4.4.2 Lakes, Rivers, and Streams

4.4.2.1 Methodology for Assessing the Impacts of the Proposed Alternatives

Stream impact analysis utilizes the approximate stream acreage (length to be impacted multiplied by average width of that stream) expected to be permanently lost or temporarily affected as a result of new location transportation infrastructure and/or disturbances during construction. Length of stream impacts was calculated using ArcGIS software by overlying streams with the potential construction footprint for both the Primitive and Principal Park Roads. Streams are identified and depicted in Figure 3-5. Attachment M-6 identifies each stream impacted per alternative and the approximate linear footage and area impacted based upon stream determinations and functional designs prior to mitigation. Both permanent and short-term impacts to streams would be expected from the potential project. If a partial-build or build alternative is selected, stream delineations may need to be conducted to determine the exact location, length, and width of stream features. Impacts to stream water quality are discussed in Section 4.4.3 of this report.

Type

Impact types are either beneficial and/or adverse. Beneficial impacts are defined as having a positive effect on streams. Adverse impacts have a negative effect on streams.

Context

Context is defined as site-specific, local, or regional. Site-specific impacts are the portions of the streams that would be filled for crossings or have culverts placed directly within their channel. Local impacts are based on current NCDOT procedures for road crossings and mussel surveys associated with streams. Localized impacts occur within 330 feet (100 m) upstream and 1,320 feet (400 m) downstream of the construction footprint. These areas would not be significantly affected by the road but may have altered flow regimes or sedimentation from the proposed project, especially during construction. Regional impacts are those impacts that occur downstream and outside of the localized impacts.

Duration

Short-term impacts are those that would occur for less than 1 year, typically as an episodic or temporary event. Long-term effects occur as a result of construction activities at a specific location throughout the life of construction (this is assumed to be between 1 year and 15 years), but the impact is more than that of a temporary event. Permanent impacts are considered to be anything that persist throughout the construction period. These impacts include the permanent loss of the stream functions (sometimes associated with culverts or fill areas) from the new road itself, and may include a complete loss of stream function.

Clarification of the term “baseline” for this project:
The Partial-Build Alternative to Bushnell and the Northern Shore Corridor include a baseline route, as well as options to that route. Baseline routes and options are detailed in Section 2.5 and shown on Figure 2-8. Baseline routes have been compared to existing conditions. Impact analyses for the options are shown as a difference from the associated baseline route.

Intensity

Intensity is the degree to which resources are affected and is categorized as negligible, minor, moderate, or major. The definitions for the stream impacts are based on the current USACE agency requirements associated with permitting for linear transportation projects (Nationwide Permit 14). Due to the potentially large number of streams that would be filled and the total area of fill needed, selection of the partial-build or build alternatives would likely exceed the threshold of a Nationwide Permit 14 and it is likely that an Individual Permit would be required. For all permits, USACE requirements utilize stream acreage impacts per linear transportation crossing to determine permitting and mitigation needs.

No/Negligible

Impacts may occur, but are not detectable and have no observable effects on streams. These impacts are not expected to be significant or observable.

Minor

Impacts associated with the fill of or complete loss of less than 0.10 acre (0.04 ha) of stream and/or occurring when the proposed project does not cross a stream but is parallel to and within 50 feet (15.2 m) of a stream. These impacts occur when a small portion of stream is impacted by fill or culvert and when the proposed road comes within a 50-foot (15.2-m) buffer of the stream but does not directly impact the stream.

Moderate

Impacts associated with the fill of or complete loss of more than 0.10 acre (0.04 ha) but less than 0.5 acre (0.2 ha) of stream.

Major

Impacts associated with the fill of or complete loss of greater than 0.5 acre (0.2 ha) of stream.

4.4.2.2 Summary of Impacts

Stream impacts for each alternative and road design are listed in Table 4-18. Vegetated buffers would also be impacted on both sides of a stream for typical road crossings. Most culverts are designed to carry a typical storm flow for a stream, but scouring and erosion may occur during high flows upstream and downstream of stream crossings. Detailed impacts to jurisdictional stream are in Attachment M-1. Impacts are based on current functional design without implementation of avoidance or minimization techniques. All values of impact are approximate and are based on function designs prior to mitigation.

Clarification of the term “baseline” for this project:
The Partial-Build Alternative to Bushnell and the Northern Shore Corridor include a baseline route, as well as options to that route. Baseline routes and options are detailed in Section 2.5 and shown on Figure 2-8. Baseline routes have been compared to existing conditions. Impact analyses for the options are shown as a difference from the associated baseline route.

There would be no impacts to any national wild and scenic rivers or rivers listed on the NRI. Also, there would be no impacts to areas designed as sole-source aquifers, groundwater recharge zones, or other groundwater drinking water sources.

Table 4-18. Stream Impacts within the Proposed Partial-Build and Build Alternatives[1]

	Laurel Branch Picnic Area[2]	**Partial-Build Alternative to Bushnell (baseline)**	Southern Option at Forney Creek Embayment	**Northern Shore Corridor (baseline)**	Southern Option at Forney Creek Embayment	Southern Option at Hazel/Eagle Creek Embayments	Southern Option Crossing Fontana Dam
Primitive Park Road **Stream Crossings**	9	34	8 less than baseline	131	8 less than baseline	8 less than baseline	15 less than baseline
Total Acreage (ha)	0.17 (0.07)	0.69 (0.28)	0.37 (0.15) less than baseline	3.86 (1.56)	0.37 (0.15) less than baseline	1.41 (0.57) less than baseline	0.44 (0.18) less than baseline
Total Linear Feet (m)	1,249 (381)	4,714 (1,437)	982 (303) less than baseline	23,230 (7,081)	982 (303) less than baseline	5,709 (1,740) less than baseline	2,422 (738) less than baseline
Principal Park Road **Stream Crossings**	NA	35	12 less than baseline	141	12 less than baseline	17 less than baseline	16 less than baseline
Total Acreage (ha)	NA	0.73 (0.30)	0.37 (0.15) less than baseline	4.27 (1.73)	0.37 (0.15) less than baseline	1.76 (0.71) less than baseline	0.48 (0.19) less than baseline
Total Linear Feet (m)	NA	5,300 (1,615)	2,102 (641) less than baseline	25,374 (7,734)	2,102 (641) less than baseline	7,298 (2,224) less than baseline	2,656 (810) less than baseline

1 All values shown are approximate and based on functional designs prior to mitigation.
2 The entrance/exit road to Laurel Branch Picnic Area is best discussed as a Primitive Park Road, but its design does not necessarily conform to the NPS design criteria for a Primitive Park Road.
N/A Not Applicable

4.4.2.2.1 No-Action

The No-Action Alternative would not impact streams and lakes in the project study corridors.

4.4.2.2.2 Monetary Settlement

The Monetary Settlement Alternative would not directly impact streams or lakes in the project study corridors. Impacts resulting from this alternative would depend on how funds are used by Swain County. Indirect impacts to streams within GSMNP would be unlikely.

Clarification of the term "baseline" for this project:
The Partial-Build Alternative to Bushnell and the Northern Shore Corridor include a baseline route, as well as options to that route. Baseline routes and options are detailed in Section 2.5 and shown on Figure 2-8. Baseline routes have been compared to existing conditions. Impact analyses for the options are shown as a difference from the associated baseline route.

4.4.2.2.3 Laurel Branch Picnic Area

The Laurel Branch Picnic Area would have nine stream crossings that include one named stream, Laurel Branch, and eight unnamed tributaries to Laurel Branch totaling approximately 0.17 acre (0.07 ha) or 1,249 linear feet (381 m). Direct loss of stream channel is confined to the construction footprint; therefore, impacts would be moderate, adverse, site-specific, and permanent. Indirect impacts occur when a road parallels a stream, especially within 50 feet (15 m). The existing hydrology or floodplain of the stream may be altered. Based on the potential road designs, the road would parallel short sections of stream channel. Indirect impacts would be minor, adverse, local, and permanent.

The Laurel Branch Picnic Area would have no impacts to Fontana Lake.

4.4.2.2.4 Partial-Build Alternative to Bushnell (Primitive and Principal Park Roads)

For the Primitive Park Road, the baseline Partial-Build Alternative to Bushnell would cross nine named streams and 25 unnamed tributaries totaling approximately 0.69 acre (0.28 ha) or 4,714 linear feet (1,437 m). The named streams include Goldmine Branch, Gray Wolf Creek, Glady Branch, Forney Creek, Jenny Branch, Gunter Branch, Monteith Branch, Chambers Creek, and Anthony Branch. The Principal Park Road would cross all of the same streams except Forney Creek and would cross 27 unnamed tributaries totaling approximately 0.73 acre (0.30 ha) or 5,300 linear feet (1,615 m). Direct impacts for both road types area classified as major, adverse, site-specific, and permanent. The existing hydrology or floodplain of the stream may be altered. Indirect impacts for both road types would be minor, adverse, local, and permanent for the baseline Partial-Build Alternative to Bushnell.

The baseline Partial-Build Alternative to Bushnell would have direct impacts to Fontana Lake. Functional designs have a boat ramp that would impact approximately 0.3 acres (0.1 ha) of the lake. These impacts would be moderate, adverse, local, and permanent.

Southern Option at Forney Creek Embayment (Primitive and Principal Park Roads)

As compared to the baseline Partial-Build Alternative to Bushnell, the Southern Option at Forney Creek Embayment would avoid impacts to Forney and Gray Wolf creeks. Both the Primitive and Principal Park Road designs for this option could cross Glady Branch and Goldmine Branch in addition to Jenny, Gunter, and Monteith branches. This alternative would reduce direct impacts for both road types. Indirect impacts would be decreased from the baseline Partial-Build Alternative to Bushnell by avoiding Gray Wolf Creek.

This option would have the same direct impacts to Fontana Lake as the baseline Partial-Build Alternative to Bushnell. The bridge proposed for this option is designed to be a steel arch bridge that would span the entire lake. Therefore, there would be no additional impacts to Fontana Lake.

Clarification of the term “baseline” for this project:
The Partial-Build Alternative to Bushnell and the Northern Shore Corridor include a baseline route, as well as options to that route. Baseline routes and options are detailed in Section 2.5 and shown on Figure 2-8. Baseline routes have been compared to existing conditions. Impact analyses for the options are shown as a difference from the associated baseline route.

4.4.2.2.5 Northern Shore Corridor (Primitive and Principal Park Roads)

The baseline Northern Shore Corridor is the longest of the alternatives and consequently has the greatest amount of impacts to streams. Both the Primitive and Principal Park Roads would cross 131 and 141 streams, respectively. The Primitive Park Road would directly impact approximately 3.86 acres (1.56 ha) comprising 23,230 linear feet (7,081 m) of stream. The Principal Park Road design would impact approximately 4.27 acres (1.73 ha) comprising 25,374 linear feet (7,734 m) of stream. Direct impacts for both road types for this alternative would be major, adverse, site-specific, and permanent. Indirect impacts would occur with the baseline Northern Shore Corridor, as the road would parallel several stream channels, including Gray Wolf Creek, Mill Branch, Pilkey Creek (Primitive Park Road), Chambers Creek (Primitive Park Road), Shehan Branch, and Hazel Creek. Indirect impacts for both road types would be major, adverse, local, and permanent.

The baseline Northern Shore Corridor would have no impacts to Fontana or Cheoah lakes.

Southern Option at Forney Creek Embayment (Primitive and Principal Park Roads)

The Southern Option at Forney Creek Embayment would avoid direct and indirect impacts to Forney and Gray Wolf creeks and their tributaries as compared to the baseline Northern Shore Corridor. This option would reduce direct impacts for both the Primitive and Principal Park Roads. Indirect impacts for both road types also would be decreased from the baseline Northern Shore Corridor by avoiding Gray Wolf Creek.

This option would have the same direct impacts to Fontana Lake as the baseline Northern Shore Corridor. The bridge anticipated for this option (e.g., steel arch) would span the entire lake. Therefore, there would be no additional impacts to Fontana Lake.

Southern Option at Hazel and Eagle Creek Embayments (Primitive and Principal Park Roads)

The Southern Option at Hazel and Eagle Creek Embayments would significantly reduce direct and indirect impacts to streams. By bridging both embayments, impacts would be avoided to Birchfield Branch, Lost Cove Creek, Eagle Creek, Shehan Branch, Laurel Branch, and Hazel Creek. This option would avoid many stream crossings by following the ridgeline of Welch Ridge, but would directly impact Augerhole Branch, Myers Branch, and Johnny Branch (Primitive Park Road only). Direct impacts would be reduced from the baseline Northern Shore Corridor for the Primitive and Principal Park Roads. Indirect impact would be reduced by not paralleling Shehan Branch and Hazel Creek. Augerhole Branch would have indirect impacts.

This option would have the same direct impacts to Fontana Lake as the baseline Northern Shore Corridor. The bridge proposed for this option is designed to be a steel arch bridge that would span the entire lake. Therefore, there would be no additional impacts to Fontana Lake.

Clarification of the term “baseline” for this project:
The Partial-Build Alternative to Bushnell and the Northern Shore Corridor include a baseline route, as well as options to that route. Baseline routes and options are detailed in Section 2.5 and shown on Figure 2-8. Baseline routes have been compared to existing conditions. Impact analyses for the options are shown as a difference from the associated baseline route.

Southern Option Crossing Fontana Dam (Primitive and Principal Park Roads)

The Southern Option Crossing Fontana Dam would avoid direct impacts for both road types to three named streams: Sweet Branch, Lewellyn Branch, and Fox Branch. Both road types of this option would directly impact two small unnamed tributaries to Fontana Lake. Indirect impacts would be reduced by avoiding indirect impacts to unnamed tributaries to Cheoah Lake.

4.4.2.2.6 Cumulative Impacts

Past actions, described in Section 4.1.2, affected streams and lakes in the study area, with the 1944 completion of Fontana Dam having the most evident impact. Past activities with the Park have caused streams in the project study corridors to be straightened, channelized, and piped. Present and reasonably foreseeable projects in the area that are in proximity to streams or include stream crossings also have the potential to impact this resource. These other projects include NCDOT TIP projects, road construction listed in local thoroughfare plans, the Ravensford Land Exchange, future sections of Foothills Parkway, and private development.

The Northern Shore Corridor, which has substantially more stream crossings than other alternatives, is projected to include as many as 141 stream crossings, resulting in major impacts. These impacts would be minimized to the extent practicable and remaining stream degradation or loss would be offset through mitigation. Due to the site-specific nature of impacts expected, no cumulative effects were identified.

4.4.2.3 Options to Address Potential Impacts

NPS would require a sequence of avoiding adverse stream impacts to the extent practicable, minimizing impacts that could not be avoided, and mitigating for remaining unavoidable adverse impacts via restoration of degraded streams. It may not be possible to avoid or mitigate all stream impacts.

Avoidance Techniques

Avoidance examines all appropriate and practicable possibilities of averting impacts to "Waters of the United States." According to a 1990 Memorandum of Agreement (MOA) between the USEPA and the USACE, in determining "appropriate and practicable" measures to offset unavoidable impacts, such measures would be appropriate to the scope and degree of those impacts and practicable in terms of cost, existing technology, and logistics in light of overall project purposes. Main avoidance techniques include relocating a road to eliminate stream crossings, bridging an entire stream and its floodplain, and reducing the width of a road. Stream crossings can be eliminated by having the road on high elevations; however, due to steep terrain, these options are not always practicable.

Clarification of the term "baseline" for this project:
The Partial-Build Alternative to Bushnell and the Northern Shore Corridor include a baseline route, as well as options to that route. Baseline routes and options are detailed in Section 2.5 and shown on Figure 2-8. Baseline routes have been compared to existing conditions. Impact analyses for the options are shown as a difference from the associated baseline route.

Minimization Techniques

Where no alternatives that avoid adverse impacts on streams are found to be practicable, minimization steps must be employed to reduce adverse impacts. Implementation of these steps would be required through design modifications and implementation of BMPs to limit and control impacts during and after project construction. Every practicable effort would be made to maintain the integrity of the natural stream systems, preserving their features and functions.

Design modifications that can minimize impacts are bottomless arch culverts or buried culverts. Traditional culverts have a bottom that can impact the hydrology and aquatic biology of the stream. Bottomless culverts avoid impacts to the stream bed and allow for the normal flow, substrate, and passage of aquatic species. The arch culvert would impact the flooding regime and stream banks. Another design modification that minimizes impacts is to construct all stream crossings perpendicular to the streams. This would limit the direct impacts to the stream, to riparian buffers, and to the hydrologic regime.

In order to determine the effectiveness of BMPs and the actual impacts on streams, NPS would conduct water quality and aquatic ecology monitoring before construction, during construction, and after construction. In addition, surveys for benthic macroinvertebrates and fish would be conducted at least once prior to construction. Monitoring during construction would be conducted to determine immediate changes in water quality. This could be achieved by continuous monitoring of physical parameters such as pH, turbidity, and conductivity. Any changes to water quality could be immediately addressed or could trigger additional water quality monitoring. Post-construction monitoring would most likely follow the same sampling regime as pre-construction monitoring.

Mitigation Techniques

After avoidance and minimization have been applied to the maximum practicable extent, remaining stream degradation or loss must be offset through mitigation. Mitigation is achieved by restoring the natural function, stability and biological condition to an existing degraded stream. Both the federal and state governments recognize natural stream channel design as the preferred restoration technique (FISWRG 1998; Doll et al. 2000). Enhancement is a type of mitigation which involves the manipulation of the physical, chemical, or biological characteristics of streams to improve specific functions. The improvements are achieved by addressing the source of degradation, usually without major channel modifications. Mitigation must often be conducted within the same watershed and be the same type of stream that was impacted. If mitigation is necessary, the NPS is committed to keep mitigation efforts within GSMNP.

4.4.2.4 Impairment Evaluation

Impairment to the streams of GSMNP and the AT would not occur under the No-Action Alternative, Monetary Settlement Alternative, Laurel Branch Picnic Area, and the Partial-Build Alternative to Bushnell. The Northern Shore Corridor is not likely to impair the streams of GSMNP or the AT based on the

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Clarification of the term “baseline” for this project:
The Partial-Build Alternative to Bushnell and the Northern Shore Corridor include a baseline route, as well as options to that route. Baseline routes and options are detailed in Section 2.5 and shown on Figure 2-8. Baseline routes have been compared to existing conditions. Impact analyses for the options are shown as a difference from the associated baseline route.

information obtained to date. Due to the magnitude of this alternative, it is likely that additional NEPA documentation would be required to address site specific impacts not currently known and to determine detailed mitigation measures as they relate to final design. The impairment determination related to streams would be re-evaluated in such documentation.

4.4.3 Water Quality

4.4.3.1 Methodology for Assessing the Water Quality Impacts

Detailed methodologies for water quality impact analyses are listed in Appendix M. As described in Section 3.4.3.1 of this report, NCDWQ classifies surface waters of the state based on their existing or proposed uses and subsequent water quality standards. Impacts were assessed based on the designated use and classification of the water body. Each stream and/or waterbody directly crossed by the potential road or the lake downstream of the crossed streams is evaluated for each applicable water quality standard. A summary list of North Carolina state water quality standards is available in Table 4-19 (NCDENR 2004).

Because data from water quality sampling is often episodic, biological indices are another method of evaluating water quality of streams and represent long-term (several years) water quality conditions. Impacts are evaluated on changes to the comprehensive NCBI scores: Excellent (<4.05), Good (4.06 – 4.88), Good-Fair (4.89 – 5.74), Fair (5.75 – 7.00), or Poor (>7.00).

Potential impacts to Fontana Lake are evaluated by the NCTSI. The NCTSI is based on a numerical score that classifies lakes as oligotrophic, mesotrophic, eutrophic, or hypereutrophic. Currently, TVA and NCDWQ collect samples from eight points on Fontana Lake. The impacts are considered for any of the sampling sites, not the overall classification for the lake.

Type

Impact types are either beneficial and/or adverse. Beneficial impacts are defined as having a positive effect on water quality. Adverse impacts have a negative effect on water quality.

Context

Context is defined as site-specific, local, or regional. The region of influence for water quality is based on the number of stream crossings and size of watersheds impacted. Site-specific impacts occur to individual stream crossings with drainage areas less than 100 acres (40.5 ha). Local impacts occur with any number of stream crossings, but with one of the stream drainage areas greater than 100 acres (40.5 ha). This drainage of greater than 100 acres (40.5 ha) is considered a large watershed. Regional impacts occur when two or more large watersheds are affected.

Clarification of the term “baseline” for this project:
The Partial-Build Alternative to Bushnell and the Northern Shore Corridor include a baseline route, as well as options to that route. Baseline routes and options are detailed in Section 2.5 and shown on Figure 2-8. Baseline routes have been compared to existing conditions. Impact analyses for the options are shown as a difference from the associated baseline route.