II. BIOLOGICAL DOMAIN

A. Vegetation

1. Characterization

a) ***What is the array and landscape pattern of plant associations and structural stages in the watershed (riparian and non-riparian)? What processes caused these patterns (e.g. fire, wind, mass wasting)?***

Blowout drainage is one of the most productive areas on the Detroit Range District in terms of biomass growth potential. The deep, fertile soils and favorable climate combine to produce lush coniferous forests.

Trees: Douglas-fir is the most abundant tree species in the area, followed by western hemlock and western redcedar. As elevations increase over 3000 feet, Pacific silver fir and noble fir become more commonplace. At the highest elevations, mountain hemlock becomes a stand component. Other associated tree species include: Pacific yew, western white pine, sugar pine and incense cedar.

Many stream channels and wet areas support pure hardwood stands or include a hardwood component in the timber stands. Red alder, big leaf maple and black cottonwood are common in these areas.

Accurate data for stand ages is only partially available for the analysis area. Age information is known for managed stands but had to be inferred from tree size class data for natural stands. The following map (*figure 5a)* depicts the current tree size class distribution for the study area. From this map, one can infer stand ages because size classes are closely associated with age. Usually the smaller the size class, the younger the stand. A historical perspective of size class distribution, and therefore ages, can be seen in *figures 5b and 5c* showing the vegetative conditions in the area in 1950 and 1893.

The Standards and Guidelines for Management of Habitat for Late-Successional and Old-Growth Related Species requires that provisions be made for retention of old-growth fragments in watersheds where little remains. The standard and guideline is applied to fifth field watersheds (20 to 200 square miles) in which federal forest lands are currently comprised of 15 percent or less late-successional forest. Within such areas, all remaining late-successional stands are to be protected. Blowout study area contains

portions of four fifth field watersheds. The following chart shows how much old growth, as defined by PNW-447, remains in each fifth field watershed and in each smaller sixth field watershed.

Table 5a. Percent of Area in PNW-447 Old Growth by Subwatershed

5th Field Water-shed	Area of 5th Field Watershed on District	Percent PNW-447 Old Growth in 5th Field on the District	Sixth Field Subwatersheds	Acres of 6th Field in Blowout	Percent PNW-447 Old Growth in Blowout by 6th Field
03	26,119	13.7	Lower Detroit Reservoir	4	2.8
04	288*	3.7	Upper Quartzville	267	3.9
			Canal/Elk Creek	7	0
78	82,667**	17.8	Upper Detroit Reservoir	6	3.0
			Lower Blowout	7,507	14.6
			Box Canyon Creek	6,602	17.8
			Middle Blowout	14,825	16.2
			Upper Blowout	4,775	17.3
			Idanha	4	0.7
79	96,304**	20.7	Bugaboo	1	0
			Twin Meadows	3	1

* At this time we do not have databases that are compatible with other landowners. So we cannot easily determine the percent of old growth in 5th field watersheds not in our ownership.

** These watershed are entirely within the Detroit Ranger District

Second Growth of Natural Origin: A common assumption by lay people is that prior to management, all timber stands were old growth. In Divide and Hawkins Creek drainages there are examples of naturally occurring stands of second growth timber. There are a few thousand acres of 70 to 80 year-old stands that were naturally regenerated by fire. These stands tend to be in the lower to mid-elevation ranges and are commonly very dense, single-storied stands dominated by Douglas-fir. Overall in the drainage, about 6000 acres have been naturally regenerated by fire within the last 100 years.

In these stands, generally few trees exceed 12 inches in diameter and understory vegetation is sparse. Some of the stands have remnant Douglas-fir, western recedar or western hemlock and the western hemlock almost always have severe dwarf mistletoe infestations.

One characteristic of these stands is that self-thinning is minimal. Few trees have much competitive advantage and are competing more or less equally

for growing space.

Shrubs: A comprehensive inventory of the shrub and herb layers has not been completed. Common shrub species in the Blowout include: rhododendron, Oregon grape, vine maple, salal, and bear grass, etc.

Plant communities are useful indicators of environmental factors. In reality these communities and the environmental factors grade more or less continuously across the landscape, but for the sake of practical application they have been artificially grouped into plant associations. Each plant association is a relatively discrete groups of plant species, which maintain stable populations over long periods of time and recur across the landscape where the environment is suitable. Normally each plant association is named by the major climax species and dominant shrub and herb layers.

For Blowout not all areas have been inventoried for plant associations, so we really only have a good picture of the climax species and not the associated shrub and herb layers. The following chart depicts the major climax species plant associations by tree size class for the study area (*see also figure 5d*).

Table 5b. Plant Associations by Tree Size Class

Tree Diameter Class*	**Western Hemlock Plant Associations**		**Pacific Silver Fir Plant Associations**		**Totals**	
	Acres	***Percent of Area***	***Acres***	***Percent of Area***	***Acres***	***Percent of Area***
0.9 - 4.9"	2,878	19	6,357	33	9,235	27
5.0 - 8.9"	1,914	13	1,158	6	3,072	9
9.0 - 20.9"	5,116	34	2,737	14	7,853	23
21"+	4,695	31	8,579	45	13,274	39
Total	**14,970**	**44**	**19,034**	**56**	**34,004**	**100**

* <2% of the stands in the drainage are in mountain hemlock and Douglas-fir plant associations and are not included in this table.

Special Habitats (Non-forest plant communities): The occurrence of special habitats and their distribution across the landscape is important for biodiversity of plant and animal species. Forest Plan standard and guideline FW-211 directs us to protect these habitats and their ecotones. The Special

Habitat Management Guide lists special habitats by plant associations and the wildlife that use them. The guide provides a methodology for inventory, mapping and databasing information as well as providing management prescriptions.

The largest number of non-forest plant communities (special habitats) in this analysis area are represented by dry rock gardens, wet meadows, and vine maple-talus patches. Dry rock gardens occur on the major peaks and ridges, including Coffin Mountain, Pinnacle Peak, Lucky Butte, Cub Point, and Blowout and Coopers Cliffs.

Various wet meadow/bog/pond special habitats occur at the headwaters of Blowout and Box Canyon Creeks and their tributaries. Many of these types are surrounded by recent harvest activities, some are not.

Vine maple-talus patches are distributed throughout the analysis area and attest to the predominance of unstable soils in both Blowout and Box Canyon watersheds.

Wet and seepy tag alder patches with associated vegetation are distributed along the upper rims of these Analysis Areas. A notable wet rock garden is located on a slope near Beard Saddle, and a beautiful spring wildflower display that includes the sensitive *Romanzoffia thompsonii* (Thompson's mistmaiden) occurs there.

A few mesic meadow types can be found at mid-elevations in the Blowout area, but are nonexistent in the Box Canyon area.

Beaver ponds and sag ponds, sedge meadows and hardwood swamps predominate in the lower elevation second growth stands. The formation and/or current condition of many of these latter sites have probably been influenced by past harvest activities.

Past management practices that have had an influence on special habitat areas include roading through or adjacent to these areas, failing to retain trees to buffer the areas, and direct disturbance of the areas during timber harvest. Wet special habitats such as wet meadows, ponds, bogs, and moist rock gardens have been disproportionately impacted by management activities (see Table 5c).

Table 5c. Special Habitats in the Blowout Analysis Area

Type of Special Habitat	Number of Habitats (approx. number of habitat types out of 133 identified by photo or in field)	Condition of Special Habitats							
		Special Habitat is within/ or bordered by Harvested Unit,		Special Habitat is Bisected by Road		Special Habitat is Bordered by Road		Invasive weedy Plants found within special habitat (based on 54 habitats inventoried in 1994)	
		Number	Percent	Number	Percent	Number	Percent	Number	Percent
Dry rock gardens	26	2	8			3	12	2	8
Vine maple - talus	22	2	9			2	9		
Wet Meadows	19	13	68	1	5	10	53	2	11
Pond	12	5	42			5	42	2	17
Mesic Meadows	10	2	20	1	10			2	20
Cliff	9					1	11		
Sitka Alder	9			1	11	1	11		
Swamp: hardwoods	8					1	13		
Sedge meadows	6	2	33			2	33	1	17
Talus	3			1	33				
Bog	3	1	33						
Vine maple - rocky soil	3	1	33						
Moist rock gardens	2	1	50	1	50			1	50
Dry meadow	1								

Sensitive Plants: Plants on the Region 6 sensitive plant list are afforded

protection by the Regional Forester by authority of Forest Service Manual (FSM) 2670. The purpose is to avoid having to list the plants as threatened or endangered due to losses incurred as a direct or indirect result of management activities. *Romanzoffia thompsonii*, Thompson's mistmaiden (Table 5d), is a Region 6 sensitive plan that is found at one location in the Blowout Analysis Area. The habitat for this plant is always rock gardens; sites where bedrock is close to the soil surface, where there is minor to no soil development, and where herbaceous species such as mosses and forbs predominate.

Table 5d. Sensitive Plants in the Blowout Analysis Area

Latin Name	Common Name	Location	Occurrences
Romanzofia thompsonii	Thompson's mistmaiden	Beard Saddle	1

Past timber management has not had a discernible impact on this one population of *Romanzoffia thompsonii*, although its habitat is surrounded by a stand only 40 years old. A road does bisect this habitat, however, and the segment of the population below the road does appear to have been impacted by sidecast gravel from the road.

Old-growth Associated Species: In the *Forest Ecosystem Management Assessment Team* (FEMAT) report and the Standards and Guidelines associated with the Record of Decision for the President's Forest Plan, a large emphasis was placed on organisms which have been largely overlooked in traditional forest management such as mosses, liverworts, lichens and fungi. These species have not been systematically inventoried anywhere in Region 6. Existing information is patchy and often associated with graduate-level research projects and research in the HJ Andrews Experimental Forest. Some information is available through herbarium specimens. A few species listed in the standards and guidelines are found on the Detroit District-no specific data is available for the Blowout Analysis Area (See Table 5e).

Table 5e. Species Listed in the President's Forest Plan Standards and Guidelines

Species Type	Latin Name	Survey Strategy
Lichen	*Lobaria pulmonaria*	4
Lichen	*Lobaria oregana*	4

False Truffle	*Rhizopogon abietis*	3
Rare False Truffle	*Alvopa alexsmithii*	1,3
Rare Undesc. False Truffle	*Hydnotrya sp.*	1,3
Rare Undesc. False Truffle	*Martellia sp.*	1,3
Vascular Plant	*Allotropa virgata*	1,2

Since no surveys have taken place, the necessity to acquire an adequate knowledge of the distribution of old-growth associated species is paramount. The two cryptogam species above will be subjects of survey strategy 4; general regional surveys to be conducted by the Regional Ecosystem Office, initiated no later than fiscal year 1996. Three of the four false truffles will be under survey strategy 1, manage known sites, and with the fourth under survey strategy 3, conduct extensive surveys and manage sites. The vascular plant, candystick, will be under survey strategy 1, and strategy 2, survey prior to activities and manage sites.

Uncommon Plants: Uncommon plants have no special status in management in Region 6. Their distributions are monitored on the Willamette National Forest because we want to prevent having to list species on the Regional Forester's List. One of the monitoring questions in the *Willamette National Forest Land and Resource Management Plan* (LRMP) has the Botany program responsible for a Forest Concern List--those species rare enough to track for purposes of maintaining biodiversity and for helping determine whether populations are increasing, decreasing or stable statewide. Four uncommon plants are found in the Blowout Analysis Area:

Table 5f. Uncommon Plants in Blowout Analysis Area

Latin Name	Common Name	Occurrences
Botrychium virginianum	Virginia grape fern	1
Brickellia grandiflora	Large-flowered brickellia	1
Castilleja rupicola	Cliff paintbrush	1
Pleuricospora fimbriolata	Fringed pinesap	Many

Populations of uncommon plants have been tracked by informal database, but in the future, sites should be placed in the GIS data base and populations tracked through time. Inventories have been conducted on an informal basis, when the District Botanist was looking for sensitive plants. It should be

noted that, like sensitive plants, most of these uncommon plants are found in special habitats. The first three occurrences in Table 5f are protected by virtue of special habitat designation. Fringed pinesap occurs in coniferous forest, and has no such protection.

Noxious Weeds: A number of noxious weeds are found in the Blowout Analysis Area (see Table 5g). An Integrated Weed Management Environmental Assessment for managing noxious weeds, signed by the Forest Supervisor in 1993, states that each infestation of weeds will be managed according to its classification; new invaders will be eradicated using all control methods available and will have highest priority. The best we can do with established infestations is keep their population numbers in check through biological and manual control methods.

Table 5g. Noxious Weeds in Blowout Analysis Area

Weed Name	Classification
Spotted knapweed	New invader
Tansy ragwort	Established
Scotch broom	Established
St. John's-wort	Established
Canada thistle	Established

Preliminary inventories of noxious weeds on the Detroit Ranger District were conducted in 1992. The inventory was manually recorded on maps and in a computer file. The infestations have been digitized and placed in the GIS data base. We will make comparisons using old and new maps to track the spread of weeds and rates of increase and to determine the effectiveness of control measures.

Presumably, continuous and increasing disturbance associated with road building and maintenance in the Blowout Analysis Area has led to population expansions of noxious weed species. Major collector roads host the majority of the infestations.

One threat to biodiversity in this analysis area is the predominance of disturbance vegetation and early successional vegetation (ruderals). This threat can be described by any or all of the following three concerns: 1) the disproportionate amount of area occupied by early successional and disturbance vegetation may effect animal-plant interactions and other

ecosystem processes; 2) the particular type of disturbance represented by timber management may change conditions such that the type of natural succession following events like fire and disease is precluded; and 3) the vast road system and other continuously disturbed areas allow for easy establishment and long-term occurrence of noxious weeds and other undesirable ruderal species. The resultant effect of all three concerns is a reduction in the number and extent of various stable native plant communities represented in the landscape.

Without more data and analysis, the significance of concerns #1 and #2 is hard to evaluate. But the effects of concern #3 is evidenced by the results of a recent district road survey of noxious weeds. In the heavily roaded areas on the east side of the analysis area, populations of noxious weeds such as St. John's wort *Hypericum perforatum*, Scotch broom *Cytisus scoparius*, Canada thistle *Cirsium arvense*, and tansy ragwort *Senecio jacobaea* are abundant. It is apparent that these populations serve as a propagule source for further weed invasions of arterial roads. On the west side, where road densities are considerably less, population densities and distribution are much reduced and restricted to just the major road routes. Other noxious weed concerns in this analysis area include small but recent infestations of spotted knapweed *Centaurea maculata* and white sweet-clover *Melilotus alba* - the latter is found in abundance on the Sweet Home Ranger District.

2. What values are associated with vegetation?

a) Vegetation has economic, life-sustaining, aesthetic and spiritual value (i.e. trees and other vegetation provide commodities, many plant provide food/shelter to humans, fish and animals, old growth provides aesthetic and spiritual value, huckleberries and cedar trees are important to Native American cultures for tribal ceremonies and basket making, etc.)

b) Natural species richness and diversity has ecological value. Plants are the oxygen providers and the base of the food chain that allows all other life forms to exist. A variety of plant species supports a variety of life forms. Plant/animal interactions can range from a simple indirect association as in the case of carnivores, to very complex interdependence where neither the plant nor the animal species can exist without each other (co-evolution). Animals can use vegetation for food, shelter, camouflage, poisons, and tools.

Without variety, living systems become simpler, and are more prone to reduction or extinction during stochastic events such as environmental

disturbance or disease outbreaks.

3. What are the highest priority issues or resource concerns associated with vegetation?

a) For a variety of reasons, old growth is a highly valued component of the ecosystem. Since most of the old growth in the watershed, takes many human lifetimes to develop to the stage it is at now, many people do not want to see any more of it harvested. Therefore, management activities that involve harvest of old growth timber, and for that matter, timber harvest of any kind have become very controversial.

b) Fire suppression has been a management goal for many decades, now the issues is whether fire suppression has significantly altered plant community and seral stage distribution and timber stand conditions in the watershed.

c) Land allocations and management goals are often based on compromise rather than science, so they are not always compatible with historic ecosystem conditions or dynamic natural systems. Management goals for land allocations such as late successional reserves, riparian reserves, scenic areas, summer home tracts, etc. require that vegetation be managed in ways that may be in conflict with historic ecosystem conditions within the watershed.

d) Wind storms in 1990 and a flood event in 1996 have resulted in a lot of downed timber throughout the watershed. This often results in increased bark beetle populations that eventually kill adjacent live trees. Furthermore, accumulations of downed and dead trees increase risk of stand replacing wild fire. This issue is whether management should actively respond to these events or let them run their natural course.

e) Noxious weeds and invasive non-native plants are a threat to native plant diversity in the watershed. These species thrive in a new environment because they arrive without the complement of predators, diseases, and other ecosystem components found in their native region of the world. Most of these species take advantage of disturbance gaps such as logged units, roads, rock quarries, burned areas, the areas surrounding human structures, and trails. Once established, these populations can serve as a seed source for further dispersal, generally along road and trail corridors.

f) There is a concern about maintaining natural biodiversity within the

watershed. The occurrence of species habitats (non-forested plant communities) and their distribution across the landscape is important for biodiversity of plant and animal species. Hickman (1976) estimated that eighty five percent of flowering plant species in the central western Cascades are found in non-forest areas such as rock outcrops and meadows, which only comprise about five percent of the land base.

4. What and where are the management direction/activities, human uses, or natural processes that affect vegetation?

a) Current Conditions

What were the distrubance factors that led to the current vegetative conditions in the watershed described in the characterization?

b) Reference Conditions

What are the historical erosion processes within the watershed (e.g. surface erosion processes, mass wasting)? Where have they occurred?

c) Comparison of Current and Reference Conditions

What are the natural and human causes of change between historical and current vegetative conditions? How and where are current vegetation types and distribution different from historic conditions?

Trends in vegetation development in the Blowout have been altered through management of timber resources (*Figures 6a and 6b*) and with fire suppression. It is relatively easy to point out differences between the natural and managed vegetation on a specific site, however it is difficult to draw conclusions about the overall effects on the drainage as a whole and even less credible when addressing the entire North Santiam Watershed. Because of the extreme swings

in disturbance from near total burning in the 1600's to nearly total late successional stands in the 1800's it is hard to arrive at a disturbance pattern that can be compared to present day management. Fire suppression in this century masks whatever fire occurrence might have happened.

Timber management activities have changed significantly since early logging in the 1940's so that comparisons between natural development and current practices need to be somewhat specific to the time frame they are being compared to.

Earlier timber management, generally up to about 1970, tended to plant few tree species, and tended to have a lower utilization of timber thus leaving more down logs. Broadcast burning for site preparation and hazard reductions varied from no burning to hot fall burns which in some cases damaged site productivity. Very few alternatives to, or alterations to the clearcut method were made.

The 1970's brought such changes as increased utilization, a period of little broadcast burning, and later spring and summer burning. They also brought better logging systems, more soil protection, shelterwoods, commercial thinning, and fertilization.

The 1980's added more tree species, including rust resistant white pine, and forest genetics. Pre-commercial thinning was modified to ensure more species diversity and pruning was reintroduced after no activity since the 1960's.

The 1990's have modified harvesting by leaving snags and green trees, much more down woody debris and have left more units unburned. The 1990's have also seen a large increase in the sales of special forest products, primarily boughs, Christmas trees, and post and poles.

Comparing planted stands and second growth, naturally regenerated is complicated by the fact that natural stands vary a great deal depending on burning intensity. Due to intensive utilization over most of the past 50 years, most plantations lack the downed material or snags that may be present in burned, naturally regenerated areas. Where very intensive burns or re-burning occurred, they may be lacking there as well. As far as species diversity of plants, there appears to be at least as many or more in the artificially regenerated sites than on the naturally burned areas. In the Blowout and most of the District, fire regenerated stands tend to be overstocked, primarily with Douglas-fir, creating a low-light condition which generally precludes the occurrence of other species. This condition may occur as early as twenty years after disturbance and persists well into the second century of development. Shade tolerant species

may occur in these stands but do not generally attain any significant development until the overstory begins to decline.

Primarily due to thinnings, managed plantations tend to create light conditions that permit earlier regeneration and release of vegetation other than the dominant tree species. The dramatic response of brush and shade tolerant conifers following commercial thinning is a common example not seen in the natural disturbance regime. The small patch sizes of most harvest openings versus larger natural fire sizes, may also be contributing to seeding from adjacent areas. Planting of multiple tree species also creates a type of diversity not commonly found in fire regenerated stands. Western red cedar and Western hemlock generally lag far behind Douglas-fir in natural stands, but planting these species at the same time and retaining them during thinnings gives them the position of codominants in the stand.

The degree of natural under burning in the Blowout is not clear since stand records are not complete enough to generally distinguish them from other multi-canopy stands. On the ground, it is relatively easy to identify under burned stands. They are generally characterized by remnant mature fire resistant trees with an understory of shade tolerant species that usually occur at very high stocking levels. Immediately after under burning and for a few decades after, these stands must have been fairly open to light, and also with a large component of snags and downed logs. This type of stand condition does not exist currently due to lack of fire.

The existence of numerous young plantations in Blowout may contribute to a condition where high intensity burns are increasingly likely. Retention of snags and increased downed material may increase resistance to control of fires. Reduced road access and reductions in personnel and timber purchaser assistance in fire suppression may all act together to increase the frequency of large fires over the level experienced previously this century.

Special Habitats (Non-forest plant communities)

This section will focus on implications for the future condition of the Blowout Analysis Area under a "new ethic" management regime compared to no management at all. The effects of the five natural disturbance agents will be discussed, as well as future management options for special habitats, species of concern, and noxious weeds.

Fire: No further management in this analysis area may, in the short term, continue to perpetuate the existing vegetation pattern. The conversion of many

> acres to an early secondary successional condition has increased the potential of repeated re-burns due to the high surface fire potential that exists in early successional Douglas-fir forest (Agee 1991). In addition, the vast tracts of even aged, second growth Douglas-fir forest low in the Blowout drainage are more susceptible to a stand replacing fire due to the lack of fire breaks. In any event, superimposing a natural fire pattern on top of current vegetation patterns will not substantially ameliorate the contrast between the low elevation second growth stands and the higher elevation old growth/early successional mosaic.

Forest management that mimics historic fire pattern can facilitate the return of pre-management landscape structures and functions. A desired future condition that distributes stand types and includes longer rotations to simulate estimated fire cycles, partial cuts and small harvest units to simulate small patchy fires of various intensities, and large units with minimal soil disturbance and retained green trees, snags, and dead and down to simulate large fires will not only be more resilient to future fire events, but will also ensure a viable distribution of effective plant and animal habitat. Reducing the intensity of management at high elevations where fire is more frequent, where plant species diversity is greatest, and where recovery from mechanical disturbance is most problematic, will also result in a more diverse and resilient system.

Flood: No further management in the Blowout Analysis Area would probably, over time, result in re-creation of some of the natural elements of flood control, including the structures and pools that dissipate energy in streams, and the swamp, marsh, and bog communities that contribute to water storage and quality. Over the short term, however, the current condition of high elevation clearcuts and extensive roads increases the likelihood of continued erosion, slumps, slides, and sediment loading into streams.

One advantage to continued management is the ability to monitor and regenerate sites where stand establishment is slow, and the ability to rehabilitate, maintain the stability of, or reclaim, roads. The opportunity also exists to accelerate the re-creation of the natural elements through restoration techniques. Working to restore the watershed in this way provides the additional benefit of stability in the short term, wile we implement landscape designs that will allow natural processes to provide stability in the long term.

Land Flow: No further management in the Blowout Analysis Area will probably result in increased long-term stability. But like the flood example, lack of routine silvicultural practices and road maintenance or sufficient reclamation of roads may result in conditions getting worse before they get better.

> Landscape planning and design can help to thwart potential soil stability problems by managing drainages and connected subdrainages as a whole. It is a much more integrative approach that dictates a closer look at Analysis Area processes and possible cumulative effects of activities. The first step is to

identify problem areas. The second step is to solicit information from all resources on what steps can be taken to promote stability. If we can avoid compounding the effect of land flow, we can begin to return the area to the level of disturbance that is inherent within the landscape. For the Blowout, the inherent level of land flow disturbance is quite high. Therefore, the amount of land flow disturbance vegetation types such as vine maple/talus and red or Sitka alder avalanche vegetation will remain quite high. But I would also expect an increase in the succession of disturbance sites to coniferous forest, and the development of various riparian associated vegetation types if preventative and restorative steps are taken.

Disease: No further management in the Blowout Analysis Area will eventually result in a return of the domination of environmental processes and cycles over insect and pathogen spread. These processes can retard or eliminate spread as well as facilitate it. If conditions are favorable, hardwoods, shrubs, and resistant conifers can invade disease centers as susceptible trees die out, thus promoting local species diversity. In the case of Phellinus, windthrow of live, mature trees can reduce innoculum in the soil since Phellinus will die in roots exposed to air (Hadfied et al 1986). Fire can keep disease populations in check. It is important to recognize that some species have evolved to exploit niches created by insect and pathogen damage, and that total elimination of these vectors is not desirable.

Landscape planning and design gives us the option to allow natural processes to influence disease and pathogen spread in areas slated for little or no management activities, while practicing control techniques in more heavily managed areas to counteract the tendency of increased spread due to management practices. We can mimic natural processes and increase biodiversity by replacing infected trees with native non-susceptible species. We can reduce the additional stress added by past management practices by wise use of prescribed fire and by adopting different harvest strategies and scheduling timber harvest in a way that minimizes edge effects. By narrowing the focus for where to apply control measures, we can be more effective with this application and ensure long term success.

Wind: No further management in the Blowout Analysis Area would, over time, revert the area to a less wind prone condition. However, steps can be taken to minimize the susceptibility of managed stands to wind damage. Vulnerable areas must be identified. Special habitats can be buffered. Harvest schedules that reduce the amount of edge can be employed. Where edge exists, creation of wedge formations and feathering can diminish or divert the full force of wind.

Special Habitats and Species of Concern

On the Willamette National Forest, our 1990 forest plan has gone beyond single species management. Hickman (1968) estimated that 85% of plant species diversity in this region can be found in non-forest plant communities such as meadows, rock outcrops, and wetlands, although these types account for only 5% of the land base. The Willamette Forest Plan directs us to maintain these habitats, and if necessary, protect them from human disturbance (FW-211). Not only does this preserve the existing biodiversity, but it protects the majority of sensitive species and other species of concern that do tend to occupy these habitat types. The forest plan also directs us to maintain existing diversity on forest, landscape and stand levels (FW-201). Other standards and guidelines address the need to leave intact areas that exhibit quality old growth characteristics and corridors that connect these areas (FW-202 to FW-207).

Combining principles from conservation biology, landscape ecology, ecological restoration and current management practices can help identify a desired future condition (see Appendix 1). The same type of strategy that has been used to survey for sensitive plants can be employed on a landscape scale to preserve and enhance existing biodiversity. As with sensitive plants, special habitats and rare forested plant associations located during field reconnaissance can be evaluated as to the need for protection as well as the opportunities available for experimental manipulation (restoration, disturbance monitoring). Disturbed areas can also be assessed regarding the feasibility and probable effectiveness of restoration work. Designing protected nodes and corridors so that they include a large proportion of special habitats and populations of species of concern will help maintain existing plant and animal biodiversity. The number of these habitats to protect will depend on such factors as the number and proportion of each type left undisturbed in the analysis area, their susceptibility to disturbance, their importance as habitat to wildlife, and the contribution they make towards water quality. Utilizing information gathered for landscape analysis such as fire pattern, wildlife and water dynamics, and human use can aid in determining the scope and extent of these factors.

In the Blowout Analysis Area, many of the mesic to hydric and species rich special habitats are found in the headwaters region. In addition to being susceptible to the adverse effects of disturbance, the high elevations at which these habitats occur suggest harsher growing conditions. Placement of a system of nodes and corridors in this area of headwalls and headwaters would likely protect biodiversity and water quality values. It also represents an opportunity to connect riparian corridors and adjacent watersheds. Midslope meadows and ponds could be connected to the riparian corridors as part of this system. It

should be pointed out that corridors do not necessarily need to be static, they can be adjacent bands of timber which are harvested on long rotations. Retention of some trees around certain special habitats may still be necessary. Since the numerous vine maple/talus communities are less prone to disturbance and are widespread within the analysis area, protection is less of an imperative and would be determined on a site specific basis.

The existing condition of the Blowout Analysis Area indicates that special habitats prone to disturbance must be protected, but it also provides endless opportunity for adaptive management. After nodes and corridors are designated, the remaining patches can be characterized according to those management activities (silviculture techniques, rotation ages, watershed restoration, wildlife habitat enhancement, etc.) that will yield the most benefit in terms of support to the protected areas, function within the matrix, and timber production. Useful information for this characterization includes stand exam (aspect, slope, elevation, etc.), watershed, wildlife, soils, and fire history data.

Restoration efforts should focus on areas where benefit/cost ratios are high. Benefit should be evaluated based on the contribution of an area to the structure and function of landscape processes. Cost should be evaluated on such factors as the probability of effectiveness and the availability of equipment and expertise. In the Blowout, the numerous beaver ponds, swamps, and sedge meadows located in the lower elevation second growth stands deserve attention. They represent a large portion of the biodiversity present in the local area. Many of these sites were either created or at least affected by earlier timber harvest activities, and are in various stages of "pristineness". Enhancing or protecting those sites that already exhibit desirable habitat qualities (based on resident species composition and richness, plant and animal) or watershed restoration opportunities (backwaters for flood control) would be a prudent investment. In many cases, this objective could be achieved by road closures and rehabilitation, followed by re-vegetation with native species if necessary.

Noxious Weeds: This procedure would also assist in retarding the spread of undesirable ruderals. Inventory and identification of areas where weed control may be effective and subsequent treatment can reverse the trend of increasing populations of non-native flora in favor of those species native to the local area. Connected corridors can provide a natural barrier to the spread of noxious weeds. Focus on weed control and steps to prevent the spread of weeds could then be directed to those areas where intensive management (disturbance) takes place, instead of the need to consider the entire landscape. Competitive plantings, using native species for re-vegetation, can help reclaim areas from weed establishment.

A desired future condition for the Blowout, therefore, should include protected and semi-protected areas that include and link biodiversity hot spots, and adaptive management areas where disturbed areas will be enhanced by various management techniques including prevention of habitat degradation by closing roads, restoration where habitat has been degraded, and stand improvement to meet other habitat objectives. Inventory and monitoring work, focused on previously ignored but important species such as cryptogams (mosses, liverworts, and lichens) and other species of concern as well as on project designs and effectiveness, must become an integral part of watershed analyses in order to successfully improve watershed health and protect biodiversity.

More information and research is needed before definite answers to the key questions concerning vegetation can be offered. However, trends are evident. Many of the special habitats in the Blowout Analysis Area have been subject to management disturbance resulting from location of timber harvest and road building activities. Aside from vegetation change or loss due to direct disturbance, influence from adjacent disturbance ranges from increased exposure to natural disturbance, edge effects such as micro climatic changes and weed invasions, to loss of the ecotone between special habitat and forest. In many cases, the ecotone provides more structural, functional, and species diversity than either the forest or the special habitat. Chen (1991) reports that "the most extreme micro climatic conditions sometimes occur at the edge rather than in the clearcut." Although thorough studies have not been done to document the effects of management disturbance on different special habitat types, we need to ensure that a representative number of each of the habitat types are left undisturbed if we are ever to find out. In the Blowout, this means full protection from further management disturbance for wet special habitat types like wet meadows, ponds, bogs, and sedge meadows.

In the past, the focus for the district botanist was primarily sensitive plant survey. The change in management philosophy towards an ecosystem approach has broadened that focus to include gathering information on many other vascular plant species, as well as many other types of species (cryptogams, fungi, etc.). Site specific information is mostly lacking for many of these species, but a start has been made on the identification of important species and the gathering of information on their habitat requirements and range status. Planning for the collection of site specific information has begun and is outlined in the President's Forest Plan and in the Willamette National Forest Land

Management Plan.

The ecosystem approach to management has also broadened our focus to more fully consider the role and effects of disturbance vegetation in ecosystem processes. Here again, more information is needed to adequately address this question. But the pattern of noxious weed occurrence in the Blowout offers no great surprises-infestations occur where disturbance is continuous (roads, rock pits), and these same features provide propagule source and dispersal routes for further infestation. The life history strategies of most noxious weeds involve disturbed area establishment, making total eradication where large scale disturbance occurs nearly impossible. However, establishment and spread of noxious weeds can be curtailed by controlling the pattern of disturbance as well as controlling large populations that serve as propagule sources.

Disturbance is a natural and integral part of the ecosystem, but its the compounding nature of disturbance due to management activities and overuse that is of concern-the associated soil compaction and loss of structure and function, and the types of species that invade after these particular types of disturbances occur. Soil compaction can either preclude vegetation from re-establishing, or can change the habitat such that different plant species invade the area replacing vegetation previously present or replacing what would be the normal early successional vegetation for that habitat type. Most disturbance centers are connected by roads that provide pathways for weeds to spread. This substantial change in vegetation type, especially in and around richly biodiverse special habitat types, may well disrupt plant-animal interactions and other ecosystem processes.