Cape Blanco Wind Farm Feasibility Study Technical Report

No. 11 - Terrestrial Ecology

BPA

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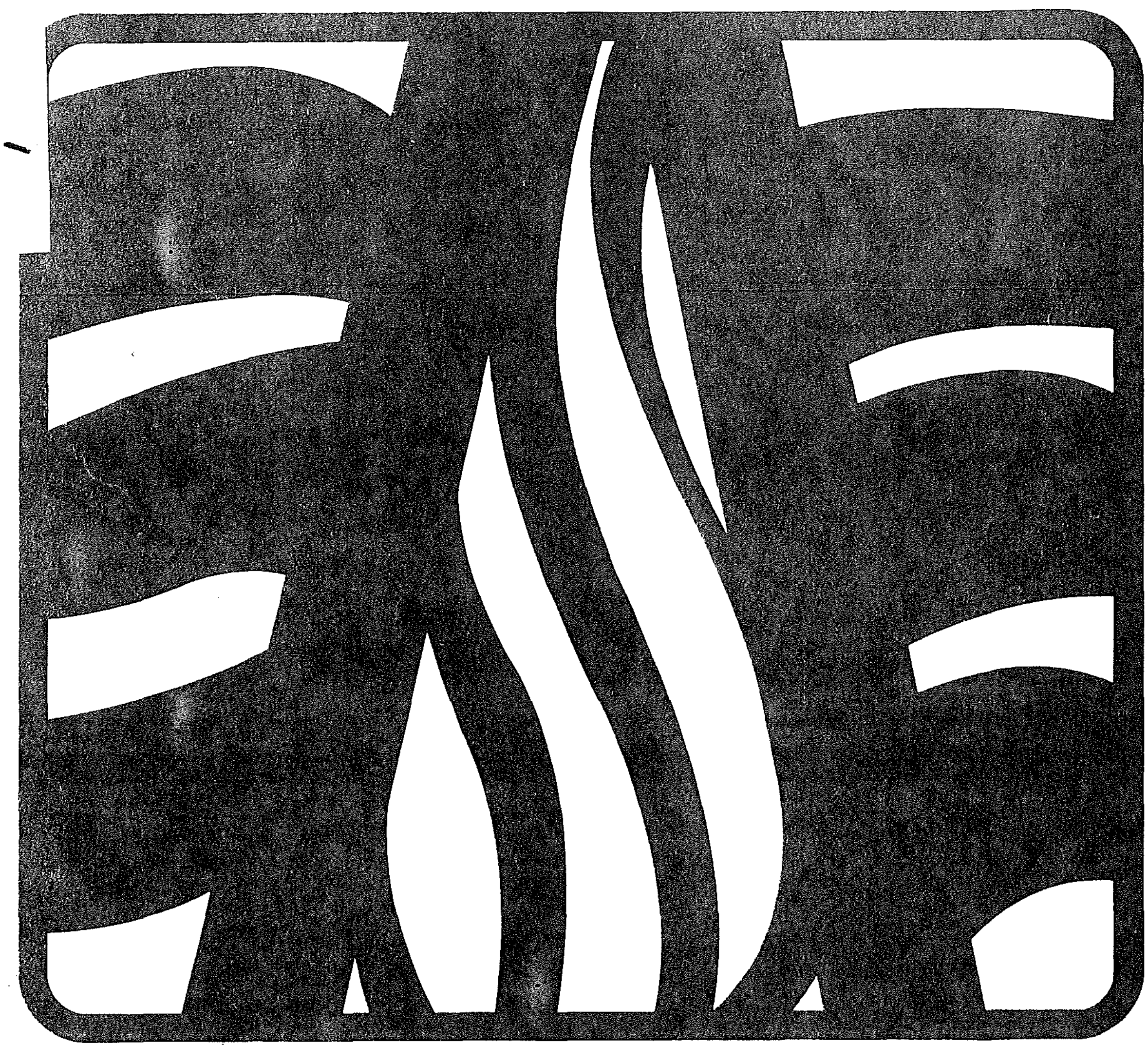

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CAPE BLANCO WIND ENERGY FEASIBILITY STUDY

TECHNICAL REPORT NO. 11

TERRESTRIAL ECOLOGY

1986

Prepared by

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Portland, Oregon

Submitted to

Bonneville Power Administration

Portland, Oregon

SUMMARY

The project site is a series of grassland bench terraces on a bluff above the Pacific Ocean. Because the site has a long history of use for sheep grazing, the vegetation is mainly pasture grasses (64 percent of the site), with patches of mixed forest cover (26 percent), and wetlands (10 percent) in the ravine dividing the site. Because of the open nature of the site, the proposed arrangement of the wind turbines and relatively little need for site modification, there are few environmental concerns. The main concerns are the potential for bird collisions with the turbines and associated apparatus and threatened and endangered bird species.

From literature reviews, site visits, and impact comparisons, the expected impacts of the project on vegetation, mammals, amphibians, reptiles, and fish have been determined to be minor (i.e., not significant). In order to predict the magnitude and importance of impacts on birds, a series of calculations were made using formulas from the literature to estimate bird kills from collisions with the wind turbines and associated apparatus. Based on stated assumptions, conservative estimates which would overestimate bird kills, were calculated for each turbine design alternative. Less than one-tenth of 1 percent of the vulnerable migrating bird population was determined to be subject to death by collision. Thus, impacts to birds were also determined to be insignificant.

The other major concern is the potential impacts of the project on five species of birds from the area that are recognized as threatened or endangered. The site provides no unique or especially important habitat for any of the five species. The likelihood of project impacts to any of them is low. The potential level of impact is also low, and, therefore, the impacts are not significant.

Impacts of the three alternatives are compared in tabular form and conclusions are drawn on the significance of the impacts. Since none of the alternatives appear to have significant impacts, mitigation measures are discussed more in terms of practices or actions which could or would reduce impacts.

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1.0 INTRODUCTION

The construction and use of electrical energy generation systems result in a variety of environmental impacts. Wind energy conversion systems offer major environmental advantages in that the energy source is renewable and without cost, little or no demand is made on water supplies, and little or no air pollution is associated with wind turbine operation (Medsker 1982). However, certain environmental issues need to be addressed when considering the site selection, construction, and operation of a wind farm.

Several federal and state regulations address wildlife and habitat issues in the siting and development of wind farms. These laws apply to public and private land sites. If a federal agency is directly involved or is processing a permit request for a significant public or private development action, compliance with the National Environmental Policy Act (NEPA) is required. An environmental assessment (EA) or environmental impact statement (EIS) would be prepared to determine the extent of project impact on the environment. The findings of an EA or EIS would include standards, design features, and mitigation recommendations to minimize negative project impacts. Other federal laws which may affect a proposed wind farm project in relation to wildlife and its habitat include the Fish and Wildlife Coordination Act, Fish and Wildlife Conservation Act, Endangered Species Act, Wild and Scenic Rivers Act, Wilderness Act, Forest and Rangeland Renewable Resources Planning Act, and the National Forest Management Act.

Oregon also sets standards for siting wind energy facilities in Oregon Administrative Rule (OAR) 345-115-040. Environmental impacts to fish, wildlife, endangered species and their habitats are among the assess ment requirements of this rule. Similar standards are designated in OAR 345-80-60 for siting transmission lines in Oregon.

The objective of this report is to evaluate the potential ecological impacts of the construction and operation of a wind-energy conversion system located near Cape Blanco in Curry County, Oregon. Because environmental effects of wind farms are primarily terrestrial, major emphasis is placed on vegetation (ie, habitat) and wildlife species (ie, birds, mammals, reptiles, amphibians). Potential effects of the project on fish are also briefly discussed.

Three wind farm alternatives are considered:

	I	II	III
Wind turbine	Boeing MOD-2	FloWind 170	DAF 6400
Axis			Horizontal
Vertical	Vertical		
Capacity (kW)	2,500	170	500
Height (ft)	350	92	132
Number of units	31	455	259

In addition to the environmental assessment of wind turbine alternatives, potential impacts of wind farm support facilities are discussed. In particular, two transmission line routes (Grassy Knob, Sixes River Road) to an existing BPA 230-kV line are evaluated for impacts to vegetation and wildlife.

The project site under consideration consists of approximately 1,600 acres located in Curry County, south of Cape Blanco along the southern Oregon coast (Figure 1). The area is characterized by a series of grassland bench terraces divided by a drainage ravine. Within the ravine is a small earth-filled dam and reservoir for irrigation. A gravel quarry operation also exists on-site. The project site is bordered on the south and west by the Elk River. The river turns north along the toe of steep ocean bluffs on the west border. Cape Blanco Road and Cape Blanco State Park form the north boundary. The entire project site lies west of Highway 101. The primary current land use of the site is livestock grazing.

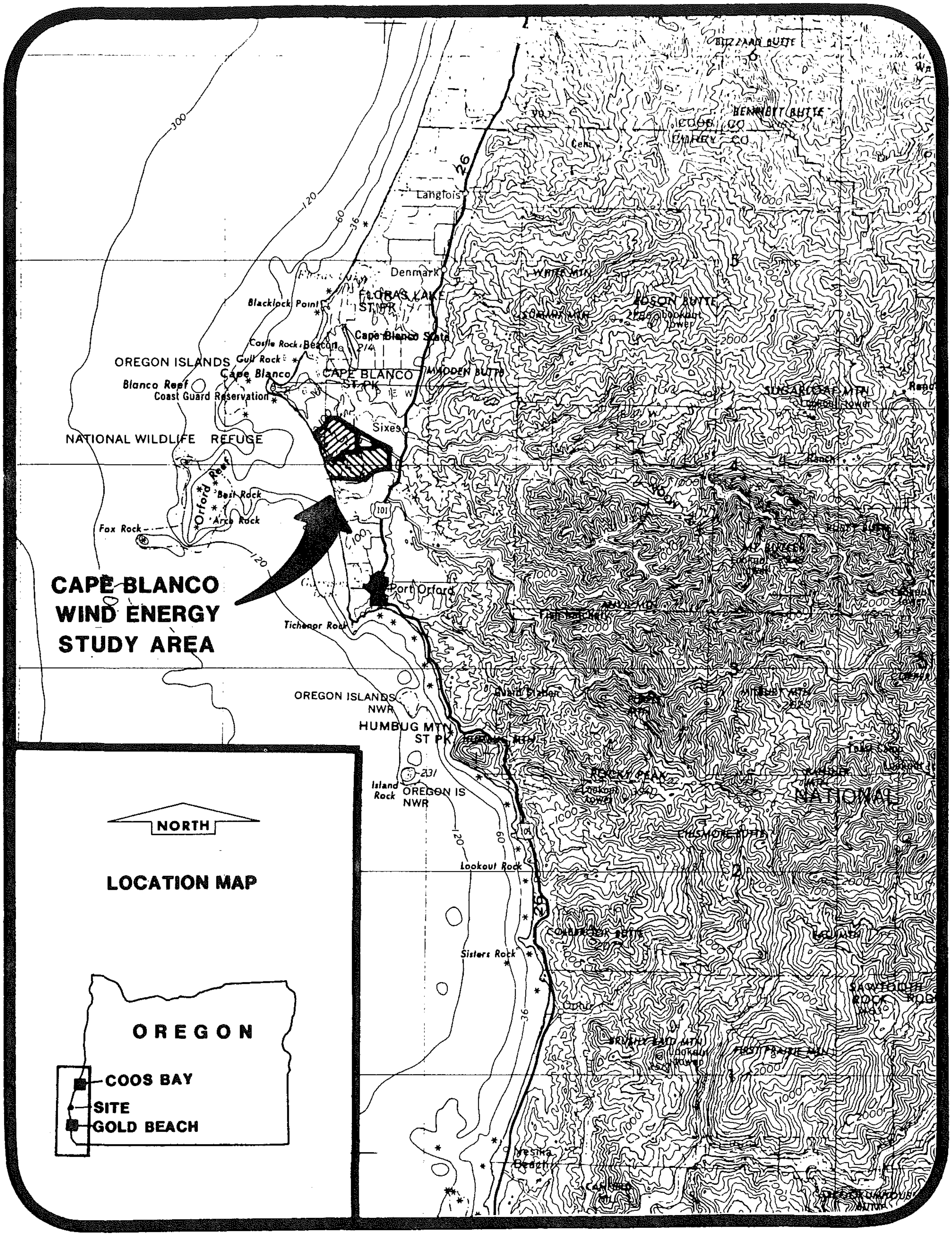

Figure 1. Cape Blanco Wind Energy Facility Study Area Map

2.0 METHODOLOGY

A major source of information regarding vegetation and wildlife composition in the Cape Blanco area was obtained from a search and review of appropriate literature. To supplement and verify findings in the literature, three site surveys were conducted on March 26-28, May 21-23 and August 27-28, 1984. All bird, mammal, amphibian, and reptile observations were noted during each visit. Dr. Phillip Gaddis conducted 11 supplementary bird census trips between late September 1984 and mid-April 1985. Each trip included five regular census routes, daily checks for collision kills at the meteorological towers, and general observations.

Fifty Sherman live traps were set along a designated transect through pasture, mixed forest, and wetland habitat to document the occurrence of small, more secretive mammal species. The traps were set for two trap nights on May 22 and 23, 1984.

Plant specimens were also collected during the May site visit for subsequent identification. Appropriate field guides (Dennis 1980, Hitchcock and Cronquist 1973, Horn 1980, Hotchkiss 1972, Niehaus and Ripper 1976, Spellenberg 1979, Steward et al. 1963, and Wiedemann et al. 1969) were used to identify the collected plant material. Taxonomic nomenclature developed by Hitchcock and Cronquist (1973) was followed in the inventory results.

The Cape Blanco Wind Farm Project area was assessed for the occurrence of plants and wildlife that are on state and federal lists of threatened and endangered species. Site visits, interviews, literature, and data bank searches were utilized to determine the extent this species group occurs on or in the vicinity of the wind farm site.

A major issue to consider when assessing environmental impacts of a wind farm installation is the possibility of bird collisions with the turbines. A predictive model developed by McCrary et al. (1983, 1984) was modified to estimate the number of interactions or potential collisions (C) per migration period based on an assumed migration traffic rate (MTR = number of birds passing over a 1-km transect per hour). The formula and the assumptions used for this model are given below:

$$C = \left[\frac{B_r \cdot T_m \cdot S_z}{H_z} \right] \cdot \left[1 - P_A \right]$$

B_T = Birds at risk = $\frac{\text{maximum turbine height}}{\text{maximum migration height}}$ • MTR • maximum width of turbine

T_m = Time (hours) of migration period.

S_Z = Strike zone; the vertical planar surface area of a wind turbine, including the blade sweep area and support structures (e.g., guy wires, blade tower).

H_Z = Hazard zone; the maximum height of the turbine multiplied by the maximum width of the turbine (vertical axis turbine width measured from guy anchor to guy anchor).

P_A = Probability of avoidance behavior.

In applying this predictive model to the Cape Blanco area, the following assumptions were made:

1. Bird flight is less than the maximum height of the wind turbine under consideration (i.e., Boeing MOD-2 = 350 ft, FloWind 170 = 92 ft, DAF 6400 = 132 ft).

2. A potential collision or interaction will occur if the bird passes through the strike zone (S_Z).

3. In the case of the Boeing MOD-2 alternative, bird flight direction is perpendicular to the blade sweep area.

4. MTR below 107 m (350 ft) = 300 birds/hr/km. McCrary et al. (1983, 1984) estimated MTRs in southern California to be 388 $\pm$ 93 below 127 m in the fall and 365 $\pm$ 44 below 111 m in the spring. While the selection of 300 as the MTR for Cape Blanco is somewhat arbitrary, it does appear to be a reasonable number.

5. Birds are evenly distributed in the air space.

6. Fall migration = September-October = 60 days at 12 hr per night.

7. Spring migration = mid-March-May = 75 days at 10 hr per night.

3.0 EXISTING ENVIRONMENT

3.1 Vegetation

The Cape Blanco wind farm site lies within the oceanfront vegetation community described by Franklin and Dyrness (1973). Vegetation community characteristics are somewhat transitional between the forest dominated vegetation (Sitka spruce/coastal pine) of the north Oregon coast and the herb-shrub communities typical of the southern Oregon coast.

Three major habitat types occur on the project site (see Figure 1). Grassland dominated by blue ryegrass, Douglas iris, sheep sorrel, and white clover represents about 64 percent (1,025 acres) of the vegetation cover on-site (Figure 2). Much of the grassland is irrigated and used to pasture sheep. Areas along Cape Blanco Road have been invaded by gorse, an introduced shrub which bears numerous spines and occurs in very dense patches. Livestock and larger wildlife species are prevented from using areas covered with gorse, which occupies about 15 acres of the grassland.

Mixed forest habitat (Figure 3) consisting primarily of Sitka spruce and red alder occurs along the sides of the drainage ravines and in areas that were not cleared for pasture. Other tree species observed on-site include coastal pine, Port Orford cedar, Douglas fir, western hemlock, and coast willow. Deciduous species willow and alder tend to predominate in areas of higher soil moisture content, such as along the Elk River and near the wetlands. Coniferous species are more abundant along the edge of the drainage ravines and on the upper terraces. Understory vegetation is comprised of various shrub and herb species such as salal, Oregon grape, blackberry, salmonberry, huckleberry, chickweed, and candy flower. Mixed forest habitat represents about 26 percent (415 acres) of the vegetation cover on the project site.

Wetlands occur on about 10 percent (160 acres) of the project area (Figure 4). Common rush, small-fruited bulrush, horsetail, cattail, skunk cabbage, water celery and yellow pond lily are the most common species found in this habitat. This plant community is restricted to an area in the bottom of the drainage ravines. Within the wetland area is a small (about 8 acres) reservoir used for irrigation water storage. Red alder is common along the reservoir edge.

Figure 2. Pasture Habitat Located in the Cape Blanco Wind Farm Project Area

Figure 3. Mixed Forest Habitat (Sitka Spruce/Red Alder)
Located in the Cape Blanco Wind Farm Project Area

Figure 4. Wetland Habitat Located in a Drainage Ravine in the Cape Blanco Wind Farm Project Area

A complete listing of plant species observed on the wind farm project site is shown in Table 1. A total of 100 species (42 families) was identified during the May 21-23, 1984 vegetation survey.

Existing disturbances to vegetation on the project site are limited to a gravel quarry operation (Figure 5) and the many unimproved roads that provide access to the quarry and sheep grazing areas. The quarry has replaced about 15 acres of pasture habitat along the edge of a bench terrace. An estimated 8 miles of road are found throughout the project area, disturbing an estimated 10 acres of vegetation cover if one assumes an average road width of 10 feet.

3.2 Birds

Table 2 lists birds observed on or adjacent to the Cape Blanco wind farm site from March 1982 to August 1984 and from September 1984 to April 1985 (Gaddis 1985). A total of 168 species (39 families) was noted during this period. Waterfowl, shorebirds, gulls, sparrows, and finches are important bird groups in the area. Species composition and relative abundance varies seasonally.

The largest number of species and highest densities of birds are found during the spring (March through May) and fall (September through November) migratory periods. Shorebirds (e.g., greater yellowlegs, western sandpiper, least sandpiper, dunlin, long-billed dowitcher) and gulls (e.g., glaucous-winged gull, Bonaparte's gull, California gull) utilize the open fields and wetlands for resting and feeding. Warblers, vireos, chickadees, and kinglets are common in wooded areas. Sparrows (e.g., white-crowned sparrow, savannah sparrow) and finches (e.g., American goldfinch, house finch) are frequently seen along fencerows and in open shrub habitat.

During the winter, gulls, some shorebirds, and Canada geese are found in the pasture areas. Mallards, bufflehead, and common mergansers frequently utilize the Elk River, reservoir, and flooded pasture. Sparrows are also a common winter resident in shrub habitat.

Common summer residents include the turkey vulture, red-tailed hawk, swallows, rufous hummingbird, marsh wren, and wrentit. Throughout the year, birds frequently seen include the great blue heron, killdeer, western gull, belted kingfisher, northern flicker, American crow, common raven, winter wren, American robin, song sparrow, and European starling. Brown-headed cowbirds and Brewer's blackbirds are seen around the sheep.

TABLE 1. PLANT SPECIES OBSERVED ON THE PROPOSED CAPE BLANCO WIND FARM SITE, MAY 21-23, 1984

Family Equisetaceae
- Horsetail(Equisetum sp)

Family Polypodiaceae
- Lady fern(Athyrium filix-femina)
- Deer fern (Blechnum spicant)
- Licorice fern (Polypodium vulgare)
- Sword fern (Polystichum munitum)
- Bracken fern (Pteridium aquilinium)

Family Cupressaceae
- Port Orford cedar (Chamaecyparis lawsoniana)
- Monterey cypress (Cupressus macrocarpa)

Family Pinaceae
- Grand fir (Abies grandis)
- Sitka spruce (Picea sitchensis)
- Coastal pine (Pinus contorta)
- Douglas fir (Pseudotsuga menziesii)
- Western hemlock (Tsuga heterophylla)

Family Salicaceae
- Coast willow (Salix hookeriana)
- Willow (Salix sp.)

Family Betulaceae
- Red alder (Alnus rubra)

Family Aceraceae
- Big leaf maple (Acer macrophyllum)

Family Rhamnaceae
- Cascara (Rhamnus purshiana)

Family Myricaceae
- Wax myrtle (Myrica californica)

Family Urticaceae
- Stinging nettle (Urtica dioica)

Family Polygonaceae
- Sheep sorrel (Rumex acetosella)
- Curly dock (Rumex crispus)
- Broadleaf dock (Rumex obtusifolius)

Family Portulacaceae
- Candy flower (Montia sibirica)

Family Caryophyllaceae
- Field chickweed (Cerastium arvense)
- Common chickweed (Stellaria media)

Family Nymphaeaceae
- Yellow pond lily (Nuphar polysepalum)

Family Ranunculaceae
- Field buttercup (Ranunculus occidentalis)
- Creeping buttercup (Ranunculus repens)
- Little buttercup (Ranunculus uncinatus)

Family Fumariaceae
- Pacific bleedingheart (Dicentra formosa)

Family Berberidaceae
- Oregon grape (Berberis nervosa)

Family Cruciferae
- Black mustard (Brassica nigra)
- Seaside bittercress (Cardamine angulata)
- Bittercress (Cardamine oligosperma)
- Hedge mustard (Sisymbrium officinale)

Family Saxifragaceae
- Fringecup (Tellima grandiflora)

Family Grossulariaceae
- Gooseberry (Ribes sp.)

Family Rosaceae
- Coast strawberry (Fragaria chiloensis)
- Oceanspray (Holodiscus discolor)
- Pacific silverweed (Potentilla pacifica)
- Nootka rose (Rosa nutkana)
- Himalayan blackberry (Rubus discolor)
- Thimbleberry (Rubus parviflorus)
- Salmonberry (Rubus spectabilis)
- Pacific blackberry (Rubus ursinus)

Family Leguminosae
- Scot's broom (Cytisus scoparius)
- Seashore lupine (Lupinus littoralis)
- Small hop clover (Trifolium dubium)
- White clover (Trifolium repens)
- Marsh clover (Trifolium wormskjoldii)
- Gorse (Ulex europaeus)
- Giant vetch (Vicia gigantea)
- Spring vetch (Vicia sativa)

Family Geraniaceae
- Dovefoot geranium (Geranium molle)

Family Oxalidaceae
- Oregon wood sorrel (Oxalis oregana)

Family Linaceae
- Narrow-leaved flax (Linum angustifolium)

Family Violaceae
- Wood violet (Viola glabella)

Family Umbelliferae
- Queen Anne's lace (Daucus carota)
- Cow parsnip (Heracleum lanatum)
- Water celery (Oenanthe sarmentosa)

Family Ericaecae
- Madrone (Arbutus menziesii)
- Salal (Gaultheria shallon)
- Western rhododendron (Rhododendron macrophyllum)
- Western azalea (Rhododendron occidentale)
- Evergreen huckleberry (Vaccinium ovatum)
- Red huckleberry (Vaccinium parvifolium)

Family Labiatae
- Red henbit (Lamium purpureum)
- Hedgenettle (Stachys mexicana)

Family Scrophulariaceae
- Foxglove (Digitalis purpurea)
- Toothed monkeyflower (Mimulus dentatus)
- California figwort (Scrophularia californica)

Family Plantaginaceae
- English plantain (Plantago lanceolata)
- Broadleaf plantain (Plantago major)

Family Rubiaceae
- Cleavers bedstraw (Galium aparine)
- Fragrant bedstraw (Galium triflorum)

Family Caprifoliaceae
- Red elderberry (Sambucus racemosa)
- Common snowberry (Symphoricarpos albus)

Family Cucurbitaceae
- Wild cucumber (Marah oreganus)

TABLE 1 (Continued)

Family Compositae
- Western yarrow (Achillea millefolium)
- Pearly everlasting (Anaphalis margaritacea)
- Chaparral broom (Baccharis pilularis)
- English daisy (Bellis perennis)
- Canadian thistle (Cirsium arvense)
- Bull thistle (Cirsium vulgare)
- Cat's ear dandelion (Hypochaeris radicata)
- Pineapple weed (Matricaria matricarioides)
- Common butterweed (Senecio vulgaris)
- Milk thistle (Silybum marianum)
- Canadian goldenrod (Solidago canadensis)
- Common sowthistle (Sonchus oleraceus)
- Common dandelion (Taraxacum officinale)

Family Juncaceae
- Common rush (Juncus effusus)

Family Cyperaceae
- Small-fruited bulrush (Scirpus microcarpus)

Family Gramineae
- Blue ryegrass (Elymus glaucus)

Family Typhaceae
- Cattail (Typha latifolia)

Family Araceae
- Skunk cabbage (Lysichitum americanum)

Family Liliaceae
- False lily-of-the-valley (Maianthemum dilatatum)
- Starry Solomon's seal (Smilacina stellata)

Family Iridaceae
- Douglas' iris (Iris douglasiana)

Figure 5. Gravel Quarry Operation on Proposed Cape Blanco Wind Farm Site

TABLE 2. BIRDS OBSERVED ON OR ADJACENT TO THE CAPE BLANCO WIND FARM STUDY AREA, MARCH 1982 TO APRIL 1985

Family Gaviidae
- Red-throated loon (Gavia stellata)
- Common loon (Gavia immer)
- Arctic loon (Gavia arctica)

Family Podicipedidae
- Pied-billed grebe (Podilymbus podiceps)
- Western grebe (Aechmophorus occidentalis)
- Horned grebe (Colymbus auritus)

Family Pelecanidae
- Brown pelican (Pelecanus occidentalis)

Family Phalacrocoracidae
- Double-crested cormorant (Phalacrocorax auritus)
- Pelagic cormorant (Phalacrocorax pelagicus)

Family Ardeidae
- Great blue heron (Ardea herodias)
- Great egret (Casmerodius albus)
- Cattle egret (Bubulcus ibis)

Family Anatidae
- Tundra swan (Cygnus columbianus)
- Brant (Branta bernicla)
- Canada goose (Branta canadensis)
- Aleutian Canada goose (Branta canadensis leucopareia)
- Green-winged teal (Anas crecca)
- Mallard (Anas platyrhynchos)
- Northern pintail (Anas acuta)
- Gadwall (Chaulelasmus streperus)
- American widgeon (Mareca americana)
- Blue-winged teal (Anas discors)
- Cinnamon teal (Anas cyanoptera)
- Wood duck (Aix sponsa)
- Greater scaup (Aythya marila)
- Lesser scaup (Aythya affinis)
- Oldsquaw (Clangula hyemalis)
- Black scoter (Melanitta nigra)
- Surf scoter (Melanitta perspicillata)
- White-winged scoter (Melanitta fusca)
- Common Goldeneye (Bucephala clangula)
- Bufflehead (Bucephala albeola)
- Hooded merganser (Lophodytes cucullatus)
- Common merganser (Mergus merganser)
- Red-breasted merganser (Mergus serrator)

Family Cathartidae
    Turkey vulture (Cathartes aura)

Family Accipitridae
    Black-shouldered kite (Elanus caeruleus)
    Cooper's hawk (Accipiter cooperi)
    Sharp-shinned hawk (Accipiter velox velox)
    Rough-legged hawk (Buteo lagopus)
    Bald eagle (Haliaeetus leucocephalus)
    Northern harrier (Circus cyaneus)
    Red-tailed hawk (Buteo jamaicensis)
    Golden eagle (Aquila chrysaetos)

Family Falconidae
    American kestrel (Falco sparverius)
    Merlin (Falco columbarius)
    Peregrine falcon (Falco peregrinus)

Family Perdicidae
    California quail (Lophortyx californica)

Family Rallidae
    American coot (Fulica americana)

Family Charadriidae
    Black-bellied plover (Pluvialis squatarola)
    Semipalmated plover (Charadrius semipalmatus)
    Killdeer (Charadrius vociferus)

Family Haematopodidae
    American black oystercatcher (Haematopus bachmani)

Family Scolopacidae
    Greater yellowlegs (Tringa melanoleuca)
    Lesser yellowlegs (Tringa flavipes)
    Wandering tattler (Heteroscelus incanus)
    Spotted sandpiper (Actitis macularia)
    Whimbrel (Numenius phaeopus)
    Long-billed curlew (Numenius americanus)
    Black turnstone (Arenaria melanocephala)
    Sanderling (Calidris alba)
    Western sandpiper (Calidris mauri)
    Least sandpiper (Calidris minutilla)
    Bairds sandpiper (Calidris bairdii)
    Pectoral sandpiper (Calidris melanotos)
    Dunlin (Calidris alpina)
    Short-billed dowitcher (Limnodromus griseus)
    Long-billed dowitcher (Limnodromus scolopaceus)
    Common snipe (Gallinago gallinago)
    Red-necked phalarope (Phalaropus lobatus)

Family Laridae
- Bonaparte's gull (Larus philadephia)
- Heermann's gull (Larus heermanni)
- Mew gull (Larus canus)
- Franklin's gull (Larus pipixcan)
- Ring-billed gull (Larus delawarensis)
- California gull (Larus californicus)
- Herring gull (Larus argentatus)
- Thayer's gull (Larus thayeri)
- Western gull (Larus occidentalis)
- Glaucous-winged gull (Larus glaucescens)
- Glaucous gull (Larus hyperboreus)
- Black-legged kittiwake (Rissa tridactyla)
- Caspian tern (Sterna caspia)
- Common tern (Sterna hirundo)

Family Alcidae
- Common murre (Uria aalge)
- Pigeon guillemot (Cepphus columba)
- Marbled murrelet (Brachyramphus marmoratus)

Family Columbidae
- Rock dove (Columba livia)
- Band-tailed pigeon (Columba fasciata)
- Mourning dove (Zenaida macroura)

Family Strigidae
- Great horned owl (Bubo virginianus)

Family Apodidae
- Black swift (Cypseloides niger)
- Vaux's swift (Chaetura vauxi)

Family Trochilidae
- Rufous hummingbird (Selasphorus rufus)
- Allen's hummingbird (Selasphorus sasin)

Family Alcedinidae
- Belted kingfisher (Ceryle alcyon)

Family Picidae
- Downy woodpecker (Picoides pubescens)
- Hairy woodpecker (Picoides villosus)
- Northern flicker (Colaptes auratus)
- Common flicker (Colaptes cafer)
- Pileated woodpecker (Dryocopus pileatus)

Family Tyrannidae
Olive-sided flycatcher (Contopus borealis)
Western wood pewee (Contopus sordidulus)
Western flycatcher (Empidonax difficilis)
Black phoebe (Sayornis nigricans)
Say's phoebe (Sayornis saya)
Western kingbird (Tyrannus verticalis)
Family Hirundinidae
Tree swallow (Tachycineta bicolor)
Violet-green swallow (Tachycineta thalassina)
Northern rough-winged swallow (Stelgidopteryx serripennis)
Cliff swallow (Hirundo pyrrhonota)
Barn swallow (Hirundo rustica)
Family Corvidae
Stellar's jay (Cyanocitta stelleri)
American crow (Corvus brachyrhynchos)
Common raven (Corvus corax)
Family Paridae
Black-capped chickadee (Parus atricapillus)
Chestnut-backed chickadee (Parus rufescens)
Family Sittidae
Red-breasted nuthatch (Sitta canadensis)
Family Certhiadae
Brown creeper (Certhia familiaris)
Family Troglodytidae
Bewick's wren (Thryomanes bewickii)
Winter wren (Troglodytes troglodytes)
Marsh wren (Cistothorus palustris)
Family Muscicapidae
Golden-crowned kinglet (Regulus satrapa)
Ruby-crowned kinglet (Regulus calendula)
Swainson's thrush (Catharus ustulatus)
American robin (Turdus migratorius)
Varied thrush (Ixoreus naevius)
Wrentit (Chamaea fasciata)
Hermit thrush (Hylocichla guttata)
Western bluebird (Sialia mexicana)
Family Mimidae
Northern mockingbird (Mimus polyglottos)

Family Motacillidae
- Water pipit (Anthus spinoletta)

Family Bombycillidae
- Cedar waxwing (Bombycilla cedrorum)

Family Laniidae
- Northern shrike (Lanius borealis)

Family Sturnidae
- European starling (Sturnus vulgaris)

Family Vireonidae
- Hutton's vireo (Vireo huttoni)
- Warbling vireo (Vireo gilvus)

Family Emberizidae
- Orange-crowned warbler (Vermivora celata)
- Yellow-rumped warbler (Dendroica coronata)
- Townsend's warbler (Dendroica townsendi)
- Black-throated gray warbler (Dendroica nigrescens)
- Palm warbler (Dendroica palmarum)
- Common yellowthroat (Geothlypis trichas)
- Wilson's warbler (Wilsonia pusilla)
- Black-headed grosbeak (Pheucticus melanocephalus)
- American tree sparrow (Spizella arborea)
- Vesper sparrow (Pooecetes gramineus)
- Black-throated sparrow (Amphispiza bilineata)
- Lark sparrow (Chondestes grammacus)
- Savannah sparrow (Passerculus sandwichensis)
- Song sparrow (Melospiza melodia)
- Golden-crowned sparrow (Zonotrichia atricapilla)

Family Emberizidae
- White-crowned sparrow (Zonotrichia leucophrys)
- Fox sparrow (Passerella iliaca)
- Dark-eyed junco (Junco hyemalis)
- Lapland longspur (Calcarius lapponicus)
- Red-winged blackbird (Agelaius phoeniceus)
- Western meadowlark (Sturnella neglecta)
- Brewer's blackbird (Euphagus cyanocephalus)
- Brown-headed cowbird (Molothrus ater)

Family Fringillidae
- Purple finch (Carpodacus purpureus)
- House finch (Carpodacus mexicanus)
- Pine siskin (Carduelis pinus)

Lesser goldfinch (Carduelis psaltria)
American goldfinch (Carduelis tristis)
Rufous-sided towhee (Pipilo maculatus)

Family Passeridae
House sparrow (Passer domesticus)

The birds listed in Table 2 include many rare species or species only occasionally observed in the area. For example, during a site visit in March 1984, an American tree sparrow was observed along a fencerow. This is the first record of this species to occur in Curry County. In May 1984, two black-throated sparrows were noted along a fencerow. Black-throated sparrows normally range in the Colorado, Mojave, and Great Basin deserts (American Ornithologists' Union 1983). These rare birds, along with the more abundant warblers, vireos, and sparrows, indicate that the Cape Blanco area is an important resting location for migrants.

Loons, grebes, cormorants, brown pelicans, and diving ducks (e.g., scoters, mergansers) are generally only seen on the Elk River or Pacific Ocean, but occasionally, these species may use the irrigation reservoir on the project site. These birds may also be seen flying over the site in transit to nearby deep water locations. The Cape Blanco wind farm site is of little importance to these species.

3.3 Mammals

Based on mammal investigations in Curry County by Sherrell (1970) and a review of pertinent mammal distribution literature (Burt and Grossenheider 1964, Ingles 1965, Larrison 1976, Maser et al. 1981), 51 species of mammal are likely to occur on or in the vicinity of the Cape Blanco project area (Table 3). The most frequently observed species on-site include brush rabbit, mountain beaver, muskrat, and black-tailed deer.

Three mammal species were trapped during the May 22-23, 1984 mammal survey (Table 4). No small mammals were collected in pasture habitat. Grazing keeps vegetation low to the ground, consequently providing insufficient cover for many species. However, the presence of moles is evident by numerous mounds observed in the area.

A total of 12 mammal species has been recorded from site visits and interviews with residents in the area. The most unusual sighting was a cougar observed in a field along Cape Blanco Road in 1974. This individual was likely a transient through the project area, illustrating that the species can be expected to visit the site occasionally.

TABLE 3. MAMMALS LIKELY TO OCCUR ON OR IN THE VICINITY OF THE CAPE BLANCO WIND FARM STUDY AREA

Family Didelphidae
- Virginia opossum (Didelphis virginiana)

Family Soricidae
- Vagrant shrew (Sorex vagrans)
- Pacific shrew (Sorex pacificus)
- Marsh shrew (Sorex bendirii)
- Trowbridge shrew (Sorex trowbridgii)

Family Talpidae
- Shrew-mole (Neurotrichus gibbsi)
- Townsend mole (Scapanus townsendii)
- Coast mole (Scapanus orarius)

Family Vespertilionidae
- Little brown bat (Myotis lucifugus)
- Yuma bat (Myotis yumanensis)
- Long-eared bat (Myotis evotis)
- Long-legged bat (Myotis volans)
- California bat (Myotis californicus)
- Silver-haired bat (Lasionycteris noctivagans)
- Big brown bat (Eptesicus fuscus)
- Hoary bat (Lasiurus cinereus)
- Western long-eared bat (Plecotus townsendi)

Family Leporidae
- Brush rabbit (Sylvilagus bachmani)*

Family Aplodontidae
- Mountain beaver (Aplodontia rufa)*

Family Sciuridae
- Townsend chipmunk (Eutamias townsendi)
- California ground squirrel (Spermophilus beecheyi)
- Chickaree (Tamiasciurus douglasi)*
- Northern flying squirrel (Glaucomys sabrinus)

Family Castoridae
- Beaver (Castor canadensis)

*Observed

Family Cricetidae
- Deer mouse (Peromyscus maniculatus)*
- Dusky-footed woodrat (Neotoma fuscipes)*
- Bushy-tailed woodrat (Neotoma cinerea)
- California red-backed vole (Clethrionomys californicus)
- White-footed vole (Arborimus albipes)
- Red tree vole (Arborimus longicaudus)
- Townsend vole (Microtus townsendi)
- Long-tailed vole (Microtus longicaudus)*
- Oregon vole (Microtus oregoni)
- Muskrat (Ondatra zibethicus)*

Family Muridae
- Black rat (Rattus rattus)
- Norway rat (Rattus norvegicus)
- House mouse (Mus musculus)

Family Zapodidae
- Pacific jumping mouse (Zapus trinotatus)*

Family Canidae
- Coyote (Canis latrans)*
- Gray fox (Urocyon cinereoargenteus)

Family Ursidae
- Black bear (Ursus americanus)*

Family Procyonidae
- Raccoon (Procyon lotor)

Family Mustelidae
- Short-tailed weasel (Mustela erminea)
- Long-tailed weasel (Mustela frenata)
- Mink (Mustela vison)
- Spotted skunk (Spilogale putorius)
- Striped skunk (Mephitus mephitus)
- River otter (Lutra canadensis)

Family Felidae
- Cougar (Felis concolor)*
- Bobcat (Felis rufus)

Family Cervidae
- Black-tailed deer (Odocoileus hemionus)*

*Observed

TABLE 4. MAMMALS LIVE-TRAPPED IN THE CAPE BLANCO WIND FARM PROJECT AREA, MAY 22-23, 1984

	Number Trapped	Habitat
Deer mouse	8	Mixed forest
Pacific jumping mouse	2	Wetland
Dusky-footed woodrat	1	Mixed forest

3.4 Amphibians and Reptiles

The project area provides habitat to a variety of reptile species. Review of the literature (Cochran and Goin 1970, Stebbins 1966, Storm 1974), shows that 13 amphibian species and 12 reptile species could occur on-site (Table 5). Areas of particular importance to amphibians and reptiles include the irrigation reservoir, understory vegetation in the drainage ravines, and dense shrub cover along or in pasture habitat.

Red-legged frogs are common along the irrigation reservoir. A northern alligator lizard and a common garter snake were observed during a March and May 1984 site visit, respectively. Both species were associated with dense shrub cover along pasture habitat.

3.5 Fish

The Elk River flows along the south and west boundaries of the project site. The river originates in the coastal mountain range and has a drainage area of approximately 94 square miles. The average monthly discharge ranges from a minimum of 65 cfs in August to 1,100 cfs in February (Oregon Department of Fish and Wildlife 1984).

Anadromous fish are an important resource of the Elk River. Species of concern include both wild and hatchery runs of fall chinook salmon (Oncorhynchus tshawytscha), a small run of coho salmon (Oncorhynchus kisutch), a wild run of winter steelhead (Salmo gairdneri gairdneri), and a run of sea-run cutthroat trout (Salmo clarki clarki).

TABLE 5. AMPHIBIANS AND REPTILES LIKELY TO OCCUR ON OR IN THE VICINITY OF THE CAPE BLANCO WIND FARM STUDY AREA

AMPHIBIANS

Family Ambystomatidae
- Northwestern salamander (Ambystoma gracile)
- Pacific giant salamander (Dicamptodon ensatus)
- Olympic salamander (Rhyacotriton olympicus)

Family Salamandridae
- Rough-skinned newt (Taricha granulosa)

Family Plethodontidae
- Dunn's salamander (Plethodon elongatus)
- Del Norte salamander (Plethodon elongatus)
- Ensatina (Ensatina eschscholtzi)
- Clouded salamander (Aneides ferreus)

Family Ascaphidae
- Tailed frog (Ascaphus truei)

Family Bufonidae
- Western toad (Bufo boreas)

Family Hylidae
- Pacific treefrog (Hyla regilla)

Family Ranidae
- Red-legged frog (Rana aurora)*
- Bullfrog (Rana catesbeiana)

REPTILES

Family Testudinidae
- Western pond turtle (Clemmys marmorata)

Family Iguanidae
- Western fence lizard (Sceloporus occidentalis)

Family Scincidae
- Western skink (Eumeces skiltonianus)

Family Anguidae
- Northern alligator lizard (Gerrhonotus coeruleus)*

Family Boidae
- Rubber boa (Charina bottae)

Family Colubridae
- Ringneck snake (Diadophis punctatus)
- Racer (Coluber constrictor)
- Gopher snake (Pituophis melanoleucus)
- Common garter snake (Thamnophis sirtalis)*
- Western aquatic garter snake (Thamnophis couchi)
- Northwestern garter snake (Thamnophis ordinoides)
- Western terrestrial garter snake (Thamnopis elegans)

*Observed

3.6 Endangered and Threatened Species

No federally designated threatened or endangered plant species occur on or near the project site, but five state-listed species may be in the vicinity in appropriate habitat (Table 6). The California pitcher plant, Oregon bleeding heart, large-flowered lasthenia, and western lily are currently under review for federal threatened or endangered classification. The silver phacelia has no federal status and is listed as threatened in Oregon (Siddall et al. 1979). These species were not observed and are not likely to occur on the project site because they require specific habitat conditions and relatively undisturbed habitat. Most of the study area has been subject to livestock grazing and logging activities since the late 1800s.

No threatened or endangered mammals, amphibians, or reptiles occur on or in the vicinity of the Cape Blanco wind farm study area. However, four federally listed and one candidate bird species have been observed or have the potential of using the project site (Table 6).

Bald eagles are known to occur in the study area. No nest sites currently exist; therefore, the project area is primarily used for feeding. The bald eagle's preferred food is fish (Snow 1973), and the Elk River provides a potential food source in view of the number of anadromous fish runs in the river. Bald eagles are most likely to utilize the site during the winter nonbreeding season or during peak runs of salmon in the Elk River. Snags, standing dead trees, near the Elk River may be important perch sites. Eagles may also be attracted to the area during the lambing season. This species also relies on carrion for food.

Peregrine falcons have also been observed in the study area. During a site visit on March 28, 1984, one falcon was observed hunting along the drainage ravine near McKenzie Road, southern boundary of the site. Gaddis (1985) also observed one on April 14, 1985 over the Sixes River floodplain. This species is a rare fall/spring migrant and winter visitor to the Cape Blanco area. It can be expected to use the project site for hunting and roosting on snags during this time.

TABLE 6. THREATENED OR ENDANGERED PLANTS AND WILDLIFE KNOWN TO OCCUR ON OR IN THE VICINITY OF THE CAPE BLANCO WIND FARM STUDY AREA

Species	Status		
	Federal	State	Site
Northern bald eagle (Haliaeetus leucocephalus alascanus)	Threatened	Threatened	Occasional year-round visitor
Peregrine falcon (Falco peregrinus)	Endangered	Endangered	Occasional migrant-winter visitor
California brown pelican (Pelecanus occidentalis californicus)	Endangered	Endangered	Uncommon off-shore migrant
Aleutian Canada goose (Branta canadensis leucopareia)	Endangered	Endangered	Rare migrant
Western snowy plover (Charadrius alexandrinus nivosus)	Candidate for Threatened	Threatened	Rare year-round visitor in suitable habitat
California pitcher plant (Darlingtonia californica)	No longer under review	Regional Endemic	Not observed
Bleeding heart (Dicentra formosa var. oregana)	No longer under review	Endangered	This variety not observed
Large-flowered lasthenia (Lasthenia macrantha ssp. prisca)	Candidate for Threatened	Threatened	Not observed
Western lily (Lilium occidentale)	No Status	Endangered	Not observed
Silver phacelia (Phacelia argentea)	No Status	Threatened	Not observed

The California brown pelican has been observed in the Cape Blanco area as an uncommon off-shore migrant. Less often, pelicans may be observed in the Elk River estuary along the western boundary. Direct use of the project site is unlikely. Gaddis (1985) observed brown pelicans flying northward over the breakers offshore on September 24-28, 1984.

Western snowy plovers are rare permanent residents along the coast in Curry County. They prefer beaches and sandy shores of rivers which are found adjacent to the wind farm project site. Because of the lack of suitable habitat on the site, direct use of the site is unlikely. This species may, however, be observed adjacent to or passing over the wind farm site. None were observed in 1984 or 1985.

Since 1979, Aleutian Canada geese have been observed in small numbers, up to 60, in the area of Langlois, Oregon, about 9 miles north of the wind-farm study area. The total goose population is an estimated 2,700. They primarily use a transoceanic migration route from their breeding grounds in the Aleutian Islands to the northwest coast of California (Pomeroy and Springer 1982). The birds proceed to winter in the central California valleys. The Oregon coast is not a wintering area for Aleutian Canada geese but serves as a brief stopover on their way to or from California. Sightings of this goose in the Langlois area may be related to severe weather during migration.

To date, this species has not been confirmed on the wind farm study area. Gaddis (1985) reported the sighting of 50 to 60 small Canada geese which were probably the Aleutian subspecies over the Elk River floodplain on April 13, 1985. Suitable pasture habitat does exist on and adjacent to the site for resting and feeding. Because Aleutian Canada geese are regularly observed in limited numbers near Langlois, Oregon, the potential exists for occasional use of the project site by this species.

4.0 ENVIRONMENTAL EFFECTS

4.1 Generic Impacts of Wind Farm Developments

The primary impact to vegetation associated with wind farm development is the permanent displacement of habitat by turbine foundations and support facilities such as switchyard and transmission lines. Temporary disturbances will also occur during construction. The extent of impact is directly related to wind farm generation capacity, the design and number of turbines proposed for a site, and the location of wind farm components. Location of the project on property on which the vegetation has already been disturbed will greatly minimize impacts to vegetation.

Habitat displacement from a wind farm facility will also displace associated wildlife. In addition, wildlife may be affected by wind turbine noise, birds may collide with a turbine or transmission lines, the wind farm may act as a barrier or disrupt traditional movements of various wildlife species, and raptors may be subject to transmission line electrocution. Responsible wind farm siting and design will reduce these potential hazards to wildlife.

In regard to bird collisions, the literature indicates man-made structures, including wind turbines, pose little threat to resident bird populations or diurnal migrants. The primary area of concern relates to nocturnal migrants, particularly songbirds (Weir 1977, Avery et al 1980). Many accounts of bird mortality with structures much taller than the proposed wind turbines have been documented. Significant mortality has, however, occurred with shorter structures, indicating that collisions with wind turbines are likely to occur. The extent of this impact can only be estimated at this time. Bird mortality at a wind farm will be a function of prevailing weather conditions, the number of nocturnal migrants at low altitude, and the number and height of wind turbines in operation.

Investigations of nocturnal bird migration behavior provide some basis for assessing the potential for collisions with various wind turbines. Under favorable migrating conditions such as clear skies or high clouds, tail wind and cool temperature, most songbirds fly at altitudes between 500 ft and 1,500 ft (Bellrose 1971, McCrary et al 1983 and 1984, Lack 1960, Weir 1977). Manning (1983) reports that migrating birds tend to fly lower at coastal locations but usually maintain altitudes over 600 ft. Larger species such as waterfowl and shorebirds migrate at much higher altitudes (Able 1974, Pettingill 1970).

After takeoff, small birds quickly reach their migration altitude, maintaining that height until after midnight, at which time the birds make a slow descent until dawn (Bellrose 1971, Able 1970). Collisions with wind turbines are most likely to occur during the first 2 hours of night at the initiation of migration and just before dawn during the descent. Changes in weather conditions during migration may also result in lower flying altitudes. Migrants tend to decrease altitude during high winds, low clouds, and light rain. Migration usually ceases during heavy rain (Rogers et al. 1977). A combination of low cloud cover, favorable winds, and active migration are factors that may produce significant mortality at a wind turbine installation.

4.2 Site-Specific Impacts of the Cape Blanco Wind Farm

4.2.1 Impacts on Vegetation

The Cape Blanco wind farm development would be restricted to the bench terraces of the project site, where the habitat consists mostly of pasture with scattered patches of mixed forest and gorse. To better utilize the site for turbine placement, some forest/shrub habitat may be cleared (Figure 1). These areas are characterized by Sitka spruce, red alder and such shrubs as salal (Figure 6). Some areas proposed for clearing are covered with gorse (Figure 7) and may require clearing for access and improved wind patterns in the case of the vertical-axis wind turbines. With the exception of the wooded areas proposed for clearing, the remaining mixed forest habitat (about 360 acres) and all of the wetlands in the drainage ravines would not be directly impacted by any of the wind farm alternatives.

For the Boeing MOD-2 alternative, 11.3 miles of access road would be required, replacing about 22 acres of pasture. Part of the access road network would consist of existing vehicle trails. The road would be approximately 16 ft wide and graveled. The Boeing MOD-2 foundations (31 units) would occupy approximately 3 acres of land. Along with the access roads and support facilities such as warehouse, storage yard, substation and visitor parking, the Boeing MOD-2 wind farm alternative would permanently eliminate vegetation from about 30 acres (2 percent of the project site).

During construction of the Boeing MOD-2 alternative, however, additional land would be disturbed. Each turbine location would require about a 1.8 acre work area to establish the foundation and erect the turbine (57 acres total). The electrical feeder network from the turbines to the substation would require about 11 miles of trenching for underground cable. The trenching would temporarily disturb about 10 acres. Altogether, construction of the Boeing MOD-2 alternative would disturb about 67 acres of vegetation, of which 30 acres would be permanently replaced by wind farm facilities.

The FloWind 170 alternative would require approximately 27 miles (53 acres) of access road. About 60 acres might have to have trees and shrubs removed to site some of the units. Wind turbine foundations (455) would replace about 5 acres of vegetative cover. Under this alternative (including support facilities), a total of 60 acres of vegetative cover would be permanently replaced, and up to 60 acres would be converted to grass cover. As with the Boeing MOD-2 alternative, additional land would be disturbed during construction. Two turbines would be erected from a single 0.7 acre construction pad, and thus up to 170 acres could be disturbed during construction. In addition, 15 miles of trenching for underground cable would be required for the electrical feeder network, temporarily disturbing about 15 acres. The total area to be cleared would probably be close to the 60 acres mentioned above.

Figure 6. Wooded Area that may be Cleared for Wind Turbine Siting. Habitat Consists Primarily of Secondary Growth Sitka Spruce-Red Alder-Salal

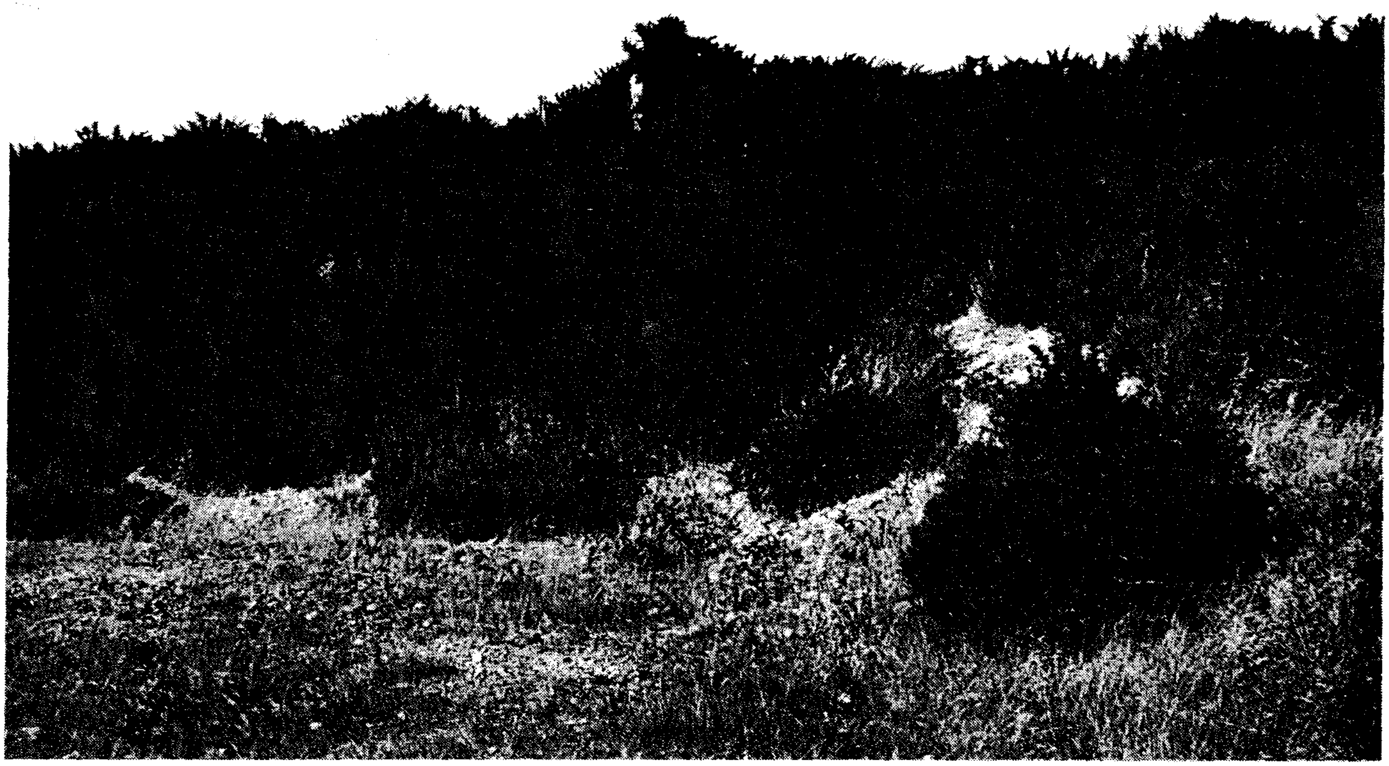

Figure 7. Pasture Area that may be Cleared of Gorse for Wind Turbine Siting.

For the DAF 6400 alternative, the civil engineering details are not complete. Therefore, the site impacts are estimated assuming many similarities between the DAF 6400 and the FloWind 170. Because both are vertical axis machines, the impacts are estimated based on size and number proportions. Therefore, the 259 DAF 6400 units would require about 20 miles of access road (about 40 acres of disturbance). If each unit requires 0.9 acres for construction and erection of the turbines, 233 acres would be disturbed. If we assume that two turbines can be erected from one pad, about 120 acres would be required. Trenching for underground cable would be about 12 to 13 miles (12 acres disturbed). Permanently replaced vegetation would total about 45 to 55 acres.

The habitat that would be directly impacted by any of the wind-farm alternatives is primarily pasture, consisting of forage grass species in addition to numerous weed and such introduced species, as English daisy, gorse and dandelion. The more valuable natural areas of the drainage ravine would not be disturbed. Permanent habitat loss for the FloWind 170 is estimated to be 60 acres, compared to 30 acres under the Boeing MOD-2 alternative. Habitat loss from the DAF 6400 alternative would be intermediate to the other alternatives.

Indirect impacts include the possibility that additional land would be affected by wind or water erosion of areas disturbed by construction activities. This could be prevented by careful construction practices. Also, the spread of noxious weeds along new roads and transmission rights-of-way would be a potential problem. However, the fact that the area is used for sheep grazing land suggests that this will not be a problem; both disturbance and weed movement vectors are already present.

In view of the current use of the project site for grazing, the absence of threatened or endangered plant species, and the species composition of the habitat in general, impacts to vegetation from the construction and operation of a wind farm facility can be considered minor.

4.2.2 Impacts on Birds

The development and operation of a wind-energy facility in the Cape Blanco area poses three potential concerns related to birds: 1) the potential of fatal bird collisions with a wind turbine, especially for nocturnal migrants; 2) adverse impacts on endangered or threatened bird species in the area; and 3) the effect of turbine noise on birds living in the vicinity of the wind farm. These concerns apply to all three wind-farm alternatives to varying degrees.

All three Cape Blanco wind farm alternatives under consideration pose a potential threat of collisions for birds flying at low altitudes. Birds at greatest risk are nocturnal migrants because of the limited visibility of the structures at night. Review of the literature, indicates that the vast majority of birds killed by collisions with man-made structures are songbirds or passerine birds that migrate singly (McCrary et al. 1983). Flocking species (waterfowl, shorebirds, gulls) die from collisions during migration with much less frequency. The vast majority of migrants would pass above wind farms using FloWind 170, DAF 6400, or Boeing MOD-2 wind turbines. Bird migration traffic rate studies conducted in the spring and fall of 1982 (McCrary et al. 1983, 1984) indicate that only about 10 percent of migratory songbirds travel at altitudes below 350 ft, the maximum height of Boeing MOD-2 turbine.

Table 7 presents estimates of bird/turbine interactions, based on the collision probability model and assumptions described on page 5 of this report. An interaction is any bird passing through the vertical planar surface area of the wind turbine, including the area outlined by the ground wires. An interaction could, therefore, result in a collision or not and in death, injury, or no harmful effects. If no avoidance behavior were displayed by nocturnal migrants (both spring and fall), 26,989 birds per year would interact with a Boeing MOD-2 wind turbine, 1,958 with the DAF 6400, and 1,174 with the FloWind 170. If 99 percent avoidance occurred, spring and winter interactions would be reduced to 270 for a Boeing MOD-2, 20 with a DAF 6400, and 12 with a FloWind 170.

The literature suggests that avoidance behavior is likely to occur with the majority of migrants passing over the Cape Blanco site. Rogers et al. (1977) observed that 6 of 9 birds showed an avoidance reaction to the blades of a 124-foot-diameter wind turbine operating at a speed of 20 rpm; the other three birds flew safely through the turbine. McCrary et al. (1983, 1984) concluded that an avoidance rate approaching 95 percent is realistic, based on the literature and their observations in southern California. Avoidance levels of 99 to 100 percent might be expected for clear, moonlight nights. Table 7 presents the full range for comparison (0 = no avoidance, 70 = similar to 6 of 9, 95 = expected, 99 = avoidance expected in good conditions). We also conclude that 95 percent avoidance is a conservative number to use in impact estimates.

The bird/turbine interactions summarized in Table 7 would result in a variable number of actual collisions that would depend upon conditions. The turbine apparatus would occupy only a small percentage of the strike zone. If the turbines were not operating and if no avoidance reaction occurred, the probability of an interaction becoming a collision with the Boeing MOD-2 turbine would be about 6 percent. Because the vertical axis turbines, with guy wires, axis tubes, blades, present a more complex obstacle to birds, the probability of an interaction with a with a nonoperating turbine becoming a collision is higher; about 9 percent for the DAF 6400 and 10 percent for the FloWind 170 without avoidance reactions. As stated above, however, a 95 percent avoidance is expected.

TABLE 7. ESTIMATED NUMBER OF BIRD INTERACTIONS WITH A FloWind 170, DAF 6400, AND Boeing MOD-2 WIND TURBINE DURING SPRING AND FALL MIGRATION AT THE CAPE BLANCO WIND FARM SITE1/

	Interactions			
	Avoidance Level			
Turbine Type/Migration Period	0 percent	70 percent	95 percent	99 percent
FloWind 170				
Spring	599	180	30	6
Fall	575	173	29	6
Total	1,174	353	59	12
DAF 6400				
Spring	999	300	50	10
Fall	959	288	48	10
Total	1,958	588	98	20
Boeing MOD-2				
Spring	13,770	4,131	689	138
Fall	13,219	3,966	661	132
Total	26,989	8,097	1,350	270

1/ Interactions are adjusted to 0 percent, 70 percent, 95 percent and 99 percen t avoidance behavior levels

The low rotor solidity will allow some birds to actually fly through an operating turbine without being struck by the blades. McCrary et al. (1983) modified a formula attributed to Rogers et al. (1976) to calculate this probability:

$$\text{Probability} = \frac{N(R)(D)}{Va}$$

where: Va = the bird's axial velocity (m/s)
N = the number of turbine blades
R = blade rotational speed (rps)
D = average depth of blade (m)

In applying this formula to the Cape Blanco wind farm project, the following assumptions were made:

1. The birds of concern are songbirds of small enough size that the variation in size is inconsequential.

2. The flight speed is the same for all species, i.e., 50 miles per hour or 22.4 m/s (Welty 1962).

3. Blade rotation speed is assumed to be constant:

   FloWind 170 = 53 rpm = 0.88 rps
   DAF 6400 = 45 rpm = 0.75 rps
   MOD-2 = 17.2 rpm = 0.29 rps

4. Turbine operation is uninterrupted throughout the migratory periods.

Applying the formula with these assumptions will provide a conservative approach, overestimating the number of collisions. It is unlikely that the turbines would be in continuous operation at optimum speed or that the number of birds would be as high as assumed for the whole migration period. Table 8 presents the estimates of bird collisions developed by applying the formula for the three wind farm alternatives.

The collisions estimated in Table 8 represent all contacts between the birds and the turbines. All collisions will not be fatal or cause serious injury because some will be glancing blows. Thus, the number of collisions of any importance is smaller yet. The earlier assumption of a bird migration traffic rate of 300 birds/hr/km may be too high. McCrary et al. (1983, 1984) pointed out that most ornithologists have assumed that migration traffic rates are much lower in the western U.S. than in the east. McCrary et al. found migration traffic rates at their study site in southern California to be similar to rates published for eastern U.S. sites, but they also noted that this study site has been noted since the early 1900s as an important route for bird migration.

TABLE 8. ESTIMATED BIRD COLLISIONS 1/

Bird/Turbine Interactions 2/	Birds Colliding with Turbine Apparatus	Turbine Blades Striking Birds	Total Bird Col-lisons	
FloWind 170	26,845	134	464	598
DAF 6400	25,382	114	374	488
MOD-2	41,850	126	997	1,123

1/ Assuming 95 percent avoidance.
2/ For the entire wind farm for a year.

Even if the collisions estimated in Table 8 are assumed to all represent fatalities, the loss would represent less than 0.1 percent of the birds assumed to be migrating over the site at altitudes low enough to interact with the turbines. This would represent 0.01 to 0.04 percent of the total migratory population passing over the site. Losses of this magnitude are biologically insignificant.

The greatest hazard to birds from vertical-axis wind turbines is the support guy wires. Each turbine is supported with three sets of two guy wires. The guy wire set runs parallel 6 in. apart from the top of the turbine to an anchor 100 ft from the central axis. When birds are migrating at low altitudes, during the initiation or end of a migratory flight or during such unfavorable weather conditions as low clouds and light rain, guy wires pose an additional threat to migratory birds because the wires are less visible. Meyer (1978) found that waterfowl approaching a transmission line at or below the level of the conductors would usually see and react to the conductors by rapidly gaining elevation. Sometimes they would not see the smaller diameter ground wire above the conductor and would collide with it. Thus, an avoidance reaction to the turbine might carry a bird into the guy wires.

Boeing MOD-2 wind turbines do not require guy wires for support. However, a potential hazard to nocturnal migrants exists if the units are lighted. Nocturnal migrants tend to be attracted to light and are reluctant to leave a lighted area (Pettingill 1970, Weir 1977). Thus, the probability of a collision with a lighted Boeing MOD-2 wind turbine is increased. Even with these added factors, the expected bird losses would be insignificant.

Further evidence supporting the conclusion that bird collision losses would be insignificant comes from on-site experience with the two meteorological towers. The towers, 200 feet and 350 feet in height, have been in place on the site for a year. Several people have looked for dead birds or signs of collisions at various times sometimes regularly although not in a statistically rigorous way, and none have been found. From review of the literature, one would expect more kills from a meteorological tower than a wind turbine. For example, at a Wyoming wind farm test site, several birds were found that had been killed by the meteorological tower or its guy wires; two killed by a 3-blade turbine; and none killed by a Boeing MOD-2 turbine (U.S. Bureau of Reclamation 1984). None of the studies to date at wind turbine installations have found that more than a few birds have been killed, and often no kills were recorded for a migratory season. It therefore seems probable that the calculations above have overestimated the bird losses by a substantial margin.

None of the five endangered or threatened bird species occurring in the vicinity of the Cape Blanco Wind Farm Project area have a very high potential for collision with the wind turbines. The Aleutian Canada goose and the western snowy plover may sometimes fly at night and, under certain conditions, might collide with a wind turbine. However, both species are among species groups that are less vulnerable because they usually migrate in flocks. The likelihood of a western snowy plover colliding with the turbines is very remote as they would rarely be found in the hazard zone. Aleutian Canada geese may move into the pasture areas at night for resting or feeding. This could bring them into the hazard zone of the turbines, but they are not noted for feeding at night. Because of the size of the goose, the likelihood is higher that it would be struck by a turbine blade if it flew into the path of a moving turbine. However, because of their sharp senses and noted wariness, they would very likely avoid the turbines. Therefore, the likelihood of an impact is remote, and a potential collision rate (less than 0.1 percent) similar to rates for other birds seems realistic. Brown pelicans, bald eagles, and peregrine falcons are active during the day and should avoid collision with any of the wind turbines under consideration as well as they avoid collision with any other object. Although they may occasionally be there, the site is not critical to any life function of any of the five species, i.e., none nest there or find the site of especially high value for foraging, roosting, or other activities. Impacts to threatened and endangered species would be of low probability.

Little information is known regarding the effects of noise on free-living wildlife species (Fletcher and Busnel 1978). Noise-induced stress symptoms and interference with acoustic communication, especially in birds, are primary concerns as noise impacts. However, many examples of bird adaptation to man-induced noise exist. Most species will react to loud transient noise but will tend to habituate to continuous noise sources such as airports, factories and cities. In the case of a wind farm installation, resident bird populations can be expected to adapt to the noise produced by wind turbines. The ability of most species to distinguish different sounds will minimize communication problems (Fletcher and Busnel 1978). Wind turbine noise will also have a positive effect in that it will facilitate the detection of the units, thus decreasing the potential of collision, especially for nocturnal migrants.

4.2.3 Impacts on Mammals

Wind turbines under all alternatives would be sited primarily in pasture (grassland) habitat. Some shrub and tree clearing (55 to 60 acres) could be required, but the majority of the mixed forest and wetland habitats would not be directly affected. Because most species are associated with forest and wetlands, mammals on the project site would be minimally affected by habitat disturbance.

Grassland species such as shrews and voles might increase in number due to the habitat complexity created by the access road network and wind turbine foundations. Adams and Geis (1983) found that small mammal densities were greater along roadways than in adjacent habitat.

The construction phase of a wind farm project would have the greatest adverse impact on mammals. During this time, additional land would be required as work areas (up to 250 acres with the FloWind 170 alternative), and a significant increase in human activity would likely induce temporary avoidance behavior in certain species.

The forested areas to be cleared for turbine foundations (Figure 1) would reduce cover for many species such as brush rabbit and black-tailed deer. Vegetation removal for the Boeing MOD-2 would be less extensive than for the vertical-axis turbines in that only tree and light shrub removal would be required. More clearing would be necessary for vertical-axis turbines to improve wind flow around the units.

Little is known about the behavioral or physiological responses of free-living mammals to man-induced noise or vibration, including that produced by wind turbines. Most species will react to loud transient noise, but many will habituate to continuous noise sources (Fletcher and Busnel 1978). Ground vibration may also discourage the use of areas adjacent to turbines by the species inhabiting grasslands, e.g., shrews, moles, voles, or nearby shrub and wooded areas. The overall impacts on mammals, however, will be minor.

4.2.4 Impacts on Amphibians and Reptiles

In general, a wind-farm development at the Cape Blanco project site will not adversely impact populations of amphibians and reptiles. The habitats most valuable to this group, wetland and mixed forest in drainage areas, will remain undisturbed under any of the wind farm alternatives. Impacts on reptiles and amphibians will be insignificant.

4.2.5 Impacts on Fish

The Elk River supports a significant anadromous fishery. Concern has been expressed about potential visual and vibrational impacts to fish. Much of the river along the south project boundary is bordered by willow/alder vegetation (Figure 8). As the river turns north, the east shore is adjacent to a 150-ft ocean bluff. Both the riparian habitat and ocean bluff obscure any visual contact caused by shadow or flickering that a fish might have with any of the proposed wind-farm installations.

The effects of ground vibration induced by various wind turbines on the Elk River fishery can only be speculated. The greatest potential exists with the large Boeing MOD-2 turbine. The Cape Blanco wind farm site consists of a series of sedimentary sand and gravel layers. Ground vibrations induced by any of the proposed wind turbines are likely to be significantly dampened or eliminated when passing through the various sedimentary layers to the river. Therefore, fish in the Elk River would not be affected by the operation of any of the proposed wind farm facilities.

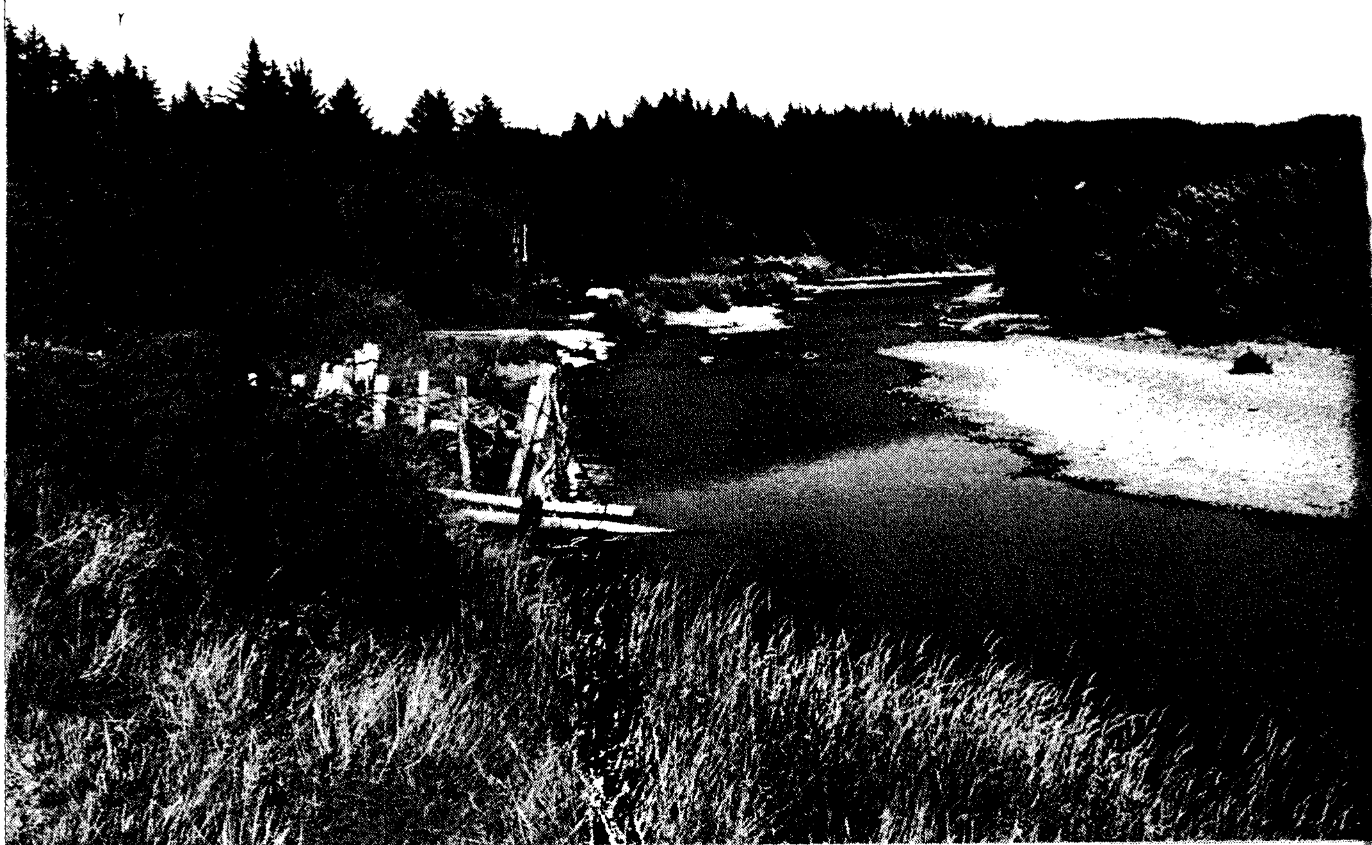

Figure 8. Elk River along the South Project Boundary, Existing Vegetation, River Banks and Ocean Bluffs will Preclude Visual Impact to Fish in the River due to the various Wind Farm Alternatives

4.2.6 Transmission Line Impacts

Two transmission line routes from the Cape Blanco wind farm substation to the BPA Fairview-Rouge 230-kV line, about 0.8 miles east of Highway 101, are proposed:

1. Sixes River Road route (3.6 miles): Build 3.6 miles of single-pole 230-kV line between the wind farm substation and the intersection of Sixes River Road and the BPA 230-kV line. One mile of the line would be on project property over pasture. The remaining 2.6 miles of line would utilize the existing 13-kV transmission line right-of-way along Cape Blanco Road (Figure 9) and Sixes River Road (Figure 10). The 13-kV line would be transferred to the new poles.

2. Grassy Knob route (2.5 miles): Build 1.7 miles of single-pole 230-kV line between the wind farm substation and the intersection of Cape Blanco Road and Highway 101. One mile of the line would be on project property over pasture. The remaining 0.7 miles would utilize the existing 13-kV transmission line right-of-way along Cape Blanco Road (Figure 9).

The 13-kV line would be transferred to the new poles. An additional 0.8 miles of new right-of-way (100-ft wide) would be required from Highway 101 to the BPA 230-kV line (Figure 11). This section would utilize 2-pole H-frame towers.

The Sixes River Road route would follow existing transmission line rights-of-way. Vegetation impacts would be limited to removal or trimming of trees that might interfere with reliable operation of the power lines. Low-growing vegetation would remain along the right-of-way. Existing access roads would be used for construction and maintenance of the lines. Impacts to the pasture vegetation and wildlife along the first mile of the route (wind farm site) would be minimal in view of the plant species composition of grass and weeds and the low use of the area by wildlife.

The Grassy Knob route would be identical to the Sixes River Road route to Highway 101. From there, approximately 10 acres of Sitka spruce/alder habitat would be cleared for the remaining 0.8 miles of the route to the existing BPA transmission line (Figure 11). Vegetation removal would be limited to the area required for access and trees that might interfere with construction and operation of the transmission line.

Although wildlife species, dependent on Sitka spruce habitat, would be displaced along the Grassy Knob route, the creation of a small open area would be apt to be an overall benefit to wildlife. The right-of-way would increase habitat diversity in the area, producing a corresponding increase in opportunities for wildlife use. For example, investigations by Anderson et al (1977) along 100-ft right-of-way corridors through deciduous forest habitat indicated an increase in bird abundance and diversity when compared to forested areas without transmission line corridors.

The potential for electrocution of large birds would be small because the lines would be designed with adequate space between conductors to prevent a bird from simultaneously touching two phases. Neither alternative route would be located where bird collisions would be expected.

Figure 9. Transmission Line Route along Cape Blanco Road. Both Proposed Transmission Line Routes for the Wind Farm would Utilize This existing Right-of-Way

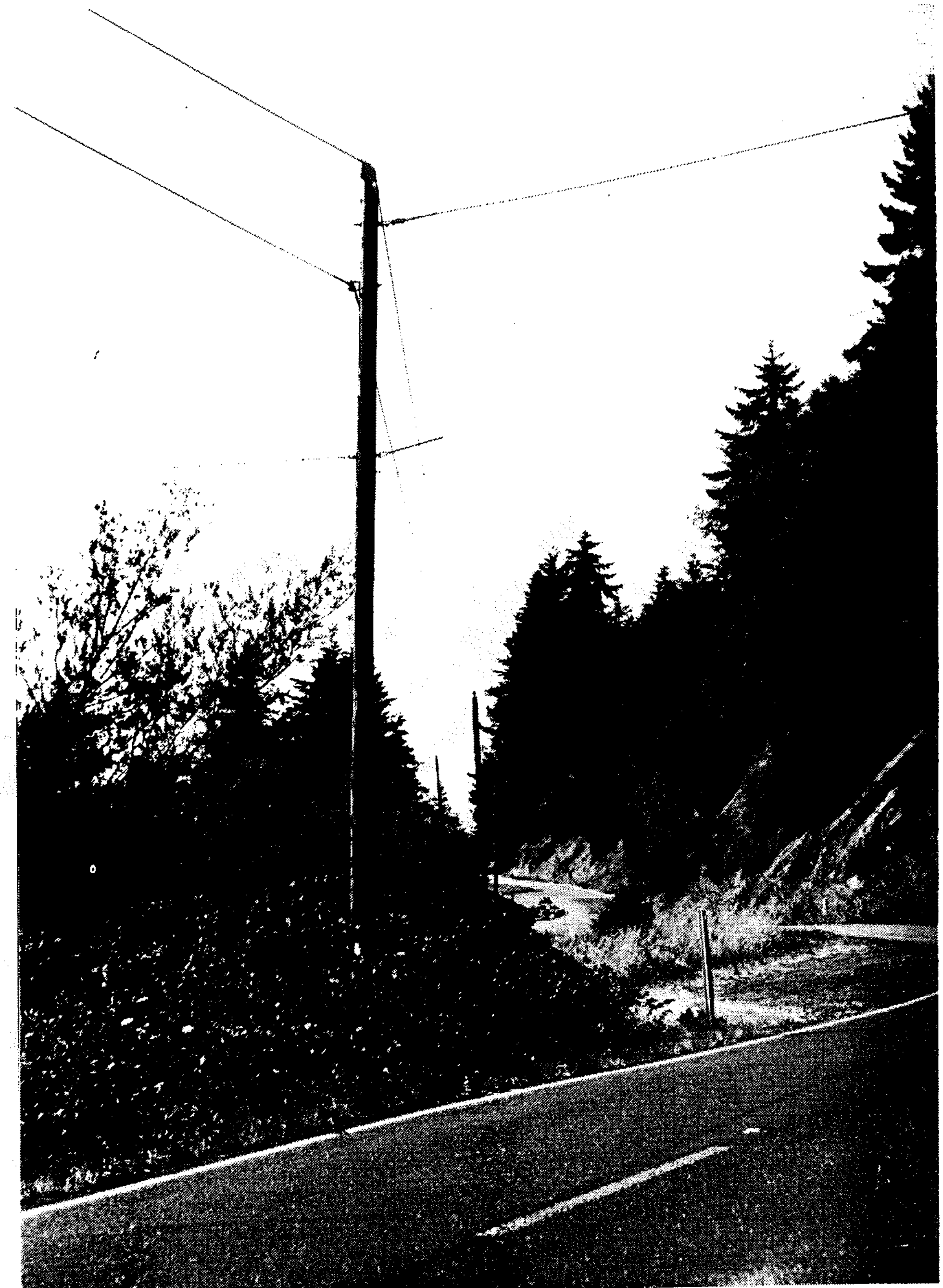

Figure 10. Sixes River Road Transmission Line Right-of-Way

Figure 11. Proposed Grassy Knob Transmission Line Route through Sitka Spruce-Red Alder Habitat. This Route Would be an Extension of an Existing Line Along Cape Blanco Road (Arrow)

5.0 COMPARISON OF ALTERNATIVES

Table 9 summarizes the environmental impacts of the three proposed wind farm alternatives. None of the impacts has been determined to be significant for any of the alternatives. Neither does any alternative stand out as having much greater or lesser impacts than the other.

TABLE 9. ENVIRONMENTAL IMPACT SUMMARY

Alternative	Impact Area: Vegetation	Birds	Mammals	Reptiles/ Amphibians	Fish	Threatened/ Endangered Species
FloWind 170 (455 units)	60 acres of forest/ shrub permanently replaced. 170 acres disturbed during construction. 15 miles of trenching to lay electrical network will temporarily disturb 14 acres.	Assuming 95% avoidance, 598 nocturnal songbird migrants estimated to collide annually with turbines. Guy wires pose additional threat to migrants. Minimal loss of habitat. Noise increases detectability.	Minimal loss of habitat; impacts insignificant.	Impacts insignificant.	Impacts insignificant.	No listed plant, mammal or herptile species on-site. No important habitat impacted. Minor collision potential with five species of T & E birds.
DAF 6400 (259 units)	15-20 acres of forest/shrub permanently replaced. 120 acres disturbed to site turbines. 12-13 miles of trenching will temporarily disturb 12 acres.	488 nocturnal songbird migrants estimated to collide with turbines. Guy wires pose additional threat to migrants. Minimal loss of habitat. Noise increases detectability.	Minimal loss of habitat; impacts insignificant.	Impacts insignificant.	Impacts insignificant.	No listed plant, mammal, or herptile species on-site. No important habitat impacted. Minor collision potential with 5 species of T & E birds.
Boeing MOD-2 (31 units)	30 acres of grassland permanently replaced. 57 acre work area to erect turbines. 11 miles of trenching to lay electrical network will temporarily disturb 10 acres.	1123 nocturnal songbird migrants estimated to collide annually with turbines. Noise increases detectability. Lighting on turbines may increase collisions.	Minimal loss of habitat; impacts insignificant.	Impacts insignificant.	Impacts insignificant.	No listed plant, mammal or herptile species on-site. No important habitat impacted. Minor collision potential with 5 species of T & # birds.
Sixes River Road Route	Limited removal or trimming of trees along existing right-of-way.	Impacts from collisions and electrocution insignificant.	Impacts insignificant.	Impacts insignificant.	No impacts.	Impacts insignificant.
Grassy Knob Route	Limited removal or trimming of trees along existing right-of-way. 10 acres of spruce/ alder habitat removed for right-of-way.	Impacts from collisions and electrocution insignificant. Vegetation removal increases habitat diversity; may increase bird use of area.	Vegetation removal increases habitat diversity; may increase mammal use of area.	Vegetation removal increases habitat diversity; may increase reptile use of area.	No impacts.	Impacts insignificant.

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6.0 MITIGATION MEASURES

Mitigation measures are usually required only when significant impacts are predicted. However, any measures taken to reduce impacts can be discussed under this topic. Site selection is a major aspect in mitigating or minimizing habitat impacts. The Cape Blanco wind farm site offers the advantages of requiring a minimum of vegetation clearing, vegetation species composition consisting of forage grass species, in addition to numerous weed and introduced species, and compatibility with the current land use, grazing. Mitigative actions, however, could be taken to minimize vegetation impacts during construction. Most of the disturbed areas should be restored by planting native grasses after construction. This would maximize pasture acreage and decrease the potential for soil erosion. Construction should also take place during late spring and summer to reduce habitat damage and soil erosion potential. Geotechnical test sites, such as borings and pits, should be filled and sealed to prevent possible groundwater contamination.

Efforts to curtail impacts to vegetation normally reduce impacts to associated wildlife. However, the threat of bird collisions with the turbines exists with all alternatives under consideration. Although calculations show that the actual bird kills would be low in number, and therefore not significant, on-site monitoring may confirm this conclusion. A potential mitigation measure could be to build the wind farm in increments and monitor for bird kills after each increment as a condition for building the next increment. The limited number of past monitoring programs, however, have found few or no bird kills and the measure may be unwarranted.

Both transmission line route alternatives use several mitigation procedures to minimize vegetation and wildlife impacts; maximum use of existing rights-of-way, selective vegetation clearing, replanting disturbed areas and access roads and construction during May through September to reduce erosion and habitat damage. However, bird collisions with transmission lines and hawk or eagle electrocution may be additional environmental concerns. To reduce the potential for bird collisions, transmission lines are mostly sited along existing rights-of-way, in areas of low bird flight intensity, and areas away from wetlands. The Sixes River Road and Grassy Knob alternatives address these siting criteria in that existing rights-of-way are used and the routes are not located in wetlands or low-altitude bird flyways.

The primary cause of bird mortality associated with transmission lines is collision with the overhead groundwire (Beaulaurier 1981, James and Haak 1979, Meyer 1978). The potential for these collisions can be reduced by not using a groundwire or possibly by marking the groundwire (eg, stripes, orange marker balls) to increase its visibility to birds.

The potential for raptor electrocution would be significantly reduced or eliminated by sufficiently spacing conductors. This would prevent any phase-to-phase or phase-to-ground contact which is required for electrocution. Both the single-pole and double-pole transmission design proposed for the Cape Blanco wind farm incorporate adequate conductor spacing and would not pose any significant threat to raptors or other large birds (e.g., herons, ravens).

7.0 CHECKLIST OF 16 COMPLIANCE

1. Wetlands

All three alternatives of the proposed project avoid the wetlands on the project site. Therefore, no direct impacts to wetlands are expected. Erosion control measures would be implemented during construction, and the existing land uses would continue. Therefore, no indirect impacts are expected.

2. Fish and Wildlife Conservation

The development of the Cape Blanco wind farm as proposed would comply with the Fish and Wildlife Coordination Act, the Fish and Wildlife Conservation Act, and the Pacific Northwest Electric Power Planning and Conservation Act because of the minor impacts. Appropriate coordination with responsible state and federal regulatory agencies has occurred.

3. Endangered and Threatened Species and Critical Habitat

Since four species of birds listed as threatened or endangered and one candidate species for listing are sometimes found on the proposed project site or nearby, additional steps will be required to complete the compliance with this checklist item. This report assesses the potential for impacts on the species. Representatives of BPA will carry the consultation process further with the U.S. Fish and Wildlife Service. Completion of the consultation process will result in compliance with the Endangered Species Act and associated regulations.

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