

FINAL REPORT

As Required by

THE ENDANGERED SPECIES ACT

TEXAS

GRANT NUMBER E-1-6

ENDANGERED RESOURCES BRANCH

Project 35: Managing and Monitoring Rare and Endangered plants on
Highway Right-of-Ways in Texas

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FINAL REPORT

State: Texas

Grant Number: E-1-6

Grant Title: Endangered and Threatened Species Conservation

Project Title: Assessment and Management Plan Development for Listed and Category Plants on Texas Department of Highways and public Transportation Rights-of-Way.

Contract Period: September 1, 1990 through September 1, 1994

Project Number: 35

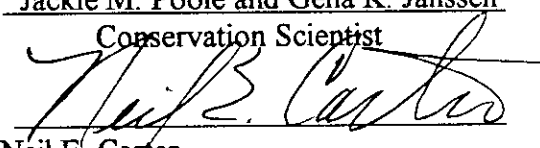
Objective: To verify known populations of listed and category plants on Texas Department of highways and Public Transportation rights-of-way; to ascertain current highway department management policies and assess their effect on listed and category plant species; to develop management plans compatible for both the highway department and the listed or category species; to formulate monitoring procedures for each listed or category species population, and to monitor plant populations on a yearly basis to check on the effectiveness of the management plans.

PREFACE

The attached Final Report entitled "Managing and Monitoring Rare and Endangered Plants on Highway Rights-of-Way in Texas" by Jackie M. Poole and Gena K. Janssen resulted from this objective and is submitted in fulfillment of the report requirement.

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diversity of habitat types (i.e., swamps, deserts, grasslands, woodlands, etc.). Data collected from 1990 to 1994 shows that of the 33 populations studied, 24 increased or remained stable under the agreed upon management regimes. For the nine populations which decreased, TxDOT management was not the cause.

METHODS

In 1989 several thousand plant locality records within the TxNHP database were scanned for proximity to highway right-of-way. The physical locations of the resulting list were then searched as time and phenology allowed. When listed or category species were relocated, a meeting was then set up between TPWD botanists and TxDOT personnel. Usually there was a year's lag time between site identification and TPWD/TxDOT meeting due to schedule conflicts, etc. Meetings were held at the site, and TxDOT management as well as rare species requirements were discussed. After reaching agreement on management strategies for both the species and the highway right-of-way, management agreements were drafted, reviewed by all parties concerned, and revised. Management agreements included the location and description of site (including maps), management techniques currently used, species of concern at the site, recommended management procedures, monitoring procedures, red flag conditions (conditions which indicate a significant decline in vigor or numbers of individuals within the population at the site), location of archived data, authorship, reviewers, revisors, and dates (see Appendix).

Usually immediately after the site meeting, monitoring plots were established, using recognized methods (Bowles et al., 1986; Travis and Sutter, 1986; Palmer, 1987; Pavlik, 1987; Spellerberg, 1991; Cropper, 1993; Given, 1994; Menges and Gordon, 1996). Each of the sites and species required a different monitoring methodology. Table 1 presents the various taxa, and the demographic and vigor methodology used for each. In general demography was tracked by counts of individuals. However in the case of clonal species, either the number of stems were counted (i.e., Ambrosia cheiranthifolia) or the areal coverage was calculated (i.e., Zizania texana). An increase or decrease was considered to be a 10% or more deviation within the number of individuals between the initial and last census. A stable population was considered to experience less than 10% variation. Vigor data was calculated using one or more of the following plant attributes: plant height, number of stems, length of stems, diameter of stems, number of leaves, number of flowers and/or fruits, areal cover (of single individuals or groups), density, and reproductive or size class. Monitoring was conducted on an annual basis with data being analyzed and compared to previous data to pinpoint trends in vigor and/or demography. If red flag conditions (decreases of more than 10% in vigor or demography) were encountered, an attempt was made

to ascertain the cause. If the conditions were the result of TxDOT management practices, the management agreement was revised.

RESULTS

Of the 150 potential sites identified in the Texas Natural Heritage Program database as possibly occurring on highway right-of-way, 57 were relocated, 15 were either not found or not found to be on highway right-of-way, and 88 still require verification as of September 1, 1995. Also highway right-of-way populations of listed or category species discovered after the original 1989 database search were added to the monitoring and management sites. Management agreements were initiated for 26 sites and a total of 26 species. Four species have multiple sites, and four sites contain 2 or more species. A total of 33 populations representing 26 species were monitored. The 26 species include 11 listed species, three Category 1 species, and 12 Category 2 species. Of the 33 populations 12 have been monitored for five years, eight for three years, six for four years, five for two years, and two for seven years. As of September 1, 1995, 16 populations increased, nine decreased, and eight remained stable. Of the 28 populations monitored more than two years, 14 have fluctuated over the years (both increased and decreased in size), including 11 of the 14 populations studied for the longest period (five to seven years). Vigor trends were extremely variable, with high standards of deviation. Table 2 gives the demographic and vigor data for all populations as of September 1, 1995. Additional data from years outside the time frame of this study acquired through other projects is included in the table.

DISCUSSION

Overall, the management agreement-monitoring program appears to have been successful (i.e., rare plants have received greater protection). Although trends continue to oscillate, most populations have increased. However there is a high likelihood of populations fluctuating after three years. A longer period of study might be required to reveal actual long-term trends in these populations (Given, 1994). Vigor data is even more inconclusive, with no trends apparent at all. This is probably due to several factors, such as small sample size, climatic fluctuations, and brief time period of data collection. Also because the standard deviation was so great for the vigor attributes examined, it would probably be better to display the attributes as totals rather than as an average per plant. Decreases were usually assignable to drought, but occasional abnormal habitat disturbances such as fiber optic cable placement contributed as well. However no decreases in either population numbers or vigor were directly attributable to TxDOT management. See Table 2 for discussion of specific trend information for each species. Part of the reason for population

increase might be the change in management activities as well as enhanced awareness on the part of the local TxDOT maintenance staff. For example the initial increase of the Callirhoe scabriuscula population was probably due to a shift in the mowing regime to after the plants had set fruit. However, most other sites benefitted from increased awareness on the part of TxDOT personnel as well as the local community. Many sites were saved from damage by concerned local citizens or TxDOT staff noting that road material piles were coming dangerously close to rare plants, or fiber optic cables being placed in highway right-of-way were trenching through endangered species habitat.

CONCLUSIONS

In the past, most damage to rare and endangered plants on highway right-of-way resulted from a lack of knowledge. If a manager is unaware that a species occurs on his property, he cannot knowingly protect it. However, once this information is gained, proactive management and planning can occur. This project established a good means of providing information to managers, and assuring them that they were part of the process. Occasional mistakes still happened due to personnel turnover, miscommunication, and rarely, intentional vandalism. However the overall benefit gained for the conservation of these rare species was much greater as the result of the information sharing among knowledgeable and concerned people.

Even more protection for these species could be accomplished by contacting the utility companies that have easements along the right-of-way as well as the adjacent private landowners. When all stakeholders in the habitat are made aware of these rare plants, the plants' prospects for long-term survival are more assured.

This project was a massive undertaking. The amount of time required to verify old locations, meet with TxDOT, formulate management agreements, set up monitoring plots, conduct annual monitoring, enter and analyze data, and write reports was too great for one or two staff members with many other projects to conduct. While this project is extremely worthwhile, it requires at least one person's full-time effort. While certain monitoring sites will continue to be visited for other purposes, the monitoring and management of rare and endangered plants on state highway right-of-way deserves to be funded.

ACKNOWLEDGEMENTS

Over the years of this project, more people than can be named, worked under less than idyllic conditions on the monitoring plots. We are greatly in their debt for helping with the data collection. We would also like to thank Rob Sutter and various other staff of

The Nature Conservancy for teaching us various techniques and skills as well as reviewing the initial plans. We also owe a great deal of thanks to the numerous personnel of the Texas Department of Transportation who met us at sites, explained their management practices, and became willing stewards of rare plants of the rights-of-way. In particular we would like to express our greatest appreciation to two TxDOT staff members, David Dunlap and Dennis Markwardt. David's encouragement advanced the task from a single protected right-of-way to a full-scale project. Dennis has been, and continues to be, a most dependable ally and liaison. His skill at negotiation has spared us many a disagreeable discussion, and his ability to get a group of maintenance foremen, bureaucrats, and conservation biologists to reach consensus is probably more responsible for the protection of these plants than all the rest of the work combined.

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Table 1. Monitored taxa with demographic and vigor methodology

Taxon (Legal Status*)	Demography	Vigor
<u>Ambrosia cheiranthifolia</u> (LE)	delineated plot, number of stems	number of stems
<u>Amsonia tharpil</u> (C2)	delineated plots, number of individuals, individuals identified	number of stems, number of flowers/fruits per plant
<u>Ancistrocactus tobuschii</u> (LE)	delineated plot, number of individuals	stem diameter, number of flowers/fruits per plant
<u>Asclepias prostrata</u> (C2)	generalized plots, number of individuals, individuals identified	number and length of stems per plant
<u>Aster puniceus</u> ssp. <u>elliottii</u> var. <u>scabrimcaulis</u> (C2)	delineated plots, number of individuals, large individuals tagged	height, number of primary stems and secondary stems, number of flowers per plant (only number of plants recorded after first year due to time restrictions)
<u>Callirhoe scabriuscula</u> (LE)	delineated plots, number of individuals	number of buds, flowers, and fruits per plant

<u>Coryphantha albicolumnaria</u> (C2)	tagged individuals	height, reproductive condition
<u>Coryphantha hesteri</u> (C2)	delineated plot, number of individuals, individuals identified	stem diameter
<u>Coryphantha minima</u> (LE)	delineated plot, number of individuals, individuals identified	stem diameter
<u>Echinocereus lloydii</u> (LE)	delineated plots, number of individuals	stem height and diameter, number of stems and flowers per plant
<u>Echinocereus viridiflorus</u> var. <u>davisii</u> (LE)	delineated plot, number of individuals, individuals identified	number of buds/flowers
<u>Frankenia johnstonii</u> (LE)	generalized plot, number of individuals	diameter, height, and number of flowers/fruits per plant
<u>Genistidium dumosum</u> (C2)	tagged individuals	height, width, reproductive state
<u>Helianthus paradoxus</u> (C1)	delineated plots, number of individuals	number of individuals

<u>Hibiscus dasycalyx</u> (C1)	tagged individuals	height, number of stems, number of flowers/fruits per individual
<u>Hoffmannseggia tenella</u> (LE)	delineated plot, number of individuals, density	number of individuals
<u>Lesquerella thamnophila</u> (C1)	generalized plot, number of individuals	number and length of stems per plant, reproductive state
<u>Nolina arenicola</u> (C2)	tagged individuals	height, diameter, number of inflorescences
<u>Paronychia wilkinsonii</u> (C2)	delineated plot, number of individuals, individuals identified	areal cover (height X width)
<u>Pediomelum humile</u> (C2)	generalized plot, number of individuals	number of leaves and flowers clusters per plant
<u>Salvia penstemonoides</u> (C2)	generally sited plots, number of individuals	number of primary and secondary stems, number of flowers/fruits per individual

<u>Spiranthes parksii</u> (LE)	delineated plot number of individuals	height, number of flowers per plant
<u>Thelocactus bicolor</u> var. <u>flavidispinus</u> (C2)	delineated plot, number of individuals, individuals identified	plant diameter
<u>Thymophylla tephroleuca</u> (LE)	delineated plot, number of individuals, individuals identified	diameter, height, and number of flowers per plant
<u>Tillandsia baileyi</u> (C2)	delineated plots, number of individuals	number of individuals per size class, number of flowering individuals
<u>Zizania texana</u> (LE)	delineated plot, number of individuals, individuals identified	areal cover

- * LE - listed as federally and state endangered
- C1 - federal candidate category 1 taxon with enough information available to propose for listing
- C2 - federal candidate category 2 taxon under current review for possible listing as either endangered or threatened, but U.S. Fish and Wildlife Service is in need of more information

APPENDIX

MANAGEMENT AND MONITORING AGREEMENTS FOR TEXAS DEPARTMENT OF TRANSPORTATION RIGHTS-OF-WAY

COUNTY	SITE NAME	SPECIES OF CONCERN
Anderson County	Palestine	<u>Aster puniceus</u> var. <u>scabrimaculis</u>
Brazos County	Edge	<u>Spiranthes parksii</u>
Brewster County	38 Hill	<u>Coryphantha albicolumnaria</u> <u>Genistidium dumosum</u>
	Marathon	<u>Coryphantha hesteri</u> <u>Coryphantha minima</u> <u>Echinocereus viridiflorus</u> var. <u>davisii</u> <u>Paronychia wilkinsonii</u> <u>Thelocactus bicolor</u> var. <u>flavidispinus</u>
Cherokee County	Ponta	<u>Hibiscus dasycalyx</u>
Culberson County	Van Horn	<u>Nolina arenicola</u>
Hays County	San Marcos	<u>Zizania texana</u>
Houston County	Lovelady	<u>Hibiscus dasycalyx</u>
Kendall County	Frederick Creek	<u>Salvia penstemonoides</u>
Kenedy County	Sarita	<u>Tillandsia baileyi</u>
Kinney County	Brackettville	<u>Ancistrocactus tobuschii</u>
Kleberg County	Bishop/Carreta Creek	<u>Hoffmannseggia tenella</u> <u>Ambrosia cheiranthifolia</u>
Pecos County	Saddle Butte	<u>Amsonia tharpii</u>
	Fort Stockton	<u>Echinocereus lloydii</u>
	Diamond Y	<u>Helianthus paradoxus</u>
Runnels County	Ballinger	<u>Callirhoe scabriuscula</u>
	Maverick	<u>Callirhoe scabriuscula</u>
Starr County	Roma	<u>Asclepias prostrata</u>
Trinity County	Neches River	<u>Hibiscus dasycalyx</u>
Val Verde County	Del Rio	<u>Pedimelum humile</u>
Van Zandt County	Ben Wheeler	<u>Aster puniceus</u> var. <u>scabrimaculis</u>
Wood County	Lake Lydia	<u>Aster puniceus</u> var. <u>scabrimaculis</u>
Zapata County	Dolores	<u>Asclepias prostrata</u> <u>Thymophylla tephroleuca</u>
	Lopeño	<u>Asclepias prostrata</u> <u>Lesquerella thamnophila</u>
	Zapata	<u>Frankenia johnstonii</u>

Table 2. Annual monitoring data for rare and endangered plants on state highway right-of-way

<i>Ambrosia cheiranthifolia</i> (Kleberg Co.) - The reason for the large increase in number of stems may be due to deferred mowing. With only two years of data, no strict conclusions should be drawn.									
	# of stems								
1993	1737								
1994	4201								
<i>Amsonia tharpii</i> (Pecos Co.) - The number of individuals at this site has remained stable. The decrease in the average number of stems and reproductive structures per plant in 1993 and 1994 was probably the result of drought. This species appears to delay flowering if adequate moisture is not present.									
	# of plants	Average # of stems/plant			Average # of flowers &/or fruits/plant				
1992	50	13.5 +-20.9			8.6 +-16.5				
1993	48	9.7 +-16.1			0.4 +-1.8				
1994	52	10.7 +-18.6			3.3 +-7.7				
1995	51	11.2 +-16.9			14.7 +-21.8				
<i>Ancistrocactus tobuschii</i> (Kinney Co.) - Although the number of individuals in this population has remained stable, the number of flowers and/or fruits has fluctuated. The average diameter decreased in 1994 due to the addition of a small seedling to the population. The reason for the drastic drop in flower and fruit number between 1992 and 1993 is not known.									
	# of plants	Average diameter in cm			Average number of flowers &/or fruits/plant				
1992	2	4.5 +-0.7			7.5 +-3.5				
1993	2	4.5 +-0.7			0.5 +-0.7				
1994	3	2.83 +-1.6			3.3 +-4.9				
1995	2	3 +-2.8			2.5 +-3.5				
<i>Asclepias prostrata</i> (Starr Co.) - Although the number of plants did increase in 1992, this population has since declined. This site is at the edge of the growing city of Roma, and the plants are subject to being runover by vehicles. Although the average number of stems per plant decreased in 1992, it has since stabilized. Stem length has fluctuated greatly, but dramatic decreases, such as 1995, are probably due to drought.									
	# of plants	Average # of stems/plant			Average stem length in cm				
1991	11	6.2 +-4.3			11.3 +-5.7				
1992	15	4.6 +-4.3			6.1 +-12.1				
1993	12	5.2 +-4.2			9.5 +-6.6				
1994	12	5.0 +-4.2			14 +-8				
1995	7	5.1 +-3.5			3.9 +-3.1				

Table 2. Annual monitoring data for rare and endangered plants on state highway right-of-way

<i>Asclepias prostrata</i> (Dolores, Zapata Co.) - Although there has been some fluctuation in the number of individuals								
at this site, numbers of individuals have increased over the last two years. This may have been due to the								
drought which opened additional habitat for colonization. However the drought was probably also								
responsible for the decrease in stem length in 1994 and 1995. Estimation of percent cover was dropped, as								
the process was too time consuming.								
	# of plants	Average # of stems/plant		Average stem length in cm		% cover per square meter		
1991	54	3.1 + -2.4		10.6 + -5.3		0.33		
1992	61	3.2 + -2.9		12.2 + -6.2		0.13		
1993	38	4.5 + -3.7		13.2 + -9.2		0.33		
1994	92	4.2 + -3.0		7.9 + -5.2		0.36		
1995	97	3.4 + -2.2		5.4 + -3.7		no data		
<i>Asclepias prostrata</i> (Tigre Chiquito, Zapata Co.) - A locally severe drought in the spring of 1992 probably caused the								
disappearance of all plants. However the population has increased even though a fiber optic cable was								
buried at this site after the 1994 monitoring. The disturbance may have offered additional habitat for								
colonization while depressing the number of stems per plant. The decrease in the number of stems and								
individuals in 1995 may also be due to drought.								
	# of plants	Average # of stems/plant		Average stem length in cm				
1991	6	5.5 + -4.2		13.8 + -6.7				
1992	0	0		0				
1993	6	2.3 + -1.3		6.6 + -3.9				
1994	11	4.1 + -2.2		8.6 + -5.5				
1995	9	2.4 + -1.4		8.1 + -8.8				
<i>Aster puniceus</i> var. <i>scabicaulis</i> (Anderson Co.) - The number of individuals has increased at this site due to the								
delayed mowing schedule. Collection of vigor data was dropped as it was too time consuming. The cause								
of the decreases in the height, number of primary stems, and average number of flowers is unknown.								
However the averages are offset by the increasing number of individuals. Data was collected for this site in								
October 1995 for another project. It is reported here even though the highway right-of-way project had								
officially ended.								
	# of plants	Average height in m		Average # of primary stems/plant		Average # of flowers/plant		
1991	16	1.4 + -0.3		5.8 + -3.9		201		
1992	17	0.6 + -0.0		1.47 + -0.3		22		
1993	128	0.7 + -0.3		1.0 + -0.0		12		
1994	111	no data		no data		no data		
1995	268	no data		no data		no data		

Table 2. Annual monitoring data for rare and endangered plants on state highway right-of-way

[illegible]

Table 2. Annual monitoring data for rare and endangered plants on state highway right-of-way

<i>Callirhoe scabriuscula</i> (Maverick, Runnels Co.) - Plants have disappeared at this site probably due to loss of habitat									
from growth of woody species. Also illegal sand removal on the highway right-of-way destroys habitat and									
plants.									
	# of plants	Average # of flowers/plant			Average # of buds/plant			Average # of fruits/plant	
1991	28		6			39		9.2 + -8.1	
1992	14		1			1		1.2 + -2.2	
1993	1		1			0		8	
1994	1		3			4		0	
1995	0		0			0		0	
<i>Coryphantha albicolumnaria</i> (Brewster Co.) - This population has remained stable with respect to number of									
individuals. The fluctuations in the number of reproductive plants may be due to dry years.									
	# of plants	# of reproductive plants			Average plant height in cm				
1991	23		8			7.8 + -3.6			
1992	no data		no data			no data			
1993	23		10			9.5 + -3.6			
1994	22		4			8.6 + -3.7			
<i>Coryphantha hesteri</i> (Brewster Co.) - The number of plants may have increased at this site possibly either through our									
increased ability to recognize them, or fewer collectors taking plants due to increased surveillance.									
	# of plants	Average diameter in cm							
1991	2		1.5 + -0.7						
1992	5		2.1 + -0.7						
1993	1		3						
1994	18		2.0 + -0.6						
1995	25		1.9 + -1.0						
<i>Coryphantha minima</i> (Brewster Co.) - This plant was not seen prior to 1992. Its disappearance by 1994 was probably									
due to collection.									
	# of plants	Average diameter in cm							
1992	1		1						
1993	1		1.2						
1994	0		0						
1995	0		0						

Table 2. Annual monitoring data for rare and endangered plants on state highway right-of-way

<i>Echinocereus lloydii</i> (Pecos Co.) - This population has basically remained stable. The discovery of smaller plants with fewer smaller stems may be the cause of the depressed averages for height, stem diameter, and stem number. Drought may have caused the dramatic drop in reproductive output in 1995.									
	# of plants	Average height in cm		Aver. st. diam. (cm)		Aver. # of stems/plant		Aver. # of fls. &/or frs./plant	
1992	19	19.3 + -9.3		6.5 + -1.7		3.5 + -4.2		1.9 + -3.9	
1993	20	17.7 + -8.7		5.9 + -1.5		2.6 + -4.6		3.2 + -8.6	
1994	22	14.4 + -8.7		4.8 + -1.8		3.0 + -4.4		3.8 + -10.3	
1995	20	14.1 + -7.1		5.5 + -1.7		3.2 + -4.7		0.5 + -0.8	
<i>Echinocereus viridiflorus</i> var. <i>davisii</i> (Brewster Co.) - The overall increase in this population may either result from increased skill in locating the plants, or avoidance of the site by collectors due to increased surveillance. Fluctuation in number of flowers is related to climatic conditions.									
	# of plants	Average # of flowers/plant							
1991	43	1.5 + -0.9							
1992	59	1.0 + -0.8							
1993	49	2.0 + -1.1							
1994	70	1.2 + -0.9							
1995	79	1.0 + -0.8							
<i>Frankenia johnstonii</i> (Zapata Co.) - With only two years of data, trends are not apparent. Number of flowers increased in 1995 due to increased rainfall.									
	# of plants	Average diameter in cm		Average height in cm		Average # of flowers/fruits/plant			
1994	36	16.8 + -17.1		17.5 + -10.2		8.4 + -20.9			
1995	36	16.9 + -17.5		16.1 + -8.7		11.6 + -43.6			
<i>Genistidium dumosum</i> (Brewster Co.) - The number of plants increased slightly due to finding more plants. The number of reproductive plants decreased due to drought at the times of monitoring.									
	# of plants	# of reproductive plants		Height in m		Width in m			
1991	16	9		0.8 + -0.2		1.1 + -1.0			
1992	no data	no data		no data		no data			
1993	18	6		0.8 + -0.2		1.2 + -0.7			
1994	18	1		0.8 + -0.2		1.1 + -0.6			

Table 2. Annual monitoring data for rare and endangered plants on state highway right-of-way

<i>Helianthus paradoxus</i> (Pecos Co.) - The drop in number of individuals in 1992 was the result of a fiber optic cable									
being put through the site. The large increase in number of individuals in 1994 was due to a large number of									
small, single-stemmed plants. Such plants do not always appear every year. The reason for this is not									
known.									
	# of plants								
1991	545								
1992	225								
1993	308								
1994	3388								
<i>Hibiscus dasycalyx</i> (Cherokee Co.) - A hybrid swarm of this species and another <i>Hibiscus</i> species occurs at									
this site. Due to the difficulty of recognizing pure <i>H. dasycalyx</i> within this swarm, only one large individual									
some distance from the swarm is monitored. The reason for the decrease in number of flowers in 1994 is									
unknown.									
	# of plants	Height in m		# of stems		# of flowers &/or fruits			
1993	1	2.5		5		183			
1994	1	2.5		6		55			
1995	1	2.6		4		100			
<i>Hibiscus dasycalyx</i> (Houston Co.) - The dramatic decrease in number of plants, stems, flowers, and fruits was									
due to herbicide spraying of the adjacent pasture by the landowner.									
	# of plants	Average height in m		Average # of stems/plant		Average # of flowers &/or fruits/plant			
1993	4	2.3 ± 0.6		10.8 ± 6.8		112.2 ± 90.3			
1994	4	2.1 ± 0.2		18.2 ± 10.1		56 ± 70.9			
1995	1	1.6		5		3			
<i>Hibiscus dasycalyx</i> (Trinity Co.) - This population has increased although it is possible that some of the individuals									
may be introgressed with another species. The decrease in the average number of flowers per plant									
was due to the addition of many juvenile plants to the population.									
	# of plants	Average height in m		Average # of stems/plant		Average # of flowers &/or fruits/plant			
1993	27	1.2 ± 0.4		2.9 ± 2.6		16.0 ± 14.8			
1994	38	1.4 ± 0.4		4.5 ± 4.5		1.6 ± 4.8			
1995	41	1.3 ± 0.4		3.4 ± 3.0		3.2 ± 5.7			

Table 2. Annual monitoring data for rare and endangered plants on state highway right-of-way

<i>Hoffmannseggia tenella</i> (Kleberg Co.) - The reasons for the increases is unknown.									
	# of plants	Average # of plants/sq. m							
1993	523		4.4 +-8.1						
1994	903		7.3 +-16.0						
<i>Lesquerella thamnophila</i> (Zapata Co.) - The main reasons for the decline of this population are drought and competition from buffelgrass. Also a load of compost-like material was dumped very near the plants in 1992, and may have affected them.									
	# of reproductive plants			# of non-reproductive plants					
1991		10			3				
1992		0			0				
1993		0			7				
1994		1			0				
1995		0			3				
<i>Nolina arenicola</i> (Culberson Co.) - Twenty-five plants were selected on the north and south sides of I-10. Between the 1993 and 1994 monitoring sessions, a fire burned the southern plot. The fire is the cause of the decrease in the average number of inflorescences per plant in the southern plot in 1994 and 1995. The reason for the decline in the average number of inflorescences per plant in the northern plant is unknown.									
	# of plants	Average height in m		Average diameter in m		Average # of inflorescences/plant			
1993North	25		1.6 +-0.3		3.0 +-1.0		2.8 +-4.4		
1994North	25		1.5 +-0.4		2.8 +-1.0		0.4 +-0.8		
1995North	25		1.6 +-0.3		3.0 +-1.0		0.4 +-1.2		
1993South	23		1.2 +-0.4		2.1 +-0.7		3.6 +-5.9		
1994South	25		1.2 +-0.3		1.9 +-0.6		0		
1995South	25		1.2 +-0.3		2.2 +-0.6		0.6 +-2.6		
<i>Paronychia wilkinsonii</i> (Brewster Co.) - The average areal coverage decreased as smaller recruits were added to the population.									
	# of plants	Average areal cover in cm							
1991	32		53.8 +-39.6						
1992	37		60.8 +-43.3						
1993	46		36.9 +-29.3						
1994	63		29.9 +-25.5						
1995	74		21.4 +-20.4						

Table 2. Annual monitoring data for rare and endangered plants on state highway right-of-way

<i>Pediomelum humile</i> (Val Verde Co.) - The population increased due to wet conditions.									
	# of plants	Average # of leaves/plant			Average # of flower clusters/plant				
1993	17		2.5 +-1.5			0			
1994	77		4.7 +-2.4			0			
1995	81		4.8 +-2.2			0.3 +-0.8			
<i>Salvia penstemonoides</i> (Kendall Co.) - The reason for the increase in the number of flowering plants in 1992 is									
unknown. This site is heavily impacted by plant collectors which might be a cause of the decreases in									
number of rosettes. Fluctuations in primary and secondary stem numbers as well as number of flowers may									
be attributable to climatic conditions. The average number of flowers per plant was obtained from randomly									
selected plants in 10% of the population.									
				1991	1992	1993	1994	1995	
Total # of flowering plants				105	258	125	112	130	
Total # of non-flowering plants				359	318	51	115	85	
Total # of primary stems				329	298	263	156	276	
Average # of primary stems/plant			3.1 +-2.9	1.2 +-0.7	2.1 +-1.9	1.4 +-1.7	2.1 +-2.4		
Total # of secondary stems			453	592	616	238	527		
Average # of secondary stems/plant			4.3 +-6.7	2.3 +-2.9	4.9 +-4.6	2.1 +-3.0	4.1 +-5.9		
Average # of flowers/plant			207.1 +-293	127.5 +-127	193.3 +-161	112 +-125.5	119.1 +-127		
<i>Spiranthes parksii</i> (Brazos Co.) - The reason for the complete disappearance of the population from the right-of-way is									
not known, but other populations in the area were also reduced in number, perhaps due to dry conditions.									
	# of plants	Average height in cm			Average # of flowers/plant				
1993	18		23.7 +-6.2			16.5 +-8.4			
1994	0		0			0			
<i>Thymophylla tephroleuca</i> (Zapata Co.) - This population suffered a steady decline due to drought. Also plants closer									
to the pavement were runover frequently. Average number of flowers per plant increased in 1994 due to an									
earlier rainfall event.									
	# of plants	Average diameter in cm			Average height in cm			Average # of flowers/plant	
1991	35		35.9 +-18.8			no data		96.3 +-60.2	
1992	38		17.7 +-6.7			18.6 +-3.5		23.0 +-18.7	
1993	10		19.2 +-9.5			16.1 +-4.9		20.4 +-18.2	
1994	14		19.4 +-9.8			12.3 +-2.6		32.1 +-36.3	
1995	11		15.0 +-7.0			10.4 +-2.4		5.3 +-6.7	

Table 2. Annual monitoring data for rare and endangered plants on state highway right-of-way

<i>Thelocactus bicolor</i> var. <i>flavidispinus</i> (Brewster Co.) - The increase in number of individuals may be due to									
increased surveillance at this site. Fluctuation in stem diameter was due to loss of larger individuals and the									
recruitment of smaller individuals.									
	# of plants	Average stem diameter in cm							
1991	5	2.48 + -1.37							
1992	7	3.48 + -1.53							
1993	7	2.47 + -0.96							
1994	9	2.9 + -1.3							
1995	14	3.08 + -1.02							
<i>Tillandsia baileyi</i> (Kenedy Co.) - Plants were placed in subjective size classes as the actual measurement of these									
epiphytic plants would have been extremely difficult. The slight increase in number of plants was probably									
due to better trained observers. The smaller size classes decreased as the larger size classes increased.									
The reason for the decrease in the number of flowering plants is unknown.									
		1993	1994						
# of trees occupied		52	69						
Total # of plants		240	256						
# of flowering plants		24	14						
# of very small plants		36	20						
# of small plants		100	85						
# of medium plants		72	92						
# of large plants		32	59						
<i>Zizania texana</i> (Hays Co.) - Although the areal coverage of the monitored wild-rice stands fluctuated, it has decreased									
for the last three years. Recreation is high at one of these stands, and may be responsible for its decrease									
in size.									
Total areal coverage (sq. m) of wild-rice within the vicinity of I-35									
1989			194.51						
1990			207.23						
1991			197.52						
1992			220.23						
1993			321.49						
1994			210.59						
1995			164.78						

**Management Agreement between
Texas Department of Transportation
and Texas Parks and Wildlife Department**

LOCATION AND DESCRIPTION OF MANAGEMENT AREA: Anderson County - west side of Highway 315, 3.3 miles north of the intersection of FM 3309 and Highway 315 (see attached map). The management area consists of marshy area at the edge of a beaver pond on the west side of the road, and is delineated by County Road 358 on the north and a utility pole on the southwest right-of-way.

MANAGEMENT TECHNIQUES CURRENTLY EMPLOYED:

Mowing: Full width once a year (in early fall) and one mower width several times a year as needed.

Herbicides: Used on delineator posts, object markers, around culverts, and pavement edge.

Seeding: None.

Future plans: No changes anticipated.

SPECIES OF CONCERN: Rough-stemmed aster (Aster puniceus ssp. elliottii var. scabrimaculis) - This category 1 species is a tall (to 10 feet), much-branched perennial herb with numerous, lavender, daisy-like flowers. The stems are covered with small, rough hairs. The lower leaves clasp the stem, and extend beyond the stem like small ears. The tips of the green involucral bracts immediately below the flower bend away from the head. The ray florets ("petals") are lavender in contrast to the yellow disk florets ("center"). Rough-stemmed aster flowers in September-November.

Rough-stemmed aster occurs in saturated soils at the margins of open ponds, marshes, and small lakes. The species grows in full sun, with wax myrtle, eastern baccharis, sweetgum, and black willow. Rough-stemmed aster is threatened by habitat conversion (removal and replacement of all native vegetation with Bermuda grass), pond drainage, and development.

This population represents one of three populations along highway right-of-way, and one of six populations known in the world. Altered management of this species on highway right-of-way should lead to an increase in numbers. Monitoring will help determine longevity of marked individuals and response to different management regimes.

RECOMMENDED MANAGEMENT PROCEDURES: Delineator posts should be used to indicate the site so as mowers can avoid this area. Outside the area mowing can be conducted as necessary. If required, herbicides should be applied by hand. No other species should be planted or seeded in the area. Any proposed disturbance of the right-of-way by other entities (i.e., utilities, local/state/federal agencies, etc.) should be reviewed by TxDOT and TPWD. If any change in management procedure is anticipated, the Texas Natural Heritage Program

of the Texas Parks and Wildlife Department should be notified before changes are implemented.

MONITORING PROCEDURES: A count will be made of all individuals of rough-stemmed aster within the highway right-of-way. The number of primary and secondary branches as well as the total number of flowers will be counted for each individual as a method of tracking vigor. Exceptionally large plants will be marked basally with numbered aluminum tags to track their longevity and vigor through time. Monitoring will continue on a yearly basis in mid-fall. Monitoring will be conducted by staff of the Endangered Resources Branch, Texas Parks and Wildlife Department.

RED FLAG CONDITIONS: A 10% decrease in the number of individuals of rough-stemmed aster will be considered a significant decline in the population. Also over any consecutive three-year period, a 10% decline in the number of flowers of the population will be considered a significant reduction in vigor. If such conditions occur, the cause will be ascertained. If the cause is related to management, management recommendations may be altered.

LOCATION OF ARCHIVED DATA: Texas Natural Heritage Program, Texas Parks and Wildlife Department, 4200 Smith School Road, Austin, Texas 78744; and Texas Department of Transportation, 125 E. 11th, Austin, Texas 78701.

WRITTEN BY: Jackie M. Poole, Texas Natural Heritage Program, Resource Protection Division, Texas Parks and Wildlife Department, 4200 Smith School Road, Austin, Texas 78744

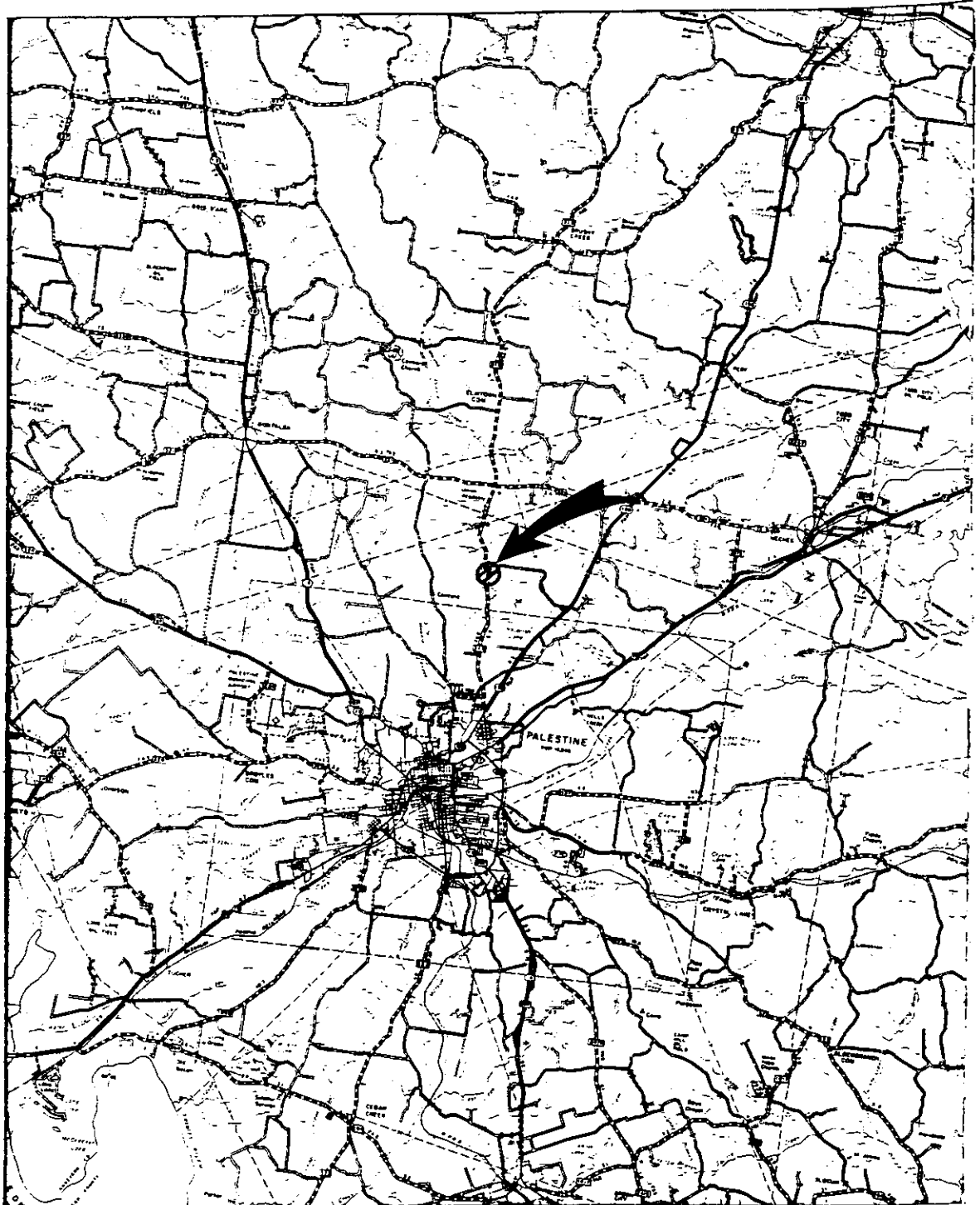
DATE WRITTEN: November 8, 1993

REVIEWED BY: Dennis Markwardt and David Dunlap

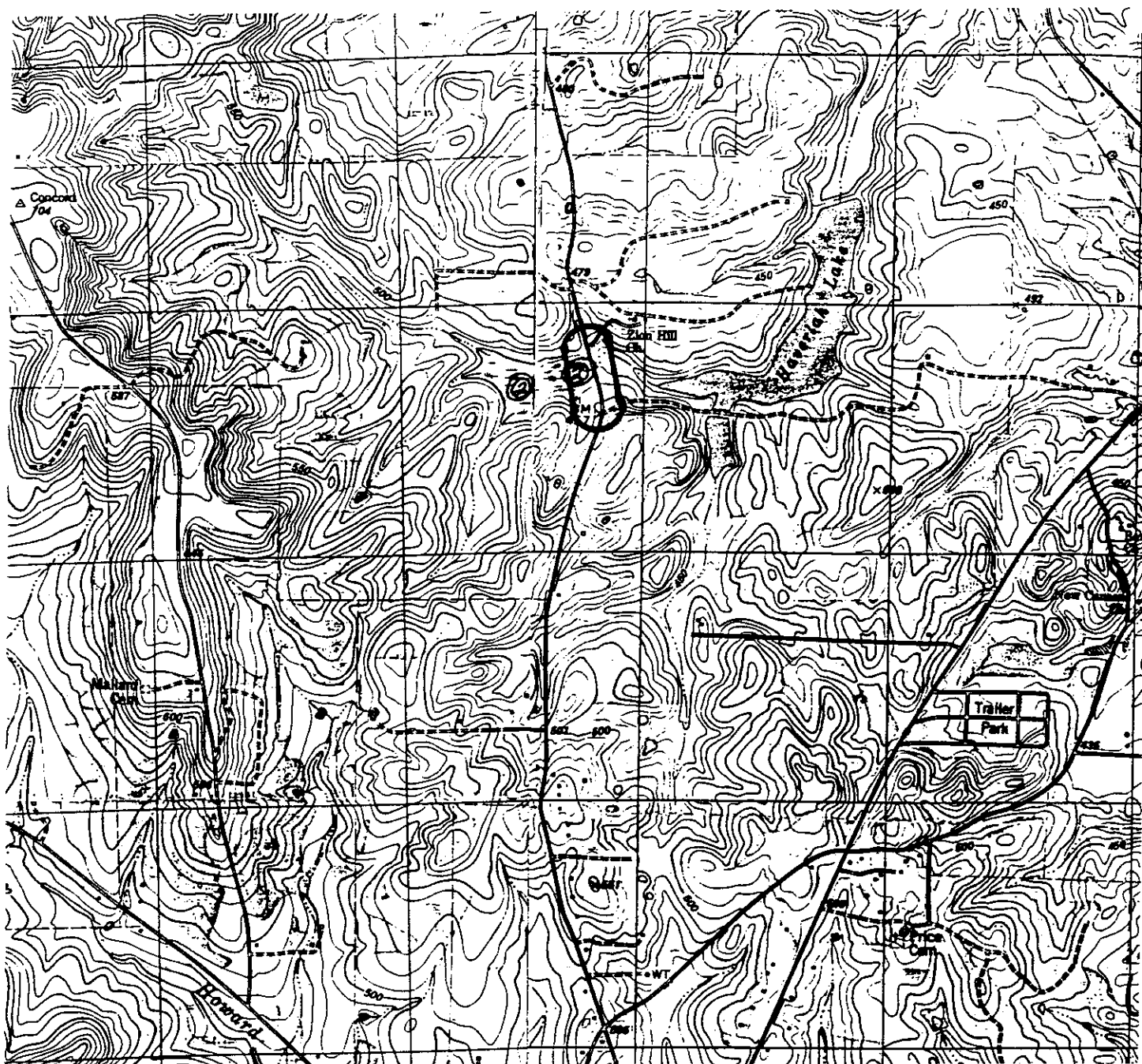
DATE REVIEWED: fall 1993

REVISED BY AND DATE: Jackie M. Poole; 30 December 1993

APPROVED BY AND DATE:



Management Area for rough-stemmed aster
Anderson County - west side of Highway 315, 3.3 miles north
of the intersection of FM 3309 and Highway 315



Northeast and Northwest Palestine 7.5' USGS Quadrangles

Location of rough-stemmed aster (*Aster puniceus* spp. *elliotti* var. *scabricaulis*) monitoring/management area located in Anderson County, north of Palestine, on Highway 315.

**Management Agreement between
Texas Department of Transportation
and Texas Parks and Wildlife Department**

LOCATION AND DESCRIPTION OF MANAGEMENT AREA: Brazos County - 2.0-2.4 miles northwest of the intersection of Highway 21 and FM 974 on the south side of FM 974 (see attached map). The management area consists of the edge of a post oak woodland and a small intermittent drainage.

MANAGEMENT TECHNIQUES CURRENTLY EMPLOYED:

Mowing: The management area is currently not mowed.

Herbicides: Used on pavement edge.

Seeding: None.

Future plans: No changes anticipated.

Other: This area is marked with delineator posts.

SPECIES OF CONCERN: Navasota ladies'-tresses (*Spiranthes parksii*) is an erect perennial herb to 15 inches tall. The leaves are clustered at ground level, and are usually gone by flowering time. The small, cream-colored flowers form a loose spiral up the stem. The side petals have a green central stripe. The bracts immediately below the flowers have pointed, white tips. The federal and state endangered Navasota ladies'-tresses blooms only for a brief period at the end of October and beginning of November. Recognition of the species in non-flowering condition is almost impossible.

Navasota ladies'-tresses occurs at the margins of post oak woodlands in sandy loams along intermittent tributaries of the Brazos and Navasota Rivers. The species is threatened primarily by urban development and strip mining.

This population of Navasota ladies'-tresses is the only large population on highway right-of-way. There are few, easily accessible populations on public land. Monitoring will aid in determining individual longevity and life cycle.

RECOMMENDED MANAGEMENT PROCEDURES: Although the management area has not been mowed since the site was delineated, shrubs may eventually encroach on the area. Because the topography of the site, mowers cannot be used. If shrub removal becomes necessary, it should be done by hand clearing. If necessary herbicides applied to the pavement edge, markers, etc. should be sparingly and carefully applied at times of little or no wind. No paving or construction materials should be stockpiled or removed in this area. No other species should be planted or seeded. Any proposed disturbance of the right-of-way by other entities (i.e., utilities, local/state/federal agencies, etc.) should be reviewed by TxDOT and TPWD. If any change in management procedure is anticipated, the Texas Natural Heritage Program of the Texas Parks and Wildlife Department should be notified before changes are implemented.

MONITORING PROCEDURES: All individuals of Navasota ladies'-tresses will be counted within permanent plots. The height and the numbers of flowers/fruits of each plant will be recorded. This data will be used to track viability. Monitoring will continue on a yearly basis during flowering season, and will be conducted by staff of the Endangered Resources Branch, Texas Parks and Wildlife Department.

RED FLAG CONDITIONS: Over any consecutive three-year period, a 10% decline in the height or numbers of flowers/fruits will be considered a significant reduction of vigor. If such conditions occur, the cause will be ascertained. If the cause is related to management, management recommendations may be altered.

LOCATION OF ARCHIVED DATA: Texas Natural Heritage Program, Texas Parks and Wildlife Department, 4200 Smith School Road, Austin, Texas 78744; and Texas Department of Transportation, Division of Environmental Affairs, 125 E. 11th, Austin, Texas 78701.

WRITTEN BY: Jackie M. Poole, Texas Natural Heritage Program, Resource Protection Division, Texas Parks and Wildlife Department, 4200 Smith School Road, Austin, Texas 78744

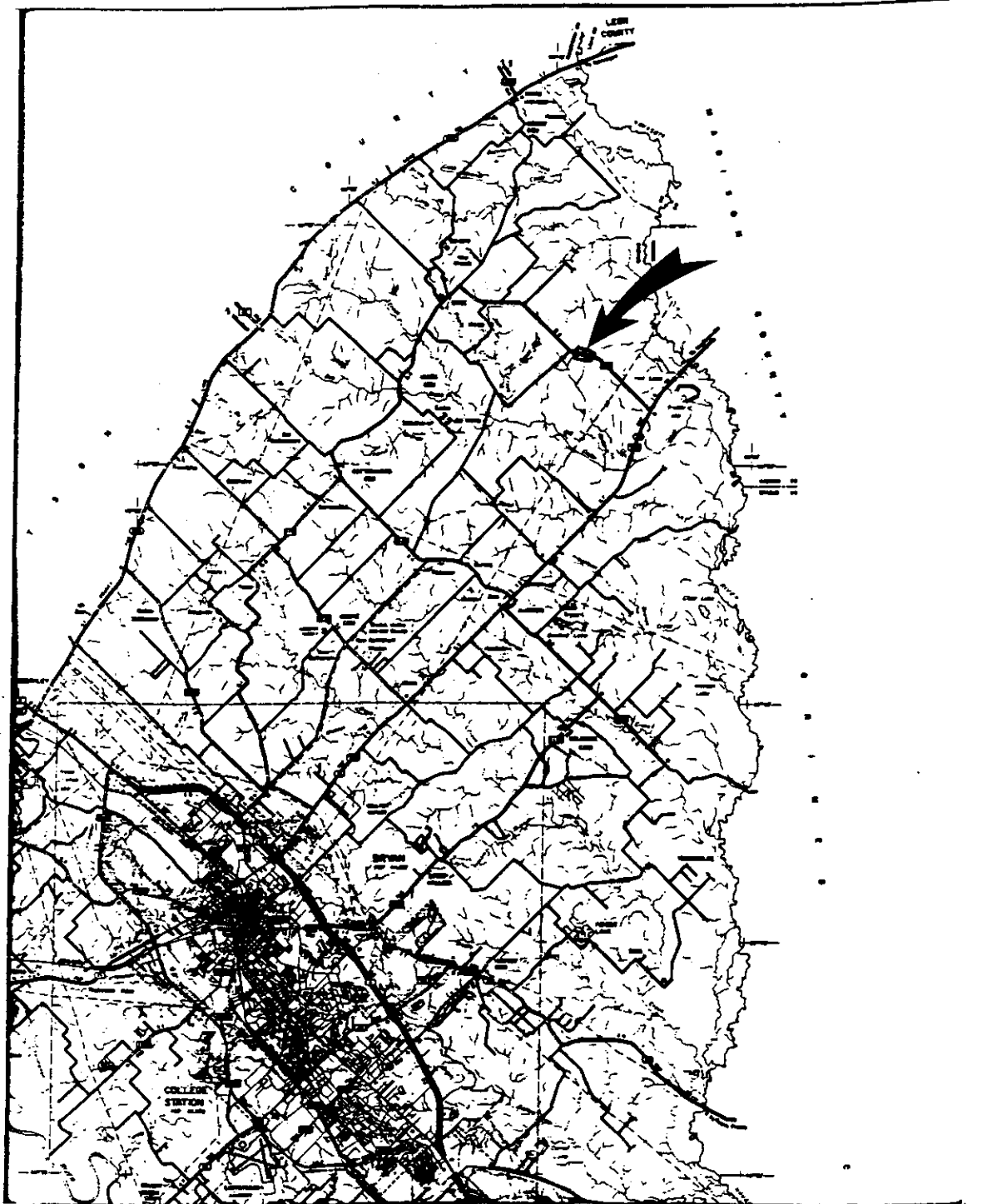
DATE WRITTEN: August 18, 1993

REVIEWED BY: Dennis Markwardt, David Dunlap, and Lonny Traweek

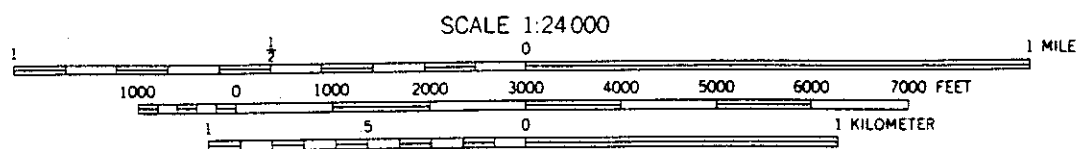
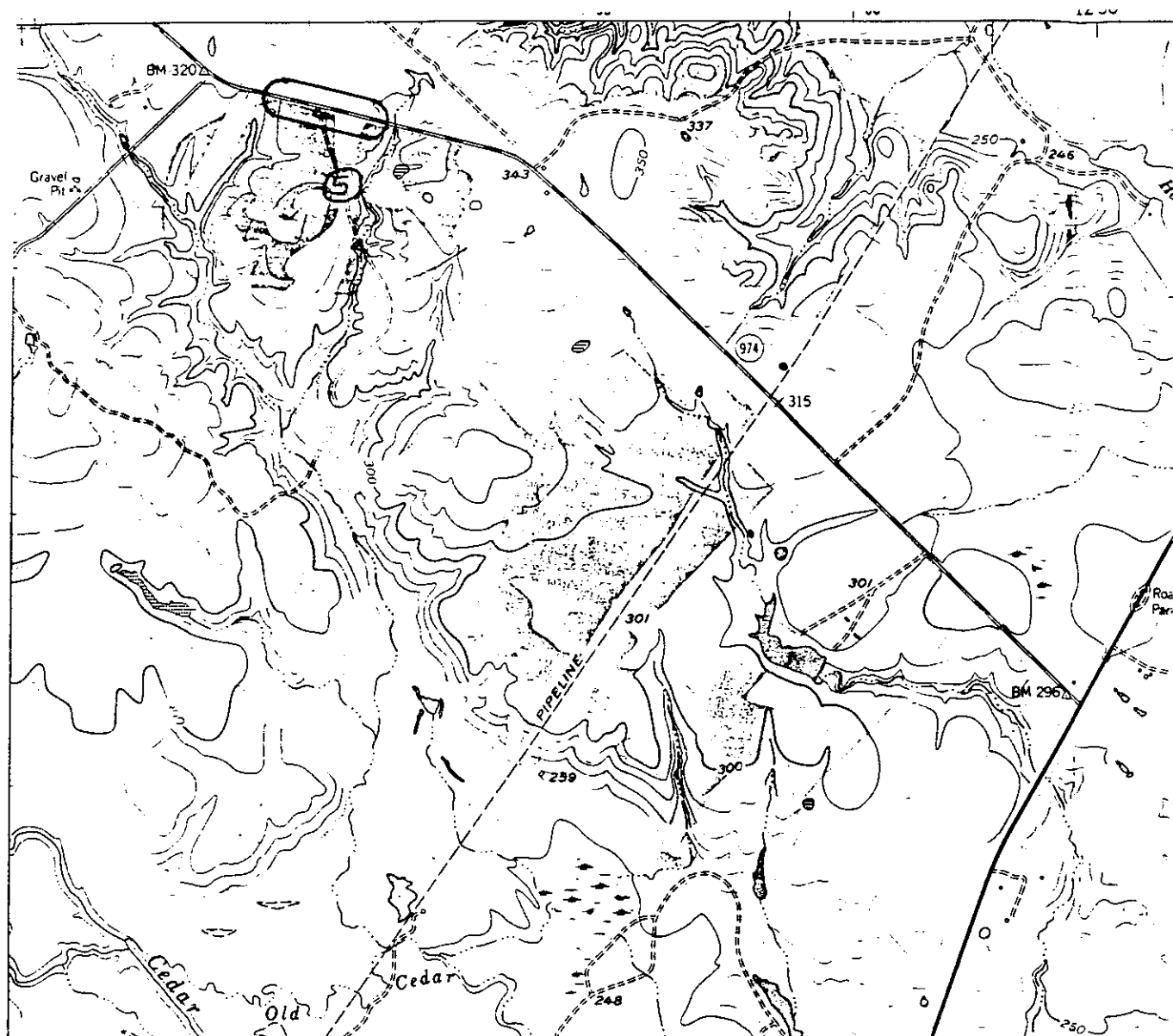
DATE REVIEWED: Fall 1993

REVISED BY AND DATE: Jackie M. Poole, 30 December 1993

APPROVED BY AND DATE:



Management Area for Navasota ladies'-tresses
Brazos County - south side of FM 974,
2.0-2.4 miles northwest of the junction of FM 974 and Hwy 21



Edge 7.5' USGS Quadrangle

Location of Navasota ladies'-tresses (*Spiranthes parksii*) monitoring/management area in Brazos County, southeast of Edge, on Highway 974.

**Management Agreement between
Texas Department of Transportation
and Texas Parks and Wildlife Department**

LOCATION AND DESCRIPTION OF MANAGEMENT AREA: Brewster County - 7.8 miles west of the junction of Highways 118 and 170, and 9.0 miles east of Lajitas, on south side of Highway 170 (see attached maps). The site is bounded on the north by a steep vertical cut through a mixture of limestone formations. The site slopes sharply upward to the east. Sparse vegetation is scattered among the angular white limestone fragments.

MANAGEMENT TECHNIQUES CURRENTLY EMPLOYED:

Mowing: None.

Herbicides: Used on delineator posts, object markers, and signs but does not effect species of concern.

Seeding: None.

Future plans: None anticipated.

SPECIES OF CONCERN:

White column cactus (Coryphantha albicolumnaria) - This small cylindrical cactus is presently assigned a Category 1 status (awaiting listing as endangered or threatened) by the U. S. Fish and Wildlife Service. The single stem is covered with numerous white, straight spines. The flowers are borne at the tip of the stem, and are pale rose pink to bright magenta. The fruits are club-shaped and pale green tinted with yellow or red, or dull pinkish red in color. Identification is easiest when the plant is in flower or fruit.

White column cactus is known from several populations in Brewster, Pecos, and Presidio Counties. The species is primarily threatened by commercial collection for the cactus trade.

The population on highway right-of-way represents one of the few populations which have been recently verified as being on public lands. It is the only population currently being monitored. Through monitoring we will be able to detect the amount and impact of illegal collecting occurring on the highway right-of-way.

Brush pea (Genistidium dumosum) - This sprawling wiry stemmed bush is listed as Category 2 (awaiting study to determine if listing is needed) by the U. S. Fish and Wildlife Service. Numerous slender rigid branches arise from the plant's base and display a few leaves (usually divided into three parts) near the actively growing tips. Flowers are also few. They are yellow and resemble small pea flowers. The fruit looks like a small pea pod, and contains 4-6 small, rounded, flattened seeds.

The brush pea is known from four populations. One is somewhat disjunct in the mountains of Coahuila, Mexico while the other three are within a mile of each other. Major threats to the species include low reproductive rate (high mortality of flowers and fruits due to desiccation and insect predation), skewed age class structure (all individuals appear to be fully mature or senescent, no seedlings or juvenile plants have been observed), and low numbers of individuals and populations (vulnerable to extinction through chance events such as natural disasters, pests or disease, or inbreeding depression). Also five of the 16 plants at this site are on or extremely close to the edge of the road cut. Any disturbance which might loosen this cut would lead to their demise.

The population on highway right-of-way represents the only individuals of this species found on public land. Careful monitoring of the population and the road cut (for destabilization) should permit the continued existence, and perhaps expansion of this species.

RECOMMENDED MANAGEMENT PROCEDURES: Recommended management procedures are not different from the currently employed management techniques. If any change in management procedure is anticipated, the Texas Natural Heritage Program of the Texas Parks and Wildlife Department should be notified before changes are implemented. Also if the south side of the road cut deteriorates in any way, the Heritage Program should be contacted immediately.

MONITORING PROCEDURES: Individual plants will be located (distance measured and angle taken) from a known object. Also individual brush peas will be tagged with numbered aluminum tags. Nearest woody neighbor of individual white column cacti will be tagged with numbered aluminum tags and their position in relation to the cactus noted. For the brush pea, height and width of the plant's maximum dimensions will be calculated as a measure of vigor. Reproductive condition will also be recorded. For the white column cactus, height and reproductive condition will be measured as an estimate of vigor. Monitoring will continue on a yearly basis and will be conducted by Jackie Poole of the Texas Natural Heritage Program, Texas Parks and Wildlife Department.

RED FLAG CONDITIONS: A 10% annual decrease in the number of individuals of brush peas or white column cacti will be considered a significant decrease in the population. Also over any consecutive three-year period, a 10% decline in the areal coverage of brush peas or the height of white column cacti will be considered a significant reduction of vigor. If such conditions occur, the cause will be ascertained. If the cause is related to management, management recommendations may be altered.

LOCATION OF ARCHIVED DATA: Texas Natural Heritage Program, Texas Parks and Wildlife Department, 4200 Smith School Road, Austin, Texas; and Texas Department of Transportation, La Costa Complex, 6400 U.S. 290 East, Austin, Texas.

WRITTEN BY: Jackie M. Poole, Texas Natural Heritage Program, Resource Protection Division, Texas Parks and Wildlife Department, 4200 Smith School Road, Austin, Texas 78744

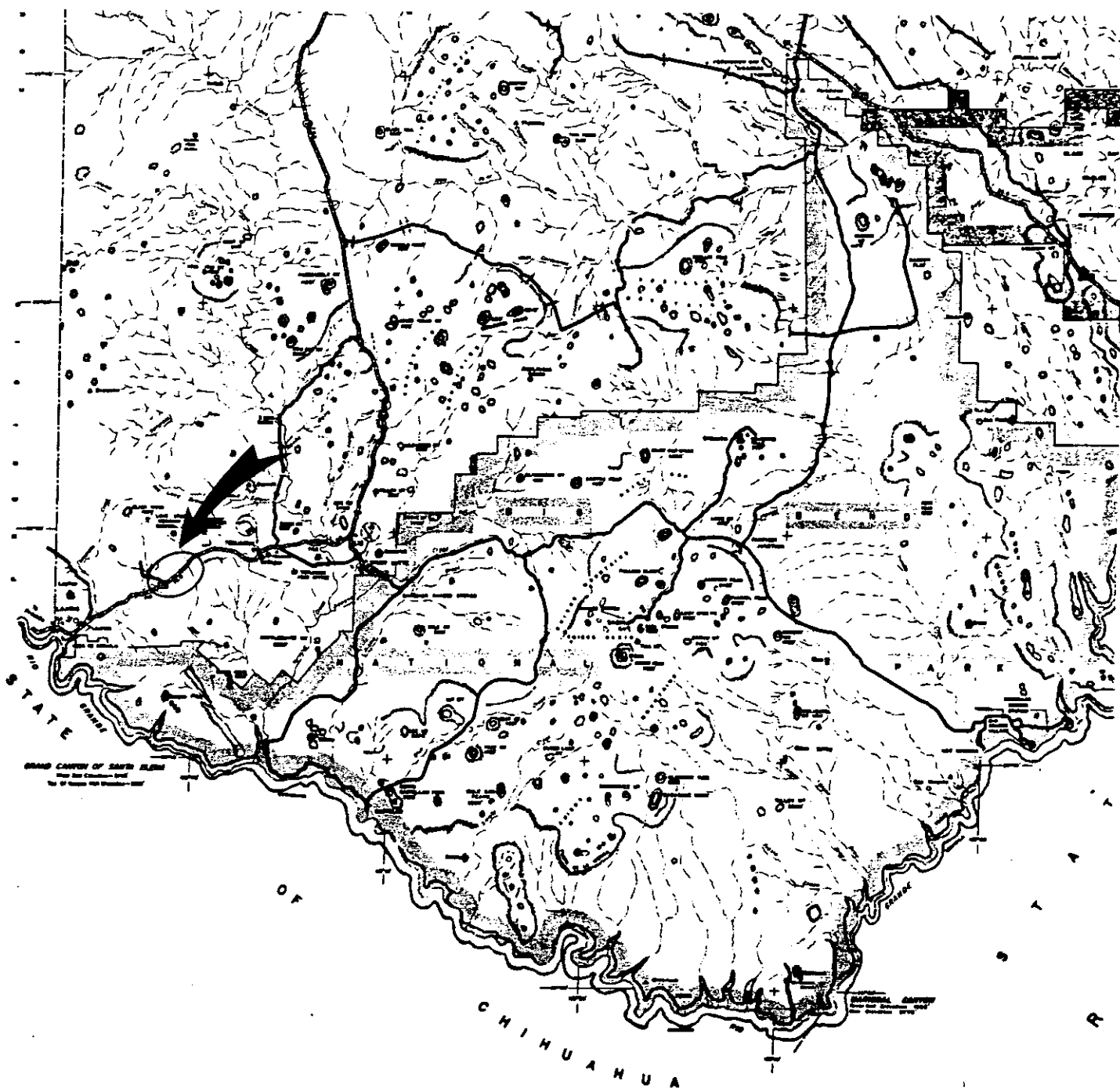
DATE WRITTEN: December 30, 1991

REVIEWED BY:

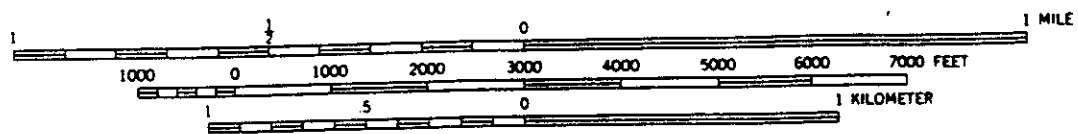
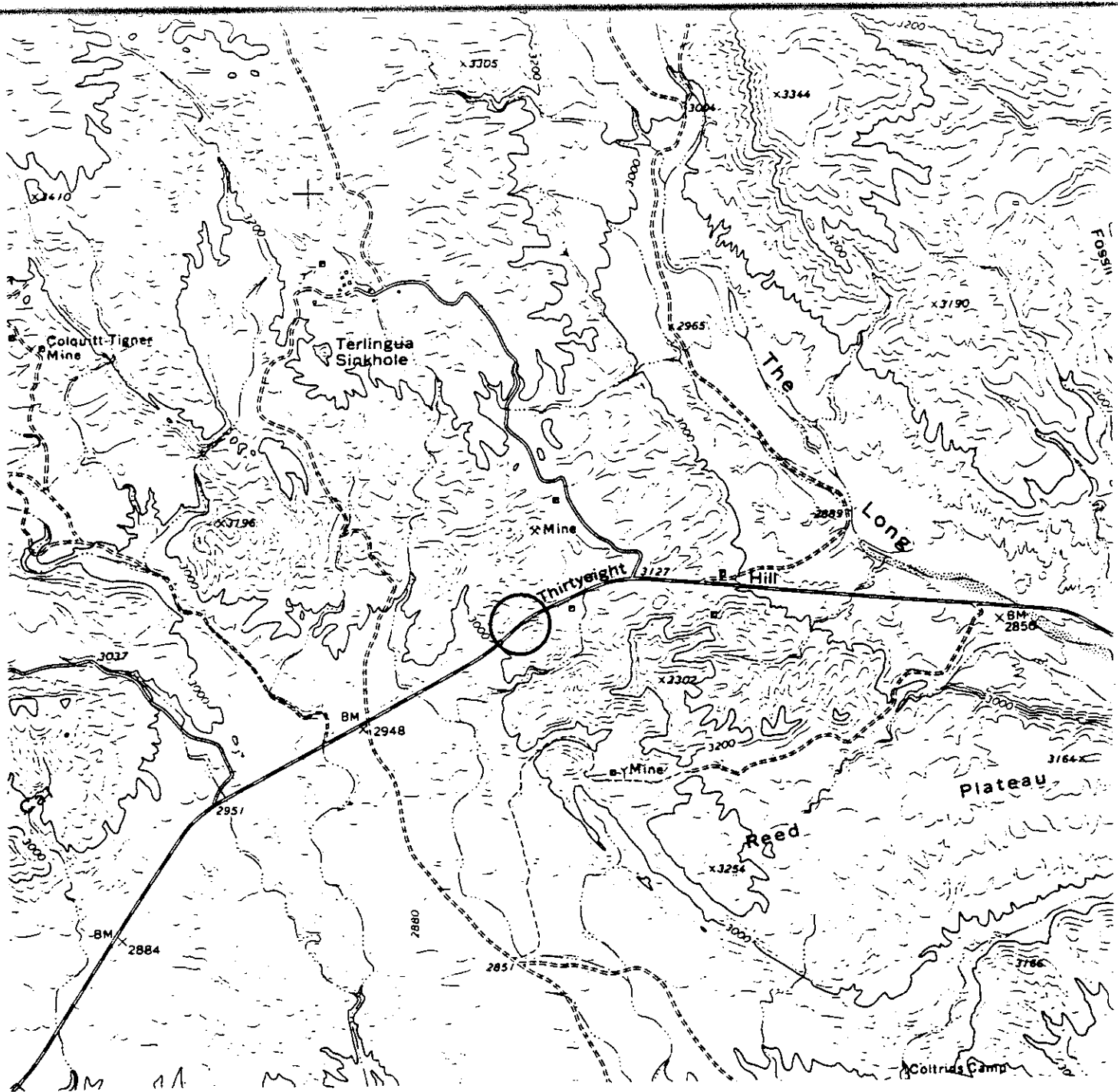
DATE REVIEWED:

REVISED BY AND DATE:

APPROVED BY AND DATE:



Management Area for white column cactus and brush pea
Brewster County - south side of Highway 170
9.0 miles east of Lajitas



Amarillo Mountain 7.5' USGS Quadrangle

Location of white column cactus (*Coryphantha albecolumnaria*) and brush pea (*Genistidium dumosum*) monitoring/management area located in Brewster County, east of Lajitas, on State Route 170.

**Management Agreement between
Texas Department of Transportation
and Texas Parks and Wildlife Department**

LOCATION AND DESCRIPTION OF MANAGEMENT AREA: Brewster County - 3.2 - 3.5 miles south of the junction of Highways 90 and 385 on both sides of Hwy 385 south of Marathon (see attached map). The site is a cut through an outcrop of Caballos Novaculite, a whitish, fractured, quartz-like rock.

MANAGEMENT TECHNIQUES CURRENTLY EMPLOYED:

Mowing: None.

Herbicides: Used only on delineator posts and object markers.

Seeding: None.

Future plans: No changes anticipated.

SPECIES OF CONCERN:

Davis' green pitaya (Echinocereus viridiflorus var. davisii) - This tiny cactus is listed as Endangered by both the state and federal governments. The stem which is mostly underground has 6 to 9 ribs, and is about 1/2 - 1 1/2 inches tall and 3/8 - 3/4 inches in diameter. The spines partially hide the stem, and are straight or curve upward. The spines are reddish-purple, gray, or white, often tipped with red. Within a spine cluster, the central spine is usually absent, but occasionally present in older plants. The outer spines number 8 to 14, and are arranged like the teeth in a comb. The flowers are greenish-yellow, and to 1 inch long and about 3/4 inch in diameter. The species is easiest to identify when in flower in mid-March.

Davis' green pitaya is known from two sites on Caballos Novaculite outcrops in Brewster County. The major threats to the species are collection for the cactus trade, and low numbers of populations which could lead to extinction of the species by chance events such as natural disasters, pests or disease, or inbreeding depression.

The population on the highway right-of-way represents the only individuals of this species found on public land. Through monitoring we will be able to detect the amount of illegal collecting occurring on the highway right-of-way.

Nellie cory cactus (Coryphantha minima) - This federal and state endangered species is a very small, single-stemmed cactus to 1 inch long and 1/4 inch in diameter. The numerous spines are ashy gray or pinkish, and thick looking. The flowers are pale pink to reddish-purple. Flowering occurs in March to June. The fruits are green and egg-shaped, with tiny black seeds.

Nellie cory cactus is known from three sites on Caballos Novaculite outcrops in Brewster County. The major threat to

the species is collection for the cactus trade. The few populations in a limited geographic area could lead to extinction of the species by chance events such as natural or man-made disasters, and pests or disease.

The one plant on the highway right-of-way represents the only individual of this species found on public land. Through monitoring we will be able to detect the amount of illegal collecting occurring on the highway right-of-way.

Hester's cory cactus (Coryphantha hesteri) - This diminutive cactus is placed in Category 2 (awaiting study to determine if listing is needed) by the U. S. Fish and Wildlife Service. The stems are spherical to egg-shaped, up to 3 inches tall and almost as wide, and usually form clumps to more than 12 inches across, but may be single. The spines are white at first, turning gray with age and acquiring red or purplish-brown tips. There are no central spines, and the outer spines number 12 to 14 or 20. The flowers are pale pink to lavender, and 1/2 to 1 1/2 inches tall and wide. Flowering occurs in May and early June.

Hester's cory cactus occurs in deserts and grasslands on rocky (limestone) soils and novaculite outcrops at several sites in Brewster and adjacent Pecos and Terrell Counties. The major threat to the species is collection for the cactus trade.

Currently this is the only recently verified population on highway right-of-way. Several other sites are in the process of being checked.

Straw-spine glory-of-Texas (Thelocactus bicolor var. flavidispinus) - This cactus is placed in Category 2 (awaiting study to determine if listing is needed) by the U. S. Fish and Wildlife Service. The stems are usually solitary, globular to oval to cylindrical, up to 4 inches high and 3 inches wide, and with 8 to 12 ribs. The spines are short (up to 1 1/2 inches long), and yellowish, often with a tinge of red in the middle. The central spines number 1 or 2, while the outer spines number 13 to 20. The flowers are large (up to 3 inches in diameter), and violet with a deep red center. The straw-spine glory-of-Texas flowers in May.

The straw-spine glory-of-Texas is only found on Caballos Novaculite in Brewster County, Texas. The major threat to the species is collection for the cactus trade.

The population on the highway right-of-way represents the only known individuals of this species found on public land.

Wilkinson's nail-wort (Paronychia wilkinsonii) - This small, herbaceous perennial is placed in Category 2 (awaiting study to determine if listing is needed) by the U. S. Fish and Wildlife Service. The many branches are covered with sharp,

tiny leaves. The flowers are minute, whitish, and produced spring through fall, depending on rainfall.

In the U.S. the species is only found on Caballos Novaculite in Brewster County. The species also grows in the Mexican states of Chihuahua and Coahuila. The species is of limited distribution and has few populations. Thus the major threat is extinction of the species due to chance events such as natural disasters, pests or disease, or inbreeding depression.

The population on the highway right-of-way represents the only known individuals of this species found on public land.

RECOMMENDED MANAGEMENT PROCEDURES: Recommended management procedures are not different from the currently employed management techniques. If necessary herbicides may be used with caution in periods of little or no wind along the road edge and around object markers, delineator posts, signs, and other structures as needed. No paving or construction materials should be stockpiled in the management area. No other species should be seeded or planted. Any proposed disturbance of the right-of-way by other entities (i.e., utilities, local/state/federal agencies, etc.) should be reviewed by TxDOT and TPWD. If any change in management procedure is anticipated, the Texas Natural Heritage Program of the Texas Parks and Wildlife Department should be notified before changes are implemented.

MONITORING PROCEDURES: Within a band 50 meters long and as wide as the right-of-way, all individuals of Davis' green pitaya, Hester's cory cactus, straw-spine glory-of-Texas, and Wilkinson's nail-wort will be identified and their location triangulated from marked nails set at one meter intervals along the fenceline. As a measure of vigor, numbers of buds/flowers/fruits will be counted and recorded for Davis' green pitaya, length X width dimensions will be calculated for the Wilkinson's nail-wort, and stem diameter will be measured for Hester's cory cactus and straw-spine glory-of-Texas. Monitoring will be conducted on a yearly basis in mid-March as this is the flowering time for Davis' green pitaya and the cryptic species is most easily located when in flower. Monitoring will be conducted by staff of the Endangered Resources Branch, Texas Parks and Wildlife Department.

RED FLAG CONDITIONS: For Davis' green pitaya and Wilkinson's nail-wort, a 10% annual decrease in the number of individuals, and for Nellie cory cactus, straw-spine glory-of-Texas, and Hester's cory cactus, the loss of a single individual or more during a year, will be considered a significant decline in the population. Also over any consecutive three-year period, a 10% decline in the numbers of buds/flowers/fruits for Davis' green pitaya or a 10% reduction in size of the other species will be considered a significant reduction in vigor. If such conditions occur, the cause will be ascertained. If the cause

is related to management, management recommendations may be altered.

LOCATION OF ARCHIVED DATA: Texas Natural Heritage Program, Texas Parks and Wildlife Department, 4200 Smith School Road, Austin, Texas 78744; and Texas Department of Transportation, Division of Environmental Affairs, 125 E. 11th, Austin, Texas 78701.

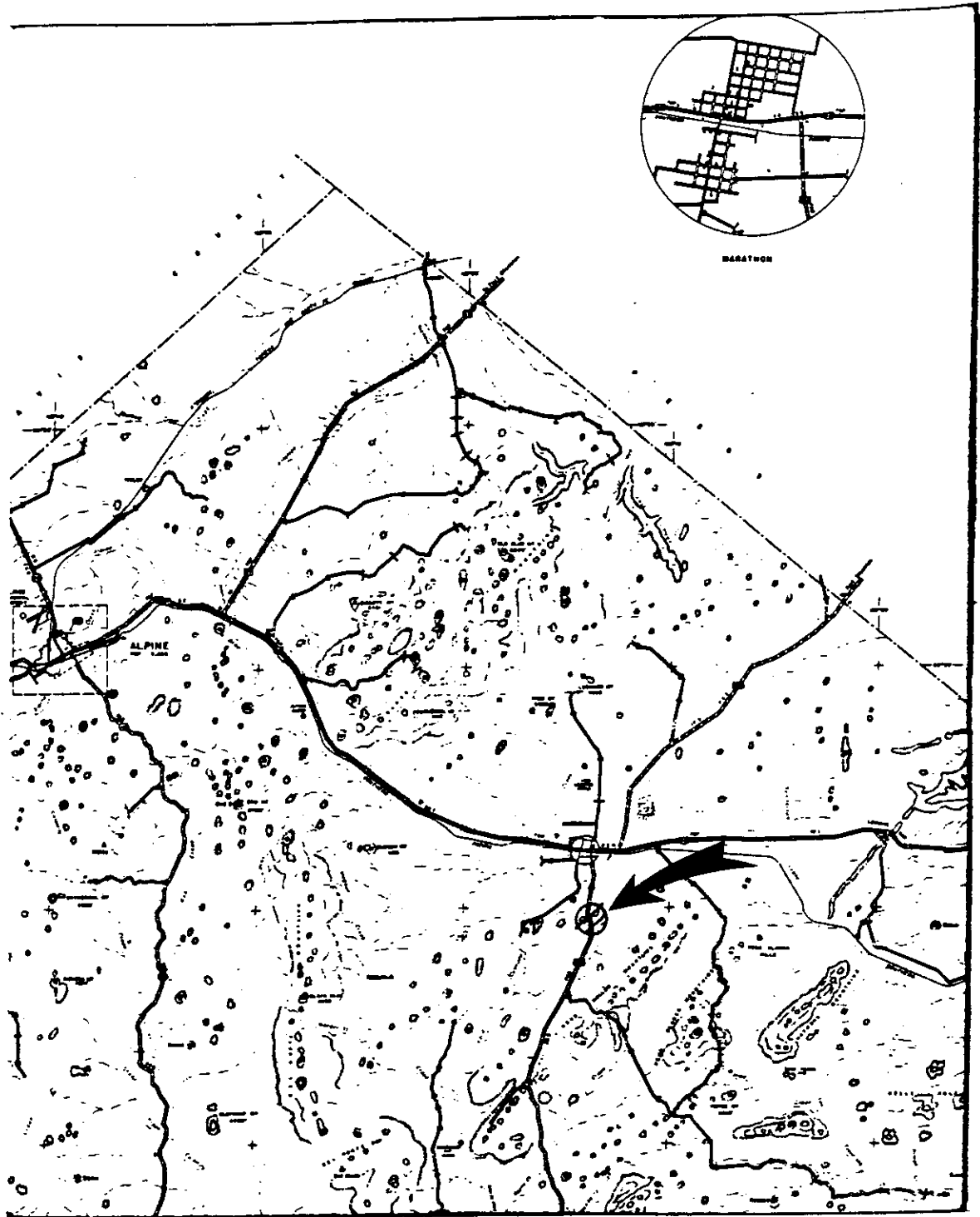
WRITTEN BY: Jackie M. Poole, Texas Natural Heritage Program, Resource Protection Division, Texas Parks and Wildlife Department, 4200 Smith School Road, Austin, Texas 78744

DATE WRITTEN: August 18, 1993 (replaces agreement written May 24, 1991)

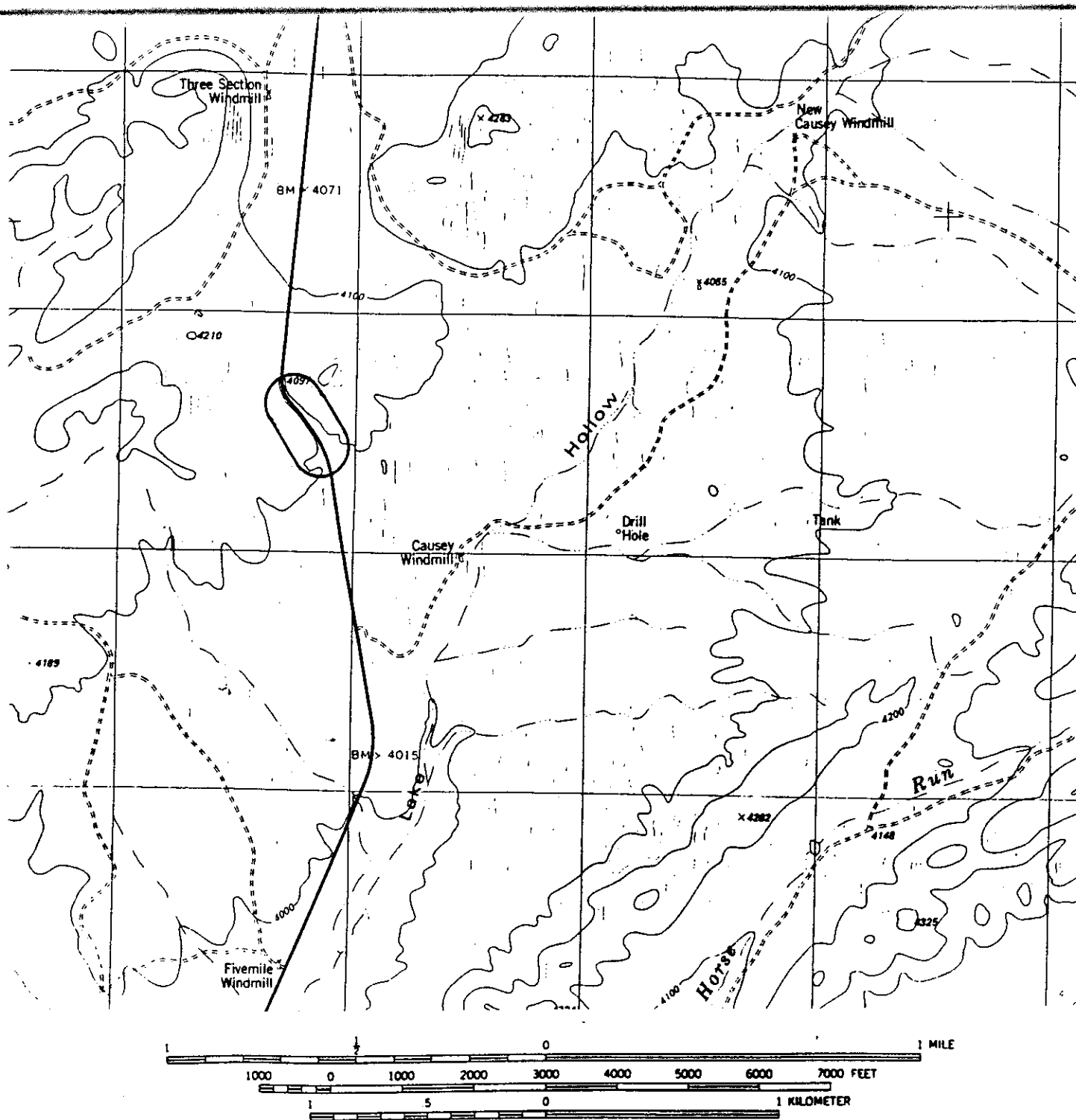
REVIEWED BY: Dennis Markwardt, David Dunlap, and Judy L. Ramsey

DATE REVIEWED: fall 1993

REVISED BY AND DATE: Jackie M. Poole; 30 December 1993



Management Area for Davis' green pitaya, Nellie cory cactus,
Hester's cory cactus, straw-spine glory-of-Texas,
and Wilkinson's nail-wort
Brewster County - west side of Highway 385, south of Marathon
3.2-3.5 miles south of the junction of Hwys 385 and 90



Marathon 7.5' USGS Quadrangle

Location of Davis' green pitaya (*Echinocereus viridiflorus* var. *davisii*), Hester's cory cactus (*Coryphantha hesteri*), straw spine cactus (*Thelocactus bicolor* var. *flavidispinus*), and Wilkinson's nailwort (*Paronychia wilkinsonii*) monitoring/management area located in Brewster County, south of Marathon, on State Route 385.

**Management Agreement between
Texas Department of Transportation
and Texas Parks and Wildlife Department**

LOCATION AND DESCRIPTION OF MANAGEMENT AREA: Cherokee County - north side of Highway 204, 1.1 miles west-northwest of the intersection of Highways 204 and 110 in Ponta (see attached map). The management area consists of a marshy area to the east of Mud Creek, and is delineated by the bridge on the west and a sign ("ice on bridge") on the east. A hybrid swarm, including individuals appearing to be Neches River rose-mallow, was found to the west of the Mud Creek bridge. Due to hybrid nature of this population it is not part of the management agreement.

MANAGEMENT TECHNIQUES CURRENTLY EMPLOYED:

Mowing: Full-width mowed once a year in November; otherwise strip-mowed as needed. However the area occupied by the single Neches River rose-mallow at this site is not mowed.

Herbicides: Used on delineator posts, object markers, around culverts, and pavement edge. Also used on Johnson grass in area. However herbicides are not used in the immediate area of the single Neches River rose-mallow within the management area.

Seeding: None.

Future plans: No changes anticipated.

SPECIES OF CONCERN: Neches River rose-mallow (Hibiscus dasycalyx) - This Category 2 species is a perennial herb to 5 feet tall. The dark green leaves are deeply three-lobed (almost T- or arrow-shaped) with saw-toothed edges. The flowers are large, showy, and bloom June through August. The sepals are densely covered with small hairs. The five creamy white petals have a deep red spot at the base. The fruit is rounded with a pointed tip, and splits open to release the seeds.

The Neches River rose-mallow grows in full sun in marshy areas along open ponds, creeks, or other open bodies of water. The species is threatened habitat alteration and destruction, hybridization with more common species, and possible overcollection.

This population is one of three populations known from highway right-of-way. Only one other population in the world is known, and it has not been relocated. Managing and monitoring this species will hopefully increase numbers of individuals in roadside populations as well as track the vigor and longevity of the individuals in the population.

RECOMMENDED MANAGEMENT PROCEDURES: Delineator posts might be used to indicate the site in the rare event that the area might be mowed. Outside the area mowing can be conducted as necessary.

If required, herbicides should be applied by hand (for Johnson grass control), or at times of little or no wind (other uses). No other species should be planted or seeded in the area. No material should be stockpiled in the area nor should any fill material be removed from the site. Any proposed disturbance of the right-of-way by other entities (i.e., utilities, local/state/federal agencies, etc.) should be reviewed by TxDOT and TPWD. If any change in management procedure is anticipated, the Texas Natural Heritage Program of the Texas Parks and Wildlife Department should be notified before changes are implemented.

MONITORING PROCEDURES: All individuals within the right-of-way will be counted, tagged, and mapped using a distance and angle from a known point. The height and the numbers of stems, flowers and fruits for each individual will be tallied as a measure of vigor. Monitoring will be conducted on a yearly basis in mid-summer by staff of the Endangered Resources Branch, Texas Parks and Wildlife Department.

RED FLAG CONDITIONS: A 10% decrease in the number of individuals of Neches River rose-mallow will be considered a significant decline in the population. Also over any consecutive three-year period, a 10% decline in the number of stems, flowers and/or fruits of the population will be considered a significant reduction in vigor. If such conditions occur, the cause will be ascertained. If the cause is related to management, management recommendations may be altered.

LOCATION OF ARCHIVED DATA: Texas Natural Heritage Program, Texas Parks and Wildlife Department, 4200 Smith School Road, Austin, Texas 78744; and Texas Department of Transportation, 125 E. 11th, Austin, Texas 78701

WRITTEN BY: Jackie M. Poole, Texas Natural Heritage Program, Resource Protection Division, Texas Parks and Wildlife Department, 4200 Smith School Road, Austin, Texas 78744

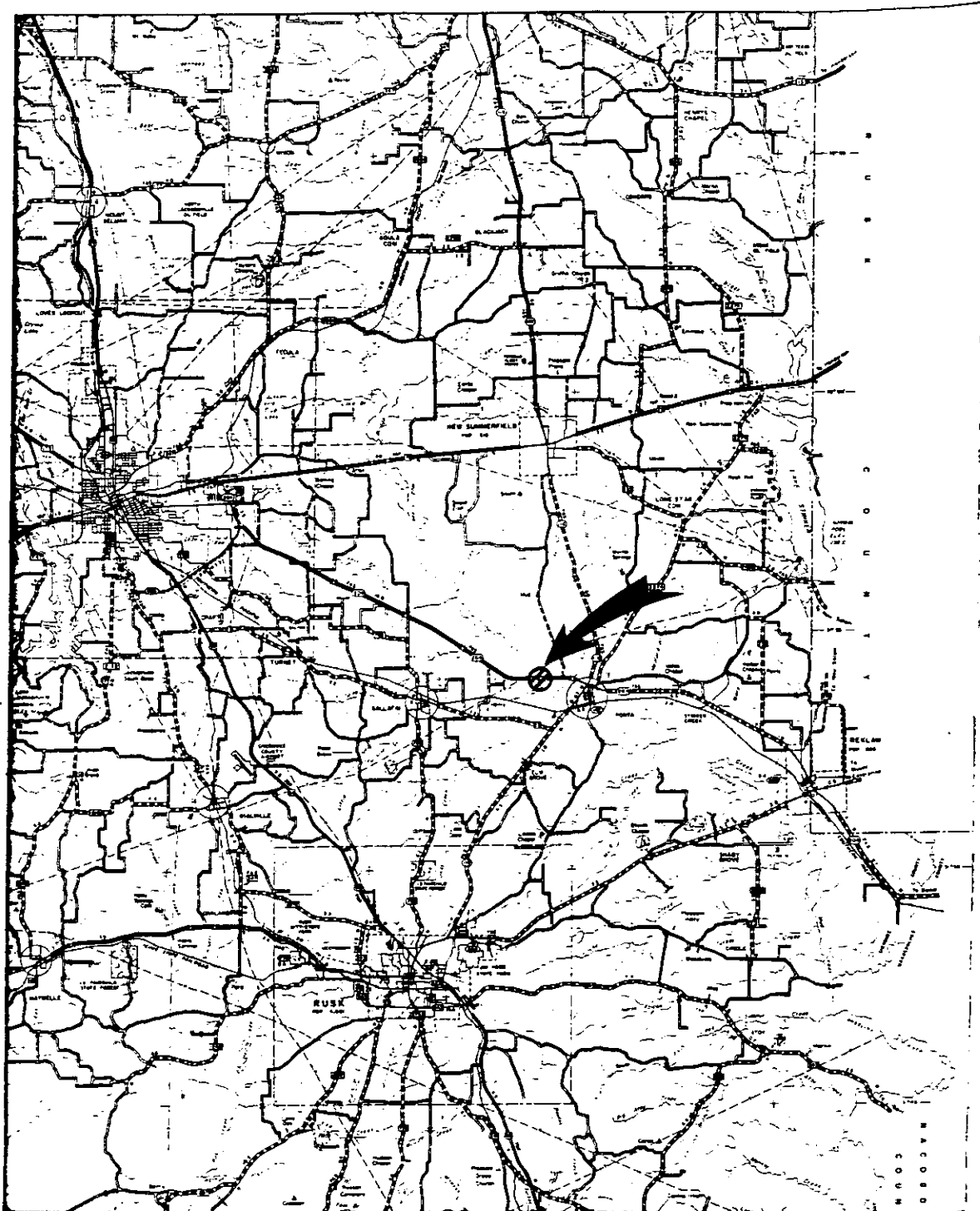
DATE WRITTEN: November 8, 1993

REVIEWED BY: Dennis Markwardt and David Dunlap

DATE REVIEWED: Fall 1993

REVISED BY AND DATE: Jackie M. Poole; 30 December 1993

APPROVED BY AND DATE:



Management Area for Neches River rose-mallow
Cherokee County - north side of Highway 204, 1.1 miles west-
northwest of the intersection of Highways 204 and 110 in Pontalene

Management Agreement between
Texas Department of Transportation
and Texas Parks and Wildlife Department

LOCATION AND DESCRIPTION OF MANAGEMENT AREA: Culberson County - 2.4 - 2.8 miles west of the Plateau interchange along IH-10 on the north side of the north access road, and 3.1-4.1 miles east of the Michigan Flat interchange on the south side of the east bound lane of IH-10, east of Van Horn (see maps). The sandy soil in this management area forms small dunes around clumps of vegetation. The area is sparsely vegetated by various sand-loving herbs and shrubs.

MANAGEMENT TECHNIQUES CURRENTLY EMPLOYED:

Mowing: Strip mowing along road edge.
Herbicides: Along road edge and around structures.
Seeding: None.
Future plans: None anticipated.

SPECIES OF CONCERN

Sand sacahuiste (Nolina arenicola) - This large bunch grass-like perennial is actually a member of the lily family (similar to sotols and yuccas). It is placed by the U. S. Fish and Wildlife Service in Category 2 (awaiting study to determine if listing is needed). The numerous, long, tough, shoe string-like leaves form large clumps. The flower stalk arises within the leaves and is covered with tiny white flowers. The fruits are rounded, brownish-black seeds covered by a triangular, papery, translucent coat.

Sand sacahuiste is only known from two (possibly three) counties in Texas. Many specimens have been misidentified. Land clearing has destroyed some habitat. Limited population area increases the species' chances of extinction through random events such as natural disasters, pests or disease, or inbreeding depression.

The highway right-of-way population is the site where the original collection of this species was made, and is the largest known population. Through monitoring and management, listing of this species may be avoided.

RECOMMENDED MANAGEMENT PROCEDURES: A strip 20 feet wide from the pavement edge may be mowed at any time. The management area should never be mowed full width or cleared in any way. Herbicides may be used with caution in periods of little or no wind along the road edge and around object markers, delineator posts, signs, and other structures as needed. If any change in management procedure is anticipated, the Texas Natural Heritage Program of the Texas Parks and Wildlife Department should be notified before changes are implemented.

MONITORING PROCEDURES: All individuals within the management area will be counted and mapped. Up to 100 randomly selected individuals will be assessed as to vigor. Measurements of vigor will include volume, and number and length of inflorescences. Monitoring will be conducted on a yearly basis in May during flowering time. Monitoring will be conducted by Jackie Poole of the Texas Natural Heritage Program, Texas Parks and Wildlife Department.

RED FLAG CONDITIONS: A 10% decrease in number of individuals of sand sacahuiste will be considered a significant decline in the population. Also over any consecutive three-year period, a 10% decrease in the volume or number and length of inflorescences within the population will be considered a significant reduction in vigor. If such conditions occur, the cause will be ascertained. If the cause is related to management actions, management recommendations may be altered.

LOCATION OF ARCHIVED DATA: Texas Natural Heritage Program, Texas Parks and Wildlife Department, 4200 Smith School Road, Austin, Texas; and Texas Department of Transportation, La Costa Complex, 6400 U.S. 290 East, Austin, Texas

WRITTEN BY: Jackie M. Poole, Texas Natural Heritage Program, Resource Protection Division, Texas Parks and Wildlife Department, 4200 Smith School Road, Austin, Texas 78744

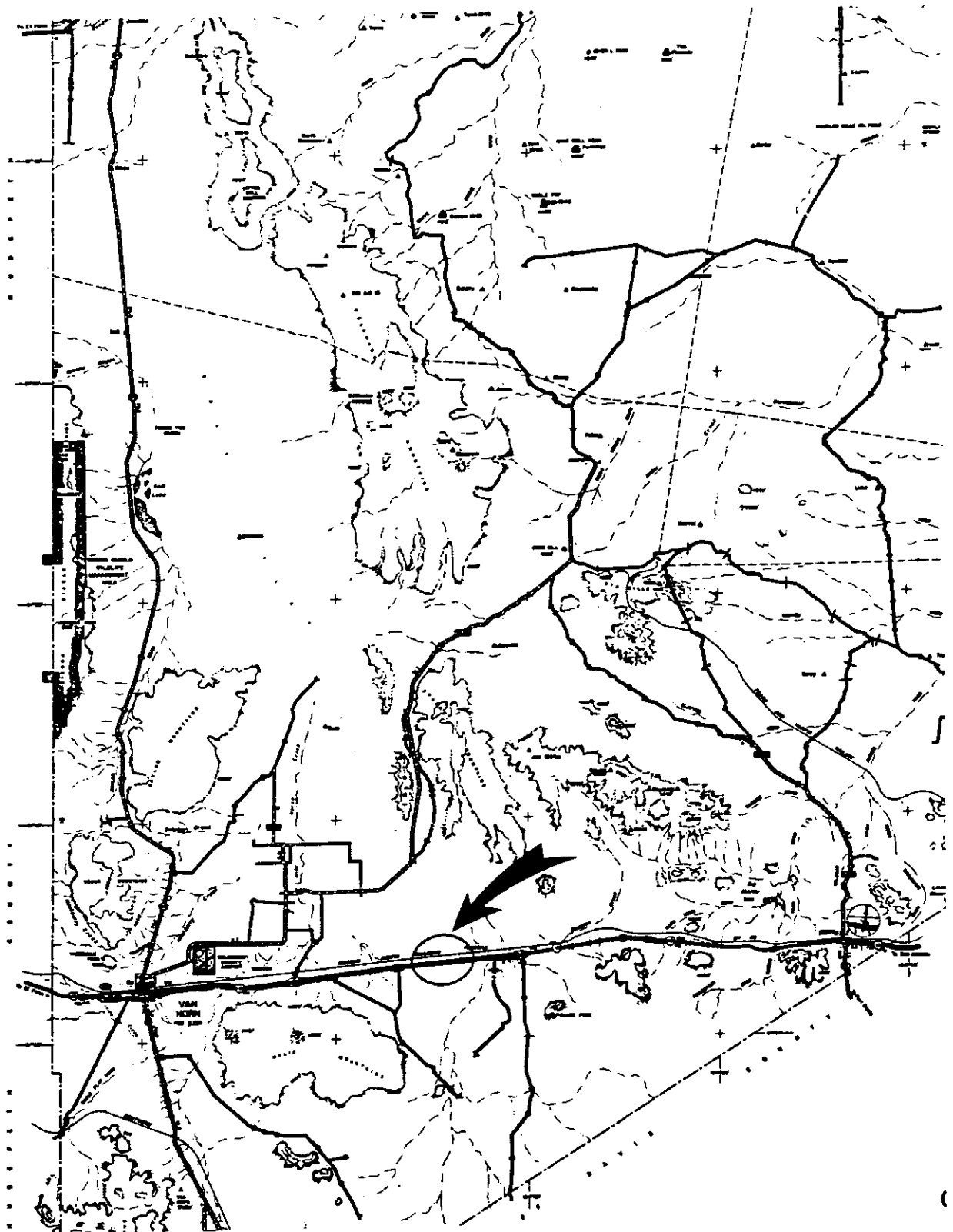
DATE WRITTEN: December 20, 1991

REVIEWED BY:

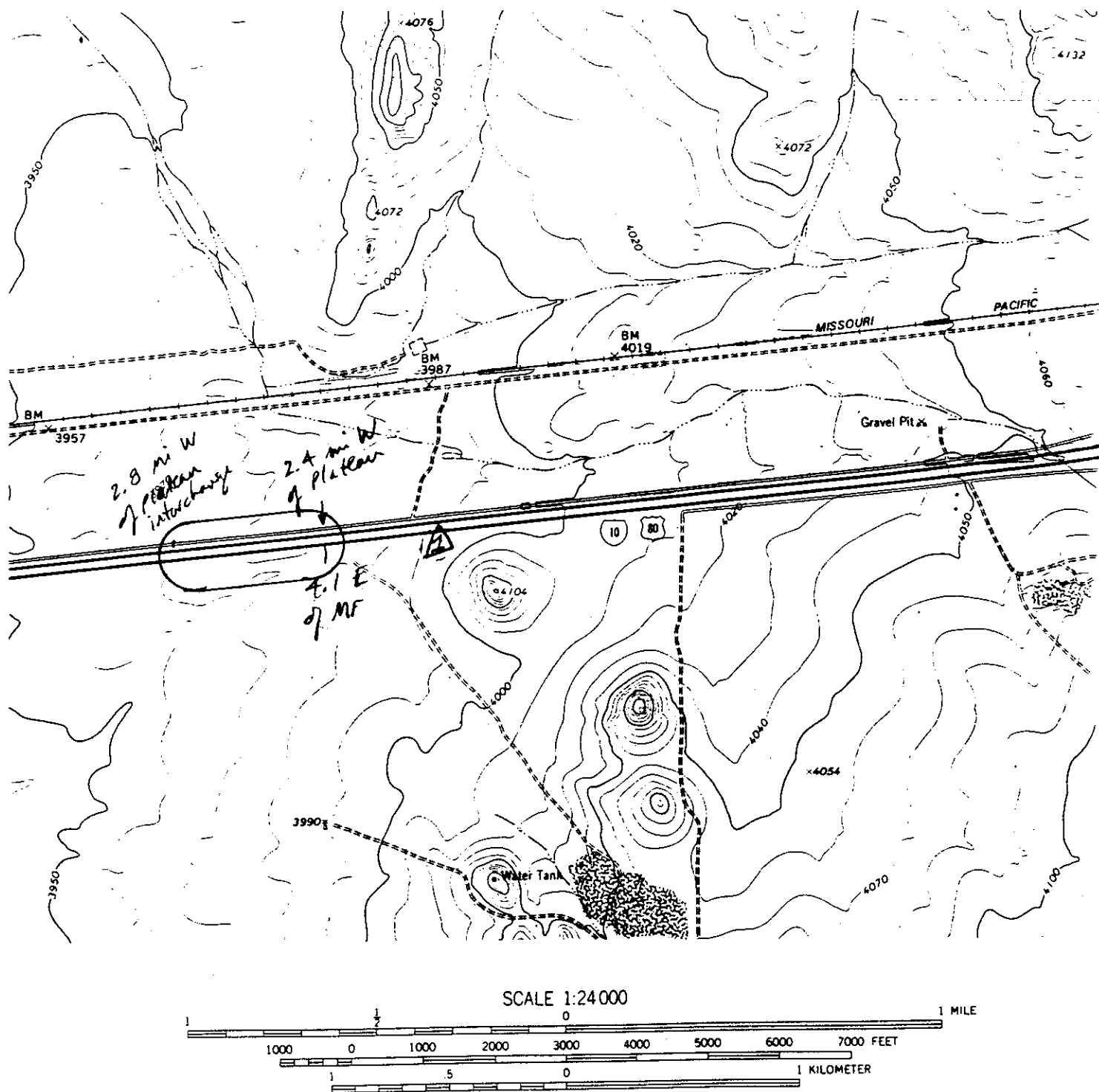
DATE REVIEWED:

REVISED BY AND DATE:

APPROVED BY AND DATE:



Management Area for sand sacahuiste
Culberson County - 2.4 to 2.8 miles west of the Plateau interchange on IH 10
and 3.1 to 4.1 miles east of the Michigan Flat interchange



Plateau 7.5' USGS Quadrangle

Location of sand sacahuiste (*Nolina arenicola*) monitoring/management area in Culberson County, east of Van Horn on IH 10.

**Management Agreement between
Texas Department of Transportation
and Texas Parks and Wildlife Department**

LOCATION AND DESCRIPTION OF MANAGEMENT AREA: Hays County - IH-35 bridges over the San Marcos River, San Marcos (see attached map). The management area consists of the terrestrial right-of-way and that part of the San Marcos River which would be directly affected by highway right-of-way management practices.

MANAGEMENT TECHNIQUES CURRENTLY EMPLOYED: This site has not been visited with TxDOT personnel. Thus exact management concerns, techniques, and strategies are unknown. A meeting should be scheduled for winter 1993.

SPECIES OF CONCERN: Texas wild-rice, Fountain Darter, and San Marcos Gambusia are known from the San Marcos River in the vicinity of the IH-35 bridge. All of these species are listed as federal and state endangered. The management of the highway is of significance to these species as the largest stand of Texas wild-rice occurs in this area, and the type locality for the San Marcos Gambusia is immediately below the IH-35 bridge.

Texas wild-rice (Zizania texana) is an aquatic perennial grass. The long green leaves stream underwater with the river current. The stems root at the nodes, with vegetative reproduction being the main method of proliferation. Only rarely does Texas wild-rice bear flowers in the wild as the narrow flower cluster must raise itself above the swift flowing water. The male and female flowers are separate, with the female flowers being above the males. Flowering occurs March through November. The seeds resemble those of commercial wild-rice, but are smaller.

Texas wild-rice usually grows in the mid-channel of the river where the current is swift. Most plants are in full sun, but some groups receive partial shade during the day. Substrate varies from gravelly sands to soft, fine clays.

The Fountain Darter (Etheostoma fonticola) is a small, reddish brown fish, usually less than an inch long. There is an interrupted lateral streak on the middle of its sides. The back is dusted with fine specks and has about 8 indistinct cross-blotches. Three small dark spots occur at the base of the tail, and there is a dark spot on the gill flap. There are dark bars in front of, below, and behind the eye. The spiny back fin is jet-black in the lower half, followed by a broad red band, and terminated by the narrow black edge.

The Fountain Darter prefers rivers with thermally constant waters and vegetated bottoms. In particular the species

favours mats of filamentous green alga, and is only rarely found in areas devoid of vegetation. While the young fish prefer quiet pools, the adults use all suitable habitats including riffles.

The San Marcos Gambusia (Gambusia georgei) is a small, livebearing fish. The scales are strongly crosshatched. The back fins tend to have prominent dark stripes across the outer edges. A diffuse stripe is often present along the sides from the fins just behind the head to the tail. The mature males have thickened upper pectoral fin rays. There is a dark bar below the eye. The side fins tend to be lemon yellow.

The San Marcos Gambusia prefers quiet waters next to swift water. The species is found primarily over muddy substrates but not silted habitats. It requires shaded sites with thermally constant waters.

The greatest threat to all the species is decreased spring flow. In addition pollution from urban runoff and pesticides (such as herbicides, insecticides, rodenticides, etc.) constitute a danger. Artificial impoundments have altered habitat to the extent that the species no longer exist in particular stretches of the river. Effluent from the sewage treatment plant has affected the species below its outfall. Exotic species threaten the native through competition, hybridization, and/or herbivory. Recreation has had the greatest impact on Texas wild-rice through knock-down of flowering heads and uprooting of plants. Mowing of aquatic vegetation to make better human swimming areas affects Texas wild-rice directly if the species is in the mower path, and the fish indirectly by altering their habitat.

RECOMMENDED MANAGEMENT PROCEDURES: As current management of this site is unknown, the following recommendations may not represent any changes. The following management recommendations are subject to change once current management for the site is known.

Probably the only management procedure to have any affect on the species of concern is the use of herbicides on the IH-35 bridges (including access roads) and their associated features. If it is necessary to use herbicides in this area, they should be non-toxic to both the fish species and Texas wild-rice. If such herbicides are not available, then removal of undesirable vegetation should be accomplished by mechanical means. A vegetated buffer should be left along all approaches to the river.

The clippings or debris from any terrestrial mowing or vegetation removal conducted in the area should not be disposed of in the river. No paving or construction materials should be stockpiled in the area unless contained by working silt fences or other appropriate sediment control measures.

Any proposed alteration of the right-of-way by other entities (i.e., utilities, local/state/federal agencies, etc.) should be reviewed by TxDOT and TPWD. If any changes in management procedure is anticipated, the Texas Natural Heritage Program of the Texas Parks and Wildlife Department should be notified before changes are implemented.

MONITORING PROCEDURES: Each separate group of Texas wild-rice will be identified and mapped using an angle and a distance from a recognizable object. The length and width of each group will be measured, and percent areal cover within the resulting rectangle will be approximated. Monitoring will continue on a yearly basis in the summer and will be conducted by staff of the Endangered Resources Branch, Texas Parks and Wildlife Department. Procedures for monitoring the fish species will be designed in consultation with specialists at a later date.

RED FLAG CONDITIONS: Over any consecutive three-year period, a 10% decline in the areal coverage of any group of Texas wild-rice within the management area will be considered a significant. If such conditions occur, the cause will be ascertained. If the cause is related to management, management recommendations may be altered.

LOCATION OF ARCHIVED DATA: Texas Natural Heritage Program, Texas Parks and Wildlife Department, 4200 Smith School Road, Austin, Texas 78744; and Texas Department of Transportation, Division of Environmental Affairs, 125 E. 11th, Austin, Texas 78701.

WRITTEN BY: Jackie M. Poole, Texas Natural Heritage Program, Resource Protection Division, Texas Parks and Wildlife Department, 4200 Smith School Road, Austin, Texas 78744

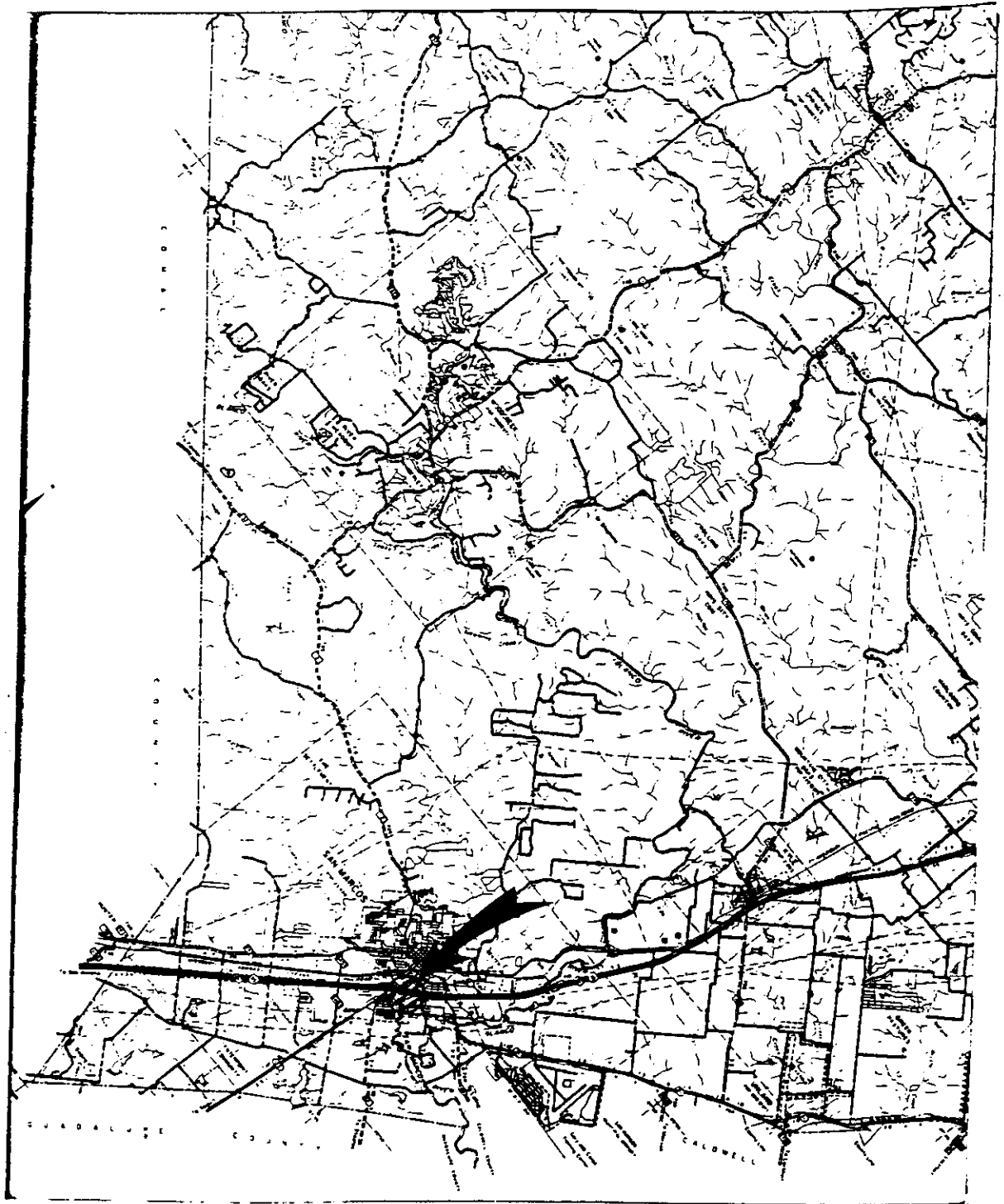
DATE WRITTEN: August 16, 1993

REVIEWED BY: Dennis Markwardt, David Dunlap, and Steve Prather

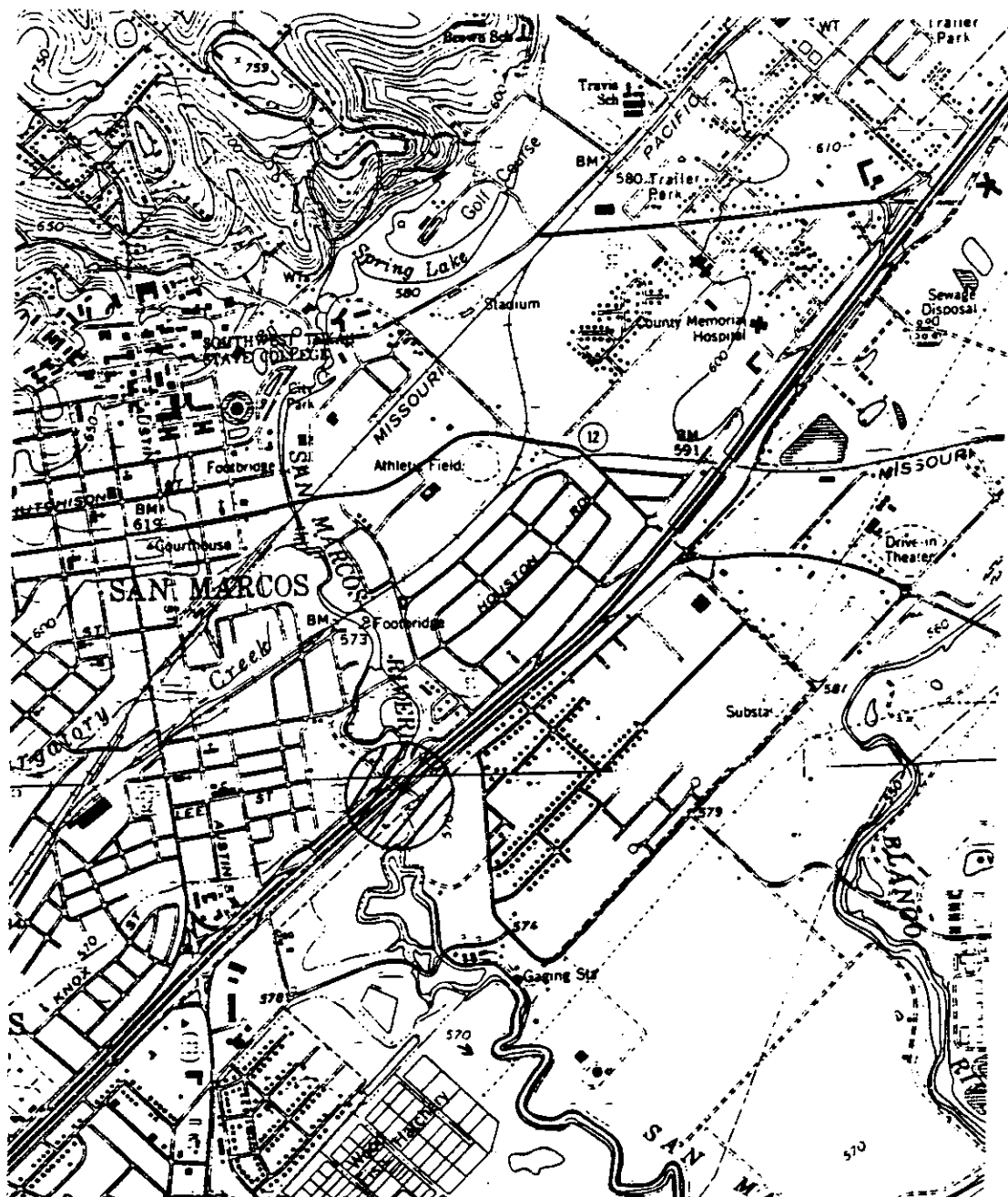
DATE REVIEWED: fall 1993

REVISED BY AND DATE: Jackie M. Poole; 30 December 1993

APPROVED BY AND DATE:



Management Area for Texas wild-rice, Fountain Darter,
and San Marcos Gambusia
Hays County - both sides of IH-35 bridge over San Marcos River



San Marcos North and South 7.5' USGS Quadrangle

Location of Texas wildrice (*Zizania texana*) monitoring/management area in Hays County, at the San Marcos River and the IH 35 bridge.

**Management Agreement between
Texas Department of Transportation
and Texas Parks and Wildlife Department**

LOCATION AND DESCRIPTION OF MANAGEMENT AREA: Houston County - northwest side of Highway 230, 2.4 miles southwest of the intersection of Highways 230 and 19 in Lovelady (see attached map). The management area consists of a marshy area along Tantabogue Creek, and is delineated by the bridge on the east and a sign ("ice on bridge") on the west.

MANAGEMENT TECHNIQUES CURRENTLY EMPLOYED:

Mowing: Full-width mowed once a year in November; otherwise strip-mowed as needed.

Herbicides: Used on delineator posts, object markers, around culverts, and pavement edge. Also used on Johnson grass in area.

Seeding: None.

Future plans: No changes anticipated.

SPECIES OF CONCERN: Neches River rose-mallow (Hibiscus dasycalyx) - This Category 2 species is a perennial herb to 5 feet tall. The dark green leaves are deeply three-lobed (almost T- or arrow-shaped) with saw-toothed edges. The flowers are large, showy, and bloom June through August. The sepals are densely covered with small hairs. The five creamy white petals have a deep red spot at the base. The fruit is rounded with a pointed tip, and splits open to release the seeds.

The Neches River rose-mallow grows in full sun in marshy areas along open ponds, creeks, or other open bodies of water. The species is threatened habitat alteration and destruction, hybridization with more common species, and possible overcollection.

This population is one of three populations known from highway right-of-way. Only one other population in the world is known, and it has not been relocated. Managing and monitoring this species will hopefully increase numbers of individuals in roadside populations as well as track the vigor and longevity of the individuals in the population.

RECOMMENDED MANAGEMENT PROCEDURES: Delineator posts should be used to indicate the site so as mowers can avoid this area. Outside the area mowing can be conducted as necessary. If required, herbicides should be applied by hand (for Johnson grass control), or at times of little or no wind (other uses). No other species should be planted or seeded in the area. No material should be stockpiled in the area nor should any fill material be removed from the site. Any proposed disturbance of the right-of-way by other entities (i.e., utilities, local/state/federal agencies, etc.) should be reviewed by TxDOT and TPWD. If any change in management procedure is

anticipated, the Texas Natural Heritage Program of the Texas Parks and Wildlife Department should be notified before changes are implemented.

MONITORING PROCEDURES: All individuals within the right-of-way will be counted, tagged, and mapped using a distance and angle from a known point. The height and the numbers of stems, flowers and fruits for each individual will be tallied as a measure of vigor. Monitoring will be conducted on a yearly basis in mid-summer by staff of the Endangered Resources Branch, Texas Parks and Wildlife Department.

RED FLAG CONDITIONS: A 10% decrease in the number of individuals of Neches River rose-mallow will be considered a significant decline in the population. Also over any consecutive three-year period, a 10% decline in the number of stems, flowers and/or fruits of the population will be considered a significant reduction in vigor. If such conditions occur, the cause will be ascertained. If the cause is related to management, management recommendations may be altered.

LOCATION OF ARCHIVED DATA: Texas Natural Heritage Program, Texas Parks and Wildlife Department, 4200 Smith School Road, Austin, Texas 78744; and Texas Department of Transportation, 125 E. 11th, Austin, Texas 78701

WRITTEN BY: Jackie M. Poole, Texas Natural Heritage Program, Resource Protection Division, Texas Parks and Wildlife Department, 4200 Smith School Road, Austin, Texas 78744

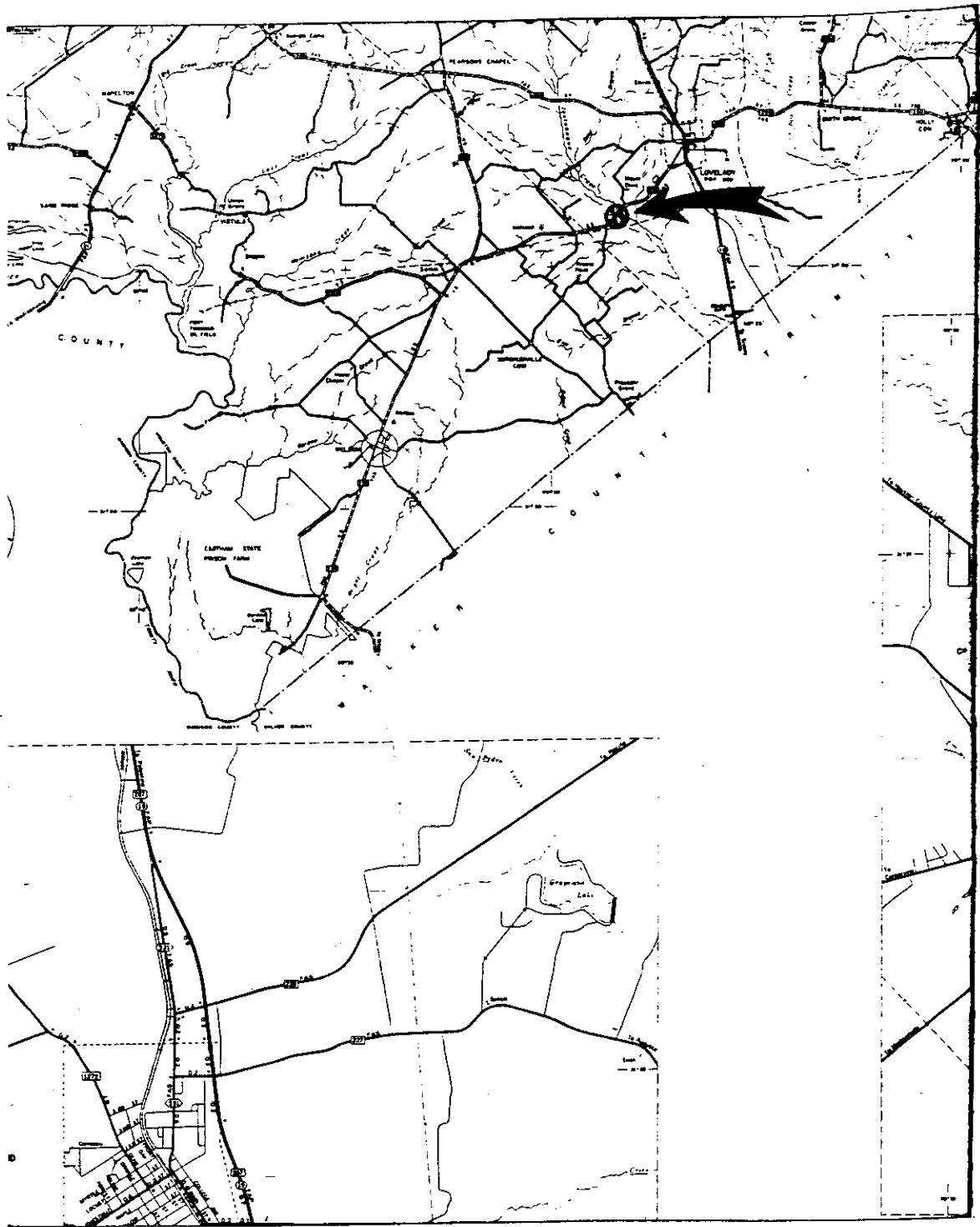
DATE WRITTEN: November 8, 1993

REVIEWED BY: Dennis Markwardt and David Dunlap

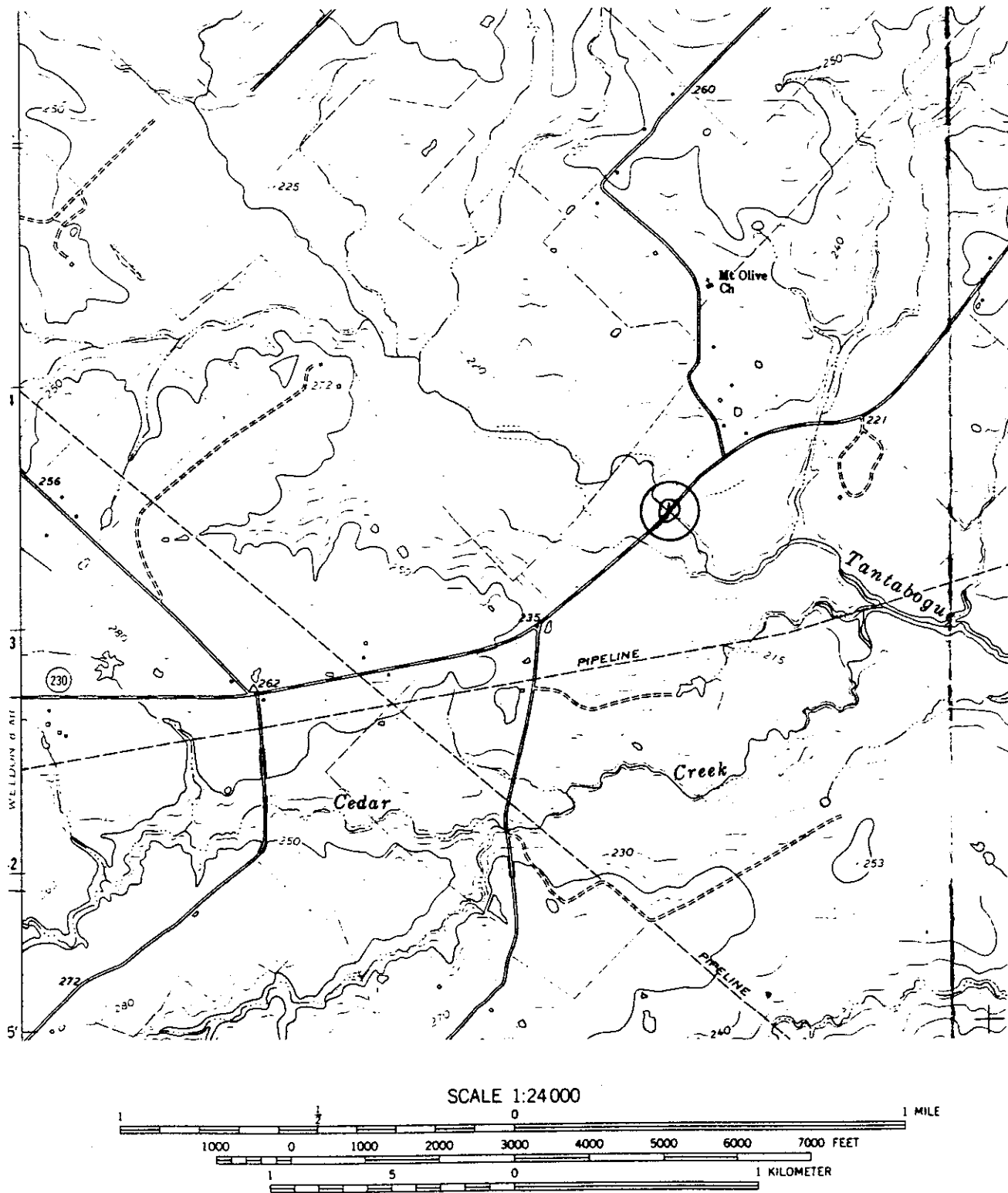
DATE REVIEWED: fall 1993

REVISED BY AND DATE: Jackie M. Poole; 30 December 1993

APPROVED BY AND DATE:



Management Area for Neches River rose-mallow
 Houston County - northwest side of Highway 230, 2.4 miles
 southwest of the intersection of Highways 230 and 19 in Lovelady



Lovelady South 7.5' USGS Quadrangle

Location of Neches River rose-mallow (*Hibiscus dasycalyx*) monitoring/management area in Houston County, southwest of Lovelady, on Highway 230.

Management Agreement between
Texas Department of Transportation
and Texas Parks and Wildlife Department

LOCATION AND DESCRIPTION OF MANAGEMENT AREA: Kendall County - 0.5 miles northwest of the intersection of IH-10 and Highway 46 on the southwest edge of Boerne (see maps). This is also where IH-10 crosses Frederick Creek. The management area encompasses right-of-way on the northwestern side of the creek. The site is relatively flat and in the floodplain of the creek. The soil is a gravelly clay. Vegetation is primarily grasses and various herbs (including massive amounts of poison ivy and dewberries) with scattered shrubs and trees.

MANAGEMENT TECHNIQUES CURRENTLY EMPLOYED:

Mowing: None.
Herbicides: None.
Seeding: None.
Future plans: None anticipated.

SPECIES OF CONCERN:

Big red sage (Salvia penstemonoides) - This species is listed as Category 2 (awaiting further study to determine if listing is needed) by the U. S. Fish and Wildlife Service. This plant is an erect perennial to several feet tall. The shiny, dark green leaves form a large mound at the plant's base. The large, attractive, wine-colored flowers make the plant very conspicuous. The fruits are inconspicuous, and the seeds are small.

The big red sage is found on moist, shaded limestone cliffs and in full sun along perennial streams. Various activities such as overgrazing, dam construction, channelization, and alteration of hydrological regimes, threaten the big red sage. Since the Highway Department altered its mowing schedule (no mowing), the population on the right-of-way appears to be doing well. However shrubs and other woody perennials are beginning to overtake the area and should be controlled by mowing.

The management area represents the largest of two populations of the big red sage on highway right-of-way. Through monitoring and careful management of these individuals, we can perhaps avoid listing this species.

RECOMMENDED MANAGEMENT PROCEDURES: Mowers should be set at 6 inches, and mowing can be done any time from October to February. The management area should be cut with hand and slope mowers. Site two (see map) will not be mowed as a control area to evaluate the effect of mowing on the plants. Herbicides should be sparingly and carefully hand-applied at times of little or no wind around the columns (piers) in

January or February. Herbicide use on highway above the management area should be carefully applied at times of little or no wind, taking great care to make sure that none is spilled or drifts onto the plants below. If any change in management procedure is anticipated, the Texas Natural Heritage Program of the Texas Parks and Wildlife Department should be notified before changes are implemented.

MONITORING PROCEDURES: Three sites within the management area will be established (see map). All individuals will be counted, and number of primary and secondary branches on flowering individuals will be tallied at all sites. Seedlings and juveniles (non-flowering plants) will also be counted at each site. Five individuals will be selected at each site, and number of flowers and fruits will be tabulated. These fifteen individuals will be selected by position (northmost, southmost, etc.) and approximate number of flowers (fewest, most numerous, etc.). Their positions will be triangulated from recognizable objects at each site. Monitoring will be conducted on a yearly basis in July. Monitoring will be conducted by Jackie Poole of Texas Natural Heritage Program, Texas Parks and Wildlife Department.

RED FLAG CONDITIONS: A 10% annual decrease in the total number of flowering individuals of big red sage from all three sites will be considered to be a significant decline in the population. Also over any consecutive three-year period, a 10% decrease in the number of primary and secondary branches or number of flowers and fruits will be considered a significant reduction in vigor. If such conditions occur, the cause will be ascertained. If the cause is related to management practices, management recommendations may be altered.

LOCATION OF ARCHIVED DATA: Texas Natural Heritage Program, Texas Parks and Wildlife Department, 4200 Smith School Road, Austin, Texas; and Texas Department of Transportation, La Costa Complex, 6400 U.S. 290 East, Austin, Texas

WRITTEN BY: Jackie M. Poole, Texas Natural Heritage Program, Resource Protection Division, Texas Parks and Wildlife Department, 4200 Smith School Road, Austin, Texas 78744

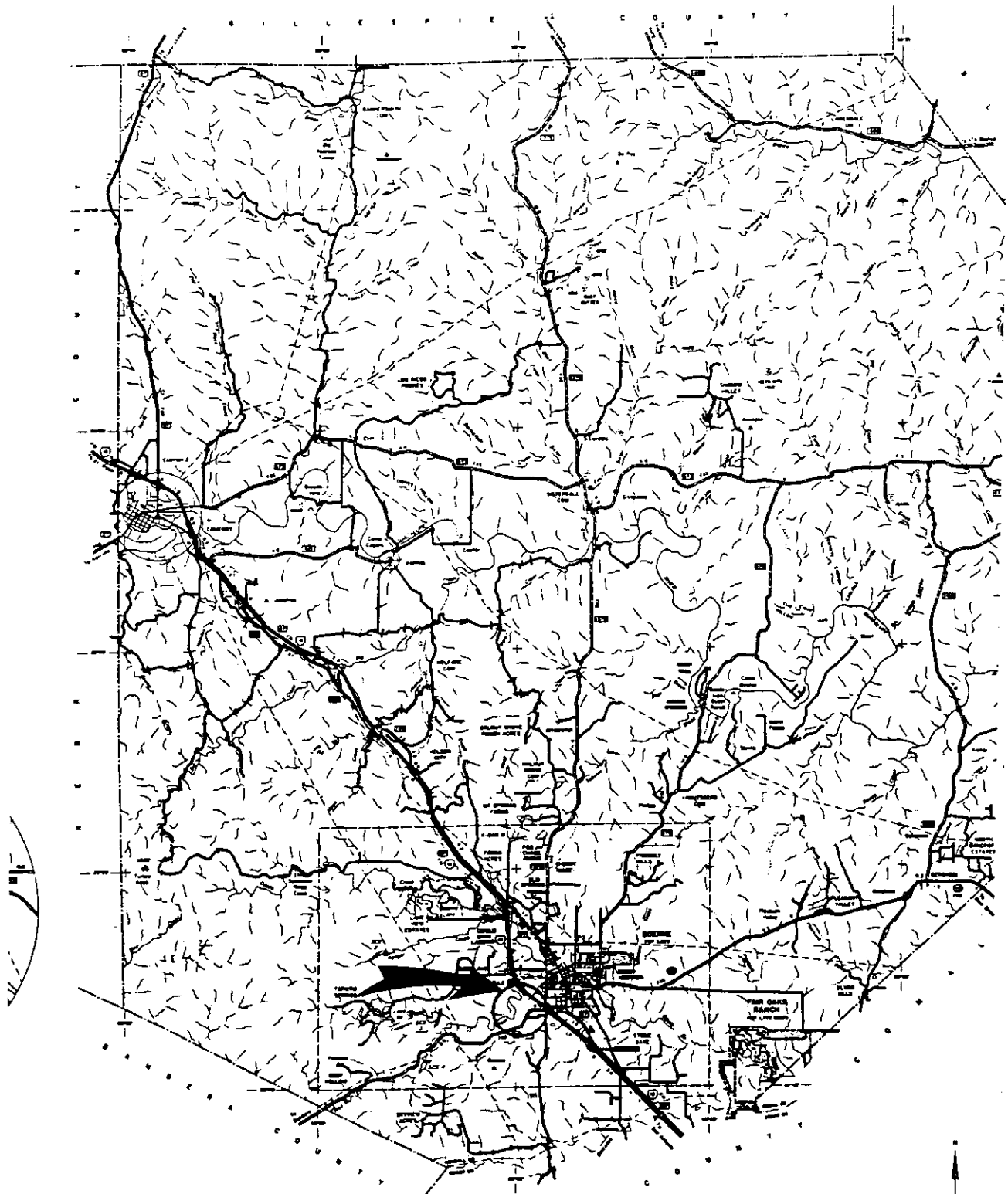
DATE WRITTEN: December 20, 1991

REVIEWED BY:

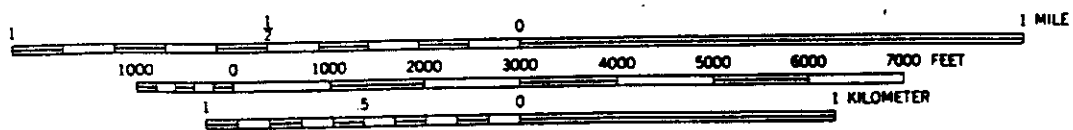
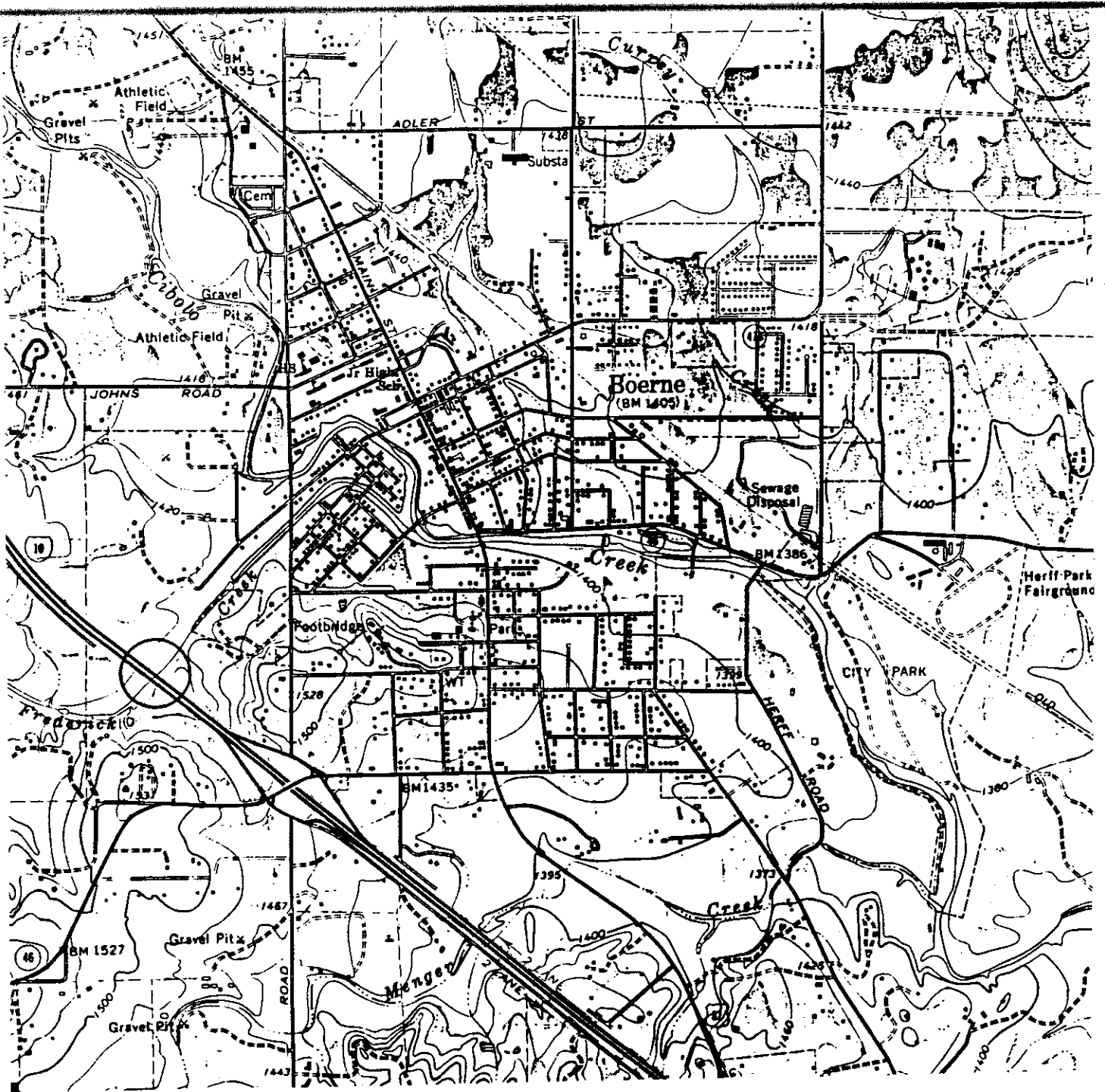
DATE REVIEWED:

REVISED BY AND DATE:

APPROVED BY AND DATE:



Management Area for big red sage
Kendall County - 0.5 miles northwest of the IH 10/Highway 46 intersection
on IH 10 at Frederick Creek



Boerne 7.5' USGS Quadrangle

Location of big red sage (*Salvia penstemonoides*) monitoring/management area located in Kendall County, southwest of Boerne, on IH-10.

**Management Agreement between
Texas Department of Transportation
and Texas Parks and Wildlife Department**

LOCATION AND DESCRIPTION OF MANAGEMENT AREA: Kenedy County - rest area in the median of Highway 77, 8.6 miles south of the intersection of Highways 285 and 77 in Riviera (see attached map). The management area consists of a liveoak motte on sandy soils 3 miles south of Sarita, and entails the entire rest area.

MANAGEMENT TECHNIQUES CURRENTLY EMPLOYED:

Mowing: Mowed frequently.

Herbicides: Herbicides have been used on the live oaks in the rest area in an attempt to kill ball moss. It is not known if herbicides are used on delineator posts, pavement edges, etc. in the rest area.

Seeding or planting: St. Augustine grass.

Future plans: Removal of dead live oak limbs and ballmoss.

SPECIES OF CONCERN: Bailey's ballmoss (Tillandsia baileyi) - This Category 2 species is an epiphyte (a non-parasitic plant which derives its moisture and nutrients from the rain and air, and grows on other plants). The ball of silvery gray-green leaves hangs or perches on tree limbs, and is up to 12 inches in diameter. The flowers are large, showy, and blossom in February through May. They project from the plant on red-bracted spikes. The petals are about pale violet. This species is somewhat similar to the common ballmoss (Tillandsia recurvata), but in general is much larger and has much showier flowers. Also Bailey's ballmoss is stemless (all the leaves originate from a bulb-like structure) while ballmoss has leaves scattered along a short stem. The stamens of Bailey's ballmoss extend beyond the petals while the stamens of ballmoss do not.

Bailey's ballmoss grows in partial shade on the branches of medium- to large-size trees such as live oaks or Texas ebonies from south Texas to northeastern Mexico. The species is threatened habitat alteration and destruction, and overcollection.

This population is the only population known from highway right-of-way. Several other small populations are known, but this is one of the largest. Managing and monitoring this species will hopefully increase numbers of individuals in roadside populations as well as track the vigor and longevity of the individuals in the population.

RECOMMENDED MANAGEMENT PROCEDURES: Mowing does not have an affect on Bailey's ballmoss, and thus can be conducted as necessary. Herbicide use to control ballmoss should be discontinued. If ballmoss is felt to be a problem, plants should be removed by

hand or branches with several plants trimmed. The use of herbicides on delineator posts, pavement edges, etc. if required, should be applied by hand, or at times of little or no wind. No live oak trees which support individuals of Bailey's ballmoss should be cut down without consultation with TPWD. If such live oak trees or branches fall from natural causes and are presenting a hazard, Bailey's ballmoss should be rescued, TPWD contacted, and a suitable site found for reintroduction. No other species should be planted or seeded in the area. No material should be stockpiled in the area nor should any fill material be removed from the site. Any proposed disturbance of the right-of-way by other entities (i.e., utilities, local/state/federal agencies, etc.) should be reviewed by TxDOT and TPWD. If any change in management procedure is anticipated, the Texas Natural Heritage Program of the Texas Parks and Wildlife Department should be notified before changes are implemented.

MONITORING PROCEDURES: All individuals within the rest area will be counted, and their location within the tree noted by directional quadrant. Trees with Bailey's ballmoss will be tagged, and all trees in the rest area mapped. Four size classes (< 5 cm, 5-10 cm, 11-15 cm, >15 cm) will be established, and flowering stems for each individual will be tallied as a measure of vigor. Monitoring will be conducted on a yearly basis in fall by staff of the Endangered Resources Branch, Texas Parks and Wildlife Department.

RED FLAG CONDITIONS: A 10% decrease in the number of individuals of Bailey's ballmoss will be considered a significant decline in the population. Also over any consecutive three-year period, a 10% decline in the size or number of flowering stems of the population will be considered a significant reduction in vigor. If such conditions occur, the cause will be ascertained. If the cause is related to management, management recommendations may be altered.

LOCATION OF ARCHIVED DATA: Texas Natural Heritage Program, Texas Parks and Wildlife Department, 4200 Smith School Road, Austin, Texas 78744; and Texas Department of Transportation, 125 E. 11th, Austin, Texas 78701

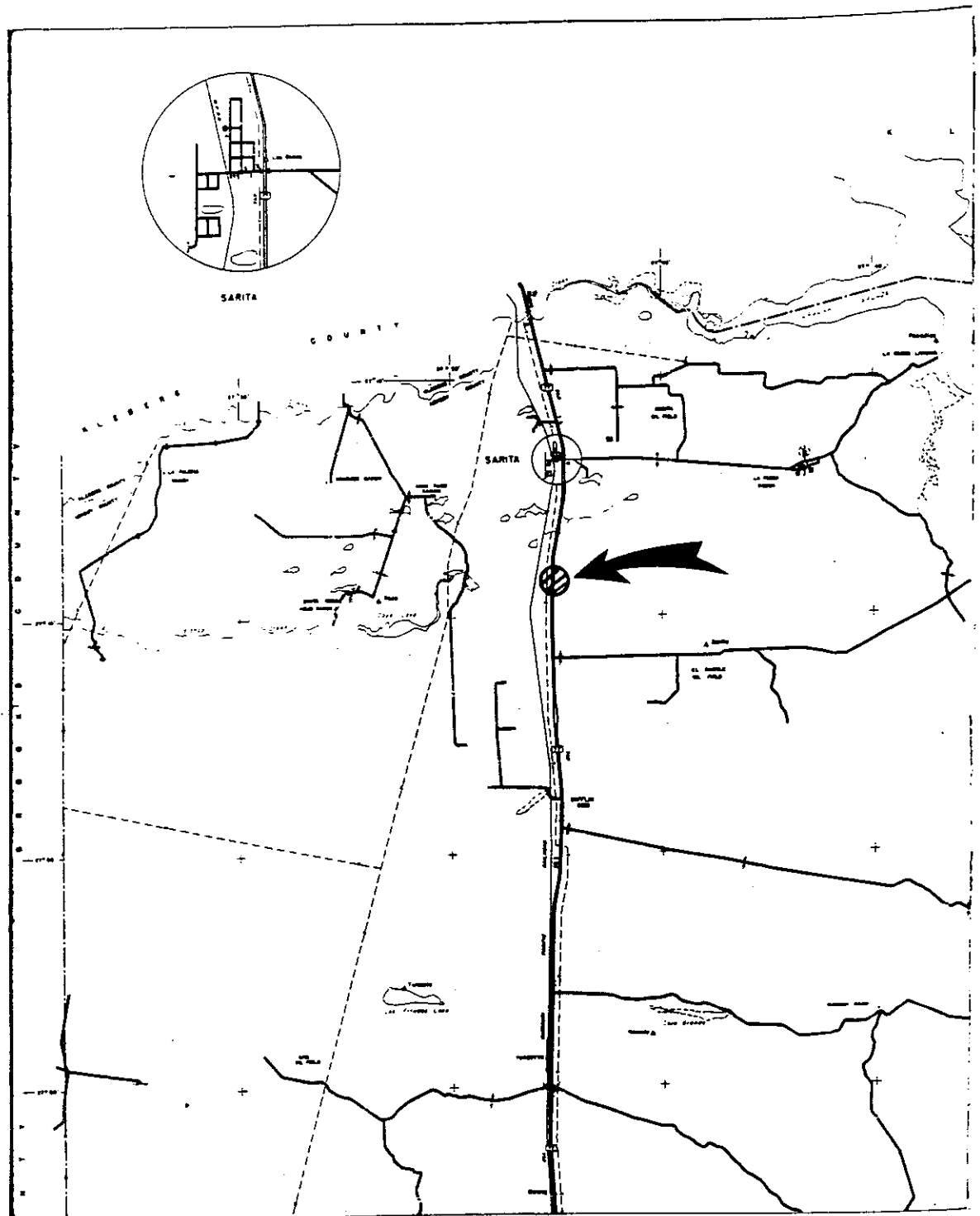
WRITTEN BY: Jackie M. Poole, Texas Natural Heritage Program, Resource Protection Division, Texas Parks and Wildlife Department, 4200 Smith School Road, Austin, Texas 78744

DATE WRITTEN: November 9, 1993

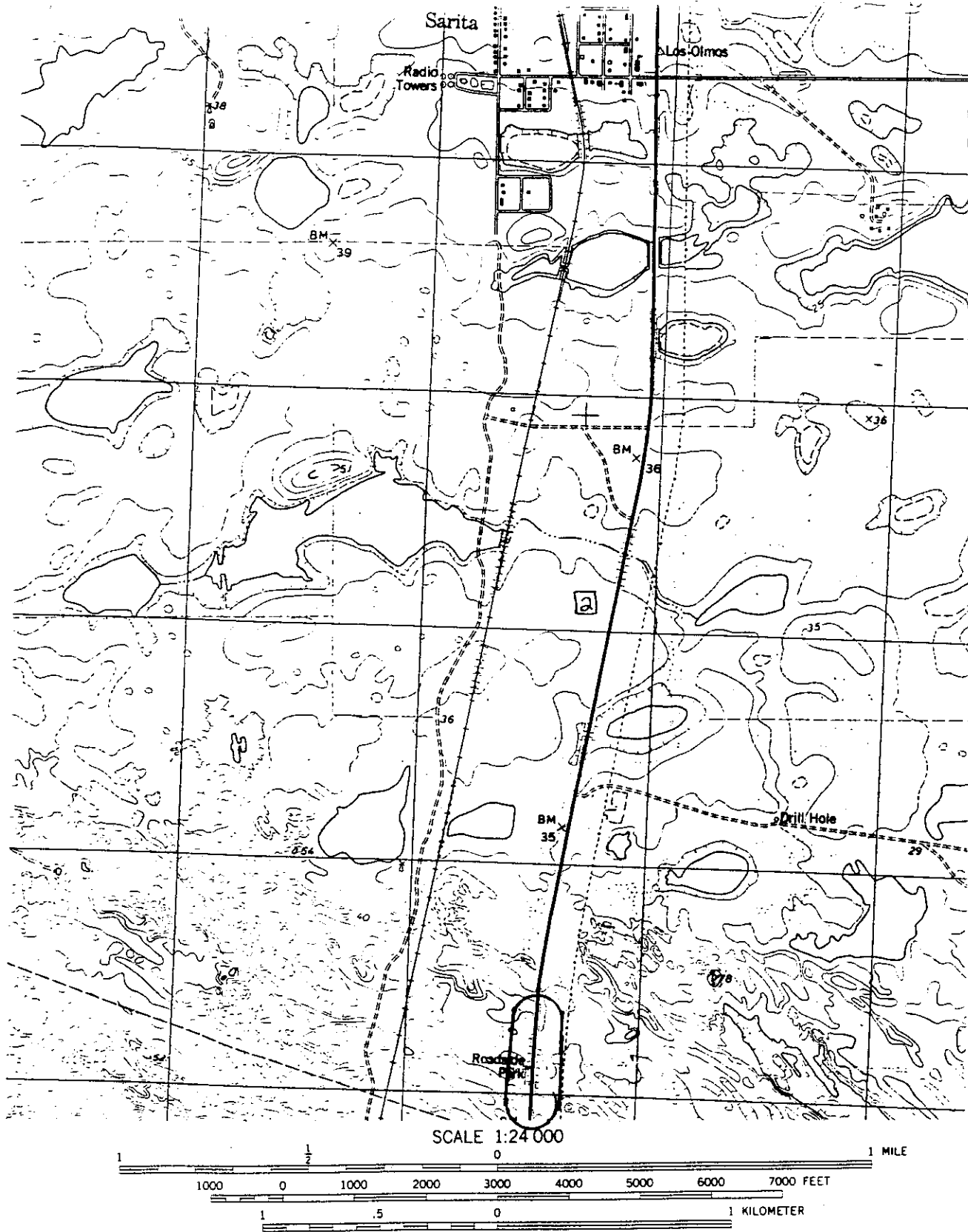
REVIEWED BY: Dennis Markwardt and David Dunlap

DATE REVIEWED: fall 1993

REVISED BY AND DATE: Jackie M. Poole; 30 December 1993
APPROVED BY AND DATE:



Management Area for Bailey's ballmoss
 Kenedy County - rest area in the median of Highway 77, 8.6 miles
 south of the intersection of Highways 285 and 77 in Riviera



Sarita 7.5' USGS Quadrangle

Location of Bailey's ball moss (*Tillandsia baileyi*) monitoring/management area in Kenedy County, south of Sarita, on Highway 77.

**Management Agreement between
Texas Department of Transportation
and Texas Parks and Wildlife Department**

LOCATION AND DESCRIPTION OF MANAGEMENT AREA: Kinney County - 11.0 miles north of the intersection of R.M. 674 and 334, along east side of RM 674 north of Brackettville (see attached map). The management area consists of a limestone rock outcrop with shallow clay soils.

MANAGEMENT TECHNIQUES CURRENTLY EMPLOYED: This site has not been visited with TxDOT personnel. Thus exact management concerns, techniques, and strategies are unknown. A meeting should be scheduled for February 1994.

SPECIES OF CONCERN:

Tobusch fishhook cactus (Ancistrocactus tobuschii) - This federally and state listed endangered species is low-growing (to 3 in. tall), small (to 4 in. in diameter), usually single-stemmed, dark green cactus. The spines consist of 7 to 12 straight outer spines and 3 to 5 central spines (the 2 or 3 upper ones point straight up while the lower ones spread away from the plant and are hooked on the end). The flowers are creamy yellow to green, and open in Mid-February to mid-March. The fruit is fleshy and green.

The Tobusch fishhook cactus is found on shallow gravelly soils on limestone rock outcrops in shortgrass grasslands in openings of live oak-juniper woodlands or in gravels along creek bottoms. It grows more or less in the full sun with an occasional rock or small plant offering a small amount of shade. The species is threatened by collection, habitat destruction and alteration, and predation.

This population represents the only plants presently verified as occurring on the highway right-of-way. Monitoring will help in determining individual longevity of this species as well as detecting any illegal collection activity or predation.

RECOMMENDED MANAGEMENT PROCEDURES: As current management of this site is unknown, the following recommendations may not represent any changes. The following management recommendations are subject to change once current management for the site is known.

Because the species grows so low to the ground, it is easily overgrown by many other species. Although mowing and certain brush clearing procedures may be beneficial by removing competing species or opening new habitat for colonization, heavy machinery may crush cacti. As the site is a rock outcrop, mowing is probably not feasible. Any brush clearing if required should be done on a limited basis by hand. If

necessary herbicides applied to the pavement edge, markers, etc., should be sparingly and carefully applied at times of little or no wind. No paving or construction materials should be stockpiled or removed in this area. No other species should be planted or seeded. Any proposed disturbance of the right-of-way by other entities (i.e., utilities, local/state/federal agencies, etc.) should be reviewed by TxDOT and TPWD. If any change in management procedure is anticipated, the Texas Natural Heritage Program of the Texas Parks and Wildlife Department should be notified before changes are implemented.

MONITORING PROCEDURES: Each individual of Tobusch fishhook cactus will be mapped using angles and distances from recognizable objects. The diameter of each plant will be measured, and the numbers of flowers and fruits recorded. This data will be used to track vigor. Monitoring will continue on a yearly basis in early spring. Monitoring will be conducted by staff of the Endangered Resources Branch, Texas Parks and Wildlife Department.

RED FLAG CONDITIONS: Any loss in the number of individuals of Tobusch fishhook cactus will be considered a significant decline in the population. Also over any consecutive three-year period, a 10% decline in the number of flowers/fruits of the population will be considered a significant reduction in vigor. If such conditions occur, the cause will be ascertained. If the cause is related to management, management recommendations may be altered.

LOCATION OF ARCHIVED DATA: Texas Natural Heritage Program, Texas Parks and Wildlife Department, 4200 Smith School Road, Austin, Texas 78744; and Texas Department of Transportation, Division of Environmental Affairs, 125 E. 11th, Austin, Texas 78701

WRITTEN BY: Jackie M. Poole, Texas Natural Heritage Program, Resource Protection Division, Texas Parks and Wildlife Department, 4200 Smith School Road, Austin, Texas 78744

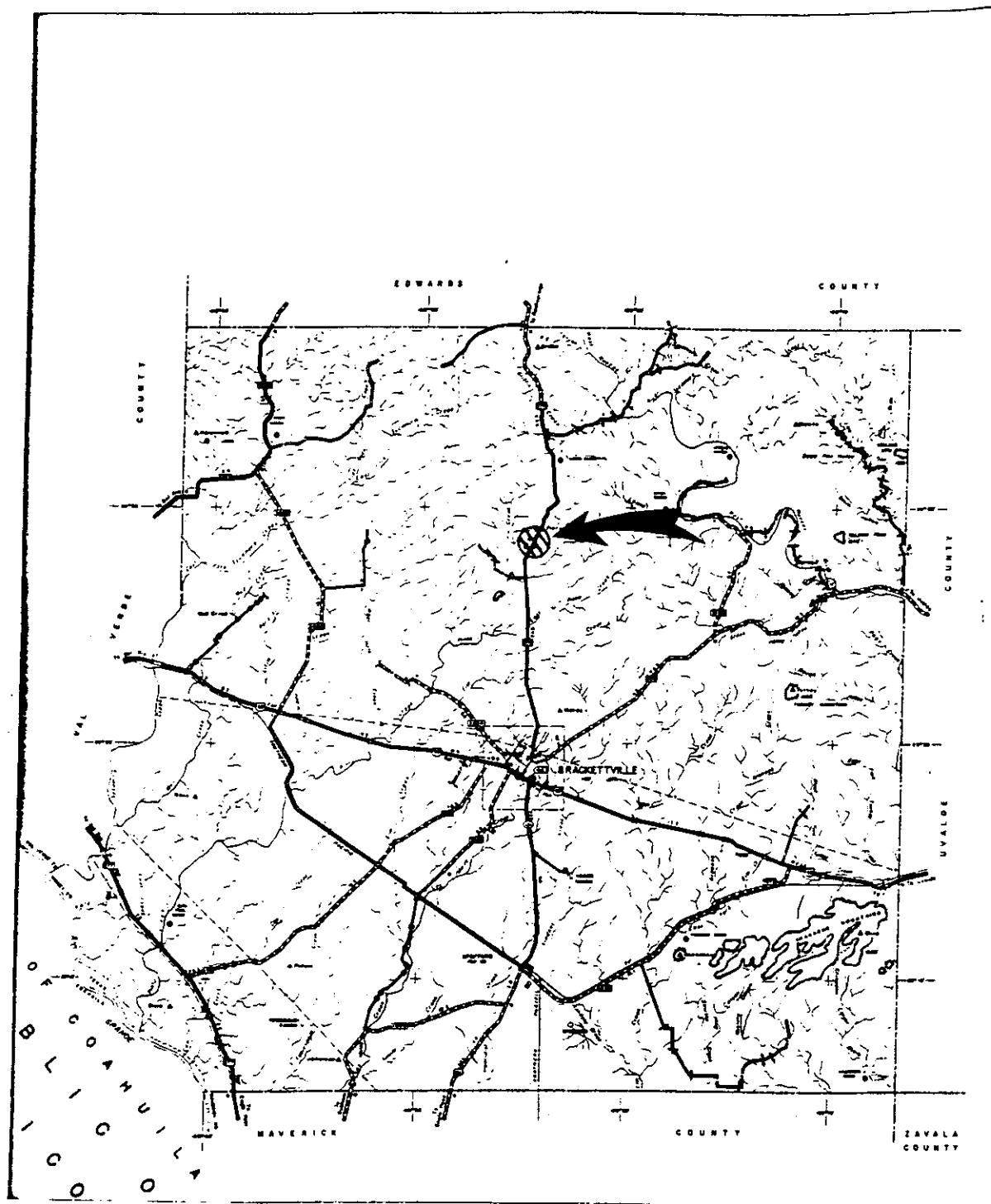
DATE WRITTEN: July 30, 1993

REVIEWED BY: Dennis Markwardt and David Dunlap

DATE REVIEWED: fall 1993

REVISED BY AND DATE: Jackie M. Poole; 30 December 1993

APPROVED BY AND DATE:



Management Area for Tobusch fishhook cactus
Kinney County - east side of RM 674,
11 miles north of the junction of RM 674 and Hwy 334

Management Agreement between
Texas Department of Transportation
and Texas Parks and Wildlife Department

LOCATION AND DESCRIPTION OF MANAGEMENT AREA: Nueces and Kleberg Counties - 0.2 miles northeast (just south of Carreta Creek) to 0.4 miles southwest of the Kleberg/Nueces County line on both sides of Highway 77 just south of Bishop (see attached map). The management area consists of grassland with mesquite and other shrub invasion in some areas.

MANAGEMENT TECHNIQUES CURRENTLY EMPLOYED:

Mowing: The management area is full-width mowed four times a year, and strip mowed every six weeks May through December.

Herbicides: Used along pavement edge and around markers, culverts, etc.

Seeding: None mentioned.

Future plans: No changes anticipated.

SPECIES OF CONCERN: Slender rush-pea (Hoffmannseggia tenella) is a small, low-growing delicate perennial legume to 6 inches tall. This federal and state listed endangered species has few to numerous branches at the base. The leaves are twice compound, that is each leaf is divided into leaflets which are divided once again. Thus each leaf has 3 to 7 primary division with each division having 5 to 6 pairs of oblong, small leaflets. The 3 to 5 small flowers per stalk are salmon to orange-colored, and usually do not arise above the leaves. The flowers bloom April through November. The fruits are small, straight, hairy, and resemble pea pods. This species grows on clayey soils near creeks in short-grass grasslands.

South Texas ambrosia (Ambrosia cheiranthifolia) is an erect, silvery to grayish- or yellowish-green perennial to 1½ feet tall. This proposed endangered species has simple, more or less oblong, hairy, gray leaves that are opposite near the base of the plant, and become alternate higher up the stem. This member of the sunflower family has small, yellow flowers. The male flowers are borne along the upper 2-4 inches of the stem, and look like hanging bowls. The inconspicuous female flowers are borne in the small clusters at the base of the leaves below the male flowers. The fruits are hard and spiny. South Texas ambrosia grows in deep clay soils in grasslands and mesquite-dominated shrublands on the coastal prairie.

Both species suffer from habitat destruction or alteration. Most habitats in this area of Texas have been converted to agricultural fields, energy production sites, or urban areas. Little natural habitat remains.

These populations of slender rush-pea and South Texas ambrosia represent the only known occurrences of these species on highway right-of-way. They are the only easily accessible populations on public land. Monitoring will aid in establishing life history and the reaction of the species to known management practices.

RECOMMENDED MANAGEMENT PROCEDURES: As the slender rush-pea grows so low to the ground, the species benefits from frequent mowing. The mowing schedule in this area is adequate. However the South Texas ambrosia would be seriously affected by frequent mowing particularly during flowering and fruiting. However this species can also be overgrown by taller species or shrubs if mowing is eliminated. For the South Texas ambrosia mowing once in the spring and again in the late fall after the species has gone to seed should deter shrub encroachment or overtopping by tall grasses. If necessary herbicides applied to the pavement edge, markers, culverts, etc. should be sparingly and carefully applied at times of little or no wind. No paving or construction materials should be stockpiled or removed within the management area. No other species should be planted or seeded. Any proposed disturbance of the right-of-way by other entities (i.e., utilities, local/state/federal agencies, etc.) should be reviewed by TxDOT and TPWD. If any change in management procedure is anticipated, the Texas Natural Heritage Program of the Texas Parks and Wildlife Department should be notified before changes are implemented.

MONITORING PROCEDURES: As South Texas ambrosia is a clonal species, counting number of individuals will not be feasible. Thus number of stems will be tallied within staked plots. Flowering and/or fruiting stems will be noted. For slender rushpea two parallel 1 X 120 meter belt transects will be set up at the southwest-most population cluster. Within the plots all rooted individual slender rushpeas will be counted. All plots will be permanently marked and triangulated from known objects. Monitoring will continue on a yearly basis in the fall and will be conducted by staff of the Endangered Resources Branch, Texas Parks and Wildlife Department.

RED FLAG CONDITIONS: A 10% annual decrease in the number of individuals of slender rushpea or number of stems of South Texas ambrosia will be considered a significant decrease in the population. Also, over any consecutive three-year period, a 10% decline in the number of flowers and fruits of the slender rushpea or the number of flowering/fruiting stems of South Texas ambrosia will be considered a significant reduction of vigor. If such conditions occur, the cause will be ascertained. If the cause is related to management, management recommendations may be altered.

LOCATION OF ARCHIVED DATA: Texas Natural Heritage Program, Texas Parks and Wildlife Department, 4200 Smith School Road, Austin,

Texas 78744; and Texas Department of Transportation, Division of Environmental Affairs, 125 E. 11th, Austin, Texas 78701.

WRITTEN BY: Jackie M. Poole, Texas Natural Heritage Program, Resource Protection Division, Texas Parks and Wildlife Department, 4200 Smith School Road, Austin, Texas 78744

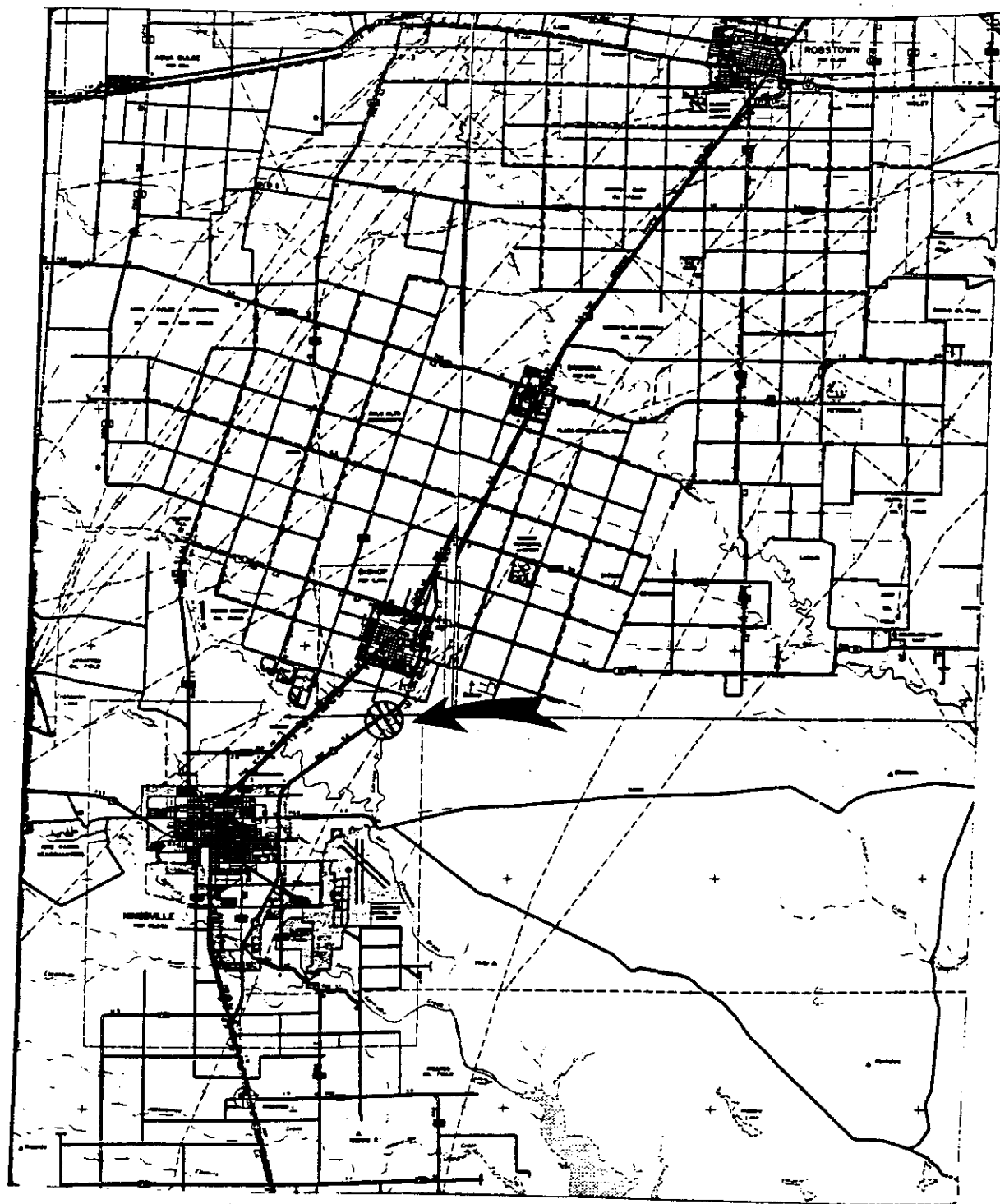
DATE WRITTEN: August 18, 1993

REVIEWED BY: Dennis Markwardt and David Dunlap

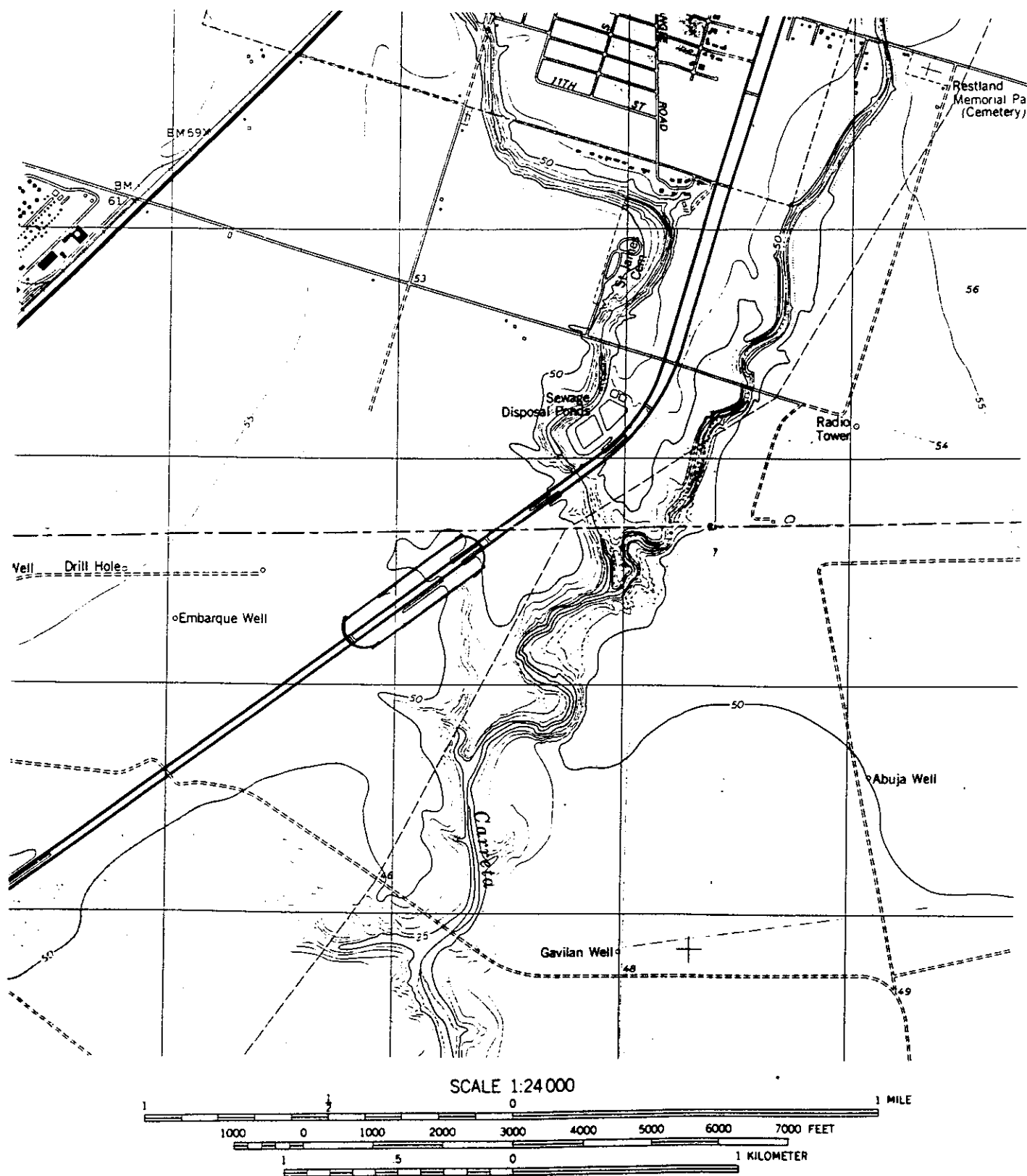
DATE REVIEWED: fall 1993

REVISED BY AND DATE: Jackie M. Poole; 30 December 1993

APPROVED BY AND DATE:

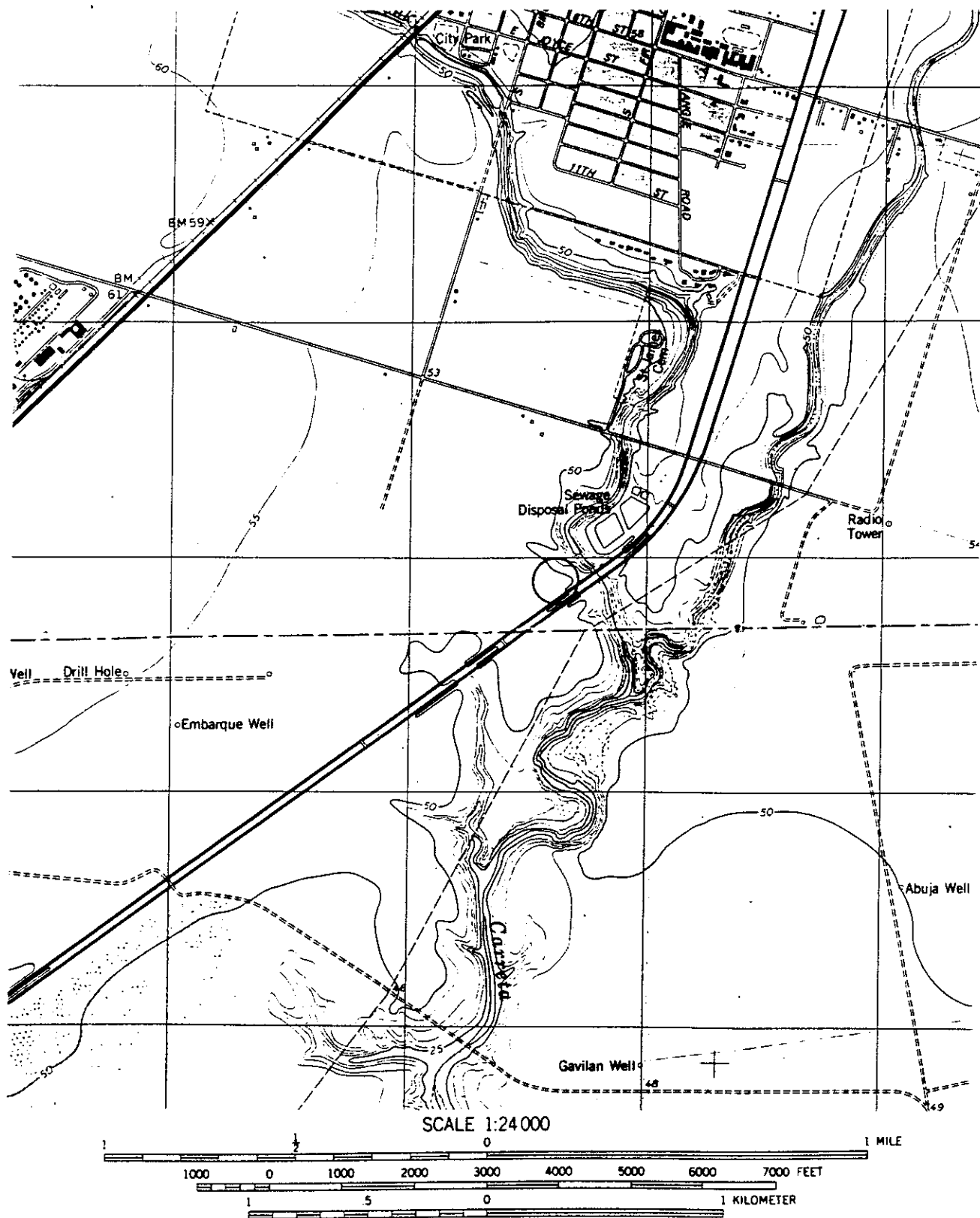


Management Area for slender rushpea and South Texas ambrosia
Nueces/Kleberg Counties - both sides of Highway 77
just south of Bishop,
0.2 miles northeast to 0.4 miles southwest
of the Kleberg/Nueces County line



Kingsville East 7.5' USGS Quadrangle

Location of slender rush-pea (*Hoffmannseggia tenella*) monitoring/management area in Kleberg County, southwest of Carreta Creek, on Highway 77.



Kingsville East 7.5' USGS Quadrangle

Location of South Texas ambrosia (*Ambrosia cheiranthifolia*) monitoring/management area in Kleberg County, just southwest of Carreta Creek, on Highway 77.

**Management Agreement between
Texas Department of Transportation
and Texas Parks and Wildlife Department**

LOCATION AND DESCRIPTION OF MANAGEMENT AREA: Pecos County - both sides of Highways 67/385, 5.4-6.4 miles northeast of the intersection of Highways 67/385 and the northern access road of IH-10 (see attached map). The management area consists of rolling terrain with very shallow, rocky (limestone, gypsum?) soils, and is delineated the picnic area to the north and the University of Texas lands fence on the south.

MANAGEMENT TECHNIQUES CURRENTLY EMPLOYED:

Mowing: Full width mowed (fall) and strip mowed (July).
Herbicides: Used on guardrails and pavement edges.
Seeding or planting: None.
Future plans: No changes anticipated.

SPECIES OF CONCERN: Tharp's blue-star (Amsonia tharpii) - This Category 2 species is a small bushy perennial to 10 inches tall. The leaves are distinctive in that the lower stem leaves are broader and larger than the upper stem leaves. The flowers are borne in clusters on the stem tips, and are pale blue, or almost white. The narrow tube is slightly less than $\frac{1}{4}$ inch long, and terminates in a five-parted, star-shaped opening. The flowers bloom April through June. The fruits are long, cylindrical pods to 5 inches long. The seeds are corky cylinders less than $\frac{1}{4}$ long.

Tharp's blue-star grows in full sun in shallow, rocky (limestone, possibly with some gypsum) soils. The surrounding community is a transitional phase from Edwards Plateau woodland to Chihuahuan Desert shrubland; however the highway right-of-way is a short grassland as a result of frequent mowing. The species is threatened by habitat destruction and alteration, and small population numbers.

This population is the only population known from highway right-of-way, and the only one of two known populations in existence. Managing and monitoring this species will hopefully increase numbers of individuals in roadside population as well as track the vigor and longevity of the individuals in the population.

RECOMMENDED MANAGEMENT PROCEDURES: Full width mowing should be done in late fall only if necessary for safety of the species and/or the public. Strip mowing should be avoided if possible during the flowering and fruiting season from March to July. If strip or full-width mowing are required for safety reasons, mowers should be set at 12 inches to avoid as much damage to the plants as possible. The use of herbicides on guardrails or pavement edges, if required, should be applied by hand, or at times of little or no wind. No other species should be

planted or seeded in the area. No material should be stockpiled in the area nor should any fill material be removed from the site. Any proposed disturbance of the right-of-way by other entities (i.e., utilities, local/state/federal agencies, etc.) should be reviewed by TxDOT and TPWD. If any change in management procedure is anticipated, the Texas Natural Heritage Program of the Texas Parks and Wildlife Department should be notified before changes are implemented.

MONITORING PROCEDURES: All individuals will be counted, and their location will be triangulated from tagged fence posts. The number of stems, plant height, and numbers of flowers/fruits will be counted or measured as an evaluation of vigor. Monitoring will be conducted on a yearly basis in late spring by staff of the Endangered Resources Branch, Texas Parks and Wildlife Department.

RED FLAG CONDITIONS: A 10% decrease in the number of individuals of Tharp's bluestars will be considered a significant decline in the population. Also over any consecutive three-year period, a 10% decline in the number of stems or flowers/fruits, or plant height, will be considered a significant reduction in vigor. If such conditions occur, the cause will be ascertained. If the cause is related to management, management recommendations may be altered.

LOCATION OF ARCHIVED DATA: Texas Natural Heritage Program, Texas Parks and Wildlife Department, 4200 Smith School Road, Austin, Texas 78744; and Texas Department of Transportation, 125 E. 11th, Austin, Texas 78701

WRITTEN BY: Jackie M. Poole, Texas Natural Heritage Program, Resource Protection Division, Texas Parks and Wildlife Department, 4200 Smith School Road, Austin, Texas 78744

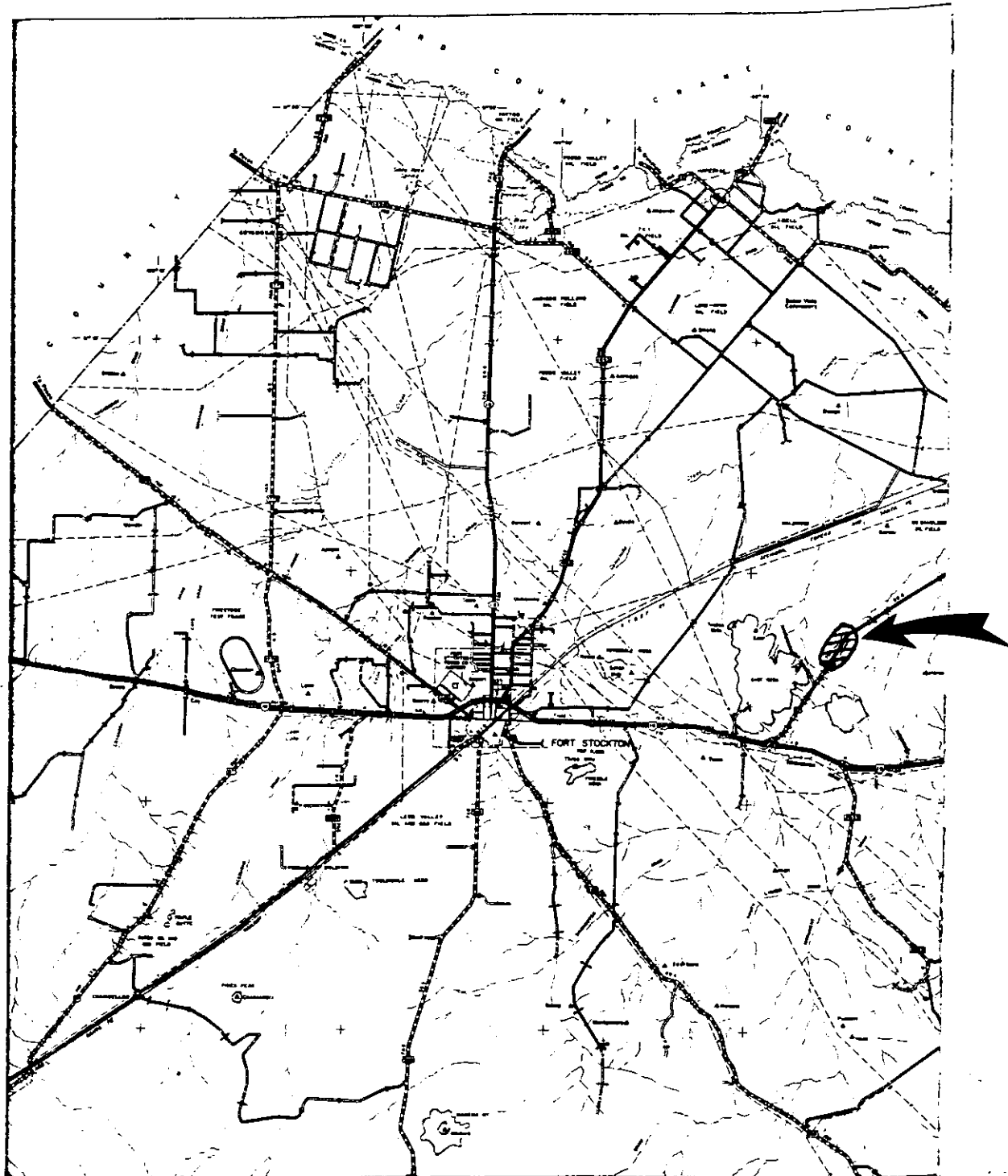
DATE WRITTEN: November 9, 1993

REVIEWED BY: Dennis Markwardt and David Dunlap

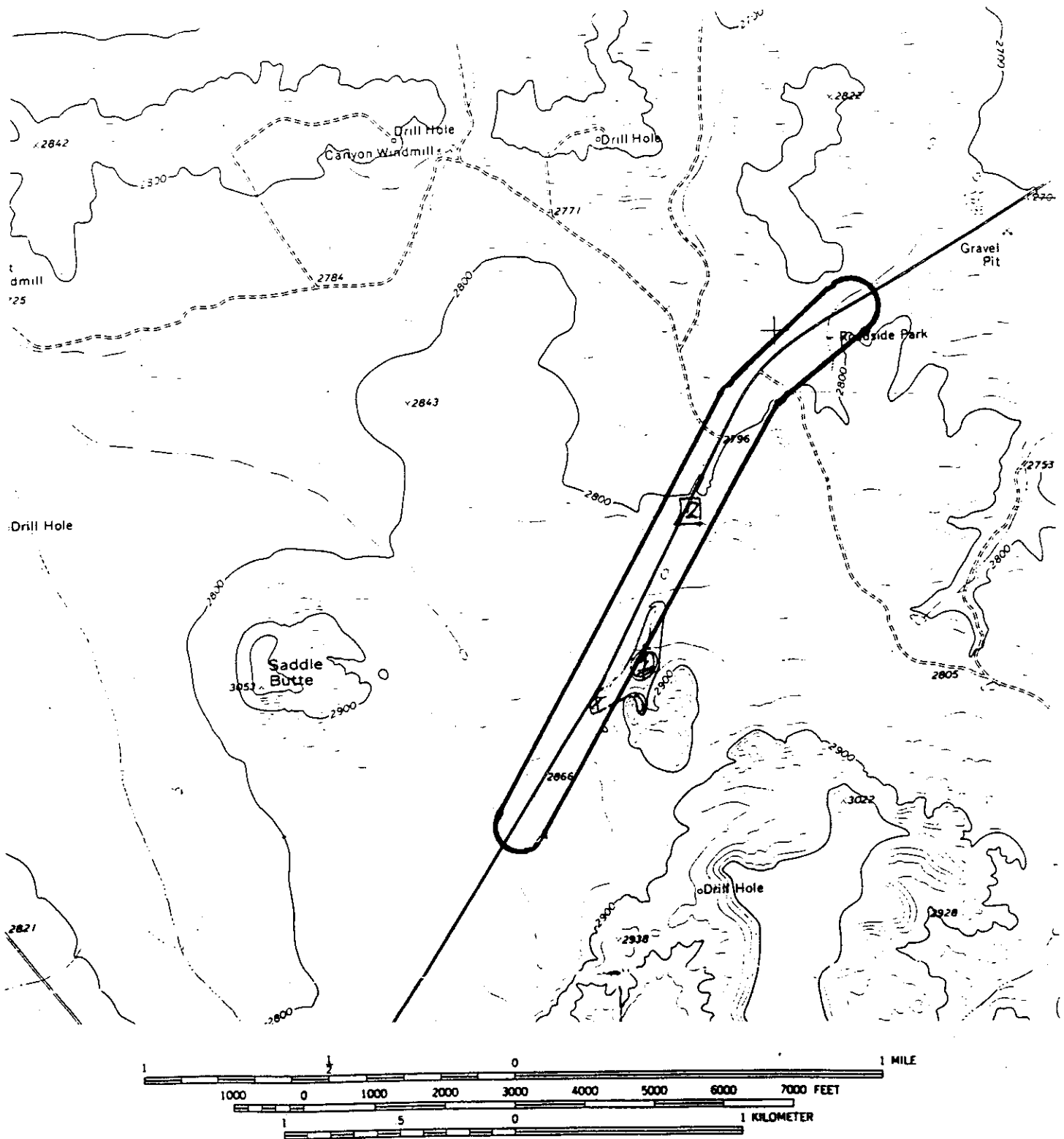
DATE REVIEWED: fall 1993

REVISED BY AND DATE: Jackie M. Poole; 30 December 1993

APPROVED BY AND DATE:



Management Area for Tharp's bluestar
Pecos County - both sides of Hwy 67/385, 5.4-6.4 miles northeast
of the intersection of Hwy 67/385 and north access road of IH-10



Saddle Butte 7.5' USGS Quadrangle

Location of Tharp's blue-star (*Amsonia tharpii*) monitoring/management area located in Pecos County, on Highway 67/385.

**Management Agreement between
Texas Department of Transportation
and Texas Parks and Wildlife Department**

LOCATION AND DESCRIPTION OF MANAGEMENT AREA: Pecos County - along IH-10 east of Fort Stockton at Reference Marker 285. The management area encompasses the southeast quadrant of the McKenzie overpass interchange along IH-10 east of Fort Stockton (see attached map). The triangular area is a mesquite grassland.

MANAGEMENT TECHNIQUES CURRENTLY EMPLOYED:

Mowing: Only a 30 foot wide strip along the roadside is mowed.

Herbicides: Used along road edge, delineator posts, sign, object markers, and structures.

Seeding: None.

Future plans: No changes anticipated.

SPECIES OF CONCERN:

Lloyd's hedgehog cactus (Echinocereus lloydii) - This cactus is listed by both the state and federal governments as endangered. The stems are one or several in a clump and cylindrical in shape. The numerous spines practically hide the stem, and are in clusters along ribs or ridges. The flowers are quite showy, come in various shades of red, and blossom April to May. The fruit is greenish and egg-shaped with numerous small, black, warty seeds.

Lloyd's hedgehog cactus is known from several sites in Texas, New Mexico, and Mexico. Overcollection by cactus enthusiasts and habitat destruction by agricultural and petroleum interests have threatened this species.

The population on highway right-of-way represents the largest population on public land within the state. Protection of this site will aid in the recovery of this species.

RECOMMENDED MANAGEMENT PROCEDURES: Two 15 foot widths may be mowed along the pavement edge of the mainlanes and ramps. Consistent with TxDOT's roadside vegetation management standards, mowing can be done at any time of year. If necessary herbicides should be applied carefully and sparingly during times of little or no wind along the road edge and on Johnson grass or mesquite within the mowing area. No paving or construction materials should be stockpiled in the management area. No other species should be seeded or planted. Any proposed disturbance of the right-of-way by other entities (i.e., utilities, local/state/federal agencies, etc.) should be reviewed by TxDOT and TPWD. If any change in management procedure is anticipated, the Texas Natural Heritage Program of the Texas Parks and Wildlife Department should be notified before changes are implemented.

MONITORING PROCEDURES: The Highway Department will grid off the management area into 100 by 100 foot square plots. During the blooming period in April, the staff of the Endangered Resources Branch of Texas Parks and Wildlife Department will count and record number of individuals within each plot. As an assessment of vigor, number, length, and diameter of stems will be tabulated, and number of flowers per plant will be counted.

RED FLAG CONDITIONS: A 10% annual decrease in the number of individuals of Lloyd's hedgehog cactus will be considered as a significant decline in the population. Also over any consecutive three-year period, a 10% decrease in the number, length, and diameter of stems or the number of flowers within the population will be considered to be a significant reduction in vigor. If such conditions occur, the cause will be ascertained. If the cause is related to management actions, management recommendations may be altered.

LOCATION OF ARCHIVED DATA: Texas Natural Heritage Program, Texas Parks and Wildlife Department, 4200 Smith School Road, Austin, Texas 78744; and Texas Department of Transportation, Division of Environmental Affairs, 125 E. 11th, Austin, Texas 78701.

WRITTEN BY: Jackie M. Poole, Texas Natural Heritage Program, Resource Protection Division, Texas Parks and Wildlife Department, 4200 Smith School Road, Austin, Texas 78744

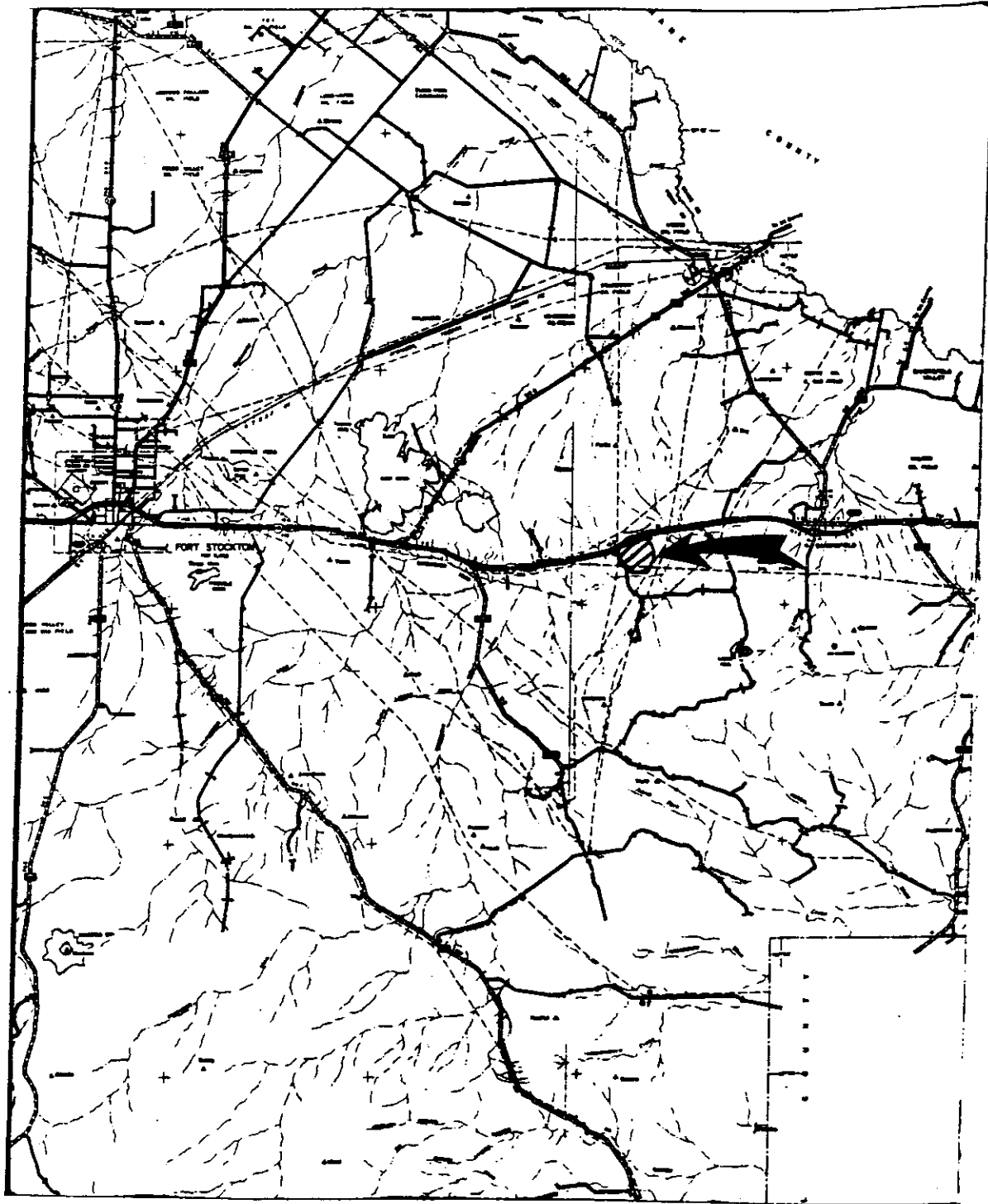
DATE WRITTEN: December 20, 1991; August 18, 1993 (minor revision)

REVIEWED BY: Dennis Markwardt, David Dunlap, Lynn G. Passmore and Laurie G. Williams

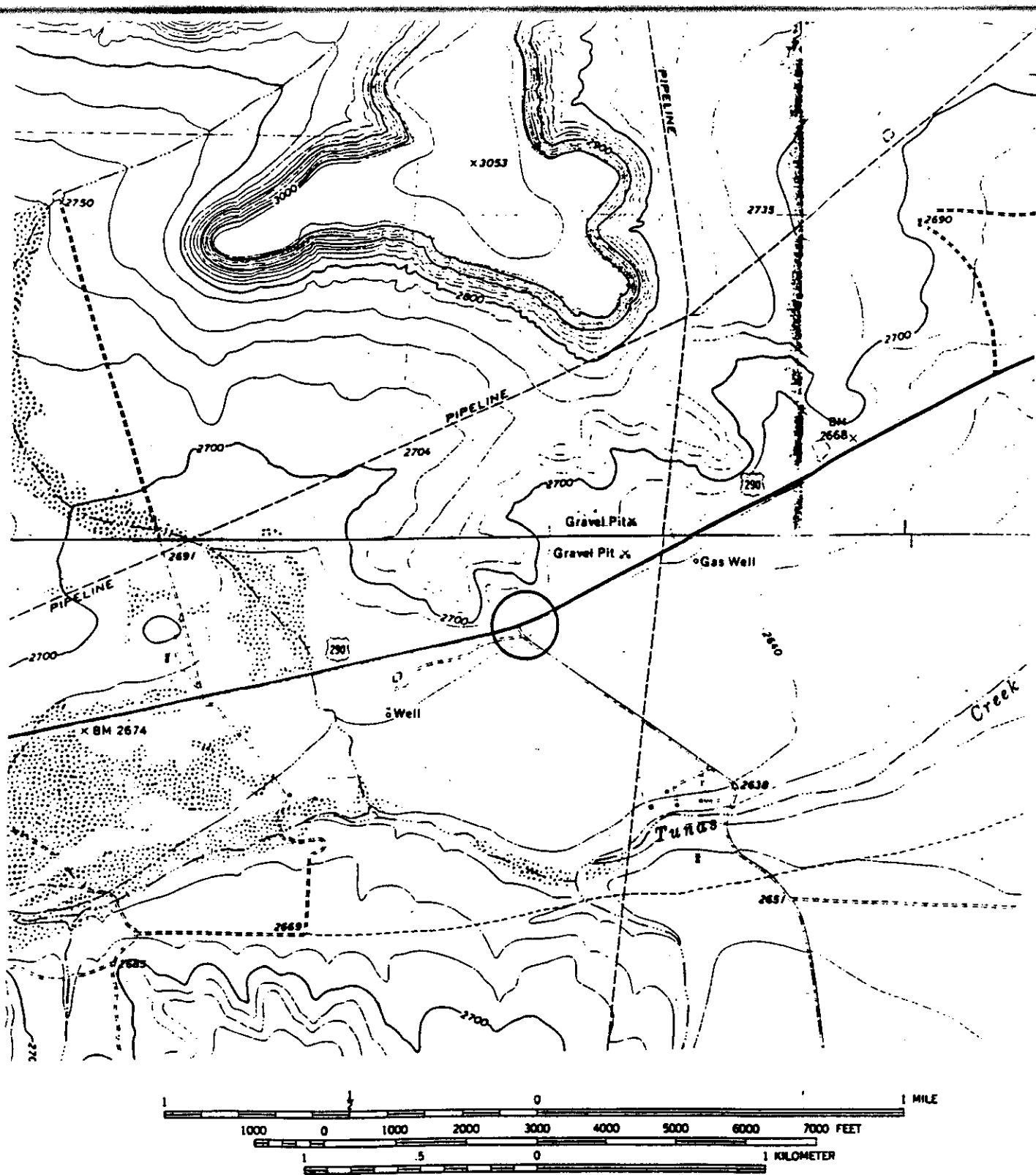
DATE REVIEWED: fall 1993

REVISED BY AND DATE: Jackie M. Poole, 30 December 1993

APPROVED BY AND DATE:



Management Area for Lloyd's hedgehog cactus
Pecos County - southeast quadrant of the McKenzie overpass
interchange on IH-10, east of Fort Stockton



Skyscraper Peak 7.5' USGS Quadrangle

Location of Lloyd's hedgehog cactus (*Echinocereus lloydii*) monitoring/management area located in Pecos County, east of Fort Stockton, on IH-10.

Management Agreement between
Texas Department of Transportation
and Texas Parks and Wildlife Department

LOCATION AND DESCRIPTION OF MANAGEMENT AREA: Pecos County - 10.1 miles north of the intersection of IH-10 and Highway 18, north of Fort Stockton (see maps). The management area includes the fenced area either side of Diamond Y drainage, and either side of the right-of-way for one mile south of the Diamond Y drainage bridge. Diamond Y drainage is a small, shallow stream surrounded by dense vegetation of grasses and herbs. South of the bridge the puzzle sunflowers are usually close to the fence where the ground is wetter.

MANAGEMENT TECHNIQUES CURRENTLY EMPLOYED:

Mowing: None within the fenced area immediately around Diamond Y drainage; mowing full width annually and one mower width at various times in the rest of the management area.

Herbicides: None used on the bridge or the immediate area; used on signs, delineator posts, objects markers, and road edge in southern part of management area.

Seeding: None.

Future plans: None anticipated.

SPECIES OF CONCERN

Puzzle sunflower (Helianthus paradoxus) - This tall annual sunflower is currently listed by the U. S. Fish and Wildlife Service as Category 1 (awaiting listing). The stems and leaves are rough to the touch. The leaves are long and narrow. Numerous sunflowers are borne on many branches at the top of the plant. Seedlings become visible in the summer, and grow quickly before blooming for a brief period in late August to early October.

Puzzle sunflower is known from one population in Texas and three in New Mexico. The Texas population is by far the largest. However the species is no longer found at many historical localities as ground water pumping has depleted the water table to a great extent, and the species is dependent on saturated soil.

The puzzle sunflowers on the highway right-of-way are part of the much larger population along Diamond Y and Leon Creeks. The plants on the highway right-of-way represent the only puzzle sunflowers on public land in Texas. Through careful monitoring and management of this sub-population, we can learn how current management policies effect this species.

RECOMMENDED MANAGEMENT PROCEDURES: Current management practices for the management area in the immediate vicinity of Diamond Y drainage should continue. For the area on either side of

the right-of-way one mile south of the bridge, full width mowing should be done December to June. From July through November only a lane one mower width wide should be done to protect the puzzle sunflowers. Herbicides should be used carefully and sparingly at times of little or no wind. Herbicides should not be used on the bridge guard rail, and vegetation there should be hand trimmed. Along the road edge and around structures vegetation should be hand trimmed or hand-hosed herbicides can be used with care. If any change in management procedure is anticipated, the Texas Natural Heritage Program of the Texas Parks and Wildlife Department should be notified before changes are implemented.

MONITORING PROCEDURES: The highway right-of-way along Diamond Y drainage will be divided into 26 approximately 5 X 10 m² plots. Numbers of individuals within each plot will be counted, and density per square meter per plot will be calculated. Monitoring will continue on a yearly basis in September. Monitoring will be conducted by Jackie Poole of the Texas Natural Heritage Program, Texas Parks and Wildlife Department.

RED FLAG CONDITIONS: A 10% annual decrease in the number of individuals of puzzle sunflower will be considered a significant decrease in the population. If such conditions occur, the cause will be ascertained. If the cause is related to management practices, management may be altered.

LOCATION OF ARCHIVED DATA: Texas Natural Heritage Program, Texas Parks and Wildlife Department, 4200 Smith School Road, Austin, Texas; and Texas Department of Transportation, La Costa Complex, 6400 U.S. 290 East, Austin, Texas

WRITTEN BY: Jackie M. Poole, Texas Natural Heritage Program, Resource Protection Division, Texas Parks and Wildlife Department, 4200 Smith School Road, Austin, Texas 78744

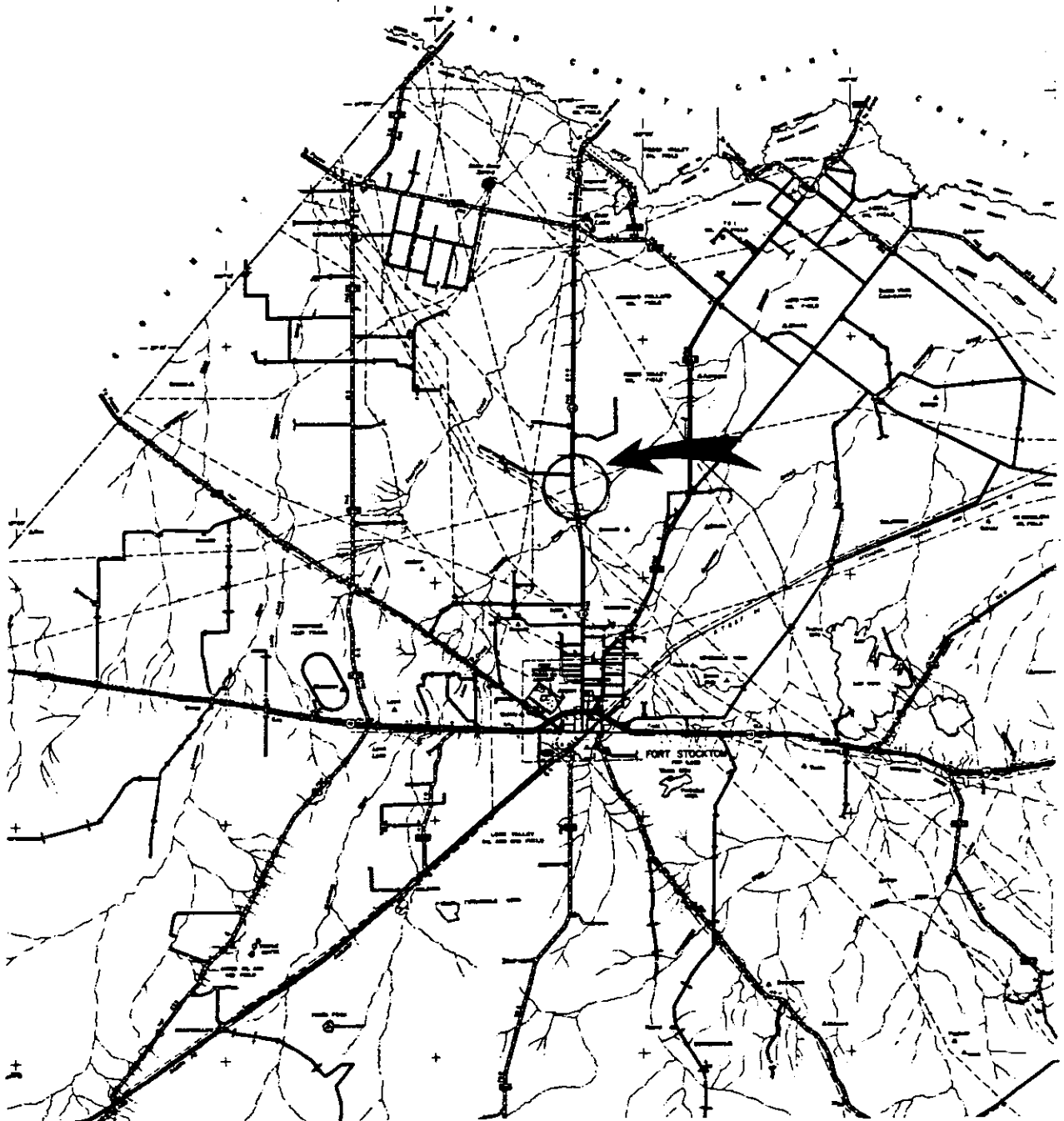
DATE WRITTEN: December 20, 1991

REVIEWED BY:

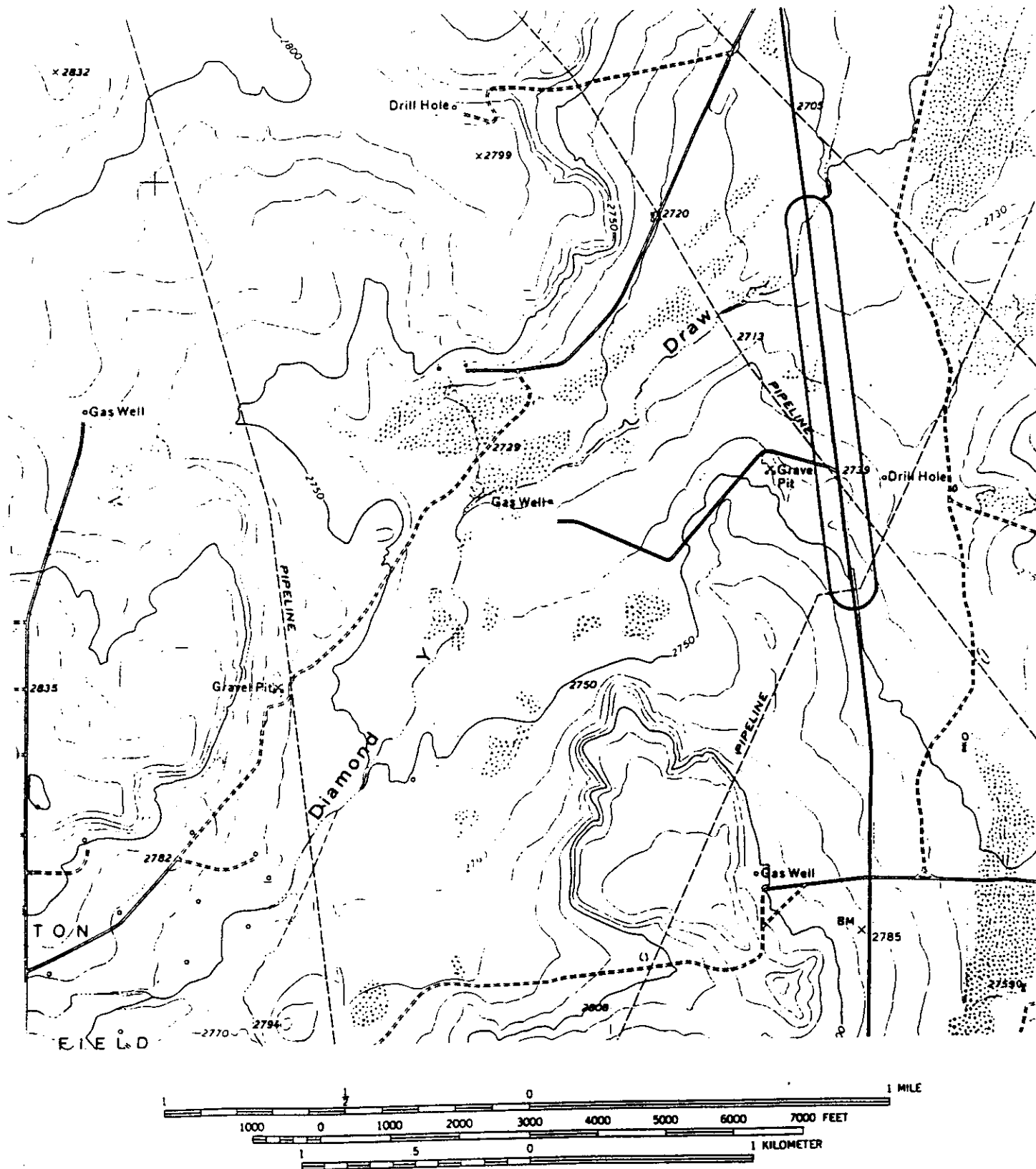
DATE REVIEWED:

REVISED BY AND DATE:

APPROVED BY AND DATE:



Management Area for puzzle sunflower
Pecos County - 10.1 miles north of the IH 10/Highway 18 intersection
on Highway 18, north of Fort Stockton



Diamond Y Spring 7.5' USGS Quadrangle

Location of puzzle sunflower (*Helianthus paradoxus*) monitoring/management area located in Pecos County, north of Fort Stockton, on State Route 18.

**Management Agreement between
Texas Department of Transportation
and Texas Parks and Wildlife Department**

LOCATION AND DESCRIPTION OF MANAGEMENT AREA: Runnels County - 0.7-2.7 miles southwest of the intersection of Highway 67 and FM 2133 south of Ballinger (see attached map). The management area includes both of the access roads rights-of-way, and has deep sandy soils with numerous wildflowers and grasses. Both ends of the management area are marked with "Wildflower Research Area" signs.

MANAGEMENT TECHNIQUES CURRENTLY EMPLOYED:

Mowing: Full width once a year (in late fall) and one mower width anytime July through January.

Herbicides: Used on delineator posts, object markers, signs, culverts, and pavement edge.

Seeding: Texas bluebonnets.

Future plans: No changes anticipated.

SPECIES OF CONCERN:

Texas poppy-mallow (Callirhoe scabriuscula) - This species is listed as endangered by both the federal and state governments. This plant is an erect perennial with 3-5 lobed leaves and large, attractive, wine-colored, cup-shaped flowers which open May to June. The fruits are flattened, disk-shaped, and partitioned into 12-20 grapefruit-like sections.

The Texas poppy-mallow is only found on deep sands in the vicinity of the Colorado River. Various activities such as sand mining, soil stabilization, agriculture, and urbanization threaten the Texas poppy-mallow. Since the Highway Department altered its mowing schedule (mowing after the Texas poppy-mallow disperses its seeds), the population on the right-of-way has increased.

The management area represents the largest population of the Texas poppy-mallow on public land. Through monitoring and careful management of these individuals, we can aid in this species' recovery.

RECOMMENDED MANAGEMENT PROCEDURES: Mowing can be conducted from July 15 to March 1 on any of the medians or rights-of-way within the management area. The three center medians can be mowed in late June if vegetation is presenting a safety hazard. A 100 foot cut around crossovers can be mowed at any time for safety reasons. If necessary herbicides should be sparingly and carefully applied at times of little or no wind. No paving or construction materials should be stockpiled in the management area. No other species should be seeded or planted. Any proposed disturbance of the right-of-way by other entities (i.e., utilities, local/state/federal agencies, etc.) should be reviewed by TxDOT and TPWD. If any change in

management procedure is anticipated, the Texas Natural Heritage Program of the Texas Parks and Wildlife Department should be notified before changes are implemented.

MONITORING PROCEDURES: Both sides of the two-mile stretch of access road right-of-way will be divided into 0.1 mile segments. Within each segment all individuals will be counted. As a measure of vigor, the number of stems, the number of viable and non-viable buds, flowers, and fruits will be tallied. Stem height will be measured in the future as an additional measure of vigor. All multiple-stemmed plants will have vigor parameters measured while a random sample of at least 100 single-stemmed individuals will be measured. All multiple-stemmed plants and 15 randomly selected single-stemmed plants will be permanently marked to evaluate longevity and vigor through time. Monitoring will continue on a yearly basis in late May. Monitoring will be conducted by the staff of the Endangered Resources Branch, Texas Parks and Wildlife Department.

RED FLAG CONDITIONS: A 10% annual decrease in the number of individuals of Texas poppy-mallows will be considered a significant decline. Over any consecutive three-year period, a 10% decline in the total number of stems, flowers, or fruits will be considered a significant reduction in vigor. If such conditions occur, the cause will be ascertained. If the cause is related to management, management recommendations may be altered.

LOCATION OF ARCHIVED DATA: Texas Natural Heritage Program, Texas Parks and Wildlife Department, 4200 Smith School Road, Austin, Texas 78744; and Texas Department of Transportation, Division of Environmental Affairs, 125 E. 11th, Austin, Texas 78701.

WRITTEN BY: Jackie M. Poole, Texas Natural Heritage Program, Resource Protection Division, Texas Parks and Wildlife Department, 4200 Smith School Road, Austin, Texas 78744

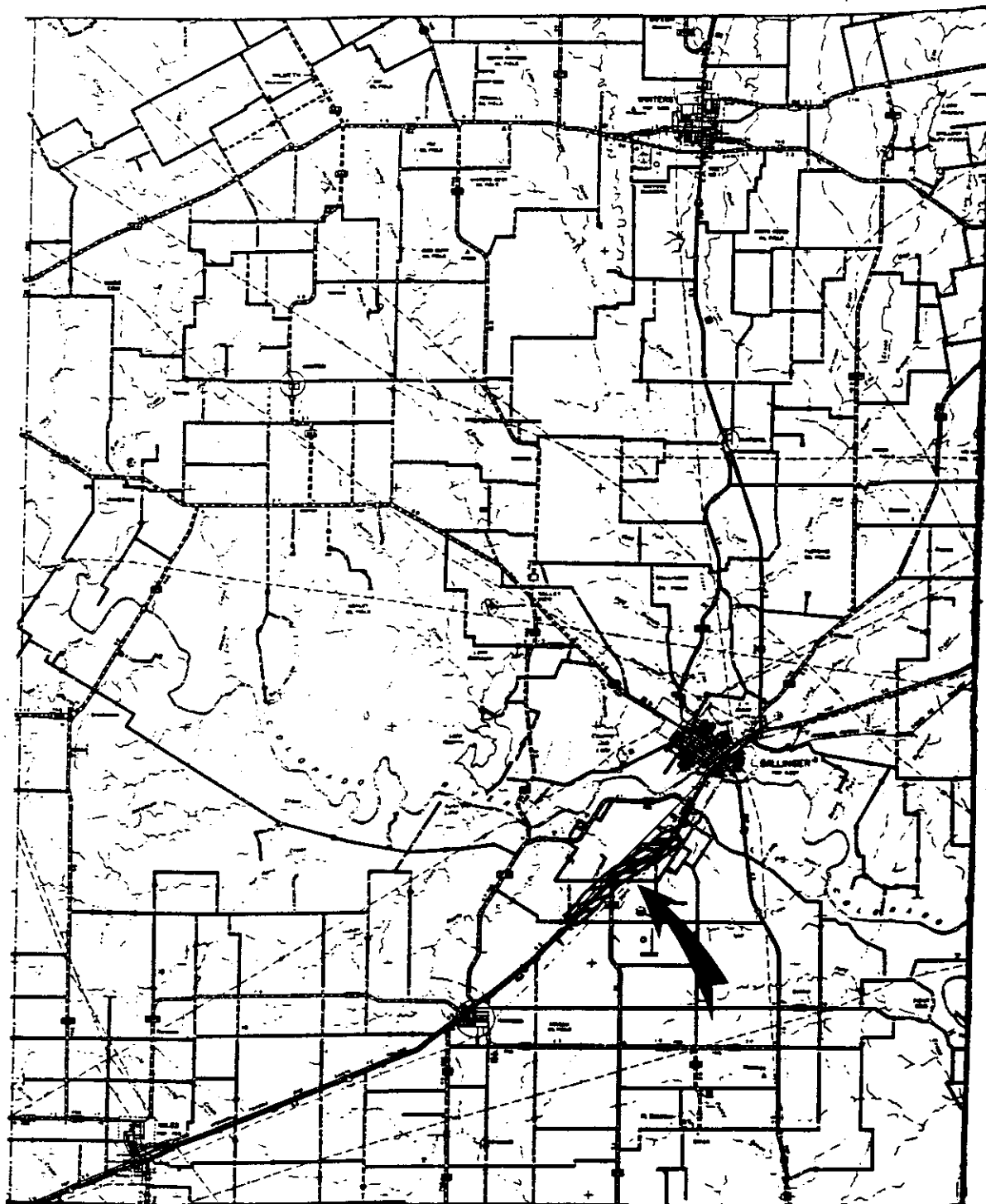
DATE WRITTEN: December 19, 1991; August 18, 1993 (minor revision)

REVIEWED BY: Dennis Markwardt and David Dunlap

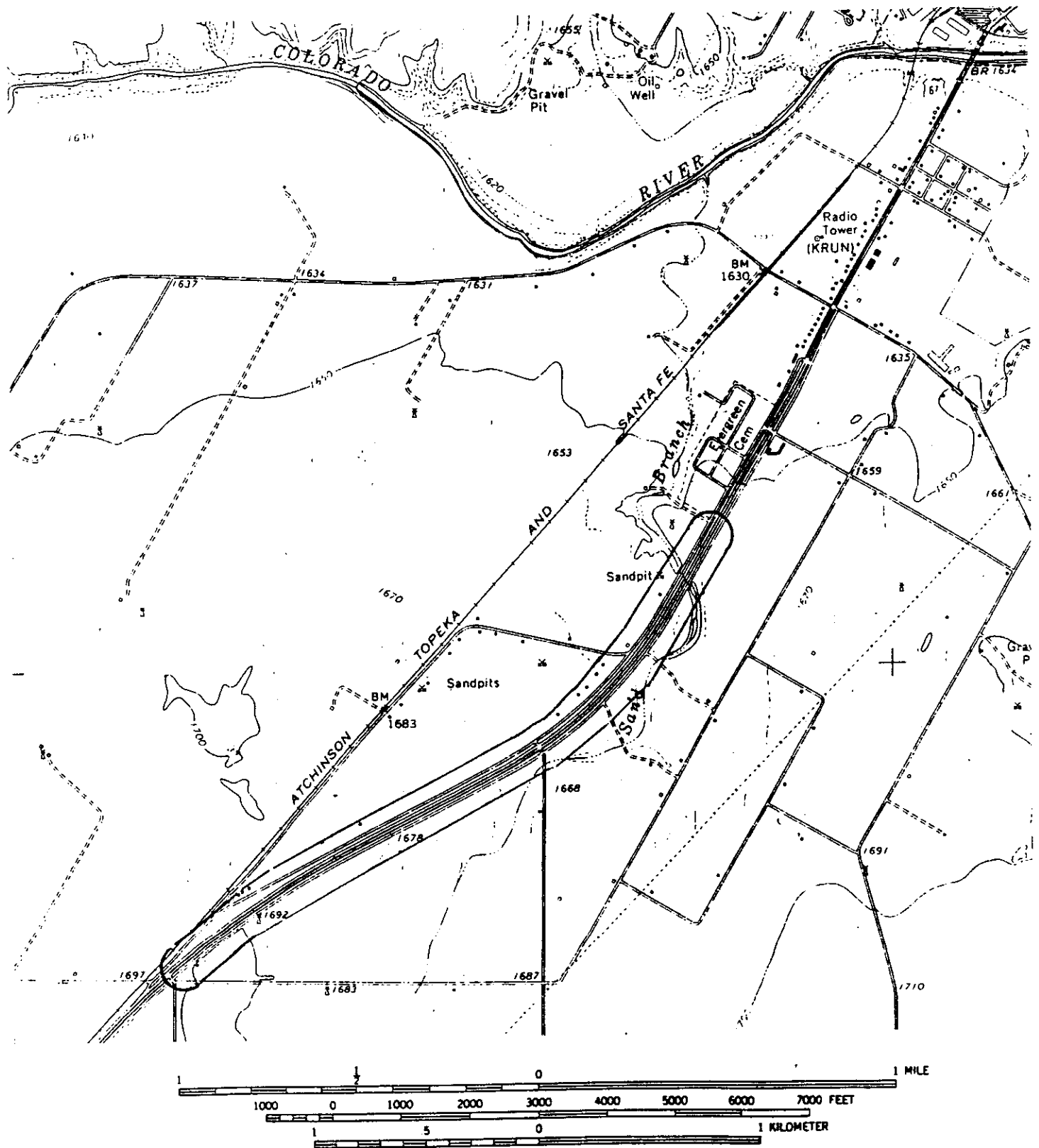
DATE REVIEWED: fall 1993

REVISED BY AND DATE: Jackie M. Poole; 30 December 1993

APPROVED BY AND DATE:



Management Area for Texas poppy-mallow
Runnels County - both sides of Highway 67,
0.7-2.7 miles southwest of the junction of Hwy 67 and FM 2133
south of Ballinger



Ballinger 7.5' USGS Quadrangle

Location of Texas poppy mallow (*Callirhoe scabriuscula*) monitoring/management area located in Runnels County, southwest of Ballinger, on State Route 67.

**Management Agreement between
Texas Department of Transportation
and Texas Parks and Wildlife Department**

LOCATION AND DESCRIPTION OF MANAGEMENT AREA: Runnels County - 0.1-1.0 miles north of the crossing of the Colorado River by FM 3115, on both sides of FM 3115 (see attached map). The management area has deep sandy soils and the vegetation is primarily wildflowers although shrubs have become established along the fence line.

MANAGEMENT TECHNIQUES CURRENTLY EMPLOYED:

Mowing: Full width once a year (in late fall) and one mower width anytime July through January.

Herbicides: Used on delineator posts, object markers, signs, culverts, and pavement edge.

Seeding: None.

Future plans: No changes anticipated.

SPECIES OF CONCERN:

Texas poppy-mallow (Callirhoe scabriuscula) - This species is listed as endangered by both the federal and state governments. This plant is an erect perennial with 3-5 lobed leaves and large, attractive, wine-colored, cup-shaped flowers which open May to June. The fruits are flattened, disk-shaped, and partitioned into 12-20 grapefruit-like sections.

The Texas poppy-mallow is only found on deep sands in the vicinity of the Colorado River. Various activities such as sand mining, soil stabilization, agriculture, and urbanization threaten the Texas poppy-mallow. Since the Highway Department altered its mowing schedule (mowing after the Texas poppy-mallow disperses its seeds), the population on the right-of-way has increased.

The management area represents the second largest population of the Texas poppy-mallow on public land. Through monitoring and careful management of these individuals, we can aid in this species' recovery.

RECOMMENDED MANAGEMENT PROCEDURES: A 15 foot width mowing can be done on the first mowing cycle in late June. Any type of mowing can be done at any time from July 15 to March 1. If necessary herbicides should be sparingly and carefully applied at times of little or no wind. No paving or construction materials should be stockpiled in the management area. No other species should be seeded or planted. Any proposed disturbance of the right-of-way by other entities (i.e., utilities, local/state/federal agencies, etc.) should be reviewed by TxDOT and TPWD. If any change in management procedure is anticipated, the Texas Natural Heritage Program of the Texas Parks and Wildlife Department should be notified before changes are implemented.

MONITORING PROCEDURES: The management area will be divided into 0.1 mile segments. Within each segment the number of individuals will be tabulated, and as a measure of vigor, the number of stems, buds, flowers, and fruits will be tallied. Monitoring will continue on a yearly basis in late May or early June. Monitoring will be conducted by the staff of the Endangered, Resources Branch, Texas Parks and Wildlife Department.

RED FLAG CONDITIONS: A 10% annual decrease in the number of individuals of Texas poppy-mallows will be considered a significant decline. Over any consecutive three-year period, a 10% decline in the total number of stems, flowers, or fruits will be considered a significant reduction in vigor. If such conditions occur, the cause will be ascertained. If the cause is related to management, management recommendations may be altered.

LOCATION OF ARCHIVED DATA: Texas Natural Heritage Program, Texas Parks and Wildlife Department, 4200 Smith School Road, Austin, Texas 78744; and Texas Department of Transportation, Division of Environmental Affairs, 125 E. 11th, Austin, Texas 78701.

WRITTEN BY: Jackie M. Poole, Texas Natural Heritage Program, Resource Protection Division, Texas Parks and Wildlife Department, 4200 Smith School Road, Austin, Texas 78744

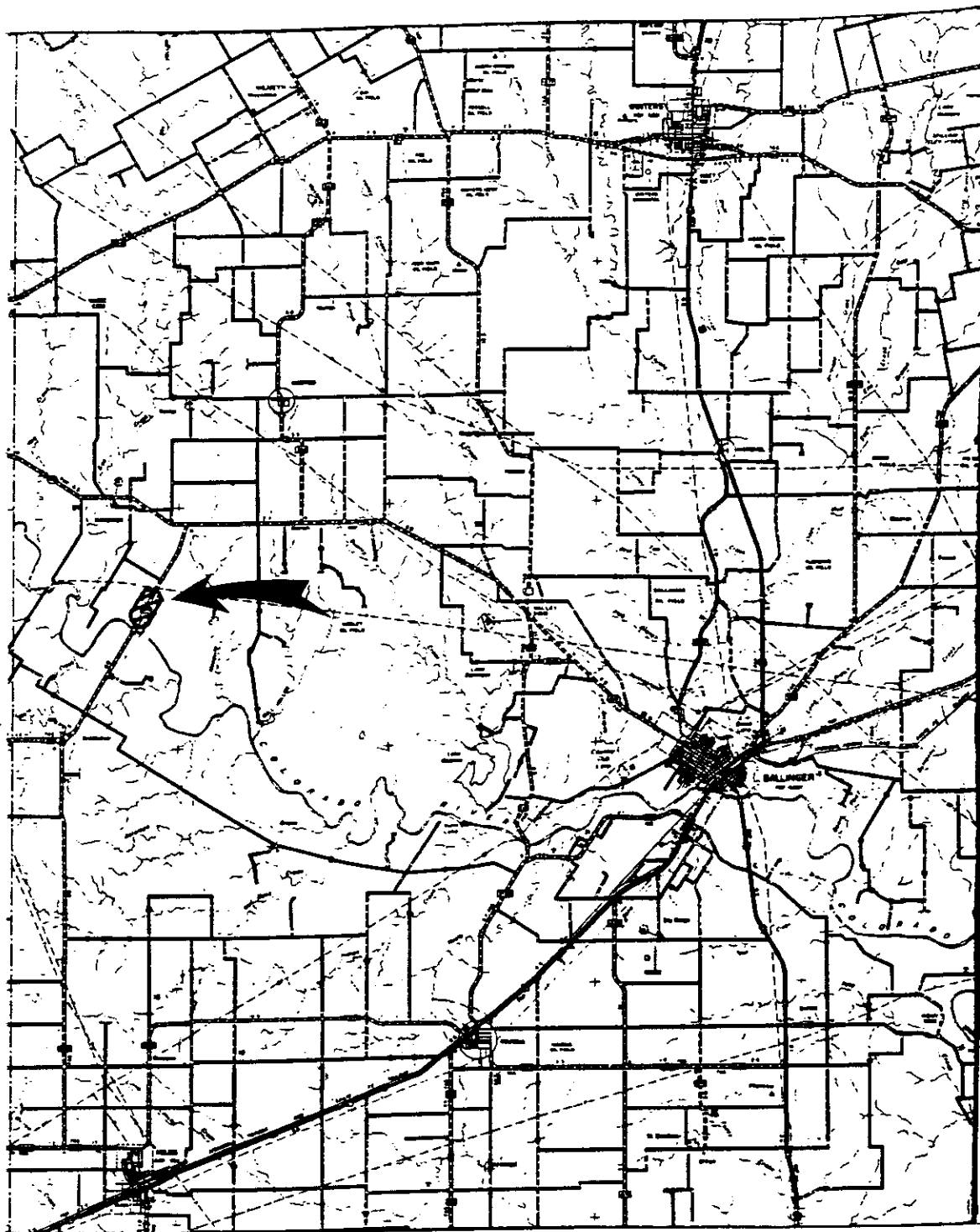
DATE WRITTEN: December 20, 1991; August 18, 1993 (minor revision)

REVIEWED BY: Dennis Markwardt and David Dunlap

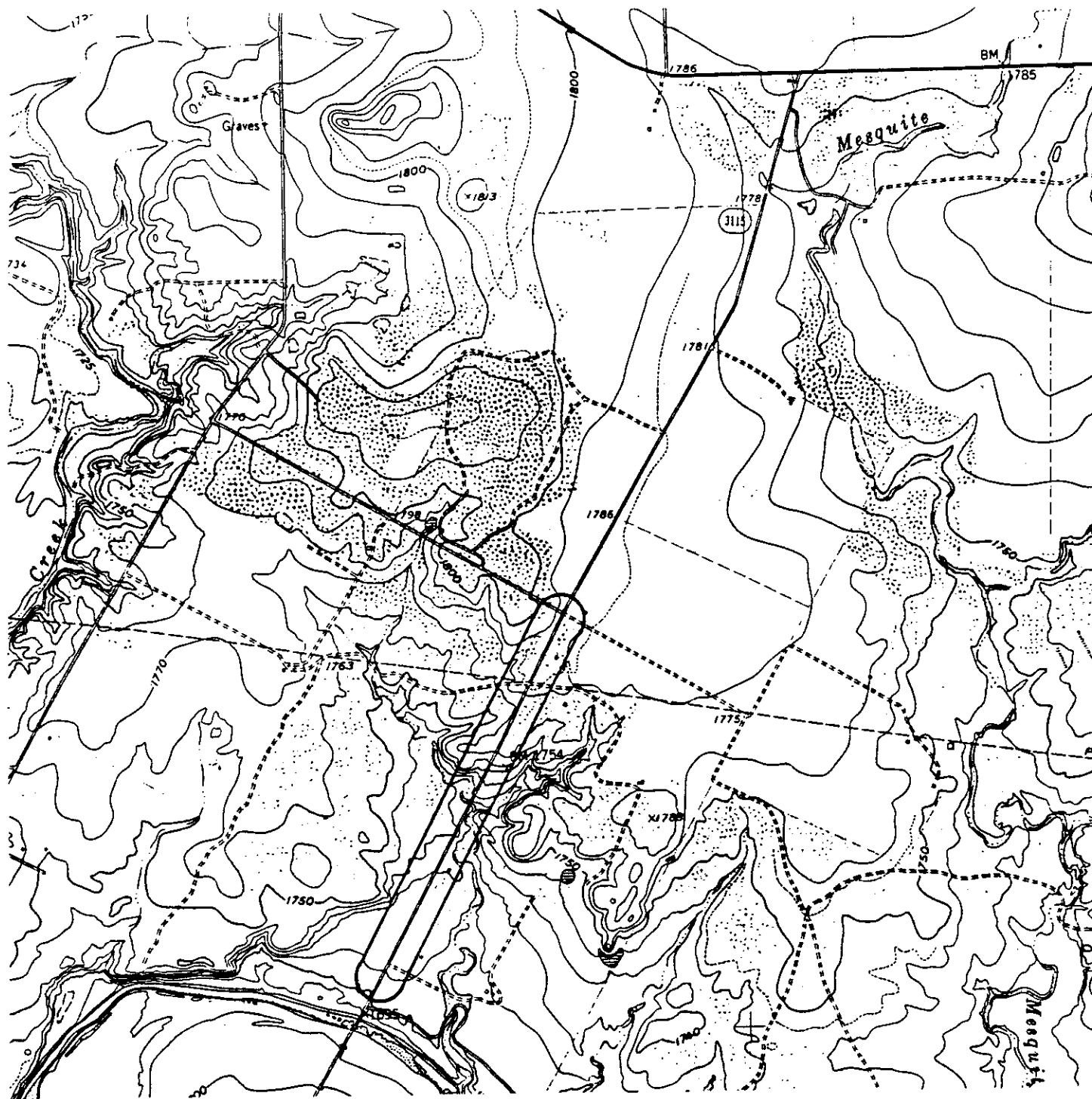
DATE REVIEWED: fall 1993

REVISED BY AND DATE: Jackie M. Poole; 30 December 1993

APPROVED BY AND DATE:



Management Area for Texas poppy-mallow
Runnels County - both sides of FM 3115,
0.1-1.0 miles north of the crossing of the Colorado River



Maverick 7.5' USGS Quadrangle

Location of Texas poppy mallow (*Callirhoe scabriuscula*) monitoring/management area located in Runnels County, near Maverick, on FM 3115.

Management Agreement between
Texas Department of Transportation
and Texas Parks and Wildlife Department

LOCATION AND DESCRIPTION OF MANAGEMENT AREA: Starr County - 0.1 miles either side of the intersection of Highways 83 and 650, along both sides of Highway 83 north of Roma (see attached maps). The management area has gravelly sandy soils with sparse grasses and herbs.

MANAGEMENT TECHNIQUES CURRENTLY EMPLOYED:

Mowing: Full width once a year (in late fall) and one mower width several times a year.
Herbicides: Used on delineator posts, object markers, signs, and pavement edge.
Seeding: None known.
Other: Some areas have been bladed to control vegetation. Fire lanes disked in some areas.
Future plans: None anticipated.

SPECIES OF CONCERN:

Prostrate milkweed (Asclepias prostrata) - This U. S. Fish and Wildlife Service Category 2 (awaiting study to determine if listing is needed) species grows flat on the soil surface. The stems spread out from a central root, and have triangular, crinkly-edged leaves. The flowers are quite unusual and are shades of yellow, red, and brown. The fruit is a large, warty pod filled with many seeds tipped with silky tufts of white hairs.

The prostrate milkweed requires full sun and is easily overgrown by many other species. Although some brush clearing procedures may be beneficial to the species by opening new habitat for colonization, seeding to exotic grasses such as coastal Bermuda and buffelgrass eradicates the prostrate milkweed by cutting off sunlight.

All three populations of prostrate milkweed are at least partially on highway right-of-way. These individuals are the only ones on public land. Through monitoring of these individuals under differing management regimes, we can learn how the species responds to disturbance and succession.

RECOMMENDED MANAGEMENT PROCEDURES: Mowing should be done as often as needed. Blading and fire lanes should be eliminated in the management area. Herbicides should be sparingly and carefully applied at times of little or no wind. If any change in management procedure is anticipated, the Texas Natural Heritage Program of the Texas Parks and Wildlife Department should be notified before changes are implemented.

MONITORING PROCEDURES: Five 1 m² plots will be used to monitor and evaluate the effect of management practices on a subset of the population of prostrate milkweed. The 1 m² plots will be centered around one or more individuals. Plots will be marked with spikes measured with a distance and angle from a known object. Cover, frequency, and density will be measured within these plots to evaluate the effect of succession in this area. Vigor of prostrate milkweeds will be evaluated by length and number of branches. Monitoring will continue on a yearly basis in spring. Monitoring will be conducted by Jackie Poole of the Texas Natural Heritage Program, Texas Parks and Wildlife Department.

RED FLAG CONDITIONS: A 10% annual decrease in the number of individuals of prostrate milkweed will be considered a significant decline in the population. Also over any consecutive three-year period, a 10% decline in the number of branches of the prostrate milkweed will be considered a significant reduction in vigor. If such conditions occur, the cause will be ascertained. If the cause is related to management, management recommendations may be altered.

LOCATION OF ARCHIVED DATA: Texas Natural Heritage Program, Texas Parks and Wildlife Department, 4200 Smith School Road, Austin, Texas; and Texas Department of Transportation, La Costa Complex, 6400 U.S. 290 East, Austin, Texas

WRITTEN BY: Jackie M. Poole, Texas Natural Heritage Program, Resource Protection Division, Texas Parks and Wildlife Department, 4200 Smith School Road, Austin, Texas 78744

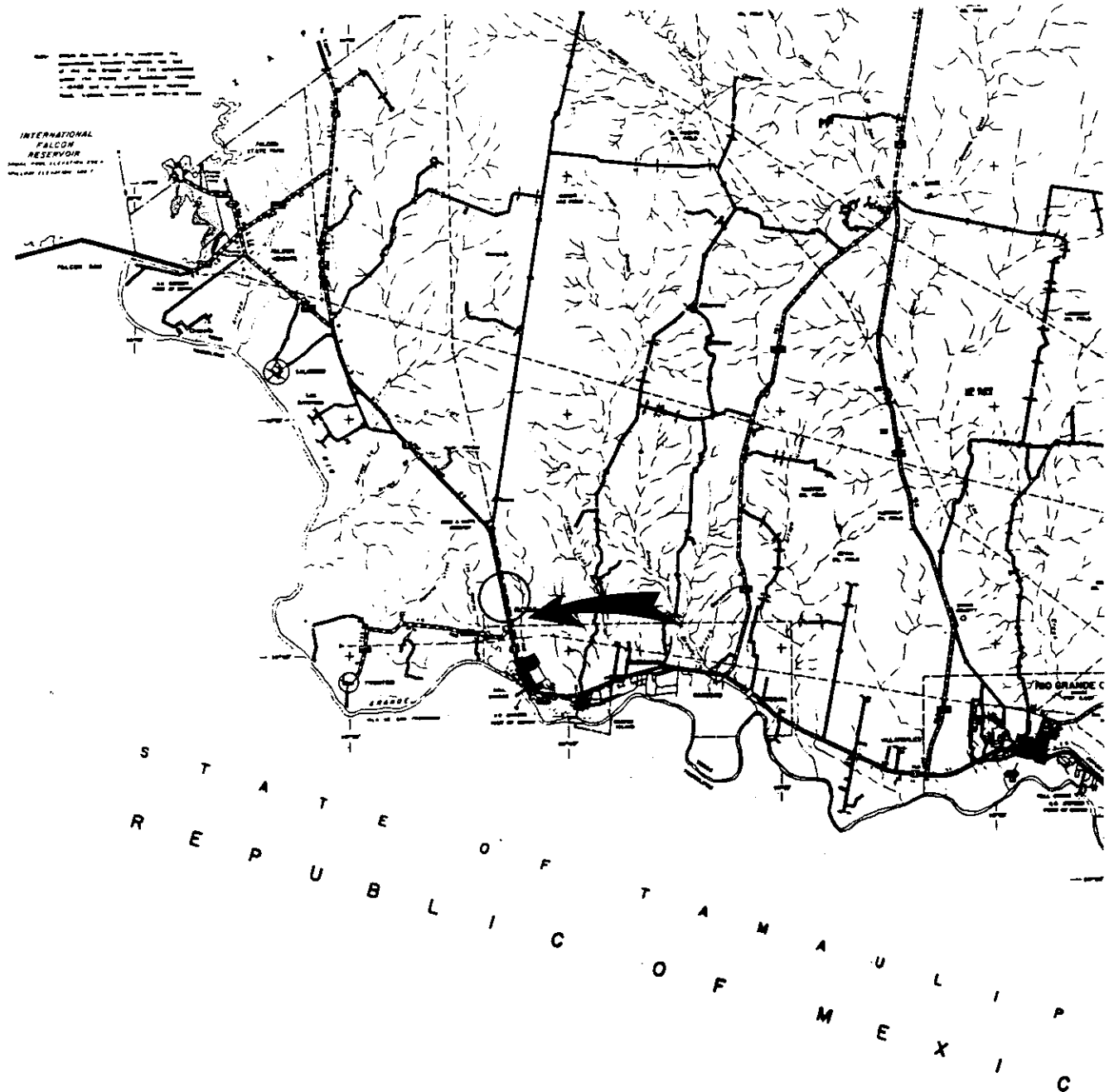
DATE WRITTEN: December 18, 1991

REVIEWED BY:

DATE REVIEWED:

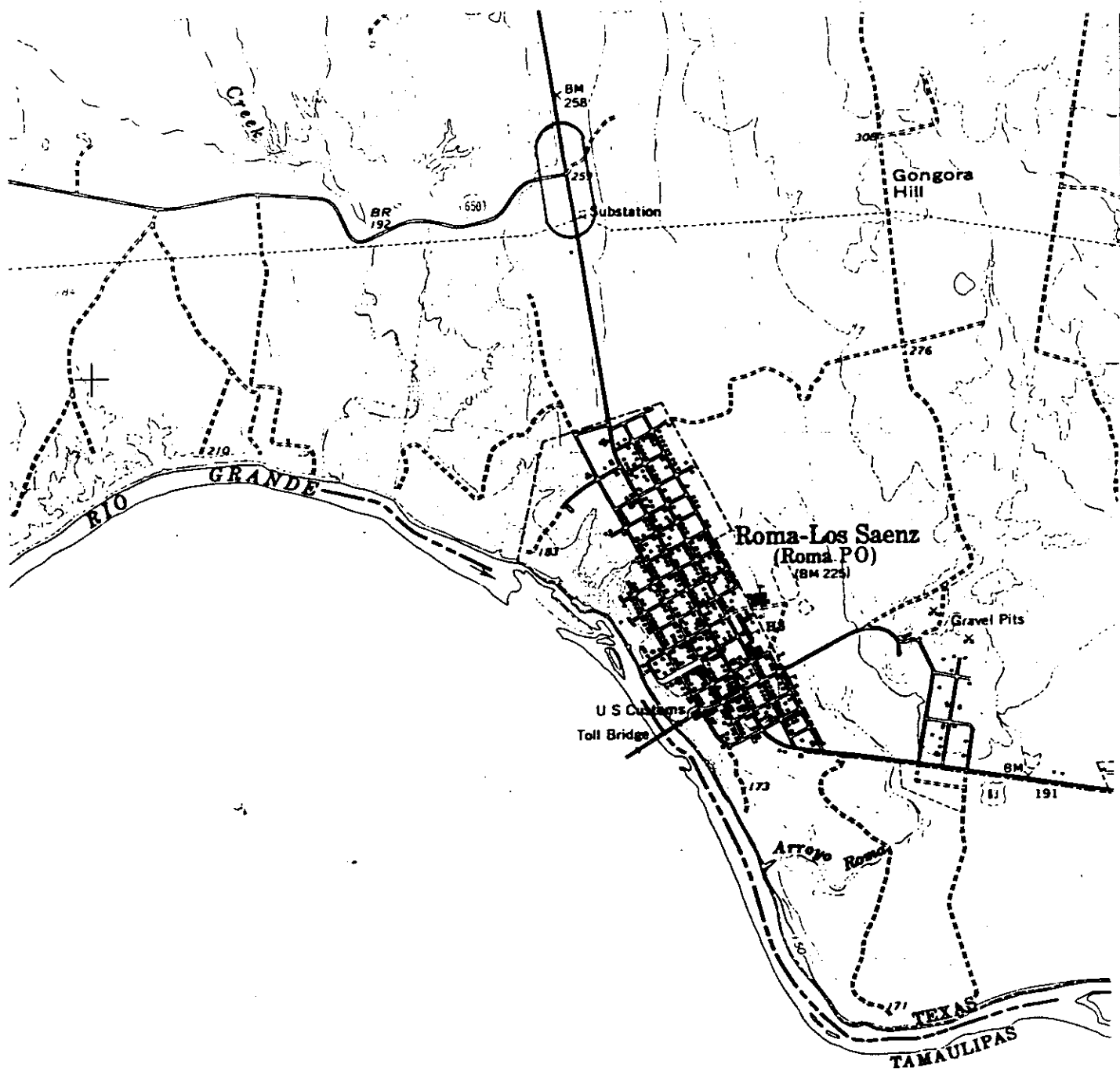
REVISED BY AND DATE:

APPROVED BY AND DATE:



GENERAL HIGHWAY MAP
STARR COUNTY
TEXAS

Management Area for prostrate milkweed
Starr County - 0.1 mile north from the Highway 83/Highway 650 intersection
on Highway 83 north of Roma



Roma-Los Saenz 7.5' USGS Quadrangle

Location of prostrate milkweed (*Asclepias prostrata*) monitoring/management area located in Starr County, north of Roma, on State Route 83.

**Management Agreement between
Texas Department of Transportation
and Texas Parks and Wildlife Department**

LOCATION AND DESCRIPTION OF MANAGEMENT AREA: Trinity County - north side of Highway 94, 1.0 miles west of Neches River bridge (see attached map). The managed area consists of a marshy area adjacent to a pond (flooded borrow pit), and is delineated by the rest area on the west end and the east end of a forested area on the east end.

MANAGEMENT TECHNIQUES CURRENTLY EMPLOYED:

Mowing: Roadside park area is mowed once a year.
Herbicides: None are used in the park.
Seeding: None.
Future plans: No changes anticipated.

SPECIES OF CONCERN: Neches River rose-mallow (Hibiscus dasycalyx)
- This Category 2 species is a perennial herb to 5 feet tall. The dark green leaves are deeply three-lobed (almost T- or arrow-shaped) with saw-toothed edges. The flowers are large and showy. The sepals are densely covered with small hairs. The five creamy white petals have a deep red spot at the base. Flowering occurs June through August. The fruit is rounded with a pointed tip, and splits open to release the seeds.

The Neches River rose-mallow grows in full sun in marshy areas along open ponds, creeks, or other open bodies of water. The species is threatened habitat alteration and destruction, hybridization with more common species, and possible overcollection.

This population is one of three populations known from highway right-of-way. Only one other population in the world is known, and it has not been relocated. Managing and monitoring this species will hopefully increase numbers of individuals in roadside populations as well as track the vigor and longevity of the individuals in the population.

RECOMMENDED MANAGEMENT PROCEDURES: If possible, mowing should be mowed one shredder width away from the current mowed edge. This may allow colonization of the area by Neches River rose-mallows. Outside this area mowing can be conducted as necessary. The wooded area should not be disturbed. No other species should be planted or seeded in the area. No material should be stockpiled in the area nor should any fill material be removed from the site. Any proposed disturbance of the right-of-way by other entities (i.e., utilities, local/state/federal agencies, etc.) should be reviewed by TxDOT and TPWD. If any change in management procedure is anticipated, the Texas Natural Heritage Program of the Texas Parks and Wildlife Department should be notified before changes are implemented.

MONITORING PROCEDURES: All individuals within the right-of-way will be counted, tagged, and mapped using a distance and angle from a known point. The height and the numbers of stems, flowers and fruits for each individual will be tallied as a measure of vigor. Monitoring will be conducted on a yearly basis in mid-summer by staff of the Endangered Resources Branch, Texas Parks and Wildlife Department.

RED FLAG CONDITIONS: A 10% decrease in the number of individuals of Neches River rose-mallow will be considered a significant decline in the population. Also over any consecutive three-year period, a 10% decline in the number of stems, flowers and/or fruits of the population will be considered a significant reduction in vigor. If such conditions occur, the cause will be ascertained. If the cause is related to management, management recommendations may be altered.

LOCATION OF ARCHIVED DATA: Texas Natural Heritage Program, Texas Parks and Wildlife Department, 4200 Smith School Road, Austin, Texas 78744; and Texas Department of Transportation, 125 E. 11th, Austin, Texas 78701

WRITTEN BY: Jackie M. Poole, Texas Natural Heritage Program, Resource Protection Division, Texas Parks and Wildlife Department, 4200 Smith School Road, Austin, Texas 78744

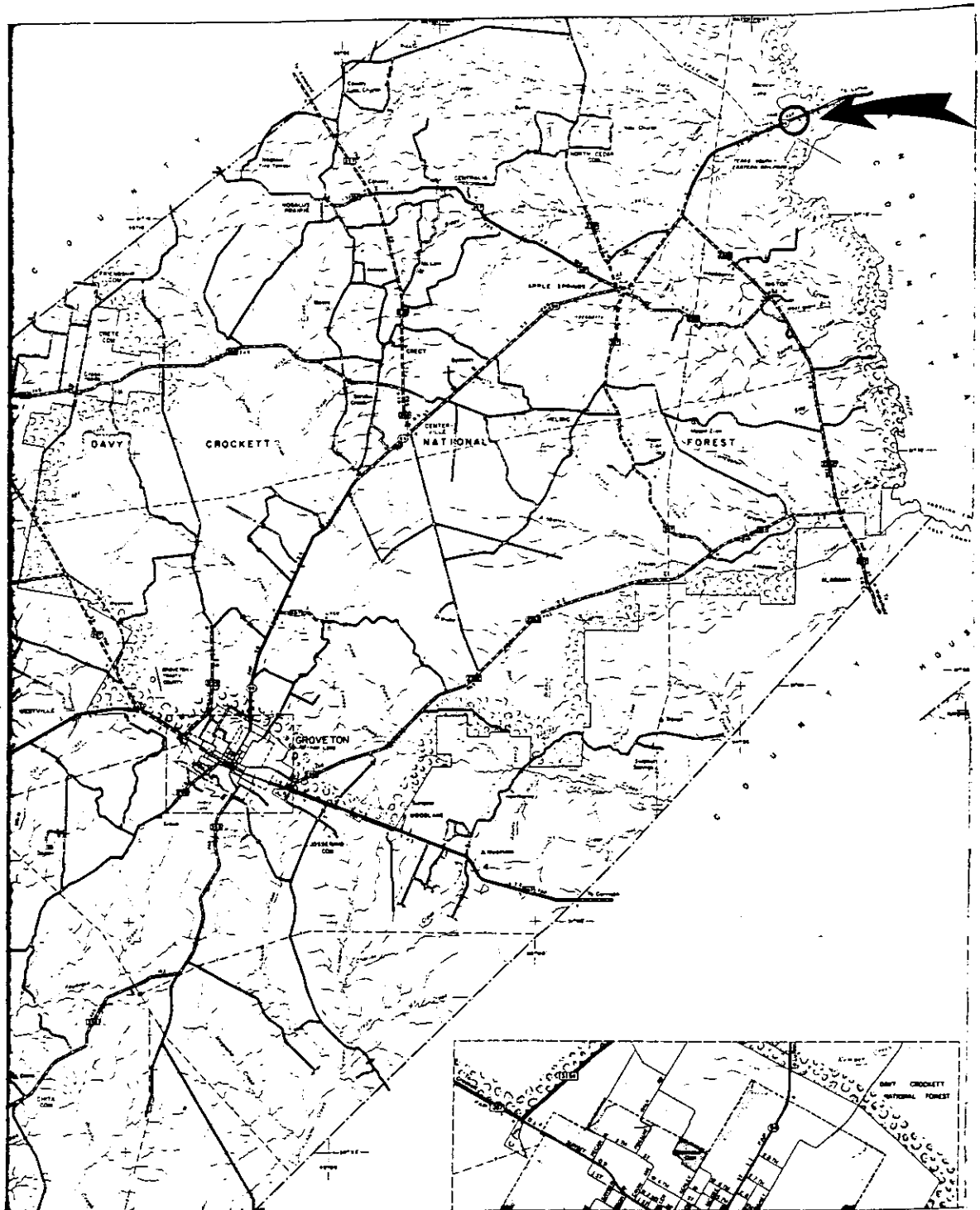
DATE WRITTEN: November 8, 1993

REVIEWED BY: Dennis Markwardt and David Dunlap

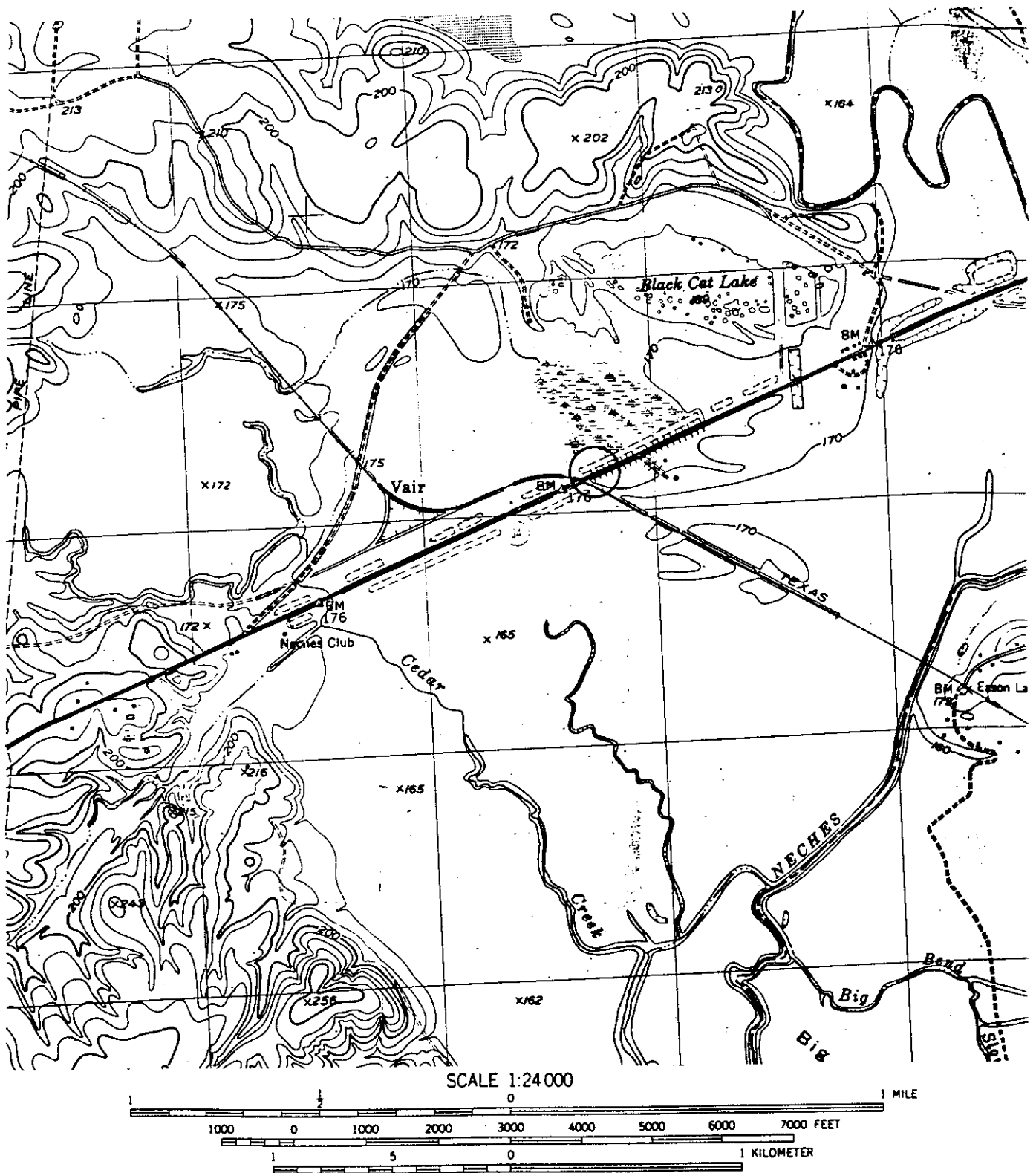
DATE REVIEWED: fall 1993

REVISED BY AND DATE: Jackie M. Poole; 30 December 1993

APPROVED BY AND DATE:



Management Area for Neches River rose-mallow
 Trinity County - north side of Highway 94,
 1.0 miles west of Neches River bridge



Wells Southwest 7.5' USGS Quadrangle

Location of Neches River rose-mallow (*Hibiscus dasycalyx*) monitoring management area in Trinity County, west of the Neches River, on Highway 94.

**Management Agreement between
Texas Department of Transportation
and Texas Parks and Wildlife Department**

LOCATION AND DESCRIPTION OF MANAGEMENT AREA: Val Verde County - east side of Highway 277, 7.8 miles of the intersection of Highways 277 and 90 on the western outskirts of Del Rio (see attached map). The management area consists of a low hill with very shallow, rocky (limestone) soils, and is delineated by a ranch road on the north and the toe of the slope on the south.

MANAGEMENT TECHNIQUES CURRENTLY EMPLOYED:

Mowing: Strip mowing as needed and fall cleanup mowing.

Herbicides: Used on delineator posts, object markers, culverts, and pavement edges.

Seeding or planting: None.

Future plans: No changes anticipated.

SPECIES OF CONCERN: Rydberg's scurfpea (Pediomelum humile) - This low-growing (to 3 inches tall) perennial herb with a woody root (to 5 inches long). The leaves are divided into three leaflets, with the leaflets being orbicular or widest at the tip. On the upper surface of the leaflets, white hairs line the veins, giving the leaflets a very distinctive appearance. The flowers are clustered on a short, hairy stalk (to 4 inches long). The color of the small flowers (less than 1 inch long) is unknown. Flowering is known to occur in April and May, but may occur later in response to precipitation. The fruit is small (less than $\frac{1}{2}$ inch long), oblong-elliptic in shape, with a very short beak.

Rydberg's scurfpea grows in full sun in shallow, rocky (limestone) soils. The surrounding community is ceniza shrubland; however the highway right-of-way is a short grassland as a result of frequent mowing. The species is threatened by habitat destruction and alteration, small numbers of individuals and populations, and collection.

This population is the only population known from highway right-of-way, and the only known population in existence. There are four other historical localities, but they have not been relocated. Managing and monitoring this species will hopefully increase numbers of individuals in roadside population as well as track the vigor and longevity of the individuals in the population.

RECOMMENDED MANAGEMENT PROCEDURES: Mowing would appear to be beneficial for the Rydberg's scurfpea as the plant is so short. Thus the present mowing policy is suitable. The use of herbicides on delineator posts, pavement edges, etc. if required, should be applied by hand, or at times of little or no wind. No other species should be planted or seeded in the

area. No material should be stockpiled in the area nor should any fill material be removed from the site. Any proposed disturbance of the right-of-way by other entities (i.e., utilities, local/state/federal agencies, etc.) should be reviewed by TxDOT and TPWD. If any change in management procedure is anticipated, the Texas Natural Heritage Program of the Texas Parks and Wildlife Department should be notified before changes are implemented.

MONITORING PROCEDURES: All individuals will be counted, and their location will be triangulated from fence posts. The number of leaves, plant height, and numbers of flowers/fruits will be counted or measured as an evaluation of vigor. Monitoring will be conducted on a yearly basis in late spring by staff of the Endangered Resources Branch, Texas Parks and Wildlife Department with volunteer assistance from local schools.

RED FLAG CONDITIONS: A 10% decrease in the number of individuals of Rydberg's scurfpea will be considered a significant decline in the population. Also over any consecutive three-year period, a 10% decline in the number of leaves or flowers/fruits, or plant height, will be considered a significant reduction in vigor. If such conditions occur, the cause will be ascertained. If the cause is related to management, management recommendations may be altered.

LOCATION OF ARCHIVED DATA: Texas Natural Heritage Program, Texas Parks and Wildlife Department, 4200 Smith School Road, Austin, Texas 78744; and Texas Department of Transportation, 125 E. 11th, Austin, Texas 78701

WRITTEN BY: Jackie M. Poole, Texas Natural Heritage Program, Resource Protection Division, Texas Parks and Wildlife Department, 4200 Smith School Road, Austin, Texas 78744

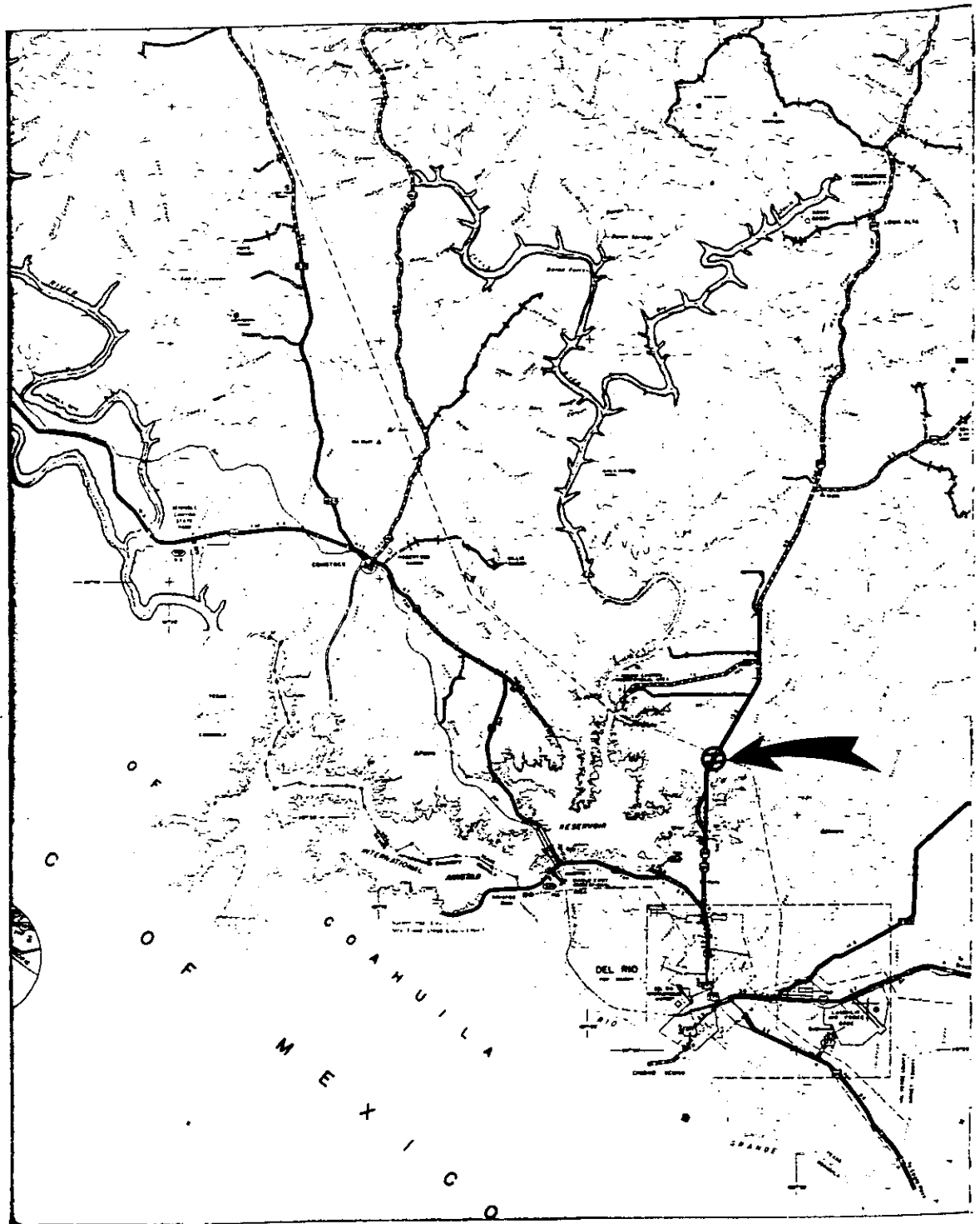
DATE WRITTEN: November 9, 1993

REVIEWED BY: Dennis Markwardt and David Dunlap

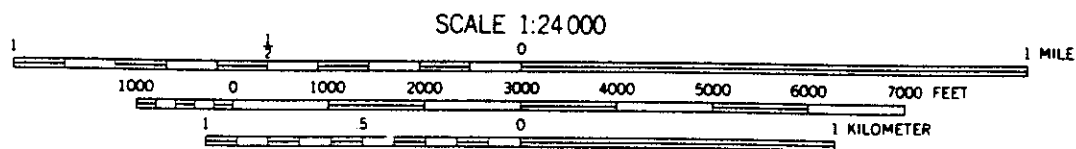
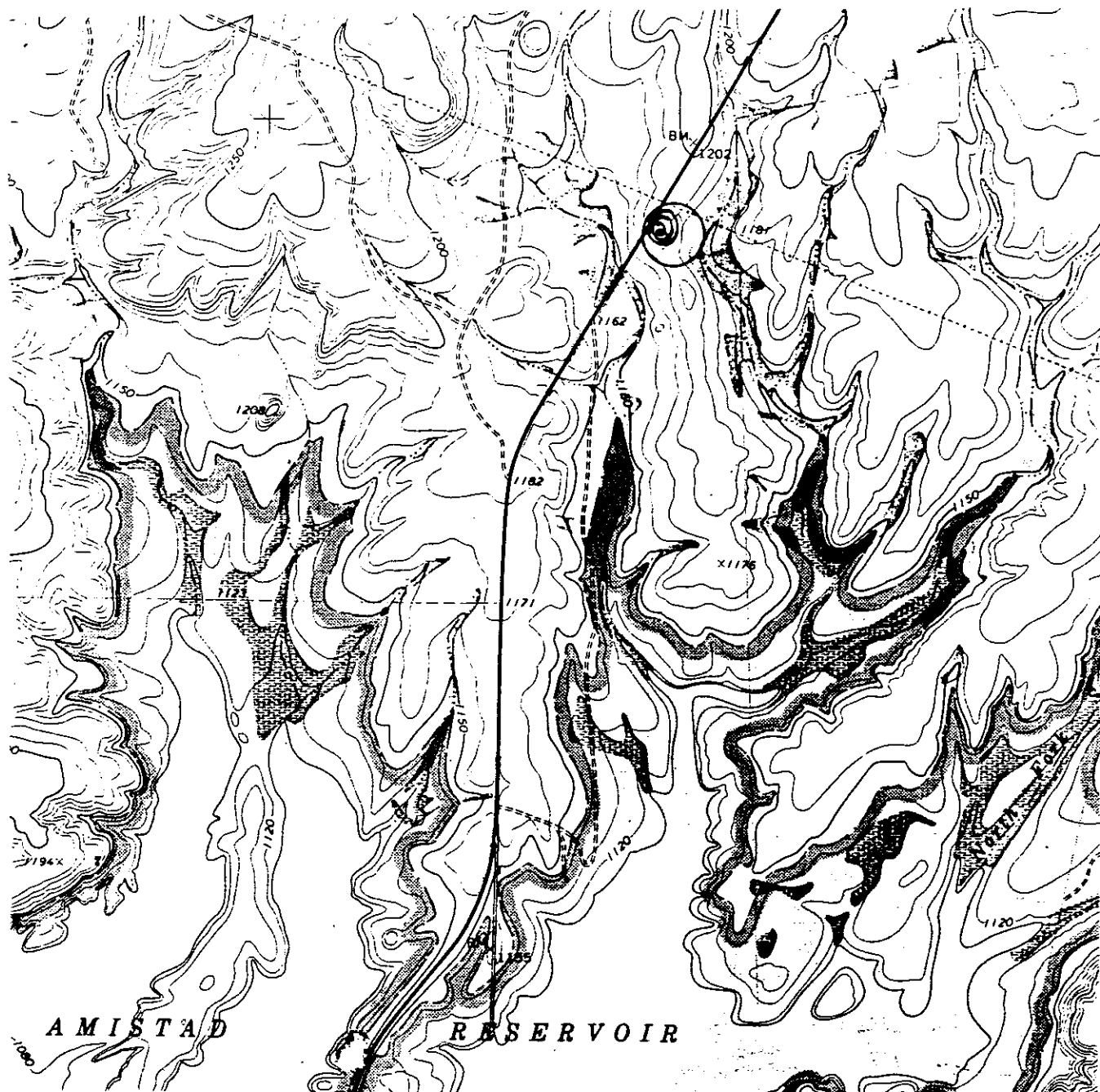
DATE REVIEWED: fall 1993

REVISED BY AND DATE: Jackie M. Poole; 30 December 1993

APPROVED BY AND DATE:



Management Area for Rydberg's scurfpea
Val Verde County - east side of Hwy 277, 7.8 miles of the
intersection of Hwys 277 and 90 on the western edge of Del Rio



Rough Canyon 7.5' USGS Quadrangle

Location of Rydberg's scurfpea (*Pediomelum humile*) monitoring/management area in Val Verde County, north of Del Rio, on Highway 277.

**Management Agreement between
Texas Department of Transportation
and Texas Parks and Wildlife Department**

LOCATION AND DESCRIPTION OF MANAGEMENT AREA: Van Zandt County - both sides of Highway 279, 3.5 miles southeast of the intersection of Highways 279 and 858 in Ben Wheeler (see attached map). The management area consists of a marshy area surrounding a small drainage and lake, and is delineated by a private road on the northwest end and a private road to Dogwood Hill on the southeast end.

MANAGEMENT TECHNIQUES CURRENTLY EMPLOYED:

Mowing: Full width once a year (in early fall; rarely done to the marshy nature of the site) and one mower width several times a year as needed.

Herbicides: Used on delineator posts, object markers, around culverts, and pavement edge.

Seeding: None.

Future plans: No changes anticipated.

SPECIES OF CONCERN: Rough-stemmed aster (Aster puniceus ssp. elliottii var. scabrimaculis) - This category 1 species is a tall (to 10 feet), much-branched perennial herb with numerous, lavender, daisy-like flowers. The stems are covered with small, rough hairs. The lower leaves clasp the stem, and extend beyond the stem like small ears. The tips of the green involucral bracts immediately below the flower bend away from the head. The ray florets ("petals") are lavender in contrast to the yellow disk florets ("center"). Flowering occurs September through November.

Rough-stemmed aster occurs in saturated soils at the margins of open ponds, marshes, and small lakes. The species grows in full sun, with wax myrtle, eastern baccharis, sweetgum, and black willow. Rough-stemmed aster is threatened by habitat conversion (removal and replacement of all native vegetation with Bermuda grass), pond drainage, and development.

This population represents one of three populations along highway right-of-way, and one of six populations known in the world. Altered management of this species on highway right-of-way should lead to an increase in numbers. Monitoring will help determine longevity of marked individuals and response to different management regimes.

RECOMMENDED MANAGEMENT PROCEDURES: Delineator posts should be used to indicate the site so as mowers can avoid this area. Outside the area mowing can be conducted as necessary. If required, herbicides should be applied by hand. No other species should be planted or seeded in the area. Any proposed disturbance of the right-of-way by other entities (i.e.,

utilities, local/state/federal agencies, etc.) should be reviewed by TxDOT and TPWD. If any change in management procedure is anticipated, the Texas Natural Heritage Program of the Texas Parks and Wildlife Department should be notified before changes are implemented.

MONITORING PROCEDURES: A count will be made of all individuals of rough-stemmed aster within the highway right-of-way. The number of primary and secondary branches as well as the total number of flowers will be counted for each individual as a method of tracking vigor. Exceptionally large plants will be marked basally with numbered aluminum tags to track their longevity and vigor through time. Monitoring will continue on a yearly basis in mid-fall. Monitoring will be conducted by staff of the Endangered Resources Branch, Texas Parks and Wildlife Department.

RED FLAG CONDITIONS: A 10% decrease in the number of individuals of rough-stemmed aster will be considered a significant decline in the population. Also over any consecutive three-year period, a 10% decline in the number of flowers of the population will be considered a significant reduction in vigor. If such conditions occur, the cause will be ascertained. If the cause is related to management, management recommendations may be altered.

LOCATION OF ARCHIVED DATA: Texas Natural Heritage Program, Texas Parks and Wildlife Department, 4200 Smith School Road, Austin, Texas 78744; and Texas Department of Transportation, Division of Environmental Affairs, 125 E. 11th, Austin, Texas 78701.

WRITTEN BY: Jackie M. Poole, Texas Natural Heritage Program, Resource Protection Division, Texas Parks and Wildlife Department, 4200 Smith School Road, Austin, Texas 78744

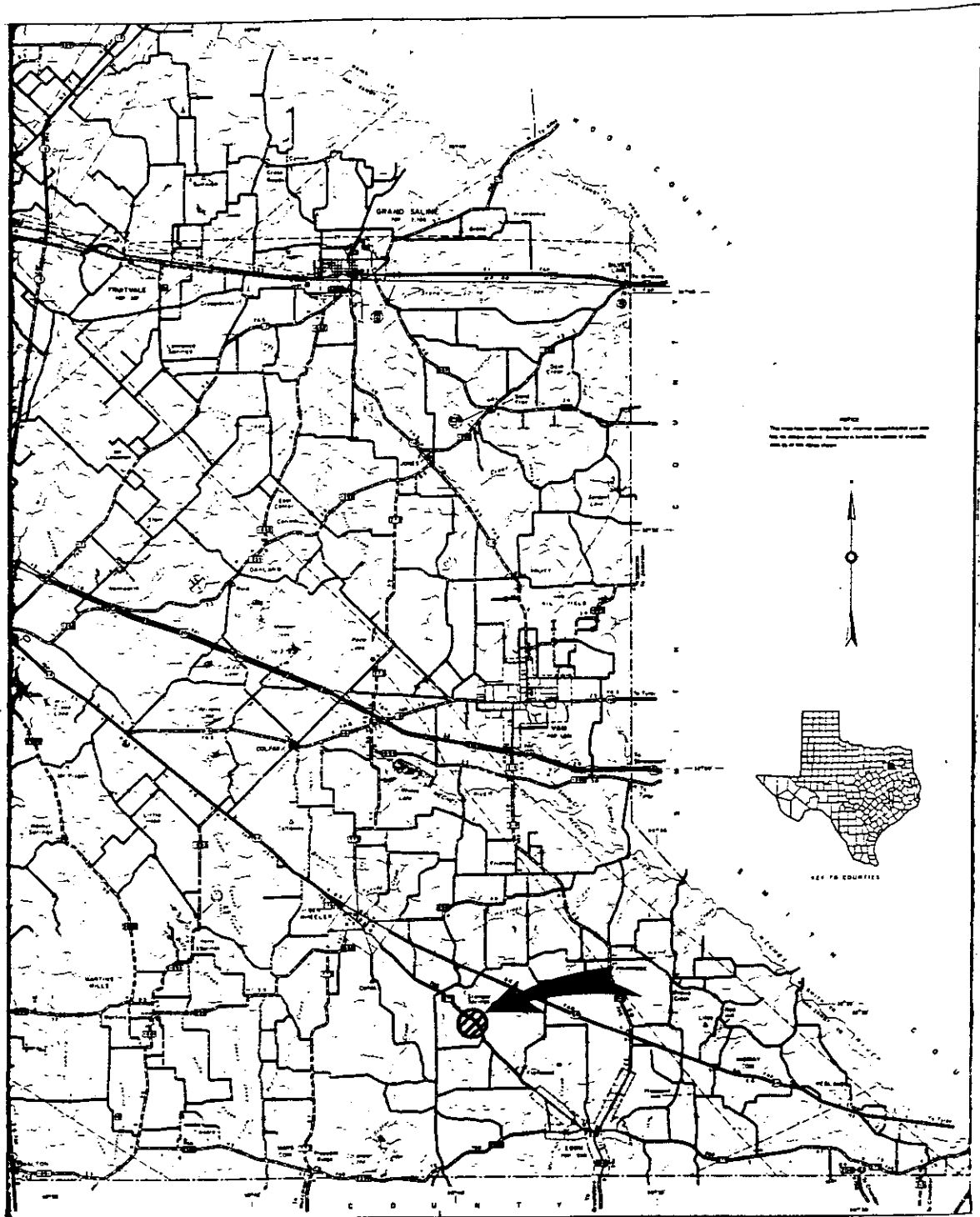
DATE WRITTEN: November 8, 1993

REVIEWED BY: Dennis Markwardt and David Dunlap

DATE REVIEWED: fall 1993

REVISED BY AND DATE: Jackie M. Poole; 30 December 1993

APPROVED BY AND DATE:



Management Area for rough-stemmed aster
 Van Zandt County - both sides of Highway 279, 3.5 miles southeast
 of the intersection of Highways 279 and 858 in Ben Wheeler

**Management Agreement between
Texas Department of Transportation
and Texas Parks and Wildlife Department**

LOCATION AND DESCRIPTION OF MANAGEMENT AREA: Wood County - both sides of Highway 154, 3.5 miles east of the intersection of Highways 154 and 37 east of Quitman (see attached map). The management area consists of marshy areas between the pavement edge and small ponds on either side of the highway, and is delineated by utility poles at either end of the marshy area.

MANAGEMENT TECHNIQUES CURRENTLY EMPLOYED:

Mowing: Full width once a year (in early fall if possible due to the marshy nature of the site) and one mower width several times a year as needed.

Herbicides: Used on delineator posts, object markers, around culverts, and pavement edge.

Seeding: None.

Other: Dirt and wood chips are dumped along the steep right-of-way to prevent erosion.

Future plans: No changes anticipated.

SPECIES OF CONCERN: Rough-stemmed aster (Aster puniceus ssp. elliottii var. scabrimaculis) - This category 1 species is a tall (to 10 feet), much-branched perennial herb with numerous, lavender, daisy-like flowers. The stems are covered with small, rough hairs. The lower leaves clasp the stem, and extend beyond the stem like small ears. The tips of the green involucral bracts immediately below the flower bend away from the head. The ray florets ("petals") are lavender in contrast to the yellow disk florets ("center"). Flowering occurs September through November.

Rough-stemmed aster occurs in saturated soils at the margins of open ponds, marshes, and small lakes. The species grows in full sun, with wax myrtle, eastern baccharis, sweetgum, and black willow. Rough-stemmed aster is threatened by habitat conversion (removal and replacement of all native vegetation with Bermuda grass), pond drainage, and development.

This population represents one of three populations along highway right-of-way, and one of six populations known in the world. Altered management of this species on highway right-of-way should lead to an increase in numbers. Monitoring will help determine longevity of marked individuals and response to different management regimes.

RECOMMENDED MANAGEMENT PROCEDURES: Delineator posts should be used to indicate the site so as mowers can avoid this area. Outside the area mowing can be conducted as necessary. If required, herbicides should be applied by hand or in periods of little or no wind. Erosion control materials should be carefully applied so as to not cover the rough-stemmed asters.

No other species should be planted or seeded in the area. Any proposed disturbance of the right-of-way by other entities (i.e., utilities, local/state/federal agencies, etc.) should be reviewed by TxDOT and TPWD. If any change in management procedure is anticipated, the Texas Natural Heritage Program of the Texas Parks and Wildlife Department should be notified before changes are implemented.

MONITORING PROCEDURES: A count will be made of all individuals of rough-stemmed aster within the highway right-of-way. The number of primary and secondary branches as well as the total number of flowers will be counted for each individual as a method of tracking vigor. Exceptionally large plants will be marked basally with numbered aluminum tags to track their longevity and vigor through time. Monitoring will continue on a yearly basis in mid-fall. Monitoring will be conducted by staff of the Endangered Resources Branch, Texas Parks and Wildlife Department.

RED FLAG CONDITIONS: A 10% decrease in the number of individuals of rough-stemmed aster will be considered a significant decline in the population. Also over any consecutive three-year period, a 10% decline in the number of flowers of the population will be considered a significant reduction in vigor. If such conditions occur, the cause will be ascertained. If the cause is related to management, management recommendations may be altered.

LOCATION OF ARCHIVED DATA: Texas Natural Heritage Program, Texas Parks and Wildlife Department, 4200 Smith School Road, Austin, Texas 78744; and Texas Department of Transportation, Division of Environmental Affairs, 125 East 11th, Austin, Texas 78701.

WRITTEN BY: Jackie M. Poole, Texas Natural Heritage Program, Resource Protection Division, Texas Parks and Wildlife Department, 4200 Smith School Road, Austin, Texas 78744

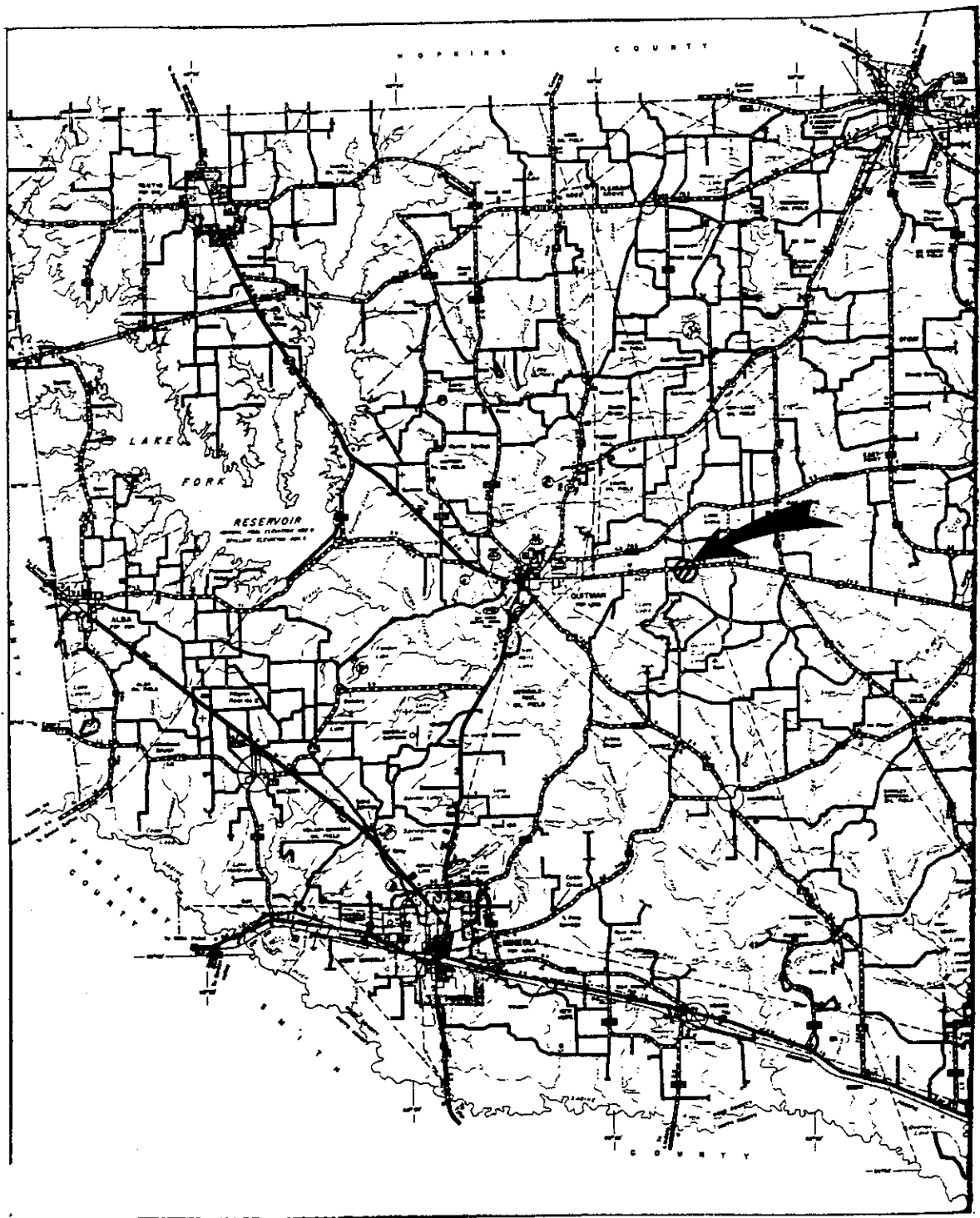
DATE WRITTEN: 8 November 1993

REVIEWED BY: Dennis Markwardt and David Dunlap

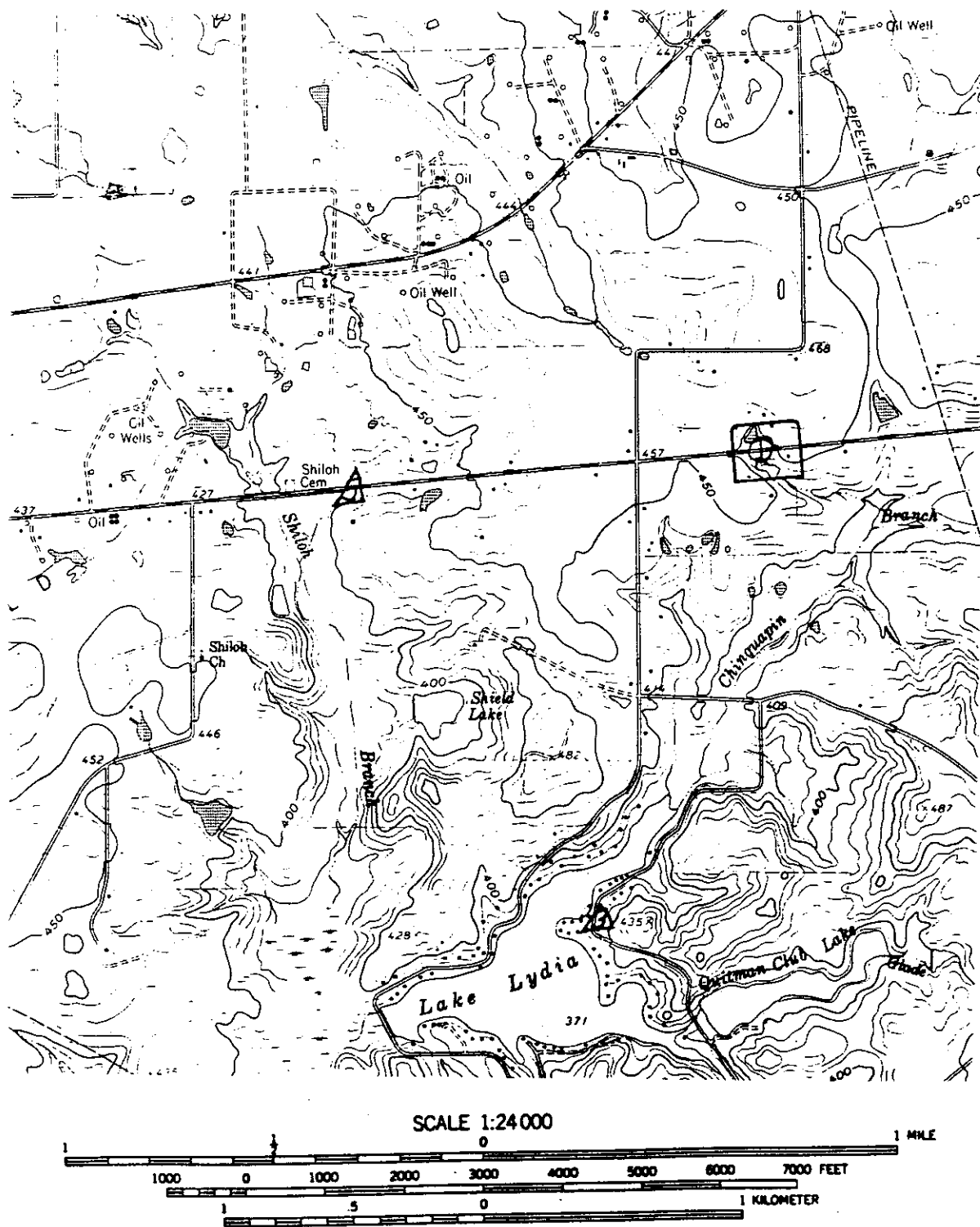
DATE REVIEWED: fall 1993

REVISED BY AND DATE: Jackie M. Poole; 30 December 1993

APPROVED BY AND DATE:



Management Area for rough-stemmed aster
Wood County - both sides of Highway 154, 3.5 miles east
of the intersection of Highways 154 and 37 east of Quitman



Quitman 7.5' USGS Quadrangle

Location of rough-stemmed aster (*Aster puniceus* ssp. *elliottii* var. *scabricaulis*) monitoring/management area in Wood County, north of Lake Lydia, on Highway 154.

**Management Agreement between
Texas Department of Transportation
and Texas Parks and Wildlife Department**

LOCATION AND DESCRIPTION OF MANAGEMENT AREA: Zapata County - 1.8 - 2.8 miles south of the Webb/Zapata County line on both sides of Highway 83 (see attached map). On the west side of the highway about half way in the management area is a jog in the fence across from a culvert. The management area has sandy soils, and the dominant vegetation is grasses and herbs with shrubs invading the inclusion.

MANAGEMENT TECHNIQUES CURRENTLY EMPLOYED:

Mowing: with the exception of the inclusion which is not currently being mowed as per a previous verbal agreement.
Herbicides: Used on delineator posts, object markers, around culvert, and pavement edge.
Seeding: None known.
Other: Fire lanes are disked along the eastern fence line.
Future plans: Disking may be eliminated.

SPECIES OF CONCERN:

Ashy dogweed (Thymophylla tephroleuca) - This federally and state listed endangered species is covered with soft, wooly, whitish to ashy gray hairs. This spreading perennial often forms large clumps up to 12 inches tall. The small, yellow, daisy-like flowers can be seen any time of year after sufficient rain.

The only verified localities of the ashy dogweed are from the highway right-of-way and the adjacent ranches in Zapata County. A historical location in Starr County has not been relocated. Continuous brush clearing and subsequent seeding to non-native species or planting of agricultural crops in the surrounding area have probably destroyed other populations. With only one population presently known, chance events such as natural disasters, pests or disease, or inbreeding depression could lead to extinction of the species.

The population on highway right-of-way represents the only individuals of this species on public land. Through the monitoring of this species under known management conditions, we will learn the species' response to various types of management.

Prostrate milkweed (Asclepias prostrata) - This U. S. Fish and Wildlife Service Category 2 (awaiting study to determine if listing is needed) species grows flat on the soil surface. The stems spread out from a central root and are covered with triangular, crinkly-edged leaves. The flowers are quite unusual and are shades of yellow, red, and brown. Flowering occurs March through October. The fruits form large, warty

Pods filled with many seeds tipped with silky tufts of white hairs.

The prostrate milkweed requires full sun and is easily overgrown by many other species. Although some brush clearing procedures may be beneficial to the species by opening new habitat for colonization, seeding to exotic grasses such as coastal Bermuda and buffelgrass eradicates the prostrate milkweed by cutting off sunlight.

All three populations of prostrate milkweed are at least partially on highway right-of-way. These individuals are the only ones on public land. Through monitoring of these individuals under differing management regimes, we can learn how the species responds to disturbance.

RECOMMENDED MANAGEMENT PROCEDURES: Mowers should be set at 6 inches to avoid damage to any of the ashy dogweeds presently in the right-of-way. Mowing should follow the currently established schedule, and the jog along the fenceline should be mowed at least once a year in an effort to eliminate woody species. If necessary herbicides should be sparingly and carefully applied at times of little or no wind. Disking should be eliminated on the western right-of-way (see map). Disking should be conducted once a year in January on the eastern right-of-way (see map). No paving or construction materials should be stockpiled in the management area. No other species should be seeded or planted. Any proposed disturbance of the right-of-way by other entities (i.e., utilities, local/state/federal agencies, etc.) should be reviewed by TxDOT and TPWD. If any change in management procedure is anticipated, the Texas Natural Heritage Program of the Texas Parks and Wildlife Department should be notified before changes are implemented.

MONITORING PROCEDURES: The management area will be divided into two macroplots (western and eastern, see map). In the western macroplot at least three 50 meter line transects will be placed along the fence line, marked by numbered fence posts and at each end by rebar placed along the fenceline so as not to present a hazard to mowing operations. For the ashy dogweed, number, linear coverage, and approximate number of flowers will be calculated to assess vigor. Prostrate milkweeds along the fence line will be measured as to linear cover, number of individuals, and number of branches of each individual as an assessment of vigor. Ashy dogweeds not along the fenceline but within the right-of-way will be located from the transect line. Diameter, approximate number of flowers, and number of dead branches will be measured as an estimate of vigor. For prostrate milkweed in the right-of-way but not along the fence line transect, at least 15 1 m² plots will be centered around one or more individuals. Plots will be located by triangulating from two marked fence posts. Cover, frequency, and density will be measured within these plots to evaluate the effect of succession in this area. Vigor of

prostrate milkweeds will be evaluated by length and number of branches.

In the eastern macroplot, numbers of individuals of prostrate milkweeds and ashy dogweed will be counted and located by numbered fence posts. No measurements of vigor will be taken as all above ground parts will probably be destroyed by disking.

For both plots monitoring will continue on a yearly basis in spring. Monitoring will be conducted by the staff of the Endangered Resources Branch, Texas Parks and Wildlife Department.

RED FLAG CONDITIONS: A 10% annual decrease in the number of individuals for ashy dogweed and prostrate milkweed will be considered a significant decline in the population. Also over any consecutive three-year period, a 10% decline in the numbers of flowers for ashy dogweed or a 10% decline in the length or number of branches of the prostrate milkweed will be considered a significant reduction in vigor. If such conditions occur, the cause will be ascertained. If the cause is related to management, management recommendations may be altered.

LOCATION OF ARCHIVED DATA: Texas Natural Heritage Program, Texas Parks and Wildlife Department, 4200 Smith School Road, Austin, Texas 78744; and Texas Department of Transportation, Division of Environmental Affairs, 125 E. 11th, Austin, Texas 78701.

WRITTEN BY: Jackie M. Poole, Texas Natural Heritage Program, Resource Protection Division, Texas Parks and Wildlife Department, 4200 Smith School Road, Austin, Texas 78744

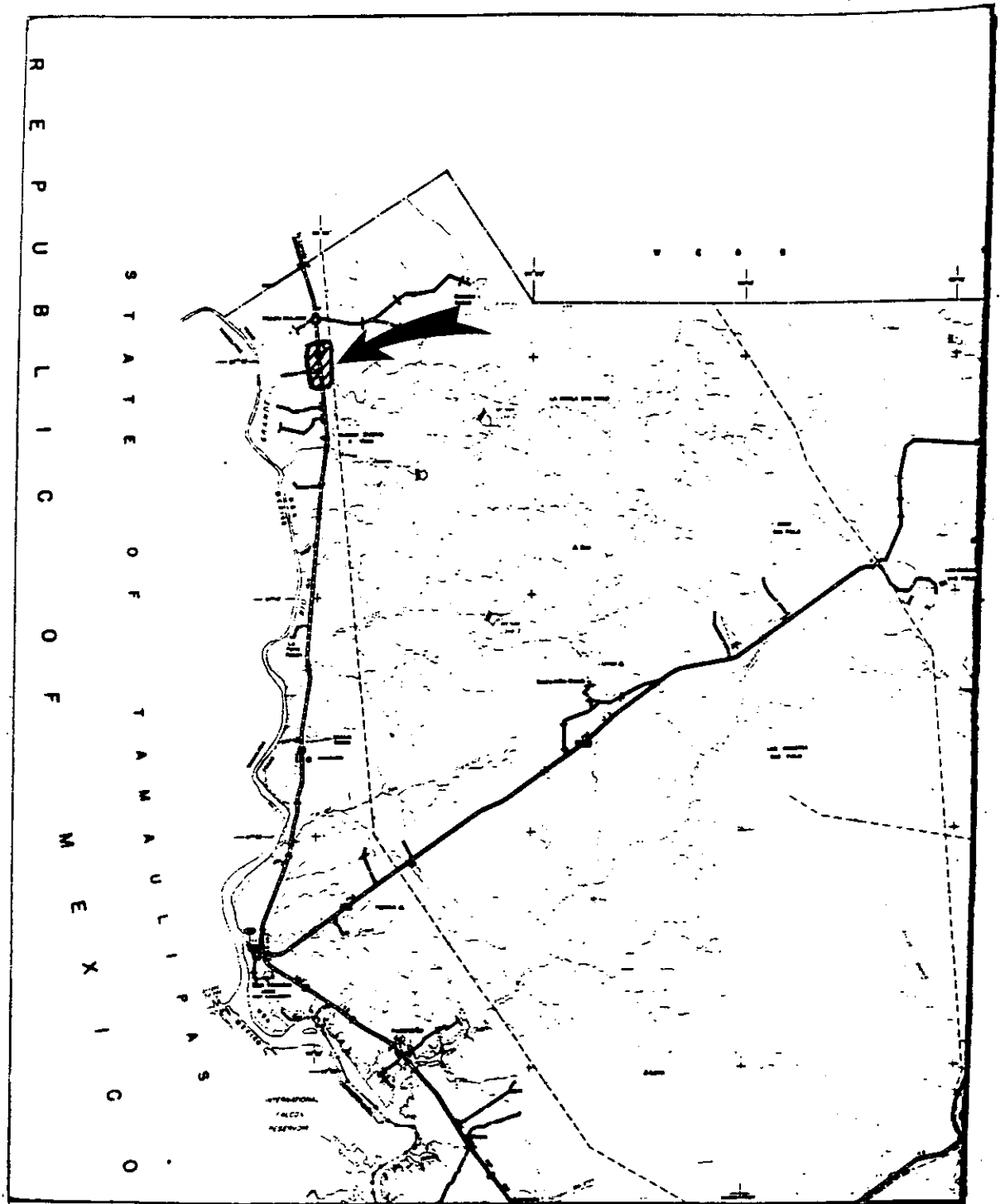
DATE WRITTEN: December 18, 1991; August 18, 1993 (minor revision)

REVIEWED BY: Dennis Markwardt, David Dunlap, and Amadeo Saenz

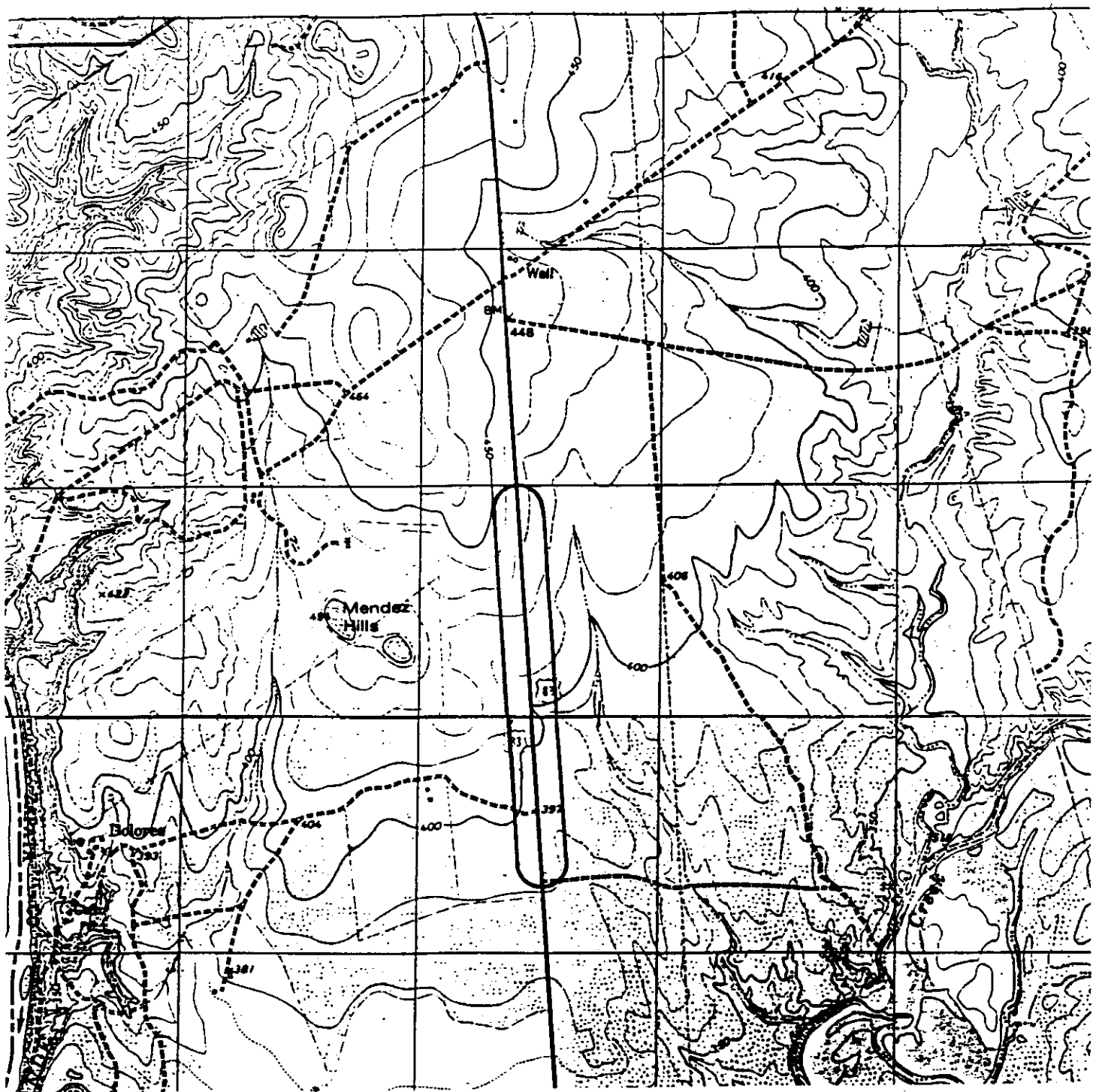
DATE REVIEWED: fall 1993

REVISED BY AND DATE: Jackie M. Poole; 30 December 1993

APPROVED BY AND DATE:



Management Area for Ashy Dogweed and Prostrate Milkweed
Zapata County - both sides of Highway 83,
1.8-2.8 miles south of the Webb/Zapata Counties



Arroyo Salado and O'Keefe Lake 7.5' USGS Quadrangles

Location of prostrate milkweed (*Asclepias prostrata*) and ashy dogweed (*Thymophylla tephroleuca*) monitoring/management area located in Zapata County, south of the Webb-Zapata county line, on Highway 83.

Management Agreement between
Texas Department of Transportation
and Texas Parks and Wildlife Department

LOCATION AND DESCRIPTION OF MANAGEMENT AREA: Zapata County - 0-0.3 miles north of the northern end of the Arroyo de Tigre Chiquita bridge on Highway 83 on the east right-of-way south of Lope_o (see attached maps). The management area is in front of an abandoned trailer park, and has gravelly sandy soils with grasses and herbs.

MANAGEMENT TECHNIQUES CURRENTLY EMPLOYED:

Mowing: Full width once a year (in late fall) and one mower width several times a year.

Herbicides: Used on delineator posts, object markers, signs, and pavement edge.

Seeding: None known.

Future plans: None anticipated.

SPECIES OF CONCERN:

Zapata bladderpod (Lesquerella thamnophila) - This silvery perennial is a U. S. Fish and Wildlife Service Category 2 (awaiting study to determine if listing is needed). The stems and the leaves are covered with tiny, silvery hairs. The stems are spreading and usually branched. The leaves are entire to pinnatifid. The small yellow flowers are scattered along a long stem. The fruits form small, orbicular pods.

The Zapata bladderpod probably does best in full sun and is easily overgrown by many other species. Although some brush clearing procedures may be beneficial to the species by opening new habitat for colonization, seeding to exotic grasses such as coastal Bermuda and buffelgrass eradicates the Zapata bladderpod by cutting off sunlight.

The management area represents the only individuals of the Zapata bladderpod on public land. Through monitoring of these individuals, we can learn how the species responds to disturbance, succession, and various management procedures.

RECOMMENDED MANAGEMENT PROCEDURES: Mowing can be done at any time between June and January. Zapata bladderpods will be actively growing in late winter and early spring, and mowing should be avoided at these times to refrain from cutting the flowers or fruits before the seeds mature. Mowers should be set at a height of 6 inches to avoid damaging any late-flowering or early growing plants. Herbicides should be sparingly and carefully applied at times of little or no wind. If any change in management procedure is anticipated, the Texas Natural Heritage Program of the Texas Parks and Wildlife Department should be notified before changes are implemented.

MONITORING PROCEDURES: If fewer than 100 individuals of Zapata bladderpod are found within the management area, total number of individuals will be counted. If more than 100 individuals are found, a randomly selected subset of 100 individuals will be monitored. Number of branches and length of branches as well as number of fruits will be determined as an assessment of vigor. The management area will be monitored on a yearly basis in April. Monitoring will be conducted by Jackie Poole of the Texas Natural Heritage Program, Texas Parks and Wildlife Department.

RED FLAG CONDITIONS: Over any continuous three-year period a 10% per year decrease in number of these annuals will be considered a significant decrease in the population. Also a 10% decrease in the length or number of branches over any continuous three-year period will be considered a significant decrease in vigor. If such conditions occur, the cause will be ascertained. If the cause is related to management activities, management recommendations may be altered.

LOCATION OF ARCHIVED DATA: Texas Natural Heritage Program, Texas Parks and Wildlife Department, 4200 Smith School Road, Austin, Texas; and Texas Department of Transportation, La Costa Complex, 6400 U.S. 290 East, Austin, Texas

WRITTEN BY: Jackie M. Poole, Texas Natural Heritage Program, Resource Protection Division, Texas Parks and Wildlife Department, 4200 Smith School Road, Austin, Texas 78744

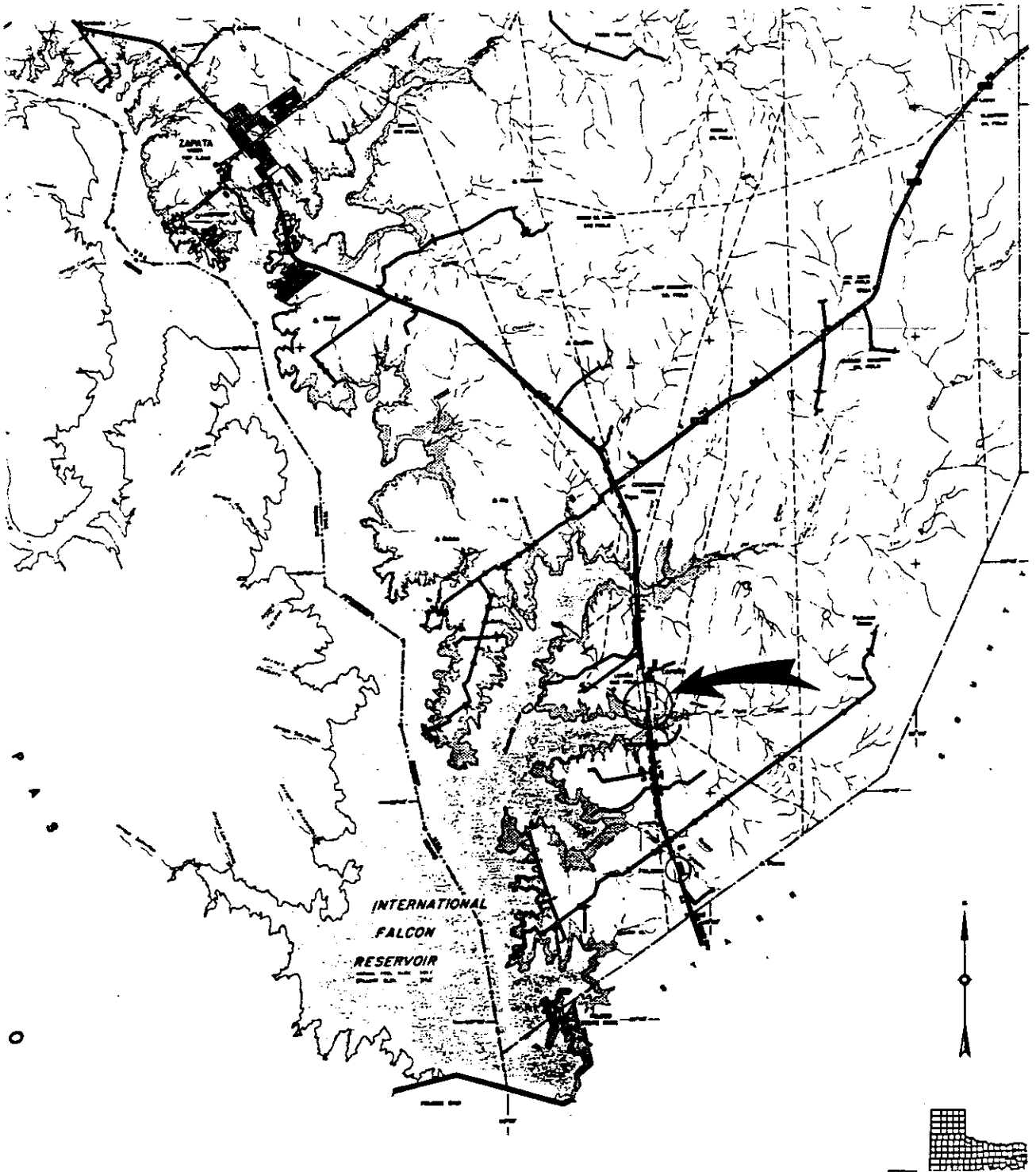
DATE WRITTEN: December 19, 1991

REVIEWED BY:

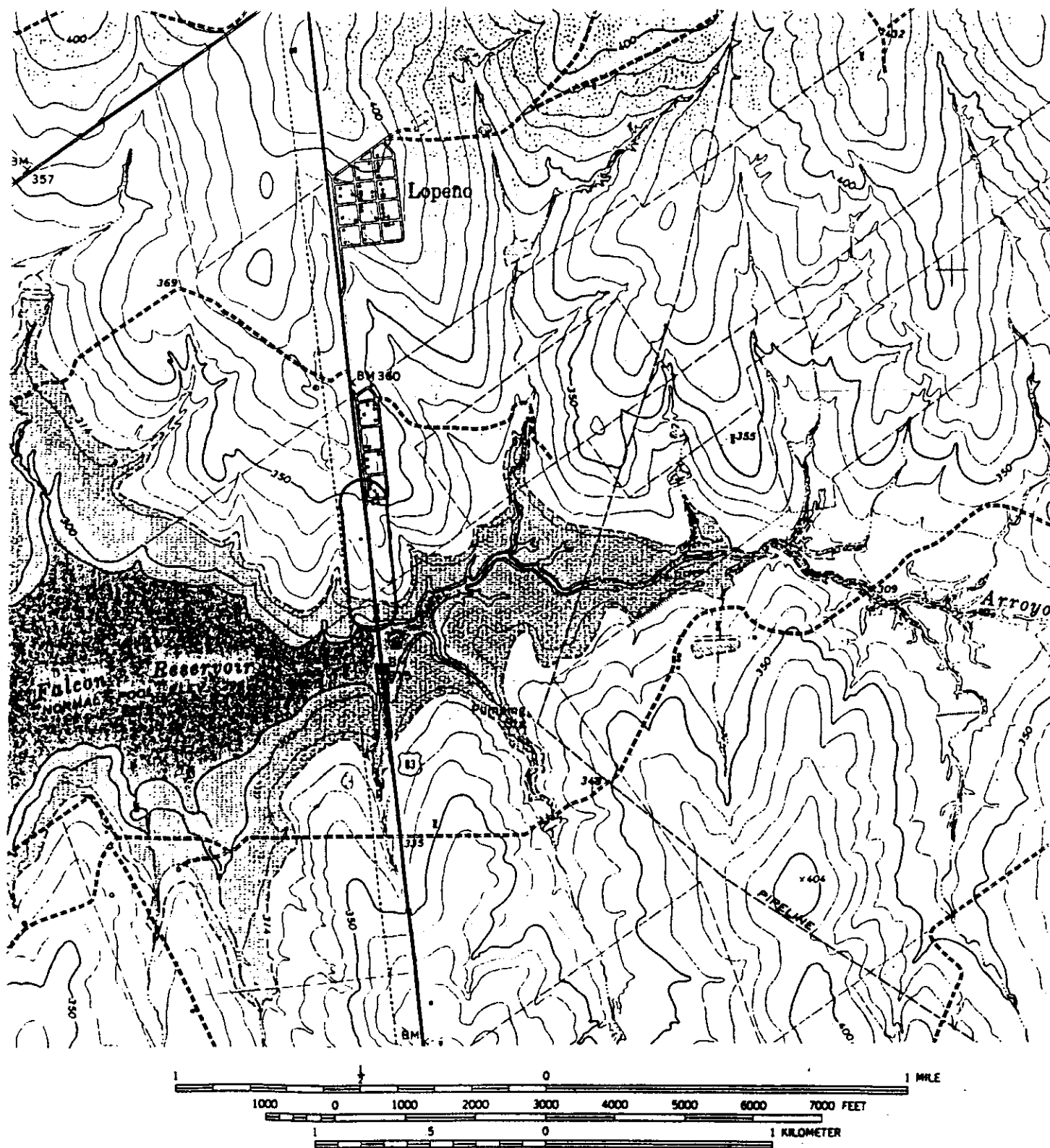
DATE REVIEWED:

REVISED BY AND DATE:

APPROVED BY AND DATE:



Management Area for prostrate milkweed and Zapata bladderpod
Zapata County - 0.3 mile north of the Arroyo de Tigre Chiquita bridge
on Highway 83 south of Lopeño



Lopeño 7.5 USGS Quadrangle

Location of Zapata bladderpod (*Lesquerella thamnophila*) monitoring/management area located in Zapata County, south of Lopeño, on Highway 83.

**Management Agreement between
Texas Department of Transportation
and Texas Parks and Wildlife Department**

LOCATION AND DESCRIPTION OF MANAGEMENT AREA: Zapata County - 5.2 miles south of the junction of Highway 16 and 83 on the west side of Highway 83 (see attached map). The management area is adjacent to the private property fenceline within a rocky opening with saladillo (Varilla texana).

MANAGEMENT TECHNIQUES CURRENTLY EMPLOYED:

Mowing: Full width once a year (in late fall) and one mower width several times a year.

Herbicides: Used on delineator posts, object markers, signs, and pavement edge.

Seeding: None known.

Future plans: Highway 83 may be widened in the future.

SPECIES OF CONCERN:

Johnston's frankenia (Frankenia johnstonii) - Johnston's frankenia is a sprawling, woody, perennial subshrub which is listed as federal and state endangered. This shin-high shrub is a halophyte (or salt loving) and grows in areas of high salinity. Saladillo, another halophyte, is usually an associate. The leaves of Johnston's frankenia are small, and often covered with visible salt crystals (especially on the underside of the leaf) which the plant excretes after salty water has been absorbed by the roots. The flowers are tiny, with five white petals and a bright yellow center. Flowering can occur any time of the year after a rain. The plants appear somewhat gray-greenish to blue-greenish in the warm weather months, but turn to a crimson red in the winter months.

Loss of habitat is the biggest threat to the species. Root plowing and seeding to monotypic grass stands and agricultural fruit fields have probably led to the disappearance of many rare plant populations in South Texas, not just the Johnston's frankenia. Additionally, this species inhabits a very narrow edaphic niche of high saline soil pockets, and does not grow in medium to low salinity areas.

RECOMMENDED MANAGEMENT PROCEDURES: Delineator posts were placed around the population occurring on the right-of-way. This will prohibit the mowers from riding over the species. Therefore, mowing can be done at any time. Herbicides should be sparingly and carefully applied at times of little or no wind. If any change in management procedure is anticipated, the Texas Natural Heritage Program of the Texas Parks and Wildlife Department should be notified before changes are implemented.

MONITORING PROCEDURES: Johnston's frankenia individuals were located and mapped using triangulation from number fenceposts. Vigor was assessed using areal diameter at the widest point, height, and number of flowers and fruits for each individual.

Monitoring will be conducted on an annual basis in April. Monitoring will be conducted by the staff of the Endangered Resources Branch, Texas Parks and Wildlife Department.

RED FLAG CONDITIONS: Since the species is a slow growing woody perennial, we do not expect to have extreme variations from year to year. Therefore, a 10% decrease in individuals without new seedling recruitment will be considered significant. Additionally, if vigor measurements drop more than 10% from year to year, this will be considered significant. If such conditions occur, the cause will be ascertained. If the cause is related to management, management recommendations may be altered.

LOCATION OF ARCHIVED DATA: Texas Natural Heritage Program, Texas Parks and Wildlife Department, 4200 Smith School Road, Austin, Texas 78744; and Texas Department of Transportation, Division of Environmental Affairs, 125 E. 11th, Austin, Texas 78701.

WRITTEN BY: Gena K. Janssen, Endangered Species Program, Resource Protection Division, Texas Parks and Wildlife Department, 4200 Smith School Road, Austin, Texas 78744

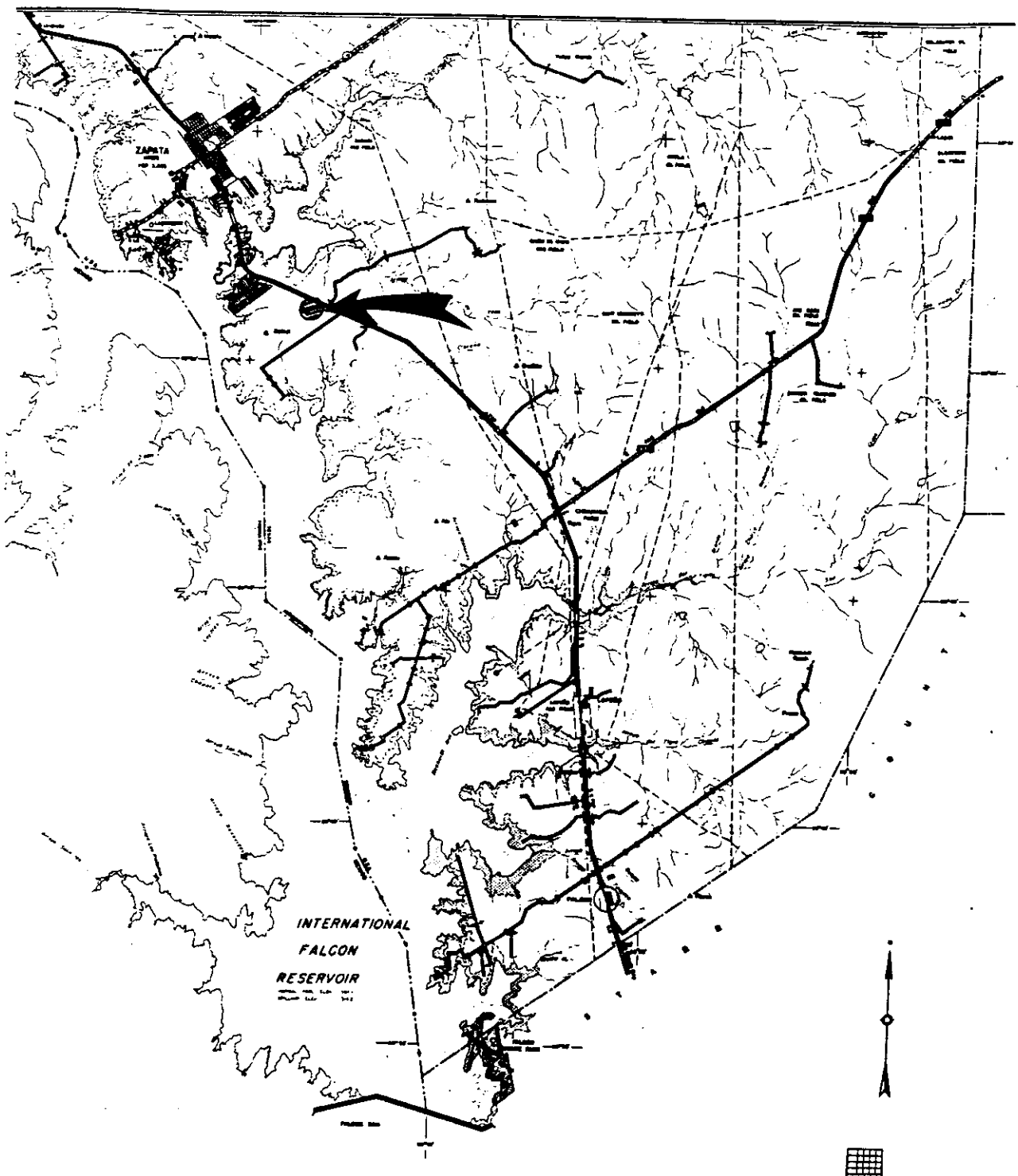
DATE WRITTEN: November 15, 1994

REVIEWED BY:

DATE REVIEWED:

REVISED BY AND DATE:

APPROVED BY AND DATE:



Management Area for Johnston's frankenia
Zapata County - on the west side of Highway 83, 5.2 miles south of the Highway 83
and 16 junction in Zapata

