# IRRIGATED LAND ASSESSMENT OF THE UPPER CLARK FORK DRAINAGE

November, 1985

Submitted to:
Montana Department of Fish, Wildlife and Parks
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### I. INTRODUCTION

The Montana Department of Fish, Wildlife and Parks (DFWP) is preparing a water reservation request for the upper Clark Fork drainage to be submitted to the Montana Department of Natural Resources and Conservation (DNRC) for review and analysis. One aspect of the water reservation request concerns the status of irrigated land and potentially irrigable land within the upper Clark Fork Valley.

This report discusses the methods used to identify potentially irrigable land and presents acreage figures for irrigated and irrigable land in the upper Clark Fork Valley. Constraints to irrigation imposed by economics and heavy metals are discussed and reflected in the data presented. No attempt was made to project how future costs may alter economic feasibility or how future reclamation activities may ameliorate heavy metal toxicity problems. In addition, the critical question of if and where water may be available for expanding irrigation in the upper Clark Fork drainage was not addressed.

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### II. MAPPING OF LANDS

### A. Arable Lands

Arable lands are those lands which have suitable soil, climatic, and topographic features for supporting sustained crop production. Arable lands only become "irrigable" when water is available and can be supplied and applied cost effectively.

Arable lands that are not currently being irrigated were mapped utilizing aerial photographs upon which soil mapping units had been delineated by the Soil Conservation Service (SCS). Photocopies were made of the aerial photographs while visiting SCS offices in Deer Lodge and Philipsburg. Composite working maps were constructed by taping the photocopies together along the match lines as delineated on the aerial photographs.

Based on capability classes and soil correlations provided by the SCS, all lands that were Class I, II, III, or IV were identified and shaded in on the composite working maps. These lands can sustain irrigated agriculture, but have certain limitations that must be considered by agriculturists.

#### B. <u>Irrigated Lands</u>

The status of irrigated lands in the upper Clark Fork Valley was determined by relying upon existing data, photointerpretation, field reconnaissance, aerial observation, and limited aerial imagery recorded on a video cassette. The State Engineer's Office has assembled existing data on irrigated lands in the form of a "Water Resources Survey" for each Montana county. Each survey includes maps showing irrigated lands,

irrigation ditches, and other pertinent features. Because, however, the Water Resources Surveys were compiled in the 1950s and 1960s, the mapping of irrigated lands is not current.

Updating the mapping of irrigated land acreages was accomplished by comparing SCS aerial photographs with the Water Resources Survey data base. Lands which appeared to be irrigated on aerial photographs, but which were not mapped on Water Resources Surveys, were added to the irrigated land base map. A constraint to updating irrigated land acreages by aerial photointerpretation was that the aerial photographs for Granite County were taken in 1965, whereas the aerial photographs for Deer Lodge and Powell counties were taken in 1976. Because the photographs were not taken at the same time, consistent updating was not possible using aerial photographs.

Additional irrigated lands were identified and mapped through direct aerial observation. A helicopter flight over the study area was made on August 3, 1984. The flight was made during the peak of the irrigation season; therefore, irrigated lands contrasted with the dessicated adjacent rangeland.

On July 18, 1985, aerial imagery was acquired on a video cassette recorder (LMS system) for irrigated lands northwest of Deer Lodge. Because it was apparent that new pivot systems had been added during the course of this study, the imagery was used with the LMS system at the DNRC to update the mapping of irrigable lands.

### C. Irrigable Lands

Irrigable lands were identified and delineated on base maps after economic and heavy metal toxicity constraints were considered. Economic

constraints were developed based on the assumption that water would either have to be pumped from an existing river or large stream or supplied from reservoirs not yet constructed. Heavy metal constraints were based on data which identified areas where waterborne mine tailings have been deposited on the floodplain of the Clark Fork River.

# 1. Pumping From Rivers

The economics of pumping irrigation water from the Clark Fork and major tributaries (i.e., Little Blackfoot and Flint Creek)<sup>1</sup> were considered based on a computer analysis using the Soil Conservation Service IRRSYS model. After updating costs of commodities such as electricity, pipes, and pumps (see Appendix A for the parameters included in the analysis), costs for supplying water, as a function of pumping lift elevation, distance, and acreage, were calculated. By varying pump lift elevation, distance, acreage, and irrigation system size, matrices were constructed (Figures 1 through 10) which show the relationships among these variables.

Based on the data generated from the IRRSYS model, costs associated with construction and operation of irrigation systems have been determined. These costs, however, do not include the cost of planting, managing, and harvesting the crop. In order for irrigation to be economically feasible, the value of the crop must offset the cost of supplying water (i.e., IRRSYS model values). Figure 11 is a flow diagram showing how the IRRSYS model used in conjunction with other information was used to identify potentially irrigable lands.

¹Only the Clark Fork and major tributaries were considered in the analysis because, based on field observations, tributary streams appear to be maximally utilized as irrigation sources at the present time. Also, it was believed that for the cost of installing a sprinkler irrigation system to be justified, a reliable source of water would be necessary throughout the growing season. The smaller tributary streams probably would not consistently provide water during dry years.

FIGURE 1

COST RELATIONSHIPS BETWEEN PUMPING LIFT ELEVATION AND DISTANCE FROM WATER SOURCE FOR A 40-ACRE WHEEL LINE IRRIGATION SYSTEM

					Pumpi	ng Lift	Pumping Lift Elevation (Feet)	ion (Fe	et)			
	40	80	120	160	200	240	280	320	360	400	440	480
.1	89	100	111	125	137	153	167	180	194	207		
.3	96	108	119	135	147	163	177	189	202			
.5	103	115	126	145	160	179	194	208				
	113	127	142	153	175	189	205					
6.	120	137	154	166	186	200						
1.1	130	144	162	173	196							
1.3	140	152	172	193	211	26						
1.5	148	159	182	205			20					
2.0	171	192	214	3.5								
2.5	204											
3.0						100		110	165			
3.5			The second						land Service		Constitution of the consti	
4.0		36 D	50									
4.5		100000000000000000000000000000000000000										
5.0												
5.5												

FIGURE 2

COST RELATIONSHIPS BETWEEN PUMPING LIFT ELEVATION AND DISTANCE FROM WATER SOURCE FOR A 80-ACRE WHEEL LINE IRRIGATION SYSTEM

40         80         120         160         240         280         320         360         400         440           13         14         15         15         162         179         192         205           3         87         103         117         133         146         161         172         193         206         205           4         109         125         139         153         168         180         204         206         207           101         118         131         147         160         177         190         214         160         177         190         214           101         115         131         144         163         180         192         227         14         150         180         192         227           1.15         124         157         176         195         207         187         200         180         180         194         215         180         180         180         180         180         180         180         180         180         180         180         180         180         180         180         180					打	Pumpi	ng Lift	Pumping Lift Elevation (Feet)	ion (Fe	et)			
83         98         111         125         137         151         162         179         192           87         103         117         133         146         161         172         193         206           94         109         125         139         153         168         180         204           101         118         131         147         160         177         190         214           106         125         139         154         172         185         215           115         131         144         163         180         192         227           120         137         151         170         187         200           121         174         199         213         207           154         174         199         213         215           178         191         217         200         214           194         208         215         207           194         208         213         200           194         208         214         215           194         208         200		40	. 80	120	160	200	240	280	320	360	400	440	480
87         103         117         133         146         161         172         193           94         109         125         139         153         168         180         204           101         118         131         147         160         177         190         214           106         125         139         154         172         185         215           115         131         144         163         180         192         227           120         137         151         170         187         200         207           141         159         176         195         207         207           154         174         199         213         215         207           178         191         217         208         213         215           194         208         208         213         215         200           194         208         215         200         200         200         200	1	83	86	111	125	137	151	162	179	192	205		COLUMN TOWN
94         109         125         139         153         168         180           101         118         131         147         160         177         190           106         125         139         154         172         185         215           115         131         144         163         180         192         227           120         137         151         170         187         200         227           141         159         180         194         215         207         207           154         174         199         213         215         215         207           194         208         213         215         215         215         215           194         208         213         215         215         215         215	.3	87	103	117	133	146	161	172	193	206			
101         118         131         147         160         177         190           106         125         139         154         172         185         215           115         131         144         163         180         192         227           120         137         151         170         187         200           125         144         157         176         195         207           141         159         180         194         215         207           178         191         217         213         215         207           194         208         213         215         207           194         208         213         213         213           194         208         213         213         213           194         208         200         200         200	.5	94	109	125	139	153	168	180	204				
106     125     139     154     172     185       115     131     144     163     180     192       120     137     151     170     187     200       125     144     157     176     195     207       141     159     180     194     215       154     174     199     213     217       194     208     217     217	.7	101	118	131	147	160	177	190	214		and the second second		
115     131     144     163     180     192       120     137     151     170     187     200       125     144     157     176     195     207       141     159     180     194     215       154     174     199     213       178     191     217       194     208	6.		125	139	154	172	185	215			30 374-003		
120     137     151     170     187       125     144     157     176     195       141     159     180     194     215       154     174     199     213       178     191     217       194     208		. ilus	131	144	163	180	192	227	should be		444.5		
125     144     157     176     195       141     159     180     194     215       154     174     199     213       178     191     217       194     208	3.0	1 100	137	151	170	187	200		7.1				
141     159     180     194       154     174     199     213       178     191     217       194     208	1.5	125	. 144	157	176	195	207	20 2 ×	134140)		and a company		
154 174 199 2 178 191 217 194 208	2.0		159	180	194	215		ONLY DATE					
178 191 194 208	2.5	1104	174	199	213		Saddle	To the Landson	50	300			- Property
194	3.0	Žuc	191	217					102				
4.5 5.0 5.5	3.5	7 (1)	208	The second second					STATE OF THE PARTY				
4.5 5.0 5.5	4.0	D.,	12.7	WCH		200	ALL MO				The second secon		
5.0	4.5	7-11			SHEW THE STREET	200							
5.5	5.0												
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FIGURE 3

COST RELATIONSHIPS BETWEEN PUMPING LIFT ELEVATION AND DISTANCE FROM WATER SOURCE FOR A 100-ACRE WHEEL LINE IRRIGATION SYSTEM

					Pumpi	ng Lift	Pumping Lift Elevation (Feet)	ion (Fe	et)			
	40	80	120	160	200	240	280	320	360	400	440	480
1.	85	86	112	124	136	150	163	179	193	206		
.3	88	103	116	133	146	159	172	192	204			
.5	95	110	124	138	151	166	179	202				12
.7	101	116	129	145	162	174	200	0.02			9	
6.	107	123	137	152	169	182	211		· · · · · · · · · · · · · · · · · · ·		. W	
1.1	113	129	146	158	176	189	221			( ) ( ) ( )	1 A 10	
1.3	117	134	153	165	183	196		W.B.B.				
1.5	123	141	159	171	190	203						1
2.0	141	155	175	196	1 8						35 26 27 27	
2.5	156	179	192	215								
3.0	172	197	222				L De L				15	5
3.5	187	212					### \$2000/e		THE APPROXIME			
4.0	215		(\$27)						V			
4.5				To the second					A CONTRACTOR OF THE PARTY OF TH			
5.0												
5.5								2				্র

FIGURE 4

COST RELATIONSHIPS BETWEEN PUMPING LIFT ELEVATION AND DISTANCE FROM WATER SOURCE FOR A 100-ACRE CENTER PIVOT IRRIGATION SYSTEM

					Pumpi	Pumping Lift Elevation (Feet)	Elevat	ion (Fe	et)			
	40	80	120	160	200	240	280	320	360	400	440	480
1	76	88	101	113	126	137	150	191	176	188	201	
.3	79	92	105	117	133	145	158	171	190	202	210	
.5	84	86	112	125	138	150	165	177	200	212	216	
.7	89	102	117	131	145	156	172	185	208	221	223	
6.	94	109	125	137	152	168	179	206	219	232	232	Ī
1.1	97	115	130	143	159	174	187	217	229	228	239	
1.3	102	119	135	148	165	182	193	230	242	235	248	E T
1.5	108	124	141	159	171	188	201	240	252	242		
2.0	121	138	155	175	186	204	252	239	250	4		
2.5	138	157	169	191	212	224	248	- 9554-1-1-1-1-1-1-1-1-1-1-1-1-1-1-1-1-1-1-	153 200			
3.0	150	171	195	207	231				000	B		1. 1. 3.
3.5	164	186	210	237			THE STREET					
4.0	188	201	227		8					1 H		i i
4.5	201	232		1 100 1	20143100							
5.0												
5.5					· ·							

FIGURE 5

COST RELATIONSHIPS BETWEEN PUMPING LIFT ELEVATION AND DISTANCE FROM WATER SOURCE FOR A 135-ACRE CENTER PIVOT IRRIGATION SYSTEM

					Fumpi	Fumping Lift Elevation (Feet)	Elevat	ion (Fe	et)			
	40	80	120	160	200	240	280	320	360	400	440	480
7	92	88	100	112	124	136	150	162	176	188	201	
.3	80	92	105	117	133	146	158	169	188	201		
.5	85	66	112	124	138	152	165	176	199			
.7	90	104	118	130	144	159	171	182	210			
6.	95	109	124	139	151	166	178	210				
1.1	100	115	130	146	159	171	183	221				
1.3	104	120	135	153	165	178	190	231				
1.5	113	130	141	158	173	186	198	CATE OF				
2.0	126	143	162	175	189	202	200	140	100 E-0			
2.5	145	166	178	194	206	14		150		445		
3.0	159	183	184	210					8911 H III 1591			
3.5	185	198	TANKS III SEE	HITTS CALL THE CALL THE							To the state of	A STATE OF
4.0	202	988										
4.5				1 8								
5.0	,1											2
5, 5	4											

FIGURE 6

COST RELATIONSHIPS BETWEEN PUMPING LIFT ELEVATION AND DISTANCE FROM WATER SOURCE FOR A 170-ACRE CENTER PIVOT IRRIGATION SYSTEM

				100	Pumpi	Pumping Lift	Elevation (Feet)	ion (Fe	et)			
ре <sup>3</sup> 3	40	80	120	160	200	240	280	320	360	400	440	480
٦.	92	88	100	107	119	138	151	163	177	190	201	
.3	81	93	106	119	133	144	158	169	188	200		1
.5	85	97	110	123	138	149	164	177	198			
1.	88	100	114	128	142	154	169	196				Tar A
6.	92	106	120	132	147	164	176	207		190 L		
1.1	96	110	125	138	153	169	181	217				
1.3	66	115	129	142	158	175	188	227				
1.5	103	118	135	152	164	183	225	\$ C	10 E 10			
2.0	112	128	147	166	177	197	0.81	70.0		682	7	
2.5	121	140	158	179	201	0.140		(A)				
3.0	138	157	171	192	216			\$17 (A)	AY H	(18) 1944 (FT)		
3.5	148	170	194	205		5 TH 15 TH 1		11 10 10				15 (A
4.0	158	182	207		Walley House the		Shelder of		1 19 (1)			
4.5	182	194	214	100	Danes - Sean			Y		9		
5.0	194	221		8								
5.5	206											

FIGURE 7

COST RELATIONSHIPS BETWEEN PUMPING LIFT ELEVATION AND DISTANCE FROM WATER SOURCE FOR A 205-ACRE CENTER PIVOT IRRIGATION SYSTEM

					Pumpin	Pumping Lift	Elevation (Feet)	ion (Fet	<b>⇒</b> t)			
	40	. 80	120	160	200	240	280	320	360	400	440	480
7	78	89	102	115	127	140	152	165	180	יפו	700	
.3	82	93	107	120	133	146	158	171	189	202	4114	
.5	84	96	109	122	136	148	161	174	195	207		
.7	98	86	111	125	138	150	164	176	200		124	
6.	87	101	115	126	141	153	167	179	205			
1.1	91	105	120	132	146	161	173	203				
1.3	95	109	124	136	151	166	179	214				
1.5	86	111	126	141	154	169	182	220		9		
2.0	118	136	148	166	184	197						
2.5	129	149	167	180	199				E			
3.0	140	159	181	202						Ē		
3.5	159	171	194	216		THE REAL PROPERTY.				10 To		1911
4.0	171	195	207									i.
4.5	183	208										
5.0	209											
5.5		- 1	S									

FIGURE 8

COST RELATIONSHIPS BETWEEN PUMPING LIFT ELEVATION AND DISTANCE FROM WATER SOURCE FOR A 240-ACRE CENTER PIVOT IRRIGATION SYSTEM

	>				Pumpir	Pumping Lift Elevation (Feet)	Elevat	ion (Fe	at)			
	40	80	120	160	200	240	280	320	360	400	440	480
-	79	91	104	117	129	141	154	166	101			
٣.	83	95	109	121	134	147	160	172	101	193	205	#
.5	98	86	112	124	138	151.	165	177	191	707		
.7	90	102	115	129	144	155	171	200	707			
6.	92	104	119	134	149	161	177	200				
1.1	96	110	125	137	154	170	182	220	* 1	10		
1.3	66	114	130	142	159	175	217	077	21			9 1
1.5	102	117	134	146	163	180	227	11				
2.0	111	128	144	163	175	195	25.2					
2.5	1119	137	155	175	188	200	707					
3.0	127	146	166	188	212						E/G	
3.5	143	165	177	200	THE PERSON NAMED IN					17.07.00		
4.0	153	174	199	*								
4.5	162	186	229							Ť		
5.0	172	196										
5.5	195	245	54					ille the				

FIGURE 9

COST RELATIONSHIPS BETWEEN PUMPING LIFT ELEVATION AND DISTANCE FROM WATER SOURCE AND A 275-ACRE CENTER PIVOT IRRIGATION SYSTEM

n N		A III	100		Pumpin	Pumping Lift	Elevati	Elevation (Feet)	et)		
	40	80	120	160	200	240	280	320	360	400	440 480
.1	81	93	105	118	131	143	156	168	182	195	
.3	84	64	109	123	136	148	161	174	193	205	
.5	88	100	113	126	140	153	166	179	203	215	
.7	91	104	117	131	145	157	172	201	214		
6.	94	109	122	136	150	166	178	211			
1.1	97	112	127	139	154	170	183	221			
1.3	101	116	131	143	160	176	189	232		11	
1.5	104	119	135	152	164	182	194	242			
2 5	113	129	146	164	176	194	211				
2.5	121	144	156	176	196	269					
3.0	135	154	176	188	211		188				
3.5	144	165	187	212							
4.0	154	176	199		2587	XES				110	
4.5	174	199						# 131 On	1		7
5.0	184	211									
5.5	195										

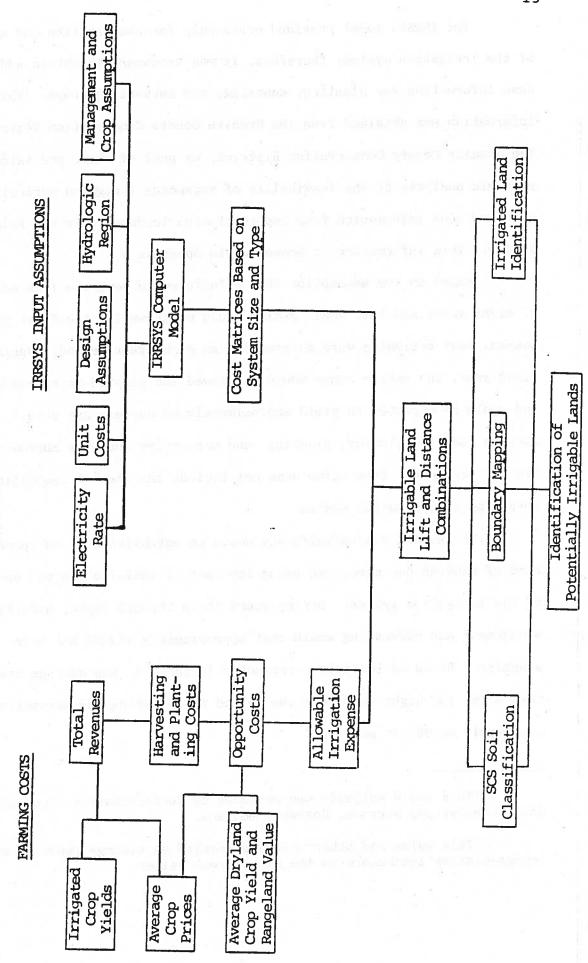
FIGURE 10

COST RELATIONSHIPS BETWEEN PUMPING LIFT ELEVATION AND DISTANCE FROM WATER SOURCE AND COMPOSITE FOR ALL IRRIGATION SYSTEMS

				9	Pumpi	Pumping Lift Elevation (Feet)	Elevati	ion (Fe	et)			
	40	80	120	160	200	240	280	320	360	400	440	480
7	92	83	100	112	124	136	150	161	176	981	100	6.5
e.	79	92	105	117	133	144	158	169	188	200	707	7
.5	85	97	110	123	138	149	164	176	198	210		
-	88	100	114	128	143	154	169	182	208		- B	
6.	92	104	119	132	147	161	176	206			Š	
115	95	110	125	137	153	169	181	217				Ū.
1.3	66	114	129	142	158	175	188	227				
1.5	102	117	134	146	163	180	194	235				
2.0	111	128	144	163	175	195	211				÷	1111年では
2.5	119	137	155	175	188	209						
3.0	127	146	166	188	205	DATE						The second
3.5	143	164	177	200	1 5 D#	ī.						Secretary of Protection
4.0	153	174	199		1	io.		100				18
4.5	162	186	212									
5.0	172	196	o i		r:							
5.5	195										2	

FIGURE 11

FLOW DIAGRAM FOR IDENTIFYING IRRIGABLE LANDS



John Tubbs, Economist, Montana Department of Natural Resources and Conservation. Source:

The IRRSYS model provided costs only for construction and operation of the irrigation system; therefore, it was necessary to obtain additional cost information for planting, managing, and harvesting crops. This information was obtained from the Granite County Conservation District.

The Granite County Conservation District, as part of their preliminary economic analysis of the feasibility of expanding irrigated agriculture, gathered cost information from representative landowners in the Flint Creek Valley. This information is presented in Appendix B.

Based on the assumption that alfalfa would be grown from seven out of eight years and that small grains would be grown for the first planting season, cost estimates were derived for an eight-year period. During the first year, the native range would be plowed and planted to spring wheat and would be expected to yield approximately 60 bushels per acre.<sup>2</sup> The average cost for plowing, planting, and harvesting would be approximately \$78.423 per acre. This value does not include the cost of installing and operating an irrigation system.

The second year alfalfa hay would be established at an approximate cost of \$109.42 per acre, excluding the cost of installation and operation of the irrigation system. During years three through eight, alfalfa management and harvesting would cost approximately \$59.03 per acre annually. Based on the values presented in Table 1, the average cost per year after the eight-year rotation period for planting and harvesting the crop would be \$67.75 per acre.

<sup>&</sup>lt;sup>2</sup>This yield estimate was provided by Jerry Schaefer, Economist, Soil Conservation Service, Bozeman, Montana.

<sup>&</sup>lt;sup>3</sup>This value and other values presented an average reported by two representative landowners in the Flint Creek Valley.

TABLE 1
PROJECTED COSTS AND CROP VALUES FOR EIGHT-YEAR ROTATION PERIOD

Year	Cost/Acre	Yield/Acre	Price1	Value/Acre
1	\$ 78.42	60 bu. <sup>3</sup>	\$3.89/bu.	\$233.40
2	\$109.42	4 tons	\$68/ton	\$272.00
3	\$ 59.03	4 tons	\$68/ton	\$272.00
4	\$ 59.03	4 tons	\$68/ton	\$272.00
5	\$ 59.03	4 tons	\$68/ton	\$272.00
6	\$ 59.03	4 tons	\$68/ton	\$272.00
7	\$ 59.03	4 tons	\$68/ton	\$272.00
8	\$ 59.03	4 tons	\$68/ton	\$272.00
Average	\$ 67.75		ne (5° neith) mai'd - titl	\$267.18

<sup>&</sup>lt;sup>1</sup>These prices are based on an 5.5 year average for spring wheat and alfalfa, adjusted to May 1984 dollar values (Kangas 1984).

<sup>&</sup>lt;sup>2</sup>This value does not consider installation costs for the sprinkler system.

<sup>&</sup>lt;sup>3</sup>This value was provided by Jerry Schaefer, Economist, Soil Conservation Service, Bozeman, Montana (October 1984).

The average value of the crop over an eight-year period was estimated to be \$267.18 per acre. In order for irrigation to become economically feasible, water would have to be delivered at a cost of less than \$195.68 per acre (\$267.18 - \$67.75 - \$3.75).4

## 2. Water Development Projects

The Granite County Conservation District is currently studying dam sites for possible water developments in the Flint Creek Valley. One site is on Boulder Creek near Princeton and another site is on the North Fork of Willow Creek above the existing Willow Creek Reservoir. Both sites would provide gravity feed irrigation water to areas that are not currently being irrigated. The Boulder Creek project would allow 5,000 acres to be converted from rangeland to cropland, whereas the Willow Creek project would expand the irrigated land base by 2,000 acres.

Although the final economic analyses of these water development projects have not been completed by the Granite County Conservation

District and the SCS, some preliminary economic information is available.

Based on the projected benefits of the project, irrigation water would have to be delivered at \$38.21 per acre-foot to provide a favorable benefit/cost ratio.

As previously stated, final economic information is not yet available on the projects, particularly in regard to costs of water delivery. In the absence of such information, data on water delivery costs compiled by Finnie (1984) were reviewed. Based on information presented by Finnie, non-subsidized project costs typically run \$50.00 per acrefoot for repairing or retrofitting existing water impoundments and between

<sup>&</sup>lt;sup>4</sup>The value of the crop is \$267.18; \$67.75 is the cost of planting, managing, and harvesting; \$3.75 is the present value of the grazing land that would be lost.

\$150.00 and \$300.00 per acre-foot for building new storage capacity. If Finnie's projected cost estimates are anywhere near correct, the cost of delivering water from the proposed Boulder Creek and Willow Creek projects would be prohibitive.

# 3. Heavy Metal Constraints

Contamination of soils by heavy metals in the upper Clark Fork drainage is a problem which limits the productive potential of some lands and may seriously impair water quality. Airborne heavy metal particulates have been emitted from the Anaconda Smelter since the late 1800s and have settled on land in the Deer Lodge Valley. Additionally, waterborne mine tailings with heavy metal concentrations have contaminated floodplain soils and some agricultural land in close proximity to the Clark Fork River. Heavy metals in soils impose constraints on various land uses including irrigated agriculture. A discussion of studies which have addressed the heavy metal problems in the Deer Lodge Valley and the riverine ecosystem downstream is presented in Appendix C.

Taking into account the constraints that heavy metals impose on irrigated agriculture, no lands were considered potentially irrigable if they occurred on the floodplain between Anaconda and Drummond. Because tailings have been deposited at least as far downstream as Drummond, agricultural activities on the floodplain along this reach of the river could mobilize heavy metals and increase contamination of the Clark Fork River.

Arable lands were considered to be potentially irrigable if they occurred on the floodplain between Drummond and Bonner. Although heavy metals may be present along this reach of the river, there are no "slickens" areas which are readily apparent. Also, there are no reports that heavy metals have affected agricultural activities along this reach of the Clark Fork.

# III. RESULTS

Acreages of irrigated and irrigable lands within the upper Clark

Fork drainage are presented for various river reaches in Table 2. Only
those irrigable acreages capable of being served economically by pumped
irrigation water are shown. Economic feasibility has been determined by
relying upon the cost values shown in the composite matrix (Figure 10).

The composite matrix was used because it reflects the maximum lifts and
distances that water could be pumped at the lowest cost for any of the size
and type irrigation systems analyzed.

Land acreages that would be irrigable with the construction of water impoundments are not presented. At this time, the benefit/cost ratio of supplying water through new storage facilities does not appear to be favorable. However, data being compiled by the Granite County Conservation District may require additional study to determine the economics of potential water development projects.

In general, the acreages of irrigable lands in the upper Clark Fork Valley occur on the terraces above the floodplain from 3/4 to 1 1/2 miles from the Clark Fork or a major tributary. Because of the distance from the water source and relatively high pumping lift elevation, most of the potentially irrigable land is economically marginal to irrigate. Probably because of the marginal benefit/cost status, very little land is irrigated by pumping directly from the Clark Fork or a major tributary. Most terraces or benches that are now being irrigated are provided with gravity-feed irrigation water supplied from tributary drainages that have been diverted at higher elevations.

TABLE 2

ACREAGE VALUES FOR IRRIGATED AND IRRIGABLE LANDS IN THE UPPER CLARK FORK DRAINAGE

River Reach I	rrigated Acres	Irrigable Acres
Clark Fork (Bonner-Rock Creek)	1,708	480
Clark Fork (Rock Creek-Drummond)	2,236	411
Clark Fork (Drummond-Gold Creek)	2,841	3,863
Perkins Creek	34	
Clark Fork (Gold Creek-Garrison)	483	1,447
Gold Creek	1,506	-,
Warm Springs Creek	52	
Carten Creek	19	
Clark Fork (Garrison-Deer Lodge)	2,992	3,456
Mullan Gulch	1,571	
Willow Creek	553	
Clark Fork (Deer Lodge-Warm Springs)	6,185	2,042
Warm Springs Creek	1,255	2,042
Lost Creek	4,572	
Race Track Creek	8,155	
Caribou Creek	1,507	
Peterson Creek	1,046	
Dempsey Creek	1,727	
Cottonwood Creek	926	
Fred Burr Creek	4,602	
Tin Cup Joe Creek	1,109	
LaMarche Creek	3,196	
Barker Creek		
Twin Lakes Creek	5)	
Flint Creek (Drummond-Maxville	7,295	1,317
Willow Creek	5,983	1,517
lint Creek (Maxville-Georgetown	0,500	
Lake)	9,698	912
North Fork Flint Creek	5	312
Silver Creek	20	
Boulder Creek	20	
Little Blackfoot (Garrison-Headwaters	3) 4,265	1,825
Dog Creek	447	1,625
Snowshoe Creek	758	
Trout Creek	604	elitis olitis
Carpenter Creek	532	
Six Mile Creek	4,137	
		-
otal	82,019	15,753

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INFORMATION SOURCES

#### INFORMATION SOURCES

- Elliott, J. 1984. Irrigated Land Assessment of the Upper Clark Drainage, Interim Report. Unpublished report submitted to the Montana Department of Fish, Wildlife and Parks, Helena, Montana.
- Finnie, B. 1984. Elements of a Water Marketing Program. Written transcript of a speech presented to the Montana Environmental Council meeting in Billings, Montana (July 13, 1984), by Bruce Finnie of ECO Northwest Ltd., Helena, Montana.
- Kangas, A. 1984. Economic data compiled by Arlen Kangas of the Montana Department of Natural Resources and Conservation, Helena, Montana.
- Schaefer, J., Economist, Soil Conservation Service, Bozeman, Montana.
  Personal communication (October 2, 1984) to Joe C. Elliott, Ecological Consultant, Helena, Montana.

#### APPENDIX A

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PARAMETERS INCLUDED IN MONTANA DEPARTMENT OF NATURAL RESOURCES AND CONSERVATION ANALYSIS

#### IRRSYS INPUT VARIABLES

Name of file: Irrsys.dat(see following pages)

% of Alfalfa: 100%

Peak Use: variable depending on hydrologic region.

Ave. Annual Use: variable depending on hydrologic region.

% Sprinkler Acreage: 100%

Ave. Irrigation Efficiency: 70% (center pivot) or 65% (wheel line)

Max. Net Application: 2 in. (center pivot) or 3 In. (wheel line)

Ave. Pumping Head: variable depending on pivot size.

Peak Management Efficiency: 95%

Seasonal Management Efficiency: 85%

Storage Costs: 0

Additional Costs: 0 for single irrigation system, include turn out costs

Lateral Electrical Energy: 0 for multiple irrigation system.

Land Right Costs: 0

Reach: 4

# of Pumps: 1

Ave. Column Diameter: 8 in. (center pivot) or 6 in. (wheel line)

Ave. Column length: 10 ft.

Max. Lift from Water Source: 5 ft.

Min. Outlet Pressure: 0

Powerline Length: 2 mi.

Total Static Head: 0

Inlet Operating Pressure: 0

Additional Flow Required: 0

Reach: variable depending on pipe used- pvc or wsp.

Reach Length: variable.

Acres Served: variable.

Max. Head Loss: 10 ft.

Elevation Change: variable.

Min. Outlet Pressure: 30 psi (center pivot) or 50 psi (wheel line).

Additional Flow: 0

Reach: may be additional reaches if multiple pivots are modeled.

Source: Communication with and review by the U.S. Department of Agriculture: Soil Conservation Service, Bozeman Montana.

Row							
1	Bl	B2	21	ANO	ANI	Vl	AKO
2	Tl	Т2	23	24	В3	B4	22
3	AN2	V2	AKl	AK 2	D3	AK3	AN3
4	AK4	AN4	E8	E9	D5	AK5	AN5
5	<b>V</b> 5	<b>T</b> 5	AK5	AN6	V6	P6	W6
6	Т6	F8	F9				
7	CO	Cl	C2	C3	U(1)	U(2)	U(3)
8	U(4)	บ(5)	U(6)	U(7)	U(8)	บ(9)	U(10)
9	U(11)	U(12)	U(13)	U(14)	E5	E6	C4
10	E7	C5	C6	ВО	C7.	F4	G4
11	F5	G5	G6	AIl	AI2:L	YO	Yl
12	Y2	Y3	AI3	AI4	AI5	AI6	Y4
13	<b>Y5</b>					1 10 2	

# DESCRIPTION OF VARIABLES USED IN IRRSYS PROGRAM

в1	Earth Canal Minimum Bottom Width (FT)
B2	Earth Canal Maximum Bottom Width (FT)
<b>Z1</b>	Earth Canal Inner Side Slopes Z1:1
ANO	N-Value of Aged Channel
ANI	N-Value of Newly Constructed Channel for TR#25 Stability Check
Vl	Maximum Allowable Velocity (FPS) for Stability Check
AKO	Water Surface Evaporation At Peak Delivery (In/Day)

Tl	Canal Top Width on Downhill Side (FT)*
T2	Canal Top Width on Uphill Side (FT)*
<b>Z</b> 3	Side Slope For Fill Areas Other Than Canal Inner Slopes
	23:1*
<b>Z4</b>	Side Slope For Excavated Areas Other Than Canal Inner
	Slopes Z4:1*
<b>B3</b>	Concrete Lined Canal Minimum Bottom Width (FT)
B4	Concrete Lined Canal Miximum Bottom Width (FT)
C 2	Congrete Lined Canal Inner Side Slopes 72:1

AN2	N-Value of Concrete Lined Canal
V2	Concrete Lined Canal Miximum Water Velocity (FPS)
AKI	Ratio of Seepage Cracks to Wetted Area In Lined Canal
AK2	Concrete Canal Lining Thickness (IN)
D3	Siphon Maximum Diameter (IN)
AK3	Siphon Sum of Loss Coefficients
AN3	N-Value for Siphon (Concrete Pipe)

AK4	Pump Sum of Loss Coefficients
AN4	N-Value for Pump Inlet Pipes
E8	Pump Efficiency
E9	Motor Efficiency (Pump Drive)
D5	Welded Steel Pipe Maximum Diameter (IN)
AK5	Welded Steel Pipe Sum of Loss Coefficients
AN5	N-Value Welded Steel Pipe

```
Welded Steel Pipe Maximum Water Velocity (FPS)
V5
        Steel Yield-Point Stress (PSI)
T5
        PVC-IPS & PVC-PIP Sum of Loss Coefficients
AK6
        PVC-IPS & PVC-PIP Hazen-Williams Design C
AN
        PVC-IPS & PVC-PIP Maximum Water Velocity
V6
        PVC-IPS & Minimum Pressure Rating (PSI)
P6
        Maximum Working Pressure SF (%)
W6
        PVC-IPS & PVC-PIP Hydrostatic Design Stress (PSI)
T6
        On-Farm Pump Efficiency
F8
        On-Farm Motor Efficiency
F9
        Unit Cost of Earth Fill ($/CYD)
CO
        Unit Cost of Earth Excavation ($/CYD)
Cl
        Unit Cost of Concrete Lining ($/CYD)
C2
        Unit Cost of Structural Concrete ($/CYD
C3
        Unit Cost 12-Inch RCP Siphon
0(1)
        Unit Cost 15-Inch RCP Siphon
U(2)
        Unit Cost 18-Inch RCP Siphon
U(3)
        Unit Cost 21-Inch RCP Siphon
U(4)
        Unit Cost 24-Inch RCP Siphon
U(5)
        Unit Cost 27-Inch RCP Siphon
U(6)
        Unit Cost 30-Inch RCP Siphon
U(7)
        Unit Cost 36-Inch RCP Siphon
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        Unit Cost 42-Inch RCP Siphon
ប(9)
        Unit Cost 48-Inch RCP Siphon
U(10)
        Unit Cost 54-Inch RCP Siphon
U(11)
        Unit Cost 60-Inch RCP Siphon
0(12)
        Unit Cost 66-Inch RCP Siphon
U(13)
        Unit Cost 72-Inch RCP Siphon
U(14)
        Unit Cost of Electricity ($/KW-HR)
E5
        Electricity Demand Charge ($/BHP)
E6
        Unit Cost of Pumps ($/BHP)
C4
        Unit Cost of Power Line Construction ($/Mile)
E7
        Unit Cost of Welded Steel Pipe ($/LB)**
C5
        Unit Cost of Welded Steel Pipe ($/DIA-IN) **
C6
        Unit Cost of Pipe Bedding ($/CYD)
BO
        Unit Cost of PVC-IPS & PVC-PIP Pipe ($/LB) ***
C7
        Sprinkler or Pumping Irrigation System Cost ($/AC)
F4
        Flood Irrigation System Cost ($/AC)
G4
        Sprinkler Irrigation Labor Requirement (HR/AC/IRR)
F5
        Flood Irrigation Labor Requirement (HR/AC/IRR)
G5
        Irrigation Labor Cost ($/HR)
G6
        Project Interest Rate (%)
All
```

AI2 YO Y1	On-Farm Interest Rate (%) Construction Period (YRS) Expected Project Life (YRS)
Y2 Y3	Expected Pump Life (YRS) Expected On-Farm System Life (YRS)
AI3	O&M (%) - Pipelines, Structures, Etc.
AI4	O&M - Ditches and Concrete Lining
AI5	O&M - Pumps
AI6	O&M - On-Farm Systems
Y4	Contingency Factor for Planning to Design (%)
Y5	Engineering and Project Administration Costs (%)
*	These values are used for both earth and concrete lined
	canals.
**	WSP installation cost = (1.6) [(weight of pipe)
	(C5)+(DIA)(C6)I+Bedding
***	PVC installation cost = (1.6) (weight of pipe) (C7)+Bedding

Unit cost of pipe accounts for trench excavation, shaping, backfill, equipment, and labor based on

estimates in dodge guide to construction costs - 1977.

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# ANNOTATED DESCRIPTION OF IRRSYS INPUTS<sup>1</sup>

#### Percent of Alfalfa: 100%

A crop composition of 100 percent alfalfa is assumed since alfalfa is one of the most water intensive crops grown in the state. The system design that will meet the consumptive demands of alfalfa will also be capable of meeting the requirements of other crop mixes. This assumption, however, results in a slight over estimation of annual costs. This over estimation is mainly a result of exaggerated electric costs over the project life. The model forecasts equal annual energy demands needed to meet the consumptive needs of alfalfa. However, annual electric demand will drop, even assuming 100 percent alfalfa, in years when, for agronomic reasons, the ground is fallow or planted with a crop with lower water needs.

# Peak Use: (variable) Average Annual Use: (variable)

These variables are dependent upon which climatic region the acreage being analyzed is located. The USDA-SCS has identified five climatic regions in the state.

# Percent Sprinkler Acreage: 100%

All irrigated acreage is assumed to be sprinkler irrigated with no flood irrigation.

# Average Irrigation Efficiency: 70% (center pivot) or 65% (wheel line)

This efficiency represents the average amount of water applied by an on-farm irrigation system that is consumed by the crop divided by the total amount applied. The unconsumed portion accounts for water losses due to deep percolation,

<sup>&</sup>lt;sup>1</sup>Source: John Tubbs, Economist, Montana Department of Natural Resources and Conservation, Helena, Montana.

evaporation, and return flow. These percentages were provided by the USDA-SCS staff in Bozeman.

# Maximum Net Application: 2 inch (center pivot), 3 inch (wheel line)

Maximum net application represents the amount of water needed to be placed in the soil by an irrigation system to meet crop water requirements. These application amounts represent the typical Montana farm and were provided by the USDA-SCS staff.

# Average Pumping Head: (variable)

Average pumping head refers to the amount of pressure needed to compensate for friction loss in the irrigation system. Friction losses were calculated using the Hazen-Williams equation.

# Peak Management Efficiency: 95%

# Seasonal Management Efficiency: 85%

These efficiencies were recommended by the USDA-SCS staff as representative of a well managed irrigation system.

# Storage Costs: 0

No storage costs were added to system costs, therefore, costs are slightly understated over the project life. A 10 percent contingency factor was included to compensate for this type of under estimation.

# Additional Costs: (variable)

No additional costs were added when the system being modeled involved only a single center pivot or wheel line. The cost of turn outs in a multiple pivot system were added, however. For example, \$3,000 of additional costs were included for a multiple system composed of two center pivots, \$1,500 for each of two turn outs.

# Lateral Electrical Costs: 0

No electrical demand was attributed to the laterals. Thus, no costs were included.

# Land Rights: 0

Land right costs are assumed to be zero, since the model identifies small acreages and the time involved in identifying land right problems is prohibitive for this study.

#### Reach: 1

This reach identifies the basic parameters needed to design the pump system. There are nine parameters that are inclusive to this reach.

# Number of Pumps: 1

Average Column Diameter: 8 inch (center pivot),
6 inch (wheel line)

# Maximum Lift from Water: 5 feet

# Minimum Outlet Pressure: 0

This is the minimum pressure needed at the inlet to the on-farm system. Since the pump is attached to the pipeline, zero pressure is assumed. IRRSYS will determine the minimum outlet pressure needed for the pipeline.

# Powerline Length

Because the upper Clark Fork basin is in the Montana Power Company service area, no costs were entered into the model for powerline construction. The Montana Power Company constructs powerlines without directly assessing the user for the cost.

#### Total Static Head: 0

Static head is zero because of the type of system modeled.

# Inlet Operating Pressure: 0

Inlet operating pressure is zero due to the type of system modeled.

#### Additional Flow: 0

Additional flow is zero because of the type of system modeled.

#### Reach #2

This reach identifies the basic parameters of the water delivery system from the pump to the on-farm system. The first input identifies the type of delivery system (earth canel or pipeline) and the type of material used (PVC or welded steel pipe (WSP)). There are six parameters that are inclusive of this reach.

# Reach Length: (variable)

This variable along with elevation change are key to the estimation of irrigable acres. By incrementally increasing reach length and distance the cost matrices are created. The underlying relationship of increasing system costs associated with increasing distances and lifts from the pump allowed the creation of the cost matrices. Reach length was increased by 1/10th of a mile increments up to 6 miles.

# Acres Served: (variable)

Acres served specifies system size. For example, a 135 center pivot serves 135 acres.

#### Maximum Head Loss: 10 Feet

Maximum head loss represents the amount of pressure needed to compensate for friction loss in the pipeline. The USDA-SCS staff in Bozeman provided this figure as representative of typical pipeline system (10 feet/1,000 feet of pipeline).

#### Elevation Change: (variable)

As discussed previously, elevation change is a key variable in estimating irrigable acres. Elevation was increased by 20 feet intervals up to 1,200 feet of lift.

#### Minimum Outlet Pressure

Minimum outlet pressure is the pressure required to pump water through the sprinkler heads of the on-farm system. These pressures were provided by the USDA-SCS staff in Bozeman for typical systems.

#### Additional Flows: 0

Additional flows are only needed with systems that include laterals. The systems we have modeled do not include any laterals.

# Reach: 3 to #n #n: Number of Pivots Plus One

Multiple pivot systems are also modeled. Assuming the pivots are located on a level bench and are adjacent to each other, the following inputs are needed for each additional pivot.

# Reach Length: (variable)

This reach length is the distance between two adjacent pivot centers. For example, reach length for two adjacent 135 acre center pivots is 2,650 feet.

# Acres Served: Pivot Size

See Maximum Head Loss above.

# Maximum Head Loss: 10 Feet

See Elevation Change above.

# Elevation Change: 0

A level bench is assumed.

# Minimum Outlet Pressure; 30 psi

See Additional Flows above.

### Additional Flow: 0

See Reach: 3 to #n above.

# Electric Rates: \$3.04/KWHr

Based on data presented by the Montana Power Company in the Salem Project Application submitted to the Montana Department of Natural Resources and Conservation.

# Electric Growth Rate: .58/year

Based on data presented by the Montana Power Company in the Salem Project Application submitted to the Montana Department of Natural Resources and Conservation.

# Number of Electrical Growth Years: 15 Years

Based on data presented by the Montana Power Company in the Salem Project Application submitted to the Montana Department of Natural Resources and Conservation.

#### APPENDIX B

PRELIMINARY ECONOMIC ANALYSIS BY GRANITE COUNTY CONSERVATION DISTRICT

# Evaluation on Feasibility of Dam in Granite County

Two landowners in the project area were interviewed to obtain cost and return information for raising irrigated crops. Information was obtained for tearing out hay or sod, establishing hay, and hay. This enterprise information was used to estimate per acre costs and returns. The AGNET system was used to obtain the results. Copies of the output for the six budgets that were run are attached.

The cost and return information for the two landowners was averaged together to obtain an average cost for each enterprise. Yield information and crop mix was also obtained for with and without project situations. This enabled net returns per acre to be calculated for with and without project situations. The change in net farm income as a result of project action would be \$76.43 per acre. If you assume two acre feet of water are required for each irrigated acre the net return per acre foot is \$38.21.

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assume 2 acre feet if water water for acre

change in not form increme per acrefont = 76,43 +2= \$38.21 /acre fort

494.07

TOTAL CROPLAND ACRES
ACRES THIS CROP BUDGET

250.0 30.0 EXPECTED YIELD PER ACRE ANIMAL UNITS OF GRAZING

80.0

		Andronies Van Andronies	ACRES	MATER	HASED RIALS COST	FUEL	REPAIR		IDIO
	OPERATION			ACRE			1.4	FIXED	TOTAL
MOL DBOAR	D PLOW		2.00		11 2	1.44	2.66	8.84	12.95
TANDEM D	ISC		6.50		19400				5.08
TANDEM D	ISC	**	6.50	* *		0.44	0.97	3.61	5. 02
SPIKE TO	OTH HARROW		IN TANDE	M	3	0.0	0.00	0.32	0.32
GRAIN DR	ILL	2 3	4.00			0.79			4.97
	SEED			1.00	6.00				6.00
10 3 0 15414	SPRINKLER	9			70.00	1,57			70.00
ROLLER O	R PACKER		7.50	ti District Section		0.39	0.57	3.39	
SPRAYER			CUSTOM	Anna Co					6.00
COMBINE,	JD55	1 1	2.00			1.58	2.00	. 11.27	14.85
TRUCK						1.20		0.96	2.40
TOTALS					7	6.29	8.20	 35.38	131.87
CASH COS				> }	WO 19		11.1	7	
CHSH CUS	PURCHASED	MOTERIALS				100		20130111	
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OVERHEAD	AND MANAGE	MENT	8 89						7
UVERNIEND	OVERHEAD		H CHOTO V	. <b>.</b>	10 THU 84 1			04	
	MANAGEMENT					<b>.</b>		. 21	
		TOTAL OVER				D2	0.	. 0	
		TOTAL COST			EITI				5.21
					D. 107.154			1	55.91
		TOTAL COST							1.95
		(BHS	ED ON EST	THHIEF	AIFFD)			٠٠٠ ج	91
	RETURNS				11000	48.4			
	ESTIMATED	CROP RETUR	N PER ACR	E		0.0	153.	60-	
	ESTIMATED	AUM GRAZIN	6 RETURNS	- 150 ad		LATE OF		. 0	
			TOTAL RET		ACDE		17. 21. 1		53.60
		COLTUMIED.	THE REL	UNIT FER	n-re				71.55 x 15.11

#### GARY METZER HAY

TYTES VARACTALISM AT MAT 14 JULY	ACRES	MATER AMOUNT	ASED IALS COST ZUNIT	FUEL AND	AND		TOTAL COSTS
OPERATION	/HOUR	/ HURE	70111			1175	
SELF-PROPELLED WINDROWER	3.00			0.84			
ELF-PROPELLED BALER	2.60			0.97	0.37	2.10	
TWINE	0.0	1.00	2.40		200		2.4
SELF-PROP. FORAGE CHOPPER	2.00			1.26	0.78	2.94	4.9
ELF-PROPELLED WINDROWER	3.00			0.84	0.55	2.10	3.4
SELF-PROPELLED BALER	2.60			0.97	0.37	2.10	3.4
TWINE		1.00	0.80				0.8
SPRINKLER		1.00					70.0
GOPHER CONTROL		1.00	1.00				1.0
SELF-PROP. FORAGE CHOPPER	2.00			1.26	0.78	2.94	
SELF-PRUP. PURHOE CHUFFER						Vi di Si	37 (18)
TOTALS				6.16	3.40	14.26	98.00
ASH COSTS	•						
PURCHASED MATERI	2.19				74	.20	
FUEL AND LUBE						. 16	
REPAIRS AND MAIN	TONONCE					.40	
The state of the s		rou	a lightly like			. 0	
CUSTOM HIRE AND						14 15	
INTEREST ON OPER					D. A. Bergery	.70	
2 00 76 W			EA ACT. A				
The state of the s		6.0 MONI	(SH				
	CASH COSTS	6.0 MUH	(RS)				90.47
TOTAL		6.0 MON!	(HS)				90.47
TOTAL (		6.0 MOH	(HS)			<b>40</b>	90.47
TOTAL ( LABOR DIRECT LABOR	CASH COSTS			ERSK JAPEN	11	. 69	90.47
TOTAL ( LABOR DIRECT LABOR ( 2.4 HRS )	CASH COSTS X 4.00/HR )	( 1.2 (O)	(ERHEAD)	PLANTA I	11	. 69	
TOTAL ( LABOR DIRECT LABOR ( 2.4 HRS )	CASH COSTS	( 1.2 (O)	(ERHEAD)	Place JATE III	11	. 69	90.47
TOTAL ( LABOR DIRECT LABOR ( 2.4 HRS ) TOTAL (	CASH COSTS X 4.00/HR )	( 1.2 (O)	(ERHEAD)	PLSA JAFTII MIN W. JAINST	11	.69	
TOTAL (  _ABOR  _DIRECT_LABOR  ( 2.4 HRS )  TOTAL (  FIXED_COSTS	CASH COSTS X 4.00/HR ) CASH COSTS (	K 1.2 (O) AND LABOR	(ERHEAD)				
TOTAL ( LABOR  DIRECT LABOR  ( 2.4 HRS : TOTAL (  FIXED COSTS  FIXED MACHINERY (	CASH COSTS  X 4.00/HR ) CASH COSTS (	K 1.2 (O) AND LABOR	(ERHEAD)		0%) 14	1.26	
TOTAL ( LABOR  DIRECT LABOR  ( 2.4 HRS )  TOTAL (  FIXED COSTS  FIXED MACHINERY (  REAL ESTATE TAXE)	CASH COSTS  X 4.00/HR ) CASH COSTS (  COSTS (INCL)	X 1.2 (O) AND LABOR UDES INTE	(ERHEAD) EREST A1	16.00	0%) 14 3	1.26 3.00	
TOTAL ( LABOR  DIRECT LABOR  ( 2.4 HRS )  TOTAL (  FIXED COSTS  FIXED MACHINERY (  REAL ESTATE TAXE  INTEREST ON LAND	CASH COSTS  X 4.00/HR ) CASH COSTS (  COSTS (INCL) S  (\$ 0.0	X 1.2 (D) AND LABOR UDES INTE VALUE/A )	(ERHEAD) EREST A1	16.00	0%) 14 3	1.26 3.00	102.16
TOTAL ( LABOR  DIRECT LABOR  ( 2.4 HRS ) TOTAL (  FIXED COSTS  FIXED MACHINERY ( REAL ESTATE TAXE INTEREST ON LAND	CASH COSTS  X 4.00/HR 3 CASH COSTS (  COSTS (INCL) S  (\$ 0.0 9	X 1.2 (D) AND LABOR UDES INTE VALUE/A )	/ERHEAD) EREST A1	7 16.00	)%) 14 3 )) (	1.26 3.00	102.16
TOTAL ( LABOR  DIRECT LABOR  ( 2.4 HRS ) TOTAL (  FIXED COSTS  FIXED MACHINERY ( REAL ESTATE TAXE  INTEREST ON LAND	CASH COSTS  X 4.00/HR ) CASH COSTS (  COSTS (INCL) S  (\$ 0.0	X 1.2 (D) AND LABOR UDES INTE VALUE/A )	/ERHEAD) EREST A1	7 16.00	)%) 14 3 )) (	1.26 3.00	102.16
TOTAL (  ABOR  DIRECT LABOR  ( 2.4 HRS ;  TOTAL (  FIXED COSTS  FIXED MACHINERY (  REAL ESTATE TAXE  INTEREST ON LAND  TOTAL (  TOTAL (	CASH COSTS  X 4.00/HR 3 CASH COSTS (  COSTS (INCL) S  (\$ 0.0 9	X 1.2 (D) AND LABOR UDES INTE VALUE/A )	/ERHEAD) EREST A1	7 16.00	)%) 14 3 )) (	1.26 3.00	102.16
TOTAL ( LABOR  DIRECT LABOR  ( 2.4 HRS ) TOTAL (  FIXED COSTS  FIXED MACHINERY ( REAL ESTATE TAXE) INTEREST ON LAND TOTAL (  TOTAL (  OVERHEAD AND MANAGEMENT	CASH COSTS  X 4.00/HR ) CASH COSTS (  COSTS (INCL) S (\$ 0.0 \( \) FIXED COSTS COST, EXCEP	X 1.2 (O) AND LABOR UDES INTE VALUE/A )	(ERHEAD) EREST AT ( 0.0 :	r 16.00 . X 1.0	0%) 14 3 0) (	).26 3.00 ).0	102.16
TOTAL ( LABOR  DIRECT LABOR  ( 2.4 HRS ) TOTAL (  FIXED COSTS FIXED MACHINERY REAL ESTATE TAXE INTEREST ON LAND TOTAL (  TOTAL (  OVERHEAD AND MANAGEMENT OVERHEAD (TOTAL)	CASH COSTS  X 4.00/HR 3 CASH COSTS ( COSTS (INCL) S (\$ 0.0 ( FIXED COSTS COST, EXCEP	X 1.2 (O) AND LABOR UDES INTE VALUE/A X T <b>@</b> VERHER X 5.00	(ERHEAD) EREST A1 < 0.0 : AD AND 1	r 16.00 : X 1.0	0%) 14 3 )) (	1.26 3.00 ).0	102.16
TOTAL ( LABOR  DIRECT LABOR  ( 2.4 HRS ) TOTAL (  FIXED COSTS FIXED MACHINERY ( REAL ESTATE TAXE INTEREST ON LAND TOTAL TOTAL OVERHEAD AND MANAGEMENT OVERHEAD (TOTAL MANAGEMENT CHARG	CASH COSTS  X 4.00/HR ) CASH COSTS ( COSTS (INCL) S (\$ 0.0 ' FIXED COSTS COST, EXCEP  CASH COSTS E (\$ 0.0 '	X 1.2 (D) AND LABOR UDES INTE VALUE/A ) T <b>@</b> VERHER X 5.00° X ESTIMA	(ERHEAD) EREST AT  CO.O.S  AD AND 1  CO.O.S  TED YIEL	7 16.00 2 X 1.0 16T.	0%) 14 3 )) (	).26 3.00 ).0	102.16
TOTAL ( LABOR  DIRECT LABOR  ( 2.4 HRS ) TOTAL (  FIXED COSTS FIXED MACHINERY ( REAL ESTATE TAXE INTEREST ON LAND TOTAL TOTAL  OVERHEAD AND MANAGEMENT OVERHEAD (TOTAL MANAGEMENT CHARG IOTAL	CASH COSTS  X 4.00/HR 3 CASH COSTS ( COSTS (INCL) S (\$ 0.0 9 FIXED COSTS COST, EXCEP  CASH COSTS E (\$ 0.0 9	X 1.2 (DY AND LABOR UDES INTE VALUE/A X T <b>1</b> VERHER X 5.00 X ESTIMA D MANAGEI	(ERHEAD) EREST AT  CO.O.S  AD AND 1  CO.O.S  TED YIEL	7 16.00 2 X 1.0 16T.	0%) 14 3 )) (	1.26 3.00 ).0	102.16
TOTAL (  ABOR  DIRECT LABOR  ( 2.4 HRS )  TOTAL (  FIXED COSTS  FIXED MACHINERY (  REAL ESTATE TAXE  INTEREST ON LAND  TOTAL (  T	CASH COSTS  X 4.00/HR 3 CASH COSTS (  COSTS (INCL) S (\$ 0.0 9 FIXED COSTS COST, EXCEP  CASH COSTS E (\$ 0.0 9 OVERHEAD AN	X 1.2 (DY AND LABOR UDES INTE VALUE/A X T @VERHER X 5.00 X ESTIMA D MANAGER	YERHEAD) EREST AT  CO.O.S  AD AND M  TED YIEL MENT	7 16.00 2 X 1.0 16T. .D)	0%) 14 3 )) (	1.26 3.00 ).0	102.16
TOTAL ( LABOR DIRECT LABOR ( 2.4 HRS ) TOTAL ( FIXED COSTS FIXED MACHINERY ( REAL ESTATE TAXE) INTEREST ON LAND TOTAL ( TOTAL ( TOTAL ( MANAGEMENT CHARG I DTAL ( TOTAL ( TOTA	CASH COSTS  X 4.00/HR 3 CASH COSTS ( COSTS (INCL) S (\$ 0.0 9 FIXED COSTS COST, EXCEP  CASH COSTS E (\$ 0.0 3 OVERHEAD AN COST PER AC COST PER UN	X 1.2 (D) RND LABOR  UDES INTE  VALUE/A )  T @VERHER  X 5.00  X ESTIMA  D MANAGER  RE  IT OF PRI	VERHEAD) PREST AT CO.O. PREST AT CO.	7 16.00 2 X 1.0 16T. .D)	0%) 14 3 )) (	1.26 3.00 ).0 4.52	17.26 17.42 17.42
TOTAL (  ABOR  DIRECT LABOR  ( 2.4 HRS ; TOTAL (  FIXED COSTS  FIXED MACHINERY ( REAL ESTATE TAXE) INTEREST ON LAND TOTAL (  TOTAL (  OVERHEAD AND MANAGEMENT OVERHEAD (TOTAL MANAGEMENT CHARG) IOTAL (  TOTAL (	CASH COSTS  X 4.00/HR 3 CASH COSTS (  COSTS (INCL) S (\$ 0.0 9 FIXED COSTS COST, EXCEP  CASH COSTS E (\$ 0.0 9 OVERHEAD AN	X 1.2 (D) RND LABOR  UDES INTE  VALUE/A )  T @VERHER  X 5.00  X ESTIMA  D MANAGER  RE  IT OF PRI	VERHEAD) PREST AT CO.O. PREST AT CO.	7 16.00 2 X 1.0 16T. .D)	0%) 14 3 )) (	1.26 3.00 ).0 4.52	102.16
TOTAL (  ABOR  DIRECT LABOR  ( 2.4 HRS (  TOTAL (  FIXED COSTS  FIXED MACHINERY (  REAL ESTATE TAXE  INTEREST ON LAND  TOTAL  TOTAL  OVERHEAD AND MANAGEMENT  OVERHEAD (TOTAL  MANAGEMENT CHARG  IOTAL  TOTAL  TOTAL  TOTAL	CASH COSTS  X 4.00/HR 3 CASH COSTS ( COSTS (INCL) S (\$ 0.0 9 FIXED COSTS COST, EXCEP  CASH COSTS E (\$ 0.0 3 OVERHEAD AN COST PER AC COST PER UN	X 1.2 (D) RND LABOR  UDES INTE  VALUE/A )  T @VERHER  X 5.00  X ESTIMA  D MANAGER  RE  IT OF PRI	VERHEAD) PREST AT CO.O. PREST AT CO.	7 16.00 2 X 1.0 16T. .D)	0%) 14 3 )) (	1.26 3.00 ).0 4.52	17.26 17.42 17.42
TOTAL (  ABOR  DIRECT LABOR  ( 2.4 HRS (  TOTAL (  FIXED COSTS  FIXED MACHINERY (  REAL ESTATE TAXE  INTEREST ON LAND  TOTAL  TOTAL  OVERHEAD AND MANAGEMENT  OVERHEAD (TOTAL  MANAGEMENT CHARG  IOTAL  TOTAL  TOTAL  TOTAL  TOTAL  TOTAL	CASH COSTS  X 4.00/HR ) CASH COSTS ( COSTS (INCL) S (\$ 0.0 ) FIXED COSTS COST, EXCEP  CASH COSTS E (\$ 0.0 ) OVERHEAD AN COST PER UN (BASED ON E	X 1.2 (DY AND LABOR UDES INTE VALUE/A ) T @VERHER X 5.00 X ESTIMA D MANAGER RE IT OF PRI STIMATED	VERHEAD) PREST AT CO. 0. 0. 3 PD AND MED YIEL DUCTION YIELD)	7 16.00 2 X 1.0 16T. .D)	0%) 14 3 0) 6	1.26 3.00 3.0 3.0 3.52 3.0	17.26 17.42 17.42
TOTAL ( LABOR  DIRECT LABOR  ( 2.4 HRS ) TOTAL (  FIXED COSTS  FIXED MACHINERY ( REAL ESTATE TAXE INTEREST ON LAND TOTAL TOTAL  OVERHEAD AND MANAGEMENT OVERHEAD (TOTAL MANAGEMENT CHARG IOTAL TOTAL  TOTAL  ESTIMATED RETURNS ESTIMATED CROP R	CASH COSTS  X 4.00/HR 3 CASH COSTS ( COSTS (INCL) S (\$ 0.0 S FIXED COSTS COST, EXCEP  CASH COSTS E (\$ 0.0 S OVERHEAD AN COST PER UN (BASED ON E	X 1.2 (D) AND LABOR  UDES INTE  VALUE/A >  T	VERHEAD) PREST AT CO.O.S PAD AND PREST MENT DUCTION YIELD)	7 16.00 2 X 1.0 16T.	0%) 14 3 )) (	1.26 3.00 3.0 3.0 4.52 3.0	17.26 17.42 17.42
TOTAL ( LABOR  DIRECT LABOR  ( 2.4 HRS ) TOTAL ( FIXED COSTS  FIXED MACHINERY ( REAL ESTATE TAXE: INTEREST ON LAND TOTAL TOTAL  OVERHEAD AND MANAGEMENT OVERHEAD (TOTAL MANAGEMENT CHARG JOTAL TOTAL TOTAL  TOTAL  ESTIMATED RETURNS ESTIMATED CROP R ESTIMATED AUM GR	CASH COSTS  X 4.00/HR 3 CASH COSTS ( COSTS (INCL) S (\$ 0.0 9 FIXED COSTS COST, EXCEP  CASH COSTS E (\$ 0.0 9 COST PER AC COST PER AC COST PER UN (BASED ON E  ETURN PER A AZING RETUR	X 1.2 (DY AND LABOR UDES INTE VALUE/A ) T @VERHER X 5.00 X ESTIMA D MANAGER RE IT OF PRI STIMATED CRE NS	VERHEAD) PREST AT CO.O. PAD AND PREST AT CO.O. VIED YIEL VIELD)	7 16.00 2 X 1.0 16T.	0%) 14 3 )) (	1.26 3.00 ).0 4.52 ).0 0.00 5.00	17.26 17.26 119.42 123.95 130.99 43.95
ABOR  DIRECT LABOR  ( 2.4 HRS TOTAL ( 2.4 HRS	CASH COSTS  X 4.00/HR 3 CASH COSTS ( COSTS (INCL) S (\$ 0.0 9 FIXED COSTS COST, EXCEP  CASH COSTS E (\$ 0.0 9 COST PER ACI COST PER ACI COST PER UN (BASED ON E  ETURN PER A AZING RETUR TED TOTAL R	X 1.2 (D) RND LABOR  UDES INTE  VALUE/A )  T	VERHEAD) PREST AT CO.O. PAD AND M TED YIEL MENT DUCTION YIELD) R ACRE	7 16.00 2 X 1.0 16T.	0%) 14 3 0) 0 4 (	1.26 3.00 ).0 4.52 ).0 0.00 5.00	17.26 17.26 119.42 123.95 30.99

# DINSMORE

	190.0	PISUA!		AL UNITS	LD PER OF GR		4.0 1.0	
The Day of the Land		M 356 M3		-	* *			· W. E
· 中国的国际 2000年			1.0	IASED		IINERY C		
	W 1979	00050	MATER		FUEL	REPAIR		
OPERATION		ACRES /	AMOUNT ACRE	COST ZUNIT	AND	MAINT.	FIXED	TOTAL COST:
SELF-PROPELLED WINDROWER		3.00			0.84	1.10	4.17	
BALER, REGULAR TWINE	11.05	2.60	1.00	2.40	1.22	0.68	2.74	4.6 2.4
SELF-PROP. FORAGE CHOPPER		2.00	1.00	2.40	1.26	1.01	3.80	
SELF-PROPELLED WINDROWER		3.00			0.84	1.10		_
BALER, REGULAR		2.60	E 7 JS		1.22	0.68	The state of the s	_
TWINE			1.00	0.80				0.8
SPRINKLER			1.00	70.00				70.0
GOPHER CONTROL		CONT. N. III	1.00	1.00	100	21 21 31 36		1.0
GELF-PROP. FORAGE CHOPPER		2.00			1.26	1.01	3.80	6.0
TOTALS					6.65	5.58	21.41	107.8
			- v		39			
ASH COSTS	01.0					G Transiti uru		
PURCHASED MATERIA	HES						.20	
FUEL AND LUBE	TOMONO	_					.65	
REPAIRS AND MAIN'			Salar Bar Sa		U.H. 700		.58	
INTEREST ON OPER					esc en		.0 .91	
							. 71	
( 86.43 X )	16.00%	FUR	6.0 MONT	CZHI				
( 86.43 X : TOTAL (			6.0 MONT	(SH)				93.34
TOTAL (			6.0 MON1	(ZH)				93.34
TOTAL (			6.0 MON1	(2H)	Antiba Antiba			93.34
TOTAL ( _ABOR _DIRECT_LABOR	CASH C	272		) HZRIS	Argent Actor	-11	.69	93.34
TOTAL ( LABOR DIRECT LABOR ( 2.4 HRS )	CASH C X 4.0	OSTS OZHR X	1.2 (OV	(ERHEAD)	Andrai Actor	11		
TOTAL ( LABOR DIRECT LABOR ( 2.4 HRS )	CASH C X 4.0	OSTS OZHR X		(ERHEAD)	ACTON ACTON	11		93.34 105.04
TOTAL ( LABOR DIRECT LABOR ( 2.4 HRS ) TOTAL (	CASH C X 4.0	OSTS OZHR X	1.2 (OV	(ERHEAD)		11		
TOTAL ( _ABOR DIRECT LABOR ( 2.4 HRS ) TOTAL (	CASH C X 4.0 CASH C	OSTS OZHR X OSTS A	1.2 (OV	(ERHEAD)	-50 L.F.		51 70 F 2	
TOTAL ( LABOR DIRECT LABOR ( 2.4 HRS ) TOTAL ( FIXED COSTS	CASH C X 4.0 CASH C COSTS S	OSTS OZHR X OSTS A	1.2 (OV ND LABOR DES INTE	(ERHEAD) (REST AT	16.00	(2) 21 3	51 70 F 2	
TOTAL ( LABOR  DIRECT LABOR  ( 2.4 HRS ) TOTAL (  FIXED COSTS  FIXED MACHINERY (  REAL ESTATE TAXES  INTEREST ON LAND	CASH C X 4.0 CASH C COSTS S <\$	OSTS OZHR X OSTS A (IM <b>©</b> LU O.O V	1.2 (OV	(ERHEAD) (REST AT	16.00	(2) 21 3	.41	
TOTAL ( LABOR  DIRECT LABOR  ( 2.4 HRS ) TOTAL (  FIXED COSTS  FIXED MACHINERY ( REAL ESTATE TAXES INTEREST ON LAND TOTAL F	CASH C X 4.0 CASH C COSTS S (S	OSTS OZHR X OSTS A (IM <b>C</b> LU O.O V COSTS	1.2 (OV ND LABOR DES INTE ALUE/A X	( 0.0 %	16.00 × 1.0	(2) 21 3	.41 .00	105.04 24.41
TOTAL ( LABOR  DIRECT LABOR  ( 2.4 HRS ) TOTAL (  FIXED COSTS  FIXED MACHINERY ( REAL ESTATE TAXES INTEREST ON LAND TOTAL F	CASH C X 4.0 CASH C COSTS S (S	OSTS OZHR X OSTS A (IM <b>C</b> LU O.O V COSTS	1.2 (OV ND LABOR DES INTE	( 0.0 %	16.00 × 1.0	(2) 21 3	.41 .00	105.04
TOTAL ( LABOR  DIRECT LABOR  ( 2.4 HRS ) TOTAL (  FIXED COSTS  FIXED MACHINERY (  REAL ESTATE TAXES  INTEREST ON LAND  TOTAL (	CASH C X 4.0 CASH C COSTS S (S	OSTS OZHR X OSTS A (IM <b>C</b> LU O.O V COSTS	1.2 (OV ND LABOR DES INTE ALUE/A X	( 0.0 %	16.00 × 1.0	(2) 21 3	.41 .00	105.04 24.41
TOTAL ( LABOR  DIRECT LABOR  ( 2.4 HRS ) TOTAL (  FIXED COSTS  FIXED MACHINERY (  REAL ESTATE TAXES  INTEREST ON LAND  TOTAL F  TOTAL (  OVERHEAD AND MANAGEMENT	CASH C  X 4.0  CASH C  COSTS  S  (S  FIXED  COST.	OSTS OZHR X OSTS A (IM <b>©</b> LU O.O V COSTS EXC <b>EP</b> T	1.2 (OVERHER	PERHEAD) REST AT O.O %	16.00 × 1.0	%) 21 3 ) 0	.41 .00 .0	105.04 24.41
TOTAL (  ABOR  DIRECT LABOR  ( 2.4 HRS )  TOTAL (  FIXED COSTS  FIXED MACHINERY (  REAL ESTATE TAXES  INTEREST ON LAND  TOTAL (  TOTAL (  OVERHEAD AND MANAGEMENT  OVERHEAD (TOTAL)	CASH C  X 4.0  CASH C  COSTS  S  (\$  FIXED  COST,	OSTS  OZHR X  OSTS A  (INCLU  O. O V  COSTS  EXCEPT	1.2 (OV ND LABOR DES INTE ALUE/A X OVERHEA	PERHEAD) REST AT O.O.2 D AND M	16.00 × 1.0	%) 21 3 ) 0	.41 .00 .0	105.04 24.41
TOTAL (  ABOR  DIRECT LABOR  ( 2.4 HRS )  TOTAL (  FIXED COSTS  FIXED MACHINERY (  REAL ESTATE TAXES  INTEREST ON LAND  TOTAL (  TOTAL (  OVERHEAD AND MANAGEMENT  OVERHEAD (TOTAL  MANAGEMENT CHARGE	CASH C  X 4.0  CASH C  COSTS  S  (\$  FIXED  COST,  CASH  E (\$	OSTS  OZHR X  OSTS A  (IMCLU  O.O V  COSTS  EXCEPT  COSTS  O.O X	1.2 (OV ND LABOR DES INTE ALUE/A X OVERHEA X 5.00% ESTIMAT	PERHEAD) REST AT O.0 % D AND M	16.00 × 1.0	%) 21 3 ) 0	.41 .00 .0	24.41 129.45
TOTAL (  ABOR  DIRECT LABOR  ( 2.4 HRS )  TOTAL (  FIXED COSTS  FIXED MACHINERY (  REAL ESTATE TAXES  INTEREST ON LAND  TOTAL (  IVERHEAD AND MANAGEMENT  OVERHEAD (TOTAL  MANAGEMENT CHARGE  TOTAL (	CASH C  X 4.0  CASH C  COSTS  S  FIXED  COST,  CASH  E (\$  OVERHE	OSTS  OZHR X  OSTS A  (IMCLU  O.O V  COSTS  EXCEPT  COSTS  O.O X  AD AND	1.2 (OV ND LABOR DES INTE ALUE/A X OVERHEA X 5.00% ESTIMAT MANAGEM	PERHEAD) REST AT O.0 % D AND M	16.00 × 1.0	%) 21 3 ) 0	.41 .00 .0	24.41 129.45 4.67
TOTAL ( LABOR  DIRECT LABOR  ( 2.4 HRS ) TOTAL (  FIXED COSTS  FIXED MACHINERY ( REAL ESTATE TAXES INTEREST ON LAND TOTAL (  TOTAL (  OVERHEAD AND MANAGEMENT OVERHEAD (TOTAL (  MANAGEMENT CHARGE TOTAL (  TOTAL (  TOTAL (	CASH C  X 4.0  CASH C  COSTS  S  (\$  FIXED  COST,  CASH  E (\$  OVERHER  COST P	OSTS  OZHR X  OSTS A  (IMCLU  O.O V  COSTS  EXCEPT  COSTS  O.O X  AD AND  ER ACR	1.2 (OV ND LABOR DES INTE ALUE/A X OVERHEA X 5.00% ESTIMAT MANAGEM	PERHEAD) REST AT O.O % D AND M ED YIEL RENT	16.00 × 1.0 GT. D)	%) 21 3 ) 0	.41 .00 .0	24.41 129.45 4.67 134.11
TOTAL (  ABOR  DIRECT LABOR  ( 2.4 HRS )  TOTAL (  FIXED COSTS  FIXED MACHINERY (  REAL ESTATE TAXES  INTEREST ON LAND  TOTAL (  TOTAL (  OVERHEAD AND MANAGEMENT  OVERHEAD (TOTAL (  TOTAL (  T	CASH C  X 4.0  CASH C  CASH C  CASH  CASH  CASH  COST P  COST P	OSTS  OZHR X  OZHR X  OSTS A  CINCLU  O. O V  COSTS  EXCEPT  COSTS  O. O X  AD AND  ER ACR  ER UNI	1.2 (OV ND LABOR DES INTE ALUE/A X OVERHEA X 5.00% ESTIMAT MANAGEM	PERHEAD) REST AT O.O % D AND M ED YIEL RENT	16.00 × 1.0 GT. D)	%) 21 3 0 0 4	.41 .00 .0	24.41 129.45 4.67 134.11 33.53
TOTAL (  ABOR  DIRECT LABOR  ( 2.4 HRS )  TOTAL (  FIXED COSTS  FIXED MACHINERY (  REAL ESTATE TAXES  INTEREST ON LAND  TOTAL (  TOTAL (  OVERHEAD AND MANAGEMENT  OVERHEAD (TOTAL  MANAGEMENT CHARGE  TOTAL (  TOTAL (  TOTAL (	CASH C  X 4.0  CASH C  CASH C  CASH  CASH  CASH  COST P  COST P	OSTS  OZHR X  OZHR X  OSTS A  CINCLU  O. O V  COSTS  EXCEPT  COSTS  O. O X  AD AND  ER ACR  ER UNI	1.2 (OV ND LABOR DES INTE ALUE/A X OVERHEA X 5.00% ESTIMAT MANAGEM E T OF PPO	PERHEAD) REST AT O.O % D AND M ED YIEL RENT	16.00 × 1.0 GT. D)	%) 21 3 0 0 4	.41 .00 .0	24.41 129.45 4.67 134.11 33.53
TOTAL ( LABOR  DIRECT LABOR  ( 2.4 HRS ) TOTAL ( FIXED COSTS  FIXED MACHINERY ( REAL ESTATE TAXES INTEREST ON LAND TOTAL ( TOTAL (  OVERHEAD AND MANAGEMENT OVERHEAD (TOTAL MANAGEMENT CHARGE TOTAL ( TOTAL (  TOT	CASH C  X 4.0  CASH C  COSTS  S  (\$  FIXED  COST,  CASH  E (\$  OVERHE  COST P  (BASED	OSTS  OZHR X  OZHR X  OSTS A  COSTS EXCEPT  COSTS O.O X  AD AND ER ACR ER UNI	1.2 (DV ND LABOR DES INTE ALUE/A X OVERHEA X 5.00% ESTIMAT MANAGEM T OF PPO TIMATED	PERHEAD) REST AT O.O % D AND M ED YIEL RENT	16.00 × 1.0 GT. D)	%) 21 3 0 0 13-1.	.41 .00 .0	24.41 129.45 4.67 134.11 33.53
TOTAL ( LABOR  DIRECT LABOR  ( 2.4 HRS ) TOTAL ( FIXED COSTS  FIXED MACHINERY ( REAL ESTATE TAXES INTEREST ON LAND TOTAL ( TOTAL (  OVERHEAD AND MANAGEMENT OVERHEAD (TOTAL MANAGEMENT CHARGE TOTAL ( TOTAL (  TOT	CASH C  X 4.0  CASH C  CASH C  CASH	OSTS  OZHR X  OZHR X  OSTS A  COSTS  EXCEPT  COSTS  AD AND ER ACR ER UNI ON ES	1.2 (DV ND LABOR DES INTE ALUE/A X OVERHEA X 5.00% ESTIMAT MANAGEM E T OF PPO TIMATED	PERHEAD) REST AT O.O % D AND M ED YIEL RENT	16.00 × 1.0 GT. D)	%) 21 3 0 0 13-1. 220	.41 .00 .0	24.41 129.45 4.67 134.11 33.53
TOTAL ( LABOR  DIRECT LABOR  ( 2.4 HRS ) TOTAL ( FIXED COSTS  FIXED MACHINERY ( REAL ESTATE TAXES INTEREST ON LAND TOTAL ( TOTAL ( OVERHEAD AND MANAGEMENT OVERHEAD (TOTAL MANAGEMENT CHARGE TOTAL ( T	CASH C  X 4.0  CASH C  COSTS  S  FIXED  COST,  CASH  E (\$  COST P  COS	OSTS  OZHR X  OZHR X  OSTS A  COSTS COSTS  EXCEPT  COSTS AD AND ER ACR ER UNI  FER ACR  PER ACR	1.2 (OV ND LABOR DES INTE ALUE/A X OVERHEA X 5.00% ESTIMATE MANAGEM T OF PPO TIMATED RE S	ERHEAD) REST AT O.O % D AND M ED YIEL RENT DUCTION YIELD	16.00 × 1.0 GT. D)	%) 21 3 0 0 13-1. 220	.41 .00 .0 .67 .0	24.41 129.45 4.67 134.11 33.53 ~ (4.1)
TOTAL (  LABOR  DIRECT LABOR  ( 2.4 HRS )  TOTAL (  FIXED COSTS  FIXED MACHINERY (  REAL ESTATE TAXES  INTEREST ON LAND  TOTAL (  TOTAL (  OVERHEAD AND MANAGEMENT  OVERHEAD (TOTAL (  MANAGEMENT CHARGE  TOTAL (	CASH C  X 4.0  CASH C  CASH C  CASH	OSTS  OZHR X  OZHR X  OSTS A  CINCLU  O. O	1.2 (OV)  DES INTE  ALUE/A X  OVERHEA  X 5.00%  ESTIMATE  TOF PPO  TIMATED  RE  S  TURN PER	ERHEAD) REST AT O.O % D AND M ED YIEL RENT DUCTION YIELD	16.00 × 1.0 GT. D)	13-1. 220 15	.41 .00 .0 .67 .0	24.41 129.45 4.67 134.11 33.53

THE CROPLAND ACRES

#### DINSMORE ESTAB HAY

250.0

EXPECTED YIELD PER ACRE

3.0

		30.0	VIII.	CONTIS	UP GR	AZING	1.0	
	(14) 14(14) 14(14) 14(14) 14(14) 14(14) 14(14) 14(14) 14(14) 14(14) 14(14) 14(14) 14(14) 14(14) 14(14) 14(14)			ASED IALS		INERY C		
			THUDMA			AND	<b>建</b> 医皮肤	TOTAL
5 5 8	OPERATION	ZHOUR	/ACRE	ZUNIT	LUBE	MAINT.	FIXED	COSTS
10LDBOARI	O PLOW	2.00				2.66		
ANDEM DI		6.50			0.44	0.97	3.61	5.08
PIKE TOO	JTH HARROW	IN TANDEM	13155.0			0.00		
FLOAT	Zivia Bowiii Jawaii	1.50				1.32		
FLOAT		1.50				1.32		
SRAIN DRI		4.00	£20 s		0.79	0.80	3.37	
	SEED			25.00				25.00 70.00
	PRINKLER		1.00	70.00	0.00	0 57	2 20	
POLLER OF		7.50			0.39	1.10	3.39	6.11
	ELLED WINDROWER	3.00						4.64
BALER, REG		2.60	1 00	9.40	1.22	V. 00		2.40
	TWINE P. FORAGE CHOPPER	2.00	1.00	2.40	1.26		3.80	
TOTALS					10.60	10.44	41.70	160.15
CASH COST	TS .							
	PURCHASED MATERIA	LS					.40	
	FUEL AND LUBE						.60	
	REPAIRS AND MAINT	ANANCE				10	.44	
	CUSTOM HIRE AND ME						. 0	
	INTEREST ON OPERA					3111119	. 48	
	€ 118.44 % 1		S.O MONT	HS)				E 10
	TOTAL C	ASH COSTS						127.92
LABOR	- 1-2		196			4 **	22	
	DIRECT LABOR		4 0 (0)	EDUEODA	,		. 22	
	6 3.6 HRS X				<i>*</i>			
	TOTAL C	ASH COSTS AN						145 14
- 1-5 -5 Sept -	, and o		IT CUDON			4 5		145.14
LE PAR			IL CUBOR	Laj es				145.14
FIXED CO	212	DOTO KINCLUI			16.0	nen 41		
FIX <b>ED</b> CO	STS FIXED MACHINERY C				16.0	0%) 41	.70	145.14
FIXED CO	STS FIXED MACHINERY C PEAL ESTATE TAXES		DES INTE	REST AT			.70 3.00	
FIXED CO	STS FIXED MACHINERY C REAL ESTATE TAXES INTEREST ON LAND	(\$ 0.0 VF	DES INTE ALUE/A >	REST A1		0) (	.70 8.00	
FIXED CO:	STS FIXED MACHINERY C REAL ESTATE TAXES INTEREST ON LAND TOTAL F	(\$ 0.0 VF IXED COSTS	DES INTE ALUE/A >	( 0.0 %	× 1.	0) (	.70 8.00	44.70
FIXED CO:	STS FIXED MACHINERY C REAL ESTATE TAXES INTEREST ON LAND TOTAL F	(\$ 0.0 VF	DES INTE ALUE/A >	REST A1 ( 0.0 ;	× 1.	3 0>	.70 8.00	
	STS FIXED MACHINERY C PEAL ESTATE TAXES INTEREST ON LAND TOTAL F TOTAL C	(\$ 0.0 VF IXED COSTS	DES INTE ALUE/A >	REST A1 ( 0.0 ;	: × 1.	3 0>	.70 8.00	44.70
	STS FIXED MACHINERY C PEAL ESTATE TAXES INTEREST ON LAND TOTAL F TOTAL C	(\$ 0.0 VF IXED COSTS OST, EXCEPT	DES INTE ALUE/A >	REST AT	: × 1.	3 0>	.70 3.00 ).0	44.70
	STS FIXED MACHINERY C PEAL ESTATE TAXES INTEREST ON LAND TOTAL F TOTAL C AND MANAGEMENT OVERHEAD (TOTAL	(\$ 0.0 VA IXED COSTS OST, EXCEPT CASH COSTS >	DES INTE ALUE/A > OVERHEA < 5.00%	REST A1 ( 0.0 % AD AND M	: × 1.	30) 20) 20 *23	.70 3.00 ).0	44.70
	STS. FIXED MACHINERY C PEAL ESTATE TAXES INTEREST ON LAND TOTAL F TOTAL C AND MANAGEMENT OVERHEAD (TOTAL MANAGEMENT CHARGE	(\$ 0.0 VA IXED COSTS OST, EXCEPT CASH COSTS >	DES INTE ALUE/A > OVERHEA < 5.00% ESTIMAT	REST A1  O.O?  O.OP  OMBO  OMB	: × 1.	30) 20) 20 *23	.70 3.00 3.00	44.70
	STS FIXED MACHINERY C REAL ESTATE TAXES INTEREST ON LAND TOTAL F TOTAL C AND MANAGEMENT OVERHEAD (TOTAL MANAGEMENT CHARGE TOTAL O	(\$ 0.0 VAIXED COSTS OST, EXCEPT CASH COSTS > (\$ 0.0 X VERHEAD AND	DES INTE ALUE/A > OVERHEA < 5.00% ESTIMAT MANAGEN	REST AT  O.O ?  O AND M  O YIEL  TED YIEL  TENT	: × 1. 16T. .D)	30) 20) 20 *23	.70 3.00 3.00	44.70
	STS FIXED MACHINERY C REAL ESTATE TAXES INTEREST ON LAND TOTAL F TOTAL C AND MANAGEMENT OVERHEAD (TOTAL MANAGEMENT CHARGE TOTAL O	(\$ 0.0 VAIXED COSTS OST, EXCEPT CASH COSTS > (\$ 0.0 X VERHEAD AND	DES INTE ALUE/A > OVERHEA < 5.00% ESTIMAT MANAGEN E	REST AT  O.O ?  O AND M  O ED YIEL  MENT	4 × 1.	30) 20) 20 *23	.70 3.00 3.00	44.70
	STS FIXED MACHINERY C REAL ESTATE TAXES INTEREST ON LAND TOTAL F TOTAL C AND MANAGEMENT OVERHEAD (TOTAL MANAGEMENT CHARGE TOTAL C TOTAL C	(\$ 0.0 VAIXED COSTS OST, EXCEPT CASH COSTS > (\$ 0.0 X VERHEAD AND	DES INTE ALUE/A > OVERHEA < 5.00% ESTIMAT MANAGEN E T OF PRO	REST AT  O.O ?  O AND M  ED YIEL  ENT	4 × 1.	30) 20) 20 *23	.70 3.00 3.00	44.70
	STS FIXED MACHINERY C REAL ESTATE TAXES INTEREST ON LAND TOTAL F TOTAL C AND MANAGEMENT OVERHEAD (TOTAL MANAGEMENT CHARGE TOTAL C TOTAL C	(\$ 0.0 VAIXED COSTS  OST, EXCEPT  CASH COSTS >  (\$ 0.0 X  VERHEAD AND OST PER ACRE OST PER UNI	DES INTE ALUE/A > OVERHEA < 5.00% ESTIMAT MANAGEN E T OF PRO	REST AT  O.O ?  O AND M  ED YIEL  ENT	4 × 1.	30) 20) 20 *23	.70 3.00 3.00	44.70
OVERHEAD	STS FIXED MACHINERY C REAL ESTATE TAXES INTEREST ON LAND TOTAL F TOTAL C AND MANAGEMENT OVERHEAD (TOTAL MANAGEMENT CHARGE TOTAL C TOTAL C	(\$ 0.0 VAIXED COSTS  OST, EXCEPT  CASH COSTS >  (\$ 0.0 X  VERHEAD AND OST PER ACRE OST PER UNI	DES INTE ALUE/A > OVERHEA < 5.00% ESTIMAT MANAGEN E T OF PRO	REST AT  O.O ?  O AND M  ED YIEL  ENT	4 × 1.		.70 3.00 3.00 3.40 3.40	44.70
OVERHEAD	STS FIXED MACHINERY C REAL ESTATE TAXES INTEREST ON LAND TOTAL F TOTAL C AND MANAGEMENT OVERHEAD (TOTAL MANAGEMENT CHARGE TOTAL C TOTAL C TOTAL C C D RETURNS ESTIMATED CROP RE	(\$ 0.0 VAIXED COSTS OST, EXCEPT CASH COSTS > (\$ 0.0 X VERHEAD AND OST PER ACRE OST PER UNIT BASED ON EST	DES INTE ALUE/A > OVERHEA < 5.00% ESTIMAT MANAGEN TOF PRO TIMATED	REST AT  O.O ?  O AND M  ED YIEL  ENT	4 × 1.	3 0) 6 165	.70 3.00 3.40 3.40 3.40	44.70
OVERHEAD	STS FIXED MACHINERY C REAL ESTATE TAXES INTEREST ON LAND TOTAL F TOTAL C AND MANAGEMENT OVERHEAD (TOTAL MANAGEMENT CHARGE TOTAL C TOTAL C TOTAL C C D RETURNS ESTIMATED CHOP RE ESTIMATED AUM GRA	(\$ 0.0 VAIXED COSTS OST, EXCEPT CASH COSTS > (\$ 0.0 X VERHEAD AND OST PER ACRE OST PER UNIT BASED ON EST	DES INTE ALUE/A > OVERHEA < 5.00% ESTIMAT MANAGEN TOF PRO TIMATED  RE	REST AT  O.O ?  O AND M  ED YIEL  MENT  DUCTION  YIELD	4 × 1.	3 0) 6 165	.70 3.00 3.40 3.40 5.00	44.70

ESTIMATED NET PETUPH PER ACPE

# GARY METZER ESTAB HAY

TOTAL CROPLAND ACRES ACRES THIS CROP BUDGET

325.0 40.0 EXPECTED YIELD PER ACRE ANIMAL UNITS OF GRAZING

3.0 1.0

180.00

27-26-2 www.terlajin.s.46-	5. 753 (142) 4	MATER	HASED RIALS	FUEL	INERY C REPAIR		
DPERATION	ACRES /HOUR	AMOUNT ACRE	9		MAINT.	FIXED	TOTA COST
MOLDBOARD PLOW	2.50			0.69	1.05	2.90	4.6
TANDEM DISC	4.00			0.43	0.31		1.9
PIKE TOOTH HARROW	IN TANDE	M	-7 "		0.00	0.24	0.2
FLOAT	2.00			0.87	0.52		3.7
FLOAT	2.00			0.87		2.36	3.7
POLLER OR PACKER	7.50			0.23		0.96	1.2
RAIN DRILL	4.00			0.43			2.9
SEED	ha aye im	1.00	25.00				25. (
IN AND			0.01				0.0
SPRINKLER	THE YES MAN	1.00		39.1			70.0
POLLER OR PACKER	7.50	1.00		0.23	0.08	0.96	
	3.00	(=)		0.23		2.10	3.4
SELF-PROPELLED WINDROWER					0.35		A SHEET THE
SELF-PROPELLED BALER	2.60	d 1 00	2.40			2.10	3.4
TWINE	0.00	1.00	2.40	4 00			2.4
ELF-PROP. FORAGE CHOPPER	2.00			1.26	0.78	2.94	4.9
TOTALS		•		6.84	4.71	20.14	129.0
ASH COSTS			8112	137			
PURCHASED MATERIAL	\$				97	.40 - 70	= 17.4
FUEL AND LUBE						.84	
REPAIRS AND MAINTA	NONCE			E Carl Market		.71	
CUSTOM HIRE AND MA		CI .				. 0	
INTEREST ON OPERAT							100
( 108.95 X 16			rues			.72	
TOTAL CA		6.0 Muni	H2)				
IUIAL CA	3M_CU313				34		117.67
0.000							4:3.6.7
ABOR						dadid *	
DIRECT LABOR	使行為自治	Sud 5/ 98	1100.00	at CRM	16	.25	
74.3 de de la € 3.4 HRS X	4.00/HR X			A pre-cit	16.14 O.E.		131 1751
TOTAL CA	SH COSTS A	ND LABOR	?			1	33.91
IXED COSTS							
FIXED MACHINERY CO		DES INTE	DEST OF	16 00	21 20	1.4	
REAL ESTATE TAXES				(11)	2 TI (T) (2	. 00	
INTEREST ON LAND				X 1. U	1) 0	. 0	
	XED COSTS				Area es		23.14
TOTAL CO	ST, EXCEPT	OVERHER	ad and M	IGT.		SHIPMS IN	157.05
IVERHEAD AND MANAGEMENT				18			
OVERHEAD (TOTAL C	ASH COSTS:	X 5.00%			5	.88	
MANAGEMENT CHARGE	(\$ 0.0 X	ESTIMAT	TED YIEL	D)	. 0	. 0	
TOTAL OVI	ERHEAD AND	MANAGEN	1ENT				5.88
	ST PER ACR					G	62.93
	ST PER UNI			1			54.31
	ASED ON ES					(	4.1
	· ·				1360	92	.43
ESTIMATED RETURNS					2 5 1307		
ESTIMATED CROP RET					165	.00	
ESTIMATED AUM GRAZ	ING RETURN	212/19/24			9 . 15	.00 .	
	N TOTAL RE						

ESTIMATED TOTAL RETURN PER ACRE

17.07

ESTIMATED NET RETURN PER ACRE

TOTAL CROPLAND AC	RES 325.0	 EXPECTED YIELD PER ACRE	80.0
ACRES THIS CROP B	UDGET 40.0	ANIMAL UNITS OF GRAZING	0.0

OPERATION		MATER	RIALS COST	FUEL AND	INERY C REPAIR AND MAINT.		
MOLDBOARD PLOW	2.50			0.69	1.05	2.90	4.65
TANDEM DISC	4.00				0.31		
TANDEM DISC	4.00				0.31		
SPIKE TOOTH HARROW	10.00		*		0.04		
FLOAT	2.00			0.87	0.52	2.36	3.7
SRAIN DRILL	4.00				0.46		
SEED		1.00	6.00		70		6.0
GOPHER CONTROL		1.00	1.00				1.0
SPRINKLER		1.00	70.00				70.0
	7.50			0.23	0.08	0.96	1.2
PRAYER	CUSTOM				*		6.0
IDMBINE, 55JD	2.00			1.58	1.50	8.45	11.50
TRUCK					0.24	0.96	2.4
TOTALS				6.04		20.41	113.9
CASH COSTS							
PURCHASED MATERIALS					. 77	. 00,	
FUEL AND LUBE						. 04	
REPAIRS AND MAINTANA	NOE					.50	1.23
CUSTOM HIRE AND MACH		90				.00	100
INTEREST ON OPERATIN				,		. 48	
( 93.54 × 16.0						. 40	
		5 . (( PH H)	HND				
TOTAL CASH		o. O MUNI	H25			1	01.03
TOTAL CASH		o. g muni	H2)			1	01.03
TOTAL CASH		s. o nunt	H2)		11		01.03
TOTAL CASH LABOR	COSTS			)	11	. 44	01.03
TOTAL CASH LABOR DIRECT LABOR	COSTS	1.2 (OV	'ERHEAD)	>	11	. 44	01.03
TOTAL CASH LABOR DIRECT LABOR ( 2.4 HRS X 4	COSTS	1.2 (OV	'ERHEAD)	)	11	. 44	
TOTAL CASH LABOR DIRECT LABOR ( 2.4 HRS X 4 TOTAL CASH	COSTS .00/HR X COSTS AM	1.2 (OV ND LABOR	'ERHEAD)			<b>. 44</b>	
TOTAL CASH  ABOR  DIRECT LABOR  ( 2.4 HRS X 4  TOTAL CASH  FIXED COSTS	COSTS .00/HR X COSTS AM	1.2 (OV ND LABOR	'ERHEAD)		%) 20	.44 1	
TOTAL CASH LABOR DIRECT LABOR ( 2.4 HRS X 4 TOTAL CASH FIXED COSTS FIXED MACHINERY COST REAL ESTATE TAXES	COSTS COZHR X COSTS AN	1.2 (OV ND LABOR OES INTE	'ERHEAD) : :REST AT	16.00	%) 20 3	. 44 1 . 41 . 00	
TOTAL CASH  ABOR  DIRECT LABOR  ( 2.4 HRS X 4  TOTAL CASH  FIXED COSTS  FIXED MACHINERY COST  REAL ESTATE TAXES  INTEREST ON LAND (\$	COSTS 0.00/HR X COSTS AN COSTS AN COSTS AN COSTS	1.2 (OV ND LABOR OES INTE	'ERHEAD) : :REST AT	16.00	%) 20 3	.44 1 .41 .00	12.47
TOTAL CASH  ABOR  DIRECT LABOR  ( 2.4 HRS X 4  TOTAL CASH  FIXED COSTS  FIXED MACHINERY COST  REAL ESTATE TAXES  INTEREST ON LAND (\$  TOTAL FIXE	COSTS  COSTS AN  COSTS AN  COSTS ON  COSTS	1.2 (OV ND LABOR DES INTE ALUE/A X	ERHEAD) REST AT	16.00 × 1.0	%) 20 3	.44 .41 .00	12.47 23.41
TOTAL CASH  LABOR  DIRECT LABOR  ( 2.4 HRS X 4  TOTAL CASH  FIXED COSTS  FIXED MACHINERY COST  REAL ESTATE TAXES  INTEREST ON LAND (\$	COSTS  COSTS AN  COSTS AN  COSTS ON  COSTS	1.2 (OV ND LABOR DES INTE ALUE/A X	ERHEAD) REST AT	16.00 × 1.0	%) 20 3	.44 .41 .00 .0	12.47 23.41 35.88
TOTAL CASH  ABOR  DIRECT LABOR  ( 2.4 HRS X 4 TOTAL CASH  FIXED COSTS  FIXED MACHINERY COST  REAL ESTATE TAXES  INTEREST ON LAND (\$ TOTAL COST	COSTS  COSTS AN  COSTS AN  COSTS ON  COSTS	1.2 (OV ND LABOR DES INTE ALUE/A X	ERHEAD) REST AT	16.00 × 1.0	%) 20 3	.44 .41 .00 .0	12.47 23.41
TOTAL CASH  ABOR  DIRECT LABOR  ( 2.4 HRS X 4 TOTAL CASH  FIXED COSTS  FIXED MACHINERY COST  REAL ESTATE TAXES  INTEREST ON LAND (\$ TOTAL FIXE  TOTAL COST	COSTS  OO/HR X COSTS AN COSTS AN COSTS AN COSTS AN COSTS	1.2 (DV ND LABOR DES INTE ALUE/A X	ERHEAD) REST AT O.0 %	16.00 × 1.0	%) 20 3 ) 0	.44 .41 .00 .0	12.47 23.41 35.88
TOTAL CASH  DIRECT LABOR  ( 2.4 HRS X 4  TOTAL CASH  FIXED COSTS  FIXED MACHINERY COST  REAL ESTATE TAXES  INTEREST ON LAND (\$  TOTAL FIXE  TOTAL COST  OVERHEAD AND MANAGEMENT  OVERHEAD (TOTAL CAS	COSTS  OO/HR X COSTS AN COSTS AN COSTS AN COSTS COSTS COSTS	1.2 (OV ND LABOR DES INTE ALUE/A X OVERHEA ( 5.00%	ERHEAD) REST AT O.O % D AND M	16.00 × 1.0	%) 20 3 ) 0 5	.44 .41 .00 .0	12.47 23.41 35.88
TOTAL CASH  ABOR  DIRECT LABOR  ( 2.4 HRS X 4 TOTAL CASH  FIXED COSTS  FIXED MACHINERY COST  REAL ESTATE TAXES  INTEREST ON LAND (\$ TOTAL FIXE  TOTAL COST  OVERHEAD AND MANAGEMENT  OVERHEAD (TOTAL CASH  MANAGEMENT CHARGE (	COSTS  OOVHR X COSTS AN COSTS AN COSTS  EXCEPT COSTS X COSTS X	1.2 (OV ND LABOR DES INTE ALUE/A X OVERHEA ( 5.00% ESTIMAT	ERHEAD) REST AT O.0 % D AND M ED YIEL	16.00 × 1.0	%) 20 3 ) 0 5	.44 .41 .00 .0	12.47 23.41 35.88
TOTAL CASH  ABOR  DIRECT LABOR  ( 2.4 HRS X 4 TOTAL CASH  FIXED COSTS  FIXED MACHINERY COST  REAL ESTATE TAXES  INTEREST ON LAND (\$ TOTAL FIXE TOTAL COST  OVERHEAD AND MANAGEMENT  OYERHEAD (TOTAL CAS MANAGEMENT CHARGE ( TOTAL OVER	COSTS  COSTS AND  COSTS AND  COSTS AND  COSTS  COST	1.2 (OV ND LABOR DES INTE ALUE/A X OVERHEA ( 5.00% ESTIMAT MANAGEM	ERHEAD) REST AT O.0 % D AND M ED YIEL	16.00 × 1.0	%) 20 3 ) 0 5	.44 .41 .00 .0	12.47 23.41 35.88
TOTAL CASH  ABOR  DIRECT LABOR  ( 2.4 HRS X 4 TOTAL CASH  FIXED COSTS  FIXED MACHINERY COST  REAL ESTATE TAXES INTEREST ON LAND (\$ TOTAL FIXE TOTAL COST  OVERHEAD AND MANAGEMENT OVERHEAD (TOTAL CAS MANAGEMENT CHARGE ( TOTAL COST	COSTS  COSTS AND  COST	1.2 (OV ND LABOR DES INTE ALUE/A X OVERHEA ( 5.00% ESTIMAT MANAGEM	ERHEAD) REST AT O.0 % D AND M ED YIEL	16.00 X 1.0 GT. D)	%) 20 3 ) 0 5	.44 .41 .00 .0	12.47 23.41 35.88
TOTAL CASH  LABOR  DIRECT LABOR  ( 2.4 HRS X 4 TOTAL CASH  FIXED COSTS  FIXED MACHINERY COST  REAL ESTATE TAXES INTEREST ON LAND (\$ TOTAL FIXE TOTAL COST  OVERHEAD AND MANAGEMENT OVERHEAD (TOTAL CASH MANAGEMENT CHARGE ( TOTAL OVER TOTAL COST TOTAL COST	COSTS  COSTS AND  COST	1.2 (OV ND LABOR DES INTE ALUE/A X OVERHEA ( 5.00% ESTIMAT MANAGEM TOF PRO	ERHEAD)  REST AT  0.0 %  D AND M  ED YIEL  ENT	16.00 X 1.0 GT. D)	%) 20 3 ) 0 5	.44 .41 .00 .0	12.47 23.41 35.88
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# APPENDIX C

HEAVY METAL PROBLEMS IN THE DEER LODGE VALLEY

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#### APPENDIX C

# HEAVY METALS

Contamination of soils by heavy metals in the upper Clark Fork drainage is a problem which limits the production potential of some lands and may seriously impair water quality. Airborne heavy metal particulates have been emitted from the Anaconda Smelter since the late 1800s and have settled on land in the Deer Lodge Valley. Additional waterborne mine tailings with high heavy metal concentrations have contaminated floodplain soils and some agricultural land in close proximity to the Clark Fork River.

Heavy metals in soils impose constraints on various land uses including irrigated agriculture. The following studies have addressed the heavy metal problems in the Deer Lodge Valley or in the riverine ecosystem downstream.

#### A. MultiTech

The consulting firms of MultiTech and Stiller and Associates have contracted with the Montana Department of Health and Environmental Sciences (DHES) through the federally funded Superfund Program to prepare the Silver Bow Creek Remedial Investigation Work Plan. This plan describes the many problems in the Anaconda-Butte area associated with past mining and smelting activities and suggests means to reduce or better identify the problems.

MultiTech cites the work of various agencies and consultants and states:

Just downstream of the Warm Springs Ponds, Warm Springs Creek and Silver Bow Creek converge to form the Clark Fork River. Warm Springs Creek is a high quality stream that is degraded in its lower reaches. The cause of the degradation is possibly a combination of seepage from AMC treatment ponds and irrigation dewatering (Casne and others 1975). Tailings deposits cover much of the floodplain of the Upper Clark Fork and contribute unknown contaminants, via runoff, to the river. MDHES (1983) study found an increase in sulfate and total copper loads for the Clark Fork River from its origin to Deer Lodge. This increase is thought to be the result of impacts from floodplain and in-stream tailing deposits (Green 1984).

Tributaries to the Clark Fork River along this reach are affected by some mining and agricultural activity. These lands may produce some contaminant loads to the Clark Fork River.

# MultiTech additionally states,

Soil contamination along the Upper Clark Fork River is nearly identical to that described for the canyon to Warm Springs Ponds river segments. A much greater extent of irrigated land is found along this portion of the Clark Fork. The downstream extent of significant contamination is presently indeterminate. Barren areas are common aong the river point bars as far as Deer Lodge. It is expected that contamination could occur at least as far downstream as Garrison.

The literature review in Section 9.4.2 documents the need for systematic identification and demarcation of those lands either known or suspected to be affected by "heavy metal" contaminated irrigation waters. Initially, those ditches that received surface waters diverted or pumped from either Silver Bow Creek or Upper Clark Fork River were identified. This effort was accomplished via review of the respective water resource surveys for Silver Bow (Buck et al. 1955a), Deer Lodge (Buck et al. 1955b), and Powell Counties (Buck et al. 1959). Secondly, those owners potentially affected were identified either through inspection of each county's land ownership (plat) books or interviewing knowledgeable Soil Conservation Service personnel in Deer Lodge (Tribelhorn and Dutton, personal communications). Thirdly, a news release was published on February 28, 1984 in the Montana Standard (Kemmick

1984) that included a solicitation for information pertinent to the irrigated lands study. The initial listing of persons that will be contacted are presented by soil conservation district in Appendix Table 9.5-5.

A preliminary estimate of areal extent of affected lands totals to 5380 acres, for the three given counties. The respective county figures are as follows: Silver Bow, 0 acres; Deer Lodge, 1115 acres; and Powell, 4265 acres. Apparently, the combined municipal and industrial effluents discharged by Butte sources into Silver Bow Creek have prevented any attempts at using its water for regular or flood irrigation purposes (Buck et al. 1955a). The inclusion of the entire Deer Lodge Valley Conservation District seems appropriate, as waters from the Clark Fork River are pumped or diverted from it throughout this area. Furthermore, "heavy metal" contamination of riparian vegetation by sediments has been documented in the vicinity of Drummond, Montana (Ray 1983). This town is located approximately 10 river miles west of the Granite County-Powell County border, implying that transport of effluents has traveled (historically) at least this far downstream.

#### B. University of Montana

The Gordon Environmental Studies Laboratory of the University of Montana has recently completed studies on the Grant-Kohrs Ranch, a National Historic Site administered by the National Park Service, and on the floodplain of the Clark Fork River between Rocker and Drummond. These studies were conducted to measure heavy metal contamination in soils which are barren of vegetation or have plant communities indicative of heavy metal pollution.

Ray (1984) found elevated levels of copper, cadmium, and arsenic at all sites studied along the Clark Fork with some of the highest concentrations being present at Drummond, the site farthest from the source of the waterborne mine tailings. All of Ray's samples were collected on barren or sparsely

vegetated areas which showed surficial evidence of waterborne sediment deposition.

Rice and Ray (1984) conducted a floral and faunal survey of the Grant-Kohrs Ranch National Historic Site. They found that the top 25 centimeters of soil on the Clark Fork floodplain had metal concentrations one to two orders of magnitude greater than the concentrations in the control samples. Only a small fraction of this contamination was attributed to deposition of airborne particulates during the period of smelter operation, 1884 through 1980. Deposition on the floodplain of toxic metal enriched sediments was determined by Rice and Ray to be the predominant and continuing mechanism of contamination.

#### C. Hydrometrics

The consulting firm, Hydrometrics (1983), conducted long-term environmental rehabilitation studies in the Deer Lodge Valley under contract to the Anaconda Minerals Company. Hydrometrics reported that milling and smelting operations at Butte and Anaconda have resulted in extensive but relatively thin tailings deposits on the floodplain. These deposits have killed riparian vegetation in numerous areas and have created barren or sparsely vegetated areas which resulted from past attempts to irrigate with poor quality water diverted from the Clark Fork River. Field reconnaissance and aerial photo-interpretation were used to map approximately one million cubic

yards of tailings (covering 1,250 acres) deposited on the floodplain between Warm Springs and Deer Lodge.

Hydrometrics also conducted soil tests in the Deer
Lodge Valley. They found that soils with low pHs had sparse
vegetation cover and that soil pH was inversely related to
soluble metal concentrations. Downward percolation of metals
from tailings and redeposition in the underlying alluvial soils
has increased concentrations of copper, zinc, manganese, and
sulfur to a depth of 24 inches in some sites.

### D. Soil Conservation Service

The Soil Conservation Service (SCS) in Deer Lodge has mapped some areas within the Deer Lodge Valley where toxic metals have affected plant growth and soil productivity. The SCS uses the term "slickens" to describe

An undifferentiated soil type consisting of accumulation of fine-textured materials, such as are separated in placer-mine and ore-mill operations. Slickens from ore mills consist largely of freshly ground rock that commonly have undergone chemical treatment during milling or smelting processes.

SCS personnel are also aware of landowners who have problem soils or suspect that heavy metals have affected their agricultural operations.

#### E. Graduate Studies

Graduate students at the University of Montana conducted studies on vegetation and soils in the vicinity of Anaconda. Munshower (1972) studied cadmium compartmentation

and cycling in grasses and soils of the Deer Lodge Valley and was able to construct isopols which linked areas of similar soil concentrations of cadmium. The isopol concentrations were attributed only to airborne deposition of particulates produced by the smelting of ore.

Other studies were conducted by Taskey (1970) and Hartman (1976). Taskey studied the contamination of soils around Anaconda by airborne heavy metals, whereas Hartman studied the influence of heavy metals on the fungal flora of the soil.

#### F. Mile High Conservation District

A reclamation project funded by the Montana Department of Natural Resources and Conservation (DNRC) Water Development Bureau has been initiated for the Mile High Conservation District, Deer Lodge Valley Conservation District, and the Headwaters Resource Conservation and Development Area. This research concerns reclamation techniques for heavy metal contaminated agricultural lands in Deer Lodge, Powell, and Silver Bow counties, with the primary focus of the research being on the development of cost-effective practices for reestablishing hay and forage production on soils contaminated by heavy metals. Such reclamation practices, however, must be permanent so future sulfide oxidation does not lower soil pH. In addition, acceptable reclamation practices must not increase the metal content of forage to levels toxic to livestock.

In recognition that irrigated agrculture could affect the vertical and areal distribution of heavy metals in soils and mobilize these metals so as to contaminate surface and shallow ground water, a detailed hydrological investigation will also be part of the reclamation study being conducted by the Mile High Conservation District. Wells, shallow ground water, and surface waters will be monitored to determine how agricultural practices affect the soil/heavy metal/hydrological interactions.

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