately $159,000. The opinion of cost for the Court Street site is $1.101 million for the precast, prestressed concrete butted box superstructure and $1.162 million for the precast concrete arch superstructure; a difference of $61,000.

As previously discussed, the two options for traffic control which were evaluated are either a full bridge closure with a detour, or phased construction which would allow one lane of traffic to remain open across the bridge during construction. The opinion of cost for phased construction includes the materials and installation of the roadway division/support structure and installation of signals at either end of the project to regulate alternating traffic flow across the structure. The cost for phased construction would be $55,000 for temporary shoring and $15,000 for the installation of traffic control devices, for a total of $70,000. The opinion of cost for the second option, complete closure of the bridge with detour, is $10,000 for Linden Street and $6,000 for Court Street. The cost for the detour is based on the required area of signage that is required to clearly alert commuters of the closure and direct them along the alternative route. The cost of the detour signs was only included in the Linden Street estimate in anticipation that the signs will become the property of the Town upon completion of the first project. The same set of signs can then be used for the detour at Court Street which will take place the following year. Based on the costs associated with phased construction and the limited detour length required for both sites, we are recommending closure and detour at both sites during construction.

Proposed retaining wall costs have been developed separately for the three options evaluated in the previous section. The opinion of cost for the MSE wall option is $16,000, the most expensive option of the three. The majority of this cost being the precast concrete wall panels. This option also required

the greatest amount of excavation and fill which is necessary for the installation of the tensile reinforcement into the slope behind the wall for stabilization. The other 2 options, cast-in-place concrete (gravity of cantilever) and mortar rubble masonry, have costs of $9,000. The difference in cost is attributed to the lower cost of structural components and reduced excavation and fill limits compared to those required for the MSE wall.

At the request of the Town, two options for the relocation of the 10-inch diameter water main at each site were evaluated. The two options are to either use directional boring to run the water mains under the river or run the water main along the underside of the bridge within a utility bay under the sidewalk. Both options would likely require a temporary bypass to provide uninterrupted service throughout the duration of the projects. The opinion of probable cost for mounting the water main to the bridge is $45,000 for each site. This cost includes all required new piping, connection hardware, and outer jacket with insulation. The opinion of probable cost for the directional boring option is $65,000 which includes the mobilization, boring, and installation of new piping.

The total project opinion of cost is determined by adding the costs together for the preferred bridge type, water main system, retaining wall, and closure option. In doing so, the resulting total project construction opinion of cost is $756,000 and $1.155 million for Linden and Court Street, respectively. These opinions of costs include all associated bridge and items, mobilization, roadway reconstruction, water, drainage, and sewer underground utility systems extending to the proposed limits of work, and construction inspection and administration. These costs do not include private utility relocation or any possible right-of-way negotiation and acquisition.

RECOMMENDATIONS

Replacement of the existing bridges with single span structures over the river is recommended to eliminate a current Municipal Red List designated structure and hydraulic constriction of the Little River. Full structure replacements are recommended over rehabilitation to minimize future flooding and road closure. New structures are anticipated to have lesser maintenance and life cycle costs than rehabilitated structures. A butted concrete box beam superstructure on pile supported stub abutments is recommended for the required spans at both sites for cost-effective and rapid construction. The roadway profile grade is recommended to be raised through the Court Street project site to allow for adequate freeboard to the roadway surface during flood events. Stone fill and other natural materials are recommended to be placed in the reconstructed channel at both sites for scour protection and to simulate a natural bottom as an improvement over existing conditions.

Summary of Recommendations:

Linden Street

- The extent and type of deterioration of the existing structure are beyond cost-effective rehabilitation. Full replacement is recommended.
- A 45-foot clear span, trapezoidal hydraulic opening (338 square feet) is recommended to pass design flows and mitigate hydraulic constriction concerns by providing hydraulic performance greater than that of the existing structure.
- A 45-foot span, butted concrete box beam superstructure on pile-supported concrete stub abutments is recommended to provide the best blend of structural, hydraulic and cost efficiency while providing a high level of structural and hydraulic stability at peak flow conditions.
- Installation of a clear span structure and adjustment of its invert to improve alignment and profile of Little River through the structure are recommended to match the historic river channel through the project site.
- U-back wing walls provide hydraulic efficiency while minimizing impacts to utilities, wetlands, and abutters.
- NHDOT Standard T2 bridge rail, transitional approach rails and energy absorbing guardrail terminals are recommended to provide an adequate level of safety for motorists. A snow screen mounted to the railing on the east side of the bridge is recommended to meet the 42-inch minimum rail height required.
- A roadway section consisting of 11-foot lanes, 2-foot and 2.5-foot north and south bound shoulders, respectively, and a 5.5-foot sidewalk at the bridge crossing is recommended to provide a travel way appropriate for the approaching roadways.
- The existing profile grade provides adequate freeboard at the low chord of the proposed structure during flood events. No change in elevation of the profile grade is required between existing and proposed structures.
- A full road closure for the duration of bridge construction is recommended, which would provide the shortest construction time and cost savings.
- Use of stone fill on embankments is recommended to provide a more natural channel, stabilize slopes and reduce susceptibility to scour at the wing walls and structure footings.

Court Street

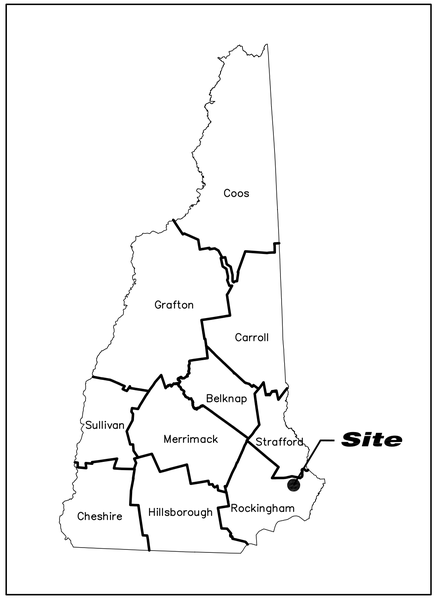
- The extent and type of deterioration of the existing structure are beyond cost-effective rehabilitation. Full replacement is recommended.
- A 55-foot clear span, trapezoidal hydraulic opening (397 square feet) is recommended to pass design flows and mitigate hydraulic constriction concerns by providing hydraulic performance greater than that of the existing structure.
- A 55-foot span, butted concrete box beam superstructure on pile-supported concrete stub abutments is recommended to provide the best blend of structural, hydraulic and cost efficiency while providing a high level of structural and hydraulic stability at peak flow conditions.
- Installation of a clear span structure and adjustment of its invert to improve alignment and profile of Little River through the structure are recommended to match the historic river channel through the project site.
- Flared wing walls provide hydraulic efficiency where required while minimizing impacts to utilities, wetlands, and abutters.
- NHDOT Standard T2 bridge rail, transitional approach rails and energy absorbing guardrail terminals are recommended to provide an adequate level of safety for motorists. A snow screen mounted to the railing on the east side of the bridge is recommended to meet the 42 inch minimum rail height required.
- A roadway section consisting of a 13-foot lane with a 7.5-foot shoulder and a 12-foot lane with a 2-foot shoulder in the south and north bound directions, respectively, at the bridge crossing is recommended to provide a travel way appropriate for the approaching roadways.
- Raising the profile grade is recommended to allow for adequate freeboard to the roadway during flood events.
- A retaining wall between the proposed wing wall and an existing retaining wall is planned in the northwest quadrant to minimize steep grades and drainage issues.
- A full road closure for the duration of bridge construction is recommended, which would provide the shortest construction time and cost savings.
- Use of stone fill on embankments is recommended to provide a more natural channel, stabilize slopes and reduce susceptibility to scour at the wing walls and structure footings.

Section 2

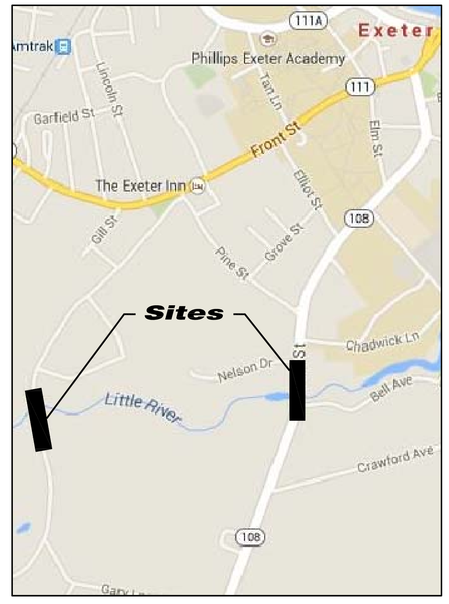
TS & L Plans

Town of Exeter, New Hampshire
Court and Linden Street
Little River Bridge Replacement
Preliminary Plans
October 2014
Sheet Index

Sheet Number	Sheet Title
--	TITLE SHEET
2-3	GENERAL PLAN AND PROFILE
4	TYPICAL SECTIONS
5-8	BORING LOGS
9-10	TRAFFIC CONTROL PLANS



Locus Plan



Project Locations

Prepared For:

Town of Exeter
13 Newfields Road
Exeter, New Hampshire 03833

Prepared By:

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Fax: 603/627-0746

10 Free Street
Portland, Maine 04101
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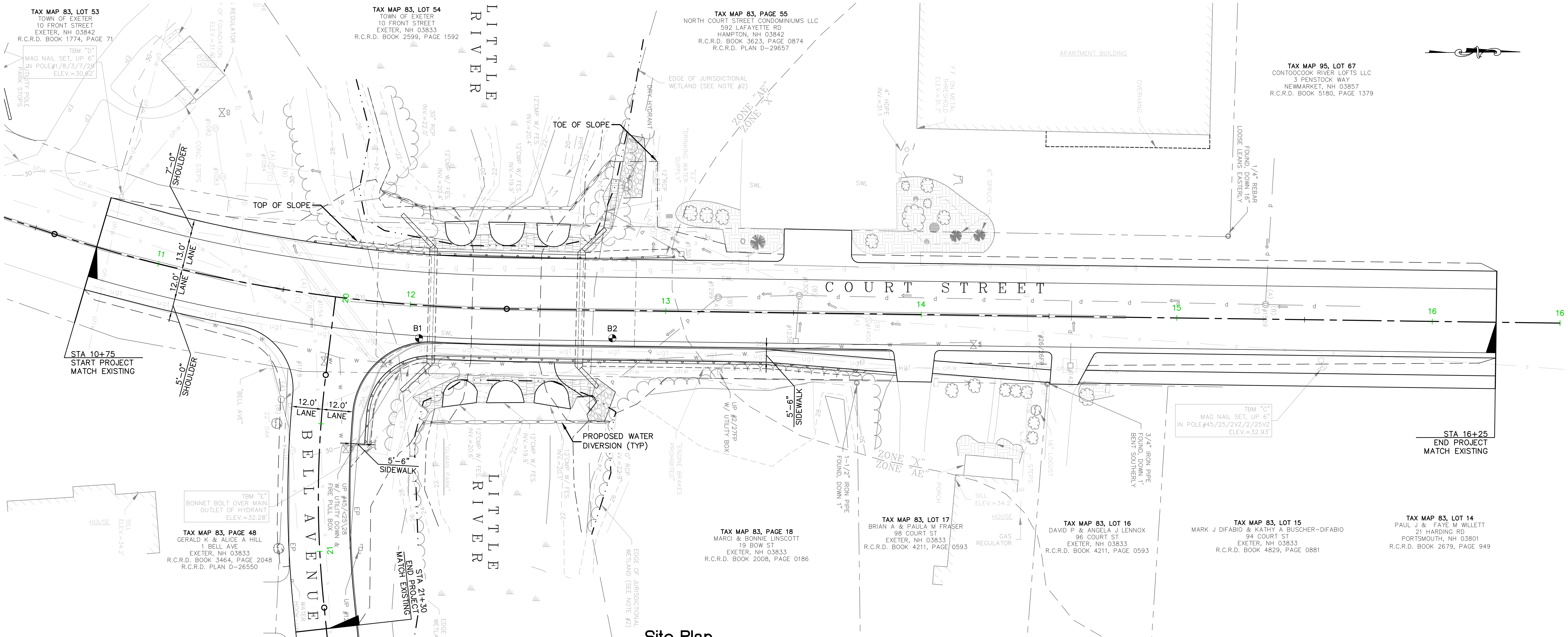
Fax: 207/541-4225

THESE PLANS HAVE BEEN PHOTOGRAPHICALLY REDUCED TO APPROXIMATELY HALF SCALE



Site Plan

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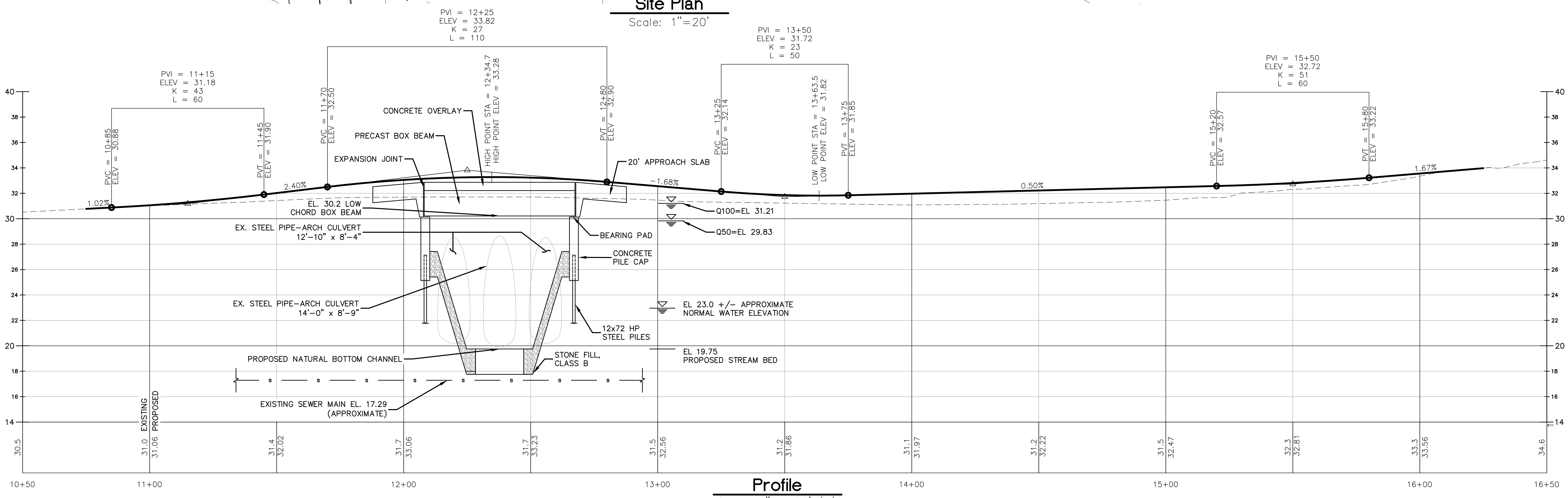

Profile

Scale: 1" = 20' (H)
1" = 4' (V)

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date:	designed by:	drawn by:	approved by:
October 2014	LBK/JLG	LBK	

project no: 923
file name: 923 - Court_Site Plan (LBK).dwg
scale: As Noted

Town of Exeter
Department of Public Works

Court and Linden Street
Little River Bridge Replacement

Court Street
General Plan and Profile

drawing no. 2

sheet: 2 of 10

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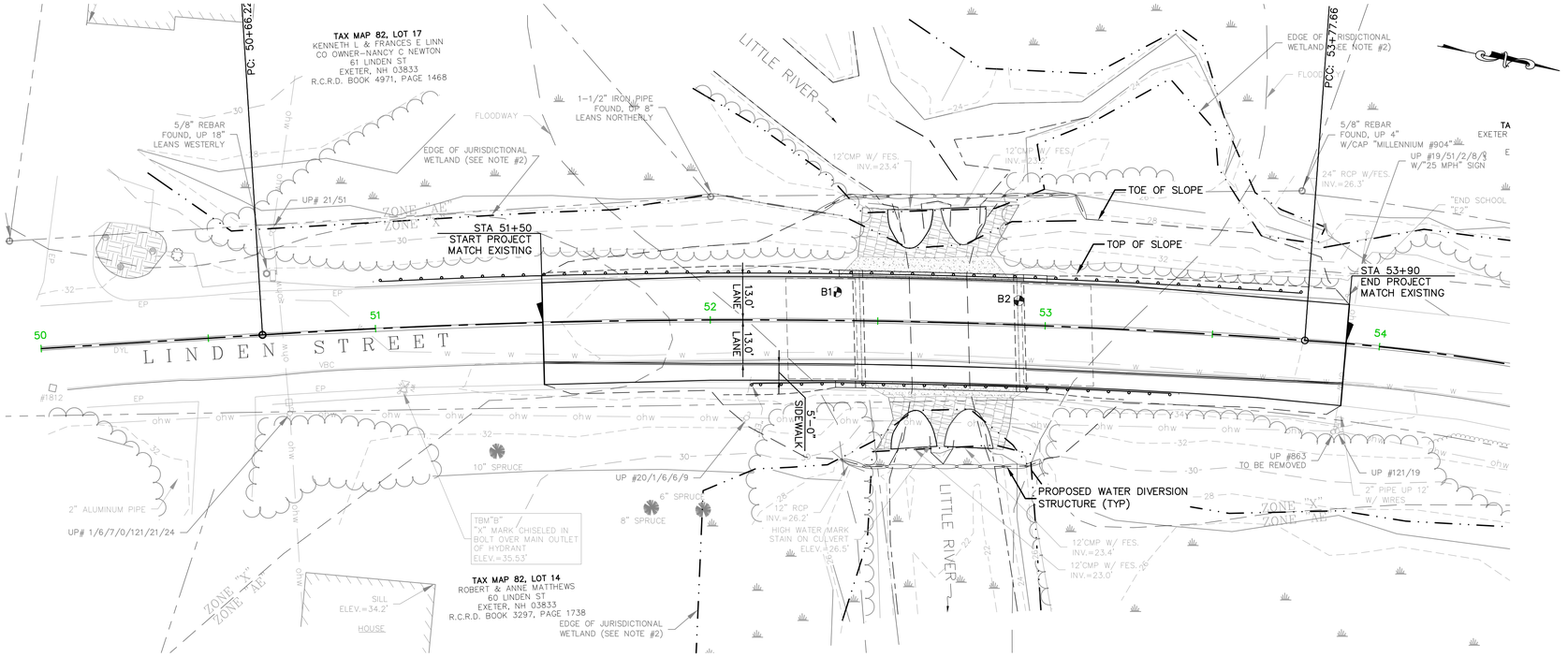
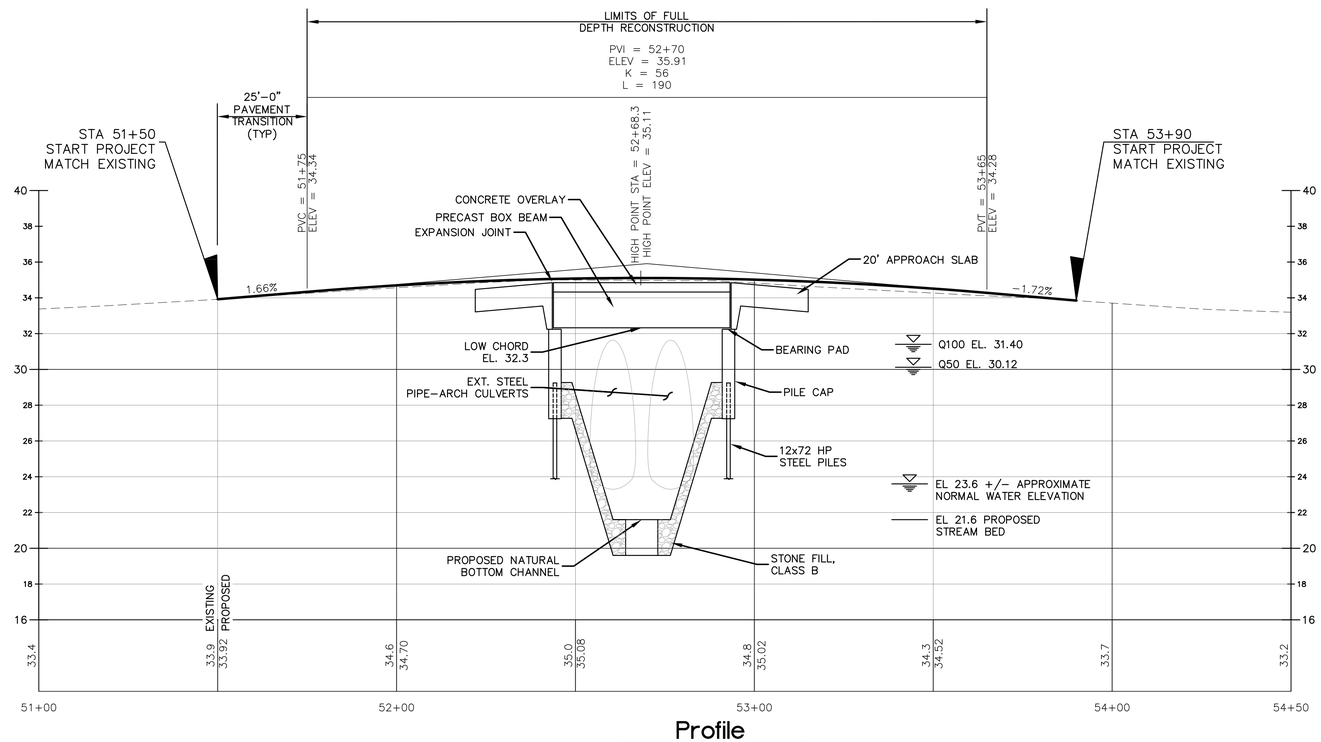


Site Plan

Scale: 1"=20'



Profile

Scale: 1" = 20' (H)
1" = 4' (V)

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no.	revision	date	by

designed by: LBK/JLG
drawn by: LBK
approved by:
date: October 2014
project no: 923
file name: 923 -Linden_Site Plan.dwg
scale: As Shown

Town of Exeter
Department of Public Works
Court and Linden Street
Little River Bridge Replacement
Linden Street
General Plan and Profile

drawing no. 3
sheet: 3 of 10

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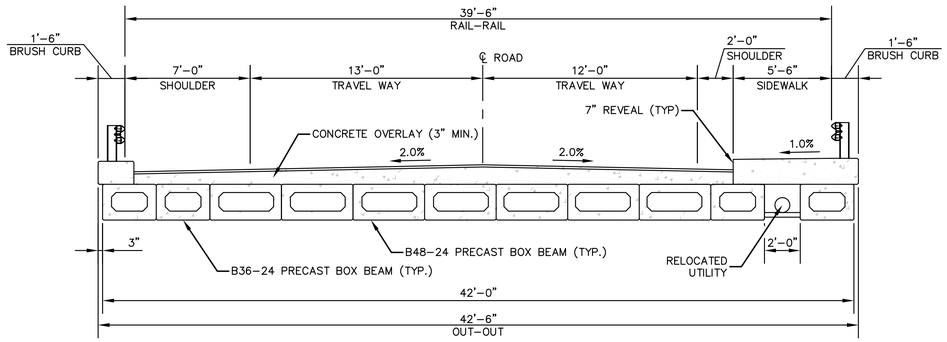
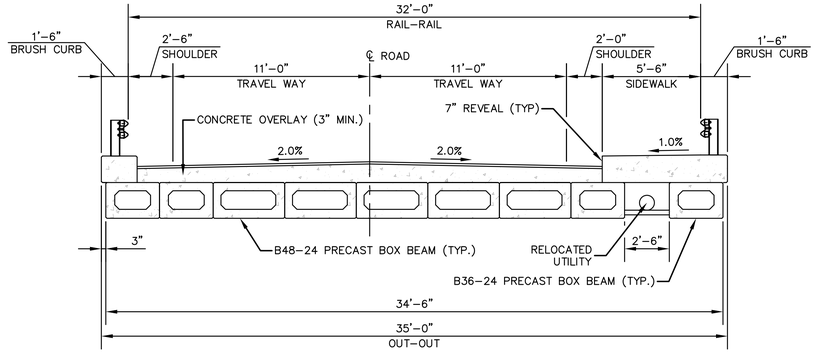


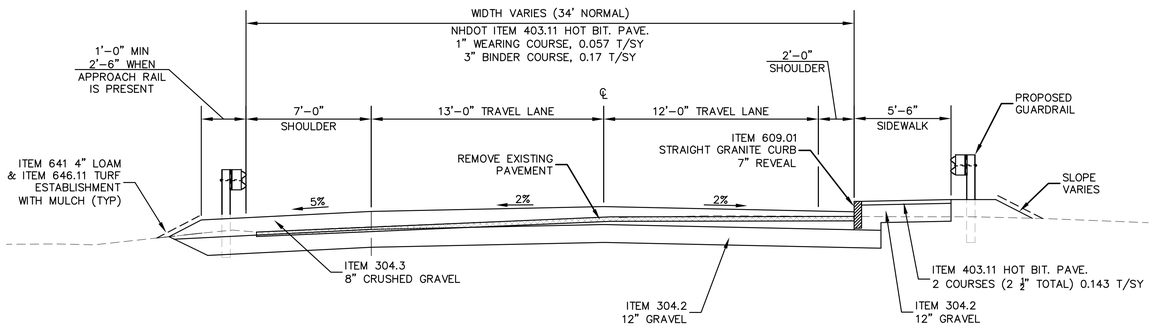
Court Street Typical Deck Section

Scale: 1/4"=1'-0"



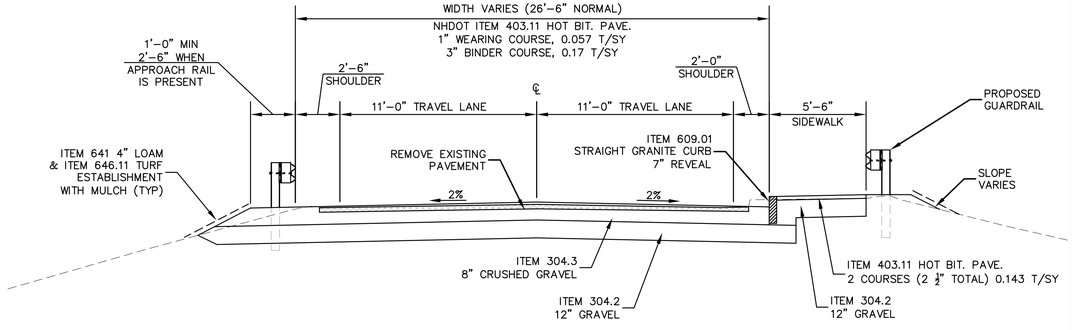
Linden Street Typical Deck Section

Scale: 1/4"=1'-0"



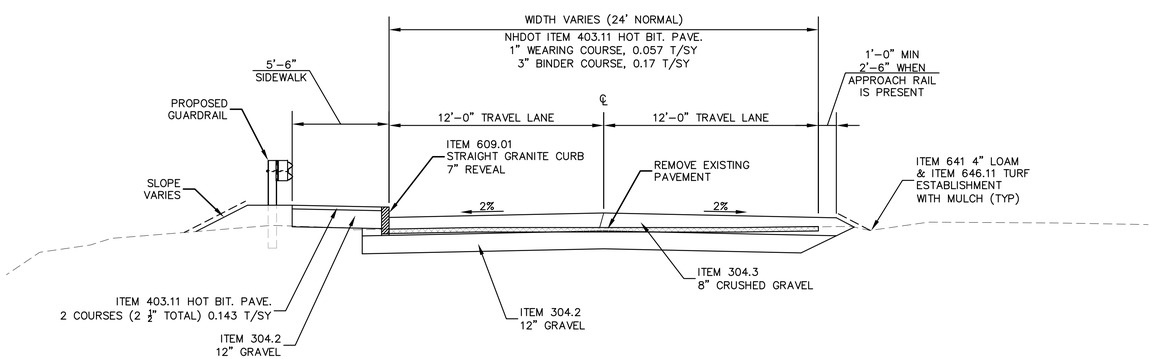
Court Street Typical Approach Roadway Section

Scale: 1/4"=1'-0"



Linden Street Typical Approach Roadway Section

Scale: 1/4"=1'-0"



Bell Avenue Typical Roadway Section

Scale: 1/4"=1'-0"

no.	revision	date	by

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designed by: LBK/JLG
drawn by: LBK
approved by:
date: October 2014
project no: 923
file name: 923 - Court_Site Plan (LBK).dwg
scale: As Shown

Town of Exeter
Department of Public Works
Court and Linden Street
Little River Bridge Replacement
Typical Bridge
and Roadway Sections

drawing no. 4

sheet: 4 of 10

Boring No. B-1
Station 12+04, 12.9 Right

TEST BORING LOG

CMA Engineers, Inc.
Civil/Environmental Engineers
35 Bow Street
Portsmouth, NH 03801
Phone: 603.431.6196
Fax: 603.431.5376

PROJECT
Description: Court St. Bridge
Location: Exeter, NH
Notes:

Test Boring Number B-1
Sheet 1 of 2

Contractor: Great Works Pump & Test Boring, Inc.
Date: July 7, 2014

CMA Engineer: Bob Grillo
Equipment: Acker Track Rig
Ground Elevation: 31.5' +/-

File Number: #923
Operator: Peter Michaud
Weather: Sun 80F

BOTTOM OF STUB ABUTMENT
ABUTMENT A (EL. 25.13)

Depth	Sample No. Depth (ft)	Blow Count	Sample Descriptions and Classifications	Remarks
1	S-1 0.5' - 2.5'	9	Brown Sand and Gravel, trace silt. Fill. Dry.	4" Asphalt Cobble at 1'
2		10		
3		16		
4		16		
5				
6	S-2 5' - 7'	7	Brown Sandy Clay. Roots and organics. Fill. Moist.	
7		2		
8		1		Groundwater Encountered at 8.0'
9		1		
10	S-3 5' - 7'	8	Gray Medium Sand, trace silt. Wood fragments. Fill.	
11		8		
12		5		
13		4		Change to Silty Clay at 12.5'
14	S-4 13' - 15'	WOH / 2'	Gray Silty Clay.	Solid stem augers to 10' 4" Casing to 13'. Drive and wash drilling.
15				
16	T-1 15' - 17'			
17	Vane Shear 17' - 17.75'		440 psf	
18	Vane Shear 17.75' - 18.5'		440 psf	
19				
20	Vane Shear 20' - 20.75'		450 psf	
21	Vane Shear 20.75' - 21.5'		450 psf	
22				
23				
24				Change to Sand at 23.7'
25	S-2	10 / 8	Gray Fine to Medium Sand, some silt, little gravel. Moist.	

Boring No. B-1
(Continued)

TEST BORING LOG

CMA Engineers, Inc.
Civil/Environmental Engineers
35 Bow Street
Portsmouth, NH 03801
Phone: 603.431.6196
Fax: 603.431.5376

PROJECT
Description: Court St. Bridge
Location: Exeter, NH
Notes:

Test Boring Number B-1
Sheet 2 of 2

Contractor: Great Works Pump & Test Boring, Inc.
Date: July 7, 2014

CMA Engineer: Bob Grillo
Equipment: Acker Track Rig
Ground Elevation: 31.5' +/-

File Number: #923
Operator: Peter Michaud
Weather: Sun 80F

Depth	Sample No. Depth (ft)	Blow Count	Sample Descriptions and Classifications	Remarks
26	25' - 27'	9	Gray Clayey Fine to Medium Sand, trace gravel and cobbles.	
27		10		
28				
29				
30		5		
31	S-6 30' - 32'	7		
32		6		
33		6		
34				
35				
36		13		
37	S-7 35' - 37'	7	Same, some gravel.	
38		10		
39		15		Cobbles encountered 37.5' to 38.5'
40				
41		18		
42	S-8 40' - 42'	15	Same	
43		11		Refused to drilling tools at 42.5'. Roller bit drilled to 45' through rock.
44		18		
45				
46				
47				
48				
49				
50				

no.	revision	date	by

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designed by: LBK/JLG
drawn by: LBK
approved by:
date: October 2014
project no: 923
file name: 923 - Court_Site Plan (LBK).dwg
scale: N.T.S.

Town of Exeter
Department of Public Works
Court and Linden Street
Little River Bridge Replacement
Court Street
Boring Logs 1

drawing no. 5
sheet: 5 of 10

Boring No. B-2
Station 12+79, 10.9' Right

TEST BORING LOG

CMA Engineers, Inc.
Civil/Environmental Engineers
35 Bow Street
Portsmouth, NH 03801
Phone: 603.431.6196
Fax: 603.431.5376

PROJECT
Description: Court St. Bridge
Location: Exeter, NH
Notes:

Test Boring Number B-2
Sheet 1 of 2

Contractor: Great Works Pump & Test Boring, Inc.
Date: July 7, 2014

CMA Engineer: Bob Grillo
Equipment: Acker Track Rig
Ground Elevation: 31.5' +/-

File Number: #923
Operator: Peter Michaud
Weather: Sun 80F

BOTTOM OF STUB ABUTMENT
ABUTMENT B (EL. 25.13)

Depth	Sample No. Depth (ft)	Blow Count	Sample Descriptions and Classifications	Remarks
1	S-1 0.5' - 2.5'	8, 14, 15, 13	Brown Sand and Gravel, trace silt. Dry. Fill	4" Asphalt
2				
3				Solid Stem Augers to advance boring
4				
5	S-2 5' - 7'	5, 5, 6, 5	Same	
6				
7				
8				Groundwater at 8.0'
9				
10	S-3 10' - 12'	2, 2, 9, 7	Gray Silty Clay overlaying Gray Fine to Medium Sand, trace silt fill.	
11				
12	S-4 12' - 14'	3, 3, 3, 4	12" Gray Sand, trace silt. Wood Fragments. Fill. 12" Gray Silty Clay	Change to Silty Clay at 12.5'
13				
14				
15	S-5 15' - 17'	2, 1, 1/12"	Gray Silty Clay	Change to Soft Silty Clay at 15.2'
16				
17				
18				
19				Change to Sand at 19'
20	Rock Core-1 19' - 22.5'			Cored through boulder
21				
22				
23				
24	S-6 24' - 26'	3, 6, 15, 12	Gray Fine to Coarse Sand, little silt and gravel	
25				

Boring No. B-2
(Continued)

TEST BORING LOG

CMA Engineers, Inc.
Civil/Environmental Engineers
35 Bow Street
Portsmouth, NH 03801
Phone: 603.431.6196
Fax: 603.431.5376

PROJECT
Description: Court St. Bridge
Location: Exeter, NH
Notes:

Test Boring Number B-2
Sheet 2 of 2

Contractor: Great Works Pump & Test Boring, Inc.
Date: July 7, 2014

CMA Engineer: Bob Grillo
Equipment: Acker Track Rig
Ground Elevation: 31.5' +/-

File Number: #923
Operator: Peter Michaud
Weather: Sun 80F

Depth	Sample No. Depth (ft)	Blow Count	Sample Descriptions and Classifications	Remarks
26				
27				
28				
29				
30				Cobbles encountered from 29.5' - 30'
31	S-7 31' - 33'	11, 14, 24, 30/5"	Gray Clayey Sand, little gravel.	Could not advance casing through cored boulder. Borehole collapsed. Pushed s.s. sampler to 31'.
32				
33				
34				
35				
36				
37				
38				
39				
40				Refusal to drilling tools at 40.5'. Roller bit drilled to 41.5' through rock.
41				
42				
43				
44				
45				
46				
47				
48				
49				
50				

no.	revision	date	by

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CIVIL/ENVIRONMENTAL ENGINEERS
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Langer Place, 55 So. Commercial Street, Manchester, NH 03101, 603/627-0708
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info@cmaengineers.com www.cmaengineers.com

designed by: LBK/JLG
drawn by: LBK
approved by:
date: October 2014
project no: 923
file name: 923 - Court_Site Plan (LBK).dwg
scale: N.T.S.

Town of Exeter
Department of Public Works
Court and Linden Street
Little River Bridge Replacement
Court Street
Boring Logs 2

drawing no. 6
sheet: 6 of 10

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Boring No. B-1
Station 52+37.6, 8.5 Left

TEST BORING LOG

CMA Engineers, Inc.
Civil/Environmental Engineers
35 Bow Street
Portsmouth, NH 03801
Phone: 603.431.6196
Fax: 603.431.5376

PROJECT
Description: Linden Street Bridge
Location: Exeter, NH
Notes:

Test Boring Number B-1
Sheet 1 of 2

Contractor: Great Works Pump & Test Boring, Inc.
Date: July 8, 2014

CMA Engineer: Bob Grillo
Equipment: Acker Track Rig
Ground Elevation: 35' +/-

File Number: #923
Operator: Peter Michaud
Weather: Sun 80F

Depth	Sample No. Depth (ft)	Blow Count	Sample Descriptions and Classifications	Remarks
				4" Asphalt
1	S-1 0.5' - 2.5'	16	Brown Sand and Gravel, trace Silt. Dry. Fill.	Solid stem augers to advance boring.
2		17		
3		14		
4		14		
5				
6	S-2 5' - 7'	5	Same. Moist.	Obstruction at 9'. Bridge Abutment? Move 2' south.
7		3		
8		5		
9		4		
10				
11	S-3 10' - 12'	2	Brown-Gray Silty Clay with brick fragments. Fill.	
12		2		
13		5		
14	S-4 12' - 14'	8	Brown-Gray Silty Clay with organics. Fill.	
15		7		
16		7		
17		9		
18	S-5 15' - 17'	9	Brown-Gray Silty Clay. Fill.	
19		10		
20		8		Rock in Spoon tip.
21	S-6 17' - 19'	5	No Recovery	
22		5		
23		5		
24				Change to Silty Clay at 19.5'
25	T-1 20' - 22'		Gray Silty Clay	Drove 4" Casing to 20', wash boring.
	Vane Shear 22' - 22.75'		730 psf	
	Vane Shear 22.75' - 23.5'		650 psf	
	Vane Shear 25' - 25.75'		530 psf	

BOTTOM OF STUB ABUTMENT
ABUTMENT A (EL. 27.24)

Boring No. B-1
(Continued)

TEST BORING LOG

CMA Engineers, Inc.
Civil/Environmental Engineers
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Portsmouth, NH 03801
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Fax: 603.431.5376

PROJECT
Description: Linden Street Bridge
Location: Exeter, NH
Notes:

Test Boring Number B-1
Sheet 2 of 2

Contractor: Great Works Pump & Test Boring, Inc.
Date: July 8, 2014

CMA Engineer: Bob Grillo
Equipment: Acker Track Rig
Ground Elevation: 35' +/-

File Number: #923
Operator: Peter Michaud
Weather: Sun 80F

Depth	Sample No. Depth (ft)	Blow Count	Sample Descriptions and Classifications	Remarks
26	Vane Shear 25.75' - 26.5'		530 psf	
27				
28				
29				Changed to Granular Soil at 28.8'
30	S-7 30' - 30.1'	50/.5"		Refused at 30.1'
31				
32				
33				
34				
35				
36				
37				
38				
39				
40				
41				
42				
43				
44				
45				
46				
47				
48				
49				
50				

by | date | revision | no.

CMA ENGINEERS
CIVIL/ENVIRONMENTAL ENGINEERS
35 Bow Street, Portsmouth, NH 03801, 603/431-6196
Langer Place, 55 So. Commercial Street, Manchester, NH 03101, 603/627-0708
10 Free Street, Portland, Maine 04101, 207/541-4223
info@cmaengineers.com www.cmaengineers.com

designed by: LBK/JLG
drawn by: LBK
approved by:
date: October 2014
project no: 923
file name: 923 - Linden_Site Plan.dwg
scale: N.T.S.

Town of Exeter
Department of Public Works
Court and Linden Street
Little River Bridge Replacement
Linden Street
Boring Logs 1

drawing no. 7
sheet: 7 of 10

F:\CADD\PROJECTS\923--Exeter Bridges\Production\Linden St\Preliminary Design\923 - Linden_Site Plan.dwg Date Plotted: Oct 24, 2014 - 3:30pm Plotted By: LKALLOCH

Boring No. B-1
Station 52+92.0, 7.2 Left

TEST BORING LOG

CMA Engineers, Inc.
Civil/Environmental Engineers
35 Bow Street
Portsmouth, NH 03801
Phone: 603.431.6196
Fax: 603.431.5376

PROJECT
Description: Linden Street Bridge
Location: Exeter, NH
Notes:

Test Boring Number B-2
Sheet 1 of 2

Contractor: Great Works Pump & Test Boring, Inc.
Date: July 8, 2014

CMA Engineer: Bob Grillo
Equipment: Acker Track Rig
Ground Elevation: 35' +/-

File Number: #923
Operator: Peter Michaud
Weather: Sun 80F

BOTTOM OF STUB ABUTMENT
ABUTMENT B (EL. 27.24)

Depth	Sample No. Depth (ft)	Blow Count	Sample Descriptions and Classifications	Remarks
1	S-1 0.5' - 2.5'	15	Brown Sand and Gravel, trace Silt. Dry. Fill.	4" Asphalt
2		15		Solid stem augers to advance boring.
3		14		
4		15		
5				
6	S-2 5' - 7'	9	Same.	
7		8		
8		5		
9		5		
10				
11	S-3 10' - 12'	8	Gray Sand and Gravel, some silt, organics. Moist. Fill.	
12		10		
13	S-4 12' - 14'	13	Gray-Brown mottled Silty Clay with fine sand lenses. Fill. Moist	Clay Fill encountered at 13'.
14		11		Groundwater at 14'.
15		10		
16	S-5 15' - 17'	15	Dark Brown to Gray Silty Clay with organics. Fill.	Drove 4" Casing to 15', wash boring.
17		13		
18	S-6 17' - 19'	11	Same to 18.5'	
19		4		
20		4		
21	S-7 20' - 22'	4	Gray Fine to Medium Sand, trace silt. Fill.	Change to Silty Clay at 19.5'
22		2		
23		2		
24		4		
25		4		
		4		
		6		
		4		
		WOH	Gray Silty Clay.	
		24"		
	Vane Shear 25' - 25.75'		560 psf	

Boring No. B-1
(Continued)

TEST BORING LOG

CMA Engineers, Inc.
Civil/Environmental Engineers
35 Bow Street
Portsmouth, NH 03801
Phone: 603.431.6196
Fax: 603.431.5376

PROJECT
Description: Linden Street Bridge
Location: Exeter, NH
Notes:

Test Boring Number B-2
Sheet 2 of 2

Contractor: Great Works Pump & Test Boring, Inc.
Date: July 8, 2014

CMA Engineer: Bob Grillo
Equipment: Acker Track Rig
Ground Elevation: 35' +/-

File Number: #923
Operator: Peter Michaud
Weather: Sun 80F

Depth	Sample No. Depth (ft)	Blow Count	Sample Descriptions and Classifications	Remarks
26	Vane Shear 25.75' - 26.5'		540 psf	
27				
28				
29				
30		14		End of Clay Layer at 31.8'
31	S-8 30' - 31.9'	9	Rock fragments mixed with gray silty clay.	Changed to Weathered Rock at 31.8'
32		8		
33		50/5"		
34				
35				Roller bit drill to 33.5' through weathered rock. Lost all drilling fluids in rock.
36				
37				
38				
39				
40				
41				
42				
43				
44				
45				
46				
47				
48				
49				
50				

no.	revision	date	by

CMA ENGINEERS
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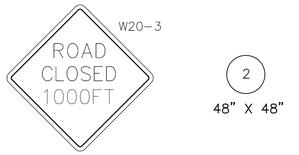
Town of Exeter
Department of Public Works
Court and Linden Street
Little River Bridge Replacement
Linden Street
Boring Logs 2

drawing no. 8

sheet: 8 of 10

1
48" X 48"



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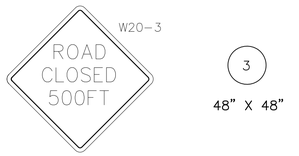
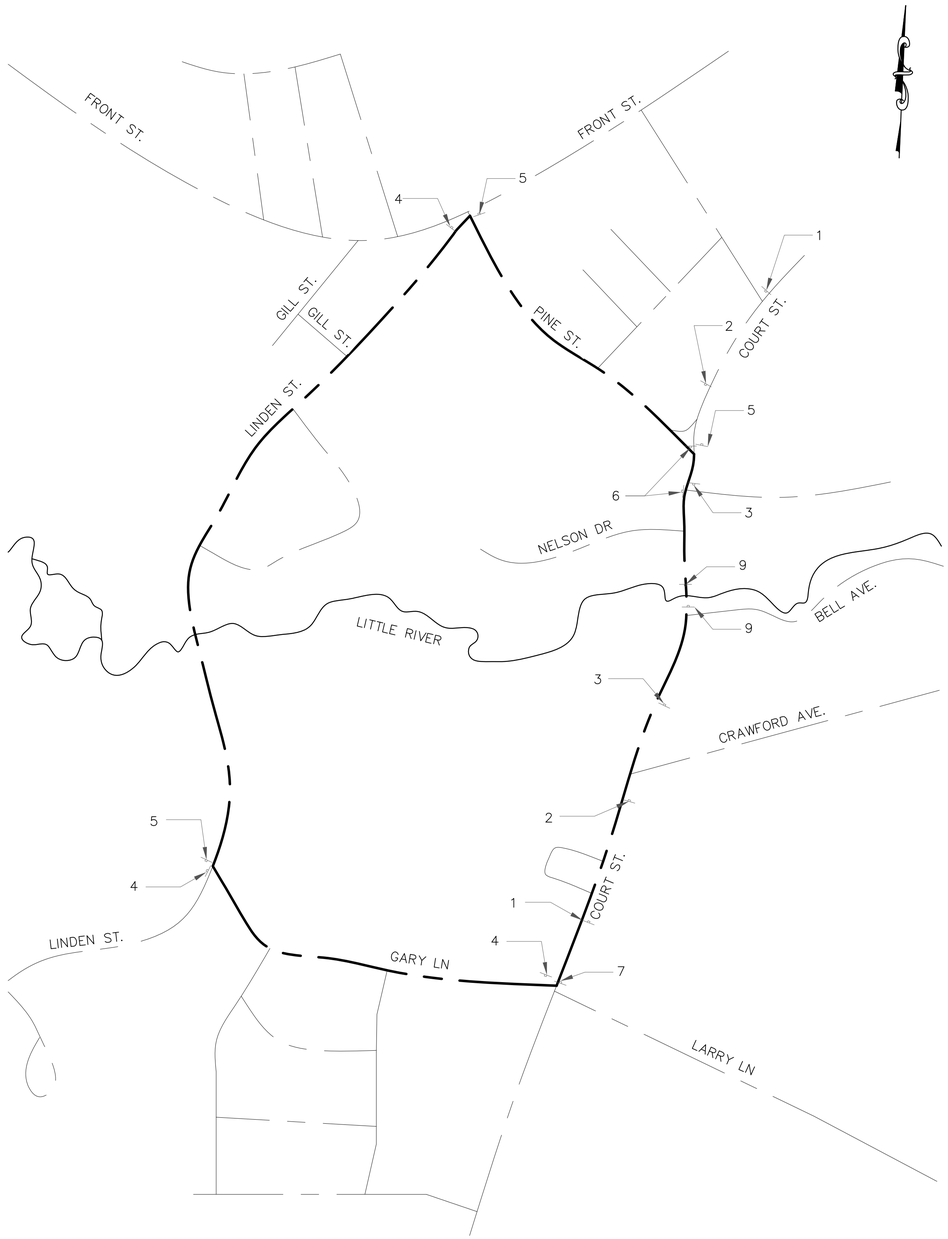
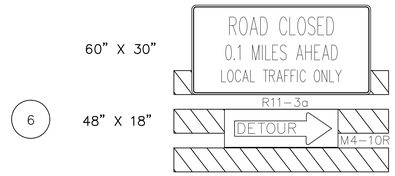


3
48" X 48"

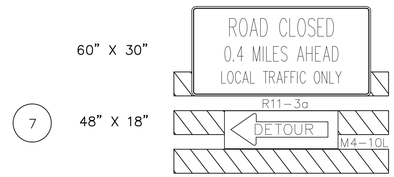
4
30" X 24"

5
30" X 24"





6
48" X 18"



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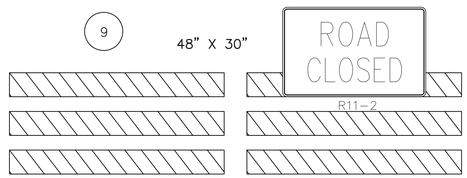
48" X 18"



9
48" X 30"

NOTES:

1. DETOUR SHALL BE SET IN COMPLIANCE WITH THE MUTCD 2009 EDITION AND THE NHDOT STANDARD SPECIFICATIONS, SECTION 619.

2. 30 LINEAR FT OF TEMPORARY CONCRETE BARRIER SHALL BE PLACED TO BLOCK THE ROADWAY DIRECTLY BEHIND THE TYPE III BARRICADES (#9).

3. CONTRACTOR IS RESPONSIBLE FOR SUPPLYING AND MAINTAINING ALL SIGNS REQUIRED FOR DETOUR.

4. SIGNS SHALL BE REMOVED OR COVERED DURING PERIODS IN WHICH THEY ARE NOT REQUIRED.

5. LAYOUT SHOWN IS NOT TO SCALE AND IS A SUGGESTED LAYOUT.

6. CONTRACTOR SHALL SUBMIT A SIGNAGE PLAN FOR APPROVAL PRIOR TO ANY WORK.

7. TOTAL ESTIMATED SIGN AREA: 201.5 SF

8. SIGN #8 OMITTED (ADJUST LINDEN ST #8 FOR TO ACCOMMODATE THE SECOND COURT ST #6 SIGN)

9.ADJUST SIGN #6 & #7 FROM LINDEN ST DETOUR ACCORDINGLY (MILEAGE) FOR COURT ST DETOUR AS INDICATED.

10. ADDITIONAL SIGNS REQUIRED FROM LINDEN ST. DETOUR FOR COURT ST DETOUR ARE AS FOLLOWS:

- (1) #1 SIGN (16 SF)
- (1) #4 SIGN (5 SF)
- (1) #5 SIGN (5 SF)
- (1) M4-10R FOR #6 SIGN (6 SF)

no.	revision	date	by

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approved by:
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file name: 923 - Traffic Plan.dwg
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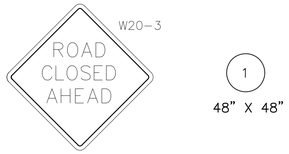
Town of Exeter
Department of Public Works
Court and Linden Street
Little River Bridge Replacement
Court Street
Traffic Control Plan

drawing no. 9
sheet: 9 of 10



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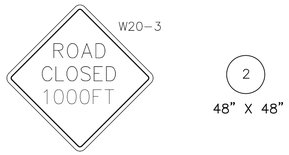
48" X 48"



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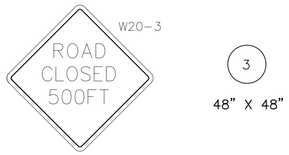
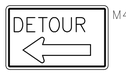
48" X 48"

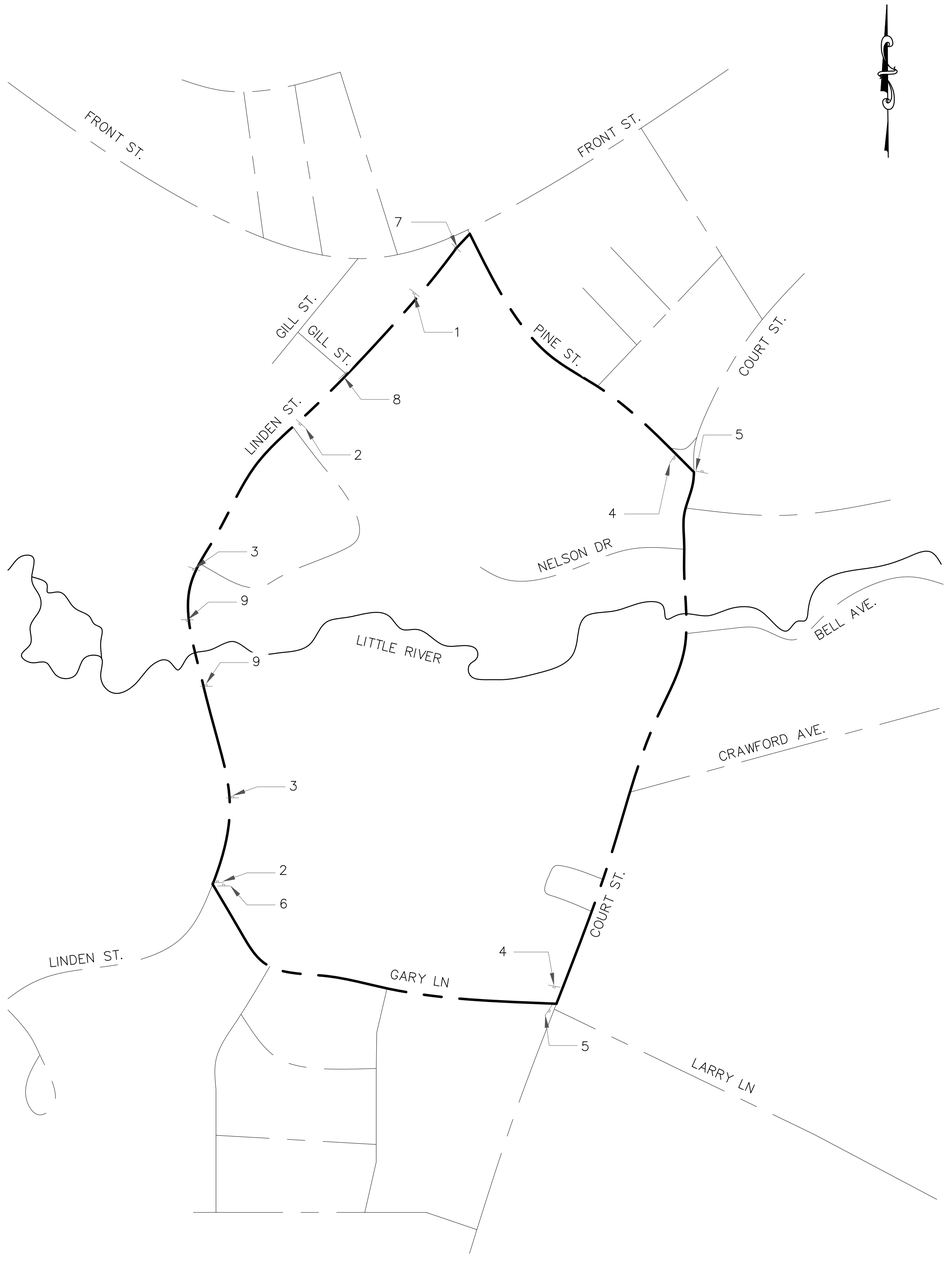


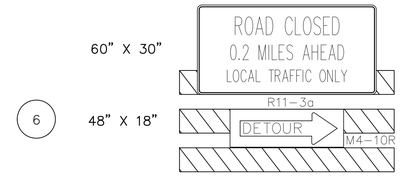
3
48" X 48"

4
30" X 24"

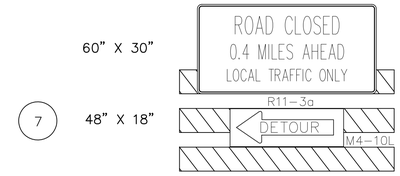


5
30" X 24"





6
48" X 18"



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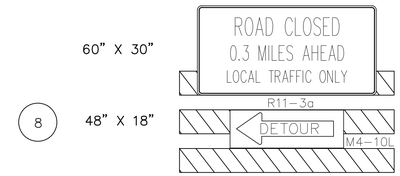
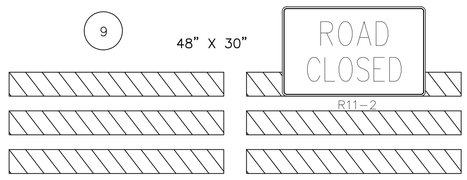
48" X 18"



8
48" X 18"



9
48" X 30"

NOTES:

1. DETOUR SHALL BE SET IN COMPLIANCE WITH THE MUTCD 2009 EDITION AND THE NHDOT STANDARD SPECIFICATIONS, SECTION 619.

2. 30 LINEAR FT OF TEMPORARY CONCRETE BARRIER SHALL BE PLACED TO BLOCK THE ROADWAY DIRECTLY BEHIND THE TYPE III BARRICADES (#9).

3. CONTRACTOR IS RESPONSIBLE FOR SUPPLYING AND MAINTAINING ALL SIGNS REQUIRED FOR DETOUR.

4. SIGNS SHALL BE REMOVED OR COVERED DURING PERIODS IN WHICH THEY ARE NOT REQUIRED.

5. LAYOUT SHOWN IS NOT TO SCALE AND IS A SUGGESTED LAYOUT.

6. CONTRACTOR SHALL SUBMIT A SIGNAGE PLAN FOR APPROVAL PRIOR TO ANY WORK.

7. TOTAL ESTIMATED SIGN AREA: 175.5 SF

no.	revision	date	by

CMA ENGINEERS
CIVIL/ENVIRONMENTAL ENGINEERS

35 Bow Street
Portsmouth, NH 03801
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Town of Exeter
Department of Public Works
Court and Linden Street
Little River Bridge Replacement
Linden Street
Traffic Control Plan

drawing no. 10
sheet: 10 of 10

Appendix A

Existing Conditions Photographs & Inspection Reports

Court Street looking north with Bell Ave. entering from the right

Court Street looking south (upstream is to the right)

Typical culvert wall rusting at the water line

Typical dry-laid granite block headwalls

Concrete outlet structure near the north-east corner of the crossing

Linden Street looking north

Linden Street looking south (upstream is to the right)

Typical culvert wall rusting at the water line

Typical stone and cast-in-place concrete infill headwalls between arches

Cracking in roadway and sidewalk pavement parallel to culverts

New Hampshire DOT
Department of Transportation

THE STATE OF NEW HAMPSHIRE
DEPARTMENT OF TRANSPORTATION

April 13, 2012

CHRISTOPHER D. CLEMENT, SR.
COMMISSIONER

JEFF BRILLHART, P.E.
ASSISTANT COMMISSIONER

Russell Dean, Exeter Town Manager
Town of Exeter
10 Front Street
Exeter, NH 03833

RE: BIENNIAL INSPECTION OF MUNICIPALLY OWNED BRIDGES
TOWN OF EXETER

Dear Mr. Dean:

Enclosed are copies of biennial bridge inspection reports for nine municipally owned bridges in the Town of Exeter. Included are a suggested guardrail detail sheet, location map, bridge-listing sheet, and a sheet explaining the condition ratings used on the reports. Please note that the Red List bridges are in bold type.

Bridge #		Location	Recommended Posting
		In order to be legal and enforceable, weight signs (black letters on a white background) and advisory width signs need to be located at each end of the bridge. At the Town's discretion, you may post a structure at a lower weight limit than the Department's recommended posting.	
044/057	1930 2008	Cross Road over Exeter River (Jointly-owned with Brentwood)	"E2" (until evaluated for certified loads) and "Narrow Bridge" Paint 2006
068/083	1930 1976	**Garrison Lane over Little River**	**No Weight or Height Posting Required, "Narrow Bridge"** Paint 2006
081/046	1993	Linden Street over Exeter River	"E2" (until evaluated for certified loads)
081/113	2000	NH 108 over Wheelwright Creek	No Posting Required
087/062	1967	**Linden Street over Little River**	**"E2" (until evaluated for certified loads)**
095/063	1965	NH 108 over Little River	"E2" (until evaluated for certified loads)
102/074	1935	String Bridge Street over Squamscott River	"E2" (until evaluated for certified loads)
103/073	1934 2002	NH 108 over Exeter River (Great Bridge)	No Posting Required
103/074	1935	String Bridge Street over Squamscott River	"E2" (until evaluated for certified loads)

Please note if there are any changes in the recommended weight posting or lack of postings for your bridges. Even though a bridge may be recommended for a weight posting or closure by the State, the decision to properly post or close the structure is the responsibility of the municipal officials. It is in the best interest of the municipality to post or sign your bridges in accordance with these recommendations. A failure to warn motorists of potential bridge hazards could result in tort liability claims. Also, if your bridges are not posted properly, it will result in forfeiture of any possible federal highway funds for projects in your municipality.

Our bridge inspectors have indicated that the bridges listed on page one of this letter are in compliance with DOT's recommendations; therefore no action needs to be taken by the Town. Please call if there are any questions.

Sincerely,

Stephen Lieb

for Nancy J. Mayville, P.E.
Municipal Highways Engineer
Bureau of Planning & Community Assistance
Tel.: (603) 271-2107 / Fax: (603) 271-8093

NJM/sa
Enclosures
cc: District 6
Exeter Public Works Director
Commissioner, Department of Education
Risk Management Representative, Local Government Center
M:\1-Municipalities\Exeter\Bridge Insp\Biennial 4-13-12.doc

Bridge Inspection Report

Exeter 087/062

Date of Inspection: 01/09/2012
Date Report Sent: 3/13/2012
☑ Picture taken during inspection
Owner: Municipality

LINDEN STREET
Over
LITTLE RIVER

Recommended Postings:
Weight: E2

☑ Weight Sign OK

Width: Not Required

☑ Width Sign OK

Primary Height Sign Recommendation: *None*
Optional Centerline Height Sign Rec: *None*

Clearances: (Feet) Over:
Under: 0.00
Route:

☑ Height Signs OK

Condition: Municipal Redlist
Deck: N N/A (NBI)
Superstructure: N N/A (NBI)
Substructure: N N/A (NBI)
Culvert: 4 Poor

Structure Type and Materials:
Number of Spans Main Unit: 2
Number of Approach Spans: 0

Main Span Material and Design Type
Steel Culvert

Sufficiency Rating: 68.9%
NBI Status: Structurally Deficient

Bridge Rail: Substandard
Rail Transition: Substandard
Bridge Approach Rail: Substandard
Approach Rail Ends: Substandard

NH Bridge Type: Metal Pipe
Deck Type: No Deck (N/A - NBI)
Wearing Surface: No Deck (N/A - NBI)
Membrane: No Deck (N/A - NBI)
Deck Protection: No Deck (N/A - NBI)
Pavement thickness: 3.0 in
Curb Reveal: Not Applicable
Plan Location: Unknown

Bridge Dimensions:
Length Maximum Span: 13.0 ft
Left Curb/Sidewalk Width: 0.0 ft
Width Curb to Curb: 0.0 ft
Approach Roadway Width (W/ Shoulders): 24.0 ft

Total Bridge Length: 29.0 ft
Right Curb/Sidewalk Width: 7.0 ft
Total Bridge Width: 29.0 ft
Median: No median
Bridge Skew: 0.00 °

Bridge Service:
Type of Service on Bridge: Highway and Pedestrian
Type of Service under: Waterway
Lanes on bridge: 2
Lanes Under: NA

Year Built: 1967
Year Rebuilt: Not Rebuilt
Detour Length: 2.0 mi

AADT: 4200
Percent Trucks: 4%
Year of AADT: 2006
Future AADT: 6216
Year of Future AADT: 2032

Bridge Inspection Report

Exeter 087/062

Federal or State Definition Bridge: Fed. Definition Bridge
Roadway Functional Class: Rural Local
New Hampshire Highway System and Class: Municipal Highway
Eligibility for the National Register of Historic Places: Possibly eligible
Traffic Direction: Two-way traffic

National Bridge Inventory (NBI) Appraisal Ratings:

Deck Geometry: Not Applicable (NBI)
Underclearances: Not Applicable (NBI)
Approach Alignment: Equal Desirable Criteria
Structural Evaluation: Minimum Tolerable
Channel/Channel Protection: Bank Slumping
Waterway Adequacy: Equal Desirable Criteria
Bridge Scour Critical Status: Stable for extreme flood
Riprap Condition: Good Condition
Debris Present: Debris Present
UNDERMINED AT ENDS OF PIPES 6 INCHES TO 1 FOOT.
Date of Underwater Inspection: Not Applicable

AASHTO CoRe Element Condition State Data:

No.	Description	Env.	Material Notes and Condition Notes
240	Culvert (includes Steel, Aluminum and Galvanized)	Moderate	*MP 6" X 2" X 3/16" PLATE. UNDER 3 FEET OF FILL. METAL PIPE AT SOUTH IS HOLED IN SEVERAL AREAS. HEAVY RUSTING AND PITTED WITH MODERATE SECTION LOSS ON INVERT. MINOR INSTALLATION DAMAGE AND SAG IN ROOF. FEW VOIDS BETWEEN STONES BETWEEN BARRELS. UNDERMINED 6 INCHES AT ENDS.*
361	Scour Condition Warning Flag	Moderate	*Element record added 2012-01-09. UNDERMINED AT ENDS OF PIPES 6 INCHES TO 1 FOOT.*
363	Section Loss Condition Warning Flag	Moderate	*Element record added 2012-01-09. MPS HOLED IN SEVERAL AREAS. HEAVY RUSTING AND PITTING.*

No.	Description	Env.	Quantity	Units	State 1	State 2	State 3	State 4	State 5
240	Culvert (includes Steel, Aluminum and C	Moderate	89	(LF)	0 %	0 %	100 %	0 %	
361	Scour Condition Warning Flag	Moderate	1	(EA)	100 %	0 %	0 %		
363	Section Loss Condition Warning Flag	Moderate	1	(EA)	0 %	100 %	0 %	0 %	

Bridge Notes:

Approach and Roadway Notes: *ASPHALT- OK. W- BEAM / CHANNEL - DAMAGED.*

Bridge Inspection Report

Exeter 087/062

Inspection History:

Inspection Date: 01/09/2012 **Inspector:** KJT

Deck: N N/A (NBI)
Super: N N/A (NBI)
Substr: N N/A (NBI)
Culvert: 4 Poor

Notes:
KJT inspection comments -
CULVERT- METAL PIPE AT SOUTH HOLED IN SEVERAL AREAS. HAS HEAVY RUSTING AND PITTED. WITH MODERATE SECTION LOSS ON INVERT. MINOR INSTALLATION DAMAGE AND SAG IN ROOF. FEW VOIDS IN STONES BETWEEN BARRELS. UNDERMINED 6 INCHES AT ENDS.

PICTURES:C443.
09.MP HOLED AT NORTHWEST.
10.HEAVY RUSTING AND PITTING.
11.WEST ELEVATION.
12.SOUTH APPROACH.

Inspection Date: 01/27/2010 **Inspector:** DPC

Deck: N N/A (NBI)
Super: N N/A (NBI)
Substr: N N/A (NBI)
Culvert: 5 Fair

Notes:
DPC inspection comments -
CULVERT- ELEMENTS IN FAIR CONDITION. METAL PIPE HAS HEAVY RUSTING WITH LIGHT SECTION LOSS ON INVERT. MINOR INSTALLATION DAMAGE AND SAG IN ROOF. FEW VOIDS IN STONES BETWEEN BARRELS. UNDERMINED 6 INCHES AT ENDS.

Inspection Date: 01/31/2008 **Inspector:** DPC

Deck: N N/A (NBI)
Super: N N/A (NBI)
Substr: N N/A (NBI)
Culvert: 5 Fair

Notes:
DPC - inspection comments -
CULVERT- ELEMENTS IN FAIR CONDITION. METAL PIPE HAS HEAVY RUSTING WITH LIGHT SECTION LOSS ON INVERT. MINOR INSTALLATION DAMAGE AND SAG IN ROOF. FEW VOIDS BETWEEN STONES BETWEEN BARRELS. UNDERMINED 6 INCHES AT ENDS.

Inspection Date: 09/06/2006 **Inspector:** RLM

Deck: N N/A (NBI)
Super: N N/A (NBI)
Substr: N N/A (NBI)
Culvert: 6 Satisfactory

Notes:
RLM inspection comments -
CULVERT- ELEMENTS IN SATISFACTORY CONDITION. METAL PIPE HAS HEAVY RUSTING WITH MINOR SECTION LOSS ON INVERT. MINOR INSTALLATION DAMAGE AND SAG IN ROOF. FEW VOIDS BETWEEN STONES BETWEEN BARRELS.

PIC(S): C324- 40.

Inspection Date: 03/04/2002 **Inspector:** DPC

Deck: N N/A (NBI)
Super: N N/A (NBI)
Substr: N N/A (NBI)
Culvert: 6 Satisfactory

Notes:
Sufficiency Rating Calculation Accepted by DEP at 09/12/2002 08:24:07
DPC inspection comments -
CULVERT- ELEMENTS IN SATISFACTORY CONDITION. METAL PIPE HAS HEAVY RUSTING WITH MINOR SECTION LOSS ON INVERT. MINOR INSTALLATION DAMAGE AND SAG IN ROOF.

Inspection Date: 09/12/2000 **Inspector:** DPC

Deck: N N/A (NBI)
Super: N N/A (NBI)
Substr: N N/A (NBI)
Culvert: 6 Satisfactory

Notes:
Sufficiency Rating Calculation Accepted by DEP at 04-09-2001 12:43:16
DPC inspection comments -
CULVERT: METAL PIPE HAS HEAVY RUSTING WITH MINOR SECTION LOSS ON INVERT. MINOR INSTALLATION DAMAGE AND SAG IN ROOF.

Inspection Date: 09/01/1996 **Inspector:** Not Available

Deck: N N/A (NBI)
Super: N N/A (NBI)
Substr: N N/A (NBI)
Culvert: 6 Satisfactory

Notes:
Sufficiency Rating Calculation Accepted by DEP at 12-23-98 08:00:31

Bridge Inspection Report

Exeter 087/062

Inspection History:

Inspection Date: 09/01/1994 **Inspector:** Not Available
Notes:

Deck: N N/A (NBI)
Super: N N/A (NBI)
Substr: N N/A (NBI)
Culvert: 6 Satisfactory

Inspection Date: 01/01/1993 **Inspector:** Not Available
Notes:

Deck: N N/A (NBI)
Super: N N/A (NBI)
Substr: N N/A (NBI)
Culvert: N N/A (NBI)

Copy Distribution:

- [x] (2) Bureau of Municipal Hghways
- [ ] (3) Bureau of Municipal Hghways
- [ ] Bureau of Turnpikes
- [ ] Border State
- [ ] Bureau of Rail and Transit
- [ ] Army Corps Of Engineers
- [ ] Railroad
- [ ] Dept. of Res. and Econ. Dev.
- [ ] Dept. of Environmental Services
- [ ] USDA Forest Service
- [ ] Bureau of Traffic

Form 4

N.H. D.O.T.

BRIDGE CAPACITY SUMMARY

TOWN Exeter

BRIDGE NUMBER 087/065

DESIGN LOAD Unknown DESIGN METHOD Unknown RATED BY OLS DATE 11/87

RATING METHOD WSD CHECKED BY _____ DATE _____

RATED MEMBER	EFFECTIVE SPAN LENGTH	REQUIRED CAPACITY			AVAILABLE CAPACITY					
		CURRENT LEGAL LOADS	CERTIFIED VEHICLES		MULTIPLE LANES LOADED			SINGLE LANE LOADED		
			SINGLE UNIT	MULTIPLE UNIT	INVENTORY	OPERATING	POSTING	INVENTORY	OPERATING	POSTING
Twin Structural Plate Pipe Arches (Buckling)	4'-0"	H14.0	—	—	H41.3	H56.7	—	H41.3	H56.7	—
Seam Strength			—	—	H35.2	H48.7	—	H35.2	H48.7	—

RECOMMENDED POSTING: Post "E-2" Until Evaluated For Certified Loads

64. (Op.) 149

66. (Inv.) 135

EXETER 087/062

LINDEN STREET over LITTLE RIVER

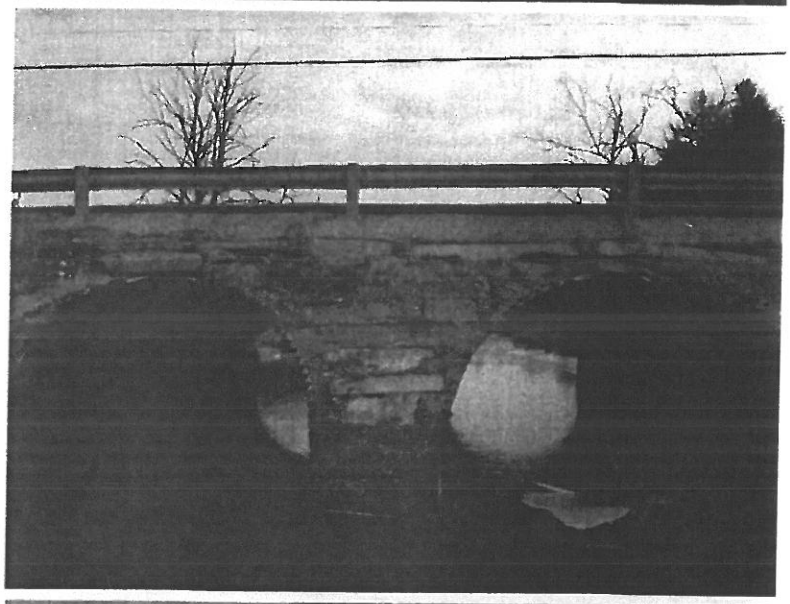
Monday, January 09, 2012

SOUTH APPROACH (RL)

C443 12

Monday, January 09, 2012

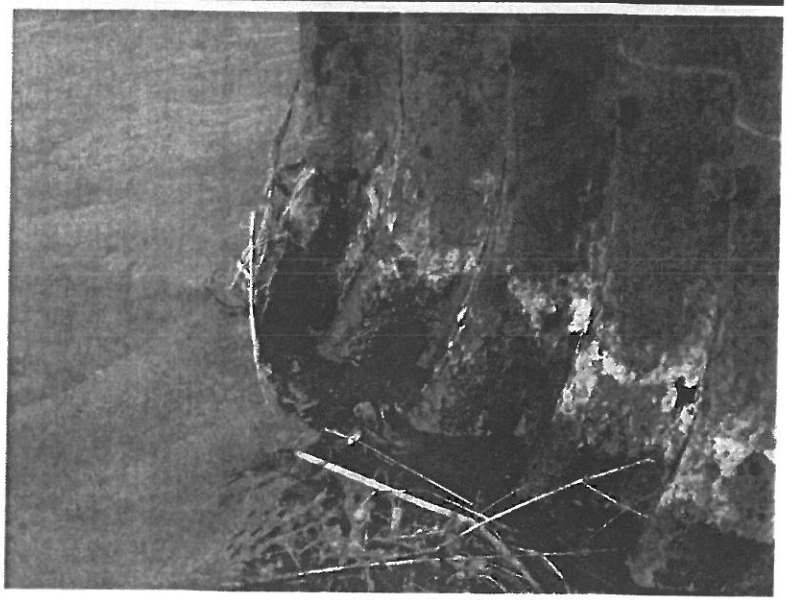
WEST ELEVATION (RL)



C443 11

Monday, January 09, 2012

MP HOLED AT
NORTHWEST (RL)



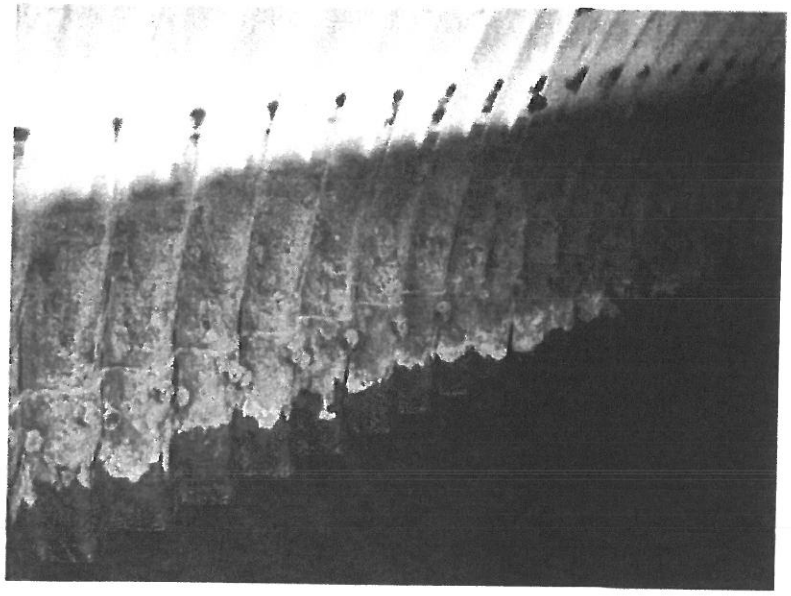
C443 09

EXETER 087/062

LINDEN STREET over LITTLE RIVER

Monday, January 09, 2012

HEAVY RUSTING AND
PITTING (RL)



C443 10

Bridge Inspection Report

Exeter 095/063

Date of Inspection: 01/06/2012
Date Report Sent: 3/13/2012
☑ Picture taken during inspection
Owner: Municipality

NH108
Over
LITTLE RIVER

Recommended Postings:
Weight: E2

☑ Weight Sign OK

Width: Not Required

☑ Width Sign OK

Primary Height Sign Recommendation: *None*
Optional Centerline Height Sign Rec: *None*

Clearances: (Feet) Over:
Under: 0.00
Route:

☑ Height Signs OK

Condition: Not on the Redlist
Deck: N N/A (NBI)
Superstructure: N N/A (NBI)
Substructure: N N/A (NBI)
Culvert: 5 Fair

Structure Type and Materials:
Number of Spans Main Unit: 3
Number of Approach Spans: 0

Main Span Material and Design Type
Steel Culvert

Sufficiency Rating: 87.4%
NBI Status: Not Deficient

Bridge Rail: Meets Standards
Rail Transition: Meets Standards
Bridge Approach Rail: Meets Standards
Approach Rail Ends: Meets Standards

NH Bridge Type: Metal Pipe
Deck Type: No Deck (N/A - NBI)
Wearing Surface: No Deck (N/A - NBI)
Membrane: No Deck (N/A - NBI)
Deck Protection: No Deck (N/A - NBI)
Pavement thickness: 4.0 in
Curb Reveal: Not Applicable
Plan Location: 3-10-3-11

Bridge Dimensions:
Length Maximum Span: 14.0 ft
Left Curb/Sidewalk Width: 0.0 ft
Width Curb to Curb: 0.0 ft
Approach Roadway Width (W/ Shoulders): 30.0 ft

Total Bridge Length: 49.0 ft
Right Curb/Sidewalk Width: 5.0 ft
Total Bridge Width: 0.0 ft
Median: No median
Bridge Skew: 0.00 °

Bridge Service:
Type of Service on Bridge: Highway and Pedestrian
Type of Service under: Waterway
Lanes on bridge: 2
Lanes Under: NA

Year Built: 1965
Year Rebuilt: Not Rebuilt
Detour Length: 3.0 mi

AADT: 6000
Percent Trucks: 5%
Year of AADT: 2008
Future AADT: 8880
Year of Future AADT: 2032

Bridge Inspection Report

Exeter 095/063

Federal or State Definition Bridge: Fed. Definition Bridge
Roadway Functional Class: Urban Local
New Hampshire Highway System and Class: Primary-Compact Maint.
Eligibility for the National Register of Historic Places: Possibly eligible
Traffic Direction: Two-way traffic

National Bridge Inventory (NBI) Appraisal Ratings:

Deck Geometry: Not Applicable (NBI)
Underclearances: Not Applicable (NBI)
Approach Alignment: Equal Desirable Criteria
Structural Evaluation: Above Min. Tolerable
Channel/Channel Protection: Minor Damage
Waterway Adequacy: Equal Minimum Criteria
Bridge Scour Critical Status: Stable for extreme flood
Riprap Condition: Good Condition
Debris Present: Debris Present
Date of Underwater Inspection: Not Applicable

AASHTO CoRe Element Condition State Data:

No.	Description	Env.	Material Notes and Condition Notes
240	Culvert (includes Steel, Aluminum and Galvanized)	Moderate	*3 Pipes - 2 1/2" X 9" X 1/8". GALV. STEEL WITH BITIMINOUS COATING. MODERATE RUSTING BELOW WATERLINE. ROOF SAGGED SLIGHTLY IN SOUTH BARREL. FEW PLATE GAPS. UNDERMINED 6 INCHES AT EACH END.*

No.	Description	Env.	Quantity	Units	State 1	State 2	State 3	State 4	State 5
240	Culvert (includes Steel, Aluminum and C	Moderate	151	(LF)	0 %	100 %	0 %	0 %	

Bridge Notes:
SEE DIVING REPORT.

Approach and Roadway Notes: *ASPHALT- CRACKS. W- BEAM RAIL- OK.*

Inspection History:

Inspection Date: 01/06/2012 **Inspector:** KJT
Deck: N N/A (NBI)
Super: N N/A (NBI)
Substr: N N/A (NBI)
Culvert: 5 Fair

Notes:
KJT - inspection comments -
CULVERTS: MODERATE RUSTING. UNDERMINED 6 INCHES AT EACH END.

PICTURES: C443-
06. SLIGHT SAG IN ROOFLINE, SOUTH MP.

Inspection Date: 06/28/2010 **Inspector:** DPC
Deck: N N/A (NBI)
Super: N N/A (NBI)
Substr: N N/A (NBI)
Culvert: 5 Fair

Notes:
DPC inspection comments -
CULVERTS: MP's- ELEMENTS IN FAIR CONDITION. MODERATE RUSTING. UNDERMINED 6 INCHES AT EACH END.

Bridge Inspection Report

Exeter 095/063

Inspection History:

Inspection Date: 01/12/2010 **Inspector:** DPC
Notes:
DPC inspection comments -
CULVERTS: MP's- ELEMENTS IN FAIR CONDITION. MODERATE RUSTING. UNDERMINED 6 INCHES AT EACH END.
Deck: N N/A (NBI)
Super: N N/A (NBI)
Substr: N N/A (NBI)
Culvert: 5 Fair

Inspection Date: 01/31/2008 **Inspector:** DPC
Notes:
DPC - inspection comments -
CULVERTS: MP's- ELEMENTS IN FAIR CONDITION. MODERATE RUSTING. UNDERMINED 6 INCHES AT EACH END.
Deck: N N/A (NBI)
Super: N N/A (NBI)
Substr: N N/A (NBI)
Culvert: 5 Fair

Inspection Date: 09/06/2006 **Inspector:** RLM
Notes:
RLM inspection comments -
CULVERTS: MP's- ELEMENTS IN SATISFACTORY CONDITION.
Deck: N N/A (NBI)
Super: N N/A (NBI)
Substr: N N/A (NBI)
Culvert: 6 Satisfactory

Inspection Date: 03/04/2002 **Inspector:** DPC
Notes:
Sufficiency Rating Calculation Accepted by DEP at 09/12/2002 08:24:07
DPC inspection comments -
MP's- ELEMENTS IN SATISFACTORY CONDITION.
Deck: N N/A (NBI)
Super: N N/A (NBI)
Substr: N N/A (NBI)
Culvert: 6 Satisfactory

Inspection Date: 12/15/2000 **Inspector:** DPC
Notes:
Sufficiency Rating Calculation Accepted by DEP at 11-21-2001 15:01:25
DPC inspection comments -
MP's- ELEMENTS IN SATISFACTORY CONDITION.
Deck: N N/A (NBI)
Super: N N/A (NBI)
Substr: N N/A (NBI)
Culvert: 6 Satisfactory

Inspection Date: 11/15/1998 **Inspector:** DPC
Notes:
Deck: N N/A (NBI)
Super: N N/A (NBI)
Substr: N N/A (NBI)
Culvert: 6 Satisfactory

Inspection Date: 09/01/1996 **Inspector:** Not Available
Notes:
Deck: N N/A (NBI)
Super: N N/A (NBI)
Substr: N N/A (NBI)
Culvert: 6 Satisfactory

Inspection Date: 09/01/1994 **Inspector:** Not Available
Notes:
Deck: N N/A (NBI)
Super: N N/A (NBI)
Substr: N N/A (NBI)
Culvert: 6 Satisfactory

Inspection Date: 01/01/1993 **Inspector:** Not Available
Notes:
Deck: N N/A (NBI)
Super: N N/A (NBI)
Substr: N N/A (NBI)
Culvert: 6 Satisfactory

Copy Distribution:

- [x] (2) Bureau of Municipal Hghways
- [ ] (3) Bureau of Municipal Hghways
- [ ] Border State
- [ ] Bureau of Rail and Transit
- [ ] Army Corps Of Engineers
- [ ] Dept. of Res. and Econ. Dev.
- [ ] Dept. of Environmental Services
- [ ] USDA Forest Service

Bridge Inspection Report

Exeter 095/063

☐ Bureau of Turnpikes ☐ Railroad ☐ Bureau of Traffic

Form 4

N.H. D.O.T.

BRIDGE CAPACITY SUMMARY

TOWN Exeter

BRIDGE NUMBER 093/063

DESIGN LOAD AASHO H20 DESIGN METHOD AASHO 1961

RATED BY DLS DATE 4/83

RATING METHOD

CHECKED BY DATE

RATED MEMBER	EFFECTIVE SPAN LENGTH	REQUIRED CAPACITY			AVAILABLE CAPACITY					
		CURRENT LEGAL LOADS	CERTIFIED VEHICLES		MULTIPLE LANES LOADED			SINGLE LANE LOADED		
			SINGLE UNIT	MULTIPLE UNIT	INVENTORY	OPERATING	POSTING	INVENTORY	OPERATING	POSTI
12'-10" W x 8'-4" H Buckling Capacity	4'-3"	H14.7	—	—	H48.7	H67.3	—	H48.7	H68.3	—
Seam Strength			—	—	H84.2	H114.3	—	H84.2	H114.3	—
14'-1" W x 8'-9" H Buckling			—	—	H48.7	H67.3	—	H48.7	H68.3	—
Seam Strength			—	—	H97.7	H132.3	—	H97.7	H132.3	—

RECOMMENDED POSTING: Post 'E-2' until evaluated for certified loads

64. (Op.) 168

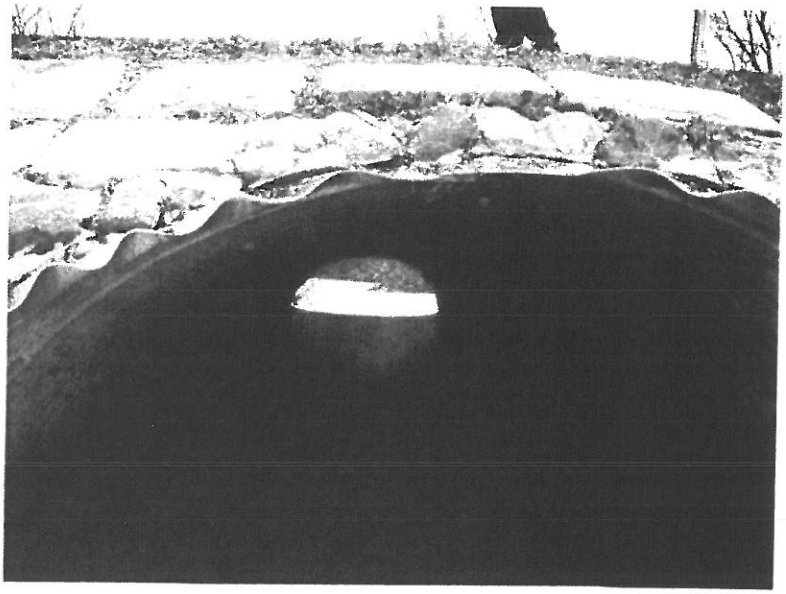
66. (Inv.) 149

EXETER 095/063

NH108 over LITTLE RIVER

Friday, January 06, 2012

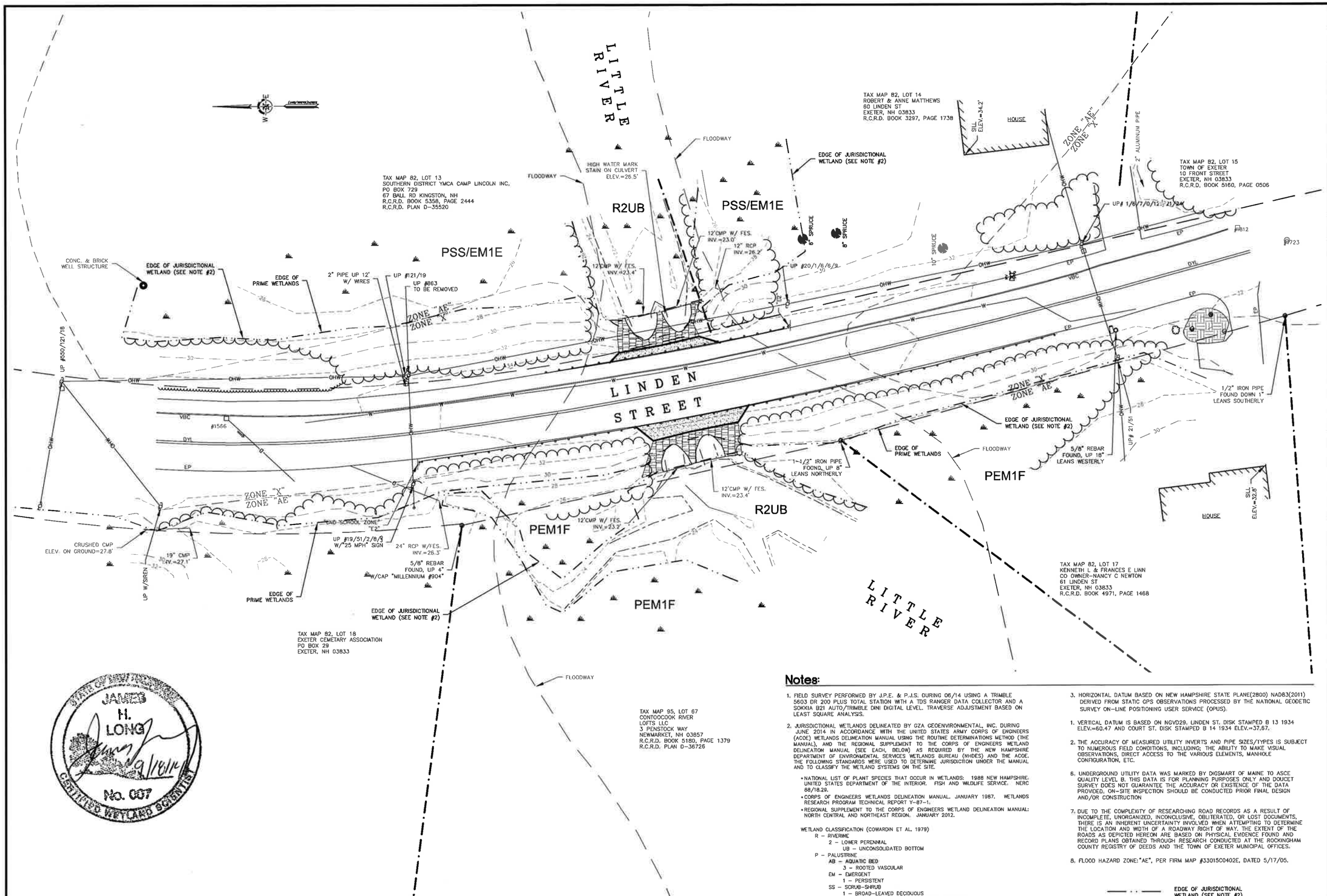
SLIGHT SAG IN ROOF LINE,
SOUTH MP



C443 06

Appendix B

Preliminary Environmental Compliance Documentation



Notes:

1. FIELD SURVEY PERFORMED BY J.P.E. & P.J.S. DURING 06/14 USING A TRIMBLE 5603 DR 200 PLUS TOTAL STATION WITH A TDS RANGER DATA COLLECTOR AND A SOKKIA B21 AUTO/TRIMBLE DNI DIGITAL LEVEL. TRAVERSE ADJUSTMENT BASED ON LEAST SQUARE ANALYSIS.

2. JURISDICTIONAL WETLANDS DELINEATED BY GZA GEOENVIRONMENTAL, INC. DURING JUNE 2014 IN ACCORDANCE WITH THE UNITED STATES ARMY CORPS OF ENGINEERS (ACOE) WETLANDS DELINEATION MANUAL USING THE ROUTINE DETERMINATIONS METHOD (THE MANUAL), AND THE REGIONAL SUPPLEMENT TO THE CORPS OF ENGINEERS WETLAND DELINEATION MANUAL (SEE EACH, BELOW) AS REQUIRED BY THE NEW HAMPSHIRE DEPARTMENT OF ENVIRONMENTAL SERVICES WETLANDS BUREAU (NHDES) AND THE ACOE. THE FOLLOWING STANDARDS WERE USED TO DETERMINE JURISDICTION UNDER THE MANUAL AND TO CLASSIFY THE WETLAND SYSTEMS ON THE SITE.
   - NATIONAL LIST OF PLANT SPECIES THAT OCCUR IN WETLANDS: 1988 NEW HAMPSHIRE. UNITED STATES DEPARTMENT OF THE INTERIOR. FISH AND WILDLIFE SERVICE. NERC 88/18.29.
   - CORPS OF ENGINEERS WETLANDS DELINEATION MANUAL. JANUARY 1987. WETLANDS RESEARCH PROGRAM TECHNICAL REPORT Y-87-1.
   - REGIONAL SUPPLEMENT TO THE CORPS OF ENGINEERS WETLAND DELINEATION MANUAL: NORTH CENTRAL AND NORTHEAST REGION. JANUARY 2012.

   WETLAND CLASSIFICATION (COWARDIN ET AL. 1979)
   - R – RIVERINE
     - 2 – LOWER PERENNIAL
       - UB – UNCONSOLIDATED BOTTOM
   - P – PALUSTRINE
     - AB – AQUATIC BED
       - 3 – ROOTED VASCULAR
     - EM – EMERGENT
       - 1 – PERSISTENT
     - SS – SCRUB-SHRUB
       - 1 – BROAD-LEAVED DECIDUOUS
         - E – SEASONALLY SATURATED OR FLOODED
         - F – SEMIPERMANENTLY FLOODED

3. HORIZONTAL DATUM BASED ON NEW HAMPSHIRE STATE PLANE(2800) NAD83(2011) DERIVED FROM STATIC GPS OBSERVATIONS PROCESSED BY THE NATIONAL GEODETIC SURVEY ON-LINE POSITIONING USER SERVICE (OPUS).

1. VERTICAL DATUM IS BASED ON NGVD29. LINDEN ST. DISK STAMPED B 13 1934 ELEV.=60.47 AND COURT ST. DISK STAMPED B 14 1934 ELEV.=37.67.

2. THE ACCURACY OF MEASURED UTILITY INVERTS AND PIPE SIZES/TYPES IS SUBJECT TO NUMEROUS FIELD CONDITIONS, INCLUDING; THE ABILITY TO MAKE VISUAL OBSERVATIONS, DIRECT ACCESS TO THE VARIOUS ELEMENTS, MANHOLE CONFIGURATION, ETC.

6. UNDERGROUND UTILITY DATA WAS MARKED BY DIGSMART OF MAINE TO ASCE QUALITY LEVEL B. THIS DATA IS FOR PLANNING PURPOSES ONLY AND DOUCET SURVEY DOES NOT GUARANTEE THE ACCURACY OR EXISTENCE OF THE DATA PROVIDED. ON-SITE INSPECTION SHOULD BE CONDUCTED PRIOR FINAL DESIGN AND/OR CONSTRUCTION

7. DUE TO THE COMPLEXITY OF RESEARCHING ROAD RECORDS AS A RESULT OF INCOMPLETE, UNORGANIZED, INCONCLUSIVE, OBLITERATED, OR LOST DOCUMENTS, THERE IS AN INHERENT UNCERTAINTY INVOLVED WHEN ATTEMPTING TO DETERMINE THE LOCATION AND WIDTH OF A ROADWAY RIGHT OF WAY. THE EXTENT OF THE ROADS AS DEPICTED HEREON ARE BASED ON PHYSICAL EVIDENCE FOUND AND RECORD PLANS OBTAINED THROUGH RESEARCH CONDUCTED AT THE ROCKINGHAM COUNTY REGISTRY OF DEEDS AND THE TOWN OF EXETER MUNICIPAL OFFICES.

8. FLOOD HAZARD ZONE:"AE", PER FIRM MAP #33015C0402E, DATED 5/17/05.

EDGE OF JURISDICTIONAL WETLAND (SEE NOTE #2)
FLOOD HAZARD ZONE (SEE NOTE#8)

STATE OF NEW HAMPSHIRE
JAMES H. LONG
No. 007
CERTIFIED WETLAND SCIENTIST

no.	revision	date	by

CMA ENGINEERS
CIVIL/ENVIRONMENTAL ENGINEERS
35 Bow Street, Portsmouth, NH 03801, 603/431-5196
Langer Place, 55 So. Commercial Street, Manchester, NH 03101, 603/627-0708
10 Free Street, Portland, ME 04101, 207/541-4223
info@cmaengineers.com
www.cmaengineers.com

designed by: -
drawn by: BEA
approved by: JLG
date: Aug. 2014
project no: 923
file name: 923-Wetlands-ECP.dwg
scale: 1" = 20' (in feet)

Town of Exeter
Linden & Court Street Bridge Replacement

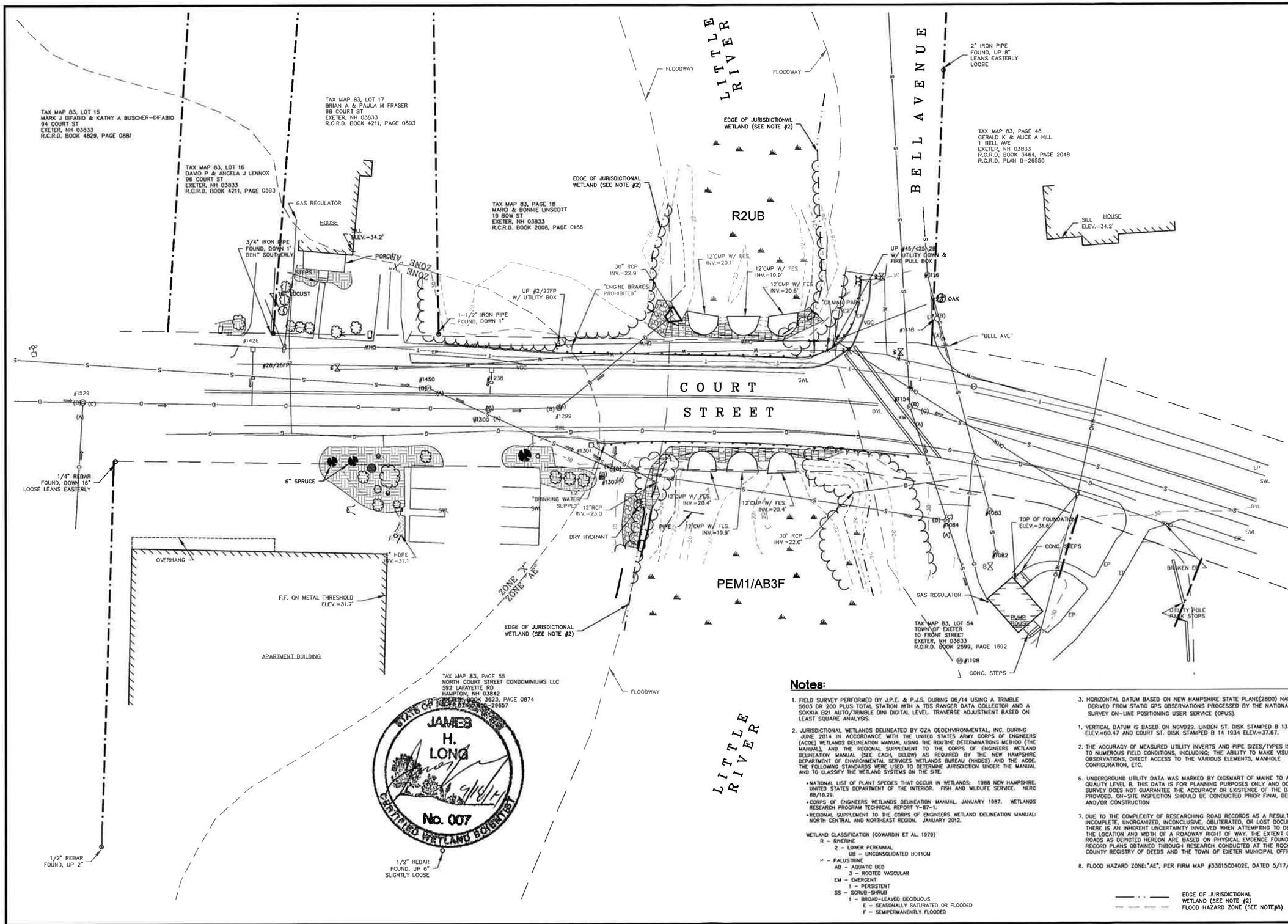
Wetlands Application Plan

Linden Street
Existing Conditions Plan

drawing no. E-1

sheet: 1 of 4

F:\CADD\PROJECTS\923-Exeter Bridges\Production\Permits\923-Wetlands-ECP.dwg Date Plotted: Aug 25, 2014 - 1:51pm Plotted By: BAUDET



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     - 2 – LOWER PERENNIAL
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7. DUE TO THE COMPLEXITY OF RESEARCHING ROAD RECORDS AS A RESULT OF INCOMPLETE, UNORGANIZED, INCONCLUSIVE, OBLITERATED, OR LOST DOCUMENTS, THERE IS AN INHERENT UNCERTAINTY INVOLVED WHEN ATTEMPTING TO DETERMINE THE LOCATION AND WIDTH OF A ROADWAY RIGHT OF WAY. THE EXTENT OF THE ROADS AS DEPICTED HEREON ARE BASED ON PHYSICAL EVIDENCE FOUND AND RECORD PLANS OBTAINED THROUGH RESEARCH CONDUCTED AT THE ROCKINGHAM COUNTY REGISTRY OF DEEDS AND THE TOWN OF EXETER MUNICIPAL OFFICES.
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EDGE OF JURISDICTIONAL WETLAND (SEE NOTE #2)
FLOOD HAZARD ZONE (SEE NOTE #8)

no.	revision	date	by

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CIVIL/ENVIRONMENTAL ENGINEERS
35 Bow Street, Portsmouth, NH 03801, 603/431-8196
Langer Place, 55 So. Commercial Street, Manchester, NH 03101, 603/627-0708
10 Free Street, Portland, Maine 04101, 207/541-4223
info@cmaengineers.com
www.cmaengineers.com

designed by: -
drawn by: BEA
approved by: JLG
date: Aug. 2014
project no: 923
file name: 923-Wetlands-ECP.dwg
scale: 1" = 20' (in feet)

Town of Exeter
Linden & Court Street Bridge Replacement
Wetlands Application Plan
Court Street
Existing Conditions Plan

drawing no. E-2
sheet: 2 of 4

GZA
GeoEnvironmental, Inc.

Engineers and Scientists

VIA EMAIL

August 12, 2014
File No. 04.0190067.00

Mr. William J. Doucet
Doucet Survey, Inc.
102 Kent Place
Newmarket, New Hampshire 03857

Re: Wetland Delineation and Function-Value Assessment Report
Court and Linden Streets
Exeter, New Hampshire

5 Commerce Park North
Suite 201
Bedford
New Hampshire
03110-6984
603-623-3600
FAX 603-624-9463
www.gza.com

Dear Mr. Doucet:

GZA GeoEnvironmental, Inc. (GZA) is pleased to provide this letter report detailing the completion of wetland delineation and a wetland function-value assessment conducted at the Court Street and Linden Street crossings of the Little River (see attached **Figure 1**). This work was performed by State of New Hampshire Certified Wetland Scientists Mr. James Long (#007) and Ms. Tracy Tarr (#281), also Certified Wildlife Biologist, on June 4 and 6, 2014. The purpose of the delineation and function-value assessment was to define and characterize wetland resources within the vicinity of two bridge replacement areas (see attached **Figure 2**). This report is subject to the attached Natural Resource Survey and Assessment Limitations in **Appendix A**.

The wetland delineation was conducted in accordance with the 1987 *Corps of Engineers Wetlands Delineation Manual*[1], using the *Routine Determination Method;* in conjunction with the *Regional Supplement*[2] *to the Corps of Engineers Wetland Delineation Manual,* the 2012 *National Wetland Plant List*[3], *Field Indicators of Hydric Soils in the United States Version 7.0*[4], *and Field Indicators for Identifying Hydric Soils in New England*[5]. Resource boundaries identified by GZA were witnessed in the field with pink and black flagging tape hung periodically on vegetation labeled as follows:

Court St:
A1 - A14 (stop)
B1 – B8 (stop)
(Edge of wetland = Top of Bank)

Linden Street:
C1 – C19 (stop)
D1-D26 (stop)
TOB1 – 7 (stop), TOB 8 – 29 (stop)

[1] Environmental Laboratory. 1987. *Corps of Engineers Wetlands Delineation Manual,* Technical Report Y-87-1, US Army Engineer Waterways Experiment Station, Vicksburg, Mississippi.

[2] U.S. Army Corps of Engineers, 2011. *Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Northcentral and Northeast Region* (Version 2.0), ed. J.S. Wakeley, R.W. Lichvar, C.V. Noble and J.F. Berkowitz. ERDC/EL Tr-12-1. Vicksburg, Mississippi; U.S. Army Engineer Research and Development Center.

[3] Lichvar, R.W. 2012. *The National Wetland Plant List.* ERDC/CRREL TR-12-11. Hanover, NH: U.S. Army Corps of Engineers, Cold Regions Research and Engineering Laboratory.

[4] United States Department of Agriculture, Natural Resource Conservation Service, 2010. *Field Indicators of Hydric Soils in the United States,* Version 7.0. Edited by L.M. Vasilas, Soil Scientist, NRCS, Washington, DC; G.W. Hurt, Soil Scientist, University of Florida, Gainesville, FL; and C.V. Noble, Soil Scientist, USACE, Vicksburg, MD in cooperation with the National Technical Committee for Hydric Soils.

[5] New England Hydric Soils Technical Committee. 2004. 3rd ed. *Field Indicators for Identifying Hydric Soils in New England,* Interstate Water Pollution Control Commission, Lowell, Massachusetts.

In order to support the survey location of the wetland flags, the approximate wetland boundaries were sketched on an aerial overlay provided by CMA Engineers, Inc. The wetland boundary sketch was provided to Doucet Survey, Inc. (DSI) on June 5, 2014 via e-mail and was also reviewed in the field with Mr. Pat Sharkey on April 4, 2014. It should be noted that the sketch is a general spatial reproduction of the locations of the delineated resources and is intended only to aid in the field location of the flags. We understand that DSI survey located wetland flags for wetland permitting plan development purposes.

As part of the wetland delineation field work, wetlands identified on site were classified in accordance with *Classification of Wetlands and Deepwater Habitats of the United States*[6] and an assessment of potential vernal pool habitat was conducted in accordance with *Identification and Documentation of Vernal Pools in New Hampshire.*[7] In addition, wetlands were assessed according to the Army Corps Highway Methodology Workbook Supplement.[8] The functions and values assessed included: groundwater recharge/discharge, floodflow alteration, fish/shellfish habitat, sediment/toxicant retention, nutrient removal, production export, sediment/shoreline stabilization, wildlife habitat, recreation, education/scientific value, visual quality/aesthetics, uniqueness/heritage, and endangered species habitat. Functions and values are considered "principal" if they are determined to be an important physical component of a wetland ecosystem, and/or are considered of special value to society, from a local, regional, and/or national perspective. Functions and values may be considered "capable" or "suitable" if a wetland can provide any given function or value on a limited basis. The rationale for the assignment of functions as principal or capable is based upon professional judgment with guidance provided in a list of considerations outlined in the Army Corps of Engineers methodology. The function-value assessment for each river crossing is presented below.

COURT STREET

The upstream portion of the Court Street bridge crossing is classified principally as a palustrine emergent and aquatic bed system (PEM1/AB3F) that is semi-permanently flooded. This portion of the wetland is impounded by the bridge crossing and lacks a noticeable channel. The downstream portion of the bridge crossing is classified as a riverine, lower perennial system that has an unconsolidated bottom (R2UB). No vernal pools were observed in the vicinity of the bridge crossing.

The tree layer bordering the river is dominated by red maple (*Acer rubrum*), willow (*Salix* spp.), and American elm (*Ulmus americana*). The shrub layer contains a mixture of native plant species including northern arrowwood (*Viburnum dentatum*), silky dogwood (*Cornus amomum*), winterberry holly (*Ilex verticillata*), gray birch (*Betula populifolia*), and red maple (*Acer rubrum*). Invasive plant species present include glossy buckthorn (*Frangula alnus*), multiflora rose (*Rosa multiflora*), and honeysuckle (*Lonicera* spp.). The aquatic bed and marsh areas located upstream support a diversity of plant species including yellow water-lily (*Nuphar advena*), pondweed (*Potomogeton* spp.), bur-reed (*Sparganium* spp.), pickerelweed (*Pontederia cordata*), broadleaf arrowhead (*Sagittaria latifolia*), broad-leaved cattail (*Typha latifolia*), duckweed (*Lemna* spp.), tussock sedge (*Carex stricta*), fringed sedge (*Carex crinita*), jewelweed, sensitive fern (*Onoclea sensibilis*), and horsetail (*Equisetum* spp.). Two invasive

[6] Cowardin, L.M., V. Carter, F.C. Golet, and E.T. LaRoe. 1979. *Classification of wetlands and deepwater habitats of the United States.* U.S. Department of the Interior, Fish and Wildlife Service, Washington, DC. Jamestown, ND, Northern Prairie Wildlife Research Center On line. http://www.npwrc. usgs.gov/ resource/ wetlands/classwet/ index.htm.

[7] New Hampshire Fish and Game Department, Nongame and Endangered Wildlife Program, 2004. 2nd edition. M. Marchand, Ed *Identification and Documentation of Vernal Pools in New Hampshire*.

[8] U.S. Army Corps of Engineers. 1999. *The Highway Methodology Workbook Supplement.* NAEEP-360-1-30a.

plant species, purple loosestrife (*Lythrum salicaria*) and bittersweet, are also present in the herbaceous layer.

View looking westerly at aquatic bed habitat in the river.

View looking westerly toward the Court Street culverts.

As part of the Little River corridor, the wetland system provides a large number of principal functions and values including floodflow alteration, sediment/toxicant retention, nutrient removal, fish habitat, wildlife habitat, and visual aesthetics. The presence of dense emergent cover provides an opportunity for nutrient attenuation and removal during low flow conditions. The wetland is hydrologically connected to the Exeter River and provides a diversity of wildlife habitats. During site assessment work, a variety of wildlife species were observed including bullfrog (*Rana catesbeiana*), red-winged blackbird (*Agelaius phoeniceus*), American robin (*Turdus migratorius*), yellow warbler (*Setophaga petechia*), black-capped chickadee (*Poecile atricapillus*), muskrat (*Ondatra zibethicus*), and beaver (*Castor canadensis*).

The wetland is also suitable for groundwater discharge, production export, sediment/shoreline stabilization, educational/scientific value, recreation and endangered species habitat. The bridge is located upstream of a public boat ramp and the river corridor provides educational opportunities and passive recreation opportunities such as kayaking, fishing, and wildlife viewing.

RARE SPECIES

Based on a review by the New Hampshire Natural Heritage Bureau (NHB) (see attached **NHB Memo NHB14-2033** dated June 6, 2014), the existing Court Street bridge is within the vicinity of a documented American eel (*Anguilla rostrata*) population and documented Blanding's turtle (*Emydoidea blandingii*) locations. The American eel is listed as a State Special Concern species and the Blanding's turtle is a State Endangered species. Both species were observed downstream in the Exeter River corridor.

American eel spawn in the Sargasso Sea and migrate to fresh water as approximately one year old juveniles called elvers. Elvers then spend approximately 10 to 40 years in freshwater riverine systems before returning to salt water to spawn. Due to their complex life cycle, American eels are susceptible to habitat loss created by migration barriers such as dams.

Blanding's turtles utilize a variety of wetland habitats for feeding, breeding, and overwintering including marshes, scrub-shrub wetlands, beaver flowages, rivers, and vernal pools. Females may also travel as far as 1 km within uplands and wetlands to find suitable nesting sites in dry exposed upland soil. Blanding's turtles are susceptible to habitat loss, habitat fragmentation, and

unnatural mortality levels created by collisions with cars, predation from pets, and loss through the illegal pet trade.

Although habitat for both species is present in the vicinity of the bridge area, the NH Fish and Game Department Nongame Department determined that they do not expect impacts to either species as a result of the project construction (see attached correspondence from Ms. Kim Tuttle **e-mail dated June 24, 2014**). The current proposal is to replace three pipe arches with a single span structure. As a result, the project will actually improve habitat connectivity and resulting aquatic life passage. To minimize potential impacts during construction, the Marine Program requests additional information on the construction schedule (see attached correspondence **e-mail dated June 24, 2014** from Ms. Cheri Patterson of the Marine Program). Diadromous fish (i.e. fish that migrate between fresh and salt water) are expected to migrate between March and June and emigrate anywhere from August to December. CMA Engineers, Inc. indicated that the Town of Exeter would likely seek to avoid construction during the school year when buses require access to the bridge. As a result, construction from late June into July would serve to avoid impacts to diadromous fish. To further reduce potential impacts on wildlife, the Nongame Program has requested that the Town avoid the use of welded plastic or 'biodegradable' erosion control netting, and instead utilize a woven organic material (e.g. coco matting) where matting is required, to limit mortality in snakes which are known to become entangled in plastic netting. However, the project itself benefits a variety of species by better matching the width of the natural stream channel, and by accommodating more natural high and low flows.

View of muskrat observed at Court Street.

View of larval dragonfly exoskeleton at Court Street.

LINDEN STREET

The channel portion of the wetland at the Linden Street bridge project is classified as a riverine, lower perennial system with an unconsolidated bottom (R2UB). The substrate of the channel is dominated by silty muck and scattered cobbles. The edges of the channel are bordered by dense palustrine emergent and scrub shrub wetland areas that are seasonally saturated or flooded (PEM/SS1E) and semi-permanently flooded (PEM1F). No vernal pools were observed within the immediate vicinity of the bridge replacement area.

The edges of this wetland system contain scattered trees and the tree layer of this wetland system is dominated by red maple, American elm, pin cherry (*Prunus pensylvanica*), willow, and ash (*Fraxinus americana*). The scrub-shrub portions of the wetland contain a diversity of shrub species including serviceberry (*Amelanchier* spp.), speckled alder, common elderberry (*Sambucus nigra*), meadowsweet (*Spiraea latifolia*), silky dogwood, willow, northern arrowwood, and wild raisin (*Viburnum cassinoides*). Two invasive plants, multiflora rose and

honeysuckle, were also observed. Plant species present in the herbaceous layer included sensitive fern, broad-leaved cattail, narrow-leaved cattail (*Typha angustifolia*), tussock sedge, fringed sedge, boneset (*Eupatorium perfoliatum*), jewelweed, northern arrowhead, pickerel weed, blunt spikerush (*Eleocharis obtusa*), green bulrush (*Scirpus atrovirens*), and goldenrod (*Solidago* spp.).

View of Linden Street culverts looking westerly.

View of Little River looking easterly from Linden Street.

The Little River wetland system at Linden Street provides five principal functions including floodflow alteration, fish habitat, production export, sediment/shoreline stabilization, and wildlife habitat. The wetland is also suitable for sediment/toxicant retention, nutrient removal, and visual aesthetics. The channel is bordered by dense emergent vegetation which is stabilizing the stream banks. The floodplain is relatively wide and the bordering emergent and scrub-shrub edges serve to slow and detain river flows during storm events. Similar to other areas of the Little River corridor, wildlife use is high due to the presence of riverine and diverse wetland habitats. During site assessments, GZA observed gray catbird (*Dumetella carolinensis*), yellow warbler, northern mockingbird (*Mimus polyglottos*), red-winged blackbird, song sparrow (*Melospiza melodia*), mourning dove (*Zenaida macroaura*), and common yellowthroat (*Geothlypis trichas*) in the wetland. These birds nest and forage in emergent and scrub-shrub habitats. Minnows and green frog (*Rana clamitans*) were observed in the channel. A variety of mammals utilize the river for food and cover, and raccoon (*Procyon lotor*) tracks were observed on the edges of the river. However, NHB did not have any records of rare species or exemplary communities near the Linden Street bridge replacement area (see attached NHB memo **NHB14-2008 dated June 2, 2014).**

View of raccoon tracks on the edge of the river channel.

View of emergent areas utilized by red-winged blackbirds.

The project includes replacement of the existing 12-foot corrugated metal pipe structures with a single span structure approximately 55-feet in length. This will serve to improve fish habitat, wildlife habitat, and production export functions of the wetland system by accommodating the natural channel width of the Little River and improving aquatic passage.

NHDES TIER STATUS

Based on watershed size, location in FEMA flood zones, and documentation of rare species, both bridge locations are considered Tier 3 Stream Crossings by NHDES and are subject to the permitting requirements outlined in New Hampshire Code of Administrative Rules Env-Wt 904.01, 904.04, 904.05, and 904.08. For permitting purposes, a formal pebble count and geomorphic assessment may be required by the NHDES Wetlands Bureau. GZA can provide a proposal for this work upon your request.

Please feel free to contact Ms. Tracy Tarr at (603) 235-6992 if you have any questions or if further information is required.

Very truly yours,

GZA GEOENVIRONMENTAL, INC.

Tracy L. Tarr, CWS, CWB, CESSWI
Assistant Project Manager

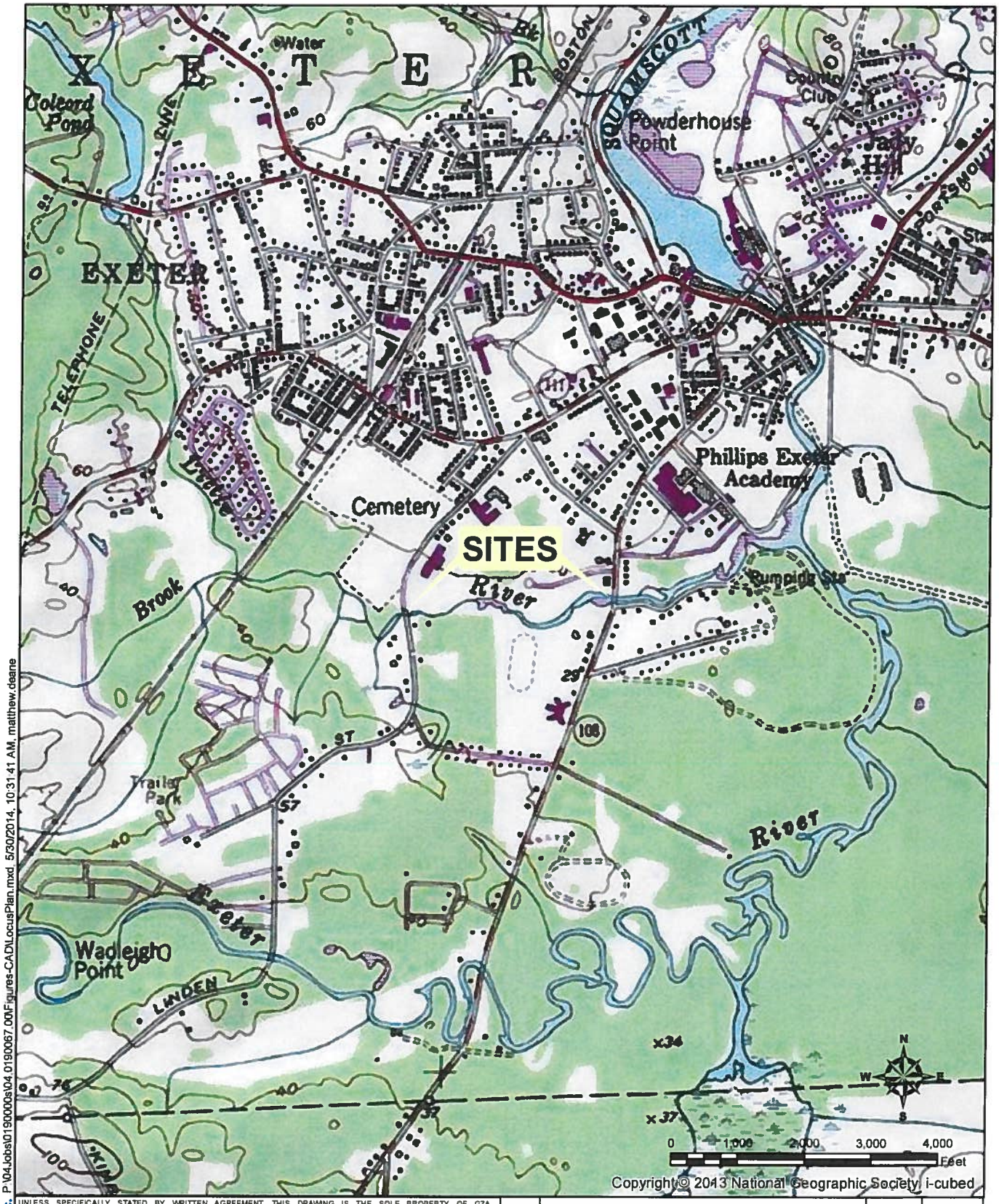
Ronald A. Breton, P.E.
Senior Principal

Deborah M. Zarta Gier, CNRP
Consultant Reviewer

TLT/RAB/DMZ:mm
P:\04Jobs\0190000s\04.0190067.00\Work\Wetland Letter Report\final 190067 Report 081214.docx

Attachments: Locus Plan
Aerial Locus Plan
NHB Memo #NHB14-2008
NHB Memo #NHB14-2033
E-mail Correspondence from the NH Fish and Game Dept.
Natural Resource Survey and Assessment Limitations

cc: Mr. Jason Gallant, CMA Engineers, Inc.



NO.	ISSUE / DESCRIPTION	BY	DATE

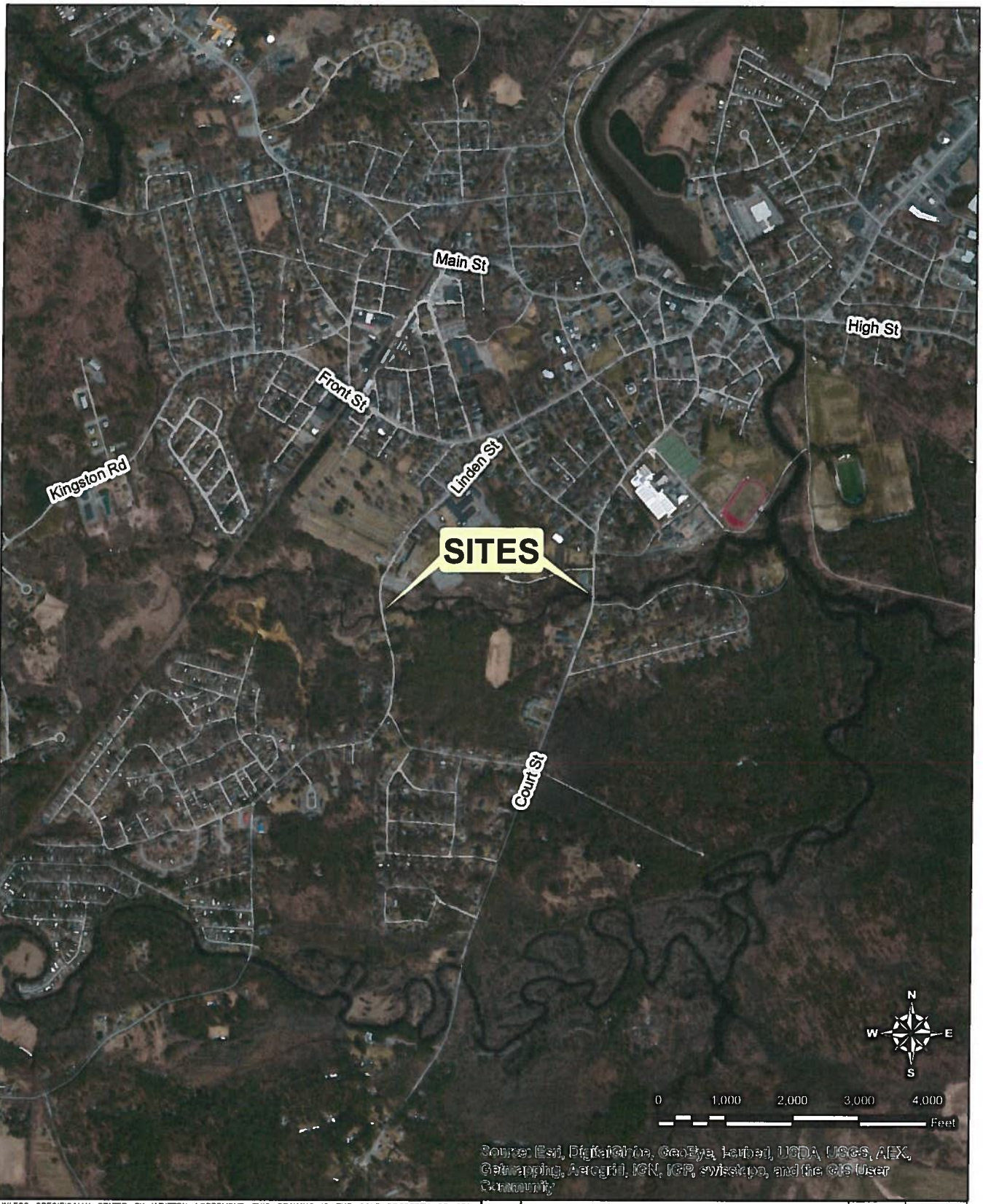
WETLAND DELINEATION
COURT STREET & LINDEN STREET CULVERTS
EXETER, NEW HAMPSHIRE

PREPARED BY:
GZA GeoEnvironmental, Inc.
Engineers and Scientists
www.gza.com

PREPARED FOR:
DOUCET SURVEY, INC.
NEWMARKET, NEW HAMPSHIRE

LOCUS PLAN

PROJ MGR: TLT	REVIEWED BY: JCM	CHECKED BY: DMZ	FIGURE 1
DESIGNED BY: MJD	DRAWN BY: MJD	SCALE: 1 inch = 2,000 feet	
DATE: MAY 2014	PROJECT NO. 04.0190067.00	REVISION NO.	



NO.	ISSUE / DESCRIPTION	BY	DATE

WETLAND DELINEATION
COURT STREET & LINDEN STREET CULVERTS
EXETER, NEW HAMPSHIRE

PREPARED BY:
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PREPARED FOR:
DOUCET SURVEY, INC.
NEWMARKET, NEW HAMPSHIRE

AERIAL LOCUS PLAN

PROJ MGR: TLT	REVIEWED BY: JCM	CHECKED BY: DMZ	FIGURE 2
DESIGNED BY: MJD	DRAWN BY: MJD	SCALE: 1 inch = 2,000 feet	
DATE: JUNE 2014	PROJECT NO. 04.0190067.00	REVISION NO.	

New Hampshire Natural Heritage Bureau

To: Matthew Deane
380 Harvey Road
Manchester, NH 03103

Date: 5/30/2014

From: NH Natural Heritage Bureau

Re: Review by NH Natural Heritage Bureau of request dated 5/30/2014

NHB File ID: NHB14-2008 Applicant: Town of Exeter- Public Works

Location: Tax Map(s)/Lot(s):
Exeter

Project Description: Town of Exeter is proposing a culvert replacement

The NH Natural Heritage database has been checked for records of rare species and exemplary natural communities near the area mapped below. The species considered include those listed as Threatened or Endangered by either the state of New Hampshire or the federal government. We currently have no recorded occurrences for sensitive species near this project area.

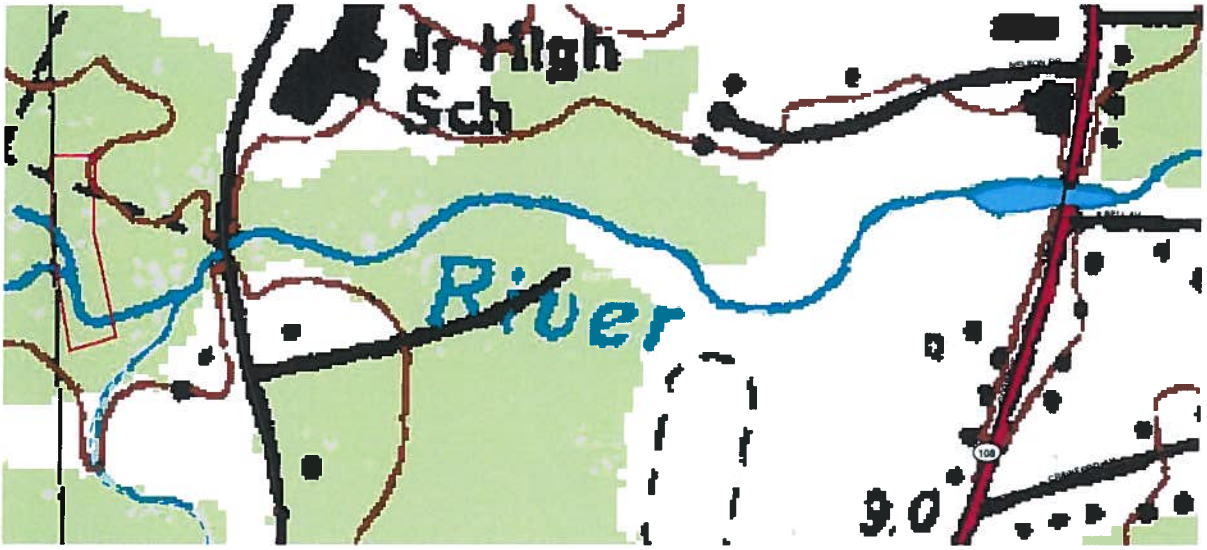
A negative result (no record in our database) does not mean that a sensitive species is not present. Our data can only tell you of known occurrences, based on information gathered by qualified biologists and reported to our office. However, many areas have never been surveyed, or have only been surveyed for certain species. An on-site survey would provide better information on what species and communities are indeed present.

This report is valid through 5/29/2015.

Department of Resources and Economic Development
Division of Forests and Lands
(603) 271-2214 fax: 271-6488

DRED/NHB
PO Box 1856
Concord NH 03302-1856

MAP OF PROJECT BOUNDARIES FOR NHB FILE ID: NHB14-2008



Department of Resources and Economic Development
Division of Forests and Lands
(603) 271-2214 fax: 271-6488

DRED/NHB
PO Box 1856
Concord NH 03302-1856

Memo

NH Natural Heritage Bureau
NHB Datacheck Results Letter

To: Matthew Deane
380 Harvey Road
Manchester, NH 03103

From: Melissa Coppola, NH Natural Heritage Bureau
Date: 6/6/2014 (valid for one year from this date)
Re: Review by NH Natural Heritage Bureau
NHB File ID: NHB14-2033 Town: Exeter Location: 99 Court Street
Description: Culvert replacement
cc: Kim Tuttle

As requested, I have searched our database for records of rare species and exemplary natural communities, with the following results.

Comments:

Vertebrate species	State[1]	Federal	Notes
American Eel (*Anguilla rostrata*)	SC	--	Contact the NH Fish & Game Dept (see below).
Blanding's Turtle (*Emydoidea blandingii*)	E	--	Contact the NH Fish & Game Dept (see below).

[1]Codes: "E" = Endangered, "T" = Threatened, "SC" = Special Concern, "--" = an exemplary natural community, or a rare species tracked by NH Natural Heritage that has not yet been added to the official state list. An asterisk (*) indicates that the most recent report for that occurrence was more than 20 years ago.

Contact for all animal reviews: Kim Tuttle, NH F&G, (603) 271-6544.

A negative result (no record in our database) does not mean that a sensitive species is not present. Our data can only tell you of known occurrences, based on information gathered by qualified biologists and reported to our office. However, many areas have never been surveyed, or have only been surveyed for certain species. An on-site survey would provide better information on what species and communities are indeed present.

Department of Resources and Economic Development
Division of Forests and Lands
(603) 271-2214 fax: 271-6488

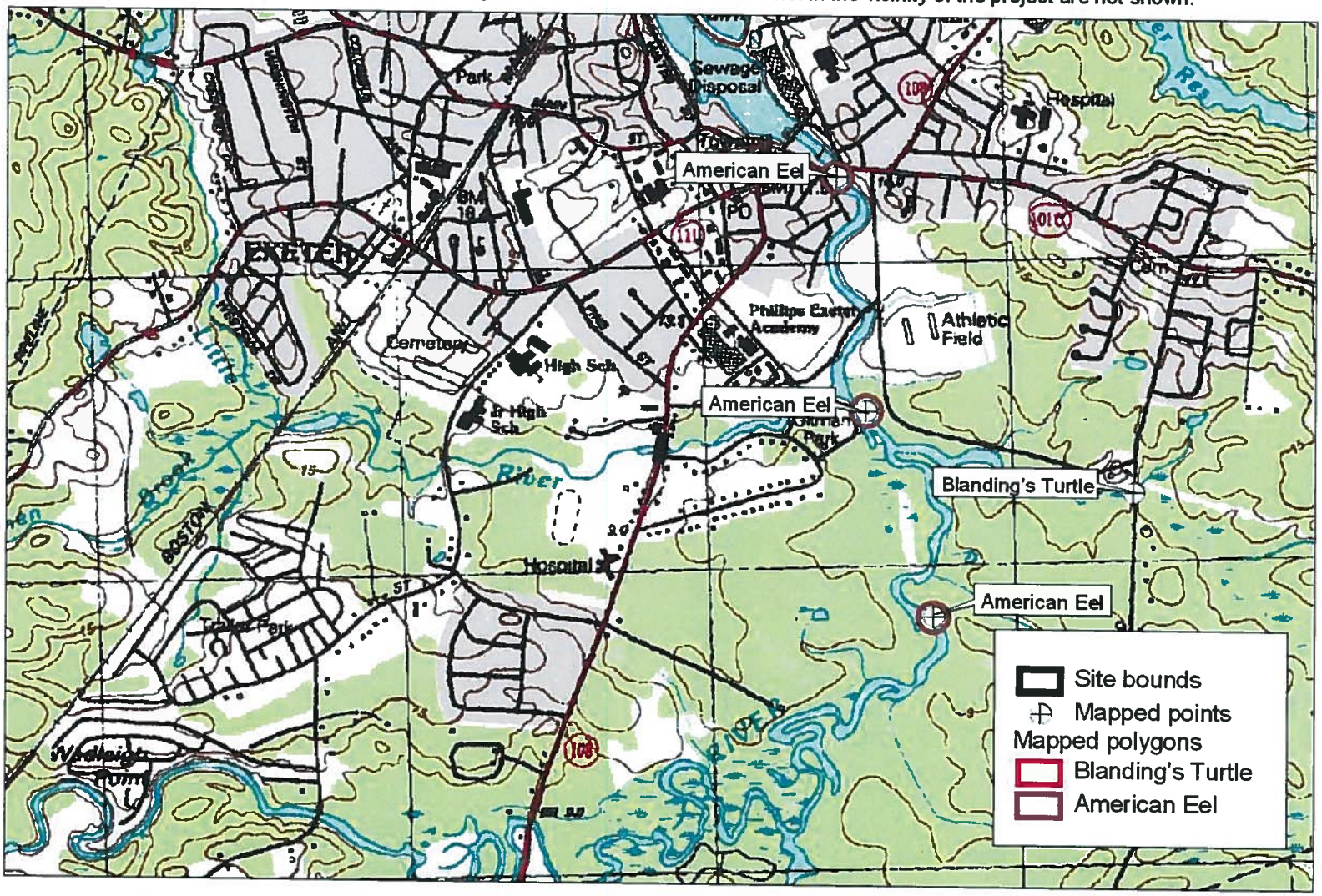
DRED/NHB
PO Box 1856
Concord NH 03302-1856

NHB14-2033

NH Natural Heritage Bureau

Known locations of rare species and exemplary natural communities

Note: Mapped locations are not always exact. Occurrences that are not in the vicinity of the project are not shown.



*Historical record

1:18000

Valid for one year from this date: 06 Jun 2014

New Hampshire Natural Heritage Bureau - Animal Record

American Eel (*Anguilla rostrata*)

Legal Status

Federal: Not listed
State: SC

Conservation Status

Global: Apparently secure but with cause for concern
State: Rare or uncommon

Description at this Location

Conservation Rank: Not ranked
Comments on Rank:

Detailed Description: 2008: Area 13324: 15 observed.
General Area:
General Comments:
Management Comments:

Location

Survey Site Name: Great Brook-Exeter River
Managed By:

County: Rockingham
Town(s): Exeter
Size: 1.9 acres

USGS quad(s): Exeter (4207088)
Lat, Long: 425851N, 0705638W
Elevation:

Precision: Within (but not necessarily restricted to) the area indicated on the map.

Directions: 2008: Exeter River

Dates documented

First reported: 2008-08-29
Last reported: 2008-08-29

The New Hampshire Fish & Game Department has jurisdiction over rare wildlife in New Hampshire. Please contact them at 11 Hazen Drive, Concord, NH 03301 or at (603) 271-2461.

New Hampshire Natural Heritage Bureau - Animal Record

American Eel (*Anguilla rostrata*)

Legal Status

Federal: Not listed
State: SC

Conservation Status

Global: Apparently secure but with cause for concern
State: Rare or uncommon

Description at this Location

Conservation Rank: Not ranked
Comments on Rank:

Detailed Description: 2008: Area 13325: 9 observed.
General Area:
General Comments:
Management Comments:

Location

Survey Site Name: Great Brook-Exeter River
Managed By: Gilman Park

County: Rockingham
Town(s): Exeter
Size: 1.9 acres

USGS quad(s): Exeter (4207088)
Lat, Long: 425826N, 0705634W
Elevation:

Precision: Within (but not necessarily restricted to) the area indicated on the map.

Directions: 2008: Exeter River

Dates documented

First reported: 2008-08-29
Last reported: 2008-08-29

The New Hampshire Fish & Game Department has jurisdiction over rare wildlife in New Hampshire. Please contact them at 11 Hazen Drive, Concord, NH 03301 or at (603) 271-2461.

New Hampshire Natural Heritage Bureau - Animal Record

American Eel (*Anguilla rostrata*)

Legal Status		Conservation Status	
Federal:	Not listed	Global:	Apparently secure but with cause for concern
State:	SC	State:	Rare or uncommon

Description at this Location

Conservation Rank: Not ranked
Comments on Rank:

Detailed Description: 2008: Area 13326: 13 observed.
General Area:
General Comments:
Management Comments:

Location

Survey Site Name: Great Brook-Exeter River
Managed By: Phillips Exeter Academy Land

County:	Rockingham	USGS quad(s):	Exeter (4207088)
Town(s):	Exeter	Lat, Long:	425804N, 0705625W
Size:	1.9 acres	Elevation:	

Precision: Within (but not necessarily restricted to) the area indicated on the map.

Directions: 2008: Exeter River

Dates documented

First reported:	2008-08-29	Last reported:	2008-08-29

The New Hampshire Fish & Game Department has jurisdiction over rare wildlife in New Hampshire. Please contact them at 11 Hazen Drive, Concord, NH 03301 or at (603) 271-2461.

New Hampshire Natural Heritage Bureau - Animal Record

Blanding's Turtle (*Emydoidea blandingii*)

Legal Status		Conservation Status	
Federal:	Not listed	Global:	Apparently secure but with cause for concern
State:	Listed Endangered	State:	Critically imperiled due to rarity or vulnerability

Description at this Location

Conservation Rank: Good quality, condition and landscape context ('B' on a scale of A-D).
Comments on Rank:

Detailed Description: 2007: Area 11793: Female laying eggs.
General Area: 2007: Area 11793: Wetlands on both sides of the road.
General Comments:
Management Comments:

Location

Survey Site Name: Great Meadows
Managed By: Phillips Exeter Academy Land

County:	Rockingham	USGS quad(s):	Exeter (4207088)
Town(s):	Exeter	Lat, Long:	
Size:	.4 acres	Elevation:	

Precision: Within (but not necessarily restricted to) the area indicated on the map.

Directions: 2007: Area 11793: Shoulder of Drinkwater Road where it crosses the outlet stream of The Cove.

Dates documented

First reported:	2007-06-11	Last reported:	2007-06-11

The New Hampshire Fish & Game Department has jurisdiction over rare wildlife in New Hampshire. Please contact them at 11 Hazen Drive, Concord, NH 03301 or at (603) 271-2461.

NATURAL RESOURCE SURVEY AND ASSESSMENT
LIMITATIONS

Use of Report

1. GZA GeoEnvironmental, Inc. (GZA) has prepared this report on behalf of, and for the exclusive use of Doucet Survey, Inc. ("Client") for the stated purpose(s) and location(s) identified in the report. Use of this report, in whole or in part, at other locations, or for other purposes, may lead to inappropriate conclusions; and we do not accept any responsibility for the consequences of such use(s). Further, reliance by any party not identified in the agreement, for any use, without our prior written permission, shall be at that party's risk, and without any liability to GZA.

Standard of Care

2. GZA's findings and conclusions are based on the work conducted as part of the Scope of Services set forth in the Report and/or proposal, and reflect our professional judgment. These findings and conclusions must be considered not as scientific or engineering certainties, but rather as our professional opinions concerning the data gathered and observations made during the course of our work. Conditions other than described in this report may be found at the subject location(s).

3. GZA's services were performed using the degree of skill and care ordinarily exercised by qualified professionals performing the same type of services, at the same time, under similar conditions, at the same or a similar property. No warranty, expressed or implied, is made.

Limits to Observations

4. Natural resource characteristics are inherently variable. Biological community composition and diversity can be affected by seasonal, annual or anthropogenic influences. In addition, soil conditions are reflective of subsurface geologic materials, the composition and distribution of which vary spatially.

5. The observations described in this report were made on the dates referenced and under the conditions stated therein. Conditions observed and reported by GZA reflect the conditions that could be reasonably observed based upon the visual observations of surface conditions and/or a limited observation of subsurface conditions at the specific time of observation. Such conditions are subject to environmental and circumstantial alteration and may not reflect conditions observable at another time.

6. The conclusions and recommendations contained in this report are based upon the data obtained from a limited number of surveys performed during the course of our work on the site, as described in the Report. There may be variations between these surveys and other past or future surveys due to inherent environmental and circumstantial variability.

Reliance on Information from Others

7. Preparation of this Report may have relied upon information made available by Federal, state and local authorities; and/or work products prepared by other professionals as specified in the report.

Unless specifically stated, GZA did not attempt to independently verify the accuracy or completeness of that information.

Compliance with Regulations and Codes

8. GZA's services were performed to render an opinion on the presence and/or condition of natural resources as described in the Report. Standards used to identify or assess these resources as well as regulatory jurisdiction, if any, are stated in the Report. Standards for identification of jurisdictional resources and regulatory control over them may vary between governmental agencies at Federal, state and local levels and are subject to change over time which may affect the conclusions and findings of this report.

New Information

9. In the event that the Client or others authorized to use this report obtain information on environmental regulatory compliance issues at the site not contained in this report, such information shall be brought to GZA's attention forthwith. GZA will evaluate such information and, on the basis of this work, may modify the conclusions stated in this report.

Additional Services

10. GZA recommends that we be retained to provide further investigation, if necessary, which would allow GZA to (1) observe compliance with the concepts and recommendations contained herein; (2) evaluate whether the manner of implementation creates a potential new finding; and (3) evaluate whether the manner of implementation affects or changes the conditions on which our opinions were made.

From: Tracy Tarr
To: "Tuttle, Kim"
Subject: RE: Court Street Bridge Replacement - Little River, Exeter NHB14-2033
Date: Tuesday, June 24, 2014 10:27:00 AM
Attachments: image001.jpg
image002.png
image003.png
image004.png

Thanks for your coordination Kim! I will ask Cheri for specific time periods.

Tracy

Tracy L. Tarr, CWS, CWB, CESSWI
Assistant Project Manager
GZA GeoEnvironmental, Inc.
380 Harvey Road | Manchester, NH 03103

o: 603.232.8739 | c: 603.235.6992 | fax: 603.624.9463
tracy.tarr@gza.com | www.gza.com

PROACTIVE BY DESIGN.® Our Company Commitment.

Follow us on: 

From: Tuttle, Kim [mailto:Kim.Tuttle@wildlife.nh.gov]
Sent: Tuesday, June 24, 2014 10:24 AM
To: Tracy Tarr
Subject: RE: Court Street Bridge Replacement - Little River, Exeter NHB14-2033

Tracy,

Below are some additional comments from NHFG Marine Division. As regards timing of the construction schedule, you should communicate directly with Marine Division about anadromous fish migration.

Regards,

Kim Tuttle

Certified Wildlife Biologist
NH Fish and Game
11 Hazen Drive
Concord, NH 03301
603-271-6544

I agree with Mike, as long as it is an open box concept or if not then we would want to be consulted with on the best design for fish and wildlife passage. We will also want to comment on timing as the construction schedule is being developed so construction doesn't affect fish migration and emigration periods.

Thanks, Kim.

Cheri Patterson
Supervisor of Marine Programs
NH Fish and Game Department
225 Main Street
Durham, NH 03824
(603)868-1095 – office
(603)868-3305 – fax

"NH Fish and Game Department: Connecting you to life outdoors"

Did you know...The NH Fish and Game Department protects, conserves and manages more than 500 species of wildlife, including 63 mammals, 18 reptiles, 22 amphibians, 313 birds, and 122 fish. For more information visit: http://wildlife.state.nh.us/Wildlife/wildlife_plan.htm

From: Dionne, Michael
Sent: Tuesday, June 24, 2014 7:47 AM
To: Tuttle, Kim
Cc: Patterson, Cheri
Subject: RE: Court Street Bridge Replacement - Little River, Exeter

Kim,
Unless Cheri has something to add, I'm good with it. A full span in the 55' range sounds great for this location and it's a big improvement compared to the existing conditions. This should allow for restoration of the full channel width which should make passage by all species of fish much easier.

Mike Dionne
Marine Biologist

NH Fish and Game...*connecting you to life outdoors*

www.wildnh.com, www.facebook.com/nhfishandgame

From: Tuttle, Kim
Sent: Tuesday, June 24, 2014 8:36 AM
To: 'Tracy Tarr'
Subject: RE: Court Street Bridge Replacement - Little River, Exeter NHB14-2033

Tracy,

The NHFG Nongame and Endangered Species Program has reviewed NHB14-2033 for the proposed Court St. bridge replacement in Exeter. Three pipe arch culverts will be replaced with a clear span structure in the 55' range. The NHB database check indicated the following species in the vicinity of the project:

American Eel (*Anguilla rostrata*) SC --
Blanding's Turtle (*Emydoidea blandingii*) E --
Codes: "E" = Endangered, "T" = Threatened, "SC" = Special Concern

We do not expect impacts to either species as a result of the project construction. Avoid the use of welded plastic or 'biodegradable' erosion control netting at this job site. There are numerous documented cases of snakes and other wildlife, including black racers and eastern hognose snakes, being trapped and killed in erosion control netting. Several 'wildlife friendly' options such as woven organic material (e.g., coco matting) are commercially available. Please feel free to call me if you have any questions regarding this review.

Sincerely,

Kim Tuttle
Certified Wildlife Biologist
NH Fish and Game
11 Hazen Drive
Concord, NH 03301
603-271-6544

From: Tracy Tarr [mailto:Tracy.Tarr@gza.com]
Sent: Monday, June 23, 2014 12:14 PM
To: Tuttle, Kim
Subject: Court Street Bridge Replacement - Little River, Exeter

Hi Kim,

We are hoping to get Fish and Game's review for a bridge replacement on Court Street in Exeter (see attached locus and photos. The existing crossing consists of three pipe arch culverts (2, 12'-

10", 1, 14'-1'). The engineer, CMA Engineers, is currently evaluating a replacement structure in the 55' range. They will complete a Hydrologic and Hydraulic Study to determine the exact appropriate sizing but the intent is to replace the three separate arch culverts with one large span.

The NHG has records of American eel and Blanding's turtle downstream in the Exeter River. I am contacting you to see if there are any BMPs or project considerations that the department would like the engineer to consider in the design.

Thanks in advance for your input!

Tracy

Tracy L. Tarr, CWS, CWB, CESSWI
Assistant Project Manager
GZA GeoEnvironmental, Inc.
380 Harvey Road | Manchester, NH 03103

o: 603.232.8739 | c: 603.235.6992 | fax: 603.624.9463
tracy.tarr@gza.com | www.gza.com

PROACTIVE BY DESIGN.® Our Company Commitment.

Follow us on: 

From:	Patterson, Cheri
To:	Tracy Tarr
Cc:	Dionne, Michael
Subject:	RE: Court Street Bridge Replacement - Little River, Exeter NHB14-2033
Date:	Tuesday, June 24, 2014 3:25:29 PM
Attachments:	image001.jpg image002.png image003.png image004.png

Tracy,

Mike and I will be looking at the site in the next couple of weeks and will get back to you, but we would need an idea of the construction schedule as some of the construction may not affect fish passage or habitat depending on the timing. Essentially diadromous fish will be running from March-June and emigrating anywhere from August through December. So if we had an idea of your construction phases we can help you with the timing.

Cheri Patterson
Supervisor of Marine Programs
NH Fish and Game Department
225 Main Street
Durham, NH 03824
(603)868-1095 – office
(603)868-3305 – fax

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Did you know...The NH Fish and Game Department protects, conserves and manages more than 500 species of wildlife, including 63 mammals, 18 reptiles, 22 amphibians, 313 birds, and 122 fish. For more information visit: http://wildlife.state.nh.us/Wildlife/wildlife_plan.htm

---

From: Tracy Tarr [mailto:Tracy.Tarr@gza.com]
Sent: Tuesday, June 24, 2014 12:35 PM
To: Patterson, Cheri
Subject: FW: Court Street Bridge Replacement - Little River, Exeter NHB14-2033

Hi Cheri,

Thanks very much for your input on the Court Street Bridge Replacement Project (sent via Kim Tuttle). Can you give me specific seasonal recommendations for American eel? I will send those along to the project engineer who is heading up environmental permitting.

Thanks in advance!

Tracy

Tracy L. Tarr, CWS, CWB, CESSWI

Assistant Project Manager
GZA GeoEnvironmental, Inc.
380 Harvey Road | Manchester, NH 03103

o: 603.232.8739 | c: 603.235.6992 | fax: 603.624.9463
tracy.tarr@gza.com | www.gza.com

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Follow us on: 

From: Tuttle, Kim [mailto:Kim.Tuttle@wildlife.nh.gov]
Sent: Tuesday, June 24, 2014 10:24 AM
To: Tracy Tarr
Subject: RE: Court Street Bridge Replacement - Little River, Exeter NHB14-2033

Tracy,

Below are some additional comments from NHFG Marine Division. As regards timing of the construction schedule, you should communicate directly with Marine Division about anadromous fish migration.

Regards,

Kim Tuttle
Certified Wildlife Biologist
NH Fish and Game
11 Hazen Drive
Concord, NH 03301
603-271-6544

I agree with Mike, as long as it is an open box concept or if not then we would want to be consulted with on the best design for fish and wildlife passage. We will also want to comment on timing as the construction schedule is being developed so construction doesn't affect fish migration and emigration periods.

Thanks, Kim.

Cheri Patterson
Supervisor of Marine Programs
NH Fish and Game Department
225 Main Street
Durham, NH 03824
(603)868-1095 – office
(603)868-3305 – fax

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From: Dionne, Michael
Sent: Tuesday, June 24, 2014 7:47 AM
To: Tuttle, Kim
Cc: Patterson, Cheri
Subject: RE: Court Street Bridge Replacement - Little River, Exeter

Kim,
Unless Cheri has something to add, I'm good with it. A full span in the 55' range sounds great for this location and it's a big improvement compared to the existing conditions. This should allow for restoration of the full channel width which should make passage by all species of fish much easier.

Mike Dionne
Marine Biologist

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Sent: Tuesday, June 24, 2014 8:36 AM
To: 'Tracy Tarr'
Subject: RE: Court Street Bridge Replacement - Little River, Exeter NHB14-2033

Tracy,

The NHFG Nongame and Endangered Species Program has reviewed NHB14-2033 for the proposed Court St. bridge replacement in Exeter. Three pipe arch culverts will be replaced with a clear span structure in the 55' range. The NHB database check indicated the following species in the vicinity of the project:

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Codes: "E" = Endangered, "T" = Threatened, "SC" = Special Concern

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Sincerely,

Kim Tuttle
Certified Wildlife Biologist
NH Fish and Game
11 Hazen Drive
Concord, NH 03301
603-271-6544

From: Tracy Tarr [mailto:Tracy.Tarr@gza.com]
Sent: Monday, June 23, 2014 12:14 PM
To: Tuttle, Kim
Subject: Court Street Bridge Replacement - Little River, Exeter

Hi Kim,

We are hoping to get Fish and Game's review for a bridge replacement on Court Street in Exeter (see attached locus and photos. The existing crossing consists of three pipe arch culverts (2, 12'-10", 1, 14'-1'). The engineer, CMA Engineers, is currently evaluating a replacement structure in the 55' range. They will complete a Hydrologic and Hydraulic Study to determine the exact appropriate sizing but the intent is to replace the three separate arch culverts with one large span.

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Thanks in advance for your input!

Tracy

Tracy L. Tarr, CWS, CWB, CESSWI
Assistant Project Manager

Please mail 2 copies of the completed form and required material to:

Cultural Resources Staff
Bureau of Environment
NH Department of Transportation
7 Hazen Drive
Concord, NH 03302

DHR Use Only
R&C # 6109
Log In Date 9/10/14
Response Date ___/___/___
Sent Date ___/___/___

Request for Project Review by the New Hampshire Division of Historical Resources for Transportation Projects

☒ This is a new submittal.
☐ This is additional information relating to DHR Review and Compliance (R&C)#:

RECEIVED
BUREAU OF ENVIRONMENT
SEP 05 2014
NH DEPARTMENT OF TRANSPORTATION

GENERAL PROJECT INFORMATION

DOT Project Name & Number

Brief Descriptive Project Title Court & Linden Street Culvert Replacement

Project Location Court Street & Linden Street (over the Little River)

City/Town Exeter

Lead Federal Agency and Contact *(if applicable)*
(Agency providing funds, licenses, or permits)

Permit Type and Permit or Job Reference #

DOT Environmental Manager *(if applicable)*

PROJECT SPONSOR INFORMATION

Project Sponsor Name Town of Exeter Public Works Department

Mailing Address 13 Newfields Road Phone Number 603-773-6157

City Exeter State NH Zip 03833 Email pvlasich@exeternh.gov

CONTACT PERSON TO RECEIVE RESPONSE

Name/Company Britt Audet, P.E. CMA Engineers, Inc.

Mailing Address 35 Bow Street Phone Number 6034316196

City Portsmouth State NH Zip 03801 Email baudet@cmaengineers.com

This form is updated periodically. Please download the current form at http://www.nh.gov/nhdhr/review. *Please refer to the Request for Project Review for Transportation Projects Instructions for direction on completing this form.* Submit 2 copies of this project review form for each project for which review is requested. Include 1 self-addressed stamped envelope to expedite review response. Project submissions will not be accepted via facsimile or e-mail. This form is required. Review request form must be complete for review to begin. Incomplete forms will be sent back to the applicant without comment. Please be aware that this form may only initiate consultation. For some projects, additional information will be needed to complete the Section 106 review. All items and supporting documentation submitted with a review request, including photographs and publications, will be retained by the DOT and the DHR as part of its review records. Items to be kept confidential should be clearly identified. For questions regarding the DHR review process and the DHR's role in it, please visit our website at: http://www.nh.gov/nhdhr/review or contact the R&C Specialist at christina.st.louis@dcr.nh.gov or 603.271.3558.

PROJECTS CANNOT BE PROCESSED WITHOUT THIS INFORMATION

Project Boundaries and Description

- ☒ Attach the relevant portion of a 7.5' USGS Map (photocopied or computer-generated) ***indicating the proposed area of potential effect (APE).*** *(See RPR for Transportation Projects Instructions and R&C FAQs for guidance. Note that the APE is subject to approval by lead federal agency and SHPO.)*
- ☒ Attach a detailed narrative description of the proposed project.
- ☒ Attach current engineering plans with tax parcel, landscape, and building references, and areas of proposed excavation, if available.
- ☒ Attach photos of the project area/APE with photo key (overview of project location and area adjacent to project location, and specific areas of proposed impacts and disturbances.) *(Blank photo logs are available on the DHR website. Informative photo captions can be used in place of a photo log.)*
- ☒ A DHR file review must be conducted to identify properties within or adjacent to the APE. Provide file review results in **Table 1**. *(Blank table forms are available on the DHR website.)*
  File review conducted on 08/20/2014.*

  **The DHR recommends that all survey/National Register nomination forms and their Determination of Eligibility (green) sheets are copied for your use in project development.*

Architecture

Are there any buildings, structures (bridges, walls, culverts, etc.) objects, districts or landscapes within the APE? ☒ Yes ☐ No
If no, skip to Archaeology section. If yes, submit all of the following information:

- ☒ Attach completed **Table 2**.
- ☒ Photographs of ***each*** resource or streetscape located within the APE. Add to the photo key and photo log noted above. (Digital photographs are accepted. All photographs must be clear, crisp and focused.)
- ☐ Copies of National Register boundary (listed *or* eligible) mapping, and add National Register boundaries for listed and eligible properties to the 7.5' USGS project map *(if applicable).*

Archaeology

Does the proposed undertaking involve ground-disturbing activity? ☒ Yes ☐ No
If yes, submit all of the following information:

- ☒ Description of current and previous land use and disturbances.
- ☒ Available information concerning known or suspected archaeological resources within the project area (such as cellar holes, wells, foundations, dams, etc.)

Please note that for many projects an architectural and/or archaeological survey or other additional information may be needed to complete the Section 106 process.

AGENCY COMMENT *This Space for DOT and Division of Historical Resources Use Only*

Sent to DHR; Authorized DOT Signature: JC Date: 9/8/14

☐ Insufficient information to initiate review.

☐ Additional information is needed in order to complete review.

Comments: No archaeology issues

No above-ground inventory is necessary at this time per information provided. Consult with property owners surrounding each subject APE regarding construction or other impacts to their properties, some of which may be historic.

If plans change or resources are discovered in the course of this project, you must contact the Division of Historical Resources as required by federal law and regulation.

Authorized DHR Signature: Laura A Black Date: Sept 12, 2014

Appendix C

Quantity and Cost Summary Sheets

Town of Exeter, NH
Linden Street Culvert, NHDOT Br. No. 087/062
CMA Engineers, Inc. Project # 923
October 2014

Opinion of Probable Project Cost, Option B: 53' Span Prestressed Box Beams on Piles

Item	Item	Quantity	Unit	Unit Price	Cost
	Earthwork				
201.1	CLEARING AND GRUBBING (F)	0.25	AC	$ 10,000.00	$ 2,500.00
504.1	COMMON BRIDGE EXCAVATION (F)	600	CY	$ 19.00	$ 11,400.00
504.2	ROCK EXCAVATION	30	CY	$ 31.00	$ 930.00
646.51	TURF ESTABLISHMENT WITH MULCH, TACKIFERS AND LOAM	450	SY	$ 3.00	$ 1,400.00
				Earthwork Subtotal	$ 16,230.00
	Structure				
209.201	GRANULAR BACKFILL (BRIDGE)(F)	60	CY	$ 35.00	$ 2,100.00
304.2	GRAVEL	210	CY	$ 25.00	$ 5,250.00
304.3	CRUSHED GRAVEL	160	CY	$ 22.00	$ 3,500.00
502	REMOVAL OF EXISTING BRIDGE STRUCTURE	1	U	$ 5,000.00	$ 5,000.00
503	DEWATERING / WATER DIVERSION	1	U	$ 15,000.00	$ 15,000.00
508	STRUCTURAL FILL	20	CY	$ 41.00	$ 800.00
520.1	CLASS AA CONCRETE	100	CY	$ 650.00	$ 65,000.00
528.323	PRESTRESSED CONCRETE BRIDGE DECK, BOX BEAMS	1600	SF	$ 90.00	$ 144,000.00
534.3	WATER REPELLENT (SILANE-SILOXANE)	10	GAL	$ 65.00	$ 650.00
538.6	BARRIER MEMBRANE, HEAT WELDED BY TORCH	170	SY	$ 25.00	$ 4,300.00
544.2	REINFORCING STEEL, EPOXY COATED	15000	LB	$ 1.20	$ 18,000.00
548.11	ELASTOMERIC BEARING PADS (F)	40	EA	$ 170.00	$ 6,800.00
559.4	ELASTOMERIC PLUG TYPE EXPANSION JOINT (F)	35	LF	$ 150.00	$ 5,250.00
559.41	MODIFIED ELASTOMERIC PLUG TYPE FLEXIBLE JOINT, 6" WIDE (F)	35	LF	$ 120.00	$ 4,200.00
585.21	STONE FILL, CLASS B (BRIDGE)	220	CY	$ 45.00	$ 9,900.00
593.421	GEOTEXTILE, PERMANENT EROSION CONTROL, CLASS 2, NON-WOVEN	400	SY	$ 3.00	$ 1,200.00
				Structure Subtotal	$ 290,950.00
	Foundation				
510.1	PILE DRIVING EQUIPMENT	1	U	$ 70,000.00	$ 70,000.00
510.2	PILE LOADING TESTS	2	E	$ 5,000.00	$ 10,000.00
510.61	FURNISHING AND DRIVING STEEL BEARING PILES	37500	LB	$ 0.50	$ 18,800.00
510.65	DRIVING POINTS FOR STEEL PILES	20	EA	$ 500.00	$ 10,000.00
520.2	CLASS B CONCRETE	60	CY	$ 350.00	$ 21,000.00
544	REINFORCING STEEL (F)	8200	LB	$ 1.15	$ 9,430.00
				Foundation Subtotal	$ 139,230.00
	Roadway				
202.7	REMOVAL OF GUARDRAIL (F)	375	LF	$ 1.10	$ 412.50
403.11	HOT BITUMINOUS PAVEMENT, MACHINE METHOD	240	TON	$ 75.00	$ 18,000.00
403.911	HOT BITUMINOUS BRIDGE PAVEMENT, 1" BASE COURSE (F)	20	TON	$ 175.00	$ 3,500.00
563.3	BRIDGE RAIL T101	100	LF	$ 150.00	$ 15,000.00
606.1455	BEAM GUARDRAIL (TERM. UNIT EAGRT 25 FT.)	3	U	$ 2,000.00	$ 6,000.00
606.12	BEAM GUARDRAIL (STD. SECTION - STEEL POST)	110	LF	$ 20.00	$ 2,200.00
606.1285	BEAM GUARDRAIL (APPROACH SECTION T101)	4	U	$ 3,000.00	$ 12,000.00
632.0104	RETROFLECTIVE PAINT PAVE. MARKING, 4" LINE (DYL)	250	LF	$ 0.50	$ 125.00
				Roadway Subtotal	$ 57,237.50
	Incidentals				
619.1	MAINTENANCE OF TRAFFIC	1	LS	$ 10,000.00	$ 10,000.00
645.7	STORMWATER PREVENTION PLAN	1	U	$ 3,000.00	$ 3,000.00
645.71	MONITORING SWPPP AND EROSIOIN AND SEDIMENT CONTROLS	1	U	$ 3,000.00	$ 3,000.00
692	MOBILIZATION	1	U	$ 36,380.00	$ 36,380.00
1008.9	ALTERATIONS AND ADDITIONS AS NEEDED - TESTING OF MATERIAL	$	1	$ 6,000.00	$ 6,000.00
				Incidentals Subtotal	$ 58,380.00
				Project Subtotal (2014)	**$ 562,030.00**
				Contingency (10%)	$ 56,200.00
				2015 Construction Escalator (3%)	$ 16,860.00
				Estimated Construction Engineering Fee	$ 76,210.00
				Project Total	**$ 711,000.00**

Town of Exeter, NH
Linden Street Culvert, NHDOT Br. No. 087/062
CMA Engineers, Inc. Project # 923
October 2014

Opinion of Probable Project Cost, Option A: 45' Span CONSPAN "O-Series" on Piles					
Item No.	Item	Quantity	Unit	Unit Price	Cost
	Earthwork				
201.1	CLEARING AND GRUBBING	0.25	AC	$ 10,000.00	$ 2,500.00
504.1	COMMON BRIDGE EXCAVATION (F)	1000	CY	$ 19.00	$ 19,000.00
504.2	ROCK EXCAVATION	50	CY	$ 31.00	$ 1,550.00
646.51	TURF ESTABLISHMENT WITH MULCH, TACKIFERS, AND LOAM	450	SY	$ 3.00	$ 1,350.00
				Earthwork Subtotal	$ 24,400.00
	Structure				
209.1	GRANULAR BACKFILL	300	CY	$ 45.00	$ 13,500.00
209.201	GRANULAR BACKFILL (BRIDGE)(F)	100	CY	$ 35.00	$ 3,500.00
304.2	GRAVEL (F)	200	CY	$ 25.00	$ 5,000.00
304.3	CRUSHED GRAVEL (F)	150	CY	$ 22.00	$ 3,300.00
502	REMOVAL OF EXISTING BRIDGE STRUCTURE	1	U	$ 5,000.00	$ 5,000.00
503.201	COFFERDAMS / DEWATERING	2800	SF	$ 40.00	$ 112,000.00
508	STRUCTURAL FILL	30	CY	$ 41.00	$ 1,230.00
520.0031	PRECAST CONCRETE ARCHED FRAME	1	U	$ 180,000.00	$ 180,000.00
520.1	CLASS AA CONCRETE	15	CY	$ 650.00	$ 9,750.00
544.2	REINFORCING STEEL, EPOXY COATED	2000	LB	$ 12.00	$ 24,000.00
585.21	STONE FILL, CLASS B	75	CY	$ 45.00	$ 3,375.00
593.421	GEOTEXTILE, PERMANENT EROSION CONTROL, CLASS 2, NON-WOVEN	225	SY	$ 5.00	$ 1,125.00
				Structure Subtotal	$ 361,780.00
	Foundation				
510.1	PILE DRIVING EQUIPMENT	1	U	$ 100,000.00	$ 100,000.00
510.2	PILE LOADING TESTS	4	U	$ 5,000.00	$ 20,000.00
510.61	FURNISHING AND DRIVING STEEL BEARING PILES	42600	LB	$ 0.50	$ 21,300.00
510.65	DRIVING POINTS FOR STEEL PILES	32	EA	$ 500.00	$ 16,000.00
520.2	CLASS B CONCRETE	35	CY	$ 350.00	$ 12,250.00
544	REINFORCING STEEL (F)	5000	LB	$ 1.15	$ 5,750.00
				Foundation Subtotal	$ 175,300.00
	Roadway				
202.7	REMOVAL OF GUARDRAIL (F)	375	LF	$ 5.00	$ 1,880.00
403.11	HOT BITUMINOUS PAVEMENT, MACHINE METHOD	300	TON	$ 75.00	$ 22,500.00
563.3	BRIDGERAIL T101	100	LF	$ 150.00	$ 15,000.00
606.1455	BEAM GUARDRAIL (TERM UNIT EAGRT. 25 FT.)	3	U	$ 2,000.00	$ 6,000.00
606.12	BEAM GUARDRAIL (STD. SECTION - STEEL POST)	140	LF	$ 20.00	$ 2,800.00
606.1285	BRIDGE APPROACH RAIL T101	4	U	$ 3,000.00	$ 12,000.00
632.0104	REFLECTIVE PAINT PAVE. MARKING, 4" LINE	250	LF	$ 0.50	$ 130.00
				Roadway Subtotal	$ 60,310.00
	Incidentals				
619.1	MAINTENANCE OF TRAFFIC	1	LS	$ 10,000.00	$ 10,000.00
645.7	STORMWATER PREVENTION PLAN	1	U	$ 3,000.00	$ 3,000.00
645.71	MONITORING SWPPP AND EROSIOIN AND SEDIMENT CONTROLS	1	U	$ 3,000.00	$ 3,000.00
692	MOBILIZATION	1	U	$ 44,650.00	$ 44,650.00
1008.9	ALTERATIONS AND ADDITIONS AS NEEDED - TESTING OF MATERIAL	$	1	$ 5,000.00	$ 5,000.00
				Incidentals Subtotal	$ 65,650.00
				Project Subtotal (2014)	**$ 687,440.00**
				Contingency (10%)	$ 68,740.00
				2015 Construction Escalator (3%)	$ 20,620.00
				Estimated Construction Engineering Fee	$ 93,220.00
				Project Total	**$ 870,000.00**

Town of Exeter, NH
Court Street Culvert, NHDOT Br. No. 095/063
CMA Engineers, Inc. Project # 923
October 2014

Opinion of Probable Project Cost, Option B: 55' Span Prestressed Box Beams on Piles

Item	Item	Quantity	Unit	Unit Price	Cost
	Earthwork				
201.1	CLEARING AND GRUBBING (F)	0.25	AC	$ 10,000.00	$ 2,500.00
504.1	COMMON BRIDGE EXCAVATION (F)	1050	CY	$ 19.00	$ 20,000.00
504.2	ROCK EXCAVATION	50	CY	$ 31.00	$ 1,550.00
646.51	TURF ESTABLISHMENT WITH MULCH, TACKIFERS AND LOAM	1400	SY	$ 3.00	$ 4,200.00
				Earthwork Subtotal	$ 28,250.00
	Structure				
209.201	GRANULAR BACKFILL (BRIDGE)(F)	75	CY	$ 35.00	$ 2,600.00
304.2	GRAVEL	550	CY	$ 25.00	$ 13,750.00
304.3	CRUSHED GRAVEL	400	CY	$ 22.00	$ 8,800.00
502	REMOVAL OF EXISTING BRIDGE STRUCTURE	1	U	$ 7,500.00	$ 7,500.00
503.21	DEWATERING	1	U	$ 15,000.00	$ 15,000.00
508	STRUCTURAL FILL	30	CY	$ 41.00	$ 1,230.00
520.1	CLASS AA CONCRETE	210	CY	$ 650.00	$ 136,500.00
528.323	PRESTRESSED CONCRETE BRIDGE DECK, BOX BEAMS	2350	SF	$ 90.00	$ 211,500.00
534.3	WATER REPELLENT (SILANE-SILOXANE)	10	GAL	$ 65.00	$ 650.00
538.6	BARRIER MEMBRANE, HEAT WELDED BY TORCH	370	SY	$ 25.00	$ 9,300.00
544.2	REINFORCING STEEL, EPOXY COATED	31000	LB	$ 1.20	$ 37,200.00
548.11	ELASTOMERIC BEARING PADS (F)	44	EA	$ 170.00	$ 7,480.00
559.4	ELASTOMERIC PLUG TYPE EXPANSION JOINT (F)	40	LF	$ 150.00	$ 6,000.00
559.41	MODIFIED ELASTOMERIC PLUG TYPE FLEXIBLE JOINT, 6" WIDE (F)	40	LF	$ 100.00	$ 4,000.00
585.21	STONE FILL, CLASS B (BRIDGE)	270	CY	$ 45.00	$ 12,150.00
593.421	GEOTEXTILE, PERMANENT EROSION CONTROL, CLASS 2, NON-WOVEN	400	SY	$ 5.00	$ 2,000.00
				Structure Subtotal	$ 475,660.00
	Foundation				
510.1	PILE DRIVING EQUIPMENT	1	U	$ 70,000.00	$ 70,000.00
510.2	PILE LOADING TESTS	2	E	$ 5,000.00	$ 10,000.00
510.61	FURNISHING AND DRIING STEEL BEARING PILES	46600	LB	$ 0.50	$ 23,300.00
510.65	DRIVING POINTS FOR STEEL PILES	20	EA	$ 500.00	$ 10,000.00
520.2	CLASS B CONCRETE	70	CY	$ 350.00	$ 24,500.00
544	REINFORCING STEEL (F)	9300	LB	$ 1.15	$ 10,695.00
				Foundation Subtotal	$ 148,495.00
	Roadway				
202.7	REMOVAL OF GUARDRAIL (F)	350	LF	$ 5.00	$ 1,750.00
403.11	HOT BITUMINOUS PAVEMENT, MACHINE METHOD	650	TON	$ 75.00	$ 48,800.00
403.911	HOT BITUMINOUS BRIDGE PAVEMENT, 1" BASE COURSE (F)	20	TON	$ 175.00	$ 3,500.00
563.3	BRIDGE RAIL T101	160	LF	$ 150.00	$ 24,000.00
606.1455	BEAM GUARDRAIL (TERM. UNIT EAGRT 25 FT.)	4	U	$ 2,000.00	$ 8,000.00
606.12	BEAM GUARDRAIL (STD. SECTION - STEEL POST)	60	LF	$ 20.00	$ 1,200.00
606.1285	BEAM GUARDRAIL (APPROACH SECTION T101)	4	U	$ 3,000.00	$ 12,000.00
632.0104	RETROFLECTIVE PAINT PAVE. MARKING, 4" LINE (DYL)	680	LF	$ 0.50	$ 340.00
				Roadway Subtotal	$ 99,590.00
	Water Main				
611.0521	10" CEMENT LINED DUCTILE IRON WATER PIPE, CL 52	150	LF	$ 150.00	$ 22,500.00
611.7101	10" GATE VALVE	2	EA	$ 2,000.00	$ 4,000.00
611.951	WATER MAIN INSULATION	1	LS	$ 2,750.00	$ 2,750.00
1008.4	ALTERATIONS AND ADDITIONS AS NEEDED - ULTILITY ADJUSTMENT**	1	LS	$ 14,500.00	$ 14,500.00
				Water Main Subtotal	$ 43,750.00
	Incidentals				
619.1	MAINTENANCE OF TRAFFIC	1	LS	$ 6,000.00	$ 6,000.00
645.7	STORMWATER PREVENTION PLAN	1	U	$ 3,000.00	$ 3,000.00
645.71	MONITORING SWPPP AND EROSIOIN AND SEDIMENT CONTROLS	1	U	$ 3,000.00	$ 3,000.00
692	MOBILIZATION	1	U	$ 56,540.00	$ 56,540.00
1008.9	ALTERATIONS AND ADDITIONS AS NEEDED - TESTING OF MATERIAL	$	1	$ 6,000.00	$ 6,000.00
				Incidentals Subtotal	$ 74,540.00
				Project Subtotal (2014)	**$ 870,290.00**
				Contingency (10%)	$ 87,030.00
				2015 Construction Escalator (3%)	$ 26,110.00
				Estimated Construction Engineering Fee	$ 118,010.00
				Project Total	**$ 1,101,000.00**

Town of Exeter, NH
Court Street Culvert, NHDOT Br. No. 095/063
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Opinion of Probable Project Cost, Option A: 54' Span CONSPAN "O-Series" on Piles

Item No.	Item	Quantity	Unit	Unit Price	Cost
	Earthwork				
201.1	CLEARING AND GRUBBING	0.25	AC	$ 10,000.00	$ 2,500.00
504.1	COMMON BRIDGE EXCAVATION (F)	1750	CY	$ 19.00	$ 33,250.00
504.2	ROCK EXCAVATION	90	CY	$ 31.00	$ 2,790.00
646.51	TURF ESTABLISHMENT WITH MULCH, TACKIFERS, AND LOAM	1600	SY	$ 3.00	$ 4,800.00
				Earthwork Subtotal	$ 43,340.00
	Structure				
290.1	GRANULAR BACKFILL	450	CY	$ 45.00	$ 20,300.00
209.201	GRANULAR BACKFILL (BRIDGE)(F)	100	CY	$ 35.00	$ 3,500.00
304.2	GRAVEL (F)	600	CY	$ 25.00	$ 15,000.00
304.3	CRUSHED GRAVEL (F)	450	CY	$ 22.00	$ 9,900.00
502	REMOVAL OF EXISTING BRIDGE STRUCTURE	1	U	$ 7,500.00	$ 7,500.00
503.201	COFFERDAMS / DEWATERING	5000	SF	$ 40.00	$ 200,000.00
508	STRUCTURAL FILL	30	CY	$ 41.00	$ 1,230.00
520.0031	PRECAST CONCRETE ARCHED FRAME	1	U	$ 200,000.00	$ 200,000.00
520.1	CLASS AA CONCRETE	10	CY	$ 650.00	$ 6,500.00
544.2	REINFORCING STEEL, EPOXY COATED	1600	LB	$ 1.20	$ 1,900.00
585.21	STONE FILL, CLASS B	190	CY	$ 45.00	$ 8,550.00
593.421	GEOTEXTILE, PERMANENT EROSION CONTROL, CLASS 2, NON-WOVEN	230	SY	$ 5.00	$ 1,150.00
				Structure Subtotal	$ 475,530.00
	Foundation				
510.1	PILE DRIVING EQUIPMENT	1	U	$ 100,000.00	$ 100,000.00
510.2	PILE LOADING TESTS	4	U	$ 5,000.00	$ 20,000.00
510.61	FURNISHING AND DRIVING STEEL BEARING PILES	59200	LB	$ 0.50	$ 29,600.00
510.65	DRIVING POINTS FOR STEEL PILES	32	EA	$ 500.00	$ 16,000.00
520.2	CLASS B CONCRETE	40	CY	$ 350.00	$ 14,000.00
544	REINFORCING STEEL (F)	5900	LB	$ 1.15	$ 6,785.00
				Foundation Subtotal	$ 186,385.00
	Roadway				
202.7	REMOVAL OF GUARDRAIL (F)	350	LF	$ 5.00	$ 1,750.00
403.11	HOT BITUMINOUS PAVEMENT, MACHINE METHOD	600	TON	$ 75.00	$ 45,000.00
563.3	BRIDGERAIL T101	160	LF	$ 150.00	$ 24,000.00
606.1455	BEAM GUARDRAIL (TERM UNIT EAGRT. 25 FT.)	4	U	$ 2,000.00	$ 8,000.00
606.12	BEAM GUARDRAIL (STD. SECTION - STEEL POST)	50	LF	$ 20.00	$ 1,000.00
606.1285	BRIDGE APPROACH RAIL T101	4	U	$ 3,000.00	$ 12,000.00
632.0104	REFLECTIVE PAINT PAVE. MARKING, 4" LINE	680	LF	$ 0.50	$ 340.00
				Roadway Subtotal	$ 92,090.00
	Water Main				
611.0521	10" CEMENT LINED DUCTILE IRON WATER PIPE, CL 52	150	LF	$ 150.00	$ 22,500.00
611.7101	10" GATE VALVE	2	EA	$ 2,000.00	$ 4,000.00
611.951	WATER MAIN INSULATION	1	LS	$ 2,750.00	$ 2,750.00
1008.4	ALTERATIONS AND ADDITIONS AS NEEDED - ULTILITY ADJUSTMENT**	1	LS	$ 14,500.00	$ 14,500.00
				Water Main Subtotal	$ 43,750.00
	Incidentals				
619.1	MAINTENANCE OF TRAFFIC	1	LS	$ 6,000.00	$ 6,000.00
645.7	STORMWATER PREVENTION PLAN	1	U	$ 3,000.00	$ 3,000.00
645.71	MONITORING SWPPP AND EROSIOIN AND SEDIMENT CONTROLS	1	U	$ 3,000.00	$ 3,000.00
692	MOBILIZATION	1	U	$ 60,000.00	$ 60,000.00
1008.9	ALTERATIONS AND ADDITIONS AS NEEDED - TESTING OF MATERIAL	$	1	$ 5,000.00	$ 5,000.00
				Incidentals Subtotal	$ 77,000.00
				Project Subtotal (2014)	**$ 918,100.00**
				Contingency (10%)	$ 91,810.00
				2015 Construction Escalator (3%)	$ 27,540.00
				Estimated Construction Engineering Fee	$ 124,490.00
				Project Total	**$ 1,162,000.00**

** Note: Price includes, but not limited to, additional connections, hangers, seals, and cleaning/testing of installed water main.

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Opinion of Probable Project Cost, Option A: Cast-In-Place Concrete (Gravity or Cantiliever)

Item No.	Item	Quantity	Unit	Unit Price	Cost
201.1	CLEARING AND GRUBBING	0.05	AC	$ 10,000.00	$ 500.00
203.1	COMMON EXCAVATION	20	CY	$ 7.00	$ 100.00
290.1	GRANULAR BACKFILL	12	CY	$ 45.00	$ 500.00
504.2	ROCK EXCAVATION	1	CY	$ 31.00	$ 30.00
508	STRUCTURAL FILL	3	CY	$ 41.00	$ 120.00
509.3	OBSTRUCTION REMOVAL	1	U	$ 1,500.00	$ 1,500.00
520.1	CLASS A CONCRETE	5	CY	$ 550.00	$ 2,900.00
544	REINFORCING STEEL	533	LB	$ 1.15	$ 600.00
593.421	GEOTEXTILE, PERMANENT EROSION CONTROL, CLASS 2, NON-WOVEN	40	SY	$ 5.00	$ 200.00
	Incidentals				
692	MOBILIZATION	1	U	$ 520.00	$ 520.00
1008.9	ALTERATIONS AND ADDITIONS AS NEEDED - TESTING OF MATERIAL	$	1	$ 1,000.00	$ 1,000.00
				Structure Subtotal (2014)	**$ 7,970.00**
				Contingency (10%)	$ 800.00
				2015 Construction Escalator (3%)	$ 240.00
				Project Total	**$ 9,000.00**

Town of Exeter, NH
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Opinion of Probable Project Cost, Option B: Mechanically Stabilized Earth (MSE) Wall

Item No.	Item	Quantity	Unit	Unit Price	Cost
201.1	CLEARING AND GRUBBING	0.05	AC	$ 10,000.00	$ 500.00
203.1	COMMON EXCAVATION	71	CY	$ 7.00	$ 500.00
290.1	GRANULAR BACKFILL	59	CY	$ 45.00	$ 2,600.00
504.2	ROCK EXCAVATION	4	CY	$ 31.00	$ 110.00
508	STRUCTURAL FILL	8	CY	$ 41.00	$ 330.00
509.3	OBSTRUCTION REMOVAL	1	U	$ 1,500.00	$ 1,500.00
592.1	MECHANICALLY STABILIZED EARTH RETAINING WALL	167	SF	$ 39.00	$ 6,500.00
593.421	GEOTEXTILE, PERMANENT EROSION CONTROL, CLASS 2, NON-WOVEN	40	SY	$ 5.00	$ 200.00
	Incidentals				
692	MOBILIZATION	1	U	$ 930.00	$ 930.00
1008.9	ALTERATIONS AND ADDITIONS AS NEEDED - TESTING OF MATERIAL	$	1	$ 1,000.00	$ 1,000.00
				Structure Subtotal (2014)	**$ 14,170.00**
				Contingency (10%)	$ 1,420.00
				2015 Construction Escalator (3%)	$ 430.00
				Project Total	**$ 16,000.00**

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Opinion of Probable Project Cost, Option C: Mortar Rubble Masonry

Item No.	Item	Quantity	Unit	Unit Price	Cost
201.1	CLEARING AND GRUBBING	0.05	AC	$ 10,000.00	$ 500.00
203.1	COMMON EXCAVATION	17	CY	$ 7.00	$ 100.00
290.1	GRANULAR BACKFILL	6	CY	$ 45.00	$ 300.00
504.2	ROCK EXCAVATION	1	CY	$ 31.00	$ 30.00
508	STRUCTURAL FILL	3	CY	$ 41.00	$ 140.00
509.3	OBSTRUCTION REMOVAL	1	U	$ 1,500.00	$ 1,500.00
570.4	MORTAR RUBBLE MASONRY (F)	7.04	CY	$ 550.00	$ 3,900.00
593.421	GEOTEXTILE, PERMANENT EROSION CONTROL, CLASS 2, NON-WOVEN	40	SY	$ 5.00	$ 200.00
	Incidentals				
692	MOBILIZATION	1	U	$ 540.00	$ 540.00
1008.9	ALTERATIONS AND ADDITIONS AS NEEDED - TESTING OF MATERIAL	$	1	$ 1,000.00	$ 1,000.00
				Structure Subtotal (2014)	**$ 8,210.00**
				Contingency (10%)	$ 820.00
				2015 Construction Escalator (3%)	$ 250.00
				Project Total	**$ 9,000.00**

Appendix D

Hydraulic Report and Recommendations

GOMEZ AND SULLIVAN Engineers, P.C.

MEMO

TO: Jason Gallant, CMA Engineers

FROM: Kevin Cassidy and Rick Stewart, Gomez and Sullivan Engineers

DATE: September 19, 2014

RE: Final Hydrologic & Hydraulic Report for Court Street and Linden Street Bridge Replacements over the Little River (Little River Study)

EXECUTIVE SUMMARY

This hydrologic and hydraulic report presents the methodology for the development of the hydrology and hydraulic model, and the results for existing and proposed hydraulic analyses for the Court Street and Linden Street Bridge replacements (Little River Study) in Exeter, NH. The Little River Bridges are affected by the backwater from the Great Dam located downstream in the Exeter River. In 2013, the Town studied the removal of the Great Dam (Exeter River Great Dam Removal Feasibility and Impact Study (Great Dam Study)). A decision by the Town was made to remove the dam. The proposed Court Street and Linden Street Bridges hydraulic analysis is based on the dam being removed.

The hydrology at the Court Street and Linden Street Bridges was developed as part of the Great Dam Study. A "rainfall-runoff" model was developed using the TR-20 methodology within the US Army Corps of Engineers Hydrologic Engineering Center's (USACE HEC) software HEC-HMS for the 50-year flow. The TR-20 50-year flow was used in the Great Study and in the Little River Study. A "statistical" approach using the Bulletin 17B methodology (17B) which applies the Log Pearson Type III distribution was used in the Great Dam Study for the 2, 10, 50 (for comparison purposes only) and 100-year flows. The 17B 2, 10 and 100-year flows were used in the hydraulic analysis.

The Great Dam Study also developed a backwater model using the USACE HEC's software HEC-RAS for the Exeter River and Little River. The Little River reach within the model contains both the Court Street and Linden Street Bridges. This section was utilized for the hydraulic analysis of the two proposed bridges.

Several hydraulic analyses were made using the hydraulic model. The first analysis determined whether the peak flow at the Great Dam or the peak flow at the mouth of the Little River controlled the hydraulics at Court Street and Linden Street Bridges. The hydraulic model was run for both the "Great Dam in Place" and the "Great Dam Removed" conditions. It was determined that the peak flow at the Great Dam controlled the hydraulics in the Little River for both the dam-in and dam-out conditions.

The second analysis compared the Great Dam hydraulic model results to the Little River Study results for existing conditions. The comparison showed the water surface elevations (WSE) were the same downstream of Court Street which means the two models matched at that point. Upstream of Court Street and Linden Street, the Little River Study WSEs are lower because the existing culverts were enlarged based on new survey that found that the culverts under both roads were larger than those modeled in the Great Dam Study.

The third analysis compared the existing Little River hydraulic results for the "Great Dam in Place" and the "Great Dam Removed" conditions. The comparison showed that with the dam removed, the WSEs dropped 1.7 feet downstream of Court Street and 1.2 feet upstream of Linden Street.

The final analysis modeled the proposed bridges at Court Street and Linden Street. At Court Street, a single span bridge with a 55-foot wide opening was modeled, and at Linden Street, a single span bridge with a 45-foot wide opening was modeled. With the two proposed bridges, the WSE dropped 3 inches upstream of Court Street and just over 1-foot upstream of Linden Street. For the 50-year design flow, the WSE is about 5 inches below the low chord at the Court Street Bridge and is 1.5 feet below the low chord at the Linden Street Bridge.

1 METHODOLOGY

1.1 Hydrology

Hydrology for the Court Street and Linden Street Bridges was developed for the Federal Emergency Management Agency's (FEMA) Flood Insurance Study (FIS) for the Town of Exeter, and for the 2013 Exeter River Great Dam Removal Feasibility and Impact Study (Great Dam Study). The FIS Exeter River and Little River flows were determined using the 1978 USGS Regional Peak Discharge Equations which were developed from gauged watersheds in NH. For the Great Dam Study, two methods were used to develop flows, a "statistical" method and a "rainfall-runoff" model. Figure 1.1-1 presents the Little River Watershed Map.

The "statistical" approach used the Bulletin 17B methodology (17B) which applied the Log Pearson Type III distribution to recorded flows from the USGS gauge at Haigh Road on the Exeter River and the nearby Parker River, and adjusted those flows for climate change. The 17B flood frequency analysis determined flows for the 2, 10, 50 and 100-year events. The flows are presented in Tables 1.1-1 and 1.1-2 for the Little River and at the Great Dam, respectively.

The "rainfall-runoff" model was developed using the TR-20 methodology, developed by the Soil Conservation Service, within the US Army Corps of Engineers Hydrologic Engineering Center's (USACE HEC) software HEC-HMS v.3.4. The most recent rainfall data from the Northeast Regional Climate Center was used in the Great Dam Study, which considers the increase in rainfall in recent years. The HEC-HMS model was calibrated for the TR-20 50-year flow. The TR-20 50-year flow of 5,858 cfs at the time of the peak flow at the Great Dam compares well with the 17B 50-year flow of 5,718 cfs, as shown in Table 1.1-2. The rainfall-runoff model is required by the NH Department of Environmental Services (NHDES) Dam Safety Rules when determining flows for dam safety analysis. The Great Dam Study used the TR-20 50-year flow in its hydraulic analysis.

To be consistent with the Great Dam Study, the TR-20 50-year flow was used in the Little River Study as well. Because the "rainfall-runoff" model was calibrated for only the 50-year flow, as noted above, the 17B flows for the 2, 10 and 100-year flows are considered more accurate and are used in the hydraulic model for the proposed bridge replacements over the Little River.

The input parameters to the HEC-HMS model developed for the Great Dam Study were spot checked for reasonableness. Twenty percent of the Little River and Exeter River 53 subareas data was checked. The data included the curve numbers, stream slope, drainage area, time of concentration and stream flow path length. All data checked was acceptable. The HEC-HMS model was then used to determine the HEC-HMS flows in Table 1.1-1 and the HEC-HMS flow in Table 1.1-2 at the Great Dam at the time of the Little River peak flow.

To determine the flows that resulted in the highest water surface elevations (WSE) in the Little River, two flow scenarios were run in the Little River hydraulic model for both the "Great Dam in Place" and Great Dam Removed" conditions. The flows used in these two scenarios are presented in Tables 1,1-1 and 1.1-2. The first scenario used the TR-20 50-year peak flow of 5,858 cfs at the Great Dam with the flow of 957 cfs in Little River 5.5 hours after the Little River peak flow. The second scenario used the TR-20 50-year peak flow of 1,112 cfs in the Little River with the flow of 5,309 cfs at the Great Dam 5.5 hours prior to the Great Dam peak flow. As discussed further in Section 2.1, the first scenario with the Great Dam peak flow of 5,858 cfs resulted in the higher WSEs due to higher backwater in Little River from the Great Dam. This

was true for both the "Great Dam in Place" and the "Great Dam Removed" conditions. The Great Dam peak flow of 5,858 cfs and the Little River flow of 957 cfs were used in the proposed bridges hydraulic model.

Table 1.1-1: Flood Flows at the Mouth of the Little River

Flows (cfs)				
Recurrence Interval (yrs)	**FEMA FIS (1981) Peak Flow in Little River**	**Bulletin 17B[1] At the Time of the Peak Flow at Great Dam**	**HEC-HMS[2, 3] (TR-20 Method) At the Time of the Peak Flow at Great Dam**	**HEC-HMS[2, 3] (TR-20 Method) Peak Flow in Little River**
2	-	224	-	-
10	345	490	-	-
50	528	863	957	1112
100	624	1073	-	-

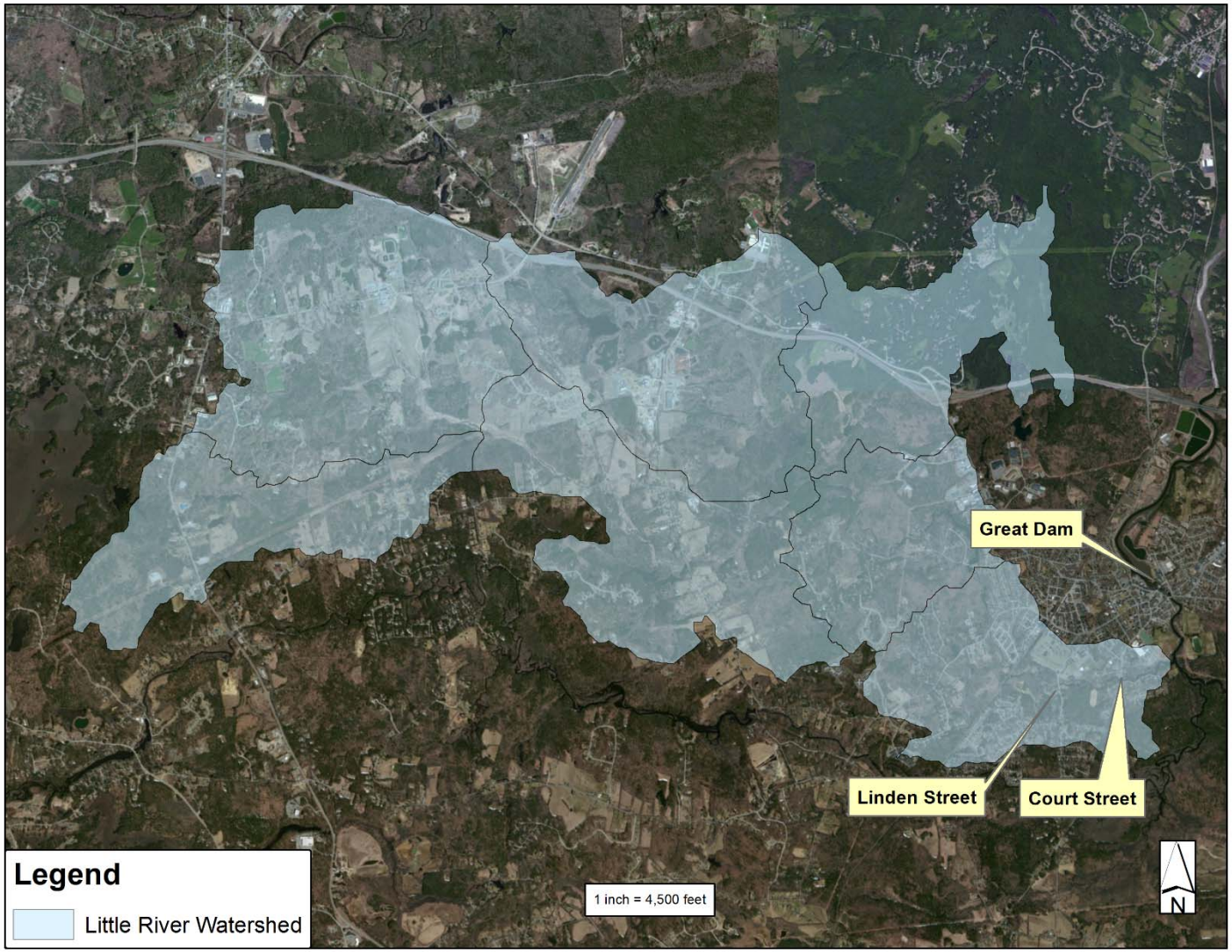
[1] From the Great Dam Study HEC-RAS model. The Great Dam Study used the ratio of the Little River and Exeter River drainage areas (15.1%) times the 17B peak flows at the Great Dam to determine the Little River flows.
[2] From the HEC-HMS model.
[3] The HEC-HMS model was calibrated for the 50-year flood event only.

Table 1.1-2: Flood Flows at the Great Dam

Flows (cfs)				
Recurrence Interval (yrs)	**FEMA FIS (1981) Peak Flow at Great Dam**	**Bulletin 17B[1] Peak Flow at Great Dam**	**HEC-HMS[2, 3] (TR-20 Method) Peak Flow at Great Dam**	**HEC-HMS[2, 3] (TR-20 Method) At the Time of the Peak Flow in Little River**
2	-	1481	-	-
10	2811	3245	-	-
50	4107	5718	5858	5309
100	4827	7109	-	-

[1] Bulletin 17B statistical analysis included in Great Dam Study.
[2] From the HEC-HMS model.
[3] The HEC-HMS model was calibrated for the 50-year flood event only.

Figure 1.1-1: *Little River Watershed Map*



1.2 Hydraulics

The Great Dam Study also developed a backwater model using the USACE HEC's software HEC-RAS for the Exeter River and Little River. The Little River reach within the model contains both the Court Street and Linden Street Bridges. This section was utilized for the hydraulic analysis of the two bridges. The HEC-RAS cross-sections in the model for the Little River extend approximately 2.4 miles upstream to Colcord Pond Dam from its confluence with the Exeter River. The extent of the Exeter River in the model is from downstream of the String Bridge, located just below the Great Dam, upstream to the Pickpocket Dam in Exeter, NH.

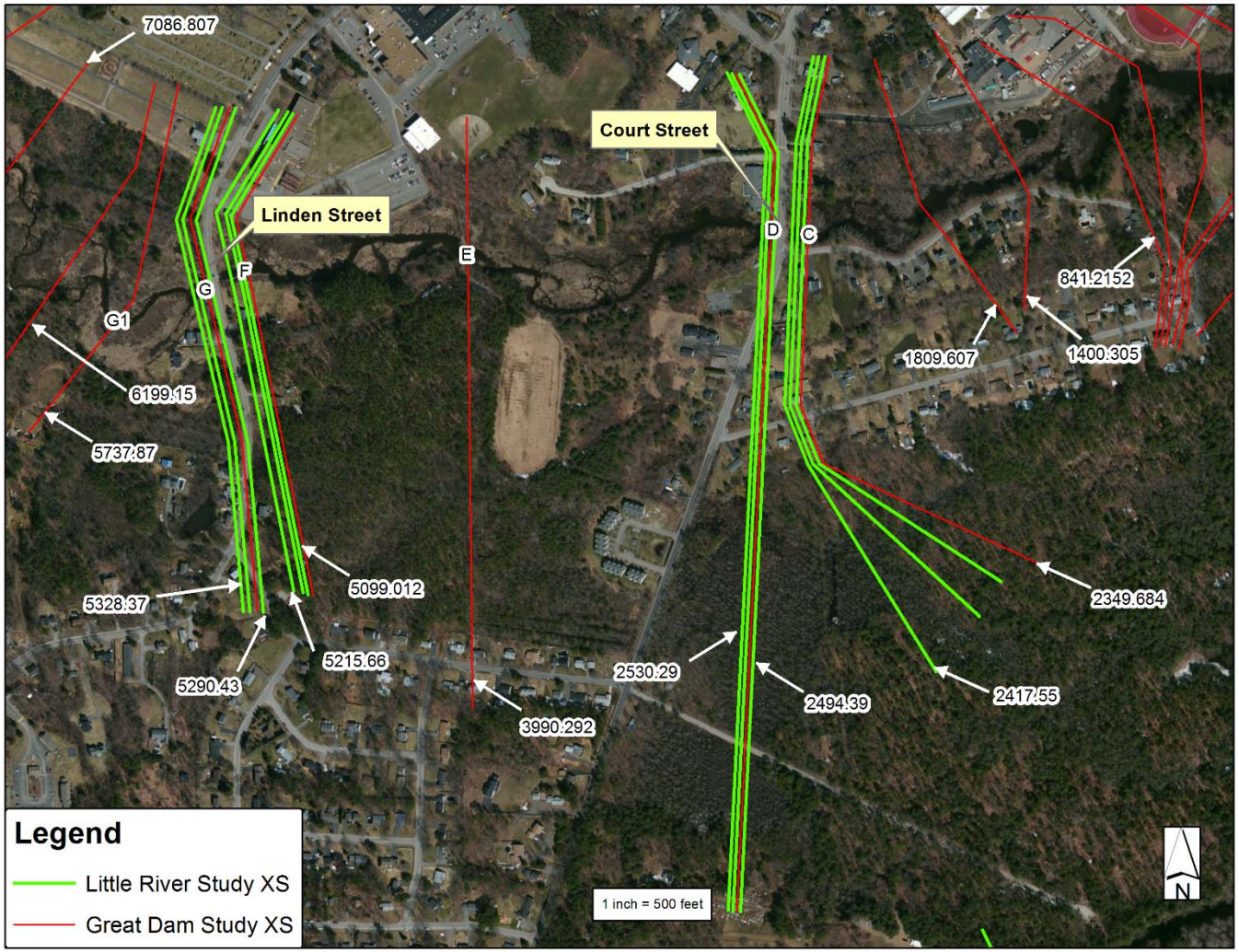
Additional surveyed cross-sections were inserted upstream and downstream of the Court Street and Linden Street Bridges between FEMA cross-sections 'G' through 'F' and sections 'E' through 'C' (See Figure 1.2-1). The Court Street and Linden Street culvert sizes and the toe-of-slope channel data at both locations were replaced with updated survey data within the channel banks.

Manning's roughness coefficients or "n values" were used in the model. The channel "n" value used was 0.04 while the overbanks values were both 0.07. For the sections with the stone fill within the proposed Court Street and Linden Street Bridges, 0.042 was used.

As flows approach or exit bridge openings or culverts the zones of active flow (where water is moving downstream) contracts or expands. Existing cross-sections within these zones of contraction and expansion used coefficients of 0.3 and 0.5 in the model. At cross-sections outside of these zones where the width of active flow is restored to the normal stream width, the coefficients used were 0.1 and 0.3.

The HEC-RAS model was run under a mixed flow regime to more accurately evaluate the water surface along a reach as it alternates between subcritical and supercritical flow. This regime requires two boundary conditions, one at the upstream end of the reach and one at the downstream end of the reach. To calculate the water surface in subcritical flow regimes, the downstream boundary used was the high-tide elevation of the Squamscott River (8.9 feet) downstream of the String Bridge and the Great Dam. The upstream boundary conditions for the Upper Exeter River and Little River were based on rating curves.

Figure 2.1-1: *Overview of Little River HEC-RAS Model Study Area*



2 EXISTING CONDITIONS HYDRAULICS

2.1 Hydraulic Model Results for Controlling Hydraulics

As discussed previously, the 50-year flows in the fourth and fifth columns of Table 1.1-1 and Table 1.1-2 were used in the hydraulic model to determine which set of flows resulted in higher WSEs at the Little River Bridges. Table 2.1-1 presents the hydraulic results with the "Great Dam in Place" for both the peak flow at the Great Dam run and the peak flow in the Little River run. The highest water surface elevations occurred when the peak flow from the Great Dam was used in conjunction with the flow in the Little River at that time. The controlling flows are 957 cfs in the Little River and 5,858 cfs in the Exeter River at the Great Dam. The water surface is just under seven inches higher at the downstream face of Court Street (see FIS XS C) when the Great Dam flow is at its peak than when the Little River flow is at its peak. The Little River peak flow begins to control the water surface upstream of the Linden Street crossing as shown in Table 2.1-1 (see FIS XS G).

The above two flow scenarios were also run in the hydraulic model with the "Great Dam Removed" to see if the WSEs are still controlled by the peak flow at the former Great Dam location. Table 2.1-2 presents the hydraulic results with the "Great Dam Removed" for both the peak flow at the Great Dam run and the peak flow in the Little River run. The highest water surface elevations occurred when the peak flow from the Great Dam was used in conjunction with the flow in the Little River at that time, as it was for the "Dam in Place" scenario. The controlling flows are 957 cfs in the Little River and 5,858 cfs in the Exeter River at the Great Dam. The water surface is just over seven inches higher at the downstream face of Court Street (see FIS XS C) when the Great Dam flow is at its peak than when the Little River flow is at its peak. The Little River peak flow begins to control the water surface upstream of the Linden Street crossing as shown in Table 2.1-2 (see FIS XS G).

For both the existing conditions "Great Dam in Place" and "Great Dam Removed" hydraulic runs, the controlling WSEs occur from the peak flow at the Great Dam or former Great Dam location, not from the peak flow in the Little River. Going forward, the hydraulic runs will use the 957 cfs in the Little River and 5,858 cfs in the Exeter River for the 50-year runs.

Table 2.1-1 – Existing Little River Conditions with "Great Dam in Place" *50-yr Hydraulic Control Test*

Station	FIS XS ID	Peak Flow at the Great Dam WSE (ft)[1]	Peak Flow in Little River WSE (ft)[2]	Difference (ft)	Station	FIS XS ID	Peak Flow at the Great Dam WSE (ft)[1]	Peak Flow in Little River WSE (ft)[2]	Difference (ft)
5737.87	G1	32.57	32.91	0.34	3990.292	E	31.54	31.51	-0.03
5328.37		32.53	32.86	0.33	2530.29		31.49	31.45	-0.04
5310.4		32.51	32.83	0.32	2510.29		31.49	31.44	-0.05
5298.415	G	32.51	32.83	0.32	2501.384	D	31.49	31.44	-0.05
5290.43		32.49	32.81	0.32	2494.39		31.49	31.44	-0.05
5287 Linden Street					2491.384 Court Street				
5215.66		31.55	31.52	-0.03	2417.55		31.46	30.9	-0.56
5203.69		31.57	31.55	-0.02	2398.58		31.46	30.9	-0.56
5170.79		31.57	31.55	-0.02	2368.64		31.45	30.89	-0.56
5099.012	F	31.57	31.55	-0.02	2349.684	C	31.45	30.89	-0.56

[1]The flow in the Little River at the time of the peak flow at the Great Dam in the TR-20 50-year model was 957 cfs.
[2]The peak flow in the Little River from the TR-20 50-year flow was 1,112 cfs.

Table 2.1-2 – Existing Little River Conditions with "Great Dam Removed" *50-yr Hydraulic Control Test*

Station	FIS XS ID	Peak Flow at the Great Dam WSE (ft)[1]	Peak Flow in Little River WSE (ft)[2]	Difference (ft)	Station	FIS XS ID	Peak Flow at the Great Dam WSE (ft)[1]	Peak Flow in Little River WSE (ft)[2]	Difference (ft)
5737.87	G1	31.41	31.57	0.16	3990.292	E	30.21	29.82	-0.39
5328.37		31.35	31.49	0.16	2530.29		30.12	29.67	-0.45
5310.4		31.32	31.45	0.13	2510.29		30.11	29.66	-0.45
5298.415	G	31.32	31.45	0.13	2501.384	D	30.11	29.66	-0.45
5290.43		31.29	31.41	0.12	2494.39		30.11	29.65	-0.46
5287 Linden Street					2491.384 Court Street				
5215.66		30.24	29.88	-0.36	2417.55		29.72	29.13	-0.59
5203.69		30.27	29.93	-0.34	2398.58		29.72	29.13	-0.59
5170.79		30.27	29.92	-0.35	2368.64		29.70	29.10	-0.60
5099.012	F	30.27	29.92	-0.35	2349.684	C	29.71	29.11	-0.60

[1]The flow in the Little River at the time of the peak flow at the Great Dam in the TR-20 50-year model was 957 cfs.
[2]The peak flow in the Little River from the TR-20 50-year flow was 1,112 cfs.

2.2 Hydraulic Model Results for Comparison of Great Dam Study to Little River Study

Table 2.2-1 displays the differences between the existing conditions model for the Great Dam Study and the Little River Study. The WSEs are the same at the most downstream section at FIS XS C which means the two models match at that location. From upstream of Court Street, the Little River Study water surface profile is lower throughout the remainder of the reach. The maximum difference between the existing conditions models was 0.57 feet at FIS XS G. This difference is because the culverts in the Great Dam Study model were undersized at Court Street and Linden Street. Based on new survey, there are two 12' 10" x 8' 4" existing pipe arch culverts at Linden Street, and there are two 12' 10" x 8' 4" pipe arches and one 14' 1" x 8' 9" pipe arch in the middle at Court Street.

Table 2.2-1 – Existing Conditions *50-yr Water Surface Elevations in the Great Dam Study vs. Little River Study*

Station	FIS XS ID	Great Dam Study WSE (ft)[1]	Little River Study WSE (ft)	Difference (ft)	Station	FIS XS ID	Great Dam Study WSE (ft)	Little River Study WSE (ft)	Difference (ft)
5737.87	G1	33.13	32.57	-0.56	3990.292	E	31.76	31.54	-0.22
5328.37		-	32.53	-	2530.29		-	31.49	-
5310.4		-	32.51	-	2510.29		-	31.49	-
5298.415	G	33.08	32.51	-0.57	2501.384	D	31.72	31.49	-0.23
5290.43		-	32.49	-	2494.39		-	31.49	
5287 Linden Street		-		-	2491.384 Court Street		-		-
5215.66		-	31.55	-	2417.55		-	31.46	-
5203.69		-	31.57	-	2398.58		-	31.46	-
5170.79		-	31.57	-	2368.64		-	31.45	-
5099.012	F	31.77	31.57	-0.2	2349.684	C	31.45	31.45	0

[1]The Great Dam Study used an approximate TR-20 50-year flow equal to 885 cfs, not the TR-20 50-year flow of 957 cfs from the HEC-HMS model.

2.3 Hydraulic Model Results for Comparison of Great Dam Removed Condition

Table 2.3-1 below compares the effects on the WSEs at the existing Linden Street and Court Street structures when the Great Dam is removed. The Little River hydraulic model was used with the backwater from the Exeter River with the Great Dam in place and with it removed. As shown In the Table, the WSE drops by 1.74 feet downstream of Court Street to 1.16 feet upstream of Linden Street when the Great Dam is removed. The Great Dam removed condition is the hydraulic model used for the proposed bridges analysis.

Table 2.3-1 – "Great Dam in Place" Vs. "Great Dam Removed" Conditions *50-yr Water Surface Elevations in the Little River Study*

Station	FIS XS ID	Dam-in Little River Study WSE (ft)	Dam-out Little River Study WSE (ft)	Difference (ft)	Station	FIS XS ID	Dam-in Little River Study WSE (ft)	Dam-out Little River Study WSE (ft)	Difference (ft)
5737.87	G1	32.57	31.41	-1.16	3990.292	E	31.54	30.21	-1.33
5328.37		32.53	31.35	-1.18	2530.29		31.49	30.12	-1.37
5310.4		32.51	31.32	-1.19	2510.29		31.49	30.11	-1.38
5298.415	G	32.51	31.32	-1.19	2501.384	D	31.49	30.11	-1.38
5290.43		32.49	31.29	-1.20	2494.39		31.49	30.11	-1.38
5287 Linden Street					2491.384 Court Street				
5215.66		31.55	30.24	-1.31	2417.55		31.46	29.72	-1.74
5203.69		31.57	30.27	-1.30	2398.58		31.46	29.72	-1.74
5170.79		31.57	30.27	-1.30	2368.64		31.45	29.7	-1.75
5099.012	F	31.57	30.27	-1.30	2349.684	C	31.45	29.71	-1.74

3 PROPOSED CONDITIONS HYDRAULICS

3.1 Hydraulic Model Results

The "Great Dam Removed" hydraulic model was run to examine the effects of the proposed bridge openings on the water surface profile versus the "Great Dam Removed" existing conditions hydraulic model.

The proposed Linden Street single span bridge opening is 45 feet wide at the low chord (elevation 31.63 feet) and tapers down to 16 feet wide at the channel invert (elevation 21.60 feet). The top of roadway was modeled as 34.98 feet. The proposed Court Street single span bridge opening is 55 feet wide at the low chord (elevation 29.4 feet) and tapers down to 26 feet wide at the channel invert (elevation 19.75 feet). The top of roadway was modeled as 32.75 feet. Each bridge opening has a 3.5-foot wide bench along the top of the stone protection on either side of the opening that wildlife can use to move through the opening.

The WSE at the upstream toe of the proposed Linden Street Bridge is at elevation 30.12 feet, which is over 1 foot lower than the WSE at the existing structure when the Great Dam is removed. The total opening for the proposed structure is 338 square feet; however, the 50-year flow does not reach the low chord therefore all the area is not used. The bridge opening area is almost 100% greater than the 170 square feet of culvert open area available at the existing structure. The entire flow passes through the opening at a velocity of approximately 3.65 feet per second with a freeboard of 1.51 feet. Figure 3.1-1 presents a section through the proposed bridge showing the WSEs at different recurrence intervals.

The WSE at the upstream toe of the proposed Court Street Bridge is at elevation 29.83 feet, which is approximately 3 inches lower than the WSE at the existing structure when the Great Dam is removed. The opening for the proposed structure is 397 square feet. Unlike Linden Street, the entire bridge opening is full when it passes the 50-year flow at a velocity of 2.41 feet per second. The WSE is about 5 inches above the low chord. The proposed bridge opening area is almost 50% larger than the 265 square foot culvert open area available at the existing structure. Figure 3.1-2 presents a section through the proposed bridge showing the WSEs at different recurrence intervals.

Table 3.1-1 – Great Dam Removed Conditions *50-yr Water Surface Elevations in the Existing Conditions Little River Study Model vs. the Proposed Bridges Model*

Station	FIS XS ID	Existing Culverts (ft)	Proposed Bridges (ft)	Difference (ft)	Station	FIS XS ID	Existing Culverts (ft)	Proposed Bridges (ft)	Difference (ft)
5737.87	G1	31.41	30.32	-1.09	3990.292	E	30.21	29.95	-0.26
5328.37		31.35	30.23	-1.12	2530.29		30.12	29.84	-0.28
5310.4		31.32	30.18	-1.14	2510.29		30.11	29.84	-0.27
5298.415	G	31.32	30.18	-1.14	2501.384	D	30.11	29.84	-0.27
5290.43		31.29	30.12	-1.17	2494.39		30.11	29.83	-0.28
5287 Linden Street					2491.384 Court Street				
5215.66		30.24	29.99	-0.25	2417.55		29.72	29.72	0
5203.69		30.27	30.02	-0.25	2398.58		29.72	29.72	0
5170.79		30.27	30.02	-0.25	2368.64		29.7	29.7	0
5099.012	F	30.27	30.02	-0.25	2349.684	C	29.71	29.71	0

Table 3.1-2 below shows the water surface elevations for four flows for the proposed bridge openings at Court Street and Linden Street. Note that for the 100-year flow with the Great Dam removed, the Exeter River still backs up over Court Street. At Linden Street, the 100-year flow passes beneath the low chord with just over 2.5 inches of freeboard.

Figures 3.1-1 and 3.1-2 also present the FEMA 100-year WSEs which were determined with the Great Dam in place. Even with the higher proposed flows vs. the lower FEMA flows (see Table 1.1-1), the existing FEMA 100-year WSEs at Linden Street and Court Street are higher than the proposed 100-year WSEs by 0.3 feet and 0.49 feet, respectively.

Table 3.1-2 – Great Dam Removed Conditions *Water Surface Elevations in the Little River Study Model with the Proposed Bridges at Linden Street and Court Street*

Station	FIS XS ID	2-Year WSE (ft)	10-Year WSE (ft)	50-Year WSE (ft)	100-Year WSE (ft)
5737.87	G1	26.36	27.78	30.32	31.55
5328.37		26.24	27.65	30.23	31.48
5310.4		26.22	27.61	30.18	31.44
5298.415	G	26.21	27.61	30.18	31.44
5290.43		26.15	27.52	30.12	31.40
5287 Linden Street					
5215.66		25.86	27.13	29.99	31.30
5203.69		25.88	27.16	30.02	31.32
5170.79		25.85	27.14	30.02	31.33
5099.012	F	25.81	27.11	30.02	31.33
3990.292	E	24.83	26.79	29.95	31.29
2530.29		23.70	26.55	29.84	31.22
2510.29		23.69	26.55	29.84	31.21
2501.384	D	23.69	26.55	29.84	31.21
2494.39		23.67	26.54	29.83	31.21
2491.384 Court Street	-	-	-	-	
2417.55		23.61	26.48	29.72	31.05
2398.58		23.58	26.48	29.72	31.05
2368.64		23.55	26.46	29.70	31.04
2349.684	C	23.57	26.47	29.71	31.04

Appendices A, B and C include HEC-RAS output summary tables, water surface profiles, plan views and cross-sections of the Little River for “Great dam in Place” existing conditions, “Great Dam Removed” existing conditions, and “Great Dam Removed” proposed conditions, respectively.

Figure 3.1-1: *Linden Street Proposed Bridge Section*

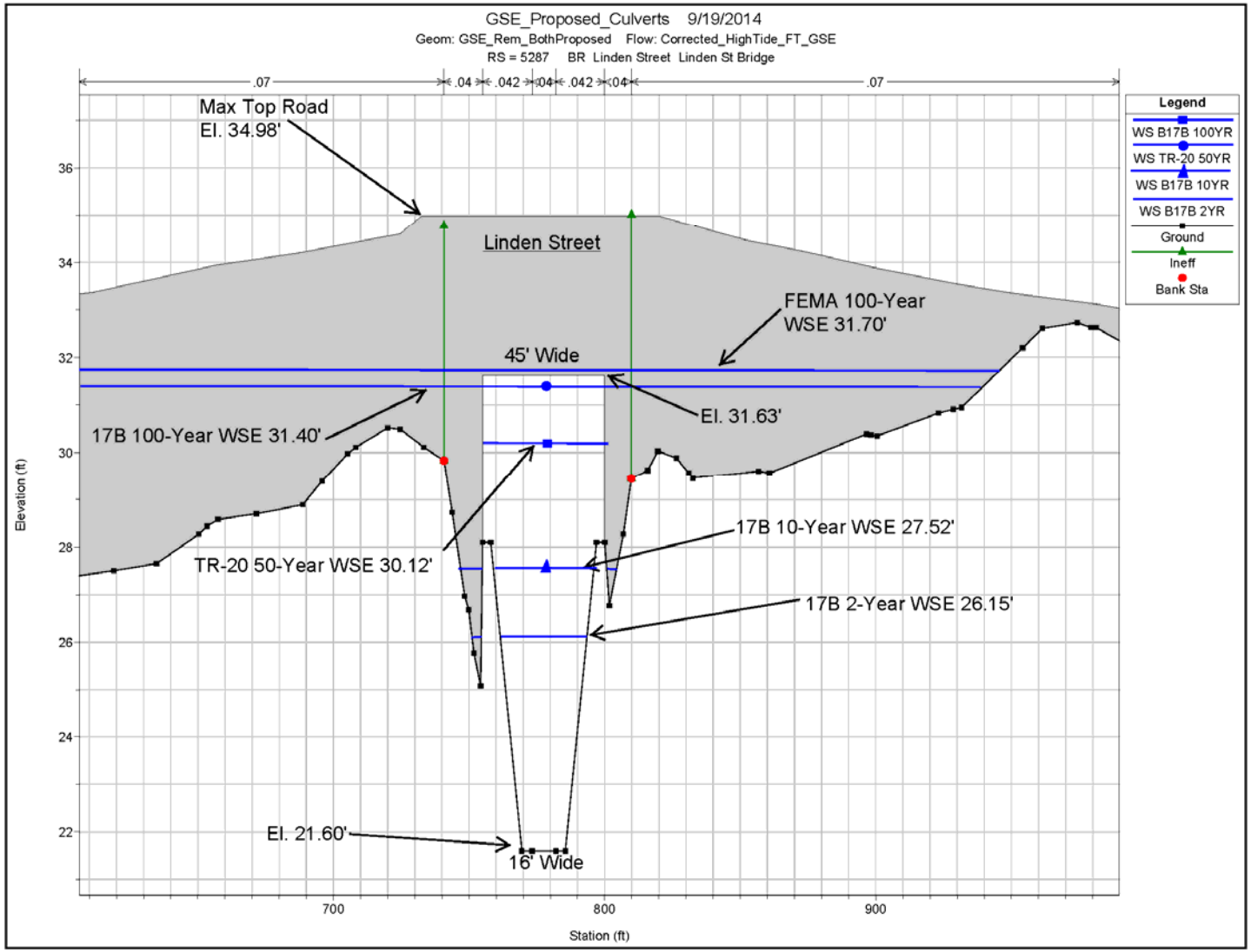
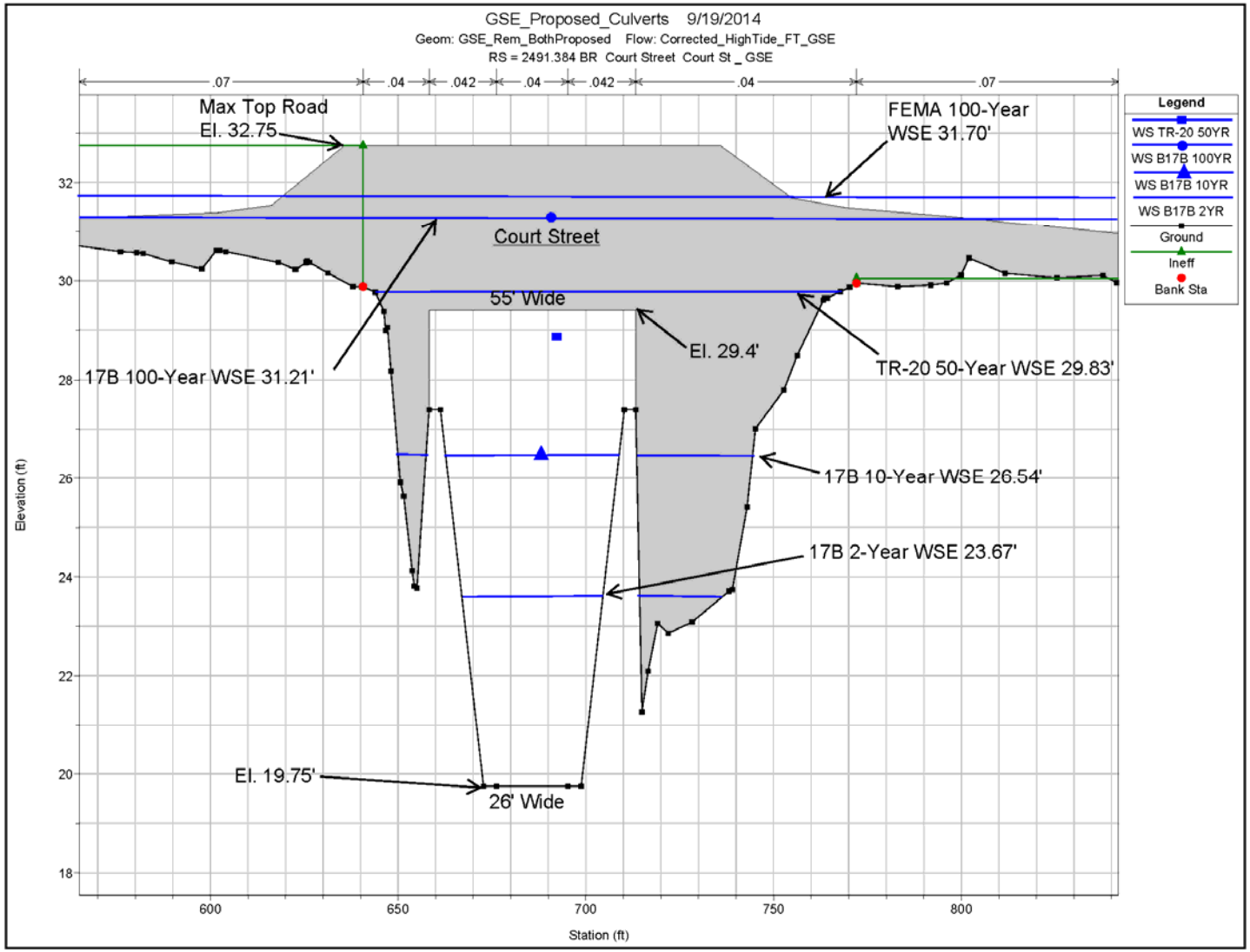


Figure 3.1-2: *Court Street Proposed Bridge Section*



Appendix E

Foundation Investigation and Recommendations

MEMORANDUM

TO: Jason Gallant

FROM: Bob Grillo

RE: Geotechnical Evaluation
Court and Linden Street Bridge Replacements
Exeter, NH

CMA #923

DATE: September 16, 2014

This memorandum presents the results of a geotechnical evaluation for the proposed replacement of two bridges in Exeter, New Hampshire. The bridges cross the Little River at Court Street (Route 108) and Linden Street. Linden Street is about 1,500 feet upstream of Court Street and is located in a similar topographic and geologic setting.

The project involves replacing bridges at Court and Linden Streets with new concrete bridges. The existing river crossings consist of steel arch culverts through an earthen embankment. There are three culverts at Court Street and two at Linden Street. The proposed bridge spans will be about 60 feet in length, roughly equal to the width of the river channel at the upstream and downstream limits of each crossing. The level of the existing roadway is about 12 feet above the riverbed at both locations. The riverbed at each bridge location will be lowered by about two feet. The approach roadway will be raised by about one foot at Court Street, and remain at the same elevation at Linden Street.

The culverts will be replaced with either a precast concrete rigid frame bridge or a concrete box beam span. The new bridges will be supported by concrete abutments and cantilevered wing walls. The abutments will be located at a depth of about 15 feet below the roadway for the rigid frame bridge and 8 feet below the roadway for the box beam span assuming deep foundation support.

Field Explorations

Soil borings were drilled on July 7 and 8, 2014 by Great Works Test Boring under full time observation of CMA Engineers, Inc. Two soil borings, designated B-1 and B-2, were drilled at each bridge location on either side of the crossing as shown on Drawings 2 and 3. The borings were advanced using solid stem augers to a depth of 10 to 15 feet, and cased drive and wash drilling techniques thereafter. Split spoon samples were taken and the Standard Penetration Test (SPT) was generally conducted continuously through the foundation zone and at five-foot intervals otherwise. Vane shear tests were conducted in soft cohesive deposits, and one undisturbed Shelby tube sample of cohesive soil was obtained at each bridge location. The soil

boring logs are shown on Drawings 5 through 8. The borings were drilled to depths of 41 and 45 feet at Court Street, and 30 and 32 feet at Linden Street.

Subsurface Conditions

The soil borings at both bridge locations encountered existing pavement and embankment fill underlain by soft silty clay deposits. The silty clay deposits were underlain by glacial till soils and bedrock at Court Street, whereas the glacial till was absent at Linden Street.

Pavement – Four inches of asphalt underlain by sand and a gravel base layer was encountered at each boring location.

Embankment Fill – The embankment fill consisted of layers of sand and gravel or silty clay, mixed with organics, wood and brick at some locations. The upper 8 feet of fill at Linden Street and the north side of Court Street consist of sand and gravel with a trace of silt. This upper sand and gravel layer is only four feet deep on the south side of Court Street. Underlying fill materials included layers of silty clay or contained organic material, wood or brick debris. The embankment fill was generally of medium dense consistency based on SPT N values. The fill was about 12 feet thick at Court Street and 19 feet thick at Linden Street.

Silty Clay – Silty clay was encountered beneath the fill at each boring location. At Court Street, this deposit was 11 and 7.5 feet thick at borings B-1 and B-2, respectively. At Linden Street, this deposit was 9 and 12 feet thick at borings B-1 and B-2, respectively. SPT N-values ranged from "weight of hammer" to less than 2 blows per foot. Borehole vane shear tests indicated a shear strength of 440 to 450 pounds per square foot (psf) at Court Street, and 530 to 730 psf at Linden Street.

Glacial Till – Glacial till was only encountered at Court Street, at thicknesses of 19 and 21 feet at boring B-1 and B-2, respectively. The till consisted of a medium dense clayey fine to medium sand.

Bedrock – Refusal to sampling tools thought to represent the bedrock surface was encountered at depths of 42.5 and 40.5 feet at Court Street borings B-1 and B-2, respectively. At Linden Street, refusal was encountered at depths of 30.1 and 31.8 feet at borings B-1 and B-2, respectively. After reaching refusal, the borehole was advanced an additional 2.5 feet through rock at Court Street boring B-1 and 1.7 feet through rock at Linden Street boring B-1 using a tri-cone roller bit. Rock core samples were not obtained to confirm bedrock encounter.

Groundwater – Groundwater was encountered at a depth of 8 feet at Court Street, and 14 feet at Linden Street based on observed soil moisture conditions. Groundwater observations were made during solid stem drilling and sampling operations. Subsequent drive and wash drilling operations introduced water to the borehole that effectively precluded the measurement of longer term stabilized water levels that may be indicative of actual groundwater depths.

Design and Construction Recommendations

Foundation Design

Subsurface conditions are not suitable for shallow or spread footing foundations at either bridge location. Spread footings would need to be founded below river elevation in either soft clay at Court Street or embankment fill overlying soft clay at Linden Street.

At Court Street, footings would be founded on soft clay with an unacceptable allowable bearing capacity of less than 1,000 psf. Further, settlement due to consolidation of the clay under the loads imposed by the footing would be expected to exceed several inches. The clay layer below footing elevations could be removed and replaced with engineered fill. This however would result in a deep excavation below river elevation requiring steel sheet pile cofferdams to support the excavation and cut off groundwater and surface water flow. Although technically feasible, this alternative would add cost and complexity compared to deep foundation alternatives.

At Linden Street, the fill at bearing layer elevations contains deleterious materials such as organics, wood and debris, and a mixture of granular and cohesive fill materials. Observations made during drilling indicate the fill was not placed in an orderly, layered and compacted fashion as would be required for a suitable engineered fill bearing soil. Further, the underlying silty clay deposit is subject to large consolidation settlements from loads imposed by the bridge abutment.

As an alternative we recommend supporting the bridge abutment loads at each crossing with end bearing piles. The piles would be driven to bedrock encountered at depths below existing ground ranging from about 40 to 43 feet at Court Street and 30 to 32 feet at Linden Street. We understand the abutments would be supported on a single row of piles. Although expected loading conditions are not known at this time, the span length and bridge geometry suggest 12-inch steel H-piles spaced at 5 to 6 foot intervals could be a viable design solution.

River Diversion and Dewatering

Excavations for the bridge abutments of the box beam span would be located at a depth of about 8 feet below the roadway, placing the excavation bottom in the embankment fill and above normal river water levels. These excavations can be made open cut with side slopes no steeper than 1.5H to 1V. Placement of the rip rap slope lining layer will entail work to be conducted in the dry in the river channel, thereby requiring river diversion and dewatering. The depth of excavation required for the stone lining will be 2 feet based on the approximate stream velocities of 3.65ft/s and 2.41ft/s for Linden and Court Street, respectively, as determined by the hydraulic model for the proposed openings. The NHDOT Bridge Design Manual, section 520.2, specifies a minimum 2 feet of stone fill to provide channel protection for velocities up to 8ft/s. This could be accomplished with sand bag diversion walls upstream and downstream of the bridge, with a temporary flow through pipe. The work area could be dewatered by pumping from sumps and trenches.

Excavations for the bridge abutments of the concrete rigid frame bridge would be located at a depth of about 15 feet below the roadway, placing the excavation bottom several feet below

normal river water levels. Lower portions of these excavations will likely require steel sheet pile cofferdams for soil support and to exclude the river water and ground water from the excavation. Driving sheet piles along the upstream (west) side of the Court Street bridge will not be possible due to a conflict with the existing buried sewer main running through that area. Alternative methods for water diversion such as sand bags or other options that do not involve driven supports should be considered for this location. The clay layer present at both sites at river bottom elevation should limit water infiltration into the excavation, which could be handled by pumping from sumps and trenches. All earth support systems and cofferdams should be designed by an experienced engineer registered in the State of New Hampshire. Stamped design plans and calculations should be submitted to the engineer for review of completeness.

Re-use of Excavated Materials

A portion of the existing embankment materials excavated to construct the bridge abutments can be used as embankment fill for the proposed bridge approaches. The sand and gravel fill encountered to a depth of 8 feet at Linden Street and the north side of the Court Street bridge, and to a depth of 4 feet on the south side of the Court Street bridge, likely meet NHDOT Specifications for Granular Fill in accordance with items 209.2.1.1 (sand) and 209.2.1.2 (gravel). Underlying fill materials contain a mixture of granular and cohesive soils along with deleterious materials, rendering this soil unsuitable for load bearing engineered fill. Fill should be placed in horizontal layers not exceeding 8 inches. Embankment fill should be compacted to at least 95 percent of its maximum dry density.

Earth Pressures

For both bridge types, deflection of abutment walls is restricted by the structure. Earth pressures on the walls therefore would develop under at rest, or K_o, conditions. Earth pressures on the walls would equal 65 pounds per square foot, per foot of depth below the ground surface. The walls should be designed with drainage media and weep holes to prevent the buildup of hydrostatic pressures behind the walls due to groundwater or river water level fluctuations.

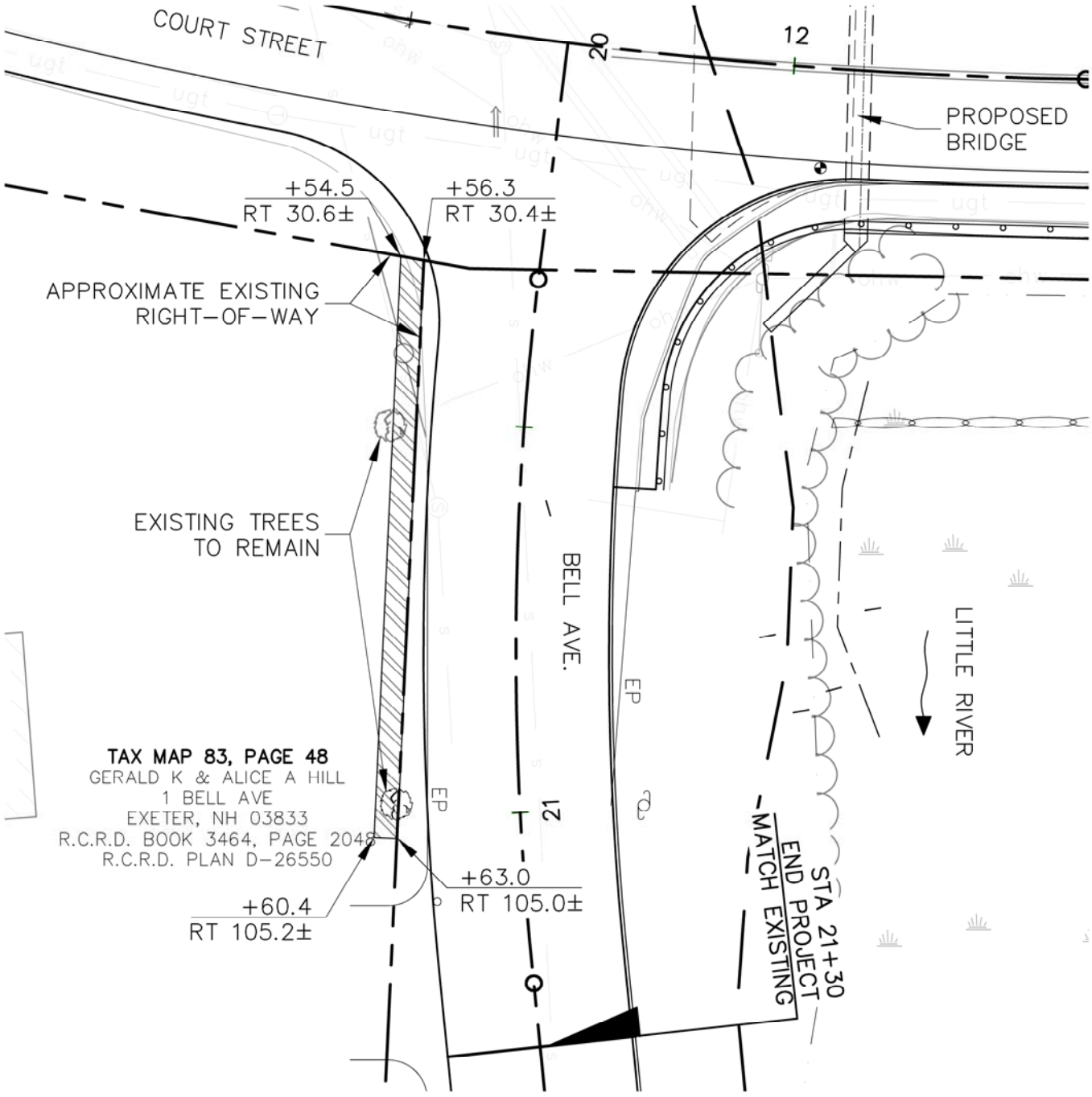
Subgrade Preparation

The work will involve excavation into soft clay deposits to shape and lower the channel depth. Rip rap will be placed on the channel side slopes and keyed into the channel bottom. The clay is easily disturbed, and will lose considerable strength when disturbed. Excavation to final grades in clay should be made with care using a smooth edge bucket.

Robert J. Grillo, P.E.

Appendix F

Right of Way Impact Plans



= AREA 1 (125± SQUARE FEET) PROPOSED TEMPORARY RIGHT OF ENTRY

CMA ENGINEERS
CIVIL/ENVIRONMENTAL ENGINEERS

35 Bow Street
Portsmouth, NH 03801
603/431-6196

Langer Place
55 So. Commercial Street
Manchester, NH 03101
603/627-0708

10 Free Street
Portland, Maine 04101
207/541-4223

info@cmaengineers.com

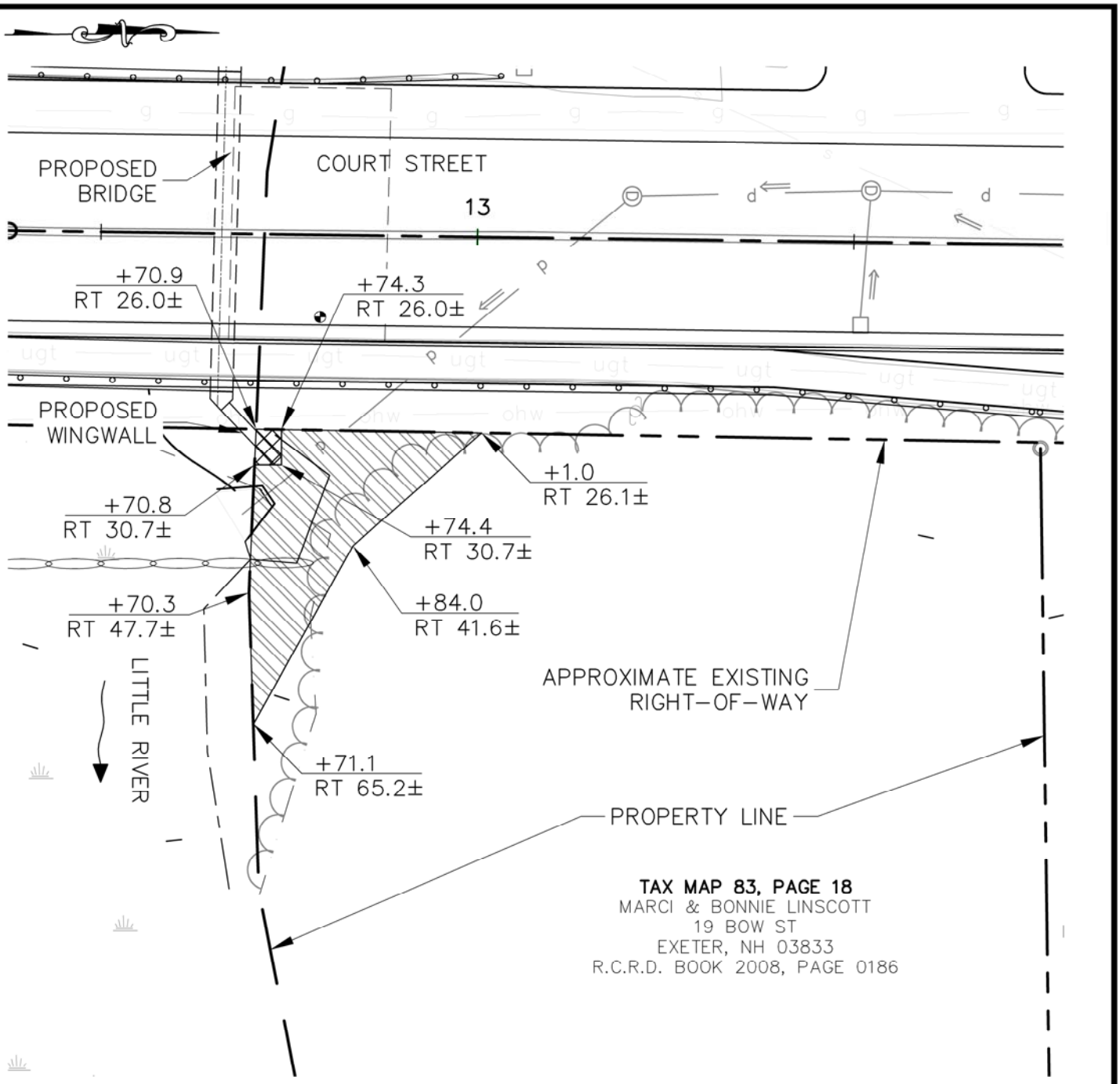
www.cmaengineers.com

Town of Exeter, New Hampshire
Exhibit 1
R.C.R.D. Book 3464, Page 2048
1 Bell Avenue

ROW Impact Plan

Approximate Scale 1" = 20'

F:\CADD\PROJECTS\923–Exeter Bridges\Production\Court St\Preliminary Design\923 – Court Street ROW Impact.dwg



= AREA 1 (490± SQUARE FEET)
PROPOSED TEMPORARY RIGHT OF ENTRY

= AREA 2 (20± SQUARE FEET)
PROPOSED PERMANENT MAINTENANCE EASEMENT

CMA
ENGINEERS
CIVIL/ENVIRONMENTAL ENGINEERS

35 Bow Street
Portsmouth, NH 03801
603/431-6196

Langer Place
55 So. Commercial Street
Manchester, NH 03101
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10 Free Street
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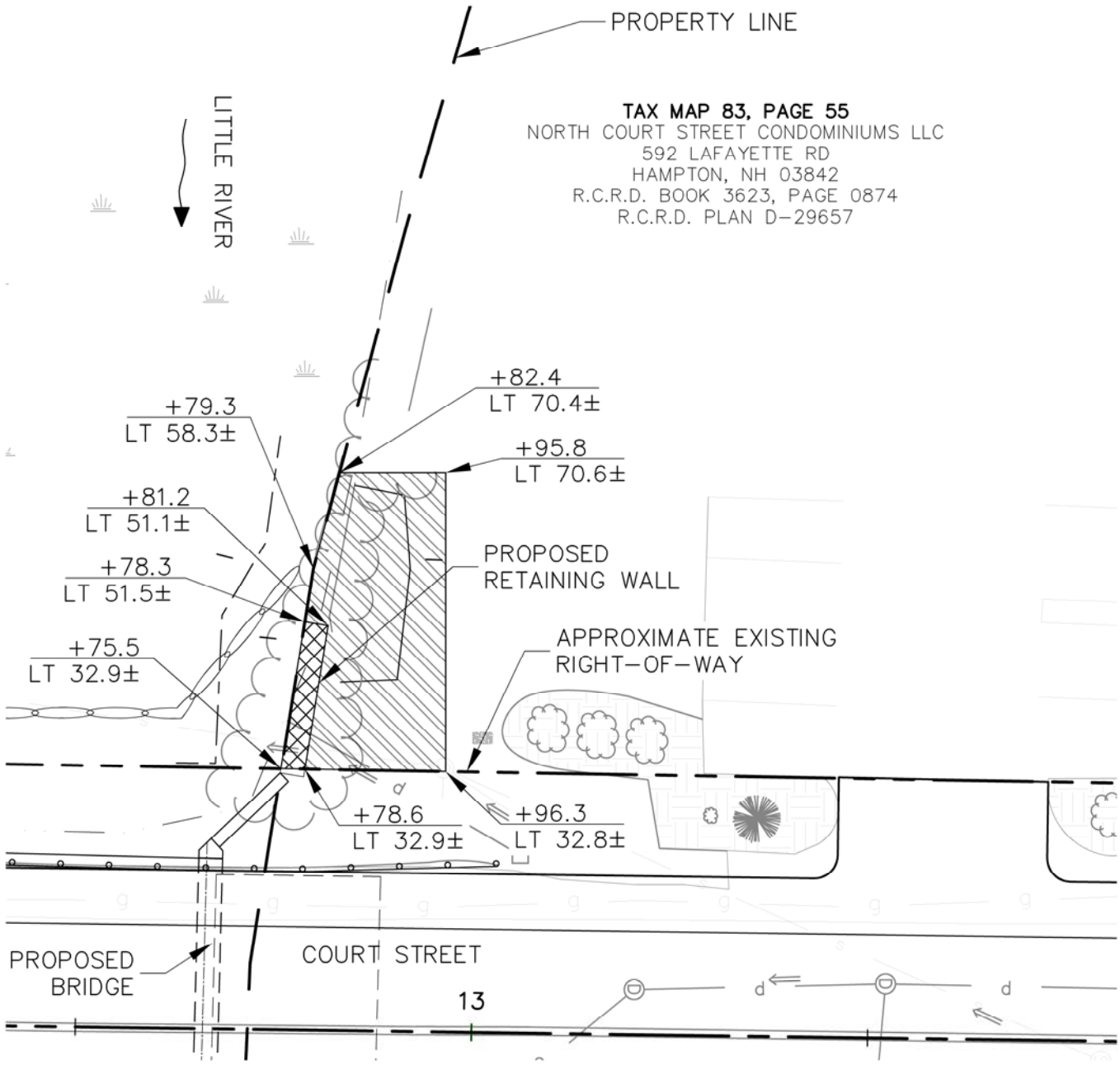
Town of Exeter, New Hampshire
Exhibit 2
R.C.R.D. Book 2008, Page 0186
Court Street

ROW Impact Plan

Approximate Scale 1" = 20'

F:\CADD\PROJECTS\923-Exeter Bridges\Production\Court St\Preliminary Design\923 - Court Street ROW Impact.dwg



= AREA 1 (610± SQUARE FEET)
PROPOSED TEMPORARY RIGHT OF ENTRY

= AREA 2 (60± SQUARE FEET)
PROPOSED PERMANENT MAINTENANCE EASEMENT

CMA
ENGINEERS
CIVIL/ENVIRONMENTAL ENGINEERS

35 Bow Street
Portsmouth, NH 03801
603/431-6196

Langer Place
55 So. Commercial Street
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10 Free Street
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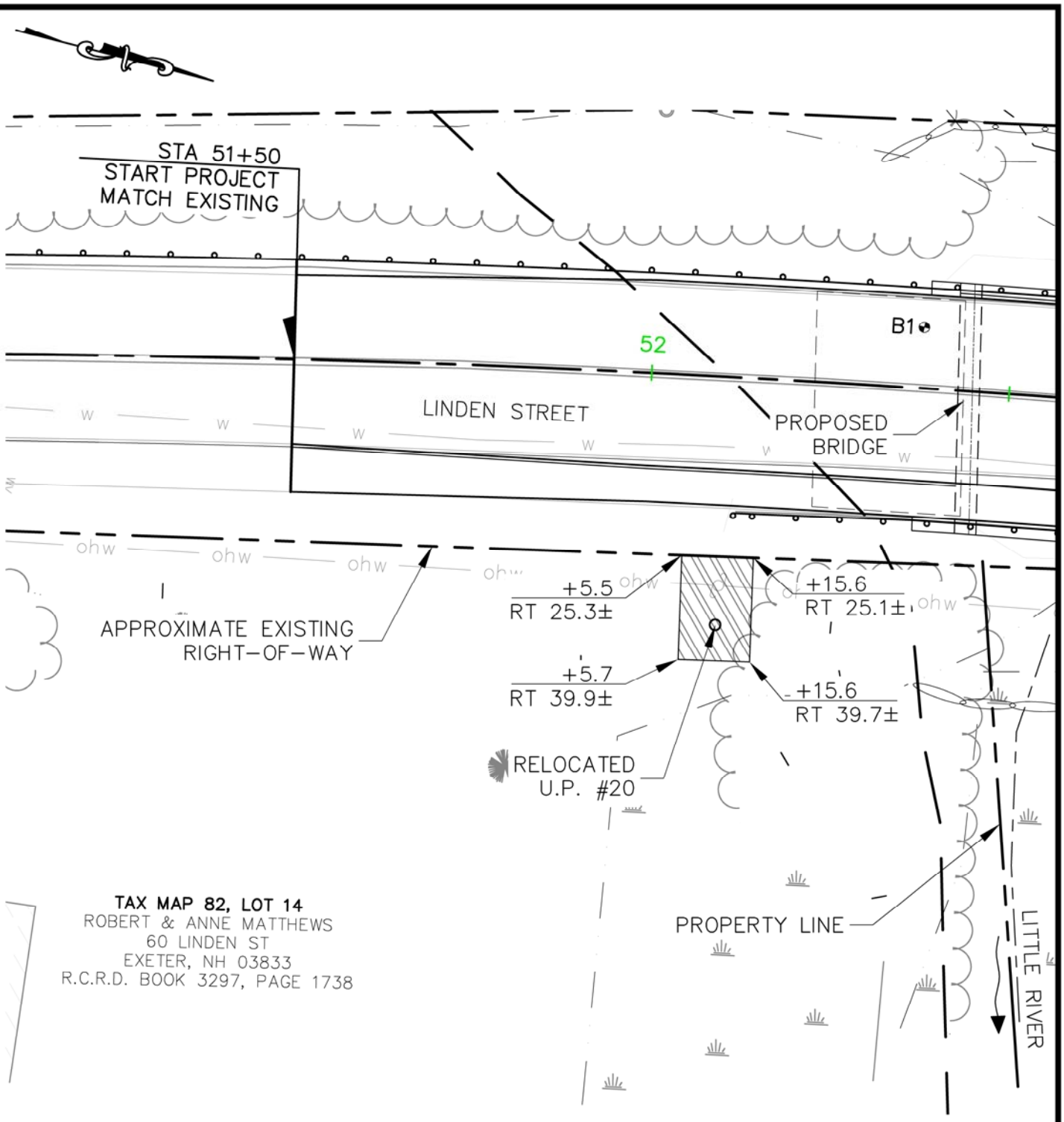
Town of Exeter, New Hampshire
Exhibit 3
R.C.R.D. Book 3623, Page 0874
95 Court Street

ROW Impact Plan

Approximate Scale 1" = 20'

F:\CADD\PROJECTS\923-Exeter Bridges\Production\Court St\Preliminary Design\923 - Court Street ROW Impact.dwg



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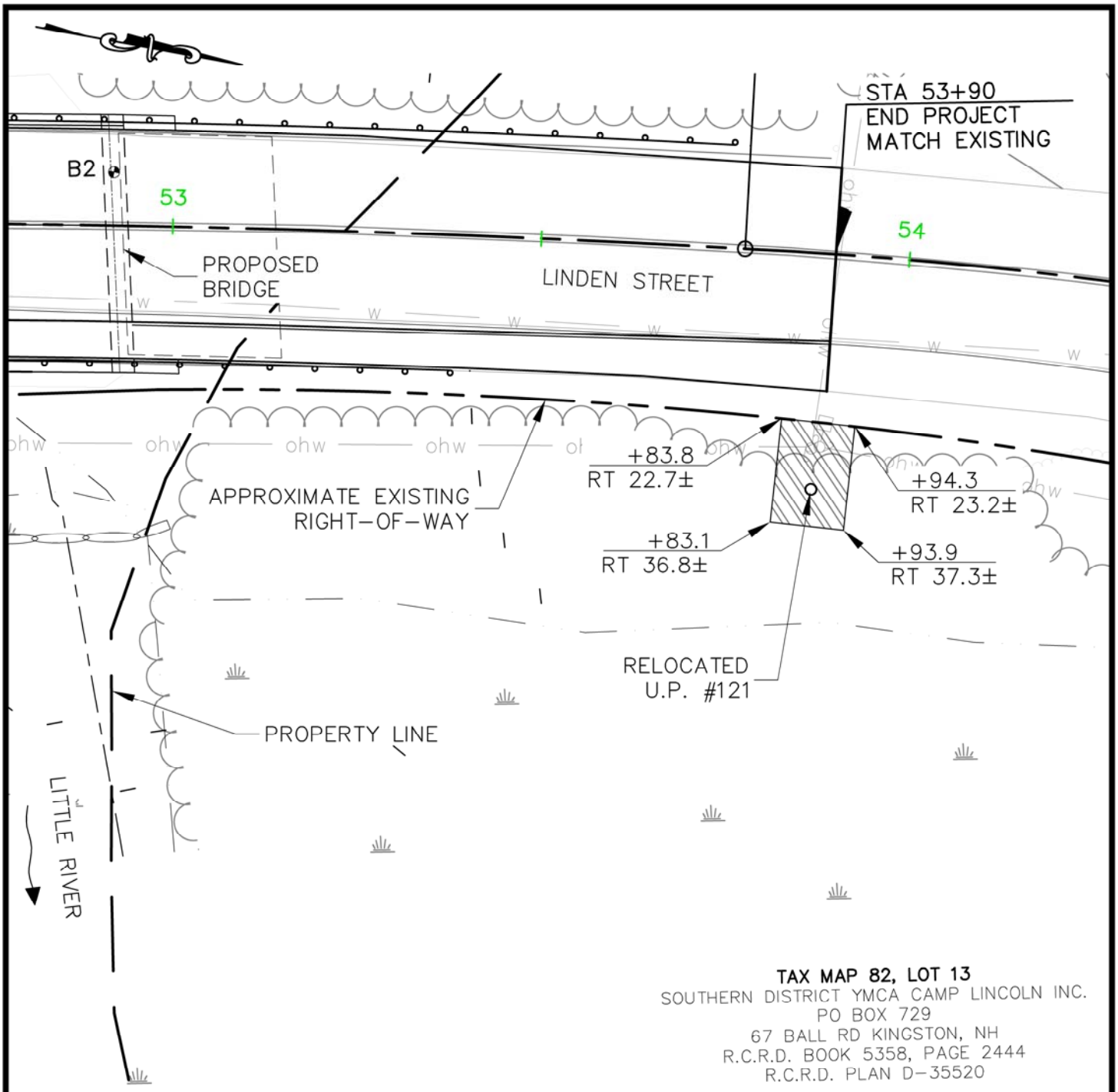
Town of Exeter, New Hampshire
Exhibit 4
R.C.R.D. Book 3297, Page 1738
60 Linden Street

ROW Impact Plan

Approximate Scale 1" = 20'

F:\CADD\PROJECTS\923-Exeter Bridges\Production\Linden St\Preliminary Design\923 - Linden Street ROW Impact.dwg



TAX MAP 82, LOT 13
SOUTHERN DISTRICT YMCA CAMP LINCOLN INC.
PO BOX 729
67 BALL RD KINGSTON, NH
R.C.R.D. BOOK 5358, PAGE 2444
R.C.R.D. PLAN D-35520

= AREA 1 (150± SQUARE FEET)
PROPOSED PERMANENT MAINTENANCE EASEMENT

CMA
ENGINEERS
CIVIL/ENVIRONMENTAL ENGINEERS

35 Bow Street
Portsmouth, NH 03801
603/431-6196

Langer Place
55 So. Commercial Street
Manchester, NH 03101
603/627-0708

10 Free Street
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Town of Exeter, New Hampshire
Exhibit 5
R.C.R.D. Book 5358, Page 2444
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ROW Impact Plan

Approximate Scale 1" = 20'

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