VI. Management Issues

This section describes the major natural resource management issues identified within the study area. While other management issues are present, this section details those issues that were encountered frequently. The management issues described here follow the same order as shown in Table II-2 of this report.

Erosion - Instream

Erosion is a natural process that refers to the transport of soil particles, the rate of which is dependent upon the soil properties, vegetative cover, and the forces exerted upon it. When erosion is accelerated it can have multiple undesirable and sometimes harmful effects.

In-stream erosion is a continually occurring process that affects morphology, water quality, and aquatic habitat. The channel materials, side slopes, presence of resistive materials such as logs and boulders, vegetation, and velocity of flows all affect the rate of in-stream erosion. Erosion can frequently be seen on outside bends of meanders where water velocity and energy are higher and where meanders touch valley walls forming massive cut banks. Exposed roots, undercut banks, and soil slumping are all evidence of where erosion is occurring.

Urban development and tiling tend to increase in-stream erosion by increasing both direct and indirect stormwater inputs. The acceleration of erosive processes leads to increased sedimentation, reduced water quality, degraded aquatic habitat, and destabilized stream banks.

Erosion - Hill slope

Erosion on hill slopes can lead to reduced water quality through increased sediment and nutrient transport, degraded aquatic habitat through increased sedimentation. Hillslope erosion occurs in a number of different ways depending on slope, soil type, presence of instream erosion, vegetative cover and land uses. In areas where more permeable soils overlay bedrock or clay, or, where groundwater seeps occur on slopes, mass wasting may occur. This process is basically where saturated soil slides downslope though the forces of gravity. Mass wasting may occur over large areas and is usually accelerated when the lower slope is disturbed by road cuts or instream erosion. Another form of hillslope erosion is gully formation. Gullies form where stormwater is concentrated on steep slopes. Gullies typically form on the lower slope and then migrate upslope though the process of headward cutting. Headward cutting gullies frequently and indiscriminately threatens structures, roads, and fields. They can travel rapidly and are often difficult to stabilize. Gullies additionally provide a significant source of sediment to downslope lakes, wetlands, or streams; contributing to sedimentation and water quality problems.

Sedimentation

Increased sedimentation can be harmful to aquatic habitat and natural stream systems. Additionally, sedimentation can inundate large areas of land and cover trees, buildings and other valuable wildlife habitat. Deposition of sediments can harm fish spawning habitat and lead to a change in stream morphology. Streams tend to become shallower and wider as sediments are deposited which often leads to an undesirable stream state; one that is less stable.

Water Quality - Eutrophication

Water quality is affected by sediments (reducing water clarity and transporting nutrients), direct nutrient input (from fertilizers and animal feces), pesticides, heavy metals, bacteria, organic matter (such as grass clippings and crop residue), and toxic fluids (automotive and farm equipment). All affect the integrity of the receiving waters and overall health of the system. Polluted water quality poses health hazards to humans as well as the aquatic and terrestrial

species that use the water. Increases in both the rate and volume of runoff can impact water quality and lead to increased downstream flooding and erosion problems. Increased transport of pollutants from urban development and farmland reduce water quality and harm habitat integrity.

Increased runoff from impervious surfaces or drainage tiles increases the frequency and duration of downstream flooding and accelerates erosion processes. When stormwater runoff volume and rate control are paired together, downstream flooding is mitigated and in-stream stability is protected. Volume control additionally replenishes groundwater supplies and helps to maintain base flows.

Eutrophication occurs where natural or anthropogenic nutrients are introduced via point or nonpoint pollution sources to streams, lakes and wetlands. This term, as it relates to trophic status, describes the process where ecosystems change from a low nutrient, low productivity condition (oligotrophy) to a high nutrient, high productivity condition (eutrophic). Many human impacts to lakes streams and wetlands result from this process. In Minnesota, phosphorus and sometimes nitrogen are the primary limiting nutrients that when increased, lead to increased production of aquatic plants including algae and macrophytes. Eutrophication also results in a shift to invasive and/or troublesome aquatic plants such as curly leaf pondweed, Eurasian water-milfoil and algal blooms. In wetlands, many relatively low nutrient plant communities such as tamarack bogs and poor fens are quickly invaded by nutrient-loving species such as cattail and reed canary grass.

Water Quality - Thermal

Thermal impacts occur when warm, surface water is discharged into streams containing large amounts of groundwater baseflow. Groundwater-fed streams have different water chemistry and more stable, year-around water temperatures than surface water-fed streams. In particular, trout and other fish and macroinvertebrates that require well oxygenated water that is maintained within a narrow annual temperature range are impacted when warmer stormwater is introduced.

Hydrologic Alterations

Alterations that affect stream flow or that drain wetlands can have dramatic effects on water quality and natural community condition. Many hydrologic alterations serve to hasten the flow of water through an area, which can have several results. One, water may spend less time in sites near the alterations and adjacent wetlands may end up drier, and two, water level fluctuation downstream may increase dramatically. This, in turn, can favor exotic species such as reed canary grass and eliminate native species with higher wildlife value. The fluctuations also significantly accelerate erosion, which adds to stream sedimentation, decreased water quality, and stream instability. In addition, alterations that encourage water to move quickly through an area reduce the amount of water that infiltrates into the ground. This infiltration process is an effective strategy for removing sediments and many pollutants, thus "cleaning" the water before it enters underground aquifers or seeps into down slope water bodies.

Stormwater Bounce

Stormwater bounce relates to the magnitude and duration of inundation within water bodies, particularly wetlands. Some wetland plant communities have evolved under conditions that favor stable surface or ground water elevations. When stormwater is introduced to these wetlands, native vegetation quickly dies back, while invasive species such as reed canary grass find an unoccupied niche. Stormwater bounce is generally measured by constructing a hydrologic/hydrologic model of the watershed to determine changes in magnitude or duration of bounce with respect to baseline conditions in a given wetland.

Protection of Rare/Unique Natural Communities, Plants & Animals

Most rare/unique natural communities, plants and animals occupy specific areas that have in some way escaped European settlement and land use conversion. High value natural resources generally occur where one or more of the following conditions are present:

- Steep, inaccessible areas
- Poor soils
- Floodplains
- Rock outcroppings/shallow bedrock
- Large river systems and associated geomorphologic processes
- Public/private landholdings dating to presettlement (e.g., railroad ROW)

As land use pressures intensify, many rare/unique natural communities, plants and animals that still remain are under increased threat due to increasing development pressures. Threats include direct impacts, such as building a home on a remnant prairie, or indirect impacts such as increased mortality to rare animal species at road crossings.

Riparian Buffers

Riparian buffers provide multiple benefits to lakes, streams and wetlands. As a general rule, transitional areas between lowland and upland areas are highly diverse and productive ecosystems. These transitional areas are especially important because they help to filter pollutants and sediments, infiltrate surface water, serve as groundwater discharge points and provide thermal protection from shrub and tree canopies. Riparian buffers are generally established as a minimum horizontal distance from the ordinary high water mark (OHW) of a lake or wetland and top of bank for a stream. Riparian buffers are most effective when planted to native plant communities suited to the specific site conditions (i.e. soils, aspect, slope).

Bluffline Setbacks

The bluffline is defined differently by various local units of government and agencies, but in general is the point where slopes level off to less than 12 to 18% grade. Bluffline setbacks require that structures are located minimum horizontal distances from the bluff line, usually a minimum of fifty feet. Bluffline setbacks help to reduce stormwater rate and volume, filter water-borne pollutants and preserve slope stability. Riparian buffers and bluffline setbacks may abut each other or in some cases overlay. Where they overlap, the most restrictive scenario usually prevails.

Fragmentation of Natural Communities

"Fragmentation" is any process that disrupts the continuity of a habitat or community, and it affects the landscape in several ways. Localized clearing associated with road, trail, logging, and home and yard construction increases the ratio of edge: interior in a community, causing an "edge effect." In woodlots, this results in higher light levels within the forest interior, and can favor the establishment of shade intolerant species such as sumac, prickly ash, and buckthorn, as well as eliminate shade-adapted, interior species. In all communities, it affects animal movement patterns and inhibits plant dispersal into and across the edge area. It favors habitat-generalists and reduces the area available to species that require large areas of interior habitat. Pileated woodpeckers and barred owls are examples of forest species that have specific habitat size requirements. The second impact of fragmentation results from the increasing isolation between similar community types and the reduction in community size.

A large site contains more species than a small one, and as they become more isolated, plant and animal migration becomes increasingly difficult. This ultimately results in reduced diversity overall, and consequently sites become less able to adapt to change. While these effects are most visible in forested sites, all native communities are susceptible to fragmentation.

Invasive/Exotic Species

"Exotic species" refers to organisms that have arrived in an area as result of European or other settlement and now occur outside of their native habitat. They often lack natural enemies to keep their populations in balance, and may not provide the wildlife value of native species. "Invasive Species" may be native or non-native, and refers to species that colonize sites aggressively, often in the wake of disturbance. They generally are good competitors, and often eliminate native species or make it difficult for them to become established. Some of the more common invasive/exotic species include:

- Red Cedar: Red Cedar is native to the eastern United States but was not historically part of the Minnesota landscape. It may be planted as a landscape tree, and provides cover for wildlife; its berries are a favorite food for some bird species. It also casts a very dense shade, which often eliminates the ground cover where it grows. It is common in old fields and pastures, where livestock generally avoid its prickly branches. It poses a threat on prairie and savanna remnants, where it shades out both sun-loving prairie species and bur oak.

- European Buckthorn: This Siberian native is an aggressive competitor, and produces abundant quantities of seed. It is tolerant of shade and readily colonizes disturbed areas in woodlands and forests, especially oak savanna, oak woodland, and to a lesser degree, oak forests. Once established, it crowds or shades out native trees, shrubs and forbs.

- Tartarian Honeysuckle: Like European buckthorn, Tartarian honeysuckle is a native of Russia, Asia, and Western Europe. It tolerates a wide range of moisture regimes and habitats, and both outcompete native plants, and possibly, chemically inhibits their growth. It establishes readily on disturbed sites.

- Siberian Elm: Also native to Asia and Eastern Siberia, Siberian elm is adapted to drought and cold. Seeds establish quickly on disturbed sites, and can form dense, competitive patches.

- Black Locust: A native to North America, black locust has become widely distributed due to massive plantings in old fields. It is not very successful at invading areas with already established vegetation, but can become locally dominant and outcompete more shade tolerant species where it has room to grow.

- Prickly Ash: This native species increases in woodlots in the aftermath of grazing, and forms dense stands that shade out other species. It will not tolerate the deep shade associated with the interior of a closed canopy forest, but thrives in edge habitat.

Invasive/Exotic Species (cont.)

- Reed Canary Grass: Reed Canary grass is found throughout the northern hemisphere, and there is debate as to whether or not it is native to the U.S. This wetland grass was widely planted for forage during the 1930's and 1940's, and today forms extremely dense stands in many wetlands. It chokes out other species with its thick cover, and offers minimal wildlife value. It tolerates a wide range of growing conditions, and responds favorably to fluctuating water levels.

- Giant Reed Grass: This species behaves similarly to Reed Canary grass, but was not planted as widely and is somewhat less aggressive.

- Purple Loosestrife: This Eurasian native is listed as a noxious weed in the State of Minnesota. Like many of the other invasive species, it produces seed abundantly and can overrun wetland sites where it becomes established. Once established, it displaces and outcompetes native species that have much higher wildlife values.

- Cattails: narrow-leaved cattail is found throughout much of the northern hemisphere, and is native to the United States. It competes aggressively, and can form nearly monotypic stands where established. It is very tolerant of nutrient-enriched sites and fluctuating water levels, and often is a sign of disturbance in marshes. It hybridizes with our other native cattail, the broad-leaved cattail, to form a vigorous hybrid called *Typha glauca*, which has similar traits.

- Spotted Knapweed: Spotted knapweed is a biennial or short-lived perennial forb of the composite family. It was likely introduced from Europe or Asia as a contaminant in alfalfa or in hay seed. In recent years, this species has invaded both undisturbed prairies as well as disturbed areas such as old fields and roadsides.

- Garlic Mustard: This European native is now a common weed in many moist woodland sites, where it colonizes rapidly after disturbance and limits the establishment of native species.

- Kentucky Bluegrass and Canada Bluegrass: Despite the regional-sounding names, these two species are in fact European natives that have been widely introduced. Both pose significant threats to native grasslands such as prairies, since they form dense sod mats that prevent other species from establishing and in fact can choke out existing natives on hospitable sites. They often establish in the wake of disturbance, and on extremely dry prairie sites tend to thrive in the light shade provided by invasions of sumac.

- Sweet Clover (White and Yellow species): These Eurasian natives are widespread in waste places throughout our region, and are problematic on prairie sites. They produce abundant seed and compete aggressively.

- Leafy Spurge: Leafy Spurge is an aggressive perennial, introduced from Europe. It tolerates a wide range of habitats, and spreads rapidly through vegetative reproduction. It is most successful at infesting dry hillsides, dry prairies, and rangelands.

Livestock/Horse Grazing

While raising livestock is an integral part of today's farm economy and a significant part of Minnesota's history, it also has a variety of impacts on the landscape. These impacts can result from dairy and beef farms, horse pastures, and other types of animal operations. Livestock grazing impacts both soil structure and vegetation. Water quality impacts are addressed under "Water Quality Section" of this chapter.

Soil Impacts

Grazing compacts soil structure, reducing or eliminating the amount of air spaces in the soil and making growing conditions less favorable for a number of native plants species, whose roots may not be able to penetrate the harder soil. Susceptibility to soil compaction varies between community types and soil types. Heavier clayey soils are highly susceptible, whereas sandy soils may sustain little structural damage. Many wetlands and forests are particularly vulnerable to soil damage from grazing, and impacts from past grazing are often apparent in the vegetation and soil structure.

Vegetation Impacts

Grazing alters the structure and species composition of plant communities. In wooded communities, browsing, soil impacts, and traffic tend to eliminate the understory and shrub layers by killing existing saplings and shrubs and preventing new seedlings from becoming established. Overgrazing can also kill canopy specimens through damage to roots and bark.

In all communities, most native forb species cannot withstand grazing pressures, and grazing favors the establishment of bur-fruited species and thorny, unpalatable shrubs such as prickly ash, buckthorn, gooseberry, and red cedar. Grazing also creates new opportunities for weedy species to colonize an area, by reducing the vigor and competitiveness of natives, and exposing new, bare soil for colonization. In wetlands, manure inputs and grazing alter the nutrient and sediment levels, and can significantly alter plant communities. Aggressive species that can withstand sustained browsing, such as reed canary grass, are favored by grazing regimes.

Grazing can affect water resources by increasing sediment and nutrient levels, as well as harming stream bank stability. Overgrazing can lead to compaction of soils and severely reduced vegetation on a site, thus increasing sediment and pollutant inputs through increased stormwater runoff (both rate and volume). Allowing pastured animals direct access to streams and wetlands disrupts shoreline vegetation that provides bank stability. Increased bank erosion destabilizes stream meanders, increases sediment loads and adds to in-stream turbidity.

If managed carefully, these impacts can play a role in maintaining natural communities that are open in character, and that have been affected by disruptions to their natural disturbance regime. For example, woody plant invasion into prairies and savannas was historically controlled by fire, and by grazing pressures from bison and elk. However, remnants of these communities today generally cannot support the intense, sustained grazing associated with farming today, due to the ecology of many of the prairie species.

ATV/Bike/ORV Use

All terrain vehicles (ATV), mountain bikes and off road vehicles (ORV) all pose a threat; especially where erodible soils occur on steep slopes. Most ATV/ORV use is by private landowners on their own land. As a general rule, avoid use of ATV/ORV where steep slopes and erodible soils occur. Avoid uses where high quality natural communities are known to occur and instead concentrate uses in lower quality areas already impacted by existing roads and trails.

Wildlife Depredation

The primary wildlife depredation issue is with white-tail deer. In areas overpopulated by deer, heavy browsing can result in loss of tree and shrub regeneration and reduction in the abundance and diversity of groundcover flora. As with cattle grazing, thorny, bur-fruited species and invasive herbaceous species (i.e., garlic mustard) may increase as a result of excessive browsing. Excessive deer browsing is generally most evident near large-lot residential areas and large tracts of land where deer harvest (during the hunting season) is minimal.

Beavers are also a potential problem, especially where damage to landscape trees and shrubs occurs. Beavers may also remove large areas of native trees and shrubs, particularly such species as aspen and willow. As a general rule, beavers enhance wildlife habitat by digging out or excavating deep water areas within wetlands and removing patches of woody shrubs and trees that are replaced by mosaics of wetland/upland communities.

Plantation Management (Thinning, Fire Protection, etc.)

Plantation management includes a variety of cultural practices that are employed to achieve specific goals. Some of the more common practices include:
Tree Seedling Release: Release is the act of freeing desirable tree seedlings from the competition of other trees, shrubs, grasses and forbs that are overtopping the tree seedling. Release may be accomplished though mechanical removal, herbicide application and in some cases, controlled burning.

Thinning: Thinning is the elimination of some of the trees in a plantation. By removing a portion of the trees within a plantation, the available sunlight, water and nutrients is allocated to fewer trees resulting in improved growth and vigor of the stand Thinning can also provide opportunities for additional species of trees, shrubs and groundcover species to become established, thus improving the stand for wildlife habitat and helping to better stabilize the soil against erosion.

In many plantations, large native oak trees existed prior to planting seedlings. Today, these large trees remain as remnents of the original oak savanna and woodland. Thinning around these trees, if they are suppressed by plantation trees, may help to improve their long-term health. Often, these same areas contain oak seedlings that became established from the residual native trees retained on the site following establishment of the plantation.

Fire Protection: While not generally considered to be a major problem in Washington County, during dry, windy conditions fires may threaten plantations. Firebreaks should be established along the boundary of plantations, particularly where buildings and other valuable infrastructure is located.

Interplanting/Interseeding: Where space within the plantation is available to accommodate additional trees, shrubs and groundcover species (which may be created by conducting a heavy thinning), planting of species adapted to the site may be practical. On some sites, shade-tolerent species such as sugar maple may be planted under white pine on the more mesic sites. On dry, sandy sites, oak species can be established within openings created during thinning. Shrub and groundcover species suited to a wide range of conditions may also be established. It is important that soil texture, fertility and pH be considered on these sites to insure that suitable species are chosen.

Stewardship Strategies

On-Site Landowner-Based Strategies

Landowner based strategies include a variety of cultural and preventative practices that may be undertaken on the scale of individual parcels or within localized areas by individual landowners, small groups of landowners, or where appropriate, units of local government. The Stewardship Strategies presented here are summarized in Table III-3.

Buffer Strips

Buffer strips can be an extremely effective tool for slowing runoff, thereby reducing sediment loads, erosion, and input of chemical contaminants (such as agricultural and urban runoff) into stream and wetland systems. If appropriate species are used, buffer strips can also help to stabilize bluff tops and slopes. A buffer strip is simply a wide band of vegetation, preferably native, planted between runoff sources such as agricultural fields, lawns, or pastures, and vulnerable sites such blufftops and slopes, wetlands, or stream corridors. Prairie vegetation is an excellent choice for planting in these areas, a) because prairie grasses are extremely deep-rooted (8 – 15'), which make them effective for infiltrating runoff and stabilizing slopes and b) they tend to form dense, stiff, above-ground clumps that reduce run-off rates. The width of buffer strips should be based on the quality and sensitivity of the resource as well as water quality/quantity goals.

It is recommended that buffer strips be designed to properly accommodate the site conditions including soils, slope, aspect, hydrologic regime and adjacent plant communities and land uses. In most cases, buffer strips serve as a vegetational transition zone between two different land uses and often, the buffer itself must function as a transitional area between one or more natural communities. I good example of this is for wetland buffers. Commonly, wetland buffers encompass both an upland area as well as the wetland fringe itself.

Invasive/Exotic Species Control

Invasive Species control can be a significant tool for Natural Community management. Eliminating aggressive exotics from a site can allow native species to recover and recolonize an area with less competition, and can help to restore the natural community structure and composition. On open sites such as prairies, woody plant removal increases light levels and is often an essential preparatory step prior to conducting prescribed burns. Efforts can be large scale eradication programs, or can be smaller scale, implemented over the course of several years. Fact sheets on control of invasive species in included in the Appendices of this report.

Livestock Fencing

Heavy grazing compacts soil and almost completely eliminates the understory. Pastured animals can kill canopy species by damaging exposed roots, and by removing tree bark by rubbing. It results in even-aged woodlots with large mature trees in the canopy, little reproduction, and few native shrubs and herbs. It also encourages the establishment of bur-fruited species and thorny, unpalatable shrubs. Fencing livestock away from susceptible areas such as streams and wetlands can significantly improve water quality in downstream resources. Limiting access to high-quality natural areas is essential for maintaining the quality of many of those sites.

Prairie/Savanna Management

Savannas, prairies, and sometimes wetlands most commonly suffer from woody encroachment, which refers to the invasion of woody plants into otherwise open communities. Invasive species include red cedar, Siberian elm, and Tartarian honeysuckle. Non-invasive native species may also encroach onto open sites, as a result of changes in the natural disturbance regime. While this can represent a natural successional process, it does convert sites into woodlands or forest. This may or may not be desirable, depending on the quality of the existing community, historic vegetative cover, and landowner goals. Woody plants can be controlled by cutting, girdling, prescribed burn, and/or herbicide application, depending on the species and target community. Fact Sheets for individual species are included in the appendix.

Burning Prairies

Prescribed Burns are deliberately set, managed fires in communities that were historically maintained by fire, such as prairies, savannas, and woodlands. Each of these communities burned with varying frequency prior to European settlement and the concomitant fire suppression. Consecutive early-season burns can severely set-back or kill species that experience their main flush of growth early in the season (including brome grass and non-native Bluegrass species), when temperatures are relatively cool, and favor the establishment and perpetuation of species that experience their main growth during warmer, mid-summer months (including most native prairie species.) Burns can also limit the establishment of woody plant species. An experienced "burn-boss" should be on hand to conduct any large burns, especially if they are near residential sites.

Mowing Prairies

Mowing is an effective technique that depending on the timing and height of the mowing can supress some species while encouraging others. Mowing is especially well suited to setting back cool season grasses while encouraging warm season grasses and forbs. Mowing of grasses is generally timed to coincide with peak growth of the species targeted for suppression, but before seed has been produced. In many cases, the warm season grasses and forbs will quickly overtake the recently mowed cool season grasses following mowing. Mowing may be completed up to two times per season (generally late spring and early fall) over several years to gradually shift growth over to more desirable species. Mowing may appropriate for any upland or wetland community where the goal is to encourage native grasses and forbs.

Stewardship Strategies for Prairie Communities

Generally, to maintain a prairie community, a management strategy should mimic the natural disturbance regime for the habitat. Ideally, this will remove accumulated plant material and invading woody species, as well as reduce or eliminate grass and forb species that are not prairie natives. In some situations, it may be necessary to decide if a prairie community is desired, or a brush-prairie or savanna community, where prairie species form the ground layer beneath an open canopy of willow, brush, or scattered oak or aspen.

- Remove Invasive Species: Cut and remove Eastern Red Cedar, Siberian Elm, sumac species, and other woody plants that are not a natural component of prairie communities. Some species may require an herbicide application to the stumps, as described in the Appendices of this Report. Additional spot-spraying with herbicide may be necessary to control populations of aggressive weeds such as spotted knapweed.
- Use Prescribed Burn as Necessary: Properly used, prescribed burns can eliminate cool season grasses and invasive shrubs, and help maintain a prairie community. If a prescribed burn is planned, clear woody debris from the site. Snags and brush piles can significantly increase the temperature of a burn, and contribute to fatal crown fires in bur oak and raise soil

temperatures high enough to destroy dormant seed, including prairie seed. If burns are not possible due to topography, homes, or for other reasons, spring mowing can mimic the effects of burning to some extent.

- Revegetation: Once invasive species have been removed, monitor for the recruitment and establishment of prairie species from existing populations and the seed bank. To help provide competition for weedy species, native seed can be collected from the site and either sown directly, or given to a reputable nursery to grow plugs to plant on-site. If off-site seed is used, local ecotype should be used as much as possible.
- Maintenance: Since prairie communities were historically maintained by fire, prescribed burns every year for the first few years and every 2 – 4 years thereafter will help to maintain the prairie. If burns are not possible, mowing may be substituted. Regardless of the strategy used, the site should be divided into several sections, with at least 1 section unmowed/unburned each year. This provides a refuge for animals and insects during the burn, and allows different microhabitats to develop within the community.
- Grazing: Use grazing practices that enhance native plant establishment and targets cool season grasses, by grazing sites early in the season (May-June), when Kentucky bluegrass and brome are actively growing and prairie species are relatively inactive.
- Reduce Fragmentation: Small, isolated prairies are more vulnerable to disturbance than is a single community with similar area, as weedy species encroachment is more aggressive around an edge than in the interior, a larger area is likely to support more species and thus be more adaptable to changing environmental conditions, and it provides a better propagule source for revegetation of disrupted areas within its boundaries. A single disturbance event is also likely to affect a smaller percent of the total area of a large site, as compared to a smaller site. Reducing the amount of edge also allows for better migration of small animals and better plant colonization and dispersal. To reduce edge, reduce the number of trails and roads through a site and keep trails narrow.
- Control Herbicide Drift: Prairies may be especially susceptible to herbicide drift, and herbicide application on adjacent fields should be performed in such a manner to eliminate drift onto prairie remnants. Herbicide should be applied on calm days, or, if there is a light breeze, it should blow herbicide away from the prairie rather than into it. Narrow bands of evergreens between prairies and fields may help shield the remnants from drift, and land managers may want to consider leaving such evergreen shelterbelts in place. Evidence for such an effect is anecdotal.
- Homeowners: Where private homes occur on prairie remnants, homeowners can help by reducing the size of their yard, reducing and eliminating use of herbicides, pesticides, and fertilizers, and landscaping with local ecotype native prairie species.

Oak Wilt Control

Control oak wilt using methods recommended by the Minnesota DNR Division of Forestry. Oak trees should not be cut, pruned, or injured between April 15 and July 1 of each year. Exposed roots injured by construction activities or grazing are just as likely to result in oak wilt infection as cut branches. If injury occurs, the wound should be treated with a tree wound dressing within 15 minutes or less to reduce the infection potential. A vibratory plow should be used to sever roots along the edge of any construction area prior to beginning work, to prevent the transfer of oak wilt fungus from exposed roots and allow for regeneration at the point of cutting. Tree protection zones should be fenced to prevent entry or compaction by construction equipment. Dirt and materials should not be stored in these areas.

Timber Stand Improvement (TSI)

Timber Stand Improvement is designed to sustain or enhance the quality of forests through a wide range of activities such as thinning, culling, and/or salvaging certain trees and/or other competing understory vegetation. In this discussion, we focus on both plantations (usually even aged conifer) and native forest, woodland and savanna communities.

Timber stand improvement practices can be used to accomplish a multiple range of objectives including:

- Improve the aesthetical value of a stand
- Encourage the growth of bigger healthier trees
- Promote a greater diversity of tree and plant species to establish and flourish,
- Provide small openings for native, shade tolerant shrub species to survive
- Provide larger openings to establish native prairie patches
- Remove invasive species such as buckthorn and other non-native plants
- Remove extra fuel buildup to prevent harmful fire conditions

Selective Thinning

Selective Thinning removes some, but not all, trees from an area. It is an effective tool for managing woodlots and forests where dense, single-species stands are developing in the understory and limiting other plant reproduction, as in cases where Oak Woodlands dominated by bur oak are becoming overgrown with ironwood or red cedar. It also can be useful on sites where thick, even-aged stands of young trees exist. There, it can improve both the growth rate and the quality of the remaining trees. Thinning can be done by girdling or cutting, and may require supplemental herbicide application to prevent resprouting.

Timber Stand Improvement for Native Forest Communities

Generally, to maintain a forest the best approach is one that encourages regeneration and favors the establishment of a canopy that is structurally diverse and species rich. This may be as simple as controlling non-native shrubs, minimizing the disturbances noted in the community descriptions, and allowing any existing seed bank to germinate. Mesic oak forests may tend to become more like a Maple-Basswood in the complete absence of fire, so, if desired, selective thinning to encourage oaks may allow oak forest to perpetuate. Some specific forest management strategies include:

- Control Invasives: Control European buckthorn, Tartarian honeysuckle, and other invasive shrubs by cutting and immediate herbicide application (see fact sheets for control of specific species). Sites should be monitored for reinfestation by these species, after control efforts are instigated. On occasion, native species may also act "invasively" and some control may be appropriate. Ironwood, especially, may form dense stands that shade out other species. Girdling will kill individual trees, and leave standing snags for wildlife.
- Natural and Artificial Regeneration: Once invasive shrubs are under control, monitor for the recruitment of native tree, shrub, and forb species. The site may need a number of years for natural recruitment effects to become apparent. If natural recruitment is not adequate, or if the landowner desires faster results, consider planting appropriate species from a local ecotype source. In general, species characteristic of the forest community type should be used with careful consideration given to specific site conditions.
- Reduce Edge: Reduce or eliminate the creation of new "edge" by eliminating roads through the interior and sighting trails in such a way that canopy species are not disturbed, as well as limiting the width of trails. In areas where two woodlots are separated by a clearing or trail, allow the forest to colonize the area, either via natural encroachment or by actively replanting the site. At construction sites, place the home and yard in front of a woodlot rather than

inside it, and use native tree and shrub species for landscape plantings. Homeowners can help significantly by controlling buckthorn and other invasive species at the junction between lawn and woods by planting the edge area with native shrubs and trees. The basic concept is to be sure that all areas are occupied by desirable species. Any openings created will eventually fill in with "something". The key is to make sure all newly created openings contain desirable species, either through natural recruitment or through plantings or seedlings.

- Avoid pasturing forest communities in the spring (April – June) when the ephemeral species are completing their annual cycle and the moist soils are especially susceptible to compaction. Rotate pastures frequently to allow native species to recover, and restrict access to streams and seepage areas.
- Buffer Strips: Leave a wide strip of uncultivated land adjacent to wooded slopes to slow the runoff rates and reduce erosion. Prairie grasses are an excellent choice for planting in such areas. Once established, clumps of native grass slow the rate of surface runoff and their deep (3' – 15'), fibrous root systems help water infiltrate while effectively holding the soil. Woody species and non-native pasture grasses are not nearly as effective for erosion control. Local ecotype seed should be used for any plantings.
- Oak Wilt: Control oak wilt using methods recommended by the Minnesota DNR Division of Forestry. Oak trees should not be cut, pruned, or injured between April 15 and July 1 of each year. Exposed roots injured by construction activities or grazing are just as likely to result in oak wilt infection as cut branches. If injury occurs, the wound should be treated with a tree wound dressing within 15 minutes or less to reduce the infection potential. A vibratory plow should be used to sever roots along the edge of any construction area prior to beginning work, to prevent the transfer of oak wilt fungus from exposed roots and allow for regeneration at the point of cutting. Tree protection zones should be fenced to prevent entry or compaction by construction equipment. Dirt and materials should not be stored in these areas.

Timber Stand Improvement for Native Woodland/Savanna Communities

Management of woodlands and savannas can take several directions. One approach allows natural succession to continue, and where conditions are appropriate the site will evolve—woodland into forest, savanna into woodland. Another strategy maintains the current condition, whereas the third approach, for woodlands, sets succession back, and converts the site into a savanna. Some suggestions for determining which community type is appropriate are discussed below, followed by information on managing oak woodland and oak savanna.

Criteria to determine is site should be managed for Oak Woodland/Savanna

In sites characterized by large-crowned, spreading bur oak in the canopy, a dense subcanopy of 1 or 2 species (especially if dominated by ironwood) and little to no regeneration of tree species in the understory, management as either woodland or savanna is appropriate. If prairie species appear to be widespread through the site, or if the shade cast by the understory layer is not overly dense and thus residual prairie species or prairie seed bank may be present, a savanna restoration is indicated. A savanna may also be most appropriate for sites that are already savanna-like in character, and need only to have the ground layer restored to prairie species, or where the more open character of a savanna is desired.

Criteria to determine if site should be managed for Oak Forest/Maple-Basswood Forest

Where the subcanopy and understory layers contain a good diversity of tree species with potential to become canopy specimens (sugar maple, red or white oak, basswood, American elm) as well as a diverse layer of subcanopy species (green ash, walnut, bitternut hickory, American elm), management for a forest may be most appropriate. These are sites that already have some of the

composition necessary to become a forest over the next 50 – 100 years. Forest management may also be appropriate on woodlands that are the result of logging or grazing activities and historically were probably forest. These generally will occur on a somewhat sheltered site, and may be immediately adjacent to forested stands. At these sites, follow the management strategies described under "*Timber Stand Improvement for Native Forest Communities.*"

Management for Oak Woodland and Oak Savanna

- Restore Community Structure and Control Invasive Species: eliminate understory trees and invasive shrubs: Understory trees such as ironwood, maple, aspen, or birch should be killed by girdling, to reduce stump sprouts; they may be left standing, for wildlife habitat, or removed. Cut and remove Eastern Red Cedar. Control invasive shrub species by cutting and immediate herbicide application (see Fact Sheets for control of specific species). In areas where the canopy is relatively close and oaks may be injured during the removal of other species, use practices that limit the spread of oak wilt.
- Use Prescribed burn as necessary: Prescribed burns can eliminate cool season grasses and invasive shrubs, and prepare the site for prairie establishment. If a prescribed burn is planned, do not leave woody debris left over from clearing, such as snags, dense brush piles, or red cedar on site, as they can significantly increase fire temperature and contribute to fatal crown fires in the bur oak.
- Revegetation: Once invasive shrubs are under control, monitor for the recruitment of native shrub and forb species from adjacent areas and from the soil seed bank. Several years may be necessary for natural recruitment efforts to become apparent. If, as is likely, exotic species begin to encroach onto the site, planting with native species will speed up the rate of revegetation, and provide competition for non-natives. Local ecotype plant material should be used.
- Maintenance: Since woodland and savanna communities were historically maintained by fire, prescribed burns every 3-8 years will help to reduce invasion by non-native species and mesic forest species. If this is not feasible, hand-control of invasive woody species is required, with periodic mowing of prairie openings and savanna.
- Reduce edge: Although the edge effect is somewhat less pronounced in woodland communities than in forest communities, since the light and moisture regime are not affected so drastically, reducing the amount of edge still allows for better migration of small animals and better plant colonization and dispersal. To reduce edge, minimize the number of roads through a site and keep trails narrow. In areas where two sites are separated by a clearing or trail, allow the target community to colonize the area, either by natural encroachment or by active management. These communities can be attractive home sites, and the home and yard should be situated at the edge or front of the site, rather than inside it. Homeowners can help by controlling buckthorn and other invasive species at the junction of their lawn and the woodland, and by using native shrubs, trees, forbs, and grasses in their landscape plantings. Again, local ecotype plant material should be used wherever possible.
- Grazing: Use grazing practices that enhance native plant establishment and target cool season grasses, by grazing sites early in the season (May – June), when Kentucky bluegrass and brome are actively growing and prairie species are relatively inactive.
- Oak Wilt: Control oak wilt using methods recommended by the Minnesota DNR Division of Forestry. (See discussion under Forest Communities).

Minimize Road/Trail Construction

Localized clearing associated with road, trail, and home and yard construction increases the amount of forest edge. This results in higher light levels within the forest interior, and can favor the establishment of shade intolerant species such as sumac, prickly ash, and buckthorn, as well as eliminate shade-adapted, interior species, affect animal movement patterns, and inhibit plant dispersal into and across the edge area. It favors habitat-generalists and reduces the area available to species that require large areas of interior habitat. Pileated woodpeckers and barred owls are examples of species that have specific habitat size requirements and generally prefer the interior areas of forest communities. Roads and trail alignments within natural communities should be kept to a minimum and should only be as wide as necessary to meet property owner's needs. Where possible, route new roads around the edges of natural areas or use existing trails. In addition, maintain vegetation on the trails to slow runoff rates, and avoid routes that run parallel to the direction of slope drainage.

Protect Standing/Down Snags

A high diversity of bird, mammal, and amphibian species depend on dead or dying snags for at least part of their life cycle requirements. The removal of such snags through intensive forest management practices, negatively impacts such wildlife populations by removing essential components of their habitat. It is recommended that large, hollow trees, especially large oak trees as well as large pine and cottonwood snags be retained unless they pose a safety problem. Downed snags are also important, especially to small forest mammals and amphibians. Where snags do not exist, they may be created by leaving trees intended to be thinned out of a forest or woodland. The easiest way to do this is to girdle the outer bark of the tree, leaving the tree standing. Snags and various nesting structures may also be placed by placing tree trunks, posts, and other structures.

Infiltration Swales/Rainwater Gardens

Infiltration swales are bioretention facilities designed to retain, infiltrate and pretreat stormwater runoff. These systems can be effective at removing dissolved nutrients through biological uptake by plants. These systems generally consist of depressions created by excavating downward into highly permeable soils. The bottom of the hole is then backfilled with a filtering media such as pea rock. Vegetation is then planted within the depression that is adapted to both dry and wet (on a temporary basis) conditions. Rainwater gardens maximize the water quality treatment of stormwater by plants within small depressions. The plants take up significant amounts of both nutrients and water. Most rainwater gardens are planted to native wet-mesic prairie/wetland grasses and forbs.

Water Quality Treatment Pond

Water quality treatment ponds are designed to retain stormwater runoff long enough to enable sediment, and pollutants that are attached to sediment, to "settle out". Properly designed ponds that have sufficient wet storage generally remove as much as 60-70% of particulate phosphorus. Water quality treatment ponds are not generally effective at removing nutrients in dissolved form.

Stormwater Diversion

Where land uses including residential development, commercial development, public infrastructure and agriculture occur adjacent to steep slopes and bluffs, increased stormwater runoff can result in increased discharge of sediment and pollutants to streams, wetlands, lakes and sensitive natural communities. Stormwater discharges can also result in erosion and gullying on steep slopes and ravines. Stormwater diversions are any practices that direct stormwater runoff away from sensitive areas and into stable waterways, retention ponds and infiltration swales.

Stormwater diversions are ideally designed to also function as buffers and are planted to native vegetation as described under buffers.

Establish Streamside Thermal Cover
Summercool streams are dependent on both a reliable groundwater source and shady streambank cover to maintain a cool, year-around supply of base flow. Thermal modeling of stream flows in trout streams shows a clear relationship between quality of streamside canopy cover and water temperature. Where existing streamside thermal cover is present, landowners should be encouraged to protect the vegetation and where necessary, provide additional plantings. Where streamside thermal cover is sparse or has mostly been removed, restoration of the natural community type(s) should be implemented. Trees, shrubs and groundcover species characteristic of the local plant community type should be by established.

Stormwater Bounce Control for Wetlands
Many wetland communities are sensitive to any increase in the magnitude and duration of stormwater bounce. Stormwater bounce, as described here, refers to the increase in water level, and time that the water level remains above normal, following a storm event. Wetland communities such as sedge meadows, fens, wet meadows and bogs are extremely sensitive to changes in stormwater bounce. Many species of wetland plants, especially sedges, are unable to withstand prolonged inundation and will quickly die out following flooding. Other wetland communities, such as cattail marshes, are able to survive both increases in stormwater bounce and increased nutrient loading.

LANDSCAPE LEVEL STRATEGIES

Landowner(s) Natural Resource Management Plan
Landowners of larger holdings and groups of landowners with smaller holdings should consider developing a management plan that identifies land owner goals and objectives, includes a detailed natural resource inventory and recommends natural resource management steps to be taken. The management plan should provide budget estimates, a schedule and possible funding sources. As a general rule, a larger parcel is much more cost-effective to manage that a small parcel; therefore, groups of landowners should work together whenever possible.

Woody/Herbaceous Species (Burn/Herbicide)
Prescribed Burns are deliberately set, managed fires in communities that were historically maintained by fire, such as prairies, savannas, and woodlands. Each of these communities burned with varying frequency prior to European settlement and the concomitant fire suppression. Consecutive early-season burns can severely set-back or kill species that experience their main flush of growth early in the season (including brome grass and non-native Bluegrass species), when temperatures are relatively cool, and favor the establishment and perpetuation of species that experience their main growth during warmer, mid-summer months (including most native prairie species.) Burns can also limit the establishment of woody plant species. An experienced "burn-boss" should be on hand to conduct any large burns, especially if they are near residential sites.

Ravine/Streambank Stabilization (Ephemeral or Perennial Streams)
Ravines or stream systems sensitive to hillslope and instream erosion should be carefully evaluated to determine causes and restoration approaches. The most effective approach is to avoid changes in stormwater runoff and land uses that destabilize the ravine in the first place. Controlling peak flow rates and volume of stormwater discharge to the ravine is critical to

protecting these areas. Placement of roads, trails and utilities should be done carefully to avoid altering runoff patterns or exposing steep slopes to erosion. Where ravines contain excessively well drained colluvium soils that are infertile and have a low pH, establishment of vegetation can be difficult due to the poor site quality. Forest and woodland management may be necessary to lower tree density and provide more opportunities for deep rooted grasses and forbs to become established. Many of the conifer plantations, established during the WPA days, are now essentially monotypes of only the conifers that were planted, with little or no groundcover or shrub species present. These plantations, which are susceptible to windthrow, could once again become series erosion problem areas.

Stormwater Rate Control

Stormwater rate control of both direct and indirect inputs provides the largest source of flood control protecting downstream users. As areas develop, stormwater runoff typically increases. Impervious surface coverage increases and natural infiltration of stormwater decreases. The tiling of agricultural lands has a similar effect. Drainage is more efficient, thereby increasing the volume and the rate at which water is removed from a site. Increasing the delivery rate, or time of concentration, can result in an earlier peak, with a significantly larger quantity of water. The creek becomes "flashy", quickly rising during storm events and then falling shortly after.

Controlling the rate at which stormwater is released to the creek reduces the magnitude of the peak, thereby mitigating flooding, and reduces both in-stream and hill slope erosion. Rate control also reduces the transport of sediment, which affects water quality. Sediments can cloud water (increasing turbidity) that is harmful to aquatic health and often carry pollutants such as phosphorus and nitrate.

Stormwater Volume Control

Control of stormwater volume mitigates erosion both in-stream and on hill slopes, and helps maintain base flows in creeks by providing groundwater recharge. When only rate control and not volume control is applied to stormwater, increases in the total volume of stormwater runoff lengthen the time it takes for the peak to pass. Maintaining elevated flows for long periods results in increased erosion damage.

Erosion is reduced by limiting the total volume of both direct stream inputs, such as culverts or tile outlets, and overland flow through drainage swales and gullies. Stormwater retained on site is allowed to infiltrate which improves water quality by naturally filtering water and by reducing the transport of sediment. Infiltration also helps to maintain creek base flows, important for aquatic health, by recharging groundwater.

Pretreatment of Urban Runoff for Water Quality

It is important to provide pretreatment of urban runoff in order to prevent or minimize the flow of harmful pollutants into downstream lakes, wetlands or creeks. Urban runoff often contains pollutants such as phosphorus, nitrates, salt, sediments, heavy metals, and toxic substances including oil, grease and other automotive fluids.

Reduce Nutrient-Inputs and Sedimentation: Use wide buffer strips planted with deep-rooted, native prairie vegetation around agricultural fields and pastures to slow the rate of run-off and increase infiltration before surface water encounters wetlands. Avoid over-grazing fields, as stands of vegetation slow runoff rates. Homeowners should be educated about appropriate timing and application rates of fertilizers, as residential use can contribute significant amounts of

nutrients to a system. Using constructed facilities such as treatment ponds and following recommended

Pretreatment of Agricultural Runoff for Water Quality
Non-point source pollution from farmlands has been recognized as the leading source of water quality degradation. Pretreatment of runoff through Best Management Practices (Appendix A.3) and treatment facilities helps maintain and improve water quality by minimizing the delivery of harmful pollutants. Agricultural runoff often contains high levels of nutrients such as phosphorus and nitrates that can over stimulate algae growth resulting in unsightly algae mats, odors, and reduced dissolved oxygen (DO) which is necessary for maintenance of aquatic life. Other pollutants include sediments, pesticides, organic matter (crop residue) and bacteria.

Create/Restore Greenway Corridors
Developing a corridor system offsets some of the effects of fragmentation, by developing a continuous network of natural habitat for plant and animal migration and aesthetic benefit. Within the corridor, restoration and reclamation efforts can enhance the value of the network by improving natural community quality and creating connections between otherwise isolated sites. Restoration and reclamation efforts are not a substitute for preserving high-quality areas, because the complexity of natural systems cannot be easily duplicated, but they can complement existing sites or help tie them together.

Restoration or Reclamation of Corridors
Restoration efforts are generally targeted at improving existing communities, by implementing exotic plant control, thinning, prescribed burn, or other strategies discussed here. Reclamation efforts involve creating a community of native species associates where none currently exists, such as planting an old field with prairie species. Both types of effort can significantly improve the habitat and water-quality impacts of a site. When the sites are part of a corridor network, these effects can be magnified across the landscape and create extensive pathways for plant and animal migration.

Protection of Natural Areas
Protection of existing high quality areas is one of the most important aspects in land management, because these areas cannot be recreated. Because of the complexity of species composition and distribution patterns in a natural community, and because there are so many unknown variables (soil condition, soil microorganisms, niche and micro habitats, species interactions, etc.) that create a natural community, restoration efforts can not replicate a system that has evolved, in many cases, over thousands of years. Since many of these areas are now small and isolated (See Fragmentation), they are more vulnerable to impacts, and activities in these sites should be carefully planned to minimize disturbances.

LAND PROTECTION TOOLS

The following section provides a brief summary of various programs designed to assist individuals who are interested in exploring land protection options. More complete information on these and other programs is available in the Appendix

Conservation Easements
A conservation easement is the voluntary and permanent transfer of specified development and land use rights from a landowner to a qualifying organization. It functions to 'assure [the land's] availability for agricultural, forest, recreational or open space use, protect natural resources,

maintain or enhance air or water quality, or preserve historical, architectural, archaeological or cultural aspects.' To be eligible for an easement, land must be evaluated by a conservation organization and determined to have qualities that serve these purposes. Easement provisions may limit certain activities on a property, depending on how the easement is structured. In general, the terms of an easement are designed to reflect the wishes of the landowner while providing meaningful protection for the significant features of the land.

Conservation Reserve Enhancement Program (CREP)/
Reinvest In Minnesota (RIM) Reserve Program

The federally funded Conservation Reserve Enhancement Program offers incentives (long-term rental payments and cost-sharing of up to 50 percent) to farmers who retire highly erodible farmland from production and establish permanent grass or forest cover on the land. Duration of agreements range from 10 to 30 years. Fields must meet eligibility requirements, and there is a limit to the number of acres admitted into the program each year. For information, contact your local Natural Resource Conservation Service (Note: This agency was previously known as the Soil Conservation Services or SCS).

Restoration Cost-Share Programs

A restoration cost-share program compensates a landowner for a percentage of the cost involved for projects undertaken to restore and protect natural areas on private lands. The majority of such programs focus on:

- Protection of wetlands and their associated upland communities
- Habitat enhancement for game species
- Management of forest lands for timber production, and
- Selected conservation practices on lands enrolled in land retirement programs.

Cost sharing is provided for a variety of landowner activities, including establishment of vegetative ground cover for erosion control, restoration of drained and degraded wetlands, and planting of native trees and shrubs. As is the case with land retirement programs, restoration cost-share programs are typically offered through government agencies and, therefore, are subject to similar limitations as to funding and availability.
Restoration cost-share programs include:

- Partners for Wildlife
- Pheasant Habitat Improvement Program
- Stewardship Incentives Program (SIP)

Deed Restrictions

A deed restriction defines specific limits regarding allowable uses and development of a property. It is established by a landowner on a property's title, typically when the landowner is selling the land and wishes to exert some influence over its use, usually to benefit adjacent lands to which he or she intends to retain title. State law presently limits enforceability of deed restrictions to 30 years (with exceptions defined in MN Title Standard No. 91A). They are subject to interpretation and nullification by the courts and are most practical in situations where the original landowner or the landowner's heirs own adjacent land and are in a position to observe and enforce any violation. There are generally no tax benefits.

Mutual Covenants

A mutual covenant is a type of deed restriction involving a legal agreement between two or more landowners in which the same set of restrictions govern the development and use of all involved properties. Also subject to the 30-year rule, it must be periodically renewed by agreement of all properties. There are generally no tax benefits.

Planning and Zoning

Planning and zoning efforts are regulations that govern local land use, and generally dictate the types of use that can be conducted in an area (agricultural, industrial, residential, etc.). Planning and zoning can also place restrictions on the use of certain areas. For example, the county or township may permit building along bluffs, but may require a minimum setback from the bluff edge in order to limit erosion problems and protect slope stability. The City, landowners, and developers can use the NRI to identify key natural resources and preserve/restore them as part of the subdivision and land development process. The NRI findings may suggest the need for additional development standards or policies to protect a certain area or resource. During the subdivision process the City has the option to require dedication of land for public park or open space purposes or to require a cash park dedication fee be paid in lieu of land dedication. The NRI information can help guide that decision making regarding land or cash dedications.

Purchase/Transfer of Development Rights

The Purchase of Development Rights Program allows a landowner to sell their development rights to a land trust or other local government agency, which awards the landowner certain tax break benefits. The purchaser then retires any development rights and a deed restriction is placed on that property. This action ensures that the land will permanently remain free from development, continuing its use as open space, agricultural, or other similar status.

The Transfer of Development Rights Program is similar in that it protects historical and natural resources (such as open space and agricultural land) from development. The process differs in that it prevents potential future development of a certain parcel of land, in exchange for the development rights to another piece of property. Although this statute has not yet been passed in Washington County, this program has the potential for offering landowners and local government another option for preservation.

DNR Forest Stewardship

The DNR Forest Stewardship Program is designed to provide technical advice and long range planning to interested landowners. All aspects of the program are voluntary. Stewardship plans are developed with the assistance of local DNR foresters, and are designed to meet landowner goals while maintaining the sustainability of the land. For more information, contact the DNR forester for your area or visit the US Forest Service Web Site at willow.ncfes.umn.edu/woodstew

DNR Neighborhood Wilds

This program provides an opportunity to restore ecosystems and improve neighborhood habitat in urbanizing areas of the seven-county metro area. It focuses on community-wide, grass-roots efforts that work across property lines to limit fragmentation and develop corridor systems. It encourages landscaping and land use planning that enhance wildlife value, by improving corridor systems, incorporating native plants, and using landscape-scale planning, rather than emphasizing individual lots. Contact the DNR forester for your area for more information.