GDOT GEOTECHNICAL BUREAU
BRIDGE FOUNDATION INVESTIGATION (LRFD) REPORT CHECKLIST

PI NUMBER______________________________DATE_________REVIEWER___________

Note: All N-values referenced throughout the checklist refer to corrected N_{60} values.

I. BRIDGE LAYOUT

☐ Note the AASHTO LRFD Specification Edition and Year

☐ Note the bridge width, bent characteristics (span length, column height, etc.) as well as the "Proposed Bridge Consists of" section of the layout.

☐ Is the bridge staged for construction? Are staging plans provided?

☐ For stream crossing bridges, take notice of the scour line and theoretical scour depth table when setting minimum tips

☐ Are there deep scour conditions that will invoke the "Scour Depth Guidance" procedure? This document can be found in the Geotechnical QA/QC Manual on ROADS.

☐ At end bents, take notice of the natural ground elevation and any proposed fill heights/MSE Wall at end bent/abutments. Keep in mind that pile tips should be embedded into natural ground by a minimum of 5 feet, and any proposed fill/MSE Wall should be evaluated for its effect on approach slab settlement, pile downdrag, and pile installation.

Note: If there is a soil survey being done for the project, settlement should be evaluated in the soil survey if the fill will be placed on soil containing compressible material within the zone of influence and the fill extends past the immediate vicinity of the approach slab.

If there is no soil survey for the project (minor projects), and/or the fill is limited to the immediate vicinity of the approach slab, these should be evaluated in the BFI. It would be good to have all relevant information before the BFI is finalized, so appropriate coordination will be necessary as these reports are being prepared.

☐ Take notice of the benchmark data on the layout for the "Elevation" note in the BFI report, if applicable.

II. BORING LOGS & SITE CLASS

☐ Has the drill rig hammer efficiency ratio / energy rating been included on each boring log? Make sure the drill rig hammer used was calibrated within two years of the drilling date. If multiple drill rig hammers were used for the same project, have they been identified by serial number on the boring logs? Please include the SPT Hammer Calibration Report in the appendices.

☐ Have the N-values been identified as corrected or uncorrected on each boring log? Please note that only automatic hammers are acceptable.

☐ Note the pile type and the minimum tips the geotechnical engineer proposed in the report.

☐ Look at each boring to see where/if hard material/rock is encountered. Can the pile type be driven through the material to reach minimum tip?

☐ If lateral stability is a concern, adjust minimum tips accordingly. Based on engineering judgement, a lateral stability analysis should be performed on a case-by-case basis.

Note: the minimum tip guidelines have taken lateral stability into consideration, therefore a good decision point for performing lateral stability analysis would be if these guidelines have not been met adequately.

☐ Is there a rock lens layer or layer with dense material above minimum tip? Note down the use of appropriate pile installation aids such as pilot holes, points, predrilling, etc.

☐ Have the seismic site class analyses been performed using the N-Values for each bent? An N-value of 1 should be used for Weight of Hammer (WOH) material.

☐ New fill to be brought to the site should not be evaluated for site class, and material to be permanently removed from the site does not have to be included in the first 100 feet of material evaluated for site class.

☐ For borings shallower than 100 ft, an N-value of 100 bpf should be used from termination to 100 ft if auger refusal or rock is encountered. Otherwise, the last N-value should be assumed to continue to a depth of 100 ft.

☐ Ensure that the most representative site class was selected, not an average across bents. In a situation where there is equal representation of two or more site classes across the bents, the worst case should be used. If there are multiple borings at a single bent, each specific boring should be analyzed individually for site class. N-values across borings at the same bent should not be combined.

III. FOUNDATION DESIGN DATA

Ensure that the foundation design data shown on the BFI report is the same as the design data recommended on the letter from the bridge designer. Check the following:

☐ Bent type

☐ Design loads (Factored and Service Loads)

☐ Foundation Type and Size

☐ Pile Grade (ksi) if applicable

☐ Compression and Tension Stresses, including Severe Environment Tension Stress where applicable

☐ Maximum Factored Structural Resistance

☐ Wall thickness and diameter for Metal Shell Piles

☐ Bottom of pile/spread footing elevation, top of shaft elevation, self-weight of shaft in kips per linear foot, and/or point of structural fixity elevation (whichever is applicable)

IV. FOUNDATION DESIGN

Pile Foundations

☐ Is the PGL being raised such that there will be fill heights 5 ft or greater at the end bents? This proposed fill should be evaluated for its effect on pile installation by including it in the static and WEAP analysis evaluations.

☐ Do you have down drag, liquefaction or scour conditions? If yes, you should have down drag or scour loads

☐ Have the static analyses been performed using the corrected N-Values for each bent?

☐ Check the driving resistance calculations (LRFD 10.5.5.2.3-1). Has the appropriate resistance factor been applied based on the planned field verification method?

☐ Ensure that the driving resistance for piles driven to hard rock is less than the pile's maximum factored structural resistance (MFSR).

Driveability

☐ Have the analyses been performed using the corrected N-Values for each bent?

☐ Is the hammer type indicated on the drivability analysis sheets?

☐ Check the blow count (blows/in) that corresponds to the target driving resistance as well as the blow count values at all the depths above this level. The target is around 6 blows /in, and should not exceed 10 blows/in. If it falls outside this range, consider changing the hammer.

Note: if the blow counts are lower than 3 bl/in, this means the hammer you are using is too big so you would want to go down in hammer size. If they're higher than 10 bl/in, your hammer is too small so you would want to go up in hammer size.

Note: If you are driving in very soft soils in the coastal plain, you may need to reduce fuel setting or hammer size for PSC piles to maintain acceptable tensile driving stresses.

☐ Check the hammer stroke value that corresponds to the target driving resistance as well as the stroke values at all the depths above this level. The target is between 7 and 9 feet. If it falls outside this range, consider changing the hammer.

- ☐ At the target driving resistance, determine the corresponding compression and tension stresses. Are these stresses exceeding those recommended by the bridge designer? Also, check all stresses above the depth corresponding to the target driving resistance. Are they within threshold?
  Note - If stresses are exceeding threshold, consider the following:
  1. For PSC/MS Piles, first try increasing the pile cushion thickness.
  2. For H-Piles, first try different hammer sizes.
  3. If you still have stress issues and you are not driving in very dense soil (for PSC and MS piles), PWR or hard rock conditions (for H-Piles), the driving resistance may be too high. In such cases, it is best to reduce the load per pile which will result in lower driving resistances. If load reduction is not feasible, the pile size or steel grade can also be changed at this point. Coordinate with the structural engineer on the feasibility of structural changes.

Spread Footing Foundations

☐ Is both the length and width of the spread footing shown under the gross and effective footing size columns in the "Spread Footing Foundation Design" table? (Note: For square footings, "15 Square" is acceptable in lieu of "15 x 15")

☐ If the construction of the footing requires cofferdam/temporary shoring and dewatering, was an alternate foundation type considered?

☐ Have factored bearing resistance analyses (LRFD 10.6.3.1.1-1) been performed using the LRFD Shallow Foundations Spreadsheet or other alternative method applicable with AASHTO LRFD?

☐ Is the factored bearing resistance greater than the factored bearing pressure provided on the foundation design data letter?

☐ Have total settlement analyses (LRFD 10.6.2.4) been performed using the LRFD Shallow Foundations Spreadsheet or other alternative method compatible with AASHTO LRFD?

☐ Is the GDOT maximum limit of 1 inch of total settlement met?

☐ For bridges with spread footings on soil, have you checked that these are pedestrian bridges with light loads? Bridges with spread footings on soil still have to meet the 1-inch total settlement criteria, therefore roadway bridges with spread footings should generally be on PWR or hard rock.

Drilled Shaft Foundations

☐ Has factored tip/side resistance (LRFD Table 10.5.5.2.4-1) been analyzed using an applicable AASHTO LRFD method? All analyses must be included in the appendices.

☐ Have the base area/circumference and factored axial resistance been correctly calculated based on the diameter of the drilled shaft provided on the foundation design data letter?

☐ Ensure that drilled shaft resistance is designed solely through end bearing or side resistance and not a combination.

☐ Has the self-weight of shafts in kips/linear feet, top of shaft elevations, and point of structural fixity elevations for the shafts been provided by the structural engineer in the design data letter?

☐ Does the total factored axial resistance of the drilled shaft exceed the design load plus the self-weight of the shaft provided on the foundation design data letter?

For end bearing shafts in sound rock, if the calculated nominal tip resistance and factored tip resistance values exceed 500 ksf and 250 ksf respectively, have the values in the report been limited to 500 ksf and 250 ksf respectively per OMAT's standard practice for drilled shaft tip resistance?

Micropile Foundations

☐ Has factored side resistance (LRFD 10.5.5.2.4-1) been analyzed using an applicable AASHTO LRFD method?

☐ Has the micropile circumference and factored axial resistance been correctly calculated based on the diameter of the micropile provided on the foundation design data letter?

☐ Does the total factored axial resistance exceed the design load provided on the foundation design data letter?

☐ Have appropriate load testing – tensile and compression, been specified in the BFI report and in the SP 999 – Micropiles?

V. <u>FOUNDATION ELEVATIONS</u>

Pile Foundations

☐ At end bents, make sure pile lengths are a minimum of 10 feet and pile tips are embedded into natural ground by a minimum of 5 feet.

☐ At intermediate bents, preliminary minimum tips should be a minimum of 10 to 15 feet below scour provided that at least 10 feet of lateral support on each side is present

☐ If minimum tips do not meet these requirements, or there is a lack of confidence that lateral stability is satisfied, lateral stability analyses should be performed (and included in the appendices of the report) to confirm lateral stability.

☐ The tolerance for minimum tip is 3 feet. If the reporting engineer's proposed minimum tip differs by more than 3 feet from the QA/QC engineer's minimum tip, that bent/boring needs to be re-evaluated.

For minimum and estimated tip, look at the DRIVEN/A-PILE output and check the following:

- ☐ At what depth is driving resistance achieved?

- ☐ Is this depth below the minimum tip? If it is not, either minimum tip or estimated tip should be adjusted so that estimated tip is either at or below minimum tip. Evaluate GRL WEAP outputs as well before deciding.

- ☐ If driving resistance is achieved above minimum tip elevation, and this tip cannot be raised due to scour, lateral and/or other constraints, the pile may need aid to get to minimum tip without damaging it. If predrilling or pilot holes are specified, the skin friction to the bottom of these zones must be zero to reflect this effort in the analyses.

- ☐ If there are down drag or scour loads, did the engineer include this in the total driving resistance he/she used to calculate depth of estimated tip? If scour loads were not included in the driving resistance due to the use of pilot holes, has the appropriate note been included beneath the "Pile Foundation Design" table? Has the total driving resistance been included in the note in the event that the contractor decides to drive the piles instead of using pilot holes?

  <u>*Note:*</u> The down drag load in table should include the side resistance in the downdrag zone and the factored downdrag load as per AASSHTO LRFD 10.7.3.7.

- ☐ Revisit the boring logs. Can the proposed pile type be driven to the depth of estimated tip?

Spread Footing Foundations

☐ Is the footing sufficiently protected from scour (2'-3' embedment into PWR or 1' embedment into hard rock for footings in stream crossings)?

Drilled Shaft Foundations

☐ For drilled shafts in rock, make sure bottom of shaft elevations reflect a minimum 7' rock socket into hard rock. A deeper rock socket may be necessary for shafts supporting long spans.

☐ Bottom of drilled shaft elevation should be below the point of structural fixity elevation shown on the foundation design data letter. Lateral stability analysis may be required to confirm this.

For bottom of shaft elevations, confirm the following through SHAFT output or hand calculations.

- ☐ At what elevation is the design load of the shaft achieved?

- ☐ If there are downdrag loads, were they accounted for?

Micropile Foundations

☐ Make sure there is a minimum 5' of bonded length into rock.

☐ Does the minimum tip provide sufficient factored axial resistance for the micropile load?

VI. GENERAL NOTES

☐ Elevation – make sure the elevation indicated here is consistent with the reference elevation/benchmark on preliminary bridge layout, survey control package, or document containing benchmarks established by a Georgia registered land surveyor for the project.

☐ Vibration Monitoring – this is required for structures located within 75 feet of the vibration source (bridge), regardless of the historical status of the structure. The distance should be measured from the structure to the closest bent of the bridge.

☐ Special Provisions – ensure that all necessary special provisions (520 for Piling, 523 for Dynamic Pile Testing, 524 for Drilled Shafts, 999 for Micropiles) are up to date and have the correct revision dates indicated. Be sure to use the appropriate SP 524 Checklist to prepare the SP 524.

VII. APPENDICES

☐ Approved preliminary bridge layout*
☐ Details
☐ Figures
☐ Foundation design data letter from structural engineer
☐ Soil classification test results
☐ All other test results (consolidation, triaxial, corrosion, etc.)
☐ Rock core pictures and test results (if applicable)
☐ Finished boring logs
☐ Finished boring layout
☐ Site photographs and reconnaissance reports/field notes
☐ Site map
☐ Previous site information, such as copies of old BFI (if applicable)*
☐ Static analysis outputs (APILE or DRIVEN)*
☐ GRLWEAP analysis outputs*
☐ Calculation sheet(s) (for site class, drilled shafts, spread footings)*
☐ Any other analysis as needed (lateral stability, slope stability, consolidation, liquefaction)*
☐ SPT Hammer Calibration Report*

* For In-House projects prepared by GDOT Engineers, not all these appendix items have to be attached to the report, however they must be included in the appropriate subfolders of the ProjectWise project folder.