U.S. Fish and Wildlife Service

Recovery Plan for

(*Lesquerella perforata*)
Spring Creek bladderpod

U.S Fish and Wildlife Service
Southeast Region
Atlanta, Georgia

RECOVERY PLAN

for

Lesquerella perforata (Spring Creek Bladderpod)

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Southeast Region
Atlanta, Georgia

Approved: _____

Regional Director, U.S. Fish and Wildlife Service

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Recovery plans delineate reasonable actions that are believed to be required to recover and/or protect listed species. Plans published by the U.S. Fish and Wildlife Service (Service) are sometimes prepared with the assistance of recovery teams, contractors, State agencies, and other affected and interested parties. Plans are reviewed by the public and submitted for additional peer review before they are adopted by the Service. The objectives of the plan will be attained and any necessary funds made available subject to budgetary and other constraints affecting the parties involved, as well as the need to address other priorities. Recovery plans do not obligate other parties to undertake specific tasks and may not represent the views nor the official positions or approval of any individuals or agencies involved in developing the plan, other than the Service. Recovery plans represent the official position of the Service **only** after they have been signed by the Regional Director as approved. Approved recovery plans are subject to modification as dictated by new findings, changes in species status, and the completion of recovery tasks.

By approving this recovery plan, the Regional Director certifies that the data used in its development represent the best scientific and commercial information available at the time it was written. Copies of all documents reviewed in the development of the plan are available in the administrative record, located at the Tennessee Field Office in Cookeville, Tennessee.

Literature citations should read as follows:

U.S. Fish and Wildlife Service. 2006. Recovery Plan for *Lesquerella perforata* (Spring Creek Bladderpod). Atlanta, Georgia. 23 pp.

Additional copies of this plan can be obtained from:

U. S. Fish and Wildlife Service
Tennessee Field Office
446 Neal Street
Cookeville, TN 38501
Telephone: 931/528-6481

Recovery plans can be downloaded from Service website:

http://www.fws.gov/endangered/recovery/Index.html

EXECUTIVE SUMMARY

Current Species Status: *Lesquerella perforata* (Spring Creek bladderpod) is federally listed as endangered. It is currently known from only 21 extant (still existing) occurrences (specific locations or sites) located within a five-mile radius in Wilson County, Tennessee.

Habitat Requirements and Limiting Factors: This rare plant, an annual, is restricted to the floodplains of three creeks (Spring Creek, Bartons Creek, and Cedar Creek), in agricultural fields, pastures, glades (exposed limestone bedrock with few or no trees), and disturbed areas in the vicinity of Lebanon, Tennessee, in Wilson County. This is a small area of the Central Basin section of the Interior Low Plateau in Tennessee. The plant requires some degree of disturbance, such as scouring from natural flooding or plowing of the soil, to complete its life cycle. Factors contributing to its endangered status are an extremely limited range and loss of habitat. It is threatened by rapid commercial, residential and industrial development in Wilson County and conversion of land to uses other than cultivation of annual crops. Encroachment of more competitive herbaceous and woody plants also presents a threat.

Recovery Objective: The goal of this recovery plan is to ensure the long-term viability of Spring Creek bladderpod in the wild, and ultimately, remove this plant from the *Federal List of Endangered and Threatened Plants*.

Recovery Criteria: Spring Creek bladderpod will be considered for reclassification to threatened status when there are 15 protected occurrences: five of which are located within the floodplain of each of the three creeks (Spring Creek, Bartons Creek, and Cedar Creek). These occurrences, located on either public or private land, must be protected by a permanent conservation easement with a management agreement. Each occurrence must consist of an average of 500 plants over a five-year period, with no less than 100 plants in any given year.

Spring Creek bladderpod will be considered for delisting when there are 25 protected occurrences, with at minimum five occurrences located within the floodplain of each of the three creeks (Spring Creek, Bartons Creek, and Cedar Creek). Each occurrence located on either public or private land must be protected by a permanent conservation easement with a management agreement. Each occurrence must consist of an average of 500 plants over a ten-year period with no less than 100 plants in any given year.

Actions Needed:
1. Protect and manage existing occurrences and habitats.
2. Develop and implement management strategies for the species.
3. Develop communication with local officials to coordinate county planning.
4. Utilize existing environmental laws to protect the plant and its floodplain habitat.
5. Conduct monitoring at all sites.

6. Conduct seed ecology studies.
7. Search for new populations.
8. Establish new occurrences within the historic range.
9. Maintain seed source *ex situ*.
10. Develop and implement public education plans.
11. Annually assess the success of recovery efforts for the species.

Estimated Cost of Recovery ($000): $6,407.5

Date of Recovery: The estimated date for recovery completion is 2025, provided that funds are available to accomplish the required recovery actions and that the recovery criteria are met.

Year	Need 1	Need 2	Need 3	Need 4	Need 5	Need 6	Need 7	Need 8	Need 9	Need 10	Need 11	Total
1	1000.0	140.0	1.0	5.0	75.0	80.0	20.0	100.0	1.0	10.0	0.5	1432.5
2	1000.0	130.0	1.0	5.0	75.0	80.0	20.0	100.0	1.0	10.0	0.5	1422.5
3	1000.0	0.0	1.0	5.0	50.0	50.0	0.0	100.0	1.0	10.0	0.5	1217.5
4	1000.0	0.0	1.0	5.0	50.0	0.0	0.0	100.0	1.0	10.0	0.5	1167.5
5	1000.0	0.0	1.0	5.0	50.0	0.0	0.0	100.0	1.0	10.0	0.5	1167.5
Total	**5000.0**	**270.0**	**5.0**	**25.0**	**300.0**	**210.0**	**40.0**	**500.0**	**5.0**	**50.0**	**2.5**	**6407.5**

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PART I.
INTRODUCTION

Background

Lesquerella perforata (Spring Creek bladderpod), described by R. C. Rollins (Rollins 1952), is an annual, restricted to a small area of the Central Basin Section of the Interior Low Plateau. This plant is currently known from only 21 extant (still existing) occurrences (specific locations or sites). These occurrences principally occur within the floodplains of Spring Creek, Bartons Creek, and Cedar Creek in the vicinity of Lebanon, Tennessee, in Wilson County.

Due to its limited area and threat of habitat alteration, this species was federally listed as endangered by the U.S. Fish and Wildlife Service (Service) on December 23, 1996 (61 FR 67493; Service 1996) under the Endangered Species Act of 1973, as amended (16 U.S.C. 1531 *et seq.*). The State of Tennessee also lists this species as endangered under the Rare Plant Protection and Conservation Act of 1985 (State of Tennessee 1985). It is threatened by habitat loss due to residential and commercial development, conversion of floodplain habitat from cropland to pasture, and encroachment of woody and herbaceous perennial vegetation. Historically, this plant has only been found in Wilson County, Tennessee.

Lesquerella is a genus of the Brassicaceae, the mustard family, named for the seventeenth century Swiss and American botanist Leo Lesquereux. There are approximately 75 taxa of *Lesquerella* with the majority occurring in the western states; only a few taxa are found in the Interior Low Plateau of Tennessee, Alabama, and Kentucky (Al-Shehbaz 1987). Only one species, *Lesquerella lescurii* (Nashville mustard), had been described in the eastern states prior to the 1950's work of Dr. Reed C. Rollins, a Harvard University expert on the Brassicaceae. From 1952 to 1955, Rollins described three new species of *Lesquerella* endemic to the Central Basin of Tennessee, *L. densipila* (Duck River bladderpod), *L. stonensis* (Stones River bladderpod), and *L. perforata* (Spring Creek bladderpod).

Description

Lesquerella perforata closely resembles *Lesquerella stonensis*, Stones River bladderpod, found only in the floodplain of the Stones River in Rutherford County, Tennessee. Both are annuals with white flowers, auriculate (ear-shaped) leaves, and inflated rounded fruits. All of the other species of *Lesquerella* in the eastern states have yellow flowers. The distinguishing character between *L. perforate* and *L. stonensis* is the mature fruit. The fruit of *L. perforata* is smooth to sparsely hairy on the outside and densely hairy on

the inside, with a hairless style attached to the fruit. *L. stonensis* bears fruit that is densely hairy on the outside with no hairs on the inside, and has a densely hairy style.

The following description of *L. perforata* is adapted from Kral (1983) and Rollins (1955): a herbaceous annual, stems several to many, outer ones usually decumbent (a plant that has its base lying on the ground and a stem that grows upward) at base, inner ones erect, simple or branched, 10 to 15 cm tall, stems and leaves are covered with fine or coarse hairs. Leaves at the base (rosette) have a petiole (leafstalk) and are lyrately (several lobes, which increase in size toward one large terminal lobe) lobed with pointed teeth on the margins. The stem leaves are sessile (stalkless and attached directly at the base), auriculate (ear shaped), oblong to obovate (egg shaped), with few to many teeth on the margins. The cross-shaped flowers are arranged in a raceme (stalked flowers arranged singly along an elongated unbranched axis), have white to pale lavender petals with a yellow base, and are 7 to 9 mm long. The fruits, or pods, are broadly obovoid (egg shaped) to pear-shaped, very inflated, 4 to 7 mm long, and divided into two halves. The outer surface of the pod is papery with very sparse hairs and the inside is densely hairy. The septum (the internal partition between the two halves) is perforated or nearly absent with only a small portion attached to the fruit wall. There are up to 10 round seeds in a pod measuring 1.5 to 2.5 mm long, strongly flattened and surrounded by a thin margin.

Distribution

Spring Creek bladderpod is endemic to the Central Basin; currently known from only three watersheds (Spring Creek, Bartons Creek, and Cedar Creek) consisting of 21 extant occurrences (sites) within a five-mile radius of the City of Lebanon in Wilson County, Tennessee. All but one of the occurrences are within the floodplain and terrace zones of these three watersheds. The only site not located in a floodplain is found in a cedar glade at the edge of a pasture situated on a rock ledge above Spring Creek. Most of the sites appear to be flooded periodically, especially in the spring. Of the 21 occurrences, six are located along Spring Creek, 11 along Bartons Creek and its tributaries, and four along Cedar Creek. All sites currently occur on private or municipally owned land.

Spring, Bartons, and Cedar Creeks are not dammed and flow into Old Hickory Lake, an impounded section of the Cumberland River. However, the lowermost (downstream) sections of these creeks, near their confluences with the Cumberland River, are impounded. Prior to impoundment of Old Hickory Lake, Spring Creek bladderpod may have occurred downstream on both creeks toward the confluence, and also along the Cumberland River. According to Rollins (1957), the unilateral movement of seeds downstream has an influence on the distribution of the species. The fruits are inflated and can float in the water for an extended period of time. The seed dispersal can be affected by surface run-off during rain events and by stream flow conditions.

Habitat

This species is found growing in floodplain fields along three streams. It is found mainly on newly disturbed sites and requires some degree of annual disturbance in order to complete its life cycle. In the present and the recent past, the disturbance occurred as a result of cultivation of annual crops; but, historically, the disturbance would have been a result of periodic flooding and associated scouring. Flooding helped remove the perennial grasses, herbs, and woody plants that quickly invaded the floodplain. Although flooding still occurs along these streams, the conversion of the floodplains to pasture has resulted in a reduction in soil erosion, scouring, and growth of other herbaceous species. Where limited cultivation of annual crops such as corn and soybeans still occur, it appears to provide a means of artificially maintaining the habitat. Cultivation that avoids the use of fall plowing and delays spring plowing until May, when the majority of the bladderpod plants have set fruit, does not appear to adversely affect the species. No-till farming techniques are believed to adversely affect the species, due to the lack of tillage and extensive use of herbicides to remove vegetation each year (Somers et al. 1993).

Geology

The drainage areas of Spring Creek, Bartons Creek, and Cedar Creek form one of the segments of the Inner Central Basin. The Inner Central Basin is characterized by mild karst topography with limestone sink holes, outcrops and underground drainage being a common physical feature (DeSelm 1959). DeSelm describes the Central Basin of Tennessee as a topographic depression in the Interior Low Plateau ranging in altitude from 500 to 700 feet, with the surrounding Highland Rim having an altitude as great as 1,000 feet. The Ordovician limestone strata that are currently exposed in the basin were deposited on the slopes of the Nashville Dome. Geologists have suggested that this dome at one time was connected to the Ozark Dome and sediments from the Mississippi were deposited over the limestone. In the Miocene or early Pliocene, middle Tennessee was thought to be a low-lying plain at a level similar to that of the current Highland Rim. The down-cutting by the Cumberland River and tributaries caused the present topography of the area, with Ordovician limestone remaining exposed and the Mississippian deposits eroded away (DeSelm 1959).

Soils

In general, Spring Creek bladderpod is found on the Egam silty clay loam and Lindell silt loam soils that are occasionally flooded and occur along the floodplains. Campbell (1996) describe these soils as being deep, nearly level, moderately well drained and occurring on floodplains and in depressions. The potential is high for row crops, hay, and pasture. Flooding occurs occasionally, but is not long or frequent enough to seriously interfere with farming. Permeability is moderate and the available water capacity is high.

Associated Vegetation

Most of the associated species are pasture, glade, and disturbance-related plants growing with row crops, such as corn and soybeans in the spring. The herbaceous species include: *Lolium arundinaceum* (tall fescue), *Sorghum halapense* (Johnson grass), *Allium* sp. (onion), *Cardamine hirsuta* (hairy bittercress), *Valerianella radiata* (beaked cornsalad), *Sedum pulchellum* (widowscross), *Daucus carota* (Queen Anne's lace), *Leavenworthia stylosa* (cedar gladecress), *Draba verna* (spring whitlowgrass), *Opuntia humifusa* (pricklypear), *Arenaria lanuginosa* (spreading sandwort), *Phacelia purshii* (Miami mist), *Brassica rapa* (field mustard), *Claytonia virginica* (spring beauty), *Onosmodium molle* ssp. *molle* (softhair marbleseed), *Rudbeckia triloba* (browneyed Susan), *Cerastium arvense* (field chickweed), *Croton monanthogynus* (prairie tea), *Geranium carolinianum* (Carolina geranium), *Viola* spp. (violet), *Taraxacum officinale* (common dandelion), *Ranunculus* sp. (buttercup), *Setaria* sp. (foxtail), *Clinopodium glabellum* (Ozark calamint), and *Glandularia canadensis* (rose mock vervain).

Ecology and Life History

Lesquerella perforata is an annual that germinates between September and early October, overwinters as a small rosette of leaves, and fully develops and flowers the following spring. Full sun is a requirement for optimum growth. Flowering usually occurs in March and April. The fruit splits open upon maturity in late April and early May, and the enclosed seeds are dispersed and lie dormant until autumn. The plant dies back soon after the fruits mature. Germination can only occur when the correct temperature coincides with adequate moisture (Pearson 1967). Upon germination, the cycle starts over again. The seeds of *L. stonensis* can remain viable in the seed bank for at least 6 years, and perhaps those of *L. perforata* do the same (Rollins 1955, Kral 1983, Baskin & Baskin 1990, Fitch 2004).

The life history and the seed dispersal mechanism of Spring Creek bladderpod result in many seeds, continuous turnover, and easy movement to new sites. Each of these characteristics favor the ability to persist as long as habitat is available and competing vegetation does not crowd it out. Rollins (1957) stated that fall and winter growth along with spring flowering and fruiting is important to the survival of *Lesquerella* in the floodplain areas. There is a relatively short period of time, about four months, in which vegetative disturbance can occur without adversely impacting the plants. The fields are usually too wet from annual spring floods to be prepared (plowed) for planting until May or June. The full development of the population is usually permitted before farm operations begin. However, the drier the weather in the spring, the earlier the farmers can start planting crops. Fitch (2004) suggested that disturbance from farm equipment between September and May could be detrimental to this species. Plowing and disking should be done at the shallowest depths possible since most seedlings failed to emerge

when seeds were buried greater than 2 centimeters (0.787 inches) beneath the soil surface (Fitch 2004).

No genetic barriers exist between the four species of *Lesquerella* that are endemic to the Central Basin of Tennessee. However, these species are essentially allopatric, occurring in separate, nonoverlapping geographic areas; requiring only adequate spatial separation to prevent gene exchange between them. They presumably arose in complete isolation from one another and some of the species have remained isolated. There is evidence for hybridization among a few species with overlapping ranges such as *L. stonensis* (Stones River bladderpod) and *L. densipila* (Duck River bladderpod) (Rollins 1957). No hybrids of *L. perforata* (Spring Creek bladderpod) have been found. The endemic species of *Lesquerella* are incapable of self-fertilization and outcrossing (mating individuals not of the same flower) is obligate. The combination of this condition and the annual habit of the plant results in the maintenance of high level of heterozygosity (genetic diversity) in a population. There is a complete turnover of genetic material each year (Rollins 1957). *L. perforata* has higher levels of genetic variability than *L. stonensis* or *L. densipila* (Baskauf 2002). In fact, despite *L. perforata's* restricted range and low number of extant populations, genetic variability estimates are similar to those cited for more widespread species (Baskauf 2002).

Threats/Reasons for Listing

Lesquerella perforata is extremely vulnerable because of its limited range and its specific floodplain habitat. The primary threat is the loss of habitat by conversion of land to uses other than cultivation of annual crops. In order for this annual plant to complete its life cycle, it is essential that the sites not be disturbed (plowed or disked) in the fall after the seeds have germinated; and, that spring plowing and planting be delayed until after the plants have matured and set seed in the spring.

Agriculture is the primary mechanism by which Spring Creek bladderpod habitat has been maintained in the recent past. Unless a site is disturbed in some manner every few years, a population will quickly dwindle. Agricultural practices are declining in Wilson County as the demand for residential development increases. Natural flooding along Spring Creek, Bartons Creek, and Cedar Creek is an important factor in dispersal of the seeds to newly disturbed sites. Any damming of these creeks or changes in the hydrology would have a direct impact on *L. perforata.*

Development pressures in Wilson County are extreme. The City of Lebanon is on the outskirts of Nashville and population numbers are rapidly increasing. New construction and improvement of sewer lines, water lines, gas lines, etc., are often located along streams, and likely will be within the habitat for the Spring Creek bladderpod.

The conversion of cropland to pastures that contain grasses (*e.g.* fescue) poses a threat because of competition and lack of annual disturbance. This is more prevalent along Bartons Creek where little agricultural activity is taking place and rapid residential development is occurring. According to the "Status Survey Report on *Lesquerella perforata*"(Somers et al. 1993), the 1993 estimates on land uses along Bartons and Spring creeks were 80% pasture, 10% forest, 5% cultivated field, and 5% other, including golf courses, sewage treatment plants, etc. This is rapidly changing, as development is increasing in all three watersheds at a high rate. There are no recent land use estimates for these three watersheds, but new residential and commercial developments are continually being built throughout these watersheds.

No occurrences have been located on property of the U.S. Army Corps of Engineers along Old Hickory Lake (Somers et al. 1993, TDEC 2001). The impounded waters of Spring Creek, Bartons Creek, and Cedar Creek occupy several miles of floodplain that may have once been habitat for *L. perforata*. The downstream limit of the extant occurrences on both creeks reaches the impounded waters. Any major changes in the hydrology of Old Hickory Lake, especially a permanent rise in water levels, could be a threat to these populations.

Conservation Measures

Current Legal Protection

The State of Tennessee lists the species as endangered under the authority of the "Rare Plant Protection and Conservation Act of 1985" (State of Tennessee 1985). Commercial exploitation or willful destruction of Spring Creek bladderpod by persons other than the landowner could result in a fine of not more than $1,000 or imprisonment for not more than six months, or both. This law does not prevent a landowner from disturbing or destroying plants on his land, nor can it be used to impede public works projects such as highway construction. It is also not a violation to destroy the plants in the course of routine forestry or agricultural practices.

The Endangered Species Act provides protection for endangered plants from removing or reducing to possession, maliciously damaging, or destroying any such species from areas of Federal jurisdiction. The Act also provides protection from removing, cutting, digging up, damaging, or destroying any endangered plants in knowing violation of any law or regulation of any State or in the course of any violation of a State criminal trespass law for any other areas not under Federal jurisdiction. There are no occurrences of Spring Creek bladderpod on Federal lands at this time. However, some of the sites are located upstream within one mile of the boundary of Old Hickory Lake, a reservoir managed by the U.S. Army Corps of Engineers. Since the seeds of this plant are known to disperse by

water, the likelihood of occurring on Federal lands in the future is greatly increased.

Site Protection/Management

All of the landowners and managers of the known occurrences have been contacted about the location of Spring Creek bladderpod on their property. Natural areas registries, conservation easements, acquisition of habitat from willing landowners, and development of cooperative management agreements will be utilized in the protection of this plant. To date, three landowners have agreed to protect occurrences of Spring Creek bladderpod through implementation of various management strategies. Cooperative management agreements with Tennessee Department of Environment and Conservation (TDEC) and the Service were signed by Cracker Barrel Old Country Store in September 1999, by TRW Automotive in March 2000, and by the City of Lebanon in January 2001 (Service 1999, 2000, 2001). These agreements will provide management and protection for approximately 4,000 plants at these sites located on Bartons Creek. Management strategies will be designed to be compatible with the life cycle of *L. perforata* and the landowners intended land use. Strategies generally include no land disturbances between September 15 and May 15 and light discing prior to September 15. Bush-hogging is permitted during the summer months.

Seed Depository

The Center for Plant Conservation (CPC) at the Missouri Botanical Garden has accessions (to record in the order of acquisition) of seeds of *Lesquerella perforata* from four occurrences. These collections were made in 1989 (1), 1994 (2), and 1995 (1). One of the 1994 accessions is being held at the National Center for Genetic Resources Preservation in Fort Collins, Colorado. Viability testing was conducted in 2004 from the 1989 and 1995 accessions (McCue 2004). The 1989 sample had less than 5 percent viability. The 1995 sample was approximately 20 percent viable. Based on these results, there are plans to make additional collections.

Seeds of *L. perforata* and other species of *Lesquerella* found in Tennessee were collected in 1995 by the U.S. Department of Agriculture for inclusion in the National Germplasm System in Beltsville, Maryland. As a part of this system, the seeds will be preserved and used for research related to the domestication of *Lesquerella* for potential use as a source for industrial oil. *Lesquerella* seed contains an oil rich in hydroxy fatty acids, an important raw material used by industry for making resins, waxes, nylons, plastics, corrosion inhibitors, coatings, lubricating greases, and cosmetics (Salywon et al. 2005). *Lesquerella fendleri*

(Fendler's bladderpod) is the only species currently being domesticated although several others may have potential. *L. fendleri* grows naturally in the southwestern U.S. from east Texas to central Arizona and from central Colorado to Mexico.

Surveys

An intensive search for additional populations of the Spring Creek bladderpod was conducted in 1991-1992 along Spring Creek. A limited search in the vicinity of each occurrence was conducted in 1997. Several new occurrences were found in 1992 and three new occurrences were found in 1997. Surveys for new populations were also conducted in 2001. One new population consisting of four occurrences was discovered on Cedar Creek, the next stream to the east of Spring Creek (TDEC 2001). All of the surveys were completed by the Tennessee Division of Natural Heritage (TDEC 2001).

Recovery Strategy

To ensure the long-term survival of *L. perforata*, it is important to protect and manage the known occurrences in the three creek drainages. Management plans should be developed for each occurrence and should include some type of disturbance regime that can be maintained by the landowner. All of the known occurrences of Spring Creek bladderpod are located on privately owned land, with the exception of one occurrence on land owned by the City of Lebanon.

Protection of occurrences should be achieved through permanent conservation easements and land acquisitions where land is managed for conservation purposes. Cooperative management agreements should be pursued and implemented with private landowners if these permanent measures cannot be immediately achieved. Protection and management of habitat is the key issue to survival of the species. The high quality occurrences of Spring Creek bladderpod are located on lands that are cultivated and planted in annual crops. Only a few sites exist that have been continuously cultivated for several years. It appears that farming is declining in Wilson County due to the development pressures and increasing land values. However, the continuation of annual disturbance is necessary for this early successional species. A coordinated outreach program will also be important to inform landowners that this plant occurs on their property and of the management required to perpetuate its continued existence.

PART II.
RECOVERY

Recovery Objective and Criteria

The goal of this recovery plan is to ensure the long-term viability of Spring Creek bladderpod in the wild, allowing initially for reclassification to threatened status (downlisting), and ultimately, removal of this plant from the *Federal List of Endangered and Threatened Plants* (delisting).

Spring Creek bladderpod will be considered for reclassification to threatened status when there are 15 protected occurrences; five occurrences located within the floodplain of each of the three creeks (Spring Creek, Bartons Creek, and Cedar Creek). These occurrences either located on public or private land must be protected by a permanent conservation easement with a management agreement. Each occurrence must consist of an average of 500 plants over a five-year period with no less than 100 plants in any given year.

Spring Creek bladderpod will be considered for delisting when there are 25 protected occurrences, with at minimum five occurrences located within the floodplain of each of the three creeks (Spring Creek, Bartons Creek, and Cedar Creek). Each occurrence either located on public or private land must be protected by a permanent conservation easement with a management agreement. Each occurrence must consist of an average of 500 plants over a ten-year period with no less than 100 plants in any given year.

Listing/Recovery Factor Criteria: Tasks listed with each criterion are examples of actions that may reduce or remove the identified threats.

Listing/Recovery Factor A: The Present or Threatened Destruction, Modification, or Curtailment of a Species Habitat or Range. To ensure the long term recovery needs of the Spring Creek bladderpod and provide adequate assurance of population stability, threats to the bladderpod's habitat must be removed or minimized (see the section on Threats/Reasons for Listing, for a discussion of applicable threats). This can be accomplished by the following actions:

a. Pursue protection with landowners. (Action 1.2)
b. Develop and implement management plans for each occurrence. (Action 1.3)
c. Investigate incentive programs. (Action 1.4)
d. Work with local officials to coordinate county planning. (Action 3)
e. Establish new occurrences within the historic range. (Action 9)

f. Conduct monitoring at all sites. (Action 5.2)

Listing/Recovery Factor B: Overutilization for Commercial, Recreational, Scientific, or Educational Purposes. There is little or no commercial trade in *Lesquerella perforata* at this time and it is not anticipated that it will become an issue in the future. However, Action 10 calls for maintaining a seed source *ex situ* for each population. These stored seeds could be used in the case of an extirpated occurrence.

Listing/Recovery Factor C: Disease or Predation. At this time, there are no data indicating that this is a limiting factor, thus no listing/recovery factor criteria are necessary.

Listing/Recovery Factor D: The inadequacy of Existing Regulatory Mechanisms. Spring Creek bladderpod is typically found growing on floodplains. There are no existing regulatory mechanisms that protect these open lands from conversion to other uses such as residential or commercial development or forestry. The following actions can help to overcome these inadequacies and lead to recovery:

a. Pursue protection with landowners through land acquisition or conservation easements. (Action 1.2)
b. Develop and implement cooperative management agreements for each occurrence. (Action 1.3)
c. Develop communication with local officials to coordinate county planning. (Action 3)
d. Develop and implement public education plans. (Action 11)

Listing/Recovery Factor E: Other Natural or Manmade Factors Affecting Its Continued Existence. No occurrences have been located on property of the U.S. Army Corps of Engineers along Old Hickory Lake. The impounded waters of Spring Creek, Bartons Creek, and Cedar Creek occupy several miles of floodplain that may have once been habitat for *L. perforata*. The downstream limit of the extant occurrences on both creeks reaches the impounded waters. Any major changes in the hydrology of Old Hickory Lake, especially a permanent rise in water levels, could be a threat to these populations. The following actions can help to overcome this manmade factor:

a. Establish new occurrences within the historic range. (Action 9)
b. Develop and implement public education plans. (Action 11)

Narrative Outline

1: Protect and manage existing occurrences and habitats.

1.1 Establish protection goals for all occurrences. The sites need to be prioritized so that the high quality sites will receive immediate protection. The priority should be determined by number of plants, feasibility of protection, and feasibility of long-term management.

1.2 Pursue protection with landowners. All existing occurrences are located on private lands. All landowners have been contacted and encouraged to protect *L. perforata* on their property. Permanent protection should be sought through land acquisition or conservation easements. Cooperative management agreements should be pursued if permanent protection cannot be attained. Regardless of the protection afforded, a cooperative management agreement (see Action 1.3) should be signed by each landowner to assure some degree of oversight of land use or assistance with management.

1.3. Develop and implement management plans for each occurrence. Until management strategy studies for the species (Action 2.1) are completed, management plans for each site should promote, first and foremost, a disturbed condition through disking or any disturbance that occurs between May and September. As more information is gathered about management of the species, these plans can be modified to include site-specific objectives. Plans must consider past and present land use in order to maintain or to enhance the condition at each site.

The following management objectives should be addressed for each site: 1) the type of land use desired; 2) the type of compatible ground cover; 3) the type of vegetative disturbance feasible with the land use; and 4) the use and application of herbicide and fertilizers. A cooperative management agreement should be developed for each landowner that would include the management plan for the site and an outline of the methods to implement the plan. This agreement would be between the landowner and Tennessee Department of Environment and Conservation (TDEC) and/or the Service, and would be strictly voluntary. One component of the agreement should be that the landowner would agree to notify the parties of the agreement if ownership or management changes. Another component is that the agencies should be able to offer technical support and possibly, if wanted, assistance for management activities. The cooperative management agreement signed in July 1999 by Cracker Barrel Old Country Store, Inc., for management of a colony on their property should be used as a guide (Service 1999).

1.4 **Investigate incentive programs.** Many of the extant sites are located in fields that were once cultivated for row crops. A few fields are currently planted in row crops; however, most fields are active or abandoned pastures. Incentive programs for landowners to manage for the species and/or promote activities compatible with the Spring Creek bladderpod may be available through various state and federal agencies. These incentives could help the landowner reduce the cost of management activities, especially for sites that have not been managed in several years.

2: Develop and implement management strategies for the species. Spring Creek bladderpod is a disturbance-dependent species. Its life cycle is compatible with many different land uses, including agriculture and possibly even grazing. However, one of the limiting factors is that the type of management must not interfere with the plant's life cycle. There is a relatively short period of time, about four months, in which vegetative disturbance can occur without adversely impacting the plants. The optimum time for disturbance is after mid-May when the fruit ripens, and before mid- September when the seeds start to germinate. The plants develop as rosettes and lie dormant until early spring. All planting, harvesting, herbicide and fertilizer treatments, and bush-hogging must occur between mid-May and mid-September.

2.1 **Conduct studies of various disturbance techniques and determine the maximum time intervals for disturbance.** The effects of different disturbance techniques, such as mowing, plowing, disking, aerating, and grazing, should be studied. Disturbances should occur at a frequency to deter succession of competitive plants. However, management on an annual basis may prove to be unnecessary or cost and time prohibitive. It is necessary to determine the frequency of disturbances necessary to maintain optimum habitat for the species.

3: Develop communication with local officials to coordinate county planning. Meet with local city and county officials to solicit their participation in the conservation of the species. Jointly develop conservation goals and objectives. At least once every two years, meet to review status of conservation efforts.

4: Utilize existing legislation and regulations to protect the plant and its floodplain habitat. Spring Creek bladderpod is listed as an endangered plant in Tennessee under that State's Rare Plant Protection and Conservation Act. This law regulates the sale of endangered plants and prohibits anyone from knowingly taking an endangered plant without the permission of the landowner or land manager. It is also a violation of the Endangered Species Act for any person to maliciously damage or destroy an endangered plant in the course of a violation of a State criminal trespass law. Executive Order 11988 (Floodplain Management) requires federal agencies to avoid to the extent possible the long- and short-term adverse impacts associated with the occupancy and modification of

floodplains and to avoid direct and indirect support of floodplain development wherever there is a practicable alternative. The Clean Water Act requires permits issued by the Corps of Engineers for projects adversely affecting waters of the U.S., which may include some floodplain areas. Similarly, Tennessee's Aquatic Resource Alteration Program requires permits for projects adversely affecting waters of the State and may include some floodplain areas. Avenues to fully utilize these State and Federal laws should be explored to promote Spring Creek bladderpod conservation.

5: Conduct monitoring at all sites. It is important to monitor each site on a regular basis. Goals of a monitoring program should be to determine the status of the occurrences and the effects of different management techniques on the species.

5.1 Complete baseline data collection. Baseline data has been collected from each site and includes estimates of population size and vigor, existing condition of each site, and past and present management. GIS should be used to determine historical land use in order to improve management techniques and help improve baseline data for each site.

5.2 Develop and implement long-term monitoring. Long-term monitoring is needed at each site. It is important to collect monitoring data to compare managed sites to non-managed sites. A standardized monitoring scheme needs to be devised. The data will be used to help determine the long-term status and population trend for each site.

6: Conduct a seed ecology study. Aspects for each of the following items should be investigated for the species: (1) phenology of the plant, particularly germination; (2) requirements for dormancy break and germination under simulated natural conditions; (3) effects of environmental conditions on germination (e.g., temperature, light, leaf litter); (4) influence of environmental disturbances on germination (e.g., herbicide, fertilizer); (5) consequences of laboratory storage on dormancy break, germination, and viability; and (6) ability to form a soil seed bank. The information collected in this study will provide much needed information for propagating the plants and can be used to improve management techniques.

7: Search for new populations within the Central Basin. Suitable habitat should be identified using aerial photography, topographic maps, soil surveys and existing Natural Heritage data. Surveys for Spring Creek bladderpod conducted in the past were focused on Bartons Creek and Spring Creek. Several adjacent creeks and floodplains within the Cumberland River Drainage need to be searched. For example, four recent occurrences were documented in Cedar Creek, located just east of Spring Creek.

8: Establish new occurrences within the historic range. Establishing new occurrences to meet the recovery goals should be considered only after extensive searches have been

conducted. Local interest in the species could encourage volunteers to help establish new sites under supervision of TDEC and the Service. Established colonies will also need active management and monitoring. The locations of the few historical populations need to be considered (if suitable habitat still exists) for establishing new colonies. Because of the annual life cycle of this species, it is recommended that seeds be used for recruitment instead of live plants. Propagated plants of this species would be difficult to transplant due to their small, fragile nature.

9: Maintain seed source *ex situ* for each population. Seeds should be collected from each occurrence and put in long-term storage for purposes of establishing new populations. The stored seeds could also be available in case the need arises to reestablish/replicate an extirpated occurrence.

10: Develop and implement public education plans. Educating the public about the life history and management requirements of the Spring Creek bladderpod should be accomplished by providing information to landowners, government agencies, local parks, schools, nature centers and the media. Because the species is geographically restricted, the recovery of this species will depend largely on the support of the local landowners and local government.

11: Annually assess the success of recovery efforts for the species. Timely review of new information and evaluation of ongoing programs are essential to ensure that full recovery occurs as rapidly and efficiently as possible.

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PART III

IMPLEMENTATION SCHEDULE

Recovery plans are intended to assist the Service and other stakeholders in planning and implementing actions to recover and/or protect endangered and threatened species. The following Implementation Schedule indicates action priorities; action numbers; action descriptions; action duration; potential stakeholders and responsible agencies; and, lastly, estimated costs. It is a guide for planning and meeting the objectives discussed in Part II of this plan. The Implementation Schedule outlines recovery actions and their estimated costs for the first 5 years of this recovery program. The estimated date of recovery is 2025, provided that funds are available to accomplish the required recovery tasks and that the recovery criteria are met. The costs are broad estimates and identify foreseeable expenditures that could be made to implement the specific recovery tasks during a 5-year period. **Actual expenditures by identified agencies and other partners will be contingent upon appropriations and other budgetary constraints.**

Priorities in column 1 of the following Implementation Schedule are assigned as follows:

1. Priority 1 - An action that must be taken to prevent extinction or to prevent the species from declining irreversibly in the foreseeable future.

2. Priority 2 - An action that must be taken to prevent a significant decline in species population/habitat quality or some other significant negative impact short of extinction.

3. Priority 3 - All other actions necessary to meet the recovery objective.

While the Act assigns a strong leadership role to the Service for the recovery of listed species, is also recognizes the importance of other Federal agencies, States, and other stakeholders in the recovery process. The "Responsible Agency" column of the Implementation Schedule identifies partners who can make significant contributions to specific recovery tasks. **The identification of agencies and other stakeholders within the Implementation Schedule does not constitute any additional legal responsibilities beyond existing authorities (e.g., Act, CWA). Recovery plans do not obligate other stakeholders to undertake specific tasks and may not represent the views nor the official positions or approval of any agencies or stakeholders involved in developing the plan, other than the Service.**

KEY TO ABBREVIATIONS

CPC - Center for Plant Conservation
ES – Ecological Services Division, U.S. Fish and Wildlife Service
TDEC - Tennessee Department of Environment and Conservation
R4 – Region 4 (Southeast Region), U.S. Fish and Wildlife Service
PVT – A university or research center
TDA – Tennessee Department of Agriculture
TNC – The Nature Conservancy
CTY – Lebanon City Government
CNTY – Wilson County Government

Spring Creek Bladderpod
Implementation Schedule

Priority	Task Number	Task Description	Task Duration	Responsible Agency FWS	Responsible Agency Other	Cost Estimates ($000s) FY1	FY2	FY3	FY4	FY5	Comments
1	1.2	Pursue protection with landowners.	Continuous	R4/ES	TDEC, TNC, CTY, CNTY	1000	1000	1000	1000	1000	
1	1.3	Develop and implement management plans for each site.	2 years	R4/ES	TDEC	105	105				
1	2.1	Conduct studies of various disturbance techniques and determine the maximum time intervals for disturbance.	3 years	R4/ES	TDEC, TDA, PVT	50	50	50			
2	1.1	Establish protection goals for all sites.	2 years	R4/ES	TDEC	25	25				
2	1.4	Investigate incentive programs.	1 year	R4/ES	TDEC, TDA, CTY, CNTY	10					
2	3.0	Develop communication with local officials to coordinate county planning.	Continuous	R4/ES	TDEC, CTY, CNTY	1	1	1	1	1	
2	4.0	Utilize existing legislation and regulations to protect the plant and its floodplain habitat.	Continuous	R4/ES	TDEC, CTY, CNTY	5	5	5	5	5	
2	5.1	Complete baseline data collection.	2 years	R4/ES	TDEC	25	25				
2	5.2	Develop and implement a long-term monitoring scheme.	Continuous	R4/ES	TDEC, CTY, CNTY	50	50	50	50	50	
2	6.0	Conduct seed ecology study.	2 years	R4/ES	PVT, TDEC	30	30				
2	7.0	Search for new populations.	2 years	R4/ES	TDEC	20	20				
2	8.0	Establish new occurrences in order to meet recovery goals.	Continuous	R4/ES	TDEC, CTY, CNTY	100	100	100	100	100	
3	9.0	Maintain seed source *ex situ*.	Continuous	R4/ES	TDEC, CPC	1	1	1	1	1	
3	10.0	Develop and implement public education plans.	Continuous	R4/ES	TDEC, CTY, CNTY, TDA	10	10	10	10	10	
3	11.0	Annually assess the success of recovery efforts for the species.	Continuous	R4/ES	TDEC, TDA	0.5	0.5	0.5	0.5	0.5	

Part IV

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