Estimating the Cost of Replacing Forage Losses on Annual Rangeland

Cooperative Extension University of California
Division of Agriculture and Natural Resources
Publication 21494

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THIS PUBLICATION IS PRINTED ON RECYCLED PAPER.

2m-pr-3/91-HS/ALS

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Valuable forage is often lost on annual rangelands because of wildfires, cultivation, road construction, and excavation. Estimating the cost of such losses cannot be based upon traditional grazing rental rates for livestock because the impact on forage production is more far reaching than the impact of grazing. All residual dry matter is removed and, except in the case of fire, the soil profile is changed. Besides the loss of the current year's forage, the following growing seasons' forage production, length of adequate forage-growing periods, and species composition are affected.

For example, after a fire or disturbance has removed all vegetation, about 50 to 70 percent as much forage will be produced the following season, and the species composition will shift primarily to forbs. The second growing season following a disturbance, forage production will be about 20 percent less than on undisturbed sites. Only in the third growing season will forage production be similar on both sites (Hervy 1949, Zavon 1982, McDougald and Frost 1989, 1990). After a high-intensity fire that leaves white ash, less than 25 percent as much forage will be produced on the burned site than on an unburned site for each of the next 3 years, and possibly longer, if reseeding is not conducted (Frost 1988). To appraise the impact of this disturbance on annual rangeland, it is necessary to assess the impact on the site, its likely productivity, and the cost of replacing the forage lost.

In areas typified by the San Joaquin Experimental Range six easily recognized, fairly broad range sites make up usable rangeland (Bentley and Talbot 1951). Precipitous slopes; large, nearly barren rock outcrops; and areas with dense brush or interior live oak cover are excluded from consideration. The six range sites identified are:

Swale sites – gentle drainage bottoms, which produce the greatest amount of forage

Gentle slope – located just above the swale; slope less than 10 percent

Open-rolling sites – gentle uplands with few rock outcrops or brush; intermediate in annual forage productivity

Rocky, brushy sites – uplands; low in annual forage productivity

Steep, rocky, brushy, north slope sites – over 30 percent slope; least productive site

Steep, rocky, brushy, south slope sites – over 30 percent slope; about twice as productive as north slopes

Adequate amounts of residual dry matter (RDM), the dry plant material left on the ground from the previous year's growth, must be left at the end of the grazing season to protect the site and to provide a favorable microenvironment for the following year's forage production (Clawson, McDougald, and Duncan 1982). Therefore, the difference between the amount of forage produced on a site and the RDM is the amount available for rangeland users. Because livestock generally harvest 50 percent of the available forage (Smith, Leung, and Love 1986), the usable amount lost to the livestock producer is one-half of the available forage with the other 50 percent being utilized by wildlife, decomposition, trampling, etc. Typical forage production, an RDM standard, estimated available forage, and usable forage for sites at SJER are presented in table 1.

An alternative to using average forage production values for a given site would be to sample forage production on similarly burned and unburned sites. Techniques available for determining forage production include clipping of plots (Cook and Stubbendieck 1986), the comparative yield method (Haydock and Shaw 1975), and use of a pasture probe (George et al. 1989), etc. Another alternative would be to use forage production estimates taken from the Soil Conservation Service ecological site description (range site guides). This forage production estimate could then be used in place of the average annual forage production value in table 1.

Table 1. Average annual forage production, residual dry matter (RDM) standards, usable forage, and forage lost to livestock producer for 6 range sites typical of the San Joaquin Experimental Range, Madera County, California*

Range site	Average annual forage production (lb/ac)	RDM standard (lb/ac)	Available forage (lb/ac)	Harvest efficiency (%)	Usable forage (lb/ac)
Swale	4,400	600	3,800	50	1,900
Gentle slope	3,000	800	2,200	50	1,100
Open, rolling	2,100	800	1,400	50	700
Rocky, brushy	1,400	1,000	400	50	200
Steep, rocky, brushy, north slope	1,200	1,000	200	50	100
Steep, rocky, brushy, south slope	1,800	1,000	800	50	400

*Adapted from Bentley and Talbot 1951.

The time of year the pasture is traditionally utilized determines the value of the forage lost as the nutrients contained in that forage must be replaced by supplemental feeding, which by definition is the supplementing of nutrients the grazed forage lacks. On California's annual rangelands, dry feed during summer and early fall lacks protein, phosphorus, and vitamin A. In fall and early winter, new forage growth is high in moisture and energy is often inadequate for desired livestock performance. Feed supplements are used commonly in the form of dry concentrated feed, liquids, or blocks formulated to provide a source of protein (or nonprotein nitrogen), phosphorus, vitamin A, and, sometimes, other minerals (i.e., copper and magnesium). At the beginning of the new forage season, protein and energy are most often supplied in the form of hay. Oat hay can supply an adequate amount of energy, but it is a poor source of protein and vitamin A. Alfalfa hay, on the other hand, is a good source of all these nutrients (table 2).

Table 2. Dry matter percentage, total digestible nutrients (TDN) percentage, protein content, and phosphorus percentage for oat and alfalfa hay and range forage

Feed	Dry matter (%)	TDN (%)	Protein content (%)	Phosphorus (%)
Alfalfa hay	90	60	17	0.22
Oat hay	90	54	9	0.21
Late dry forage	90	45	3	0.15
Early green forage	30	20	6	0.08
Early green forage	90	60	18	0.25
Late spring forage	60	45	10	0.18
Late spring forage	90	60	15	0.25

Calculations to determine the value of forage lost are included in a set of worksheets, (a Sample Worksheet plus Examples 1-3). These calculations take into account the forage productivity of the site, the reduction in productivity due to a disturbance, the RDM standard necessary to protect the site, the harvest efficiency of grazing livestock, and the number of acres affected.

Three examples are presented to clarify the process outlined previously. For the examples that follow oat hay was used as the supplemental feed when the pasture was used summer or fall and alfalfa hay when the pasture was used in spring. Oat hay is comparable, in terms of TDN to late dry forage, although it is higher in protein content (table 2). Alfalfa hay is comparable to green forage in TDN, protein content, and phosphorus. If the reduced forage production on a site is less than the RDM standard, that site is ignored when calculating usable forage.

Example 1 (pages 9 to 12)

An escaped fire from a welding project burned 150 acres of ungrazed annual rangeland in June. This pasture was typically used in fall (the dry forage period) when available forage is somewhat similar in quality to oat hay. The cost of substituting oat hay for the lost forage was used to appraise the value of forage lost in this pasture.

The fire encompassed 8 acres of swale site; 34 acres of open, rolling site, 45 acres of rocky, brushy site; 32 acres of steep, rocky, brushy, north slope site; and 31 acres of steep, rocky, brushy, south slope site. By using the values from table 1 in the worksheets it was determined in Example 1 that 31 tons of usable forage were lost at the time of the fire, 22 tons were lost for the first growing season, and 13 tons for the second growing season following the fire. A total of 66 tons of usable forage were lost from this disturbance. With a value assigned of $100 per ton for the purchase, delivery, and feeding of oat hay, the total value of forage lost is $6,600.

Example 2 (pages 13 to 16)

In this scenario, a pasture similar to the Example 1 pasture is typically used in the adequate green forage period when the quality of forage is comparable to alfalfa hay. At the time of the fire this pasture had already been grazed to the proper RDM levels, so no usable forage was lost at that time. The impact of the fire will only be apparent in the following two growing seasons. The value of the forage lost can be evaluated by determining the cost of purchasing, transporting, and feeding a comparable amount of alfalfa hay. Calculations for this example are presented in Example 2.

The growing season following the fire forage production will be reduced about 40 percent resulting in a loss in total usable forage production of more than 44,000 pounds. In the second growing season, total forage production will be reduced by about 20 percent, creating a loss of just under 26,000 pounds of usable forage. For the two growing seasons about 35 tons (70,000 pounds) of usable forage will be lost. To compensate for this loss, 35 tons of alfalfa hay must be purchased, delivered, and fed at a cost of $125 per ton, for a total of $4,375.

Example 3 (pages 17 to 20)

In this third example the situation is similar to Examples 1 and 2, but this time the forage loss will be calculated using the USDA Soil Conservation Service ecological site descriptions (range site guides) (USDA Soil Conservation Service 1984). In this instance, swale, gentle slope, and open rolling slope are described by the Blue oak/annual grass/granitic site description, and the rocky brush slope and the steep rocky brushy slope by the Blue oak/annual grass/shallow granitic site description. Average forage production for these items is:

Blue oak/annual grass/granitic	2,000 lb/ac
Blue oak/annual grass/shallow granitic	1,300 lb/ac

Substituting these sites and production values on the worksheets produces the following results for the situation presented in Example 2. Calculations for this example are presented in Example 3.

Again, this pasture has been grazed to proper RDM levels at the time of the fire so no usable forage was lost at that time. Following the fire, the 40 percent reduction in forage production resulted in a decrease of 33,000 pounds of usable forage in the first growing season and a 20 percent reduction in forage production in the second growing season, creating a reduction of just over 22,000 pounds. Thus, purchase, delivery, and feeding of 27.5 tons (55,000 pounds) of supplemental alfalfa hay, at a cost of $125 per ton, resulted in a cost of $3,437.50.

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WORKSHEET

Replacement Value of Usable Forage Lost

Replacement value of usable forage depends on: site productivity, area impacted, season of use, harvest efficiency and cost of substitute feeds. The formula below is a quick method to appraise the replacement value of usable forage lost.

If no grazing had occurred on this area and it was intended for fall use all of the usable forage has been lost and must be replaced. Use equation (A).

If the area had been grazed, but not to the RDM standard, use (AA) to determine the amount of usable forage lost.

A. Beginning Inventory

	Site	Forage Produced (lb/ac)		RDM (lb/ac)		Harvest Efficiency (Percent)		No. Acres		Usable Forage Lost (lb)
1.	_____	(_____	-	_____)	X	_____	X	_____	=	_____
2.	_____	(_____	-	_____)	X	_____	X	_____	=	_____
3.	_____	(_____	-	_____)	X	_____	X	_____	=	_____
4.	_____	(_____	-	_____)	X	_____	X	_____	=	_____
5.	_____	(_____	-	_____)	X	_____	X	_____	=	_____

Total Pounds _____

$$\frac{\text{Total Pounds Usable Forage Lost}}{} \div 2000 = \frac{\text{Total Tons Usable Forage Lost}}{} \quad (A)$$

AA. Partial Use Prior to Disturbance

	Site	Standing Crop lb/ac		RDM (lb/ac)		Harvest Efficiency (Percent)		No. Acres		Usable Forage Lost (lb)
1.	_____	(_____	-	_____)	X	_____	X	_____	=	_____
2.	_____	(_____	-	_____)	X	_____	X	_____	=	_____
3.	_____	(_____	-	_____)	X	_____	X	_____	=	_____
4.	_____	(_____	-	_____)	X	_____	X	_____	=	_____
5.	_____	(_____	-	_____)	X	_____	X	_____	=	_____

Total Pounds _____

Total Pounds Usable Forage Lost	÷ 2000 =	Total Tons Usable Forage Lost	(AA)

B. First Growing Season

	Site	Forage Production (lb/ac)	1 - % Reduction (Percent)	RDM (lb/ac)	Harvest Efficiency (Percent)	No. Acres	Usable Forage Available (lb)	
1.	_____	[(_____	X _____)	- _____]	X _____	X _____	= _____	(1)
2.	_____	[(_____	X _____)	- _____]	X _____	X _____	= _____	(2)
3.	_____	[(_____	X _____)	- _____]	X _____	X _____	= _____	(3)
4.	_____	[(_____	X _____)	- _____]	X _____	X _____	= _____	(4)
5.	_____	[(_____	X _____)	- _____]	X _____	X _____	= _____	(5)

	Typical Usable Forage Produced		Usable Forage Avail		Usable Forage Lost
(1)	Site 1 (lb) (A1)	-	(lb)	=	(lb)
(2)	Site 2 (lb) (A2)	-	(lb)	=	(lb)
(3)	Site 3 (lb) (A3)	-	(lb)	=	(lb)
(4)	Site 4 (lb) (A4)	-	(lb)	=	(lb)
(5)	Site 5 (lb) (A5)	-	(lb)	=	(lb)

Total Pounds _____
First growing season
usable forage lost

Total Pounds Usable Forage Lost First Growing Season	÷ 2000 =	Total Tons Usable Forage Lost First Growing Season	(B)

C. Second Growing Season

Site	Forage Production (lb/ac) Table I	1 - % Reduction (Percent)	RDM (lb/ac)	Harvest Efficiency (Percent)	No. Acres	Usable Forage Available (lb)
1.	[(	X	) -	] X	X	= (1)
2.	[(	X	) -	] X	X	= (2)
3.	[(	X	) -	] X	X	= (3)
4.	[(	X	) -	] X	X	= (4)
5.	[(	X	) -	] X	X	= (5)

(1) Typical Usable Forage Produced Site 1 (lb) (A1) - Usable Forage Avail (lb) = Usable Forage Lost (lb)

(2) Typical Usable Forage Produced Site 2 (lb) (A2) - Usable Forage Avail (lb) = Usable Forage Lost (lb)

(3) Typical Usable Forage Produced Site 3 (lb) (A3) - Usable Forage Avail (lb) = Usable Forage Lost (lb)

(4) Typical Usable Forage Produced Site 4 (lb) (A4) - Usable Forage Avail (lb) = Usable Forage Lost (lb)

(5) Typical Usable Forage Produced Site 5 (lb) (A5) - Usable Forage Avail (lb) = Usable Forage Lost (lb)

Total Pounds _____
Second growing season usable forage lost

Total Pounds Usable Forage Lost Second Growing Season ÷ 2000 = Total Tons Usable Forage Lost Second Growing Season (C)

D. Substitution Value

The substitution value is based upon normal season of use, delivery feeding cost.

1. Dry Forage Period Season of Use

Substitution value per ton = $\frac{\text{Purchase, delivery and feeding cost per ton of oat hay}}{}$ (D1)

2. Green Forage Period Season of Use

Substitution value per ton = $\frac{\text{Purchase, delivery and feeding cost per ton of alfalfa hay}}{}$ (D2)

E. Total Cost

((A) or (AA) $\frac{\text{Beginning Tons Lost}}{}$ X (D) $\frac{\text{Substitution Value Per Ton}}{}$) +

((B) $\frac{\text{Tons Lost First Growing Season}}{}$ X (D) $\frac{\text{Substitution Value Per Ton}}{}$) +

((C) $\frac{\text{Tons Lost Second Growing Season}}{}$ X (D) $\frac{\text{Substitution Value Per Ton}}{}$) = (E) $\frac{\text{Total Replacement Value of Usable Forage Lost}}{}$

WORKSHEET

Replacement Value of Usable Forage Lost

Replacement value of usable forage depends on: site productivity, area impacted, season of use, harvest efficiency and cost of substitute feeds. The formula below is a quick method to appraise the replacement value of usable forage lost.

If no grazing had occurred on this area and it was intended for fall use all of the usable forage has been lost and must be replaced. Use equation (A).

If the area had been grazed, but not to the RDM standard, use (AA) to determine the amount of usable forage lost.

A. Beginning Inventory

		Site	Forage Produced (lb/ac)		RDM (lb/ac)		Harvest Efficiency (Percent)		No. Acres		Usable Forage Lost (lb)
(S)	1.	Swale	(4,400	-	600	) X	50%	X	8	=	15,200
(OR)	2.	Open Rolling	(2,100	-	800	) X	50%	X	34	=	22,100
(RB)	3.	Rocky Brushy	(1,400	-	1,000	) X	50%	X	45	=	9,000
(SRBN)	4.	Steep Rocky Brushy N	(1,200	-	1,000	) X	50%	X	32	=	3,200
(SRBS)	5.	Steep Rocky Brushy S	(1,800	-	1,000	) X	50%	X	31	=	12,400
									Total Pounds		61,900

61,900 (Total Pounds Usable Forage Lost) ÷ 2000 = 31 (Total Tons Usable Forage Lost) (A)

AA. Partial Use Prior to Disturbance

	Site	Standing Crop lb/ac		RDM (lb/ac)		Harvest Efficiency (Percent)		No. Acres		Usable Forage Lost (lb)
1.		(	-		) X		X		=	
2.		(	-		) X		X		=	
3.		(	-		) X		X		=	
4.		(	-		) X		X		=	
5.		(	-		) X		X		=	
								Total Pounds		

Total Pounds Usable Forage Lost	÷ 2000 =	Total Tons Usable Forage Lost	(AA)

B. First Growing Season

	Site	Forage Production (lb/ac)		1 - % Reduction (Percent)		RDM (lb/ac)		Harvest Efficiency (Percent)		No. Acres		Usable Forage Available (lb)	
1.	S	[(4,400	X	60%	) -	600	] X	50%	X	8	=	8,160	(1)
2.	OR	[(2,100	X	60%	) -	800	] X	50%	X	34	=	7,820	(2)
3.	RB	[(1,400	X	60%	) -	1,000	] X	50%	X	45	=	Ø	(3)
4.	SRBN	[(1,200	X	60%	) -	1,000	] X	50%	X	32	=	Ø	(4)
5.	SRBS	[(1,800	X	60%	) -	1,000	] X	50%	X	31	=	1,240	(5)

(1)	15,200 Typical Usable Forage Produced Site 1 (lb) (A1)	-	8,160 Usable Forage Avail (lb)	=	7,040 Usable Forage Lost (lb)	
(2)	22,100 Typical Usable Forage Produced Site 2 (lb) (A2)	-	7,820 Usable Forage Avail (lb)	=	14,280 Usable Forage Lost (lb)	
(3)	9,000 Typical Usable Forage Produced Site 3 (lb) (A3)	-	Ø Usable Forage Avail (lb)	=	9,000 Usable Forage Lost (lb)	
(4)	3,200 Typical Usable Forage Produced Site 4 (lb) (A4)	-	Ø Usable Forage Avail (lb)	=	3,200 Usable Forage Lost (lb)	
(5)	12,400 Typical Usable Forage Produced Site 5 (lb) (A5)	-	1,240 Usable Forage Avail (lb)	=	11,160 Usable Forage Lost (lb)	

Total Pounds 44,680
First growing season usable forage lost

Total Pounds Usable Forage Lost First Growing Season	÷ 2000 =	Total Tons Usable Forage Lost First Growing Season	(B)
44,680		22	

C. Second Growing Season

	Site	Forage Production (lb/ac) Table I		1 - % Reduction (Percent)		RDM (lb/ac)		Harvest Efficiency (Percent)		No. Acres		Usable Forage Available (lb)	
1.	S	[(4,400	X	80%	) -	600	] X	50%	X	8	=	11,680	(1)
2.	OR	[(2,100	X	80%	) -	800	] X	50%	X	34	=	14,960	(2)
3.	RB	[(1,400	X	80%	) -	1,000	] X	50%	X	45	=	2,700	(3)
4.	SRBN	[(1,200	X	80%	) -	1,000	] X	50%	X	32	=	Ø	(4)
5.	SRBS	[(1,800	X	80%	) -	1,000	] X	50%	X	31	=	6,820	(5)

(1) 15,200 (Typical Usable Forage Produced Site 1 (lb) (A1)) - 11,680 (Usable Forage Avail (lb)) = 3,520 (Usable Forage Lost (lb))

(2) 22,100 (Typical Usable Forage Produced Site 2 (lb) (A2)) - 14,960 (Usable Forage Avail (lb)) = 7,140 (Usable Forage Lost (lb))

(3) 9,000 (Typical Usable Forage Produced Site 3 (lb) (A3)) - 2,700 (Usable Forage Avail (lb)) = 6,300 (Usable Forage Lost (lb))

(4) 3,200 (Typical Usable Forage Produced Site 4 (lb) (A4)) - Ø (Usable Forage Avail (lb)) = 3,200 (Usable Forage Lost (lb))

(5) 12,400 (Typical Usable Forage Produced Site 5 (lb) (A5)) - 6,820 (Usable Forage Avail (lb)) = 5,580 (Usable Forage Lost (lb))

Total Pounds 25,740 Second growing season usable forage lost

25,740 (Total Pounds Usable Forage Lost Second Growing Season) ÷ 2000 = 13 (Total Tons Usable Forage Lost Second Growing Season) (C)

D. Substitution Value

The substitution value is based upon normal season of use, delivery feeding cost.

1. Dry Forage Period Season of Use

Substitution value per ton = $\frac{\$100.00}{\text{Purchase, delivery and feeding cost per ton of oat hay}}$ (D1)

2. Green Forage Period Season of Use

Substitution value per ton = $\frac{\quad}{\text{Purchase, delivery and feeding cost per ton of alfalfa hay}}$ (D2)

E. Total Cost

((A) or (AA) $\frac{31}{\text{Beginning Tons Lost}}$ X (D) $\frac{\$100.00}{\text{Substitution Value Per Ton}}$) +

((B) $\frac{22}{\text{Tons Lost First Growing Season}}$ X (D) $\frac{\$100.00}{\text{Substitution Value Per Ton}}$) +

((C) $\frac{13}{\text{Tons Lost Second Growing Season}}$ X (D) $\frac{\$100.00}{\text{Substitution Value Per Ton}}$) = (E) $\frac{\$6,600.00}{\text{Total Replacement Value of Usable Forage Lost}}$

WORKSHEET

Replacement Value of Usable Forage Lost

Replacement value of usable forage depends on: site productivity, area impacted, season of use, harvest efficiency and cost of substitute feeds. The formula below is a quick method to appraise the replacement value of usable forage lost.

If no grazing had occurred on this area and it was intended for fall use all of the usable forage has been lost and must be replaced. Use equation (A).

If the area had been grazed, but not to the RDM standard, use (AA) to determine the amount of usable forage lost.

A. Beginning Inventory

		Site	Forage Produced (lb/ac)		RDM (lb/ac)		Harvest Efficiency (Percent)		No. Acres		Usable Forage Lost (lb)
(S)	1.	Swale Open	(4,400	-	600)	X	50%	X	8	=	15,200
(OR)	2.	Rolling Rocky	(2,100	-	800)	X	50%	X	34	=	22,100
(RB)	3.	Brushy Steep Rocky	(1,400	-	1,000)	X	50%	X	45	=	9,000
(SRBN)	4.	Brushy N Steep Rocky	(1,200	-	1,000)	X	50%	X	32	=	3,200
(SRBS)	5.	Brushy S	(1,800	-	1,000)	X	50%	X	31	=	12,400
									Total Pounds		61,900

$$\frac{\text{Total Pounds Usable Forage Lost}}{2000} = \frac{\text{Total Tons Usable Forage Lost}}{\text{(A)}}$$

AA. Partial Use Prior to Disturbance

	Site	Standing Crop lb/ac		RDM (lb/ac)		Harvest Efficiency (Percent)		No. Acres		Usable Forage Lost (lb)
1.	S	(600	-	600)	X	50%	X	8	=	Ø
2.	OR	(800	-	800)	X	50%	X	34	=	Ø
3.	RB	(1,000	-	1,000)	X	50%	X	45	=	Ø
4.	SRBN	(1,000	-	1,000)	X	50%	X	32	=	Ø
5.	SRBS	(1,000	-	1,000)	X	50%	X	31	=	Ø
								Total Pounds		Ø

Ø	÷ 2000 =	Ø	(AA)
Total Pounds Usable Forage Lost		Total Tons Usable Forage Lost	

B. First Growing Season

	Site	Forage Production (lb/ac)	1 - % Reduction (Percent)	RDM (lb/ac)	Harvest Efficiency (Percent)	No. Acres	Usable Forage Available (lb)	
1.	S	[(4,400	X 60%)	- 600]	X 50%	X 8	= 8,160	(1)
2.	OR	[(2,100	X 60%)	- 800]	X 50%	X 34	= 7,820	(2)
3.	RB	[(1,400	X 60%)	- 1,000]	X 50%	X 45	= Ø	(3)
4.	SRBN	[(1,200	X 60%)	- 1,000]	X 50%	X 32	= Ø	(4)
5.	SRBS	[(1,800	X 60%)	- 1,000]	X 50%	X 31	= 1,240	(5)

(1)	15,200 Typical Usable Forage Produced Site 1 (lb) (A1)	-	8,160 Usable Forage Avail (lb)	=	7,040 Usable Forage Lost (lb)	
(2)	22,100 Typical Usable Forage Produced Site 2 (lb) (A2)	-	7,820 Usable Forage Avail (lb)	=	14,280 Usable Forage Lost (lb)	
(3)	9,000 Typical Usable Forage Produced Site 3 (lb) (A3)	-	Ø Usable Forage Avail (lb)	=	9,000 Usable Forage Lost (lb)	
(4)	3,200 Typical Usable Forage Produced Site 4 (lb) (A4)	-	Ø Usable Forage Avail (lb)	=	3,200 Usable Forage Lost (lb)	
(5)	12,400 Typical Usable Forage Produced Site 5 (lb) (A5)	-	1,240 Usable Forage Avail (lb)	=	11,160 Usable Forage Lost (lb)	

Total Pounds 44,680
First growing season usable forage lost

44,680	÷ 2000 =	22	(B)
Total Pounds Usable Forage Lost First Growing Season		Total Tons Usable Forage Lost First Growing Season	

C. Second Growing Season

	Site	Forage Production (lb/ac) Table I		1 - % Reduction (Percent)		RDM (lb/ac)		Harvest Efficiency (Percent)		No. Acres		Usable Forage Available (lb)	
1.	S	[(4,400	X	80%	) -	600	] X	50%	X	8	=	11,680	(1)
2.	OR	[(2,100	X	80%	) -	800	] X	50%	X	34	=	14,960	(2)
3.	RB	[(1,400	X	80%	) -	1,000	] X	50%	X	45	=	2,700	(3)
4.	SRBN	[(1,200	X	80%	) -	1,000	] X	50%	X	32	=	Ø	(4)
5.	SRBS	[(1,800	X	80%	) -	1,000	] X	50%	X	31	=	6,820	(5)

(1) 15,200 (Typical Usable Forage Produced Site 1 (lb) (A1)) - 11,680 (Usable Forage Avail (lb)) = 3,520 (Usable Forage Lost (lb))

(2) 22,100 (Typical Usable Forage Produced Site 2 (lb) (A2)) - 14,960 (Usable Forage Avail (lb)) = 7,140 (Usable Forage Lost (lb))

(3) 9,000 (Typical Usable Forage Produced Site 3 (lb) (A3)) - 2,700 (Usable Forage Avail (lb)) = 6,300 (Usable Forage Lost (lb))

(4) 3,200 (Typical Usable Forage Produced Site 4 (lb) (A4)) - Ø (Usable Forage Avail (lb)) = 3,200 (Usable Forage Lost (lb))

(5) 12,400 (Typical Usable Forage Produced Site 5 (lb) (A5)) - 6,820 (Usable Forage Avail (lb)) = 5,580 (Usable Forage Lost (lb))

Total Pounds 25,740 (Second growing season usable forage lost)

25,740 (Total Pounds Usable Forage Lost Second Growing Season) ÷ 2000 = 13 (Total Tons Usable Forage Lost Second Growing Season) (C)

D. Substitution Value

The substitution value is based upon normal season of use, deliver feeding cost.

1. Dry Forage Period Season of Use

Substitution value per ton = _____ (D1)
Purchase, delivery and feeding cost per ton of oat hay

2. Green Forage Period Season of Use

Substitution value per ton = *$125.00* (D2)
Purchase, delivery and feeding cost per ton of alfalfa hay

E. Total Cost

((A) or (AA) *Ø* Beginning Tons Lost X (D) *$125.00* Substitution Value Per Ton) +

((B) *22* Tons Lost First Growing Season X (D) *$125.00* Substitution Value Per Ton) +

((C) *13* Tons Lost Second Growing Season X (D) *$125.00* Substitution Value Per Ton) = (E) *$4,375.00* Total Replacement Value of Usable Forage Lost

WORKSHEET

Replacement Value of Usable Forage Lost

Replacement value of usable forage depends on: site productivity, area impacted, season of use, harvest efficiency and cost of substitute feeds. The formula below is a quick method to appraise the replacement value of usable forage lost.

If no grazing had occurred on this area and it was intended for fall use all of the usable forage has been lost and must be replaced. Use equation (A).

If the area had been grazed, but not to the RDM standard, use (AA) to determine the amount of usable forage lost.

A. Beginning Inventory

	Site	Forage Produced (lb/ac)		RDM (lb/ac)		Harvest Efficiency (Percent)		No. Acres		Usable Forage Lost (lb)
(BOAGG) 1.	*Blue Oak -Annual Grass Granite*	(*2,000*	-	*800*	) X	*50%*	X	*45*	=	*25,200*
(BOAGSG) 2.	*Blue Oak -Annual Grass Shallow Granite*	(*1,300*	-	*1,000*	) X	*50%*	X	*108*	=	*16,200*
3.		(	-		) X		X		=	
4.		(	-		) X		X		=	
5.		(	-		) X		X		=	

Total Pounds _____

_____ ÷ 2000 = _____ (A)

Total Pounds Usable Forage Lost — Total Tons Usable Forage Lost

AA. Partial Use Prior to Disturbance

	Site	Standing Crop lb/ac		RDM (lb/ac)		Harvest Efficiency (Percent)		No. Acres		Usable Forage Lost (lb)
1.	*BOAGG*	(*800*	-	*800*	) X	*50%*	X	*42*	=	*Ø*
2.	*BOAGSG*	(*1,000*	-	*1,000*	) X	*50%*	X	*108*	=	*Ø*
3.		(	-		) X		X		=	
4.		(	-		) X		X		=	
5.		(	-		) X		X		=	

Total Pounds *Ø*

Ø	÷ 2000 =	Ø	(AA)
Total Pounds Usable Forage Lost		Total Tons Usable Forage Lost	

B. First Growing Season

	Site	Forage Production (lb/ac)	1 - % Reduction (Percent)	RDM (lb/ac)	Harvest Efficiency (Percent)	No. Acres	Usable Forage Available (lb)	
1.	BOAGG	[(2,000	X 60%) -	800]	X 50%	X 42	= 8,400	(1)
2.	BOAGSG	[(1,300	X 60%) -	1,000]	X 50%	X 108	= Ø	(2)
3.	_____	[(_____	X _____) -	_____]	X _____	X _____	= _____	(3)
4.	_____	[(_____	X _____) -	_____]	X _____	X _____	= _____	(4)
5.	_____	[(_____	X _____) -	_____]	X _____	X _____	= _____	(5)

(1)	25,200 Typical Usable Forage Produced Site 1 (lb) (A1)	-	8,400 Usable Forage Avail (lb)	=	16,800 Usable Forage Lost (lb)	
(2)	16,200 Typical Usable Forage Produced Site 2 (lb) (A2)	-	Ø Usable Forage Avail (lb)	=	16,200 Usable Forage Lost (lb)	
(3)	_____ Typical Usable Forage Produced Site 3 (lb) (A3)	-	_____ Usable Forage Avail (lb)	=	_____ Usable Forage Lost (lb)	
(4)	_____ Typical Usable Forage Produced Site 4 (lb) (A4)	-	_____ Usable Forage Avail (lb)	=	_____ Usable Forage Lost (lb)	
(5)	_____ Typical Usable Forage Produced Site 5 (lb) (A5)	-	_____ Usable Forage Avail (lb)	=	_____ Usable Forage Lost (lb)	

Total Pounds 33,000
First growing season usable forage lost

33,000	÷ 2000 =	16.5	(B)
Total Pounds Usable Forage Lost First Growing Season		Total Tons Usable Forage Lost First Growing Season	

C. Second Growing Season

	Site	Forage Production (lb/ac) Table I		1 - % Reduction (Percent)		RDM (lb/ac)		Harvest Efficiency (Percent)		No. Acres		Usable Forage Available (lb)	
1.	BOAGG	[(2,000	X	80%	) -	800	] X	50%	X	42	=	16,800	(1)
2.	BOAGSG	[(1,300	X	80%	) -	1,000	] X	50%	X	108	=	2,160	(2)
3.		[(	X		) -		] X		X		=		(3)
4.		[(	X		) -		] X		X		=		(4)
5.		[(	X		) -		] X		X		=		(5)

(1) 25,200 (Typical Usable Forage Produced Site 1 (lb) (A1)) - 16,800 (Usable Forage Avail (lb)) = 8,400 (Usable Forage Lost (lb))

(2) 16,200 (Typical Usable Forage Produced Site 2 (lb) (A2)) - 2,160 (Usable Forage Avail (lb)) = 14,040 (Usable Forage Lost (lb))

(3) _____ (Typical Usable Forage Produced Site 3 (lb) (A3)) - _____ (Usable Forage Avail (lb)) = _____ (Usable Forage Lost (lb))

(4) _____ (Typical Usable Forage Produced Site 4 (lb) (A4)) - _____ (Usable Forage Avail (lb)) = _____ (Usable Forage Lost (lb))

(5) _____ (Typical Usable Forage Produced Site 5 (lb) (A5)) - _____ (Usable Forage Avail (lb)) = _____ (Usable Forage Lost (lb))

Total Pounds 22,440 (Second growing season usable forage lost)

22,440 (Total Pounds Usable Forage Lost Second Growing Season) ÷ 2000 = 11 (Total Tons Usable Forage Lost Second Growing Season) (C)

D. Substitution Value

The substitution value is based upon normal season of use, delivery feeding cost.

1. Dry Forage Period Season of Use

Substitution value per ton = Purchase, delivery and feeding cost per ton of oat hay (D1)

2. Green Forage Period Season of Use

Substitution value per ton = *$125.00* Purchase, delivery and feeding cost per ton of alfalfa hay (D2)

E. Total Cost

((A) or (AA) *Ø* Beginning Tons Lost X (D) *$125.00* Substitution Value Per Ton) +

((B) *16.5* Tons Lost First Growing Season X (D) *$125.00* Substitution Value Per Ton) +

((C) *11* Tons Lost Second Growing Season X (D) *$125.00* Substitution Value Per Ton) = (E) *$3,437.50* Total Replacement Value of Usable Forage Lost

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