



Integrated Vegetation Management

IVM Partners

Managing Ecosystems Together!

Baltimore Gas & Electric Company Integrated Vegetation Management Plan Columbia Pilot

The main objective of the BGE vegetation management program is safe and reliable transmission of electricity and natural gas to provide vital energy services to the public. Integrated vegetation management techniques shall be used to balance benefits of control, costs, public health, environmental quality, and regulatory compliance.

Integrated Vegetation Management Plan

Baltimore Gas & Electric (BGE) proposes the implementation of an Integrated Vegetation Management (IVM) pilot program, in cooperation with Citizens for Lake Elkhorn's Environmental Restoration (CLEER), the Columbia Association and Howard County, MD, in which the rights-of-way (ROW) vegetation is first inspected, action thresholds are determined and various control options are considered and implemented to develop compatible vegetative communities. Control options include manual, mechanical, biological, chemical, and cultural techniques. The choice of control option(s) is based on effectiveness, environmental impact, site characteristics, worker and public health and safety concerns, security and economics.

The BGE IVM strategy is to manage vegetation with a minimum of inputs and disturbance to extirpate populations of tall growing, incompatible tree species and select for retention low growing, compatible plant species. This may first involve manual and/or mechanical cutting of trees with subsequent application of herbicides to stop regrowth of the incompatible species. Controlling the incompatible trees allows more growing space for low growing grass, forbs and shrubs and permits more selective and lower disturbance rates as natural competition between plant species, and the activity of wildlife, result in cultural and biological controls. The result is a fairly stable meadow or prairie plant community in the electric transmission wire zone of the ROW corridor, and shrub-scrub habitat along the ROW border zone. The wire zone is defined as the area under the conductors extending 20 feet to the outside of the outermost conductor, and the border zone is the area outside the edge of the wire zone extending to the edge of the ROW.

The wire zone is managed for plant communities that do not exceed 5 feet in height at maturity, to prevent vertical growth into the conductor trigger zone and

to provide clear sight lines and access for inspections, construction, operation and maintenance of energy facilities. The border zone is managed for shrub/scrub plant species with growth height potential exceeding 5 feet but below the maximum mature height that potentially could fall within the wire zone/border zone trigger envelope. The trigger envelope for the Columbia Pilot ROW is 25 feet and 20 feet clearance respectively from the 500 kV and 230kV conductors to vegetation, at maximum engineered sag.

Shrub/scrub habitat may also be managed, where clearances allow, within the wire zone area where steep slopes (50% slope and 10,000 square feet or greater) or sensitive environmental areas (stream valleys or delineated wetlands) exist. Vegetation density shall not preclude easily traversing the area by foot or light all-terrain vehicles. Areas within border zones, slopes and sensitive areas that contain underground energy facilities shall be managed 10 feet either side of the underground conductor or pipe for plant species with mature heights less than 5 feet for underground electric facilities, and for herbaceous plants-only for gas facilities, to allow for access, inspection and maintenance.

Management vs. Maintenance

Past vegetation maintenance practices on the BGE Columbia Pilot ROW involved twice yearly cyclic mowing in accessible areas to provide ready access and meet low growth expectations of the neighboring community. Vegetation in sensitive wetland areas and steep slopes was periodically cut with chainsaws and mowers, the most recent cutting being performed in the spring of 2007. This cutting removed all tall growth that had existed for several years and resulted in complaints from the neighbors and inquiry into alternative ROW maintenance practices.

The need for all tall growth removal by BGE was prompted by the North American Electric Reliability Council Standard (NERC) FAC-003-1, adopted by the Federal Energy Regulatory Commission following the August 14, 2003 blackout of electricity to 50 million people in the United States and Canada. This blackout was triggered by vegetation contact of electric transmission conductors in Ohio, which resulted in the United States - Canadian Blackout Report that called for improved vegetation management of electric transmission corridors.

To meet the NERC Standards and insure that vegetation does not threaten the safety and reliability of the BGE high voltage electric transmission system, tall growing vegetation can no longer be maintained in the critical wire zone of the ROW. The BGE Transmission Vegetation Management Program (TVMP), which has been designed to meet the NERC mandate, restricts wire zone vegetation height to no more than 5 feet at maturity. Tall growing tree specie maintenance to this height limit would necessitate annual cutting of the vegetation, with the inherent increased risks to worker safety, soil disturbance and aesthetic impact. Routine cutting would perpetuate dissatisfaction by the community residents,

increase pollution of hydrocarbons and the carbon footprint of maintenance, and serve to exacerbate the spread of non-native invasive weeds.

The alternative to routine hand cutting and mowing maintenance of all existing vegetation is to manage for low growing vegetation that does meet the criteria of the BGE TVMP. Vegetation management requires that the interfering tall growing plants are selectively removed and their root systems rendered inoperative through the application of various herbicides. Vegetation can be selected by one of two techniques: 1) Broad spectrum herbicides can be applied to only the tall growing plants allowing other desirable plants to remain; 2) Herbicides whose chemical mode of action only affects certain types of plants can be applied to all the plants on an area of ROW with the knowledge that only the target plants will be affected.

Herbicide Application Techniques

Various herbicide application techniques may be used depending on the type and density of target plants, topography, accessibility and soil moisture. As an electric and natural gas utility, the primary objective of the BGE Vegetation Management Plan is the control of trees whose height or roots could pose a safety and reliability threat to the electrical conductors and pipelines, or limit access for maintenance or emergency repairs. Non-native invasive shrub and herb control would not normally be considered an objective for a utility, since their control is for aesthetics and ecosystem management, not safety and reliability. However, BGE is incorporating these secondary objectives into its ROW Plan as part of its partnership agreement with the community and county. Thus the prescribed application techniques below reflect these secondary management objectives:

Stump Treatment

The stumps of trees cut with chainsaws shall immediately (within 30 minutes) be treated with herbicide applied to the cambium layer. Only herbicides approved for use in wetlands or water shall be used in those respective areas.

Accord

Frilling

Axe cuts shall be made around the bole of the tree and herbicide is applied to the cuts using bottle sprayers. This technique may be used on a tree, growing in or adjacent to the ROW border zone or in deep ravines, to convert it into a wildlife den tree.

Accord and/or Arsenal

Radiarc

The Radiarc has a series of spray nozzles mounted on a truck or tractor that broadcast applies herbicide in water to foliage of ROW plants at a set calibration and pattern under low pressure. A speed-measuring device (Raven) may be used with the Radiarc to accurately treat at a calibrated rate (25 gallons) per acre under varying topography and speeds. Dye may be added to the tank mix to visually mark treated areas.

This technique may be used in wetlands with products labeled for that use.

Krenite, Arsenal, Escort, Milestone + surfactant - upland

Accord, Habitat, Garlon 3A + surfactant – wetland

Widecast

This technique is similar to the Radiarc except the nozzle orifices are smaller and Thinvert (a paraffin oil-based emulsifier product that encapsulates the herbicide, acts as a surfactant and sticks to the leaves of the treated foliage) is used as the carrier instead of water. Thinvert is colored white and provides visual marking of treated areas.

The Widecast may be mounted on small, light vehicles (ATV) to accurately broadcast treat foliage of plants at a calibrated 5 gallons per acre rate, either in uplands or wetlands.

Herbicides are the same as Radiarc

Hydraulic

Herbicides mixed in water shall be applied by individual applicators through spray hoses and adjustable nozzles mounted on trucks or tractors. Hydraulic applications are made to the foliage of light-heavy density brush at a rate of 25-100 gallons/acre. Dye may be added to the tank mix to visually mark treated areas. Accurate application to target plants provides the selectivity when broad spectrum herbicides are used.

Same herbicides as noted above for uplands and wetlands.

Backpack

This technique shall be used to apply herbicides mixed in water or Thinvert (~2-12 gallons/acre) selectively to light-density brush. Backpack treatments shall not be used on sites dominated by dense stands of target plants.

This technique can be extremely accurate and is preferred for sparse vegetation to avoid collateral damage to desirable vegetation or to rare or endangered plant species.

Same herbicides as noted above for uplands and wetlands.

Herbicide Mode-Of-Action Summary

By Purdue University

The mode-of-action is the overall manner in which an herbicide affects a plant at the tissue or cellular level. Herbicides with the same mode-of-action will have the same translocation (movement) pattern and produce similar injury symptoms.

Plants are complex organisms with well-defined structures in which multitudes of vital (living) processes take place in well-ordered and integrated sequences. Plants are made up of organs (root, stem, leaf, and flower); organs consist of tissues (meristems, conducting, photosynthetic, structural); and tissues are made up of cells. Plant cells contain subunits including walls, membrane systems (golgi, plasma membrane, nuclear membrane, endoplasmic reticulum) and organelles (mitochondria, nucleus, chloroplasts), and undifferentiated cytoplasm.

Some vital metabolic plant processes include photosynthesis (capture of light energy and carbohydrate synthesis), amino acid and protein synthesis, fat (lipid) synthesis, pigment synthesis, nucleic acid synthesis (RNA, DNA essential to information storage and transfer), respiration (oxidation of carbohydrate to provide CO₂ and usable energy), energy transfer (nucleic acids) and maintenance of membrane integrity. Other vital processes include growth and differentiation, mitosis (cell division) in plant meristems, meiosis (division resulting in gamete and seed formation), uptake of ions and molecules, translocation of ions and molecules, and transpiration. One or more of the vital processes must be disrupted in order for an herbicide to kill a weed.

I. Foliar Applied Herbicides

A. Downwardly Mobile Herbicides

These herbicides are capable of moving from leaves (sources of sugar production) with sugars to sites of metabolic activity (sinks of sugar utilization) such as underground meristems (root tips), shoot meristems (shoot tips), storage organs and other live tissues. Since movement to sites is essential for continued plant growth, these herbicides have the potential to kill simple perennial and creeping perennial weeds with only one or two foliar applications. Symptoms are evident on new growth first. Pigment loss (yellow or white), stoppage of growth, and distorted (malformed) new growth are typical symptoms. Most injury appears only after several days or weeks. Plants die slowly.

1. Auxin Growth Regulators

The effects associated with auxins help set them apart from other downwardly mobile herbicides. Bending and twisting of leaves and stems is evident almost immediately after application. Delayed symptom development includes root formation on dicot stems; misshapened leaves, stems, and flowers; and abnormal roots. Soil activity varies from almost none to long residual depending on herbicide and dose.

Picolinic Acids (Pyridines) and Relatives
triclopyr GARLON
aminopyralid MILESTONE

2. Amino Acid Inhibitors (Aromatic)

Glyphosates are compounds with this mode of action. Uses are limited to foliar applications only, since these chemicals are rapidly inactivated in the soil. Symptoms include yellowing of new growth and death of treated plants in days to weeks.

glyphosate ROUNDUP/ACCORD

3. Amino Acid Inhibitors

Imidazolinones

Shoot meristems cease growth; yellow, pink and purple symptoms appear; roots tend to develop poorly; and the secondary roots are shortened and all nearly the same length producing a "bottlebrush" appearance. Complete symptom development is very slow and requires two to three weeks or more. Compounds are residual (weeks) to long-residual (several months) depending on herbicide dose.

imazapyr ARSENAL/HABITAT

4. Sulfonylureas

Sulfonylurea herbicides are applied preplant incorporated, preemergence, and post emergence at doses of 0.5 to 6 ounces active ingredient per acre. High soil pH greatly increases persistence since only biodegradation takes place at higher soil pHs.

metsulfuron ESCORT

B. BUD INHIBITOR

1. Plant growth regulator

Ethyl hydrogen (aminocarbonyl) phosphonate

Mode of Action: Fosamine ammonium functions as a plant growth regulator. It is sometimes referred to as a "dormancy enforcer," but its specific mechanism of action has not been identified. There is some evidence that it inhibits mitosis in susceptible plants. Deciduous plants treated with fosamine ammonium fail to refoliate and die, without going through the "brown out" caused by many other herbicides. When applied to deciduous plants two months prior to leaf drop, the compound is absorbed with little or no apparent effect. In the following spring, buds either fail to open at all, or produce only spindly, miniature leaves. Evergreen plants such as pines show response soon after application.

Fosamine KRENITE

Mist-trol Mist control agent for hydraulic application to reduce fine droplets

Bullseye Blue dye to mark application area leaves

Columbia Pilot 2009 Herbicide Prescriptions

Radiarc Upland	1.50 gal Krenite S + 1 oz Escort + 7 oz Arsenal + 7 oz Milestone + 4 oz Bullseye + 0.25 gal Surfactant in water broadcast @ 25 gallons solution per acre
Widecast Upland	1.50 gal Krenite S + 1 oz Escort + 7 oz Arsenal + 7 oz Milestone in Thinvert broadcast @ 5 gallons solution per acre
Hydraulic Wetlands/Slopes	1.25 gal Accord + 7 oz Habitat + 0.25 gal Garlon 3A + 10 oz Mist-trol + 0.25 gal Surfactant + 4 oz Bullseye in 100 gallons water applied to wet
Backpack	0.50 gal Accord + 4 oz Habitat + 4.5 gal Thinvert applied selectively
Stump	0.50 gal Accord + 0.50 gal water applied as a solution to the cambium layer of cut tree stumps

Note: Vegetation density in 2009 will necessitate the use of broadcast Radiarc or Widecast applications in the routinely mowed grass areas, and hydraulic application in wetland and steep slope areas. It is anticipated that a 90% efficacy rate will be achieved on target plants.

Backpack selective treatments will be the application of choice to follow-up in 2010 and achieve close to 100% efficacy of the original target plants.

Backpack selective treatments will be the application of choice to selectively remove target plants that reseed in subsequent years (2013 or 2014, and then 3-4 year cycles).

Radiarc or Widecast applications may periodically be necessary to manage healthy plant communities in the grass areas due to invasive plants. Additional foliar herbicide products or pre-emergent chemicals may be needed to control and prevent further spread of invasive plants, such as garlic mustard and mile-a-minute. BGE will assist its partners in further development of vegetation plans to address these threats.

Columbia Pilot Detailed Plan Oakland Mills to Carved Stone Roads

Oakland Mills Road - Landscaped trees are spaced along Oakland Mills Rd and must be regularly pruned to prevent tree - conductor interference. These trees should be removed over time and replaced with compatible trees or shrubs that do not require pruning maintenance. The application of tree growth regulators should be considered to extend time between needed pruning.

A 1.5 acre grass area exists between Oakland Mills and Dasher Court Roads that has been mowed twice each year. This area shall be broadcast herbicide treated in fall 2009 using the Radiarc or Widecast.

A small area of unkempt brush exists within the center of the mowed area and shall be removed after leaf drop in fall 2009 and the cut vegetation stump treated.

Dasher Court - Compatible dogwood trees are spaced along Dasher Court Rd but volunteer trees, invasive shrubs and vines have been allowed to overtop the landscaped trees. This dense growth also clogs the drainage ditch and shall be removed after leaf drop in fall 2009 and the cut vegetation stump treated. The 2.7 acre wetland area south of Dasher Court shall receive a selective hydraulic herbicide treatment in fall 2009. Incompatible trees and invasive shrubs shall be targeted but silky dogwood and native shrubs shall be selected to remain.

The wetland leads to a 1.2 acre upland area that has been mowed twice each year. This upland shall be treated fall 2009 with the Radiarc or Widecast and an unkempt brush area shall be cut during this time and stump treated. Neighbor gardening and landscaping encroaches into the west side of the ROW.

Elkhorn Lake - South of this upland drops into another 4 acre wetland that drains the lake. This wetland shall also receive a selective hydraulic treatment fall 2009. A botanical study transect is established in this wetland just east and north of the trail bridge off Angelina Circle under the 500kV conductors.

Mowed Grass Study - South of this wetland the land rises again and is intersected by several nature trails. The 1 acre area on the east side of the ROW has been mowed routinely while the west side is rocky and infested with incompatible trees and invasive plants. The east side shall receive a fall 2009 broadcast treatment with the Radiarc or Widecast while the west side shall be treated the same where slope allows, or broadcast treated with the hydraulic technique.

Incompatible trees have encroached into the ROW on the west side near the nature trail posing a blow-out hazard to the conductors. These trees shall be removed and stump treated during the winter of 2010.

At the top of the hill a study transect has been established on the east side of the ROW near the 230kV tower #26E to document plant community changes. This grass area is infested with invasive plants and received a spring 2009 mowing just after botanical documentation. This area will be broadcast herbicide treated fall 2009 and compared against another grass area study farther south on the ROW that did not receive a spring mowing.

Brush Study - Grass continues south for another 1.6 acres until the slope increases and splits the ROW into a 1/2 acre grass area on the east side and 1.5 acres of brush on the west side. The grass areas will receive a Radiarc or Widecast treatment while the brush will receive a hydraulic treatment. Most of the trees in the brush area are Ailanthus (Tree-of-heaven) and black locust where a study transect has been established under the 500kV conductors to document plant succession after the incompatible trees are herbicide treated. Neighboring gardens encroach on the east side of the ROW.

Residences Development - The ROW is crossed by a trail and Hickory Limb Lane to the Residences development. Landscape shrubs are spaced along the lane but pose no threat to the conductor safety. Grass continues 2 acres south of the lane with the exception of an encroaching stand of bamboo on the east side at tower 27E. The grass will be treated by Radiarc or Widecast while the bamboo, due to its height, will need to be treated with the hydraulic applicator.

Ivory Hand Trail

The ROW drops down another slope and is split by grass on the east side and brush on the west, each about 1.2 acres up to Ivory Hand Trail, and 1/2 acres each past the trail. Brush that is heavily infested with invasive plants dominates both sides of the trail and clogs the brook, increasing risk from flooding and decreasing the health and aesthetics of the wetlands. The brush will be treated by hydraulic applicators and the grass with Radiarc or Widecast. A few scattered trees encroach into the east side of the ROW just south of Ivory Hand Trail and shall be pruned back in the winter of 2010.

Carved Stone Road

Grass that has not received a spring 2009 mowing dominates the entire ROW for 5.2 acres up to Carved Stone Road. The exception to this is a neighbor swing-set encroachment into the west side of the ROW that includes a landscaped tree, and another 9,000 square foot lawn area that receives weekly mowing by a neighbor. A botanical study transect is established at 230kV tower #28E to compare the results of broadcast herbicide treatment with the mowed grass site at tower 26E.

Acreage Summary

Radiarc or Widecast broadcast applications to grass areas will total approximately 15 acres, while hydraulic application to brush areas on slopes and wetlands total about 11 acres.

Research and Education

Four botanical studies are being conducted by Michael Robin Haggie of Chesapeake Wildlife Heritage; one wetland study, one brush and two grassland studies. The purpose of these studies is to establish baseline data of the plant specie and density in spring 2009 due to the regimen of mowing and hand cutting vegetation, and then to document over the next two years the changes in plant species and density due to the introduction of herbicide treatments with an integrated vegetation management approach. This data will help guide future vegetation management practices on similar suburban ROW of the BGE system, and can help educate other utilities, government agencies and conservation in the best vegetation management practices.

Botanical Studies:

- A. Wetland** - A linear survey 10 x 50m, with 2 x 1m plots every 5m is established. This site was mowed and hand cut in spring 2007, resulting in willow and maple tree sprouts as the main targets for a fall 2009 selective hydraulic herbicide treatment. Silky dogwood, alder, blackberry, elderberry and many herbaceous plants are compatible and will be avoided. Due to the choice of selective hydraulic as the application technique, herbaceous invasive plants are not specifically targeted.
- B. Upland Grass I** - A linear survey 10 x 60m, with 3 x 1m plots every 5m is established. This site received a spring mowing in May 2009, and although it appears from a distance to be a grass site, wild pear and crabapple trees, as well as non-native invasive Japanese honey-suckle, multi-flora rose and autumn olive dominate the site. With the density of these undesirable plants, a broadcast Radiarc or Widecast herbicide treatment will be the application of choice in fall 2009.
- C. Brush Study** - Two random block surveys have been established; 10 x 20m and 10 x 25m. This site was mowed and hand cut in spring 2007, resulting in multiple sprouts of wild cherry and root-suckering Ailanthus and black locust trees that have reach an average 12-feet tall after 2 growing seasons. Due to the trees' height and slope of ground, as well as a dense invasive plant cover (multi-flora rose, autumn olive, Japanese honey-suckle, mile-a-minute) a broadcast hydraulic application will be chosen for fall 2009.
- D. Upland Grass II** - A linear survey 10 x 25m, with 3 x 1m plots every 5m is established. This site received a summer 2008 mowing but was not mowed in spring 2009, thus its data will be used to compare plant succession against the spring 2009 mowed Upland I Study. This site has several species of grass and herbaceous plants but is also populated with

crabapple, wild pear, ash, wild cherry, multi-flora rose, autumn olive and Japanese honeysuckle. Thus it will receive a broadcast Radiarc or Widecast herbicide treatment in fall 2009.

Public education can be enhanced through the use of interpretive signage placed along the nature trails to explain the IVM practices and results. A "right tree - right place" landscape arboretum is also recommended for planting in the ROW buffer zone near a trail to guide homeowner plantings near electric ROW.

Environmental Issues

The BGE Integrated Vegetation Management Plan Columbia Pilot Project cuts across several environmental issues of national importance but defines them specifically to the local ecosystem sensitivities:

National Environmental Policy Act (NEPA) – The project's case studies will help define which vegetation management practices create and maintain conditions for man and nature to exist in productive harmony.

Federal Insecticide, Fungicide and Rodenticide Act (FIFRA) – The project will help define the best IVM techniques for federal agencies to promote through procurement and regulatory policies.

Endangered Species Act (ESA) – The project will demonstrate which IVM practices can restore or protect habitat conducive to the survival of rare or endangered species, and help the EPA direct product labeling and regulation.

Food Quality Protection Act (FQPA) – The project will document the actual herbicide rates, application frequency and techniques used under an integrated program to help chemical manufacturers and regulators label products specific to rights-of-way (ROW).

Pesticide Environmental Stewardship Program (PESP) – The project will help define and document which IVM practices on ROW lower the level of risk to both humans and the environment, and help encourage wider adoption.

Energy Policy Act of 2005 – The project will help define what IVM practices are best for electric system reliability to help guide energy corridor siting and management.

Executive Order #13212 – The project will help federal agencies assess energy corridor environmental impacts when reviewing applications to improve transmission of energy while maintaining safety, health and environmental protection.

Executive Order #13112 – The project will help agencies coordinate noxious or exotic species control, monitoring and study and define the best practices to restore native species and habitat.

Clean Water Act – This project will help define which IVM practices limit erosion and sedimentation of streams and introduction of pollutants into water systems, and provide riparian buffers to maintain cool water temperatures necessary for aquatic survival.

Clean Air Act – This project will help define which IVM practices limit pollution of hydrocarbons and carbon dioxide into the air.

Climate Change – This project will demonstrate that the development of a stable, low growing plant community can reduce the carbon footprint of ROW maintenance.

Pollinators – This project will help identify which practices promote plant communities along ROW that are conducive to the survival and expansion of wild bees, butterflies, birds and bats.

EEI-Federal Agency MOU – This project will help in the implementation of IVM programs on federal lands by helping to define best IVM practices for Edison Electric Institute member electric companies and land management agencies.

American National Standard Institute ANSI A300 (Part 7) – 2006 - This project will assist in the adoption of the standard by demonstrating the regional results of IVM practices.

Department of Energy, Federal Energy Regulatory Commission (FERC), North American Electric Reliability Council (NERC) and Maryland Public Service Commission - This project will assist in defining best practices and policy for insuring safe and reliable transmission of energy.

National Partners

IVM Partners is cooperating with several national industry and conservation organizations to help educate practitioners, the public, policy makers and regulators on the best IVM practices. With permission and cooperation from the Columbia Pilot Project Partners, workshops and field tours are proposed in conjunction with regional and national conferences to further education.

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