Pellissippi Wetland PARK

Prepared by the Community Design Assistance Center

Prepared for the Town of Lebanon and the Lebanon Wetland Project Team

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Acknowledgements

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Pellissippi

Pellissippi is the historic Native American name for the Clinch River, one of the most biologically diverse rivers in the world, in terms of mussels. The Clinch River originates in Tazewell County and flows southwest through the Great Appalachian Valley, gathering various tributaries before joining the Tennessee River in East Tennessee.

Pellissippi Wetland Park

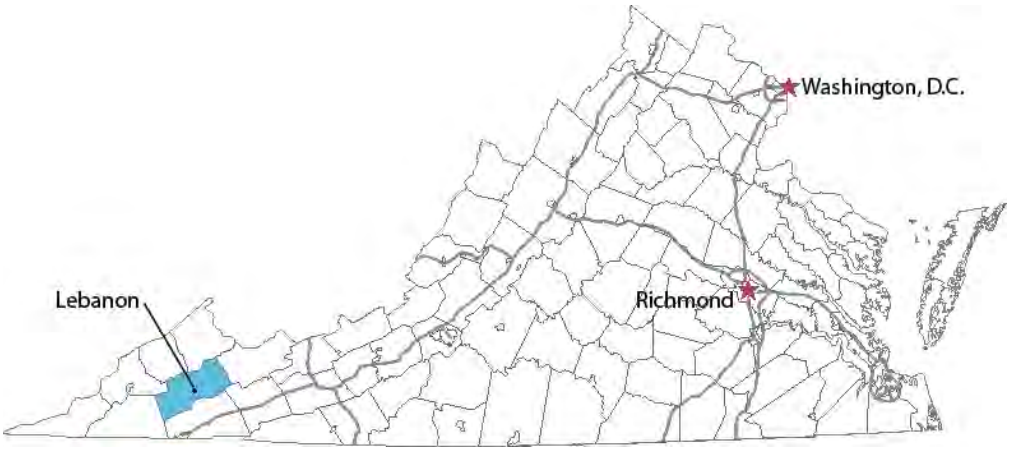
Project Description

Context

The proposed Pellissippi Wetland Park is located in heart of Lebanon, Virginia, county seat for Russell County. The site is immediately adjacent to the Russell County Government Center as well as a proposed farmer's market and Veteran's Memorial. Northrup Grummon and CGI offices border the western edge of the side, while a new residential development lies immediately to the north of the site. The park is in walking distance from Lebanon Primary, Elementary, and Middle Schools as well as the Russell County Library. Opportunities for connectivity within the community are great.

The project site is approximately 5 to 7 acres. The land was deemed unfit for development, allowing the Russell County Industrial Development Authority to lease the land to the Town of Lebanon for environmental education and recreation purposes.

The project site and its surrounding context lie within the Clinch River Watershed. Water from Pellissippi Wetland Park enters the Clinch River via Little Cedar Creek. The park aims to offer educational opportunities to residents and visitors related to environmental stewardship, environmental functions and diversity, and low impact development. It also aims to improve the quality of the water that passes through its boundaries before it enters the Clinch River.



State context map showing Russell County and the Town of Lebanon.

Photo of project site taken from the Russell County School Board offices.

http://maps.google.com/maps?f=q&source=s_q&hl=en&geocode=&q=russell+county,+va&sll=3...

County context map.

Purpose and Goals

A team of educators, local officials, and agency experts were asked to participate in the Pellissippi Wetland Park project team to guide the design development, funding, and implementation of the park. Patrick Smith, an Office of Surface Mining Volunteer in Service to America (OSM/VISTA) intern was brought in to coordinate this effort. The project team contacted the Community Design Assistance Center to request conceptual design assistance for the park site. Goals for the park include:

- Preserve and Enhance Existing Natural Areas on the Site
- Increase Positive Environmental Functions on the Site
- Provide Opportunities for Environmental Education
- Ensure Accessibility (ADA) and Connectivity to the Broader Community
- Increase Habitat and Biodiversity
- Offer Opportunities for Passive Recreation

Area Context Map

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Design Process

CDAC team looks at the soil clay content on site with Tom Biebighauser (second from right), a wetland expert with the US Forest Service.

Mayor Dodi (left) reviews preliminary design concepts at the November 2009 presentation.

The CDAC design team began the Pellissippi Wetland project with an initial site visit and meeting with the project partners in late July 2009. At that time, the CDAC team introduced themselves and their role in the project to the Lebanon Town Council and the Clinch Valley Soil and Water Conservation District.

The CDAC team returned in August to gather additional information about the site to begin preparing site inventory and analysis maps. The team was able to spend some time on site with Army Corps of Engineer staff member Annette Poore, to discuss the existing wetlands and initial ideas for enhancing the site. The CDAC team continued to gather additional information about the site, meeting with Virginia Department of Conservation and Recreation staff for guidance and feedback, particularly as it related to the sinkhole on site.

In September 2009, U.S. Forest Service Wildlife Biologist and wetland expert, Tom Biebighauser, toured the project site, along with members of the project team and various state agencies. The CDAC team discussed opportunities for enhancing existing wetlands and creating additional small vernal wetlands on site with Mr. Biebighauser. With his guidance, the CDAC team and Patrick Smith (OSM/VISTA) did some initial soil tests to determine the clay content of the soil in certain places and its subsequent potential for serving as a base for created wetlands.

Following this meeting, the CDAC team worked to finalize the site inventory and analysis information and continued to meet or talk with various state agency experts and Virginia Tech professors related to wetlands, the existing stormwater detention basin, and the sinkhole on site. The CDAC team also met with W. Dale Huff, Western Region Landscape Architect for VDOT, to discuss site circulation and connectivity to the broader community.

Preliminary design concepts were developed and presented to the client team, agency experts from Virginia Department of Conservation and Recreation, Soil and Water Conservation, and US Army Corps of Engineers, and the CDAC design review panel, for review and comment. The design concepts were also presented to Virginia Department of Environmental Quality staff members for review and comment, as a portion of the project site was designated as a conservation easement as of October 2009.

Based on this feedback, the preliminary concepts were refined into one final conceptual master plan for Pellissippi Wetland Park. This short, supporting report documents the site inventory, analysis, and design process for the project. It also presents the final conceptual master plan, accompanied by a written narrative and supporting sketches.

Site Inventory

View of project site looking north, Gardenside Residential Development can be seen in the background.

CDAC team looks at the sinkhole on site and surrounding vegetation.

The CDAC design team began the site inventory process by gathering 2006-2007 Virginia Base Mapping Digital Orthophotography data (aerial photography) of the site from the Virginia Tech library. CADD files for the site , including topographic information, estimated locations of existing vegetation, gravel swale and sediment basin location and footprints for the Russell County Government Center building and parking lot were provided by Thompson-Litton Engineering.

The CDAC team utilized this mapping information as well as information gathered in the field to identify existing conditions on site of importance to the project. Some key existing elements to enhance and protect include:

- An existing wetland
- Existing vegetation
- An ephemeral stream
- An existing sinkhole

An existing sediment (detention) basin, site drainage swales, and drainage outlets emitting runoff onto the site also need to be considered. Site issues to be addressed include:

- Site accessibility (topographic limitations for American Disabilities Act accessibility)
- Existing erosion (two significant headcuts)

An 11x17 site inventory drawing identifying these aforementioned features/issues can be found on the following page.

Site Inventory

The Pellissippi Wetland Park site is located in the Town of Lebanon, Virginia adjacent to the County Goverment Center and recent commercial and recential development. Key site features include an existing wetland, an ephemeral stream, and an existing sinkhole. Site issues include drainage outlets, swales, a sediment basin, erosion (head cuts), and pedestrian and vehicular access.

Existing Wetland:

The site has one naturally occurring wetland towards the northeastern part of the site. The wetland appears to be functioning well and has a diversity of plant species growing in it.

Ephemeral Stream:

The site possesses a small stretch of stream which may have had its natural course altered in the generations past for farming purposes.According to Tom Biebighauser (USFS Wetland Specialist), the stream occurred on a higher level of the site than natural, which was likely due to the farmer's activities on site changing its flow pattern to increase fertile crop land. The stream is amidst dense vegetation and is almost invisible from the outside. The stream has a gentle flow of water which disappears into the sinkhole after a certain point. The stream flows over a stony path, which also could have been a result of possible development on the site.

Pedestrian and Vehicular Access:

Currently parking for people accessing the site is provided in the parking lot in front of the Russell County Government Center or along the Technology Center Drive. Quite a few pedestrians can be found walking on Technology Center Drive during lunchtime. Current pedestrian access to the site is limited by steep slopes. The access road to the sediment basin provides the only easy pedestrian access at the moment.

Existing Sinkhole:

The site has a large sinkhole which has possibly expanded over the last few years. Due to the karst landscape, there has been a gradual removal of the bedrock (limestone) due to water percolation. This has been confirmed since when the initial study of the site took place. It is important to address the sinkhole in a proper manner to ensure site safety and protection of groundwater.

There are two existing headcuts on the site in existing drainageways. These headcuts should be addressed in the near future to minimize the extent of damage and corresponding expense to repair and to reduce erosion and sedimentation.

Site Drainage: Existing Swales and Drainage Outlets

The gravel swale on the site flows east-west across the site, following the topography of the site.The swale transports runoff from CGI and Northrup Grummon to the sediment basin. At the end of the swale, the rock had slid off the geo-textile matted exposed (and removed in one place) and quite a bit of undercutting was occurring. A grassed swale runs from the edge of the sediment basin toward Main Street. A gravel spillway would direct any overflow from the sediment basin into this grassed swale. There are three drainage outlets that also give stormwater input into the site from adjacent properties.

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Site Analysis

CDAC team member Daniel Langston (left) sets up survey equipment with Tom Biebighauser (right).

CDAC team member Mara Grossman selectively samples the soil pH on site.

CDAC team members look at soil texture with Patrick Smith (center left) and Tom Biebighauser (center right).

The CDAC team gathered and analyzed available information about soils, slope, and other site attributes to better understand opportunities and limitations of the site. After completing the soil and slope analyses, the CDAC team prepared a composite analysis map that highlights findings from the slope and soil analyses as well as other physical, biological, and cultural factors of the site. This information was used as a basis for initial concept development.

Soil Analysis

The CDAC team gathered initial soil information from the National Resource Conservation Service's (NRCS) web soil survey. The team also consulted with Jeannine Freyman, USDA Soil Scientist, about the soil on site and the implications of urban soils. Based on the findings of the NRCS's web soil survey, the project site is comprised of two primary soils types: Wyrick-Marbie silt-loam, 8 to 15 percent slope (61C) and Udorthents-urban land complex, 0 to 80% slope (54F).

The majority of the site (about 64% of the site area) consists of Udorthents, loamy soil. The soils in the drainage way are not disturbed and hence contain the Wyrick-Marbie soil unit. However, drainage way soils are very variable and contain many different soil inclusions. The drainage way soils have limestone bedrock wherein the karst geology needs to be kept in mind during planning and design. There is currently one existing sinkhole on the site. All residual soils, which is the remainder of the site have been disturbed by earth moving equipment. Therefore natural soils properties will not conform, and should not be used for these altered soils. The only general soils information that can be stated for these soils are limestone derived with varying depths and bedrock occurring throughout the area in no specific pattern. But since these are disturbed soils now - soil depths and bedrock occurrences are not what they were in the natural soil state.

Wyrick-Marbie (61C) silt loams

This soil type contain Wyrick (55%) and Marbie (40%) soils, which are suitable for construction of paths and trails. The possible activities supported on this soil are established based on soil properties that affect traffic ability and erodability. These properties are stoniness, depth to a water table, ponding, flooding, slope and texture of the surface layer. It is a soil classified as Farmland of statewide importance.

Udorthents-urban land complex (54F)

"Udorthents-urban land complex are in areas of cut and fill. Where soil material has been removed, the material is typically similar in the subsoil or substratum of adjacent soils. In fill or disposal areas, the soil material has more variable characteristics because it usually consists of varying amounts of material from the subsoil and substratum of nearby soils. Slope is dominantly 2 to 6 inches, although it ranges from 0 to 10 percent." (http://www.auditor.co.geauga.oh.us/ag/soilsLegend/Ud.htm).

Typically, 60 inches of the upper soil profile is silty clay loam, clay loam or silt loam. Some of the areas on terraces and flood plains have sandy and gravelly material. The available water capacity is variable, but it is dominantly low or very low in the root zone. Permeability is generally slow. Glacial pebbles and fragments of shale and sandstone are commonly on the soil surface. The soil is firm and dense. Tilt is poor. Hard rains tend to seal the soil surface, reducing infiltration and restricting the emergence and growth of seedlings. A seasonal high water table is present in some areas. Reaction of the root zone ranges from medium acid to mildly alkaline.

In most areas Udorthents (class 54F), loamy, are used for parks, recreation fields, and buildings. The properties of these soils vary greatly with depth; however, they are generally well suited to use as building sites. Restrictive layers and buried objects generally obstruct deep excavations. These soils are fairly suited to lawns, landscaping, and vegetable gardens. In urban areas vegetable gardens generally can be planted if soil tests are made to identify possibly contaminated soil, as with heavy metals. These soils differ greatly from place to place: consequently, on site investigation is needed to assess the suitability of the soils for specific land uses.

Soil samplesere gathered by the CDAC team and were analyzed at the Virginia Cooperative Extension Soil Lab to identify pH, organic material and macro and micronutrient content. Nutrients were determined to be sufficient, and no lime or fertilizer is recommended. The pH was high in one location, typical of a disturbed soil site. Additional pH measurements were taken in various spots on the site by the CDAC team with a pH meter. The secondary pH sampling locations were chosen based probable future plantings and results were used to guide the selection of appropriate plant species for those areas. The secondary reading showed average to high pH over the site.

These measurements show general site conditions, and allowed the CDAC team to choose plants for the site. However, pH and soil nutrients vary over time and location and therefore once construction is complete and specific planting sites are chosen, more soil tests should be taken prior to planting to determine if any soil amendments are needed. An 11x17 of the soil analysis can be found on page 9.

Slope Analysis

The CDAC team utilized the topographic information (CADD file) provided by Thompson-Litton Engineering to analyze the existing slopes on the site. Findings from the slope analysis helped guide the team in placing trails and other site features in areas that would require minimal grading and allow users with a diverse range of physical abilities to enjoy the park. An 11x17 pullout of the slope analysis can be found on page 10.

Composite Analysis

The CDAC team combined the findings from the soil and slope analysis along with information gathered from field visits and meetings with agency experts to prepare a composite site analysis. The composite analysis identifies views to enhance, areas to consider wetland enhancement or creation, suitable slopes for trails, possible pedestrian access points to the park, potential pedestrian connections to adjacent areas, the location of the soil samples taken to analyze the location of the existing sinkhole, and the boundaries of the conservation easement on site. A conservation easement was placed on a portion of the site containing existing wetlands. This easement was created in response to a consent order given to the Russell County Development Group by the Department of Environmental Quality (see page 16 for more information on the conservation easement). An 11x17 pullout of the composite analysis can be found on page11.

Soil Analysis

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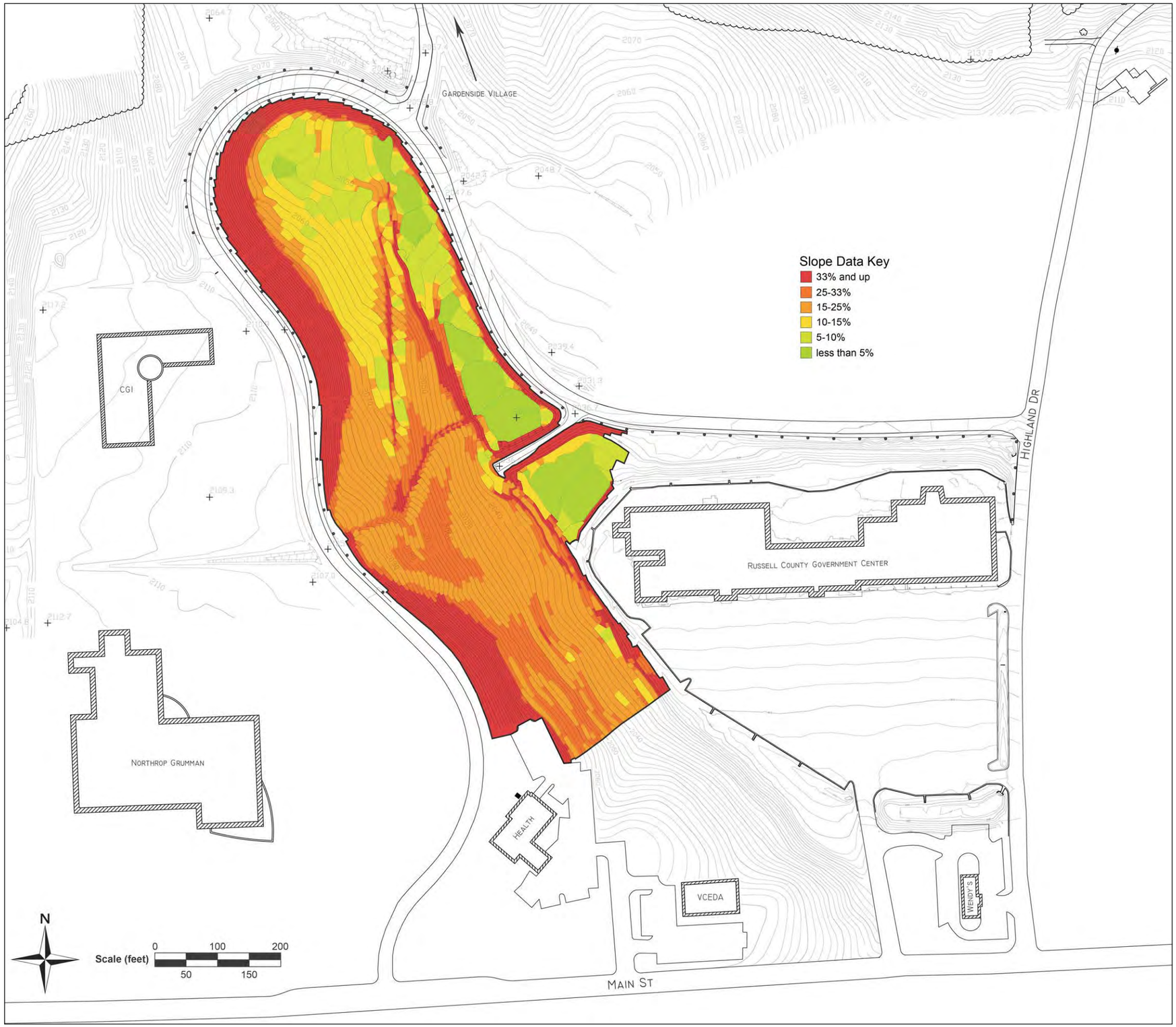
Slope Analysis



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Composite Analysis

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Preliminary Design Concepts

CDAC team member Daniel Langston presents site inventory and analysis information that informed the preliminary design concepts.

The CDAC design team prepared two preliminary design concepts for Pellissippi Wetland Park. These alternative designs, along with site inventory and analysis information, were presented to the project partners as well as Virginia Department of Environmental Quality staff for review and comment on November 4, 2009.

Concept A: Enhancing Natural Systems

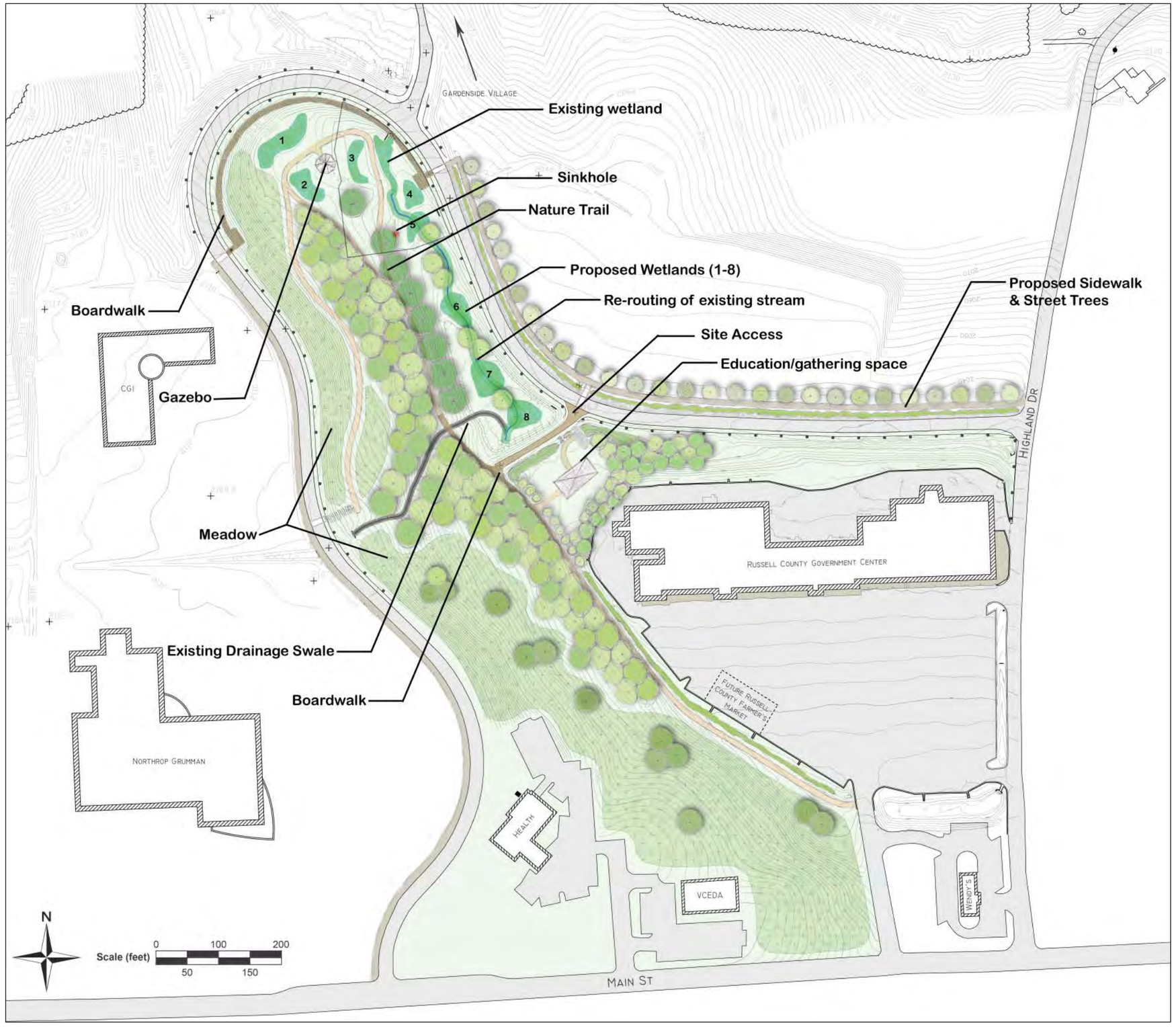
Concept A was guided by a desire to highlight the natural systems of the site and to minimize the inclusion of man made structures in the landscape. The primary site access is located at the current access road. This location allows a flat, broad path into the site and is a good location for easy loading and unloading of school buses bringing classes to the site. A covered gathering space is proposed adjacent to the site entrance. This shelter can serve as a place to gather classes and prepare them for their educational exploration of the site. It can also serve as a place to reconvene and discuss findings before returning to school. The shelter would also provide a covered seating area for the general public for picnics or other events.

A series of wetlands are proposed along the eastern edge of the site. There is currently one wetland on site, as well as a short section of ephemeral stream. Concept A proposes rerouting the stream through the proposed wetlands. The current channel was likely rerouted for farming purposes in the early part of this century. Rerouting the stream would divert water from directly entering the existing sinkhole and meander it through the wetlands, create additional habitat and improving water quality.

A proposed boardwalk trail brings visitors into the site, enabling the trail to maintain a moderate grade that meets ADA accessibility standards. Moving north along the trail, park visitors pass through a canopy of existing and proposed trees. The trail forks, creating a small loop and offers users the opportunity to have a closer look at the proposed and existing wetlands on site. A small gazebo allows for reflection or wildlife observation. Stairs and a meandering trail provide access to the site from the western edge, allowing employees of CGI and Northrup Grumman easy access to a scenic lunch spot and providing an alternative location for a lunchtime stroll. The steeper western side slopes are planted with meadow grasses, increasing habitat. Some additional tree clusters are also proposed. A proposed trail extends along the eastern edge of the side toward Main Street, connecting the park to the Russell County Government Center. A sidewalk is proposed along Technology Center Drive, providing pedestrian connectivity from the park to the greater community. A section of boardwalk is proposed on the northern curve of the site, giving users a safe area to walk separated from vehicles. This boardwalk also would provide wonderful views into the site and the wetlands.

An 11x17 of Concept A, with supporting images, can be found on the following page.

Preliminary Concept A



Trail Examples

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Concept B: Highlighting Culture and Environmental Education

Concept B sought to incorporate opportunities for community gathering, art exhibition, and environmental education through details and site design. Like Concept A, the primary site entrance is located off of Technology Center Drive, where the existing site access is situated. Concept B proposed a designed entryway in the form of an arch or decorative gate. This would create a formal entrance to the space and could speak to the heritage of the Town as well as the site in the specific design of the structure. A whimsical playground is proposed near the site entry. Play equipment could be designed so that the structures themselves provide an educational experience - taking on the form of plant life and showing details of plant structures.

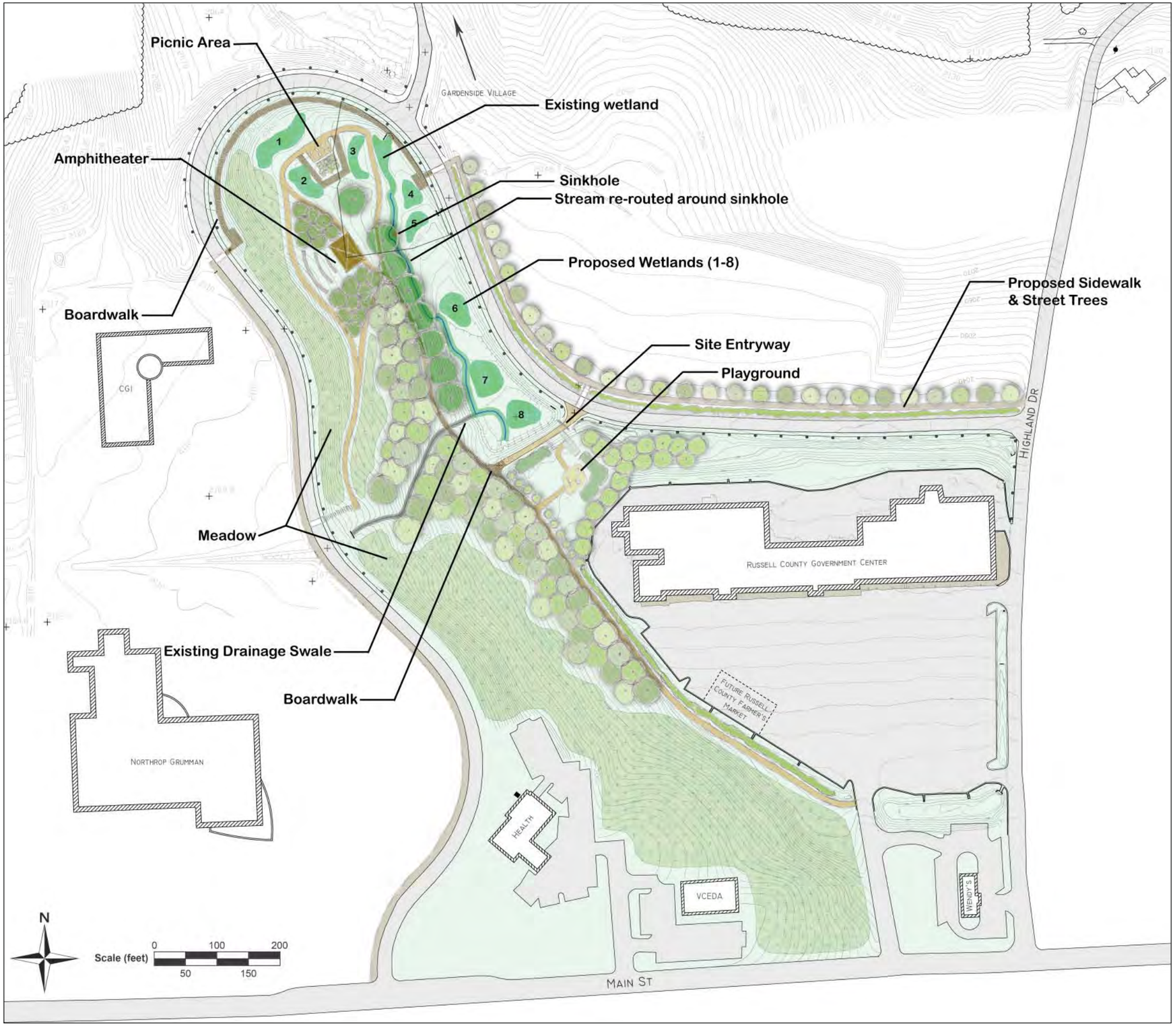
Eight wetlands are proposed, similar to Concept A, but the existing ephemeral stream maintains its current channel, with the exception of a minor rerouting around the sinkhole. The existing sinkhole should be addressed with an inverted filter and should be registered with the EPA as a Class 5 Injection Well (See Appendix A for more information).

A decked picnic/gathering area is proposed between two proposed wetlands. This area can be used as an educational gathering space with seating and deck overlooks as well as a space to enjoy an outdoor lunch. An amphitheater is proposed for outdoor concerts or other cultural events. This space could also serve as an outdoor classroom of sorts.

Like Concept A, a sidewalk is proposed along Technology Center Drive, providing pedestrian connectivity from the park to the greater community. A section of boardwalk is proposed on the northern curve of the site, giving users a safe area to walk separated from vehicles. This boardwalk also would provide wonderful views into the site and the wetlands. A trail is also proposed along the eastern edge of the site, providing connection to the Russell County Government Center and the proposed farmer's market.

An 11x17 of Concept B, with supporting images, can be found on the following page.

Preliminary Concept B



Amphitheater Examples




Entryway Examples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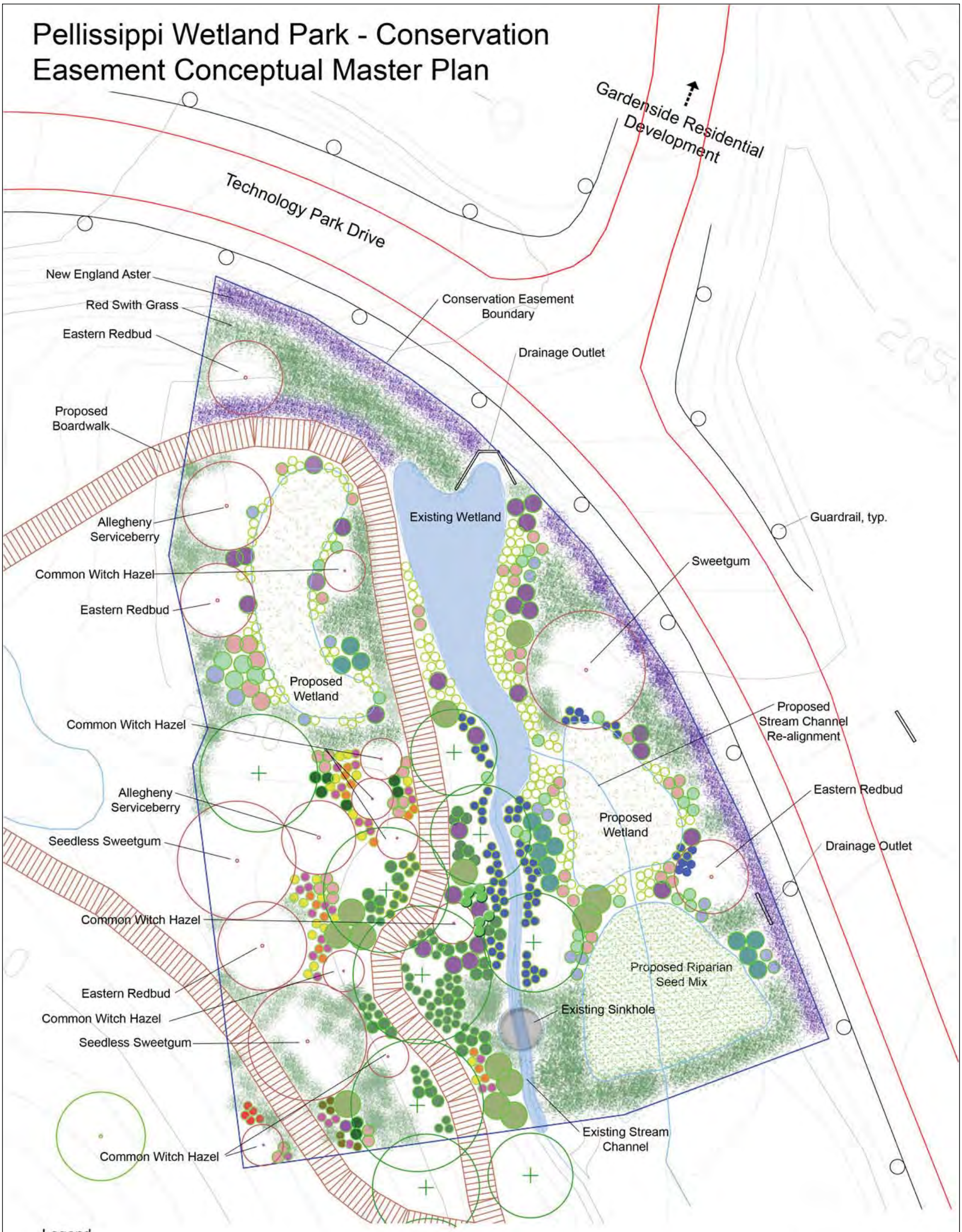
Conservation Easement Area

A portion of the Pellissippi Wetland site was placed under a conservation easement (held by the Industrial Development Authority) in October 2009. The Russell County Development Group was charged to enhance the stream channel, remove invasive species, and plant a riparian buffer in this area as part of a Virginia Department of Environmental Quality (DEQ) consent order. The CDAC team worked to prepare a detailed planting plan for the conservation easement area for the DEQ to review in hopes of increasing the biodiversity of the proposed plantings and tying the plans for this portion of the site together with the rest of the conceptual design proposal.

The plan was reviewed and approved by the DEQ as plantings that were consistent with the aims of the consent order. An 11x17 pullout of the proposed plantings can be found on the following page.

Pellissippi Wetland Park - Conservation Easement Conceptual Master Plan



Legend

- Existing Trees
- Cinnamon Fern
- Swamp Sunflower
- Purple Coneflower
- Black Eyed Susan
- Summer Phlox
- Summer Phlox
- Sweet Pepperbush
- Buttonbush
- Black Chokeberry
- Virginia Sweetspire
- Winterberry
- Common Elderberry
- Silky Dogwood
- Full Sun Herbaceous Wetland Mix: Marsh Marigold, Sallow Sedge, Southern Blue Flag Iris, Soft Rush, Sweet Flag, White Turtlehead, and Lizard's Tail
- Part Shade Herbaceous Wetland Mix: Sallow Sedge, Sweet Flag, White Turtlehead, and Lizard's Tail
- Inkberry Holly

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Conservation Easement Planting Plan

Final Conceptual Master Plan

The final conceptual master plan for Pellissippi Wetland Park draws ideas from Preliminary Concepts A and B and responds to feedback the CDAC design team received from the client team as well as field experts from different state and federal agencies. The design for the park seeks to:

- preserve and enhance existing natural assets
- increase positive environmental functions on the site
- provide opportunities for environmental education
- ensure accessibility and connectivity
- increase habitat and biodiversity
- offer opportunities for passive recreation

Key features of the design concept that support these goals include the addition of multiple vernal wetlands to increase habitat and improve water quality; the re-alignment of the stream channel to reduce erosion and possible groundwater contamination by routing it around an existing sinkhole; the addition of native trees, shrubs, and grasses to increase biodiversity on site and minimize maintenance; the creation of planted bioswales, rain gardens, and bio-rentention tree islands to allow storm water to infiltrate instead of increasing urban runoff to the Clinch River; and the creation of civic, recreational, and educational gathering places through the amphitheater, covered shelter, and boardwalk trails.

Addressing universal accessibility while minimizng grading was a challenge for this site because of the steep and varied topography. The CDAC team utilitzed the existing access to the stormwater basin to serve as the primary ADA accesss point to the site. This area can serve as a bus drop-off for schools visiting the outdoor classroom. The adjacent proposed covered shelter can serve as a gathering place for classes before and after they enter the outdoor classroom. A porous concrete trail leads users from this site access point to the covered shelter and serves as both an accessible surface material and a demonstration of best management materials for stormwater management on site.

Boardwalk trails are proposed both in environmentally sensitive areas as well as areas that need boardwalk to maintain an appropriate grade for accessible trail use. Crushed stone trails are recommended around the amphitheater and along the hillslopes, connecting to CGI/Northrup Grummon.

Park uses can also access the site from the Russell County Government Center parking lot via a tree-lined walking trail that leads users along a planted bioswale. This bioswale will intercept some parking lot runoff and allow it to infiltrate into the ground. Plants help clean the water by taking up pollutants in runoff such as oils and gas drippings from cars. This trail provides a direct connection to the park from the new Farmer's Market structure.

Lastly, sidewalks are proposed along a portion of Technology Center Drive to provide safe pedestrian connections to the site from nearby schools and other downtown destinations. A perimeter boardwalk trail is proposed along the northern edge of the site is in a section where the construction of sidewalk is not feasible. This perimeter boardwalk will provide a safe walking environment for users desiring to pass along the perimeter of the site for exercise or destination walking. It will also provide a unique environment to experience the site, with excellent views to the vernal wetlands and other site features.

Final Conceptual Master Plan

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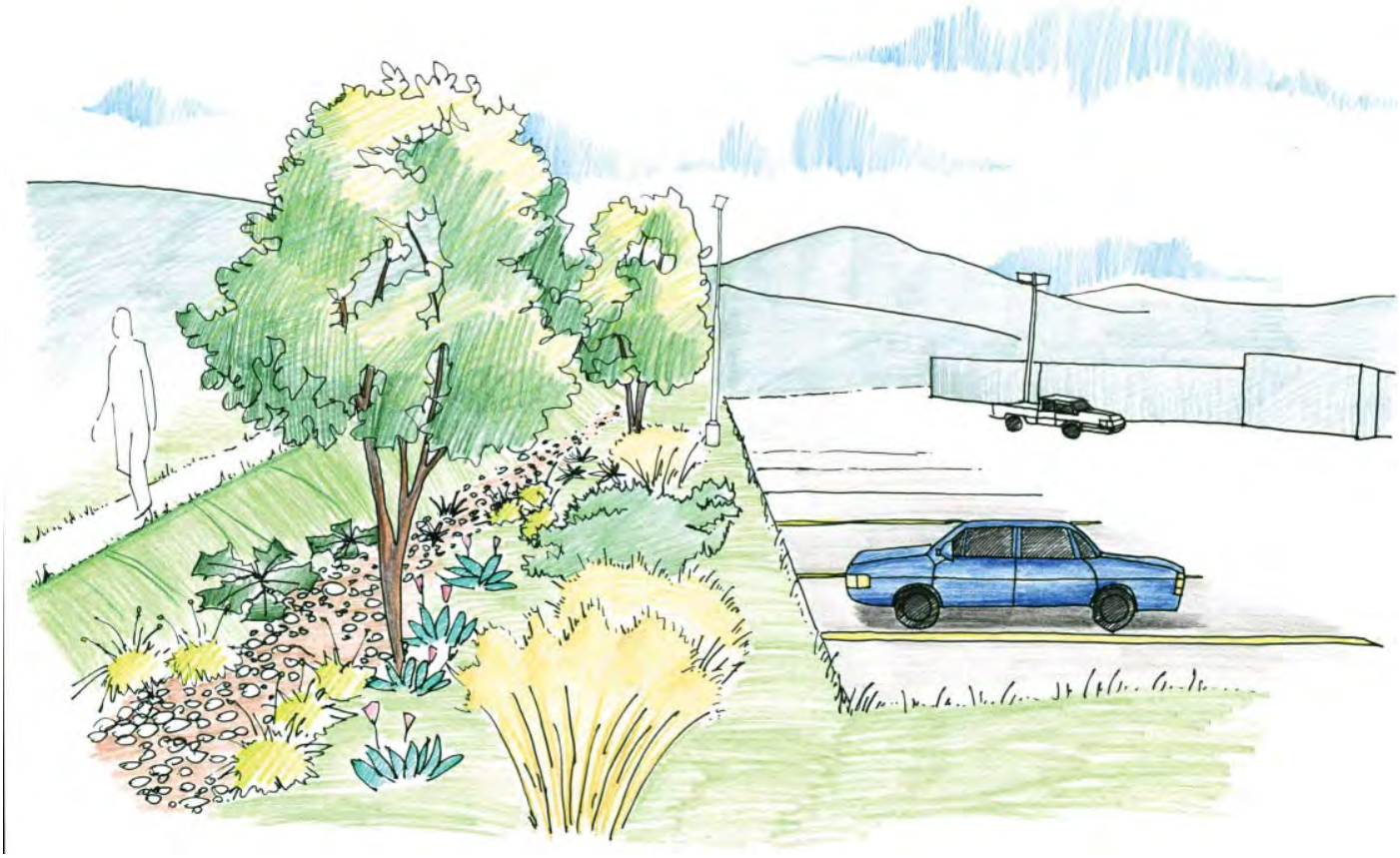
Supporting Sketches

Sketch of proposed amphitheater. Pervious grass pavers are recommended for the stage area, providing a firm and level surface while also allowing for infiltration in storm events.

Sketch of proposed perimeter boardwalk.

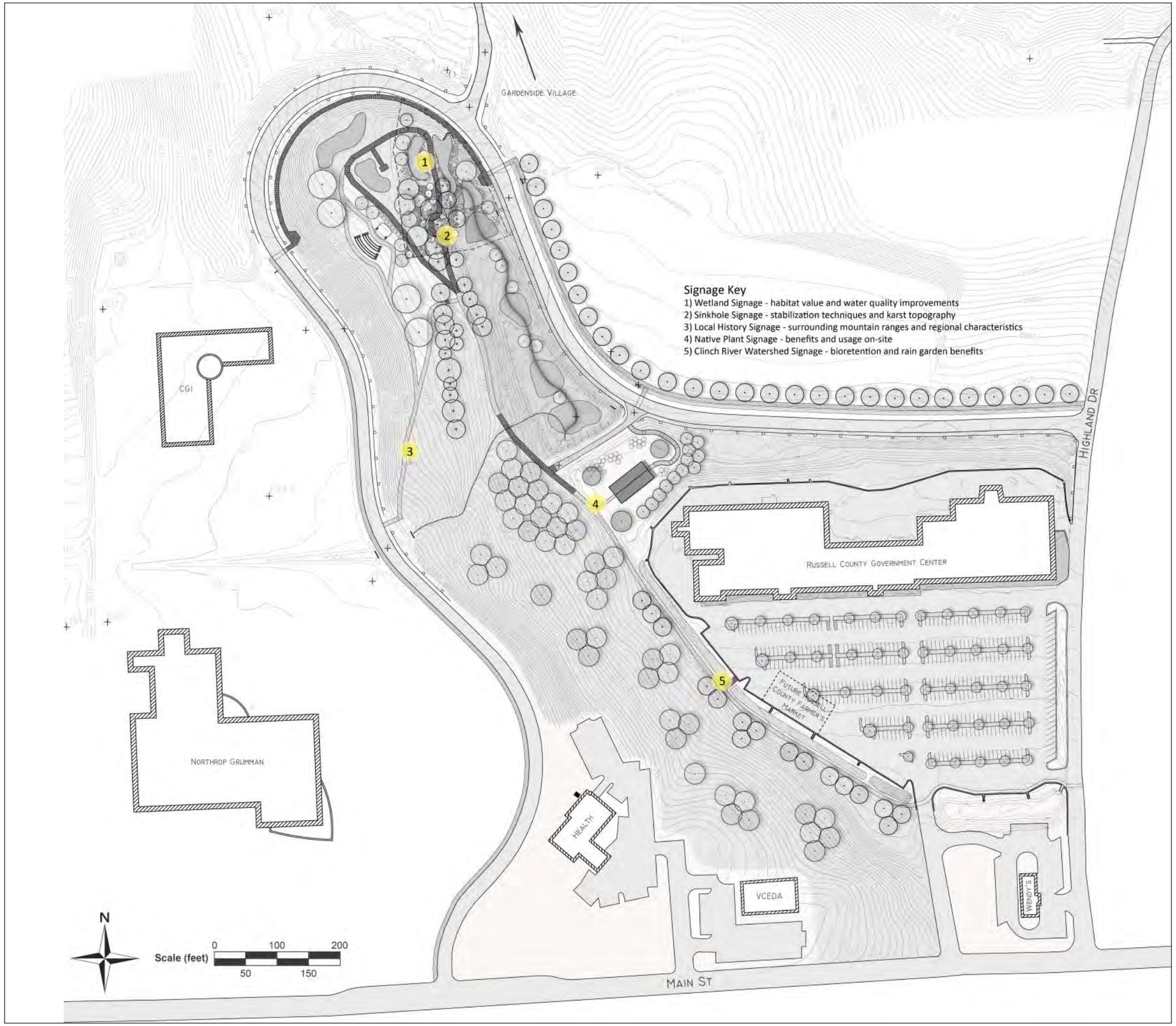
Sketch of proposed boardwalk trail skirting the edge of proposed and existing wetlands.

Sketch of proposed covered shelter and accessible site access. Proposed plantings around the shelter serve as a demonstration of native plantings with aesthetic and wildlife/habitat value.



Sketch of proposed trail connecting the park to the Farmer's Market and the Russell County Government Center. The proposed trail is adjacent to a bioswale (illustrated above).

Signage Location Plan



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Plant Recommendations

The CDAC design team prepared planting recommendations for three different site conditions: riparian, hillslope/meadow, and wildlife garden. These recommendations were prepared based on site conditions such as soil pH, soil moisture level, sun exposure. Selections were also made to promote biodiversity, decrease erosion, improve water quality, and create both a desirable habitat and park experience.

An 11x17 pullout of the planting plan can be found on page 29. Photographs of the proposed plant palette can be found on the subsequent pages, organized by the aforementioned categories of riparian, hillslope/meadow, and wildlife garden. Plants are further organized by herbaceous, shrub, and trees within each category. An Excel spreadsheet listing the plant scientific and common name, culture information, anticipated size at maturity, and recommended planting size is also included, following the plant images.

Planting Plan

Symbol	Common Name	Scientific Name	Notes
	Sycamore	*Platanus occidentalis*	
	Hillside tree mix		see complete plant list for selected species in this mix
	Sweetgum	*Liquidambar styraciflua*	seedless cultivar next to sidewalk and along stream re-route
	Allegheny serviceberry	*Amelanchier laevis*	
	Eastern redbud	*Cercis canadensis*	
	Eastern redcedar	*Juniperus virginiana 'Burkii'*	
	Cockspur hawthorn, thornless variety	*Craetagus crusgalli var. inermis*	
	American hophornbeam	*Ostrya virginiana*	
	American hornbeam	*Carpinus caroliniana*	
	Winterberry holly	*Ilex verticillata*	
	Wildlife garden herbaceous & shrub mix		see complete plant list for selected species in this mix
	Bioretention herbaceous & shrub mix		see complete plant list for selected species in this mix
	New England aster Switchgrass	*Aster novae-angliae* *Panicum virgatum*	

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College of Architecture and Urban Studies
Virginia Polytechnic Institute and State University

Pellissippi Wetland Park Plant List

HillSlope/Meadow areas:

Any steep areas should remain as grassy/meadow areas. This area can be seeded with a native mix of grasses and wildflowers. Ernst Conservation Seeds has a seed mix called Virginia Gentleman's Mix that would be appropriate for this area: http://www.ernstseed.com/seed_mixes_detail.aspx?id=12

Moderate slopes can be planted with shrubs and trees.

Shrubs:

Aronia melanocarpa, Black chokeberry

Ilex verticillata, Winterberry

Rubus alleggheniensis, Alleghany blackberry

Sambucus canandensis, Common elderberry

Spiraea latifolia, Broad leaved meadowsweet

Trees:

Craetagus phaenopyrum, Washington hawthorn

Juniperus virginiana, Eastern redcedar

Liquidambar styraciflua, Sweetgum

Platanus occidentalis, Sycamore

Quercus palustris, Pin oak

Quercus phellos, Willow oak

Riparian/Wetland areas:

Constructed wetlands:

The wetlands will need to be seeded to prevent erosion and undesirable plants. The seed should be sown above the water line with a mix of native seeds and wheat seed. The area should then be mulched with straw.

Agrecol sells a seed mix for flood basins: http://agrecol.com/cms/seed_mixes_page14.aspx. These plants are native to Virginia and hardy to our zone.

Herbaceous planting along streambed:

Osmunda cinnamomea, Cinnamon fern

Caltha palustris, Marsh marigold

Carex lurida, Sallow sedge

Iris virginica, Southern blue flag

Juncus effusus, Soft rush

Panicum virgatum, Red switch grass

Acorus calumnus, Sweet flag

Asclepias incarnata, Swamp milkweed

Aster novi-angliae (new name *Symphyotrichum novi-angliae*,) New England aster

Chelone glabra, White turtlehead

Saururus cernuus, Lizard's tail

Shrubs:

Aronia arbutifolia, (new name *Photinia pyrifolia*), Red chokeberry

Aronia melanocarpa, (new name *Photinia melanocarpa*), Black chokeberry

Cephalanthus ocidentalis, Buttonbush

Clethra alnifolia, Sweet pepperbush

Cornus amomum, Silky dogwood

Hamamelis virginiana, Common witch hazel

Ilex glabra, Inkberry holly

Ilex verticillata, Winterberry

Itea virginica, Virginia sweetspire

Sambucus canandensis, Common elderberry

Trees:

Acer rubrum, Red maple

Amelanchier laevis, Allegheny serviceberry

Cercis canadensis, Eastern redbud

Juniperus virginiana, Eastern redcedar

Liquidambar styraciflua, Sweetgum

Morus rubra, Red mulberry

Platanus occidentalis, Sycamore

Quercus bicolor, Swamp white oak

Quercus michauxii, Swamp chestnut oak

Quercus palustris, Pin oak

Bioretention/Parking Area:

Herbaceous plants:

Asclepias incarnata, Swamp milkweed

Aster novi-angliae (new name *Symphyotrichum novi-angliae*), New England aster

Chelone glabra, White turtlehead

Panicum virgatum, Red switch grass

Eupatorium purpureum, Joe pye weed

Lobelia cardinalis, Cardinal flower

Vernonia noveboracensis, Ironweed

Shrubs:

Aronia arbutifolia (new name *Photinia pyrifolia*), Red chokeberry

Cephalanthus ocidentalis, Buttonbush

Clethra alnifolia, Sweet pepperbush

Cornus amomum, Silky dogwood

Ilex glabra, Inkberry holly

Itea virginica, Virginia sweetspire

Sambucus canandensis, Common elderberry

Trees:

Carpinus caroliniana, American hornbeam

Craetagus crusgalli var. inermis, Cockspur hawthorn, thornless variety.

Ostrya virginiana, American hophornbeam

Wildlife Garden:

The following herbaceous plants are recommended by the Virginia Native Plants Society and the Virginia Department of Game and Inland Fishers (DGIF) for use in butterfly gardens. These plants are also attractive to other forms of wildlife such as birds and insects. This area presents educational opportunities for wildlife studies.

Herbaceous plants:

Asclepias incarnata, Milkweed

Asclepias tuberosa, Butterfly weed

Aster novae-angliae, New England aster

Coreopsis lanceolata, Tickseed

Echinacea purpurea, Purple coneflower

Eupatorium purpureum, Joe pye weed

Helianthus angustifolius, Swamp sunflower

Liatris spicata, Blazing star

Lobelia cardinalis, Cardinal flower

Monarda didyma, Bee balm

Phlox paniculata, Summer phlox

Rudbeckia hirta, Black eyed susan

Solidago speciosa, Goldenrod

Stokesia laevis, Stoke's aster

Vernonia noveboracensis, Ironweed

Shrubs:

Clethra alnifolia, Sweet pepperbush

Ilex glabra, Inkberry holly

Sambucus canandensis, Common elderberry

Trees:

Amelanchier laevis, Allegheny serviceberry

Cercis canadensis, Eastern redbud

Juniperus virginiana, Eastern redcedar

HillSlope/Meadow Plant Pictures

Plant images courtesy of plants.usda.gov and ncstate-plants.net

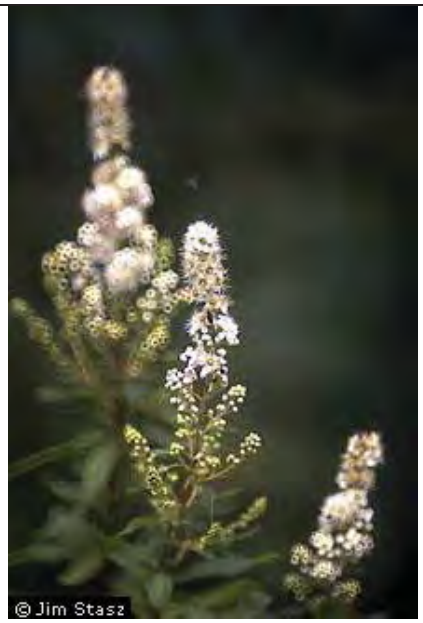
HillSlope/Meadow areas

Aronia melanocarpa
Black chokeberry

Ilex verticillata
Winterberry

Rubus alleggheniensis
Alleghany blackberry

Sambucus canandensis
Common elderberry



Spiraea latifolia
Broad leaved meadowsweet

Craetagus phaenopyrum
Washington hawthorn

Photo courtesy hort..uconn.edu
Juniperus virginiana
Eastern redcedar

Liquidambar styraciflua
Sweetgum

Platanus occidentalis
Sycamore

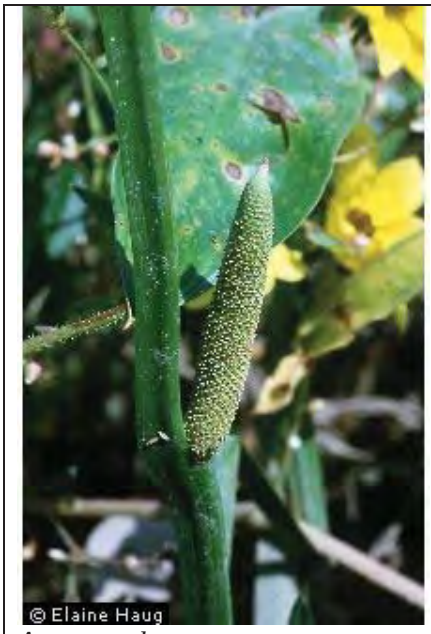
Photo courtesy cnr.vt.edu
Quercus palustris
Pin oak

Quercus phellos
Willow oak

Riparian/Wetland Plant Pictures

Plant images courtesy of plants.usda.gov and ncstate-plants.net unless otherwise noted

Riparian/wetland areas



Acorus calumnus
Sweet flag

Asclepias incarnata
Milkweed

Aster novi-angliae
New England aster

Caltha palustris
Marsh marigold

Carex lurida
Sallow sedge

Chelone glabra
White turtlehead

Iris virginica
Southern blue flag

Juncus effusus
Soft rush

Panicum virgatum
Red switch grass

Osmunda cinnamonea
Cinnamon fern

Saururus cernuus
Lizard's tail

Aronia arbutifolia red chokeberry

Aronia melanocarpa black chokeberry

Cephalanthus ocidentalis, Buttonbush

Clethra alnifolia sweet pepperbush

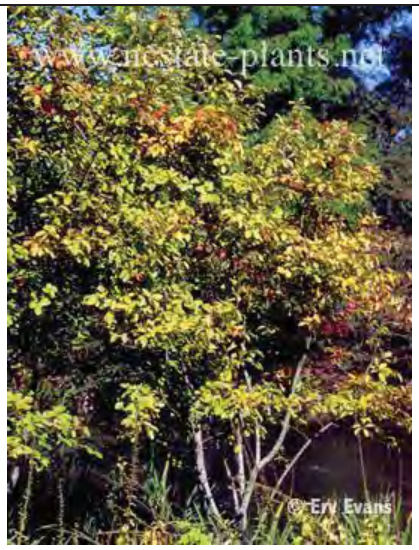
Cornus amomum Silky dogwood

Ilex glabra Inkberry holly

Ilex verticillata Winterberry

Itea virginica
Virginia sweetspire

Sambucus canandensis common elderberry



Amelanchier laevis, Allegheny serviceberry

Cercis canadensis
Eastern redbud

Photo courtesy hort..uconn.edu
Juniperus virginiana
Eastern redcedar

Liquidambar styraciflua
Sweetgum

Photo courtesy cas.vanderbilt.edu

Morus rubra
Red mulberry

Platanus occidentalis
Sycamore

Photo courtesyumaine.edu

Quercus bicolor
Swamp white oak

Photo courtesy cas.vanderbilt.edu

Quercus michauxii
Swamp chestnut oak

Photo courtesy cnr.vt.edu

Quercus palustris
Pin oak

Bioretention/Parking Lot Plant Pictures

Plant images courtesy of plants.usda.gov and ncstate-plants.net unless otherwise noted

Bioretention/Parking lot area

Chelone glabra
White turtlehead

Asclepias incarnata
Milkweed

Aster novi-angliae
New England aster

Eupatorium purpureum
Joe pye weed

Lobelia cardinalis
Cardinal flower

Vernonia noveboracensis
Ironweed

Panicum virgatum
Red switch grass

Aronia arbutifolia red chokeberry

Cornus amomum
Silky dogwood

Cephalanthus ocidentalis,
Buttonbush

Clethra alnifolia sweet pepperbush

Sambucus canandensis common elderberry

Ilex glabra
Inkberry holly

Itea virginica
Virginia sweetspire

Ostrya virginiana,
American hophornbeam

Craetagus crusgalli var. *inermis*,
Cockspur hawthorn, thornless variety

Carpinus caroliniana,
American hornbeam

Wildlife Garden Plant Pictures

Plant images courtesy of plants.usda.gov and ncstate-plants.net

Wildlife Garden

Asclepias incarnata
Milkweed

Asclepias tuberosa
Butterfly weed

Aster novae-angliae
New England aster

Coreopsis lanceolata
Coreopsis

Echinacea purpurea
Purple coneflower

Eupatorium purpureum
Joe pye weed

Helianthus angustifolius
Swamp sunflower

Liatris spicata
Blazing star

Lobelia cardinalis
Cardinal flower

Monarda didyma
Bee balm

Phlox paniculata
Summer phlox

Rudbeckia hirta.
Black eyed susan

Solidago speciosa
Goldenrod

Stokesia laevis
Stoke's aster

Vernonia noveboracensis
Ironweed

Clethra alnifolia
Sweet pepperbush

Ilex glabra
Inkberry holly

Sambucus canandensis
Common elderberry

 *Cercis canadensis* Eastern redbud	 *Photo courtesy hort..uconn.edu* *Juniperus virginiana* Eastern redcedar	 *Amelanchier laevis* Allegheny serviceberry

Appendices

Appendix A: Sinkhole Information

Appendix B: Stream Restoration

Appendix C: Plant Resources

Appendix D: Clinch River Watershed Information

Appendix E: Calculations for Proposed Site Elements

Appendix A: Sinkhole Information

The Pellissippi Wetland Park site has an existing sinkhole on site. This is the only visible sinkhole, though the entire area is karst and the appearance of future sinkholes is not beyond the realm of possibility. The current open sinkhole has shown signs of growth over the past few years, marked by the change in position of a barbed-wire fence. This fence previously marked the edge of the sinkhole. The fence now lies closer to the center of the sinkhole.

Various government agencies have been on site to investigate the sinkhole, including DCR, DOF, USFS, DEQ, and EPA. There is an ephemeral stream that flows directly into the sinkhole. As such, there is concern about future possible contamination of groundwater.

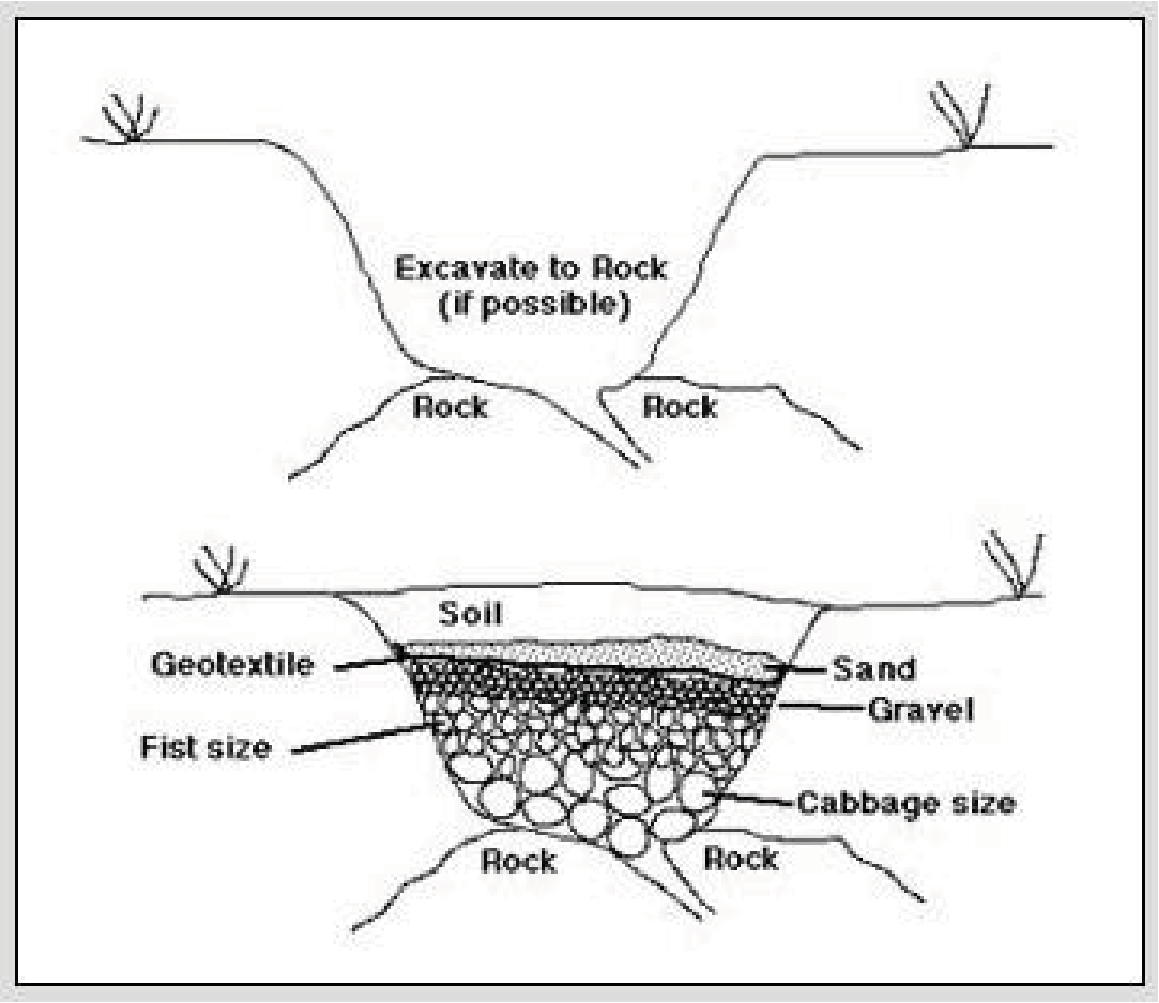
The first course of action for the sinkhole is to register it as a Class 5 Injection Well with the EPA. If the sinkhole continues to receive stormwater runoff after this project (stream not realigned), then a Town official should contact Mike Eller or Brian Poe at Region 3 EPA Underground Injection Control program to register the feature (sinkhole) as required by federal law. Note that neither VA-DCR nor DEQ regulate such discharges. Part of this process involves conducting a dye test to trace where the water that enters the sinkhole travels and exits, giving agencies knowledge of areas to check in case of any kind of spill or excess sedimentation entering the sinkhole from upstream. Through advance coordination with Will Orndorff, there is an opportunity to engage the Lebanon High School ecology class (or any other classes interested) in the dye test. This would be an excellent education experience for the students.

Through conversations with DCR Karst Protection Coordinator, Wil Orndorff; DCR Engineer Cody Boggs; and Virginia Tech Geosciences Professor Tom Burbey, the CDAC team feels in addition to the Class 5 Injection Well, an inverted filter should be applied to the sinkhole. Inverted filters have proven effective at stabilizing sinkholes for landowners throughout Southwest VA. The inverted filters should be installed per approved specifications. Some examples, provided by Wil Orndorff and Cody Bogss, can be found on pages 46-48.

As a further measure, the CDAC design team would like to encourage the Town of Lebanon to pursue electrical resistivity testing for the Pellissippi Wetland site. A brief explanation of this process can be found on pages 49-51. This testing would help identify future areas where possible sinkholes may form and could confirm the appropriateness of the placement of boardwalk trails, the covered shelter and the outdoor amphitheater. ATS International, a private company in Christiansburg, has provided some information about Electrical Resistivity Testing that has been included in this appendix. Their contact information as well as Professor Tom Burbey's contact information are included at the end of this appendix.

Images of the existing sinkhole on the Pellissippi Wetland Park project site.

Inverted Filter Cross-section Information

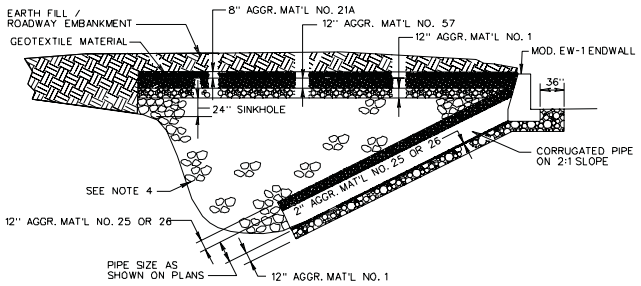


Simple cross-section outlining the basic components of an inverted filter. Sketch provided by Cody Boggs, DCR.

DESIGN FEATURES RELATING TO CONSTRUCTION OR TO REGULATION AND CONTROL OF TRAFFIC MAY BE SUBJECT TO CHANGE AS DEEMED NECESSARY BY THE DEPARTMENT

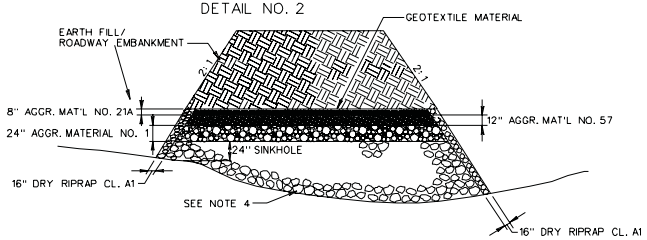
REVISED	STATE	FEDERAL AID PROJECT		STATE PROJECT		SHEET NO.
	VA					

DETAIL NO. 1



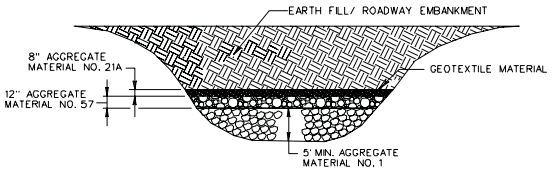
REMOVE ALL FOREIGN MATTER INCLUDING TRASH, REFUSE OR OTHER WASTE MATERIALS. EXCAVATE THE BOTTOM OF THE SINK TO ROCK. EXCAVATE THE SIDES (BACK, AHEAD, AND TOWARD TOE OF FILL SLOPE) TO AN ANGLE OF REPOSE OF 27° (2:1 SLOPE) FROM THE BOTTOM PLANE OF THE SINK. INSTALL A PIPE OF SUFFICIENT LENGTH TO INSURE POSITIVE DRAINAGE INTO THE SINK AT THE TOE OF FILL SLOPE. BED THE PIPE WITH 12" OF AGGREGATE MATERIAL NO. 1 OVERLAYED BY 2" OF AGGREGATE MATERIAL NO. 25 OR 26 FOR A LEVELING COURSE. PLACE 12" AGGREGATE MATERIAL NO. 25 OR 26 ALONG THE SIDES AND TOP OF THE PIPE FOR PROTECTION AGAINST THE BACKFILL. BACKFILL WITH DRY RIP RAP, CLASS II TO A HEIGHT OF 24" ABOVE ORIGINAL GROUND AS SHOWN. CAP WITH 12" AGGREGATE MATERIAL NO. 1, 12" AGGREGATE NO. 57 AND 8" AGGREGATE MATERIAL NO 21A. OVERLAY AGGREGATE MATERIAL WITH GEOTEXTILE MATERIAL AND BACKFILL WITH EARTH FILL AS NEEDED.

DETAIL NO. 2

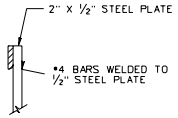


REMOVE ALL FOREIGN MATTER INCLUDING ALL VEGETATION, TRASH, REFUSE OR OTHER WASTE MATERIALS. EXCAVATE ALL UNSTABLE SOILS FROM THE SIDES AND BOTTOM OF THE SINK. BACKFILL WITH DRY RIP RAP, CLASS I TO A HEIGHT OF 24" ABOVE THE SURFACE DRAINAGE LINE. CAP WITH 24" AGGREGATE MATERIAL NO. 1, 12" AGGREGATE MATERIAL NO. 57 AND 8" AGGREGATE MATERIAL NO. 21A. A HEAVY VIBRATOR SHALL BE USED TO STABLIZE THE RIP RAP AND THE AGGREGATE MATERIAL AS EACH COURSE IS PLACED. PLACE A LAYER OF GEOTEXTILE MATERIAL ABOVE THE AGGREGATE MATERIAL COURSES. EARTH FILL IS BE PLACED ABOVE THE GEOTEXTILE FABRIC AS NEEDED. OVERLAY EXPOSED RIP RAP/AGGREGATE FILL SLOPES WITH 16" DRY RIPRAP CLASS A1.

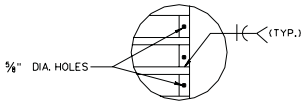
DETAIL NO. 3



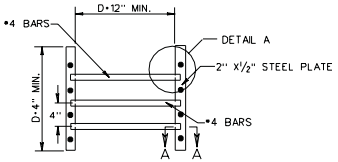
TREATMENT SHALL INCLUDE CLEARING AND GRUBBING, STRIPPING TOPSOIL AND REMOVING EXCESS ORGANIC MATERIAL. ALL FOREIGN MATTER INCLUDING TRASH, WHITE GOODS AND OTHER REFUSE OR WASTE MATERIALS SHALL BE REMOVED. STRIPPED SINKHOLE SHALL BE BACKFILLED WITH A MINIMUM OF 5' DEPTH OF NO. 1 AGGREGATE OVERLAID WITH 12" OF NO. 57 AGGREGATE AND 8" OF AGGREGATE MATERIAL NO. 21A. THE AGGREGATE SHALL BE OVERLAID WITH A GEOTEXTILE MATERIAL.



SECTION A-A

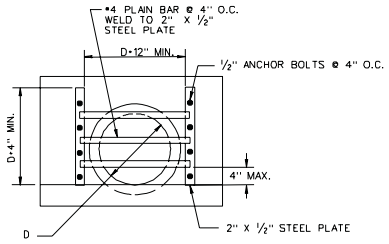


DETAIL A



GRATE ASSEMBLY AS SHOWN SHALL BE GALVANIZED AFTER FABRICATION.

SPECIAL DESIGN GRATE DETAIL



ATTACHMENT TO STANDARD EW-1

FOR USE ON STANDARD EW-1

GENERAL NOTES

1. PRIOR TO ANY SINKHOLE EXCAVATION THE CONTRACTOR SHALL CONTACT THE DISTRICT MATERIALS ENGINEER.
2. EACH SINKHOLE SHOULD BE TREATED ON AN INDIVIDUAL, SITE SPECIFIC BASIS DEPENDING ON THE CONDITIONS IN THE AREA.
3. CONSECUTIVE LAYERS OF AGGREGATE SHALL BE PLACED IN SUCH A MANNER AS TO PREVENT FUTURE MIGRATION OF SMALLER STONES INTO LARGER STONES.
4. WHEN THE DEPTH OF A SINKHOLE OR A DEPRESSION IS LESS THAN 10', AGGREGATE MATERIAL NO. 1 SHALL BE USED FOR BACKFILL IN LIEU OF DRY RIP-RAP. THE AGGREGATE MATERIAL NO. 1 SHALL EXTEND TO A HEIGHT OF 24" ABOVE THE SURFACE DRAINAGE LINE. THE AGGREGATE MATERIAL NO. 1 SHALL BE CAPPED WITH NO. 57 AGGREGATE, NO. 21A AGGREGATE, AND GEOTEXTILE MATERIAL AS NOTED ON THE APPLICABLE DETAIL.
5. EXCAVATION NECESSARY FOR PLACEMENT OF THE SINKHOLE FILL SHALL BE MEASURED AND PAID FOR AS REGULAR EXCAVATION IN ACCORDANCE WITH THE SECTION 303 OF THE SPECIFICATIONS. ALL OTHER MATERIAL SHALL CONFORM TO AND BE MEASURED AND PAID FOR IN ACCORDANCE WITH THE APPLICABLE SECTIONS.
6. GEOTEXTILE MATERIAL SHALL CONFORM TO SECTION 245.03(B) OF THE SPECIFICATIONS
7. BASIS OF PAYMENT FOR SPECIAL DESIGN GRATE WILL BE MEASURED AND PAID FOR AT THE CONTRACT UNIT PRICE PER EACH. THIS PRICE SHALL INCLUDE ALL COST FOR FURNISHING THE FABRICATED GRATE AND ITS INSTALLATION. ALL HARDWARE, EQUIPMENT, LABOR, TOOLS, GALVANIZING AND INCIDENTALS NECESSARY TO COMPLETE THE WORK SHALL BE INCLUDED IN THE UNIT PRICE PER EACH COST.

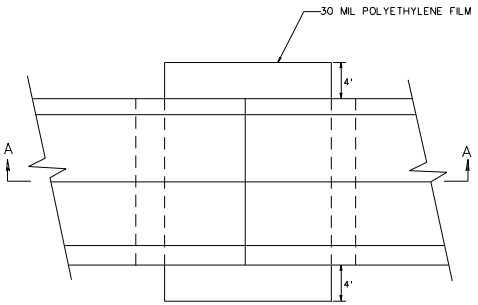
NEW 11/02
SPECIAL DESIGN SECTION
DRAWING NO. 2944

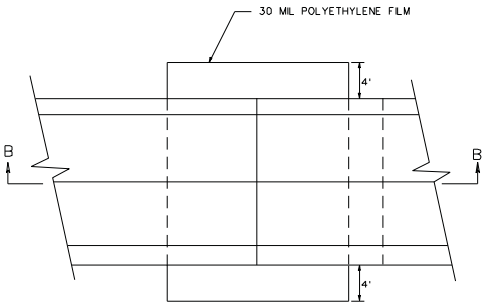
SINKHOLE TREATMENT DETAILS

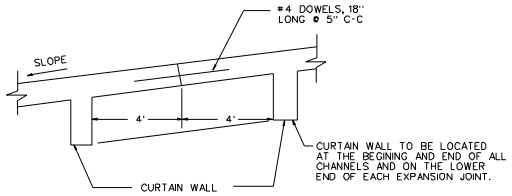
PLAN NO.	PROJECT	FILENO.	SHEET NO.

DESIGN FEATURES RELATING TO CONSTRUCTION OR TO REGULATION AND CONTROL OF TRAFFIC MAY BE SUBJECT TO CHANGE AS DEEMED NECESSARY BY THE DEPARTMENT

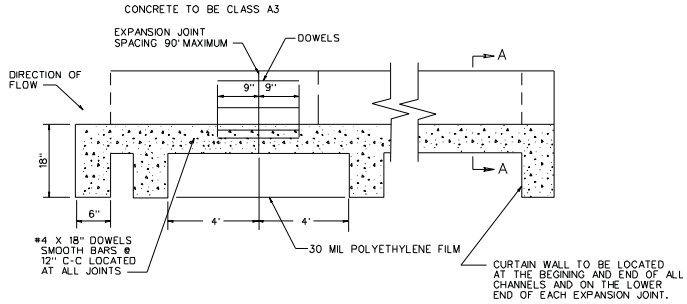
REVISED	STATE	FEDERAL AID PROJECT	STATE ROUTE	STATE PROJECT	SHEET NO.
	VA.				







SECTION A-A
STANDARD PG-2A MODIFIED



STANDARD PG-5 MODIFIED

BASIS OF PAYMENT

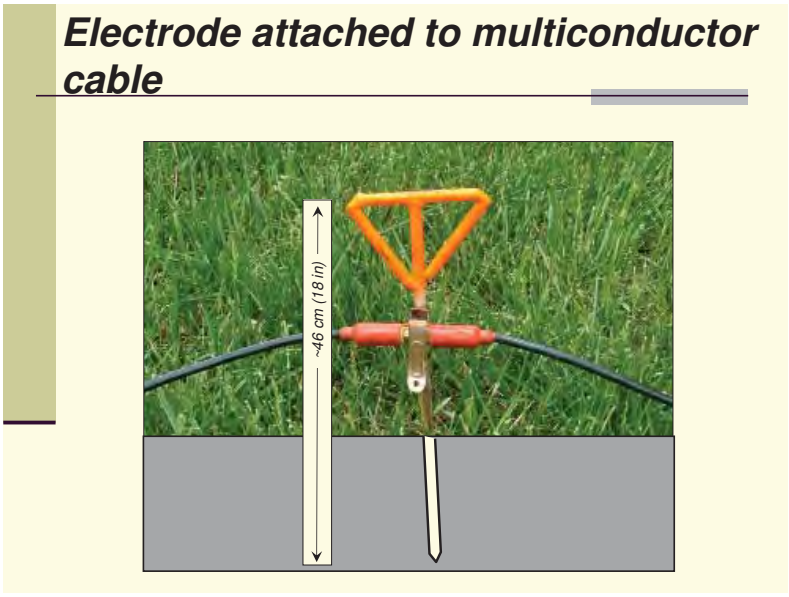
STANDARD PG-2A MODIFIED AND PG-5A MODIFIED IS TO BE PAID FOR AT THE CONTRACT UNIT PRICE IN SQUARE YARDS. THE PRICE INCLUDES CLASS A3 CONCRETE, REINFORCING STEEL, 30 MIL POLYETHYLENE FILM, COMPLETE-IN-PLACE FURNISHING ALL MATERIALS, TOOLS, EQUIPMENT, AND INCIDENTALS NECESSARY TO COMPLETE THE WORK.

NEW 11/02
SPECIAL DESIGN SECTION
DRAWING NO. 2945

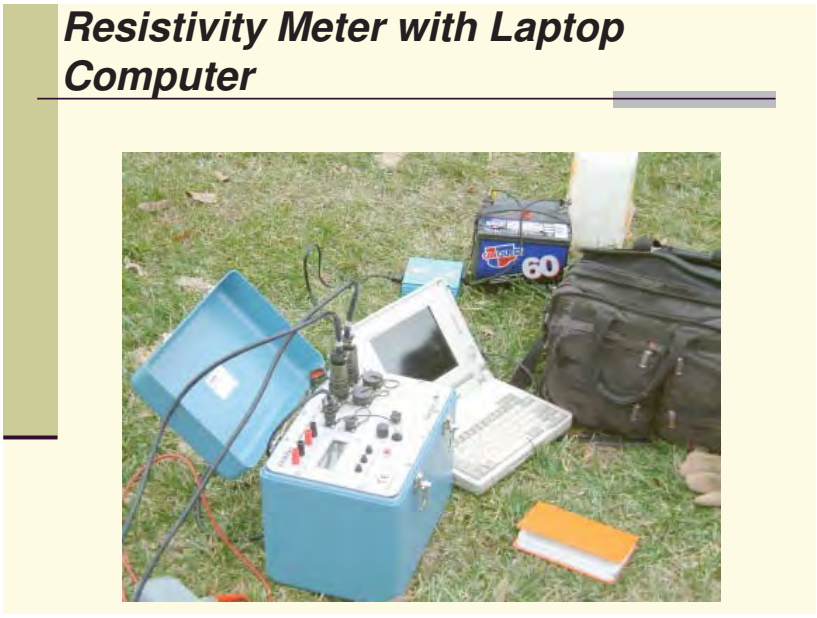
PLAN NO.	PROJECT	FILE NO.	SHEET NO.

Electrical Resistivity Testing

ATS International provided the following slides as an introduction to Electrical Resistivity Testing.

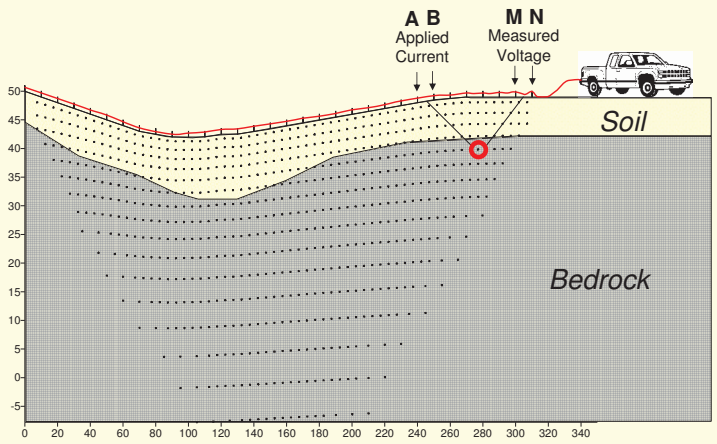


Slide 1: Illustrates a resistivity electrode in the ground attached to the resistivity cable. We have a system that will allow us to put up to 56 electrodes in the ground at one time.



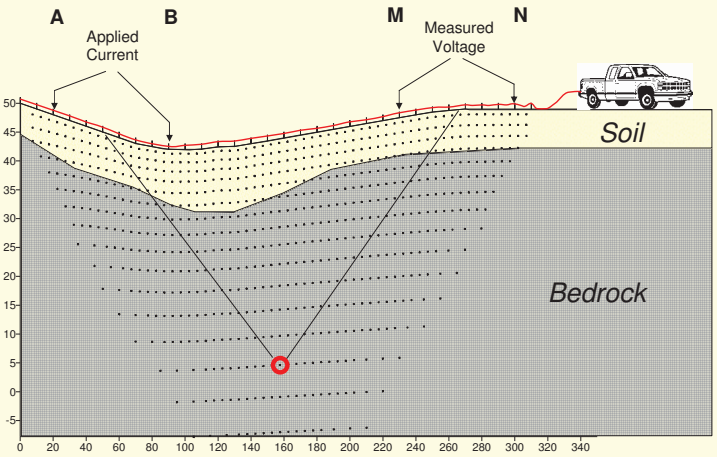
Slide 2: Shows the computer control box that sends the electric current to the electrodes and measures the potential field.

Shallow Data Acquisition



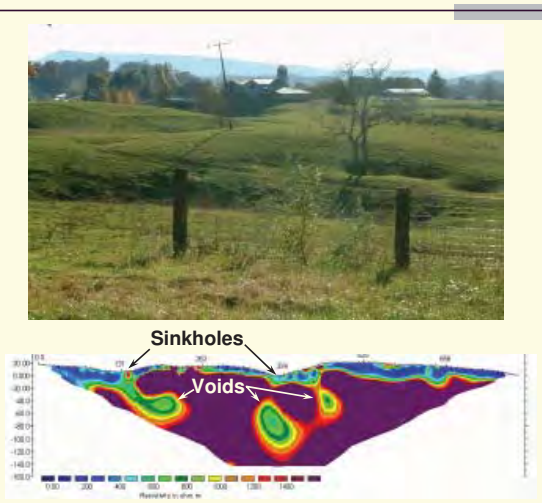
Slides 3 and 4: Conceptual cross-section illustrating the multi-electrode array and how deeper data are collected by widening the spacing between the electrodes being used for measurement.

Deep Data Acquisition

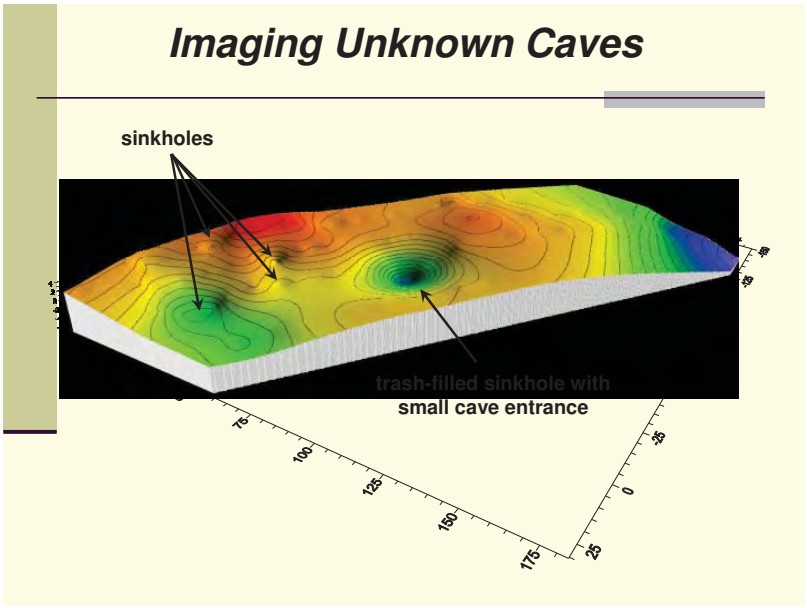


Slide 4

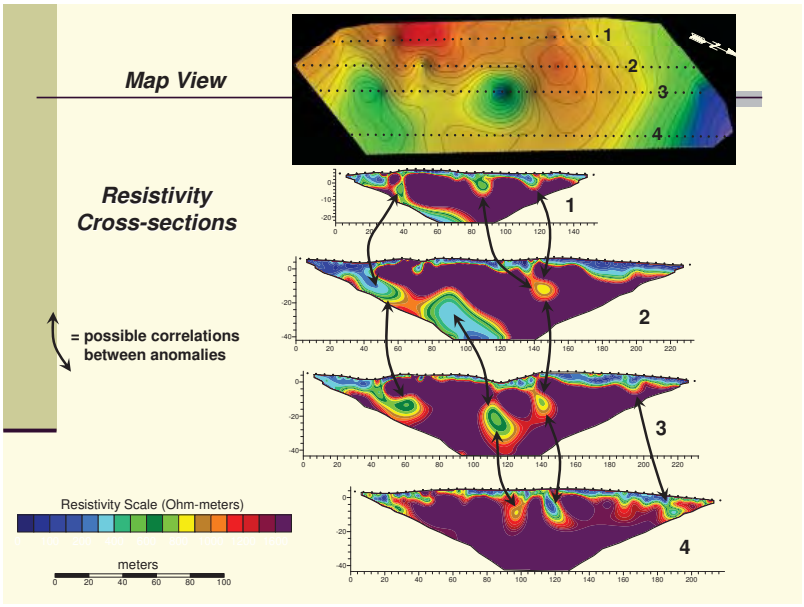
Detection of Voids and Karst Features



Slide 5: Example cross section illustrating how the subsurface geology can be inferred from the resistivity. The resistivity cross-section illustrates low-resistivity soil underlain by high-resistivity rock, but also shows low-resistivity voids within the rock. These voids are filled or partially filled with soil that has raveled down from the sinkhole into solution cavities in the limestone.



Slides 6 and 7: By collecting data from parallel lines we can get a quasi-3D look at the karst development.



Slide 7

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Appendix B: Stream Restoration

The small ephemeral stream flowing through the site has been altered up and downstream. Indeed, most likely the entire course of the stream has been changed over time in our site. A small stretch of stream was not disturbed during the construction of Tech Center Drive and the sediment basin. This stretch does have some issues to be addressed, including an open sinkhole and a severe headcut. The Final Conceptual Master Plan for Pellissippi Wetland Park proposes that this stretch of stream be realighend. Cost comparisons of stream realignment versus measures needed to maintain the current alignment without severe erosion and sedimentation should be explored. Costs for realignment may prove comparable to maintaining the existing channel with the advised improvements.

Stream Channel Realignment

The Final Conceptual Master Plan proposes a realignment of the existing stream channel. This realignment would bring the stream through the series of proposed wetlands, offering opportunities for increased water filtration through the added native plant species. The realignment would bring the movement of water through the site into greater public view. It would also eliminate the stream from flowing directly into the current sinkhole. Further investigation and more detailed design specifications need to be prepared before initiating a stream re-alignment process. Proper review of the proposed stream alignment designs and acquisition of required state permits also need to be made. Grade controls (see DCR Stream Restoration and BMP Manual for details) will need to be installed at the start and end of the realignment to ensure the water flow travels in its intended course. Additionally, the old channel should be backfilled to prevent water entering this area and causing erosion or undesired effects.

If the stream channel is rerouted, the current sinkhole possibly would not need to be addressed via an inverted filter, since water would not regularly flow directly into the sinkhole. The CDAC design team recommends obtaining a Class 5 Injection Well permit from the EPA for the sinkhole regardless of whether the stream is realigned or not. The dye test involved with the Class 5 Injection Well permit process would be an excellent educational opportunity for Lebanon High School students. Coordination should be made will DCR staff member Wil Orndorff to incorporate applicable classes to observe the dye test process.

The existing headcut could also be addressed differently (possibly less construction) if the stream is realigned.

Maintaining the Current Stream Channel Alignment

Should the project partners choose not to realign the stream in the near future, immediate action should be taken to address the sinkhole and the headcut caused by the stream channel entering the sediment basin. For the sinkhole, a Class 5 Injection Well permit should be obtain. Second, an inverted filter should be installed and the stream channel should be reconstructed to flow overtop of the inverted filter.

The head cut should be stabilized and could be addressed with the creation of a cascade into the existing basin.The design of this feature should ensure implementation of a cascade addresses rather than exacerbates erosion. There is an opportunity to create a desirable feature in place of the current headcut. Based on the plans made available to the CDAC design team, no design provisions have been made for how the stream channel should move through the site after dropping into the basin. Currently, most water drops into the sinkhole. This will change after the inverted filter is installed (see Appendix A for more details on inverted filters).

Additional Resources

Department of Conservation and Recreation's Stream Restoration and BMP Manual:
http://www.dcr.virginia.gov/soil_and_water/documents/streamguide.pdf

National Resource Conservation Service's National Engineering Handbook - Stream Restoration Design:
http://www.ndcsmc.nrcs.usda.gov/technical/Stream/

North Carolina State University Stream Restoration Natural Channel Design Handbook:
http://www.bae.ncsu.edu/programs/extension/wqg/srp/guidebook.html

Virginia Department of Game and Inland Fisheries Landowner Incentive Program:
http://www.dgif.virginia.gov/habitat/lip/

Little Stoney Creek realignment example in Giles County, Virginia. Photo courtesy of Justin Laughlin, DGIF

Appendix C: Plant Resources

Appendix C is intended to serve as support information for suggested plantings for the Pellissippi Wetland Park. Included in Appendix C is the following information:

- Potential sources for native plants
- Information on wetland indicator species
- 11x17 pullouts of Excel plant lists with notes and some suggested quantities

Sources for Native Plants:

The Virginia Native Plant Society has a list of suppliers:

http://www.vnps.org/nurserylist.pdf

The Virginia DCR lists these suppliers for native plants:

http://www.dcr.virginia.gov/chesapeake_bay_local_assistance/documents/RipBufferManual_Rev06/AppendE_NativNurs_%20Final.pdf

The West Virginia DNR list has this list of suppliers: http://www.wvdnr.gov/Wildlife/NativeVegetation.shtm

The US Fish and Wildlife Services lists these Virginia suppliers:

http://www.fws.gov/chesapeakebay/BayScapes/bsresources/bs-nurseries.htm#VA

PlantNative.com has a directory of native plant nurseries, searchable by state:

http://www.plantnative.com/index.htm

Wetland Indicator Status

Data and definitions in the PLANTS wetland reports are abstracted from:

U.S. Fish and Wildlife Service. 1988. *National list of vascular plant species that occur in wetlands.* U.S. Fish & Wildlife Service Biological Report 88 (26.9).

U.S. Fish and Wildlife Service. 1993. *1993 supplement to list of plant species that occur in wetlands: Northwest (Region 9).* Supplement to U.S. Fish & Wildlife Service Biological Report 88 (26.9).

PLANTS wetlands reports contain some names from these two wetland lists that are now considered to be synonyms. Wetland status is reported individually for each synonym, and these are indented below the currently accepted name.

Indicator categories

Indicator Code	Wetland Type	Comment
OBL	Obligate Wetland	Occurs almost always (estimated probability 99%) under natural conditions in wetlands.
FACW	Facultative Wetland	Usually occurs in wetlands (estimated probability 67%-99%), but occasionally found in non-wetlands.
FAC	Facultative	Equally likely to occur in wetlands or non-wetlands (estimated probability 34%-66%).
FACU	Facultative Upland	Usually occurs in non-wetlands (estimated probability 67%-99%), but occasionally found on wetlands (estimated probability 1%-33%).
UPL	Obligate Upland	Occurs in wetlands in another region, but occurs almost always (estimated probability 99%) under natural conditions in non-wetlands in the regions specified. If a species does not occur in wetlands in any region, it is not on the National List.

The Wetland Indicator Status information is included to provide a brief explanation of the five different wetland indicator codes and their corresponding wetland type.

Pellissippi Wetland Park Plant List

Area: (S, R, B, W) HillSlope, Riparian, Bioretention, Wildlife Garden	Plant scientific name	Plant common name	Type	Culture	Wetland Indicator status	Size at Maturity	Native Y/N	Recommended Size	Quantity	Notes		
R	Acorus calumus	Sweet flag	Herbaceous perennial	Full sun to part shade, medium to wet soils	OBL	Height: 2 to 2.5 feet, Spread: 1 to 1.5 feet	Y	4 inch pot	37			
R, W, B	Asclepias incarnata	Swamp milkweed	Herbaceous perennial	Full sun, medium to wet soils	OBL	Height: 4 to 5 feet, Spread: 2 to 3 feet	Y	4 inch pot				
W	Asclepias tuberosa	Butterfly weed	Herbaceous perennial	Full sun, dry to medium soils		Height: 1 to 2.5 feet, Spread: 1 to 1.5 feet	Y	4 inch pot				
R, W, B	Aster novi-angliae, new name Symphyotrichum novi-angliae	New England aster	Herbaceous perennial	Full sun, medium to wet soils	FACW	Height: 3 to 6 feet, Spread: 2 to 3 feet	Y	4 inch pot				
R	Carex lurida	Sallow sedge	Sedge	Full sun to part shade, medium to wet soils	OBL	Height: 1.5 to 2 feet, Spread: 1 to 2 feet	Y	4 inch pot	37			
R	Caltha palustris	Marsh marigold	Herbaceous perennial	Full sun, wet soils	OBL	Height: 1 to 1.5 feet, Spread: 1 to 1.5 feet	Y	4 inch pot	20			
R, B	Chelone glabra	White turtlehead	Herbaceous perennial	Full sun to part shade, medium to wet soils	OBL	Height: 2 to 3 feet, Spread: 1.5 to 2.5 feet	Y	4 inch pot	37			
W	Coreopsis lanceolata	Tickseed	Herbaceous perennial	Full sun, dry to medium soils	FACU	Height: 1 to 2 feet, Spread: 1 to 1.5 feet	Y	4 inch pot				
W	Echinacea purpurea	Purple coneflower	Herbaceous perennial	Full sun to part shade, dry to medium soils		Height: 2 to 5 feet, Spread: 1.5 to 2 feet	Y	4 inch pot				
W, B	Eupatorium purpureum	Joe pye weed	Herbaceous perennial	Full sun to part shade, medium soils	FAC	Height: 4 to 7 feet, Spread: 2 to 4 feet	Y	4 inch pot				
W	Helianthus angustifolius	Swamp sunflower	Herbaceous perennial	Full sun, dry to medium soils	FACW	Height: 4 to 6 feet, Spread: 2 to 4 feet	Y	4 inch pot				
R	Iris virginica	Southern blue flag	Herbaceous perennial	Full sun, wet soils	OBL	Height: 1 to 3 feet, Spread: 1 to 3 feet	Y	4 inch pot	20			
R	Juncus effusus	Soft rush	Rush	Full sun, wet soils	OBL	Height: 2 to 4 feet, Spread: 2 to 4 feet	Y	4 inch pot	19			
W	Liatris spicata	Blazing star	Herbaceous perennial	Full sun, medium soils	FAC	Height: 2 to 4 feet, Spread: 1 to 2 feet	Y	4 inch pot				
W, B	Lobelia cardinalis	Cardinal flower	Herbaceous perennial	Full sun to part shade, medium to wet soils	FACW	Height: 2 to 4 feet, Spread: 1 to 2 feet	Y	4 inch pot				

Pellissippi Wetland Park Plant List

Area: (S, R, B, W) HillSlope, Riparian, Bioretention, Wildlife Garden	Plant scientific name	Plant common name	Type	Culture	Wetland Indicator status	Size at Maturity	Native Y/N	Recommended Size	Quantity	Notes		
W	Monarda didyma	Bee balm	Herbaceous perennial	Full sun to part shade, medium to wet soils	FAC	Height: 2 to 4 feet, Spread: 2 to 3 feet	Y	4 inch pot				
R	Osmunda cinnamomea	Cinnamon fern	Fern	Part sun to full shade, medium to wet soils	FACW	Height: 2 to 3 feet, Spread: 2 to 3 feet	Y	1 gallon container	89			
R, B	Panicum virgatum	Red switch grass	Grass	Full sun to part shade, medium to wet soils	FAC	Height: 3 to 6 feet, Spread: 2 to 3 feet	Y	1 gallon container	seed open areas			
W	Phlox paniculata	Summer phlox	Herbaceous perennial	Full sun to part shade, medium soils	FACU	Height: 2 to 4 feet, Spread: 2 to 3 feet	Y	4 inch pot				
W	Rudbeckia hirta	Black eyed susan	Herbaceous perennial	Full sun, medium soils	FACU	Height: 2 to 3 feet, Spread: 1 to 2 feet	Y	4 inch pot				
R	Saururus cernuus	Lizard's tail	Herbaceous perennial	Full sun to part shade, wet soils	OBL	Height: 1 to 2 feet, Spread: 1 to 2 feet	Y	4 inch pot	36			
W	Solidago speciosa	Goldenrod	Herbaceous perennial	Full sun, dry to medium soils		Height: 2 to 3 feet, Spread: 2 to 3 feet	Y	4 inch pot				
W	Stokesia laevis	Stoke's aster	Herbaceous perennial	Full sun, medium soils		Height: 1 to 2 feet, Spread: 1 to 1.5 feet	Y	4 inch pot				
W, B	Vernonia noveborocensis	Ironweed	Herbaceous perennial	Full sun, medium to wet soils	FACW	Height: 4 to 6 feet, Spread: 3 to 4 feet	Y	4 inch pot				
R, B	Aronia arbutifolia, new name Photinia pyrifolia	Red chokeberry	Deciduous shrub	Full sun to part shade, medium soils	FACW	Height: 3 to 6 feet, Spread: 3 to 6 feet	Y	18-24"				
R, S	Aronia melanocarpa new name Photinia melanocarpa	Black chokeberry	Deciduous shrub	Full sun to part shade, medium soils	FAC	Height: 3 to 6 feet, Spread: 3 to 6 feet	Y	18-24"	9			
R, B	Cephalanthus occidentalis	Buttonbush	Deciduous shrub	Full sun to part shade, medium to wet soils	OBL	Height: 5 to 12 feet, Spread: 4 to 8 feet	Y	18-24"	24			
R, W, B	Clethra alnifolia	Sweet pepperbush	Deciduous shrub	Full sun to part shade, medium to wet soils	FAC	Height: 3 to 8 feet, Spread: 4 to 6 feet	Y	18-24"	49			
R, B	Cornus amomum	Silky dogwood	Deciduous shrub	Full sun to part shade, medium to wet soils	FACW	Height: 6 to 10 feet, Spread: 6 to 10 feet	Y	3-4 foot B&B	13			
R	Hamamelis virginiana	Common witch hazel	Deciduous shrub	Full sun to part shade, medium soils	FAC	Height: 15 to 20 feet, Spread: 15 to 20 feet	Y	3-4 foot B&B	8			
R, W, B	Ilex glabra	Inkberry holly	Evergreen shrub	Full sun to part shade, medium to wet soils	FACW	Height: 5 to 8 feet, Spread: 5 to 8 feet	Y	18-24"	7			

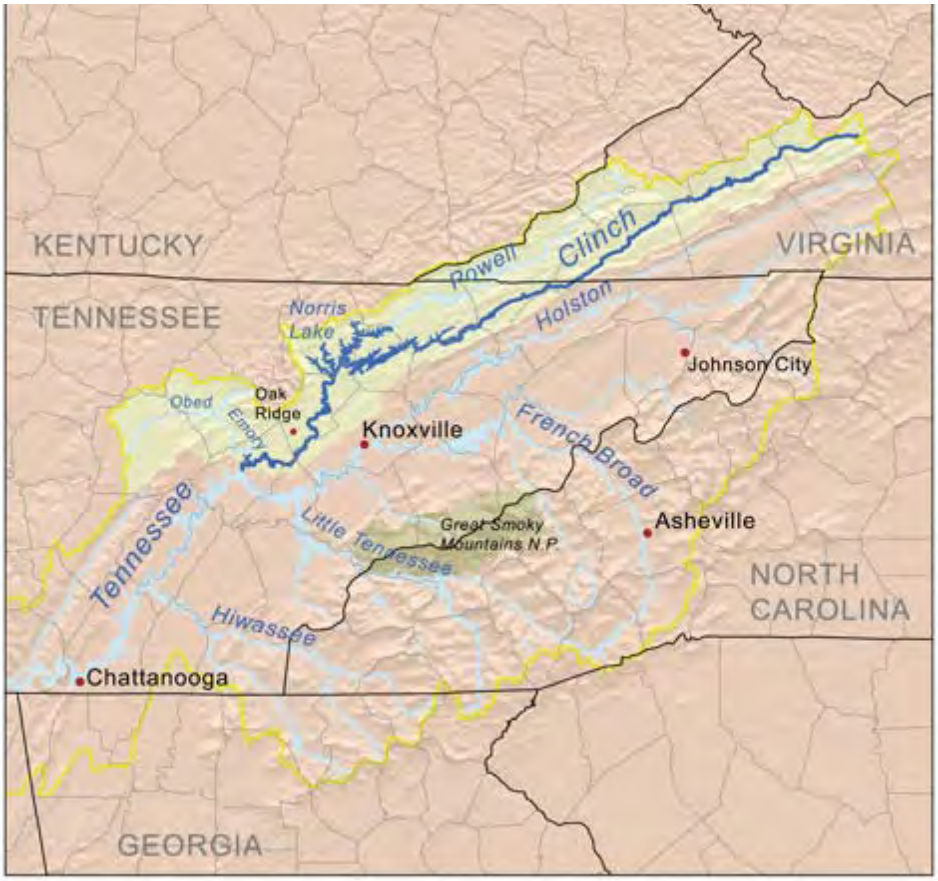
Pellissippi Wetland Park Plant List

Area: (S, R, B, W) HillSlope, Riparian, Bioretention, Wildlife Garden	Plant scientific name	Plant common name	Type	Culture	Wetland Indicator status	Size at Maturity	Native Y/N	Recommended Size	Quantity	Notes		
R, S	Ilex verticillata	Winterberry	Deciduous shrub	Full sun to part shade, medium to wet soils	FACW	Height: 3 to 12 feet, Spread: 3 to 12 feet	Y	18-24”	13	Winter Red - female; Apollo - Male (plant at least one male for every 8 female plants)		
R, B	Itea virginica	Virginia sweetspire	Deciduous shrub	Full sun to part shade, medium to wet soils	OBL	Height: 3 to 5 feet, Spread: 3 to 5 feet	Y	15-18”	16			
S	Rubus allegheniensis	Alleghany blackberry	Deciduous shrub	Full sun to part shade, medium soils	FACU	Height: 3 to 9 feet, Spread: 6 to 12 feet	Y	15-18”				
R, S, W, B	Sambucus canandensis	Common elderberry	Deciduous shrub	Full sun to part shade, medium to wet soils	FACW	Height: 5 to 12 feet, Spread: 5 to 12 feet	Y	15-18”	27			
S	Spiraea latifolia	Broad leaved meadowsweet	Deciduous shrub	Full sun to part shade, medium soils	FACW	Height: 3 to 6 feet, Spread: 3 to 6 feet	Y	15-18”				
R	Acer rubrum	Red maple	Deciduous tree	Full sun to part shade, medium to wet soils	FAC	Height: 40 to 70 feet, Spread: 30 to 50 feet	Y	2” cal. B&B				
R, W	Amelanchier laevis	Allegheny serviceberry	Deciduous tree	Full sun to part shade, medium soils		Height: 15 to 40 feet, Spread: 15 to 40 feet	Y	3-4 foot B&B	2	Clump mutli-stem		
B	Carpinus caroliniana	American hornbeam	Deciduous tree	Full sun to shade	FAC	Height: 20 to 30 feet, Spread: 20 to 30 feet	Y	2” cal. B&B				
R, W	Cercis canadensis	Eastern redbud	Deciduous tree	Full sun to part shade, medium soils	FACU	Height: 20 to 30 feet, Spread: 25 to 35 feet	Y	2” cal. B&B	4			
B	Craetagus crusgalli var. inermis	Cockspur hawthorn, thornless variety	Deciduous tree	Full sun	FACU	Height: 20 to 30 feet, Spread: 25 to 35 feet	Y	2” cal. B&B				
S	Craetagus phaenopyrum	Washington hawthorn	Deciduous tree	Full sun, medium soils	FAC	Height: 25 to 30 feet, Spread: 25 to 30 feet	Y	2” cal. B&B		Do not plant close to high traffic area due to thorns.		
R, S, W	Juniperus virginiana ‘Burkii’	Eastern redcedar	Evergreen tree	Full sun, dry to moist well drained soils	FACU	Height: 15 to 25 feet, Spread: 8 to 15 feet	Y	4’5 foot B&B or transplant fieldgrown				
R, S	Liquidambar styraciflua	Sweetgum	Deciduous tree	Full sun, medium soils	FAC	Height: 60 to 80 feet, Spread: 40 to 60 feet	Y	2” cal. B&B	3	Seeds can be a problem. In high traffic areas, use the cultivar Rotundiloba which is seedless.		

Pellissippi Wetland Park Plant List

Area: (S, R, B, W) HillSlope, Riparian, Bioretention, Wildlife Garden	Plant scientific name	Plant common name	Type	Culture	Wetland Indicator status	Size at Maturity	Native Y/N	Recommended Size	Quantity	Notes		
R	Morus rubra	Red mulberry	Deciduous tree	Full sun to part shade, medium soils	FACU	Height: 35 to 60 feet, Spread: 30 to 40 feet	Y	2” cal. B&B				
B	Ostrya virginiana	American hophornbeam	Deciduous tree	Full sun to part shade	FACU	Height 25’ to 40’. Spread 15’ to 30’	Y	2” cal. B&B				
R, S	Platanus occidentalis	Sycamore	Deciduous tree	Full sun, medium to wet soils	FACW	Height: 75 to 100 feet, Spread: 75 to 100 feet	Y	2” cal. B&B				
R	Quercus bicolor	Swamp white oak	Deciduous tree	Full sun, medium to wet soils	FACW	Height: 50 to 60 feet, Spread: 50 to 60 feet	Y	2” cal. B&B				
R	Quercus michauxii	Swamp chestnut oak	Deciduous tree	Full sun, medium to wet soils	FACW	Height: 60 to 80 feet, Spread:	Y	2” cal. B&B				
R, S	Quercus palustris	Pin oak	Deciduous tree	Full sun, medium to wet soils	FACW	Height: 50 to 70 feet, Spread: 40 to 60 feet	Y	2” cal. B&B				
S	Quercus phellos	Willow oak	Deciduous tree	Full sun, medium to wet soils	FAC	Height: 40 to 75 feet, Spread: 25 to 50 feet	Y	2” cal. B&B				

Appendix D: Clinch River Watershed



Clinch River Watershed. Map taken from http://en.wikipedia.org/wiki/Clinch_River

The Clinch River rises in Southwest Virginia near Tazewell, VA and flows southwest through the Great Appalachian Valley, gathering various tributaries including the Powell River before joining the Tennessee River in East Tennessee.

A peninsula located at the mouth of the Clinch River, called Southwest Point, was the site of an early frontier fort which has been recently reconstructed. The site was important to Native Americans. A treaty between the Cherokee and settlers was signed at Southwest Point, allowing the capital of Tennessee to be moved there. The Tennessee General Assembly technically fulfilled this requirement by meeting in Kingston for one day and voting to move the state capital elsewhere.

The river was once called "Clinch's River" and "Pelisipi River" (and variant spellings such as "Pelisippi").[1]

A huge coal-fired power plant sits on the Clinch River at Carbo in Russell County, Virginia; it was built in 1957 and is owned by Appalachian Power, a part of American Electric Power. On June 25, 2008, permits were approved by the state Air Pollution Control Board for another coal-fired power plant, a few miles away outside St. Paul, Virginia, by Dominion Virginia Power.

Pollution from mining in the region has caused great concern among environmentalists because several rare species inhabit the river. Some mussels have been reintroduced to the Cleveland, Virginia, area from outside the state the early 2000s after pollution in the 20th century wiped out much of the population.

This aerial photograph depicts the former course of the ephemeral stream that flows into the Little Cedar Creek through our project site. Image taken from NRCS web soil survey website.

In 2008 a massive release of fly ash from TVA's Kingston Fossil Plant deposited fly ash in the lower section of the river below the confluence of the Emory River.

The Clinch River above Clinton, Tennessee (tailwaters of Norris Dam) is stocked with rainbow trout and brown trout by the Tennessee Wildlife Resources Agency.

Before being dammed, the Clinch River was a major producer of freshwater mussels and pearls. The rivers of the southern Appalachians are still notable for their unusually rich mussel biodiversity. The mussels were an important food source for Native Americans and were later used by settlers as bait and hog feed. The freshwater pearl industry thrived throughout the southern Appalachians in the late 19th century and early 20th century. The Clinch River and the Emory River were considered the economic heart of the pearl industry, and the state of Tennessee was one of the top six states in the United States for pearl production. The mussel-based industries began to decline in the early 20th century and were effectively eliminated by the dams built by the TVA. The first major Tennessee River dam was Wilson Dam, built at a site known as Muscle Shoals, referring to the freshwater mussels of the region. Norris Dam on the Clinch River flooded one of the other famous mussel areas near Young's Island. [2]

1. USGS GNIS: Clinch River (http://geonames.usgs.gov/pls/gnispublic/f?p=gnispq:3:4165610648126017::NO::P3_FID:1307258_

2. Davis, Donald Edward. "Where There Are Mountains, An Environmental History of the Southern Appalachians". University of Georgia Press: 2005.

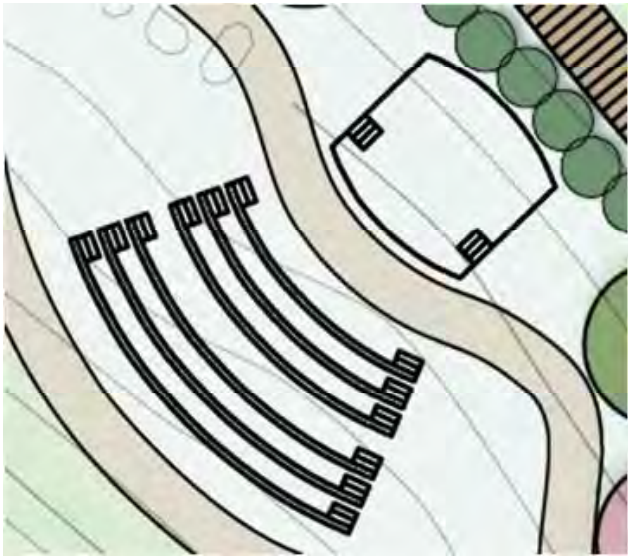
Information taken from http://en.wikipedia.org/wiki/Clinch_River

Appendix E: Calculations for Proposed Site Elements

The CDAC team prepared approximations of length and area for key proposed elements for the conceptual master plan. These figures are intended to assist the client team with cost estimates for park.

Square Footage of Amphitheater Stage

Porous Pavers – 663.5 square feet



Amphitheater Dimensions

Number of Rows – 6

Front Row – 42 feet long

Back Row – 63 feet long

Distance between risers – 3.5 feet

Distance between upper & lower sections – 6 feet

Linear Feet of Trail

Interior Boardwalk – 1090.25 feet

Perimeter Boardwalk – 717.25 feet

Crushed Stone – 2446.50 feet

Porous Concrete – 190 feet

Square Footage of Wetlands

Existing – 2331.75 square feet

Proposed – 24044 square feet

Linear Feet of Stream Realignment

Proposed Length – 586.5 feet

Bioswale Dimensions

Bioswale 1 (Technology Center Drive) – 6.5 feet wide, 1360 feet long

Bioswale 2 (Farmer's Market) – 15 feet wide, 686.5 feet long

Shelter Dimensions

40 feet wide, 80 feet long

Footbridge to Farmer's Market

10 feet wide, 30 feet long