

An Integrated Approach to Boulder's
Mule Deer Situation

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Abstract

Biological, political, and legal aspects of the mule deer population in Boulder, Colorado, were studied in order to develop an integrated management plan. Such a plan was necessitated by the daily occurrence of mule deer in residential areas of the city, a situation which has been identified by some members of the community as the "mule deer problem." Although many residents enjoy observing the animals, mule deer cause substantial property damage and are often involved in collisions with automobiles.

A segment of the mule deer population was monitored in a study area in southwest Boulder. Field surveys were conducted in 1986 and 1987 in an effort to detect the movement of tagged mule deer between municipal open space areas and residential neighborhoods. Data suggested that a relatively small proportion of the mule deer population extensively utilizes suburban habitat.

To evaluate the political aspects of the mule deer situation, 350 questionnaires were distributed among residents of the study area. The questionnaires were designed to elicit comments regarding the existence and extent of the mule deer problem, and the need for remedial action. Responses to the questionnaires indicated that study site residents generally believe that Boulder has a mule deer problem. Most residents, however, do not personally object to the use of their property by mule deer nor do they feel that action should be initiated to

eliminate the animals from suburban areas.

The legal implications of the Boulder mule deer situation were investigated at the law library of the University of Colorado at Boulder. In particular, I researched theories of legal liability for damage or injury caused by wildlife. State statutes and case law suggest that the City of Boulder has no legal liability for damage inflicted by mule deer. Although the State of Colorado has a proprietary interest in all wildlife, current legislation does not provide a legal remedy for home owners who sustain damage to their property as a result of foraging mule deer.

Management recommendations included a determination of the carrying capacity of municipal open space and mountain parks for mule deer, appropriate studies on the behavior and ecology of urbanized mule deer, and a limited chemical fertility control program in residential areas.

To be valid, the study must be based on the assumption that the deer population is not significantly affected by the study.

Some of the results of the study are as follows:

- 1. The carrying capacity of the study area is approximately 100 deer.
- 2. The study area is currently overpopulated with approximately 150 deer.
- 3. The study area is currently overpopulated with approximately 150 deer.

Acknowledgments

The urbanization of mule deer in Boulder, Colorado, is an emotional and intellectually challenging issue. Addressing this issue as part of my graduate studies has been enjoyable and has greatly contributed to my personal growth as a biologist. I would like to take this opportunity to express my appreciation and gratitude to the people who have made this project possible.

A very special thanks must go to my graduate advisor, Dr. Charles H. Southwick, for his invaluable support and guidance. Dr. Southwick's compassion, political insight, and intellectual enthusiasm are reflected in the pages of this paper.

I also wish to thank the members of my committee, Dr. David M. Armstrong and Dr. John T. Windell. Their encouragement and friendship were much appreciated.

I thank the Natural Science Program of the University of Colorado which provided financial support for the distribution of the questionnaires.

The City of Boulder was kind enough to share its data on the resident mule deer population. The City was also responsible for tagging the mule deer which were observed during this study.

Finally, I would like to express my gratitude to my wife, Lisa, for her support and understanding, and to my daughter, Gina, who was a constant source of delight.

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Introduction

This is a study of the ecology, behavior, and urbanization of mule deer in Boulder, Colorado, during the years 1986 and 1987.

The City of Boulder is located along the eastern foothills of the Rocky Mountains in northeastern Colorado. It is a medium-sized city of approximately 81,300 inhabitants. On November 7, 1967, Boulder initiated a program involving the acquisition, maintenance, and protection of open space areas. One of the goals of the open space program was the preservation of wildlife and wildlife habitats.

The mule deer (Odocoileus hemionus) is a native species of Boulder County. In contrast to many animals, mule deer have thrived in close proximity to urban development. In part, the success of the mule deer is due to the establishment of municipal open space and mountain parks. The deer enjoy legal protection in a relatively natural environment. Public use of open space has led to numerous contacts between mule deer and the general public. Many of these animals have become habituated to the presence of humans and now frequent suburban areas of the city. Although many residents enjoy the opportunity of observing mule deer at close range, complaints about damage to yards, shrubbery, and gardens have become commonplace. The occurrence of mule deer in residential locations has been identified by some members of the community as the "mule deer problem," but will be referred to in this paper as the mule deer situation.

In response to citizen complaints, the Boulder City Council

commissioned Western Resource Development Corporation (WRDC) to prepare a report on the local mule deer population. WRDC conducted a two-year study (1982-1984) which included two censuses of the mule deer population, an assessment of movement patterns, and the development of several management alternatives. WRDC concluded, inter alia, that there was a regular movement of mule deer between natural habitats and adjacent residential areas (Western Resource Development Corporation, 1984). The report suggested that a substantial portion of the resident population contributed to the perceived problem.

In 1986 I participated in a study of mule deer in the open space and mountain parks areas of Boulder. The study was conducted from January of 1986 to May of 1986 and was supervised by the Boulder Departments of Open Space and Mountain Parks. The purpose of the project was to determine population trends, habitat and dispersal, and to generally monitor the activity of the resident mule deer population. Contrary to the conclusions of WRDC, the data indicated that only a small portion of the deer population routinely visited residential areas. It is my hypothesis that the mule deer situation is the result of a relatively small number of deer which have permanently incorporated suburban areas into their home ranges. In effect, there are now open space deer and city deer.

Proper management and conservation of both mule deer and open space requires an intimate understanding of animal behavior and habitat requirements. In addition, the nonbiological realities of the Boulder mule deer population must be

acknowledged. Unlike conventional wildlife preserves, the City of Boulder must balance environmental and ecological considerations against the rights of home owners and other urban residents. Although many people regard Boulder's wildlife as an asset to be cultivated and enjoyed, mule deer forage on ornamental plants and cause substantial property damage. Owners of damaged property often consider the deer unnatural nuisances. Furthermore, many mule deer are involved in automobile accidents. In 1986, 116 deer were killed in Boulder as a result of car collisions (City of Boulder, 1987).

The purpose of this study was to investigate several aspects of the mule deer situation and to attempt to formulate an integrated solution. As a preliminary matter, I felt that it was crucial to identify the deer observed in residential areas. If these animals are part of a general, regular movement of deer between natural and suburban habitats, then management action directed towards the population as a whole will affect the deer in the suburban areas. (If, however, there is a subpopulation of city deer, then an appropriate response to the mule deer situation must focus on specific animals.

I also wanted to evaluate the legal and political implications of Boulder's mule deer situation. Although the various reports prepared by WRDC and municipal employees have provided valuable preliminary data, these studies have concentrated on biological and ecological considerations. The biologists who prepared the reports recognized the complexity of the situation and generally declined to make management recommendations. As a result, the City has no established policy

toward the mule deer or other wildlife species found within municipal boundaries. The difficulty of harmonizing the biological with the political, and the environmental with the legal, has led to a wait-and-see response to this developing situation.

Scientific literature describing similar associations between mule deer and man is minimal. Residential development is generally thought to eliminate mule deer habitat and to adversely impact deer numbers and distribution (Wallmo, 1981). Geist, however, described a population of mule deer which has settled into a small town in Waterton Lakes National Park (Duffey and Watt, 1971). The deer rest on lawns, feed on ornamental shrubs, and utilize houses as shelter. Apparently, these animals are not perceived as a problem. Geist indicated that mule deer and human residents simply ignore each other.

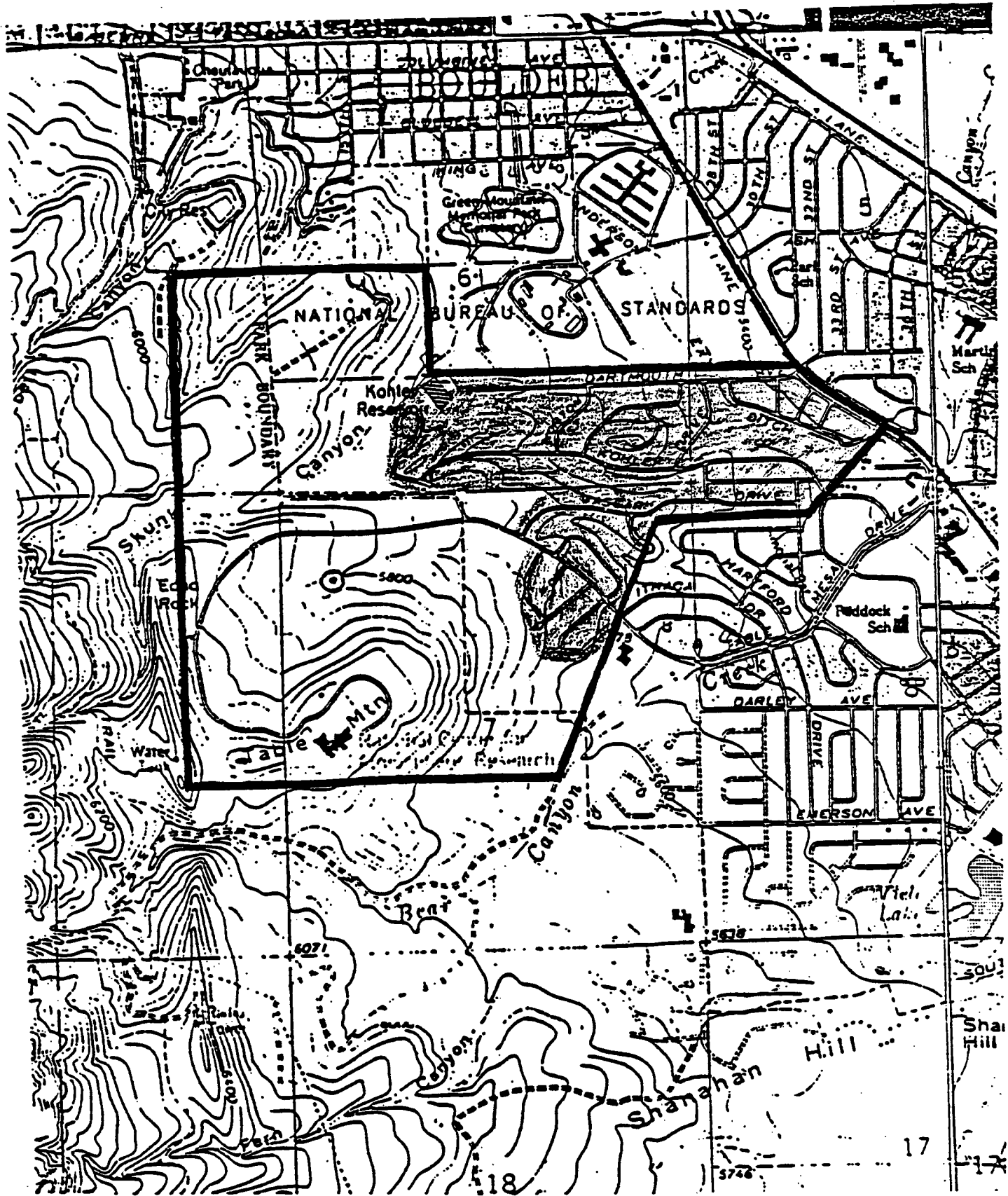
Although there is little literature on the adverse impacts of mule deer on urban communities, a number of articles describe damage sustained by timber (Oh et al., 1967) and agricultural crops (Wallmo, 1981) as a result of foraging mule deer. Harder (1968) reviewed orchard damage and discussed several methods of minimizing deer damage. He suggested that recreational hunting offered the best and most economical solution to the problem.

Statement of Methods

To test the hypothesis that the mule deer situation is the result of a relatively small number of deer extensively utilizing residential property, I monitored a segment of the mule deer population. A study area was established in south Boulder. The site consists of a suburban neighborhood and the adjacent open space regions. Figure 1 is a map of southwest Boulder on which the study area has been circumscribed by a heavy black line. The suburban portion of the study site is approximately 80 hectares (198 acres) and is often utilized by mule deer. Some of these animals wear ear tags and are easily identified. The adjacent open space is approximately 187 hectares (461 acres). Vegetation in the open space varies in relation to moisture and elevation (which ranges from 1680 meters to 1890 meters). The highest areas in the study site are dominated by ponderosa pine (Pinus ponderosa). Shrubs are found primarily along Skunk Creek which flows east from the foothills. Grasses in the study area include various species of shortgrass and midgrass. Dominant shortgrass species include buffalo-grass (Buchloe dactyloides) and blue grama (Bouteloua gracilis). The most common midgrass species are needle-and-thread (Stipa comata) and western wheatgrass (Pascopyrum smithii). The open space portion of the study area supports a large number of easily observed mule deer, many of which have been tagged.

Transects were established in both sections of the study area. I conducted field surveys two or three times a week from January of 1987 to April of 1987. On each occasion I

Figure 1. Map of southwest Boulder. The study area is indicated by a heavy black line. Suburban portions of the study site are shaded.



attempted to locate and identify tagged mule deer either within, or visible from, the study area. Survey times varied throughout the daylight hours. Transects within the suburbs were traveled by automobile while open space transects were covered by foot. I also drove through the residential areas on either side of the study site approximately once a week. These excursions were designed to detect any movement of tagged mule deer between open space areas within the study site and remote, but accessible, suburban areas outside the study site. My observations were recorded in a field notebook and the location of each tagged animal was marked on a map of the study site. In addition, the City of Boulder provided me with similar data from its 1986 and 1987 mule deer studies.

After completing the field work, I prepared an individual map for each marked mule deer found within the study region. The maps reflect the locations where the animals were sighted and movements of the mule deer between open space and residential areas. This information was also converted to graphic or tabular form.

Field data were categorized in several ways. First, I analyzed the total set of data, which included the observations of city employees, student interns, and private citizens, as well as those observations which I made during the 1986 and 1987 field seasons. Although these analyses benefited from a relatively large number of data points, there is a question as to whether field workers spent equal time in open space areas versus residential areas. A disproportionate amount of field work in either area would produce biased results. In

both the municipal studies and my own research, roughly equal time was spent monitoring mule deer in the open space and suburban areas. These two sources of observations account for the vast majority of field data. Nevertheless, there are no records which establish that proportionate amounts of time were spent in the various areas of the study site.

To minimize the problem of unequal field coverage, I repeated the analyses using only my own observations from 1987. During that field season, I traversed the open space area nine times and the suburban area 10 times.

Finally, I divided the field data into observations made in 1986 and observations made in 1987. This classification was useful in detecting general trends and also revealed changes in the habits of individual mule deer.

To evaluate the political aspects of Boulder's mule deer situation, I distributed 350 questionnaires among the residents of the study area. A copy of the questionnaire is attached as Appendix 1. Each questionnaire was personally delivered to the home of a study site resident along with a preaddressed and stamped envelope. Completed questionnaires were mailed to the Natural Science Program at the University of Colorado.

The questionnaire was designed to elicit comments regarding the existence and extent of a mule deer problem, the need for remedial action, and appropriate responses to the situation. Where practicable, I requested yes/no answers. Responses to these questions were tallied and converted into a percentage of the total number of responses. Answers to other questions were

categorized by the nature of the response and then converted into a percentage of the total number of responses. In several instances, I divided the respondents into defined classes and compared answers to a particular question.

I investigated the legal aspects of the mule deer situation at the law library of the University of Colorado at Boulder. In particular, I researched theories of legal liability as a result of damage or injury caused by wildlife. Although most of my research involved Colorado statutes and case law, I reviewed a number of decisions from other jurisdictions which were influential or unusual.

Results

Field Surveys

Twenty-five tagged mule deer were observed in the study site. Individual animals were seen and identified from one to 35 times. Appendix 2 is composed of 25 maps of the study area, each of which corresponds to an individual deer. The location of each observation is indicated by a dark circle. Table 1 divides the total number of deer sightings into observations which occurred in the suburbs and observations which occurred in the open space. The percentages of observations which occurred in the residential section of the study site are computed in the right-hand column. These percentages are presented graphically in Figure 2.

Of the 25 tagged animals, 14 (56.0%) were seen in both open space and residential areas. Ten deer (40.0%) were never observed in the suburbs and one animal (4.0%) was never observed in the open space. Eighteen of the mule deer (72.0%) were observed in the suburbs less than 50 percent of the time. Seven deer (28.0%) were observed in the suburbs at least 60 percent of the time. None of the deer was seen in the residential area 50 to 59 percent of the time.

The frequency distribution in Figure 2 is essentially bimodal. Such a distribution is usually indicative of two statistical populations and suggests that there is a segment of the Boulder mule deer population which utilizes residential areas to a much greater extent than the population as a whole.

Table 2 summarizes my personal observations of tagged mule

Table 1. Observations of tagged mule deer in 1986 and 1987. Data obtained from the City of Boulder, student interns, private citizens, and from my own field work in 1986 and 1987.

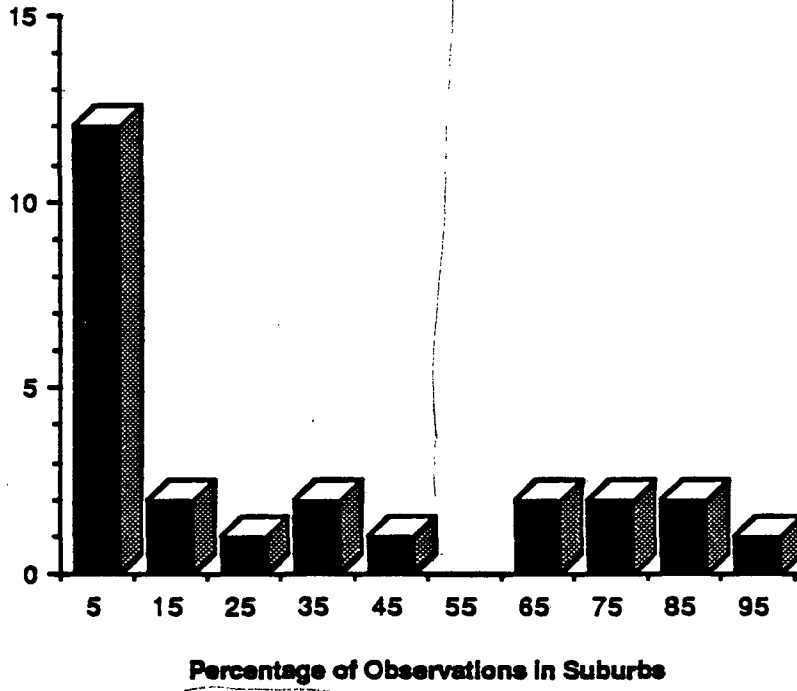
Tag Number	Observations in Suburbs	Observations in Open Space	Percentage of Observations in Suburbs
Y10	1	8	11.1%
Y12	5	1	83.3
Y18	7	10	41.2
Y20	0	2	0.0
Y40	16	7	69.6
Y127	0	15	0.0
Y130	3	18	14.3
Y133	23	7	76.7
Y134	0	11	0.0
Y135	25	4	86.2
Y136	4	10	28.6
Y137	16	0	100.0
Y138	0	33	0.0
Y140	12	23	34.3
Y142	2	23	8.0
Y144	0	31	0.0
Y145	2	31	6.1
Y146	0	32	0.0
Y148	0	33	0.0
Y149	11	3	78.6

Table 1 (continued).

Tag Number	Observations in Suburbs	Observations in Open Space	Percentage of Observations in Suburbs
Y150	11	23	32.4%
Y201	0	5	0.0
Y202	0	10	0.0
Y203	3	2	60.0
O157	0	1	0.0

Figure 2. The percentage of observations of tagged mule deer which occurred in the suburbs. Data obtained from the City of Boulder, student interns, private citizens, and from my own field work in 1986 and 1987.

Number of Tagged Mule Deer



$\frac{12}{52}$
70% of
total

$\frac{12}{52}$
20% of
total

$\frac{12}{52}$
20% of
total

$N = 52$

deer during the 1987 field season. Once again, deer sightings are divided into observations which occurred in the suburbs and observations which occurred in the open space. Percentages of observations which occurred in the residential area of the study site are computed in the right-hand column. These percentages are presented graphically in Figure 3.

In 1987, four of the 25 tagged animals (16.0%) were seen in both open space and residential areas. Fifteen deer (60.0%) were never observed in the suburbs and six animals (24.0%) were never observed in the open space. Sixteen of the mule deer (64.0%) were seen in the suburbs less than 20 percent of the time. Nine deer (36.0%) were observed in the suburbs at least 60 percent of the time. None of the deer was seen in the residential area 20 to 59 percent of the time.

The frequency distribution in Figure 3 is clearly bimodal. The existence of two subpopulations of mule deer, occupying different areas of the study site, is indicated.

Table 3 categorizes deer sightings by year. In 1986, 12 of the tagged mule deer (50.0%) were seen in both open space and residential areas. In 1987, five of these 12 animals (41.7%) were seen in both areas, four deer (33.3%) were observed only in the suburbs, and three animals (25.0%) were observed only in the open space. One deer, which had only been observed in the open space in 1986, was observed in both residential and open space areas in 1987.

The information summarized in Table 3 is presented graphically in Figures 4 and 5. The frequency distribution in Figure 4 corresponds with deer observations in 1986, and the

Table 2. Observations of tagged mule deer. Data obtained from my own field work during the 1987 field season.

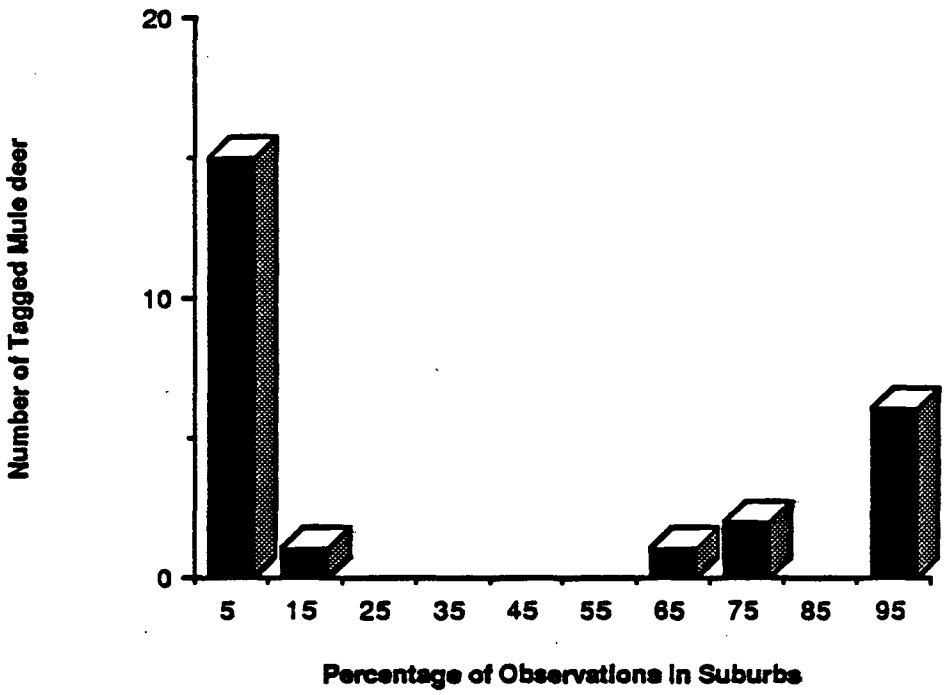
Tag Number	Observations in Suburbs	Observations in Open Space	Percentage of Observations in Suburbs
Y10	0	1	0.0%
Y12	1	0	100.0
Y18	0	1	0.0
Y20	0	1	0.0
Y40	5	0	100.0
Y127	0	1	0.0
Y130	0	5	0.0
Y133	6	0	100.0
Y134	0	2	0.0
Y135	8	0	100.0
Y136	0	1	0.0
Y137	1	0	100.0
Y138	0	4	0.0
Y140	7	2	77.8
Y142	1	5	16.7
Y144	0	1	0.0
Y145	0	5	0.0
Y146	0	3	0.0
Y148	0	2	0.0
Y149	2	0	100.0
Y150	3	1	75.0

Table 2 (continued).

Tag Number	Observations in Suburbs	Observations in Open Space	Percentage of Observations in Suburbs
Y201	0	3	0.0%
Y202	0	6	0.0
Y203	2	1	66.7
O157	0	1	0.0

Figure 3. The percentages of observations of tagged mule deer which occurred in the suburbs. Data obtained from my own field work in 1987.

Handwritten notes:
I = 30
of the total.



Handwritten note: 11-20

Table 3. Observations of tagged mule deer categorized by year of occurrence. Data obtained from the City of Boulder, student interns, private citizens, and from my own field work.

Tag Number	Observations Occurring in 1986		Observations Occurring in 1987	
	Suburbs	Open Space	Suburbs	Open Space
Y10	0 (0.0%)	3 (100.0%)	0 (0.0%)	5 (100.0%)
Y12	1 (50.0) ✓	1 (50.0)	4 (100.0) ✓	0 (0.0)
Y18	6 (50.0) ✓	6 (50.0)	1 (20.0)	4 (80.0)
Y20	0 (0.0)	1 (100.0)	0 (0.0)	1 (100.0)
Y40	2 (25.0)	6 (75.0)	12 (92.3) ✓	1 (7.7)
Y127	0 (0.0)	9 (100.0)	0 (0.0)	6 (100.0)
Y130	3 (21.4)	11 (78.6)	0 (0.0)	7 (100.0)
Y133	7 (50.0) ✓	7 (50.0)	16 (100.0) ✓	0 (0.0)
Y134	0 (0.0)	5 (100.0)	0 (0.0)	6 (100.0)
Y135	6 (60.0) ✓	4 (40.0)	18 (100.0) ✓	0 (0.0)
Y136	4 (30.8)	9 (69.2)	0 (0.0)	1 (100.0)
Y137	14 (100.0) ✓	0 (0.0)	2 (100.0) ✓	0 (0.0)
Y138	0 (0.0)	21 (100.0)	0 (0.0)	12 (100.0)
Y140	2 (10.0)	18 (90.0)	10 (66.7) ✓	5 (33.3)
Y142	1 (6.2)	15 (93.8)	1 (11.1)	8 (88.9)
Y144	0 (0.0)	24 (100.0)	0 (0.0)	7 (100.0)
Y145	2 (9.5)	19 (90.5)	0 (0.0)	12 (100.0)
Y146	0 (0.0)	23 (100.0)	0 (0.0)	9 (100.0)
Y148	0 (0.0)	25 (100.0)	0 (0.0)	8 (100.0)
Y149	4 (57.1) ✓	3 (42.9)	7 (100.0) ✓	0 (0.0)
Y150	2 (9.5)	19 (90.5)	9 (69.2) ✓	4 (30.8)

Table 3 (continued).

Tag Number	Observations Occurring in 1986		Observations Occurring in 1987	
	Suburbs	Open Space	Suburbs	Open Space
Y201	0 (0.0%)	2 (100.0%)	0 (0.0%)	3 (100.0%)
Y202	0 (0.0)	1 (100.0)	0 (0.0)	9 (100.0)
Y203	0 (0.0)	1 (100.0)	3 (75.0)	1 (25.0)
O157	no record		0 (0.0)	1 (100.0)

Figure 4. Observations of tagged mule deer in 1986. Data obtained from the City of Boulder, student interns, private citizens, and from my own field work.

87.5% < 50%
of the time

12.5% > 50%
of the time.

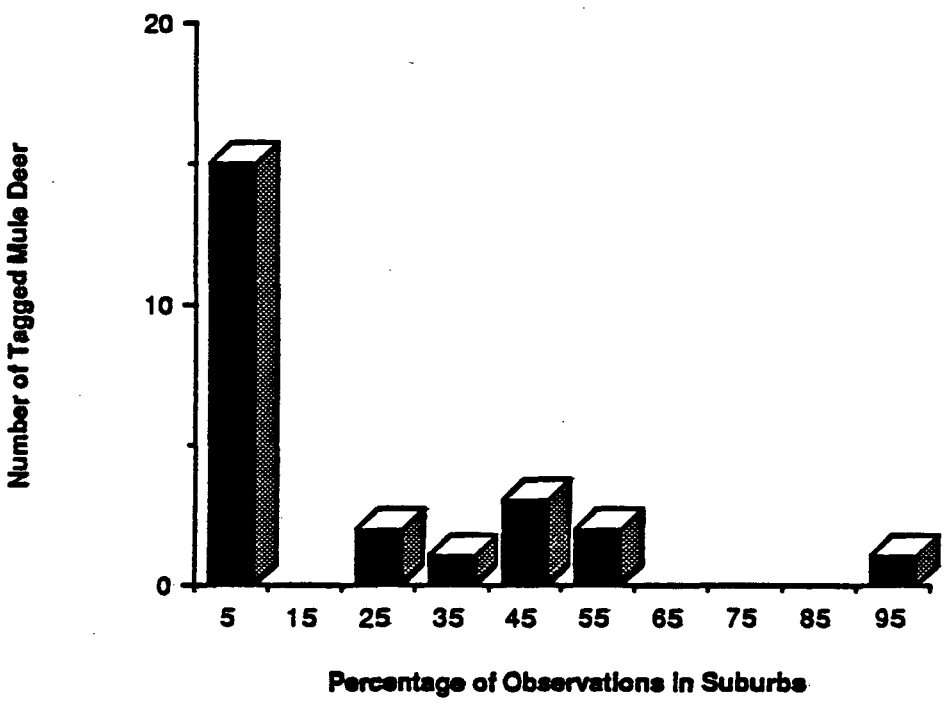
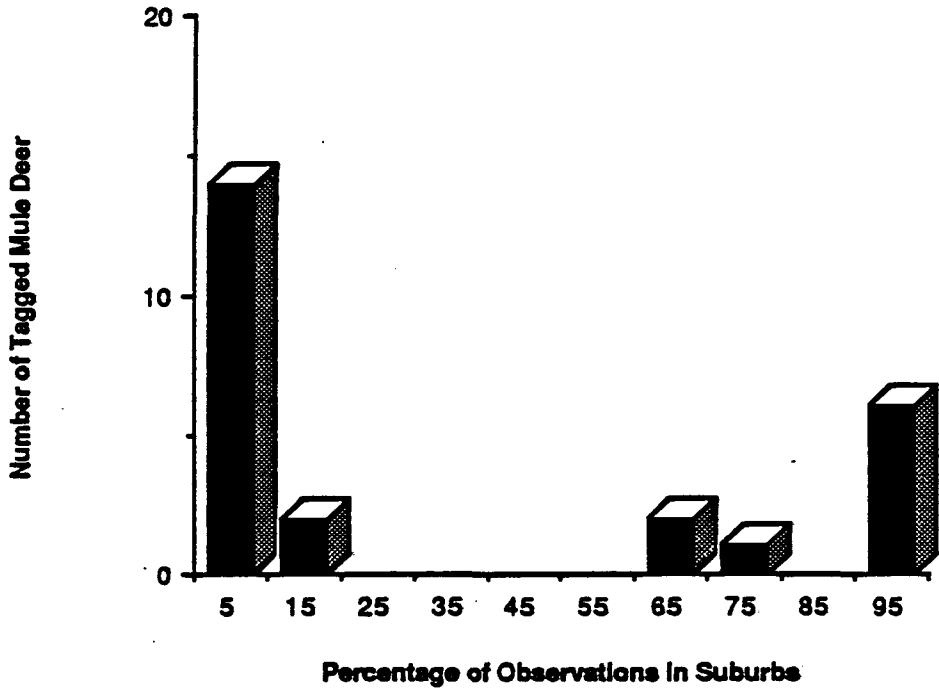


Figure 5. Observations of tagged mule deer in 1987. Data obtained from the City of Boulder, student interns, private citizens, and from my own field work.

12. 10/10 < 50%
1/10

$\frac{9}{10} = 90\% > 50\%$
1/10



distribution in Figure 5 corresponds with deer observations in 1987. In both years, the majority of the tagged mule deer in the study site were rarely, if ever, seen in the residential area. In 1986, one-third of the tagged deer were seen in the suburban area 20 to 60 percent of the time. In 1987, none of the tagged animals was observed in the suburban area 20 to 60 percent of the time. Instead, a larger proportion of the deer population was observed predominantly in the residential section of the study site.

The distribution in 1987, which is based upon observations from a number of sources, is strikingly similar to the distribution in Figure 3 which is based solely upon my own observations in 1987. This similarity supports my previous assumption that municipal and student field workers spent roughly equal amounts of time in the two areas of the study site.

Of the 25 tagged mule deer, 13 (52.0%) were female, 11 (44.0%) were male and one (4.0%) was undetermined. Among the deer seen principally in the open space, 11 (64.7%) were female and six (35.3%) were male. Among the deer seen principally in the suburban areas, only two (28.6%) were female while five (71.4%) were male.

Questionnaires

I received 125 responses to the 350 questionnaires distributed (35.7% return). Seven of the 24 questions and requests for information required a "yes" or "no" answer. The replies to these questions are tallied in Table 4. Some respondents wrote comments to one or more of the seven questions either in lieu of, or in addition to, a "yes" or "no" answer. When the intent of the respondent was reasonably clear, I included the appropriate answer in Table 4. If the reply was inconsistent or ambiguous, I treated the question as unanswered.

Of the 125 respondents, 124 (99.2%) experienced mule deer visits. Forty-four residents (40.0%) objected to these visits. Seventy-seven persons (67.0%) believed that Boulder has a mule deer problem. However, only 53 of the respondents (47.3%) felt that action should be initiated to eliminate mule deer from residential areas.

One hundred and ten respondents answered question 3 by indicating the number of days on which mule deer visited their properties during the week preceding questionnaire completion. The responses to question 3 are summarized in Table 5. On average, deer utilized the properties of these residents 4.8 days during the week in question. For purposes of Table 5, I used the most conservative estimate of deer visits provided by each respondent. I interpreted answers indicating that deer visits occurred almost daily as meaning that deer visited six times during the preceding week.

One hundred and nineteen respondents calculated the average number of days per month on which mule deer utilized their

Table 4. Responses to questions 2, 5, 8, 11, 14, 16, and 18 of the questionnaire distributed to study site residents.¹

Question	Affirmative Responses	Negative Responses
2. Do mule deer visit your yard?	124 (99.2%)	1 (.8%)
5. Does the frequency of mule deer visits vary during the year?	88 (75.2)	29 (24.8)
8. Have you ever sustained property damage as a result of deer activity?	102 (85.0)	18 (15.0)
11. Have you taken any steps to minimize property damage?	78 (63.4)	45 (36.5)
14. Do you object to the use of your property by deer?	44 (40.0)	66 (60.0)
16. In general, do you feel that Boulder has a mule deer problem?	77 (67.0)	38 (33.0)
18. Should action be initiated to eliminate mule deer from residential areas?	53 (47.3)	59 (52.7)

1. Based on 125 returns; however, the numbers of responses to each question varied, hence the divisors were different for different questions.

Table 5. Number of days on which mule deer visited respondents' property during the week preceding questionnaire completion.

Number of Days	Number of Responses	CUMULATIVE
0	10 (8.8%)	8.8
1	6 (5.3)	14.1
2	6 (5.3)	19.4
3	15 (13.3)	32.7
4	11 (9.7)	42.4
5	11 (9.7)	52.1
6	7 (6.2)	58.3
7	47 (41.6)	104.9
Total		113 (99.9%)

property. Responses to question 4 are summarized in Table 6. Once again, I included only the most conservative estimate of mule deer visits. Answers indicating that deer visits occurred almost everyday were interpreted as meaning that deer visited 26 to 31 days per month. Answers indicating that deer visits occurred most days were interpreted as meaning 11 to 20 days per month.

In Table 7, the answers to questions 14, 16, and 18 are divided into three categories: responses from residents experiencing deer visits zero to 10 days per month, responses from residents experiencing deer visits 11 to 20 days per month, and responses from residents experiencing deer visits 21 to 31 days per month. Residents who reported deer visits more than 10 days per month were more than four times as likely to object to the use of their property by deer than residents who experienced deer visits zero to 10 days per month. Residents who reported deer visits 11 to 20 days per month were 28.6 percent more likely to characterize the mule deer situation as a problem than respondents who experienced fewer days of deer visitation. Surprisingly, the same residents were even more likely to perceive a deer problem than respondents who experienced 21 to 31 days of deer visitation. Residents who reported more than 10 days of deer visits per month were over three times as likely to believe that the mule deer should be eliminated from residential areas as respondents who experienced fewer deer visits.

Responses to questions 6 and 7 indicated that most deer visits occurred during the winter and that the fewest visits occurred during the summer (Table 8). It should be noted that

Table 6. Average number of days on which mule deer visited respondents' property per month.

Number of Days	Number of Responses
0 - 5	17 (14.3%)
6 - 10	12 (10.1)
11 - 15	17 (14.3)
16 - 20	20 (16.8)
21 - 25	8 (6.7)
26 - 31	45 (37.8)
	Total 119 (100.0%)

Table 7. Answers to questions 14, 16, and 18, categorized by the number of days per month mule deer visited the respondents' property.

Question	Zero to Ten Days		11 to 20 Days		21 to 31 Days	
	Yes	No	Yes	No	Yes	No
No. 14 <i>visit to use of your property?</i>	3 (11.1%)	24 (88.9%)	17 (51.5%)	16 (48.5%)	23 (48.9%)	24 (51.1%)
No. 16 <i>is mule deer a problem?</i>	13 (46.4)	15 (53.6)	27 (75.0)	9 (25.0)	34 (69.4)	15 (30.6)
No. 18 <i>should deer be eliminated?</i>	4 (15.4)	22 (84.6)	20 (60.6)	13 (39.4)	25 (50.0)	25 (50.0)

→ AVE. = 58% NO / 42% YES

Table 8. Responses to questions 6 and 7. (During which seasons do the most and the fewest mule deer visits occur?)

#6	Season When Most Deer Visits Occur	Number of Responses
	Winter	49 (45.8%)
	Spring	21 (19.6)
	Summer	17 (15.9)
	Fall	20 (18.7)

#7	Season When Fewest Deer Visits Occur	Number of Responses
	Winter	20 (22.0%)
	Spring	6 (6.6)
	Summer	56 (61.5)
	Fall	9 (9.9)

the number of answers in Table 8 often exceeds the number of respondents replying to the particular question. Many people identified more than one season when answering questions 6 and 7.

Of the 102 residents who sustained property damage as a result of mule deer activity, 69 were able to estimate the value of the property damaged. Table 9 summarizes these valuations. When a range of monetary damage was indicated by a respondent, I used the midpoint of that range in Table 9. I interpreted answers which described deer damage as negligible or minimal as meaning less than \$50.00 of damage per year.

In Table 10, the answers to questions 14, 16, and 18 are divided into three categories: responses from residents who have not sustained property damage as a result of deer activity, responses from residents who have sustained damage in the amount of \$50.00 or less per year, and responses from residents who have suffered damage exceeding \$50.00 per year. Data in Table 10 suggest a correlation between the amount of property damage sustained by a resident and that resident's inclination to object to residential deer activity, to perceive a mule deer problem, and to believe that mule deer should be removed from the suburbs. For instance, a respondent who suffered yearly deer damage exceeding \$50.00 was more than seven times as likely to feel that Boulder has a mule deer problem as a respondent who experienced no mule deer damage.

Of the 77 residents who felt that Boulder has a mule deer problem, 65 specifically described the nature of the problem. These responses can be divided into four categories: concern about property damage, concern about personal injury as a result

Table 9. Responses to question 10. (On the average, what is the value of the property damaged by mule deer each year?)

Average Value of the Property Damaged by Mule Deer Each Year	Number of Responses
\$0.00 - \$50.00	42 (60.0%)
51.00 - 100.00	9 (12.9%)
101.00 - 200.00	8 (11.4%)
201.00 or more	11 (15.7%)
Total	70 (100.0%)

Table 10. Answers to questions 14, 16, and 18, categorized by the value of the property damaged by mule deer each year.

Question	No Damage		Damage in the Amount of \$50.00 or Less		Damage Exceeding \$50.00	
	Yes	No	Yes	No	Yes	No
No. 14 <i>object to use of your property</i>	1 (6.7%)	14 (93.3%)	6 (16.2%)	31 (83.8%)	22 (84.6%)	4 (15.4%)
No. 16 <i>are deer a problem</i>	2 (13.3)	13 (86.7)	24 (58.5)	17 (41.5)	26 (96.3)	1 (3.7)
No. 18 <i>should deer be eliminated?</i>	1 (6.7)	14 (93.3)	12 (31.6)	26 (68.4)	22 (84.6)	4 (15.4)

of deer activity, concern about the welfare of the mule deer, and miscellaneous concerns (Table 11). Property damage was generally considered the most significant aspect of the mule deer situation. A substantial number of respondents were also concerned about the welfare of the animals. Many people believed that the urban deer are subjected to less demanding environmental pressures than their open space counterparts and are therefore less healthy as a subpopulation. Ten people worried about personal injury as a result of deer activity. Although most of these respondents anticipated injury as a result of automobile accidents, several residents were concerned that mule deer may physically assault small children. The data in Table 11 were obtained from the answers to question 17 and from any other comments which reflected the opinions of the respondents with reasonable clarity.

Questions 19 and 20 encouraged the respondents to recommend appropriate methods of reducing the residential mule deer population (where such action was deemed necessary). Of the 53 residents who felt that mule deer should be eliminated from the suburbs, 35 suggested one or more specific courses of action. Table 12 summarizes these suggestions. (A plurality of the respondents advocated a relocation program. The most direct method of population control--killing the deer--was recommended in 31.0 percent of the responses.)

Table 11. Responses describing the nature of the mule deer problem.

Concern of the Resident	Number of Responses
Property Damage	41 (63.1%)
Personal Injury	10 (15.4)
Welfare of the Deer	11 (16.9)
Miscellaneous	3 (4.6)
Total	65 (100.%)

Table 12. Recommendations for the elimination or reduction of the mule deer population from residential areas.

Specific Recommendations	Number of Responses
Harvesting	13 (31.0%)
Relocating	18 (42.9)
Birth Control	6 (14.3)
Fencing	5 (11.9)
Total	42 (100.1%)

Legal Research

Any discussion of the legal aspects of the Boulder mule deer situation must begin with Title 33 of the Colorado Revised Statutes (1973). Entitled Wildlife and Parks and Outdoor Recreation, Title 33 is the framework of wildlife law in the State of Colorado. The legislative intent is described in subsection 33-1-101(1), C.R.S.1973: "It is the policy of the state of Colorado that the wildlife and their environment are to be protected, preserved, enhanced, and managed for the use, benefit, and enjoyment of the people of this state and its visitors." Subsection 33-1-101(2) states that "All wildlife within this state not lawfully acquired and held by private ownership is declared to be the property of this state." The effect of these legislative declarations is to place the ownership of wildlife, such as mule deer, in the State of Colorado for the benefit of its residents. Public ownership of wildlife resources enables the State to develop comprehensive management programs, but invariably conflicts with the concept of private ownership of homes and land.

Recognizing the incompatibility of public ownership of wildlife and private property rights, the state legislature enacted Article 3 of Title 33 in 1963. Section 33-3-102, C.R.S.1973 provides that "The state of Colorado is liable for certain damages caused by wildlife, but only to the extent provided in this article." The operative portions of Article 3 are sections 3-3-102 and 3-3-104. Section 33-3-103 enumerates the circumstances in which the State is not liable for wildlife

damage. Of particular interest are subsections (1)(b) and (1)(c) which specifically shield the State from liability for automobile damage and for personal injury or death caused by wildlife. Thus, Boulder residents injured in a car collision with a mule deer, or kicked by an irate doe, are not entitled to statutory compensation.

Section 33-3-104 describes the situations in which the State will assume liability for property damage. Subsection 33-3-104(1)(d) permits compensation for damage caused by big game animals (including mule deer) to orchards, nurseries, crops under cultivation, harvested crops, certain fences and some livestock forage. Although not explicitly stated, it appears that professionals who suffer agricultural or horticultural losses are the intended beneficiaries of this statute. Section 33-3-104 does not provide a legal remedy for private property owners who sustain damage to their yards as a result of foraging wildlife. The absence of such a provision, in conjunction with section 33-3-102, effectively denies Boulder residents statutory compensation for mule deer damage.

A number of appellate cases have involved the applicability and constitutionality of Colorado's wildlife laws. In Collopy v. Wildlife Com'n. Etc., 625 P.2d 994 (1984), the Colorado Supreme Court addressed a situation similar in many respects to the mule deer problem experienced by some Boulder residents. The appellant, Charles T. Collopy, was the owner of a farm in Weld County. In 1968, pursuant to its goose protection and management program, the Colorado Wildlife Commission prohibited the hunting of geese in an area which included Mr. Collopy's property. This

hunting prohibition encouraged geese to forage in the closed areas and resulted in damage to the appellant's crops. Mr. Collopy contended, among other things, that the closure of his property to hunting, and the lack of compensatory remedies in Article 3 of Title 33, C.R.S.1973, damaged his property for a public purpose without just compensation in violation of the Colorado Constitution, Art. II, Sec. 15. According to the appellant, the actions of the Wildlife Commission transformed his farm into a de facto game refuge and appropriated his crops for fodder. Although the Supreme Court recognized the validity of the legal principle cited by Mr. Collopy, it held that the incidental injuries suffered by the appellant were not sufficient to render either the closure of his property to hunting, or the state wildlife statutes, unconstitutional. Collopy v. Wildlife Com'n. Etc., supra.

Colorado appellate courts have consistently held that the Colorado wildlife statutes are constitutional as applied and that compensation for wildlife-caused damage is limited by these same statutes. Nevertheless, cases like Collopy v. Wildlife Com'n. Etc. do not foreclose the possibility of a successful suit. The Colorado Supreme Court stated "a different result [than that reached in the Collopy case] may be commended by Art. II, Sec. 15 if the wildlife-inflicted property damage accompanying a closure were to prove more substantial than that here incurred..." Collopy v. Wildlife Com'n. Etc.' supra, at page 1002. Indeed, courts from other jurisdictions have held that the State cannot establish the equivalent of a game refuge on private property if

wildlife congregating on the refuge cause substantial, uncompensated property damage. State v. Herwig, 117 N.W.2d 335 (1962); Shellnut v. Arkansas State Game and Fish Commission, 258 S.W.2d 570 (1953).

The establishment of municipal open space, and the protection of wildlife within those areas, have created the equivalent of a game refuge. Arguably, the damage sustained by some Boulder home owners as a result of mule deer activity is sufficient to warrant monetary compensation. Mr. Collopy suffered property damage in the amount of \$250.00 per year. Many Boulder residents claim annual property damage well in excess of that amount. More importantly, Mr. Collopy's property damage was sustained on a 160 acre farm. The relative impact of the geese was minimal. Comparable damage to a small residential lot may be deemed significant enough to justify a legal remedy.

⊗ [An important aspect of state wildlife law is that municipalities such as Boulder have minimal responsibility for wildlife and wildlife damage. As a practical matter, the City of Boulder is unlikely to be held legally accountable for the acts of mule deer. The State is liable for certain wildlife-inflicted damages because it is the owner of the animals and because the legislature has specifically made it liable under designated circumstances. The City, however, has no proprietary interest in mule deer and is protected by the doctrine of sovereign immunity. This doctrine protects the State and its subdivisions from suits for injury suffered by private persons. In Colorado, a municipal government is insulated from tort liability unless the state legislature or the municipal government waives sovereign

immunity. Since there has been no waiver of immunity for wildlife damage, the City of Boulder is presumably protected from liability for such injury. See the "Colorado Governmental Immunity Act," Article 10 of Title 24, C.R.S.1973.

A negative aspect of state wildlife law is that management of mule deer, even within city limits, is solely within the discretion of the state division of wildlife. The Colorado Division of Wildlife has a well-earned reputation for developing progressive wildlife programs. Nevertheless, the Division's programs tend to be comprehensive and devoted to the entire state. It is difficult for the State to allot adequate resources to a purely local situation such as the Boulder mule deer situation.

In spite of its limited authority, the City of Boulder has enacted several ordinances which directly affect the mule deer situation. Section 8-3-5 of the Boulder Revised Code (1981) generally prohibits any person from hunting, trapping, netting, impeding, harassing, molesting, chasing, or killing wildlife. Section 6-1-9 generally prohibits any person from distributing animal poisons, setting leg-hold traps, or operating other mechanical traps which are designed to capture or kill animals. Subsection 6-1-4(b)(6) prohibits any person from feeding or keeping deer. For purposes of this ordinance, feeding includes the provision of salt licks. Subsection 9-3-26(a)(4)(C) permits certain residents to utilize electric fences to protect crops and plantings.

In summary, mule deer are the wards of the State of

Colorado and are managed on behalf of its residents. State statutes limit liability for deer-inflicted property damage to businesses engaged in agriculture or horticulture. Under the present state of the law it appears that the City of Boulder has no legal liability for damage or personal injury caused by mule deer.

Discussion

Field Surveys

In 1984, Western Resource Development Corporation found that there was a regular movement of mule deer between municipal open space and adjacent residential areas. WRDC concluded that the terms "open space deer" and "city deer" had little, if any, significance. Nevertheless, a distinction between mule deer which avoid residential areas and deer which routinely utilize such areas is justified by data from 1986 and 1987. Figures 2 through 5 (which reflect mule deer observations from different sources, in different years) reveal that approximately one-half of the tagged deer in the study site were observed in open space regions at least 90 percent of the time. Removal of these animals from the general population would have little direct impact on the mule deer situation in the City of Boulder.

The remainder of the tagged mule deer (those animals observed more than 10 percent of the time in the suburbs) may be designated "city deer" in the sense that they all routinely utilize residential habitat. However, even among these animals the extent of urbanization varies considerably. Data indicate that there is a subpopulation of city deer which utilize residential areas to a much greater extent than the city deer population as a whole. This discrepancy is seen most clearly in Figure 5 which summarizes mule deer observations in 1987. Of the 11 tagged animals observed at least 10 percent of the time in the suburbs, nine were seen in the residential area at least 60

percent of the time, and the remaining two mule deer were observed in the suburbs less than 20 percent of the time.

A distinction should also be made between city deer which have incorporated both open space and residential areas into their home ranges, and city deer which rarely leave the suburbs. (In 1987, six of the tagged mule deer (24.0%) were observed at least 90 percent of the time in the suburbs. It is my impression that these animals occupy home ranges which are almost entirely residential.) Certain mule deer are observable in the suburbs regardless of season, weather, or time of day. Residents have reported seeing these animals mate and fawn in their yards.

The existence of mule deer which permanently reside in the city has not been previously reported in the scientific literature. The mule deer described by Geist were apparently winter visitors to the town of Waterton, Alberta (Duffey and Watt, 1971). Geist did not indicate whether the deer remained exclusively in town during their seasonal visits.

The presence of mule deer in Boulder, which permanently occupy residential areas, has important implications. It is likely that members of such a subpopulation account for a disproportionate amount of the deer-inflicted property damage complained of by some residents. Mule deer which make periodic forays into residential areas, and then return to open space habitat, presumably play a lesser role in the mule deer situation. The occurrence of deer which are apparently independent of open space resources also suggests that the mule deer situation may spread to other parts of Boulder. Deer which have successfully adapted to an urban lifestyle may choose to

live in central sections of town, well away from municipal open space regions.

The number of mule deer which have adapted to an exclusively urban existence appears to be increasing. Figures 4 and 5 illustrate an interesting trend. In 1986, nine tagged mule deer were observed more than 10 percent of the time in the suburbs. Eight of these animals (88.9%) were seen in the residential area 20 to 60 percent of the time. Only one tagged deer was observed in the suburbs more than 90 percent of the time. Thus, in 1986 the vast majority of city deer utilized both open space and residential areas.

The situation changed in 1987. Six of the city deer (54.5%) were observed in the suburbs over 90 percent of the time. Significantly, all six of these animals were city deer in 1986. Three mule deer (27.3%) were seen in the residential area 60 to 80 percent of the time. All three of these animals were open space deer in 1986. A certain amount of habituation is apparently necessary before a mule deer can sever its ties with the open space. It is likely that the three deer which were observed in the suburbs 60 to 80 percent of the time in 1987 will permanently reside in the city in 1988.

Although individual deer spent more time in the suburbs in 1987, the total number of tagged city deer remained relatively constant from 1986 to 1987. There were 11 city deer in 1987 and nine such animals in 1986. Two of the 1987 city deer were infrequent visitors to the residential area of the study site. Y18 was observed in the suburbs 20 percent of the time and

Y142 was seen there only 11.1 percent of the time. Therefore, the growth of the mule deer problem (as described by some study site residents) may be the result of individual animals spending more time in the suburbs, rather than an increase in the number of mule deer which routinely visit residential neighborhoods.

Questionnaires

As a preliminary matter, it should be emphasized that the residents who responded to these questionnaires were not randomly selected, nor are they representative of the Boulder community.

Mule deer probably utilize the residential areas within the study site more extensively than they do any other suburban location in the city. Many inhabitants of the study site encounter deer on a daily basis and are intimately acquainted with the various aspects of the mule deer situation. It is very likely that the responses to these questionnaires represent the extremes of Boulder public opinion. Nevertheless, study site residents, and other similarly situated Boulder inhabitants, constitute a politically significant segment of the community. Moreover, views which are extreme now may be typical if the mule deer situation becomes prevalent.

(In answer to question 16, 67.0 percent of the responding residents expressed a belief that Boulder has a mule deer problem. However, only 40.0 percent of the respondents personally objected to mule deer visitation and only 47.3 percent felt that action should be initiated to eliminate the animals from residential areas.) These discrepancies may be attributed to several prevalent attitudes among questionnaire respondents. First, many people believed that the mule deer situation is really a potential problem. There seems to be a widespread conviction that the uncurtailed growth of the mule deer population will lead to intolerable levels of property damage and other obtrusive behavior. Respondents often suggested that the extent of deer visitation is currently acceptable, but would be objectionable if

the number of mule deer was permitted to increase.

The public perception of a mule deer population explosion has been encouraged by the City of Boulder, but may be unfounded. In its 1987 mule deer update, the City stated that mule deer numbers increased 10 percent annually from 1983 to 1986. In fact, the City's data do not statistically support this conclusion. The report relied upon population estimates made in 1983, 1984, and 1986. Although the sample means increased, the 90 percent confidence intervals overlapped substantially. Thus, the deer population estimates were not significantly different by standard statistical criteria. The City's report is also somewhat inconsistent with other studies. Southwick and Southwick (unpubl. data) found that mule deer numbers in the NCAR mesa area fluctuated from year to year, but remained relatively constant over the long term.

Another common attitude among study area residents was that the solutions to the mule deer problem were more objectionable than the problem itself. Relocation was the most frequently proposed method of eliminating city deer (Table 12). However, it was generally acknowledged that trapping the deer and transporting them to a more natural environment would be costly and probably ineffectual. Harvesting the deer was a notably unpopular response to the mule deer situation. Only 13 of the 125 respondents advocated killing the animals. A number of residents stated that killing the mule deer would be unacceptable regardless of the magnitude of the deer problem.

Finally, some respondents were clearly uncomfortable with the

absence of a comprehensive plan for managing the mule deer *
population. These residents were reluctant to advocate action
without a well developed goal and a program for achieving that
goal. (Other respondents indicated that the mule deer topic has
been sufficiently discussed and urged immediate action.)

The data in Table 10 suggest that the perception of a mule
deer problem is correlated with the amount of property damage
sustained by a questionnaire respondent. Residents who suffered
deer-inflicted property damage in excess of \$50.00 per year were
more than seven times as likely to feel that the mule deer were a
problem as residents who suffered no damage. However, I believe
that economic loss, in itself, is relatively unimportant to most
respondents. In general, residents of the study area appear
affluent. Nevertheless, excessive property damage represents a
serious violation of traditional property rights. Many people
object to the unauthorized, obtrusive use of their property by
wildlife. Questionnaire respondents frequently complained of
their inability to maintain landscaping or a vegetable garden.
Thus, monetary compensation for deer-inflicted property damage
may not adequately address the mule deer problem.

*Lead
1. all
a number
of cases*

Although the study area residents constitute a select and
often biased sample group, it may be possible to extrapolate the
attitudes of other city inhabitants from the questionnaire
responses. Tables 7 and 10 provide a crude profile of the
Boulder resident who is likely to view the mule deer as a
problem. Such a person experiences mule deer visits more than 10
days per month and suffers some annual property damage. In
general, people who experienced infrequent deer visits and

suffered little property damage were much less likely to perceive the mule deer as a problem than residents who frequently experienced destructive deer visits. Since the city deer phenomenon tends to be localized along the western edge of the city, it is probable that the majority of Boulder residents do not experience mule deer visits and do not view the mule deer situation as a problem.

Management Alternatives and Recommendations

Both the City of Boulder (1987) and Western Resource Development Corporation (1984) have presented and analyzed various management alternatives to the mule deer situation. Unfortunately, neither report recommended a particular course of action. Rather than summarize all possible approaches to the mule deer situation, I propose an integrated management plan. Although this proposal has undoubtedly been influenced by my own attitudes and biases toward wildlife, I believe that these recommendations realistically address the biological, political, and legal aspects of the Boulder mule deer situation.

(An effective management program must accomplish three principal functions: (1) it must preserve the quality of municipal open space habitats; (2) it must maintain the health and vitality of the resident mule deer population; and (3) it must minimize conflicts between mule deer and Boulder's human inhabitants.) Such a program will require the concerted efforts of the City of Boulder and the State of Colorado. While the City is responsible for the care and maintenance of municipal open space and mountain parks, the State is the legal trustee of mule deer and other wildlife. It may therefore be advantageous for these two political bodies to form a committee or some other permanent liaison to coordinate and develop management activities.

Preservation and protection of Boulder's open space is an extremely important consideration in managing the mule deer population. The City's system of open space and mountain parks provides the citizenry with unique recreational and aesthetic opportunities. Boulder has achieved favorable national

Urbanization, residential areas increase the overall carrying capacity depending on how often deer use them. There is no practical way to sample such urban areas.

recognition for its open space program. Moreover, the maintenance of a healthy mule deer population is dependent upon suitable habitat. It is therefore imperative that we determine the optimum carrying capacity of city open space for mule deer. Without such data, we may permit the mule deer population to severely damage or deplete its habitat, and to suffer subsequent mortality.

Admittedly, a determination of the number of mule deer which can be maintained in good condition, without harming the open space, may be difficult and somewhat speculative. We must first assess available browse in terms of its nutritional value to mule deer. Other population limiting factors, such as hunting and predation, have little effect on the Boulder mule deer population. Preliminary data on the supply of forage has already been amassed by Boulder rangers. In 1986, the City sampled various open space areas to determine vegetational composition and forage production. It was concluded that the open space was not generally overutilized by mule deer and that the carrying capacity of open space habitat had not been exceeded. Although the City's habitat analysis provided useful preliminary information, the study was hindered by inadequate funds and manpower. A relatively small number of sampling plots was used to survey the quality and quantity of the diverse open space vegetation. To effectively evaluate municipal open space as mule deer habitat we must conduct a much more thorough inventory of forage resources. Browse surveys should be performed on a periodic basis and should draw upon a larger number of sample plots.

In conjunction with vegetational inventories, accurate mule deer population estimates should be obtained. As previously noted, (the City of Boulder is responsible for three previous censuses. Unfortunately, the estimates were too imprecise to provide all of the necessary information on population trends.) Once again, lack of manpower and financing were responsible for the limited success of the City's efforts. Future population estimates must rely upon larger sample sizes if variability is to be reduced. It may also be useful to increase the proportion of tagged animals in the mule deer population. Straandgaard (1967) found it necessary to mark two-thirds of the animals in a roe deer population in order to obtain precise population estimates with the Lincoln index. (Boulder uses a modified Lincoln-Peterson formula.)

Once data are acquired on the availability and condition of vegetation in the municipal open space, and on the number of mule deer which utilize this vegetation, we can begin to balance the mule deer population with its habitat. Annual surveys of deer numbers and vegetation should reveal trends in forage production and depletion. Comparisons of various levels of habitat utilization with mule deer densities should also be feasible. With this information, we can make an educated determination of the maximum number of mule deer which can be supported by the municipal open space without unacceptably impacting the environment.

As stated previously, the daily occurrence of mule deer in residential areas is the primary source of conflict between the mule deer and Boulder's human inhabitants. Questionnaire

responses suggested that city deer really are a problem and that a management program must be developed to address the situation. The City of Boulder has already instituted a number of measures designed to lessen the impact of city deer. It passed ordinances which prohibit the feeding of mule deer and which permit some residents to erect electric fences. The City also published a pamphlet which describes ways in which Boulder inhabitants can better coexist with mule deer. This pamphlet provides phone numbers for information regarding repellents, fencing, and mule deer ecology.

Unfortunately, questionnaire responses indicated that the City's efforts are largely unrecognized. Improved public awareness is clearly required. Perhaps fireside talks, which are periodically scheduled by Boulder rangers, could be devoted to the mule deer situation and the City's involvement in wildlife management.

In addition to the existing efforts at minimizing conflicts between mule deer and man, a management program aimed at reducing the number of city deer should be initiated. Relocating the animals to a more natural environment is the most politically acceptable method of population control. However, such a program would be expensive and probably unfeasible (Western Resource Development Corporation, 1984; City of Boulder, 1987). Hunting or poisoning is effective, but would certainly meet with public outrage. A chemical fertility control program may be the most humane yet efficient method of managing Boulder's city deer. A substantial number of commercial contraceptive steroids are

Expense
↑
Funds

Still in study stage as to
↑
feasibility

currently available. Long-acting drugs can be administered by
darts from a tranquilizer gun (Kirkpatrick et al., 1982; Turner
and Kirkpatrick, 1982). The ability to deliver contraceptives
remotely would enable us to approach the mule deer situation in a
selective way. Individual city deer could be singled out and
treated with the drug. Alternatively, contraceptives could be
administered in the form of subcutaneous steroid implants, oral
prostaglandins, or intrauterine devices. Fertility control also
permits management flexibility. In general, the effects of
contraceptive drugs are reversible. If the city deer
subpopulation were to suffer unanticipated and excessive
mortality, or if there were a change in the public perception of
the mule deer situation, treatment with contraceptive drugs could
be withdrawn and the mule deer would revert to normal
reproductive activity.

A successful chemical fertility control program would
require a vigorous commitment from Boulder and the State of
Colorado. The public must first be convinced of the merits of
the management program. Information regarding the management of
city deer could be disseminated through public meetings and
literature. Public dialogue would serve two purposes: it would
help overcome distrust of fertility control and remote injection,
and it would dispel the widespread notion that Boulder lacks a
coherent program of wildlife management. It would also be
necessary to tag and monitor a larger number of city deer. (If,
as this study indicates, the mule deer situation is the result of
a relatively small number of deer extensively utilizing
residential habitat, then the city deer must be identified and

targeted.) Finally, as responsible members of the ecosystem, we would need to carefully assess the results of contraceptive administration. A fertility control program must not immoderately affect the behavior or health of the mule deer, or interfere with the dynamic ecological system of which the mule deer population is a component.

*→ fertility control of antelope
not also the mule deer since
it alters population structure.*

In summary, the Boulder mule deer situation has developed into a complex and interesting public issue. In the past, the City of Boulder and the State of Colorado have made well-intentioned, but inadequate, attempts at addressing this issue. Questionnaire responses indicate that the time has come for a more active approach to the mule deer situation. An appropriate management program should address the biological, political, legal, and social aspects of the mule deer population. Accordingly, I have proposed what I consider a viable, integrated wildlife management program. There are various alternatives to these recommendations, with various points of emphasis. Any successful management plan, however, must be accompanied by a renewed appreciation of the mule deer and our other open space resources. The municipal open space and its mule deer inhabitants are visited and enjoyed by a large portion of the community and deserve a suitable financial and emotional commitment.

Summary of Recommendations

- I. Functions of an effective mule deer management plan.
 - A. Preservation and protection of municipal open space.
 - B. Maintenance of mule deer health and vitality.
 - C. Reduction of conflict between mule deer and human residents.
- II. Management recommendations.
 - A. Determine the optimum carrying capacity of municipal open space for mule deer.
 1. Assess available forage in terms of nutritional value to deer.
 - a. Conduct browse surveys on a periodic basis.
 - b. Increase the number of sample plots to adequately reflect vegetational composition and forage production.
 2. Accurately census the mule deer population.
 - a. Perform censuses on a periodic basis.
 - b. Increase sample size to improve precision.
 - c. Increase the proportion of tagged animals in the mule deer population.
 3. Compare levels of habitat utilization with mule deer densities.
 4. Determine the maximum number of mule deer which can be supported by municipal open space without unacceptably impacting the environment.
 - B. Initiate a chemical fertility control program to reduce

the number of city deer.

1. Identify city deer.
2. Increase the number of tagged city deer.
3. Selectively administer long-acting
contraceptive drugs.
4. Assess the behavioral and ecological effects of
contraceptive administration.

C. Improve public awareness of municipal wildlife
management programs.

1. Devote fireside talks to the mule deer situation.
2. Disseminate literature describing management
activities.
3. Schedule public meetings to discuss management
alternatives.

D. Encourage a renewed appreciation of mule deer and other
open space resources.

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Appendix 1. Copy of the questionnaire distributed to 350 residents of the study area.

Dear Resident:

My name is Anthony Turrini. I am a neighbor and a graduate student in biology at the University of Colorado. I am presently conducting a study on the urbanization of mule deer in the Boulder area. In particular, I am interested in the attitudes of city residents in contact with the animals. I would very much appreciate it if you would complete the enclosed questionnaire and return it to me in the pre-addressed and stamped envelope provided.

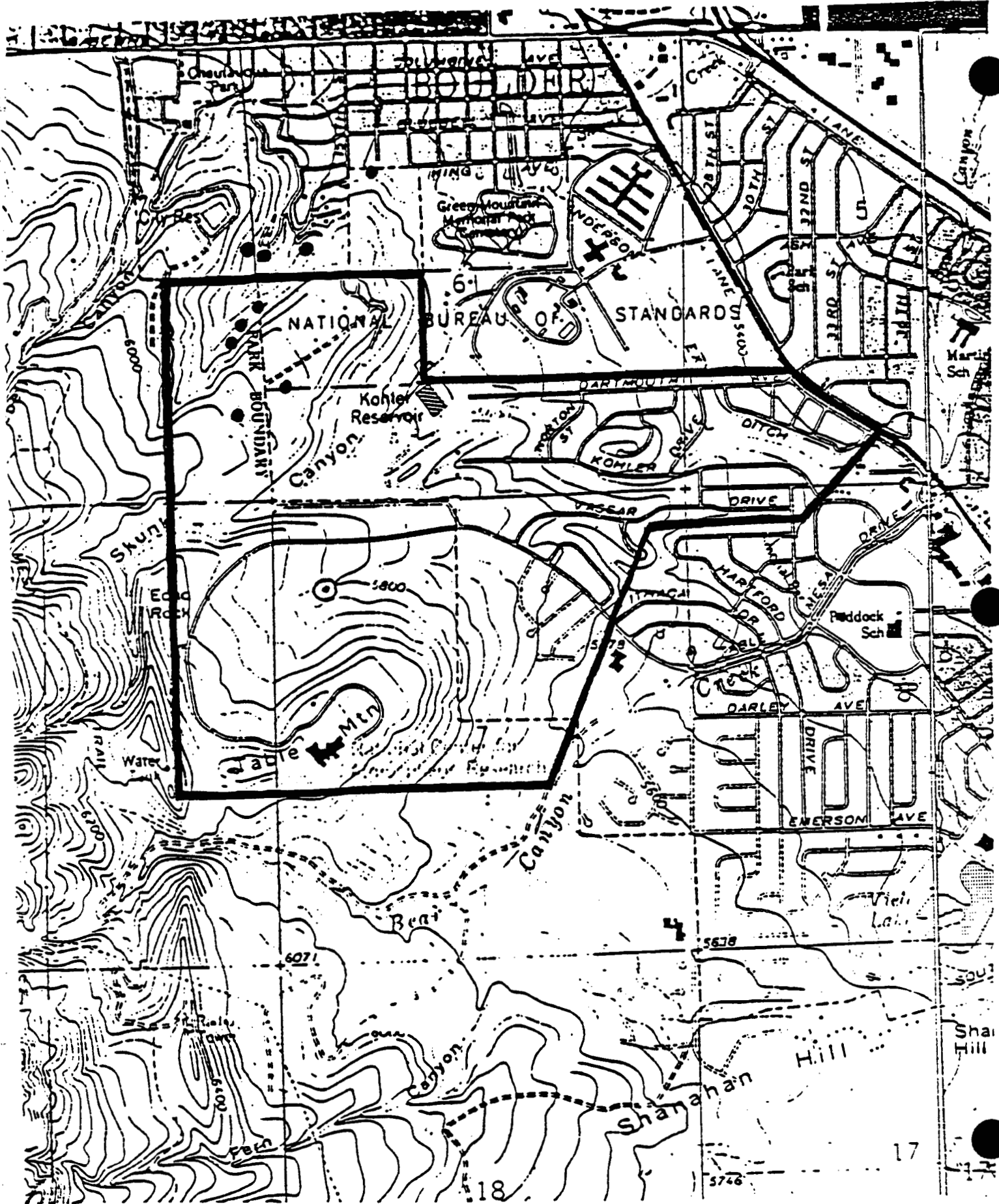
Thank you for your cooperation.

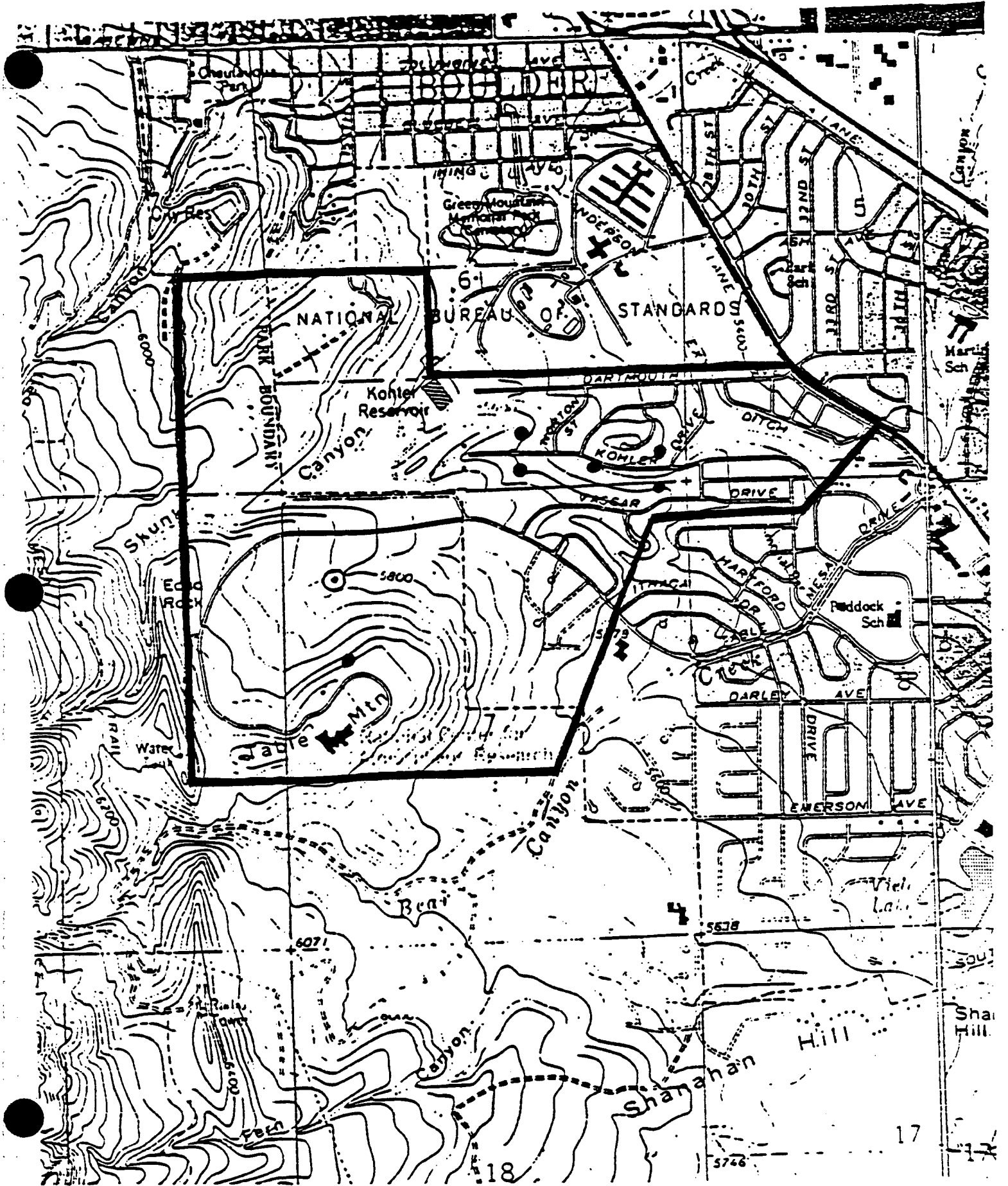
1. What is your name(s) and address?
2. Do mule deer visit your property? Yes____ No____
3. On how many days did mule deer visit your property during the last week? _____
4. On the average, how many days per month do mule deer visit your property? _____
5. Does the frequency of mule deer visits vary during the year? Yes____ No____
6. If so, during what season do most deer visits occur? _____
7. During what season do the fewest deer visits occur? _____
8. Have you ever sustained property damage as a result of deer activity? Yes____ No____
9. If so, please describe the nature of the property damage.
10. On the average, what is the value of the property damaged by mule deer each year? _____
11. Have you taken any steps to minimize property damage? Yes____ No____
12. If so, please describe the steps taken.
13. What was the cost of the steps taken? _____
14. Do you object to the use of your property by deer? Yes____ No____

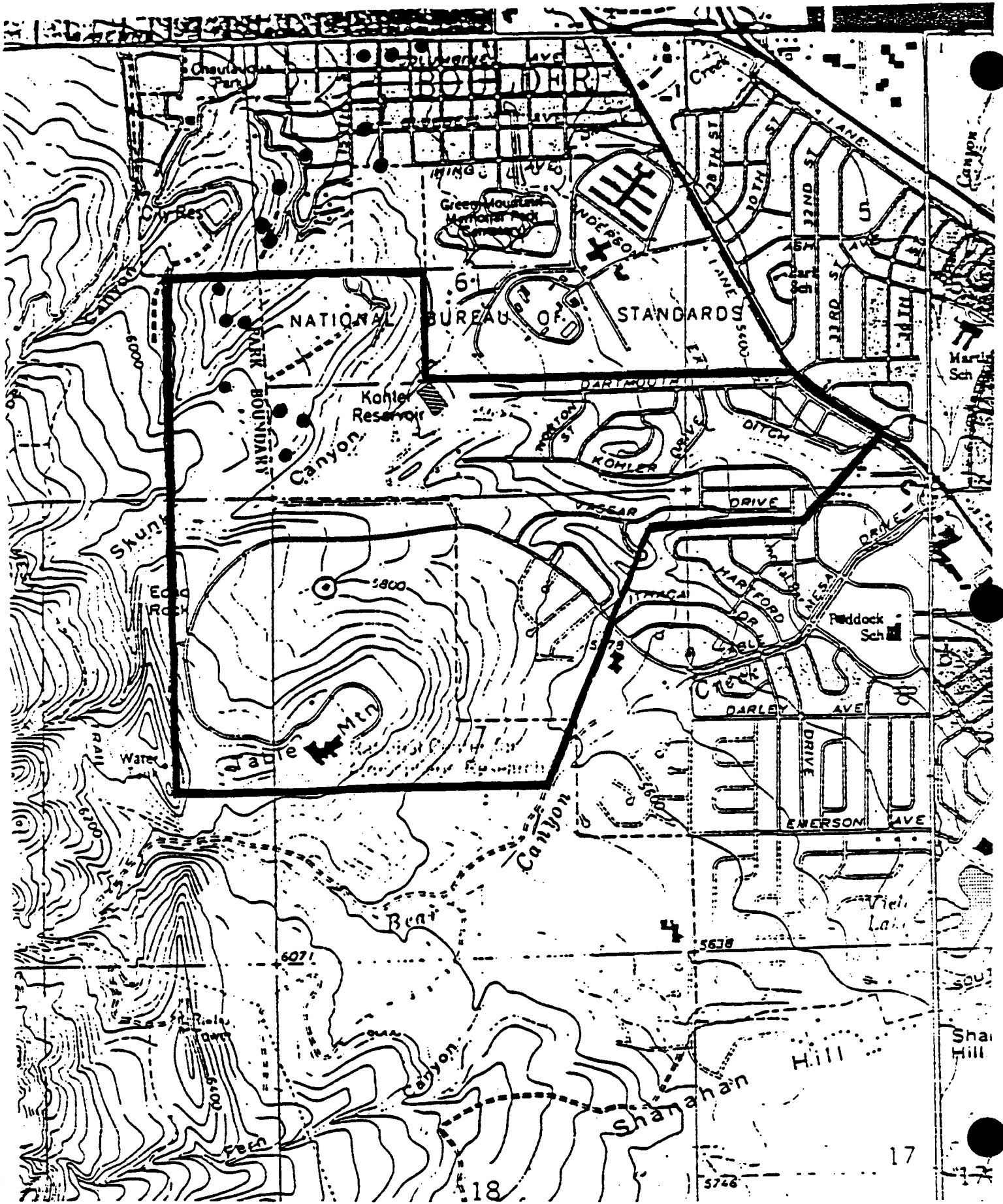
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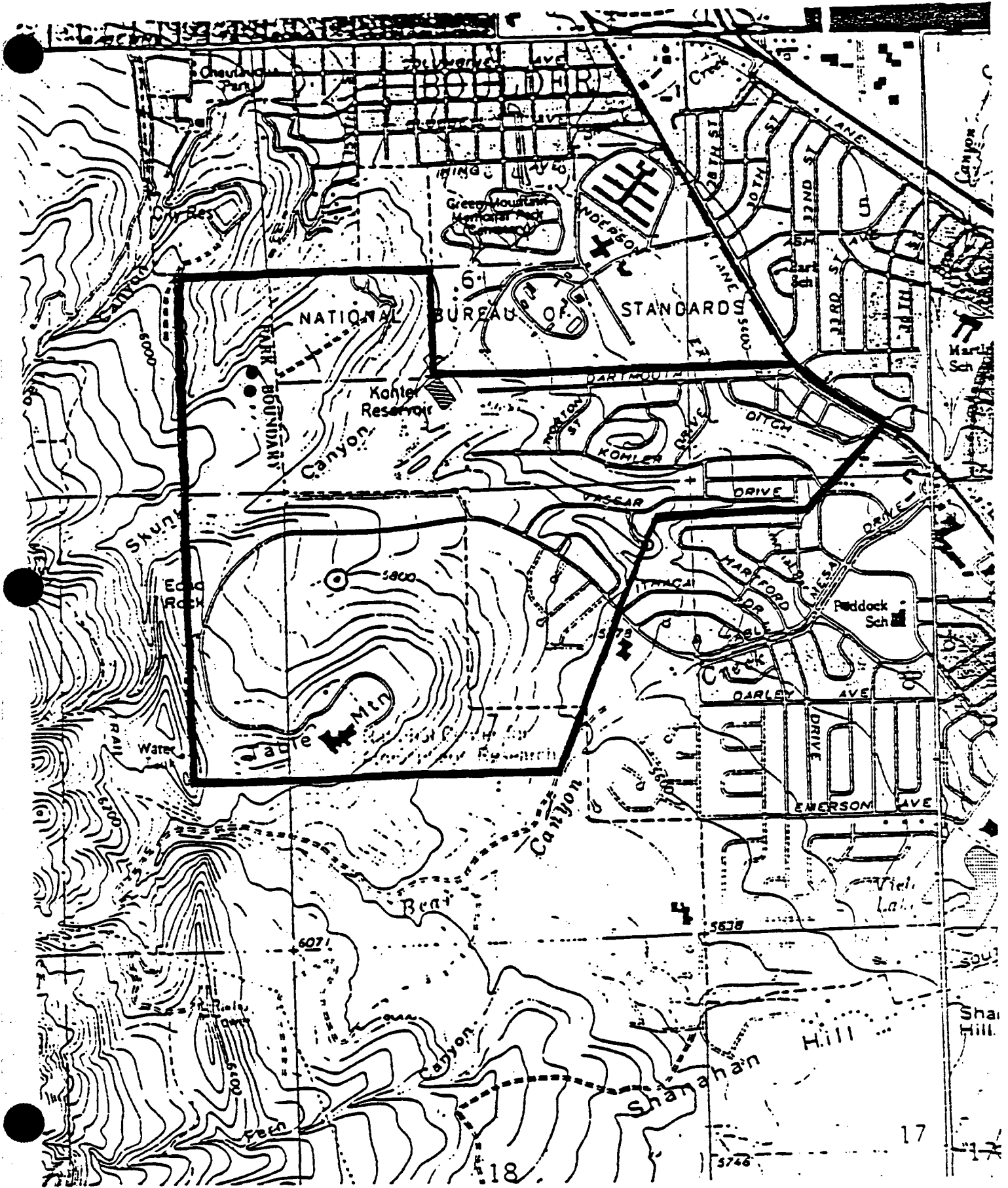
15. If so, what is the nature of your objection?
16. In general, do you feel that Boulder has a mule deer problem? Yes_____ No_____
17. If so, what is the nature of the problem?
18. Should action be initiated to eliminate mule deer from residential areas? Yes_____ No_____
19. If so, what sort of action would be appropriate?
20. What policy should the City of Boulder adopt in regards to the mule deer?
21. What policy should the City of Boulder adopt in regards to injury or property damage caused by mule deer?
22. If you were on city council, what action, rule or ordinance would you advocate in regards to Boulder's mule deer population?
23. Additional comments (please attach additional pages if necessary).
24. Date of questionnaire completion: _____

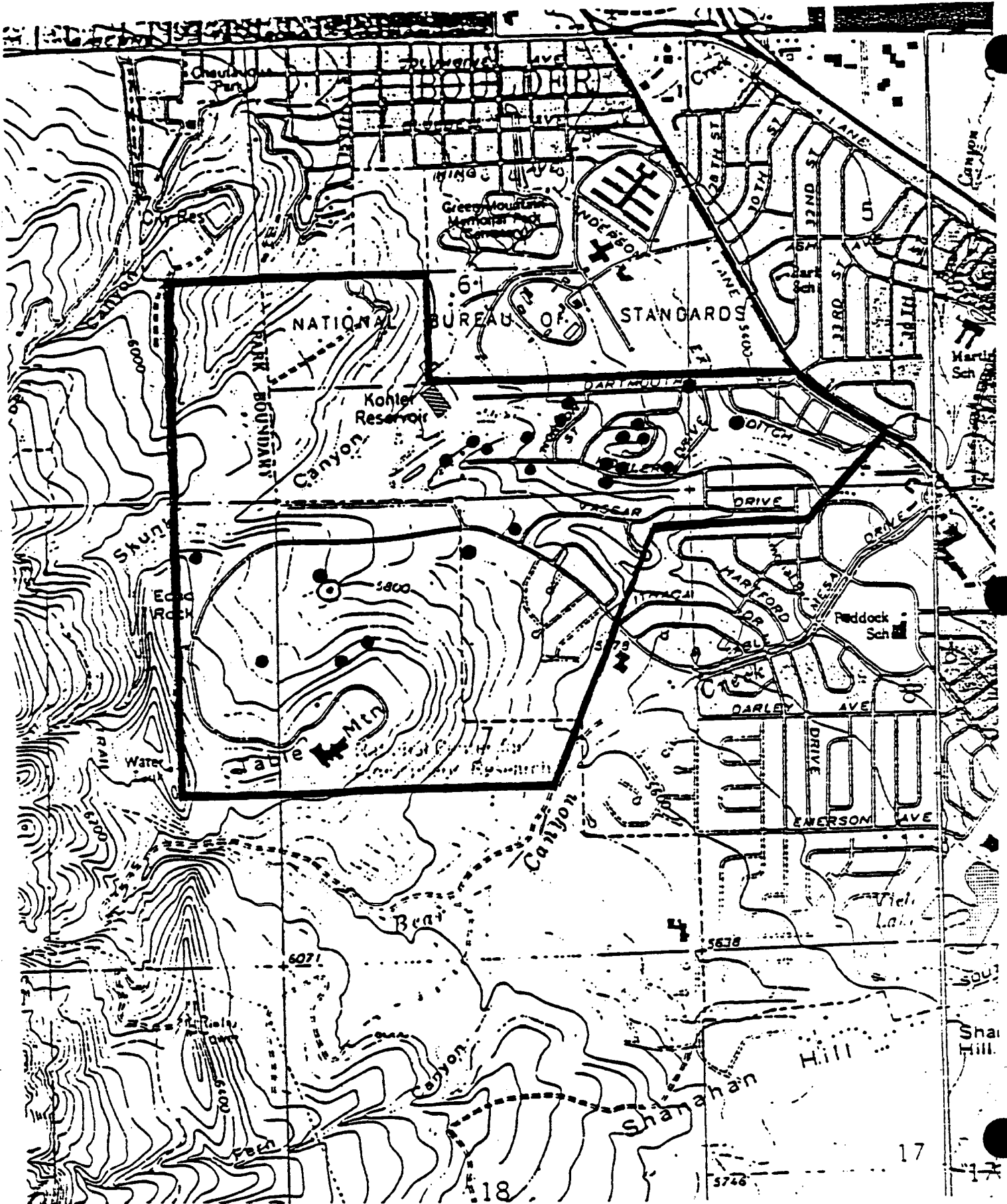
Appendix 2. Twenty-five maps of the study area, each of which corresponds to an individual deer. The location of each observation is indicated by a dark circle. Data obtained from the City of Boulder, student interns, private citizens, and from my own field work, in 1986 and 1987.



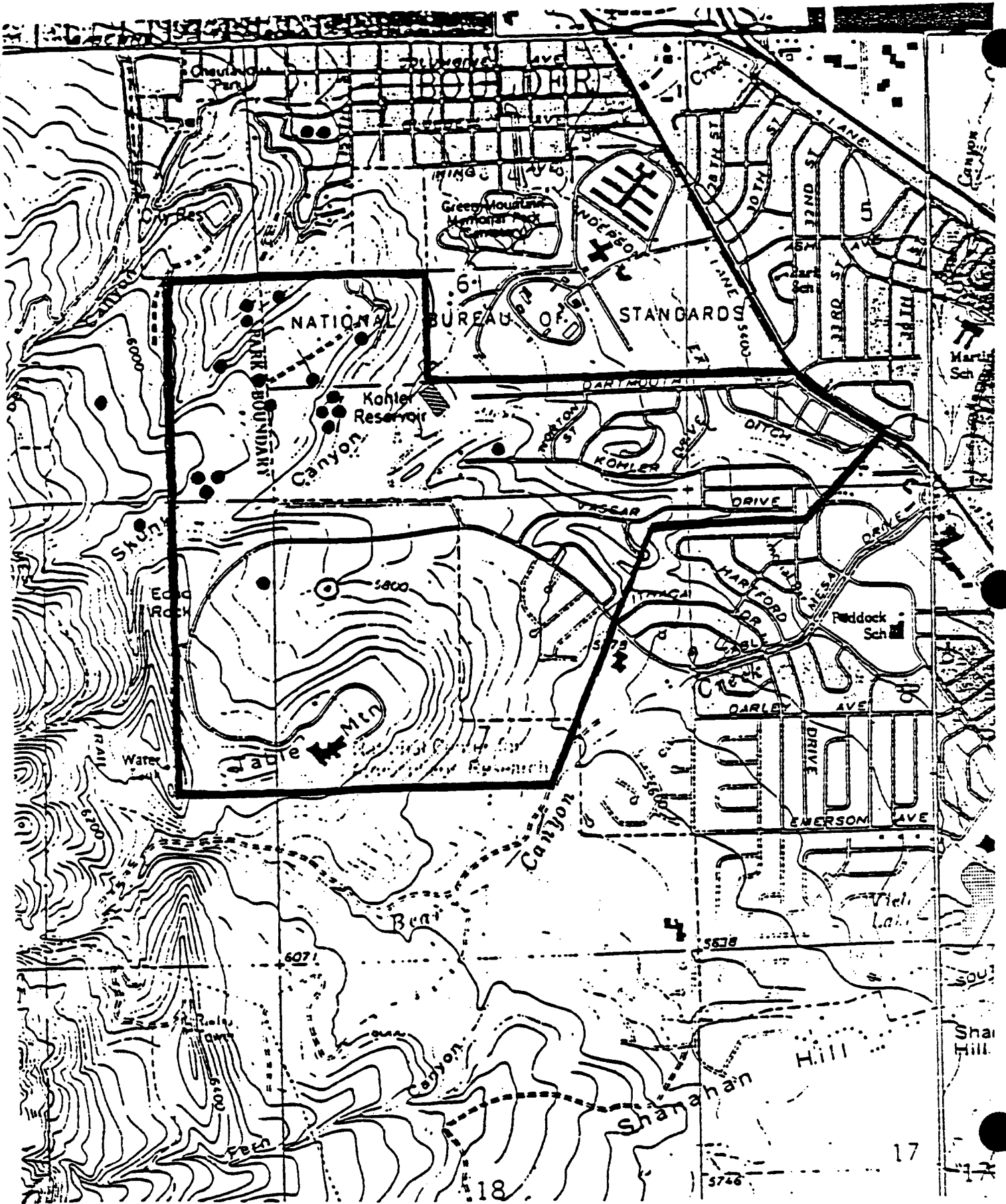




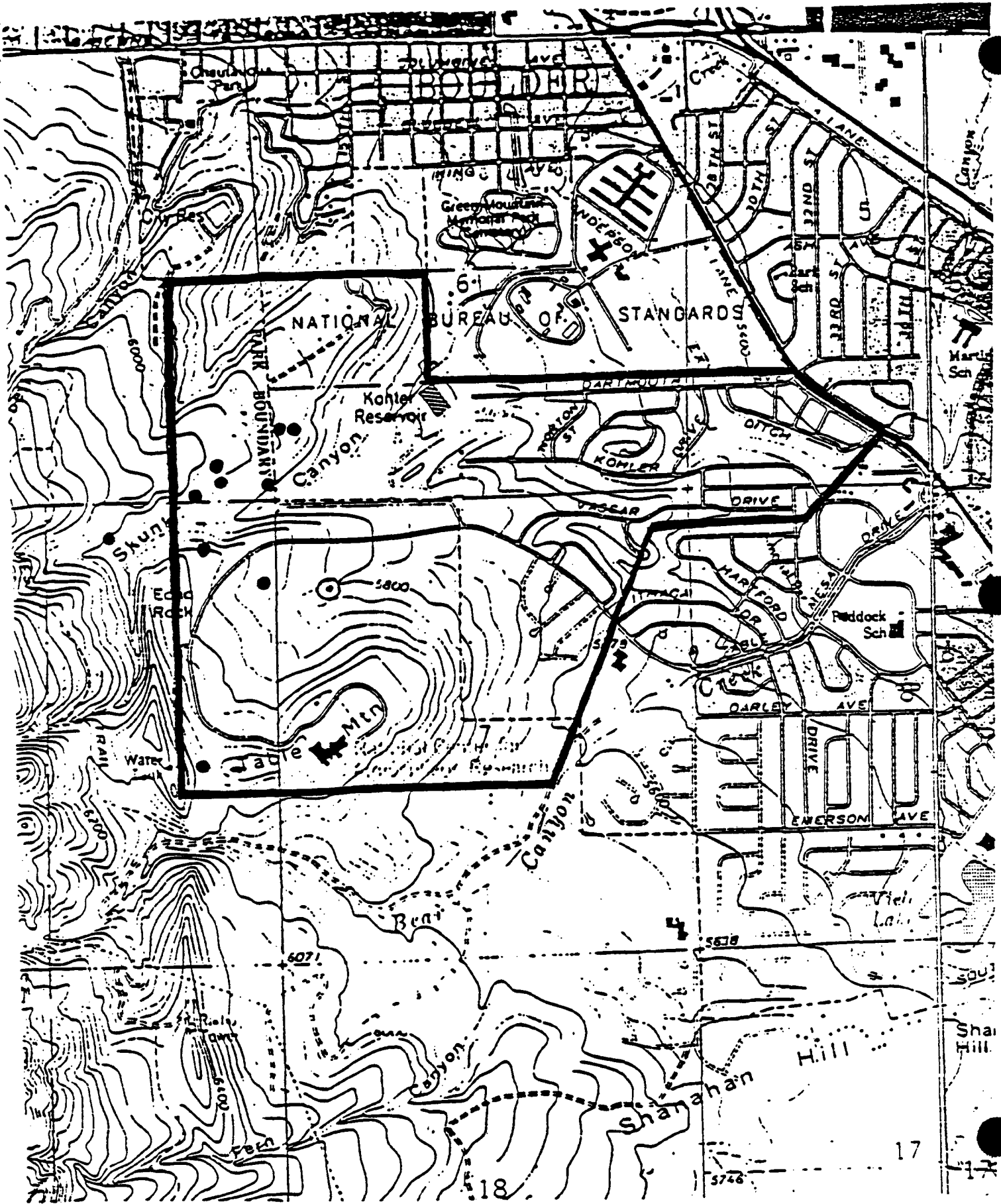


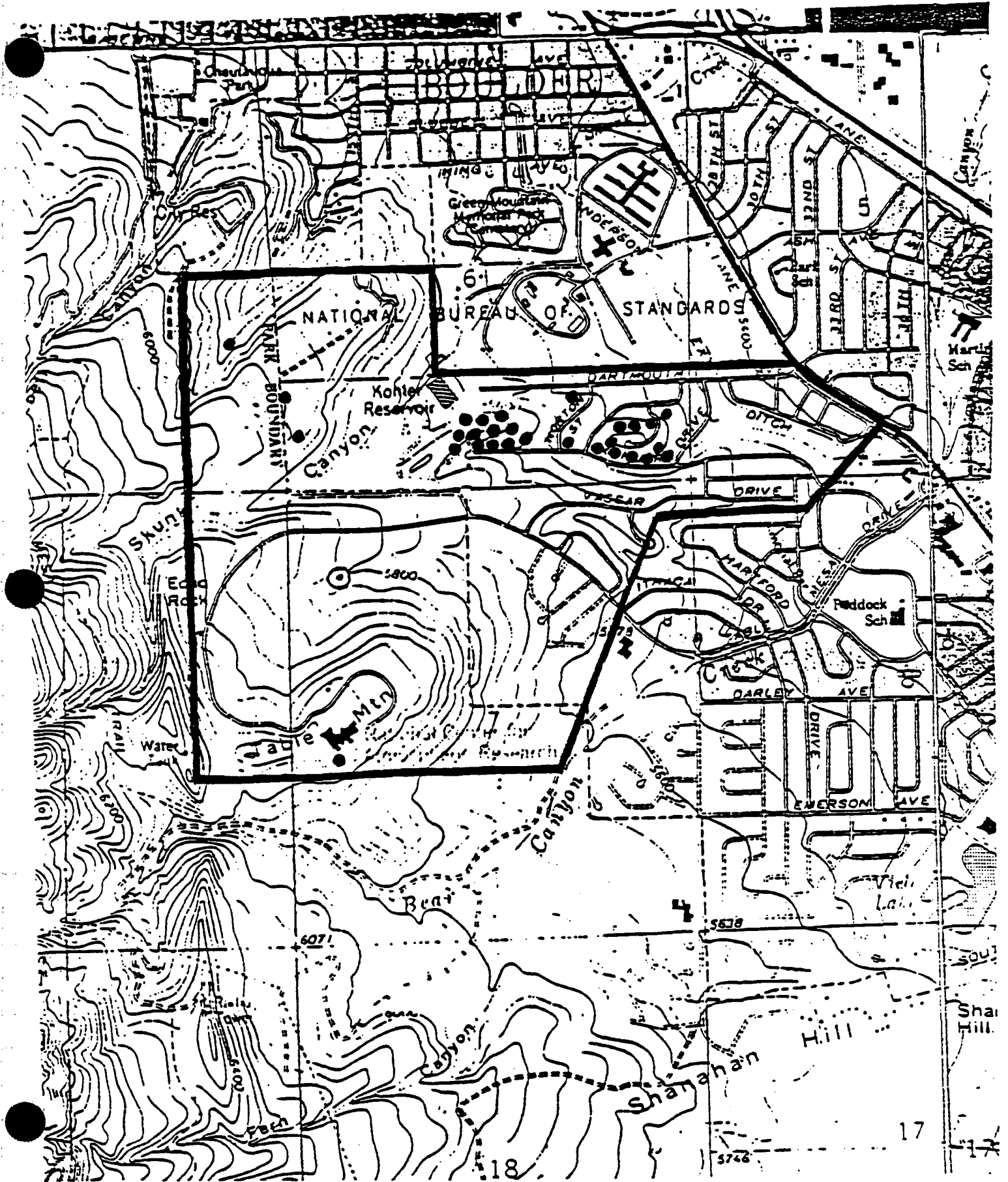


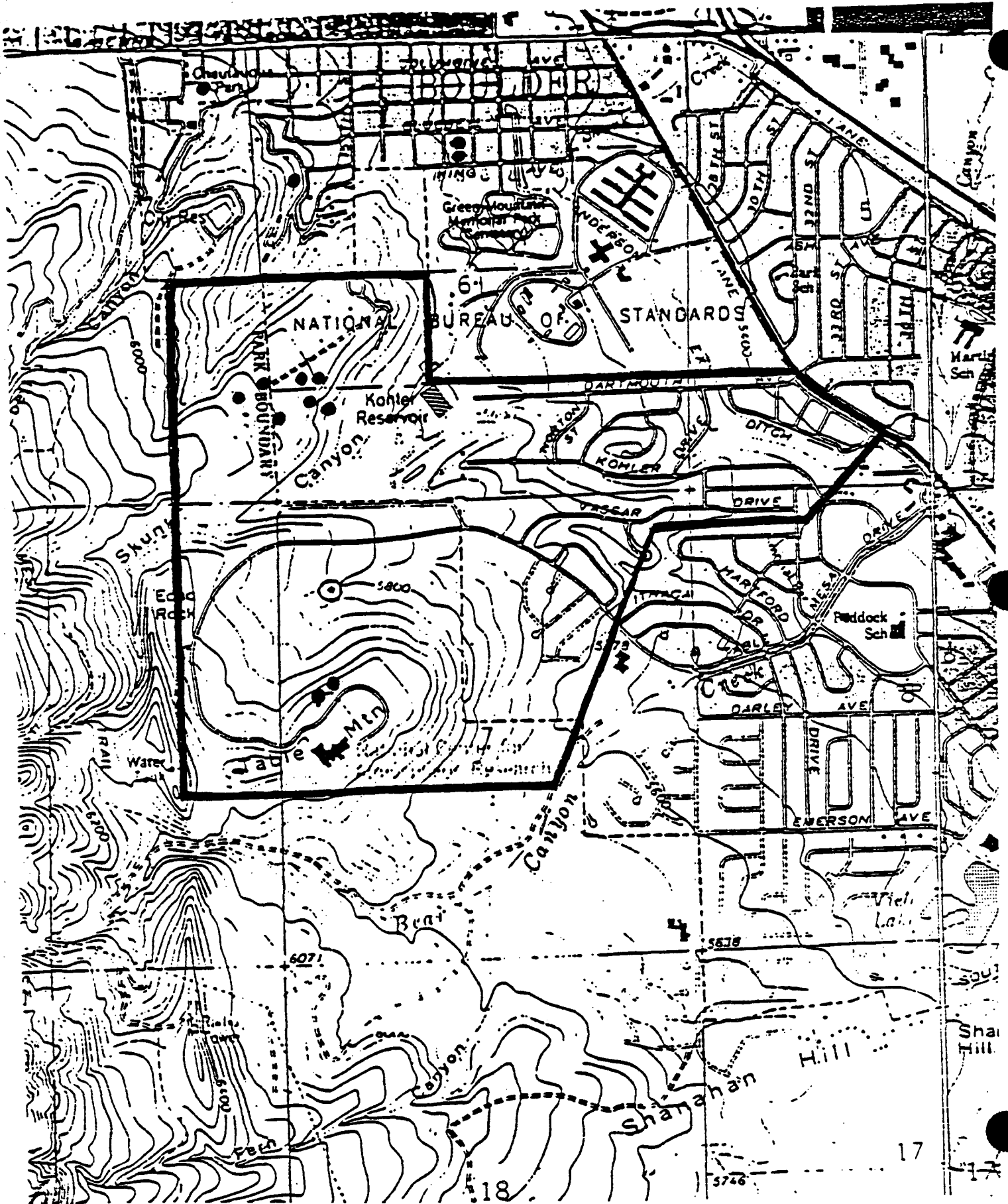




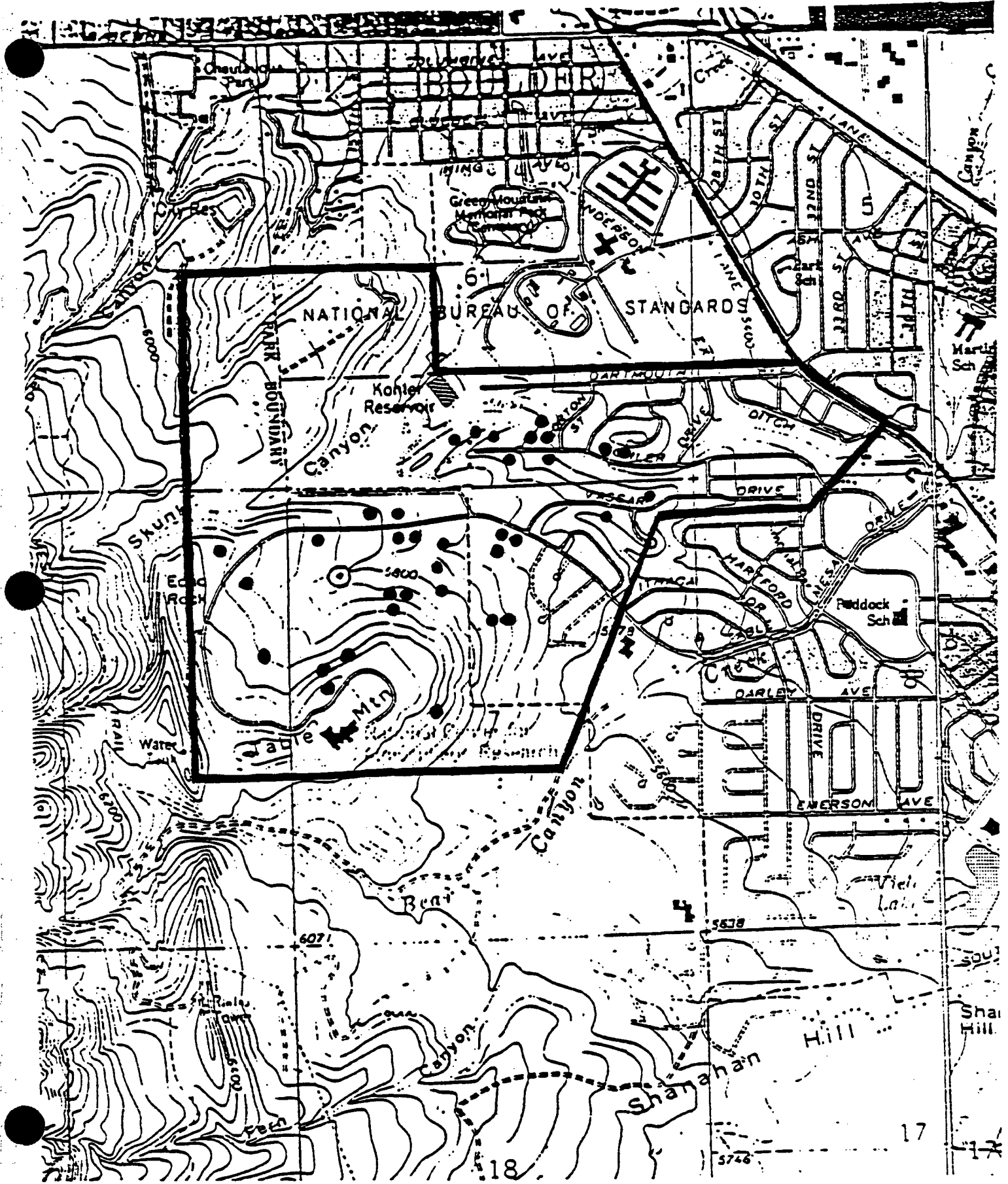


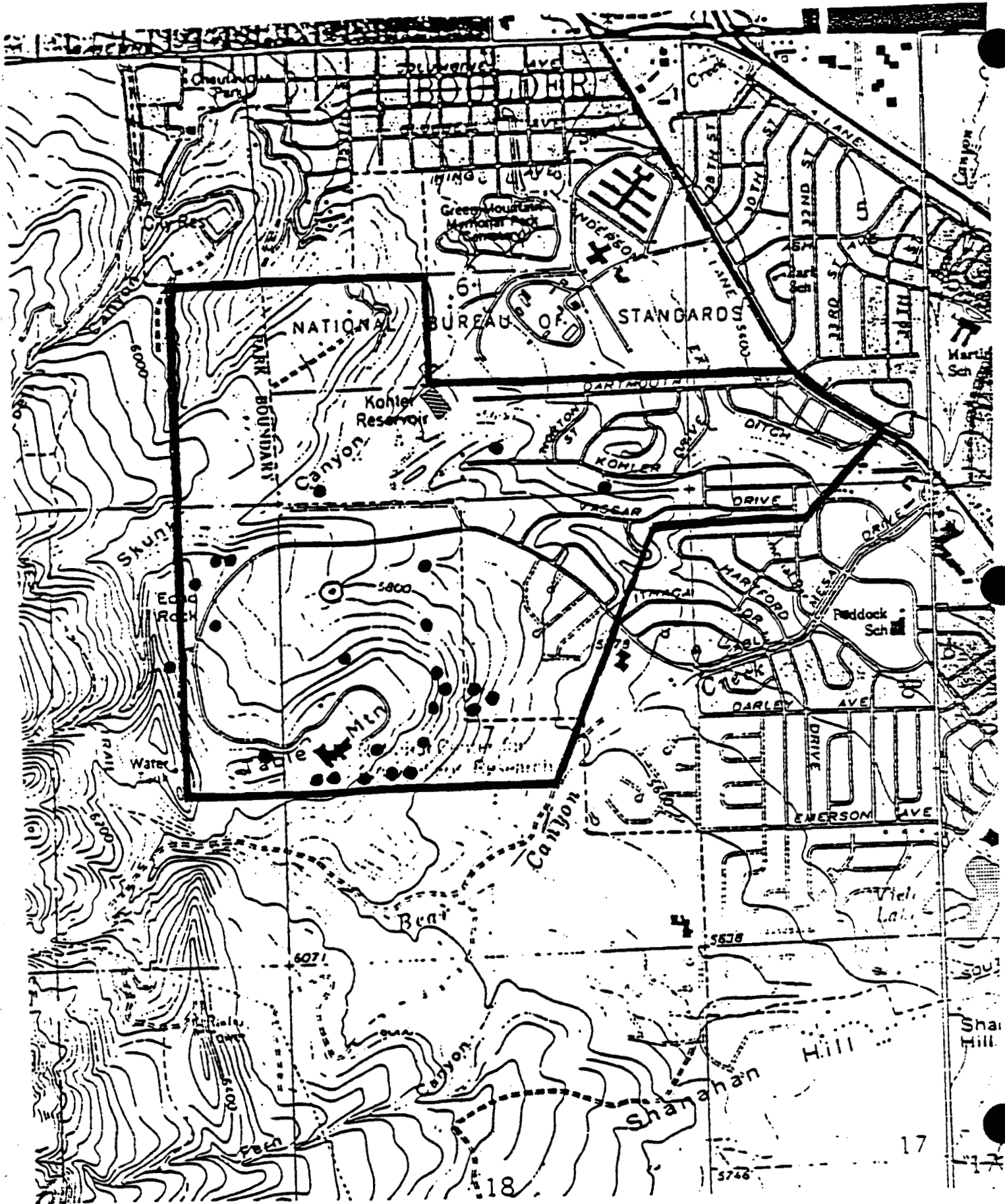












Y144 - female

