Restoration Planting Community Prediction Tool

Guidelines Document

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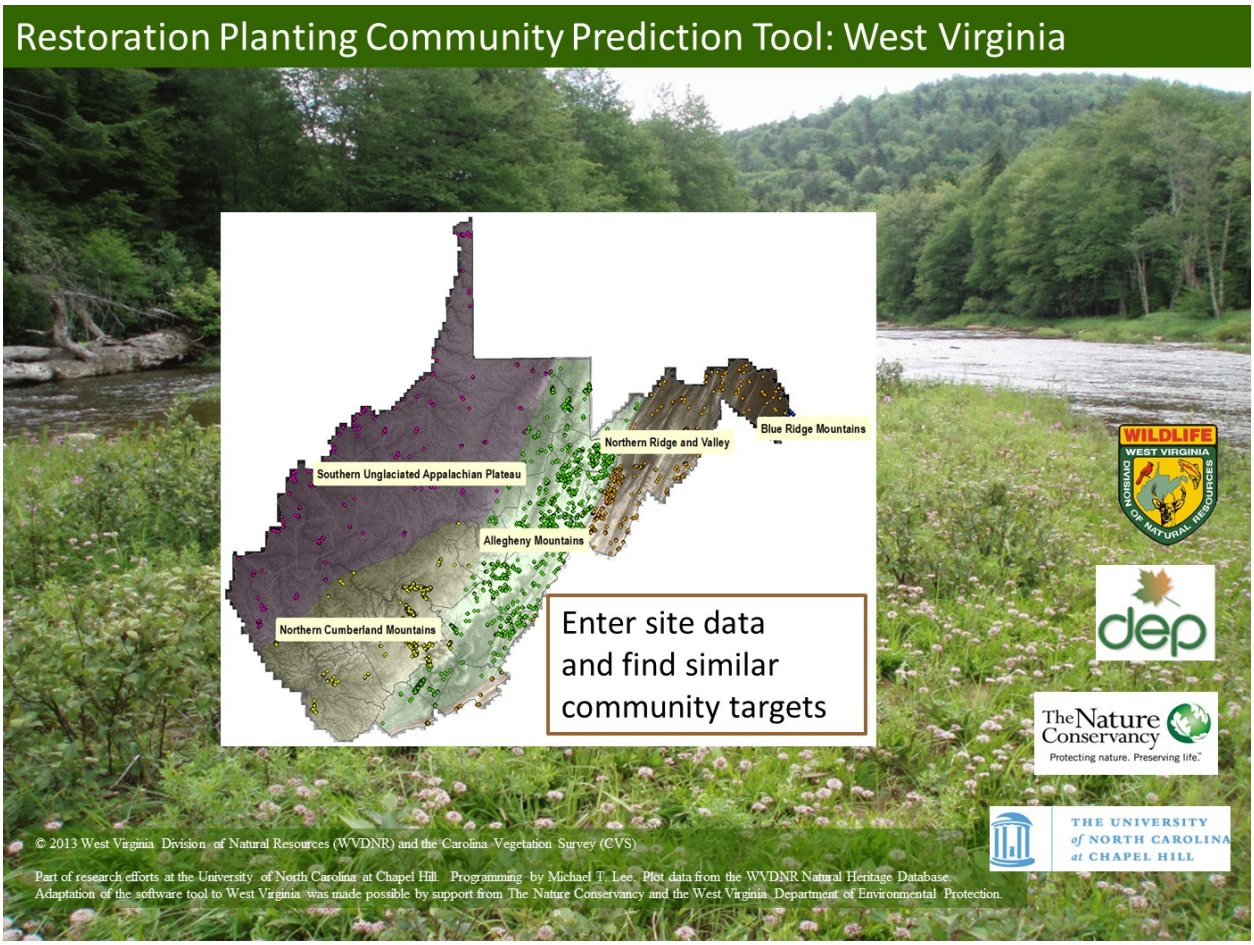
http://www.dep.wv.gov/WWE/getinvolved/Pages/Restoration-Planting-Tool.aspx



This software tool is part of research efforts at the University of North Carolina at Chapel Hill. Programming was done by Michael T. Lee, Database Programmer and Administrator at the Carolina Vegetation Survey. The source data for the software is 4,220 vegetation plots from the WVDNR Natural Heritage Database. These plots were sampled in natural vegetation communities statewide and reflect the best of our knowledge about high quality natural habitats that support native wildlife biodiversity in the state of West Virginia. Plot data was tailored to the requirements of the software by Elizabeth Byers, Vegetation Ecologist at WVDNR. Adaptation of the software tool to West Virginia was made possible by support from The Nature Conservancy and the West Virginia Department of Environmental Protection.

Contents

What do I need to know before using the tool?

The Restoration Planting Community Prediction Tool works by comparing your restoration site characteristics with the characteristics of known natural vegetation communities. Closely matching communities are shown in the results, and a planting list based on common species in these similar natural communities is exported.

It is important to fill in as many site variables as you can in order to get a good community prediction. **Seven variables are required** (shown in bold on the data entry form). **Try to fill in at least 12 variables**. Leave blank any site variables that you do not know. Many site variables are best determined during a **field visit**. A **soil sample** can greatly improve the prediction accuracy. You can estimate 14 of the variables from maps and air photos, but be aware that these may not represent the actual conditions on the ground. An **interactive map** providing 12 of the possible variables, including 5 of the 7 required variables, is available at: http://www.dep.wv.gov/WWE/getinvolved/Pages/Restoration-Planting-Tool.aspx (click on "3. Go to the interactive map"). Or you can type "Restoration Planting Tool West Virginia" into a search engine to find the web page.

How large a site can I assess using the tool?

Assessment sites can be any size, but they should be homogenous in terms of the site variables. If you have a large heterogeneous site, you can run the tool multiple times to get customized planting lists for each homogenous sub-unit of the site. For example, a 20-acre site might have several different restoration sub-units based on differing slope, aspect, drainage qualities, or soil chemistry.

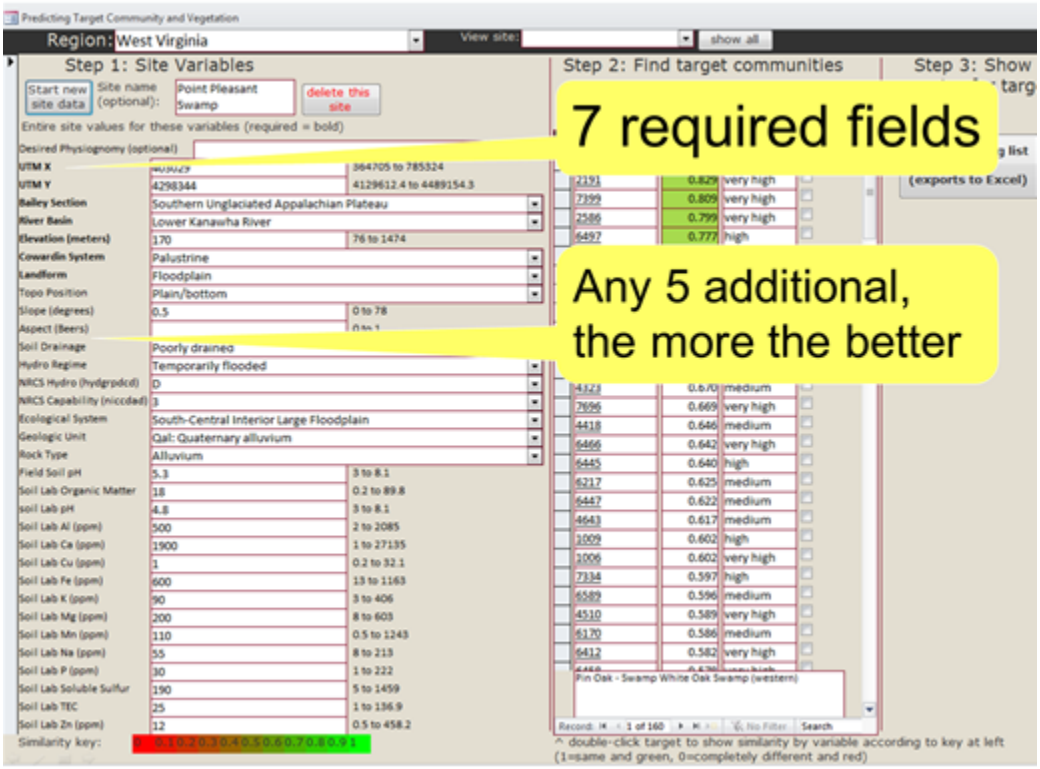
How does the tool integrate into an overall planting plan?

The Prediction Tool is only one piece of the puzzle. It will give you a list of native plants that comprise natural communities likely to thrive on your restoration site, and a little information about each of the species, including its tolerance of human disturbance, wetland status, rarity, and growth habit. It does not tell you which plants are available at local nurseries, easy to grow, resistant to herbivory, or

affordable in terms of cost – all critical factors. It does not replace a site visit by an experienced restoration ecologist, who will be able to recognize potential natural regeneration of target species, and also evaluate nearby sources of invasive species. If you are collecting your own seed from local sources (a great strategy to conserve germplasm and local genetics), you will need to work with local nurseries to research seed collection and propagation methods.

Step 1: Site Variables (step-by-step instructions)

Seven variables are required for the tool to run. They are listed in bold font on the "Step 1" dialog. At least **five more variables (your choice)** should be filled out for a good result. The more variables you can specify, the better your result will be. You can photocopy the **datasheet** on the last page of these guidelines to record your variables so that you have them all in one place before entering them into the tool.



1. **Start new site data**: **Click this button** to start entering data for a new restoration site, or a new sub-unit of your site.

2. **Site Name**: **Type in the name** that you use to refer to your restoration site, or to the homogenous sub-unit of your site. This name will populate the drop-down list of sites, so that you can retrieve your results and/or make edits to your site variables as you get more information.

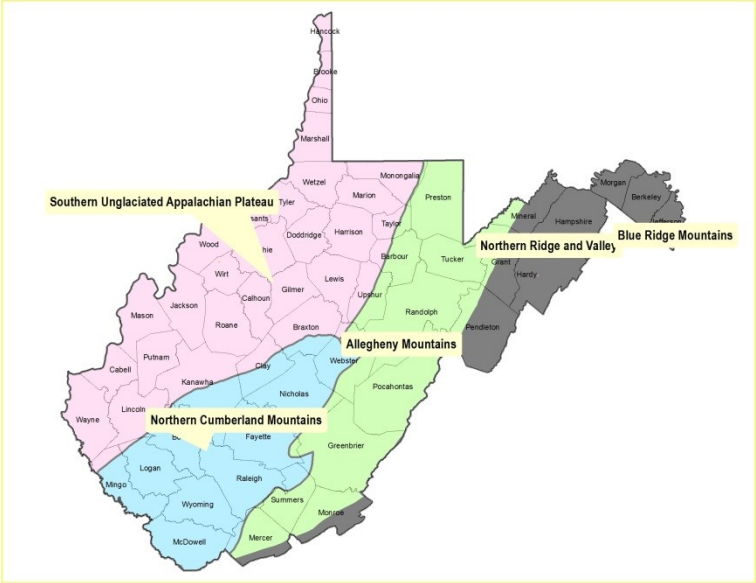
3. **Desired Physiognomy** (optional): **This factor should be left blank** if you would like the prediction tool to select the most suitable natural community targets of any physiognomy (the recommended default). If you prefer a certain physiognomic class, *e.g.,* a forest or a shrubland, for your restoration

project, then you can indicate your preference here. Communities with matching physiognomies will be ranked higher in the results. The Physiognomic Classes below are defined by the relative percent cover of the tree, shrub, dwarf shrub, herbaceous, and nonvascular strata. The strata must be rooted in the community, not overhanging into community (*e.g.*, an open shoreline might be an herbaceous or sparsely vegetated community even if it was completely shaded by overhanging trees from the adjacent forested community).

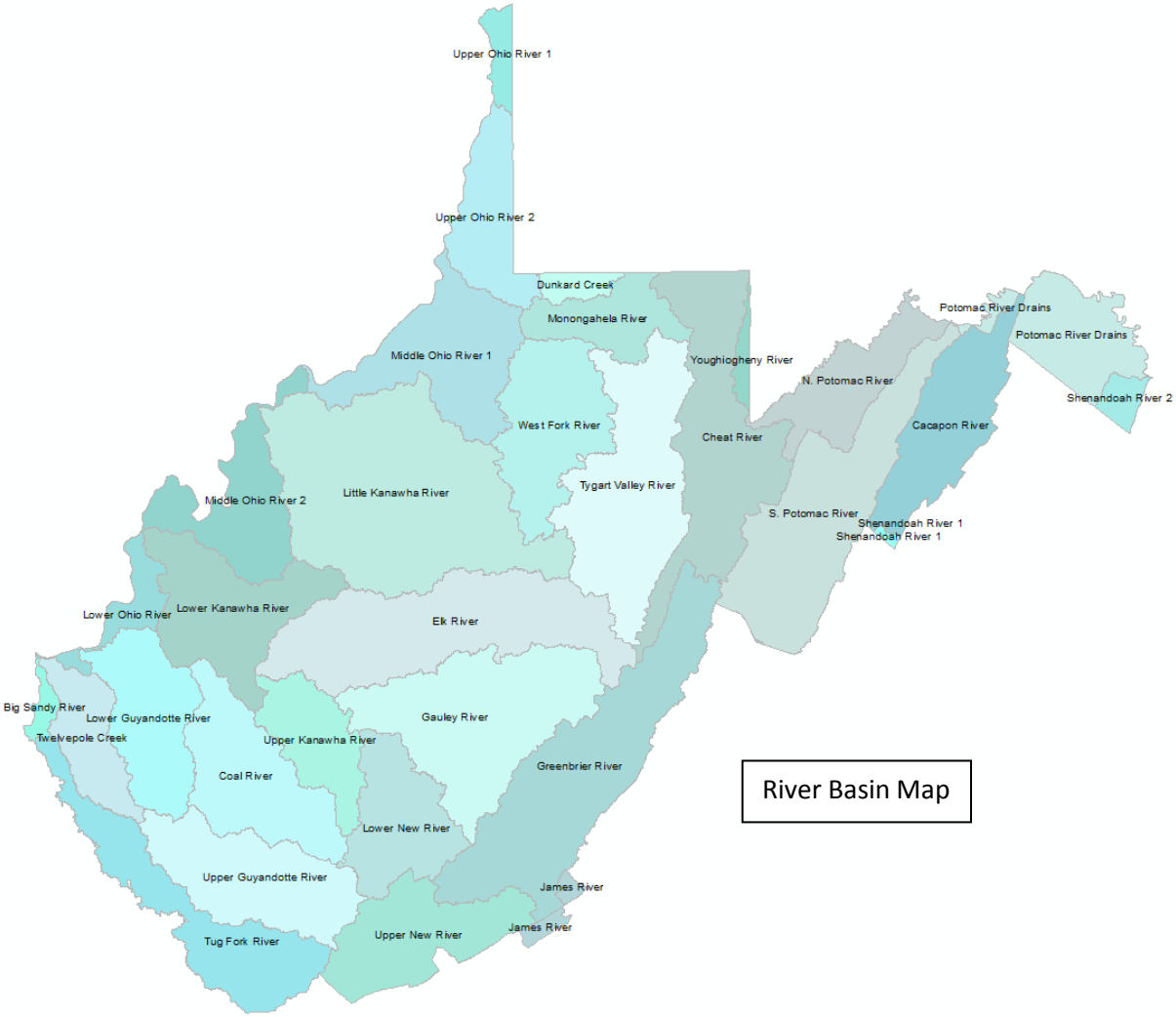
- FOREST Trees over 5m tall. The majority of the tree crowns are overlapping (60%-100% cover). Shrubs, herbs and nonvascular plants may be present at any cover value.
- WOODLAND Trees over 5m tall. Trees cover 10-60% of the surface. Shrubs, herbs, and nonvascular plants may be present at any cover value.
- SHRUBLAND Shrubs are 0.5-5.0 meters tall and cover greater than 25% of the surface. Trees may be present but cover 10% or less of the surface. Herbs and nonvascular plants may be present at any cover value.
- DWARF SHRUBLAND Shrubs are generally less than 0.5 meters tall (though known dwarf forms between 0.5 and 1m can be included such as in a dwarf shrub bog community), and cover greater than 25% of the surface. Trees (>5 m tall) and shrubs (0.5 to 5 m tall) may be present but cover for each is 10% or less. Herbs and nonvascular plants may be present at any cover value.
- HERBACEOUS Herbaceous vegetation (graminoid, forbs and ferns) with cover greater than 25%. Trees, shrubs, and dwarf shrubs may be present, but each with 10% or less cover. Non vascular plants may be present at any cover value. Aquatic vegetation such as submergent and free-floating forms are included here.
- SPARSE VEGETATION Abiotic substrate features dominant. Vegetation is scattered to nearly absent and generally restricted to areas of concentrated resources (total vegetation cover is typically less than 25% and greater than 0%).
- NONVASCULAR VEGETATION Nonvascular cover (bryopytes, lichens, and algae) dominant (generally forming at least 25% cover). Non-vascular cover may be less than 25% where it exceeds tree, shrub, dwarf-shrub, and herb cover, respectively.
- FLOATING AQUATIC: Aquatic vegetation with floating leaves, such as water lilies.
- SUBMERGED AQUATIC: Aquatic vegetation with largely submerged leaves, such as eelgrass, mud-plantain, or coontail.

4. **UTM X, UTM Y**: **Required. Available from interactive map.** Whole numbers are fine; there is no need to use decimal places. Coordinates in Universal Transverse Mercator, Zone 17, Datum = NAD 83. Web converters are available if your coordinates are in latitude/longitude or another system. A web search on “convert lat long utm” should bring up several converters. Google Earth can convert for you using Tools/Options/3D View.

5. **Bailey Section**: **Required. Available from interactive map.** Sections M221A-D, 221E from USFS ecological maps by Bailey (see map at right).



6. **River Basin: Required. Available from interactive map.** West Virginia watersheds (see map below).



River Basin Map

7. **Elevation (meters): Required. Available from interactive map.** Whole numbers are fine; there is no need to use decimal places. One foot = 0.3048 meters. Web converters are available, *e.g.,* you can enter the following text into a search box "1350 feet = meters". Available as a GIS layer. Google Earth can give you elevations in feet or meters (Tools/Options/3D View).

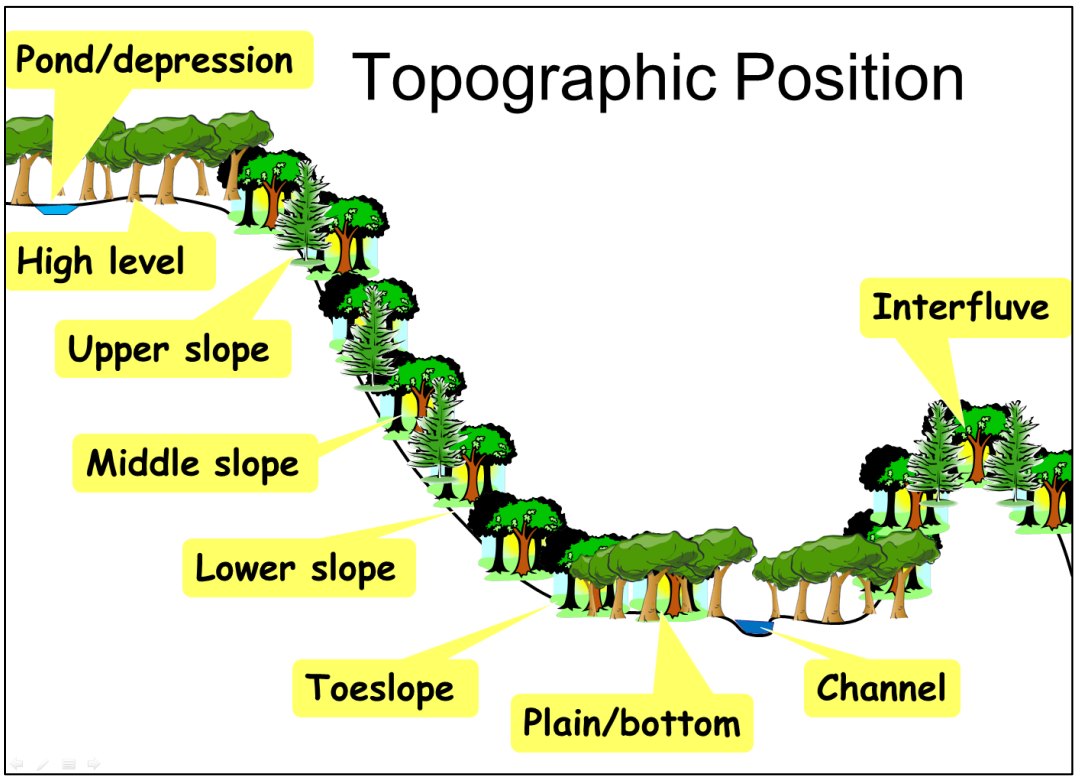
8. **Cowardin System**: **Required. From field inspection, or estimate from maps or air photos.** Broad land classification from Cowardin 1979 "Classification of Wetlands and Deepwater Habitats of the United States". Nearly all sites in West Virginia will be either Upland or Palustrine.
   - Palustrine: All wetlands dominated by trees, shrubs, persistent emergents, emergent mosses, or lichens. Wetlands in West Virginia often have no standing water, but their soils are saturated for at least 10 days during the growing season. This is long enough to create hydric soils and support hydrophytic vegetation. The palustrine category also includes open water wetlands with all of the following characteristics: (1) area less than 8 ha; (2) lacking an active wave-formed or bedrock boundary; and (3) water depth in the deepest part of the basin less than 2 m (6.6 ft) at low water.
   - Riverine: Wetlands and deepwater habitats contained within a channel except those wetlands dominated by trees, shrubs, persistent emergents, emergent mosses, or lichens. Submerged aquatic bed communities in mid-to-large rivers, *e.g.,* eelgrass/mud-plantain communities in the Potomac River, are considered Riverine.
   - Lacustrine: Wetlands and deepwater habitats (1) situated in a topographic depression or dammed river channel; (2) lacking trees, shrubs, persistent emergents, emergent mosses, or lichens with greater than 30% areal coverage; and (3) whose total area exceeds 8 hectares (20 acres); or area less than 8 hectares if the boundary is active wave-formed or bedrock or if water depth in the deepest part of the basin exceeds 2 m (6.6 ft) at low water.
   - Upland: 99% of West Virginia is upland, i.e., not a wetland; not characterized by hydrophytic vegetation or hydric soils, and not saturated or flooded during more than about 10 days during the growing season.

9. **Landform**: **Required. From field inspection, or estimate from maps or air photos.** Select the most appropriate landform name from the list below.
   - Ridge/interfluve**:** Elevated summit or linear crest of a ridge, hill, or mountain between two drainage ways that sheds water to the drainage ways.
   - Plateau: Extensive upland mass with a relatively flat summit area that is considerably elevated (more than 100m) above adjacent lowlands, and is separated from them on one or more sides by escarpments. A comparatively large part of a plateau surface is near summit level.
   - Saddle/gap: Low point on a ridgeline, generally a divide between the heads of streams flowing in the opposite directions.
   - Mountain slope/hillslope: Slope forming the flank of an incised valley.
   - Slope bench/ledge/step: Narrow, more or less level area on a slope bordered by steeper terrain both upslope and downslope.
   - Cove/ravine/gorge: Concave landform formed by downcutting of a headwater stream or streams; includes hollows.
   - Bedrock outcrop/cliff/escarpment/bluff: Exposed surface of bedrock, may be flat (e.g., clifftop), sloping (e.g., sandstone glade), or vertical (e.g., cliff); usually produced by differential erosion or stream incision.

- Boulderfield/talus/debris slide: Unconsolidated boulders, stones, or other rock fragments detached from bedrock and transported downslope by ice, water and gravity, or moved along an upper slope/plateau due to frost action (e.g., rock glaciers, rock rivers). Rock fragments are usually coarse and angular, as distinguished from floodplain cobble bars which would be river-rounded.
- Sinkhole: Closed depression formed either by solution of the surficial bedrock (e.g., limestone, dolostone) or by collapse of underlying caves; if poorly drained, it will form a natural pond or depression wetland lacking an outlet.
- Headwater basin: Concave low-slope stream headwater landforms, generally wetlands, characterized by groundwater-controlled hydrology and little or no active alluvial deposition. Beaver ponds, beaver meadows, and peatlands are common. Typically occurs either above the area of permanent channel formation or along low-gradient first- and second-order streams. Especially common at high elevations in the Allegheny Mountains, but occurs throughout the state.
- Alluvial terrace: Step-like surface bordering a valley floor, that represents the former position of a floodplain, but which is no longer subject to inundation, or flooding is so rare that it does not affect the composition of the vegetation (e.g., it lies above the 100-year floodplain). The term is usually applied to both the relatively flat summit surface (platform, tread), cut or built by former stream action, and the steeper descending slope (scarp, riser), graded to a lower base level of erosion.
- Floodplain: Nearly level alluvial plain that borders a stream and is subject to inundation under flood stage conditions unless protected artificially. It is usually composed of unconsolidated sediment deposited during overflow and lateral migration of the stream. Typically comprises the 100-year floodplain, and includes backswamps, sloughs, oxbows, and levees.
- Channel (below bankfull): Active stream channel, i.e., the channel bed, channel bars, depositional bars, and the channel bank below bankfull level. On a stream that is not entrenched, bankfull is at or near the top of the bank. On entrenched streams, the bankfull stage is identified as a scour line, bench, or the top of a point bar. Does not include the floodplain above the bankfull level.

10. **Topo Position**: **Recommended. From field inspection, or estimate from maps or air photos.** Indicate the appropriate topographic position of the plot relative to the local relief, i.e., on a scale running from the nearest stream bottom to the nearest ridge crest. This may sometimes be more accurately done by assessing the plot location on a USGS topographic map.
    - Interfluve: (crest, summit, ridge) Linear top of ridge, hill, or mountain; the elevated area between two fluves (drainageways) that sheds water to the drainageways.
    - High level: (plateau) Extensive upland mass with a relatively flat summit area that is considerably elevated (more than 100m) above adjacent lowlands. A comparatively large part of a plateau surface is near summit level.
    - Upper slope: (shoulder slope, upper slope, convex creep slope) Geomorphic component that forms the uppermost inclined surface at the top of a slope. Surface is often convex in profile and erosional in origin.
    - Middle slope: (transportational midslope, middle slope) Intermediate slope position; may include cliff and ledge segments.
    - Lower slope (lower slope, foot slope, colluvial footslope) Lower slope position; surface profile is often concave and a transition between middle slope and toeslope.

- Toeslope: Hillslope position at the base of a slope, forming the lower part of a slope continuum that grades to a valley or closed depression. They are characterized by alluvial deposition and often are areas of moisture concentration.
- Plain/bottom: (low level) Low-lying areas with very low relief, floodplains, or bottoms.
- Channel: Sloping side or bed of an active channel, below the current floodplain.
- Pond/depression: Ponds, pools, isolated depression wetlands.



11. **Slope (degrees): Recommended. From field inspection, or from interactive map.** Whole numbers are fine; there is no need to use decimal places. Convert from percent slope if necessary. It is best to collect the slope variable in the field, but it is also available from the interactive map.

12. **Aspect (Beers): Recommended. From field inspection, or from interactive map.** Use two decimal places for the aspect. It is best to collect the aspect variable in the field, but it is also available from the interactive map. **If the site is flat, leave this field blank since aspect is not important.** Beers transformation of aspect is calculated as: (1-Cos(Aspect_in_degrees)*3.14159/180-45*3.14159/180))/2. The Beers transformation gives low values to sites with cool wet northeast aspect and high values to sites with warm dry southwest aspect. Here are some typical values:

Aspect	Beers Aspect	Aspect	Beers Aspect
N	0.15	S	0.85
NE	0	SW	1.0
E	0.15	W	0.85
SE	0.5	NW	0.5

13. **Soil Drainage**: **Recommended. From field inspection.** The soil drainage classes are defined in terms of (1) actual moisture content (in excess of field moisture capacity), and (2) the extent of the period during which excess water is present in the plant root zone. It is recognized that permeability, level of groundwater, and seepage are factors affecting moisture status. However, because these are not easily observed or measured in the field, they cannot be used generally as criteria of moisture status. It is further recognized that soil profile morphology, for example, mottling, normally, but not always, reflects soil moisture status. Although soil morphology may be a valuable field indication of moisture status, it should not be the overriding criterion. Soil drainage classes cannot be based solely on the presence or absence of mottling. Topographic position and vegetation as well as soil morphology are useful field criteria for assessing soil moisture status. For rocky substrates with little or no soil: guess at value based on levels of steady water and degree of runoff.
    - RAPIDLY DRAINED The soil moisture content seldom exceeds field capacity in any horizon except immediately after water addition. Soils are free from any evidence of gleying throughout the profile. Rapidly drained soils are commonly coarse textured or soils on steep slopes.
    - WELL DRAINED The soil moisture content does not normally exceed field capacity in any horizon (except possibly the C) for a significant part of the year. Soils are usually free from mottling in the upper 3 feet, but may be mottled below this depth. B horizons, if present, are reddish, brownish, or yellowish.
    - MODERATELY WELL DRAINED The soil moisture in excess of field capacity remains for a small but significant period of the year. Soils are commonly mottled (chroma < 2) in the lower B and C horizons or below a depth of 2 feet.
    - MODERATELY-POORLY DRAINED (formerly called Somewhat Poorly Drained; name changed for ease of abbreviation) The soil moisture in excess of field capacity remains in subsurface horizons for moderately long periods during the year. Soils are commonly mottled in the B and C horizons. The matrix generally has a lower chroma than in well-drained soil on similar parent material.
    - POORLY DRAINED The soil is saturated within 30 cm of the surface for a large part of the year. The surface soils are usually very dark and of low chroma in the subsoil with mottling of high chroma concentrations.
    - VERY POORLY DRAINED Free water remains at or above the surface most of the year. The surface soils are usually very dark to black. Subsurface horizons usually are of low chroma and mottling with high chroma concentrations may be present. Very poorly drained soils usually have a mucky or peaty surface horizon.

14. **Hydrologic Regime**: **Recommended. From field inspection.** Select the closest fit for hydrologic regime from the list below, based on field observation.
    - Permanently Flooded: Water covers the land surface at all times of the year in all years. Equivalent to Cowardin's "permanently flooded".
    - Semi-permanently flooded: Surface water persists throughout the growing season in most years. Land surface is normally saturated when water level drops below soil surface. Includes Cowardin's Intermittently Exposed and semipermanently Flooded modifiers.
    - Saturated: Surface water is seldom present, but substrate is saturated to surface for extended periods during the growing season. Equivalent to Cowardin's Saturated modifier.
    - Temporarily flooded: Surface water present for brief periods during growing season, but water table usually lies below soil surface. Often characterizes floodplain wetlands. Equivalent to Cowardin's Temporary modifier.

- Moist: Soil surface above the maximum water level; normal soil profile development hampered because of imperfect drainage. Upper 1 2 feet of soil well aerated during vegetative season. On mineral soils a severely mottled to homogeneous brown horizon (color B) is present. Occurs also on heavy textured soils with perched water table and on dry deep peat.
- Somewhat moist: Loams and sandy loams with some rust mottling in lower part of B or C horizon. Moist variants or zonal soil types.
- Dry: Deep silty sands and loamy sands, not influenced by ground water.
- Very dry: Medium and coarse sands; shallow soils, not influenced by ground water.
- Extremely dry: Steep eroding sands, rock piles, gravel.

15. **NRCS Hydro (hydgrpdcd): Recommended. Available from interactive map.** SSURGO 1999 hydrologic group variable "hydgrpdcd" with values A-D (A high infiltration/low runoff to D low/high). Hydrologic Group is a grouping of soils that have similar runoff potential under similar storm and cover conditions. This data is also available from the NRCS Web Soil Survey, or may be determined by a soil scientist in the field.
    - A Combination of the following factors: High infiltration rate, low runoff potential when thoroughly wet; very deep, well drained to excessively drained; sands or gravelly sands; high rate of water transmission.
    - B Combination of the following factors: Moderate infiltration rate, moderate runoff potential when thoroughly wet; moderately deep or deep, moderately well drained to well drained; moderately fine to moderately coarse; moderate rate of water transmission.
    - C Combination of the following factors: Slow infiltration rate, slow runoff potential when thoroughly wet; has layer that impedes downward movement of water; moderately fine to fine; slow rate of water transmission.
    - D Combination of the following factors: Very slow infiltration rate, high runoff potential when thoroughly wet; has permanent high water table, claypan or clay layer at or near surface, or shallow over nearly impervious layer; clayey soil that has high shrink-swell potential; very slow rate of water transmission.

16. **NRCS Capability (niccdad): Recommended. Available from interactive map.** SSURGO non-irrigated capability class variable "niccdad" with values 1-8 (slight-severe limitations). This data is also available from the NRCS Web Soil Survey, or may be determined by a soil scientist in the field.
    - Class I (1) soils have slight limitations that restrict their use.
    - Class II (2) soils have moderate limitations that reduce the choice of plants or require moderate conservation practices.
    - Class III (3) soils have severe limitations that reduce the choice of plants or require special conservation practices, or both.
    - Class IV (4) soils have very severe limitations that restrict the choice of plants or require very careful management, or both.
    - Class V (5) soils have little or no hazard of erosion but have other limitations, impractical to remove, that limit their use mainly to pasture, range, forestland, or wildlife food and cover.
    - Class VI (6) soils have severe limitations that make them generally unsuited to cultivation and that limit their use mainly to pasture, range, forestland, or wildlife food and cover.
    - Class VII (7) soils have very severe limitations that make them unsuited to cultivation and that restrict their use mainly to grazing, forestland, or wildlife.

- Class VIII (8) soils and miscellaneous areas have limitations that preclude their use for commercial plant production and limit their use to recreation, wildlife, or water supply or for esthetic purposes.

17. **Ecological System Name: Recommended. Available from interactive map, or from field inspection, but see advisory below.** Often restoration sites will be mapped as **"NLCD developed classes"** or **"NLCD agricultural classes"**, which are **not valid inputs** to the Restoration Planting Tool. If the interactive map gives you these results, then **this factor should be left blank**. However, if you are comfortable with the taxonomy of ecological systems in West Virginia, then you can probably determine the appropriate system for "developed" and "agricultural" areas by reading the descriptions of Ecological Systems in Appendix B. Note that riparian and wetland systems are easier to determine than upland systems.

18. **Geologic Unit**: **Recommended. Available from interactive map.** Bedrock geology as mapped by the WVGES, or as documented by a skilled observer in the field.

19. **Rock Type**: **Recommended. Available from interactive map, or from field inspection.** Dominant lithology of the mapped geologic unit (WVGES field Rocktype1), or as documented by a skilled observer in the field. For example, if your site is mapped as shale, but you observe abundant sandstone outcrops, you should use your field observation rather than the interactive map result.

20. **Soil pH**: **Recommended. Measured in the field.** You may use any technique. The data is matched to field soil pH measured with a Lovibond Soil pH Test Kit. Field measurement of soil pH is strongly recommended, especially if you are not able to send a soil sample to the lab for analysis.

Site Variables 21-34: Recommended. Soil sample is collected in the field and sent to lab. The soil lab variables are based on laboratory analysis of the top 10 cm of mineral soil, composited from 3 locations at the site. A trowel or soil knife can be used to dig 3 small holes and gather at least 100 grams of soil in a Ziploc bag. The soil sample should be air-dried before sending to the lab. Values in the database were analyzed by Brookside Labs. The soil lab fields are optional but if the data is available, they will increase the goodness of fit with a natural community. If your restoration site has highly disturbed soils, you may want to collect an additional soil sample at a nearby reference site, if one is available. Try to sample the soil you will be planting in!

21. Soil Lab TEC (total extractable cations, same as cation exchange capacity)
22. Soil Lab Organic Matter: % OrganicMatter
23. Soil Lab pH
24. Soil Lab Al (ppm)
25. Soil Lab Ca ppm
26. Soil Lab Cu ppm
27. Soil Lab Fe (ppm)
28. Soil Lab K (ppm)
29. Soil Lab Mg (ppm)
30. Soil Lab Mn (ppm)
31. Soil Lab Na (ppm)
32. Soil Lab P (ppm)
33. Soil Lab S (soluble sulphur, ppm)
34. Soil Lab Zn (ppm)

Step 2: Find Target Communities

Natural communities similar to your restoration site are highlighted in green, with similarity scores >9 highlighted in dark green. Dissimilar communities are highlighted in red. You can **double-click the Target Code** (4 digit number) and the site variables will be shaded according to the similarity of that variable to the particular natural community. This breaks down the aggregate score to help you understand how your restoration site matches with a particular natural community. Choose the communities that are most similar (perhaps the top three), or those which are similar and also meet other requirements of your project (such as forested wetland), and **check the Select box** to the right of each community type. All the selected types will be included and summarized in terms of species constancy in the compiled planting list. You may want to experiment with several selections before deciding on a final list. Community names are listed, along with the 4-digit target code, at the end of this document.

Step 3: Create Planting List

The planting list is automatically exported and opened in Excel. The software takes a few moments to process – please wait for the "Planting List Complete" message before working with the Excel results.

The recommended planting list is restricted to native species that are not invasive. In selecting species to plant for your restoration project, you will want to **focus on foundation species with relatively high constancy (>25%) and cover (>10%)**, with an **FQI in the restoration "sweet spot" (typically 4-8)**, and **wetland codes that are compatible with the hydrologic conditions** at your site. You should not select species that are in decline statewide due to known **pathogens**, including **hemlock, beech, and all ash species**.

Planting List Quick Reference

Focus on species with:

- Constancy >25%
- Cover >10%
- FQI 4-8

The information presented on the Excel spreadsheet includes the following:

1. **Scientific Name:** Scientific name in use by the WVNDR Natural Heritage Database, which generally follows the standards of Harmon, P. J., D. Ford-Werntz, W. Grafton. 2006. Checklist and Atlas of the Vascular Flora of West Virginia. West Virginia Division of Natural Resources, Wildlife Resources Section, Elkins, WV. 381 pp. Some species have been updated according to recent work in the Flora of North America project.

2. **Common Name:** The name listed here is the one used in the WVDNR Natural Heritage Database, but many other common names may be in use and perfectly acceptable.

3. **FQI:** Floristic Quality Index rating: This rating is based on faithfulness to a natural plant community, and tolerance of and/or dependence on disturbance (particularly human disturbance). The "sweet spot" where your plantings are likely to have the best impact is for plants with FQI values ranging from 4 – 8. The criteria used to assign FQI values are as follows:
   - 0: Exotic or introduced plants.
   - 1-2: Native plants with a wide range of ecological tolerances and adapted to severe habitat degradation. These weedy species thrive under conditions of anthropogenic disturbance.
   - 3-4: Native plants associated with more stable though degraded habitat, but which may be found in a variety of habitats. They are generally widespread and not an indicator of a particular community type.
   - 5-6: Native plants with an intermediate range of ecological tolerances and often associated with a specific natural vegetation community. They include many common dominant species, and can persist under moderate degradation.
   - 7-8: Native plants with a narrow range of ecological tolerances, often associated with advanced successional stage, and typically associated with stable natural vegetation communities and natural areas. They can persist where habitat has been slightly degraded.
   - 9-10: Native plants with a very high degree of fidelity to a narrow range of pristine habitats, and highly sensitive to anthropogenic disturbance. They are generally restricted to high-quality natural areas.

4. **Wetland Code**: Consider the wetland status of your restoration site when selecting species. A good match between species' tolerances and your site will help promote successful plant growth. The National Wetland Inventory codes with updates for West Virginia are:
   - OBL: Obligate Wetland. Occur almost always (estimated probability >99%) under natural conditions in wetlands.
   - FACW: Facultative Wetland. Usually occur 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 occur in non-wetlands (estimated probability 67%-99%), but occasionally found in wetlands (estimated probability 1%-33%).

5. **SRank**: State Conservation Status Rank. If indicated, target site could potentially provide habitat for these rare species. We do not recommend planting rare species since they are unlikely to thrive until the habitat has been fully restored. Information on rare species is provided to help land managers better appreciate the potential habitat value of the site being restored.
   - S1: Critically imperiled in the state, because of extreme rarity (often 5 or fewer occurrences) or because of some factor(s) such as very steep declines making it especially vulnerable to extirpation.
   - S2: Imperiled in the state, because of rarity due to very restricted range, very few populations (often 20 or fewer), steep declines, or other factors making it very vulnerable to extirpation.
   - S3: Vulnerable in the state, due to a restricted range, relatively few populations (often 80 or fewer), recent and widespread declines, or other factors making it vulnerable to extirpation.
   - SNR: Unranked. State conservation status not yet assessed.
   - SH: Possibly Extirpated (Historical). Species occurred historically in the state, and there is some possibility that it may be rediscovered. Its presence may not have been verified in the past 20-40 years. A species could become SH without such a 20-40 year delay if the only known occurrences were destroyed or if it had been extensively and unsuccessfully looked for. The SH rank is reserved

for species for which some effort has been made to relocate occurrences, rather than simply using this status for all elements not known from verified extant occurrences.

- S#S#, G#G# Range Rank —A numeric range rank (e.g., S2S3) is used to indicate any range of uncertainty about the status of the species. Ranges cannot skip more than one rank (e.g., SU is used rather than S1S4).

6. **Growth Habit:** The typical growth habit of the species (forb/herb, graminoid, vine, subshrub, shrub, tree). Nonvascular species may be recognized by the common name*, e.g.,* delicate fern moss.

7. **Average Cover by Community:** The average percent cover of the species within each selected target community is listed on the Excel spreadsheet. Planting plans typically focus on species that have **high average cover (>10%)** within one or more of the target communities; however, any species on the list can be a suitable candidate for planting. For example, species with lower cover may be chosen for their pollinator, wildlife food, or ornamental value.

8. **Constancy by Community:** The constancy of the species within each selected target community is listed on the Excel spreadsheet. Constancy is defined as the number of community plots containing the species divided by the total number of plots used to characterize the community.

9. **Overall Constancy:** The overall constancy of the species within the selected target communities is listed on the Excel spreadsheet. Planting plans typically focus on species with **high overall constancy (>25%).** Species with **high overall constancy and high average cover** are known as **foundation species,** and should form the **core of any restoration project.** Species with lower constancy may also be included if desired.

Appendices

A. List of Community Names by 4-digit Target Code

Additional information on each of the communities below is available from WVDNR Natural Heritage Program. Descriptions of communities with target codes greater than 2000 may be viewed in the U.S. National Vegetation Classification at http://usnvc.org/explore-classification/ Type the 4-digit code into the search box on the USNVC website to access the NatureServe description of the community.

1001 Calcareous Forests and Woodlands
1002 Dry Rocky Pine/Oak Forests and Woodlands
1003 Hemlock Forests
1004 Limestone Barrens and Glades
1005 Mixed Mesophytic Forests
1006 Sycamore - Sugar Maple Floodplain Forest
1007 Dogbane Rivershore
1008 Water Starwort Spring Seep
1009 Woolly Sedge - Tussock Sedge Marl Fen
1010 Marsh Spikerush Marl Marsh
1011 Sinkhole Marsh
1012 Indian Grass Marl Wet Meadow
1013 Northern Hardwoods Forests
1014 Oak/Heath and Oak/White Pine Forests
1015 Oak/Hickory and Dry/Mesic Oak Forests
1016 Sandstone Glades
1017 Shale Barrens
2026 Large Bur-reed Marsh
2191 Buttonbush Swamp
2256 Lake Sedge Fen
2257 Beaked Sedge Fen
2381 Speckled Alder Swamp
2386 Water Lily Slough
2411 Tulip Poplar - Basswood - Buckeye - Sugar Maple Forest
2432 Pin Oak - Swamp White Oak Swamp (western)
2472 Larch Peatland
2586 Silver Maple Floodplain Forest (central/west)
2596 Northern White-cedar / Bristleleaf Sedge - Purple Cliffbrake Woodland
3683 White Ash - Pignut Hickory / Rock Muhly - Woodland Sunflower - Elmleaf Goldenrod Woodland
3725 Sycamore - River Birch Riverscour Woodland
3836 Giant Cane Woodland
3896 Sycamore Riverscour Woodland (Potomac)
3939 Mountain Laurel - Black Huckleberry - Blueberry - Minniebush Shrubland
3958 Blueberry Dwarf-shrubland
4073 Sycamore - Box Elder Floodplain Forest (Potomac)
4103 Twisted Sedge Rivershore
4286 Water Willow Riverbed
4290 Mild Water Pepper Slough
4323 American Lotus Slough

4333 Eelgrass - Mudplantain Riverbed
4418 Sweetgum - Tulip Poplar Floodplain Forest (Gauley)
4510 American Bur-reed Marsh
4643 Pin Oak Sinkhole Swamp
4714 Red Oak - Chestnut Oak / Hairgrass - Oatgrass - Reedgrass Woodland
4725 Pondweed - Waterweed Slough
4793 Chinquapin Oak - White Oak - Red Oak - Bitternut Hickory / Blackhaw Forest
4821 Pitch Pine - Chestnut Oak / Huckleberry / Pennsylvania Sedge Woodland
4973 Yellow Buckeye - Yellow Birch - Sugar Maple / Mountain Maple / Blue Cohosh - Bugbane Forest
4996 Pitch Pine / (Bear Oak) / Chokeberry / Hairgrass Woodland
5008 Sugar Maple - White Ash - Basswood / Mountain Maple / Blue Cohosh Forest
5014 American Beech - Maple Floodplain Forest (Meadow River)
5023 Chestnut Oak - (White Oak, Scarlet Oak) / Mapleleaf Viburnum – (Mountain Laurel) Forest
5174 Bluejoint Grass Wet Meadow
5222 Tuliptree - Basswood - Buckeye - Sugar Maple / (Umbrella Magnolia) Forest
6003 Balsam Fir - Black Ash Swamp
6017 Sugar Maple - Chinquapin Oak / Redbud Forest
6029 Red Spruce - Eastern Hemlock - American Beech / Intermediate Woodfern Forest
6037 Eastern Redcedar - White Ash / Pennsylvania Sedge - Hairy Lipfern Circumneutral Shale Barrens
6045 Sugar Maple - Yellow Birch - Black Cherry Northern Hardwood Forest
6047 Eastern Red-cedar / Sideoats Grama - Bristleleaf Sedge Limestone Glade
6057 Chestnut Oak - Red Oak / Witch Hazel Forest
6108 Red Pine / Minnie bush / Appalachian Rockcap Fern Forest
6109 Eastern Hemlock - Yellow Birch - Sugar Maple / Woodfern Northern Hardwood Forest
6125 Northern Red Oak - Sugar Maple - Tuliptree Forest
6132 Red Maple - Black Gum - Peatmoss Swamp
6152 Red Spruce - (Eastern Hemlock) / Rhododendron Forest
6170 Baltic Rush Marl Fen
6193 Golden Saxifrage Seep
6206 Eastern Hemlock - Yellow Birch - Black Cherry / Rhododendron Northern Hardwood Forest
6217 Silver Maple Floodplain Forest (Potomac)
6231 Chinquapin Oak - Redbud / Roundleaf Groundsel - Hoary Puccoon Woodland
6254 Red Spruce / Mountain Laurel - Minniebush Rocky Woodland
6271 (Chestnut Oak, Scarlet Oak) / Mountain Laurel / (Galax, Wintergreen) Forest
6275 Softstem Bulrush Marsh
6277 Spruce - Hemlock - Rhododendron Swamp
6279 Hemlock - Rhododendron Swamp
6282 Chestnut Oak - (Red Oak, Black Oak) / Lowbush Blueberry Forest
6283 Big Bluestem - False Blue Indigo Riverscour
6286 Chestnut Oak - Red Oak / Rhododendron / Galax Forest
6288 Virginia Pine - Eastern Redcedar - Red Oak / Atlantic Goldenrod - Prickly Pear Woodland
6299 Chestnut Oak - (Scarlet Oak, Red Oak) / Mountain Laurel / Hillside Blueberry Forest
6304 Tuliptree - Eastern White Pine - Eastern Hemlock - (Red Oak, White Oak) / Christmas Fern Forest
6305 Silky Willow Swamp
6349 Woolgrass Wet Meadow
6412 Tussock Sedge Wet Meadow
6445 Bitternut Hickory Floodplain Forest
6447 Hairy-fruit Sedge Rivershore

6458 Sycamore - Green Ash - Wingstem Floodplain Forest
6461 Rice Cutgrass Marsh
6462 Oak - Muscletree Floodplain Forest
6463 Black Willow - Threesquare Riverbank Woodland
6464 Bushy St. Johnswort Swamp
6466 Sycamore - Buckeye Floodplain Forest
6477 Switchgrass - Big Bluestem Riverscour
6480 Wingstem - Deertongue Rivershore
6481 Mistflower Rivershore (Potomac bedrock)
6483 Nut-sedge Rivershore
6487 American Beech - Tulip Poplar - Sycamore - Slippery Elm - Red Oak Temporarily Flooded Forest
6497 Swamp White Oak - Black Gum Swamp (eastern)
6545 Chokeberry - Wild Raisin Peatland
6548 Green Ash - Silver Maple Swamp
6549 Silvery Sedge Fen
6552 Threeway Sedge Fen
6556 Spruce - Yellow Birch - Mannagrass Swamp
6557 Pitch Pine - Scarlet Oak / Lowbush Blueberry Woodland
6562 Virginia Pine - Chestnut Oak / Shale-barren Ragwort - Moss Phlox Woodland
6565 Sweet Birch - Chestnut Oak / Virginia Creeper Woodland
6567 Skunk Cabbage Seep
6568 Goldenrod Wet Meadow
6570 Cottongrass Fen
6571 Steeplebush Swamp
6587 Pitch Pine - Spruce Heath Peatland
6588 Spruce Heath Peatland
6589 Bog-rosemary Bog
6590 Spruce - Three-seeded Sedge Peatland
6591 Balsam Fir - Winterberry Swamp
6592 Balsam Fir - Oatgrass Swamp
6593 Spruce - Southern Mountain Cranberry Swamp
6594 Quaking Aspen Swamp
6595 Meadowsweet Swamp
6596 Blueberry - Bracken Fern Swamp
6597 Rough Sedge Seep
6598 Barbara's Buttons Ice Meadow
6620 Hemlock Floodplain Forest
6623 Big Bluestem - Riverbank Goldenrod Prairie
6624 Virginia Pine Riverscour Woodland
6923 Eastern Hemlock - Chestnut Oak - Sweet Birch Forest
7056 Pitch Pine - Tussock Sedge Swamp
7062 Hazel Alder Swamp
7119 Virginia Pine - (Pitch Pine, Shortleaf Pine) - (Chestnut Oak) / Hillside Blueberry Forest
7131 Red Spruce / Southern Mountain Cranberry / Mountain Woodfern Forest
7267 Chestnut Oak - (Red Oak) - Hickory / Sourwood - Flowering Dogwood Forest
7268 Chestnut Oak - Shagbark Hickory - Red Oak / Sugar Maple Forest
7300 Red Oak / (Flame Azalea) / (Hay-scented Fern, New York Fern) Forest
7334 Forested Marl Swamp

7399 Pin Oak - Black Ash Swamp (Meadow River)
7441 Hemlock - Black Ash Swamp
7543 Sweet Birch - Tulip Poplar - Red Maple / Rhododendron Forest
7696 Arrow Arum - Lizardtail Slough
7771 Nodding Sedge - Prickly Bog Sedge Fen
7853 Red Maple - White Oak Swamp
7856 Cranberry - Beakrush Peatland
7861 Yellow Birch - Hemlock / Rhododendron Northern Hardwood Forest
8407 Hemlock - (American Beech, Basswood) / Umbrella Magnolia Forest
8412 Sugar Maple - Black Maple - Basswood / Pawpaw / Twinleaf - Blue Cohosh Forest
8449 Virginia Pine - Redcedar Bedrock Terrace Woodland
8501 Red Spruce / Yellow Birch / Three-lobed Bazzania Forest
8504 Yellow Birch / American Mountainash - Mountain Maple / Appalachian Rockcap Fern Forest
8506 Red Oak - (White Oak) / Mountain Holly / Hay-scented Fern - Whorled Yellow Loosestrife Forest
8514 Red Oak - Chestnut Oak - Red Hickory / (Redbud) / Wreath Goldenrod Forest
8515 White Oak - Chestnut Oak - Pignut Hickory / Flowering Dogwood / Hillside Blueberry Forest
8516 Chestnut Oak - Red Oak - Red Hickory / Pennsylvania Sedge - (Reedgrass) Forest
8517 Red Oak - Sugar Maple / Hophornbeam / Cutleaf Toothwort Forest
8518 Red Oak - (Shagbark Hickory, Red Hickory) - White Ash / Black Snakeroot - Shawnee Salad Forest
8523 Chestnut Oak - Red Oak / Hillside Blueberry - (Pink Azalea) Forest
8524 Chestnut Oak / Catawba Rhododendron - Mountain Laurel Forest
8525 Virginia Pine - Chestnut Oak / Bear Oak / (Green's Hawkweed, Birdsfoot Violet) Woodland
8534 Star Sedge Fen
8539 White Pine - White Oak - Chestnut Oak / Deerberry Forest
8540 Chestnut Oak - Virginia Pine - (Table Mountain Pine) / Little Bluestem - Witchgrass Woodland

B. Ecological Systems of West Virginia

The Ecological Systems known to be in West Virginia are listed below, followed by summary descriptions. More information on each of these systems is available on the NatureServe Explorer website.

Wetland and Riparian Systems

- High Allegheny Wetlands
- Central Appalachian River Floodplain
- Central Appalachian Stream and Riparian
- South-Central Interior Large Floodplain
- South-Central Interior Small Stream and Riparian
- Central Interior Highlands and Appalachian Sinkhole and Depression Pond
- Cumberland Riverscour

Upland Systems

- Allegheny-Cumberland Dry Oak Forest and Woodland
- Appalachian (Hemlock)-Northern Hardwood Forest
- Appalachian Shale Barrens
- Central and Southern Appalachian Montane Oak Forest
- Central and Southern Appalachian Spruce-Fir Forest
- Central Appalachian Alkaline Glade and Woodland
- Central Appalachian Dry Oak-Pine Forest
- Central Appalachian Pine-Oak Rocky Woodland
- Northeastern Interior Dry-Mesic Oak Forest
- Northern Appalachian-Acadian Rocky Heath Outcrop
- South-Central Interior Mesophytic Forest
- Southern and Central Appalachian Cove Forest
- Southern Appalachian Grass and Shrub Bald
- Southern Appalachian Oak Forest
- Southern Ridge and Valley / Cumberland Dry Calcareous Forest

Cliff and Talus Systems

- Cumberland Acidic Cliff and Rockhouse
- North-Central Appalachian Acidic Cliff and Talus
- North-Central Appalachian Circumneutral Cliff and Talus

Wetland and Riparian Systems

High Allegheny Wetlands

Quick tip: >2400' elevation in flat-lying headwater basin

This system occurs along the high plateau of the Allegheny Mountains, immediately west of the Allegheny Front at elevations between 730 and 1430 m. Wetlands in this system are drained by low-gradient, meandering, intermittent to small headwater streams. Drainage is impounded in high, flat-lying basins by natural dams or "knickpoints" of resistant sandstone. In addition to poor moisture drainage, cold air drains from the surrounding uplands to pool in the flat basins, which function as frost pockets. Rainfall is plentiful, averaging about 1300 mm/year. Communities in this system may have substrates of shallow to deep peat or, less commonly, mineral soil. Soils are acidic to circumneutral. These high Allegheny wetlands form complex mosaics ranging in size from a few hectares to 6000

hectares. Forested swamps occupy the less disturbed margins or slightly higher "islands." Ombrotrophic bogs are rare but occur in undisturbed portions of a few of the larger wetlands. The more central, flood- or beaver-influenced portions contain shrub swamps, sedge fens, wet meadows, and open marshes. Forested swamps are dominated by Picea rubens, with varying cover by Acer rubrum, Tsuga canadensis, and Betula alleghaniensis var. alleghaniensis. Where limestone or calcareous shale influences seepage water, Abies balsamea and Fraxinus nigra are typical canopy dominants. Common shrub species are Viburnum nudum var. cassinoides, Rhododendron maximum, Vaccinium myrtilloides, Alnus incana ssp. rugosa, Hypericum densiflorum, Ilex verticillata, and Photinia melanocarpa. Herbaceous species frequently include Rubus hispidus, Solidago uliginosa, Juncus effusus, Eriophorum virginicum, Osmunda cinnamomea var. cinnamomea, Polygonum sagittatum, Carex folliculata, Carex gynandra, Leersia oryzoides, Galium tinctorium, Solidago rugosa, Symplocarpus foetidus, Lycopus uniflorus var. uniflorus, Scirpus cyperinus, Carex scoparia var. scoparia, and Carex trisperma var. trisperma. Sphagnum spp. and Polytrichum spp. dominate the bryophyte layer. This system is maintained by a spatially complex mix of seepage, low-energy flooding, beaver activity, and rainfall.

Central Appalachian River Floodplain

Quick tip: Potomac watershed, 1:24,000 polygon

This system encompasses floodplains of medium to large rivers in Atlantic drainages from southern New England to Virginia. This system can include a complex of wetland and upland vegetation on deep alluvial deposits and scoured vegetation on depositional bars and on bedrock where rivers cut through resistant geology. This complex includes floodplain forests in which Acer saccharinum, Populus deltoides, and Platanus occidentalis are characteristic, as well as herbaceous sloughs, shrub wetlands, riverside prairies and woodlands. Most areas are underwater each spring; microtopography determines how long the various habitats are inundated. Depositional and erosional features may both be present depending on the particular floodplain.

Central Appalachian Stream and Riparian

Quick tip: Potomac watershed, 1:24,000 line

This riparian system ranges from southern New England to Virginia and West Virginia and occurs over a wide range of elevations. It develops on floodplains and shores along river channels that lack a broad flat floodplain due to steeper sideslopes, higher gradient, or both. It may include communities influenced by flooding, erosion, or groundwater seepage. The vegetation is often a mosaic of forest, woodland, shrubland, and herbaceous communities. Common trees include Betula nigra, Platanus occidentalis, and Acer negundo. Open, flood-scoured rivershore prairies feature Panicum virgatum and Andropogon gerardii, and Carex torta is typical of wetter areas near the channel.

South-Central Interior Large Floodplain

Quick tip: Ohio watershed, 1:24,000 polygon

This floodplain system is found in the Interior Highlands as far west as eastern Oklahoma, as well as throughout the Interior Low Plateau, Cumberlands, Southern Ridge and Valley, and Western Allegheny Plateau, and lower elevations of the Southern Blue Ridge. Examples occur along large rivers or streams where topography and alluvial processes have resulted in a well-developed floodplain. A single occurrence may extend from river's edge across the outermost extent of the floodplain or to where it meets a wet meadow or upland system. Many examples of this system will contain well-drained levees, terraces and stabilized bars, and some will include herbaceous sloughs and shrub wetlands resulting, in part, from beaver activity. A variety of soil types may be found within the floodplain from very well-drained sandy substrates to very dense clays. It is this variety of substrates in combination with different flooding regimes that creates the mix of vegetation. Most areas, except for the montane alluvial forests,

are inundated at some point each spring; microtopography determines how long the various habitats are inundated. Although vegetation is quite variable in this broadly defined system, examples may include Acer saccharinum, Platanus occidentalis, Liquidambar styraciflua, and Quercus spp. Understory species are mixed, but include shrubs, such as Cephalanthus occidentalis and Arundinaria gigantea ssp. gigantea, and sedges (Carex spp.). This system likely floods at least once annually and can be altered by occasional severe floods. Impoundments and conversion to agriculture can also impact this system.

South-Central Interior Small Stream and Riparian

Quick tip: Ohio watershed, 1:24,000 line

This system is found throughout the Interior Low Plateau, Southern Ridge and Valley, Western Allegheny Plateau, lower elevations of the Southern Blue Ridge, and parts of the Cumberlands. Examples occur along small streams and floodplains with low to moderately high gradients. There may be little to moderate floodplain development. Flooding and scouring both influence this system, and the nature of the landscape prevents the kind of floodplain development found on larger rivers. This system may contain cobble bars with adjacent wooded vegetation and rarely have any marsh development, except through occasional beaver impoundments. The vegetation is a mosaic of forests, woodlands, shrublands, and herbaceous communities. Canopy cover can vary within examples of this system, but typical tree species may include Platanus occidentalis, Acer rubrum var. trilobum, Betula nigra, Liquidambar styraciflua, and Quercus spp. Shrubs and herbaceous layers can vary in richness and cover. Some characteristic shrubs may include Hypericum densiflorum, Salix spp., and Alnus spp. Small seeps dominated by sedges (Carex spp.), ferns (Osmunda spp.), and other herbaceous species can often be found within this system, especially at the headwaters and terraces of streams.

Central Interior Highlands and Appalachian Sinkhole and Depression Pond

Quick tip: Isolated sinkhole wetlands, only a few acres in all of WV

This system of ponds and wetlands is found in the Interior Highlands of the Ozark, Ouachita, and Interior Low Plateau regions, and ranges north from the southern and central Appalachians to the northern Piedmont regions. Stands occur in basins of sinkholes or other isolated depressions on uplands. Soils are very poorly drained, and surface water may be present for extended periods of time, rarely becoming dry. Water depth may vary greatly on a seasonal basis and may be a meter deep or more in the winter. Some examples become dry in the summer. Soils may be deep (100 cm or more), consisting of peat or muck, with parent material of peat, muck or alluvium. Ponds vary from open water to herb-, shrub-, or tree-dominated. Tree-dominated examples typically contain Quercus species, Platanus occidentalis, Fraxinus pennsylvanica, Acer saccharinum, or Nyssa species, or a combination of these. In addition, Liquidambar styraciflua may be present in southern examples. Cephalanthus occidentalis is a typical shrub component. The herbaceous layer is widely variable depending on geography.

Cumberland Riverscour

Quick tip: restricted to New River scour zone

Examples of this riverscour-influenced system may occur on high-gradient and very high-gradient streams in the gorges of the Cumberland Plateau, the Cumberland Mountains, and the more rugged parts of the Ridge and Valley in Kentucky, Tennessee, and Alabama, and possibly in Georgia. The succession of woody plants (particularly trees) is retarded by the force of "flashy," high-velocity water traveling down the stream channels. This system may occur on flood-scoured acidic or calcareous bedrock, cobble, pebble, or sandbar substrates of sandstone, limestone, dolomite, and possibly other sedimentary and weakly metamorphosed geologies. The most distinctive parts of the system are dominated by shrubs, perennial grasses, and forbs. In some areas, a riparian woodland composed of Betula nigra and Platanus occidentalis may be a component association. Some common shrubs include

Alnus serrulata, Betula nigra, Cephalanthus occidentalis, Cornus amomum, Fothergilla major, Itea virginica, Salix caroliniana, Rhododendron arborescens, Toxicodendron radicans, and Juniperus virginiana var. virginiana. Some grasses (typical of prairies) include Andropogon gerardii, Sorghastrum nutans, Schizachyrium scoparium, Chasmanthium latifolium, Tripsacum dactyloides, and/or Panicum virgatum. Forbs are diverse and variable from occurrence to occurrence. This system is affected by flood-scouring in some areas and deposition in others. There is typically a gradient from dry, nutrient-poor conditions upslope to moist and relatively enriched conditions downslope. A variety of these conditions may exist at any one site. Some areas are prone to severe drought periods that may stress or kill some (particularly woody) vegetation. Flood-scouring is a powerful and ecologically important abrasive force along the riverbanks where this system is found.

Upland Systems

Allegheny-Cumberland Dry Oak Forest and Woodland

This system encompasses dry hardwood forests on predominately acidic substrates in the Allegheny and Cumberland plateaus, and ridges in the southern Ridge and Valley. Its range is more or less consistent with the "Mixed Mesophytic Forest Region" of Braun (1950) and Greller (1988), although it is not a mesic forest type. These forests are typically dominated by Quercus alba, Quercus falcata, Quercus prinus, Quercus coccinea, with lesser amounts of Acer rubrum, Carya glabra, and Carya alba. Small inclusions of Pinus echinata and/or Pinus virginiana may occur, particularly adjacent to escarpments or following fire. In addition, Pinus strobus may be prominent in some stands in the absence of fire. It occurs in a variety of situations, including on nutrient-poor or acidic soils. Sprouts of Castanea dentata can often be found where it was formerly a common tree.

Appalachian (Hemlock)-Northern Hardwood Forest

This forested system of the northeastern U.S. ranges from central New England west to Lake Erie and south to the higher elevations of Virginia and West Virginia. It is one of the matrix forest types in the northern part of the Central Interior and Appalachian Division. Northern hardwoods such as Acer saccharum, Betula alleghaniensis, and Fagus grandifolia are characteristic, either forming a deciduous canopy or mixed with Tsuga canadensis (or in some cases Pinus strobus). Other common and sometimes dominant trees include Quercus spp. (most commonly Quercus rubra), Liriodendron tulipifera, Prunus serotina, and Betula lenta. It is of more limited extent and more ecologically constrained in the southern part of its range, in northern parts of Virginia and West Virginia.

Appalachian Shale Barrens

This system encompasses the distinctive shale barrens of the central and southern Appalachians at low to mid elevations. The exposure and lack of soil create extreme conditions for plant growth. Vegetation is mostly classified as woodland, overall, but may include large open areas of sparse vegetation. Dominant trees are primarily Quercus prinus and Pinus virginiana, although on higher-pH substrates the common trees include Juniperus virginiana and Fraxinus americana. Shale barren endemics are diagnostic in the herb layer. The substrate includes areas of solid rock as well as unstable areas of shale scree, usually steeply sloped. The fully exposed areas are extremely dry. These barrens are high in endemic species.

Central and Southern Appalachian Montane Oak Forest

This generally oak-dominated system is found in the central and southern Appalachian Mountains. These high-elevation deciduous forests occur on exposed sites, including ridgecrests and south- to west-facing slopes, mostly between 915 and 1372 m (3000-4500 feet) elevation, less commonly ranging up to 1680 m (5500 feet). In most associations attributed to this system, the soils are thin, weathered,

nutrient-poor, low in organic matter, and acidic. The forests are dominated by Quercus spp. (most commonly Quercus rubra and Quercus alba), with the individuals often stunted or wind-flagged. Castanea dentata sprouts are also common, but the importance of chestnut in these forests has been dramatically altered by chestnut blight. Ilex montana and Rhododendron prinophyllum are characteristic shrubs.

Central and Southern Appalachian Spruce-Fir Forest

This system consists of forests in the highest elevation zone of the Blue Ridge and parts of the Central Appalachians, generally dominated by Picea rubens, Abies fraseri, or by a mixture of spruce and fir. Abies fraseri is the constituent fir from Mount Rogers in Virginia southward. Examples occur above 1676 m (5500 feet) in the Southern Blue Ridge, but as low as 975 m (3200 feet) at the northern range in West Virginia, and may range up to the highest peaks. Elevation and orographic effects make the climate cool and wet, with heavy moisture input from fog as well as high rainfall. Strong winds, extreme cold, rime ice, and other extreme weather are periodically important.

Central Appalachian Alkaline Glade and Woodland

This system occurs at low to moderate elevations from the Central Appalachians (with a few northward incursions into southernmost New York and New England possible) down into the Ridge and Valley. It consists of woodlands and open glades on thin soils over limestone, dolostone or similar calcareous rock. In some cases, the woodlands grade into closed-canopy forests. Juniperus virginiana is a common tree, filling in in the absence of fire, and Quercus muehlenbergii is indicative of the limestone substrate. Rhus aromatica, Cercis canadensis, and Ostrya virginiana may occur. Prairie grasses are the dominant herbs (Andropogon gerardii, Schizachyrium scoparium, Bouteloua spp.); forb richness is often high. Characteristic forbs include Asclepias verticillata, Monarda fistulosa, Salvia lyrata, Symphyotrichum oblongifolium, and Brickellia eupatorioides (Braun 1950). Fire is sometimes an important natural disturbance factor, but open physiognomies may also be maintained by drought and landslides.

Central Appalachian Dry Oak-Pine Forest

These oak and oak-pine forests cover large areas in the low- to mid-elevation Central Appalachians and middle Piedmont. The topography and landscape position range from rolling hills to steep slopes, with occasional occurrences on more level, ancient alluvial fans. In the highly dissected fall zone of Maryland and the District of Columbia, where the Piedmont and Coastal Plain meet, it is also found on dry knolls capped with Pleistocene- and Tertiary-aged fluvial cobble and gravel terrace deposits. Soils are typically coarse and infertile; they may be deep (on glacial deposits in the northern and terrace deposits in the southern parts of the system's range), or more commonly shallow, on rocky slopes of acidic rock (shale, sandstone, other acidic igneous or metamorphic rock). The well-drained soils and exposure create dry conditions. The forest is mostly closed-canopy but can include patches of more open woodlands. It is dominated by a variable mixture of dry-site oak and pine species, most typically Quercus prinus, Pinus virginiana, and Pinus strobus, but sometimes Quercus alba and/or Quercus coccinea. The system may include areas of oak forest, pine forest (usually small), and mixed oak-pine forest. Heath shrubs such as Vaccinium pallidum, Gaylussacia baccata, and Kalmia latifolia are common in the understory and often form a dense layer. Embedded submesic ravines and concave landforms support slightly more diverse forests characterized by mixtures of oaks, several hickories, Cornus florida, and sometimes Liriodendron tulipifera. Small hillslope pockets with impeded drainage may support small isolated wetlands with Acer rubrum and Nyssa sylvatica characteristic. Disturbance agents include fire, windthrow, and ice damage. Increased site disturbance generally leads to secondary forest vegetation with a greater proportion of Pinus virginiana and weedy hardwoods such as Acer rubrum.

Central Appalachian Pine-Oak Rocky Woodland

This system encompasses open or patchily wooded hilltops and outcrops or rocky slopes in the Central Appalachians, High Allegheny Plateau, and Lower New England / Northern Piedmont. It occurs mostly at lower elevations, but occasionally up to 1220 m (4000 feet) in West Virginia. The substrate rock is generally granitic or of other acidic lithology, although near the northern limit of its range in New England, examples can also occur on intermediate, base-rich, or mafic bedrock including traprock. The vegetation is patchy, with woodland as well as open portions. Pinus rigida (and within its range Pinus virginiana) is diagnostic and often mixed with xerophytic Quercus spp. and sprouts of Castanea dentata. In New England, some examples lack pine and feature Juniperus virginiana or Ostrya virginiana as important codominants with oak. Some areas have a fairly well-developed heath shrub layer, others a graminoid layer, the latter particularly common under oaks or other deciduous trees. Conditions are dry and for the most part nutrient-poor, and at many, if not most, sites, a history of fire is evident. In the Central Appalachians ecoregion, this system is rarely found on sandy soils rather than rock.

Northeastern Interior Dry-Mesic Oak Forest

These oak-dominated forests are one of the matrix forest systems in the northeastern and north-central U.S. Occurring in dry-mesic settings, they are typically closed-canopy forests, though there may be areas of patchy-canopy woodlands. They cover large expanses at low to mid elevations, where the topography is flat to gently rolling, occasionally steep. Soils are mostly acidic and relatively infertile but not strongly xeric. Local areas of calcareous bedrock, or colluvial pockets, may support forests typical of richer soils. Oak species characteristic of dry-mesic conditions (e.g., Quercus rubra, Quercus alba, Quercus velutina, and Quercus coccinea) and Carya spp. are dominant in mature stands. Quercus prinus may be present but is generally less important than the other oak species. Castanea dentata was a prominent tree before chestnut blight eradicated it as a canopy constituent. Acer rubrum, Betula lenta, and Betula alleghaniensis may be common associates; Acer saccharum is occasional. With a long history of human habitation, many of the forests are early- to mid-successional, where Pinus strobus, Pinus virginiana, or Liriodendron tulipifera may be dominant or codominant. Within these forests, hillslope pockets with impeded drainage may support small isolated wetlands, including non-forested seeps or forested wetlands with Acer rubrum, Quercus bicolor, or Nyssa sylvatica characteristic.

Northern Appalachian-Acadian Rocky Heath Outcrop

This outcrop ecological system ranges across New England and adjacent Canada, and southward at higher elevations to northern Pennsylvania, on ridges or summits of resistant acidic bedrock. Throughout most of its range, it occurs at low to mid elevations (600-1000 m, lower on the coast of eastern Maine and the Maritimes). The vegetation is patchy, often a mosaic of woodlands and open glades. Quercus rubra and various conifers, including Pinus strobus and Picea rubens, or (especially near the coast) Picea mariana, are characteristic trees. Low heath shrubs, including Kalmia angustifolia, Vaccinium angustifolium, Gaylussacia baccata, and Photinia melanocarpa, are typically present. Exposure and occasional fire are the major factors in keeping the vegetation relatively open.

South-Central Interior Mesophytic Forest

These high-diversity, predominately deciduous forests occur on deep and enriched soils (in some cases due to, or enhanced by, the presence of limestone or related base-rich geology), in non-montane settings and usually in somewhat protected landscape positions such as coves or lower slopes. The core distribution of this system lies in the Cumberland and Allegheny plateaus, extending into the adjacent southern Ridge and Valley and portions of the Interior Low Plateau where it is located entirely south of the glacial boundary. Dominant species include Acer saccharum, Fagus grandifolia, Liriodendron tulipifera, Tilia americana, Quercus rubra, Magnolia acuminata, and Juglans nigra. Tsuga canadensis may

be a component of some stands. Trees may grow very large in undisturbed areas. The herb layer is very rich, often with abundant spring ephemerals. Many examples may be bisected by small streams.

Southern and Central Appalachian Cove Forest

This system consists of mesophytic hardwood or hemlock-hardwood forests of sheltered topographic positions in the Southern Blue Ridge and central Appalachian Mountains. Examples are generally found on concave slopes that promote moist conditions. The system includes a mosaic of acidic and "rich" coves that may be distinguished by individual plant communities based on perceived differences in soil fertility and species richness (rich examples have higher diversity and density in the herbaceous layer). Both acidic and rich coves may occur in the same site, with the acidic coves potentially creeping out of the draw-up to at least midslope on well-protected north-facing slopes. Characteristic species in the canopy include Aesculus flava, Acer saccharum, Fraxinus americana, Tilia americana, Liriodendron tulipifera, Halesia tetraptera, Tsuga canadensis, Fagus grandifolia, Magnolia acuminata, and Magnolia fraseri.

Southern Appalachian Grass and Shrub Bald

This ecological system consists of dense herbaceous and shrubland communities in the highest elevational zone of the Southern Appalachians, generally above 1524 m (5000 feet) but occasionally to 1220 m (4000 feet), and at slightly lower elevations at its northern limit in Virginia and West Virginia, and in the Cumberland Mountains along the Virginia-Kentucky border. Vegetation consists either of dense shrub-dominated areas (heath balds) or dense herbaceous cover dominated by grasses or sedges (grassy balds). Heath balds are most often dominated by Rhododendron catawbiense, but substantial examples are also dominated by Rhododendron carolinianum, Kalmia latifolia, or a mixture of shrubs. One large example, dominated by Alnus viridis ssp. crispa, is generally also regarded as related to the heath balds. Grassy balds are characteristically dominated by Danthonia compressa or Carex spp. Large areas have also become dominated by Rubus allegheniensis and by mixtures of native grasses with exotic pasture grasses. Most examples of grassy balds have some invading shrubs and trees, often dense enough to threaten the herbaceous vegetation. Heath balds may contain sparse stunted trees barely larger than the shrub canopy. The combination of high-elevation, non-wetland sites and dense herbaceous or shrub vegetation without appreciable rock outcrop conceptually distinguishes this system from all others in the Southern Appalachians. However, the widespread areas of degraded spruce-fir with grass and shrub cover and the invasion of grassy balds by trees blur the distinction somewhat.

Southern Appalachian Oak Forest

This system consists of predominantly dry-mesic (to dry) forests occurring on open and exposed topography at lower to mid elevations in the Southern Blue Ridge and Southern Ridge and Valley ecoregions. This is the upland forest that characterizes much of the lower elevations of these areas. Substrates of stands included in this system can range from acidic to circumneutral or basic, and the vegetation varies accordingly. Bedrock may be of any type. Soils are usually deep residual soils but are often rocky. Some shallow soils and colluvium may be present locally within the group, but shallow soils tend to produce environments that are more extreme and have a larger component of various pine species. Typically, the vegetation consists of forests dominated by oaks, especially Quercus prinus, Quercus alba, Quercus rubra, Quercus velutina, and Quercus coccinea, with varying amounts of Carya spp., Nyssa sylvatica, Acer rubrum, and other species such as Pinus strobus and Fraxinus americana. Historically, Castanea dentata was a dominant or codominant in many of these communities until its virtual elimination by the chestnut blight fungus (Cryphonectria parasitica] during the early 1900s. Some areas (usually on drier sites) now have dense evergreen ericaceous shrub layers of Kalmia latifolia, with Rhododendron spp. on more mesic sites. Some other areas have deciduous ericad layers, sometimes

consisting of Vaccinium spp. or Gaylussacia spp. This system concept also includes many successional communities that have been impacted by logging or agriculture, such as types dominated by Liriodendron tulipifera, Pinus spp., and Robinia pseudoacacia. This system is naturally dominated by stable, uneven-aged forests, with canopy dynamics dominated by gap-phase regeneration. Most oaks are long-lived with typical age of mortality ranging from 200 to 400 years. Scarlet and black oaks are shorter lived with typical ages being approximately 50 to 100 years, while white oaks can live as long as 600 years.

Southern Ridge and Valley / Cumberland Dry Calcareous Forest

This system includes dry to dry-mesic calcareous forests of the Southern Ridge and Valley region of Alabama and Georgia, extending north into Tennessee, Kentucky, Virginia and adjacent West Virginia. It includes calcareous forests on lower escarpments of the Cumberland Plateau and other related areas. Examples occur on a variety of different landscape positions and occur on generally deeper soils than glade systems of the same regions. This system is distinguished from those farther north in the Ridge and Valley because of its southerly location in the region, an area which is transitional to the "Oak-Pine-Hickory" region. High-quality and historic examples are typically dominated by combinations of Quercus species and Carya species, sometimes with Pinus species and/or Juniperus virginiana as a significant component in certain landscape positions and with particular successional histories. These forests occur in a variety of habitats and are the matrix vegetation type that covers most of the landscape under natural conditions. Examples can occur on a variety of topographic and landscape positions including ridgetops and upper and midslopes. Fire frequency and intensity are factors determining the relative mixture of deciduous hardwood versus evergreen trees in this system. Much of this system is currently composed of successional forests that have arisen after repeated cutting, clearing, and cultivation of the original forests. The range of this system is primarily composed of circumneutral substrates, which exert an expected influence on the composition of the vegetation.

Cliff and Talus Systems

Cumberland Acidic Cliff and Rockhouse

This sandstone cliff ecological system is found in the Cumberland Plateau and Mountain regions of the southeastern United States. Examples are extremely steep or vertical rock faces exposed along bluffs often associated with rivers. The aspect is variable but best developed on south- and west-facing sites. Plants are infrequent due to the lack of crevices capable of accumulating soil, the highly acidic nature of the bedrock, and the frequent weathering and erosion of the substrate. Lichen cover may be extensive in places, especially on the more exposed portions. These cliffs are also prone to harsh climatic conditions; frequent disturbances include drought stress and wind and storm damage. As a result, examples are characterized by sparse herbaceous cover and few, if any, trees. Vegetation consists of scattered individuals of Asplenium montanum, Silene rotundifolia, and other species rooted in crevices and erosion pockets. In some parts of its range, this system is the primary or sole habitat for rare endemic species, such as Minuartia cumberlandensis and Ageratina luciae-brauniae. This system includes a mosaic of cavelike features (often called "rockhouses") and associated sandstone box canyons in the western Appalachian foothills regions of Kentucky, Alabama, West Virginia, and possibly southeastern Ohio. Where present, the rockhouses are a prominent and diagnostic feature of the system.

North-Central Appalachian Acidic Cliff and Talus

This system comprises sparsely vegetated to partially wooded cliffs and talus slopes in the Central Appalachians and adjacent ecoregions, occurring on rocks of acidic lithology and lacking any indicators

of enriched conditions. This cliff system occurs at low to mid elevations from central New England south to Virginia, and up to 1500 m in West Virginia. It consists of vertical or near-vertical cliffs and the talus slopes below, formed on hills of granitic, sandstone, or otherwise acidic bedrock. In some cases, especially in periglacial areas, this system may take the form of upper-slope boulderfields without adjacent cliffs, where talus forms from freeze/thaw action cracking the bedrock. Most of the substrate is dry and exposed, but small (occasionally large) areas of seepage are often present. Vegetation in seepage areas tends to be more well-developed and floristically different from the surrounding dry cliffs. The vegetation is patchy and often sparse, punctuated with patches of small trees that may form woodlands in places. Juniperus virginiana is a characteristic tree species, Toxicodendron radicans a characteristic woody vine, and Polypodium virginianum a characteristic fern. Within its range, Pinus virginiana is often present.

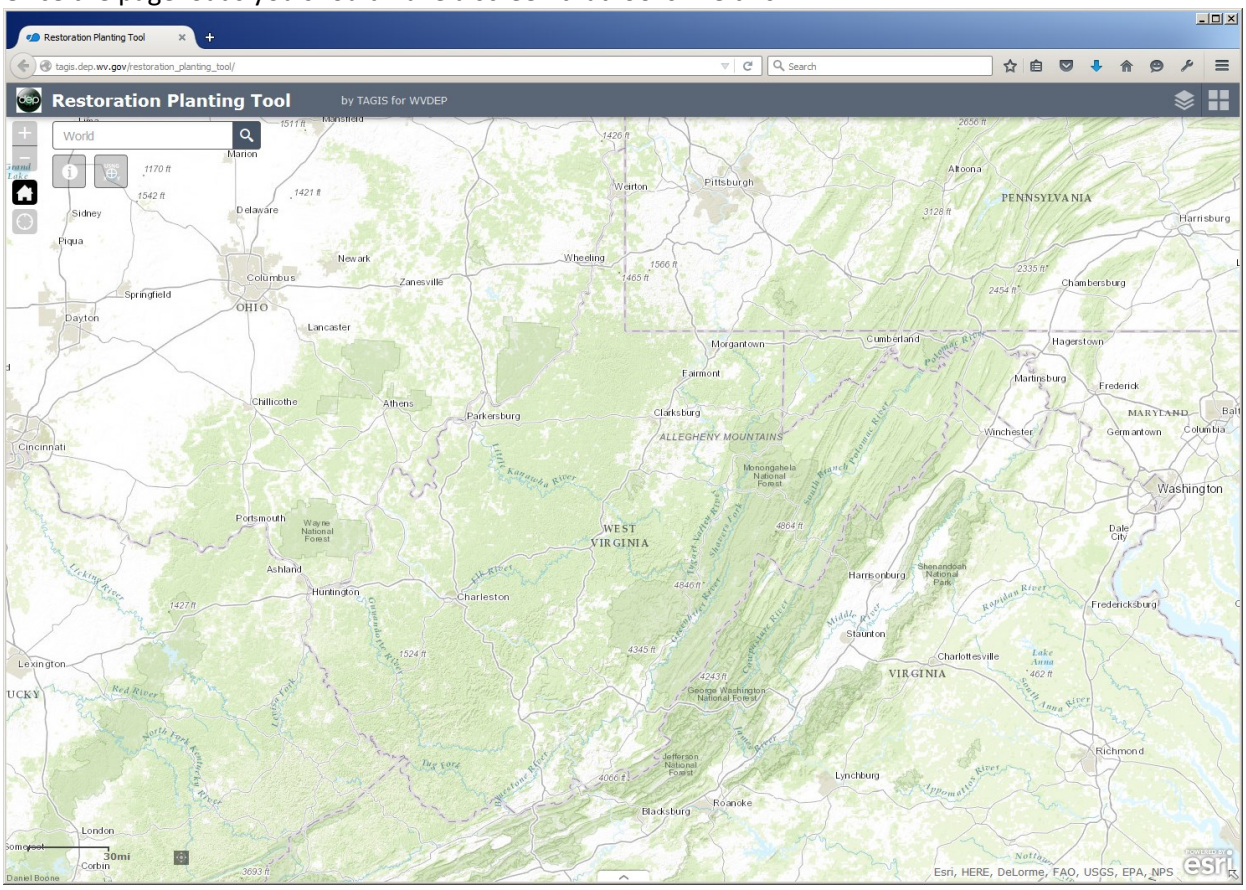
North-Central Appalachian Circumneutral Cliff and Talus

This cliff system occurs at low to mid elevations from central New England south to Virginia and West Virginia. It consists of vertical or near-vertical cliffs and steep talus slopes where weathering and/or bedrock lithology produce circumneutral to calcareous pH and enriched nutrient availability. Substrates include limestone, dolomite and other rocks. The vegetation varies from sparse to patches of small trees, in places forming woodland or even forest vegetation. Fraxinus spp., Tilia americana, and Staphylea trifolia are woody indicators of the enriched setting. Thuja occidentalis may occasionally be present but is more characteristic of the related Laurentian-Acadian system to the north. The herb layer is typically not extensive but includes at least some species that are indicators of enriched conditions, e.g., Impatiens pallida, Pellaea atropurpurea, Asplenium platyneuron, or Woodsia obtusa.

C. Using the Interactive Map for the Restoration Planting Tool

Created by Chris Kyle, WVDEP, 4/5/2016

Open up your web browser and go to:
http://tagis.dep.wv.gov/restoration_planting_tool
Once the page loads you should have a screen that looks like this:



This is the home page for the application that has extents set to show the whole state of West Virginia.

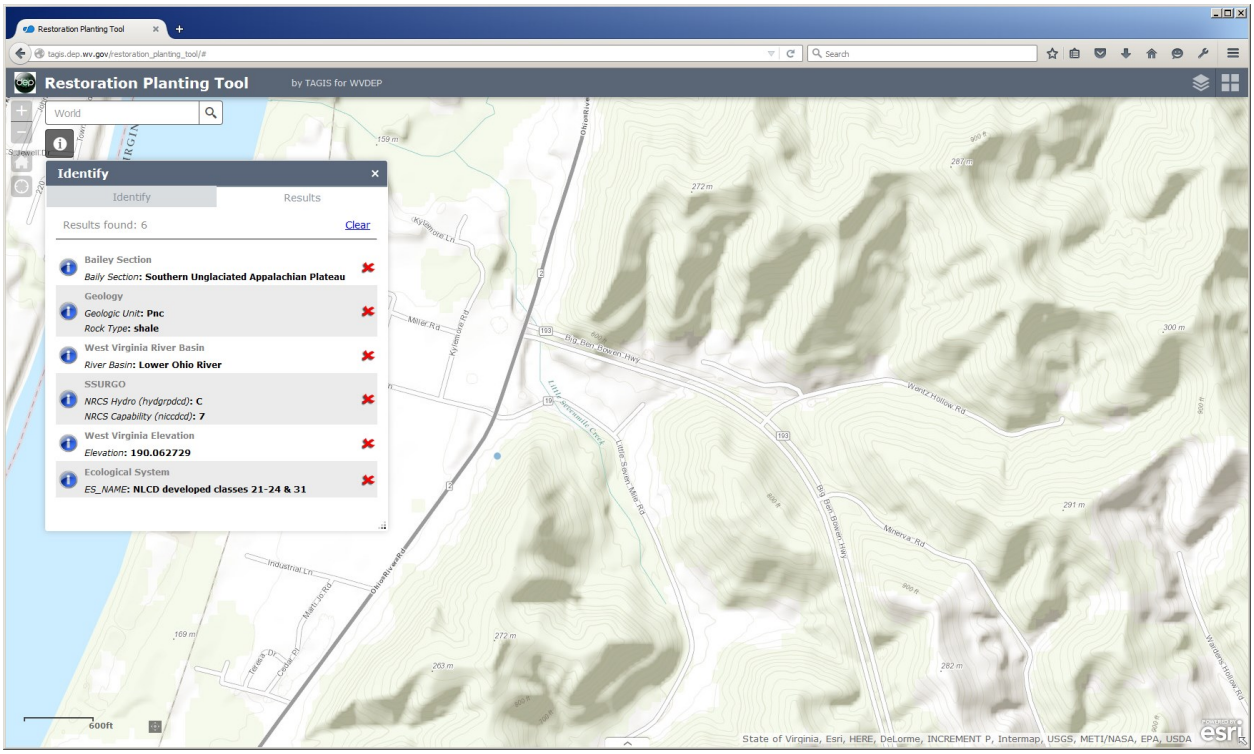
Tools for the Application

Icon	Name	Description
	Identify Button	Tool used to select your location to view the GIS data for that point.
	Location Button	Tool used to insert coordinates to find your location.
	Zoom Slider	This is used to zoom in and out of the map.
	Home Button	This returns you to the extent of the default map. (State of West Virginia)
	My Location	This zooms and shows your current location.
	Layer List	List of Data layers used in the application.
	Basemap Gallery	Changes your basemap for the application. (ie. Aerial Photography)
	Coordinate	Tool used to show you the coordinates of a location that you click on the map. (UTM)
	Point Button	This tool is located under the Identify Button. Once you click the Identify Button the Point Button is on by default. If you need to make a new point location you can click on this button to activate the event.

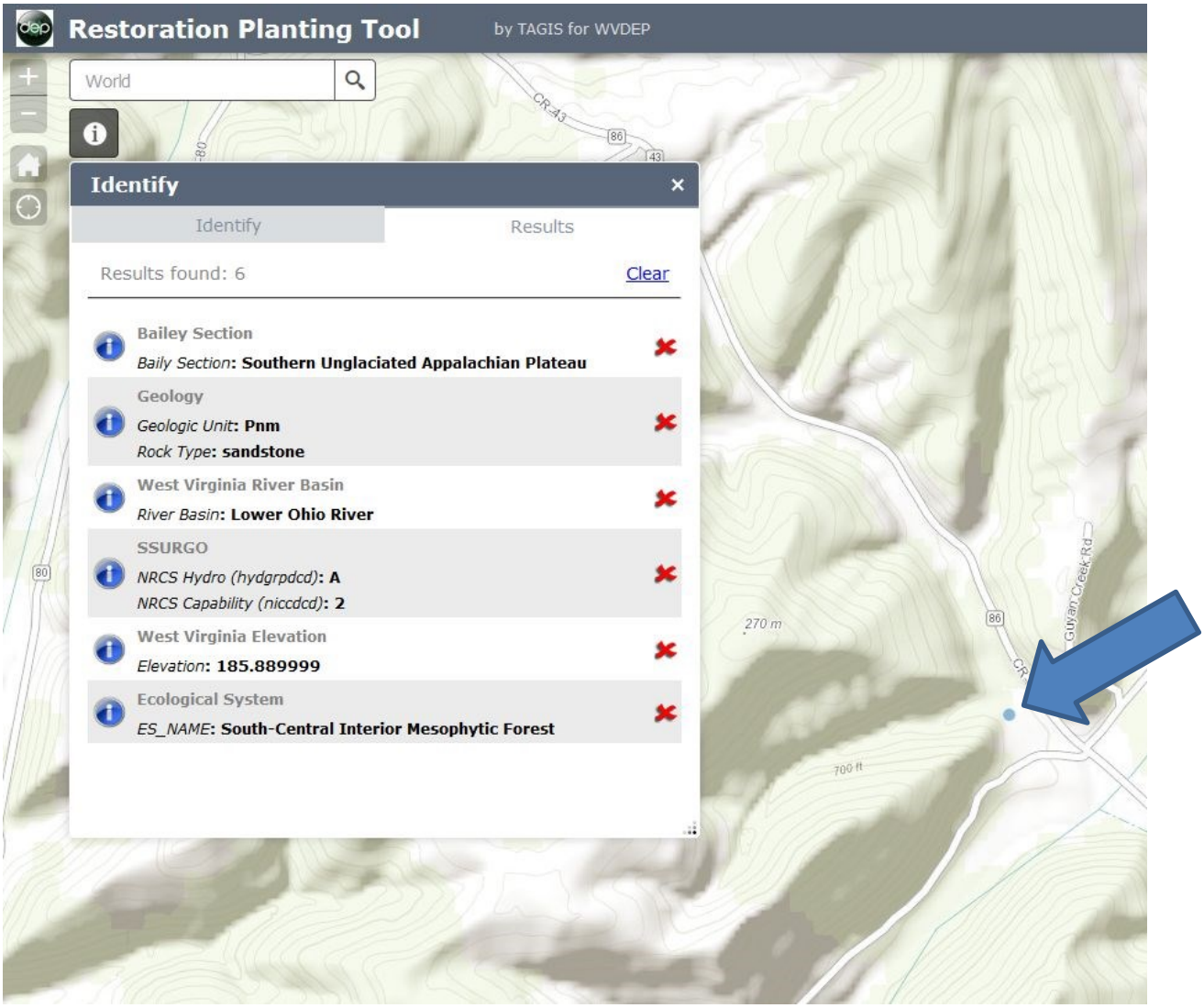
Using the Identify Tool

Once you are ready to start using the application, click on the Identify Button  below the search bar to activate your mouse click event.

Find your location that you are wanting to find the information for and click on the right mouse button:

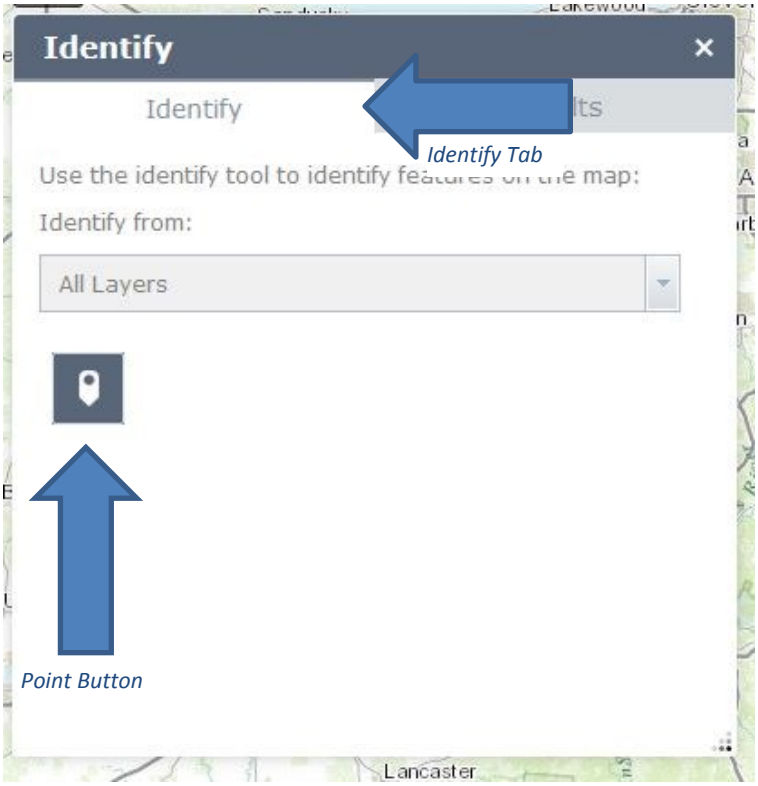


As you can see when you click it creates a blue dot for the location and then displays the Results in a window below the Identify Tool.



If you want to do another selection, you can click the Clear link and it will default back to a blank Results page which will then allow you to perform a new mouse click.

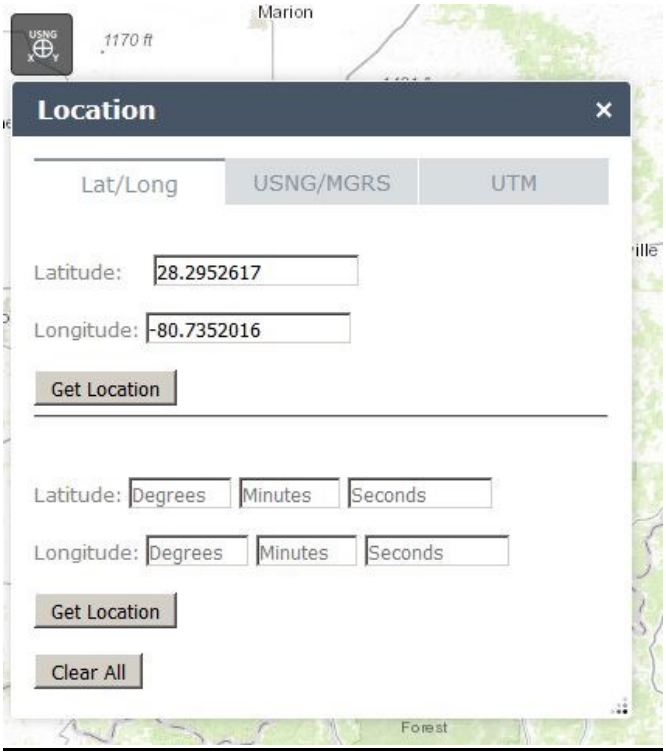
Note: If the new selection doesn't default back to a point selection, you can click on the Identify tab and then click on the point button to activate a new point selection.



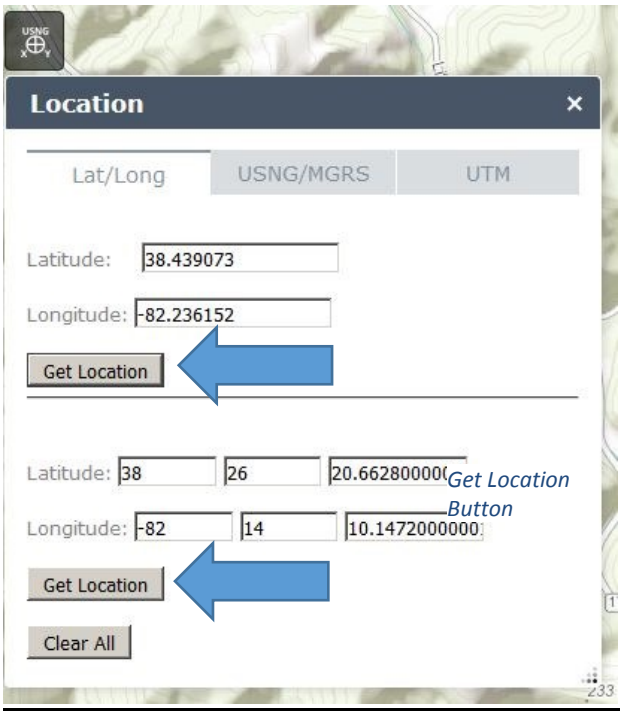
Using the Location Tool

If you are wanting to find your location using some coordinates that you collected with a GPS or mapping application, this tool can help you zoom to that location. Click on the Location Button  below the search bar and next to the Identify Tool to bring up the menu box for the Location Tool.

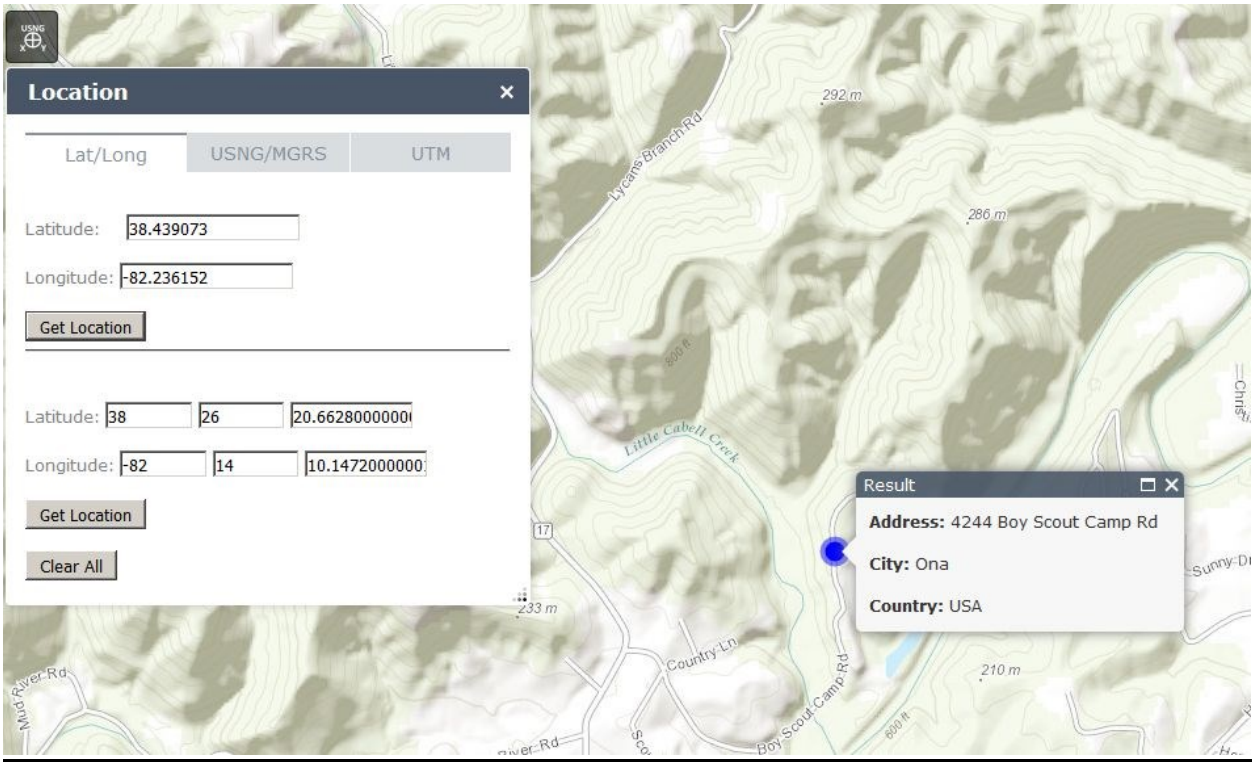
After clicking on the button you should have a menu box that looks like this:



In this menu you can enter in your Latitude and Longitude coordinates in Decimal Degrees or in Degrees Minutes and Seconds. Fill in the appropriate fields to the format in which you have collected them. Once you have your coordinates filled into the field, click the Get Location button.



After you have clicked on the Get Location button your map will zoom you to the location in which you have put in the coordinate's field.



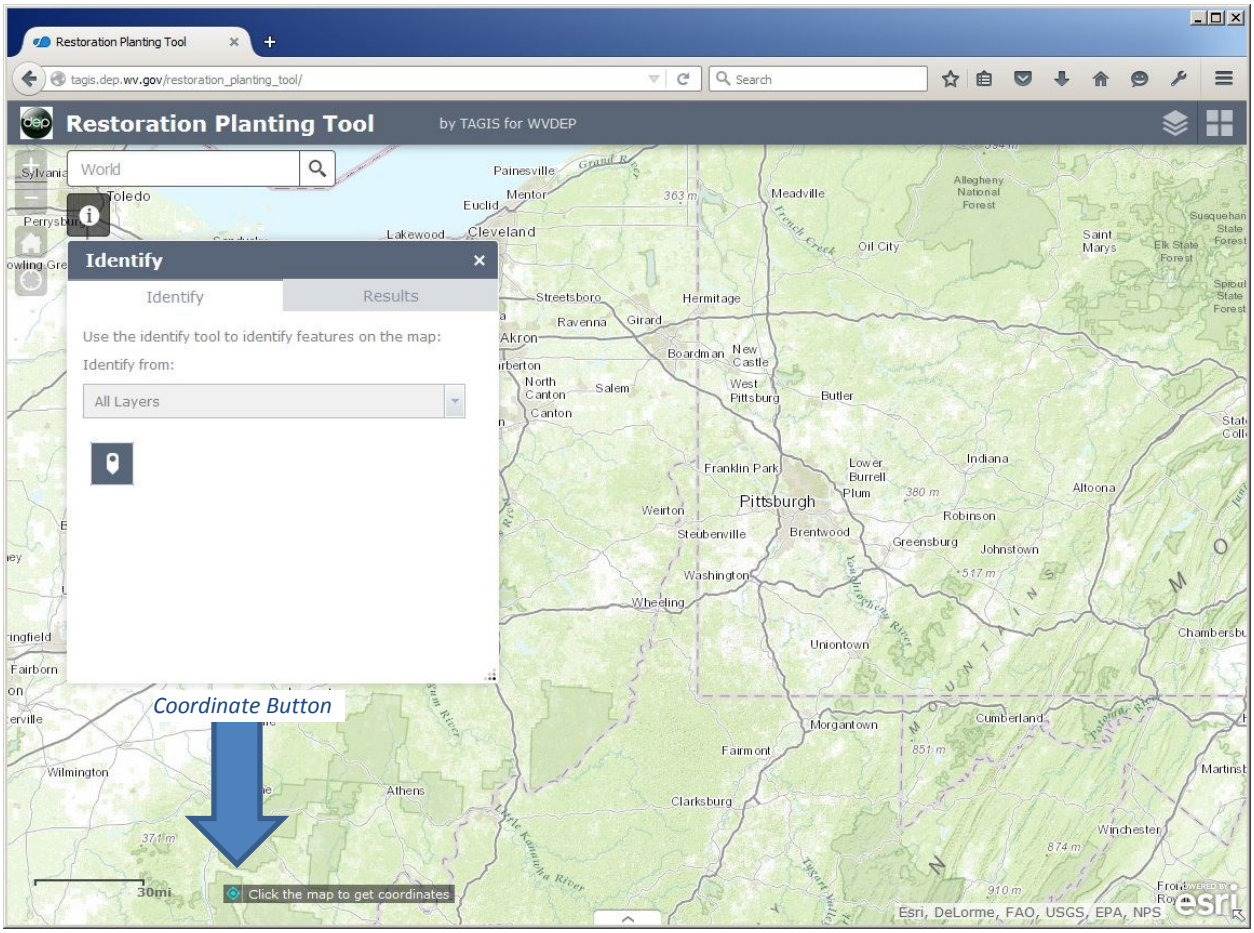
Once the map has zoomed to that location, it will place a circle in that location as well as place a pop-up box with some information.

Note: If you close out the pop-up box it will remove the location circle.

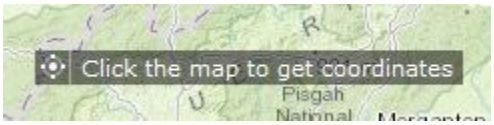
Now you can click on the Identify Button and place your cursor over the location circle to gather the information for your site.

Using the Coordinate Tool

This tool will get you the coordinates for the location of your site. The coordinates are displayed in UTM meters.



Located at the bottom of the screen beside the scale bar is the Coordinate Button. Once you click on it the tool will activate and look like this:



Once you get the button that looks like the picture above you can then click on your site in the state and it will populate in the bar the UTM coordinates.

D. Data Sheet – Quick Reference

Restoration Planting Tool WV-1.0

Note: Have your instructions open as you fill out the data fields below! Be sure to read the definitions, especially for the field-measured variables and for the "Ecological System" from the interactive map.

Site Name: _____ Evaluator:_____ Date:_____

Desired Physiognomy: (leave blank unless you require a specific type) _____

Required fields

UTM X _____ (from **interactive map**, or **field** GPS; whole number)

UTM Y _____ (from **interactive map**, or **field** GPS; whole number)

Bailey Section _____ (from **interactive map**; pick list)

River Basin _____ (from **interactive map**; pick list)

Elevation (m) _____ (from **interactive map**, or field GPS; whole number)

Cowardin System _____ (from **field** inspection, or maps/air photos; pick list)

Landform _____ (from **field** inspection, or maps/air photos; pick list)

Recommended fields

Topo Position _____ (from **field** inspection, or maps/air photos; pick list)

Slope (degrees) _____ (from **field** inspection, or **interactive map**; whole number)

Aspect (Beers) _____ (from **field** inspection, or **interactive map**; 2 decimal places)

Soil Drainage _____ (from **field** inspection; pick list)

Hydro Regime _____ (from **field** inspection; pick list)

NRCS Hydro _____ (from **interactive map**; pick list)

NRCS Capability _____ (from **interactive map**; pick list)

Ecological System _____ (from **interactive map**, or **field**, often left blank; pick list)

Geologic Unit _____ (from **interactive map**; pick list)

Rock Type _____ (from **interactive map**, or **field** inspection; pick list)

Field Soil pH _____ (from **field** inspection; 1 decimal place)

Did you collect a soil sample (top 10 cm of mineral soil from 3 locations on the site)? Yes____ No____

Soil lab analysis results

Organic Matter	_____	Mg (ppm)	_____
pH	_____	Mn (ppm)	_____
Al (ppm)	_____	Na (ppm)	_____
Ca (ppm)	_____	P (ppm)	_____
Cu (ppm)	_____	Soluble Sulfur	_____
Fe (ppm)	_____	TEC	_____
K (ppm)	_____	Zn (ppm)	_____

Planting List Quick Reference

Focus on species with:

- Constancy >25%
- Cover >10%
- FQI 4-8