

SECTION 900 GREENWAY TRAILS
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901 General

All construction shall conform to the requirements and dimensions on the approved construction plans, Town Standard Details, the Unified Development Ordinance, the latest edition of AASHTO Guide for the Development of Bicycle Facilities, Section 405 of 2009 ANSI A117.1., and the Shared Use Path Accessibility Guidelines as published by the United States Access Board, or as stated in these Specifications, whichever, in the opinion of the ENGINEER, is applicable. Any conflicting requirements or lack of information shall be brought to the attention of the Town prior to construction.

902 Greenway Design Plans

A. General

Greenway designs shall be on a separate plan and profile sheet. Plan view grading shall be at a maximum scale of 1 inch equals 40 feet with 1 foot contours shown. Cross sections shall be provided at a minimum of every 50 feet. Plan and profile for greenway trails, and an Engineer-sealed estimate of probable cost, which is approved by the Director of Parks, Recreation, and Cultural Resources, and the Director of Water Resources or their designee, are required for Construction Plan approval. The total length of greenway trail to be constructed shall be listed on the plan sheet. The length of each trail section with a running slope in excess of 5 percent shall be indicated, and the overall percentage of the designed trail that exceeds 8.33 percent shall be indicated. All trail amenities, fences, storm drainage, proximate utilities, easements, details, notes, and any other requirements shall be shown on these plans.

B. Record Drawings

Record drawings will be required prior to acceptance of routine maintenance/warranty of the greenway by the Town (refer to Unified Development Ordinance Section 14.1.5.C.5 Performance Guarantee).

C. Easements, Encroachments, and Permits

Greenway easements shall be dedicated with the first final subdivision plat submitted for the development. All easements, encroachments, and/or permits required for on-site and off-site facilities must be obtained by applicant prior to beginning work. Easements within which shoulders, swales, or appurtenances are not contained will require amendment via recorded plat. All required permitting, certifications, and geotechnical reports shall be submitted to the Town prior to the Town's acceptance of routine maintenance/warranty on public or private greenway trails.

D. Plan Notes

The following notes shall be included on all greenway design plans:

1. Contractor shall confine construction activity within limits of disturbance.
2. Contractor shall retain a North Carolina Professional Land Surveyor to stake centerline of the trail as shown on the Layout Plan. The trail shall be staked at 50 foot intervals in the field.
3. Staked centerline of the trail shall be approved by the Parks and Greenways Planner or designee for Town projects.
4. Erect tree protection fence along limit of disturbance for approval by Site Inspector.
5. Install required erosion control measures prior to construction.
6. Contractor shall call for utility locations prior to construction.
7. All disturbed areas shall be seeded per North Carolina Department of Environmental Quality Temporary and Permanent Seeding Specifications.
8. Grade side slopes and adjacent ground to drain. Ensure that there is no standing water on the uphill side of the trail. Install a diversion ditch as needed to direct water to culverts.
9. Additional culverts will be added as needed during construction to prevent erosion and standing water on the greenway trail.
10. The Infrastructure Inspector shall inspect proof-roll of Town maintained greenway trails prior to placement of fabric and stone. The trail shall also be proof-rolled prior to paving. A minimum of 100 percent compaction is required. All private greenway trails shall be proof-rolled by a NC-licensed Geotechnical Engineer who shall provide a report to the Infrastructure Inspector.
11. All trails that intersect with a curbed road shall have an accessible Greenway Curb Ramp as specified on plans. Ramp widths shall be same width as trail, and include a level landing at top of ramp in accordance with the Standard Detail. If intersecting a road with no curb and gutter, a detectable warning surface shall be installed in accordance with the Detail. The centerline of all Greenway Curb Ramps perpendicular to roadway shall align with centerline of trail.
12. The contractor shall ensure that all access points leading to the trail are posted with signs that read Trail Closed for Construction. Barriers shall be installed at the ends of any incomplete greenway segments that have a longitudinal slope greater than 3:1, or other hazardous conditions.

13. Asphalt technicians shall verify asphalt depth on site and provide certification in writing to the Infrastructure Inspector via email for review and approval.
14. All greenway bridges, boardwalks, and retaining walls will require Town of Apex building permits.
15. All trail intersections with roadways, sidewalks, or other trails shall include 3.5 feet minimum edge radii.
16. One trash and recycle receptacle with concrete slab and one dog station with concrete slab shall be installed at each access entrance after trail has been paved prior to trail acceptance by Town, and benches may be provided along trails.
17. Developer/applicant shall obtain Wake County and NCDOT Rail Division approval for trail connections and alterations within the American Tobacco Trail corridor; if any changes are requested by Wake County or NCDOT, these changes must be reviewed and approved by Town of Apex Technical Review Committee staff as a revision to approved plans. See NCDOT Rail Corridor Preservation Policy, Adopted Policy # A.09.0102, as updated.
18. Adequate sight distance shall be provided for trail users at trail entrances and intersections.

903 Greenway Trails

A. General

All proposed greenways shall conform to the Bicycle and Pedestrian System Plan Map. Town greenway trails are intended to accommodate multiple user types including pedestrians, bicyclists, non-motorized scooters, and rollerbladers among others.

B. Easements

Public Greenway Easements (PGE) shall be 20 feet minimum width with the trail centered within the easement and encompass swales and culverts for maintenance. Trail connections to neighborhoods shall be publicly owned and maintained. PGEs may not be located within residential lots. Shared public greenway and water or sanitary sewer easements shall be 30 feet minimum width, but could be greater depending on the utility line size and depth in accordance with Section 700. No greenway trails or easements shall be co-located within any stormwater control measures (SCMs) or access easements, except private trails as approved by Town staff. No shrub or tree plantings, or private fences are allowed within the greenway easement.

C. Design Speed

In establishing horizontal and vertical curvature for paved greenway trails, a design speed of 18 mph shall be used. For greenway connector trails (short lengths of publicly maintained paved trail from a neighborhood to the main greenway trail), street-side greenways, and private trails, a design speed of 12 mph may be used.

D. Horizontal Alignment

All public greenway and private trails shall be designed with a centerline alignment and stationing every 100 feet. All tangent sections of public greenways shall be connected with horizontal curves. Greenway trail alignments shall have a minimum horizontal curve radius of 60 feet to meet the 18 mph design speed at a 20 degree lean angle. Greenway connector trails and street-side greenways shall have a minimum horizontal curve radius of 27 feet to meet the 12 mph design speed at a 20 degree lean angle. Minimum lateral clearances shall be met on all horizontal curves to provide adequate stopping sight distance.

E. Cross Slope

All public greenway and private trails shall have 1 percent minimum and 2 percent maximum cross slope with slope towards the downstream side. On vertical slopes with grades in excess of 5 percent, cross slopes shall be sloped to the inside of downhill curves.

F. Vertical Alignment

All vertical tangent sections shall be connected with vertical curves. Vertical curves shall be designed to provide adequate stopping sight distance on the trail. Unless necessitated by exceptional topography, greenway trail grades shall not be less than ½ percent. Maximum grades on greenways shall be 5 percent. Where topography necessitates grades to be in excess of 5 percent, Shared Use Path Accessibility Guidelines shall be applied to determine maximum length of grade and spacing of flat landings:

- Grades greater than 5 percent and up to a maximum of 8.33 percent shall be allowed for a maximum of 200 feet before requiring a landing 10 feet long with maximum slope of 2 percent in all directions.
- Grades greater than 8.33 percent and up to a maximum of 10 percent shall be allowed for a maximum of 30 feet before requiring a 10-foot landing.
- Grades greater than 10 percent and up to 12 percent shall be allowed for a maximum of 10 feet before requiring a 10-foot landing.
- No more than 30 percent of a greenway may exceed 8.33 percent.
- Grades that approach roadway or greenway crossings shall be limited to 5 percent maximum at least 10 feet ahead of the intersection or back of landings associated with curb ramps.

In all instances where grades exceed 8.33 percent, a metal handrail shall be installed on both sides, offset 1 foot from the edge of the trail.

G. Side Slopes

Side slope should be 3:1 or flatter. Where fill slopes are steeper than 3:1, or where the trail is adjacent to a body of water, provide 5 feet graded shoulder width adjacent to the edge of paved trail for recovery, graded at 6:1 or flatter. Where a recovery area of 5 feet cannot be provided, a physical barrier such as safety rail shall be provided in the following circumstances:

- Slopes 3:1 or steeper, with a drop of 6 feet or more;
- Slopes 3:1 or steeper, adjacent to a parallel body of water;
- Slopes 2:1 or steeper, with a drop of 4 feet or more;
- Slopes 1:1 or steeper, with a drop of 1 foot or more.

Fill slopes steeper than 3:1 shall be engineered. Safety rail shall be located 1 foot minimum offset from trail edge where required.

H. Pavement Structure

Public greenway trails shall be constructed from either hot-mix asphalt (HMA) material or Portland cement concrete (PCC). For asphalt greenway construction a woven geotextile fabric shall be used below the aggregate base course, with the following properties:

	TYPICAL	TEST
Tensile Strength	200 lbs.	ASTM D4632-86
Elongation at Break	15%	ASTM D4632
Puncture Strength	100 lbs.	ASTM D0751
Mullen Burst	400 psi	ASTM D0751/3786
Trapezoid Tear	75 lbs.	ASTM D4533

I. Drainage

After asphalt surface course is installed, the edge of pavement shall be backfilled with 2 inches of aggregate base course and seeded using an approved seed mix. All aggregate base course as part of the 2-foot shoulder shall be compacted to at least 95 percent of their standard Proctor maximum dry density. Site drainage should be collected on the uphill side of the trail in a grassed diversion ditch sized appropriately with minimum 1 foot depth, and piped to direct water under the trail to a creek or storm drain culvert, to eliminate flow across the trail. A Class B rip-rap dissipater with filter fabric shall be installed at upstream and downstream ends of all culverts. When culverts are located within the Town of Apex 100 foot Riparian Buffer area, properly sized culverts will be permitted to address natural swale and drainage draws. SCM outlets/culverts shall be extended under greenways located at toe of slope of SCMs with a yard inlet or catch basin installed on the upstream side of the greenway. When dealing with drainage situations that cannot meet the requirements stated above due to topography or regulatory issues, a series of 8-inch pipes may be considered as an alternative solution.

J. Clearances

A minimum lateral clearance of 5 feet shall be maintained from the edge of the trail and vertical clearance of 10 feet from the trail surface, whenever possible. In shared greenway and utility corridors, the edge of pavement should be a minimum of 2 feet from the edge of any utility surface covers/plates (e.g. water valve covers, blow-offs, manholes), and boardwalk and bridge footings should be no closer than 4 feet from any utility.

Trees shall be limbed up a vertical distance of 10 feet from the forest floor, within 5 feet from the outside edge of the trail. Tree limbs and dead trees that present a danger to pedestrians utilizing the trail shall be removed during construction, as directed by the Parks and Greenways Planner or other Town staff. Minimum vertical clearance from trail surface to the lowest horizontal structural member of bridges shall be 10 feet.

904 Proof-Rolling of Subgrades for Greenways

The Infrastructure Inspector shall oversee the proof-roll of public greenway trails. Private trails shall be proof-rolled under supervision of a NC-licensed Geotechnical Engineer and a report shall be submitted to the Zoning Compliance Officer for acceptance. Public greenway and private trail proof-rolls shall be performed on the exposed subgrade soils along the full length of the proposed paved trail after clearing, grubbing, and topsoil removal are complete.

Proof-rolling shall be performed using a fully-loaded tandem-axle dump truck or equipment with minimum 10 ton static weight approved by Geotechnical Engineer. The Infrastructure Inspector for public trails, or Geotechnical Technician for private trails, shall assess problems including rutting, deflection, or pumping of subgrade soils and shall determine if the subgrade soils are suitable to allow placement of geotextile fabric and stone base. The Geotechnical Technician may require an NC-Licensed Geotechnical Engineer to evaluate and determine the need for remedial measures. The aggregate base course shall also be proof-rolled prior to asphalt or concrete placement. A minimum of 100 percent compaction is required.

905 Trail Amenities

All trailhead/trail access points shall have one trash receptacle, one recycling receptacle, and one dog station per Standard Detail which shall be shown on the approved plans and field located by the Parks and Greenway Planner or designee once the trail has been paved. Bollards shall be provided per Standard Detail.

906 Signage

A. Regulatory and Warning

Greenway signage shall be established in accordance with MUTCD: Traffic Control for Bicycle Facilities, Part 9. Greenway signage shall be located where necessary in accordance with Standard Details and approved plans. Coordination with the Town Transportation and Engineering staff is required to determine vehicular sign needs for all greenway crossings of roadways.

B. Wayfinding

All trail access points, intersections, and trailheads shall utilize the appropriate Wayfinding signs per Standard Detail. Wording on the sign and exact placement will be determined by the Parks and Greenways Planner. A proof of the proposed signage shall be submitted to the Parks and Greenways Planner for approval prior to ordering materials.

907 Street Crossings

A. At-Grade Crossings

When greenway trails cross a major collector road or higher order facility it is preferred that the crossing occurs at a signalized intersection with a crosswalk or via grade-separated crossing. This may require that the trail be extended a longer distance than would typically be required. Greenway trail crossings at mid-block or at unsignalized intersections shall be evaluated on a case-by-case basis per the North Carolina Pedestrian Crossing Guidance. Final greenway trail mid-block and unsignalized crossing designs shall be approved by Transportation and Engineering staff. Where roadway crossings are approved, a 10 feet wide high-visibility crosswalk with fluorescent yellow-green pedestrian crossing warning signs and downward arrow plaques shall be used. Site-specific supplemental signage and markings may be required.

Where a pedestrian crossing island is deemed necessary per Town engineering review, the island shall be raised, 6 feet minimum width, and 6 feet across to meet Public Right-of-Way Accessibility Guidelines. Angled crosswalks in the median that orient a pedestrian's attention toward oncoming traffic are preferred.

Crosswalk lighting needs shall be evaluated on a case-by-case basis. Where crosswalk lighting is deemed necessary, luminaires should provide 20 vertical lux at the crosswalk. Luminaries should be placed 10 feet in front of the crosswalk. On two directional roadways without the presence of a refuge median, 2 luminaries (1 on either side of the crossing) shall be provided.

B. Grade-Separated Crossings

Grade-separated crossings such as pedestrian tunnels and bridges are required when crossing controlled access facilities such as interstates, highways, and railroads. Consideration for grade separated crossings shall also be given when all of the following conditions prevail:

- A significant greenway corridor with high user volumes;
- Crossing of a facility with speed limit of 45 mph or higher;
- Crossing of a facility with 4 or more travel lanes;
- Absence of a signalized crossing within 1,000 feet.

908 Retaining Walls

Refer to Section 200 for retaining wall specifications. Building permits for retaining walls must be obtained in accordance with local permitting authorities. Wherever possible, retaining walls should be located outside of Public Greenway Easements. In residential developments, retaining walls which cannot be located outside of the Public Greenway Easement shall be located in a Retaining Wall Easement and shall be privately maintained. All retaining walls shall be installed at the lines, grades, and depths as shown on the approved plans. The base block size shall be commercial grade block. Compact, mini-block, or garden size block is not acceptable. Block retaining walls shall have a cap unit on the top of the wall and shall be integrally tinted medium or dark brown or rust color (per UDO Section 8.1). The selected retaining wall system shall be joined, pinned, and/or secured in accordance with the manufacturer's recommendations. Retaining walls with a vertical drop of 1 foot or more located adjacent to a trail shall provide safety railing per Standard Detail. For retaining walls that require screening with plantings, no plantings shall be located such that they will encroach into the trail or the 2-foot shoulders when plant reaches maturity. Trails shall maintain 2-foot level shoulders free of walls or fencing with a 3:1 or flatter side slope beyond the shoulder to the top of the adjacent retaining wall.

909 Greenway Structures

Greenway structures are required to be certified by a North Carolina Professional Engineer and shall include all necessary plan documents with the final Construction Plan set for approval. Working drawings shall be submitted by the manufacturer to the Town for review prior to manufacturing of any pre-fabricated structure.

A Town of Apex building permit must be obtained and approved Construction Plans must be submitted with the building permit application for all greenway structures.

Site soil properties are assumed to support foundation loads. Prior to construction, the contractor shall submit a geotechnical report to the Infrastructure Inspector and building permit authorities, indicating that the soil properties can support the foundation loads.

All required geotechnical reports and a sealed certification from a Structural Engineer (stating that boardwalk and/or bridge structures, including to outside ends of boardwalk approach ramps, were constructed in accordance with sealed designs) shall be submitted to the Infrastructure Inspector prior to Town's acceptance of the structure for maintenance.

All pedestrian structures, underpasses, and tunnels crossing roads owned and maintained by the NC Department of Transportation must receive NCDOT approval prior to beginning any work within the right of way.

All trail overpasses (over roadways and railways) shall meet current AASHTO and ADA standards for slopes per Section 903 F.

A. Boardwalks & Bridges

Boardwalks and bridges shall be designed in accordance with the AASHTO Standard Specifications for Highway Bridges, current edition. Design Live Load shall be for an AASHTO H5 vehicle with an evenly distributed load of 85 lbs./sf or a concentrated load of 10,000 pounds at mid-span. Typical maximum longitudinal slope in any direction should not exceed 4 percent. Metal plaques shall be permanently affixed to both ends of structures indicating maximum weight capacity of structure and inside clear width.

Greenway bridges can either be constructed with a pre-engineered laminated beam construction or with structural steel with wooden decking and handrails. Typically, pre-engineered laminated beam bridges shall be utilized at locations that have adequate crane access for installation. Both styles of bridge shall be designed to meet or surpass the design requirements listed below.

Boardwalks and bridges that encroach FEMA floodway or non-encroachment area require a Conditional Letter of Map Revision prior to construction.

1) Clearance

Abutments shall not be located within the FEMA floodway and shall be located a minimum of 5 feet from the top of the stream bank. Boardwalks/bridges and abutments shall not be located within a sanitary sewer easement where crossing a waterway. In shared utility and greenway corridors boardwalk structures shall be located a minimum of 10 feet from the center of all existing sewer lines, and bridges and abutments shall be located a minimum of 20 feet from the center of all sewer lines. The lowest horizontal component of structures shall be a minimum of 4 feet above normal water level, and shall be above the 25-year storm elevation; elevation above the 100-year storm should be evaluated for feasibility. Minimum pile penetration for piers shall be 10 feet or a depth recommended by a North Carolina Professional Engineer. Illustrate

how high-water levels will pass without damaging bridge. Provide a section of the proposed bridge with the construction documents.

2) Footings and Wing Walls

Footings and wing walls shall be constructed with reinforced concrete as designed and sealed by a North Carolina Professional Engineer. A representative of the Geotechnical Engineer's staff shall approve the footing excavation bottoms prior to constructing bridge footings and placement of rebar and concrete. Tops of footings shall be 2 feet below adjacent creek bed elevation. Rip-rap stone shall be used to armor slopes and protect wing walls for bridge crossings per Standard Detail.

3) Concrete Approach

Approach slabs and everything between slabs shall be included in all required bridge and boardwalk certifications, and shall be considered part of bridge/ boardwalk structure. Bridge and boardwalk railings shall extend 8 feet minimum beyond the ends of bridge/ boardwalk per Standard Detail. Rip-rap stone shall be used to armor slopes for bridge/ boardwalk crossings, including areas around wing walls and end bents to reduce erosion at structures per Standard Detail.

4) Handrails

A handrail shall be installed on the railing of both sides of bridges and boardwalks that exceed a 5 percent running slope (approved only on a case-by-case basis). Handrails shall be designed and located in accordance with ADA and AASHTO requirements. Handrails must be of uniform height, 34 to 38 inches from the finished surface.

5) Materials

All structural members shall have a minimum nominal thickness of material of at least 2 inches. All hardware and fabricated connections shall be hot-dipped galvanized after fabrication in accordance with ASTM A153. Small members shall have pre-drilled holes to prevent splitting during construction. All members shall be screwed or bolted together. Joist hangers shall be galvanized. Treated lumber shall be used and be in accordance with the most current NCDOT Standard Specifications for Roads and Structures (Section 1082). For boardwalks, Southern Yellow Pine, Grade No. 2, shall be used except for top rail and routed handrail which shall be Southern Yellow Pine, Grade No. 1. For bridges Southern Yellow Pine, Grade No. 1, shall be used.

Structural bridge components shall be fabricated from laminating lumber. Laminating lumber shall be Southern Pine Kiln Dried and graded to meet the requirements of Standard Specifications for Structural Glued Laminated Timber (AITC 117). Lumber combination shall be used for identification. Laminated

components shall be per AITC architectural appearance grade. Miscellaneous solid sawn lumber for decking shall be Southern Pine graded in accordance with Southern Pine Inspections Bureau. Preservative treatment for glulam components shall consist of pressure treated laminated lumber (treated prior to gluing) with pentachlorophenol type C in accordance with AITC 109 and AWWA C28. Exterior stringers and all other glulam components shall be 0.6 pcf retention. Solid sawn decking shall be pressure treated in accordance with C2 for above ground use. Laminated lumber handrail posts shall be fastened to the exterior beam with galvanized steel carriage bolts. Handrails must be metal and meet current requirements as stated in the ADA Accessibility Guidelines (ADAAG).

Adhesives shall be wet-use (waterproof) complying with ANSI/AITC A190.1 – latest edition. Each bearing and template shall be fabricated to accommodate 1³/₄-inch diameter anchor bolt. Anchor bolts shall be aligned longitudinally with the bridge. All steel for bearing connection plates shall be ASTM A36. Minimum yield (F_y) shall be greater than 36,000 psi. The manufacturer shall furnish all connecting steel and hardware. Decking shall be secured using stainless steel deck screws. Pre-engineered bridge manufacturer is not responsible for the template, setting plates, or anchor bolts.

6) Fabrication

Workmanship, fabrication, and shop connections shall be in accordance with the latest version of American Institute of Timber Construction and all related Interim Specifications. Bridges may be assembled at the site or at the manufacturer. At the End Bents, the bridge shall be fabricated to produce a 6-inch longitudinal distance from centerline of anchor bolts to end of beam. A 1-inch open joint shall exist between the end of the bridge and the end bent backwall.

7) Bridge Railings and Accessories

Structural bridge railings fabricated from laminated lumber shall have a smooth inside surface with no protrusions or depressions and all members, railings, corners, and ends of lumber shall be sanded smooth and edges eased. Finished railing height shall be 42 inches or higher in high hazard situations. Maximum spacing of railings shall be such that a 3¹/₂-inch sphere shall not pass between the members.

8) Finishes

All glulam materials shall receive one factory applied coat of clear penetrating sealer.

- 9) **Delivery and Erection**
Bridges or bridge components will be delivered by truck to a location nearest to the site accessible by roads. The contractor shall provide for the installation of anchor bolts to be installed. The information required to develop the template shall include the size, configuration, and spacing of the bolts as they shall be installed in the footing.
- 10) **Quality**
The bridge manufacturer shall maintain records assuring that all lumber, bolts, and materials used are in accordance with the material specified and certified by a North Carolina Professional Engineer. A copy of the records shall be provided to the owner. The bridge shall be identified and marked (on both ends) with a permanent metal nameplate showing the manufacturer's name, location, date of manufacture, maximum load carrying capacity, and inside clearance width. Structural materials shall be traceable to the bridge.
- 11) **Pre-Engineered Bridges**
The manufacturer shall have 5 years minimum experience in design and fabrication of pre-engineered pedestrian bridges. The design shall be in accordance with the American Institute of Timber Construction, AITC 117-2001, or latest edition, the total bridge dead load applied to the End Bent shall not exceed 37,000 pounds and shall be designed for a minimum wind load of 30 pounds (approximately 120 mph). The wind is calculated on the entire vertical surface of the bridge as is fully enclosed. All bridges shall be designed for seismic loads of the intensity required by local codes. Bridge camber at center of the bridge span shall be a maximum of 2.5 percent of the total bridge span. This should produce a localized deck slope of 12:1. Bridge shall be cambered to offset full dead load deflections. Bridge span shall be defined as the distance from center to center of the bearings. The bridge being designed shall have bearing elevations that are equal. Manufacturer shall provide for one deck plank at each end of the bridge to span the 1-inch gap as described below to prevent debris from falling through the gap. This deck plank shall match the decking of the bridge and shall be installed at the site after the backwall is installed.
- 12) **Pedestrian Rail**
Wherever the top grade of the boardwalk decking exceeds 30 inches from finished ground level or any other hazardous drop-off exists, pedestrian rails shall be provided. Where boardwalk decking height is 30 inches or less from finished ground level, a toe-rail may be installed per Standard Detail. Design considerations should be made to avoid multiple transitions between pedestrian rail and toe-rail.

B. Underpasses, Tunnels, and Culverts

Greenway tunnels shall be 12 feet x 12 feet reinforced cast-in-place concrete structures as specified by NCDOT. Tunnels shall exhibit a 1 percent minimum longitudinal slope; 2 percent maximum cross slope. Headwalls with wing-walls are required at both ends of the tunnel.

Special consideration shall be placed on the drainage design at the entrance to the tunnel. Where necessary trench drains should be incorporated at the tunnel entrance to intercept water from pooling within the tunnel.

Contractor/applicant shall be responsible for coordinating review and approval by NCDOT (where crossing NCDOT roadways) and for obtaining any required encroachment permits prior to beginning any work.

All tunnels shall be lighted. Power meter for tunnel lighting shall be located above the 100-year flood elevation and minimum 10 feet above trail surface.