Geologic Resources Inventory Scoping Summary
Big South Fork National River and Recreation Area & Obed Wild and Scenic River

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The Geologic Resource Evaluation (GRE) Program provides each of 270 identified natural area National Park Service units with a geologic scoping meeting, a digital geologic map, and a geologic resource evaluation report. Geologic scoping meetings generate an evaluation of the adequacy of existing geologic maps for resource management, provide an opportunity for discussion of park-specific geologic management issues and, if possible, include a site visit with local geologic experts. The purpose of these meetings is to identify geologic mapping coverage and needs, distinctive geologic processes and features, resource management issues, and potential monitoring and research needs. Outcomes of this scoping process are a scoping summary (this report), a digital geologic map, and a geologic resource evaluation report.

The National Park Service held a GRE scoping meeting for Big South Fork National River and Recreation Area and Obed Wild and Scenic River on June 4, 2007 at Big South Fork park headquarters in Oneida, Tennessee followed by a site visit in Big South Fork NRRA on June 5, 2007. Tim Connors (NPS-GRD) facilitated the discussion of map coverage and Lisa Norby (NPS-GRD) led the discussion regarding geologic processes and features at the two units. Participants at the meeting included NPS staff from the park, Appalachian Highlands Network, Southeast Region, and Geologic Resources Division, geologists from the Tennessee Division of Geology (TDG) and Kentucky Geological Survey (KGS) as well as cooperators from Colorado State University (see table 1). This scoping summary highlights the GRE scoping meeting for Big South Fork and Obed Rivers including the geologic setting, the plan for providing digital geologic maps, prioritized lists of geologic resource management issues, descriptions of significant geologic features and processes, lists of recommendations and action items, and a record of meeting participants.

Park and Geologic Setting

Both Big South Fork National River and Recreation Area and Obed Wild and Scenic River lie within the Cumberland Plateau physiographic province encompassing some 125,310 and 5,056 acres, respectively. The Cumberland Plateau is a northeast-southwest trending upland area stretching from northeast Kentucky to central Alabama. The Big South Fork of the Cumberland River begins in northeastern Tennessee at the confluence of the New River and Clear Fork. Large tributaries include White Oak Creek, North White Oak Creek, Bandy Creek, Laurel Fork, Williams Creek, Bear Creek, Roaring Paunch Creek, and Rock Creek. Big South Fork flows some 79 km (49 miles), 60 km (37 miles) of which are free flowing. Lake Cumberland, a reservoir managed by the U.S. Army Corps of Engineers, lies along the northernmost 13 km (8 miles) of the Big South Fork Cumberland River in the park. Collectively, Obed River and its main tributaries (Clear Creek, Daddy's Creek, and Emory River) flow unimpeded more than 72 km (45 miles) within park boundaries in north-central Tennessee. The pristine condition of the Obed River is among the best in Tennessee. For this reason, it is classified as a Wild and Scenic River. The parks and associated watershed boundaries of interest for resource management cover 48 7.5-minute quadrangles.

Big South Fork and Obed River cut deep gorges more than 150 m (500 ft) deep in to the surrounding rolling upland areas. Relatively undeformed layers of sandstones, shales, coal seams, limestones, and siltstones comprise the geologic units of the Cumberland Plateau. Local strata thicken towards a Paleozoic Era depocenter east of the parks. Differential erosion of these geologic units controls the regional topography. Exposed in the deepest gorges throughout the area, Mississippian shales and thin limestones (Pennington Formation) weather relatively quickly in contrast with the thick, conglomeratic Pennsylvanian-age sandstones (Rockcastle Conglomerate and Corbin Sandstone) that comprise the steep cliff walls in the gorge area. There is an unconformable contact between Mississippian marine and estuarine deposits and Pennsylvanian fluvial sandstones representing a period of erosion and incision. Erosion, regional dip, and oriented fracture sets control the formation of many stone overhangs and arches in the parks, particularly at Big South Fork.

Geologic Mapping for Big South Fork National River and Recreation Area & Obed Wild and Scenic River

During the scoping meeting Tim Connors (NPS-GRD) showed some of the main features of the GRE Programs digital geologic maps, which reproduce all aspects of paper maps, including notes, legend, and cross sections, with the added benefit of GIS compatibility. The NPS GRE Geology-GIS Geodatabase Data Model incorporates the standards of digital map creation set for the GRE Program. Staff members digitize maps or convert digital data to the GRE digital geologic map model using ESRI ArcMap software. Final digital geologic map products include data in geodatabase, shapefile, and coverage format, layer files, FGDC-compliant metadata, and a Windows HelpFile that captures ancillary map data. Completed digital maps are available from the NPS Data Store at http://science.nature.nps.gov/nrdata/.

When possible, the GRE program provides large scale (1:24,000) digital geologic map coverage for each park's area of interest, usually composed of the 7.5-minute quadrangles that contain park lands (figure 1). Maps of this scale (and larger) are useful to resource management because they capture most geologic features of interest and are positionally accurate within 40 feet. The process of selecting maps for management use begins with the identification of existing geologic maps and mapping needs in vicinity of the park. Scoping session participants then select appropriate source maps for the digital geologic data to be derived by GRE staff as well as determine areas in need of further mapping or refinement. Tables 2 and 3 (at the end of this document) list the source maps chosen for Big South Fork National River and Recreation Area and Obed Wild and Scenic River as well as any further action required to make these maps appropriate for inclusion.

Park resource management identified geologic, landslide, and coal map coverage as needed data sets for BISO and OBRI. Early coal mapping often overlooked minor coal beds that were not economically viable. The parks also need to know which coal seams contain significant sulfur. Both Big South Fork and Obed River also expressed interest in obtaining map coverage in their respective watersheds for the upstream reaches of the rivers that flow through the parks (7.5' quadrangles: Wiborg, Nevelsville, Whitley City, Barthell, Bell Farm, Ketchen, Winfield, Oneida North, Barthell Southwest, Sharp Place, Pioneer, Huntsville, Oneida South, Honey Creek, Stockton, Jamestown, Jacksboro, Block, Norma, Robbins, Rugby, Burrville, Grimsley, Lake City, Duncan Flats, Fork Mountain, Gobey, Pilot Mountain, Twin Bridges, Jones Knob, Clarkrange, Windrock, Petros, Camp Austin, Lancing, Hebbertsburg, Fox Creek, Isoline, Campbell Junction, Cardiff, Ozone, Dorton, Crossville, Pleasant Hill, Roddy, Grassy Cove, Vandever, and Melvine).

For the Kentucky portion of BISO, large-scale digital geologic mapping exists for all quadrangles of interest in Kentucky. The KYGS is in the process of ground checking and digitizing landslide maps. Coal feature maps are available for the areas of interest, but none of the mapping is digital at this time. GRE staff will likely work with the KYGS to find ways to get these features into a digital GIS format.

For the Tennessee portion of BISO and all of OBRI, 1:24,000-scale mapping needs persist in many quadrangles. During scoping, it was mentioned that the TDG is nearing completion of the Stockton, Robbins, Rugby, Gobey, Windrock, Petros and Lancing 7.5’ quadrangles. On October 24, 2008, Tim Connors spoke with Mike Hoyal (TDG) on current map status for Tennessee quadrangles. Mike mentioned that the Stockton 7.5’ should be released Summer 2009. Many of the other quadrangles are still in various stages of production. GRE staff would like to enter into discussions with TDG on the best approach for completing compiled BISO-OBRI digital geologic maps.

TDG staff are seeking support for mapping and could prioritize their efforts on the quadrangles needed for digital geologic map coverage at Big South Fork National River and Recreation Area and Obed Wild and Scenic River. The Tennessee State Map Committee assigns areas of focus and the GRE will work to encourage mapping on the Cumberland Plateau. Geologic mapping within the three states have different nomenclature for geologic units. GRE staff will need to correlate these differences and list both unit names for rock units that change across state boundaries. Tables 2 and 3 list the source maps chosen for Big South Fork National River and Recreation Area and Obed Wild and Scenic River and mapping needs in certain quadrangles, in addition to a unique “GMAP ID” number assigned to each map by GRE staff for data management purposes, map scale, and action items.

During the scoping in June 2007, it was desired to target by end of FY 2009 for any compilation of the BISO and OBRI digital geologic maps. However, given the unknown status for much of the Tennessee portion of these parks, it will likely take longer than that. Upon commencement of these projects, GRE staff will once again conduct a thorough review of all available data (bedrock, surficial, landslide, coal, etc.) and formats (paper, digital, published and unpublished) to determine the best plan for completing digital geologic maps for these two parks.

Current understanding of best available data and maps to use is as follows:

For the **Wiborg** 7.5’ quadrangle, GRE staff will use the following maps:

- (74714) Unknown authors, 2007, Spatial database of the Corbin 30x60 quadrangle, Kentucky. Kentucky Geological Survey, Digitally Vectorized Geological Quadrangle, 1:100,000 scale

- (74703) Taylor, A.R. and Thomas, R.E., 1982, Landslides and Related Features of the Wiborg, KY. Quadrangle, U.S. Geological Survey, Open-File Report OF-82-653 (G-13), 1:24,000 scale

For the **Nevelsville** 7.5’ quadrangle, GRE staff will use the following maps:

- (74717) Unknown authors, 2007, Spatial database of the Corbin 30x60 quadrangle, Kentucky. Kentucky Geological Survey, Digitally Vectorized Geological Quadrangle, 1:100,000 scale

- (74704) Taylor, A.R. and Thomas, R.E., 1982, Landslides and Related Features of the Nevelsville, KY. Quadrangle, U.S. Geological Survey, Open-File Report OF-82-653 (G-12), 1:24,000 scale

For the **Whitley City** 7.5' quadrangle, GRE staff will use the following maps:

- (74714) Unknown authors, 2007, Spatial database of the Corbin 30x60 quadrangle, Kentucky. Kentucky Geological Survey, Digitally Vectorized Geological Quadrangle, 1:100,000 scale

- (74706) Taylor, A.R. and Thomas, R.E., 1982, Landslides and Related Features of the Whitley City, KY. Quadrangle, U.S. Geological Survey, Open-File Report OF-82-653 (F-13), 1:24,000 scale

For the **Barthell** 7.5' quadrangle, GRE staff will use the following maps:

- (74714) Unknown authors, 2007, Spatial database of the Corbin 30x60 quadrangle, Kentucky. Kentucky Geological Survey, Digitally Vectorized Geological Quadrangle, 1:100,000 scale

- (74701) Taylor, A.R. and Thomas, R.E., 1982, Landslides and Related Features of the Barthell, KY. Quadrangle, U.S. Geological Survey, Open-File Report OF-82-653 (F-12), 1:24,000 scale

For the **Bell Farm** 7.5' quadrangle, GRE staff will use the following maps:

- (74714) Unknown authors, 2007, Spatial database of the Corbin 30x60 quadrangle, Kentucky. Kentucky Geological Survey, Digitally Vectorized Geological Quadrangle, 1:100,000 scale

- (74707) Taylor, A.R. and Thomas, R.E., 1982, Landslides and Related Features of the Bell Farm, Kentucky Quadrangle, U.S. Geological Survey, Open-File Report OF-82-653 (E-13), 1:24,000 scale

For the **Ketchen** 7.5' quadrangle, GRE staff will use the following maps:

- (74714) Unknown authors, 2007, Spatial database of the Corbin 30x60 quadrangle, Kentucky. Kentucky Geological Survey, Digitally Vectorized Geological Quadrangle, 1:100,000 scale

- (8242) Englund, K.J., 1966, Geologic map of the Ketchen quadrangle, Tennessee-Kentucky, U.S. Geological Survey, Geologic Quadrangle Map GQ-500, 1:24,000 scale

- (74713) Taylor, A.R. and Thomas, R.E., 1982, Landslides and Related Features of the Ketchen, Tenn. - KY. Quadrangle, U.S. Geological Survey, Open-File Report OF-82-653 (E-14), 1:24,000 scale

For the **Winfield** 7.5’ quadrangle, GRE staff will use the following maps:

- (74714) Unknown authors, 2007, Spatial database of the Corbin 30x60 quadrangle, Kentucky. Kentucky Geological Survey, Digitally Vectorized Geological Quadrangle, 1:100,000 scale

- (2427) Pomerene, J.B., 1964, Geology of the Whitley City quadrangle, Kentucky and the Kentucky part of the Winfield quadrangle, U.S. Geological Survey, GQ-260, 1:24,000 scale

- (74708) Taylor, A.R. and Thomas, R.E., 1982, Landslides and Related Features of the Winfield, Tenn. - KY. Quadrangle, U.S. Geological Survey, Open-File Report OF-82-653 (E-13), 1:24,000 scale

For the **Oneida North** 7.5’ quadrangle, GRE staff will use the following maps:

- (74714) Unknown authors, 2007, Spatial database of the Corbin 30x60 quadrangle, Kentucky. Kentucky Geological Survey, Digitally Vectorized Geological Quadrangle, 1:100,000 scale

- (1523) Pomerene, Joel B., 1964, Geology of the Barthell quadrangle and part of the Oneida North quadrangle, Kentucky, U.S. Geological Survey, GQ-314, 1:24,000 scale

- (74699) Taylor, A.R. and Thomas, R.E., 1982, Landslides and Related Features of the Oneida North, Tenn. - KY. Quadrangle, U.S. Geological Survey, Open-File Report OF-82-653 (E-12), 1:24,000 scale

For the **Barthell Southwest** 7.5’ quadrangle, GRE staff will use the following maps:

- (74714) Unknown authors, 2007, Spatial database of the Corbin 30x60 quadrangle, Kentucky. Kentucky Geological Survey, Digitally Vectorized Geological Quadrangle, 1:100,000 scale

- (1517) Smith, J. Hiram, 1978, Geologic map of the Bell Farm quadrangle and part of the Barthell SW quadrangle, McCreary and Wayne Counties, Kentucky, U.S. Geological Survey, GQ-1496, 1:24,000 scale

- (74700) Taylor, A.R. and Thomas, R.E., 1982, Landslides and Related Features of the Barthell SW, Tenn. - KY. Quadrangle, U.S. Geological Survey, Open-File Report OF-82-653 (E-11), 1:24,000 scale

For the **Sharp Place** 7.5’ quadrangle, GRE staff will use the following maps:

- (74714) Unknown authors, 2007, Spatial database of the Corbin 30x60 quadrangle, Kentucky. Kentucky Geological Survey, Digitally Vectorized Geological Quadrangle, 1:100,000 scale

- (1518) Taylor, Alfred R., 1977, Geologic map of the Parmleysville quadrangle and part of the Sharp Place quadrangle, Wayne and McCreary counties, Kentucky, U.S. Geological Survey, GQ-1405, 1:24,000 scale

- (74702) Taylor, A.R. and Thomas, R.E., 1982, Landslides and Related Features of the Sharp Place, Tenn. - KY. Quadrangle, U.S. Geological Survey, Open-File Report OF-82-653 (E-10), 1:24,000 scale

For oil & gas mapping coverage of the **Wiborg, Nevelsville, Whitley City, Barthell, Bell Farm, Ketchen, Winfield, Oneida North, Barthell SW, and Sharp Place** 7.5' quadrangles, GRE staff will contact the KGS for up-to-date coverage of oil and gas wells in Kentucky (similar information is available from the TDG for oil and gas wells in Tennessee) and will reference the following map:
(53368) Nuttall, B.C., 1999, Oil and gas map of the Corbin 30 x 60 minute quadrangle, Kentucky Geological Survey, Map and Chart Series MCS-11_022, 1:100,000 scale

For water well and spring mapping coverage of the **Wiborg, Nevelsville, Whitley City, Barthell, Bell Farm, Ketchen, Winfield, Oneida North, Barthell SW, and Sharp Place** 7.5' quadrangles, GRE staff will use the following map:
(56034) Davidson, O.B., 2003, Water well and spring map of the Corbin 30 x 60 minute quadrangle, Kentucky, Kentucky Geological Survey, Map and Chart Series MCS-12_054, 1:100,000 scale

For the **Pioneer** 7.5' quadrangle, GRE staff will use the following maps:

- (2425) Englund, K.J., 1957, Geology and coal resources of the Pioneer quadrangle, Scott and Campbell Counties, Tennessee, U.S. Geological Survey, C-39, 1:24,000 scale

- (74715) Taylor, A.R. and Thomas, R.E., 1982, Landslides and Related Features of the Pioneer, Tenn. - KY. Quadrangle, U.S. Geological Survey, Open-File Report OF-82-653, 1:24,000 scale

For the **Huntsville** 7.5' quadrangle, no large-scale geologic mapping coverage currently exists. Cooperate with the U.S. Geological Survey, Tennessee Division of Geology, and other mapping agencies to promote mapping of this quadrangle. GRE will use the following landslide map:
(74716) Taylor, A.R. and Thomas, R.E., 1982, Landslides and Related Features of the Huntsville, Tennessee 7.5' Quadrangle, U.S. Geological Survey, Open-File Report OF-82-653, 1:24,000 scale

For the **Oneida South** 7.5' quadrangle, no large-scale geologic mapping coverage currently exists. Cooperate with the U.S. Geological Survey, Tennessee Division of Geology, and other mapping agencies to promote mapping of this quadrangle. GRE will use the following landslide map:
(74717) Taylor, A.R. and Thomas, R.E., 1982, Landslides and Related Features of the Oneida South, Tennessee 7.5' Quadrangle, U.S. Geological Survey, Open-File Report OF-82-653, 1:24,000 scale

For the **Honey Creek** 7.5' quadrangle, no large-scale geologic mapping coverage currently exists. Cooperate with the U.S. Geological Survey, Tennessee Division of Geology, and other mapping agencies to promote mapping of this quadrangle. GRE will use the following landslide map:
(74718) Taylor, A.R. and Thomas, R.E., 1982, Landslides and Related Features of the Honey Creek, Tennessee 7.5' Quadrangle, U.S. Geological Survey, Open-File Report OF-82-653, 1:24,000 scale

For the **Stockton** 7.5’ quadrangle, no large-scale geologic mapping coverage currently exists. Cooperate with the U.S. Geological Survey, Tennessee Division of Geology, and other mapping agencies to promote mapping of this quadrangle. GRE will use the following landslide map: (74719) Taylor, A.R. and Thomas, R.E., 1982, Landslides and Related Features of the Stockton, Tennessee 7.5' Quadrangle, U.S. Geological Survey, Open-File Report OF-82-653, 1:24,000 scale

For the **Jamestown** 7.5’ quadrangle, GRE staff will use the following maps:

- (67756) Milici, R.C. and Moore, J.L., 1992, Geologic Map of the Jamestown Quadrangle, Tennessee, 79, Geologic Quadrangle Map GM 115-NW, 1:24,000 scale

- (74720) Taylor, A.R. and Thomas, R.E., 1982, Landslides and Related Features of the Jamestown, Tennessee 7.5' Quadrangle, U.S. Geological Survey, Open-File Report OF-82-653, 1:24,000 scale

For the **Jacksboro** 7.5’ quadrangle, GRE staff will use the following maps:

- (67754) Swingle, G.D., 1960, Geologic Map of the Jacksboro Quadrangle, Tennessee, 79, Geologic Quadrangle Map GM 136-SW, 1:31680 scale

- (74721) Taylor, A.R. and Thomas, R.E., 1982, Landslides and Related Features of the Jacksboro, Tennessee 7.5' Quadrangle, U.S. Geological Survey, Open-File Report OF-82-653, 1:24,000 scale

For the **Block** 7.5’ quadrangle, GRE staff will use the following maps:

- (68226) Luther, E.T., 1967, Geologic Map of the Block Quadrangle, Tennessee, 79, Geologic Quadrangle Map 128 SE, 1:24,000 scale

- (74722) Taylor, A.R. and Thomas, R.E., 1982, Landslides and Related Features of the Block, Tennessee 7.5' Quadrangle, U.S. Geological Survey, Open-File Report OF-82-653, 1:24,000 scale

For the **Norma** 7.5’ quadrangle, GRE staff will use the following maps:

- (68428) Luther, E.T. and Avery, G.G., 1970, Geologic Map of the Norma Quadrangle, Tennessee, 79, Geologic Quadrangle Map GM 128-SW, 1:24,000 scale

- (74723) Taylor, A.R. and Thomas, R.E., 1982, Landslides and Related Features of the Norma, Tennessee 7.5' Quadrangle, U.S. Geological Survey, Open-File Report OF-82-653, 1:24,000 scale

For the **Robbins** 7.5’ quadrangle, no large-scale geologic mapping coverage currently exists. Cooperate with the U.S. Geological Survey, Tennessee Division of Geology, and other mapping agencies to promote mapping of this quadrangle. GRE will use the following landslide map: (74724) Taylor, A.R. and Thomas, R.E., 1982, Landslides and Related Features of the Robbins, Tennessee 7.5' Quadrangle, U.S. Geological Survey, Open-File Report OF-82-653, 1:24,000 scale

For the **Rugby** 7.5’ quadrangle, no large-scale geologic mapping coverage currently exists. Cooperate with the U.S. Geological Survey, Tennessee Division of Geology, and other mapping agencies to promote mapping of this quadrangle. GRE will use the following landslide map: (74725) Taylor, A.R. and Thomas, R.E., 1982, Landslides and Related Features of the Rugby, Tennessee 7.5' Quadrangle, U.S. Geological Survey, Open-File Report OF-82-653, 1:24,000 scale

For the **Burrville** 7.5’ quadrangle, GRE staff will use the following maps:

- (67749) Jewell, J.W., 1972, Geologic Map of the Burrville Quadrangle, Tennessee, 79, Geologic Quadrangle Map 115-SE, 1:24,000 scale

- (74726) Taylor, A.R. and Thomas, R.E., 1982, Landslides and Related Features of the Burrville, Tennessee 7.5' Quadrangle, U.S. Geological Survey, Open-File Report OF-82-653, 1:24,000 scale

For the **Grimsley** 7.5’ quadrangle, no large-scale geologic mapping coverage currently exists. Cooperate with the U.S. Geological Survey, Tennessee Division of Geology, and other mapping agencies to promote mapping of this quadrangle. GRE will use the following landslide map: (74727) Taylor, A.R. and Thomas, R.E., 1982, Landslides and Related Features of the Grimsley, Tennessee 7.5' Quadrangle, U.S. Geological Survey, Open-File Report OF-82-653, 1:24,000 scale

For the **Lake City** 7.5’ quadrangle, GRE staff will use the following map:
(68365) Swingle, G.D., 1960, Geologic Map of the Lake City Quadrangle, Tennessee, 79, Geologic Quadrangle Map 137-NW, 1:31680 scale

For the **Duncan Flats** 7.5’ quadrangle, GRE staff will use the following maps:

- (68393) Statler, A.T.; Sykes, C.R., 1970, Geologic Map and Mineral Resources Summary of the Duncan Flats Quadrangle (Blackline Copy Only), Tennessee Division of Geology, Geologic Quadrangle Map 129 NE, 1:24,000 scale

- (74728) Taylor, A.R. and Thomas, R.E., 1982, Landslides and Related Features of the Duncan Flats, Tennessee 7.5' Quadrangle, U.S. Geological Survey, Open-File Report OF-82-653, 1:24,000 scale

For the **Fork Mountain** 7.5’ quadrangle, GRE staff will use the following maps:

- (68310) Garman, R.K.;Ferguson, C.C.;Jones, M.L., 1975, Geologic Map and Mineral Resources Summary of the Fork Mountain Quadrangle, Tennessee Division of Geology, Geologic Quadrangle Map 129 NW, 1:24,000 scale

- (74729) Taylor, A.R. and Thomas, R.E., 1982, Landslides and Related Features of the Fork Mountain, Tennessee 7.5' Quadrangle, U.S. Geological Survey, Open-File Report OF-82-653, 1:24,000 scale

For the **Gobey** 7.5’ quadrangle, no large-scale geologic mapping coverage currently exists. Cooperate with the U.S. Geological Survey, Tennessee Division of Geology, and other mapping agencies to promote mapping of this quadrangle. GRE will use the following landslide map:

(74730) Taylor, A.R. and Thomas, R.E., 1982, Landslides and Related Features of the Gobey Mountain, Tennessee 7.5' Quadrangle, U.S. Geological Survey, Open-File Report OF-82-653, 1:24,000 scale

For the **Pilot Mountain** 7.5’ quadrangle, GRE staff will use the following maps:

- (68448) Finlayson, C.P., Powell, R.L., Kronman, G.E., and Moore, J.L., 1985, Geologic Map of the Pilot Mountain Quadrangle, Tennessee, 79, Geologic Quadrangle Map GM 122-NW, 1:24,000 scale

- (74731) Taylor, A.R. and Thomas, R.E., 1982, Landslides and Related Features of the Pilot Mountain, Tennessee 7.5' Quadrangle, U.S. Geological Survey, Open-File Report OF-82-653, 1:24,000 scale

For the **Twin Bridges** 7.5’ quadrangle, GRE staff will use the following maps:

- (68526) Coker, A.E., 1965, Geologic Map of the Twin Bridges Quadrangle, Tennessee, 79, Geologic Quadrangle Map GM 116-NE, 1:24,000 scale

- (74732) Taylor, A.R. and Thomas, R.E., 1982, Landslides and Related Features of the Twin Bridges, Tennessee 7.5' Quadrangle, U.S. Geological Survey, Open-File Report OF-82-653, 1:24,000 scale

For the **Jones Knob** 7.5’ quadrangle, GRE staff will use the following maps:

- (67760) Coker, A.E., 1965, Geologic Map of the Jones Knob Quadrangle, Tennessee, 79, Geologic Quadrangle Map GM 116-NW, 1:24,000 scale

- (74733) Taylor, A.R. and Thomas, R.E., 1982, Landslides and Related Features of the Jones Knob, Tennessee 7.5' Quadrangle, U.S. Geological Survey, Open-File Report OF-82-653, 1:24,000 scale

For the **Clarkrange** 7.5’ quadrangle, no large-scale geologic mapping coverage currently exists. Cooperate with the U.S. Geological Survey, Tennessee Division of Geology, and other mapping agencies to promote mapping of this quadrangle. GRE will use the following landslide map: (74734) Taylor, A.R. and Thomas, R.E., 1982, Landslides and Related Features of the Clarkrange, Tennessee 7.5' Quadrangle, U.S. Geological Survey, Open-File Report OF-82-653, 1:24,000 scale

For the **Windrock** 7.5’ quadrangle, no mapping coverage currently exists. Cooperate with the U.S. Geological Survey, Tennessee Division of Geology, and other mapping agencies to promote mapping of this quadrangle.

For the **Petros** 7.5’ quadrangle, no large-scale geologic mapping coverage currently exists. Cooperate with the U.S. Geological Survey, Tennessee Division of Geology, and other mapping agencies to promote mapping of this quadrangle. GRE will use the following landslide map: (74736) Taylor, A.R. and Thomas, R.E., 1982, Landslides and Related Features of the Petros, Tennessee 7.5' Quadrangle, U.S. Geological Survey, Open-File Report OF-82-653, 1:24,000 scale

For the **Camp Austin** 7.5’ quadrangle, GRE staff will use the following maps:

- (74747) Moores, James L. and others, 2004, Geologic Map of the Camp Austin Quadrangle, Tennessee, 79, Geologic Quadrangle Map GM122-SE, 1:24,000 scale

- (74737) Taylor, A.R. and Thomas, R.E., 1982, Landslides and Related Features of the Camp Austin, Tennessee 7.5' Quadrangle, U.S. Geological Survey, Open-File Report OF-82-653, 1:24,000 scale

For the **Lancing** 7.5’ quadrangle, no large-scale geologic mapping coverage currently exists. Cooperate with the U.S. Geological Survey, Tennessee Division of Geology, and other mapping agencies to promote mapping of this quadrangle. GRE will use the following landslide map:
(74738) Taylor, A.R. and Thomas, R.E., 1982, Landslides and Related Features of the Lancing, Tennessee 7.5' Quadrangle, U.S. Geological Survey, Open-File Report OF-82-653, 1:24,000 scale

For the **Hebbertsburg** 7.5’ quadrangle, no large-scale geologic mapping coverage currently exists. Cooperate with the U.S. Geological Survey, Tennessee Division of Geology, and other mapping agencies to promote mapping of this quadrangle. GRE will use the following landslide map:
(74739) Taylor, A.R. and Thomas, R.E., 1982, Landslides and Related Features of the Hebbertsburg, Tennessee 7.5' Quadrangle, U.S. Geological Survey, Open-File Report OF-82-653, 1:24,000 scale

For the **Fox Creek** 7.5’ quadrangle, no large-scale geologic mapping coverage currently exists. Cooperate with the U.S. Geological Survey, Tennessee Division of Geology, and other mapping agencies to promote mapping of this quadrangle. GRE will use the following landslide map:
(74740) Taylor, A.R. and Thomas, R.E., 1982, Landslides and Related Features of the Fox Creek, Tennessee 7.5' Quadrangle, U.S. Geological Survey, Open-File Report OF-82-653, 1:24,000 scale

For the **Isoline** 7.5’ quadrangle, no large-scale geologic mapping coverage currently exists. Cooperate with the U.S. Geological Survey, Tennessee Division of Geology, and other mapping agencies to promote mapping of this quadrangle. GRE will use the following landslide map:
(74741) Taylor, A.R. and Thomas, R.E., 1982, Landslides and Related Features of the Isoline, Tennessee 7.5' Quadrangle, U.S. Geological Survey, Open-File Report OF-82-653, 1:24,000 scale

For the **Campbell Junction** 7.5’ quadrangle, no large-scale geologic mapping coverage currently exists. Cooperate with the U.S. Geological Survey, Tennessee Division of Geology, and other mapping agencies to promote mapping of this quadrangle. GRE will use the following landslide map:
(74742) Taylor, A.R. and Thomas, R.E., 1982, Landslides and Related Features of the Campbell Junction, Tennessee 7.5' Quadrangle, U.S. Geological Survey, Open-File Report OF-82-653, 1:24,000 scale

For the **Cardiff** 7.5’ quadrangle, GRE staff will use the following map:
(68241) Tiedemann, H.A., Jewell, J.W., and Swingle, G.D., 1965, Geologic Map of the Cardiff Quadrangle, Tennessee, 79, Geologic Quadrangle Map GM 123-NW, 1:24,000 scale

For the **Ozone** 7.5’ quadrangle, no mapping coverage currently exists. Cooperate with the U.S. Geological Survey, Tennessee Division of Geology, and other mapping agencies to promote mapping of this quadrangle.

For the **Dorton** 7.5’ quadrangle, no mapping coverage currently exists. Cooperate with the U.S. Geological Survey, Tennessee Division of Geology, and other mapping agencies to promote mapping of this quadrangle.

For the **Crossville** 7.5’ quadrangle, GRE staff will use the following maps:

- (68275) Moore, J.L., 1981, Geologic Map of the Crossville Quadrangle, Tennessee, 79, Geologic Quadrangle Map GM 109-NE, 1:24,000 scale

- (55998) Thomas, R.E., 1981, Landslides and related features, Tennessee; northwest half of Chattanooga 1x2 sheet, U.S. Geological Survey OF-81-1318, 1:24,000 scale

For the **Pleasant Hill** 7.5’ quadrangle, GRE staff will use the following maps:

- (68452) Moore, J.L., 1985, Geologic Map of the Pleasant Hill Quadrangle, Tennessee, 79, Geologic Quadrangle Map GM 109-NW, 1:24,000 scale

- (55998) Thomas, R.E., 1981, Landslides and related features, Tennessee; northwest half of Chattanooga 1x2 sheet, U.S. Geological Survey OF-81-1318, 1:24,000 scale

For the **Roddy** 7.5’ quadrangle, GRE staff will use the following map:
(68471) Milici, R.C. and Swingle, G.D., 1972, Geologic Map of the Roddy Quadrangle, Tennessee, 79, Geologic Quadrangle Map GM 117-SE, 1:24,000 scale

For the **Grassy Cove** 7.5’ quadrangle, GRE staff will use the following map:
(68328) Milici, R.C., 1965, Geologic Map of the Grassy Cove Quadrangle, Tennessee, 79, Geologic Quadrangle Map GM 117-SW, 1:24,000 scale

For the **Vandever** 7.5’ quadrangle, GRE staff will use the following maps:

- (68530) Moore, J.L. and Milici, R.C., 1990, Geologic Map of the Vandever Quadrangle, Tennessee, 79, Geologic Quadrangle Map GM 109-SE, 1:24,000 scale

- (55998) Thomas, R.E., 1981, Landslides and related features, Tennessee; northwest half of Chattanooga 1x2 sheet, U.S. Geological Survey OF-81-1318, 1:24,000 scale

For the **Melvine** 7.5’ quadrangle, GRE staff will use the following maps:

- (68403) Milici, R.C. and Coker, A.E., 1967, Geologic Map of the Melvine Quadrangle, Tennessee, 79, Geologic Quadrangle Map GM 110-NE, 1:24,000 scale

- (55998) Thomas, R.E., 1981, Landslides and related features, Tennessee; northwest half of Chattanooga 1x2 sheet, U.S. Geological Survey OF-81-1318, 1:24,000 scale

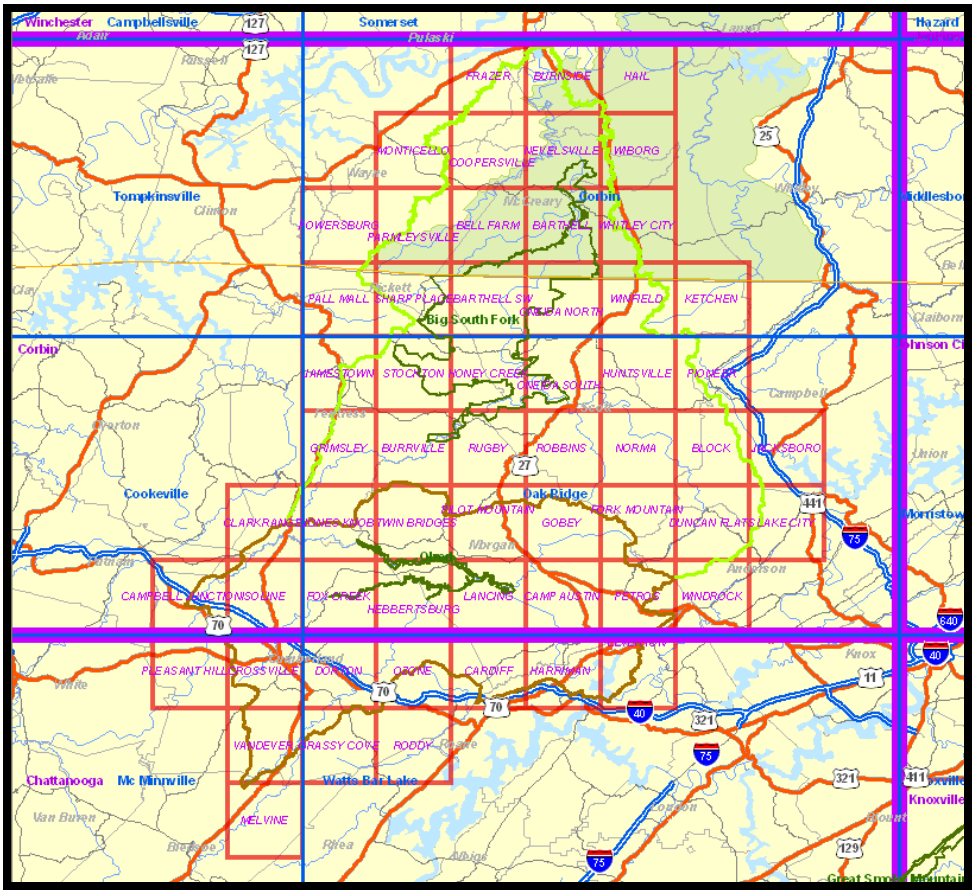

Figure 1. Quadrangles of interest for Big South Fork National River and Recreation Area and Obed Wild and Scenic River. The figure shows USGS 7.5' quadrangles (red outline), 30' × 60' sheet (blue outline, blue font labels), and 1° × 2° sheets (purple outline, purple font labels). The green outlines represent park boundaries. The watersheds of Big South Fork of the Cumberland River and Emory River are outlined in pale green and brown, respectively.

Additional items of interest pertaining to geologic mapping from the scoping

The parks have some interest in groundwater flow maps, mapping any cave and karst features, landscape evolution maps, and mapping landslide areas. The TDG and KGS will cooperate to reconcile different nomenclature for geologic mapping that crosses state boundaries. The KGS is layering geology with slope to determine specific correlations between geologic units and mass wasting potential. In addition to this, the KGS produces land use planning maps for every county in Kentucky and a similar product would be useful for park resource management, infrastructure planning, and interpretation programs at Big South Fork National River and Recreation Area and Obed Wild and Scenic River. The TDG has individual coal mine maps and drill hole information in Tennessee. Points of these locations should be a layer in the digital geologic map geodatabase. The mine maps may be useful to scan and include with the digital geologic map.

Geologic Resource Management Issues

The scoping session for Big South Fork National River and Recreation Area (BISO) and Obed Wild and Scenic River (OBRI) provided the opportunity to develop a list of geologic features and processes, which will be further explained in the final GRE report. During the meeting, participants prioritized the most significant geologic issues as follows:
(1) Fluvial issues
(2) Oil & gas development
(3) Coal mining, disturbed lands, and adjacent land use
(4) Mass wasting
(5) Ecological relationships
(6) Seismicity
(7) Paleontological resources

Fluvial Issues

The Big South Fork of the Cumberland River, Obed River and their associated tributaries are the primary natural resources at the parks. The free-flowing stretches of water are among the last in the eastern United States. The Obed River is classified as a Wild and Scenic River. Stretches of fast, turbulent white water and quiet pools surrounded by huge blocks of rock shed from the overlying bluffs characterize both rivers (figure 2). Obed River has pristine water quality. Both rivers offer recreation opportunities and vital riverine habitat. The inherent steepness of the river courses leads to high-energy instability along their corridors as well as a series of rapids for kayak and canoe use. Flows can range significantly over the course of a season. At Big South Fork, the flow can range between 10 and 50,000 cubic feet per second (cfs).

Important resources at both parks are large mid-stream cobble bars and outwash areas. These unique habitats are analogous to tall grass prairies, anchor adjacent mussel beds, and support threatened and endangered species. There are only 500 acres of this type of habitat left in Kentucky and Tennessee. As anthropogenic activities affect stream flow, channel morphology, and sediment load, these unique habitats are at risk of negative impacts.

Fluvial issues include riverbank and head-cutting erosion. At the Yamacraw Bridge area, the park (BISO) installed engineering structures such as boulder-filled blocks, gabions, cloth, and riprap to stabilize the shoreline at the canoe launch.

Increased sedimentation occurs in some streams near high use areas such as horse trails. Many horse trails with river crossings require stabilization and block reinforcement. Some trails were developed using a bulldozer that cut a wide swath through the forest. Subsequent accelerations in runoff and erosion locally increase sediment load and changes channel morphology. Flooding threatens park infrastructure including a boardwalk and gazebo at Big South Fork.

Coal mining has impacted the water quality of many of the streams in the region (i.e. Zenith and White Oak areas). Historically, large amounts of sediment and debris washed into the streams during the mining process. Waste water from coal processing also contributed to water quality degradation. The Mining activity often disrupts groundwater flow patterns. Today, many of the abandoned coal mines continue to severely impact both surface and ground water quality by the leaching of sulfuric acid from the pyritic shales found in the waste material (for more see Coal Mining, Disturbed Lands, and Adjacent Land Use section below).

Abandoned oil and gas wells also have the potential to adversely impact surface water quality from leaking pumpjacks, production equipment, and contaminated pits and soils. During rainfall events hydrocarbons and brine (produced water) can be washed in to nearby streams and degrade surface water quality. The following section contains more detailed information about oil and gas impacts at the parks.

Figure 2. View from Devils Jump overlook at BISO showing rapids formed by the steep gradient of the river and large block fall deposits shed from the overlying sandstone cliffs. Photograph is by Trista L. Thornberry-Ehrlich (Colorado State University).

Oil & Gas Development

The Mississippian-age geologic units are the primary oil and gas producers in the area. In 1818, salt mine operations along mineral seeps at Salt Town struck oil. Beatty Well #1 was the first commercial oil well in the United States at McCreary (then Wayne) County, Kentucky. At Big South Fork, oil and gas exploration activity is focused south of the park. In the Rugby quadrangle there are 900 oil and gas wells. Within the park boundary are 326 oil and gas related sites including wells, tank batteries, compressors, abandoned wells, peripheral sites and unreclaimed areas. Most of of the oil and gas development occurred before the 1974 enabling legislation for the park. The enabling legislation prohibits oil and gas extraction and development within the gorge area, but allows for permitted development in the adjacent areas. Since 1990, no new wells have been drilled within park boundaries. In 1991, developers drilled and plugged a well at Cooper, Kentucky west of Big South Fork. At Obed River, oil and gas wells concentrate north of the park with 55 wells located in the watershed. Five wells are sited within park boundaries. A company called Montello Resources has plans to drill a new well adjacent to the park near Howard White #1 – the site of a well blow-out on July 19, 2002. This well blow-out continues to leak hydrocarbons into the river. The National Park Service is in the midst of preparing an oil and gas management plan and environmental impact statement (EIS) that will address issues related to current and future management of oil and gas operations in both the Big South Fork National River and Recreation Area and Obed Wild and Scenic River.

Most oil and gas operations in the Big South Fork and Obed River area are small-scale operations conducted by small oil and gas companies. In the past, most of the oil and gas operators did not properly maintain and correct problems associated with their operations. Oil and gas activities in the area include shothole drilling and detonation, construction of roads, wellpads, production facilities, flowlines, and pipelines, and ATV and truck use to access to oil and gas operations areas. Shothole drilling and detonation have not yet occurred inside park boundaries, but could happen associated with future 3-D seismic exploration. Poor drilling practices and well maintenance have caused a number of issues including eroding access roads and wellpads, resulting in increased surface runoff and erosion, rutting and compaction; loss of soil productivity; leaking pumpjacks, flowlines, and pipelines; contaminated pits; leaking gas wells; tank batteries and loading areas leaking fuel; and brine contamination that has harmed vegetation and riparian areas. The lack of fencing around wellsites poses public safety problems. Many pumpjacks are on timers, which are disruptive to the natural soundscapes in the parks.

As technology advances and the economic interest increases, exploration for deeper reservoirs and resources may accelerate in the parks' areas. Wells to the west of the parks have been drilled as deep as 180 m (600 ft). New wells may encounter natural gas reservoirs. These wells produce longer than traditional oil wells and have a longer impact on the environment.

Coal Mining, Disturbed Lands, and Adjacent Land Use

The Cumberland Plateau has long been associated with coal mining. In the Big South Fork and Obed River area, significant coal beds exist between and within the Mississippian- and Pennsylvanian-age strata including the White Oak, Wilder, Nemo, Rex, Hooper, Poplar Creek, Coal Creek, Jellico, Big Mary, and Peewee Coals (Tennessee nomenclature). Remnants from large operations persist at Blue Heron and Worley at Big South Fork. The largest coal mining operation in the Cumberland Watershed was by the Stearns Coal and Lumber Company founded in 1902. At its peak in 1929, the Stearns Coal Zone of the middle and lower Beattyville Shale Member of the Lee Formation (Kentucky nomenclature) produced 1,000,000 tons of coal. Local mining continues today. At Big South Fork, legislation prohibits mining within the gorge, but permits extraction on the plateau. No surface or strip mining is permitted. Approximately 20,000 acres of parkland have outstanding private mineral rights.

Active mining is taking place in the New River Basin. Because the Big South Fork NRRA lies in the downstream portion of a very large watershed, adjacent land uses including coal mining, oil and gas development and logging create resource management issues for the park. According to the enabling legislation for Big South Fork NRRA, the park has jurisdiction over the water quality of New River and thus some authority in determining land use activities there. The Tennessee Valley Authority owns 20% of the coal in the New River basin. Proposals to develop surface mines there are on hold pending an EIS for the coal leasing program. The EIS will be prepared, in part due to a petition filed by the National Parks Conservation Association and National Audubon Society with the Office of Surface Mining, Reclamation and Enforcement requesting compliance with the Surface Mining Control and Reclamation Act of 1977. Technology advances make it possible to use dirtier coals for energy and areas once considered unviable due to the low quality of the coal are experiencing new interest. There is no mineral exploration at Obed Wild and Scenic River, but surrounding areas have coal mining and operations there may negatively impact park resources.

Coal mining artificially exposes coal to air and water. When high-sulfur coal and pyritic shale deposits are exposed to air and water, oxidation produces acidic drainage. Acid mine drainage is a condition resulting from sulfides (pyrite – FeS_2) reacting with water and lowering the pH by producing sulfuric acid (H_2SO_4), sulfate (SO_4^{2-}), and reduced ferrous iron (Fe^{2+}). This reaction is self-sustaining in the presence of Thiobacillus bacteria, which generate energy by using oxygen from the atmosphere to oxidize ferrous iron (Fe^{2+}) to ferric iron (Fe^{3+}) which in turn reacts with more iron sulfide to produce more ferrous iron for the bacteria and sulfuric acid. The cycle continues until the iron sulfide supply is exhausted. High acidity increases the solubility of some potentially harmful metals. Acidic drainage from mine features in the area may include iron, heavy metals, and traces of hydrocarbons in solution and is often referred to as contaminated mine drainage.

Big South Fork contains 112 known mine openings, the majority of which are in Kentucky. Most of these mines were deep shafts that following a coal seam and incorporated local streams and ventilation punchouts on a nearby slope face. At Big South Fork, various local streams and springs drain abandoned coal mines some of which expose high-sulfur coals (figure 3). Streams such as Bear and Rock Creeks have pH levels ranging between 2 and 4.5, prior to any remediation. There are 15 acid mine drainage streams in the park. Mine areas susceptible to acid mine drainage include Zenith and White Oak.

Low pH streams are often devoid of aquatic life. The park wants to increase pH in affected areas. There are at least 15 different methods to treat contaminated mine drainage. Many involve wetlands and bogs, ponds, and limestone neutralization. At Rock Creek, the State of Kentucky raised the stream's pH by 2 units by dumping limestone sand into the drainage. Natural buffering occurs where carbonate-rich rocks or intergranular cements underlie acidic streams. Remediation of many sites in the park is limited by the size of the exposed creek bed and local topography. Some techniques involve the formation of a series of pools; each controlling a particular chemical reaction to neutralize the water and collect heavy metal precipitates. Some streams have limited area to construct the pools and other necessary structures to neutralize the water before it enters Big South Fork. For example, at Worley, eight acres are necessary to remediate the mine drainage, but only four are available.

In addition to contaminated mine drainage, abandoned coal mines are associated with geologic hazards including shaft collapse and subsidence holes. Two subsidence holes are a result of the collapse of underlying coal mine features in the Kentucky portion of Big South Fork. Potential exists for collapse and subsidence into many other abandoned coal mine features. Piles of soil and rock plug most mine openings, but as this unconsolidated fill settles and slumps, some openings are exposed. Other openings have metal gates preventing access. The park would prefer to use bat gates for mine closures to allow bats access to cave habitat and to prevent public access.

Mine tailings and spoils also present resource management issues because the unconsolidated deposits are prone to mass wasting. At Blue Heron, spoil piles were pushed into a nearby spring. Water from the spring lubricates the underlying deposits and solifluction moves large masses downslope opening large crevasses. Below the Devils Jump Overlook, mine spoil piles and an old railroad bed flank the eastern edge of the river (figure 4). The spoil piles are slow to revegetate and today appear as a conspicuous grassy slope. During 1985 reclamation efforts by the U.S. Army Corps of Engineers, a D-9 bulldozer was stuck and buried beneath the unconsolidated material. As with the Blue Heron site, local springs lubricate the bottom of the spoil pile resulting in contaminated mine waste flowing into Big South Fork. In the New River corner of the basin, steeper gradients associated with spoil piles resulted in ~26-acre slides. This area is outside the park, but could impact water resources of the New River and Big South Fork.

The Pennsylvanian sandstone units in both park areas make attractive building material and flagstones. On the western side of Big South Fork, dimension stones derived from the Rockcastle Conglomerate are quarried for local developments. Obed River recently acquired an abandoned sandstone quarry near Clear Creek. Early German settlers mined rocks to crush for aggregate along Williams Creek and Cub Branch. Most of the roadways in Scott County contain material from early quarrying. Some colluvial mining is ongoing, but is small in scale. Rock mining creates significant surface disturbances.

Other land use activities including logging and ATV use are of concern to resource management at Big South Fork and Obed River. ATV access is not approved except during hunting season on multipurpose trails, but illegal use still occurs. The North White Oak region may be an ATV planning area. Impacts from illegal ATV use include increased erosion, rutting, compaction, and ecosystem degradation. The Scott Forest, adjacent to Obed River is subject to logging. The park has scenic easements, but private landowners retained timber rights that allow limited logging with park regulatory involvement. Early developers did not properly abandon access roads in the parks. Some abandoned access roads from mining, logging, and oil and gas are now used for multi-purpose trails. There are 645 km (400 miles) of roads and trails at Big South Fork plus an additional 160 km (100 miles) of roads related to oil and gas operations. The parks want to concentrate use at public trailheads. Erosion and subsequent sedimentation in local streams occurs on sloped access roads.

As local populations increase, the parks are concerned about negative impacts on their natural resources. There are very few regulations on housing/urban development in this area of Tennessee and Kentucky. As populations increase and development proceeds, stabilizing forests will be logged, impermeable surfaces such as roads, parking lots, and driveways will increase. Potential negative effects range from overuse of the parks' facilities, increased erosion and sediment load to water contamination from septic systems and sewers as well as increased surface runoff.

Figure 3. Contaminated mine drainage in a stream at the Worley area at BISO. Note the orange colored precipitate coating the stream rocks. View is looking upstream from the riverbank of the Big South Fork of the Cumberland River. Photograph is by Trista L. Thornberry-Ehrlich (Colorado State University).

Figure 4. View from Devils Jump Overlook of remediated mine waste area (grassy slope) at BISO. Note the difference in vegetation between the remediated area and surrounding forest. Photograph is by Trista L. Thornberry-Ehrlich (Colorado State University).

Mass Wasting

The Big South Fork of the Cumberland River and Obed River cut through steep slopes, terraces, bluffs, and alluvial fans. Gravity, frost and plant root wedging, differential erosion, and minor karst dissolution are primary natural causes of slope instability. As such, hillslope processes such as landsliding and rockfall are a prevalent issue at both parks. Geologic units containing significant shale layers act as regional slip surfaces and are often present at the toe of slides. The Mississippian-age Pennington Formation contains expandable clays that cause instability, but this unit only outcrops in the deepest reaches of the gorge at Big South Fork. At Worley, eroding unburned "paper" shales contain naturally occurring arsenic and cyanide (figure 5). These shales wash off the upland hillsides and into the river causing local contamination. The roadway down in to the gorge at the Blue Heron mining camp is prone to landslides, especially in the shale layers associated with the contact between Mississippian- and Pennsylvanian-age rocks. Sprayed concrete and drain structures have been used in this area to mitigate the slide hazard.

Colluvial fans composed of loose and incoherent deposits transported by gravity occur at the base of many slopes and bluffs along the river corridors. Ancient rockfalls and slides left scars along the slopes of the river valleys and large blocks of Pennsylvanian sandstone are ubiquitous with the valley floors. Any steep slope at the parks poses a landslide hazard and rockfall is a threat along

long stretches of the rivers. Most ancient slides are more or less stable. Anthropogenic changes to the hill slopes such as road and trail construction, mining, undercutting, and deforestation are the most common triggers of active sliding. Engineering structures designed to redirect water and stabilize riverbanks often lead to instability and reactivation of old landslides. Visitors need to be aware of rockfall potential and warned about active slide and rockfall areas.

Figure 5. Paper shales (dark flaky rock) in the Worley area containing natural arsenic and cyanide. Photograph is taken at the edge of Big South Fork of the Cumberland River. Photograph is by Trista L. Thornberry-Ehrlich (Colorado State University).

Ecological Relationships

Important correlations exist between flora, fauna, and geologic outcrops at Big South Fork and Obed River. This area sits at the intersection of 2-3 climate zones and contains more plant families of woody species than the Great Smoky Mountains. Rocks containing intergranular calcareous cements support localized colonies of aquatic life, plants (ferns), birds and animals. Other plant communities are associated with cliffs and the shaly contact areas between large sandstone units. The many stone shelters and alcoves provide unique habitats for bats, plants (e.g. sandwort and a newly described lily), and other animals in the region. Threatened and endangered Indiana bats roost in trees and stone shelters in the area during summer feeding seasons. They hibernate in karst caves further north during the winter months. Three ancient crayfish species survived periglacial conditions during the Pleistocene Ice Age events in the Roaring Paunch Creek drainage and eventually repopulated streams throughout the region. Twenty-six species of mussels are present in the Big South Fork gorge six of which are threatened and endangered. This is among the most diverse mussel assemblage for any river in the country. In areas where acid mine drainage has lowered pH, the mussels are absent. In areas where the high acidity is diluted between New River and Bear Creek, populations are flourishing. Detailed geologic maps of these areas could help focus ecological research at both parks.

Seismicity

Both parks are north of the Southern Appalachian Seismic Zone, which runs just northeast of Knoxville, Tennessee. Nearly 100 small earthquakes occur every year along this zone. Most of these events are too minor to be felt at the surface, but the potential for seismicity is present at Big South Fork and Obed River. Seismic events may trigger landslides, rockfall and damage park infrastructure. The U.S. Geological Survey and the Center for Earthquake Research and Education with the University of Memphis monitor seismic activity throughout the region.

Paleontological Resources

The marine deposits of the Mississippian Period are fossiliferous on the Cumberland Plateau. Exposed at Leavenworth Ford in Big South Fork, Mississippian fossils include horn corals and other coelenterates, bivalves, blastoids, and linguila brachiopods. Pennsylvanian age rocks at both parks contain abundant plant fossil remains (paleodendron, lepidodendron), trace fossils and tree casts (figure 6). Other fossils include calamites, sphenophylla bushes, medulosa and sigillaria. Many fossils occur in friable shales and at the tops of coal beds, which flex and swell with humidity and are not durable for long-term preservation. Most invertebrate fossils are not considered rare or especially valuable, but the threat of theft is still possible. Exposed in McCreary County outside of Big South Fork park boundaries, is a primitive reptile trackway in the Pennsylvanian-age Rockcastle Conglomerate. Other trackways may exist in rocks within the parks. The potential also exists for Pleistocene animal remains (cave bears, mastodons, mammoths, etc.) in the many stone shelters, notches, and small caves throughout the parks.

Tom Des Jean (NPS-BISO) in 2006 compiled a paleontological resource inventory of Big South Fork from literature sources and limited field observations. The Smithsonian also conducted a recent fossil survey (contact: Bill DiMichelle) (Greb written communication 2009). There is potential for insect, amphibian, and vertebrate fossils to exist within both park boundaries. Formal field-intensive paleontological inventories of Big South Fork National River and Recreation Area and Obed Wild and Scenic River do not exist, but a literature review of all paleontological data related to the parks is being done for the NPS Inventory and monitoring program. A comprehensive inventory of the paleontological resources in the parks would be a valuable data set for resource management and potential interpretive programs at both parks.

Figure 6. Fossil wood fragments from lepidodendron at BISO along the trail to Angel Falls. Photograph is by Trista L. Thornberry-Ehrlich (Colorado State University).

Features and Processes

Arches and Stone Shelters

At Big South Fork National River and Recreation Area and Obed Wild and Scenic River, lithology, preferential erosion, oriented fracture sets, ridgeline location, and local dipping beds control the formation of certain geomorphic features such as arches, overhangs, balanced rocks, chimneys, and stone shelters. Notable examples of these types of features include Chimney Rocks, Twin Arches, Split Bow, and Needle Arch at Big South Fork as well as an arch along Point Trail, and Devils Breakfast Table at Obed River. These features tend to form in resistant Pennsylvanian-age sandstones that are locally undercut by erosion of less resistant underlying shales and siltstones. A single ridge can host a suite of features ranging in erosional development from an overhang to an arch followed by a fin to a chimney, which is the last erosional remnant of a ridgeline.

Stone shelters contain significant cultural and archaeological resources at both parks (figure 7). Remnants include flint chips, arrowheads, fragments of torches, and skeletal remains. The archaeological record at the parks preserves 10,000 years of human occupation. Stone shelters hosted prehistoric big game hunting camps. These Paleo-Indians used fluted points. From the early Archaic to the middle Archaic, climate changes caused crops to fail and a population decline. By the Late Archaic, people returned to the uplands during summer hunting expeditions and spent the winter months in the more temperate, sheltered lower valley elevations. During the Woodland Period, there were isolated encampments rather than large villages due the region's narrow gorges and a lack of riverine area for agriculture. During the late Mississippian Period (archaeological time period A.D. 1,000-1,400), local indigenous tribes were better adapted to the dry, rugged conditions of the uplands of the Cumberland Plateau and populations increased. The archaeological record preserves changes in subsistence practices.

Centuries later, miners extracted potassium nitrate (saltpetre or "nitre") from sediments in small caves and shelters. Saltpetre is an oxidizing component that is combined with charcoal and brimstone (sulfur) to make black powder. Mining for saltpetre from cliff mines at Big South Fork flourished around the time of the War of 1812 and there was a local resurgence during the American Civil War. Remnants from this activity include old workings as well as wooden supports, which may pose a collapse hazard in certain areas. At Big South Fork at Half Field Ridge, 150-year-old oak posts support large boulders associated with nitre mining. Stone shelters also became early homes for settlers to the region. Some remote areas of the park housed moonshine distilleries.

The exact number and locations of these features remains enigmatic due to their remoteness and vegetative cover. The concentration of arches at Big South Fork may rival Arches National Park in Utah.

Figure 7. Stone shelter at BISO containing archaeological artifacts including flint flakes. Photograph is by Trista L. Thornberry-Ehrlich (Colorado State University).

Caves and Karst

Karst processes are active to a minor degree on the landscape at Big South Fork and Obed River. Karstification involves the processes of chemical erosion and weathering of limestone or dolomite (carbonate rocks) (Palmer, 1981). Dissolution occurs when acidic water reacts with carbonate rock surfaces along cracks and fractures. At Big South Fork and Obed River, karst dissolution occurs in every unit that contains carbonate or carbonate cemented sandstone. Karst features have not developed to any appreciable extent unlike other areas of Kentucky and Tennessee because the primary limestone Mississippian age units are only exposed in the deepest part of the gorges.

Karst features include small caves, conduits, pits, alcoves, and springs (figure 8). Dissolution caves at Big South Fork include True Cave at Oil Well Branch and small openings along Angel Falls trail. There may be more karst development in the western areas of the watershed (Highland Rim) near Wilder and Jamestown. Further karst and cave feature identification, mapping, and digitization is a significant resource management need at Big South Fork National River and Recreation Area and Obed Wild and Scenic River. Any caves are at risk of vandalism, archaeological looting, and speleothem theft at the parks. Cave locations and maps are considered sensitive data.

Figure 8. Small cave along the trail to Angel Falls at BISO. Photograph is by Trista L. Thornberry-Ehrlich (Colorado State University).

Lake Cumberland

Lake Cumberland is located along the northernmost 13 km (8 miles) of the Big South Fork of the Cumberland River in the park. The lake level fluctuates depending on the management of the dam. It is the largest reservoir in the United States east of the Mississippi River. The U.S. Army Corps of Engineers built the dam on geologic units prone to karstification. At present, the reservoir levels are low to allow the corps to install a new apron to the front of the dam and regrout exposed holes in the dam. This process should take 6-7 years.

Other lacustrine features in the parks' areas include a few small ponds and bogs.

Gorges and Bluffs

The focal points of both parks are the narrow, v-shaped gorges and sheer bluffs along the larger waterways. Bluffs above the Obed River are as high as 150 m (500 ft) above the gorge floor. The nearly vertical cliffs and overhangs of Pennsylvanian-age sandstone are attractive to climbers and the area has become a major recreation destination. Obed Wild and Scenic River has a climbing management plan to deal with the impacts and hazards associated with extensive rock climbing in the park. Popular climbing areas are often overused causing local vegetation to be trampled at the top and bottom of the routes. Drilling anchors into the rock for securing ropes may degrade the rock face. Climbing may disturb delicate habitat along cliff faces and alcoves. Visitor safety in the face of potential rockfall is also a concern for park management. Currently, climbers need permits to climb at Obed River and the park is restricting the development of any new rock climbing routes. Management hopes to protect fragile habitat by removing some routes and diverting trails away from cliffs. Big South Fork National River and Recreation Area is also a potential hotspot for climbing recreation especially at areas such as O&W along the gorge. At present, there is no management plan in-place for climbing there.

Periglacial Features

Entrenchment of the gorges at Big South Fork and Obed River may have interesting connections to the evolution of the Ohio River Valley drainage before and after the Pleistocene ice ages. Prior to the advance of glacial ice, the Ohio River was but a small tributary to the Mississippi River. Drainage of the Appalachian area was further north. Upon advance of thick glacial ice during the Pleistocene, the northern drainage was dammed and water was forced to carve the Ohio River Valley. This in turn caused major downcutting of regional rivers. These connections, if present, are complex and not yet well understood.

Type Sections and Other Unique Features

Type sections refer to the originally described sequence of strata that constitute a geologic unit. It serves as an objective standard for comparison with spatially separated parts of that same unit. Preferably, a type section describes an exposure in an area of maximum unit thickness and completeness. There are excellent quality exposures of the Pennsylvanian sandstones in bluffs along the gorges in both parks. Outside of Obed Wild and Scenic River, but potentially in the area to be mapped may be type sections for the Vandever Formation, Newton Sandstone, Whitwell Shale, Dorton Shale, and Rockcastle Conglomerate (in the Jamestown quadrangle).

The sheer cliffs along the gorges at Big South Fork and Obed River are striking geologic features at both parks. Relief in some stretches is more than 150 m (500 ft). These waterways contain many named rapids, some of which are class IV. Waterfalls are prevalent during the high flow seasons including Slate Falls in Tennessee. Yahoo Falls along the Kentucky stretch of Big South Fork are the highest in the state.

Mineral seeps and salt springs near Bear Creek and Oil Well Branch fueled early settlements in the area. Salt-saturated water was boiled to extract the salt crystals. During early land grant programs, a parcel of land was available in exchange for a specified quantity of salt. Abundant local coal and clay deposits also supported a brick factory in Robbins, Tennessee.

When coal seams ignite, often due to lightning strikes or human activities, the heat from the burning coal bakes the overlying rock layers. Remnants of this process are called "red dog" or clinker. This material is hard and brittle, pH neutral, and makes an excellent trail base. The park would like to put clinker down as a trail base on well-used horse paths prone to intense erosion, but have limited resources to do so. Known locations of clinker deposits throughout the park areas would be a useful data set for resource management.

Recommendations

(1) Perform further groundwater dye trace studies to understand the flow of groundwater in both parks and delineate the subterranean watershed.
(2) Use the KGS Geoportal online to access a variety of geologic information including local maps, GIS layers, aerial photographs, well sites, etc. as well as links to other Kentucky publications, records, and maps. Website is: kgsweb.uky.edu/main.asp
(3) Perform a comprehensive paleontological inventory of the river corridors. Establish a plan to deal with potential illegal sampling and collecting of fossils in the parks.
(4) Seek NPS funds for more operational support for oil and gas sites.
(5) Research rock structures below the river for potential habitat for aquatic organisms.
(6) Locate and inventory all vertebrate paleontological resources, archaeological and cultural remains in stone overhangs, shelters, and small caves in the parks.
(7) Study sedimentation patterns and distribution along both river corridors noting areas of sediment loss and gain.
(8) Increase awareness of and monitor seismic activity through the websites managed by the U.S. Geological Survey and Center for Earthquake Research and Education (University of Memphis).
(9) Promote research into the overall tectonic history of the region as the rivers expose rocks that are elsewhere covered and/or overgrown including understanding the relationships between structure, stratigraphy, economic resource development, etc., as well as the fluvial geomorphology, and mass wasting history in the parks through careful mapping and stratigraphic studies.
(10) Determine locations and extents of geologic units with significant carbonate content either as whole rock limestone or as intergranular cement that may be useful in buffering of acid mine drainage.
(11) Locate all high sulfur coal seams within the parks and target areas where seams are exposed near surface streams and springs for pH monitoring.
(12) Develop a basin-wide hydrogeologic model.
(13) Gather baseline information for contamination research and future monitoring.

(14) Allocate resources for stabilizing roads and trails, remediate other abandoned access roads. Locate and map all clinker deposits.
(15) Continue to remediate contaminated mine sites.
(16) Attempt to purchase existing mineral rights for areas inside the park boundaries and potentially adjacent areas.
(17) Map spoil areas and mines using aerial photographs, ground checking, and historical information.
(18) Interpret the geologic map for both parks for visitors focusing on formation of the gorges, geologic resources, historic mineral extraction and settlement patterns.

Action Items

(1) GRE staff will discuss promoting cave inventory with NPS-GRD.
(2) GRE will produce digital geologic map for Big South Fork and Obed River including landslide and coal feature coverage (see above geologic mapping section).
(3) GRD personnel should contact federal contacts on the State Map Committee to encourage focusing mapping in Tennessee on the Cumberland Plateau area.
(4) GRE report author will obtain a PDF on coal beds in Tennessee at www.tngis.org.
(5) GRD will consider a possible paleontological inventory for the parks.
(6) GRE geologic map team will investigate academic studies of the Cumberland Plateau to compile map unit descriptions for digital geologic map help file.
(7) GRE report author will access federal and state reports regarding acid mine drainage, oil and gas development, and geochemical studies throughout the area.
(8) GRE report author will research Rock Creek reclamation project at www.epa.gov/owow/nps/success319/state/ky/htm and locate AGI publications for coal remediation work.
(9) GRE report author will obtain Bill Wolf's paper, a U.S. Geological Survey geomorphological study in river and stream hydrology.

References

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Table 1. Scoping Meeting Participants

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Table 2. GRE Mapping Plan for Big South Fork National River and Recreation Area

Table 2. GRE Mapping Plan for Big South Fork National River and Recreation Area

Covered Quadrangles	GMAP[1] ID	Reference	GRE appraisal	GRE Action	Scale
Wiborg	74714	Unknown authors, 2007, Spatial database of the Corbin 30x60 quadrangle, Kentucky. Kentucky Geological Survey, Digitally Vectorized Geological Quadrangle	(1522) Smith, J. Hiram, 1970, Geologic map of the Wiborg quadrangle, McCreary County, Kentucky, U.S. Geological Survey, GQ-867	Conversion after checking to see that all attributes from original paper reference (preceding column) were captured	100000 compiled from 24000
Wiborg	74703	Taylor, A.R. and Thomas, R.E., 1982, Landslides and Related Features of the Wiborg, KY. Quadrangle, U.S. Geological Survey, Open-File Report OF-82-653 (G-13)	Landslide data would be useful for RM, KGS may be digitizing	Check with KGS as to digitization status, digitize or convert	24000
Nevelsville	74714	Unknown authors, 2007, Spatial database of the Corbin 30x60 quadrangle, Kentucky. Kentucky Geological Survey, Digitally Vectorized Geological Quadrangle	(1520) Smith, J. Hiram, 1976, Geologic map of the Nevelsville quadrangle, south-central Kentucky, U.S. Geological Survey, GQ-1326	Conversion after checking to see that all attributes from original paper reference (preceding column) were captured	100000 compiled from 24000
Nevelsville	74704	Taylor, A.R. and Thomas, R.E., 1982, Landslides and Related Features of the Nevelsville, KY. Quadrangle, U.S. Geological Survey, Open-File Report OF-82-653 (G-12)	Landslide data would be useful for RM, KGS may be digitizing	Check with KGS as to digitization status, digitize or convert	24000
Whitley City	74714	Unknown authors, 2007, Spatial database of the Corbin 30x60 quadrangle, Kentucky. Kentucky Geological Survey, Digitally Vectorized Geological Quadrangle	(2427) Pomerene, J.B., 1964, Geology of the Whitley City quadrangle, Kentucky and the Kentucky part of the Winfield quadrangle, U.S. Geological Survey, GQ-260	Conversion after checking to see that all attributes from original paper reference (preceding column) were captured	100000 compiled from 24000
Whitley City	74706	Taylor, A.R. and Thomas, R.E., 1982, Landslides and Related Features of the Whitley City, KY. Quadrangle, U.S. Geological Survey, Open-File Report OF-82-653 (F-13)	Landslide data would be useful for RM, KGS may be digitizing	Check with KGS as to digitization status, digitize or convert	24000
Barthell	74714	Unknown authors, 2007, Spatial database of the Corbin 30x60 quadrangle, Kentucky. Kentucky Geological Survey, Digitally Vectorized Geological Quadrangle	(1523) Pomerene, Joel B., 1964, Geology of the Barthell quadrangle and part of the Oneida North quadrangle, Kentucky, U.S. Geological Survey, GQ-314	Conversion after checking to see that all attributes from original paper reference (preceding column) were captured	100000 compiled from 24000
Barthell	74701	Taylor, A.R. and Thomas, R.E., 1982, Landslides and Related Features of the Barthell, KY. Quadrangle, U.S. Geological Survey, Open-File Report OF-82-653 (F-12)	Landslide data would be useful for RM, KGS may be digitizing	Check with KGS as to digitization status, digitize or convert	24000
Bell Farm	74714	Unknown authors, 2007, Spatial database of the Corbin 30x60 quadrangle, Kentucky. Kentucky Geological Survey, Digitally Vectorized Geological Quadrangle	(1517) Smith, J. Hiram, 1978, Geologic map of the Bell Farm quadrangle and part of the Barthell SW quadrangle, McCreary and Wayne Counties, Kentucky, U.S. Geological Survey, GQ-1496	Conversion after checking to see that all attributes from original paper reference (preceding column) were captured	100000 compiled from 24000

Table 2. GRE Mapping Plan for Big South Fork National River and Recreation Area

Covered Quadrangles	GMAP[1] ID	Reference	GRE appraisal	GRE Action	Scale
Bell Farm	74707	Taylor, A.R. and Thomas, R.E., 1982, Landslides and Related Features of the Bell Farm, Kentucky Quadrangle, U.S. Geological Survey, Open-File Report OF-82-653 (E-13)	Landslide data would be useful for RM, KGS may be digitizing	Check with KGS as to digitization status, digitize or convert	v
Ketchen	74714	Unknown authors, 2007, Spatial database of the Corbin 30x60 quadrangle, Kentucky. Kentucky Geological Survey, Digitally Vectorized Geological Quadrangle	Digital coverage is of KY portion, paper reference in following row for TN portion	Conversion after checking to see that all attributes from original paper reference were captured	100000 compiled from 24000
Ketchen	8242	Englund, K.J., 1966, Geologic map of the Ketchen quadrangle, Tennessee-Kentucky, U.S. Geological Survey, Geologic Quadrangle Map GQ-500	GRE should use	Digitization of TN portion of map, match with KY digital coverage	24000
Ketchen	74713	Taylor, A.R. and Thomas, R.E., 1982, Landslides and Related Features of the Ketchen, Tenn. - KY. Quadrangle, U.S. Geological Survey, Open-File Report OF-82-653 (E-14)	Landslide data would be useful for RM, KGS may be digitizing KY portion	Check with KGS as to digitization status, digitize or convert; digitize TN portion	24000
Winfield	74714	Unknown authors, 2007, Spatial database of the Corbin 30x60 quadrangle, Kentucky. Kentucky Geological Survey, Digitally Vectorized Geological Quadrangle	Digital coverage is of KY portion, paper reference in following row for TN portion	Conversion after checking to see that all attributes from original paper reference were captured	100000 compiled from 24000
Winfield	2427	Pomerene, J.B., 1964, Geology of the Whitley City quadrangle, Kentucky and the Kentucky part of the Winfield quadrangle, U.S. Geological Survey, GQ-260	GRE should use	Digitization of TN portion of map, match with KY digital coverage	24000
Winfield	74708	Taylor, A.R. and Thomas, R.E., 1982, Landslides and Related Features of the Winfield, Tenn. - KY. Quadrangle, U.S. Geological Survey, Open-File Report OF-82-653 (E-13)	Landslide data would be useful for RM, KGS may be digitizing KY portion	Check with KGS as to digitization status, digitize or convert; digitize TN portion	24000
Oneida North	74714	Unknown authors, 2007, Spatial database of the Corbin 30x60 quadrangle, Kentucky. Kentucky Geological Survey, Digitally Vectorized Geological Quadrangle	Digital coverage is of KY portion, paper reference in following row for TN portion	Conversion after checking to see that all attributes from original paper reference were captured	100000 compiled from 24000
Oneida North	1523	Pomerene, Joel B., 1964, Geology of the Barthell quadrangle and part of the Oneida North quadrangle, Kentucky, U.S. Geological Survey, GQ-314	GRE should use	Digitization of TN portion of map, match with KY digital coverage	24000
Oneida North	74699	Taylor, A.R. and Thomas, R.E., 1982, Landslides and Related Features of the Oneida North, Tenn. - KY. Quadrangle, U.S. Geological Survey, Open-File Report OF-82-653 (E-12)	Landslide data would be useful for RM, KGS may be digitizing KY portion	Check with KGS as to digitization status, digitize or convert; digitize TN portion	24000
Barthell SW	74714	Unknown authors, 2007, Spatial database of the Corbin 30x60 quadrangle, Kentucky. Kentucky Geological Survey, Digitally Vectorized Geological Quadrangle	Digital coverage is of KY portion, paper reference in following row for TN portion	Conversion after checking to see that all attributes from original paper reference were captured	100000 compiled from 24000

Table 2. GRE Mapping Plan for Big South Fork National River and Recreation Area

Covered Quadrangles	GMAP[1] ID	Reference	GRE appraisal	GRE Action	Scale
Barthell SW	1517	Smith, J. Hiram, 1978, Geologic map of the Bell Farm quadrangle and part of the Barthell SW quadrangle, McCreary and Wayne Counties, Kentucky, U.S. Geological Survey, GQ-1496	GRE should use	Digitization of TN portion of map, match with KY digital coverage	24000
Barthell SW	74700	Taylor, A.R. and Thomas, R.E., 1982, Landslides and Related Features of the Barthell SW, Tenn. - KY. Quadrangle, U.S. Geological Survey, Open-File Report OF-82-653 (E-11)	Landslide data would be useful for RM, KGS may be digitizing KY portion	Check with KGS as to digitization status, digitize or convert; digitize TN portion	24000
Sharp Place	74714	Unknown authors, 2007, Spatial database of the Corbin 30x60 quadrangle, Kentucky. Kentucky Geological Survey, Digitally Vectorized Geological Quadrangle	Digital coverage is of KY portion, paper reference in following row for TN portion	Conversion after checking to see that all attributes from original paper reference were captured	100000 compiled from 24000
Sharp Place	1518	Taylor, Alfred R., 1977, Geologic map of the Parmleysville quadrangle and part of the Sharp Place quadrangle, Wayne and McCreary counties, Kentucky, U.S. Geological Survey, GQ-1405	GRE should use	Digitization of TN portion of map, match with KY digital coverage	24000
Sharp Place	74702	Taylor, A.R. and Thomas, R.E., 1982, Landslides and Related Features of the Sharp Place, Tenn. - KY. Quadrangle, U.S. Geological Survey, Open-File Report OF-82-653 (E-10)	Landslide data would be useful for RM, KGS may be digitizing KY portion	Check with KGS as to digitization status, digitize or convert; digitize TN portion	24000
Wiborg, Nevelsville, Whitley City, Barthell, Bell Farm, Ketchen, Winfield, Oneida North, Barthell SW, Sharp Place	53368	Nuttall, B.C., 1999, Oil and gas map of the Corbin 30 x 60 minute quadrangle, Kentucky Geological Survey, Map and Chart Series MCS-11_022	Oil and gas data would be useful for RM, KGS may be digitizing	Check with KGS as to digitization status, digitize or convert	100000
Wiborg, Nevelsville, Whitley City, Barthell, Bell Farm, Ketchen, Winfield, Oneida North, Barthell SW, Sharp Place	56034	Davidson, O.B., 2003, Water well and spring map of the Corbin 30 x 60 minute quadrangle, Kentucky, Kentucky Geological Survey, Map and Chart Series MCS-12_054	Water well and spring data would be useful for RM, KGS may be digitizing	Check with KGS as to digitization status, digitize or convert	100000
Pioneer	2425	Englund, K.J., 1957, Geology and coal resources of the Pioneer quadrangle, Scott and Campbell Counties, Tennessee, U.S. Geological Survey, C-39	GRE should use	Digitization	24000
Pioneer	74715	Taylor, A.R. and Thomas, R.E., 1982, Landslides and Related Features of the Pioneer, Tenn. - KY. Quadrangle, U.S. Geological Survey, Open-File Report OF-82-653	Landslide data would be useful for RM	Digitization	24000
Huntsville	74716	Taylor, A.R. and Thomas, R.E., 1982, Landslides and Related	No known 1:24,000 scale geologic	Await mapping by TDG or	24000

Table 2. GRE Mapping Plan for Big South Fork National River and Recreation Area

Covered Quadrangles	GMAP[1] ID	Reference	GRE appraisal	GRE Action	Scale
		Features of the Huntsville, Tennessee 7.5' Quadrangle, U.S. Geological Survey, Open-File Report OF-82-653	mapping; Landslide data would be useful for RM	other agency, digitize landslide map	
Oneida South	74717	Taylor, A.R. and Thomas, R.E., 1982, Landslides and Related Features of the Oneida South, Tennessee 7.5' Quadrangle, U.S. Geological Survey, Open-File Report OF-82-653	No known 1:24,000 scale geologic mapping; Landslide data would be useful for RM	Await mapping by TDG or other agency, digitize landslide map	24000
Honey Creek	74718	Taylor, A.R. and Thomas, R.E., 1982, Landslides and Related Features of the Honey Creek, Tennessee 7.5' Quadrangle, U.S. Geological Survey, Open-File Report OF-82-653	No known 1:24,000 scale geologic mapping; Landslide data would be useful for RM	Await mapping by TDG or other agency, digitize landslide map	24000
Stockton	74719	Taylor, A.R. and Thomas, R.E., 1982, Landslides and Related Features of the Stockton, Tennessee 7.5' Quadrangle, U.S. Geological Survey, Open-File Report OF-82-653	No known 1:24,000 scale geologic mapping; Landslide data would be useful for RM	Await mapping by TDG or other agency, digitize landslide map	24000
Jamestown	67756	Milici, R.C. and Moore, J.L., 1992, Geologic Map of the Jamestown Quadrangle, Tennessee, 79, Geologic Quadrangle Map GM 115-NW	GRE should use	Digitization	24000
Jamestown	74720	Taylor, A.R. and Thomas, R.E., 1982, Landslides and Related Features of the Jamestown, Tennessee 7.5' Quadrangle, U.S. Geological Survey, Open-File Report OF-82-653	Landslide data would be useful for RM	Digitization	24000
Jacksboro	67754	Swingle, G.D., 1960, Geologic Map of the Jacksboro Quadrangle, Tennessee, 79, Geologic Quadrangle Map GM 136-SW	GRE should use	Digitization, reconciling scale	31680
Jacksboro	74721	Taylor, A.R. and Thomas, R.E., 1982, Landslides and Related Features of the Jacksboro, Tennessee 7.5' Quadrangle, U.S. Geological Survey, Open-File Report OF-82-653	Landslide data would be useful for RM	Digitization	24000
Block	68226	Luther, E.T., 1967, Geologic Map of the Block Quadrangle, Tennessee, 79, Geologic Quadrangle Map 128 SE	GRE should use	Digitization	24000
Block	74722	Taylor, A.R. and Thomas, R.E., 1982, Landslides and Related Features of the Block, Tennessee 7.5' Quadrangle, U.S. Geological Survey, Open-File Report OF-82-653	Landslide data would be useful for RM	Digitization	24000
Norma	68428	Luther, E.T. and Avery, G.G., 1970, Geologic Map of the Norma Quadrangle, Tennessee, 79, Geologic Quadrangle Map GM 128-SW	GRE should use	Digitization	24000
Norma	74723	Taylor, A.R. and Thomas, R.E., 1982, Landslides and Related Features of the Norma, Tennessee 7.5' Quadrangle, U.S. Geological Survey, Open-File Report OF-82-653	Landslide data would be useful for RM	Digitization	24000
Robbins	74724	Taylor, A.R. and Thomas, R.E., 1982, Landslides and Related Features of the Robbins, Tennessee 7.5' Quadrangle, U.S. Geological Survey, Open-File Report OF-82-653	No known 1:24,000 scale geologic mapping though TDG is close to completion; Landslide data would be useful for RM	Await mapping by TDG or other agency, digitize landslide map	24000
Rugby	74725	Taylor, A.R. and Thomas, R.E., 1982, Landslides and Related Features of the Rugby, Tennessee 7.5' Quadrangle, U.S. Geological Survey, Open-File Report OF-82-653	No known 1:24,000 scale geologic mapping though TDG is close to completion; Landslide data would be	Await mapping by TDG or other agency, digitize landslide map	24000

Table 2. GRE Mapping Plan for Big South Fork National River and Recreation Area

Covered Quadrangles	GMAP[1] ID	Reference	GRE appraisal	GRE Action	Scale
			useful for RM		
Burrville	67749	Jewell, J.W., 1972, Geologic Map of the Burrville Quadrangle, Tennessee, 79, Geologic Quadrangle Map 115-SE	GRE should use	Digitization	24000
Burrville	74726	Taylor, A.R. and Thomas, R.E., 1982, Landslides and Related Features of the Burrville, Tennessee 7.5' Quadrangle, U.S. Geological Survey, Open-File Report OF-82-653	Landslide data would be useful for RM	Digitization	24000
Grimsley	74727	Taylor, A.R. and Thomas, R.E., 1982, Landslides and Related Features of the Grimsley, Tennessee 7.5' Quadrangle, U.S. Geological Survey, Open-File Report OF-82-653	No known 1:24,000 scale geologic mapping; Landslide data would be useful for RM	Await mapping by TDG or other agency, digitize landslide map	24000
Lake City	68365	Swingle, G.D., 1960, Geologic Map of the Lake City Quadrangle, Tennessee, 79, Geologic Quadrangle Map 137-NW	GRE should use	Digitization, reconciling scale	31680
Duncan Flats	68293	Statler, A.T.;Sykes, C.R., 1970, Geologic Map and Mineral Resources Summary of the Duncan Flats Quadrangle (Blackline Copy Only), Tennessee Division of Geology, Geologic Quadrangle Map 129 NE	GRE should use	Digitization	24000
Duncan Flats	74728	Taylor, A.R. and Thomas, R.E., 1982, Landslides and Related Features of the Duncan Flats, Tennessee 7.5' Quadrangle, U.S. Geological Survey, Open-File Report OF-82-653	Landslide data would be useful for RM	Digitization	24000
Fork Mountain	68310	Garman, R.K.;Ferguson, C.C.;Jones, M.L., 1975, Geologic Map and Mineral Resources Summary of the Fork Mountain Quadrangle, Tennessee Division of Geology, Geologic Quadrangle Map 129 NW	GRE should use	Digitization	24000
Fork Mountain	74729	Taylor, A.R. and Thomas, R.E., 1982, Landslides and Related Features of the Fork Mountain, Tennessee 7.5' Quadrangle, U.S. Geological Survey, Open-File Report OF-82-653	Landslide data would be useful for RM	Digitization	24000
Windrock			No known 1:24,000 scale geologic mapping	Await mapping by TDG or other agency	
Gobey, Pilot Mountain, Twin Bridges, Jones Knob, Clarkrange, Petros	More of these quadrangle sits in OBRI map coverage, see below table				

Table 3. GRE Mapping Plan for Obed Wild and Scenic River

Covered Quadrangles	GMAP[1] ID	Reference	GRE appraisal	GRE Action	Scale
Gobey	74730	Taylor, A.R. and Thomas, R.E., 1982, Landslides and Related Features of the Gobey Mountain, Tennessee 7.5' Quadrangle, U.S. Geological Survey, Open-File Report OF-82-653	No known 1:24,000 scale geologic mapping though TDG is close to completion; Landslide data would be useful for RM	Await mapping by TDG or other agency, digitize landslide map	24000
Pilot Mountain	68448	Finlayson, C.P., Powell, R.L., Kronman, G.E., and Moore, J.L., 1985, Geologic Map of the Pilot Mountain Quadrangle, Tennessee, 79, Geologic Quadrangle Map GM 122-NW	GRE should use	Digitization	24000
Pilot Mountain	74731	Taylor, A.R. and Thomas, R.E., 1982, Landslides and Related Features of the Pilot Mountain, Tennessee 7.5' Quadrangle, U.S. Geological Survey, Open-File Report OF-82-653	Landslide data would be useful for RM	Digitization	24000
Twin Bridges	68526	Coker, A.E., 1965, Geologic Map of the Twin Bridges Quadrangle, Tennessee, 79, Geologic Quadrangle Map GM 116-NE	GRE should use	Digitization	24000
Twin Bridges	74732	Taylor, A.R. and Thomas, R.E., 1982, Landslides and Related Features of the Twin Bridges, Tennessee 7.5' Quadrangle, U.S. Geological Survey, Open-File Report OF-82-653	Landslide data would be useful for RM	Digitization	24000
Jones Knob	67760	Coker, A.E., 1965, Geologic Map of the Jones Knob Quadrangle, Tennessee, 79, Geologic Quadrangle Map GM 116-NW	GRE should use	Digitization	24000
Jones Knob	74733	Taylor, A.R. and Thomas, R.E., 1982, Landslides and Related Features of the Jones Knob, Tennessee 7.5' Quadrangle, U.S. Geological Survey, Open-File Report OF-82-653	Landslide data would be useful for RM	Digitization	24000
Clarkrange	74734	Taylor, A.R. and Thomas, R.E., 1982, Landslides and Related Features of the Clarkrange, Tennessee 7.5' Quadrangle, U.S. Geological Survey, Open-File Report OF-82-653	No known 1:24,000 scale geologic mapping; Landslide data would be useful for RM	Await mapping by TDG or other agency, digitize landslide map	24000
Petros	74736	Taylor, A.R. and Thomas, R.E., 1982, Landslides and Related Features of the Petros, Tennessee 7.5' Quadrangle, U.S. Geological Survey, Open-File Report OF-82-653	No known 1:24,000 scale geologic mapping; Landslide data would be useful for RM	Await mapping by TDG or other agency, digitize landslide map	24000
Camp Austin	74747	Moores, James L. and others, 2004, Geologic Map of the Camp Austin Quadrangle, Tennessee, 79, Geologic Quadrangle Map GM122-SE	GRE should use	Digitization	24000
Camp Austin	74737	Taylor, A.R. and Thomas, R.E., 1982, Landslides and Related Features of the Camp Austin, Tennessee 7.5' Quadrangle, U.S. Geological Survey, Open-File Report OF-82-653	Landslide data would be useful for RM	Digitization	24000
Lancing	74738	Taylor, A.R. and Thomas, R.E., 1982, Landslides and Related Features of the Lancing, Tennessee 7.5' Quadrangle, U.S.	No known 1:24,000 scale geologic mapping;	Await mapping by TDG or other agency, digitize landslide	24000

Table 3. GRE Mapping Plan for Obed Wild and Scenic River

Covered Quadrangles	GMAP[1] ID	Reference	GRE appraisal	GRE Action	Scale
		Geological Survey, Open-File Report OF-82-653	Landslide data would be useful for RM	map	
Hebbertsburg	74739	Taylor, A.R. and Thomas, R.E., 1982, Landslides and Related Features of the Hebbertsburg, Tennessee 7.5' Quadrangle, U.S. Geological Survey, Open-File Report OF-82-653	No known 1:24,000 scale geologic mapping though a folio might exist; Landslide data would be useful for RM	Attempt to locate folio coverage for evaluation; Await mapping by TDG or other agency, digitize landslide map	24000
Fox Creek	74740	Taylor, A.R. and Thomas, R.E., 1982, Landslides and Related Features of the Fox Creek, Tennessee 7.5' Quadrangle, U.S. Geological Survey, Open-File Report OF-82-653	No known 1:24,000 scale geologic mapping though a folio might exist; Landslide data would be useful for RM	Attempt to locate folio coverage for evaluation; Await mapping by TDG or other agency, digitize landslide map	24000
Isoline	74741	Taylor, A.R. and Thomas, R.E., 1982, Landslides and Related Features of the Isoline, Tennessee 7.5' Quadrangle, U.S. Geological Survey, Open-File Report OF-82-653	No known 1:24,000 scale geologic mapping; Landslide data would be useful for RM	Await mapping by TDG or other agency, digitize landslide map	24000
Campbell Junction	74742	Taylor, A.R. and Thomas, R.E., 1982, Landslides and Related Features of the Campbell Junction, Tennessee 7.5' Quadrangle, U.S. Geological Survey, Open-File Report OF-82-653	No known 1:24,000 scale geologic mapping; Landslide data would be useful for RM	Await mapping by TDG or other agency, digitize landslide map	24000
Cardiff	68241	Tiedemann, H.A., Jewell, J.W., and Swingle, G.D., 1965, Geologic Map of the Cardiff Quadrangle, Tennessee, 79, Geologic Quadrangle Map GM 123-NW	GRE should use	Digitization; check to see if GMAP 55998 covers this quad and digitize	24000
Ozone			No known 1:24,000 scale geologic mapping	Await mapping by TDG or other agency, check to see if GMAP 55998 covers this quad and digitize	
Dorton			No known 1:24,000 scale geologic mapping	Await mapping by TDG or other agency, check to see if GMAP 55998 covers this quad and digitize	
Crossville	68275	Moore, J.L., 1981, Geologic Map of the Crossville Quadrangle, Tennessee, 79, Geologic Quadrangle Map GM 109-NE	GRE should use	Digitization	24000
Crossville	55998	Thomas, R.E., 1981, Landslides and related features, Tennessee; northwest half of Chattanooga 1x2 sheet, U.S. Geological Survey OF-81-1318	Landslide data would be useful for RM	Digitization	24000
Pleasant Hill	68452	Moore, J.L., 1985, Geologic Map of the Pleasant Hill Quadrangle, Tennessee, 79, Geologic Quadrangle Map GM 109-NW	GRE should use	Digitization	24000
Pleasant Hill	55998	Thomas, R.E., 1981, Landslides and related features,	Landslide data would be	Digitization	24000

Table 3. GRE Mapping Plan for Obed Wild and Scenic River

Covered Quadrangles	GMAP[1] ID	Reference	GRE appraisal	GRE Action	Scale
		Tennessee; northwest half of Chattanooga 1x2 sheet, U.S. Geological Survey OF-81-1318	useful for RM		
Roddy	68471	Milici, R.C. and Swingle, G.D., 1972, Geologic Map of the Roddy Quadrangle, Tennessee, 79, Geologic Quadrangle Map GM 117-SE	GRE should use	Digitization; check to see if GMAP 55998 covers this quad and digitize	24000
Grassy Cove	68328	Milici, R.C., 1965, Geologic Map of the Grassy Cove Quadrangle, Tennessee, 79, Geologic Quadrangle Map GM 117-SW	GRE should use	Digitization; check to see if GMAP 55998 covers this quad and digitize	24000
Vandever	68530	Moore, J.L. and Milici, R.C., 1990, Geologic Map of the Vandever Quadrangle, Tennessee, 79, Geologic Quadrangle Map GM 109-SE	GRE should use	Digitization	24000
Vandever	55998	Thomas, R.E., 1981, Landslides and related features, Tennessee; northwest half of Chattanooga 1x2 sheet, U.S. Geological Survey OF-81-1318	Landslide data would be useful for RM	Digitization	24000
Melvine	68403	Milici, R.C. and Coker, A.E., 1967, Geologic Map of the Melvine Quadrangle, Tennessee, 79, Geologic Quadrangle Map GM 110-NE	GRE should use	Digitization	24000
Melvine	55998	Thomas, R.E., 1981, Landslides and related features, Tennessee; northwest half of Chattanooga 1x2 sheet, U.S. Geological Survey OF-81-1318	Landslide data would be useful for RM	Digitization	24000

Table 4. GRE Mapping Plan for BISO and OBRI
SUMMARY TABLE

30x60 sheet	7.5' Quadrangle[1]	Why of interest	Largest-scale known "geologic" coverage[23]	landslide	coal
Corbin	Hail KY	South Fork Cumberland watershed	(15807) Smith, J.H.; Pomerene, J.B.; Ping, R.G., 1973, Geologic map of the **Hail** quadrangle, McCreary and Pulaski Counties, Kentucky, U.S. Geological Survey, Geologic Quadrangle Map GQ-1058, 1:24000 scale	(74709) Taylor, A.R. and Thomas, R.E., 1982, Landslides and Related Features of the **Hail**, KY. Quadrangle, , Open-File Report OF-82-653 (H-13), 1:24000 scale	
Corbin	Burnside KY	South Fork Cumberland watershed	(15992) Taylor, A.R.; Lewis, R.Q.; Smith, J.H., 1975, Geologic map of the **Burnside** quadrangle, south-central Kentucky, U.S. Geological Survey, Geologic Quadrangle Map GQ-1253, 1:24000 scale	(74710) Taylor, A.R. and Thomas, R.E., 1982, Landslides and Related Features of the **Burnside**, KY. Quadrangle, , Open-File Report OF-82-653 (H-12), 1:24000 scale	
Corbin	Frazer KY	South Fork Cumberland watershed	(15968) Lewis, R.Q., 1975, Geologic map of the **Frazer** quadrangle, Pulaski and Wayne Counties, Kentucky, U.S. Geological Survey, Geologic Quadrangle Map GQ-1223, 1:24000 scale	(74711) Taylor, A.R. and Thomas, R.E., 1982, Landslides and Related Features of the **Frazer**, KY. Quadrangle, , Open-File Report OF-82-653 (H-11), 1:24000 scale	
Corbin	Wiborg KY	South Fork Cumberland watershed	(1522) Smith, J. Hiram, 1970, Geologic map of the **Wiborg** quadrangle, McCreary County, Kentucky, U.S. Geological Survey, GQ-867, 1:24000 scale	(74703) Taylor, A.R. and Thomas, R.E., 1982, Landslides and Related Features of the **Wiborg**, KY. Quadrangle, , Open-File Report OF-82-653 (G-13), 1:24000 scale	
Corbin	**Nevelsville KY**	**Intersects BISO**	(1520) Smith, J. Hiram, 1976, Geologic map of the **Nevelsville** quadrangle, south-central Kentucky, U.S. Geological Survey, GQ-1326, 1:24000 scale	(74704) Taylor, A.R. and Thomas, R.E., 1982, Landslides and Related Features of the **Nevelsville**, KY. Quadrangle, , Open-File Report OF-82-653 (G-12), 1:24000 scale	
Corbin	Coopersville KY	South Fork Cumberland watershed	(1521) Lewis, Richard Q., Sr.; Taylor, Alfred R., 1976, Geologic map of the **Coopersville** quadrangle, Wayne and McCreary counties, Kentucky, U.S. Geological Survey, GQ-1315, 1:24000 scale	(74705) Taylor, A.R. and Thomas, R.E., 1982, Landslides and Related Features of the **Coopersville**, KY. Quadrangle, , Open-File Report OF-82-653 (G-11), 1:24000 scale	
Corbin	Monticello KY	South Fork Cumberland watershed	(16033) Taylor, A.R., 1976, Geologic map of the **Monticello** quadrangle, Wayne County, Kentucky, U.S. Geological Survey, Geologic Quadrangle Map GQ-1319, 1:24000 scale	(74712) Taylor, A.R. and Thomas, R.E., 1982, Landslides and Related Features of the **Monticello**, KY. Quadrangle, , Open-File Report OF-82-653 (G-10), 1:24000 scale	
Corbin	Whitley City KY	South Fork Cumberland watershed	(2427) Pomerene, J.B., 1964, Geology of the **Whitley City** quadrangle, Kentucky and the Kentucky part of the Winfield quadrangle, U.S. Geological Survey, GQ-260, 1:24000 scale	(74706) Taylor, A.R. and Thomas, R.E., 1982, Landslides and Related Features of the **Whitley City**, KY. Quadrangle, , Open-File Report OF-82-653 (F-13), 1:24000 scale	
Corbin	**Barthell KY**	**Intersects BISO**	(1523) Pomerene, Joel B., 1964, Geology of the **Barthell** quadrangle and part of the Oneida North quadrangle, Kentucky, U.S. Geological Survey, GQ-314, 1:24000 scale	(74701) Taylor, A.R. and Thomas, R.E., 1982, Landslides and Related Features of the **Barthell**, KY. Quadrangle, , Open-File Report OF-82-653 (F-12), 1:24000 scale	
Corbin	**Bell Farm KY**	**Intersects BISO**	(1517) Smith, J. Hiram, 1978, Geologic map of the **Bell Farm** quadrangle and part of the Barthell SW quadrangle, McCreary and Wayne Counties, Kentucky, U.S. Geological Survey, GQ-1496, 1:24000 scale	(74707) Taylor, A.R. and Thomas, R.E., 1982, Landslides and Related Features of the **Bell Farm**, Kentucky Quadrangle, , Open-File Report OF-82-653 (E-13), 1:24000 scale	
Corbin	Parmleysville KY	South Fork Cumberland watershed	(1518) Taylor, Alfred R., 1977, Geologic map of the **Parmleysville** quadrangle and part of the Sharp Place quadrangle, Wayne and McCreary counties, Kentucky, U.S. Geological Survey, GQ-1405, 1:24000 scale	(74744) Taylor, A.R. and Thomas, R.E., 1982, Landslides and Related Features of the Parmleysville, Kentucky Quadrangle, , Open-File Report OF-82-653 (---), 1:24000 scale	
Corbin	Powersburg	South Fork	(1519) Lewis, Richard Q., Sr., 1977, Geologic map of the	(74745) (Taylor, A.R. and Thomas, R.E., 1982, Landslides and	

[1] **Bolding** denotes a 7.5' quadrangle that intersects NPS area; red fill indicates a quadrangle ruled out during GRE scoping session as being not of interest to NPS
[2] Yellow highlighting denotes maps covered in Corbin 30x60 digital compilation (GMAP 74714); not sure all attributes from paper maps captured though; needs verified by KYGS and GRE staff
[3] Pink highlighting denotes areas without known dedicated 7.5' geologic mapping; here the Tennessee state geologic map is the largest-known digital map to cover these quadrangles

Table 4. GRE Mapping Plan for BISO and OBRI
SUMMARY TABLE

30x60 sheet	7.5' Quadrangle[1]	Why of interest	Largest-scale known "geologic" coverage[23]	landslide	coal
	KY	Cumberland watershed	**Powersburg** quadrangle and part of the Pall Mall quadrangle, Wayne and Clinton counties, Kentucky, U.S. Geological Survey, GQ-1377, 1:24000 scale	Related Features of the Powersburg, Kentucky Quadrangle, , Open-File Report OF-82-653 (---), 1:24000 scale	
Corbin	Ketchen KY-TN	South Fork Cumberland watershed	(8242) Englund, K.J., 1966, Geologic map of the **Ketchen** quadrangle, Tennessee-Kentucky, U.S. Geological Survey, Geologic Quadrangle Map GQ-500, 1:24000 scale	(74713) Taylor, A.R. and Thomas, R.E., 1982, Landslides and Related Features of the **Ketchen**, Tenn. - KY. Quadrangle, , Open-File Report OF-82-653 (E-14), 1:24000 scale	
Corbin	Winfield KY-TN	South Fork Cumberland watershed	(2427) Pomerene, J.B., 1964, Geology of the Whitley City quadrangle, Kentucky and the Kentucky part of the **Winfield** quadrangle, U.S. Geological Survey, GQ-260, 1:24000 scale	(74708) Taylor, A.R. and Thomas, R.E., 1982, Landslides and Related Features of the **Winfield**, Tenn. - KY. Quadrangle, , Open-File Report OF-82-653 (E-13), 1:24000 scale	
Corbin	**Oneida North KY-TN**	**Intersects BISO**	(1523) Pomerene, Joel B., 1964, Geology of the Barthell quadrangle and part of the **Oneida North** quadrangle, Kentucky, U.S. Geological Survey, GQ-314, 1:24000 scale	(74699) Taylor, A.R. and Thomas, R.E., 1982, Landslides and Related Features of the **Oneida North**, Tenn. - KY. Quadrangle, , Open-File Report OF-82-653 (E-12), 1:24000 scale	
Corbin	**Barthell Southwest KY-TN**	**Intersects BISO**	(1517) Smith, J. Hiram, 1978, Geologic map of the Bell Farm quadrangle and part of the **Barthell SW** quadrangle, McCreary and Wayne Counties, Kentucky, U.S. Geological Survey, GQ-1496, 1:24000 scale	(74700) Taylor, A.R. and Thomas, R.E., 1982, Landslides and Related Features of the **Barthell SW**, Tenn. - KY. Quadrangle, , Open-File Report OF-82-653 (E-11), 1:24000 scale	
Corbin	**Sharp Place KY-TN**	**Intersects BISO**	(1518) Taylor, Alfred R., 1977, Geologic map of the Parmleysville quadrangle and part of the **Sharp Place** quadrangle, Wayne and McCreary counties, Kentucky, U.S. Geological Survey, GQ-1405, 1:24000 scale	(74702) Taylor, A.R. and Thomas, R.E., 1982, Landslides and Related Features of the **Sharp Place**, Tenn. - KY. Quadrangle, , Open-File Report OF-82-653 (E-10), 1:24000 scale	
Corbin	Pall Mall KY-TN	South Fork Cumberland watershed	(1519) Lewis, Richard Q., Sr., 1977, Geologic map of the Powersburg quadrangle and part of the **Pall Mall** quadrangle, Wayne and Clinton counties, Kentucky, U.S. Geological Survey, GQ-1377, 1:24000 scale	(74746)Taylor, A.R. and Thomas, R.E., 1982, Landslides and Related Features of the Pall Mall, Tenn. - KY. Quadrangle, , Open-File Report OF-82-653 (E-10), 1:24000 scale	
Oak Ridge	Pioneer TN	South Fork Cumberland watershed	(2425) Englund, K.J., 1957, Geology and coal resources of the **Pioneer** quadrangle, Scott and Campbell Counties, Tennessee, U.S. Geological Survey, C-39, 1:24000 scale	(74715) Taylor, A.R. and Thomas, R.E., 1982, Landslides and Related Features of the **Pioneer**, Tenn. - KY. Quadrangle, , Open-File Report OF-82-653, 1:24000 scale	
Oak Ridge	**Huntsville TN**	**Intersects BISO**	(74110) Nicholson, S.W., Dicken, C.L., Horton, J.D., Labay, K.A., Foose, M.P., and Mueller, J.A.L., 2005, Preliminary integrated geologic map databases for the United States: Kentucky, Ohio, Tennessee, and West Virginia, , Open-File Report OF-2005-1324, 1:100000	(74716) Taylor, A.R. and Thomas, R.E., 1982, Landslides and Related Features of the **Huntsville**, Tennessee 7.5' Quadrangle, , Open-File Report OF-82-653, 1:24000 scale	
Oak Ridge	**Oneida South TN**	**Intersects BISO**		(74717) Taylor, A.R. and Thomas, R.E., 1982, Landslides and Related Features of the **Oneida South**, Tennessee 7.5' Quadrangle, , Open-File Report OF-82-653, 1:24000 scale	
Oak Ridge	**Honey Creek TN**	**Intersects BISO**		(74718) Taylor, A.R. and Thomas, R.E., 1982, Landslides and Related Features of the **Honey Creek**, Tennessee 7.5' Quadrangle, , Open-File Report OF-82-653, 1:24000 scale	
Oak Ridge	**Stockton TN**	**Intersects BISO**		(74719) Taylor, A.R. and Thomas, R.E., 1982, Landslides and Related Features of the **Stockton**, Tennessee 7.5' Quadrangle, , Open-File Report OF-82-653, 1:24000 scale	
Oak Ridge	Jamestown TN	South Fork Cumberland watershed	(67756) Milici, R.C. and Moore, J.L., 1992, Geologic Map of the **Jamestown** Quadrangle, Tennessee, 79, Geologic Quadrangle Map GM 115-NW, 1:24000 scale	(74720) Taylor, A.R. and Thomas, R.E., 1982, Landslides and Related Features of the **Jamestown**, Tennessee 7.5' Quadrangle, , Open-File Report OF-82-653, 1:24000 scale	
Oak Ridge	Jacksboro TN	South Fork Cumberland watershed	(67754) Swingle, G.D., 1960, Geologic Map of the **Jacksboro** Quadrangle, Tennessee, 79, Geologic Quadrangle Map GM 136-SW, 1:31680 scale	(74721) Taylor, A.R. and Thomas, R.E., 1982, Landslides and Related Features of the **Jacksboro**, Tennessee 7.5' Quadrangle, , Open-File Report OF-82-653, 1:24000 scale	

Table 4. GRE Mapping Plan for BISO and OBRI
SUMMARY TABLE

30x60 sheet	7.5' Quadrangle[1]	Why of interest	Largest-scale known "geologic" coverage[23]	landslide	coal
Oak Ridge	Block TN	South Fork Cumberland watershed	(68226) Luther, E.T., 1967, Geologic Map of the **Block** Quadrangle, Tennessee, 79, Geologic Quadrangle Map 128 SE, 1:24000 scale	(74722) Taylor, A.R. and Thomas, R.E., 1982, Landslides and Related Features of the **Block**, Tennessee 7.5' Quadrangle, , Open-File Report OF-82-653, 1:24000 scale	74422-74428
Oak Ridge	Norma TN	South Fork Cumberland watershed	(68428) Luther, E.T. and Avery, G.G., 1970, Geologic Map of the **Norma** Quadrangle, Tennessee, 79, Geologic Quadrangle Map GM 128-SW, 1:24000 scale	(74723) Taylor, A.R. and Thomas, R.E., 1982, Landslides and Related Features of the **Norma**, Tennessee 7.5' Quadrangle, , Open-File Report OF-82-653, 1:24000 scale	74411-74415
Oak Ridge	Robbins TN	South Fork Cumberland watershed	(74110) Nicholson, S.W., Dicken, C.L., Horton, J.D., Labay, K.A., Foose, M.P., and Mueller, J.A.L., 2005, Preliminary integrated geologic map databases for the United States: Kentucky, Ohio, Tennessee, and West Virginia, , Open-File Report OF-2005-1324, 1:100000	(74724) Taylor, A.R. and Thomas, R.E., 1982, Landslides and Related Features of the **Robbins**, Tennessee 7.5' Quadrangle, , Open-File Report OF-82-653, 1:24000 scale	
Oak Ridge	**Rugby TN**	**Intersects BISO**		(74725) Taylor, A.R. and Thomas, R.E., 1982, Landslides and Related Features of the **Rugby**, Tennessee 7.5' Quadrangle, , Open-File Report OF-82-653, 1:24000 scale	
Oak Ridge	**Burrville TN**	**Intersects BISO**	(67749) Jewell, J.W., 1972, Geologic Map of the **Burrville** Quadrangle, Tennessee, 79, Geologic Quadrangle Map 115-SE, 1:24000 scale	(74726) Taylor, A.R. and Thomas, R.E., 1982, Landslides and Related Features of the **Burrville**, Tennessee 7.5' Quadrangle, , Open-File Report OF-82-653, 1:24000 scale	74418-74419
Oak Ridge	Grimsley TN	South Fork Cumberland watershed	(74110) Nicholson, S.W., Dicken, C.L., Horton, J.D., Labay, K.A., Foose, M.P., and Mueller, J.A.L., 2005, Preliminary integrated geologic map databases for the United States: Kentucky, Ohio, Tennessee, and West Virginia, , Open-File Report OF-2005-1324, 1:100000	(74727) Taylor, A.R. and Thomas, R.E., 1982, Landslides and Related Features of the **Grimsley**, Tennessee 7.5' Quadrangle, , Open-File Report OF-82-653, 1:24000 scale	
Oak Ridge	Lake City TN	South Fork Cumberland watershed	(68365) Swingle, G.D., 1960, Geologic Map of the **Lake City** Quadrangle, Tennessee, 79, Geologic Quadrangle Map 137-NW, 1:31680 scale	??	
Oak Ridge	Duncan Flats TN	South Fork Cumberland watershed	(68293) Statler, A.T.;Sykes, C.R., 1970, Geologic Map and Mineral Resources Summary of the **Duncan Flats** Quadrangle (Blackline Copy Only), Tennessee Division of Geology, Geologic Quadrangle Map 129 NE, 1:24000 scale	(74728) Taylor, A.R. and Thomas, R.E., 1982, Landslides and Related Features of the **Duncan Flats**, Tennessee 7.5' Quadrangle, , Open-File Report OF-82-653, 1:24000 scale	74399-74404
Oak Ridge	Fork Mountain TN	South Fork Cumberland watershed Emory Watershed	(68310) Garman, R.K.;Ferguson, C.C.;Jones, M.L., 1975, Geologic Map and Mineral Resources Summary of the **Fork Mountain** Quadrangle, Tennessee Division of Geology, Geologic Quadrangle Map 129 NW, 1:24000 scale	(74729) Taylor, A.R. and Thomas, R.E., 1982, Landslides and Related Features of the **Fork Mountain**, Tennessee 7.5' Quadrangle, , Open-File Report OF-82-653, 1:24000 scale	74405-74410
Oak Ridge	Gobey TN	South Fork Cumberland watershed Emory Watershed	(74110) Nicholson, S.W., Dicken, C.L., Horton, J.D., Labay, K.A., Foose, M.P., and Mueller, J.A.L., 2005, Preliminary integrated geologic map databases for the United States: Kentucky, Ohio, Tennessee, and West Virginia, , Open-File Report OF-2005-1324, 1:100000	(74730) Taylor, A.R. and Thomas, R.E., 1982, Landslides and Related Features of the **Gobey Mountain**, Tennessee 7.5' Quadrangle, , Open-File Report OF-82-653, 1:24000 scale	
Oak Ridge	**Pilot Mountain TN**	**Intersects OBRI**	(68448) Finlayson, C.P., Powell, R.L., Kronman, G.E., and Moore, J.L., 1985, Geologic Map of the **Pilot Mountain** Quadrangle, Tennessee, 79, Geologic Quadrangle Map GM 122-NW, 1:24000 scale	(74731) Finlayson, C.P., Powell, R.L., Kronman, G.E., and Moore, J.L., 1985, Geologic Map of the **Pilot Mountain** Quadrangle, Tennessee, 79, Geologic Quadrangle Map GM 122-NW, 1:24000 scale	
Oak Ridge	**Twin Bridges TN**	**Intersects OBRI**	(68526) Coker, A.E., 1965, Geologic Map of the **Twin Bridges** Quadrangle, Tennessee, 79, Geologic Quadrangle Map GM 116-NE, 1:24000 scale	(74732) Taylor, A.R. and Thomas, R.E., 1982, Landslides and Related Features of the **Twin Bridges**, Tennessee 7.5' Quadrangle, , Open-File Report OF-82-653, 1:24000 scale	
Oak Ridge	**Jones Knob TN**	**Intersects OBRI**	(67760) Coker, A.E., 1965, Geologic Map of the **Jones Knob** Quadrangle, Tennessee, 79, Geologic Quadrangle	(74733) Taylor, A.R. and Thomas, R.E., 1982, Landslides and Related Features of the **Jones Knob**, Tennessee 7.5'	74417

Table 4. GRE Mapping Plan for BISO and OBRI
SUMMARY TABLE

30x60 sheet	7.5' Quadrangle[1]	Why of interest	Largest-scale known "geologic" coverage[23]	landslide	coal
			Map GM 116-NW, 1:24000 scale	Quadrangle, , Open-File Report OF-82-653, 1:24000 scale	
Cookeville	Clarkrange TN	South Fork Cumberland watershed Emory Watershed	(74110) Nicholson, S.W., Dicken, C.L., Horton, J.D., Labay, K.A., Foose, M.P., and Mueller, J.A.L., 2005, Preliminary integrated geologic map databases for the United States: Kentucky, Ohio, Tennessee, and West Virginia, , Open-File Report OF-2005-1324, 1:100000	(74734) Taylor, A.R. and Thomas, R.E., 1982, Landslides and Related Features of the **Clarkrange**, Tennessee 7.5' Quadrangle, , Open-File Report OF-82-653, 1:24000 scale	
Oak Ridge	Windrock TN	South Fork Cumberland watershed		??	
Oak Ridge	Petros TN	South Fork Cumberland watershed Emory Watershed		(74736) Taylor, A.R. and Thomas, R.E., 1982, Landslides and Related Features of the **Petros**, Tennessee 7.5' Quadrangle, , Open-File Report OF-82-653, 1:24000 scale	
Oak Ridge	Camp Austin TN	Emory Watershed	(74747) , Moores, James L. and others, 2004, Geologic Map of the **Camp Austin** Quadrangle, Tennessee, 79, Geologic Quadrangle Map GM122-SE 1:24000 scale	(74737) Taylor, A.R. and Thomas, R.E., 1982, Landslides and Related Features of the **Camp Austin**, Tennessee 7.5' Quadrangle, , Open-File Report OF-82-653, 1:24000 scale	
Oak Ridge	**Lancing TN**	**Intersects OBRI**	(74110) Nicholson, S.W., Dicken, C.L., Horton, J.D., Labay, K.A., Foose, M.P., and Mueller, J.A.L., 2005, Preliminary integrated geologic map databases for the United States: Kentucky, Ohio, Tennessee, and West Virginia, , Open-File Report OF-2005-1324, 1:100000	(74738) Taylor, A.R. and Thomas, R.E., 1982, Landslides and Related Features of the **Lancing**, Tennessee 7.5' Quadrangle, , Open-File Report OF-82-653, 1:24000 scale	
Oak Ridge	**Hebbertsburg TN**	**Intersects OBRI**		(74739) Taylor, A.R. and Thomas, R.E., 1982, Landslides and Related Features of the **Hebbertsburg**, Tennessee 7.5' Quadrangle, , Open-File Report OF-82-653, 1:24000 scale	
Oak Ridge	**Fox Creek TN**	**Intersects OBRI**		(74740) Taylor, A.R. and Thomas, R.E., 1982, Landslides and Related Features of the **Fox Creek**, Tennessee 7.5' Quadrangle, , Open-File Report OF-82-653, 1:24000 scale	
Cookeville	Isoline TN	Emory Watershed		(74741) Taylor, A.R. and Thomas, R.E., 1982, Landslides and Related Features of the **Isoline**, Tennessee 7.5' Quadrangle, , Open-File Report OF-82-653, 1:24000 scale	
Cookeville	Campbell Junction TN	Emory Watershed		(74742) Taylor, A.R. and Thomas, R.E., 1982, Landslides and Related Features of the **Campbell Junction**, Tennessee 7.5' Quadrangle, , Open-File Report OF-82-653, 1:24000 scale	
Watts Bar Lake	Elverton TN	Emory Watershed		(55998) Thomas, R.E., 1981, Landslides and related features, Tennessee; northwest half of Chattanooga 1x2 sheet, USGS OF-81-1318, 1:24,000 scale THIS PRODUCT UNOBTAINED BY GRE STAFF AND THUS NOT SURE IF BY "NORTHWEST" IT MEANS THE AREA ONLY COVERED BY THE MCMINNVILLE 30x60 (NOT WATTS BAR LAKE 30x60). If it is only northwest, than the Elverton, Harriman, Cardiff, Ozone, Dorton, Roddy and Grassy Cove 7.5' quadrangles	
Watts Bar Lake	Harriman TN	Emory Watershed	(68336) Moore, J.L., Finlayson, C.P., Milici, R.C., and Horton, A.B., 1993, Geologic Map of the **Harriman** Quadrangle, Tennessee, 79, Geologic Quadrangle Map GM 123-NE, 1:24000 scale		
Watts Bar Lake	Cardiff TN	Emory Watershed	(68241) Tiedemann, H.A., Jewell, J.W., and Swingle, G.D., 1965, Geologic Map of the **Cardiff** Quadrangle, Tennessee, 79, Geologic Quadrangle Map GM 123-NW, 1:24000 scale		74420
Watts Bar Lake	Ozone TN	Emory Watershed	(74110) Nicholson, S.W., Dicken, C.L., Horton, J.D., Labay, K.A., Foose, M.P., and Mueller, J.A.L., 2005, Preliminary integrated geologic map databases for the United States: Kentucky, Ohio, Tennessee, and West Virginia, , Open-File Report OF-2005-1324, 1:100000		
Watts Bar Lake	Dorton TN	Emory Watershed			
McMinnville	Crossville TN	Emory Watershed	(68275) Moore, J.L., 1981, Geologic Map of the **Crossville** Quadrangle, Tennessee, 79, Geologic Quadrangle Map		

Table 4. GRE Mapping Plan for BISO and OBRI
SUMMARY TABLE

30x60 sheet	7.5' Quadrangle[1]	Why of interest	Largest-scale known "geologic" coverage[23]	landslide	coal
			GM 109-NE, 1:24000 scale		
McMinnville	Pleasant Hill TN	Emory Watershed	(68452) Moore, J.L., 1985, Geologic Map of the **Pleasant Hill** Quadrangle, Tennessee, 79, Geologic Quadrangle Map GM 109-NW, 1:24000 scale		
Watts Bar Lake	Roddy TN	Emory Watershed	(68471) Milici, R.C. and Swingle, G.D., 1972, Geologic Map of the **Roddy** Quadrangle, Tennessee, 79, Geologic Quadrangle Map GM 117-SE, 1:24000 scale		
Watts Bar Lake	Grassy Cove TN	Emory Watershed	(68328) Milici, R.C., 1965, Geologic Map of the **Grassy Cove** Quadrangle, Tennessee, 79, Geologic Quadrangle Map GM 117-SW, 1:24000 scale		74421
McMinnville	Vandever TN	Emory Watershed	(68530) Moore, J.L. and Milici, R.C., 1990, Geologic Map of the **Vandever** Quadrangle, Tennessee, 79, Geologic Quadrangle Map GM 109-SE, 1:24000 scale		
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