# DISSERTATION

# ROOT DYNAMICS OF A SHORTGRASS ECOSYSTEM

Submitted by

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In partial fulfillment of the requirements for the Degree of Doctor of Philosophy Colorado State University Fort Collins, Colorado December, 1971

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WE HEREBY RECOMMEND THAT THE THESIS PREPARED UNDER OUR SUPERVISION BY Dale Lee Bartos ENTITLED "Root Dynamics of a Shortgrass Ecosystem" BE ACCEPTED AS FULFILLING IN PART REQUIREMENTS FOR THE DEGREE OF Doctor of Philosophy.



Head of Department

## ABSTRACT OF DISSERTATION

## ROOT DYNAMICS OF A SHORTGRASS ECOSYSTEM

Seasonal dynamics of roots of a shortgrass system were determined by samples collected at two week intervals for two growing seasons (1969-1970) with a fall and winter sampling period in between. Soil cores were taken to a depth of either 10 cm or 80 cm; the deep cores were used to determine the entire profile distributions of roots. The cores were washed free of soil particles and then the root mass was dried, weighed, ashed and reweighed. All values were expressed on an ash-free basis.

Sixty percent of the root weight was in the 0-10 cm segment and 75% was found in the upper 20 cm of the soil profile. The upper 10 cm increment had significant variations between dates, but the lower levels remained quite constant.

Four grazing treatments (none, light, moderate, heavy) were used to determine if grazing had an effect on the root mass. No significant differences were found among the four treatments.

The usual concept of substrate storage in roots and subsequent utilization was not supported by the data. Losses of root weights did not coincide with periods of leaf initiation. An alternative model was developed which better represented the fluctuations found during the

iii

1969 growing period. This model reflects a hypothesis of root decomposition and growth which is a new approach to understanding root dynamics.

The mathematical model consists of two logistic equations added together. The resultant equation was fitted to the original data via a direct search curve fitting program.

Two curves were separated from the main equation with the declining curve representing decomposition and the rising curve growth. Various constants were added to the equation to limit the indicated amount of decomposition. The various curves presented all have merit, however, more work needs to be done to determine what actually occurs in nature.

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iv

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v

# TABLE OF CONTENTS

																				Page
ABSTE	RACT		•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	٠	iii
ACKN	OWLEI	DGEN	1EP	ITS	5	•	•	•	•	•	•	•	٠	•	•	•	•	•	•	v
LIST C	OF TAI	BLES		•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	viii
LIST C	OF FIG	URES	5	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	x
INTRC	DUCT	ION	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	1
2	Study C	Dbject	tive	s	•	•	•	•	•	•	•	•	•	•	٠	•	•	•	•	2
LITER	RATUR	E RE	VII	ΞW	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	3
	Method	ls of ]	Roc	ot S	ar	npl	ing	ŗ		•	•	•			•				•	3
	Grazin	g Effe	ect	s o	n ]	Rod	ots	•		•		•				•		•		6
	Decom	positi	ion	an	d '	Гет	npe	era	atu	re	•			•	•	•				11
	Ouantif	tative	M	eas		en	nen.	ts	of	Ro	ot	Ma	ass							13
-	Advanc	es in	M	ode	11	ing		•	•	•	•••	•	•	•	•	•		•	•	13
METH	IODS A	ND M	(A]	EF	RI/	L	5	•	•	•	•	•	•	•	•	٠	•	•	•	18
	Descri	ption	of	Stu	ıdv	r Si	te		•										•	18
	Genera	l San	npl	ing	S	che	me	2	•	•						•		•	•	24
	Specifi	c San	npl	ing	Μ	et	ıod	s (	19	69)			•	•	•			•		27
	Specifi	c San	npl	ing	M	[et]	nod	s (	19	70)				•						32
	Data M	lanipu	ilat	tion	ı a	nd	Co	m	pila	atic	on	•	•	•	•	•	•	•	•	39
RESU	LTS .	• •	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	43
	Treatn	n <b>ent</b> I	Effe	ect	s		•			•	•		•						•	43
	Vertic	al Dis	stri	ibut	tio	n c	of F	٥٥	ots			•	•	•				•		50
	Season	al Tr	ene	ds	•	•	•	•	•	•	•	•	•	•	•	•	•	٠	•	57
DISCU	ISSION	• •	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•		68
	Effects	s of H	[er]	biv	or	es	on	Ro	oot	Ma	ass	s •	•	•	•	•	•	•	•	68
	Vertic	al Dis	stri	ibu	tio	nc	of F	کەر	ots		•	•	•	•	•			•	•	69
	Dynam	ic Mo	ode	1 of	fS	ea	sor	al	Va	ria	ati	ons	3.	•	•	•	•	•	•	71

# TABLE OF CONTENTS (Cont.)

				Page
SUMMARY AND CONCLUSIONS • • • • • • • •	•	•	•	87
LITERATURE CITED	•	•	•	89
APPENDICES · · · · · · · · · · · · · · · · · · ·	•	•	•	97
Appendix 1. Soils map of sections 15 and 23				
Pawnee Site $\cdot \cdot \cdot \cdot \cdot \cdot \cdot \cdot$	•	•	•	98
Appendix 2. Listing of program $R \phi \phi TAS \cdot \cdot \cdot$	•	•	•	100
Appendix 3. Samples of various tables of individual root mass weights • • •	•	•	•	114
Appendix 4. Graphs of exponential fits to 1969 root data •••••••••••	•	•	•	120
Appendix 5. Complete set of ANOV tables run on various depth increments • • •	•	•	•	125

# LIST OF TABLES

Table		Page
1	Literature concerning effects of herbage removal upon root weights	8
2	Literature concerning quantitative measure- ments of roots in various grasslands	14
3	Location of grazing treatments used in the primary producer studies on the Pawnee Site during 1969 and 1970	19
4	Average time cost in man minutes for field and laboratory steps necessary to obtain one core sample. (Based upon times taken during the 9 September 1969 sampling period.)	31
5	Grazing treatment means and standard errors for root mass for 21 sampling dates	44
6	Maximum and minimum amount of root mass present during the 1969 growing season for four grazing treatments	48
7	Analysis of variance table containing six main effects and all possible combinations which were run on individual samples for the 1969 summer sampling period	51
8	Analysis of variance table containing six main effects and all possible combinations which were run on individual samples for the 1969 fall-winter sampling period	52
9	ANOV table for parameters (A + B) obtained from a negative exponential fit	54

# LIST OF TABLES (Cont.)

Table		Page
10	ANOV of depth distribution parameter (c) obtained from a negative exponential fit run on 8 dates (1969) with crowns present	56
11	ANOV of depth distribution parameter (c) obtained from a negative exponential fit run on 8 dates (1969) without crowns	56
12	ANOV of depth distribution parameter (c) obtained from a negative exponential fit run on 12 dates (1969 and 1970) with crowns present	56
13	Summary of ANOV's run on various depth increments using watershed means. Com- plete ANOV tables are in Appendix 5	57
14	Original data and values calculated by the Rosenbrock direct search optimization technique	78
15	Various parameters calculated by the Rosenbrock direct search optimization technique for various portions remaining of the decomposition curve	79

# LIST OF FIGURES

Figure			Page
1	Monthly precipitation, Central Plains Experi- mental Range (CPER), 1969	•	20
2	Monthly precipitation, Pawnee Site, 1970 (Striffler 1971)	•	21
3	Maximum and minimum air temperatures for 1969, recorded at Central Plains Experi- mental Range (CPER) weather station	•	22
4	Maximum and minimum air temperatures for 1970, recorded at Central Plains Experi- mental Range (CPER) weather station		23
5	An example of a macroplot location with respect to a microwatershed. Generally, there is 10-20 feet separating the two		25
6	Flow diagram of field and laboratory sampling procedures for 1969	•	26
7	Example of data sheet used during the 1969 sampling period for recording root biomass values	•	30
8	Root core sampler used for rapid collection of samples during the 1970 growing season	•	34
9	Flow diagram of field and laboratory sampling procedures for 1970	•	36
10	Adapted handy-man jack used in removing an 80 cm core from the ground • • • • • • • • • • • • • • • • • • •	•	38
11	Three data sheets used for recording various values during the 1970 growing season	•	40

# LIST OF FIGURES (Cont.)

Figure			]	Page
12	Root weight decreases with depth as repre- sented by these three curves plotted from fitted negative exponential equations	•	•	55
13	Root weights (0-10 cm) for no grazing treat- ment plotted for 21 sampling periods crowns present	•	•	59
14	Root weights (0-10 cm) for light grazing treatment plotted for 21 sampling periods crowns present	•	•	60
15	Root weights (0-10 cm) for moderate grazing treatment plotted for 21 sampling periods crowns present	•	•	61
16	Root weights (0-10 cm) for heavy grazing treat- ment plotted for 21 sampling periodscrowns present	•	•	62
17	Root weights (0-10 cm) for no grazing treat- ment plotted for 21 sampling periodscrowns absent	•	•	63
18	Root weights (0-10 cm) for light grazing treat- ment plotted for 21 sampling periodscrowns absent	•	•	64
19	Root weights (0-10 cm) for moderate grazing treatment plotted for 21 sampling periods crowns absent			65
20	Root weights (0-10 cm) for heavy grazing treat- ment plotted for 21 sampling periodscrowns absent	•	•	66
21	Raw data for summer 1969 representing root fluctuations	•	•	67
22	Decreasing logistic growth curve $Y_t = (a_2/b_2)/(1 + e^{a_2(x-x_2)})$ with $a_2 = 16.5$ , $b_2 = 2.6$ , $Y_0 = 631$ , and $x_2 = 2.03$	•		75

# e

## LIST OF FIGURES (Cont.)

#### Page Figure Increasing logistic growth curve $Y_t = (a_1/b_1)/(1 + e^{-a_1(x-x_1)})$ with $a_1 = 11.5$ , $b_1 = 1.8$ , 23 76 24 Plots of the original data points of root mass, the sum of two logistic curves, and the separated curves . 80 . . 25 Plots of the original data points of root mass, the sum of two logistic curves, and the separated curves with decomposition becoming asymptotic at 60% of the total . . . . . . . . . 81 26 Plots of the original data points of root mass, the sum of two logistic curves, and the separated curves with decomposition becoming asymptotic at 33% of the total . . . . 82 27 Plots of the original data points of root mass, the sum of two logistic curves, and the separated curves with decomposition becoming asymptotic at 50% of the total • • • • • • • • 83

### INTRODUCTION

Virtually all of the 280 million acres of shortgrass prairie in the United States is used as rangeland (Stoddart and Smith 1955). Therefore, understanding the function of a shortgrass ecosystem is not only of scientific interest but is most important from a management viewpoint.

Primary producers are an important compartment of an ecosystem. The role of the primary producer is to fix energy via photosynthesis, which can be self utilized or passed on through different trophic levels.

A majority of the primary producer component in a shortgrass ecosystem occurs underground. Root systems act as the conductive mechanism between the aerial portions of the primary producer and the soil medium; energy and nutrient storage organs; food source for small herbivores; and are essential in the cycling of nutrients within the ecosystem.

A system is a group of objects united by some type of interactions. During the past several years ecologists have become more concerned with studying entire ecological systems or ecosystems. Odum (1965) defines an ecosystem as "any area of nature that includes living organisms and nonliving substances interacting to produce an exchange of materials between the living and nonliving parts." Of course, no system will be studied in all its detail, but with the use of more quantitative approaches and computer facilities more breath and depth can be added than ever before.

# Study Objectives

The basic purpose of this project was to study the seasonal and annual dynamics of the root mass of a shortgrass ecosystem. This particular study was one facet of an overall ecosystem effort; the specific objectives of this study are:

- 1. measure and interpret fluctuations in the root mass during the 1969 and 1970 growing season.
- 2. test the influence of grazing by large herbivores on underground organs.

### LITERATURE REVIEW

In order to understand the entire ecosystem it is essential to have a thorough understanding of the primary producers. The producers are not only important aboveground but also belowground. It has been reported for various grassland ecosystems that from 80% to 95% of the vegetation occurs underground (Nilsson 1970; Hanson and Stoddart 1940; and Ovington, Heitcamp and Lawrence 1963). Because of the proportion and role of roots in a grassland ecosystem it seems necessary to study them in more detail.

### Methods of root sampling

Pavlychenko (1937a) gives a detailed discussion of root studies during the past two centuries. Many of the early studies were conducted because of agronomic interests (Weaver 1920 and 1926; Weaver and Crist 1922). Studies of root systems, during the first portion of the twentieth century, were non-quantitative and are typified by Markle (1917) and Preston (1900). These two studies dealt with root penetration and distribution of cacti and shrubs.

Weaver (1920 and 1926), Weaver et al. (1922) and Weaver and Crist (1922) reported the use of the laborious and tedious trench and pick method of determining root distribution. This involved digging a trench approximately 1.8 meters deep and then using an ice-pick to rid the profile of soil particles.

The next major advance in root sampling was reported by Pavlychenko (1937b). His soil-block washing method has been modified to various degrees and is being used at the present time. In his introduction, Pavlychenko gives a thorough account of previously used methods for root studies.

Prior to 1945 the two major soil sampling methods were Weaver's trench and pick method and Pavlychenko's soil-block washing method. A modification of the soil-block washing method was developed in 1947 employing a soil sampling machine mounted on the back of a truck. This apparatus enabled the sampler to collect 2" -4" diameter samples to a depth of 6' (Kelley, Hardman and Jennings 1947). These samples were virtually undisturbed and could be sectioned as desired. Roots could be separated from the soil either by dry sieving or a washing process.

A major portion of the root samples collected since 1947 have been taken with various types of hydraulic corers. Uniform samples are obtained rapidly compared to the soil-block or trenching method. Moir and Bachelard (1969) compared coring to excavation and found coring to be more efficient and less tedious.

Boehle, et al. (1963), Kotanska (1967), Feherenbacher and Alexander (1955) and Dahlman and Kucera (1965) are among those

4

who used soil cores and a washing process to obtain root mass measurements.

One of the easiest and quickest ways of separating the roots from the soil is using water and different size screens for root collection. Comparison of hand washing of samples and a machine developed by Fribourg (1953) showed the machine to be 10 times faster.

McKell, Wilson and Jones (1961) described a floatation method for separation of roots and soil. This method as outlined is widely used today and has been modified (Lauenroth and Whitman 1971).

Milner and Hughes (1968) give a fairly complete summary of root sampling techniques available through 1968 which pertain to production of grasslands.

A recent innovation developed by Blevins, et al. (1968) is the use of liquid nitrogen which freezes the soil, thus a large, undisturbed soil sample can be obtained. This is a modification of the soil-block technique. It is, of course, much quicker than conventional methods of sampling.

Another way of determining root penetration and distribution is by the use of a box with one glass side (Lavin 1961; Muzik and Whitworth 1962; and Crider 1955). These are mainly used for crops or transplanted plants and would be difficult to use under natural conditions. The glass side is placed on the bottom and the box is tilted at

5

a  $30^{\circ}-40^{\circ}$  angle. Geotropism causes the roots to grow against the glass where they can be easily studied.

One of the newest ways of determining root biomass and turnover rates is by the use of radioactive materials. Dahlman and Kucera (1968) allowed growing grass to assimilate  ${}^{14}CO_2$  and then measured the translocated radioactive carbon in various parts of the plant.

In certain agricultural studies radioactive phosphate (<sup>32</sup>P) has been used. The <sup>32</sup>P was placed at various depths in the soil and the aerial portions were monitored to determine when the roots actually reached these particular levels (Hall et al. 1953). When radiophosphorus techniques were compared to the soil-block technique it was found they both gave comparable results, however, the <sup>32</sup>P was far less laborious (Pettit and Jaynes 1971).

Neilson (1964) used <sup>14</sup>C and other radioactive materials for determining root activity. Dodd and Van Amburg (1970) tested <u>Andropogon scoparius</u> clones, via <sup>134</sup>Cs, to determine tiller activity. It was found that groups of tillers acted as individual plants and most of the <sup>134</sup>Cs was concentrated in the upper 5 cm of roots.

# Grazing effects on roots

Many studies have been conducted to determine grazing effects on roots. Some have used clipped vegetation to simulate grazing by herbivores. Troughton (1957) and Jameson (1963) have both reviewed the literature concerning effects of herbage removal on root growth and root weights. A summary of the more pertinent studies is presented in Table 1.

Most studies of grazing effects on roots showed that grazing (or hand clipping) reduces the amounts of roots. However, in a study of a grass-sagebrush community in eastern Idaho, Pearson (1965) found that grazed areas had more roots than ungrazed areas. He attributed this to (1) differences in species composition of the two areas or (2) root growth stimulated by grazing.

Newly seeded blue grama (<u>Bouteloua gracilis</u>) was utilized to see what effects clipping had on carbohydrate contents of the roots (Dodd and Hopkins 1958). Under controlled conditions increases in underground parts varied inversely with rates of growth; generally, however, this trend did not hold for those plants clipped. In the month after clipping there was a decrease in carbohydrates which was usually restored during the second month after clipping.

Crider (1955), removing varing percents of aerial growth, demonstrated that continuous clipping (grazing) had an adverse effect on root growth. If 70% or more of the foliage was removed, root growth was completely curtailed. One of the species Crider worked with was blue grama, where he found that root growth stopped for 17 and 13 days when the aerial portion was cut to a 2" height. This stoppage occurred the first and second day after clipping. Blue grama root production was reduced 85% by clipping.

7

	Location & Major			
Citation	Vegetation Represented	Treatment	Root Mass	Comments
Pearson (1965)	Rexburg, Idaho			
	Stipa comata	Grazed (70 yrs.)	$\frac{2}{1031 \text{ g/m}}$ / 40 cm	80% (0-20 cm)
	Artemisia tridentata	Ungrazed (11 yrs.)	704 g/m <sup>2</sup> /40 cm	18% (20-40 cm)
			(Ovendry wts.)	
Schuster (1964)	Colorado Springs,			
	Colorado	Heavy grazed	•	71% (0-31 cm)
		(17 yrs.)	395 g/m <sup>2</sup> /61 cm	18% (31-61 cm)
	Bouteloua gracilis	Moderately grazed	2	79% (0-31 cm)
	Muhlenbergia montana	(17 yrs.)	482 g/m <sup>2</sup> /61 cm	14% (31-61 cm)
	Festuca arizonica	Ungrazed (20 yrs.)	$\frac{2}{570 \text{ g/m}^2/61 \text{ cm}}$	82% (0-31 cm)
	Artemisia frigida		(Air-dry wts.)	12% (31-61 cm)
Lorenz & Rogler	Mandan, North Dakota	· · · · · · · · · · · · · · · · · · ·		
(1967)		Heavy grazed		78% (0-31 cm)
	Agropyron smithii	(45 yrs.)	$36407 \text{ g/m}^2/61 \text{ cm}$	14% (31-61 cm)
	Stipa comata			
	Boutelous gracilis	Moderate grazed	2	74% (0-31 cm)
	Artemisia frigida	(45 yrs.)	35702 g/m <sup>2</sup> /61 cm	15% (31-61 cm)
			(ovendry wts.)	No significant difference
				between the two treatments.

Table 1. Literature concerning effects of herbage removal upon root weights.

Table 1. (continued)

Citation	Location & Major Vegetation Represented	Treatment	Root Mass	Comments
Biswell & Weaver (1933)	Lincoln, Nebraska Bouteloua gracilis	Hand clipped Not clipped	$4 \text{ g/m}^2/61 \text{ cm}$ 105 g/m <sup>2</sup> /61 cm	These values were obtained from transplanted plants. Roots of the clipped grass grew very poorly. Length of roots were greatly reduced by clipping.
Cook, Stoddart, & Kinsinger (1958)	Logan, Utah Agropyron desentorum	Clipped to 1" ht. Clipped to 3" hr.	1159 g/m <sup>2</sup> /46 cm 1328 g/m <sup>2</sup> /46 cm	When more is left above- ground there is more below- ground. Clipping reduced roots most in the upper 15 cm.
Jameson & Huss (1959)	South Central Texas Andropogon scoparius	Check Leaves removed Stems removed Leaves & Stems removed	. 63 g/pot . 47 g/pot . 41 g/pot . 34 g/pot (ovendry wts.)	Individual plants were used. "Apparently the major influ- ence of clippings on the roots was to stop further root growth rather than to utilize the carbohydrates already in the roots. "
Blydenstein (1966)	Tucson, Arizona <u>Bouteloua curtipendula</u> <u>Bouteloua filiformis</u>	Grazed Ungrazed Grazed Ungrazed	2 11.7 # roots in 2 15.5 # roots in 11.2 # roots in 29.0 # roots in	"Root system represents almost 1/2 of the total material produced by that plant."

Table 1. (continued)

Citation	Location & Major Vegetation Represented	Treatment	Root Mass	Comments
Hanson & Stoddart	Southern Cache Valley,	nana Anon, 2017, 2017, 2017, 2017, 2017, 2017, 2017, 2017, 2017, 2017, 2017, 2017, 2017, 2017, 2017, 2017, 2017		
(1940)		Grazed	$422 \text{ g/m}^2 / 10 \text{ cm}$	
	Agropyron inerme	Ungrazed	$2585 \text{ g/m}^2 / 10 \text{ cm}$	Average root/shoot = 13:1

### Decomposition and temperature

One of the factors associated with root mass fluctuations is that of decomposition. However, a search of the literature reveals that little work has been done concerning root decomposition under natural conditions.

Rodin and Bazilevich (1967) discuss the root-decay process. These workers indicate that during dry years the decomposition process is much slower and that this is why there is more root mass during dry years as opposed to wet years.

An in depth study of root decomposition in undisturbed prairie soils was conducted by Weaver (1947). He was concerned with three species, <u>Andropogon gerardi</u>, <u>Andropogon scoparius</u> and blue grama. Blue grama lost 67% of its weight in two years and Weaver felt that little decomposition occurs the first year. He also indicated that of the three species blue grama was the most resistant to decay.

In an early study, Weaver and Zink (1946b) used a banding technique to determine how long roots lived. After three growing seasons only 45% of the blue grama roots were alive. It must be kept in mind that this study was done under very disturbed conditions where sods were moved to the laboratory for observation. An earlier banding study indicated grass roots live at least a year and many in excess of two years (Stoddart 1935).

11

Pilat (1969) found that decreases in roots coincided with periods of increased soil moisture; he therefore concluded that rates of decomposition were related to soil moisture.

Turnover values were calculated for the root mass in a tall grass prairie (Dahlman and Kucera 1965), by using the following formula:

$$T = \frac{M - N}{M}$$

where;

T = turnover value

M = maximum amount of root mass

N = minimum amount of root mass

They calculated that approximately one-fourth of the mass was replaced each year, and concluded that a complete turnover of roots occurred every four years.

Probably the major factor effecting root growth is that of temperature (Tajima 1965; Bommer 1960; Garwood 1965; Takeda and Agata 1966; and Beard 1959).

Stuckey (1941) attributed the stoppage of root growth during the summer months to high soil temperatures. He found that root tip cells of Kentucky bluegrass (<u>Poa pratensis</u>) were actively dividing at  $0^{\circ}$ C which should indicate root growth.

In a Japanese study on Ladino clover (Kumai, Hirose, and Sanada 1965) it was postulated that when top growth was at a maximum root initiation was very slow and decay of old roots occurred. They associated root weight decreases from April to August with flowering and rapid aerial growth.

### Quantitative measurements of root mass

Within the past 20 years considerable work has been done concerning roots and root fluctuations of natural vegetation. This, of course, is quite essential in understanding the function of the entire ecosystem. Some of the major studies pertinent to grassland ecosystems are referenced in Table 2 and quantitative values are given for comparison.

Although quantitative root studies in the grassland ecosystem are somewhat scarce, there is valuable information to be gathered from the literature. Studies by Weaver (1958, 1961) have provided pertinent information on the root systems of shortgrass prairies. Dahlman and Kucera (1965) have provided useful information on root systems of a tallgrass prairie.

#### Advances in modelling

Modelling has been proposed as a method of organizing the study of the entire ecosystem and parts thereof (Van Dyne 1969). He suggests an abstraction of the real world situation into mathematical

Citation	Location & Major Vegetation Represented	Amounts Present	Comments
	Lincoln, Nebraska to Colorado Springs, Colo.		Blue grama and buffalo grass have a shallow root system to benefit from light rain showers.
	Bouteloua gracilis Buchloe dactyloides	Avg. 448 g/m <sup>2</sup> /10 cm	79% (0-15 cm) 10% (15-31 cm)
Weaver & Zink (1946a)	Eastern Nebraska Native prairie Bouteloua gracilis	562 g/m <sup>2</sup> /61 cm	Root/shoot ratios: 1943 = .29 1944 = .25 1945 = .21 94% (0-31 cm)
Dittmer (1937)	Iowa City, Iowa <u>Secale cereale</u> (winter rye)	Total surface area 639 m <sup>2</sup>	Surface area of underground to tops was 130 times greater.
Bray (1963)	Summary of 28 tem- perate anglosperms. Mean yearly, net herbaceous production of belowground parts	354 g/m /?	Belowground/aboveground ratio increased from moist to mesic to xeric species.
Ovington, Heitcamp, and Lawrence (1963)	Minneapolis and St. Paul, Minnesota Tallgrass prairie	2 482 g/m / 50 cm (ovendry wt.)	91% of total biomass was found undergrounds.
	<u>Stipa spartea</u> Poa pratensis Andropogon gerardi	·····,	

Table 2. Literature concerning quantitative measurements of roots in various grasslands.

Table 2.	(continued)	

	Location & Major				
Citation	Vegetation Represented	Amounts Present	Comments		
Dahlman & Kucera	Columbia, Missouri	Spring = 1449 $g/m^2/86$ cm	80% (0-25 cm)		
(1965)		$Summer = 1860 \text{ g/m}^2/86 \text{ cm}$			
	Tallgrass Prairie	$Fall = 1901 \text{ g/m}^2/86 \text{ cm}$	Root turnover every 4 years.		
		Winter = $1755 \text{ g/m}^2/86 \text{ cm}$			
Nilsson (1970)	Smaland, South Sweden	$Peak = 1700 \text{ g/m}^2 / 10 \text{ cm}$	77-82% (0-10 cm)		
	Hay Meadow	$I_{cm} = 900 = (m^2/10 \text{ cm})$	97% (0-72 cm)		
		2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	94% of the organic matter in the hay meadow		
		$Peak = 1950 \text{ g/m}^{-10} \text{ cm}$	consisted of humus.		
	Wet Site	Low = $940 \text{ g/m}^2 / 10 \text{ cm}$	A thorough study of a natural system.		
Andersson (1970)	Lund, Sweden	$Aerial = 470 g/m_{a}^{2}$			
		$Roots = 1300 \text{ g/m}^2/50 \text{ cm}$			
		Litter = $240 \text{ g/m}^2$	Ratio of aboveground to belowground		
		Hum us = $30405 \text{ g/m}^2 / 50 \text{ cm}$	organic matter = 1/49.		
		$Total = 32405 \text{ g/m}^2$			
		Dry weight			
Weaver (1961)	Lincoln, Nebraska				
	Stipa spartea	605 g/m <sup>2</sup> /31 cm			
	Andropogon scoparius	986 g/m <sup>2</sup> /31 cm			
Kucera, Dahlman &	Columbia, Missouri	The root system contributed	1962 roots had ca. 2. 18 X 10 <sup>6</sup> cal/m <sup>2</sup>		
Koelling (1967)		ca. 469 g/m <sup>2</sup> of the total net	energy.		
	Tallgrass prairie	productivity during 1962.	Turnover of roots every 4 years.		

Citation	Location & Major Vegetation Represented	Amounts Present	Comments	
Pilat (1969)	Czechoslovakia		This biomass variation was attributed to root growth and decomposition rate of dead roots which was regulated by changing environ- mental conditions.	
	Arrhenatheretum	643-1050 g/m <sup>2</sup> /32 cm		
	Mesobrometum	$1582-2592 \text{ g/m}^2/32 \text{ cm}$		
Hopkins (1953)	Hays, Kansas	Seeded 9 yrs. before sampling 1365 g/m <sup>2</sup> /15 cm	Blue grama consistently produced a heavier root system than buffalo grass.	
		Seeded 8 yrs. before sampling 1094 g/m <sup>2</sup> /15 cm		
	Bouteloua gracilis	Seeded 3 yrs. before sampling 1025 g/m <sup>2</sup> /15 cm		
Burton, DeVane and Carter (1954)	Tifton, Georgia			
	Carpet grass	93.6% in upper 61 cm	The more shallow the root system, the more susceptible to drought.	
	Coastal Bermuda	65.1% in upper 61 cm		
	Suwannee Bermuda	68.8% in upper 61 cm		

notation which will in turn be interpreted to applicable conclusions for the real world.

Models are a means of studying complex phenomena (Forrester 1964). It is quite conceivable to have word, picture or box and arrow type of models, any of which could be developed further into mathematical expressions. Most mathematical models of dynamic systems are either of the difference or differential equation type.

Van Dyne (1969) and Watt (1968) suggest the use of models as a tool to better understand the entire ecosystem. Indeed, if such a large undertaking is accomplished it will have to be done with the use of some simplifying abstraction.

The use of models in predicting root mass changes or in fitting root data is quite limited. Bledsoe and Jameson (1969) discuss plant growth in a mathematical equation and root material was one particular variable considered. Both a constant and a varying coefficient model were used by Kelley, et al. (1969) to represent actual collected root biomass data. It was found that the best fit was obtained by the varying coefficient model.

### METHODS AND MATERIALS

### Description of study site

The study area is located on the Pawnee Site, US-IBP Grassland Biome.<sup>1</sup> Study plots are located in Weld County, Colorado, 40 miles N.E. of Fort Collins in Section 15 and 23, Township 10N, Range 66W.

The Pawnee Site was established in 1968 to serve as the Intensive Site for the US-IBP Grassland Biome. Sections 15 and 23 were designated for study purposes of all major trophic levels in a shortgrass ecosystem. A further description and past history of the Pawnee Site and adjacent areas is given by Jameson and Bement (1969). A complete soils map of sections 15 and 23 is presented in Appendix 1.

Four different grazing intensities were used in this study. These treatments were initiated in 1939 and have been maintained to the present time (Jameson and Bement 1969). The four different treatments and their location are given in Table 3.

Hydrologic studies required establishment of 0.5 ha microwatersheds to be established. Eight microwatersheds were

<sup>&</sup>lt;sup>1</sup>The Pawnee Site is located on the Central Plains Experimental Range (Agricultural Research Service, USDA) and adjacent areas of the Pawnee National Grassland (Forest Service, USDA).

constructed to represent two replications of each treatment as outlined above (Smith and Striffler 1969). All eight microwatersheds were located on sandy-loam soils of the Ascalon Series.<sup>2</sup>

Treatment Number	Replicate	Type of grazing	Macroplot Number	Location
1	1	Ungrazed	2	23E <sup>*</sup> .
1	2	้า	8	15 W <sup>*</sup>
2	1	Light	4	23W
2	2	т 11	5	23 W
3	1	Moderate	6	15E
3	2	11	7	15E
4	1	Heavy	1	23E
4	2	11	3	23E

Table 3. Location of grazing treatments used in the primary producer studies on the Pawnee Site during 1969 and 1970.

\* Exclosure

Complete growing season precipitation values for the study area are given by Smith (1971). Average precipitation and temperature values for 1969 and 1970 are presented in Figs. 1, 2, 3, and 4.

The Ascalon soil series has a uniform vegetation cover. Major species are blue grama, <u>Bouteloua gracilis</u>; red threeawn, <u>Aristida</u> <u>longiseta</u>; buffalograss, <u>Buchloe dactyloides</u>; western wheatgrass, <u>Agropyron smithii</u>; sun sedge, <u>Carex heliophila</u>; fringed sagewort, <u>Artemisia frigida</u>; scarlet guara, <u>Gaura coccinea</u>; broom snakeweed,

<sup>&</sup>lt;sup>2</sup>Soil profiles were examined by James Crabb, Soil Conservation Service, USDA.



CPER 30 year mean

CPER 1969

Figure 1. Monthly precipitation, Central Plains Experimental Range (CPER), 1969.



CPER 30 year mean

Pawnee Site 1970

-

Figure 2. Monthly precipitation, Pawnee Site, 1970 (Striffler 1971).





Figure 3. Maximum and minimum air temperatures for 1969, recorded at Central Plains Experimental Range (CPER) weather station.



——— Minimum Air Temperature - CPER (degrees F)



Figure 4. Maximum and minimum air temperatures for 1970, recorded at Central Plains Experimental Range (CPER) weather station.

<u>Gutierrezia sarothrae</u>; evening-primrose, <u>Oenothera coronopifolia</u>; plains pricklypear, <u>Opuntia polyacantha</u>; scarlet globemallow, <u>Sphaeralcea coccinea</u>; and slimflower scurfpea, <u>Psoralea tenuiflora</u>. Sample herbarium specimens are filed at the Pawnee Site Headquarters, Nunn, Colorado, and voucher specimens are at the CSU Herbarium in Fort Collins, Colorado. A complete plant list is given by Jameson and Bement (1969).

Macroplots were established adjacent to each of the microwatersheds (example, Fig. 5). These plots were selected to be representative of vegetation found within the microwatersheds. All primary production work was initiated within or adjacent to these macroplots. The terms macroplots and watersheds will be considered to be synonymous.

#### General sampling scheme

In order to accomplish the objectives of this study it was necessary to have a general sampling procedure (Fig. 6). Essentially the 1969 sampling period was considered as a pilot study to get an efficient sampling scheme worked out for the 1970 and later seasons.

To better understand the workings of the primary producer section of the shortgrass ecosystem it was necessary to obtain good estimates of the root mass. From this data production figures could


Figure 5. An example of a macroplot location with respect to a microwatershed. Generally, there is 10-20 feet separating the two.



Figure 6. Flow diagram of field and laboratory sampling procedures for 1969.

be obtained and, therefore, a most important compartment of the primary producer would be better understood.

Root measurements were conducted in conjunction with the aboveground vegetative sampling (Uresk 1971) and plots clipped for aerial samples were also sampled for roots. Besides root data, other variables were sampled, i.e. crown mass, total organic matter and roots for chemical analysis; thus, the primary producer was thoroughly sampled.

## Specific sampling methods (1969)

In order to determine root mass, soil cores were obtained using a hydraulic corer which was mounted on the back of a pickup truck. Because the motor heat from the truck scorched and the tires broke the vegetation the sampling was limited to the peripheral areas of the macroplot (see Fig. 5 dotted areas).

Soil cores were taken in  $0.25 \text{ m}^2$  plots that had been clipped for aboveground standing crop measurements (Uresk 1971). Four clipped plots were utilized for root samples during the eight sampling periods for summer 1969 (May 24 - September 10).

The ranked-set method was utilized in determining the plots to be sampled for root mass (Halls and Dell 1966). The two plots at either end of the macroplot were ranked as to high and low amounts of aboveground vegetation. If the high production plot was selected at one end, the low production plot was used on the opposite end. Thus, only two of the four plots were used to determine root mass. All four plots were used to determine crown mass and organic matter.

In determination of root mass a 7.62 cm diameter core was used to a 40 cm depth and a 2.54 cm diameter core was used to continue to a depth of 80 cm. It was assumed that at least 95% of the roots would be sampled by going to a depth of 80 cm (Weaver 1958; Shantz 1911).

The total 80 cm core was divided into 5 sections of 10 and 20 cm length as outlined in Fig. 6. The core sections were placed in paper sacks and properly marked with the necessary identifying information.

The samples were transported to the headquarters building where the cores were washed to extract the roots. Generally, root washing was done the same day as the cores were collected to prevent drying of cores prior to washing.

The cores were soaked in pails between 15-30 minutes and then the mixture was poured through a 32 mesh screen. It was assumed that less than 1% of the root mass was being lost. Gist and Smith (1948) stated that some roots were lost through a 20 mesh screen and they assumed that a similar proportion was lost from all samples. In 1946a (Weaver and Zink) reported a small fraction of 1% lost via washing of intact root systems.

All attempts were made to get the roots as clean as possible, however, even after a clean water "rinse" they were still not

absolutely clean. To reduce the errors from adhering soil particles the root mass was converted to an ash-free basis. Therefore, after being oven-dried for 48 hrs at  $105^{\circ}$ C they were weighed, ashed at  $610^{\circ}$ C for 8 hrs and then reweighed. The underground material was expressed on an ash-free basis and the values were converted to grams per square meter. A sample of the data sheets used is presented in Fig. 7.

Four organic matter samples per macroplot were taken using a 2.54-80 cm core. This core was subdivided into sections in the same manner as the root sample cores (Fig. 6). A 1 cm horizontal section of soil was taken from the center of each subdivision, oven-dried at  $105^{\circ}$ C for 48 hrs, and weighed, ashed at  $610^{\circ}$ C for 8 hrs, and reweighed. This organic matter was expressed on a grams per meter square basis. The remainder of the cores were combined by depth for each macroplot, washed and dried at  $105^{\circ}$ C for 48 hrs and saved for future chemical analysis.

The samples for chemical analysis were stored until June 1971. At this time the 0-10 cm increments were combined by treatment and the lower depths were all combined by sampling dates. The combined material was ground in a Wiley Mill through a 20 mesh screen.

Samples of crown material, i.e., the vegetation above the roots which was not removed by clipping, was obtained by coring. The crown material, approximately 1 cm thick, was oven-dried at 105<sup>°</sup>C

Depth (cm)	Weights I	CRU #∕	Weights 2	CRU #	Weights 1	CRU #	Weights 2	CRU #
0 - 10								
				╞╌┠		_		<u>  </u>
10 - 20		++		┼╌┼				
		╉╍╋		╂╌╂	and the second			+
20-40		╉╌╋		┼─┼	ange wetten an eine belänget die gem			+
		╉╋		╂╌╋			<u></u>	
40 - 60								
						+++		
	<b></b>				848-4-9-5 talena and a second second			
60 - 80		++		┟┈┤		┽╋		
		╉		╉╌╂				

Figure 7. Example of data sheet used during the 1969 sampling period for recording root biomass values.

ROW \_\_\_\_\_

ROW \_\_\_\_\_

WATERSHED \_\_\_\_\_

DATE \_\_\_\_\_

ROOT PRODUCTION

for 48 hrs and ashed at 610°C. A portion of the crown mass measurements were obtained from the cores used for root samples.

During the last sampling period detailed time measurements of the various sampling steps in Fig. 6 were recorded (Table 4). Values are given by depth for the various steps involved. Different time values for weighing and ashing the various depths are due to the varying volume and fineness of roots.

Table 4. Average time cost in man minutes for field and laboratory steps necessary to obtain one core sample. (Based upon times taken during the 9 September 1969 sampling period.)

Travel Between Plots 2.7 min	ł	FIE Anchorin 5.5	LD ng Truck min		C 3.	oring 0 min
<u> </u>		LABOR	ATORY			
Root level (cm)	0-10	10-20	20-40	40-60	60-80	Total
Washing (min)	18.5	20.3	22.7	14.2	11.5	87.2
Weighing and Handling (min)	2.9	2.4	2.4	1.7	1.7	11.1

Root estimates were also obtained in November and December 1969. Samples were taken using a small core within the large one just as was done in the summer 1969. Number of samples were increased and taken within the macroplot as opposed to the peripheral area. Four clipped plots were utilized and three cores within each of the clipped plots were obtained. This was three times the number of cores procured during the summer sampling period. Crown material, organic matter, and chemical samples were not collected during this sampling period.

## Specific sampling methods (1970)

Belowground material was sampled eleven times during the 1970 growing season at approximately two week intervals. Modifications of the 1969 sampling was implemented to facilitate rapid and efficient collection of roots.

Observation of 1969 data indicated that approximately 60% of the root mass occurred in the upper 10 cm and that variability of the lower depths was slight compared to the 0-10 cm increment. Therefore, it was decided to sample the 0-10 cm depth with greater accuracy (more samples per plot) and more often during the growing season. The lower depths were sampled only twice during the growing season.

A rapid, T shaped sampler was designed that would take 10 cm cores with a diameter of 7.5 cm (Fig. 8). With the use of this corer, a sample could be obtained in approximately 30 seconds.

Root samples were collected on eight 0.25 m<sup>2</sup> plots, which were located randomly within the macroplot and had been clipped to determine the amount of herbage (Uresk 1971), thus the actual aboveground standing crop was known for the sampled area.

During two sampling periods (July 2 and August 18) deep cores were taken to a depth of 80 cm. These were collected to obtain a



Figure 8. Root core sampler used for rapid collection of samples during the 1970 growing season.



more accurate estimate of the distribution of the root mass. To collect the deep cores a pneumatic hammer<sup>3</sup> was adapted to fit a 5 cm diameter corer which was a meter in length. These cores were divided into 5 sections as outlined in Fig. 9.

The motor driven pneumatic hammer was used to collect cores within the macroplot with minimal destruction to the vegetation. A handy-man jack was modified to aid in extracting the cores from the ground (Fig. 10).

All core samples for 1970 were handled the same irrespective of how they were collected. The samples were placed in paper sacks and given an identification number. The collected cores were then taken to the IBP Grassland Biome Field Laboratory where the roots were separated from the soil.

The 1969 washing process was employed in 1970. No dispersing agents were used and the cores were washed the same day as collected or shortly thereafter. The root mass was collected on a 32 mesh (500 micron) screen and ovendried at 105°C for 48 hours. This material was weighed, ashed at 610°C and reweighed. Root mass was expressed on an ash-free basis to correct for any adhering soil particles and the data were converted to grams per square meter.

<sup>&</sup>lt;sup>3</sup>A Cobra model which is manufactured by the Atlas Copco Company in Belgium and can be purchased from Atlas Copco, Inc., Denver, Colorado.



Figure 9. Flow diagram of field and laboratory sampling procedures for 1970.



Figure 10. Adapted handy-man jack used in removing an 80 cm core from the ground.



The root mass values were not corrected for the ash content of the roots.

#### Data manipulation and compilation

Because of the voluminous amount of data collected and the inherent chance for error, it was necessary to develop a rapid, computer compatible data handling system. Examples of the three data sheets are given in Fig. 11. All root data for 1969 were converted to this form for uniform presentation.

The basic premise of the data acquisition system was that a single number was easier to keep track of than a detailed description and therefore gave less chance of error. Data sheet no. 3 was used in the field and each sample was given a number and pertinent identification information. Through the washing and ashing steps the sample was identified only by this number. Data sheets one and two were used in the laboratory for recording weights before ashing (no. 1) and after ashing (no. 2).

It was found that the various procedures were easily explained to technicians and a minimal amount of data was lost. The threesheet system was particularily useful when more than 200 samples were being processed because of the time that would be required to locate particular samples on a single data sheet, but would be unnecessary for fewer samples.



Figure 11. Three data sheets used for recording various values during the 1970 growing season.

A computer program ( $R \phi \phi TAS$ ) was written which is a sort and condensation program. Three arrays are used to store data for manipulation. The primary purpose of the program is to take the identification information contained on card 3 and sort through cards 1 and 2 to find the rest of the data for a particular sample. A complete listing of  $R \phi \phi TAS$  is presented in Appendix 2.

 $R \phi \phi TAS$  is adaptable for use on similar types of data. For example, variations of this program were used in calculations of crown material and for presentation of organic matter values.

After the initial weight difference is determined, the program calculates the grams of root material on a square meter basis. These values are then arranged in tables by macroplot and include such pertinent information as; site (PAWNEE, abbreviated PAW), date (year-month-day), watershed number (1-8), microplot number (0-100), core number within plot, and weight  $(g/m^2/cm-depth)$  for various increments when applicable. Where data are missing, average values are automatically substituted. Means and standard errors are calculated for each macroplot.

The program also presents all data, by treatments, summarized into tables for each date. These particular tables contain the following:

1. Number of plots contained in each treatment mean.

2. Mean root weight by depth (where applicable) and total means.

3. Standard errors for each mean.

All data (sorted, tabular and FØRTRAN usable) are preserved in the central IBP data bank under file number A2U003B.

#### **RESULTS**

## **Treatment effects**

Individual samples for root measurements were taken on 21 sampling dates between May 24, 1969, and September 12, 1970. All data are presented in tabular form via  $R \phi \phi TAS$ ; a sample of the various tables is contained in Appendix 3.

No pattern was observed for the mean root weights for the various macroplots. In the summer of 1969 weights ranged from a low of 793 g/m<sup>2</sup>/80 cm on July 31 to a high of 2068 g/m<sup>2</sup>/80 cm on August 27. Generally, a decrease in the amount of root material occurred between the November and the December sampling period. This decrease is approximately 400 g/m<sup>2</sup>/80 cm. Maximum and minimum amounts of total root mass for the various treatments occurred on different dates. The 1970 data which includes both crowns and roots also appears to vary erratically. The high and low both occurred on July 2 with 2768 g/m<sup>2</sup>/80 cm measured in macroplot 6 and 1753 g/m<sup>2</sup>/80 cm in macroplot 5.

Date summaries for the grazing treatments are presented in Table 5. The treatment means and standard errors are useful for comparative purposes. In 1969 all treatments were found to reach the minimum value on July 31, except for the moderate grazed

1       1       4       44.0       1       1       1       4       44.0       1       1       1       4       1<				SHAMARY TARLE OF A	L WATERSHED	SINTS) RY	TOFATMENT	(TRT)		
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2         4         1         74.0100         74.22         71.24         10.75         71.1         2.400         10.77.2           4         5         2         4.30000         70000         7.22         2.604         1.59         4.31         1.22         1245.20           5         7         3         4421000         74.74         14.73         7.64         1.77         2.41         1109.00           5         7         3         4421000         7.62         1.42         74         2.24         131.42.00           5         7         3         44210000         7.62         1.47.77         7.64         1.77         2.41         1109.00           6         7.5000         7.62         1.49000         7.62         1.47.77         4.41         1.62.00         1.15         1.60000         4.62         1.81         1.82.00           75.77         11.77         9.11         1.77         9.11         6.00000         4.61         1.61         1.60000         4.61         6.01         4.62         8.61         6.61         6.61         6.61         6.61         6.61         6.61         6.61         6.61         6.61         6.61         <	1	•	**		0~,43	11+61	0+04 84	4.70	0 5 14	1001+20
4         5         2         4         5         2         4         1.53         1.15         1.16         1.16         1.16         1.16         1.16         1.16         1.16         1.16         1.15         <			,		75 34	31 86	10 13	4 1 4	2.49	1637.82
4         5         2         μ(3) μ(7) μ(2) μ(7) μ(2)         1,13         1,43         1,47         1,42,09         1,47         1,42,09         1,47         1,4	-	-	,	57 414 1P 4 PLUIS	5.02	2.68	1.50		.12	115.54
	4	c	2	VENN OF A PLOTS	50.38	15.84	8.25	3.22	2.23	1245.20
Λ         7         1	•	,		STANDARD FRRDP	3,18	.96	.43	.47	.42	22.55
CTAYORAN FORMO         7.42         1.42         70         .24         .37         142.09           SITE = DAV         DATE = 400702         A-10 (M 10-20 CM 20-40 CM 40-A0 CM 60-A0 CM 60-A0 CM 7074         TOTAL           1         3         4         MEAN DP 4 DLOTS         57.77         11.77         4.31         6.03         4.27         1359.45           2         4         1         4         MEAN DP 4 DLOTS         57.77         11.77         4.31         6.03         4.27         1359.45           2         4         1         4         MEAN DP 4 DLOTS         57.77         11.77         4.31         6.03         4.27         1359.45           2         4         1         4         MEAN DP 4 DLOTS         57.77         11.77         4.31         6.03         4.27         1859.45           4         5         2         MEAN DP 4 DLOTS         57.75         17.36         17.36         17.37         14.20         19.77         14.60         13.16         13.10         19.77         14.60         13.16         13.10         19.77         14.60         17.74         14.07         7.30         14.72         50.31.03         10.77         14.17         2.49         13.10	*	7	7	HEAT OF 4 PLOTS	56.76	14.73	7.64	1.77	2.41	1189.09
STIF = DAN       DATE =000702         UTS APPO WTS = TOT       0-10 (M 10-20 CM 20-40 CM 40-00 CM 60-80 CM TOTAL				STANDARD FORD	7,42	1.42	.79	.24	.37	142.09
SITE 2 DAY DATE 20072 STAPP WSD PFR CM 02014			******				*********	**********	********	
415       APP WTS = T9T       A-10 CW       10-20 CW       20-60 CW       40-60 CW       60-80 CW       T0TAL         1       3       4       WEAU OF A DLOTE       57.77       11.77       4.31       6.03       4.27       1359.45         2       9       1       WEAU OF A DLOTE       71.53       17.50       A.57       3.60       3.81       1513.27A         4       5       7       MEAU OF A DLOTE       7.31       1.52       1.01       .20       .44       600.14         4       5       7       MEAU OF A DLOTE       7.73       14.57       3.60       2.30       99.27         6       7       3       WEAU OF A DLOTE       7.73       7.73       7.73       .20       .44       600.16         5       7       MEAU OF A DLOTE       7.73       7.73       .42       .44       60.04       99.27         6       7       3       WEAU OF A DLOTE       57.735       77.36       .417       .250       357.451         11       3       A       MEAU OF A DLOTE       57.735       7.30       .417       .250       157.435         11       3       A       MEAU OF A DLOTE       57.475 </td <td>SITE =</td> <td>DAW</td> <td>DAT+</td> <td>=690702</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td>	SITE =	DAW	DAT+	=690702						
1       3       4       MEAN OF A DLOTS       57.77       11.77       4.30       6.03       4.27       1359.45         2       9       1       MEAN OF A DLOTS       77.75       11.77       4.31       6.03       4.27       1359.45         2       9       1       MEAN OF A DLOTS       77.53       17.59       4.52       1.01       .20       3.44       60.14         4       5       2       MEAN OF A DLOTS       77.53       17.51       1.75.9       4.52       1.01       .20       3.44       60.14         4       5       2       MEAN OF A DLOTS       77.53       14.10       9.31       5.117       7.40       1660.90         6       7       3       MEAN OF A DLOTS       77.31       14.10       9.31       5.17       11.01       .22       30       9.97         6       7       3       MEAN OF A DLOTS       77.75       10.64       1.10       .12       .47       .20       31.04         5       10       .04       17       .25       11.25       .27       .20       .25       .23       .29       .29       .20       .20       .20       .20       .20       .20<	WTS AN	N #15	= TPT		0-10 см	10-20 CH	20-40 CM	40-60 CM	60-80 CM	TOTAL
1         3         4         MEAN OF A DLOTS         57.77         11.77         4.31         6.03         4.27         1359.45           2         9         1         MEAN OF A DLOTS         71.53         7.60         3.81         1513.26           4         5         7         4.9107         71.53         17.59         4.6         3.01         1513.26           4         5         7         4.41 OF A DLOTS         71.53         1.62         1.01         .20         .44         600.16           6         7         3         MEAN OF A DLOTS         57.73         17.73         9.63         6.54         3.66         1427.03         9.64         2.39         944.7           7         3         MEAN OF A DLOTS         57.73         17.30         9.63         6.54         3.66         1.27         .20         31.04           511F         2001         57.73         17.30         9.67         3.04         7.30         16         .52         3.66         1.27         .20         31.05         .55         .21         31.05         .55         .21         31.05         .55         .56         .21         .22         .76         .22         <		*****	******				=================	**********	**********	*******
1       1       4       M (M ) 0 f 4       0,01 (2)       57.77       11.77       4.31       6.03       4.27       1359.45         2       2       1       M (M ) 0 f 4       0,01 (2)       1.15       4.40       0.04       .42       80.34         2       2       1       M (M ) 0 f 4       0,01 (2)       1.51       7.40       3.60       3.81       1513.76         4       5       7       M (M ) 0 f 4       0,01 (2)       7.33       1.4.10       9.31       5.17       7.80       16.60.92         6       7       3       M (M ) 0 f 4       0,01 (2)       7.73       1.4.10       9.31       5.17       7.80       16.60.92         6       7       3       M (M ) 0 f 4       0,01 (2)       7.73       1.7.15       9.47       .23       3.1.04         STATINGO FROMD       1.16       1.21       .40       1.42       .23       3.1.04         STATINGO FROMD       2.10 (2)       1.40       7.70       1.40       7.70       1.41       .41       .41       .41       .41       .41       .41       .41       .41       .41       .41       .41       .41       .41       .41 </td <td></td> <td></td> <td></td> <td></td> <td></td> <td>ANS OFP M</td> <td>SQ PFR CM</td> <td>DEPTH</td> <td></td> <td>G/MSQ</td>						ANS OFP M	SQ PFR CM	DEPTH		G/MSQ
<	1	4	4	WEAN OF 4 PLATS	57.77	11.77	4.31	6.03	4.27	1359,45
4         5         2         1         1         4         7         3,60         3,81         1513,2%           4         5         2         1         1         22         1.61         22         1.61         24         60,1A           4         5         2         1         1         1.1         1.92         1.61         1.1         24         7.44         60,1A           4         5         2         1.91         7.35         1.7.31         1.04					4.15	1.15	• 94	•0A	.42	89.34
4       5       2       0.100000000000000000000000000000000000	-	4	1	STANDIDD ED000	71.53	17.59	4.57	3,60	3.81	1513.26
6         7         1 <th1< th=""> <th1< th=""> <th1< th=""> <th1< th=""></th1<></th1<></th1<></th1<>	4	5	,	MELH OF A DIATS	70 37	1.32	9 21	= 17	, 44	00.1A
$ \begin{array}{cccccccccccccccccccccccccccccccccccc$	•	,	ŕ	STANDADO EDDOU	2.17	.51		36	2 10	1000.97
STANMAP FRED         1.16         1.10         1.12         4.7         .24         31.04           SITF = PAW         PATE =00716         0-10 CM 10-20 CM 20-40 CM 40-60 CM 60-80 CM 7074L         0-10 CM 10-20 CM 20-40 CM 40-60 CM 60-80 CM 7074L           I         3         4         MEAN OF 6 PC CM 7.79         14.07         7.30         4.17         2.95         127.51           2         3         1         MEAN OF 6 PC CM 7.79         14.07         7.50         4.17         2.95         127.51           2         3         1         MEAN OF 6 PC CM 7.79         14.07         7.50         4.17         2.95         127.51           2         3         1         MEAN OF 6 PC CM 7.51         16.07         5.35         1.34         92.06           4         5         7         MEAN OF 6 PC CM 7.51         1.55         1.5         7.47         14.08.02           4         7         3         MEAN OF 6 PC CM 7.51         1.35         1.5         7.47         14.08.02           5         7         3         MEAN OF 6 PC CM 7.5         3.325         11.54         4.650         4.63         3.66.20           13         4         MEAN OF 6 PC CM 53.27         7.60         4.77	6	7	1	VEAN OF A PLOTS	57.15	17.36	9.61	6.54	2.54	1430 03
SITF = DAW       DATE =690716       0-10 CM 10-20 CM 20-40 CM 40-60 CM 60-80 CM T0TAL         1       3       4       MEAN OF 4 DLOTS       47.74 14.07       7.30       4.17       2.95       1127.51         1       3       4       MEAN OF 4 DLOTS       47.74 14.07       7.30       4.17       2.95       1127.51         2       A       1       WEAN OF 4 DLOTS       47.74 14.07       7.30       4.17       2.95       127.51         2       A       1       WEAN OF 4 DLOTS       64.75       16.23       10.04       4.72       5.03       1557.93         2       A       1       WEAN OF 4 DLOTS       51.45       18.72       8.09       2.85       1.74       108.00         4       5       2       WEAN OF 4 DLOTS       51.45       18.79       9.10       5.05       3.02       1211.25         5       TANDADD ERMOP       5.60       1.19       .78       66       .20       108.44         5       TANDAD       ERMOP       2.20       70       6.07       3.15       66.20       .20       108.44         5       TANDAD       ERMOP       2.20       70       7.0       7.7       6.23       3.15	•	•							3404	1467491
SITF = DAW DATE = A90716 WTS = NO WTS = TOT 1 3 4 WEAN OF 4 DLOTS 67.24 14.07 7.30 4.17 2.95 1127.51 2 4 1 WEAN OF 4 DLOTS 67.24 14.07 7.30 4.17 2.95 1127.51 2 4 1 WEAN OF 4 DLOTS 64.73 16.23 10.04 4.72 5.03 1557.93 3 57.93 51.34 92.06 4 5 2 WEAN OF 4 DLOTS 64.31 1.47 5.0 .35 1.34 92.06 4 5 2 WEAN OF 4 DLOTS 64.31 1.47 5.0 .35 1.34 92.06 5 7 WEAN OF 4 DLOTS 64.31 1.50 .455 1.15 74.78 1 3 4 WEAN OF 4 DLOTS 64.31 1.50 .455 1.15 74.78 3 WEAN OF 4 DLOTS 64.31 1.50 .455 1.15 74.78 5 11F = DAW DATE #690731 WTS AND AUTS = TOT 1 3 4 WEAN OF 4 DLOTS 51.45 11.54 4.50 4.63 3.15 866.69 2 A 1 WEAN OF 4 DLOTS 51.45 11.54 4.51 4.63 3.15 866.69 2 A 1 WEAN OF 4 DLOTS 51.45 11.54 4.51 4.63 3.15 866.69 2 A 1 WEAN OF 4 DLOTS 51.45 11.54 4.51 4.63 3.15 866.69 2 A 1 WEAN OF 4 DLOTS 51.45 11.54 4.51 4.63 3.15 866.69 2 A 1 WEAN OF 4 DLOTS 51.45 11.54 4.51 4.63 3.15 866.69 2 A 1 WEAN OF 4 DLOTS 51.45 11.90 7.06 4.16 2.66 1138.89 3 STANDADD EBROP 2.29 .79 6.60 .73 .40 366.38 1 3 4 WEAN OF 4 DLOTS 51.45 11.90 7.06 4.16 2.66 81.38.89 3 STANDADD EBROP 2.29 .70 6.61 .73 .40 366.39 3 STANDADD EBROP 2.43 .778 6.677 3.26 1687.03 5 TANDADD EBROP 2.43 .778 6.677 3.26 1687.03 5 TANDADD EBROP 2.43 .778 6.63 .977 2.75 1139.20 5 TANDADD EBROP 6.29 .85 1.82 1.35 .98 1.35 .98 1.35 .977 .328 128.54 5 TANDADD EBROP 6.29 .85 1.82 1.35 .98 1.35 .977 .320 128.55 5 TANDADD EBROP 6.29 .85 1.82 1.35 .99 1.275 1.192.20 5 TANDADD EBROP 6.29 .85 1.82 1.35 .99 1.43 .778 6.73 .975 .31 .92.20 5 TANDADD EBROP 6.29 .85 1.82 1.35 .99 1.275 1181.18 5 TANDADD EBROP 6.29 .85 1.82 1.35 .98 1.82 .93 4.12 5 TANDADD EBROP 6.29 .85 1.82 1.37 .97 .30 1281.55 4 5 2 WEAN OF 4 PLOTS 6.25 1.77 .30 .92 2.975 1181.18 5 TANDADAD EBROP 6.21 1.714 .90 5.77 .22 .75 1181.18 5 TANDABD EBROP 6.42 1.03 .35 .77 .23 .71 .52 .75 1181.18 5 TANDABD EBROP 6.42 1.0				STANDARD FRROP	3.16	1.19	.12	.47	.29	31,04
wfS AND wTS = TOT       0-10 CM 10-20 CM 20-40 CM 40-60 CM 60-80 CM TOTAL         1       3       4       MEAN DF 4 DLOTS       47.2% 14.07       7.3n       4.17       2.95       1127.51         2       A       1       MEAN DF 4 DLOTS       64.7% 14.07       7.3n       4.17       2.95       1127.51         2       A       1       WEAN DF 4 DLOTS       64.75       16.23       22.76         3       STAMDADD EPRDP       64.75       16.23       10.04       4.72       5.03       1557.93         4       5       2       MEAN DF 4 DLOTS       51.45       18.75       16.23       10.04       4.72       5.03       1557.93         4       5       2       MEAN DF 4 DLOTS       51.45       18.75       1.67       1198.00       2.85       1.74       1198.00         4       5       2       MEAN DF 4 DLOTS       51.46       13.92       9.10       5.05       3.42       1211.25         5       1.3       4       MEAN DF 4 DLOTS       33.25       11.54       4.50       4.63       3.63       4.03       3.63       3.40       36.33         5       2       MEAN DF 4 PLOTS       33.25       11.54       4.50			*=====	574HN4PN FRRNP ===================================	3.16 *********	1.10	.12	.47	.29 *********	31.04
		222222	1===== DATE	57440400 FRROP ===================================	3.16 *********	1.10	SI.	,47 ********	,29 	31.04
1       3       4       MEAN OF & 0 LOTS       47.79       14.07       7.30       4.17       2.05       1127.51         2       A       1       MEAN OF & 0 LOTS       64.75       16.21       10.00       4.72       5.03       157.93         2       A       1       MEAN OF & 0 LOTS       64.75       16.21       10.00       4.72       5.03       1557.93         4       5       2       MEAN OF & 0 LOTS       51.85       18.75       16.21       10.00       4.72       5.03       1557.93         4       5       2       MEAN OF & 0 LOTS       51.85       18.75       16.45       115       15       74.74       1198.00         4       5       2       MEAN OF & 0 LOTS       5.45       1.15       15       74.74       1198.00         5       11.74       11.01       74.74       10.20       CM 20-40       CM 40-60       CM 60.73       10.64       10.74       11.65       10.50       3.02       121.25         5       11.74       10.70       5.46       11.90       70.60       73       400       36.34       11.80         5       7       MEAN OF 4 PLOTS       33.25       11.54	SITE = WTS AN		111111 111111 1111111	57400AD0 FRROD ===================================	3.16 	1.10 1.10	SI 20-40 CM	.47 ************************************	.29 ************************************	31.04 *********
1       3       4       MEAN OF 4       0.075       47.79       14.07       7.30       4.17       2.95       1127.51         2       A       1       WFAN OF 4       0.015       64.75       16.21       10.08       4.72       5.03       1557.93         4       5       2       WEAN OF 4       0.015       51.85       18.72       8.00       2.45       1.74       1190.40         64       5       2       WEAN OF 4       0.0175       51.85       18.72       8.00       2.45       1.74       1190.40         64       7       3       WEAN OF 4       0.0175       51.85       18.79       9.10       5.05       3.02       121.25         5       74       MEAN OF 4       0.0175       5.40       1.19       .78       .666       .20       106.44         STANDARD ERROP       5.40       1.19       .78       .666       .20       106.44         STANDARD ERROP       5.40       1.19       .78       .666       .20       106.44         STANDARD ERROP       2.29       .70       .60       .73       .40       36.34         STANDARD ERROP       .2	51TF = WTS AN		PATE PATE 191 =	STANDARD FRRDR ==================================	3.16 0-10 CM	1.10 1.10 10-20 CM	-12 20-40 CM	.47	.29	31.04
2       R       1       VERANDAPD ERROR       2,30       63       -35       .61       .53       22.7K         2       R       1       VERANDAPD ERROR       6.01       1.47       .50       .35       1.34       92.06         4       5       2       VERANDF 4 PINTS       51.85       18.72       8.00       2.85       1.74       1198.00         4       5       2       VERANDF 4 PINTS       51.85       18.72       8.00       2.85       1.74       1198.00         6       7       3       VERANDF 4 PINTS       51.85       18.72       8.00       2.85       1.74       1198.00         511F = PAN       NATE ±690731       VERANDF       6.01       1.99       .78       0.05       3.02       1211.25         511F = PAN       NATE ±690731       VERANDF       0-10 CM       10-20 CM       20-40 CM       40-60 CM       60-80 CM       TOTAL         Standard Error         511F = PAN       NATE ±690731       0-10 CM       10-20 CM       20-40 CM       40-60 CM       60-80 CM       TOTAL         Standard Error       2.29       .73       .60       .73       .40       36.38       .36.3	SITE = WTS AN	 PAW 10 WTS	nate 1911 = 191	STANDADD FRROD ===================================	3.16 0-10 CM	1.10 10-20 CM	-12 20-40 CH	.47 40-60 CM	60-80 CM	31.04 TOTAL G/MSQ
2       A       1       MFAN OF & PLOTS       64.75       16.21       10.0R       4.72       5.03       1557.93         4       5       2       MFAN OF & PLOTS       51.45       18.72       8.09       2.45       1.74       1196.90         4       7       3       MEAN OF & PLOTS       51.45       18.72       8.09       2.45       1.74       1196.90         4       7       3       MEAN OF & PLOTS       51.45       13.92       9.10       5.05       3.02       1211.25         5.11       5.40       1.19       .7R       .66       .20       108.46         9.15       AND OF STANDADE ERROP       5.40       1.19       .7R       .66       .20       108.46         9.15       AND WTS = TRT       0-10 CM       10-20 CM       20-40 CM       40-60 CM       60-80 CM       TOTAL         1       3       4       MFAN OF 4 PLOTS       33.25       11.54       4.50       4.63       3.15       866.69         2       R       1       MEAN OF 4 PLOTS       53.46       11.90       7.06       4.16       2.66       113.89         4       5       7       MFAN OF 4 PLOTS       51.46	SITF = WTS AN	:===== РАН Ю. WTS :======= 3	1 PATE = TQT =======	51400400 FRR00 ==================================	7.16 0-10 CM	10-20 CM 10-20 CM PAMS PFR M 14.07	-12 20-40 CM 50 PER CM 7-30	.47 40-60 CM DEPTH 4.17	.24 60-80 CM	31.04 TOTAL G/MSQ 1127.53
STANDAD         ENDIN         A.31         1.47         .50         .35         1.34         92.04           4         5         2         #EAN         0F         40.05         51.8,72         8.00         2.85         1.74         1198.09           6         7         3         WEAN         0F         4.31         1.50         .45         .15         .15         74.74           6         7         3         WEAN         0F         4.63         13.92         9.10         5.05         3.02         1211.25           5         STANDADD EROP         5.60         1.19         .78         .66         .20         100.44           STANDADD EROP         5.60         1.19         .78         .66         .20         100.44           STANDAD EROP         .20         .79         .60         .73         .40         36.315         866.69           1         3         4         FAN OF 4         PLOTS         51.46         11.90         7.06         .71         .40         36.38           2         R         1         MEAN OF 4         PLOTS         51.46         11.90         .706         .118         .77<	51TF = wts an #=====	:===== : PAH ::::::::::::::::::::::::::::::::::::	0 ATE - TQT - TQT 	STANDARD FRROP 	3.16 0-10 CM 	10-20 CM 10-20 CM 10-	-12 20-40 CM 50 PER CM 7.30 -35	.47 40-60 CM DEPTH 4.17 .61	.24 60-80 CM 	31.04 TOTAL G/MS0 1127.51 22.76
a       5       2       MEAN OR 4 PLOTS       51.85       18.72       0.04       2.65       1.74       1100.04         A       7       3       MEAN OR 6 PLOTS       48.63       13.92       9.10       5.05       3.02       1211.25         STANDAPD EROP       5.40       1.19       .78       .66       .20       108.46         STANDAPD EROP       5.40       1.19       .78       .66       .20       108.46         STANDAPD EROP       5.40       1.19       .78       .66       .20       108.46         STF = DAN       DATE *690731       0-10 CM 10-20 CM 20-40 CM 40-60 CM 60-80 CM TOTAL	SITF = wts an =====	PAN ID WTS IIIIIII 3 R	0416 = TQT = 1QT 4 1	STANDARD FRRDR ==================================	0-10 CM 	10-20 CM 10-20 CM PAMS PFR M 14.07 .63 16.23	-12 20-40 CM 50 PER CM 7.30 .35 10.08	40-60 CH DEPTH 4.17 .61 4.72	,24 60-80 CM 2,95 ,53 5+03	31.04 TOTAL G/MSO 1127.51 22.76 1557.93
A       7       3       YEAN OF 4 PLOTS       4.31       1.30	SITF = wts an 1 2	: PAW ID WTS ::::::::::::::::::::::::::::::::::::	nate = Tet = Tet =	STANDARD FRRDR ==================================	3.16 0-10 CM 47.99 2.30 64.75 6.01	10-20 CM 10-20 CM 10-20 CM 14-07 .63 16-21 1.47	-12 20-40 CM 50 PFR CM 7.30 .35 10.08 .50	40-60 CH DEPTH 4.17 .61 4.72 .35	,29 60-80 CM 2,95 ,53 5,03 1,34	31.04 TOTAL G/MSO 1127.51 22.76 1557.93 92.06
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	SITF = WTS AN ====== 1 2	: РАЧ Ю WTS :======= 3 а 5	nate = Tet = Tet 4 1 2	STANDADD FRRDD = 690716 MEAN OF 4 PLOTS STANDADD FRRDP WEAN OF 4 PLOTS STANDADD FRRDP WEAN OF 4 PLOTS STANDADD FRRDP	3.16 0-10 CM 47.74 2.30 64.75 6.01 51.45	10-20 CM 10-20 CM 10-20 CM 14.07 14.07 16.21 1.47 18.72	-12 20-40 CM 50 PER CM 7.30 10.08 50 8.09	40-60 CM DEPTH 4.17 61 4.72 .35 2.85	,29 60-80 CM 2.95 .53 5.03 1.34 1.74	31.04 TOTAL G/MSO 1127.51 22.76 1557.93 92.06 1198.99
SITF = PAW       DATE ±690731       0-10 CM 10-20 CM 20-40 CM 40-60 CM 60-80 CM T07AL         MTS AND WTS = TRI       0-10 CM 10-20 CM 20-40 CM 40-60 CM 60-80 CM T07AL         1       3       4       MFAN OF 4 PLOTS       33.25       11.54       4.57       4.63       3.15       866.69         1       3       4       MFAN OF 4 PLOTS       53.25       11.54       4.57       4.63       3.15       866.69         2       R       1       MEAN OF 4 PLOTS       51.46       11.90       7.06       4.16       2.66       1138.89         2       R       1       MEAN OF 4 PLOTS       51.46       11.90       7.06       4.16       2.66       1138.89         4       5       2       MFAN OF 4 PLOTS       51.46       11.90       7.06       4.16       2.66       1138.89         4       5       2       MFAN OF 4 PLOTS       50.56       15.23       7.95       3.97       2.75       1189.48         5       2       MFAN OF 4 PLOTS       50.56       15.23       7.95       3.97       2.75       1189.48         4       7       3       MFAN OF 4 PLOTS       50.56       16.23       7.95       3.97       2.75       1189.48	SITF = wts an 1 2 4	:===== : РАН ID WTS :====== 3 	pare - Tet - Tet - 1 - 2	STANDARD FRRDP ====================================	3.16 0-10 CM 47,74 2.30 64,75 6.01 51,85 4.31	1.10 10-20 CM 14-24 PAMS PFR M 14.07 .63 16.23 1.47 18.72 1.50	.12 20-40 CM 50 PFR CM 7.30 .35 10.0R 50 8.09 .45	40-60 CM 0EPTH 4.17 61 4.72 .35 2.85 .15 0 00	.29 60-80 CM 2.95 .53 5.03 1.34 1.74 .15	31.04 TOTAL G/MSO 1127-51 22.76 1557.93 92.06 1198.90 74.74
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	SITF = WTS AN ===== 1 2 4	РАН Ю WTS 3 2 5 7	nate = Tet 4 1 2 3	STANDARD FRROP ====================================	3.16 0-10 CM 47,74 2.30 64,75 6.01 51,85 4.31 48,63 5.0	14.07 10-20 CM 14.07 14.07 14.07 1.47 1.50 13.99 1.19	-12 20-40 CM 50 PER CM -35 10.0R -50 8.09 -45 9.10	47-60 CM 0EPTH 4.17 .61 4.72 .35 2.85 .15 5.05	.29 60-80 CM 2.95 53 5.03 1.34 1.74 1.74 .15 3.02	31.04 TOTAL G/MSO 1127.51 22.76 1557.93 92.06 1198.99 74.78 1211.25
SITF = PAW       DATE ±690731         WTS AND WTS = TRT       0-10 CM 10-20 CM 20-40 CM 40-60 CM 60-80 CM TOTAL         1       3       4       WFAN OF 4 PLOTS       33.25       11.54       4.50       4.63       3.15       866.69         1       3       4       WFAN OF 4 PLOTS       51.86       11.90       7.06       4.63       3.15       866.69         2       R       1       MEAN OF 4 PLOTS       51.86       11.90       7.06       4.16       2.66       1138.80         4       5       2       MFAN OF 4 PLOTS       37.00       14.34       7.76       6.77       3.26       1087.03         4       5       2       MFAN OF 4 PLOTS       50.56       15.23       7.96       3.97       2.75       11.89.20         6       7       3       WFAN OF 4 PLOTS       50.56       15.23       7.97       3.97       2.75       1189.20         51TF = DAM       0ATF ±690913       415       415       10-20       CM 20-40       CM 40-60       CM 60-80       CM TOTAL         1       3       4       FANDARD ERROP       6.79       .85       1.82       10.17       4.09       1575.43         2       9 </td <td>SITF = wTS AN ====== 1 2 4</td> <td>PAW 10 WTS 3 2 5 7</td> <td>0 ATE = TQT 4 1 2 3</td> <td>STANDAPD FRRDP = 690716 = 690716</td> <td>3.16 0-10 CM 47.74 2.30 64.75 4.01 51.45 4.31 48.63 5.40</td> <td>10-20 CM 10-20 CM 14.07 .63 16.21 1.47 18.72 1.50 13.92 1.10</td> <td>-12 20-40 CM 50 PER CM -35 10.0A -50 8.09 -45 9.10 -78</td> <td>.47 40-60 CM DEPTH 4.17 .61 4.72 .35 2.45 5.05 .66</td> <td>.29 60-80 CM 2.95 .53 5.03 1.34 1.74 .15 3.02 .20</td> <td>31.04 TOTAL G/MSO 1127.51 22.76 1557.93 92.06 1198.90 74.78 1211.25 108.44</td>	SITF = wTS AN ====== 1 2 4	PAW 10 WTS 3 2 5 7	0 ATE = TQT 4 1 2 3	STANDAPD FRRDP = 690716 = 690716	3.16 0-10 CM 47.74 2.30 64.75 4.01 51.45 4.31 48.63 5.40	10-20 CM 10-20 CM 14.07 .63 16.21 1.47 18.72 1.50 13.92 1.10	-12 20-40 CM 50 PER CM -35 10.0A -50 8.09 -45 9.10 -78	.47 40-60 CM DEPTH 4.17 .61 4.72 .35 2.45 5.05 .66	.29 60-80 CM 2.95 .53 5.03 1.34 1.74 .15 3.02 .20	31.04 TOTAL G/MSO 1127.51 22.76 1557.93 92.06 1198.90 74.78 1211.25 108.44
WIS AND WIS = 101       0=10 (W 10=20 (W 20=0 (W 40=0 (W 40=0 (W 60=0 (W 10=0	SITF = WTS AN ====== } 2	2 PAW 40 WTS 3 2 5 7	PATE TRT 4 1 2 3	STANDAPD FRRDP       \$=690716       MEAN OF 4 PLOTS       STANDAPD FRRDP       YFAN OF 4 PLOTS       STANDAPD FRRDP       YEAN OF 4 PLOTS       STANDAPD FRRDP	3.16 0-10 CM 47,74 2.30 64,75 4.01 51,85 4.31 48,63 5,40	10-20 CM 10-20 CM 14.07 .63 16.21 1.47 18.72 1.59 1.19 1.19	20-40 CM 7-30 7-31 10.0A 8-09 .45 9-10 .78	40-60 CM 0EPTH 4.17 61 4.72 .35 2.85 .15 5.05 .66	.29 60-80 CM 2.95 5.3 5.03 1.34 1.74 .15 3.02 .20	31.04 TOTAL G/MSO 1127.51 22.76 1557.93 92.06 1198.99 74.78 1211.25 108.44
1       3       4       NFAN OF 4 PLOTS       33.25       11.54       4.50       4.63       3.15       866.69         2       A       1       MEAN OF 4 PLOTS       51.46       11.90       7.06       4.63       3.15       866.69         2       A       1       MEAN OF 4 PLOTS       51.46       11.90       7.06       4.16       2.66       1138.89         4       5       2       MFAN OF 4 PLOTS       51.46       11.90       7.06       4.36       .36       .34       11.80         4       5       2       MFAN OF 4 PLOTS       37.00       14.34       7.78       6.77       3.26       1087.03         5       3       MFAN OF 4 PLOTS       50.56       15.23       7.95       3.97       2.75       1189.20         5       3       MFAN OF 4 PLOTS       50.56       15.23       7.95       3.97       2.75       1189.20         5       7       3       MFAN OF 4 PLOTS       50.56       15.23       7.95       3.97       2.75       1189.20         5       7       3       MFAN OF 4 PLOTS       61.86       14.63       10.52       10.17       4.09       1575.43 <td< td=""><td>SITF = wts an 1 2 4 6 5ITF =</td><td>: РАМ 40 мтя 3 2 5 7 7</td><td>PATF = TQT 4 1 2 3</td><td>STANDARD FRRDR = 690716 MEAN OF 4 PLOTS STANDARD FRRDR WEAN OF 4 PLOTS STANDARD FRRDR STANDARD FR</td><td>3.16 0-10 CM 47,74 2.30 64,75 6.01 51.85 4.31 48.63 5.60</td><td>10-20 CM 10-20 CM 14.07 63 16.21 1.47 1.50 13.99 1.19</td><td>20-40 CM 20-40 CM 50 PFR CM 7.30 10.08 50 8.09 .50 9.10 .78 .78</td><td>40-60 CM 0EPTH 4.17 61 4.72 .35 2.85 .15 5.05 .66</td><td>.29 60-80 CM 2.95 5.33 1.34 1.74 .15 3.02 .20</td><td>31.04 TOTAL G/MSO 1127.51 22.76 1557.93 92.06 1190.99 74.7A 1211.25 108.44</td></td<>	SITF = wts an 1 2 4 6 5ITF =	: РАМ 40 мтя 3 2 5 7 7	PATF = TQT 4 1 2 3	STANDARD FRRDR = 690716 MEAN OF 4 PLOTS STANDARD FRRDR WEAN OF 4 PLOTS STANDARD FRRDR STANDARD FR	3.16 0-10 CM 47,74 2.30 64,75 6.01 51.85 4.31 48.63 5.60	10-20 CM 10-20 CM 14.07 63 16.21 1.47 1.50 13.99 1.19	20-40 CM 20-40 CM 50 PFR CM 7.30 10.08 50 8.09 .50 9.10 .78 .78	40-60 CM 0EPTH 4.17 61 4.72 .35 2.85 .15 5.05 .66	.29 60-80 CM 2.95 5.33 1.34 1.74 .15 3.02 .20	31.04 TOTAL G/MSO 1127.51 22.76 1557.93 92.06 1190.99 74.7A 1211.25 108.44
1       3       4       WFAN OF 4 PLOTS       33.25       11.54       4.57       4.63       3.15       866.69         2       A       1       MEAN OF 4 PLOTS       51.46       11.90       7.06       4.16       2.66       1138.89         2       A       1       MEAN OF 4 PLOTS       51.466       11.90       7.06       4.16       2.66       1138.89         4       5       2       MFAN OF 4 PLOTS       51.466       11.90       7.06       4.16       2.66       11.80         4       5       2       MFAN OF 4 PLOTS       51.466       14.34       7.78       6.77       3.266       1087.03         5       7       MFAN OF 4 PLOTS       50.56       15.23       7.95       3.97       2.75       1189.20         5       7       3       WFAN OF 4 PLOTS       50.56       15.63       .44       .28       55.37         5       7       3       WFAN OF 4 PLOTS       61.86       14.63       10.52       10.17       4.09       1575.43         6       7       3       WFAN OF 4 PLOTS       61.86       14.63       10.52       10.17       4.09       1575.43         5115       <	SITF = wts an 1 2 4 6 5.11F = wts an	: PAM 40 wTS 3 3 5 7 7 : PAW 40 wTS	nate = Tet 4 1 2 3 	STANDAPD FRRDP ===================================	3.16 0-10 CM 47,74 2.30 64,75 6.01 51.45 4.31 48.63 5.40	10-20 CM 10-20 CM 14.07 14.07 1.47 1.47 1.50 13.99 1.19 10-20 CM	-12 20-40 CM 50 PFR CM -50 8.09 -51 9.10 -78 20-40 CM	40-60 CM DEPTH 4.17 .61 4.72 .35 2.85 .15 5.05 .66 40-60 CM	.29 60-80 CM 2.95 53 5.03 1.34 1.74 .15 3.02 .20 60-80 CM	31.04 ToTAL G/MS0 1127.51 22.76 1557.93 92.06 1198.90 74.7A 1211.25 108.44
1       3       40       36.38         2       8       1       MEAN OF 4 PLOTS       51.46       11.90       7.06       4.16       2.66       1138.80         4       5       2       MFAN OF 4 PLOTS       51.46       11.90       7.06       4.16       2.66       1138.80         4       5       2       MFAN OF 4 PLOTS       37.00       14.34       7.77       3.26       1087.03         4       5       2       MFAN OF 4 PLOTS       50.56       15.23       7.95       3.97       2.75       1189.20         6       7       3       MFAN OF 4 PLOTS       50.56       15.23       7.95       3.97       2.75       1189.20         51TF       DAW       DATF       ±690913       4.38       .56       .63       .44       .28       55.37         51TF       DAW       DATF       ±690913	SITF = wis an 1 2 4 6 5 5 1 5 5 1 5 4 6 5 1 5 5 1 5 5 1 5 1 5 1 5 1 5 1 5 1 5	: PAH 40 WTS 3 2 5 7 7	natf = Tet 4 1 2 3 	STANDADD FRRDD = 690716 MEAN OF 4 PLOTS STANDADD ERROP WEAN OF 4 PLOTS STANDADD ERROP WEAN OF 4 PLOTS STANDADD ERROP EXANDE 4 PLOTS STANDADD ERROP EXANDADD ERROP	3.16 0-10 CM 47.74 2.30 64.75 6.01 51.45 4.31 48.63 5.60	10-20 CM 14.07 14.07 14.07 14.07 1.47 1.47 1.50 13.92 1.10 10-20 CM	20-40 CM 7.30 50 PFR CM 7.31 0.0A 50 8.09 .45 9.10 .7R 20-40 CM	.47 40-60 CM DEPTH 4.17 .61 4.72 .35 2.85 5.05 .66 40-60 CM	.29 60-80 CM 2.95 5.33 5.03 1.34 1.74 1.74 1.5 3.02 .20 60-80 CM	31.04 TOTAL G/MSO 1127.51 22.76 1557.93 92.06 1198.90 74.78 1211.25 108.44
2       R       1       MEAN OF 4 PLOTS       51.46       11.90       7.06       4.16       2.66       1138.80         4       5       2       MFAN OF 4 PLOTS       37.00       14.34       7.78       6.77       3.26       1087.03         4       5       2       MFAN OF 4 PLOTS       37.00       14.34       7.78       6.77       3.26       1087.03         6       7       3       MFAN OF 4 PLOTS       50.56       15.23       7.95       3.97       2.75       1189.20         6       7       3       MFAN OF 4 PLOTS       50.56       15.23       7.95       3.97       2.75       1189.20         51TF = DAM       0ATF ±690913       4.38       .56       .63       .44       .28       55.37         1       3       4       MFAN OF 4 PLOTS       61.86       14.63       10.52       10.17       4.09       1575.43         7       8       TANDARD ERPOR       6.29       .85       1.82       1.35       .56       1.82       1.35       .56       1.44       .16       12.96       9.06       3.18       2.44       10.55       1.44       12.96       9.06       3.18       2.44       1080.	SITF = wTS AN 1 2 4 5 5 1 5 1 5 1 5 1 5 1 5 1 5 1 5 1 5 1	: PAW IO WTS 3 3 5 7 7 5 7		STANDADD FRRDD       = 690716       MEAN OF 4 PLOTS       STANDADD FRRDD       YFAN OF 4 PLOTS       STANDADD FRRDD       YEAN OF 4 PLOTS	3.16 0-10 CM 47,74 2.30 64,75 6.01 51,85 4.31 48,63 5.40 0-10 CM	10-20 CM 10-20 CM 14.07 .63 16.23 1.47 18.72 1.50 13.92 1.10 10-20 CM RAMS PFR M 11.54	20-40 CM 30 PFR CM 7.30 35 10.0R .35 10.0R .45 9.10 .7R .7R .7R .7R .7R .7R .7R .7R	40-60 CM 0EPTH 4.17 61 4.72 .35 2.85 .15 5.05 .66 40-60 CM DEPTH 4.63	.29 60-80 CM 2.95 5.3 5.03 1.34 1.74 1.74 .15 3.02 .20 60-80 CM	31.04 TOTAL G/MSO 1127.51 22.74 1557.93 92.06 1198.99 74.74 1211.25 108.44 TOTAL
4       5       2       MFAN OF 4 PLOTS       37.00       14.34       7.78       6.77       3.26       1087.03         4       5       2       MFAN OF 4 PLOTS       37.00       14.34       7.78       6.77       3.26       1087.03         6       7       3       WFAN OF 4 PLOTS       50.56       15.23       7.95       3.97       2.75       1189.20         5       7 A WFAN OF 4 PLOTS       50.56       15.23       7.95       3.97       2.75       1189.20         5       7 A WFAN OF 4 PLOTS       50.56       15.23       7.95       3.97       2.75       1189.20         5       7 A WFAN OF 4 PLOTS       50.56       15.23       7.95       3.97       2.75       1189.20         51TF = DAM       0ATF #690913       4.38       .56       .63       .44       .28       55.37         1       3       4       MFAN OF 4 PLOTS       61.86       14.63       10.52       10.17       4.09       1575.43         1       3       4       MFAN OF 4 PLOTS       61.86       14.63       10.52       10.17       4.09       1575.43         2       4       NOF 4 PLOTS       61.86       14.63	SITF = WTS AN 3 4 4 5 5 1 5 1 5 1 5 1 1 3	арам арам	04TF = TQT 4 1 2 3 	STANDAPD FRRDP = 690716 MEAN OF 4 PLOTS STANDAPD FRRDP MEAN OF 4 PLOTS STANDAPD FRRDP MEAN OF 4 PLOTS STANDAPD FRRDP HEAN OF 4 PLOTS STANDAPD FRPDP 	3.16 0-10 CM 47,74 2.30 64,75 4.31 51.85 4.31 48.63 5.60 0-10 CM	10-20 CM 10-20 CM 14.07 63 16.21 1.47 1.57 1.59 1.19 10-20 CM RAMS PFR M 11.54 -79	20-40 CM SQ PFR CM 7.30 10.08 50 8.09 .50 9.10 .78 20-40 CM .50 PFR CM .50 .50 PFR CM .60	40-60 CM 0EPTH 4.17 61 4.72 .35 2.85 .15 5.05 .66 40-60 CM DEPTH 4.63 .73	.29 60-80 CM 2.95 5.03 1.34 1.74 1.74 .15 3.02 .20	31.04 TOTAL G/MSO 1127-51 22.76 1557-93 92.06 1198.49 74.7A 1211.25 108.44 TOTAL G/MSO 866.69 36.3A
4       5       2       MFAN OF 4 PLOTS       37.00       14.34       7.78       6.77       3.26       1087.03         5       3       STANDARD ERROR       2.43       .76       .26       .92       .31       54.48         6       7       3       WFAN OF 4 PLOTS       50.56       15.23       7.95       3.97       2.75       1189.20         51TF       DAW       DATF       ±690913       .56       .63       .44       .26       55.37         SITF       DAW       DATF       ±690913	SITF = wTS AN } 2 4 6 SITF = wTS AN = 1 2	: DAW ID WTS 3 2 5 7 : DAW ID WTS 3 8	0 ATF = TQT 4 1 2 3 ================================	STANDAPD FRRDP = 690716 = 690716 = 690716 = 690716 = 690716 = 690716 = 690716 = 690716 = 690731 = 760731 = 760731 = 760731 = 76075 = 76075	3.16 0-10 CM 47.74 2.30 64.75 4.31 47.63 5.40 0-10 CM 0-10 CM 33.25 2.29 51.46	10-20 CM 14.07 14.07 14.07 16.21 1.47 1.50 13.92 1.19 10-20 CM RAMS PFR M 11.54 .79 11.90	20-40 CM 20-40 CM 20-40 CM 30 PFR CM 30 0R 45 9.10 78 20-40 CM 20-40 CM 4.50 60 7.05		.29 60-80 CM 2.95 .53 5.03 1.34 1.74 .75 3.02 .20 60-80 CM 	31.04 TOTAL G/MSO 1127.51 22.76 1557.93 92.06 1198.90 74.7A 1211.25 108.44 TOTAL TOTAL G/MSO 866.69 36.38.89
STANDARD ERROR       2.43       .74       .26       .92       .31       54.48         6       7       3       MFAN OF 4 PLOTS       50.56       15.23       7.95       3.97       2.75       1189.20         STANDARD ERROR       4.38       .56       .63       .44       .28       55.37         STIF = DAW       NATF ±690813       .438       .56       .63       .44       .28       .55.37         1       3       4       #CAN OF 4 PLOTS       0-10 CM       10-20 CM       20-40 CM       40-60 CM       60-R0 CM       TOTAL         1       3       4       #FAN OF 4 PLOTS       61.86       14.63       10.52       10.17       4.09       1575.43         2       A       1       MEAN OF 4 PLOTS       52.52       14.42       6.55       4.54       3.50       1201.56         4       5       2       MEAN OF 4 PLOTS       52.52       14.42       6.55       4.54       3.50       1201.56         4       5       2       MEAN OF 4 PLOTS       52.52       14.42       6.55       4.54       3.50       1201.56         4       5       2       MEAN OF 4 PLOTS       52.52       14.42	SITF = wTS AN 1 2 4 6 SITF = wTS AN ====== 1 2	10 AM 10 MTS 3 2 5 7 10 MTS 10 MTS 3 8		STANDARD FRRDP = 690716 = 690716 = 690716 = 57400400 ERRDP = 640 OF 4 PLOTS STANDAPD ERRDP = 800731 = 10075 = 100731 = 10075 =	3.16 0-10 CM 47.74 2.30 64.75 4.31 51.45 4.31 51.45 5.40 0-10 CM 0-10 CM 33.25 2.29 51.46 2.29	10-20 CM 10-20 CM 14.07 .63 16.21 1.47 1.55 1.59 1.19 10-20 CM 10-20 CM 11.54 .79 11.90 .70	20-40 CM 7.30 7.31 0.0A .55 9.10 .78 9.10 .78 20-40 CM 50 PFR CM 4.50 .60 7.06 .43	40-60 CM DEPTH 4.17 61 4.72 .35 2.85 5.05 .66 40-60 CM DEPTH 4.63 .73 4.16 .36	.29 60-80 CM 2.95 5.3 5.03 1.34 1.74 .15 3.02 .20 60-80 CM 	31.04 TOTAL G/MSO 1127.51 22.76 1557.93 92.06 1198.00 74.78 1211.25 108.44 TOTAL TOTAL G/MSO 866.69 36.38 1138.89 11.80
6       7       3       WFAN OF 4 PLOTS       50.56       15.23       7.95       3.97       2.75       1189.20         STANDARD ERROR       4.38       .56       .63       .44       .28       55.37         STIF = DAM       DATF ±690913       0-10 CM       10-20 CW       20-40 CM       40-60 CM       60-R0 CM       TOTAL         1       3       4       WFAN OF 4 PLOTS       61.86       14.63       10.52       10.17       4.09       1575.43         2       A       1       MFAN OF 4 PLOTS       61.86       14.63       10.52       10.17       4.09       1575.43         3       MFAN OF 4 PLOTS       61.86       14.63       10.52       10.17       4.09       1575.43         2       A       1       MFAN OF 4 PLOTS       52.52       14.42       6.55       4.54       3.50       1201.56         4       5       2       NFAN OF 4 PLOTS       44.10       12.96       9.06       3.18       2.44       1060.25         4       5       2       NFAN OF 4 PLOTS       44.10       12.96       9.06       3.18       2.44       1060.25         4       5       2       NFAN OF 4 PLOTS	SITF = wTS AN 1 2 4 6 5ITF = wTS AN 1 2 4	аран аран	PATE = TeT 4 1 2 3 1 1 2 3 1 1 1 1 2 4 1 2	STANDAPD FRROP == 690716 MEAN OF 4 PLOTS STANDAPO ERROP MEAN OF 4 PLOTS STANDAPD ERROP MEAN OF 4 PLOTS STANDAPD ERROP == 500731 MEAN OF 4 PLOTS STANDAPD ERROP MEAN OF 4 PLOTS STANDAPD ERROP MEAN OF 4 PLOTS STANDAPD ERROP MEAN OF 4 PLOTS	3.16 0-10 CM 47,74 2,30 64,75 4.31 51,45 4.31 48,63 5.40 0-10 CM 0-10 CM 0-10 CM 33,25 2.29 51.46 .29 37,00	10-20 CM 10-20 CM 14.07 16.21 1.47 1.50 1.47 1.50 1.49 1.10 10-20 CM RAMS PFR M 11.54 .70 11.90 .70 14.34	20-40 CM 7.30 10.0P .35 10.0P .45 9.10 .7R 20-40 CM .50 PFR CM 4.50 .60 7.06 .43 7.78	40-60 CM DEPTH 4.17 611 4.72 .35 2.85 .15 5.05 .66 40-60 CM DEPTH 4.63 .73 4.16 .36 .6,77	29 60-80 CM 2.95 53 5.03 1.34 1.74 1.74 .15 3.02 .20 60-80 CM 	31.04 TOTAL G/MSO 1127.51 22.76 1557.93 92.06 1198.99 74.7A 1211.25 108.44 TOTAL TOTAL G/MSO 866.69 36.3A 1138.89 11.80 1087.03
STANDARD ERROR       4.38       .56       .63       .44       .28       55.37         STIF = DAW       DATF #690813         #TS AND NTS = TPT       0~10 CM       10-20 CM       20-40 CM       40-60 CN       60-80 CM       TOTAL         1       3       4 MEAN OF 4 PLOTS       61.86       14.63       10.52       10.17       4.09       155.43         2       A       1 MEAN OF 4 PLOTS       61.86       14.63       10.52       10.17       4.09       155.43         3       4 MEAN OF 4 PLOTS       61.86       14.63       10.52       10.17       4.09       155.43         2       A       1 MEAN OF 4 PLOTS       52.52       14.42       6.55       4.54       3.50       1281.54         4       5       2 MEAN OF 4 PLOTS       44.10       12.96       9.06       3.18       2.44       1080.25         4       5       2 MEAN OF 4 PLOTS       44.10       12.96       9.06       3.18       2.44       1080.25         4       7       3 MEAN OF 4 PLOTS       44.10       12.96       9.06       3.18       2.44       1080.25         5       7       3 MEAN OF 4 PLOTS       44.10       12.97       83	SITF = WTS AN 3 4 4 5 5 1 7 2 4 3 2 4	аран аран	PATE = TQT 4 1 2 3 3 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5	STANDAPD FRRDP ====================================	3.16 0-10 CM 47,74 2.30 64,75 4.31 51,45 4.31 48,63 5.40 0-10 CM 0-10 CM 33,25 2.29 51,46 .29 37,00 2,43	10-20 CM 14.07 14.07 14.07 14.07 15.0 1.47 1.50 1.50 1.9 1.19 10-20 CM RAMS PFR M 11.54 1.56 1.57 1.50 1.57 1.50 1.57 1.50 1.57 1.50 1.57	20-40 CM 50 PFR CM 50 PFR CM 50 PFR CM 50 PFR CM 20-40 CM 50 PFR CM 50 PFR CM 50 7.06 .43 7.78 .26	40-60 CM 0EPTH 4.17 61 4.72 .35 2.85 .15 5.05 .66 40-60 CM 0EPTH 4.63 .73 4.16 .36 6.77 .92	29 60-80 CM 2.95 53 5.03 1.34 1.74 1.74 .15 3.02 .20 60-80 CM 60-80 CM 3.15 .40 2.66 .34 3.26 .31	31.04 TOTAL G/MSO 1127.51 22.76 1557.93 92.06 1190.90 74.90 74.97 1211.25 108.44 TOTAL G/MSO 866.69 366.69 11.80 1087.03 54.46
SITF = PAM       NATF #690913         #TS 4ND WTS = TPT       0=10 CM 10=20 CM 20=40 CM 40=60 CM 60=80 CM TOTAL        GPANS PER MS0 PER CM DEPTH G/MS0         1       3         MEAN OF 4 PLOTS       61.86         6.29       .85         1       3         MEAN OF 4 PLOTS       61.86         6.29       .85         1       3         MEAN OF 4 PLOTS       52.52         1       3.3         4       5         7       MEAN OF 4 PLOTS         4       5         7       MEAN OF 4 PLOTS         412       1.02         83       3.18         2.44       1002.75         3.3       44.12         3.3       44.12         3.3       4.12         4.5       7         4.64       10.2	SITF = wTS AN } 2 4 6 5 5 5 5 5 4 2 4 6	10 MTS 10 MTS 3 2 7 10 MTS 10 MTS 3 8 5 7	0 ATR = TQT 4 1 2 3 ================================	STANDAPD FRROP = 690716 = 690716 = 690716 = 690716 = 690716 = 690716 = 690716 = 690716 = 690716 = 690731 = 7690731 = 769075 = 769075 = 769075 = 769075 = 769075 = 769075 = 769075 = 769075 =	3.16 0-10 CM 47.74 2.30 64.75 4.31 48.63 5.40 0-10 CM 0-10 CM 33.25 2.29 51.46 .29 37.00 2.43 50.56	10-20 CM 14.07 14.07 14.07 14.77 1.50 13.92 1.19 10-20 CM RAMS PFR M 11.54 .70 14.34 .70 14.34 .70 14.34 .70 15.23	20-40 CM 7.30 35 PFR CM 7.30 50 PFR CM 50 PFR CM 50 PFR CM 50 PFR CM 4.50 60 7.06 7.06 7.06 7.05	.47 40-60 CM DEPTH 4.17 .61 4.72 .35 2.45 5.05 .66 40-60 CM DEPTH 4.63 .73 4.16 .36 6.77 .92 3.97	.29 60-80 CM 2.95 5.33 1.34 1.74 .15 3.02 .20 60-80 CM 3.15 .40 2.66 .34 3.26 .31 2.75	ToTAL ToTAL G/MSO 1127.51 22.76 1557.93 92.06 1198.90 74.7A 1211.25 108.44 ToTAL ToTAL G/MSO 866.69 36.3A 1138.89 11.80.89 11.80.80 1087.03 54.4A 1189.20
SITF = DAW       DATF #690813         #TS AND WTS = TPT       0+10 CM 10-20 CW 20-40 CM 40-60 CM 60-80 CM TOTAL         1       3       4 KAN OF 4 PLOTS       61.86       14.63       10.52       10.17       4.09       1575.43         1       3       4 KAN OF 4 PLOTS       61.86       14.63       10.52       10.17       4.09       1575.43         2       A       1       MEAN OF 4 PLOTS       52.52       14.42       6.55       4.54       3.50       1201.56         4       5       2       MEAN OF 4 PLOTS       52.52       14.42       6.55       4.54       3.50       1201.56         4       5       2       MEAN OF 4 PLOTS       52.52       14.42       6.55       4.54       3.50       1201.56         4       5       2       MEAN OF 4 PLOTS       44.10       12.96       9.06       3.18       2.44       1080.25         5       5       5       5       5       5       5       5       1.61         4       5       2       MEAN OF 4 PLOTS       44.10       12.96       9.06       3.18       2.44       1080.25         5       5       5       1.52       1.07       1.03<	SITF = wTS AN 3 4 5 5 1 5 1 7 4 1 2 4 6	ID AW ID WTS 3 3 5 7 5 7 10 WTS 0 WTS 3 8 5 7		STANDARD FRROP 	3.16 0-10 CM 47,74 2.30 64,75 4.31 51,85 4.31 48,63 5,40 0-10 CM 0-10 CM 33,25 2,29 51,46 0,243 50,56 4.38	10-20 CM 10-20 CM 14.07 .63 16.21 1.47 18.72 1.50 13.99 1.10 10-20 CM 11.90 10-20 CM 11.90 .70 11.90 .70 14.34 .79 15.23 .56	20-40 CM 7.30 7.31 .35 10.0A .45 9.10 .78 20-40 CM 20-40 CM 20-400	40-60 CM DEPTH 4.17 61 4.72 .35 5.05 .66 40-60 CM DEPTH 4.63 .73 4.16 .36 6.77 .92 3.97 .44	.29 60-80 CM 2.95 5.3 5.03 1.34 1.74 .15 3.02 .20 60-80 CM 	31.04 TOTAL G/MSO 1127.51 22.76 1557.93 92.06 1198.00 74.78 1211.25 108.44 TOTAL TOTAL G/MSO 866.69 36.38 1138.89 11.80 1087.03 54.44 1189.20 55.37
#T5 AND WTS = TPT       0-10 CM 10-20 CW 20-40 CM 40-60 CM 60-80 CM TOTAL         1       3       4 FAN OF 4 PLOTS       61.86       14.63       10.52       10.17       4.09       1575.43         1       3       4 FAN OF 4 PLOTS       61.86       14.63       10.52       10.17       4.09       1575.43         2       A       1 MEAN OF 4 PLOTS       52.52       14.42       6.55       4.54       3.50       1201.56         2       A       1 MEAN OF 4 PLOTS       52.52       14.42       6.55       4.54       3.50       1201.56         4       5       2 MEAN OF 4 PLOTS       44.10       12.96       9.06       3.18       2.44       1080.25         4       5       2 MEAN OF 4 PLOTS       44.10       12.96       9.06       3.18       2.44       1080.25         5       5       7       3 MEAN OF 4 PLOTS       44.10       12.96       9.06       3.18       2.44       1080.25         6       7       3 MEAN OF 4 PLOTS       44.10       12.96       9.06       3.18       2.44       1080.25         6       7       3 MEAN OF 4 PLOTS       44.10       12.02       .83       .37       .20       81.13	SITF = WIS AN 3 4 4 5 5 1 7 4 8 4 6	аран аран	PATE T T T T 4 1 7 3 DATE T T T 4 1 2 3 3	STANDARD FRROP 	3.16 0-10 CM 47,74 2,30 64,75 4.31 51,45 4.31 48,63 5.40 0-10 CM 0-10 CM 0-10 CM 33,25 2,29 51.46 .29 37,60 2,43 50.56 4.38	10-20 CM 14.07 14.07 14.07 14.72 1.57 1.47 1.47 1.47 1.59 1.19 1.19 10-20 CM 11.54 11.54 1.56 11.54 .70 11.99 .70 11.90 .70 11.90 .70 .70 .70 .55 .55 .55	20-40 CM 7.30 10.0A .35 10.0A .45 9.10 7R 20-40 CM 20-40 CM 20-40 CM 20-40 CM 30 PFR CM 4.50 7.06 7.06 7.95 .63	40-60 CM DEPTH 4.17 611 4.72 .35 2.85 .15 5.05 .66 40-60 C4 DEPTH 4.63 .73 4.16 .35 .66 .677 .92 3.97 .44	29 60-80 CM 2.95 53 5.03 1.34 1.74 1.74 1.74 2.0 20 60-80 CM 3.15 .40 2.66 .31 3.26 .31 2.75 .28	31.04 TOTAL G/MSO 1127.51 22.76 1557.93 92.06 1198.99 74.7A 1211.25 108.44 TOTAL TOTAL G/MSO 8666.69 36.3A 1138.80 11.80 1087.03 54.4A 1189.20
1         3         4 KAN OF 4 PLOTS         61.86         14.63         10.52         10.17         4.09         1575.43           1         3         4 KAN OF 4 PLOTS         61.86         14.63         10.52         10.17         4.09         1575.43           2         4         1         MEAN OF 4 PLOTS         52.62         14.42         6.55         4.54         3.50         1281.86           2         4         1         MEAN OF 4 PLOTS         52.62         14.42         6.55         4.54         3.50         1281.86           4         5         2         NFAN OF 4 PLOTS         52.62         14.42         6.55         4.54         3.50         1281.86           4         5         2         NFAN OF 4 PLOTS         44.10         12.96         9.06         3.18         2.44         1080.25           5         STANDARD FRPOP         4.12         1.02         .83         -33         +20         81.13           6         7         3         MEAN OF 4 PLOTS         48.51         17.14         7.04         4.62         2.75         1181.18           5         7         3         MEAN OF 4.PLOTS         48.21         1.03 <t< td=""><td>SITF = WTS AN 3 2 4 5 5 1 7 4 6 5 1 7 4 6</td><td>10 wTS 10 wTS 3 2 7 10 wTS 10 wTS 3 8 5 7 7 10 wTS 10 wTS</td><td>0 ATF = TQT 4 1 7 3 </td><td>STANDARD FRROP == 690716 == 690717 == 690</td><td>3.16 0-10 CM 47,74 2.30 64,75 4.31 48,63 5,40 0-10 CM 0-10 CM 33,25 2.29 51,46 .29 37,00 2,43 50,56 4.38</td><td>10-20 CM 14.07 14.07 14.07 14.72 1.50 13.92 1.19 10-20 CM 11.54 1.55 1.59 1.19 1.59 1.59 1.59 1.59 1.59 1.50</td><td>20-40 CM 50 PFR CM 7.30 10.0R 50 PFR CM 7.30 8.09 .45 9.10 .7R 20-40 CM .50 PFR CM .60 7.06 .43 7.78 .63</td><td>40-60 CM DEPTH 4.17 61 4.72 .35 2.85 .15 5.05 .66 40-60 CM DEPTH 4.63 .73 4.16 .36 6.77 .92 3.97 .44</td><td>29 60-80 CM 2.95 .53 5.03 1.34 1.74 3.02 .20 60-80 CM 3.15 .40 2.66 .34 3.26 .31 2.75 .28</td><td>31.04 TOTAL G/MSO 1127.51 22.76 1557.93 92.06 1196.00 74.78 1211.25 108.44 TOTAL G/MSO 866.69 36.38 11.38.69 11.80 1087.03 55.37</td></t<>	SITF = WTS AN 3 2 4 5 5 1 7 4 6 5 1 7 4 6	10 wTS 10 wTS 3 2 7 10 wTS 10 wTS 3 8 5 7 7 10 wTS 10 wTS	0 ATF = TQT 4 1 7 3 	STANDARD FRROP == 690716 == 690717 == 690	3.16 0-10 CM 47,74 2.30 64,75 4.31 48,63 5,40 0-10 CM 0-10 CM 33,25 2.29 51,46 .29 37,00 2,43 50,56 4.38	10-20 CM 14.07 14.07 14.07 14.72 1.50 13.92 1.19 10-20 CM 11.54 1.55 1.59 1.19 1.59 1.59 1.59 1.59 1.59 1.50	20-40 CM 50 PFR CM 7.30 10.0R 50 PFR CM 7.30 8.09 .45 9.10 .7R 20-40 CM .50 PFR CM .60 7.06 .43 7.78 .63	40-60 CM DEPTH 4.17 61 4.72 .35 2.85 .15 5.05 .66 40-60 CM DEPTH 4.63 .73 4.16 .36 6.77 .92 3.97 .44	29 60-80 CM 2.95 .53 5.03 1.34 1.74 3.02 .20 60-80 CM 3.15 .40 2.66 .34 3.26 .31 2.75 .28	31.04 TOTAL G/MSO 1127.51 22.76 1557.93 92.06 1196.00 74.78 1211.25 108.44 TOTAL G/MSO 866.69 36.38 11.38.69 11.80 1087.03 55.37
1         3         4         MEAN OF 4 PLOTS         61.86         14.63         10.52         10.17         4.09         1575.43           1         3         4         MEAN OF 4 PLOTS         61.86         14.63         10.52         10.17         4.09         1575.43           2         4         1         MEAN OF 4 PLOTS         52.52         14.42         6.55         4.54         3.50         1201.56           2         4         1         MEAN OF 4 PLOTS         52.52         14.42         6.55         4.54         3.50         1201.56           4         5         2         MEAN OF 4 PLOTS         52.52         14.42         6.55         4.54         3.50         1201.56           4         5         2         MEAN OF 4 PLOTS         44.10         12.96         9.06         3.18         2.44         1000.25           5         3         MEAN OF 4 PLOTS         44.51         1.02         .83         .37         .20         81.13           6         7         3         MEAN OF 4 PLOTS         44.51         1.02         .83         .37         .20         81.13           5         3         MEAN OF 4 PLOTS         44.51	SITF = wTS AN } 2 4 6 5JTF = wTS AN 2 4 6 5JTF = 3 5JTF = 3 4 6	10 MTS 10 MTS 10 MTS 10 MTS 10 MTS 11 MTS 12 MTS 10 MTS		STANDAPD FRROP = 690716 MEAN OF 4 PLOTS STANDAPD ERROP WEAN OF 4 PLOTS STANDAPD ERROP WEAN OF 4 PLOTS STANDAPD ERROP MEAN OF 4 PLOTS STANDAPD ERROP MEAN OF 4 PLOTS STANDAPD ERROP MEAN OF 4 PLOTS STANDAPD ERROP WFAN OF 4 PLOTS STANDAPD ERROP	3.16 0-10 CM 47.74 2.30 64.75 4.31 48.63 5.40 0-10 CM 0-10 CM 2.43 37.00 2.43 50.56 4.38 0-10 CM	10-20 CM 10-20 CM 14.07 .63 16.21 1.47 18.72 1.550 13.99 1.19 10-20 CM 11.54 .79 11.90 .70 14.34 .79 15.23 .56 10-20 CM	20-40 CM 7.30 .50 PFR CM 7.30 .50 B.09 .45 9.10 .7R 20-40 CM 50 PFR CM 4.50 .60 7.06 .43 7.78 .26 7.95 .63	.47 40-60 CM DEPTH 4.17 .61 4.72 .35 2.85 5.05 .66 40-60 CM DEPTH 4.63 .73 4.16 .36 6.77 .92 3.97 .44 40-60 CM	.29 60-80 CM 2.95 5.3 5.03 1.34 1.74 .15 3.02 .20 60-80 CM 3.15 .40 2.66 .34 3.25 .28 .275 .28	31.04 TOTAL G/MSO 1127.51 22.76 1557.93 92.06 1198.90 74.78 1211.25 108.44 TOTAL G/MSO 866.69 36.38 1138.89 11.80 1087.03 55.37
1       3       4       MEAN OF 4 PLOTS       01.86       14.63       10.52       10.17       4.09       1575.43         5       STANDARD ERPOR       6.29       .85       1.82       1.35       .58       148.83         2       A       1       MEAN OF 4 PLOTS       52.52       14.42       6.55       4.54       3.650       1201.56         4       5       2       MEAN OF 4 PLOTS       52.52       14.42       6.55       4.54       3.650       1201.56         4       5       2       MEAN OF 4 PLOTS       44.10       12.96       9.06       3.18       2.44       1000.25         5       3       MEAN OF 4 PLOTS       44.10       12.96       9.06       3.18       2.44       1000.25         5       STANDARD FROP       4.12       1.02       .83       .37       .20       81.13         6       7       3       MEAN OF 4 PLOTS       44.51       17.14       7.04       4.62       2.75       1181.18         5       74NDARD ERROP       4.21       1.03       .35       .77       .23       71.52	SITF = wTS AN 3 3 4 6 5 1 7 4 6 5 1 7 4 6 5 1 7 4 6	10 AM 10 MTS 3 2 7 2 7 2 7 3 8 5 7 3 8 5 7 10 MTS 10		STANDARD FRRDP = 690716 	3.16 0-10 CM 47.74 2.30 64.75 4.31 51.45 4.31 44.63 5.40 0-10 CM 33.25 2.29 51.46 .243 50.56 4.38 0-10 CM	10-20 CM 10-20 CM 14.07 .63 16.21 1.47 18.72 1.50 13.99 1.10 10-20 CM 10-20 CM 10-20 CM	20-40 CM 7.30 7.30 8.09 .45 9.10 7.8 9.10 7.8 .20-40 CM 7.06 7.06 7.06 7.9 .43 7.78 .26 7.95 .63	40-60 CM DEPTH 4.17 61 4.72 .35 5.05 5.05 .66 40-60 CM DEPTH 4.63 .73 4.16 .36 6.77 .92 3.97 .44 40-60 CM	29 60-80 CM 2.95 5.3 5.03 1.34 1.74 1.74 2.60 60-80 CM 3.15 .40 2.66 .31 3.27 .28 .20 .20 .20 .20 .20 .20 .20 .20 .20 .20	31.04 TOTAL G/MSO 1127.51 22.76 1557.93 92.06 1198.00 74.78 1211.25 108.44 TOTAL G/MSO 8666.69 36.38 1138.80 11.80 1087.03 54.41 1189.20 55.37
TANDARD ENFOR         P.79         .85         1.82         1.35         .58         148.83           2         A         MEAN OF & PLOTS         52.52         14.42         6.55         4.54         3.50         1281.83           4         STANDARD ERROR         2.39         .67         .30         .28         .33         44.12           4         5         2         MEAN OF 4 PLOTS         44.10         12.96         9.06         3.18         2.44         1080.25           5         STANDARD FRPOP         4.12         1.02         .83         .37         .20         81.13           5         7         MEAN OF 4         PLOTS         44.51         17.14         7.04         4.62         2.75         118.1A           5         TANDARD ERROP         4.21         1.03         .35         .77         .23         71.52	SITF = WIS AN I SITF = SITF = WIS AN I SITF = SITF = SITF = SITF = SITF =	3 3 3 3 5 7 7 5 7 7 7 7 7 7 7 7 7 7 7 7 7	PATE T PT 4 1 2 3 T PT 4 1 2 3 1 2 3 1 2 3 1 2 3 1 1 2 3 1 1 2 3 1 1 2 3 1 1 2 3 1 1 1 1 1 1 1 1 1 1 1 1 1	STANDARD ERROP #EAN OF 4 PLOTS STANDARD ERROP #FAN OF 4 PLOTS STANDARD ERROP	3.16 0-10 CM 47,74 2.30 64,75 4.31 51,45 4.31 48,63 5.40 0-10 CM 0-10 CM 2,43 50.56 4.38 0-10 CM	10-20 CM 10-20 CM 14.07 16.21 1.4.72 1.50 1.4.72 1.50 1.4.72 1.50 1.4.72 1.50 1.4.72 1.50 1.4.74 1.50 1.4.74 1.50	20-40 CM 7.30 10.0A .35 10.0A .45 9.10 7R 20-40 CM 20-40 CM 7.05 .63 7.7A .26 7.95 .63	40-60 CM DEPTH 4.17 611 4.72 .35 2.85 .15 5.05 .66 40-60 CM DEPTH 4.63 .73 4.16 .66 .77 .92 3.97 .44 40-60 CM	29 60-80 CM 2.95 53 5.03 1.34 1.74 1.74 1.75 3.02 20 60-80 CM 3.15 .40 2.66 .31 2.75 .28 .40 2.66 .31 2.75 .28	31.04 TOTAL G/MSO 1127.51 22.74 1557.93 92.06 1198.99 74.74 1211.25 108.44 TOTAL G/MSO 8666.69 36.38 1138.89 11.80 1087.03 54.44 1189.20 55.37
C         T         MERTOR         72-72         14.47         0.95         4.54         3.50         1201.56           STANDARD ERROR         2,39         .67         .30         .28         .33         44.12           4         5         2         NFAN         0F         4         10         12.96         9.06         3.18         2.44         1080.25           5         2         NFAN         0F         4         10         12.96         9.06         3.18         2.44         1080.25           5         STANDARD         FRROP         4.12         1.02         .83         .37         .20         81.13           6         7         3         MEAN         0F         4         10.12         1.03         .35         .77         .23         71.52	SITF = WTS AN 3 4 4 5 5 1 7 4 6 5 1 7 4 6 5 1 7 4 1	ID AW ID WTS 3 3 5 7 7 ID WTS 3 8 5 7 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	0 ATF = TQT 4 1 2 3 	STANDAPD FRROP = 690716 MEAN OF 4 PLOTS STANDAPD ERROP MEAN OF 4 PLOTS STANDAPD ERROP	3.16 0-10 CM 47,74 2.30 64,75 4.31 47,63 5.40 0-10 CM 0-10 CM 2243 50.56 4.38 0-10 CM	10-20 CM 10-20 CM 14.07 14.07 16.21 1.47 1.57 1.59 1.19 10-20 CM 11.54 1.56 10-20 CM 10-20 CM 10-20 CM 10-20 CM	20-40 CM SQ PFR CM 7.30 10.0R 50 9.10 7.8 9.10 7.8 9.10 7.8 9.10 7.8 9.10 7.7 7.7 8.0 7.7 7.7 6.0 7.6 7.95 6.3 20-40 CM 20-40 CM 50 PFR CM 20-40 CM		.29 60-80 CM 2.95 .53 5.03 1.34 1.74 3.02 .20 60-80 CM 3.15 .40 2.66 .34 3.26 .31 2.75 .28 60-80 CM	31.04 TOTAL G/MSO 1127.51 22.76 1557.93 92.06 1198.90 74.78 1211.25 108.44 TOTAL TOTAL G/MSO 1087.03 55.37 TOTAL TOTAL
4         5         2         NEAN OF         4         10         12.96         9.06         3.18         2.44         1080.27           4         5         2         NEAN OF         4         10         12.96         9.06         3.18         2.44         1080.27           5         3         XANDARD FRROP         4.12         1.02         .83         .37         .20         81.13           6         7         3         MEAN OF         4 PLOTS         48.51         17.14         7.04         4.62         2.75         1181.18           5         TANDARD ERROP         4.21         1.03         .35         .77         .23         71.52	SITF = wTS AN 3 2 4 6 5 5 1 7 4 6 5 1 7 4 6 5 1 7 4 6	10 AW 10 WTS 3 3 7 10 WTS 3 8 7 10 WTS 10 WTS 10 WTS 3 0 10 WTS 10 WTS 11 WTS		STANDAPD FRROP = 690716 MEAN OF 4 PLOTS STANDAPD ERROP WEAN OF 4 PLOTS STANDAPD ERROP WEAN OF 4 PLOTS STANDAPD ERROP MEAN OF 4 PLOTS STANDAPD ERROP MEAN OF 4 PLOTS STANDAPD ERROP MEAN OF 4 PLOTS STANDAPD ERROP WEAN OF 4 PLOTS STANDAPD ERROP	3.16 0-10 CM 47.74 2.30 64.75 4.31 48.63 5.40 0-10 CM 0-10 CM 2.43 37.00 2.43 50.56 4.38 0-10 CM	10-20 CM 10-20 CM 14.07 .63 16.21 1.47 18.72 1.55 13.99 1.19 10-20 CM RAMS PFR M 11.54 .79 11.90 .70 14.34 .79 15.23 .56 10-20 CM PAMS PER M 14.63 .85 .65	20-40 CM 7.30 7.30 7.30 7.30 7.30 8.09 .50 9.10 .78 20-40 CM 50 PFR CM 4.50 .60 7.06 7.06 .63 20-40 CM .20-40 CM	40-60 CM DEPTH 4.17 61 4.72 .35 2.85 5.05 .66 40-60 CM DEPTH 4.63 .73 4.16 .36 6.77 .92 3.97 .44 40-60 CM DEPTH 10.17 1.35	.29 60-80 CM 2.95 .53 5.03 1.34 1.74 .15 3.02 .20 60-80 CM 3.15 .40 2.66 .31 3.275 .28 60-80 CM	31.04 TOTAL G/MSO 1127.51 22.76 1557.93 92.06 1198.90 74.78 1211.25 108.44 TOTAL G/MSO 866.69 36.38 1138.89 11.80 1087.03 54.48 1189.20 55.37 TOTAL G/MSO 6/MSO 157.43 148.83
STANDARD FROP         4.12         1.02         83         37         2.04         1000.25           6         7         3         MEAN OF 4 PLOTS         44.51         17.14         7.04         4.62         2.75         118.18           STANDARD ERROP         4.21         1.03         .35         .77         .23         71.52	SITF = wTS AN 3 4 6 5 5 1 7 4 6 5 1 7 4 6 5 1 7 4 6 5 1 7 1 2 4 5 1 7 4 1 2 4 5 1 7 1 2 4 1 2 4 1 2 4 1 5 1 1 2 1 2 1 2 1 2 1 2 1 2 1 2 1 2 1	ID AW ID WTS ID WTS	PATE T PAT 4 1 2 3 DATE T PT 4 1 2 3 0 ATE T PT 4 1 2 3 0 ATE 1 2 4 1 2 3 1 1 2 1 1 1 2 3 1 1 1 1 1 1 1 1 1 1 1 1 1	STANDARD ERROP 	3.16 0-10 CM 47,74 2.30 64,75 4.31 51,85 4.31 48,63 5,40 0-10 CM 0-10 CM 2,43 50,56 4.38 0-10 CM 0-10 CM	10-20 CM 10-20 CM 14.07 16.21 1.47 18.72 1.50 13.92 1.10 10-20 CM 11.54 10-20 CM 11.54 10-20 CM 10-20 CM 10-20 CM 14.63 .56 10-20 CM	20-40 CM 7.30 7.30 8.09 .45 9.10 7.8 .78 20-40 CM 50 PFR CM .60 7.06 7.06 4.50 .63 7.78 .63 20-40 CM 10.52 1.82 6.55	40-60 CM DEPTH 4.17 61 4.72 .35 2.85 5.05 .66 40-60 CM DEPTH 4.63 .73 4.16 .36 6.77 .92 3.97 .44 40-60 CM DEPTH 10.17 1.35 4.54	.29 60-80 CM 2.95 .53 5.03 1.34 1.74 .15 3.02 .20 60-80 CM 3.15 .40 2.66 .31 3.27 .28 60-80 CM .31 2.75 .28 60-80 CM .31 3.26 .31 3.27 .28 .28 .28 .28 .28 .28 .28 .28 .28 .28	31.04 TOTAL G/MSO 1127.51 22.76 1557.93 92.06 1198.90 74.78 1211.25 108.44 TOTAL G/MSO 866.69 36.38 1138.89 11.80 1087.03 54.48 1189.20 55.37 TOTAL TOTAL G/MSO 1575.43 148.83 1201.55
6         7         3         MEAN OF 4 PLOTS         48.51         17.14         7.04         4.62         2.75         118.18           STANDARD ERROP         4.21         1.03         .35         .77         .23         71.52	SITF = WTS AN 3 4 5 5 5 1 7 4 6 6 5 1 7 4 6 6 5 1 7 4 8 7 4 7 4 7 4 7 4 7 4 7 4 7 4 7 4 7	10 AV 10 WTS 3 3 5 7 10 PAV 10 WTS 3 4 5 7 10 WTS 3 4 5 7 10 WTS 10	nate 1 2 1 2 3 1 2 3 1 2 3 1 2 3 1 2 3 1 2 3 1 2 4 1 2 3 1 2 3 1 2 1 1 2 3 1 1 2 1 1 2 1 1 2 1 1 1 2 1 1 1 2 1 1 1 1 1 1 1 1 1 1 1 1 1	STANDARD ERROP == 690716 == 690716 == 690716 == 690716 == 690716 == 690716 == 690717 == 690777 == 6907777 == 6907777 == 60077777777777777777777	3.16 0-10 CM 47,74 2.30 64,75 4.31 51,45 4.31 48,63 5.40 0-10 CM 0-10 CM 2.43 50.56 4.38 0-10 CM 0-10 CM	10-20 CM 10-20 CM 14.07 14.07 16.21 1.47 1.57 1.57 1.99 1.19 10-20 CM 11.54 11.54 1.53 .70 11.90 .70 11.90 .70 11.90 .70 14.34 .74 15.23 .55 14.45 .65 14.45 .65 .65 .65 .65 .75 .55 .55 .55 .55 .55 .55 .5	20-40 CM 30 PFR CM 7.30 10.0R .35 10.0R .35 10.0R .35 9.10 8.09 .45 9.10 0 .7R 20-40 CM .50 PFR CM 20-40 CM .63 7.76 .63 .63 .50 PFR CM 10.52 1.82 .30 .30 .30 .30 .31 .45 .45 .50 .50 PFR CM .50 PFR CM	40-60 CM DEPTH 4.17 611 4.72 .35 2.85 .15 5.05 .66 40-60 CM DEPTH 4.63 .73 4.16 .36 .6.77 .92 3.97 .44 40-60 CM DEPTH 10.17 1.35 4.54 .28	29 60-80 CM 2.95 53 5.03 1.34 1.74 1.74 1.75 3.02 20 60-80 CM 3.15 .40 2.66 .31 2.75 .28 60-80 CM 4.09 .88 3.50 .33 .35 .33 .35 .33 .35 .34 .34 .34 .34 .34 .34 .34 .34	31.04 TOTAL G/MSO 1127.51 22.76 1557.93 92.06 1190.00 74.78 1211.25 108.44 TOTAL G/MSO 866.69 36.38 11.80 866.69 36.38 11.80 1087.03 55.37 TOTAL G/MSO 1575.43 148.63 1291.56
STANDARD ERROP 4.21 1.03 .35 .77 .23 71.52	SITF = WTS AN 3 4 6 SITF = WTS AN - 	ID AW ID WTS 3 3 5 7 ID AW ID WTS 3 8 5 7 ID WTS 10 WTS 3 8 5 7 8 5 7		STANDAPD FRROP == 690716 == 690717 == 69077 == 69077 == 690777 == 690777 == 690777 == 69077	3.16 0-10 CM 47.74 2.30 64.75 4.31 47.63 5.40 0-10 CM 0-10 CM 0-10 CM 2.43 37.00 2.43 50.56 4.38 0-10 CM 0.243 50.56 4.38 0-10 CM	10-20 CM 14.07 14.07 14.07 14.07 15.21 10-20 CM 10-20 CM 11.56 11.56 11.57 11.50	20-40 CM 7.30 7.30 8.09 .45 9.10 .7R 20-40 CM 50 PFR CM 4.50 .60 7.66 7.66 7.66 7.65 .63 20-40 CM 50 PFR CM 10.52 1.82 6.55 .30 9.06	.47 40-60 CM DEPTH 4.17 .61 4.72 .35 2.45 5.05 .66 40-60 CM DEPTH 4.63 .73 4.16 .36 .73 4.16 .36 .74 .28 .75 .64 .28 .64 .72 .64 .28 .64 .28 .64 .28 .64 .28 .65 .64 .28 .64 .28 .65 .64 .28 .65 .64 .28 .65 .64 .28 .65 .65 .66 .64 .28 .65 .65 .66 .66 .77 .61 .61 .61 .64 .72 .64 .63 .73 .64 .72 .64 .72 .64 .72 .64 .72 .64 .72 .64 .72 .64 .73 .64 .74 .63 .73 .64 .72 .64 .72 .64 .72 .64 .72 .64 .72 .64 .72 .64 .73 .64 .74 .64 .75 .65 .65 .65 .75 .65 .65 .75 .75 .75 .75 .75 .75 .75 .7	.29 60-80 CM 2.95 .53 5.03 1.34 1.74 1.74 3.02 .20 60-80 CM 3.15 .40 2.66 .31 2.75 .28 60-80 CM .31 2.75 .28 60-80 CM .31 2.75 .28 .31 2.75 .28 .31 2.75 .28 .31 2.75 .28 .31 2.75 .28 .31 2.75 .28 .31 2.75 .33 2.44 .33 2.44	31.04 TOTAL G/MSO 1127.51 22.76 1557.93 92.06 1198.90 74.7A 1211.25 108.44 TOTAL TOTAL G/MSO 866.69 36.3A 1138.89 11.80 1087.03 55.37 TOTAL TOTAL TOTAL G/MSO 1575.43 148.83 1201.56 44.12 1980.25
	SITF = wTS AN 3 2 4 6 ====== 3 3 2 4 6 ====== 3 1 2 4 6 5 1TF = 1 2 4 5 1 7 4 4 6	ID AW ID WTS 3 3 3 5 7 40 WTS 3 8 5 7 10 WTS 3 4 5 7 7		STANDARD FRROP == 690716 == 690717 == 690731 == 690	3.16 0-10 CM 47.74 2.30 64.75 4.31 48.63 5.40 0-10 CM 0-10 CM 0-10 CM 0-10 CM 0.51.45 2.29 51.46 0.243 50.56 4.38 0-10 CM 0.56 52.52 2.39 52.52 2.39 4.10 4.12 4.51	10-20 CM 10-20 CM 14.07 .63 16.21 1.47 18.72 1.50 13.99 1.19 10-20 CM RAMS PFR M 11.50 .70 14.34 .79 15.23 .56 10-20 CW PAMS PER M 14.63 .67 12.96 1.02 7.14	20-40 CM 7.30 7.31 9.67 CM 7.30 8.09 .45 9.10 7.8 9.10 7.8 9.10 7.8 4.50 6.0 7.06 7.06 7.06 7.06 7.06 7.06 7.05 6.5 80 PFR CM 10.52 1.82 6.55 3.0 9.06 8.33 7.44	40-60 CM DEPTH 4.17 61 4.72 .35 2.85 5.05 .66 40-60 CM DEPTH 4.63 .73 4.16 .36 6.77 .92 3.97 .44 40-60 CM DEPTH 10.17 1.35 4.54 .28 3.19 .28 .29 .29 .20 .20 .20 .20 .20 .20 .20 .20	.29 60-80 CM 2.95 5.3 5.03 1.34 1.74 1.74 3.02 .20 60-80 CM 3.15 .40 2.66 .31 2.75 .28 60-80 CM 2.66 .31 2.75 .28 60-80 CM 2.66 .31 2.75 .28 .31 2.75 .28 .31 2.75 .28 .31 2.44 .20 .33 2.44 .20	31.04 TOTAL G/MSO 1127.51 22.76 1198.90 74.78 1211.25 108.44 TOTAL G/MSO 666.69 36.38 1138.89 11.80 1087.03 55.37 TOTAL G/MSO 1275.43 148.63 1201.56 44.13 108.25 81.13 108.25 11.05 10.0
∊─ <b>∊∊∊∊∊∊∊∊∊∊∊∊∊∊∊∊∊∊∊∊∊∊∊∊∊∊∊∊∊∊∊∊∊∊∊</b>	SITF = wTS AN 3 3 4 6 5 5 1 7 4 6 5 1 7 4 6 5 1 7 4 6 7 1 7 4 5 4 6	ID AW ID WTS ID WTS	PATE TAT 4 1 2 3 DATE TAT 4 1 2 3 0 ATE TAT 4 1 2 3 0 ATE 3 0 ATE 3 0 ATE 3 0 4 1 2 3 0 0 1 1 1 1 1 1 1 1 1 1 1 1 1	STANDARD ERROP #EAN OF 4 PLOTS STANDARD ERROP	3.16 0-10 CM 47,74 2.30 64,75 4.31 51,85 4.31 48,63 5,40 0-10 CM 0-10 CM 2.43 50,56 4.38 0-10 CN 2.43 50,56 4.38 0-10 CN 0-10 C	10-20 CM 10-20 CM 14.07 16.21 1.47 18.72 1.50 13.92 1.10 10-20 CM 11.54 1.47 1.50 13.92 1.10 10-20 CM 11.54 .79 11.54 .79 11.54 .79 11.54 .79 11.54 .79 14.54 .79 15.23 .55 14.54 .79 15.23 .55 14.54 .79 15.23 .55 14.54 .56 .57 .57 .57 .57 .57 .57 .57 .57	20-40 CM 7.30 80 PFR CM 7.30 8.09 .45 9.10 7.06 7.06 7.06 7.06 7.06 7.06 7.06 7.0	.47 40-60 CM DEPTH 4.17 .61 4.72 .35 2.85 .15 5.05 .66 40-60 CM DEPTH 4.63 .73 4.16 .36 6.77 .922 3.97 .44 40-60 CM DEPTH 10.17 1.35 4.54 .28 3.14 .27 4.62 .27 .27 .26 .27 .27 .28 .28 .28 .28 .28 .28 .28 .28	.29 60-80 CM 2.95 5.3 5.03 1.34 1.74 1.74 2.50 .20 .20 .20 .20 .20 .20 .20 .20 .20 .2	31.04 TOTAL G/MSO 1127.51 22.76 1557.93 92.06 1198.90 74.78 1211.25 108.44 TOTAL G/MSO 866.69 36.38 1138.89 11.80 1087.03 54.48 1189.20 55.37 TOTAL G/MSO 1575.43 148.83 1201.56 44.12 1088.21 181.18

# Table 5. Grazing treatment means and standard errors of root biomass for 21 sampling dates.

Table 5 (Continued).

SUMMARY TARLE OF ALL WATERSHEDS (WTS) BY TREATMENT (TRT)

	******		****************						
SITE =	DAW	DATE	=690827				**********	**********	*==*===
WTS ANI		TOT		0-10 04	10. 20. 04	20 40 04			
				17-10 (M		20-40 (.4	40-60 CM	60+H0 CM	TOTAL
								*********	********
1	2		NEAN 05 ( DI 070	0.00	<b>NAM2 PEN M</b>	SO PER CH	DEPTH		G/MSQ
•	,	4		24.64	20.01	14-13	8.49	7.13	1816.47
3			STATING ( DLATE	4.42	2.13	•71	.80	•89	90.01
e	· ·	1	TEAN OF & PLOIS	57.14	15.27	9.03	4.13	2.80	1244.1R
	~	•	STANDAND ENNIN	4.07	. 75	.80	.41	•38	86,31
4	~		WEBN DE 4 PLOTS	59.73	23.65	9.11	3,13	2.76	1417.23
	_	_	STANDADD EPPOR	3.41	4.71	. 39	.06	.31	110,07
5	7	3	MEAN OF 4 PLOTS	76.51	17.46	10.65	2,78	3.04	1586.39
			STANDARD EPROP	9.72	.76	.49	.11	.49	119.40
======	******	*******		***=========		*=========			********
STTE =		DATE	=690910						
WTS AN	ก่ษระ	TOT		0-10 CH	10-20 CM	20-40 CH	40-60 CM	60-80 CM	CTOTAL
								******	
					04MC 050 1	CA DED CH	DEDIN	1	C /MCO
,	2		WEAN OF 4 DIOTS	60 76	10 40	7 97	E 91	2 09	1 1609 03
1	,	••	TANDADO EDDOD	3.63	1 64	7.7	7471	3,00	77 44
2	•			50 F0	1+74		100	10	1405 00
-	-	1		7,77	11.447	7.00	1.10	3.73	1442144
	~	•		40.13	10 40		• 7 1	49.3	1633 00
4	5	~	MEAN OF 4 DENIS	6×.15	IN OH	10.20	f+14	4+71	1033.00
	_	_	STANDAR'S FRANK	* 04	•40	.43	1.12	• 14	80.14
6	7	ż	HEAN DE 4 PLOTS	54,50	19.81	12.30	1.57	3,53	1576.41
			STANDARD FRRDR	] <b>,</b> AM	•79	.47	.94	+14	67+1R
323222	*******		************************	=======================================	==================	tassssz====			**********
STTF =	PAW	DATE	=691109						
WT5 AN	D WTS =	= TOT		0-10 CM	10-50 CM	20-40 CM	40-60 CM	60-80 CM	TOTAL
	******	*******	1	************		============	**********		********
					WANS PER .	ISO PER CH	DEPTH		GZMSO
1	٦	4	YEAN OF PRINTS	85.76	14.57	7.90	4.48	2.97	1627.64
,		-	STANDARD FRAND	4.03	41	. 35	16	14	56.04
2		1	HEAN OF 9 DIATE	43.04	17 93	9 07	L L 7	A 00	1725 63
~	-			D7.94	11.00	7.4/		~.00	1123432
	~	•		6.40		+ < 3	+10		C4+37
4	5	2	MEAN OF P PLOTS	64.43	15,19	9+50	4,70	2.89	1452.34
			STANDAR() EQPOR	1.61	.56	45	.37	+15	32.61
6	7	3	MEAN OF A PLOTS	72.14	14.94	7.84	4,97	2.07	1460.55
			STANDARD ERROP	2.57	•23	•32	•21	.09	41.31
	******		*****************	************	**********			**********	**********
STIF =	DAW	DATE	=691219						
WTC AN									
	IN JTC -	- ТОТ		0-10 CM	10-20 CM	20-40 CH	40-60 CM	60-80 CM	TOTAL
	10 ¥TS =	= TOT		0-10 CM	10-20 CM	20-40 04	40-60 CN	60-80 CM	TOTAL
	ID 475 =	= TOT		9-10 CM	10-20 CM	20-40 C4	40-60 CM	60-80 CM	TOTAL
	1) ¥TS : :======	: TOT ::::::::		9-10 CM	10-20 CM	20-40 C4 20-40 C4 450 PFP C4 7 25	40-60 CN	60-80 CM	TOTAL G/N50
1	10 275 : ======= 3	= TPT ======== 4	MEAN OF A PLOTS	9-LA CM	10-20 CM	20-40 C4 11111111 450 PFP C4 7.35	40-60 CM =========== DFPTH 3,96	60-80 CM	TOTAL 6/N50 1238-24
1	10 475 : **=**** 3	= TPT ==================================	MEAN OF A PLOTS STANDADD FORD	9-10 CM	10-20 CM 04M5 PFR 14.10 .63	20-40 C4 450 PFP C4 7.35 .37	40-60 CM =========== NFPTH 3.96 .14	60-80 CM 2.25 .11	TOTAL 6/N50 1238.24 44.50
1	10 275 : :====== 3 4	= TPT ======== 4 1	ЧЕАЧ ОГ 4 РЦОТС Standadd fodd VFAN OF 8 РЦОТС	9-10 CM 	10-20 CM 04M5 PER 14.10 .63 11.87	20-40 CM 450 PFP CM 7.35 .37 6.01	40-60 CM ======== 0FPTH 3.96 .14 3.64	60-80 CM 2.25 .11 2.07	TOTAL 6/N50 1238.24 44.50 1257.22
1	10 475 : ======= 3 4	= TDT ======= 4 ]	ЧЕАЧ ОГ Н РЦАТС Стандара город Чеан ог в рцатс Стандара город	9-10 CM 57.83 2.36 65.27 2.94	10-20 CM 04M5 PFR 14.10 .63 11.87 .35	20-40 CM 150 PFP CM 7.35 .37 6.01 .24	40-60 CM ======== 0FPTH 3.96 .14 3.64 .10	60-80 CM 2.25 .11 2.07 .05	TOTAL 6/N50 1238.24 44.50 1257.22 44.23
1 2 4	10 275 : ====== 3 4 5	= TDT ======= 4 1 2		0-10 CM 57.83 2.36 65.27 2.94 60.15	10-20 CM 04M5 PFR 14.10 .63 11.87 .35 14.09	20-40 CM 450 PFP CM 7.35 .37 6.01 .24 7.05	40-60 CM 	60-80 CM 2.25 .11 2.07 .05 2.55	TOTAL G/N50 1238.24 44.50 1257.22 44.23 1257.0A
1	10 UTS = ====== 3 4 5	* TDT 4 1 2	ЧГАЧ ОГ н Р[1]ТС стачпарп гропр ЧГАЧ ПАрп гропр ЧГАЧ ОГ в Р[1]ТС стачпарп гропр МГАЧ ОГ 9 Р[1]Т5 стачпарп гропр	9-10 CM 	10-70 CM 04M5 PFR 1 14-10 .63 11.87 .35 14.00 .27	20-40 CM 450 PFP CM 7.35 6.01 .24 7.06 .27	40-60 CM 	60-80 CM 2.25 .11 2.07 .05 2.55 .11	TOTAL G/M50 1238.24 44.50 1257.22 44.73 1257.0A 34.65
1 2 4 6	10 UTS 2 12===== 3 4 5 7	= TPT  4 1 2 3	ЧЕАЧ ОГ Н РЦЛТС Стачлара горор Чеан ог в рцлтс Стачлара горор Меан Ог в оцлтс Чеан Ог в оцлтс	0-L0 CM	10-70 CM 04M5 PFR 1 14.10 63 11.87 .35 14.00 .27 16.43	20-40 CM 450 PFP CM 7.35 .32 6.0] .24 7.06 .27 8.08	41-60 CM ========= 3,96 .14 3,64 .10 3,60 .11 3,87	60-80 CM 2.25 .11 2.07 .05 2.55 .11 2.64	TOTAL G/N50 1238.24 44.50 1257.22 44.73 1257.64 34.65 1342.70
1 2 4 5	10 UTS 2 3 4 5 7	= TPT  4 1 2 3	MFA1         OF         H         DL114           STANDAON         F0000           MFAN         OF         R         PL014           STANDAUN         F0000         MEA1         OF         R         PL014           STANDAUN         F0000         MEA1         OF         PL015         STANDAUN         F0000           MEA1         OF         N         PL015         STANDAUN         F0000           MEA1         OF         N         PL015         STANDAUN         F0000	0-10 CM	10-70 CM 10-70 CM 14.10 .63 11.87 .35 14.00 .27 16.83 .40	20-40 CM 450 PFP CM 7.35 6.01 .24 7.06 .27 R.08 .21	40-60 CM 	60-80 CM 2.25 .11 2.07 .05 2.55 .11 2.64 .09	TOTAL G/MS0 1238.24 44.50 1257.22 44.73 1257.0A 34.65 1342.79 44.65
1 2 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4	10 UTS 2 3 4 5 7	* TPT 4 1 2 3	ЧЕАЧ ОГ Н РЦОТС Стачпарт гроор Чеан ог в Рцотс Стачпарт гроор Неач ог ч Рцотс Стачпарт гроор Чеач ог ч Рцотс Стачпарт гроор	0-10 CM 57.83 2.36 55.27 2.04 60.15 1.03 61.43 3.27	10-20 Cm 04M5 PFR 1 14.10 .63 11.87 .35 14.00 .27 16.43 .40	20-40 CM 450 PFP CM 7.35 .37 6.01 .24 7.06 .27 R.08 .21	40-60 CM 	60-80 CM 2.25 .11 2.07 .05 2.55 .11 2.64 .09	TOTAL G/M50 1238.24 44.50 1257.22 44.73 1257.0A 34.65 1342.70 44.65
1	10 UTS ======= 3 4 5 7	= TPT 	44 44 0F + DLATC CTANDADD FORDD 46 44 0F & DLATC CTANDADD FORDD 46 44 0F & DLATC CTANDADD FORDD 46 44 0F + DLATC CTANDADD FORDD	0-L0 CM	10-20 Cm 50AMS DFR 1 14.10 .64 11.87 .35 14.00 .27 16.43 .40	20-40 CM 450 PFP CM 7.35 6.01 .24 7.06 27 8.07 8.07 8.07 8.07	40-60 CM NFDTH 3,96 .14 3,64 .10 3,66 .11 3,87 .13	60-80 CM 2.25 .11 2.07 .05 2.55 .11 2.64 .09	TOTAL 6/NSO 1238.24 44.50 1257.22 44.23 1257.08 34.65 1342.70 44.65
1 2 4 4 5 5 1 1 5 1 1 1 1 1 1 1 1 1 1 1 1 1	3 2 5 7 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	4 1 2 3 5 5 6 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7	мғач оғ н релте стачларп борор           чған оғ я релте           чған оғ я релте           чган а я я я я я я я я я я я я я я я я я я	0-10 CM	10-20 CM 10450 DFR 1 14.10 .63 11.87 .35 14.00 .27 16.83 .40	20-40 CM 450 PFP CM 7.35 6.01 .24 7.06 .27 R.08 .21	40-60 CM NFPTH 3,96 .14 3,64 .10 3,60 .11 3,87 .13	60-80 CM 2.25 .11 2.07 .05 2.55 .11 2.65 .11	TOTAL G/MSO 1238.24 44.50 1257.22 44.23 1257.0A 34.65 1342.79 44.65
1 2 4 4 5 5 1 5 1 5 1 7 4 6 5 5 1 7 5 1 7 6 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7	10 UTS = 3 4 5 7 7 10 UTS =	• TPT • • 1 ? • • • • • • • • • • • • •	ЧЕАЧ ОГ н РЦАТС СТАЧЛАОЛ ГОРОО ЧЕАН ОГ Я РЦОТС СТАЧЛАОЛ ГОРОО НЕАЧ ОГ Я РЦОТС СТАЧЛАОЛ ГОРОО ЧЕАЧ ОГ Я РЦОТС СТАЧЛАОЛ ГОРОО =700702	0-10 CM	10-20 CM 104MS DFR 1 14.10 .64 11.87 14.00 .27 16.83 .40 10-20 CM	20-40 CM 450 PFP Cu 7,35 6,01 .24 7,05 .27 R,n8 .21 .20-40 CM	40-60 CM	60-80 CM	TOTAL G/MS0 1238.24 44.50 1257.22 44.21 1257.0A 34.65 1342.70 44.65
======= 1 2 4 4 5 1 1 1 1 1 1 1 1 1 1 1 1 1	3 3 5 7 9 0 WTS	4 1 2 3 0ATE TPT	44 AN OF H DUATE STANDADD FODD 45 AN OF R DUATE STANDADD FODD MEAN OF A DUATE STANDADD FODD 46 AN OF H DUATE STANDADD FODD 46 AN OF H DUATE 5700702	0-L0 CM	10-20 CM 004MS DFR 1 14.10 .64 11.87 .35 14.00 .27 16.43 .40 .00 .27 .64 .00 .27 .64 .64 .00 .27 .64 .00 .00 .00 .00 .00 .00 .00 .0	20-40 CM 450 PFP Cu 7.35 6.01 .24 7.06 .77 R.08 .27 20-40 CM	40-60 CM	60-80 CM	TOTAL
======= 1 2 4 4 5 5 1 1 5 1 1 1 1 1 1 1 1 1 1 1 1 1	3 4 5 7 6 8 8 9 8 9 8 9 8 9 8 9 8 9 8 9 8 9 8 9	4 1 2 3 0ATE	MFAN OF Η ΡΙΟΤΟ           STANDADD FORDD           VFAN OF R ΡΙΟΤΟ           STANDADD FORDD           HEAN OF R ΡΙΟΤΟ           STANDADD FORDD           STANDADD FORDD           HEAN OF R ΟΙΟΤΟ           #700702	0-10 CM	10-20 CM 10450 PFR 1 14.10 .64 11.87 .35 14.00 .27 16.43 .40 .27 .64 .40 .27 .40 .40 .40 .40 .40 .40 .40 .40	20-40 CM 450 PFP CM 7.35 6.01 .24 7.06 .27 R.08 .21 20-40 CM	40-60 CM NFPTH 3.96 .14 3.66 .10 3.60 .11 3.87 .13 40-60 CM	60-80 CM	TOTAL G/MSO 1238.24 44.50 1257.22 44.23 1257.0A 34.65 1342.79 44.65 TOTAL
1 2 4 5 5 1 5 1 5 1 7 1	10 UTS = 3 4 5 7 5 7 5 7 5 7 5 7 10 UTS = 10 UTS =	4 1 2 3 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	ΨΕΑΝ ΟΕ Ν         ΦΕΑΝ ΟΕ Ν         ΦΕΑΝ ΟΕ Ν           ΨΕΑΝ ΟΕ Ν         ΦΕΑΝ ΟΕ Ν         ΦΕΑΝ ΟΕ Ν           ΨΕΑΝ ΟΕ ΙΑ ΡΙΟΤΟ         ΦΕΑΝ ΟΕ ΙΑ ΡΙΟΤΟ           ΞΤΟ0702         ΨΕΑΝ ΟΕ ΙΑ ΡΙΟΤΟ	0-10 CM	10-20 CM 104MS DFR 1 14.10 .67 14.07 .35 14.00 .27 16.43 .40 .27 16.43 .40 .27 10-20 CM .24 .24.61	20-40 CM 450 PFP Cu 7,35 .37 6,01 .24 7,06 .27 8,08 .27 8,08 .21 .20-40 CM 450 PFR CM 18,13	40-60 CM NFDTH 3.96 .14 3.64 .10 3.60 .11 3.87 .13 40-60 CM DEDTH 7.42	60-A0 CM 2.25 .11 2.07 .05 2.55 .11 2.64 .09 60-R0 CM	TOTAL G/MS0 1238.24 44.50 1257.22 44.23 1257.0A 34.65 1342.79 44.65 TOTAL G/MS0 2231.91
1 2 4 4 5]TF = wts an ======	3 8 5 7 7 9 AW 10 WTS =	4 1 2 3 0ATE TPT	ΨΕΑΎ ΟΕ Η ΡΕΩΤΕ           ΥΓΑΎ ΟΕ Η ΡΕΩΤΕ           ΥΓΑΥ ΟΕ ΡΕΩΤΕ           ΞΤΟ0702           ΨΕΑΝ ΟΕ ΙΑ ΡΕΩΤΕ           ΥΓΑΝ ΔΕΩ ΕΛΟΥ	0-L0 CM	10-20 CM 104NS PFR 1 14.10 .64 11.87 .35 14.00 .27 16.43 .40 10-20 CM 10-20 CM .24.61 .88	20-40 CM 450 PFP Cu 7.35 .37 6.01 .24 7.06 .27 R.08 .27 R.08 .21 20-40 CM 16.13 1.66	40-60 CM DFDTH 3.96 .14 3.64 .10 3.60 .11 3.87 .13 40-60 CM DEPTH 7.42 .23	60-80 CM 2.25 .11 2.07 .05 2.55 .11 2.64 .09 60-80 CM	TOTAL G/MSO 1238.24 44.50 1257.22 44.21 1257.0A 34.65 1342.70 44.65 TOTAL G/MSO 2231.91 69.69
1 2 4 5 5 5 5 1 2	3 4 5 7 7 8 9 AW 80 WTS 3	4 1 2 3 	wf Δη OF         μ Di NTG           STANDADD FODOD           WF Δη OF         μ Di NTG           STANDADD FODOD           MF Δη OF         μ Di NTG           STANDAUN FODOD           WF Δη OF         μ Di NTG           STANDAUN FODOD           ΨF Δη OF         μ Di NTG           STANDAUN FODOD           #FΔη OF         μ Di NTG           #700702           WFΔη OF         Α Pi NTG           STANDARD FROD           WFΔη OF         Α Pi NTG           STANDARD FROD	0-10 CM	10-20 CM 104MS PFR 1 14.10 .64 11.67 .35 14.00 .27 16.43 .40 10-20 CM PAMS PFR 4 .24.61 .84 .22.24	20-40 CM 450 PFP Cu 7.35 .37 6.01 .24 7.06 .27 R.nR .21 20-40 CM 16.13 1.66 11.02	4n-60 CM NFDTH 3.96 .14 3.64 .10 3.60 .11 3.87 .13 4n-60 CM DEDTH 7.42 .23 8.14	60-A0 CM 2.25 .11 2.07 .05 2.55 .11 2.64 .09 60-A0 CM	TOTAL G/MSO 1238.24 44.50 1257.22 44.23 1257.04 34.65 1342.79 44.65 1342.79 44.65 TOTAL G/MSO 2231.91 69.69
1 2 4 5 511F = 1 2	3 2 5 7 7 8 9 Aw 10 wTS = 3 8	4 1 2 3 0 ATE TPT 4	ΨΕΑΥ ΟΕ Η ΡΙΩΤΟ           ΥΓΑΥ ΟΕ Η ΡΙΩΤΟ           ΥΓΑΥ ΟΕ Α ΡΙΩΤΟ           ΥΓΑΥ ΟΕ ΙΑ ΡΙΩΤΟ	0-L0 CM	10-20 CM 100ANS DFR 1 14.10 .64 11.87 .35 14.00 .27 16.43 .40 .27 16.43 .40 .27 .40 .27 .40 .27 .40 .27 .40 .27 .40 .27 .40 .27 .40 .27 .40 .40 .27 .40 .40 .27 .40 .40 .27 .40 .40 .40 .27 .40 .40 .40 .40 .40 .40 .40 .40	20-40 CM 450 PFP Cu 7.35 .37 6.01 .24 7.06 .7.0 R.08 .21 20-40 CM 18.13 1.66 11.02 .34	40-60 CM DFDTH 3.96 .14 3.64 .10 3.60 .11 3.87 .13 40-60 CM DEDTH 7.42 .23 8.14	60-A0 CM 2.25 .11 2.07 .05 2.55 .11 2.64 .09 60-A0 CM 4.42 .09 15.77 2.78	TOTAL G/MSO 1238.24 44.50 1257.22 44.23 1257.0A 34.65 1342.79 44.65 TOTAL G/MSO 2231.91 69.69 2056.86 73.41
1 2 4 5 11F = wts an 1 2	3 4 5 7 7 9 AW 10 WTS 3 8	4 1 2 3 0ATE TPT	wf Δy OF         μ DL OTC           STANDADD         F000D           #600702         #FAN OF           wf Δy OF         16           wf Δy OF         16           STANDARD         FROP           wf Δy OF         16           STANDARD         FROP	0-L0 CM	10-20 CM 10-20 CM 14.10 .63 14.00 .77 16.43 .40 10-20 CM 10-20 CM 24.61 .84 22.24 1.39 1.67 .64 .64 .64 .64 .64 .64 .64 .64	20-40 CM 450 PFP CM 7.35 6.01 .24 7.06 .27 R.08 .27 R.08 .21 .24 .20-40 CM 18.13 1.66 11.02 .34 .56 .34 .56 .37 .24 .24 .24 .25 .24 .24 .24 .24 .24 .24 .24 .24	40-60 CM DFDTH 3.96 .14 3.64 .10 3.60 .11 3.87 .13 40-60 CM DEDTH 7.42 .23 8.14 .33 4.71	60-A0 CM 2.25 .11 2.07 .05 2.55 .11 2.64 .09 60-A0 CM 60-A0 CM 15.77 2.78	TOTAL 6/MS0 1238.24 44.50 1257.22 44.21 1257.0A 34.65 1342.70 44.65 TOTAL 6/MS0 2231.91 69.69 2056.86 73.41
1 2 4 5 5 5 1 2 4 1 2 4	3 8 5 7 7 9 AW 3 8 9 5	4 1 2 3 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	ΨΕΑΥ ΟΕ Η ΡΙΩΤΟ           ΥΓΑΥ ΟΑΟ ΕΡΟΟΟ           ΨΓΑΥ ΟΕ Α ΡΙΩΤΟ           ΥΓΑΥ ΟΕ ΙΑ ΡΙΩΤΟ           ΞΤΟΟΤΟ2           ΨΕΑΝ ΟΕ ΙΑ ΡΙΩΤΟ           ΥΓΑΝ ΟΕ ΙΑ ΡΙΩΤΟ	0-10 CM	10-20 CM 104MS DFR 1 14.10 .67 14.07 .35 14.07 .27 16.M3 .40 .27 10-20 CM .24.61 .84 22.24 1.39 16.09 .27 .27 .27 .27 .24.61 .84 .27 .27 .27 .27 .27 .27 .27 .27	20-40 CM 450 PFP Cu 7.35 .37 6.01 .24 7.06 .27 R.nR .21 .20-40 CM 150 PFR CM 18.13 1.66 11.07 .34 15.63	40-60 CM NFDTH 3.966 .14 3.64 .10 3.60 .11 3.87 .13 40-60 CM DE0TH 7.42 .23 8.14 .33 4.71	60-A0 CM 2.25 .11 2.07 .05 2.55 .11 2.64 .09 60-R0 CM 60-R0 CM 15.77 2.76 3.13	TOTAL G/MS0 1238.24 44.50 1257.22 44.23 1257.0A 34.65 1342.70 45.65 1342.70 45.65 1342.70 45.65 1345.75 1345.75 1345.75 1345.75 1345.75 1345.75 1345.75 1345.75 1345.75 1345.75 1345.75 1345.75 1345.75 1345.75 1345.75 1345.75 1345.75 1345.75 1345.75 135.7
1 2 4 5 11F = wT5 4N ======= 1 2 4	3 25 7 7 7 8 9 AW 10 WTS = 3 8 5 5	4 1 2 3 0 AATE TPT 4 1 2	ΨΕΑΥ ΟΕ Η ΡΙΟΤ           ΥΓΑΥ ΟΕ Η ΡΙΟΤ           ΥΓΑΥ ΟΕ Α ΡΙΟΤ           ΞΤΟΟΤΟ2           ΨΕΑΝ ΟΕ ΙΑ ΡΙΟΤ           ΥΓΑΝ ΟΕ ΙΑ ΡΙΟΤ           ΥΓΑΝΟΕ ΙΑ ΡΙΟΤ	0-L0 CM	10-20 CM 10-20 CM 14.10 .64 11.87 .35 14.00 .27 16.43 .40 .27 16.43 .40 .27 16.43 .40 .27 16.43 .40 .27 .24.61 .84 .22.24 1.39 .23 .24.91 .84 .25.2	20-40 CM 450 PFP Cu 7.35 .37 6.01 .24 7.06 .77 R.08 .21 20-40 CM 16.13 1.66 11.02 .34 15.63 1.01	40-60 CM DFDTH 3.96 14 3.64 10 3.60 11 3.87 13 40-60 CM 40-60 CM 23 8.14 .33 4.71 .16 7.42 .23 8.14 .33 4.71 .16 .17 .17 .17 .17 .17 .17 .17 .17	60-A0 CM 2.25 .11 2.07 .05 2.55 .11 2.64 .09 60-A0 CM 4.42 .09 15.77 2.76 3.13 .08	TOTAL G/MSO 1238.24 44.50 1257.22 44.73 1257.0A 34.65 1342.70 44.65 TOTAL G/MSO 2231.91 69.69 2056.84 73.41 1777.70 40.60
1 2 4 5 11F = wt5 3N 1 2 4	10 UTC 2 3 4 5 7 7 10 WTS 3 10 WTS 3 11 S 11	4 1 2 3 1 1 2 1 1 2 3	wf Δ <sup>4</sup> ) OF         μ Di DTG           STANDAON FODOD           WF Δ <sup>4</sup> ) OF         R Di DTG           STANDADN FODOD           WF Δ <sup>4</sup> ) OF         R Di DTG           STANDAUN FODOR           WF Δ <sup>4</sup> ) OF         N Di DTG           STANDAUN FODOR           WF Δ <sup>4</sup> ) OF         N Di DTG           STANDAUN FODOR           WF Δ <sup>4</sup> ) OF         N DI DTG           STANDAUN FODOR           WF Δ <sup>4</sup> ) OF         N DI DTG           STANDARD FROD           WF Δ <sup>4</sup> ) OF         A DLOTG           STANDARD FROP           WF Δ <sup>4</sup> ) OF         15 DLOTG           STANDARD FROP           WF Δ <sup>4</sup> ) OF         16 DLOTG           STANDARD FROP           WF Δ <sup>4</sup> ) OF         16 DLOTG           STANDARD FROP           WF Δ <sup>4</sup> ) OF         16 DLOTG	0-L0 CM	10-20 CM 10-20 CM 14.10 .63 14.00 .77 16.43 .40 10-20 CW 10-20 CW 24.61 .87 22.24 1.39 16.09 .29 19.41	20-40 CM 450 PFP Cu 7.35 .27 6.01 .24 7.06 .27 R.08 .21 20-40 CM 16.13 1.66 11.02 .34 15.63 1.61 11.69	40-60 CM NFDTH 3.96 .14 3.64 .10 3.60 .11 3.87 .13 40-60 CM 40-60 CM 0E0TH 7.42 .23 8.14 .33 4.71 .16 7.11	60-A0 CM 2.25 .11 2.07 .05 2.55 .11 2.64 .09 60-R0 CM 60-R0 CM 4.42 .09 15.77 2.76 3.13 .08 5.05	ToTAL 6/MS0 1238.24 44.50 1257.22 44.23 1257.0A 34.65 1342.79 44.65 TOTAL TOTAL 6/MS0 2231.91 69.69 2056.84 73.41 1777.70 40.60 2475.40
1 2 4 5 5 5 1 2 4 5 1 2 4 5	3 8 5 7 9 AW 10 WTS 3 9 5 7	4 1 2 3 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	ΨΕΑΥ ΟΓ Η ΡΙΟΤ           ΥΓΑΥ ΟΓ ΙΑ ΡΙΟΤ           ΥΓΑ	0-10 CM	10-20 CM 104MS DFR 1 14.10 .63 14.00 .27 16.43 .40 10-20 CM 10-20 CM 10-20 CM 24.61 .84 24.61 .84 1.39 16.09 .29 19.41 .37	20-40 CM 450 PFP Cu 7.35 .37 6.01 .24 7.06 .27 R.nR .21 20-40 CM 18.13 1.66 11.02 .34 15.63 1.01 11.88 .28	40-60 CM DFDTH 3.966 .14 3.64 .10 3.60 .11 3.87 .13 40-60 CM DEPTH 7.42 .23 8.14 .33 4.71 .16 7.11 .11	60-A0 CM 2.25 .11 2.07 .05 2.55 .11 2.64 .09 60-A0 CM 60-A0 CM 15.77 2.78 3.13 .08 5.05 .15	TOTAL G/MSO 1238.24 44.50 1257.22 44.23 1257.0A 34.65 1342.79 45.65 1342.79 40.69 69.69 73.61 177.76 40.40 69.97
1 2 4 511F = wts an 1 2 4	3 2 5 7 7 7 8 8 8 7 3 8 5 7 7	4 1 2 3 0 AATE TPT 4 1 2 3	ΨΕΑΥ ΟΕ Η ΡΙΟΤ           ΥΓΑΥ ΟΕ Η ΡΙΟΤ           ΥΓΑΥ ΟΕ ΑΡΟΤΟ           ΨΓΑΥ ΟΕ ΑΡΟΤΟ           ΥΓΑΥ ΟΕ ΑΡΟΤΟ           ΞΤΟΟΤΟΖ           ΞΤΟΟΤΟΖ           ΨΕΑΝ ΟΕ ΙΑ ΡΙΟΤ           ΥΓΑΝ ΟΕ ΙΑ ΡΙΟΤ           ΥΓΑΝΟΑΡΟ ΕΡΒΟΡ           ΨΕΑΝ ΟΕ ΙΑ ΡΙΟΤ           ΥΓΑΝΟΑΡΟ ΕΡΒΟΡ           ΨΕΑΝ ΟΕ ΙΑ ΡΙΟΤ           ΥΓΑΝΟΑΡΟ ΕΡΒΟΡ           ΨΕΑΝ ΟΕ ΙΑ ΡΙΟΤ           ΥΠΑΝΟΑΡΟ ΕΡΒΟΡ           ΨΕΑΝ ΟΕ ΙΑ ΡΙΟΤ           ΥΓΑΝΟΑΡΟ ΕΡΒΟΡ           ΨΕΑΝΟΑΡΟ ΕΡΡΟΡ	0-L0 CM	10-20 CM 10-20 CM 14.10 .64 11.87 .35 14.00 .27 16.43 .40 10-20 CW 10-20 CW 10-20 CW 24.61 .84 22.24 1.39 16.09 .29 19.41 .37	20-40 CM 450 PFP Cu 7.35 .37 6.01 .24 7.06 .77 R.08 .27 R.08 .21 .20-40 CM 16.13 1.66 11.07 .34 15.63 1.01 11.88 .28	40-60 CM DFDTH 3.96 14 3.64 10 3.60 11 3.87 13 40-60 CM 40-60 CM 0E0TH 7.42 23 8.14 .33 4.71 .16 7.11 .11	60-A0 CM 2.25 .11 2.07 .05 2.55 .11 2.64 .09 60-A0 CM 60-A0 CM 4.42 .09 15.77 2.76 3.13 .08 5.05 .15	TOTAL G/MSO 1238.24 44.50 1257.22 44.23 1257.0A 34.65 1342.70 44.65 TOTAL G/MSO 2231.91 69.69 2056.84 73.41 1777.70 40.60 2475.40
1 2 4 5 5 1 7 2 4 5 1 2 4 5	3 4 5 7 7 8 9 80 wTS = 3 8 5 7	4 1 2 3 1 1 2 1 1 2 3	wf Δ <sup>4</sup> ) OF       μ Di ntc         STANDADD FDDOD         WFΔ <sup>4</sup> ) OF       R Di ntc         STANDADD FDDOD         wFΔ <sup>4</sup> ) OF       9 Di ntc         STANDAUD FDDOD         wFΔ <sup>4</sup> ) OF       9 Di ntc         STANDAUD FDDOD         wFΔ <sup>4</sup> ) OF       μ Di ntc         STANDAUD FDDOD         wFΔ <sup>4</sup> ) OF       μ Di ntc         STANDADD FDDOD         #FΔN OF       Ι DI ntc         STANDADD FROD         #FΔN OF       Ι A DL Ntc         STANDADD FROD         WFΔN OF       Ι A DL Ntc         STANDADD FROD         WFΔN OF       Ι A DL Ntc         STANDADD FROD         WFΔN OF       Ι A DL Ntc         STANDADD FROD         WFAN OF       Ι A DL Ntc         STANDADD FROD         WFAN OF       Ι A DL Ntc         STANDADD FROD         WFAN OF       Ι A DL Ntc         STANDADD FROD       STANDADD FOROD         WFAN OF       Ι A DL NTC         STANDADD FROD       STANDADD FOROD	0-10 CM	10-20 CM 104MS PFR 1 14.10 .64 11.67 .36 14.00 .27 16.43 .40 10-20 CM 10-20 CM .2461 .84 22.24 1.39 16.09 .29 19.41 .37	20-40 CM 7.35 .37 6.01 .24 7.06 .27 8.08 .27 8.08 .27 8.08 .27 8.08 .27 8.08 .27 8.08 .27 8.08 .27 8.08 .27 8.08 .27 8.08 .21 .20 .20 .20 .20 .20 .20 .20 .20 .20 .20	4n-60 CM NFDTH 3.96 .14 3.64 .10 3.60 .11 3.87 .13 4n-60 CM DEPTH 7.42 .23 8.14 .33 4.71 .11 .11	60-A0 CM 2.25 .11 2.07 .05 2.55 .11 2.64 .09 60-A0 CM 60-A0 CM 4.42 .09 15.77 2.76 3.13 .08 5.05 .15	ToTAL 6/MS0 1238.24 44.50 1257.22 44.23 1257.0A 34.65 1342.70 45.65 1342.70 45.65 1342.70 45.65 1342.75 45.65 1342.75 45.65 1342.75 45.65 1342.75 45.65 1345.75 1345.75 135.75
1 2 4 5 5 1 7 1 2 4 5 1 1 2 4 5 5 1 1 2 4 5 5	3 4 5 7 PAW 10 WTS = 3 8 5 7 7 2 2 2 3 8 5 7 2 2 3 8 5 7 2 3 8 5 7 2 3 8 5 7 2 3 8 5 7 2 5 7 2 5 7 2 5 7 2 5 7 2 5 7 2 5 7 7 2 7 7 7 7 7 7 7 7 7 7 7 7 7	4 1 2 3 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	ΨΕΑΝ ΟΕ Η ΡΙΟΤ         ΥΓΑΝ ΟΕ ΡΕΡΟΟ         ΨΓΑΝ ΟΕ ΑΡΙΟΤ         ΥΓΑΝ ΟΕ ΑΡΙΟΤ         ΥΓΑΝ ΟΕ ΑΡΙΟΤ         ΥΓΑΝ ΟΕ ΑΡΙΟΤ         ΥΓΑΝ ΟΕ ΙΑ ΡΙΟΤ         Ξ700702         ΨΕΑΝ ΟΕ ΙΑ ΡΙΟΤ         ΥΓΑΝ ΟΕ ΙΑ ΡΙΟΤ         ΥΓΑΝΟΑΠ ΕΡΟΡΟ         ΞΤΟΟΘΑΖ         ΞΤΟΘΑΖ	0-10 CM	10-20 CM 1004MS DFR 14.10 .64 11.87 .36 14.00 .27 16.43 .40 10-20 CM 10-20 CM 24.61 .88 22.24 1.39 16.09 .29 19.41 .37	20-40 CM 450 PFP Cu 7.35 .37 6.01 .24 7.06 .27 R.nR .21 20-40 CM 18.13 1.66 11.07 .34 15.63 1.01 11.88 .28	40-60 CM NFDTH 3.96 .14 3.64 .10 3.60 .11 3.87 .13 40-60 CM DE0TH 7.42 .23 8.14 .33 4.71 .16 7.11 .11	60-A0 CM 2.25 .11 2.07 .05 2.55 .11 2.64 .09 60-R0 CM 60-R0 CM 15.77 2.78 3.13 .08 5.05 .15	TOTAL G/MSO 1238.24 44.50 1257.22 44.23 1257.0A 34.65 1342.79 44.65 TOTAL G/MSO 2231.91 69.69 2056.86 73.41 1777.70 40.40 69.97 TOTAL
1 2 4 4 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5	3 4 5 7 7 8 9 8 9 5 7 7 2 9 8 5 7	4 1 2 3 0ATE 7 3 3 3 3	wF AN OF       μ DLATC         STANDADD F000D       F000D         #FAN OF       μ DLATC         STANDARD F000D       μFAN OF         #FAN OF       16 PLATC         STANDARD F000D       μFAN OF         WFAN OF       16 PLATS         STANDARD F000D       μEAN OF         S	0-L0 CM	10-20 CM 10-20 CM 14.10 .67 14.00 .77 16.43 .40 10-20 CM 10-20 CM 1.37 16.09 .29 19.41 .37 10-20 CM	20-40 CM 450 PFP CM 7.35 .37 6.01 .24 7.06 7.06 7.06 .27 R.08 .21 20-40 CM 16.13 1.66 11.02 .34 15.63 1.01 11.88 .28 .20-40 CM	40-60 CM NFDTH 3.96 .14 3.64 .10 3.60 .11 3.87 .13 40-60 CM DEPTH .23 8.14 .33 4.71 .16 7.11 .11 .11	60-80 CM	TOTAL G/MSO 1238.24 44.50 1257.22 44.73 1257.0A 34.65 1342.70 44.65 TOTAL G/MSO 2231.91 69.69 2056.86 73.41 1777.70 40.40 2475.40 69.97 TOTAL
1 2 4 5 5 5 5 5 5 5 5 5 5 5 5 5	3 4 5 7 7 7 7 7 7 3 8 5 7 7 7 7 7 7 7 7 7 7 7 7 7	4 1 2 3 0 0 0 1 2 3 3 1 2 3 3	wf Δ <sup>4</sup> 1 OF       μ Di Di C         CTANDADD FODOD         WF Δ <sup>4</sup> 1 OF       μ Di Di C         CTANDADD FODOD         WF Δ <sup>4</sup> 1 OF       μ Di Di C         CTANDADD FODOD         STANDAUD FODOD         WF Δ <sup>4</sup> 1 OF       μ Di Di C         STANDAUD FODOD         WF Δ <sup>4</sup> 1 OF       μ Di Di C         STANDAUD FODOD         #FΔ1 OF       μ Di Di C         STANDADD FODOD         #FΔN OF       A DI C         #FΔN OF       A DI C         WFΔN OF       A DI C         WFΔN OF       I A DI C         STANDAPD FOROP       WFAN OF         WFAN OF       I A DI C         STANDAPD FOROP       WFAN OF         WFAN OF       I A DI C         STANDAPD FOROP       NFAN         WFAN OF       I A DI C         STANDAPD FOROP       STANDAPD FOROP         WFAN OF       I A DI C         STANDAPD FOROP       STANDAPD FOROP         STANDAPD FOROP       STANDAPD FOROP         STANDAPA FOROP       STANDAP         STANDAPA FOROP       STANDAP         STANDAPA FOROP       STANDAP         STANDAPA FOROP       STANDAP	0-10 CM	10-20 CM 104MS PFR 1 14.10 .67 14.00 .27 16.H3 .40 10-20 CM PAMS PFR 4 .24.61 .8A 22.24 1.39 16.09 .29 19.41 .37 10-20 CM	20-40 CM 450 PFP CM 7.35 .37 6.01 .24 7.06 .27 R.nR .21 20-40 CM 18.13 1.66 11.02 .34 15.63 1.01 11.88 .28	4n-60 CM NFDTH 3.96 .14 3.64 .10 3.60 .11 3.87 .13 4n-60 CM DEDTH 7.42 .23 8.14 .33 4.71 .11 .11	60-80 CM 2.25 .11 2.07 .05 2.55 .11 2.64 .09 60-80 CM 4.42 .09 15.77 2.78 3.13 .08 5.05 .15	TOTAL G/MS0 1238.24 44.50 1257.22 44.23 1257.0A 34.65 1342.70 44.65 1342.70 44.65 TOTAL G/MS0 2231.91 69.69 2056.86 73.41 1777.70 40.40 2475.40 69.97 TOTAL
1 2 4 5 5 5 1 2 4 5 5 1 2 4 5 5 1 2 4 5 5 1 2 4 5 5 1 5 5 1 5 5 1 5 5 5 5 5 5 5 5 5 5 5 5 5	3 3 5 7 PAW 10 WTS 3 8 5 7 5 7 5 7 8 8 5 7 8 8 5 7 8 8 5 7 8 8 5 7 8 8 5 7 8 8 5 7 8 8 8 7 8 8 8 8 8 8 8 8 8 8 8 8 8	4 1 2 3 0ATE TOT 4 1 2 3 3 3	wf Δy OF H DLOTC         STANDADD FODDD         WFΔY OF H DLOTC         STANDADD FODDD         WFΔY OF H DLOTC         STANDADD FODDR         WFΔY OF H DLOTC         STANDADD FODDR         #FΔY OF H DLOTC         STANDADD FODDR         #FΔY OF H DLOTC         STANDADD FODDR         #FΔY OF IA DLOTC         STANDARD FOROP         #FΔY OF IA DLOTC         STANDARD FOROP         WFAN OF IA DLOTC         STANDARD FOROP         WFAN OF IA DLOTS         STANDAPD FOROP         WFAN OF IA DLOTS         STANDAPD FOROP         WFAN OF IA PLOTS         STANDAPD FOROP         WFAN OF IA PLOTS         STANDAPD FOROP         WFAN OF IA PLOTS         STANDAPD FOROP         STANDAPD FOROP         WFAN OF IA PLOTS         STANDAPA FOROP         STANDAPA FOROP         WFAN OF IA PLOTS         STANDAPA FOROP         STANDAPA FOROP         STANDAPA FOROP         WFAN OF IA PLOTS         STANDAPA FOROP         STANDAPA FOROP         STANDAPA FOROP         STANDAPA FOROP     <	0-10 CM	10-20 CM 1004MS PFR 1 14.10 .64 11.87 .36 14.00 .27 16.43 .40 10-20 CM 10-20 CM 1.39 16.09 .29 19.41 .37 10-20 CM	20-40 CM 450 PFP Cu 7.35 .37 6.01 .24 7.06 .27 R.07	40-60 CM NFDTH 3.96 .14 3.64 .10 3.60 .11 3.87 .13 40-60 CM DE0TH 7.42 .23 8.14 .33 4.71 .16 7.11 .11 .11	60-A0 CM 2.25 .11 2.07 .05 2.55 .11 2.64 .09 60-A0 CM 4.42 .09 15.77 2.78 3.13 .08 5.05 .15	TOTAL G/MS0 1238.24 44.50 1257.22 44.23 1257.0A 34.65 1342.79 44.65 TOTAL G/MS0 2231.91 69.69 2056.84 73.61 1777.70 40.40 69.97 TOTAL G/MS0
1 2 4 4 5 1 5 1 2 4 5 1 2 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5	3 4 5 7 7 9 AW 10 WTS 3 8 5 7 7 7 7 8 9 AW 5 7 7 7 8 9 AW 8 9 AW 9 AW 9 AW 9 AW 9 AW 9 AW 9 AW 9 AW	4 1 2 3 1 2 1 2 3 1 2 3 3 3 1 2 3	wf A4) OF H DL 11C         STANDADD FDDOD         WF A4) OF R DL 11C         STANDADD FDDOD         WF A4) OF R DL 11C         STANDADD FDDOD         WF A4) OF H DL 11C         STANDADD FDDOD         WF A4) OF H DL 11C         STANDADD FDDOD         #FAN OF 1A DL 11C         STANDADD FDDOD         #FAN OF 1A DL 11C         STANDADD FDDOD         #FAN OF 1A DL 11C         STANDADD FDROD         WFAN OF 1A DL 15         STANDADD FDROD         WEAN OF 1A DL 15         STANDADD FDROD         STANDADD FDROD         WEAN OF 1A DL 15         STANDADAD FDDOD         STANDADAD FDROD         WEAN OF 16 DL015         STANDADAD FDROD         WEAN OF 16 DL015         STANDADAD FDDOD	0-10 CM	10-20 CM 100ANS DFR 1 14.10 .67 14.00 .77 16.43 .40 10-20 CM 10-20 CM 10-20 CM 1.37 10-20 CM 10-20 CM 10-20 CM 10-20 CM	20-40 CM 450 PFP CM 7.35 .27 6.01 .24 7.06 .27 R.08 .21 .20-40 CM 16.13 1.66 11.02 .34 15.63 1.01 11.88 .28 .29 .20-40 CM .29 .20-40 CM .20 .20 .20 .20 .20 .20 .20 .20	40-60 CM NFDTH 3.96 .14 3.64 .10 3.60 .11 3.87 .13 40-60 CM DEPTH 0EPTH 7.03	60-A0 CM 2.25 .11 2.07 .05 2.55 .11 2.64 .09 60-R0 CM 4.42 .09 15.77 2.76 3.13 .08 5.05 .15 60-A0 CM	ToTAL G/MSQ 1238.24 44.50 1257.22 44.21 1257.23 1257.23 44.65 1342.79 44.65 1342.75 40 69.97 TOTAL G/MSQ 1863.75
1 2 4 5 5 5 5 5 5 5 5 5 5 5 5 5	3 4 5 7 7 7 7 7 3 8 7 7 7 7 7 7 7 7 7 7 3 8 5 7 3 8 5 7 3 8 5 7 3 8 5 7 3 8 5 7 3 8 5 7 3 8 5 7 3 8 5 7 3 8 5 7 3 8 5 7 3 8 5 7 3 8 5 7 3 8 5 7 3 8 5 7 3 8 5 7 5 7 5 7 5 7 5 7 7 5 7 7 7 7 7 7 7 7 7 7 7 7 7	4 1 2 3 0ATE 1 2 3 4 1 2 3 3	ΨΕΑΝ ΟΕ Η ΡΙΩΤΟ         ΥΓΑΝ ΟΑΟΛ ΕΦΡΟΟ         ΨΓΑΝ ΟΕ Α ΡΙΩΤΟ         ΥΓΑΝ ΟΕ Α ΡΙΩΤΟ         ΥΓΑΝ ΟΕ Α ΡΙΩΤΟ         ΥΓΑΝ ΟΕ Α ΡΙΩΤΟ         ΥΓΑΝ ΟΕ Α ΡΙΩΤΟ         Ξ700702	0-10 CM	10-20 CM 100AMS DFR 1 14.10 .63 14.00 .27 16.43 .27 16.43 .40 10-20 CM 24.61 .84 22.24 1.39 16.09 .29 19.41 .37 10-20 CM GRAMS DFR 4 13.16 .21 .21 .21 .21 .21 .21 .21 .21	20-40 CM 450 PFP CM 7.35 .37 6.01 .24 7.06 .27 R.08 .27 R.08 .27 8.0 PFR CM 18.13 1.66 11.07 .34 15.63 1.01 11.88 .28 .20-40 CM .29 .20-40 CM .20 .20 .20 .20 .20 .20 .20 .20	40-60 CM NFDTH 3.96 .14 3.64 .10 3.60 .11 3.87 .13 40-60 CM DE0TH 0E0TH 10EPTH	60-A0 CM 2.25 .11 2.07 .05 2.55 .11 2.64 .09 60-A0 CM 15.77 2.78 3.13 .08 5.05 .15 60-A0 CM	TOTAL G/MSQ 1238.24 44.50 1257.22 44.23 1257.0A 34.65 1342.70 40.69 69.69 107.70 40.65 107.70 40.65 107.70 40.65 107.70 40.65 107.70 40.65 107.70 107.70 40.65 107.75 107.70 107.70 107.75
1 2 4 5 5 5 1 2 4 5 5 5 5 5 5 1 2 4 5 5 1 2 4 5 5 1 2 4 5 5 5 5 5 5 5 5 5 5 5 5 5	3 2 3 3 5 7 3 8 5 7 3 8 5 7 5 7 5 7 5 7 5 7 5 7 3 8 5 7 3 8 5 7 3 8 5 7 3 8 5 7 3 8 5 7 3 8 5 7 7 8 8 7 7 8 8 7 7 8 8 7 7 8 8 7 7 8 8 7 7 8 8 7 7 8 8 7 7 8 8 7 7 8 8 7 7 8 8 7 7 8 8 7 7 8 8 7 7 7 8 8 7 7 8 8 7 7 7 8 8 7 7 8 8 7 7 8 8 7 7 8 8 7 7 8 8 7 7 8 8 7 7 8 8 7 7 8 8 8 7 7 8 8 7 7 8 8 7 7 8 8 7 7 8 8 7 7 8 8 8 7 7 8 8 8 8 8 8 8 8 8 8 8 8 8	4 1 2 3 0ATE TOT 4 1 2 3 3 4 1 2 3	wf Any OF A DLATC         STANDADD FODDD         wf Any OF A DLATC         STANDADD FODDD         wf Any OF A DLATC         STANDADD FODDR         wf Any OF A DLATC         STANDADD FODDR         wf Any OF A DLATC         STANDADD FODDR         #FAN OF A DLATC         STANDARD FROP         #FAN OF A DLATC         STANDARD FROP         #FAN OF A DLATC         STANDARD FROP         WFAN OF A DLATC         WFAN OF A DLATC         WFAN OF A DLATC         STANDARD FROP         WFAN OF A DLATC	0-10 CM	10-20 CM 1004MS PFR 1 14.10 .64 11.87 .36 14.00 .27 16.43 .40 10-20 CM .29 10-20 CM .29 19.41 .37 10-20 CM .29 19.41 .37 .37 .37 .37 .37 .37 .37 .37	20-40 CM 450 PFP Cu 7.35 .37 6.01 .24 7.06 .27 R.08 .27 R.08 .21 .20-40 CM 16.13 1.66 11.02 .34 15.63 1.01 11.88 .28 .20-40 CM .24 .24 .24 .25 .20-40 CM .24 .24 .24 .24 .24 .24 .24 .24	40-60 CM DFDTH 3.96 .14 3.64 .10 3.60 .11 3.87 .13 40-60 CM DEDTH .16 7.42 .23 8.14 .33 4.71 .16 7.41 .11 .11 .11 .11 .11 .11 .11	60-A0 CM 2.25 .11 2.07 .05 2.55 .11 2.64 .09 60-A0 CM 4.42 .09 15.77 2.78 3.13 .08 5.05 .15 .15	TOTAL G/MSQ 1238.24 44.50 1257.22 44.23 1257.0A 34.65 1342.70 44.65 TOTAL G/MSQ 2056.84 73.61 1777.70 40.60 2056.84 69.97 TOTAL TOTAL G/MSQ 1863.75 33.13 1894.69
1 2 4 5 5 5 1 2 4 5 5 5 5 5 5 1 2 4 5 5 5 1 2 4 5 5 5 5 5 5 5 5 5 5 5 5 5	3 4 5 7 7 8 9 8 9 8 7 7 7 7 7 7 8 7 7 8 7 7 8 7 7 8 7 8	4 1 2 3 1 2 3 1 2 3 3 1 2 3 3 1 2 3	wf A4 OF H DL 11C         STANDADD FDDDD         WF A4 OF R DL 11C         STANDADD FDDDD         WF A4 OF R DL 11C         STANDADD FDDDD         WF A4 OF H DL 11C         STANDADD FDDDD         WF A4 OF A DL 11C         STANDADD FDDDD         #FAN OF A DL 11C         STANDADD FDDDD         #FAN OF A DL 11C         STANDADD FDDDD         #FAN OF A DL 15         STANDADD FDRDD         WFAN OF A DL 16         STANDADD FDRDD         WFAN OF A DL 16         STANDADD FDRDD	0-10 CM	10-20 CM 14.10 .64 14.10 .7 14.00 .7 14.00 .7 16.03 .7 10-20 CM .7 10-20 CM .7 10-20 CM .7 .7 .7 .7 .7 .7 .7 .7 .7 .7	20-40 CM 450 PFP CM 7.35 .27 6.01 .24 7.06 .27 R.nR .21 20-40 CM 18.13 1.66 11.02 .34 15.63 1.01 11.89 .28 .20-40 CM .24 .24 .24 .25 .20 .20 .24 .24 .25 .25 .25 .25 .25 .25 .25 .25	40-60 CM NFDTH 3.96 .14 3.64 .10 3.60 .11 3.87 .13 40-60 CM DEDTH .23 8.14 .33 4.71 .11 .11 .11 .11 .11 .11 .11	60-A0 CM 2.25 .11 2.07 .05 2.55 .11 2.64 .09 60-A0 CM 4.42 .09 15.77 2.76 3.13 .08 5.05 .15 .15 .15 .15 .15 .15 .15 .15 .12 .60-20 CM	TOTAL G/MSO 1238.24 44.50 1257.22 44.23 1257.0A 34.65 1342.70 44.65 1342.70 44.65 1342.70 44.65 1342.70 44.65 2231.91 69.69 2056.86 73.41 1777.70 40.60 2475.40 69.97 TOTAL G/MSO 1864.75 33.13 1894.69 45.66
1 2 4 5 5 5 5 5 1 2 4 5 5 5 1 2 4 5 1 2 4 5 5 1 2 4 5 5 1 5 1 1 5 1 1 1 1 1 1 1 1 1 1 1 1 1	3 4 5 7 7 7 7 3 8 7 7 7 7 7 7 7 7 7 8 9 8 9 8 7 7 7 8 9 8 9 8 7 7 8 9 8 8 8 8 8 8 8 8 8 8 8 8 8	4 1 2 3 1 2 1 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7	wf Any OF       A DLATE         STANDADD FORDD       WFAN OF       A DLATE         STANDADD FORDD       MFAN OF       A DLATE         #FAN OF       A DLATE       A DLATE         #FAN OF       IA PLATE       STANDARD FORDD         #FAN OF       IA PLATE	0-10 CM	10-20 CM 1004MS PFR 1 14.10 .64 11.87 .36 14.00 .27 16.43 .40 10-20 CM 10-20 CM 1.39 10-20 CM 10-20 CM 10-20 CM 10-20 CM 13.16 .21 16.71 .33 16.11	20-40 CW 350 PFP Cu 7.35 .37 6.01 .24 7.06 .27 R.nR .21 20-40 CW 18.13 1.66 11.02 .34 15.63 1.01 11.88 .28 .20-40 CW .20-40 CW	40-60 CM NFDTH 3.96 .14 3.64 .10 3.60 .11 3.87 .13 40-60 CM DE0TH 7.42 .23 8.14 .33 4.71 .16 7.11 .11 .11 .11 .11 .11 .12 .12	60-A0 CM 2.25 .11 2.07 .05 2.55 .11 2.64 .09 60-A0 CM 15.77 2.78 3.13 .08 5.05 .15 .15 .05 .15 .05 .15 .05 .12 .00 .12 .00 .12 .09	TOTAL G/MSO 1238.24 44.50 1257.22 44.23 1257.0A 34.65 1342.79 44.65 1342.79 44.65 1342.79 44.65 1342.79 45.66 73.41 1777.70 40.40 69.97 TOTAL G/MSO 1863.75 33.13 1894.69 45.06 1944.81
1 2 4 5 5 5 5 5 5 5 5 5 5 5 5 5	3 4 5 7 7 7 7 7 7 7 7 7 7 7 7 7	4 1 2 3 0ATE TPT 4 1 2 3 3 3 5 5 5 5 7 7 7 7 7 7 7 7 7 7 7 7 7	wf A4) OF H DI NTC       STANDADD FODDD       WF A4) OF R DI NTC       STANDADD FODDR       WF A4) OF R DI NTS       STANDADD FODDR       WF A4) OF H DI NTS       STANDADD FODDR       WF A4) OF H DI NTS       STANDADD FODDR       WF A4) OF H DI NTS       STANDADD FODDR       WF A4 OF IA PL NTS       STANDADD FODDP       WF A4 OF IA PL NTS       STANDADD FOROP       WF A4 OF IA PL NTS	0-L0 CM	10-20 CM 10-20 CM 14.10 .64 11.87 .35 14.00 .27 16.43 .40 10-20 CM 10-20 CM 10-20 CM 10-20 CM 10-20 CM 10-20 CM 13.16 .37 16.11 .37 16.11 .37	20-40 CM 450 PFP CM 7.35 .37 6.01 .24 7.06 .27 R.08 .21 20-40 CM 16.13 1.66 11.07 .34 15.63 1.01 11.89 .28 .20-40 CM 10.31 .24 .20 .20 .20 .20 .20 .20 .20 .20	40-60 CM DFDTH 3.96 .14 3.64 .10 3.60 .11 3.87 .13 40-60 CM 0E0TH 0E0TH 10E0TH 10E0TH 10E0TH 10E0TH 10E0TH 10E0TH 10E0TH 10E0TH 10E0TH 10E0TH 10E0TH 10E0TH 10E0TH 10E0TH	60-A0 CM 2.25 .11 2.07 .05 2.55 .11 2.64 .09 60-A0 CM 4.42 .09 15.77 2.78 3.13 .08 5.05 .15 .15 .05 .12 .08 .13 .08 5.05 .12 .09 .09 .09 .09 .09 .09 .09 .09 .09 .09	ToTAL G/MSO 1238.24 44.50 1257.22 44.23 1257.0A 34.65 1342.79 44.65 TOTAL TOTAL G/MSO 2231.91 69.69 2056.86 73.41 1777.70 40.60 2475.40 69.97 TOTAL G/MSO 1863.75 33.13 1894.69
1 2 4 5 5 5 1 2 4 5 5 5 5 5 5 5 1 2 4 5 5 5 5 5 5 5 5 5 5 5 5 5	3 4 5 7 7 7 7 7 7 7 7 7 7 7 7 7	4 1 2 3 1 2 1 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7	wf A4 OF H DL ATC         STANDADD FODDD         WFAH OF R PLATC         STANDADD FODDD         CTANDADD FODDD         WFAH OF H PLATC         STANDAUD FODDD         WFAH OF H PLATC         STANDAUD FODDD         WFAH OF H PLATC         STANDAUD FODDD         #FAN OF 16 PLATC         STANDARD FORDD         #FAN OF 16 PLATC         STANDARD FORDP         WFAN OF 16 PLATC         STANDAPD FORDP <td>0-10 CM 57.83 2.36 65.27 2.94 60.15 1.93 61.43 3.27 0-10 CM 0-10 CM 94.00 2.86 72.45 1.93 79.20 1.75 130.55 4.90 0-10 CM 91.57 2.04 9.20 0.15 1.05 1.93 7.45 1.93 7.5 1.93 7.5 1.93 7.5 1.93 7.04 9.45 7.04 9.45 7.04 9.45 7.04 9.45 7.04 9.45 7.04 9.45 7.04 9.45 7.04 9.45 7.04 9.45 7.04 9.45 7.04 9.45 7.04 9.45 7.04 9.5 7.04 9.5 7.04 9.5 7.04 9.5 7.04 9.5 7.04 9.5 7.04 9.5 7.04 9.5 7.04 9.5 7.04 9.5 7.04 9.5 7.04 9.5 7.04 9.5 7.04 9.5 7.04 9.5 7.04 7.</td> <td>10-20 CM 1004MS DFR 1 14.10 .63 14.00 .27 16.H3 .27 16.H3 .24 10-20 CM .24.61 .84 22.24 1.39 16.09 .99 19.41 .37 10-20 CM .29 13.16 .21 .31 .21 .22 .24 .24 .24 .24 .24 .24 .24</td> <td>20-40 CM 450 PFP CM 7.35 .37 6.01 .24 7.06 .27 R.nR .21 20-40 CM 18.13 1.66 11.02 .34 15.63 1.01 11.88 .28 .20-40 CM .20 .34 .21 .20 .20 .20 .20 .20 .20 .20 .20</td> <td>40-60 CM NFDTH 3.96 .14 3.64 .10 3.60 .11 3.87 .13 40-60 CM DEPTH 0EPTH 0EPTH 0EPTH 10EPTH 3.64 .23 8.14 .33 4.71 .11 .11 .11 .11 .11 .11 .11</td> <td>60-A0 CM 2.25 .11 2.07 .05 2.55 .11 2.64 .09 60-R0 CM 60-R0 CM 4.42 .09 15.77 2.78 3.13 .08 5.05 .15 .15 .05 .09 .09 .09 .09 .09 .09 .09 .09</td> <td>TOTAL G/MS0 1238.24 44.50 1257.22 44.23 1257.0A 34.65 1342.70 44.65 1342.70 44.65 1342.70 44.65 1342.70 44.65 1342.70 44.65 1342.70 44.65 73.41 1777.70 40.40 2475.40 69.97 TOTAL TOTAL G/MS0 1864.75 33.13 1894.69 45.06 1944.81 24.25 2002</td>	0-10 CM 57.83 2.36 65.27 2.94 60.15 1.93 61.43 3.27 0-10 CM 0-10 CM 94.00 2.86 72.45 1.93 79.20 1.75 130.55 4.90 0-10 CM 91.57 2.04 9.20 0.15 1.05 1.93 7.45 1.93 7.5 1.93 7.5 1.93 7.5 1.93 7.04 9.45 7.04 9.45 7.04 9.45 7.04 9.45 7.04 9.45 7.04 9.45 7.04 9.45 7.04 9.45 7.04 9.45 7.04 9.45 7.04 9.45 7.04 9.45 7.04 9.5 7.04 9.5 7.04 9.5 7.04 9.5 7.04 9.5 7.04 9.5 7.04 9.5 7.04 9.5 7.04 9.5 7.04 9.5 7.04 9.5 7.04 9.5 7.04 9.5 7.04 9.5 7.04 9.5 7.04 7.	10-20 CM 1004MS DFR 1 14.10 .63 14.00 .27 16.H3 .27 16.H3 .24 10-20 CM .24.61 .84 22.24 1.39 16.09 .99 19.41 .37 10-20 CM .29 13.16 .21 .31 .21 .22 .24 .24 .24 .24 .24 .24 .24	20-40 CM 450 PFP CM 7.35 .37 6.01 .24 7.06 .27 R.nR .21 20-40 CM 18.13 1.66 11.02 .34 15.63 1.01 11.88 .28 .20-40 CM .20 .34 .21 .20 .20 .20 .20 .20 .20 .20 .20	40-60 CM NFDTH 3.96 .14 3.64 .10 3.60 .11 3.87 .13 40-60 CM DEPTH 0EPTH 0EPTH 0EPTH 10EPTH 3.64 .23 8.14 .33 4.71 .11 .11 .11 .11 .11 .11 .11	60-A0 CM 2.25 .11 2.07 .05 2.55 .11 2.64 .09 60-R0 CM 60-R0 CM 4.42 .09 15.77 2.78 3.13 .08 5.05 .15 .15 .05 .09 .09 .09 .09 .09 .09 .09 .09	TOTAL G/MS0 1238.24 44.50 1257.22 44.23 1257.0A 34.65 1342.70 44.65 1342.70 44.65 1342.70 44.65 1342.70 44.65 1342.70 44.65 1342.70 44.65 73.41 1777.70 40.40 2475.40 69.97 TOTAL TOTAL G/MS0 1864.75 33.13 1894.69 45.06 1944.81 24.25 2002
1 2 4 5 5 5 1 2 4 5 5 1 2 4 5 5 1 2 4 5 5 1 2 4 5 5 5 5 5 5 5 5 5 5 5 5 5	3 4 5 7 7 7 7 7 7 7 7 7 7 7 7 7	4 1 2 3 1 2 1 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7	wf Any OF       A DI DI C         STANDADD FODDD         WFAN OF       A DI DI C         STANDADD FODDD         #FAN OF       A DI DI C         STANDARD FODDD         #FAN OF       IA PLOTS         STANDARD FORDD         WFAN OF       IA PLOTS         STANDARD FORDD         WFAN OF       IA PLOTS         STANDARD FORDD         WFAN OF       IA PLOTS         STANDARD FORDP         WFAN OF       IA PLOTS         STANDARD FORDP       WFAN OF         WFAN OF       IA PLO	0-10 CM	10-20 CM 14.10 .64 14.10 .64 11.87 .36 14.00 .27 16.43 .40 10-20 CM .24.61 .84 22.24 1.39 16.09 .29 19.41 .37 10-20 CM .29 10-20 CM .37 .21 .31 .21 .33 .21 .33 .21 .33 .21 .33 .21 .33 .21 .33 .21 .33 .21 .33 .21 .33 .21 .33 .21 .33 .21 .33 .21 .34 .21 .35 .21 .35 .21 .35 .21 .35 .21 .35 .21 .35 .21 .35 .21 .35 .21 .35 .21 .35 .21 .35 .21 .35 .21 .37 .21 .21 .37 .21 .21 .21 .21 .21 .23 .21 .23 .24 .21 .24 .21 .37 .22 .24 .21 .21 .21 .21 .21 .21 .21 .21	20-40 CM 450 PFP Cu 7.35 .32 6.01 .24 7.06 .27 R.nR .21 20-40 CM 18.13 1.66 11.07 .34 15.63 1.01 11.88 .28 .20-40 CM MSO PER Cu .20-40 CM MSO PER Ca .21 10.55 .24 .20-40 CM .24 .25 .20-40 CM .24 .25 .25 .26 .27 .20-40 CM .27 .20-40 CM .27 .20-40 CM .27 .20-40 CM .27 .20-40 CM .27 .20-40 CM .27 .20-40 CM .20-40 CM	40-60 CM DFDTH 3.96 .14 3.64 .10 3.60 .11 3.87 .13 40-60 CM DE0TH 7.42 .23 8.14 .33 4.71 .16 7.11 .11 .11 .11 .11 .11 .11 .1	60-A0 CM 2.25 .11 2.07 .05 2.55 .11 2.64 .09 60-A0 CM 5.76 3.13 .08 5.05 .15 60-A0 CM 4.42 .09 15.77 2.78 3.13 .08 5.05 .15 .12 60-A0 CM	TOTAL G/MSO 1238.24 44.50 1257.22 44.23 1257.0A 34.65 1342.79 44.65 1342.79 44.65 1342.79 44.65 1342.79 44.65 1342.79 45.66 69.97 TOTAL TOTAL G/MSO 1863.75 33.13 1894.69 45.06 1944.81 24.25 2029.14
1 2 4 4 5 5 5 5 1 2 4 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5	3 4 5 7 7 7 7 7 7 7 7 7 7 7 7 7	4 1 2 3 1 2 1 2 3 1 2 3 1 2 3 1 2 3	wf A4) OF H DL 11C         STANDADD FODDD         WF A4) OF R DL 11C         STANDADD FODDR         WF A4) OF R DL 11C         STANDADD FODDR         WF A4) OF R DL 11C         STANDADD FODDR         WF A4) OF H DL 11C         STANDADD FODDR         WF A4) OF A DL 11C         STANDADD FODDR         WF A4) OF A DL 11C         STANDADD FOROP         WF A4) OF A DL 11C         STANDADD FOROP         WF A4 OF A DL 15         STANDADD FOROP         WF A4 OF A DL 15         STANDADD FOROP         WF A4 OF A DL 15         STANDADD FOROP         WF A4 OF A DL 16 DL 015         STANDADD FOROP         WF A4 OF A DL 16 DL 015         STANDADD FOROP         WF A4 OF A DL 16 DL 015         STANDADD EPOR         WF A4 OF A DL 16 DL 015         STANDADD EPOR         WF A4 OF A DL 16 DL 015         STANDADD EPOR         WF A4 OF A DL 16 DL 015         STANDADD EPOR         WF A4 OF A DL 16 DL 015         STANDADD EPOR         WF A4 OF A DL 16 DL 015         STANDADA EPROP         WF A4 OF A DL 015	0-10 CM	10-20 CM 10-20 CM 14.10 .64 11.87 .35 14.00 .27 16.43 .40 10-20 CM 10-20 CM 10-20 CM 10-20 CM 10-20 CM 10-20 CM 13.16 .37 16.11 .37 16.11 .37 16.11 .37 .40 .29 .29 .29 .29 .29 .29 .29 .29	20-40 CM 450 PFP CM 7.35 .27 6.01 .24 7.06 .27 R.08 .21 20-40 CM 450 PFR CM 16.13 1.66 11.02 .34 15.63 1.01 11.88 .28 .20-40 CM MSO PER CC 10.30 .24 .20 .20 .20 .20 .20 .20 .20 .20	40-60 CM 3.96 14 3.64 .10 3.60 .11 3.87 .13 40-60 CM 0E0TH 0E0TH 1.1 .11 .11 .11 .11 .11 .11	60-A0 CM 2.25 .11 2.07 .05 2.55 .11 2.64 .09 60-R0 CM 4.42 .09 15.77 2.76 3.13 .08 5.05 .15 60-A0 CM 4.45 .22 6.22 .26 6.40 .11 4.40	ToTAL 6/MS0 1238.24 44.50 1257.22 44.23 1257.0A 34.65 1342.79 44.65 TOTAL 69.69 2056.86 73.41 1777.70 40.60 2475.40 69.97 TOTAL 6/MS0 1863.75 33.13 1894.69 45.06 1944.81 24.25 2029.14 38.96

Table 5 (Continued).

	SUMMARY	TARLE OF	F ALL WATEPSHEDS(WTS)	HY TREATMEN	T (TRT)
		*********	************************	************	****=====
SIN	1 - PAW AND WT9	0ATI 5 # 101	E =/00424	0-10 04	****
	*******	, - 141 teseszes:	***************	17411 C4	
				G/#50/C4	6/450
ł	3	4	MEAN OF 16 PLOTS	93.RI	2045.83
2	•		STANDARD FPROR	1.72	21.51
	н	1	STANDARD FRAM	94.89	2059.34
4	5	2	NEAN OF 16 PLOTS	96.77	18.94 2082 85
		•	STANDAPO FRADR	.95	11.85
- 6	7	٦	MEAN OF 16 PLOTS	104.45	2178.80
			STANDARD ERROP	1,51	14.97
			***************************************	********	
5111		1)A11 	E #700504	0-10 CM	TOTAL
8223	22322222	, - ,., :::::::::::::::::::::::::::::::::::			
				67450764	6ZMSQ
1	3	4	HEAN OF 1- PLOTS	109.45	2244.33
		,	STANDADI FUUNU	114 05	22.64
~	-	,	STANDARD FRADP	117447	18.43
4	5	2	MEAN OF TH PLOTS	96 68	2081.71
			STANDADI) FODDO	1.81	22.64
٨	7	٦	MEAN OF 15 PLOTS	101.32	2139.72
			STANDADD FODDD	2.14	26.71
***		*******			
SIT		DATI DATI	F =700522	0-10 04	
910 233		********			
				6/450/04	61450
1	3	4	4664 JE 14 PLOTS	3P.40	1978.21
-			STANDED'S EPPOR	2,05	25.74
2	я	1	STANDADD 6000	101.10	2165.44
4	5	2	MEAN DE 16 PLOTS	45.36	1540.21
			STANDADO FODOD	1.60	20.02
6	7	1	HEAN OF 16 PLOTS	41.48	2014.23
			CT100408 E3080		
			ALB HIMP I FINNIN	1.97	24.64
222 C T T		*******		1.97	74. <b>64</b> *******
*** 5j7	F = PAW		F =790604	1,97 	74.64 **********
*** 5j1 ¥T5	F = PAV AND NT		F =790604	1.47 	24.66 ********** TOTAL
*** 5]T ¥T5	F = PAW AND WT		F =790604	0+10 CN G/MSO/CN	TOTAL G/MSQ
*** 5jT *T5 ***	F = PAU AND NT	nat S = TPT 200-2001	F =790604	0+10 CM G/MSO/C4 92.75	24.64 TOTAL G/MSQ 2032.61
*** 5j7 *** 1	F = PAW AND NT	nat s = tot =================================	F =700604	6+10 CM 6/M50/C4 92.75 1.61	24.64 TOTAL TOTAL 2032.61 20.07
*== 5jT ¥T5 === 1 2	F = PAU AND NT	ο ο ο ο ο ο ο ο ο ο ο ο ο ο	GIB HILD OF PLATE           F =700604           WFAN OF 16 PLOTS           STANDADO FOROP           MFAN OF 16 PLOTS           STANDAPO FOROP	1.97 	24.64 TOTAI, G/MSQ 2032.61 20.07 2052.98 18.89
x== 5jT wT5 === 1 2	F ± PAU AND NT	ο το	F =700604 F =700604 STANNAPO F980P MFAN OF 16 PLOTS STANDAPO F980P MFAN OF 16 PLOTS	1.97 A-10 C4 G/MS0/C4 92.75 1.61 94.34 1.51	24.64 TOTAL G/MSQ 2032.61 20.07 2052.98 18.89 2069.71
x== 5JT wT5 === 1 2 4	F = PAU AND NT 3 8 8	nat S = Tot 	(124000)         (12400)           F = 700604           VFAN ΩF 16 ΡLΩΤς           STANDAPD FPROP           MFAN ΩF 16 ΡLΩΤς           STANDAPD FROP           WFAN 0F 16 ΡLΩΤς           STANDAPD FROP           STANDAPD FROP           STANDAPD FROP           STANDAPD FROP           STANDAPD FROP	6+10 CM 6+10 CM 6/M50/CM 92.75 1.61 94.39 1.51 95.72 1.55	24.64 TOTAL G/MSQ 2032.61 20.07 2052.98 18.89 2069.71 19.51
*** 5JT ¥T5 *** 1 2 4 6	F = PAU AND WT 3 8 8 7	ο ο ο ο ο ο ο ο ο ο ο ο ο ο	F =700604 WFAN OF 16 0LOTS STANDADD FOROD WFAN OF 16 0LOTS STANDADD FOROD WFAN OF 16 0LOTS STANDADD FOROD WFAN OF 16 0LOTS STANDADD FOROD	6,407 6,4050,474 92,75 1,61 94,34 1,51 95,72 1,56 91,96	24.64 TITAL G/MSQ 2032.61 20.07 2052.98 18.89 2069.71 19.51 2022.74
x== 5jT wT5 === 1 2 4 6	F = PAU AND NT 3 3 5 7	ο ο ο ο ο ο ο ο ο ο ο ο ο ο	(1)         (1)         (1)           (F)         =700604           (F)         =700704           (F)         =700704	6,40 6,4050,74 92,75 1,61 94,34 1,51 95,72 1,56 41,96 1,47	24.64 TOTAL G/MSQ 2032.61 20.07 2052.98 18.89 2069.71 19.51 2022.74 18.39
x== 5jT wT5 === 1 2 4 6 x== 5jT	F = PAU AND NT 3 3 5 7 7		(1)         (1)         (1)         (1)           (F)         = 700604	6+10 CM 6/W50/CM 92.75 1.61 94.39 1.61 95.72 1.56 41.96 1.47	24.64 TOTAL G/MSQ 2032.61 20.07 2052.94 18.89 2069.71 19.51 2022.74 18.39
**** 5]T *** 1 2 4 6 ***	F ± PAW AND NT 3 3 3 5 5 7 5 5 5 5 5 7 7		(1) (1) (1) (1) (1) (1) (1) (1) (1) (1)	6-10 CM 6/MS0/C4 92.75 1.61 94.39 1.51 95.72 1.55 91.96 1.47	24.44 TOTAL G/MSQ 2032.61 20.07 2052.94 18.89 2069.71 19.51 2022.74 18.39
x = = 5 J T WTS = = = 1 2 4 6 x = = 1 WTS = = =	F = PAW - AND NT - AND NT - AND NT - AND NT - AND NT - AND NT	A TRT	(1) (1) (1) (1) (1) (1) (1) (1) (1) (1)	1,97 6+10 CM 6/MS0/CM 92,75 1,61 94,39 1,51 95,72 1,55 41,96 1,47 0-10 CM	24.64 TOTAL G/MSQ 2032.61 20.07 2052.94 18.89 2069.71 19.51 2022.74 19.39
1 2 4 6 x=x 5 1 T	F = PAW AND NT AND NT S S S F = PAW S AND NT	S = TOT S = TOT 1 2 3 3 5 = TRT	(1) (1) (1) (1) (1) (1) (1) (1) (1) (1)	6/M50/C4 6/M50/C4 92.75 1.61 94.39 1.51 95.72 1.55 91.95 1.47 0.10 CM	24.44 TOTAL C/MSQ 2032.61 20.07 2052.94 18.89 2069.71 19.51 2022.74 18.39 TOTAL
**************************************	F = PAW AND NT 3 7 5 7 7 7 7 7 8 8 8 8 9 8 9 8 9 8 9 8 9 8 9	A S = TOT S = TOT A 1 2 3 3 5 = TRT 4	(1) (1) (1) (1) (1) (1) (1) (1) (1) (1)	6/M50/r4 6/M50/r4 92.75 1.61 94.33 1.51 95.72 1.56 91.47 1.47 0-10 CM 6/M50/rM 119.09	24.64 TOTAL G/MSQ 2032.61 20.07 2052.94 18.89 2069.71 19.51 2022.74 19.53 2022.74 19.34 TOTAL TOTAL G/MSQ 2361.81 34.60
x == SIT WTS == 1 2 4 6 x == SIT WTS == 1 2 2	F = PAW AND NT AND NT 3 7 7 7 7 7 8 8 8 8 8 8 9 8 9 8 9 8 9 8 9	A 1 2 3 4 1 2 3 4 1 5 5 7 0 AT 5 4 1 2 0 AT 5 4 1 2 1 3 4 1 2 1 1 4 1 2 1 1 1 1 1 1 1 1 1 1 1 1 1	(1) (1) (1) (1) (1) (1) (1) (1) (1) (1)	6/WSO/CM 6/WSO/CM 92.75 1.61 94.39 1.51 95.72 1.55 91.96 1.47 0-10 CM 6/WSO/CM 119.09 2.92 120.18	24.64 TOTAL G/MSQ 2032.61 2032.61 2032.61 20.07 2052.94 18.89 2069.71 19.51 2022.74 19.39 TOTAL TOTAL C/MSQ 2361.81 36.49 2375.45
x == = 51T wTS == = 1 2 4 6 x == = 1 wTS x == = 1 2 x = = 1 2 x = = 1 2 x = = 1 2 x = = 1 x = = 1 x	F = PAW F = PAW AND WT 7 7 F = PAW AND WT 3 A	A A A A A A A A A A A A A A	(1) (1) (1) (1) (1) (1) (1) (1) (1) (1)	6/WSO/CM 92.75 1.61 94.34 1.51 95.72 1.65 41.96 1.47 0-10 CM 6/WSO/CM 113.09 2.92 120.19 1.73	24.64 TOTAL G/MSQ 2032.61 20.32.61 20.32.94 18.89 2069.71 19.51 2022.74 19.51 2022.74 19.53 2022.74 19.53 2022.74 19.53 2023.74 19.53 2023.74 19.53 2023.74 19.53 2023.74 19.53 2023.74 19.53 2023.74 19.55 2024.74 19.55 2025.75 2025.
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str str 1 2 4 6 str str wrs str str str str str str str s	F = PAW F = PAW AND NT F = PAW F = PAW AND WT F = PAW AND WT F = PAW AND WT F = PAW AND WT F = PAW AND T F = PAW T T T T T T T T T T T T T	S = TPT S = TPT A 1 2 3 3 5 = TRT 4 1 2 3 5 = TRT 5 = TPT 5 = TPT 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 1 2 1 3 1 2 1 3 1 2 1 3 1 2 1 3 1 2 1 3 1 2 1 3 1 2 1 3 1 2 1 3 1 2 1 3 1 2 1 3 1 1 2 1 3 1 1 2 1 1 2 1 1 1 2 1 1 1 2 1 1 1 2 1 1 1 1 2 1 1 1 1 1 2 1 1 1 1 1 1 2 1 1 1 2 1 1 1 2 1 1 1 2 1 1 1 2 1 1 1 1 1 1 1 1 1 1 1 1 1	F = 700604 $F = 700604$ $F = 700619$ $F = 700717$ $F = 700709$ $F = 16 PL075$ $F = 700717$ $F = 700717$ $F = 700717$ $F = 700717$	1,97 6/M50/r4 92.75 1.61 94.34 1.51 95.72 1.56 94.34 1.51 95.72 1.56 91.96 1.47 1.47 1.47 1.47 1.73 96.84 2.07 118.08 0-10 CM 0-10 CM 0.45 1.57 1.67 1.47 1.57 1.67 1.47 1.73 1.57 1.47 1.75 1.47 1.57 1.47 1.57 1.47 1.75 1.47 1.57 1.47 1.75 1.47 1.57 1.47 1.47 1.57 1.47 1.57 1.47 1.57 1.47 1.57 1.47 1.57 1.47 1.57 1.47 1.57 1.47 1.57 1.47 1.57 1.47 1.57 1.47 1.57 1.47 1.57 1.47 1.57 1.47 1.57 1.47 1.57 1.47 1.57 1.47 1.57 1.47 1.75 1.47 1.47 1.57 1.47 1.75 1.47 1.57 1.47 1.57 1.47 1.57 1.47 1.57 1.47 1.57 1.47 1.57 1.75 1.47 1.47 1.47 1.47 1.57 1.75 1.47 1.47 1.47 1.47 1.47 1.57 1.47 1.30 .44 1.45 1.47	24.64 TOTAL TOTAL TOTAL C/mSQ 2032.61 20.07 2052.94 1A.89 2069.71 19.51 2022.74 19.39 TOTAL TOTAL C/mSQ 2361.81 36.49 2375.45 21.61 2043.71 25.93 2349.24 76.05 TOTAL C/mSQ 2206.90 1A.97 2470.04 23.41 2337.01 17.77 2503.31 29.45

Table 5 (Continued).

SUMMARY TABLE OF ALL WATERSHEDS (WTS) BY TREATMENT (TRT) DATE =700729 SITE = PAW TOTAL WTS AND WTS = TPT 0-10 CM G/MSO/CH G/MSQ MEAN OF 16 PLOTS 1 3 4 113.76 2295.24 STANDADD FODOD 2.00 25.02 2 8 1 MEAN OF 14 PLOTS 114.27 2326.64 STANDARD FRROR 2.17 27.12 4 5 2 MEAN OF 16 PLOTS 102.21 2150.85 STANDADD ERDOR 1.70 21.21 7 3 MEAN OF 16 PLOTS 6 115.00 2310.75 STANDAUD ERPOR 2.31 28.90 DATE =700812 SITE = PAW WTS AND WTS = TPT 0-10 CM TOTAL G/MSO/CM G/MSQ 1 ٦ 4 MEAN OF 16 PLOTS 106.51 2204.55 STANDARD FRROR 1.64 20.53 2 MEAN OF 16 PLOTS 114.72 8 1 2307.26 STANDARD ERROR 1.35 16.87 2221.91 5 2 MEAN OF 16 PLOTS 107.90 STANDAPD FOUDP 21.31 1.71 6 7 2 MEAN OF 16 PLOTS 94.62 2055.94 1.53 STANDARD ERROP 19.08 DATE =700912 SITE = PAW WTS AND WTS = TPT 0-10 CM TOTAL G/MSO/CM G/MSQ 2289.67 113.32 MEAN OF 16 PLOTS 1 3 5.56 28.22 STANDARD FRROP 2054.00 94.46 MEAN OF 16 PLOTS 2 8 1 1.45 18.07 STANDARD EPROR 97,56 2092.70 5 2 MEAN OF 16 PLOTS 13.80 STANDARD FRROP 1.10 MEAN OF 16 PLOTS 110.33 2252.36 2 7 6 2.13 STANDARD FRROP 26.67 

treatment 3 (Table 6). It should be noted that the value for treatment 3 was only slightly larger on July 31 than on June 21.

Treatme Number	nt r	Root	Weight	Date
1	Maximum	2007 g/1	$m^2/80 \text{ cm}$	6/21/69
1	Minimum	1411	11	7/31/69
2	Maximum	2050	11	9/10/69
2	Minimum	1226	13	7/31/69
3	Maximum	1889	11	9/10/69
3	Minimum	1350	11	6/21/69
		(1480)	TI	(7/31/69)
4	Maximum	2155	17	8/27/69
4	Minimum	1065	11	7/31/69

Table 6. Maximum and minimum amount of root mass present during the 1969 growing season for four grazing treatments.

The data from the November sample indicates that total root mass in all treatments increased during the fall. The December sampling period shows a uniform root mass which is lower than the November period for all treatments except the heavy grazed pasture (treatment 4).

Summer 1970 root material for the 0-10 cm increment varied as follows: heavy grazing 884 g/m<sup>2</sup> (May 22) to 1138 g/m<sup>2</sup> (July 29); moderate grazing 916 g/m<sup>2</sup> (May 22) to 1305 g/m<sup>2</sup> (July 2 and 17); light grazing 792 g/m<sup>2</sup> (July 2) to 1171 g/m<sup>2</sup> (July 17); and no grazing 725 g/m<sup>2</sup> (July 2) to 1278 g/m<sup>2</sup> (July 17). A marked difference in sampling error was noted by comparing the summer and winter errors. The range of standard errors of the means for the summer 1969 was 1%-12% with an average of 5.4%, this range was reduced for the fall and winter sampling periods to 1.5%-4% with an average of 2.9%. This could indicate that 1969 fluctuations were not measured very accurately, however, the standard errors reported are acceptable. The 1970 sampling period had an average of 1.3% and a range of .5%-3.5%. The standard errors improved for the 1970 sampling period which can be attributed to more samples taken.

Analysis of variances were carried out to test if differences existed in the individual samples of roots. A computer program, STAT02V, developed by Dixon (1970) has been converted for use on the Colorado State University computer.

Because of the design of the experiment (four treatments with two replications each) statistical analysis was easily accomplished via the factorial design program (STAT02V). For this program to work all factors have to be balanced; a five increment sample cannot be tested against a single increment sample.

The data were segregated into three main periods (Summer 1969, Fall-Winter 1969, and Summer 1970) allowing for utilization of STAT02V. Generally, during these particular periods balanced samples were collected. All individual samples could not be used in STAT02V because the limits of the program were exceeded.

Individual samples for the two 1969 data sets were utilized to detect any treatment differences. These two periods were balanced and small enough to use STAT02V. The six main effects considered in this run were dates, treatments, depth increments, watersheds within treatments, plots within watersheds-treatments, and cores within watersheds-treatments-plots. These particular components plus all possible interactions were considered for summer 1969 (Table 7) and fall-winter 1969 (Table 8).

An observation of these two analysis of variance tables indicates significance (.05% level) for only dates, depth increments, and dateincrement interaction. Because of these results it did not appear necessary to test the 1970 data using individual observations.

#### Vertical distribution of roots

Observation of treatment means (Table 5) shows the vertical distribution of underground plant material. Sixty percent of the root weight was in the upper 10 cm, and this proportion held across treatments, sampling dates and years.

During the 1969 summer sampling period crown material was separated from the 0-10 cm increment. Crown mass contributed 15% of the total material. This percentage should hold for the other sampling periods where crowns and roots were not separated.

S	samples for the 1969 summer sampling period.							
Source	D.F.	s.s.	M.S.	F				
D	7	5765.0	823.6	4.587 (7,28)	**			
Т	3	152.2	50.7	.139 (3,4) N	1.S.			
I	4	525837.8	131459.5	1158.473 (4,16)	**			
TI	12	1255.2	104.6	.922 (12,16) N	1.S.			
W(T)	4	1464.4	366.1	1.608 (4,8) N	1.S.			
P(WT)	8	1821.5	227.7	1.677 (8,16) N	1.S.			
C(PWT)	16	2172.6	135.8	1.826 (16,448)	*			
DT	21	4724.4	225.0	1.253 (21,28)	1.S.			
DI	28	9422.8	336.5	3.013 (28,112)	**			
DW(T)	28	5017.0	179.5	.876 (28,56) N	1.S.			
D·P(WT)	56	11470.2	204.8	1.863 (56,112)	**			
D.C(PWT)	112	12312.0	109.9	1.478 (112,448)	**			
DIT	84	9731.4	115.9	1.037 (84,112) M	1.S.			
I•W(T)	16	1815.6	113.5	.970 (16,32) 1	٩.S.			
I·P(WT)	32	3744.4	117.0	1.086 (32,64)	1.S.			
I·C(PWT)	64	6898.2	107.8	1.449 (64,448)	*			
IDW(T)	112	12511.6	111.7	.830 (112,224)1	1.S.			
IDP(WT)	224	30145.3	134.6	1.809 (224,448)	**			
IDC(PWT)	448	33320.0	74.4					

Table 7. Analysis of variance table containing six main effects and all possible combinations which were run on individual samples for the 1969 summer sampling period.

where: D = Dates, T = Treatments, W = Watershed, P = Plots, C = Core, and I = Increments.

\* = Significant at 5% level

**\*\*** = Significant at 1% level

Source	D.F.	s.s.	M.S.	F				
D	1	4082.3	4082.3	12.589 (1,4)	*			
Т	3	547.1	182.4	.232 (3,4)	N.S.			
I	4	607113.9	151778.5	313.619 (4,16)	**			
TI	12	2228.5	185.7	.384 (12,16)	N.S.			
W(T)	4	3147.2	786.8	2.268 (4,24)	N.S.			
P(WT)	24	8326.2	346.9	1.652 (24,64)	N.S.			
C(PWT)	64	13440.9	210.0	1.648 (64,280)	**			
DT	3	892.4	297.5	.917 (3,4)	N.S.			
DI	4	9060.9	2265.2	9.193 (4,16)	**			
DW(T)	4	1297.1	324.3	1.117 (4,24)	N.S.			
D·P(WT)	24	6967.6	290.3	1.719 (24,64)	*			
D·C(PWT)	64	10806.4	168.9	1.325 (64,280)	N.S.			
DIT	12	2269.1	189.1	.767 (12,16)	N.S.			
I·W(T)	16	7743.3	484.0	1.747 (16,96)	*			
I·P(WT)	96	26591.6	277.0	1.411 (96,232)	*			
I.C(PWT)	232	45561.7	196.4	1.541 (232,280)	**			
IDW(T)	16	3942.6	246.4	.909 (16,96)	N.S.			
IDP(WT)	96	26035.6	271.2	2.129 (96,280)	**			
IDC(PWT)	280	35677.0	127.4					

Table 8. Analysis of variance table containing six main effects and all possible combinations which were run on individual samples for the 1969 fall-winter sampling period.

where; D = Dates, T = Treatments, W = Watersheds, P = Plots, C = Cores, and I = Increments.

\* = Significant at 5% level

**\*\*** = Significant at 1% level

Approximately 73% of the roots were present in the upper 20 cm of the soil profile. The following increments contributed these per-centages:

$$20-40 \text{ cm} = 14\%$$
  
 $40-60 \text{ cm} = 8\%$   
 $60-80 \text{ cm} = 5\%$ 

Where depth increments were sampled (12 dates) the data were fit to a negative exponential in an attempt to determine if the depth distribution varied by treatment. This regression equation takes the form:

$$Y = a + be^{-CX}$$

where;

a = determines the asymptote (the distance the parallel portion of the curve is from the x-axis).

b = Y intercept - a.

c = controls the curvature of the line.

Treatment means for dates by depths were fit to this equation with the aid of a computer program (TAYLN).<sup>4</sup> The iterative calculations for solving this equation can be found in Williams (1959).

Values were obtained for the three parameters (a, b, and c). First, a factorial analysis of variance of parameters a and b indicated that no treatment differences existed (Table 9). This is comparable to an analysis of total root weight.

<sup>&</sup>lt;sup>4</sup>TAYLN was written by Donald Jameson, Range Science Department, Colorado State University, Fort Collins.

Source	D.F.	S.S.	M.S.	F	
Dates	11	91283.8	8298.5	.806	N.S.
Treatments	3	12177.5	4059.2	. 394	N.S.
Error	33	339754.4	10295.6		
Total	47	443215.7			

Table 9. ANOV table for parameters (A + B) obtained from a negative exponential fit.

N.S. = Non-significant

The next step was to do analysis of variance of the c parameter, which controls the curvature of the line. This is essentially a test of the depth distribution. Various combinations of the data were tested, with the following tests conducted:

- 1. Summer 1969 crowns present (Table 10)
- 2. Summer 1969 crowns absent (Table 11)
- 3. Summer and Fall 1969 + two dates in 1970 (Table 12).

For comparative purposes the various negative exponential equations were plotted. Eight date means for 1969 summer sampling period were plotted, the data had crown meterial absent from the 0-10 cm increment. Three equations for the more diverse situations during the summer 1969 are presented (Fig. 12). Individual graphs are in Appendix 4.

To further examine the date-increment interaction separate analysis were done on each depth increment with the use of watershed means. These means were used because it was shown earlier that



Figure 12. Root weight decreases with depth as represented by these three curves plotted from fitted negative exponential equations.

pre	8CIIC.			
Source	D.F.	S.S.	M.S.	F
Dates	7	.00369	.00053	1.3589 N.S.
Treatments	3	.00297	.00099	2.5385 N.S.
Error	21	.00827	.00039	
Total	31	.01494		

Table 10. ANOV of depth distribution parameter (c) obtained from a negative exponential fit run on 8 dates (1969) with crowns present.

Table 11.	ANOV of depth distribution parameter (c) obtained from a
	negative exponential fit run on 8 dates (1969) without
	crowns.

Source	D.F.	s.s.	M.S.	F
Dates	7	.00358	.00051	1.2143 N.S.
Treatments	3	.00276	.00092	2.1905 N.S.
Error	21	.00873	.00042	
Total	31	.01507		

Table 12. ANOV of depth distribution parameter (c) obtained from a negative exponential fit run on 12 dates (1969 and 1970) with crowns present.

Source	D.F.	s.s.	M.S.	F
Dates	11	.01000	.00091	2.022 N.S.
Treatments	3	.00316	.00105	2.333 N.S.
Error	33	.01483	.00045	
Total	47	.02799		_

no differences existed when individual sample values were used.

Table 13 shows which tests were made and the results of same.

Table 13. Summary of ANOV's run on various depth increments using watershed means. Complete ANOV tables are in Appendix 5.

Data	F Value (Dates) <sup>1</sup>	Results
Crowns	.873	N.S.
0-10 cm depth + crowns	2.975	*
0-10 " "	4.242	**
10-20 " "	1.951	N.S.
20-40 "	2.879	*
40-60 "	2.560	*
60-80 " "	.945	N.S.

\* = Significant at 5% level

\*\* = Significant at 1% level

<sup>1</sup>Degrees of Freedom = 7,28

The results of these analyses indicate that the major reason for significant differences between dates was change in the weight of the 0-10 cm increment. Crowns had essentially no change, and the lower depth has less change than the 0-10 cm increment.

## Seasonal trends

All twenty-one dates were plotted using treatment means and numbering the dates from 1 (January 1, 1969) - 730 (December 31, 1970). SN $\phi\phi$ P, a computer program for two dimensional plotting was used (Frayer 1968). First, plottings were done with crowns added into the 0-10 cm increment and these plots are in Fig. 13-16. After observing the erratic fluctuations in these particular figures it appeared desirable to subtract the crown weights. All data were again plotted with crowns deleted from the first 8 sampling periods of 1969 (Fig. 17-20).

Data of the summer of 1969, when plotted without crowns presented a general curve which appears to have some biological interpretation. Because there are no significant differences among treatments or watersheds an average value across treatments was used for each of the eight dates. These data points were plotted (Fig. 21).


Figure 13. Root weights (0-10 cm) for no grazing treatment plotted for 21 sampling periods -- crowns present.



Figure 14. Root weights (0-10 cm) for light grazing treatment plotted for 21 sampling periods--crowns present.



Figure 15. Root weights (0-10 cm) for moderate grasing treatment plotted for 21 sampling periods--crowns present.



Figure 16. Root weights (0-10 cm) for heavy grazing treatment plotted for 21 sampling periods -- crowns present.



Figure 17. Root weights 0-10 cm) for no grazing treatment plotted for 21 sampling periods -- crowns absent.











Figure 20. Root weights (0-10 cm) for heavy grazing treatment plotted for 21 sampling periods -- crowns absent.



Figure 21. Raw data for summer 1969 representing root fluctuations.

## DISCUSSION

#### Effects of herbivores on root mass

A main objective of this project was to measure the effects large herbivores have upon the roots in a shortgrass ecosystem. A simple ANOV run on individual samples using a factorial design showed no treatment differences in the root mass. Significant differences were found only among dates, increments, and combinations of the two.

The lack of grazing treatment effect is in contrast to most results in the literature. Most grazing studies have shown decreased root mass with grazing (Schuster 1964; Lorenz and Rogler 1967; Biswell and Weaver 1933; Cook, Stoddart and Kinsinger 1958; and Jameson and Huss 1959); the only reported increase was that described by Pearson (1965). Schuster (1964) indicated the aerial portion of blue grama was reduced by heavy grazing although Lang and Barnes (1942) present contradictory results.

It is of particular interest to note that all studies of blue grama have reported decreasing root weights with grazing. It appears that some of the data is questionable, however, Lorenz and Rogler (1967) found ca. 36,000  $g/m^2/61$  cm in a mixed grass area and Biswell and Weaver (1933) in a greenhouse experiment found a maximum  $105 \text{ g/m}^2/61 \text{ cm}$ . This a wide range of values, therefore, caution should be used in making conclusive statements concerning them.

Research has shown that grass roots stop growing when the aerial portions are clipped. Crider (1955) found that these periods of no root growth occurred for periods of 6-18 days for various species. He found that roots of clipped plants weighed one-eighth as much as the roots of the unclipped plants. Clipped blue grama, for example, produced approximately 85% less root mass than unclipped blue grama.

Possible explanations for lack of treatment effects include:

- 1. All samples were taken on the same soil type, thus, this may be a unique feature of the Ascalon soil type.
- 2. The major plant species is blue grama and it has been reported as having a very dense root system (Hopkins 1953) which might be effected less by the influence of grazing animals.
- 3. There were no treatment differences in the aerial portion (Uresk 1971) and there may be a close correlation between the aerial and belowground compartments.
- 4. This phenomenon might have been peculiar for the two years sampled.
- 5. Inherent "feedback" mechanisms adequately compensated for any grazing effect.

# Vertical distribution of roots

On the Pawnee Site, 60 percent of the root weight occurred in the upper 10 cm of the soil profile compared to about 75 percent in the upper 20 cm. These values correspond very closely with values observed for blue grama-buffalo grass communities by Weaver (1958), 79% in the upper 15 cm and Weaver and Zink (1946a), 80% in the upper 35 cm.

These figures show that shortgrass prairies have a shallow root system maintained by the low and erratic precipitation (Stoddart and Smith 1955). Weaver (1958) substantiates this finding by stating that blue grama and buffalo grass have a shallow root system which probably provides maximum benefit from moisture furnished by light showers. Earlier Weaver and Albertson (1943) indicated root depth corresponded to rainfall penetration.

As early as 1911 (Shantz) indicated that the shortgrass root system was limited to the upper 18 inches of the soil. Markel (1917) suggested that a superficial root system is due to soil moisture content and Weaver and Crist (1922) said the main factor was available water. Most of the roots occur in the upper levels of the soil profile (Weaver 1958 and Nilsson 1970) and decrease rapidly with depth (Dahlman and Kucera 1965). Nilsson (1970) stated that grass roots concentrate in the upper soil layers because grass plants are shallow rooters and grass roots are thicker in their proximal parts even if not functional.

It was observed in this study that the shortgrass ecosystem has a greater fraction of the vegetative mass below the soil surface than above it. Distribution of this mass follows a distribution hypothesized by other investigators. Concentration of shortgrass roots in the upper layers of the soil can be attributed to frequent small and shallow penetrating rain showers.

Negative exponential curves were fitted to the data to show how root weights decreased by depth and the parameters of the equations were used to see if any treatment differences existed. The series of curves reflected the root weight fluctuations over the growing period. In general all curves have approximately the same asymptotes; the major difference can be seen to occur in the upper most increment. During May the Y-intercept of these curves is at a high point, dropping considerably during the end of July. The Y-intercept rose to a point comparable to the May value.

Analysis of variance run on the various parameters showed no significant treatment effect. Inspection of the data indicated differences in increments which were confirmed when an analysis of variance was run using data by depth increments. The major date difference was confined to the 0-10 cm increment and the root mass below 10 cm varied little.

### Dynamic model of seasonal variations

With crowns present (Figs. 13-16) the root mass data were very erratic. With crown weights deleted, however, the graphs at least had an observable trend during the 1969 growing season (Figs. 17-20).

These graphs show a very slight increase in roots between May and June with a marked decrease of roots occurring the last of July. Following the root decrease, there was a rapid increase of root material to a point slightly greater than the early season value of  $616 \text{ g/m}^2/10 \text{ cm}.$ 

Four studies of grass root decomposition that were reviewed are applicable here. First, Weaver and Zink (1946b) approximated the length of life of root systems at 4 years. Weaver (1947) reported that blue grama roots lost 67% of their weight during a two year period and presumed that a majority of this mass was lost during the second growing season. Working in a tallgrass prairie Dahlman and Kucera (1965) calculated turnover rates of roots to be 4 years. Nilsson (1970) calculated a turnover rate for hay meadows to be 50% or a new root system every two years.

Weaver (1958) stated that "complete decomposition of the roots, to a condition in which no particles could be distinguished by the naked eye from the soil, required 3 to 5 years."

Quantitative measurements of roots have been discussed by various investigators and it is apparent that the fluctuations of grass roots are not the same. Nilsson (1970) working in southern Sweden found a peak belowground mass occurring at the end of June with gradual decrease till the following growing season. It was shown by Pilat (1969) that decreases in roots coincided with periods of

increased soil moisture. Kucera et al. (1967) indicated that lack of soil moisture impeded root decomposition. Dahlman and Kucera (1965) sampled only four times during the year and found peak root material occurring during the summer.

Crider (1955) stated that "the growth and rest periods of the roots alternated with growth and rest periods of the tops." Dodd and Hopkins (1958) agree that when aerial growth is occurring there is little storage in the roots and vice-versa. Clipping the aerial vegetation caused the carbohydrate content of the roots to be low for a month.

The general pattern observed by Dodd and Hopkins was an increase in root growth during June (slow aerial growth) and less root growth in July (rapid aerial growth).

The usual explanation of the mid-season dip in root weight and subsequent recovery is that stored carbohydrates are utilized for growth and that new carbohydrates are stored later in the season. Pilat (1969), however, observed that there was no evidence of any gradual accumulation of underground biomass that could be attributed to assimilate storage. This view is supported by May (1960) but is quite opposite from those given by Dodd and Hopkins (1958) and others. It is clear, however, that it is possible to make equally valid interpretations of root dynamics using concepts of growth and decomposition, without requiring a concept of storage for subsequent translocation to tops. In order to understand variations in root material it is first necessary to recognize two major components, i.e. the total mass is composed of a dead or dying root fraction and a living or actively growing part.

A model was hypothesized that would attempt to explain these data (Fig. 21). Certain assumptions must be made in order for this model to be valid. The following ideas should be kept in mind:

- The decomposing material is highest at the beginning of the growing season, dropping to a low value as the season progresses and only more resistant material remains. This rapid loss early in the season coincides with sufficient soil moisture (Pilat 1969).
- 2. New roots are minimal at the first of the season and increase to a high point later in the growing period.

With these two major points established it is possible to write an equation that behaves similarly to the variation in the root mass. Both processes should give a sigmoid curve such as the logistic curve. The decomposition rate can be represented by a decreasing logistic growth curve (Fig. 22) and root growth as an increasing logistic curve (Fig. 23) (Pielou 1969). If these two formulae are added together the following equation results:

$$Y = \frac{a_1/b_1}{1 + e^{-a_1(x-x_1)}} + \frac{a_2/b_2}{1 + e^{a_2(x-x_2)}}$$

where

$$a_1$$
 and  $a_2 = \frac{Y}{X}$  at the point  $x_1$  and  $x_2$ 





 $b_1$  and  $b_2$  = incorporated into determination of the

upper asymptote by 
$$\frac{a_1}{b_1}$$
 and  $\frac{a_2}{b_2}$ 

and  $x_1$  and  $x_2$  = inflection point of the two curves and  $a_1, a_2, b_1, b_2, x_1, and x_2 > 0$ 

The particular program (MAIN) used to solve this non-linear model was written by Ibbitt (1970) and it utilizes Rosenbrock's (1960) hill-climbing optimization method.<sup>5</sup> The model parameters are found automatically by minimizing the differences between the measured and model derived values.

The model was fit to the data and required the following constraints:

$$0 < a_{1} < 50$$

$$0 < b_{1} < 10$$

$$210 < x_{1} < 260$$

$$0 < a_{2} < 50$$

$$0 < b_{2} < 10$$

$$150 < x_{2} < 210$$

<sup>&</sup>lt;sup>5</sup>This program was adapted to the CSU Scope 3 system by Freeman Smith. He also provided valuable help in writing the subroutines required and supplied general information concerning the running of the program.

The parameters changed as follows:

	Initial	Calculated		
a <sub>l</sub>	13	11.47		
<sup>b</sup> 1	2.05	1.78		
×1	225	213		
<sup>a</sup> 2	21	16.52		
<sup>b</sup> 2	3.36	2.62		
×2	200	203		

A good indication of the goodness of fit is indicated by the estimated values calculated via the program as opposed to the given values. For comparative purposes Table 14 was constructed.

Day	Data Value	Calculated Value
144	$616 \text{ g/m}^2$	$631 \text{ g/m}^2$
172	637 "	633 "
183	642 "	628 "
197	541 "	547 ''
212	431 "	424 "
225	518 "	534 ''
239	646 ''	616 "
253	620 "	638 "

Table 14. Original data and values calculated by the Rosenbrock direct search optimization technique.

The calculated parameters were used in the model and the function was plotted with the measured values (Fig. 24). To represent the two subprocesses that occurs, the main equation was separated into the two logistic curves and these were plotted (Fig. 24).

With the relative free constraints the curve representing process l fell to zero. This does not appear to represent the natural situation, and three more sets of curves were calculated. The decomposition curve was restricted to 60% (Fig. 25), 33% (Fig. 26), and 50% (Fig. 27) of the total mass.

These curves were calculated via the optimization program with a constant value added into the decreasing logistic portion of the function which accounted for the varying percentages that remained. With this change the values for the various parameters varied (Table 15).

		Parameters					
% Remaining	a <sub>1</sub>	<sup>ь</sup> 1	×1	<sup>a</sup> 2	<sup>b</sup> 2	×2	
33	10.3	2.4	215	21.1	5.1	200	
50	13.6	4.2	220	21.2	6.8	201	
60	23.9	9.4	224	18.4	7.3	201	

Table 15. Various parameters calculated by the Rosenbrock direct search optimization technique for various portions remaining of the decomposition curve.



Figure 24. Plots of the original data points of root mass, the sum of two logistic curves, and the separated curves.



Figure 25. Plots of the original data points of root mass, the sum of two logistic curves, and the separated curves with decomposition becoming asymptotic at 60% of the total.



Figure 26. Plots of the original data points of root mass, the sum of two logistic curves, and the separated curves with decomposition becoming asymptotic at 33% of the total.



Figure 27. Plots of the original data points of root mass, the sum of two logistic curves, and the separated curves with decomposition becoming asymptotic at 50% of the total.

The pair of curves which has the decomposition logistic accounting for 40% root loss (Fig. 25) shall be considered first. The decomposition curve seems quite realistic and has a slope similar to decomposition rates of buried cellulose (Clark 1970). However, it does reach an asymptote at a value considerably higher than Clark reported. The beginning of decay + respiration losses occurs on the first of July, which seems to be late.

This curve indicates that growth commences on July 20, which is indeed late in the season, and continues for a thirty-day period. The average growth rate of  $14 \text{ g/m}^2$ /day is slightly higher than the maximum daily photosynthetic material produced in a shortgrass ecosystem; Dye<sup>6</sup> found that 9-12 g/m<sup>2</sup>/day is the rate during the peak of the season. It must be kept in mind that 1-2 g/m<sup>2</sup>/day will be retained in the aboveground standing crop which leaves approximately  $10 \text{ g/m}^2$ /day being shunted to the root compartment.

For the second pair of curves to be considered, 67% of the roots decomposed over a growing season (Fig. 26). Growth initiation appears to be more realistic with June 15 being the starting date. The growth rate per day (10 g/m<sup>2</sup>/day) is within limits observed by Dye.<sup>6</sup> This curve would require over 450 g/m<sup>2</sup> to be produced per growing season which appears to be to high to be explained by photosynthesis.

<sup>&</sup>lt;sup>6</sup>Information supplied by A. J. Dye, Graduate Student, Range Science Dept. Colorado State University, Fort Collins.

Decomposition begins early and drops to a point which is quite close to that reported by Clark (1970), but he reported only on cellulose which decomposes rapidly. More resistant materials in the roots should prevent root decomposition from being as complete.

The last pair of curves (Fig. 27) are in between the previous pairs. The separated curves both start on July 1 and come to equilibrium around September 1. The growth curve produces  $10 \text{ g/m}^2$ / day at its peak period which is comparable to the previous curve. The curve representing decomposition follows cellulose decay (Clark 1970), but does not drop to as low a level as was reported.

It is quite difficult to say which of the various pairs of curves most closely represent the root growth and decomposition that occurs in nature. In any event, however, the root mass has no significant long term trend over several years; an amount equal to that produced in one year will be decomposed in one year. During the first year of decomposition the more easily broken down fractions would disappear while the resistant fractions would accumulate. Lignin could persist for long periods of time, but if present as fragments it would not be included in the root harvesting procedure.

The basic assumptions of the general model are straight forward and a method of further research to evaluate specific pairs of curves suggests itself. To evaluate the hypothetical curves actual data values of the growth and decomposition components need to be

obtained. Although the dynamic model is quite crude at this point, it does represent a hypothesis which can be tested.

## SUMMARY AND CONCLUSIONS

This study was designed to investigate the root fraction of the primary producer compartment of a shortgrass ecosystem. The two primary objectives of this study were (1) to estimate and interpret root mass fluctuations and (2) to determine if grazing herbivores had an effect on the root mass.

Data were collected for two growing seasons (1969 and 1970) with a fall and winter sampling period in between. Sampling was adequate as indicated from the low standard errors calculated (within 5% of the mean). The sampling scheme for the second season was modified according to information obtained from the first sampling season.

Summer 1969 data showed a seasonal sequence in root weights, but in 1970 the data fluctuated erratically because crowns were not separated from the 0-10 cm increment.

Various attempts were made to determine if grazing had an effect on the roots, however, no significant differences among the four grazing treatments were found. Therefore, further studies to determine root differences among the treatments need not be continued.

Vertical distribution of root biomass was quite pronounced. The 0-10 cm segment of the soil profile contained 60% of the roots and 75% was found in the upper 20 cm. Significant variations between dates was limited to the upper 10 cm with lower levels remaining quite constant.

Most authors explain root mass fluctuations on the basis of a storage and utilization philosophy. An hypothesis of root decomposition and growth was developed as an alternative which overcomes some of the disadvantages of the storage-utilization view.

In an analysis of the decomposition-growth hypothesis a mathematical model was fitted to the 1969 data. Two logistic equations were added together and fitted to the original data via a non-linear optimization program. The resultant curve was separated into an increasing curve representing growth and a decreasing curve representing decomposition and respiration losses. The fitted curves represented the original data. The various pairs of curves all have merit, however, more experimentation is needed to determine what is happening in the natural system.

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APPENDICES

Soils map of sections 15 and 23, Pawnee Site



Listing of program  $R \phi \phi TAS$ 

PROGRAM	5	ROOTAS	FORTRAN	EXTENDE	D VERSIO	N 2.0		11/19/7	1	19	5.11.	40.
		PROC	GRAM ROOT	AS ITAPE	5+COPY1+	TAPE6=CO	PY1.TAPE	1.FORT1.	TAPE2=FORT	11.00	A	1
		1TPU1	T+PLOTS1+	TAPF 3=PL	OTS1.WAT	ER1 .TAPF	4=WATER1	+TREAT1+	TAPE7=TREA	AT1)	A	2
	С	CCC	000000000000000000000000000000000000000	00000000	ccccccc	00000000	00000000	cccccccc	000000000000000000000000000000000000000	22223	A	3
	¢										A	4
05	С	THE	PURPOSE	OF THES	PROGRAM	IS TO MA	KE THE C	OLLECTIO	IN AND ANAL	YS15	A	5
	c	OF I	ROUL BICH	ASS DATA	FASTER	AND EAST	ER. AF	TELD SAM	PLE IS GIV	VEN A	A	6
	с	NUM	BER IN TH	E FIELD	AND PERT	INENT IN	FORMATIO	IN IS REC	ORDED (COD	DE 3)	A	7
	с	THE	SAMPLE N	IMBER IS	THE SAM	E FOR TH	E WASHED	SAMPLE	WHICH IS		A	8
	с	WET	GHED AND	READIED	FOR ASHI	NG. THE	SAMPLE	DRY WEIG	HT IS IDEN	VTIFI	A	9
10	с	87 .	ITS NUMBE	9 + CRUC	IBLE NUM	BER (COD	E 1). A	FTER ASH	ING ONLY 1	THE	A	10
	c	ASH	WEIGHT I	S RECORD	ED WITH	THE CRUC	IBLE NUM	RER (COD	E 5) . TH	JS+	A	- 11
	с	ANY	SAMPLE H	AS INFOR	MATION O	N 3 CARD	S AND IS	IDENTIF	IED BY A P	BATCH	A	12
	С	NUM	RER (DATE	OF COLL	ECTION).	THE PR	OGRAM TA	KES THE	WEIGHT DI	FFERE	A	13
	c	OF	CARD 1 -	2 AND ID	ENTIFIES	IT WITH	INFORMA	TION ON	CARD 3.	THE	A	14
15	C	INF	ORMATION	IS SORTE	D ON THP	EE COLUM	NS (SEE	A. BELOW	I) AND THE	N	A	15
	ç	PRE	SENTED IN	TAPULAR	FORM (S	EE A. BE	LOW).				A	16
	c											-17
	ç	CCCC	CCCCCCCCC	CUCCCCCC			CCCCCCCCC		cececece	33333		18
34		LONI	MON WILDU	IJ +KCRUC	10011+10	CNI (001+	5) + JA ( 50	31.414160	2.5.41.TO	7 9 K 1 14 7 A 1 7 1	A	19
20		21.6	10] #NULA1	. YDAD/10	10-10VI)	+UREF (0)	4 JF 166 11	0120.7.0	243401410	MENT	A .	20
		21.17	FUCTON TO	10/31. C	4884AMCA 58735	W(10/+50	CLI +DVDW	R ( C V + / + 7	· •		A A	21
			243104 1-	1813/1 3								22
			FGFR WISA								A	24
25	c		-GENERAL	FORMAT	FOP ALL	NUMBER 1	.2.AND 3	CARDS.	INPUT DAT	A IS	Ā	25
2.5	č		GRAMS A	ND MTELT	METERS.			•••••••	1	••••	Ã	26
	č		HEADER	CARD STA	TEMENTS.	THESE	HEADER C	ARDS SHO	ULD BE REA	AD IN	Ä	27
	č		EACH BA	TCH OF D	ATA. NP	LOT = NU	MBER OF	PLOTS. N	CORE = NUN	HER	A	28
	c	***	CORES.	NSECT =	NUMBER O	F SECTIO	NS. THIC	K = TOTA	L THICKNES	SS OF	A	29
30	С		COPE (MT	LLIMETER	5).						A	- 30
		1 REAL	n (5+77)	NPLOT+NC	ORE +NSEC	T+THICK					A	31
		IF	(NPLOT.LF	.10.AND.	NCORE+LE	.5.AND.N	SECT.LE.	5) GO TO	2		A	- 35
		WRI	TE (5+78)								A	- 33
	С		-+KTHICK	= THICKN	ESS OF E	ACH SECT	ION OF C	ORF (MIL	( IMETERS)	•	A	- 34
35		S REAL	0 (5+79)	(KTHICK (	1)+1=1+5	)					A	- 35
	с		DREF =	REFERENC	E VALUES	USED TO	SUBSTIT	UTE WHEN	DATA IS P	11551	A	- 36
	-	REAL	D (5+80)	(DREF(I)	•1=1•5)							37
	¢		-KBAICH	= REFERE	NCE BATC	H NUMBER	•				A	- 38
	•	REAL	0 (5+81)	KBATCH								- 39
40	C		ZERO UU	I THE AN	RIABLES						<u>.</u>	. 40
		3 101	3 [#[#3								<u></u>	41
		3 171	K(1)+0									42
		KWA.	¥ <b>=</b> 0								- 2	43
45		NST	=NSFCT+1									44
45		DO	4 T=1.601								Ā	44
		WTI	(1) = 0.0									47
		KCR	UC(I)=0								Ã	48
		NDT	A(1)=0								A	49
50		NTH	ICK(1)=0								Ä	50
		DO	4 J=1+6								A	51
		4 IDE	1=(L+I) TN	0H							A	52
		DO	5 J=1+NPL	от								53

PROGRAM	RO	OTAS	FORTRAN EXTENDED	VERSION 2.0	11/19/71	15.11	.40.
C F		00	5 L=1+NST			A	54
22		5 819	5 K-1+0 AD1 1-1 AK1=0.0			A	55
		WRT	TF (6+82)			ŝ	57
	с		READ NUMBER ONE	(1) CARDS.		Ā	58
		K=0				A	59
60		6 REA	D (5,76) IBATCH+NG	CARD+NCART+NCRU	IC+WGT	A	60
	С		CHECK TO SEE ALL	NIMBER ONE CA	RDS RELONG TO THIS BATCH.		61
		IF	(IBATCH.EQ.KBATCH)	GO TO 7		A	62
		WRI	TE (6+83) NCARD			A .	63
45		/ 1F	(NCRUC GT.0) GO TO			A .	- 04 4 E
0.5		A 101	TE (6+83) NCAPD	, ,			66
		GO	TO 6			Â	67
		9 IF	(NCART.LE.0) GO TO	3 8		A	68
		JK=	1				69
70	С		JK WAS SUBSTITU	FD FOR NUMBER	1 TO AVOID AN ERROR MODE 0.	A	70
		L=1				A	71
		CAL	L STAK (NCRUC+K+JH	(+L+IPTR+ICT)			72
		15	(K.GI.601) WRITE (	(6+84)		A	73
75		1 - 2	ULIRIENCARI			Å	74
13		C &L 2	STAK INCART	(AL - TOTO-TOT)			76
		1=3	L STAK MCARTERIUR			ŝ	77
		CAL	L STAK (NCART+K+JH	(+L + TPTR+TCT)		Â	78
		WTC	K)=WGT			Â	79
80		WX E	K)=WT(K)			A	80
	-	GO	TO 6			A	81
	c.		CHECK TO SEE TH	AT THIS SECTION	CONTAINS ONLY NUMBER 1#5.	A	82
	1	0 16	(NCARD.NE.2) WRITE	(6+85) NCARD	NCART	A	83
0 <b>E</b>		A54 60	=WG1 To 13			<u> </u>	84
00	c		READ NUMBER TWO	(2) CARDS.			85
	<u> </u>	1 REAL	D (5+76) IBATCH+NG	ARD . IDUM .NCRUC	+ASH+(IDFN(I)+I=1+6)+NDM+NTM	Ā	87
	с		CHECK TO SEE ALL	NUMBER 2 CARE	S BELONG TO THIS BATCH.	Ä	88
		1F	(IBATCH.EQ.KBATCH)	GO TO 12		A	89
90		WRI	TE (6+83) NCARD			A	90
	1	2 IF	(NCARD.NE.2) GO TO	0 16		A	91
		IF	(NCRUC.GT.0) 60 TO	) 13		<b>A</b>	92
		60 #K1	12 (0+03) NCARU			A A	93
95	1	3 151	AG=2				94
,,		1=1	RO-E				95
		CAL	L STAK (NCRUC+K+JF	LAG+L+IPTR+ICI	`)	Â	97
		IF	(JFLAG.NE.0) GO TO	) 14		Â	98
		IDE	N(1)=4HZZZZ			A	99
100		60	TO 11			A	100
	1	4 NCA	RT=KCRUC(K)			A	101
		JFL	AG=Z			A	102
		L=2				Å	103
105			L STAR INCARTAKAJA Tielag ne ov co ta	1 1 C	• •	Å	104
100		105	13FLA0+NE+U7 90 PC	2 1 3		A A	105
		+				_	**0

PROGRAM	F	ROOTAS	FORTRAN EXTENDED	VERSION 2.0	11/19/71	15,11,40.
110	с	GO TC 15 WT (K) GO TC 	11 =WT(K)-ASH   11 CHECK TO SEE THA  CARD.NE.3) WRITE =IDUM	T THIS SECTION CONTAIN (6,85) NCARD+K	NS ONLY NUMBER 2≢S.	A 107 A 108 A 109 A 110 A 111 A 112 A 113
115	c c	ICT=0 GO TO 17 READ	20 READ NUMBER THRE (5+76) IBATCH+NC CHECK TO SEE ALL	E(3) CARDS. ARD.NCART.IDUM.DUM.(II	DEN(1)+[=1+6)+NDM+NTM	A 114 A 115 A 116 A 117
120	C	IF (1 WRITE 18 IF (N IF (N WRITE	BATCH.EQ.KBATCH) (6+83) NCARD (CARD.NF.3) GO TO (CART.GT.0) GO TO (6+83) NCARD	GO TO 18 24 19	5 TU INIS SAICH.	A 118 A 119 A 120 A 121 A 122 A 123
125		GO TO 19 N=N+1 20 JA(N) JFLAO L=3	=N =2			A 124 A 125 A 126 A 127 A 128
130		CALL IF (J IDEN( NDIA) NTHIC	STAK (NCART+K+JF FLAG+NF+0) GO TO 1)=4H7777 K)=NDM K(K)=NTM	LAG+L+IPTR+ICT) 22		A 129 A 130 A 131 A 132 A 133
135		00 21 21 10EN1 GO TO 22 NOIAO NTHIO	I=1+6 (K+I)=IDEN(I) 17 K)=NDM K(K)=NTM			A 134 A 135 A 136 A 137 A 138
140	ç	DO 23 23 IDENT IF (W GO TO	I=1+6 (K+I)=IDEN(I) (T(K)+LE+0+) IDEN 17 THIS DECODING CO	T(K+1)=4HZZZZ NVERTS KBATCH WHICH WA	AS READ IN AN A FORMAT	A 139 A 140 A 141 A 142 T A 143
145	с с с	DECOD 9932 24 WRITE DO 25	INTEGER FORM. E(6+9932+KRATCH) Format(16) (6+86) K=1+N	KBUNCH		A 144 A 145 A 146 A 146 A 147 A 148
150	0000	25 CONTI CCCCC	NUE			A 149 A 150 CC A 151 A 152 A 153
155		THIS FIELD IDENT (2-8)	SORT ROUTINE ARR S(IDENT). THIS IFIERS AS NEEDED - I.	ANGES THE DATA BY THE Section can be changed , only two changes ne	FIRST THREE IDENTIFIE ) TO SORT ON AS MANY EDED+ I = 1+(1-7)+ K	A 154 R A 155 A 156 = A 157 A 158 A 159

PROGRAM		R001	TAS FO	RTRAN	EXTENDED	VERSION	2+0	11/19/	71	15.11	.40.
160	c		000000	000000	<b>20000000</b> 0	0000000	000000000000000000000000000000000000000	000000000000000000000000000000000000000		A Di	160
			00 31 . K=4-1	=1+3						A 	101
			DO 26 1	= ] - N							162
										Å	164
165		26		DENT	1.6)					<u></u>	165
105		L.4	INDEX=	4-1						ĩ	166
			IND=0	••						Â	167
		27	D0 29 1	4=1 • INF	DEX					Â	168
			IF (IA	(M)-TA	(#+1)) 29	.29.28				A	169
170		- 28	ISAVE=	[A(M+1)	)					A	170
			JSAVE=	JA (M+1)	)					A	171
			IA(M+1	)=IA(M)	)					A	172
			JA (M+1	)=JA(M)	)					A	173
			1A(M)=	ISAVE						A .	174
1/5			JA(M)≍. THO:0	158VE						A .	175
			INC-1	7						A .	170
		20	CONTIN	IF							179
		27	IF (IN	), 30.3	31.30					Â	170
180		30	INDEX=	THOLD	31430					Â	180
			IND=0							Â	181
			GO TO 2	27						A	182
		31	CONTIN	JE							183
	С		TI	IS SEC	CTION WRI	TES THE	RESULTS OF	THE GROUPIN	G PROCESS.	A	184
185			K=0								185
			IDN=4H	- • •						<b>A</b>	186
			00 32 1	=1+N						A .	187
				) [h] <b>T</b> / h, 1						A	188
100				16.891	I J ST. GE IUN	/	1.61.WT/ IN				107
170		32	CONTIN	IF	011000					Â	191
		54	IF IK.	0.01 0	50 TO 33						192
			WRITE	(6+89)	ĸ					Â	193
	с		CI	ECK FC	OR ZERO D	EVISORS.				A	194
195		- 33	DO 34 I	=1+5						A	195
			IF (KT)	ICKILI	).EQ.0) W	RITE (6)	90) (KTHICK	((1)+1=1+5)			196
		34	CONTIN	JE						A	197
			IF (TH	ICK+E0	.0.OR.NCO	RE.EQ.0.	OP.NPLOT.EQ	).0) WRITE (	6+91) THICK+NC	A 01	198
			IRE INPL						-	A	199
200			IF UH	LCK .NE (	•U+OR •NCO	RE.NE.U.	UR.NPLUI.NE	•0) GO 10 3	<b>,</b>		200
	~		60 10	11	******	~~~~~~~					201
	č									.C. A.	202
	č		8.								203
205	č									ĩ	205
	č		THIS S	ECTION	CONVERTS	THE RAN	DATA INTO	A MORE READ	ABLE FORM. TH		206
	Ċ		DATA I	S PRESE	ENTED BY	VARIOUS	WATERSHEDS	AND BY PLOT	+ CORE+ AND		207
	С		SECTIO	N. MEI	ANS AND S	TANDARD	ERRORS ARE	CALCULATED	AND INCLUDED 9	N A	208
	с		THE TA	BLES.	A SUMMAR	Y TABLE	IS CALCULAT	ED FOR EACH	DATE.		209
210	C									<b>A</b>	210
	ç		CCCCCC	cccccc	cccccccc	ccccccc	2222222222222	22222222222222		C A	211
	C									4	212

PROGRAM		R001	AS FORTRAN EXTENDED VERSION 2.0 11/19/71	15.11.40.
	c	35	INITIALIZE REFERENCE VALUES AND COUNT THEM. IRF=0	A 213 A 214
215			MACRO=0	A 215
		~		A 216
		30		A 217
			IF (NN+NE+I+UK+NN+NE+N) MM=JA(NN+I) M= 14 (NN)	A 218
220	c		H-JAINNI CHECK EAD NEW TOEATHENT ADEA	A 219
220	ç		TE (IDENT(M.3) FO IDE) CO TO 61	A 220
			$IF (IRF_F0.0) GO TO 58$	A 221
		37	IF (ICOUNT.(T.4) GO TO 58	A 223
	C		INITIALIZE TOTAL	A 224
225	С		NSCT IS A COUNTER. THIS SEQUENCE OF WRITING ON A THE	APE WILL A A 225
	С		USED TO PUT THE ERPOR STATEMENT AT THE END OF THE TI	ABLE RATHE & 226
	С		THAN THE FIRST OF THE TABLE.	A 227
			REWIND 1	A 228
			NSCT=0	A 229
230			DO 40 JEINPLOT	A 230
			DU GU KEIGNCHRE	A 231
	c		TOTAL (JIK) - 0.0	A 232
	C		DO 40 1=1-5	A 233
235			15 (WTD(  -K+1 ).GT. 0.6ND WTD(  -K+1 ) +5 (100 #DDEE(1))) CO.	# CJ4
	C		WHEN NSECT = 1+ STANDARD VALUES ARE SUBSTITUTED. HO	10 37 A 235
	C		WRITE STATEMENT ISN#T EXECUTED.	A 237
			IF (L.GT.NSFCT) GO TO 38	A 238
			NSCT=NSCT+1	A 239
240			WRITE (1) JFILE(J)+J+K+L+DREF(L)	A 240
	~	38	WTD(J+K+L)#DREF(L)	A 241
	C	20	TOTAL ALE AND TOTAL AND DIVIDE BY THICKNESS,	A 242
		40	10(AL(J+K)=10(AL(J+K)+W)()(J+K+L) WTD(1-K-))=WTD(1-K-()////(AT(KTUTCH/)))= 0010	A 243
245	c		THE FOLLOWING PEONCES THE WEIGHT TO A DED ON VALUE	A 244
243	÷		DO 41 JELANDIOT	A 245
			DO 41 K=1.NCORE	A 240
			D0 41 L=1,5	A 248
	С		THIS FACTOR OF .01 CONVERTS THE WEIGHT WTD(J+K+L) TO	G/M2/CH A 249
250	С		RATHER THAN G/M2/M.	A 250
		41	WTD(J+K+L)=WTD(J+K+L)+.01	A 251
			DO 42 J=1+NPLOT	A 252
			DO 42 K=1+NCORE	A 253
		42	TOTAL(J+K)=TOTAL(J+K)/(THICK+.001)	A 254
255			IF (NSECI-EQ.I) GO TO 43	A 255
			WK[IL (0+93) (10EN)(MM+J)+J=1+3)	A 256
		4.7	UU IU 44 HDTTE /6-061 (IDENT/MM. 1). 1-1.35	A 257
	c	40	HALLE TOTTTT TIDENTIANTUITUITUITUITUITUITUITUITUITUITUITUITUIT	A 258
260		44	DO 45 MIX=1+NPI OT	A 239
			DO 45 NIX=1+NSECT	A 200 A 261
		45	XBAR(MIX+NIX)=0.0	A 262
		,	D0 46 L=1+NST	A 263
		46	XMEAN(L)=0.0	A 264
265			DO 53 J=1.NPLOT	A 265

PROGRAM	R	DOTAS	FORTRAN	EXTENDED	VERSION 2.0	i i	11/19/71	19	5.11	.40.
		00	47 L=1+NS	T					A	266
	4	47 XBA	R(J+L)=0.	0						267
		DO	49 K=1+NC	ORE						268
		DO	48 L=1,NS	ECT					<b>A</b>	269
270		48 XBA	$R{J+L}=XB$	AR (J+L) +WT	D(J+K+L)				A	270
	-	XBA	R(JINST)=	XBAR (J+NST	)+TOTAL (J+M	0				271
	¢		WRITE O	UT CALCULA	TED WEIGHTS				A	272
		1 N - T	12 (2195)	TIDENTINA	+113+11=1+1	JI + J + K + M SEC I	+ (WID(J+K+L))	L=1+N2FC1	. <u>.</u>	2/3
375		40 WDT	TE (6.100		NE ANTO CAN		CT1. TOTAL / 1.8	<b>r 1</b>	•	276
215		47 <b>8</b> 41	50 1 =1.NS	7 (FILL()/				.,		276
		50 XRA	D ( 1+1 )=XR	AR (.1+1.) /NC	ORE				- î	277
	С		WRITE O	UT MEANS B	Y PLOTS.				- Â	278
	-	WRI	TE (3+95)	(IDENT (MH	+ () + () = 1 + 3	) . J.NCORE . N	SECT+ (XBAR (J	L)+L=1+NS	Ä	279
280		11)							Ä	280
	•	WRI	TE (6+96)	(XBAR(J+L	)+L=1+NST)				A	281
		DO	51 MIX=1+	NPLOT						282
		DO	51 NIX#1+	NST						- 283
	9	51 BXB	AR (MIX+NT	X+IRF)=XBA	R(MIX+NIX)				A	284
285		WRI	TE (6+97)	_					A	285
		DO	52 L*1+NS							286
		52 XME	AN (L) =XME	AN (L) +XBAR	(J+L)/NPLOT					287
		53 CON	TINUE			~			. <u>A</u>	288
204	Ç		TE (4. OF)	JI REANS D	T WATERSHEL	D. NOLOT NCO				209
290		1.44	12 (4773) Ti	110241 (114	- JJ) + JJ-1+3	JANELUT ALU	ACTINGELT FIAME		- 2	290
		191	TE (6.99)	(XMEAN (L)	AL BLANSTI				- 2	292
		CAI	I STDEV (	KRAR-MST-N	PLOTASD				- î	207
	с		WRITE O	UT STANDAR	D ERRORS BY	WATERSHEDS			- 2	294
295	•	WRI	TE (4+95)	(IDENT (MM	- JJ) + JJ=1+3		RE+NSECT+(SD)	(L)+L=1+NS	Â	295
		17)							Ä	296
		WRI	TE (6+98)	(SO(L)+L=	1+NST)				A	297
		1F	INSECT.EQ	1) GO TO	54				A	298
		WRI	TE (6+101	)						299
300		GO	TO 55							300
		54 WRI	TE (6+102	)					A	301
		55 REN	IND 1		-				A	305
		1F	(NSCT.EQ.	0) GO 10 5	7				, A	303
		00	50 [SUI#]	9NSCI 13.13.14.5	• •				. <u>A</u>	304
305		85.8 84 WD1	TE (6-97)	1211311417	1				. <u>.</u>	305
	~ `	20 MMT	12 (0172)	E DOINT A	1975 I 117					300
	Ľ,	57 MAC		I	W1 •				- 2	307
		27 MAC 28 105	TOFNT (M.	3)					- 2	300
310		JU LIUF	-100411440	57					- î	310
510		00	59 J=1+NP	OT					- Î	311
	с		ZERO OU	T THE WEIG	HT ARRAY OF	PREVIOUS B	ATCH.		Â	312
		59 JF1	LE(J)=-10		•				Ā	313
		00	60 J=1+NP	LOT					A	314
315		DO	60 K=1+NC	ORE					A	315
		DO	60 L=1.5							316
	4	60 WTC	)(J+K+L)=-	1.0E-15						317
		ICO	)UNT=0							318

PROGRAM	R001	AS FORTRAN EXTENDED VERSION 2	2.0 11/19/71 1	5.11.40.
320	61 62	JJ≖IDENT(M+4) D0 62 J=1+NJ IF (JJ+FQ+JFILE(J)) G0 T0 63 CONTINUE		A 319 A 320 A 321 A 322 A 322
325	C 63	J=NJ JFILE(NJ)=JJ NJ=NJ+1 CMECK TO SEE THAT J IS NO IF (J.GT.0.AND.J.LE.NPLOT) GO `	LARGER THAN NPLOT. 10 64	A 323 A 324 A 325 A 326 A 327
330	64 C	J=NPLOT+1 K=IDENT(M+5) CHECK TO SEE THAT K IS NO IF (K.GT.0.AND.K.LE.NCORE) GO K=NCORE+1	GRFATER THAN NCORE. 10 65	A 328 A 329 A 330 A 331 A 332
335	с <sup>65</sup> с	L=IDENT(M+6) CHECK TO SFE THAT L IS NO IF (L.GT.0.AND.L.LE.NSECT) GO L=NSECT+L CHECK TO SFE IF NDIA OR N	T LARGER THAN NSECT. 10 66 Thick is equal to 0, and if 50	A 333 A 334 A 335 A 336 A 337
340	с 66 С	SURSTITUTE A KNOWN VALUE. IF (NDIA(M).EQ.0) GO TO 67 IF (NTHICK(M).EQ.0) GO TO 67 THIS (.01) CONVERTS THE R DIAMETER WASN&T EXPRESSED	PORTED VALUES TO A MILLIMETER BASIS AS MILLIMETERS.	A 338 A 339 A 340 A 341 A 342
345	c c	RADSQ=FLOAT(NDIA(M))*FLOAT(NDI 3.1416 * (.001 * .001)/4.0 = 7 AREA=RADSQ*7.854E-7 WTD(J+K+L)=WT(M)/APEA ICOUNT IS A COUNTER THAT	A(M))+.01 .854 E-7 Is used to determine if enough infor	A 343 A 344 A 345 A 346 A 346 A 347
350	c c	FXISTS FOR CONSTRUCTION OF TABLE IS PRODUCED. ICOUNT=ICOUNT+1 IF (KTHICK(L).GT.NTHICK(M)) WT J/FLOAT(NTHICK(M)))	F A TABLE. IF ICOUNT IS LESS THAN 5 )(J+K+L)=WTD(J+K+L)*(FLOAT(KTHICK(L)	5 A 348 A 349 A 350 A 351 A 352
355	67 68	IF (WTD(J,K+L).GT.0AND.WTD(J CONTINUE WTD(J+K+L)=DREF(L) Continue IF (NN-N) 69+70+71	K+L).LE.(100.+DREF(L))) GO TO 68	A 353 A 354 A 355 A 356 A 356 A 357
360	70 71	NN=NN+1 G0 TO 36 NN=NN+1 G0 TO 37 JF (NSECT.ED.1) G0 TO 72 JETE (4.102) (JDENT(HM.1). (1)	-21	A 358 A 359 A 360 A 361 A 362 A 362
365	72 C C	GO TO 73 WRITE (6+104) (IDENT(MM+J)+J=1 WTSA AND WTSB ARE USED IN OF TREATMENT MEANS AND ST	*C' \$2) SUBROUTINE TRFAT AND USED FOR CALCU ANDARD ERRORS.	A 365 A 364 A 365 J A 366 A 367 A 369
370	73	WTSH=1 WTSH=3 Call TPEAT (NPLOT+NST+PXBAR+WT WTSA=2	SA+WTSB+SE+IDENT+MM)	A 369 A 370 A 371

PROGRAM	ROOTAS	FORTRAN EXTENDED	VERSION 2.0	11/19/71	15.11	.40.
	WTS	B=8				372
	CAL	L TREAT (NPLOT+NST	+BXBAP+WTSA+WTSB	+SE+IDENT+MM)	Ä	373
	WTS.	A=4			A	374
375	WTS	A=5			A	375
	CAL	L TREAT (NPLOT+NST	+BXBAR+WTSA+WTSB	+SE+IDENT+MM)	A	376
	WTS	A=6			A	377
	WTS				A	378
308	CAL	L TREAT (NPLOTINST	+ HXHAR+#ISA+#ISH	(+SE+IUENI+MM)	A.	379
380	11	(NSECT + E(A+1) 00 10	/ /4			380
	60	TO 75				382
	74 181	TE (6+106)			2	381
	75 IF	(NCARD.NF.0) STOP			Â	384
385	c	EACH BATCH OF DA	TA SHOULD BE SEP	ARATED BY A CARD WITH KBATCH	A A	385
	C	PUNCHED AND COLL	JMN 7 LEFT RLANK.	THE PROGRAM WILL TERMINATE	. A	386
	C	WITH & NUMBER IN	I COLUMN 7.		A	387
	G <b>O</b>	TO 1			<b>A</b>	388
	с				A	389
390	76 FOR	MAT (A6+11+215+F9.	4 • 4 • 17 • 13 • 14 • 21	3+214)	A	390
	77 FOP	MAT (315+F5.0)			A	391
	78 108	MAT ( INM HEAVEN (	ARD ERROR)		<u>.</u>	392
	19 FUH	MAI (515)			<b>.</b>	383
205	80 FOR	MAT (3710+0)			A .	394
373	82 500	MAT (1H1)				395
	83 FOR	MAT ( 214 CARD FRR	OR CARD TYPE+13)		Ā	397
	84 FOR	MAT ( 4H K= +13)			A	398
	85 FOR	MAT (1H 2110. 22H	CARD OUT OF SEQ	IUENCE)	A	399
400	86 FOR	MAT (1H0+ 47H IND1	VIDUAL OBSERVATI	ONS GROUPED BY IDENTIFIERS ./	'/ A	400
	1)				A	401
	87 FOR	MAT ( 15H RECORD N	1UMBER +15+3X+ 23	H HAS NO NUMBER TWO CARD)	A	402
	88 FOR	MAT (10X13+4XA4+5X	16+5X+ 2HWS+12+	5X13+5X12+5×12+5×F10+4)		403
	A9 FOR	MAT (1H015+3X+ 46P	I BLANK ICFNTIFIE	R RECORDS. DATA MAY BE MISSI	N A	404
405	1G)					405
	90 708	481 (18 515) May (19 - 7010108		CODE - TELEY. JUNDLOT - TEL	A	405
	91 108	MAT ( 64 CELL -61	5.3X. 33W 0ATA M	NURE		407
	10.3	. 12H SUBSTITUTED	54544 556 0A1= 4	TO THE DIRACHAST AND C OF AF	1 4	408
410	93 FOR	MAT (1H1100( 1H=)	7. 5H STTE . A4.5	X. 4HDATE.17.5X. 13HWATERSH	IF · A	410
	1D N	0++I3/+ 1H +2X+ 1	OH PLOT CORE . SX.	8H 0-10 CM+7X+ 8H10-20 CM	. A	411
	27%+	8H20-40 CM+7X+	8H40-60 CM+7X+	8460-80 CM+6X+ SHTOTAL+/+	1 A	412
	3H •	100( 1H=)/• 1H •	17X+21( 1H-)+ 2	GHORAMS PER MSO PER CM DEPTH	i. A	413
	421 (	1H-)+9X+ 5HG/MS	io)		A	414
415	94 FOR	MAT (1H145( 1H=)/	• 5H SITE . 44.5X	+ 4HDATE+17+5X+ 13HWATERSHE	D 🔺	415
	1 NO	•+13/• 1H +2X+ 10	H PLOT CORE.5X.	BH 0-10 CM+BX+ SHTOTAL+/+	A	416
	21H	•45( 1H=)/• 1P •	14X 14HG/MSQ/CM	DEPTH+5X+ SHGZMSQ)		417
	95 109	MAT (AJ+10+411+0FO			A .	418
420	90 FOP	MAI ( DH MEANIORD Mat /14	12.3/1		Å	419
	98 509	MAT ( 104 STO F000	P-116F15.31		, , , , , , , , , , , , , , , , , , ,	420
	99 FAD	MAT ( 5H MEAN-AXA	F15.3)		2	422
	100 FOR	MAT (1H 215+6F15.3	3)		Â	423
	101 FOR	MAT (1H 100( 1H=)	• •			424

PROGRAM	ROOTAS	FORTRAN EX	TENDED V	ERSION 2.0		11/19/71		15.11.40	•
425	102 FORM 103 FORM 1NT 2ND W	AT (1H 45( AT (1H122X+ (TRT)+/100( HTS = TRT+24	1H=)) 56HSUNN 1H=)/4 X, 9H	ARY TABLE ( 7H SITE = 0-10 CH+2X	DF ALL WAT =+A4+5X+ + 8H10-20 SHTOTAL +/	ERSHEDS(WT) 6HDATE =+1( ) CM+2X+ AI	5) BY TREATM 5/• 18H WTS 420-40 CM•2X (39X•12/ 14	A 42 E A 42 A A 42 • A 42	5 6 7 8
430	4)+ 2 104 FORM 1T(TR 2TS = 3+4X+	6HGRAMS PER AT (1H13X+ T)+/61( 1H TRT+25X+ 6HG/MSQ )	NSQ PEF 54HSUMM/ #)/, 7+ 8H 0-10	CM DEPTHAN	5X+ 6HDA 5X+ 6HDA TOTAL+/61	3X+ 5HG/M RSHEDS(WTS) TE =+16/+ 1H=)/43X+	SQ) BY TREATNE LOH WTS AND BHG/MSQ/C	M A 43 M A 43 M A 43 M A 43 M A 43 A 43	0 1 2 3
435	105 FORM 106 FORM	AT (1H 100( AT (1H 61(	1H=}} 1H=}}					A 43 A 43	5 6 7
	Liib			IDENT LIST	ROOTAS -L+-R			R 73	•
		000000	022606	//	COMMON				
		020237	02023/	VADDIM.	LOCAL				
		020237	000000	ENTRY.	LOCAL				
		020237	002026	CODE.	LOCAL				
		022265	000371	DATA.	LOCAL				
		022656 022670	000012	DATA HOL.	LOCAL				
			022672	PROGRAM L	ENGTH				
				ENTRY POI	NTS				
				020237	ROOTAS	000000	TAPESE	002022	COPYIE
				004044	TAPE1:	000000	FORTIE	000066	TAPEZ
				016176	TREATIE	016176	TAPETE	014124	WAIEKII
				EXTERNALS					
				Q8NTRY. OUTPTB.	IPUTCI. STDEV	INPUTC. IPUTRI.	OPUTCI. O INPUTB. T	UTPTC. REAT	STAK STOP.
022672 HOL.				END	ROOTAS				

SUBROUTINE	STAK	FORTRAN EXTENDED VERSION 2.0 11/19/71	15.11.40.
c	S	UBROUTINE_STAK_(N+K+JFLAG+L+IPTR+ICT) CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC	8 1 C R 2
č	s	URROUTINE STAK	B 4
05 C	т	HTS SUBPOUTINE DEVELOPES THREE LISTS OF NUMBERS WHEN HELAG FOUND	65 64
č	i	. AS NUMBER ONE CARDS ARE READ IN STAK IS CALLED AND THESE LIST	587
c	A	RE CONSTRUCTED。 LIST ONE = NUMBER OF NCRUC FROM CARD 1。 LIST TH ND THREE = NCRUC OR CARTON NUMBER。 WHEN JELAG TS TWO THESE THREE	# B 8 F R 0
10 Č	ĩ	ISTS ARE SEARCHED. AS NUMBER TWO CARDS ARE READ IN. STAK IS CALL	8 10
C C	A 1	ND NCRUC IS SEARCHED FOR IN LIST 1 AND NCART IS SEARCHED FOR IN 1st 2. WHEN NUMBER THREE CARDS ARE BEING READ IN. LIST THREE IS	8 11 8 12
č	5	EARCHED FOR NCART. AS NUMBERS ARE FOUND PROPER EQUATING IS DONE	B 13
15 C	A	ND COMPLETELY MATCHED GROUPS OF NUMBERS ARE AVAILABLE IN THE ATM PROGRAM.	B 14 B 15
Č		a Dal Fronzación a	B 16
с	- C	CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC	C B 17 B 18
	Ğ	0 TO (1+6)+ JFLAG	8 19
20	1 K	MIN=1PTR(L) F (1PTR(L)_6T.600) WRITE (6•10) L•1PTR(L)	8 20
	ŕ	F (KMIN.EQ.0) GO TO 3	8 22
	D	0 2 I=l+KMIN F (LIST(L+TL-FO-N) GO TO 4	B 23 B 24
25	2 0	ONTINUE	8 25
	3 K	=IPTR{L}+1 fst(1 *K}=N	8 26
	ī	PTR(L)=K	8 28
30	G 4 w	0 TO 5 RITE (6+11) N+L+I	B 29 8 30
	5 R	ETURN	8 31
	6 L 1	DNG=IPIH(L) F (IX.EQ.1) GO TO 7	8 32
	I	(=)	B 34
35	70	) B I=I+LONG 7 (N_EO+LIST(L+I)) GO TO 9	B 36
	8 C	DNTINUE	B 37
	W J	RITE (B+12) N+L FLAG=0	B 39
40	Ĩ		B 40
	L	*LONG*101 [ST(L+K)=0	8 42
	R	TURN	8 43
45	9 K	≤1 [ST(L,I)=0	8 45
	R	TURN	B 46
c	10 F	)RMAT (1H + 5HIPTR(+13+ 2H)=+14)	8 48
	11 F	RWAT ( 17H DUPLICATE NUMBER+15+ 16H IN LIST NUMBER+13+ 13H 9TE	B 49
50	1M 12 Fi	NUMHER(15) )RMAT ( 12H ITEN NUMRER(16+ 36H NOT FOUND IN STACK FOR LIST NUMM	B 51
	16	R 14)	8 52
	E	iD	8 33

SUBROUTIN	E STDE	EV FORTRAN	EXTENDED	VERSION 2.0	1	1/19/71	1	5.11.	40.
		SUBROUTINE ST	TDEV (XBAR	+NST+NPLOT	SD)			¢	1
	C C	cccccccccccc					222222222	C C	23
<b>AE</b>	ć	SUBROUTINE S	TDEV					ç	4
05	č	THIS SUBROUT	INE IS ACT	IVATED TO C	ALCULATE STAN	DARD ERRORS	(SD) OR	č	6
	c c	STANDARD DEV	LD SLIGHTL	Y CHEMUVE C	INE UTVISION	SY NPLUID IO	CALCULAT	c	é
10	с с	00000000000						c	9 10
		DIMENSION XS DO 1 I#1+NST	UM (6) + XB/	NR2(6) + XBAF	{(10+7)+ SD{7	)		cc	11 12
		XSUM(1)=0.0 XBAR2(1)=0.0						c c	13 14
15		DO 1 J=1+NPL	0T (1)+X848(	1.1)				c	15
	1	XBAP2(1)=XBA	P2(I)+X8AF	(J+I)*XBAR	(J+I)			č	17
	2	SD(I)=((SQPT	((XBAR2(I)	-XSUM(1)++2	VNPLOT)/(NPL	0T-1)))/NPL0	173	č	19
20	•	END						C	20
				IDENT	STDEV				
				-101					

000000	000004	START.	LOCAL
000004	000010	VARDIN.	LOCAL
000014	000000	ENTRY.	LOCAL
000014	000035	CODE .	LOCAL
000051	000002	DATA.	LOCAL
000053	000014	DATA	LOCAL
000067	000000	HOL	LOCAL
000067	000004	XBAR	LOCAL
000073	000003	NST	LOCAL
000076	000004	NPI OT	LOCAL
000102	000002	SD	LOCAL
AAAIAE		30	

000104 PROGRAM LENGTH

## ENTRY POINTS 000002 STDEV

EXTERNALS

000104 SD

END

SUBROUTINE	TR	EAT FORTRAN EXT	ENDED V	EPSION 2.0	11/1	9/71	15.11.40.
(	2	SUBROUTINE TREAT	INPLOT	+NST+BXHAR+	WTSA+WTSB+SE+IN	ENT+MM)	0 1 2 0 2:
(	2	SURROUTINE TREAT					D 3 D 4
05 0	:	-					0 5
(	2	THIS SUBROUTINE	IS USED	TO CALCULA	TE MEAN WEIGHTS	BY TREATMENTS	D 6
	2	FOR VARING NUMBE	45 UF P				0 /
	č	000000000000000000000000000000000000000	ccccccc	000000000000000000000000000000000000000	000000000000000000000000000000000000000		ะ อีว
10		INTEGER WTSA.WTS	<b>9</b>				D 10
		DIMENSION XXMEAN	1(7)+ BX	BAR (20+7+9)	+ SE(7)+ IDENT(	(601+6)	D 11
		DO 1 1=1+NST					0 12
		1 XXMEAN(1)=0.0					D 13
15		00 2 1=1+NPI 01					0 15
1.5		XXMEAN (L) = XXMEAN	IL)+BXA	ARIJILIWTS	+BXBAR (J+L+WTS	(8)	D 16
		2 CONTINUE					0 17
		XXMEAN(L)=XXMEAP	1(L)/(NP	LOT+2)			0 18
24		CALL EPPOR (BXR)	PANST-N	PL OT . SF . WT	A.WTCR)		0 20
20		IF (WTSA+EQ.1.A	D.WTSR.	EQ.3) ITRT:	=4		0 21
		IF (WTSA.EQ.6.A	D.WTSB.	EQ.7) ITRT:	= 7		D 55
		IF WISA.ER.4.A	D.WTS9.	EQ.5) ITRT:	:?		D 23
35		IF (WTSA.EO.2.A	ID.WTSB.	EQ.8) ITRT:	= ]		D 24
25		WPI=NPE(1+2 WPITE (7+4) (10)	NT (MM.		TTOT.NOT. / YYME	N(I) . Tal .NST)	0 25
		WRITE (6+5) WTS	A+#TSB+1	TRT+NPT+(X)	(MEAN(I)+I=1+NS)	[]	0 27
		WRITE (7+4) (10	NT (MM+J	J)+JJ=1+3)	TTRT+NPT+(SE(I)	+1=1+NST)	D 28
		WRITE (6+6) (SE	(1)+1=1+	NST)			0 59
30	~	RETURN					D 30
	L I	4 FORMAT (43-16-2	11.12.65	8.21			0 32
		5 FORMAT (1H 1X+1)	•7ו11•	5%+11+5%+	SHMEAN OF +12+	9H PLOTS +6F1	10 0 33
		1.2)	_				D 34
35		6 FORMAT (1H 22X+	18HSTAN	DARD EPPOR	+6F10.7)		0 35
		END		TOENT	TOPAT		0 35
				LIST			
		000000	000004	START.			
		000004	000010	VARDIM.	LOCAL		
		000014	000000	ENTRY.	I OCAL		

		IDENT LIST	TREAT
000000	000004	START.	LOCAL
000004	000010	VARDIM.	LOCAL
000014	000000	ENTRY.	LOCAL
000014	000221	CODE .	LOCAL
000235	000025	DATA.	LOCAL
000262	000007	DATA	LOCAL
000271	000000	HOL.	LOCAL
000271	000003	NPLOT	LOCAL
000274	000006	NST	LOCAL
000302	000005	BXBAR	LOCAL
000307	000002	WTSA	LOCAL
000311	000002	WTSB	LOCAL
000313	000003	SE	LOCAL

SUBROUTINE	ERRO	R FORTRAN EXTENDED VERSION 2.0 11/19/71 15	j <b>.</b> 11.40.
	c	SUBROUTINE ERROR (BXBAR+NST+NPLOT+SE+WTSA+WTSB) CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC	E 1 E 2
AE		SUBROUTINE ERROR	£ 3 E 4
<b>U</b> 5 (		THIS SUBROUTINE IS USED TO CALCULATE STANDARD ERRORS FOR TREATMENT	E 6 F 7
	č		E 8
10	C	DIMENSION XXSUM(12)+ XXBAR2(12)+ BXBAR(20+7+9)+ SE(7) INTEGER WTSA+WTSB	E 10 E 11
	· .	DO ] K=1+NST XXSUN(K)=0.0	E 12 E 13
15	1	DO 2 J=1+NST DO 2 J=1+NPLOT	E 14 E 15 E 16
	2	XXSUN([]=XXSUN(])+BXBAR(J+I+WTSA)+BXBAR(J+I+WTSB) XXBAR2(])=XXBAR2(])+(BXBAR(J+I+WTSA)++2)+(BXBAR(J+I+WTSB)++2)	E 17 E 18
20		IF (FPT.LE.1.) GO TO 5 DO 4 IFINST	E 20 E 21
		IF (XXBAR2(I).LE.XXSUM(I)**2/FPT) GO TO 3 SE(I)=((SQRT((XXBAR2(I)-XXSUM(I)**2/FPT)/(FPT-1)))/FPT)	E 23
25	3	GO TO 4 SE(I)=-0.	E 24 E 25
	4	CONTINUE RETURN CONTINUE	E 26 E 27
20	5	SE(1)=0.	E 29
50		END LOENT FROM	E 31
		LIST -L+R	
		000000 000004 57407 4 0044	

000000	000004	START.	LOCAL
000004	000010	VARDIM.	LOCAL
000014	000000	ENTRY.	LOCAL
000014	000067	CODE.	LOCAL
000103	000006	DATA.	LOCAL
000111	000030	DATA	LOCAL
000141	000000	HOL.	LOCAL
000141	000005	BXBAR	LOCAL
000146	000003	NST	LOCAL
000151	000002	NPLOT	LOCAL
000153	000005	SE	I OCAL
000160	000002	WTSA	LOCAL
000162	000002	WISB	I OCAL

000164 PROGRAM LENGTH

Samples of various tables of individual root mass weights

SITE		DATE 690524	WATERSHED NO.	20-40 CM	40-60 CM		TOTA:
======							:223322722722322
				PEP MSD PEP C	N DEPTH		G/MSQ
7	1	85,686	24.401	12.211	12.690	1.638	2039,551
7	5	53.544	18,612	13.690	6.769	1.717	1456.349
MEAN		69.615	21.507	12.950	9.729	1.677	1747.950
10	1	66.455	14.779	11.642	8.743	4.322	1633.088
10	2	87.431	14.141	9,892	7.855	4.855	1834.689
MEAN		76,943	14,460	10.767	8.299	4.588	1733.889
MEAN		73.279	17.984	11.858	9.014	3,133	1740.919
STD F	RROP	?.591	2.491	.772	.506	1.029	4.971
====	======		.========================				==================

	========					=========================	===========
SITE	PAW	DATE 691218	WATERSHED NO.	1			
PI	OT COR	E 0-10 CM	10-20 CM	20-40 CM	40-60 CM	60-80 CM	TOTAL
====	=======================================			***************			==================
			GRAM9	S PEP MSQ PEP CI	M DEPTH		GZMSO
51	9 1	56,813	11.025	7.104	3.636	3.329	1199.681
5/	8 <u>S</u>	33.901	11.194	6.698	3.613	5,568	960.639
51	<b>ч</b> з	48.496	20.413	11,505	2.888	1.066	1247.813
MEAN		46.403	14.211	8.435	3.379	3.321	1136.044
5.	ə 1	67.374	7.087	4.763	2.424	1.445	1146.561
5	9 2	63.854	11.240	5.733	4.086	1.528	1222.377
2	9 3	69.371	6.811	5.128	2.648	1.346	1180.330
MEAN	-	66.867	8.379	5,208	3.053	1.440	1183.089
9	2 1	17.126	15.389	6.495	3.662	2.307	718.033
9	2 2	82.921	15,163	5,980	5,959	3.262	1606.062
9	2 3	64.383	14.832	6,708	3.013	2.278	1290.162
MEAN		54.810	15,128	6.394	4.211	2.616	1204.752
8	A 1	29.535	5.013	3,334	2.078	1,582	606.693
8	8 2	8.738	4-114	2,127	2,094	1.503	303.758
Ř	8 3	20.126	14.045	1.246	3.516	1.570	585.423
MEAN		19,466	7.724	2.236	2,563	1.552	498.625
MEAN		46.886	11.361	5.568	3.301	2.232	1005-628
STD	FRROP	5.029	.962	.648	.173	.225	84.804
====	======					================================	============

SITE PAW		DATE 700424	WATERSHED NO. 1			
PLOT	COPE	0-10 CM	TOTAL			
22222222	====	***************				
		GIMSGICM DEPTH	GIMSO			
72	1	115.327	2321,052			
72	2	94.344	2052.513			
72	3	87.705	1969.526			
72	4	34.994	1359.391			
72	5	67.148	1712,558			
MEAN		80.784	1883.008			
73	1	104,299	2176,950			
73	2	90.335	2002.404			
73	વે	131,176	2512,915			
73	4	97.769	2005 322			
73	5	103 500	2166 062			
	,	105 616	2100,907			
		1.776410	F140.410			
00			<b>0000</b> 000			
	1	91.913	2020.AH0			
89	2	144.846	2683.783			
80	7	127.770	2470.332			
90	4	112.355	2277.649			
99	5	120.316	2377.160			
MFAN		119.420	2365,961			
25	1	126.629	2456.072			
25	2	67.836	1721,160			
25	3	224.250	3676.342			
25	4	153.325	2789,773			
25	5	105.177	2187,928			
MEAN		135.443	2566.255			
		• • • • • •				
64	,	145,749	2695.073			
64	خ	122.271	2401.606			
69	2	116 189	2125 579			
<b>5</b> 0	1.	136 490	2570 221			
60	5	171 741	2010 074			
	~	174 200	2604 211			
HE BAI		1.15 + 430				
		(0.337	1700 010			
		54.137	1739.414			
27	2	24.71	1017+003			
27	4	93.724	2044 . 760			
27	4	39.739	1361.202			
27	5	147.019	2710,946			
MFAN		41.734	1994.886			
11	1	55.044	1561.892			
11	2	H2.6H2	1906.741			
11	٦	100.145	2125.030			
11	4	91.028	2011.062			
11	5	43.324	1414,762			
MEAN		74.455	1803.898			
		-	· · •			
69	1	95.356	2065.160			
69	2	82.820	1908.467			
6.9	, 1	120 660	2381.460			
20		104 113	2174 630			
		*U V*E	1736 623			
	-1	34 403	2062 262			
MP AR		94 . 4 7 1	rugg <b>, re</b> r			
		103 760	2170 210			
14P AN		101.100	20 251			
STD FRR	14	1.14n	34.731			
=======	====		*****************			

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SITE PAW		DATE 70050F	B WATERSHED NO.	8
PLOT	CORE	0-10 0	CM TOTAL	
========	====			=
		GIMSOICH D	DEPTH GZMSQ	
3	1	178.17	74 3099,141	
3	2	117.51	16 2342,160	
3	3	134.47	74 2554.139	
MFAN		143.35	55 2665,147	
54	1	113.36	52 2290.240	
54	5	87.61	10 1968.337	
54	3	94.4	14 2053,390	
MFAN		98.41	52 2103 984	
		-	· · · · · ·	
23	1	172.60	46 3031-292	
23	2	138.2	19 2600 939	
23	้า	167 9	53 2072 751	
MEAN		159.60	00 2868 327	
		1 1 4 6 4 1 4		
2	1	160 6	30 <b>307</b> 0 ლაკ	
2	1	100.4		
á	2	10/00/		
MEAN	.1	139.19	47 1016+486 21 3540 653	
MEAN		ז +רכב	21 6264*825	
~ ~ ~	,			
91	1	105.9	56 <b>7985</b> .115	
41	2	36.1		
91	5	124.4	14 2414.132	
MEAN		10.3*8	DZ Z240.488	
92	1	120.95	52 2385.110	
92	2	153.7	14 2794.640	
02	3	140.3	53 2627.619	
MFAN		138.34	40 2602.456	
_				
94	1	148.5	22 2729.733	
94	5	81.6	75 1894.150	
94	3	176.3	36 3077.411	
MFAN		135.5	11 2567.098	
43	1	129.8	95 2496,900	
43	2	108.0	36 2223.664	
43	3	147.0	77 2711.681	
MEAN		128.3	36 2477.415	
MEAN		131.1	51 2512,597	
STD FRRC	R	2.4	00 29.998	
	=====	================		= =

STTE DAL		======================================	WATERSHED NO	·=====================================	.==========================		==================
PLOT	CORE	0-10 CM	10-20 CM	20-40 CM	40-60 CM	60-80 CM	TOTAL
=======	========	====================					=================
			GRAMS	PER MSQ PER CM	DEPTH		G/MSQ
52	1	68.378	19,643	14.673	12.167	9.873	2018,080
MEAN		68.378	19.643	14.673	12.167	9.873	2018.080
13	1	84,324	19,806	22,987	9,885	6-455	2284-823
MEAN	-	84.324	19,806	22.987	9.885	6.455	2284.823
62	,	86 550	24 492	14 105	12 412	5 924	2104 524
MEAN		86.550	24.492	14.105	12.412	5.824	2196.524
	<u>.</u>	( <b>)</b> ( ) ( <b>–</b>					
42	1	61+645	19,180	17,398	3.048	3.247	1602.623
MEAN		61.645	19,180	17.398	3.048	3.247	1602.623
2	1	56.226	15,009	10.917	10.275	6.814	1590.591
MEAN		56+556	15.009	10.917	10.275	6.814	1590.591
23	1	62.378	10.033	4,996	4.487	1.721	1185.256
MEAN		62 <b>.</b> 378	10.033	4.996	4.487	1.721	1185,256
1	1	15,605	102.562	15 376	9 319	4 607	2209.575
MEAN		15.605	102,562	15,376	9.318	4.607	2209.575
71	,	20 221	16 400	0.401	4 E11	4 523	1200 620
MEAN	I	39.231	16.409	9,491	6.511	4.523	1208.620
		50 200	20.202			<b>F</b> 303	
MCAN		74.242	CM • 59C	13,143	8.513	5.383	1/8/.011
STU ERR	(OK	2,909	3,783	•677	• 4 3 4	•309	56,234
	=========						================

Graphs of exponential fits to 1969 root data









Complete set of ANOV tables run on various depth increments

Key to the abbreviations used in Appendix 5

D	=	Dates
Т	=	Treatments
W(T)	=	Watersheds within treatments
DT	=	Date-treatment interaction
DW(T)	=	Error term
N.S.	=	Non-significant
*	=	Significant at 5% level
**	=	Significant at 1% level

Source	D.F.	s.s.	M.S.	F	
D	7	590.6	84.4	.873(7,28)	N.S.
Т	3	105.1	35.0	1.258(3,4)	N.S.
W(T)	4	111.3	27.8	.288(4,28)	N.S.
DT	21	1246.0	59.3	.614(21,28)	N.S.
DW(T)	28	2704.5	96.6		

ANOV run on crown mass using 1969 watershed means.

Source	D.F.	s.s.	M.S.	F	
D	7	5733.5	819.1	2.975(7,28)	*
т	3	455.3	151.8	.549(3,4)	N.S.
Ŵ(T)	4	1105.7	276.4	1.004(4,28)	N.S.
DT	21	5306.8	252.7	.918(21,28)	N.S.
DW(T)	28	7709.0	275.3		

ANOV run on 0-10 cm increment using 1969 watershed means with crowns.

Source	D.F.	s.s.	M.S.	F	
D	7	3585.2	512.2	4.242(7,28)	*
Т	3	128.5	42.8	.311(3,4)	N.S.
W(T)	4	551.5	137.8	1.142(4,28)	N.S.
DT	21	2599.6	123.8	1.025(21,28)	N.S.
DW(T)	28	3380.5	120.7		

ANOV run on 0-10 cm increment using 1969 watershed means with crowns deleted.

Source	D.F.	s.s.	M.S.	F	
D	7	209.6	29.9	1.951(7,28)	N.S.
т	3	29.8	9.9	.304(3,4)	N.S.
W(T)	4	130.9	32.7	2.132(4,28)	N.S.
DT	21	249.1	11.9	.773(21,28)	N.S.
DW(T)	28	429.8	15.4		

ANOV run on 10-20 cm increment using 1969 watershed means.

Source	D.F.	s.s.	M.S.	F	
D	7	105.5	15.1	2.879(7,28)	*
Т	3	4.8	1.6	.514(3,4)	N.S.
W(T)	4	12.5	3.1	.596(4,28)	N.S.
DT	21	85.4	4.1	.776(21,28)	N.S.
DW(T)	28	146.6	5.2		

ANOV run on 20-40 cm increment using 1969 watershed means.

Source	D.F.	s.s.	M.S.	F	
 D	7	76.7	11.0	2.560(7,28)	*
т	3	30.9	10.3	.990(3,4)	N.S.
W(T)	4	41.6	10.4	2.429(4,28)	N.S.
DT	21	120.3	5.7	1.338(21,28)	N.S.
DW(T)	28	119.9	4.3		

ANOV run on 40-60 cm increment using 1969 watershed means.

Source	D.F.	S.S.	 M. S.		
D	7	24.7	3.5	.945(7,28)	N.S.
Т	3	8.5	2.8	.578(3,4)	N.S.
W(T)	4	19.5	4.9	1.305(4,28)	N.S.
DT	21	70.4	3.4	.897(21,28)	N.S.
DW(T)	28	104.6	3.7		

ANOV run on 60-80 cm increment using 1969 watershed means.

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