

Technical Report No. 1

GENERAL DESCRIPTION OF THE PAWNEE SITE

GRASSLANDS BIOME

U.S. International Biological Program

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ABSTRACT

The Pawnee Site, the Intensive Site location of the Grassland Biome, lies within the western division of the Pawnee National Grasslands which is administered by the U.S. Forest Service. At the western edge of the Pawnee National Grasslands lies the Central Plains Experimental Range operated by the Agricultural Research Service. Intensive studies requiring careful experimental control are conducted on the Central Plains Experimental Range; more extensive studies requiring a great deal of space but less control are conducted on the Pawnee National Grasslands.

HISTORY

First agricultural use of the Central Great Plains was livestock grazing on the open range. Later homesteading under quarter-section and half-section limitations brought most of the land under private ownership. Purchase and lease of land grant railroad sections and state school lands also aided in placing more than 90% of the total area under farm and ranch management. Most of the homesteaders attempted to grow cultivated crops by eastern farming methods. The native sod on millions of acres was plowed to the detriment of both soil and man. These farming methods opened the way for wind erosion during the agricultural depression from 1921-1939 (Klipple and Costello, 1960). The abandonment of cultivation beginning soon after settlement resulted in all stages of secondary succession from nearly bare fields to areas which have almost, if not entirely, returned to the original condition (Costello, 1944). Because a large proportion of the land was abandoned during the depression and dust bowl years, land utilization projects were established as management units of this abandoned land. These land utilization projects were first administered by the Soil Conservation Service until the Agriculture Reorganization Act in 1953; since that time the lands have been administered by the U.S. Forest Service. The Pawnee National Grassland is therefore made up of the abandoned portions of these lands which are interspersed with lands remaining in private ownership. Private and public lands are frequently operated together. In the western division of the Pawnee National Grasslands the livestock operation is largely through the Crow Valley Livestock Association, an association of many small ranchers in the area. The federal lands are usually used for summer grazing at a moderate rate, while private lands are used for winter grazing.

LOCATION AND LAND MANAGEMENT

The Pawnee Site is made up of two administrative units, the Central Plains Experimental Range and the Pawnee National Grassland (Fig. 1). The western division of the Pawnee National Grasslands is about 105,000 acres and the Central Plains Experimental Range about 15,000 acres.

The Central Plains Experimental Range portion of the Pawnee Site is about 12 miles northeast of Nunn, Colorado, and 25 miles south of Cheyenne, Wyoming. The Range was established in 1939 to answer many questions which were obviously important as a result of the land use of the 1930's. A number of pastures were set aside for long-term experiments. A number of scientific publications have resulted (Appendix A). Twelve half-section (320 acres) pastures were assigned four each to heavy, moderate, and light summer grazing. In 1958 two of the replicates were changed to winter grazing.

Each of these and several other pastures also have at least one enclosure of one or two acres excluding grazing since 1939. Permanent quadrats have been established in these pastures, and in most years composition of vegetation has been measured.

All of the Central Plains Experimental Range is available for IBP use, but some is primarily dedicated to other studies conducted by the Agricultural Research Service and IBP studies on these pastures are of an incidental nature. Other pastures, however, have been designated for more intensive use of the IBP. The Pawnee National Grasslands, as mentioned above, is available for extensive studies which require a great deal of land area but do not require rigid control for experimental purposes. For example, such studies are jackrabbit population dynamic studies, bird population studies, etc. The Central Plains

Experimental Range portion, on the other hand, is utilized for intensive studies which require greater control.

TYPE OF GRASSLAND

The native shortgrass range vegetation described by Klipple and Costello (1960) is a basically blue grama and buffalo grass, supplemented in many areas by thread leaf and needle leaf sedges. Several midgrasses, such as western wheatgrass, needle-and-thread, green needle grass, little bluestem and side oats grama grow in association with the shortgrasses. These associated species seldom attain sufficient densities to dominate the vegetation type, although they may at times provide an inconspicuous part of the aspect.

Perennial forbs which are commonly found include scarlet globemallow (*Sphaeralcea coccinea*), slim flower scurfpea (*Psoralea tenuiflora*), slenderbush eriogonum (*Eriogonum microthecium*), and scarlet gaura (*Gaura coccinea*). Various other forms may become conspicuous in wet years. Annual forbs include Russian thistle, (*Salsola kali tenuifolia*), cryptantha (*Cryptantha* spp.), stickseed (*Lappula* spp.), pale evening primrose (*Oenothera pallida*), lambs-quarter (*Chenopodium* spp.), and bee flower (*Cleome serrulata*). Fringed sagewort (*Artemisia frigida*), saltbrush (*Atriplex canescens*), and winterfat (*Eurotia lanata*) are leading browse species; other shrubs include rubber rabbitbrush (*Chrysothamnus nauseosus*), broom snakeweed (*Gutierrezia sarothrae*), and big sagebrush (*Artemisia tridentata*). Plains prickly pear (*Opuntia polyacantha*) is widely distributed on the experimental area. A list of plant species collected prior to 1968 is included in Table 1.

Common mammals of the area are antelope, white-tailed jackrabbit (*Lepus townsendii*), black-tailed jackrabbit (*Lepus californicus*), 13-lined ground

squirrel (*Spermophilus tridecemlineatus*), northern grasshopper mouse (*Onychomys leucogaster*), Ord's kangaroo rat (*Dipodomys ordii*), and deer mouse (*Peromyscus maniculatus*). Other mammals which have been found on the area are shown in Table 2.

The most common birds on the area are the very conspicuous lark bunting (*Calamospiza melanocorys*) and the horned lark (*Eremophila alpestris*). Other birds which have been found previously on the area are shown in Table 3.

As for insects, the various species of grasshoppers are certainly the most predominant. From the over 30 orthopteran insects the most common are *Melanoplus gladstoni* and *Xanthippus corallipes*. Scarab beetles (*Scarabaeidae*) are common insects in the soil.

CLIMATE

The site is in the western part of the Central Great Plains where the average annual precipitation varies from 10 to 15 inches. About 80% of the precipitation falls during the summer months of May through September. Although most of the storms are light summer thundershowers, the greatest fluctuations are caused by storms greater than one inch. Seasonal distribution of precipitation is shown in Fig. 2.

Temperature records have been collected from the experimental range since 1947. Monthly annual temperatures are shown in Fig. 3.

On the intensive portion of the Pawnee Site common soil series are Ascalon, Vona, Renohill, and Shingle. The Renohill and Shingle series are formed on shale and siltstone outcrops of the Pierre sedimentary formation, while the Ascalon series is formed predominantly by fluvial outwash materials. The Vona generally is formed by somewhat courser outwash materials. Interspersed among these upland soils are alluvial plains of more recent origin.

These alluvial plains are high in clay content. The name Nunn is frequently given to these alluvial soils, although this nomenclature will not be adequate in all cases. Topography is gently rolling with few predominant topographic features. Soil texture classes by profile of the common soils are given in Table 4, and soil distributions are shown in Fig. 4.

PHYSICAL FACILITIES

The Pawnee Site includes a dining room, kitchen, laboratory facility, the 12-man dormitory, a garage, storage facility, wells, resident building, corrals, fences, etc. Plans of the various buildings are shown in Appendix B.

Table 1. Tentative check list of plants of the Pawnee Site.

SYM	SCIENTIFIC NAME AND AUTHOR	COMMON NAME
ABFR	ABRONIA FRAGRANS NUTT.	SNOWBALL SANDVERBENA
ACLA	ACHILLEA LANULOSA NUTT.	WESTERN YARROW
AGDE	AGROPYRON DESERTORUM (FISCH.) SCHULT.	CRESTED WHEATGRASS
AGSM	AGROPYRON SMITHII RYDB.	WESTERN WHEATGRASS
AGSMM	AGROPYRON SMITHII MOLLE (SCRIBN. + SMITH) JONES	
AGTR	AGROPYRON TRACHYCALUM (LINK) MALTE	SLENDER WHEATGRASS
ALDR	ALLIUM DRUMMONDII REGEL	DRUMMOND ONION
ALTE	ALLIUM TEXTILE NELS. + MACBR.	TEXTILE ONION
AMBL	AMARANTHUS BLITOIDES S. WATS.	PROSTRATE AMARANTH
AMGR	AMARANTHUS GRAECIZANS L.	TUMBLEWEED AMARANTH
AMPS	AMBROSIA PSILOSTACHYA DC.	WESTERN RAGWEED
AMRE	AMARANTHUS RETROFLEXUS L.	REDROOT AMARANTH
AMTR	AMBROSIA TRIFIDA L.	GIANT RAGWEED
ANCO	ANTHEMIS COTULA L.	MAYWEED CAMOMILE
ANGE	ANDROPOGON GERARDI VITMAN	BIG BLUESTEM
ANHA	ANDROPOGON HALLII HACK.	SAND BLUESTEM
ANSC	ANDROPOGON SCOPARIUS MICHX.	LITTLE BLUESTEM
ARDR	ARTEMISIA DRACUNCULOIDES PURSH	FALSETARRAGON SAGEBRUSH
ARFE	ARISTIDA FENDLERIANA STEUD.	FENDLER THREE-AWN
ARFI	ARTEMISIA FILIFOLIA TORR.	SAND SAGEBRUSH
ARFR	ARTEMISIA FRIGIDA WILLD.	FRINGED SAGEWORT
ARHO	ARENARIA HOOKERI NUTT.	HOOKER SANDWORT
ARIN	ARGEMONE INTERMEDIA SWEET	PRICKLEPOPPY
ARLO	ARISTIDA LONGISETA STEUD.	RED THREEAWN
ARLU	ARTEMISIA LUDOVICIANA NUTT.	CUDWEED SAGEWORT
ARMI	ARCTIUM MINUS (HILL) BERNH.	SMALLER BURDOCK
ASBI	ASTRAGALUS BISULCATUS (HOOK.) A. GRAY	TWOGROOVED LOCO
ASDR	ASTRAGALUS DRUMMONDII DOUGL.	DRUMMOND MILKVETCH
ASGR	ASTRAGALUS GRACILIS NUTT.	
ASHA	ASCLEPIAS HALLII A. GRAY	HALLS MILKWEED
ASHU	ASTRAGALUS HUMISTRATUS GRAY	
ASMI	ASTRAGALUS MISSOURIENSIS NUTT.	MISSOURI LOCO
ASMO	ASTRAGALUS MOLLISSIMUS TORR.	WOOLLY LOCO
ASPE	ASTRAGALUS PECTINATUS (HOOK.) DOUGL.	NARROWLEAF POISONVETCH
ASSE	ASTRAGALUS SERICOLEUCUS A. GRAY	
ASTA	ASTER TANACETIFOLIUS H.B.K.	TANSYLEAF ASTER
ATAR	ATRIPLEX ARGENTEA NUTT.	
ATCA	ATRIPLEX CANESCENS (PURSH) NUTT.	FOURWING SALTBUCH
ATGA	ATRIPLEX GARDNERI (MOQ.) STANDL.	GARDNER SALTBUCH
BAOP	BAHIA OPPOSITIFOLIA (NUTT.) DC.	PLAINS BAHIA
BESY	BECKMANNIA SYZIGACHNE (STEUD.) FERN.	AMERICAN SLOUGHGRASS
BOCU	BOUTELOUA CURTIPENDULA (MICHX.) TORR.	SIDE-OATS GRAMA
BOGR	BOUTELOUA GRACILIS (H.B.K.) LAG.	BLUE GRAMA
BOHI	BOUTELOUA HIRSUTA LAG.	HAIRY GRAMA
BRCO	BROMUS COMMUTATUS SCHRAD.	HAIRY BROME
BRIN	BROMUS INERMIS LEYSS.	SMOOTH BROME
BJA	BROMUS JAPONICUS THUNB.	JAPANESE BROME
BTE	BROMUS TECTORUM L.	CHEATGRASS BROME
BUDA	BUCHLOE DACTYLOIDES (NUTT.) ENGELM.	BUFFALOGRASS
CAAQ	CAREX AQUATILIS WAHL.	WATER SEDGE
CAEL	CAREX ELEOCHARIS BAILEY	NEEDLELEAF SEDGE
CAFI	CAREX FILIFOLIA NUTT.	THREADLEAF SEDGE
CAHE	CAREX HELIOPHILA MACKENZ.	SUN SEDGE
CAIN	CALLIRHOE INVOLUCRATA (T. + G.) A. GRAY	PURPLE POPPYMALLOW

Table 1. (Continued)

CALO	CALAMOVILFA LONGIFOLIA (HOOK.) SCRIBN.	PRAIRIE SANDREED
CERE	CENTAUREA REPENS L.	RUSSIAN CENTAUREA
COAR	CENCHRUS TRIBULOIDES L.	DUNE SANDBUR
CHAL	CHENOPodium ALBUM L.	LAMBSQUARTERS GOOSEFOOT
CHLE	CHENOPodium LEPTOPHYLLUM NUTT.	SLIMLEAF GOOSEFOOT
CHNA	CHRYSOTHAMNUS NAUSEOSUS (PALL.) BRITT.	RUBBER RABBITBRUSH
CHVI	CHRYSOPSIS VILLOSA (PURSH) NUTT.	HAIRY GOLDASTER
CIAR	CIRSIIUM ARVENSE (L.) SCOP.	CANADA THISTLE
CIR	CIRSIIUM HALL	THISTLE
CIUN	CIRSIIUM UNDULATUM (NUTT.) SPRENG.	WAVYLEAF THISTLE
CLSE	CLEOME SERRULATA PURSH	BEE SPIDERFLOWER
COPA	COMANDRA PALLIDA A. DC.	COMMON COMMANDRA
CRCR	CRYPTANTHA CRASSISEPALA (TORR. + GRAY) GREENE	PLAINS HIDDENFLOWER
CRFE	CRYPTANTHA FENDLERI (GRAY) GREENE	
CRJA	CRYPTANTHA JAMESII (TORR.) PAYSON	JAMES CRYPTANTHA
CRMI	CRYPTANTHA MINIMA RYDB.	
DECA	DESCHAMPSIA CAESPITOSA (L.) BEAUV.	TUFTED HAIRGRASS
DEGE	DELPHINIUM GEYERI GREENE	GEYER LARKSPUR
DEPI	DESCURAINIA PINNATA (WALT.) BRITT.	PINNATE TANSYMUSTARD
DEVI	DELPHINIUM VIRESCENS NUTT.	PLAINS LARKSPUR
DIST	DISTICHLIS STRICTA (TORR.) RYDB.	INLAND SALTGRASS
DYPA	DYSSODIA PAPPOSA (VENT.) HITCHC.	PRAIRIE DOGWEEED
ELAC	ELEOCHARIS ACICULARIS (L.) R. + S.	NEEDLE SPIKESEDGE
ELCA	ELYMUS CANADENSIS L.	CANADA WILD RYE
ELHI	ELYMUS HIRTIFLORUS HITCHC.	
ELMA	ELEOCHARIS MACROSTACHYA BRITT.	
ELPA	ELEOCHARIS PALUSTRIS (L.) R. + S.	COMMON SPIKESEDGE
ELTR	ELYMUS TRITICOIDES BUCKL.	CREeping WILD RYE
ELAN	EPILOBIUM ANGUSTIFOLIUM L.	FIREWEED
EQAR	EQUISETUM ARVENSE L.	FIELD HORSETAIL
ERAS	ERYSIMUM ASPERUM (NUTT.) DC.	PLAINS ERYSIMUM
ERBE	ERIGERON BELLIDIASTRUM NUTT.	
ERCA	ERIGERON CANADENSIS L.	HORSEWEED FLEABANE
ERGR	ERYTHRONIUM GRANDIFLORUM PURSH	LAMBSTONGUE FAWN LILY
ERMI	ERIOGONUM MICROTHECIUM NUTT.	SLENDERRUSH ERIOGONUM
ERPU	ERIGERON PUMILUS NUTT.	LOW FLEABANE
ERRA	ERIOGONUM RACEMOSUM NUTT.	REDROOT BUCKWHEAT
EUFE	EUPHORBIA FENDLERI T. + G.	FENDLER EUPHORBIA
EUGL	EUPHORBIA GLYPTOSPERMA ENGELM.	RIDGESEED EUPHORBIA
EULA	EUROTIA LANATA (PURSH) MDQ.	COMMON WINTERFAT
EUMI	EUPHORBIA MISSURICA RAF.	MISSOURI EUPHORBIA
EUST	EUPHORBIA STRICTOSPERA ENGELM.	
EVNU	EVOLVULUS NUTTALLIANUS ROEM. + SCHULT.	NUTTALL EVOLVULUS
FEOC	FESTUCA OCTOFLORA WALT.	SIXWEEKS FESCUE
FRDI	FRANSERIA DISCOLOR NUTT.	SKELETONLEAF BURSAGE
GACO	GAURA COCCINEA NUTT. EX PURSH	SCARLET GAURA
GILA	GILIA LAXIFLORA (COULT.) OSTERH.	
GISP	GILIA SPICATA NUTT.	SPIKE GILIA
GLLE	GLYCYRRHIZA LEPIDOTA PURSH	AMERICAN LICORICE
GRSO	GRINDELIA SQUARROSA (PURSH.) DUNAL	CURLYCUP GUMWEED
GUSA	GUTIERREZIA SAROTHRAE (PURSH) BRITT. + RUSBY	BROOM SNAKEWEED
HASP	HAPLOPAPPUS SPINULOSUS (PURSH) DC.	IRONPLANT GOLDENWEED
HEAN	HELIANTHUS ANNUUS L.	COMMON SUNFLOWER
HENU	HELIANTHUS NUTTALLII TORR. + GRAY	
HEPE	HELIANTHUS PETIULARIS NUTT.	PRAIRIE SUNFLOWER
HOJUC	HORDEUM JUBATUM CAESPITOSUM (SCRIBN.) HITCHC.	BOBTAIL BARLEY
HOJU	HORDEUM JUBATUM L.	FOXTAIL BARLEY
HYLU	HYMENOPAPPUS LUGENS GREENE	
HYM	HYMENOXYS CASS.	HYMENOXYS
IVAX	IVA AXILLARIS PURSH	POVERTY SUMPWEED

Table 1. (Continued)

KOCR	KOELERIA CRISTATA (L.) PERS.	PRAIRIE JUNEGRASS
KOSC	KOCHIA SCOPARIA (L.) SCHRAD.	BELVEDERE SUMMERCYPRESS
LU	LATHYRUS FUCOSMUS BUTTERS + ST. JOHN	BUSH PEAVINE
LAPD	LATHYRUS POLYMDRPHUS NUTT.	SHOWY PEAVINE
LAPU	LACTUCA PULCHELLA (PURSH) DC.	CHICORY LETTUCE
LARE	LAPPULA REDOWSKII (HORNEM.) GREENE	REDOWSKIS STICKSEED
LASC	LACTUCA SCARIOLA L.	PRICKLY LETTUCE
LEDE	LEPIDIUM DENSIFLORUM SCHRAD.	PRAIRIE PEPPERWEED
LELU	LESQUERELLA LUDOVICIANA (NUTT.) S. WATS.	SILVER BLADDERPOD
LEMO	LEUCOCRINUM MONTANUM NUTT.	COMMON STARLILY
LIAR	LINUM ARISTATUM ENGELM.	
LIIN	LITHOSPERMUM INCISUM LEHM.	GROMWELL
LIPU	LIATRIS PUNCTATA HOOK.	DOTTED GAYFEATHER
LIRI	LINUM RIGIDUM PURSH	STIFFSTEM FLAX
LUPU	LUPINUS PUSILLUS PURSH	RUSTY LUPINE
LYJU	LYGODESMIA JUNCEA (PURSH) D. DON.	RUSH SKELETONPLANT
MAVE	MARSILEA VESTITA HOOK. + GREV.	PEPPERWORT
MAVI	MAMMILLARIA VIVIPARA (NUTT.) HAW.	
MAVU	MARRUBIUM VULGARE L.	COMMON HOARHOUND
MEAL	MELILOTUS ALBA DESR.	WHITE SWEETCLOVER
MENU	MENTZELIA NUDA (PURSH) TORR. + GRAY	BRACTLESS MENTZELIA
MEOF	MELILOTUS OFFICINALIS (L.) LAM.	YELLOW SWEETCLOVER
MESA	MEDICAGO SATIVA L.	ALFALFA
MEST	MENTZELIA STRICTA (OSTERH.) STEVENS	
MILI	MIRABILIS LINEARIS (PURSH) HEIMERL.	FOUR O CLOCK
MUDI	MUSINEON DIVARICATUM (PURSH) NUTT.	
MUFI	MUHLENBERGIA FILICULMIS VASEY	SLIMSTEM MUHLY
MSQ	MUNROA SQUARROSA (NUTT.) TORR.	FALSE-BUFFALOGRASS
MUTO	MUHLENBERGIA TORREYI (KUNTH) HITCHC.	RING MUHLY
DECO	DENOTHERA CORDOPIFOLIA TORR. + GRAY	
OELA	DENOTHERA LATIFOLIA (RYDB.) MUNZ	EVENINGPRIMROSE
OEN	DENOTHERA L.	PALE EVENINGPRIMROSE
OEPA	DENOTHERA PALLIDA LINDL.	COMMON PRICKLYPEAR
OPHU	OPUNTIA HUMIFUSA RAF.	PLAINS PRICKLYPEAR
OPPD	OPUNTIA POLYACANTHA HAW.	INDIAN RICEGRASS
ORHY	ORYZOPSIS HYMENOIDES (ROEM. + SCHULT.) RICKER	
ORLU	OROBANCHE LUDOVICIANA NUTT.	LAMBERT CRAZYWEED
OXLA	OXYTROPIS LAMBERTII PULSH	SILKY CRAZYWEED
OXSE	OXYTROPIS SERICEA NUTT.	COMMON WITCHGRASS
PACA	PANICUM CAPILLARE L.	
PADE	PARONYCHIA DEPRESSA NUTT. EX TORR. + GRAY	JAMES NAILWORT
PAJA	PARONYCHIA JAMESII TORR. + GRAY	WHITE PENSTEMON
PEAL	PENSTEMON ALBIDUS NUTT.	NARROWLEAF PENSTEMON
PEAN	PENSTEMON ANGUSTIFOLIUS NUTT.	WHITE PRAIRIECLOVER
PECA	PETALOSTEMON CANDIDUS (WILLD.) MICHX.	TOADFLAX PENSTEMON
PELI	PENSTEMON LINARIODES A. GRAY	SCORPION WEED
PHA	PHACELIA JUSS.	FOGFRUIT
PHCU	PHYLA CUNEIFOLIA (TORR.) GREENE	
PHCU	PHYLA CUNEIFOLIA (TORR.) GREENE	GROUNDCHERRY
PHLA	PHYSALIS LANCEOLATA MICHX.	
PHLO	PHYSALIS LOBATA TORR.	WOOLLY INDIANWHEAT
PLPU	PLANTAGO PURSHII ROEM. + SCHULT.	PLAINS BLUEGRASS
POAR	POA ARIDA VASEY	PROSTRATE KNOTWEED
PAV	POLYGONUM AVICULARE L.	BIENNIAL CINQUEFOIL
POBI	POTENTILLA BIENNIS GREENE	HORSE CINQUEFOIL
POHI	POTENTILLA HIPPIANA LEHM.	RABBITFOOT POLYPOGON
POMO	POLYPOGON MONSPELIENSIS (L.) DESF.	COMMON PURSLANE
POOL	PORTULACA OLERACEA L.	PENNSYLVANIA SMARTWEED
POPE1	POLYGONUM PENNSYLVANICUM L.	PENNSYLVANIA CINQUEFOIL
POPE2	POTENTILLA PENNSYLVANICA L.	

Table 1. (Continued)

PORI	POTENTILLA RIVALIS NUTT.	BROOK CINQUEFOIL
POSC	POA SCABRELLA (THURB.) BENTH.	PINE BLUEGRASS
PLR	POLANISIA TRACHYSPERMA TORR. + GRAY	ROUGHSEED CLAMMYWEED
PSLA	PSORALEA LANCEOLATA PURSH	LEMON SCURFPEA
PSTE	PSORALEA TENUIFLORA PURSH	SLIMFLOWER SCURFPEA
RACO	RATIBIDA COLUMNARIS (SIMS.) D. DON.	UPRIGHT PRAIRIECONEFLOWER
RACOP	RATIBIDA COLUMNARIS PULCHERRIMA (DC.) D. DON	
RHTR	RHUS TRILOBATA NUTT.	SKUNKBRUSH SUMAC
RIB	RIBES L.	GOOSEBERRY, CURRANT
ROSI	RORIPPA SINUATA (NUTT.) A. S. HITCHC.	
ROWOF	ROSA WOODSI FENDLERI (CREPIN) RYDB.	FENDLER WOODS ROSE
RUPA	RUMEX PATIENTIA L.	
RUVE	RUMEX VENOSUS PURSH	VEINY DOCK
SAKAT	SALSOLA KALI TENUIFOLIA TAUSCH.	TUMBLING RUSSIANTHISTLE
SAL	SALIX L.	WILLOW
SALA	SAGITTARIA LATIFOLIA WILLO.	COMMON ARROWHEAD
SARE	SALVIA REFLEXA HORNEM.	LANCELEAF SAGE
SCAM	SCIRPUS AMERICANUS PERS.	AMERICAN BULRUSH
SCBR	SCUTELLARIA BRITTONII PORTER	BRITTONS SKULLCAP
SCPA	SCHEDONNARDUS PANICULATUS (NUTT.) TREL.	TUMBLEGRASS
SCPA	SCIRPUS PALUDOSUS A. NELS.	ALKALI BULRUSH
SECR	SENECIO CROCATUS RYDB.	SAFFRON GROUNDSEL
SEIT	SETARIA ITALICA (L.) BEAUV.	FOXTAIL MILLET
SEMU	SENECIO MULTICAPITATUS GREENE	
SEMU	SENECIO MUTABILIS GREENE	
SEVI	SETARIA VIRIDIS (L.) BEAUV.	
SIAL	SISYMBRIUM ALTISSIMUM L.	GREEN BRISTLEGRASS
SHY	SITANION HYSTRIX (NUTT.) J.G. SMITH	TUMBLEMUSTARD
SIDE	SOLIDAGO DECUMBENS GREENE	BOTTLEBRUSH SQUIRRELTAIL
SOGI	SOLIDAGO GIGANTEA AIT.	DECUMBENT GOLDENROD
SORO	SOLANUM ROSTRATUM DUNAL	GIANT GOLDENROD
SOSE	SOPHORA SERICEA NUTT.	BUFFALOBUR NIGHTSHADE
SOTR	SOLANUM TRIFLORUM NUTT.	SILKY SOPHORA
SPAI	SPOROBOLUS AIROIDES TORR.	CUTLEAF NIGHTSHADE
SPCO	SPHAERALCEA COCCINEA (PURSH) RYDB.	ALKALI SACATON
SPCR	SPOROBOLUS CRYPTANDRUS (TORR.) A. GRAY	SCARLET GLOBEMALLOW
SPGR	SPARTINA GRACILIS TRIN.	SAND DROPSEED
SPTI	SPOROBOLUS TEXANUS VASEY	ALKALI CORDGRASS
STCO1	STIPA COMATA TRIN. AND RUPR.	TEXAS DROPSEED
STCO2	STIPA COLUMBIANA MACOUN	NEEDLEANDTHREAD
STVI	STIPA VIRIDULA TRIN.	SUBALPINE NEEDLEGRASS
SUSU	SUCKLEYA SUCKLEYANA (TORR.) RYDB.	GREEN NEEDLEGRASS
TAPA	TALINUM PARVIFLORUM NUTT.	POISON SUCKLEYA
THAM	THELESPERMA AMBIGUUM A. GRAY	PRAIRIE FAMEFLOWER
THDI	THERMOPSIS DIVARICARPA A. NELS.	COLORADO GREENTHREAD
THME	THELESPERMA MEGAPOTAMICUM (SPRENG.) KUNTZE	SPREADING THERMOPSIS
THTR	THELASPERMA TRIFIDUM (POIR.) BRITT.	
TOGR	TOWNSENDIA GRANDIFLORA NUTT.	
TOSE	TOWNSENDIA SERICEA HOOK.	
TROC	TRADESCANTIA OCCIDENTALIS (BRITT.) SMYTH	PRAIRIE SPIDERWORT
TRPO	TRAGOPOGON PORRIFOLIUS L.	VEGETABLE-OYSTER SALSIFY
TRPR	TRAGOPOGON PRATENSIS L.	MEADOW SALSIFY
TRTE	TRIBULUS TERRESTRIS L.	PUNCTUREVINE
TULA	TYPHA LATIFOLIA L.	COMMON CATTAIL
VEBR	VERBENA BRACTEATA LAG. + RODR.	BIGBRACT VERBENA
VEFA	VERNONIA FASCICULATA MICHX.	
VIAMM	VICIA AMERICANA MINOR HOOK.	AMERICAN VETCH
VINU	VIDUA NUTTALLII PURSH	NUTTALL VIOLET
XASP	XANTHIUM SPECIOSUM KEARNEY	COCKLEBUR
YUGL	YUCCA GLAUCA NUTT.	SMALL SOAPWEED

Table 1. (Continued)

ZYGR ZYGADENUS GRAMINEUS RYDB.

GRASSY DEATHCAMAS

CHECK LIST LARGELY FROM AGRICULTURAL RESEARCH SERVICE COLLECTIONS.
MOST OF THE NOMENCLATURE ACCORDING TO A RECENT CHECK LIST PREPARED BY
U.S.D.A. FOREST SERVICE.

Table 2. Species of mammals for Pawnee Site (Prepared by R. M. Hansen).

Scientific Name	Common Name
Order INSECTIVORA--Insectivores	
Family SORICIDAE--Shrews	
<i>Sorex cinereus</i>	Masked Shrew
<i>Sorex vagrans</i>	Vagrant Shrew
<i>Sorex nanus</i>	Dwarf Shrew
<i>Sorex merriami</i>	Merriam's Shrew
Order CHIROPTERA--Bats	
Family VESPERTILLIONIDAE--Vespertilionid Bats	
<i>Myotis lucifugus</i>	Little Brown Myotis
<i>Myotis evotis</i>	Long-eared Myotis
<i>Myotis thysanodes</i>	Fringed Myotis
<i>Myotis volans</i>	Long-legged Myotis
<i>Myotis californicus</i>	California Myotis
<i>Myotis subulatus</i>	Small-footed Myotis
<i>Lasionycteris noctivagans</i>	Silver-haired Bat
<i>Eptesicus fuscus</i>	Big Brown Bat
Order LAGOMORPHA--Lagomorphs	
Family LEPORIDAE--Hares and Rabbits	
<i>Sylvilagus floridanus</i>	Eastern Cottontail
<i>Sylvilagus nuttalli</i>	Nuttall's Cottontail
<i>Sylvilagus audubonii</i>	Desert Cottontail
<i>Lepus townsendii</i>	White-tailed Jack Rabbit
<i>Lepus californicus</i>	Black-tailed Jack Rabbit
Order RODENTIA--Rodents	
Family SCIURIDAE--Squirrels	
<i>Eutamias minimus</i>	Least Chipmunk
<i>Marmota flaviventris</i>	Yellow-bellied Marmot
<i>Spermophilus tridecemlineatus</i>	Thirteen-lined Ground Squirrel
<i>Cynomys ludovicianus</i>	Black-tailed Prairie Dog
<i>Sciurus niger</i>	Fox Squirrel

Table 2. (Continued)

Scientific Name	Common Name
Family GEOMYIDAE--Pocket Gophers	
<i>Thomomys talpoides</i>	Northern Pocket Gopher
Family Heteromyidae--Heteromyids	
<i>Perognathus fasciatus</i>	Olive-backed Pocket Mouse
<i>Perognathus flavescens</i>	Plains Pocket Mouse
<i>Perognathus flavus</i>	Silky Pocket Mouse
<i>Perognathus hispidus</i>	Hispid Pocket Mouse
<i>Dipodomys ordii</i>	Ord's Kangaroo Rat
Family CASTORIDAE--Beavers	
<i>Castor canadensis</i>	Beaver
Family CRICETIDAE--New World Rats and Mice	
<i>Reithrodontomys montanus</i>	Plains Harvest Mouse
<i>Reithrodontomys megalotis</i>	Western Harvest Mouse
<i>Peromyscus maniculatus</i>	Deer Mouse
<i>Peromyscus difficilis</i>	Rock Mouse
<i>Onychomys leucogaster</i>	Northern Grasshopper Mouse
<i>Neotoma mexicana</i>	Mexican Wood Rat
<i>Neotoma cinerea</i>	Bushy-tailed Wood Rat
<i>Microtus pennsylvanicus</i>	Meadow Vole
<i>Microtus longicaudus</i>	Long-tailed Vole
<i>Microtus ochrogaster</i>	Prairie Vole
<i>Lagurus curtatus</i>	Sagebrush Vole
<i>Ondatra zibethicus</i>	Muskrat
Family MURIDAE--Old World Rats and Mice	
<i>Rattus norvegicus</i>	Norway Rat
<i>Mus musculus</i>	House Mouse
Family ERETHIZONTIDAE--New World Porcupines	
<i>Erethizon dorsatum</i>	Porcupine
Order CARNIVORA--Carnivores	
Family CANIDAE--Canids	
<i>Canis latrans</i>	Coyote
<i>Vulpes vulpes</i>	Red Fox
<i>Vulpes macrotis</i>	Kit Fox

Table 2. (Continued)

Scientific Name	Common Name
Family PROCYONIDAE--Procyonids	
<i>Procyon lotor</i>	Raccoon
Family MUSTELIDAE--Mustelids	
<i>Mustela erminea</i>	Ermine
<i>Mustela frenata</i>	Long-tailed Weasel
<i>Mustela nigripes</i>	Black-footed Ferret
<i>Taxidea taxus</i>	Badger
<i>Spilogale putorius</i>	Spotted Skunk
<i>Mephitis mephitis</i>	Striped Skunk
Family FELIDAE--Cats	
<i>Felis concolor</i>	Mountain Lion
<i>Lynx rufus</i>	Bobcat
Order ARTIODACTYLA--Even-toed Ungulates	
Family CERVIDAE--Cervids	
<i>Cervus canadensis</i>	Wapiti
<i>Odocoileus hemionus</i>	Mule Deer
<i>Odocoileus virginiana</i>	White-tailed Deer
Family ANTILOCAPRIDAE--Pronghorn	
<i>Antilocapra americana</i>	Pronghorn

Table 3. A checklist of birds of the Pawnee Site in north central Colorado
(Compiled by Ronald A. Ryder).

AOU Number	Species	AOU Number	Species
004	Eared Grebe	264	Long-billed Curlew
001	Western Grebe	265	Whimbrel (one record only)
006	Pied-billed Grebe	261	Upland Plover
194	Great Blue Heron	263	Spotted Sandpiper
202	Black-crowned Night Heron	256	Solitary Sandpiper
203	Yellow-crowned Night Heron	258	Willet
172	Canada Goose	254	Greater Yellowlegs
132	Mallard	255	Lesser Yellowlegs
135	Gadwall	239	Pectoral Sandpiper
143	Pintail	241	Baird's Sandpiper
139	Green-winged Teal	242	Least Sandpiper
140	Blue-winged Teal	232	Long-billed Dowitcher
141	Cinnamon Teal	249	Marbled Godwit
137	American Widgeon	251	Hudsonian Godwit
142	Shoveler	225	American Avocet
146	Redhead	224	Wilson's Phalarope
147	Canvasback	223	Northern Phalarope
148	Greater Scaup	053	California Gull
149	Lesser Scaup	054	Ring-billed Gull
151	Common Goldeneye	059	Franklin's Gull
167	Ruddy Duck	069	Forster's Tern
129	Common Merganser	077	Black Tern
325	Turkey Vulture	313.1	Rock Dove
333	Cooper's Hawk	316	Mourning Dove
332	Sharp-shinned Hawk	365	Barn Owl
337	Red-tailed Hawk	375	Great Horned Owl
342	Swainson's Hawk	378	Burrowing Owl
347	Rough-legged Hawk	366	Long-eared Owl
348	Ferruginous Hawk	367	Short-eared Owl
349	Golden Eagle	418	Poor-will
352	Bald Eagle	420	Common Nighthawk
331	Marsh Hawk	432	Broad-tailed Hummingbird
354	Gyr Falcon	390	Belted Kingfisher
355	Prairie Falcon	413	Red-shafted Flicker
356	Peregrine Falcon	406	Red-headed Woodpecker
357	Pigeon Hawk	393	Hairy Woodpecker
360	Sparrow Hawk	394	Downy Woodpecker
293	Scaled Quail	444	Eastern Kingbird
309	Ring-necked Pheasant	447	Western Kingbird
206	Sandhill Crane	448	Cassin's Kingbird
214	Sora	457	Say's Phoebe
221	American Coot	464	Western Flycatcher
273	Killdeer	462	Western Wood Pewee
281	Mountain Plover	459	Olive-sided Flycatcher

Table 4 Texture of major soils on the Pawnee Site (by W. Franklin).

Soil and Horizon	Depth (inches)	Gravel 1/ < 2 mm	Sand (mm)					Silt (μ)				Clay (μ)					
			2-1	1-.5	.5-.25	.25-.1	.1-.05	Total	50-20	20-5	5-2	Total	2-.2	<.2	Total		
<u>Ascalon</u>																	
A	0-6	2	4	9	11	26	14	64	13	5	2	19	5	11	17		
B _{2t}	6-11	1	2	7	10	24	12	56	12	5	2	18	6	20	26		
B _{3t}	11-15	0	2	7	9	24	14	56	11	5	2	18	6	20	26		
C _{ca}	24-30	1	2	8	13	39	13	75	7	3	2	12	5	9	14		
C ₂	30-48	14	4	9	13	35	14	75	6	3	2	11	4	10	14		
<u>Vona</u>																	
A	0-7	-	1	9	18	35	11	74	6	5	2	13	6	7	13		
B ₂	7-14	-	0	6	18	39	9	73	3	2	2	8	5	15	20		
B ₃	14-30	-	0	4	14	47	10	76	4	3	2	9	6	10	15		
C ₁	30-36	-	1	8	22	41	9	80	3	2	2	7	4	9	13		
C ₂	36-50	-	1	9	21	39	8	78	2	2	3	7	6	10	15		
<u>Renohill</u>																	
A	0-4	2	1	5	10	37	16	69	10	5	2	16	6	9	15		
B ₁	4-6	1	1	6	10	28	11	56	7	4	3	14	12	18	30		
B ₂	6-14	2	2	7	11	25	8	53	7	7	3	16	13	18	31		
C ₁	14-19	1	1	3	5	11	6	27	10	14	5	29	16	28	44		
R	19-30	26	0	1	1	2	7	11	14	18	7	39	22	29	51		
<u>Shingle</u>																	
A ₁	0-6	-	1	4	11	24	13	53	8	11	3	21	10	16	26		
A ₃	6-15	-	0	3	9	18	16	47	9	10	2	21	12	21	33		
B	15-24	-	-	1	2	10	21	34	15	13	3	30	15	21	36		
C _{ca}	24-30	-	0	4	13	32	17	65	6	7	2	15	9	12	20		

^{1/} Gravel as percentage of total soil weight.

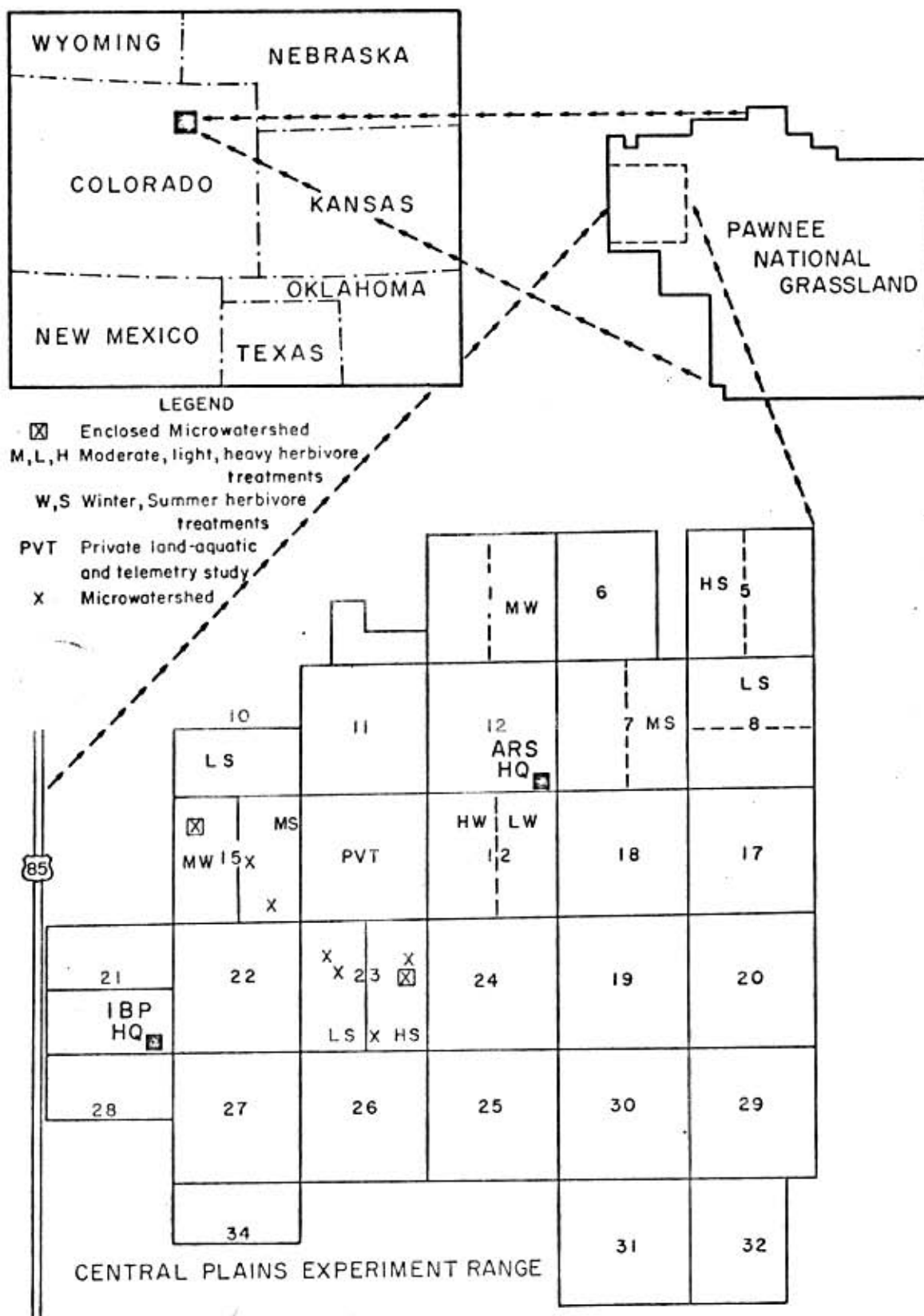


Fig. 1. Location of the Pawnee Site and larger experimental units.

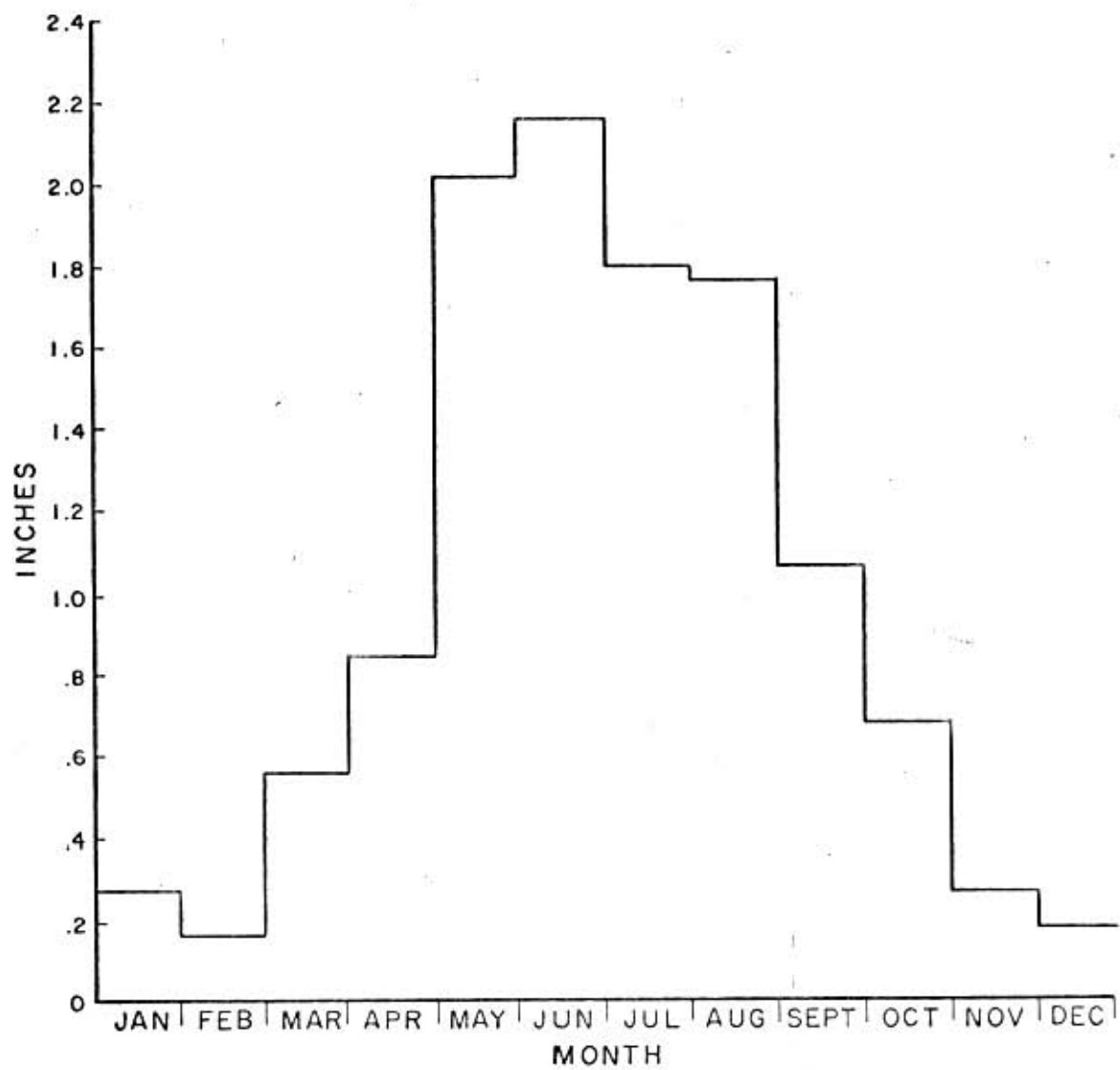


Fig. 2. Seasonal distribution of precipitation.

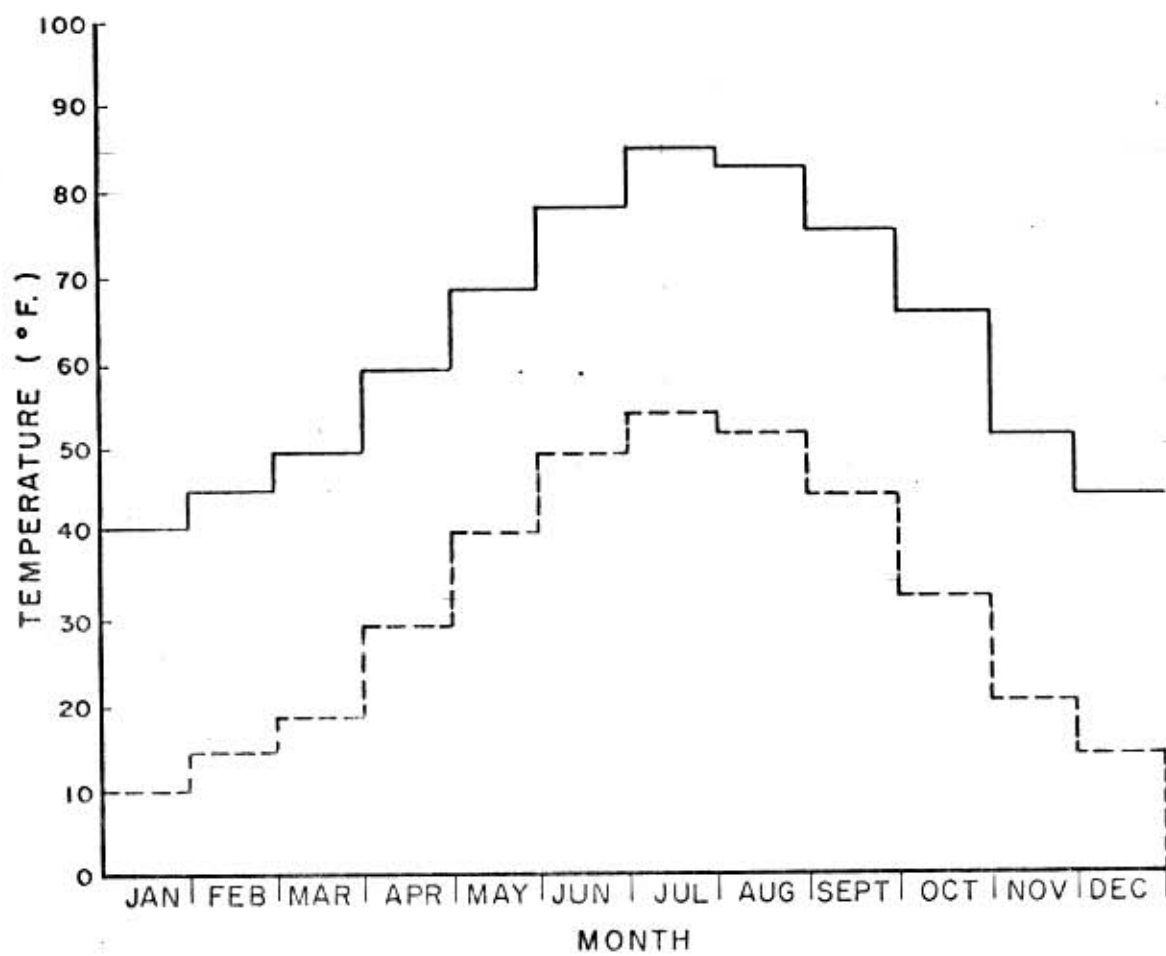
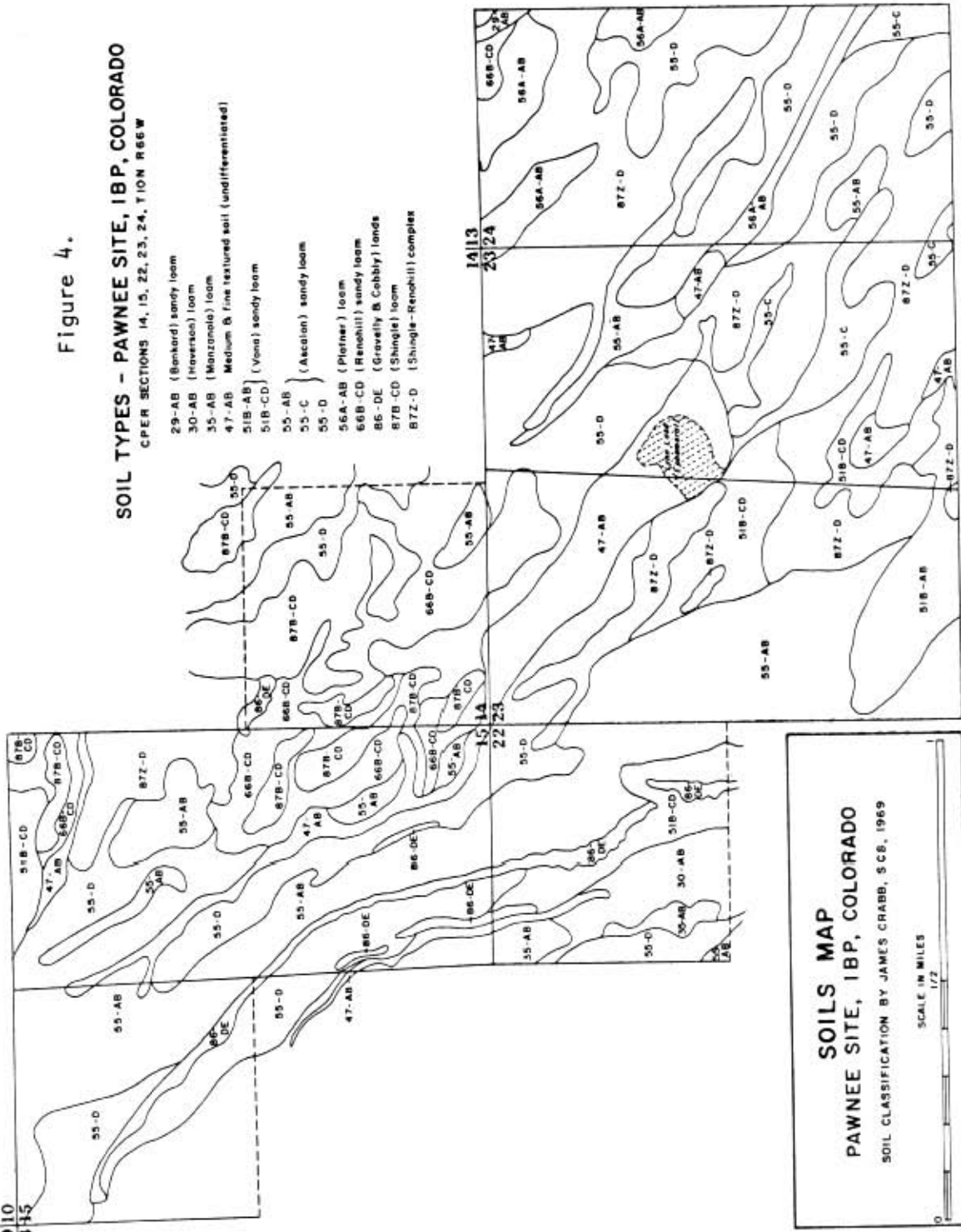


Fig. 3. Monthly annual temperatures.

910
1345



APPENDIX A

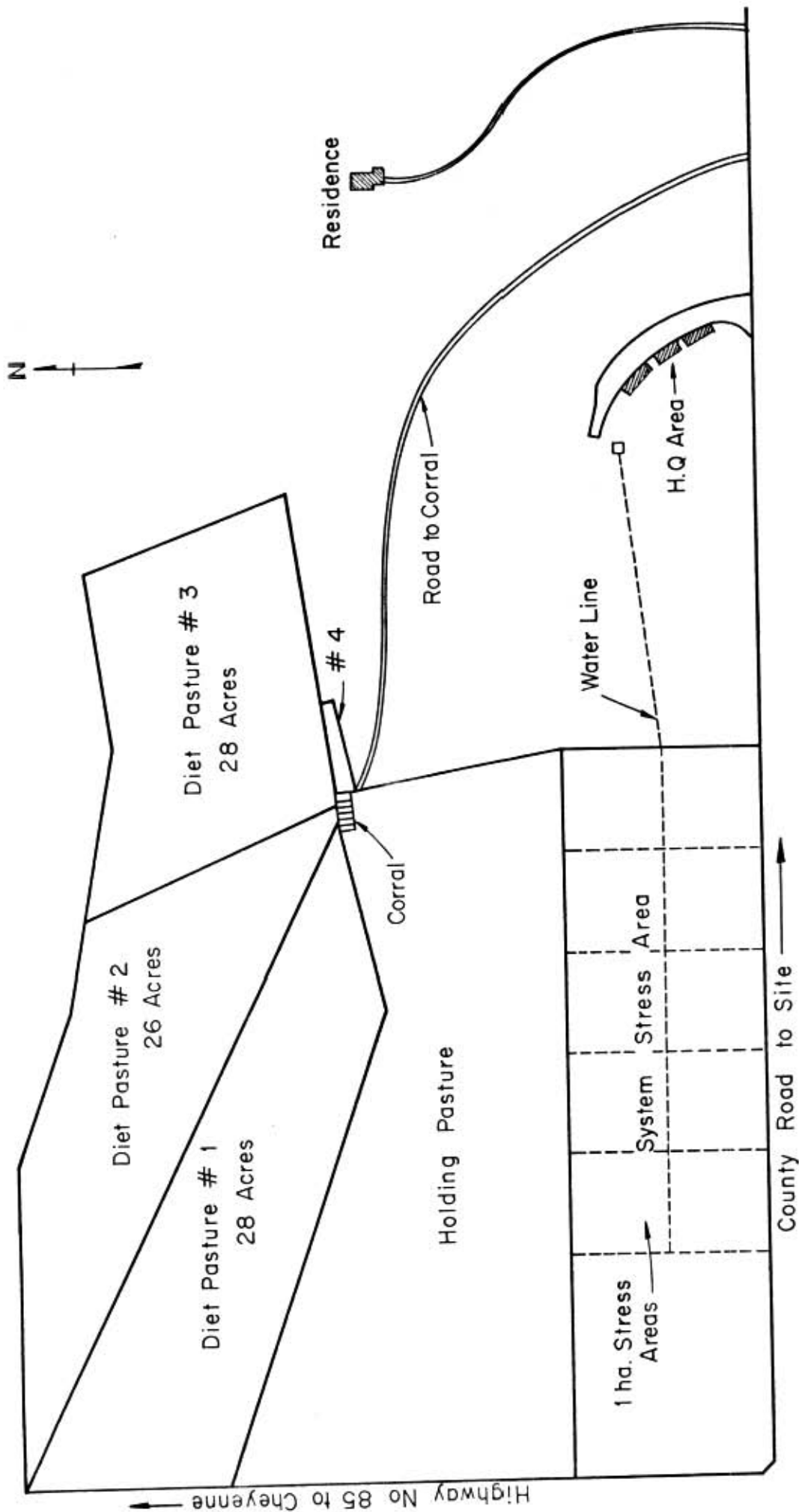
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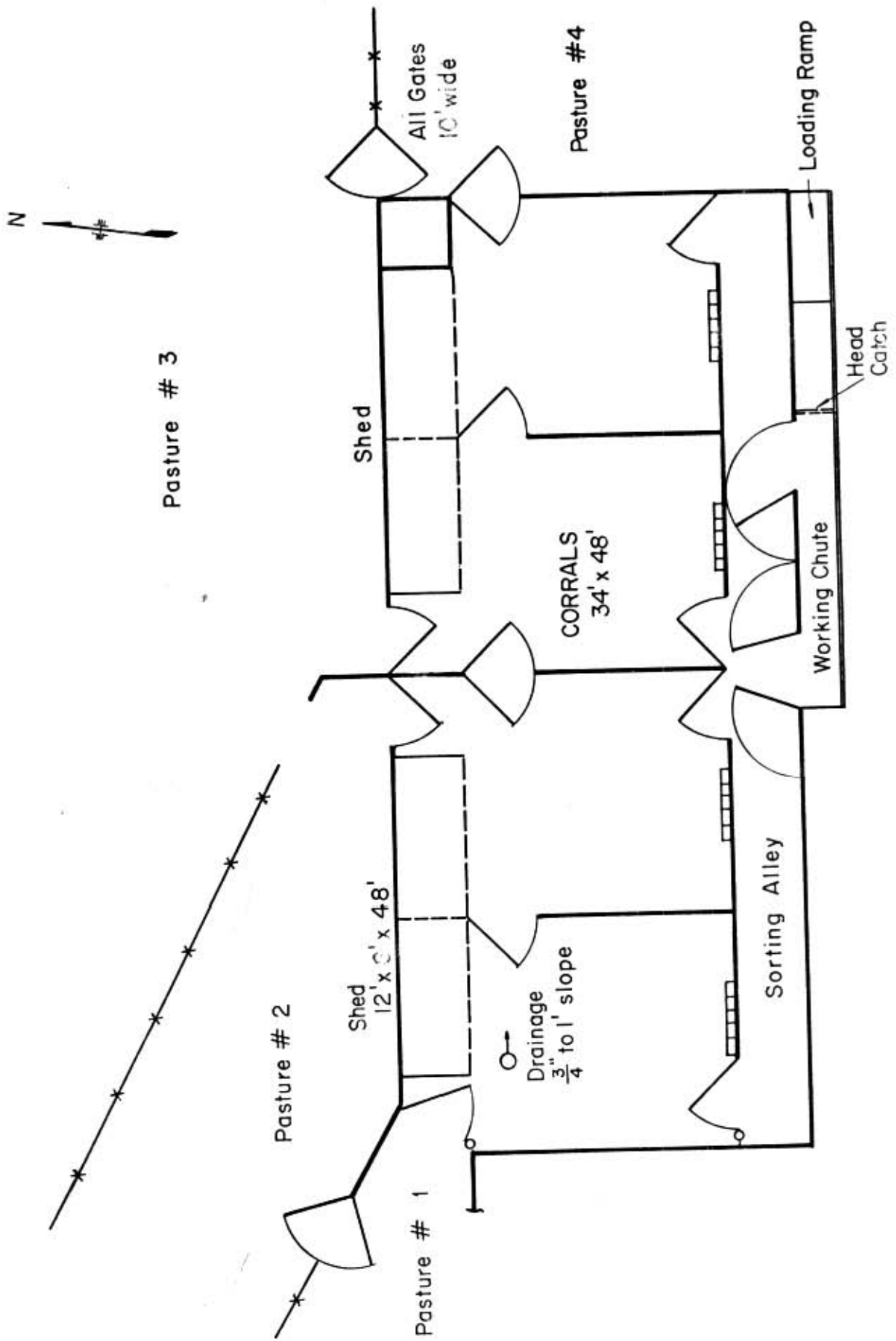
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APPENDIX B

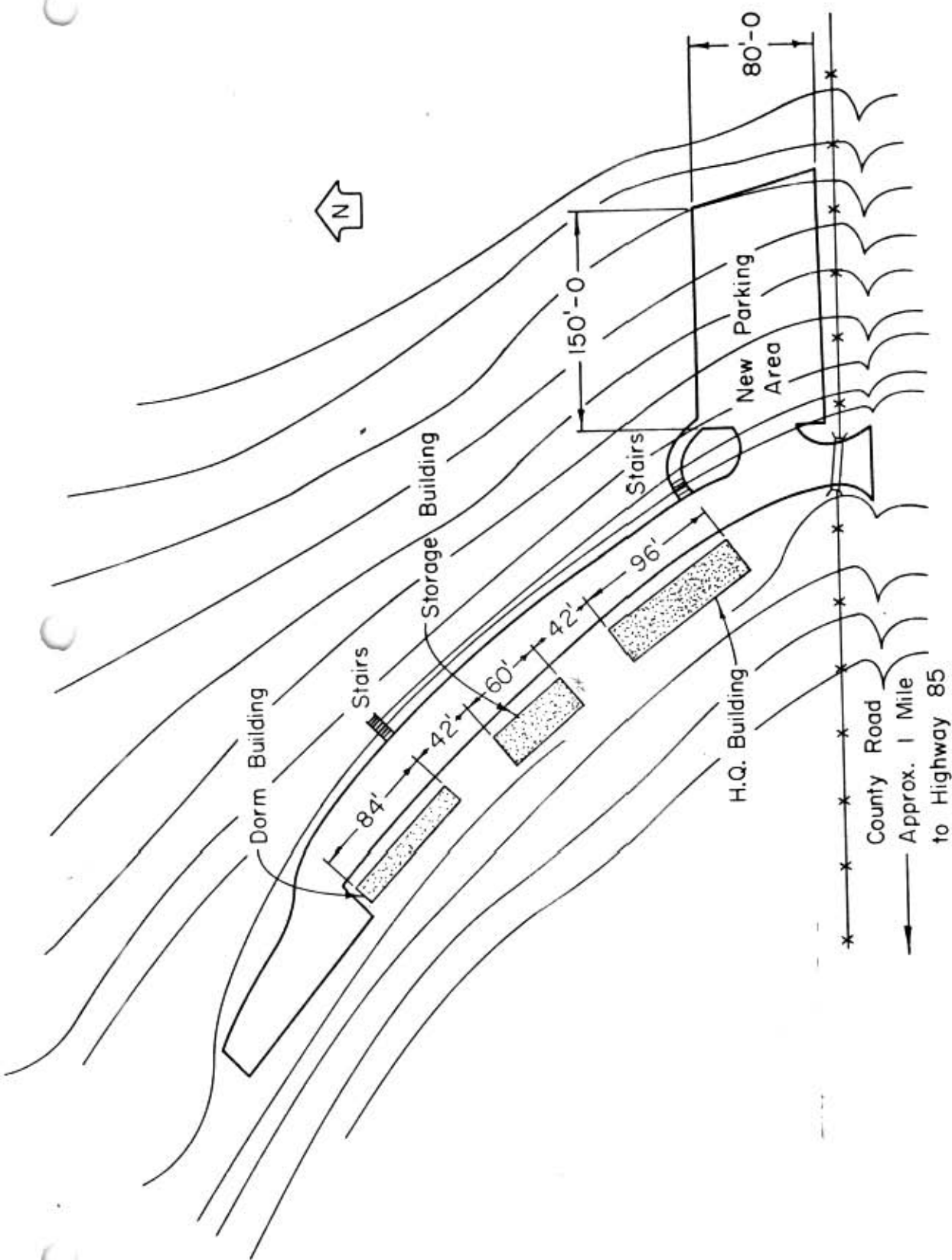
PHYSICAL FACILITIES AT THE PAWNEE SITE



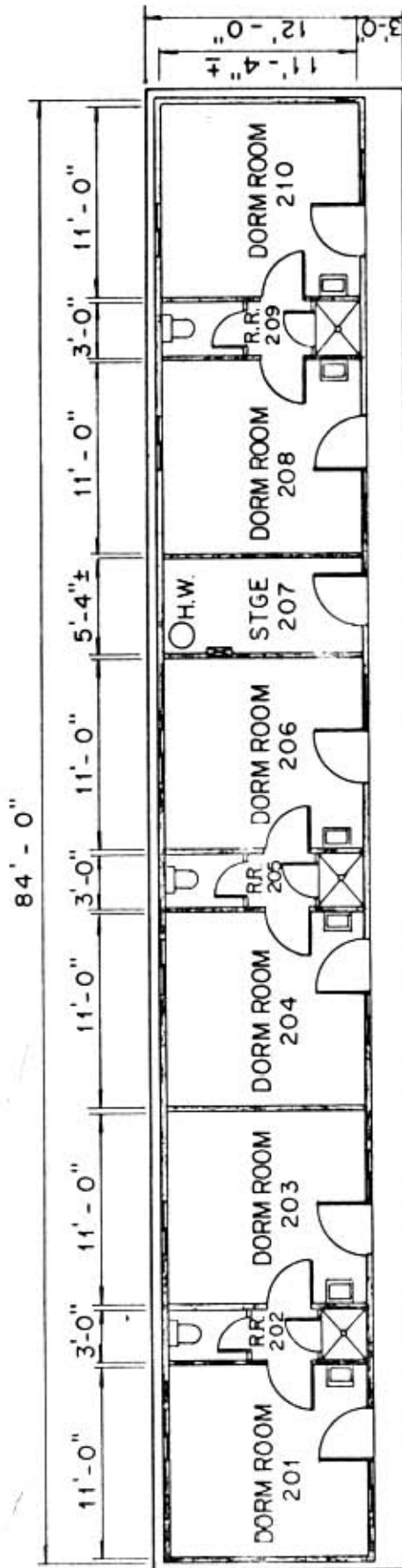
PAWNEE SITE LARGE MAMMAL COMPARATIVE DIET AREA AND
SYSTEM STRESS AREA



PAWNEE SITE CORRAL DETAIL



SITE PLAN I BP NUNN, COLORADO



DORMITORY BUILDING FLOOR PLAN

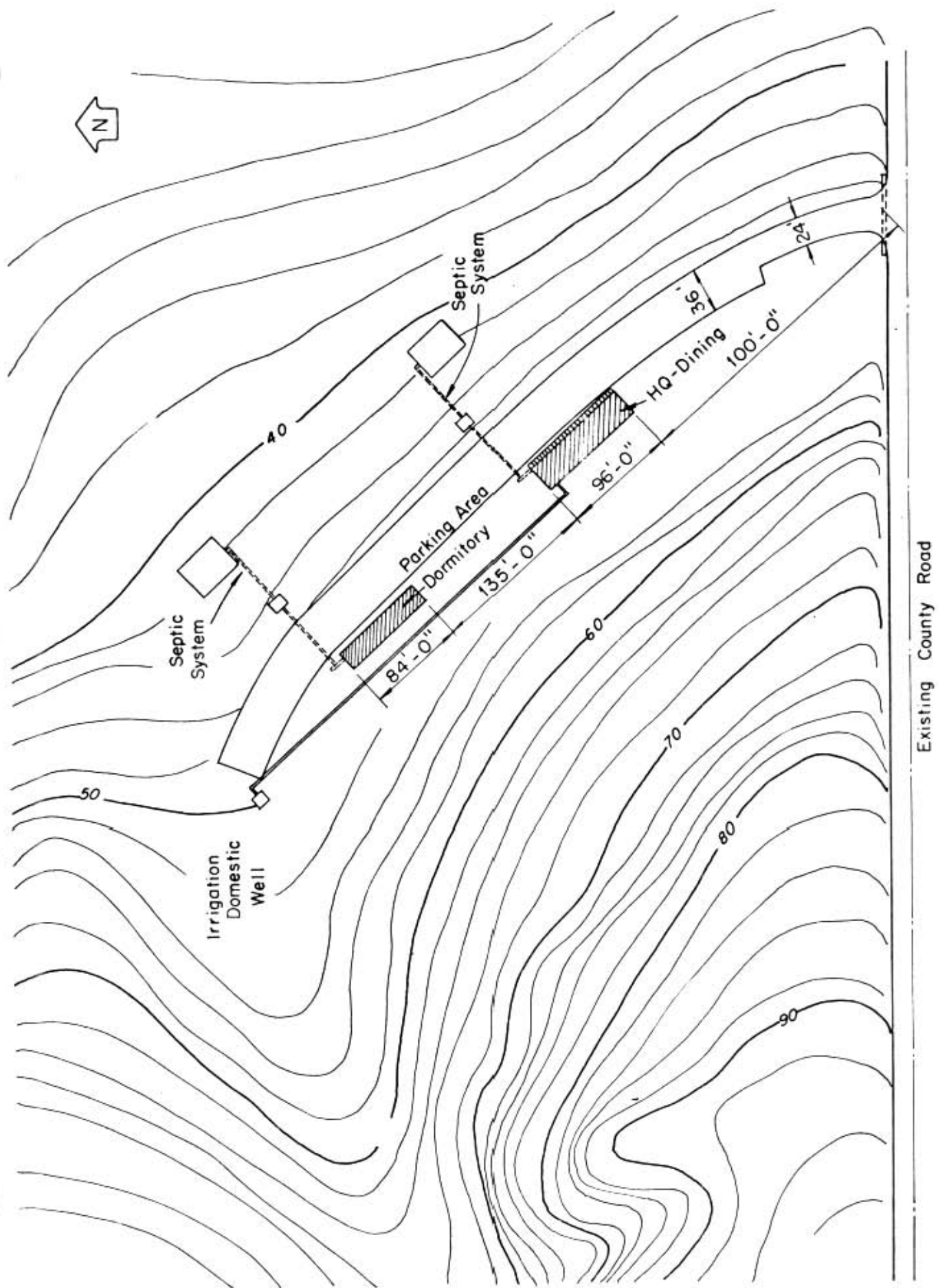
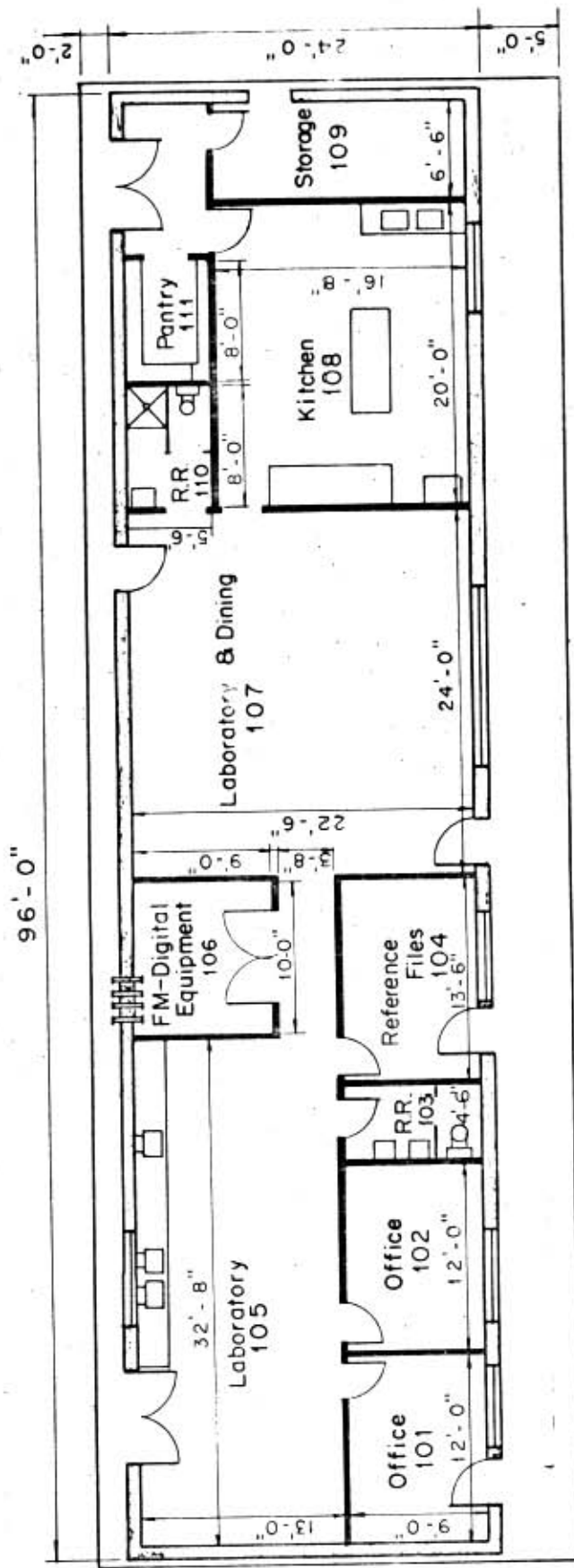


Figure 6.51.4

SITE PLAN-INTERNATIONAL BIOLOGICAL PROGRAM



HEADQUARTERS BUILDING FLOOR PLAN

A field laboratory-office and a minimal dormitory facility will soon have been constructed from the first year's funding. Eight of the microwatersheds have been completed and others soon will be. General plans for necessary additions to facilities and equipment have been developed. In our continued quest for optimality, however, a major portion of the Pawnee Site Director's time during the coming year will be concerned with design modifications of field facilities which will be most useful in promoting the various measurements and experiments.

Other details on progress to date were covered in Section 4 of this proposal; details of equipment to be purchased and cost estimates of facilities are included in the budget portion (Section 9).

Field laboratory. Major laboratory analyses will be conducted in the central laboratory on the CSU campus (see Section 6.2). *Field laboratory studies at the Pawnee headquarters will be restricted to those requiring immediate analyses, and as such, will be minimal in nature.* Special emphasis will be on sample freezing and drying, field reference collections, etc., (Figure 6.51.3). Although the lab building will be completed from the first year's money, some equipment remains to be added.

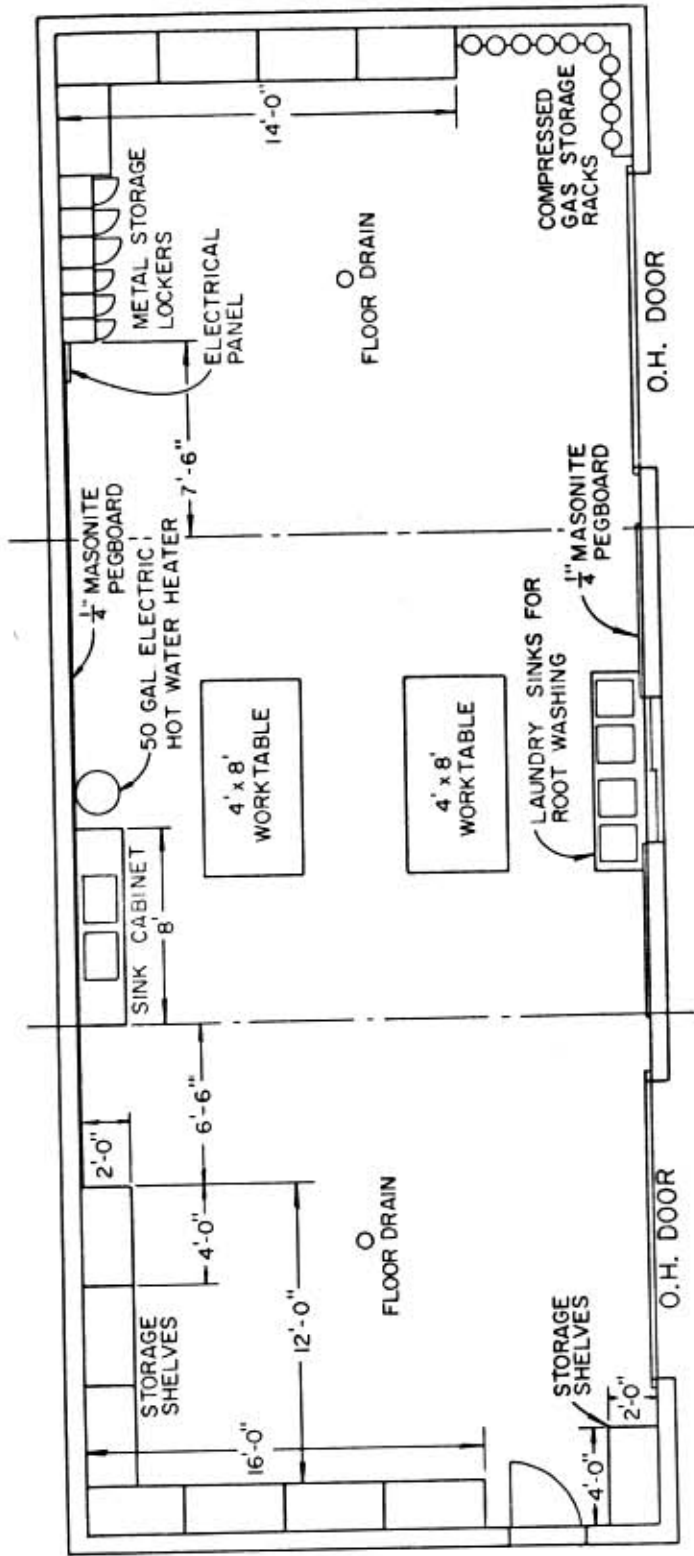
Buildings. Funds are requested for (a) a residence for the site resident, and (b) a storage building-garage. Both of these buildings were foreseen in the original proposal but were deferred for lack of funding. We will probably use a mobile home for the residence, and an unheated, uninsulated slab-on-grade construction for the garage. Space for these buildings has been provided in the general building plan (Figure 6.51.4). At this time we are not requesting funds for additional dormitory space; we will first determine the amount of occupancy of the existing dormitory (Figure 6.51.5).

System stress control. Facilities will be developed to provide adequate control of system stress so that experiments on system stress can proceed on a predetermined schedule. These sites will be fully instrumented with adequate meteorological and hydrological instrumentation. Part of the basic meteorological equipment was procured with the first year's funds.

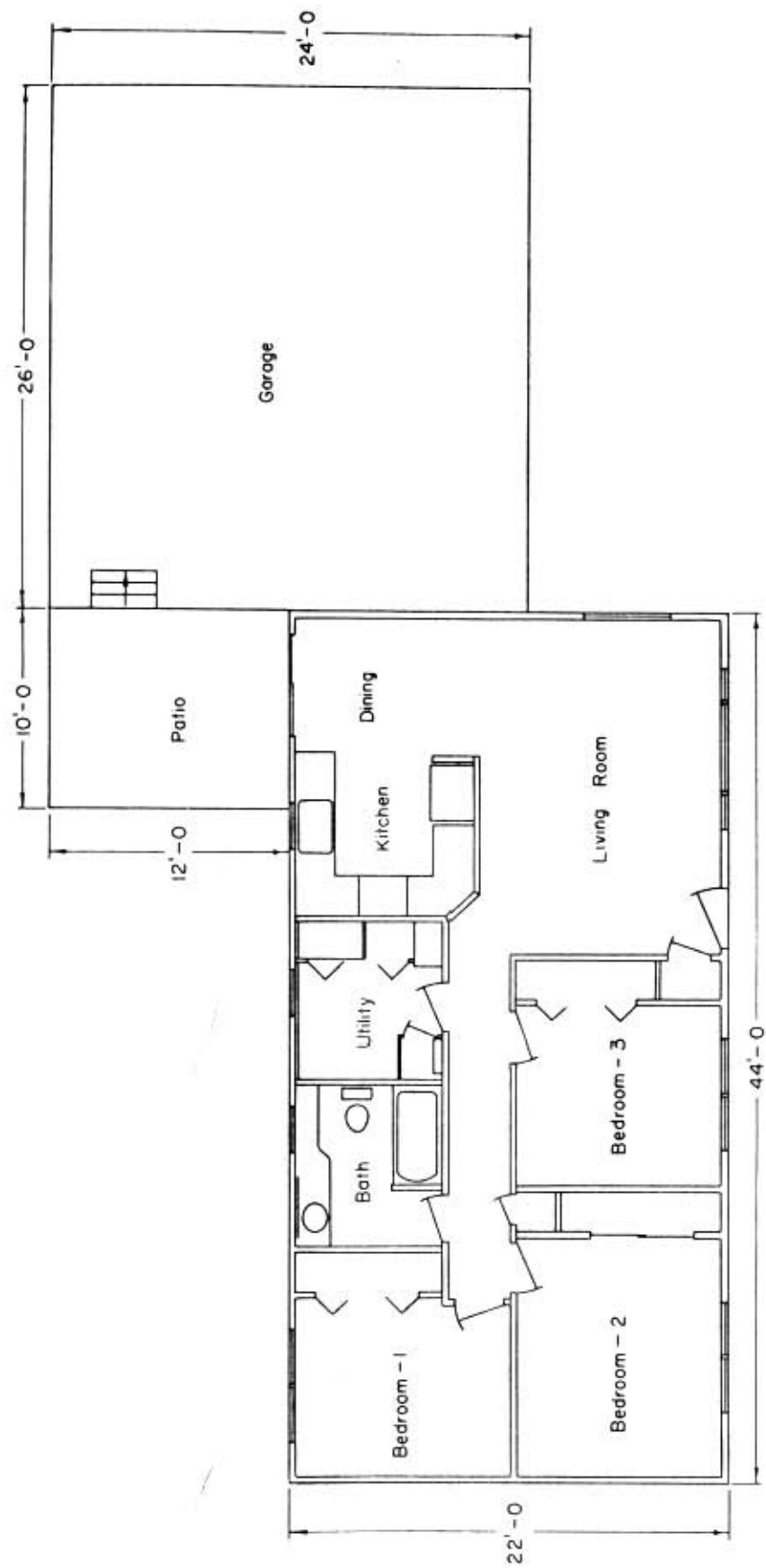
Instrumentation, power and cable, and data acquisition. Because of the great amount of data to be collected, *a rapid means of handling data is essential.* The necessary instrumentation requires an adequate power source, cables to return data to a data-acquisition system, and the data acquisition system itself.

A special room has been provided in the laboratory building for the data acquisition equipment. For the sake of economy, some cables leading to the microwatersheds were installed at the same time the telephone to the site was installed; other cables and power lines to individual research sites still remain to be completed.

Mobile laboratory. During the first year's effort, we have developed field equipment for a number of measurements. In some cases, strip chart recordings have been made to facilitate debugging the equipment. Our eventual goal in this area is to have an integrated mobile laboratory which can handle meteorology, photosynthesis measurements, and evapotranspiration measurements, and store the data with a single data-acquisition system.



STORAGE BUILDING FLOOR PLAN



RESIDENCE BUILDING FLOOR PLAN