

City of Boulder 1996 Amphibian and Reptil

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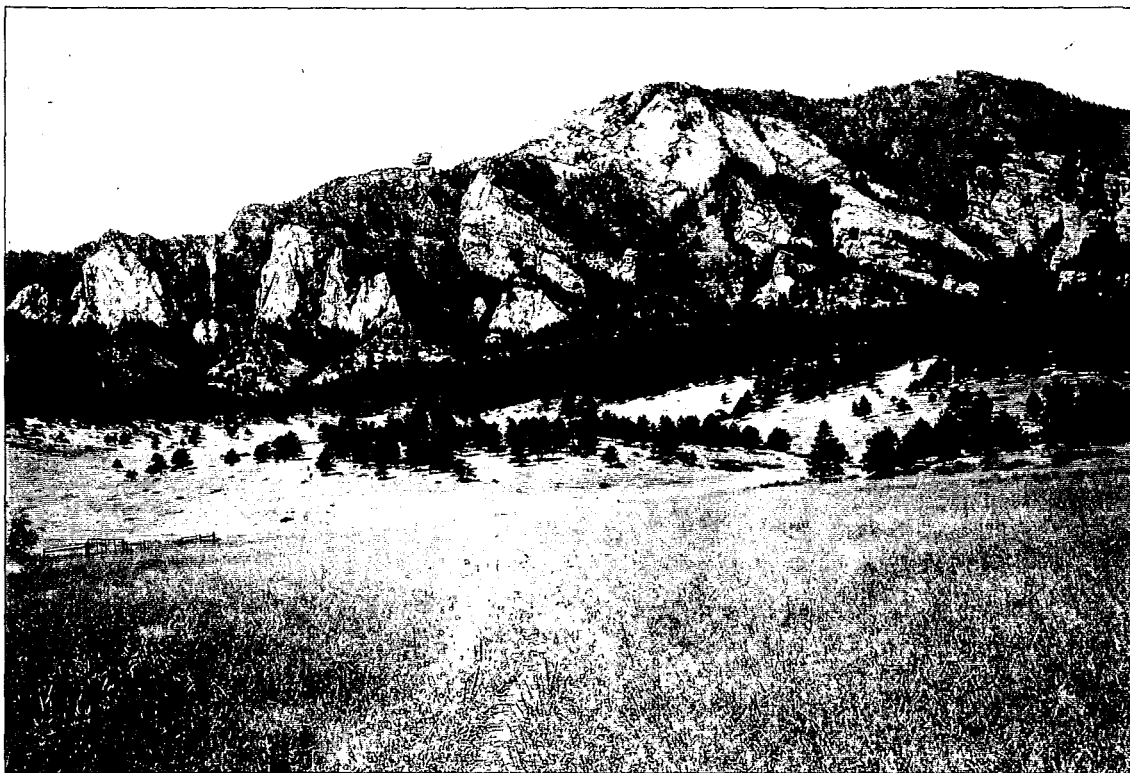


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## City of Boulder 1996 Amphibian and Reptile Survey



1997

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# City of Boulder 1996 Amphibian and Reptile Survey

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**Abstract:** A total of 2,058 amphibians and reptiles were recorded during the 1996 amphibian and reptile surveys for the City of Boulder Open Space and Mountain Parks programs. Of 25 species documented from Boulder County, 21 were observed during survey work or through ancillary reports from reliable sources. Four species with very limited distributions in Boulder County were not observed in 1996: Great Plains toads (*Bufo cognatus*), spiny softshell turtles (*Apalone spinifera*), smooth green snakes (*Liochlorophis vernalis*), and lined snakes (*Tropidoclonion lineatum*).

Most specimens (1,895) were observed during 198 observer-hours of Visual Encounter Surveys. Three species were only detected through directed techniques: Turning of 2,411 rocks and other surface objects produced the only observations of plains blackhead snakes (*Tantilla nigriceps*), 157 miles of night driving produced the only observations of the plains spadefoot (*Spea bombifrons*), and 44.5 hours spent turtle trapping produced the only observations of snapping turtles (*Chelydra serpentina*).

Conservation and management recommendations are summarized.

## Introduction

Eight amphibian and 17 reptile species have been reported from Boulder County, Colorado (Hammerson 1982a, Livo et al. 1996). Local amphibians include the tiger salamander and seven species of anurans (frogs and toads). One of these, the bullfrog (*Rana catesbeiana*), is an introduced species with established populations in the county (Hammerson 1982a). Boulder area reptiles include three native turtles, three lizards, and 11 snakes. A few other species (for example, western hognose snakes and many-lined skinks) might have natural populations in the county but lack reliable documentation of their presence at this time (Livo et al. 1996).

Compared to other areas in Colorado, the herpetofauna of Boulder County is relatively well known. For example, while Boulder County (with 748 square miles) occupies only 0.7 % of the land area in the state of Colorado, it has 15 % of the historical records (1,728 of 11,225 records) in the Amphibian and Reptile Database (Colorado Division of Wildlife 1994). In addition, Maslin (1964) provided broad summaries of habitat and elevational range information for amphibians and reptiles of the Boulder area.

Despite this relative wealth of herpetological information, detailed knowledge of the distribution and abundance of amphibians and reptiles in the Boulder area is rudimentary. Among the objectives of the City of Boulder Open Space and Mountain Parks programs is preservation of native animals and communities. Yet continued development (including recreation and urbanization) often functions to reduce animal diversity. For example, in a suburban area of Indianapolis, Indiana, Minton (1968) observed a decrease over time in the number of amphibians and reptiles from a total of 21 species between 1949-1958 to only seven species in 1963-1964.

The survey work described in this report was intended to provide information on the following topics:

- Distribution of amphibians and reptiles.
- Identification of species of special concern.
- Encounter frequency for amphibian and reptile species.
- Comparison of observation techniques.
- Availability of dispersal routes between populations.
- Recommendations for future herpetological studies.

## Methods

For all surveys we completed a data sheet developed by Dr. P. Stephen Corn<sup>1</sup> of the National Biological Service. Although this form was developed specifically for use with amphibians, it was also appropriate for use with the reptiles we encountered. Since this form includes information about the amount of time spent on a survey, total observer-hours can be used to compare the results and amount of effort in these surveys with future surveys. This quantification of search effort corresponds to Time-Constrained Search (Corn and Bury 1990), a form of Visual Encounter Survey (Crump and Scott 1994). A copy of this form appears in Appendix A.

For all field sessions we copied appropriate portions of USGS quadrangles and indicated locations for all amphibians and reptiles observed. Copies of these field forms and maps are on file with the City of Boulder Open Space. Although the emphasis of our field work was on City owned lands, we made some incidental observations of amphibians and reptiles elsewhere in southeastern Boulder County. Maps in Appendix A show the general survey area.

Many of Boulder County's amphibians and reptiles are associated with wetlands and riparian areas, so considerable effort was expended in surveying these habitats. We also selected areas with specialized features, such as rocky cliffs, to survey for species that use these habitat features. Several methods were used to detect amphibians and reptiles. We used binoculars to scan shorelines, rocky cliffs, and other areas for amphibians and reptiles. This permitted location and identification of several individuals that would otherwise have probably disappeared from view upon our approach.

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As many species are most readily found under surface objects, we turned rocks and other objects when these potential shelters were available. For all surveys we counted the number of objects turned in an area and noted this on the field survey forms. Surface objects are important components of local habitats, and objects that are dislodged and left out of place mar the aesthetics of an area. For these two reasons, we only selected objects for turning that could be replaced. This meant that mostly small- and moderate-sized objects were turned, while large objects were left undisturbed. All turned objects were replaced to minimize disturbance.

Other techniques used for performing surveys included:

- Walking transects
- Night driving
- Turtle trapping

Each of these techniques is discussed in more detail below.

### **Walking transects**

Boulder Open Space has established 15 transects for wildlife surveys. We walked the ERTL, Van Vleet, VARRA, and North Wittimeyer transects (see "Transects Walked" map in Appendix A) during the survey and tallied all amphibians and reptiles encountered.

### **Night driving**

Night driving can be considered a specialized type of transect in which a road comprises the route taken. Night driving allows surveyors to detect some amphibians and reptiles that are difficult to detect by other survey methods. For example, plains spadefoot toads (*Spea bombifrons*) are active almost entirely at night after rains. By driving slowly (approximately 15-



20 mph) on roads that pass through suitable habitat, surveyors may find species that otherwise would be nearly impossible to encounter. For each route we recorded start and end times, and number of miles driven. Where possible, we chose routes adjacent to Boulder Open Space lands (see "Night Driving Routes" map in Appendix A).

### **Turtle trapping**

Scanning the shore and surface of bodies of water can reveal aquatic turtles, especially those that are basking. Some turtle species, such as the snapping turtle, spend a relatively small portion of their time at or near the surface. Deploying traps can increase the likelihood of observing such species (Karns 1986).

We set up turtle traps at five sites: Boulder Creek, Eggleston Reservoir Number 4, Teller Lake Number 5, an unnamed lake near Valmont Road and 57th Avenue, and an unnamed lake along East Boulder Trail (see "Turtle Trapping Sites" map in Appendix A). Each trap had a single opening and was baited with canned sardines in oil. In ponds and still bodies of water we set up traps with the opening facing away from shore. In streams we set up the traps with the opening facing downstream. In all cases, the traps were set up in shallow water so that an air space was available for any trapped turtles. The total number of trap hours for each site was recorded.

### **Results**

A total of 2,058 amphibians and reptiles were recorded in the course of the field work. Table 1 lists all amphibian and reptiles species documented from Boulder County. Contents of the individual columns is as follows:

<u>Column</u>	<u>Contents</u>
1	<b>Scientific name:</b> Scientific name of the amphibian or reptile, based on Collins (1990), except the genus name for the smooth green snake follows Oldham and Smith (1991).
2	<b>Common name:</b> Common name, based on Collins (1990), except that here the western toad is listed as the boreal toad.
3	<b>1992:</b> Indicates whether this species was documented in the 1992 survey.
4	<b>1996:</b> Indicates whether this species was documented in the current (1996) survey.
5	<b>Number of individuals:</b> The number of individuals encountered during 1996, including those reported by reliable sources. Separate amphibian choruses are counted as a single individual, as are individual egg masses or nests and identifiable shed skins.
6	<b>N (Native):</b> Indicates whether the species is native and documented for Boulder County (based on Livo et al. 1996).
7	<b>I (Introduced):</b> Indicates whether the species is introduced to Boulder County (based on Livo et al., in review).
8	<b>E (Expected):</b> Indicates that a taxa is likely to occur in Boulder County, but no specimens have been documented at this time. For example, although the known distribution approaches Boulder county, neither the many-lined skink ( <i>Eumeces multivirgatus</i> ) nor the prairie lizard ( <i>Sceloporus undulatus garmani</i> ) have been found in Boulder County.

Individual accounts discussing the status for each species are in Appendix B.

Table 1: Amphibians and reptiles in Boulder County							
Scientific name	Common name	1992	1996	Number of individuals	N	I	E
<i>Ambystoma tigrinum</i>	Tiger salamander	✓	✓	5	✓		
<i>Bufo boreas</i>	Western toad		✓	0	✓		
<i>Bufo cognatus</i>	Great Plains toad			0	✓		
<i>Bufo woodhousii</i>	Woodhouse's toad	✓	✓	97	✓		
<i>Pseudacris triseriata</i>	Western chorus frog	✓	✓	119	✓		
<i>Rana catesbeiana</i>	Bullfrog		✓	1,591		✓	
<i>Rana pipiens</i>	Northern leopard frog	✓	✓	79	✓		
<i>Spea bombifrons</i>	Plains spadefoot		✓	2	✓		
<i>Apalone spinifera</i>	Spiny softshell			0	✓		
<i>Chelydra serpentina</i>	Snapping turtle	✓	✓	2	✓		
<i>Chrysemys picta</i>	Painted turtle	✓	✓	96	✓		
<i>Terrapene ornata</i>	Ornate box turtle			0		✓	✓
<i>Cnemidophorus sexlineatus</i>	Six-lined racerunner	✓	✓	13	✓		
<i>Eumeces multivirgatus</i>	Many-lined skink			0			✓
<i>Holbrookia maculata</i>	Lesser earless lizard			0		✓	✓
<i>Phrynosoma douglassii</i>	Short-horned lizard		✓	1	✓		
<i>Sceloporus undulatus erythrocheilus</i>	Red-lipped plateau lizard	✓	✓	3	✓		
<i>Sceloporus undulatus garmani</i>	Prairie lizard			0			✓
<i>Coluber constrictor</i>	Racer	✓	✓	10	✓		
<i>Crotalus viridis</i>	Western rattlesnake		✓	2	✓		

Table 1: Amphibians and reptiles in Boulder County							
Scientific name	Common name	1992	1996	Number of individuals	N	I	E
<i>Heterodon nasicus</i>	Western hognose snake			0			✓
<i>Lampropeltis triangulum</i>	Milk snake		✓	2	✓		
<i>Liochlorophis vernalis</i>	Smooth green snake			0	✓		
<i>Nerodia sipedon</i>	Northern water snake	✓	✓	2	✓		
<i>Pituophis catenifer</i>	Bullsnake	✓	✓	12	✓		
<i>Tantilla nigriceps</i>	Plains blackhead snake		✓	2	✓		
<i>Thamnophis elegans</i>	Western terrestrial garter snake		✓	6	✓		
<i>Thamnophis radix</i>	Plains garter snake	✓	✓	13	✓		
<i>Thamnophis sirtalis</i>	Common garter snake		✓	1	✓		
<i>Tropidoclonion lineatum</i>	Lined snake			0	✓		
<b>Total</b>				2058			

### Species of Special Concern

The Colorado Natural Heritage Program (1996) lists the following species of special concern that occur in Boulder County:

- Boreal toad, *Bufo boreas*
- Northern leopard frog, *Rana pipiens*
- Smooth green snake, *Liochlorophis vernalis*
- Lined snake, *Tropidoclonion lineatum*

Of these species, boreal toads live at high elevations (usually above 8,000 feet) in western Boulder County and probably do not occur on Boulder Open Space or Mountain Parks lands. This species has been listed as endangered since November 1993 by the Colorado Division of Wildlife (Goettl et al. 1997). It is listed by the U.S. Fish and Wildlife Service as a candidate species (Goettl et al. 1997).

The northern leopard frog, smooth green snake, and lined snake have historic or current distributions in or near Boulder Open Space or Mountain Parks lands. See individual species accounts in Appendix B for more detailed information.

Accounts in Winternitz and Crumpacker (1986) recommend that bullfrogs (*Rana catesbeiana*) also be considered a species of special concern, as this introduced species has been associated with declines in leopard frog populations.

The following species may have extensive populations outside of Boulder County, but within the County appear to have very limited distributions:

- The Great Plains toad, *Bufo cognatus*
- Plains spadefoot, *Spea bombifrons*
- Spiny softshell, *Apalone spinifera*
- Six-lined racerunner, *Cnemidophorus sexlineatus*
- Smooth green snake, *Liochlorophis vernalis*
- Lined snake, *Tropidoclonion lineatum*

The effects of land use decisions should be considered for Boulder Open Space and Mountain Parks lands on which these species occur. In addition, there is some indication that populations of short-horned lizards, *Phrynosoma douglassii*, are declining. Research targeted at

determining the status of this species where it occurs on Boulder Open Space or Mountain Parks lands might be valuable.

### **Walking transects**

Only five transects were in operation at the time of the 1992 amphibian and reptile survey (Dale and Merritt 1993). We walked several transects but had difficulty in finding the markers, since the tags were often missing. Because of this difficulty and because we wanted to obtain information for a more extensive geographic area than would have been permitted by limiting our main efforts to walking transects, we abandoned this as a separate technique and combined the observations with the visual encounter survey tallies.

### **Visual encounter survey**

We spent 198 observer-hours in the field on visual encounter surveys. In this time we found 1,895 individuals. We also tallied as single individuals:

- Separate amphibian choruses.
- Individual egg masses or nests.
- Identifiable shed skins.

Our observation rate was approximately 9.57 individuals per hour. Bullfrogs were the single most frequently encountered species, accounting for 1,591 (84 %) of the total amphibians observed in visual encounter surveys.

During the visual encounter surveys, we turned 2,411 objects and found 37 individuals of nine different species for a 1.5 % success rate. However, this was the only method that revealed plains blackhead snakes. It also accounted for more than half the observed racers. Although no

smooth green snakes or lined snakes were found in this survey, turning objects is probably the most effective way of detecting these species (pers. obs.).

The following table lists the species found under objects, the number of individuals per species, and the proportion and percentage of individuals for each of the species found under objects (including all individuals of the species found by all methods).

Table 2. Species found under objects			
Species	Number	Proportion	Percent
<i>Ambystoma tigrinum</i>	1	1/5	20%
<i>Bufo woodhousii</i>	4	4/97	4.1%
<i>Pseudacris triseriata</i>	12	12/119	10%
<i>Rana catesbeiana</i>	6	6/1591	0.4%
<i>Coluber constrictor</i>	6	6/10	60%
<i>Pituophis catenifer</i>	1	1/12	8.3%
<i>Tantilla nigriceps</i>	2	2/2	100%
<i>Thamnophis elegans</i>	1	1/6	16.7%
<i>Thamnophis radix</i>	4	4/13	30.8%
<b>Total</b>	37		

Although the type of object was not tallied, rocks probably accounted for more than 75 % of the objects turned. However, most amphibians and reptiles were found under wooden objects, despite the fact that this category of objects was in the minority. This may have been due to better insulation qualities offered by wood compared to rocks or that wood was less settled into the substrate, thereby offering greater access to amphibians and reptiles.

Success rate also appeared to vary over time, as summarized in the following table. By the end of summer, many animals may have been dispersing to overwintering sites, accounting for an increased likelihood in seeking shelter under objects. However, most sites were surveyed only once, so differences in success rate might also be due to some unknown bias in the types of sites surveyed in the different time periods.

Date	Number of objects turned	Number of amphibians or reptiles	Percent success
March to June	794	6	0.76%
July	698	1	0.14%
August	168	15	8.9%
September	751	15	2.0%

### Night driving

Optimal night driving conditions include suitable weather conditions (which vary for different species), pavement rather than gravel, and low traffic volume. The relatively high traffic volume that exists on even rural Boulder County roads complicates night driving. High traffic volume made night driving a relatively risky mode of detecting animals. We spent 12.4 hours (15.4 observer-hours) driving 157 miles and found 87 individuals of nine species. Table 4 lists the species found, the number of individuals of each species, and the proportion and percent that were observed using this method.



High traffic volume probably depresses local populations of animals in Boulder County by directly removing individuals from the populations. Of the 87 individuals we found on the road, 59 (67.8 %) had been killed by traffic.

Auditory surveys while night driving yielded 14 anuran choruses, all of *Pseudacris triseriata*, a species with a rather penetrating call. Twelve of the choruses were heard on two nights in May, while the remaining two choruses were heard on a rainy July night. On all occasions, the noise from traffic interfered with the ability to hear anuran calls.

Species	Number	Proportion	Percent
<i>Ambystoma tigrinum</i>	3	3/5	60%
<i>Bufo woodhousii</i>	30	30/97	30.9%
<i>Pseudacris triseriata</i>	41	41/119	34.4%
<i>Rana catesbeiana</i>	6	6/1591	0.38%
<i>Spea bombifrons</i>	2	2/2	100%
<i>Pituophis catenifer</i>	2	2/12	16.7%
<i>Thamnophis elegans</i>	2	2/6	33.3%
<i>Thamnophis radix</i>	1	1/13	7.7%
<b>Total</b>	<b>87</b>		

Roads varied considerably in their "productivity." The Valmont and Cherryvale roads tended to be good night-driving roads in terms of productivity. The Neva Road north of Boulder did not produce any observations in the three times I drove it. The Foothills Highway north of Boulder had dangerous amounts of traffic, thus slow enough speeds for observations could not be maintained with regard to safety.

## Turtle trapping

Although the turtle traps were ordered in February, they were not delivered until June, reducing the available time for using them. We set the traps five times for a total of 44.5 trap-hours and caught six turtles (2 snapping turtles and 4 painted turtles). Only two trapping sessions were productive (one at Teller Lake 5, the other at the pond located south of Valmont at 57th Avenue). Large numbers of painted turtles were sometimes observed at a site without any of them entering the traps (for example, one time at Teller Lake 5 and another time at Eggleston Reservoir). However, trapping was the only method that resulted in snapping turtle observations in 1996. The table below lists the species observed from turtle trapping, the number of individuals of each species, and the proportion and percent that were observed through this method.

Species	Number	Proportion	Percent
<i>Chelydra serpentina</i>	2	2/2	100%
<i>Chrysemys picta</i>	4	4/96	4.2%
<b>Total</b>	6		

## Discussion

Visual encounter surveys resulted in most of the observations during the 1996 amphibian and reptiles survey. However, each of the more specialized methods (turning objects, night driving, and turtle trapping) resulted in observation of at least one species not detected by other means. If the object of future amphibian and reptile surveys is to detect the maximum number of species, several methods need to be employed. If particular species are the targets of future

survey efforts, the data provided in this report will provide some indication of methods that might be useful for detecting that organism. For example, night-driving is the most effective method for detecting plains spadefoot toads. In contrast, a variety of methods (visual encounter surveys, night-driving, and turning objects) all produce observations of Woodhouse's toads.

### **Continuing survey efforts**

There is a need for continued monitoring of certain amphibian and reptile populations. Volunteers might be incorporated into one or more long-term monitoring programs. Perhaps weekly or monthly volunteer visits to wetlands of particular interest (such as northern leopard frog breeding sites) could become an "adopt-a-pond" type of program.

Any night surveys for bird calls could also incorporate anuran calls (especially chorus frogs). However, anuran call surveys are difficult to perform in an urban area, and even the rural areas of Boulder County have high traffic volumes which reduces the ability to hear choruses.

Volunteers could be trained with audiotapes or compact disks of local anuran calls. A recently released compact disk (Davidson 1996) contains calls to all the anuran species in our area. Karns (1986) suggests the following index for anuran call surveys:

- 0      Absence of calling
- 1      Single individual calling
- 2      Occasional calling by several individuals
- 3      Low intensity, relatively frequent calling
- 4      Medium intensity, continuous calling
- 5      High intensity, continuous calling

### Introduced species

Introduced species may have deleterious effects on native amphibian and reptile populations. Although there are scattered reports of several specimens that represent introductions (see Livo et al., in review), the only reptile or amphibian species with established populations in the Boulder area is the bullfrog (*Rana catesbeiana*). As detailed in the species accounts, introduced bullfrogs are associated with declines in northern leopard frogs (Hammerson 1982b). Introduced crayfish, which are also present in some areas, are associated with declines in some salamanders (Gamradt and Kats 1996).

Wiese (1985) recommends attempting the eradication of bullfrogs, at least from isolated ponds. Few of the occupied ponds in the Boulder area appear to meet that criterion, although the Cowdry Reservoir Number 2 may best approach this standard. One bullfrog was heard calling, but otherwise the status of bullfrog populations at this site is unknown. If bullfrog invasion is at an early stage at this site, eradication efforts now may help preserve the current leopard frog populations in the vicinity.

The red-eared slider (*Trachemys scripta*) was the only introduced species other than the bullfrog that was observed during the 1996 surveys. This species is popular in the pet trade and the specimens we observed were probably intentionally released. Individual specimens were seen at Varsity Pond on the University of Colorado campus and at Sawhill Pond number 1. There is no evidence that this species has established populations at this time.

### Trail effects

Little is known about the effects trails have on amphibian and reptile populations. Many lizards and snakes bask; for these species trails might be attractive features in their habitats.

Occasional individuals are crushed on trails: this summer we found one dead Woodhouse's toad on a trail and a dead hatchling racer in the hoofprint of a horse on another trail. Based on our experiences this summer, developing an approach to study trail effects is likely to be difficult. Only 1.5 % of the objects we turned were used as cover by amphibians and reptiles during the 1996 field season. Clint Miller (pers. comm.) placed coverboards at various distances along selected trails without detecting any amphibians or reptiles. Arrays of pitfall traps would be even more labor intensive without assurance that they would yield any more detailed information.

A set of transects along and at varying distances from a trail in an area known to be occupied by at least one easily detected species might help elucidate the effects of trails, at least for that species. The six-lined racerunners in the White Rocks area may be useful study subjects, as we observed individuals both along trails and in areas distant from trails. The short-horned lizards along the Eagle Trail or the Greenbelt Plateau trail may also be suitable for such a study.

### **Traffic**

Traffic may be a serious problem for some amphibian and reptile populations in the Boulder area. More than half (67.8 %) of the amphibians and reptiles we found on the road had been killed by traffic. Near Ottawa, Canada, Fahrig et al. (1995) reported decreases in anuran populations with increasing road traffic. Rosen and Lowe (1994) documented damage to snake populations by traffic in Arizona.

Both the plains spadefoot and the Great Plains toad are anurans often found on roads (pers. obs.). If their distribution in Boulder County is as limited as the available information suggests, roads near breeding sites and other development may result in local extirpation of these species. Maps in Appendix B indicate known localities for these species in Boulder County.

These localities should be surveyed at night during or immediately after warm summer rains.

Auditory surveys at these localities could help pinpoint breeding sites and establish the degree of vulnerability of these populations. Containment fencing may be appropriate in areas where breeding ponds are adjacent to roadways.

### **Grazing**

The effects of grazing on reptile and amphibian populations is largely unknown. However, the majority of studies indicate that grazing reduces species diversity of native amphibians and reptiles. Recurrent mass die-offs took place in the tiger salamander population of a Utah lake that was contaminated by nitrogenous waste from sheep grazing (Worthylake and Hovingh 1989). Grazing may alter native vegetation in ways that make an area more susceptible for invasion by non-native bullfrogs (Jenning and Hayes 1994).

Szaro et al. (1985) established exclosures in a montane riparian habitat occupied by *Thamnophis elegans*. They found that numbers of these garter snakes were significantly higher in the exclosures compared to grazed sections of the stream.

In contrast, grazed sage habitats supported more short-horned lizards than ungrazed sage habitats, unless the sage became converted to crested wheatgrass (Reynolds 1979). Another lizard (*Sceloporus graciosus*) was more common on ungrazed land.

Bock et al. (1993) suggest that livestock exclosures be established on as much as 20 % of public rangelands to provide a refuge for plants and animals harmed by grazing and to provide a reference point for future studies concerning the effects of grazing. Such an exclosure system may be a useful research effort on City lands.

Further, because water levels are at their lowest and the concentration of metamorphosing or newly metamorphosed amphibians is at their highest in mid- to late summer, this may be the optimum time to exclude grazers from certain sites with northern leopard frogs or other species of concern. Fencing can be constructed around anuran breeding sites, and stock tanks provided for the use of grazing animals.

### **Summary of Management Recommendations**

Management and conservation recommendations are discussed in several places within this report. This section provides brief summaries of these recommendations.

#### **Amphibians**

- The northern leopard frog (*Rana pipiens*) is a species of special concern (Colorado Natural Heritage Program 1996) that has breeding populations on Boulder Open Space and Mountain Parks lands. Known breeding sites should have annual monitoring in which the number of individuals and egg masses are tallied. It may be possible to initiate a volunteer "adopt-a-pond" program to perform this function. Grazers should be excluded from known breeding sites, either by removal of livestock or by construction of fences around ponds.
- Introduced bullfrogs (*Rana catesbeiana*) have been implicated as possible factors in the decline of native leopard frog populations. It probably is not feasible to eliminate large populations, such as those in the vicinity of Boulder Creek. However, eradication should be considered at more isolated sites where they are not yet well established. One such site

may be Cowdrey Reservoir Number 2. Their status at this site should be determined and eradication efforts considered.

- The plains spadefoot (*Spea bombifrons*) has a limited distribution in Boulder County and occurs near Teller Lake Number 5. The Great Plains toad (*Bufo cognatus*) appears to have even more restricted distribution in the Boulder area, with records from the Louisville area. Surveys should be performed at night after warm, spring rains to try to locate breeding sites for these species and to determine the vulnerability of these amphibians to local extirpation. Containment fencing might be appropriate in areas where breeding ponds are adjacent to roadways.
- Annual call surveys for chorus frogs (*Pseudacris triseriata*) could be part of continued monitoring efforts. Such surveys could be conducted by volunteers assigned to specific routes and trained to recognize the distinctive call of this species.

### Reptiles

- Little is known about the effects of trail use on amphibian and reptile populations. The six-lined racerunner (*Cnemidophorus sexlineatus*) has a limited distribution in Boulder County, but is relatively abundant in the White Rocks area. Transects set up along and at varying distances from the trail in the White Rocks area could be used to evaluate the effect of trails on this locally abundant species.
- Additional turtle trapping should be performed. Some suggested bodies of water for turtle trapping include Boulder Creek, Eggleston Reservoir Number 4, Teller Lake, Wonderland Lake, and the unnamed pond along Eagle Trail in the Boulder Valley Ranch area.



- The spiny softshell (*Apalone spinifera*), smooth green snake (*Liochlorophis vernalis*) and lined snake (*Tropidoclonion lineatum*) appear to have very limited distributions in Boulder County. Any observation of these species (or any new county record) should be documented with photographs. Copies of the photographs, along with information about the observer, date of observation, and locality, should be deposited in the University of Colorado Museum.
- The short-horned lizard (*Phrynosoma douglassii*) may have undergone population declines in some areas. Monitoring activities for this species to determine its status in the Boulder area would be appropriate.

### **Acknowledgments**

Clint Miller of Boulder Open Space and Steve Armstead of Boulder Mountain Parks provided the funding that made the survey possible. Mark Gershman (Boulder Open Space) developed the base maps used to illustrate the distribution of amphibians and reptiles in the Boulder area. Todd Wilcox was an able field assistant. Dr. Cindy Carey (University of Colorado) spearheaded the proposal and provided moral support throughout the survey. Turtle trapping and other collecting activities were conducted under authorization of a scientific collection permit issued by the Colorado Division of Wildlife to Dr. Carey. Greg Maniero, Craig Harper, and Greg Hayes informed me of supplementary sightings of amphibians and reptiles. Roseanne Humphrey, assistant vertebrate curator at the University of Colorado Museum, gave me access to specimens under her care. Dr. Gordon Rodda (National Biological Service) discussed the possible interactions between introduced crayfish and tiger salamanders. Drs. Hobart M. Smith and David Chiszar were always happy to discuss microbiogeographical issues with me.

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## **Appendix A. Survey form and site selection maps**

The following pages contain:

- The form used in the 1996 surveys
- A map of the transects walked
- A map showing night-driving routes
- A map showing turtle-trapping sites



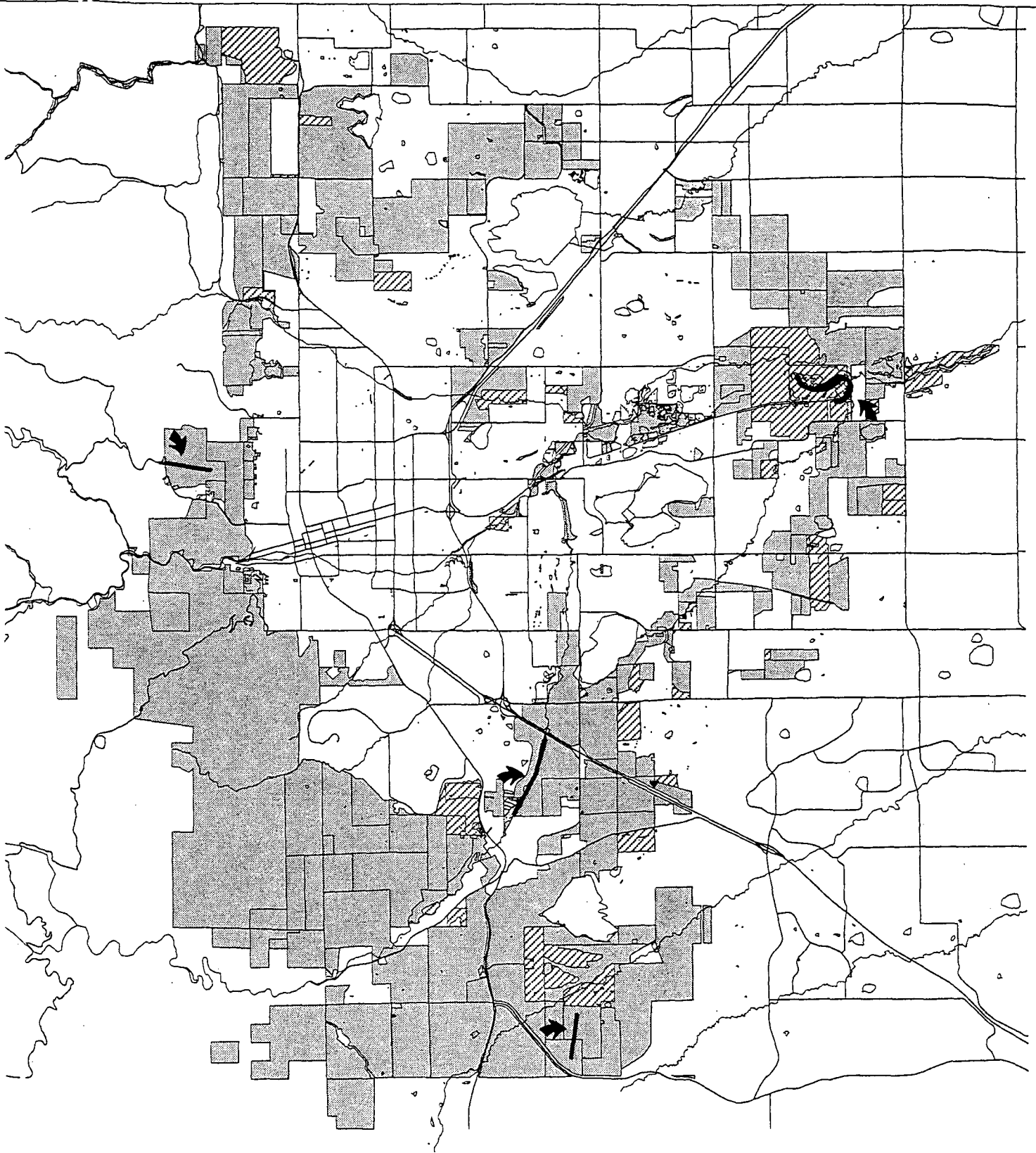
# AMPHIBIAN SURVEY DATA SHEET - US FISH & WILDLIFE SERVICE, 4512 McMURRY AVE, FT. COLLINS, CO 80526-3400

(circle choice for shaded variables; supply values for others)

(ver. 2/7/92)

DATE		BEGIN TIME		END TIME		OBSERVERS								
LOCALITY														
STATE		COUNTY		MAP NAME		OWNER		ELEVATION (circle scale) M FT						
T	R	S	SECTION DESCRIPTION		UTM ZONE	NORTHING (or LAT)		EASTING (or LONG)						
AMPHIBIAN AND/OR GARTER SNAKE SPECIES PRESENT (INDICATE NUMBERS IN CATEGORIES IF POSSIBLE)						CIRCLE METHOD AND INDICATE IF VOUCHER SPECIMEN WAS COLLECTED								
SPECIES		ADULTS/JUVENILES		CALLING?		TADPOLES/LARVAE		EGG MASSES		METHOD:				
				Y N						VISUAL/AURAL ID DIP NET/SEINE HAND COLLECTED TRAPPED VOUCHER COLLECTED? YES NO				
				Y N						VISUAL/AURAL ID DIP NET/SEINE HAND COLLECTED TRAPPED VOUCHER COLLECTED? YES NO				
				Y N						VISUAL/AURAL ID DIP NET/SEINE HAND COLLECTED TRAPPED VOUCHER COLLECTED? YES NO				
				Y N						VISUAL/AURAL ID DIP NET/SEINE HAND COLLECTED TRAPPED VOUCHER COLLECTED? YES NO				
				Y N						VISUAL/AURAL ID DIP NET/SEINE HAND COLLECTED TRAPPED VOUCHER COLLECTED? YES NO				
FISH PRESENT?		YES ??? NO		FISH SPECIES:										
ENTIRE SITE SEARCHED?		YES NO		IF NO, INDICATE AREA				METERS OF SHORELINE MP OF HABITAT						
PHYSICAL AND CHEMICAL ENVIRONMENT (CHEMISTRY VARIABLES OPTIONAL - USE EXTRA SPACES FOR ADDITIONAL MEASUREMENTS)														
WEATHER:		CLEAR		OVERCAST		RAIN		SNOW		WIND:	CALM	LIGHT	STRONG	
AIR TEMP (circle scale)		°C °F		WATER TEMP (circle scale)		°C °F		COLOR:		CLEAR	STAINED	TURBIDITY:	CLEAR	CLOUDY
pH		ANC												
SITE DESCRIPTIONS - (SKETCH SITE AND PUT ADDITIONAL COMMENTS ON BACK OF SHEET) OMIT THIS SECTION IF DATA HAVE BEEN COLLECTED ON A PREVIOUS VISIT														
ORIGIN:		NATURAL		MAN-MADE		DRAINAGE:		PERMANENT		OCCASIONAL		NONE		
DESCRIPTION:		PERMANENT LAKE/POND		TEMPORARY LAKE/POND		MARSH/BOG		STREAM		SPRING/SEEP		ACTIVE BEAVER POND		INACTIVE BEAVER POND
SITE LENGTH (M)		SITE WIDTH (M)		MAXIMUM DEPTH:		< 1 M		1 - 2 M		> 2 M				
STREAM ORDER		1		2		3		4		5 +				
PRIMARY SUBSTRATE:		SILT/MUD		SAND/GRAVEL		COBBLE		BOULDER/BEDROCK		OTHER				
% OF POND LAKE MARGIN WITH EMERGENT VEGETATION:		0		1 - 25		25 - 50		> 50						
EMERGENT VEGETATION SPECIES (LIST IN ORDER OF ABUNDANCE)														
NORTH SHORELINE CHARACTERS:		SHALLOWS PRESENT		SHALLOWS ABSENT		EMERGENT VEG PRESENT		EMERGENT VEG ABSENT						
DISTANCE (M) TO FOREST EDGE		FOREST TREE SPECIES:												

# Transects Walked



Study Area (City of Boulder Open Space and Mountain Parks)

Conservation Easements

Lakes/Reservoirs

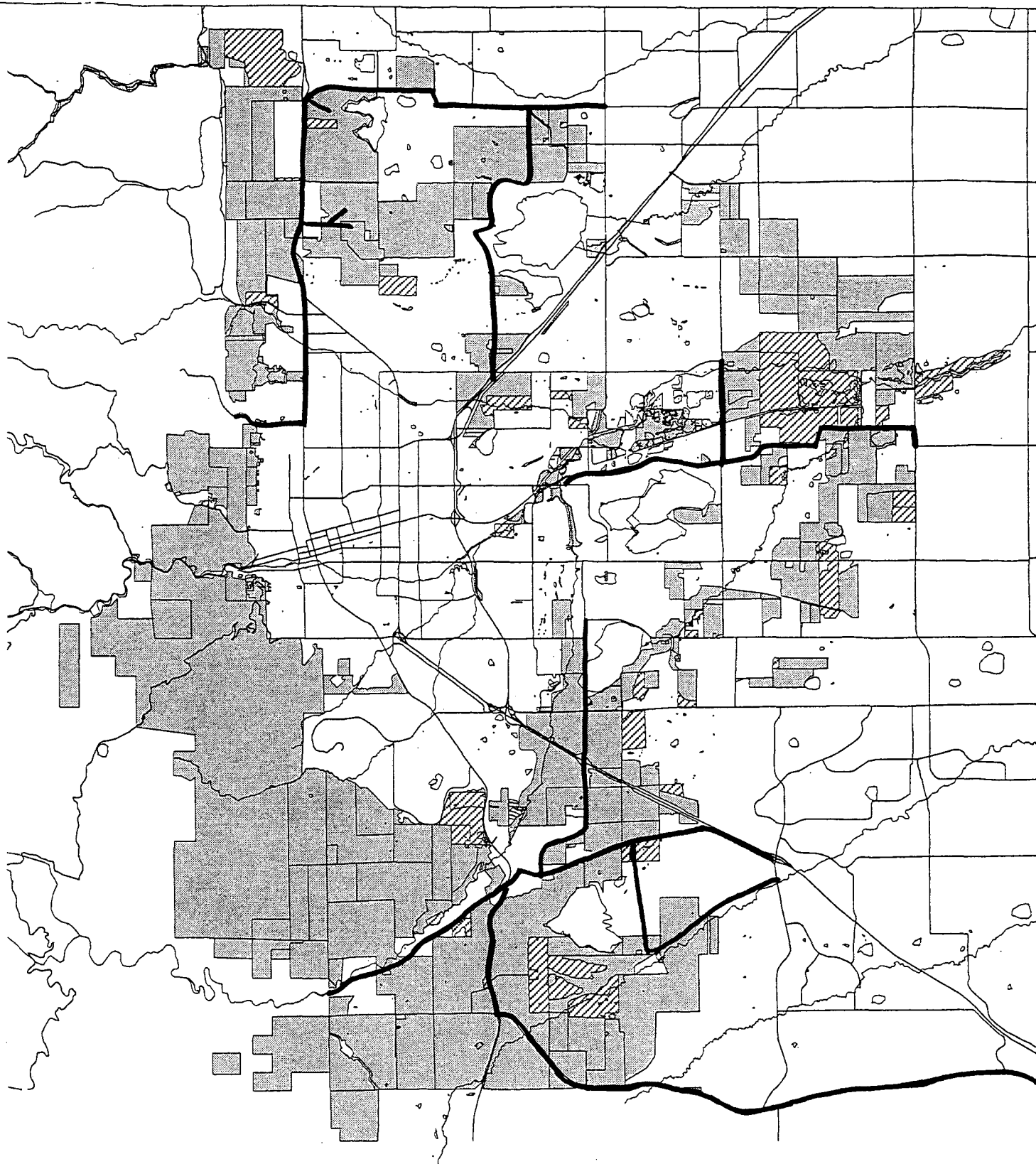
Creeks


Roads

2 0 2 Miles



# Night Driving Routes



 Study Area (City of Boulder Open Space and Mountain Parks)

 Conservation Easements

 Lakes/Reservoirs

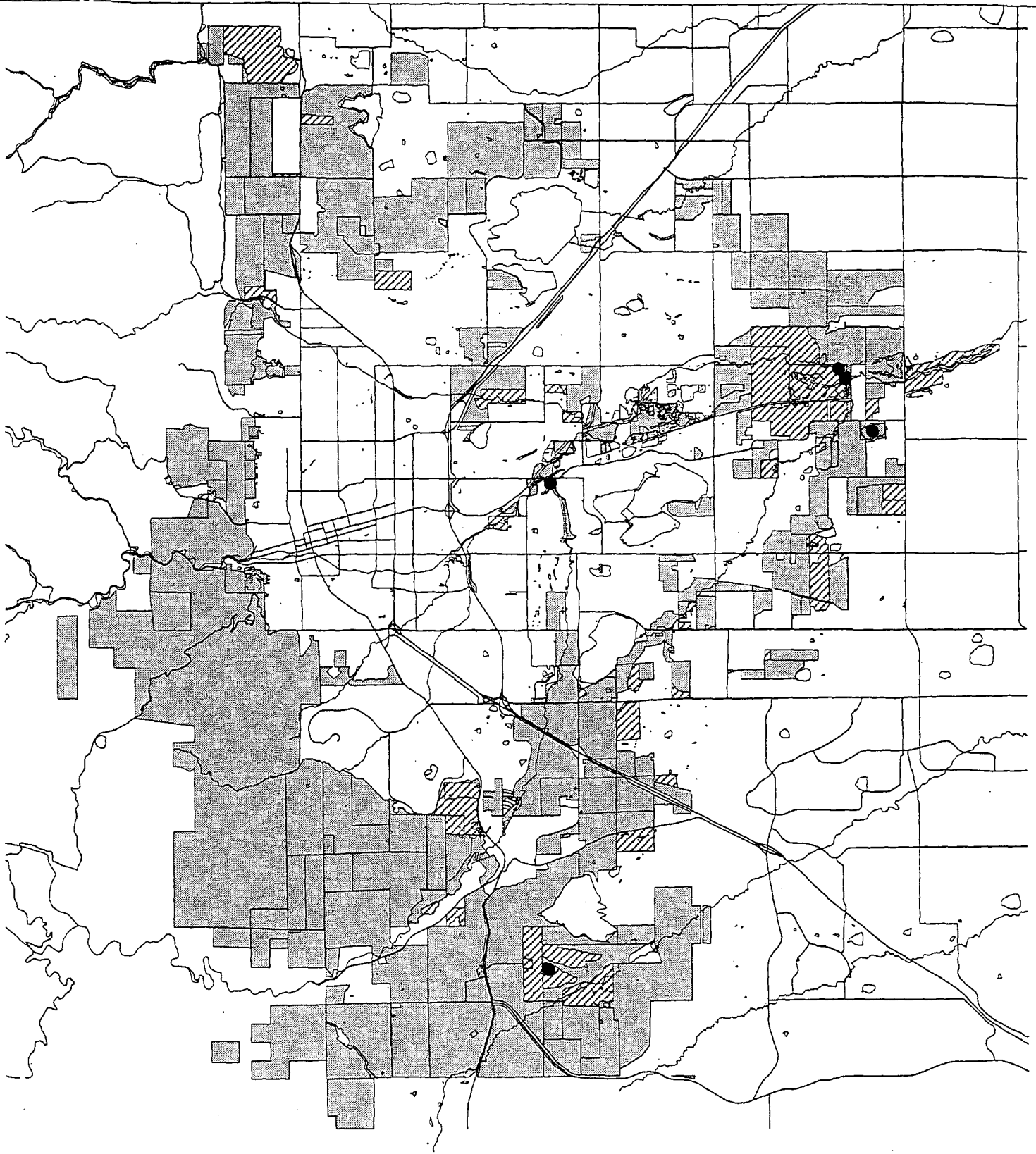
 Creeks

 Roads

2 0 2 Miles



# Turtle Trapping Sites



Study Area (City of Boulder Open Space and Mountain Parks)

Conservation Easements

Lakes/Reservoirs

Creeks

Roads

2 0 2 Miles



## Appendix B: Species accounts

This section provides descriptions of the status of all species known from or expected to occur in the Boulder area. The species are grouped as follows, and within group placed in alphabetical order by scientific name:

- Amphibians (salamander and anurans)
- Turtles
- Lizards
- Snakes

Breeding sites list areas where calling (by anurans), eggs, larvae, or very young (newly metamorphosed, newly hatched, or newly born) animals were observed.

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### Tiger salamander

*Ambystoma tigrinum*

**Breeding sites:** Doudy Draw (located at T1S, R70W, NW 1/4 Section 32); Shanahan Hill (Gordon Rodda, pers. comm.).

**Comments:** Tiger salamanders are relatively common in Boulder County and are expected to occur in most or all Open Space and Mountain Parks lands. They breed in ponds, quiet pools in streams, and other lentic situations. Tiger salamanders may comprise a multi-species complex (Shaffer and McKnight 1996; Collins et al. 1980).

According to Gordon Rodda (pers. comm.), crayfish are potential problems at tiger salamander breeding sites. He described how Shanahan Hill has four ponds that are reported localities for tiger salamander. While tiger salamanders persist in three of the ponds, they have disappeared from Abbey Pond, which now contains the introduced crayfish species *Orconectes virilis*. Gamradt and Kats (1996) provide evidence that another crayfish species, *Procambarus clarkii*, preys on eggs and larvae of the California newt, causing local population declines of the salamander.

Worthylake and Hovingh (1989) attributed mass mortality in a Utah population of tiger salamanders to grazing by sheep and the sheep-produced nitrogenous waste entering the lake.

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### Boreal toad

*Bufo boreas*

**Breeding sites:** None observed.

**Comments:** This species is not expected to occur on Open Space or Mountain Parks lands, as it is found primarily above 8,000 feet elevation in western Boulder County. This toad was observed in 1996 at a site west of Nederland (pers. obs.). For a recent summary of other sightings of this endangered species in western Boulder County, see Livo (1995).

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**Great Plains toad***Bufo cognatus***Breeding sites:** None observed.

**Comments:** Great Plains toads were first reported from Boulder County in 1978 (Colorado Division of Wildlife 1994). Additional specimens were observed in 1979 and 1981. All records of this species are in the Louisville area. These localities are:

- SW Louisville City Hall (0.7 mi W, 0.4 mi S Louisville City Hall)
- Louisville exit, US 36 (just N exit)
- Site of Cowdrey Reservoir (NE Louisville-Superior exit US 36)

Development and traffic may threaten this toad if it is still present in Boulder County. U.S. Highway 36 (the Boulder Turnpike) probably presents a barrier to dispersal to the southwest in the Coal Creek drainage. This drainage should be surveyed after heavy rains specifically to search for additional localities of the Great Plains toad.

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**Woodhouse's toad***Bufo woodhousii*

**Breeding sites:** Coal Creek (T1S, R70W, SW 1/4 Section 27); Flatirons Vista (T1S, R70W, NW 1/4 Section 33); White Rocks area (T1N, R69W, W 1/2 Section 17, E 1/2 Section 18); Cowdry Reservoir No. 2 (T1S, R70W, NE 1/4 Section 22); Boulder Valley Ranch (T1N, R69W, NW 1/4 Section 5, SE 1/4 Section 5); Big Bluestem Trail (T1S, R70W, NE 1/4 Section 19).

**Comments:** This species is both widespread and common in the Boulder area. Traffic presents a hazard to individual toads, but populations in the Boulder area appear to be secure.

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**Western chorus frog***Pseudacris triseriata*

**Breeding sites:** Boulder Creek area (T1N, R69W, SE 1/4 Section 18, NW 1/4 Section 24; T1N, R70W, SE 1/4 Section 13, S 1/2 Section 22, N 1/2 Section 24); South Boulder Creek (T1S, R70W, NE 1/4 Section 9, NW 1/4 Section 10, NE 1/4 Section 16); Ponds south of Marshall Road (T1S, R70W, SW 1/4 Section 14; NW 1/4 Section 23; NW 1/4 Section 26); Doudy Draw (T1S, R70W, SE 1/4 Section 31; NW 1/4 Section 32); Along Foothills Highway (T1N, R71W, SE 1/4 Section 1, NE 1/4 Section 12); Near Boulder Reservoir (T1N, R70W, SE 1/4 Section 4); West end Sixmile Reservoir (T1N, R70W, NE 1/4 Section 9); Shanahan Hill (T1S, R70W, NW 1/4 Section 18); Greenbelt Plateau (T1S, R70W, N 1/2 Section 28).

**Comments:** Chorus frogs are widely distributed and common in the Boulder Area. Traffic presents a hazard to individual frogs, but populations in the Boulder area appear to be secure. This species is easily detectable through its calls, and was the only species detected by auditory surveys during night-driving. It may be feasible to track general population trends for this species by establishing randomized calling survey routes to be run (or walked) a few times in the spring of each year, perhaps by volunteers.

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**Bullfrog***Rana catesbeiana*

**Breeding sites:** Sawhill Ponds (1a, but probably breeding widespread in this area); Teller Lake No. 5 (T1N, R69W, NE 1/4 Section 20).

**Comments:** Bullfrog populations are most dense along the Boulder Creek drainage. There also is a population at Varsity Lake on the University of Colorado campus and in the Marshall Mesa area. It is important to train rangers and other field personnel to distinguish between bullfrogs, an introduced species (Bury and Whelan 1984), and northern leopard frogs, a native ranid and to report observations of both species. Survey efforts at selected ponds could be repeated on an annual basis to determine if bullfrogs are continuing to expand their range in Boulder County. In 1978 and 1979 at Sawhill Ponds, 96 % of the ranid frogs observed by Hammerson (1982b) were northern leopard frogs. However, in 1980 through 1982, 74 % of the ranids observed in the same area were bullfrogs (Hammerson 1982b).

The Sawhill Ponds area continues to support large bullfrog populations and diminished leopard frog populations. Bullfrogs are reported from ponds 1, 1a, 2, 3, 4, 5, 6, 7, 9, 11, 12, 13, 16, and the pond east of the parking lot (Colorado Division of Wildlife 1994; pers. obs.).

Wiese (1985, 1989, 1990) seldom found bullfrogs more than 1 meter from water and concluded that there was a low probability of movement between ponds separated by dry terrain. However, elsewhere in Colorado I have observed bullfrogs at considerable distances from water on rainy nights (unpublished data), and Hammerson (1982b) has found them more than 1.6 km from permanent water. In this study, bullfrogs were sometimes found on roads following rain. The presence of streams and irrigation ditches in the Boulder area provides opportunities for bullfrogs to disperse to new sites. The Colorado Amphibian and Reptile Database lists only a few localities for bullfrogs in Boulder County, with the first report in 1947. Dale and Merritt (1993) did not observe any bullfrogs during a 1992 survey of several Boulder Open Space lands, including the White Rocks area where several bullfrogs were recorded in the present survey.

In the Boulder area, bullfrogs begin their activity season soon after ice is off the ponds. At Sawhill's Pond 1a I observed a dead adult and active tadpoles on February 22. Metamorphosis appears to peak in early July. At Pond 1a more than 50 newly metamorphosed frogs had appeared by June 30, while 150 were counted a week later on July 6. Large tadpoles continued to be present on July 28, but no tadpoles were observed at this site on August 18. Egg deposition dates are unknown in Colorado. Although I carefully checked this site for eggs at each visit, I never observed them.

Bullfrogs require permanent water since tadpoles typically overwinter at least once prior to metamorphosis. Wiese (1985) recommends attempting eradication of bullfrog populations, especially at isolated sites. He suggests that several years of effort may be involved at a single site because the tadpoles have a prolonged larval period. Substances that could kill tadpoles also would be expected to harm any leopard frogs or tadpoles present at the site, so should not be used in bullfrog eradication efforts.

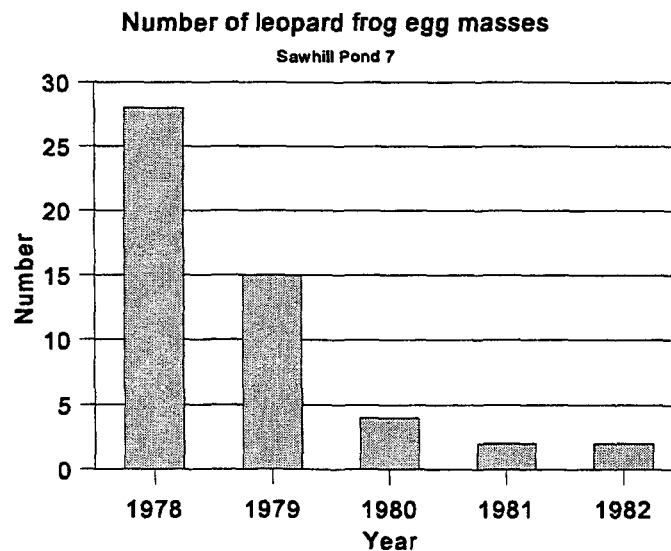
**Northern leopard frog***Rana pipiens*

**Breeding sites:** Douidy Draw (T1S, R70W, SE 1/4 Section 31); Coal Creek (T1S, R70W, SW 1/4 Section 27).

**Comments:** Although there are numerous historic records for this species in the Boulder Area, populations have declined in the past 15 years.

In Boulder County, northern leopard frogs usually breed in March and April, producing egg masses containing 645 to 6272 eggs (Corn and Livo 1990). Between 1978 and 1982, I observed a decrease in the number of northern leopard frog egg masses deposited in Pond 7 at Sawhill (Livo 1984), as shown in the figure below. In 1995, leopard frogs in this pond produced only 3 egg masses (pers. obs.). This corresponds to an increase in bullfrog populations (for additional details on bullfrogs, see the bullfrog account above). Populations along Boulder Creek are threatened by bullfrogs. Douidy Draw and the upper reaches of the Coal Creek area appear to be free from bullfrogs at present. The status of leopard frog populations in the north Boulder area is unknown.

I recommend annual site visits to known breeding sites to determine whether they continue to maintain populations of this species. The number of frogs observed in one circuit of the pond and a count of egg masses will provide some easily gathered information about trends.



**Figure 1.** Decline in leopard frog egg masses.

In addition to surveys, known leopard frog sites should be protected from grazing. Jennings and Hayes (1994) attributed the declines of native ranid frogs in the southwest in part to alteration of riparian vegetation from livestock grazing. These alterations simultaneously made the habitat more suitable for invasion by the bullfrog by increasing water temperatures and vegetation around the margins of aquatic habitats (Jennings 1988).



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**Plains spadefoot***Spea bombifrons***Breeding sites:** None observed.

**Comments:** Plains spadefoot toads appear to have a limited distribution along the eastern margins of the Boulder area. This anuran is seldom active at times other than warm, rainy nights. The most effective method of detecting its presence is by night-driving during suitable weather conditions. Additional survey efforts to determine its status and level of vulnerability appear warranted.

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**Spiny softshell***Apalone spinifera***Breeding sites:** None observed.

**Comments:** There is only one report of a spiny softshell from Boulder County, and that was established in 1947 six miles south and one mile east of Longmont. This turtle is most frequently found in rivers and streams, but sometimes inhabits ponds adjacent to streams. If it occurs in the Boulder area, it is most likely to be in Boulder Creek. Dams appear to present obstacles to dispersal for this very aquatic turtle. Deployment of turtle traps in Boulder Creek, especially in areas with sandbars, might reveal the presence of this turtle in the Boulder area.

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**Snapping turtle***Chelydra serpentina***Breeding sites:** None observed.

**Comments:** Snapping turtles require permanent water and spend most of their time submerged, making them relatively difficult to detect. This is a game species, and I have observed remains of snapping turtles at Sawhill Ponds collected for their shells and flesh. Additional turtle trapping would be the best method to provide more information about the distribution of this turtle in the Boulder area. Snapping turtles nest on land, and racoons are probably major nest predators.

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**Painted turtle***Chrysemys picta***Breeding sites:** Bank along north end of Teller Lake No. 5 (T1N, R69W, NE 1/4 Section 20).

**Comments:** Painted turtles occupy many ponds in the Boulder area and often occur in large numbers. Compared to snapping turtles, they are easily observed since they spend a great deal of time basking or merely floating near the water's surface with the head projecting into the air. They can be identified at a distance with binoculars due to the striped pattern on the head. At Sawhill ponds, this turtle has been reported from most of the ponds (numbers 1, 3, 4, 6, 7, 11, 12, 16 and the pond east of the parking lot)(Colorado Division of Wildlife 1994, pers. obs.).

Like other turtle species, painted turtles nest on land. We observed numerous turtle nests at Teller Lake 5 that had been destroyed by nest predators such as racoons. If such predation reduces populations, wire mesh can be placed over fresh nests to protect them from racoons. In Boulder County, nesting usually occurs in late June and early July (Hammerson 1982a). Nest construction disturbs the soil in the vicinity, and usually takes place in open areas within a few dozen meters of water.



Figure 2. Destroyed turtle nest (Teller No. 5).

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**Ornate box turtle**

*Terrapene ornata*

**Breeding sites:** None observed.

**Comments:** While the ornate box turtle may have natural populations in eastern Boulder County (although none have been reported), all occurrences in the Boulder area are of introduced specimens (Livo et al., in review). This includes the record from Wonderland in the Boulder Open Space Wildlife Sightings database.

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**Six-lined racerunner**

*Cnemidophorus sexlineatus*

**Breeding sites:** White Rocks area (T1N, R69W, N ½ Section 17, N ½ Section 18)

**Comments:** The six-lined racerunner has a limited distribution in Boulder County with most reports from the White Rocks area, although it also occurs northwest of Lyons. The mapped record from "Valmont, Colo 60" actually may be a site closer to White Rocks than to Valmont.

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**Many-lined skink**

*Eumeces multivirgatus*

**Breeding sites:** None observed.

**Comments:** In north-central Colorado, this species is found as far west as extreme western Weld County. This indicates that it may have natural populations in eastern Boulder County, although no specimens have been documented to date.

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**Lesser earless lizard**

*Holbrookia maculata*

**Breeding sites:** None observed.

**Comments:** In north-central Colorado, this species is found as far west as extreme western Weld County. This indicates that it may have natural populations in Boulder County, although no specimens have been documented to date. A record from Boulder in 1907 is believed to either be an introduced specimen or a mistaken locality (Livo et al., in review).

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**Short-horned lizard**

*Phrynosoma douglassii*

**Breeding sites:** None observed.

**Comments:** This is Colorado's only live-bearing lizard. It prefers open areas. Reynolds (1979) suggests that under certain conditions this species may benefit from grazing. The status of Boulder County populations is undetermined.

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**Red-lipped plateau lizard**

*Sceloporus undulatus erythrocheilus*

**Breeding sites:** None observed.

**Comments:** Ferner (1972) and Rand (1991) conducted research on red-lipped plateau lizards in the foothills west of Boulder. These lizards live in rocky areas and appear to be common in suitable habitat.

---

**Prairie lizard**

*Sceloporus undulatus garmani*

**Breeding sites:** None observed.

**Comments:** In north-central Colorado, this subspecies is found as far west as extreme western Weld County. This indicates that it may have natural populations in Boulder County, although no specimens have been documented to date.

---

**Racer**

*Coluber constrictor*

**Breeding sites:** Beech (T2N, R70W, NW 1/4 Section 31); Cottonwood Trail (T1N, R70W, SW 1/4 Section 16); Big Bluestem Trail (T1S, R70W, SE 1/4 Section 17).

**Comments:** This is an active, diurnal snake, so is encountered relatively frequently. It is widespread in the Boulder area and has been reported as recently as 1970 within developed parts of Boulder. Although mostly a plains species, it sometimes is found in the foothills and has been reported as far west as 0.5 miles south of Rowena above Lefthand Creek (Colorado Division of Wildlife 1994).

---

**Western rattlesnake**

*Crotalus viridis*

**Breeding sites:** None observed.

**Comments:** Reports of western rattlesnakes are mostly from the foothills, although this species sometimes ascends into mountain canyons. Its status is undetermined.

---

**Western hognose snake**

*Heterodon nasicus*

**Breeding sites:** None observed.

**Comments:** This species may have natural populations in Boulder County, although no specimens have been documented to date. Elsewhere along the Front Range, it occurs as far west as Larimer, Jefferson, and Douglas counties.

---

**Milk snake**

*Lampropeltis triangulum*

**Breeding sites:** None observed.

**Comments:** This harmless species is encountered rather infrequently. Its red, black, and cream bands cause it to be mistaken for the venomous coral snake. Geographic records indicate that it is more common in the foothills and lower montane than lower elevations in Boulder County.

---

**Smooth green snake**

*Liochlorophis vernalis*

**Breeding sites:** None observed.

**Comments:** There are only three records of the smooth green snake in Boulder County: Chautauqua (1911), Green Mountain (1942), and Caribou Ranch (1970s) (Colorado Division of Wildlife 1994). This species may be present in riparian areas in the lower montane zone, such as the southern edge of the Mt. Sanitas area and in some Mountain Parks lands. Because of the paucity of records, any observations of this species should be as complete as possible (precise locality, date, identifying details). It may be confused with the racer, which also has smooth scales and is green. However, the smooth green snake rarely is more than two feet long and the nostril is located in the center of a scale. In contrast, adult racers are typically longer than two feet and have the nostril located between scales.

---

**Northern water snake**

*Nerodia sipedon*

**Breeding sites:** None observed.

**Comments:** This species is most common in ponds along Boulder Creek. Mark Gersham (pers. comm.) found this snake as far west as about 1 mile south of Boulder at Colorado Highway 93.

---

**Bullsnake**

*Pituophis catenifer*

**Breeding sites:** None observed.

**Comments:** The bullsnake is widespread and common in the Boulder area. Because of its large size, it is often killed by automobile traffic.

---

**Plains blackhead snake**

*Tantilla nigriceps*

The plains blackhead snake was first documented in Boulder County in 1908. Boulder County localities include: Red Rocks, 1 mi NW Boulder, 2.5 mi N Boulder, 6 mi N Boulder along hwy 7, small canyon N of Kalmia St.

**Breeding sites:** None observed.

**Comments:** Elsewhere in the state, this small snake is usually associated with grasslands and riparian areas. In the Boulder area it has been found on numerous occasions on slopes in the foothills. The relatively scanty information about this species is probably due to its secretive nature.

---

**Western terrestrial garter snake**

*Thamnophis elegans*

**Breeding sites:** Cottonwood Trail (T1N, R70W, SW 1/4 Section 16).

**Comments:** This is a species more typical of the mountains, with populations extending to the east along steams. Although not particularly common in the immediate vicinity of Boulder, it is very common at higher elevations (Livo 1995).

---

**Plains garter snake**

*Thamnophis radix*

**Breeding sites:** None observed.

**Comments:** This is the most commonly encountered reptile in the Boulder area. It is encountered even in urban areas, usually along streams and irrigation ditches.

---

**Common garter snake**

*Thamnophis sirtalis*

**Breeding sites:** None observed.

**Comments:** The common garter snake is primarily associated with streams and ponds in the Boulder area. It is relatively common at places like Sawhill Ponds.

---

**Lined snake**

*Tropidoclonion lineatum*

**Breeding sites:** None observed.

**Comments:** There are only a handful of records of lined snakes from Boulder County. Three records are from the 3000 block of 3rd street (Colorado Division of Wildlife 1994; D. Chiszar pers. com.), an area that borders the Mt. Sanitas area. A dead specimen was collected on 3rd Street between Evergreen and Forest in 1991 (University of Colorado Museum records), implying that a colony is still present in this area. Other records lack precise locality data (e.g., "Boulder"). Two specimens, both collected on the same date in 1959, are from the vicinity of the High Altitude Observatory (University of Colorado Museum records). However, the exact location of this facility is unknown. I have mapped it on the University of Colorado campus, although this might be in error. There are no documented occurrences of the lined snake on City lands. It is expected to occur along the eastern edge of the Mt. Sanitas area, but repeated visits to this area (and 620 objects turned to look for this secretive snake) did not result in any observations. These snakes usually are found under objects. Populations can be dense; a population in Denver on a 0.6 ha site contained at least 76 snakes (Livo 1985).

## Appendix C: Distribution maps

This appendix contains distribution maps for all species known to occur in the area of Boulder County covered by the following USGS topographic maps:

- Boulder
- Eldorado Springs
- Louisville
- Niwot

The maps in this appendix are intended to provide a general overview of the distribution of amphibians and reptiles in the Boulder area. In contrast to the localities from 1996 survey work, many mapped historical localities lack precision, as these records often provide only a general description of the locality (for example, "Boulder," or "2 miles N Boulder"). In addition, place names associated with the records often are no longer in use. I did not map localities that lacked definite current place names (as indicated by listing in the 1993 edition of the United States Geological Survey's "Geographic Names Information System") unless there was other information about the location of the site.

The explanation for the map symbols used to indicate localities is shown in the table below:

Symbol	Source material
•	Historic localities, including distributional records from personal records, literature sources, the University of Colorado Museum, and the Colorado Division of Wildlife (1994).
■	Localities observed during the 1996 amphibian and reptile survey.

Because of the lack of precision for many of the historical records, mapped locations should be interpreted as indicating that a species was historically present in the vicinity rather than as an exact location of an extant population. Specimens were often collected from the same general area (such as leopard frogs from the Sawhill Ponds area) over a period of years; such numerous records often are represented with a single dot.

Many historical localities from within the developed portions of Boulder County may no longer support populations of amphibians or reptiles. For example, there are records from 1911 and 1938 of milk snakes on the University of Colorado campus, although it is unlikely that this snake currently occurs here. However, some species do continue to survive in developed areas: bullfrogs and painted turtles were among the amphibians and reptiles observed at Varsity Pond on the University of Colorado campus in 1996.

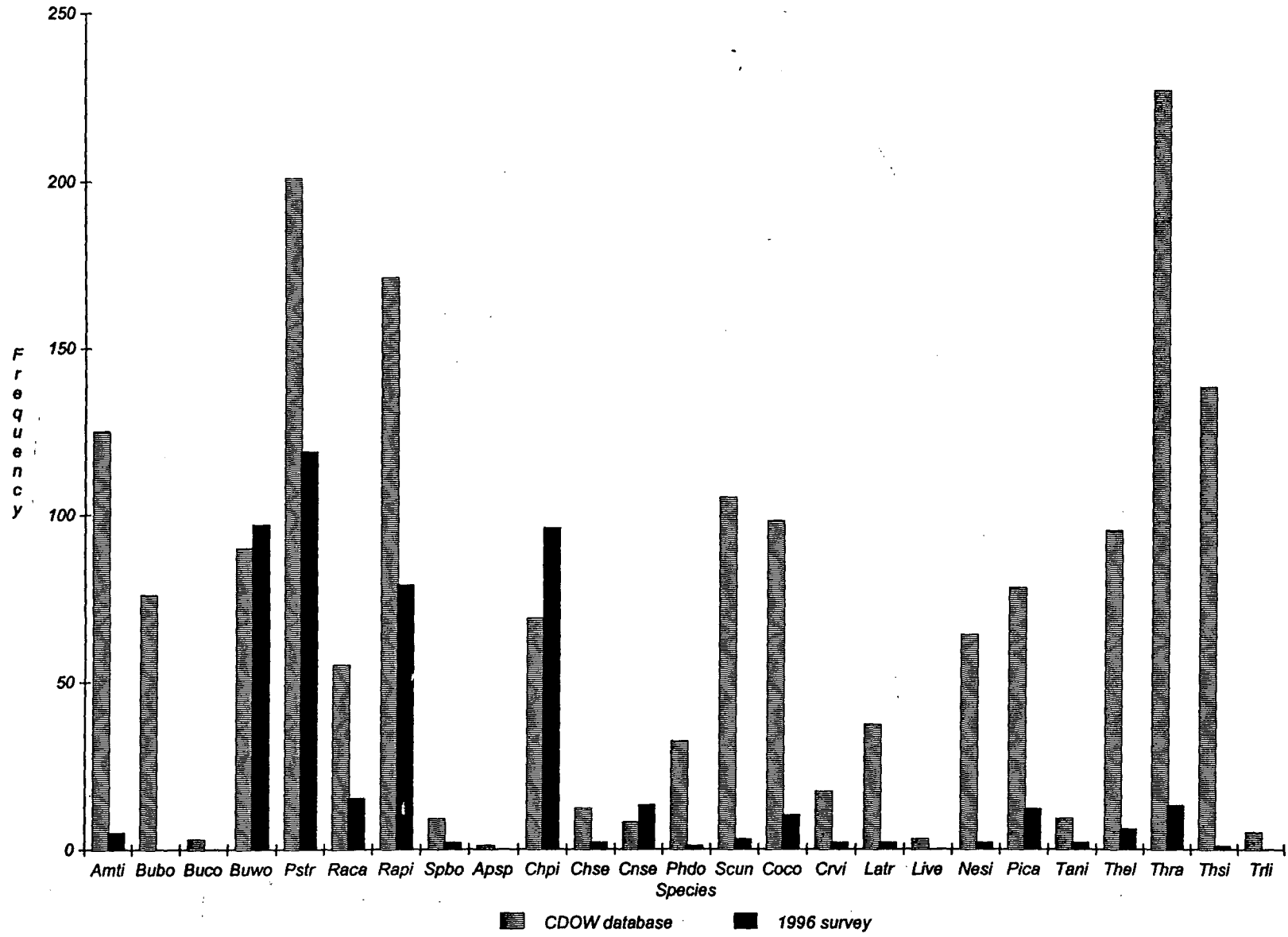
Finally, the collection effort at different times and for particular species varies considerably. A greater emphasis on collecting specimens was prevalent in earlier decades of this century while there are relatively fewer recent records. Turtles, especially large ones like snapping turtles, are difficult to preserve in museum collections, and so are often underrepresented compared to their actual abundance. In contrast, unusual or colorful species

such as milk snakes may be overrepresented. The chart on the following page shows the relative abundance of records for each of the species found in Boulder County compared to the number of individuals of each species observed during the 1996 survey. (Note: The 1,591 bullfrogs observed in 1996 are represented by the 15 times they were observed to prevent undue distortion of the chart.) The next chart compares observations made during the 1992 and 1996 surveys.

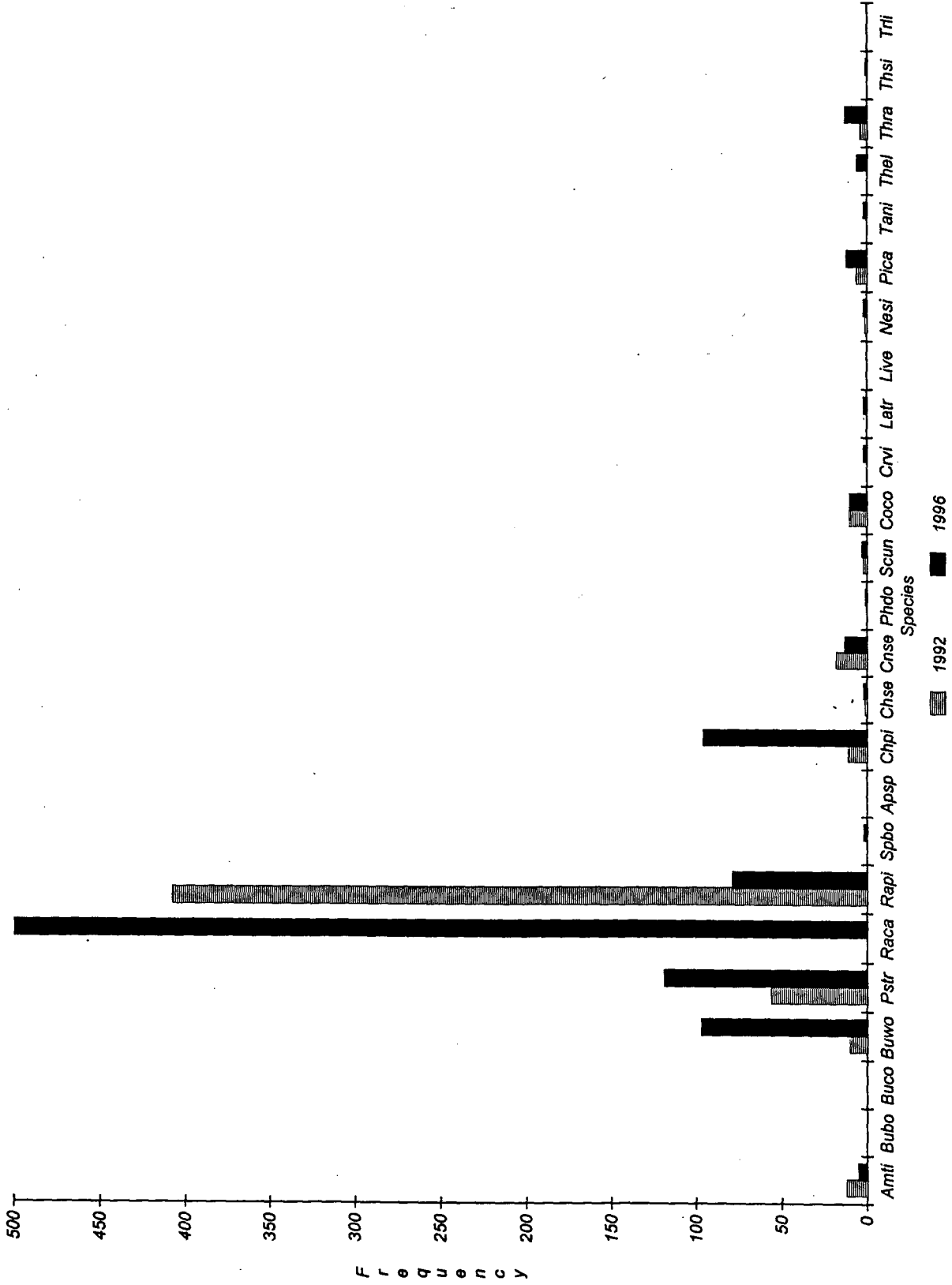


# Amphibians and Reptiles

*Boulder County*

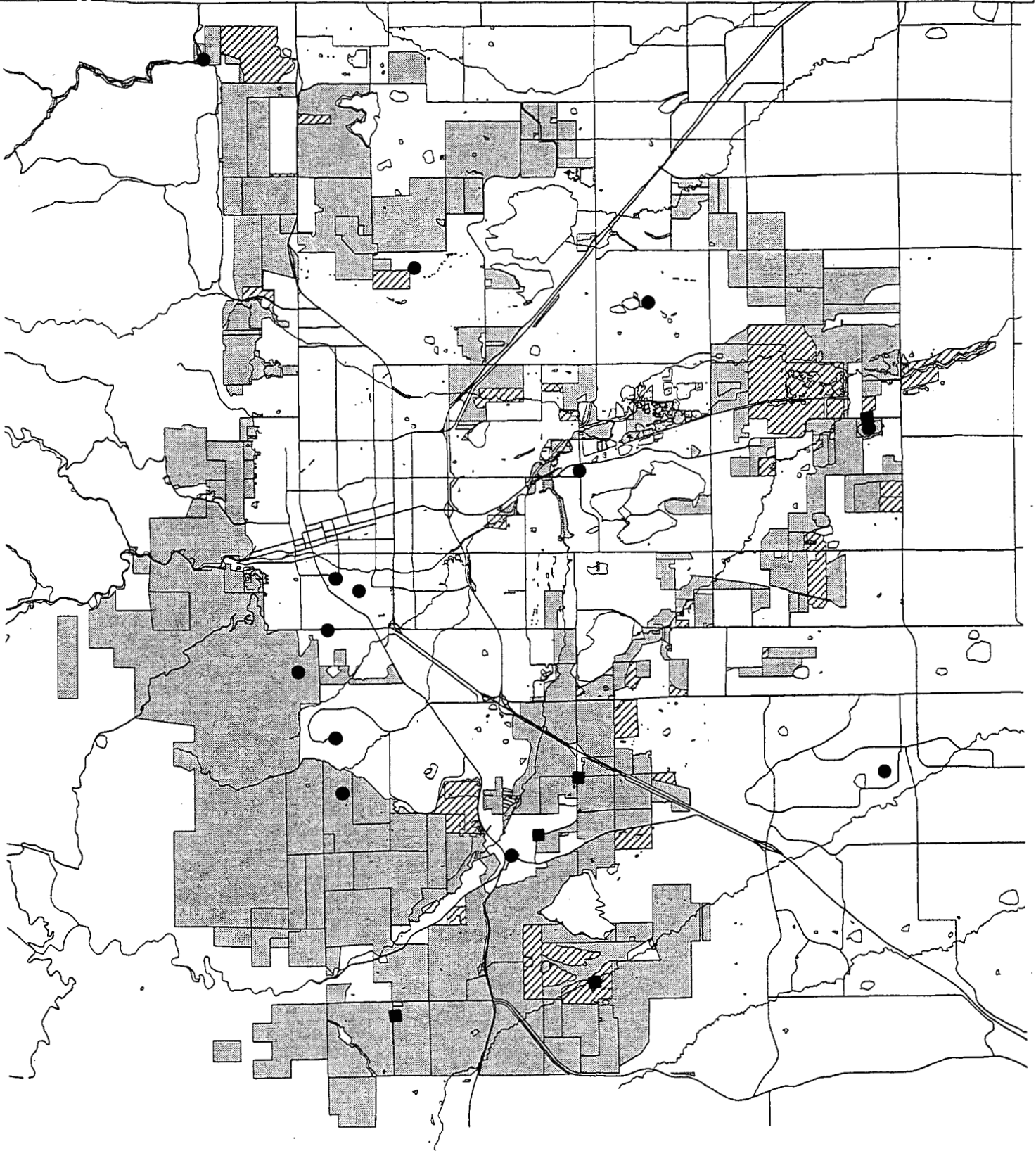


Comparison of 1992 and 1996 surveys\*



1591 Raca seen, but graphed here as 500 individuals.

*Ambystoma tigrinum*



Study Area (City of Boulder Open Space and Mountain Parks)

Conservation Easements

Lakes/Reservoirs

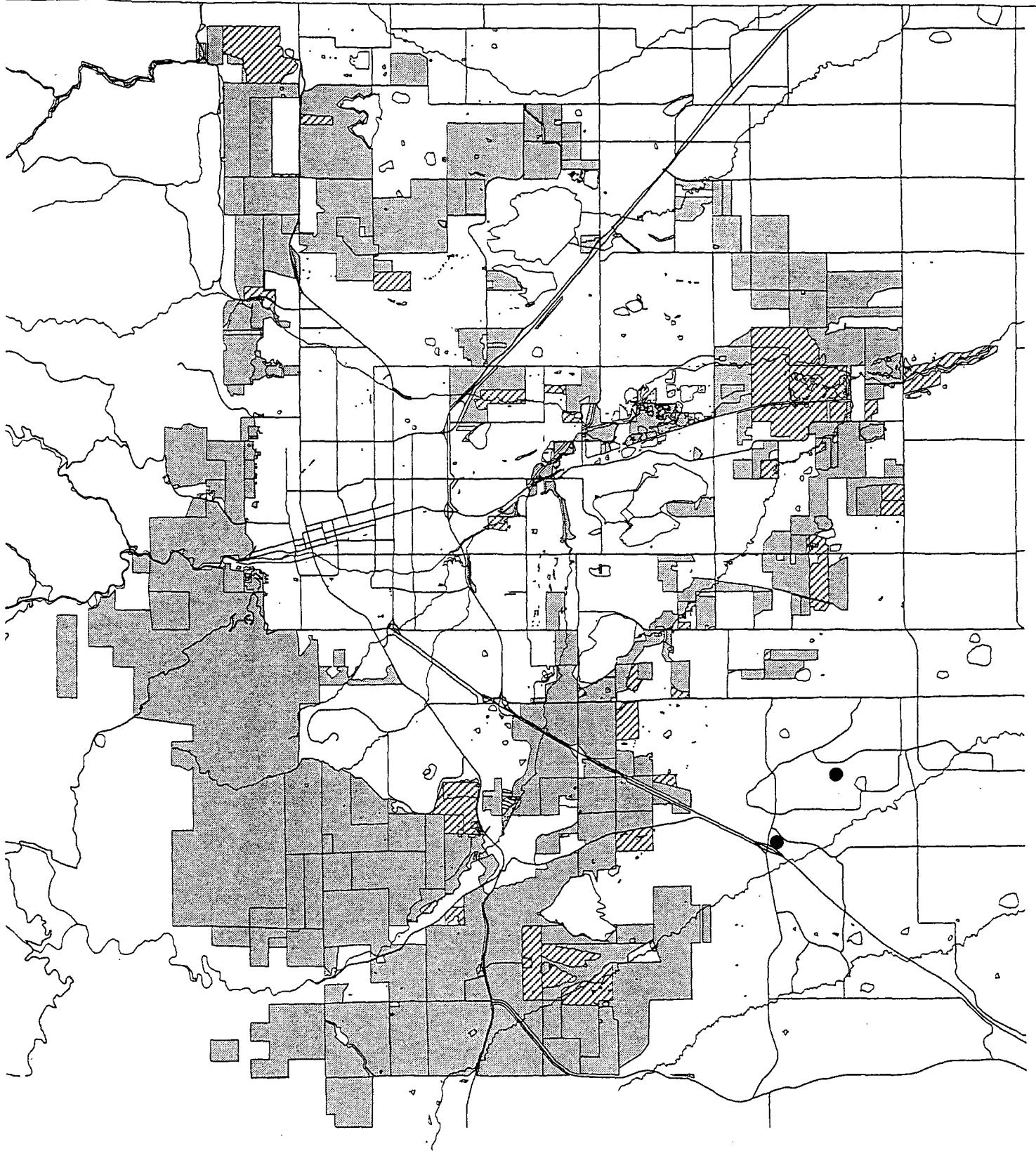
Creeks

Roads

2 0 2 Miles



*Bufo cognatus*



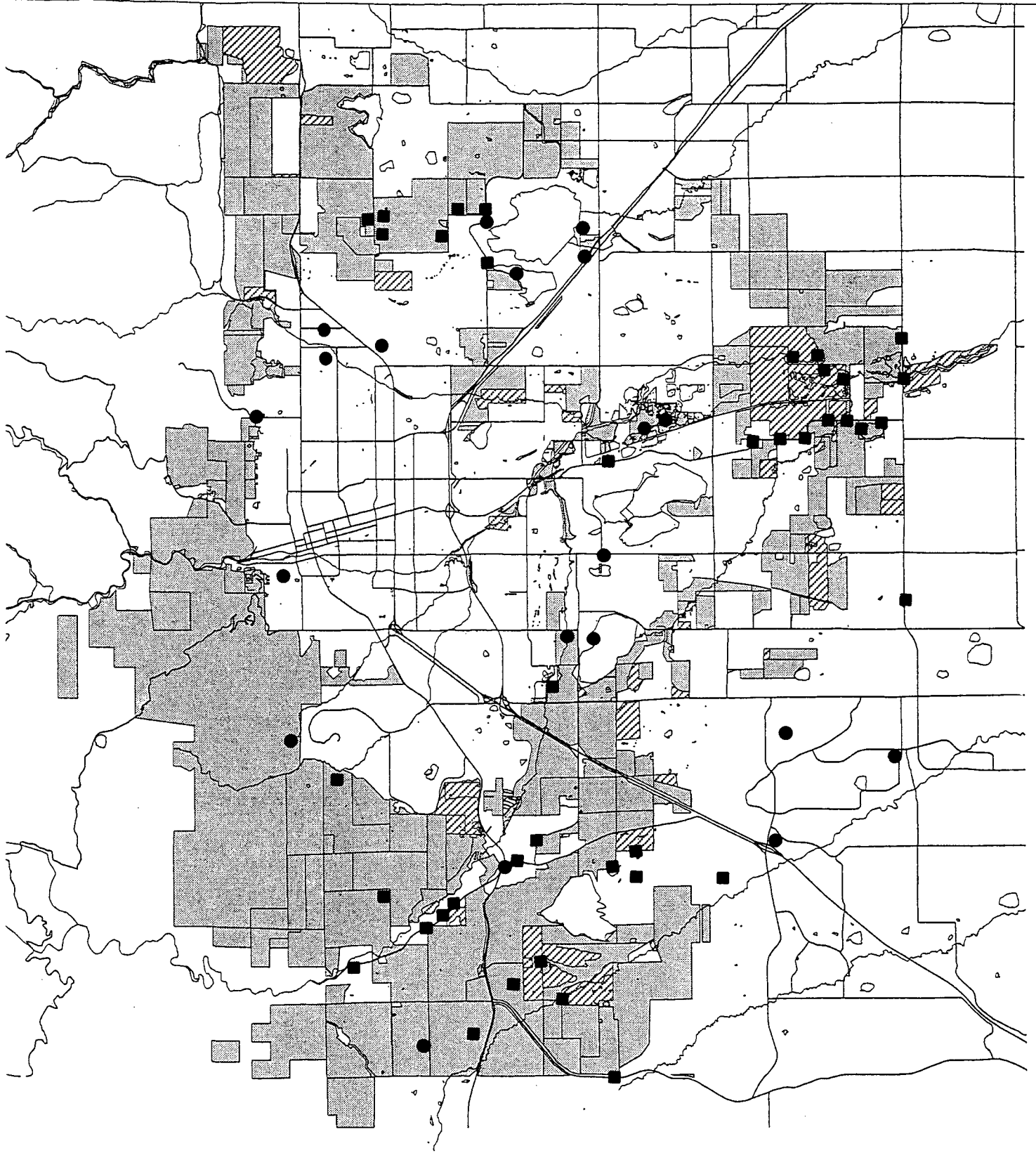
Legend:

- Study Area (City of Boulder Open Space and Mountain Parks)
- Conservation Easements
- Lakes/Reservoirs
- Creeks
- Roads

Scale: 2 0 2 Miles

North Arrow

*Bufo woodhousii*



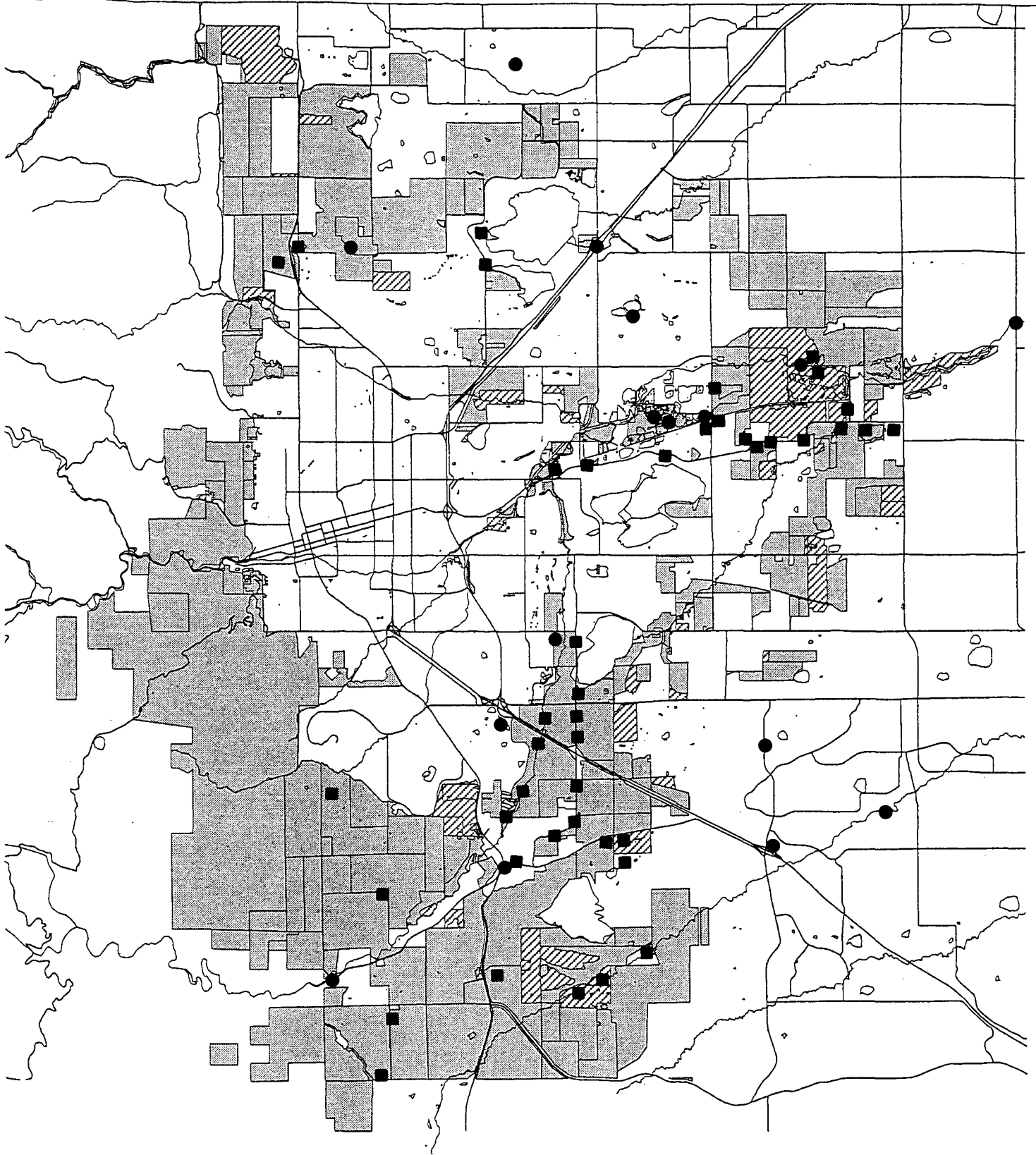
Legend:

- Study Area (City of Boulder Open Space and Mountain Parks)
- Conservation Easements
- Lakes/Reservoirs
- Creeks
- Roads

Scale: 2 0 2 Miles

North Arrow: N

*Pseudacris triseriata*



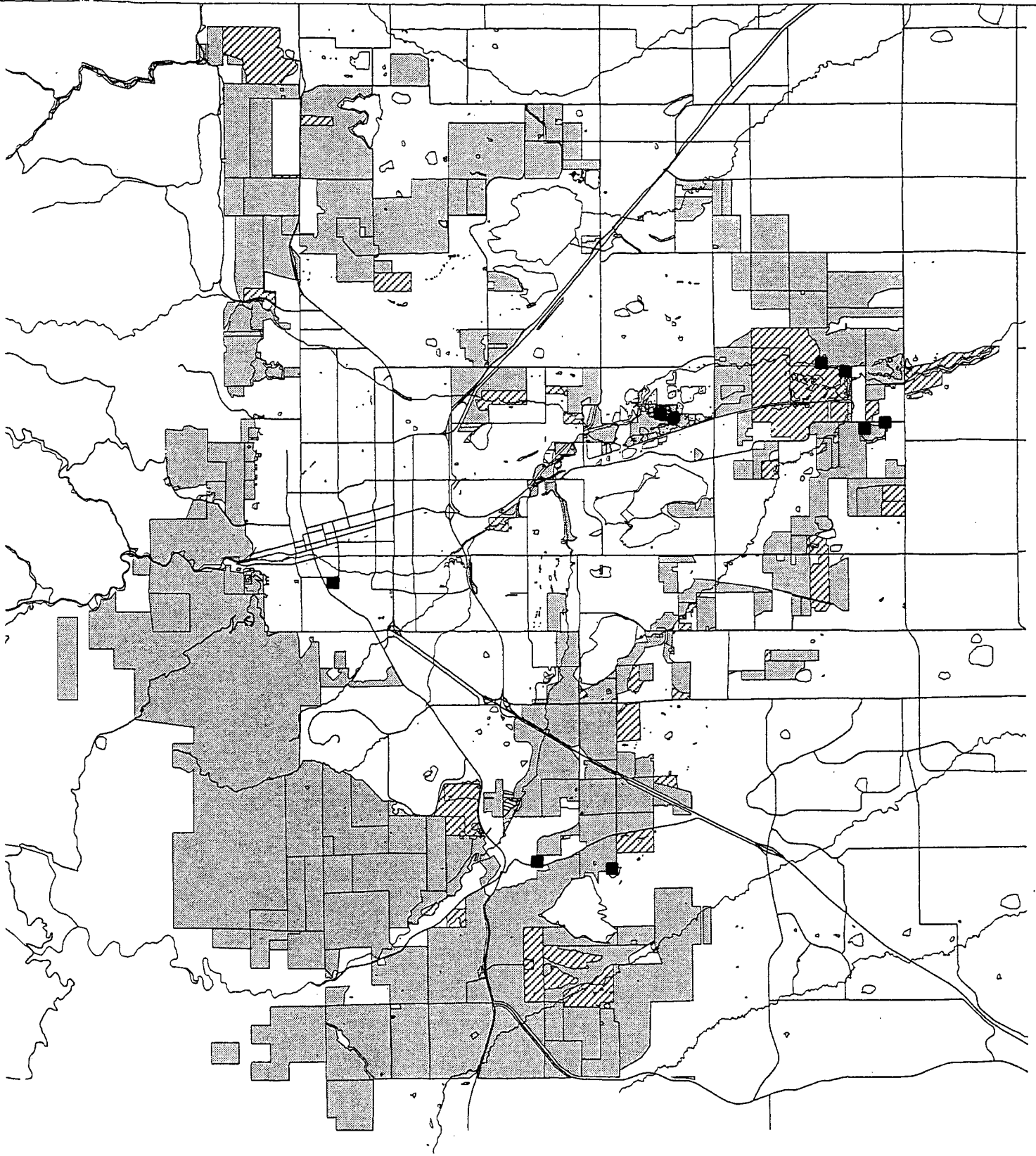
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



- Study Area (City of Boulder Open Space and Mountain Parks)
- Conservation Easements
- Lakes/Reservoirs
- Creeks
- Roads

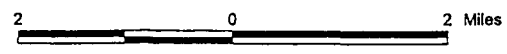
Scale: 2 0 2 Miles

North Arrow

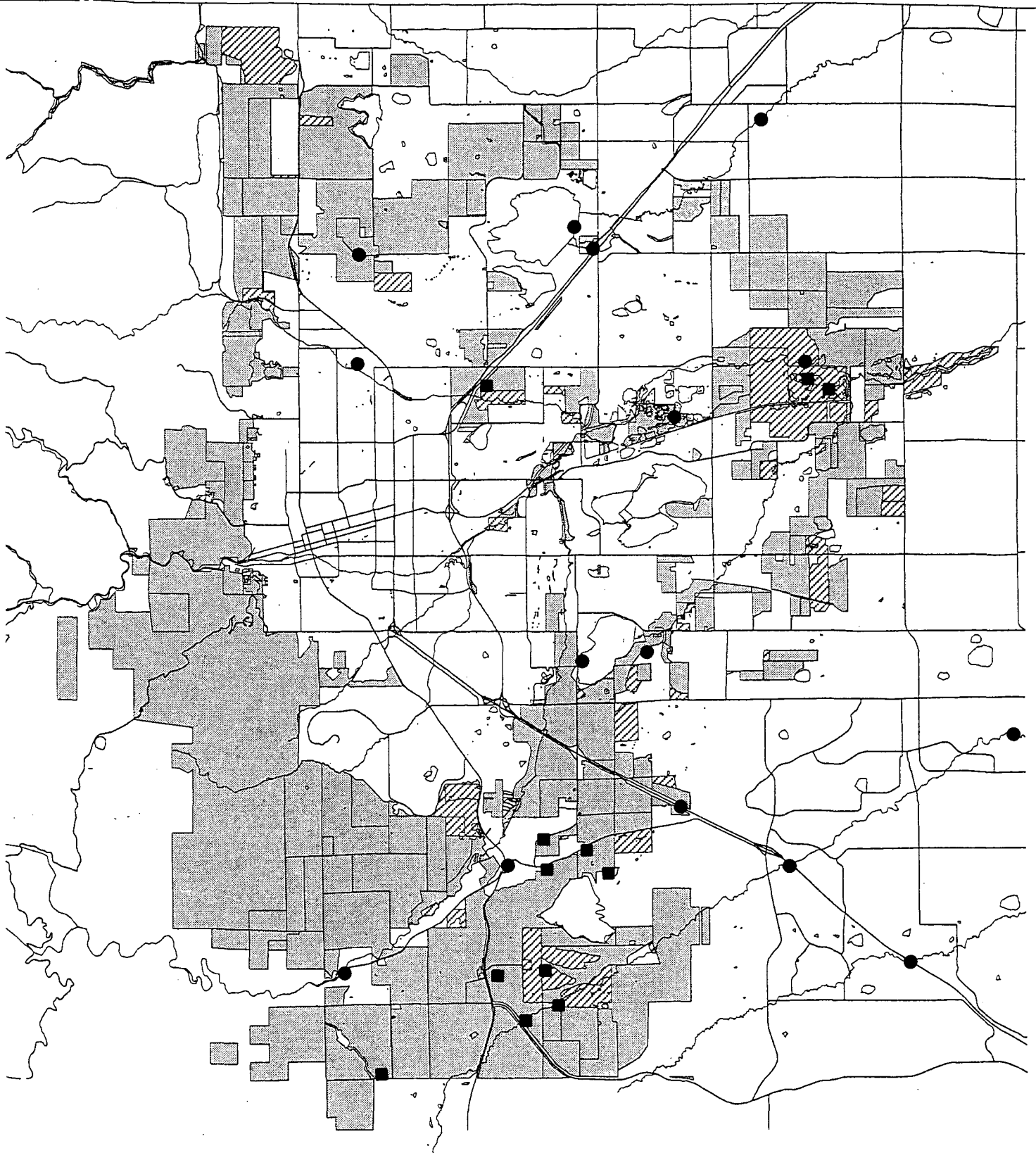
*Rana catesbeiana*



-  Study Area (City of Boulder Open Space and Mountain Parks)
-  Conservation Easements
-  Lakes/Reservoirs
-  Creeks
-  Roads



*Rana pipiens*



Study Area (City of Boulder Open Space and Mountain Parks)

Conservation Easements

Lakes/Reservoirs

Creeks

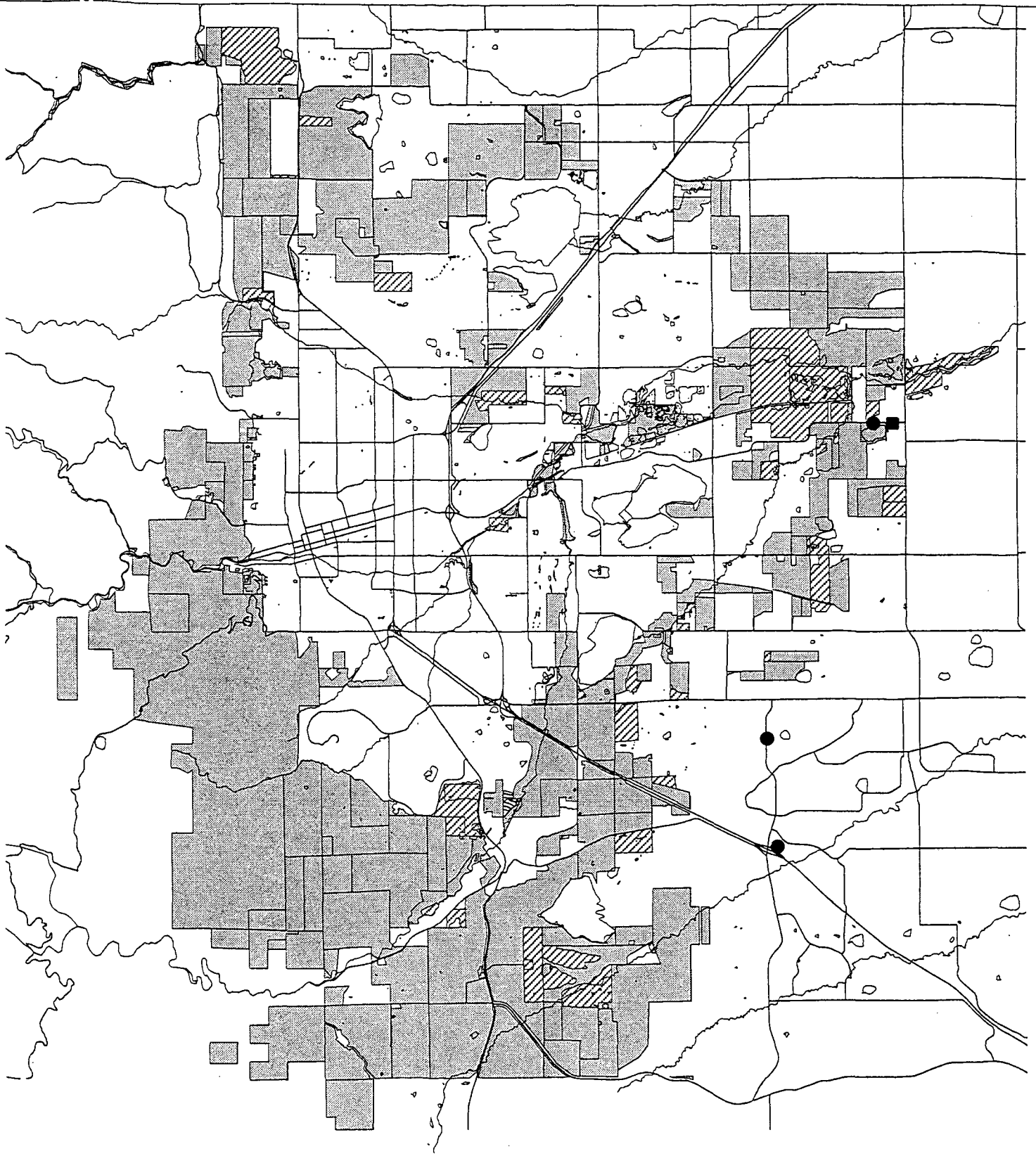
Roads

2 0 2 Miles





*Spea bombifrons*



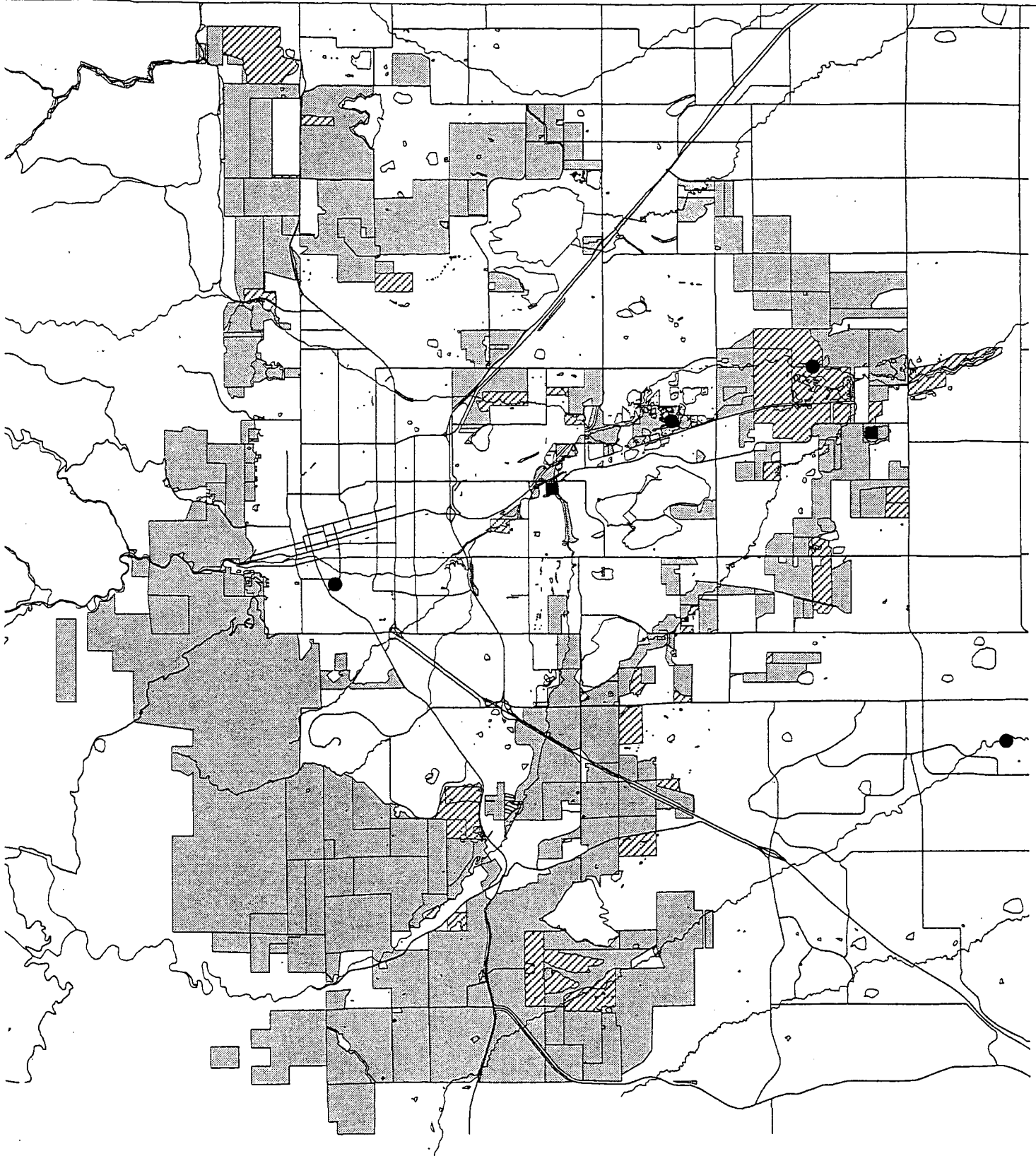
Legend:

- Study Area (City of Boulder Open Space and Mountain Parks)
- Conservation Easements
- Lakes/Reservoirs
- Creeks
- Roads

Scale: 2 0 2 Miles

North Arrow: N

*Chelydra serpentina*



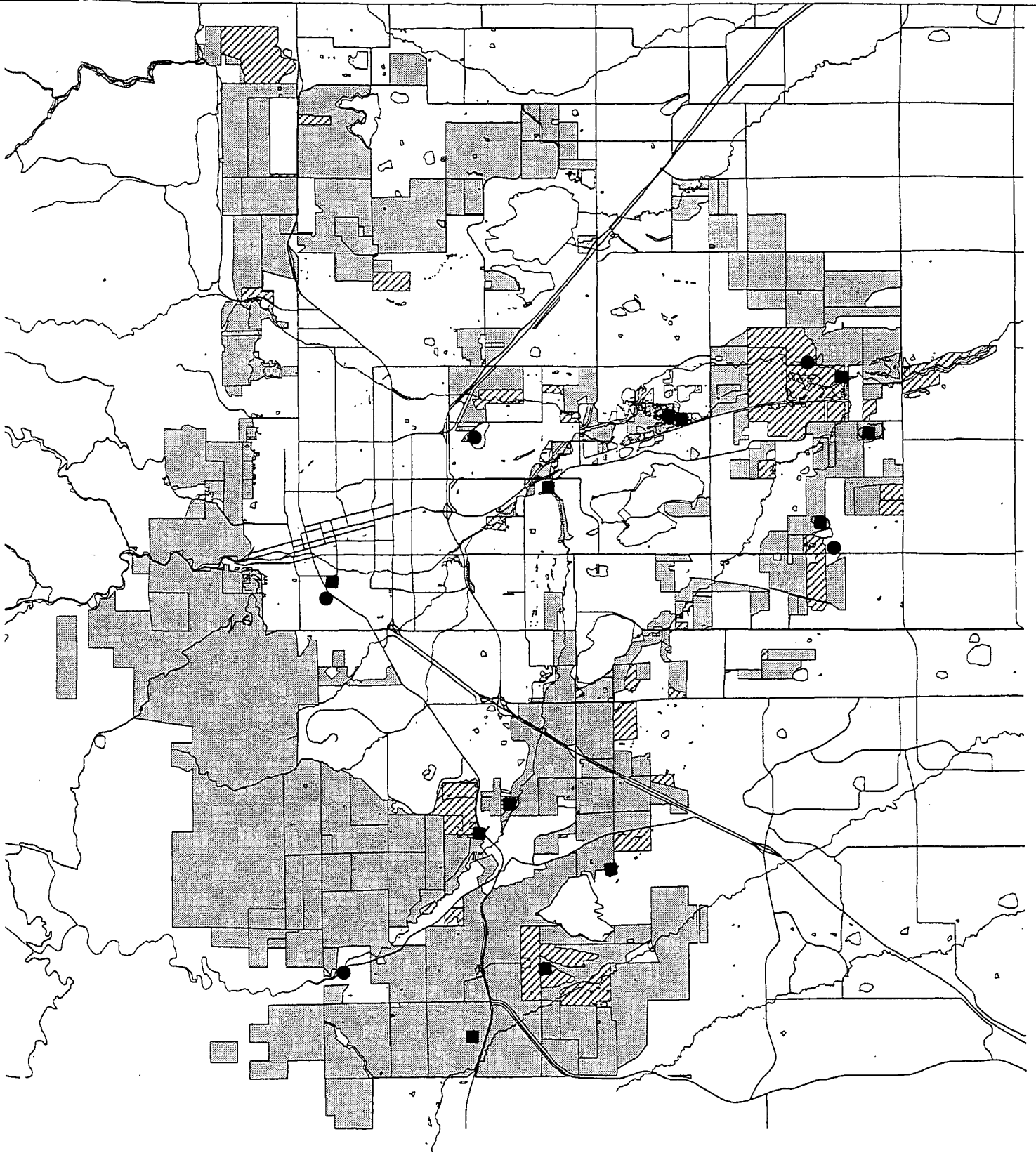
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




- Study Area (City of Boulder Open Space and Mountain Parks)
- Conservation Easements
- Lakes/Reservoirs
- Creeks
- Roads

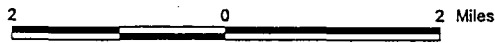
Scale: 2 0 2 Miles

North Arrow

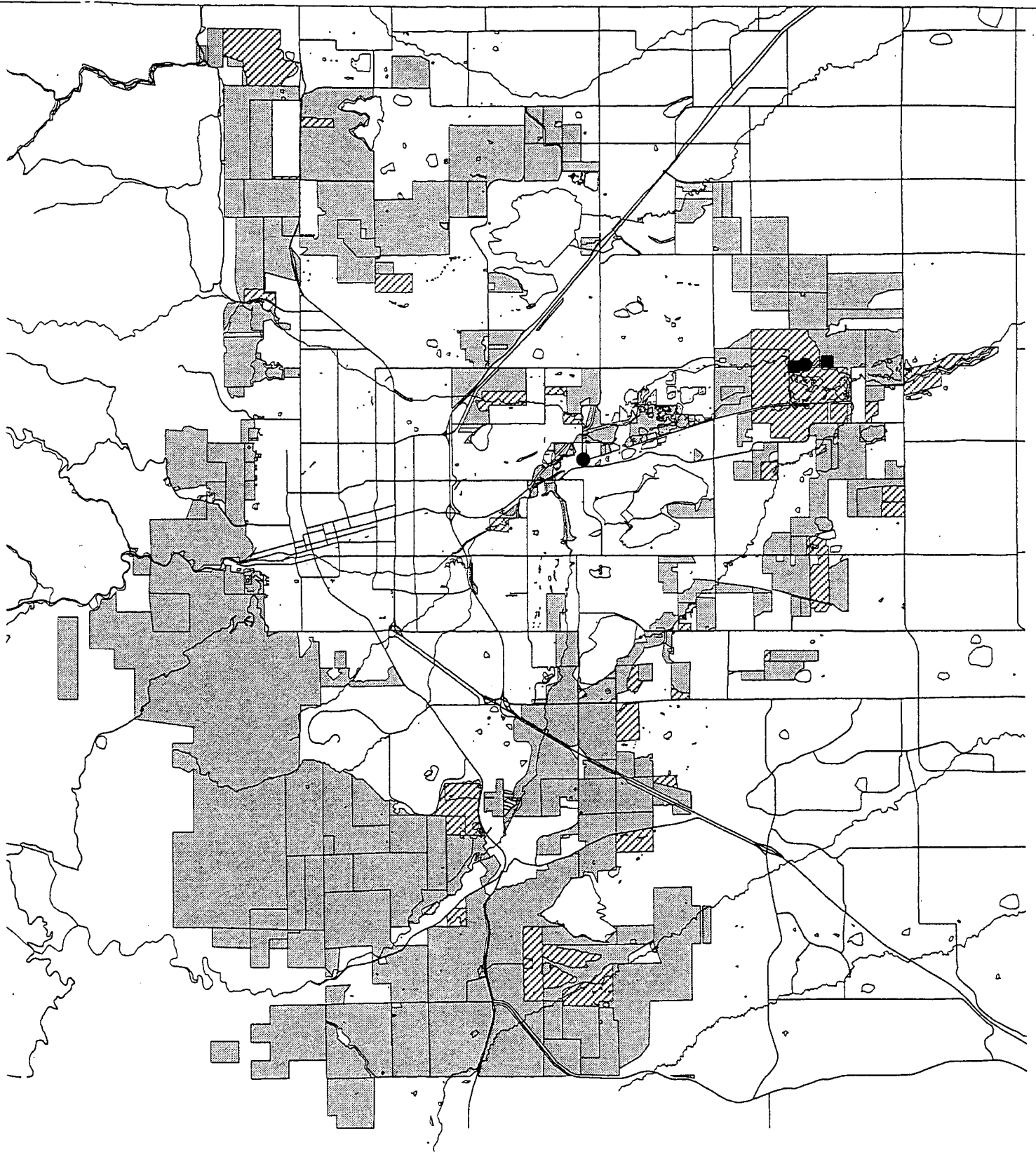
*Chrysemys picta*



-  Study Area (City of Boulder Open Space and Mountain Parks)
-  Conservation Easements
-  Lakes/Reservoirs
-  Creeks
-  Roads



*Cnemidophorus sexlineatus*

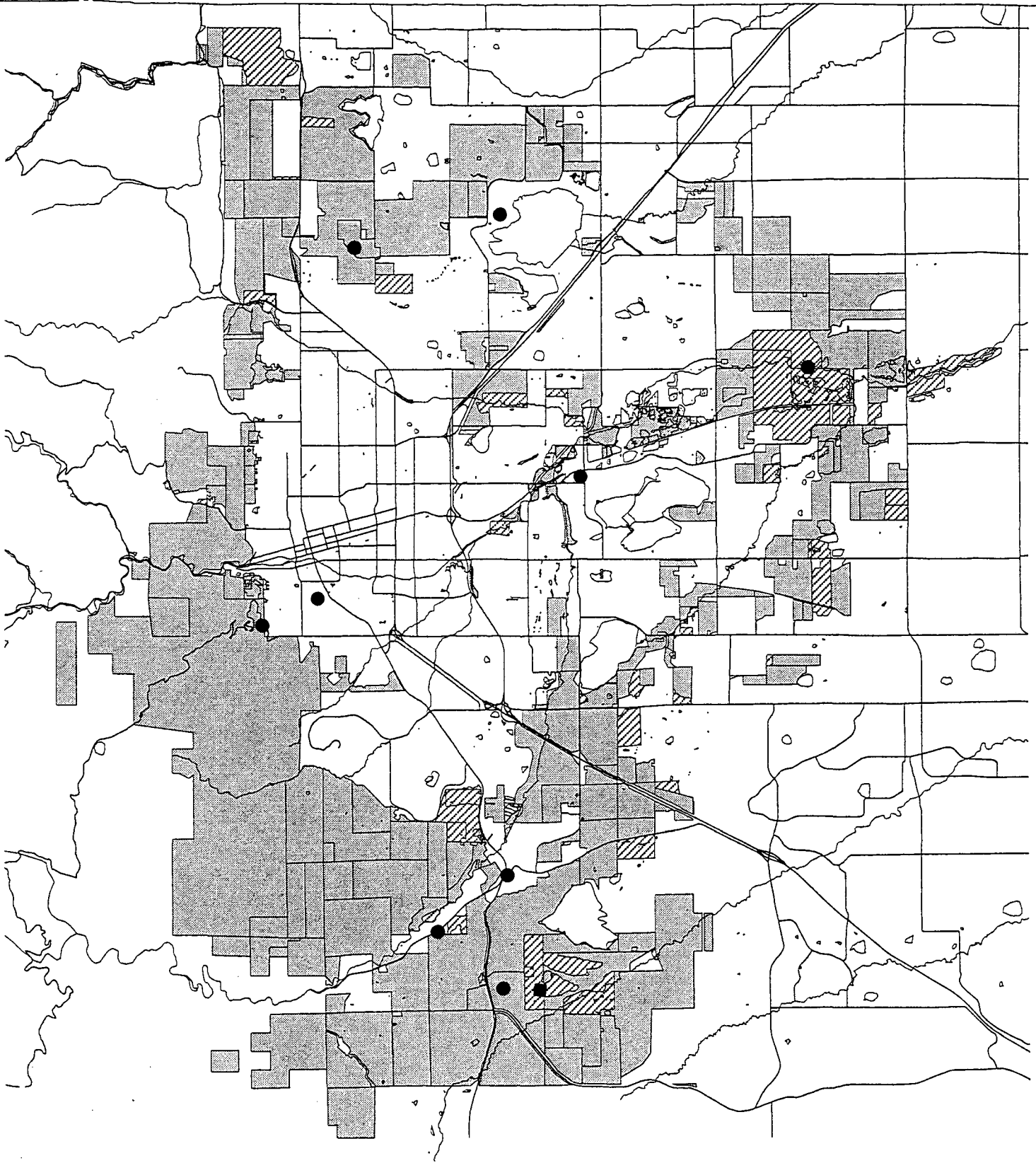







■ Study Area (City of Boulder Open Space and Mountain Parks)  
▨ Conservation Easements  
□ Lakes/Reservoirs  
∩ Creeks  
∩ Roads

2 0 2 Miles

N

*Phrynosoma douglassii*

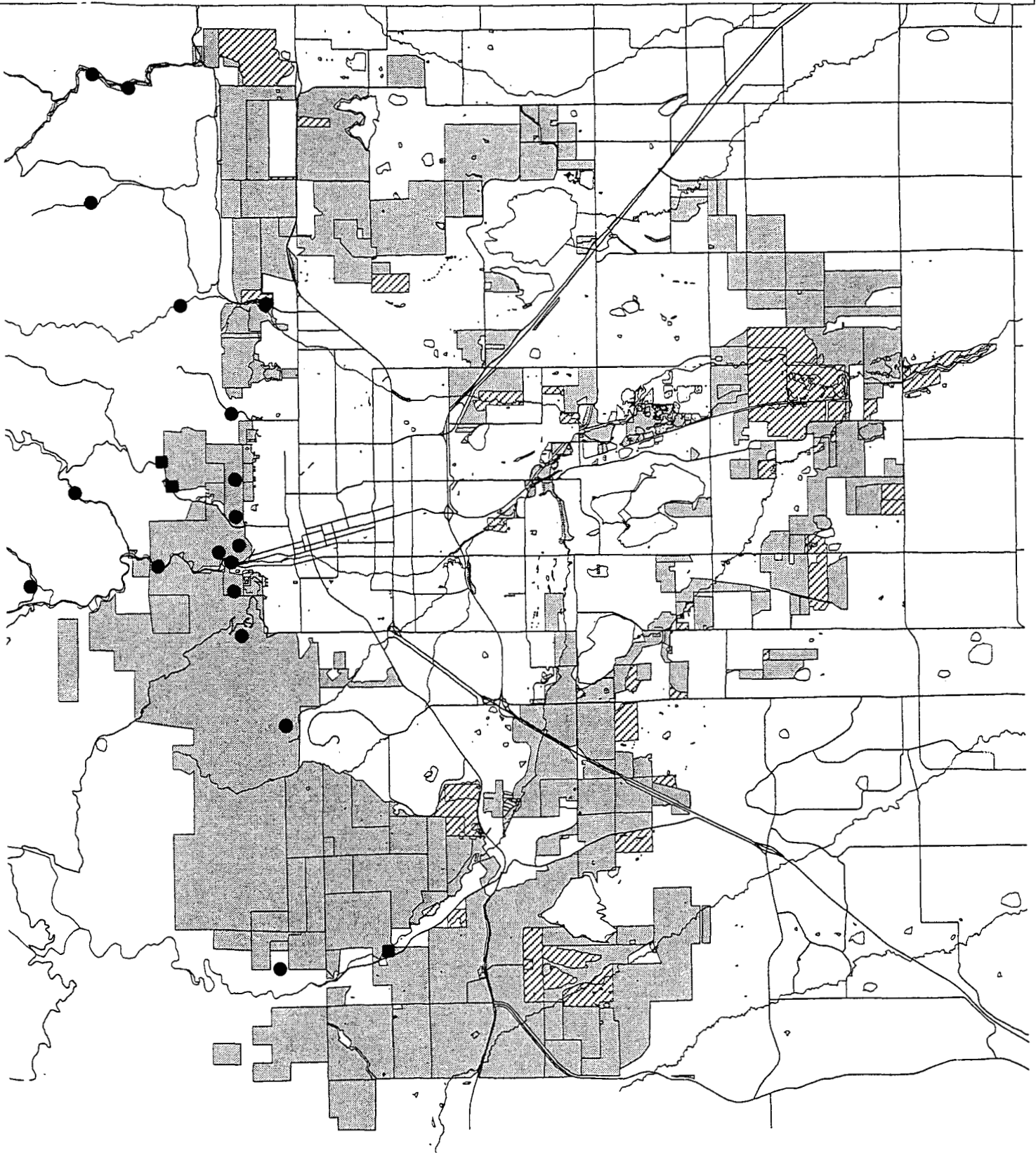


-  Study Area (City of Boulder Open Space and Mountain Parks)
-  Conservation Easements
-  Lakes/Reservoirs
-  Creeks
-  Roads

2 0 2 Miles



*Sceloporus undulatus erythrocheilus*



Study Area (City of Boulder Open Space and Mountain Parks)

Conservation Easements

Lakes/Reservoirs

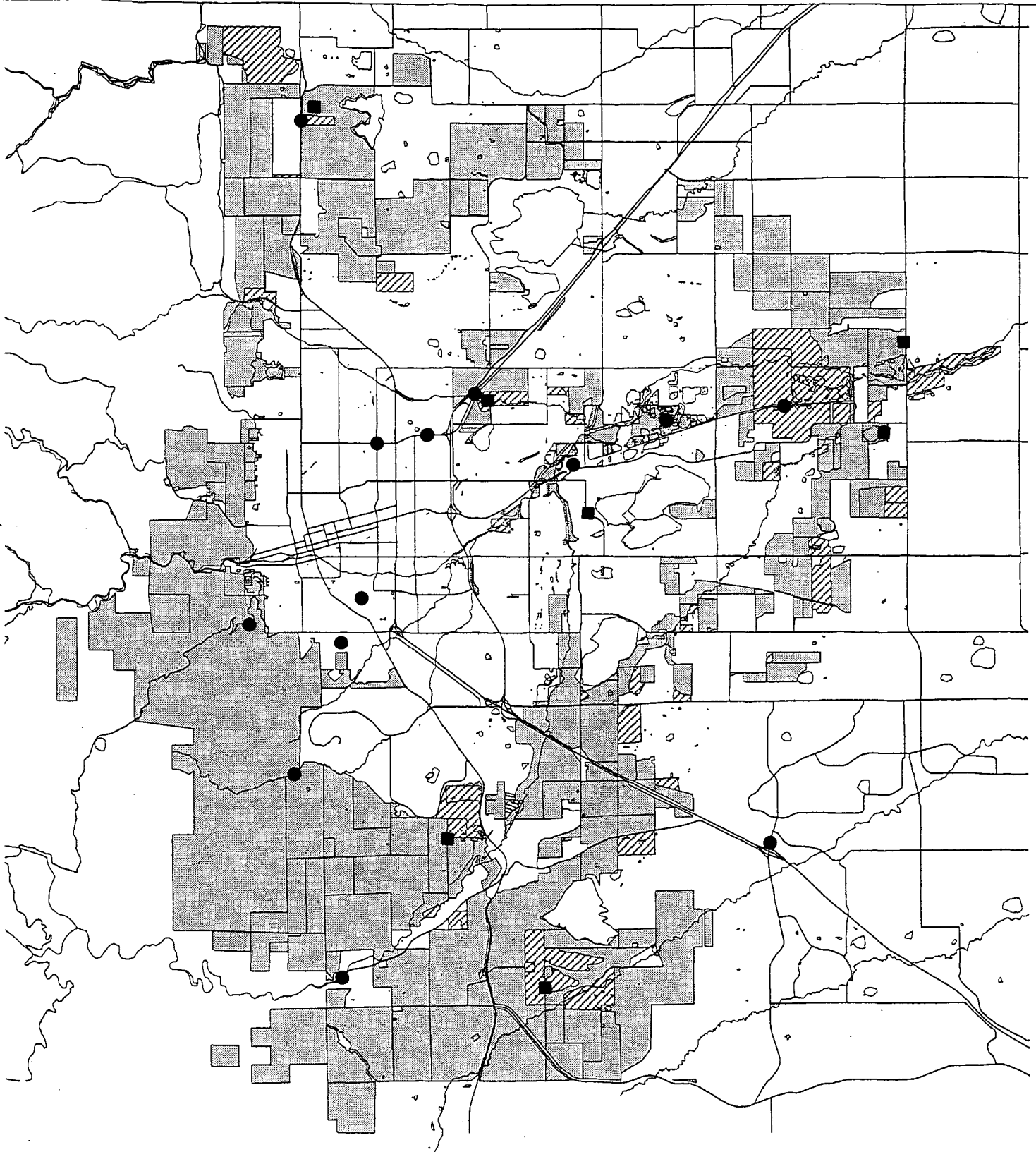
Creeks

Roads

2 0 2 Miles



*Coluber constrictor*



■ Study Area (City of Boulder Open Space and Mountain Parks)

▨ Conservation Easements

□ Lakes/Reservoirs

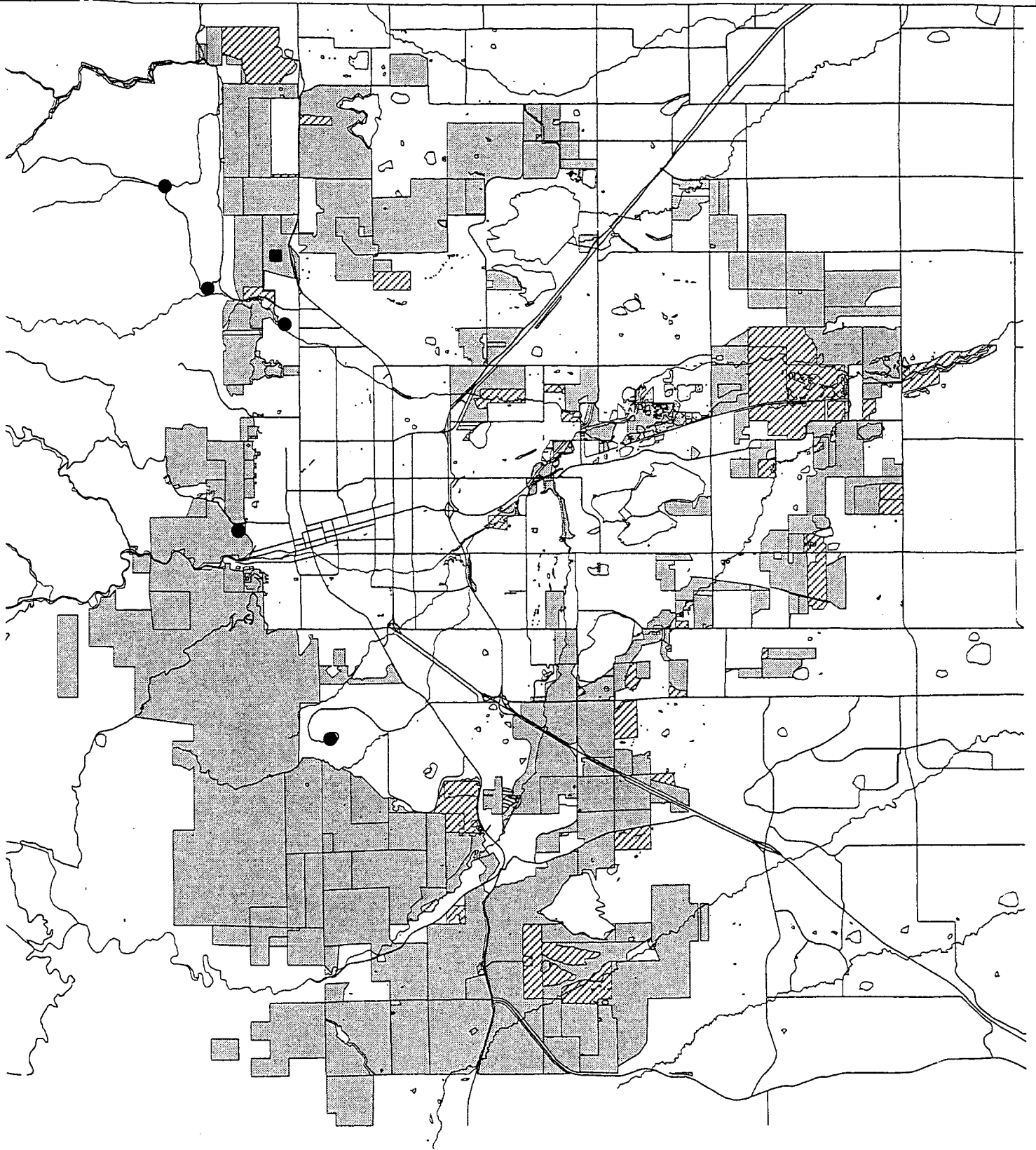
∕ Creeks

∕ Roads

2 0 2 Miles

N

*Crotalus viridis*



Study Area (City of Boulder Open Space and Mountain Parks)

Conservation Easements

Lakes/Reservoirs

Creeks

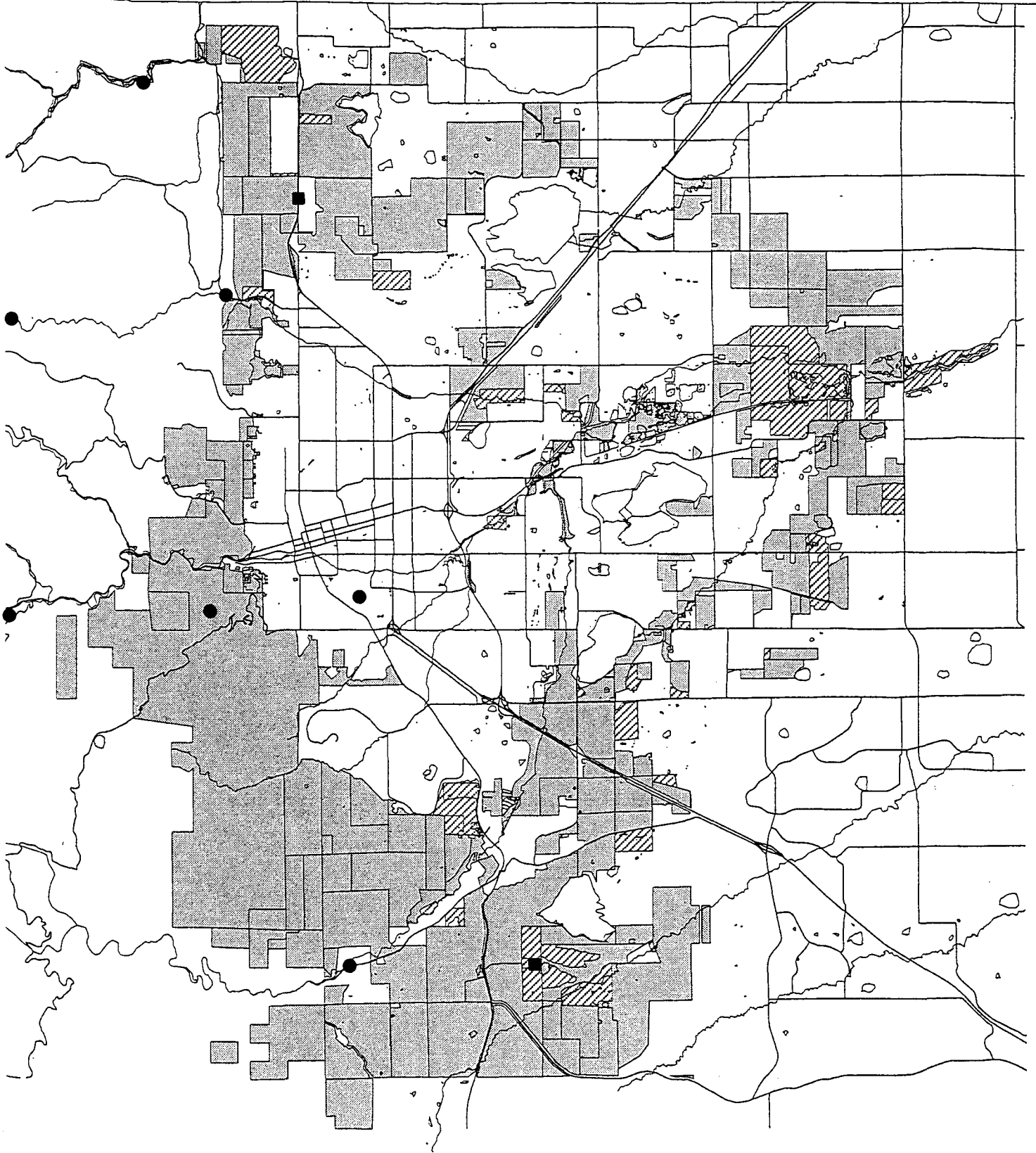
Roads

2 0 2 Miles





*Lampropeltis triangulum*



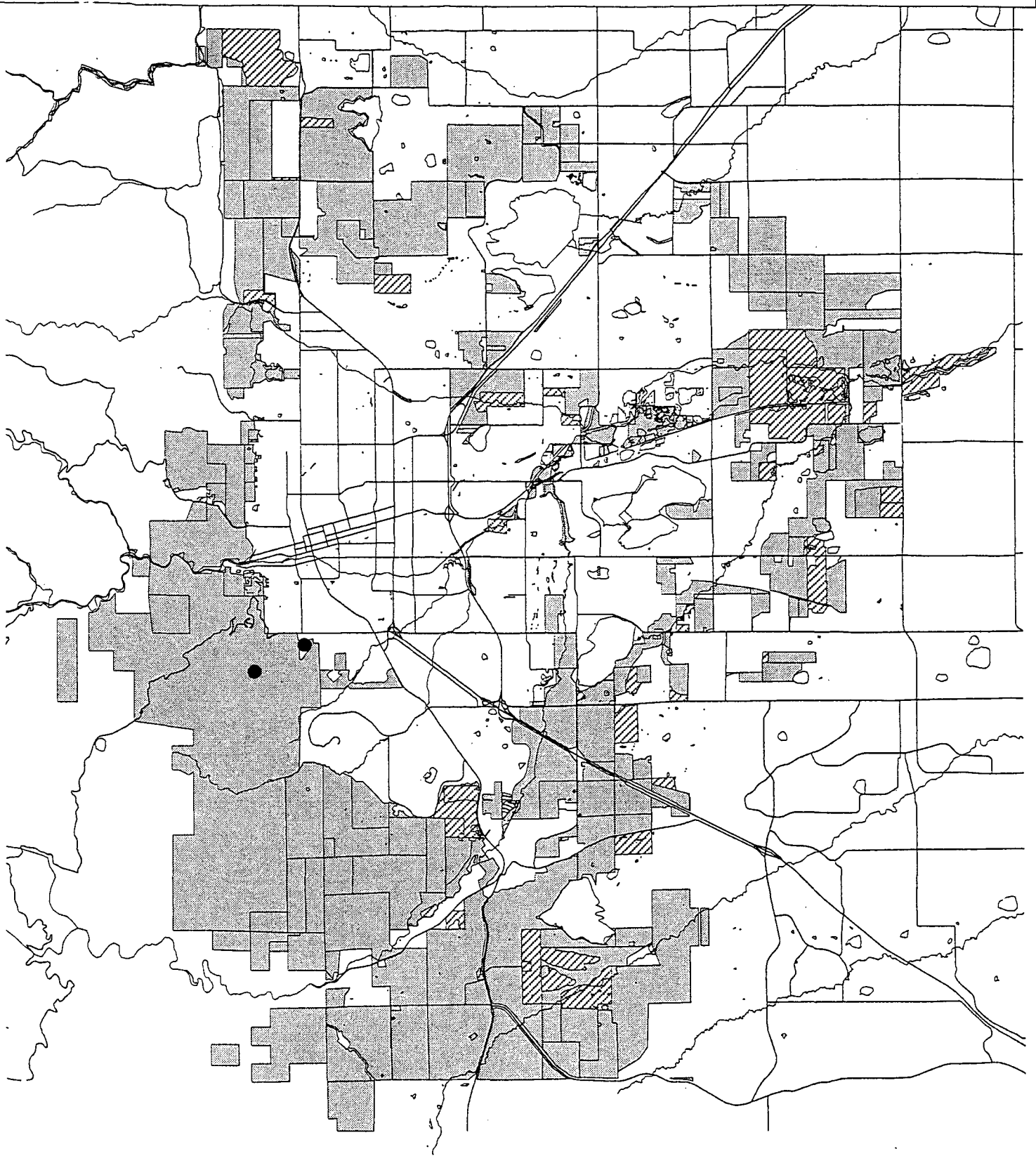
Legend:

- Study Area (City of Boulder Open Space and Mountain Parks)
- Conservation Easements
- Lakes/Reservoirs
- Creeks
- Roads

Scale: 2 0 2 Miles

North Arrow

*Liochlorophis vernalis*



Study Area (City of Boulder Open Space and Mountain Parks)

Conservation Easements

Lakes/Reservoirs

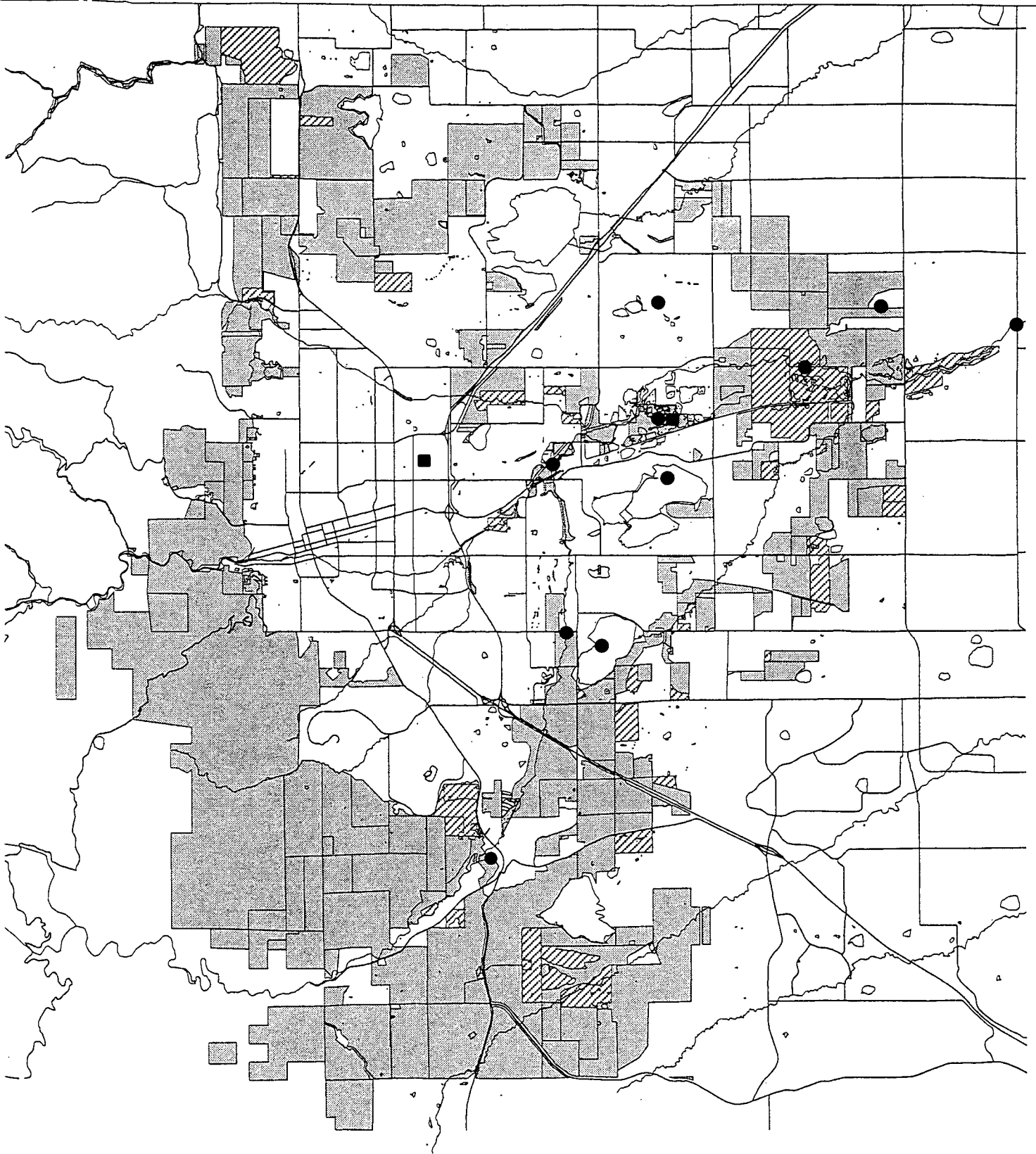
Creeks

Roads

2 0 2 Miles



*Nerodia sipedon*



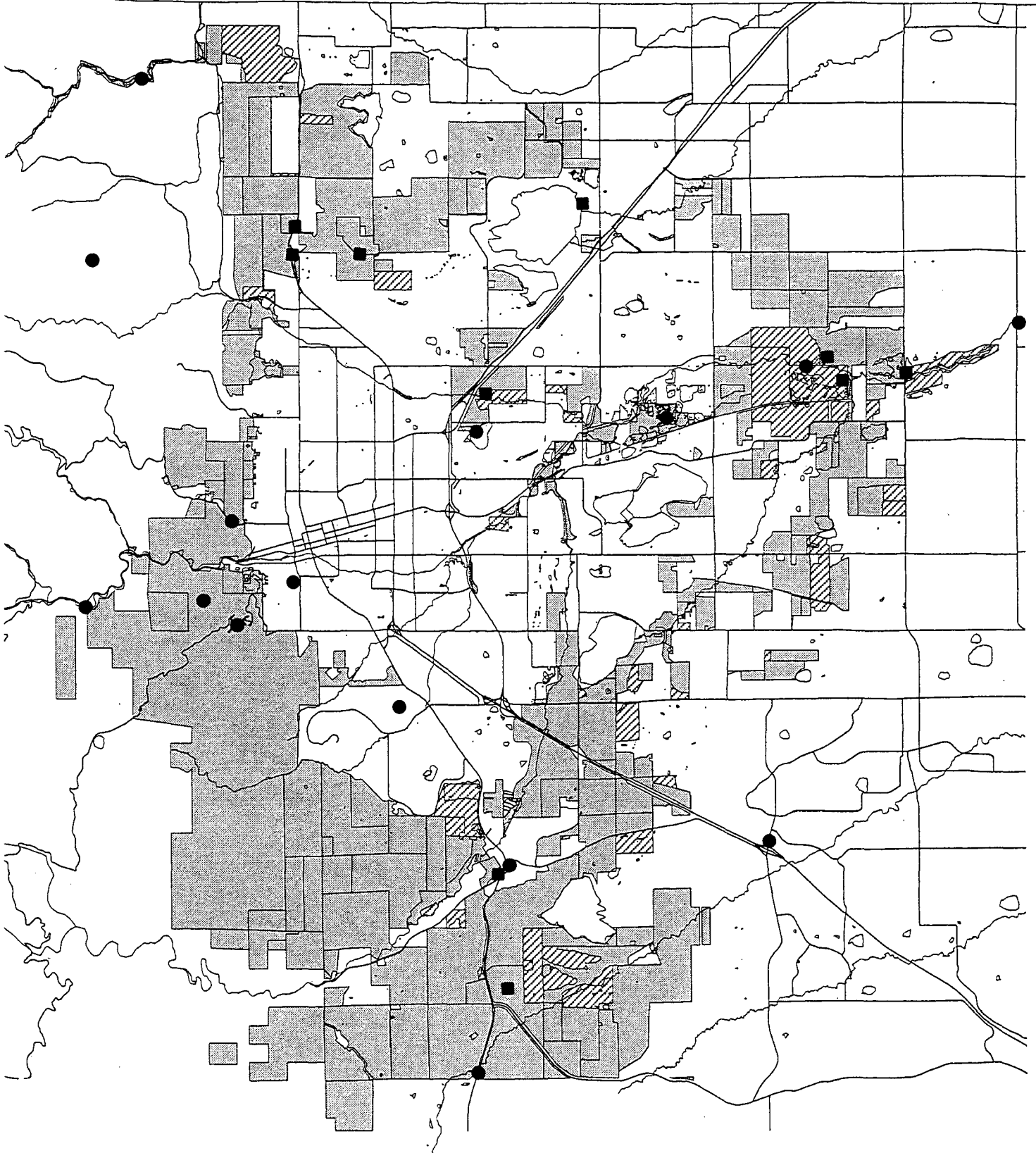
Legend:

- Study Area (City of Boulder Open Space and Mountain Parks)
- Conservation Easements
- Lakes/Reservoirs
- Creeks
- Roads

Scale: 2 0 2 Miles

North Arrow: N

*Pituophis catenifer*



Study Area (City of Boulder Open Space and Mountain Parks)

Conservation Easements

Lakes/Reservoirs

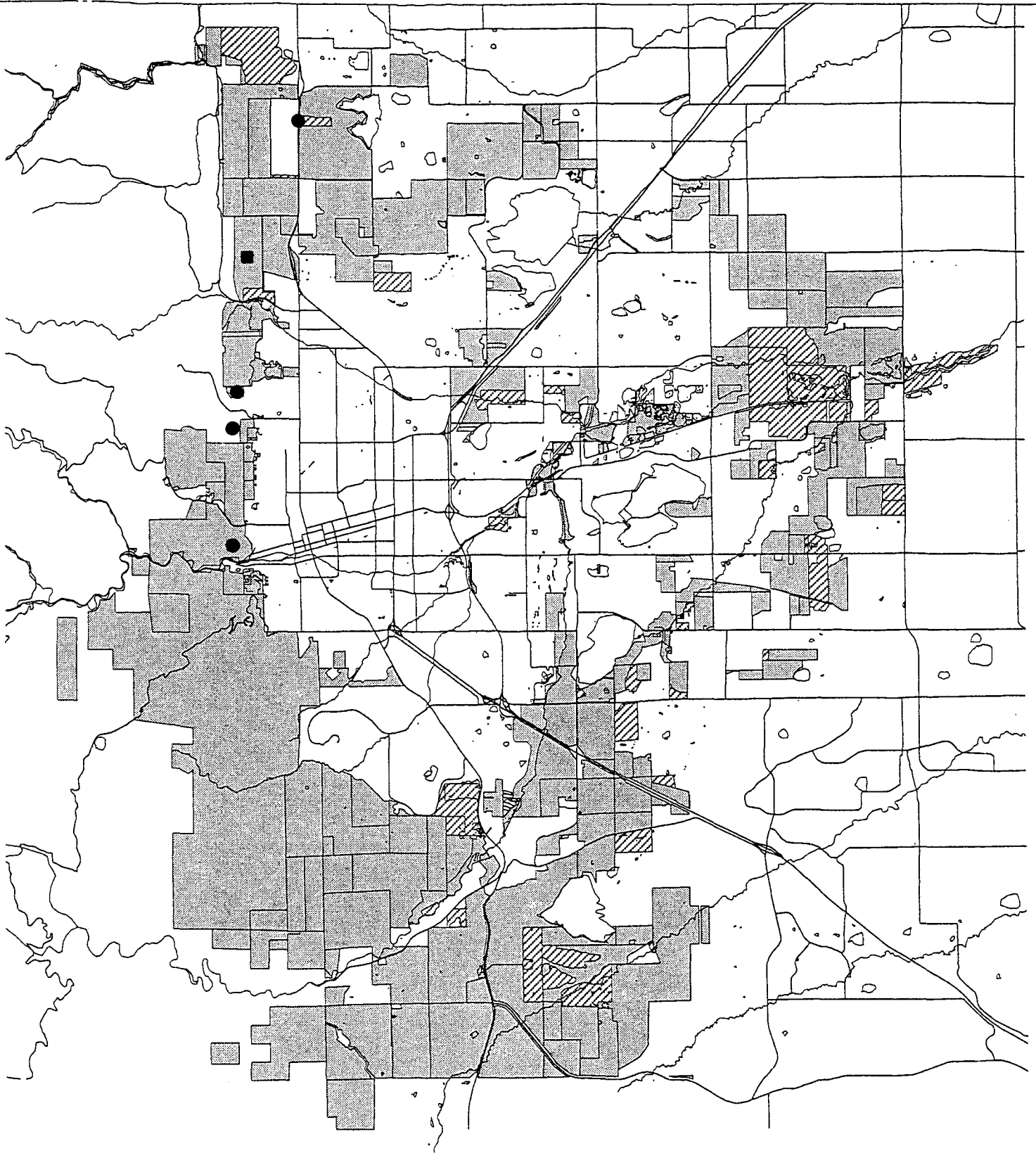
Creeks

Roads

2 0 2 Miles



*Tantilla nigriceps*



Study Area (City of Boulder Open Space and Mountain Parks)

Conservation Easements

Lakes/Reservoirs

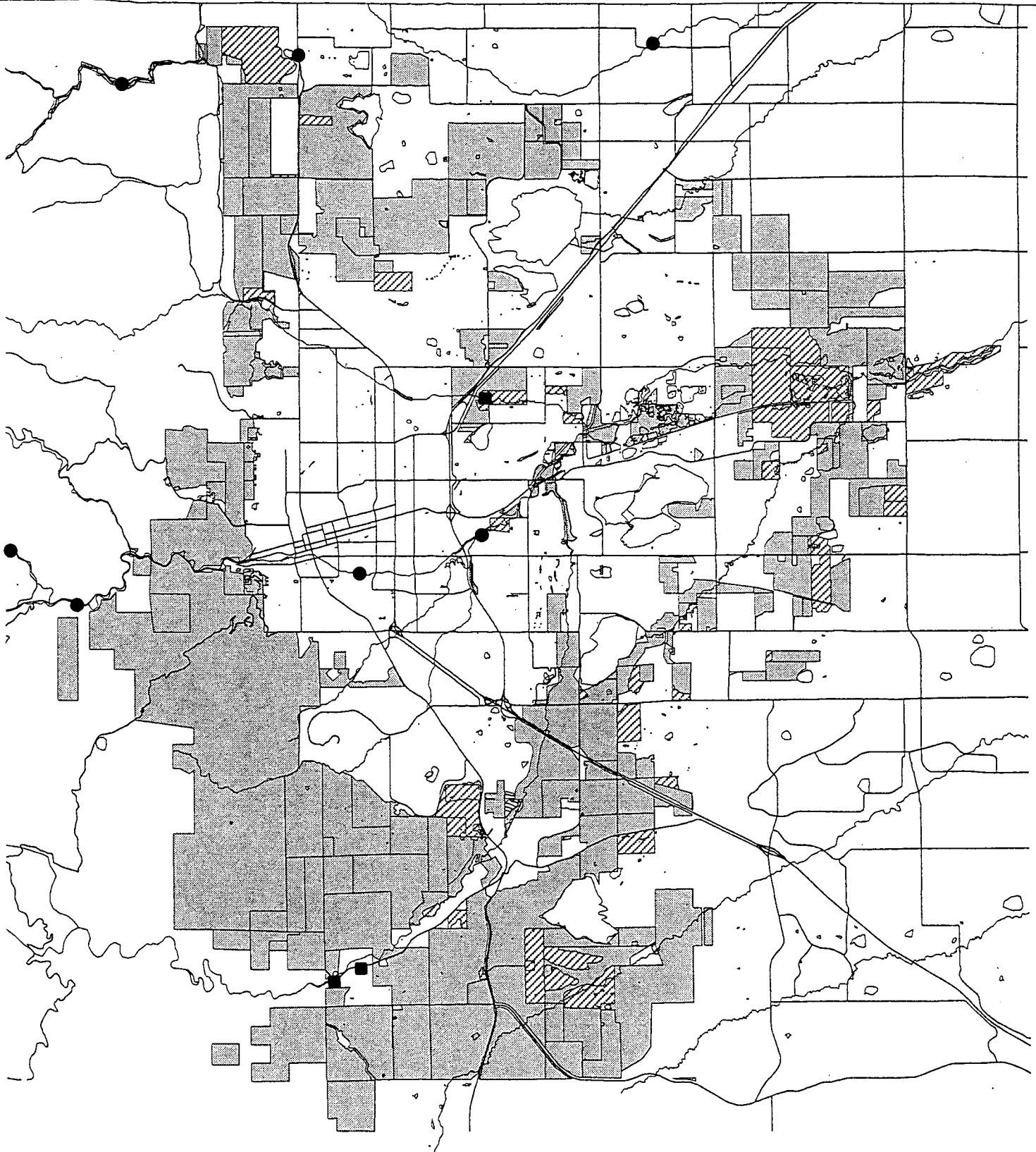
Creeks

Roads

2 0 2 Miles



*Thamnophis elegans*



Study Area (City of Boulder Open Space and Mountain Parks)

Conservation Easements

Lakes/Reservoirs

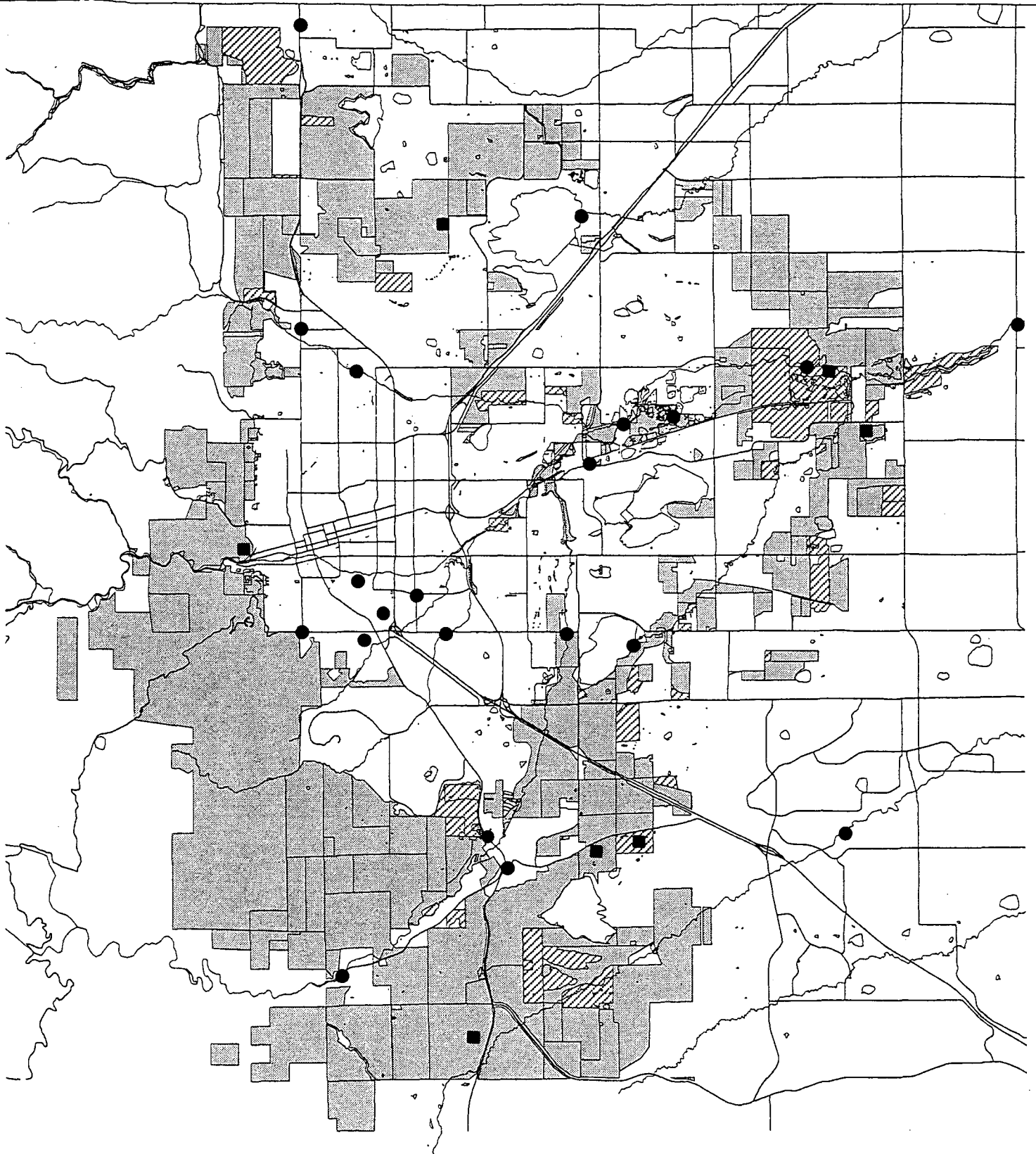
Creeks

Roads

2 0 2 Miles



*Thamnophis radix*



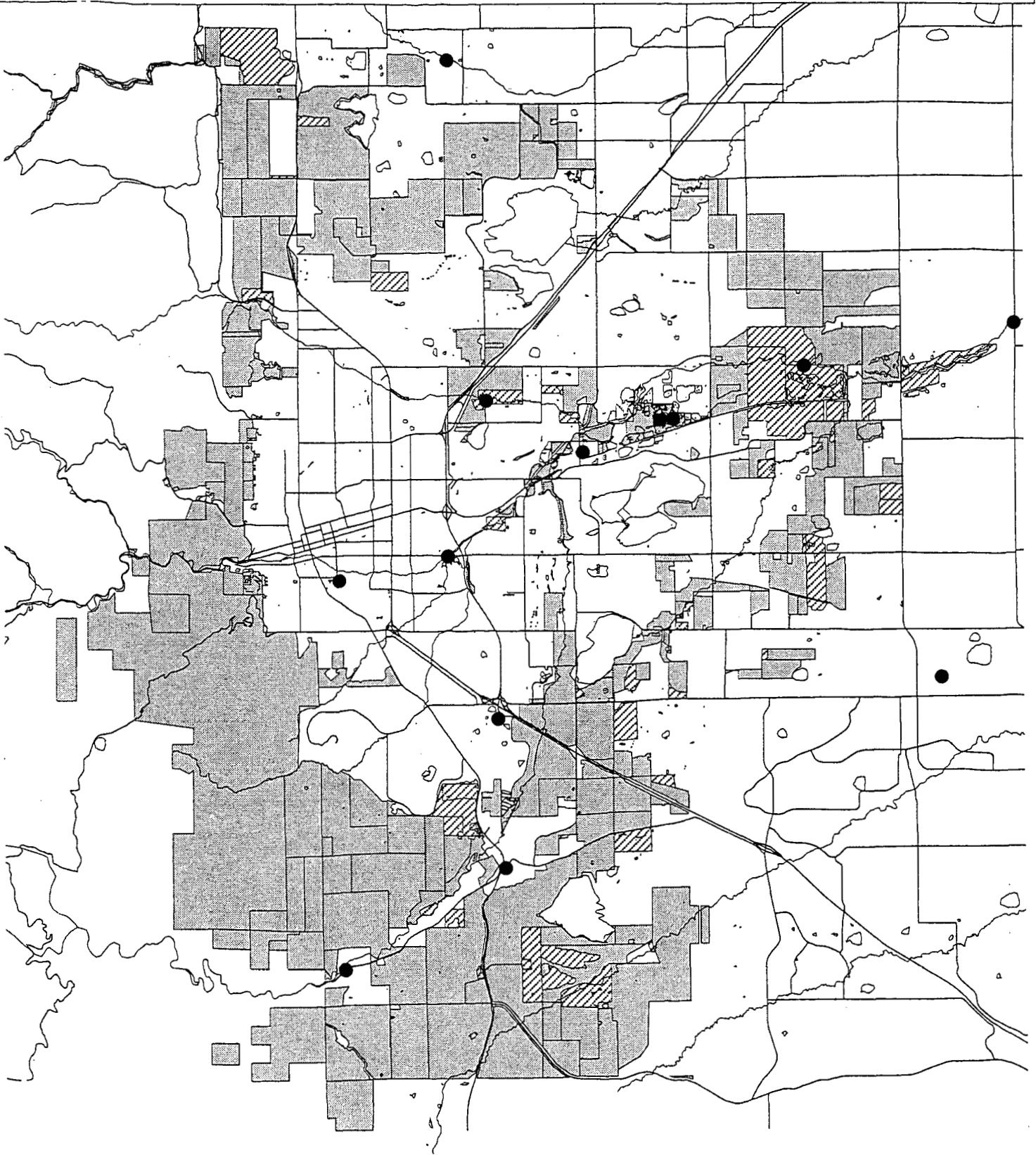
Legend:

- Study Area (City of Boulder Open Space and Mountain Parks)
- Conservation Easements
- Lakes/Reservoirs
- Creeks
- Roads

Scale: 2 0 2 Miles

North Arrow

*Thamnophis sirtalis*



Study Area (City of Boulder Open Space and Mountain Parks)

Conservation Easements

Lakes/Reservoirs

Creeks

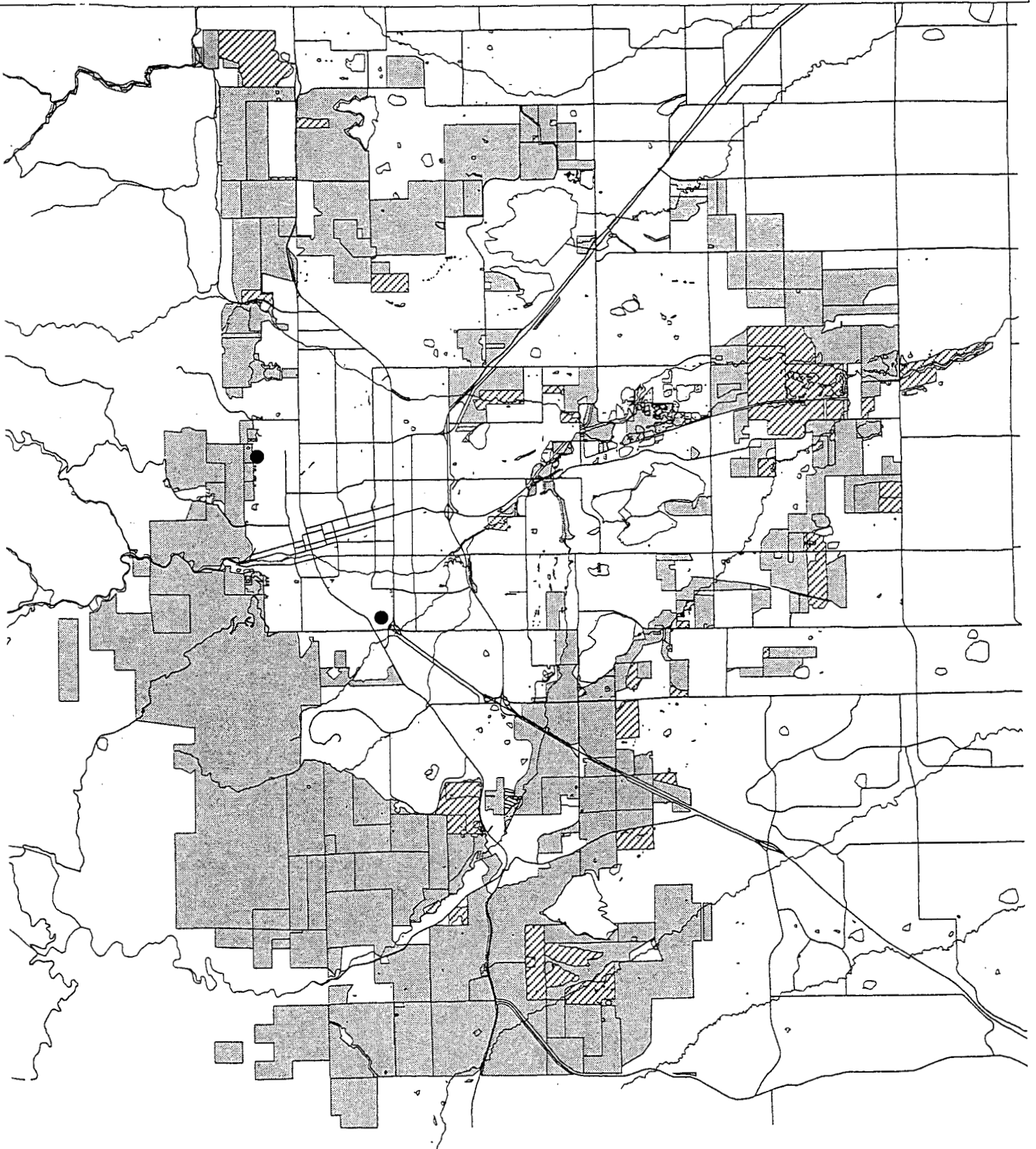
Roads

2 0 2 Miles





*Tropidoclonion lineatum*



Study Area (City of Boulder Open Space and Mountain Parks)

Conservation Easements

Lakes/Reservoirs

Creeks

Roads

2 0 2 Miles

