

ANALYSIS OF THE DEFINITION
OF ECOLOGICALLY-VITAL GROUND WATER
UNDER THE PROPOSED GROUND-WATER
CLASSIFICATION GUIDELINES

Prepared for
The Office of Ground-Water Protection
and
The Office of Policy Analysis

April 1986

ANALYSIS OF THE DEFINITION
OF ECOLOGICALLY-VITAL GROUND WATER
UNDER THE PROPOSED GROUND-WATER
CLASSIFICATION GUIDELINES

Prepared for
The Office of Ground-Water Protection
and
The Office of Policy Analysis

April 1986

ANALYSIS OF THE DEFINITION
OF ECOLOGICALLY-VITAL GROUND WATER
UNDER THE PROPOSED GROUND-WATER
CLASSIFICATION GUIDELINES

OVERVIEW

Over the past year, EPA's Office of Ground-Water Protection has been developing the Agency's Ground Water Classification Guidelines. The Classification Guidelines propose three classes of ground water based on their value to society, use, and vulnerability to contamination. Class I ground waters deserving "special" protection have received much study recently. One of the key definitions for designating Class I ground water is "ecologically-vital" ground water where a ground-water discharge within a sensitive ecological system supports a unique habitat. The term "ground-water discharge" means an area of land beneath which there is a net annual transfer of water from the saturated zone to a surface water body, land surface, or root zone. A "sensitive ecological system" is defined as an aquatic, wetland, or terrestrial ecosystem located in a ground-water discharge area. A "unique habitat" is primarily defined as a habitat for an endangered or threatened species. (These and other terms are defined in Attachment A.)

During January 1986, the Office of Ground-Water Protection (OGWP) and the Office of Policy Analysis (OPA) were assisted by ICF Incorporated and supported by Geraghty & Miller Inc. in analyzing the practical effects of defining ground water as Class I ecologically-vital.

A work group of interagency officials and public interest group representatives was convened on January 15 and again on January 29 to provide expert peer review of the proposed Guidelines definitions, to review case studies for testing the definitions, and to determine the extent to which

classifying ecologically-vital ground waters would result in Class I determinations. (A list of the work group members is presented in Attachment B.)

ANALYTICAL TASKS

Several analytical tasks were carried out during this study. These helped shape recommendations offered by the work group for classifying and determining the extent of ecologically-vital ground waters. These tasks are briefly described below.

Case Studies

Four case studies were developed for the work group to apply and test the currently proposed definitions of ecologically-vital ground water. The case studies represented a broad selection of unique habitats and hydrogeologic settings. Federal and state agencies were consulted to determine whether the unique habitats cited in each case were within a hypothetical classification review area (CRA). In addition, each case study illustrated a situation where a federal endangered or threatened species was known to have a habitat near or within the CRA. Available hydrogeologic information was used to determine the location of ground-water discharge areas (i.e., sensitive ecological systems) within the CRA. The proposed definitions were then applied to each case to determine whether the ground water was Class I ecologically-vital. (Each of these case studies is presented in Attachment C.)

The case studies were prepared for illustrative purposes only. They should not be interpreted as the actual classification of an area. The case studies illustrate various situations that may be encountered when classifying

ground waters on a site-specific basis. They illustrate the procedures for determining whether or not ecologically-vital ground waters are present. Simply because a unique habitat is located in a classification review area, ground water is not automatically designated ecologically-vital. A sensitive ecological system (as defined in Attachment A) must be present within the unique habitat and a determination must also be made that the ground water is highly vulnerable to contamination. (Vulnerability is determined by applying EPA's DRASTIC index: a score of 150 or greater indicates highly vulnerable ground waters generally in the eastern U.S. and a score of 120 or greater indicates highly vulnerable ground waters generally in the western U.S. A complete description of how to determine a DRASTIC score is presented in the Guidelines.)

In the first case study, the CRA directly intersects the critical habitat of a small endangered fish, the Maryland darter. After determining that a sensitive ecological system is present within this species' habitat and analyzing the vulnerability of the ground waters by applying DRASTIC (a score greater than 150 was assumed), the ground water underlying the CRA is determined to be Class I ecologically-vital.

In the second case study, prevailing karst terrain requires that the classification review area be expanded to include nearby discharge areas. When the CRA is expanded, it includes two potential unique habitats: the Mammoth Cave National Park and the critical habitat of the Kentucky cave shrimp. Consultation with the Mammoth Cave National Park supervisor indicates that this park is designated and managed for the protection of its ecological values and therefore it should be considered a unique habitat for the purposes of classifying ground waters. This consultation is important

because some national parks are managed as historic sites (e.g., Clara Barton house in Glen Echo, Maryland). Ground water located in national parks that are managed for values other than ecological protection (e.g., historic or recreation values), would not be eligible for Class I "ecologically-vital" designation. They would be protected under Class II. The presence of a critical habitat of a listed, federal endangered species within the extended CRA is another indication that a unique habitat is present. Thus, two different types of unique habitats are present. Individually, they each contribute to the definition of Class I ecologically-vital ground water along with the presence of a sensitive ecological system and highly vulnerable ground water.

In the third case study, four alternative scenarios are analyzed to illustrate how the presence of potential unique habitats contributes to the determination of Class I ground waters. One scenario discusses the situation where a CRA intersects National Forest land yet no unique habitat is present because the forest lands are managed for multiple uses, not just the ecological values associated with them. Therefore, the ground waters would be classified as Class II which provides adequate protection of ground water supporting the multiple uses for which federal forest lands are managed. Class I determinations result in other scenarios where the CRA intersects a wilderness area or the habitat of a listed, federal threatened species.

In the fourth case study, a CRA overlaps a historical habitat of the bunched arrowhead, which is a listed, federal endangered plant. Consultation with the state's Heritage Program officer confirms that the species is not present in its historical habitat but does exist within its current habitat

locations outside the CRA. The ground waters in this case are then classified as Class II, and not Class I ecologically-vital.

These case studies show how potential ecologically-vital ground waters would be designated under the currently proposed Guidelines for Ground-Water Classification. More importantly, they illustrate the consultative, case-by-case process for determining when and where ecologically-vital ground waters should be classified. This process includes consultation with U.S. Fish and Wildlife Service and State Heritage Program representatives. In situations where a unique habitat, a sensitive ecological system, and highly vulnerable ground water co-exist, ground waters will be classified as Class I ecologically-vital. In cases where the status of a unique habitat is uncertain, further consultation with appropriate federal (and state) agency officials (e.g., U.S. Forest Service, Bureau of Land Management, National Park Service, etc.) will be required. For all federal actions, Section 7 of the Endangered Species Act¹ establishes a formal consultative mechanism which can be used by federal agencies for determining the scope of ground-water impacts on endangered or threatened species' habitats. Similar consultative or reporting mechanisms have also been established in the Remedial Investigation/Feasibility Study (RI/FS) Guidance of Superfund and Phase I Location Guidance of the Resource Conservation and Recovery Act.

Co-Location Maps

Four state maps were prepared to illustrate the co-location of CRAs and potential unique habitats. An analysis was conducted to determine the

¹ As used in this report, this act refers to the Endangered Species Act as amended by Public Law 97-304 (The Endangered Species Act Amendments of 1982).

practical effects of including different types of federal (and state) lands as potential unique habitats in the classification guidelines. State lands were included in this task for analytical purposes only. EPA's proposed Ground-Water Classification Guidelines focus on the classification of ground waters underlying facilities and sites subject to EPA regulations and administrative authorities. For state ground-water protection programs, states may adopt the definitions given in the Guidelines. They may in turn expand the definitions to include other land uses that could be defined as potential unique habitats (e.g., private lands managed for ecological values). In this analytical task, potential unique habitats on state lands were assumed to be similar in nature to the types of federal lands that are typically managed for their ecological values such as parks, wildlife refuges, wilderness areas, and habitats for endangered and threatened species.

Four states were selected for this exercise: Delaware, Maryland, Louisiana, and California. Each state was analyzed to estimate the frequency of CRA overlap with potential unique habitats. For this exercise, CRAs (i.e., circles with 2-mile radii) were drawn around the approximate location of all RCRA treatment, storage, and disposal facilities; CERCLA NPL sites; and UIC Class I underground injection wells that could be located on a map.²

² References:

Resource Conservation and Recovery Act (RCRA) treatment, storage, and disposal facilities: U.S. Environmental Protection Agency, Hazardous Waste Data Management System, February 1985.

Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) National Priority List (NPL) sites: National Priority List: 786 Current and Proposed Sites in Order of Ranking and by State, U.S. Environmental Protection Agency, October 1984.

Underground Injection Control (UIC) Program Class I Underground Injection Wells (regulated under The Safe Drinking Water Act): Report to Congress on Injection of Hazardous Waste, U.S. Environmental Protection Agency, May 1985.

Examples of unique habitats representing federal lands included the National Parks, National Forests, National Wilderness Areas, and National Wildlife Refuges. Unique habitats representing state land included state parks, forests and refuges. Also included as unique habitats were the designated critical habitats for listed federal endangered and threatened plants and animals.³ These definitions were employed in order to examine the largest possible extent to which unique habitats could be included in the Class I ecologically-vital definition. Realistically, however, these analyses produce a higher number of Class I ecologically-vital than may actually exist.

Frequency Tables of CRAs Overlapping Potential Unique Habitats

The results of the co-location mapping task are displayed in Tables 1, 2 and 3. Each table presents an estimated frequency of the number of times a classification review area overlaps a potential federal unique habitat (i.e., critical habitat, national park, or "other federal land" such as federal forests, wildlife refuges, etc.).⁴ The scale of each state map and the CRAs were such that the overlap of a CRA with a potential unique habitat could be estimated. The results of this analysis provide a first order approximation of the frequency that the CRA of an EPA regulated activity would likely intersect a potential unique habitat and therefore require a Class I ecologically-vital review.

³ Reference: 50 CFR Part 17 Endangered and Threatened Wildlife and Plants, Subpart B - Lists.

⁴ Similar frequencies for potential state unique habitats have been estimated using the proposed guidelines for determining federal unique habitats. These estimates are presented for illustrative purposes only. The States will be responsible for determining which state lands will be considered for unique habitat designation.

For this exercise, it was not possible to determine with certainty the number of CRAs having Class I ecologically-vital ground water. Only a detailed site-specific analysis can determine this. Nevertheless, an attempt was made to estimate, in gross terms, a likely number of CRAs that could receive a Class I ecologically-vital designation. Based on the information available from Tables 1, 2 and 3 (i.e., CRAs that overlap potential federal unique habitats) and information from the co-location maps (i.e., proximity of CRAs to rivers, streams, wetlands, etc.), it was possible to assign "best professional judgment" probabilities that broadly represented the likelihood of a CRA (or group of CRAs) which could receive a Class I ecologically-vital designation. Table 4 presents these probabilities and the estimated number of CRAs that would likely have a Class I ecologically-vital ground water.

In Table 1, only 2 of the 115 (about 2%) CRAs in Delaware and Maryland were estimated to likely overlap a critical habitat for a listed, federal endangered species. No CRA appeared to overlap a national park. Eleven of the 115 (10%) CRAs in Delaware and Maryland were estimated to likely intersect "other federal land." In Table 4, the two CRAs which likely overlap critical habitats were assigned a "best professional judgment" probability of 1.0 (or 100%) for having a Class I ecologically-vital ground water. Both CRAs appeared to be located along streams and therefore would likely have a sensitive ecological system and highly vulnerable ground water. Similarly in Table 4, 6 of the 11 (about 50%) CRAs that appear to overlap "other federal land" would also likely have a sensitive ecological system and highly vulnerable ground water using the same rationale as for critical habitat location near discharge points. Based on these findings, approximately 7%

Table 1
DELAWARE and MARYLAND
Estimated Frequency of a Classification Review Area (CRA)
Overlapping a Potential Unique Habitat

CRA	Potential Unique Habitats			State Land ⁵	Estimated Frequency
	Critical Habitat	National Park	Other Federal Land ⁴		
RCRA treatment, storage and disposal facilities ¹	2	0	9	30	41/109
CERCLA NPL sites ²	0	0	2	3	5/6
UIC Class I wells ³	0	0	0	0	-
Total	2	0	11	33	46/115

¹ There are 109 RCRA facilities in the study area as of February 1985.

² There are 11 NPL sites (excluding proposed sites) in the study area as of October 1984. Five of the eleven sites could not be mapped.

³ There are no Class I Underground Injection Wells in the study area as of May 1985.

^{4,5} These areas (federal/state forests, wildlife refuges, etc.) are assumed to be unique habitats for this exercise.

(i.e., 8 of 115) of the total number of CRAs in Delaware and Maryland would likely receive a Class I ecologically-vital ground water designation.

In Table 2, there is no known critical habitat in Louisiana and no CRA appears to overlap a national park. Five of 157 (3%) CRAs were estimated to likely intersect "other federal land." Louisiana has 68 UIC Class I injection wells of which only two (included in the 5 above) appear to overlap potential unique habitats. In Table 4, 4 of 5 (80%) CRAs likely are located in a sensitive ecological system and have highly vulnerable ground water (based on "best professional judgment" using the state co-location map). As a result, approximately 4 of 157 (3%) CRAs would likely receive a Class I ecologically-vital ground-water designation.

Table 3 presents the results for California. This western state was selected because of the high number of federally regulated facilities (i.e., RCRA facilities, CERCLA NPL sites and UIC Class I wells) and high density of federal, potential unique habitats located within the state. A total of 26 out of 325 (8%) CRAs was estimated to likely intersect critical habitats. An additional 30 out of 325 (9%) CRAs likely would overlap a national park or "other federal land." In Table 4, approximately 16 of 26 (60%) CRAs intersecting critical habitats would likely have both a sensitive ecological system and highly vulnerable ground water (based on "best professional judgment" using the state co-location map). Of the remaining CRAs overlapping potential unique habitats, approximately 15 of 30 (50%) would likely have both a sensitive ecological system and highly vulnerable ground water. These preliminary findings suggest that approximately 31 of 325 (10%) of the total number of CRAs would likely receive a Class I ecologically-vital designation.

Table 2
LOUISIANA

**Estimated Frequency of a Classification Review Area (CRA)
Overlapping a Potential Unique Habitat**

CRA	Potential Unique Habitats			State Land ⁵	Estimated Frequency
	Critical Habitat	National Park	Other Federal Land ⁴		
RCRA treatment, storage and disposal facilities ¹	0	0	3	9	12/84
CERCLA NPL sites ²	0	0	0	0	0/5
UIC Class I wells ³	0	0	2	5	7/68
<hr/>	<hr/>	<hr/>	<hr/>	<hr/>	<hr/>
Total	0	0	5	14	19/157

¹ There are 86 RCRA facilities in the study area as of February 1985. Two facilities could not be mapped.

² There are 5 NPL sites (excluding proposed sites) in the study area as of October 1984.

³ There are 68 Class I Underground Injection Wells in the study area as of May 1985.

^{4,5} These areas (federal/state forests, wildlife refuges, etc.) are assumed to be unique habitats for this exercise.

Table 3
CALIFORNIA

**Estimated Frequency of a Classification Review Area (CRA)
Overlapping a Potential Unique Habitat**

CRA	Potential Unique Habitats			State Land ⁶	Estimated Frequency
	Critical Habitat ⁴	National Park	Other Federal Land ⁵		
RCRA treatment, storage and disposal facilities ¹	24	1	28	3	56/304
CERCLA NPL sites ²	2	0	1	0	3/19
UIC Class I wells ³	0	0	0	0	0/2
<hr/> Total	<hr/> 26	<hr/> 1	<hr/> 29	<hr/> 3	<hr/> 59/325

¹ There are 324 RCRA facilities in the study area as of February 1985. Twenty facilities could not be mapped.

² There are 19 NPL sites (excluding proposed sites) in the study area as of October 1984.

³ There are 2 Class I Underground Injection Wells in the study area as of May 1985.

⁴ Critical habitat for the California Condor was not mapped. The critical habitat for the condor is generally confined to areas with elevations greater than 3000 feet. None of the mapped CRAs is located at elevations of 3000 feet or higher.

^{5,6} These areas are assumed to be unique habitats for this exercise.

⁶ Includes only state parks. Boundaries of state forest and wildlife refuges were not readily available for this exercise.

Table 4
**ESTIMATED NUMBER OF POSSIBLE CLASS I
 ECOLOGICALLY-VITAL GROUND WATERS**

State	CRA/Critical Habitat ¹	Probability Assumption ²	CRA/National Park ¹	Probability Assumption	CRA/Other Federal Land ¹	Probability Assumption	Total ³
Delaware and Maryland	2	1.0 0.5	0	-	11	0.5 0.5	8/115 (7%) 7/115 (6%)
Louisiana	0	-	0	-	5	0.8 0.5	4/157 (3%) 3/157 (2%)
California	26	0.6 0.5	1	0.5 0.5	29	0.5 0.5	31/325 (10%) 29/325 (9%)

¹ Number of CRAs that likely overlap critical habitats, national parks, and other federal lands, respectively.

² To be read as "probability of a CRA likely to overlap a potential unique habitat, and likely to have both a sensitive ecological system and highly vulnerable ground water." The first row represents "best professional judgement" probabilities. The second row simply assumes a 50% probability.

³ Totals are rounded up.

The preliminary findings presented in Table 4 indicate that the range of Class I ecologically-vital determinations is between 3 and 10 percent when "best professional judgment" is applied. If, on the other hand, it is simply assumed that CRAs overlapping potential unique habitats uniformly meet the remaining conditions for Class I ecologically-vital ground water 50% of the time, then the range is slightly lower: 2 to 9 percent versus 3 to 10 percent.

Land Area Matrix of Potential Unique Habitats

The matrix in Table 5 presents the approximate land acreage of potential federal (and state) unique habitats in the contiguous 48 states. Federal land includes the National Park System (National Park lands such as recreational parks and historical sites are not included); National Refuges, Wilderness and Natural Areas; and National Forests (some lands such as national grasslands and timber production areas are excluded). Also listed are approximate land acreages for the habitats (including critical habitats) of listed, federal endangered and threatened species. Other land areas noted are those managed for scientific research, and lands recognized by environmental conservation groups.

The matrix indicates that approximately 6.3% of the total land area of the 48 contiguous states could be considered as potential unique habitats for Class I ecologically-vital classification. This figure would increase to about 12% of the total U.S. land area if all potential unique habitats in Alaska (and Hawaii) are included. These figures represent the upper range of those lands (not ground waters) that could possibly be considered Class I ecologically-vital because, after going through the consultative review process with the appropriate agencies, land areas for truly unique habitats

Table 5
Land Area¹ Matrix of Potential Unique Habitats

	<i>Endangered/ Threatened Species w. Critical Habitat</i>	<i>Endangered/ Threatened Species w/o Critical Habitat</i>	<i>National Park System²</i>	<i>National Refuges, Wilderness and Natural Areas³</i>	<i>Other Federal Lands⁴</i>	<i>State Parks/ Forests</i>	<i>Other State Land</i>	<i>County/Local Land</i>	<i>Other⁵</i>
<i>UNIQUE HABITAT</i>	YES 92 Federal listed species	Consult with FWS, State 295 Federal listed species	YES/NO	YES/NO	YES/NO	YES/NO	YES/NO	YES/NO	YES/NO
<i>SENSITIVE ECOLOGICAL SYSTEM</i>	YES if located in a CRA discharge area	YES if located in a CRA discharge area	YES/NO	YES/NO	YES/NO	YES/NO	YES/NO	YES/NO	YES/NO
<i>APPROX. ACREAGE/ % TOTAL U.S. LAND</i>	1,000's to 10,000's/ <.003%	100,000's to millions (?)/ <0.3%	15 million/ 0.8%	46 million/ 2.4% ⁶	49 million/ 2.5%	5 million/ 0.3%	?	?	?

CRA: classification review area

E/T: endangered and threatened

FS: Forest Service, U.S. Department of Agriculture

FWS: Fish and Wildlife Service, U.S. Department of the Interior

NPS: National Park Service, U.S. Department of the Interior

YES/NO: Consult with appropriate officials.

¹ Contiguous 48 states

² Maintained by the National Park Service. Examples include the National Parks, National Preserves, National Seashores, National Lakeshores, and National Rivers.

³ Maintained by the Fish and Wildlife Service, Forest Service, Bureau of Land Management, and other federal agencies.

⁴ Area includes the National Forest System (excluding areas managed for timber production, national grasslands and wilderness areas) maintained by the Forest Service.

⁵ Other may include land designated for scientific research, land owned by The Nature Conservancy, The Audubon Society, etc.

⁶ 90 million/6% if Alaska is included.

will indeed be less. If one then considers (1) what proportion of the remaining land area is overlapped by a classification review area, (2) the likelihood of ground water discharging into the unique habitat within the CRA, and (3) the likelihood of the ground water being highly vulnerable to contamination, it becomes evident that the area for Class I ecologically-vital ground water is relatively limited. If one were to assume that all of these conditions were met 50% of the time, less than 3% of the land area of the contiguous 48 states could potentially be classified Class I ecologically-vital.

IDENTIFYING UNIQUE HABITATS - THE CONSULTATIVE PROCESS

Currently, the proposed definition of a unique habitat is defined as habitats for endangered or threatened species (pursuant to the Endangered Species Act) and certain federal land areas which have been designated for the purpose of ecological protection (regardless of the presence of endangered or threatened species). Such federal land may be included in the National Park System, the National Forest System, and the National Refuge System. Whereas the critical habitats of federal endangered and threatened species have been defined to be unique habitats, all other land areas overlying potential "ecologically-vital ground waters" must be reviewed in consultation with appropriate federal or state officials to determine their unique habitat status.

To identify federal lands of ecological importance, one can refer to a U.S. Geological Survey topographic map and identify those federal or state lands that are potential unique habitats. The next step is to consult with the appropriate federal agency responsible for managing and maintaining the

land to determine whether a unique habitat is present. This consultation process is also important when considering federal lands that are managed for multiple uses. Section 7 of the Endangered Species Act provides a consultative process for considering any action authorized, funded, or carried out by a federal agency that is likely to jeopardize the continued existence of any endangered or threatened species or result in the destruction or adverse modification of the species' habitat. (Similar consultation may be warranted at the state level for state endangered and threatened species.)

The consultative process was used repeatedly while preparing the case studies. For example, to determine which federal lands should be considered as unique habitats, telephone calls were placed to the regional office of the appropriate federal agency (this process is documented in each case study). The regional office would normally refer the inquiry to the district or field office. After consulting with the appropriate official, it could then be determined whether the land in question comprised a unique habitat. (For each case study, it required about half a day to locate, contact, and eventually consult with the responsible agency official.)

To identify the habitat⁵ of endangered and threatened species in the CRA, a telephone call was placed to the regional office of the U.S. Fish and Wildlife Service. (Attachment D presents a list of these offices.) Again, the inquiry was generally referred to the field office which was more familiar with the habitat of the species. The U.S. Fish and Wildlife Service has published site maps for most of the 92 critical habitats (50 CFR Part 17B)

⁵ As of January 15, 1986, 92 of the 387 listed, federal endangered and threatened species have a designated "critical habitat." The habitats of the remaining 295 species are equally protected under the Endangered Species Act although these areas can be more geographically widespread.

that have been defined in the regulations. Habitat locations for all species can be identified by consulting with the U.S. Fish and Wildlife Service, State Natural Heritage Program Offices, and other conservation organizations.

State Natural Heritage Programs are staffed by authorities on species' habitats and natural land areas. (Attachment E presents a list of the State Heritage Offices.) Forty-one states currently maintain a Heritage Program. The State Heritage office provides information about the status and distribution of endangered and threatened species, natural communities, and other ecological features within a state. Their map and computer files make the information readily accessible.

For each case study, the U.S. Fish and Wildlife Service recommended that the State Heritage Office also be consulted for site information related to ecological significance. The State Heritage Office provided general information over the phone (e.g., habitats for species and natural land areas likely to be found in the general CRA) but required that specific site inquiries be submitted in writing. Based on telephone calls to several state offices, a complete ecological inventory review for one site takes on the average from two to three weeks (although the Maryland State Heritage Office reportedly has a backlog of several months). A field survey is sometimes required to confirm the presence of a species' habitat. This survey can take days and for some unusual cases, may not be scheduled until the species can be readily identified in the field (e.g., a rare tiny plant that flowers only in the spring.)

DEFINITION CHANGES RECOMMENDED BY THE WORK GROUP

- Definition of "sensitive ecological system"

The work group recommends that the definition of "sensitive ecological system" be expanded to include wetland ecosystems. This expanded definition better represents ecosystems that fall between terrestrial ecosystems and aquatic ecosystems.

- Definition of "unique habitat"

The work group recommends that the definition of unique habitat as it applies to listed, federal endangered or threatened species (presently 387) be expanded to include species that are currently proposed for federal listing (approximately 60). Although this recommended expansion would increase the initial list of species from 387 to approximately 447, only about 57 (13%) of these species would likely have a habitat naturally occurring within a sensitive ecological system (i.e., an aquatic, wetland or terrestrial ecosystem located in a ground-water discharge area).⁶

The work group also recommends that more areas of ecological importance be considered as unique habitats in addition to parks, forests and wildlife refuges. Natural research areas, and lands where conservation easements have been granted are other possibilities. The designation of these lands and state land areas as unique habitats will be the responsibility of appropriate state and local agencies, where authority for managing these land uses resides.

⁶ Personal communication with Larry Thomas, Wildlife Biologist, U.S. Fish and Wildlife Service, Washington, D.C., January 29, 1986.

COST ESTIMATES FOR CLASSIFYING CLASS I ECOLOGICALLY-VITAL GROUND WATER

The cost of classifying ecologically-vital ground water can vary, depending on the availability of information which is needed to make a determination. In many cases, reviewing available information and consulting with one or two agencies will suffice. For a relatively simple case like the Maryland darter in the first case study, the cost may be less than \$1,000 (direct labor, administration, travel, etc.) if information can be readily accessed and analyzed from maps, telephone calls, and one or two consultative meetings.

There can be other costs. For cases where much of the hydrogeologic information is not readily available or does not exist, it may be necessary to conduct literature searches (\$1,000's and up) or field surveys (\$10,000's and up). Other costs may be associated with obtaining ecological information about a site. The State Heritage Office can provide a complete ecological inventory review upon written request. The service charge for this is typically \$50 although it varies from state to state. In addition, a field survey is sometimes required to confirm the presence of a species' habitat in a study area. A field survey costs about \$150/day per field person plus expenses. This cost is generally incurred by the party making the inquiry.

LIST OF ATTACHMENTS

- Attachment A Key Terms and Concepts
- Attachment B List of Work Group Members
- Attachment C Case Studies
- Case Study No. 1: Maryland darter
- Case Study No. 2: Kentucky cave shrimp
- Case Study No. 3: California Paiute cutthroat trout
- Case Study No. 4: Bunched arrowhead in North Carolina
- Attachment D List of Offices of Endangered Species,
 U.S. Fish and Wildlife Service
- Attachment E List of State Natural Heritage Program Offices
- Attachment F List of Additional References

ATTACHMENT A

KEY TERMS AND CONCEPTS

The draft Guidelines for Ground-Water Classification (February 1986)

define Class I ecologically-vital ground water as follows:

- "ecologically-vital" ground water is defined as supplying a sensitive ecological system supporting a unique habitat,

where:

a "sensitive ecological system" is defined as an aquatic, wetland, or terrestrial ecosystem located in a ground-water discharge area;

a "unique habitat" is primarily defined as a habitat for an endangered or threatened species (pursuant to the Endangered Species Act as amended) that is listed or proposed. Certain federal land areas, congressionally designated for the purpose of ecological protection, regardless of the presence of rare and endangered species (e.g., wildlife refuges, wilderness areas, natural areas used for research, etc.) may also be included; and,

a "discharge area" is defined as an area of land beneath which there is a net annual transfer of water from the saturated zone to a surface water body, the land surface, or root zone. Net discharges are "manifested by an increase of hydraulic heads with depth" (upward ground-water flow). Zones may be associated with natural areas of discharge (e.g., springs, geysers, wetlands, bays, and playas).

- The ground water must also be highly vulnerable to contamination,

where:

a highly vulnerable ground water has a relatively high potential for contaminants to enter or to be transported within the ground-water flow system. This term encompasses the leaching potential of the soil and the ability of the saturated flow system to move contaminants over a large geographic area (not just beneath any given facility or action).

The EPA recommends the use of DRASTIC (a rating index) to determine vulnerability. The method is referred to as DRASTIC. A "DRASTIC" score of 150 indicates high vulnerability in areas

generally east of the Mississippi River; a score of 120 is being proposed as the indicator of high vulnerability for areas generally west of the Mississippi River.

The definition of critical habitat is also presented here as it is defined in The Endangered Species Act as amended by Public Law 97-304 (The Endangered Species Act Amendments of 1982).

SEC. 3. For the purposes of this Act --

(5)(A) The term "critical habitat" for a threatened or endangered species means --

(i) the specific areas within the geographical area occupied by the species, at the time it is listed in accordance with the provisions of section 4 of this Act, on which are found those physical or biological factors (I) essential to the conservation of the species and (II) which may require special management considerations or protection; and

(ii) specific areas outside the geographical area occupied by the species at the time it is listed in accordance with the provisions of section 4 of this Act, upon a determination by the Secretary that such areas are essential for the conservation of the species.

(B) Critical habitat may be established for those species now listed as threatened or endangered species for which no critical habitat has heretofore been established as set forth in subparagraph (A) of this paragraph.

(C) Except in those circumstances determined by the Secretary, critical habitat shall not include the entire geographical area which can be occupied by the threatened or endangered species.

ATTACHMENT B
LIST OF WORK GROUP MEMBERS

U.S. Environmental Protection Agency

Marian Mlay
Office of Ground-Water Protection

Ron Hoffer
Office of Ground-Water Protection

Bob Raucher
Office of Policy Analysis

Sam Napolitano
Office of Policy Analysis

Brendan Doyle
Office of Policy Analysis

Margaret Schneider
Office of Federal Activities

Carol Hudson Jones
Compliance Policy and Planning Branch
Office of Enforcement and Compliance Monitoring

Others

Larry Thomas
Wildlife Biologist
Office of Endangered Species
U.S. Fish and Wildlife Service
1000 North Glebe Road
Suite 500
Arlington, Virginia 22201

Phil Metzger
Conservation Foundation
1255 23rd Street
Suite 200
Washington, D.C. 20037

Larry E. Morse
Director of National Scientific Databases
The Nature Conservancy
Natural Heritage Programs
1800 North Kent Street
Arlington, Virginia 22209

Arnold Norden
Maryland Natural Heritage and Environmental Review
Department of Natural Resources
Land Planning Services
Tawes Building
Annapolis, Maryland 21401

Contractor Support

Paul Bailey, Ron Scullin
ICF Incorporated
1850 K Street, N.W.
Suite 950
Washington, D.C. 20006

William Doucette, Caroline Hoover
Geraghty & Miller, Inc.
844 West Street
Annapolis, Maryland 21401

ATTACHMENT C

CASE STUDY NO. 1

Introduction

Case Study No. 1 illustrates a situation where a unique habitat and a sensitive ecological system are partially located in the classification review area (CRA). The classification of the ground water beneath the CRA is Class I ecologically-vital.

Preliminary Information with Respect to the Classification Review Area

General

The ground water underlying a facility alongside the lower reach of Deer Creek in Maryland (Figure 1) is being classified. The CRA is located upgradient of the creek. There is a State Park on the opposite side of the creek. Also, 1.5 miles of the creek are designated as a critical habitat for the Maryland darter, which is listed as a federal endangered fish.

Geology/Hydrogeology

Locally, the geology of the Wissahickon Formation consists of highly deformed schists and metagabbro bedrock overlain by variably thick saprolitic material (Figure 2). Ground water flow within the schists and bedrock is controlled principally by the fracture permeability. The saprolite may exhibit

CASE STUDY NO. 1: MARYLAND DARTER

Figure 1

BASE MAP OF CLASSIFICATION REVIEW AREA

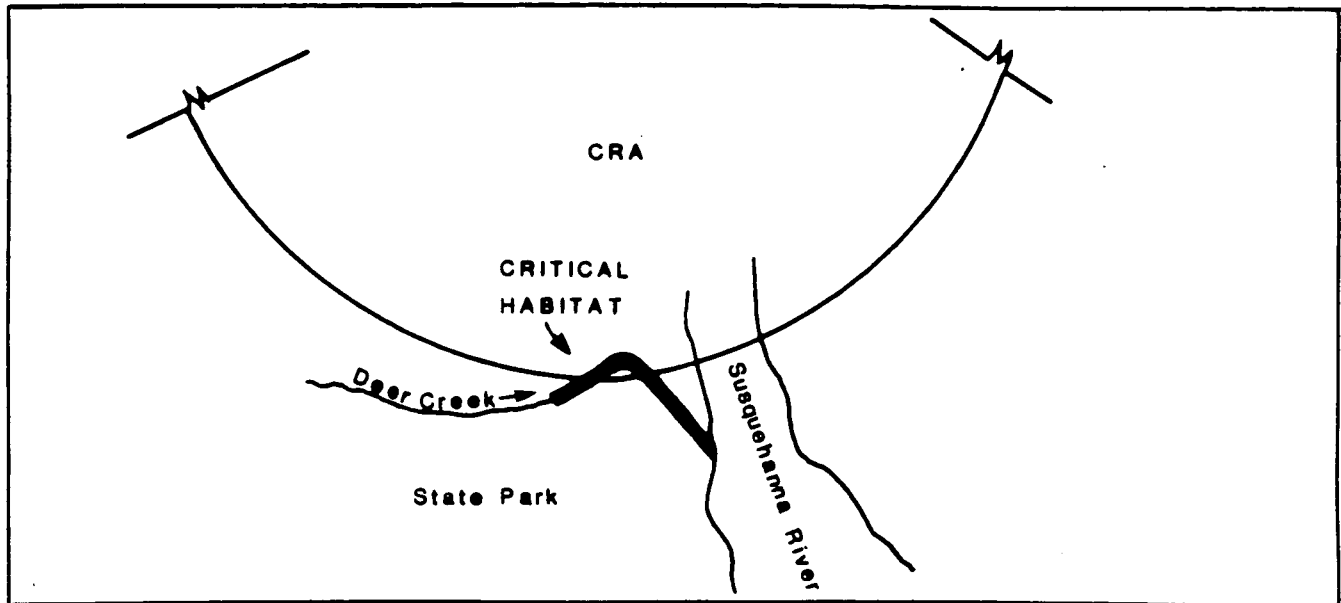
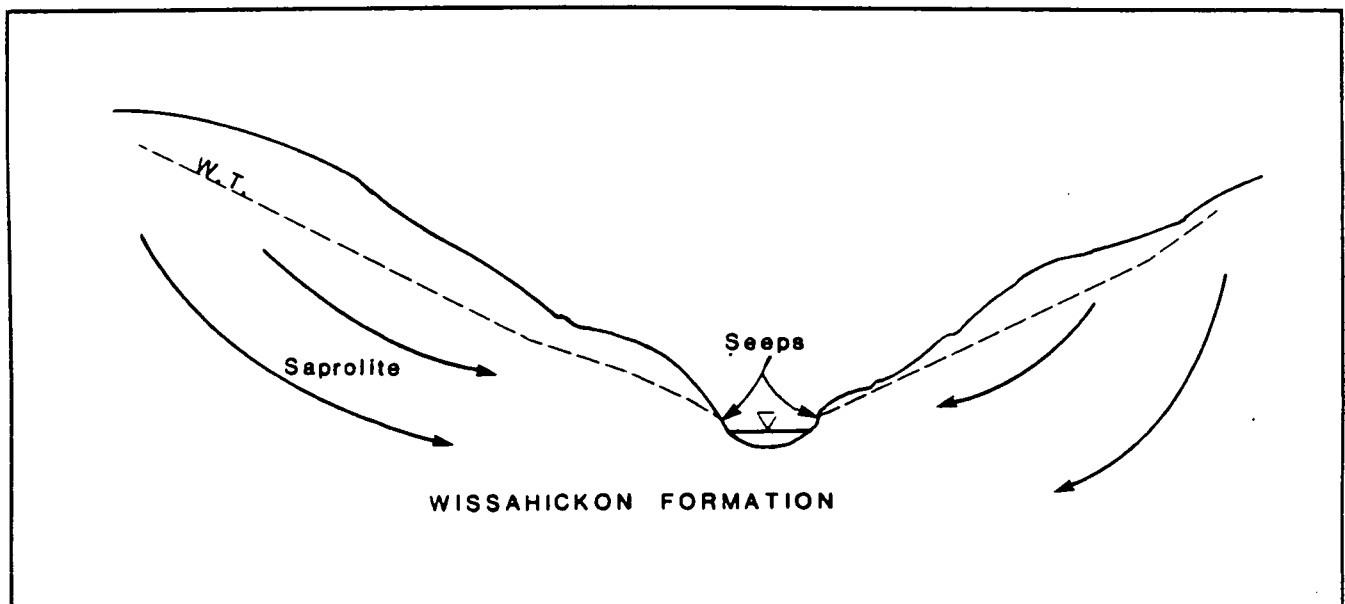


Figure 2

TYPICAL HYDROGEOLOGIC PROFILE OF DEER CREEK



bedding plane fractures that serve as the major pathway for ground-water movement. Because of the secondary permeability within the saprolite, precipitation/recharge to the consolidated bedrock aquifer can be quick and significant. Ground water can also flow along the saprolite-bedrock interface to surface streams which have ephemeral springs and seeps.

Consultative Process

The regional office of the U.S. Fish and Wildlife Service, Newton Corner, Massachusetts, is consulted to identify listed and proposed federal endangered or threatened species' habitats within the CRA. The inquiry is directed to the field office in Annapolis, Maryland. After conferring with this office, it is determined that a critical habitat for the Maryland darter has been defined for a reach of Deer Creek that extends 1.5 miles upstream from the junction of the Susquehanna River. A segment of this critical habitat is located within the CRA. Also, Deer Creek is a likely discharge area for ground water. Therefore, the CRA overlaps a unique habitat (i.e., critical habitat) which has a sensitive ecological system. This CRA has the potential of having ecologically-vital ground water.

Vulnerability

A vulnerability analysis is the next step in the ground-water classification process because it has been

determined that a potential ecologically-vital ground water is present. The vulnerability analysis establishes whether the area is highly vulnerable to ground-water contamination.

A DRASTIC score of greater than 150 points is assumed for this example. Therefore, this area constitutes a highly vulnerable hydrogeologic setting.

Classification of Ground Water

Referring to the Classification Guide for Candidate Class I Ground Water, the following questions are addressed for Class I ecologically-vital ground water.

Step	Question/Direction	Response/Comment
1	Establish Classification Review Area and collect preliminary information.	
2	Does the CRA overlap a potential ecologically-vital ground water? • Yes, go to next step • No	Yes
3	Perform vulnerability analysis (DRASTIC). Is the CRA a highly vulnerable hydrogeologic setting? • Yes, then the ground water is CLASS I ECOLOGICALLY-VITAL	Yes, the DRASTIC rating exceeds 150 points.

FINAL CLASS DETERMINATION: CLASS I ECOLOGICALLY-VITAL

CASE STUDY NO. 2

Introduction

Case Study No. 2 is located in a karst terrain which requires the classification review area (CRA) to be enlarged to include the terminal discharge area for this hydrogeologic setting. It illustrates a situation where a unique habitat and a sensitive ecological system are located downgradient of a proposed facility. The classification of the ground water beneath the CRA is Class I ecologically-vital.

Preliminary Information with Respect to the Classification Review Area

General

The ground water underlying a facility in northwest Kentucky (Figure 1) is being classified. This area is near the Mammoth Cave National Park which includes a critical habitat for the Kentucky cave shrimp, a listed federal endangered crustacean.

Geology/Hydrogeology

The area is located within the Central Kentucky karst terrain characterized by sinkholes, infrequent streams, and an integrated system of subsurface drainage conduits and caves within carbonate bedrock. As a "mixture" karst setting, integrated conduit flow of ground water predominates over

diffuse flow thereby allowing rapid infiltration of surface fluids to the ground-water regime and rapid transport in the subsurface.

Surface fluids enter sinkholes with little filtering by the soils. This process allows rapid introduction of contaminants to the ground water and transport over long distances during short time periods. The ground water and any associated contaminants will move through the conduit/cave system to single or multiple springs along the Green River.

Ground water within the subsurface conduit system may travel various paths depending upon the intensity of the precipitation/recharge event (Figure 2). Within "mature" karst settings, a high degree of interconnection between subparallel conduit/cave systems exists, which during periods of intense recharge allows ground water to migrate perpendicular to the base-flow direction and enter separate conduit/cave systems. The result of this hydraulic process is that ground water and contaminated fluids introduced into a single ground-water basin may potentially migrate to several ground-water basins or subbasins and areally affect the quality of numerous trunk conduits and springs serving as habitats for cave shrimp.

Because the CRA is located in a karst system, the CRA boundary extends beyond the two mile radius and out to the Green River which is the discharge area for this hydrogeologic setting.

CASE STUDY NO. 2: KENTUCKY CAVE SHRIMP

Figure 1

BASE MAP OF CLASSIFICATION REVIEW AREA

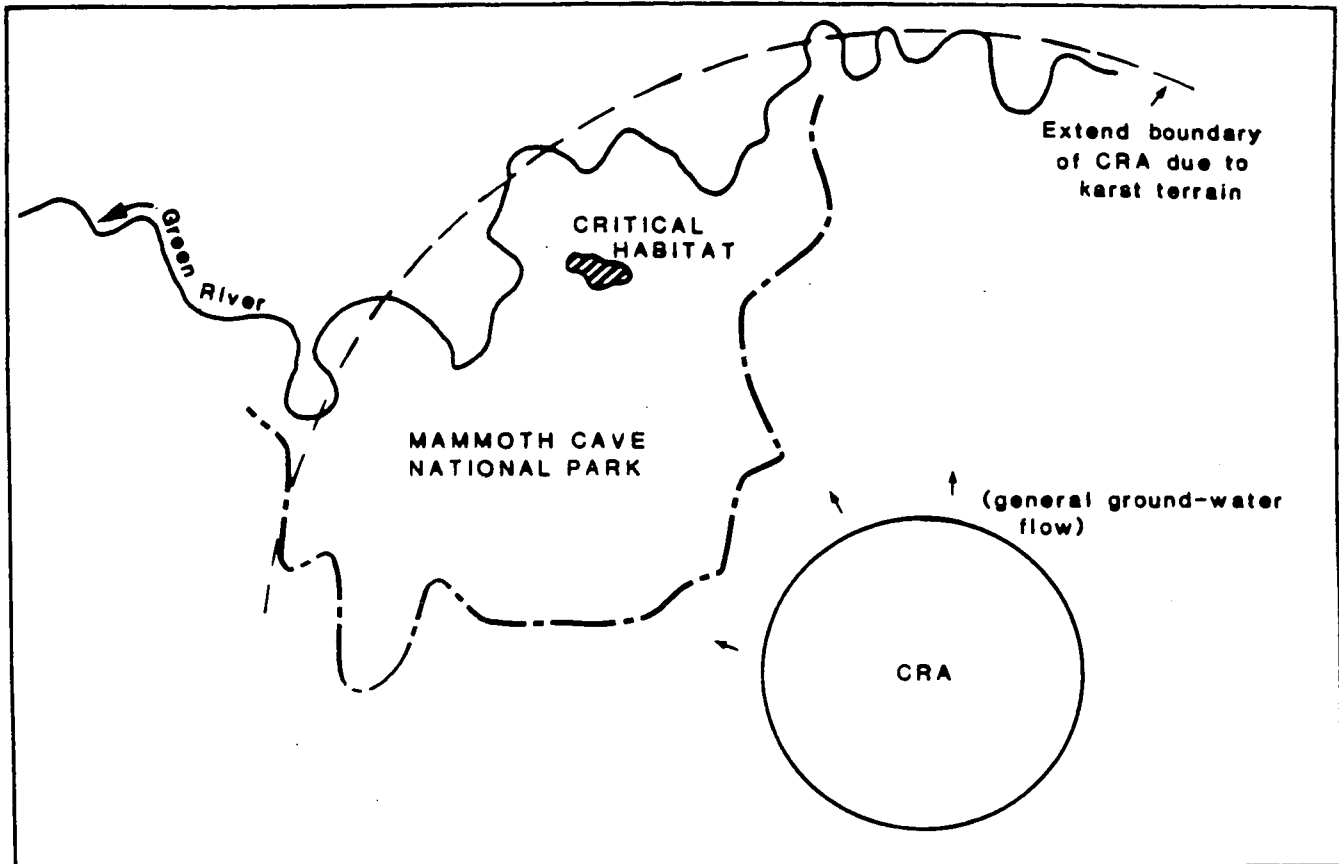
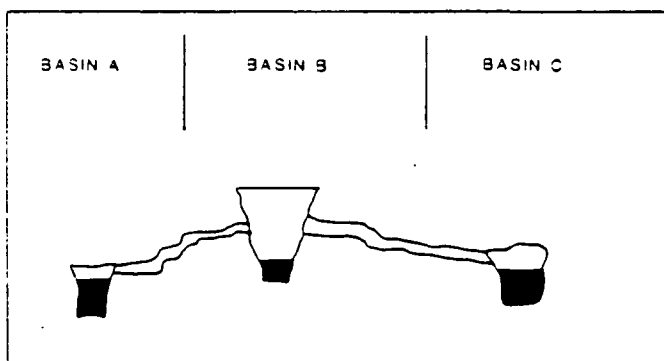
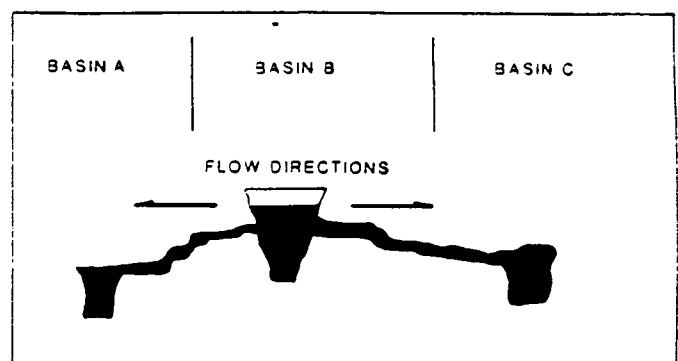


Figure 2

TYPICAL HYDRAULIC CONNECTION OF BASINS



BASE FLOW CONDITION



HIGH INTENSITY FLOW CONDITION

Consultative Process

The regional office of the U.S. Fish and Wildlife Service, Atlanta, Georgia, is consulted to identify listed and proposed federal endangered and threatened species' habitats within the CRA. The inquiry is directed to the field office in Asheville, North Carolina, and the Kentucky Nature Preserves Commission in Frankfort, Kentucky. After conferring with both offices, it is determined that the Kentucky cave shrimp has a critical habitat which is located inside the Mammoth Cave National Park. A phone call to the regional office of the National Park Service in Atlanta, Georgia, indicates that this National Park should also be considered as a unique habitat because it compromises land that has been designated for the protection of its ecological value. Because of the karst terrain, the unique habitat of the Park has intermittent ground-water discharge areas (e.g., the critical habitat of the cave shrimp). It can therefore be demonstrated that a sensitive ecological system is present within the unique habitat. As a result, the CRA has the potential of having ecologically-vital ground water.

Vulnerability

A DRASTIC score of greater than 150 points is assumed for this example. Therefore, this area constitutes a highly vulnerable hydrogeologic setting.

Classification of Ground Water

The following questions are addressed for Class I ecologically-vital ground water.

Step	Question/Direction	Response/Comment
1	Establish Classification Review Area and collect preliminary information.	
2	Does the CRA overlap a potential ecologically-vital ground water? • Yes, go to next step • No	Yes
3	Perform vulnerability analysis (DRASTIC). Is the CRA a highly vulnerable hydrogeologic setting? • Yes, then the ground water is CLASS I ECOLOGICALLY-VITAL	Yes, the DRASTIC rating exceeds 150 points.

FINAL CLASS DETERMINATION: CLASS I ECOLOGICALLY-VITAL

CASE STUDY NO. 3

Introduction

Case Study No. 3 illustrates four scenarios of unique habitats and sensitive ecological systems within a classification review area (CRA). The classification of the ground water beneath the CRA is determined to be Class I ecologically-vital in two scenarios and Class II in two other scenarios depending on the potential unique habitat under consideration.

Preliminary Information with Respect to the Classification Review Area

General

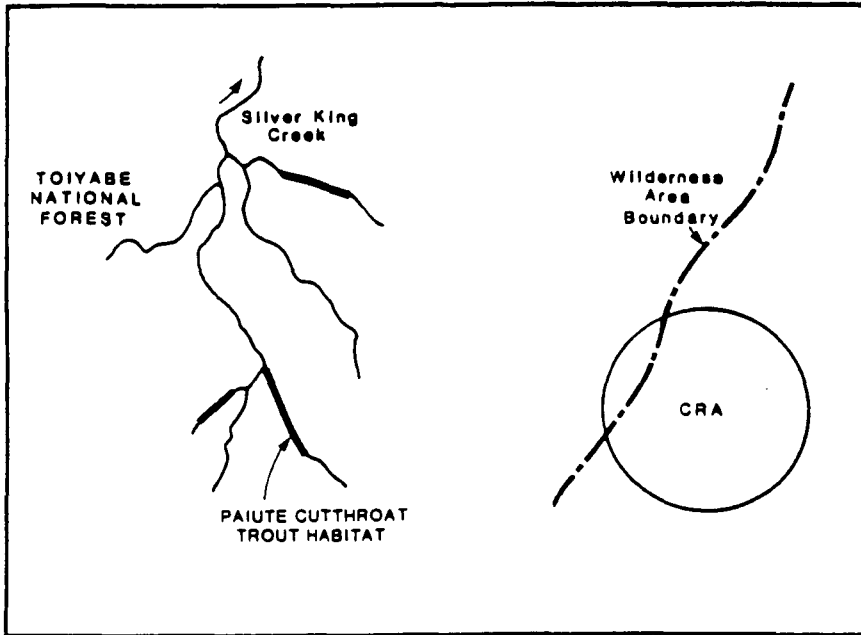
The ground water underlying a facility located on private land within the Toiyabe National Forest (Figure 1) is being classified. The CRA is located upgradient of the Silver King Creek. Possible unique habitats in the watershed are the Toiyabe National Forest, the Carson-Iceberg Wilderness Area (which is within the Toiyabe National Forest), and selected stream reaches of Silver King Creek which are current habitat for the California Paiute cutthroat trout, a listed federal threatened fish.

CASE STUDY NO.3: PAIUTE CUTTHROAT TROUT

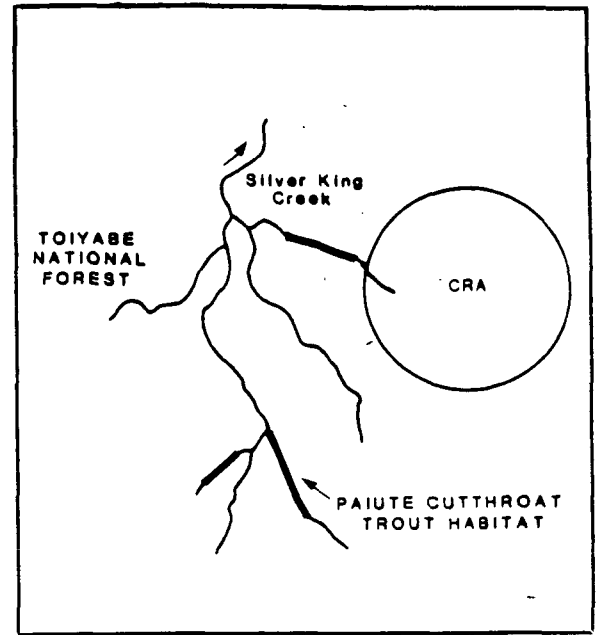
Figure 1

BASE MAP OF CLASSIFICATION REVIEW AREA

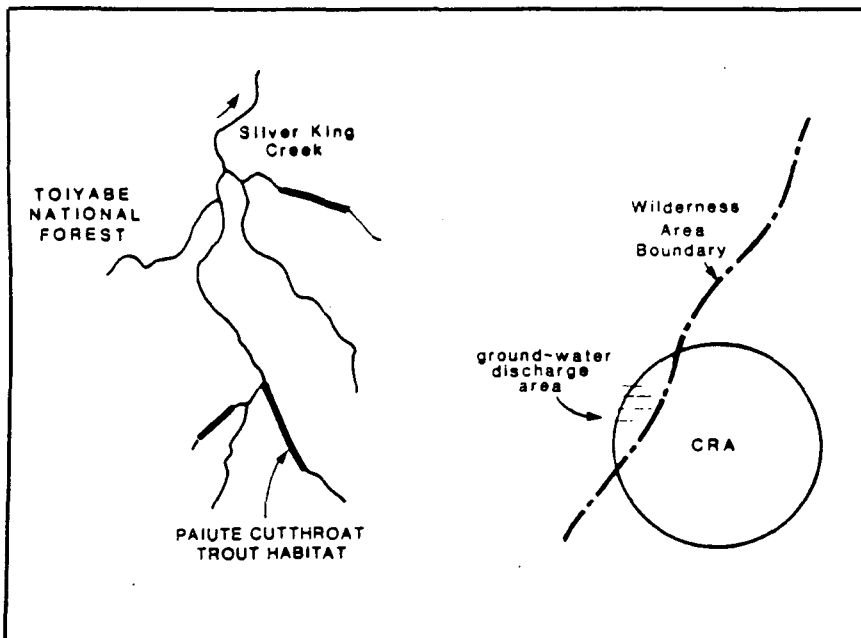
Scenario A



Scenario C



Scenario B



Scenario D

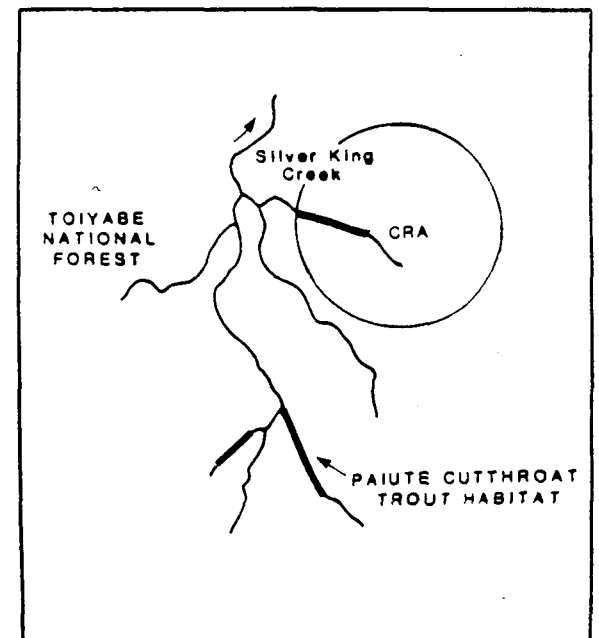
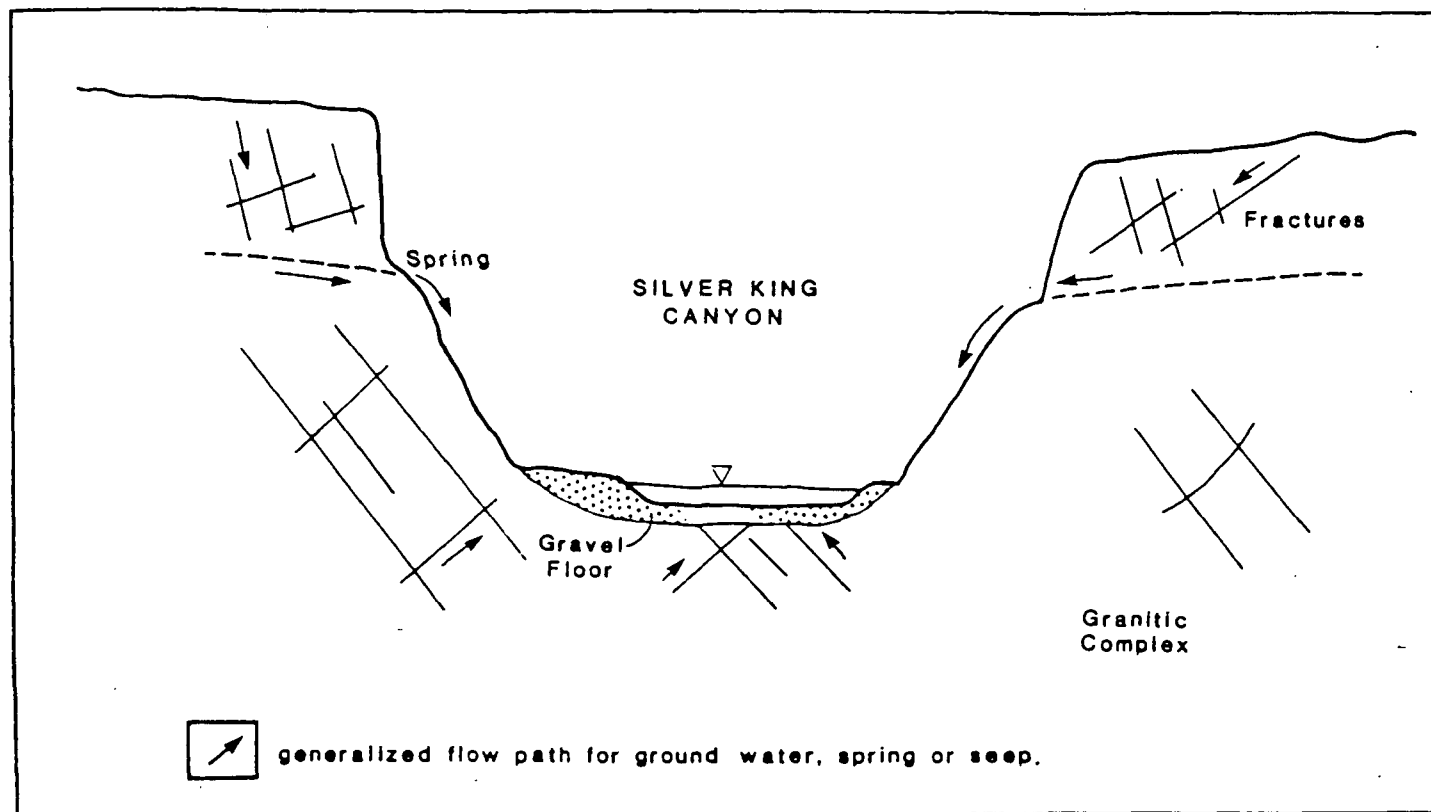


Figure 2
TYPICAL HYDROGEOLOGIC PROFILE OF SILVER KING CANYON



Geology/Hydrogeology

Silver King Canyon is characterized by an extensive flat valley floor with steep canyon walls. The valley floor consists of reworked gravels of granite and metavolcanic origin. Ground water flows through the rock fractures and within geologic unconformities (Figure 2). Both ephemeral and perennial springs exist in the area which establish the base flow for Silver King Creek. The origin of stream water is from direct precipitation, recharge derived from springs and seeps, and deep hydrothermal springs from the basement paleozoic metavolcanic complex.

Consultative Process

The regional office of U.S. Fish and Wildlife Service and the California National Diversity Database office, both in Sacramento, California, are consulted to identify listed and proposed federal endangered and threatened species' habitats within the CRA. After conferring with these offices, it is determined that the habitat of the Paiute cutthroat trout is located in selected reaches of the Silver King Creek. (No "critical habitat" has been determined for this species.) Also, the regional U.S. Forest Service office in San Francisco, California, is consulted to determine whether the National Forest or the Wilderness Area (which is within the National Forest) or both should be considered as unique habitat. For this case study, the Wilderness Area is selected to be a unique

habitat. Four scenarios (lettered A through D) are presented below to demonstrate the ground-water classification process:

- A. The CRA overlaps a part of the Carson-Iceberg Wilderness Area. Available hydrogeologic data suggest that there is no ground-water discharge into the Wilderness Area and therefore there is no sensitive ecological system present within the unique habitat. The CRA is determined not to have a potential ecologically-vital ground water.
- B. The CRA overlaps a part of the Carson-Iceberg Wilderness Area. There is also a ground-water discharge into the Wilderness Area which establishes the presence of a sensitive ecological system within the unique habitat. The CRA is determined to have a potential ecologically-vital ground water.
- C. The CRA overlaps a part of Toiyabe National Forest that includes an upper reach of a Silver King Creek tributary. Hydrogeologic data suggest that there is ground-water discharge directly into this reach of the tributary. Because neither the National Forest nor the tributary upstream of the cutthroat trout habitat is a unique habitat, the CRA is determined not to have potential ecologically-vital ground water.
- D. The CRA overlaps a part of Toiyabe National Forest that includes a reach of Silver King Creek that is current habitat for the California Paiute cutthroat trout. Hydrogeologic data suggest that ground water discharges directly into the trout habitat. Because ground water discharges into this unique habitat, a sensitive ecological system is present. Therefore, the CRA is determined to have a potential ecologically-vital ground water.

Vulnerability

A DRASTIC score of greater than 120 points is assumed for this example. Therefore, this area constitutes a highly vulnerable hydrogeologic setting.

Classification of Ground Water

The following questions are addressed for Class I ecologically-vital ground water.

Step	Question/Direction	Response/Comment	
1	Establish Classification Review Area and collect preliminary information.		
2	Does the CRA overlap a potential ecologically-vital ground water? <ul style="list-style-type: none">• Yes, go to next step• No	Scenario A Scenario B Scenario C Scenario D	No Yes No Yes
3	Perform vulnerability analysis (DRASTIC). Is the CRA a highly vulnerable hydrogeologic setting? <ul style="list-style-type: none">• Yes, the ground water is CLASS I ECOLOGICALLY-VITAL• No	Scenario B Scenario D	Yes, the DRASTIC rating exceeds 120 points. Yes, the DRASTIC rating exceeds 120 points.
FINAL CLASS DETERMINATION:			
Scenario A: CLASS II			
Scenario B: CLASS I ECOLOGICALLY-VITAL			
Scenario C: CLASS II			
Scenario D: CLASS I ECOLOGICALLY-VITAL			

CASE STUDY NO. 4

Introduction

Case Study No. 4 illustrates a situation where a potential unique habitat and a sensitive ecological system are located inside the the classification review area (CRA). The classification of the ground water beneath the CRA is Class II.

Preliminary Information with Respect to the Classification Review Area

General

The ground water underlying a facility in North Carolina is being classified. The area is generally undeveloped and is characterized by scattered bogs and seeps (Figure 1). The CRA is near a current habitat of the bunched arrowhead, a listed federal endangered plant. (No "critical habitat" has been determined for this species.) The CRA also overlaps an area where a historical siting of this species has occurred.

Geology/Hydrogeology

The area is located within the Piedmont Blue Ridge region. The area is underlain with unconsolidated material derived from weathering of the bedrock. Underlying the floodplains in larger stream valleys are thin, alluvial stream deposits. The bedrock consists of fractured igneous and sedimentary rock (Figure 2).

CASE STUDY NO.4: BUNCHED ARROWHEAD

Figure 1
BASE MAP OF STUDY AREA

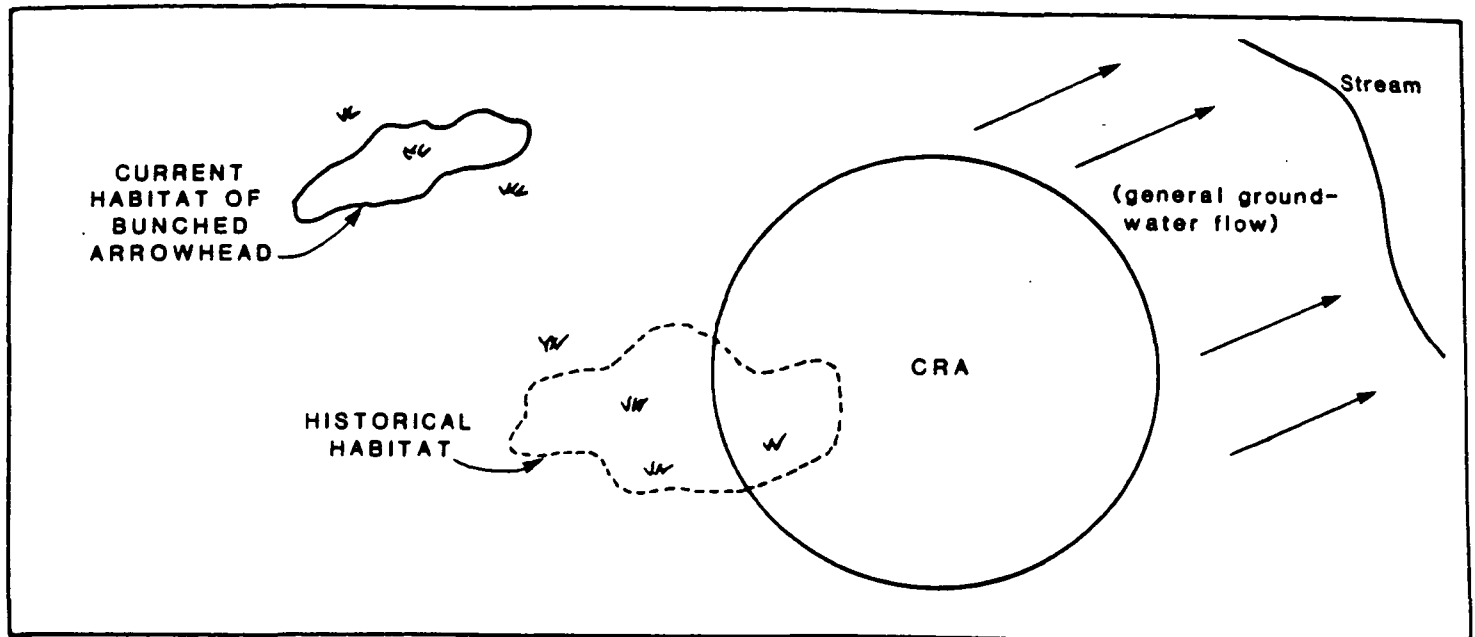
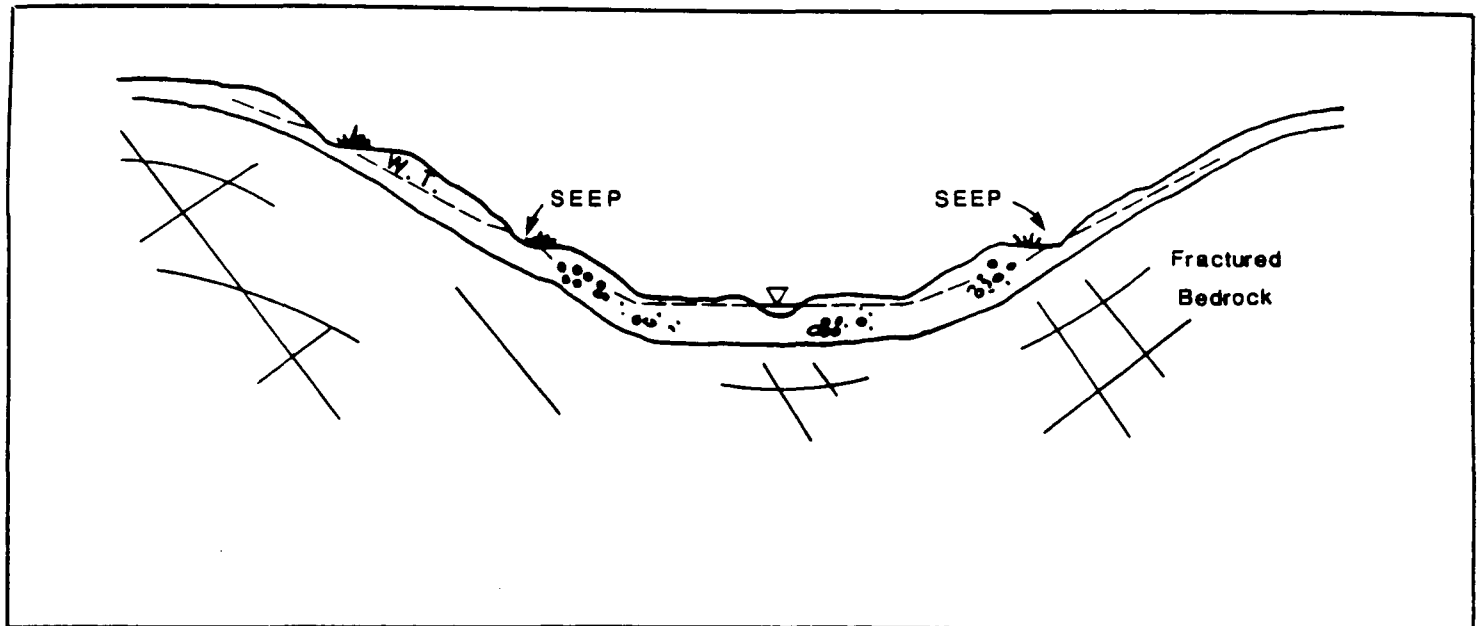


Figure 2
TYPICAL HYDROGEOLOGIC PROFILE OF STREAM



Ground water is contained in the pores of the unconsolidated material and alluvium whereas ground water in the bedrock material flows in the fractures. The unconsolidated material and alluvium serve as a reservoir which slowly supplies water to the underlying bedrock fractures.

Ground water occurs as springs and seeps along the base of the ridges. Recharge occurs in the floodplains and the discharge base of the ridges.

Consultative Process

The regional office of the U.S. Fish and Wildlife Service, Atlanta, Georgia, is consulted to identify listed and proposed federal endangered and threatened species' habitats within the CRA. The inquiry is directed to the field office in Asheville, North Carolina, and the North Carolina Natural Heritage in Raleigh, North Carolina. After conferring with both offices, it is determined that there is a current habitat of the plant located just outside of the CRA. Even though this unique habitat is in a ground-water discharge area, it is upgradient of the CRA and does not represent a sensitive ecological system. The CRA also overlaps a historical habitat of the plant but no sitings of the plant can be documented based on a recent field survey. Therefore this historical habitat is not considered to be a unique habitat. As a result, the CRA does not overlay a potential ecologically-vital ground water.

Classification of Ground Water

The following questions are addressed for Class I ecologically-vital ground water.

Step	Question/Direction	Response/Comment
1	Establish Classification Review Area and collect preliminary information.	
2	Does the CRA overlap a potential ecologically- vital ground water? • Yes, go to next step • No	No
FINAL CLASSIFICATION: CLASS II GROUND WATER		

May 1985

ATTACHMENT D

LIST OF OFFICES OF ENDANGERED SPECIES
U.S. FISH AND WILDLIFE SERVICES

The Fish and Wildlife Service, a unit of the U.S. Department of the Interior, has been delegated the main responsibility for coordinating national and international efforts on behalf of Endangered Species.

In the case of marine species, however, actions are taken in cooperation with the Secretary of Commerce, through the Director of the National Marine Fisheries Service (Liaison listed on page 8). Similarly, in the area of import/export enforcement for Endangered plants, Interior cooperates with and is assisted by the Department of Agriculture through the Animal and Plant Health Inspection Service (Liaison listed on page 7).

PROGRAM MANAGER--ENDANGERED SPECIES--Mr. Ronald E. Lambertson
Associate Director--Federal Assistance
U.S. Fish and Wildlife Service
U.S. Department of the Interior
Washington, D.C. 20240
Telephone: 202/343-4646

CATEGORY COORDINATOR--ENDANGERED SPECIES--Mr. Roman Koenings
Deputy Associate Director--Federal Assistance
U.S. Fish and Wildlife Service
U.S. Department of the Interior
Washington, D.C. 20240
Telephone: 202/343-4646

Mr. John M. Murphy, Chief
Office of Program Development
and Administration
U.S. Fish and Wildlife Service
1000 North Glebe Road, Room 629
Arlington, Virginia
Telephone: 703/235-1726, 7, 8

Mailing Address for Office of Program
Development and Administration

U.S. Fish and Wildlife Service
Washington, D.C. 20240

Mr. John L. Spinks, Jr. Chief
Office of Endangered Species
U.S. Fish and Wildlife Service
1000 North Glebe Road, Suite 500
Arlington, Virginia
Telephone: 703/235-2771, 2

Mailing Address for Office of
Endangered Species

U.S. Fish and Wildlife Service
Washington, D.C. 20240

Dr. Kenneth R. Russell, Chief, Branch of Biological Support
Telephone: 703/235-1975, 6, 7

Mr. Brian Cole, Chief, Branch of Management Operations
Telephone: 703/235-2760, 1, 2

Chief
Federal Wildlife Permit Office
U.S. Fish and Wildlife Service
1000 North Glebe Road, Suite 600
Arlington, Virginia
Telephone: 703/235-1937, 8, 9

Mailing Address for Federal
Wildlife Permit Office

U.S. Fish and Wildlife Service
Washington, D.C. 20240

Mr. Clark Bavin, Chief
Division of Law Enforcement
U.S. Fish and Wildlife Service
1735 K Street, NW., 3rd Floor
Washington, D.C.
Telephone: 202/343-9242

Mailing Address for Division
of Law Enforcement

P.O. Box 28006
Washington, D.C. 20005

Mr. Thomas Striegler, Special-Agent-in-Charge, Branch of Investigations
Telephone: 202/343-9242

Dr. Richard L. Jachowski, Chief
Office of the Scientific Authority
U.S. Fish and Wildlife Service
1717 H Street, NW., Room 536
Washington, D.C.
Telephone: 202/653-5948, 49, 50

Mailing Address for Office of
the Scientific Authority

U.S. Fish and Wildlife Service
Washington, D.C. 20240

Regional Endangered Species Coordinators:

The U.S. Fish and Wildlife Service is comprised of seven Regional Offices. (See map on inside back cover for geographic boundaries.) Each office has a senior official who has been designated as a Regional Endangered Species Coordinator. Additionally, each of the regions has several Field Offices. Problems of a local nature should be referred to these offices.

Region 1 Regional Director (Attention: Mr. Sanford R. Wilbur
Endangered Species Specialist)
U.S. Fish and Wildlife Service
Suite 1692, Lloyd 500 Building
500 NE. Multnomah Street
Portland, Oregon 97232
Telephone: 503/231-6131 (FTS: 8/429-6131)

Field Offices

California
1230 "N" Street, 14th Floor
Sacramento, California 95814
Telephone: 916/440-2791 (FTS: 8/448-2791)

Idaho
4696 Overland Road, Room 566
Boise, Idaho 83705
Telephone: 208/334-1806 (FTS: 8/554-1806)

Nevada

Great Basin Complex
4600 Kietzke Lane, Building C
Reno, Nevada 89502
Telephone: 702/784-5227 (FTS: 8/470-5227 or 5228)

Washington/Oregon

Building-3, 2625 Parkmont Lane
Olympia, Washington 98502
Telephone: 206/753-9444 (FTS: 8/434-9444)

Pacific Islands Administrator

300 Ala Moana Boulevard, Room 5302
P.O. Box 50167
Honolulu, Hawaii 96850
Telephone: 808/546-5608 (FTS: 8/546-5608)

Region 2 Regional Director (Attention: Mr. James Johnson
Endangered Species Specialist)
U.S. Fish and Wildlife Service
500 Gold Avenue, SW.
P.O. Box 1306
Albuquerque, New Mexico 87103
Telephone: 505/766-3972 (FTS: 8/474-3972)

Field Offices

Arizona

2934 West Fairmont Avenue
Phoenix, Arizona 85017
Telephone: 602/241-2493 (FTS: 8/261-2493)

New Mexico

P.O. Box 4487
Albuquerque, New Mexico 87196
Telephone: 505/766-3966 (FTS: 8/474-3966)

Oklahoma/Texas

222 South Houston, Suite A
Tulsa, Oklahoma 74127
Telephone: 918/581-7458 (FTS: 8/736-7458)

Texas

c/o CCSU, Box 338
6300 Ocean Drive
Corpus Christi, Texas 78411
Telephone: 512/888-3346 (FTS: 8/734-3346)

Fritz Lanham Building, Room 9A33
819 Taylor Street
Fort Worth, Texas 76102
Telephone: 817/334-2961 (FTS: 8/334-2961)

Region 3 Regional Director (Attention: Mr. James M. Engel
Endangered Species Specialist)
U.S. Fish and Wildlife Service
Federal Building, Fort Snelling
Twin Cities, Minnesota 55111
Telephone: 612/725-3276 (FTS: 8/725-3276)

Region 4 Regional Director (Attention: Mr. Alex B. Montgomery
Endangered Species Specialist)
U.S. Fish and Wildlife Service
The Richard B. Russell Federal Building
75 Spring Street, SW.
Atlanta, Georgia 30303
Telephone: 404/221-3583 (FTS: 8/242-3583)

Field Offices

Alabama/Arkansas/Louisiana/Mississippi
Jackson Mall Office Center
300 Woodrow Wilson Avenue, Suite 3185
Jackson, Mississippi 39213
Telephone: 601/960-4900 (FTS: 8/490-4900)

Florida/Georgia
2747 Art Museum Drive
Jacksonville, Florida 32207
Telephone: 904/791-2580 (FTS: 8/946-2580)

Kentucky/North Carolina/South Carolina/Tennessee
Plateau Building, Room A-5
50 South French Broad Avenue
Asheville, North Carolina 28801
Telephone: 704/258-2850 ext. 382 (FTS: 8/672-0321)

Puerto Rico/Virgin Islands
P.O. Box 3005
Marina Station
Mayaguez, Puerto Rico 00709
Telephone: 809/833-5760 (FTS: 8/967-1221)

Region 5 Regional Director (Attention: Mr. Paul Nickerson
Endangered Species Specialist)
U.S. Fish and Wildlife Service
Suite 700, One Gateway Center
Newton Corner, Massachusetts 02158
Telephone: 617/965-5100 ext. 316 (FTS: 8/829-9316, 7, 8)

Field Offices

Connecticut/Maine/Vermont/Massachusetts

New Hampshire/Rhode Island

P.O. Box 1518

Concord, New Hampshire 03301

Telephone: 603/224-9558, 9 (FTS: 8/834-4726)

District of Columbia/Delaware/Maryland

Virginia/West Virginia

1825 Virginia Street

Annapolis, Maryland 21401

Telephone: 301/269-6324 (FTS: 8/922-4197)

New Jersey/Pennsylvania

112 West Foster Avenue

State College, Pennsylvania 16801

Telephone: 814/234-4090 (FTS: 8/727-4621)

New York

100 Grange Place

Cortland, New York 13045

Telephone: 607/753-9334 (FTS: 8/882-4246)

Region 6 Regional Director (Attention: Mr. Don Rodgers
Endangered Species Specialist)

U.S. Fish and Wildlife Service

P.O. Box 25486, Denver Federal Center

Denver, Colorado 80225

Telephone: 303/234-2496 (FTS: 8/234-2496)

Field Offices

Colorado/Utah

Room 1406, Federal Building

125 S. State Street

Salt Lake City, Utah 84138

Telephone: 801/524-4430 (FTS: 8/588-4430)

Kansas/Nebraska/North Dakota/South Dakota

223 Federal Building

P.O. Box 250

Pierre, South Dakota 57501

Telephone: 605/224-8692 (FTS: 8/782-5226)

Montana/Wyoming

Federal Building, Room 3035

316 North 26th Street

Billings, Montana 59101

Telephone: 406/657-6059 or 6062 (FTS: 8/657-6059)

Region 7 Regional Director (Attention: Mr. Dennis Money
Endangered Species Specialist)
1011 E. Tudor Road
Anchorage, Alaska 99503
Telephone: 907/786-3435 (FTS: 8/907/786-3435)

ATTACHMENT E

LIST OF STATE NATURAL HERITAGE PROGRAM OFFICES October 1985

Nongame Branch
ARIZONA HERITAGE PROGRAM
Arizona Game & Fish Department
2222 W. Greenway Rd.
Phoenix, AZ 85023
602/942-3000 x245

Branch Supervisor: Terry Johnson
Zoologist: Dick Todd
Zoologist: Cecil Schwalbe
Zoologist: Jim Brooks
Data Manager: Rich Glinksi
Habitat Spec.: Bruce Palmer
Wildlife Rehab: Cindy Dorothy

ARKANSAS NATURAL HERITAGE INVENTORY
225 E. Markham, Suite 200
Little Rock, AR 72201
501/371-1706

Coordinator/Zoologist: Ken Smith
Ecologist: Tom Foti
Botanist: Steve Orzell
Data Manager: Cindy Osborne

CALIFORNIA NATURAL DIVERSITY DATABASE
c/o CA Dept. of Fish & Game
1416 9th Street
Sacramento, CA 95814
916/322-2493

Section Leader: Steve Nicola
Prog. Manager/Ecol: Deborah Jensen
Zoologist: Larry Eng
Res.Asst/Zool: Carrie Shaw
Aquatic Ecol: John Ellison
Ecologist: Bob Holland
Botanist: Jim Shevock
Asst.Botanist: Cindy Roy
Data Handler: Sylvia Gude
Element Pres./Plan: Roxanne Bittman
End.Plants Coord: Susan Cochrane
SNAP Coordinator: Chris Unkel

COLORADO NATURAL HERITAGE INVENTORY
Dept. of Natural Resources
1313 Sherman St., Rm.718
Denver, CO 80203
303/866-3311

Botanist: Steve O'Kane
Ecol: Susan Galatowitsch
303/860-9142

CONNECTICUT NATURAL DIVERSITY DATABASE
Natural Resources Center
Dept. of Environmental Protection
State Office Building, Rm. 553
165 Capitol Avenue
Hartford, CT 06106
203/566-3540

Biologist/Data Man: Nancy Murray
Ecologist: Ken Metzler
Data Handler: Megan Rollins

FLORIDA NATURAL AREAS INVENTORY
254 E. 6th Avenue
Tallahassee, FL 32303
904/224-8207

Coordinator: Steve Gatewood
Zoologist: Dale Jackson
Botanist: Dennis Hardin
Res.Spec/Data Manager: Jim Muller
Secretary: Judith Lyons

* HAWAII HERITAGE
1116 Smith St., #201
Honolulu, HI 96817
808/537-4508
Director: Audrey Newman

IDAHO NATURAL HERITAGE PROGRAM
4696 Overland Rd., Suite 518
Boise, ID 83705
208/334-3402 or 3649
Coordinator/Zool: Craig Groves
Botanist/Ecologist: Steve Caicco
Data Handler/Biol: Pam Peterson

INDIANA HERITAGE PROGRAM
Div. of Nature Preserves, IN DNR
612 State Office Bldg.
Indianapolis, IN 46204
317/232-4078

Coordinator/Bot: Jim Aldrich
Ecologist: Mike Homoya
Plant Ecologist: Tom Post
Zoologist: Brian Abrell

IOWA NATURAL AREAS INVENTORY
State Conservation Commission
Wallace State Office Bldg.
Des Moines, IA 50319
515/281-8524
Ecologist: John Pearson
Data Handler: John Fleckenstein
Zoologist: Daryl Howell
Botanist: Mark Leoschke

KENTUCKY HERITAGE PROGRAM
KY Nature Preserves Commission
407 Broadway
Frankfort, KY 40601
502/564-2886

Director: Richard Hannan
Botanist: Marc Evans
Zoologist: Ronald Cicerello
Ornithol: Brainerd Palmer-Ball
Aquatic Biol: Bill Fisher
Secretary: Julie Smither

LOUISIANA NATURAL HERITAGE PROGRAM
Department of Natural Resources
Coastal Management Division
P.O. Box 44124
Baton Rouge, LA 70804-4124
504/342-4602

Coordinator/Ecol: Nancy Jo Craig
Zoologist: Gary Lester
Botanist: Annette Parker
Data Manager: Alanea Williams

* MAINE NATURAL HERITAGE PROGRAM
Maine Chapter
122 Main Street
Topsham, ME 04086
207/729-5181
Coordinator: John Albright
Data Manager/Bot: Amy Osterbrock

MARYLAND NATURAL HERITAGE &
ENVIRONMENTAL REVIEW
Dept. of Natural Resources
C-3, Tawes State Office Bldg.
Annapolis, MD 21401
261-1402 x3656 D.C. DIRECT DIAL
301/269-3656
Coordinator/Bot: Dan Boone
Environmental Spec: Arnold Norden
Man. Area Spec: Derek Richerson

* MODEL NATURAL HERITAGE PROGRAM
The Nature Conservancy
1800 N. Kent St., Suite 800
Arlington, VA 22209
703/841-5307
Zoologist: David Wilcove
Botanist: Mary Palmer
Ecologist: being hired

MASSACHUSETTS HERITAGE PROGRAM
Div. of Fisheries & Wildlife
100 Cambridge St.
Boston, MA 02202
617/727-9194
Coordinator/Ecol: Henry Woolsey
Botanist: Bruce Sorrie
Zoologist: Scott Melvin
Data Manager: Joanne Tribble
Hab.Prot.Spec: Annie Marlowe

MICHIGAN NATURAL FEATURES INVENTORY
Mason Building, 5th floor
Box 30028
Lansing, MI 48909
517/373-1552

Coordinator/Bot: Sue Crispin
Ecologist: Kim Chapman
Zoologist: Leni Wilsmann
Data Manager: Stu Ouwings

MINNESOTA NATURAL HERITAGE PROGRAM
Department of Natural Resources
Box 6
St. Paul, MN 55155
612/296-4284

Coordinator: Barbara Coffin
Botanist: Welby Smith
Ecologist: Keith Wendt
Zoologist: Lee Pfannmuller
Data Manager: Carmen Converse

MISSISSIPPI NATURAL HERITAGE PROGRAM
111 N. Jefferson St.
Jackson, MS 39202
601/354-7226
Coord/Bot/Wild.Bio: Ken Gordon
Zoologist: Bob Jones
Ecologist: Jim Wiseman

MISSOURI NATURAL HERITAGE INVENTORY
Missouri Dept. of Conservation
P.O. Box 180
Jefferson City, MO 65102
314/751-4115
Coordinator: Mike Sweet
Biologist: Dennis Figg-X310
Secretary: Diana Munstarmen

MONTANA NATURAL HERITAGE PROGRAM
State Library Building
1515 E. 6th Ave.
Helena, MT 59620
406/444-3009
Coordinator/Zool: David Genter
Botanist: Steve Shelly
Ecologist: Nancy Grulke
Data Tech/Sec: Lisa Shepperd

NAVAJO NATURAL HERITAGE PROGRAM
Box 2429
Window Rock, AZ 86515-2429
602/871-6453 or 5449
Acting Coord/Botanist: Donna House
Data Manager: Virgil Link
Zoologist: vacant

NEVADA NATURAL HERITAGE PROGRAM
Dept. of Conservation & Natural
Resources
c/o Div. of State Parks
Capitol Complex, Nye Bldg.
201 S. Fall St.
Carson City, NV 89710
702/885-4360

Coordinator/sci.: being hired
Research sci.: being hired

NEW HAMPSHIRE NATURAL HERITAGE PROGRAM
c/o Society for the Protection of N.H.
Forests
54 Portsmouth Street
Concord, NH 03301
603/224-9945
Coordinator/Bot: Frances Brackley
Data Manager: Edie Hentcy

NEW JERSEY NATURAL HERITAGE PROGRAM
Office of Natural Lands Management
109 W. State St.
Trenton, NJ 08625
609/984-1339 or 1170
Coordinator/Ecol: Thomas Breden
Botanist: David Snyder
Zoologist: Jim Scalscia
Data Manager: Jane Saks
Data Handler: Elena Williams

NEW MEXICO NATURAL RESOURCES
SURVEY SECTION
Villagra Bldg.
Santa Fe, NM 87503
505/827-7862
Coordinator: Cathy Carruthers
Botanist: Paul Knight-7850
Botanist: Anne Cully
Data Handler: Leslie Price
Mgmt. Analyst: Denise Gross

NEW YORK NATURAL HERITAGE PROGRAM
Wildlife Resources Center
Delmar, NY 12054-9767
518/439-8014 x203
Coordinator/Zool: Pat Mehltop
Ecologist: Carol Reschke
Botanist: Steve Clements
Data Manager: Rachel Plautner
L.I. Botanist: Bob Zarembo
367-3225

NORTH CAROLINA NATURAL HERITAGE
Dept. of Natural & Economic Res.
Div. of State Parks
Box 27687
Raleigh, NC 27611
919/733-7795

Coordinator: Charles E. Roe
Botanist: Laura Manaberg
Ecologist: Alan Weakley
Protection Spec: Julie H. Moore
Wetlands Inv.Res.Spec: Steven Leonard
Zoologist: Harry LeGrand, Jr.
Inv. Info. Spec: Mike Schafale

NORTH DAKOTA NATURAL HERITAGE INVENTORY
N.D. Game & Fish Department
100 N. Bismarck Expressway
Bismarck, ND 58501
701/221-6310
Coordinator/Zool: Randy Kreil
Botanist: Alexis Duxbury
Plant Ecologist: Bonnie Heidel
Data Manager: Patay Crooke

OHIO NATURAL HERITAGE PROGRAM
OH DNR, Div. of Nat. Areas & Pres.
Fountain Square, Bldg. F
Columbus, OH 43224
614/265-6453

Coordinator: Bob McCance
Botanist: Allison Cusick
Botanist: Jim Burns
Zoologist: Dan Rice
Plant Ecologist: Dennis Anderson
Data Supervisor: Pat Jones
Data Specialist: MaryAnn Silagy
Data Specialist: Lauren McEleney

OKLAHOMA NATURAL HERITAGE PROGRAM
Oklahoma Tourism & Recreation Dept.
500 Will Rogers Bldg.
Oklahoma City, OK 73105
405/521-2973
Coord/Stat-Analyst: Lela Brown

OREGON NATURAL HERITAGE PROGRAM
Oregon Field Office
1234 NW 25th Avenue
Portland, OR 97210
503/228-9550
Coord/Ecologist: Jimmy Kagan
Botanist: Sue Yamamoto
Zoologist: Connie Levesque

PENNSYLVANIA NATURAL DIVERSITY
INVENTORY
Bureau of Forestry
Department of Environmental Resources
34 Airport Road
Middletown, PA 17057
717/783-1712
Coordinator/Ecologist: Tom Smith
Zoologist: Anthony Wilkinson

PROGRAMA PRO-PATRIMONIO NATURAL
Apartado 5887
Puerta de Tierra, Puerto Rico 00906
809/724-0960
Coord/Zoologist: Peter Ortiz
Bot/Data Man: Vicente Quevedo
Secretary: Myrta Hernandez

RHODE ISLAND HERITAGE PROGRAM
Dept. of Environmental Mgmt.
Div. of Planning & Development
22 Hayes St.
Providence, RI 02903
401/277-2776
Coordinator/Bot: Rick Enser
Zoologist: Chris Raithel

SOUTH CAROLINA HERITAGE TRUST
S.C. Wildl. & Marine Resources Dept.
P.O. Box 167
Columbia, SC 29202
803/758-0014
Coord/Zool: Steve Bennett
Fish & Wildl. Bio: John Cely
Envir. Planner: Stu Greeter
Botanist: Doug Rayner
Ecologist: John Nelson
F&W Bio/Preserve Mgr: Jim Sorrow
Secretary: Kaye Dial Daniels

SOUTH DAKOTA NATURAL HERITAGE
S.D. Dept. of Game, Fish & Parks
Div. of Parks & Recreation
Sigurd Anderson Bldg., 8-114
Pierre, SD 57501
605/773-4226
Botanist: David Ode
Data Spec: George Vandel

(TENNESSEE HERITAGE PROGRAM)
ECOLOGICAL SERVICES DIVISION
TN Department of Conservation
701 Broadway
Nashville, TN 37203
615/742-6545
Director: Dan Eager
Zoologist: Paul Hamel
Plant Ecol/Prot. Plan: Larry Smith
Botanist: Paul Somers
Wildlife Ecol: Daryl Durham
Data Base Manager: Dave Shupe
Aq. Bio/Pro. Rev. Coord: Roberta Hylton

TEXAS NATURAL HERITAGE PROGRAM
General Land Office
Stephen F. Austin Bldg.
Austin, TX 78701
512/475-0660, 0661, 0800
Asst. Deputy Commissioner/
Land Mgmt. Div: Ben Brown
512/475-1539
Coordinator: Tina Bondy
Zoologist: Rex Wahl
Ecologist: David Diamond
Botanist: Jackie Poole
Data Manager: Robert Murphy
Secretary: Jackie Soliz

TVA REGIONAL HERITAGE
Office of Natural Resources
Norris, TN 37828
615/494-9800
Coordinator: William H. Redmond-X2613
Project Manager: J. Ralph Jordan
Botanist: Joseph L. Collins
Nat. Areas Coord: Judith B. Powers
Zoologist: Charles P. Nicholson

*VERMONT NATURAL HERITAGE PROGRAM
Vermont Field Office
138 Main Street
Montpelier, VT 05602
802/229-4425
Coordinator: Marc DesMeules
Ecologist/Data Man: Liz Thompson

WASHINGTON NATURAL HERITAGE PROGRAM
Department of Natural Resources
Mail Stop EX-13
Olympia, WA 98504
206/753-2448
Coordinator/Bot: Mark Sheehan
Ecologist: Linda Kunze
Plant Ecologist: Reid Schuller
Secretary: Charlotte Nelson
Habitat Preserv. Spec: Betty Roderick

WEST VIRGINIA WILDLIFE/HERITAGE
DATABASE
Wildlife Resources Division
DNR Operations Center
P.O. Box 67
Elkins, WV 26241
304/636-1767
Asst. Director: Pete Zurbuch
Coordinator/Ecol: Brian McDonald
Data Handler: Sandra Mehringer
Botanist: Garrie Rouse

WISCONSIN NATURAL HERITAGE PROGRAM
Endangered Resources/4
Dept. of Natural Resources
101 S. Webster St., Box 7921
Madison, WI 53707
608/266-0924
Zoologist: Bill Smith
Ecologist: Eric Epstein
Botanist: June Dobberpuhl
Data Manager: Kathy Bleser

WYOMING NATURAL HERITAGE PROGRAM
1603 Capitol Avenue, Rm. 323
Cheyenne, WY 82001
303/860-9142
Coord/Botanist: vacant

NATIONAL OFFICE HERITAGE TASK FORCE

Bob Jenkins, Vice President, Science	841-5320
Hardy Wieting, Director, Heritage	841-5325
Shelley Rodman, Assistant Director, HFA	841-5367
Bob Chipley, Director, PS&D	841-5322
Jung Ja An, Budget Specialist	841-5368
Jack White, National Ecologist	217/367-8770
Dorothy Allard, Classification Ecol.	217/367-8770
Larry Morse, Director, Nat'l Database	841-5361
Mary Brosnan, Nat'l Databases Associate	841-5360
Margaret Ormes, National Info.Man.	841-5360
Dave Mehlman, Microcomputer Analyst	841-5355
Bernadette Schadeewald, Microcomputer Specialist	841-5355
Ken Wright, Senior Programmer/Anal.	841-5356
Carol Hodge, Administrative Asst., HFA	841-5354
Brandy Clymire, part-time Secretary, HFA	841-5354
Ursula McGhee, Exec. Secretary, Science	841-5321

REGIONAL:

EASTERN HERITAGE TASK FORCE
The Nature Conservancy
294 Washington St.
Boston, MA 02108
617/542-1908
Coordinator/Zool: Larry Master
Ecologist: Tom Rawinski
Reg.Info.Mgr.: Jan Cassin
Zoologist: Dale Schweitzer
Data Handler: Marianne Silberman

MIDWEST HERITAGE TASK FORCE
Midwest Regional Office
The Nature Conservancy
1313 Fifth St., SE
Minneapolis, MN 55414
612/379-2207
Coordinator: Steve Chaplin
Ecologist: being hired
Reg.Info.Mgr.: being hired

ROCKY MOUNTAIN HERITAGE TASK FORCE
The Nature Conservancy
1370 Pennsylvania St., Suite 190
Denver, CO 80203
303/860-9142
Coordinator/Bot: J. Scott Peterson
Ecologist: Patrick Bourgeron
Zoologist: Blair Cauti (415/777-0541)
Reg.Info.Mgr.: Robin Voigt
Data Hand/Sec: Lisa Vestel

ATTACHMENT F
LIST OF ADDITIONAL REFERENCES

50 CFR 17.11 and 17.12, Endangered and Threatened Wildlife and Plants, January 1, 1986.

U.S. Fish and Wildlife Service, Contaminant Issues of Concern - National Wildlife Refuges, January 1986.

Guidance on Ground Water Classification: Approach to Completing Follow-up Research, January 1985, prepared by GCA Corporation for the U.S. Environmental Protection Agency - Land Disposal Branch, Washington, D.C., Contract No. 68-01-6871.

40 CFR 270.3(c), EPA Administered Permit Programs: The Hazardous Waste Permit Program.

Guidance on Remedial Investigations Under CERCLA, Chapter 9, EPA/540/G-85/002, June 1985.

Guidance on Feasibility Studies Under CERCLA, Chapter 6, EPA/540/G-85/003, June 1985.