

**Assessing the ecological impacts of ATV trail construction and use on  
public lands: factors to consider and a review of the literature**

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## I. Introduction

This document is intended to provide a summary of the *potential* impacts of All Terrain Vehicles (ATV). The intent is to describe 1) the potential impacts of *trails themselves as physical entities*, 2) the potential impacts associated with *the use of the trails*, and 3) *the potential impacts to nearby areas when ATVs are driven off-trail*. Impacts are analyzed in a generic sense rather than evaluating the effects of a specific proposed trail system. It contains methodology for addressing the impacts of linear facilities such as trails, including suggestions for selecting routes that minimize impacts to ecological features. To some extent, the information is also relevant to Off Highway Motorcycles (OHM), and 4-wheel drive road vehicles. However, the primary topic is ATVs, and some of the material may not apply to these other motorized recreational activities. Finally, this analysis focuses primarily on the impacts associated with the establishment and use of designated ATV trails, rather than the more dispersed (in time and location) ATV traffic that is ancillary to other recreational or commercial pursuits such as hunting, trapping, berry picking, timber management, or leeching.

To adequately assess ecological impacts<sup>1</sup>, it is necessary to gain some understanding of how and why ATVs are actually used by recreationists, the characteristics of ATV trails and the process of trail design, and the influence of the magnitude of use. Part II of this paper comprises an analysis of these factors. Parts III and IV continue with an analysis of potential impacts, based on pertinent literature and first-hand experience of Environmental Review staff.

It should be kept in mind that *some* of the potential impacts of ATVs can be reduced or perhaps eliminated (mitigated) with Best Management Practices (BMPs). The intent here, however, is to describe reasonably foreseeable impacts of ATVs, a step that must come *prior* to the development of final BMPs. A portion of the DNR's draft trail BMPs (currently under development) is attached as Appendix A because of its relevance to trail siting and impact reduction (Chapter 3, Physical Sustainability of Natural Surface Trails).

## II. Characteristics of ATV technology and use that influence assessment of impacts and selection of trail routes

An assessment of impacts must begin with an understanding of the physical features of the recreational facility. Perhaps most importantly, it is important to understand how such a facility is proposed to withstand traffic. The failure of some trails to adequately support motorized traffic has been observed in Minnesota to be a primary source of major adverse impacts. The discussion in this section is focused on five factors related to understanding impacts: ATV technology and uses, trail width and durability, project "life", ATV traffic level effects, and regulatory and enforcement effectiveness.

**II.A. ATV technology and its uses.** An assessment of potential impacts of ATV trails and their uses needs to be cognizant of the technology itself and the manner in which its enthusiasts use it. This is particularly relevant to the type and severity of impacts. This section addresses impact issues in relation to ATV purpose, how they are being used, and the challenge of designing an attractive *trail* for a vehicle designed for *off-trail* use.

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<sup>1</sup> Impacts to fisheries, wildlife, and native plants and plant communities will be referred to collectively as "ecological impacts" for readability, except when specifically noted.

ATVs are very good at doing just what the name implies: traveling across landscapes without trails, where other larger and heavier vehicles cannot go. They are geared down to creep over obstacles, can accelerate rapidly, their tires are knobby to grab and pull. Tires are often wide so they won't sink in muck, and their undercarriage is designed to slide across and push down obstacles such as brush, woody debris, and small trees. Advertisements for the vehicles often show them overcoming such obstacles. For some users, riding an *all terrain* vehicle on a designated trail may seem contrary to the recreational purpose of the machine. In a sense, a trail for ATVs is somewhat of a non sequitur, i.e., a conclusion that doesn't follow from its premise. From a regulatory and impact assessment point of view, this means that an objective assessment must take into account off-trail impacts as riders merely do what their machines are designed to accomplish.

Because of their design and weight, ATVs operated off trails on public lands are capable of causing heavy environmental damage compared to other recreational uses of public lands. In the course of being operated in this manner, sod and surface vegetation is churned up, soil is exposed, wetland functions compromised, and sediment transported into streams and other water bodies -- because of the inherent design of the vehicle, and the desire of some users to overcome obstacles with their machines. Thus, after a trailblazer starts a new trail, only a few additional passes results in the appearance of an obvious trail, and, a small "road" or trail comes into existence. On hillsides, for example, such a trail becomes an immediate site of gully creation, and a source of sedimentation. This activity is ongoing in forested lands, creating permanent sites of degradation, while other intense activities such as timber harvesting are infrequent events with long recovery times.

The challenge of keeping all terrain vehicles on trails appears to a major problem all over the United States. This is clearly recognized as a major challenge in trail design in the Draft Guidelines, and noted in discussion with its author (Parker 2002). Ironically, to keep challenge-seeking riders on the trail, the trail may have to purposely traverse environmentally sensitive areas such as steep hills and wetlands. Locating a trail system in less environmentally damaging areas may fail to achieve its overall purpose of impact reduction if the users leave the trail seeking more challenging riding.

ATV travel across lands without following designated trails is a major issue in many states (e.g. Joslin and Youmans 1999 and the two specific studies described below.) The adverse impacts caused by off-trail use are not necessarily caused by large numbers of ATV users causing damage; rather it is more likely a function of *some* users merely doing what the machines are designed to do best, and the fact that the vehicles are inherently individually capable of causing substantial environmental impacts because of the nature of the technology.

In a review of motorized recreation in Maine, Vail (2001) compared Maine's successful attempts to manage snowmobile environmental damage and conflicts with other users with its mostly unsuccessful attempt (so far) to transfer this model to ATVs:

*"Extending the Snowmobile Governance Model to ATVs. All-terrain vehicle drivers currently have a reputation for lawlessness similar to snowmobilers in the 1970s. However, since ATVs can—and do—go virtually anywhere at any time of year, they have proven more difficult to tame. An unruly minority have provoked hostility among large and small land owners, as well as snowmobilers, back country camp owners, and other recreationists. They trespass on posted land, chew up snowmobile trails, silt up salmon spawning streams, and harass hikers and bikers. . . . (Maine has 40,000 registered ATVs, up 110% since 1990, and many more are unregistered.)"*

*"Responding to complaints. . . .the Department of Conservation is attempting to replay the strategy that worked effectively with sledgers. It urges ATVs to join clubs, encourages the clubs to police trails in their locales, offers courses on rules and safety at clubs and in secondary schools, and channels part of ATV registration fees back to the clubs for trail maintenance. Thus far, the initiative has had limited effect. With nearly half as many registered ATVs as snowmobiles, there are just one-seventh the number of ATV clubs and one-tenth the number of club members. . . . The monitoring and enforcement problems mentioned above strengthen ATVer's incentive to free ride. And the minimal need for a highly developed trail infrastructure, in contrast to snowmobilers, limits the incentive effect of Trail Grants. To date, ATV driving is not as much a family-and community-based activity as snowmobiling, so the DOC has also been unable to get much leverage over ATVer's attitudes and behavior through group activities. One consequence is that a growing number of landowners, large and small, are posting land and gating trailheads, a form of retaliation that adversely affects all kinds of back country recreationists....."(Vail 2001.)*

In a study of impacts of trail users on public lands in Indiana, Mortenson (1989) studied the impacts of hiking, camping, horseback riding, and other uses on the 58 mile long Knobstone Hiking Trail. He noted that, in spite of ATV traffic being prohibited from the trail, *"The most striking impact was pervasive damage by off-road vehicles, including tread widening, entrenchment, and soil exposure."* He noted the prevalence of tread widening in response to motorized vehicle use (OHV and ATV) on hillsides, and described an area where the trail had become about 130 feet wide.

**II.B. Trail alignment, width and durability.** The imprint on the landscape from a facility is a major starting point for assessing potential impacts of any project. Just as one of the first environmental review questions to a road authority is a request for a Plan/Profile design sheet, so is this necessary for an ATV trail. An ATV trail's alignment, width and its ability to withstand traffic are important, fundamental factors in understanding potential impacts. Trail alignment is obviously a major determinant of potential impacts and is a critical aspect for review (see Section III.A. for additional information). In some previous reviews, proposed ATV trail routes in state forests were selected primarily because there were already trails present, such as skid trails, snowmobile trails, or trails established by informal ATV use. While there may be logistic, economic and environmental benefits to utilizing existing trails, a thorough environmental analysis should evaluate whether the existing trail is a good place to put a permanent ATV trail. According to the author of the draft Trail Guidelines, snowmobile trails are often poor locations for ATV trails (Parker 2002.)

Much of the current controversy in Minnesota concerns erosion on hillsides and rutting or mudhole formation on trails in wet areas and wetlands. Both of these phenomena result in wider trails, greater impacts, sedimentation of streams and wetlands and soil exposure. At all locations where these occur, the common denominator is that the trail's design could not withstand the traffic that was occurring.

This is both an impact assessment and regulatory compliance issue. Under the Clean Water Act, facilities must meet stormwater standards designed to control erosion and prevent sediment from entering water bodies.

These factors are addressed by the draft Trail Guidelines, Chapter 3, as follows:

*"Physical sustainability for Natural Surface Trails. . .Paramount factors (for trail*

sustainability) are trail alignment and tread drainage built into that alignment. Natural surface trail failures are almost always due to poor trail alignment or an inability of the trail surface to withstand use by visitor's modalities (which is itself partly an alignment problem.). . .Loams... are the most common components of soils in Minnesota's state forests. These loams are classified as weak soils with little internal bonding... Trail tread material can optionally be strengthened by supplementing or replacing it with stony material or a number of other techniques."

"Sustainable tread design and maintenance has four objectives that work together:

1. Drain water off the tread before it accumulates.
2. Stay within the ability of the tread material to withstand both user-induced and natural forces with only limited change over time.
3. Use rolling grade to self-limit trail erosion in a series of small, independent tread watersheds. (Note: "rolling grade" means dips and rises in the trail so that all micro-watersheds contributing to the exposed soil are small.)
4. Ensure that tread drainage is sustainably designed and maintained."

(4/25/2002 draft, see also Appendix A of this memorandum.)

This quote illustrates that options and choices made in trail design can help confine the trail to its intended landscape footprint. Conversely, if these objectives are not followed the trail's footprint will become larger, and adverse environmental impacts will occur. In fact, there is little choice but to follow these guidelines, since other linear facilities designed for motorized traffic (such as roads for larger vehicles) are all designed to prevent instability, erosion, and other environmental damage.

Resource managers reviewing specific trail proposals can use the draft Trail Guideline objectives identified above to reduce impacts. Trail segments that do not meet these objectives should be discussed, and determinations made as to why the trail would be built to lesser standards that would cause preventable impacts. In our experience so far, trail proposals we have reviewed fail to meet Objective 2 most frequently. In addition, some ATV trail segments that follow snowmobile trails are problematic with respect to Objectives 1 and 3. A clear choice indicated in the draft Trail Guidelines is to move the trail to a more suitable location and restore the vegetation at the former site.

How to assess the physical size of proposed trails and their associated impacts is currently unclear. ATVs theoretically require smaller trails than 4-wheel drive road vehicles. In previous reviews of ATV trails, trail developers have proposed trail widths ranging from 3 to 8 feet. However, many ATV segments are wider than this and could easily accommodate a 4-wheel drive vehicle. This may occur for the following reasons:

- the ATV trail is also a snowmobile trail. Snowmobile trails resemble small forest roads;
- The ATV trail is placed on a skid trail, and existing users expand into the space available;
- The ATV trail is proposed to be on a trail developed by informal use which users have widened;
- The trail was constructed for or modified by users to accommodate two-way traffic;
- The trail is on a steep, eroded hill, or in a wetland or mudhole, and has undergone widening

as travelers avoid gullies and deep mudholes.

Some segments of these trail proposals are inherently unstable: erosion will enlarge them. In addition, they traverse weak soils, with no provisions for hardening. Rutting and trail enlargement will result (See Appendix A).

**II.C. Project life.** It is necessary to look at impacts of ATV trails, and use of trails in the context of "life of project". Discussion and debate about specific routes is often based only on immediate considerations, such as current forest conditions, and current existing trails. Such an approach does not fit environmental assessment practices, and may well result in a trail being located in inappropriate locations.

For example, a trail segment on a steep slope above a stream or wetland that does not meet the criteria for sustainability described in Section II.B., will be a chronic source of significant sediment impacts to the stream and wetland. Over time, this could result in severe damages and conversion of the wetland to upland because of sedimentation. (Page 3.8 of Appendix A notes that "20 or more tons" of sediment washed into a trout stream from the gully on bare soils on the slope above the stream.) Such a site is also susceptible to noxious weed infestation *during the life of the project*. The footprint on the land of such a trail is substantially larger than a sustainable trail, and poses serious risks to nearby aquatic habitats *for the life of the project*. Furthermore, this is a preventable impact by re-routing the trail, or by specific design features at the site (See Appendix A.)

Trail location should be selected based on an awareness of impact potential and resource risk over the life of a project. Often, for the sake of planning and environmental assessment purposes, a project life of 50 years is used. A typical choice then would be do we want to select a location that has a constant future risk of severe erosion, such as siting an ATV trail segment on a snowmobile trail that runs straight up a hill, because the trail is already there? Or do we want to build it according to the above-described principles, which likely means building it elsewhere?

**II.D. ATV traffic levels.** Severity of impacts to fisheries, wildlife and native plant communities is fundamentally and directly related to levels of traffic on trails. The higher the traffic level, the greater the impact severity. Examples of adverse impacts directly related to traffic levels are:

- Noise and other disturbance impacts to wildlife,
- Impacts to adjacent areas from off-trail excursions: the higher the traffic level, the greater the numbers of off-trail excursions,
- Effects on vegetation and wildlife from pollution associated impacts.

Intensive trail use can make any one of these types of impacts significant, whereas with low traffic levels, these impacts might not be very important.

As yet, no estimates of traffic levels for specific ATV trail projects have been provided. Yet trail systems like the Spider Lake area seem to have high traffic levels, especially on weekends.

Therefore, for the sake of understanding impacts, it is assumed that there will be frequent, near capacity traffic on weekends on these trails throughout the open season after the trail system is

established and advertised. This assumption may not hold as additional ATV trail systems are developed, but will likely reflect reality for the first few trails.

**II.E. Enforcement.** Enforcement of trail closures and off-trail prohibitions is being recognized as crucial with respect to both current problem areas, and for the future after trails are established. For several reasons, enforcement needs to be clearly identified as a means of *mitigating impacts*:

- Viewing enforcement as a mitigation measure immediately places it in the proper perspective: is it achieving adequate reduction of impacts? Measures can then be developed to evaluate success. (This is particularly crucial given the current and projected shortage of conservation officers.)
- Viewing enforcement as being unproven until proven as a means of reducing impacts will allow a rapid assessment of whether to seek additional legal authority, such as vehicle confiscation, or, for example, designation of a new kind of pursuit vehicle. (Currently, Conservation Officers cannot legally pursue an ATV running away because the only legally authorized pursuit vehicle is a road vehicle such as a squad car or pickup equipped with emergency lights and siren.)
- Listing it as a mitigation measure that will be measured and adjusted accordingly will allow the DNR to use it in the MEQB decision process as to required findings about whether EIS's are needed.

### III. Ecological Impacts of ATVs

This section will summarize impacts that have been directly documented for ATVs, as well as use applicable information developed during research of other related linear facilities. It will include some references to how mitigation measures can address the impacts

**III.A. Relevance of research on impacts of roads.** An ATV trail causes many of the same *types* of ecological impacts as are caused by roads, although the *magnitude* of the impacts is usually (not always) less, and some of the impacts of roads are negligible for ATV trails. However, ATV trails that are also groomed snowmobile trails are essentially small roads and have equivalent impacts. During our review of proposed ATV trails in the White Earth area, we observed snowmobile road widths of 30 feet (including the bulldozed area) where snowmobile trails followed side-hills. An experimental segment of the Moosewalk snowmobile trail (Lake County) is more than 50 feet wide. Some new sections of ATV trails overlap such snowmobile trails.

In a study of forest roads in the Appalachian mountains, Haskell (2000) notes that the data collected "... suggest that even relatively narrow roads through forests can produce marked edge effects that may have negative consequences for the function and diversity of the forest ecosystem." The roads this author studied ranged from 9-22 feet, with a median width of 12 feet (Haskell 2002.)

The basic reasons for the similarity in impact type are:

- Both facilities are linear facilities devoted to motorized traffic -- both involve traffic noise and disturbance, and can cause direct mortality from collisions and crushing of wildlife species;

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- Both involve substantial changes in soils and creation of linear edges that act as barriers or corridors;
- Both fragment habitat (if constructed in natural plant communities and/or wildlife habitat);
- Both facilitate the introduction of exotic species – linear facilities cross a variety of habitats and create disturbed conditions, providing an ideal route for dispersal.
- Both can result in chronically exposed soil on hillsides, alter local hydrology, and be a chronic source of sediment to water bodies (if not properly built);
- Both can alter drainage patterns.

The understanding of the ecological impacts of roads was strongly enhanced by research published in the February 2000 issue of *Conservation Biology*, which contained a special section on this topic. Studies published in this journal will be specifically cited in the sections below. It is stressed that the intention is not to infer that the magnitude of impacts from roads and highways is the same as the magnitude of impacts of ATVs – clearly this is not the case. The abstract of the overview article in this issue provides a useful summary of the types of ecological impacts, and these are indeed similar between these two kinds of traffic facilities:

*"Roads are a widespread and increasing feature of most landscapes. We reviewed the scientific literature on the ecological effects of roads and found support for the general conclusion that they are associated with negative effects on biotic integrity in both terrestrial and aquatic ecosystems.*

*Roads of all kinds have seven general effects: mortality from road construction, mortality from collision with vehicles, modification of animal behavior, alteration of the physical environment, alteration of the chemical environment, spread of exotics, and increased use of areas by humans.*

*Road construction kills sessile and slow-moving organisms, injures organisms adjacent to a road, and alters physical conditions beneath a road. Vehicle collisions affect the demography of many species, both vertebrates and invertebrates; mitigation measures to reduce roadkill have been only partly successful.*

*Roads alter animal behavior by causing changes in home ranges, movement, reproductive success, escape response, and physiological state. Roads change soil density, temperature, soil water content, light levels, dust, surface waters, patterns of runoff, and sedimentations, as well as adding heavy metals (especially lead), salts, organic molecules, ozone, and nutrients to roadside environments. Roads promote the dispersal of exotic species by altering habitats, stressing native species, and providing movement corridors. Roads also promote increased hunting, fishing, passive harassment of animals, and landscape modifications.*

*Not all species and ecosystems are equally affected by roads, but overall the presence of roads is highly correlated with changes in species composition, population sizes, and hydrologic and geomorphic processes that shape aquatic and riparian systems. More experimental research is needed to complement post-hoc correlative studies. Our review underscores the importance to conservation of avoiding construction of new roads in roadless or sparsely roaded areas and of removal or restoration of existing roads to benefit both terrestrial and aquatic biota." (Trombulak and Frissell 2000.)*

One would be hard pressed to find any *type* of impact mentioned in this abstract that is not also applicable to ATV trails, or portions of trails, except perhaps including heavy metals and salt as pollutants. It is therefore useful as a checklist.

**III.B. Impacts of linear facilities.** Simply by nature of their shape, linear facilities such as roads, trails and utilities have a set of relatively unique considerations.

**III.B.1. Siting and route selection.** All else being equal, impacts for linear facilities often result in greater ecological impacts than for fixed-location facilities:

- Unless an area is a uniform ecological feature, an unlikely event, the impacts of a linear facility are not confined to one habitat type.
- Simply in order to "get here from there", a linear facility must at times be sited in an environmentally unfavorable location that would have been avoided, compared to a fixed site facility. A related issue is that routing around a sensitive ecological feature is likely expensive, or may not be compatible with design features;
- Substantial analysis must be done up front on any given route of a linear facility to identify "project stoppers" at a given segment, since if one is found late in the process, the whole "facility" is not feasible until an alternative route is selected. If a very environmentally or culturally sensitive feature is discovered late in the design process -- for example after there has been agreement among multiple property owners or land managers -- it is very difficult to avoid damaging the site. Impacts zones of fixed facilities are much easier to determine early in the environmental assessment process.
- Linear facilities provide a singularly effective route for the spread of exotic species into a great variety of habitats.
- Linear facilities provide a ready-made travel route for predators, increasing their effectiveness at finding and surprising prey species, and locating nests.

**III.B.2. Ecological impact zones for linear facilities.** Extensive studies of the ecological impacts of roads have led to the development of the concept and mapping of impact zones, or road-effect zones. (Forman 1999 **citation needed**; Forman and Deblinger 1999.) This concept applies equally to ATV trails. For example, a trail that passes through a wetland buffer zone (see section below on wetlands) would have at least some adverse impacts to the wetland as a whole, since amphibians populating the wetland would be subject to higher mortality from being run over, and because of losing important buffer habitat. This "trail effect zone" in the wetland would be even more severe if regulatory enforcement is unable to stop the current behavior of ATV riders driving into wetlands.

A second example is a trail that passes through a grassy forest opening. This site would be susceptible to infestation and spread of the exotic weed species spotted knapweed into the entire area of the grassed opening. From a plan or "bird's eye" view of a trail system, mapping ecological impact areas would indicate impact zones extending hundreds of feet in some instances, and a relatively small distance in others.

**III.C. Landscape scale effects** [Placeholder -- need some information on the overall and cumulative effects of trails and roads at the landscape scale. What are ecological implications of

various densities of roads/trails and other human disturbance on natural landscapes?

**III.D. Physical alteration of the landscape.** ATV trails and traffic on them can result in direct alteration of the landscape in a number of ways, which in turn cause ecological impacts. Determining the ecological significance of placing a trail in any given area basically cannot be done without first assessing whether the trail facility itself is physically stable, and determining whether its users will stay on the trail. A crucial point – in fact *the* crucial point – for determining the magnitude of the physical alterations of the landscape concerns whether or not the trail is successfully built according to the criteria described in Section II.B. If it is not built in this manner, the landscape in which the trail is located will continue to be altered by erosive forces exacerbated by the trail and by responses of trail users to the obstacles created by these factors, during the years it is in use.

**III.D.1. Construction of the trail.** ATV trails in hilly terrain to a greater or lesser degree involve initial landscaping. If built according to the sustainability criteria of the DNR's Draft Trail Guidelines, this will involve side hill cuts. Trails constructed according to these criteria on level ground and on weak soils will involve some sort of armoring or hardening, likely with material brought to the site if it is not present (such as crushed rock.) Another factor associated with the construction of the trail is the trail width. Although the width necessary to accommodate ATVs is relatively narrow, eight feet or less, the actual impacts from construction are dictated by the size of the construction equipment and the methods of construction, which may result in a considerably wider impact zone.

**III.D.2. Soil compaction.** ATV traffic results in soil compaction, especially on certain susceptible soils and wetter soils. Soil compaction results in increased runoff and can lead to increased erosion on lower portions of the trail. Soil compaction around the rooting zone of plants can also adversely affect vegetation alongside the trail. (Douglass, Hamann, and Joslin 1999. **citation needed**)

**III.D.3. Soil erosion.** A fundamental issue regarding ecological impacts of ATV trail systems is the determination of the susceptibility of the trail to erosive forces. Studies have documented cases where ATV trails are improperly designed, or placed on skid trails or old roads, create large gullies, result in many tons of topsoil movement downstream, including into streams and wetlands. This is occurring in Minnesota in the Spider Lake area, and is documented in the draft Trail Guidelines. (See Appendix A)

Trails built in locations susceptible to erosion will result in sediment reaching streams and wetlands, will continue to have chronically unstable slopes with exposed soils, and will result in enlarged trails. (See Douglas, Hamann and Joslin, 1999 and Mortenson 1989.) There is evidence that trails and roads built in such areas will continue to cause adverse ecological impacts for years to come. A study done by the Forest Service determined that roads that had been abandoned 30-40 years before that were rehabilitated with landscaping withstood large precipitation events while other such long abandoned roads continued to fail and degrade streams (Harr and Nichols 1993.)

**III.D.4. Tread widening.** ATV trails receiving high traffic levels become wider if they are built on weak soils and steep slopes, creating a larger impact zone. (Mortenson 1989, Draft Trail Guidelines 2002)

**III.E. Impacts to vegetation.** On a nationwide basis, travel by ORVs on public lands is a substantial nationwide problem. Douglas, Hamann, and Joslin (1999) have provided a good literature review of the impacts to native vegetation from motorized traffic. This should be consulted for a more complete description, but here are extracts:

*"Vegetation suffers directly and indirectly from passage of. . . (ORV's). The effects can last*

decades or even centuries (Blackburn and Davis 1994 **citation needed**.) A report by the White House Council on Environmental Quality (**citation needed**) states 'ORVs have damaged every kind of ecosystem found in the United States. . . ' Blackburn and Davis states 'There's a strong correlation between damage to soil and damage to vegetation. Compaction and erosion, for instance, influence the ability of plants to take up nutrients and carbon dioxide, experience proper root growth, and have enough stability to grow upwards...Unless regulations exist and are strictly enforced, users will choose their own routes and hillclimb areas. Unfortunately, they select areas for their challenge, not for their soil type and stability.'

"A controlled study by Leininger and Payne (1971 **citation needed**) showed that forbes were damaged by ...ATVs most significantly in early fall. Shrubby species were impacted most during spring and early summer. Graminoids were least affected from vehicle travel. Eight passes with a vehicle caused significant loss of shrub cover. ORVs and other severe disruptions destroy the balance (of plant relationships) and make it impossible for the plants to continue to coexist. Some plants are better able to endure the presence of ORVs than others.....These plants flourish while more sensitive species disappear."

**III.F. Effects on macroinvertebrate soil fauna.** Understanding of ecosystem dynamics has reached the point where ecologists are beginning to determine cause-effect relationships for previously puzzling declines in ecosystem health. Sometimes obscure relationships have profound effects on the forest. A study of the impacts of small forest roads in hardwood forests has determined that soil macroinvertebrate populations are affected up to 100 meters from these small roads, which averaged about 12 feet in width (Haskell 1999. **citation needed**).

ATV trails where widening has occurred would be expected to have similar effects. While the ecological significance of this sort of change is difficult to determine, this report demonstrates that impacts of even small trails and roads do not stop at the trail edge.

**III.G. Exotic/Invasive species.** The ecological damage caused by exotic plant species has been well documented, and need not be documented here. ATV trails and other such linear facilities enhance the spread of exotic species. This happens in two ways: by carrying seeds of exotic species on machines; and by changing habitats and soil conditions in ways that favor invasion of exotic species.

**III.G.1. ATVs carrying seeds of exotic plant species.** ATVs can carry seeds of these species into areas where they are not presently found. For example, in parts of Minnesota containing grasslands--both native grasses and pastures--the exotic plant spotted knapweed is a growing threat. Spotted knapweed in Minnesota has been identified as a "severe" threat in Minnesota's Report and Recommendations of the Interagency Exotic Species Task Force, and has been termed an ecologically harmful species (Rendall 1992) Spotted knapweed is present in the rights of way of numerous roads in (for example) Clearwater County. ATVs commonly use these road rights of way.

A study by the Montana State University Extension Service found that, "People and their motorized vehicles are a major cause of knapweed spread in Montana. Vehicles driven several feet through a knapweed site can acquire up to 2000 seeds, 200 of which may still be attached after 10 miles of driving. It is imperative to wash the undercarriage of vehicles that have been in weed-infested areas. Dispersal of weed seeds can be minimized by not driving, walking, or trailing livestock through weed-infested areas." (Duncan, et al. 2002.)

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Purple loosestrife is another ecologically damaging species that infests wetlands, and currently is not nearly as abundant in northern Minnesota wetlands as in southern Minnesota, with some of the Minnesota and Mississippi river bottom lands having very severe infestations. It also produces abundant seeds. ATVs that have driven through purple loosestrife infestations in southern Minnesota and have been transported to northern Minnesota for recreation on a trail system, could well carry purple loosestrife seeds into wetland fringes not presently infested with purple loosestrife. In turn, if such infestations are not checked, expansion into other wetlands or lake edges could occur.

**III.G.2. Role of disturbance in spreading invasive species.** Trail use and construction, as well as off-trail use that results in bare soil or vegetation destruction, creates conditions that favor the invasion of exotic species. A number of exotic species are very invasive on disturbed soils (Trombulak and Frissell 1999; Douglass, Hamann and Joslin 1999; Parendes and Jones 1999.) Trails through forested and hilly areas that are not built to sustainable standards (such as on hills and wet areas) will result in chronically exposed soil through the life of the facility as new erosion occurs with each large rain event. These areas will become nursery areas for infestations and for the further spread of exotic species into the nearby habitats.

**III.G.3 Invasion of other species.** Linear facilities (roads) have been shown to be the source of pathogens and insects – which may or may not be exotic species – spreading into adjacent forest via damaged root systems, and decreasing the abundance of certain trees valued for timber (Trombulak and Frissell 1999.)

**III.G.4 Mitigation measures for invasive/exotic species.** With respect to measures to reduce ecological damages from exotic species spread from ATVs, measures could include:

- Not allowing trail connections from spotted knapweed infested road rights of way to public lands containing grassland patches.
- Inspection of ATV trails and control of new infestations by DNR trail managers to prevent establishment.
- Educational brochures and signs at trailheads, especially focused on those coming from southern Minnesota asking if ATVs have been operated in areas containing purple loosestrife
- Closing ATV trails where purple loosestrife is present.

**III.H. ATV impacts to wetlands.** It has been well established in Minnesota that ATVs are traversing wetlands on public lands, and that sediment from eroding slopes damaged by ATV traffic is entering wetlands and streams. This section is intended to describe the adverse impacts that occur to the ecological values of wetlands.

**III.H.1. Ecological zones around wetlands and other water bodies.** An important concept in assessing potential ATV impacts to wetlands is the fact that wetland functions can be degraded without direct encroachment into the wetland. The importance of certain ecological zones around wetlands has long been recognized, so much so that the concept of "buffer zone", "filter strips", and "setbacks" are built into management plans and practices, as well as into formal regulations. The proliferation of terms, and the apparently conflicting actual numbers for width of such zones can be confusing. Some resource managers approach this in a strictly regulatory manner, and ask, "What

is the proper size of a buffer strip according to the BMPs for this public land category?" Or, "What do the regulations say as far as setback distance?" The more relevant question for the purposes of impact assessment is, "What are the ecological zones around wetlands that, if damaged by ATV use and trails, would have adverse ecological consequences?"

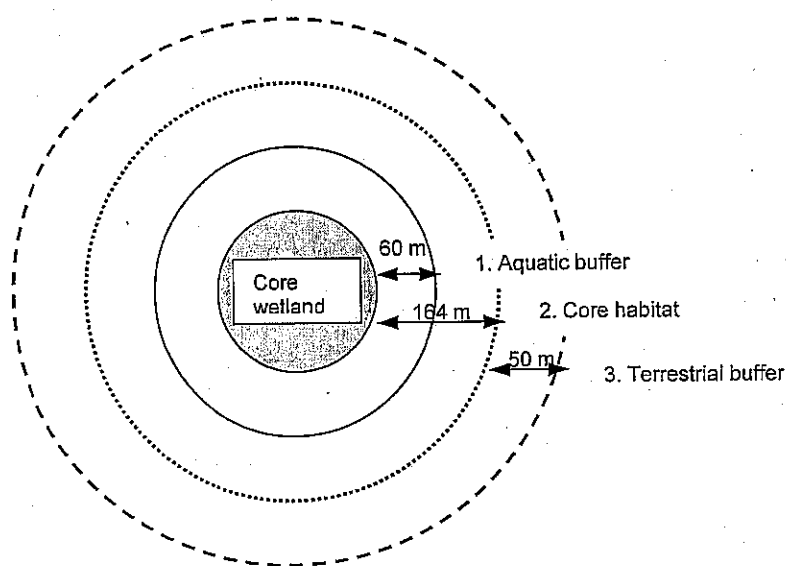
A recent paper provides a scientific means of relating buffer zone widths to the functional values of wetlands:

*"The terrestrial habitats adjacent to and surrounding wetlands are critical for the management of natural resources. Most conservationists and land managers understand that this land and water interface protects adjoining aquatic resources by filtering chemical pollutants, moderating temperature, and ameliorating siltation and other pollution caused by human activities such as timber harvesting, road building, agriculture and urbanization. Furthermore, scientists and others generally agree that patches or strips of terrestrial habitat ranging from 30 to 60 meters wide can function as essential barriers around core aquatic habitats to protect them from surrounding land use practices. These upland "buffer zones" (also called "buffer strips" and "riparian buffers") receive much attention for their value in protecting aquatic resources....."*

*"But what about the upland itself? These terrestrial zones of upland habitat surrounding wetlands serve another critical but often overlooked function. Rather than simply a buffer, they are core habitat for many semi-aquatic and terrestrial "ecotone" species. They are therefore essential for the survival of a number of species and for the preservation of biological diversity." (Semlitsch and Jensen 2001)*

This paper goes on to describe three zones around wetlands that would provide some assurance that all wetland functions would be protected: 1) Aquatic buffer, 60 meters from wetland edge – designed to buffer the core aquatic habitat and protect water resources; 2) Core habitat, 164 meters from wetland edge – core terrestrial habitat utilized by semi-aquatic species; and 3) Terrestrial buffer, 50 meters from edge of core habitat – buffer for core terrestrial habitat (Figure 1). ATV trails proposed to be sited within these zones would cause adverse ecological impacts.

Figure 1. Wetland ecological zones. From Semlitsch and Jensen, 2001.



Other studies and other programs have arrived at various widths designed to protect the functions of wetlands and other aquatic resources. A recent study done for the Minnehaha Creek Watershed District of Minnesota reviewed 41 reports concerning buffer strips and zones. It found that the minimum effective buffer width for protecting most wetland functions was 50 feet (Emmons and Olivier Resources, Inc 2001.) The recommended width of filter strips along lakes, streams and wetlands for protection against timber management practices in Minnesota varies from 50 to 150 feet, depending on slope

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(Minnesota Forest Resources Council, 1999).

Most or all of the ATV trails in Minnesota are proposed in forested areas. There are numerous wetlands in these forested areas, and these wetlands have important ecological values. An interagency federal study provides an excellent description of the values and types of forested wetlands, and recommendations for protecting these resources (Welsch et al., 1994.) This study contains good information relevant to assessment of impacts of ATV trails, and impacts of ATV use of wetlands and wetland buffer areas. It contains the following information about vernal ponds, which are:

*"...small ponds (in forested areas) that are most obvious during the spring of the year... they result from various combinations of snowmelt precipitation and high water tables associated with the spring season. The ponds tend to occur in small depressions and while many dry up in late summer, a few have water year round. ... (and) support a rich community of amphibians and invertebrates. ..."* (Welsch et al. 1994)

These wetlands are important for species that spread out in the forest upland during the later part of the summer. Management recommendations for vernal ponds in the report by Welsch et al. (1994) included establishing a buffer zone around the pond two chains (132 feet) wide.

III.H.2. Specific wetland impacts of ATVs. ATV trails and travel in wetlands, and in wetland buffer zones, may have the following adverse impacts:

- Hydrologic and physical impacts. ATVs can alter both surface and groundwater flow in wetlands in several ways. Rutting in peat soils can reduce or eliminate the movement of water through the top, permeable layer of peat, causing conditions to become wetter upstream of the rut and drier downstream, thereby altering wetland plant communities. Single passes of mechanized vehicles in bog wetlands have been known to cause changes that in turn change vegetation, and create tracks visible years later (See Glaser 1990, and Glaser 2002 **need citation**). ATV trails can downcut into the soil over time, sometimes enough to effectively create a ditch that drains the wetland. Heavy ATV traffic can excavate substrate from some areas and redeposit it in others, altering water depths and possibly converting areas to non-wetland status. ATV trails inappropriately constructed on hillsides adjacent to wetlands, and unauthorized ATV traffic on hillsides leading to soil exposure, can lead to large amounts of sediment moving downstream, and filling of portions of wetlands. (When this occurs in conjunction with an authorized construction project, such as road construction, it is subject to regulatory authority under Section 404 of the Clean Water Act and the Minnesota Wetlands Conservation Act, and is considered fill into the wetland without a permit.)
- Destruction of wetland vegetation. ATV traffic in wetlands destroys wetland vegetation, which adversely affects the maintenance of native plant communities, degrades fish and wildlife habitat, and reduces the wetland's ability to remove sediment and nutrients from water passing through the wetland.
- Invasion by invasive/exotic species. Loss of vegetation exposes wetland soils to invasion by undesirable plant species such as purple loosestrife and reed canary grass. In addition to creating conditions suitable for growth of undesirable plants, ATVs may also carry seeds from these species into wetlands from previously infested areas.

### III.1. Impacts on fish and wildlife.

III.1.1 Noise and other forms of human disturbance. ATV traffic, as well as associated human activities, will introduce substantial noise and human disturbance into the area of the trail during seasons when such disturbance did not previously occur, or occurred at low levels. Youmans (1999 **need citation**) provides a good overview of the effects of disturbance:

*"Disturbance caused by recreational pursuits or other human activity may elicit behavioral responses and/or physiological responses in wildlife. . . . Behavioral responses may be of short duration (temporary displacement) or long term, such as abandonment of preferred foraging areas. . . . Physiological responses to disturbance cannot be assumed to be observable. . . . Effects of disturbance may have ramifications to populations. For example, disturbance that alters behaviors within a local population, which then results in distribution and habitat use changes, may ultimately (affect) the health and status of the population." (Pp. 1.8-1.12)*

This study goes on to note there are important differences among species, and because of specific circumstances. For example, intense weekend ATV traffic that causes displacement for 2-3 days may eventually result in driving a particular species away from an area. Therefore, average ATV traffic levels may not be a good indicator of disturbance levels, since the high use times may be the determining factor. This effect may also change depending on season. For example, deer with young may be more prone to abandon an area entirely in the spring due to intense weekend disturbance, because of lack of habituation or other factors, while later in the season other deer will return immediately after the intense use period ends.

Waller et al. (1999 **need citation**), in a review of the literature regarding recreational effects on semi-aquatic mammals, noted that semi-aquatic animals may be particularly sensitive to disturbance: "(Another study is cited). . . indicated that otters in Idaho seemed to prefer areas with minimum human activity and exhibited a nocturnal activity pattern in summer but not in winter, possibly in response to increased human disturbance during summer daylight hours. . ." (pp. 5.8.)

In a study of recreational trails in forest and prairie habitats, Miller et al. (1998) showed that bird species composition was altered adjacent to trails, with generalist species more prevalent and specialist species lacking. Nest predation was also higher near trails (Miller et al. 1998).

Studies of the effects of highways on wildlife suggest that traffic noise may play a role in altering bird communities by interfering with bird communication during incubation and fledgling phases (Forman and Deblinger, 2000). The potential exists for intensively used ATV trails or recreation areas to have similar effects.

Sime (1999 **need citation**) noted the adverse effects on wildlife of pet dogs accompanying recreationists, especially the many problems with large mammals.

III.1.2. Wildlife exploitation effects. This is primarily an issue for hunted and trapped species. Increased motorized access to interior forest areas increases hunter densities and harvest rates. Examples of impacts are changes to deer age and sex structure (from harvest of older-aged bucks), increased harvest levels across large areas of forest on ruffed grouse that are shot along trails, etc. In addition, these trails provide access to bait dealers and harvesters which can lead to degradation of forested wetlands and shallow lakes for waterfowl and other species, and increased access to these basins by waterfowl hunters which can lead to reduced security areas for ducks and geese. (**Need citations**)



III.I.3 Effects on reptiles and amphibians. Reptiles and amphibians are particularly susceptible to traffic related impacts and to habitat alterations because they are unable to avoid most vehicles, and because they are dependent on and often concentrated in relatively large zones around water bodies. (Trombulak and Frissel 2000, Maxell and Hokit 1999 **need citation**). Habitat management guidelines for these species recognize the importance of protecting these zones around wetlands and water bodies (Kingsbury and Gibson 2002).

A study of turtles has indicated that the most stringent (state) regulatory buffer zone around wetlands protected only 44% of the nest and hibernation sites, a 73 meter zone protected 90% of the sites, and a 275 meter upland buffer zone would be necessary to protect 100% of the sites (Burke and Gibbons 1995.) These figures provide a guide for assessing impacts if ATV trails were located within these zones. It is also possible that turtles would be attracted to the exposed soil of ATV trails for nest sites, and thus even higher mortality would result.

Amphibian recruitment may also be adversely affected when egg masses are smothered by sediment stirred up by ATVs traversing through streams, lakes, ponds and wetlands.

III.I.4. Habitat fragmentation. Numerous studies have shown that populations of some bird species are area-sensitive; i.e., populations cannot be sustained when the size of the available habitat falls below certain thresholds (Robbins et al. 1989, Ambuel and Temple 1983, Winter and Faaborg, 1999, Brown and Dinsmore 1986). (See for example Robinson, et al. 1995; Robertson, R.J. and N.J. Flood. 1980; and Meyer et al, 1997 – need citations) A study conducted in Minnesota revealed that amphibian species richness was adversely affected by wetland isolation and increasing road density (Lehtinen et al. 1999). To the extent that ATV trails effectively fragment and isolate habitat patches, similar impacts on bird and amphibian populations can be expected to occur.

III.J. Effects of air pollution. The effects of pollutants from automobiles on areas adjacent to roads have been studied and well established. These effects have also been studied somewhat for intensely used snowmobile areas. Some pollution will likely occur in intensively used ATV areas, but effects are unknown. However, according to the California Air Resources Board (located in the California Environmental Protection Agency) "Off-road motorcycle and ATVs produce 118 times as much smog-forming pollutants as modern automobiles on a per-mile basis. . . .(they) are comprised of 2 and 4-stroke models. The 2-stroke engines emit 10 times as much smog precursors as the 4-stroke engines for each mile of travel, and 90 percent . . . comes from 2-stroke engines." (Board web site, 2002.) The site goes on to note a conversion to 4-stroke models is in progress.

#### **IV. Aesthetic values in hunting and fishing, and non-motorized outdoor activities.**

People who hike, hunt on foot, or ride horses through forested trails do not experience these specific recreational activities in isolation from the aesthetic appreciation of their location. These aesthetic values are at least partially the basis for selecting remote areas for these pursuits. For example, Shannon et al. (1995 **need citation**) notes that:

*"The use of 'scenic quality' as a decision or impact criterion within the disciplines of environmental planning and landscape architecture has become a well-known tool in professional practice over the past 20 years. . . .The St. Lawrence River Valley . . . is a rich and diverse landscape with a history revolving around the land, the river, and the economic fortunes*

*related to these resources. . . the interaction of land and water is by far the dominating feature in the visual landscape. . . As time passes, it appears it is also becoming one of the most vulnerable features in the landscape. Planning for tourism is seen as an economic necessity." (Shannon, et al. 1995, pp 357-358.)*

With respect to the aesthetic effect of cumulative habitat degradation, Meyer et al. (1997 **need citation**) captured the consequences to people whose intent is to have a recreational experience of nature:

*"Finally, the loss of nighttime choruses of calling frogs and toads from lakes reduces a value that is hard to quantify – namely the wilderness character of northern lakes. ....it was unsettling to go from the din of a full chorus of frogs and toads on an undeveloped lake...to a developed lake that was absolutely silent – and only two miles apart."*

Construction of an ATV trail system in some areas currently used by recreationists for non-motorized uses will degrade the experience of at least some, and perhaps most, of these users. There are some locations where the non-motorized uses are more prevalent and traditional. In those places, impacts would be higher, especially since ATV traffic would occur from spring dry-up through the fall hunting seasons.

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