

THE TENNESSEE VALLEY AUTHORITY



Clinch River Small Modular Reactor Site

Terrestrial Plant Communities and Botanical Resources Survey Report

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12/07/2011

Revision 1 – 01/09/2013
Revision 2 – 08/20/2014
Revision 3 – 09/22/2014
Revision 4 – 03/01/2015
Revision 5 - 10/28/2015

This study has been prepared as a supporting document for the Clinch River Small Modular Reactor Site (CR SMR) Early Site Permit Application Project and is being distributed for project use. The study provides a summary of documented terrestrial plant communities and protected botanical resources present in CR SMR study area including the adjacent Clinch River, Roane County, TN.

Affected Environment

Terrestrial Ecology (Plants)

The Clinch River Property is located in the Southern Limestone/Dolomite Valleys and Rolling Hills and Southern Dissected Ridges and Knobs ecoregions, which are subdivisions of the Ridge and Valley. The Ridge and Valley, which occurs between the Blue Ridge Mountains on the east and the Cumberland Plateau on the west, is a relatively low-lying region made up of roughly parallel ridges and valleys that were formed through extreme folding and faulting events in past geologic time (Griffith et al. 1998). Over 95 percent of the area of potential effect is found within the Southern Limestone/Dolomite Valleys and Rolling Hills, which is a heterogeneous region, composed predominantly of limestone and cherty dolomite. Landforms are mostly undulating valleys and rounded ridges with many caves and springs. Land cover in this ecoregion varies and includes forest, pasture, intensive agriculture, and areas of commercial, industrial, and residential development. The southern tip of Clinch River Property, which comprises less than five percent of the site, is part of the Southern Dissected Ridges and Knobs ecoregion. This region contains more crenulated, broken, or hummocky ridges, that support chestnut oak and pine forests in the higher elevations and stands of white oak, mixed mesophytic forest, and tulip poplar on the lower slopes (Griffith et al. 1998).

Field surveys were conducted in April and July 2011 and September 2013 to assess the terrestrial community structure, to document infestations of invasive plants, and to search for possible threatened and endangered plant species on the Clinch River Property. Representative plant species observed during field inspections are listed in Appendix A – Table 1. This list is not comprehensive and only includes representative species noted during site visits. Areas representative of each vegetation type present on the Clinch River Property were visited during the surveys.

Using the National Vegetation Classification System (Grossman et al. 1998), vegetation types found on the Clinch River Property can be classified as a combination of deciduous, evergreen, and mixed evergreen-deciduous forest and herbaceous vegetation (Table 2). Developed areas have been heavily manipulated and have no appreciable vegetative cover. Previous environmental reviews state that much of the site was undergoing secondary succession due to previous disturbance associated with farming and logging and that plant communities present there were not unique because thousands of acres of comparable habitat occur on adjacent lands within the Oak Ridge National Reservation (NRC 1977; NRC 1982). In addition, 292 forested acres were cleared in preparation for construction of the original Clinch River Breeder Reactor project (NRC 1982).

Mixed evergreen-deciduous forest is defined as a forest stand where both evergreen and deciduous species contribute from 25 to 75 percent of total canopy cover. This forest type accounts for approximately 42 percent of the vegetation cover on the Clinch River Property and occurs primarily as dry oak-hickory-pine stands along ridgelines. The oak-hickory-pine forest is dominated by oaks (black, chestnut, northern red, southern red, and white), hickories (mockernut, pignut, and shagbark) and Virginia pine with scattered eastern redcedar. Black gum, muscle wood and sourwood are common understory species with black snakeroot, Christmas fern, little brown jug, ebony spleenwort, pennywort, running ground cedar, spotted wintergreen, wood sorrel and yellow giant hyssop in the herb layer.

Deciduous forest, which is characterized by trees with overlapping crowns where deciduous species account for more than 75 percent of the canopy cover, covers about 31 percent of the the Clinch River Property. The mixed mesophytic forest subtype has a rich herbaceous layer including species like bishop's cap, blue cohosh, bloodroot, dog-tooth violet, doll's eyes, foam-flower, Jack-in-the-pulpit, maidenhair fern, Solomon's plume, and Solomon's seal. The forest is dominated by tulip poplar with American beech, white oak and yellow buckeye. The midstory is also diverse and includes American holly, Carolina buckthorn, flowering dogwood, maple-leaf viburnum, pawpaw, sassafras, serviceberry, and wild black cherry.

A second subtype, calcareous forest, occurs on portions of the Clinch River Property underlain by limestone. Species present here include the woody plants bladdernut, eastern redcedar, eastern redbud and the herbaceous species Appalachian bugbane, glade fern, green violet, harbinger of spring, Jacob's ladder, twin-leaf and walking fern. Most of the calcareous forest occurs within the Grassy Creek Habitat Protection Area and along a few mesic slopes adjacent to the river. This habitat type supports two Tennessee species of special concern: American ginseng and spreading false foxglove.

The third subtype of deciduous forest present on the Clinch River Property is wetland forest. Wetland forest was found primarily near the edge of Watts Bar Reservoir and within riparian areas of tributaries found on the site. These areas are dominated by American sycamore, black willow, buttonbush, silky dogwood and tag alder. In addition, persimmon is common along the shoreline along with box elder, Chinese privet, false indigo, multiflora rose and silver maple. Herbaceous species such as netted chain fern, jewelweed, lizard tail, poison hemlock, rose mallow, water willow, yellow flag, and several species of grasses, rushes, and sedges are present. *Populus X jackii* (Balm of Gilead) was encountered in a forested wetland associated with an unnamed stream near a transmission line that borders parcels 142 and 143. This species is often cultivated and can escape in natural areas (Dickmann and Kuzovkina 2008).

Table 2. Vegetation/land cover types, percent coverage, and acreage on the CRN Site.

Vegetation/land cover type	Approximate acreage	Percent site coverage
Mixed evergreen-deciduous forest ¹	390	42
Deciduous forest ²	292	31
Herbaceous vegetation ³	204	22
Evergreen forest	32	3
Roads/developed areas	14	2
Ponds	3	0.3
Total	935	100

Notes:

1 – Includes 1.0 ac of wetlands

2 – Includes 12.72 ac of wetlands

3 – Includes 1.82 ac of wetlands

Herbaceous vegetation has greater than 25 percent cover of grasses and forbs and occurs on about 22 percent of the Clinch River Property. Approximately 292 acres of the site has been previously cleared for construction projects and much of that land was revegetated with non-native species like sericea lespedeza and tall fescue. These cleared areas are in the process of undergoing secondary succession and support a number of weedy species such as black-eyed Susan, broom-sedge, Canada goldenrod, Johnson grass, Queen Anne's lace, tickseed, and various other common forbs. Young eastern redcedar is scattered throughout these heavily disturbed areas. One area of herbaceous vegetation differs from that found on the rest of site in having a predominantly native flora. This small site covers about 1.4 acres in a transmission line right-of-way and resembles a disturbed cedar glade, which are areas of exposed limestone that support sparse vegetation dominated by low-growing herbaceous species and eastern red cedar (Quarterman 1993). In addition to eastern red cedar and winged elm, herbaceous vegetation included blue-eyed grass, butterfly weed, hoary puccoon, creeping bush clover, false pennyroyal, pale spiked lobelia, rose pink, roundleaf thoroughwort, twining snoutbean, and whorled milkweed. Given its position on the landscape, it is likely the plant community formed as a result of disturbance associated with previous work on the Clinch River Site and construction of the 161-kV Kingston FP – Fort Loudoun HP #1 line. Considered along with the small size and anthropogenic origin of the plant community, the absence of any rare plant species typical of glades further indicates that this site possesses little if any conservation value.

Several small emergent wetlands occur on the Clinch River Property. See the wetland section of this document for additional information on the structure and composition of vegetation on those sites.

Evergreen forest occur as remnants of planted loblolly and white pine plantations and accounts for about three percent of the total land cover.

Invasive Non-Native Plant Species

Much of the Clinch River Property was extensively altered during previous projects, resulting in the introduction and spread of invasive non-native plants. Executive Order 13112 defines an invasive non-native species as any species, including its seeds, eggs, spores, or other biological material capable of propagating that species, that is not native to that ecosystem; and whose introduction does or is likely to cause economic or environmental harm or harm to human health (USDA 2007). Some invasive nonnative plants have been introduced into this country accidentally, but most were brought here as ornamentals or for livestock forage. These robust plants arrived without their natural competitors that tend to keep native plants in check. According to Morris et al. (2004), invasive non-native species are the second leading threat to imperiled native species.

Common invasive plant species occurring on the Clinch River Property include autumn olive, Chinese privet, Japanese honeysuckle, Japanese stilt grass, Johnson grass, mimosa, multiflora rose, and sericea lespedeza. All of these species have the potential to adversely impact the native plant communities because of their potential to spread rapidly and displace native vegetation and are considered a severe threat in Tennessee (Tennessee Exotic Plant Pest Council 2009). No federal noxious weeds were encountered during field surveys of the Clinch River Property.

Threatened and Endangered Plant Species

A review of the TVA Regional Natural Heritage database indicates that no federally listed plants have been previously reported from within five miles of the Clinch River Property, but two federally listed and one candidate for federal listing have been previously reported from Roane County, Tennessee (Table 3). Designated critical habitat for plants does not occur on the Clinch River Property. American Hart's-tongue fern, monkey-face orchid, and Virginia spiraea have very specific requirements and the assemblage of elements constituting suitable habitat do not occur on the site. Federally listed plant species would not be affected by the proposed action.

The TVA Regional Natural Heritage database indicates that seventeen species listed by the state of Tennessee have been reported from within five miles of the Clinch River Property (Crabtree 2014). In preparation for field surveys, the TVA botanist considered the unique habitat requirements of each of the species and used remote sensed data including aerial photos, geologic quadrangles, national wetland inventory data, and topographic maps to identify areas where rare species would be most likely to occur. Specifically, glade/barrens habitat, rich calcareous forest, and forested wetlands were prioritized as areas of interest. Field survey efforts were subsequently focused on locating these habitats to maximize the likelihood that rare plants would be found if present on the property. Two plants designated by the state of Tennessee as species of special concern were observed within the boundaries of the Grassy Creek Habitat Protection Area during field surveys of the Clinch River Property. These species were observed within the Grassy Creek Habitat Protection Area only and would not be affected by the proposed work on the Clinch River Nuclear Site.

American ginseng (*Panax quinquefolius*) is a commercially exploited herb valued for the purported medicinal value of the roots. This species prefers mesic sites and flowers from May-July, with fruits ripening later in the summer. Collection of ginseng is regulated by the state of Tennessee through the Ginseng Dealer Registration Act of 1983 and the Ginseng Harvest Season Act of 1985.

Spreading false-foxglove (*Aureolaria patula*) is perennial member of the figwort family that is parasitic on the roots of oaks. It grows on steep, partially shaded calcareous slopes above large streams and rivers and is often found within a few meters of the water. This species flowers from August through the first frost.

Table 3. All plant species of conservation concern previously reported from within five miles of the Clinch River Property as well as candidates for federal listing and federally listed plants reported from Roane County, Tennessee.

Common Name	Scientific Name	Federal Status	State Rank/Status
Earleaf Foxglove	<i>Agalinis auriculata</i>	-	END/S2
American Hart's-tongue fern ²	<i>Asplenium scolopendrium</i> var. <i>americanum</i>	THR	END/S1
Spreading False-foxglove ¹	<i>Aureolaria patula</i>	-	SPCO/S3
River Bulrush	<i>Bolboschoenus fluviatilis</i>	-	SPCO/S3
Tall Larkspur	<i>Delphinium exaltatum</i>	-	END/S2
Branching Whitlow-wort	<i>Draba ramosissima</i>	-	SPCO/S2
Waterweed	<i>Elodea nuttallii</i>	-	SPCO/S2
Godfrey's Thoroughwort	<i>Eupatorium godfreyanum</i>	-	SPCO/S1
Naked-stem Sunflower	<i>Helianthus occidentalis</i>	-	SPCO/S2

Butternut	<i>Juglans cinerea</i>	-	THR/S3
Short-head Rush	<i>Juncus brachycephalus</i>	-	SPCO/S2
Slender Blazing-star	<i>Liatris cylindracea</i>	-	THR/S2
Loesel's Twayblade	<i>Liparis loeselii</i>	-	THR/S1
American ginseng ¹	<i>Panax quinquefolius</i>	-	S-CE/S3S4
Pale Green Orchid	<i>Platanthera flava</i> var. <i>herbiola</i>	-	THR/S2
Monkey-face orchid ²	<i>Platanthera integrilabia</i>	C	S2S3/END
Heller's Catfoot	<i>Pseudognaphalium helleri</i>	-	SPCO/S2
Prairie Goldenrod	<i>Solidago ptarmicoides</i>	-	END/S1S2
Virginia Spiraea ²	<i>Spiraea virginiana</i>	THR	END/S2
Shining Ladies'-tresses	<i>Spiranthes lucida</i>	-	THR/S1S2

Status codes: **C** = Candidate; **END** = Endangered; **SPCO** = Special Concern; **S-CE** = Special Concern-Commercially Exploited; **THR** = Threatened.

Rank Codes: **S1** = Extremely rare and critically imperiled in the state with 5 or fewer occurrences, or very few remaining individuals, or because of some special condition where the species is particularly vulnerable to extirpation; **S2** = Very rare and imperiled within the state, 6 to 20 occurrences; **S3** = Rare or uncommon with 21 to 100 occurrences; **S4** = Apparently secure; **S#S#** = Denotes a range of ranks because the exact rarity of the element is uncertain (e.g., S1S2).

¹Species of conservation concern observed during field surveys of the Clinch River Property.

²Federal-listed plant species previously reported from Roane County, Tennessee, but not from within 5 miles of the Clinch River Property..

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Appendix A –

Plant List from field reviews at the Clinch Small Modular Reactor Site (2011 and 2013)

Table 1. Representative plant species observed during field reviews of the Clinch Small Modular Reactor Site (2011 and 2013).

Common Name	Scientific Name
American beech	<i>Fagus grandifolia</i>
American ginseng	<i>Panax quinquefolius</i>
American holly	<i>Ilex opaca</i>
American sycamore	<i>Platanus occidentalis</i>
Amur honeysuckle	<i>Lonicera maackii</i>
Angularfruit milkvine	<i>Matelea gonocarpus</i>
Appalachian bugbane	<i>Cimicifuga rubifolia</i>
Autumn olive	<i>Elaeagnus umbellata</i>
Axilflower	<i>Mecardonia acuminata</i>
Balm of Gilead	<i>Populus X jackii</i>
Beaked panic grass	<i>Panicum anceps</i>
Beechdrops	<i>Epifagus virginiana</i>
Big bluestem	<i>Andropogon gerardii</i>
Bishop's cap	<i>Mitella diphylla</i>
Black oak	<i>Quercus velutina</i>
Black snakeroot	<i>Cimicifuga racemosa</i>
Black walnut	<i>Juglans nigra</i>
Black willow	<i>Salix nigra</i>
Black-eye Susan	<i>Rudbeckia hirta</i>
Blackgum	<i>Nyssa sylvatica</i>
Bladdernut	<i>Staphylea trifolia</i>
Bloodroot	<i>Sanguinaria canadensis</i>
Blue cohosh	<i>Caulophyllum thalictroides</i>
Blue phlox	<i>Phlox divaricata</i>
Blunt broom sedge	<i>Carex tribuloides</i>
Box elder	<i>Acer negundo</i>
Callery pear	<i>Pyrus calleryana</i>
Broad beechfern	<i>Phegopteris hexagonoptera</i>
Bulblet bladderfern	<i>Cystopteris bulbifera</i>
Butterfly weed	<i>Asclepias tuberosa</i>
Buttonbush	<i>Cephalanthus occidentalis</i>
Canada violet	<i>Viola canadensis</i>
Carolina buckthorn	<i>Rhamnus caroliniana</i>
Carolina coralbead	<i>Cocculus carolinus</i>
Cattail	<i>Typha latifolia</i>

Chestnut oak	<i>Quercus montana</i>
Chinese privet	<i>Ligustrum sinense</i>
Christmas fern	<i>Polystichum acrostichoides</i>
Common adder's tongue fern	<i>Ophioglossum vulgatum</i>
Common threesquare	<i>Schoenoplectus pungens</i>
Creeping jenny	<i>Lysimachia nummularia</i>
Crownbeard	<i>Verbesina alternifolia</i>
Crownbeard	<i>Vebesina occidentalis</i>
Cucumber magnolia	<i>Magnolia acuminata</i>
Dog-tooth violet	<i>Erythronium americanum</i>
Doll's eyes	<i>Actaea pachypoda</i>
Dutchman's breeches	<i>Dicentra cucullaria</i>
Dwarf larkspur	<i>Delphinium tricorne</i>
Eastern red bud	<i>Cercis canadensis</i>
Eastern red cedar	<i>Juniperus virginiana</i>
Ebony spleenwort	<i>Asplenium platyneuron</i>
Fall bentgrass	<i>Agrostis perennans</i>
Field thistle	<i>Cirsium discolor</i>
Flowering dogwood	<i>Cornus florida</i>
Fluxweed	<i>Isanthus brachiatus</i>
Foam flower	<i>Tiarella cordifolia</i>
Frank's sedge	<i>Carex frankii</i>
Fringeleaf wild petunia	<i>Ruellia humilis</i>
Frostweed	<i>Verbesina virginica</i>
Fox sedge	<i>Carex vulpinoidea</i>
Giant chickweed	<i>Stellaria pubera</i>
Giant sedge	<i>Carex gigantea</i>
Glade fern	<i>Diplazium pycnocarpon</i>
Golden eye saxifrage	<i>Saxifraga careyana</i>
Green Ash	<i>Fraxinus pennsylvanica</i>
Green violet	<i>Hybanthus concolor</i>
Grooved flax	<i>Linum sulcatum</i>
Hairy small-leaf tick trefoil	<i>Desmodium ciliare</i>
Harbinger of spring	<i>Eriogenia bulbosa</i>
Harper's triparted violet	<i>Viola tripartita</i> var. <i>glaberrima</i>
Hoary puccoon	<i>Lithospermum canescens</i>
Hyssopleaf thoroughwort	<i>Eupatorium hyssopifolium</i>
Indian pink	<i>Spigelia marilandica</i>
Jack in the pulpit	<i>Arisaema triphyllum</i>
Jacob's ladder	<i>Polemonium reptans</i>
Japanese honeysuckle	<i>Lonicera japonica</i>
Japanese stiltgrass	<i>Microstegium vimineum</i>
Jewel weed	<i>Impatiens capensis</i>
Johnson's grass	<i>Sorghum halepense</i>
Kudzu	<i>Pueraria montana</i> var. <i>lobata</i>
Largeleaf waterleaf	<i>Hydrophyllum macrophyllum</i>
Lateflowering thoroughwort	<i>Eupatorium serotinum</i>
Leafy bulrush	<i>Scirpus polyphyllus</i>

Little brown jug	<i>Hexastylis arifolia</i>
Lizard tail	<i>Saururus cernuus</i>
Loblolly pine	<i>Pinus taeda</i>
Longleaf summer bluet	<i>Houstonia longifolia</i>
Maiden hair fern	<i>Adiantum pedatum</i>
Maple-leaf viburnum	<i>Viburnum acerifolium</i>
Maryland senna	<i>Senna marilandica</i>
Mockernut hickory	<i>Carya tomentosa</i>
Monkey flower	<i>Mimulus alatus</i>
Multiflora rose	<i>Rosa multiflora</i>
Muscle wood	<i>Carpinus caroliniana</i>
Narrowleaf vervain	<i>Verbena simplex</i>
Netted chain fern	<i>Woodwardia areolata</i>
Nettleleaf sage	<i>Salvia urticifolia</i>
Northern red oak	<i>Quercus rubra</i>
Orange coneflower	<i>Rudbeckia fulgida</i>
Oriental bittersweet	<i>Celastrus orbiculatus</i>
Pale spike lobelia	<i>Lobelia spicata</i>
Pawpaw	<i>Asimina triloba</i>
Persimmon	<i>Diospyros virginiana</i>
Pignut hickory	<i>Carya glabra</i>
Poison hemlock	<i>Conium maculatum</i>
Poison ivy	<i>Toxicodendron radicans</i>
Princess tree	<i>Paulownia tomentosa</i>
Prostrate ground tick trefoil	<i>Desmodium rotundifolium</i>
Rattlesnake plantain	<i>Goodyera pubescens</i>
Red maple	<i>Acer rubrum</i>
Red mulberry	<i>Morus rubra</i>
Red trillium	<i>Trillium erectum</i>
Resurrection fern	<i>Pleopeltis polypodioides</i>
Rice cutgrass	<i>Leersia oryzoides</i>
Rose mallow	<i>Hibiscus moscheutos</i>
Rosepink	<i>Sabatia angularis</i>
Roughseed St. John's wort	<i>Hypericum sphaerocarpum</i>
Roundhead lespedeza	<i>Lespedeza capitata</i>
Roundleaf thoroughwort	<i>Eupatorium rotundifolium</i>
Roundleaf greenbrier	<i>Smilax rotundifolia</i>
Running ground pine	<i>Diphasiastrum digitatum</i>
Rusty blackhaw	<i>Viburnum rufidulum</i>
Sassafras	<i>Sassafras albidum</i>
Sericea lespedeza	<i>Lespedeza cuneata</i>
Serviceberry	<i>Amelanchier</i> sp.
Showy orchis	<i>Galearis spectabilis</i>
Silky dogwood	<i>Cornus amomum</i>
Silver plume grass	<i>Saccharum alopecuroides</i>
Silver maple	<i>Acer saccharinum</i>
Slippery elm	<i>Ulmus rubra</i>
Softstem bulrush	<i>Schoenoplectus tabernaemontani</i>

Solomon's plume	<i>Maianthemum racemosum</i>
Solomon's seal	<i>Polygonatum biflorum</i>
Sourwood	<i>Oxydendrum arboreum</i>
Spicebush	<i>Lindera benzoin</i>
Spotted wintergreen	<i>Chimaphila maculata</i>
Sprangle-top	<i>Tridens flavus</i>
Spreading false foxglove	<i>Aureolaria patula</i>
Squarestem spike rush	<i>Eleocharis quadrangulata</i>
Squarrose sedge	<i>Carex squarrosa</i>
Sugar maple	<i>Acer saccharum</i>
Sugarberry	<i>Celtis laevigata</i>
Swamp milkweed	<i>Asclepias incarnata</i>
Sweetgum	<i>Liquidambar styraciflua</i>
Tag alder	<i>Alnus serrulata</i>
Tall false indigo	<i>Amorpha fruticosa</i>
Tall fescue	<i>Festuca arundinacea</i>
Tall thoroughwort	<i>Eupatorium altissimum</i>
Trailing lespedeza	<i>Lespedeza procumbens</i>
Tree-of-Heaven	<i>Ailanthus altissima</i>
Trumpet creeper	<i>Campsis radicans</i>
Tulip poplar	<i>Liriodendron tulipifera</i>
Twining snoutbean	<i>Rhynchosia tomentosa</i>
Twinleaf	<i>Jeffersonia diphylla</i>
Umbrella magnolia	<i>Magnolia tripetala</i>
Vasey's trillium	<i>Trillium vaseyi</i>
Virginia dayflower	<i>Commelina virginica</i>
Virginia pine	<i>Pinus virginiana</i>
Walking fern	<i>Asplenium rhizophyllum</i>
Water willow	<i>Decodon verticillatus</i>
White grass	<i>Leersia virginica</i>
White oak	<i>Quercus alba</i>
White pine	<i>Pinus strobus</i>
White-blue-eyed grass	<i>Sisyrinchium albidum</i>
Whorled milkweed	<i>Asclepias verticillata</i>
Wild basil	<i>Satureja vulgaris</i>
Wild black cherry	<i>Prunus serotina</i>
Wild geranium	<i>Geranium maculatum</i>
Wild ginger	<i>Asarum canadensis</i>
Winged elm	<i>Ulmus alata</i>
Wood sorrel	<i>Oxalis</i> sp.
Wool grass	<i>Scirpus cyperinus</i>
Yellow buckeye	<i>Aesculus flava</i>
Yellow flag	<i>Iris pseudacorus</i>
Yellow giant hyssop	<i>Agastache nepetoides</i>
Yellow trillium	<i>Trillium luteum</i>