# Technical Reclamation Memorandum

# TRM # 3

**Date:** October 28, 1982

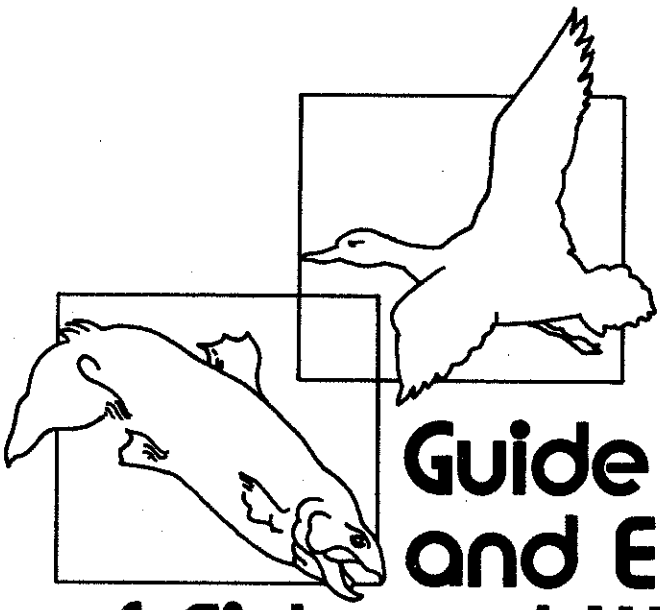
**From:** William C. Eddins, Director
Division of Reclamation Services

**Subject:** Protection and enhancement of fish and wildlife values

Kentucky Department for Surface Mining Reclamation and Enforcement

Attached is the Guide for Protection and Enhancement of Fish and Wildlife Values for Surface Coal Mining and Reclamation Operations prepared by the Kentucky Department for Fish and Wildlife Resources (KDFWR) in conjunction with this department.

The purpose of this guideline is to assist coal mining operators in preparing permit applications with respect to fish and wildlife. As is discussed in detail in the Foreword, this department strongly recommends that permit applicants utilize these guidelines, but applicants may choose not to do so. This department and KDFWR will review each permit application on its own merits to ensure that the applicant has adequately addressed protection and enhancement of fish and wildlife values in accordance with the surface mining regulations. This guideline contains some key concepts that must be addressed by every permit application, even though the applicant may choose alternative methodologies.



# Guide for Protection and Enhancement of Fish and Wildlife Values for Surface Coal Mining and Reclamation Operations

Prepared by Kentucky Department of
Fish and Wildlife Resources
in conjunction with Kentucky
Department for Surface Mining
Reclamation and Enforcement

October 1982

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## FOREWORD

The federal Surface Mining Control and Reclamation Act and the Kentucky surface mining regulations (KAR, Title 405, Chapters 7 through 24) require coal mining operators to minimize disturbances and adverse impacts of their operations on fish, wildlife, and related environmental values to the extent possible using the best technology currently available and to achieve enhancement of such resources where practicable.

This guideline document has been developed by the Kentucky Department of Fish and Wildlife Resources (KDFWR) in conjunction with the Kentucky Department for Surface Mining Reclamation and Enforcement (DSMRE) to assist operators in the preparation of applications for surface coal mining and reclamation permits and to provide guidance regarding reclamation practices that will ensure compliance with the fish and wildlife protection requirements of the surface mining law.

The original federal surface mining regulations on permit applications contained extensive premining data collection requirements and reclamation plan requirements related to fish and wildlife. These provisions have been deleted from the regulations due to a court ruling. However, there still remain performance standards that require protection and enhancement of fish, wildlife, and related environmental values. Also there remain permit application requirements regarding premining environmental information and the mining and reclamation plan that relate to fish and wildlife.

These guidelines are based only on those permanent program regulations which are still in effect. The court ruling remanding portions of the fish and wildlife requirements of the permit application does not eliminate the requirement for consideration of fish and wildlife and related environmental values.

In order for the operator to comply with the performance standards for fish and wildlife, the applicant must plan his operation in advance and his permit application will have to indicate that adequate advance planning has been done. Then the measures that the applicant has proposed for protection and enhancement of fish and wildlife must be approved by the department in the permit issuance process.

As for the premining environmental information, there are two key sections of the regulations. The first is the vegetation information that must be presented in the application describing the existing vegetation. One aspect of the vegetation description will be the potential for fish and wildlife habitat. Secondly, the statement of the condition, capability and productivity of the land that is required in the description of the premining land use should include a discussion of the capability of the land to support fish and wildlife.

Similarly, for the mining and reclamation plan, the applicant must incorporate into his revegetation plan a description of how diversity of species, edge effects, etc. will be included in order to enhance fish and wildlife as is practicable and compatible with the postmining land use plan. In addition, the description of the proposed postmining land use must include a discussion of the potential for fish and wildlife habitat.

The above discussion most directly pertains to terrestrial habitats. With respect to aquatic habitats, a basic assuption will be that the hydrologic requirements of the regulations in conjunction with the 100 foot buffer zone for perennial and biological streams will protect the aquatic habitat and, in general, no premining aquatic habitat data will be necessary. However, if the applicant applies for a waiver of the 100 foot buffer zone to lessen the buffer zone, there must be a demonstration of how adverse effects on water quantity and water quality will be mitigated and premining site specific data may be necessary. If the applicant proposes to divert the stream channel, then the stream channel must be restored or relocated to approximate premining conditions or better. In order to meet those requirements the applicant must gather data on the premining stream channel characteristics in order that those characteristics can be restored.

The KDFWR, through an agreement with DSMRE and as promulgated in the "Permanent Program Regulations for Surface Coal Mining and Reclamation Operations and Coal Exploration Operations" will assist DSMRE in the review of permit applications for coal mining activities to insure fish and wildlife considerations.

It is strongly recommended that all permit applicants utilize these guidelines to fulfill requirements regarding fish and wildlife evaluation and reclamation on the potential permit area. An application prepared in conformance with these guidelines should be approvable with respect to fish and wildlife. However, when an applicant chooses not to use these guidelines, DSMRE and KDFWR will review the permit application on its own merits to ensure that the applicant has adequately addressed protection and enhancement of fish and wildlife values in accordance with the regulations. DSMRE and KDFWR will evaluate the premining environmental resource information and the mining and reclamation plan to determine the extent to which the application adequately considers key fish and wildlife habitat concerns such as premining and postmining habitat and vegetation descriptions, interspersion, planting patterns, value of revegetation for food and cover, restoration of stream channel characteristics, protection of buffer zones, protection of primary consideration sites, etc.

There are many methods of arriving at a site description and reclamation plan; however, applicants must bear in mind that the final product must be useful and meaningful to DSMRE and KDFWR for review and evaluation of permit applications with respect to fish, wildlife, and related environmental values.

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# INTRODUCTION

This document includes data collection efforts and reclamation techniques that the Kentucky Department of Fish and Wildlife Resources (KDFWR) recommends to obtain a sufficient description of a potential mining site and to develop reclamation plans to fulfill the fish and wildlife requirements under the regulatory program of the Department for Surface Mining Reclamation and Enforcement (DSMRE).

Use of the procedures and methodologies outlined here will serve the purposes of (1) supplying KDFWR and DSMRE with enough complete and consistent data to expedite the review process required by 405 KAR 8:010E; (2) minimizing the cost of study design which would have to be borne by the applicant; (3) identifying potentially valuable fish and wildlife areas early in the permit process; and (4) guiding the applicant into a reclamation plan that would tend toward postmining enhancement of fish and wildlife on the permit site, as required by 405 KAR 16:180E. (Note that although references in this document are to KAR, Title 405, Chapter 16 for surface mining activities, there are corresponding regulations in KAR, Title 405, Chapter 18 for underground mining actvities.) Also included in this text is a bibliography that may aid the applicant in the search for additional applicable literature.

All data collections required herein should be made by a qualified professional, such as a biologist, forester, etc. after the following guidelines have been carefully read and understood. Two report forms are presented in the text of this publication. Submission of these forms along with all other information (maps, calculations, etc.) requested in the text will constitute a completed fish and wildlife assessment for application for a mining permit. Information may be submitted in alternative formats, however, incomplete or inadequate information on the application will result in the application being returned to the applicant, causing delays in processing. Blank copies of the forms herein are available from DSMRE.

Although these guidelines do not require biological specimen collection, please note that it is necessary for individuals or companies collecting biological information in Kentucky to have a collector's permit for the taking of specimens. Permit applications can be obtained from the Kentucky Department of Fish and Wildlife Resources, #1 Game Farm Road, Frankfort, Kentucky 40601. (Tel. 502-564-3400)

Guidelines contained herein address surface coal mining operations in general, including underground mining activities. If the applicant is applying for a underground mine permit, these guidelines should be applied to the surface operations area.

The term "fish and wildlife" includes all species of animals, vertebrate or invertebrate, warm-blooded or cold-blooded, aquatic or terrestrial that live in or normally live in natural surroundings and derive their livelihood by natural means.

All forms of fish and wildlife, both aquatic and terrestrial must be considered collectively when considering the impacts of mining. Impacts upon either the terrestrial or the aquatic realm will have a corresponding effect on the other habitat. The existence, extent, and relative quality of the collective habitats is essential to the continued existence of the fish and wildlife these habitats support. The living components of habitat which demonstrate the interrelationships and dependencies of the aquatic and terrestrial realms are collectively referred to as the biotic community.

The biotic community is inherently and subtly dynamic in its internal and external functioning. Changes are barely discernible as they occur due to the interactions of the living and non-living entities of the community. Man and the catastrophic forces of nature are paramount in their interactions with the biotic community. They alone can invoke the power that causes abrupt change. While these forces change the community in the short term, they need not destroy it in the long term. We cannot control the destructive forces of nature; however, we can control and direct those of man. Man has the ability to enhance and mitigate the damage inflicted upon the biotic community through mining activites, and is required by law to do so.

To put mining and fish and wildlife in perspective, it must be realized that:

1) Every potential mining site has intrinsic fish and wildlife resource values.

2) Regulations (405 KAR 16:060E; 405 KAR 16:070E; 405 KAR 16:080E; 405 KAR 16:090E) promulgated by DSMRE are designed, in part, to protect the aquatic realm. Runoff from the mine site and from other sites disturbed incidental to mining must be passed through a sediment control structure and treated for acid and toxic pollutants where applicable to minimize pollution. Runoff discharged from the mine site must meet minimum water quality criteria set for total iron, total manganese, total suspended solids, settleable solids, and pH. A 100-foot buffer zone must be maintained adjacent to perennial streams or streams supporting a biological community.

   Given the above water quality controls, damages to aquatic wildlife resources due to mining should not occur except in instances where the precautions taken to prevent them are inadequate or a precipitation event larger than the 10-year, 24-hour event occurs. It is obvious, then, that the fate of aquatic wildlife resources is dependent upon the effectiveness of the water treatment facilities and the quality of water discharged from the mine site.

3) Mining activities will, almost without exception, destroy existing terrestrial wildlife habitats on the site and the individuals of a species that are incapable of relocation.

4) Designated postmining land uses are controlled by the applicant to a large degree with review and approval being given by DSMRE and the state and federal agencies having land management concerns (405 KAR 16:210E). Only if such land uses are forestry or fish and wildlife habitat will the postmining site be available primarily to fish and wildlife.

5) Even if fish and wildlife habitat is the primary postmining land use, it may be many years before the site will mature to a point where species that require mature habitats will reap the benefits.

6) Regardless of the designated postmining land use, reclamation must tend toward fish and wildlife enhancement (405 KAR 16:180E). Since fish and wildlife will, in most cases, be secondary to other land uses, the size, location, and composition of habitat types to be reestablished on the reclaimed lands are vitally important to fish and wildlife enhancement.

7) Wildlife enhancement on the postmining site is necessary since premining wildlife habitats have been destroyed. Past efforts at reclamation have been directed largely toward soil stabilization with emphasis on herbaceous cover with little value to wildlife. Enhancement will take the form of increased diversity in herbaceous and woody ground cover, which will stabilize the land and also enhance the area's value to wildlife.

If the postmining land use is fish and wildlife or forestry, reclamation in accordance with the approved reclamation plan and the surface mining regulations for those land uses will constitute fish and wildlife enhancement. If other land uses are designated following mining, fish and wildlife enhancement must be incorporated into that land use by the creation of quality fish and wildlife habitats. It is generally accepted by fish and wildlife professionals that wildlife is a product of the edges. Where one habitat type meets with another, an "edge effect" is created which increases its value to wildlife. Interspersion of habitats refers to the occurrence of different habitats in proximity to one another. Where high levels of interspersion occur, high levels of species diversity likewise occur while the "edge effect" created by the meeting of the differing habitat types leads to potentially higher wildlife population levels.

Regardless of the types of habitat that exist off the permit site, the outer perimeter of the site will create an interspersion area upon reclamation. This "edge effect" on the outer perimeter is not sufficient for the well being of wildlife over the entire site. Therefore, it will be essential to break up what could potentially be a monocultural interior through the creation of a degree of interspersion and subsequently increase the "edge effect." With the exception of postmining land uses of forestry and fish and wildlife, we must equate enhancement with interspersion in the reclamation of mining sites.

In addition to the primary consideration sites discussed below, DSMRE and KDFWR consider other areas important. Specifically, they are areas where fish and wildlife has been designated as the primary postmining land use. When this occurs, the applicant should contact: Kentucky Department of Fish and Wildlife Resources, Frankfort, Kentucky 40601. (Tel. 502-564 3400) A staff biologist will then assist the applicant in plan development.

Fish inventory and physical/chemical data are available on many of the streams of Kentucky. This information is available from KDFWR on specific request.

Lists of fish and wildlife refuges, preserves, and management areas are available from KDFWR on specific request.

Fish and wildlife resources information relevant to the potential mine site and contiguous acreages will be adequately provided by the compilation and submission of data as described in the following sections. To meet minimum requirements the application must demonstrate that:

1) Recommendations given herein are met in substantial conformity as they relate to:

a) submission of recommended charts, tables, maps, and calculations, or their equivalents;

b) requirements relevant to interspersion proportions and practices as they relate to wildlife enhancement practices according to primary postmining land uses, placement of wildlife plantings and use of listed plant species or others of equal or increased values to wildlife; and

c) requirements relevant to aquatic resource data, sampling techniques, etc.

2) Criteria of DSMRE and KDFWR are met to the satisfaction of DSMRE as related to:

a) establishment of vegetation at a living density that meets the reclamation requirements of DSMRE for herbaceous, shrub, and tree cover;

b) control of erosion on the permitted site and stabilization of potentially critical slide and fill areas; and

c) water quality.

## I. PRIMARY CONSIDERATION SITES

DSMRE, KDFWR, and the U.S. Fish and Wildlife Service (USFWS) have determined that the fish and wildlife resources or their habitats on certain sites possess characteristics which may warrant additional investigation and special considerations from the applicant. The areas are called primary consideration sites and are set forth below. Permit applications must identify all such areas that may be impacted by the proposed operation. The applicant should contact DSMRE or KDFWR for assistance when these sites are encountered.

1) Any site which supports populations of or potential habitats for endangered species. The Commonwealth of Kentucky has no official endangered species list, but has adopted the federal list. There are 14 species which occur in Kentucky that are on the federal list. They are:

| | | |
|---|---|---|
| Mammals: | Eastern cougar | Felis concolor concolor |
| | Indiana bat | Myotis sodalis |
| | Gray bat | Myotis grisescens |
| | Virginia big-eared bat | Plecotus townsendii virginianus |
| Birds: | Red-cockaded woodpecker | Picoides borealis |
| | Kirtland's warbler | Dendroica kirtlandii |
| | * Bachman's warbler | Vermivora bachmanii |
| | Bald eagle | Haliaeetus leucocephalus |
| | * Arctic peregrine falcon | Falco peregrinus tundrius |
| | American peregrine falcon | Falco peregrinus anatum |
| | Ivory-billed woodpecker | Campephilus principalis |
| Mussels: | Dromedary pearly mussel | Dromus dromas |
| | Yellow blossom pearly mussel | Epioblasma florentina |
| | Tuberculated-blossom pearly mussel | Epioblasma torulosa torulosa |
| | Tan riffle shell clam | Epioblasma walkeri |
| | Pink mucket pearly mussel | Lampsilis orbiculata |
| | White warty-back pearly mussel | Plethobasus cicatricosus |
| | Rough pigtoe pearly mussel | Pleurobema plenum |
| | Fat pocketbook mussel | Potamilus capax |
| | Appalachian monkeyface pearly mussel | Quadrula sparsa |
| | Cumberland bean pearly mussel | Villosa trabalis |

* Rarely pass through Kentucky on migration

If the proposed operation would impact a habitat for an endangered species, the applicant should contact KDFWR or the U.S. Fish and Wildlife Service for assistance.

It should be noted that because a given species is not classified as rare or endangered, it should not be considered unimportant. No species is an entity within itself, but each is a link in a chain where continuity should be maintained to ensure continued existence.

2) All proposed mining sites which will affect wetlands as described by Cowardin et al. (1979). Brief descriptions of the wetland types likely to be found in Kentucky are found in Appendix A, Habitat Type Descriptions. Cowardin et al. (1979) should be consulted for more detailed descriptions.

3) All proposed mining sites that occur in areas having karst topography or having caves or exposed natural cliff areas.

All proposed mining permits on sites that fall into any of the above-mentioned categories may require additional investigations and/or initiation of specific reclamation practices or mitigatory steps that tend to lessen or eliminate the adverse effects of mining on the site and adjacent areas. For such sites, mining may be prohibited or limited. Also, such sites may be designated as unsuitable for mining as fragile lands. In any event, if the applicant determines that the proposed permit area falls into any one of these categories, DSMRE or KDFWR should be contacted immediately. Specific sampling techniques are available from DSMRE or KDFWR should additional sampling or investigations be necessary.

## II. TERRESTRIAL PHASE

### 1) Map of habitat types and vegetative survey

Prepare a map of the area at a scale of 1:6000 (1 inch equals 500 feet) or larger. General habitat types (as derived from the descriptions in Appendix A), location of any reference area, streams, ponds, lakes, and roads on the site and within 500' of the permit area should be shown on the map and appropriately labeled. The habitat types should be outlined with solid black lines. Within each of the designated areas, its habitat type should be denoted using the letter(s) given to the right of each habitat description heading given in Appendix A. (For example, upland forest habitat types should be outlined in solid black lines with the letters UF inscribed within the area.) Lakes, ponds, or other water resource structures should be outlined and labeled with "WR," streams should bear their appropriate name, and roads should bear their appropriate name or number. The map should show the location of the potential mine site in relation to permanent landmarks.

Within some of the habitat types, subdivisions of the habitats are given. On Form 1 (Figure 1), enter the acreages encompassed by the habitat types and further break it down if necessary into the subdivisions described in the Habitat Type Descriptions in Appendix A.

A brief and concise description of premining land use classification(s) should be appended to Form 1.

Within each habitat type, a walk-through vegetative survey must be conducted. The technique to be employed here is the stratum-rank technique (Lindsey, et al., 1969 and Adams and Geis, 1978). This method is a rapid and subjective method which is used to assign dominance to vegetative species based on integration of observed numerical abundance, cover, and size of individual species. A vegetative survey is necessary to obtain an accurate description of the habitat types and to verify the habitat designation, to evaluate the existing vegetation's value as habitat for wildlife, and to facilitate identifying primary consideration sites.

The walk-through survey should course each different habitat type on the permit site as well as those within 500' of it. The observer should proceed with the walk-through and record dominance (size), and abundance. These observations are mentally integrated into a stratum-rank value for each species (see example in Table 1). Stratum-rank values are given in Table 1. Direct line of sight is the only limit placed on the distance at which a species can be included. When the end of the walk-through is complete, the species listed should be assigned their final stratum-rank values. A species list with its stratum-rank values should be developed for each individual habitat type on the permit site and appended to Form 1.

2) Determine interspersion index

As previously stated, interspersion, or the occurrence of different habitat types in proximity to one another, is of vital importance to many wildlife species. When the reclamation plan involves establishing vegetation types and planting patterns different from that which existed on the area prior to mining, an analysis of the premining and postmining interspersion must be made. The method proposed by Baxter and Wolfe (1972) effectively meets this need.

To carry out this measurement and determine the interspersion index of the premining site, simply begin with the map of the area. This will most likely be an irregular shape. To bring consistency in establishment of the lines of measurement, draw a square or rectangle around the site which incorporates the outermost points of the permit site and draw two diagonal lines through the square or rectangle (Figure 2). The interspersion index is the sum of the different habitat types that occur along the two diagonal lines. Enter the index value in Form 1.

The postmining interspersion index is then determined by drawing a map of the proposed habitat types based on the revegetation planting pattern and following the above technique. By comparing the premining and postmining interspersion indices, a general idea of the effectiveness of the reclamation plan can be ascertained.

3) Select target species for reclamation plan

Fish and wildlife resources information is related to the habitat types that occur on the potential mine site. The diversity of species present will be relative to the habitat type or types. Twelve wildlife species that are known to occur across the state have been selected as indicator species. The particular species listed were chosen because they are characteristic of specific or varying combinations of the habitat types defined, yet they all do not utilize each habitat type.

The 12 species listed are indicative of a given habitat type or combinations thereof. Each species has been rated by KDFWR wildlife biologists to denote the value of each habitat type to the species that are known to utilize it. Rating was standardized using magnitude estimation where one of the habitat types is rated as best and the others are judged in relation to it. Ratings were according to: (1) each habitat type's ability to fulfill the life requirements of the species, and (2) the individual preference of each species utilizing that particular habitat type. The two scores were then averaged to give the overall value for each biologist. Individual rating scores were then averaged to give a composite view of the value of each habitat type to each species utilizing it. The habitat ratings given in Table 2. are those figures which reflect the habitat type's value for each species listed and are applicable to each premining site.

The potential value of the premining site is found by determining the acreage of each habitat type on the premining site and entering it in the space for acreage (ac.) on Form 2 as shown by the example acreages in Figure 3 (Form 2). The acreage figure is then multiplied by the habitat rating (r) that occurs in the column below each habitat type for which an acreage figure was entered. The resulting product yields the habitat value (v) for each species according to the habitat types present on the premining site. The figures are then summed horizontally and the sum is placed in the Total Habitat Value (tv) column. These figures reflect the existing potential of the premining site to support certain wildlife indicator species. Determine the three species which have the highest total habitat values and put an asterisk for those species in the Thre Highest Values column.

General interspersion requirements for each of the 12 wildlife indicator species described previously are given in Table 3. These basic interspersion requirements are applicable to all categories of postmining land uses. The similarities in the interspersion requirements per species per post mining land use are unavoidable since residual herbaceous, shrub, and tree cover are the only three components of habitat that can be replaced for near term benefits.

To determine the reclamation plan, refer to the three species recognized in the Three Highest Values column from Form 2 (Figure 3). These species are indicative of the area of the mine site and adjacent areas and are therefore readily available for recruitment into the reclamation area. Refer to the general interspersion requirements (Table 3) and determine which of the three species has the smallest home range and whose basic requirements are the closest spatially. That species should be the reclamation target species (from example in Figure 3, gray squirrel should be chosen). By choosing the species with the smallest home range, the operator is assured of creating good habitat interspersion by reclaiming small areas toward management for that species. Small area management is easier for the operator to perform and also greatly enhances the overall wildlife value of the mining site by creating a large quanity of "edge effect", thereby benefiting many wildlife species.

4) Terrestrial reclamation plans and methodologies

Recommendations given below are those which should be applied to all sites where fish and wildlife will be secondary to other land uses. This occurs where the following are the primary postmining land uses: cropland, pasture or land occasionally cut for hay, grazing land, residential, industrial/commercial, recreation, developed water resources, undeveloped land or no current use or land management. (Apply definitions for each of the preceding land uses that are given in 405 KAR 7:020E. Note the differences between those terms, which are land use categories, and the ones given in Appendix A, which are habitat types, so as to avoid confusion.)

The following paragraphs discuss general reclamation plans and reclamation plans for specific postmining land uses. The general plan must be applied to all sites while the latter is applied, as the name implies, according to the postmining land use.

Methodologies to be applied in implementing reclamation plans are given in Appendix B. Note that the different species recommended therein have differing values to wildlife. Information given in Table 1, Appendix B, summarizes the value of those plant species to the wildlife species which utilize them. In general, plant species choices in reclamation plantings should provide a mixture of species which supply either food or cover, or both. Other important considerations in choosing plant species is tolerance to sunlight or the lack of it and pH of the soil where planting is to occur (explained in footnotes to Tables 4 and 5).

a) General reclamation plan:

From Table 3, Appendix B, choose a herbaceous ground cover mixture that corresponds to the time of year that reclamation and seeding will occur and that will be valuable as food and cover for the target species. Such mixture should be planted over the entire area of the permit site using generally accepted methods. At this time, special attention should be given to outslope areas, benches, or other areas where stability is critical. Recommendations concerning plantings in these areas are given in the Planting Patterns Beneficial to Wildlife segment of this section.

Strips of shrubs and/or trees should be planted around the entire perimeter of the site at a rate and density that complies with reclamation rules. Strips should be at least 50 feet wide and be composed of species given in Tables 4 and 5, Appendix B. Special emphasis should be given to the use of species which produce a seed or mast crop to serve as a food source for wildlife on the site (see Table 1, Appendix B).

Contour mines and underground mines developed in upland forests that do not create expansive disruptions to the overall habitat, enhance wildlife habitat by creating interspersion. Tree plantings are not necessarily required in these cases. However, the operator must establish herbaceous vegetation that is suitable for food and cover.

It is possible for a given site to have several postmining land uses within its borders. If such is the case, each different use category should be completely surrounded by a shrub and/or tree strip such as that described in the preceding paragraph.

All impoundments or catchments of water that are left on the postmining site or created during grading are natural gathering places for fish and wildlife and would serve to enhance fish and wildlife on any permit site. Each impoundment or water catchment should be encircled with shrub and/or tree strips similar to those mentioned above.

b) Reclamation plan for specific postmining land uses:

Locate the designated primary postmining land use below and incorporate the general interspersion requirements for the reclamation target species (or one of the other of the top three indicator species if one of the others is more compatible with the postmining land use) as given in Table 3. Also, follow any instructions that are given for the specific designated postmining land uses that follow.

Wildlife:

When fish and wildlife is to be the designated primary postmining land use, the applicant should contact: Kentucky Department of Fish and Wildlife Resources, Frankfort, Kentucky 40601. (Tel. 502-564-3400) A staff biologist will then assist the applicant in plan development. A set of guidelines for utilizing the fish and wildlife postmining land use option will be available in the near future.

Cropland:

Incorporate basic interspersion requirements from Table 3. If livestock are to be turned into the croplands at any time, they should be excluded from the areas where vegetation plantings occur for wildlife. This can be done either by the construction of standard 3 or 4 strand barbed wire fences or through the planting and insured maintenance of living fences.

Pastureland or Land Occasionally Cut for Hay:

Incorporate basic interspersion requirements from Table 3. In all cases, livestock should be excluded from the areas where vegetation plantings occur for wildlife. This can be done either by the construction of standard 3 or 4 strand barbed wire fences or through the planting and insured maintenance of living fences.

Grazingland:

Incorporate basic interspersion requirements from Table 3. In all cases, livestock should be excluded from the areas where vegetation plantings occur for wildlife. This can be done either by the construction of standard 3 or 4 strand barbed wire fences or through the planting and guaranteed maintenance of living fences.

Residential:

Open spaces that are associated with residential complexes should, to the greatest degree possible, incorporate the basic interspersion requirements from Table 3. Again, fencing should exclude other uses of vegetative plantings that are placed for the benefit of wildlife.

Industrial/Commercial:

Open spaces and all support facilities which include, but are not limited to, railroad right-of-ways, road right-of-ways, and other transportation facilities that are associated with industrial/commercial complexes should, to the greatest degree possible, incorporate the basic interspersion requirements from Table 3.

With the exception of areas where cosmetic maintenance may be necessary, all other uses of areas vegetated to benefit wildlife should be precluded by fencing.

Recreation:

Recreation and fish and wildlife are generally linked, as fish and wildlife and their habitats are usually aesthetically pleasing to the recreator. In all cases, basic interspersion requirements from Table 3 should be incorporated into the recreation area.

Developed Water Resources:

Due to the probable small size of such water resources in relation to the overall size of the permit site, they will probably be accompanied by another land use designation. Regardless of and in addition to the accompanying designation, guidelines set forth previously in the General Reclamation Plan section should be followed in relation to the impoundment.

Undeveloped Land or No Current Use or Land Management:

It is recommended that the operator consider developing such areas for fish and wildlife and designate the postmining land use as fish and wildlife.

Forestry:

Establishment of trees for forest management should be done according to accepted guidelines as provided by state, federal, or private foresters. In order to benefit wildlife species within the forest unit, a diversity of tree species should be used. Pure stands of coniferous forest are much less productive in terms of wildlife than mixtures of hardwoods and coniferous trees. Coniferous stands should have no less than 20 percent hardwood species that produce a mast crop intermixed. Hardwood stands should likewise emphasize the use of mast producing species.

5) Planting patterns beneficial to wildlife

Some patterns of planting vegetation are, in general, more attractive to wildlife than others. The basic principle in creating high quality wildlife habitat is providing a variety of habitat types (i.e. woodlands, shrubby areas, grass/legume areas), freely interspersed to create an abundance of "edge effect." For example, strip plantings, border plantings, and clump plantings of woody species in and around areas planted to grass/legume mixtures are desirable for wildlife. "Edges" increase food and cover for wildlife and provide for better wildlife distribution.

Any revegetated minesite can be improved for wildlife with alternating rather than solid plantings of herbs, trees, or shrubs. For example, where remining of previously mined areas leaves a highwall, bench, and outslope, a basic planting could be as follows: plant two or three rows of conifers and one or two rows of European alder or black locust adjacent to the highwall (these would eventually screen the highwall); plant the bench to alternating strips or blocks of herbaceous species and shrubs; plant the edge of the bench adjacent to the outslope to a few rows of conifers; and plant the outslope to herbs and woody plants. Strip plantings on the outslope are, again, more desirable. If practical, plant the outslope by alternating woody strips with

herbaceous cover species that will insure quick erosion control. Extremely steep spoil banks and highwalls may inhibit the movement of some wildlife. Access points should be provided that allow wildlife to travel freely between newly-revegetated areas and undisturbed areas.

Strip plantings of grass/legume mixtures 100 - 150 feet wide alternating with strips of shrubs and/or trees 30 - 50 feet wide would be a useful pattern on expansive sites. For smaller areas the widths of vegetative strips should be proportionally decreased. On cuts less than 100 feet wide, a single row of woody vegetation or randomly spaced clumps of woody species may create sufficient diversity. Open areas seeded to grass/legume mixtures should be at least one-half acre in size. Such openings can be created by seeding old roadways. Escape or winter cover composed of woody evergreen species should be included at these sites and may serve as well to screen highwalls from view.

For single contour mining, habitat diversity can be achieved by using bands of different types of vegetation. Variety results by utilizing plants having different growth forms, foliage retention, fruit retaining dates, etc. In the case of multiple contour operations, diversity is easily gained by incorporating a different revegetation plan on each contour.

In areas of poor drainage with high water tables, artificial wetlands may be created which will enhance the areas for wildlife use. These areas should be seeded with grass/legume mixtures utilizing such species as reed canary grass, red top, and alsike clover which are tolerant to wet site conditions. Shrub species such as alders should be used for woody strip or clump plantings. Pond areas are also very beneficial to fish and wildlife. Pond borders should be similarly planted with wet site species such as those mentioned in Table 3, Appendix B.

Basic fish and wildlife management principles can also be incorporated into the more specific land uses considered for reclamation. Where area-mined sites are to be revegetated for pasture or hay, such tracts of extensive seeding can be diversified by planting a strip, not over 20 feet in width, to shrubs such as amur privet, autumn olive, or bicolor lespedeza. Such plantings may also serve as woodland-field borders at the edge of proposed pastures or cropland. Shrubs can be useful as hedges and living fences extending across future crop fields or along cropfield and pasture boundaries. These usually consist of one or two rows of shrubs laid out on the contour. Two or three rows of pine planted along one side of a single row of autumn olive, bayberry, or rugosa rose can provide an effective windbreak for a future pasture or cropland while improving nesting, escape, and winter cover. One can also plant one to ten rows of trees and shrubs, or shrubs only, at right angles to the direction of the prevailing winds. Scattered clump plantings of conifers and shrubs in an open field also provide needed food and cover.

Travel lanes for wildlife can be provided by planting one row of a dense growing shrub such as bristly locust or two rows of shrubs such as autumn olive, bicolor lespedeza, or tatarian honeysuckle. Row plantings, although they may appear artificial, create runways for many ground dwelling birds and mammals. A random planting pattern may be more pleasing to the eye, but it creates gaps in the cover that some birds and mammals are unwilling to cross.

Christmas tree plantations can be planted that will also benefit wildlife. Proper planning and management will provide harvesting on a continuous rotating basis. In this way part of the understory remains unshaded and can develop vegetational variety on the area. A double or single row shrub border spaced six feet between rows and planted adjacent to a conifer plantation will further improve the wildlife value of the area.

Mixed forest plantations are best for wildlife. Planting blocks of conifers within mixed hardwood plantations increases the variety of food and cover types available for wildlife while providing potential wood products. Sections of hardwoods may be separated from coniferous rows by grass-legume strips to provide more edge and open areas. Hardwood timberlots will also be more desirable to wildlife if provided with a double or single row shrub border about 40 feet from the edge of the woods.

If the landowner desires to reclaim his stripped area to a simple woodlot from which posts or pulp can eventually be cut, the area can also be managed for wildlife. Small woodlots of uneven age are very beneficial to wildlife.

In any of the above examples, additional forms of cover may be necessary to increase the general wildlife carrying capacity of the area. Escape cover can be created artificially from boulders, logs, slash, brush, and so forth. Such materials can be piled in odd areas, travel lanes, or other places. Space artificial cover 200 to 250 feet apart when suitable natural cover is lacking. Food patches also can be planted to help sustain wildlife populations. However, food patches cannot serve as substitutes for permanent food-bearing plants. A food patch is any plot of domestic food plants reserved for wild animal usage. Plots should not be less than one-eighth acre in size. Generally, one-eighth to one-half acre patches spaced at one patch per acre minimum is beneficial. Long, narrow food patches near cover are best.

It must be remembered that vegetation changes with time; therefore the quality and quantity of food and cover, in turn, will be affected. In order to counteract this natural process of change, some maintenance procedures may be necessary. For example, open areas will become overgrown and make cutting disking, or controlled burning necessary to preserve this cover type. Recommendations for the best maintenance procedures may be obtained from professional biologists, conservationists, and foresters.

Figure 1. (Form 1) Description of Permit Site

| Habitat Types | Acreages | Acres periodically inundated* |
|---|---|---|
| Upland Forest - grazed | | |
| - ungrazed | | |
| Industrial/Residential | | |
| Woodlot - grazed | | |
| ungrazed | | |
| Agri - lands | | |
| Shrublands - grazed | | |
| - ungrazed | | |
| Grasslands - prairie | | |
| - pasture | | |
| - hayfield | | |
| Wetlands - Riverine | | |
| - Palustrine | | |
| - Lacustrine | | ** |
| Abandoned Mine Lands | | |
| TOTALS | | |

* + if periodically inundated
  - if not periodically inundated
** not applicable

Interspersion Index

Premining _____
Postmining _____

Attach species list and stratum rank values to this form.

Table 1. Stratum - Rank (SR) Classes

| Class | Description |
|---|---|
| SR-9 | A sole dominant species, no other species exceeds SR-2. |
| SR-8 | A species so outstanding as to be called the sole dominant, no other species exceeds SR-6. (Given to only one species.) |
| SR-7 | A species sharing dominance. Given to one, but rarely two species (for example oak - hickory). |
| SR-6 | A species sharing dominance with another, but markedly less important than the main dominant. Or, a species sharing dominance more or less equally with a number of species. |
| SR-5 | Given to the third or forth subdominant where there are two clear dominants, usually given only if all remaining species have low SRs. |
| SR-4 | A subordinate species, not a dominant or subdominant, but contributing significantly to both numbers and cover. |
| SR-3 | A species with three to several individuals furnishing substantial cover. |
| SR-2 | A species with two to several individuals, but infrequent in number and inconsequential in cover. |
| SR-1 | A species for which only a single individual is observed. |

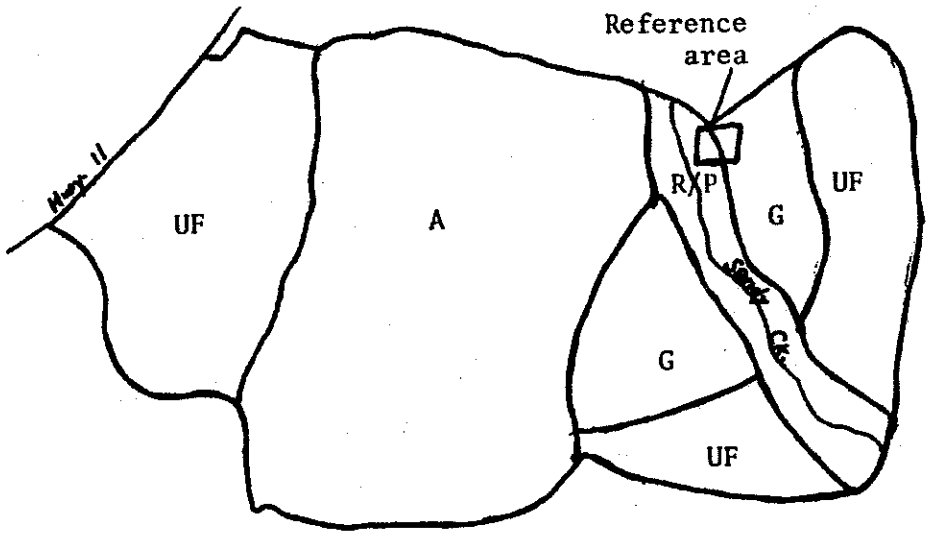
Example

Upland Forest - UF

| Species | Stratum Rank |
|---|---|
| Quercus alba | SR - 7 |
| Quercus velutina | SR - 3 |
| Quercus falcata | SR - 3 |
| Carya tomentosa | SR - 3 |
| Carya ovata | SR - 7 |
| Acer saccharum | SR - 2 |
| Tilia americana | SR - 1 |
| Cornus florida | SR - 2 |
| Oxydendrum arboreum | SR - 2 |

Wetlands - WL

| Species | Stratum Rank |
|---|---|
| Acer saccharinum | SR - 6 |
| Acer rubrum | SR - 6 |
| Acer negundo | SR - 3 |
| Fraxinus pennsylvanica | SR - 3 |
| Betula niger | SR - 6 |

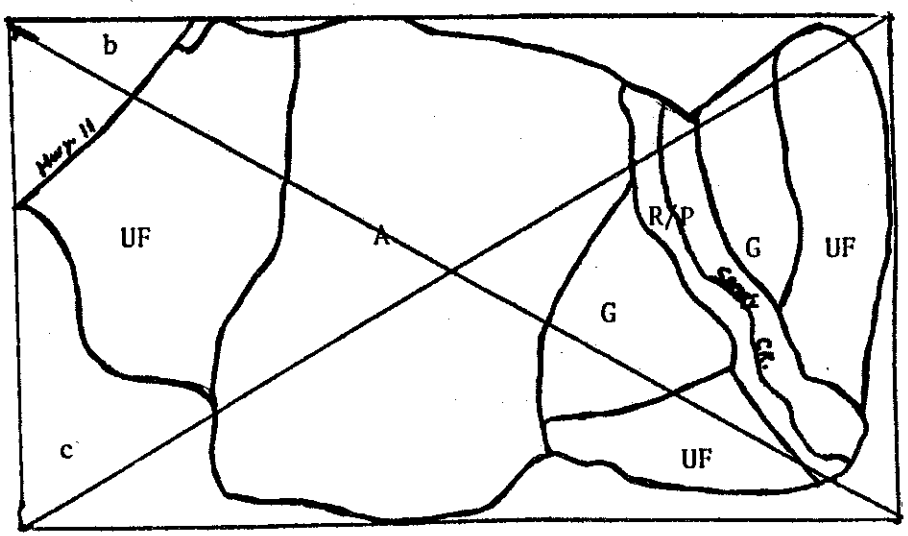



COVER MAP OF PERMIT SITE

Figure 2. Interspersion Index determination.

Begin with cover map as prepared according to instructions given previously.






COVER MAP WITH INTERSPERSION
INDEX MEASUREMENT LINES

(Not to Scale)

Draw square or rectangle around the site which incorporates the outermost points of the site and draw two diagonal lines through the square or rectangle. The interspersion index is the sum of the different habitat types that occur along the two diagonal lines, e.g., line b crosses 5 habitat types and line c crosses 4. Thus, the Interspersion Index of the site is 9.

Table 2. Habitat Ratings for Wildlife Indicator Species

| Species | Habitat Types | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Industrial/ Residential | Upland Forest | Riparian/ Palustrine | Woodlots | Shrublands | Grassland | Agri-land | Wetlands |
| Quail | 28 | | | 53 | 93 | 54 | 65 | |
| Rabbit | 53 | | | 55 | 92 | 74 | 56 | |
| Grey Squirrel | 45 | 98 | 64 | 86 | | | | |
| Deer | | 89 | 73 | 58 | 77 | 36 | 44 | 45 |
| Dove | 56 | | 35 | 38 | 58 | 40 | 91 | |
| Wood Duck | | | 100 | | | | | 100 |
| Turkey | | 99 | 89 | 25 | 34 | 27 | 22 | |
| Whitefooted Mouse | 70 | 74 | | 86 | 90 | | | |
| Meadowlark | 28 | | | | | 100 | 68 | |
| Red Fox | | | | 82 | 84 | 59 | 53 | |
| Raccoon | 27 | 75 | 98 | 70 | 39 | 21 | 32 | 74 |
| Kestrel | 51 | | | 49 | 93 | 82 | 65 | |

Figure 3. (Form 2) Determination of the Three Indicator Species Best Suited to the Area Proposed to be Mined

| Species | | Industrial/ Residential | Upland Forest | Riparian/ Palustrine | Woodlots | Shrublands | Grassland | Agri-land | Wetlands | Total Habitat Value (tv) | Three Highes Values |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | ac. | 100 ac. | ac. | ac. | 10 ac. | ac. | 10 ac. | ac. | / / / / / / | / / / |
| Quail | r | 28 | / / / / | / / / / / / | 53 | 93 | 54 | 65 | / / / / / | / / / / / / | / / / |
| | v | | / / / / | / / / / / / | | 930 | | 650 | / / / / / | 1,580 | |
| Rabbit | r | 53 | / / / / | / / / / / / | 55 | 92 | 74 | 56 | / / / / / | / / / / / / | / / / |
| | v | | / / / / | / / / / / / | | 920 | | 560 | / / / / / | 1,480 | |
| Grey Squirrel | r | 45 | 98 | 64 | 86 | / / / / / / | / / / / / | / / / / / | / / / / / | / / / / / / | / / / |
| | v | | 9,800 | | | / / / / / / | / / / / / | / / / / / | / / / / / | 9,800 | * |
| Deer | r | / / / / / / | 89 | 73 | 58 | 77 | 36 | 44 | 45 | / / / / / / | / / / |
| | v | / / / / / / | 8,900 | | | 770 | | 440 | | 10,100 | * |
| Dove | r | 56 | / / / / | 35 | 38 | 58 | 40 | 91 | / / / / / | / / / / / / | / / / |
| | v | | / / / / | | | 580 | | 910 | / / / / / | 1,490 | |
| Wood Duck | r | / / / / / / | / / / / | 100 | / / / / / | / / / / / / | / / / / / | / / / / / | 100 | / / / / / / | / / / |
| | v | / / / / / / | / / / / | | / / / / / | / / / / / / | / / / / / | / / / / / | | | |
| Turkey | r | / / / / / / | 99 | 89 | 25 | 34 | 27 | 22 | / / / / / | / / / / / / | / / / |
| | v | / / / / / / | 9,900 | | | 340 | | 220 | / / / / / | 10,460 | * |
| Whitefooted Mouse | r | 70 | 74 | / / / / / / | 86 | 90 | / / / / / | / / / / / | / / / / / | / / / / / / | / / / |
| | v | | 7,400 | / / / / / / | | 900 | / / / / / | / / / / / | / / / / / | 8,300 | |
| Meadowlark | r | 28 | / / / / | / / / / / / | / / / / / | / / / / / / | 100 | 68 | / / / / / | / / / / / / | / / / |
| | v | | / / / / | / / / / / / | / / / / / | / / / / / / | | 680 | / / / / / | 680 | |
| Red Fox | r | / / / / / / | / / / / | / / / / / / | 82 | 84 | 59 | 53 | / / / / / | / / / / / / | / / / |
| | v | / / / / / / | / / / / | / / / / / / | | 840 | | 530 | / / / / / | 1,370 | |
| Raccoon | r | 27 | 75 | 98 | 70 | 39 | 21 | 32 | 74 | / / / / / / | / / / |
| | v | | 7,500 | | | 390 | | 320 | | 8,210 | |
| Kestrel | r | 51 | / / / / | / / / / / / | 49 | 93 | 82 | 65 | / / / / / | / / / / / / | / / / |
| | v | | / / / / | / / / / / / | | 930 | | 650 | / / / / / | 1,580 | |

Habitat value (v) equals the product of habitat acreage (ac) and habitat rating (r).
Total habitat value (tv) equals the sum of the habitat values for each species.

Table 3. General Interspersion Requirements* for Indicator Species.

| Species | Home Range | *Interspersion requirements |
|---|---|---|
| White-tailed deer (Odocoileus virginianus) | Usually less than 300 acres, but can be upwards to 1-2 square miles. | Minimum of 25 acres of evergreen or pine stands per sq. mile. Stands should have a minimum of 20% mast producing species intermixed. |
| Raccoon (Procyon lotor) | 200 acres or from 0.5 to 1.5 square miles. miles. | 10-15 acres of trees including conifers/ 200 acre plot. |
| Red fox (Vulpes fulva) | 1-2 miles (Burt and Grossenheider, 1964). | With such large home range, it is best to concentrate efforts on prey species. Refer to rabbit requirements. |
| White-footed mouse (Peromyscus leucopus) | 0.1 to 10 acres. | Due to smallness of home range, specific requirements are difficult to meet in combination with other land uses. Refer to quail requirements. |
| Gray squirrel (Sciurus carolinensis) | 10-40 acres with maximum range of 320 acres. | 10-20 acre tree stand/300 acres. Tree species should be primarily of the mast producing type. Plot should be centrally located. |
| Eastern cottontail (Sylvilagus floridanus) | Usually between 1-16 acres (Willis, 1975). | 10-20% shrubland, 10-20% herbaceous cover. |
| Wood duck (Aix sponsa) | Unstable (Bellrose, 1976) | Applies only to riparian and palustrine areas. 2-4 wood duck boxes/acre of stream or pond. Construction and placement as in Appendix C. |
| American kestrel (Falco sparverius) | From as small as 0.12 mile to 1.5 miles. | 10-20% sparse shrubland, 10-20% herbaceous cover. |

Table 3. (continued)

| Species | Home Range | *Interspersion requirements |
|---|---|---|
| Bobwhite (Colinus virginianus) | 24-120 acres. | 10% herbaceous cover, 5% shrubland, and 5% woodland. Placement of each should be parallel to the other in widths of 30', 20', 20', respectively. |
| Turkey (Meleagris gallopavo) | Normally 400-640 acres, normal cruising range 2-4 miles. | Permanent water is essential. 10% woodland of which 20% should be conifers and remainder mast producers. 10% sparse shrubland. Placement should be contiguous to outer perimeter with shrubland adjoining open areas. |
| Mourning dove (Zenaidura macroura) | Unstable. | Permanent water is essential. 10% scattered belts composed of shrubland and open woodlots where at least 20% of trees are coniferous. |
| Eastern Meadowlark (Sturnella magna) | 7-7.5 acres. | 20% of area in grass-shrub mixture. |

*For more general information regarding placement and patterns to benefit wildlife consult Planting Patterns Beneficial to Wildlife in this section.

Unless otherwise noted, information regarding interspersion requirements is adapted from: U.S. Department of the Interior, 1978. Draft of Terrestrial Habitat Evaluation Criteria Handbook. Ecoregion 2211, Appalachians. Division of Ecological Services, Fish and Wildlife Service.

## III. Aquatic Phase

### 1) Buffer zone variance

This portion of these guidelines should be consulted only when the applicant seeks a variance to 405 KAR 16:060E, Section 11, which states "no lands within 100 feet of a perennial stream or a stream with a biological community .... shall be disturbed by surface mining activities, unless the department specifically authorizes surface mining activities closer to or through such a stream." In such cases these guidelines will insure that the applicant is supplying the necessary data needed by DSMRE, KDFWR, and other reviewing agencies and that the reclamation techniques utilized will be satisfactory to comply with the regulations.

Both the preliminary and comprehensive applications for mining require that a "mining and reclamation plan map" be submitted by the applicant. The preliminary application should indicate if the applicant intends to request a variance from the stream buffer zone requirements. The comprehensive application requires additional detailed information on each variance and stream channel change and appropriate reclamation plans to comply with regulations 405 KAR 16:060E and 405 KAR 16:080E.

When a stream is to be modified, regulation 405 KAR 16:080E establishes that permanent diversions should reflect the original meander, gradient, longitudinal profile, and aquatic habitats of the original stream. To comply with this regulation a detailed map showing direction of geographic north, direction of flow, sand bars, islands, waterfalls, instream vegetation, riffle areas, rock outcrops, sampling points and the general meander must be compiled for the comprehensive application. The map should be drawn to a scale of 1:300 (1 inch = 25 feet) or larger. An example of such a map is given in Figure 4.

A diagram exhibiting the longitudinal profile and typical cross-sections of the stream (showing widths, depths, and structure) would also prove most beneficial in planning the design of the new channel. Figure 5 shows an example of these features.

Establishing and/or restoring a new channel to acceptable environmental conditions may at first seem to be an unsurmountable task; however, with proper planning and attention to detail it can be readily accomplished. A new channel can be built that is the same length and curvature and approximates the average slope, width, and depth of the old stream channel. Artificial stream habitats (i.e. riffles and gabion dams and deflectors) can then be placed in the new channel to provide feeding, resting, and reproductive areas for aquatic organisms. Utilizing these techniques will create a new stream of similar productivity to that of the premining natural stream.

Determination of stream length and curvature can be accomplished through standard surveying techniques. Measurement of the stream widths and depths should be done by making transects across the stream at approximately 50 feet intervals for the length of the stream to be affected. Depth measurements should be made at 2 foot intervals across these transects and stream width measured at each transect. These measurements will then be used to reconstruct similar riffle/pool areas during reclamation. Length measurements for each riffle and pool should also be made. Utilizing these measurements the operator can then construct the new channel during grading processes for reclamation. The longitudinal profile diagram discussed earlier will also be of assistance at this time in determining the necessary elevation changes throughout the channel.

The replacement of stream structures and habitats can be fairly easily accomplished with proper planning. The overall difficulty depends upon the types of structures and habitats needed to replace what was lost from the old channel. Simple measures include placement of large boulders in the new channel in a random manner; placement of rock bars, islands, and riffles; and installing log check dams and deflectors. Structures such as islands and gravel bars can be easily constructed during construction of the new channel by placing and shaping materials to resemble the original structures. Artificial structures requiring more elaborate efforts include the construction and placement of gabion dams and deflectors. Figures 6 through 8 show examples of artificial riffles, gabion dams and deflectors, and some possible arrangement patterns for these structures. All materials used in these structures should be non-erodible and stabilized in such a manner as to prevent failure of the structure. The map of the original stream will prove very useful in correctly placing these artificial structures during reclamation.

Revegetation of stream banks and the associated buffer zone should be planned in conjunction with the overall reclamation plan. It is important to plant species of plants that were found along the original stream or to plant species that are similar and have high fish and wildlife values. Once again, the map of the original stream should indicate the types, amounts, and location of vegetation that existed and similar revegetation should be planned.

It is recommended that channel construction and all mitigation work be completed before any water is diverted into the new channel. This will reduce the suspended solids load and turbidity levels downstream of the construction site and allow the operator to utilize conventional equipment for the work.

In instances where a variance is requested to eliminate some portion of the 100 foot buffer zone, but not to alter the physical characteristics of the stream channel, measures must be taken to protect the fish and wildlife resources that will be affected. In order to protect the stream from excessive sedimentation, runoff which would otherwise flow through the 100 foot buffer zone should be diverted through sedimentation control structures such as straw dikes, sediment fences, check dams, vegetative filters, dugouts, etc. prior to release to the stream. If the area affected is extensive, a series of such devices may be necessary. The final effluent from the structures must meet water quality standards for the receiving stream.

2) Other aquatic reclamation plans and methodologies

Watering areas are natural gathering places for a great variety of wildlife species. Since the regulatory program requires that impoundments be constructed on the permit site to contain runoff and trap sediment, a unique opportunity exists to enhance such areas for fish and wildlife.

If the existence of an impoundment is not in conflict with the designated postmining land use and if the impoundment is in compliance with the requirements for a permanent structure (as outlined in 405 KAR 16:100E) it can be left for fish and wildlife purposes. Enhancement of the area surrounding the impoundment should be carried out as described in the Terrestrial Reclamation Plans and Methodologies of this document. Further, if the physical features of the impoundment are such that it is approximately one acre in size, and water depth is eight to ten feet over 15-75 percent (Schwab, et al., 1971) of the water area at normal water level, and if the water depth at the shoreline is about two feet (Henley, 1976), the impoundment is probably suitable for fish stocking. In such cases, the Kentucky Department of Fish and Wildlife Resources should be contacted to supply fish for stocking. Contact can be made by writing: Department of Fish and Wildlife Resources, Frankfort, Kentucky 40601. (Tel. 502-564-3400)

In addition, when final grading is completed, water holding depressions could be left which would add considerable value to the overall site in terms of fish and wildlife enhancement and habitat establishment.

In all instances where water resources are impacted or eliminated by mining activities, reclamation must seek to re-establish such resources. This includes but is not limited to reconstruction of ponds, lakes, or other water catchments that existed prior to mining.

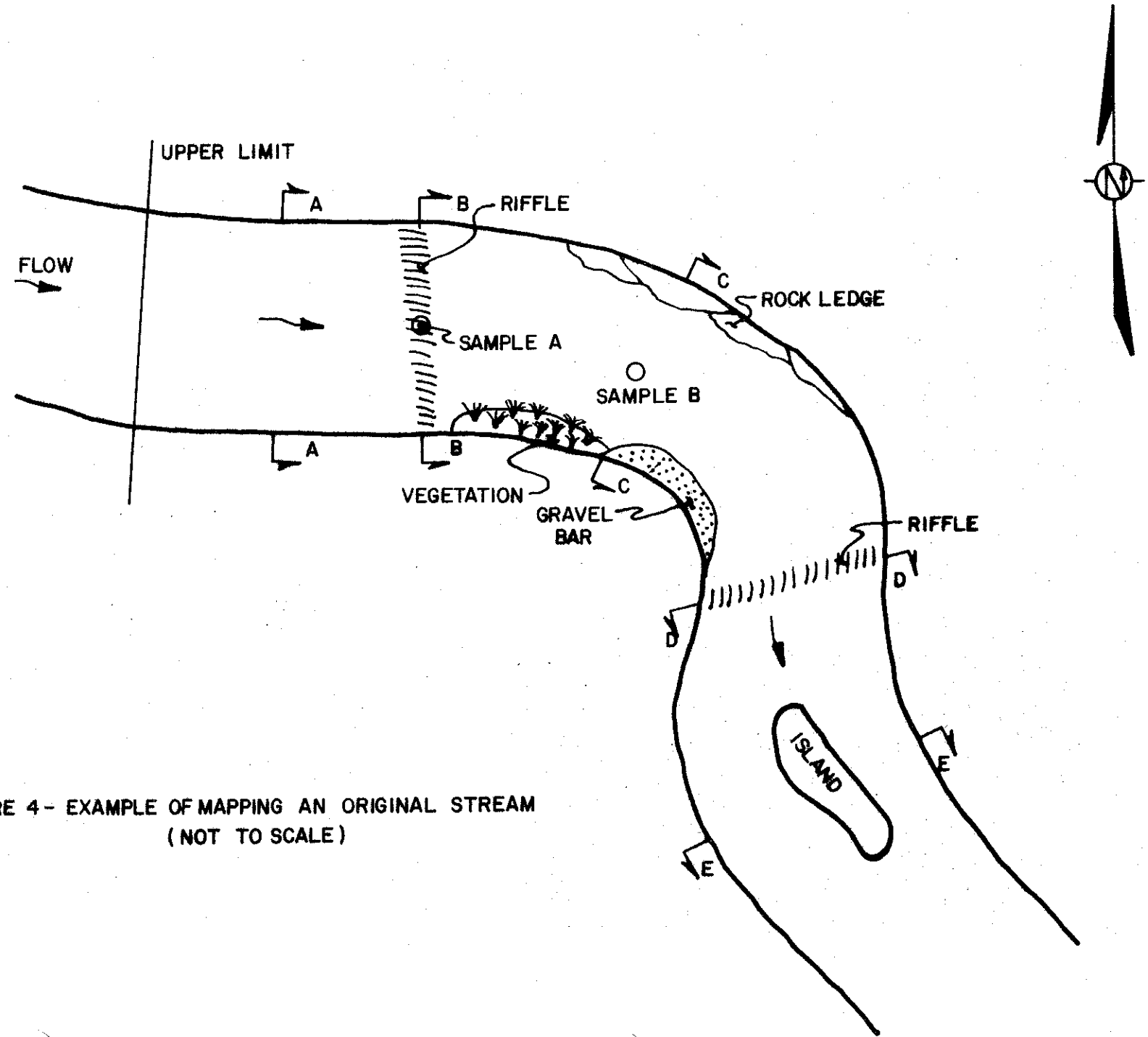
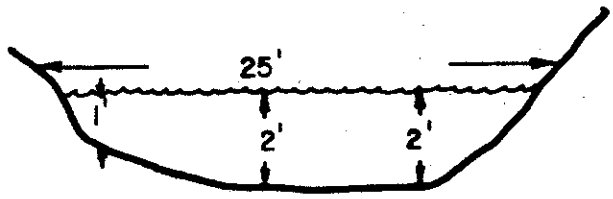
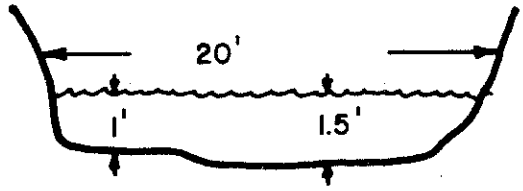


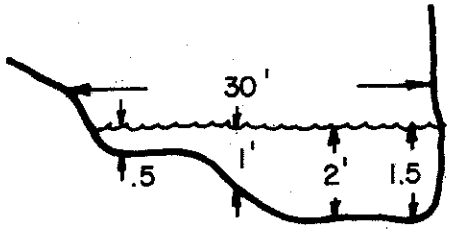

FIGURE 4 - EXAMPLE OF MAPPING AN ORIGINAL STREAM
(NOT TO SCALE)



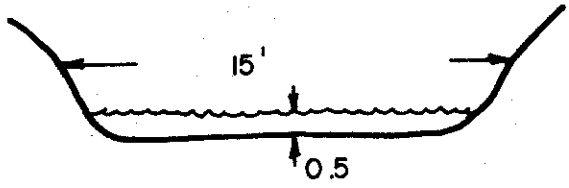

SECTION A-A



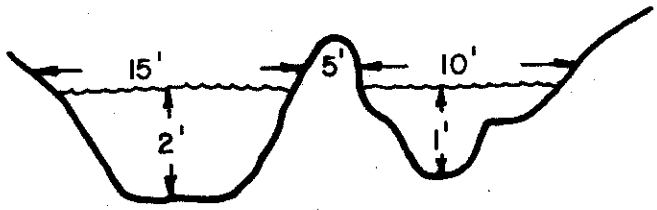

SECTION B-B




SECTION C-C




SECTION D-D




SECTION E-E

CROSS SECTIONS

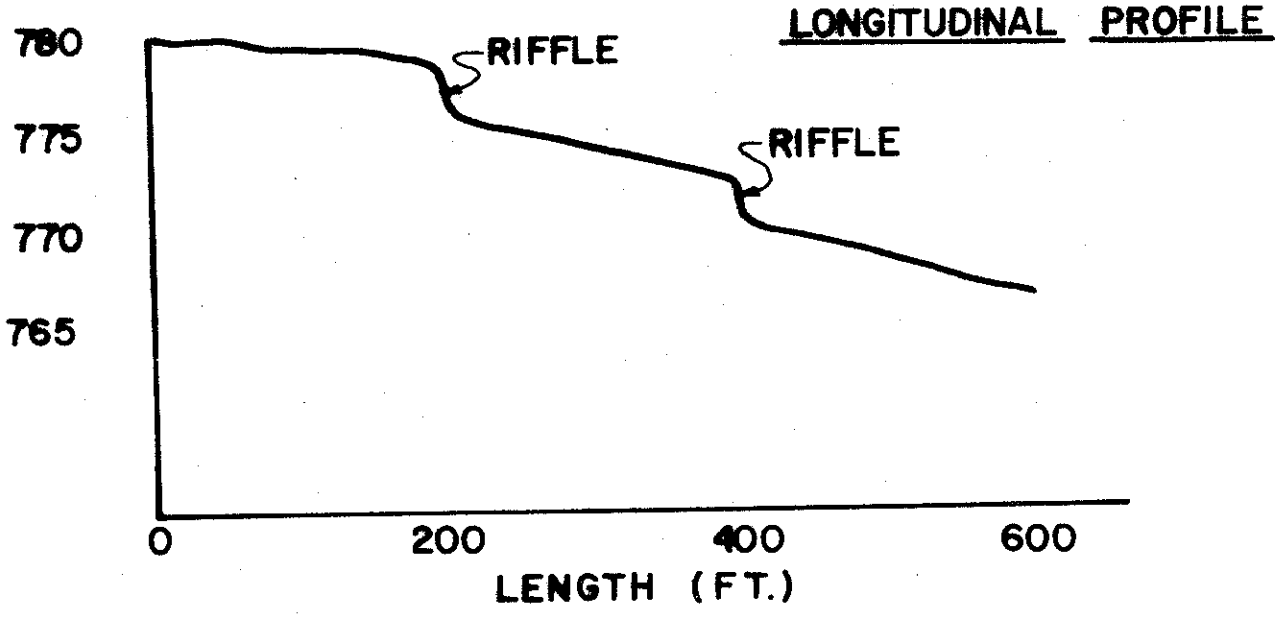
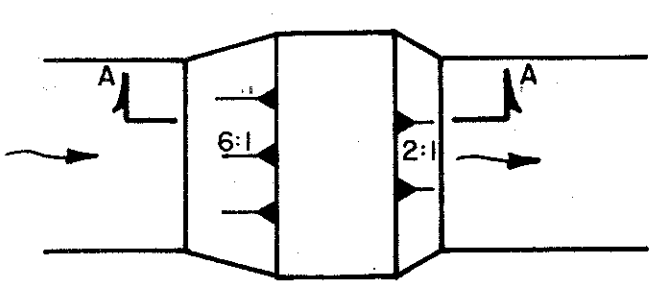
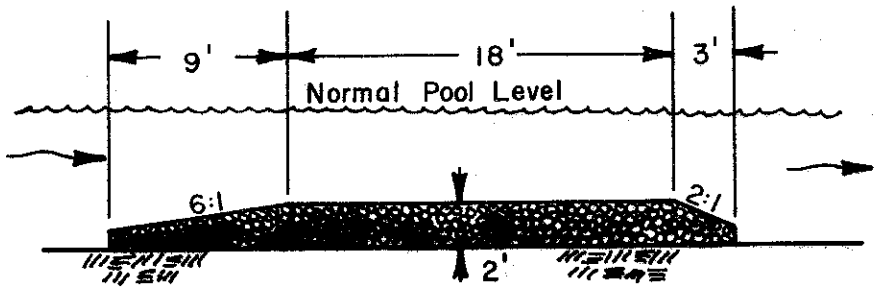



FIGURE 5

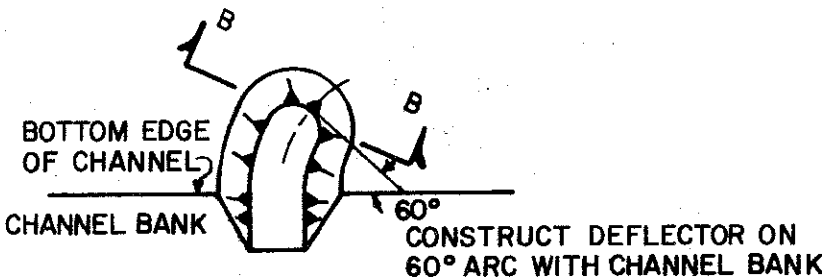



PLAN VIEW

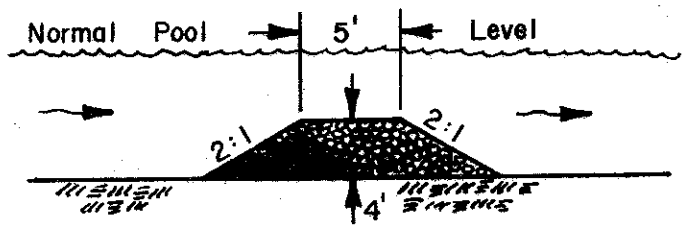



SECTION A-A

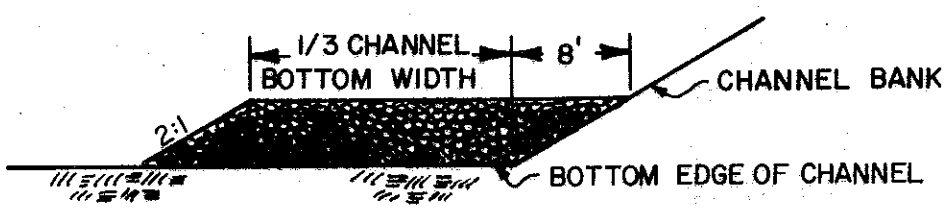
## RIFFLE STRUCTURE (No Scale)




PLAN VIEW



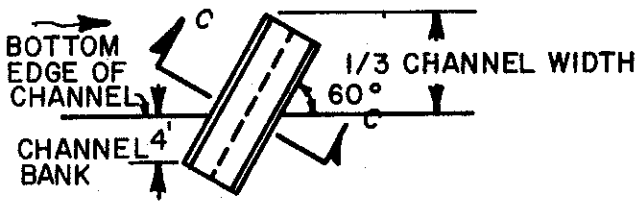

SECTION B-B



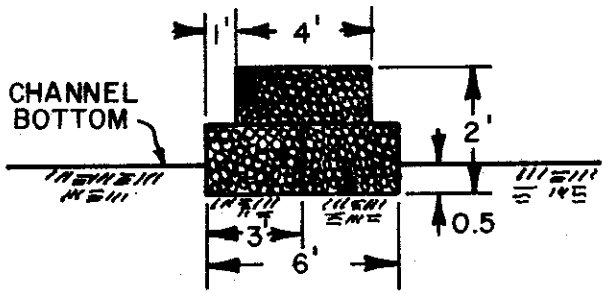

ELEVATION

## DUMPED STONE DEFLECTOR (No Scale)

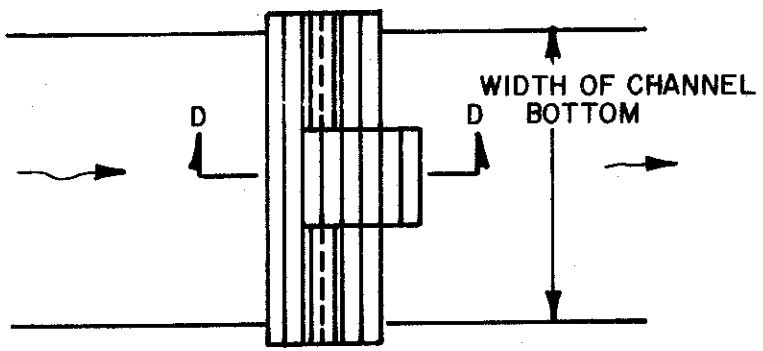
Figure 6.



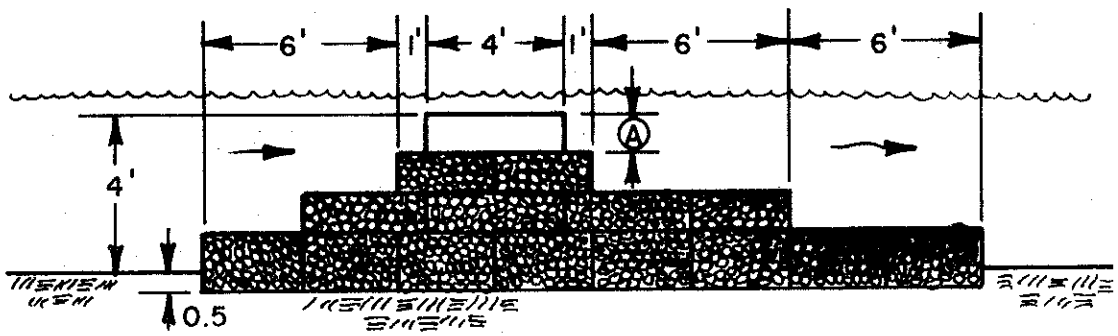

PLAN VIEW
GABION DEFLECTOR
(No Scale)



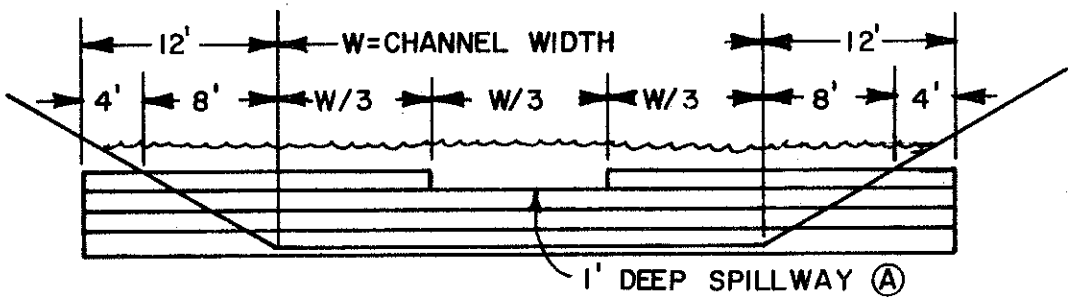

SECTION C-C




PLAN VIEW
GABION DAM
(No Scale)




SECTION D-D

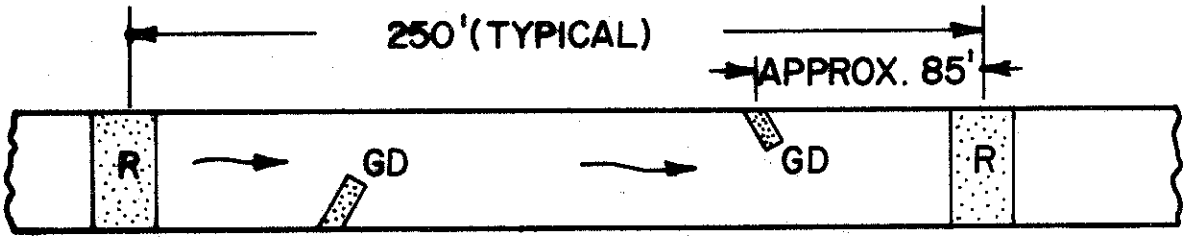



ELEVATION OF DAM

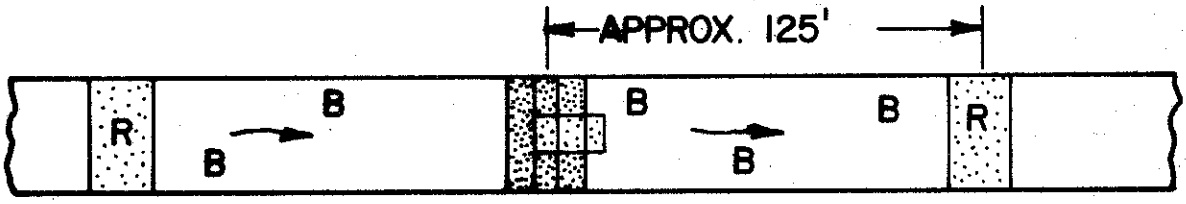
NOTE -
DIMENSIONS FOR GABIONS ARE APPROXIMATE
MANUFACTURER'S SPECIFICATIONS SHALL APPLY

Figure 7.

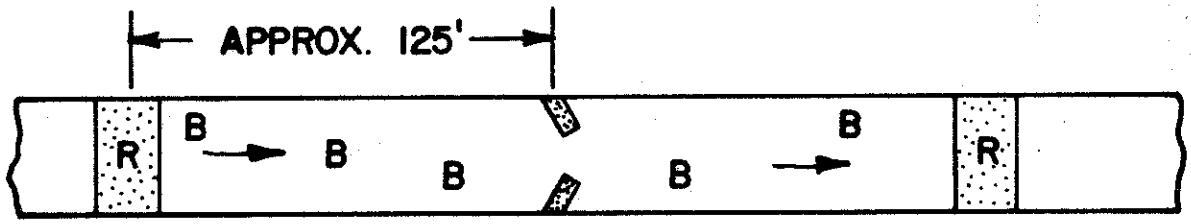
# POSSIBLE MITIGATION SCHEMES (No Scale)



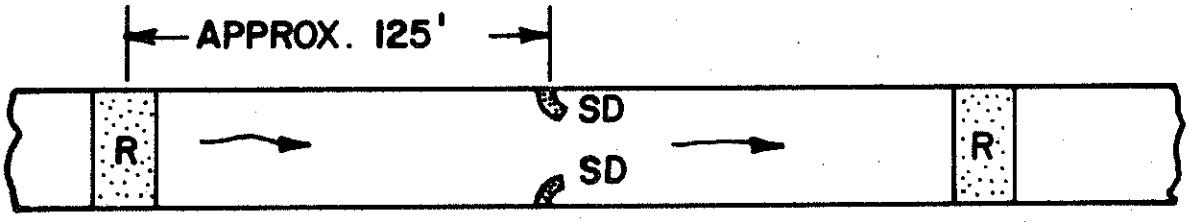

CHANNEL I




CHANNEL II




CHANNEL III




CHANNEL IV

USE MOST DURABLE SANDSTONE OR LIMESTONE IN THE AREA FOR ALL MITIGATION DEVICES

BOULDERS = 12 TO 16 CU. FT.

OTHER DEVICES = 75% 2 TO 25 CU. FT.
25% LESS THAN 2 CU. FT.

Figure 8.

Figure 6.

Rock used to construct riffle structures and dumped stone deflectors should consist of 80 percent in the range of 4 to 8 cubic feet and 20 percent smaller stone to fill the voids. Rock should be keyed 1 to 2 feet below the lines shown on the drawing.

Figures 7 and 8.

Gabions used in the gabion deflectors should meet the following specifications:

Materials — Gabions should be made of zinc coated steel wire, triple twisted, forming a uniform hexagonal mesh pattern of approximately 3 inch x 4 inch openings. The galvanized wire forming the mesh should have a diameter of not less than 0.114 inch. The frame wires should have a diameter of not less than 0.145 inch. The gabions should be supplied with diaphragms to form individual cells of equal length and width. The diaphragms should be of the same material composiiton as the gabion. Tying and connecting wire should have a diameter of not less than 0.094 inch. All portions of the gabions (wire mesh, frame wires, diaphragms, and typing and connecting wire) should be zinc-coated with a minimum coating of 0.80 oz. sq. ft. The length, width, and height of the gabions as shown in the plans are the minimum dimensions acceptable and gabions of slightly greater dimensions will be allowed. The stone used to fill the gabions should be hard, durable limestone or sandstone. The gradation of the stone shall be such that 100 percent will pass through a 1-foot square opening and 100 percent will be retained on a 4-inch screen.

Construction Methods — The foundations should be accurately prepared to accept the gabions as indicated in the plans. The gabions should be unfolded and assembled as recommended by the manufacturer, being careful that each gabion basket is stretched and manipulated as is necessary to assume the proper rectangular shape. The gabions should be filled to a depth of approximately 1 foot, then 2 connecting wires shall be placed in each direction and looped around two meshes of the gabion wall. This operation shall be repeated until the gabions are completely filled. The stone should be placed so as to prevent open pockets or large voids within the gabions. The adjoining gabions should be laced together by their vertical and horizontal edges, empty gabions stacked on filled gabions should be laced to the filled gabions along the front and back edges. The lacing wire should pass through every other hexagonal opening in the mesh along the edges to be secured. After the gabions are filled the tops should be folded shut and laced to the ends, sides, and diaphragms.

APPENDIX A

## HABITAT TYPES

The following is a description of the various habitat types that are likely to be encountered in Kentucky. Within each habitat type description is a listing of the plant species which characterize it.

The definitions of the habitat types should be applied literally as they are not designed to leave undefined areas within the permit boundaries. Instructions on their use are given in the Fish and Wildlife Resource Information and Reclamation section.

### Habitat Type Definitions

Upland Forest: To be designated on maps as UF.

For the purpose of definition, a forest is a block of wooded vegetation with dominant species present being greater than 4 inches in diameter at breast height (dbh) (4.5 ft. above ground level) and comprised of an area greater than 17 acres. If the area within the permit site is less than 17 acres but adjoining like vegetation that makes the total area greater than 17 acres, it is considered forest.

Upland forest is designated primarily by relative elevation - not specific elevations, and generally lies above the floodplain or river bottomland. This designation is unique to a particular drainage and is not a static figure.

In some cases, the forest may be used as pasture for cattle. This however, has no bearing on its designation as pastures are described later in the text. It does, however, have a bearing on the relative value of the stand to wildlife and should be noted on Form 1.

Characteristic tree species of the upland forest in Kentucky are:

white oak (Quercus alba)
black oak (Q. velutina)
bur oak (Q. macrocarpa)
southern red oak (Q. falcata)
post oak (Q. stellata)
chinquepin oak (Q. muehlenbergii)

pignut hickory (Carya glabra)
mockernut hickory (C. tomentosa)
shagbark hickory (C. ovata)
black gum (Nyssa sylvatica)
Virginia pine (Pinus virginiana)

white ash (Fraxinus americana)
sugar maple (Acer saccharum)
cherry (Prunus serotina)
basswood (Tilia americana)
beech (Fagus grandifolia)
tulip tree (Liriodendron tulipifera)
hemlock (Tsuga canadensis)
birch (Betula spp.)
red maple (Acer rubrum)

Characteristic understory species of the upland forest in Kentucky are:

| | |
|---|---|
| dogwood (Cornus florida) | service berry (Amelanchier spp.) |
| holly (Ilex opaca) | paw paw (Asimina triloba) |
| sourwood (Oxydendrum arboreum) | spicebush (Lindera benzoin) |
| redbud (Cercis canadensis) | witch hazel (Hamamelis virginiana) |
| ironwood (Ostrya virginiana) | strawberry bush (Euonymus americanus) |
| greenbrier (Smilax spp.) | wahoo (E. atropurpurea) |
| magnolia (Magnolia grandiflora) | laurel (Kalmia latifolia) |

Industrial/Residential: To be designated on maps as I/R.

These habitats are typically a composite of other habitat types such as woodlots, shrublands, and grasslands that are interlaced with roads, parking facilities, buildings, and subsequently have high levels of human activity. They are addressed as a separate habitat type to display the human influence factor which tends to be prevalent throughout. Habitat types mentioned above are relatively stable and are maintained so as to allow for much interspersion. In fact, interspersion levels are probably much higher in such areas than they are in other more typical fish and wildlife habitats.

Characteristic plant species are those which characterize the different habitat types included herein.

Woodlots: To be designated on maps as W.

These are wooded areas that were, at one time, left around or adjacent to "home places" or "odd areas." The woodlot was generally small and used as a source of fence posts and firewood. The need for such areas has diminished in present years, but its presence is still with us. Many times the woodlot (or so it is called) is nowhere near habitation, but merely left uncleared for a variety of reasons. In years gone by the woodlot averaged about 17 acres in size (Telford, 1927). Our present day average size will remain the same, much for the sake of definition.

Due to the smallness of typical woodlots, their value to wildlife is much the same as any "edge" area. It is extremely valuable.

Characteristic plant species would be similar to upland or bottomland forest depending on location.

Agri-land: to be designated on maps as A.

Agri-land is one of three general habitat types which are associated with disturbed lands that are either managed or recently abandoned managed lands. The other two types, shrublands and grasslands, will be described later.

Species composition of agri-lands is monocultural since it is characterized by rowcrops (corn, soybeans, tobacco) small grains (oats, wheat, rye), or seed production plantings (any of the previously mentioned crops plus others).

In themselves, agri-lands are most valuable to wildlife as food production areas which provide food for a great variety of wildlife. They have some value as cover but it is limited to certain times of the year and is seldom residual.

Agri-land that has been abandoned for less than five years should still be considered agri-land. If abandonment persists longer than five years, the vegetation composition will be such that it should be classified as a shrubland (see definition).

Shrublands: To be designated on maps as S.

Shrublands are either limited to or are a composite of abandoned fields, fencerows or hedges, and overgrown road or railroad right-of-ways.

Abandoned fields may fall into two categories, abandoned grassland and abandoned agri-land. Grassland that has been abandoned and allowed to grow up in woody vegetation is considered shrubland. Woody species characteristic of these areas are cedar (Juniperus virginiana), coralberry (Symphoricarpos orbiculata), sweetgum, sassafras (Sassafras albidum), sumac (Rhus spp.), and tulip tree intermingled with the residual herbaceous grasses or legumes. It is simply an early stage of succession of vegetation that will ultimately result in upland or bottomland forest depending on location.

Unlike abandoned grassland, abandoned agri-land results in a typical old-field succession (Odum, 1971) which begins as a bare field. In the first year of abandonment, crabgrass (Digitaria sanguinalis) becomes established along with horseweed (Conzya canadensis). Crabgrass is present into the second year when asters (Aster spp.) and other annual and perennial flowering species enter on the scene. Grasses, like broomsedge (Andropogon virginicus) or others typical to the area, also become established at this time. In the third year, the grasses become better established and shrubs such as sassafras, sumac, and blackberry (Rubus spp.) emerge. Tree species such as tulip tree, sweetgum, cedar, pine (Pinus spp.), and vines such as trumpet vine (Campsis radicans) and honeysuckle (Lonicera japonica) are present. This composition may persist for as long as twenty years at which time cedars and pines will shade out the smaller shrubs and grasses and vegetation succession will proceed to upland or bottomland forest. The whole process as described will take upwards to 100 years to complete.

Fencerows and hedges will be similar in vegetation composition to a shrubland (as previously described) if the fencerows are uncleared and grown up with vegetation (cleared and maintained fencerows may be excluded as a habitat type). Vegetative species found in uncleared fencerows will include sassafras, sumac, autumn olive (Elaeagnus umbellata), multiflora rose (Rosa multiflora), cedar, blackberry, coralberry, trumpet vine, honeysuckle, and a variety of tree species.

Overgrown roads and railroad right-of-ways will exemplify all of the previously mentioned vegetative species in a variety of stages and should simply be recorded or mapped as such.

Grasslands: To be designated on maps as G.

Grasslands, like agri-lands, tend to be monotonous but are of significant value to wildlife as cover for protection, nesting, and brooding. There are several types of grasslands which include prairie, pasture, hayfields, and maintained road and railroad right-of-ways.

True prairie is not likely to be encountered because it has been largely replaced by agri-lands and is generally perpetuated by fire which is essentially precluded from occurring. Native prairie in Kentucky would be of the tall grass type (Odum, 1971) and composed of species like big bluestem (Andropogon gerardi), switchgrass (Panicum virgatun), Indian grass (Sorghastrum nutans), or sloughgrass (Beckmannia syzigachne).

Pasture denotes a grassland community that is managed to supply food for grazing livestock. In most cases, the grass species is fescue (Festuca spp.) which has a very low desirability rating for wildlife purposes. Other grass species that could occur on a limited basis are broomsedge, bluegrass (Poa spp.), brome grass (Bromus spp.), reed canarygrass (Phalaris arundinacea), orchard grass (Dactylis glomerata), redtop (Agrostis alba), deertongue (Panicum clandestinum), or timothy (Phleum pratense). All of the latter have a high desirability rating for wildlife but pasture lands are normally overgrazed to the point where they support little in the way of vertebrate wildlife.

Hayfields differ from pasture in that the crop is removed from the field and fed to grazing livestock elsewhere. Disturbance, therfore, is limited to certain periods of the growing season. Grass species composition would be the same as for pasture with the inclusion of legume species such as alfalfa (Medicago sativa), red or white clover (Trifolium spp.), sweet clover (Melilotus spp.) or lespedeza (Lespedeza spp.). Hayfields support a wider variety of wildlife species than do pastures due to the greater species diversity and residual cover characteristics.

Abandoned Mine Lands: To be designated as AML.

This is an area where abandoned surface mine sites, surface disturbance sites from abandoned underground mines, or abandoned coal processing facilities exist. Inclusive are those adjacent acreages that have been deleteriously affected by the aforementioned disturbances. The major criteria delineating this habitat type is the absence or extremely sparse nature of the vegetative community on such sites. Such habitat types should not be confused with former mining disturbances that have adequately revegetated either naturally or under past reclamation laws. Most occurrences of this habitat type will be represented by relatively small acreages. Where such areas of no or extremely sparse vegetation exist, this habitat type should be included.

This habitat type was not included in the habitat rating for indicator species described in the text of this document. While such areas are undoubtedly utilized by wildlife to some degree, the necessity of its presence for the well-being of wildlife is negligible.

Wetlands: To be designated on maps as WL.

Classification of wetlands should follow Cowardin et al. (1979). Basically, three of the wetland systems described in Cowardin's work occur in Kentucky. These are the Riverine, Palustrine, and Lacustrine systems. Each of these systems is briefly described below. For more detailed descriptions and a better understanding of the classification of wetlands within each of these systems, Cowardin et al. (1979) should be consulted.

The "Riverine System" (Figure 1) includes wetlands and deepwater habitats contained within a channel in which there is usually a maintained flow, with the exception of 1) wetlands dominated by trees, shrubs, persistent emergents, emergent mosses, or lichens, and 2) habitats with water containing ocean-derived salts in excess of 0.5 percent. Thus in Kentucky most streams will fall into this system.

The "Palustrine System" (Figure 2) includes all nontidal wetlands dominated by trees, shrubs, persistent emergents, emergent mosses, or lichens and any areas having the following four characteristics: 1) wetland areas less than 8 ha (20 acres) in size; 2) active wave formed or bedrock shoreline features lacking; 3) water depth in the deepest part is less than 2 M (6.6 ft.) at low water; and 4) salinity due to ocean derived salts less than 0.5 percent. The Palustrine System in Kentucky includes areas commonly called marshes, bogs, swamps, and ponds. Also included as Palustrine wetlands are the shoreward sides along lakes, river channels, river floodplains, isolated catchments, and on slopes (See Figures 1-3).

The "Lacustrine System" (Figure 3) wetland areas of deepwater habitat where 1) the total area exceeds 8 ha (20 acres); 2) there is less than 30 percent coverage of the area by trees, shrubs, persistent emergents, emergent mosses or lichens; and 3) is situated in a topographic depression or dammed river channel. Thus in Kentucky deepwater lakes, or ponds meeting the above criteria would be classified as Lacustrine.

Within each of these major systems of wetlands there are subsystems, classes, subclasses, and dominance types. The applicant may want to utilize Cowardin et al. (1979) to further delineate the wetland types that will be affected by the proposed mining activity. This information should be appended to Form 1 and would prove useful to the reviewers of the application when considering the wetland concerns.

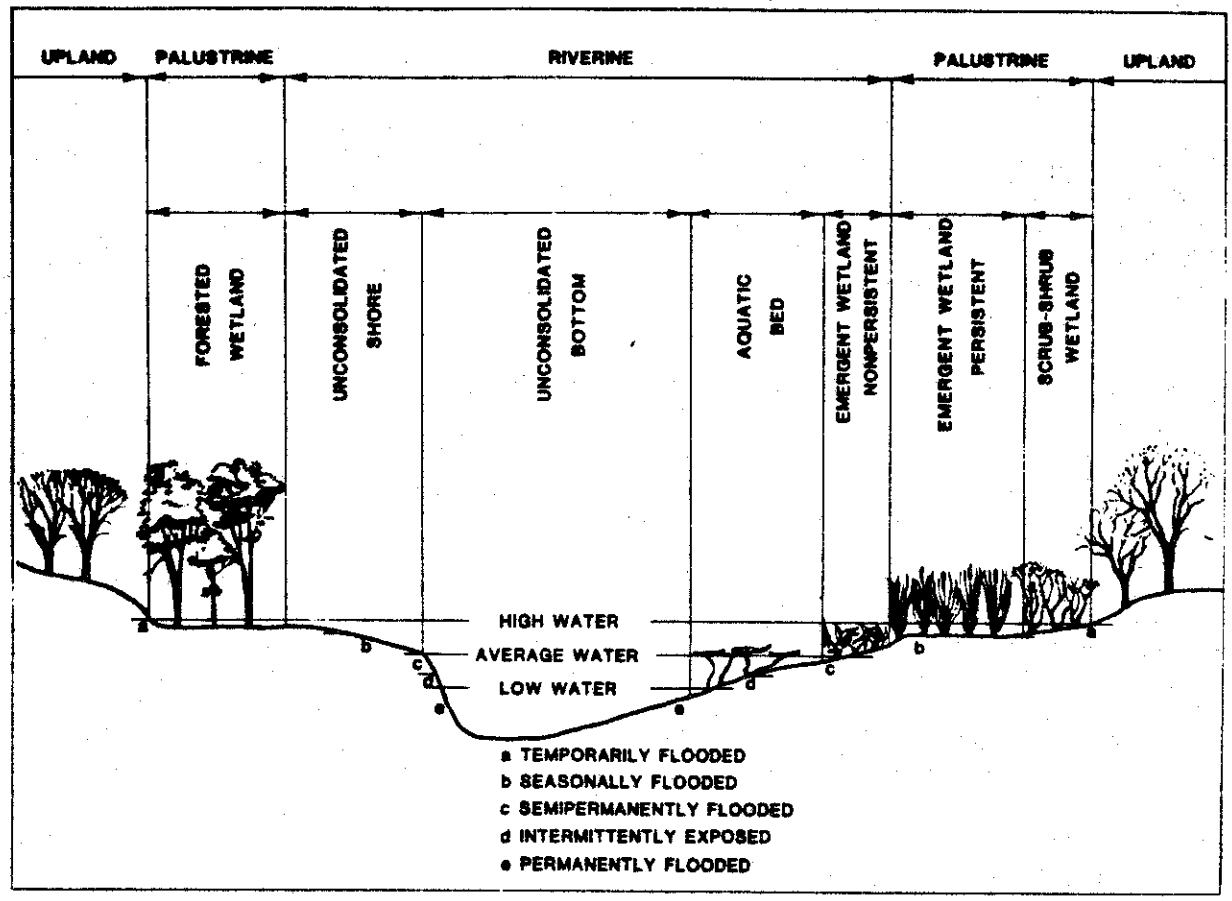



Fig. 1 Distinguishing features and examples of habitats in the Riverine System.

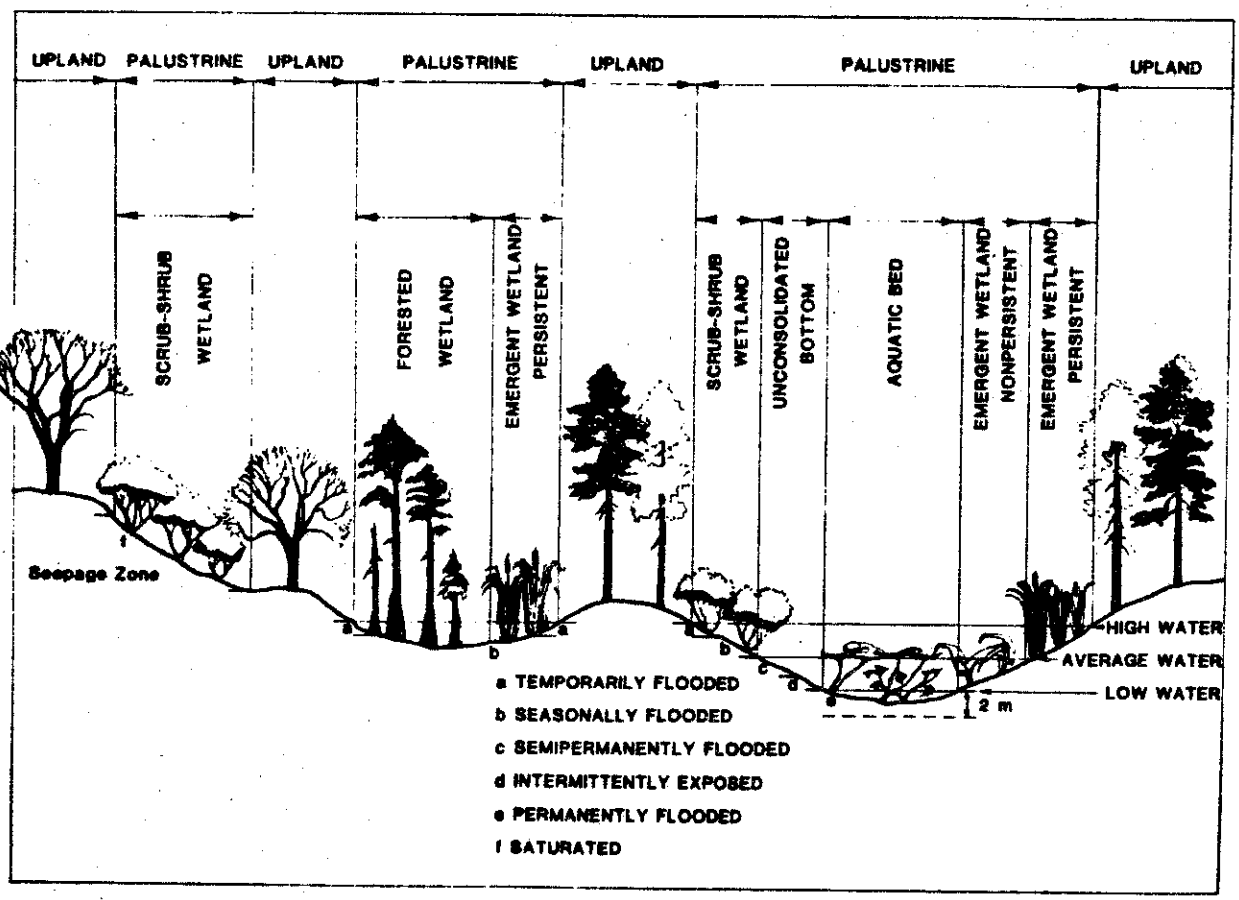



Fig. 2 Distinguishing features and examples of habitats in the Palustrine System.

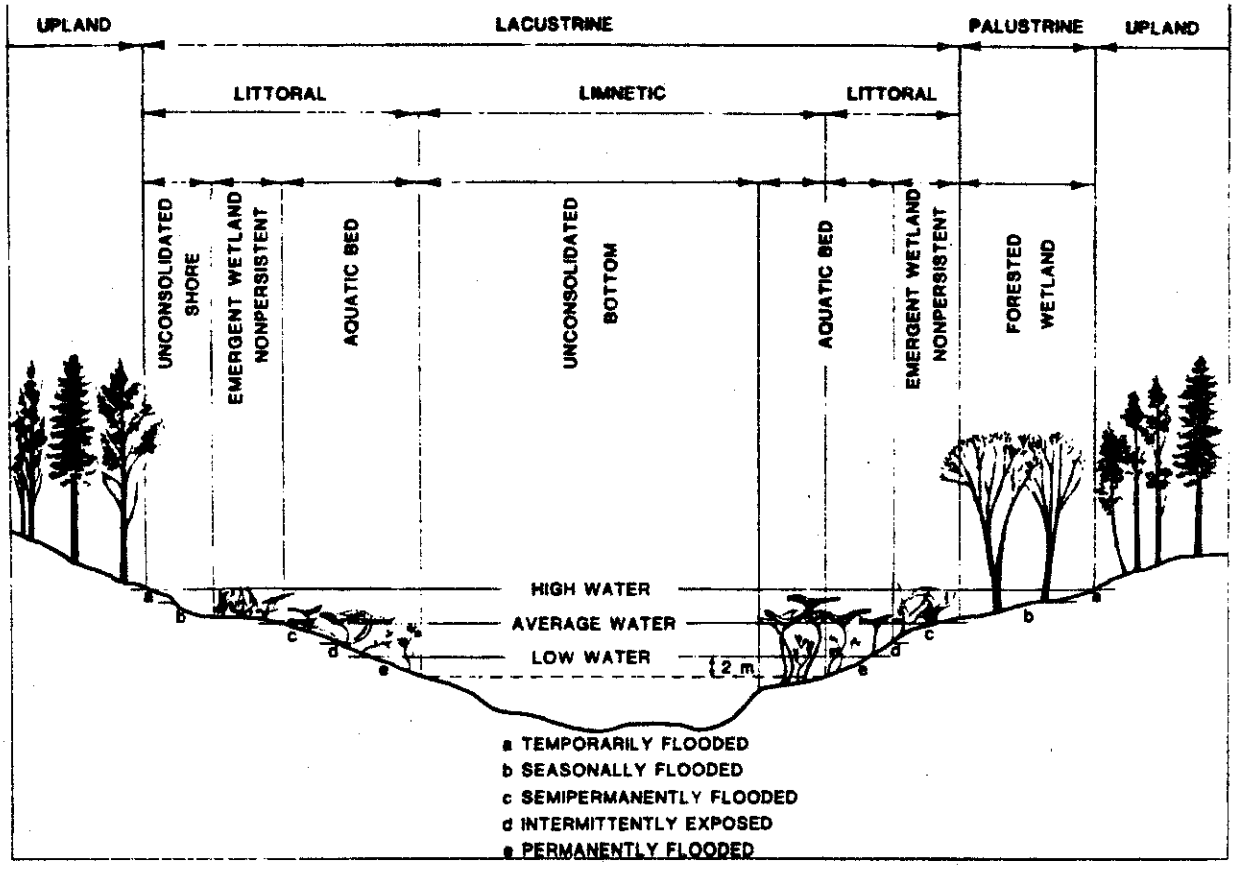



Fig. 3 Distinguishing features and examples of habitats in the Lacustrine System.

APPENDIX B

## Reclamation Methodologies

Methodologies given here are either taken verbatim or adapted from the following publication: Rafaill, B. L. and W. G. Vogel. 1978. A Guide for Vegetating Surface Mined Lands for Wildlife in Eastern Kentucky and West Virginia. U.S. Department of the Interior, Fish and Wildlife Service. Publ. No. FWS 14-16-0009-77-923. 89 pp.

Different species recommended in the following paragraphs and tables have differing values to wildlife. Information given in Table 1 summarizes the values of those plant species to the wildlife species which utilize them. In general, plant species choices in reclamation plantings should provide a mixture of species which supply either food, cover, or both. Other important considerations in choosing plant species is tolerance to sunlight or the lack of it and pH of the soil where planting is to occur (explained in footnotes to tables 4 and 5).

The basic components of reclamation plantings are herbs, shrubs, and trees. Planting methods presented here appear in that order.

### Herbs:

Herbaceous plants are of a non-woody type which are used to provide coverage to bare or disturbed soil and thus prevent erosion and stabilize the area. They are classified as forbs or grasses. Many of the forbs are legumes which fix atmospheric nitrogen and make it available to other plants. Many herbaceous plants are important food sources for wildlife and also supply needed cover (see Table 1).

Herbaceous plants are either annual, biennial, or perennial. Some species that are well suited to use on strip mined lands are given in Table 2. Also given are pH limits and growth seasonality. Annuals are perhaps the most effective species to plant for quick cover because they rapidly establish vegetative growth, flower and die within a single growing season. Annuals reproduce only from the seed they produce. Some species such as Kobe and Korean lespedeza naturally regenerate a stand from these seeds, but most do not. Biennials establish themselves the first year, flower and produce seed the second year and then die. Perennial plants normally live three years or longer, die back each year, and produce seed crops annually for life.

Herbaceous plants are further grouped by their season of growth (Table 2). Cool season species grow mostly in the spring and fall, but are nearly dormant or grow poorly in the summer. Warm season species grow during late spring and summer and are dormant in early spring and fall. All are dormant in the winter. Generally, stands of cool season species can be established from either spring or fall seedings.

Herbaceous plantings constitute the basic element of soil stability on reclaimed sites. Since they are the basic element of stability they will also be the basic element of wildlife habitat on the reclaimed site. Mixtures of herbaceous plants that are of particular value to wildlife are given in Table 3. As previously recommended in this document, all herbaceous mixtures should come from the listings in Table 3 and be applied to the land within the times specified.

Shrubs:

Shrubs are woody plants with few to many stems arising from ground level. They usually are smaller than most trees and are extremely valuable sources of wildlife cover and food. Some shrubs are also useful for controlling soil erosion and can be utilized for screening and windbreaks for cropland. When properly planted and managed, some species such as amur privet form natural fencerows or field borders. Some shrub species that are adaptable to use on strip mined lands are given in Table 5.

When planting to support wildlife populations, it is helpful to know how soon food supplies will be produced. The average time that it takes for the recommended shrubs to begin seed production is shown in Table 5. Many shrubs are important food sources for wildlife and also supply needed cover (Table 1).

Trees:

Trees are woody plants which generally have but one main stem arising from ground level. They provide food for wildlife in the form of seeds or mast, have value as wildlife cover, and provide erosion control on outslopes when planted with herbaceous species. Some species which are adaptable to use on strip mined lands are given in Table 4.

The recommended trees can be subdivided into hardwoods and softwoods or conifers. Hardwoods are deciduous or drop their leaves each fall and generally produce seed or mast crops which supply food to wildlife (Table 1). Softwoods or conifers are evergreen and are particularly valuable as cover for wildlife (Table 1).

Table 1. Usefulness to wildlife of the recommended plant species as Cover (C), Browse (B), Herbage or Foliage (H), Mast (M), Fruit (F), or Seeds (S)*.

| Plant | Uses** |
|---|---|
| **Herbs** | |
| Redtop - (Agrostis alba) | CHS |
| Bluestems - (Andropagon spp.) | CHS |
| Oats - (Avena sativa) | SH |
| Bermuda grass - (Cynodon dactylon) | HS |
| Orchardgrass - (Dactylis glomerata) | HSC |
| Japanese millet - (Echinochloa spp.) | S |
| Weeping lovegrass - (Eragrostis curvula) | CHS |
| KY-31 tall fescue - (Festuca arundinacea) var. | HSC *** |
| Ryegrass - (Lolium spp.) | HS |
| Deertongue - (Panicum clandestinum) | HSC |
| Proso millet - (Panicum milaceum) | S |
| Switchgrass - (Panicum virgatum) | CSH |
| Pearl millet - (Pennisetum glaucum) | S |
| Reed canary grass - Phalaris arundinacea) | SC |
| Timothy - (Phleum pratense) | SH |
| Rye - (Secale cereale) | SH |
| Foxtail millet - (Setaria italica) | S |
| Indianagrass - Sorghastrum nutans) | CHS |
| Sorghums - (Sorghum spp.) | S |
| Wheat - (Triticum aestivum) | SH |
| **Herbs (Leguminous Forbs)** | |
| Partridge pea - (Cassia fasciculata) | S |
| Crownvetch - (Coronilla varia) | CH |
| Soybean - (Glycine max) | SH |
| Flatpea - (Lathyrus sylvestris) | CHS |
| Sericea lespedeza - (Lespedeza cuneata) | CSH |
| Annual lespedeza - (Lespedeza spp.) | S |
| Birdsfoot trefoil - (Lotus corniculatus) | HC |
| Alfalfa - (Medicago sativa) | HSC |
| Sweet clover - (Melilotus spp.) | SH |
| Clovers - (Trifolium spp.) | HS |
| Hairy vetch - (Vicia villosa) | HSC |
| Cowpea - (Vigna sinensis) | SH |
| **Herbs (Non-Leguminous Forbs)** | |
| Buckwheat - (Fagopyrum spp.) | SH |
| Sunflower - (Helianthus annuus) | S |
| **Shrubs** | |
| Indigobush - (Amorpha fruticosa) | CBS |
| Dogwoods - (Cornus spp.) | FBC |
| Hawthorns - (Crataegus spp.) | CFB |
| Autumn olive - (Elaeagnus umbellata) | FBC |

Table 1 (continued)

| Plant | Uses** |
|---|---|
| Shrubs (continued) | |
| Bicolor lespedeza - (Lespedeza bicolor) | SHC |
| Amur privet - (Ligustrum amurense) | FC |
| Japanese honeysuckle - (Lonicera japonica) | CBF |
| Bush honeysuckle - (Lonicera spp.) | FBC |
| Bayberry - (Myrica pennsylvanica) | FCB |
| Sumacs - (Rhus spp.) | FBC |
| Bristly locust - (Robinia hispidus) | CS |
| Rose - (Rosa spp.) | CFBS |
| Coralberry - (Symphoricarpos orbiculatus) | FBC |
| Cranberrybush, arrowwood - (Viburnum spp.) | FBC |
| Trees | |
| Eastern redcedar - (Juniperus virginiana) | CFB |
| Spruces - (Picea spp.) | CSB |
| Pines - (Pinus spp.) | CSB |
| Maples - (Acer spp.) | SB |
| European black alder - (Alnus glutinosa) | CSB |
| Birches - (Betula spp.) | BSC |
| Chinese chestnut - (Castanea mollissima) | MB |
| Flowering dogwood - (Cornus florida) | FBC |
| Russian olive - (Elaeagnus angustifolia) | FC |
| Ashes - (Fraxinus spp.) | SB |
| Black walnut - (Juglans nigra) | M |
| Sweetgum - (Liquidambar styraciflua) | SC |
| Tulip poplar - (Liriodendron tulipifera) | SB |
| Crabapples - (Malus spp.) | FCB |
| Sycamore - (Platanus occidentalis) | SB |
| Oaks - (Quercus spp.) | MBC |
| Black locust - (Robinia pseudoacacia) | SCB |
| Sassafras - (Sassafras albidum) | BFCS |

*Mast - nuts and acorns. Seeds - dry fruits, grains, and seeds. Browse - bark, buds, twigs, small branches, and whole heads of fruit. B, H, M, F, and S are different components of diet used by wildlife species to differing degrees.

**The uses of each plant are arranged in descending order of their overall importance to wildlife. The relative importance of these uses can vary for different species of wildlife.

***KY-31 tall fescue has been used extensively in vegetating surface mines and is valuable in stabilizing areas subject to erosion; however, it has a low value for wildlife. DSMRE and KDFWR recommend that its use be limited to areas subject to erosion and that large areas of fescue monoculture be avoided.

Table 2. Some characteristics of herbaceous plants suitable for revegetating coal stripmined areas for wildlife.

| Species | Lower pH limit | Season* | Duration* |
|---|---|---|---|
| Grasses | | | |
| Redtop | 4.5 | Cool | Perennial |
| Big bluestem | 4.5 | Warm | Perennial |
| Little bluestem | 4.5 | Warm | Perennial |
| Oats | 4.5 | Cool | Annual |
| Bermuda grass | 4.0 | Warm | Perennial |
| Orchardgrass | 4.5 | Cool | Perennial |
| Japanese millet | 4.5 | Warm | Annual |
| Weeping lovegrass | 4.0 | Warm | Perennial |
| KY-31 tall fescue*** | 4.5 | Cool | Perennial |
| Annual ryegrass | 4.5 | Cool | Annual |
| Perennial ryegrass | 4.5 | Cool | Perennial |
| Deertongue | 4.0 | Warm | Perennial |
| Proso millet | 5.0 | Warm | Annual |
| Switchgrass | 4.5 | Warm | Perennial |
| Pearl millet | 4.5 | Warm | Annual |
| Reed canarygrass | 4.5 | Cool | Perennial |
| Timothy | 4.5 | Cool | Perennial |
| Rye | 4.5 | Cool | Annual |
| Foxtail millet | 4.5 | Warm | Annual |
| German millet | 4.5 | Warm | Annual |
| Indiangrass | 4.5 | Warm | Perennial |
| Grain sorghum | 5.0 | Warm | Annual |
| Sudangrass X Sorghum hybrid | 4.5 | Warm | Annual |
| Wheat | 4.5 | Cool | Annual |
| Leguminous Forbs | | | |
| Partridge pea | 5.0 | Warm | Annual |
| Crownvetch | 5.0 | Cool** | Perennial |
| Soybean | 5.0 | Warm | Annual |
| Flatpea | 4.5 | Warm | Perennial |
| Sericea lespedeza | 4.5 | Warm | Perennial |
| Korean lespedeza | 5.0 | Warm | Annual |
| Common lespedeza | 4.5 | Warm | Annual |
| Kobe lespedeza | 4.5 | Warm | Annual |
| Birdsfoot trefoil | 4.5 | Cool** | Perennial |
| Alfalfa | 5.5 | Cool** | Perennial |
| Sweet clover | 5.5 | Cool | Biennial |
| Alsike clover | 5.0 | Cool | Perennial |
| Red clover | 5.0 | Cool | Biennial or Perennial |
| White clover | 5.5 | Cool | Perennial |
| Ladino clover | 5.5 | Cool | Perennial |
| Hairy vetch | 5.5 | Cool | Annual |
| Cowpea | 4.5 | Warm | Annual |

Table 2 (continued)

| Species | Lower pH limit | Season* | Duration* |
|---|---|---|---|
| Non-Leguminous Forbs | | | |
| Buckwheat | 4.5 | Warm | Annual |
| Sunflower | 5.0 | Warm | Annual |

*See text for explanation.
**These plants normally are planted in the spring or fall (cool season) but will grow in summer as well as in the spring and fall.

***KY-31 tall fescue has been used extensively in vegetating surface mines and is valuable in stabilizing areas subject to erosion; however, it has a low value for wildlife. DSMRE and KDFWR recommend that its use be limited to areas subject to erosion and that large areas of fescue monoculture be avoided.

Table 3. Suggested herbaceous mixtures for wildlife habitat and erosion control.

| | Species | Seeding rate* Pounds/acre PLS |
|---|---|---|
| | **FEBRUARY 15 to MAY 15** | |
| | **Permanent Species** | |
| I | Orchard grass | 10 |
| | or | |
| | Timothy | 8 |
| | White or Ladino clover | 2 |
| | Red clover | 6 |
| II | Orchardgrass | 10 |
| | or | |
| | Timothy | 8 |
| | White or Ladino clover | 1 |
| | Red clover | 4 |
| | Korean and/or Kobe lespedeza | 10 |
| III | Orchardgrass | 10 |
| | or | |
| | Timothy | 8 |
| | Birdsfoot trefoil | 8 |
| | or | |
| | Afalfa | 15 |
| IV | Wheat | 25 |
| | or | |
| | Spring oats | 32 |
| | Switchgrass | 10 |
| | Indiangrass | 10 |
| | Big bluestem | 5 |
| | Little bluestem | 5 |
| | Birdsfoot trefoil | 6 |
| | **Temporary (Quick Cover) Species** Add one of the following species to permanent mixture I, II, or III. Do not add to mixture IV.** | |
| | Wheat (before April 15) | 30 |
| | Spring oats (before April 15) | 32 |
| | Balbo rye (before April 15) | 30 |
| | Perennial ryegrass | 10 |
| | Annual ryegrass | 5 |
| | Weeping lovegrass (after April 1) | 2 |

Table 3 (continued)

| Species | Seeding rate* Pounds/acre PLS |
|---|---|
| **MAY 15 to AUGUST 01** | |
| **Permanent Species** | |
| I Orchardgrass | 10 |
| or | |
| Timothy | 8 |
| Korean and/or Kobe lespedeza | 15 |
| Red clover | 4 |
| White clover | 1 |
| or | |
| Birdsfoot trefoil | 6 |
| or | |
| Alfalfa | 12 |
| **Temporary Species** Add one to the permanent mixture.** | |
| Sorghum | 20 |
| Foxtail (German) millet | 12 |
| Japanese millet | 15 |
| Soybeans | 40 |
| Cowpeas | 40 |
| Pearl millet | 10 |

Note: If the perennial legumes or grasses fail to establish from the summer seeding, they can again be sown in late summer (August 15 to September 15) or early the following spring.

| | | |
|---|---|---|
| **AUGUST 01 to OCTOBER 01** | | |
| **Permanent Species** | | |
| I | Orchardgrass | 10 |
| | or | |
| | Timothy | 8 |
| | White or Ladino clover | 2 |
| | Red clover | 6 |
| II | Orchardgrass | 10 |
| | or | |
| | Timothy | 8 |
| | Alfalfa | 15 |
| | or | |
| | Birdsfoot trefoil | 8 |
| III | Deertongue | 12 |
| | Birdsfoot trefoil | 8 |

Table 3 (continued)

| Species | Seeding rate* Pounds/acre PLS |
|---|---|
| **Temporary Species** Add one to a permanent mixture.** | |
| Winter wheat | 30 |
| Balbo rye or winter rye | 30 |
| Winter oats | 32 |
| Perennial ryegrass | 10 |
| Annual ryegrass | 5 |
| **Mixtures for Wet or Poorly Drained Areas and Pond Borders** | |
| For Spring Seeding (February 15 to May 15) Seeding | |
| I Japanese millet | 10 |
| Redtop | 2 |
| or | |
| Reed canarygrass | 15 |
| Alsike clover | 4 |
| Common annual lespedeza | 10 |
| For Spring or Fall (August 1 to October 1) Seeding | |
| II Redtop | 3 |
| Reed canarygrass | 15 |
| Alsike clover | 6 |

*Seeding rates are for Pure Live Seed (PLS). Seeding rate of the permanent species can be increased if desired, but do not exceed the seeding rate of the temporary species.

**Use only one of the temporary species at the rates shown. If more than one is used, reduce seeding rate of each species according to number of species used; i.e., for two species use one-half seeding rate of each.

Table 4. Some basic requirements for trees suitable for revegetating coal stripmine areas for wildlife.

| Species | Lower limit pH | Shade tolerance* | Elevation |
|---|---|---|---|
| Conifers | | | |
| Eastern redcedar | 5.0 | intolerant | |
| Shortleaf pine | 4.0 | intolerant | Below 2,500 feet |
| Austrian pine | 4.0 | intermediate | |
| Pitch pine | 4.0 | intolerant | |
| White pine | 4.5 | intermediate | |
| Scotch pine | 4.0 | intolerant | |
| Virginia pine | 4.0 | intolerant | Below 2,500 feet |
| Loblolly pine | 4.0 | intermediate | |
| Hardwoods | | | |
| Red maple | 4.5 | intermediate | |
| Silver maple | 4.0 | intermediate | |
| Sugar maple | 4.5 | tolerant | |
| European (black) alder | 4.0 | intolerant | Below 2,500 feet |
| Sweet birch | 4.5 | tolerant | |
| River birch | 4.0 | intermediate | Below 2,000 feet |
| European white birch | 4.0 | intolerant | |
| Chinese chestnut | 4.5 | intermediate | |
| Flowering dogwood | 5.0 | tolerant | |
| Russian olive | 5.5 | intermediate | |
| White ash | 4.0 | intermediate | |
| Green ash | 4.0 | intermediate | |
| Black walnut | 5.0 | intolerant | |
| Crabapple | 4.5 | intolerant | |
| Sweetgum | 4.0 | intolerant | Below 3,000 feet |
| Tulip or yellow-poplar | 4.5 | intolerant | Below 3,000 feet |
| Sycamore | 4.0 | intolerant | Below 2,500 feet |
| Sawtooth oak | 4.0 | intolerant | |
| White oak | 5.0 | intermediate | |
| Pin oak | 5.0 | intolerant | Below 1,500 feet |
| Red oak | 4.0 | intermediate | |
| Black locust | 4.0 | intolerant | Below 3,000 feet |
| Sassafras | 5.0 | intolerant | |

*Shade tolerance of species is generally categorized and defined as follows:
Tolerant - can withstand completely shaded conditions;
Intermediate (tolerant) - partial shade is tolerated; plant requires some sunlight;
Intolerant - shade is not tolerated; plant requires full sunlight.

Table 5. Some basic requirements of shrubs suitable for revegetating coal stripmine areas for wildlife.

| Species | Lower limit pH | Shade tolerance | time to fruit/seed (years) | Month of mature fruit/seed |
|---|---|---|---|---|
| Indigobush | 4.0 | intermediate | 3 | AUG |
| Silky dogwood | 4.5 | tolerant | 4 - 5 | AUG-SEP |
| Gray dogwood | 5.0 | intermediate | 5 | SEP-OCT |
| Washington hawthorn | 5.5 | intolerant | 4 - 5 | OCT-NOV |
| Autumn olive | 4.0 | intermediate | 3 - 4 | AUG-OCT |
| Bicolor lespedeza | 4.5 | intolerant | 3 | OCT-NOV |
| Amur privet | 4.5 | tolerant | 4 | SEP-NOV |
| Japanese honeysuckle | 4.5 | tolerant | 3 - 5 | AUG-NOV |
| Amur honeysuckle | 4.5 | intermediate | 3 - 4 | SEP-OCT |
| Tatarian honeysuckle | 4.5 | intermediate | 3 - 4 | JUL-AUG |
| Bayberry | 4.0 | intermediate | 3 - 5 | OCT |
| Fragrant sumac | 4.5 | tolerant | 5 | JUL-AUG |
| Shining sumac | 4.0 | intermediate | 4 | SEP-OCT |
| Smooth sumac | 4.5 | intermediate | 4 | SEP-OCT |
| Bristly locust | 3.5 | intolerant | 3 - 5 | SEP-OCT |
| Rugosa rose | 5.0 | intolerant | 3 | JUL-SEP |
| Coralberry | 5.0 | tolerant | 3 | SEP-OCT |
| Arrowwood viburnum | 4.5 | tolerant | 3 - 5 | SEP-OCT |
| Cranberrybush | 4.5 | intermediate | 3 - 5 | AUG-SEP |

*Shade tolerance of species defined as follows:
tolerant - can withstand completely shaded conditions;
intermediate - partial shade is tolerated; plant requires some sunlight;
intolerant - shade is not tolerated; plant requires full sunlight.

APPENDIX C

Wood Duck Box Construction and Placement (Bellrose, 1976 and U.S.F.W.S., 1976)

No one type of nest house or placement meets all the requirements imposed by the diversity of habitat and predators. Consequently, each nest house program needs to be designed with local conditions in mind. However, certain generalizations are warranted.

1. Initially, wood houses are more acceptable to wood ducks than metal houses, but, because of greater nest success, metal houses in a few years may have the higher occupancy rate. Rough-cut lumber is best for wood houses, but when smooth wood is used a "ladder" of 1/4-inch-mesh hardware cloth should be attached inside so that the day-old duckling may climb out. Vertical metal houses should be provided with either a hardware cloth ladder inside or with a car undercoat material sprayed or troweled inside to permit ducklings to exit.

2. Houses should be made as predator-proof as possible or should be mounted in such a way as to prevent predators from entering. North of the Mason-Dixon line, both wood and metal houses should have elliptical "coon-proof" entrances. Where starlings are likely to be a problem, and houses can be placed on posts in marshes and water areas, horizontal cylindrical houses are recommended. Houses vulnerable to raccoons and placed on posts should be provided with inverted metal cones of adequate diameter, or, instead, the bases of vertical metal houses can be centered on steel pipes.

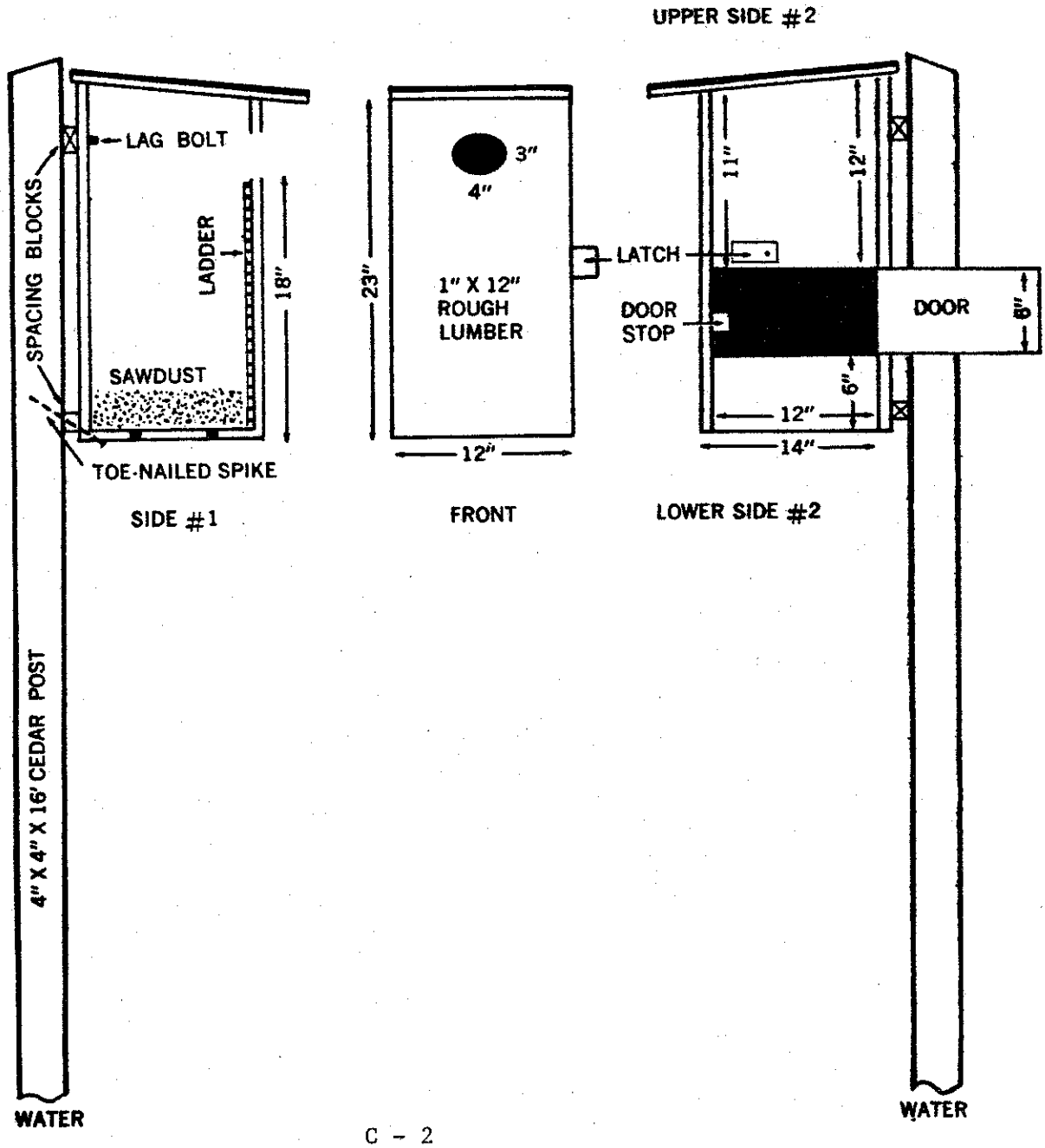
3. All nest houses should be provided with 3 to 4 inches of sawdust, wood chips or shavings, a necessity for the nest base and for covering the eggs during laying.

4. Houses placed in groups of 2 to 4 per acre ultimately have the highest use because of homing of successful nesters and the association of young birds with homing adults. However, the grouping of houses increases their exposure to predation. Without adequate protection from predators, grouped houses can be a disaster to nesting wood ducks. Unprotected houses should be spaced no closer than one per 10 acres.

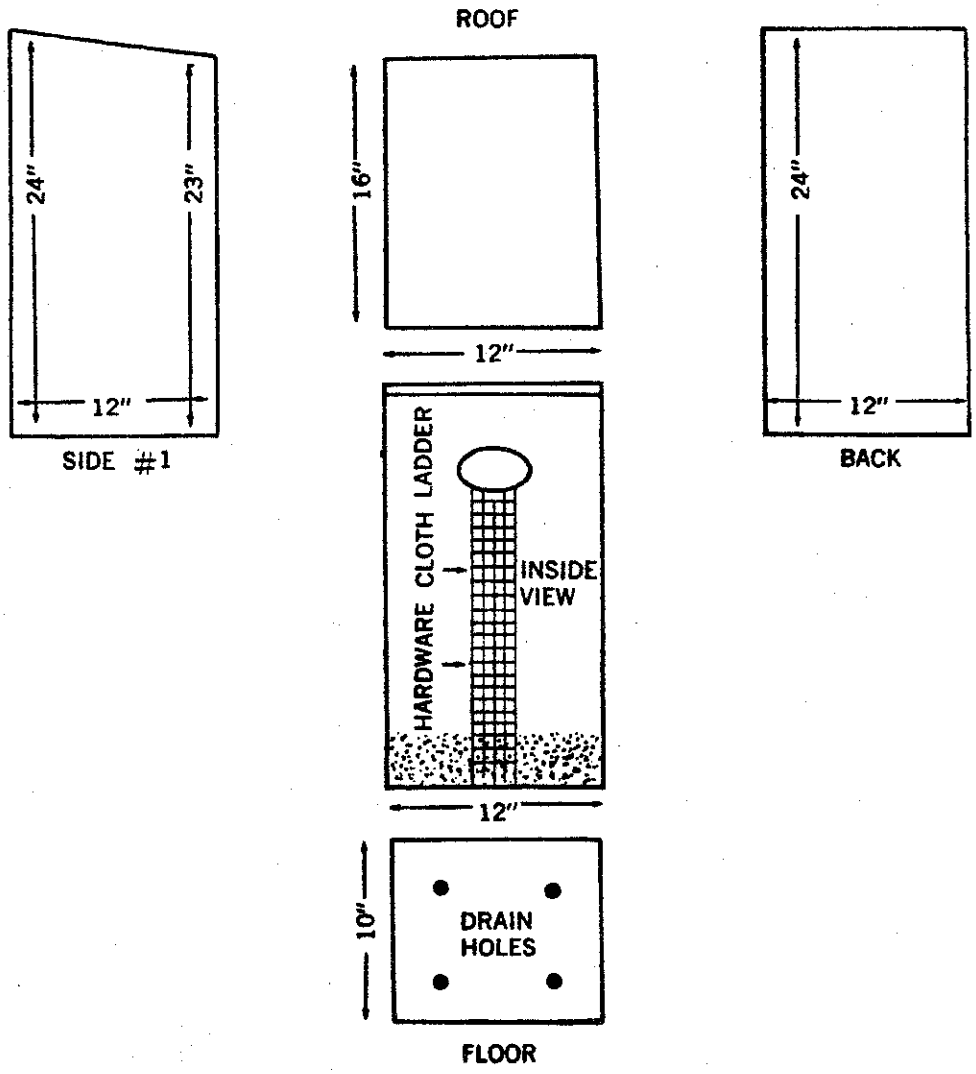
5. Wood ducks use nest houses on poles in water at a higher rate than those in woods. In woods, the nearer the water the better, but up to 0.25 mile is fine, 0.5 mile satisfactory, and 1 mile a possibility. The more open and parklike the woods, the better for wood ducks and, unfortunately, for starlings. But dense woodland deters starlings more than wood ducks. Houses in trees should be placed 12 to 20 feet above the ground, where the canopy is open and does not overhang the entrance.

# STANDARD WOOD DUCK NESTING BOX

This nesting box is cheap to build, easy to maintain and, properly safe-guarded, inaccessible to such nest predators as raccoons, snakes, and squirrels.

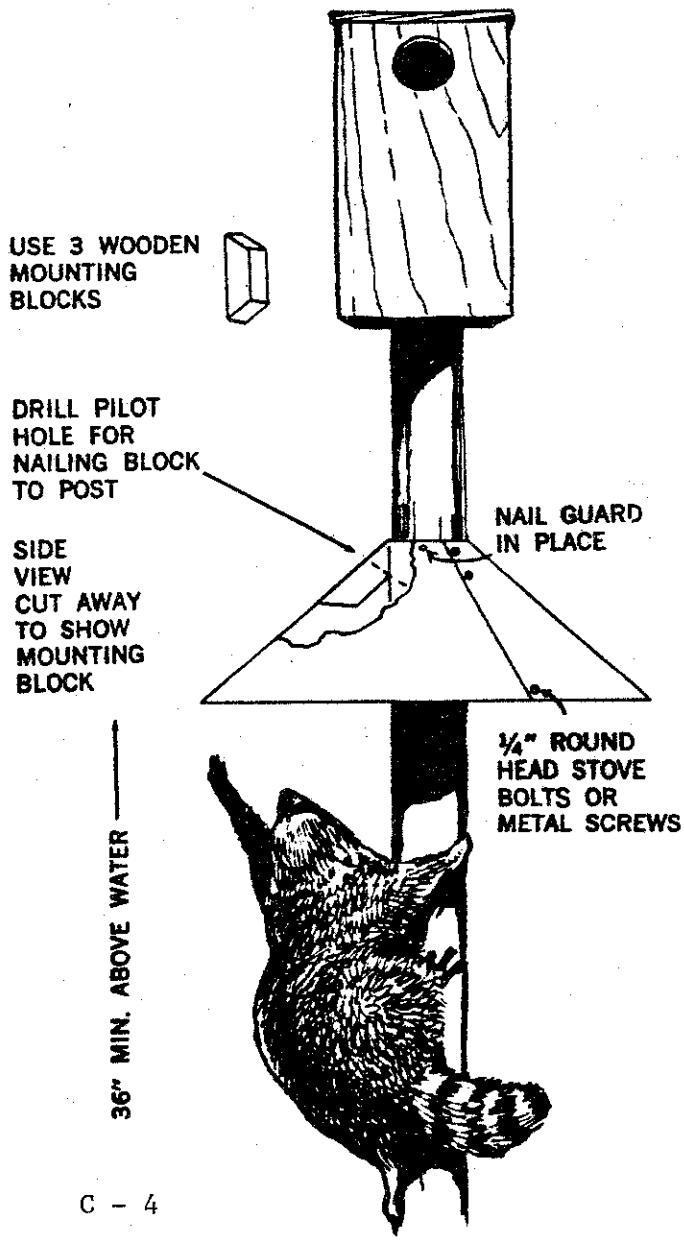


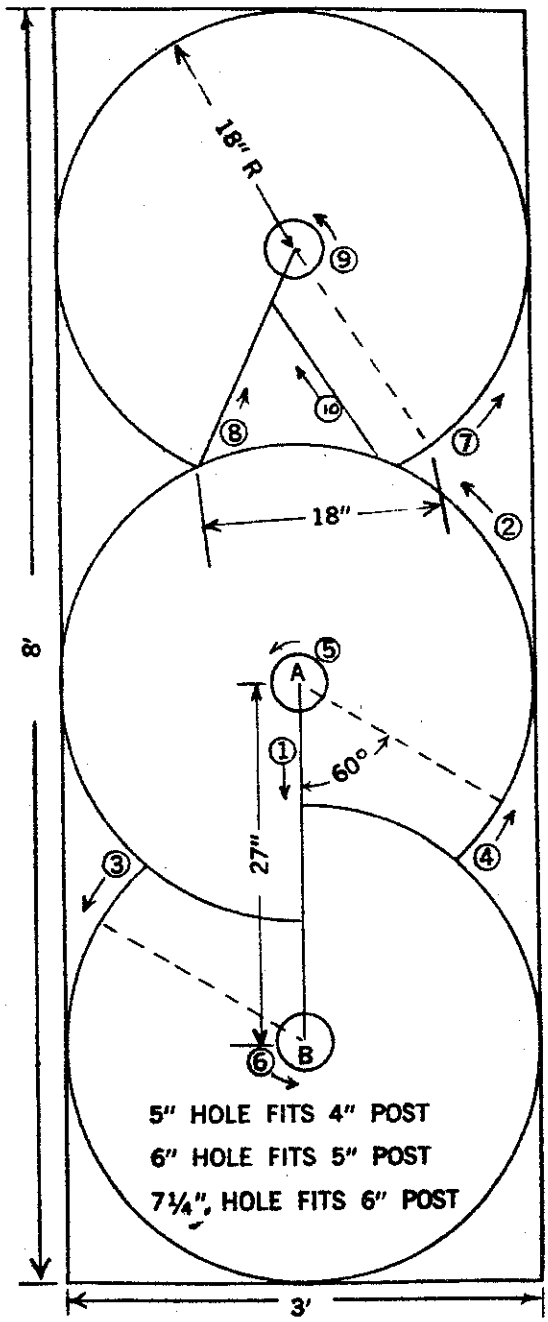
The box should be constructed of unplaned cedar, cypress, or other weather-resistant lumber. It should NOT be painted, stained, or creosoted. As the diagram indicates, the entrance should be oval-shaped with the broadest distance horizontal. On the inside front of the box, beneath the hole, a strip of screen or hardware cloth should be tacked to provide the ducklings a means of escaping the box.

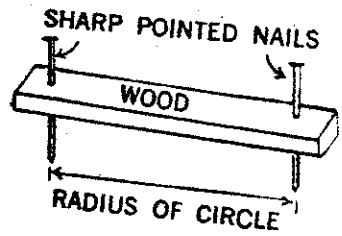


# PREDATOR GUARD

Cone-shaped, sheet-metal guard for protecting nest structures from predators. At right is layout for cutting 3 predator guards from a 3′ x 8′ sheet of 26-gauge galvanized metal. When installing the guard, overlap the cut edge to the dotted line. To facilitate cutting (on solid lines only) follow the sequence of numbers. Make circular cuts in counterclockwise direction. To make initial cut on line A–B, make a slot at A with a cold chisel. Use tinsnips and wear leather gloves.






HOME MADE COMPASS
FOR SCRIBING METAL

APPENDIX D

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This is not a complete bibliography, but rather a list of publications that we feel will be of greater benefit to you.

APPENDIX F

GLOSSARY

"blue line" stream - any stream or moving body of water that appears as a solid blue line on a U.S. Geological Survey Topographical map. Refers to a permanently flowing stream.

cosmetic maintenance - remedial work to control vegetative growth to give a more pleasing or appealing appearance.

critical habitats - all wetlands, large expanses of forest, or native prairie and virgin stands of forest.

cruising range - area which may be visited by a given individual of a mobile species in its daily movement pattern.

diversity - refers to a greater variety of different plant or animal species which occupy a given area.

habitat stratification - as the habitat matures, changes will occur within it which allow for higher degrees of utilization by a greater number of species or species groups. It becomes layered and the different species or species groups occupy the various layers.

home range - that area within which most or all of a mobile species life requirements are supplied; a restricted area of occupation.

karst topography - the typical surface terrain of a limestone region, characterized by an abundance of sinkholes, disappearing or underground streams, exposed rock outcrops or ledges, and underground caverns.

living fence - woody growth, usually in the form of shrubs, that is planted close enough together so that the branches create a barrier to intruders.

monoculture - expansive growth of vegetation that consists of a single type or species. Taken here to be opposite of diversity.

odd area - refers to sinks, gullies, steep slopes or areas that don't fit geometrically with the surrounding land or land uses.

reference area - an area of the applicants choosing, which must be representative of the geology, soil, slope, and vegetative cover on the mine permit site. Used for the purpose of measuring vegetation ground cover, productivity, and plan species diversity.

wildlife - refers to all species of animals, vertebrate or invertebrate, warm blooded or cold blooded, aquatic or terrestrial that live in or normally live in natural surroundings and derive their livelihood by natural means.

Form 1 - Description of Permit Site

| Habitat Types | Acreages | Acres periodically inundated* |
|---|---|---|
| Upland Forest - grazed | | |
| - ungrazed | | |
| Industrial/Residential | | |
| Woodlot - grazed | | |
| ungrazed | | |
| Agri - lands | | |
| Shrublands - grazed | | |
| - ungrazed | | |
| Grasslands - prairie | | |
| - pasture | | |
| - hayfield | | |
| Wetlands - Riverine | | |
| - Palustrine | | |
| - Lacustrine | | ** |
| Abandoned Mine Lands | | |
| TOTALS | | |

* + if periodically inundated
  - if not periodically inundated
** not applicable

Interspersion Index

Premining _____
Postmining _____

Attach species list and stratum rank values to this form.

Form 2 - Determination of the Three Indicator Species Best Suited to the Area Proposed to be Mined

| Species | | Industrial/ Residential | Upland Forest | Riparian/ Palustrine | Woodlots | Shrublands | Grassland | Agri-land | Wetlands | Total Habitat Value (tv) | Three Highest Values* |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | ac. | ac. | ac. | ac. | ac. | ac. | ac. | ac. | / / / / / / | / / / / |
| Quail | r | 28 | / / / / | / / / / / / | 53 | 93 | 54 | 65 | / / / / / | / / / / / / | / / / / |
| | v | | / / / / | / / / / / / | | | | | / / / / / | | |
| Rabbit | r | 53 | / / / / | / / / / / / | 55 | 92 | 74 | 56 | / / / / / | / / / / / / | / / / / |
| | v | | / / / / | / / / / / / | | | | | / / / / / | | |
| Grey Squirrel | r | 45 | 98 | 64 | 86 | / / / / / / | / / / / / | / / / / / | / / / / / | / / / / / / | / / / / |
| | v | | | | | / / / / / / | / / / / / | / / / / / | / / / / / | | |
| Deer | r | / / / / / / | 89 | 73 | 58 | 77 | 36 | 44 | 45 | / / / / / / | / / / / |
| | v | / / / / / / | | | | | | | | | |
| Dove | r | 56 | / / / / | 35 | 38 | 58 | 40 | 91 | / / / / / | / / / / / / | / / / / |
| | v | | / / / / | | | | | | / / / / / | | |
| Wood Duck | r | / / / / / / | / / / / | 100 | / / / / / | / / / / / / | / / / / / | / / / / / | 100 | / / / / / / | / / / / |
| | v | / / / / / / | / / / / | | / / / / / | / / / / / / | / / / / / | / / / / / | | | |
| Turkey | r | / / / / / / | 99 | 89 | 25 | 34 | 27 | 22 | / / / / / | / / / / / / | / / / / |
| | v | / / / / / / | | | | | | | / / / / / | | |
| Whitefooted Mouse | r | 70 | 74 | / / / / / | 86 | 90 | / / / / / | / / / / / | / / / / / | / / / / / / | / / / / |
| | v | | | / / / / / | | | / / / / / | / / / / / | / / / / / | | |
| Meadowlark | r | 28 | / / / / | / / / / / / | / / / / / | / / / / / / | 100 | 68 | / / / / / | / / / / / / | / / / / |
| | v | | / / / / | / / / / / / | / / / / / | / / / / / / | | | / / / / / | | |
| Red Fox | r | / / / / / / | / / / / | / / / / / / | 82 | 84 | 59 | 53 | / / / / / | / / / / / / | / / / / |
| | v | / / / / / / | / / / / | / / / / / / | | | | | / / / / / | | |
| Raccoon | r | 27 | 75 | 98 | 70 | 39 | 21 | 32 | 74 | / / / / / / | / / / / |
| | v | | | | | | | | | | |
| Kestrel | r | 51 | / / / / | / / / / / / | 49 | 93 | 82 | 65 | / / / / / | / / / / / / | / / / / |
| | v | | / / / / | / / / / / / | | | | | / / / / / | | |

Habitat value (v) equals the product of habitat acreage (ac) and habitat rating (r).
Total habitat value (tv) equals the sum of the habitat values for each species.